CASINO

March 16, 2015

Ken McKinnon
YESAB Executive Committee
Suite 200-309 Strickland Street
Whitehorse, Yukon
Y1A 2J9

Re: Casino Mine Project – Casino Mine Supplementary Information Report Project No. 2014-0002

Dear Mr.McKinnon,

In response to your letter and Adequacy Review Report received on January 27, 2015, Casino Mining Corporation has compiled a supplementary information report (SIR) with the aim of meeting the requirements of paragraph 42(1)(b),(c) and (e) to (h) of the YESAA. As per your request, we have endeavoured to draft the SIR in a manner that clearly identifies the responses to requests made in the ARR. The SIR follows the same framework as the original Project Proposal submitted January 3, 2014, so as to make the review of supplementary information as straightforward as possible.

In accordance with the Executive Committee Screening Rules: Filing Requirements, we have submitted the following:

- Two printed copies including all appendices (CMC has personally delivered copies to SFN, LSCFN and TH, as discussed with YESAB);
- Eight printed copies of the SIR with digital copies of the appendices included on a USB drive; and
- Five individual copies of the complete SIR and appendices on individual USB drives.

CMC anticipates that the information in this SIR and in the Project Proposal, when considered together, is adequate to commence the Screening phase of the project assessment.

Sincerely,

Paul West-Sells
President
Casino Mining Corporation

Toll Free: 1.888.966.9995
T: 604.684.9497
F: 604.669.2929

Casino Mining Corp.
1800 – 570 Granville St.
Vancouver, British Columbia
Canada, V6C 3P1

VOLUME A.I: PREFACE

VOLUME A.II: PROJECT INTRODUCTION & OVERVIEW

- **A.1** Introduction
  - **A.1A** Concordance Table to the Executive Committee's Request for Supplementary Information
- **A.2** First Nations and Community Consultation
  - **A.2A** Traditional Knowledge Bibliography
- **A.3** Project Location
- **A.4** Project Description
  - **A.4A** Tailings Management Facility Construction Material Alternatives
  - **A.4B** Information on Alternative Access Road Alignments
  - **A.4C** Feasibility Design of the Heap Leach Facility
  - **A.4D** Report on the Feasibility Design of the Tailings Management Facility
  - **A.4E** Results of Additional Lab Testing of Leach Ore
  - **A.4F** Waste Storage Area and Stockpiles Feasibility Design
  - **A.4G** Updated Hydrometeorology Report
  - **A.4H** Cold Climate Passive Treatment Systems Literature Review
  - **A.4I** Open Pit Geotechnical Design
  - **A.4J** Laboratory Evaluation of the SO_2/Air and Peroxide Process
  - **A.4K** Metal Uptake in Northern Constructed Wetlands
  - **A.4L** Revised Tailings Management Facility Seepage Assessment
  - **A.4M** Processing Flow Sheets
  - **A.4N** Scoping Level Assessment of Casino Property
  - **A.4O** Advanced Metallurgical Assessment of the Casino Copper Gold Project
  - **A.4P** Production of Environmental Tailings Samples for the Casino Deposit
  - **A.4Q** Mine Site Borrow Materials Assessment Report
  - **A.4R** Report on Laboratory Geotechnical Testing of Tailings Materials
- **A.5** Effects Assessment Methodology

VOLUME A.III: BIOPHYSICAL VALUED COMPONENTS

- **A.6** Terrain Features
- **A.7** Water Quality
  - **A.7A** Variability Water Balance Model Report
  - **A.7B** Water Quality Predictions Report
  - **A.7C** Potential Effects of Climate Change on the Variability Water Balance
  - **A.7D** Updated Appendix B5 to Appendix 7A
  - **A.7E** 2008 Environmental Studies Report: Final
  - **A.7F** The Effect of Acid Rock Drainage on Casino Creek
  - **A.7G** Toxicity Testing Reports
  - **A.7H** Appendix A2 to Casino Waste Rock and Ore Geochemical Static Test Assessment Report: Cross-Sections
  - **A.7I** Casino Kinetic Testwork 2014 Update for Ore, Waste Rock and Tailings
  - **A.7J** Preliminary Risk Assessment Metal Leaching and Acid Rock Drainage
  - **A.7K** Casino Mine Site Borrow Sites ML/ARD Potential
  - **A.7L** Casino Geochemical Source Term Development: Appendix B
  - **A.7M** 2013-2014 Groundwater Data Report
  - **A.7N** Extension of Numerical Groundwater Modelling to include Dip Creek Watershed
- **A.8** Air Quality
  - **A.8A** Emissions Inventory for Construction and Operations
- **A.9** Noise
- **A.10** Fish and Aquatic Resources
  - **A.10A** Updated Fish Habitat Offsetting Plan
  - **A.10B** Fish Habitat Evaluation: Instream Flow and Habitat Evaluation Procedure Study
- **A.11** Rare Plants and Vegetation Health
- **A.12** Wildlife
  - **A.12A** Wildlife Mitigation and Monitoring Plan V.1.2.
  - **A.12B** Wildlife Baseline Report V.2
  - **A.12C** Moose Late Winter Habitat Suitability Report

VOLUME A.IV: SOCIO-ECONOMIC VALUED COMPONENTS

- **A.13** Employment and Income
  - **A.13A** Economic Impacts of the Casino Mine Project
- **A.14** Employability
- **A.15** Economic Development and Business Sector
- **A.16** Community Vitality
- **A.17** Community Infrastructure and Services
- **A.18** Cultural Continuity
  - **A.18A** Heritage Resources Assessment Areas
  - **A.18B** Heritage Sites Summary
- **A.19** Land Use and Tenure

VOLUME A.V: ADDITIONAL YESAA REQUIREMENTS

- **A.20** Effects of the Environment on the Project
- **A.21** Accidents and Malfunctions
- **A.22** Environmental Management
  - **A.22A** Waste and Hazardous Materials Management Plan
  - **A.22B** Spill Contingency Management Plan
  - **A.22C** Sediment and Erosion Control Management Plan
  - **A.22D** Invasive Species Management Plan
  - **A.22E** Road Use Plan
  - **A.22F** Socio-Economic Management Plan
  - **A.22G** Liquid Natural Gas Management Plan
  - **A.22H** ML/ARD Management Plan
- **A.23** Environmental Monitoring Plans
- **A.24** Conclusions
- **A.25** References

TABLE OF CONTENTS

A.1 – INTRODUCTION A.1-1
A.1.1 PROJECT OVERVIEW A.1-1
A.1.2 LEGISLATIVE REQUIREMENTS A.1-1
A.1.3 PURPOSE OF THE SIR A.1-2
A.1.4 ORGANIZATION OF THE SIR A.1-3
A.1.5 SUMMARY OF CHANGES TO THE PROJECT PROPOSAL A.1-7

A.2 – FIRST NATIONS AND COMMUNITY CONSULTATION A.2-1
A.2.1 INTRODUCTION A.2-1
A.2.2 TRADITIONAL KNOWLEDGE AND TRADITIONAL LAND USE A.2-3
A.2.2.1.1 R395 .... A.2-3
A.2.2.1.2 R396 .... A.2-8
A.2.2.1.3 R397 .... A.2-9
A.2.2.1.4 R398 .... A.2-10
A.2.2.1.5 R399 .... A.2-11
A.2.3 TRAPPING AND OUTFITTING A.2-12
A.2.3.1.1 R405 .... A.2-12
A.2.3.1.2 R406 .... A.2-13
A.2.4 QUARTZ AND PLACER CLAIM HOLDERS A.2-14
A.2.4.1.1 R408 .... A.2-14

A.3 – PROJECT LOCATION A.3-1
A.3.1 INTRODUCTION A.3-1

A.4 – PROJECT DESCRIPTION A.4-1
A.4.1 INTRODUCTION A.4-1
A.4.2 ALTERNATIVES A.4-18
A.4.2.1 Tailings Management Facility A.4-18
A.4.2.1.1 R1 .... A.4-18
A.4.2.1.2 R2 .... A.4-20
A.4.2.2 Mine Access Route A.4-20
A.4.2.2.1 R3 .... A.4-20
A.4.3 OVERSIGHT OF DESIGN, CONSTRUCTION, OPERATION, AND CLOSURE A.4-24
A.4.3.1 R4 .... A.4-24
A.4.3.2 R5 .... A.4-25
A.4.3.3 R6 .... A.4-25
A.4.4 CONSTRUCTION A.4-26
A.4.4.1 R7 .... A.4-26
A.4.4.2 R8 .... A.4-27

A.4.4.3 R9 ... A.4-28
A.4.5 FEASIBILITY OF THE SULPHIDES REMOVAL PROCESS ... A.4-28
A.4.5.1 R10 ... A.4-28
A.4.5.2 R11 ... A.4-29
A.4.5.3 R12 ... A.4-29
A.4.6 ROADS, SUPPLY ROUTES AND TRANSPORTATION ... A.4-31
A.4.6.1 Freegold Road Extension and Upgrade ... A.4-31
A.4.6.1.1 R13 ... A.4-31
A.4.6.1.2 R14 ... A.4-36
A.4.6.1.3 R15 ... A.4-37
A.4.6.1.4 R16 ... A.4-37
A.4.6.1.5 R17 ... A.4-38
A.4.6.1.6 R18 ... A.4-38
A.4.6.1.7 R19 ... A.4-41
A.4.6.1.8 R20 ... A.4-41
A.4.6.2 Existing Highways ... A.4-41
A.4.6.2.1 R21 ... A.4-41
A.4.6.2.2 R22 ... A.4-46
A.4.6.2.3 R23 ... A.4-46
A.4.6.2.4 R24 ... A.4-46
A.4.6.2.5 R25 ... A.4-47
A.4.6.3 Traffic Through Carmacks During By-pass Construction ... A.4-47
A.4.6.3.1 R26 ... A.4-47
A.4.6.3.2 R27 ... A.4-47
A.4.6.4 Imports and Exports ... A.4-48
A.4.6.4.1 R28 ... A.4-48
A.4.6.4.2 R29 ... A.4-49
A.4.6.5 Dangerous Goods ... A.4-50
A.4.6.5.1 R30 ... A.4-50
A.4.7 WATER MANAGEMENT PLAN ... A.4-51
A.4.7.1 R31 ... A.4-51
A.4.7.2 Conveyance of Water ... A.4-52
A.4.7.2.1 R32 ... A.4-52
A.4.7.2.2 R33 ... A.4-53
A.4.7.2.3 R34 ... A.4-53
A.4.7.2.4 R35 ... A.4-54

A.4.7.2.5 R36 .... A.4-54
A.4.7.2.6 R37 .... A.4-54
A.4.7.2.7 R38 .... A.4-54
A.4.7.2.8 R39 .... A.4-55
A.4.7.3 Storage of Water A.4-55
A.4.7.3.1 R40 .... A.4-55
A.4.7.3.2 R41 .... A.4-56
A.4.7.4 Probability of Failure Analysis of Infrastructure Components A.4-57
A.4.7.4.1 R42 .... A.4-57
A.4.8 HEAP LEACH FACILITY A.4-58
A.4.8.1 Foundation Conditions and Preparation A.4-58
A.4.8.1.1 R43 .... A.4-58
A.4.8.1.2 R44 .... A.4-58
A.4.8.1.3 R45 .... A.4-59
A.4.8.2 Liners A.4-59
A.4.8.2.1 R46 .... A.4-59
A.4.8.2.2 R47 .... A.4-59
A.4.8.3 Leak Detection and Recovery A.4-59
A.4.8.3.1 R48 .... A.4-59
A.4.8.3.2 R49 .... A.4-60
A.4.8.4 Leachate Solution and Water Flows A.4-60
A.4.8.4.1 R50 .... A.4-60
A.4.8.4.2 R51 .... A.4-61
A.4.8.4.3 R52 .... A.4-61
A.4.8.4.4 R53 .... A.4-62
A.4.8.4.5 R54 .... A.4-65
A.4.8.5 Wells A.4-65
A.4.8.5.1 R55 .... A.4-65
A.4.8.6 Ore Stacking Rate A.4-65
A.4.8.6.1 R56 .... A.4-65
A.4.8.6.2 R57 .... A.4-66
A.4.8.6.3 R58 .... A.4-66
A.4.8.6.4 R59 .... A.4-67
A.4.8.7 Road Section Details A.4-67
A.4.8.7.1 R60 .... A.4-67
A.4.8.8 Construction and Commissioning A.4-68

A.4.8.8.1 R61 ....A.4-68
A.4.8.8.2 R62 ....A.4-69
A.4.8.8.3 R63 ....A.4-69
A.4.8.8.4 R64 ....A.4-69
A.4.9 TAILINGS MANAGEMENT FACILITY A.4-70
A.4.9.1 Design Methodology and Feasibility A.4-70
A.4.9.1.1 R65 ....A.4-70
A.4.9.1.2 R66 ....A.4-71
A.4.9.1.3 R67 ....A.4-72
A.4.9.1.4 R68 ....A.4-72
A.4.9.2 Earthquakes A.4-72
A.4.9.2.1 R69 ....A.4-72
A.4.9.2.2 R70 ....A.4-73
A.4.9.2.3 R71 ....A.4-73
A.4.9.2.4 R72 ....A.4-73
A.4.9.2.5 R73 ....A.4-73
A.4.9.2.6 R74 ....A.4-74
A.4.9.3 Flood Modeling A.4-74
A.4.9.3.1 R75 ....A.4-74
A.4.9.4 Spillways A.4-75
A.4.9.4.1 R76 ....A.4-75
A.4.9.4.2 R77 ....A.4-76
A.4.9.4.3 R78 ....A.4-76
A.4.9.4.4 R79 ....A.4-77
A.4.9.4.5 R80 ....A.4-78
A.4.9.5 Embankment Failure A.4-78
A.4.9.5.1 R81 ....A.4-78
A.4.9.6 Dam Core and Downstream Filter A.4-80
A.4.9.6.1 R82 ....A.4-80
A.4.9.7 Use of Cyclone Sand in Embankments A.4-81
A.4.9.7.1 R83 ....A.4-81
A.4.9.7.2 R84 ....A.4-82
A.4.9.7.3 R85 ....A.4-82
A.4.9.7.4 R86 ....A.4-82
A.4.9.8 Faults and Shear Zones A.4-83
A.4.9.8.1 R87 ....A.4-83

A.4.9.9 Hydraulic Conductivity of Bedrock and Overburden ... A.4-83
A.4.9.9.1 R88 ... A.4-83
A.4.9.9.2 R89 ... A.4-84
A.4.9.10 Presence of Frost-Susceptible or Frozen Materials During Construction ... A.4-85
A.4.9.10.1 R90 ... A.4-85
A.4.9.10.2 R91 ... A.4-85
A.4.9.11 Cold Weather Construction of the Embankments ... A.4-86
A.4.9.11.1 R92 ... A.4-86
A.4.9.11.2 R93 ... A.4-86
A.4.9.11.3 R94 ... A.4-86
A.4.9.11.4 R95 ... A.4-88
A.4.9.11.5 R96 ... A.4-89
A.4.9.11.6 R97 ... A.4-89
A.4.9.11.7 R98 ... A.4-90
A.4.9.12 Quality and Quantity of Borrow Source Materials ... A.4-90
A.4.9.12.1 R99 ... A.4-90
A.4.9.12.2 R100 ... A.4-91
A.4.9.12.3 R101 ... A.4-92
A.4.9.13 Starter Dam and Tailings Interface ... A.4-93
A.4.9.13.1 R102 ... A.4-93
A.4.9.14 Missing Information ... A.4-93
A.4.9.14.1 R103 ... A.4-93
A.4.10 LIQUEFIED NATURAL GAS AND DIESEL ... A.4-94
A.4.10.1 Description of LNG Facilities ... A.4-94
A.4.10.1.1 R104 ... A.4-94
A.4.10.1.2 R105 ... A.4-118
A.4.10.1.3 R106 ... A.4-121
A.4.10.1.4 R107 ... A.4-121
A.4.10.2 Description of Diesel Facilities ... A.4-122
A.4.10.2.1 R108 ... A.4-122
A.4.11 CONCEPTUAL CLOSURE AND RECLAMATION PLAN ... A.4-122
A.4.11.1 General Concerns ... A.4-122
A.4.11.1.1 R109 ... A.4-122
A.4.11.1.2 R110 ... A.4-126
A.4.11.2 Long-Term Closure and Ongoing Monitoring and Maintenance ... A.4-128
A.4.11.2.1 R111 ... A.4-128

A.4.11.2.2 R112 .... A.4-130
A.4.11.2.3 R113 .... A.4-131
A.4.11.2.4 R114 .... A.4-133
A.4.11.3 Design and Operation of Wetland Water Treatment System A.4-134
A.4.11.3.1 R115 .... A.4-134
A.4.11.3.2 R116 .... A.4-134
A.4.11.3.3 R117 .... A.4-135
A.4.11.3.4 R118 .... A.4-136
A.4.11.3.5 R119 .... A.4-136
A.4.11.3.6 R120 .... A.4-136
A.4.11.3.7 R121 .... A.4-137
A.4.11.3.8 R122 .... A.4-138
A.4.11.3.9 R123 .... A.4-139
A.4.11.3.10 R124 .... A.4-140
A.4.11.4 Open Pit and Low Grade Ore Stockpile Water Quality A.4-142
A.4.11.4.1 R125 .... A.4-142
A.4.11.4.2 R126 .... A.4-142
A.4.11.4.3 R127 .... A.4-144
A.4.11.5 Open Pit Stability A.4-145
A.4.11.5.1 R128 .... A.4-145
A.4.11.5.2 R129 .... A.4-147
A.4.11.6 Open Pit and Wildlife A.4-147
A.4.11.6.1 R130 .... A.4-147
A.4.11.7 HLF Closure and Cyanide A.4-147
A.4.11.7.1 R131 .... A.4-147
A.4.11.7.2 R132 .... A.4-148
A.4.11.7.3 R133 .... A.4-148
A.4.11.8 HLF and Cover Material A.4-148
A.4.11.8.1 R134 .... A.4-148
A.4.11.9 TMF Winter Seepage Mitigation Pond A.4-150
A.4.11.9.1 R135 .... A.4-150
A.4.11.9.2 R136 .... A.4-151
A.4.11.9.3 R137 .... A.4-151
A.4.11.9.4 R138 .... A.4-152
A.4.11.10 TMF Embankment Vegetation A.4-153
A.4.11.10.1 R139 .... A.4-153

A.4.11.11 Climax Vegetation in Reclaimed Areas A.4-157
A.4.11.11.1 R140 .... A.4-157
A.4.11.12 Temporary or Early Closure A.4-157
A.4.11.12.1 R141 .... A.4-157
A.4.11.12.2 R142 .... A.4-166
A.4.11.13 Mine Reclamation and Security A.4-167
A.4.11.13.1 R143 .... A.4-167
A.4.11.13.2 R144 .... A.4-167
A.4.11.14 Missing Information A.4-169
A.4.11.14.1 R145 .... A.4-169
A.4.12 WASTE MANAGEMENT A.4-170
A.4.12.1 R146 .... A.4-170

A.5 – EFFECTS ASSESSMENT METHODOLOGY A.5-1
A.5.1 INTRODUCTION A.5-1
A.5.2 HUMAN HEALTH RISK ASSESSMENT A.5-1
A.5.2.1.1 R445 .... A.5-1

A.6 – TERRAIN FEATURES A.6-1
A.6.1 INTRODUCTION A.6-1
A.6.2 PERMAFROST A.6-2
A.6.2.1.1 R147 .... A.6-2
A.6.2.1.2 R148 .... A.6-3
A.6.3 THERMAL EROSION MODELING A.6-3
A.6.3.1.1 R149 .... A.6-3
A.6.3.1.2 R150 .... A.6-4
A.6.4 GROUND THERMAL CONDITION AND PERMAFROST TEMPERATURE MONITORING A.6-4
A.6.4.1.1 R151 .... A.6-4
A.6.4.1.2 R152 .... A.6-4
A.6.4.1.3 R153 .... A.6-4
A.6.4.1.4 R154 .... A.6-5
A.6.5 SURFICIAL GEOLOGY AND TERRAIN MAPPING METHODS AND MAPS A.6-5
A.6.5.1.1 R155 .... A.6-5
A.6.6 TERRAIN HAZARDS ASSESSMENT A.6-5
A.6.6.1.1 R156 .... A.6-5
A.6.6.1.2 R157 .... A.6-7

A.7 – WATER QUALITY A.7-1
A.7.1 INTRODUCTION A.7-1

A.7.2 AVERAGE HYDROLOGIC CONDITIONS AND NORMAL OPERATING/CLOSURE SCENARIOS A.7-11
A.7.2.1.1 R158 .... A.7-11
A.7.2.1.2 R159 .... A.7-11
A.7.2.1.3 R160 .... A.7-12
A.7.3 WATER AND SEDIMENT QUALITY BASELINE A.7-12
A.7.3.1.1 R161 .... A.7-12
A.7.3.1.2 R162 .... A.7-13
A.7.3.1.3 R163 .... A.7-14
A.7.3.1.4 R164 .... A.7-16
A.7.3.1.5 R165 .... A.7-18
A.7.3.1.6 R166 .... A.7-23
A.7.3.1.7 R167 .... A.7-24
A.7.3.2 Sediment Quality A.7-25
A.7.3.2.1 R168 .... A.7-25
A.7.4 HYDROLOGY BASELINE A.7-25
A.7.4.1.1 R169 .... A.7-25
A.7.4.1.2 R170 .... A.7-27
A.7.4.1.3 R171 .... A.7-27
A.7.4.1.4 R172 .... A.7-28
A.7.4.1.5 R173 .... A.7-33
A.7.4.1.6 R174 .... A.7-33
A.7.4.1.7 R175 .... A.7-34
A.7.4.1.8 R176 .... A.7-34
A.7.4.1.9 R177 .... A.7-38
A.7.4.1.10 R178 .... A.7-38
A.7.5 HYDROGEOLOGY BASELINE A.7-39
A.7.5.1.1 R179 .... A.7-39
A.7.5.1.2 R180 .... A.7-41
A.7.5.1.3 R181 .... A.7-42
A.7.6 GEOCHEMISTRY AND SOURCE TERM PREDICTIONS A.7-42
A.7.6.1 Geochemical Characterization of Ore, Waste Rock and Tailings A.7-42
A.7.6.1.1 R182 .... A.7-42
A.7.6.1.2 R183 .... A.7-45
A.7.6.1.3 R184 .... A.7-45
A.7.6.1.4 R185 .... A.7-45
A.7.6.1.5 R186 .... A.7-45

A.7.6.1.6 R187 .....A.7-45
A.7.6.1.7 R188 .....A.7-46
A.7.6.1.8 R189 .....A.7-46
A.7.6.1.9 R190 .....A.7-49
A.7.6.1.10 R191 .....A.7-50
A.7.6.1.11 R192 .....A.7-51
A.7.6.1.12 R193 .....A.7-55
A.7.6.2 TMF Embankment Loadings A.7-55
A.7.6.2.1 R194 .....A.7-55
A.7.6.2.2 R195 .....A.7-56
A.7.6.2.3 R196 .....A.7-57
A.7.6.3 Missing Information A.7-58
A.7.6.3.1 R197 .....A.7-58
A.7.6.3.2 R198 .....A.7-58
A.7.6.3.3 R199 .....A.7-59
A.7.6.3.4 R200 .....A.7-59
A.7.7 NUMERICAL GROUNDWATER MODEL A.7-59
A.7.7.1.1 R201 .....A.7-59
A.7.7.1.2 R202 .....A.7-59
A.7.7.1.3 R203 .....A.7-59
A.7.7.1.4 R204 .....A.7-61
A.7.7.1.5 R205 .....A.7-61
A.7.7.1.6 R206 .....A.7-62
A.7.7.1.7 R207 .....A.7-62
A.7.7.1.8 R208 .....A.7-64
A.7.7.1.9 R209 .....A.7-64
A.7.7.1.10 R210 .....A.7-65
A.7.7.1.11 R211 .....A.7-65
A.7.7.1.12 R212 .....A.7-68
A.7.7.1.13 R213 .....A.7-68
A.7.7.1.14 R214 .....A.7-69
A.7.7.1.15 R215 .....A.7-71
A.7.7.1.16 R216 .....A.7-71
A.7.7.1.17 R217 .....A.7-72
A.7.7.1.18 R218 .....A.7-72
A.7.7.1.19 R219 .....A.7-72

A.7.7.1.20 R220 .... A.7-74
A.7.7.1.21 R221 .... A.7-74
A.7.7.1.22 R222 .... A.7-74
A.7.7.1.23 R223 .... A.7-75
A.7.8 WATER BALANCE MODEL A.7-76
A.7.8.1.1 R224 .... A.7-76
A.7.8.1.2 R225 .... A.7-76
A.7.8.1.3 R226 .... A.7-76
A.7.8.1.4 R227 .... A.7-77
A.7.8.1.5 R228 .... A.7-77
A.7.8.1.6 R229 .... A.7-77
A.7.8.1.7 R230 .... A.7-77
A.7.9 WATER QUALITY MODEL REPORT A.7-78
A.7.9.1 Transparency of Water Quality Predictions A.7-78
A.7.9.1.1 R231 .... A.7-78
A.7.9.1.2 R232 .... A.7-78
A.7.9.1.3 R233 .... A.7-78
A.7.9.1.4 R234 .... A.7-78
A.7.9.1.5 R235 .... A.7-78
A.7.9.1.6 R236 .... A.7-79
A.7.9.2 Source Term Loading from TMF Seepage A.7-79
A.7.9.2.1 R237 .... A.7-79
A.7.10 WATER QUALITY OBJECTIVES A.7-79
A.7.10.1 Site Specific Water Quality Objectives A.7-79
A.7.10.1.1 R238 .... A.7-79
A.7.10.1.2 R239 .... A.7-106
A.7.10.2 Metal Mining Effluent Regulations A.7-106
A.7.10.2.1 R240 .... A.7-106
A.7.11 DOWNSTREAM EXTENT OF WATER QUALITY EFFECTS A.7-107
A.7.11.1.1 R241 .... A.7-107
A.7.11.1.2 R242 .... A.7-108
A.7.12 SUBMERSION OF PAG MATERIALS A.7-109
A.7.12.1.1 R243 .... A.7-109
A.7.12.1.2 R244 .... A.7-109
A.7.13 OPEN PIT WATER QUALITY A.7-111
A.7.13.1.1 R245 .... A.7-111
A.7.14 HISTORIC ADIT A.7-112

A.7.14.1.1 R246 ...... A.7-112
A.7.14.1.2 R247 ...... A.7-112
A.7.14.1.3 R248 ...... A.7-114

A.8 – AIR QUALITY A.8-1

A.8.1 INTRODUCTION...... A.8-1
A.8.2 BASELINE CLIMATE REPORT...... A.8-3
A.8.2.1.1 R249 ...... A.8-3
A.8.2.1.2 R250 ...... A.8-3
A.8.2.1.3 R251 ...... A.8-4
A.8.2.1.4 R252 ...... A.8-5
A.8.2.1.5 R253 ...... A.8-5
A.8.2.1.6 R254 ...... A.8-5
A.8.2.1.7 R255 ...... A.8-6
A.8.2.1.8 R256 ...... A.8-6
A.8.2.1.9 R257 ...... A.8-8
A.8.2.1.10 R258 ...... A.8-8
A.8.3 CLIMATE CHANGE REPORT A.8-9
A.8.3.1.1 R259 ...... A.8-9
A.8.3.1.2 R260 ...... A.8-10
A.8.3.1.3 R261 ...... A.8-11
A.8.4 AIR QUALITY MODELLING A.8-12
A.8.4.1 Model Inputs...... A.8-12
A.8.4.1.1 R262 ...... A.8-12
A.8.4.1.2 R263 ...... A.8-12
A.8.4.1.3 R264 ...... A.8-12
A.8.4.1.4 R265 ...... A.8-12
A.8.4.2 Mitigations A.8-13
A.8.4.2.1 R266 ...... A.8-13
A.8.4.2.2 R267 ...... A.8-13
A.8.4.3 Exceedances...... A.8-13
A.8.4.3.1 R268 ...... A.8-13
A.8.4.3.2 R269 ...... A.8-13
A.8.5 DUST AND DUSTFALL A.8-14
A.8.5.1.1 R270 ...... A.8-14
A.8.5.1.2 R271 ...... A.8-14
A.8.6 AIR QUALITY MANAGEMENT PLAN A.8-14
A.8.6.1.1 R272 ...... A.8-14

A.9 – NOISE A.9-1
A.9.1 INTRODUCTION A.9-1
A.9.2 NOISE A.9-2
A.9.2.1.1 R411 ..... A.9-2
A.9.2.1.2 R412 ..... A.9-3
A.9.2.1.3 R413 ..... A.9-3
A.9.2.1.4 R414 ..... A.9-4
A.9.2.1.5 R415 ..... A.9-5
A.9.2.1.6 R416 ..... A.9-6
A.10 – FISH AND AQUATIC RESOURCES A.10-1
A.10.1 INTRODUCTION A.10-1
A.10.2 FISHERIES ACT – FISHERIES PROTECTION PROVISIONS A.10-6
A.10.2.1.1 R273 ..... A.10-6
A.10.3 CHARGE WEIGHTS A.10-7
A.10.3.1.1 R274 ..... A.10-7
A.10.4 BASELINE DATA A.10-7
A.10.4.1.1 R275 ..... A.10-7
A.10.4.1.2 R276 ..... A.10-8
A.10.4.1.3 R277 ..... A.10-21
A.10.4.1.4 R278 ..... A.10-24
A.10.4.1.5 R279 ..... A.10-24
A.10.4.1.6 R280 ..... A.10-25
A.10.4.2 Missing Appendices Documenting Baseline Data A.10-25
A.10.4.2.1 R281 ..... A.10-25
A.10.5 HABITAT LOSS, ALTERATION AND COMPENSATION A.10-26
A.10.5.1 Flow and Wetted Area Reduction A.10-26
A.10.5.1.1 R282 ..... A.10-26
A.10.5.1.2 R283 ..... A.10-26
A.10.5.1.3 R284 ..... A.10-26
A.10.5.1.4 R285 ..... A.10-26
A.10.5.2 Tailings Management Facility Fish Barrier A.10-30
A.10.5.2.1 R286 ..... A.10-30
A.10.5.2.2 R287 ..... A.10-31
A.10.5.3 Airstrip Diversion Channel A.10-32
A.10.5.3.1 R288 ..... A.10-32
A.10.5.3.2 R289 ..... A.10-32
A.10.5.4 Fisheries Protection Provisions of the Fisheries Act A.10-33

A.10.5.4.1 R290 ....A.10-33
A.10.5.5 Physical Habitat Simulation Model and Habitat Evaluation Procedure....A.10-33
A.10.5.5.1 R291 ....A.10-33
A.10.5.5.2 R292 ....A.10-34
A.10.5.6 Habitat Loss Calculations – Airstrip Diversion Channel....A.10-34
A.10.5.6.1 R293 ....A.10-34
A.10.5.6.2 R294 ....A.10-34
A.10.5.7 Habitat Evaluation Procedure Analysis....A.10-34
A.10.5.7.1 R295 ....A.10-34
A.10.5.8 Ford Rehabilitation A.10-35
A.10.5.8.1 R296 ....A.10-35
A.10.6 WATERCOURSE CROSSINGS....A.10-35
A.10.6.1 Embedded Culverts on Fish Bearing Streams....A.10-35
A.10.6.1.1 R297 ....A.10-35
A.10.6.2 Existing Stream Crossings....A.10-35
A.10.6.2.1 R298 ....A.10-35
A.10.6.3 Nordenskiold River Bridge A.10-36
A.10.6.3.1 R299 ....A.10-36
A.10.6.3.2 R300 ....A.10-36
A.10.6.3.3 R301 ....A.10-37
A.10.6.4 Classification of Crossings....A.10-38
A.10.6.4.1 R302 ....A.10-38
A.10.6.5 Erosion A.10-39
A.10.6.5.1 R303 ....A.10-39
A.10.6.5.2 R304 ....A.10-39
A.10.6.5.3 R305 ....A.10-115
A.10.7 AQUATIC MONITORING PLAN A.10-116
A.10.7.1.1 R306 ....A.10-116
A.10.8 CLARIFICATION....A.10-117
A.10.8.1.1 R307 ....A.10-117

A.11 – RARE PLANTS AND VEGETATION HEALTH A.11-1
A.11.1 INTRODUCTION....A.11-1
A.11.2 PROJECT INFRASTRUCTURE AND SENSITIVE HABITATS....A.11-2
A.11.2.1.1 R308 ....A.11-2
A.11.2.1.2 R309 ....A.11-4
A.11.2.1.3 R310 ....A.11-5
A.11.3 SELECTION OF INDICATORS FOR THE VEGETATION HEALTH VALUED COMPONENT.....A.11-7

A.11.3.1.1 R311 .... A.11-7
A.11.3.1.2 R312 .... A.11-7
A.11.4 SOIL EROSION, RE-VEGETATION AND INVASIVE SPECIES A.11-8
A.11.4.1.1 R313 .... A.11-8

A.12 – WILDLIFE A.12-1
A.12.1 INTRODUCTION A.12-1
A.12.2 REFERENCES A.12-7
A.12.2.1.1 R314 .... A.12-7
A.12.3 FREEGOLD ROAD AND OTHER ACCESS ROADS A.12-8
A.12.3.1 Population Dynamics A.12-8
A.12.3.1.1 R315 .... A.12-8
A.12.3.2 Wildlife Crossing Areas A.12-9
A.12.3.2.1 R316 .... A.12-9
A.12.3.3 Road Management A.12-10
A.12.3.3.1 R317 .... A.12-10
A.12.3.3.2 R318 .... A.12-11
A.12.3.3.3 R319 .... A.12-11
A.12.3.3.4 R320 .... A.12-11
A.12.4 EFFECTS ASSESSMENT FOR MAMMALS A.12-13
A.12.4.1 Caribou A.12-13
A.12.4.1.1 R321 .... A.12-13
A.12.4.1.2 R322 .... A.12-14
A.12.4.1.3 R323 .... A.12-14
A.12.4.1.4 R324 .... A.12-14
A.12.4.1.5 R325 .... A.12-15
A.12.4.1.6 R326 .... A.12-15
A.12.4.1.7 R327 .... A.12-15
A.12.4.1.8 R328 .... A.12-15
A.12.4.1.9 R329 .... A.12-15
A.12.4.2 Moose A.12-16
A.12.4.2.1 R330 .... A.12-16
A.12.4.2.2 R331 .... A.12-16
A.12.4.2.3 R332 .... A.12-16
A.12.4.2.4 R333 .... A.12-17
A.12.4.2.5 R334 .... A.12-18
A.12.4.2.6 R335 .... A.12-18
A.12.4.3 Grizzly Bear A.12-18

A.12.4.3.1 R336 .... A.12-18
A.12.4.3.2 R337 .... A.12-18
A.12.4.3.3 R338 .... A.12-20
A.12.4.3.4 R339 .... A.12-20
A.12.4.3.5 R340 .... A.12-21
A.12.4.3.6 R341 .... A.12-22
A.12.4.3.7 R342 .... A.12-22
A.12.4.3.8 R343 .... A.12-22
A.12.4.3.9 R344 .... A.12-23
A.12.4.4 Collared Pika A.12-24
A.12.4.4.1 R345 .... A.12-24
A.12.4.5 Wolverine A.12-24
A.12.4.5.1 R346 .... A.12-24
A.12.4.5.2 R347 .... A.12-24
A.12.4.6 Little Brown Myotis A.12-25
A.12.4.6.1 R348 .... A.12-25
A.12.4.6.2 R349 .... A.12-26
A.12.4.7 Dall Sheep A.12-26
A.12.4.7.1 R350 .... A.12-26
A.12.5 EFFECTS ASSESSMENT FOR BIRDS A.12-26
A.12.5.1 Alpine Bird Species at Risk A.12-26
A.12.5.1.1 R351 .... A.12-26
A.12.5.1.2 R352 .... A.12-29
A.12.5.2 Baseline Data for Species at Risk A.12-30
A.12.5.2.1 R353 .... A.12-30
A.12.5.3 Bird Mortality Risk A.12-30
A.12.5.3.1 R354 .... A.12-30
A.12.5.4 Habitat Loss A.12-31
A.12.5.4.1 R355 .... A.12-31
A.12.5.4.2 R356 .... A.12-31
A.12.5.4.3 R357 .... A.12-31
A.12.5.5 Noise Effects A.12-32
A.12.5.5.1 R358 .... A.12-32
A.12.5.5.2 R359 .... A.12-32
A.12.5.5.3 R360 .... A.12-32
A.12.5.6 Cliff-Nesting Raptor Survey A.12-32

A.12.5.6.1 R361 .... A.12-32
A.12.5.6.2 R362 .... A.12-32
A.12.5.7 Cliff-Nesting Raptor Nest Sites A.12-33
A.12.5.7.1 R363 .... A.12-33
A.12.5.8 Waterfowl – Presence of Wetlands A.12-33
A.12.5.8.1 R364 .... A.12-33
A.12.5.8.2 R365 .... A.12-33
A.12.5.8.3 R366 .... A.12-33
A.12.5.9 Waterfowl – Mine Water Bodies A.12-34
A.12.5.9.1 R367 .... A.12-34
A.12.5.9.2 R368 .... A.12-34
A.12.5.9.3 R369 .... A.12-35
A.12.5.9.4 R370 .... A.12-35
A.12.5.10 Bird Baseline Clarification A.12-36
A.12.5.10.1 R371 .... A.12-36
A.12.6 CONSIDERATION OF CLIMATE CHANGE IN RELATION TO WILDLIFE A.12-37
A.12.6.1.1 R372 .... A.12-37
A.12.6.1.2 R373 .... A.12-37
A.12.7 WILDLIFE MITIGATION AND MONITORING PLAN A.12-38
A.12.7.1.1 R374 .... A.12-38

A.13 – EMPLOYMENT AND INCOME A.13-1
A.13.1 INTRODUCTION A.13-1
A.13.2 SUPPORTING DOCUMENTATION A.13-2
A.13.2.1.1 R381 .... A.13-2

A.14 – EMPLOYABILITY A.14-1
A.14.1 INTRODUCTION A.14-1
A.14.2 TRAINING AND EDUCATION A.14-2
A.14.2.1.1 R382 .... A.14-2
A.14.3 AFFECTED COMMUNITIES' ACCESS A.14-5
A.14.3.1.1 R383 .... A.14-5
A.14.3.1.2 R384 .... A.14-5
A.14.4 EMPLOYMENT AND MIGRATION A.14-6
A.14.4.1.1 R385 .... A.14-6
A.14.4.1.2 R386 .... A.14-9
A.14.5 FLY-IN-FLY OUT AND SHIFT STRUCTURE A.14-10
A.14.5.1.1 R387 .... A.14-10
A.14.5.1.2 R388 .... A.14-11

A.15 – ECONOMIC DEVELOPMENT AND BUSINESS SECTOR A.15-1
A.15.1 INTRODUCTION A.15-1
A.15.2 BOOM AND BUST CYCLES A.15-2
A.15.2.1.1 R375 .... A.15-2
A.15.2.1.2 R376 .... A.15-3
A.15.2.1.3 R377 .... A.15-4
A.15.3 BUSINESS OPPORTUNITY A.15-5
A.15.3.1.1 R378 .... A.15-5
A.15.3.1.2 R379 .... A.15-6
A.15.4 ECONOMIC EFFECTS MONITORING A.15-7
A.15.4.1.1 R380 .... A.15-7
A.16 – COMMUNITY VITALITY A.16-1
A.16.1 INTRODUCTION A.16-1
A.16.2 METHODOLOGY A.16-2
A.16.2.1.1 R389 .... A.16-2
A.16.3 SOCIAL AND CULTURAL EFFECTS MONITORING A.16-3
A.16.3.1.1 R390 .... A.16-3
A.16.4 EFFECTS ASSESSMENT VALUED COMPONETS A.16-7
A.16.4.1.1 R391 .... A.16-7
A.17 – COMMUNITY INFRASTRUCTURE AND SERVICES A.17-1
A.17.1 INTRODUCTION A.17-1
A.18 – CULTURAL CONTINUITY A.18-1
A.18.1 INTRODUCTION A.18-1
A.18.2 HERITAGE MANAGEMENT PLAN A.18-2
A.18.2.1.1 R392 .... A.18-2
A.18.3 NATURE AND NUMBER OF ARCHAEOLOGICAL AND HISTORIC SITES A.18-7
A.18.3.1.1 R393 .... A.18-7
A.18.4 FREEGOLD ROAD HISTORIC SITES A.18-8
A.18.4.1.1 R394 .... A.18-8
A.19 – LAND USE AND TENURE A.19-1
A.19.1 INTRODUCTION A.19-1
A.19.2 FISHERIES A.19-2
A.19.2.1.1 R400 .... A.19-2
A.19.3 HARVESTING OF PLANTS A.19-3
A.19.3.1.1 R401 .... A.19-3
A.19.3.1.2 R402 .... A.19-3
A.19.4 HARVESTING OF ANIMALS A.19-3
A.19.4.1.1 R403 .... A.19-3

A.19.4.1.2 R404 .... A.19-3
A.19.5 TRAPPING AND OUTFITTING A.19-5
A.19.5.1.1 R407 .... A.19-5
A.19.5.1.2 R409 .... A.19-7
A.19.5.1.3 R410 .... A.19-7
A.20 – EFFECTS OF THE ENVIRONMENT ON THE PROJECT A.20-1
A.20.1 INTRODUCTION A.20-1
A.20.2 WILDFIRE A.20-2
A.20.2.1.1 R429 .... A.20-2
A.20.2.1.2 R430 .... A.20-3
A.21 – ACCIDENTS AND MALFUNCTIONS A.21-1
A.21.1 INTRODUCTION A.21-1
A.21.2 ACCIDENTS AND MALFUNCTIONS METHODOLOGY A.21-3
A.21.2.1.1 R417 .... A.21-3
A.21.3 GENERAL EMERGENCY A.21-4
A.21.3.1.1 R418 .... A.21-4
A.21.3.1.2 R419 .... A.21-6
A.21.3.1.3 R420 .... A.21-7
A.21.3.1.4 R421 .... A.21-9
A.21.3.2 Evacuation A.21-10
A.21.3.2.1 R422 .... A.21-10
A.21.4 FIRE A.21-11
A.21.4.1 Mine Infrastructure and Fire A.21-11
A.21.4.1.1 R423 .... A.21-11
A.21.4.1.2 R424 .... A.21-11
A.21.4.1.3 R425 .... A.21-12
A.21.4.1.4 R426 .... A.21-13
A.21.4.1.5 R427 .... A.21-13
A.21.4.1.6 R428 .... A.21-15
A.21.5 MEDICAL AND HEALTH A.21-16
A.21.5.1.1 R431 .... A.21-16
A.21.5.1.2 R432 .... A.21-16
A.21.5.1.3 R433 .... A.21-17
A.21.5.1.4 R434 .... A.21-18
A.21.6 EMERGENCY SERVICES AND OTHER USERS A.21-19
A.21.6.1.1 R446 .... A.21-19
A.21.7 ACCIDENTS AND MALFUNCTIONS A.21-19

A.21.7.1.1 R447 .... A.21-19
A.21.7.1.2 R448 .... A.21-19

A.22 – ENVIRONMENTAL MANAGEMENT PLANS A.22-1
A.22.1 INTRODUCTION A.22-1
A.22.2 MEDICAL AND HEALTH A.22-5
A.22.2.1.1 R435 .... A.22-5
A.22.3 DANGEROUS GOODS, SPILLS AND LEAKS A.22-7
A.22.3.1.1 R436 .... A.22-7
A.22.3.2 Flotation and Heap Leach Constituents A.22-7
A.22.3.2.1 R437 .... A.22-7
A.22.3.3 Materials Management Plans A.22-8
A.22.3.3.1 R438 .... A.22-8
A.22.3.3.2 R439 .... A.22-10
A.22.3.3.3 R440 .... A.22-10
A.22.3.3.4 R441 .... A.22-10
A.22.3.3.5 R442 .... A.22-12
A.22.3.3.6 R443 .... A.22-15
A.22.4 HUMAN HEALTH RISK ASSESSMENT A.22-15
A.22.4.1.1 R444 .... A.22-15
A.22.5 ACCIDENTS AND MALFUNCTIONS A.22-18
A.22.5.1.1 R449 .... A.22-18

A.23 – ENVIRONMENTAL MONITORING PLANS A.23-1
A.23.1 INTRODUCTION A.23-1

A.24 – CONCLUSION .... A 24-1

A.25 – REFERENCES A.25-1

LIST OF TABLES

Table A.2.1-1 Requests for Supplementary Information Related to First Nations and Community Consultation A.2-3
Table A.2.2-1 Summary of Consultation Events A.2-4
Table A.2.2-2 Requested Traditional Knowledge and Traditional Land Use Information and Data A.2-5
Table A.2.3-1 Consultation Log for Trapline Concession Holders A.2-12
Table A.2.3-2 Consultation Log for Outfitting Concession Holders A.2-13

Table A.4.1-1 Requests for Supplementary Information Related to Project Description A.4-1
Table A.4.2-1 Additional Information on the Alternative Access Road Alignments A.4-21
Table A.4.2-2 Preliminary Access Route Concepts (Expanded from Table 4.8-7 of the Proposal) A.4-23
Table A.4.4-1 Casino Traffic Projections during Construction Phase (update to Appendix H of Appendix 4B Freegold Road Report) A.4-28
Table A.4.5-1 KM3512 2012 Pilot Pyrite Rougher Tailing Total Sulphur Content (%S) A.4-30
Table A.4.5-2 Sulphide Sulphur Requirements to Maintain CaNP/AP > 2.0 Based on Ore Feed Carbonate Content A.4-30
Table A.4.6-1 Required Permits for Construction and Operation of Temporary Construction Camps A.4-36
Table A.4.6-2 Projected Traffic Volumes during the Operations Phase (Proposal Table 4.4-5) A.4-42
Table A.4.6-3 Yukon FHWA-based Vehicle Classification System A.4-42
Table A.4.6-4 Traffic and Truck Count Statistics from the Whitehorse Corridor (Summer 2011) and Predicted Project-related Truck Traffic A.4-43
Table A.4.6-5 Transportation and Usage of Potentially Dangerous Goods A.4-51
Table A.4.7-1 Summary of Design Criteria and Probability of Exceedances for Water Management Components A.4-57
Table A.4.8-1 Annual Process Water Makeup Requirements for HLF A.4-63
Table A.4.8-2 Additional Lab Testing of Leach Ore A.4-66
Table A.4.9-1 Dam Classification A.4-70
Table A.4.9-2 Extreme 24-hr Rainfall Values A.4-74
Table A.4.9-3 Inflow Design Flood and Earthquake Design Ground Motion A.4-93
Table A.4.10-1 LNG Facilities Applicable Codes and Standards A.4-95
Table A.4.10-2 LNG Facilities Design Criteria Codes and Standards A.4-96
Table A.4.10-3 LNG Facility Major Equipment and Process Information A.4-113
Table A.4.10-4 LNG Storage Capacity Calculations A.4-115
Table A.4.10-5 LNG Facility Utility Requirements A.4-116
Table A.4.11-1 Major Mine Component Reclamation Summary A.4-123
Table A.4.11-2 Conceptual Post-Closure Maintenance Requirements by Mine Component A.4-131
Table A.4.11-3 Summary of Closure and Post-Closure Monitoring Schedule A.4-133
Table A.4.11-4 Stages of constructed wetland treatment system testing and optimization A.4-135
Table A.4.11-5 Ore Stockpile Seepage Endpoints and Travel Times A.4-144
Table A.4.11-6 Adaptive Management for HLF Cover Planning Testwork and Objectives A.4-149
Table A.4.11-7 Adaptive Management for Re-vegetation Planning A.4-156
Table A.4.11-8 Time Required for Flooding of the Open Pit at Various Temporary Closure Years A.4-159
Table A.4.11-9 Ore Stockpile Schedule A.4-161
Table A.4.11-10 Tailings Management Facility Elevations during Operations A.4-163
Table A.4.11-11 Feasibility Reclamation and Closure Cost Estimate A.4-167

Table A.5.1-1 Requests for Supplementary Information Related to Effects Assessment Methodology A.5-1

Table A.6.1-1 Requests for Supplementary Information Related to Terrain Features A.6-1

Table A.7.1-1 Requests for Supplementary Information Related to Water Quality and Quantity A.7-1
Table A.7.3-1 Flow from Historical Adit 2011 - 2012 ....A.7-20
Table A.7.3-2 Station W43 Water Quality Results August 23 and October 4, 2011 compared to 2008-2012 site statistics for select parameters A.7-21
Table A.7.3-3 Station W4 Water Quality Results August 23 and October 4, 2011 compared to 2008-2012 site statistics for select parameters...A.7-22
Table A.7.3-4 Targeted and measured values of constituents in the mixtures A.7-24
Table A.7.4-1 Baseline Hydrology Estimates Downstream of Dip Creek A.7-26
Table A.7.4-2 Baseline Hydrology Estimates in Yukon River at Britannia Creek......................................A.7-27
Table A.7.4-3 Recommended Peak Flow Values for Project Streamflow Stations (update to Table 5.1-2 from Appendix 7B)..A.7-34
Table A.7.4-4 Regional Peak Flow Return Period Coefficients (update to Table 5.2-1 from Appendix 7B) ..A.7-35
Table A.7.4-5 10-Year Wet and Dry Monthly Runoff (update to Table 5.3-1 from Appendix 7B)..............A.7-36
Table A.7.6-1 CAP sample pH by Lithology A.7-43
Table A.7.6-2 Percentage of ARD Samples Collected According to Lithologic Unit and Relative Proportion of each Lithologic Unit in the Casino Pit (Table 3-3 & 3-4 from Appendix 7D) A.7-43
Table A.7.6-3 ML/ARD Characteristics for Major Alteration Zones A.7-44
Table A.7.6-4 Range of Fluoride and Uranium Concentrations in Shake Flask Extraction Leachate........A.7-46
Table A.7.6-5 Ore and Waste Production Schedule (derived from M3 2013) A.7-48
Table A.7.6-6 Summary of ML/ARD Management Options...A.7-53
Table A.7.10-1 Water Quality Model Variability Model Updates to Average Case Model............................A.7-80
Table A.7.10-2 Predicted Parameter Concentrations for the Average Case and Variability Water Quality Models...A.7-82

Table A.8.1-1 Requests for Supplementary Information Related to Air Quality A.8-1
Table A.8.2-1 Extreme 24-hr Rainfall Values A.8-4
Table A.9.1-1 Requests for Supplementary Information Related to Noise...A.9-1
Table A.9.2-1 Octave Band Spectrums for the Major Sources...A.9-5

Table A.10.1-1 Requests for Supplementary Information Related to Fish and Aquatic Resources.............A.10-2
Table A.10.4-1 Fish Sampling Effort above an Identified Barrier (2008-2010)..A.10-21
Table A.10.4-2 Rationale for Non-Fish-Bearing Status along the proposed Freegold Upgrade, Extension, and Airstrip and Airstrip Road A.10-23
Table A.10.4-3 Fisheries Baseline Information Locater...A.10-25
Table A.10.5-1 Fish Habitat Sites and Habitat Quality Assessment..A.10-27
Table A.10.5-2 Habitat Index values (m^2/s per 1000 m stream) versus flow for all life stages of Arctic grayling in Casino Creek including adult and juvenile winter values A.10-28
Table A.10.5-3 Results of the March 2013 Pool Investigations in Casino Creek A.10-29

Table A.11.1-1 Requests for Supplementary Information Related to Rare Plant and Vegetation Health A.11-1

Table A.11.2-1 Summary of baseline studies that overlapped fen and tor habitats that intersect the proposed Freegold Road upgrade alignment....A.11-3
Table A.11.4-1 Adaptive Management for Re-vegetation Planning A.11-10

Table A.12.1-1 Requests for Supplementary Information Related to Wildlife A.12-1
Table A.12.5-2 Species Known or Likely to Occur in the Project Area, not Included as Key Indicators (update to Table 12.1.3-2) A.12-28
Table A.12.5-4 Predicted TMF Pond Water Quality Compared to CCME Guidelines (from Appendix A.7B sub-appendix IV) A.12-36

Table A.13.1-1 Requests for Supplementary Information Related to Employment and Income A.13-1

Table A.14.1-1 Requests for Supplementary Information Related to Employability....A.14-1
Table A.14.4-1 Estimated Population Changes....A.14-7

Table A.15.1-1 Requests for Supplementary Information Related to Economic Development and Business Sector A.15-1

Table A.16.1-1 Requests for Supplementary Information Related to Community Vitality....A.16-1

Table A.18.1-1 Requests for Supplementary Information Related to Cultural Continuity A.18-1

Table A.19.1-1 Requests for Supplementary Information Related to Land Use and Tenure....A.19-1

Table A.20.1-1 Requests for Supplementary Information Related to Effects of the Environment on the Project A.20-1

Table A.21.1-1 Requests for Supplementary Information Related to Accidents and Malfunctions....A.21-1
Table A.21.3-1 External Emergency Contact List....A.21-6

Table A.22.1-1 Requests for Supplementary Information Related to Environmental Management Plans...A.22-4
Table A.22.3-1 Rates of Use of Reagents for Sulphide Ore and Oxide Ore Circuits....A.22-8
Table A.22.3-2 Potential Interactions between Transportation of Hazardous Materials and Value Components A.22-12
Table A.24-1 Updated Table of Commitments A.24-2

LIST OF FIGURES

Figure A.1.4-1 Document Organization for Proposal and SIR A A.1-4
Figure A.1.5-1 SIR Document Map A.1-5
Figure A.1.5-2 Proposal Document Map with Replacement Sections A.1-6

Figure A.4.4-1 Freegold Road Upgrade and Freegold Road Extension Construction Schedule A.4-27
Figure A.4.6-1 Location of the Mine Site Construction Camp A.4-34
Figure A.4.6-2 Freegold Road Extension Camp (Figure B-6 from Appendix 4B) A.4-35
Figure A.4.6-3 Yukon Highway Schematic and 2010 Traffic Volumes (Yukon Government 2014) A.4-45
Figure A.4.6-4 Conceptual Rendering of Skagway Port Facilities (M3 2013) A.4-50
Figure A.4.8-1 Containment Ditch and Culvert for Road Crossings A.4-60
Figure A.4.8-2 Heap Leach Facility – Accumulated Water and Monthly Surplus A.4-64
Figure A.4.9-1 TMF Closure Spillway – Inflow and Outflow Hydrograph A.4-77
Figure A.4.9-2 Typical sand cell construction showing cyclone underflow contained by berms and compacted by dozer. A.4-88
Figure A.4.10-1 LNG Facility Site Layout A.4-97
Figure A.4.10-2 LNG Facility Process Block Diagram A.4-98
Figure A.4.11-1 Closure Activities Timeline A.4-127
Figure A.4.11-2 Removal rate coefficient equation A.4-139
Figure A.4.11-3 Open Pit Decant System A.4-141
Figure A.4.11-4 Closure Planning Adaptive Management Framework A.4-150
Figure A.4.11-5 WMP, TMF Pond and H18 Discharge A.4-152
Figure A.4.11-6 Kemess Mine Tailings Dam – Simplified Design Section (from Martin 2011) A.4-153
Figure A.4.11-7 Casino TMF Typical Section Year 22 (from Appendix A.4D) A.4-154
Figure A.4.11-8 Kemess South Tailings Dam (September 22, 2014) A.4-154
Figure A.4.11-9 Kemess South Tailings Dam Face, Looking Downslope at Dam and Buttress (September 22, 2014) A.4-155
Figure A.4.11-10 Plot of Stockpile Volume Relative to Pit Volume A.4-162
Figure A.4.11-11 Tailings Management Facility Waste Deposition Strategy Typical Sections A.4-163
Figure A.4.11-12 Potential Borrow Areas A.4-165
Figure A.4.11-13 Open Pit Development Outlines A.4-166

Figure A.7.3-1 Median Concentrations of Total and Dissolved Iron and TSS, 2008-2012 A.7-17
Figure A.7.3-2 Historical Adit Discharge Pipe (May 28, 2014) A.7-19
Figure A.7.3-3 Lower Casino Creek Station (W4) Measured Discharge Hydrograph A.7-23
Figure A.7.3-4 Station H18, M18 and W18 Locations (from Figure 7.2-2) A.7-25
Figure A.7.4-1 Station W14 Measured Discharge Hydrograph (From Appendix 7B) A.7-29
Figure A.7.4-2 Station W3 Measured Discharge Hydrograph (From Appendix 7B) A.7-29
Figure A.7.4-3 Station W16 Measured Discharge Hydrograph (From Appendix 7B) A.7-30
Figure A.7.4-4 Station W9 Measured Discharge Hydrograph (From Appendix 7B) A.7-30
Figure A.7.4-5 Station R2 Measured Discharge Hydrograph (From Appendix 7B) A.7-31
Figure A.7.4-6 Station W4 Measured Discharge Hydrograph (From Appendix 7B) A.7-31
Figure A.7.4-7 Station H18 Measured Discharge Hydrograph (From Appendix 7B) A.7-32
Figure A.7.4-8 Station W11 Measured Discharge Hydrograph (From Appendix 7B) A.7-32
Figure A.7.4-9 Station W18 Measured Discharge Hydrograph (From Appendix 7B) A.7-33

Figure A.7.6-1 Waste Rock Production Schedule ... A.7-47
Figure A.7.6-2 Embankment oxygen concentration, pyrite volume fraction, and oxidation rate with depth (Figure 5-3 from Appendix 7D) ... A.7-56
Figure A.7.6-3 Illustration of Embankment Loading Pathway via Runoff or Infiltration (Figure 7-2 from Appendix 7D) ... A.7-57
Figure A.7.6-4 Mass Loading Flow Paths through the TMF Pond System (Operations Phase) (replicated from Appendix A.7B) ... A.7-58
Figure A.7.7-1 Mass Transport Flow Paths through the Post-Closure Pit Lake System ... A.7-60
Figure A.7.7-2 Mass Transport Flow Paths through the TMF Pond (post-closure) ... A.7-60
Figure A.7.7-3 Groundwater Monitoring Locations ... A.7-66
Figure A.7.7-4 Hydrogeological Cross Section – Casino Creek and Dip Creek Catchments ... A.7-67
Figure A.7.7-5 Inferred Permafrost and Recharge Spatial Distribution ... A.7-70
Figure A.7.10-1 Predicted Annual Maximum and Monthly Cadmium Concentrations for Casino Creek ... A.7-84
Figure A.7.10-2 Predicted Annual Maximum and Monthly Cadmium Concentrations in Dip Creek ... A.7-85
Figure A.7.10-3 Predicted Annual Maximum and Monthly Copper Concentrations for Casino Creek ... A.7-87
Figure A.7.10-4 Predicted Annual Maximum and Monthly Copper Concentrations in Dip Creek ... A.7-88
Figure A.7.10-5 Predicted Annual Maximum and Monthly Fluoride Concentrations for Casino Creek ... A.7-90
Figure A.7.10-6 Predicted Annual Maximum and Monthly Fluoride Concentrations in Dip Creek ... A.7-91
Figure A.7.10-7 Predicted Annual Maximum and Monthly Iron Concentrations for Dip Creek ... A.7-94
Figure A.7.10-8 Predicted Annual Maximum and Monthly Molybdenum Concentrations for Casino Creek . A.7-95
Figure A.7.10-9 Predicted Annual Maximum and Monthly Selenium Concentrations for Casino Creek ... A.7-97
Figure A.7.10-10 Predicted Annual Maximum and Monthly Selenium Concentrations for Dip Creek ... A.7-98
Figure A.7.10-11 Predicted Annual Maximum and Monthly Sulphate Concentrations for Casino Creek ... A.7-101
Figure A.7.10-12 Predicted Annual Maximum and Monthly Uranium Concentrations for Casino Creek ... A.7-104
Figure A.7.10-13 Predicted Maximum Annual Values for the Discharge at the Mixing Point (update to Figure 7.4-1) ... A.7-107
Figure A.7.12-1 Effect of Variability Water Balance Modeling on the TMF Water Cover ... A.7-110
Figure A.7.13-1 Casino Property Geology – Cross Section (Figure 8-2 from M3 2013) ... A.7-111
Figure A.7.14-1 Drill Hole Locations Near Historic Adit (taken from Figure 1.2 in Appendix 7C) ... A.7-112
Figure A.7.14-2 Casino Silver Mines Ltd Plan of Adit Level and Surface Showings (Casino Silver Mines Ltd. 1966) ... A.7-113

Figure A.10.4-1 Overview Map of the Casino Mine Roads and Watersheds ... A.10-13
Figure A.10.4-2 Freegold Road Upgrade Fish Presence/Absence (Map 1) ... A.10-14
Figure A.10.4-3 Freegold Road Upgrade Fish Presence/Absence (Map 2) ... A.10-15
Figure A.10.4-4 Freegold Road Upgrade Fish Presence/Absence (Map 3) ... A.10-16
Figure A.10.4-5 Freegold Road Extension Fish Presence/Absence (Map 1) ... A.10-17
Figure A.10.4-6 Freegold Road Extension Fish Presence/Absence (Map 2) ... A.10-18
Figure A.10.4-7 Freegold Road Extension Fish Presence/Absence (Map 3) ... A.10-19
Figure A.10.4-8 Airstrip and Airstrip Access Road Fish Presence/Absence ... A.10-20
Figure A.10.4-9 Casino Creek Fish and Aquatic Resources Baseline Summary Map ... A.10-22
Figure A.10.5-1 Proposed drop fish barrier structure downstream of the TMF on Casino Creek ... A.10-30
Figure A.10.5-2 Average winter water surface elevations (WSE) at Casino Creek low gradient riffle 182 during baseline, construction, operation, closure, and post-closure conditions ... A.10-31
Figure A.10.6-1 Freegold Road Extension Map 1 Erosion Potential ... A.10-40
Figure A.10.6-2 Freegold Road Extension Map 2 Potential Ecological Consequences ... A.10-65

Figure A.10.6-3 Freegold Road Extension Map 3 Overall Erosion and Sedimentation Risk.......................A.10-90

Figure A.11.2-1 Airstrip Vegetation Polygons (update to Figure 3.1 of Appendix 11A)................................A.11-6

Figure A.12.4-1 Snow conditions during the first grizzly bear den survey (April 20, 2012).........................A.12-19
Figure A.12.4-2 Snow conditions typically observed during the early spring (February 24, 2014) A.12-19

Figure A.21.3-1 Emergency Response Organizational Chart...A.21-5

Figure A.22.1-1 Development of Management and Monitoring Plans..A.22-1
Figure A.22.1-2 Environmental Management Plan Submission Sequence...A.22-3
Figure A.22.2-1 Pre-conditions for Environmental Risk Potential..A.22-6

APPENDICES

Appendix A.1A	Concordance Table to the Executive Committee’s Request for Supplementary Information
Appendix A.2A	Traditional Knowledge Bibliography
Appendix A.4A	Tailings Management Facility Construction Material Alternatives
Appendix A.4B	Information on Alternative Access Road Alignments
Appendix A.4C	Feasibility Design of the Heap Leach Facility
Appendix A.4D	Report on the Feasibility Design of the Tailings Management Facility
Appendix A.4E	Results of Additional Lab Testing of Leach Ore
Appendix A.4F	Waste Storage Area and Stockpiles Feasibility Design
Appendix A.4G	Updated Hydrometeorology Report
Appendix A.4H	Cold Climate Passive Treatment Systems Literature Review
Appendix A.4I	Open Pit Geotechnical Design
Appendix A.4J	Laboratory Evaluation of the SO2/Air and Peroxide Process
Appendix A.4K	Metal Uptake in Northern Constructed Wetland
Appendix A.4L	Revised Tailings Management Facility Seepage Assessment
Appendix A.4M	Processing Flow Sheets
Appendix A.4N	Scoping Level Assessment of Casino Property
Appendix A.4O	Advanced Metallurgical Assessment of the Casino Copper Gold Project
Appendix A.4P	Production of Environmental Tailings Samples for the Casino Deposit
Appendix A.4Q	Mine Site Borrow Materials Assessment Report
Appendix A.4R	Report on Laboratory Geotechnical Testing of Tailings Materials
Appendix A.7A	Variability Water Balance Model Report
Appendix A.7B	Water Quality Predictions Report
Appendix A.7C	Potential Effects of Climate Change on the Variability Water Balance
Appendix A.7D	Updated Appendix B5 to Appendix 7A
Appendix A.7E	2008 Environmental Studies Report: Final
Appendix A.7F	The Effect of Acid Rock Drainage on Casino Creek
Appendix A.7G	Toxicity Testing Reports
Appendix A.7H	Appendix A2 to Casino Waste Rock and Ore Geochemical Static Test Assessment Report: Cross-Sections
Appendix A.7I	Casino Kinetic Testwork 2014 Update for Ore, Waste Rock and Tailings
Appendix A.7J	Preliminary Risk Assessment Metal Leaching and Acid Rock Drainage
Appendix A.7K	Casino Mine Site Borrow Sites ML/ARD Potential
Appendix A.7L	Casino Geochemical Source Term Development: Appendix B
Appendix A.7M	2013-2014 Groundwater Data Report
Appendix A.7N	Extension of Numerical Groundwater Modelling to include Dip Creek Watershed
Appendix A.8A	Emissions Inventory for Construction and Operations
Appendix A.10A	Updated Fish Habitat Offsetting Plan
Appendix A.10B	Fish Habitat Evaluation: Instream Flow and Habitat Evaluation Procedure Study
Appendix A.12A	Wildlife Mitigation and Monitoring Plan V.1.2
Appendix A.12B	Wildlife Baseline Report V.2

Appendix A.12C Moose Late Winter Habitat Suitability Model Report

Appendix A.13A Economic Impacts of the Casino Mine Project

Appendix A.18A Heritage Resources Summary Report
Appendix A.18B Heritage Sites Summary

Appendix A.22A Waste and Hazardous Materials Management Plan
Appendix A.22B Spill Contingency Management Plan
Appendix A.22C Sediment and Erosion Control Management Plan
Appendix A.22D Invasive Species Management Plan
Appendix A.22E Road Use Plan
Appendix A.22F Socio-Economic Management Plan
Appendix A.22G Liquefied Natural Gas Management Plan
Appendix A.22H ML/ARD Management Plan

ABBREVIATIONS

%HA .... percent highly annoyed
AANDC .... Aboriginal Affairs and Northern Development Canada
AEP .... annual exceedance probability
ANFO .... Ammonium nitrate/fuel oil
API .... American Petroleum Institute
ARD .... Acid rock drainage
ARR .... Adequacy Review Report
ASME .... American Society of Mechanical Engineers
Atlas .... Rainfall Frequency Atlas for Canada
BB .... burbot
BC MOE .... British Columbia Ministry of Environment
BC MoF .... BC Ministry of Forests
BC OGC .... British Columbia Oil and Gas Commission
BC .... British Columbia
BCP .... Background concentration procedure
BLEVE .... boiling liquid expanding vapor explosion
BMPs .... Best Management Practices
BMPs .... Best Management Practices
BOG .... Boil off gas
CACs .... criteria air contaminants
CCG .... slimy sculpin
CCME .... Canadian Council of Ministers of the Environment
CCMTA .... Canadian Council of Motor Transport Administrators
CCRP .... Conceptual Closure and Reclamation Plan
CCSD .... Canadian Council on Social Development
CDA .... Canadian Dam Association
CH .... juvenile Chinook salmon
CIC .... Carbon in column
CMC .... Casino Mining Corporation
CMHC .... Canada Mortgage and Housing Corporation
CNIM .... Centre for Northern Innovation in Mining
COC .... contaminant of concern
COPC .... Constituents of potential concern
COSEWIC .... Committee on the status of endangered wildlife in Canada
CRA .... commercial, recreational and Aboriginal
CSA .... Canadian Standards Association
CWBI .... Community Well-Being Index
DFO .... Department of Fisheries and Oceans Canada
DW .... dry weight
Ecofor .... Ecofor Consulting Ltd.
EDI .... Environmental Dynamics
EEM .... Environmental effects monitoring
EF .... electrofishing
ELC .... Ecological Land Classification

EMS .... Emergency Medical Services
EMSRP.......... Environmental Monitoring, Surveillance and Reporting Plan
ERP .... Emergency Response Plan
ESD .... Emergency shutdown
FHWA .... Federal Highways Administration
FTE.......... full-time equivalent
FWSP .... Freshwater Supply Pond
GHG .... Greenhouse Gases
GJ.......... Giga-joule
GMA .... Game management area
GPM .... Gallon per minute
GR .... Arctic Grayling
HAZOP .... Hazard and Operability Study
HEP .... Habitat Evaluation Procedure
HHRA .... Human health risk assessment
HKPL .... Hallam Knight Piésold Ltd.
HLF.......... Heap leach facility
HP .... Horse power
HPW .... Highways and Public Works
HRMP.......... Heritage Resources Management Plan
HSC.......... habitat suitability criteria
HSU .... hydrostratigraphic unit
ICP-MS.......... Inductively coupled plasma mass spectrometry
IDF.......... Inflow design flood
IGRP.......... Independent Geotechnical Review Panel
IHRMP.......... Interim Heritage Resources Management Plan
IJC.......... International Joint Commission
ILCR .... incremental life time cancer risk
IPCC .... UN Intergovernmental Panel on Climate Change
ISO .... International Standards Organization
KI .... Key Indicator
KP.......... Knight Piésold
L_D.......... daytime sound level
LFL .... Lower Flammability Limit
L_N .... nighttime sound level
LNG .... liquefied natural gas
LOEL .... Lowest observed effect level
LSA .... Local study area
LSCFN.......... Little Salmon / Carmacks First Nation
MAA .... Mutual Aid Agreement
MAP.......... mean annual precipitation
masl.......... metres above sea level
MBCA.......... *Migratory Bird Convention Act*
mbgs.......... meters below ground surface
MDE .... Maximum design earthquake
MiHR .... Mining Industry Human Resources Council

ML .... metal leaching
MMBTU .... One thousand thousand British Thermal Units
MMER .... Metal Mine Effluent Regulations
MSC .... Meteorological Service of Canada
MSDS .... Material Safety Data Sheet
MT .... minnow trapping
MVTA .... Motor Vehicle Transport Act
MW .... Mega-watt
n/a .... not applicable
NFC .... No fish caught
NFPA .... National Fire Protection Association
NGOs .... Non-Government Organizations
NOC .... National Occupation Code
NP .... Neutralization Potential
NP .... Neutralization Potential
NP/AP .... Neutralization Potential/Acid Production Potential
NRC .... Natural Resources Canada
NRCan .... Natural Resources Canada
NRO .... Natural Resource Officer
NSC .... Canadian National Safety Code
NWT .... Northwest Territories
OGC .... British Columbia Oil and Gas Commission
OMS .... Operation, Maintenance and Surveillance
P&ID .... Process and instrumentation diagrams
PAG .... potentially acid generating
PASS .... Passive Air Sampling System
PDA .... Project disturbance area
PDA .... Potential Disturbance Area
PET .... potential evapotranspiration
PGA .... Peak ground acceleration
PMF .... Probable Maximum Flood
PMP .... Probable maximum precipitation
psig .... Pounds per square inch gauge
PSLs .... permissible sound levels
QA/QC .... Quality Assurance/Quality Control
QML .... Quartz Mining License
RPD .... Relative percent difference
RRC .... Renewable Resource Council
RSA .... Regional Study Area
RWDI .... RWDI Air Inc.
S .... Sulphur
SARA .... *Species at Risk Act*
SART .... Sulphidization, Acidification, Recycling and Thickening
SCF/hr .... Standard cubic feet per hour
SEA .... Source Environmental Associates
SEMP .... Socio-Economic Management Plan

SFN .... Selkirk First Nation
SIR .... Supplementary Information Report
SMCF .... Standard million cubic feet per hour
SSWQO .... Site-specific water quality objective
STI .... Sexually transmitted infection
SWE .... snow water equivalent
TBD .... To be decided
TDS .... Total dissolved solids
TH .... Tr'ondëk Hwëch'in First Nation
the ARR .... Adequacy Review Report: Project Assessment 2014-0002, Casino Mine
the College .... Yukon College
the Project .... Casino Project
TK .... Traditional Knowledge
TKN .... total Kjeldhal nitrogen
TLU .... Traditional Land Use
TMF .... Tailings Management Facility
TOC .... total organic carbon
TSS .... Total suspended solids
TSV .... thermal relief valves
Type A WUL .... Type A Water Use Licence
U.S. EPA .... United States Environmental Protection Agency
UFA .... Umbrella Final Agreement
VC .... Valued Component
VCs .... valued components
VDTR .... SIS
VECs .... Valued Ecosystem Components
WCGC .... Western Copper and Gold Corporation
WMMP .... Wildlife Mitigation and Monitoring Plan
WMO .... World Meteorological Organization
WMP .... water management pond
WSC .... Water Survey of Canada
WSE .... water surface elevations
WUL .... Water use licence
WWMP .... Wildlife Mitigation and Monitoring Plan
YBS .... Yukon Bureau of Statistics
YESAA .... Yukon Environmental and Socio-economic Assessment Act
YESAB .... Yukon Environmental and Socio-economic Assessment Board
YFWMB .... Yukon Fish and Wildlife Management Board
YG .... Yukon Government
YMTA .... Yukon Mine Training Association
YOGA .... Yukon Oil and Gas Act
YOR .... YESAB online registry
YOY .... young-of-the-year
ZOI .... Zone of Influence

A.1 – INTRODUCTION

A.1.1 PROJECT OVERVIEW

Casino Mining Corporation (CMC) proposes to develop the Casino Project (the Project) 150 km northwest of Carmacks and 300 km from Whitehorse. The Project is designed to process approximately 120,000 t/d or 43.8 million t/y of copper and gold ore over a 22 year mine life. During the life-of-mine operations, the Casino Project will produce an anticipated 5.72 million ounces of gold, 30.26 million ounces of silver, 3.58 billion pounds of copper, and 325 million pounds of molybdenum.

Access to the project area is gained from Whitehorse via a network of existing paved highways linking Northern British Columbia and the Port of Skagway in Alaska. From Whitehorse, the paved Klondike Highway (Yukon Highway 2) affords access to the Village of Carmacks. From Carmacks, the access will follow for approximately 83 km on the existing gravel Freegold Road, which will be upgraded to accommodate Project requirements, referenced herein as the Freegold Road Upgrade. At the terminus of the Freegold Road, an extension (referenced as the Freegold Road Extension) will be constructed to provide all-weather gravel access over the approximate 120 km to the Project, generally following the existing and historic Casino Trail alignment.

Ore will be removed from the Open Pit and will then be hauled by truck and delivered to one of two ore processing facilities at the Casino mine site, one for sulphide ore and one for oxide ore. The sulphide ore processing facility will produce mineral concentrates of copper (which also contains gold) and molybdenum using conventional flotation technology. The oxide ore processing facility will produce gold and silver doré bars via heap leaching and carbon adsorption technology.

Located southeast of the Open Pit within the valley formed by the headwaters of Casino Creek, the tailings management facility will act as storage for all waste rock, process tailings, and process water from the operations. Storage for up to 947 Mt of tailings and 658 Mt of potentially reactive waste rock and overburden materials is considered in the design of the TMF.

A.1.2 LEGISLATIVE REQUIREMENTS

CMC submitted a Project Proposal under the *Yukon Environmental and Socio-economic Assessment Act* (YESAA) to the Yukon Environmental and Socio-economic Assessment Board (YESAB) on January 3, 2014. The Project Proposal contained five volumes and 25 chapters of documentation to support the assessment of the Project under the YESAA regulations. As production capacity of the proposed Project is greater than 300 t/day, the Project is subject to an Executive Committee Screening for the proposed construction, decommissioning and closure activities.

Following submission of the Project Proposal, on March 13, 2014 the YESAB Executive Committee determined that for the purposes of s. 50(3) of the YESAA, CMC's statutory requirement for consultation with the Selkirk First Nation (SFN), Little Salmon / Carmacks First Nation (LSCFN) and Tr'ondëk Hwëch'in (TH) First Nation, and the residents of the communities of Carmacks and Pelly Crossing was deemed to have been met. Consequently, the Project entered the pre-screening adequacy review phase of the YESAA process.

Subsequently, on May 23, 2014, CMC requested that the Executive Committee place the review of the Project on hold for all parties for an up to 180 day period to enable Casino to continue engagement with affected First Nations. YESAB subsequently granted the request on June 2, 2014, and, under the understanding that supplementary information may result from the continued engagement, did not issue an adequacy review report or information request during the hold period. The hold period was lifted on November 27, 2014, and issuance of an *Adequacy Review Report: Project Assessment 2014-0002, Casino Mine* occurred on January 27, 2015.

The Executive Committee considers a proposal to be adequate if, in the opinion of the Executive Committee, the proponent "has in its proposal taken into account the matters referred to in paragraphs 42(1)(b),(c) and (e) to (h) of the Act; and the proposal contains sufficient information to enable the Executive Committee to prepare a statement of the scope of the project under section 34; contains sufficient information to enable the Executive Committee to commence the screening; and complies with the applicable rules" (YESAB, 2005). If the Executive Committee determines that the proposal is not adequate, then it provides a request for supplementary information required, which, as discussed above, was provided to CMC on January 27, 2015.

Following submission of the supplementary information from CMC, within 30 days (and a possible extension of a further 30 days) the Executive Committee will determine if the supplementary information provided meets the requirements, listed below, of YESAA (2005) for an adequate proposal:

> ***42.*** *(1) In conducting an assessment of a project or existing project, a designated office, the executive committee or a panel of the Board shall take the following matters into consideration:*
>
> *(b) all stages of the project or existing project;*
>
> *(c) the significance of any environmental or socio-economic effects of the project or existing project that have occurred or might occur in or outside Yukon, including the effects of malfunctions or accidents;*
>
> *(e) alternatives to the project or existing project, or alternative ways of undertaking or operating it, that would avoid or minimize any significant adverse environmental or socio- economic effects;*
>
> *(f) mitigative measures and measures to compensate for any significant adverse environmental or socio-economic effects;*
>
> *(g) the need to protect the rights of Yukon Indian persons under final agreements, the special relationship between Yukon Indian persons and the wilderness environment of Yukon, and the cultures, traditions, health and lifestyles of Yukon Indian persons and other residents of Yukon; and*
>
> *(h) the interests of residents of Yukon and of Canadian residents outside Yukon.*

The supplementary information report (SIR) provided herein is in response to the request for supplementary information received from YESAB on January 27, 2015, and aims to meet the requirements of YESAA summarized above. The purpose of the SIR, and the organization of the SIR are outlined below.

A.1.3 PURPOSE OF THE SIR

This Supplementary Information Report (SIR) has been written to respond to the *Adequacy Review Report: Project Assessment 2014-0002, Casino Mine* (the ARR) received from YESAB on January 27, 2015. The information contained in the SIR should be used to supplement the information presented in the Project Proposal, but does not change the conclusion of potential effects and determinations of significance presented in the Proposal. A table of concordance outlining the individual requests in the ARR and where the responses can be found in the SIR is provided in Appendix A.1A.

Following submission of the SIR, the legislated YESAA process allows for 30 days (with a possible 30 day extension) for YESAB to review the SIR and to provide notice of adequacy to CMC and identified decision bodies, or to request further information. The determination of adequacy will trigger the commencement of the screening and recommendation phase of the YESAA Executive Committee assessment process. CMC may be requested to submit further information following public review and prior to the preparation of the draft screening report by YESAB.

A.1.4 ORGANIZATION OF THE SIR

The SIR consists of five volumes of information, 25 sections and numerous detailed technical appendices. As much as possible, the SIR has been laid out to follow the same structure as the Project Proposal, to simplify the review process. To avoid confusion between the Proposal and the SIR, while section names have remained consistent (e.g., Section 7 – Water Quality), in the SIR a prefix of the letter "A" has been added to all Section numbers and Appendices. This will allow for all future supplementary information responses to be sequentially lettered, (e.g., Section B.7 - Water Quality, Appendix B.7A), and it will be immediately clear to the reader if they are reading a document from the original Proposal (no prefix, e.g., Section 7), of the SIR (prefix "A", e.g., Section A.7). This is illustrated for Sections 1 through 5 in Figure A.1.4-1.

For additional clarity, Figure A.1.4-2 provides a Document Map of the SIR, which offers an "at a glance" directory of the material found in each section, within each volume, with their appurtenant appendices. The purpose of the SIR is to provide supplementary information to support the initial risk assessment, and not to re-conduct the risk assessment process. During the adequacy review period, some appendices have been updated to reflect reviewer comments. Appendices of the Project Proposal replaced by appendices in the SIR are indicated in Figure A.1.4-3.

Some appendices provided herein to support the SIR are feasibility level reports, or reports generated prior to the submission of the Project Proposal. These documents are meant to provide support to responses outlined in the SIR; however, it should be understood that where details in the feasibility level documents differ from the Project Proposal and/or SIR, the Project Proposal and SIR should be taken to be correct. This is due to the iterative nature of the engineering design, which results in project refinements subsequent to the submission of the feasibility study to minimize adverse effects and maximize project benefits. Engineering details will continue to be refined throughout the permitting and detailed engineering phases of the Project.

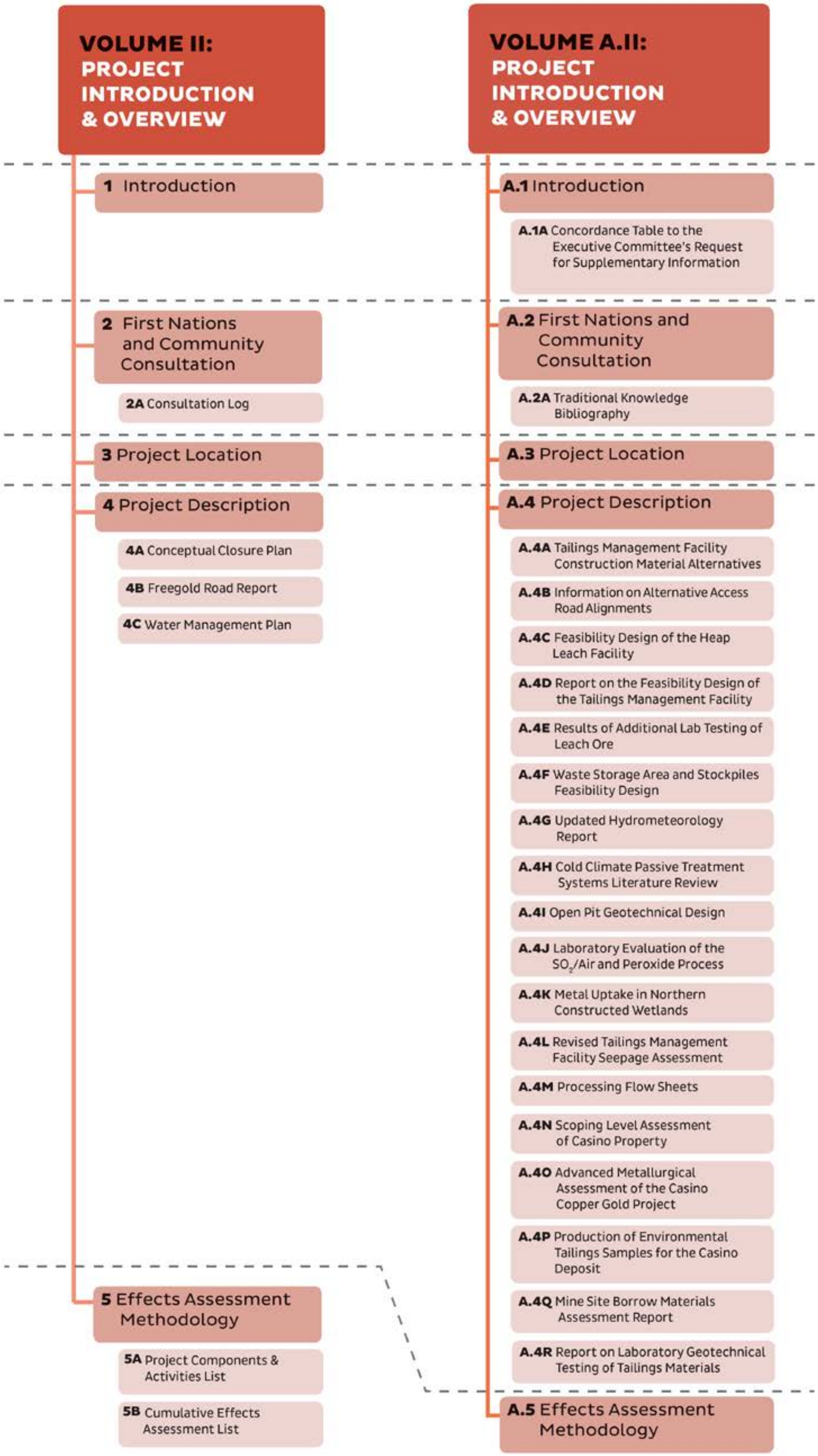


Figure A.1.4-1 Document Organization for Proposal and SIR A

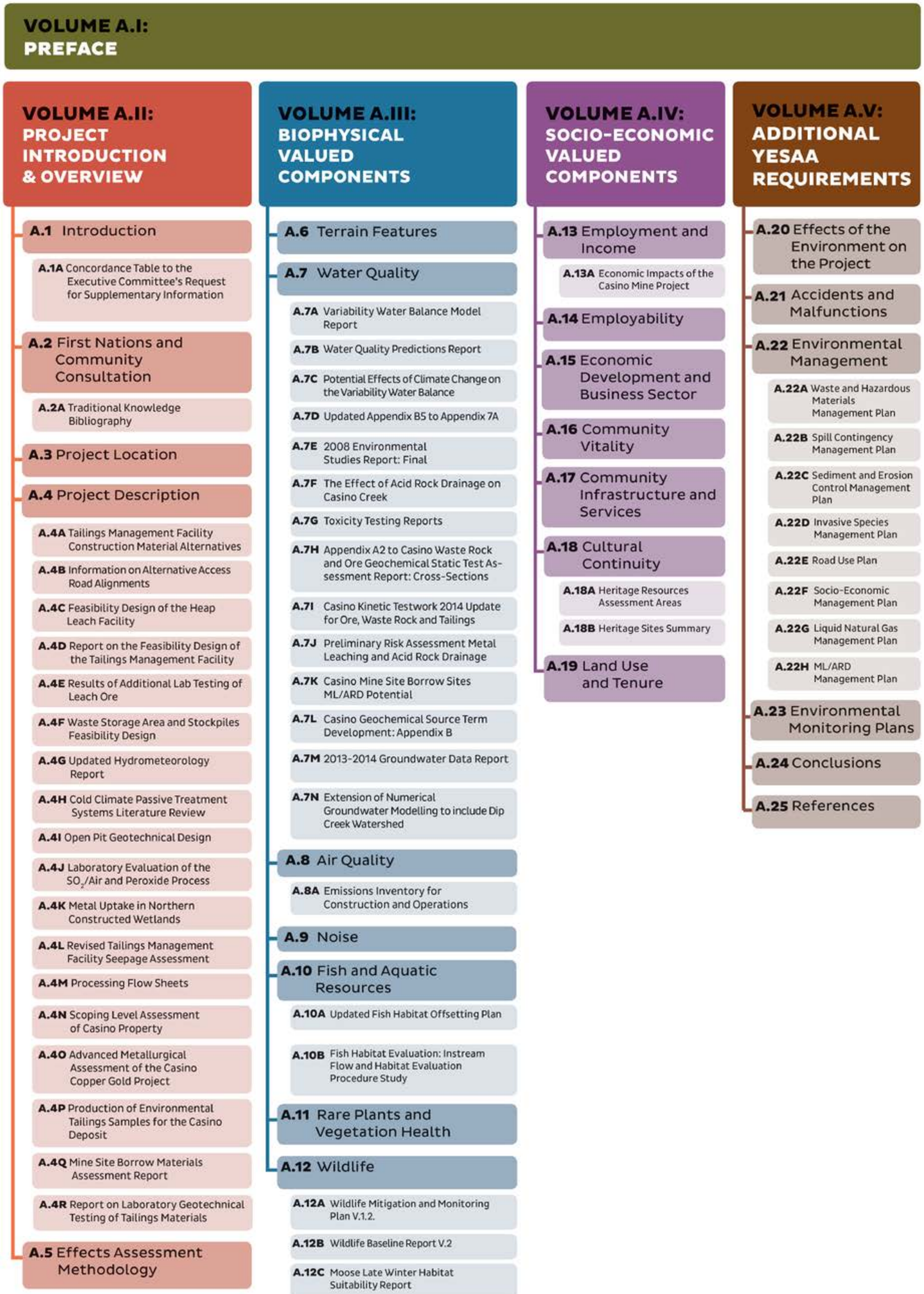


Figure A.1.4-2 SIR Document Map

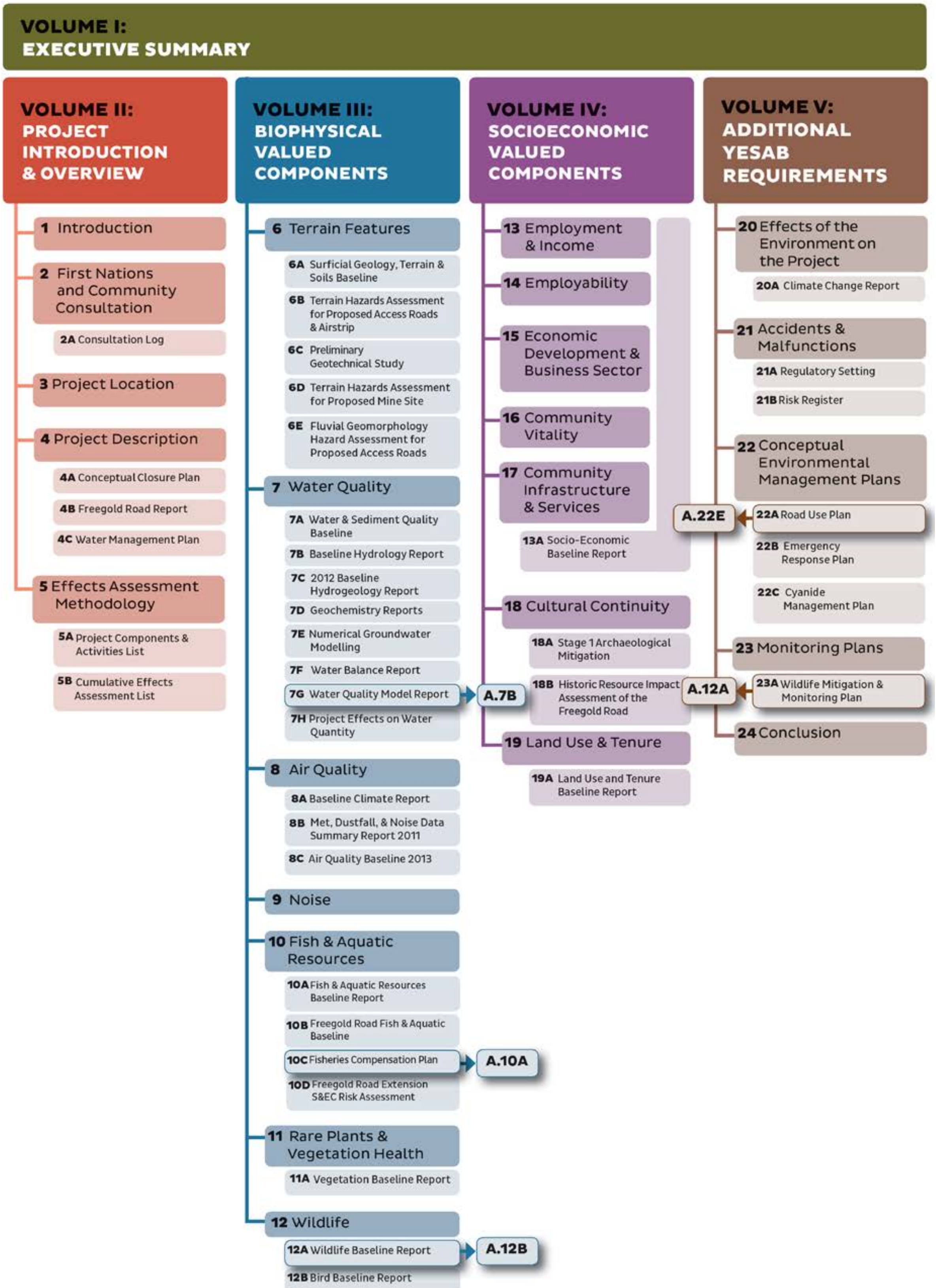


Figure A.1.4-3 Proposal Document Map with Replacement Sections

A.1.5 SUMMARY OF CHANGES TO THE PROJECT PROPOSAL

Following submission of the Proposal, and receipt of reviewer's comments during the adequacy review period, CMC has made only one change to the Proposal, which is to incorporate the Winter Seepage Mitigation Pond at the beginning of operations, instead of during the closure period. There is now a single water management pond that will be installed throughout the life of the Project, and will be labelled the Water Management Pond (WMP) throughout this document. Consistent with the Project Proposal, water in the WMP will be pumped back to the TMF during operations and closure Phase I, and will only be allowed to discharge to the environment during the May – October period in conjunction with TMF spillway overflow. See Section A.7 for details.

All other details provided in the Proposal remain valid, including the determinations of significance of potential project effects.

A.2 – FIRST NATIONS AND COMMUNITY CONSULTATION

A.2.1 INTRODUCTION

Casino Mining Corporation (CMC) is committed to developing and operating the Casino Project (the Project) in a safe, ethical and socially-responsible manner. Consistent with this, CMC recognizes that meaningful First Nations and stakeholder engagement is important to the success of the Project. CMC has completed consultation in accordance with the Yukon Environmental and Socio-economic Assessment Board (YESAB) Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions ("Information Requirements Guide") (YESAB 2005). Consultation activities and the provision of information about the Project have been undertaken with First Nations, the Yukon Government and Agencies, the Federal Government, Municipal Governments, and communities. Consultation tracking was employed to compile and track consultation activities that have occurred to date and will continue to be employed into the future. A detailed log of the consultation activities that were undertaken prior to Proposal submission was provided in Appendix 2A of the Proposal.

As summarized in Section 2 of the Proposal, CMC has shared information and consulted with potentially affected First Nations, local communities, Yukon government and federal agencies, non-government organizations (NGOs), and individuals since 2008. CMC's consultation program included a range of techniques to identify concerns and methods to address those concerns. Techniques used by CMC to consult included: one-on-one, group and community meetings, Open Houses, presentations, field trips, general and Project Proposal meetings, interviews and questionnaires, as well as phone calls, e-mails, and letters.

Since the initiation of the consultation program in 2008, CMC has engaged the following First Nations, the Yukon Government and Agencies, the Federal Government, Municipal Governments, and communities:

First Nations and Renewable Resource Councils:

- Selkirk First Nation;
- Selkirk Renewable Resource Council;
- Little Salmon/Carmacks First Nation;
- Carmacks Renewable Resource Council;
- Tr'ondëk Hwëch'in First Nation;
- Champagne and Aishihik First Nation;
- Kluane First Nation; and
- White River First Nation.

Yukon Based Government and Agencies:

- Yukon Community Services;
- Yukon Development Assessment Branch;
- Yukon Development Corporation;
- Yukon Energy Corporation;
- Yukon Energy, Mines and Resources;
- Yukon Environment;
- Yukon Executive Council;
- Yukon Environmental and Socio-Economic Assessment Board (YESAB);
- Yukon Fish and Wildlife Management Board;
- Yukon Health and Social Services;
- Yukon Highways and Public Works;
- Yukon Housing Corporation;
- Yukon Tourism and Culture; and
- Yukon Water Board.

Federal Government:

- Canadian Northern Economic Development Agency;
- Environment Canada;
- Fisheries and Oceans Canada;
- Natural Resources Canada; and
- Transport Canada.

Yukon Public:

- Village of Carmacks;
- Carmacks (Tantalus) School;
- Carmacks Health Centre;
- City of Whitehorse;
- Whitehorse Chamber of Commerce;
- Whitehorse Hospital;
- Royal Canadian Mounted Police;
- Yukon College;
- Yukon Tourism Industry Association;
- Yukon Mine Training Association;
- Yukon Conservation Society;
- Yukon Fish and Game Association;
- Yukon River Panel;
- Trapping Concession #121;
- Trapping Concession #148;
- Trapping Concession #116;
- Trapping Concession #122;
- Trapping Concession #130 and Land Owner;
- Trapping Concession #131;
- Trapping Concession #145;
- Trapping Concession #146;
- Other Trapline Tenure holders;
- Prophet Muskwa Guide Outfitters;
- Mervyn's Yukon Outfitting; and
- Local businesses.

Additionally, CMC shared and received information from various NGOs, special interest groups and individuals.

Following submission of the Project Proposal (YESAB Project No. 2014-0002) on January 3, 2014, on March 3, 2014 the YESAB Executive Committee determined that for the purposes of s. 50(3) of the YESAA, CMC's statutory requirement for consultation with the Selkirk First Nation (SFN), Little Salmon / Carmacks First Nation (LSCFN) and Tr'ondëk Hwëch'in (TH) First Nation, and the residents of the communities of Carmacks and Pelly Crossing was deemed to have been met. Consequently, the Project entered the pre-screening adequacy review phase of the YESAB process.

Based on discussions between CMC and LSCFN, on May 23, 2014, CMC made a request to the Executive Committee of YESAB to place the review on hold for all parties for a period of up to 180 days. The purpose of this request was to enable CMC to engage in additional consultation with LSCFN and other First Nations. CMC believes that the hold period and the additional consultation has placed the Project on a better footing for the YESAB process moving forward. CMC continues to carry out consultation and will consider and integrate new information as it becomes available.

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered received comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). Casino Mining

Corporation is providing this Supplementary Information Report (SIR) to comply with the Executive Committee's ARR; CMC anticipates that the information in the SIR and Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has 8 requests for supplementary information related to Section 2 First Nations and Community Consultation of the Project Proposal submitted on January 3, 2014. These requests are outlined in Table A.2.1-1. Some responses require detailed technical information, data, and figures. Where necessary, this additional supporting information is provided as appendices to the SIR, as outlined in Table A.2.1-1.

Table A.2.1-1 Requests for Supplementary Information Related to First Nations and Community Consultation

Request #	Request for Supplementary Information	Response
R395	Clarification on the specific efforts and processes undertaken by the Proponent to gather TK and TLU in order to inform the proposal. A description of what TK or TLU information the Proponent received for the purposes of drafting the proposal.	Section A.2.2.1.1 Appendix A.2A Traditional Knowledge Literature Review Bibliography
R396	A TK and TLU study for the Project.	Section A.2.2.1.2
R397	A review of effects from resource projects and effects on TLU in a northern context.	Section A.2.2.1.3
R398	A framework for monitoring effects to TLU resulting from the Project.	Section A.2.2.1.3 Appendix A.22F Socio-Economic Management Plan
R399	An assessment of impacts of the Project on traditional economy.	Section A.2.2.1.4
R405	Description of discussions with and feedback from affected trapline concession holders including how many trapline concession holders were contacted and responded.	Section A.2.3.1.1
R406	Description of discussions with and feedback from affected outfitting concession holders including how many outfitting concession holders were contacted and responded.	Section A.2.3.1.2
R408	A description of any contact or discussions between CMC and mineral rights holders in relation to the road.	Section A.2.4.1.1

Notes:

1. Request # refers to the assigned identification number in the YESAB Adequacy Review Report January 27, 2015 Prepared by Executive Committee Yukon Environmental and Socio-economic Assessment Board.
2. Response refers to the location of CMC's response to the YESAB request for supplementary information.

A.2.2 TRADITIONAL KNOWLEDGE AND TRADITIONAL LAND USE

A.2.2.1.1 R395

R395. Clarification on the specific efforts and processes undertaken by the Proponent to gather TK and TLU in order to inform the proposal. A description of what TK or TLU information the Proponent received for the purposes of drafting the proposal.

Consultation Efforts and Processes

The *Yukon Environmental and Socio-economic Assessment Act* (YESAA) defines traditional knowledge (TK) as "the accumulated body of knowledge, observations and understandings about the environment, and about the relationship of living beings with one another and the environment, that is rooted in the traditional way of life of first nations". Traditional Land Use (TLU) is not defined by YESAA but the Proposal considers traditional uses to include hunting, trapping and guide outfitting, fishing, and forest uses (firewood collection and gathering). Throughout the consultation process, since 2008, CMC and its consultants have made efforts and undertaken processes to engage First Nations and communities about appropriate and effective ways of collecting and incorporating TK and TLU information into the Casino Project.

Casino Mining Corporation values the knowledge and expertise that is held by knowledge holders and if available and appropriate, CMC will take TK and TLU information into consideration to further the Project's understanding of potential effects. Throughout the consultation process and development of the Proposal, CMC has balanced its desire to collect and consider TK and TLU information with the need to protect sensitive information and ensure confidentiality within the YESAB process. Casino Mining Corporation is also aware that there are several proposed developments that are making similar requests for TK and TLU information, which may increase research fatigue and frustration among knowledge holders. Casino Mining Corporation is sensitive to this reality and has asked for input and guidance from knowledge holders on proceeding in the most appropriate manner.

It continues to be the intention of CMC to work collaboratively with First Nations and communities to develop and agree upon approaches for TK and TLU data collection and consideration for the Casino Project prior to undertaking any work. CMC has engaged with First Nations, their respective Renewable Resource Councils, special advisors on TK and consultants regarding the potential to conduct a TK or TLU study for the Casino Project on 17 separate events (Table A.2.2-1).

Table A.2.2-1 Summary of Consultation Events

Event No.	First Nations	CMC Record of Contact ID No.	Event Type	Date
1	SFN	95	Meeting	May 3, 2008
2	SFN	21	Drop-in Visit/ Casual Meeting	May 4, 2008
3	SFN	22	Open House	October 20, 2008
4	SFN	26	Meeting	October 20, 2008
5	SFN	12	Meeting	June 10, 2009
6	SFN	17	Meeting	October 14, 2009
7	SFN	121	Email	October 30, 2009
8	SFN	413	Memo	March 2, 2010
9	SFN	31	Meeting	March 16, 2010
10	SFN	112	Letter	October 24, 2011
11	SFN	465	Meeting	April 10, 2012
12	SFN	173	Email	January 11, 2013
13	SFN	182	Email	January 18, 2013
14	SFN	274	Meeting	February 14, 2013
15	LSCFN	472	Meeting	June 5, 2012
16	LSCFN	301	Meeting	February 12, 2013
17	LSCFN	323	Email	June 11, 2013

Through these in-person meetings, community open houses, and correspondences, CMC has discussed the need for, collection of, and incorporation of TK and TLU information into the Proposal. The following is not an exhaustive list but summarizes the types of information requested of First Nations and communities by CMC:

- Past and contemporary land and resource use information;
- Traditional knowledge information;
- TK or TLU studies that have been completed;
- Information on when the TK or TLU studies were conducted and their purpose or objective(s);
- If CMC can receive a copy of the studies or be able to review them together;
- Interest in undertaking a TK or TLU study and preference to complete a full or partial program, or no program; and
- The approaches preferred by First Nations and communities for collecting TK or TLU information and for incorporating the information into the Proposal.

In more advanced discussions that have occurred with SFN prior to submission of the Proposal, CMC suggested that the types of information and data that would assist CMC to successfully and comprehensively integrate TK and TLU information into the Proposal are those listed in Table A.2.2-2. The following table was provided to SFN in CMC's memo of March 2, 2010 (Table A.2.2-1) as an overview of the types of TK and TLU information CMC wished to collect collaboratively in order to contribute to a more informed understanding of potential effects.

Table A.2.2-2 Requested Traditional Knowledge and Traditional Land Use Information and Data

Traditional Land Use Information	Traditional Knowledge
• Burial/Sacred sites • Camps and/or cabins, settlements, villages, community • Culturally modified trees (CMTs) • Culturally significant landscape features (e.g., mountains, marked boulders, confluence of two rivers) • Trails and/or travel routes • Key sites for hunting, trapping, fishing plant/berry/bark harvesting • Any other important sites of significance to Selkirk First Nation • Place names • Other lesser locations and numbers of people hunting, trapping and fishing • Broader cultural issues, context and history	• Valued Ecosystem Components (VECs) • Culturally important wildlife, bird and fish species • Culturally important plants, berries, trees, mushrooms • Avalanche/Landslides – location, dates and severity • Wildlife, birds and fish – locations, numbers, changes in numbers and behaviours, culturally significant species, migration corridors, rare and/or diseased wildlife, birds or fish • Plant, trees, soil – condition, location and uses of plants, trees, mushroom and/or soil. Rare or diseased fauna • Changes in weather and climate • Disasters: Flooding, wildfires, droughts • Wind: Dominant direction and speed

Traditional Land Use Information	Traditional Knowledge
	• Air and water quality • Potential effects • Mitigation measures • Aboriginal language use: number of speakers and levels of fluency • Government system • Stories/Legends • Clan/house/family system

In summary, the responses to CMC's request for TK and TLU information ranged from:

- Referral to another person;
- Request for elders to be involved;
- Suggestion to develop a simple protocol for handling the collection of TK and TLU information;
- Suggestions of combining efforts with the Minto Project (also currently collecting TK and TLU);
- Concerns about community research fatigue; and
- Statements that TK and TLU are not necessary.

Casino Mining Corporation continued to follow-up with First Nations and communities to confirm CMC's understanding of their responses and to request further clarity and direction about next steps and appropriate approaches. For First Nations with whom there have been more advanced discussions, CMC has proposed different options for going forward for their review and consideration. The following list is meant to summarize the different options considered and proposed by CMC throughout the consultation process from 2008 to 2013 with SFN, in preparation for the development of the Casino Project Proposal, a more detailed discussion of consultation was provided in Section 2 of the Proposal:

- A desk-based effort informed by previous TK and TLU studies and ethnographic research with minimal involvement of knowledge holders to update and add to existing information. Results will be compiled by First Nations and provided to CMC for use in the Casino Project Proposal. Integration of this information into the Casino Project Proposal will be a collaborative and iterative process between First Nations and CMC.
- A dialogue-based effort. A meeting will be organized between key discipline leads (i.e., wildlife, archaeology, and fish) and knowledge holders and First Nations leadership. This option would entail an exchange of information about the Project, including a Project description and information gathered to date by discipline leads and input and information from knowledge holders as to their knowledge and use of the area in and around the Casino Project.
- A field-based effort whereby key knowledge holders go on site to discuss and document their past and current use sites and knowledge of the area.
- An interview-based effort. Involves organizing one-on-one or group interviews with a mapping exercise to locate and describe sites.

Information Received

The Project took into consideration and incorporated available TK and TLU information throughout the Proposal, keeping in mind the need to protect sensitive information and ensure confidentiality. For example, CMC selected Valued Components (VCs) taking into consideration input from First Nations and local communities. In addition, all CMC consultants that provided input into the Proposal were instructed to incorporate TK and TLU information into their disciplines to the best of their ability and a number of personal connections were made over the years between consultants and knowledge holders which informed the Proposal. The types of TK and TLU information received and integrated into the Proposal include:

- Traditional harvest of wildlife;
- Traditional harvest of plants and plant products from secondary TK information;
- Avian-specific secondary TK information;
- *Community-Based Fish and Wildlife Work Plan Little Salmon Carmacks First Nation Traditional Territory 2012-2017* (Little Salmon/Carmacks Fish and Wildlife Planning Team 2011);
- *Opening the Land: a Study of the Impacts of the Casino Trail on the Northern Tuchone of Pelly Crossing and Carmacks, Yukon Territory* (Pearse and Weinstein 1988); and
- Potentially important sites along the Freegold Road.

With respect to discussions around incorporating TK into the Proposal, the importance of protecting locations of traditional harvest of wildlife is a consistent theme expressed by First Nations. The Proposal has considered and taken into account potential adverse effects on existing natural resources (including wildlife) that are potentially used for traditional purposes by First Nations.

In the absence of primary information related to the traditional harvest of plants and plant products, the Proposal identified TK information from secondary sources. This information informed the Vegetation Baseline Report (Appendix 11A) and effects assessment, wherever possible. The Proposal reference list includes 10 sources of avian-specific secondary TK information. While this information is of a more general nature, it is presented in the Bird Baseline Report (Appendix 12B).

The *Community-Based Fish and Wildlife Work Plan Little Salmon Carmacks First Nation Traditional Territory 2012-2017* was developed jointly by the Little Salmon/Carmacks First Nation (LSCFN), the Carmacks Renewable Resources Council and Yukon Government (Little Salmon/Carmacks Fish and Wildlife Planning Team 2011). This publicly available report was designed to coordinate the efforts of each of the participants in addressing fish and wildlife concerns in the LSCFN Traditional Territory. The plan noted that access due to mining and exploration activity was a concern, due to effects on wildlife and wildlife habitat; it was noted that awareness and monitoring of traffic patterns and access routes would contribute to determine how linear features affect wildlife. The plan specifically notes ongoing concerns for the Klaza Caribou herd related to access and high traffic from bison hunters and miners. The proposed work to be conducted by the planning participants includes a full census survey on the herd; collecting baseline information, including project information from other sources; updating habitat information; and monitoring of harvest levels. The information presented in the plan has contributed to the development of proposed wildlife mitigation measure proposed by CMC in its Wildlife Mitigation and Monitoring Plan (Appendix A.12A).

In 2008, CMC, at the advice of SFN, acquired historical documents that were prepared for SFN in response to previous plans (circa 1980's) to develop a mine at the current proposed location of the Casino Project. These documents contained important traditional knowledge and formed an important foundation for the development of proposed mitigation measures included in the Proposal. In particular the report *Opening the Land: a Study of the Impacts of the Casino Trail on the Northern Tuchone of Pelly Crossing and Carmacks, Yukon Territory* (Pierce and Weinstein 1988) was particularly helpful with respect to providing TK. This report and other materials are noted in the bibliography in Appendix A.2A.

Casino Mining Corporation has held in-depth consultations with LSCFN and SFN regarding potentially important sites along the Freegold Road Extension. These discussions about potentially important sites and relevant publically-available secondary sources of information have been incorporated into the Proposal. To mitigate for potential adverse effects to traditional uses related to the Freegold Road, CMC has proposed mitigation measures, including:

- Avoidance of known or suspected historical, cultural, or archaeological places. If the places cannot be avoided, then the necessary staged archaeological mitigation of the archaeological sites and recording and archival research as well as excavation and removal will be completed following the *Operational Policy for Heritage Resources Management on Yukon Lands* (Yukon Tourism and Culture 2010).
- The Freegold Road Extension will be managed as a privately owned and operated road from km 106 to the mine site, with no public access.
- A Road Use Plan will be developed in coordination with First Nations and the Yukon Government to manage and limit public access, minimize increased hunting pressures on wildlife, reduce possible wildlife-human conflicts and protect existing wildlife-dependent land users (draft provided in Appendix A.22E).

On-going Consultations and Efforts

Discussions are ongoing between CMC and First Nations and communities to gauge the level of interest to undertake TK and TLU studies and/or to participate in activities to share TK and TLU information with CMC.

Since the submission of the Proposal on January 3, 2014, CMC has completed a search of publically-available secondary sources of information related to potential traditional knowledge and traditional uses of key components within the Project area. A bibliography of the publicly-available literature sources reviewed as part of this desk-top effort is presented as *Traditional Knowledge Literature Review Bibliography* (Appendix A.2A). The information collected is not included in the SIR at this time because CMC has not had an opportunity to consult potential knowledge holders and the secondary sources of information have not been verified. Discussions with potential knowledge holders on the appropriateness and application of the secondary sources of information could take place if there is interest.

A.2.2.1.2 R396

R396. A TK and TLU study for the Project.

Discussions are ongoing between CMC and First Nations with respect to a TK and/or TLU study for the Project. Casino Mining Corporation has written to SFN to confirm our understanding of their views on the collection of TK and TLU information for the Casino Project. Casino Mining Corporation is willing to cooperate with SFN and other First Nations if there is general agreement from First Nations and potential knowledge holders to share TK and TLU information for the Project.

Casino Mining Corporation is willing to assist interested First Nations in assembling TK and TLU information for the Project and to explore opportunities to consider and integrate any collected information either during the YESAB review or subsequent permitting processes. The details of any TK and/or TLU study will need to be jointly developed by CMC and interested First Nations through an agreement or protocol.

If there is interest, CMC anticipates that the parties will need to meet to develop a work plan which will include the agreed upon approach to document relevant information and include details on Project personnel, their respective roles and responsibilities and associated budgetary needs, including compensation to participating Elders and knowledge holders; specifics on information processing, including provision for transcription, translation and synthesis of documented information; and coordination and review of TK and TLU information integration efforts, and a work schedule and milestones for completion of specific tasks. This work plan could also identify how and when collected TK and TLU information will be used.

A.2.2.1.3 R397

R397. A review of effects from resource projects and effects on TLU in a northern context.

Selkirk First Nations in its review of the Proposal states that “in order to better understand impacts to TK and TLU, a comparison of other similar projects’ impacts to TK and TLU within a northern context would be beneficial” (YOR 2014-0002-258-1). The Executive Committee has requested a review of effects from resource projects and effects on TLU in a northern context.

It is CMC’s view that a comparison of the Project’s potential effects to other project’s impacts and effects on TLU in a northern context is not a requirement of YESAA. With respect to understanding the Project’s potential residual effects on traditional uses, the Land Use and Tenure Baseline Report (Appendix 19A of the Proposal) characterizes existing TLU in the Local Study Area (LSA) and Regional Study Area (RSA). Traditional and domestic uses, hunting, guide outfitting, and trapping have been considered in the Proposal. Characterization of the Project’s potential residual effects on these traditional uses after the implementation of mitigation measures is presented as part of the Land Use and Tenure Valued Component (VC) in the Proposal (Section 19).

In addition to considering the Project’s residual effects on traditional uses, the Proposal presents a Cumulative Effects Assessment (CEA) for the Land Use and Tenure VC to identify potential cumulative effects and assess the significance of those cumulative effects. The CEA was limited to those residual effects (post-mitigation) on VCs resulting from past, present, or reasonably foreseeable human activities or actions, as defined by YESAA. Cumulative effects have the potential to occur within the time and space where an overlap between the residual effects resulting from the activities related to the Project and the residual effects of other actions and projects may occur.

The Proposal reviewed other projects and activities that overlap with the Land Use and Tenure LSA and it was determined that very few past, present or reasonably foreseeable land uses occurred in the area that would have a measurable/quantifiable residual effect that might combine cumulatively with the Project’s residual effects. Potential residual effects from other projects or activities spatially overlapping the LSA and temporally overlapping the construction, operations and closure and decommissioning phases of the Project are predicted to be limited to future placer and quartz exploration and mining activities. Residual effects associated with increased exploration and mining activity predicted to occur in the future due to improved access along the Freegold Road is predicted to combine cumulatively with similar projects’ residual effects. Potential residual cumulative effects are predicted to include increase in noise levels, emissions and traffic and changes in disturbed and reclaimed areas. The potential cumulative residual effects on land use and tenure are rated as low in magnitude, localized in geographic extent and reversible over time. New future exploration and mining activities, that have not been deemed as reasonably foreseeable, cannot be assessed because their details are uncertain at this time.

Casino Mining Corporation believes that the Proposal has fulfilled the YESAA requirement by assessing the potential for residual adverse effects of the Project on traditional uses and has also taken into consideration the potential cumulative effects of other past, present or reasonably foreseeable human activities or actions.

A.2.2.1.4 R398

R398. A framework for monitoring effects to TLU resulting from the Project.

Casino Mining Corporation is willing to develop a framework for monitoring potential effects of the Project to TLU if it is determined to be appropriate and meaningful. A preliminary *Socio-Economic Management Plan* (SEMP) has been developed by CMC to mitigate potential adverse residual effects of the Project and to enhance potentially beneficial residual effects (Appendix A.22F). Conceptually, the SEMP can be expanded to include a specific monitoring program to support this initiative.

At this time, the preliminary SEMP describes commitments and policies that CMC will undertake to promote positive socio-economic benefits to improve quality of life and well-being for those that live in neighbouring communities and is consistent with the Mining Association of Canada's Guiding Principles of "Towards Sustainable Mining" (MAC 2014). Prior to construction and throughout the life of the Project, the SEMP will be updated to include details and actions to monitor Project-specific socio-economic effects, the effectiveness of the mitigation measures, and a framework to adaptively manage unpredicted adverse effects. The SEMP is not a static document, but will be informed by suggestions and recommendations received through consultations with stakeholders throughout the YESAB review and subsequent mine permitting processes, and also regularly throughout the implementation of the plan for the life of the Project.

For the purpose of responding to this information request by the Executive Committee, CMC is providing a conceptual framework for monitoring effects to TLU based on the three areas of potential effects identified in the Proposal:

- Change (reduced or increased) in area available for traditional land use activities;
- Change (reduced or improved) in access to the area for traditional land users, or others; and
- Change (reduced or improved) in wilderness experience for traditional land users, trappers, and guide outfitters.

As part of the Proposal, CMC commits to mitigate potential adverse residual effects to Land Use and Tenure, including traditional land use activities, by working collaboratively with First Nations and Yukon Governments to establish monitoring programs to track potentially conflicting land uses as a result of the Project. If appropriate and meaningful, CMC will work with First Nations and Yukon Government to develop an agreed upon framework for monitoring effects to TLU and for monitoring the effectiveness of mitigation measures, which will be documented in the monitoring plan.

The conceptual monitoring framework, that would become an extension of the SEMP, will include collaboration with First Nations, traditional land use users and Yukon Government to review anticipated potential effects, proposed mitigation measures, pre-Project baseline and the selection of indicators for the monitoring program. The potential monitoring program could track indicators for TLU such as:

- The ability of harvesters to relocate elsewhere;
- Level and change of harvesting in proximity to the mine site and the Freegold Road; and
- New users of the study area and the effects of these new uses on harvesting and other traditional use activities.

Monitoring protocols for the potential program could include:

1. **Timing:** Monitoring may commence at the start of the Project activity (likely in the construction phase) and continue for the life of the monitoring program.

2. **Frequency**: Frequency of monitoring will be established in consultation with First Nations, traditional land users and Yukon Government but is anticipated to be more frequent in the construction phase than the operations phase.
3. **Extent:** Establish geographic area(s) that will be monitored specific to each potential effect.

Indicator selection would be conducted in collaboration with the relevant Yukon Government departments and agencies so as to ensure the information is of greatest use in the understanding and management of potential direct Project-effects, including consistency with the existing monitoring and management measures of the Yukon Government. This will also permit the development of time series covering the pre-Project and post-Project periods and provide a measure of change from the baseline conditions for traditional land use.

The geographic extent that will be monitored will be specific to each potential effect, and will be established in consultation with First Nations, traditional land users and Yukon Government. The geographic areas monitored will be influenced by the known locations where traditional land uses are located. At this point it is anticipated that the monitoring program will include the area around the mine site, the Village of Carmacks and along the Freegold Road.

Finally, the results of the monitoring program for TLU could be shared through community meetings and routine information sharing protocols.

A.2.2.1.5 R399

R399. An assessment of impacts of the Project on traditional economy.

Casino Mining Corporation is committed to recognizing and to the extent practicable, enhancing positive Project effects on the traditional economy of First Nations and their relationship with the wilderness environment. As stated in Section 2(f) of YESAA, one purpose of the Act is “to recognize and, to the extent practicable, enhance the traditional economy of Yukon Indian persons and their special relationship with the wilderness environment”.

The Proposal presents the potential effects of the Project on Subsistence and Recreational Harvesting (Section 18) and Traditional Land Uses (Section 19) that may contribute to traditional economies. While not explicitly addressed as traditional economy, the Proposal has considered traditional economic activities such as hunting, fishing and trapping and has used available information on these activities to inform the assessment. Casino Mining Corporation recognizes that other potential activities, aside from hunting, fishing and trapping, could also contribute to traditional economies, though these other activities are likely inherently social, cultural and interrelated with the biophysical environment and this information was not available. CMC has taken into consideration the components of the natural environment that have the potential to contribute to traditional economies in the selection of Valued Components (VC) for the Proposal.

The Proposal has considered and integrated available information received from First Nations on traditional economies. The information includes:

- SFN have identified the development of hunting and the traditional economy as priorities and many members obtain a significant portion of their food supply through these means;
- Yukon First Nations have a Final Agreement in place that set out harvesting rights. First Nation members can give, trade, barter, or sell meat or fish obtained through their subsistence rights with other beneficiaries of the Final Agreements or of adjacent Trans-boundary Agreements for domestic purposes but not for commercial purposes (meat and fish cannot be traded or sold to non-First Nation people); and

- LSCFN's Integrated Community Sustainability Plan identifies subsistence hunting, fishing, and trapping as a way of life for their membership (Inukshuk Planning and Development 2009).

Casino Mining Corporation is willing to look for opportunities, to the extent practicable, to understand and enhance the traditional economy of First Nations and their relationship with the wilderness environment.

A.2.3 TRAPPING AND OUTFITTING

A.2.3.1.1 R405

R405. Description of discussions with and feedback from affected trapline concession holders including how many trapline concession holders were contacted and responded.

Appendix 19A, Section 1.3.4 provides information on trapping with specific details on the registered trapping concession holders potentially affected by Project components and activities. An abbreviated consultation log for consultations carried out by CMC or its consultants with trapline concession holders is reproduced in Table A.2.3-1.

Table A.2.3-1 Consultation Log for Trapline Concession Holders

Record #	Event Type	Date	Participating Organizations	Stakeholder Org Type	Event Summary
80	Letter	May 22 2012	Casino Trapping Concession #121, CMC	Trapline Tenure (Aboriginal)	CMC extended an invitation to attend a community meeting on the project in Carmacks on 12/05/28 or in Whitehorse on 12/05/30.
81	Letter	May 22 2012	Casino Trapping Concession #148/#150, CMC	Trapline Tenure (Aboriginal)	CMC extended an invitation to attend a community meeting on the project in Carmacks on 12/05/28 or in Whitehorse on 12/05/30.
211	E-mail	Sept 25 2012	Casino Trapline, CMC Socio-economic Consultant	Trapline Tenure	CMC Socio-economic consultant requested a meeting to discuss the Project and the stakeholder's trapline; stakeholder agreed. Stakeholder provided the name of another trapper who should be consulted.
230	Meeting	Oct 3 2012	Casino area trapline, CMC Socio-economic consultant	Trapline tenure	Socio-economic data collection. Trapper provided information on his trapline, including access, use and harvest information. Noted that access could be an issue unless it is controlled. Requested regular updates and communication on the Project. Concerns: (a) access of others to the trapline; (b) open communication.
191	E-mail	Oct 15 2012	Trapping Concession #121, CMC Socio-economic consultant	Trapline tenure (Aboriginal)	Socio-economic data collection. Discussed trapping and potential project effects on his tenure. Project will have limited effects on his tenure as long as it is confined to the upper portion. Concern: (a) project effects on trapping in portions of the tenure.

Notes:

1. Concession number #150 was not identified in the Project Proposal Consultation Log (Appendix 2A) but in CMC's record of consultation minutes it notes that this individual has two trapping concessions.

CMC interviewed three trappers regarding their traplines and how the Project might impact them; attempts were made to contact additional trappers but those have been unsuccessful to date. The trappers interviewed were concerned about road access, and the potential effects of air and noise on wildlife. Trappers expressed support for resource development in general, provided that it could be done in an environmentally responsible manner, and without resulting in a loss of their trapping livelihood.

The concerns of the trappers who participated in interviews have already been considered in the Proposal as part of the identification of potential effects and mitigation measures discussed in Section 19 Land Use and Tenure. In summary, the Proposal considered both potentially adverse and potentially beneficial effects of the Project including:

- The potential loss and decrease of available area for trapping and outfitting during construction, operations and closure and decommissioning of the Project;
- Easier access to area for others whose activities may conflict with trappers and outfitters (due to the Freegold Road Upgrade);
- Easier access to permitted concession areas for trappers and outfitters (due to the Freegold Road Upgrade);
- Reduced wilderness experience for trappers and outfitters utilizing the area;
- Negotiated road access to areas for existing trappers and outfitters (Freegold Road Extension); and
- Reduced access to trapping and outfitting concession areas due to Project traffic during construction, operations and closure and decommissioning.

The Proposal outlines mitigation measures to avoid and/or minimize potential adverse effects to trappers. The mine footprint will be minimized to the extent possible and the Project will implement appropriate best management practices. CMC commits to ongoing communications with registered trapline holders that may be affected by the Project. Individual access arrangements for the Freegold Road Extension could be negotiated with trappers and outfitters so that potential adverse effects due to access are minimized. CMC has committed to creating a communications protocol with respect to the Freegold Road Extension, which will inform road users with timely information on road access, road conditions, and wildlife mitigations and incidents.

CMC intends to engage additional trappers in the Project area (specifically, trapping concessions 122, 131, 146, 147, 149, and 408). To increase the success of the engagement activities, CMC will continue to work with SFN and LSCFN to contact trappers and discuss the potential effects of the Project on their ability to use their trapping concessions. CMC commits to continuing dialog with interested guide outfitters as they are part of the group of impacted stakeholders.

A.2.3.1.2 R406

R406. Description of discussions with and feedback from affected outfitting concession holders including how many outfitting concession holders were contacted and responded.

Appendix 19A, Section 1.3.4 provides information on guide outfitting concession holders with specific details on the guide outfitting concessions potentially affected by the Project components and activities. An abbreviated consultation log for consultations by CMC or its consultants with outfitting concession holders is reproduced in Table A.2.3-2.

Table A.2.3-2 Consultation Log for Outfitting Concession Holders

Record #	Event Type	Date	Participating Organizations	Stakeholder Org Type	Event Summary
474	Meeting	Nov 20 2012	Mervyn's Outfitters, CMC Socio-economic consultant	Land & Resource Use	CMC Socio-economic consultant met with the stakeholder and discussed the Project, potential effects on the guide-outfitting business.

Record #	Event Type	Date	Participating Organizations	Stakeholder Org Type	Event Summary
170	Email	Nov 23 2012	Prophet Muskwa Outfitters, CMC Socio-economic consultant	Land & Resource Use	CMC Socio-economic consultant requested a meeting with the stakeholder to discuss the project and potential effects on his guide-outfitting business.
171	Email	Nov 26 2012	Prophet Muskwa Outfitters, CMC Socio-economic consultant	Land & Resource Use	Stakeholder responded to CMC Socio-economic consultant's request to discuss the Project and potential effects on his guide-outfitting business.
475	Phone call	Nov 28 2012	Prophet Muskwa Outfitters, CMC Socio-economic consultant	Land & Resource Use	CMC Socio-economic consultant met with the stakeholder and discuss the Project, potential effects on the guide-outfitting business
298	Phone call	April 15 2013	Casino Trapping Concession #116, CMC Socio-economic consultant	Trapline tenure (Aboriginal)	Left a voicemail requesting a call back to discuss his trapline and the Project
414	Meeting	May 10 2013	Casino Trapline, CMC Socio-economic consultant	Trapline Tenure	Local trapper outlined the importance and scope of his trapping activities in the project area and stated concerns about the environmental effects the project is likely to result in including a reduced amount of wildlife within his trapline area. Suggested he would like to find an amicable solution with CMC.

Section 1.3.4.3 of the Land Use and Tenure Baseline (Appendix 19.A) discusses the outfitters who operate in the area. Casino Mining Corporation is not aware of any operating guide outfitting camps near the Freegold Road Extension or Freegold Road Upgrade or within the Land Use and Tenure LSA; as well, CMC is aware that hunting is closed in two of the game management zones in the LSA. Casino Mining Corporation commits to continuing the dialog with outfitters as part of the group of impacted stakeholders and adaptively manage any impacts that may arise as a result of the Project.

A.2.4 QUARTZ AND PLACER CLAIM HOLDERS

A.2.4.1.1 R408

R408. A description of any contact or discussions between CMC and mineral rights holders in relation to the road.

Placer Claim Mineral Rights Holders

Casino Mining Corporation contracted a Whitehorse-based engineer (NEW ERA Engineering Corporation) with expertise and extensive experience in the placer field to consult with placer mine owners/operators who may be impacted by the Freegold Road Extension and Freegold Road Upgrade. Placer mine owners/operators are considered to be all holders of claims and prospecting leases issued by the Yukon Government pursuant to the *Yukon Placer Mine Act* (R.S.C., 1985, c. Y-3) in good standing at the time of consultation.

The proposed access road for the Casino Project is composed of two segments: the Freegold Road Upgrade and the Freegold Road Extension. The Freegold Road Upgrade is an existing secondary, unpaved road currently maintained by Yukon Government (YG) that extends 83 km northwest of the village of Carmacks. Yukon Government owns and currently maintains the road on a seasonal basis up to km 60. YG is currently developing a new set of regulations to better manage industrial resources access roads: the Resources Access Road

Regulation, which would enable it to construct and/or manage resource industry access roads. Through this enabling legislation, the Freegold Road Extension will be constructed, operated and maintained as a private industry access road by CMC.

As part of the consultation activities carried out by NEW ERA Engineering Corporation on behalf of CMC, both a ground and aerial reconnaissance of the proposed Freegold Road were conducted in September 2013. Photo-mosaic maps of each area of overlapping placer claims and prospecting leases were produced and emailed/mailed with introductory letters to all registered owners of placer claims and leases in November 2013. The intent of this outreach was to allow potential impacted placer mine owners/operators to more fully understand the proposed alignments and existing works. Follow up meetings to answer questions from placer miners and to receive their suggestions and concerns were undertaken through to March 2014. Key observations from the consultations are:

- No owners/operators interviewed or corresponded with were against the extension or upgrade of the Freegold Road, all felt that they could benefit from an improved surface on the existing Freegold Road Upgrade or possibly from the proposed new extension into the Hayes Creek area;
- All of the miners were grateful to receive the photo-mosaic maps of their claim areas;
- Most owner/operators in the Big Creek area mine upstream (south) of Big Creek and would not have potential mine areas covered with the new alignments of the Freegold Road;
- Some owners/operations had concerns regarding the potential isolation of placer by the Freegold Road;
- No owners/operators expressed opposition to the proposed Freegold Road; and
- Some placer owners/operators provided helpful local knowledge with respect to hydrology and permafrost that will assist in the detailed engineering design of the Freegold Road.

Casino Mining Corporation does not anticipate that any areas will be newly isolated by the Freegold Road Extension or Freegold Road Upgrade. If required, mitigation measures can be implemented to ensure access for mining. This discussion would take place as part of the licensing process under the *Territorial Lands (Yukon) Act*.

Quartz Claim Mineral Rights Holders

Quartz claim holders are holders of valid recorded Quartz Claims pursuant to the *Yukon Quartz Mining Act.* These claim holders have been granted an interest in the minerals including certain rights of access to those minerals. A specific study and engagement of quartz claim holders was not warranted because no mineral leases were identified along the proposed Freegold Road Upgrade or Freegold Road Extension. As well, the quartz claim holders have long-established rights and interests in the area and are familiar with the Casino Project, including the proposed development of the Freegold Road Extension and Freegold Road Upgrade. If potentially impacted claim holders are identified and/or consultation is deemed warranted, CMC anticipates that consultations will take place during the licensing process under the *Territorial Lands (Yukon) Act.*

A.3 – PROJECT LOCATION

A.3.1 INTRODUCTION

Section 3 of the Proposal presented a general overview of the Project area, within approximately 150 km of the mine site. The Project is located approximately 300 km north by air or 380 km by road from Whitehorse and 150 km by air or 200 km by road from the village of Carmacks.

The Project is located on Crown Land administered by the Yukon Government, and is located within the Whitehorse Mining District. In update to the Proposal, as of late 2014, the property consists of 731 full and partial Quartz Claims, totalling approximately 13,497 ha in area, and 55 Placer Claims, totalling approximately 490 ha in area, acquired in accordance with the *Yukon Quartz Mining Act*. All claims are registered to and wholly-owned by CMC, although some parts of the property are subject to royalty agreements.

A total of 28 active placer claims held by others (at the time of writing) are staked around Canadian Creek and overlap the Casino property mineral claims. Western Copper and Gold Corporation (WCGC), the owner of CMC, staked a five mile Placer Lease along Casino Creek and a three mile Placer Lease along Britannia Creek in 2010; in 2011 these leases were converted to claims and in 2014 the Placer Leases along Britannia Creek were dropped. As of 2014, CMC holds 55 placer claims on Casino Creek.

The Project is located within the Boreal Cordillera ecozone, which comprises much of the southern Yukon and a large portion of northern BC, and within the Klondike Plateau ecoregion. The Boreal Cordillera ecozone is broadly characterized by the presence of several mountain ranges, including the Dawson Range, that trend in the north-westerly direction and include extensive plateau regions. The plateaus consist of flat or gently rolling terrain separated by broad valleys and lowlands. The elevation of the Project area ranges from approximately 650 metres above sea level (masl) at the airstrip location to 1,400 masl on top of Patton Hill at the mine site.

The climate is characterized by long, cold, dry winters and short, warm, wet summers, with conditions varying according to altitude and aspect. February through April is typically the driest time, while June through August is typically the wettest. The mean annual temperature for the Project area (at an elevation of 1,200 masl) is -3 C, with minimum and maximum mean monthly temperatures of -18°C and 11°C occurring in January and July, respectively. The extreme minimum temperature is -50°C and the extreme maximum temperature is 30°C.

The mean annual precipitation for the Project area is 460 mm, with 66% falling as rain and 34% falling as snow. The 2-year 24-hour rainfall event is 32 mm and the 100-year 24-hour rainfall event is 71 mm. Mean annual wind speed for the Project area is 2.3 m/s with maximum wind gust speed being 14.9 m/s; northerly winds are predominant. The annual maximum snow water equivalent (SWE) is typically recorded in April or May with the mean annual maximum SWE over the period of record being 142 mm. The estimated mean monthly snowmelt volumes for the Casino snow survey station in April and May are 22 mm and 120 mm, respectively. Based on the calibration model the site wide mean annual SWE at an elevation of 1,200 masl is estimated to be 100 mm.

The Project is situated primarily in the Casino Creek watershed, with some components in the Canadian Creek watershed. Casino Creek flows in a southerly direction before joining Dip Creek, which drains to the southwest, eventually flowing into the White River via the Donjek and Klotassin Rivers. The White River is a tributary of the Yukon River. Canadian Creek flows in a northerly direction before joining Britannia Creek, which discharges directly into the Yukon River.

On January 27, 2015, the Executive Committee requested that Casino Mining Corporation (CMC) provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive

Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR).

The Executive Committee had no requests related to information presented in Section 3 Project Location of the Project Proposal submitted on January 3, 2014. As such, CMC considers that the documentation provided in the Proposal to be sufficient to deem the Proposal adequate for this section.

A.4 – PROJECT DESCRIPTION

A.4.1 INTRODUCTION

Section 4 of the Proposal provided an overview of the principal Project, related components and activities and accessory activities that make up Casino Project (the Project). Accessory activities are defined by YESAB as the activities that must be undertaken for the principal project to proceed (YESAB 2005).

The Project overview was divided into three sections:

- Principal Project Components and Activities (Section 4.1.1.1);
- Related Components and Activities (Section 4.1.1.2); and
- Accessory Activities (Section 4.1.1.3).

The anticipated schedule of the Project, including Project phases and anticipated duration, was presented in Section 4.2. Detailed information on Project components and activities for the construction, operation, closure and decommissioning and post-closure phases of the Project was provided in Section 4.3 to Section 4.5.

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered received comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). Casino Mining Corporation is providing this Supplementary Information Report (SIR) to comply with the Executive Committee's Adequacy Review Report; CMC anticipates that the information in the SIR and Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has 146 requests related to information presented in Section 4 Project Description of the Project Proposal submitted on January 3, 2014. These requests are outlined in Table A.4.1-1. Some responses require detailed technical information, data, and figures. Where necessary, this additional supporting information is provided as appendices to the SIR, as summarized in Table A.4.1-1.

Table A.4.1-1 Requests for Supplementary Information Related to Project Description

Request #	Request for Supplementary Information	Response
R1	All information and rationale used for the selection of the proposed tailings management facility over alternative disposal methods.	Section A.4.2.1.1 Appendix A.4A Tailings Management Facility Construction Material Alternatives
R2	Alternative dam construction methods to using cyclone sand.	Section A.4.2.1.2 Appendix A.4A Tailings Management Facility Construction Material Alternatives
R3	All information and rationale used to justify the proposed road alignment over alternative alignments.	Section A.4.2.2.1 Appendix A.4B Information on Alternative Access Road Alignments

Request #	Request for Supplementary Information	Response
R4	Identify whether broad-based stakeholder risk assessment processes, such as failure modes and effects analysis, will be completed and/or whether external expert review panels will be used as internal quality controls to guide the project.	Section A.4.3.1
R5	Identify if and how independent regulatory audits will be conducted.	Section A.4.3.2
R6	Describe how best practices, in relation to oversight, will be applied to the Project given the scale and nature of challenges associated with the proposed activities and site.	Section A.4.3.3
R7	A description of all other staging and preparation activities. For example, equipment, fuel, and material staging for the upgrade to the Freegold Road and construction of the Freegold Road Extension.	Section A.4.4.1
R8	Describe the interdependency of and critical path for staging and construction activities.	Section A.4.4.2
R9	Details regarding planned barging activity, including frequency, temporal periods, and types of freight anticipated by barge. Additionally, please describe any ancillary activities associated with barging, such as landing sites and access road.	Section A.4.4.3
R10	The reports that show results of metallurgical testing and sulphur removal performance from 2009 and 2010 bench tests, as well as the 2012 pilot test by G&T.	Section A.4.5.1 Appendix A4.N Scoping Level Assessment of Casino Property Appendix A4.O Advanced Metallurgical Assessment of the Casino Copper Gold Project Appendix A.4P Production of Environmental Tailings Samples for the Casino Deposit
R11	Additional information to support the feasibility of the sulphide removal process. Details should include: a. detailed description of the sulphide removal process; b. how the process will account for variations in the mineral composition of processed ore and the large tonnage of tailings; and, c. QA/QC for tailings classification including a detailed schedule for testing.	Section A.4.5.2 Appendix A4.O Advanced Metallurgical Assessment of the Casino Copper Gold Project

Request #	Request for Supplementary Information	Response
R12	Additional information on the NAG tailings, or cyclone sand, produced through the sulphide removal process. Details should include: a. data to show that the sulphide removal will be effective for all ore types; b. sulphide levels required to produce non-acid generating cyclone sand and tailings; c. residual sulphide concentrations; d. how the sulphide removal process will be managed and how the cyclone sand will be monitored and tested during operation to ensure that the required performance limits are consistently achieved; and e. any remedial measures that may be required should the sulphide removal process be shown to be ineffective.	Section A.4.5.3 Appendix A4.N Scoping Level Assessment of Casino Property Appendix A4.O Advanced Metallurgical Assessment of the Casino Copper Gold Project Appendix A.4P Production of Environmental Tailings Samples for the Casino Deposit Appendix A.22H ML/ARD Management Plan
R13	Detailed description of the temporary construction camp including: a. layout of infrastructure such as camp facilities, generators, sewage disposal system, fuel storage, and generators; b. proximity to surface water; c. human-wildlife conflict prevention; and d. fuel storage requirements and capacity of diesel generators.	Section A.4.6.1.1 Appendix A.22A Waste and Hazardous Materials Management Plan Appendix A.12A Wildlife Mitigation and Monitoring Plan
R14	Detailed description of activities required for construction of camp including: a. site preparation such as clearing, grubbing, and disposal of materials; b. construction material volumes and sources (e.g. granular material requirements); and c. anticipated timing and duration of the proposed activities.	Section A.4.6.1.2
R15	Details and information regarding the authorization requirements of the proposed alignment through Settlement Lands.	Section A.4.6.1.3
R16	Discussion of potential impacts to values associated with Settlement Lands and mitigations proposed to address these effects.	Section A.4.6.1.4
R17	Describe progress on the Road Use Agreement and relevant details that informed the Road Management Plan.	Section A.4.6.1.5
R18	A detailed Road Management Plan for the entire Freegold Road. Specific details for the Freegold Road extension should include: a. description of what other users will have access to the Freegold Road extension; and b. description of the legal instruments and measures that will be implemented to control access to the Freegold Road extension.	Section A.4.6.1.6 Appendix A.22E Road Use Plan

Request #	Request for Supplementary Information	Response
R19	Please confirm that the Road Use Plan, the Extension Access Management Plan, and the Traffic Management Plan refer to the same management plan.	Section A.4.6.1.7 Appendix A.22E Road Use Plan
R20	Reconcile the intention to decommission the access road with the need to maintain access in order to monitor and maintain permanent infrastructure. Details should include a detailed discussion of access requirements for on-going monitoring and maintenance of site infrastructure and how these activities will be undertaken if the road is decommissioned.	Section A.4.6.1.8
R21	A breakdown of Project related traffic volumes, by vehicle type, for the Alaska, North Klondike, and South Klondike highways. Provide a comparison against current traffic levels and capacities including seasonal fluctuations.	Section A.4.6.2.1
R22	Implications of projected traffic due to this Project on the Alaska, North Klondike, and South Klondike highways.	Section A.4.6.2.2
R23	Details on fleet management to ensure rapid response to possible accidents or spills.	Section A.4.6.2.3 Appendix A.22B Spill Contingency Management Plan Appendix A.22A Waste and Hazardous Materials Management Plan
R24	Describe if weight restrictions are predicted to interfere with Project logistics including the anticipated frequency for which a special variance permit may be requested.	Section A.4.6.2.4
R25	Describe maximum predicted haulage weights, including maximum anticipated weights for the importation of equipment and infrastructure.	Section A.4.6.2.5
R26	Traffic projections for mine related traffic within Carmacks, detailed by vehicle class and type, prior to the Carmacks by-pass becoming operational.	Section A.4.6.3.1
R27	A traffic management plan for routing traffic through Carmacks prior to the completion of the Carmacks by-pass. Details should include: a. route through Carmacks; b. timing of transportation activities (e.g. daily, weekly and monthly restrictions); c. safety of residents with particular focus given to routes with no pedestrian sidewalks; d. communication with residents within community; and e. congestion aversion.	Section A.4.6.3.2 Appendix A.22E Road Use Plan

Request #	Request for Supplementary Information	Response
R28	Describe the sourcing of primary mine materials, delineating supplies arriving from Skagway from those from British Columbia and elsewhere. Please distinguish between materials such as primary flotation supplies, heap leach supplies, lubricants, fuels, and cyanide.	Section A.4.6.4.1
R29	Confirm that the export plan is, or will be, logistically possible.	Section A.4.6.4.2 Appendix A.4B Information on Alternative Access Road Alignments
R30	Describe, as best as possible (if data are unavailable, please indicate anticipated rates of use), the frequency, weight, size, truck type, and carrying capacity of trucks carrying: a. pebble lime; b. sodium disobutyl dithiophashinate; c. sodium diethyl dithiphoshinate; d. methyl isobutyl caribinol; e. potassium xanthate; f. sodium hydro-sulphide; g. sodium cyanide; h. sodium hydroxide; i. hydrochloric acid; j. sulphuric acid; k. ammonium nitrate; l. diesel; m. lubricants; n. liquefied natural gas; o. ore concentrates; and p. other hazardous materials.	Section A.4.6.5.1
R31	Additional detail in the Water Management Plan that includes all Project components and phases. Details should include: a. appropriate figures and plans illustrating site water management, including flow sheet information such as monthly water volumes; and b. figures, plans, and sections for key collection and conveyance facilities associated with the Project.	Section A.4.7.1
R32	A description of the methodology used to determine flows for storm events including supporting information such as catchment areas, time of concentrations, inclusion of rain and snow melt events, design events, and results.	Section A.4.7.2.1 Appendix A.7A Variability Water Balance Model Report
R33	Detail and describe the methodology and references used to determine the probable maximum precipitation in relation to conveyance channel design and events pond standards.	Section A.4.7.2.2

Request #	Request for Supplementary Information	Response
R34	Typical cross-sections and design drawings of alignments for diversion ditching across the project site with particular focus around the HLF including: a. confining embankment; b. access road section; and c. event ponds area.	Section A.4.7.2.3 Appendix A.4C Feasibility Design of the Heap Leach Facility
R35	A discussion of measures to be taken should one or more sections of the proposed heap leach facility (HLF) diversion ditches be found to be ineffective or should excessive erosion become an issue.	Section A.4.7.2.4
R36	A discussion of alternatives that CMC considered, including justification and rationale for the use of the proposed ditches.	Section A.4.7.2.5 Appendix A.4C Feasibility Design of the Heap Leach Facility
R37	A description of the diversion ditch on the southwest side of the HLF, including a drawing indicating its proximity to the edge of Brynelson Creek north tributary sub-watershed. Include a discussion of potential effects to and relevant mitigations for this watershed.	Section A.4.7.2.6
R38	Additional information regarding design of channels in the area that will be susceptible to erosion.	Section A.4.7.2.7
R39	Rationale for directing various non-contact water sources into the TMF. Include a discussion of how non-contact water will be managed throughout the life of the Project.	Section A.4.7.2.8
R40	Further rationale for sizing of the water management pond and sedimentation ponds in terms of sediment removal and confirm if the proposed sizes will meet objectives.	Section A.4.7.3.1 Appendix A.4D Report on the Feasibility Design of the TMF
R41	Clarify whether the size of the event pond is for managing return period rainfall events or return period snow melt-rain events.	Section A.4.7.3.2
R42	Details and rationale on the selection of return period design criteria for all the WMP components during all phases of the Project, including long-term closure. Details should include calculation of the failure probabilities.	Section A.4.7.4.1 Appendix A.4C Feasibility Design of the Heap Leach Facility Appendix A.4D Report on the Feasibility Design of the TMF
R43	Detailed information on the sources and quantities of suitable borrow materials.	Section A.4.8.1.1 Appendix A.4C Feasibility Design of the Heap Leach Facility

Request #	Request for Supplementary Information	Response
R44	Clarify whether HLF excavations will be to competent bedrock or weathered bedrock. Provide justification and the criteria used to determine the suitability of the foundation for the HLF.	Section A.4.8.1.2 Appendix A.4C Feasibility Design of the Heap Leach Facility
R45	Details on foundation preparation including drainage management and accommodation of the proposed liner.	Section A.4.8.1.3 Appendix A.4C Feasibility Design of the Heap Leach Facility
R46	Rationale for the sufficiency of a 30 cm thick soil liner.	Section A.4.8.2.1
R47	A description of the composition and potential effects of the overliner on the performance of the liner considering permeability and hydraulic head.	Section A.4.8.2.2
R48	Details on the mitigation and management of leaks from the HLF including during all stages of operations.	Section A.4.8.3.1 Appendix A.4C Feasibility Design of the Heap Leach Facility
R49	Details on the maintenance and repair of the LDRS sump and pumps.	Section A.4.8.3.2
R50	Details on the pipelines, pumps, and related infrastructure connecting the components of the HLF including SART, cyanide, and gold extraction facilities. Include details on pipeline alignments and leak detection measures.	Section A.4.8.4.1 Appendix A.4C Feasibility Design of the Heap Leach Facility
R51	Volumes and sources of water stored in the embankment and the events pond during a 1 in 100 year 24-hour storm event.	Section A.4.8.4.2
R52	Sensitivity analyses for makeup water requirements and water retention requirements for different moisture content values for stacked ore and wetter or dryer climatic conditions. Include a discussion on any implications in relation to HLF and events pond storage capacity.	Section A.4.8.4.3 Appendix A7.A Variability Water Balance Model Report Appendix A7.C Potential Effects of Climate Change on the Variability Water Balance
R53	A description of the HLF solution balance including in wet and dry conditions.	Section A.4.8.4.4 Appendix A7.A Variability Water Balance Model Report Appendix A7.C Potential Effects of Climate Change on the Variability Water Balance
R54	Rationale for the selection of design criteria for HLF events pond and events pond spillway sizing. Include a discussion on potential consequences resulting from larger hydrological events.	Section A.4.8.4.5

Request #	Request for Supplementary Information	Response
R55	Discussion on the potential for the buckling and decreasing efficiency of collection wells for leachate recovery.	Section A.4.8.5.1
R56	Estimates for the approximate tonnage in each ore lift within the HLF.	Section A.4.8.6.1
R57	Clarification on the leach cycle activities and durations.	Section A.4.8.6.2 Appendix A4.C Feasibility Design of the Heap Leach Facility
R58	Identify additional metallurgical test work that has been undertaken or is planned prior to/during construction and operation to improve leach cycle time estimates.	Section A.4.8.6.3 Appendix A.4E Results of Additional Lab Testing of Leach Ore
R59	A discussion on the implications of the following scenarios and provide consideration of options that the mine could implement should the following unforeseen conditions occur during construction and operations: a. leach times that are significantly increased for short or extended times. As an example, if the leach cycle is unexpectedly increased from 60 days to 100 days for an extended time; b. shortages in stockpile capacity for excess oxide ore should the expected HLF stacking rate need to be reduced; c. possible extension of the HLF operation beyond Year 15 due to longer than anticipated leach cycles; and d. requirements for additional gold ore stockpile capacity and/or provisional spare leach pad later during operations since the surface area of the lifts will be reduced as the heap extends upslope.	Section A.4.8.6.4 Appendix A.4F Waste Storage Area and Stockpiles Feasibility Design
R60	Additional details regarding the HLF confining embankment giving consideration to the varying functions of the structure (i.e. HLF stability, leach solution storage, road traffic, and housing services). Details should include: a. construction methods and design of the section of the access road situated between the confining embankment toe and the events pond; b. measures incorporated into its design to protect any buried services and the confining embankment drainage blanket; and c. clarification regarding whether or not the confining embankment drainage blanket will extend under the road and daylight in the tailings management facility area.	Section A.4.8.7.1
R61	A detailed schedule for the works required to construct the HLF and commence leaching operations. Consideration should be given to key QA/QC requirements and contingency planning for scheduling delays.	Section A.4.8.8.1

Request #	Request for Supplementary Information	Response
R62	Implications of scheduling delays or suspension of HLF construction.	Section A.4.8.8.2
R63	Details on the specialized personnel required to construct, operate, maintain, monitor and oversee the HLF.	Section A.4.8.8.3
R64	The missing Section 4.4.4 of the project proposal.	Section A.4.8.8.4
R65	Additional justification and rationale for the “high” hazard classification for the tailings management facility. In addition, provide details on construction and design implications of using an “extreme” hazard classification.	Section A.4.9.1.1
R66	If available, comparisons with other similar sand embankments or compacted sand dams, and/or natural analogs within similar environments. The discussion should include details on permeability, stress, strength, and performance of these structures.	Section A.4.9.1.2 Appendix A.4D Report on the Feasibility Design of the TMF
R67	Detailed rationale for the selection of the factor of safety during dam construction.	Section A.4.9.1.3
R68	Evidence demonstrating that the stability of the proposed TMF dam can be achieved through a post-closure period lasting thousands of years. Include a discussion on technically feasible options for managing the risk to downstream areas in perpetuity.	Section A.4.9.1.4
R69	An explanation on the likelihood and implications of saturation of the TMF dam’s foundation, drains, and lower portions.	Section A.4.9.2.1
R70	Justification and rationale for using a factor of 1.5 for ground motion amplification for potential slip surfaces in the embankment foundation.	Section A.4.9.2.2
R71	Clarification if V_{s30} is site specific and how it was derived.	Section A.4.9.2.3
R72	Mean peak ground acceleration values derived from EZ-FRISK.	Section A.4.9.2.4
R73	Explanation of the difference between Natural Resources Canada spectral periods and the spectral periods presented in the report on the feasibility of the TMF.	Section A.4.9.2.5
R74	Explanation on monitoring and remediation activities that may be required during closure including the extent of remediation required in event of an MDE.	Section A.4.9.2.6
R75	Reassess and model the IDF and PMP using modern storm expansion techniques. In addition, provide: a. a full description of the methodology used; and b. rationale for using a 100-year design snowpack.	Section A.4.9.3.1 Appendix A.4D Report on the Feasibility Design of the TMF Appendix A.4G Updated Hydrometeorology Report

Request #	Request for Supplementary Information	Response
R76	Rationale for not constructing an emergency spillway for the TMF during operations.	Section A.4.9.4.1 Appendix A.4D Report on the Feasibility Design of the TMF
R77	A discussion on potential consequences of HLF failure resulting in displacement of water in the TMF.	Section A.4.9.4.2 Appendix A.4C Feasibility Design of the Heap Leach Facility
R78	A discussion and details of the methodology used to determine closure spillway requirements and relevant data such as time distribution of rainfall and relevant hydrographs.	Section A.4.9.4.3
R79	Discussion of the potential for closure spillway blockages and expected extent of maintenance and monitoring the spillway.	Section A.4.9.4.4
R80	Identify mitigations, with appropriate thresholds for implementation, and monitoring activities for closure spillway related erosion, both in the spillway channel and downstream water bodies.	Section A.4.9.4.5
R81	A dam breach analysis with water/tailings inundation modeling consistent with the Canadian Dam Association's dam safety guidelines including: a. probable maximum flood inundation map showing the maximum extent of flooding relating to a sudden full storage embankment breach extending to when expected flooding is within the natural water channels; b. an assessment of environmental and human impacts associated with a release of tailings; c. an assessment of potential impacts to First Nation Settlement Lands; d. an assessment of impacts to downstream infrastructure; e. mitigation measures in the event of a tailings breach; and f. for each proposed breach scenario a cross section of the critical TMF embankment, proposed loading factors, and each scenario's factor of safety.	Section A.4.9.5.1
R82	Rationale for the proposed thickness of the core and downstream filter, considering the dam height and permanent performance requirements.	Section A.4.9.6.1 Appendix A.4D Report on the Feasibility Design of the TMF
R83	Rationale for the ceiling of 12 percent fines in cycloned sand to be used in embankment construction including a discussion of frost susceptibility and drainage characteristics.	Section A.4.9.7.1
R84	Provide testing or analyses to demonstrate that pore pressures, shear strength, angles of friction, and contraction of cyclone sand is acceptable at all pressures found in the TMF embankment.	Section A.4.9.7.2 Appendix A.4R Report on Laboratory Geotechnical Testing of Tailings Materials

Request #	Request for Supplementary Information	Response
R85	Clarification on the specific gravities of cyclone overflow and underflow.	Section A.4.9.7.3 Appendix A.4D Report on the Feasibility Design of the TMF
R86	Justify the upper range of 2.0 m for proposed lift heights of cyclone sand.	Section A.4.9.7.4
R87	Supporting evidence for the absence or presence of faults and fractures within the TMF and embankment areas including their activity.	Section A.4.9.8.1 Appendix A.4D Report on the Feasibility Design of the TMF
R88	Additional drill results, with detailed analysis and discussion, to provide an accurate characterization of the hydraulic conductivity and identification fault/shear zones within the embankment foundation.	Section A.4.9.9.1 Appendix A.4D Report on the Feasibility Design of the TMF Appendix A.4L Report on Revised Tailings Management Facility Seepage Assessment
R89	Details regarding the cut off trench and seepage control for the TMF embankment including: a. clarification on the depth of the cut-off trench and justification based on the depth of overburden and fractured bedrock; b. an updated cross section of the TMF embankment that includes the cut off trench and associated seepage barrier; c. a profile diagram of the cut off trench showing its depth across the dam core, along with available information on the depth of overburden and fractured bedrock; d. a discussion of measures to address fractured bedrock; and e. a discussion on the use of a grout curtain to control seepage	Section A.4.9.9.2 Appendix A.4D Report on the Feasibility Design of the TMF
R90	Further characterization of the dam foundation materials to confirm the presence and distribution of permafrost.	Section A.4.9.10.1
R91	Details regarding plans to ensure embankment foundations do not incorporate frozen and/or frost susceptible soils during construction.	Section A.4.9.10.2
R92	A detailed schedule for the works required to construct the TMF before and during operations. Consideration should be given to key QA/QC requirements and contingency planning for scheduling delays and freezing conditions.	Section A.4.9.11.1
R93	Implications of scheduling delays or suspension of dam construction during the nine month construction period.	Section A.4.9.11.2
R94	A review of relevant examples of sand embankment dams constructed in cold weather environments. This review should identify challenges, potential issues, and solutions surrounding sand placement and QA/QC.	Section A.4.9.11.3
R95	Methods of erosion control during dam construction.	Section A.4.9.11.4

Request #	Request for Supplementary Information	Response
R96	Description of ground surface conditions currently in relation to overburden and vegetation and any modification in preparation for the construction and filling of the TMF.	Section A.4.9.11.5 Appendix A.4D Report on the Feasibility Design of the TMF
R97	Discussion on any hydrological changes expected from changing ground thermal conditions and any monitoring to this effect.	Section A.4.9.11.6 Appendix A.4D Report on the Feasibility Design of the TMF
R98	Confirmation that natural or artificial liners are not included as part of the technical design of the TMF embankment.	Section A.4.9.11.7
R99	Confirmation of the availability of non-frost susceptible materials for the construction of the dam core. Include a discussion that demonstrates that the material with a 20 percent or more fines is not a frost susceptible material.	Section A.4.9.12.1 Appendix A.4D Report on the Feasibility Design of the TMF
R100	Please provide the Mine Site Borrow Materials Assessment Report (VA101-325/16-3). If not part of the assessment report, include detailed information about:a. the locations of borrow sources;b. description of dimensions of borrow source excavations including area and depth of excavations;c. the estimated quantities of suitable borrow material available;d. the quantity of borrow material required for engineered mine components;e. proposed mitigation measures to minimize potential adverse effects associated with the development and use of the proposed borrow sites; andf. alternatives in the event that dam core material cannot be sourced at the site in sufficient quantities.	Section A.4.9.12.2 Appendix A.4Q Mine Site Borrow Materials Assessment Report
R101	A discussion on the thawing and containment of borrow and embankment excavations.	Section A.4.9.12.3
R102	Clarification on the use of filter-graded zones between the waste rock shells (if selected) of the starter dam and the overlying tailings shells (e.g. to prevent possible future deformation of the tailings shells).	Section A.4.9.13.1
R103	The missing information referenced in footnote No. 6 on p. 4-54 of the proposal related to Table 4.3-7 (Inflow Design Flood and Earthquake Design Ground Motion).	Section A.4.9.14.1
R104	For the LNG storage facilities, regasification facilities, and mobile fueling stations, provide: a. a detailed description for all facilities related to LNG including location, design, construction, operation and closure; b. measures for the safety of Project personnel including separation distances from office and living areas; c. design measures and operating procedures to prevent a cascading accident; and d. a list of standards and codes that will apply to design and operation of the each component identified above.	Section A.4.10.1.1 Appendix A.22G LNG Management Plan

Request #	Request for Supplementary Information	Response
R105	Identification of potential hazards to LNG facilities at the Casino Mine site associated with seismic activity, extreme weather events, wildfire, unstable terrain, and degradation of discontinuous permafrost, and a quantitative assessment of the related risk to those facilities.	Section A.4.10.1.2 Appendix A.22G LNG Management Plan
R106	Identification of the potential supplier of LNG from British Columbia and the established supplier of LNG from Alaska. Indicate the nature of any supply agreements that are in place. Indicate the nature of any uncertainties about the LNG facility in British Columbia being operational by the time LNG is required at the Casino Mine site. Provide documentation to confirm that the facility in Alaska will be able to supply LNG in sufficient quantity to meet the needs of the Casino Mine, should LNG not be available from the proposed facility in British Columbia. Describe the Casino Mining Corporation's fallback plan in the event that LNG is unavailable from either identified source, or is not available in sufficient quantity. Indicate whether an alternative source of electrical power might be required in such a case. Assess the effect of the above scenarios on the project's economic feasibility.	Section A.4.10.1.3
R107	The earthquake design basis for the LNG storage tank at the mine site.	Section A.4.10.1.4 Appendix A.22G LNG Management Plan
R108	A description of diesel storage facilities along with anticipated rates of use and storage volumes for each stage of the Project.	Section A.4.10.2.1
R109	A table or tables that summarize the following information for each major mine component: a. where appropriate, dimensions, mass, volume, centroid and elevation; b. reclamation characteristics (slope aspects, cover type and depth, volume required, re-vegetation type); c. source controls (e.g. liners, compacted graded drained foundations, and covers over reclaimed features) and any features associated with fluid management and stabilization and/or water management and treatment; and d. geotechnical protocols and results (e.g. FOS).	Section A.4.11.1.1 Appendix A.4C Feasibility Design of the Heap Leach Facility Appendix A.4D Report on the Feasibility Design of the Tailings Management Facility Appendix A.4F Waste Storage Area and Stockpiles Feasibility Design
R110	Conservative considerations for the long-term operational and maintenance requirements for the site.	Section A.4.11.1.2
R111	Analysis of closure options including long-term and short-term costs, care and maintenance requirements, and long-term environmental risks. The options analysis should include: a. open pit; b. tailings management facility; c. heap leach facility; d. stockpile areas; and e. water management and treatment.	Section A.4.11.2.1 Appendix A.4H Cold Climate Passive Treatment Systems Literature Review

Request #	Request for Supplementary Information	Response
R112	Discuss and if necessary update the conceptual closure plan to take into account the most recent Government of Yukon Reclamation and Closure Planning for Quartz Mining Projects, Plan Requirements and Closure Costing Guidance (Government of Yukon, 2013).	Section A.4.11.2.2
R113	Clarify what is meant by regular or infrequent site presence or what degree of on-site presence is envisioned (e.g. yearly during summer, once every 10 years, or site presence in step with closure stage).	Section A.4.11.2.3
R114	Justification and clarification of the proposed five year post-closure monitoring period given that actual closure conditions will not be established for about 95 years (pit discharge) and other closure conditions are not fully known or presented here (e.g. time for contaminated groundwater sources to report to TMF/seepage).	Section A.4.11.2.4
R115	Examples of successful similar treatment systems with similar contaminant loads, flows and climate.	Section A.4.11.3.1 Appendix A.4H Cold Climate Passive Treatment Systems Literature Review
R116	Initiation of laboratory studies to confirm the effectiveness of the wetlands as a water treatment system for the purpose of closure and to inform future field studies. The Executive Committee expects that results from these studies will be provided throughout the assessment process.	Section A.4.11.3.2 Appendix A.4K Metal Uptake in Northern Constructed Wetland
R117	Detailed plans on field studies to support and refine the effectiveness of the wetland water treatment system. Details should include: a. a preliminary schedule for studies; b. location and sequencing of field scale studies; and c. any required activities, such as earthworks, required for field studies.	Section A.4.11.3.3
R118	Details on any proposed pilot studies for the bioreactor system associated with the HLF.	Section A.4.11.3.4
R119	An assessment of uncertainty associated with the performance of the proposed passive treatment system.	Section A.4.11.3.5
R120	Prediction of a worst case scenario of downstream water quality assuming no treatment system. Predictions should extend as far downstream as necessary to demonstrate no further exceedances of the CCME surface water quality objectives attributed to the mine (or 90th percentile of background for those constituents that naturally exceed CCME).	Section A.4.11.3.6

Request #	Request for Supplementary Information	Response
R121	A discussion of contingency, alternative, or additional treatment options that could achieve water quality objectives should the passive treatment system not be viable or perform as required.	Section A.4.11.3.7
R122	A discussion of the requirements and merits for conventional treatment as the treatment method.	Section A.4.11.3.8 Appendix A.4H Cold Climate Passive Treatment Systems Literature Review
R123	A discussion and rationale on how the design of the north end of the tailings management facility wetlands will accommodate a range of possible flows from the pit lake.	Section A.4.11.3.9 Appendix A.7B Water Quality Predictions Report
R124	Details and design considerations for the remotely operated solar powered decant valves. Details should include: a. infrastructure requirements; b. monitoring and maintenance requirements, including an estimated timeframe; c. contingency planning related to malfunctions, inappropriate feedback and interaction; and d. case studies where such systems are effectively used;	Section A.4.11.3.10
R125	Details and rationale on the proposed storage and disposal of low-grade ore. Details should include: a. detailed geochemical characterization of material in the low-grade ore stockpile; and b. supporting evidence and rationale as to why leaving this material on surface to continue to generate acid and metal contaminants before much later disposal in the pit is any more beneficial than disposing same under water in the TMF when this material is first encountered.	Section A.4.11.4.1
R126	Details and discussion on groundwater collection and/or infiltration suppression to manage seepage through the low grade ore stockpile.	Section A.4.11.4.2
R127	A detailed discussion on lake stratification or mixing in relation to discharge including: a. any evidence or assumptions for lake mixing or stratification; and b. stratifications or mixing impacts to discharge water quality and the tailings management facility wetlands.	Section A.4.11.4.3 Appendix A.7B Water Quality Predictions Report
R128	Additional analysis to inform and update the Conceptual Closure and Reclamation Plan to address potential pit wall instability in post-closure.	Section A.4.11.5.1 Appendix A.4I Open Pit Geotechnical Design
R129	A sensitivity analysis examining the effect of less stable pit walls and show how the additional waste rock would be managed if the wall slopes had to be relaxed.	Section A.4.11.5.2
R130	A description of the barrier to prevent access to pit walls.	Section A.4.11.6.1

Request #	Request for Supplementary Information	Response
R131	Results and analysis of testing of heap leach facility detoxification using samples and conditions similar to an exhausted heap of friable ore approximately 150 m high.	Section A.4.11.7.1
R132	A discussion on alternative mitigation measures that may be required if heap leach facility rinsing and detoxification is not successful. The discussion should include examples of successful heap rinsing at comparable sites where materials of a similar nature, mass and northern location have been encountered.	Section A.4.11.7.2 Appendix A.4J Laboratory Evaluation of the SO2/Air and Peroxide Process
R133	Describe how fluid impoundment behind the HLF embankment will be prevented at closure.	Section A.4.11.7.3
R134	Additional details on the design basis and requirements for cover materials. Details should include: a. cover modeling and assessment including validation of assumed infiltration rates; b. availability and location of sufficient construction materials to meet the design requirements; c. composition of materials to be used for the cover system including mineral soil, topsoil, and vegetation; d. range of expected performance of proposed cover systems; and e. long-term monitoring and maintenance requirements.	Section A.4.11.8.1
R135	Feasibility level design details for the winter seepage mitigation pond cut-off wall and cut-off trench/barrier. Include a discussion of how the structures are to be constructed.	Section A.4.11.9.1
R136	Rationale for the construction of a cut-off barrier only after operations.	Section A.4.11.9.2 Appendix A.7B Water Quality Predictions Report
R137	Additional details about the winter seepage mitigation pond dam should include: a. proposed design standards (e.g. Canadian Dam Association Safety Guidelines); b. cross-sections; c. construction materials; d. consequence of failure classification; e. detailed foundation characterization; and f. monitoring and maintenance requirements.	Section A.4.11.9.3
R138	Demonstrate that the rate of discharge from the proposed winter seepage mitigation pond can be controlled in response to downstream flow rates within Casino Creek in order to meet downstream water quality objectives. Details should include WSMP capacity to handle excess water that is not discharged due to low flow conditions in Casino Creek.	Section A.4.11.9.4 Appendix A.7A Variability Water Balance Report

Request #	Request for Supplementary Information	Response
R139	Detailed plans for establishing vegetation on the downstream slope of the tailings management facility west and main embankments. Details should include:a. examples of successful projects where vegetation was established on similar slopes under similar climatic conditions as supporting rationale for the proposed closure and reclamation plan;b. a conceptual schedule for the site vegetation studies and feasibility level site vegetation designs, including the maintenance expectations; andc. a description of the estimated feasibility level costs of site vegetation upon mine closure account for the site-specific conditions.	Section A.4.11.10.1
R140	Further discussion regarding site infrastructure that may not be conducive to climax vegetation in closure. Include measures that you will implement to ensure long-term integrity of this reclaimed infrastructure.	Section A.4.11.11.1
R141	Additional details in the Conceptual Closure and Reclamation Plan with regard to temporary or early closure. Details should include: a. water and solution management and any requirements for water treatment; b. infrastructure requirements (e.g. ability of heap leach facility or tailings management facility to accommodate temporary or early closure); c. identify critical points in the project life cycle where temporary or early closure is most probable and most challenging; and d. length of time project could remain in temporary closure before discharge would be required.	Section A.4.11.12.1
R142	Contingency measures or alternatives that may be required in the event of early closure if passive treatment system field trials have not been completed or are shown to be unsuccessful.	Section A.4.11.12.2
R143	Update the CCRP and security estimates based on the Government of Yukon's updated guidance document: Reclamation and Closure Planning for Quartz Mining Projects, Plan Requirements and Closure Costing Guidance (Government of Yukon, 2013).	Section A.4.11.13.1
R144	Additional justification and discussion on security estimates. Details should include: a. all major mine components; b. all reclamation and closure stages; c. consideration of temporary or early closure; d. consideration of accidents and malfunctions; and e. consideration of effects of the environment.	Section A.4.11.13.2
R145	The following documents referenced in the Conceptual Closure and Reclamation Plan (Appendix 4A): a. R&C Environmental Services, 2010 b. pers.comm. J. Marsden, 2013	Section A.4.11.14.1 Appendix A.4J Laboratory Evaluation of the SO2/Air and Peroxide Process

Request #	Request for Supplementary Information	Response
R146	A detailed description of waste management for the Project including: a. location and size of all facilities associated with waste management; b. detailed description of waste storage facilities including the waste management facility, landfill, incinerator, land treatment facility, and sewage treatment plant; c. detailed description of waste management at the various facilities; d. anticipated volumes of waste at various stages of the Project; e. details on special waste and hazardous waste handling including anticipated volumes; and f. a more detailed waste management plan.	Section A.4.12.1 Appendix A.22A Solid Waste and Hazardous Materials Management Plan

Notes:

1. Request # refers to the assigned identification number in the YESAB Adequacy Review Report January 27, 2015 Prepared by Executive Committee Yukon Environmental and Socio-economic Assessment Board.
2. Response refers to the location of CMC's response to the YESAB request for supplementary information.

A.4.2 ALTERNATIVES

A.4.2.1 Tailings Management Facility

A.4.2.1.1 R1

R1. All information and rationale used for the selection of the proposed tailings management facility over alternative disposal methods.

Casino Mining Corporation has interpreted R1 as a request for additional information on the evaluation process applied to select subaqueous tailings disposal as the preferred tailings disposal method for the Project over other commonly considered tailings technologies, as an alternative location assessment was presented in Section 4.8.4.4 of the Proposal. Alternative tailings disposal technologies were considered as part of the Tailings Management Facility Construction Material Alternatives (Appendix A.4A). A summary of the rationale and considerations that resulted in the selection of the proposed tailings disposal strategy is outlined.

It is important to recognize that feasible and safe alternative tailing disposal methods for the Project are limited due to a number of intervening factors. Early in the planning process, it was determined that the anticipated production rates for the Project would be in excess of what could be managed only by dry stack tailings. As well, additional testing confirmed that the geochemical characteristics of the tailings preclude encapsulation of reactive waste in the dry stack as a practical approach. These factors were confounded by the operational challenges facing successful construction of a dry stack facility in cold climates and anticipated large throughput of the Project. Two types of tailings disposal were considered: slurry tailings and dry stack tailings. The trade-offs of each alternative disposal method are discussed below in the context of the Project.

Slurry Tailings

Slurry tailings can be discharged using subaqueous (below water) or subaerial techniques (above the water line, typically deposed of on natural ground or the existing tailings beach). Subaerial deposition allows for development of an extensive beach above water. The tailings beach keeps the pond at a distance from the embankment crest, which reduces hydraulic gradients through the embankment and improves embankment stability. For these reasons, subaerial deposition is the preferred method for tailings discharge at the embankment crest. The subaerial deposition method is only suitable for non-reactive tailings at the Project; and potentially reactive tailings and waste rock require subaqueous disposal in designated areas to prevent oxidation and associated potential acid generation and/or metal leaching.

Dry Stack

The use of dewatered (filtered) tailings for storage within a “dry stack” facility was considered as an alternative tailings deposition method. Filtered tailings are produced using pressure or vacuum forces in presses, drums or belt filtration units. The dewatered tailings are transported by conveyors or trucks to a ‘dry stack’ where they can be compacted in lifts to improve density and stability and allow machinery to work on the impoundment surface to facilitate on-going expansion.

Challenges for the dry stack operation include dust emissions for dewatered tailings (aggravated by freeze-drying and other frost processes), the need to prevent snow or ice accumulations on the tailings surface, potential for ice-lens development and thaw weakening of tailings, and challenges with compaction and trafficability during wet periods. The above issues will be exacerbated by the need to produce a consistent dewatered tailings product that satisfies performance requirements for a large tonnage, high production rate (of greater than 100,000 tonnes per day) operation anticipated for the Project. The dry stack facility, for the Project, would have to be constructed at an unprecedented production rate in a challenging climate. Dry stack operations in Alaska and Canada include the Greens Creek, Raglan and Pogo mines, which process filtered tailings at rates between approximately 1,500 and 2,500 tonnes per day, about 50 times smaller than anticipated to be required for the Project.

Due to the fact that the anticipated production rates for the Project would be in excess of what could be managed only by a dry stack facility, CMC considered a separate facility for subaqueous storage and confinement of potentially reactive waste rock and tailings together with a dry stack facility. This separate facility is also required for water management (including recovery to the mill) and contingency storage for those periods when the dry stack facility or dewatering plant is not operational (including when dewatered tailings placement is not possible due to adverse climatic conditions). The separate facility does not allow for development of a beach due to the reactive nature of the tailings.

An alternative approach to limit the effects of filtered tailings facilities on water quality is by encapsulating the reactive waste in the dry stack. This approach does not use a water cap to prevent oxidation of reactive materials. Instead it relies on low seepage rates through the filtered tailings to slow down transport of products resulting from chemical reactions in the waste (acidic drainage and soluble metals). It is imperative that seepage rates are kept to an absolute minimum using this approach. Seepage controls have been required at the dry stack facilities of La Coipa Mine in Chile, the Mineral Hill Mine in Montana and the Raglan Mine in Quebec. At Greens Creek Mine in Alaska, a continuous addition of organic carbon to the tailings is required to assure their long-term chemical stability in order to meet water quality requirements.

Preferred Tailings Disposal Method

In summary, the comparative evaluation indicated that the use of cyclone sand for embankment construction (with subaqueous disposal of all reactive waste material) is the preferred option for tailings disposal and provides the most efficient and cost effective design concept for the Project’s TMF. In addition, use of cyclone sand as embankment fill reduces the amount of solids that would be stored within the TMF. This allows for either additional storage capacity or a reduced embankment height. The development of a dry stack facility requires provision of a second facility to accommodate subaqueous disposal of all potentially reactive waste rock and tailings materials; making it less preferred.

A.4.2.1.2 R2

R2. Alternative dam construction methods to using cyclone sand.

A TMF embankment construction material alternatives analysis for the Project was completed in 2010 and is provided in Appendix A.4A Tailings Management Facility Construction Material Alternatives.

The evaluation of the potential embankment materials included consideration of the potential advantages and short-comings of each option relative to economic, environmental, design and operating factors. Local borrow material was considered as an alternative to cyclone sand as the primary construction material for the dam embankment. For both options, rockfill would be used to construct the shell zone of the starter dam and embankment construction to facilitate staged expansion of the TMF would be carried out using suitable rockfill sourced from local quarrying first, proceeded by cycloned sand.

The study determined that the primary advantage of utilizing borrowed material is potentially being able to construct year-round compared to only being able to construct approximately nine months of the year with cyclone sand.

The study determined that the disadvantages of utilizing borrowed material include:

- An increased quantity of tailings to be stored in the TMF;
- An embankment that is approximately 18 m higher and a larger impoundment footprint because of increased storage requirements;
- Increased cost of approximately $270 million; and
- Increased disturbance area.

The findings of the comparative assessment indicate that the use of cyclone sand for embankment construction is the preferred option and provides the most efficient and cost effective design concept for the Project's TMF.

A.4.2.2 Mine Access Route

A.4.2.2.1 R3

R3. All information and rationale used to justify the proposed road alignment over alternative alignments.

Casino Mining Corporation has evaluated multiple potential access road alignments for the Project and has undertaken numerous evaluations, studies and consultations to justify the selection of the Freegold Road over other potential alignments. The information presented in the Proposal is a summary of a compendium of information from efforts taken by CMC to evaluate the risk associated with each alternative alignment. The alternatives assessment framework is presented in Proposal Section 4.8.4.2.

Casino Mining Corporation believes that the information presented in the Proposal adequately meets the requirements of Yukon Environmental and Socio-economic Assessment Act (YESAA 2005) for an assessment of alternative means to the Project as the "various technically and economically feasible ways that the project could be implemented or carried out". A key reason for examining alternatives means to the Project is to ensure consideration of alternative ways of undertaking or operating it, that would avoid or minimize any significant adverse environmental or socio-economic effects. Since the beginning of the selection process for the access road alignment, CMC has explored alternative alignments to minimize potential adverse environmental and socio-economic effects and to maximize economics and technical feasibility. At the conclusion of the evaluation process, the Freegold Road was selected as CMC's preferred access road alignment.

Casino Mining Corporation is submitting additional information as a package containing Information on Alternative Access Road Alignments (Appendix A.4B). It is important to remember that the studies and evaluations that were carried out prior to selecting the Freegold Road, were completed for internal consideration and discussion within CMC; in no way do the studies and evaluations pre-judge the outcome of consultations with communities, First Nations and Yukon Government or the YESAB review that have led to the selection of the Freegold Road as the preferred access road alignment for the Project. In addition, prior studies may include access road alignments and variations of the seven alignments that were presented in the Proposal under different route names.

Table A.4.2-1 Additional Information on the Alternative Access Road Alignments

Information	Format, Date	Description
Project Transportation Scoping Study	Report prepared by Associate Engineering (AE), March 2008	A pre-feasibility study to examine transportation options to a deep-sea port. A review was done of five transportation modes and an analysis was undertaken of seven alternative routes for an all-weather road access to the Mine capable of operation throughout the year.
Yukon River Crossing and Minto Route Reconnaissance	Letter Report from Associated Engineering (AE), September 6, 2012	Findings from the Casino Mine Access route alternatives reconnaissance (August 9th, 2012). The objective of the trip was to investigate alternative corridors to the Casino Mine that avoid the Woodland Caribou wintering grounds in the Dawson Range.
Review of Access Road Alternatives	PowerPoint from CMC, November 22, 2012	CMC presentation to Yukon Government Department of Environment Fish and Wildlife Branch.

In March 2008, Associated Engineering (AE) completed a very preliminary study examining transportation options for the Project (Project Transportation Scoping Study, Appendix 4A.B Information on Alternative Access Road Alignments).

Associated Engineering examined seven alternative routes for an all-weather road access to the mine. The analysis included consideration of the ports of Skagway and Haines as seawater ports for the mine to receive imports. Their report also evaluated alternative modes of transportation include barge, pipeline, rail, air, and truck. It was concluded that trucking presents the most reliable means of transporting concentrate and supplies to and from the Project. The results of this study concluded that the port of Haines would likely provide the most advantageous port and the recommended trucking route was Onion Creek which would be the most economic alignment in terms of haul distance, road construction costs and terrain traveled. The Onion Creek route was used in the Casino Project's Pre-Feasibility Study in 2008 as the access road.

Upon further review, CMC determined that the port at Skagway offers the advantage of developing a dedicated terminal and space for receiving and storage of concentrates. The Port of Skagway is discussed further is the response to R29.

After the selection of the port of Skagway, the Freegold Road was selected as the preferred access road alignment for the Pre-Feasibility Study Update of the Casino Project. The Freegold Road was selected because it minimizes new disturbances and follows an already impacted corridor (the Casino Trail) along a metal-rich belt. A trucking route using the Freegold Road and the Klondike Highway would provide the most economic alignment in terms of haul distance, road construction costs and terrain traveled. In addition, the Casino Trail has a long history of engineering and baseline studies with planning dating back 45 years. For example, Casino Trail baseline studies completed include:

- Socio-economic impact review (1988);
- Terrain Analysis (1986);
- Moose population inventory (1987);
- Raptor nest survey (1988); and
- Caribou inventory (1991).

At that time, CMC recognized that the Freegold Road had the potential to open new access to wilderness areas and the potential to affect the Klaza caribou herd winter habitat. Therefore, consultations and additional investigations were carried out by CMC to explore alternative alignments to avoid potential impacts to the Klaza caribou herd.

In August 2012, in an effort by CMC to consider alternative access road alignments to the Freegold Road Extension to avoid Woodland Caribou wintering range in the Dawson Range, a reconnaissance of the area was undertaken (Yukon River Crossing and Minto Route Reconnaissance, Appendix A4.B Information on Alternative Access Road Alignments). The alternative corridor investigations included the following three elements:

- Yukon River Bridge - Yukon River crossing locations and connecting roads near Minto, YT.
- The Minto Route Corridors - east-west route from Yukon River near Minto west to Hayes Creek.
- The Wolverine Route Corridor - Big Creek north to Wolverine Creek and west to Hayes Creek.

The reconnaissance concluded that a feasible route, from an engineering perspective, from Minto to Hayes Creek could be located though additional detailed mapping and was required to identify a preferred route option, confirm the alignment, and estimate the cost and to better understand the potential environmental, socio-economic and geotechnical issues in the area. After further consultation with First Nations, the company decided not to pursue further this route option.

In November 2012, CMC shared with Yukon Government Department of Environment Fish and Wildlife Branch and First Nations an overview of the access road alternatives considered for the Project. This PowerPoint presentation is attached as part of the Information on Alternative Access Road Alignments (Appendix A4.B). The materials contained in this presentation were used extensively in a range of presentations and meetings with First Nations governments, Renewable Resource Councils and community meetings.

Additional investigations were carried out by Associated Engineering for the Freegold Road alignment to provide a detailed overview of the Project's access road to support the Project Proposal (Appendix 4B Freegold Road Report). The scope the work included both the Freegold Road Extension and Freegold Road Upgrade.

On January 3, 2014, the Proposal submitted to YESAB presented seven access road alignments/concepts that were considered by CMC since 2008. These routes are shown on Figure 4.8-1 and described in Table 4.8-7 of the Proposal. The primary reasons for screening out four of the seven access road alignments from further evaluation was presented in Table.4.8-7 of the Proposal, which has been reproduced in Table A.4.2-2 with additional rationale and supporting information to justify why they were not selected or carried forward for additional consideration. The four evaluation criteria used in the selection process included:

- <u>Economic viability</u>, which explores if the Project is able to sustain operation on the basis of current and projected revenues versus current and planned expenditures;

- Technical feasibility, which considers applicability, system integrity and reliability as appropriate to the issue, to describe the suitability or expected technical performance of a given alternative;
- Socio-economic acceptability, which evaluates if the Project will cause positive or negative socio-economic effects; and
- Environmental acceptability, which considers the overall environmental effects of the Project, ability to mitigate effects and amenability to reclamation.

Table A.4.2-2 Preliminary Access Route Concepts (Expanded from Table 4.8-7 of the Proposal)

Route Concept	Rationale Provided in the Proposal	Additional Rationale and Supporting Information
Aishihik Road: Casino Mine Site via Onion Creek to Alaska Highway to Aishihik Road Intersection	This route would follow the same alignment as Onion Creek from the mine site and east of the wetland to a crossing of the Nisling River close to Onion Creek. It would then follow the south slopes of the Nisling River Valley, before turning south to follow along the existing, summer-only Aishihik Lake Road to the Alaska Highway. This route was excluded from further consideration due to potential challenges with permitting because it follows the Nisling River area which is known wildlife habitat.	This route was considered a high risk option because: • Crosses areas of potentially significant and active First Nations traditional use • Multiple fish species habitat at the north end of Aishihik Lake, including Nisling River salmon • Crosses Aishihik caribou range • In proximity to approximately 20 settlement land selections and passes four First Nations traditional territories • Crosses Osprey nesting areas • Additional impact on Wood Bison core range • Crosses waterfowl and sharp-tailed Grouse nesting habitats • Salmon suitability in Aishihik drainage is unknown • Affects eleven trapping concessions and one group concession, in mostly undeveloped areas • Adjacent to additional outfitter camp
East Route: New Mine Access to Nisling River to East Route	This route would follow the same alignment as Onion Creek from the mine site and east of the wetland to a crossing of the Nisling River close to Onion Creek. It would then follow the south slopes of the Nisling River Valley, before turning south to follow along the existing Aishihik Lake Road to the Alaska Highway. This route was excluded from further consideration due to potential challenges with permitting. The Nisling River area supports a healthy population of wood bison. There is also evidence of sheep and moose in the area. Up-grading the existing Aishihik Road would require agreements from the Champagne and Aishihik First Nation.	This route was considered a high risk option because : • One of the longest sections of new access of all options • Crosses First Nations settlement land selections • Crosses five First Nations traditional territories • Significant interactions with moose winter range • Crosses Bald Eagle nesting area • Crosses winter ranges of caribou (Klaza, Kluane and Aishihik) herds • Crosses core area within Bison Management Area (although Bison is abundant) north of Aishihik Lake • Crosses three salmon bearing streams, good fish habitat (Klotassin, Nisling and Nordenskiold rivers, and Rowlinson Creek) and wetland crossing • Crosses twelve trap-line concessions and two outfitter concessions • Adjacent to a trapping at Tyrell Creek and forestry reserves • Crosses grazing lease • In proximity to one outfitter camp

Route Concept	Rationale Provided in the Proposal	Additional Rationale and Supporting Information
Klaza River: Mine Access to Nisling River to Klaza River Route	This route is similar to the East Route but instead of following the Nisling River east to Nansen Mine Road it would follow the more mountainous route of Klaza Creek. The purpose of pursuing this route was to avoid the wetland of the Nisling River. Even though it would be a slightly shorter section of new road than the East Route, it is likely to be too costly to build and to operate and was excluded from further consideration. As well, it follows known wildlife habitat and has potential challenges with permitting.	This route was considered a high risk option because: • Crosses through fall range and into core area of winter range of Klaza and Aishihik caribou herds • Crosses important winter habitat for thinhorn sheep • On the northern edge of the Bison Management Area (though bison are abundant) • Crossing of high suitability salmon habitat river and salmon bearing streams including Klotassin, Nisling and Klaza rivers • Increased interaction with place and quartz mining exploration activities • Crosses four First Nations traditional territories and the settlement land selections of four First Nations • Crosses eight trapping concessions
Yukon River: Mine Access to Battle Creek to Yukon River Route	This is an extension of the Minto Route, instead of crossing the Yukon River at Minto, the road would connect with the Klondike Highway at Carmacks. This route was excluded from further consideration because objections can be expected from wildlife, tourist and sport-fishing interest groups due to its proximity to the Yukon River.	This route was considered to be a medium risk option because: • Adjacent to First Nations Settlement Lands • Within one First Nations traditional territory • Northern edge of Caribou winter range and Gray falcon nesting area • Crosses two First Nations settlement land selections • Crosses three high suitability salmon habitat streams and good salmon habitat • High level of mineral claim activity resulting in increased interactions with other mine exploration activities • Route crosses trap-lines and two outfitter concessions

The selection process for potential access road alignments for evaluation is complex and based on CMC's overall understanding of the potential risks associated with each option. The risks of each alignment were evaluated and weighed carefully by CMC and their technical consultants and the selection process was informed by consultations between CMC and Yukon Government, First Nations and local community. Casino Mining Corporation has selected the preferred access road alignment (the Freegold Road Upgrade and Freegold Road Extension) that balances technical, environmental, social and economic costs and benefits.

A.4.3 OVERSIGHT OF DESIGN, CONSTRUCTION, OPERATION, AND CLOSURE

A.4.3.1 R4

R4. Identify whether broad-based stakeholder risk assessment processes, such as failure modes and effects analysis, will be completed and/or whether external expert review panels will be used as internal quality controls to guide the project.

Casino Mining Corporation will voluntarily establish an Independent Geotechnical Review Panel (IGRP) for the Casino Project to review and consider the Project's TMF and Heap Leach Facility (HLF) with a focus on their structural stability and integrity. The IGRP will provide independent, expert oversight, opinion and advice to CMC on the design, construction, operational management and ultimate closure of the TMF and HLF. The IGRP will have unimpeded access to all technical data necessary to enable them to assess CMC's TMF and HLF on an ongoing basis to ensure that these structures meet internationally accepted standards and practices which effectively minimize risks to employees, lands and communities.

Should the IGRP recommend it, CMC may undertake failure modes and effects analysis for select components of the Project. The inundation study to be completed by CMC (see the response to R81) will include an evaluation of credible modes of failure of the TMF embankment.

A.4.3.2 R5

R5. Identify if and how independent regulatory audits will be conducted.

Casino Mining Corporation has interpreted R5 as a request for information on existing government (or regulatory) inspections that will be conducted as part of the conditions of the Quartz Mining License (QML) for the Project.

Casino Mining Corporation's understands that all mineral exploration and development in Yukon are subject to regular, periodic inspections by designated inspectors with the Department of Energy, Mines and Resources Compliance Monitoring and Inspections branch. These inspections include review of physical works and records to determine compliance with Operating Conditions of the QML and require program activities to fall within the established thresholds of its class. Tailings dams, such as the Casino TMF, require an annual geotechnical inspection and periodic dam safety reviews (every five years depending on the consequences of failure and changes in the dam or surroundings), at a minimum.

If during an inspection a Natural Resource Officer (NRO) believes that the operator has contravened or is about to contravene the Operating Conditions of the QML, or is causing unnecessary danger to people, property or the environment, the NRO will instruct the operator in writing to rectify the situation or to cease the activity and define a timeline for action. Based on compliance with these instructions, the operation may be permitted to continue operating or with the consent of the Chief of Mining Land Use, the NRO may take the appropriate measures to comply with the instruction, at the operator's expense. In the event that a person contravenes the *Quartz Mining Act* and/or the *Quartz Mining Land Use Regulation*, upon summary conviction, the person would become liable for a fine as defined in Sections 150, 151 and 152 of the *Quartz Mining Act*.

Similarly, quartz mineral exploration and development in the Yukon are subject to regular, periodic inspections by designated inspectors appointed by the Minister under the *Water Act*. These inspections include review of physical works and records to determine compliance with Sections 6(1) or 7(1) of the *Water Act*. If during an inspection the inspector identifies non-compliance with Sections 6(1) or 7(1), or circumstances causing unnecessary danger to people, property or the environment, the inspector has the authority to cease work, prevent use, prevent deposit, or issue instructions to counteract, mitigate, or remedy the adverse effects. Based on the future compliance with the inspector's instructions, the operation may be permitted to continue operating. In the event that a person contravenes the *Water Act* upon summary conviction, the person would become liable for a fine as defined in Sections 38(2), and/or 38(3).

A.4.3.3 R6

R6. Describe how best practices, in relation to oversight, will be applied to the Project given the scale and nature of challenges associated with the proposed activities and site.

In addition to the regulatory inspections described in the response to R5, construction and material quality control and quality assurance procedures will be carried out by qualified professionals on behalf of CMC during the various Project phases.

Casino Mining Corporation will establish Quality Assurance/Quality Control (QA/QC) procedures to maintain an effective quality control program for the Project prior to commencement and during execution of the all works. This program will form the means of ensuring compliance with the design requirements, drawings and specifications and for maintaining records of control, including tests and inspections, their findings, and the remedial actions taken when necessary. Frequency, duration and type of testing will be consistent with applicable codes maintained under the Canadian Standards Association.

The QA/QC procedures will include sampling of construction materials and tests considered necessary to ascertain that the materials being placed meet the material requirements and specifications. The results of the tests carried out will determine whether the materials are in compliance with the specifications and drawings.

The QA/QC program will carry out continuous inspections of construction methodologies and material quality testing through the construction of the works. As well, a Professional Engineer representing CMC will carry out periodic independent inspection and testing throughout the construction of the works. For quality assurance the Professional Engineer representing CMC will approve QA/QC testing results prior to proceeding with works. The QA/QC testing results will be recorded and available for inspection on site by regulatory inspectors.

During the operations phase, monitoring and inspections of the TMF instrumentation, such as piezometers, inclinometers and survey monuments is usually required at least monthly. These records are maintained onsite and are available for review by regulatory inspectors.

For environmental and socio-economic considerations, a qualified representative for CMC will conduct regular monitoring of water quality and quantity, air quality and fugitive dust deposition, metal leaching/acid rock drainage/ (ML/ARD), meteorology, aquatics, permafrost, wildlife, and reclamation as specified in applicable Acts and Licenses. During the construction phase the qualified representative is generally a third party monitor, who is replaced by a company employee during the operations phase. Monitoring locations, frequencies, and durations of these programs will comply with the requirements of applicable Acts and Licenses. The results of the monitoring programs will be reported to the regulatory agencies as specified in the applicable Acts and Licenses.

A.4.4 CONSTRUCTION

A.4.4.1 R7

R7. A description of all other staging and preparation activities. For example, equipment, fuel, and material staging for the upgrade to the Freegold Road and construction of the Freegold Road Extension.

It is seen as important that the Carmacks By-pass is completed early in the construction process. Construction of the Carmacks By-Pass and upgrades to the Freegold Road are expected to be supported from the Highways and Public Works yard and staging area near Carmacks as the Freegold Road Upgrade portion is a public road, and development of this section of the access road is expected to fall under the purview of the Yukon Government.

Casino Mining Corporation will also stage some of its shipments of equipment, materials and supplies at a facility in Carmacks close to the junction of the Klondike Highway and the Carmacks By-pass. The main staging area for the construction of the Freegold Road Extension will be the camp described in the AE report at the end of the Freegold Road (Appendix 4B Freegold Road Report). This will serve as a staging area for all supplies and equipment for the westward construction of the access road. In addition a secondary staging area for bridges and bridge components may be used at the end of the present Casino Trail. This would allow bridge erection to proceed on two fronts in a westerly direction. As road construction progresses subsidiary staging areas will be utilized along the route.

The details of the proposed work on the Freegold Road Upgrade and Freegold Road Extension portions of the access road are provided in the Associated Engineering Casino Project Access Overview for Submission to YESAB report provided in Appendix 4B. A preliminary schedule for access road construction is provided in Figure A.4.4-1.

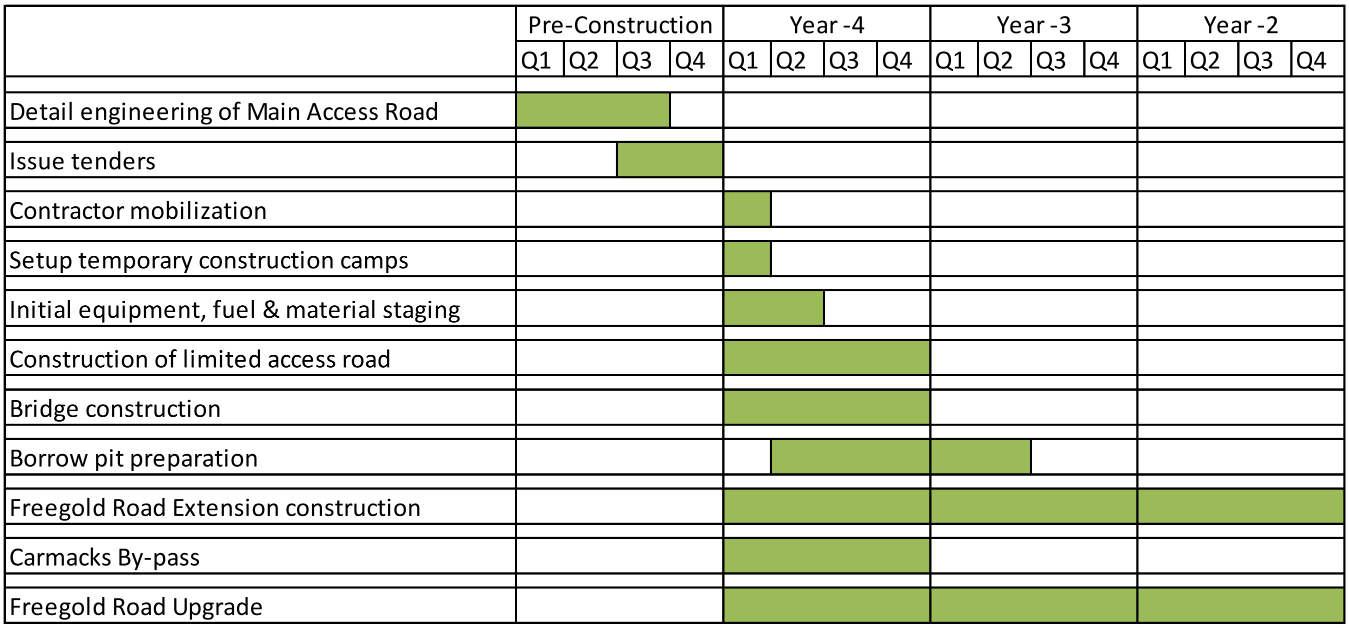


Figure A.4.4-1 Freegold Road Upgrade and Freegold Road Extension Construction Schedule

A.4.4.2 R8

R8. Describe the interdependency of and critical path for staging and construction activities.

The key to achieving the construction schedule objectives is being able to mobilized materials, supplies and equipment to locations required, i.e. to the start of the Freegold Road Extension for road construction in a westerly direction and also to site for mine facilities construction and Freegold Road Upgrade construction in an easterly direction.

Getting material to the start of the Freegold Road Extension is a relatively simple task as the existing Freegold Road is serviceable for the relatively small volumes of traffic that would entail. Getting materials to site for the first year's construction activities will require a substantial mobilization of goods along a winter road starting at the end of the existing Freegold Road prior to the start of the year's construction activities.

During the first year of construction for the Freegold Road Extension, the main objective will be to complete a single lane "tote" road along the full length of the alignment. This road will not necessarily be to full elevation and the surfacing will be uneven and rough in places. In order to enable the tote road to be successfully constructed in the first year it will be critical that all bridges are pre-ordered and available to the contractor to sequentially install them. To further facilitate rapid advance of the road, CMC has elected to use short span bridges on all fish bearing stream crossings. This will allow crossing of the streams without any in-stream work that would be restricted to certain time periods. In some cases temporary bridges may be required to enable construction to progress smoothly.

By the start of the second year, year-round access to the site will be available on the tote road. The access will be slow due to the partially constructed nature of the road, however, it will be sufficient to enable the relatively small number of vehicles to access the site with construction requirements and supplies. It is hoped by this time that the construction of the Carmacks By-pass and the Nordenskiold Bridge will be complete.

Completion of all stages of the access road to the mine site is planned for the end of the third year allowing full year round unrestricted access.

A.4.4.3 R9

R9. Details regarding planned barging activity, including frequency, temporal periods, and types of freight anticipated by barge. Additionally, please describe any ancillary activities associated with barging, such as landing sites and access road.

Significant barging along the Yukon River is not proposed for the Project. Barging was initially considered, and the footnote in the table in Appendix H of the *Access Overview for Submission to YESAB* (Appendix 4B Freegold Road Report) was a relic of previous iterations of the road route planning process. The table in question has been updated and is now Table A.4.4-1.

Table A.4.4-1 Casino Traffic Projections during Construction Phase (update to Appendix H of Appendix 4B Freegold Road Report)

		Distribution of Truckloads by Year			
		Year -4	**Year -3**	**Year -2[1.]**	**Year -1**
Mine Construction	Casino Project Inland Freight	50	1500	2500	950
	Casino Mining Equipment[2.]	20	54	12	12
	Construction Equipment to site[3.]	130	100	200	200
	Camp	20	40		
	Supplies	525	1200	1800	1800
Freegold Road Upgrade and Extension Construction	Fuel	100	720	550	320
	Mobilization/Demobilization of Equipment	180			180
	Construction Camps	40			40
	Bridges	110			
	Culverts & Geotextile	100	34	15	15
	Total "Heavy" Traffic	1275	3648	5077	3517
	Avg/Day "Heavy"	**3**	**10**	**14**	**10**
	Light Vehicles[4.]	200	3000	5000	6000
	All Vehicles Types[5.]	1475	6648	10077	9517
	Avg/Day "All Types"[6.]	**4**	**18**	**28**	**26**

Notes

1. Heap Leach in operation.
2. Assumes 3 truckloads/piece of mining equipment
3. Assumes 2 truckloads per piece of construction equipment
4. Light vehicles include: autos, light trucks up to 10 ton capacity
5. Construction equipment, camp and supplies along road are excluded
6. Peak traffic may approach 200 – 250% of average values for limited durations

A.4.5 FEASIBILITY OF THE SULPHIDES REMOVAL PROCESS

A.4.5.1 R10

R10. Please provide the reports that show results of metallurgical testing and sulphur removal performance from 2009 and 2010 bench tests, as well as the 2012 pilot test by G&T.

The requested metallurgical reports associated with the KM2459, KM2721 and KM3512 metallurgical studies are provided in Scoping Level Assessment of Casino Property (Appendix A4.N), Advanced Metallurgical Assessment of the Casino Copper Gold Project (Appendix A4.O) and Production of Environmental Tailings Samples for the Casino Deposit (Appendix A.4P). Pilot test runs conducted in 2012 indicate that the pyrite rougher tails derived from hypogene rock on average maintain total Sulphur (S) content < 0.2 %S. Most notably the lock cycle testing indicates that the pyrite removal circuits, when finely tuned, is very effective at removing sulphur to levels <0.1 %S. These results, along with the neutralizing potential assays of the materials in question, confirm that sulphur removal by the designed pyrite flotation circuit is an effective method of producing non-Potentially Acid Generating (non-PAG) tailings.

A.4.5.2 R11

R11. Please provide additional information to support the feasibility of the sulphide removal process. Details should include:

- **a. detailed description of the sulphide removal process;**
- **b. how the process will account for variations in the mineral composition of processed ore and the large tonnage of tailings; and**
- **c. QA/QC for tailings classification including a detailed schedule for testing.**

The sulphide minerals are removed from the ground ore through a flotation process. The flow sheet by which this is performed can be found in the ALS metallurgy report KM3512 on page 12 of Advanced Metallurgical Assessment of the Casino Copper Gold Project (Appendix A.4O). Additional flow sheets are provided in Appendix A.4M for all processing activities (from M3 2013).

Through several different composites from the Casino ore body, the ability of the flotation process to reduce the sulfur content to achieve a CaNP/AP > 2.0 was obtained.

It is expected that the tailings will be assayed by on-stream analyzers on a continuous basis and this will checked against periodic assays taken and analyzed by more conventional means.

A.4.5.3 R12

R12. Please provide additional information on the NAG tailings, or cyclone sand, produced through the sulphide removal process. Details should include:

- **a. data to show that the sulphide removal will be effective for all ore types;**
- **b. sulphide levels required to produce non-acid generating cyclone sand and tailings;**
- **c. residual sulphide concentrations;**
- **d. how the sulphide removal process will be managed and how the cyclone sand will be monitored and tested during operation to ensure that the required performance limits are consistently achieved; and**
- **e. any remedial measures that may be required should the sulphide removal process be shown to be ineffective.**

Part a.

Additional metallurgical reports have been provided to YESAB for review as Appendix A4.N (Scoping Level Assessment of Casino Property), Appendix A4.O (Advanced Metallurgical Assessment of the Casino Copper Gold Project) and Appendix A.4P (Production of Environmental Tailings Samples for the Casino Deposit).

Lock cycle metallurgical testing has indicated that a pyrite flotation circuit can reduce total S content in tailings to < 0.10 %S (Appendix A.4N Scoping Level Assessment of Casino Property) from predominately supergene ore.

Sulphur has also been shown to be effectively removed by a pyrite circuit during the pilot test (KM3512 - December 2012) for both hypogene and supergene ore as tabulated in Table A.4.5-1.

Table A.4.5-1 KM3512 2012 Pilot Pyrite Rougher Tailing Total Sulphur Content (%S)

Time Interval	KM3512-P1 HYP PP Composite	KM3512-P2 HYP PP Composite	KM3512-P3 HYP PP Composite	KM3512-P4 SUS PP Composite	KM3512-P5 SUS PP Composite
1	0.15	0.15	0.26	0.14	0.26
2		0.19	0.18	0.19	0.26
3		0.2	0.2	0.28	0.22
4		0.26	0.13	0.37	0.18
5		0.15	0.26	0.14	0.26
6		0.19	0.18	0.19	0.26
7		0.21	0.15	0.28	0.22
8		0.26	0.13	0.36	0.18
Average (%S)	0.15	0.20	0.19	0.24	0.23
Required NP (kg$CaCO_3$/t)	9	13	12	15	14

Part b.

The amount of NP in the tailings is dependent on the amount of NP in the ore feed. Based on the range of Neutralization Potential (NP) observed in the Casino Hypogene ore, Sulphur (S) content ranging from 0.15 %S and 1.39 %S is required to maintain a Neutralization Potential/Acid Production Potential (NP/AP) > 2.0. A CaNP/AP criterion of 2.0 is very conservative and a CaNP/AP = 1.5 is likely more appropriate for the low-sulphur desulphurized tailings as shown by the low sulphide oxidation rates in the tailings kinetic tests and liberation of carbonate minerals in the finely ground tailings. The sulphur content required to achieve the CaNP/AP > 2.0 criterion for the various ore types are listed in Table A.4.5-2. The table indicates that non-PAG tailings with S content within the range obtained from lock cycle testing and pilot tests can be routinely derived from Hypogene ore. However, only a portion of the Supergene ore could be used to derive non-PAG tailings. Based on the current inventory of Supergene ore samples, it is estimated that 25% of the processed Supergene would produce non-PAG pyrite rougher tailings.

Table A.4.5-2 Sulphide Sulphur Requirements to Maintain CaNP/AP > 2.0 Based on Ore Feed Carbonate Content

CaNP	SOX		SUS		HYP	
Percentile	CaNP	%S	CaNP	%S	CaNP	%S
90th	16	0.34	27	0.58	65	1.39
75th	6	0.13	12.5	0.27	51	1.09
Med	2	0.04	3	0.06	27	0.58
10th	0.4	0.01	0.5	0.01	7	0.15

Part c.

Residual sulphide concentrations can be found in the additional metallurgical reports that have been provided in the SIR as Scoping Level Assessment of Casino Property (Appendix A4.N), Advanced Metallurgical Assessment of the Casino Copper Gold Project (Appendix A4.O) and Production of Environmental Tailings Samples for the Casino Deposit (Appendix A.4P).

Part d.

Operational monitoring will be conducted to confirm the non-PAG characteristic of hypogene tailings used for the construction of the embankment or the final tailings cover that will be placed on the upper surface of the TMF. Should Supergene ore be required for embankment construction or non-PAG tailings, operational monitoring of blast holes will be required to ensure that the ore will contain adequate neutralization potential to produce non-PAG tailings. A more detailed account of the operational procedure is provided in the ML/ARD Management Plan (Appendix A22.H of the SIR).

Part e.

It is not expected that the sulphide removal process will be ineffective, but if it determined to be so, optimization of the sulfide removal process by additional metallurgical testing examining different reagents, grinding, etc. could be carried out to improve the removal process.

A.4.6 ROADS, SUPPLY ROUTES AND TRANSPORTATION

A.4.6.1 Freegold Road Extension and Upgrade

A.4.6.1.1 R13

R13. Detailed description of the temporary construction camp including:

a. layout of infrastructure such as camp facilities, generators, sewage disposal system, fuel storage, and generators;

b. proximity to surface water;

c. human-wildlife conflict prevention; and

d. fuel storage requirements and capacity of diesel generators.

As described in the Access Overview for Submission to YESAB report (Appendix 4B), two construction camps will be required to support the construction of the access road and mine facilities: a nominal 1000-man capacity construction camp at the mine site (Figure A.4.6-1) and a temporary nominal 84 man construction camp near the end of the existing Freegold Road just before Big Creek (Figure A.4.6-2), as described below.

Mine Site Construction Camp

A nominal 1000-man capacity camp will be built in stages to support construction of the mine. The camp will be located on a ridge top approximately 2 km to the east of the mine site (Figure A.4.6-1). This mine construction camp will be utilised to support the construction of the access roads and airstrip. The access construction personnel will share the communal camp facilities with the larger mine construction operation. Erection of the construction camp will be proceed in two phases. The first phase will be the relocation of the existing camp from its present location at the new mill plant site and the construction of the new pioneer camp, which will include three Worker’s dorms, one Supervisor’s dorm, and a kitchen/diner/recreation unit for approximately 264 personnel. The second phase will begin the following construction season with further site preparation and construction of the foundations. The second phase will expand the construction camp by approximately 684 personnel for a total of approximately 948 personnel. It will include seven additional Worker’s dorms, one additional Supervisor’s dorm, and two new Executive dorms. It will also include additional kitchen/dining facilities, and recreation facilities.

Power for the camp will also be installed in phases with the ultimate capacity being approx. 20 MW supplied by dual-fuel generators (i.e., the supplementary power plant to be installed during construction). The primary fuel for the generators will be LNG (diesel during the construction phase) which will be stored in a number of appropriately sized bullet tanks. Potable water will be obtained from a well and treated using a package treatment plant. Dedicated fire and potable water tanks will be used at the camp to store water. A packaged waste water treatment plant will be used to treat effluent from the camp.

Freegold Road Extension Camp

A temporary construction camp will also be required near the end of the existing Freegold Road. The proposed camp location is an open, flat, valley section near the first crossing of Big Creek (Figure A.4.6-2). Some clearing has already been completed at this site for previous access roads and mining activities. This camp will support construction of the new Freegold Road extension towards the mine and construction of upgrades on the existing Freegold Road towards Carmacks. This temporary construction camp will be provided and maintained by the contractor hired to complete the work, therefore sizes and facility descriptions provided below are approximate and will ultimately depend on the selected contractor's available resources.

The camp will consist of prefabricated modular trailer units with capacity to accommodate and support up to approximately 84 people, with a total footprint of approximately 6 Ha. The camp will include bunk houses, kitchen, dining area, recreation space, office space, washrooms, and showers. Other camp infrastructure to support of personnel will include diesel generators (likely with a total installed capacity of about 500 kW) for power, propane for heating and cooking, water supply including a small packaged treatment system, solid waste disposal, and an approved septic tank/field or small packaged sewage treatment system. Solid waste will be incinerated or hauled off site for recycling or disposal.

A laydown area will be provided for storage of construction materials and equipment. Parking will be provided for pickups and other vehicles. This area will also be used for the servicing of construction vehicles and heavy equipment.

Fuel storage will support two weeks of construction plus operation of the power generators. Based on this requirement the total tank capacity would be around 100 m^3 for diesel plus another 10 m^3 for gasoline. The contractor may elect to use different tank sizes based on the security of fuel supplies. The fuel storage will comply with the *Yukon Fuel Storage Regulations* for appropriately sized containment.

Freegold Road Upgrade Camp

It is expected that the construction of the Carmacks by-pass, Nordenskjold Bridge and Freegold Road upgrade will be executed from the YG works yard in Carmacks, however this work will be under the control of YG. Workers could be housed locally or specific worker accommodation could be setup.

Waste Management

All camps will comply with the wildlife minimization techniques outlined in the Waste and Hazardous Materials Management Plan (Appendix A.22A) and the Wildlife Mitigation and Monitoring Plan (Appendix A.12A), including:

- Storing and incinerating garbage in an enclosed area surrounded by electric fencing. The gate will remain closed at all times.
- Installing a stack scrubber in all kitchen vents to reduce food odour during cooking.
- Storing all food and waste inside buildings or within an enclosed, bear proof area, unless field crews are working remotely. Field crew lunches will be sealed in airtight containers and all garbage will be pack out and properly disposed of.
- Burning all food and kitchen waste in an incinerator.
- Adding lime and dirt to latrines on a regular basis to reduce odour.

- Storing all fuel in airtight containers in areas inaccessible to bears (i.e., fuel shed or fenced enclosure).
- Training all workers in wildlife management protocols, including garbage management, bear encounter protocols

The temporary construction camps will comply with, and acquire permits for, as necessary, all Yukon and Federal Acts and regulations as they apply to the construction and operation of camp facilities, including those summarized in Table A.4.6-1.

KEY PLAN
SCALE: N.T.S.

WORKFORCE HOUSING LAYOUT
SCALE: 1 : 1000 CONSTRUCTION/PERMANENT

20000 0 20000 40000
1:1,000
DO NOT SCALE 11x17 DRAWINGS

REFERENCES		REFERENCES		REVISIONS						REVISIONS					
DWG. NO.	TITLE	DWG. NO.	TITLE	NO.	DESCRIPTION	BY	APP'D	DATE	CLIENT	NO.	DESCRIPTION	BY	APP'D	DATE	CLIENT
960-GA-000	PHASED LAYOUTS														
960-GA-001	WORKFORCE HOUSING LAYOUT														

		DATE
SCALE:	1:1000	
DESIGNED BY	TFB	APR 12
DRAWN BY	TFB	APR 12
CHECKED BY		
PROJECT MGR		
CLIENT APPR.		

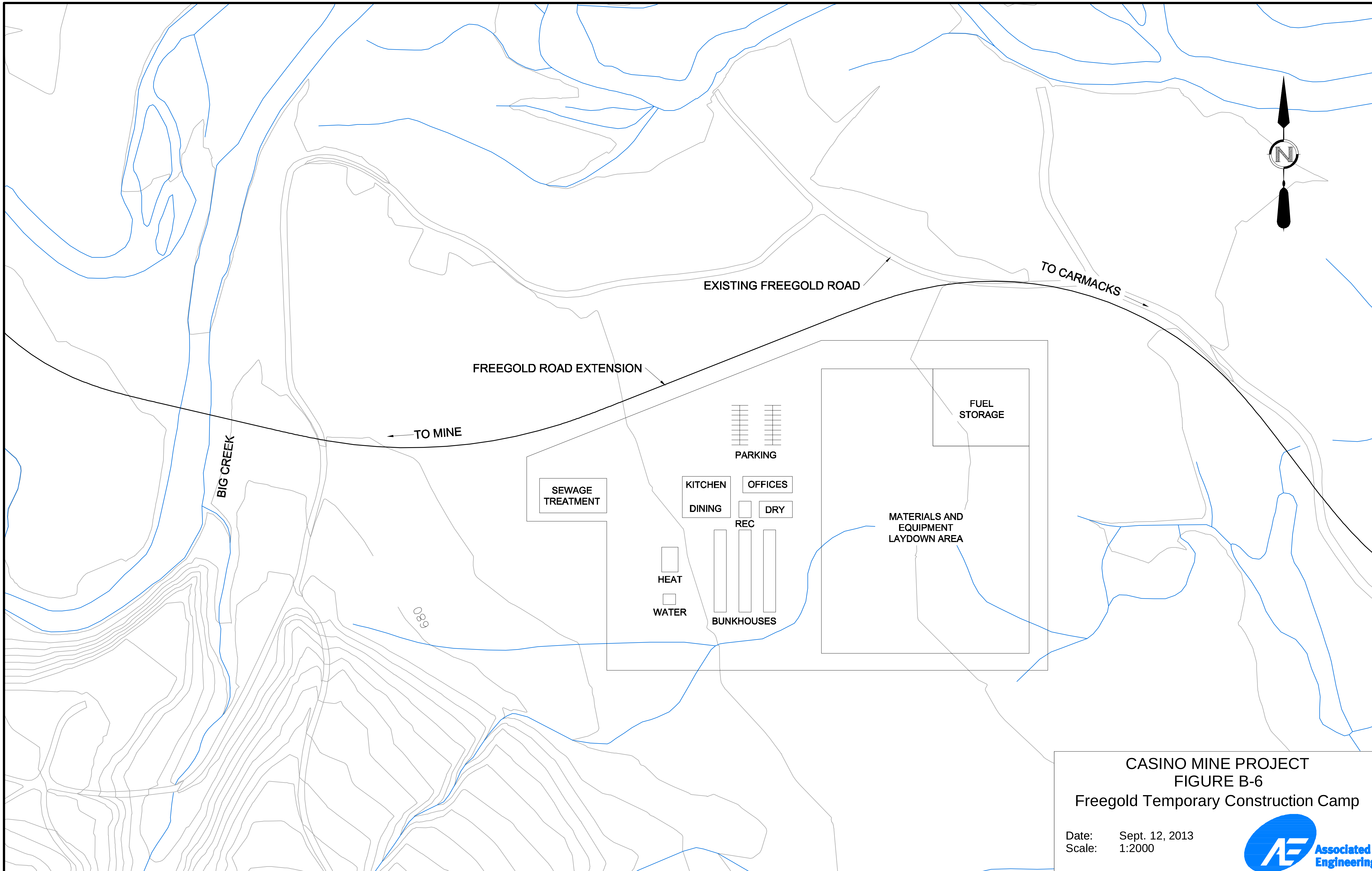
m3
ARCHITECTURE
ENGINEERING
CONSTRUCTION MANAGEMENT
Tucson, Arizona
Chandler, Arizona
Hermosillo, Sonora Mexico
www. m3eng.com

CASINO MINING CORPORATION

CASINO FEASIBILITY STUDY

CASINO PROJECT
OVERALL SITE
GENERAL ARRANGEMENT
WORKFORCE HOUSING LAYOUT

PROJECT NO. M3-PN 120001
DWG NO.
000-GA-004
REV NO. P4
DATE 28 JAN 13



CASINO MINE PROJECT
FIGURE B-6
Freegold Temporary Construction Camp

Date: Sept. 12, 2013
Scale: 1:2000

Associated Engineering

Table A.4.6-1 Required Permits for Construction and Operation of Temporary Construction Camps

<table>
<tr><th colspan="2">Legislation</th><th>Permit/License</th><th>Requirement</th><th>Government Agency</th></tr>
<tr><td colspan="2">Building Standards Act</td><td>Building Permit</td><td>Occupancy permit for construction of buildings outside of a municipality</td><td>Community Services, Building Safety</td></tr>
<tr><td rowspan="4">Environment Act Consolidated Permit</td><td>Environment Act, Air Emissions Regulation</td><td>Air Emissions Permit</td><td>Release of air pollutants</td><td rowspan="2">Yukon Environment, Environmental Programs</td></tr>
<tr><td>Environment Act, Special Waste Regulation</td><td>Special Waste Permit</td><td>Handling, disposal, generation or storage of special (hazardous) wastes</td></tr>
<tr><td rowspan="2">Environment Act, Storage Tank Regulation</td><td>Storage Tanks Systems Permit</td><td>Storage and handling of petroleum products</td><td rowspan="2">Community Services, Protective Services, Fire Marshal’s Office</td></tr>
<tr><td>Application for Operation, Closure, Abandonment or Renovations to Storage Tanks</td><td>Use of storage tanks containing petroleum and allied petroleum products</td></tr>
<tr><td colspan="2">Public Health and Safety Act</td><td>Permit to Install a Sewage Disposal System</td><td>Installation and operation of construction phase septic tanks and sewage holding tanks</td><td>Yukon Health and Social Services</td></tr>
<tr><td colspan="2">Waters Act</td><td>Notice to Use Water Without a License or Type “B” water license if more than 300 cubic metres per day is required</td><td>Water use</td><td>Yukon Water Board</td></tr>
</table>

A.4.6.1.2 R14

R14. Detailed description of activities required for construction of camp including:
a. site preparation such as clearing, grubbing, and disposal of materials;
b. construction material volumes and sources (e.g. granular material requirements); and
c. anticipated timing and duration of the proposed activities.

Site preparation for the Freegold Road Extension camp will be kept to a minimum as the facilities are temporary and designed to be easily transported, erected and dismantled.

As described above, the construction camp will require a footprint of approximately 6 Ha. Camp preparation will consist of clearing trees and brush from the area but little or no grubbing is expected to be necessary. Cleared material will be disposed of by burning.

Where buried utilities are required utilities will be run in utilidors wherever possible The general area will be filled using native material and graded to promote the drainage of water and prevent inundation during periods of high runoff (e.g. during freshet). Drainage channels may be constructed to divert water. Imported granular fill will be used in areas of traffic to provide a suitable driving surface for construction vehicles and heavy equipment.

Wherever possible the fill material will be native unprocessed material from a local borrow pit. A borrow source located an approximate chainage 0+000 of the Freegold Road will be the likely source of the materials (drawing 20092374-00-1-101 in Appendix 4B). Fill requirements of approximately 50,000 m^3 are anticipated.

The timing and duration of these activities is somewhat difficult to predict exactly. Schedules elsewhere in the Project Proposal show the work commencing at the start of Year -4. However this is really a reference with respect to the start-up of the process facilities. The actual start dates will depend on the issue of permits and construction contracts. Some adjustments may need to be made to accommodate weather conditions; mobilizing equipment and facilities in winter months provides a solid ground on which to transport goods but performing earthworks at this time of year would not be practical. Establishment of a camp such as this should take no longer than a couple of weeks under ideal conditions; it may be more of a progressive exercise depending on the weather conditions.

Following the completion of access construction activities, the camp will be decommissioned in accordance with an approved Land Use Permit. As part of decommissioning, all structures, equipment, and facilities will be removed.

A.4.6.1.3 R15

R15. Details and information regarding the authorization requirements of the proposed alignment through Settlement Lands.

The existing Casino Trail runs through parcel Selkirk First Nation (SFN) R-9A, which is SFN Category ‘A’ Settlement Land as designated under the Selkirk Final Agreement. The current access right-of-way through is not suitable to support the design standard required for the Project access road. As such, CMC has applied for a Land Use Permit from SFN to authorize realignment of the access road within parcel SFN R-9A. The proposed realignment has been presented in a general way to SFN staff, leadership and in community meetings since 2010. A formal presentation on the proposed Freegold Road Extension, including the proposed alignment across Settlement Lands was made to Chief and Council on February 26, 2013.

The Freegold Road Upgrade is also proposed to intersect Category ‘A’ Settlement lands designated to Little Salmon/Carmacks First Nation (LSCFN), parcels LSC R-9A and LSC R-8A. The Freegold Road Upgrade will be the responsibility of the Yukon Government, and as such, the Yukon Government will be responsible for acquiring authorisation from LSCFN to allow the proposed work on those lands.

Consultation with LSCFN and SFN has been ongoing, by both CMC and the Yukon Government, and CMC does not foresee that acquisition of these Land Use Permits or other required authorisation will impact the alignment of the road. Casino Mining Corporation will work with Yukon Government and First Nation governments to deliver an agreement between all parties for construction and management of the proposed Freegold Road Upgrade and Freegold Road Extension.

A.4.6.1.4 R16

R16. Discussion of potential impacts to values associated with Settlement Lands and mitigations proposed to address these effects.

Section 19 of the Proposal describes potential effects of the Project on Land Use and Tenure values. The access road for the Project may result in direct loss of available area, as well as changes in noise levels, air quality, traffic conflicts and access.

From the context of Traditional Land Use (TLU), First Nations settlement lands will be affected to varying degrees as the Project progresses through construction, operations, closure and decommissioning and post closure. During construction several sections of the upgrade to the existing Freegold Road and Freegold Road Extension following the Casino Trail will be built on or proximate to SFN and LSCFN settlement lands. The mine site falls within the SFN Traditional Territory. During operations the area occupied by the Freegold Road Extension and mine site will be unavailable for traditional land uses. Following closure and decommissioning the area occupied by the Freegold Road Extension and area within the mine site that has not been permanently withdrawn will be available for traditional land use.

Noise and emissions from construction activities and traffic associated with the Freegold Road Upgrade and Extension may affect the wilderness experience associated with traditional land use activities. These effects would be reduced substantially once construction is complete. Although the mine site is considered relatively remote there is the potential for activities during all Project phases to adversely affect the local ambience and wilderness experience for First Nations conducting traditional land use activities proximate to the mine site. Post closure, the local ambience is predicted to be neutralized and return to conditions that blend into the surrounding environment.

The construction of the Freegold Road Upgrade will provide easier access to areas frequented by First Nations for TLU activities. The upgraded design criteria and year round management of road conditions will facilitate access and make travel safer along the entire Freegold Road. There is the potential, however, for reduced access to areas frequented for TLU. Conflicts between Project activities and traditional land use will vary; with construction activities being the primary issue due to safety issues that will be mitigated with construction management measures. Once construction of the Freegold Road Upgrade is complete, traffic conflicts are expected to be infrequent and short term. The potential exists for other land use activities (i.e. recreational hunting) to conflict with First Nations TLU activities due to increased access along the Freegold Road Upgrade (managed by the Yukon Government, not CMC).

Access along the Freegold Road Extension will be limited to mine site traffic. Existing tenure and individual access arrangements will be negotiated with Yukon Government and First Nations Governments. Traditional land use is focussed primarily along the existing Freegold Road Upgrade and portions of the Freegold Road Extension where existing trails and winter road access is located. Casino Mining Corporation anticipates that during construction, operation and decommissioning, traditional users can be given rights of access and if additional mitigation is required, it can be addressed directly by agreement between CMC, Yukon and First Nation governments.

A.4.6.1.5 R17

R17. Describe progress on the Road Use Agreement and relevant details that informed the Road Management Plan.

Agreements on use of the road are under active discussions with LSCFN and SFN. Yukon Government has proposed a change to the *Territorial Lands (Yukon) Act* to provide improved tools for Yukon Government's management of resource roads such as presented in this proposal. This is described below in R18.

A.4.6.1.6 R18

R18. A detailed Road Management Plan for the entire Freegold Road. Specific details for the Freegold Road extension should include:

a. description of what other users will have access to the Freegold Road extension; and

b. description of the legal instruments and measures that will be implemented to control access to the Freegold Road extension.

A detailed Road Use Plan will be the outcome of further discussions with Little Salmon Carmacks First Nation, Selkirk First Nation and Yukon Government. CMC expects this to be a regulatory requirement pursuant to the *Territorial Lands (Yukon) Act* and the Quartz Mining License. The Road Use Plan has been updated and is attached in Appendix A.22E. A detailed description of other users of the road will be determined in further discussions with First Nations and Yukon Government and be reflected in the final Plan and cannot be determined at this time. The principle will be to ensure that local use as it exists now will continue. Industrial activities are subject to licensing which includes review by YESAB for projects beyond the scope of this review. Traditional Use is protected under land claims agreements and is expected to continue. New use is beyond the scope of this project and is not proposed.

The legal instruments are identified in Section 2 of the Road Use Plan. Further details are provided below.

Territorial lands in the Yukon are administered by the Ministry of Energy, Mines and Resources pursuant to the *Territorial Lands (Yukon) Act*, SY 2003, c. 17 ("TLYA"). Section 6 states:

"Subject to this Act, the Commissioner in Executive Council may authorize the sale, lease, or other disposition of territorial lands and may make regulations authorizing the Minister to sell, lease, or otherwise dispose of territorial lands subject to such limitations and conditions as the Commissioner in Executive Council may prescribe."

Yukon Government is working towards developing a new regulation pursuant to the *Territorial Lands (Yukon) Act*. The intent is to manage the construction, operation and maintenance and finally decommissioning and reclamation of access road over the life of the project.

The new regulation is expected to address 6 key issues that are missing in the current regulations:

- Ability to tie the life of the permit to the life of the main project
- Provide for appropriate security consistent with other policy direction (i.e. mine site reclamation policy);
- Ensure that resource roads do not become public;
- Ensure decommissioning plans are developed;
- Provide compliance and enforcement tools for road management; and
- Ability to manage and restrict access.

It is also expected to include an ability to authorize multiple permit holders and facilitate agreements for multi-use as may be allowed under a management plan.

Yukon Government Highways and Public Works released a document titled *Resource Access Road Framework* (2013). The Framework outlines the "goals and principles that guide decisions around the development and management of resource access roads". Resource Access Roads are defined as "all routes needed by industry to access their properties and move their product to market." The Proposed Freegold Road Extension will be a Mine Haul Road, defined as:

"A new road built to a haul/industrial standard that meets vehicle and employee safety standards and is used to transport minerals from a developed mine or for re-supply and movement of people and goods to and from the mine site. In most cases, mine haul roads connect to a publicly maintained existing road network" (Yukon Government, 2013).

First Nations Governments

Little Salmon Carmacks First Nation (LSCFN) and Selkirk First Nation (SFN) were established in 1997 through Settlement Legislation in Canada and the Yukon that gives effect to their final agreements. LSCFN and SFN are responsible for their settlement lands and resource management on these lands. Under their Self-Government Agreements, LSCFN and SFN have the legislative powers to manage, administer and control the right or benefits of persons enrolled under their final agreements. SFN has established a Constitution for the purpose of protection of its settlement lands and resources, and governing the rights of its citizens on these lands. LSCFN has not established legislation for the management and administration of settlement lands

The statutory authority to enter into an Access Agreement for SFN and LSCFN comes from the *Yukon First Nations Self-Government Act (Self-Government Act).* This is a federal statute that establishes as legal entities those First Nations that are listed in the Act (because they have settled land claims). Both First Nations are listed in the Self-Government Act and have the powers granted under that Act which include law-making authority in relation to their respective Settlement Lands.

Specifically in relation to settlement land, each of the SFN and LSCFN have the authority under s. 11(1) and s. 1 of Part III of the Self-Government Act to enact laws in relation to, among other things, the “use, management, administration, control and protection of settlement land”. There are similar provisions in the Final Agreement for each of the SFN and the LSCFN.

Co-Management Structure

As noted above, First Nations governments have the statutory authority to enact laws and enter into agreements with respect to settlement lands and impose conditions, including a requirement for a management plan.

Yukon Government has the statutory authority to impose license terms and conditions for the access road on Crown lands including a requirement for a management plan. The intent is for the Yukon Government to exercise this authority with due regard to First Nations rights and interests with respect to their Traditional Territories, and responsibilities for co-management or management of renewable resources under the land claims agreements.

The Freegold Road Upgrade includes a proposal that would see some sections of the road cross LSCFN Settlement Land. If this proposal is accepted by LSCFN, then they would become a Decision Body for the project under the YESAA and the ability to exercise their statutory authority.

The Freegold Road Extension includes a proposal that would see one section cross SFN Settlement Land. Casino Mining Corporation has submitted an application to SFN for an access agreement to cross these settlement lands.

While the proposal provides for each government to exercise their statutory authority without being fettered, the objective is to work towards consensus acceptable to all governments and provide for operational requirements for the mine. Essentially co-management between the governments is required between SFN Government, LSCFN Government and Yukon Government.

Yukon Government Department of Energy, Mines and Resources released a Resource Access Road Regulation Discussion Paper in 2014 (Yukon Government, 2014). The discussion paper outlines the scope of new regulatory authorities proposed by the Yukon Government that would apply to the proposed Freegold Road Extension.

The legal instrument currently in place to manage the Freegold Road Extension is through a long-term surface lease and land use permit pursuant to the *Territorial Lands (Yukon) Act*, and agreement with Selkirk First Nation pursuant to Selkirk’s internal land use approval process. In the absence of new legislation as proposed by Yukon Government, CMC would seek to license the construction and operation of the road through these existing legal instruments - a long-term lease and land use permit as identified in the proposed Land Use Plan. The long term management of the road would be done through a lease or license. Once a road is built through a land use permit, the lease/license would be the guiding legal instrument and can include authority for maintenance needs or minor realignments.

There are active discussions with Little Salmon Carmacks First Nation to determine an appropriate approach to authorizing use of that First Nation’s settlement lands for the purposes of upgrading the existing Freegold Road.

A.4.6.1.7 R19

R19. Please confirm that the Road Use Plan, the Extension Access Management Plan, and the Traffic Management Plan refer to the same management plan.

The Road Use Plan (Appendix A22.E) will be the primary tool by which the company will implement measures to ensure the protection of wildlife and safety. It will include a monitoring and reporting requirement that allows adjustments to be made to the plan to ensure an appropriate level of protection is achieved. It will be prepared by CMC. Implementation of the Road Use Plan will become a commitment of CMC and a license requirement for the Project.

An outcome of this plan is expected to result in a number of agreements, some which may be specific to the Freegold Road Extension, others to the public portion, which is the Freegold Road Upgrade. A Traffic Management Plan (not yet developed) is expected to form a component of the Road Use Plan (Appendix A22.E). Some of these agreements are currently subject to further negotiation. There will be a number of management plans that will be required as part of the overall Road Use Plan. These are identified in Section 23 of the Proposal.

A.4.6.1.8 R20

R20. Reconcile the intention to decommission the access road with the need to maintain access in order to monitor and maintain permanent infrastructure. Details should include a detailed discussion of access requirements for on-going monitoring and maintenance of site infrastructure and how these activities will be undertaken if the road is decommissioned.

Site access requirements are expected to ramp down with following closure activities as described in the response to R113. It is expected that within approximately 20 years following active closure the site will be physically stable such that any maintenance could be carried out with a limited amount of equipment. The options for mobilizing equipment range from:

- Leave some equipment on site, for example an excavator, truck and dozer;
- Mobilize parts and equipment by air;
- Mobilize along decommissioned road in winter, following the currently existing Casino Trail; and/or
- Utilize road systems that access Placer Claims in the area (which may be as yet undeveloped).

As stated in the Freegold Road Report (Appendix 4B), the decision to decommission the Freegold Road Extension will be made in consultation with all stakeholders. A decision could also be made to decommission a section of road to the degree that vehicle access beyond that section is prevented, but that could be reconstructed if access is required in the future.

A.4.6.2 Existing Highways

A.4.6.2.1 R21

R21. A breakdown of Project related traffic volumes, by vehicle type, for the Alaska, North Klondike, and South Klondike highways. Provide a comparison against current traffic levels and capacities including seasonal fluctuations.

During operations, the Project induced traffic on highways will consist of trucks carrying LNG from British Columba via the Alaska Highway. These vehicles will be travelling northwest on the Alaska Highway via Watson Lake to Whitehorse, and turn north onto the North Klondike Highway to the Carmacks By-pass.

Copper/molybdenum concentrates will be trucked from the mine site to Skagway, with grinding media and lime backhauled from Skagway to the mine site. Additional supplies are anticipated to be procured in Whitehorse and transported to site while personnel will be flown into site via the Casino Airstrip. A breakdown of Project-related highway traffic volumes is reproduced in Table A.4.6-2 (from Table 4.4-5 of the Proposal).

Table A.4.6-2 Projected Traffic Volumes during the Operations Phase (Proposal Table 4.4-5)

Vehicle Type	FHWA Classes	Inbound (loads per day)	Outbound (loads per day)
LNG Fuel	8-13	11	11
Diesel and Lubricants etc.	8-13	4	4
Lime (as backhaul)	8-13	6	0
Grinding Media (as backhaul)	8-13	3	0
Camp and Catering Supplies	3-7	2	2
Copper Concentrate	8-13	0	17
Molybdenum Concentrate	8-13	0	4
Other	10:3-7, 10:8-13	10	10
Buses, vans , light vehicles	3-7	20	20
TOTAL		**56**	**68**

Note:

1. Daily and seasonal variations will occur. Peak outbound results can arise from years of higher than life-of-mine average copper concentrate production. For example, copper concentrate outbound loads can reach 24 loads per day in some years

Yukon Government, Department of Highways and Public Works (HPW), Transportation Engineering Branch has adapted the standard United States Federal Highways Administration (FHWA) classification scheme for Yukon (Table A.4.6-3). For planning purposes, FHWA classes are often grouped into light vehicles (classes 1-3), single-unit truck vehicles (classes 4-7) and heavy trailer truck vehicles (classes 8-13) (Jeffrey 2014 pers. comm.).

Table A.4.6-3 Yukon FHWA-based Vehicle Classification System

FHWA Classification	Vehicle Description
1	Motorcycles
2	Cars
3	Light Trucks
4	Buses
5	Dual-Wheel Light Trucks
6	3-axle Single-unit Trucks
7	4-axle Single-unit Trucks
8-13 (sum)	Multi-axle Trailer Trucks

Note:

Source: Yukon Government 2011

Anticipated average daily project-related highway traffic north of Whitehorse to Carmacks is 54 vehicles in FHWA Classes 3-7 (light trucks and single-unit trucks) and 70 vehicles in FHWA classes 8-13 (truck and trailer). Total numbers of Project-related vehicles are not expected to affect other road users as this represents a less than three percent increase in average daily traffic anywhere on the route (Yukon Government 2011, Jeffrey 2014, pers. comm.). Furthermore, single unit trucks (FHWA Classes 3-7) are not expected to have an effect on other highway users (Jeffrey 2014, pers. comm.).

Project-related trailer truck traffic (FHWA Classes 8-13) is anticipated to represent a greater proportional increase in this type of vehicle on the highway route. Trailer trucks are bigger and longer, accelerate and travel more slowly and turn more widely than light vehicles (Jeffrey 2014, pers. comm.).

An estimate of non-Project trailer truck traffic on the South Klondike Highway can be made using automated traffic counts collected over 1-2 weeks at various locations in the Whitehorse Corridor during the summer of 2011 (Yukon Government 2014). Information from that summary is provided in Table A.4.6-4.

Table A.4.6-4 Traffic and Truck Count Statistics from the Whitehorse Corridor (Summer 2011) and Predicted Project-related Truck Traffic

Location on Alaska Highway	Average Daily Traffic (ADT)	% Trucks	Est. Number of Non-project Trucks/day	Predicted Number of Project Trailer Trucks/day	Predicted Total Number of Trucks/day	Predicted % Trucks
South of Carcross Cutoff (km 1404.2)	2720	6.9%	188	22	210	7.2%
North of Carcross Cutoff (km 1404.5)	4381	8.5%	372	52	424	8.8%
Whitehorse, Two-mile Hill (km 1426.3)	13480	6.6%	890	70	960	6.6%
South of North Klondike (km 1432.2)	6166	7.7%	475	70	545	8.1%
North of North Klondike (km 1437.1)	1716	12.1%	208	70	278	13.9%

Source: Yukon Government 2014

An estimate of non-Project trailer truck traffic on the Alaska Highway between Watson Lake and Whitehorse can be made using 2011 Whitehorse Corridor automated traffic counts collected over 1-2 weeks at various locations in the Whitehorse Corridor during the summer of 2011 (Yukon Government 2014). An average of 188 trailer trucks per day was recorded on the Alaska Highway south of the Carcross Cutoff (Alaska Highway km 1401.2). The Project is proposing 22 Project-related trailer trucks loads per day along the Alaska Highway south-east of Whitehorse. This represents a potential increase of trailer truck traffic from 6.9% to 7.2% on the Alaska Highway south of Whitehorse.

An estimate of non-Project trailer truck traffic on the South Klondike Highway can be made from the 2011 Whitehorse Corridor automated traffic counts. An average of 188 trailer trucks per day were recorded on the Alaska Highway south of the Carcross Cutoff (Alaska Highway km 1401.2) and an average 372 of trailer trucks north of the Carcross Cutoff (Alaska Highway km 1404.4) (Yukon Government 2014). The difference is 184 trailer trucks per day travelling the South Klondike Highway during the measurement period of summer 2011. The Project is proposing 30 project-related trailer trucks loads per day along the South Klondike Highway. This represents a potential increase of trailer truck traffic from 11.1% to 11.5% on the South Klondike Highway.

Project-related trailer truck traffic is not expected to result in an increase in the percentage of trailer truck traffic through Whitehorse (6.6%).

An estimate of non-Project trailer truck traffic on the North Klondike Highway can be made using automated traffic counts collected in the Whitehorse Corridor during the summer of 2011 (Yukon Government 2014). An average of 475 trailer trucks per day were recorded on the Alaska highway east (closer to Whitehorse) of the North Klondike Highway intersection (Alaska Highway km 1432.2) and an average of 208 trailer trucks per day were recorded west of the North Klondike intersection (Alaska Highway km 11437.1) (Yukon Government 2014). The difference is an estimated 267 trailer trucks per day travelling the North Klondike Highway during the measurement period of summer 2011. The Project is proposing 70 project-related trailer trucks loads per day along the North Klondike Highway. This represents a potential increase from 6.0% to 7.0% of trailer truck traffic on the North Klondike Highway.

The North Klondike, Alaska and South Klondike highways each have a design capacity of 1500 vehicles per hour per lane. Capacity can vary between 1200 to 1800 vehicles per hour per lane depending on road geometry, terrain, and other factors (from proposal p.17-16, citation: YG-HPW 2012, pers. comm.). Volume/capacity ratio is a measure of amount of traffic on the road and the road capacity in order to maintain flow. The highest volume/capacity ratio on the project highway route occurs in summer, in Whitehorse, on the Alaska Highway. The maximum number of vehicles (in both lanes) per hour in the Whitehorse Corridor measured in summer 2011 ranged from 121 to 1356, or volume capacities of 0.04 to 0.45 (i.e. 4 to 45% of the highway design capacity) (Yukon Government 2014). Average daily traffic volumes decrease considerably outside of the Whitehorse Corridor and highway capacity remains similar (Figure A.4.6-3). The 124 light and heavy trucks loads per day related to the Casino Project are not anticipated to have an effect on highway volume/capacity.

There is currently no quantitative information available on queue lengths for traffic on the North Klondike, South Klondike and Alaska highways (Jeffrey 2014 pers. comm.). Light trucks and single unit vehicles (FHWA Classes 3-7) are not anticipated to affect queue lengths. Project-related trailer truck traffic is anticipated to increase along the route by 22 to 70 loads per day or between 12 to 26 per cent, depending on the highway segment. Road users travelling faster than Project-related trailer traffic are likely to encounter these trailer trucks.

Project traffic turn at two uncontrolled intersections (North Klondike and Alaska Highway, Alaska and South Klondike Highways) and pass through three controlled intersections (Alaska Highway at Wann Road, Two-Mile Hill and Robert Service Way) on the route. Levels of service at the controlled intersections are not expected to be significantly affected by Project-related traffic (Jeffrey 2014 pers. comm.). Project-related trailer truck traffic turning right at the uncontrolled intersections are expected to decelerate over longer distances but have little effect on traffic flow. Project-related trailer truck traffic turning left (east) from the North Klondike onto the Alaska Highway (41 loads per day) and left (west) from the South Klondike onto the Alaska Highway (9 loads per day) are expected to require longer inter-traffic distances in order to enter and merge with traffic flow on the Alaska Highway. This requirement is consistent with non-project trailer truck vehicles. Little effect on queue length/time is expected. Yukon Government is currently undertaking additional traffic studies and planning for the “Whitehorse Corridor-Alaska Highway” that may include consideration of additional capacity improvements (Jeffrey 2014 pers. comm.)

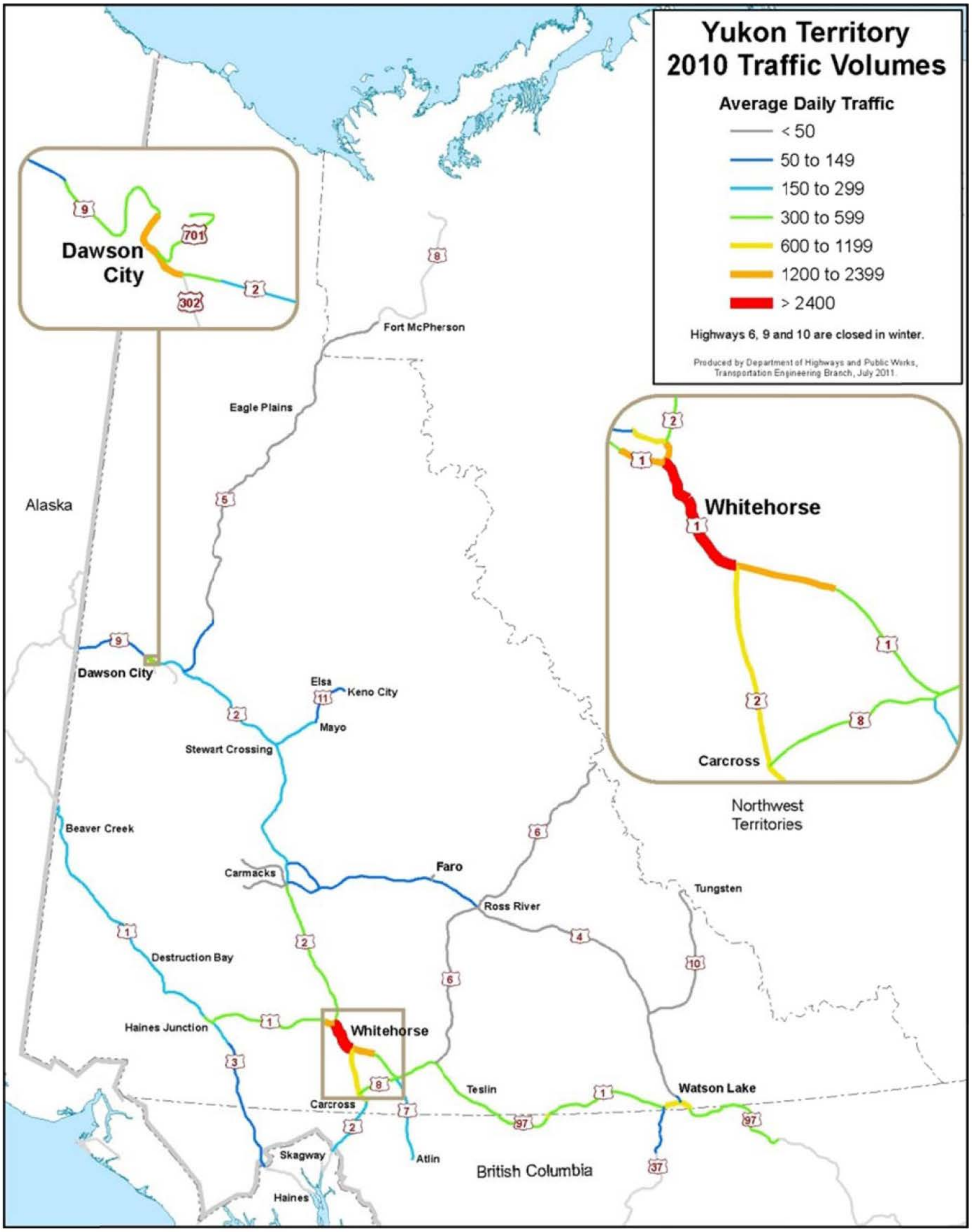


Figure A.4.6-3 Yukon Highway Schematic and 2010 Traffic Volumes (Yukon Government 2014)

A.4.6.2.2 R22

R22. Implications of projected traffic due to this Project on the Alaska, North Klondike, and South Klondike highways.

The implications, in terms of predicted relative increase in traffic on existing highways a result of Project-induced traffic, are discussed in the response to R21. Figure A.4.6-3 shows the pattern of traffic volumes on the North Klondike, South Klondike and Alaska highways in 2010. Projected average daily traffic volumes, including Project-induced traffic, are well below design capacity for all routes. The Whitehorse Corridor has more traffic than other highways/segments, yet flow approaches only 0.45 volume/capacity at peak flow, at peak locations (Yukon Government 2014).

Non-Project traffic volume predictions are not available for the Klondike and Alaska highways. Highways and Public Works suggested that traffic volumes are typically related to human population. Whitehorse is the area of highest population growth along the Project highway route, experiencing about a one percent per year overall population growth between 1994 and 2011. Without future population growth, total Project-related traffic in the context of summer 2011 traffic volume would represent 0.9% of the traffic through Whitehorse (Yukon Government 2014). Project related traffic is not expected to influence the predicted volumes of traffic used for highway planning purposes by Highways and Public Works.

A.4.6.2.3 R23

R23. Details on fleet management to ensure rapid response to possible accidents or spills.

A preliminary Emergency Response Plan (ERP) for the Project was included as Appendix 22B of the Proposal and details regarding fleet management to ensure rapid response to possible accidents and spills are addressed in the Appendix A.22B Spill Contingency Management Plan and Appendix A.22A Waste and Hazardous Materials Management Plan. The will be amended or updated as required, to accommodate change in construction, operational procedures, regulations and guidelines. A plan for spill response is required for both a Quartz Mining License and a Water Use License.

The prevention of spills and accidents are considered in the design of the road route (e.g., speed limits, pull-out opportunities), and details on fleet management will be considered during the detailed engineering and procurement process for the Project.

A.4.6.2.4 R24

R24. Describe if weight restrictions are predicted to interfere with Project logistics including the anticipated frequency for which a special variance permit may be requested.

Weight restrictions are not predicted to interfere with transportation during construction or operation of the Casino Project. Although the exact timing varies somewhat from year to year, weight restrictions are a known event and as such construction, operations and associated logistics will be planned around their occurrence, as all seasonal variations are incorporated into plans.

The need for overland permits will depend on specific types of construction and process equipment and materials used and the specific manufacturers selected to supply those items. Wherever possible, equipment, materials and supplies of any kind will be delivered in loads appropriate to restrictions in place along the delivery path at the time of transit. At a preliminary design phase, CMC estimates that approximately during the construction phase, 30 over-weight loads will require permits for transport, and the maximum weight of an individual piece of equipment or component will be approximately 100 tonnes. Approximately 75 loads may require over-dimension permits for transport. Many of the over-dimension loads may simply require placards; however, others will require pilot/escort cars. In any event, all such loads will be transported in strict conformance with the conditions and requirements stipulated in the permit for the load.

A.4.6.2.5 R25

R25. Describe maximum predicted haulage weights, including maximum anticipated weights for the importation of equipment and infrastructure.

The maximum weights for haulage and/or importation of equipment and infrastructure will conform to the appropriate highways regulations for Canadian Provinces, the Yukon Territory and Alaska.

A.4.6.3 Traffic Through Carmacks During By-pass Construction

A.4.6.3.1 R26

R26. Traffic projections for mine related traffic within Carmacks, detailed by vehicle class and type, prior to the Carmacks by-pass becoming operational.

Traffic projections for mine related traffic during the construction phase, detailed by vehicle class and types of loads is presented in the response to R9. Project related traffic through Carmacks can be eliminated by the early completion of the Carmacks By-pass. This will be the responsibility of the Yukon Government.

A.4.6.3.2 R27

R27. A traffic management plan for routing traffic through Carmacks prior to the completion of the Carmacks by-pass. Details should include:

a. route through Carmacks;
b timing of transportation activities (e.g. daily, weekly and monthly restrictions);
c. safety of residents with particular focus given to routes with no pedestrian sidewalks;
d. communication with residents within community; and
e. congestion aversion.

The Road Use Plan (Appendix A.22E) will be the primary tool by which CMC will implement measures to manage Project related traffic; a traffic management plan will be developed in support of the Road Use Plan. At this time, the Road Use Plan is preliminary and a number of agreements are anticipated to come from this plan that will inform the management of traffic, some of which may be specific to the Freegold Road Extension, others to the public portion, which include the Freegold Road Upgrade and Carmacks By-pass. These agreements to inform traffic management for the Freegold Road Extension, Freegold Road Upgrade and Carmacks By-pass are currently subject to further negotiations between CMC, Yukon Government and First Nations Governments. There will be a number of management plans that will be required as part of the overall Road Use Plan that are developed as a result of these negotiations.

A traffic management plan is expected to form a large component of the Road Use Plan (Appendix A.22E). It will include a monitoring and reporting requirement that allows adjustments to be made to the plan to ensure the objectives are achieved and adverse effects are avoided or minimized. The traffic management plan will prepared by CMC and the implementation of it (and the larger Road Use Plan) will become a commitment of CMC and a license requirement for the Project under the *Territorial Lands (Yukon) Act* and the Quartz Mining License.

A.4.6.4 Imports and Exports

A.4.6.4.1 R28

R28. Describe the sourcing of primary mine materials, delineating supplies arriving from Skagway from those from British Columbia and elsewhere. Please distinguish between materials such as primary flotation supplies, heap leach supplies, lubricants, fuels, and cyanide.

The feasibility of the various import and export routes is detailed in the Feasibility Report (M3 2013). Associated Engineering examined seven alternative routes for an all-weather road access to the mine. The analysis included consideration of the ports of Skagway and Haines as seawater ports for the mine to receive imports. Their report also evaluated alternative modes of transportation include barge, pipeline, rail, air, and truck. It was concluded that trucking presents the most reliable means of transporting concentrate and supplies to and from the project. A trucking route using the Freegold Road and the Klondike Highway will provide the most economic alignment in terms of haul distance, road construction costs and terrain traveled. Highway-capable trucks will carry inbound and outbound materials and supplies. No substantial rail cargo service exists within the Yukon Territory.

As discussed in Section 4.4.1.6 of the Proposal, throughout the operations phase of the Project, trucking will be the primary inbound and outbound transport from the Casino mine site complemented by aircraft for transporting personnel. Concentrate trucks are anticipated to travel round trip between the Casino mine site and the Port of Skagway daily on a year round basis by utilizing the Freegold Road. The access road will also be used to resupply the Casino mine site and remove wastes, and for the transport of oversized equipment. CMC anticipates that trucking will be utilized for the following activities:

- Copper concentrate from the Casino mine site to the Port of Skagway;
- Molybdenum concentrate from the Casino mine site to the Port of Skagway;
- Copper sulphide precipitate from the Casino mine site to the Port of Skagway;
- Supplies and equipment inbound to the Casino mine site; and
- Special Waste removal from the Casino mine site to appropriate disposal facilities.
- LNG will be transported to the site from Fort Nelson, British Columbia via tanker trucks.

The exact location of materials to build and operate the mine will be determined throughout the procurement process during the engineering, procurement and construction management (EPCM) phase of the Project, and will depend on availability of suppliers.

As stated in the Feasibility Study (M3 2013), the majority of mechanical and electrical equipment required for the Project will be procured within North America. Concrete, building construction materials and timber products will be sourced primarily in the Yukon. Structural and miscellaneous steel, piping, tanks, electrical and miscellaneous process equipment will be largely sourced within Canada, and to the extent practical, within the region. Some commodities, such as structural steel, may be sourced out of country. Equipment and bulk material suppliers will be selected via a competitive bidding process.

For the purposes of the Feasibility Study (M3 2013), budget quotations were received for reagents supplied to Skagway, AK, or from local sources where available with allowance for freight to the Project. Casino Mining Corporation is confident that sources of materials required to operate the Project are available, and can be shipped to the site safely.

Transportation of dangerous goods and materials to the Project will be contracted out to a certified transporter in compliance with the *Transportation of Dangerous Goods Act* and *Regulations*. Transportation of dangerous goods is regulated under the *Dangerous Goods Transportation Act*, which requires transporters to have a certified contract and a spill response plan for all goods to be transported. The transporter will be required to:

- MSDSs accompany all goods and materials.
- Non-compatible materials will be transported in a separate shipment.
- Fire extinguisher and fire prevention materials will be adequate and appropriate for the material being transported.
- Containers will be appropriate for the material being shipped.
- Containers will be properly secured.
- Containers and trucks will be properly marked, labelled, and placarded.
- Manifests will be maintained in accordance with federal and provincial regulations.
- Spill response materials will be adequate and appropriate for the materials being transported.
- Drivers will be adequately trained and equipped for spill first response, containment, and communication.

To the extent possible, the transportation of hazardous materials will only take place when road conditions are suitable. During winter months transport may be curtailed during periods when the roads are not safe for trucks due to ice or snow related hazards. When road conditions are uncertain for the transportation of hazardous materials, the vehicle or truck will be accompanied by an escort vehicle along the access road. The access road will be maintained to provide a safe and effective transportation route for all hazardous materials required on site.

A.4.6.4.2 R29

R29. Confirm that the export plan is, or will be, logistically possible.

As detailed in Appendix A.4B, Associated Engineering examined the ports of Skagway and Haines as seawater ports for the mine. The port at Skagway offers the advantage of developing a dedicated terminal and space for receiving and storage of concentrates. The Port of Skagway is located 560 km from the Casino site and has been selected as the port of export for the project. The port has historically exported up to 600,000 tonnes annually of lead and zinc concentrates and currently exports the copper concentrates from Capstone Mining's Minto operation. An engineering evaluation has determined that the existing concentrate storage and handling facilities at Skagway can be economically up-graded to serve the Casino export requirements. The Port of Skagway and the Alaska Industrial Development and Export Authority (AIDEA) have expressed interest in providing concentrate storage and load-out services to Casino in their to be expanded facilities, consistent with the conceptual design prepared by CMC (Figure A.4.6-4).

Studies completed by the Yukon Government and the Municipality of Skagway (2010) concluded that shipping from Carmacks to Skagway via Highway 2 instead of to Stewart via Highways 2, 1 and 37 would reduce the shipment distance by 868 km and would save approximately $100/ton in transportation costs.

Additionally, the Municipality of Skagway has recently received funding approval from the State of Alaska for $65 million USD for the Yukon Gateway Project, that would include increase the dock and channel capacities to accept and berth ore ships and increase proximal upland capacity to accept, store, track and transfer large quantities of ore concentrate from multiple shipments (Municipality of Skagway 2015). The municipality is currently in the planning and design phase of the project (Municipality of Skagway 2015).

Figure A.4.6-4 Conceptual Rendering of Skagway Port Facilities (M3 2013)

A.4.6.5 Dangerous Goods

A.4.6.5.1 R30

R30. Describe, as best as possible (if data are unavailable, please indicate anticipated rates of use), the frequency, weight, size, truck type, and carrying capacity of trucks carrying:

a. pebble lime;
b. sodium disobutyl dithiophashinate;
c. sodium diethyl dithiphoshinate;
d. methyl isobutyl caribinol;
e. potassium xanthate;
f. sodium hydro-sulphide;
g. sodium cyanide;
h. sodium hydroxide;
i. hydrochloric acid;
j. sulphuric acid;
k. ammonium nitrate;
l. diesel;
m. lubricants;
n. liquefied natural gas;
o. ore concentrates; and
p. other hazardous materials.

As prepared for the Feasibility Study (M3 2013), the anticipated usage, frequency, truck type and capacity for the various hazardous materials are summarized in Table A.4.6-5.

Table A.4.6-5 Transportation and Usage of Potentially Dangerous Goods

Material	Usage Rate	Transportation		
		Frequency	Truck Type	Capacity
Pebble lime	Up to 270 tonnes/day	Up to 7 trucks/day	Dual trailer side dump truck	40 tonnes/truck
Sodium diisobutyl dithiophoshinate (Aerophine 3418A)	Up to 1008 kg/day	~1-2 trucks/month	Flatbed with totes	20 tonnes
Sodium diethyl dithiophoshinate (Aerofloat 208)	2004 kg/day	~3 trucks/month	Flatbed with totes	20 tonnes
Methyl isobutyl caribinol (MIBC)	1200 kg/day	~2 trucks/month	Flatbed with totes	20 tonnes
Potassium amyl xanthate (PAX – 350)	4,800 kg/day	~7 trucks/month	Flatbed	20 tonnes
Sodium hydrosulphide (NaHS)	~7,000 kg/day	~8 trucks/week	Tanker	20 tonnes
Sodium cyanide	12.5 tonnes/day (1,000 kg bag boxes)	~11 trucks/week	Flatbed	Flatbed
Sodium hydroxide	325 kg/day (1,000 kg bag boxes)	~1 truck every 2 months	Flatbed	20 tonnes
Hydrochloric acid	250 kg/day	~1 truck every 3 months	Flatbed	20 tonnes
Sulphuric acid	8,200 kg/ day	~3 trucks/week	Tanker	20 tonnes
Diesel	Maximum 136,500 liters/day	~3 trucks/day	Tanker	50,000 liter
Lubricants	14,100 liters/day	~1 truck every 3 days	Tanker	50,000 liter
Liquefied natural gas	1,000 m^3/day	10 trucks/day	Double tanker trailer	95 m^3
Ore concentrates	1,000 tonnes/day copper concentrate 31 tonnes/day molybdenum concentrate	25 trucks/day	Dual trailer side dump	20 tonnes per trailer, 40 tonnes total

A.4.7 WATER MANAGEMENT PLAN

A.4.7.1 R31

R31. Additional detail in the Water Management Plan that includes all Project components and phases. Details should include:

a. appropriate figures and plans illustrating site water management, including flow sheet information such as monthly water volumes; and

b. figures, plans, and sections for key collection and conveyance facilities associated with the Project.

The water balance submitted to the YESAB for the Proposal (Appendix 7F Water Balance Report) has been updated to include climate variability. The objective of the water balance modelling exercise was to evaluate the quantity of flow of water in the ground, in the streams, and in various mine facilities under a variety of climate conditions. The water balance model also provided the platform on which the water quality model was developed.

The supplementary report provided as Variability Water Balance Model Report (Appendix A.7A) outlines the climate inputs and water management assumptions that were used for climate variability water balance modelling, and presents the results of the study.

a. Figures illustrating site water management are provided in Appendix B of the Water Balance Report (Appendix 7F), and flow schematics used for the derivation of the water balance are provided in Appendix C of the Water Balance Report (Appendix 7F). Water balance flow rates are provided in Appendix E of the Water Balance Report (Appendix 7F). For values derived from the variability water balance, please refer to Appendix A.7A (Variability Water Balance Model Report).

b. Figures, plans and sections for the main infrastructure are provided in the appendices to Section A.4, and include the feasibility design of the Tailings Management Facility, the Heap Leach Facility, the Waste Storage Area and Stockpiles, and the Open Pit. Reviewers should refer to each specific plan for details for each key collection and conveyance facility.

A.4.7.2 Conveyance of Water

A.4.7.2.1 R32

R32. A description of the methodology used to determine flows for storm events including supporting information such as catchment areas, time of concentrations, inclusion of rain and snow melt events, design events, and results.

Return period peak flows and peak flow hydrographs used for the detailed design of hydraulic structures such as diversion ditches, sediment control ponds and spillways, will be generated using HydroCAD rainfall-runoff modelling software, with the input parameters (curve numbers, time of concentration, unit hydrograph) calibrated to produce peak flows that are in generally consistent with the peak flow values specified in the Baseline Hydrology Report (Appendix 7B of the Proposal). This consistency will take into account scaling effects, as the report values are for relatively large drainage areas, while the majority of the hydraulic structures will service relatively small drainage areas that would tend to have proportionately higher peak flows. An example is given below:

Q_{100} for a 25 ha area:

From the Baseline Hydrology Report (Appendix 7B)

Q_{100} = 516 l/s/km^2 (assume for 25 km^2, the smallest drainage area in Table 5.1-2)

Table 5.1-1: Scaling exponent = 0.855 for the Q_{100}. However, a value of 0.8 was selected because it is more conservative for downscaling and is in keeping with the climate and physiography of the project area (Cathcart, 2001).

Therefore, for a drainage area of 25 ha, the **Q_{100} =** (25 km^2 x 516 l/s/km^2) x (0.25 km^2/25 km^2)^0.8 = **0.32 m^3/s**.

The corresponding peak daily Q_{100}, which is based on an instantaneous to daily peak flow ratio of 2.5 (a ratio of 1.6 was specified in the Baseline Hydrology Report for relatively large basins, and the ratio tends to increase with decreasing area), **0.13 m^3/s**.

Rainfall-Runoff Model

100 year 24-hr precipitation = 71 mm

SCS CN = 80 (curve number)

Time of Concentration (Tc) = $2.4A^{0.5}$ = 1.2 x 0.25^0.5 = 1.2 hrs = 72 minutes (BC MOE equation for natural basins with slopes > 1% and <10%)

Unit Hydrograph = Gamma 200

Q_{100} = 0.35 m^3/s

The corresponding peak daily Q_{100}, which is based on a computed storm runoff depth of 36 mm, is **0.10 m^3/s**.

The rainfall-runoff model estimates for the peak daily and peak instantaneous Q100 values are generally consistent with the values presented in the Baseline Hydrology Report (Appendix 7B), which were based on a frequency analysis of measured and synthesized peak flow data for the Project area.

A.4.7.2.2 R33

R33. Detail and describe the methodology and references used to determine the probable maximum precipitation in relation to conveyance channel design and events pond standards.

Details and a description of the methodology used to determine the Probably Maximum Precipitation (PMP) is presented as Part a. of the response to R75.

A.4.7.2.3 R34

R34. Typical cross-sections and design drawings of alignments for diversion ditching across the project site with particular focus around the HLF including:

a. confining embankment;

b. access road section; and

c. event ponds area.

The surface water management system for the site, as presented on Figure 5.8 in the Feasibility Design of the Heap Leach Facility (Appendix A.4C) consists of a series of ditches constructed around the perimeter of the HLF to intercept overland surface runoff around the HLF pad and to convey flows to the TMF. The ditches are designed to meet the following design criteria:

- Convey the 1 in 100 24-hour duration storm event;
- Minimum freeboard = 0.3 m;
- Minimum ditch grade = 0.01 m/m;
- Side slopes = 2H:1V; and
- Channel shape = trapezoidal.

Lining and protection of the ditch channels from erosion and scouring is required for all permanent ditches due to the steep ditch grades associated with the natural topography and the anticipated high runoff flowrates.

Ditches A3 and B2 are designed to convey stormwater around the confining embankment with an offset of approximately ten metres. This arrangement prevents contact of 1 in 100 24-hour storm event flows with the confining embankment, which avoids erosion that could weaken the embankment.

Ditches A4 and B3 convey stormwater under the access road via corrugated culverts. The culverts underlying the access road will be sized to pass 1 in 100 24-hour storm event flows in order to avoid road wash-outs.

Ditches A4 and B3 convey stormwater around and to the crest of the events pond. The ditching will avoid surface water entering the events pond which could result in excessive overtopping that could affect events pond embankment.

A.4.7.2.4 R35

R35. A discussion of measures to be taken should one or more sections of the proposed heap leach facility (HLF) diversion ditches be found to be ineffective or should excessive erosion become an issue.

Diversion ditch cross-sections will be prepared as part of the detailed design for construction. It is important to note that even with detailed design, some field fitting of the typical ditch cross-section is required during construction to suit the conditions present onsite. Should erosion become an issue, erosion control Best Management Practices (BMPs) will be applied as and when required to prevent ditch erosion.

In the event that ditch design is observed to be ineffective in passing storm flows, ditch sizing will be re-evaluated. As appropriate, ditch width and depth will be increased while maintaining minimum freeboard, minimum ditch grade, and retaining side slopes and channel geometry. Where excessive erosion is encountered, additional channel lining and protection shall be implemented to prevent erosion and preserve the integrity of the landform as well as installing energy dissipating structures in order to reduce sediment transport.

A.4.7.2.5 R36

R36. A discussion of alternatives that CMC considered, including justification and rationale for the use of the proposed ditches.

Additional detail of the proposed water conveyance system for the HLF is provided in Appendix A.4C Feasibility Design of the Heap Leach Facility, with specific reference to Section 5.5 and Figure 5.8 of the report.

The only other technically feasible option to the open drainage ditches in this application would be a French drain system that is more technically challenging to size, very difficult to construct in steep terrain and has the potential to become silted during operations reducing the effectiveness to transfer water. For these reasons the open ditch system was determined to be the preferred water conveyance system option over the French drain system.

A.4.7.2.6 R37

R37. A description of the diversion ditch on the southwest side of the HLF, including a drawing indicating its proximity to the edge of Brynelson Creek north tributary sub-watershed. Include a discussion of potential effects to and relevant mitigations for this watershed.

Further design of the diversion ditch on the southwest side of the HLF including the exact proximity of the ditch to the Brynelson Creek north tributary sub-watershed will be undertaken as part of detailed design required for future Quartz Mining License and Water Use License applications and for construction.

Note that with the HLF is proposed as a valley leach facility and all ditching is located within the Upper Casino Creek catchment area. The ditching is not expected to have an adverse effect on the environment in the Brynelson Creek north tributary sub-watershed because they are located in two separate watersheds.

A.4.7.2.7 R38

R38. Additional information regarding design of channels in the area that will be susceptible to erosion.

The detailed design of all channels will be completed during the detailed design phase of the Project. As a general concept, though, all channels constructed in areas that are susceptible to erosion will require lining with riprap or an equivalent revetment type, all of which will be underlain with suitable bedding and filter materials. As well, should erosion become an issue, erosion control Best Management Practices (BMPs) will be applied as and when required to prevent channel erosion.

A.4.7.2.8 R39

R39. Rationale for directing various non-contact water sources into the TMF. Include a discussion of how non-contact water will be managed throughout the life of the Project.

The location of the TMF in the upper reaches of the Casino Creek watershed limits the extent of the upstream undisturbed catchment area. This factor, combined with the relatively steep terrain of the area and the placement of the HLF and gold ore and low grade ore stock piles upstream of the TMF, will make the construction and operation of diversion channels difficult and impractical. Furthermore, since the TMF will operate in a water deficit condition for the majority of the mine life, makeup water will be required, and the most logical source is water collected in the TMF. Accordingly, by allowing runoff from the upper Casino Creek catchment to naturally flow into the TMF, and thereby be available for reclaim, the need to obtain additional makeup water from other sources, such as pumping it from the Yukon River valley, will be minimized.

A detailed description of how non-contact water is proposed to be managed throughout the life of the Project is provided in the Water Management Plan (Appendix 4C of the Proposal). The plan covers water management objectives and strategies the Project life from construction through to post-closure and is consistent with the overall objectives to manage water in a manner that provides sufficient water to support ore processing, while minimizing the potential for storm flows to cause damage to mine structures and for mining operations to cause adverse effects to downstream water quality.

A.4.7.3 Storage of Water

A.4.7.3.1 R40

R40. Further rationale for sizing of the water management pond and sedimentation ponds in terms of sediment removal and confirm if the proposed sizes will meet objectives.

The Water Management Pond design is described in the Report on the Feasibility Design of the TMF (Appendix A.4D) and also in Appendix 4C (Water Management Plan) of the Proposal and has the following functions:

- During the construction phase (Years -4 and -3), the pond will function as a sediment control pond to detain runoff from disturbed areas and allow sediment to settle out. The pond will be designed according to guidelines developed by the British Columbia Ministry of Environment, Guidelines for Assessing the Design, Size and Operation of Sedimentation Ponds Used in Mining (BC MOELP 2001). The British Columbia guidelines were adopted for the Project in the absence of any relevant Yukon guidelines. The pond will be designed to settle out sediment particles sized 0.005 mm (and larger), while providing a detention time of at least 15 hours. The pond will be designed to accommodate 0.5 m of dead storage (i.e. sediment), plus a live storage equal to the 1 in 10 year 24-hour storm event. According to the sedimentation pond design manual (BC MOELP 2001), all structures within the pond must be designed to withstand a 1 in 200 year 24-hour storm event, and therefore the pond will be designed with an overflow spillway sized to safely pass large flood flows, up to and including the 200 year flood.
- Starting in Year -2, the water management pond will function as a collection pond for surface runoff and seepage from the TMF embankments (Main and West), and the collected water will be pumped back to the

TMF. The pond storage volumes will be sized based on the maximum estimated seepage, as well as to provide storage for the 1 in 10 year 24-hour storm event. Any storm events greater than the 1 in 10 year will discharge through the pond overflow spillway. During normal pond operation, the pond has been designed as a dry-pond and a pump station will return the water stored in the pond back to the TMF.

Temporary sedimentation ponds are described in Appendix 4C of the Proposal:

- During the construction phase, temporary sedimentation ponds will be constructed at the end of collection ditches to detain sediment-laden runoff long enough to allow the majority of the sediment to settle out.
- The ponds will be designed in accordance with the Guidelines (BC MOELP 2001) outlined above. General considerations are that the pond be constructed with a narrow shape (5L:1W), and with sufficient depth to provide a minimum 0.5 m of dead storage for accumulated sediment. The temporary ponds will be decommissioned when the runoff from the source area meets discharge requirements.

A.4.7.3.2 R41

R41. Clarify whether the size of the event pond is for managing return period rainfall events or return period snow melt-rain events.

As described in the Water Management Plan (Appendix 4C) of the Proposal, the events pond is designed to store runoff (rainfall and snowmelt) inflows resulting from the 1:100 year 24-hr rainfall event plus associated snowmelt. The potential snowmelt during 1:100 year 24-hr rainfall event was taken into consideration when estimating the resulting storm volume. The potential snowmelt that could occur in conjunction with the 1:100 year 24-hr rainfall (71 mm) was estimated by applying a formula that considers the mean maximum daily temperature and typical maximum wind speeds that would occur during the storm event. The resulting highest potential snowmelt for a 24-hour period was estimated to be 34 mm during the rainfall event. Therefore, the total potential runoff depth from a combined rainfall event and snowmelt for the 1:100 year event was estimated to be 105 mm.

The potential runoff depth was applied to contributing HLF footprint of 1.5 km^2, which includes the maximum HLF footprint of 1.3 km^2 and 0.2 km^2 of HLF embankment area. Modeling of the HLF storm runoff was undertaken using the Hydrologic Modeling System (HEC-HMS) which was designed by the Hydrologic Engineering Centre (U.S. Army Corps of Engineers) to simulate precipitation-runoff processes of dendritic drainage basins. The model uses site specific data to accurately capture the specific climate and catchment conditions for the project, including: storm precipitation intensity distribution, snowmelt, catchment slope, and drainage and precipitation losses (KP, 2012a). Based on the surface runoff results generated by the model, the following storage requirements for the events pond were identified:

- Total runoff estimate for 1:100 year 24-hr event (rainfall + snowmelt) = 157,000 m^3
- 1:25 year 24-hr rainfall only (included in in-heap pond capacity) = 82,600 m^3
- Total events pond Storage Capacity = 74,400 m^3

The events pond capacity takes into account that the in-heap pond already provides storage for the 1:25 year 24-hr rainfall volume; therefore the events pond volume (74,400 m^3) is based on the total runoff generated by the 1:100 year 24-hr event (rainfall + snowmelt) (157,000 m^3) minus the 1:25 year 24-hr rainfall event (82,600 m^3).

A.4.7.4 Probability of Failure Analysis of Infrastructure Components

A.4.7.4.1 R42

R42. Details and rationale on the selection of return period design criteria for all the WMP components during all phases of the Project, including long-term closure. Details should include calculation of the failure probabilities.

A summary of the return period design criteria, rationale for selection and probability of design exceedance is presented in Table A.4.7-1.

Table A.4.7-1 Summary of Design Criteria and Probability of Exceedances for Water Management Components

Report	Components	Return Period Design Criteria	Design Life Phase	Design Life (years)	Probability of Design Exceedence	Rationale	Reference (Page)
Water Management Plan Report	Water Management Pond (WMP)	10 yr, 24-hr storm event	Construction and Operation	33	97%	Design guidelines by (BC MELP, 2001)	12
	WMP Overflow Spillway	200 yr, 24-hr storm event	Operation	33	15%	Small structure and mid to low consequence of exceedence.	12
		200 yr, 24-hr storm event	Closure	100	39%	Structure must operate in perpetuity	15
	Coffer Dams	10 yr, 24-hr storm event	Construction	1	10%	Temporary structures	12
	Diversion Ditches	100 yr, 24-hr storm event	Construction and Operation	33	28%	Reasonably lowe consequence of exceedence.	14
	Sediment Settling Ponds	10 yr, 24-hr storm event	Construction	2	19%	Design guidelines by (BC MELP, 2001)	
	Sediment Settling Pond Spillway	200 yr 24 hr storm event	Construction	2	1%	Design guidelines by (BC MELP, 2001)	13
Tailings Management Facility Report	TMF Pond and Spillway	Pond: 1000 year 72-hour storm	Up to Year 1 of Operation	3	0.3%	Large structure. Based on CDA Guidelines.	
		Pond: 1/3 between the 72-hr 1000 yr storm and 72 hr PMF	Operation	28	0.03%		
		Spillway: PMF, 24-hr PMP + 100 year snowpack	Closure	-	By definition, the PMF cannot be exceeded.		
Heap Leach Feasibility Design Update Memo	HLF Spillway	200 yr, 24-hr storm event	Operation	33	15%	Small structure and mid to low consequence of exceedence.	10
	HLF In-Heap Storage	Total capacity of 172,600 m^3 (90,000 m^3 for normal operating capacity and 82,600 m^3 for storm capacity based on 25 yr, 24-hr storm event)	Construction and Operation	33	74%	Low consequences if storage is exceeded. Overflow will discharge into the TMF.	
	HLF Embankment Spillway	200 yr 24 hr storm event	Construction and Operation	33	15%	Small structure and mid to low consequence of exceedence.	

Report	Components	Return Period Design Criteria	Design Life Phase	Design Life (years)	Probability of Design Exceedence	Rationale	Reference (Page)
	HLF Events Pond	74,000 m^3 of storage capacity based on the 100 yr storm event (rainfall + snowmelt)	Construction and Operation	33	28%	Storage capacity to contain excess HLF leachate and surface runoff. Reasonably low consequence of exceedence.	29
	Events Pond Spillway	200 yr, 24-hr storm event	Construction and Operation	33	15%	Small structure and mid to low consequence of exceedence.	29
	Diversion Ditches	100 yr, 24-hr storm event	Construction and Operation	33	28%	Reasonably low consequence of exceedence.	31

A.4.8 HEAP LEACH FACILITY

A.4.8.1 Foundation Conditions and Preparation

A.4.8.1.1 R43

R43. Detailed information on the sources and quantities of suitable borrow materials.

Sufficient borrow materials are present on site to satisfy the required quantities for construction of the heap leach facility. The soil liner material requires low permeability at relatively low confining stresses, which may require selection of residual soils with higher fines content, additional screening, or enrichment with bentonite powder. The borrow sources for other construction materials (including common fill, transition zones, and drain material) are expected to be coarse residual soils and processed bedrock, or alluvial channel deposits. The borrow materials will require processing in order to comply with the grading limits. Please refer to Appendix A.4C Feasibility Design of the Heap Leach Facility.

A.4.8.1.2 R44

R44. Clarify whether HLF excavations will be to competent bedrock or weathered bedrock. Provide justification and the criteria used to determine the suitability of the foundation for the HLF.

Additional detail on the HLF foundation preparation is provided in Appendix A.4C Feasibility Design of the Heap Leach Facility. Information relevant to this request includes:

- At the start of each of the development stages preparation of the pad foundation is required. Foundation preparation entails the stripping of approximately 0.5 m of topsoil and vegetation and the removal of any talus boulders.
- The topsoil will be stockpiled at a location north of the HLF and used for reclamation of the HLF at closure.
- The underlying frozen colluvial and residual soils will be excavated down to a competent, stable bedrock foundation.
- Any ice-rich materials will not be suitable for use as borrow in embankment construction and therefore will be transported to the TMF for disposal.
- A 2 m excavation depth has been estimated for foundation preparation to competent ground.

- In order to provide a uniformly and positively graded surface to place the pad liner system, rough grading and backfill will be used to level the naturally undulating bedrock surface and to ensure that the pad grading will promote leachate flow to be positively draining towards the leachate collection piping system and sump.

A.4.8.1.3 R45

R45. Details on foundation preparation including drainage management and accommodation of the proposed liner.

Additional detail on the HLF foundation preparation, drainage management and accommodation of the proposed liner is provided in Appendix A.4C Feasibility Design of the Heap Leach Facility. Please also refer to the response to R44 above.

A.4.8.2 Liners

A.4.8.2.1 R46

R46. Rationale for the sufficiency of a 30 cm thick soil liner.

The adoption of a 30 cm thick soil liner for the HLF is based on the Yukon precedent set at Brewery Creek Mine. The Brewery Creek Mine was successfully permitted, operated and closed, and incorporated a 0.3 m soil liner consisting of on-site silty material. This precedent illustrates the adequacy of a 30 cm soil liner throughout life of mine, within the Yukon jurisdiction. In both cases the liner systems consist of the overliner, geosynthetic liner, soil liner, geotextile, leak detection and recovery system, geosynthetic liner and prepared subgrade. Further analysis of and details regarding the design of the soil liner will be completed as part of detailed design required for future Quartz Mining License and Water Use License applications.

A.4.8.2.2 R47

R47. A description of the composition and potential effects of the overliner on the performance of the liner considering permeability and hydraulic head.

A protective layer approximately 1 m thick of coarse crushed ore will be placed over the entire liner system footprint to protect the soil liner from damage during ore placement. The technical specifications of the overliner will be developed in the detailed design phase, based on physical characterization of the ore material. The overliner also acts as a drainage layer, promoting leachate solution drainage into the piped leachate collection system, therefore reducing head loading on the liner and maximizing solution recovery. The overliner will be clean, free draining material with a higher permeability than the geosynthetic liner to promote collection of the leach solution and reduce hydraulic head.

A.4.8.3 Leak Detection and Recovery

A.4.8.3.1 R48

R48. Details on the mitigation and management of leaks from the HLF including during all stages of operations.

Additional detail on mitigation and management of the HLF is provided in Appendix A.4C Feasibility Design of the Heap Leach Facility, with specific reference to Section 5.3 and Figure 5.7 (Leachate Collection System and Leak Detection and Recovery System). Figure A.4.8-1 shows details of typical piping containment ditches and culverts for road crossings.

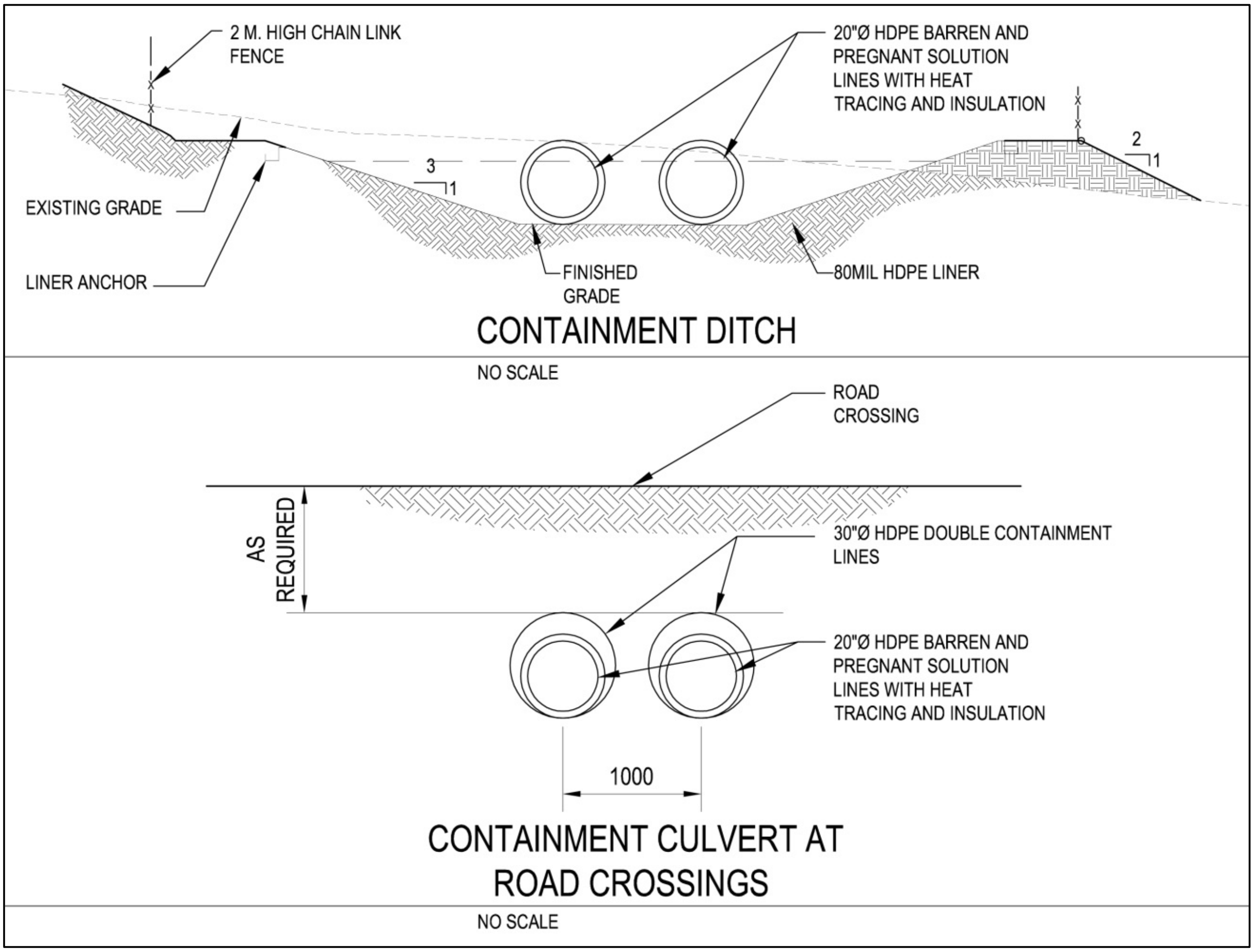


Figure A.4.8-1 Containment Ditch and Culvert for Road Crossings

A.4.8.3.2 R49

R49. Details on the maintenance and repair of the LDRS sump and pumps.

There are a variety of commercially-available pumps that are suitable for use in the LDRS application. Pumps will be pulled and routine maintenance performed by operating personnel on an as-needed basis and as generally specified in the operating and maintenance manual provided by the supplier of the equipment. Spare components required for maintenance will either be provided by the supplier directly or may be held in stock within a warehouse facility on the mine property. Operating maintenance personnel will be trained in procedures for removal of the pumps and to perform routine maintenance.

A.4.8.4 Leachate Solution and Water Flows

A.4.8.4.1 R50

R50. Details on the pipelines, pumps, and related infrastructure connecting the components of the HLF including SART, cyanide, and gold extraction facilities. Include details on pipeline alignments and leak detection measures.

Additional detail on the HLF is provided in Appendix A.4C Feasibility Design of the Heap Leach Facility, specifically Section 5.3 provides information on the leachate collection system and leak detection and recovery system.

It is CMC's intention that cyanide use will be consistent with the principles and standards of practice of the International Cyanide Management Code. The Cyanide Code includes principles and standards applicable to several aspects of cyanide use including its purchase (sourcing), transport, handling / storage, use, facilities decommissioning, worker safety, emergency response, training, and public consultation and disclosure. The Code is a voluntary industry program developed through a multi-stakeholder dialogue under the auspices of the United Nations Environment Program and administered by the International Cyanide Management Institute.

Per the International Cyanide Management Code, it is CMC's intention with respect to pipelines, pumps, and related infrastructure connecting the components of the HLF including SART, cyanide, and gold extraction facilities that :

- Design and construct unloading, storage, mixing and transfer facilities consistent with sound, accepted engineering practices and quality control and quality assurance procedures, spill prevention and spill containment measures;
- Operate unloading, storage, mixing and transfer facilities using inspections, preventive maintenance and contingency plans to prevent or contain releases and control and respond to worker exposures;
- Implement measures designed to manage seepage from cyanide facilities to protect the beneficial uses of ground water;
- Provide spill prevention or containment measures for process tanks and pipelines; and
- Implement quality control/quality assurance procedures to confirm that cyanide facilities are constructed according to accepted engineering standards and specifications.

A.4.8.4.2 R51

R51. Volumes and sources of water stored in the embankment and the events pond during a 1 in 100 year 24-hour storm event.

Please refer to the response to R41 which speaks to the size of the events pond for managing return period rainfall events and return period snow melt-rain events.

The in-heap pond has a total capacity of 172,600 m^3, which consists of:

- 90,000 m^3 for normal operating capacity, which is based on 20 m of operational head for the in-heap pond pumping system, and
- 82,600 m^3 of storm storage capacity based on the rainfall generated from a 25 year 24-hr storm event.

In the event that the storage requirement is greater than this, excess runoff/solution will spill to the events pond downstream of the heap via the embankment spillway. The HLF embankment spillway is designed to convey the peak flow generated from the 200 year storm event.

A.4.8.4.3 R52

R52. Sensitivity analyses for makeup water requirements and water retention requirements for different moisture content values for stacked ore and wetter or dryer climatic conditions. Include a discussion on any implications in relation to HLF and events pond storage capacity.

The water balance submitted to YESAB for the Proposal (Appendix 7F Water Balance Report), which includes the HLF, has been updated to determine the potential impact of climate variability on estimated water flows and requirements. Details of the climate variability water balance model are summarized in Appendix A7.A Variability Water Balance Model Report and Appendix A7.C Potential Effects of Climate Change on the Variability Water Balance. Model outputs, and in particular flow volumes, were compiled as distributions for each month in each year, from which probabilities of occurrence could be determined. The probabilities of occurrence presented for the water balance results represent the following conditions:

- Median scenario – 50% chance of being equaled or exceeded in any given month or year;
- 95th percentile scenario – 95% chance of the water volume or flow rate not being equaled or exceeded in any given month or year (5% chance that it will be); also referred to as the 95th percentile wet; and
- 5th percentile scenario – 5% chance of a water volume or flow rate not being equaled or exceeded in any given month or year (95% chance that it will be); also referred to as the 95th percentile dry.

The results of the climate variability water balance indicate that the HLF will operate in a water deficit condition during all months of operations when ore stacking is active (Years -3 to 15), however the makeup requirements predicted by the climate variability water balance are slightly lower than those predicted by the deterministic water balance. The more water availability based on the climate variability inputs also results in more discharge from the heap to the TMF pond and/or Open Pit in the active closure phases of heap operations. This will not have implications to the events pond capacity, as any excess water during operations, and active closure (rinse and draindown) of the heap is pumped to recycled back to the heap and pumped to the Open Pit, respectively. Also, the events pond throughout operations and active closure is kept dry in order to maintain storm storage capacity for the 100-year 24-hr event.

The HLF design parameters were based on the Feasibility Study design developed by M3 (2013). At this time, a sensitivity analysis on the moisture content values in the HLF water balance has not been completed, but may be addressed during the detailed design phase of the Project if warranted.

A.4.8.4.4 R53

R53. A description of the HLF solution balance including in wet and dry conditions.

The heap will be actively irrigated with cyanide solution for the 18 years (Years -3 to 15) of active ore stacking via the irrigation pumping systems, with pregnant solution being routed through the Carbon ADR Plant/SART for metals recovery. Clean water diversion ditches will divert runoff from the upslope catchment area around the HLF. Makeup water required (for both wet and dry conditions) to bring stacked ore up to the leaching moisture content will be sourced from a fresh water supply pond and an events pond in Years -3 to -1, and through a fresh water pipeline from the Yukon River and/or TMF pond for the remainder of HLF operations until the end of Year 18.

From Year 16 through Year 18, ore stacking will cease and ore will continue to be irrigated with cyanide solution until supplemental gold recovery is no longer profitable. In wet conditions, any excess water that exceeds the operating capacity of the in-heap pond during operations will be recycled back to areas of the heap that are not being irrigated.

Irrigation of ore with cyanide solution ceases and detoxification (rinsing) of the HLF will commence in Years 19 to 23, with the detoxified water being recirculated back onto the heap via the irrigation pumping system in order to remove cyanide and reduce the pH of the stacked ore. During this time, any excess water accumulated in the in-heap storage will be treated for cyanide and pumped to the Open Pit to aid in pit filling. The pregnant solution recovery system will be decommissioned during this phase.

As of Year 24, the rinsing of the heap will cease, which will initiate draindown of the water stored in the heap. The draindown water will be pumped to the Open Pit for approximately 5 years until the draindown flows are reduced to manageable levels. The final heap closure activities will include:

- Removal of geosynthetic liners from the overflow spillway and the events pond, as required;
- Removal of pregnant solution and events pond pumps and pipeworks;
- Decommissioning of the events pond. Heap infiltration and runoff flows will be discharged to the TMF pond; and
- Decommissioning of all upstream diversion ditches.

Grading, covering and re-vegetation of the final heap slopes will be completed to reduce infiltration and increase evapotranspiration from the vegetated cover. The closure cover will also provide erosion protection from surface runoff. The closure cover will be designed to reduce overall infiltration into the HLF to 50% of net precipitation.

Details of the HLF water balance for variable climate conditions and climate change conditions are provided in KP Appendix A7.A Variability Water Balance Model Report and Appendix A7.C Potential Effects of Climate Change on the Variability Water Balance. The results of the reports are summarized below.

Heap Leach Facility

The results of the climate variability water balance indicate that the HLF will operate in a water deficit condition during all months of operations when ore stacking is active (Years -3 to 15). Table A.4.8-1 summarizes the annual makeup water requirements during operations when ore is being actively irrigated with cyanide solution, and shows that the makeup water requirements will decrease each year as water released from inactive areas becomes available and the environmental contributions will increase due to the increasing heap footprint. The makeup requirements predicted by the climate variability water balance are slightly lower than those predicted by the deterministic water balance; however, this also results in more discharge from the heap to the TMF pond and/or Open Pit in the active closure phases of heap operations, as shown on Figure A.4.8-2.

Table A.4.8-1 Annual Process Water Makeup Requirements for HLF

Mine Year	**Process Water Makeup Requirements (m^3/yr.)**					
	Mean	**Maximum**	**5th Percentile Dry**	**Median**	**95th Percentile Wet**	**Minimum**
-3	166,700	467,500	342,500	143,600	112,400	94,500
-2	33,800	186,900	169,600	0	0	0
-1	7,500	147,900	80,400	0	0	0
1	497,900	623,800	599,300	492,800	377,800	250,700
2	463,200	605,700	577,600	462,800	329,200	192,800
3	429,400	593,700	551,500	420,800	301,800	179,200
4	421,200	578,500	547,800	408,100	290,000	189,800
5	409,900	564,300	536,700	394,700	276,600	183,200
6	401,700	562,300	535,100	388,900	263,000	181,400
7	385,100	561,700	521,600	373,300	243,900	169,700
8	381,100	553,400	515,200	369,400	250,800	181,100
9	372,500	547,600	516,400	357,100	248,000	179,400
10	367,800	541,500	504,800	354,700	246,400	179,800

Mine Year	Process Water Makeup Requirements (m³/yr.)					
	Mean	Maximum	5th Percentile Dry	Median	95th Percentile Wet	Minimum
11	362,500	529,100	500,100	355,600	234,500	159,200
12	318,400	493,200	457,000	306,000	187,700	118,200
13	383,800	565,000	522,300	371,500	257,100	187,300
14	379,600	569,900	518,700	367,800	255,400	189,200
15	216,100	329,200	298,400	208,100	175,400	170,200
16	240,200	356,200	315,000	229,500	197,400	192,200
17	239,400	352,700	320,000	226,800	195,800	190,600
18	237,400	357,600	315,100	226,600	193,800	190,700
19	235,300	355,600	311,700	225,000	191,800	189,600
20	240,500	357,400	313,500	229,900	199,500	194,500
21	239,800	348,400	315,100	226,900	198,700	193,400
22	238,700	348,300	313,300	229,900	195,600	190,600
23	239,500	352,700	320,200	228,900	194,800	192,800

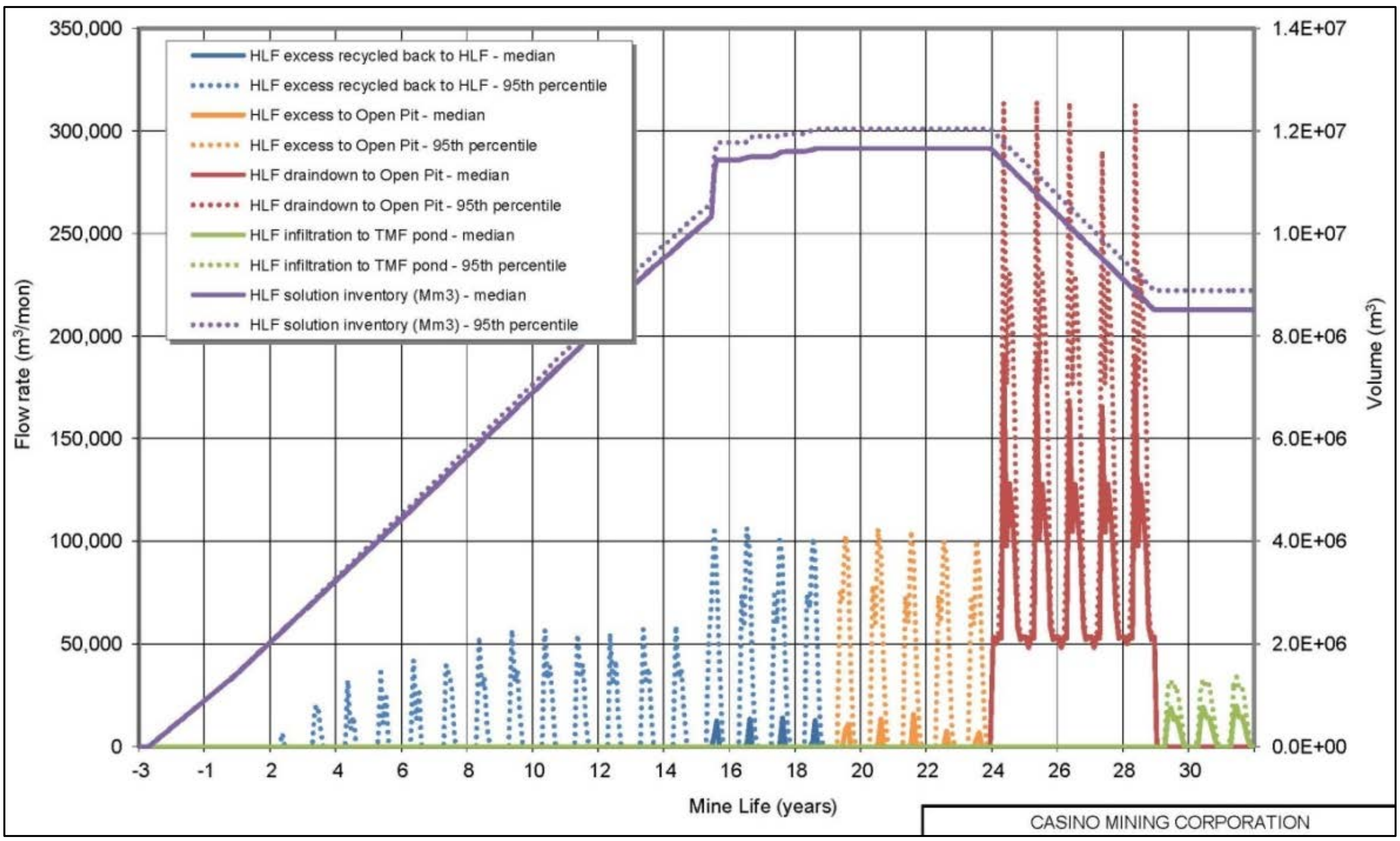


Figure A.4.8-2 Heap Leach Facility – Accumulated Water and Monthly Surplus

Figure A.4.8-2 presents estimates of the surplus water generated from the heap as well as the accumulated water stored in the heap, for the median and 95th percentile wet cases. The heap will be in a surplus condition from July to September, in Years 15 to 23 (median case), because the environmental inputs will exceed the leaching water requirements during these months. The surplus water from Years 15 to 18 (blue line) is assumed to be recycled to inactive areas of the heap, therefore adding to the water inventory in the heap. During the rinsing phase (Years 19 to 23) no additional water will accumulate in the heap because the surplus water (orange line) will be pumped to the Open Pit to aid in pit filling. Once the heap draindown commences in Year 24, the stacked ore is assumed to drain to the long-term residual moisture content of 5% (by mass) over 5 years until Year 29. During the heap draindown phase, the draindown water will be discharged from the heap at a constant rate of 52,535 m3/mon (1726 m3/day) plus whatever environmental inputs occur (rain plus snowmelt), which will result in the seasonal discharge pattern illustrated by the red line on Figure A.4.8-2. The surplus water during this phase is assumed to be pumped to the Open Pit. Once the draindown flow reaches manageable levels, as of Year 29, the closure cover on the heap is assumed to become effective by reducing the infiltration through the heap by 80% of net precipitation, and accordingly the water discharged from the heap will be reduced, as shown by the green line. From this time onwards, in perpetuity, the heap discharge as well as the runoff from the closure cover will be routed naturally downstream to the TMF pond.

A.4.8.4.5 R54

R54. Rationale for the selection of design criteria for HLF events pond and events pond spillway sizing. Include a discussion on potential consequences resulting from larger hydrological events.

The consequences that could potentially result from the occurrence of a hydrological event that is larger than a design event will depend on how much the event exceeds the design event. The events pond is sized to store the excess HLF surface runoff volume associated with 1 in 100 year 24-hour rainfall event plus snowmelt. If the storage capacity of the events pond is exceeded, water would discharge over the spillway and into the TMF, where it would be contained. If the capacity of the spillway is exceeded, which is very unlikely given that the spillway will be sized to pass flows with a return period of 200 years while maintaining 0.3 m of freeboard, then the spillway would overtop and flow would spill onto the face of the events pond embankment and could cause erosion and ultimately failure of the embankment. If this was to occur, the eroded embankment material and the contents of the events pond would discharge into the TMF.

A.4.8.5 Wells

A.4.8.5.1 R55

R55. Discussion on the potential for the buckling and decreasing efficiency of collection wells for leachate recovery.

The potential for “buckling” or other events that could result in a significant decrease in the efficiency of collection wells is low, but there are some situations (e.g. seismic event) that could result in this occurring. In the unlikely event of “buckling” or any other event that results in a significant decrease in the efficiency of collection wells for leachate recovery which cannot be rectified using reasonable corrective measures, a new leachate recovery well would be developed at a suitable location in proximity to the existing well (but far enough away to avoid any associated problems attributable to the original cause of the decrease in the efficiency of the collection well).

A.4.8.6 Ore Stacking Rate

A.4.8.6.1 R56

R56. Estimates for the approximate tonnage in each ore lift within the HLF.

The ore will be placed in bench lifts approximately eight metres in height. The total tonnage associated with each lift depends on the length of the lifts which is dictated by the natural ground slope. The approximate average tonnage will be 4,250,000 tonnes per lift.

A.4.8.6.2 R57

R57. Clarification on the leach cycle activities and durations.

The HLF will be relatively insensitive to leach cycle duration due to the multi-lift design. Additional detail is provided in Appendix A4.C Feasibility Design of the Heap Leach Facility, with specific reference to Section 6.2 of the report.

Ore stacking will be conducted 300 days/year and leaching 365 days/year until the leach pad is no longer required for operations. Seasonal stacking of the ore reduces the risks and challenges associated with stacking during winter. Ore stacking will be placed in subsequent eight metre lifts and irrigation lines will be set in place. Then the overlying ore lift will be placed to a thickness greater than the depth-of-freeze to prevent freeze up of the irrigation lines and permit year round leaching. Each leach cycle will last for approximately 60 days. Complete drawdown will occur once the active leaching process has been completed for any given slice of the heap footprint.

A.4.8.6.3 R58

R58. Identify additional metallurgical test work that has been undertaken or is planned prior to/during construction and operation to improve leach cycle time estimates.

Please see Table A.4.8-2 below for a summary of the test work that is either planned or underway. Lab reports are provided in Results of Additional Lab Testing of Leach Ore (Appendix A.4E).

Table A.4.8-2 Additional Lab Testing of Leach Ore

Report Date	Author	Testing Laboratory	Title
Metallurgical Reports			
May 2012	G. Fontes	Metcon Research	Column Leach Study On Gold Composite Sample
Feb 2014	S. Brinkman	Knight Piésold; Daniel B. Stephens and Associates	Geotechnical Laboratory Testing of Leach Ore (ref. no. VA101-325/16-2)
Oct 2014	M. Gantumur	SGS Metcon	Column Leach Study on Lithology Composites
Oct 2014	K. Ausburn	FLS Smidth	Swelling Clay Analysis
Jan 2015	A. Guzman	HydroGeoSense	Hydrodynamic Characterization
Jan 2015	N. Katsikaros	Gekko Systems	Cyanide Detox Group Testwork Report

Currently, CMC has various metallurgical test work programs in progress, including column leach testing of representative composite samples, hydrological testing (including ore permeability testing), and material characterization work. Depending on the final results of such testing, CMC may initiate further follow up testing to further develop and optimize the design and operating parameters for the proposed heap leach operation.

A.4.8.6.4 R59

R59. A discussion on the implications of the following scenarios and provide consideration of options that the mine could implement should the following unforeseen conditions occur during construction and operations:

a. leach times that are significantly increased for short or extended times. As an example, if the leach cycle is unexpectedly increased from 60 days to 100 days for an extended time;

b. shortages in stockpile capacity for excess oxide ore should the expected HLF stacking rate need to be reduced;

c. possible extension of the HLF operation beyond Year 15 due to longer than anticipated leach cycles; and

d. requirements for additional gold ore stockpile capacity and/or provisional spare leach pad later during operations since the surface area of the lifts will be reduced as the heap extends upslope.

Please also refer to the response to R57 for a description of the leach cycle activities and durations.

A designated Gold Ore Stockpile is present to the east of the deposit area. The gold ore is stockpiled here prior to crushing and placement in the heap. The production rate of leachable ore from the Open Pit is highly variable from one year to the next, while leaching operations are limited by the available equipment to a certain range of annual production rates. The ore stockpile attenuates the variability of the Open Pit production, in years when an excess of ore is produced all excess is placed in the stockpile, in years when Open Pit production is lower than the design HLF stacking rate the remaining ore demand is sourced from the stockpile.

The variability of the gold ore production and the resulting size of the Gold Ore stockpile are listed in Table 4.2 of Appendix A.4F Waste Storage Area and Stockpiles Feasibility Design. The Gold Ore stockpile reaches its maximum size in Year 3, closely followed by Year 10. Additional storage capacity could be made available by either expanding the footprint of the Gold Ore stockpile, or by placing the gold ore in low grade ore stockpile areas that are not used to their full extent at this time.

Please note that subsequent to the completion of the Appendix A.4F Waste Storage Area and Stockpiles Feasibility Design, the ore and waste stockpile schedule was updated and included in the Proposal submitted on January 3, 2014.

As the operation of the heap leach facility is generally independent of the other mine facilities, no complications are expected to be associated with extended heap operation.

A.4.8.7 Road Section Details

A.4.8.7.1 R60

R60. Additional details regarding the HLF confining embankment giving consideration to the varying functions of the structure (i.e. HLF stability, leach solution storage, road traffic, and housing services). Details should include:

a. construction methods and design of the section of the access road situated between the confining embankment toe and the events pond;

b. measures incorporated into its design to protect any buried services and the confining embankment drainage blanket; and

c. clarification regarding whether or not the confining embankment drainage blanket will extend under the road and daylight in the tailings management facility area.

The access road construction between the confining embankment toe and the events pond will use the same methodology as other roads on-site. Construction details will be prepared during detailed design.

All pipelines, liners and drainage blankets will be installed as per best management practice guidelines and industry standard methods. These methods and guidelines dictate minimum burial depths, bedding material thicknesses, tie-in requirements and anchoring systems.

The drainage blanket under the HLF embankment will extend under the road and be hydraulic connected into the Events Pond. The drainage blanket under the Events Pond embankment will be hydraulically connected to the TMF.

A.4.8.8 Construction and Commissioning

A.4.8.8.1 R61

R61. A detailed schedule for the works required to construct the HLF and commence leaching operations. Consideration should be given to key QA/QC requirements and contingency planning for scheduling delays.

The proposed heap leach pad will be developed in five stages in order to reduce schedule and cost implications at each stage.

At the start of each of the development stages preparation of the pad foundation and embankment foundation is required. Foundation preparation entails the stripping of approximately 0.5 metres of topsoil and vegetation and the removal of any talus boulders. The underlying frozen colluvial and residual soils will be excavated down to a competent, stable bedrock foundation. Any ice-rich materials will not be suitable for use as borrow in embankment construction and therefore will be transported to the TMF for disposal. Once foundation preparations are completed construction of that stage of the HLF embankment will be completed.

Once that stage of embankment is completed, the prepared subgrade, geosynthetic liner, leak detection and recovery system, geotextile, soil liner, and geosynthetic liner will be placed on the pad and embankment face. With each successive embankment lift the liner system will be extended up the face to create a continuous liner system. Timing of embankment raises will be developed to ensure that water and solution management requirements are met and to promote stability of the stacked ore.

Once the facility is lined, the leachate recovery system will be put in place in the overliner layer and ore stacking will be ready to commence.

During the construction phase, construction and material quality control and quality assurance procedures will be carried out on behalf of CMC. The QA/QC procedures shall establish and maintain an effective quality control program prior to commencement and during execution of the all works. This will form the means of ensuring compliance with the design requirements, drawings and specifications and for maintaining records of control, including tests and inspections, their findings, and the remedial actions taken when necessary. Frequency, duration and type of testing will be consistent with applicable Codes maintained under the Canadian Standards Association.

Samples of construction materials and tests considered necessary to ascertain that the materials being placed meet the material requirements and specifications will be taken. The results of the tests carried out will be used to determine whether the materials are in compliance with the Specifications and Drawings.

Continuous inspection of construction methodologies and material quality testing through the construction of the Works will be done. A Professional Engineer representing CMC will carry out periodic independent inspection and testing throughout the construction of the works. For quality assurance the Professional Engineer representing CMC will approve QA/QC testing results prior to proceeding with Works. The QA/QC testing results will be recorded and available for inspection on site by applicable regulatory inspectors.

A contingency will be built into the HLF construction plan to account for unforeseen circumstances, including but not limited to issues identified through the QA/QC process.

A.4.8.8.2 R62

R62. Implications of scheduling delays or suspension of HLF construction.

Any reasonably foreseeable scheduling delays or suspension of the HLF construction can be addressed through stockpiling of the gold ore until construction resumes. Once construction resumed, ore crushing and processing would resume.

A.4.8.8.3 R63

R63. Details on the specialized personnel required to construct, operate, maintain, monitor and oversee the HLF.

The requirements of specialized personnel for the construction, operation, maintenance, monitoring and oversight of heap leaching operations have been well-documented in the industry and there is generally a good understanding of the requirements. The management and supervision of facilities at the Project will be performed by qualified and experienced individuals directing operating personnel would have been trained to operate the facilities safely, effectively and with due regard for the importance of operating in an environmentally responsible manner.

A.4.8.8.4 R64

R64. The missing Section 4.4.4 of the project proposal.

The reference to Section 4.4.4 of the Proposal was in error. An outline of the location of information describing the HLF in the Proposal is provided below (bold sections content, other headings are included for ease of reference):

PROJECT DESCRIPTION
4.3 CONSTRUCTION PHASE
4.3.2 Principal Project Components and Activities
4.3.2.4 Heap Leach Facility Development
4.5 CLOSURE AND DECOMMISSIONING PHASE
4.5.2 Closure Objectives for Principal Project Components and Activities
4.5.2.2 Heap Leach Facility
4.7 TECHNOLOGIES
4.7.1 Heap Leach Technology
4.7.2 Heap Leach Reclamation Technology

APPENDICES
Appendix 4A Conceptual Closure and Reclamation Plan
Appendix 7F Water Balance Report

A.4.9 TAILINGS MANAGEMENT FACILITY

A.4.9.1 Design Methodology and Feasibility

A.4.9.1.1 R65

R65 Additional justification and rationale for the "high" hazard classification for the tailings management facility. In addition, provide details on construction and design implications of using an "extreme" hazard classification.

A dam classification was carried out to enable appropriate design earthquake and flood events design criteria applicable for the TMF. The selection of appropriate design earthquake and flood events has been based on classification of the tailings dam using criteria provided by the Canadian Dam Association's (CDA) "Dam Safety Guidelines" (2007), shown in Table A.4.9-1.

Table A.4.9-1 Dam Classification

Dam Class	Population at Risk[1]	Incremental Losses		
		Loss of Life[2]	Environmental and Cultural Values	Infrastructure and Economics
Low	None	Zero	Minimal short-term loss No long-term loss	Low economic losses; area contains limited infrastructure or services
Significant	Temporary only	Unspecified	No significant loss or deterioration of fish or wildlife habitat Loss of marginal habitat only Restoration or compensation in kind highly possible	Losses to recreational facilities; seasonal workplaces, and infrequently used for transportation services
High	Permanent	10 or fewer	Significant loss or deterioration of *important* fish or wildlife habitat Restoration or compensation in kind highly possible	High economic losses affecting infrastructure, public transportation, and commercial facilities
Very High	Permanent	100 or fewer	Significant loss or deterioration of *critical* fish or wildlife habitat Restoration or compensation in kind possible but impractical	Very high economic losses affecting important infrastructure or services (e.g., highway, industrial facility, storage facilities for dangerous substances)
Extreme	Permanent	More than 100	Major loss of critical fish or wildlife habitat Restoration or compensation in kind impossible	Extreme losses affecting critical infrastructure or services (e.g., hospital, major industrial complex, major storage facilities for dangerous substances)

NOTES

1. Definitions for population risk:
   None – There is no identifiable population at risk, so there is no possibility of loss of life other than through unforeseeable misadventure.
   Temporary – People are only temporarily in the dam-breach inundation zone (e.g. seasonal cottage use, passing through on transportation routes, participating in recreational activities).
   Permanent – The population at risk is ordinarily located in the dam-breach inundation zone (e.g. as permanent residents); three consequence classes (high, very high, extreme) are proposed to allow for more detailed estimates of potential loss of life (to assist in decision-making if the appropriate analysis is carried out).
2. Implications for loss of life:
   Unspecified – The appropriate level of safety required at a dam where people are temporarily at risk depends on the number of people, the exposure time, the nature of their activity, and other conditions. A higher class could be appropriate, depending on the requirements. However, the design flood requirement, for example, might not be higher if the temporary population is not likely to be present during the flood season.

Classification of a tailings dam is carried out by considering the potential incremental consequences of a failure. The incremental consequences of failure are defined by the CDA as *"the total damage from an event with dam failure minus the damage that would have resulted from the same event had the dam not failed."* The consequences of failure considered include loss of life, environmental and cultural impacts and losses, and economic loss.

There is no permanent population at risk downstream of the TMF and the potential for loss of life from a dam failure is considered minor, but cannot be discounted, particularly during operations when there will be work activities in the waste storage area and intermittently in areas downstream of the TMF. The economic consequences (including clean-up, repair and remedial works) would also be high.

The environmental impact on downstream watercourses has the potential to be significant if a failure resulted in the release of tailings and/or process water into Casino Creek. An uncontrolled release into Casino Creek may flow into Dip Creek and potentially to the Yukon River by way of the Klotassin, Donjek and White Rivers. Fish species present in Casino Creek include Arctic Grayling, Burbot, and Slimy Sculpin. In addition to these species, Round Whitefish have been observed, and Chinook Salmon are likely present in Dip Creek. The fish species present are all currently listed as 'Unthreatened' under the Species at Risk Act and are widespread in the region, as is rearing habitat. Based on the methodology presented by Eagen and Greenaway (2010, 2011) and the results of environmental baseline studies, the environmental consequences of a dam failure would be defined as HIGH, based on the classification criteria provided by the CDA Guidelines.

Consequently, a HIGH dam classification was assigned to the TMF. It should be noted that the height and size of the dam is not part of the criteria set by CDA to determine the Hazard Classification Consequence Category, though this was taken into consideration and the dam was designed to exceed the requirements set by HIGH consequence classification in the CDA guidelines.

Maximum embankment deformations and settlements calculated for the 1/10,000 year seismic event (consistent with an EXTREME classification) are less than 0.5 m and do not have a significant impact on the available embankment freeboard (minimum of 3.0 m) or result in any loss of embankment integrity (Appendix A.4D Report on the Feasibility Design of the Tailings Management Facility).

The dam is designed to pass a flood event consistent with an EXTREME classification (24-hour PMF) post-closure, when a spillway is present. Additional conservatism was adopted for flood events during operations, when no spillway is present. The IDF during operations is the "one third between 1,000 years and the Probable Maximum Flood (PMF) event". The IDF during operations was based on the more conservative 72-hr duration return period values, compared to the commonly adopted 24-hour duration values. The resulting design flood volume exceeds that of the 24-hour PMF. The resulting flood event was deemed to provide a design with sufficient freeboard and storm storage to safeguard the TMF during operations. Additional explanation for the rationale for selection of the flood events is provided in R75.

A.4.9.1.2 R66

R66. If available, comparisons with other similar sand embankments or compacted sand dams, and/or natural analogs within similar environments. The discussion should include details on permeability, stress, strength, and performance of these structures.

Information and discussion of the considerations and performance of large cyclone sand dams and cold climate considerations is provided in the Report on the Feasibility Design of the Tailings Management Facility (Appendix A.4D). The report includes a discussion on the potential impact of large confining stresses (high dam) on material permeability and shear strength.

Additional investigation, materials testing and analyses will be carried out during detailed design to investigate and confirm the influence of dam size and cold climate on material characteristics, constructability and long-term performance.

Please refer to the response to R94 for additional information for similar cyclone sand embankment dams in cold regions.

A.4.9.1.3 R67

R67. Detailed rationale for the selection of the factor of safety during dam construction.

The minimum factor of safety requirements adopted for the embankment design are consistent with the recommendations of the CDA Dam Safety Guidelines (2007). Recommendations provided by the CDA Technical Bulletin "Application of Dam Safety Guidelines to Mining Dams" (including minimum factor of safety requirements) have also been considered during the design process.

It is understood that the minimum factor of safety of 1.3 for "End of Construction before Reservoir Filling" provided by the 2007 CDA Guidelines may not apply to a tailings dam that is constructed in stages and filled over time. The CDA Technical Bulletin for Mining Dams (2014) indicates a minimum factor of safety (between 1.3 and 1.5) should be selected based on consideration of the consequence of failure, the loading conditions, and strength parameters. The bulletin suggests that "a factor of safety of 1.3 may be acceptable during construction of a dam where the consequences could be minor and measures are taken during construction to manage the risk such as detailed inspection, instrumentation, etc.". Regardless, the TMF embankment design satisfies a minimum static factor of safety requirement of 1.5. Stability analyses conducted for the Feasibility Design studies indicate static factors of safety greater than 2.

It is anticipated that a minimum static factor of safety requirement of 1.5 will be used for future embankment design studies and stability assessments. The minimum factor of safety requirements will be reviewed during each stage of the design process and for each embankment raise, through to the final dam configuration and for closure. This will include consideration of the level of data and confidence in material strength characterisation, including potential for long-term strength degradation and the effect of high confining stresses.

A.4.9.1.4 R68

R68. Evidence demonstrating that the stability of the proposed TMF dam can be achieved through a post-closure period lasting thousands of years. Include a discussion on technically feasible options for managing the risk to downstream areas in perpetuity.

The dam has been designed for closure to criteria corresponding to the highest (EXTREME) dam consequence classification to satisfy long term stability. Stability analyses planned for detailed design will include consideration of the level of data and confidence in material strength characterisation, the potential for long-term strength degradation and the effect of high confining stresses and seismic loading.

A.4.9.2 Earthquakes

A.4.9.2.1 R69

R69. An explanation on the likelihood and implications of saturation of the TMF dam's foundation, drains, and lower portions.

The design objective is to maintain sand fill in an unsaturated state. Sufficient embankment drainage provisions will be provided to achieve this objective. The condition of the embankment sand fill and the performance of the drainage conditions and provisions will be monitored during operations (including appropriate instrumentation) and reviewed for each stage of TMF expansion. Additional details and analyses for the embankment drainage provisions and expected performance will be developed during detailed design. This will include review and comparison to the characteristics and performance of existing large sand fill embankments.

The embankment drainage zones will be designed to be sufficiently oversized and robust to accommodate long-term fill settlements (with consideration of the large confining stresses) and potential deformations (e.g. due to earthquake loading).

A.4.9.2.2 R70

R70. Justification and rationale for using a factor of 1.5 for ground motion amplification for potential slip surfaces in the embankment foundation.

Foundation conditions (and corresponding Vs30) were estimated using information and data provided by geotechnical drilling investigations at the site. Amplification factor is based on the foundation conditions encountered at the site and correlation with typical (published) amplification factors for similar ground conditions and ground motion amplitudes.

Site-specific dynamic response analyses to estimate potential ground motion amplification will be conducted for detailed design studies. This will include incorporation of the findings of previous and additional geotechnical drilling investigations to review and refine the characterization of foundation conditions (including selection of appropriate dynamic stiffness and damping characteristics).

A.4.9.2.3 R71

R71. Clarification if V_{s30} is site specific and how it was derived.

Please see the response to R70.

A.4.9.2.4 R72

R72. Mean peak ground acceleration values derived from EZ-FRISK.

A detailed site-specific seismic hazard analysis will be completed in detailed design. This will include the most recent ground motion attenuation equations applicable to the region, and consideration of near-field (shallow crustal) earthquake sources and more distant faults. The Alaska-Aleutian mega-thrust (subduction) zone will also be considered in the analysis to examine its contribution to the seismic hazard at the project site. Ground motion parameters provided by the seismic hazard analysis will include design ground motion amplitudes (including the mean peak ground acceleration), response spectra defining the frequency characteristics of scenario events, and earthquake magnitudes.

A.4.9.2.5 R73

R73. Explanation of the difference between Natural Resources Canada spectral periods and the spectral periods presented in the report on the feasibility of the TMF.

The difference in response spectra is primarily due to the use of more recently published ground motion attenuation equations (NGA), compared to that used for the NRC spectra. The spectra used for the Feasibility design are more conservative than the NRC spectra (over the period range of interest), and likely more accurate as it incorporates more recent ground motion attenuation relations. This will be reviewed and revised as appropriate as part of the detailed site-specific seismic hazard analysis to be completed for detailed design.

A.4.9.2.6 R74

R74. Explanation on monitoring and remediation activities that may be required during closure including the extent of remediation required in event of an MDE.

Details of monitoring requirements during operations and closure and potential remediation activities required during closure will be developed as part of the Operation, Maintenance and Surveillance (OMS) and Closure Plan documents developed during detailed design. This will include consideration of remediation activities required following an MDE event, based on the predicted response and performance of the TMF provided by detailed seismic response and deformation analyses completed for detailed design.

A.4.9.3 Flood Modeling

A.4.9.3.1 R75

R75. Reassess and model the IDF and PMP using modern storm expansion techniques. In addition, provide:

a. a full description of the methodology used; and

b. rationale for using a 100-year design snowpack.

Part a.

The methodology for developing the return period 24 hour precipitation events for the TMF feasibility study were estimated for the project site using a statistical method approach, as presented in the Rainfall Frequency Atlas for Canada (Hogg 1985). This approach involves using estimates of the mean and standard deviation of the annual 24-hour extreme precipitation, and utilizes frequency factors based on the Extreme Value Type I (Gumbel) distribution. Estimates of the mean and standard deviation were derived directly from the Atlas. A factor of 1.2 was applied, as recommended in the Atlas, in recognition of potential orographic effects and the fact that the Atlas values are largely based on data from valley stations. The resulting mean and standard deviation values are 25 mm and 6 mm, respectively, and the corresponding 24-hour return period rainfall depths are summarized in Table A.4.9-2.

Table A.4.9-2 Extreme 24-hr Rainfall Values

Return Period (years)	Frequency Factor	Extreme Event (mm)
2	-0.164	29
5	0.719	35
10	1.305	39
15	1.635	42
20	1.866	43
25	2.044	45
50	2.592	49
100	3.137	53
200	3.679	56
500	4.395	62
1000	4.936	**66**
PMP	17.973	**159**

As stated in the Report on the Feasibility Design of the Tailings Management Facility (Appendix A.4D), the 72-hour PMP and 1:1,000 year rainfall depths were estimated by scaling the 24-hour values by ratios of 1.6 and 1.3, respectively, based on measured depth-duration values developed by the National Oceanic and Atmospheric Administration (NOAA 1999). A clarification should be made that the 1000 year ratio was based on rainfall data in Alaska (NOAA 2012), not California as stated in YG's comment. NOAA (2012) does not provide equivalent PMP depth-duration values for Alaska, so that is why the California data was used for the PMP scaling factor. The storm regime in California is likely different than that of Casino and Alaska, but the PMP scaling ratio was taken as the upper end of the envelope and is believed to be reasonably conservative (i.e. high) for scaling from the 24-hr duration to the 72-hr duration.

The Hershfield method is based on a statistical estimation approach, as outlined in the World Meteorological Organization's (WMO) report "Manual of Estimation of Probable Maximum Precipitation (PMP)" (2009). The WMO report (2009) presents various methods for estimating PMP for smaller watersheds (< 1000 km^2); however, the majority of the methodologies require long-term detailed climate records, i.e. 50 years or more of hourly and daily rainfall, temperature, dewpoint and wind data. For the Casino project, the Hershfield method was the most appropriate given the short-term site specific climate available, since dewpoint and wind records are insufficient or lacking.

To account for the size and potential impact of failure of the TMF, the inflow design flood (IDF) used in the design of the TMF was based on the 72-hr duration return period values, which equate to much greater volumes than the corresponding and more commonly adopted 24-hr duration values. The resulting 72-hr PMP value of 254 mm was deemed to provide a design with sufficient freeboard and storm storage to safeguard the TMF during operations.

Part b.

The snowpack present during the IDF was assumed to be equivalent to a 1:100 year snowpack with a snow water equivalent (SWE) of 256 mm. Selection of the 100 year snowpack was based on the HIGH dam classification assigned to the TMF, for which the appropriate IDF of "one third between 1,000 years and the Probable Maximum Flood (PMF)" event was adopted. Based on recommendations in the CDA Guidelines (CDA 2007), the PMF was computed with the PMP combined with snow accumulation with a frequency of 1 in 100 years. The Yukon Government maintains a snow course station (09CD-SC01) within the proposed project site footprint, and the average annual maximum snowpack was estimated to be approximately 140 mm (SWE), with a standard deviation of 36.9 mm, based on SWE data from 1977 to 2011 (refer to Table 2.10 in Appendix A.4G). The 100 year snowpack value of 256 mm was estimated using these values and assuming a Gumbel distribution.

Additional details are provided in:

- Appendix A.4D: Report on the Feasibility Design of the Tailings Management Facility, VA101-325/8-10, Rev 0, December 20, 2012, prepared by Knight Piesold Ltd.; and
- Appendix A.4G: Updated Hydrometeorology Report, VA101-325/8-11, Rev 0, July 9, 2012, prepared by Knight Piesold Ltd.

A.4.9.4 Spillways

A.4.9.4.1 R76

R76. Rationale for not constructing an emergency spillway for the TMF during operations.

As described in Appendix A.4D (Report on the Feasibility Design of the Tailings Management Facility), there is no spillway during operations to pass flood water from the TMF. The rationale for not providing an emergency spillway during operations is based on the factors described below.

Based on the site wide water balance for the project, the system (including the TMF, open pit dewatering, and contributing catchments) operates in a deficit condition during operations, in that it is not able to supply enough water to meet all the mill process water requirements. Therefore, make-up water is required from an outside source (i.e. pumping from the groundwater extraction system adjacent to the Yukon River) to support mill operations. Hence, the TMF was designed with sufficient pond capacity to store the maximum pond volume predicted from the water balance, so that the maximum amount of water available can be used in mill processing to reduce the amount of make-up water required from an outside source.

During operations when tailings and waste rock are being deposited and inundated in the TMF pond, the water quality is not suitable for discharge to the downstream environment without treatment. Therefore, the TMF has been designed with sufficient freeboard and storm storage requirements during operations to safely store the maximum predicted pond volume, as well as the Inflow Design Flood (IDF) based on the dam hazard classification (Appendix A.4D).

The TMF IDF storm storage and freeboard requirements are described in Appendix A.4D. Based on the HIGH dam classification assigned to the TMF, an appropriate IDF is an event equal to the 24-hour “one third between 1,000 years and the Probable Maximum Flood (PMF)” event. However, since there is no spillway during operations the 72-hour “one third between 1,000 years and the Probable Maximum Flood (PMF)”event was adopted as the IDF during operations to ensure sufficient storm storage on top of the freeboard requirements and prevent discharge from the facility.

A.4.9.4.2 R77

R77. A discussion on potential consequences of HLF failure resulting in displacement of water in the TMF.

Additional detail on the heap leach facility is provided in Appendix A.4C (Feasibility Design of the Heap Leach Facility), and specific information relevant to the request is provided below.

- The stability analyses for the Casino heap leach facility were carried out using the limit equilibrium computer program SLOPE/W. In this program a systematic search is performed to obtain the minimum factor of safety from a number of potential slip surfaces. Factors of safety were calculated using the rigorous Morgenstern-Price method of analysis.
- Predicted heap leach pad deformations calculated for the design earthquake are negligible, if any, and would not impact operations at the HLF.
- The consequences of failure of the HLF during an earthquake event are likely to be minimal and restricted to some displacement of the heap leach pad slopes.
- There would be negligible impact on the integrity of the HLF and little, if any, impact on other Mine site facilities.

Based on the foregoing, an analysis of the potential consequences of HLF failure resulting in displacement of water in the TMF has not been conducted.

A.4.9.4.3 R78

R78. A discussion and details of the methodology used to determine closure spillway requirements and relevant data such as time distribution of rainfall and relevant hydrographs.

The closure spillway was sized to safely convey the PMF hydrograph, which was generated on the basis of the PMP plus associated snowmelt. Details of the PMP and snowmelt determination are provided in the response to R76. The PMP was distributed assuming an SCS Type II rainfall distribution, which produces the highest intensity rainfall of the four SCS distribution types, and the SCS runoff curve number was selected to be 98, which is exceptionally high and reflects a condition of snow and ice cover with virtually no abstraction and infiltration losses. The unit hydrograph for the storm was assumed to be the standard SCS unit hydrograph, and the time of concentration was estimated to be very short 48 minutes. The inflow hydrograph had an estimated peak flow of 919 m^3/s, which includes a snowmelt contribution of 64 m^3/s. The resulting peak outflow in the spillway was approximately 45 m^3/s, with the water level rising a maximum of 1.1 m above the spillway invert, to elevation 996.1 m, thereby providing 1.9 m of freeboard. The TMF Closure Spillway inflow and outflow hydrographs are shown on Figure A.4.9-1.

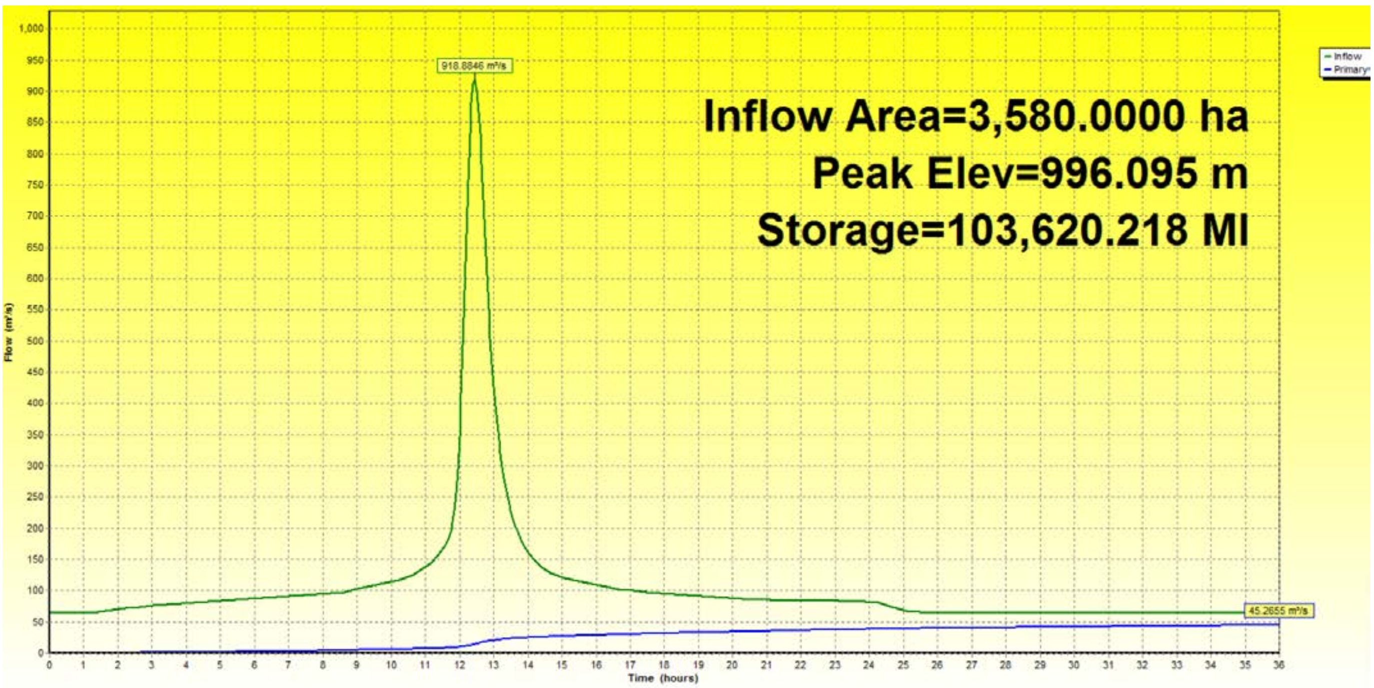


Figure A.4.9-1 TMF Closure Spillway – Inflow and Outflow Hydrograph

A.4.9.4.4 R79

R79. Discussion of the potential for closure spillway blockages and expected extent of maintenance and monitoring the spillway.

The potential for closure spillway blockage is considered low due to the large size of the spillway, the relative absence of large woody debris within the TMF catchment, and the likelihood that any such debris would be trapped within the wetlands upgradient of the spillway. The spillway will be a 20 meter wide side sill, with 2 horizontal to 1 vertical lateral slopes, excavated in bedrock to an invert elevation of 3 m below the crest of the dam. The condition of the spillway (including the potential for blockages) will be inspected and assessed on an annual basis during closure, and any necessary debris removal or maintenance undertaken at that time.

A.4.9.4.5 R80

R80. Identify mitigations, with appropriate thresholds for implementation, and monitoring activities for closure spillway related erosion, both in the spillway channel and downstream water bodies.

The requested details of mitigations, thresholds for implementation and monitoring activities associated with the closure spillway will be developed as part of the environmental management and monitoring plans prepared for submission for the Quartz Mining License and Water Use License applications.

A.4.9.5 Embankment Failure

A.4.9.5.1 R81

R81. A dam breach analysis with water/tailings inundation modeling consistent with the Canadian Dam Association's dam safety guidelines including:

a. probable maximum flood inundation map showing the maximum extent of flooding relating to a sudden full storage embankment breach extending to when expected flooding is within the natural water channels;

b. an assessment of environmental and human impacts associated with a release of tailings;

c. an assessment of potential impacts to First Nation Settlement Lands;

d. an assessment of impacts to downstream infrastructure;

e. mitigation measures in the event of a tailings breach; and

f. for each proposed breach scenario a cross section of the critical TMF embankment, proposed loading factors, and each scenario's factor of safety.

Casino Mining Corporation will undertake a dam breach analysis and inundation model consistent with the Canadian Dam Association's (CDA) dam safety guidelines.

The CDA recommends that a dam breach analysis be undertaken for two reasons:

- To assess potential incremental consequences of failure as a basis for determining Dam Classification in accordance with CDA "Dam Safety Guidelines"; and
- To prepare inundation mapping in support of emergency response and preparedness planning.

It is important to acknowledge that standardized procedures and guidelines for conducting tailings dam breach modelling do not exist at this time in Canada, the US, or, to the best of our knowledge, any first world jurisdiction. The guidelines for dam breach analyses that are generally followed throughout the world were developed for water retaining dams, and as such, are not fully applicable for tailings dams. The CDA recently issued a Technical Bulletin in 2014 titled "Application of Dam Safety Guidelines to Mining Dams"; however, this document does not prescribe procedures for conducting dam breach analyses, but rather is limited to identifying "some specific issues that should be considered during the design and safety evaluation of mining dams" (CDA 2014). Accordingly, the choice of what methodology is selected for tailings dam breach analyses, including whatever simplifying assumptions are made about the mode of failure and its defining characteristics, is largely reliant on the judgment and experience of the engineer.

In general, the mining and dam safety communities are making efforts to standardize the procedure for a dam breach analysis and they are struggling with the practicalities of conducting meaningful assessments when every step of the process is inherently uncertain. Tailings storage facilities are designed to contain tailings and associated water for all conceivable conditions, and as such, should never fail if they are designed, constructed and operated according to standard engineering practices. Accordingly, it is very difficult to conceive of a credible failure mode for properly engineered structures. In order to conduct a dam breach analysis for the purpose of assessing potential downstream consequences, a failure mode must be selected, the size of the embankment breach must be approximated, the volumes of released tailings and water must be estimated, and the resulting runout pattern of the released material must be modelled. The considerable uncertainty involved in each step of the analysis, combined with the lack of any standardized or mandated approach for completing such an analysis, results in very large uncertainty in the modelled results. It is important that all dam breach modelling results be viewed in the context of this framework and its limitations.

Casino Mining Corporation and its consultants have developed a work plan to respond to the request for information in R81: however, CMC believes that it is most appropriate to develop mitigation measures in the event of tailings dam breach as part of emergency response and preparedness planning and this is not warranted at this stage of the Project.

The CDA (2007) further outlines that “the evaluation should address initial hydrologic conditions for the following:

- “Sunny-day” failure – This is a sudden dam failure that occurs during normal operations. It may be caused by internal erosion, piping, earthquakes, mis-operation leading to overtopping, or another event.
- “Flood-induced” failure (or “rainy day”) – This is a dam failure resulting from a natural flood of a magnitude that is greater than what the dam can safely pass.”

The dam breach analysis will be completed for the sunny and rainy day failure scenarios for the ultimate TMF dam arrangement, with the largest volumes of tailings and water in the impoundment.

A dam breach analysis requires information from a variety of previous reports and studies for input such as:

- The design of the TMF embankments and other relevant facilities;
- Topography (i.e. elevation data) and type of terrain downstream of the dam;
- Hydrologic information for the downstream network; and
- Identification of downstream points of interest including human settlements, important infrastructure, and locations of particular environmental or social concern.

In order to assess the incremental effect of a dam breach event on the downstream environment, an assessment of various natural return period flood events is necessary, including estimating the relevant return period flood events for main downstream tributaries for the sunny and rainy day failure scenarios.

The dam breach analysis and resulting inundation mapping relies heavily on the dam breach characteristics used in the analysis. These characteristics include identification of the location of the breach and other breach parameters, such as shape, width, depth, and rate of formation.

This task will identify the credible failure modes (i.e. *overtopping* or *collapse*) for the relevant sunny and rainy day failure modes. A dam breach analysis is used to determine the discharge from a hypothetical breach of a dam immediately downstream of the dam based on a set of breach characteristics. Results from this task will include:

- The volume of free water in the pond;
- The volume of mobilized tailings;
- The peak discharge; and
- The outflow flood hydrograph.

Sensitivity analysis will be used to investigate how alternative parameters for breach size, time of breach development, and initial reservoir conditions affect the peak discharge. A “worst case” for the sunny and rainy day dam failure scenarios will be carried forward to flood routing and inundation mapping.

Flood routing describes the movement of the flood wave as it traverses downstream of the dam to a location far enough downstream where the effects would be negligible. Flood routing is used to determine the reduction of the peak discharge as the flood moves downstream (attenuation), the travel time of the peak flood to various points of interest, the maximum water levels (depth) at various points of interest, and the change in shape of the flood hydrograph as it moves downstream. The maximum flood depth (inundation depth) is used to generate inundation maps.

One dimensional hydraulic routing model will be developed to provide an understanding of flood routing and inundation levels downstream. The model will use existing project mapping covering the areas downstream of the TMF in combination with the publically available NTS maps. A potential limitation of the model will be the available mapping, which are 25 m contours closer to the Project and 100 ft contours farther downstream. The model will be developed in the software package HEC RAS or an equivalent modelling system, and will interface with GIS to develop the inundation maps.

There are limitations in accurately modelling the effects of a tailings dam breach because the science is relatively new (CDA, 2014). There is no definitive “state of practice” for such an analysis. Two common approaches are:

- Tailings are modelled as an equivalent volume of water if released with an initial discharge of water.
- Tailings are modelled as mud/debris flow using a rheological model.

Modelling tailings as an equivalent volume of water tends to be more conservative and has been more commonly used in practice. The latter approach is highly uncertain as the rheological parameters for the tailings outflow are unknown. It tends to be restricted to paddock style impoundments with relatively flat receiving environment, or research type studies. The first approach will be used in this study.

The effects of the governing (worst case) dam breach failure scenario will be assessed for the downstream environment. Within this assignment, this task will focus specifically on the impacts to downstream infrastructure, First Nation Settlement Lands, and other human impacts.

The results of the dam breach and inundation study will be summarized in a technical report. Though CMC would like to point out that it is very important that all dam breach modelling results be viewed in the context of its framework and limitations. The report will include a summary of the TMF embankment design, and a discussion of dam breach characteristics, flood routing characteristics, inundation mapping, and potential impacts.

A.4.9.6 Dam Core and Downstream Filter

A.4.9.6.1 R82

R82. Rationale for the proposed thickness of the core and downstream filter, considering the dam height and permanent performance requirements.

The dam has been designed with a conventional centreline construction method that is commonly adopted and well accepted for tailings dam design. The starter dam, which will retain water at the start of operations, is designed using a tapered core zone. A tailings beach will be developed upstream of the dam to accommodate subsequent raises. The tailings beach is an integral part of the design which keeps the pond at a distance from the dam. This reduces both the quantity of seepage and the hydraulic gradient. Results from the seepage analysis verify that only a small portion of the seepage passes through the core above 830 m elevation, and reduced hydraulic gradients are present. The potential for piping through the dam is further decreased by implementing filter and transition zones.

Preliminary analyses documented in the Report on Feasibility Design of the Tailings Management Facility (Appendix A.4D) indicate maximum deformations and settlement resulting from a 1/10,000 year seismic event are less than 0.5m. The thickness of the core zone (20m), filter (4m) and minimum freeboard (3m) exceed the calculated maximum deformation. Consequently the 1/10,000 year seismic event is not expected to have a significant impact on the available embankment freeboard (minimum of 3m) or result in any loss of embankment integrity.

Advanced deformation analyses are typically conducted during detailed design to verify the predicted deformations and settlements.

A.4.9.7 Use of Cyclone Sand in Embankments

A.4.9.7.1 R83

R83. Rationale for the ceiling of 12 percent fines in cycloned sand to be used in embankment construction including a discussion of frost susceptibility and drainage characteristics.

The particle size distribution of the Casino mill tailings is a key consideration for determining the suitability of the bulk non-reactive tailings to provide cyclone sand of suitable quality and in sufficient quantity. Coarser tailings are preferred, as a higher sand fraction or ‘split’ can be realized. Clean sand with sufficiently low fines content will be required for placement, in order to facilitate rapid drainage and subsequent compaction.

Experience from existing large cyclone sand dams indicates that the sand fill should have an in situ permeability equal to or greater than 2×10^{-4} cm/s (Barrera, Valenzuela and Campana 2011). This will ensure the rapid drainage of construction water (following cyclone sand placement), seepage water and direct precipitation. Cyclone sand from copper tailings with a fines content in the range of 15 and 20 percent typically have a sufficiently high permeability for adequate drainage. This criterion continues to be valid provided the sand grain size is not significantly changed by particle crushing, due to high confining stresses imposed by dams of large height. Chilean experience for large copper cyclone sand tailings dams indicates that high confining stresses do not significantly affect the sand grain size.

Permeability and strength testing has been conducted on a laboratory generated sample of cyclone sand material, generated from the anticipated bulk tailings stream. The testing did not indicate evidence of particle crushing, and measured permeability values were greater than 2×10^{-4} cm/s, even at high confining stresses. From consideration of the large height and size of the Main Embankment, the current design requires that the fines content of the cyclone sand be less than 15%, in order to ensure adequate compaction, strength and drainage characteristics. A maximum fines content of 12% has been adopted for the Feasibility design. There may be an opportunity to increase the fines content a few percent to allow increased sand quantities, based on actual performance during operations and material characteristics (permeability and strength) of the cyclone sand. The potential to provide more sand fill material will allow increased operating flexibility related to construction activities.

Please refer to response R94 for a discussion of cyclone sand operations in cold climates, including frost susceptibility.

A.4.9.7.2 R84

R84. Provide testing or analyses to demonstrate that pore pressures, shear strength, angles of friction, and contraction of cyclone sand is acceptable at all pressures found in the TMF embankment.

A discussion of the strength characteristics of cyclone sand is provided in Section 5.3 of The Report on Laboratory Geotechnical Testing of Tailings Materials (Appendix A.4R).

The manufactured cyclone underflow was tested up to confining stresses of 2760 kPa. This stress range covers the conditions in the majority of the embankment, especially since the highest stresses occur within the Stage 1 (starter) dam, which does not contain any cyclone sand.

Interpretation of the triaxial shear strength test shows contractive behaviour under high stresses, as noted by the reviewer, resulting in a large strain strength that is lower than the peak strength. The design team has recognised the potential for strain-softening of the cyclone sand and consequently used strength parameters for large strains (20%) in stability analyses. The large strain friction angle is an estimate for the critical state friction angle, and not the peak strength as suggested by the reviewers.

A.4.9.7.3 R85

R85. Clarification on the specific gravities of cyclone overflow and underflow.

Section 2.2 of Appendix A.4D Report on the Feasibility Design of the Tailings Management Facility indicates a specific gravity of 2.70 for the whole tailings but 2.71 for tailings overflow and 2.80 for cyclone underflow. The reviewer comments are that are it is not clear how the specific gravities of both constituent parts can be greater than the specific gravity of the whole.

This inconsistency will be validated in detailed design by conducting additional specific gravity laboratory testing. However, refinement of the specific gravities for cyclone tailings overflow and cyclone tailings underflow are not expected to significantly change the cyclone sand volume calculations. The estimated average dry density of cyclone sand used for design was 1.65 tonnes/m^3. Typical values for compacted cyclone sand fill are in the range of 1.6 to 1.65 tonne/m^3 (Appendix A.4D).

The Kemess Mine experience shows 100% standard proctor density or greater can be achieved in practice with proper construction and compaction methods (Rasmussen G *et al.* 2004). Compacted densities of around 1.55 tonne/m^3 are typically achieved in the Kemess sand cells. Standard proctor testing of the manufactured cyclone underflow at Casino indicate a 100% standard proctor density of 1.56 tonne/m^3. It is reasonable to assume a 95% or even 100% standard proctor density can be achieved based on the Kemess experience. Loading resulting from dam raises will result in further compaction of the cyclone sand. The effect of densification is illustrated by the results of triaxial tests on cyclone underflow, which indicate dry densities of 16.6 tonne/m^3 at approximately 350 kPa to 17.3 tonne/m^3 at 2750 kPa. It is concluded that the selected density is within the range of expected densities.

Both the specific gravity and dry density design estimate will be verified during detailed design.

A.4.9.7.4 R86

R86. Justify the upper range of 2.0 m for proposed lift heights of cyclone sand.

The lift thickness for the cyclone sand using the cell construction method is expected to be between 0.5 m and 2.0 m. This range is based on typical lift thicknesses successfully used in existing operations with cyclone sand deposition. The maximum thickness that can be used at Casino will depend on the ability to compact the material to the specified density. The design of the sand cells, including the lift height, will be refined during detailed design. Trial test cells will be used to verify that the sand cells will provide a suitable dense fill that complies with construction specifications. The sand placement operations will be further optimized during operations, as required.

A.4.9.8 Faults and Shear Zones

A.4.9.8.1 R87

R87. Supporting evidence for the absence or presence of faults and fractures within the TMF and embankment areas including their activity.

Site investigations have encountered zones of broken rock in the embankment area that could indicate faults or shear zones. These zones were identified in drillholes and geophysics. Additional site investigations as part of detailed design will investigate the presence and properties of discontinuities in the embankment area, including test trenching and additional drillholes.

Review of historical earthquake records and regional tectonics indicates that the Project site is situated in a region of low seismicity. No earthquakes (>3.5 magnitude) are listed in the earthquake databases within 80 km radius of the Project site, as illustrated in Figure 3.1 of Appendix A.4D Report on the Feasibility Design of the Tailings Management Facility. This indicates that faults in the Project area have not been active for the period of record. Consequently, no evidence is available of any active faults in the Project area.

A.4.9.9 Hydraulic Conductivity of Bedrock and Overburden

A.4.9.9.1 R88

R88. Additional drill results, with detailed analysis and discussion, to provide an accurate characterization of the hydraulic conductivity and identification fault/shear zones within the embankment foundation.

Geotechnical site investigation programs were conducted in 1994, 2010, and 2011 to collect data within the embankment foundation to characterize subsurface geology and hydraulic conductivity. Results of these investigations indicate the following geologic conditions exist beneath the embankment:

- Drilling with packer testing (Lugeon and falling head tests) was conducted in 18 drillholes in and near the embankment foundation. Bedrock within the embankment foundation was described as highly fractured/weathered or faulted at drillholes DH10-01, DH10-02, DH10-03, DH10-04, DH10-05, DH11-21A, DH11-23A, and DH11-25.
- Based on subsurface temperature data collected from thermistors, anecdotal information from standpipes such as the presence of frozen water, and the results of inferred permafrost mapping, drillholes with unfrozen subsurface conditions advanced in and near the proposed embankment foundation include drillholes 94-348, DH10-01, DH10-02, DH10-03, 94-350, 94-351, DH11-22, and DH11-29. Results of hydraulic conductivity tests conducted within the upper 35 m in bedrock from these unfrozen drillholes range from <1x10-8 m/s (DH11-22) to 5x10-6 m/s (94-351) with a geometric mean value of 2x10-7 m/s. No additional hydraulic conductivity data has been collected within the embankment foundation since 2011, or since preparation of the Proposal.
- Based on seismic surveys conducted in 2011 and summarized in the Report on the Feasibility Design of the Tailings Management Facility (Appendix A.4D), two zones within the competent bedrock were identified with relatively low seismic velocities. These low velocity zones were encountered in the seismic refraction data at

chainage 40 NE on line G11-08 (on the east abutment of the Main Embankment) and at chainage 600 NE on line G11-06 (near drillhole DH10-03 on the west abutment). These low velocities are consistent with zones of highly fractured and weathered bedrock, and likely indicate shear or fault zones in the bedrock.

The hydraulic conductivity values assigned to the seepage model presented in the Report on Revised Tailings Management Facility Seepage Assessment (Appendix A.4L) are consistent and slightly conservative for the bulk hydraulic conductivity values encountered within the near surface bedrock beneath the proposed embankment. Bulk hydraulic conductivity values assigned to the seepage model were $5x10^{-7}$ m/s for the near surface fractured rock layer and $1x10^{-7}$ m/ for the underlying bedrock layer. The analysis of hydraulic conductivity values only included results from test intervals that were considered to be unfrozen.

Additional work to characterize hydraulic conductivity with in the embankment foundation is planned ahead of detailed design. The additional work includes advancing new drillholes within the embankment foundation, conducting packer testing in the drillholes, and conducting response tests in standpipes. Trenching will also be conducted to identify fault/shear zones beneath the embankment foundation.

A.4.9.9.2 R89

R89. Details regarding the cut off trench and seepage control for the TMF embankment including:

- **a. clarification on the depth of the cut-off trench and justification based on the depth of overburden and fractured bedrock;**
- **b. an updated cross section of the TMF embankment that includes the cut off trench and associated seepage barrier;**
- **c. a profile diagram of the cut off trench showing its depth across the dam core, along with available information on the depth of overburden and fractured bedrock;**
- **d. a discussion of measures to address fractured bedrock; and**
- **e. a discussion on the use of a grout curtain to control seepage.**

Part a., b., c. and d.

The overburden in the Casino Creek valley bottom comprises fine grained ice-rich colluvial apron, and coarse alluvium close to Casino Creek. Thawing of these soils could potentially lead to stability issues, differential settlements, and zones of high permeability. The area underlying the embankment that is characterised by these deposits is shown on Figure 4.2 of Appendix A.4D. All soils in this area will be excavated to competent bedrock. The depth to bedrock increases to over 20m towards the valley bottom, with an average of approximately 10m in this area. The removed material will be replaced with core, filter or shell zone material, depending on the location relative to the embankment. Replacing the predominantly ice-rich overburden with core zone material effectively provides a large seepage cut-off, as illustrated on the main embankment cross-section in Figure 5.9 of Appendix A.4D.

Thin deposits of colluvial veneer and residual soil dominate the valley slopes (i.e., outside of the area shown in Figure 4.2 of Appendix A.4D Report on the Feasibility Design of the Tailings Management Facility). These materials will be removed when ice-rich and underlying the embankment. Materials can be left in place at locations where they do not contain excess ice. At these locations a low permeability cut-off is required beneath the core zone to provide an effective seepage control barrier. The seepage cut-off trench will extend through the foundation soils and key into competent bedrock, at an average depth of about three meters for both the Main and West Embankment. A typical section through the West Embankment is also provided in Figure 5.9.

The estimated depth of excavation of unsuitable materials as described above includes the upper meters of bedrock where the rock mass is very weak, completely to highly weathered, and heavily fractured. The actual depth is not known accurately before the start of construction and will be determined by assessing the geotechnical conditions during excavation. The geotechnical criteria to determine this depth will be developed as part of the detailed design, and will be based on rock mass characteristics, hydraulic conductivity testing, seismic refraction data and ripability.

The hydraulic conductivity of the rock mass underlying the TMF was investigated using packer permeability and falling head tests. The upper 35 m of bedrock is characterized by a saturated hydraulic conductivity of 5×10^{-5} cm/s, and the underlying rock mass has a conductivity of 1×10^{-5} cm/s. A low permeability seepage cutoff cannot be practically achieved by excavation for these conditions. A 5 metre thick low permeability upstream blanket is included in the design to reduce seepage from the TMF.

Additional characterization of the rock mass underlying the TMF will be completed as part of detailed design.

Part e.

Weak zones and discontinuities that act as preferential seepage paths below the core zone of the dam are expected to require grouting. The extent of the grouting is to be assessed during detailed design and will be adjusted based on conditions encountered during construction.

Injection grouting is challenging in cold temperatures and areas where permafrost is present as ice can form a blockage to any grouting paths through the rock. Ground heating methods can be implemented as required to thaw ground before injection. It will be important to determine the effectiveness of grouting by testing the permeability of the foundation before and after grouting, and to monitor the amount of grout accepted by the foundation.

A.4.9.10 Presence of Frost-Susceptible or Frozen Materials During Construction

A.4.9.10.1 R90

R90. Further characterization of the dam foundation materials to confirm the presence and distribution of permafrost.

Discontinuous permafrost is present beneath the proposed embankment foundation. The inferred spatial distribution of permafrost at the site is presented in Figure 2.3 of the Baseline Hydrogeology Report (Appendix 7C of the Proposal). Permafrost within the embankment is expected beneath the Embankment footprint along the northwest-facing valley slope and along the lower banks surrounding both sides of the stream channel. The base of permafrost extends to between 27 to 68 mbgs at thermistor locations within and near the dam footprint (94-349, DH11-21B, DH11-23B, DH12-01, DH12-02, and DH12-03). Additional site investigation work within the dam foundation is planned as part of detailed design.

A.4.9.10.2 R91

R91. Details regarding plans to ensure embankment foundations do not incorporate frozen and/or frost susceptible soils during construction.

Additional site investigations, including test pits and laboratory testing, will be conducted during detailed design to further characterize foundation soils. The overburden in the embankment footprint will also be visually assessed during construction to determine suitability as foundation material.

A.4.9.11 Cold Weather Construction of the Embankments

A.4.9.11.1 R92

R92. A detailed schedule for the works required to construct the TMF before and during operations. Consideration should be given to key QA/QC requirements and contingency planning for scheduling delays and freezing conditions.

In the existing schedule, conservative assumptions have been made to take into account scheduling delays due to cold weather. A detailed schedule for works associated with the construction of the TMF will be prepared as part of the Quartz Mining License and Water Use License applications. Please refer to the response to R93 for a discussion of the considerations and mitigations measures that have been incorporated into the Project to avoid and minimize the potential effects of cold climate on the construction schedule.

A.4.9.11.2 R93

R93. Implications of scheduling delays or suspension of dam construction during the nine month construction period.

The potential implications of dam construction delays as a result of cold climate are minimized by the Project through the following measures:

- Conservative estimates are used for flood events and allowance for run-up protection.
- The core and filter zones of the dam will be constructed during warmer months when soil freezing will not occur. The dam will be built to an elevation that provides sufficient capacity to satisfy the storage requirements until (at least) the next construction season. This effectively means that the dam is built ahead of the minimum required height. Any delays during the construction season can be compensated by continuing construction in winter under less favourable conditions, before the storage requirement is reached at the start of the next construction season.
- The dam will be constructed using a minimum 3H:1V overall downstream slope. Surplus sand produced after initial years of operations will be placed at the toe of the dam, outside of the minimum footprint for the embankment raise. This additional material already in place at the toe of the dam provides a contingency for potential delays during construction of the next lift.
- Contingency borrow rockfill sources are available for unexpected shortages of cyclone sand. Placement of rockfill in the embankment shell zone can take place any time of the year, including under freezing conditions.

Winter temperatures can have the benefit by improving the conditions on sites with soft ground, allowing machinery to access otherwise swampy areas while the earth is frozen. This advantage will be used in scheduling construction activities, to undertake activities including construction of roads, clearing of vegetation, stripping of topsoil and preparation of the dam foundation in winter conditions. Limiting the number of activities required for dam construction during the construction season reduces the potential for construction delays.

A.4.9.11.3 R94

R94. A review of relevant examples of sand embankment dams constructed in cold weather environments. This review should identify challenges, potential issues, and solutions surrounding sand placement and QA/QC.

There is ample precedent in North America for tailings dam construction using cyclone sand, but this technique has not been used for large tailings dams in the Yukon. The key challenges related to hydraulic placement of cyclone sand during extended periods of freezing temperatures are:

- Freezing of saturated sands in active cells before compaction takes place
- Burial of frozen fill in the embankment could result in impermeable layers below active cells preventing the required downward drainage required for hydraulic fill placement

Examples of mine operations in British Columbia, where cyclone sand is used to construct the tailings dams, include the Kemess, Gibraltar and Highland Valley mines. Placement of cyclone sand was mostly avoided during the winter months at Gibraltar and Highland Valley because the materials balance for these respective operations did not require placement through the winter months. However, cycloning operations for sand fill construction have been possible during extended periods of freezing temperatures at the Highland Valley and Kemess mines, as outlined below.

A construction delay at the Highland Valley Copper operation required placement of cyclone sand during December 1988 and January 1989 when temperatures did not exceed -10°C for extended lengths of time. The warm cyclone underflow prevented rapid freezing in and below active cells. Inactive cells were subjected to surficial freezing. The frozen layer was ripped up to maintain drainage and eliminate development of a continuous impermeable layer prior to depositing new tailings. The warm tailings slurry subsequently thawed the scarified frozen tailings. Embankment construction was successfully completed during the winter months with no detrimental effect on the quality of the fill placement. Compaction requirements were met as confirmed by field and laboratory testing.

Ongoing raising of the dam necessitated the placement of cyclone sand during the winter months at the Kemess mine, with temperatures typically ranging from -5ºC to -40ºC (Lysay, Davidson and Martin 2007). A placement strategy that provided successful construction of cyclone sand cells in temperatures as low as -40ºC was developed and refined during operations. Sand placement can take place during low temperatures provided a continuous flow of tailings slurry runs through the system. Water is run through the pipes during periods of non-placement to avoid freezing. Interruption of flow is avoided whenever possible as pipelines are susceptible to freezing, require thawing prior to resumption of placement. Critical components including cyclones, flotation cells, and valve stations are heated to prevent freezing.

Construction of the starter berms and preparation of the cells at Kemess takes place during non-freezing temperatures whenever possible. The foundation is inspected to ensure that frozen soil, ice, and excess snow are removed prior to sand placement in the cell.

The Kemess operation allows a maximum of 15% fines in the downstream shell of the dam. Gradation testing indicates fines contents are consistently below this target and generally average about 12%. The cycloned sand at Gibraltar has a fines content range of 7% to 13%, averaging 10%. The maximum allowed fines content of 12% is used for design at Casino. Cyclone sand for these projects is potentially frost susceptible based on the criteria discussed in R99. However, the experience at Kemess shows that the cell construction methodology mitigates ice development in the downstream shell during construction. The final dam will be subjected to seasonal freeze-thaw action post-closure, and the final cover will be designed to account for this.

The above experiences demonstrate cyclone sand placement is possible during winter months, with adequate design, planning and quality control. Nevertheless, the cyclone plant and cyclone sand placement activities are assumed to be operational for only an average 9 months of the year (with a 90% sand plant availability to account for maintenance and other downtime). A comprehensive strategy for cyclone sand placement at the Casino mine will be developed for detailed design and optimized based on experience gained during operations. Rockfill borrow sources can be used if a shortfall of cyclone sand is encountered.

A.4.9.11.4 R95

R95. Methods of erosion control during dam construction.

The downstream shell of the Main Embankment will be built using the cyclone sand cell construction method. This will require construction of long, narrow cells along the face of the embankment. The cyclone sand slurry will be discharged into each construction cell and will be heavily track packed by dozers to meet compaction specifications. The cells will be designed during detailed design, but the cyclone underflow will likely be contained by rockfill berms similar to those shown in Figure A.4.9-2. Filter and transition layers may be required to prevent the migration of tailings sand into the rockfill berms and at other locations where rockfill is utilised for embankment construction. After the cells are no longer active and buried by embankment raises, the rockfill berms will act as internal drains. The rockfill berm at the downstream end of the embankment will form a protective rockfill layer to protect the cyclone sand shell from erosion.

Figure A.4.9-2 Typical sand cell construction showing cyclone underflow contained by berms and compacted by dozer.

Water expelled from the sand will drain from the cells for collection in the downgradient water management pond at the toe of the embankment. Solids collection and water recovery measures will be required at the embankment toe to protect downstream fisheries resources. The sediments will need to be removed by dredging or excavation and all water will be pumped back into the TMF through dedicated pipelines pump-back system.

Provisions will be required to prevent dusting of cyclone sand fill. The potential for dusting can be exacerbated during cold winter conditions as a 'freeze drying' process tends to destroy capillary tensions in partially saturated sand materials, making it more susceptible to dusting. This may mean that the cyclone sand will need capping with erosion resistant fill material such as rockfill, particularly during the cold winter months, when it may be impractical to continue with active sand placement.

In addition to the above provisions related to cyclone sand cell construction, the best management practices for erosion and sediment control described in the Water Management Plan (Appendix 4C) will be implemented.

A.4.9.11.5 R96

R96. Description of ground surface conditions currently in relation to overburden and vegetation and any modification in preparation for the construction and filling of the TMF.

Please refer to Section 4.2.4 of Appendix A.4D Report on the Feasibility Design of the Tailings Management Facility, specifically:

Foundation preparation for the TMF embankments will involve the stripping of topsoil and vegetation and the removal of all talus boulders. The topsoil will be stockpiled for reclamation purposes. The underlying frozen soils will be excavated down to a competent bedrock or suitable overburden foundation, depending on the location relative to the embankment (as discussed in R89). Ice-rich materials are expected to be unsuitable for use as borrow in embankment construction and will be removed to spoil. The quantity of spoil will be significant and may require special measures such as dams or berms to provide containment of the thaw-saturated materials. The ice-rich spoil will be placed in the TMF impoundment to satisfy this requirement.

Overburden (including topsoil) will be left in place in the impoundment area upstream of the dam. Disturbance of the vegetative mat will be avoided to the maximum extent possible to minimize thermal degradation prior to placement of waste materials. The effects that filling of the impoundment will have on the ground conditions will be assessed during detailed design required for future Quartz Mining License and Water Use License applications.

A.4.9.11.6 R97

R97. Discussion on any hydrological changes expected from changing ground thermal conditions and any monitoring to this effect.

Please refer to Section 4.2.3 of the Report on the Feasibility Design of the Tailings Management Facility (Appendix A.4D) for information regarding ground thermal conditions. A summary of key information related to R97 is provided below for the ease of the reviewer.

Thawing of ice-rich soils may lead to excessive settlements, and loss of strength. The ice-rich soils typically exhibit very low strengths when thawed, and flow even under very flat slopes. Two gelifluction lobes that were observed within the colluvial apron in the TMF embankment area are evidence of this potential for instability. Ice-rich soils also have the potential for long term creep displacements.

Disturbance or removal of the vegetative cover may result in the melting of permafrost and the development of unstable conditions. Frozen overburden and bedrock that are underlying part of the tailings impoundment and embankments are expected to thaw over time, as the tailings and water stored in the TMF will act as a heat source. It is therefore recommended that all ice-rich overburden encountered during construction be removed along the entire foundation of the TMF embankments. Ground ice is not expected to be significant in bedrock, and therefore the bedrock will provide a stable foundation for the embankments. Preferential seepage paths may develop when ice filled discontinuities thaw. Bedrock may have to be steamed and grouted if this is the case.

Thermistors were installed during the 2011 and 2012 site investigations to provide a better understanding of the thermal regime in the bedrock. Additional site investigations will be required to confirm the characteristics of the overburden and bedrock, and the extent of permafrost within the TMF embankment area. Thermal modelling may also be required to predict the effect of the proposed TMF on foundation conditions.

A.4.9.11.7 R98

R98. Confirmation that natural or artificial liners are not included as part of the technical design of the TMF embankment.

The TMF embankments will be constructed as water-retaining zoned structures with a low permeability core zone and appropriate filter and transition zones, all constructed of natural materials, to prevent downstream migration of fines. The embankment will be constructed of natural materials that form a competent barrier for tailings and contact water. The core zone of the TMF embankment will include a seepage cut-off keyed into competent rock in the foundation. The embankment filter and transition zones will prevent the migration of fines from the dam core zone and filter zone into the pervious downstream shell zone (rockfill and cyclone sand) and will reduce pore pressures within the embankment. . The filter and transitions zones will consist of suitable crushed and screened rock or local borrow materials. No artificial liners are currently included in the TMF design.

A.4.9.12 Quality and Quantity of Borrow Source Materials

A.4.9.12.1 R99

R99. Confirmation of the availability of non-frost susceptible materials for the construction of the dam core. Include a discussion that demonstrates that the material with a 20 percent or more fines is not a frost susceptible material.

Several guidelines exist for frost susceptibility classification. As a first approximation, soils having more than 10% of material passing the #200 sieve (0.075mm) can be assumed frost susceptible (Barker and Thomas 2013). The Corps of Engineers (Johnson et al. 1986) indicate that gravels with less than 1.5% finer than 0.02mm and sands with less than 3% smaller than 0.02mm are classified to have negligible to low frost susceptibility. All other soils have a wide range of possible frost susceptibility, with a tendency to be more frost susceptible for higher fines content.

The proposed core zone material, with a minimum fines content of 20%, will be frost susceptible based on the above criteria. Frost susceptible soils subjected to repeated freeze-thaw action may exhibit reduced shear strength and increased hydraulic conductivity, which is detrimental to the performance a core zone. However, it is possible to construct a dam with a frost-susceptible core zone in cold regions. This can be achieved by insulating the core zone, thereby preventing the core material to be subjected to repeated freeze-thaw action. Several dams with glacial till core zones have been constructed in cold climates using this approach.

The feasibility report (Appendix A.4D) incorrectly states non-frost susceptibility as a requirement for core zone borrow material. Rather, ice-rich soils should be avoided to prevent potential thaw weakening of this material. Ice-poor core zone borrow materials may be used if thawing prior to placement results in stable materials that are suitable for construction.

Construction of the core zone for Casino will not take place during winter months when soil freezing is likely to occur. Adequate insulation of the core material will be required for the final dam and for intermediate stages. Insulating layers are to be placed over the core after each lift and removed immediately prior to construction of the consecutive lift. Insulating blankets and tarps will be used to keep lifts from freezing during placement and compaction of the dam. Engineers should be in close contact with contractors during the construction phase to verify adequate material quality and compaction, and revise construction procedures as necessary.

A.4.9.12.2 R100

R100. Please provide the Mine Site Borrow Materials Assessment Report (VA101-325/16-3). If not part of the assessment report, include detailed information about:

a. the locations of borrow sources;

b. description of dimensions of borrow source excavations including area and depth of excavations;

c. the estimated quantities of suitable borrow material available;

d. the quantity of borrow material required for engineered mine components;

e. proposed mitigation measures to minimize potential adverse effects associated with the development and use of the proposed borrow sites; and

f. alternatives in the event that dam core material cannot be sourced at the site in sufficient quantities.

The Mine Site Borrow Materials Assessment Report is attached as Appendix A.4Q and addresses requests part a. through d. of R100.

Part e.

Final borrow source selection will consider environmental and socioeconomic values. Measures to partially mitigate the effects of borrow sources on environmental and socioeconomic values are identified in a number of management plans submitted with the Proposal and as supplementary information. CMC will apply the following mitigation measures to reduce the environmental effects of borrow sites, wherever possible:

- Borrow sources will be established outside of riparian areas.
- Avoid new clearing for establishment of borrow areas during the breeding bird nesting season (May 1 to July 31 in Yukon), or conduct nest surveys immediately prior to clearing activities (Appendices A.12A Wildlife Mitigation and Monitoring Plan).
- Sediment and erosion control measures will be used to minimise sediment transport beyond the borrow pit and pits will be sloped away from any watercourses (Appendix A.22C Sediment and Erosion Control Management Plan).
- Natural drainage patterns will be maintained and additional drainage ditches may be necessary to divert surface run-off around borrow pits and reduce the potential for erosion and sediment transport (Appendix A.22C Sediment and Erosion Control Management Plan).
- Avoid the development borrow sites in areas of potentially unstable terrain.
- The number of gravel pits/borrow pits in the area of the Klaza Caribou Herd winter range will be minimized to the extent possible (Appendix A.12A Wildlife Mitigation and Monitoring Plan, Section 4.1).

- The Project footprint, including borrow sources, will not disturb important wildlife habitat features (e.g., mineral licks) or known locations of rare plant occurrences (Appendix A.12A Wildlife Mitigation and Monitoring Plan, Section 4.1).
- Soil will be salvaged during land clearing for use during reclamation (Appendix A.22D Invasive Species Management Plan).
- Areas will be allowed to naturally re-vegetate to reduce the potential introduction of invasive plant species.

Part f.

As discussed in the Mine Site Borrow Materials Assessment Report (Appendix A.4Q), in the event that sufficient core material is not identified from local borrow sources, alternate approaches will be considered including amendments to local borrow (bentonite) and use of an asphalt core. The alternatives presently under consideration have an environmental impact that is equal to or lesser than the local borrow approach proposed as part of the Proposal.

Environmental, economic, design and operating factors will be assessed, including consideration of TMF construction and operation in cold climate conditions. The alternatives to local borrow material will have smaller disturbance areas, and consequently are expected to have less environmental impact.

A.4.9.12.3 R101

R101. A discussion on the thawing and containment of borrow and embankment excavations.

Fill material, from borrow excavations, should be free of frost, snow and ice when used for construction to prevent the development of ice lenses. The borrow areas were selected to contain either non-frozen or ice-poor material which is thaw stable. Soils with high ice contents were avoided in selecting the borrow areas.

Borrow areas that are frozen will be stripped of topsoil to promote thawing during the summer months. The exposure of borrow pits that will be used during several construction seasons will be minimised in order to limit freezing during winter months. Ground insulation such as thermal blankets or mulching may be required to prevent frost-susceptible materials from freezing.

The borrow sites will be excavated in stages to keep pace with construction demands, while minimizing the area of disturbance. Reclamation of the borrow areas will begin when sites are no longer needed, to reduce the potential for soil erosion and sedimentation. The areas will be ripped and graded as required to satisfy long term stability. Measures will be implemented to support re-vegetation and create a stable thermal regime.

Ice-rich materials in the TMF embankment foundation are expected to be unsuitable for use as construction material and will be removed to spoil. The ice-rich soils typically exhibit very low strengths when thawed, and will likely require berms to provide containment of the spoil. The berms will be constructed of coarse soil or rockfill to promote drainage of the thaw-saturated materials. The ice-rich spoil material will be placed in the TMF impoundment, which reduces the requirement for sediment and erosion control measures as sediment laden water will be contained in the impoundment. Details regarding the spoil areas and retaining embankment design will be provided in detailed design for future Quartz Mining License and Water Use License applications.

A.4.9.13 Starter Dam and Tailings Interface

A.4.9.13.1 R102

R102. Clarification on the use of filter-graded zones between the waste rock shells (if selected) of the starter dam and the overlying tailings shells (e.g. to prevent possible future deformation of the tailings shells).

It is recognized that additional transition zones will be required between the various construction materials to satisfy filter relationships and / or reduce differential settlements. Placement of additional rockfill will also be used in the downstream shell of the Main Embankment to supplement any shortfall of the cyclone sand, and to provide additional structural support and drainage, if required, during on-going expansion of the facility. Details will be provided in subsequent design phases and may be amended based on observations on the performance of the rockfill and cyclone sand shell materials.

A.4.9.14 Missing Information

A.4.9.14.1 R103

R103. The missing information referenced in footnote No. 6 on p. 4-54 of the proposal related to Table 4.3-7 (Inflow Design Flood and Earthquake Design Ground Motion).

Please see Table A.4.9-3 below which replaces Table 4.3-7 from the Proposal.

Table A.4.9-3 Inflow Design Flood and Earthquake Design Ground Motion

Dam Class[1]	Annual Exceedance Probability (AEP)	
	Inflow Design Flood (IDF)	Earthquake Design Ground Motion (EDGM)[3]
Low	1/100	1/500
Significant	Between 1/100 and 1/1,000[4]	1/1,000
High	1/3 between 1/1,000 and Probable Maximum Flood[5]	1/2,500[6]
Very High	2/3 between 1/1,000 and Probable Maximum Flood[5]	1/5,000[6]
Extreme	Probable Maximum Flood (PMF)[6]	1/10,000

Notes:

1. AS DEFINED IN TABLE 2-1 OF THE CDA DAM CLASSIFICATION GUIDELINES (2007).
2. EXTRAPOLATION OF FLOOD STATISTICS BEYOND 1/1,000 YEAR FLOOD (10^{-3} AEP) IS DISCOURAGED.
3. AEP LEVELS FOR EDGM ARE TO BE USED FOR MEAN RATHER THAN MEDIAN ESTIMATES FOR THE HAZARD.
4. SELECTED ON THE BASIS OF INCREMENTAL FLOOD ANALYSIS, EXPOSURE, AND CONSEQUENCE OF FAILURE.
5. PMF HAS NO ASSOCIATED AEP. THE FLOOD DEFINED AS "1/3 BETWEEN 1/1,000 YEAR AND PMF" OR "2/3 BETWEEN 1/1,000 YEAR AND PMF" HAS NO DEFINED AEP.
6. THE EDGM VALUE MUST BE JUSTIFIED TO DEMONSTRATE CONFORMANCE TO SOCIETAL NORMS OF ACCEPTABLE RISK. JUSTIFICATION CAN BE PROVIDED WITH THE HELP OF FAILURE MODES ANALYSIS FOCUSED ON THE PARTICULAR MODES THAT CAN CONTRIBUTE TO FAILURE INITIATED BY A SEISMIC EVENT. IF THE JUSTIFICATION CANNOT BE PROVIDED, THE EDGM SHOULD BE 1/10,000.

A.4.10 LIQUEFIED NATURAL GAS AND DIESEL

A.4.10.1 Description of LNG Facilities

A.4.10.1.1 R104

R104. For the LNG storage facilities, regasification facilities, and mobile fueling stations, provide:

a. a detailed description for all facilities related to LNG including location, design, construction, operation and closure;
b. measures for the safety of Project personnel including separation distances from office and living areas;
c. design measures and operating procedures to prevent a cascading accident; and
d. a list of standards and codes that will apply to design and operation of the each component identified above.

Power at the Casino Project will be provided by a liquefied natural gas (LNG) fueled power plant, with construction phase power provided by the Supplementary Power Plant (20 MW) and operations phase power provided by the Main Power Plant (130 MW). The power plant configuration is provided in Figure A.4.10-1.

The Supplementary Power Plant will consist of three internal combustion engines, dual fuel driven generators capable of operating under diesel or LNG. Once the Main Power Plant is functional, power from the Supplementary Power Plant will be used to supplement the Main Power Plant as required and to a limited extent act as a back-up supply if the Main Power Plant is out of commission. The Main Power Plant will produce power from two gas turbine driven generators and one steam driven generator. The internal gas combustion engines will operate solely on LNG.

Beginning in Year -3, the LNG receiving, storage, regasification and distribution facility will be constructed. The LNG receiving, storage and distribution facility will be located at the Plant Site as shown in Figure A.4.10-1. Construction of the LNG facility involves preparation of the foundations, impermeable liners and bedding, layout and welding of floor plates, erecting the LNG storage tank and receiving unit, erecting the vaporization facility, leak testing, installation of interconnecting piping, and installation of dispensing modules for fuel offloading.

The receiving station will unload and transfer the LNG from tanker trucks into the 10,000 m^3 site fabricated storage tank. The LNG will be stored in the tank at -162°C, at 1+ atmosphere pressure. A vaporization facility will convert the LNG into natural gas at an appropriate pressure for use at the power plants or for gas distribution. In addition to providing fuel for the power plants, the LNG facility may provide fuel for the mine haulage fleet, over-the-highway tractors hauling concentrates, lime, grinding media, and the LNG tanker trucks. Two mobile re-fuelers and two portable fueling stations will supply LNG to required locations throughout the Casino mine site. The equivalent of about 10 days of LNG consumption will be stored on site.

Casino Mining Corporation anticipates that LNG will be transported to the Casino mine site from Fort Nelson, British Columbia via double wall vacuum tanker trucks at an average frequency of 2 trucks per day in Years -2 to -1 and 11 trucks per day from Years 1 to 22 (equivalent to 1000 m^3/day). During the first year of the construction phase, primarily diesel fuel will be transported to the Casino mine site and stored in a diesel fuel storage tank installed next to the supplementary power plant. The equivalent of about 10 days of diesel fuel consumption will be stored on site.

The following sections outline further details of the power plant and supporting LNG facility to address comments received during the adequacy review phase of the YESAB process. Specifically, applicable codes and standards, process flow diagrams, key facility parameters and inherent safety mechanisms that will be incorporated into the design of the facility. Emergency response and LNG handling, storage and transportation management are detailed in the Liquefied Natural Gas Management Plan (Appendix A.22G).

The information provided below is based on feasibility level design engineering, and aims to provide assurances to the standards and guidelines that will be met or exceeded in the design of the power plant. Generally, the power plant and ancillary facilities will be required to meet the applicable territorial and federal guidelines and standards, and will require a processing plant license under the Yukon *Oil and Gas Act* Yukon Gas Processing Plant Regulation. Details of the plant operational parameters and design will be provided during the license application process.

Regulatory Context

The LNG facility and ancillary storage tanks will be constructed to meet the requirements outlined in the Yukon *Oil and Gas Act* (YOGA) *Yukon Gas Processing Plant Regulations*, Canadian Standards Association (CSA) standards CSA Z276, National Fire Protection Association (NFPA) codes 59A and NFPA 54, as well as American Petroleum Institute (API) standards 625 and API 620 Appendix Q.

The LNG technical codes and standards summarized in Table A.4.10-1 apply to the LNG supply chain for Casino to include the design, siting, operations and maintenance of the LNG liquefaction supply terminal, LNG transport loading facility, highway transport components and operations, LNG transport unloading (receiving) facility, LNG storage, and vaporization. Examples of specific code sections as they apply to design criteria are outlined in Table A.4.10-2. Additionally, the LNG transportation facilities will comply with the following Canadian Regulations references:

- Canadian Council of Motor Transport Administrators (CCMTA).
- Canadian National Safety Code (NSC) standards.
- *Motor Vehicle Transport Act* (MVTA) that enables provincial and territorial regulation of extra-provincial truck and bus carriers on behalf of the federal government. Under the MVTA, two federal regulations that govern hours of service for commercial vehicle drivers and the issuance or revocation of safety fitness certificates, are:
    - The Motor Carrier Safety Fitness Certificate Regulations, which requires federally-regulated bus and truck motor carriers crossing provincial boundaries or international borders to obtain a safety fitness certificate before they may operate on Canadian highways. These regulations also set criteria for jurisdictions to issue or remove motor carrier safety fitness certificates; and
    - The Commercial Vehicle Drivers Hours of Service Regulations, which set the hours of work and rest rules for federal motor carriers and their drivers.

Table A.4.10-1 LNG Facilities Applicable Codes and Standards

Code or Standard	Topic
NFPA 59A	US based counterpart to CSA Z276 and has similar LNG storage requirements
API 620/API 625	Referenced in both CSA Z276 and NFPA 59A and is the basis for the design of the storage tank systems.
ASME B31.3	The primary standard for the associated piping from the storage tanks to the vaporizers
ASME Section VIII, Vol 1	The primary standard referenced for the design of the vaporizers
API 610	Centrifugal Pumps for General Refinery Services

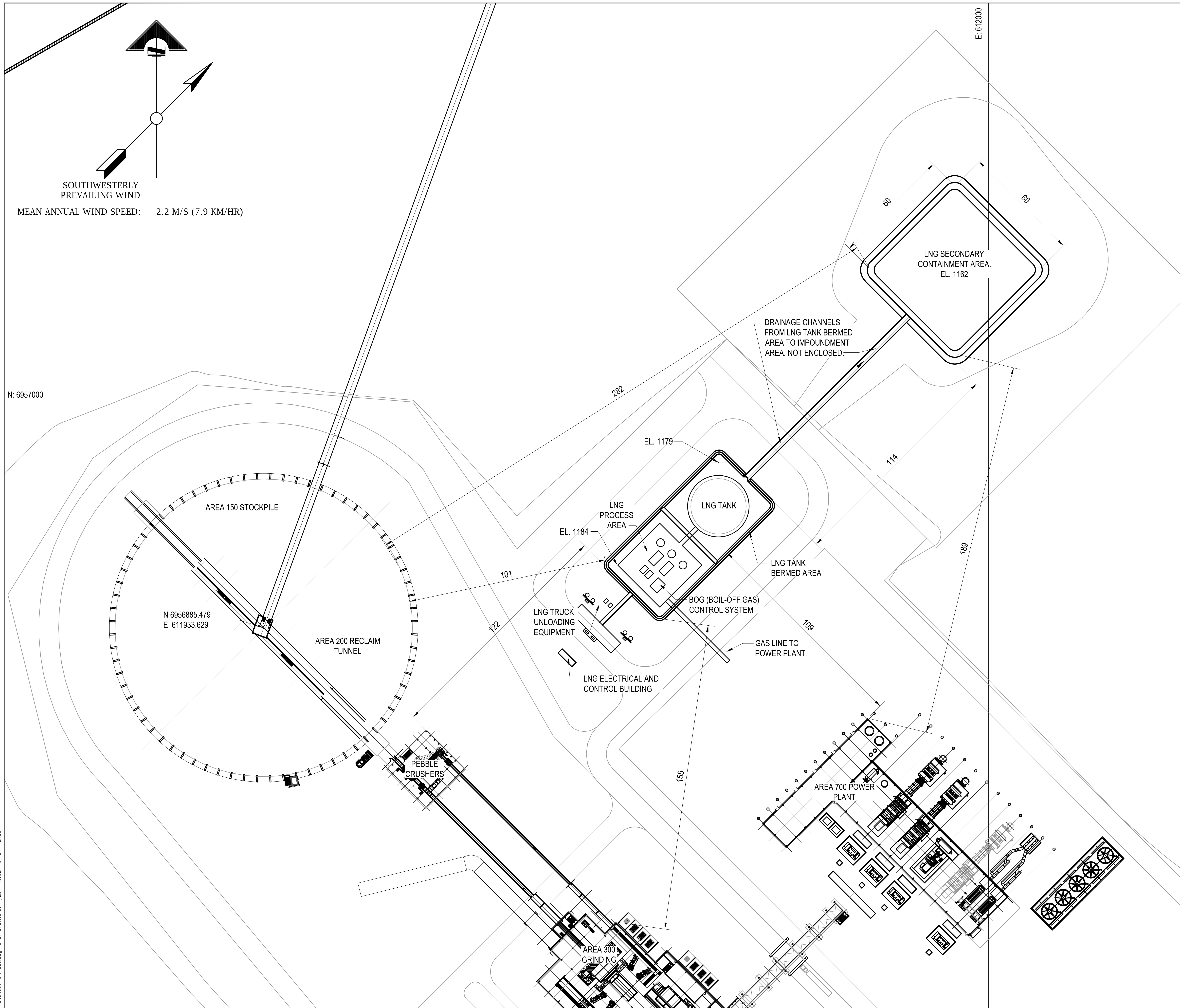
Code or Standard	Topic
CSA Z276	CSA Z276 Canadian Federal Standards for the design, production, storage, and- handling of liquefied natural gas.
Yukon's Oil and Gas Act Gas Processing Plant Regulation	Yukon Territories LNG regulation for design, production, storage, and- handling of liquefied natural gas. This regulation incorporates CSA Z276 by reference.
Canadian Federal Transportation of Dangerous Goods Regulations	Part 5.10: anyone offering for transport or transporting Class 2 gases in large tanks comply with the selection and use criteria set out in CSA Standard B622. Part 5.14: requires that requires that anyone offering for transport or transporting Class 3, 4, 5, 6.1, 8 and 9 dangerous goods in large tanks comply with the selection and use criteria set out in CSA Standard B621.
CSA B620	Tank construction and maintenance for continued dangerous goods service.
CSA B108-99	Natural Gas Fuelling Stations Installation Code: applicable to fleet and public stations
CSA B108-99	Annex –Indoor Refuelling of Natural Gas Vehicles Fueling: facilities within a building with primary functions other than fueling. Does not cover public stations.
CSA B109-01	Natural Gas for Vehicles Installation Code: Applies to "installation, servicing and repair of NG fuel systems on self-propelled vehicles."
NFPA 52	Vehicular Gaseous Fuel Systems Code: US code referenced in Canadian codes for LNG and CNG gaseous vehicle fuel systems and fueling station design and operations.

Table A.4.10-2 LNG Facilities Design Criteria Codes and Standards

Design Criteria	Specific Code/Standard
Secondary Containment	Yukon Gas Processing Plant Regulation
	CSA Z 276: 5.2.2
	NFPA 59A: 5.3.2
Seismic Design	CSA Z276: 7.1.5
Flanged Joints	CSA Z276: 9.3.2.2
Ignition Source Control	CSA Z276: 13.3.4
Uncontrolled Releases	CSA Z276: 8.3.3, 8.3.4, 9.2.1.2, 9.1.4, 9.1.5, 9.1.6 & 9.9.2
Overflow Prevention	CSA Z276: 10.1.1.1. 10.1.1.2, 10.1.1.3, 10.1.1.4, 10.1.2.1
Downwind Ignition Sources	CSA Z276: 5.2.2.1, 5.2.2.2, 13.3.4.4,
Ventilation and Explosion Prevention	CSA Z276: 5.3.2.1, 5.3.2.4

Site Layout

The LNG facility site layout drawing is provided in Figure A.4.10-1, and the process and instrumentation diagrams (P&ID) are provided in Figure A.4.10-2. At this time, only design criteria can be provided, as detailed design of the LNG facility has yet to be completed. Proposed details of the LNG storage tank, utility requirements, loading and unloading facilities and the inherent safety design criteria are provided below. A list of major equipment and process information proposed for the Casino LNG facility is provided in Table A.4.10-3.



LNG FACILITY DATA :

LNG STORAGE TANK AND SECONDARY CONTAINMENT AREA, INCLUDING THE CHANNEL CROSSING THE ROAD AND TO THE IMPOUNDMENT AREA, DESIGNED TO THE SPECIFIC REQUIREMENTS OUTLINED IN THE FOLLOWING STANDARDS:

A. CSA Z276;
B. API 620 APPENDIX Q;
C. NFPA 59A.

LNG SECONDARY CONTAINMENT AREA

SIZE (INSIDE EDGE OF BERM):	60 M X 60 M
CONTAINMENT AREA:	3,600 SQUARE METERS (MAXIMUM AREA FOR POOL SIZE / RADIATION CALCULATION)
CONTAINMENT VOLUME:	11,000 CUBIC METERS (110% OF LNG TANK VOLUME)

LNG TANK

TANK SIZE:	28 M DIAMETER X 17.5 M HIGH (INTERIOR DIMENSIONS)
TANK VOLUME:	10,000 CUBIC METERS
LNG TANK BERM:	2 M WIDE, .75 M HIGH (AREA PROTECTION BERM. NOT THE CONTAINMENT BERM.)

LNG UNLADING PUMPS

NUMBER:	4
CAPACITY:	90 M³/HR. EACH (LNG)

LNG TANK PUMPS

NUMBER:	2
CAPACITY:	45 M³/HR. EACH (LNG)

LNG BOOSTER PUMPS (SUBMERGED)

NUMBER:	3
CAPACITY:	23 M³/HR. EACH (LNG)

LNG GLYCOL/WATER CIRCULATION PUMPS

NUMBER:	2
CAPACITY:	185 M³/HR. EACH (LNG)

LNG VAPORIZERS

NUMBER:	2
CAPACITY:	45 M³/HR. EACH (LNG)

LNG BOG (BOIL-OFF GAS) COMPRESSORS

NUMBER:	2
CAPACITY:	1,171.6 M³/HR. EACH (GAS)

PRELIMINARY
NOT FOR CONSTRUCTION

LNG FACILITY LAYOUT
SCALE: 1:1000

25 12.5 0 25 50
SCALE IN METERS
DO NOT SCALE 11x17 DRAWINGS

REFERENCES		REFERENCES		REVISIONS						REVISIONS					
DWG. NO.	TITLE	DWG. NO.	TITLE	NO.	DESCRIPTION	BY	APP'D	DATE	CLIENT	NO.	DESCRIPTION	BY	APP'D	DATE	CLIENT

SCALE:	1:2000	DATE
DESIGNED BY	TFB	JUL 14
DRAWN BY	TFB	JUL 14
CHECKED BY		
PROJECT MGR		
CLIENT APPR.		

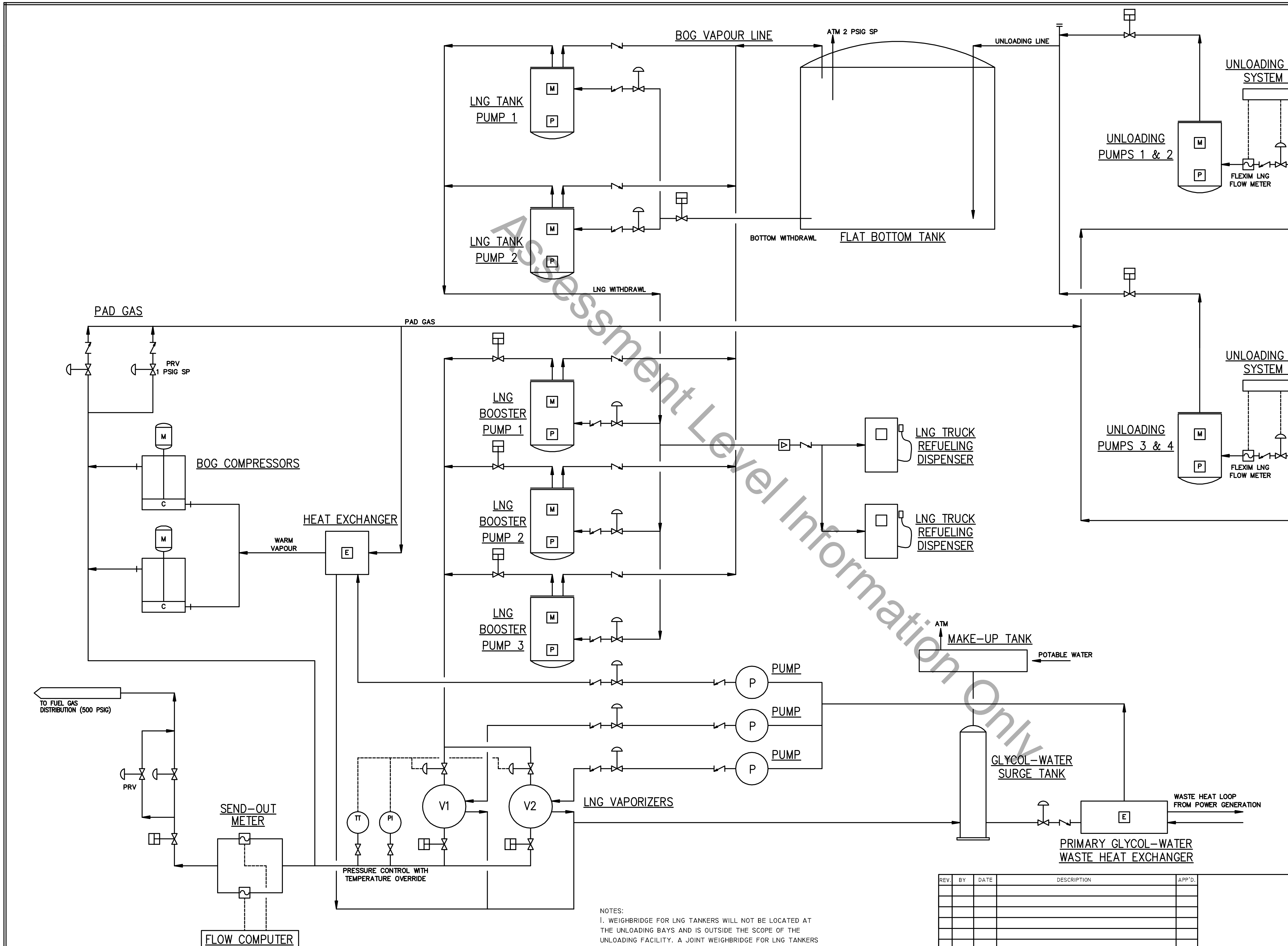
m3 — ARCHITECTURE, ENGINEERING, CONSTRUCTION MANAGEMENT
Tucson, Arizona
Chandler, Arizona
Hermosillo, Sonora Mexico
www. m3eng.com

CASINO MINING CORPORATION

CASINO FEASIBILITY STUDY

CASINO PROJECT
OVERALL SITE
GENERAL ARRANGEMENT
LNG FACILITY LAYOUT

PROJECT NO. M3-PN 120001	
DWG NO.	000-GA-009
REV NO.	DATE
P1	17 SEP 14



NOTES:
1. WEIGHBRIDGE FOR LNG TANKERS WILL NOT BE LOCATED AT THE UNLOADING BAYS AND IS OUTSIDE THE SCOPE OF THE UNLOADING FACILITY. A JOINT WEIGHBRIDGE FOR LNG TANKERS AND ORE TRUCKS WILL BE CONSTRUCTED APART FROM THE UNLOADING FACILITY.
2. IN LIEU OF USING WEIGHBRIDGES DURING THE UNLOADING PROCESS, FLEXIM LNG FLOWMETERS WILL BE USED.

REV.	BY	DATE	DESCRIPTION	APP'D.

SCALE: NONE

APP'D.

DATE

BRAEMAR ENGINEERING.PNG

BRAEMAR TECHNICAL SERVICES (ENGINEERING) INC.
9225 KATY FREEWAY, SUITE 307
HOUSTON, TX 77024

WESTERN COPPER GOLD – CASINO
PROCESS FLOW DIAGRAM
LNG STORAGE & RECEIVING FACILITY

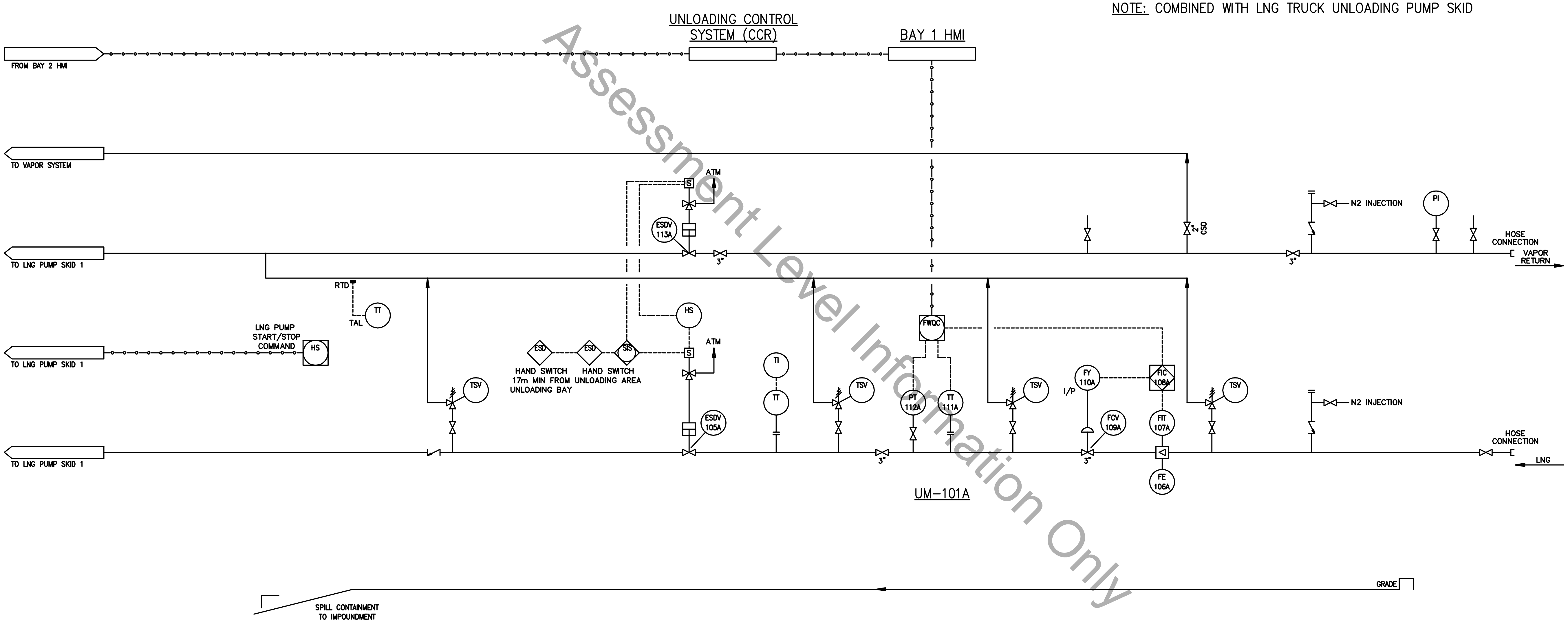
DRAWN TAP | DATE 08/21/2012

DWG. NO. 0

UM-101A
LNG TANKER UNLOADING MANIFOLD
MANIFOLD

DESIGN CAPACITY: 90
DESIGN CAPACITY UNITS: m3/hour (LNG)
OPERATING PRESSURE [barg]: 19
ANSI CLASS: 150
DESIGN TEMP LOW [°C]: −161
DESIGN TEMP HIGH [°C]: 38
MAIN MATERIAL: SS
DESIGN CODE: TBD

NOTE: COMBINED WITH LNG TRUCK UNLOADING PUMP SKID



REV.	BY	DATE	DESCRIPTION	APP'D.

SCALE: NONE

APP'D.
DATE

BRAEMAR ENGINEERING.PNG

BRAEMAR TECHNICAL SERVICES (ENGINEERING) INC.
9225 KATY FREEWAY, SUITE 307
HOUSTON, TX 77024

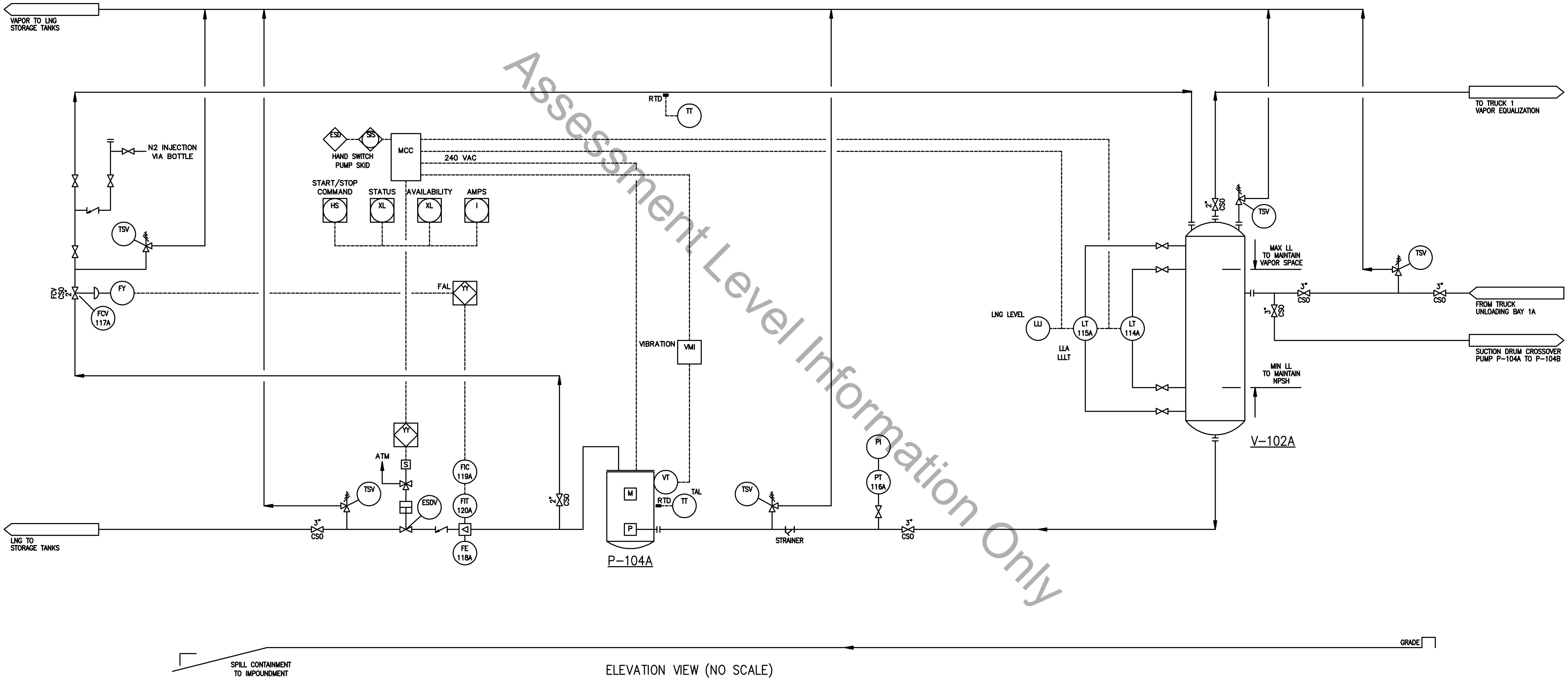
WESTERN COPPER GOLD – CASINO
P&ID AREA 1 LNG TANKER
UNLOADING MANIFOLD BAY 1

DRAWN TAP | DATE 08/21/2012

DWG. NO. 1

V-102A
LNG SUCTION DRUM
VERTICAL VESSEL

DESIGN CAPACITY: 0.50
DESIGN CAPACITY UNITS: m3
OPERATING PRESSURE [barg]: 19
ANSI CLASS: 150
DESIGN TEMP LOW [°C]: −161
DESIGN TEMP HIGH [°C]: 38
MAIN MATERIAL: SS
DESIGN CODE: ASME VIII



ELEVATION VIEW (NO SCALE)

P-104A
LNG TRUCK UNLOADING PUMP
CENTRIFUGAL POT MOUNTED SUBMERGED PUMP & MOTOR

DESIGN CAPACITY: 90
DESIGN CAPACITY UNITS: m3/hour (LNG)
OPERATING PRESSURE [barg]: 8
ANSI CLASS: 150
DESIGN TEMP LOW [°C]: −161
DESIGN TEMP HIGH [°C]: −150
MAIN MATERIAL: SS
DESIGN CODE: TBD

REV.	BY	DATE	DESCRIPTION	APP'D.

SCALE: NONE

APP'D.
DATE

BRAEMAR ENGINEERING.PNG

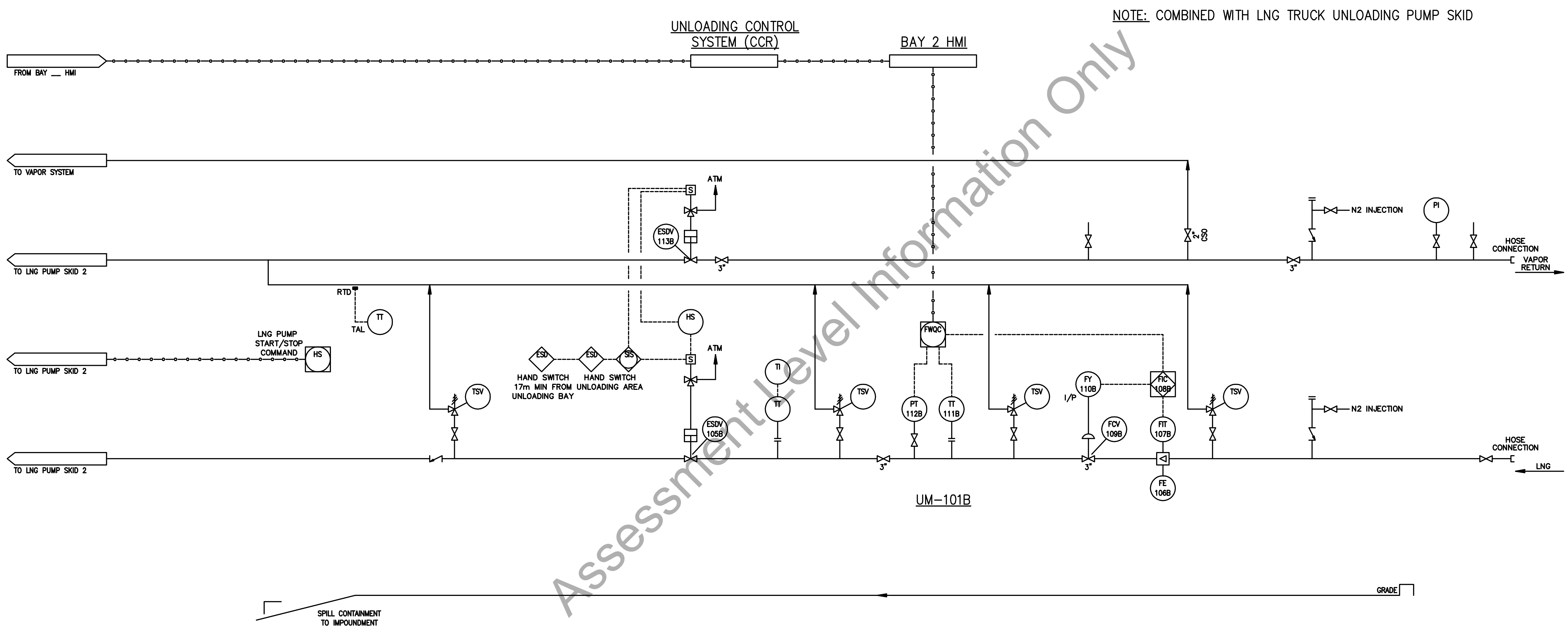
BRAEMAR TECHNICAL SERVICES (ENGINEERING) INC.
9225 KATY FREEWAY, SUITE 307
HOUSTON, TX 77024

WESTERN COPPER GOLD – CASINO
P&ID AREA 1 TRUCK UNLOADING PUMP SKID 1 BAY 1

DRAWN TAP | DATE 08/21/2012
DWG. NO. 2

UM–101B
LNG TANKER UNLOADING MANIFOLD
MANIFOLD

DESIGN CAPACITY: 90
DESIGN CAPACITY UNITS: m3/hour (LNG)
OPERATING PRESSURE [barg]: 19
ANSI CLASS: 150
DESIGN TEMP LOW [°C]: –161
DESIGN TEMP HIGH [°C]: 38
MAIN MATERIAL: SS
DESIGN CODE: TBD



REV.	BY	DATE	DESCRIPTION	APP'D.

SCALE: NONE

APP'D.
DATE

BRAEMAR ENGINEERING.PNG

BRAEMAR TECHNICAL SERVICES (ENGINEERING) INC.
9225 KATY FREEWAY, SUITE 307
HOUSTON, TX 77024

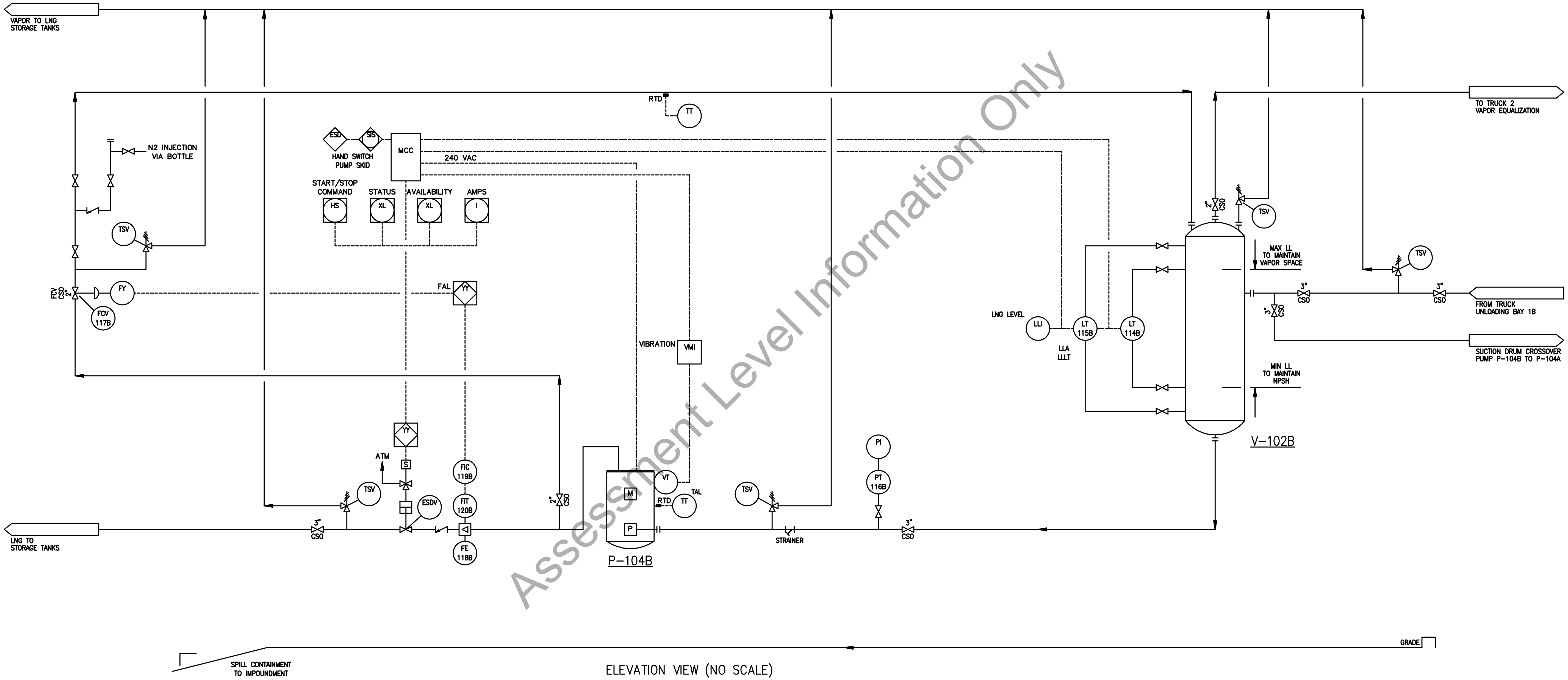
WESTERN COPPER GOLD – CASINO
P&ID AREA 1 LNG TANKER
UNLOADING MANIFOLD BAY 2

DRAWN TAP | DATE 08/21/2012

DWG. NO. 3

V-102B
LNG SUCTION DRUM
VERTICAL VESSEL

DESIGN CAPACITY: 0.50
DESIGN CAPACITY UNITS: m3
OPERATING PRESSURE [barg]: 19
ANSI CLASS: 150
DESIGN TEMP LOW [°C]: -161
DESIGN TEMP HIGH [°C]: 38
MAIN MATERIAL: SS
DESIGN CODE: ASME VIII



ELEVATION VIEW (NO SCALE)

P-104B
LNG TRUCK UNLOADING PUMP
CENTRIFUGAL POT MOUNTED SUBMERGED PUMP & MOTOR

DESIGN CAPACITY: 90
DESIGN CAPACITY UNITS: m3/hour (LNG)
OPERATING PRESSURE [barg]: 8
ANSI CLASS: 150
DESIGN TEMP LOW [°C]: -161
DESIGN TEMP HIGH [°C]: -150
MAIN MATERIAL: SS
DESIGN CODE: TBD

REV.	BY	DATE	DESCRIPTION	APP'D.

SCALE: NONE

APP'D.
DATE

BRAEMAR ENGINEERING.PNG

BRAEMAR TECHNICAL SERVICES (ENGINEERING) INC.
9225 KATY FREEWAY, SUITE 307
HOUSTON, TX 77024

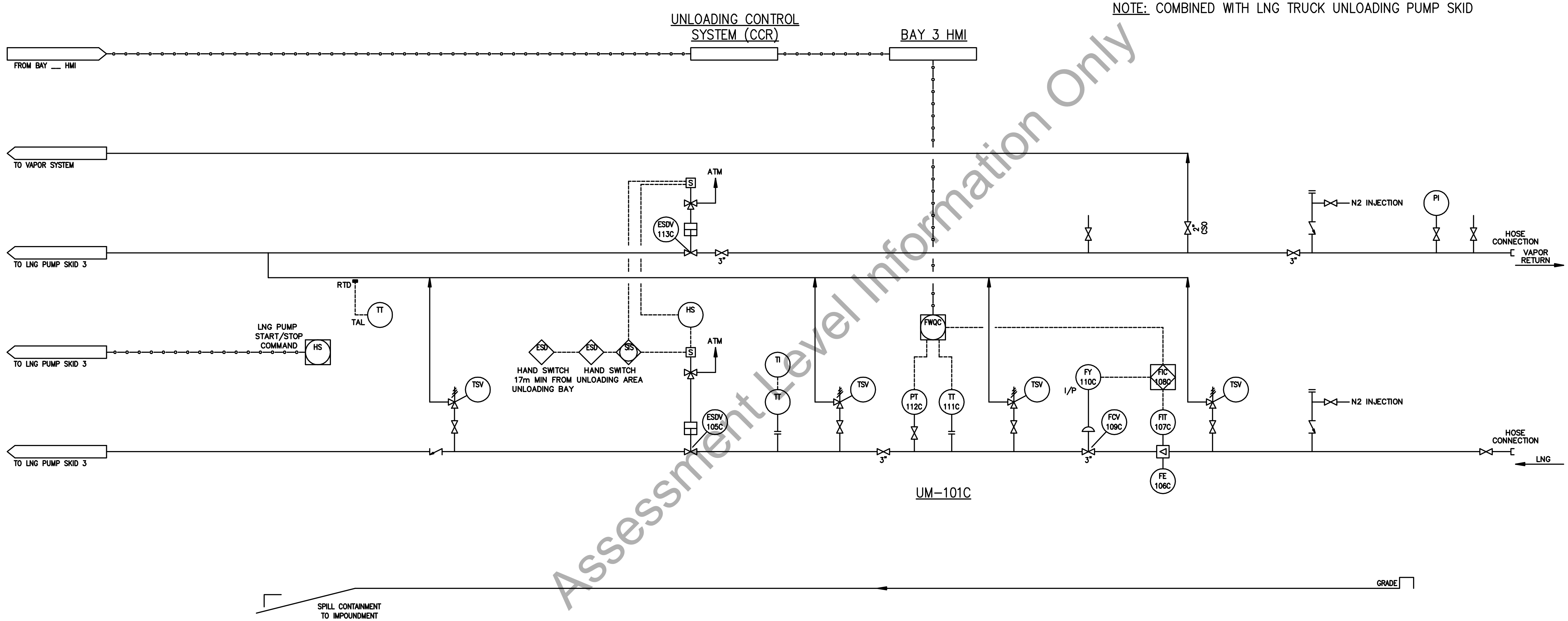
WESTERN COPPER GOLD - CASINO
P&ID AREA 1 TRUCK UNLOADING
PUMP SKID 2 BAY 2

DRAWN TAP | DATE 08/21/2012
DWG. NO. 4

UM-101C
LNG TANKER UNLOADING MANIFOLD
MANIFOLD

DESIGN CAPACITY: 90
DESIGN CAPACITY UNITS: m3/hour (LNG)
OPERATING PRESSURE [barg]: 19
ANSI CLASS: 150
DESIGN TEMP LOW [°C]: -161
DESIGN TEMP HIGH [°C]: 38
MAIN MATERIAL: SS
DESIGN CODE: TBD

NOTE: COMBINED WITH LNG TRUCK UNLOADING PUMP SKID



REV.	BY	DATE	DESCRIPTION	APP'D.

SCALE: NONE

APP'D. ____
DATE ____

BRAEMAR ENGINEERING.PNG

BRAEMAR TECHNICAL SERVICES (ENGINEERING) INC.
9225 KATY FREEWAY, SUITE 307
HOUSTON, TX 77024

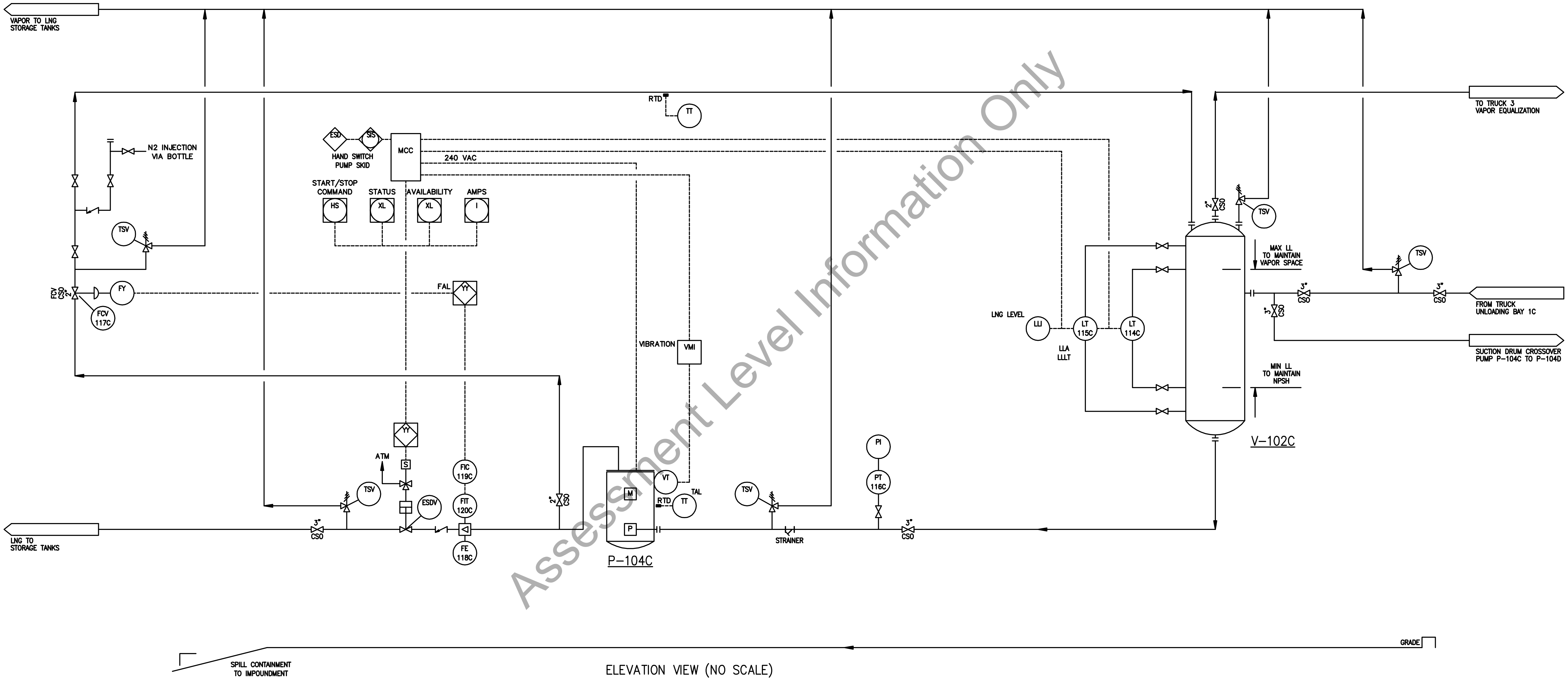
WESTERN COPPER GOLD – CASINO
P&ID AREA 1 LNG TANKER
UNLOADING MANIFOLD BAY 3

DRAWN TAP | DATE 08/21/2012

DWG. NO. 5

V–102C
LNG SUCTION DRUM
VERTICAL VESSEL

DESIGN CAPACITY: 0.50
DESIGN CAPACITY UNITS: m3
OPERATING PRESSURE [barg]: 19
ANSI CLASS: 150
DESIGN TEMP LOW [°C]: –161
DESIGN TEMP HIGH [°C]: 38
MAIN MATERIAL: SS
DESIGN CODE: ASME VIII



ELEVATION VIEW (NO SCALE)

P–104C
LNG TRUCK UNLOADING PUMP
CENTRIFUGAL POT MOUNTED SUBMERGED PUMP & MOTOR

DESIGN CAPACITY: 90
DESIGN CAPACITY UNITS: m3/hour (LNG)
OPERATING PRESSURE [barg]: 8
ANSI CLASS: 150
DESIGN TEMP LOW [°C]: –161
DESIGN TEMP HIGH [°C]: –150
MAIN MATERIAL: SS
DESIGN CODE: TBD

REV.	BY	DATE	DESCRIPTION	APP'D.

SCALE: NONE

APP'D.
DATE

BRAEMAR ENGINEERING.PNG

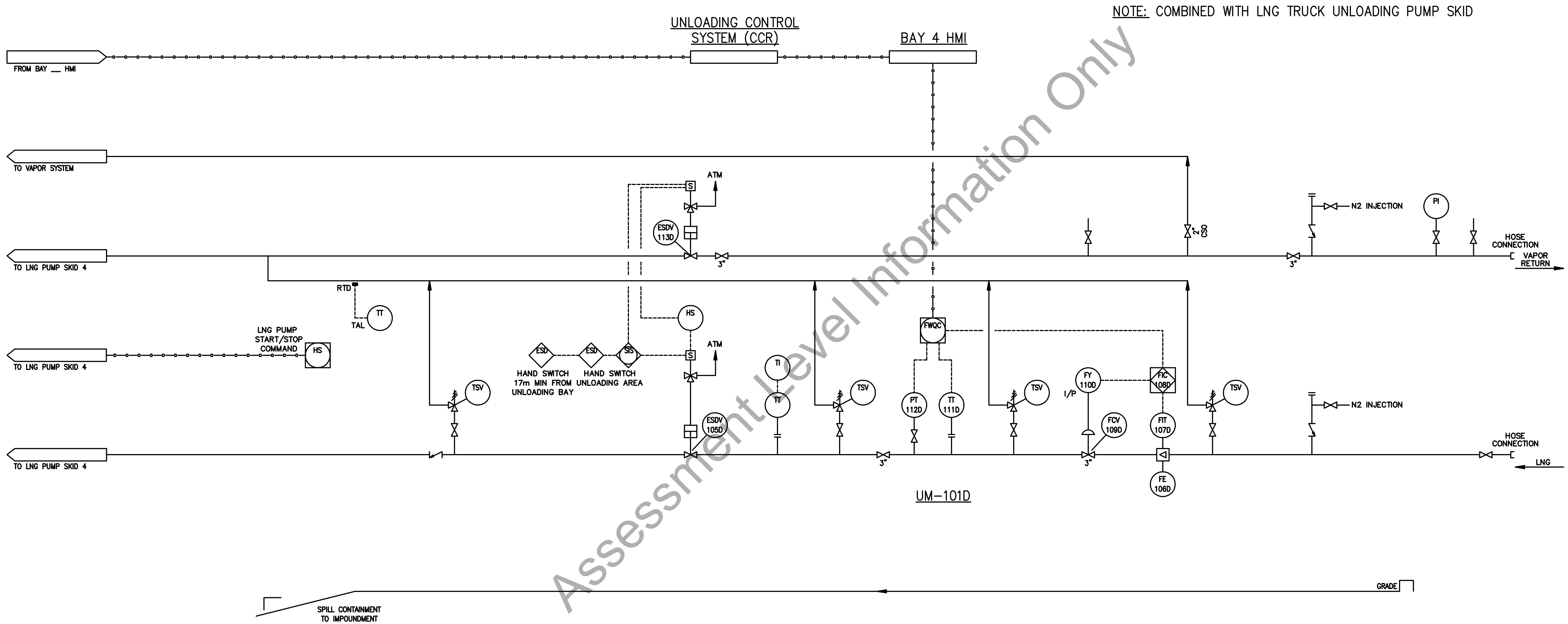
BRAEMAR TECHNICAL SERVICES (ENGINEERING) INC.
9225 KATY FREEWAY, SUITE 307
HOUSTON, TX 77024

WESTERN COPPER GOLD – CASINO
P&ID AREA 1 TRUCK UNLOADING
PUMP SKID 3 BAY 3

DRAWN TAP | DATE 08/21/2012
DWG. NO. 6

UM-101D
LNG TANKER UNLOADING MANIFOLD
MANIFOLD

DESIGN CAPACITY: 90
DESIGN CAPACITY UNITS: m3/hour (LNG)
OPERATING PRESSURE [barg]: 19
ANSI CLASS: 150
DESIGN TEMP LOW [°C]: -161
DESIGN TEMP HIGH [°C]: 38
MAIN MATERIAL: SS
DESIGN CODE: TBD



REV.	BY	DATE	DESCRIPTION	APP'D.

SCALE: NONE

APP'D.

DATE

BRAEMAR ENGINEERING.PNG

BRAEMAR TECHNICAL SERVICES (ENGINEERING) INC.
9225 KATY FREEWAY, SUITE 307
HOUSTON, TX 77024

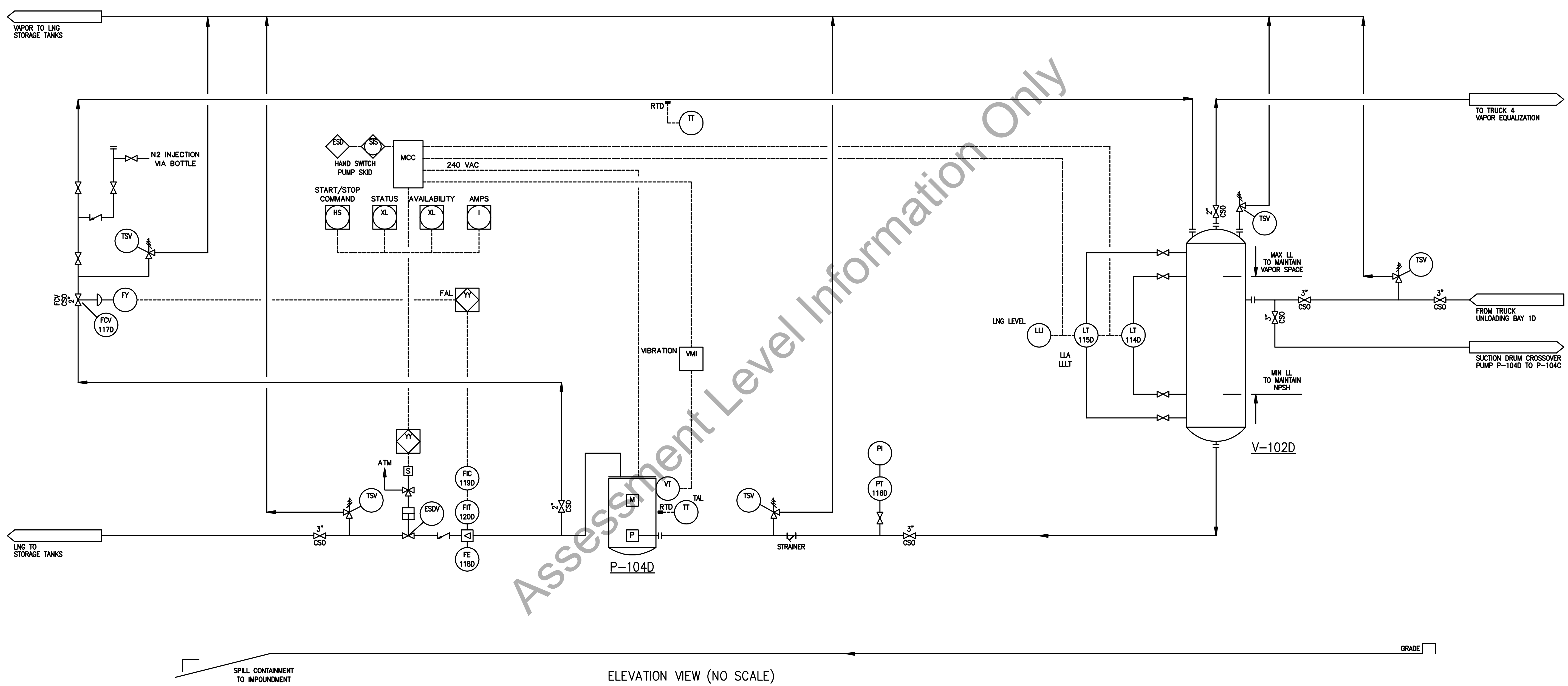
WESTERN COPPER GOLD – CASINO
P&ID AREA 1 LNG TANKER
UNLOADING MANIFOLD BAY 4

DRAWN TAP | DATE 08/21/2012

DWG. NO. 7

V-102D
LNG SUCTION DRUM
VERTICAL VESSEL

DESIGN CAPACITY: 0.50
DESIGN CAPACITY UNITS: m3
OPERATING PRESSURE [barg]: 19
ANSI CLASS: 150
DESIGN TEMP LOW [°C]: −161
DESIGN TEMP HIGH [°C]: 38
MAIN MATERIAL: SS
DESIGN CODE: ASME VIII



ELEVATION VIEW (NO SCALE)

P-104D
LNG TRUCK UNLOADING PUMP
CENTRIFUGAL POT MOUNTED SUBMERGED PUMP & MOTOR

DESIGN CAPACITY: 90
DESIGN CAPACITY UNITS: m3/hour (LNG)
OPERATING PRESSURE [barg]: 8
ANSI CLASS: 150
DESIGN TEMP LOW [°C]: −161
DESIGN TEMP HIGH [°C]: −150
MAIN MATERIAL: SS
DESIGN CODE: TBD

REV.	BY	DATE	DESCRIPTION	APP'D.

SCALE: NONE

APP'D.

DATE

BRAEMAR ENGINEERING.PNG

BRAEMAR TECHNICAL SERVICES (ENGINEERING) INC.
9225 KATY FREEWAY, SUITE 307
HOUSTON, TX 77024

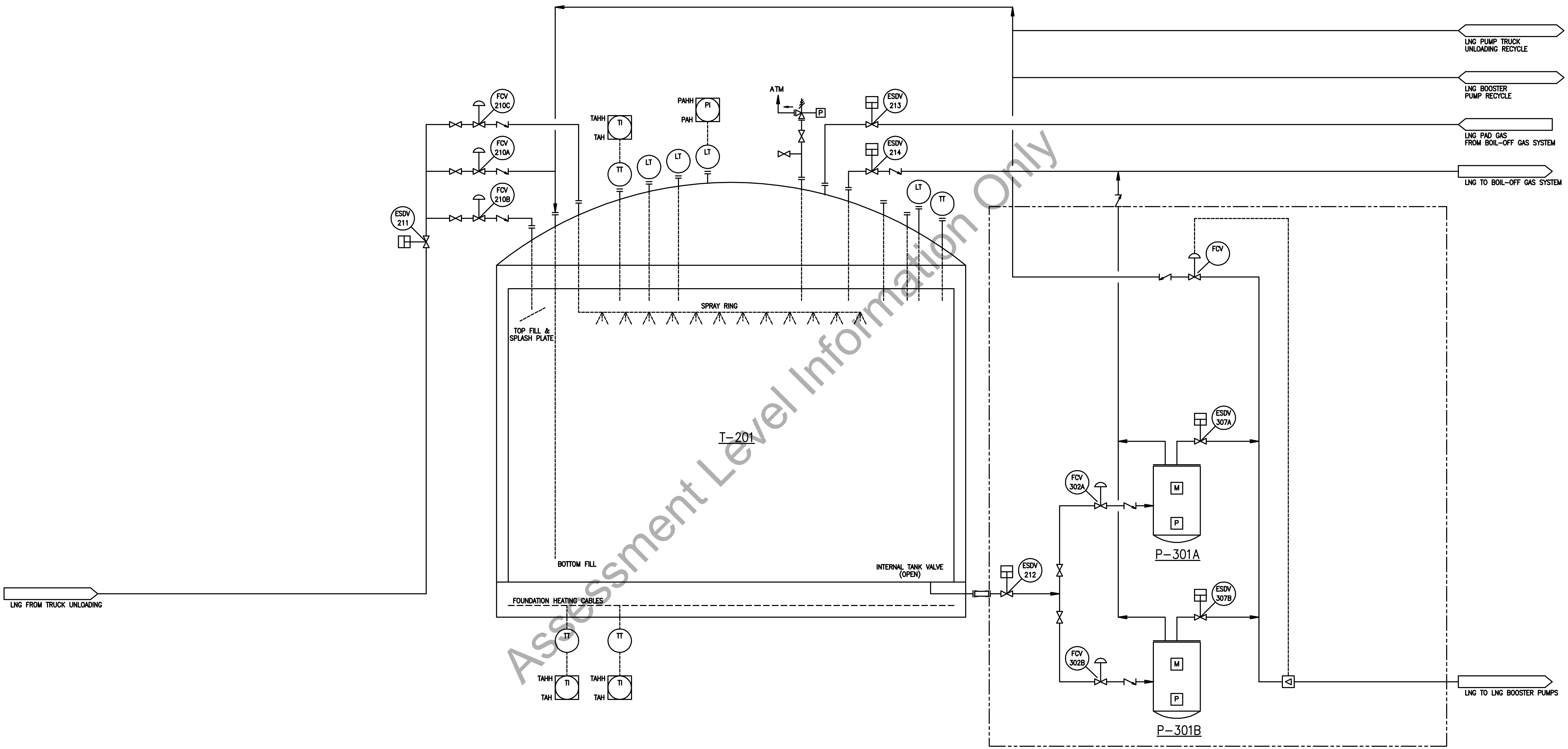
WESTERN COPPER GOLD – CASINO
P&ID AREA 1 TRUCK UNLOADING
PUMP SKID 4 BAY 4

DRAWN TAP | DATE 08/21/2012

DWG. NO. 8

T-201
LNG STORAGE TANK
SITE FABRICATED, SINGLE CONTAINMENT LNG TANK

DESIGN CAPACITY: 8000
DESIGN CAPACITY UNITS: m3
OPERATING PRESSURE [barg]: 0.138
ANSI CLASS: VARIES
DESIGN TEMP LOW [°C]: −161
DESIGN TEMP HIGH [°C]: −150
MAIN MATERIAL: SS PRIMARY CS OUTER
DESIGN CODE: API 620



P-301A/B
LNG TANK PUMPS
CENTRIFUGAL POT MOUNTED SUBMERGED PUMP & MOTOR

DESIGN CAPACITY: 45
DESIGN CAPACITY UNITS: m3/hour (LNG)
OPERATING PRESSURE [barg]: 8
ANSI CLASS: 150
DESIGN TEMP LOW [°C]: −161
DESIGN TEMP HIGH [°C]: −150
MAIN MATERIAL: SS
DESIGN CODE: TBD

REV.	BY	DATE	DESCRIPTION	APP'D.

SCALE: NONE

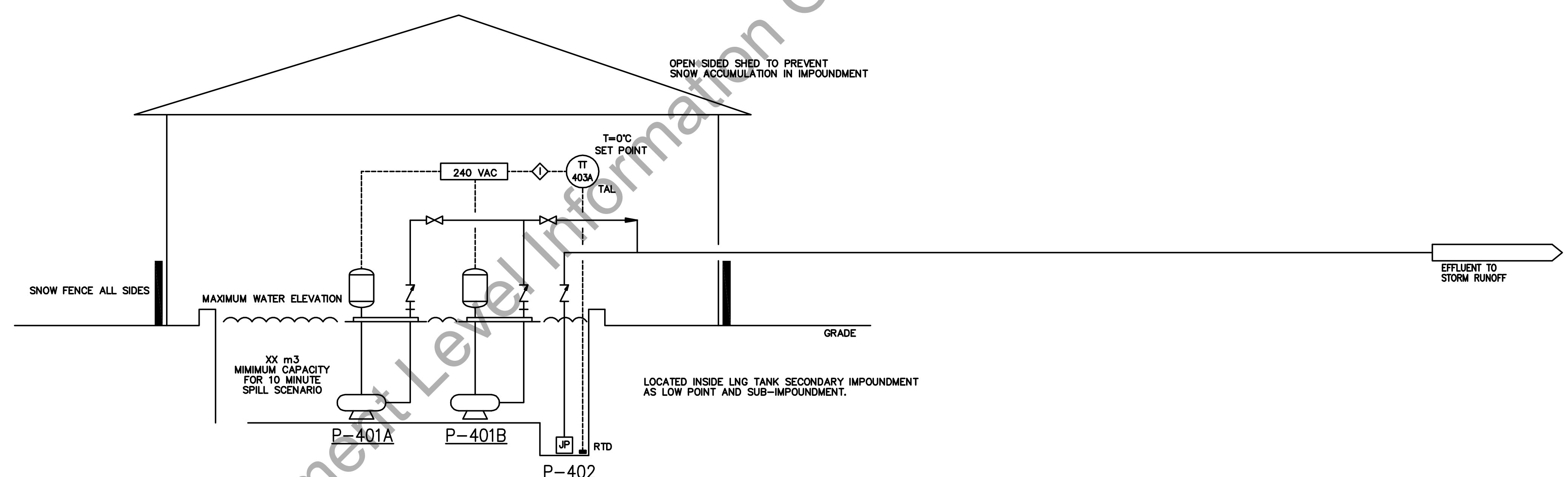
APP'D.
DATE

BRAEMAR ENGINEERING.PNG

BRAEMAR TECHNICAL SERVICES (ENGINEERING) INC.
9225 KATY FREEWAY, SUITE 307
HOUSTON, TX 77024

WESTERN COPPER GOLD – CASINO
P&ID AREA 2 AND 3
LNG STORAGE TANK AND PUMPS

DRAWN TAP
DATE 08/21/2012
DWG. NO. 9



EQUIPMENT:

1. P1&P2: 2 – 100% SUBMERSIBLE WATER PUMPS W/AUTO START/STOP LEVEL SWITCH, SIZED FOR 10 YEAR STORM EVENT.
   JP – MIMIMUM FLOW SUBMERSIBLE WATER JOCKEY PUMP W/AUTO START/STOP LEVEL SWITCH FOR SMALL ACCUMULATIONS OF WATER.
   LOW TEMPERATURE INTERLOCK DISABLES ALL PUMPS TO AVOID PUMPING LNG SPILL FROM IMPOUNDMENT.

P-401A/B
IMPOUNDMENT STORMWATER SUBMERSIBLE PUMPS

DESIGN CAPACITY: TBD
DESIGN CAPACITY UNITS: m3/hour (WATER)
OPERATING PRESSURE [barg]: 10
ANSI CLASS: N/A
DESIGN TEMP LOW [°C]: 0
DESIGN TEMP HIGH [°C]: 38
MAIN MATERIAL: CS
DESIGN CODE: TBD

P-402
IMPOUNDMENT STORMWATER SUBMERSIBLE JOCKEY PUMP

DESIGN CAPACITY: TBD
DESIGN CAPACITY UNITS: m3/hour (WATER)
OPERATING PRESSURE [barg]: 10
ANSI CLASS: N/A
DESIGN TEMP LOW [°C]: 0
DESIGN TEMP HIGH [°C]: 38
MAIN MATERIAL: CS
DESIGN CODE: TBD

SCALE: NONE

REV.	BY	DATE	DESCRIPTION	APP'D.

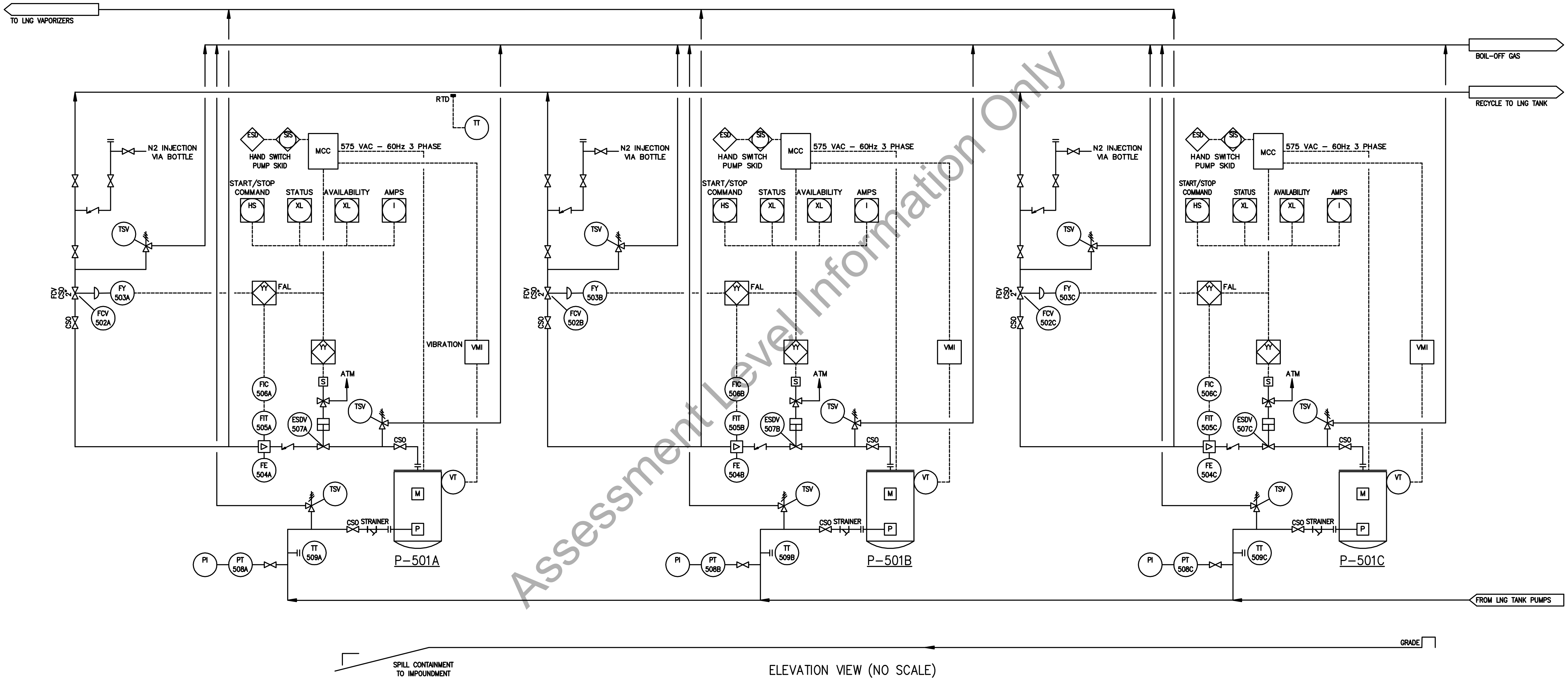
APP'D.
DATE

BRAEMAR ENGINEERING.PNG

BRAEMAR TECHNICAL SERVICES (ENGINEERING) INC.
9225 KATY FREEWAY, SUITE 307
HOUSTON, TX 77024

WESTERN COPPER GOLD – CASINO
P&ID AREA 4
LNG SPILL SUB-IMPOUNDMENT

DRAWN TAP | DATE 08/21/2012
DWG. NO. 10



P-501A/B
LNG BOOSTER PUMPS
CENTRIFUGAL POT MOUNTED
SUBMERGED PUMP & MOTOR

DESIGN CAPACITY: 25
DESIGN CAPACITY UNITS: m3/hour (LNG)
OPERATING PRESSURE [barg]: 40
ANSI CLASS: 300
DESIGN TEMP LOW [°C]: -161
DESIGN TEMP HIGH [°C]: -150
MAIN MATERIAL: SS
DESIGN CODE: TBD

REV.	BY	DATE	DESCRIPTION	APP'D.

SCALE: NONE

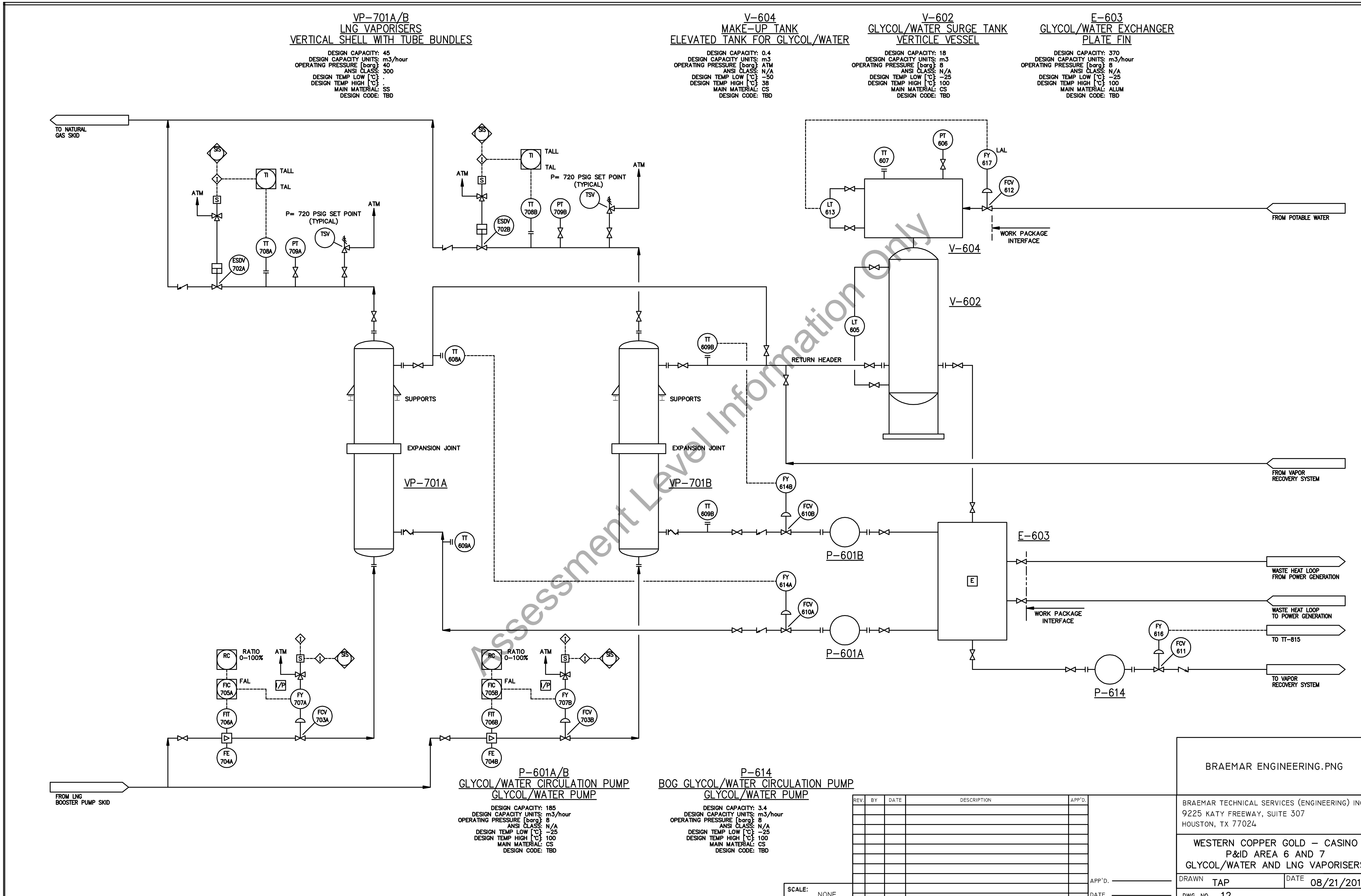
APP'D.
DATE

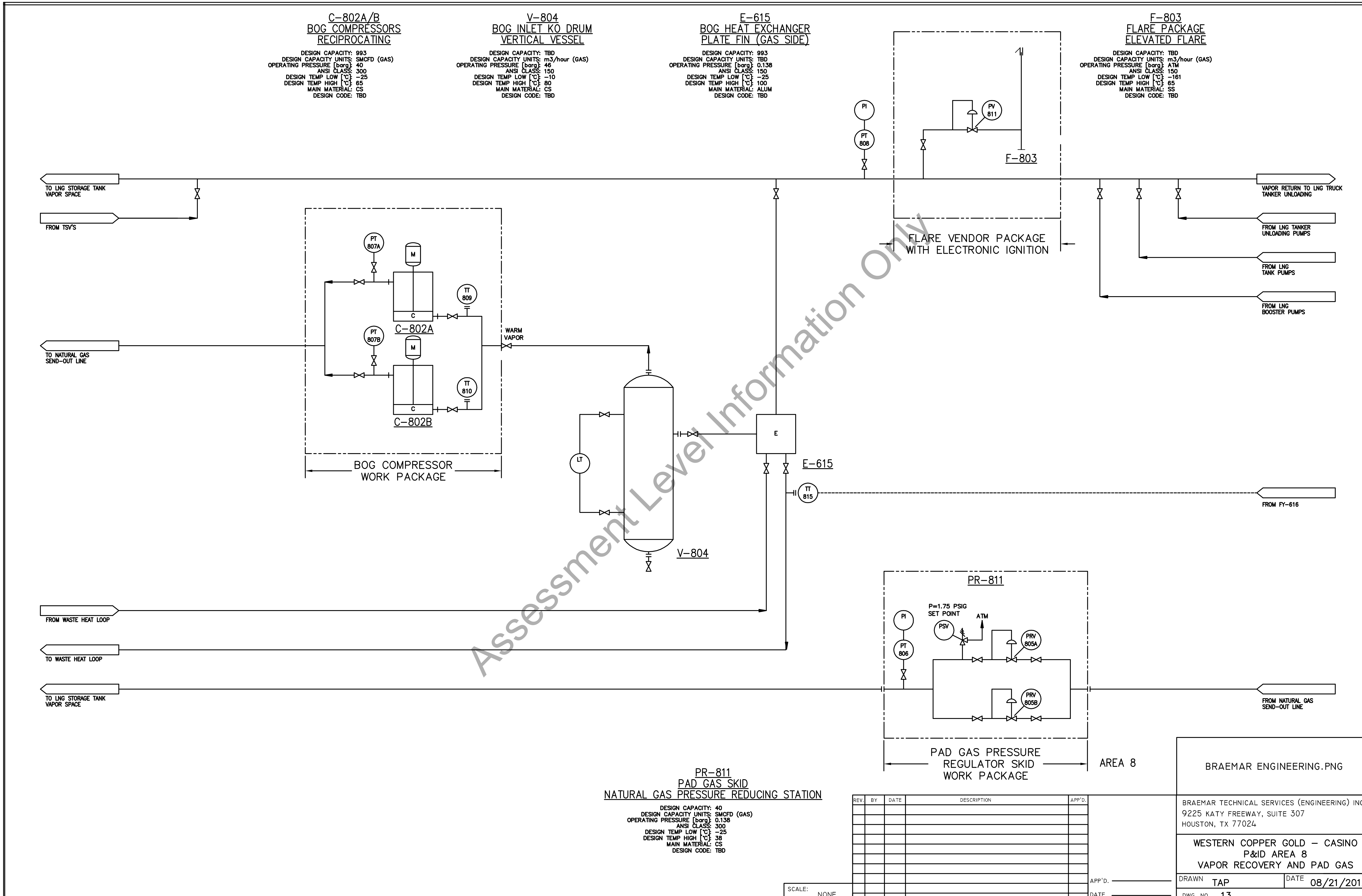
BRAEMAR ENGINEERING.PNG

BRAEMAR TECHNICAL SERVICES (ENGINEERING) INC.
9225 KATY FREEWAY, SUITE 307
HOUSTON, TX 77024

WESTERN COPPER GOLD - CASINO
P&ID AREA 5
LNG BOOSTER PUMPS

DRAWN TAP
DATE 08/21/2012
DWG. NO. 11


VP-701A/B
LNG VAPORISERS
VERTICAL SHELL WITH TUBE BUNDLES
DESIGN CAPACITY: 45
DESIGN CAPACITY UNITS: m3/hour
OPERATING PRESSURE [barg]: 40
ANSI CLASS: 300
DESIGN TEMP LOW [°C]: .
DESIGN TEMP HIGH [°C]: .
MAIN MATERIAL: SS
DESIGN CODE: TBD
V-604
MAKE-UP TANK
ELEVATED TANK FOR GLYCOL/WATER
DESIGN CAPACITY: 0.4
DESIGN CAPACITY UNITS: m3
OPERATING PRESSURE [barg]: ATM
ANSI CLASS: N/A
DESIGN TEMP LOW [°C]: -50
DESIGN TEMP HIGH [°C]: 38
MAIN MATERIAL: CS
DESIGN CODE: TBD
V-602
GLYCOL/WATER SURGE TANK
VERTICLE VESSEL
DESIGN CAPACITY: 18
DESIGN CAPACITY UNITS: m3
OPERATING PRESSURE [barg]: 8
ANSI CLASS: N/A
DESIGN TEMP LOW [°C]: -25
DESIGN TEMP HIGH [°C]: 100
MAIN MATERIAL: CS
DESIGN CODE: TBD
E-603
GLYCOL/WATER EXCHANGER
PLATE FIN
DESIGN CAPACITY: 370
DESIGN CAPACITY UNITS: m3/hour
OPERATING PRESSURE [barg]: 8
ANSI CLASS: N/A
DESIGN TEMP LOW [°C]: -25
DESIGN TEMP HIGH [°C]: 100
MAIN MATERIAL: ALUM
DESIGN CODE: TBD
TO NATURAL GAS SKID
SIS
TI
TALL
TAL
ATM
S
P= 720 PSIG SET POINT (TYPICAL)
TSV
TT 708A
PT 709A
ESDV 702A
TT 708B
PT 709B
ESDV 702B
TT 607
PT 606
FY 617
LAL
FCV 612
LT 613
FROM POTABLE WATER
WORK PACKAGE INTERFACE
V-604
V-602
LT 605
TT 608A
TT 609B
RETURN HEADER
SUPPORTS
EXPANSION JOINT
VP-701A
VP-701B
FROM VAPOR RECOVERY SYSTEM
FY 614B
FCV 610B
P-601B
E-603
E
TT 609A
WASTE HEAT LOOP FROM POWER GENERATION
FY 614A
FCV 610A
P-601A
WASTE HEAT LOOP TO POWER GENERATION
TO TT-815
FY 616
FCV 611
P-614
TO VAPOR RECOVERY SYSTEM
RC
RATIO 0-100%
FIC 705A
FAL
I/P
FY 707A
FCV 703A
FIT 706A
FE 704A
FIC 705B
FY 707B
FCV 703B
FIT 706B
FE 704B
FROM LNG BOOSTER PUMP SKID
P-601A/B
GLYCOL/WATER CIRCULATION PUMP
GLYCOL/WATER PUMP
DESIGN CAPACITY: 185
DESIGN CAPACITY UNITS: m3/hour
OPERATING PRESSURE [barg]: 8
ANSI CLASS: N/A
DESIGN TEMP LOW [°C]: -25
DESIGN TEMP HIGH [°C]: 100
MAIN MATERIAL: CS
DESIGN CODE: TBD
P-614
BOG GLYCOL/WATER CIRCULATION PUMP
GLYCOL/WATER PUMP
DESIGN CAPACITY: 3.4
DESIGN CAPACITY UNITS: m3/hour
OPERATING PRESSURE [barg]: 8
ANSI CLASS: N/A
DESIGN TEMP LOW [°C]: -25
DESIGN TEMP HIGH [°C]: 100
MAIN MATERIAL: CS
DESIGN CODE: TBD
Assessment Level Information Only
REV. BY DATE DESCRIPTION APP'D.
SCALE: NONE
APP'D.
DATE
BRAEMAR ENGINEERING.PNG
BRAEMAR TECHNICAL SERVICES (ENGINEERING) INC.
9225 KATY FREEWAY, SUITE 307
HOUSTON, TX 77024
WESTERN COPPER GOLD – CASINO
P&ID AREA 6 AND 7
GLYCOL/WATER AND LNG VAPORISERS
DRAWN TAP
DATE 08/21/2012
DWG. NO. 12

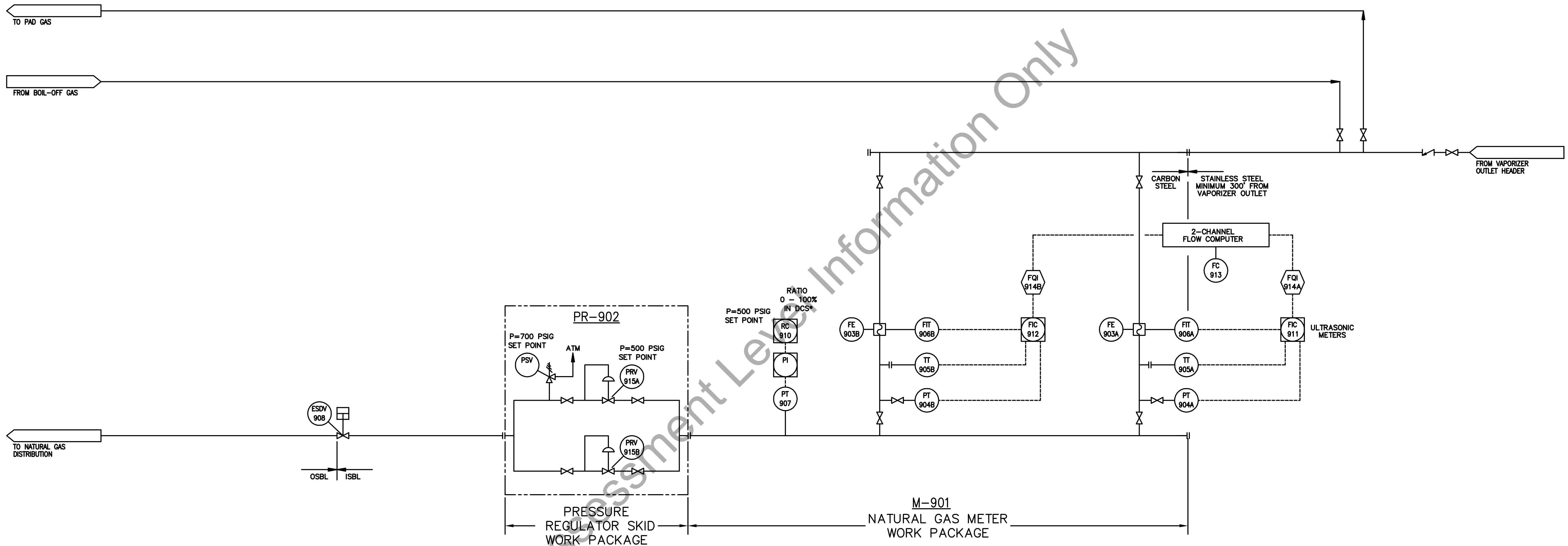

C-802A/B
BOG COMPRESSORS
RECIPROCATING
DESIGN CAPACITY: 993
DESIGN CAPACITY UNITS: SMCFD (GAS)
OPERATING PRESSURE [barg]: 40
ANSI CLASS: 300
DESIGN TEMP LOW [°C]: -25
DESIGN TEMP HIGH [°C]: 65
MAIN MATERIAL: CS
DESIGN CODE: TBD
V-804
BOG INLET KO DRUM
VERTICAL VESSEL
DESIGN CAPACITY: TBD
DESIGN CAPACITY UNITS: m3/hour (GAS)
OPERATING PRESSURE [barg]: 46
ANSI CLASS: 150
DESIGN TEMP LOW [°C]: -10
DESIGN TEMP HIGH [°C]: 80
MAIN MATERIAL: CS
DESIGN CODE: TBD
E-615
BOG HEAT EXCHANGER
PLATE FIN (GAS SIDE)
DESIGN CAPACITY: 993
DESIGN CAPACITY UNITS: TBD
OPERATING PRESSURE [barg]: 0.138
ANSI CLASS: 150
DESIGN TEMP LOW [°C]: -25
DESIGN TEMP HIGH [°C]: 100
MAIN MATERIAL: ALUM
DESIGN CODE: TBD
F-803
FLARE PACKAGE
ELEVATED FLARE
DESIGN CAPACITY: TBD
DESIGN CAPACITY UNITS: m3/hour (GAS)
OPERATING PRESSURE [barg]: ATM
ANSI CLASS: 150
DESIGN TEMP LOW [°C]: -161
DESIGN TEMP HIGH [°C]: 65
MAIN MATERIAL: SS
DESIGN CODE: TBD
PI
PT 808
PV 811
F-803
FLARE VENDOR PACKAGE
WITH ELECTRONIC IGNITION
TO LNG STORAGE TANK VAPOR SPACE
FROM TSV'S
VAPOR RETURN TO LNG TRUCK TANKER UNLOADING
FROM LNG TANKER UNLOADING PUMPS
FROM LNG TANK PUMPS
FROM LNG BOOSTER PUMPS
PT 807A
PT 807B
M
C
TT 809
TT 810
C-802A
C-802B
WARM VAPOR
TO NATURAL GAS SEND-OUT LINE
BOG COMPRESSOR
WORK PACKAGE
LT
E
E-615
TT 815
FROM FY-616
V-804
FROM WASTE HEAT LOOP
TO WASTE HEAT LOOP
TO LNG STORAGE TANK VAPOR SPACE
PR-811
P=1.75 PSIG
SET POINT
ATM
PSV
PRV 805A
PRV 805B
PT 806
FROM NATURAL GAS SEND-OUT LINE
PAD GAS PRESSURE
REGULATOR SKID
WORK PACKAGE
AREA 8
PR-811
PAD GAS SKID
NATURAL GAS PRESSURE REDUCING STATION
DESIGN CAPACITY: 40
DESIGN CAPACITY UNITS: SMCFD (GAS)
OPERATING PRESSURE [barg]: 0.138
ANSI CLASS: 300
DESIGN TEMP LOW [°C]: -25
DESIGN TEMP HIGH [°C]: 38
MAIN MATERIAL: CS
DESIGN CODE: TBD
REV. BY DATE DESCRIPTION APP'D.
SCALE: NONE
APP'D.
DATE
BRAEMAR ENGINEERING.PNG
BRAEMAR TECHNICAL SERVICES (ENGINEERING) INC.
9225 KATY FREEWAY, SUITE 307
HOUSTON, TX 77024
WESTERN COPPER GOLD – CASINO
P&ID AREA 8
VAPOR RECOVERY AND PAD GAS
DRAWN TAP
DATE 08/21/2012
DWG. NO. 13

PR–902
SEND–OUT REGULATOR SKID
NATURAL GAS PRESSURE REDUCING STATION

DESIGN CAPACITY: 27,400
DESIGN CAPACITY UNITS: m3/hour (GAS)
OPERATING PRESSURE [barg]: 40
ANSI CLASS: 300
DESIGN TEMP LOW [°C]: –25
DESIGN TEMP HIGH [°C]: 65
MAIN MATERIAL: CS
DESIGN CODE: TBD

M–901
SEND–OUT GAS METERING STATION
METERING STATION

DESIGN CAPACITY: 27,400
DESIGN CAPACITY UNITS: m3/hour (GAS)
OPERATING PRESSURE [barg]: 40
ANSI CLASS: 300
DESIGN TEMP LOW [°C]: –25
DESIGN TEMP HIGH [°C]: 65
MAIN MATERIAL: CS
DESIGN CODE: TBD



NOTE*: PRESSURE SIGNAL TO RATIO CONTROLLER IN DCS TO MAINTAIN 500 PSIG ON METER OUTLET HEADER.

REV.	BY	DATE	DESCRIPTION	APP'D.

SCALE: NONE

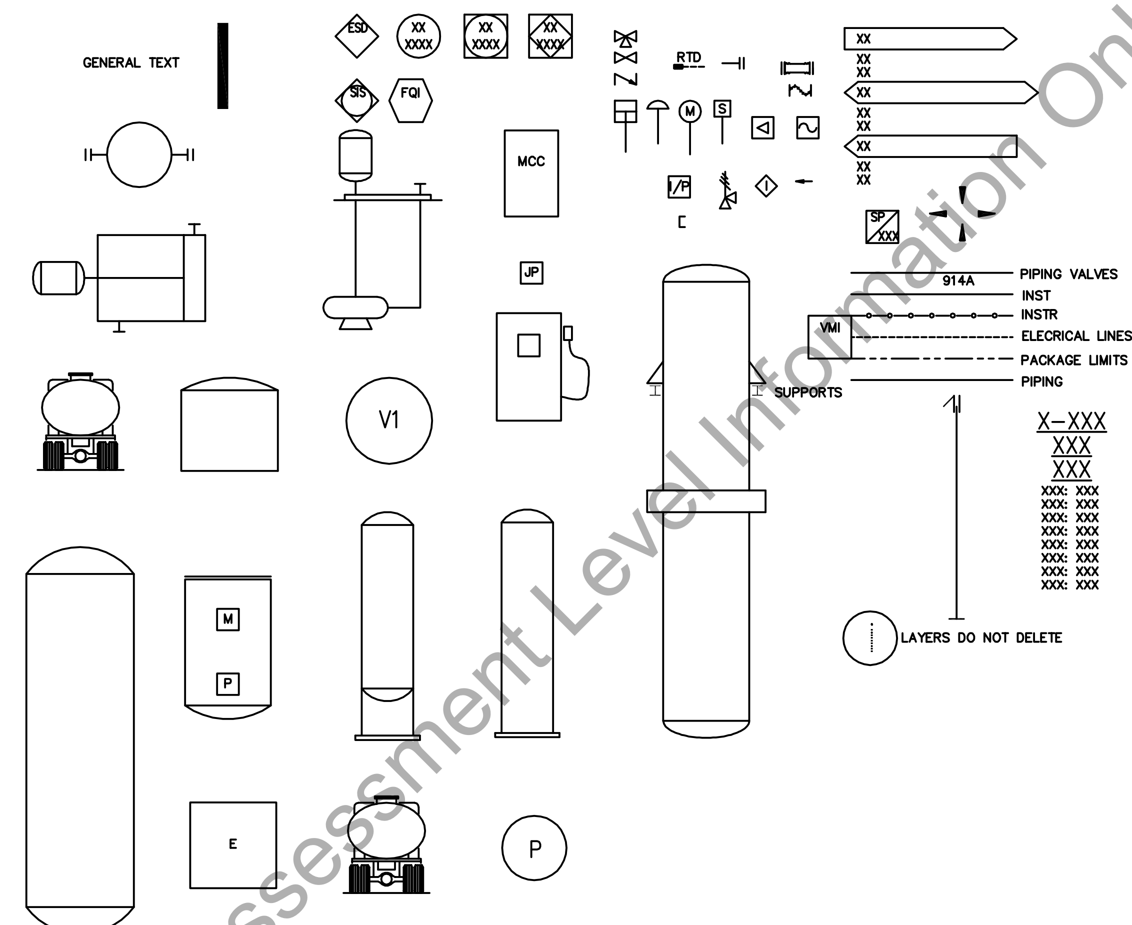
APP'D.
DATE

BRAEMAR ENGINEERING.PNG

BRAEMAR TECHNICAL SERVICES (ENGINEERING) INC.
9225 KATY FREEWAY, SUITE 307
HOUSTON, TX 77024

WESTERN COPPER GOLD – CASINO
P&ID AREA 9 NATURAL GAS SEND–OUT
AND OVER PRESSURE PROTECTION

DRAWN TAP DATE 08/21/2012
DWG. NO. 14



BRAEMAR ENGINEERING.PNG

REV.	BY	DATE	DESCRIPTION	APP'D.

SCALE: NONE

APP'D.
DATE

BRAEMAR TECHNICAL SERVICES (ENGINEERING) INC.
9225 KATY FREEWAY, SUITE 307
HOUSTON, TX 77024

WESTERN COPPER GOLD – CASINO
PFD AND P&ID
SYMBOLS

DRAWN TAP | DATE 08/21/2012
DWG. NO. 15

Table A.4.10-3 LNG Facility Major Equipment and Process Information

Tag No.	Service	Type	Design Capacity	Design Capacity Units	Operating Pressure (barg)
FD-103A	LNG Fuel Dispenser	Dispenser	11.4	m^3/hour (LNG)	6
FD-103B	LNG Fuel Dispenser	Dispenser	11.4	m^3/hour (LNG)	6
P-104A	LNG Truck Unloading Pump	Centrifugal Pot Mounted Submerged Pump & Motor	90	m^3/hour (LNG)	8
P-104B	LNG Truck Unloading Pump	Centrifugal Pot Mounted Submerged Pump & Motor	90	m^3/hour (LNG)	8
P-104C	LNG Truck Unloading Pump	Centrifugal Pot Mounted Submerged Pump & Motor	90	m^3/hour (LNG)	8
P-104D	LNG Truck Unloading Pump	Centrifugal Pot Mounted Submerged Pump & Motor	90	m^3/hour (LNG)	8
UM-101A	LNG Tanker Unloading Manifold	Manifold	90	m^3/hour (LNG)	19
UM-101B	LNG Tanker Unloading Manifold	Manifold	90	m^3/hour (LNG)	19
UM-101C	LNG Tanker Unloading Manifold	Manifold	90	m^3/hour (LNG)	19
UM-101D	LNG Tanker Unloading Manifold	Manifold	90	m^3/hour (LNG)	19
V-102A	LNG Suction Drum	Vertical Vessel	0.50	m^3	19
V-102B	LNG Suction Drum	Vertical Vessel	0.50	m^3	19
V-102C	LNG Suction Drum	Vertical Vessel	0.50	m^3	19
V-102D	LNG Suction Drum	Vertical Vessel	0.50	m^3	19
T-201	LNG Storage Tank	Site Fabricated, Single Containment LNG Tank	10000	m^3	0.138
P-301A	LNG Tank Pump	Centrifugal Pot Mounted Submerged Pump & Motor	45	m^3/hour (LNG)	8
P-301B	LNG Tank Pump	Centrifugal Pot Mounted Submerged Pump & Motor	45	m^3/hour (LNG)	8
P-401A	Impoundment Stormwater Pump	Submersible Pump	172.6	m^3/hour (water)	10
P-401B	Impoundment Stormwater Pump	Submersible Pump	172.6	m^3/hour (water)	10

Tag No.	Service	Type	Design Capacity	Design Capacity Units	Operating Pressure (barg)
P-402	Impoundment Stormwater Jockey Pump	Submersible Pump	4.5	m^3/hour (water)	10
P-501A	LNG Booster Pump	Centrifugal Pot Mounted Submerged Pump & Motor	23	m^3/hour (LNG)	40
P-501B	LNG Booster Pump	Centrifugal Pot Mounted Submerged Pump & Motor	23	m^3/hour (LNG)	40
P-501C	LNG Booster Pump	Centrifugal Pot Mounted Submerged Pump & Motor	23	m^3/hour (LNG)	40
E-603	Glycol/Water Exchanger for VP-701A and VP-701B	Plate Fin	370	m^3/hour	8
P-601A	Glycol/Water Circulation Pump for VP-701A	Glycol/Water Pump	185	m^3/hour	8
P-601B	Glycol/Water Circulation Pump for VP-701B	Glycol/Water Pump	185	m^3/hour	8
P-614	BOG Glycol/Water Circulation Pump for E-615 BOG gas inlet	Glycol/Water Pump	3.4	m^3/hour	8
V-602	Glycol/Water Surge Tank	Vertical Vessel	18	m^3	8
E-615	BOG Glycol/Water Exchanger for BOG gas inlet	Plate Fin (Glycol Water Side)	3.4	m^3/hour	8
V-604	Makeup Tank	Elevated Tank for Glycol/Water	1	m^3	Atmospheric pressure
VP-701A	LNG Vaporizer	Vertical Shell With Tube Bundles	45	m^3/hour (LNG)	40
VP-701B	LNG Vaporizer	Vertical Shell With Tube Bundles	45	m^3/hour (LNG)	40
C-802A	BOG Compressor	Reciprocating	1,171.6	m^3/hour (gas)	40
C-802B	BOG Compressor	Reciprocating	1,171.6	m^3/hour (gas)	40
PR-811	Pad Gas Skid	Natural Gas Pressure Reducing Station	47.2	m^3/hour (gas)	0.138
E-615	BOG Heat Exchanger	Plate Fin(Gas Side)	1,171.6	m^3/hour (gas)	0.138
F-803	Flare Package	Elevated Flare	5,899.3	m^3/hour (gas)	Atmospheric pressure
V-804	BOG Inlet KO Drum	Vertical Vessel	1	m^3	46

Tag No.	Service	Type	Design Capacity	Design Capacity Units	Operating Pressure (barg)
M-901	Sendout Gas Metering Station	Metering Station	32,328	m^3/hour (gas)	40
PR-902	Sendout Monitor Regulator Skid	Natural Gas Pressure Reducing Station	32,328	m^3/hour (gas)	40
A-1102	Instrument Air Package	Instrument Air Supply	TBD	m^3/hour (air)	10
N-1101	Nitrogen Package	Vertical Vessel	TBD	m^3/hour (nitrogen)	10

LNG Storage Tank

The receiving station will unload and transfer the LNG from tanker trucks into the 10,000 m^3 site fabricated storage tank. The LNG will be stored in the tank at -162°C, at 1+ atmosphere pressure. The LNG storage tank will be a single containment tank system surrounded by a secondary containment system, designed based on the codes and standards outlined in Table A.4.10-2 for secondary containment. The LNG storage tank will be designed for a MDE corresponding to 1 in 2,500 year earthquake with a mean PGA of 0.13g and a design earthquake magnitude of 8.0.

The storage tank sizing is based on expected average demand, and includes the availability of the facility (52%), the required days of storage (10 days), and the LNG trucking and unloading rates (1,212 m^3/day), as summarized in Table A.4.10-4. Consequently, the tank is sized for a nominal 10,000 m^3 capacity for expected average demand.

Table A.4.10-4 LNG Storage Capacity Calculations

Generated Power	Peak Natural Gas Use							Peak LNG Use			Required LNG storage
MW/hr	MMBTU/hr	MMBTU/d	GJ/hr	GJ/d	SCF/hr	SMCF/hr	SMCF/d	m^3/hr	m^3/d	GPM	m^3
112.5	738	17,732	779	18,708	724,799	724	17,395	33	802	147	8,023
150	985	23,643	1,039	24,945	966,399	966	23,193	45	1,070	196	10,697
170	116	26,796	1,178	28,271	1,095,252	1,095	26,286	50	1,212	222	12,124

Storage tank secondary impoundment dimensions will be dependent upon the spill scenario, but will have a volume to contain, at a minimum of 110% of the LNG storage capacity. An additional allowance will be made for snow and ice accumulations to maintain the minimum required capacity. Impoundment dimensions will consider the requirement to minimize pool evaporation by constructing a deeper pool, dependent on structural constraints. The location of the impoundment must contain the ½ Lower Flammability Limit (LFL) contour and the 5000 W/m^2 thermal radiation contour within the property boundary. The above factors, in addition to other meteorological and geological factors, will be incorporated into an approved vapor dispersion and thermal radiation model to determine the accurate dimensions of the impoundment which will satisfy the code and standard criteria.

LNG Facility Utilities

The LNG facility is a self-contained process with shared infrastructure for power supply, a glycol-water heating loop for LNG vaporization and utility air supply. Physical infrastructure requirements based on thermal radiation, design spills, distances from containers and impoundment areas are outlined in CSA Z276 Table 1-6, which will be used in the design of the LNG facility utilities. At this stage, there are only calculated estimates based on the current facility design basis, and the requirements for process glycol, voltage, air, nitrogen and potable water are provided in Table A.4.10-5. Instrument air requirements are estimated based on guidelines of 2 Nm^3/h for control valves with diaphragm actuator and positioner and I/P converter and 5 Nm^3/h for on-off type valves with piston actuator and positioner.

Table A.4.10-5 LNG Facility Utility Requirements

Utility Item	Rate	LNG Facility Storage
Process Glycol Water Heating Loop	6,200 l/min	
Hi-Voltage (motors >200 HP) (i.e. LNG pump motors/BOG compressor)	100 kilowatt maximum estimated design rate	4160 VAC 3 phase, 575 single phase
Instrument Air	105 nm^3/hr for entire plant	
Nitrogen	Infrequent for purging	10 barg pressure to be supplied by the mine nitrogen system
Potable Water for personnel and maintenance	150 L/per person, infrequent maintenance washdown	

Loading and Unloading Facilities

Two unloading bays with two unloading manifolds per bay to accommodate both single trailers and B-train double trailers, and one LNG vehicle fueling disperser per bay will be constructed at the LNG facility. The unloading skid consists of a LNG suction drum, LNG truck unloading pump, LNG fuel dispenser, and the LNG tanker unloading manifold. These are designed for cryogenic service (i.e. handling of LNG) and the design criteria for these components are summarized in Table A.4.10-3.

The design spill and impoundment size for the Casino unloading area will be determined based on CSA Z276 guidelines for LNG transfer, specifically section 5.2.2.2. The design spill rate is the maximum flow of LNG that can be spilled from the largest branch connection, relief valve, or gasket failure. In addition, a 10 minute spill at this rate is used to size the impoundment. The maximum rate is 90 m^3/hr for the design spill. For a 10 minute spill scenario, the total spill volume is 15 m^3.

The impoundment depth will be determined after the vapor dispersion and thermal radiation analyses have been complete, as a deeper impoundment will reduce the vapor dispersion and thermal radiation limits. However, a deeper impoundment is more expensive than a shallow impoundment with larger dimensions. Regardless of the impoundment dimensions, it must be able to hold 15 m^3, with an additional allowance for ice and snow.

Additionally, mine vehicles may be operated on LNG fuel. A portable refueler is not tied to a specific location and can go anywhere needed with minimal effort and is more cost effective. A permanent LNG refueling facility is typically constructed with multiple fueling bays, overhead protection, regulated safety devices, some sort of payment transaction console, and will use pump and measurement systems certified by provincial or national weights and measures. A fixed refueling station is ultimately a better option for the Casino Project as the LNG needs at the mine are extensive and would require higher capacity than a mobile unit is able to provide. A typical fixed refueling layout consists of an LNG truck unloading manifold, the LNG storage tank, and the LNG truck fueling dispenser. Details of the location of the refueling station, equipment specifications, and hazard assessment will be developed during detailed engineering, and will adhere to code NPFA 52 and other applicable codes and standards.

Vaporizers

The proposed facility will incorporate two 100% capacity stainless steel vertical shell & tube vaporizers connected to the glycol/water loop to provide the heat needed to vaporize LNG to natural gas. Vaporizers operate in pressure control mode to maintain the constant downstream pressure of 35 bar (500 psig). The LNG supply pumps and vaporizers will be heavily instrumented to control and monitor the process, and to shut down the process if unsafe conditions are detected. Design capacity is 45 m^3/hr of LNG supply to each vaporizer; however, each vaporizer can run at a rate between 0% and 100%.

The vaporization pressure is built up through the use of multistage centrifugal LNG booster pumps. The LNG booster pumps build-up the pressure upstream of the vaporizers, in order to meet or exceed the gas distribution pressure. The LNG booster pumps are submerged in a pump canister with an integral induction electric motor and variable frequency drive. During vaporization, a phase transition from liquid to vapor occurs and discharges warm (about 10 to 15°C) natural gas into the send-out gas distribution system with required send-out pressure a nominal 35 bar (500 psig). Initial starting of LNG pumps requires that the pump cool-down procedure be strictly adhered to so as to prevent thermal shock to pump components prior to start-up. The LNG pumps are started in minimum recycle mode to maintain minimum flow, and avoid dead heading the pump. The LNG pump recycle line is routed back to the LNG tank and includes a back pressure control valve to maintain a discharge pressure of 35 bar (500 psig).

The gas send-out line will have a temperature override system to prevent the outlet gas temperature from falling below the gas discharge set point of 15°C to prevent cold gas or LNG from passing from the vaporizer and exposing the carbon steel pipe to cryogenic temperature.

Emergency shutdown (ESD) valves will isolate the vaporizers during an emergency. The ESD valve closure is delayed to prevent LNG from becoming trapped within the vaporizer, which would result in thermal expansion of the LNG, and subsequent lifting of the vaporizer TSV (thermal relief) valves.

Boil off gas (BOG) compressors are not designed to compress gas at cryogenic temperature and therefore gas vapor from the LNG tank must first be warmed prior to compression to protect the compressor from exposure to low temperature vapor. A heat exchanger is connected to the compressor suction port, and receives heating from the glycol/water loop to provide the heat needed to warm vapor prior to compression.

BOG compressors operate when there is high pressure in the vapor system and compressors are sequenced and automatically operate with sufficient capacity to maintain LNG tank vapor space pressure to prevent a high pressure condition that could lead to relief valve lifting and atmospheric venting. BOG compressors operate in pressure control, and are designed to recover the excess vapor and transfer high pressure natural gas to the send-out line for use as fuel gas, and designed for all normal operating conditions and remain below the set point of pressure relief valves.

High pressure conditions may occur when there is tanker unloading, or when the volume of LNG sent out from the storage tank to the vaporizers is less than the volume of BOG generated in the vapor system. Regional weather systems can sometimes cause rapid changes in barometric pressure that impact vapor system pressure. The BOG compressor discharge port is piped to the natural gas send-out line prior to the send-out meter, and flow rate proportionally reduces the quantity of gas to be vaporized.

Flares and Venting

As a means of last resort, a common LNG facility flare system is provided to facilitate disposal of excess vapor pressure to the atmosphere in a safe location in the event of abnormal process conditions or pressure buildup that exceeds fuel gas consumption. Flaring is preferred over venting of un-ignited gas due to concerns of producing significant releases of flammable gas that could potentially create safety hazards from flammable mixtures in air, ground level accumulation of vapor, and undesirable noise.

Natural gas and LNG vapor are lighter than other hydrocarbon vapor as the primary component, methane, has a low density and specific gravity. Therefore, natural gas and LNG have positive buoyancy at ambient temperature resulting in rapid rise and dispersion to the atmosphere to below the lower flammability limit rather than accumulating at ground level.

The flare is designed to vent vertically upward to provide jet momentum forces, to promote mixing with air for a clean burn and avoid soot caused by an incomplete burn. At the Casino Project, low ambient temperature may cause vented gas to be heavier than warm gas due to higher density of the gas at colder temperature. However, air at colder temperature is also heavier due to higher density. The net effect is that vented gas has even greater positive buoyancy in air at extremely cold ambient temperatures.

The vapor disposal system is generally an elevated vertical pipe with a flare tip and an electronic ignition system (not a standing pilot), located in a safe area where flammable gas can be safely discharged. In normal operations, there are no hydrocarbon emissions from the flare. The pipework feeding the flare is provided with a small low point ‘boot’ to detect liquid carry-over into the vent system. In the event of liquid being present, a level element in the boot alarms. No liquid knock out drum is provided as the only potential liquid release sources into the vapor system are thermal release valves where the lines are un-insulated to act as an ambient vaporizer. The design vent height above grade is 8 meters.

A.4.10.1.2 R105

R105. Identification of potential hazards to LNG facilities at the Casino Mine site associated with seismic activity, extreme weather events, wildfire, unstable terrain, and degradation of discontinuous permafrost, and a quantitative assessment of the related risk to those facilities.

The design and operations of the LNG supply chain in Fort Nelson, during LNG road transport, and LNG receiving and vaporization send-out will incorporate a loss prevention philosophy based on LNG industry best practices and designed to:

- Protect the public, and employees from unsafe conditions;
- Provide for a safe and healthy work environment;
- Present the requisite training and instruction in order to conduct safe and efficient operations;
- Impart adequate supervision to ensure safe work practices;
- Comply with all laws, regulations, and company standards and policies pertaining to these areas; and
- Identify, report, and evaluate hazards, near misses, first aid incidents, and recordable incidents.

Inherent safety serves to eliminate the potential for hazards by using materials and process conditions that are more benign. Inherent safety mechanisms are incorporated into the design of the LNG facility to minimize potential for incidents. An example of inherent safety is the design of the LNG storage tank to contain the maximum pressure predicted due to any credible upset such as an internal explosion. The approach that will be used for inherently safer processes and plants will comply with the following guidelines:

- Minimize – reduce quantities of hazardous substances.
- Substitute – replace a material with a less hazardous substance.
- Moderate – use less hazardous conditions, or a less hazardous form of a material (i.e. use water instead of a flammable solvent).

- Simplify – design facilities to eliminate complexity and thus make operating errors less likely.
- Employee Training.

Some measures of inherent safety that will be incorporated into the LNG facility design include:

- Compliance with all applicable codes and standards, to ensure high safety ratings based on current industry best practices.
- Locating flare and LNG storage tank downwind of facility, based on predominant wind direction.
- Locating heat exchangers, vaporizers and the control room upwind of facility, based on predominant wind direction.
- Separation distances for hazardous and non-hazardous areas will be determined following a Hazard and Operability Study (HAZOP), which will consider requirements in CSA Z276 and distance requirements for heat flux, lower flammability limit (LFL) contours, noise, vapor dispersion, thermal radiation and spill scenarios.
- Separation distances for all equipment and buildings in the plant will be determined using an approved model for vapor dispersion and thermal radiation (VDTR) calculations, and considering the requirements in CSA Z276 for ½ LFL contour as well as the heat flux contours. The distances between equipment, buildings, non-LNG operations, and the property line will be determined after the VDTR analysis has been performed.
- Use of blast resistant material in areas where active fire protection systems may have difficulty mitigating the fire hazard. Examples of areas where blast resistant material may be used include:
  - Between buildings with dissimilar occupancy types such as between the warehouse and process areas;
  - Between unrelated processes such as vaporization and LNG unloading if those areas are in close proximity;
  - Between occupied areas and process areas such as the control room building and the LNG vaporization area; and
  - Between critical operations such as the electrical and instrumentation room and the process areas.
- The following general criteria for the location of buildings is adhered to in order to eliminate hazards:
  - Efficient, reliable and safe plant operations;
  - Safe and efficient maintenance of equipment;
  - Reduced potential for incident escalation;
  - Easier access for emergency services;
  - Safe and efficient construction;
  - Effective and economical use of plot space; and
  - Compliance with inter-unit spacing requirements outlined in the Guidelines for Engineering Design for Process Safety (Center for Chemical Process Safety, 2012).
- Passive fire suppression and prevention systems:
  - Proper layout and spacing of equipment and facilities to code (CSA Z276).

- Proper containment and drainage for spill scenarios to code (CSA Z276).
- Fireproofing of equipment structural steel, vessel/column skirts, exchanger pedestals, cable trays, and electrical and instrumentation conduits where identified from a fire hazard analysis evaluation (performed during detailed engineering).
- Fire and blast walls.
- Electrical area classification (Canadian Electrical Code).

- Active fire suppression and prevention systems:
  - Flammable Gas detection:
    - Detects the presence of potentially flammable vapor/air mixtures before they reach the LFL and become a potential source of a fire or explosion.
    - The actions of the flammable gas detection system will trigger outputs and site wide alarms and can shut down the facility through the safety instrumentation system.
    - Factors used when locating gas detector sensors include potential leakage points, gas density, wind direction, and potential ignition source location.
    - Flammable gas detectors will be of high performance and reliability. Detectors will be set to detect gas releases early, with high sensitivity, at all times and in all weather conditions, yet to be highly immune to false alarms.
  - Fire detection:
    - Detects a fire by either sensing the heat, sensing the combustion products from a fire, or sensing the infrared or ultraviolet light from a fire.
    - Applicable for critical process areas such as the vaporizers, storage, and unloading areas.
    - Flame detectors will be of high performance and reliability. Detectors will be set to detect fire early, with high sensitivity, at all times and in all weather conditions, yet to be highly immune to false alarms.
  - LNG Spill Detection:
    - Detects the presence of LNG spills to LNG transfer trenches and impoundments.
    - The actions of the LNG spill detection system trigger outputs and site wide alarms and can shut down the facility through the safety instrumentation system.
    - Factors used when locating LNG spill detector sensors are potential leakage points, transfer trenches and LNG impoundments.
    - LNG spill detectors will be of high performance and reliability. Detectors will be set to detect LNG releases early, with high sensitivity, at all times and in all weather conditions, yet to be highly immune to false alarms.

Specific responses to specific events are detailed in the Liquefied Natural Gas Management Plan (Appendix A.22G).

Detailed design of the LNG facilities and gas distribution system, including a hazard analysis, quantitative risk assessment for tank selection and a spill scenario assessment, amongst others, will be conducted in the detailed design phase of the project. All design will meet or exceed the various applicable codes and standards, at the time of design. A license for a LNG facility will be obtained under the Yukon *Oil and Gas Act*, which will require engineered design details, as well as details of the management system, safety program, environmental protection program, non-destructive testing program, quality control and quality assurance program, abandonment plan, and description of the facilities and flaring and venting systems. All details with respect to CSA Z276 conformance will also be provided in the license application.

CMC will initiate discussions with Yukon Government Department of Health and Social Services, Yukon Government Department of Community Services, and local first responders in Carmacks to ensure that they are appropriately aware of and trained for responding to traffic accidents involving LNG as well as all of the designated hazardous materials that will travel the Freegold Road.

A.4.10.1.3 R106

R106. Identification of the potential supplier of LNG from British Columbia and the established supplier of LNG from Alaska. Indicate the nature of any supply agreements that are in place. Indicate the nature of any uncertainties about the LNG facility in British Columbia being operational by the time LNG is required at the Casino Mine site. Provide documentation to confirm that the facility in Alaska will be able to supply LNG in sufficient quantity to meet the needs of the Casino Mine, should LNG not be available from the proposed facility in British Columbia. Describe the Casino Mining Corporation's fallback plan in the event that LNG is unavailable from either identified source, or is not available in sufficient quantity. Indicate whether an alternative source of electrical power might be required in such a case. Assess the effect of the above scenarios on the project's economic feasibility.

As detailed in the Feasibility Study (M3 2013) CMC proposes to ship LNG from Fort Nelson, British Columbia. CMC is currently in negotiations with a number of potential suppliers to construct, own and operate a natural gas liquefaction plant in Fort Nelson. The supplier will be responsible for sourcing sufficient natural gas for supply to the Casino Project. CMC will purchase the LNG from the supplier in Fort Nelson.

Should LNG not be available in sufficient quantity for the Project, the Project may be run on diesel fuel. An evaluation of the economic feasibility of the Project under diesel fuel was conducted in the Feasibility Study (M3 2013). The capital cost estimate under the diesel case was estimated to be $2.445 billion total direct and indirect costs for the diesel mining equipment case; whereas the capital cost using LNG was $2.456 billion; however, the operating cost of the Project using diesel would be higher. An economic analysis of the Project using diesel indicated that it would be economic under the all diesel scenario.

A.4.10.1.4 R107

R107. The earthquake design basis for the LNG storage tank at the mine site.

As described in the Liquefied Natural Gas Management Plan (Appendix A.22G), the process equipment and piping will be designed to comply with the CSA-Z276 standards for site specific seismic conditions. The LNG storage tank will be designed for MDE corresponding to 1 in 2,500 year earthquake with a mean PGA of 0.13g and a design earthquake magnitude of 8.0.

A.4.10.2 Description of Diesel Facilities

A.4.10.2.1 R108

R108. A description of diesel storage facilities along with anticipated rates of use and storage volumes for each stage of the Project.

As stated in the Section 4 of the Proposal, diesel consumption volumes are as follows, based on using diesel for the mining fleet:

- Diesel consumption during construction, 26,000 m^3 per year (71,232 liters per day)
- Diesel consumption during operations, 32,000 m^3 per year (87,671 liters per day)
- Diesel consumption during closure and decommissioning, 2,000 m^3 per year (5,479 liters per day)

Storage of diesel is to be in two bulk storage tanks, each with a capacity of approximately 330 m^3. The combined capacity of 660 m^3 would allow for seven days of safety stock.

All aspects of fuel storage, safety and handling will be done in accordance with applicable Federal and Yukon Codes, Standards and Regulations.

A.4.11 CONCEPTUAL CLOSURE AND RECLAMATION PLAN

A.4.11.1 General Concerns

A.4.11.1.1 R109

R109. A table or tables that summarize the following information for each major mine component:

- **a. where appropriate, dimensions, mass, volume, centroid and elevation;**
- **b. reclamation characteristics (slope aspects, cover type and depth, volume required, re-vegetation type);**
- **c. source controls (e.g. liners, compacted graded drained foundations, and covers over reclaimed features) and any features associated with fluid management and stabilization and/or water management and treatment; and**
- **d. geotechnical protocols and results (e.g. FOS).**

For each major mine component, Table A.4.11-1 provides a summary of the following:

- Maximum dimensions;
- Source controls during operations;
- Source controls at closure and during post-closure; and
- Reclamation characteristics such as slope gradient, slope aspect, cover type and depth, volume of cover material required, and re-vegetation types.

Details of the major mine components have been provided in Section 4 of the Proposal, and are supplemented by Section A.4 of the SIR. Geotechnical protocols and results can be found in the following feasibility design reports:

- Appendix A.4C Feasibility Design of the Heap Leach Facility
- Appendix A.4D Report on the Feasibility Design of the Tailings Management Facility
- Appendix A.4F Waste Storage Area and Stockpiles Feasibility Design

Please note that these reports were written for the purposes of feasibility level design of the Project, and may be superseded by details provided in the Proposal and SIR.

Table A.4.11-1 Major Mine Component Reclamation Summary

	Source Controls		Reclamation Characteristics
Dimensions[1]	**Operations**	**Closure**	
Open Pit			
Footprint: 3.14 km^2 Depth: 600 m Width: 2,400 m	• Pit water pumped to TMF or used for process water	• Lime amendment during placement of waste rock if required • Flooding to reduce pit wall exposure • Remotely operated gravity discharge system to North TMF wetland • Options for intermittent biological treatment of pit water to stimulate microbial activity, if necessary	• n/a
Temporary Ore Stockpiles			
Footprint[2]: – North-East Gold Ore: 0.5 km^2 – North-West Supergene Oxide and Low Grade Ore: 4.32 km^2 – South-East Low Grade Ore: 1.3 km^2 – South-West Low Grade Ore: 0.3 km^2 – Marginal Grade Ore: 0.2 km^2 Volume[2]: – Gold Ore:	• Diversion ditches to intercept runoff upgradient of stockpiles, collection ditches to collect runoff from stockpiles • Runoff captured by constructing piles within catchment of open pit and TMF • Groundwater collection or infiltration suppression system installed to intercept potentially contaminated groundwater issuing from the Supergene Oxide	• All stockpiled ore processed or removed from surface • Removal of any contaminated soil or rock within footprint or downslope • Maintain groundwater seepage mitigation system until seepage quality acceptable, then decommission • Post-closure, runoff will discharge to TMF thus ultimately will discharge	• Foundation contoured to adjacent topography which slopes gently to south or southeast • Foundation reclaimed with vegetation substrate[3] • Vegetate[4]

[1] Dimensions are given as maximums.
[2] Maximums occur at different times in mine life.
[3] Vegetation substrate refers to potential mixture of overburden, topsoil, and/or amendments depending on results of reclamation research.
[4] Re-vegetation objectives, such as natural seed availability, vegetation trials for re-vegetation and nutrient level deficiencies in available soils will be evaluated to determine the most appropriate selection for re-vegetation of the site. This applies to all mine components.

	Source Controls		Reclamation Characteristics
Dimensions[1]	Operations	Closure	
20,711,053 m3 – Supergene Oxide: 17,057,895 m3 – Low Grade Ore: 75,698,947 m3 – Marginal Grade Ore: 4,651,105 m3	stockpile	via south TMF wetland	
Processing Facility and Infrastructure			
Total disturbed area: 3.4 km^2		• Remove hazardous materials and ship off-site for disposal at licensed facility • Bioremediate any hydrocarbon contaminated soil in on-site facility	• Cover landfill with leached rock from HLF and vegetation substrate • Vegetate
Heap Leach Facility			
Footprint: 1.5 km^2 Height 150 m Mass: 157.5 Mt	• Upslope diversion ditch to intercept runoff upgradient of HLF • Liners • Ponds	• Bioreactor to remove Hg and Se from draindown prior to discharge to open pit • Post-closure, runoff will discharge to TMF thus ultimately will discharge via south TMF wetland	• Overall downslope angle reduced to between 5H:1V to 10H:1V at closure. • 0.75 m low permeability cover, 1.1 Mm^3 of low permeability material
Tailings Management Facility			
Footprint: 11.2 km^2 Embankment height: 286 m Length (along crest): 2,460 m Storage: 956 Mt tailings, 658 Mt PAG waste rock	• Tailings and PAG waste rock deposited concurrently within TMF. • The sequence of rock placement allows geochemical reactions which significantly reduce the concentration of metals in seepage and TMF pond water. • Seepage pathways are restricted due to the low permeability tailings placed closest to the dam.	• PAG waste rock covered by 3 m de-pyritized tailings plus a permanent water cover. Source of tailings is LGO which addresses removal of stockpiled LGO. • PAG waste rock remains subaqueous post-closure • Construction of north and south wetland • Seasonal discharge of seepage from water management pond (see	• Two constructed wetlands. • Beaches reclaimed with vegetation substrate (0.5 Mm^3) • Embankment slope 3H:1V • Reclaim embankment with vegetation substrate (1 Mm^3) • Vegetate (see R139)

	Source Controls		Reclamation Characteristics
Dimensions[1]	Operations	Closure	
	• Geochemically worst PAG rock (1.5%) stockpiled for milling, or disposal in pit, at end of pit operations to improve TMF pond and seepage water quality to ensure successful passive treatment post-closure. • Pump-back from water management pond at toe of main embankment to recover seepage.	R135 – R138)	
Airstrip and Access Roads			
Length: 1,720 m Width: 30 m Grade width: 80 m			• Roads not required for post-closure activities reclaimed by removing culverts and safety berms, re-establishing natural drainage channels, scarifying the surface and vegetating. • Airstrip will not be reclaimed to allow post-closure monitoring and maintenance.
Freegold Road Extension			
Length: 120 km			Road decommissioning will be carried out to stabilize the road footprint, restore natural drainage, and reduce potential for landslides. The degree of decommissioning activities required to achieve these objectives will vary depending on characteristics of each road segment (refer to section 3.8 of CCRP and R20)

A.4.11.1.2 R110

R110. Conservative considerations for the long-term operational and maintenance requirements for the site.

Casino Mining Corporation recognizes that a “walk-away” condition is not achievable, but also that reliance on long term “active care”, such as active treatment is not acceptable. CMC has designed the Casino Project for “passive care” requiring only minimal management and maintenance during the post-closure period.

For clarity, these terms are defined as follows:

Active Care: frequent or continuous site presence and high level of activity, such as pumping and chemically treating contaminated drainage.

Passive Care: Infrequent, periodic site presence for monitoring (environmental or geotechnical) and low effort maintenance as necessary (such as repairs to spillways, covers, wetlands).

Walk Away: No need for any future activity. For large modern mines this is typically achievable for mine components only, such as buildings, roads or non-PAG waste dumps.

Casino Mining Corporation has taken a comprehensive and conservative approach to mine planning for closure to ensure that key objectives are met and that there is no expectation of long-term active care. This has involved a number of key steps as follows:

1. Development of detailed site characterization database. This has included geology, geochemistry, and receiving environment conditions (water quality, aquatic life and terrestrial environment).
2. Development of a mine plan which is economically feasible and technically achievable.
3. Iterative evaluation of the potential impacts of the mine plan and subsequent adaptations to the mine plan to minimize potential impacts during and following operations, and to ensure that post-closure active care is not required. These mine plan iterations have been conducted with the ongoing input of mine designers, geologists/geochemists, water quality specialists and mine closure experts. As a result of this process, the mine plan includes the following key elements:
   a. Design and construction of the final TMF dam for the 1 in 10,000 year earthquake and probable maximum flood (the highest standards recommended by the Canadian Dam Association (2013)).
   b. Conservative design of all mine components to ensure protection of the receiving environment.
   c. Segregation of the tailings in the mill into non-PAG tailings, which are deposited as the tailings beach or used as the source of cyclone sand material for dam construction, and a PAG tailings which is deposited underwater in the pond area of the TMF.
   d. All PAG waste rock is placed strategically in the upper portion of the TMF where:
      i. Seepage pathways are restricted due to the low permeability tailings placed closest to the dam, and
      ii. The sequence of rock placement allows geochemical reactions which significantly reduce the concentration of metals in seepage and TMF pond water.
   e. Marginal grade ore is stockpiled for milling or disposal in the pit at the end of pit operations to minimize potential geochemical reactivity.
   f. All LGO stockpiles are situated within the catchments of the Open Pit and TMF, and contact water will report to these two locations. A groundwater collection or infiltration suppression system will be installed

to intercept potentially contaminated groundwater issuing from the Supergene Oxide Low Grade Ore Stockpile.

g. Processing of all Low Grade Ore stockpiles is conducted toward the end of mine life which:

   i. Provides a reclamation surface in the TMF; and

   ii. Ensures that no PAG material is left on surface at closure.

h. Design of passive care closure systems (North and South TMF Wetlands, Water Management Pond, and the Open Pit gravity discharge system) for water management to mitigate residual water quality concerns that cannot be addressed through modification of the mine plan.

i. Seepage interception system downslope of the TMF embankment to capture 100% of the potential seepage, and subsequently recycle back to the TMF or discharge in a controlled manner from the water management pond.

j. An active closure period of seven years to remove mine infrastructure from the site and construct covers on the TMF embankment, HLF, and stockpile footprints.

k. A long-term monitoring program corresponding to phases of active closure, closure and post-closure.

Casino Mining Corporation intends to carry out progressive reclamation activities to the extent possible throughout operations. In addition, CMC anticipates that closure and decommissioning activities can commence one year before the end of the operations phase followed by a seven year active closure and decommissioning phase. An overall schedule of closure activities is provided in Figure A.4.11-1.

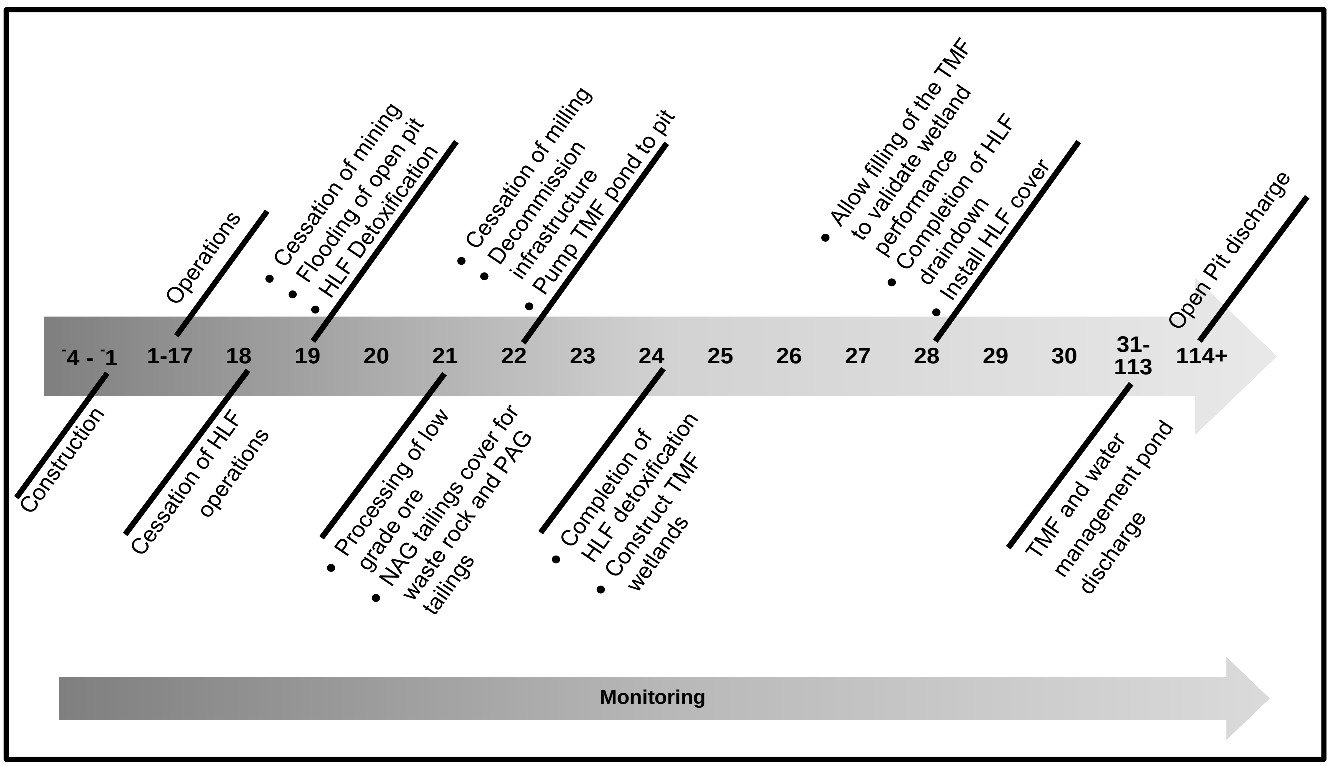


Figure A.4.11-1 Closure Activities Timeline

Casino Mining Corporation is committed to ensuring all of the above criteria and plans are adhered to throughout the mine life. Comprehensive monitoring and reporting systems will be established in the Regulatory phase to demonstrate that objectives are being met.

The comprehensive closure and reclamation plan will be reviewed and revised throughout operation to reflect operational changes, and changes in reclamation procedures identified through on-going studies, at least every five years (Yukon Government 2006). Prior to the start of the closure and decommissioning phase, a comprehensive closure and reclamation plan will be prepared for the Casino Project to meet all Yukon Government regulatory, licensing, and policy requirements. This plan will be developed in accordance with the Yukon Mine Site Reclamation and Closure Policy and will involve the participation of relevant Yukon Government departments, First Nations, local communities and stakeholders (Yukon Government 2006). The final closure plan will match the vision of the Policy, which is to ensure that reclamation is conducted "*in a manner that fosters sustainable development and a healthy environment*" (Yukon Government 2006).

Reclamation and closure activities have been selected based upon best practicable technology currently available to achieve the closure objectives. Future updates to the plan may incorporate new and improved technologies as they become technically and economically viable.

A.4.11.2 Long-Term Closure and Ongoing Monitoring and Maintenance

A.4.11.2.1 R111

R111. Analysis of closure options including long-term and short-term costs, care and maintenance requirements, and long-term environmental risks. The options analysis should include:

a. open pit;
b. tailings management facility;
c. heap leach facility;
d. stockpile areas; and
e. water management and treatment.

All components of the Casino project were designed for closure. Key in this regard was the alternatives assessment for selection of the best location for the TMF (Section 4.8.4.4 of the Proposal). Selection of practical and feasible closure options were based on: design for closure, placing uneconomic PAG material in the TMF for permanent underwater disposal, and ensuring no post-closure active care of the site. Costs were not a significant consideration, as the selection of options is based on appropriate closure scenarios. Costs will be further evaluated during the finalization of the closure plan for Quartz Mining Licencing. Options that did not meet these objectives were rejected early in the development of the conceptual closure plan, limiting the remaining options to the following:

- **Open Pit:** The options considered for closure of the open pit were:
    1. *Canadian Creek* diversion or flow into the open pit. To minimize the amount of post-closure maintenance of diversion ditches, and to take advantage of the alkalinity, and the more rapid filling of the pit provided by retraining Canadian Creek back to its original pathway, the flow into the open pit option was chosen.
    2. *Discharge of open pit lake overflow* to the TMF could be either pumped (active care) or remotely managed with the discharge system proposed. The discharge system as proposed was selected to meet the objective of passive care. Additionally, the controlled discharge system may in itself be a contingency measure, as the North Wetland may be able to accept flow directly from the

open pit, without control. Experimental laboratory results (R116) will further detail the requirements for control of flow from the open pit lake.

3. *Lime treatment* may be required for material disposed of in the pit during closure. Lime addition requirements will be determined at the time, and will depend on the geochemical characteristics of the material.
4. *In-situ pit lake treatment* may include biological remediation measures (e.g., carbon source dosing, chemical dosing) that increase microbial activity to reduce metal concentrations in the pit lake water. While the current treatment regime does not require pit lake treatment, monitoring of the pit lake in post-closure will be conducted to ensure the water quality is protective of waterfowl that may come into contact with the pit lake, and in-situ treatment may be initiated if required.

- **TMF**: The TMF is designed to provide permanent underwater disposal of PAG materials behind a dam which is designed for the MCE and PMF. This is the highest design standard considered in the mining industry. Closure of the TMF is focused on maintaining the geotechnical stability of the dam and infrastructure, and maintaining the geochemical integrity of the PAG material disposed of in the impoundment. As such, options for closure of the TMF are limited and are merely to manage overflow through the spillway to ensure an adequate water cover over the tailings.
- **HLF**: Options for closure of heap leach facilities are generally limited to cover systems, and fluid management. Often, options for cover systems and fluid management must be carefully designed and operated to ensure minimal infiltration and subsequent contamination of runoff. However, the Casino Project is unique in that it has both a HLF and a TMF, and as the former drains into the later, the TMF provides for containment of any infiltration through the HLF. Therefore, low infiltration cover design is not necessarily required, nor is leachate management, as long as it does not adversely affect the TMF supernatant pond and subsequent wetland treatment system.

  As discussed in R134, cover systems will be evaluated during the operations phase of the Project, and iterative designs will be evaluated to meet the objectives for long term geotechnical stability and long term minimization of infiltration into the spent pile.

  As discussed in R118, the bioreactor system associated with the HLF is a contingency measure being considered for the draindown period while the HLF discharge is being pumped to the open pit (which is not yet full nor discharging). This contingency may be required if water chemistry in the HLF draindown water is predicted to unacceptably affect the water quality of the Pit Lake.

  Water quality modelling will be conducted to determine if the bioreactor is warranted, what predicted impacts to water quality would be, and what other passive means of treatment may be feasible. If the bioreactor is deemed to be necessary (i.e., that it is likely to have a significantly positive impact that cannot be brought about by other more passive means), then testing and design will follow a phased program similar to that outlined for the wetlands.
- **Stockpile Areas**: All stockpiles of PAG material are situated within the catchment of the TMF. All of these materials must be either processed in the mill or relocated to the pit at closure. A limited quantity of locally available potential cover materials precludes a viable plan for in-situ closure of these piles.
- **Water Management and Treatment**: Water management and treatment during closure must comply with the Yukon Government's policy, which states that "reliance on long term active treatment is not considered acceptable for reclamation and closure planning" (Yukon Government 2006). CMC recognizes that a "walk-away" condition is not achievable, but also that reliance on long term "active care", such as

long-term active water treatment is not acceptable. As such, CMC has designed the Casino Project for a long-term closure scenario of “passive care”, requiring only minimal management and maintenance during the post-closure period. To this extent, an objective in designing the closure plan was to select the most well proven conventional “passive care” treatment methods that meet the Yukon Government’s requirements.

As detailed in R122, CMC utilized the Interstate Technology Research Council (ITRC) Mining Waste Treatment Technology Selection Guidance Document, which provides an efficient process for identifying appropriate treatment technologies through use of a formal decision matrix and technical backup. CMC and its consultants have also made use of applicable northern climate guidance documents in the decision process, such as those produced by Mine Environmental Neutral Drainage (MEND).

The conventional treatment methods of constructed wetlands and bioreactors were selected for the Casino site based on a thorough review of literature for available technologies, as well as application of the ITRC web decision making tools and guidance documents produced by MEND. These have been selected as proven and conventional treatments, but with the realization that they need to be applied in a site-specific manner, through a phased program for design and optimization. Casino Mining Corporation has committed to undertake such a program, which is discussed in greater detail in the above sections. Aside from the conventional and proven treatment methods that were selected as primary means of water treatment in closure for this project, several contingency methods of passive water treatment were also identified through the technology review process (Appendix A.4H Cold Climate Passive Treatment Systems Literature Review). In addition to the selection of conventional treatment technologies, contingency passive treatment methods, and a phased research program for the site-specific design, optimization, and implementation of these technologies, the current state of knowledge will be regularly reassessed through CMCs reclamation research program to ensure the technologies being applied are appropriate to the closure objectives of the site.

A.4.11.2.2 R112

R112. Discuss and if necessary update the conceptual closure plan to take into account the most recent Government of Yukon Reclamation and Closure Planning for Quartz Mining Projects, Plan Requirements and Closure Costing Guidance (Government of Yukon, 2013).

Casino Mining Corporation developed the mine plan and conceptual closure plan consistent with the policies and objectives of the Yukon Mine Site Reclamation and Closure Policy (Yukon Government 2006), upon which the Reclamation and Closure Planning for Quartz Mining Project, Plan Requirements and Closure Costing Guidance document is based. In this regard, CMC is of the opinion that the mine development and conceptual closure plan for the Casino Project meets the policies and objectives of the Yukon Mine Site Reclamation and Closure Policy to the extent which is practical and feasible. In this regard, CMC is of the opinion that there is no acceptable option or strategy which could further reduce post-closure activity or improve water quality.

The CCRP provided for the Proposal is a preliminary plan, and will be refined throughout the permitting process and subsequently as required by the Quartz Mining License (QML) and the Type A Water Use License (WUL). All subsequent CCRPs will be updated to reflect current policy and regulations, and will contain the requirements of the most up to date guidance documents.

A.4.11.2.3 R113

R113. Clarify what is meant by regular or infrequent site presence or what degree of on-site presence is envisioned (e.g. yearly during summer, once every 10 years, or site presence in step with closure stage).

With respect to post-closure monitoring and maintenance what is meant by regular though infrequent site presence is that a regular schedule of site presence will be required, but the scheduling will be infrequent as will be described further. Site presence will be in step with phases of closure and is expected to decrease over time such that by Year 35 site presence will be required only annually.

Maintenance

The closure strategy for the Casino Mine is to minimize the requirements for post-closure activities to the extent which is practical. There will not be a requirement for any of the typical elements of active care such as year-round site presence, power, or long term operation of a water treatment plant.Long-term passive care is expected to require minimal maintenance and consist of:

- Operation of valves to all gravity releases of water from the Open Pit, Water Management Pond, TMF and others as necessary. Following an annual spring maintenance and commissioning, it is envisioned that the operation of the valves and control of flows could then continue remotely (i.e. without need for site presence until decommissioning in the fall;
    - Annual or bi-annual inspection and maintenance of:
    - Wetlands;
    - TMF dam and spillway; and
    - Seepage mitigation pond dam and liner system.
    - HLF cover repair.
- Some minor power may be required, but will be provided through solar panel powered battery banks.

Table A.4.11-2 provides an outline of the requirements for post-closure maintenance for each of the mine components. It is expected that regular site inspections and post-closure maintenance can be completed within a week to two annually. Unless otherwise specified, all maintenance is expected to be carried out during the ice free season by a site care taker.

Table A.4.11-2 Conceptual Post-Closure Maintenance Requirements by Mine Component

Mine Component	Inspections/Maintenance Requirements	Frequency
General	Maintain diversion ditches and permanent flow ways clear of obstructions.	Twice annually
	Maintain access for light truck traffic for monitoring.	Annually
	Maintain accommodations for monitoring and maintenance activities.	Annually
	Maintain vegetation (i.e. if necessary reseed and fertilize areas not successfully established as well as invasive species removal).	Annually
Pit	Maintain discharge system consisting of valve and remote monitoring equipment. This would include maintenance of fuel and solar cells for energy collection, and ensure valves are operational. For all of the flow regulating systems, sensitive components could be removed at the	Twice annually

Mine Component	Inspections/Maintenance Requirements	Frequency
	end of the summer season and reinstalled at the beginning of the season to prevent exposure to winter conditions.	
TMF	Dam inspection.	Annually by Professional Engineer
	Maintain spillway clear of obstructions.	Annually
	Repair any damage to soil and vegetation cover observed during regular physical inspections.	Annually for 5 years
	Maintain discharge system consisting of valve and remote monitoring equipment. This would include maintenance of fuel and solar cells for energy collection, and ensure valves are operational. For all of the flow regulating systems, sensitive components could be removed at the end of the summer season and reinstalled at the beginning of the season to prevent exposure to winter conditions.	Twice annually
	Maintenance of constructed wetland treatment systems. Repairs to spillways and finger dykes to maintain flow paths and retention time. Monitor and maintain wetland vegetation though natural adaptation expected.	Every 5-10 years for 20 years and again post pit discharge.
HLF	Repair any damage to cover observed during regular physical inspections vegetation cover well established.	Annually for 10 years
	If bioreactor required for treatment of drain down water design life will only be to Year 29. Matrix replacement/repairs not expected.	

Monitoring

Environmental monitoring will provide important indicators of the successful closure of the Project. A final post-closure monitoring program will be compliant with the applicable guidelines and regulations, and will be implemented to ensure the reclamation measures remain effective and continue to provide a high level of protection for the public and the environment. A preliminary closure and post-closure monitoring schedule is provided in Table A.4.11-3. The monitoring requirements correspond to the closure and post-closure phases as follows:

- Interim Care and Maintenance (2 Years);
- Phase I Closure - Active Closure (Years 23 - 30);
- Phase II Closure - Pit Flooding (Years 31 - 113); and
- Phase III Post Closure (Years 114+).

During Phase I and for a period of 5 years subsequent to completion of active decommissioning and reclamation measures (to Year 35), the environmental and physical compliance monitoring and inspections will be focussed on ensuring that closure elements, specifically the TMF wetlands and the water management pond discharge system, are fully functional prior to initial discharge from the TMF (Year 31).

It is anticipated that for the period from Years 36 to two years prior to pit flooding (Year 111) of Phase II Closure, the frequency and possibly the number of stations, can be reduced.

Approximately two years prior to pit flooding, monitoring will be increased to ensure that pit water quality is suitable for discharge to the TMF (Year 111-112). Increased monitoring and inspections will continue for 5 years following pit overflow to demonstrate the performance of the TMF wetland systems.

If the results from monitoring indicate that the site is stable with acceptable geotechnical and environmental performance, then it would be proposed that the amount (frequency and/or number of stations) decrease and potentially no longer be required.

Table A.4.11-3 Summary of Closure and Post-Closure Monitoring Schedule

Phase	**Interim Care and Maintenance**	**Phase I** **Active Closure**	**Phase II** **Pit Flooding**			**Phase III** **Pit Overflow**	
Project Years	**Temporary Closure**	**23-30**	**31- 35**	**36-110**	**Year 111-113**	**114-117**	**118+**
Monitoring Component		**Monitoring Frequency***					
Surface Water Monitoring	Q	Q	Q	A	Q	A	
Groundwater Monitoring	Q	Q	Q	A	Q	A	
Aquatic Environment							
Fish Community and Habitat	A	3	3			A	
Biological	A	A	A			A	
Terrestrial							
Vegetation Health	A	5	5				
Metal in soils	A	5	5				
Wildlife	A	3	3				
Physical Inspections							
TMF dam inspection	A	A	A	A	A	A	A
Covers	NR	A	A				
CWTS	NR	A	A		A	A	

NOTES:

1. *Frequency: M - monthly; Q – quarterly (seasonal conditions permitting); A – annually; 3 - once every three years; 5 - once every five years; NR – not required.

A.4.11.2.4 R114

R114. Justification and clarification of the proposed five year post-closure monitoring period given that actual closure conditions will not be established for about 95 years (pit discharge) and other closure conditions are not fully known or presented here (e.g. time for contaminated groundwater sources to report to TMF/seepage).

Please refer to R113 for the proposed post-closure monitoring plan that is in step with closure phase and exceeds 95 years (pit discharge).

A.4.11.3 Design and Operation of Wetland Water Treatment System

A.4.11.3.1 R115

R115. Examples of successful similar treatment systems with similar contaminant loads, flows and climate.

A literature review on passive treatment of mine-impacted water in cold climates was commissioned by CMC and conducted by the Yukon Research Centre at the Yukon College (Cold Climate Passive Treatment Systems Literature Review Appendix A.4H). The literature review provides supporting examples of successful passive treatment (such as bioreactors and engineered wetlands) for similar systems as those proposed for the Project, in climatic conditions comparable to Northern Canada. Passive treatment systems must be designed and implemented in a site-specific manner to be successful. While no two systems are ever the same, significant information can be gleaned from a diverse range of treatment systems, as scientific principles such as thermodynamic laws, Stoke's laws (settling), and concepts of coupled biogeochemical reactions are globally applicable. Moreover, there are known calculations such Arrhenius' equation that can be applied to adjust for temperature in chemical reactions. However, laboratory, pilot-scale (off site) and demonstration-scale (on site) experiments are needed before full-scale implementation to ensure site-specific robustness and kinetics of treatment. It should be noted that most passive treatment systems described in literature have generally not undergone a science- and evidence-based phased design and optimization program as CMC is undertaking through their reclamation research program. The phased design and optimization program for passive water treatment at the Casino mine is intended to be an adaptive and responsive program, allowing for the systems to be effectively developed to treat water for the ranges of contaminant loads, flows, and climate at the Casino site, for successful treatment in perpetuity.

A.4.11.3.2 R116

R116. Initiation of laboratory studies to confirm the effectiveness of the wetlands as a water treatment system for the purpose of closure and to inform future field studies. The Executive Committee expects that results from these studies will be provided throughout the assessment process.

A phased design and optimization program is being implemented for the site-specific development of the treatment wetlands. These phases are: 1) site assessment and information gathering including technology selection and conceptual design, 2) bench/laboratory-scale and pilot-scale testing and optimization (controlled environment), 3) on-site demonstration-scale confirmation and optimization, and 4) full-scale implementation. The phases of testing are outlined in Figure A.4.11-4. Each phase will be undertaken as early as is reasonably possible based on the mine design, construction, and operations schedule given the requirements of the phase of testing. For example, the laboratory-scale testing requires predicted water chemistry, and the pilot-scale testing builds upon laboratory-scale testing with a further requirement that a site-assessment be performed in the context of natural treatment wetlands and local plants harvested for use in the testing. It is anticipated that on-site demonstration-scale testing will begin early in operations, shortly after there is water of appropriate chemistry available. Preliminary bench-scale testing has already been initiated with a study undertaken by the Yukon College in June 2014. Results of this study are provided in Metal Uptake in Northern Constructed Wetland (Appendix A.4K), which will be used as a base for further bench- and pilot-scale studies.

Table A.4.11-4 Stages of constructed wetland treatment system testing and optimization

Aspects and Parameters Related to Different Constructed Wetland Scales	Site Assessment and Information Gathering	Constructed Wetland Scale			
		Bench/ Laboratory	Pilot (off site)	Demo (on site)	Full
Phase	1	2	2	3	4
Characterization of water for treatment	+				
Evaluation of water discharge and mixing point options	+				
Site assessment	+				
Conceptual design of pilot-scale CWTS	+				
Test various water chemistries and formulations		+	+		
Test different sediment makeups		+	+		
Test different plant efficacies/properties		+	+		
Environmental parameter control		+	+		
Develop flow rates and water depths (HRT)			+		
Develop rate coefficients and kinetics			+		
Acquire proof-of-concept			+		
Intensive monitoring		+	+	+	
Determine parameters for proper sizing			+	+	
Measure removal extent			+	+	+
Evaluate cold weather performance			+*	+	+
Compare demo/full scale data to pilot data (e.g., rate coefficients)				+	+
Confirm removal rates/extents				+	+

NOTE:
*if performed outdoors

A.4.11.3.3 R117

R117. Detailed plans on field studies to support and refine the effectiveness of the wetland water treatment system. Details should include:
a. a preliminary schedule for studies;
b. location and sequencing of field scale studies; and
c. any required activities, such as earthworks, required for field studies.

As discussed in R116, a phased research program is being conducted to inform and refine the designs for an on-site demonstration-scale wetland field study. This includes the development of detailed plans for field-studies to support and optimize the effectiveness of the wetland water treatment system. In order to develop the details needed for field (demonstration-scale) studies, pilot-sale (off-site) wetland studies are first required to evaluate and optimize preliminary design concepts. Each phase will be undertaken as early as is reasonably possible in the mine construction and operations schedule given the requirements of the phase of testing. Conceptually, the field-work for on-site demonstration-scale testing may involve construction of an intermediate sized wetland at the toe of the TMF by the WMP. This would be built after the pilot-scale testing is completed, once there is water of appropriate chemistry available for treatment by the wetland. It is currently anticipated that this may occur near year 5 of operations. The construction of the demonstration-scale wetland will require minor earthworks, which will be determined by the wetland design consultant. In the near term, studies are planned this year to assess the latent potential for remediation in natural wetlands at the Casino site to aid in designing the treatment wetlands in a site-specific and evidence-based manner.

A.4.11.3.4 R118

R118. Details on any proposed pilot studies for the bioreactor system associated with the HLF.

The bioreactor system associated with the HLF is a contingency measure being considered for the draindown period while the HLF discharge is being pumped to the open pit (which is not yet full nor discharging). This contingency may be required if water chemistry in the HLF draindown water is predicted to unacceptably affect the water quality of the Pit Lake.

Water quality modelling will be conducted to determine if the bioreactor is warranted, what predicted impacts to water quality would be, and what other passive means of treatment may be feasible. If the bioreactor is deemed to be necessary (i.e., that it is likely to have a significantly positive impact that cannot be brought about by other more passive means), then testing and design will follow a phased program similar to that outlined for the wetlands in R116.

A.4.11.3.5 R119

R119. An assessment of uncertainty associated with the performance of the proposed passive treatment system.

As with any water treatment system, an assessment of the uncertainty associated with the performance of the proposed passive treatment systems will be conducted as part of the design and testing process. Uncertainties will be evaluated and integrated into the phased research program in order to identify their scope and develop contingencies to address them. The phased approach being undertaken in the design and optimization of the passive treatment systems has been developed specifically to address uncertainties associated with such systems, allowing for optimizations, design revisions, and contingency options to be integrated through the process. As discussed above, while some uncertainty remains with the currently proposed systems, CMC is confident that all foreseeable uncertainty will be addressed through the execution of appropriately planned laboratory, bench- and field-scale experiments and subsequent monitoring of the installed systems. Additionally, CMC is confident in the conservative nature of the water quality model predictions (as discussed in Section A.7 of the SIR), and that the treatment systems proposed will result in discharge water quality that will be protective of the receiving environment.

A.4.11.3.6 R120

R120. Prediction of a worst case scenario of downstream water quality assuming no treatment system. Predictions should extend as far downstream as necessary to demonstrate no further exceedances of the CCME surface water quality objectives attributed to the mine (or 90th percentile of background for those constituents that naturally exceed CCME).

Casino Mining Corporation is not proposing a Project with no treatment of discharge prior to release to the receiving environment. As such, water quality modelling results without mitigation were not included in the water quality modelling assessment. Results of the water quality model assessment are provided in Appendix A.7B.

A.4.11.3.7 R121

R121. A discussion of contingency, alternative, or additional treatment options that could achieve water quality objectives should the passive treatment system not be viable or perform as required.

Casino Mining Corporation has designed the Casino Project for “passive care”, requiring only minimal management and maintenance during the post-closure period. An objective in designing the closure plan was to select the most well proven conventional treatment methods that meet the Yukon Government’s requirement that long-term active treatment is not considered acceptable for reclamation and closure planning. The requirements and merits of the selected treatment methods are provided in R115, along with methods for selection based on widely accepted decision matrices for mine closure planning. As discussed above, a robust schedule of testwork will be conducted to establish criteria for the treatment wetlands, such as final design, sizing, and predicted performance under a variety of plausible conditions specific to the Casino site. Additionally, long-term demonstration-scale field trials will be conducted to verify these criteria prior to installation of the ultimate full-scale wetlands. Comprehensive monitoring following installation will be conducted to ensure that the systems are functioning appropriately, and are sufficiently protective of the receiving environment.

While there is a high level of confidence that the proposed systems will address the water treatment goals of this project, as an added measure of conservatism the phased program of testwork is being developed in the context of additional passive contingency, alternative, or additional treatment options that could be implemented should it be deemed necessary, and may include:

- Allocation of greater area for treatment wetlands than expected to be needed, providing for additional wetland treatment areas if needed.
- Testing of multiple wetland designs at pilot-scale to refine optimal site-specific design and operation strategy.
- Control of flow from Open Pit with solar powered valve.
- Treatment of HLF draindown by bioreactor prior to pumping to Open Pit.
- In-pit treatment prior to discharge of Open Pit to TMF.
- Added treatment wetland for HLF seepage to TMF.
- Construction of demonstration-scale treatment wetland at WMP early in operations, with retention of this treatment capacity in closure.
- Enhancing wetland treatment by periodic dosing of electron donors (e.g., ethanol, methanol, straw, wood chips).
- Incorporation of materials with iron in conveyance channels and wetland construction materials to promote targeted cation-anion balances.
- Strategic co-management of water sources and treatment locations (e.g., HLF, Open Pit, TMF, WMP).
- Strategic incorporation of spillways/conveyance channels to promote glaciation in winter months.
- Sizing of North TMF wetland assuming no regulation of flows coming from open pit and also no application of a bioreactor during draindown period.
- Evaluation of possibility of designing South TMF wetland to treat for water, assuming North TMF wetland not constructed.

- Evaluation of timing for when to build the North TMF wetland.

These potential contingency measures will be evaluated as the design of the closure landscape for the Project is further defined.

A.4.11.3.8 R122

R122. A discussion of the requirements and merits for conventional treatment as the treatment method.

The Yukon Government states that "reliance on long term active treatment is not considered acceptable for reclamation and closure planning" (Yukon Energy, Mines and Resources, 2006). Casino Mining Corporation recognizes that a "walk-away" condition is not achievable, but also that reliance on long term "active care", such as long-term active water treatment is not acceptable. As such, CMC has designed the Casino Project for a long-term closure scenario of "passive care", requiring only minimal management and maintenance during the post-closure period. To this extent, an objective in designing the closure plan was to select the most well proven conventional "passive care" treatment methods that meet the Yukon Government's requirements.

A well-respected and commonly used tool used in the evaluation of passive treatment technologies is the Interstate Technology Research Council (ITRC) Mining Waste Treatment Technology Selection Guidance Document (http://www.itrcweb.org/miningwaste-guidance/). The ITRC is an organization that brings together environmental experts and stakeholders from the public and private sectors with a two-fold mandate to develop technical knowledge and streamline the regulation of new environmental technologies. The ITRC Mining Waste Treatment Technology Selection Guidance Document provides an efficient process for identifying appropriate treatment technologies through use of a formal decision matrix and technical backup. These are in the form of technical guidance documents that facilitate more detailed evaluation, design, and implementation of the identified preferred treatment technologies. This process is particularly well suited for incorporation in the assessment of conventional treatment technologies for the reclamation and closure plan.

The technology review process applies to all impacted media (air, water, soil, and vegetation). The decision tree is presented in a series of questions with recommended options depending on the media impacted and the time frame required for action. The decision tree is a useful tool to streamline the decision process for selection of closure options at the Casino Mine. CMC and its consultants have also made use of applicable northern climate guidance documents in the decision process, such as those produced by Mine Environmental Neutral Drainage (MEND).

The conventional treatment methods of constructed wetlands and bioreactors were selected for the Casino site based on a thorough review of literature for available technologies, as well as application of the ITRC web decision making tools and guidance documents produced by MEND. These have been selected as proven and conventional treatments, but with the realization that they need to be applied in a site-specific manner, through a phased program for design and optimization. Casino Mining Corporation has committed to undertake such a program, which is discussed in greater detail in the above sections. Aside from the conventional and proven treatment methods that were selected as primary means of water treatment in closure for this project, several contingency methods of passive water treatment were also identified through the technology review process (Appendix A.4H Cold Climate Passive Treatment Literature Review). In addition to the selection of conventional treatment technologies, contingency passive treatment methods, and a phased research program for the site-specific design, optimization, and implementation of these technologies, the current state of knowledge will be regularly reassessed through CMCs reclamation research program to ensure the technologies being applied are appropriate to the closure objectives of the site.

A.4.11.3.9 R123

R123. A discussion and rationale on how the design of the north end of the tailings management facility wetlands will accommodate a range of possible flows from the pit lake.

Treatment wetlands are able to accommodate for variable flow rates by designing and sizing for critical time-points. It is imperative that if a specific outflow concentration is required of the wetland, that the treatment wetland be correctly sized, and not simply made 'as big as possible', as evaporation will play a role in the concentration of elements. In such cases, the cost/benefit of decreased load compared to higher outflow concentration must be carefully weighed in terms of project objectives and protection of downstream receiving environments. The critical time-points that drive wetland sizing are identified through treatment capacity modelling based on: influent concentration, required outflow concentration, volume of wetland, flow rate of water, climate, as well as the element and system-specific removal rate coefficient (*k*). Data from pilot- and demonstration-scale systems can be used to accurately size the full-scale systems as this data is used to calculate a removal rate coefficient (*k*) according to the top equation in Figure A.4.11-2, where *Cf* is final concentration, *Ci* is initial concentration, and *t* is the hydraulic retention time from the pilot- and/or demonstration-scale systems. Once *k* has been calculated (e.g., from literature, comparable sites, pilot- or demonstration-scale data), the top equation in Figure A.4.11-2 can be rearranged to solve for the hydraulic retention time *(t)*, and hence, estimated full-size needed for the CWTS to achieve outflow objectives, given a known influent concentration and flow rate. Likewise, it can be used to solve for an outflow concentration, given a known retention time and influent concentration, thereby being a necessary tool for use in any CWTS design. Removal rate coefficients can be adjusted for temperature conservatively by using the Arrhenius equation. That being said, removal rate coefficients are highly specific and must be developed in a site-specific manner, for each element of interest. While they may sometimes be applied in a conceptual manner to other situations/sites, caution should be taken in applying a removal rate coefficient developed for one design and water chemistry to a very different chemistry or design basis. It is often the case that *k* must be calculated and applied for different ranges of certain constituents. For this reason, the pilot-scale CWTSs should be constructed with more than 1 cell in a series to test different ranges of element concentrations as they are treated through the system. Analysis of this type has recently been performed by Contango Strategies Ltd. on the updated water quality model (Appendix A.7B) to size the North TMF wetland for the Open Pit outflows both with and without controlled release. It was found that it should be possible to design and construct the North TMF wetland to treat for the uncontrolled release from the open pit, however, the designed controlled release valve will be retained in the plan as a contingency measure.

$$k = \frac{-ln(C_f/C_i)}{t}$$

$$t = \frac{-ln(C_f/C_i)}{k}$$

Figure A.4.11-2 Removal rate coefficient equation

A.4.11.3.10 R124

R124. Details and design considerations for the remotely operated solar powered decant valves. Details should include:

- **a. infrastructure requirements;**
- **b. monitoring and maintenance requirements, including an estimated timeframe;**
- **c. contingency planning related to malfunctions, inappropriate feedback and interaction; and**
- **d. case studies where such systems are effectively used.**

Once the Open Pit fills to the point of overflow, pit drainage will be controlled by a gravity decant system (Figure A.4.11-3), which will allow for storage of water during the winter months and release during the biologically active summer months of June through September. Pit lake outflow will discharge to the North TMF wetland for passive treatment prior to discharge to the TMF pond.

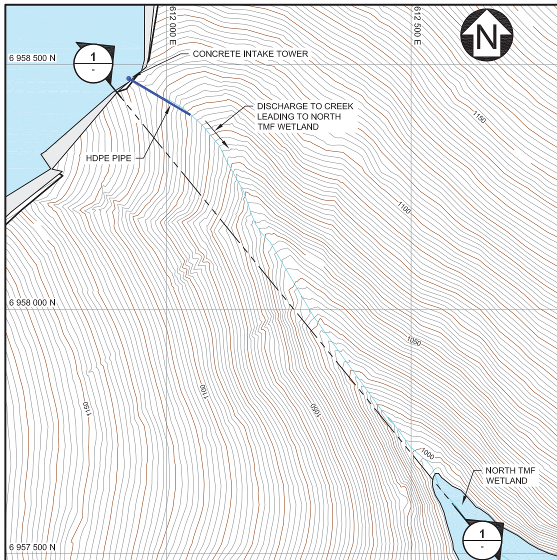
The conceptual pit discharge system (Figure A.4.11-3) will have the ability to control, power, and monitor remotely a valve actuator that will in turn regulate the pit outflow. The system will include monitoring capability that can report data such as water level, valve position, temperature etc., which would all be done through satellite communication. The pit discharge system will include the following components:

- Gravity release from the pit to the north TMF wetland treatment system;
- The intake elevation has been conservatively calculated taking into account the following information:
  - o The freeboard in the pit is 10 m below pit invert elevation of 1165 m;
  - o Water level fluctuation was back calculated from the mean annual outflow to wetland (average 2 Mm^3) approximately 0.5 m;
  - o Allowance for 1 in 200 year maximum flood of 2 m;
  - o Pipe intake 2 m below minimum water level to prevent freezing; and
  - o Total allowances result in pipe intake elevation being 15 m below pit invert.

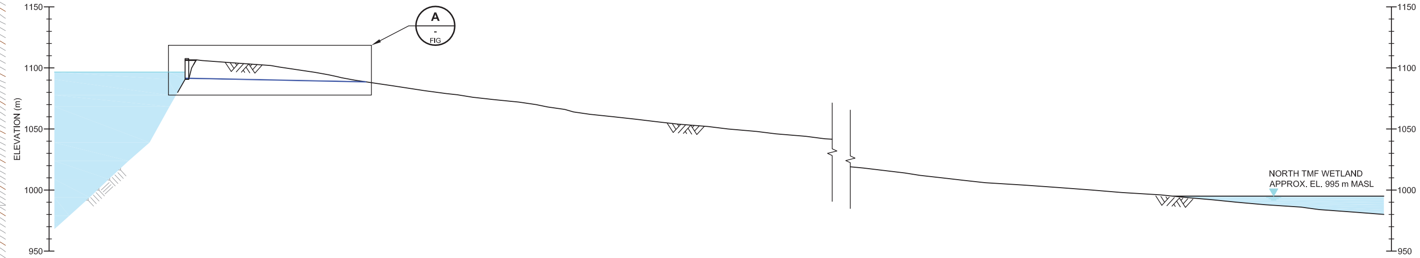
Gravity drainage requires a 30 cm diameter pipe sloping at 2% from intake within the pit wall and discharge to the ditch leading to the north TMF wetland. The pipe would be installed by drilling a hole from the pit wall to daylight on natural ground, followed by installation and grouting in place an HDPE pipe. Alternatively the pipe could be installed by excavating a trench, laying pipe in the bottom, and constructing a concrete or earthen dam to back fill the trench to the pit invert elevation.

The intake system will be supported with a concrete tower. The intake end of the pipe will have a riser to above the water level. The regulating valve will be below water with an adjustable valve. The pipe valve would be connected to a data up-link via satellite which can be controlled for optimal conditions within the wetland treatment system (i.e. temperature). The proposed power supply for all components is a hybrid fuel cell/solar power supply with a failsafe closed battery backup. Monitoring of the solar powered system is outlined in Table A.4.11-2.

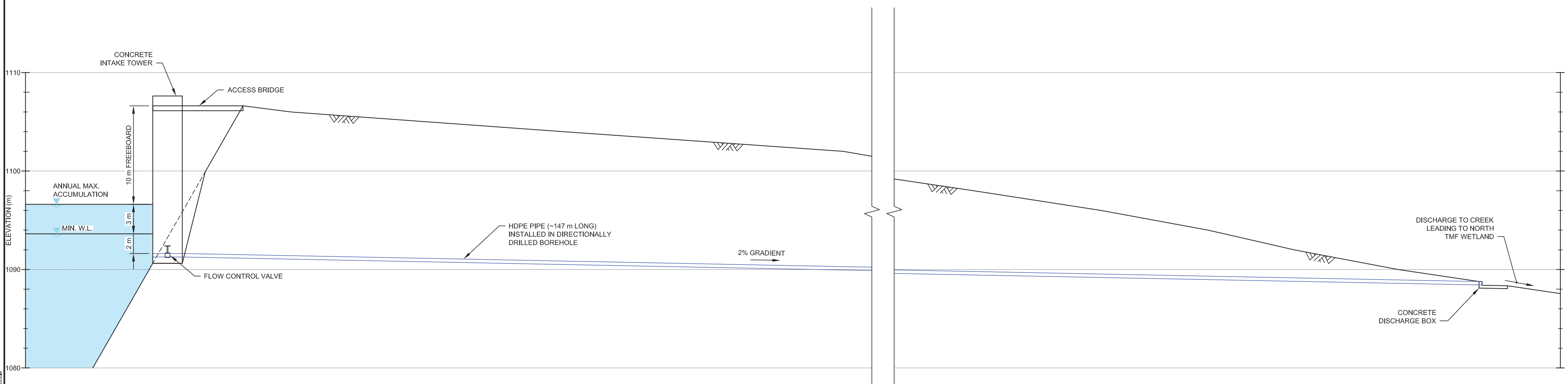
A system which has the capacity to control, power and communicate (monitor) remotely a valve actuator that will in turn regulate the outflow from the open pit is currently available technology. This system could involve solar panels to provide the required energy, and satellite communications to transmit data and operating signals. In addition, the system would report water level and valve position through satellite communication. It is assumed that the equipment will be serviced annually, but otherwise the system will be able to operate unattended. CMC is confident that the technology to remotely operate the open pit decant system will be readily available when the open pit is predicted to overflow (i.e., 95+ years).



GRAVITY DISCHARGE SYSTEM
SCALE A



1 SECTION
SCALE B



A DETAIL
SCALE C

SCALE C	4	2	0	4	8	12	16	20 m
SCALE B	40	20	0	40	80	120	160	200 m
SCALE A	100	50	0	100	200	300	400	500 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
-	17SEP'14	ISSUED WITH	-	TAM	-	-

CASINO MINING CORPORATION

CASINO PROJECT

PIT LAKE DISCHARGE SYSTEM
PLAN AND PROFILE

BRODIE CONSULTING

P/A NO. VA101-325/17 | REF NO. -

FIGURE A.4.11-4 | REV -

A.4.11.4 Open Pit and Low Grade Ore Stockpile Water Quality

A.4.11.4.1 R125

R125. Details and rationale on the proposed storage and disposal of low-grade ore. Details should include:

a. detailed geochemical characterization of material in the low-grade ore stockpile; and

b. supporting evidence and rationale as to why leaving this material on surface to continue to generate acid and metal contaminants before much later disposal in the pit is any more beneficial than disposing same under water in the TMF when this material is first encountered.

Detailed geochemical characterization of the low-grade ore (LGO) material (hypogene LGO, supergene sulphide LGO, supergene oxide LGO and marginal grade ore) was conducted for the Geochemistry Report (Appendix 7D of the Proposal). The various work stages leading to the development of these source term concentrations for the individual stockpiles can be summarized as follows, with details available in Appendix 7D (Geochemistry Reports):

- Selection of kinetic tests representative of various rock types and weathering states (acidic vs. neutral) for model input;
- Calculation of temperature effects on acid generation and metal leaching rates;
- Estimate of percent of ore that can be expected to become acidic during mine life;
- Calculation of average loading rates to represent each ore stockpile;
- Scale-up of loads to simulate reaction within stockpiles;
- Application of secondary mineral controls (speciation calculations); and
- Comparison of output concentrations to other mine sites and adjustment of model parameters as necessary.

To maximize economic output the mine plan includes maximum processing of all of the low grade ore. However, to remain conservative, CMC has assumed that there will be a small portion of the ore stockpiles that will be not suitable for processing, and therefore an allowance has been provided for 5% of the total volume of MGO rock (7.2 Mt) to be relocated to the pit following the closure of the mill. This provision allows for some of that 5% to include removal of soil/rock in the footprint of the stockpiles, which may have become contaminated due to seepage from the overlying oxidizing rock. A source term was also generated for metal release associated with sub-aqueous disposal of weathered ore. Additionally, while the current mine plan does not include processing of the marginal grade ore, economic conditions at the end of mine life may warrant processing of some or all of this material.

Therefore, conservative modeling has assumed that the full 16.1 Mt will be disposed of in the pit, although the economic reality at the time may enable processing of larger quantities of stockpiled ore to be processed than is currently in the mine plan.

A.4.11.4.2 R126

R126. Details and discussion on groundwater collection and/or infiltration suppression to manage seepage through the low grade ore stockpile.

During the construction phase (approximately Year -2) the ore stockpiles will be established, diversion ditches will be constructed to divert runoff around the various stockpiles to the TMF pond, and collection ditches will be constructed to collect runoff from the stockpiles and direct it to the TMF pond. Potential seepage pathways from the proposed ore stockpiles were characterized using the MODPATH particle tracking and endpoint analysis, as summarized in Appendix 7E (Numerical Groundwater Modelling). MODPATH analysis was completed using the Year 4, 10 and 19 models, which are the mine effects models with stockpiles present. Approximate groundwater travel time along the seepage pathways only considered advective travel and disregarded the effects of dispersion and diffusion.

The results of the MODPATH model are summarized in Table A.4.11-5 and indicate that in Years 1 through 18, 5% of the overall seepage from the Low Grade Supergene Sulfide Ore Stockpile will discharge to the TMF supernatant pond, but can take between 4.6 and 71 years to reach it. Without mitigation, infiltration below this stockpile is predicted to contribute to the TMF seepage that comes to surface downstream of the embankment based on the characterization of the potential groundwater flow pathways. Consequently, an infiltration suppression system and/or groundwater collection system will be established beneath the Low Grade Supergene Sulfide Ore Stockpile that will pump intercepted groundwater to the TMF pond. Once the TMF spillway overflows (approximately 10 years following the cessation of milling) groundwater collection and pumping will be discontinued.

Details regarding the proposed low grade supergene oxide ore stockpile will be finalized during detailed design, including design of the foundation, the need for groundwater control, and design of the seepage collection system. The groundwater seepage mitigation system would begin with foundation preparation and construction of seepage collection works prior to ore being placed in order to reduce infiltration into the groundwater flow paths beneath the pile. Following placement of the ore, the seepage would be collected and conveyed to the TMF pond. This system would be operated until Year 23 when all the ore had been processed in the mill, and would continue for another 10 years until the TMF is predicted to overflow via the closure spillway.

Further investigation during detailed design is required to assess hydrogeologic conditions immediately beneath the proposed stockpile in order to optimize the collection system design. Considerations during detailed design will include a base liner and groundwater interception system (pump-back wells and/or underdrain system). The effectiveness of a base liner does not depend on the hydrogeologic characteristics of the subsurface. To be effective, a groundwater interception system requires the subsurface to have a suitably high hydraulic conductivity to transmit water to the wells. Hydraulic testing conducted within the upper bedrock along the hillslopes indicates hydraulic conductivity values range from 10^{-8} to 10^{-5} m/s. Groundwater modelling suggests the upper bedrock layer has a representative hydraulic conductivity on the order of 10^{-7} m/s. Based on the available data, it is reasonable to consider that a groundwater interception system would be an effective option for seepage mitigation.

Table A.4.11-5 Ore Stockpile Seepage Endpoints and Travel Times

Discharge Location	Percent of Total Seepage Discharge (%)			Travel Time to Discharge Location (Years)			
	Year 4	Year 10	Year 19	Average	Median	Minimum	Maximum
Gold Ore Stockpile							
Open Pit	15%	20%	20%	3.1	2.8	1.3	7.3
TMF Supernatant Pond	85%	80%	80%	0.8	0.5	0.1	4.7
Marginal Grade Ore Stockpile							
Open Pit	100%	100%	100%	0.6	0.4	0.2	2.6
Low Grade Supergene Sulfide Ore Stockpile							
Open Pit	95%	95%	100%	1.9	1.1	0.3	8.7
TMF Supernatant Pond	5%	5%	0%	28	24	4.6	71
Low Grade Supergene Oxide Ore Stockpile							
TMF Supernatant Pond	70%	70%	65%	0.9	0.4	0.1	27
TMF Embankment Drains	30%	30%	25%	5.4	3.2	1.9	18
TMF Water Management Pond	0%	0%	10%	27	27	16	40
Supergene Oxide and Low Grade Hypogene Ore Stockpile							
Open Pit	5%	4%	3%	2.2	1.9	1.2	4.9
TMF Supernatant Pond	95%	95%	95%	0.8	0.3	<0.1	11
TMF Embankment Drains	0%	1%	1%	8.3	8.5	6.3	10
TMF Water Management Pond	0%	0%	1%	15	13	12	20

A.4.11.4.3 R127

R127. A detailed discussion on lake stratification or mixing in relation to discharge including:

a. any evidence or assumptions for lake mixing or stratification; and

b. stratifications or mixing impacts to discharge water quality and the tailings management facility wetlands.

As discussed in the Water Quality Predictions Report (Appendix A.7B), in modeling the open pit, full mixing throughout the water column was assumed, such that geochemical conditions would be the same throughout the pit lake. This is considered to be a worst case assumption. Typically, pit lake stratification assumes the denser water near the bottom of the pit lake has the worse water quality and the lighter overlying water near the lake discharge elevation has better quality water. Assuming fully-mixed conditions is typically considered a conservative assumption.

A.4.11.5 Open Pit Stability

A.4.11.5.1 R128

R128. Additional analysis to inform and update the Conceptual Closure and Reclamation Plan to address potential pit wall instability in post-closure.

Appendix A.4I (Open Pit Geotechnical Design) was prepared to provide geotechnical pit slope design parameters and recommendations for feasibility mine planning. The 2012 geotechnical assessment did not address the post-closure pit stability.

The stability of open pit rock slopes is typically controlled by wall geology, structural geology, rock mass characteristics, and hydrogeological conditions. The Casino deposit is hosted by a suite of igneous intrusive rock with a hydrothermal alteration overprint. The proposed ultimate pit walls will be largely formed within the Dawson Range Batholith that is comprised of granodiorite and diorite, both of which are considered hard rock. The identified faulting structures within in the deposit are sub vertical or steeply dipping, and will not have significant impact to pit wall stability. Weathered bedrock is presented throughout the deposit area varying from 20 to 200 m in thickness. The weathered rock is moderately strong with fair quality, while the fresh bedrock is strong and competent. Adverse rock mass structural features were identified in the proposed North Wall where flatter slope angles were recommended. The weathered zone is relatively permeable and is expected to be depressurized naturally during pit development.

Geotechnical site investigations covered the proposed pit development site, which allowed a geotechnical design model be developed for pit slope stability analyses. Detailed kinematic slope stability analyses were performed using various data sources including oriented drill core and televiewer surveys (see Section 5.3 and Appendix B of the Open Pit Geotechnical Design (Appendix A.4I). Flatter inter-ramp slope angles were selected for the areas where adverse structural features are expected to be encountered (i.e., the North Walls). Further rock mass sensitivity analyses were conducted for the inter-ramp scale slopes to demonstrate the slope stability under various uncertainties, including soil/rock mass strength parameters, pore water pressure conditions, blasting disturbance, and stress relaxation factors (see Section 5.4 of the KP Open Pit Slope Design report (Appendix A.4I)). The recommended slope configurations represented our best judgment based on available geotechnical information along with some reasonable but slightly conservative assumptions, corresponding slope stability analysis results, and our experience in the project region. The proposed pit slope angles (42 to 45 degree inter-ramp angles, 39 to 42 degree overall slope angles) are reasonable and comparable provided that low damage controlled blasting, effective slope depressurization, and careful slope monitoring are implemented throughout the pit operations.

In an open pit mine, some bench scale and even multiple bench scale slope instabilities are acceptable provided that proper worker safety and management measures are implemented during mine operations. Given the conservative slope recommendations, large scale slope layback of entire pit walls is unlikely for the Casino Project. Localized slope instabilities are possible during pit development and should be managed as part of routine pit operations. The common slope remedial measure would be either leaving a stepout in lower slope or laying back the upper slope around the instability zone.

During pit operations, the pit dewatering and slope depressurization systems will be functioning to maintain a dry pit bottom and to keep phreatic surface away from slope surface. The calculated global factors of safety of the ultimate pit walls ranged between 1.3 and 1.6. When pit operations stop, the pit dewatering and slope depressurization systems are expected to be decommissioned. The phreatic surface will likely be elevated to near the slope surface in the lower pit walls, while the upper slope will likely remain drained particularly in the weathered zone. Elevated water levels in the pit lake will increase the pore water pressure and reduce the effective strength of rock mass in the lower slopes, which often result in a slightly lower factor of safety in the pit slopes. The sensitivity stability analyses indicated that the overall slope factors of safety will drop to 1.1 (in the highest Northeast Wall) if the lower pit walls are fully saturated (see Appendix C of the Open Pit Geotechnical Design, Appendix A.4I). However, the factors of safety of the post closure slopes will eventually increase when the pit lake reaches a certain level that the filled water acts as a buttress to pit slopes. When the pit lake reaches the ultimate elevation of approximately 1110 m, the computed factors of safety of overall slope are expected to be higher than those during the operations.

The exposed pit walls (above the final pit lake) will likely range in height from 15 m to 200 m. The slopes will largely be formed by well drained weathered rock or overburden. Given a much shallower height of slopes, relatively flat slope angles, and the buttressing factor, large scale, deep seated slope failure in the post closure pit is less likely. However, surficial sloughing and ongoing raveling of the upper slopes are expected due to possible ongoing degradation of soil and rock mass after closure, particularly along the upper Northeast Wall and Southwest Wall where nearly 200 m high slopes will be exposed above pit lake level. Localized bench scale to multiple bench scale slope instabilities may occur due to elevated pore water pressure and/or slope deterioration.

It is anticipated that the critical period of post closure pit slope stability will likely be in the early stages of pit infilling. It is recommended that the Casino Mine continue the pumping operations at perimeter depressurization wells (if applicable) in the first three years of closure. Slope monitoring and inspection for the critical slopes (i.e., the Northeast and Southwest Walls) should be performed in the early years of pit closure, particularly during the spring freshet, until the slopes show no signs of continuous displacement. The potentially unstable areas should be fenced and public access to these areas should be forbidden.

If necessary, detailed post-closure pit slope stability analyses can be conducted during detailed design to estimate the probability of slope instability during various stages of post closure. The analyses may also determine the sizes and material quantities of possible slides if a potential for slope failure exists. Further detailed wave analysis can be subsequently performed to estimate the height of wave generation in the Casino post closure pit lake.

The governing factors of wave generation include: mass and volume of a potential landslide, landslide thickness and width, the slide impact angle and velocity, still water depth, and radial distance from slide to the over topping point. As discussed previously, the potential post closure slides are likely surficial sloughing and raveling with relatively small volumes. The locations of the potential slides are at least 1 km away from the discharge point located at the southeast end of the pit lake. Considering such a large, deep pit lake at the Casino Pit, the risk of overtopping caused by in-pit land slide generated wave is expected to be low.

A documented case of post closure instability in the Berkeley Pit at Butte, Montana supports our preliminary findings (Hustrulid, Kuchta, and Martin 2013). The Berkeley Pit was flooded in 1982 following the mine closure. A rapid landslide involving approximately 2.1 million tons of material was triggered by elevated groundwater levels in the alluvial sediments exposed in the southeast highwall of the pit. The failure of the Berkeley Pit wall occurred during the night and no eyewitness accounts were available. However, it was evident that a significant water wave was generated, which caused a small unmanned boat that was floating on the pit lake to be displaced onto a bench that was approximately 6 m above the pit water level. There was no damage outside the pit lake.

Another case observed in the post closure pit lake at the Kemess South Mine in BC also supports our preliminary findings (Yang, Mercer, Brouwer, and Tomlinson 2011). The Kemess South Mine completed mining operations in 2010. The depleted open pit was used for waste rock and tailings disposal in the late stages of mill operations. The Kemess South Pit has stored approximately 17.2 Mt of tailings and 41.5 Mt of waste rock during flooding process. The pit has been flooded and is currently under care and maintenance for closure and reclamation. The slope monitoring data and recent pit inspection suggested that ongoing creeping failure within the West-Northwest Wall Epiclastic Toodoggone unit will likely continue after pit closure. The creeping style regressive failure is typically very slow and predicable under careful monitoring. The shallow surface mudflow has not generated a wave higher than 1 m to the discharge point.

Based on a preliminary evaluation, the impact of potential landslide-generated wave to downstream environment at the Casino Pit will be negligible provided that a freeboard on the order of 5 to 10 m is maintained around the discharge point of the post closure pit lake.

A.4.11.5.2 R129

R129. A sensitivity analysis examining the effect of less stable pit walls and show how the additional waste rock would be managed if the wall slopes had to be relaxed.

Localized slope remediation may increase the waste volume by laybacks, but is also possible to reduce the waste rock quantity by leaving stepouts. Compared to the designed storage capacity of the waste rock dumps, these minor quantity changes are not expected to make any major impact to overall waste rock storage scheme.

It is noted that the mining plans and executions will evolve during mine operations. It takes at least 15 years to reach the final configurations of the open pit and waste storage facilities at the proposed Casino Mine. In the later stages of the mine life, the design of the final pit walls will be conducted. This will incorporate the prevailing economic conditions and the assessment of the interim pit wall stability. It is anticipated that this approach will result in final pit walls with low risk of major failures. The economics of the resulting quantity of waste rock will be included in that analysis. If there is additional waste rock, then it must be managed in the same manner as all other waste rock, or the extent of mining could be reduced.

A.4.11.6 Open Pit and Wildlife

A.4.11.6.1 R130

R130. A description of the barrier to prevent access to pit walls.

Typical mitigations to prevent injury to wildlife by inadvertent access into the open pit prior to flooding include construction of a boulder barrier around the open pit (Golder 2013), installation of fences (electric, wire, barbed-wire, seasonal and game fences) and/or odour deterrents, such as the application of scents along a roadside to deter animal crossings (Rescan 2012). Design considerations for these barriers include the height and depth, visibility, and safety (Rescan 2012). Decisions on what kind of exclusion barrier to install at the Project will be made in conjunction with First Nations and other end use land users to ensure that land use goals can be maintained, and any infrastructure required during post-closure is not compromised.

A.4.11.7 HLF Closure and Cyanide

A.4.11.7.1 R131

R131. Results and analysis of testing of heap leach facility detoxification using samples and conditions similar to an exhausted heap of friable ore approximately 150 m high.

Work is presently underway will examine detoxification of a wider variety of solutions, please refer to R58.

A.4.11.7.2 R132

R132. A discussion on alternative mitigation measures that may be required if heap leach facility rinsing and detoxification is not successful. The discussion should include examples of successful heap rinsing at comparable sites where materials of a similar nature, mass and northern location have been encountered.

The use of rinsing techniques has been demonstrated to be effective for the preparation of gold and silver cyanide heap leaching operations for closure. At some locations, cyanide destruction techniques must be used to augment natural cyanide attenuation processes that occur within heap leach operations after the addition of fresh cyanide to the heap leaching system has stopped. A sulfur dioxide-air cyanide destruction process is proposed to be installed for the project to treat effluent solutions, and this will provide cyanide-depleted solution for rinsing of the heap, avoiding the need to use large volumes of fresh water after leaching has stopped or been reduced to very low levels (see Laboratory Evaluation of the SO2/Air and Peroxide Process Appendix A.4J for testwork results). Effective heap closure processes will be used in combination with rinsing, natural cyanide attenuation and, if necessary chemically-assisted cyanide destruction techniques. Such closure processes include, where necessary, re-contouring of heap slopes and surfaces, re-channeling of stormwater runoff, re-covering of heap surfaces and side slopes with topsoil and/or low permeability cover, and re-vegetation of the heap surface. When used in combination, the above methods are expected to be effective at minimizing inflows into the heap and reducing effluent flows emitted from the base of the heap to low and manageable levels, suitable for downstream treatment prior to solution discharge.

A.4.11.7.3 R133

R133. Describe how fluid impoundment behind the HLF embankment will be prevented at closure.

Following completion of the rinsing stage, the liner would be perforated, allowing drainage to flow to the TMF.

A.4.11.8 HLF and Cover Material

A.4.11.8.1 R134

R134. Additional details on the design basis and requirements for cover materials. Details should include:

a. cover modeling and assessment including validation of assumed infiltration rates;
b. availability and location of sufficient construction materials to meet the design requirements;
c. composition of materials to be used for the cover system including mineral soil, topsoil, and vegetation;
d. range of expected performance of proposed cover systems; and
e. long-term monitoring and maintenance requirements.

Part a.

It is expected that an annual infiltration rate of 20% can be achieved with an engineered cover system consisting of 0.75 m of low permeability, locally sourced material as proposed in the CCRP. An infiltration rate greater than 24% but less than 30% was reported for the 0.25 m cover constructed for the HLF at Brewery Creek (EBA, 2011). If monitoring during operations and closure of the HLF indicates that Se loads are less than predicted, the cover design may be refined.

Part b.

Investigations will be carried out to verify the availability and suitability of locally sourced materials. Should there be a short-fall of suitable material (similar material is required for construction of the core of the dam) a very low permeability geosynthetic can be used for the upper, flat surface of the heap. A low permeability geosynthetic can be effective in reducing the rate of infiltration to <1%. A geosynthetic cover will not be applied on slope areas because of stability issues.

Parts c. and d.

The design of the engineered cover will be undertaken during operations as knowledge of the site conditions, including local climatic data (temperature, precipitation, evaporation, solar radiation, wind and snowpack) and HLF data (e.g., moisture content, pore water pressures, hydraulic conductivity, temperature and oxygen content) is attained. The engineered cover will be designed to current engineering standards, using the most up to date technology. Ongoing test work at other mines in the Yukon and in northern climates will be evaluated to determine the most appropriate application for the Project HLF.

Design of the engineered cover system will be conducted using an adaptive management approach, to ensure that the ultimately accepted and implemented system is optimized to the Project site, and field proven to meet the objectives for long-term environmental protection. The adaptive management framework shown in Figure A.4.11 will include the iterative nature of laboratory and field scale testwork to reach an ultimate best solution. Testwork that may be required to meet cover objectives is summarized in Table A.4.11-6.

In conjunction with cover design objectives, re-vegetation objectives, such as natural seed availability, vegetation trials for re-vegetation and nutrient level deficiencies in available soils, will also be evaluated to determine the most appropriate selection for re-vegetation of the site, and incorporation into the HLF cover system (Table A.4.11-6).

Part e.

Long-term maintenance requirements for the HLF are detailed in the response to R114.

Table A.4.11-6 Adaptive Management for HLF Cover Planning Testwork and Objectives

Test Case	Implementation of Test Case	Monitoring of Test Case	Measurement of Success
Natural seed availability	Assessment of natural seed in the Project area.	Assess natural seed collection success.	Ability to collect enough natural seed to meet re-vegetation requirements.
Vegetation trials for re-vegetation	Establishment of trial plots.	Evaluation of re-vegetative success.	Achievement of 100% cover using native species.
Nutrient level deficiencies in available soils	Examination of various methods of nutrient supplementation (e.g., fertilizer, nitrogen fixing plant species, biochar, etc.)	Analysis of subsequent nutrient concentrations and successful growth of native plant species.	Maximum growth of native plant species.
Engineered cover system for HLF	Investigation of various cover systems to achieve <20% infiltration.	Installation of test plots during operations to evaluate the effectiveness of each kind of cover system.	Cover system with <20% infiltration.

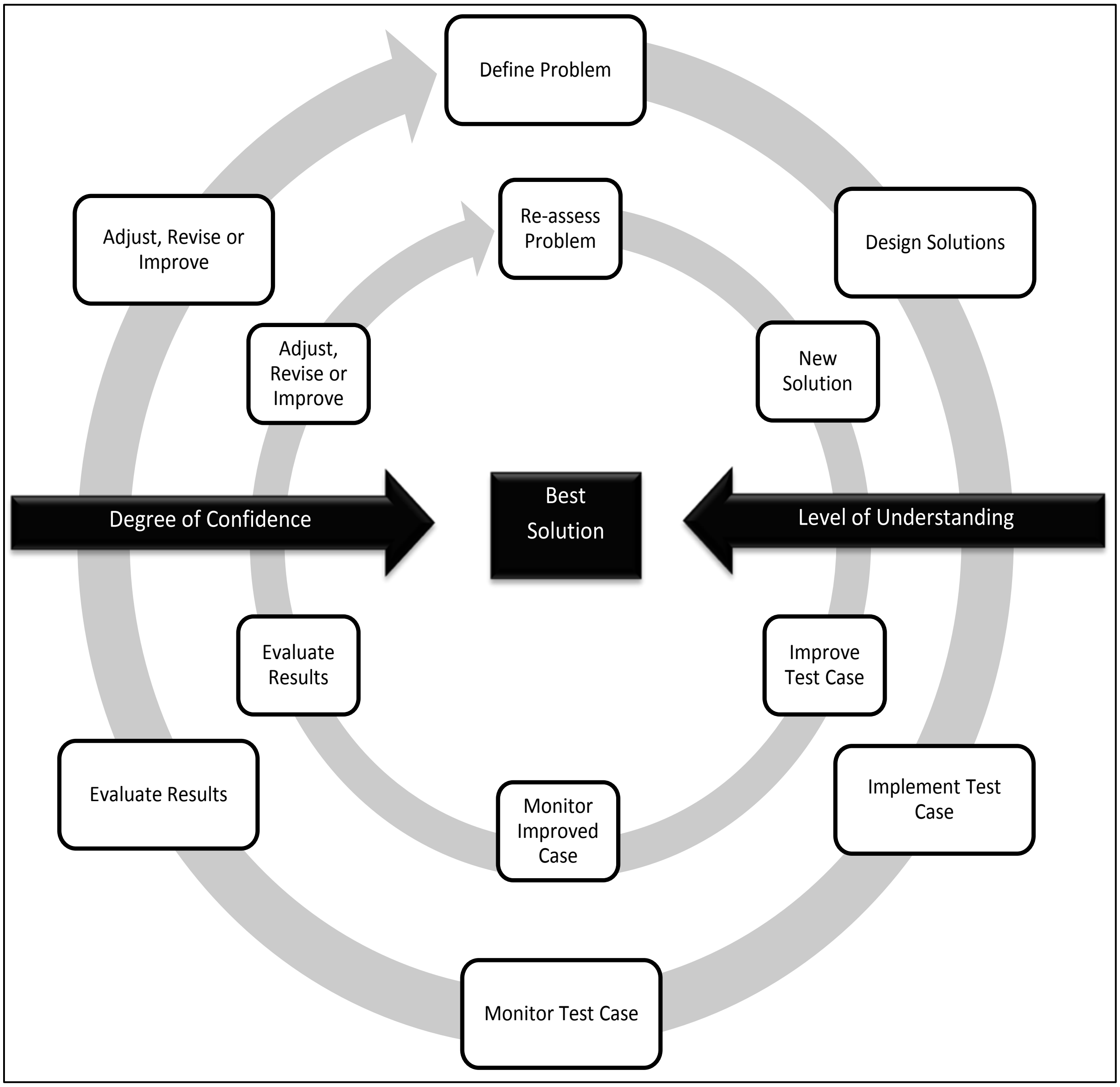


Figure A.4.11-4 Closure Planning Adaptive Management Framework

A.4.11.9 TMF Winter Seepage Mitigation Pond

A.4.11.9.1 R135

R135. Feasibility level design details for the winter seepage mitigation pond cut-off wall and cut-off trench/barrier. Include a discussion of how the structures are to be constructed.

Feasibility level designs and construction methodology for the winter seepage mitigation pond cut-off wall and cut-off trench/barrier are not available at present. This work is contingent upon additional site investigation to confirm local ground conditions. The site investigations will characterize soil type, presence of permafrost, depth to weathered and unweathered bedrock, hydraulic conductivities for the various materials and groundwater elevations and flow directions. This work will form an input to feasibility design of the winter seepage mitigation pond cut-off wall and cut-off trench/barrier which is required for future Quartz Mining License and Water Use License applications.

A.4.11.9.2 R136

R136. Rationale for the construction of a cut-off barrier only after operations.

Following reviewers comments, CMC has incorporated the winter seepage mitigation pond, and associated groundwater collection system in the operations phase, as opposed to only during the closure phase, and is labelled “water management pond” for all phases of the Project. This change results in seepage capture which is represented in the water quality model throughout all Project phases, as reflected in the *Water Quality Predictions* report (Appendix A.7B) and discussed in Section A.7 of the SIR.

A.4.11.9.3 R137

R137. Additional details about the winter seepage mitigation pond dam should include:

a. proposed design standards (e.g. Canadian Dam Association Safety Guidelines);
b. cross-sections;
c. construction materials;
d. consequence of failure classification;
e. detailed foundation characterization; and
f. monitoring and maintenance requirements.

The requested additional details about the winter seepage mitigation pond are discussed below:

Part a.

The design would conform to the Canadian Dam Association (CDA) Dam Safety Guidelines.

Part b. and c.

Cross-sections and construction materials are contingent upon additional site investigation to confirm local ground conditions which is expected to be completed as input to feasibility design required for future Quartz Mining License and Water Use License applications.

Part d.

The consequence of failure classification will be conducted as part of feasibility level design following the CDA Dam Safety Guidelines and will take into account population at risk, environmental and cultural values and infrastructure and economics.

Part e.

Detailed foundation characterization will occur as part of site investigations planned for this area (please see R135).

Part f.

Monitoring and maintenance requirements will be conform to the requirements specified in Plan Requirement Guidance for Quartz Mining Projects including the physical stability and potential erosion of slopes, the integrity of liners, evidence of deformation or settlement and the stability of conveyance channels and spillways.

A.4.11.9.4 R138

R138. Demonstrate that the rate of discharge from the proposed winter seepage mitigation pond can be controlled in response to downstream flow rates within Casino Creek in order to meet downstream water quality objectives. Details should include WSMP capacity to handle excess water that is not discharged due to low flow conditions in Casino Creek.

As detailed in Section A.7 of the SIR, during the post-closure period, once the TMF begins discharge through the spillway, discharge from the Winter Seepage Mitigation Pond (WSMP) was stored during the winter months, and then discharged beginning in May after the onset of the spring freshet. However, the results of the variability model indicated that in some years, the pond would be full prior to the spring freshet and would therefore be discharged uncontrolled, resulting in undesirable water quality in the receiving environment. Therefore, CMC has implemented a system where discharge from the WSMP is controlled based on the available flow from Brynelson and from the TMF pond (described in more detail in the Variability Water Balance Report (Appendix A.7A)). This management change has improved the water quality in the downstream receiving environment.

As illustrated in Figure A.4.11-5 for Project years 65 – 75, and with monthly values provided for Project years 69 and 70, discharge from the WMP (red line) only occurs when there is flow in Brynelson Creek (green line). A flow monitoring system will be installed in Brynelson Creek and will be linked to the release valve from the WMP to actuate the valve once flow in Brynelson is detected. The control system will dictate the rate at which discharge from the WMP and from the TMF can occur, and the system will be monitored and calibrated annually at the same time as the annual monitoring for the tailings dam.

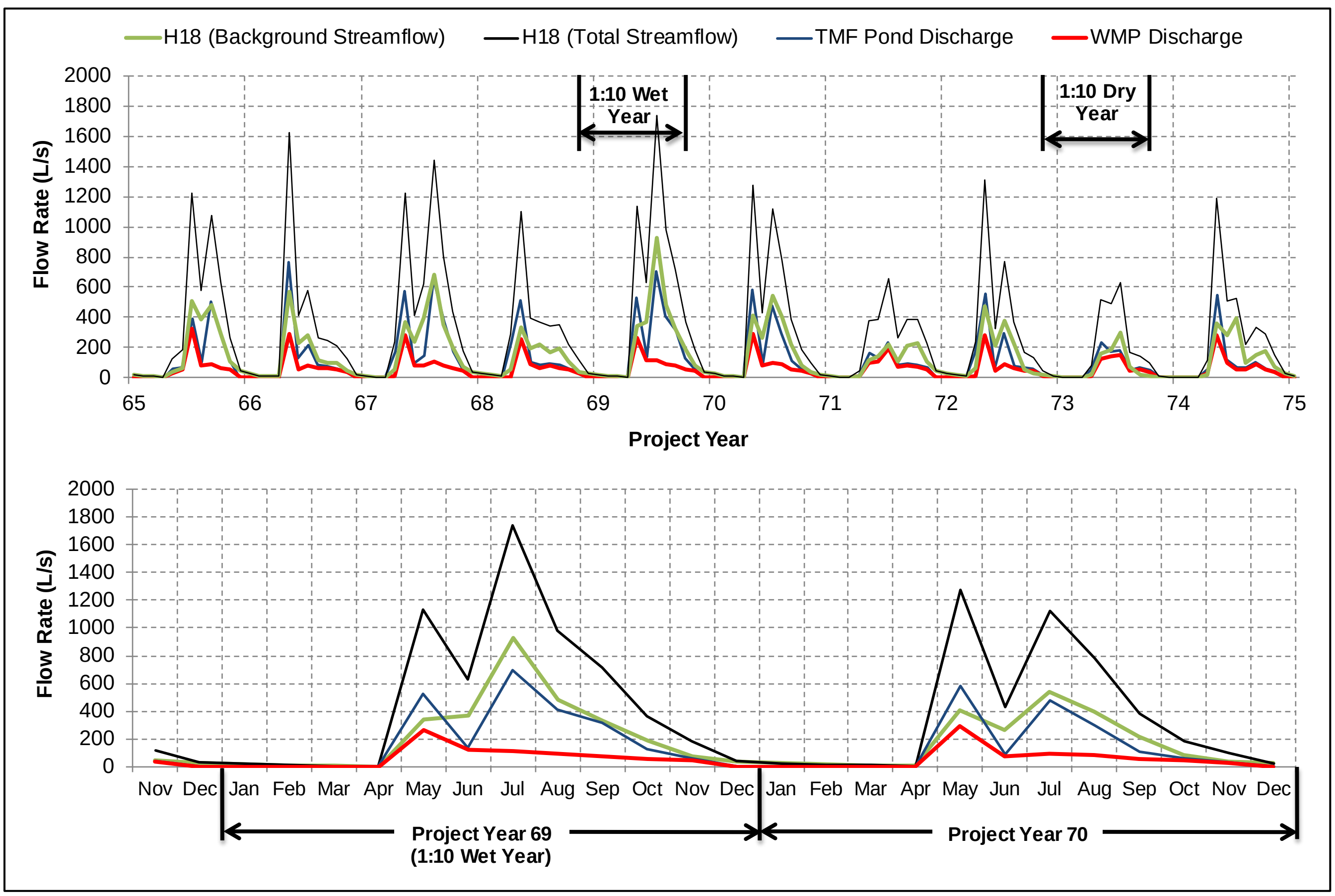


Figure A.4.11-5 WMP, TMF Pond and H18 Discharge

Additionally, based on reviewer comments received during the adequacy review of the Proposal, CMC has included the installation of the groundwater control system, previously proposed only during the closure and post-closure period, to be installed during the operations period. This has resulted in a modeled scenario of 100% seepage capture downstream of the tailings dam, and has consequently also benefited the downstream water quality. Also, CMC has changed the name of the pond to be the Water Management Pond (WMP), for all phases of the project, as there is now no change in water management for seepage from operations, through closure or post-closure, expect that during operations and closure water collected in the pond is pumped back to the TMF or to the Open Pit, and during post-closure, the WMP discharges to the receiving environment.

A.4.11.10 TMF Embankment Vegetation

A.4.11.10.1 R139

R139. Detailed plans for establishing vegetation on the downstream slope of the tailings management facility west and main embankments. Details should include:

a. examples of successful projects where vegetation was established on similar slopes under similar climatic conditions as supporting rationale for the proposed closure and reclamation plan;

b. a conceptual schedule for the site vegetation studies and feasibility level site vegetation designs, including the maintenance expectations; and

c. a description of the estimated feasibility level costs of site vegetation upon mine closure account for the site-specific conditions.

Part a.

The Kemess South mine is located in the Omineca mountain range of north-central British Columbia, approximately 300 km northwest of Mackenzie (Martin 2011). It was an open pit mine, with associated waste rock dump and tailings storage dam.

Temperatures at the mine site range from -35°C to 30°C and average annual precipitation amounts to 890 mm. Commonly, snow does not leave the higher elevations until late June (SRK 2013). With similar climate to the Casino Project, the overall end land use objective is also to achieve adequate wildlife habitat via slope stabilization, surface erosion control and successional revegetation (McConnachie et al 2010).

The Kemess South tailings dam is a central clay till core dam raised via the centreline method, with rockfill buttresses and NPAG cyclone sand tailings as the upper-most supportive layer. The simplified design of the tam is shown in Figure A.4.11-6, and for comparison the Casino TMF typical section for year 22 is provided in Figure A.4.11-7.

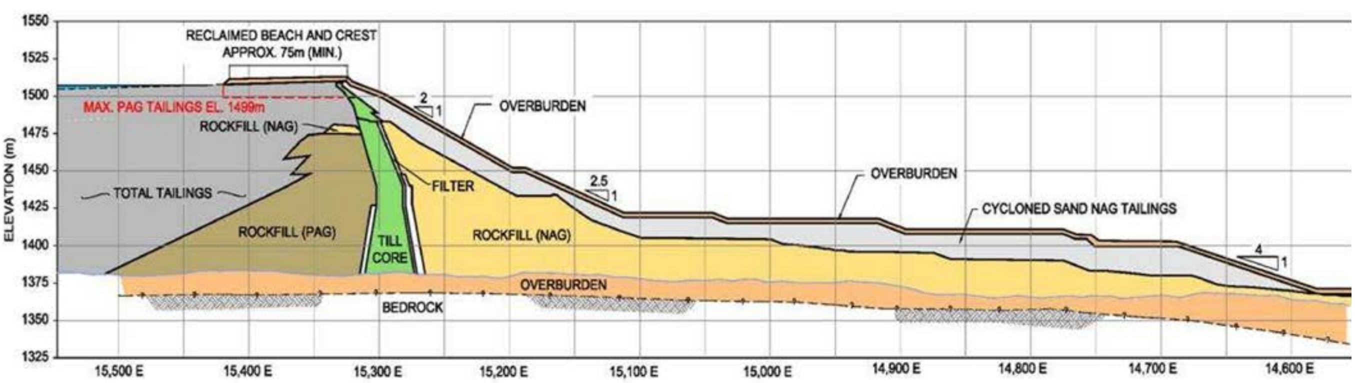


Figure A.4.11-6 Kemess Mine Tailings Dam – Simplified Design Section (from Martin 2011)

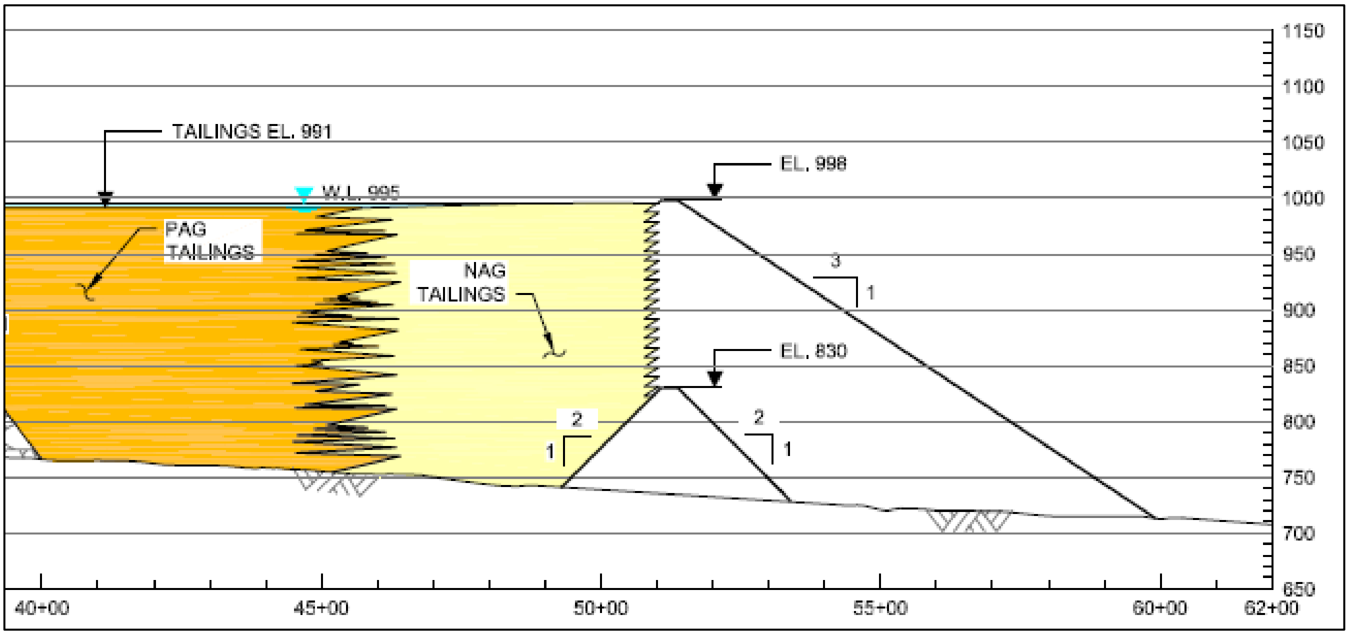


Figure A.4.11-7 Casino TMF Typical Section Year 22 (from Appendix A.4D)

At Kemess South, in preparation for closure a layer of overburden was placed on top of the cyclone sand tailings layer in 0.2 m – 0.3 m depths. The surface was roughened using heavy machinery and plantings of lodgepole pine and white spruce and plugs of willow and arctic lupine were planted on the dam buttresses in 2008 (McConnachie et al 2010). Native seed mixes were also applied on the dam face (McConnachie et al 2010).

As of September 2014, the dam face was well vegetated (Figure A.4.11-8) with successful growth of both native grasses and woody species (Figure A.4.11-9). The end goal of the vegetation is not to avoid the ingress of trees and woody species, but to introduce native pioneer species to initiate successional processes of recovery (McConnachie et al 2010) and create a vegetative mosaic of open spaces and treed area appropriate for wildlife habitat (Bent 2009).

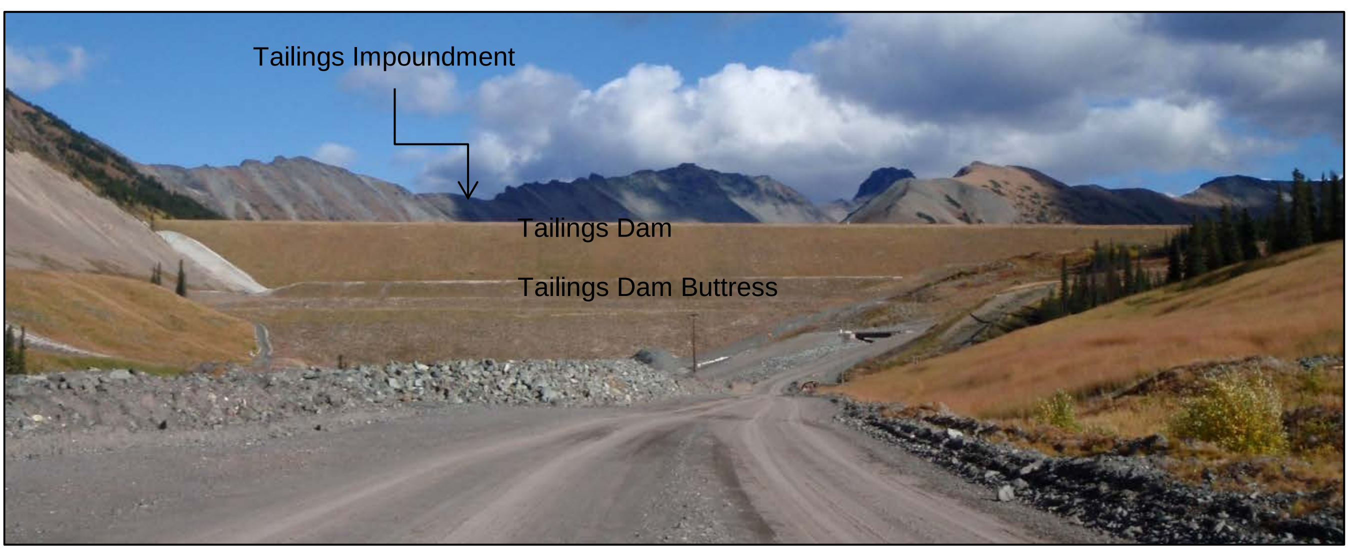


Figure A.4.11-8 Kemess South Tailings Dam (September 22, 2014)

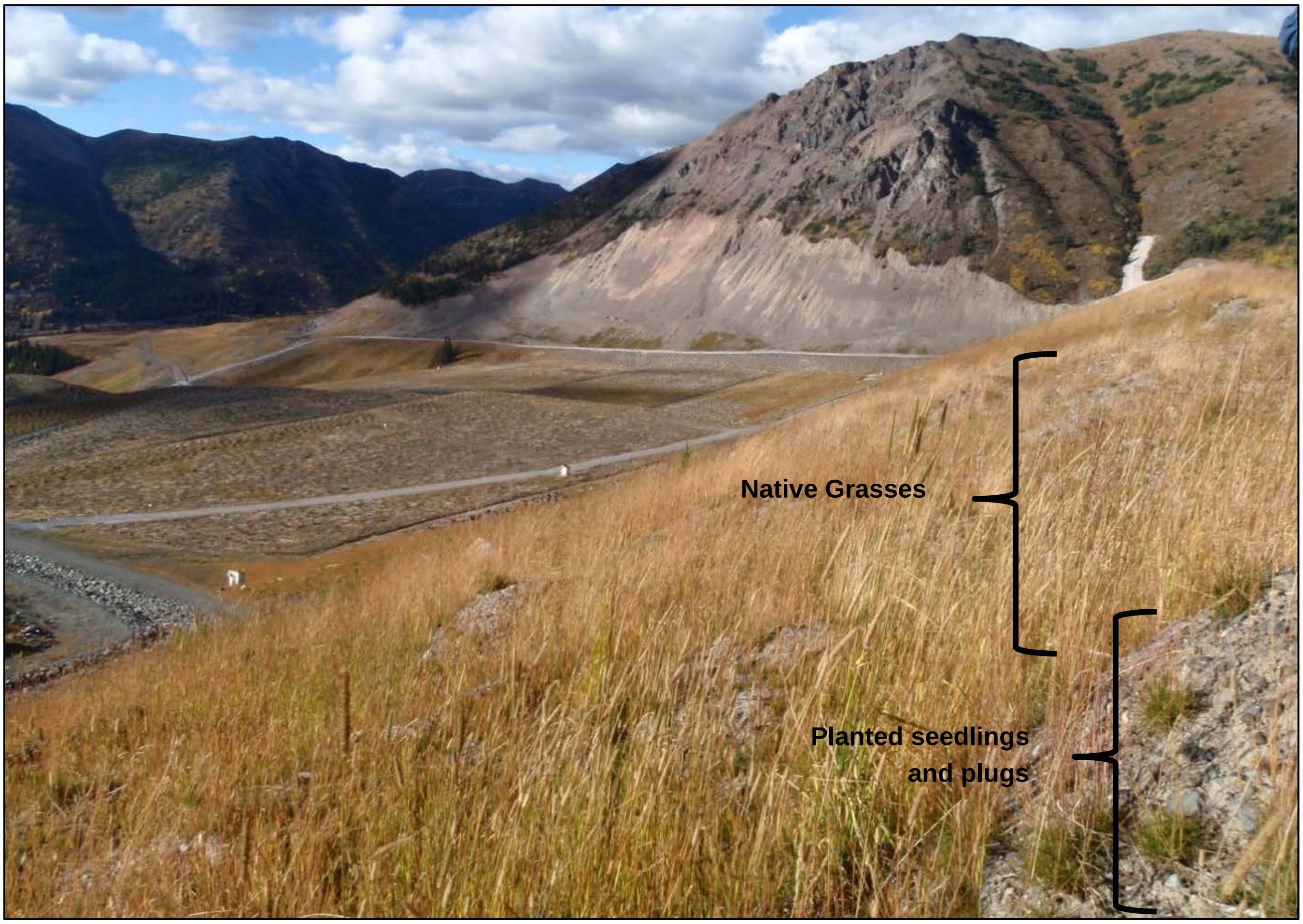


Figure A.4.11-9 Kemess South Tailings Dam Face, Looking Downslope at Dam and Buttress (September 22, 2014)

A July 2, 2014 inspection by the BC Ministry of Energy and Mines has required that Kemess South remove 4,000 of the 70,000 trees planted on the tailings dam due to concerns of blow down of trees with large root balls, internal erosion pathways created by rotting roots and habitat created by burrowing animals (Hoekstra 2014). Therefore, CMC will continue to monitor the reclamation success at Kemess South, as well as identify other examples of successful reclamation at tailings dams with slopes and conditions comparable to those at Casino, and will incorporate them into the progressive reclamation and reclamation planning for re-vegetation at the Project.

Part b.

Re-vegetation trials will be carried out during operations to evaluate the composition and nutrient level of materials used for a vegetation substrate as well as consideration of erosion control to meet the objective of long-term physical stability of all final landforms. Details of the re-vegetation plan will be developed and updated throughout the mine life using the results from pilot plots and other testing at the Project, and in the larger research community.

An Environmental Monitoring, Surveillance and Reporting Plan and a Vegetation Monitoring Plan will be developed to ensure successful re-vegetation of disturbed areas of the Casino Mine Project and will consider the following:

- Vegetation surveying and sampling has been completed as part of the baseline assessment (Appendix 11A). The vegetation monitoring plan will focus on rare plant species monitoring, invasive plant species monitoring and vegetative health monitoring.
- Monitoring of progressive reclamation activities will include re-vegetation monitoring.
- Re-vegetation will also be guided by native species, and First Nations traditional knowledge and future land use objectives.

As shown in Table A.4.11-7, successful re-vegetation of the mine site will require field trials during operations to evaluate appropriate plant species and potential soil amendments to ensure re-vegetative success. To ensure that the re-vegetation activities meet the requirements for successful re-vegetation, research programs will be required, and may include:

- Assessing the availability of natural seed or the availability of productive seed material from local surroundings;
- Undertaking vegetation trials using native plant species;
- Assessing nutrient level deficiencies in available soils to determine necessary amendments;
- Determining appropriate seed mixes, fertilization and growth media through experimental test plots; and
- Establishing performance standards to measure re-vegetation success.

Table A.4.11-7 Adaptive Management for Re-vegetation Planning

Test Case	Implementation of Test Case	Monitoring of Test Case	Measurement of Success
Natural seed availability	Assessment of natural seed in the Project area.	Assess natural seed collection success.	Ability to collect enough natural seed to meet re-vegetation requirements.
Vegetation trials for re-vegetation	Establishment of trial plots.	Evaluation of re-vegetative success.	Achievement of 100% cover using native species.
Nutrient level deficiencies in available soils	Examination of various methods of nutrient supplementation (e.g., fertilizer, nitrogen fixing plant species, biochar, etc.)	Analysis of subsequent nutrient concentrations and successful growth of native plant species.	Maximum growth of native plant species.

The above studies will be undertaken during the early operations phase, in conjunction with a First Nations working group, as identification of preferred plant species to be available in the ultimate closure landscape will be imperative.

Part c.

In the feasibility level costing of the closure plan, stabilization of the embankment was costed at $344,500, and included the costs for rip rap and vegetation to be conducted during the closure phase. The post-closure costs that were integrated into the feasibility level assessment included an annual geotechnical inspection, survey inspections, surface and water sampling, repair of erosion in covers and removal of problem vegetation for 200 years (NPV = $19,950,900). These costs will be refined during generation of the reclamation and closure plan for application for a QML and WUL.

A.4.11.11 Climax Vegetation in Reclaimed Areas

A.4.11.11.1 R140

R140. Further discussion regarding site infrastructure that may not be conducive to climax vegetation in closure. Include measures that you will implement to ensure long-term integrity of this reclaimed infrastructure.

As described in the response to R134 the determination of the re-vegetation requirements for closure of site infrastructure will be conducted during mining operations using an adaptive management approach, to evaluate the best techniques for long term success of re-vegetation techniques, while maintaining the structural integrity of the site infrastructure. The long-term integrity of the site infrastructure will be the primary goal of the closure objectives, with secondary goals of establishment of an ecosystem appropriate for desired land and wildlife use.

As detailed in the previous section describing re-vegetation of the South Tailings Dam at Kemess, the current approach to closure of sand tailings dams is evolving in the mining industry. CMC is committed to respecting this evolution. If this evolves to ensuring no trees on dams, then CMC will modify the closure plan and financial security to ensure that trees cannot become established on the dam after closure. Rock cover instead of soil cover is one way to mitigate the growth of trees on tailings embankments, while still minimizing the effects of erosion.

A.4.11.12 Temporary or Early Closure

A.4.11.12.1 R141

R141. Additional details in the Conceptual Closure and Reclamation Plan with regard to temporary or early closure. Details should include:

a. water and solution management and any requirements for water treatment;
b. infrastructure requirements (e.g. ability of heap leach facility or tailings management facility to accommodate temporary or early closure);
c. identify critical points in the project life cycle where temporary or early closure is most probable and most challenging; and
d. length of time project could remain in temporary closure before discharge would be required.

Temporary Closure

Temporary closures could be short term (weeks) or long term (years). The reclamation measures required in the event of temporary closure will depend upon the duration and extent of the mining activities at the time of mine closure and have been outlined in Section 8.1 of the CCRP. Temporary closure measures will be initiated for both planned and unplanned closures. In accordance with the Yukon Mine Site and Reclamation Closure Policy (Yukon Government 2006) in the event of a temporary closure:

- Facilities and equipment will remain on site and will be maintained in working order so that production may resume;
- All monitoring, reporting, and progressive reclamation activities will be maintained; and
- Any unanticipated risks of significant adverse effects resulting from the temporary closure not addressed in the approved reclamation and closure plan will be identified; the plan will be updated to reflect any potential adverse effects. Associated security to cover the liability associated with the temporary closure may be required.

Measures to prevent personal injury, property damage, and damage to the environment during temporary closure will be implemented, including but not limited to:

- Closure of all entrances and exits to prevent unauthorized access through surveillance or gating;
- Stabilization of all disturbed surface areas;
- Securing of all buildings, power transmission sources and other structures and facilities at the site;
- Securing of all machinery, equipment, and storage tanks at the site, including any storage tanks containing petroleum products, hazardous substances and chemicals; and
- Stabilization of the TMF, waste rock storage areas, heap leach piles, and landfill sites.

In addition to the required activities listed above, activities specific to temporary closure of the Project include:

- Open Pit dewatering will be stopped and water will be allowed to accumulate in the pit;
- Accumulation of water in the TMF will be monitored to ensure freeboard level is maintained at the dam. If necessary, surplus water will be pumped to the pit;
- TMF seepage return pumping will be maintained;
- HLF operations will continue with ongoing circulation of water onto the heap and processing of water in the recovery plant. Cyanide addition to the circulating water will be stopped. Surplus water will be processed in the cyanide destruction plant and be pumped to the pit;
- Site power, security and personnel for the above activities will be maintained; and
- The mill will remain heated, but tanks and piping will be drained to the TMF.

A key issue of temporary closure is the management of water collected in the TMF and the Open Pit. Pumping from the Yukon River would cease once milling operations cease, hence only surplus precipitation would accumulate in the TMF, and the Open Pit would be flooded with groundwater inputs as well as surplus precipitation. The time required for the TMF to fill (maintaining freeboard) and the Pit to fill will be a function of the stage in the mine development, and even time of year as it relates to water balance. However, should temporary closure extend long enough, as the TMF excess is pumped to the Open Pit for storage, eventually the pit would overflow and treatment of pit water would be required prior to discharge. Temporary closure early in the mine life is more likely to result in the need for water treatment prior to discharge. Temporary closure later in the mine life is more likely to result in implementation of strategies for closure outlined in the closure plan at the end of mine life.

To evaluate the various temporary closure scenarios for Open Pit filling, the water balance was assessed at Years 2 through 10 (Table A.4.11-8), and the time to fill the Open Pit ranges from 1.5 years (Project Year 2) to 16.6 years (Project Year 10) to 37.4 years at the final pit footprint (assuming only the inflows shown in Table A.4.11-8). The time to fill the pit increases as pit development increases, to a maximum in Year 18 (shown as Year 22 in Table A.4.11-8). Therefore, depending on the point in time when temporary closure occurs, the mine could remain in temporary closure for a minimum of 1.5 years before treatment of pit water would be required. Closure early in the mine life is unlikely, due to the capital investment of building the milling infrastructure.

Table A.4.11-8 Time Required for Flooding of the Open Pit at Various Temporary Closure Years

Final Year Before Shutdown	Inflow (l/s)							Pit Volume (Mm^3)	Years of Filling
	Precipitation on Lake Surface	Groundwater	Ore Stockpile Seepage	Pit Wall Runoff	Upslope Overland Runoff	Pumping from TMF Pond	Total		
1	0	9	1	21	3	179	213		
2	0	15	1	22	3	176	217	10.2	1.5
3	0	21	2	22	3	188	236	22.8	3.1
4	0	24	2	27	3	191	247	35.3	4.5
5	0	24	2	27	3	182	238	54.1	7.2
6	0	24	2	27	3	184	240	72.8	9.6
7	0	24	2	27	3	187	243	91.5	11.9
8	0	24	2	27	3	192	248	110.3	14.1
9	0	24	2	27	3	194	250	121.9	15.5
10	0	25	2	32	3	193	255	133.5	16.6
22	4	25	0	35	33	140	237	280	37.4

Should a decision be made to close the mine permanently, the Project will progress into early closure, described below.

Early Closure

The Proponent’s Guide to Information Requirements for Executive Committee Project Proposal Submissions (YESAB 2005) requires that the conceptual closure plan provide the same level of detail for early closure as is required for closure. Conceptual descriptions of temporary and early closure scenarios for the Casino Mine Project are described in Section 8 of the Conceptual Closure and Reclamation Plan (Appendix 4A of the Proposal). While still conceptual, more information regarding early closure scenarios and key early closure issues is provided below.

In the event of early closure the closure plan as described in the CCRP will be implemented, along with the following early closure specific activities:

- Pit dewatering will cease and water allowed to accumulate in the pit, all pit infrastructure will be removed, and the closure decant system will be installed;
- Canadian Creek will re-directed to the Open Pit (assuming early closure occurs at a time when the pit outline has intercepted Canadian Creek);
- All LGO stockpiles will be processed as needed for TMF reclamation (minimum 1 m cover on all PAG waste rock) or relocated to the Open Pit for sub-aqueous disposal;
- A spillway invert elevation, consistent the requirements for dam freeboard, will be determined. Any PAG tailings higher than 1 m below the invert elevation will be relocated such that a final cover of minimum 1 m of water is provided;
- Erosion protection will be placed on exposed sand areas of the dam;
- Water in the TMF will be temporarily pumped to the pit to lower the pond level for construction of the wetlands;

- Heap operations will continue with ongoing circulation of water onto the heap and processing of water in the recovery plant. Cyanide addition to the circulating water will be stopped. Once gold recovery ceases, water will be processed in the cyanide destruction plant and used to rinse the heap. Drain-down water will be processed in the cyanide destruction plant, through the bio-reactor for selenium removal and then pumped the pit; and
- All infrastructure will be removed as per the closure plan.

In order to better define the scope of potential activities associated with an early closure scenario, the mine plan has been examined to identify those stages when early closure would be most problematic. The issues resulting from early closure are common to all years, though of varying degrees. The most problematic time of early closure is in the early years of the mine life up to approximately Year 4. However, it is important to note that closure early in the mine life is very unlikely given the significant investment required to construct the mine and infrastructure.

The primary concerns during early closure scenarios are as follows:

- Disposal of ore stockpiles;
- Tailings dam crest elevation relative to the elevation of waste rock within the TMF; and
- Pit lake water quality and outflow management.

These issues are detailed further below.

Management of Ore Stockpiles

As illustrated in Figure A.4.11-10 and detailed in Table A.4.11-9 the ore stockpile volumes vary over the mine life in accordance with the mine plan. In the event of early closure, final closure strategies would need to be implemented to dispose of the material stockpiled on surface, as opposed to a temporary closure scenario, where resumption of operations and eventual processing of that material would occur.

Stockpiled gold ore would be relocated to the HLF without crushing, where it would managed with the geochemically similar material already on the HLF. Gold ore would be managed as described in the conceptual closure plan for final closure of the HLF (Appendix 4A Conceptual Closure and Reclamation Plan, Section 3.4), including detoxification, draindown and cover.

A portion of the remaining stockpiles will be milled to provide tailings to cover the PAG tailings and waste rock in the TMF as per Figure A.4.11-11. The volume will be dependent on the surface area of PAG tailings and waste rock stored in the TMF at the time of early closure and the requirements to establish wetland systems. However, as of the first year of milling (Year 1), the stockpile volumes exceed 17 Mm^3, which is more than sufficient to cover end of mine life area of the TMF (11 km^2). Therefore, it is not expected that there will be a shortfall of ore stockpiled on surface to provide tailings to cover the material stored in the TMF, regardless of early closure timing.

Disposal of the ore stockpiled on surface not required for cover may be conducted in one of the following ways:

1. Mill processing;
2. Relocation to the TMF;
3. Relocation to the pit; or
4. Covering in place.

Mill processing of the ore stockpiles is not considered a viable early closure option, as the time required to process this material is comparable to the remaining mine life, and would therefore not be considered "closing" of the mine, but continued operations. Also, mill processing would require the sustained operation of supporting infrastructure, including the camp, freshwater pipeline, TMF raising, etc.

With the exception of a small quantity of this material, relocation to the TMF is not considered a viable option due to the limited capacity of the TMF. Therefore, the remaining options are to relocate to the pit or cover in place.

As shown in Table A.4.4-9 and Figure A.4.11-10, while the pit volume increases each year, there may not be sufficient storage in the pit to dispose of the entire volume of stockpiled ore prior to Year 8. Pit volumes are shown up to Year 8 as adequate capacity is available for disposal of ore stockpiles in subsequent years. If selected as the most viable option at closure marginal grade ore would preferentially be disposed of in the Open Pit and in-situ stabilization will be considered for the remaining material. The maximum volume that might require in-situ stabilization would occur in Year 4, with approximately 12 Mm^3 of LGO and 15 Mm^3 of supergene oxide.

In-situ stabilization would require a combination of covers and downstream seepage mitigation. Conceptually, a geosynthetic cover would be installed on the flat top areas of a stockpile, with a soil cover on the slopes (where a geosynthetic cover is not stable). Downstream mitigation of any seepage could involve a permeable reactive barrier and/or an expanded wetland.

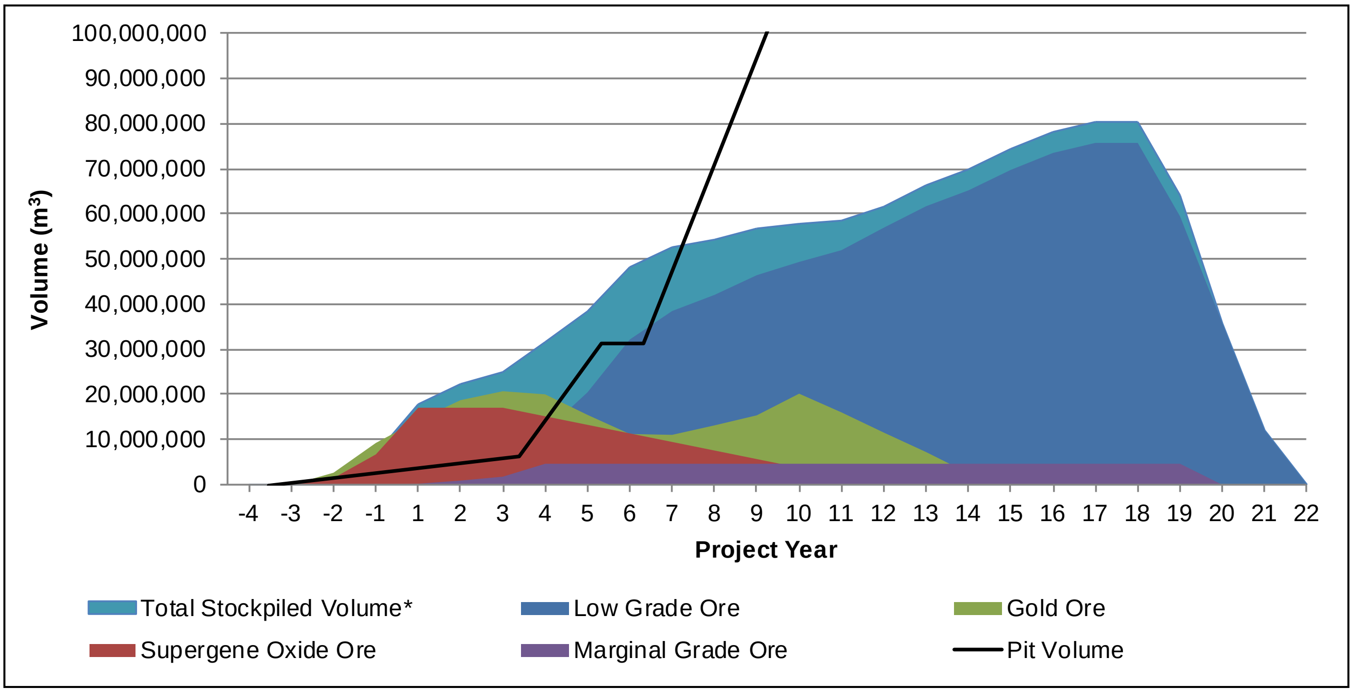
Table A.4.11-9 Ore Stockpile Schedule

	Ore Stockpile Volumes (m^3)					Pit Volume	Balance
Year	**LGO**	**SOX**	**Gold Ore**	**MGO**	**Total**	**(m^3)**	**(m^3)**
-3	0	10,526	0	0	10,526		
-2	0	1,487,368	2,669,474	2,132	1,489,500		
-1	96,842	6,724,211	9,263,684	11,368	6,832,421		
1	538,421	17,057,895	14,285,789	233,053	17,829,368		
2	4,321,053	17,057,895	18,735,263	927,711	22,306,658	6,120,339	16,186,319
3	6,108,421	17,057,895	20,711,053	1,791,947	24,958,263		
4	11,777,895	15,163,158	20,018,421	4,651,105	31,592,158	31,345,145	247,013
5	20,468,947	13,268,421	15,476,316	4,651,105	38,388,474	31,345,145	7,043,329
6	32,171,053	11,373,684	11,237,895	4,651,105	48,195,842		
7	38,472,105	9,478,947	11,052,632	4,651,105	52,602,158		
8	42,037,895	7,584,211	13,150,526	4,651,105	54,273,211	100,686,455	-46,413,244
9	46,405,789	5,689,474	15,375,263	4,651,105	56,746,368		
10	49,340,000	3,794,737	20,170,000	4,651,105	57,785,842	123,948,622	-66,162,780
11	51,942,105	1,900,000	16,032,105	4,651,105	58,493,211		
12	56,921,579	0	11,558,421	4,651,105	61,572,684		
13	61,673,684	0	7,242,632	4,651,105	66,324,789		
14	65,184,211	0	2,565,263	4,651,105	69,835,316		
15	69,721,053	0	0	4,651,105	74,372,158		
16	73,480,000	0	0	4,651,105	78,131,105		
17	75,698,947	0	0	4,651,105	80,350,053		
18	75,698,947	0	0	4,651,105	80,350,053		

	Ore Stockpile Volumes (m^3)					Pit Volume	Balance
Year	LGO	SOX	Gold Ore	MGO	Total	(m^3)	(m^3)
19	59,427,895	0	0	4,651,105	64,079,000		
20	35,715,789	0	0	0	35,715,789		
21	12,039,474	0	0	0	12,039,474		
22	0	0	0	0	0		

Notes:

1. Volume based on bulk density of 1.9 tonnes/m^3; Pit volume to 10m below spill point; Gold ore reports to HLF



*Total stockpiled volume excludes Gold Ore, as Gold Ore will be disposed of on the HLF in early closure

Figure A.4.11-10 Plot of Stockpile Volume Relative to Pit Volume

Tailings Dam Crest Elevation

A total of 658 million tonnes of mine waste materials will be mined from the Open Pit. Waste rock and overburden will be stored subaqueously within the proposed TMF in a Waste Storage Area located in the upper (northern) region of the TMF basin (Figure A.4.11-11). Each stage of TMF development has been sized to store tailings (based on the mine production schedule), together with potentially reactive waste rock from the Open Pit and a supernatant water pond. Additional capacity is provided for storm water storage for the inflow design flood event and an allowance of 2 m of embankment freeboard for wave run-up protection.

As shown on the cross-sections of the TMF at Years 1, 4, 10 and 22 in Figure A.4.11-11 and in Table A.4.11-10 the waste rock elevation exceeds the elevation of the tailings dam throughout operations (Years 1 to 21). While this is a normal operating strategy, concerns arise during early closure, as subaqueous storage of waste rock would require raising the elevation of the dam. The maximum difference between waste rock elevation and dam crest elevation is 15 m at Years 6 and 15.

In the case of premature mine closure, some portion of the WSA may need to be relocated to an elevation below the final pond elevation in the TMF. This would be required to ensure potentially reactive waste materials will be maintained in a saturated state with a sufficient minimum pond cover (2 m). In addition, and if required, the dam could be raised to an appropriate height to facilitate the 2 m tailings cover, the 2 m water cover and the storm event freeboard (3 m). Dam raise material would be sourced from locally available borrow (Figure A.4.11-12) to allow a dam raise to be carried out without operation of the mill to produce sand for dam construction.

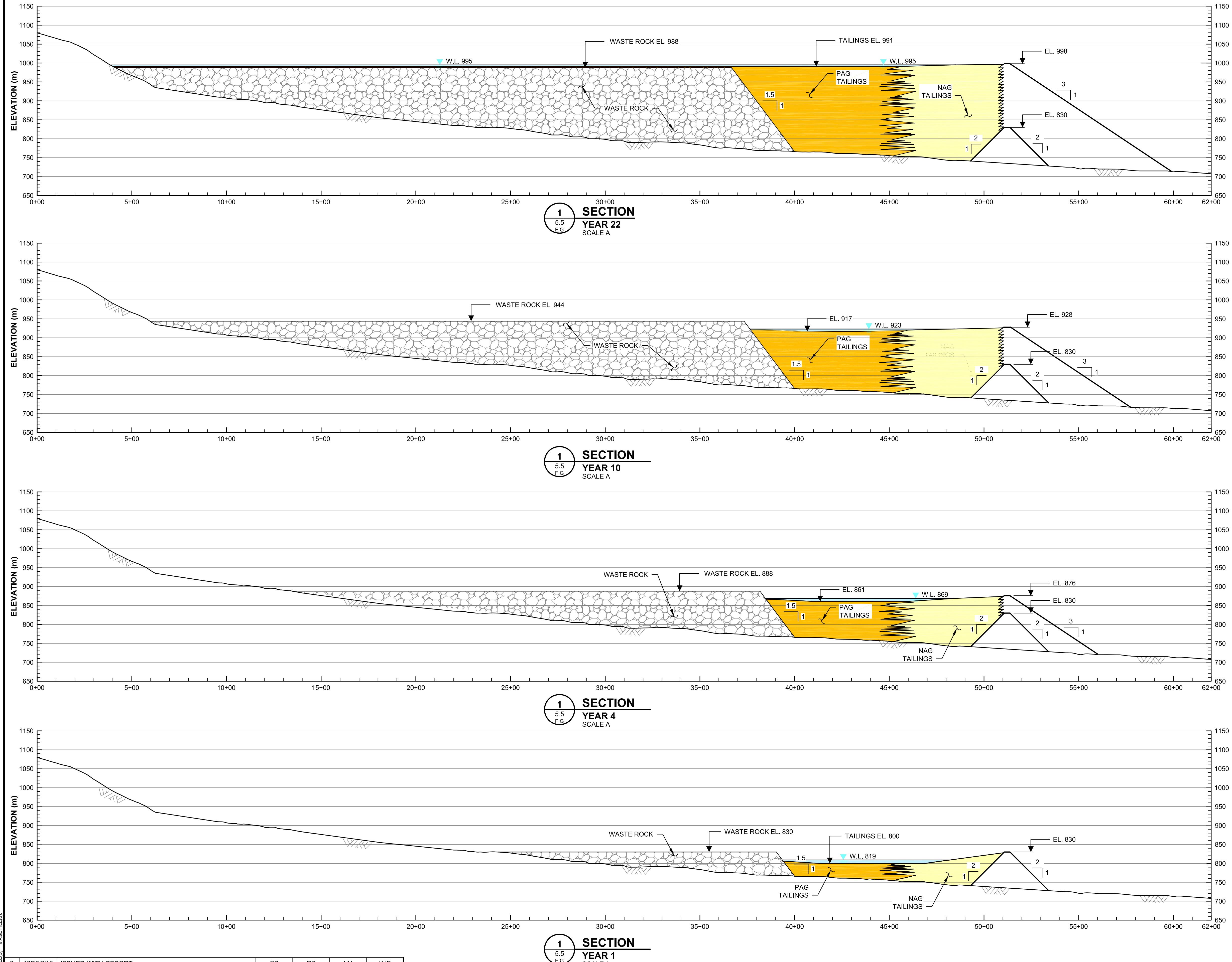
Table A.4.11-10 Tailings Management Facility Elevations during Operations

Year	Embankment Crest Elevation (masl)	Tailings Elevation (masl)	Pond Elevation (masl)	Waste Rock Elevation (masl)
2	849	829	841	851
4	876	861	869	885
6	894	881	888	909
10	928	918	923	942
15	962	953	957	977
22	998	991	995	988

Pit Lake Water Management

As discussed in Section 4, and shown in Figure A.4.11-13, the Open Pit development footprint increases throughout the mine life. By Year 2 the entire pit rim is below the elevation of the original surface. Throughout development, the geochemical composition of the pit walls shift from mostly oxidized in the upper part of the leached cap to a mix of oxide, supergene and sulphide rocks. In general, the exposure of potentially reactive rocks increases through the mine life, with the greatest exposure at the end of the mine life. Submergence of the Open Pit with the developing pit lake will limit oxidization of the pit walls below water.

During an early closure scenario, placement of ore within the pit would be carried out such that a 1 m depth of water would be maintained above the elevation of the backfilled rock and the passive pit water management system could still be implemented. Backfilling of the pit would be sequenced such that the geochemically worst rock is preferentially disposed of in the pit. As the pit lake may be smaller than the proposed ultimate closure scenario (depending on the Project year in which early closure is implemented), there will be less dilution available to minimize contaminant concentrations in the pit lake. Therefore, backfilled material may be amended with lime during backfilling. Preliminary testwork on the acidic waste rock humidity cells have indicated that Cd, Co, Cu, Fe and Zn effluent concentrations could be reduced by >99% with pH adjustment using lime to a pH of 10 (SGS 2013). Requirements for lime addition have been estimated to be approximately 1 kg of lime per tonne of rock. Alternatively, a diffusion barrier of local soil could be placed over the backfilled material. The thickness of the barrier layer would depend upon soil properties. Optimization and refinement of the plan for management of pit water quality would be based on the phase of mine development at early closure.



NOTES:

1. DIMENSIONS ARE IN METRES UNLESS NOTED.

VERT. SCALE 100 50 0 100 200 300 400 500 m

HORIZ. SCALE 200 100 0 200 400 600 800 1000 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	19DEC'12	ISSUED WITH REPORT	SB	PP	LM	KJB

CASINO MINING CORPORATION

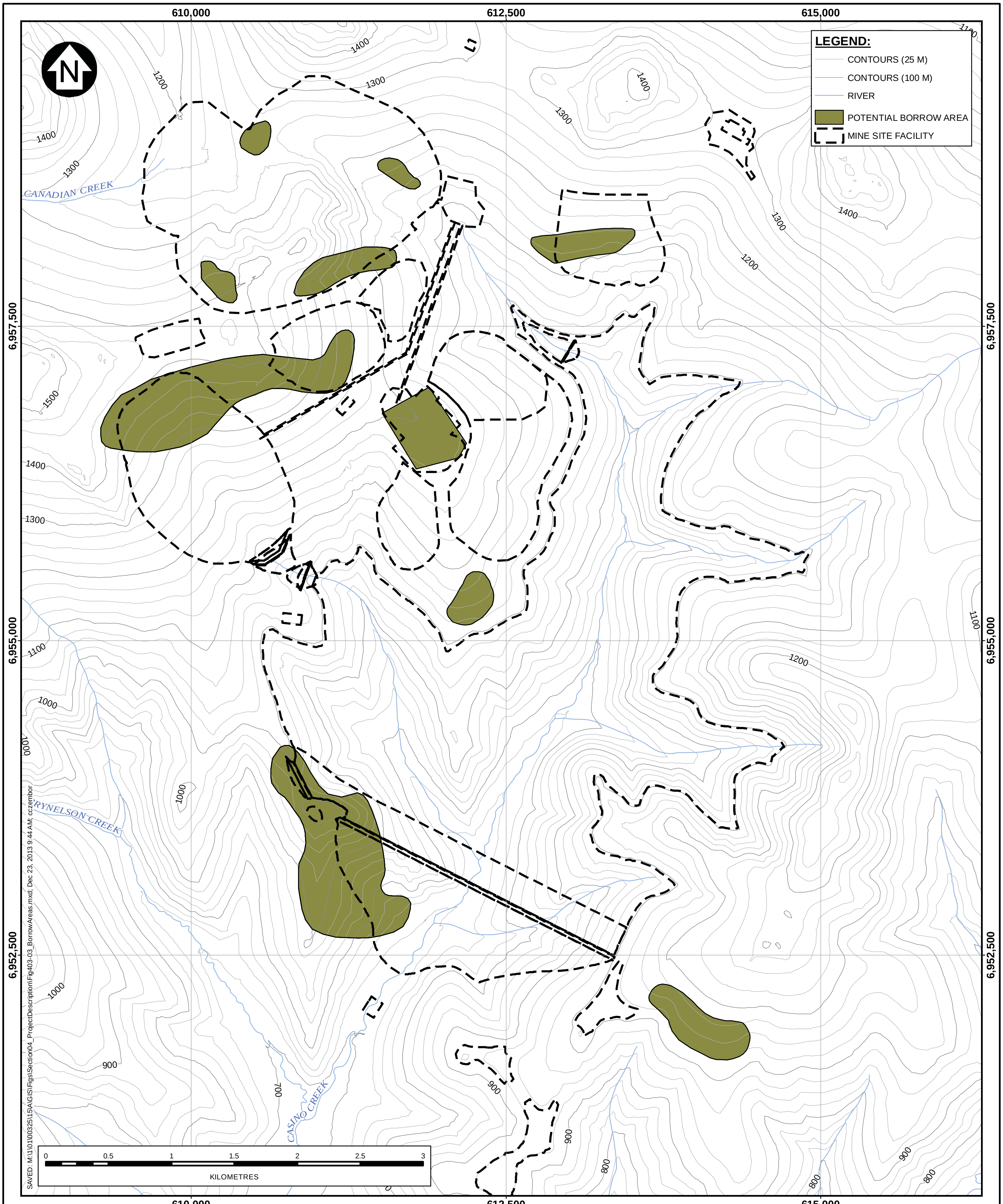
CASINO COPPER-GOLD PROJECT

TAILINGS MANAGEMENT FACILITY WASTE DEPOSITION STRATEGY TYPICAL SECTIONS (YEARS 1, 4, 10 and 22)

Knight Piésold CONSULTING

P/A NO. VA101-325/8 | REF NO. 10

FIGURE 5.6 REV 0



PREPARED BY:

Knight Piésold
CONSULTING

DESIGNED	GLS/CAH
DRAWN	CC
CHK'D	CAH
APP'D	GLS
REV	0
DATE	16DEC'13

NOTES:
1. BASE MAP: EAGLE MAPPING
2. PROJECTION: NAD 1983 UTM ZONE 7N
3. COORDINATE GRID: METRES

CASINO
COPPER AND GOLD

POTENTIAL CORE ZONE BORROW MATERIAL

CASINO PROJECT

FIGURE A.4.11-12

REF 1

P/A VA101-325/15

Figure A.4.11-13 Open Pit Development Outlines

A.4.11.12.2 R142

R142. Contingency measures or alternatives that may be required in the event of early closure if passive treatment system field trials have not been completed or are shown to be unsuccessful.

The Yukon Government states that "reliance on long term active treatment is not considered acceptable for reclamation and closure planning" (Yukon Government 2006). This applies for any closure scenario, be it planned closure for final mine footprint, or early closure. As discussed above, a robust schedule of testwork will be conducted to establish criteria for the passive treatment systems, such as sizing and composition, and long-term field trials will be conducted to verify these criteria prior to installation. This testwork will be conducted sufficiently early in the mine process so as to be available in the case of early closure. Additionally, comprehensive monitoring following installation will be conducted to ensure that the systems are functioning appropriately, and are sufficiently protective of the receiving environment. CMC will be required to achieve closure objectives, regardless of the timing of closure.

A.4.11.13 Mine Reclamation and Security

A.4.11.13.1 R143

R143. Update the CCRP and security estimates based on the Government of Yukon's updated guidance document: Reclamation and Closure Planning for Quartz Mining Projects, Plan Requirements and Closure Costing Guidance (Government of Yukon, 2013).

The CCRP provided for the Proposal is a preliminary plan, and will be refined throughout the permitting process and subsequently as required by the Quartz Mining License (QML) and the Type A Water Use License (WUL). All future iterations of the CCRP will be updated to conform to current policy and regulations. As outlined in the Reclamation and Closure Planning for Quartz Mining Project, Plan Requirements and Closure Costing Guidance (Yukon Government, 2013), while QMLs "may be issued without detailed reclamation and closure plans (RCPs), approval to begin mining activities will not be granted until approval of an RCP". A detailed plan will be required for the Water Use Licencing application, and for the QML application. CMC will provide an updated CCRP at that time.

A.4.11.13.2 R144

R144. Additional justification and discussion on security estimates. Details should include:

a. all major mine components;
b. all reclamation and closure stages;
c. consideration of temporary or early closure;
d. consideration of accidents and malfunctions; and
e. consideration of effects of the environment.

As discussed above, a detailed reclamation and closure plan will be provided in support of the QML and WUL applications. The detailed plan will include a detailed estimate of costs, as required by Reclamation and Closure Planning for Quartz Mining Project, Plan Requirements and Closure Costing Guidance (Yukon Government, 2013).

The $125.9M stated in the 2013 Feasibility Study (M3 2013) was derived from the values provided in Table A.4.11-11. The estimate calculated for the feasibility study was based on the mine plan at the time.

Table A.4.11-11 Feasibility Reclamation and Closure Cost Estimate

Component	Cost Estimate
Open Pit	
Access control	$108,307
Spillway construction	$52,906
Pit flooding (assumes lime addition)	$1,670,000
Open Pit Closure Total	**$1,831,213**

Component	Cost Estimate
Tailings Management Facility	
Rip rap for stabilization	$344,463
Wetland development	$13,340,674
Pump TMF water to pit to establish wetlands	$4,500,000
Spillway construction	$688,496
Removal of operations phase infrastructure	$70,731
Instrumentation installation	$200,000
Tailings Management Facility Closure Total	**$19,144,364**
Ore and Overburden Stockpiles	
Topsoil and vegetation of stockpiles	$3,119,179
Low grade ore stockpile relocation to open pit, re-contouring and vegetation	$30,675,491
Stockpile Closure Total	**$33,794,669**
Decommissioning of Buildings	
Building decontamination and hazardous materials removal	$73,920
Demolition of buildings and piping	$4,780,604
Grade and contour	$4,651,275
Reclamation of site roads	$402,710
Buildings Closure Total	**$4,780,604**
Hazardous Materials	
Hazardous materials audit (Phase I & Phase II)	$300,000
Disposal of hazardous materials	$500,000
Contaminated soil removal	$270,458
Hazardous Materials Closure Total	**$1,070,458**
Water Management	
Construction of WSMP	$517,461
Groundwater collection system	$250,000
Water Management Total	**$767,461**
Mobilization of Equipment	
Mobilization of equipment from Edmonton	$283,829
Mobilization of workers	$696,000

Component	Cost Estimate
Mobilize miscellaneous supplies	$1,500,000
Worker accommodations	$4,680,000
Pump TMF seepage to pit	$622,200
Care and maintenance for 5 year closure period	$3,072,192
Mobilization Total	**$10,854,221**
Post-closure Monitoring and Maintenance	
Monitoring and Inspections	$199,000
Annual passive treatment of pit water	$500,000
Post-Closure Monitoring and Maintenance Total	**$699,000**
Discount rate	3.5%
Number of year for post-closure activity	200 years
Present Value	**$19,950,901**
Total	**$125,912,236**

A.4.11.14 Missing Information

A.4.11.14.1 R145

R145. The following documents referenced in the Conceptual Closure and Reclamation Plan (Appendix 4A):
a. R&C Environmental Services, 2010
b. pers. comm. J. Marsden, 2013

Part a.

The Laboratory Evaluation of the SO2/Air and Peroxide Process Cyanide Removal Process for Solution Treatment (R&C Environmental Services, 2010) is provided in Appendix A.4J.

Part b.

The personal communication from John Marsden (2013) was extracted from draft meeting minutes, and has not been submitted as a finalized report, hence cannot be provided at this time. CMC will continue to work with John Marsden to refine the closure of the heap leach facility, including parameters for leaching of ore after stacking has ceased, rinsing of ore and drain-down of the heap.

A.4.12 WASTE MANAGEMENT

A.4.12.1 R146

R146. A detailed description of waste management for the Project including:

a. location and size of all facilities associated with waste management;

b. detailed description of waste storage facilities including the waste management facility, landfill, incinerator, land treatment facility, and sewage treatment plant;

c. detailed description of waste management at the various facilities;

d. anticipated volumes of waste at various stages of the Project;

e. details on special waste and hazardous waste handling including anticipated volumes; and

f. a more detailed waste management plan.

A detailed waste management plan will be provided as part of the Type A Water Use License Application and as part of Quartz Mining License application - Part 2 Environmental Protection Plans. The detailed plan will include the location and size of all facilities associated with waste management, anticipated volumes of waste at various stages of the Project, and other details as required by the Plan Requirement Guidance for Quartz Mining Projects (Yukon Government 2013). At this stage of the project, these details are not yet known. However, CMC commits to meeting the requirements of the *Quartz Mining Act*, the *Environment Act*, the *Explosives Act*, the Occupational Health and Safety Regulations, the *Transportation of Dangerous Goods Act*, the *Public Health and Safety Act*, and the *Nuclear Safety and Control Act*, and others as required, as they pertain to the transportation, storage and disposal of solid waste and hazardous materials.

A preliminary Solid Waste and Hazardous Materials Management Plan is provided in Appendix A.22A and is an update to Section 22.3.1 provided in the Proposal. The Solid Waste and Hazardous Materials Management Plan is a preliminary plan to describe the type of waste generated and related management strategies to responsibly handle, store, transport, and dispose of waste. The objective of the Solid Waste and Hazardous Materials Management Plan is to ensure that the handling, storage, transportation, and disposal of all wastes (solids, liquids, special wastes) generated by the Project are conducted in such a manner as to reduce potential adverse environmental effects associated with waste materials. The Solid Waste and Hazardous Materials Management Plan (Appendix A.22A) is preliminary and aims to describe the type of waste generated and related management strategies to responsibly handle, store, transport, and dispose of solid waste and hazardous materials, based on feasibility level design details. To achieve this, CMC will:

- Comply with all applicable territorial and federal waste management regulations;
- Minimize waste generation;
- Select products that are less harmful to the environment;
- Reuse and/or recycle materials;
- Transfer wastes in a safe and responsible manner; and
- Train staff and contractors on policies and operations.

The Solid Waste and Hazardous Materials Management Plan will also describe the transportation, storage, use, and handling of hazardous materials to ensure protection of the environment and human health and safety, both of mine employees and members of the public. The major sources of waste from the Project will likely include:

- Hazardous waste: used reagent containers, batteries, paint;

- Non-hazardous solid waste: domestic camp waste (food, plastics, paper), and inert bulk wastes (rubber belts, drywall, etc.);
- Fuels and lubricants (petroleum products and oils); and
- Sewage (human sewage and gray water).

Details pertaining to the management of hazardous materials include:

- Hazardous material transport methods, routes, frequency, driver qualifications, spill kit requirements;
- Volumes and amounts of each material used, storage locations, containment measures (segregation, secondary containment, etc.), Material Safety Data Sheets;
- Employee training programs (e.g., Workplace Hazardous Materials Information System) related to proper handling techniques, use of personal protective equipment, and familiarity with the site layout and emergency stations;
- Site and substance-specific operating procedures describing unloading, mixing, plant operations, entry into confined spaces, and maintenance for reagents, including cyanide, to minimize risk to health and safety of mine personnel;
- Communication procedures between on-site and off-site personnel (suppliers, contractors, receivers);
- Inspection measures and frequency;
- Monitoring and reporting requirements;
- Location of copies of the Spill Contingency Plan and Emergency Response Plan and how the plans will be implemented as needed as they relate to hazardous materials; and
- Waste disposal methods.

The Solid Waste and Hazardous Materials Management Plan will be updated as the project is refined, and has been derived from Plan Requirement Guidance for Quartz Mining Projects (Yukon Government 2013). The final Solid Waste and Hazardous Materials Management Plan will describe the methods used to manage all domestic and industrial solid, liquid, special wastes and hazardous materials for all phases of the Project, and will include a table of proponent commitments made during the environmental assessment process relevant to waste management, and indicate how the plan addresses the commitments. Terms and conditions of any applicable licences, permits and approvals required for the Project operations will also be included, once acquired.

A.5 – EFFECTS ASSESSMENT METHODOLOGY

A.5.1 INTRODUCTION

Section 5 of the Proposal outlined the assessment methods and framework for the assessment of potential effects utilized for the Proposal, which were developed in accordance with current YESAB guidance (YESAB 2005) and are considered best practices from other national and international regimes. Casino Mining Corporation (CMC) believes that the assessment method used is an effective tool for CMC to determine the potential for significant adverse residual effects as a result of the Project, after the implementation of appropriate mitigation measures.

On January 27, 2015, the Executive Committee requested that Casino Mining Corporation (CMC) provide supplementary information to the proposed Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Proposal in preparation of the Adequacy Review Report (ARR). Casino Mining Corporation is providing this Supplementary Information Report (SIR) to comply with the Executive Committee's ARR; CMC anticipates that the information in the SIR and Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has one request that CMC has identified as related to information presented in Section 5 Effects Assessment Methodology of the Project Proposal submitted on January 3, 2014. This request is outlined in Table A.5.1-1, and is responded to below.

Table A.5.1-1 Requests for Supplementary Information Related to Effects Assessment Methodology

Request #	Request for Supplementary Information	Response
R445	Add a valued component and assessment for worker health and safety to the Project proposal.	Section A.5.2.1.1

Notes:
1. Request # refers to the assigned identification number in the YESAB Adequacy Review Report January 27, 2015 Prepared by Executive Committee Yukon Environmental and Socio-economic Assessment Board.
2. Response refers to the location of CMC's response to the YESAB request for supplementary information.

A.5.2 HUMAN HEALTH RISK ASSESSMENT

A.5.2.1.1 R445

R445. Add a valued component and assessment for worker health and safety to the Project proposal.

Casino Mining Corporation had defined Valued Components (VCs) as environmental and socio-economic components of the environment that are considered by CMC, the public, First Nations, technical specialists, YESAB and/or other government agencies involved in the assessment process to have scientific, ecological, economic, social, cultural, archaeological, historical, or other importance. The selection of VCs for the Proposal was informed by professional judgement, the experience of CMC and its consultants and through engagement with YESAB, First Nations, and local community representatives.

YESAB has requested that worker health and safety be added as a VC to the Proposal to allow the Executive Committee to assess potential Project effects to human health. Under the Yukon *Occupational Health and Safety Act (2002)*, a "worker" is a person who performs services for the employer under an express or implied contract of employment or apprenticeship, and includes (a) any person engaged in training for mine rescue work and any person who is doing rescue work at a mine after an accident, and (b) the employees of a contractor who is engaged in operations under a contract the contractor has with another person.

Worker health and safety was not selected as a VC by CMC because:

- Worker health and safety is protected by a legally binding government requirement that requires mandatory compliance;
- Existing regulations and guidelines to ensure the protection of Worker Health and Safety have been developed based on a wealth of information and knowledge regarding potential effects;
- Worker health and safety is restricted to workers and by definition does not include the public;
- Public access to the mine site and Freegold Road Extension is controlled; and
- Management and response plans will outline procedures to protect worker health and safety.

The *Occupational Health and Safety Act* and its supporting regulations and guidelines have been developed based on a wealth of information and knowledge regarding typical mine-related activities and the potential to adversely affect worker health and safety. The regulatory frameworks that have been established, which require mandatory compliance, are intended to avoid potentially significant adverse effects to worker health and. CMC is required to comply with the *Occupational Health and Safety Act* and related regulations (such as the *Explosives Act* and the *Transportation of Dangerous Goods Act*) and guidelines, and therefore additional analysis of potential effects on worker health and safety is not warranted, as potential effects are not acceptable outcomes under the governing Acts.

It is reasonable to expect that all workers for the Project will be performing services and carrying out Project-related activities within the mine site or within transport vehicles that will travel along pre-designated roads and highways. There is very limited, to no potential for the public and Project activities within the Casino mine site or along the Freegold Road Extension to interact because access is controlled at these locations.

Under the *Quartz Mining Act (2003) Section 10 Safety of Public* "A mining recorder may summarily order any mining works to be so carried on as not to interfere with or endanger the safety of the public or any employee of the mining works, any public work, highway, mining property or mineral claim, mining claim, bed-rock drain or bed-rock flume, and any abandoned works shall by the order of the mining recorder be either filled up or guarded to his or her satisfaction". The Casino mine site and Freegold Road Extension is proposed to be private property of CMC, with controlled access throughout the life of the Project; in general, the public will not be allowed within the mine site or on the Freegold Road Extension without the prior consent of CMC.

In addition, CMC is required to provide mine management, and environmental management plans that outline the structure in place to manage risks to worker health and safety. The Proposal and SIR present several of these conceptual management plans, including:

- Appendix 22C Cyanide Management Plan;
- Appendix 22B Emergency Response Plan;
- Appendix A.22A Waste and Hazardous Materials Management Plan;
- Appendix A.22B Spill Contingency Management Plan;
- Appendix A.22E Road Use Plan (replaces Appendix 22A Road Use Plan); and
- Appendix A.22G Liquid Natural Gas Management Plan.

All Project related activities will be conducted in a manner that minimizes risk to worker health and safety through training, awareness, and continuous improvement. Worker health and safety is the primary objective of the detailed *Occupational Health and Safety Plan* that will be developed by CMC and submitted to the Yukon Government for review and approval as part of the Quartz Mining License application (Yukon Water Board 2013). The detailed *Occupational Health and Safety Plan* will outline potential worker exposure scenarios and procedures to minimize worker exposure. The *Occupational Health and Safety Plan* will also outline how worker health and safety will be monitored and what measures will be utilized in exposure situations. In addition to the detailed *Occupational Health and Safety Plan*, CMC will be required to submit other plans for the Quartz Mining License application that are related to worker health and safety, including:

- A description of all dust control measures that will be employed to ensure worker health and safety and minimize effects on the environment;
- A Spill Contingency Plan to communicate to staff, contractors, and workers the actions to be taken when responding to spills during mine construction, operation and closure; and
- An Emergency Response Plan which will be reviewed for completeness by the Yukon Workers' Compensation Health and Safety Board.

For the reasons identified above, worker health and safety was not selected as a VC for the Proposal and CMC believes that additional analysis of potential effects on worker health and safety as part of the Proposal is not warranted.

A.6 – TERRAIN FEATURES

A.6.1 INTRODUCTION

Section 6 of the Proposal summarized the effects assessment conducted for terrain features at the Project. Terrain features were selected as a Valued Component (VC) by Casino Mining Corporation (CMC) for the Casino Project (the Project) because of their importance to regional and localized ecological processes. The Proposal defines terrain features as the geological surface features, topography, and layers of mineral and organic materials covering the underlying bedrock geology. The assessment focused on potential effects of the Project to three unique types of terrain features: thaw lakes (lakes found in thermokarst that develop in a depression and accumulate either permafrost melt water or rain water), pingos (mounds of earth-covered ice which grow as a result of periglacial processes), and tors (isolated pillar-like rock outcrops situated on ridges, associated with unglaciated terrain). The Proposal concluded that the potential effects of the Project on existing terrain features are considered to be adverse and irreversible; however, the adverse residual effect is considered Not Significant, since the effects will be on individual terrain features and localized to the Project footprint.

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). Casino Mining Corporation is providing this Supplementary Information Report (SIR) to comply with the Executive Committee's ARR; CMC anticipates that the information in the SIR and Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has 11 requests related to information presented in Section 6 Terrain Features of the Project Proposal submitted on January 3, 2014. These requests and the corresponding sections of the SIR where the responses can be found are outlined in Table A.6.1-1.

Table A.6.1-1 Requests for Supplementary Information Related to Terrain Features

Request #	Request for Supplementary Information	Response
R147	A detailed discussion on the short and long-term stability of mine infrastructure and surrounding slopes in the upper Casino Creek watershed due to permafrost degradation. Consideration should be given to the effects of permafrost degradation related to site infrastructure and climate change.	Section A.6.2.1.1
R148	Maps and relevant references showing permafrost distribution within the mine site as well as the Freegold Road, the airstrip and the airstrip access road.	Section A.6.2.1.2
R149	A detailed thermal modeling analysis of the proposed TMF and associated infrastructure on foundation conditions to support engineering design (including determination of embankment height, width of right of way, safety margin, etc.) and to assess the effects of the Project on the ground thermal regime. Include a detailed discussion and analysis about potential impacts to mine infrastructure from altered foundation conditions.	Section A.6.3.1.1
R150	An analysis of how climate change has been incorporated into the thermal erosion analysis to support Project design and the impact assessment.	Section A.6.3.1.2

Request #	Request for Supplementary Information	Response
R151	The depths at which ground temperatures have been measured for each cable installed in 1994.	Section A.6.4.1.1
R152	The ground temperature readings for all thermistor cables (from 1994 to 2013) in the same format (graphs of ground temperature with depth at a given time) which will allow an assessment of the impacts of recent climate warming (from 1994 until now) on permafrost.	Section A.6.4.1.2
R153	A discussion of whether ground temperature monitoring is planned for the proposed alignment of the Freegold Road Extension.	Section A.6.4.1.3
R154	Please clarify the assumption that permafrost might have low ice content based on the comparison between depth of permafrost and depth to groundwater.	Section A.6.4.1.4
R155	Clarification of the legends used in the baseline terrain maps as well as a simpler interpretation (label) of the units, especially those with multiple capital letters and integers. This will help establish the baseline surficial geology (terrain).	Section A.6.5.1.1
R156	Develop and present a site-specific terrain hazard classification scheme for the mine site, the Freegold Road, and the airstrip and airstrip access road, consistent with the YESAB draft guidance document titled Geohazards and Risk: A Proponents Guide to Linear Infrastructure (YESAB, 2014).	Section A.6.6.1.1
R157	Clarification of whether an ice-rich permafrost distribution map has been considered in the terrain hazard classification scheme	Section A.6.6.1.2

Notes:

1. Request # refers to the assigned identification number in the YESAB Adequacy Review Report of January 27, 2015 Prepared by the Executive Committee of the Yukon Environmental and Socio-economic Assessment Board.
2. Response refers to the location of CMC's response to the YESAB request for supplementary information.

A.6.2 PERMAFROST

A.6.2.1.1 R147

R147. A detailed discussion on the short and long-term stability of mine infrastructure and surrounding slopes in the upper Casino Creek watershed due to permafrost degradation. Consideration should be given to the effects of permafrost degradation related to site infrastructure and climate change.

Potential significant adverse residual effects due to permafrost degradation on the short term and long term stability of proposed mine infrastructure and surrounding slopes of the upper Casino Creek valley are not anticipated because of proposed mitigation measures and design standards. For example, prior to construction, the footprints of the mine infrastructure will be stripped of the surficial soils that may otherwise contribute to instability. In general, construction and site preparation techniques on permafrost require frozen, organic and ice-rich colluvium and residual soils to be ripped, blasted and/or excavated to competent, non-frost susceptible bedrock for subgrade preparation. All ice-rich overburden and heavily weathered rock will be removed to prevent potential thaw-settlement resulting from melting permafrost. The exposed bedrock will provide a thaw-stable foundation for mine infrastructure.

In support of future refinement in the Project design and future construction activities, ground temperature data are currently being collected at a number of locations across the site using thermistor strings and data loggers that were installed in vertical drillholes. Continued monitoring in the operations phase will allow for identification of real-time changes in permafrost conditions that may be connected with climate change. The need for additional mitigations for permafrost degradation to ensure the stability of the slopes of the upper Casino Creek valley will be assessed in detailed design taking into account the additional ground temperature data currently being collected.

With the mitigation measures and ground temperature data monitoring program in place, as well as an opportunity to incorporate any new information from ongoing monitoring into the refinement of the Project design, CMC does not anticipate significant adverse residual effects due to permafrost degradation on the short term and long term stability of proposed mine infrastructure and surrounding slopes of the upper Casino Creek valley.

A.6.2.1.2 R148

R48. Maps and relevant references showing permafrost distribution within the mine site as well as the Freegold Road, the airstrip and the airstrip access road.

Permafrost features and processes were rigorously incorporated into the terrain mapping provided in the Proposal. Please refer to the Project terrain and terrain hazards maps in the Surficial Geology, Terrain and Soils Baseline (Appendix 6A of the Proposal), which provides details of the permafrost landforms. Processes that exist in the Project area are based on available information.

Permafrost distribution maps are presented in the Hydrogeology Baseline Assessment (Appendix 7C of the Proposal). The permafrost distribution maps were derived from the terrain maps, which include permafrost processes as an attribute of the existing terrain. The main addition to the permafrost areas shown on the terrain maps was to assume permafrost is present in bedrock slopes and summits that are upslope from colluvial slopes where permafrost was identified (either through terrain mapping or site investigation). In addition, permafrost was assumed to be present in areas where cryoplanation terraces (erosional steps in bedrock), sorted stone polygons and solifluction lobes were identified. The observed depths of permafrost in the various terrain units are discussed in the original mapping reports.

A.6.3 THERMAL EROSION MODELING

A.6.3.1.1 R149

R149. A detailed thermal modeling analysis of the proposed TMF and associated infrastructure on foundation conditions to support engineering design (including determination of embankment height, width of right of way, safety margin, etc.) and to assess the effects of the Project on the ground thermal regime. Include a detailed discussion and analysis about potential impacts to mine infrastructure from altered foundation conditions.

Casino Mining Corporation would like to take this opportunity to clarify that the Report on the Feasibility Design of the Tailings Management Facility (provided herein as Appendix A.4D) states that "Thermal modelling may also be required to predict the effect of the proposed TMF on foundation conditions"; it does not state that predicting effects of the proposed TMF on foundation conditions will require thermal analysis as paraphrased in the ARR.

A detailed thermal modelling analysis has not been completed; though thermistors were installed during the 2011 and 2012 site investigations to provide a better understanding of the thermal regime in the bedrock of the proposed foundation of the TMF. In addition, ongoing site investigations will inform the characteristics of the overburden and bedrock and the extent of permafrost within the TMF embankment area.

The current design of the Project includes mitigation to remove frozen, organic and ice-rich colluvium and residual soils to competent or non-frost susceptible bedrock for subgrade preparation within all infrastructure foundations.

If foundation conditions are suspected to be susceptible to the effects of thermal erosion, after the removal of permafrost to non-frost susceptible bedrock, additional site investigation and detailed thermal analysis will be completed and additional mitigations measures will be applied if required.

A.6.3.1.2 R150

R150. An analysis of how climate change has been incorporated into the thermal erosion analysis to support Project design and the impact assessment.

This supplementary information builds on CMC’s response to R149. A detailed thermal analysis has not been completed, though these assessments can input factors that are attributes of climate change.

A.6.4 GROUND THERMAL CONDITION AND PERMAFROST TEMPERATURE MONITORING

A.6.4.1.1 R151

R151. The depths at which ground temperatures have been measured for each cable installed in 1994.

Sensor depths of the thermistor strings installed in 1994 are provided on page A1-55 of the 2012 Baseline Hydrogeology Report (Appendix 7C of the Proposal). Thermistor sensors were numbered sequentially, increasing in number (i.e., VW1, VW2, etc.) downhole. Numbered sensors were installed at the same depths in each drillhole and were installed at depths of 2 m, 3 m, 5 m, 6 m, 8 m, 11 m, 15 m, 27 m, 52 m, and 76 m.

A.6.4.1.2 R152

R152. The ground temperature readings for all thermistor cables (from 1994 to 2013) in the same format (graphs of ground temperature with depth at a given time) which will allow an assessment of the impacts of recent climate warming (from 1994 until now) on permafrost.

Six thermistor strings were installed in drillholes from June to August 1994. Data at each of these locations was manually downloaded once or twice per month until December 1994 or January 1995. All six 1994 thermistor strings have been reportedly damaged or lost and none are currently functioning. The available ground temperature readings for thermistor cables installed in 1994 are provided in Figures C.2.1 through C.2.6 of the 2012 Baseline Hydrogeology Report (in Appendix C2 of Appendix 7C of the Proposal). Temperatures below zero were recorded in the deposit area at 94-321, 94-331, and 94-334, and downstream of the proposed TMF embankment at 94-349. Recorded temperatures were above zero at sensors 94-344 and 94-345 located in Casino Creek valley.

A.6.4.1.3 R153

R153. A discussion of whether ground temperature monitoring is planned for the proposed alignment of the Freegold Road Extension.

A geotechnical site investigation is being planned for the Freegold Road Extension and may include the installation of thermistors to monitor ground temperature. The plan includes installation of thermistors in the swamp areas on the valley floors where the permafrost table is expected to be close to ground surface and the potential is greater for massive ground ice. The thermistor data for these areas will be used to analyze the permafrost conditions and design the insulating embankment upon which the road is to be constructed. The plan also includes installation of thermistors at several bridge sites to determine the permafrost conditions and to investigate the possibility of frost jacking of piles.

A.6.4.1.4 R154

R154. Please clarify the assumption that permafrost might have low ice content based on the comparison between depth of permafrost and depth to groundwater.

Natural Resources Canada's request for "clarification on the assumption that permafrost might have low ice content based on the comparison between depth of permafrost and depth to groundwater" at CAS-034 (YOR 2014-0002-245-1), refers to the following statement in the 2012 Baseline Hydrogeology Report (Appendix 7C of the Proposal): "Since the depth to groundwater within CAS-034 is greater than 99.5 mbgs (Figure 3.2), permafrost at CAS-034 is inferred to be dry or to have low ice content." The sentence was intended to highlight that even though the inferred depth of permafrost (ground at temperature <0ºC) at CAS-034 is 104 mbgs and is among the deepest permafrost depths measured at the site, the permafrost is mostly (if not all) associated with the unsaturated zone; however, it would not be unreasonable for the approximate 100 m thick soil and rock column above the water table to contain ice lenses or wedges due to freezing of infiltrating water within the unsaturated zone, particularly if the near-surface overburden is fine grained.

Natural Resources Canada further commented that "Inferring low ice content can have implications for the disposal procedure of the overburden (containment and sediment control)" (YOR-2014-0002-245-1). The disposal procedure of the overburden will be determined based on actual conditions observed in the field rather than inferred conditions. Care will be taken to follow appropriate procedures for the given material that is encountered.

A.6.5 SURFICIAL GEOLOGY AND TERRAIN MAPPING METHODS AND MAPS

A.6.5.1.1 R155

R155. Clarification of the legends used in the baseline terrain maps as well as a simpler interpretation (label) of the units, especially those with multiple capital letters and integers. This will help establish the baseline surficial geology (terrain).

The terrain unit integers found in labels on Maps 11 to 17 are an adaptation to Howes and Kenk (1997). The integers are deciles that are applied to composite symbols to represent the proportion of each geological component within the terrain unit as outlined in Chapter 6, Terrain Symbols, p.63–64 (Howes and Kenk 1997). The decile method of composite symbolization is an alternative to delimiter symbols ("•" ; "/" ; "//") found on Maps 1 to 10; both methods of symbolization provide the relative proportions of each component. In the example symbol highlighted by the reviewer, the integers represent 70% sxDv, 20% zxsxCv, and 10% R, as interpreted within the terrain unit polygon. Decile composite symbols were used by AECOM in the vicinity of the Casino Mine Site and Airstrip; whereas delimiter symbolization was used by Knight Piésold for the Freegold Road. Please refer to the map legend provided as Figure 1 of the Terrain Hazards Assessment for Proposed Mine Site (Appendix 6D of the Proposal).

A.6.6 TERRAIN HAZARDS ASSESSMENT

A.6.6.1.1 R156

R156. Develop and present a site-specific terrain hazard classification scheme for the mine site, the Freegold Road, and the airstrip and airstrip access road, consistent with the YESAB draft guidance document titled Geohazards and Risk: A Proponents Guide to Linear Infrastructure (YESAB, 2014).

Casino Mining Corporation acknowledges the Executive Committee's request and is aware of the YESAB draft guidance document titled Geohazards and Risk: A Proponents Guide to Linear Infrastructure. This draft guidance document was made available for review in March 2014 after the submission of the Proposal on January 3, 2014. Furthermore, the document "provides guidance and information only. It is not intended to provide legal advice or direction" (YESAB, 2014).

Nonetheless, the site-specific terrain hazard classification scheme that was presented in the Proposal generally conforms to the requirements of the draft guidance, including the adoption of a framework that considers:

- Review of existing guidelines and best practices related to infrastructure;
- Work scale;
- Spatial and temporal data;
- Approaches for geohazards and mapping;
- Risk analysis;
- Consequence assessment;
- Approaches for risk analysis;
- Risk evaluation;
- Risk management, and
- Mitigation.

The information presented in the Proposal also conforms to the information requirements identified within the draft guidance, which includes:

- Project initiation and scoping;
- Objectives;
- Study area and work scale;
- Background information;
- Analysis of baseline data;
- Field investigation;
- Geohazard Assessment;
- Risk assessment;
- The risk assessment: how geohazards affect the proposed development;
- The risk assessment: how geohazards affect construction and engineering;
- Reporting, and
- Map requirements.

The terrain hazard scheme presented in the Proposal generally conforms to the YESAB (2014) guidance and does not warrant updating.

A.6.6.1.2 R157

R157. Clarification of whether an ice-rich permafrost distribution map has been considered in the terrain hazard classification scheme

The ice-rich permafrost distribution map has been considered in the terrain hazard classification scheme. Ice-rich soils within the mine site, the Freegold Road, and the airstrip and airstrip access road were identified and carried through to the terrain hazard classification. Ice-rich permafrost in the terrain maps provided in the Proposal (Appendix 6B and 6D) are those areas denoted with the permafrost process subclass symbol ‘i’.

A.7 – WATER QUALITY

A.7.1 INTRODUCTION

Section 7 of the Proposal, and supporting appendices, evaluated potential effects of the Project on water quality, and included an assessment of surface water, groundwater and sediment quality to determine the potential effects on fish and aquatic resources, wildlife and human health. The indicators selected to assess changes in water quality were acidity, alkalinity, metals, sulphate, cyanide and nutrients. The risk assessment found that no significant water quality changes or cumulative effects were predicted to occur due to the Casino Project. All residual effects were considered non-significant due to the low geographical extent, and low to medium magnitude of the anticipated impacts. The assessment of significance is contingent on the complete implementation of mitigation measures, including an effective water management plan and reclamation plan.

While there will be detectable change in surface water quality from the natural range of variability in chemical characteristics in Casino Creek, the predictions fall within a reasonable threshold where alternative water quality guidelines that take into account site-specific water chemistry, such as high water hardness and elevated baseline metal concentrations, are appropriately protective. Residual effects from elevated metal and sulphate concentrations are limited to Casino Creek with improvements in water quality downstream in Dip Creek. The designation of non-significance is directly formulated on results from the water quality model. Limitations that are associated with the water quality assessment are based on the uncertainties in the water quality model.

On January 27, 2015, the Executive Committee requested that Casino Mining Corporation (CMC) provide supplementary information to the proposed Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). Casino Mining Corporation is providing this Supplementary Information Report (SIR) to comply with the Executive Committee's ARR; CMC anticipates that the information in the SIR and Proposal, when considered together, is adequate to commence Screening.

The requests from the Executive Committee related to Section 7 Water Quality of the Project Proposal submitted on January 3, 2014, are outlined below in Table A.7.1-1. Some responses require detailed technical information, data, and figures. Where necessary, this additional supporting information is provided as appendices to the SIR.

Table A.7.1-1 Requests for Supplementary Information Related to Water Quality and Quantity

Request #	Request for Supplementary Information	Response
R158	An assessment of potential water quality under a broader range of hydrologic conditions, including: a. the ability to manage waters during wet, dry and average years; b. the receiving water effects during typical and extreme summer and winter low flows (7Q20 and 7Q10); and c. the water storage and receiving water effects during freshet and event flow.	Section A.7.2.1.1 Appendix A.7A Variability Water Balance Model Report Appendix A.7B Water Quality Predictions Report
R159	An assessment of the potential effects of climate change on source loadings and receiving water effects.	Section A.7.2.1.2 Appendix A.7A Variability Water Balance Model Report Appendix A.7C Potential Effects of Climate Change

Request #	Request for Supplementary Information	Response
		on the Variability Water Balance
R160	An assessment of potential water quality under a broader range of operating/closure scenarios, including permit limits, atypical operations, accident scenarios, with and without passive treatment.	Section A.7.2.1.3 Appendix A.7B Water Quality Predictions Report
R161	Additional baseline water quality data for key water sampling locations on a minimum monthly basis for a minimum period of one year to estimate seasonal variability. The Executive Committee expects that results from ongoing water quality data collection will be provided throughout the assessment process.	Section A.7.3.1.1 Appendix A.7D Updated Appendix B5 to Appendix 7A
R162	An analysis regarding dataset robustness, which should at a minimum include additional analysis of central tendency (i.e. standard deviation) and could include better description of data distribution, data variance and other summary statistics where data is not normally distributed to aid in understanding the robustness of the present water quality dataset.	Section A.7.3.1.2 Appendix A.7D Updated Appendix B5 to Appendix 7A
R163	Additional details on water sampling protocols and field sampling methodologies. Details should include: a. filtration protocol/methodology (e.g. field filtered, filtered in lab); b. sample handling and preservatives protocol; and c.analytical hold times, chain of custody, etc.	Section A.7.3.1.3
R164	Clarify whether water quality parameters being monitored and conclusions are being drawn from total metals content, dissolved metals content, or both. Discuss whether elevated metals were a result of additional metals associated with higher suspended sediments.	Section A.7.3.1.4 Appendix A.7D Updated Appendix B5 to Appendix 7A Appendix A.7F The Effect of Acid Rock Drainage on Casino Creek
R165	Further discussion and clarification on baseline data from the existing adit. Details should include: a. rationale as to the limited amount of data from the adit; and b. an analysis for loadings (mass-balance) at additional points along the pathway from the adit to site W4.	Section A.7.3.1.5
R166	Toxicity testing and evaluation on water quality samples using early-life stages of salmonid and non-salmonid fish species, invertebrate species, and aquatic plant species.	Section A.7.3.1.6 Appendix A.7G Toxicity Testing Reports
R167	Clarify and provide further justification for the use of water monitoring stations W18, M18, and H18.	Section A.7.3.1.7 Appendix A.7B Water Quality Predictions Report
R168	Toxicity and bioaccumulation testing and evaluation on sediment quality samples.	Section A.7.3.2.1 Appendix A.7G Toxicity Testing Reports
R169	Baseline hydrological information for streams and rivers downstream of W16 on Dip Creek and the Yukon River (e.g. Klotassin River and White River), inclusive of the Yukon River at the respective point of	Section A.7.4.1.1

Request #	Request for Supplementary Information	Response
	confluence.	
R170	Provide estimates of flow rates for the Yukon River either at the point of confluence with Britannia Creek or at the point of planned water withdrawal from the Yukon River;	Section A.7.4.1.2
R171	Confirm whether on-going hydrometric monitoring will continue to improve the reliability of described baseline flow characteristics.	Section A.7.4.1.3
R172	Survey cross-sections of the stream gauging stations as well as an assessment of the accuracy of the measured peak flows considering the rating curve data.	Section A.7.4.1.4
R173	Confirm whether hydrometric monitoring station W1 that was discontinued in 2011 will be re-established. If not, provide rationale as to chosen approach.	Section A.7.4.1.5
R174	Discuss the use of stage-discharge measurements prior to 2011 (measurements which did not include benchmarks) in developing rating curves. Discuss the implications of only using data from 2013 and onwards in developing rating curves.	Section A.7.4.1.6
R175	A detailed description of the methodology used to select the Big Creek drainage as a regional surrogate watershed to develop the synthetic flow series. Consideration should be given to developing a focussed regional relationship using the larger and more current data set.	Section A.7.4.1.7
R176	Update tables 5.1-2, 5.2-1, and 5.3-1 in Appendix 7B, Hydrology Baseline Report to include discharge estimates (e.g. cubic meters per second or liters per second.	Section A.7.4.1.8
R177	A discussion on, and if necessary reassess, the values identified in Tables 5.2-1 and 5.3-1 of Appendix 7B (Hydrology Baseline Report) given that a comparison with regional hydrometric data suggests that values presented are higher than regional values.	Section A.7.4.1.9
R178	The following referenced report: Knight Piésold Ltd. 2010 Hydrometeorology Report (Ref. No. VA101-325/3-1, June 2010)	Section A.7.4.1.10 Appendix A.4G Updated Hydrometeorology Report
R179	An update and overview of current hydrogeology baseline information. Details should be provided for the following: a. whether additional conductivity studies are being done in the TMF Main Embankment area and rationale for the selected approach; b. characterization of hydrogeology in the open pit area outside the immediate footprint; and c. characterization of hydrogeology in the gold ore, supergene oxide/low grade ore, and low grade ore stockpile areas.	Section A.7.5.1.1 Appendix A.7M 2013-2014 Groundwater Data Report
R180	Additional discussion and supporting rationale on groundwater seepage from the open pit area to the Canadian Creek drainage. The discussion should include implications to base flows during operations and water quality during closure and post-closure.	Section A.7.5.1.2
R181	The following document for review: Knight Piésold Ltd. Revised Tailings Management Facility Seepage Assessment (Ref. No. VA101-325/8-13, December, 2012).	Section A.7.5.1.3 Appendix A.4L Revised Tailings Management Facility Seepage Assessment
R182	Additional detail and rationale to indicate that samples collected for	Section A.7.6.1.1

Request #	Request for Supplementary Information	Response
	geochemical characterization of ore, waste rock, and tailings, provide a statistically representative dataset. Details should include:a. results of sensitivity analysis and gap analysis of geochemical characterization program;b. summation of geochemical sampling program relative to rock lithology and alteration types; andc. if current sampling is found to be incomplete, please update accordingly with a suitable number of samples for ABA, as well as appropriate kinetic testing.	Appendix A.7H Appendix A2 to Casino Waste Rock and Ore Geochemical Static Test Assessment Report: Cross-Sections
R183	Complete cross-section and long-sectional diagrams of the open pit. Diagrams should include: a. all sample locations; b. all geologic units and lithologies; c. ore body outline; and d. any other data that will increase understanding of the deposit geology.	Section A.7.6.1.2 Appendix A.7H Appendix A2 to Casino Waste Rock and Ore Geochemical Static Test Assessment Report: Cross-Sections
R184	The following referenced reports: a. Lorax Environmental Service Ltd. (2009) Casino Phase I Geochemical Assessment Report prepared for Western Copper Corporation, January, 2009. b. Lorax Environmental Services Ltd. (2010) Casino Phase II Geochemical Assessment Report, prepared for Western Copper Corporation, January 2010.	Section A.7.6.1.3
R185	Describe or otherwise comment upon the added dimension of lithology in their analysis.	Section A.7.6.1.4
R186	Information on and description of the “FZ” lithology listed in Table 3-2 report titled Casino Waste Rock and Ore Geochemical Static Test Assessment (Appendix 7D, Lorax, Dec 3, 2013).	Section A.7.6.1.5
R187	Clarify why there are only about 12 percent of HYP samples included in the shake flask extraction testwork when the HYP type makes up almost 37 percent of the alteration types.	Section A.7.6.1.6 Appendix A.7I Casino Kinetic Testwork 2014 Update for Ore, Waste Rock and Tailings
R188	Rational as to why there are no values presented for uranium and fluoride despite having identified them as parameters of interest.	Section A.7.6.1.7
R189	Details on: mining sequence; production of ore and waste types relative to lithology and alteration; and blending schedule. Details should include: a. an ore/waste production schedule (tables and figures) broken down by lithologic/alteration units and tonnages mined; and b. demonstration that the mixing CAP and SUP material with HYP material could be implemented and will be an effective mitigation.	Section A.7.6.1.8 Appendix A.4F Waste Storage Area and Stockpiles Feasibility Design Appendix A.22H ML/ARD Management Plan
R190	Update and provide a discussion of on-going kinetic testwork. Provide any results and demonstrate how those results may inform the Project. Details should include: a. discussion on whether any of the tests recommended by Knight Piésold have been conducted or initiated; b. any additional laboratory reports that are available; and	Section A.7.6.1.9 Appendix A.7I Casino Kinetic Testwork 2014 Update for Ore, Waste Rock and Tailings

Request #	Request for Supplementary Information	Response
	c. discussion on what experiments/test work will be conducted prior to starting construction of the heap.	
R191	Details demonstrating the ore beneficiation process proposed to produce suitable concentrate. Details should include the process steps, reagents to be used, and resulting concentrates and wastes generated.	Section A.7.6.1.10 Appendix A.4M Processing Flow Sheets Appendix A.22H ML/ARD Management Plan
R192	For the Freegold Road upgrade and extension, access road borrow sources, airstrip, airstrip access road, and mine site borrow sources, provide additional details and information on: a. all geological materials, including estimates of volumes, that will be excavated, exposed or otherwise disturbed; b. geochemical characterization, analysis, and interpretation on representative samples for those geological materials; c. consideration of potential effects and appropriate mitigation measures associated with excavating, exposing, or disturbing those materials.	Section A.7.6.1.11 Appendix A.7J Preliminary Risk Assessment Metal Leaching and Acid Rock Drainage Appendix A.7K Casino Mine Site Borrow Sites ML/ARD Potential Appendix A.12A Wildlife Mitigation and Monitoring Plan V.1.2 Appendix A.22A Waste and Hazardous Materials Management Plan Appendix A.22C Sediment and Erosion Control Management Plan Appendix A.22D Invasive Species Management Plan Appendix A.22H ML/ARD Management Plan
R193	The following referenced report: Lorax Environmental Services Ltd. (2012) Casino Road: Preliminary Risk Assessment Metal Leaching and Acid Rock Drainage.	Section A.7.6.1.12 Appendix A.7J Preliminary Risk Assessment Metal Leaching and Acid Rock Drainage
R194	Details and justification on the depth of reaction and loadings source of 2.0 m for the face of the embankment when the active oxidation zone will initially be over a much deeper zone and will evolve downward over time. Justify the loading rates in the source term as a function of the oxidation zone only.	Section A.7.6.2.1
R195	Clarify the loadings as either runoff on the embankment slope and/or the downward infiltration that will eventually daylight as seepage from the embankment.	Section A.7.6.2.2 Appendix A.7B Water Quality Predictions Report
R196	Justify the depth of oxidation on the tailings beach and show the effect and implications of oxidation on the loadings associated with the infiltrating porewater and tailings seepage.	Section A.7.6.2.3 Appendix A.7B Water Quality Predictions Report
R197	The text on page 4-66 refers to Figure 4.1.4 yet this could not be found, or appears to be mislabelled. Please provide this figure for review.	Section A.7.6.3.1
R198	Casino Cross Sections (Appendix A2 – in LORAX (2013) Casino Geochemical Static Test Assessment, 3-Dec-13, J862-5).	Section A.7.6.3.2 Appendix A.7H Appendix A2 to Casino Waste Rock and Ore Geochemical Static

Request #	Request for Supplementary Information	Response
		Test Assessment Report: Cross-Sections
R199	Supplemental Unsaturated Kinetic Test Results (Appendix B – LORAX (2013) Casino Geochemical Source Term Development, 4 December, J862-5).	Section A.7.6.3.3 Appendix A.7L Casino Geochemical Source Term Development: Appendix B
R200	The following referenced report: Himmelright, J. R., 1994: The effect of natural acid rock drainage on Casino Creek. Prepared for Pacific Sentinel Gold Corp. August 1994.	Section A.7.6.3.4 Appendix A.7F The Effect of Acid Rock Drainage on Casino Creek
R201	Re-run the numerical groundwater model with updated groundwater baseline data.	Section A.7.7.1.1
R202	A copy of the updated Modflow numerical groundwater model and all input data used in the modeling runs including: a. a copy of all model outputs as summary tables and figures; and b. further discussion of assumptions used in the modeling.	Section A.7.7.1.2
R203	Discuss whether the open pit lake seepage predicted by the numerical model, to Casino Creek after closure, is assessed in the overall loadings to the TMF and the downstream environment. If not, provide rationale for its exclusion.	Section A.7.7.1.3 Appendix A.7B Water Quality Predictions Report
R204	If the majority of the predicted seepage, from the open pit lake, of 12 L/s will report to the upper groundwater system in Casino Creek:a. identify what the predicted magnitude of the remaining seepage will be; andb.identify where the remaining seepage is predicted to report to and what the effect of that seepage will be.	Section A.7.7.1.4
R205	Discuss whether the potential for preferential flow through faults below the TMF were considered and if not, discuss why and if so, discuss what were the results and implications for water quality downstream of the TMF.	Section A.7.7.1.5 Appendix A.4D Report on the Feasibility Design of the Tailings Management Facility Appendix A.4L Revised Tailings Management Facility Seepage Assessment
R206	Clarify whether hydraulic conductivity values of the tailings and embankment materials are estimates or laboratory measured values. If they are estimates, please indicate if, and when laboratory testing will be conducted.	Section A.7.7.1.6 Appendix A.4L Revised Tailings Management Facility Seepage Assessment
R207	Update the numerical groundwater model to specifically include the seepage recovery pond and calculate the seepage recovery pond's efficiency including the flux of untreated water that will bypass the pond.	Section A.7.7.1.7
R208	Justification for using a series of steady state models rather than one transient model to predict groundwater flows.	Section A.7.7.1.8
R209	A description of how the numerical groundwater model is to be used and updated during the mining process in order to improve mine management and predictions for closure. Indicate when any updates would be released during operations.	Section A.7.7.1.9
R210	Groundwater level data between the proposed TMF and the Dip Creek watershed. The area of greatest concern is along the	Section A.7.7.1.10 Appendix A.7M 2013-2014

Request #	Request for Supplementary Information	Response
	watershed divide just beyond the eastern end of the main embankment.	Groundwater Data Report Appendix A.7N Extension of Numerical Groundwater Modelling to include Dip Creek Watershed
R211	A NW-SE geological cross-section (same approximate orientation as the main embankment) from the TMF to Dip Creek since this could demonstrate potential groundwater flow pathways across the topographic divide.	Section A.7.7.1.11
R212	Numerical groundwater flow modeling that extends into the Dip Creek watershed and eliminates the assumption of a no-flow boundary. Modeling should consider the potential for subpermafrost groundwater flow across the topographic divide. Modeling the seepage from the TMF should consider three dimensional flow from the TMF in order to consider not only vertical flow through or beneath the dam but also horizontal flow around the dam and potentially into Dip Creek tributaries.	Section A.7.7.1.12
R213	Map of the elevation of the base of permafrost and data on deep permafrost conditions east of the proposed tailings management facility.	Section A.7.7.1.13 Appendix A.7N Extension of Numerical Groundwater Modelling to include Dip Creek Watershed
R214	Justification for not including the subsurface distribution of permafrost (in particular lower hydraulic conductivity of frozen ground as a barrier to groundwater flow) in the numerical groundwater flow modeling.	Section A.7.7.1.14
R215	A discussion of the effect of permafrost distribution on the observed and modelled patterns of groundwater flow.	Section A.7.7.1.15
R216	Discussion of hydraulic conductivities of frozen and unfrozen hydrostratigraphic units. Details should include:a. estimates of frozen and unfrozen hydraulic conductivities of all rock materials subject to permafrost; andb. how thermal changes (due to facility construction and climate change) will affect the groundwater regime.	Section A.7.7.1.16
R217	A discussion and consideration of a numerical permafrost model to assess the effects of the mine components on permafrost distribution in the mine footprint.	Section A.7.7.1.17
R218	A discussion on the discrepancies between the Inferred Spatial Distribution of Permafrost (Figure 2.3 of Appendix 7C) and the Groundwater Recharge Zones (Figure 3.4 of Appendix 7E).	Section A.7.7.1.18
R219	A discussion of how recharge distributions were modified and their potential effects on the numerical groundwater flow model.	Section A.7.7.1.19
R220	A new figure combining both the recharge and permafrost distributions so that it is possible to identify where the distributions overlap and differ.	Section A.7.7.1.20
R221	Complete groundwater modeling on the period of time that the TMF is dewatered to allow construction of the TMF wetlands.	Section A.7.7.1.21
R222	Modeling for seepage flow rates from the water management pond if the water level exceeds desired levels.	Section A.7.7.1.22

Request #	Request for Supplementary Information	Response
R223	Verification methods for seepage flow not captured by the water management pond.	Section A.7.7.1.23
R224	An assessment of potential water quantity under a broader range of hydrologic conditions, including: a. the ability to manage waters during wet, dry and average years; b. the receiving water effects during typical and extreme summer and winter low flows (7Q20 and 7Q10); and c. the water storage and receiving water effects during freshet and event flow.	Section A.7.8.1.1 Appendix A.7A Variability Water Balance Model Report
R225	An assessment of the potential effects of climate change on water balance.	Section A.7.8.1.2 Appendix A.7A Variability Water Balance Model Report Appendix A.7C Potential Effects of Climate Change on the Variability Water Balance
R226	An assessment of potential water quantity under a broader range of operating/closure scenarios, including permit limits, atypical operations, and accident scenarios.	Section A.7.8.1.3 Appendix A.7A Variability Water Balance Model Report
R227	Provide sensitivity analysis for the site water balance model identifying: a.the potential impact of variation in assumed values for key water balance model parameters; and b. the potential impact of temporal change in the assumed distribution of precipitation and snowmelt.	Section A.7.8.1.4 Appendix A.7A Variability Water Balance Model Report Appendix A.7B Water Quality Predictions Report
R228	Identify if the results of the sensitivity analysis materially affect the Water Management Plan for the project proposal, and if yes, update the Water Management Plan.	Section A.7.8.1.5 Appendix A.7A Variability Water Balance Model Report
R229	A description of how the water balance model is to be used and updated during the mining process in order to improve mine management and predictions for closure. Indicate when any updates would be released during operations.	Section A.7.8.1.6 Appendix A.7A Variability Water Balance Model Report Appendix A.7C Potential Effects of Climate Change on the Variability Water Balance
R230	Provide the reasoning for selecting Big Creek as the most representative long-term hydrometric station for generating site synthetic stream flow data.	Section A.7.8.1.7
R231	Re-run the water quality model with updated water quality baseline data.	Section A.7.9.1.1
R232	A copy of the GoldSim model and all input data used in the	Section A.7.9.1.2

Request #	Request for Supplementary Information	Response
	assessment.	Appendix A.7B Water Quality Predictions Report
R233	A copy of all model outputs as summary tables and figures.	Section A.7.9.1.3 Appendix A.7B Water Quality Predictions Report
R234	A discussion of assumptions used in the modeling.	Section A.7.9.1.4 Appendix A.7B Water Quality Predictions Report
R235	Any additional information that the Proponent may have used in their assessment so as to facilitate an independent calculation of potential water quality effects by reviewers.	Section A.7.9.1.5 Appendix A.7A Variability Water Balance Model Report
R236	A description of how the water quality model is to be used and updated during the mining process in order to improve mine management and predictions for closure. Indicate when any updates would be released during operations.	Section A.7.9.1.6
R237	An explanation of how loadings from embankment runoff and embankment seepage relate to the conceptual flow diagram in Figure 7-2 in LORAX (2013) Casino Geochemical Source Term Development, 4 December, J862-5. In addition, please confirm that those loadings were included in the water quality model.	Section A.7.9.2.1 Appendix A.7B Water Quality Predictions Report
R238	Additional details and rationale supporting the use of site specific water quality objectives (SSWQO) for certain contaminants of concern. Details should include: a. justification for not using CCME guidelines to develop SSWQO; b. demonstration that aquatic biota remain protected to the same degree as provided by the CCME guidelines; c. how SSWQO account for chronic/long-term acceptable limits; and d. consideration for the new, hardness-dependent, long-term limit for cadmium now available from CCME.	Section A.7.10.1.1 Appendix A.7A Variability Water Balance Model Report Appendix A.7B Water Quality Predictions Report Appendix A.7E 2008 Environmental Studies Report: Final
R239	Predictions for pH in table 7.4-3 (Water Quality Model Parameters and CCME and BC MOE Guidelines) and Tables 7.4-8 through 7.4-10 (Summary of Predicted Water Quality in Casino Creek at M18 and W4 and Dip Creek at W5).	Section A.7.10.1.2 Appendix A.7B Water Quality Predictions Report
R240	Predictions for toxicity, pH, and radium 226 in the tailings management facility pond and the winter seepage mitigation pond. Provide a discussion on how these parameters address the limits under the Metal Mining Effluent Regulations.	Section A.7.10.2.1 Appendix A.7B Water Quality Predictions Report
R241	An assessment of potential water quality effects extending downstream to include water monitoring station W16 and, if necessary, as far downstream to demonstrate no further exceedances of the CCME surface water quality objectives attributed to the mine (or 90th percentile of background for those constituents that naturally exceed CCME). The assessment should consider scenarios both with and without use of the passive treatment system.	Section A.7.11.1.1

Request #	Request for Supplementary Information	Response
R242	Additional rationale supporting the use of station M18/W18 as the receiving environment for the Project. Consideration should be given to: a. how this site fits within the intent of CCME; and b. to what degree does contribution of water from Brynelson Creek provide a buffer for the project meeting CCME or site specific water quality objectives for the protection of aquatic resources.	Section A.7.11.1.2
R243	Expected length of time PAG materials will be exposed to oxygen and water before submersion in the TMF and any expected resulting acid generation.	Section A.7.12.1.1 Appendix A.7I Casino Kinetic Testwork 2014 Update for Ore, Waste Rock and Tailings
R244	An analysis of scenarios that may cause exposure of PAG materials considering variation of meteorological factors, vegetative interception, and seepage losses. Details should include:a. an analysis of successive dry years on TMF water balance and its implications on PAG tailings and waste rock oxidizing due to low water levels;b. the minimum annual precipitation required to maintain PAG materials below the water table in the TMF;c. scenarios during closure that would cause the water table in the TMF to be low enough to allow oxidation of the PAG materials; andd. the potential effects associated with metals mobilization under these scenarios.	Section A.7.12.1.2 Appendix A.4D Report on the Feasibility Design of the Tailings Management Facility
R245	A plan describing mitigations in case unsuitable (e.g. elevated metal concentrations) water is encountered via pit dewatering (i.e. prior to sufficient storage developed on-site).	Section A.7.13.1.1
R246	Details on the characterization of groundwater and flow patterns near the adit.	Section A.7.14.1.1
R247	A comprehensive description of the adit including: a. physical characteristics (e.g. incline or decline, dimensions, length); and b. extent of fracturing.	Section A.7.14.1.2
R248	How and when the adit will be reclaimed. Describe implications of reclamation on surrounding groundwater and infrastructure such as the HLF.	Section A.7.14.1.3

Notes:

1. Request # refers to the assigned identification number in the YESAB Adequacy Review Report January 27, 2015 Prepared by Executive Committee Yukon Environmental and Socio-economic Assessment Board.
2. Response refers to the location of CMC's response to the YESAB request for supplementary information.

A.7.2 AVERAGE HYDROLOGIC CONDITIONS AND NORMAL OPERATING/CLOSURE SCENARIOS

A.7.2.1.1 R158

R158. An assessment of potential water quality under a broader range of hydrologic conditions, including:

a. the ability to manage waters during wet, dry and average years;

b. the receiving water effects during typical and extreme summer and winter low flows (7Q20 and 7Q10); and

c. the water storage and receiving water effects during freshet and event flow.

A deterministic water balance model was initially developed by Knight Piésold Limited (KP) in 2013 and was described in Appendix 7F. The 2013 water balance was representative of average annual hydrologic conditions at the site. Water quality modelling for the average annual water balance was carried out by Source Environmental Associates (SEA) (Appendix 7G).

In 2014, a climate variability water balance model was developed by KP (Appendix A.7A) to account for the expected variability in hydrological conditions (i.e. wet and dry periods) from year to year. The climate variability water balance was used as the basis for an updated water quality model described in Appendix A.7B. Appendix A.7B contains all information relevant to the water quality model, and repeats the pertinent information previously provided in the December 2013 report.

Input to the climate variability water balance model was developed by correlating existing site hydrology data with regional data to derive a long-term synthetic dataset of monthly site conditions. A dataset of monthly hydrological conditions (e.g. streamflow, temperature, precipitation) was developed from 52 years of continuous regional data. A correlation was established between the regional data and data collected at the Project site. The correlation was used to convert the regional dataset to a 52-year synthetic dataset of weather conditions at the Project site. Because the model was run over a simulation period of ~200 years, the 52-year input dataset repeats approximately four times during a given simulation.

Geochemical source terms for the water quality model were developed by Lorax Environmental Services Ltd. (Appendix 7D) and were incorporated into the GoldSim model as the basis for mass loading calculations. The source terms for the climate variability water quality model are consistent with the source terms used in the model presented in the 2013 water quality modelling report.

The climate variability model covers wet, dry and average years, as well as typical and extreme summer and winter low flows. No changes to water management infrastructure is required following the assessment of the variability water balance model, although some changes to the storage and discharge from the water management pond during operations and closure have been incorporated into the Project (see the response to R238 and Appendices A.7A and A.7B).

A.7.2.1.2 R159

R159. An assessment of the potential effects of climate change on source loadings and receiving water effects.

In order to address this request projected climate change conditions were used as input to the variability water balance (Appendix A.7A) and the results are summarized in Appendix A.7C, *Casino Project – Potential Effects of Climate Change on the Variability Water Balance*. For the purposes of the letter, the variable water balance model

(Appendix A.7A) was used as the “base case” water balance to provide a means of comparison for the projected climate change effects on estimates of flow quantity for the project.

Based on the climate change model results, it was determined that the projected climate change effects on flow quantity were within the range of conditions already predicted by the base case water balance for which mitigation measures have developed for (Appendix A.7A). Therefore, climate change is not expected to adversely affect the water quality impact on the project. The results of the water quality modelling for the base case model are discussed separately in Appendix A.7B.

A.7.2.1.3 R160

R160. An assessment of potential water quality under a broader range of operating/closure scenarios, including permit limits, atypical operations, accident scenarios, with and without passive treatment.

The proposed water management and closure activities provided in the project description were accounted for in the water quality model development. Water quality model results for the proposed system were used to show the effectiveness of the proposed plan. Scenarios outside the scope of the project description were not included in the water quality model results because they were not proposed as part of the project. Variability in hydrometerological conditions was accounted for in the updated 2014 modelling. The revised modelling approach is described in Appendix A.7B.

A.7.3 WATER AND SEDIMENT QUALITY BASELINE

The Casino Project aquatic study area is defined by the boundaries of the two watersheds surrounding the ore body: the Britannia Creek watershed to the north and the Dip Creek watershed to the south. Current baseline sampling stations were based on sampling stations from the 1993-1995 baseline studies. A total of 26 stations between 2008 and 2012 were chosen for water quality sampling (Figure 1 in Appendix 7A). Stations were concentrated in the Casino Creek (a tributary to Dip Creek) and Britannia Creek watersheds as they have the potential to be directly affected by the Project. The results of baseline water and sediment quality sampling are summarized in Appendix 7A: *Water and Sediment Quality Baseline Report*. However, Appendix B5 of that baseline report is replaced by Appendix A.7D, herein, as some parameter results were not properly included in the original Appendix B5, as noted in highlighting in Appendix A.7D.

Supporting baseline reports for the 2008-2012 monitoring periods were provided in Appendices A1-A5 of the Baseline report. However, the 2008 baseline report was missing some figures and was not noted as finalized. The finalized 2008 baseline report is provided in Appendix A.7E.

A.7.3.1.1 R161

R161. Additional baseline water quality data for key water sampling locations on a minimum monthly basis for a minimum period of one year to estimate seasonal variability. The Executive Committee expects that results from ongoing water quality data collection will be provided throughout the assessment process.

Monthly sampling was attempted in 2009-2010 for 15 consecutive months. Attempts at winter (under ice sampling) were often met with extreme temperatures, limited daylight and unreliable safe access for field staff. Monthly visits to the Casino study area between August 2009 and October of 2010 were made in an effort to obtain consecutive monthly data for a minimum of 1 year. Of the 23 stations that were active during that time period, samples were obtained 15 out of 15 months only at stations W9 and W3. For the 2008-2012 period, a minimum of 1 sample per each calendar month was obtained for stations R2, W20, W21 and W15. Stations W2 and W6b are missing only 1 month each, January and December, respectively. The 2008-2012 dataset (Appendix A.7D) represents more than a full calendar year of baseline water quality monitoring. Those sites with no data during January to April of 2010 had no flow and therefore no detectable concentrations of water quality parameters. Based on the baseline data obtained to date, it appears that there is very little change in water quality during the winter months.

Baseline data reporting (Appendix 7A) and subsequent effects assessment (Proposal Section 7) was based on data collected between 2008 and 2012, and sampling has continued at select stations in 2013 and 2014, and will continue as CMC transitions into construction monitoring. Once project financing is in place, a round of high intensity sampling will be carried out to address:

1. Data gaps for 3 years of monthly sampling at key stations;
2. Two 5-in-30 day sampling events at key stations (i.e. Canadian Creek (W7), Britannia Creek (W3), Casino Creek (W4), Dip Creek (W5) and reference sites on Dip Creek (W9) and Britannia Creek (W14); and
3. Surface water toxicity in Brynelson Creek (W18) and Casino Creek (W28) using invertebrate species and early-life stages of salmonid fish species, consistent with pre-mining environmental effects monitoring (EEM) as prescribed in MMER.

Similarly, sediment sampling conducted in 2008 to 2012 was completed to compare historical sampling conducted by KP in 1993 to 1995 with more current analyses. The results of sediment sampling analyses support the overall trends in water quality conditions throughout the project area. It is recognized that additional data on sediment characteristics in certain areas would be necessary for long-term monitoring throughout the life of the mine and into closure. In summer 2014 toxicity sampling of sediment from Brynelson Creek (W18) for 10-d midge and 28-d amphipods was initiated, the results of which are presented in the response to R166. Pre-construction monitoring will also be conducted, similarly to water quality sampling, and will include:

1. One round of sediment sampling for pH, metals, SEM-AVS, TOC at key stations (i.e. Canadian Creek (W7), Britannia Creek (W3), Casino Creek (W4), Dip Creek (W5) and reference sites on Dip Creek (W9) and Britannia Creek (W14);
2. Sediment toxicity using 10-d midge and 28-d amphipods from W4 (Casino Creek), W9 (Dip Creek, upstream of Casino Creek) and W5 (Dip Creek, downstream of Casino Creek); and
3. Sediment bioaccumulation tests using 28-d oligochaetes from W18, W4, W9 and W5.

Baseline data collected during the assessment process (i.e., 2013, 2014, 2015, etc.) will be provided in the Water Use Licence Application under the *Waters Act*, and hydrologic and water quality models will be updated with the updated baseline data.

A.7.3.1.2 R162

R162. An analysis regarding dataset robustness, which should at a minimum include additional analysis of central tendency (i.e. standard deviation) and could include better description of data distribution, data variance and other summary statistics where data is not normally distributed to aid in understanding the robustness of the present water quality dataset.

The Appendix B5 of the *Casino Project Water and Sediment Quality Baseline Report* (Appendix 7A) provides data summaries for all stations and all parameters for all samples taken 2008 – 2012. Statistics provided in the data tables include the number of samples (n), the minimum, maximum, mean, median, standard deviation, standard error, and covariance values, as well as the number of non-detectable values, number of exceedances of the CCME guidelines, and the percent of parameters that exceed CCME guidelines. Appendix B5 has been updated (Appendix A.7D), as some values provided in the Project Proposal were provided with insufficient decimal places, and updates from the Project Proposal are indicated by highlighted cells in the tables.

Summary statistics for sediment samples are provided in Appendix C2 of Appendix 7A and include the number of samples (n), the minimum, maximum, mean, median, and standard deviation.

A.7.3.1.3 R163

R163. Additional details on water sampling protocols and field sampling methodologies. Details should include:

a. filtration protocol/methodology (e.g. field filtered, filtered in lab);
b. sample handling and preservatives protocol; and
c. analytical hold times, chain of custody, etc.

Water and sediment sampling was, and continues to be conducted in accordance with CCME's *Protocols Manual for Water Quality Sampling in Canada* (CCME 2011), and includes the following quality assurance and quality control measures (in addition to those described in Appendix 7A):

- Samples for dissolved metals were filtered in the field through a 0.45 micron disposable filterware and laboratory supplied syringe; syringes were rinsed with site water prior to attachment to the filter and were disposed after each site;
- Preservatives were supplied by the laboratory and only fresh ones were used for each field visit;
- Preservatives were immediately added to the sample bottles with gloved hands once the water sample was collected;
- All water bottles were placed in sample coolers immediately after sample collection;
- Ice packs were placed in coolers at the end of each day of sample collection; effort was made to collect water samples at the end of the field day;
- All samples were collected using only laboratory issued bottles and were rinsed 3 times with site water (including the lid) before the final sample collection;
- Coolers accompanied staff from the Casino site to the Air North Cargo office in Whitehorse for shipment to the third party laboratory in BC; coolers were kept cold at the Air North Cargo office while waiting for delivery;
- All samples were attempted to be delivered to the analytical laboratory within analytical hold times; in situations where hold times could not be met, all results included a footnote indicating recommended analytical hold times were passed; these data were reviewed to ensure data integrity; and
- Signed chain-of-custody forms accompanied all coolers.

Field sampling, laboratory and quality assurance/quality control methods are summarized in Section 3.2 and 3.3 of the Casino Project Water and Sediment Quality Baseline Report (Appendix 7A), and is provided below.

Water Quality Field Sampling Methods

All surface water samples are grab samples, collected mid-stream approximately 20 cm under the surface with the bottle mouth facing upstream. In the winter months, a steel pole ice chipper or a gas powered auger was used to break through the ice layer to access the water. As water levels in the winter were substantially lower than in the summer, samples were collected at any depth below the surface of water whenever possible. Water quality samples for general chemical parameters were collected in two pre-cleaned 1 L plastic bottles supplied by the accredited third party laboratory (e.g., Maxxam Analytics or ALS Environmental). Samples for total metals are collected in 120 mL acid-washed plastic bottles supplied by the laboratory and preserved in the field with laboratory-supplied nitric acid. Samples for dissolved metals are filtered in the field through 0.45- micron disposable filterware and preserved with laboratory-supplied nitric acid immediately after filtration.

Samples for nutrients – ammonia, total Kjeldhal nitrogen (TKN), Total Organic Carbon (TOC), and dissolved orthophosphate – are collected in 120 mL bottles and preserved in the field with laboratory supplied sulphuric acid. Total cyanide is collected in 120 mL bottles and preserved in the field with laboratory-supplied sodium hydroxide. Samples for Radium-226 are collected in pre-cleaned 1 L plastic bottles.

Field measurements of pH, temperature, dissolved oxygen and specific electrical conductivity are made at each station using an HI 9828 Hanna meter or a YSI Pro pH/conductivity/temperature meter.

Water Quality Laboratory Methods

Maxxam Analytics and ALS Environmental are accredited laboratories by the Canadian Association for Environmental Analytical Laboratories. Internal quality assurance/quality control programs are designed to comply with or exceed the data quality objectives of Industry, Canadian Regulators, United States Environmental Protection Agency (U.S. EPA) and the International Standards Organization (ISO). Every sample submission is subject to a full Quality Assurance analysis, which included matrix spikes, spiked blanks, method blanks and duplicates.

These analyses provide a measure of laboratories' analytical precision. The results of the quality analysis for the baseline water quality samples all met the standards for QA/QC (QC limits of 80% - 120% for blanks/spikes and 20% for duplicate RPDs).

Quality Assurance/Quality Control

All field equipment was maintained in good working condition and measuring instruments were calibrated both in the field and in the office prior to travelling to the site. The HI 9828 Hanna Meter or YSI 556 was calibrated for pH prior to each field trip using prepared solutions with pH of 4, 7 and 10, and conductivity was checked prior to each field trip using the standard 1,413 µS/cm conductivity solution. In the field, the water quality meter was re-calibrated using the quick calibration option, which calibrates dissolved oxygen, pH and conductivity using a single point procedure. In addition, dissolved oxygen was re-calibrated at each station as required, when changes in temperature or atmospheric pressure were noted.

Water quality samples were collected by qualified aquatic biologists and were carried out by the same individual at each sampling station to ensure consistency. All water samples were collected using the industry standard sampling protocol: *CCME's Protocols Manual for Water Quality Sampling in Canada* (CCME 2011). Appropriate measures were taken by staff to reduce potential for sample contamination.

Field staff wore disposable nitrile gloves when sampling and used bottles and preservative supplied by the analytical laboratory. All samples were collected with the mouth of the sampling bottle facing upstream. Care was taken to ensure that no upstream disturbances occurred as the result of walking on the creek bed prior to sampling.

Sediment Quality Field Methods

Sediment samples are collected using laboratory supplied acid-washed glass samples jars as a scoop. Care is taken by the sampler to not disturb or stir up the area before obtaining the samples. Samples are collected from depositional areas of the stream, near the stream bank, at approximately 30-50 cm depth. Samples are collected from the top 4-6 cm layer to fill 120 mL jars. Only the finest materials are collected and material is only collected from areas with an intact and relatively flat surface layer.

Sediment Quality Laboratory Methods

All sediment samples are analyzed for percent moisture, pH and total metal concentrations at a third part accredited laboratory. Metal concentrations are expressed as mg/kg dry weight (DW). Samples are dried at 55 ± 5°C, then sieved through a #10 mesh (2 mm) screen and digested using a nitric and hydrochloric acid mixture at 95°C for two hours. ICP-MS is used to analyze samples for metals content. The pH of the samples is measured using a combination pH electrode with an Ag/AgCl reference electrode.

Sediment Quality Assurance and Quality Control

Sediment quality samples are collected by a qualified aquatic biologist. Appropriate measures are taken to reduce potential for sample contamination. Field staff wear disposable nitrile gloves when sampling and use pre-cleaned sample bottles supplied by the laboratory. Care is taken to ensure the inner portion of the sample container and caps do not touch anything other than the sample itself. Sample containers are kept in the laboratory supplied cooler before and after collection of the sample. All samples are kept cold at all times between sample collection and delivery to the laboratory. Chain of Custody forms accompanied all samples.

A.7.3.1.4 R164

R164. Clarify whether water quality parameters being monitored and conclusions are being drawn from total metals content, dissolved metals content, or both. Discuss whether elevated metals were a result of additional metals associated with higher suspended sediments.

The discussion around baseline water quality refers to the ***total*** metal fraction, unless otherwise specified.

Water samples were collected and analyzed for the full suite of physical parameters, anions, nutrients, cyanide and total and dissolved metals. Minimum, mean, median and maximum concentrations were calculated for each parameter at all stations (updated site statistics are provided in Appendix A.7D). Exceedances of the CCME guidelines for the protection of freshwater aquatic life were observed for a total of ten parameters (copper, cadmium, aluminum, iron, uranium, fluoride, zinc, lead, pH and silver) throughout the project area. The number of exceedances was highest for aluminum, cadmium, copper and iron. With the exception of uranium, exceedances were most numerous in the summer season (May to October), indicating a seasonal trend likely related to hydrological factors.

Hydrologic factors refer to surface runoff and stream flow, which typically correspond to increased TSS as the flows can pick up or stir up soil and sediment. Higher flows and therefore higher TSS in the spring and summer months leads to higher concentrations of metals that are bound to the suspended solids. These metals are reported in the total metals analysis. Low TSS in the winter months corresponds to lower concentrations of metals, mostly in the dissolved phase.

As discussed in the water and sediment quality baseline report (Appendix 7A), particle-associated metals tend to be found at higher concentrations when TSS levels are also elevated (Horowitz 1991). Comparison of total metals with dissolved metals, paired with TSS, was provided in Figure 9 of Appendix 7A, and is shown below in Figure A.7.3-1 for iron to determine whether exceedances in metals concentrations were due to turbid waters (i.e. caused by particulate bound metals) and whether or not this was also reflected by the dissolved metals data. The red dashed line in Figure A.7.3-1 is the CCME guidelines, the blue line is TSS, the black diamond line is total iron and the open circle line is dissolved iron.

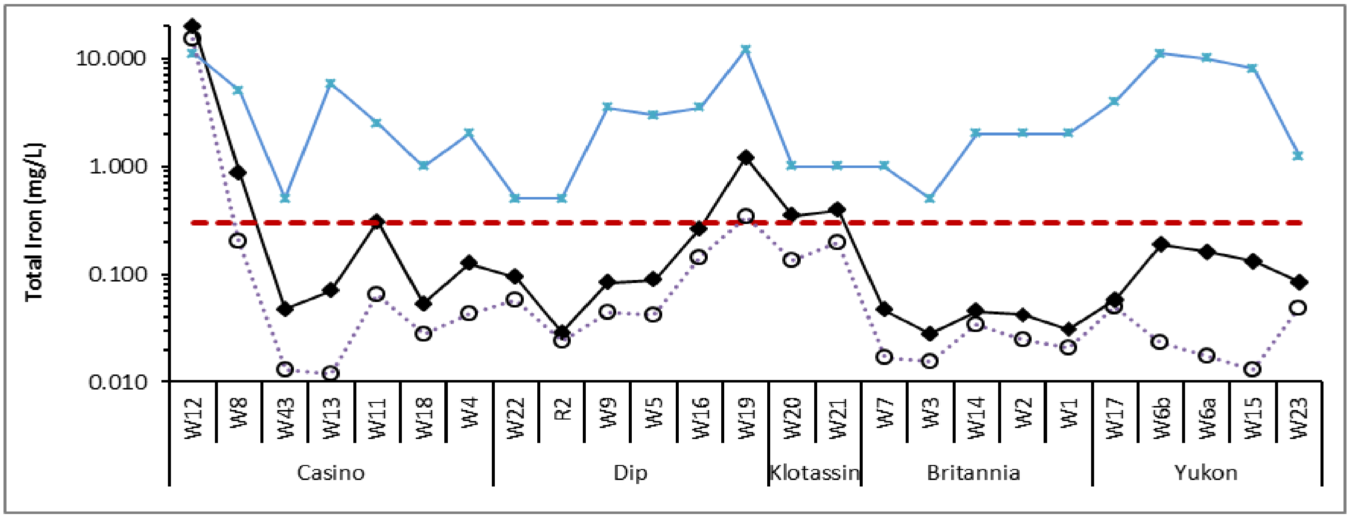


Figure A.7.3-1 Median Concentrations of Total and Dissolved Iron and TSS, 2008-2012

On a whole, the total and dissolved metal concentrations followed the same spatial trends as TSS. Stations with higher TSS had correspondingly higher metal concentrations. Also, the fraction of the total metals concentration that was made up by dissolved metals was consistent throughout the stations for each metal. For cadmium, silver, uranium, copper, zinc, and chromium, the dissolved metals fraction was very close if not equal to the total metals concentration, indicating that most of the metals in the water bodies were in the dissolved phase. Conversely, the dissolved metals fraction for aluminum, iron and lead were noticeably lower than the total metals fraction. This is generally due to the complexing nature of these metals with suspended sediment which results in lower concentrations in the dissolved fraction. Factors such as low pH and low alkalinity can contribute to the mobilization of these metals into the dissolved phase (Butcher 1988; Phippen et al. 2008; Nagpal 1987), which can explain the high dissolved fractions at W12 (Proctor Gulch; median pH 3.43).

For cadmium, uranium, copper, aluminum, iron and chromium, the metals were mainly in the dissolved fraction for the tributaries to the Yukon River (W1-Britannia, W17-Sunshine and W23-Excelsior) but then switched to the particulate fraction in the Yukon River (W6b, W6a, W15). This is likely due to the Yukon River being a larger system with faster currents, which tends to stir up more particulate matter.

Another exception to the overall trends is seen for cadmium, silver, lead, zinc and somewhat in copper, at the historical adit (W43). The metals at this station were amongst the highest of all the stations, yet the TSS concentration was amongst the lowest. This indicates that TSS is not responsible for the high concentrations at this station and that it is likely attributable to the ARD from the historical lead/zinc/silver exploration activities.

Nutrient levels at all stations were below CCME guidelines, with approximately 20-70% of all ammonia, nitrite, nitrate, nitrate+nitrite-N, total phosphate and orthophosphate concentrations below analytical detection limits. Levels of many metals and anions were consistently low, with concentrations equal to or lower than analytical detection limits observed for 50% to 90% of the samples, including those for beryllium, boron, bismuth, bromide, chloride, mercury, tin, silver, titanium, thallium, vanadium and zirconium in all study areas.

The 2008-2012 water quality program confirmed the unique water chemistry of Proctor Gulch documented in Himmelright (Appendix A.7F). Exceedances of CCME guidelines for pH, copper, aluminum and iron were found in

100% of the 16 samples from Proctor Gulch. Fluoride, cadmium, lead and zinc were also elevated in samples from Proctor Gulch. Additionally, water quality at this station exhibited highest values for acidity (and lowest pH), hardness, conductivity, total dissolved solids and turbidity, as well as lowest values for alkalinity.

Spatially, it was observed that copper, aluminum and iron concentrations were highest at Proctor Gulch (W12) and decreased at each successive downstream station (W8, W11 and W4). This indicates that inflows from Casino Creek tributaries including Meloy Creek, Brynelson Creek and Austin Creek, effectively dilute the water from Proctor Gulch. Proctor Gulch consistently shows higher concentrations in the winter than in the summer for all the metals as groundwater is the major source of flow in the winter months.

The historical adit (W43) was found to have the highest concentrations of cadmium, lead, silver and zinc of all the stations sampled. However, due to the relatively small flow from the adit, only one cadmium sample (0.00004 mg/L in April 2011) resulted in the exceedance of CCME guidelines in the lower reach of Casino Creek at W4.

Some effects from Proctor Gulch and the historical adit are observed in Dip Creek at station W5, just downstream of Casino Creek, particularly for copper, cadmium, lead and zinc; however, the effects are greatly reduced in comparison with Casino Creek as background concentrations for these metals are much lower in the upstream Dip Creek watershed. Although less pronounced an overall similar spatial pattern of upstream to downstream decreasing concentrations of cadmium, zinc, copper, aluminum, iron and lead was also observed in Canadian Creek and Britannia Creek. The uppermost station on Canadian Creek (W7) is situated in close proximity to the ore body and therefore likely receives groundwater discharge with similar water quality to Proctor Gulch.

On the whole, hardness, conductivity and nitrogen based nutrients were higher in the winter months. Conversely, TSS, phosphorus based nutrients, organic matter and metal concentrations were higher in the summer months for the majority stations, indicating a seasonal trend most likely related to the different primary sources of streamflow (surface runoff during the summer and groundwater discharge during the winter) between these two seasons.

Detailed information on water and sediment quality baseline was provided in Appendix 7A, and is supplemented with information to respond to adequacy review comments below.

A.7.3.1.5 R165

R165. Further discussion and clarification on baseline data from the existing adit. Details should include:

a. rationale as to the limited amount of data from the adit; and

b. an analysis for loadings (mass-balance) at additional points along the pathway from the adit to site W4.

The historical adit is located in upper Meloy Creek watershed. The adit was established as part of historical (between 1965 and 1980) access to a lead/zinc/silver deposit in the upper Meloy Creek watershed. When construction crews arrived at the historical Casino site in 2007, the adit had collapsed and all that was left was the pipe coming out of it and a few exposed broken timbers. The crew removed the old camp and shop buildings and re-contoured and vegetated the site, including the area where the adit was. Currently, a pipe from the adit to upper Casino Creek is all that remains of the adit infrastructure (Figure A.7.3-2).

Water discharges via a pipe to surface only during the spring and summer months and is frozen from November to April. At the point of discharge it travels down the watershed for roughly two kilometres before joining Meloy Creek proper. The adit is a remnant of historical mining activities and as such, is considered an anthropogenic source of water. For development of SSWQOs, a preliminary analysis was conducted to assess whether or not the adit had any effects on the water quality of lower Casino Creek at Site W4.

Figure A.7.3-2 Historical Adit Discharge Pipe (May 28, 2014)

Accounting for Loadings from the Adit

To quantify the loads from the adit water to Casino Creek, flows were measured using a 10-L bucket and a timer at W43 on 17 occasions between May 2011 and October 2011 (Table A.7.3-1, median flow 0.55 L/s). Water from the adit generally flows from May to October, whereas during November to April the water is frozen. To compute a reliable loading estimate, flow data from August 23, 2011 and October 4, 2011 were used as these were the only two dates in which both flow and water quality were measured at both W43 and W4. The W43 flows on these two dates (0.88 L/s and 0.43 L/s, respectively) are representative of the upper and lower range of flows from the adit measured in 2011 (Table A.7.3-1). Flows at station W4 are shown on Figure A.7.3-3 and measured discharges on August 17 and October 4, 2011 are used in the calculations for loadings below. The water quality data on these dates is also suitably representative of the baseline dataset (Table A.7.3-2 and Table A.7.3-3).

An analysis for loadings was conducted to determine whether the seasonal flow from the adit had any effect on the downstream water quality. Loadings were only presented at W4 as it represents the only water quality site that accounts for the contributions of all the tributaries to Casino Creek. All other water quality sites on Casino Creek are within the proposed TMF footprint. With the exceptions of cadmium and zinc, and to a lesser degree, dissolved lead, the adjusted concentrations were only marginally lower than the original concentrations. On average, the adjusted concentrations for all the other parameters were close to 100% of the unadjusted concentrations. This indicates that virtually no loading of these parameters is contributed by the adit, and the adit discharge has negligible impact to Casino Creek for the majority of parameters. However, as described in the Proposal, the loading assessment does indicate that the adit discharge is a significant contributor of cadmium and zinc, as estimated cadmium and zinc loadings at W4 are almost 100% of the loadings from W43.

Flow/discharge values were multiplied by the concentrations to obtain a load in milligrams per second, as follows, for cadmium:

$$Load_{W43} = Q_{W43} \times [Cd]_{W43} \left(\frac{mg}{s}\right)$$

On August 23, 2011, cadmium loadings were as follows:

$$Load_{W43} = 0.88L/s \times 0.0456\text{mg/L} = 0.0401\text{mg/s}$$

$$Load_{W4} = 1936L/s \times 0.000053mg/L = 0.203\text{mg/s}$$

Where the loading at W43 is 39% of the loading at W4, whereas in October, the cadmium loadings were as follows:

$$Load_{W43} = 0.43L/s \times 0.0402\text{mg/L} = 0.0173\text{mg/s}$$

$$Load_{W4} = 294L/s \times 0.000034mg/L = 0.0100\text{mg/s}$$

Resulting in a load from W43 which is 173% that of the load at W4. Whereas, for copper, the loads on August 23 and October result in loads from W43 which are 0.3% and 1.1% of those at W4 as follows:

August 2011

$$Load_{W43} = 0.88L/s \times 0.0697\text{mg/L} = 0.061\text{mg/s}$$

$$Load_{W4} = 1936L/s \times 0.0106mg/L = 20.52\text{mg/s}$$

October 2011

$$Load_{W43} = 0.43L/s \times 0.0524\text{mg/L} = 0.022\text{mg/s}$$

$$Load_{W4} = 294L/s \times 0.00673mg/L = 1.98\text{mg/s}$$

Table A.7.3-1 Flow from Historical Adit 2011 - 2012

Date	Flow Rate (L/s)	Date	Flow Rate (L/s)
22-May-11	0.435	28-Aug-11	0.88
29-May-11	0.517	4-Sep-11	0.81
5-Jun-11	0.526	11-Sep-11	0.67
12-Jun-11	0.500	18-Sep-11	0.63
19-Jun-11	0.517	4-Oct-11	0.43
26-Jun-11	0.545	2-Jun-12	0.44
3-Jul-11	0.698	10-Jun-12	0.42
10-Jul-11	0.698	**Minimum**	**0.42**
31-Jul-11	0.75	**Maximum**	**1.15**
7-Aug-11	1.15	**Median**	**0.55**

Table A.7.3-2 Station W43 Water Quality Results August 23 and October 4, 2011 compared to 2008-2012 site statistics for select parameters

Parameter	Units	Site Statistics 2008-2012*			August 23, 2011	October 4, 2011
		Min	Max	Median		
Hardness	mg/L $CaCO_3$	80	141	100	90	100
Acidity	mg/L	4.6	22.1	10.74	15.2	4.6
Alkalinity	mg/L $CaCO_3$	59	93	70	59	69
Sulphate (SO_4)	mg/L	34	54	38.5	38	36
Cyanide (Total CN)	mg/L	0.00025	0.00025	0.00025	<0.0005	<0.0005
Cyanide (WAD)	mg/L	0.00025	0.00025	0.00025	<0.0005	<0.0005
Chloride (Cl)	mg/L	0.25	5	0.25	<0.5	<0.5
Fluoride (F)	mg/L	0.08	0.092	0.09	0.08	0.08
Total Aluminum (Al)	mg/L	0.0023	0.0269	0.0139	0.0254	0.0068
Total Antimony (Sb)	mg/L	0.00201	0.00366	0.00294	0.00201	0.00237
Total Arsenic (As)	mg/L	0.00043	0.00152	0.00068	0.00068	0.00057
Total Barium (Ba)	mg/L	0.04	0.07	0.0475	0.0648	0.0497
Total Cadmium (Cd)	mg/L	0.0396	0.068	0.0013	0.0456	0.0402
Total Calcium (Ca)	mg/L	21.4	38.9	27.4	24.7	27.4
Total Chromium (Cr)	mg/L	0.00005	0.00005	0.00005	<0.0001	<0.0001
Total Cobalt (Co)	mg/L	0.000162	0.000524	0.000221	0.000524	0.000221
Total Copper (Cu)	mg/L	0.0463	0.0909	0.0686	0.0697	0.0524
Total Iron (Fe)	mg/L	0.021	0.112	0.047	0.072	0.035
Total Lead (Pb)	mg/L	0.00429	0.0183	0.00991	0.0183	0.00854
Total Magnesium (Mg)	mg/L	6.38	10.7	7.57	6.91	7.57
Total Manganese (Mn)	mg/L	0.247	1.07	0.351	1.07	0.358
Total Mercury (Hg)	mg/L	0.000005	0.000005	0.000005	<0.00001	n/a
Total Molybdenum (Mo)	mg/L	0.00003	0.00003	0.00003	<0.00005	<0.00005
Total Nickel (Ni)	mg/L	0.00039	0.00062	0.00049	0.00062	<0.00054
Total Potassium (K)	mg/L	1.1	1.62	1.35	1.35	1.38
Total Selenium (Se)	mg/L	0.00002	0.00002	0.00002	<0.00004	<0.00004
Total Silver (Ag)	mg/L	0.000045	0.000215	0.000105	0.000215	0.000127
Total Sodium (Na)	mg/L	2.74	3.75	3.28	2.92	3.12
Total Thallium (Tl)	mg/L	0.000022	0.0000293	0.000025	0.000029	0.000024
Total Uranium (U)	mg/L	0.00077	0.00238	0.00126	0.000765	0.00110
Total Zinc (Zn)	mg/L	2.22	3.62	2.55	2.55	2.53

* Values less than the detection limit are taken to be ½ the detection limit for the purposes of calculating site statistics.

Table A.7.3-3 Station W4 Water Quality Results August 23 and October 4, 2011 compared to 2008-2012 site statistics for select parameters

Parameter	Units	Site Statistics 2008-2012*			August 23, 2011	October 4, 2011
		Min	Max	Median		
Hardness	mg/L $CaCO_3$	37	176	111	103.5	133
Acidity	mg/L	0.25	4.5	1.64	1.65	<0.5
Alkalinity	mg/L $CaCO_3$	22	125	78.04	77.5	98
Sulphate (SO_4)	mg/L	7.16	70.5	39.02	33.5	44
Cyanide (Total CN)	mg/L	0.00025	0.0021	0.00053	<0.0005	<0.0005
Cyanide (WAD)	mg/L	0.00025	0.0017	0.00049	<0.0005	<0.0005
Chloride (Cl)	mg/L	0.25	6.4	0.83	<0.5	<0.5
Fluoride (F)	mg/L	0.04	0.1	0.068	0.07	0.06
Total Aluminum (Al)	mg/L	0.012	0.945	0.1589	0.2645	0.0843
Total Antimony (Sb)	mg/L	0.00010	0.00046	0.00013	0.000135	0.00013
Total Arsenic (As)	mg/L	0.00029	0.00243	0.00043	0.00086	0.00056
Total Barium (Ba)	mg/L	0.04	0.1	0.06	0.05885	0.0715
Total Cadmium (Cd)	mg/L	0.000012	0.000271	0.000048	0.000053	0.000034
Total Calcium (Ca)	mg/L	10.1	47.2	29.55	27.35	34.2
Total Chromium (Cr)	mg/L	0.00005	0.00126	0.00023	0.00045	0.0002
Total Cobalt (Co)	mg/L	0.000017	0.0017	0.000227	0.000465	0.000186
Total Copper (Cu)	mg/L	0.0015	0.0278	0.0079	0.0106	0.00673
Total Iron (Fe)	mg/L	0.011	1.93	0.258	0.4855	0.188
Total Lead (Pb)	mg/L	0.000028	0.0107	0.000751	0.001185	0.000267
Total Magnesium (Mg)	mg/L	2.85	15.1	9.13	8.56	11.5
Total Manganese (Mn)	mg/L	0.0038	0.215	0.0275	0.0335	0.0252
Total Mercury (Hg)	mg/L	0.000005	0.00001	0.0000055	<0.00001	n/a
Total Molybdenum (Mo)	mg/L	0.00037	0.00138	0.00103	0.00092	0.00116
Total Nickel (Ni)	mg/L	0.00016	0.00171	0.00047	0.000695	0.00032
Total Potassium (K)	mg/L	0.59	1.54	1.04	0.905	1.16
Total Selenium (Se)	mg/L	0.00002	0.00015	0.00007	0.0001	0.00007
Total Silver (Ag)	mg/L	0.000003	0.000090	0.000003	<0.000005	<0.000005
Total Sodium (Na)	mg/L	1.22	6.02	4.08	3.51	4.61
Total Thallium (Tl)	mg/L	0.0000010	0.0000300	0.0000020	0.000005	0.000003
Total Uranium (U)	mg/L	0.00222	0.01850	0.00663	0.006875	0.0102
Total Zinc (Zn)	mg/L	0.00050	0.02380	0.00180	0.004	0.0025

* Values less than the detection limit are taken to be ½ the detection limit for the purposes of calculating site statistics.

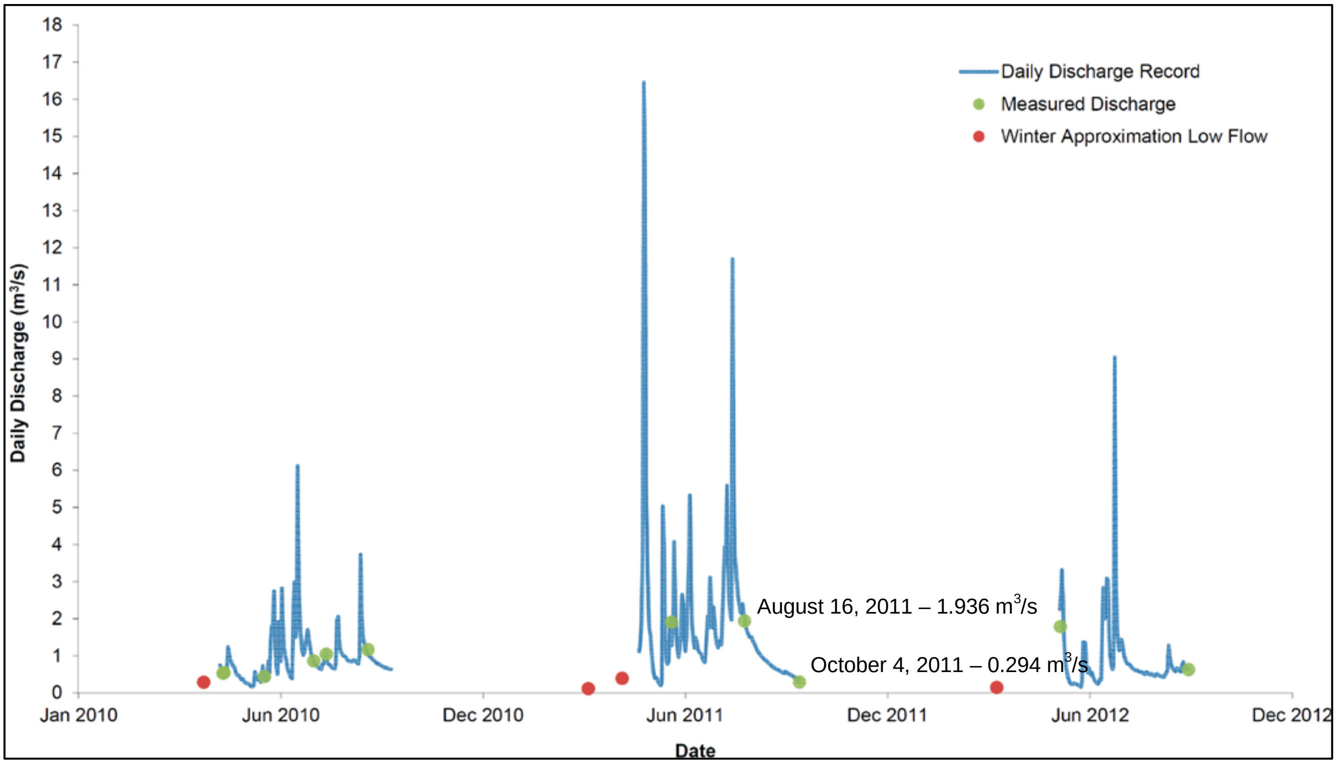


Figure A.7.3-3 Lower Casino Creek Station (W4) Measured Discharge Hydrograph

A.7.3.1.6 R166

R166. Toxicity testing and evaluation on water quality samples using early-life stages of salmonid and non-salmonid fish species, invertebrate species, and aquatic plant species.

In support of the determinations made in the Proposal, toxicity testwork was conducted in 2014 to evaluate the interactive effects of contaminants on sensitive receptors. The full lab results are provided Appendix A.7G. Freshwater sediment toxicity tests were carried out using sediment samples and sub-lethal toxicity tests were carried out on water samples from site W18 on Brynelson Creek. Water quality samples were subsequently spiked with various constituents to emulate predicated water quality in Casino Creek at Post-Closure.

Sediment toxicity testwork involved a 28-d *Hyalella azteca* and a 10-d *Chironomus dilutus* survival and growth test conducted on the sample following procedures described in USEPA (2000) for *H. azteca* and Environment Canada (1997) for *C. dilutus*. Water quality toxicity testwork consisted of a 7-day *Ceriodaphnia duba* survival and reproduction test and a 72-hour algal (*Pseudokirchneriella subcapitata*) growth inhibition test conducted following Environment Canada protocols (2007a and 2007b).

There were no effects on survival or dry weight of either *H. azteca* or *C. dilutus.* The survival (%) and growth (mg) of *H. azteca* on the W18 sample was 92.0± 8.4 (mean ± SD) and 0.37±0.19, respectively, compared with 94.0±5.5 and 0.43±0.11, respectively, of the control sediment. The survival and growth of *C. dilutus* was 88.0±11.0 and 2.04±0.16, respectively, compared with 92.0±13.0 and 2.04±0.26, respectively of the control sediment. These tests indicate that baseline sediment toxicity in Brynelson creek showed no effects on survival and growth of typical test organisms and can therefore be reasonably carried forward as having no toxic effects on survival and growth in aquatic organisms in Brynelson Creek.

The purpose of the spiked water quality bioassays was to evaluate the interactive effects of the contaminants of concern by simulating predicted Casino Creek water at M18 during the post-closure period. Two mixtures of concentrations were provided to Nautilus for the testing. Mixture 1 represents the approximate average concentrations (as per the water quality model presented in the Proposal – Appendix 7E) and Mixture 2 represents the approximate predicted maximum concentrations (Table A.7.3-4).

Table A.7.3-4 Targeted and measured values of constituents in the mixtures

Parameter	W18 (mg/L)	Mixture 1		Mixture 2	
		Targeted (mg/L)	Measured (mg/L)	Targeted (mg/L)	Measured (mg/L)
Hardness	70.1	495	512	642	659
SO_4	20.8	441	441	573	581
HCO_3 [1]	75.8	54.5	82.6	70.8	84.1
Cl	5.5	13.7	15.8	17.8	18.8
F	0.03	0.78	0.68	1.02	0.87
Cd	<0.00005	0.0005	0.00055	0.00065	0.00066
Ca	19	182	186	236	242
Cu	0.0012	0.0174	0.0167	0.0226	0.0199
Fe [1]	0.055	0.0057	0.067	0.0074	0.097
Mg	5.5	10	11.4	13	13.1
Mn	0.004	0.702	0.691	0.912	0.883
Mo	0.001	0.1	0.113	0.13	0.146
K	<2	1.8	2	2.3	2.3
Se	<0.0010	0.003	0.0035	0.004	0.0046
Si [1]	5.4	3.55	5.67	4.62	5.62
Na	3.2	15.6	16.7	20.2	20.4
U [2]	0.0027	0.021	0.0028	0.0273	0.00283

1 Measured value exceeded target value because this constituent already contained the measured amount upon receipt.

2 Uranium was not added to the mixture

No adverse effects were observed on *C. dubia* survival or reproduction; the LC50, IC25 and IC50 were >100%. In the 72-h *P. subcapitata* toxicity test, a reduction in cell yield was observed relative to the unspiked W18 sample, resulting in an IC25 of 74.9%. However, cell yield was greater than in the laboratory water control in all test concentrations. Thus, there was no adverse effect in the test concentrations relative to control performance.

A.7.3.1.7 R167

R167. Clarify and provide further justification for the use of water monitoring stations W18, M18, and H18.

Station H18 is a hydrometric monitoring station on Casino Creek just below Brynelson (6951451N, 610860E). Station W18 is a water quality sampling station on lower Brynelson Creek, just before the confluence with Casino Creek (6951180N, 610893E). The two stations are approximately 275 m apart (Figure A.7.3-4). Station M18 is used interchangeably with station H18 to represent a *modelled* water quality station. The reason for assigning a new name to the site is to differentiate between W18, with is a water quality sampling site, and M18, which is a modelled water quality site. No baseline water quality was collected at station M18, hence why water quality at H18 is assumed to be equal to that from station M18. Station M18 represents the water quality at the point of discharge to the receiving environment in the water quality model (Appendix A.7B).

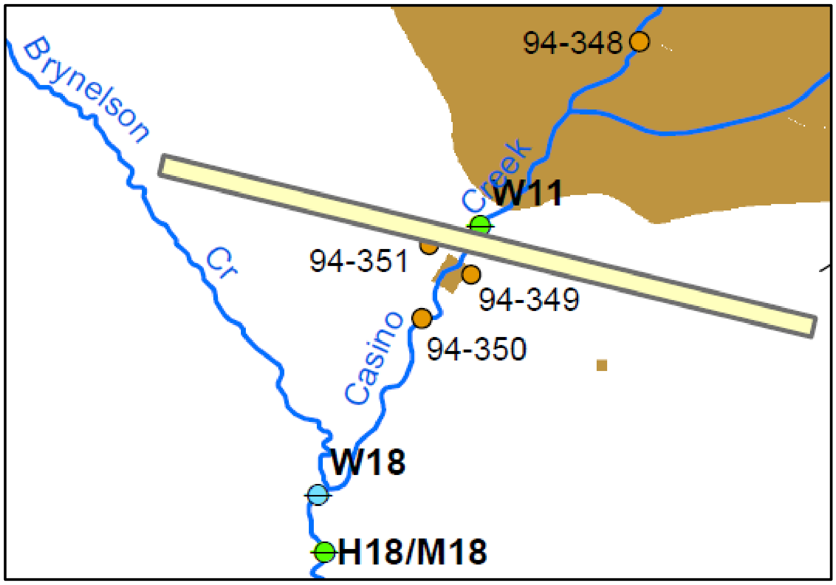


Figure A.7.3-4 Station H18, M18 and W18 Locations (from Figure 7.2-2)

A.7.3.2 Sediment Quality

A.7.3.2.1 R168

R168. Toxicity and bioaccumulation testing and evaluation on sediment quality samples.

As discussed in the response to R166, toxicity testwork was conducted in 2014 to evaluate the interactive effects of contaminants on sensitive receptors. Freshwater sediment toxicity tests were carried out using sediment samples and sub-lethal toxicity tests were carried out on water samples from site W18 on Brynelson Creek.

These tests indicate that baseline sediment toxicity in Brynelson creek showed no effects on survival and growth of typical test organisms and can therefore be reasonably carried forward as having no toxic effects on survival and growth in aquatic organisms in Brynelson Creek.

A.7.4 HYDROLOGY BASELINE

A.7.4.1.1 R169

R169. Baseline hydrological information for streams and rivers downstream of W16 on Dip Creek and the Yukon River (e.g. Klotassin River and White River), inclusive of the Yukon River at the respective point of confluence.

To supplement the baseline hydrometric data for the nine hydrometric monitoring stations in the Project area provided in Appendix 7B, estimates of baseline hydrology downstream of Dip Creek in the Klotassin River, Donjek River and Yukon River at White River and at Britannia Creek are presented in Table A.7.4-1. These four systems were preferentially selected as they each represent an approximate order-of-magnitude increase in watershed area from the nearest upstream location for which baseline hydrology was estimated. The values presented in Table A.7.4-1 were derived as follows:

Klotassin River at Dip Creek

Klotassin River values were derived by scaling the 1974-2013 daily streamflow record collected by the Water Survey of Canada (WSC) on Big Creek (09AH003), by the ratio of drainage area between Big Creek and Klotassin River. This approach is reasonable given the similarity in topography between the two watersheds, that their headwaters share a watershed divide, and that they are a similar distance inland from the hydrometeorological influences of the Pacific Ocean and the Saint Elias Mountains. The minimum, mean and maximum values were extracted from the resultant 39-year dataset.

Donjek River at Klotassin River

Donjek River values were derived using data collected by WSC within the Donjek river system upstream of the Klotassin River (Donjek River below Kluane River (09CA003) and Nisling River below Onion Creek (09CA006)), and using the Klotassin River values derived above. The watersheds above these three locations comprise almost 90% of the Donjek River watershed area at Klotassin River; flow from the other 10% was estimated by scaling the Nisling River values by the ratio of watershed area. Unfortunately, there are no concurrent streamflow data between the Donjek River and the Nisling and Klotassin Rivers. However, since each data-set included at least 12 years of data the average for each month was considered a reasonable approximation of the long-term average at each station. Long-term mean monthly discharge in the Donjek River at Klotassin River was estimated by summing the long-term mean monthly discharge values for each of the upstream watersheds. The minimum and maximum monthly values were approximated using the ratio of minimum and maximum monthly flow to mean monthly flow in the Nisling River and Donjek River WSC datasets.

Yukon River at White River

Yukon River values were derived using monthly streamflow data collected by WSC on the Yukon River upstream and downstream of the White River (Yukon River above White River (09CD001)) and Yukon River at Stewart River (09EB002) and on the Stewart River (Stewart River at the Mouth (09DD003)). Monthly streamflow in the Stewart River was subtracted from concurrent values in the Yukon River at Stewart River to derive monthly streamflow in the Yukon River below the White River. Ratios were then developed between the concurrent monthly flows in the Yukon River below White River and the Yukon River above White River; unfortunately, only one year of data was available to develop these ratios. Rounded and optimized versions of these monthly ratios were then applied to the long-term Yukon River above White River monthly values to estimate monthly streamflow in the Yukon River below the White River. Resultant minimum, mean and maximum monthly flows are presented in Table A.7.4-1.

Table A.7.4-1 Baseline Hydrology Estimates Downstream of Dip Creek

Location	Drainage Area (km^2)	Flow Statistic	Discharge (m^3/s)												
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Klotassin River at Dip Creek Confluence	2030	Min	0.01	0.01	0.01	0.00	7.2	5.3	3.0	2.1	2.7	1.3	0.25	0.03	2.4
		Mean	0.44	0.31	0.27	2.6	30	19	21	16	12	4.8	1.7	0.78	9.4
		Max	1.5	1.4	1.4	25	87	44	48	42	39	13	4.6	2.7	18

Location	Drainage Area (km²)	Flow Statistic	Discharge (m^3/s)												
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Donjek River at Klotassin River Confluence	25300	Min	17	15	14	20	96	230	420	369	153	64	32	21	145
		Mean	34	30	30	50	231	382	676	646	368	171	73	44	228
		Max	51	43	48	116	475	584	957	1088	699	309	114	69	327
Yukon River below White River Confluence	200000	Min	329	293	293	326	1064	2403	2228	1799	1363	905	568	398	1148
		Mean	502	447	406	449	1988	3939	3959	3081	2404	1561	870	607	1684
		Max	721	612	528	647	3821	6885	6765	4472	4263	2928	1620	1082	2292

A.7.4.1.2 R170

R170. Provide estimates of flow rates for the Yukon River either at the point of confluence with Britannia Creek or at the point of planned water withdrawal from the Yukon River.

An estimate of baseline hydrology in the Yukon River is presented in Table A.7.4-2. Discharge in the Yukon River at Britannia Creek was derived by scaling the 1966-2012 daily streamflow record collected by WSC on the Yukon River above White River (09CD001) by the ratio of watershed area at these two locations. The applied watershed area ratio is approximately 0.99.

Table A.7.4-2 Baseline Hydrology Estimates in Yukon River at Britannia Creek

Location	Drainage Area (km²)	Flow Statistic	Discharge (m^3/s)												
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Yukon River at Britannia Creek Confluence	146900	Min	270	241	241	268	777	1755	1331	1075	927	743	466	327	817
		Mean	412	367	333	369	1452	2877	2366	1841	1635	1282	715	498	1179
		Max	593	503	434	531	2790	5028	4042	2672	2899	2406	1331	889	1579

A.7.4.1.3 R171

R171. Confirm whether on-going hydrometric monitoring will continue to improve the reliability of described baseline flow characteristics.

Hydrological data has been collected at the Project since 1993, with a comprehensive program ongoing since 2008. The historic data set was used to provide long-term streamflow estimates for the Project area by comparing the available Project data (2008 – 2012) with regional streamflow stations operated by the Water Survey of Canada (WSC). While not presented in the Proposal, baseline hydrometric monitoring at the nine hydrometric monitoring stations has continued through 2013 and 2014, and will continue throughout the YESAB and permitting process.

The current baseline dataset is sufficient to characterize baseline hydrology within the LSA; however, hydrologic monitoring conducted during the YESAB process, prior to submission of the Type A Water Use Licence (WUL) application will be incorporated into an updated hydrology baseline report, and subsequently into an updated water balance and water quality model. These updated reports and models will be submitted to the Yukon Water Board as part of the Type A WUL application, as stated in the *Type A and B Quartz Mining Undertakings Information Package for Applicants* (YWB 2012):

> "The Board expects that surface water data collection (both for flow and quality) will be continued during and subsequent to the *YESAA* project assessment and that data collected after the submission of the Project Proposal will be incorporated into the water use licence application."

A.7.4.1.4 R172

R172. Survey cross-sections of the stream gauging stations as well as an assessment of the accuracy of the measured peak flows considering the rating curve data.

As discussed in the Hydrology Baseline Report (Appendix 7B), benchmarks were installed at Project hydrology stations at the outset of the 2011 open water season in order to improve data quality for ongoing data collection efforts by linking future hydrometric data at each station to a local benchmark datum. These stations were surveyed during each subsequent site visit in 2011 and 2012 to prevent loss of continuity in the stage time-series.

Stage-discharge measurements provided the primary basis for guiding stage adjustments at stations where there was no reason to suspect that the stage-discharge relationship had changed over time due to changes in channel geometry, downstream beaver dam activity, or other similar factors. At each such station, the surveyed stage-discharge measurements collected in 2011 and 2012 were compared to the un-surveyed pre-2011 measurements and an appropriate vertical adjustment was applied to the pre-2011 stage values to bring the points into alignment with the 2011-12 stage-discharge points. The stage-discharge measurements, their corresponding rating curves, and measured hydrographs used in this analysis are provided in tables and figures in Appendix A of Appendix 7B.

The British Columbia hydrometric guidelines (BC MoE 2009) specify that a minimum of 10 stage-discharge points are necessary to define a rating curve, and that rating curves should be extrapolated to no greater than twice the maximum measured discharge. While these guidelines are taken from a neighbouring jurisdiction, they are generally applicable to the collection of good-quality hydrometric data and provide a useful basis for assessing the data collected to date in the Project area. Most of the monitoring stations have 10 or more stage-discharge points defining their rating curves, although this has been achieved by subjectively adjusting the pre-2011 stage data, as described above, which introduces some uncertainty. The exceptions are stations W16 and R2 which have eight and nine stage-discharge points, respectively, defining their rating curves.

The rating curves for most of the monitoring stations are not fully developed for high-flow conditions. Therefore, large extrapolations are required to estimate the discharge values associated with the highest flow events. Only two stations have sufficiently developed rating curves such that the maximum estimated discharge (by rating curve extrapolation) was less than two times the maximum measured discharge. These two stations are W14, and W11. Greater extents of rating curve extrapolation were required at the other stations, making their high-flow estimates generally less certain.

However, as shown in Figure A.7.4-1 through Figure A.7.4-9, the measured discharge points fit very well onto the daily discharge record, indicating that the stage-discharge curves appropriately convert measured water level to flow at all monitoring sites.

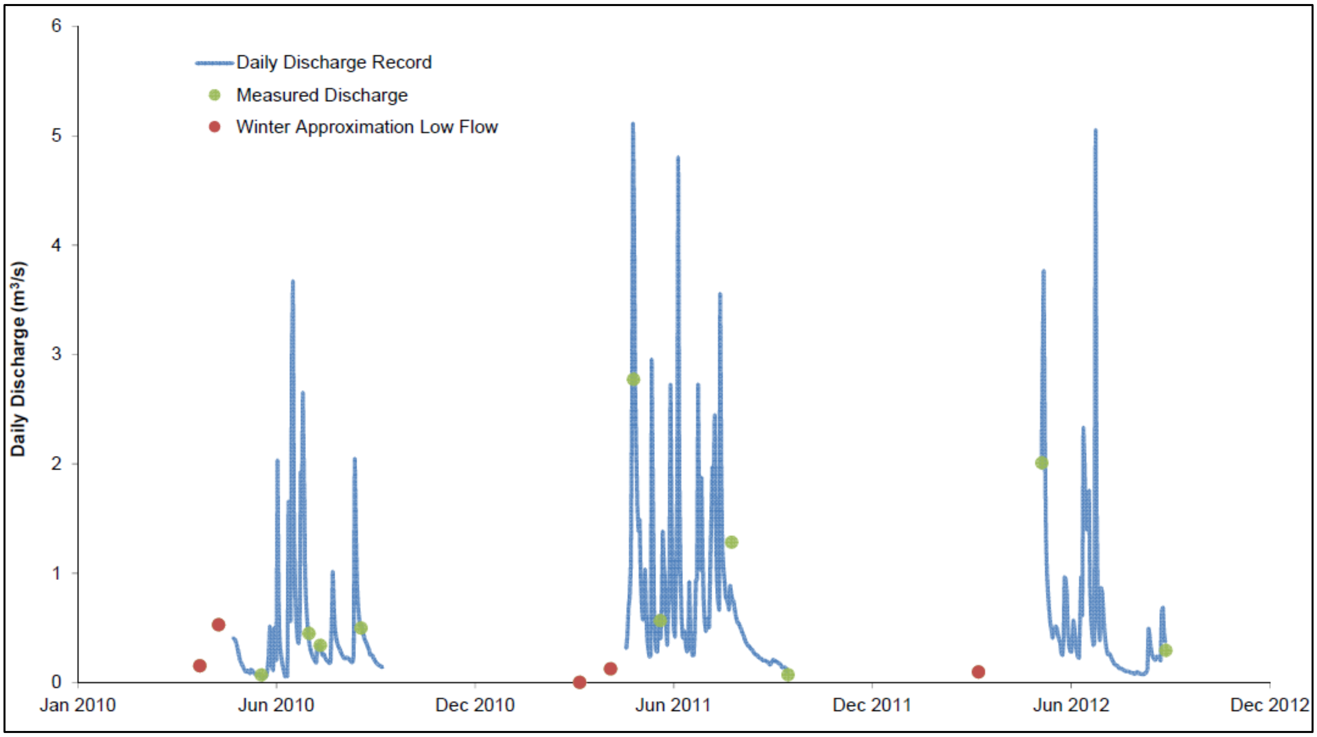


Figure A.7.4-1 Station W14 Measured Discharge Hydrograph (From Appendix 7B)

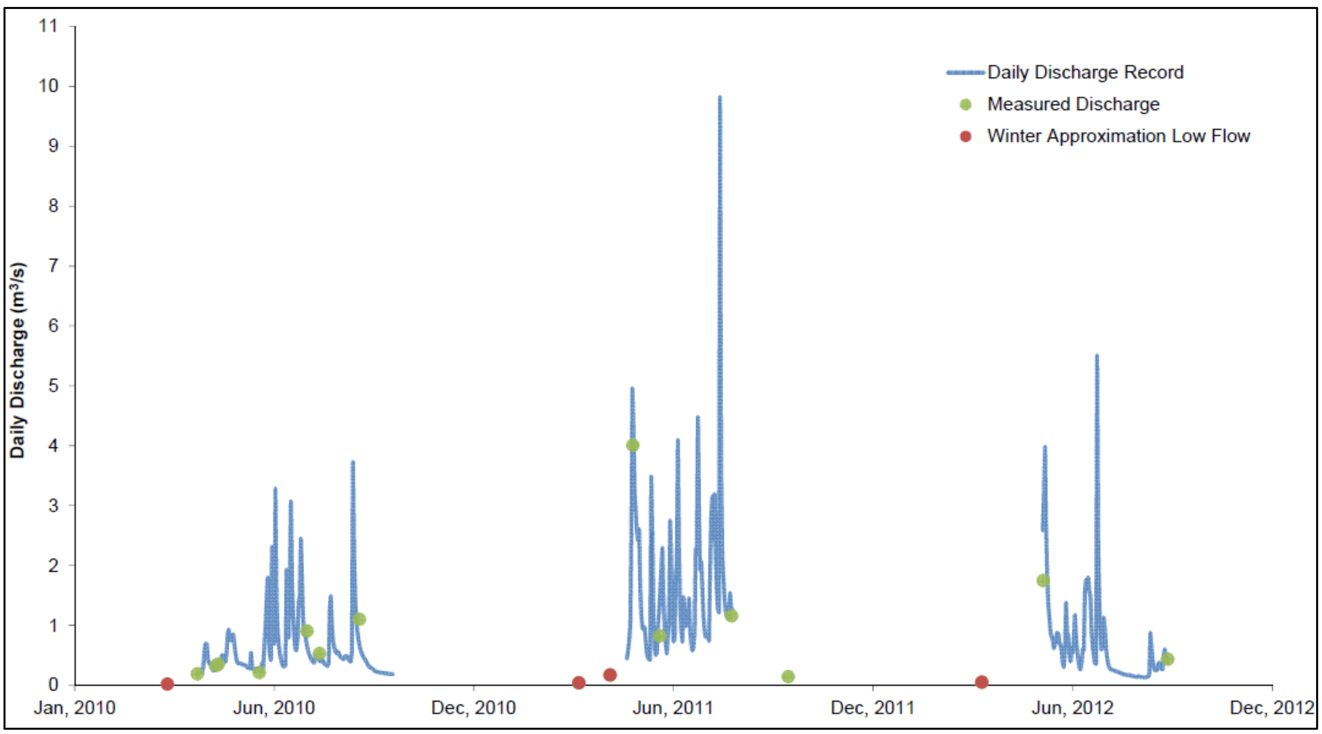


Figure A.7.4-2 Station W3 Measured Discharge Hydrograph (From Appendix 7B)

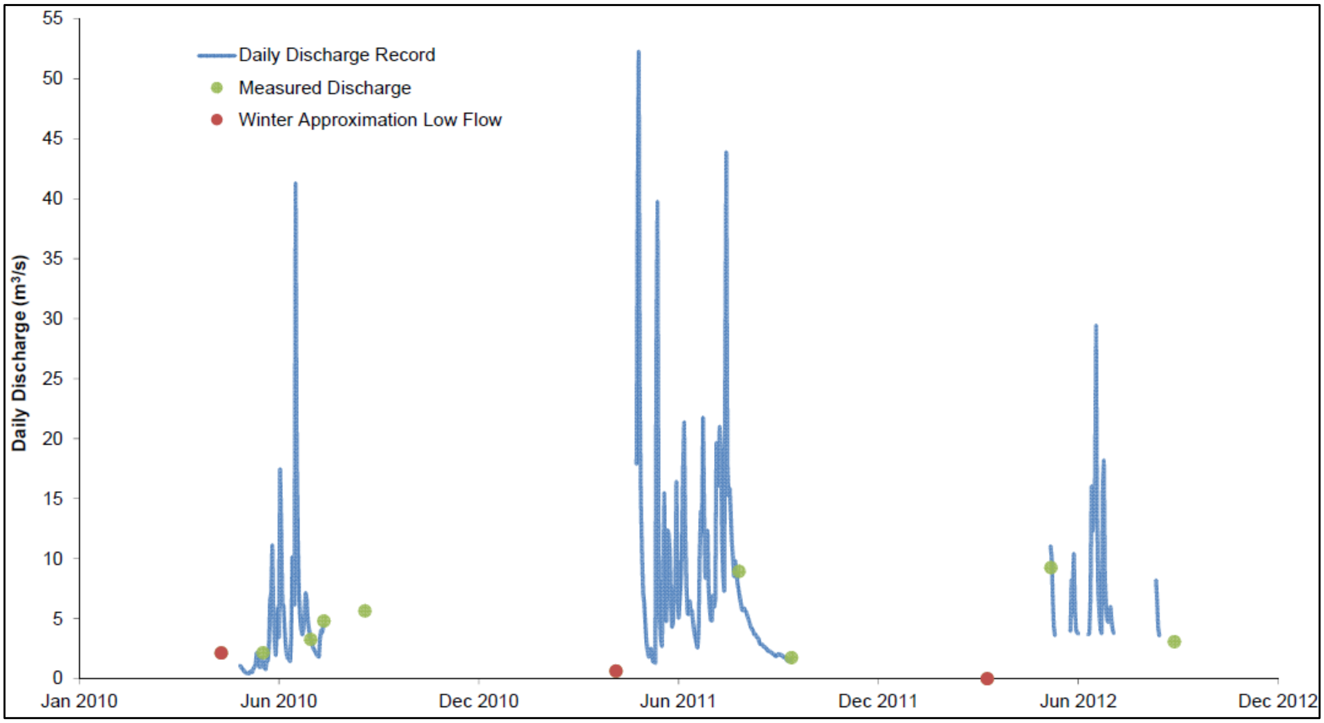


Figure A.7.4-3 Station W16 Measured Discharge Hydrograph (From Appendix 7B)

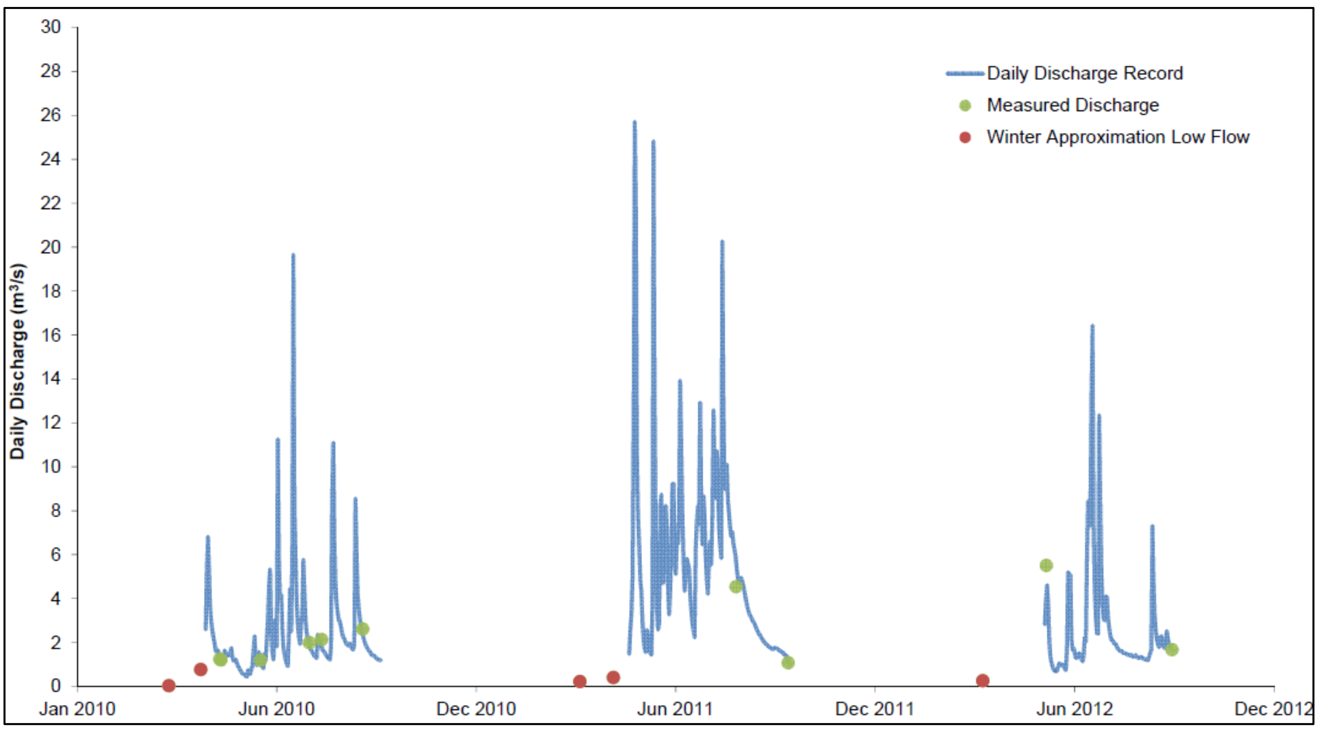


Figure A.7.4-4 Station W9 Measured Discharge Hydrograph (From Appendix 7B)

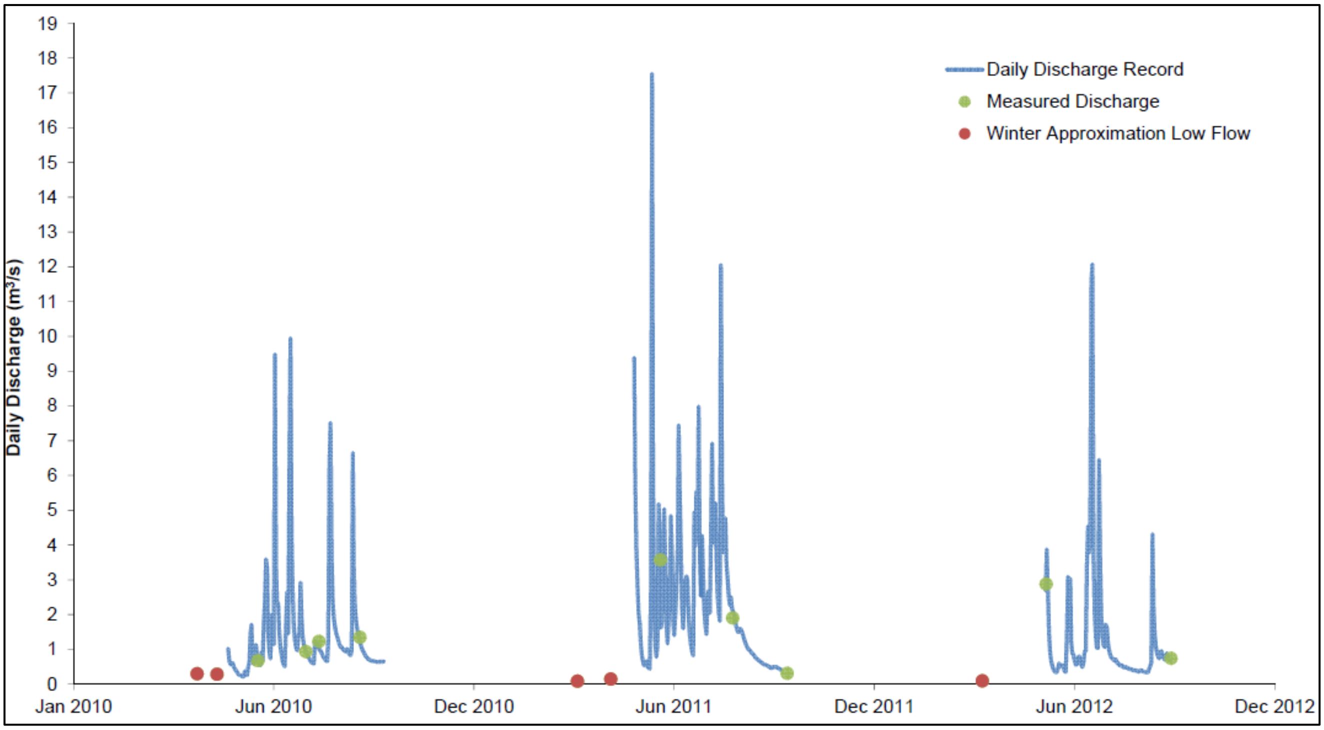


Figure A.7.4-5 Station R2 Measured Discharge Hydrograph (From Appendix 7B)

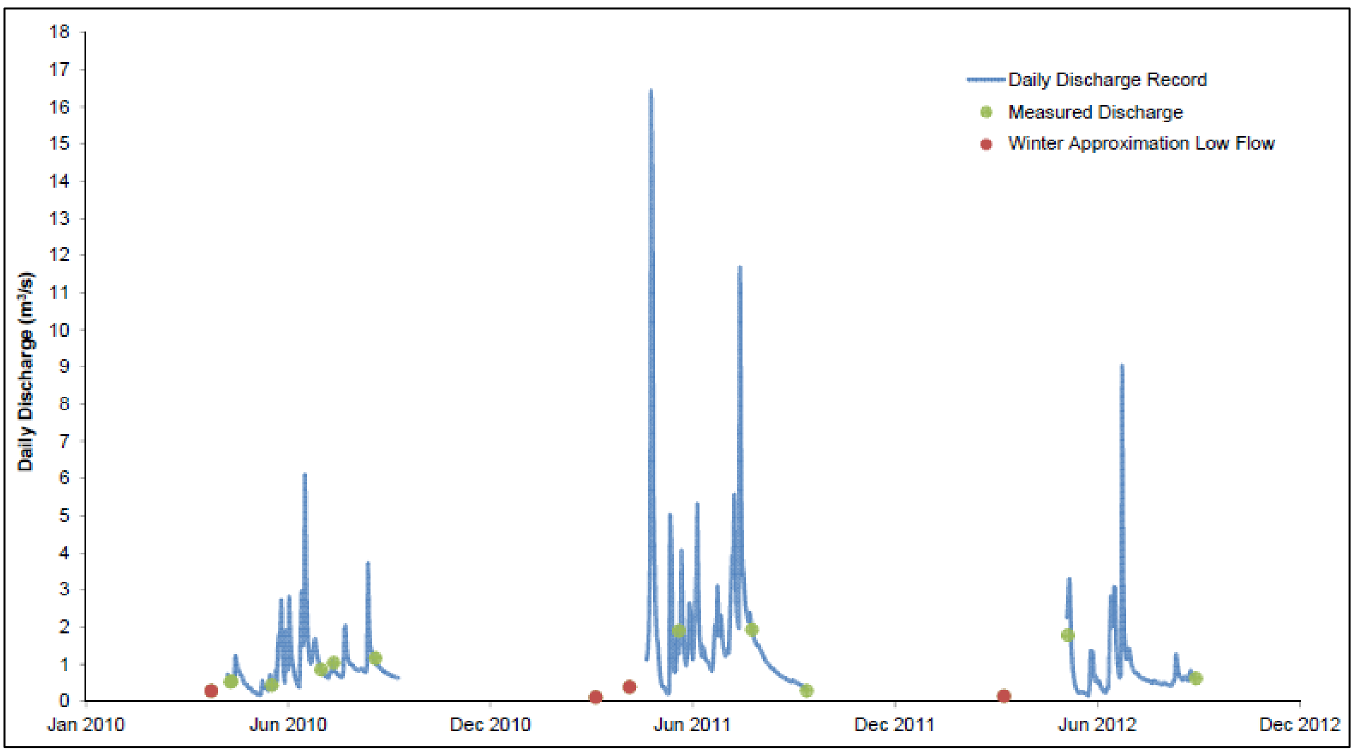


Figure A.7.4-6 Station W4 Measured Discharge Hydrograph (From Appendix 7B)

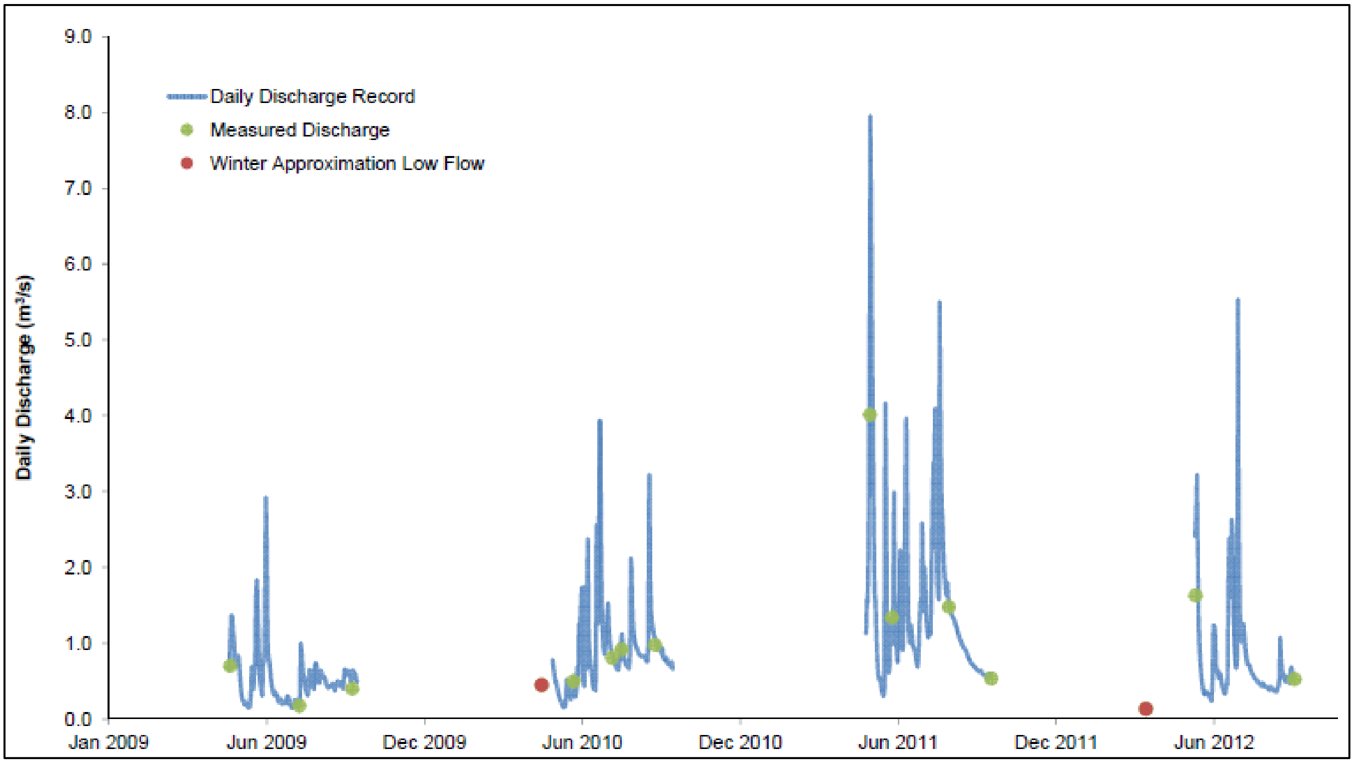


Figure A.7.4-7 Station H18 Measured Discharge Hydrograph (From Appendix 7B)

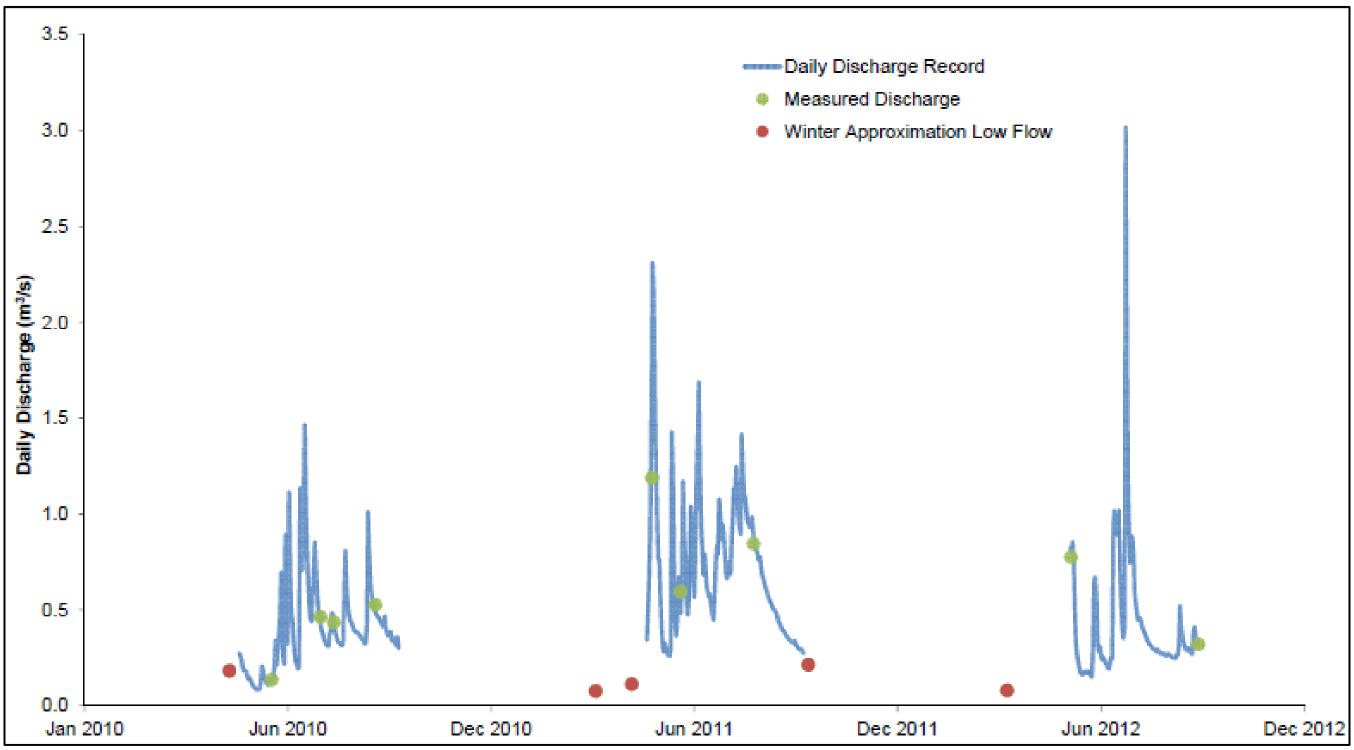


Figure A.7.4-8 Station W11 Measured Discharge Hydrograph (From Appendix 7B)

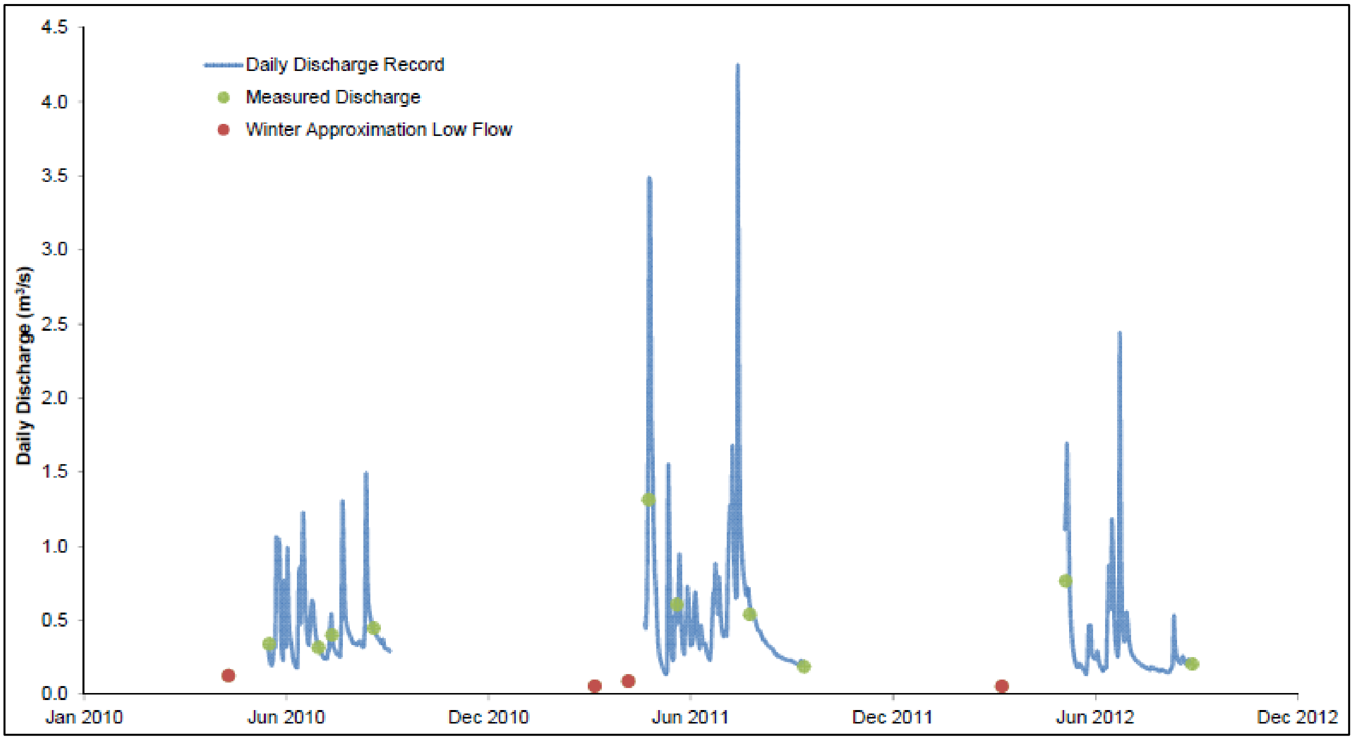


Figure A.7.4-9 Station W18 Measured Discharge Hydrograph (From Appendix 7B)

A.7.4.1.5 R173

R173. Confirm whether hydrometric monitoring station W1 that was discontinued in 2011 will be re-established. If not, provide rationale as to chosen approach.

As discussed in the Hydrology Baseline Report (Appendix 7B), station W1 was deactivated in 2011 due to the development and natural destruction of a beaver dam that interfered with the station's hydraulic control and caused the loss of the 2011 data. Two baseline hydrology stations continue to be operated within the Britannia Creek watershed, and together they monitor runoff from 75 percent of the watershed. Given this percentage, CMC considers the current baseline dataset to be sufficient to characterize baseline hydrology within Britannia Creek; however, CMC will evaluate a location for a suitable hydrometric monitoring location on lower Britannia Creek and should one be found, CMC will consider installing a hydrometric monitoring station on lower Britannia Creek.

A.7.4.1.6 R174

R174. Discuss the use of stage-discharge measurements prior to 2011 (measurements which did not include benchmarks) in developing rating curves. Discuss the implications of only using data from 2013 and onwards in developing rating curves.

Stage-discharge measurements recorded prior to the utilization of survey benchmarks were not directly used in rating curve development. Rather, the rating curves were used to assess the stability of the channel and monitoring station, and to determine whether pre-2011 data could be used in the development of baseline streamflow records.

Rating curve development methodology is presented in the Hydrology Baseline Report (Appendix 7B). Rating curves were developed using stage-discharge measurements collected in 2011 and 2012 using surveyed benchmarks. Stage-discharge measurements collected during prior years, without the utilization of survey benchmarks, were then adjusted by a single station specific offset to fit each rating curve. If the data fit the curve, as was the case for most stations, it was determined that the channel bed was stable during the years prior to 2011 and could be included in development of baseline streamflow records. If the pre-2011 stage-discharge measurements did not fit the curve, such as during 2008 at W11 and W14, and during 2008 and 2009 at W3, the channel bed or monitoring station was determined to have been different than during the 2011-2012 period, and consequently the data collected during these years was not included in streamflow record development.

A.7.4.1.7 R175

R175. A detailed description of the methodology used to select the Big Creek drainage as a regional surrogate watershed to develop the synthetic flow series. Consideration should be given to developing a focussed regional relationship using the larger and more current data set.

Data from the Water Survey of Canada gauging station on Big Creek (09AH003) were selected for correlation with site specific flow data to develop a long-term synthetic flow series for the project site gauging stations. This dataset was chosen because it was deemed to be the best available for this purpose on the basis of its close proximity to the Casino site, length of complete years of record (31 years), basin size (smallest of all active stations in the region), operating status (currently operating), and general similarity in terms of measured unit runoff. It is recognized that the dataset is not ideal for this purpose because of the relatively large size of the watershed (1750 km^2), but long-term operating WSC station data are very limited in the Yukon, and this dataset represents the best dataset currently available for simulating flows in the Casino Project area, and the results of the correlation modelling indicate that it serves this purpose very well as a strong match between the measured and synthesized flow data.

A.7.4.1.8 R176

R176. Update tables 5.1-2, 5.2-1, and 5.3-1 in Appendix 7B, Hydrology Baseline Report to include discharge estimates (e.g. cubic meters per second or liters per second.

Updates to Tables 5.1-2, 5.2-1 and 5.3-1 from Appendix 7B are provided in Table A.7.4-3, Table A.7.4-4 and Table A.7.4-5, respectively.

Table A.7.4-3 Recommended Peak Flow Values for Project Streamflow Stations (update to Table 5.1-2 from Appendix 7B)

Station	Drainage Area (km^2)	Mean Annual	2 Year	5 Year	10 Year	20 Year	50 Year	100 Year	200 Year
		Instantaneous Discharge (l/s/km^2)							
W14	45	167	162	238	283	322	368	399	425
W3	64	159	41	225	284	345	428	495	564
W16	384	183	173	272	331	383	443	484	522
W9	194	183	167	264	326	386	461	516	572
R2	84.5	199	194	268	314	353	398	431	459
W4	82	140	130	201	245	285	334	370	406

Station	Drainage Area (km^2)	Mean Annual	2 Year	5 Year	10 Year	20 Year	50 Year	100 Year	200 Year
H18	67	129	124	184	219	250	286	310	332
W11	39	144	138	205	243	276	314	339	362
W18	25	143	135	199	239	275	318	348	376
		Discharge (m^3/s)							
W14	45	8	7	11	13	14	17	18	19
W3	64	10	3	14	18	22	27	32	36
W16	384	70	66	104	127	147	170	186	200
W9	194	36	32	51	63	75	89	100	111
R2	84.5	17	16	23	27	30	34	36	39
W4	82	11	11	16	20	23	27	30	33
H18	67	9	8	12	15	17	19	21	22
W11	39	6	5	8	9	11	12	13	14
W18	25	4	3	5	6	7	8	9	9

Table A.7.4-4 Regional Peak Flow Return Period Coefficients (update to Table 5.2-1 from Appendix 7B)

Station	Drainage Area (km^2)	Instantaneous Discharge ($l/s/km^2$)		Discharge (l/s)	
		Mean Annual	10 Year	Mean Annual	10 Year
W14	45	0.07	0.00	3.2	0.0
W3	64	0.08	0.00	5.1	0.0
W16	384	0.02	0.00	7.7	0.0
W9	194	0.17	0.01	33.0	1.9
R2	84.5	0.09	0.00	7.6	0.0
W4	82	0.28	0.01	23.0	0.8
H18	67	0.27	0.01	18.1	0.7
W11	39	0.26	0.01	10.1	0.4
W18	25	0.24	0.01	6.0	0.3

Table A.7.4-5 10-Year Wet and Dry Monthly Runoff (update to Table 5.3-1 from Appendix 7B)

	Casino Creek Watershed			Dip Creek Watershed			Britannia Creek Watershed		
	10-Year Dry	Average	10-Year Wet	10-Year Dry	Average	10-Year Wet	10-Year Dry	Average	10-Year Wet
	Monthly Unit Runoff ($l/s/km^2$)								
Jan	0.1	0.6	1.3	0.05	0.31	0.69	0.04	0.21	0.47
Feb	0.07	0.4	0.86	0.04	0.21	0.44	0.02	0.14	0.3
Mar	0.06	0.35	0.76	0.03	0.18	0.39	0.02	0.12	0.27
Apr	0.11	2	5.4	0.05	1.9	4.2	0.02	0.99	2.2
May	3	13	31	2.4	12	31	3.2	15	33
Jun	3.6	11	19	4.3	14	28	3.8	11	20
Jul	4.7	13	23	3.3	16	30	1.8	10	21
Aug	4.2	9.8	17	2.7	11	22	1.3	6.3	14
Sep	5.5	9.6	15	3	8.1	15	2.4	6.5	12
Oct	3.6	5.4	7.2	1.7	3.2	4.7	1.3	2.5	3.6
Nov	0.91	2.5	4.5	0.42	1.2	2.2	0.32	0.94	1.7
Dec	0.22	1.2	2.6	0.1	0.55	1.2	0.08	0.43	0.92
	Monthly Discharge (m^3/s)								
Jan	0.01	0.05	0.11	0.02	0.10	0.22	0.002	0.010	0.02
Feb	0.01	0.03	0.07	0.01	0.07	0.14	0.001	0.006	0.01
Mar	0.00	0.03	0.06	0.01	0.06	0.13	0.001	0.005	0.01
Apr	0.01	0.17	0.45	0.02	0.61	1.37	0.001	0.04	0.10
May	0.25	1.07	2.57	0.78	4.03	9.98	0.15	0.67	1.47
Jun	0.30	0.87	1.59	1.40	4.71	9.04	0.17	0.48	0.88
Jul	0.38	1.08	1.85	1.06	5.10	9.76	0.08	0.45	0.96
Aug	0.35	0.80	1.36	0.89	3.51	7.09	0.06	0.29	0.64
Sep	0.45	0.78	1.20	0.98	2.63	4.88	0.11	0.29	0.54

	Casino Creek Watershed			Dip Creek Watershed			Britannia Creek Watershed		
	10-Year Dry	Average	10-Year Wet	10-Year Dry	Average	10-Year Wet	10-Year Dry	Average	10-Year Wet
Oct	0.30	0.44	0.59	0.54	1.03	1.54	0.06	0.11	0.16
Nov	0.07	0.21	0.37	0.14	0.39	0.71	0.01	0.04	0.08
Dec	0.02	0.10	0.21	0.03	0.18	0.39	0.00	0.02	0.04

NOTES:

1. RETURN PERIOD VALUES WERE GENERATED USING PALISADE DECISION TOOLS @RISK DISTRIBUTION FITTING SOFTWARE AND THE LONG-TERM SYNTHETIC FLOW SERIES DEVELOPED FOR EACH OF THE CASINO HYDROLOGY STATIONS.
2. THE CASINO CREEK WATERSHED VALUES WERE ESTIMATED USING THE DRAINAGE AREA FOR W4 (82 km^2).
3. THE DIP CREEK WATERSHED VALUES WERE ESTIMATED USING THE DRAINAGE AREA FOR W16 (325 km^2).
4. THE BRITANNIA CREEK WATERSHED VALUES WERE ESTIMATED USING THE DRAINAGE AREA FOR W14 (45 km^2).

A.7.4.1.9 R177

R177. A discussion on, and if necessary reassess, the values identified in Tables 5.2-1 and 5.3-1 of Appendix 7B (Hydrology Baseline Report) given that a comparison with regional hydrometric data suggests that values presented are higher than regional values.

Table 5.2-1

A review of the regional data for the three smallest basin WSC gauging stations in the Yukon (King Creek – area 13.7 km^2; Tagish Creek – area 76.9 km^2; Giltana Creek – area 190 km^2) indicates mean annual unit low flow values of 1.26 $l/s/km^2$, 1.46 $l/s/km^2$ and 0.32 $l/s/km^2$, respectively, which are all higher than the mean annual 7-day unit low flow values presented in Table 5.2-1 for the mine area watersheds. As such, and without accounting for the fact that the comparison is between 7-day values and single day values, the values presented are lower than regional values, not higher. Furthermore, it is should be noted that the project area values are largely based on measured winter flows, and accordingly are representative of actual conditions. Finally, in terms of the 10 year 7-day low flows, the presented values are almost all zero.

Table 5.3-1

The 10-year dry mean monthly analysis and results were reviewed in light of request R177. The results presented in Section 5.0 of Appendix 7B were determined to be reasonable, and consistent with the data measured on site. However, the values were derived by fitting statistical distributions to the data, and by fitting a different distribution the values can change. An assessment of the applicable best-fit distributions suggested that the current values could be marginally reduced through the selection of a different distribution. However, since the intent of this information is to demonstrate the temporal variability of streamflow within each watershed, and these values do not influence the assessment of project related effects on hydrology, the analysis will not be updated at this time. Rather, the analysis may be updated during the permitting phase of project development, when more site data are available.

A.7.4.1.10 R178

R178. The following referenced report: Knight Piésold Ltd. 2010 Hydrometeorology Report (Ref. No. VA101-325/3-1, June 2010).

The Updated Hydrometeorology Report (VA101-325/8-11, July 9, 2012) is provided in Appendix A.4G. The updated report supersedes the earlier version, dated June 15, 2010 (VA101-325/3-1). The updated version incorporates an additional two years of climate and streamflow records collected in the Project area and provides refined estimates of climatic and hydrologic parameters. Overall, the updated estimates for key parameters are in agreement with previously estimated values.

A.7.5 HYDROGEOLOGY BASELINE

A.7.5.1.1 R179

R.179 An update and overview of current hydrogeology baseline information. Details should be provided for the following:

- **a. whether additional conductivity studies are being done in the TMF Main Embankment area and rationale for the selected approach;**
- **b. characterization of hydrogeology in the open pit area outside the immediate footprint; and**
- **c. characterization of hydrogeology in the gold ore, supergene oxide/low grade ore, and low grade ore stockpile areas.**

The 2013-2014 groundwater data report is provided in Appendix A.7M, and responses to R179 are as follows:

a. Additional conductivity studies within the Main Embankment are planned for the detailed design phase of the Project. Proposed studies include packer testing within geotechnical drillholes to further characterize the subsurface beneath the Embankment. Response testing will also be conducted where standpipes are installed.

b. Data are available to characterize the hydrogeology in the open pit area outside the immediate footprint from two paired monitoring wells installed in 2013, MW13-02D/S. The two monitoring wells are located approximately 150 m north of the proposed pit rim: MW13-02S (installed to 18.3 mbgs) and MW13-02D (installed to 30.3 mbgs). The wells are located within the saddle of the valley adjacent to Canadian Creek. Characteristics of the baseline groundwater flow regime north of the proposed Open Pit are consistent with those of a valley area flow regime and include:

- The full length of the drillholes for the two monitoring wells encountered silty sand material that is interpreted to be a fault zone or alluvial deposit.
- Permafrost was encountered to a depth of approximately 10 mbgs during drilling. These observations are consistent with the interpreted distribution of permafrost presented on Figure 2.3 of the Baseline Hydrogeology Report (Appendix 7C).
- The measured depth to water in both wells is within 2 m of ground surface, which indicates that the baseline water table at this location is at or near ground surface, as would be expected for wells located in a valley. Comparison of measured water levels in paired monitoring wells indicates the vertical hydraulic gradient is upward and this location is a groundwater discharge zone.
- The estimated hydraulic conductivity values from a response test conducted in MW13-2D was $1x10^{-5}$ m/s, and is consistent with a typical value for silty sand.
- Groundwater quality north of the proposed Open Pit has been characterized based on seven samples collected in 2013 and 2014; four from MW13-02D and three from MW13-02S. Samples from MW13-02D/S are characterized as sodium and bicarbonate type; in contrast, samples from most monitoring wells in the proposed Open Pit area are characterized as the calcium-magnesium-sulphate type. Total dissolved solids (TDS) concentrations were lower in monitoring wells MW13-02D/S compared to other wells in the proposed Open Pit area. Groundwater samples from the proposed Open Pit area were typically slightly acidic to slightly basic and similar results were observed at the monitoring wells to the north. Alkalinity results were lower in these new wells (ranged from 14.5 mg/L CaCO3 to 48.9 mg/L CaCO3) compared to most of the other wells in the proposed Open Pit area (typically greater than 80 mg/L CaCO3). Water hardness results for the MW13-02D/S

samples were lower, typically within the soft water classification (<60 mg/L CaCO3), compared to the very hard water (>180 mg/L CaCO3) observed in samples from most other wells in the proposed Open Pit area. Fluoride, aluminum, cadmium, iron, and zinc concentrations exceeded the CCME Water Quality Guidelines for the Protection of Aquatic Life (CCME) in some or all of the samples from MW13-02D/S, though concentrations were typically lower than those measured in samples from other monitoring wells in the proposed Open Pit area. There were no exceedances of the Yukon Contaminated Sites Regulations (YCSR) for samples from monitoring wells MW13-02D/S. Arsenic, cobalt, copper, and uranium concentrations were lower in the samples from monitoring wells MW13-02D/S compared to most wells in the proposed Open Pit area where guideline exceedances were common for these parameters and none were reported for MW13-02D/S

c. Data are available to characterize the hydrogeology in the gold ore, supergene oxide/low grade ore, and low grade ore stockpile areas from six monitoring wells installed in 2013 as well as eight additional installations from historic programs. The monitoring wells installed in 2013 include the following paired installations: MW13-01D/S (installed up to 41.2 mbgs), MW13-03D/S (installed up to 36.6 mbgs) and MW13-04D/S (installed up to 41.2 mbgs). Groundwater data are also available within the stockpile area at monitoring wells MW11-01A/B, MW11-02A/B, and 94-342 and standpipes DH11-32, DH11-33, and DH11-34. Characteristics of the baseline groundwater flow regime in the proposed stockpile areas include:

- Surficial geology within drillholes advanced in the proposed stockpile areas generally consisted of a thin layer of colluvium (up to 3 m) but was up to 9 m thick near Meloy Creek valley. Geology in drillholes primarily consists of Granodiorite bedrock (WRGD) with meta-sedimentary rock (YQMT) near the southern footprint of the stockpile area. Bedrock was described as weathered to depths of between 8 mbgs and 42 mbgs. Fault (<5 m) and shear zones were encountered in select drillholes.
- Frozen conditions at the wells indicate permafrost is present at monitoring well locations MW13-01D/S and MW13-03D/S. Field observations suggest that permafrost is present to a depth that is near the screened interval of the shallow monitoring well (13 mbgs). Permafrost is present at standpipe locations DH11-32, DH11-34 and 94-342. These observations of permafrost are consistent with the interpreted distribution of permafrost presented in Figure 2.3 of the Baseline Hydrogeology Report (Appendix 7C).
- The measured depth to water ranges from to 4 mbgs 26 mbgs in wells in the area. Seasonal fluctuations range from approximately 20 m (MW13-03D) in the upper slopes and less than 5 m in valley areas along the upper hillslopes (MW11-02A/B). Comparison of measured water levels in paired monitoring wells indicates the vertical hydraulic gradient is downward and this area is a groundwater recharge zone.
- Estimated hydraulic conductivity values from response tests conducted at standpipes and monitoring wells ranges from $5x10^{-6}$ m/s to $<1x10^{-8}$ m/s. This range of hydraulic conductivity values is consistent with typical values for weathered and competent bedrock.
- Groundwater quality in vicinity of the stockpile areas is consistent with the description provided for the hillslope area in Baseline Hydrogeology Report (Appendix 7C), with a summary provided here. In the hillslope area the groundwater samples were dominantly calcium-bicarbonate type, mean TDS values in water collected from monitoring wells were indicative of slight to moderately mineralized groundwater. Samples from monitoring wells installed near the Historic Meloy Creek mine adit, near the Low Grade Ore Stockpiles (MW11-01A/B and MW11-02A/B), reported higher mean TDS values

than others from the hillslope area. Slightly higher mean TDS and higher concentrations of sulphate, sodium, fluoride, and chloride were reported in water samples obtained from the shallow groundwater well compared to the deep well. In samples from the hillslope area, cadmium, copper, and zinc were the only metals detected at concentrations that exceed the CCME guideline limits on a regular basis.

A.7.5.1.2 R180

R180. Additional discussion and supporting rationale on groundwater seepage from the open pit area to the Canadian Creek drainage. The discussion should include implications to base flows during operations and water quality during closure and post-closure.

Upon cessation of mining activities, the Open Pit will be flooded to maintain a Pit Lake and groundwater elevations immediately surrounding the Open Pit are expected to recover to the water surface elevation of the Pit Lake (1,100 masl; Figure B.6 from Appendix 7E). As stated in Section 4.6.2 of the *Numerical Groundwater Modelling report* (Appendix 7E): *MODPATH particle tracking was used to assess the down gradient discharge location of seepage from the Pit Lake. Results of the particle tracking indicate that seepage from the Pit Lake will discharge to surface within the upper valley of Casino Creek, upslope of the TMF.* The simulated groundwater contours during Post-Closure are provided in Figure B.6 from Appendix 7E and indicate that seepage from the Open Pit would flow to the upper valley of Casino Creek due to the fact that the baseline water table elevation along the northern extent of the Open Pit is approximately 100 m above the ultimate proposed water surface elevation of the Pit Lake (1,100 masl). Therefore, the Pit Lake elevation will be lower than the surrounding water table in Canadian Creek Watershed and groundwater flow direction will be from Canadian Creek to the Pit Lake and seepage from the Pit Lake will be entirely into the Casino Creek valley. No seepage is expected from the Pit toward Canadian Creek.

To confirm the model results, paired monitoring wells MW13-02S/D, located adjacent to Canadian Creek and approximately 150 m north of the proposed ultimate northern extent of the Open Pit, were installed in 2013. The measured water level in both wells is less than 2 m below ground surface, indicating that the baseline water table elevation at this location is approximately 1,196 masl and, as expected, the water table is at or near ground surface immediately beside Canadian Creek. Since the water table elevation at these two wells is approximately 100 m higher than the proposed maximum water surface elevation of the Pit Lake (1,100 masl), the hydraulic gradient driving groundwater flow will be sustained from Canadian Creek to the Pit Lake even during the Post-Closure period.

Groundwater model results indicate total seepage from the Pit Lake is predicted to be 12 L/s. Based on the simulated groundwater contours during Post-Closure (Figure B.6 from Appendix 7E), all of this seepage would flow to the upper valley of Casino Creek. Seepage from the Pit Lake is not predicted to report anywhere other than the upper valley of Casino Creek. As stated in Section 4.6.2 of the *Numerical Groundwater Modelling report* (Appendix 7E), “MODPATH particle tracking was used to assess the down-gradient discharge location of seepage from the Pit Lake. Results of the particle tracking indicate that seepage from *the Pit Lake will discharge to surface within the upper valley of Casino Creek, upslope of the TMF.”*

Impacts to baseflow in Canadian Creek were assessed using the Modflow model. Impacts were assessed at hydrology station W3 located on Canadian Creek at the confluence with Britannia Creek and approximately 12 km downstream of the ultimate northern extent of the pit. Average annual baseflow (groundwater discharge to surface) at hydrology station W3 was estimated to be approximately 100 L/s in baseline conditions. Baseflow reductions at hydrology station W3 when the Open Pit is at its maximum extent are estimated to be approximately 6 L/s, equivalent to a 6% decrease in flows. Baseflow reductions at hydrology station W3 are expected to be less than 6 L/s during other phases of the mine life.

A.7.5.1.3 R181

R181. The following document for review: Knight Piésold Ltd. Revised Tailings Management Facility Seepage Assessment (Ref. No. VA101-325/8-13, December, 2012).

The *Report on Revised Tailings Management Facility Seepage Assessment* (VA101-325/8-13) December 19, 2012 is provided in Appendix A.4L.

A.7.6 GEOCHEMISTRY AND SOURCE TERM PREDICTIONS

A.7.6.1 Geochemical Characterization of Ore, Waste Rock and Tailings

A.7.6.1.1 R182

R182. Additional detail and rationale to indicate that samples collected for geochemical characterization of ore, waste rock, and tailings, provide a statistically representative dataset. Details should include:

a. results of sensitivity analysis and gap analysis of geochemical characterization program;

b. summation of geochemical sampling program relative to rock lithology and alteration types; and

c. if current sampling is found to be incomplete, please update accordingly with a suitable number of samples for ABA, as well as appropriate kinetic testing.

The major influence on how rock types influence ML/ARD is the unique mineral assemblage associated with any one lithology and how this assemblage could affect drainage chemistry or the probability that rock associated with this unit could be PAG. The formation of the oxide CAP and Supergene zones is associated with a weathering process that is independent of the primary lithologies in the Casino deposit and has overprinted the primary mineral assemblage with a secondary oxidized mineral assemblage and a mixed secondary sulphide mineral assemblage. These secondary mineral assemblages are the dominant geologic control on the metal leaching and the ARD characteristics of both the oxide CAP rock and the supergene rock. Although the association between lithology and ARD characteristics for the CAP and supergene were evaluated, they were not reported due to little correlation because of the geologic controls mentioned above and limited utility for ML/ARD management planning.

From a mine waste management perspective the overall characteristic of the supergene zone is that it is PAG with high metal leaching potential due to the highly leachable secondary sulphide minerals and an acid-base balance that will lead to the formation of acidic conditions. The geochemical characterization of the supergene rock indicates that all supergene rock will require special handling consideration since well over 90 percent of the supergene samples are PAG and the range of leaching rates and the effects of pH adjustment have been evaluated. At the EA stage, additional characterization of the supergene with respect to the primary lithologies was not considered necessary to further formulate management plans or assess environmental impact.

Similarly, from a mine waste management perspective the dominant characteristic of the oxide zone is that it will produce mildly acidic drainage immediately upon exposure. Due to the depletion of carbonate from the oxide CAP zone and the predominance of acidic sulphate minerals such as jarosite, the measured pH of the samples provide a better estimate of the acid generating potential than NPR. The Casino Waste Rock and Ore Geochemical Static Test Assessment report (Appendix 7D) specifies that portions of the CAP with a paste pH > 7, also have a lower metal leaching potential. These pH-neutral samples occur preferentially in the Dawson Range unit (WR) in the east portion of the pit as illustrated in Appendix F and Appendix G of the report and Table A.7.6-1 below, which indicates a tendency for slightly higher pH is possible for waste rock (WR) samples. The differences in in-situ pH between CAP lithologies are not considered significant enough to be considered in waste management planning at this stage. Additional characterization of CAP rock in this area will be undertaken prior to construction if NAG CAP rock is proposed for use for construction.

Table A.7.6-1 CAP sample pH by Lithology

pH	WR	PP	MX	IX
median	4.9	4.3	4.3	4.5
90th percentile	6.7	5.6	5.2	5.2

The association between lithology and ML/ARD characteristics for Hypogene samples was reported in Section 5.3.5 of the Casino Waste Rock and Ore Geochemical Static Test Assessment report (Appendix 7D) because the weathering/alteration processes that formed the oxide CAP and supergene zones did not directly influence the Hypogene rocks.

ARD sampling for the Casino Project follows the available guidance regarding sampling. Although not clearly summarized in the Casino Project Proposal, Price (1997) recognizes that the number of samples will depend on the variability observed in a specific deposit and should be used as a starting point. More recent guidance applicable to the Casino Project regarding design of an ARD program can be found in Price (2009) and the GARD Guide (INAP 2014). These documents generally indicate that the number of samples required is dependent on what is required to meet the objective of the study, which in this case is to obtain adequate information to formulate waste management plans at an EA level. Guidance regarding sampling for ML/ARD characterization found in Price 2009 is that the "*recommended frequency should be determined site specifically based on the variability of analysis results for critical parameters, prediction objectives and required accuracy*". The GARD Guide provides similar direction regarding sampling with the following statements: "*The number of samples required for source characterization of each material type depends on the following: (a) the amount of disturbance (i.e., the volume/mass of material extracted or the amount exposed on pit/mine walls or production tonnage as determined by the block model); (b) the compositional variability within a material type; and (c) the statistical degree of confidence that is required for the assessment*."

A summation of the mineralogic zones and rock types and ore/waste designations within the Casino open pit is provided in Table 3-2 of the *Casino Waste Rock and Ore Geochemical Static Test Assessment report* (Appendix 7D) and the distribution of the samples is illustrated in Figure 3-1 and Appendix A2. Note that Appendix A2 content was missing from Appendix 7D, and is provided in Appendix A.7H. Table 3-4 of the Static Test Assessment report (reproduced in Table A.7.6-2) illustrates that the proportion of samples collected and corresponds to the proportion of rock type volumes within the pit.

Table A.7.6-2 Percentage of ARD Samples Collected According to Lithologic Unit and Relative Proportion of each Lithologic Unit in the Casino Pit (Table 3-3 & 3-4 from Appendix 7D)

Lithologic Unit	Dominant Lithology	Samples Collected		Relative Proportion in Pit
		No.	%	%
Patton Porphyry (PP)	Dacite to rhyodacite	222	15.4	10
Intrusion Breccia (IX)	PP matrix with WR clasts	105	7.3	4
Dawson Range Batholith and earlier	Granodiorite and diorite	1003	69.5	66

Lithologic Unit	Dominant Lithology	Samples Collected		Relative Proportion in Pit
		No.	%	%
metamorphic rocks (WR)				
Post-mineral explosion breccia (MX)	Latite groundmass with altered microbreccia fragments	108	7.5	5
Undefined/Overburden		6	0.4	15
Total		**1444**	**100**	**100**

Applying the sampling frequency tabulated in Price 1997 to derive a benchmark of 6,000 samples for the Casino Project is considered by Price 1997 to be arbitrary and would be a benchmark to apply when "no other guidance is available for initial sampling". There is additional guidance for sampling at Casino. Sampling was undertaken in several phases to identify the relationship between geology and ML/ARD characteristics. The results of the study presented in Chapters 4 and 5 of the Casino Waste Rock and Ore Geochemical Static Test Assessment report (Appendix 7D) indicate that *in situ* weathering associated with the formation of the Oxide Cap and Supergene Zone have produced distinct mineralogic assemblages that are not associated with the original lithology. Conversely, the hypogene rocks were not weathered *in situ* and retain the original mineralogical and leaching characteristics of the rock lithologies. The mineralogical associations for each of the zones are presented in Chapter 4 and the ML/ARD characteristics are presented in Chapter 5. These results consistently indicate that the ARD potential (PAG) and metal leaching characteristic (pH) are consistent within the mineralized zones as summarized in Table A.7.6-3 below. Due to the distinct trends of these key characteristics within the geologic units discussed in the report provides sufficient understanding of the systems at an EA level to design ML/ARD management plans. Additional sampling will be undertaken in support of permit applications and during operations as outlined in the Casino ML/ARD Management and Monitoring Plan (Appendix A.22H).

Table A.7.6-3 ML/ARD Characteristics for Major Alteration Zones

Management Unit	ARD Potential	Median NP	90 percentile NPR	Median in-situ pH
Oxide CAP	Moderate PAG, small zones of NPAG with higher	0.4	0.32	4.7
SOX / SUS	Strong PAG	0.4/2.8	0.33/0.39	5.7/7.0
Hypogene PP	PAG but initially neutral	28	1.4	8.14
Hypogene IX	PAG but initially neutral	36	2.0	8.17
Hypogene WR	PAG but initially neutral	25	2.1	8.12
Hypogene MX	PAG but initially neutral	48	1.1	6.28

From Table 5-1 and Section 5.3.5 of Casino Geochemical Static Test Assessment Report (Appendix 7D)
SUS = Supergene Sulphide Zone, SOX = Supergene Oxide Zone

A.7.6.1.2 R183

R183. Complete cross-section and long-sectional diagrams of the open pit. Diagrams should include:

a. all sample locations;
b. all geologic units and lithologies;
c. ore body outline; and
d. any other data that will increase understanding of the deposit geology.

The complete cross-sections of the open pit, including sample locations, geologic units and lithologies, ore body outline and depth should have been included as Appendix A2 of the *Lorax Casino Waste Rock and Ore Geochemical Static Test Assessment report* (Appendix 7D), but were omitted from the original submission, and are subsequently provided herein as Appendix A.7H.

A.7.6.1.3 R184

R184. The following referenced reports:

a. Lorax Environmental Service Ltd. (2009) Casino Phase I Geochemical Assessment Report prepared for Western Copper Corporation, January, 2009.
b. Lorax Environmental Services Ltd. (2010) Casino Phase II Geochemical Assessment Report, prepared for Western Copper Corporation, January 2010.

As described in the *Casino Waste Rock and Ore Geochemical Static Test Assessment Report* (Appendix 7D), in 2010, inconsistencies in drill core logs for the Casino deposit were recognized by CMC. Subsequently, drill core was re-logged which resulted in a revised rock categorization system that included revision of the mineralization zone and lithologic unit designations in the logs. As such, the 2013 report (Appendix 7D) provides the complete results for all available samples, which includes a revision of the Phase I and Phase II data according to the 2010 re-logging, incorporates supplemental static testwork completed for Phase III (2009 sampling) and Phase IV (2011 sampling); and presents the results for overburden samples collected from test pits at the Casino site. Therefore, provision of the 2009 and 2010 Phase I and Phase II reports would be providing reviewers with data which is no longer relevant. Reviewers should refer to *Casino Waste Rock and Ore Geochemical Static Test Assessment Report* (Appendix 7D) for details.

A.7.6.1.4 R185

R185. Describe or otherwise comment upon the added dimension of lithology in their analysis.

See the response to R182.

A.7.6.1.5 R186

186. Information on and description of the “FZ” lithology listed in Table 3-2 report titled Casino Waste Rock and Ore Geochemical Static Test Assessment (Appendix 7D, Lorax, Dec 3, 2013).

FZ refers to fault zone. The samples from this zone are highly fractured and a primary rock type was not defined.

A.7.6.1.6 R187

R187. Clarify why there are only about 12 percent of HYP samples included in the shake flask extraction testwork when the HYP type makes up almost 37 percent of the alteration types.

A preliminary metal leaching assessment was conducted on a subset of Phase I samples to evaluate the relative metal leaching potential of the various rock and alteration types in the deposit. The primary focus of that assessment was to determine the soluble metal load of the CAP rock in comparison to the other rocks. Subsequent to this an extensive kinetic test program has been undertaken to evaluate the leaching potential of the Casino waste rock, ore and tailings. The shake flask extraction data were not presented to provide a conclusive estimate of metal leaching potential for the hypogene rock but are included in the report for completeness. The results of the kinetic test program are provided in Appendix A.7I.

A.7.6.1.7 R188

R188. Rational as to why there are no values presented for uranium and fluoride despite having identified them as parameters of interest.

The values (mg/L) for U and F missing from Table 5-5 in the Casino Waste Rock and Ore Geochemical Static Test Assessment report (Appendix 7D) are presented below in Table A.7.6-4.

Table A.7.6-4 Range of Fluoride and Uranium Concentrations in Shake Flask Extraction Leachate

	F	U
Maximum	1.00	0.069
90th percentile	0.326	0.015
75th percentile	0.190	0.002
Mean	0.153	0.006
Median	0.060	0.001
25th percentile	0.030	0.0002
10th percentile	0.030	0.0001
Minimum	0.030	0.0001
n	19	60

A.7.6.1.8 R189

R189. Details on: mining sequence; production of ore and waste types relative to lithology and alteration; and blending schedule. Details should include:

a. an ore/waste production schedule (tables and figures) broken down by lithologic/alteration units and tonnages mined; and

b. demonstration that the mixing CAP and SUP material with HYP material could be implemented and will be an effective mitigation.

As discussed in the *Waste Storage Area and Stockpiles Feasibility Design* (Appendix A.4F), approximately 658 million tonnes of waste rock and overburden will be produced over the life of the mine. This waste has been identified as potentially acid generating (PAG) and metal leaching (ML), and hence will be placed and stored subaqueously in the waste storage area located within the tailings management facility (TMF).

The specific lithology of the waste rock depends on the schedule of extraction from the open pit, as detailed in Table A.7.6-5, and as shown on Figure A.7.6-1. In the early years of production, generated waste rock is dominated by leach cap, with lesser inputs from supergene oxide and sulfide waste. Hypogene waste rock is produced more significantly in year 5, and in later project years is the dominant kind of waste rock produced. This will result in mixed waste rock, with a leach cap more dominant in early years, and hypogene more dominant in later years.

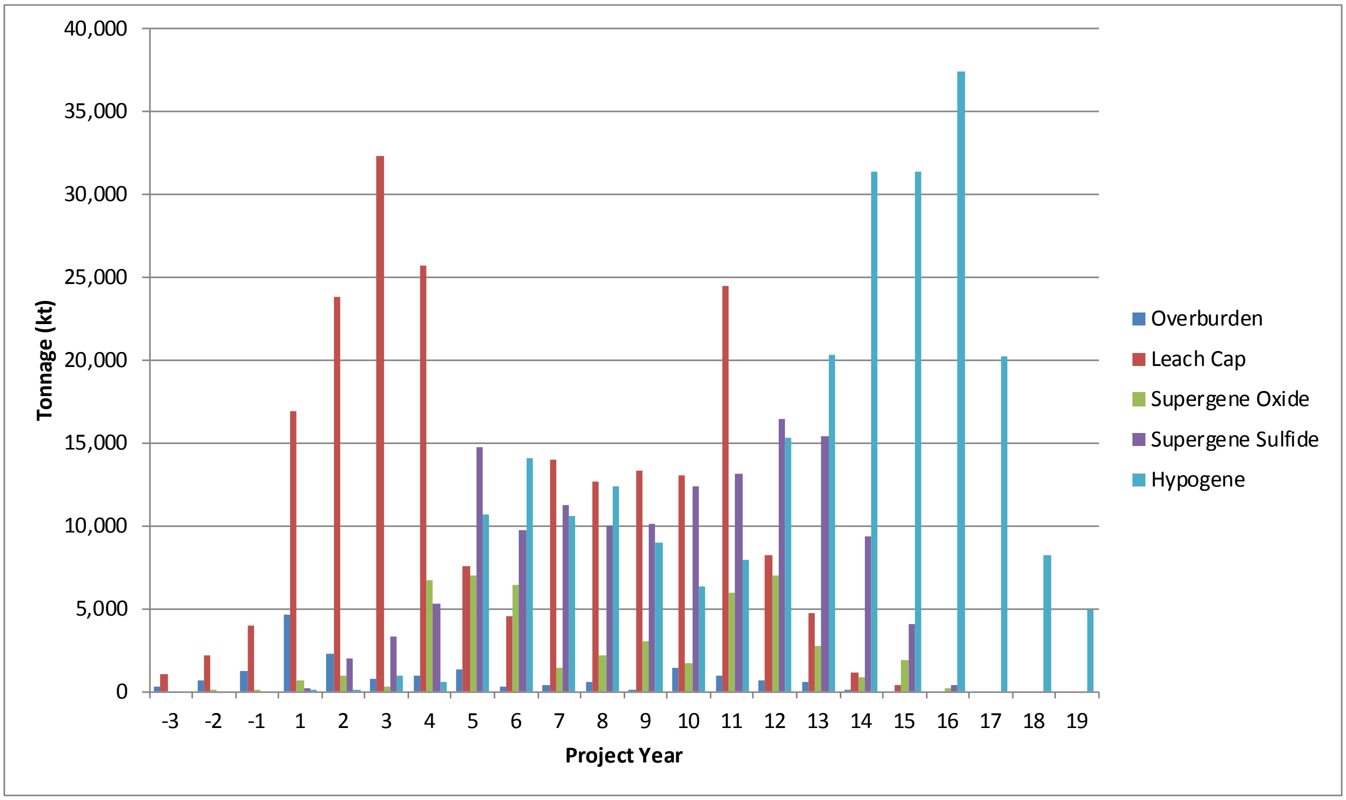


Figure A.7.6-1 Waste Rock Production Schedule

The ML/ARD Management Plan (Appendix A.22H) details the waste placement strategy. In general, the waste placement strategy is to locate the most reactive material in areas of the TMF where the lowest flow rates are expected, and the relatively non-reactive tailings where the highest seepage rates are expected. Waste rock is relatively reactive compared to the tailings in the TMF owing to the presence of partially weathered CAP, SOX and SUS. Therefore, waste rock is placed in the upstream section of the TMF, where hydrologic head gradients are generally expected to be lower than in the downstream portion of the facility where the tailings are deposited. In the final years of mine life, a layer of de-pyritized tailings will be placed over the waste rock.

During placement of waste rock, the crest elevation of the waste rock will be maintained several metres higher than the tailings and supernatant pond to provide a dry, stable surface for access and placement of waste rock by haul trucks. Waste rock placed in the TMF will remain unsaturated for an average of three years before saturation.

Table A.7.6-5 Ore and Waste Production Schedule (derived from M3 2013)

	Tonnage (kt)											
Project Year	**-3**	**-2**	**-1**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Direct Feed Mill Ore	0	603	4,326	29,571	45,928	45,814	42,056	41,653	41,605	41,576	42,145	42,491
SOX Stockpile	20	2,806	9,950	19,634	0	0	0	0	0	0	0	0
Low Grade Ore	0	0	184	839	7,187	3,396	10,772	16,513	22,234	11,972	6,775	8,299
Gold Ore	6,580	14,197	21,654	18,667	17,579	12,879	7,809	495	1,072	8,773	13,111	13,352
Total Ore	**6,600**	**17,606**	**36,114**	**68,711**	**70,694**	**62,089**	**60,637**	**58,661**	**64,911**	**62,321**	**62,031**	**64,142**
Overburden	336	690	1,206	4,614	2,311	818	993	1,345	336	353	617	138
Leach Cap	1,043	2,187	3,960	16,879	23,787	32,290	25,694	7,534	4,516	14,007	12,718	13,345
Supergene Oxide	0	9	39	681	919	338	6,724	6,979	6,399	1,407	2,167	3,083
Supergene Sulfide	0	0	0	255	2,014	3,311	5,348	14,727	9,721	11,269	10,027	10,114
Hypogene	0	0	0	5	159	943	573	10,690	14,096	10,579	12,401	8,952
Waste - Unclassified	103	50	57	78	116	211	31	64	21	64	39	226
Waste Material	**1,482**	**2,936**	**5,262**	**22,512**	**29,306**	**37,911**	**39,363**	**41,339**	**35,089**	**37,679**	**37,969**	**35,858**
Total Material	**8,082**	**20,542**	**41,376**	**91,223**	**100,000**	**100,000**	**100,000**	**100,000**	**100,000**	**100,000**	**100,000**	**100,000**

	Tonnage (kt)										
Project Year	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**TOTAL**
Direct Feed Mill Ore	41,175	41,095	42,251	46,249	45,798	45,187	45,064	44,772	44,934	14,676	788,969
SOX Stockpile	0	0	0	0	0	0	0	0	0	0	32,410
Low Grade Ore	5,575	4,944	9,461	9,029	6,670	8,620	7,142	4,216	0	0	143,828
Gold Ore	18,235	1,263	625	925	238	0	0	0	0	0	157,454
Total Ore	**64,985**	47,302	52,337	56,203	52,706	53,807	52,206	48,988	44,934	14,676	1,780,528
Overburden	1,450	943	723	596	35	0					17,504
Leach Cap	13,072	24,510	8,220	4,704	1,127	429					210,022
Supergene Oxide	1,679	6,016	6,989	2,712	914	1,948	210	0	0	0	49,213
Supergene Sulfide	12,390	13,166	16,448	15,443	9,337	4,068	353	0	0	0	137,991
Hypogene	6,369	7,931	15,273	20,341	31,372	31,379	37,370	20,242	8,266	4,932	241,873
Waste - Unclassified	55	132	10	1	0	5	1				1,264
Waste Material	**35,015**	**52,698**	**47,663**	**43,797**	**42,785**	**37,829**	**37,934**	**20,242**	**8,266**	**4,932**	**657,867**
Total Material	**100,000**	**100,000**	**100,000**	**100,000**	**95,491**	**91,636**	**90,140**	**69,230**	**53,200**	**19,608**	**1,780,528**

The timing of waste rock production will result in vertical stratification of rock types in the waste rock storage area. Geochemical characterization data indicates that SUP and HYP are PAG rock units, with only minor amounts of NAG. In fact, a portion of the SUP waste rock placed in the waste rock storage zone will be NP deplete, and may become acidic prior to being flooded. Although the HYP is PAG it contains sufficient NP to remain pH-neutral for the relatively brief period it will be exposed in the TMF prior to flooding. The management plan calls for the NP-deplete SUP rock to be blended with the high-NP HYP rock in the mixed waste rock zone that will be constructed in Years 5 through 15. Layering these two rock types will limit the severity of potential acid generation during the relatively brief time period that the waste rock is exposed before subaqueous disposal. In addition, the layering configuration will allow alkalinity addition into porewaters along the flow path through the flooded wastes prior to discharge into the TMF pond or foundation.

Implementation of the waste rock management plan will require special monitoring and handling requirements at different phases of the project:

- Pre-production - Identification of pH-neutral CAP rock to segregate sufficient material to be used for the construction of the starter embankment of the TMF. In-pit monitoring for grade, paste pH and total S.
- Operation Years 1 through 4 – Identification of acidic SUS waste rock for placement in the Marginal Grade Ore Stockpile. Identification of mineralization type and confirmation of waste grade will be required to segregate acidic SUS for placement in the Marginal Grade Ore Stockpile. In-pit monitoring for grade, paste pH and total S.
- Operation Years 5 through 15 – Identification of HYP and acidic SUS waste rock for placement of layered rock in the TMF to achieve mixing criteria for waste rock deposition. All HYP will be sent to TMF, no segregation is required for this unit. In-pit monitoring of HYP for grade. All SUP will be handled as PAG and flooded in the facility. However, a portion of the PAG SUP has an acidic in-situ pH and will need to be layered with the HYP rock to limit ARD. This unit will be segregated by in-situ pH, in-pit monitoring of SUS for grade, paste pH and total S.
- Operation Years 1 to 5 - CAP waste rock has little or no sulphide content, therefore it is not considered PAG, however, it has a mildly acidic in-situ pH and the unit has an intermediate metal leaching potential. All CAP waste rock will be sent to the TMF. No segregation is planned for this unit.

A.7.6.1.9 R190

R190. Update and provide a discussion of on-going kinetic testwork. Provide any results and demonstrate how those results may inform the Project. Details should include:

a. discussion on whether any of the tests recommended by Knight Piésold have been conducted or initiated;

b. any additional laboratory reports that are available; and

c. discussion on what experiments/test work will be conducted prior to starting construction of the heap.

The *Casino Kinetic Testwork 2014 Update for Ore, Waste Rock and Tailings* (Appendix A.7I) provides results for kinetic testwork up to September 2014. The Casino kinetic test program evaluates the metal leaching and acid rock drainage (ML/ARD) potential of waste rock, tailings and ore samples in support of the geochemical assessment for the Casino Project. A total of 53 kinetic tests have been undertaken for the Casino Project, which includes saturated columns, unsaturated columns, humidity cells and field weathering bins. Additional data has continued to be collected for a number of kinetic tests discussed in the 2013 Kinetic Test Update report and/or the 2013 Casino Source Term Development report (Appendix 7D).

Additional testing of the heap leach ore and residues are being conducted to evaluate leaching characteristics. These tests will include:

- Time series of pregnant leach solutions from six cyanide leach columns
- Time series of rinse solutions from six cyanide leach columns
- Cyanide destruction tests on cyanide leach solutions
- Characterization of leach residues by acid-base accounting, mineralogy and metal content.
- Long term leaching of cyanide leach residues to evaluate the evolution of drainage chemistry from heap leach.

Part a. – c.

Please refer to the response to R58 for a list of additional lab testing of leach ore.

A.7.6.1.10 R191

R191. Details demonstrating the ore beneficiation process proposed to produce suitable concentrate. Details should include the process steps, reagents to be used, and resulting concentrates and wastes generated.

The Casino Project will have two ore processes:

- A sulphide ore process, consisting of primary crushing followed by a single-line semi-autogenuous (SAG) mill, ball mill circuit and conventional copper-molybdenum flotation circuits
- An oxide ore process, which will use cyanide leaching followed by Adsorption Desorption and Recovery (ADR) to recover gold and silver, and Sulphidization Acidification Recycle and Thickening (SART) to recover copper sulphide precipitate within the HLF and process unit.

In January 2013, M3 Engineering & Technology Corporation (M3) completed a feasibility study for the Casino Project (M3 2013). The feasibility study presented the results of the cyanide heap leach and SART process and flotation testing conduced on core produced during the 2010 and 2012 exploration programs. The results of the feasibility study indicate that the ore beneficiation process proposed are unambiguous and will be used to further the design of the Casino Project ore processing facilities. Process steps, reagents to be used and resulting concentrates and wastes generated are detailed in the feasibility study (M3 2013), and process flow sheets are provided for review in Appendix A.4M.

Once operational, CMC will monitor and test the tailings and waste rock deposited into the TMF to ensure proper disposal techniques, as discussed in the ML/ARD Management Plan (Appendix A.22H).

A.7.6.1.11 R192

R192. For the Freegold Road upgrade and extension, access road borrow sources, airstrip, airstrip access road, and mine site borrow sources, provide additional details and information on:

a. all geological materials, including estimates of volumes, that will be excavated, exposed or otherwise disturbed;

b. geochemical characterization, analysis, and interpretation on representative samples for those geological materials;

c. consideration of potential effects and appropriate mitigation measures associated with excavating, exposing, or disturbing those materials.

The access road to the Casino Project includes the Freegold Road Upgrade that extends 82 km from Carmacks and new construction of the Freegold Road Extension that extends an additional 120 km to the Casino Project Site. A risk based approach to evaluate ML/ARD potential associated with the Freegold Road Extension was reported in *Casino Road: Preliminary Risk Assessment Metal Leaching and Acid Rock Drainage* (Appendix A.7J) and the *Freegold Road Upgrade in the Site Access Road ML/ARD Risk Assessment – Update* (Appendix 7D). The reports identified areas of potential ML/ARD risk that will require additional sampling and evaluation in order to fully understand the ML/ARD risk posed by road construction.

Part a.

Description of the geologic materials and volumes that will be disturbed along the Freegold Road Extension and the Freegold Road Upgrade are provided in Appendix A.7J and Appendix 7D, respectively. Geologic materials along the Freegold Road Extension are illustrated on maps and photos and discussed in Section 3.2.1 and Appendix I of Appendix A.7J. The volumes of these materials are provided in Section 4 and Appendix III. Additional information along the Freegold Road Extension is provided in Section 3.0 of Appendix 7D. A description of the geologic materials along the Freegold Road Upgrade are provided in Section 2.1 of Appendix 7D.

Part b.

Geochemical characterization, analysis and interpretation of the Freegold Road Extension are provided in Section 3.2.2 and Appendix II of Appendix A.7J. Geochemical characterization, analysis and interpretation of the Freegold Road Extension are provided in Section 2.2 and Appendix A and C of Appendix 7D. The additional characterization and risk assessment will be conducted in advance of detailed road design and the results of the analysis will be used to inform the design of the road and selection of quarry sites. A preliminary evaluation of borrow used for airstrip construction was conducted and the results are presented in Casino Mine Site Borrow Sites ML/ARD Potential (Appendix A.7K). Additional characterization of the borrow material that will be used for airstrip construction is planned.

Part c.

Consideration of the potential effects of the Freegold Road Extension are discussed in Section 4.0 of Appendix A.7J and Section 3.0 of Appendix 7D. Consideration of the potential effects of the Freegold Road Upgrade are provided in Appendix 7D. As detailed in the ML/ARD Management Plan (Appendix A.22H), the primary purpose of the ML/ARD Risk Assessment for the road is to identify areas that would have an unacceptable risk to impact water quality and aquatic life. The primary method to mitigate potential effects is via road design. Mitigation by design is accomplished by avoidance or minimizing disturbance of materials with a high ML/ARD potential. The proposed management presented in the ML/ARD Management Plan identifies and lists preliminary management options that are available to minimize the potential environmental effects of ML/ARD along the Casino access road, should the primary mitigation via design and avoidance cannot be implemented. The summary provided in Table A.7.6 6 identifies the basic, conceptual options, and is intended to serve as the basis for further discussion and ongoing refinement, as the project progresses.

Various mitigation options for controlling and/or treating ML/ARD have been identified and evaluated over the past several decades. Research and practical experience is limited, but is adequate to provide a general indication of the options that are available, and the advantages and disadvantages of each. A total of five options have been identified that could be implemented should distinct sections of the road pose high risk of ML/ARD (Table A.7.6-6).

CMC will undertake detailed design work and continue to refine the ARD risk evaluation in support of the detailed road design. Preliminary borrow sites were detailed in Appendix 4B (Freegold Road Report) and associated design drawings (Appendix C of that report).

Final borrow source selection will consider environmental and socioeconomic values. Measures to partially mitigate the effects of borrow sources on environmental and socioeconomic values are identified in a number of management plans submitted with the Proposal and as supplementary information. CMC will apply the following mitigation measures to reduce the environmental effects of borrow sites, wherever possible:

- Borrow sources will be established outside of riparian areas (Appendix A.22C).
- Avoid new clearing for establishment of borrow areas during the breeding bird nesting season (1 May to 31 July in Yukon), or conduct nest surveys immediately prior to clearing activities (Appendices A.12A and A.22A).
- Sediment and erosion control measures will be used to minimise sediment transport beyond the borrow pit and pits will be sloped away from any watercourses (Appendix A.22C).
- Natural drainage patterns will be maintained and additional drainage ditches may be necessary to divert surface run-off around borrow pits and reduce the potential for erosion and sediment transport (Appendix A.22C).
- Avoid the development of borrow sites in areas of potentially unstable terrain.
- The number of gravel pits/borrow pits in the area of the Klaza Caribou Herd winter range will be minimized to the extent possible (Appendix A.12A, Section 4.1).
- The Project footprint, including borrow sources, will not disturb important wildlife habitat features (e.g., mineral licks) or known locations of rare plant occurrences (Appendix A.12A, Section 4.1).
- Soil will be salvaged during land clearing for use during reclamation (Appendix A.22D).

Areas will be allowed to naturally re-vegetate to reduce the potential introduction of invasive plant species.

Table A.7.6-6 Summary of ML/ARD Management Options

Decision Criteria	MANAGEMENT OPTIONS				
	Prevention and Control			Water Treatment	
	1 - Blending	2 - Dry Cover	3 - Water Cover	4 - Passive Treatment	5 - Active Treatment
Description	Potentially acid generating and acid consuming waste (limestone or other) can theoretically be blended or layered to produce a geochemically benign composite.	The purpose of a dry cover is to minimize water/oxygen ingress into underlying sulphide-rich rock. The cover forms a barrier to limit infiltration, or stores and releases stormwater, while maintaining saturated conditions under the cover.	Dispose sulphide-rich rock under water (subaqueous disposal) to inhibit oxidation. Laboratory and field studies indicate that flooding sulphide minerals is the most successful method presently known for preventing and controlling ARD.	Passive treatment systems use natural chemical, biological or physical processes to modify water that has been impacted by ML/ARD. Examples include anoxic limestone drains and constructed wetlands.	Active treatment systems may use chemical, physical (membrane) or biological processes to raise pH and extract metals from water affected by ML/ARD.
Limitations	Achieving adequate mixing to reduce sulphide oxidation rates is not considered feasible at field scale (requires adequate mixing to affect pore water chemistry).	Dry covers may limit the volume of drainage generated, however the reduced drainage volume may still contain high metal concentrations. Maintaining long-term performance of covers may be challenging.	Does not control oxidation that occurs prior to submergence, requires maintenance of water cover in perpetuity, does not immobilize all metals, any discharge may still require treatment.	Canadian climate and aquatic environments pose challenges, especially for biologically-driven systems. Passive treatment systems must be able to operate effectively in cold temperatures, drought, large storm events, and spring “freshet”.	High capital and operating cost. It may not be practical to reduce pH and all metal concentrations to meet regulatory requirements or relevant guidelines. Sludge management, disposal and storage capacity may require careful consideration.

Decision Criteria	MANAGEMENT OPTIONS				
	Prevention and Control			Water Treatment	
	1 - Blending	2 - Dry Cover	3 - Water Cover	4 - Passive Treatment	5 - Active Treatment
Residual Uncertainty	Moderate to High – Blending may delay the onset of acidic effluent, and reduce acid and/or metal loadings by providing attenuation for drainage, but is unlikely to eliminate metal leaching.	Moderate to High - The long-term durability of dry covers is uncertain. It has been suggested that cover systems should be designed to “fail” over geologic time such that the natural environment can withstand the incremental “failure”.	Moderate – “…fundamental understanding of many phenomena influencing their performance is unknown, and the minimum depth of water required cannot be confidently determined”	Moderate – the long-term performance of passive treatment systems through climatic and weather extremes may be difficult to maintain.	Low to Moderate – Effluent quality can generally be maintained within a predictable range in the short to medium term. Long-term commitment to operate and maintain treatment system may be difficult to ensure.
Further Work Required to Reduce Uncertainty	Field tests to evaluate degree of blending that can be achieved and blending methodology, and to evaluate geochemical behaviour of blended material. Ongoing monitoring is required to characterize receiving environment and evaluate attenuation capacity.	Define cover performance criteria, evaluate options and select cover design. Predict long-term performance. Ongoing monitoring of both cover performance and environmental effects.	Identification of suitable site. Evaluation of chemical and physical design considerations. Ongoing monitoring of outfall, and to characterize receiving environment and attenuation capacity.	Define quality of influent and performance objectives. Research and design treatment system. Undertake sensitivity analysis and predict long-term performance. Define maintenance requirements. Water management system to collect and convey water.	Define quality of influent and performance objectives. Research and design treatment system. Determine method for sludge disposal. Water management system to collect and convey water to treatment system, and effluent to natural channel.
Capital Cost	Moderate – intensive re-handling required to excavate, mix and replace road base	Low to Moderate – depending on whether material can be covered in place or must be relocated.	Moderate – removal and replacement of road bed, preparation and deposition in impoundment	Low – limited to construction of passive system, including site grading, planting, *etc*.	High – cost to design and construct treatment plant may be considerable (average $7.5M, high $40M).
Operating Cost	Low – ongoing water quality monitoring	Low to Moderate – depending on cover monitoring requirement.	Low- ongoing water quality monitoring	Low – minor maintenance and monitoring.	High – average cost to operate treatment plant is $1.50 / m^3
Key Reference	MEND 1998	MEND 2004	MEND 1998	MEND 1996	MEND 2013

A.7.6.1.12 R193

R193. The following referenced report: Lorax Environmental Services Ltd. (2012) Casino Road: Preliminary Risk Assessment Metal Leaching and Acid Rock Drainage.

This report is provided in Appendix A.7J. This report is supplemented by the Site Access Road ML/ARD Risk Assessment – Update (November 2013) provided in Appendix 7D.

A.7.6.2 TMF Embankment Loadings

A.7.6.2.1 R194

R194. Details and justification on the depth of reaction and loadings source of 2.0m for the face of the embankment when the active oxidation zone will initially be over a much deeper zone and will evolve downward over time. Justify the loading rates in the source term as a function of the oxidation zone only.

As detailed in the Casino Geochemical Source Term Development Report (Appendix 7D), simulation of unsaturated sulfide oxidation at Casino Embankment Sand was conducted using a reactive transport code MIN3P (Mayer et al. 2002). MIN3P is a general-purpose numerical model for reactive transport problems in variably saturated media. The model formulation includes the relevant transport and key geochemical processes influencing sulphide mineral oxidation within unsaturated waste rock piles.

Figure A.7.6-2 shows the simulation results for oxygen concentration, pyrite volume fraction, and oxidation rate with depth. The depths with higher oxidation rates at each simulation time indicate where active pyrite oxidation is occurring at that time. This corresponds to approximately 8-10, 15-16, and 21-22 m for 20, 50, and 100 years of simulation times. The depth of oxygen ingress increases with time. The zone of active pyrite oxidation is approximately 2 m thick and this 2 m thick zone continues to progress down through the embankment with time. It is this zone of active oxidation that will be the source of metal loading. The MIN3P model results indicate that the pyrite above the zone of active oxidation has completely oxidized and that the volumetric pyrite content is effectively 0 in this upper region.

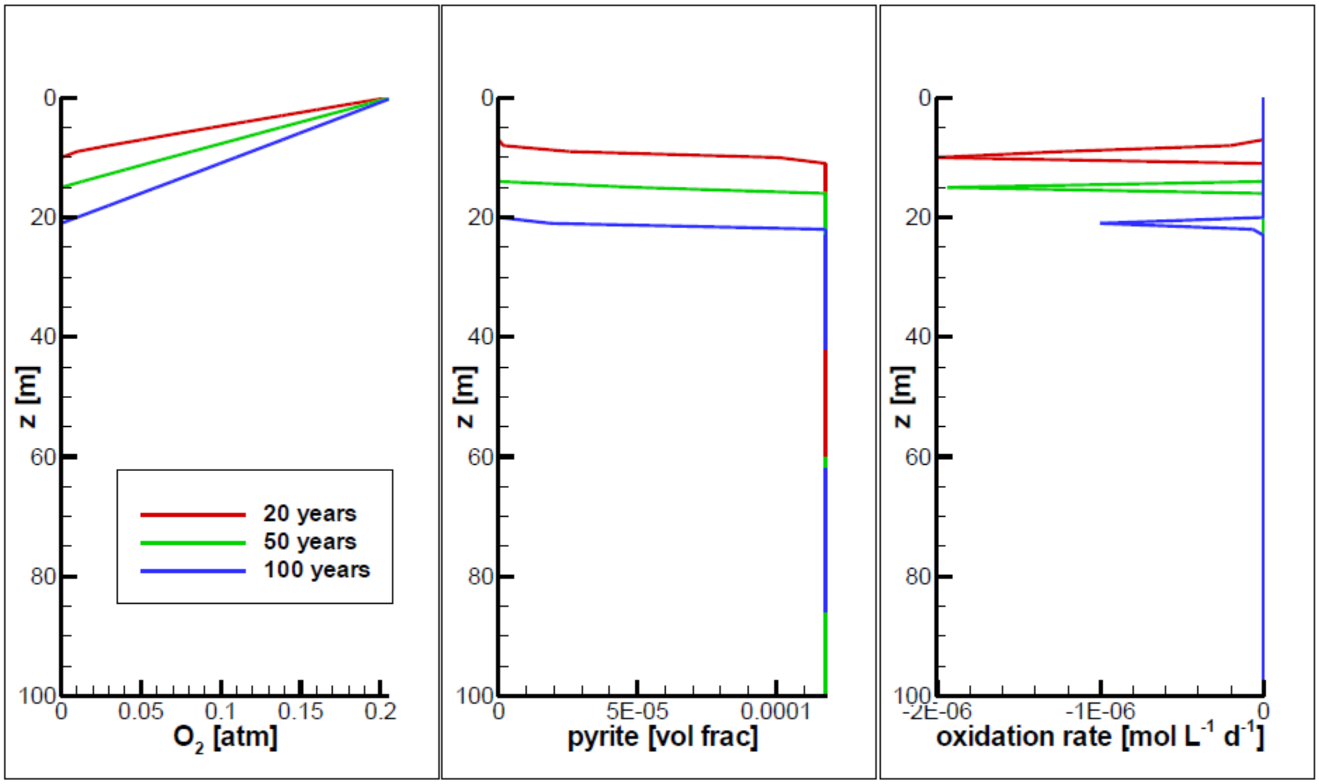


Figure A.7.6-2 Embankment oxygen concentration, pyrite volume fraction, and oxidation rate with depth (Figure 5-3 from Appendix 7D)

A.7.6.2.2 R195

R195. Clarify the loadings as either runoff on the embankment slope and/or the downward infiltration that will eventually daylight as seepage from the embankment.

The Casino Geochemical Source Term Development report (Appendix 7D), discusses the development of Geochemical source terms for several flows exiting the saturated TMF (Figure 7-2, reproduced in Figure A.7.6-3) including flow through the foundation of the facility (Flow 9), seepage through the embankment (Flow 10), seepage into the tailings pond from waste rock, PAG tailings and NAG tailings (Flows 15, 17 and 19, respectively). The model predicts that each of these flows will be influenced by porewaters originating from various zones within the TMF.

For the purpose of source term calculation, runoff and infiltration from the Embankment were not distinguished. That is, the TMF embankment source term represents both runoff and infiltration. In the water quality model, the loads from the embankment are added to the loads from the interior of the impoundment at the toe of the dam. The water quality model does not differentiate between the possible mechanisms that are responsible for the transport of the soluble load from the embankment (Appendix A.7B). However, the oxidation model discussed in the response to R194 indicates that the source zone will be 2 metres below the surface 20 years into closure, so during the majority of the closure phase, loads will be transported via infiltration. Possible pathways for the embankment loads are shown by blue arrows on Figure A.7.6-3 (i.e. both infiltration and runoff).

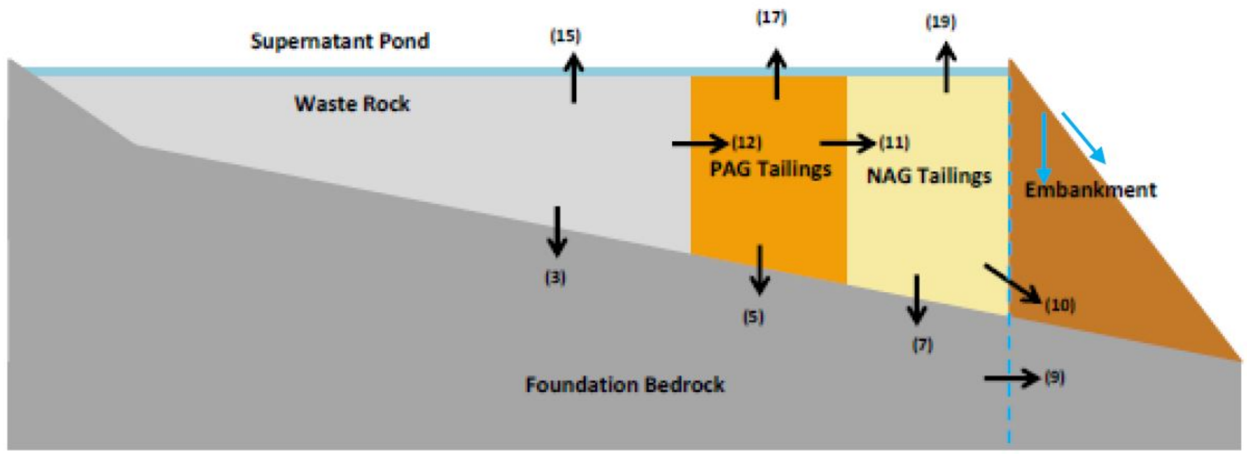


Figure A.7.6-3 Illustration of Embankment Loading Pathway via Runoff or Infiltration (Figure 7-2 from Appendix 7D)

A.7.6.2.3 R196

R196. Justify the depth of oxidation on the tailings beach and show the effect and implications of oxidation on the loadings associated with the infiltrating porewater and tailings seepage.

As detailed in the Casino Geochemical Source Term Development Report (Appendix 7D), starting in year 1 of mine operations, pyrite rougher tailings will be discharged to a center-line construction tailings dam. Cyclone overflow slimes and the bulk of the tailings supernatant will be deposited in the submerged upstream portion of the TMF. Tailings sands from the cyclone underflow will be deposited along the downstream crest of the embankment and will be used to construct the unsaturated tailings embankment. During the winter months, tailings cycloning ceases and whole tailings are discharged directly into the upstream portion of the TMF. The tailings embankment and tailings beach will remain unsaturated and subject to oxidation during mine life and upon closure.

In order to assess the impact of runoff and seepage from these exposed tailings facilities, geochemical source terms were developed using samples collected from metallurgical tailings samples produced in 2010 and 2012. These samples were subjected to static and kinetic laboratory tests which form the basis of source term development. The various work stages leading to the development of these source term concentrations for the individual stockpiles include:

- Description of tailings embankment and beach construction;
- Selection of kinetic test data for model input;
- Application of scaling factors;
- Application of secondary mineral controls (speciation calculations).

The oxidation load from the tailings beach is applied to runoff and shallow seepage. The tailings beach source term is derived from humidity cell leaching rates. The water quality model places all of the loads derived from the tailings beach to the pond (Appendix A.7B – replicated in Figure A.7.6-4). Loading derived from oxidation of the tailings beach is not applied to a deep infiltration pathway because 3D groundwater models indicate that shallow tailings pore water is moving upward and discharging into the pond or moving laterally through the tailings toward the embankment (Appendix 7E). However, loading from the tailings porewater has been accounted for separately from the tailings beach by utilizing leaching rates of tailings from saturated column experiments. Deep tailings porewater loads are derived from the dissolution of water soluble and redox sensitive minerals rather than sulphide oxidation, hence, assessing the loads from tailings using the saturated column data was deemed to be more appropriate than humidity cell data.

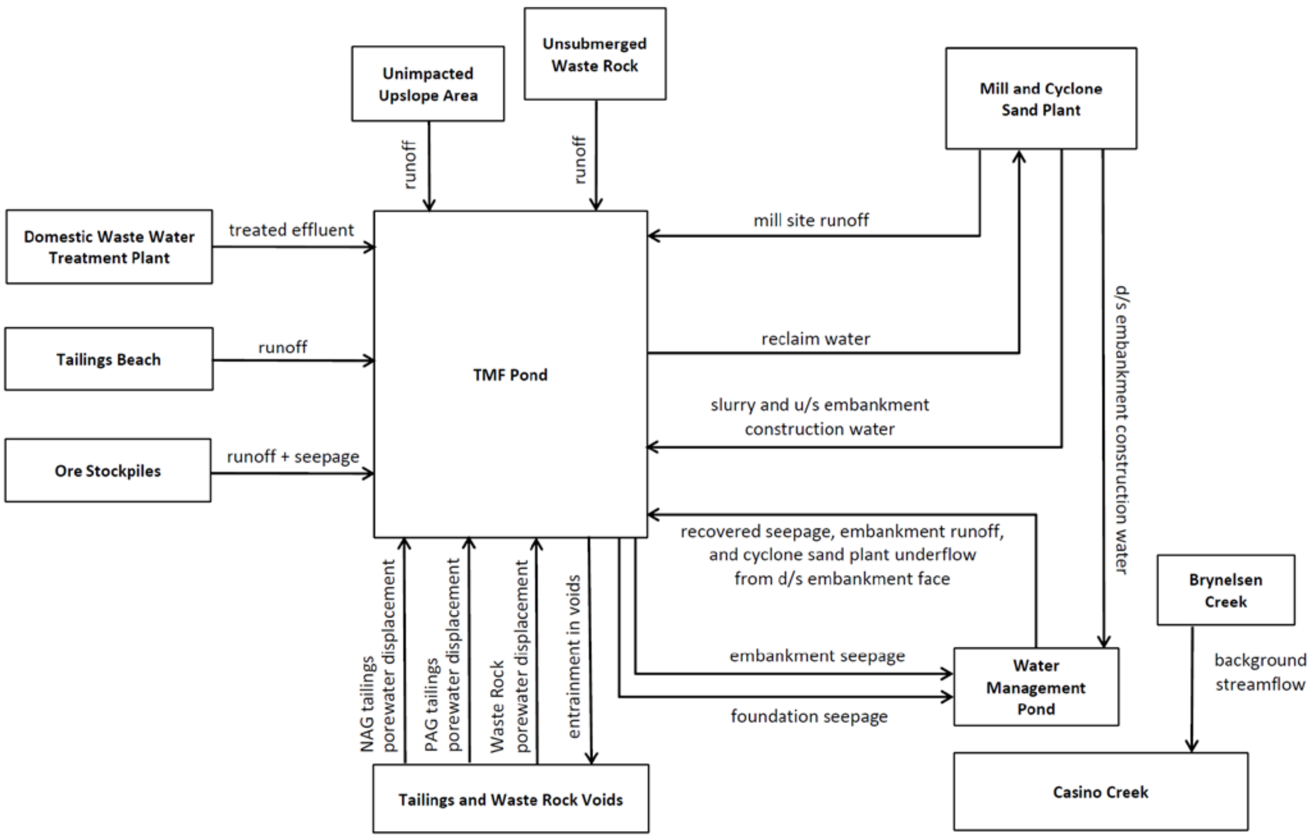


Figure A.7.6-4 Mass Loading Flow Paths through the TMF Pond System (Operations Phase) (replicated from Appendix A.7B)

A.7.6.3 Missing Information

A.7.6.3.1 R197

R197. The text on page 4-66 refers to Figure 4.1.4 yet this could not be found, or appears to be mislabelled. Please provide this figure for review.

The correct reference on page 4-66 is Figure 4.1.5 and not Figure 4.1.4.

A.7.6.3.2 R198

R198. Casino Cross Sections (Appendix A2 – in LORAX (2013) Casino Geochemical Static Test Assessment, 3-Dec-13, J862-5).

These cross sections are provided in Appendix A.7H.

A.7.6.3.3 R199

R199. Supplemental Unsaturated Kinetic Test Results (Appendix B – LORAX (2013) Casino Geochemical Source Term Development, 4 December, J862-5).

The missing Appendix B from Casino Geochemical Source Term Development is provided in Appendix A.7L.

A.7.6.3.4 R200

R200. The following referenced report: Himmelright, J. R. 1994: The effect of natural acid rock drainage on Casino Creek. Prepared for Pacific Sentinel Gold Corp. August 1994.

The Effect of Natural Acid Rock Drainage on Casino Creek (Himmelright 1994) is provided in Appendix A.7F.

A.7.7 NUMERICAL GROUNDWATER MODEL

A.7.7.1.1 R201

R201. Re-run the numerical groundwater model with updated groundwater baseline data.

Groundwater baseline data has been collected in 2013 and 2014, and will continue throughout the YESAB and permitting process. Updated baseline data will be provided for water use licensing purposes, and the numerical groundwater model will be updated, as will the water balance and water quality models, which receive inputs from the numerical groundwater model.

A.7.7.1.2 R202

R202. A copy of the updated Modflow numerical groundwater model and all input data used in the modeling runs including:

a. a copy of all model outputs as summary tables and figures; and
b. further discussion of assumptions used in the modeling.

The Modflow numerical groundwater model will be updated for water use licensing, but will not be updated within the YESAB process.

A.7.7.1.3 R203

R203. Discuss whether the open pit lake seepage predicted by the numerical model, to Casino Creek after closure, is assessed in the overall loadings to the TMF and the downstream environment. If not, provide rationale for its exclusion.

As detailed in the Water Quality Model Report (Appendix A.7B) and the Water Balance Model Report (Appendix 7F), pit lake seepage was modelled to discharge to the North TMF Wetland (Figure A.7.7-1) during the closure and post-closure phases. The value for water discharged to the wetland system in the water balance model, and subsequently in the water quality model is composed of direct precipitation, background runoff, Pit Lake discharge, and seepage (up to 11 L/s) from the Pit Lake.

Any discharges to the downstream environment would be modeled through embankment and foundation seepage from the TMF pond, as shown in Figure A.7.7-2.

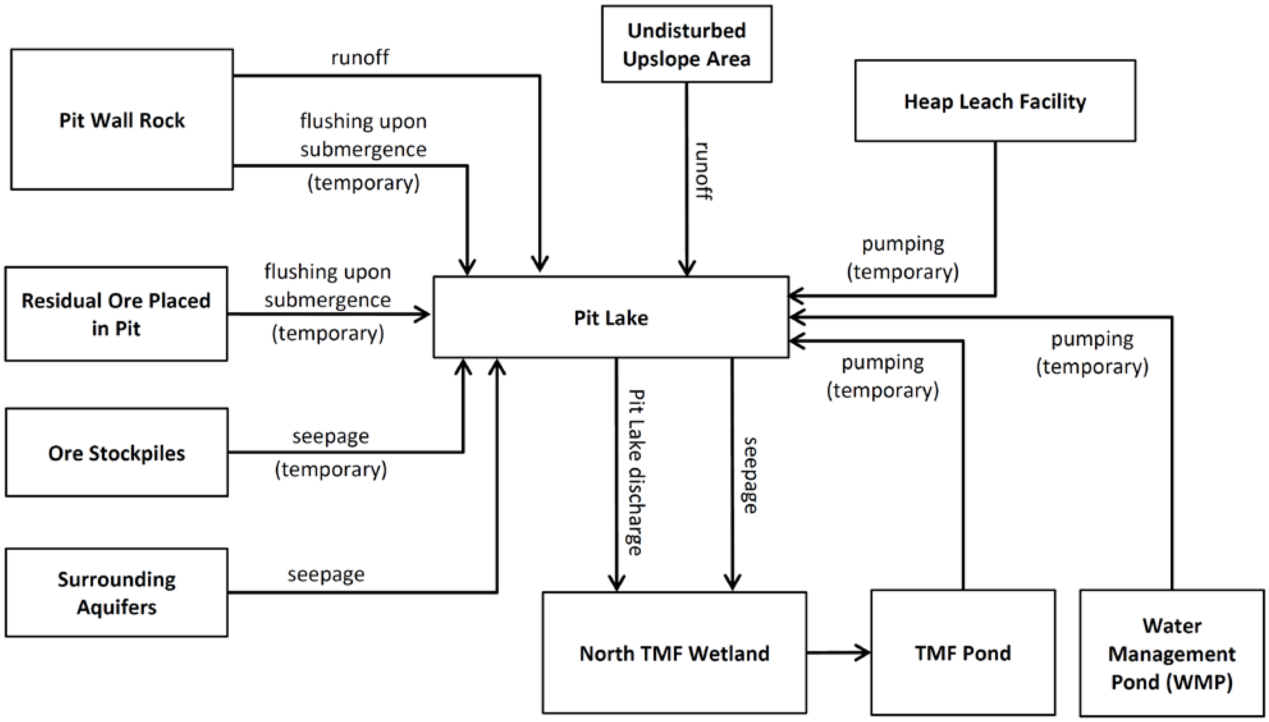


Figure A.7.7-1 Mass Transport Flow Paths through the Post-Closure Pit Lake System

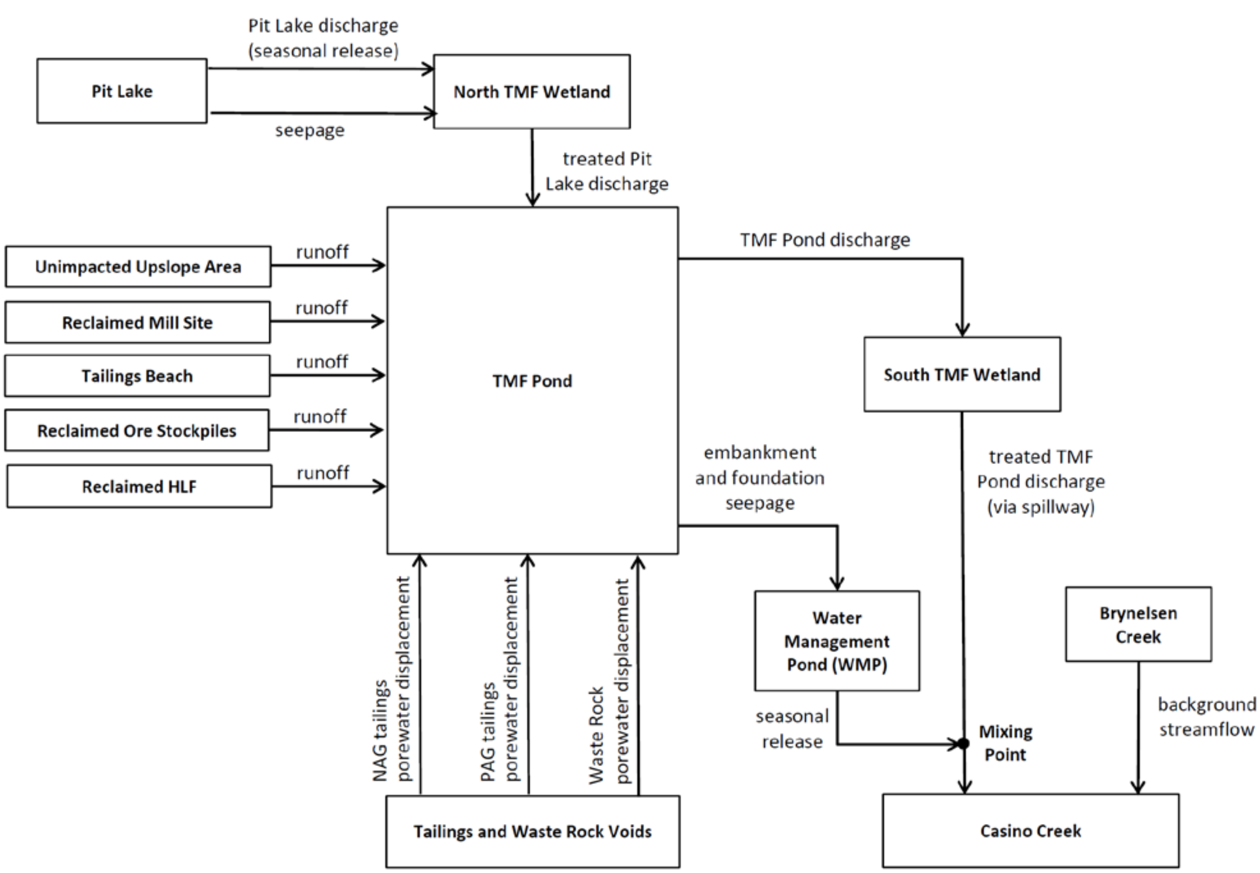


Figure A.7.7-2 Mass Transport Flow Paths through the TMF Pond (post-closure)

A.7.7.1.4 R204

R204. If the majority of the predicted seepage, from the open pit lake, of 12 L/s will report to the upper groundwater system in Casino Creek:

a. identify what the predicted magnitude of the remaining seepage will be; and

b. identify where the remaining seepage is predicted to report to and what the effect of that seepage will be.

The 12 L/s predicted from the groundwater model (Appendix 7E) was defined for a pit lake elevation of 1100 m. However, the maximum pit filling elevation is 1095 m. A linear extrapolation from 1100 m to 1095 m resulted in a maximum seepage of 11 L/s. As detailed in the Water Balance Model Report (Appendix 7F) the entire 11 L/s is modeled to report to the TMF pond, as shown above in Figure A.7.7-1 and Figure A.7.7-2.

A.7.7.1.5 R205

R205. Discuss whether the potential for preferential flow through faults below the TMF were considered and if not, discuss why and if so, discuss what were the results and implications for water quality downstream of the TMF.

Data collected during site investigations conducted within the TMF footprint have identified small-scale structures and shear zones within the TMF footprint; however, no large-scale structures with elevated permeability have been identified (*Report on Feasibility Design of the Tailings Management Facility*, Appendix A.4D). Review of historical earthquake records and regional tectonics indicates that the Casino Project site is situated in a region of low seismicity. No earthquakes (>3.5 magnitude) are listed in the earthquake databases within 80 km radius of the project site, as illustrated in Figure 3.1 of Appendix A.4D. This indicates that faults in the project area have not been active for the period of record. Consequently, no evidence is available of any active faults in the project area.

In addition, no groundwater features have been identified that would support the presence of a groundwater pathway along a permeable fault underlying the footprint of the TMF Embankment (water level anomalies, hydrogeologic test results, springs, etc.). Based on this dataset, a fault beneath the TMF footprint was not considered in the base case numerical model for the seepage assessment. However, to ensure possible zones of elevated permeability at the large-scale were considered in the numerical model (corresponding to a model grid size of 50 to 100 m), an elevated permeability value was assigned to the upper bedrock layer of Model 2 of the base case seepage assessment (Appendix 7E). This elevated permeability value was five times higher than the hydraulic conductivity value that provided the best fit to model calibration criteria adopted in base case Model 1. The seepage results from the more conservative base case Model 2 were subsequently used to develop geochemical source terms and water quality predictions. Conversely, the potential for flow through faults below the TMF was not explicitly considered in the numerical groundwater model. While small scale structures and shear zones have been identified within the TMF footprint (Revised Tailings Management Facility Seepage Assessment, Appendix A.4L), no large scale structures have been identified. If future field investigations identify a large scale structure beneath the TMF, the effect on TMF seepage rates will be assessed.

Additional site investigations are planned to investigate the presence and properties of discontinuities in the embankment area. Two narrow zones of low velocity within competent bedrock were encountered in seismic refraction data collected within the TMF Embankment footprint (Appendix 6D). One zone is located on the east abutment of the Main Embankment and the other is located on the west abutment near drillhole DH10-03. The low velocity zones are consistent with zones of highly fractured and weathered granodiorite, and are interpreted to indicate shear or fault zones in the bedrock. The effect on TMF seepage rates will be assessed if future field investigations identify either of these zones or any additional zones as a large-scale conductive structures beneath the TMF. Field investigations are will be conducted in 2015. See Section A.4 for more details on the TMF.

A.7.7.1.6 R206

R206. Clarify whether hydraulic conductivity values of the tailings and embankment materials are estimates or laboratory measured values. If they are estimates, please indicate if, and when laboratory testing will be conducted.

Additional hydraulic conductivity studies (packer testing) are planned in support of detailed design within the TMF footprint and the Heap Leach Facility. Hydraulic testing is also planned along the ridge east of the TMF Embankment that separates Casino Creek and Dip Creek watersheds. Response testing will also be conducted where standpipes are installed.

Hydraulic conductivity values assigned to tailings and embankment materials within the numerical model were based on laboratory measured values. Laboratory measured values are presented in Table 3.1 of the TMF Seepage Assessment Report (Appendix A.4L).

A.7.7.1.7 R207

R207. Update the numerical groundwater model to specifically include the seepage recovery pond and calculate the seepage recovery pond's efficiency including the flux of untreated water that will bypass the pond.

The Water Management Pond (seepage recovery pond) was represented in the Modflow model in a simplistic and conservative manner, which included:

- No subsurface representation of a low permeability cut-off wall; and
- A pond surface water elevation equal to the ground surface elevation of the 50 m by 50 m model grid cell. The pond was not represented as an excavated and dewatered pond.

Assessing the efficiency of the seepage recovery pond using the numerical model was initially evaluated during the modelling process using two different approaches:

- Assigning the pond as a hydrostratigraphic unit (HSU) in order to calculate fluxes in and out of the pond as requested by Natural Resources Canada. Unfortunately, only the net inflow to the HSU representing the pond could be calculated using this technique, which includes both TMF seepage as well as non-contact groundwater from the upgradient catchment. Therefore, it was not possible to delineate inflows to the pond that originate as TMF seepage and as non-contact groundwater using this method.
- Using MODPATH forward particle tracking by placing particles within all cells of the TMF and tracking them forward to their downstream discharge location. However, as stated in the Numerical Groundwater Modelling Assessment (Appendix 7E), "*A MODPATH particle tracking analysis was not used for the final seepage analysis due to the sensitivity of the simulated results to the MODPATH-input sink strength that controls termination criterion for particle flow paths.*" The sink strength specifies the minimum percent of water that must be removed from a cell by a boundary condition in order to terminate a particle trace in that cell. Assigning a 50% sink-strength in the Mine Effects model resulted in 100% particle capture before or at the Water Management Pond (100% efficiency). Increasing the particle strength to 80% or 100% resulted in a lower percent capture efficiency. Particles originating from the TMF were all located

within the model layer representing the alluvium unit at the location of the Water Management Pond and no particles were located in bedrock units beneath the pond. Results of the particle tracking indicate that any remaining TMF seepage at the location of the Water Management Pond is expected to be shallow and primarily contained within the alluvial unit.

The calculation of seepage recovery efficiency presented in the Numerical Groundwater Modelling report (Appendix 7E) was a Darcy-based flow calculation since it was considered to be transparent and not influenced by sensitive model parameters. The seepage recovered by the pond was calculated as the predicted amount of TMF seepage in excess of what could be transmitted within the alluvium unit beneath the pond, "*The capacity for groundwater flow beneath the water management pond within the Casino Creek valley alluvium was determined using a Darcy flow calculation to be 3 L/s"* (Appendix 7E). The flux of groundwater passing within the subsurface beneath the Water Management Pond was also assessed using the Modflow model. Modflow model results predict that groundwater flux within the alluvium unit beneath the pond is approximately 3 L/s and is in agreement with the Darcy-based calculation.

The foundation seepage recovery efficiency of the water management pond downstream of the main TMF Embankment was estimated using a mass balance approach taking into consideration predicted seepage through and beneath the Main TMF Embankment seepage and the capacity for groundwater flow through the alluvial deposit beneath the water management pond. Based on the results of the analysis, approximately 90-95% of the TMF foundation seepage is predicted to be recovered by the water management pond assuming that the pond is maintained with as low of a water level as possible. The remaining 5-10% of foundation seepage is expected to bypass the pond and discharge further downstream to Casino Creek.

Results of the TMF seepage assessment indicate that seepage through the TMF Main Embankment and foundation at the end of operations (Year 22) is predicted to be 36 L/s (38 L/s total TMF seepage minus the 2 L/s seepage through the TMF West Embankment). The capacity for groundwater flow beneath the water management pond within the Casino Creek valley alluvium was determined using a Darcy flow calculation to be 3 L/s. The Darcy calculation used a hydraulic conductivity for the alluvial deposit of 1E-5 m/s, an average height of alluvial sediments of 20 m, a width of the alluvial sediments of 250 m, and a hydraulic gradient of 0.05 m/m.

The Winter Seepage Mitigation Pond (WSMP) was proposed to replace the water management pond (WMP) during the closure phases of the Project to collect and store seepage from the TMF during the winter months. The WSMP was designed to be larger than the WMP installed during construction and would incorporate an upstream cut-off wall keyed into bedrock to intercept all seepage from the TMF dam and force it to surface to discharge to the WSMP. The WSMP would be lined with LLDPE or HDPE membrane, and initial design incorporated a 10 m high earthen dam with a gravity decant pipe system which would be closed during the winter months, and opened during the spring freshet (see Section A.4.11.9 for more details).

Reviewers have identified that it may be possible to install the proposed WSMP and supplementary groundwater cut-off wall previously proposed to be installed during the closure phase, during operations, in lieu of the WMP. In light of this comment, CMC proposes to initially install the water management pond at the location of the WSMP, and to monitor the seepage captured in the water management pond, and the water quality in the downstream receiving environment. Should water quality indicate that seepage is evident in the downstream environment; a groundwater cut-off wall may be installed in advance of the closure period. Regardless of installation details, all water collected in the water management pond installed downstream of the tailings management facility will be pumped back to the TMF during construction, operations, and through closure phase I. Discharge from the WMP will only be conducted during the April – November ice-free period, in conjunction with TMF spillway overflow.

Downstream seepage beyond the water management pond will be monitored through visual observation of upwelling flow and through water quality monitoring at station W28 (confluence of Brynelson and Casino Creek, same station at hydrology station H18 – see details in Section A.7.11.1.2 R242). If upwelling water is identified downstream of the water management pond, and upstream of Brynelson, it will be assumed to be seepage, and monitoring and effects analysis under the Metal Mine Effluent Regulations (MMER) will be applied.

A.7.7.1.8 R208

R208. Justification for using a series of steady state models rather than one transient model to predict groundwater flows.

A steady state model was used as model properties, such as hydraulic conductivity or layer surface elevation cannot be changed during a transient simulation. Therefore, in order to simulate development of the TMF it was necessary to build the TMF in the Modflow model using an isolated series of models. Assessing seepage from the TMF using a series of steady state models is considered to be conservative with respect to estimated quantities of seepage.

The construction of a transient groundwater model for the Casino Project was considered during development of the conceptual hydrogeologic model. However, building a Modflow model that represents progressive development of a TMF using a transient groundwater model is complex. Complexity is introduced since Modflow model properties such as hydraulic conductivity and layer surface elevation cannot be changed during a transient simulation. Therefore, it would be necessary to represent TMF development using an isolated series of transient Modflow models to represent the progressive growth of the TMF. Based on the amount of data available and that the required outcome needed to be conservative, the effort required to construct a transient model was not justified. Using the series of steady state models presented in the Numerical Groundwater Modelling report (Appendix 7E) or assess TMF seepage is considered conservative with respect to the estimated quantities of seepage.

CMC agrees that a transient calibrated model could be useful as a predictive and management tool and may provide additional insight into the potential for TMF seepage from the ridge along the east side of the facility. However, insufficient transient data is currently available to support the calibration of such a model. Model results and the resultant potential for seepage would have a high level of uncertainty without suitable transient data for calibration. The database of groundwater data collected during construction and early operations of the mine should be sufficient to support the construction of a transient model.

No updates to the numerical groundwater model are currently planned.

A.7.7.1.9 R209

R209. A description of how the numerical groundwater model is to be used and updated during the mining process in order to improve mine management and predictions for closure. Indicate when any updates would be released during operations.

It is anticipated that the model will be updated during the application for Quartz Mining License and Type A Water Use Licence. At that time, the model would be updated with the additional groundwater baseline data that has been collected at the site. The updates will provide information on how mine site facilities will interact with groundwater and be used to update predicted seepage rates, potential flow paths, and travel times for flows originating from mine facilities. Updated model results would be used to inform the Mine Waste and Water Management Plan and design of the groundwater monitoring network.

Results from an updated numerical model, such as predicted rates of seepage from a facility and flow between units within the TMF, would be used as updated inputs to the water quality model. Model results would also be used to support the Type A Water Use Licence application and in developing a closure plan.

A.7.7.1.10 R210

R210. Groundwater level data between the proposed TMF and the Dip Creek watershed. The area of greatest concern is along the watershed divide just beyond the eastern end of the main embankment.

Groundwater baseline conditions at the Casino Project were detailed in Appendix 7C, and the interpretation of site hydrogeological conditions considered data collected at the project site during hydrogeology, hydrometeorology, geotechnical, and geomechanical site investigations. Data reviewed included permeability testing at 287 locations, thermistor measurements at 14 locations, water levels at 57 locations, geophysical surveys along eight transects (including seismic refraction, ground penetrating radar, and electromagnetic conductivity surveys), and water quality data collected from 20 locations. Additionally, eleven groundwater monitoring wells were installed at six locations in June 2013 to collect hydrogeologic information in areas where data was previously unavailable (Figure A.7.7-3). Monitoring wells were installed adjacent to proposed stockpile footprints (MW13-01S/D, MW13-03S/D, and MW13-04S/D), east of the proposed TMF (MW13-05 and MW13-06S/D), and north of the deposit adjacent to Canadian Creek (MW13-02S/D).

Groundwater level data are available for three groundwater monitoring wells installed along the eastern slopes of the proposed TMF and the Dip Creek watershed (MW13-05 and MW13-06S/D). Available water level data from these monitoring wells indicates that the water table is approximately 30 to 40 mbgs, with recorded seasonal water level fluctuations of up to 12 m. The water level measured in standpipe DH10-06 installed on the eastern hillslope in the vicinity of the proposed TMF Embankment was 3 mbgs. Monitoring wells MW13-05 and MW13-06S/D installed in 2013 remain unfrozen, implying that permafrost does not exist at either of the two locations.

The potential for seepage through the ridge adjacent to the eastern end of the main embankment was assessed using an updated numerical groundwater (Modflow) model (Appendix A.7N). The updated model domain includes the ridge adjacent to the TMF.

A.7.7.1.11 R211

R211. A NW-SE geological cross-section (same approximate orientation as the main embankment) from the TMF to Dip Creek since this could demonstrate potential groundwater flow pathways across the topographic divide.

A geological cross-section along the proposed TMF Embankment to Dip Creek is provided on Figure A.7.7-4.

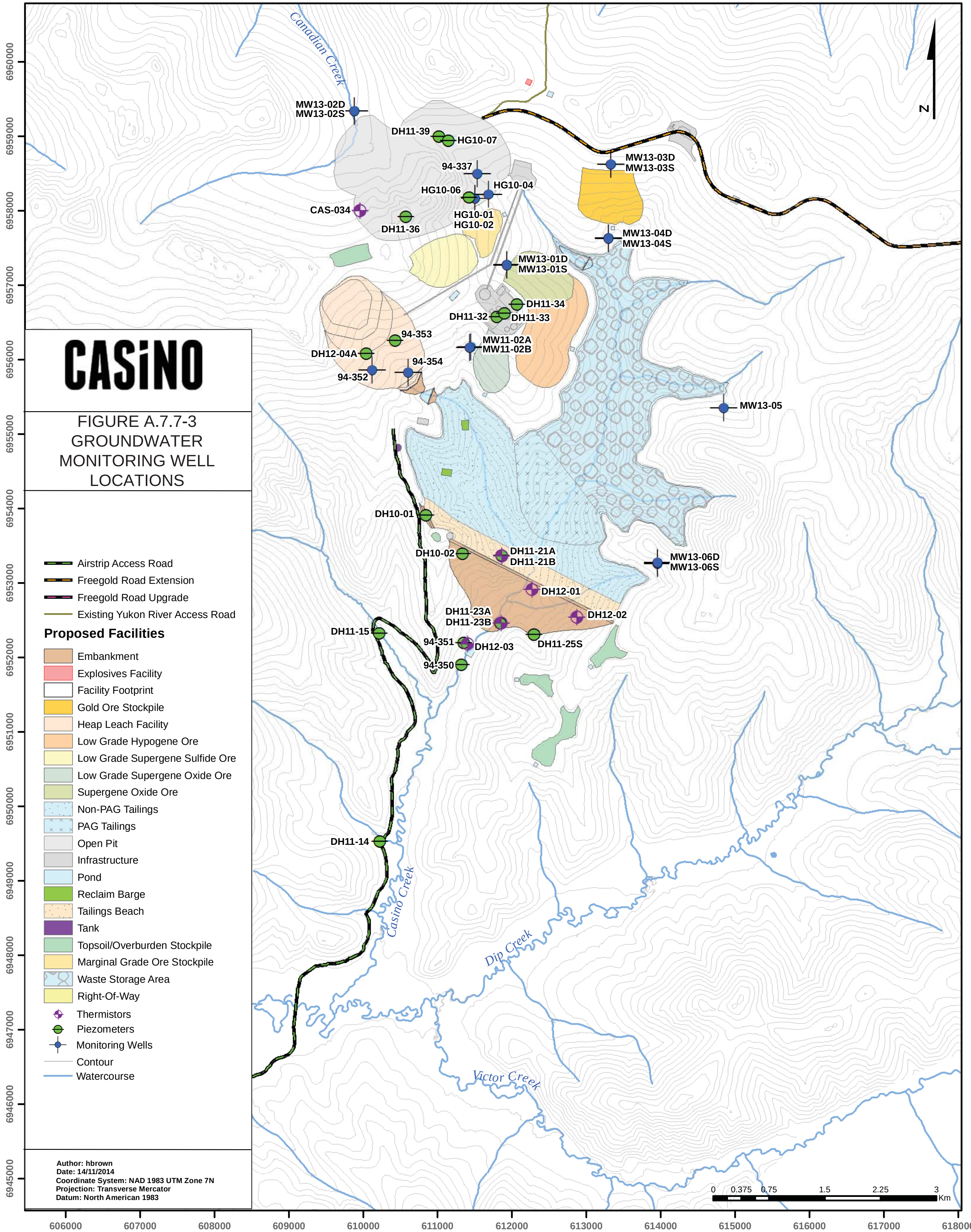
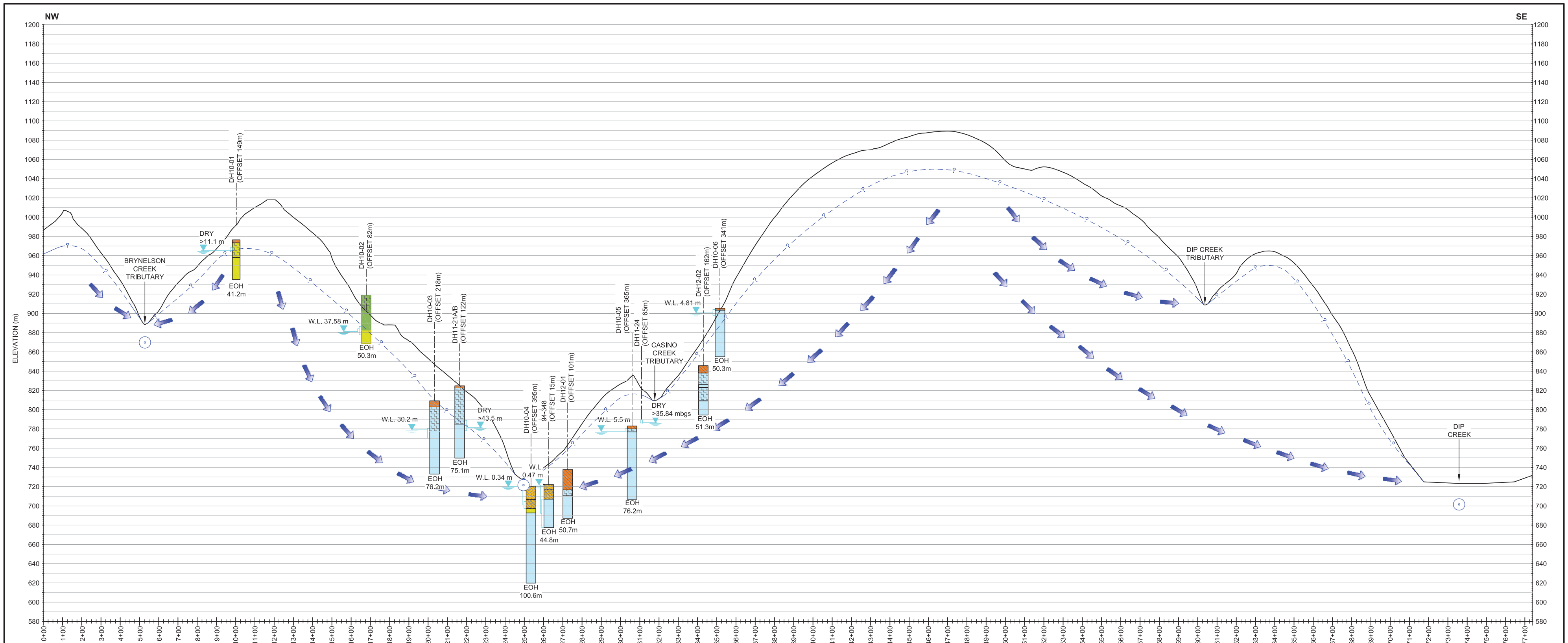
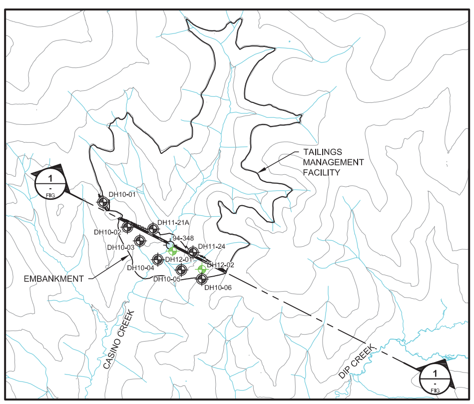


FIGURE A.7.7-3
GROUNDWATER MONITORING WELL LOCATIONS



SECTION 1
HILLSLOPE AREA AND CASINO CREEK VALLEY
HORIZONTAL SCALE A; VERTICAL SCALE B



KEY PLAN
NTS

LEGEND:

- COLLUVIAL VENEER
- COLLUVIAL VENEER FROZEN
- COLLUVIAL APRON
- COLLUVIAL APRON FROZEN
- MICROBRECCIA (MB)
- PATTON PORPHYRY (PP)
- INTRUSION BRECCIA (IX)
- GRANODIORITE / QUARTZ DIORITE (WRGD)
- WEATHERED GRANODIORITE / QUARTZ DIORITE (WRGD)
- GNEISS (YMGN)
- WEATHERED GNEISS (YMGN)
- YUKON METAMORPHIC COMPLEX - QUARTZITE (YMQT)
- WEATHERED QUARTZITE (YMQT)
- GW EL. GROUNDWATER LEVEL (mbgs) / SCREEN INTERVAL
- INFERRED GROUNDWATER LEVEL
- INFERRED GROUNDWATER FLOW DIRECTION
- GROUNDWATER FLOW OUT OF PAGE
- THERMISTOR
- MONITORING WELL
- GEOTECHNICAL PIEZOMETER

NOTES:

1. GROUNDWATER ELEVATIONS ARE CALCULATED USING WATER LEVEL MEASUREMENTS OBTAINED BETWEEN SEPT. 27 AND OCT. 2, 2014 EXCEPT DH10-03 AND DH10-04 (MAY 2010).
2. A BLOCKAGE WAS MEASURED IN 94-348 AT 6.2 mbgs WHEN THE WATER LEVEL WAS MEASURED.

SCALE B: 40 20 0 40 80 120 160 200 m
SCALE A: 200 100 0 200 400 600 800 1000 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	25NOV'14	ISSUED WITH REPORT	CAS	TAM	DJG	KJB

CASINO MINING CORPORATION

CASINO COPPER-GOLD PROJECT

HYDROGEOLOGICAL CROSS SECTION
CASINO CREEK AND DIP CREEK CATCHMENTS

Knight Piésold CONSULTING

P/A NO. VA101-325/17 | REF NO. 2

FIGURE A.7.7-4 | REV 0

SAVED: M:\1\01\00325\17\A\Acad\FIGS\B03_r0, 11/25/2014 1:17:07 PM, TMACGOWAN PRINTED: 11/25/2014 1:21:27 PM, Layout1, TMACGOWAN

A.7.7.1.12 R212

R212. Numerical groundwater flow modeling that extends into the Dip Creek watershed and eliminates the assumption of a no-flow boundary. Modeling should consider the potential for sub-permafrost groundwater flow across the topographic divide. Modeling the seepage from the TMF should consider three dimensional flow from the TMF in order to consider not only vertical flow through or beneath the dam but also horizontal flow around the dam and potentially into Dip Creek tributaries.

The potential for seepage through the ridge adjacent to the eastern end of the main embankment was assessed using an updated numerical groundwater (Modflow) model. The updated model domain includes the ridge adjacent to the TMF and the results are provided in Appendix A.7N.

A.7.7.1.13 R213

R213. Map of the elevation of the base of permafrost and data on deep permafrost conditions east of the proposed tailings management facility.

Available thermistor data indicates that discontinuous permafrost is present at the site to depths slightly greater than 100 mbgs (104 mbgs at CAS-034 in the deposit area and 111 mbgs at DH13-04 in Dip Creek valley). Permafrost has not been encountered or inferred to be present onsite at depths below 111 mbgs. Available thermistor data limited to within Casino Creek valley indicates permafrost in the valley and nearby slopes extends to depths of 40 to 70 mbgs (DH11-21B, DH11-23B, DH12-01, DH12-02, and DH12-03). Information on permafrost conditions east of the TMF is available from data collected from the following drillholes with thermistor, monitoring well, and standpipe installations:

- Thermistor string DH12-02 located on a north-facing slope adjacent to the eastern edge of the proposed TMF Embankment. Data from thermistor sensors at DH12-02 indicate that permafrost is present to a depth of 46 mbgs and the active layer extends to approximately 5 mbgs. Sensors at this location are installed to a maximum depth of 50 mbgs.
- Three monitoring wells installed along the hillslope east of the TMF in June 2013. Monitoring well MW13-05 is located on a north-facing slope at a ground surface elevation of 1,024 masl and has a total depth of 50.0 mbgs. Paired monitoring wells MW13-06S/D are located on a south-facing slope at a ground surface elevation of 1,070 masl. Total depth of the shallow well (MW13-06S) is 36.9 mbgs and of the deep well (MW13-06D) is 48.4 mbgs. The water column in each of the three monitoring wells has remained unfrozen, which suggests that permafrost does not exist at any of these locations.
- Standpipe DH10-06 was installed to a depth of 5.8 mbgs on a north-facing slope at the eastern extent of the proposed TMF Embankment. Water in the standpipe was free of ice during the site visit conducted in October 2014. Additional water level data and description of ice content at DH10-06 are unavailable. Since the depth of the active layer at the thermistor string DH12-02 installed nearby extends to 5 mbgs, this standpipe may be installed above permafrost.

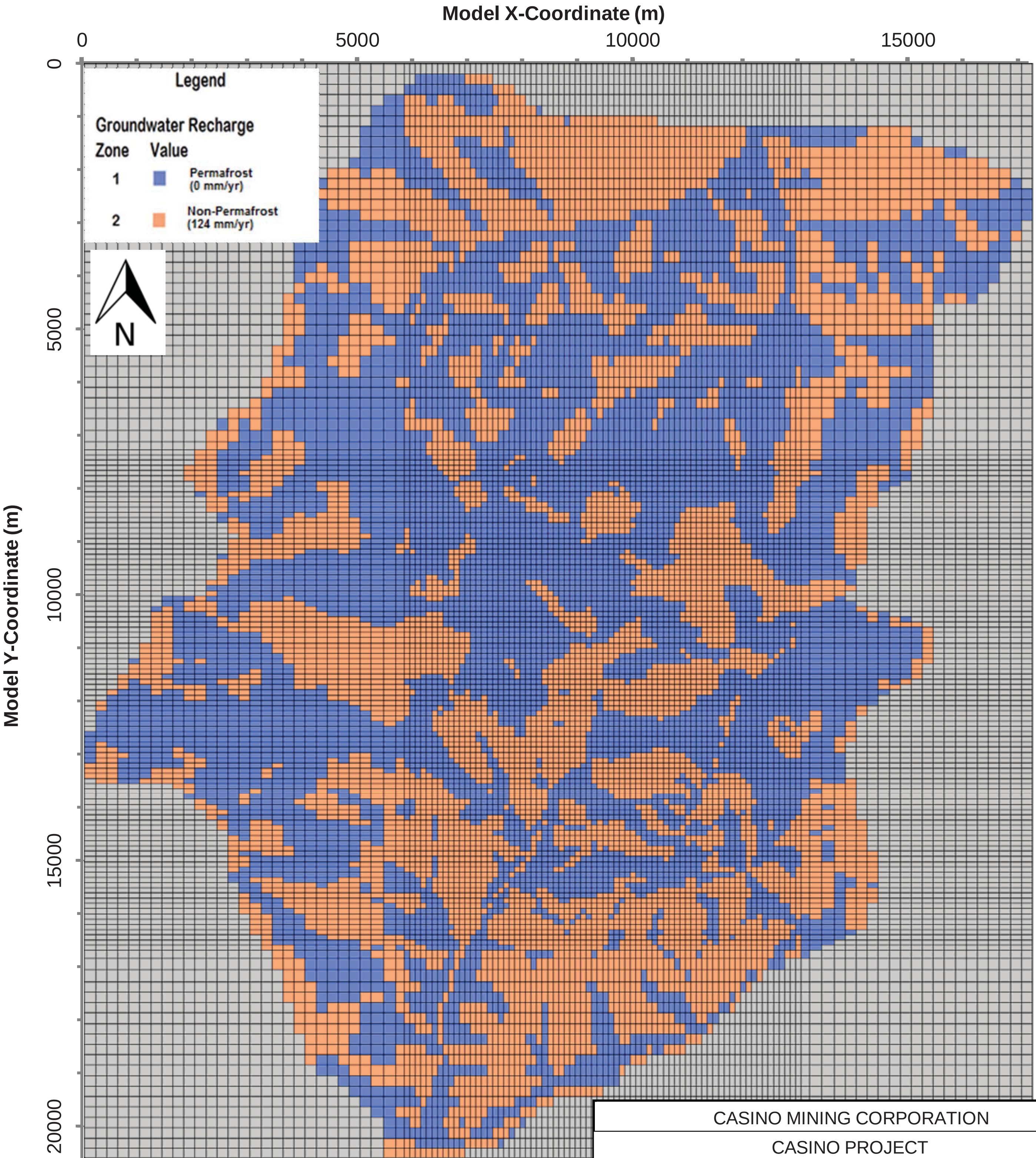
Thermistor and water level data are available in the 2013-2014 Groundwater Data Report provided in Appendix A.7M and the thermistor locations shown on Figure A.7.7-3.

A.7.7.1.14 R214

R214. Justification for not including the subsurface distribution of permafrost (in particular lower hydraulic conductivity of frozen ground as a barrier to groundwater flow) in the numerical groundwater flow modeling.

The most recent inferred spatial distribution of permafrost and the spatial distribution of recharge assigned to the Modflow model is shown in Figure A.7.7-5. In the Numerical Groundwater Modelling Report (Appendix 7E), the distribution of permafrost represented in the Modflow model was updated following the generation of the Hydrogeology Baseline Report (Appendix 7B), and the baseline Modflow model was not updated to reflect this new interpretation. However, the recharge distribution assigned to the Modflow model reflects a greater area of "non-permafrost" (greater area of recharge) than the updated interpretation of permafrost distribution. These additional windows where recharge was assigned to the model that are interpreted to consist of permafrost include areas upslope of the Heap Leach Facility and near the southwestern catchment boundary of Canadian Creek. Smaller windows also exist within upslope areas near catchment boundaries. The increased area of non-permafrost assigned to the model results in a greater amount of groundwater contributing to the Open Pit and the TMF than would be estimated using the updated permafrost distribution. Therefore, estimated TMF seepage rates reported in the Numerical Modelling Report (Appendix 7E) would be overestimated and can be considered to be a conservative representation.

Additionally, inclusion of a permafrost model within the numerical groundwater model has not been conducted, as CMC believes that the inclusion of such a model would not increase the understanding of groundwater flow at the site given the complexity and associated uncertainty involved with creating a permafrost model. In the Modflow groundwater model, permafrost was not assigned to subsurface layers of the model in order to keep the level of detail representative of available data. Assigning permafrost to subsurface layers increases model complexity and implies that greater knowledge about the discontinuous permafrost distribution is known.



NOTES:
1. THE DISTRIBUTION OF PERMAFROST AND NON-PERMAFROST ZONES IS BASED ON KP (2012) AND PRESENTED IN KP (2013B).

CASINO MINING CORPORATION

CASINO PROJECT

BASELINE GROUNDWATER MODEL
GROUNDWATER RECHARGE ZONES

Knight Piésold CONSULTING

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	23JAN'15	ISSUED WITH LETTER	KTD	CAS	KJB

P/A NO. VA101-325/17
CONT. NO. VA15-01965

FIGURE A.7.7-5
REV 0

A.7.7.1.15 R215

R215. A discussion of the effect of permafrost distribution on the observed and modelled patterns of groundwater flow.

The Modflow model was constructed with the level of detail required to represent the primary groundwater flow pathways. Refining the model to include spatially distributed permafrost by assigning subsurface layers as no flow would restrict groundwater flow within select regions. However, groundwater flow would still be forced to follow a similar flow path due to the steep topography at the site. At the small-scale (i.e., 10's of meters) the predicted groundwater flow paths would differ if permafrost was included in the model. However, at the large-scale (i.e., 100's of meters) that is represented by the Modflow model, the predicted flow paths would be similar.

By definition, the hydraulic conductivity of permafrost is zero; therefore, the hydraulic conductivity of frozen hydrostratigraphic units will also be zero and no groundwater flow will occur through the frozen unit. Thermal changes within the permafrost (frozen unit) are not expected to influence groundwater flow since it will still remain a (frozen) barrier to flow. Based on the relatively steep topography at the site, groundwater flow is expected to follow local flow paths and discharge to valleys and local topographic lows. Under the influence of this steep topography, flow paths are expected to be short, with groundwater discharging to adjacent streams.

A.7.7.1.16 R216

R216. Discussion of hydraulic conductivities of frozen and unfrozen hydrostratigraphic units. Details should include:

a. estimates of frozen and unfrozen hydraulic conductivities of all rock materials subject to permafrost; and

b. how thermal changes (due to facility construction and climate change) will affect the groundwater regime.

Part a.

As discussed above, representation of permafrost in the numerical groundwater model as a barrier to groundwater flow was considered during initial development of the numerical model. However, the decision was made not to represent permafrost zones with a lower hydraulic conductivity within the subsurface of the baseline numerical model since the distribution of permafrost is not expected to have a significant effect on the regional-scale seepage pathways from facilities to downstream receptors or impact seepage rates. The relatively steep topography at the site is expected to drive groundwater flow and define groundwater recharge and discharge zones at topographic highs and lows, respectively. The baseline groundwater model resulted in an acceptable calibration as constructed.

Part b.

Thawing of ice-rich soils may lead to excessive settlements, and loss of strength. The ice-rich soils typically exhibit very low strengths when thawed, and flow even under very flat slopes. Two gelifluction lobes that were observed within the colluvial apron in the TMF embankment area are evidence of this potential for instability. Ice-rich soils also have the potential for long term creep displacements.

Disturbance or removal of the vegetative cover may result in the melting of permafrost and the development of unstable conditions. Frozen overburden and bedrock that are underlying part of the tailings impoundment and embankments are expected to thaw over time, as the tailings and water stored in the TMF will act as a heat source. It is therefore recommended that all ice-rich overburden encountered during construction be removed along the entire foundation of the TMF embankments. Ground ice is not expected to be significant in bedrock which will likely provide a stable foundation for the embankments. Preferential seepage paths may develop when ice filled discontinuities thaw. Bedrock may have to be steamed and grouted if this is the case.

Thermistors were installed during the 2011 and 2012 site investigations to provide a better understanding of the thermal regime in the bedrock. Additional site investigations will be required to confirm the characteristics of the overburden and bedrock, and the extent of permafrost within the TMF embankment area. Thermal modelling may also be required to predict the effect of the proposed TMF on foundation conditions.

The potential for permafrost degradation was included in the Mine Effects groundwater models (Appendix 7E) by specifying all areas beneath major mine facilities (stockpiles and TMF Embankment) to be absent of permafrost. This assumption of permafrost degradation is conservative and allows potential seepage to proceed uninhibited within the model from the facility footprint to downstream receptors. Inclusion of all potential pathways from the facilities to the environment was appropriate for consideration of environmental effects.

Thermal modelling may be required to predict the effect of the proposed TMF on foundation conditions. Thermal modelling of the subsurface area beneath the proposed TMF Embankment may be conducted as part of detailed design to support the design of the TMF foundation.

Additional modelling that considers climate change impacts on permafrost distribution in the long-term post closure groundwater modelling will be considered during the application for Quartz Mine License. Projected future climate scenarios, as modeled by using emission scenarios outlined by the UN Intergovernmental Panel on Climate Change (IPCC), indicate that over the next 50 years mean annual temperatures in the Dawson region of the Yukon, including the Casino Mine Site, might increase in the order of 1°C to 4°C (Appendix 7F). Warmer temperatures could alter the permafrost conditions in the project area and affect the extent of the active layer.

A.7.7.1.17 R217

R217. A discussion and consideration of a numerical permafrost model to assess the effects of the mine components on permafrost distribution in the mine footprint.

Thermal modelling may be required to predict the effect of the proposed TMF on foundation conditions. Thermal modelling of the subsurface area beneath the proposed TMF Embankment may be conducted as part of detailed design to support the design of the TMF foundation. Additional modelling that considers impacts of the TMF footprint in the long-term post closure groundwater modelling will be considered during the Quartz Mining License application.

A.7.7.1.18 R218

R218. A discussion on the discrepancies between the Inferred Spatial Distribution of Permafrost (Figure 2.3 of Appendix 7C) and the Groundwater Recharge Zones (Figure 3.4 of Appendix 7E).

The most recent interpretation of permafrost distribution at the project site is presented in Figure 2.3 of the Hydrogeology Baseline Report (Appendix 7C). The recharge distribution assigned in the Modflow model (Appendix 7E) was based on an earlier interpretation of permafrost distribution at the site. The permafrost distribution was subsequently updated after the baseline Modflow model was constructed, and the baseline Modflow model was not updated to reflect this new interpretation.

A.7.7.1.19 R219

R219. A discussion of how recharge distributions were modified and their potential effects on the numerical groundwater flow model.

The recharge distribution assigned to the numerical groundwater model was not *modified*; rather, an earlier interpretation of the permafrost distribution was used as model input. A larger area of the model was assigned recharge than what would have been assigned based on the updated interpretation of permafrost distribution. This additional model area assigned recharge is primarily located upslope of the Heap Leach Facility and within the southwestern headwaters of the Canadian Creek catchment, with smaller areas located in other portions of sub-catchment headwaters. Differences between areas of the Modflow model assigned recharge and the updated interpretation of permafrost distribution are shown on Figure A.7.7-5.

To assess the potential effects on the numerical model due to the discrepancy in recharge and permafrost, the following points are offered for consideration:

- The recharge rate required to calibrate the model to target baseflow values at the hydrology stations would increase if the permafrost distribution assigned to the model was updated and a smaller area of the model was assigned recharge. A total 15.6 km^2 additional area in the Modflow model was assigned recharge, including 4.0 km^2 in the Casino Creek W11 sub-catchment and 5.3 km^2 in the Canadian Creek W3 sub-catchment. Assuming the model-calibrated recharge rate is proportionally related to area, the recharge rate would have to increase to approximately 150 mm from 124 mm in order to match target baseflows in the W3 and W11 sub-catchments using the updated permafrost distribution. Even though the modelled recharge rate would increase, the net recharge specified to the model (m^3) would essentially remain unchanged in order to match baseflow targets during calibration.
- An increased recharge rate may require that a slightly higher hydraulic conductivity value is specified within the upper bedrock layer to optimize model calibration to hydraulic head targets. Since water level data is not available within zones where a discrepancy between permafrost and recharge exist, no hydraulic head targets used in model calibration were located within any of these zones. Water level data is available at monitoring wells 94-352, 94-353, and 94-354 located nearby and down-gradient of the zone upslope of the heap leach facility. The calibrated hydraulic heads in the existing model at these three locations are lower than the target hydraulic heads, indicating that the specified hydraulic conductivity value in this area is already higher than a value that would provide the best fit to measured water levels for the current recharge rate.
- The seepage assessment was conducted using two models: Model 1 which was assigned hydraulic conductivity values that provided the best fit to hydraulic head and baseflow targets during calibration; and Model 2 which had a hydraulic conductivity value assigned to the upper bedrock layer that was five times higher than the best fit identified in Model 1. The seepage results from the more conservative Model 2 were used for water quality modelling and geochemical source term development. The seepage results were therefore already based on a hydraulic conductivity value that was higher than the model-calibrated best fit.

Based on the above, the potential effect on the numerical model results due to the discrepancy in recharge and permafrost is expected to be negligible. The model would be assigned a different distribution of recharge but the total recharge assigned to the model would remain the same in order for the model to remain calibrated to baseflow targets. While a slightly higher hydraulic conductivity value may provide a better match to hydraulic heads using the updated permafrost distribution, a hydraulic conductivity value that is five times higher than the value providing the best match to the existing recharge rate and permafrost distribution was already used to develop results for the TMF seepage assessment. Given the level of effort required to assign the updated permafrost distribution to the baseline and refined operations numerical models, and that present results are considered to be conservative, the permafrost distribution used to assign model recharge was not updated.

A.7.7.1.20 R220

R220. A new figure combining both the recharge and permafrost distributions so that it is possible to identify where the distributions overlap and differ.

The most recent interpretation of permafrost distribution and the distribution of recharge assigned to the Modflow model are shown on Figure A.7.7-5.

A.7.7.1.21 R221

R221. Complete groundwater modeling on the period of time that the TMF is dewatered to allow construction of the TMF wetlands.

The waste rock within the TMF will not be exposed to the atmosphere when the water level of the TMF Pond is lowered to construct the passive treatment wetlands. The construction sequence and water level fluctuations prior to and during construction of the passive treatment wetland will include (from Appendix 4C):

- Waste rock in the TMF will remain exposed to the atmosphere during operations.
- A 3 m tailings cover will be placed over the waste rock and the waste rock will be submerged in Year 21 prior to construction of the passive treatment wetland. When the water level is drawn down to build the passive treatment wetland the surficial tailings cover will be exposed but the waste rock and the earlier tailings portion of the TMF will remain submerged.
- The wetland will be built and planted during a 5 year period and then the pond will be flooded.

The period of time that the TMF is dewatered to allow construction of the wetland is not considered to have a significant effect on physical groundwater flow in the area of the TMF. The water surface of the TMF Supernatant Pond is planned to be lowered less than three meters to accommodate construction of the wetland. This lowered water surface elevation is expected to result in a negligible change or marginally lower TMF seepage rate that is expected to be within the magnitude of uncertainty of model predictions.

A.7.7.1.22 R222

R222. Modeling for seepage flow rates from the water management pond if the water level exceeds desired levels.

As stated in the response to R207 above, the water management pond was represented in a conservative manner in the Modflow model. The pond elevation in the model was specified as the ground elevation of the model grid cell and the pond water level not represented lower than ground level. In reality, the pond will be excavated and the water level will be drawn down to maintain minimal dead storage. The pond is therefore already represented in the Modflow model with a water level that exceeds the desirable design water level as requested by EC in the Comment.

The Darcy-based flow calculation used to calculate seepage recovery efficiency of the pond (Appendix 7E) used a value for the height of the alluvium unit (20 m) that was considered representative of height of the deposit across the full (250 m) width of the valley. The height of the alluvium unit was not decreased in the calculation to account for an unsaturated height of alluvium associated with an excavated and dewatered pond.

Seepage can be monitored during operations by conducting water level and water quality monitoring, particularly water quality monitoring of conservative tracers originating from the mining operations. Use of conservative tracers usually includes monitoring for sulphate concentrations.

A.7.7.1.23 R223

R223. Verification methods for seepage flow not captured by the water management pond.

As discussed in the response to R206 above, assessing the efficiency of the seepage recovery pond using the numerical model was initially evaluated during the modelling process using two different approaches:

- Assigning the pond as a hydrostratigraphic unit (HSU) in order to calculate fluxes in and out of the pond as requested by Natural Resources Canada. Unfortunately, only the net inflow to the HSU representing the pond could be calculated using this technique, which includes both TMF seepage as well as non-contact groundwater from the upgradient catchment. Therefore, it was not possible to delineate inflows to the pond that originate as TMF seepage and as non-contact groundwater using this method.
- Using MODPATH forward particle tracking by placing particles within all cells of the TMF and tracking them forward to their downstream discharge location. However, as stated in the Numerical Groundwater Modelling Assessment (Appendix 7E), "*A MODPATH particle tracking analysis was not used for the final seepage analysis due to the sensitivity of the simulated results to the MODPATH-input sink strength that controls termination criterion for particle flow paths."* The sink strength specifies the minimum percent of water that must be removed from a cell by a boundary condition in order to terminate a particle trace in that cell. Assigning a 50% sink-strength in the Mine Effects model resulted in 100% particle capture before or at the Water Management Pond (100% efficiency). Increasing the particle strength to 80% or 100% resulted in a lower percent capture efficiency. Particles originating from the TMF were all located within the model layer representing the alluvium unit at the location of the Water Management Pond and no particles were located in bedrock units beneath the pond. Results of the particle tracking indicate that any remaining TMF seepage at the location of the Water Management Pond is expected to be shallow and primarily contained within the alluvial unit.

The calculation of seepage recovery efficiency presented in the Numerical Groundwater Modelling report (Appendix 7E) was a Darcy-based flow calculation since it was considered to be transparent and not influenced by sensitive model parameters. The seepage recovered by the pond was calculated as the predicted amount of TMF seepage in excess of what could be transmitted within the alluvium unit beneath the pond, "*The capacity for groundwater flow beneath the water management pond within the Casino Creek valley alluvium was determined using a Darcy flow calculation to be 3 L/s"* (Appendix 7E). The flux of groundwater passing within the subsurface beneath the Water Management Pond was also assessed using the Modflow model. Modflow model results predict that groundwater flux within the alluvium unit beneath the pond is approximately 3 L/s and is in agreement with the Darcy-based calculation.

The foundation seepage recovery efficiency of the water management pond downstream of the main TMF Embankment was estimated using a mass balance approach taking into consideration predicted seepage through and beneath the Main TMF Embankment seepage and the capacity for groundwater flow through the alluvial deposit beneath the water management pond. Based on the results of the analysis, approximately 90-95% of the TMF foundation seepage is predicted to be recovered by the water management pond assuming that the pond is maintained with as low of a water level as possible. The remaining 5-10% of foundation seepage is expected to bypass the pond and discharge further downstream to Casino Creek.

Results of the TMF seepage assessment indicate that seepage through the TMF Main Embankment and foundation at the end of operations (Year 22) is predicted to be 36 L/s (38 L/s total TMF seepage minus the 2 L/s seepage through the TMF West Embankment). The capacity for groundwater flow beneath the water management pond within the Casino Creek valley alluvium was determined using a Darcy flow calculation to be

3 L/s. The Darcy calculation used a hydraulic conductivity for the alluvial deposit of 1E-5 m/s, an average height of alluvial sediments of 20 m, a width of the alluvial sediments of 250 m, and a hydraulic gradient of 0.05 m/m.

A.7.8 WATER BALANCE MODEL

A.7.8.1.1 R224

R224. An assessment of potential water quantity under a broader range of hydrologic conditions, including:

a. the ability to manage waters during wet, dry and average years;

b. the receiving water effects during typical and extreme summer and winter low flows (7Q20 and 7Q10); and

c. the water storage and receiving water effects during freshet and event flow.

The water balance submitted to the YESAB for the Project (Appendix 7F) has been updated to include climate variability. The objective of the water balance modelling exercise was to evaluate the quantity of flow of water in the ground, in the streams, and in various mine facilities under a variety of climate conditions. The water balance model also provided the platform on which the water quality model was developed. The report provided in Appendix A.7A outlines the climate inputs and water management assumptions that were used for climate variability water balance modelling, and presents the results of the study. Only the water quantity model and results are discussed in this letter, water quality impacts are discussed in Section A.7.9.

A.7.8.1.2 R225

R225. An assessment of the potential effects of climate change on water balance.

The water balance has been updated to consider climate change, and the results provided in Appendix A.7C. The objective of the original water balance was to evaluate the quantity of water flowing in the ground, in the streams, and in various mine facilities, as well as provide a platform for development of the water quality model. The water balance submitted as part of the YESAB Proposal (the Proposal) in December 2013 was based on mean monthly climate conditions and was subsequently updated in January 2015 to include climate variability (Appendix A.7A).

For the purposes of the climate change water balance model, the climate variability water balance model will be used as the “base case” water balance to provide a means of comparison for the projected climate change effects on estimates of flow quantity for the project.

The climate change water balance model outlines changes to inputs and assumptions in the base case water balance that were made in order to model projected climate change effects, and to present the flow quantity results of the modelling. Based on the climate change model results, it was determined that the projected climate change effects on flow quantity were within the range of conditions already predicted by the base case water balance for which mitigation measures have been developed.

A.7.8.1.3 R226

R226. An assessment of potential water quantity under a broader range of operating/closure scenarios, including permit limits, atypical operations, and accident scenarios.

Climate variability was modelled by systematically varying climatic inputs based on a 52 year historical climate record (precipitation and temperature) developed for the project site (Appendix A.7A). The climate variability model was run with 52 iterations for each year of simulated mine life, enabling a large number of combinations of resulting wet, dry, and median months and years of precipitation to be considered. CMC considers that the climate variability water balance model sufficiently evaluated a variety of scenarios, and that atypical operations and accident scenarios are not required to be modelled above and beyond those examined by the variability water balance model.

A.7.8.1.4 R227

R227. Provide sensitivity analysis for the site water balance model identifying:

a. the potential impact of variation in assumed values for key water balance model parameters; and

b. the potential impact of temporal change in the assumed distribution of precipitation and snowmelt.

The water balance submitted to YESAB as part of the Project Proposal (Appendix 7F) has been updated to include climate variability. The assumptions, methodology and results of the updated water balance are presented in the KP letter *Casino Project – Updated YESAB Water Balance to Include Climate Variability* (Appendix A.7A). The purpose of the KP letter is to outline the climate inputs and water management assumptions that were used for water balance model sensitivity analyses, and to present the results of the study. Only the water quantity model and results are discussed, as the water quality model is documented separately in Appendix A.7B.

A.7.8.1.5 R228

R228. Identify if the results of the sensitivity analysis materially affect the Water Management Plan for the project proposal, and if yes, update the Water Management Plan.

The basic components of the Water Management Plan (Appendix 4C) remain unchanged, however, the updated water balance model to include climate variability (Appendix A.7A) led to modifications to the water management plan as a result of an iterative process based on the updated water quality predictions. The water management plan modifications are summarized in Appendix A.7A.

A.7.8.1.6 R229

R229. A description of how the water balance model is to be used and updated during the mining process in order to improve mine management and predictions for closure. Indicate when any updates would be released during operations.

As discussed above, the water balance model will be updated to incorporate baseline data collection between the date of submission of the YESAB Proposal and the generation of the Type A Water Use Licence (WUL) application. However, during operations, the water balance model would only need to be updated should there be evidence of changing hydrometeorological conditions (or changes to mine design that affects watershed boundaries). Given that the water balance model has accounted for both annual variability (Appendix A.7A) and climate change (Appendix A.7C), CMC does not expect that an update to the model will be required. CMC expects that updates to the model may be necessary to inform reclamation and closure plan updates.

A.7.8.1.7 R230

R230. Provide the reasoning for selecting Big Creek as the most representative long-term hydrometric station for generating site synthetic stream flow data.

See response to R175.

A.7.9 WATER QUALITY MODEL REPORT

A.7.9.1 Transparency of Water Quality Predictions

A.7.9.1.1 R231

R231. Re-run the water quality model with updated water quality baseline data.

Water quality and hydrological baseline data has been collected in 2013 and 2014, and will continue throughout the YESAB and permitting process. Updated baseline data will be provided for water use licensing purposes, and the numerical models will be updated, as will the water balance and water quality models, which receive inputs from the numerical models.

A.7.9.1.2 R232

R232. A copy of the GoldSim model and all input data used in the assessment.

The GoldSim model has been described in detail in Appendix A.7B (Water Quality Predictions Report) and all of the input data used in the assessment has been included. It is not typical for water quality models to be provided in a digital format, as models are considered proprietary. CMC will conduct information sessions following the determination of adequacy in the YESAB process, if reviewers are interested, to inform interested parties of details of the water balance and quality modelling.

A.7.9.1.3 R233

R233. A copy of all model outputs as summary tables and figures.

Output tables for all modelled parameters are summarized in the sub-Appendices of Appendix A.7B (Water Quality Predictions Report). Water quality model output tables are provided for the Open Pit (Sub-Appendix I, Table I-B1), TMF Pond (Sub-Appendix IV, Table IV-B1), and WMP (Sub Appendix V, Table V-B1). Output tables for Casino and Dip Creek are provided in the main body of the report as well as in Sub-Appendix VI (Tables VI-6 to Table VI-8).

A.7.9.1.4 R234

R234. A discussion of assumptions used in the modeling.

Input assumptions for source terms, flow rate, and loading rates are outlined in Appendix A.7B (Water Quality Predictions Report). Sub-Appendices I to V provide a detailed breakdown of the mass loading balances for the Open Pit, Ore Stockpiles, HLF, TMF Pond, and WMP mass loading balances. Detailed descriptions of water quality input assumptions for Casino and Dip Creek are provided in the main body of the report as well as in Sub-Appendix VI.

A.7.9.1.5 R235

R235. Any additional information that the Proponent may have used in their assessment so as to facilitate an independent calculation of potential water quality effects by reviewers.

All details on the water quality model may be independently calculated by combining the input values provided in the sub-appendices of the Water Quality Predictions Report (Appendix A.7B), and in the water balance reports (Appendices 7F and A.7A). The water balance and water quality models were created using GoldSim and were fully integrated using the GoldSim software.

A.7.9.1.6 R236

R236. A description of how the water quality model is to be used and updated during the mining process in order to improve mine management and predictions for closure. Indicate when any updates would be released during operations.

As discussed above, the water balance model will be updated to incorporate baseline data collection between the date of submission of the YESAB Proposal and the generation of the Type A Water Use Licence (WUL) application. However, during operations, the water balance model would only need to be updated should there be evidence of changing hydrometeorological conditions (or changes to mine design that affects watershed boundaries), and the water quality model would only require updates when new source term data comes available from on-going test work. Similar to the response to R299 above, CMC may update the water quality model along with the water balance model, in conjunction with the reclamation and closure plan updates.

A.7.9.2 Source Term Loading from TMF Seepage

A.7.9.2.1 R237

R237. An explanation of how loadings from embankment runoff and embankment seepage relate to the conceptual flow diagram in Figure 7-2 in LORAX (2013) Casino Geochemical Source Term Development, 4 December, J862-5. In addition, please confirm that those loadings were included in the water quality model.

Loadings from the embankment that are discussed in Chapter 5 of the Geochemical Source Term Development report (Appendix 7D) are added to the loads from the other areas of the TMF in the water quality model. These loads are added to the loads associated with flow paths 9 and 10 downstream of the TMF, in the Water Management Pond. The incorporation into the water quality model is shown conceptually in Figure A.7.7-2 and described in sub-appendices IV and V of the Water Quality Predictions Report (Appendix A.7B).

A.7.10 WATER QUALITY OBJECTIVES

A.7.10.1 Site Specific Water Quality Objectives

A.7.10.1.1 R238

R238. Additional details and rationale supporting the use of site specific water quality objectives (SSWQO) for certain contaminants of concern. Details should include:

a. justification for not using CCME guidelines to develop SSWQO;

b. demonstration that aquatic biota remain protected to the same degree as provided by the CCME guidelines;

c. how SSWQO account for chronic/long-term acceptable limits; and

d. consideration for the new, hardness-dependent, long-term limit for cadmium now available from CCME.

To clarify, CMC did not present site specific water quality objectives (SSWQO) in the Project Proposal. The purpose for presenting guidelines such as those outlined in the CCME water quality guidelines for the protection of aquatic life (CCME 2007), or alternative guidelines such as BC MOE or US EPA guidelines was to determine the significance of effects of water quality parameters that have been predicted to exceed CCME guidelines.

SSWQOs will be presented during the Type A Water Use Licence application, and will be used to determine appropriately protective limits for discharge to the environment.

Following the incorporation of the variability water balance model into the water quality model, as detailed in Appendix A.7B, the water quality predictions previously provided in Section 7.4.3 have been updated to include the results of the variability water quality model. As a result of the model updates, some project refinements have been added to the Project description based on the results of the variability model, and incorporating comments made during adequacy review of the Proposal. Based on the initial results of the updated water quality model, the changes outlined in Table A.7.10-1 were made to the proposed water management regime, and consequently in the water quality model.

Table A.7.10-1 Water Quality Model Variability Model Updates to Average Case Model

Key Assumption	Average Case Model (Appendix 7F)	Variability Model (Appendix A.7B)
Background (baseline) water quality	Appendix 7A	No change
Geochemical source terms	Appendix 7D	Update to Cu loading from tailings embankment at closure and to Mo loading from tailings beach. Update in Appendix A.7E.
Water balance model	Appendix 7E	Stochastic streamflow, as per Appendix A.7A.
Simulation time	Model simulation was run for a time period beginning a few years prior to Construction and continued for 200 years following the beginning of Operations using monthly time steps.	
Environmental conditions	• Seasonal monthly flows • Seasonal median baseline water quality	• Variable monthly flows • Seasonal median baseline water quality
Loadings to the receiving environment	• Seepage bypass of the Water Management Pond • WSMP discharge • TMF spillway discharge	• 100% seepage collection throughout all project phases • WMP discharge • TMF spillway discharge

The results of the water quality model and the significance on the effects assessment are detailed below.

As discussed in the Proposal, water quality is predicted in Casino Creek at model point M18 (just downstream of the confluence of Brynelson and Casino Creek, and analogous to site H18) and W4 (mouth of Casino Creek). W4 is a baseline water quality monitoring site, while M18 is a modeled site, although baseline hydrology was collected at M18 (hydrology station H18). M18 represents the water quality at the point of discharge to the receiving environment and represents the receiving environment as the most upstream location in Casino Creek. In other words, when the TMF (and associated water management pond) is in place, there will no water in Casino Creek until the point where Brynelson Creek and the TMF spillway connect with Casino Creek. W4 represents the water quality in the lower reaches of Casino Creek just prior to discharge into Dip Creek. Water quality in Casino Creek between M18 and W4 is gradational between these two sets of results. Water quality in Dip Creek is modeled at W5, a baseline monitoring site just downstream of the Casino Creek confluence.

As detailed in the Water Quality Predictions Report (Appendix A.7B), the site-wide water balance model developed by Knight Piésold was used as the basis for the water quality model. The water balance and the water quality models were fully integrated in GoldSim. For the variability model, existing site weather data was correlated with regional weather data to derive a long-term record of monthly historic site data. The regional data set is 52 years of monthly weather data and after correlation to site conditions, the resulting 52-year data set represents the best estimate of the range in weather conditions at the site. The data set represents the natural historic variability in hydrologic conditions (i.e. wet and dry periods) that have occurred at the site. Over the ~200 year model simulation, the 52-year input dataset repeats approximately four times. Additional information about the development of the water balance model is provided in Appendices 7F and A.7A.

To evaluate the impact of the variability model on the water quality, a version of the Monte-Carlo method was implemented by using the 52-year input dataset. As the dataset contains 52 unique years of monthly values, 52 unique continuous datasets (realizations) were generated to represent possible scenarios over the simulation period. Of the 52 realizations run in the model, the first realization began from Year 1 of the synthetic dataset. The second realization began at Year 2, the next one used Year 3, and so on. This continued until the 52^{nd} realization which began at Year 52 of the dataset.

To evaluate the results of the variability water quality model through an effects assessment, the 50^{th} percentile values were extracted from the Monte-Carlo simulation. That is, for each monthly time step, the software selected and outputted the 50^{th} percentile value for that time step. The median and maximum 50^{th} percentile values are summarized in Table A.7.10-2 for each contaminant of concern (COC) previously identified in the Proposal, and are compared to the average case model results (from Section 7). Hardness is also provided in Table A.7.10-2, as water quality guidelines for SO_4, Cd, Cu, Pb and Ni are hardness dependent. It should also be noted that the Cd value used throughout this assessment is the updated Cd guideline from CCME (2014).

From Table A.7.10-2, water quality for all parameters have improved, due to a change in the water management that was implemented as a result of the variability water quality model. Previously, discharge from the Water Management Pond (WMP) was stored during the winter months, and then discharged beginning in May after the onset of the spring freshet. However, the results of the variability model indicated that in some years, the pond would be full prior to the spring freshet and could therefore discharge early, resulting in undesirable water quality in the receiving environment. Therefore, CMC has implemented a system where discharge from the WMP is controlled based on the available flow from Brynelson and from the TMF pond (described in more detail in the Variability Water Balance Report (Appendix A.7A)). This management change has improved the water quality in the downstream receiving environment.

Additionally, based on reviewer comments received during the adequacy review of the Proposal, CMC has included the installation of the groundwater control system, previously proposed only during the closure and post-closure period, to be installed during the operations period. This has resulted in a modeled scenario of 100% seepage capture downstream of the tailings dam, and has consequently also benefited the downstream water quality.

Table A.7.10-2 Predicted Parameter Concentrations for the Average Case and Variability Water Quality Models

Site	Parameter	Predicted Values (mg/L)				CCME Guideline (mg/L)
		Average Case Model		Variability Model (50th percentile)		
		Median	Maximum	Median	Maximum	
M18 (Casino Creek)	Hardness	334	497	191	530	-
	Cadmium	0.00011	0.0005	0.00009	0.00036	0.00037[1.]
	Copper	0.004	0.0174	0.0043	0.0139	0.0026[1.]
	Fluoride	0.52	0.8	0.28	0.84	0.12
	Molybdenum	0.053	0.1	0.030	0.091	0.073
	Selenium	0.0028	0.004	0.001	0.005	0.001
	Sulphate	211	441	128	449	309[1.2.]
	Uranium	0.013	0.021	0.008	0.016	0.015
W4 (Casino Creek)	Hardness	278	463	167	486	-
	Cadmium	0.000087	0.00045	0.000073	0.000326	0.00037[1.]
	Copper	0.0034	0.0157	0.0038	0.0139	0.0026[1.]
	Fluoride	0.4	0.72	0.23	0.75	0.12
	Molybdenum	0.039	0.091	0.024	0.082	0.073
	Selenium	0.0024	0.0035	0.001	0.004	0.001
	Sulphate	167	404	107	407	309[1. 2.]
	Uranium	0.012	0.019	0.007	0.015	0.015
W5 (Dip Creek)	Hardness	135	192	119	209	-
	Cadmium	0.00004	0.00011	0.00004	0.00013	0.00015[1.]
	Copper	0.0018	0.0043	0.0022	0.0067	0.0022[1.]
	Fluoride	0.15	0.26	0.12	0.30	0.12
	Iron	0.039	0.74	0.067	0.806	0.30
	Selenium	0.0005	0.0013	0.0004	0.0015	0.0010

Notes:

1. Guidelines for Cd, Cu, SO_4 are hardness dependent and predicted hardness values were used to calculate the guideline.
2. BC MOE Guideline for hardness between 76 -180 mg/L.

Below follows a discussion of the results of the variability water quality model (comparable to Section 7.4.3.1.2 and 7.4.3.1.3 of the Proposal), as well as the full water quality effects assessment on fish and aquatic resources, which was originally presented in Section 10.4.1.3, in order to provide a comprehensive presentation of water quality effects on the aquatic receiving environment.

In the graphs below, the maximum annual value was subsequently extracted from the 50th percentile values to illustrate the maximum predicted concentrations that could reasonably be expected for each model year. Additionally, for the year with the maximum concentrations, the monthly values are provided in the subsequent figure to allow a more thorough evaluation of the cause and implication of the highest concentrations. CMC considers that this is a reasonable way to evaluate the results from the variability model. These representations are comparable to the annual maximum and monthly values presented in Figures 7.4-2 through 7.4-13 of the Proposal.

Cadmium

The annual maximum of the variability model monthly 50th percentile predictions for dissolved Cd concentrations at M18 and W4 in Casino Creek and W5 in Dip Creek are presented in Figure A.7.10-1 and Figure A.7.10-2, respectively.

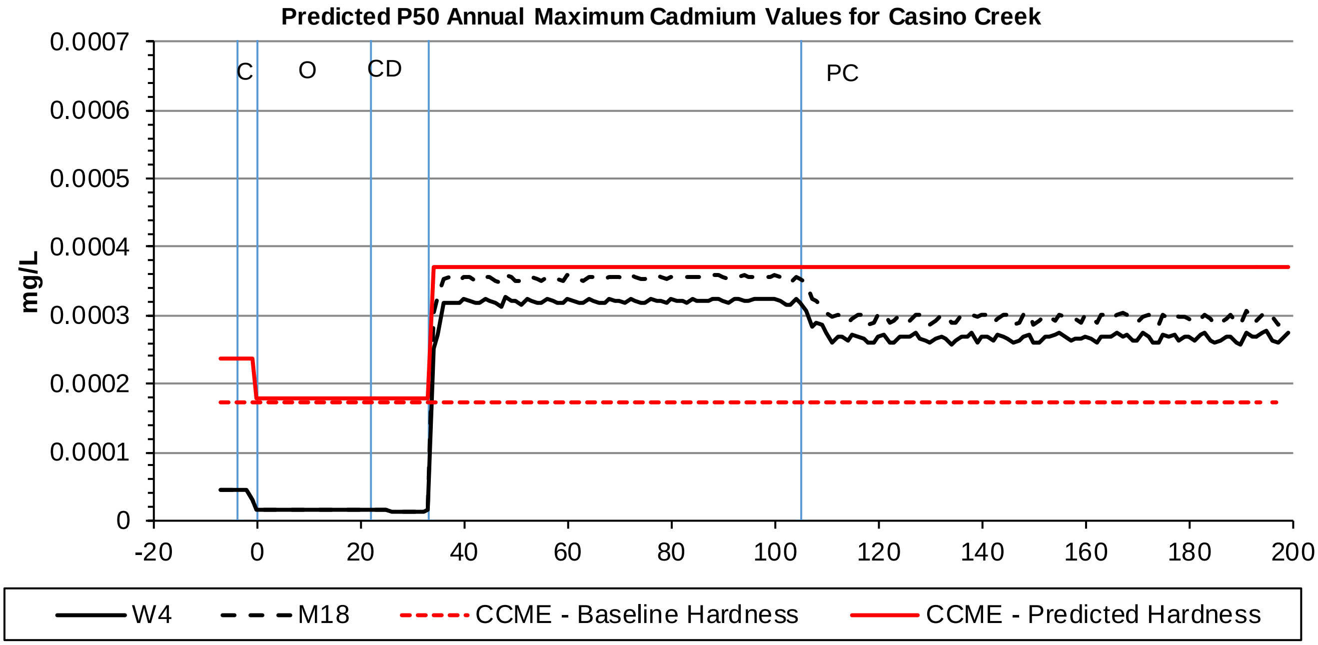
Following issuance of the Proposal in January 2013, an updated CCME water quality guideline for the protection of aquatic life for cadmium was presented in February 2014 (CCME 2014). This update provides a long-term guideline as follows:

$$CCME\ Guideline = 10^{\{0.83(log[hardness])-2.46\}}$$

Using median baseline hardness values of 111 mg/L and 90 mg/L for Casino Creek and Dip Creek, respectively, the resulting long-term cadmium guidelines are equal to 0.00017 mg/L in Casino Creek and 0.00015 mg/L in Dip Creek, as shown in Figure A.7.10-1 and Figure A.7.10-2. The CCME guideline for predicted hardness is also shown on Figure A.7.10-1 and Figure A.7.10-2, and varies with predicted hardness, in parallel to the predicted cadmium concentrations.

While the predicted median cadmium concentration (0.000073 mg/L) in Casino Creek does not exceed the updated CCME guidelines, the predicted maximum (0.000326 mg/L) does exceed the updated guideline using baseline hardness. Exceedances occur during periods of discharge from the water management pond (May – November), although the cadmium concentrations in Casino Creek are below the CCME guidelines using predicted hardness (0.00037). The predicted median (0.00004 mg/L) and maximum (0.00013 mg/L) cadmium concentrations in Dip Creek concentrations do not exceed the updated guidelines under baseline or predicted hardness scenarios.

The drop in water quality seen in the graphs below at the start of the operations period is due to the installation of the tailings dam, and the resulting interception of the poor water quality from upper Casino Creek. The spike at the commencement of the post-closure period is due to the discharge from the seepage pond and from the TMF pond. The water quality effects assessment of predicted cadmium concentrations on fish and aquatic resources is provided below.



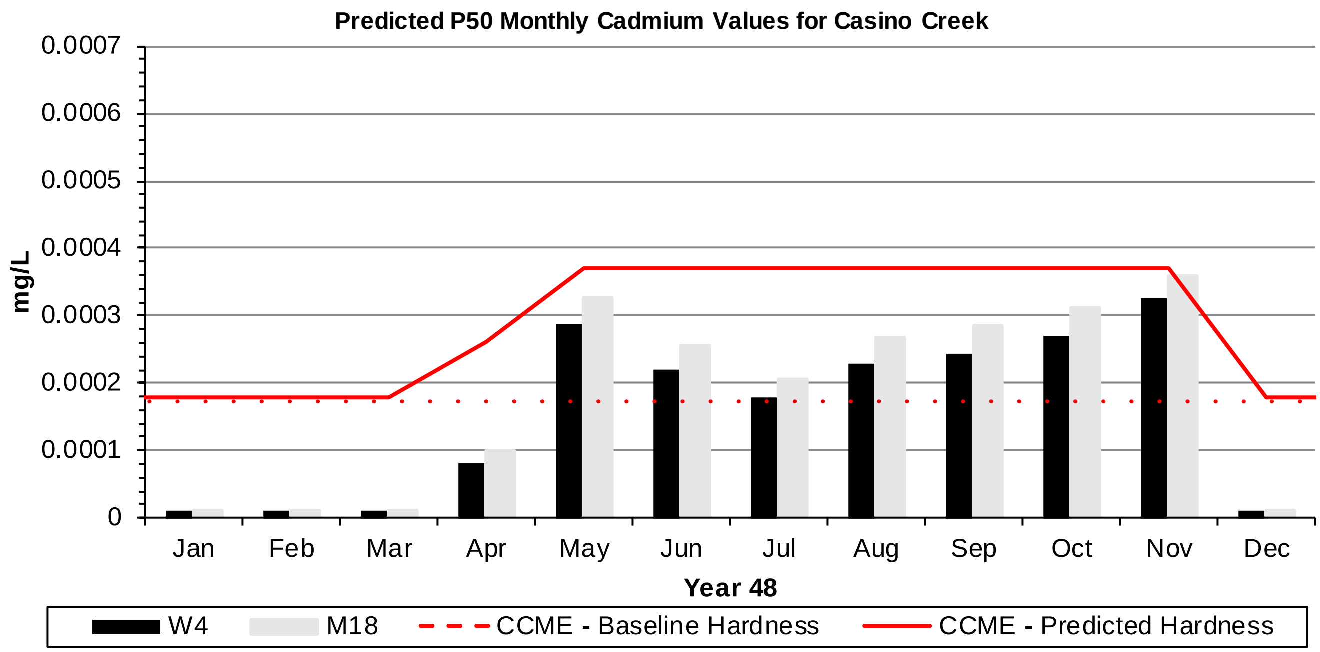
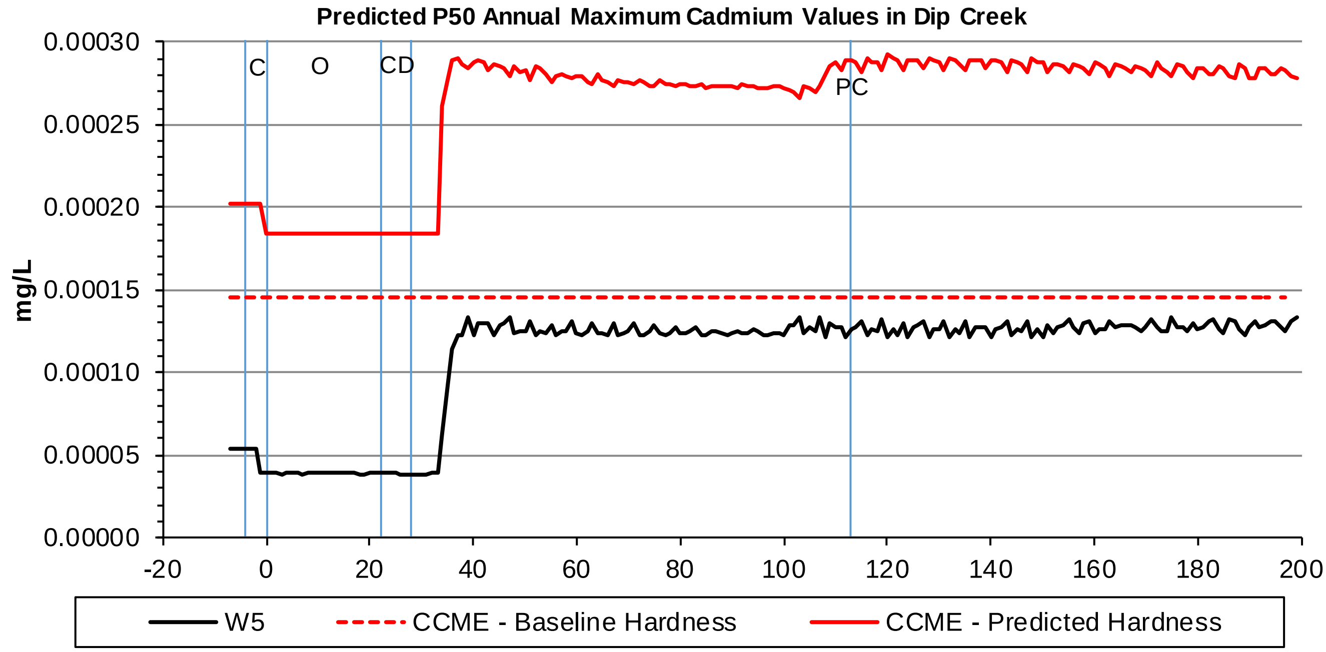


Figure A.7.10-1 Predicted Annual Maximum and Monthly Cadmium Concentrations for Casino Creek



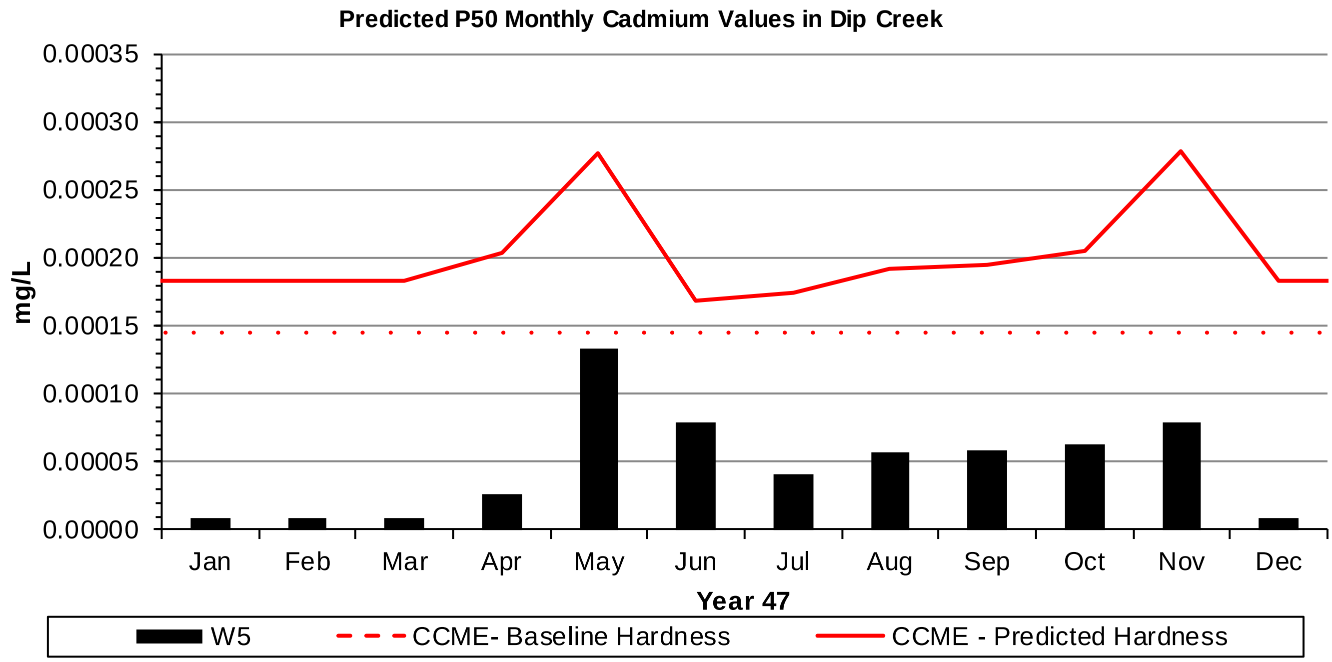


Figure A.7.10-2 Predicted Annual Maximum and Monthly Cadmium Concentrations in Dip Creek

Cadmium is an unessential element for aquatic life and is toxic at very low concentrations (US EPA 2001). Salmonids are the most sensitive fish family to cadmium toxicity, and thus provide a conservative threshold for developing cadmium guidelines (CCME 2014). Cadmium can disrupt the functioning of fish gills, kidneys and intestines, with the effects manifested as reduced growth and reproduction rates (Eisler 1985, Beširović et al. 2010). Cadmium has been shown to bioaccumulate, however evidence for cadmium biomagnification in aquatic life is conflicting (CCME 2014). There are several potential cellular mechanisms for cadmium toxicity including

DNA and mitochondrial damage (Belyaeva et al. 2006, Bertin and Averbeck 2006, Viau et al. 2008), activation of proteases (Lee et al. 2007, Hsu et al. 2009), the promotion of radicals (Pathak and Khandelwal 2006, Liu et al. 2009, Risso-de Faverney et al. 2001), and disruption of homeostasis (Yang et al. 2007). Cadmium toxicity is complex, as the various chemical forms have differing toxicities and bioconcentration factors, and are dependent on numerous other parameters including pH, hardness, redox potential, organic ligands, hydroxides, and anions (CCME 2014; US EPA 2001).

The recently updated CCME cadmium guideline incorporates a more scientifically robust approach to determining potential toxicity on aquatic biota (CCME 2014). Using the elevated predicted water hardness values for Casino Creek, which will act to ameliorate cadmium toxicity, cadmium concentrations will remain below the CCME guidelines during all project phases. Thus, potential residual effects on aquatic biota in Casino Creek due to cadmium concentrations are anticipated to be minor.

Copper

The annual maximum of the variability model monthly 50th percentile predictions for dissolved Cu concentrations at M18 and W4 in Casino Creek and W5 in Dip Creek are presented in Figure A.7.10-3 and Figure A.7.10-4, respectively. Due to the installation of groundwater recovery during the construction period, the copper concentrations downstream no longer increase throughout the operations phases. Increases in copper concentrations in Casino and Dip Creeks are only predicted to occur once discharge from the water management pond begins in approximately year 32. The median copper concentration at post-closure is predicted to be about 0.0051 mg/L, 0.0057 mg/L and 0.0022 mg/L at W4, M18 and W5, respectively. The 50th percentile values are in exceedance of the CCME guideline for copper (0.0026 mg/L in Casino Creek and 0.0022 mg/L in Dip Creek) during the discharge period (April – November), but are well below the CCME guideline during the water storage phase (December – March). As discussed in Section 7.4.3.1.1, development of a site-specific water quality objective (SSWQO) for copper (in lieu of using the CCME guideline, for the purposes of evaluating effects) is considered to be appropriate, due to the naturally high baseline concentrations. The background concentration procedure (BCP) was selected, and the 90th percentile baseline value at W4 and W5 were used to calculate the SSWQO (P90) values for Casino and Dip Creeks, as shown on Figure A.7.10-3 and Figure A.7.10-4. Predicted maximum copper concentrations do not exceed the SSWQO during any project phase, with maximum values of 0.0139 mg/L at W4 M18 in Casino Creek, and 0.0067 mg/L at W5 in Dip Creek (Table A.7.10-2).

The drop in water quality seen in the graphs below at the start of the operations period is due to the installation of the tailings dam, and the resulting interception of the poor water quality from upper Casino Creek. The spike at the commencement of the post-closure period is due to the discharge from the seepage pond and from the TMF pond. The water quality effects assessment of predicted copper concentrations on fish and aquatic resources is provided below.

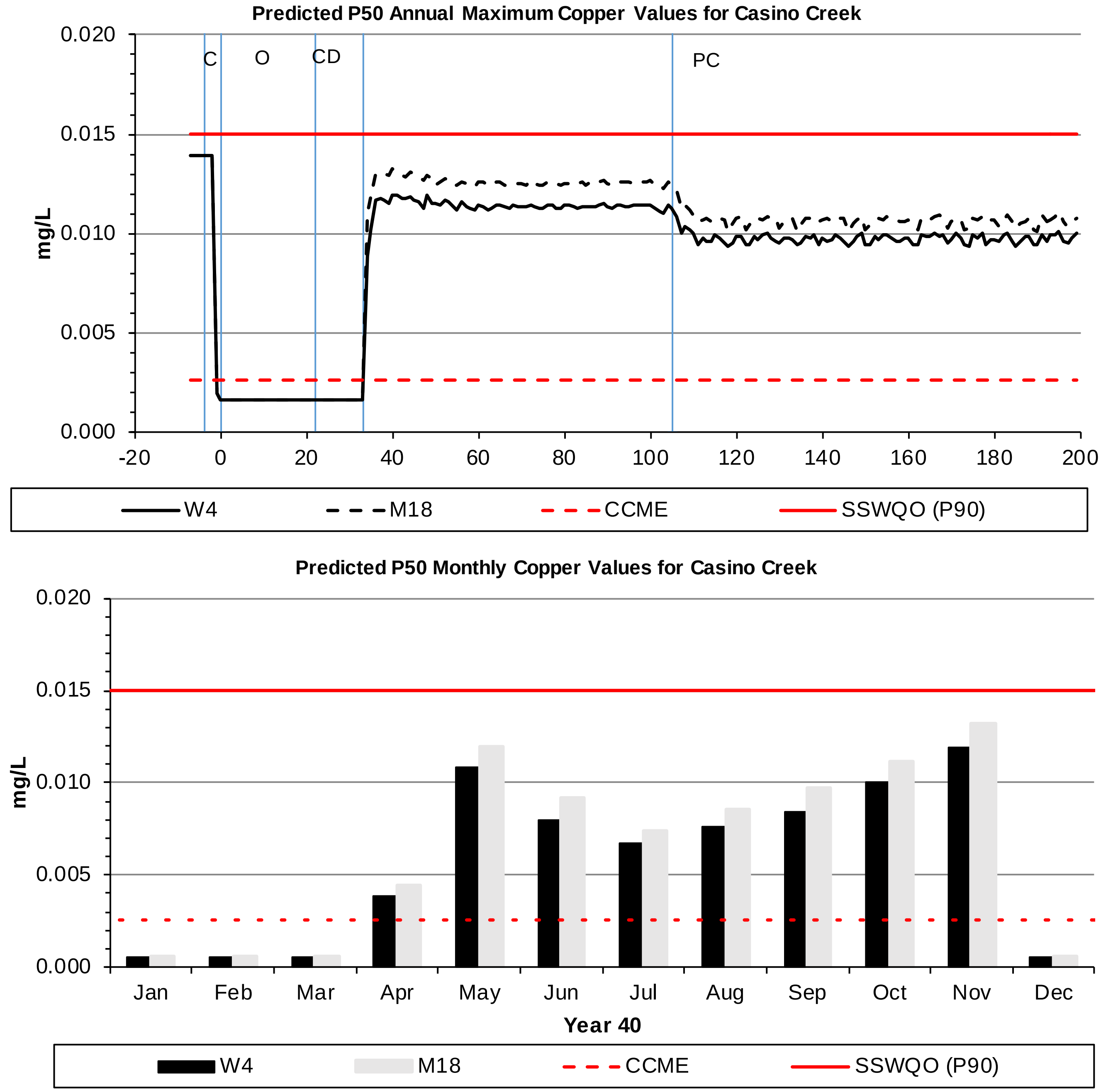
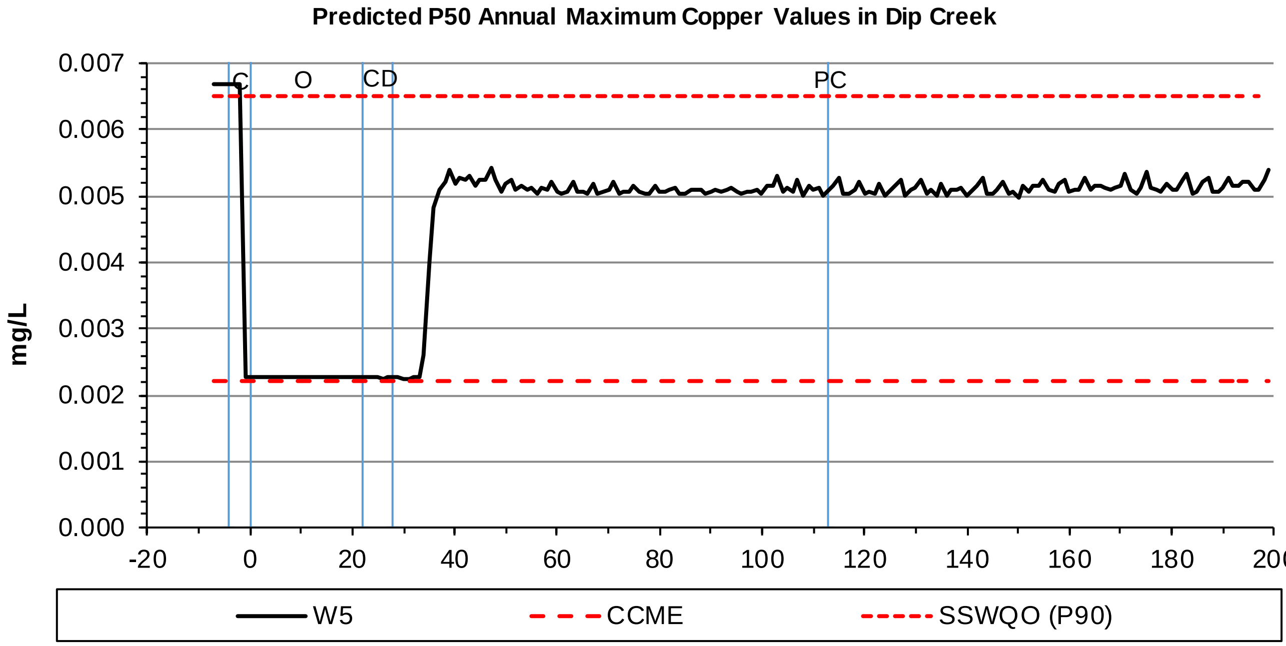


Figure A.7.10-3 Predicted Annual Maximum and Monthly Copper Concentrations for Casino Creek



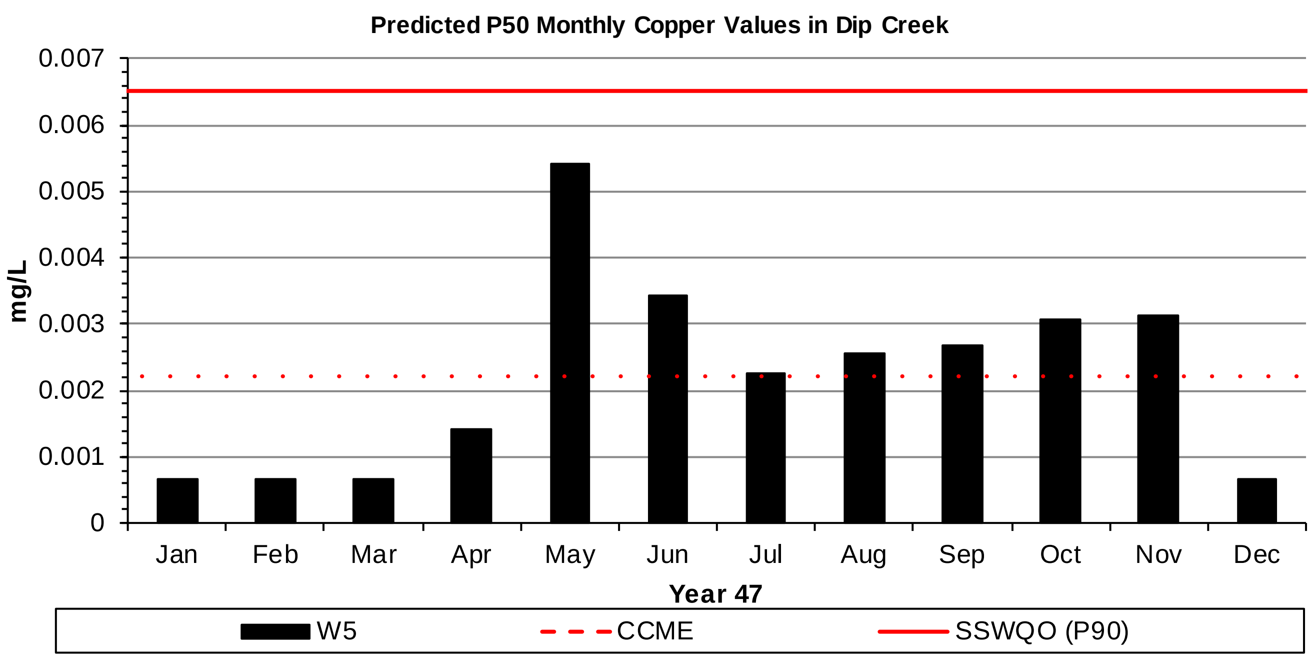


Figure A.7.10-4 Predicted Annual Maximum and Monthly Copper Concentrations in Dip Creek

Copper is an essential micronutrient for plants and animals at low concentrations, but can be toxic at elevated concentrations (US EPA 2007). Potential chronic effects from copper exposure include disruption of gill function, osmoregulation, oxygen transport, and energy metabolism in fish (Reid and McDonald 1991; Eisler 1998); and inhibited membrane permeability, cytoplasmic function, osmoregulation, ionic regulation and respiration in invertebrates (Alberta Environmental Protection 1996). Copper speciation and resultant bioavailability is complex as numerous physicochemical characteristics of the ambient water can produce markedly different toxicities, including temperature, dissolved organic compounds, suspended particles, pH, various inorganic ions, and alkalinity (US EPA 2007). While predicted maximum copper concentrations will exceed the CCME copper guidelines of 0.0022-0.0026 mg/L based on baseline hardness values, copper concentrations are naturally elevated above CCME guidelines in Casino Creek (median copper concentration of 0.0059 mg/L in Casino Creek (Table VI-2 from the Water Quality Predictions report, Appendix A.7B)).

While there are a substantial number of studies that have investigated and confirmed sub-lethal impacts on fish from low-level copper exposure (e.g., Hansen et al. 1999a,b; Baldwin et al. 2003; McIntyre et al. 2008; Meyer and Adams 2010; Baldwin et al. 2011; Kennedy et al. 2012), these findings are not currently reflected in the derivation of regulatory guidelines (Meyer and Adams 2010). Furthermore, it is uncertain whether noted impacts on fish olfactory systems yield population-level impacts (McIntyre et al. 2008). Fish and aquatic biota in Casino and Dip Creeks will experience minor increases of copper within their environments as a result of project activities, which may increase habitat avoidance behaviour, or in worst case scenarios impact aquatic biota health. However, given that current guidelines do not account for these impacts, and the uncertainty of a population-level impact, the potential for a far-reaching regional effect is considered unlikely.

Considering that maximum predicted copper concentrations will not exceed SSWQOs, no significant adverse impacts are anticipated on local fish and aquatic biota.

Fluoride

The annual maximum of the variability model monthly 50^{th} percentile predictions for dissolved fluoride (F) concentrations at M18 and W4 in Casino Creek and W5 in Dip Creek are presented in Figure A.7.10-5 and Figure A.7.10-6, respectively. The water quality model predicts F concentrations to increase once discharge from the seepage pond and the TMF commences, and there is a slight increase during the pit lake overflow phase with a maximum concentration at W4 of 0.75 mg/L and at W5 of 0.30 mg/L. Predicted F concentrations are compared to the CCME guideline, and also to the BC MOE guideline, which is 0.4 mg/L for water hardness less than 10 mg/L, and hardness dependent as per the following equation for other hardness values:

$$LC_{50}\, fluoride = (-51.73 + 92.57 \log_{10} Hardness)0.01$$

Using a pre-construction hardness value of 63 mg/L, the BC MOE fluoride guideline is 1.1 mg/L (Figure A.7.10-5). A variable guideline based on predicted hardness is shown in the monthly values in Figure A.7.10-5 and Figure A.7.10-6. Predicted fluoride values in Casino Creek and Dip Creek are less than the BC MOE guideline using baseline hardness (guidelines = 1.1 mg/L).

The water quality effects assessment of predicted fluoride concentrations on fish and aquatic resources is provided below.

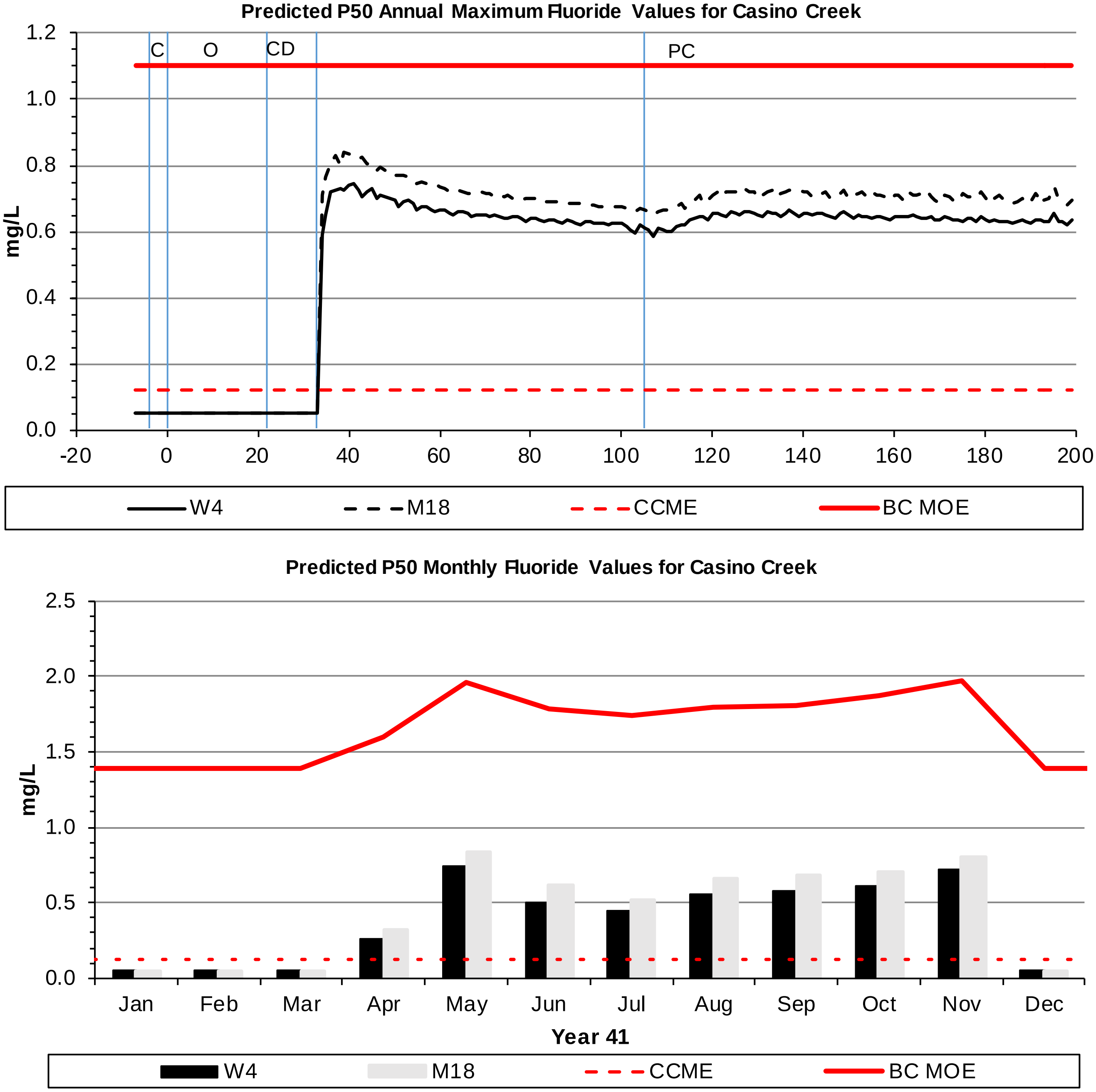
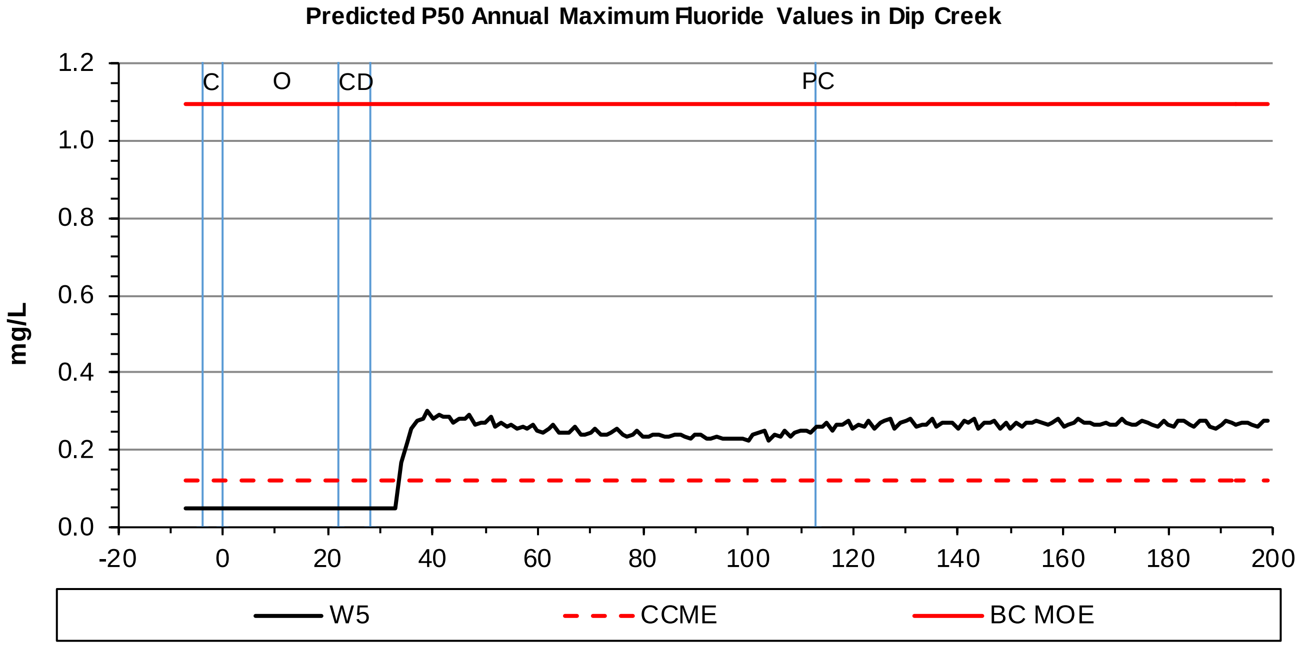


Figure A.7.10-5 **Predicted Annual Maximum and Monthly Fluoride Concentrations for Casino Creek**



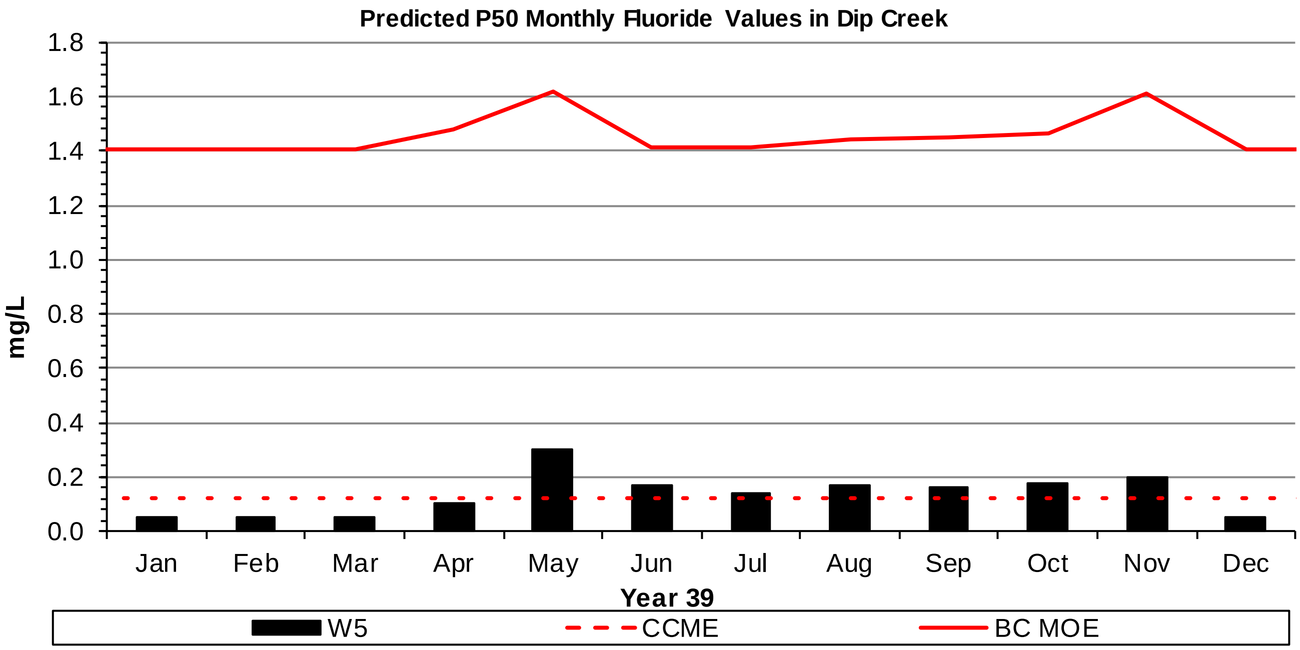


Figure A.7.10-6 Predicted Annual Maximum and Monthly Fluoride Concentrations in Dip Creek

The accumulation of fluoride ions in bone, teeth, scales and exoskeletons is cumulative and permanent (BC MOE 2011). On a cellular level, fluoride inhibits enzyme activity, disrupting metabolic processes such as glycolysis and protein synthesis (Camargo 2003). Salmonid species have demonstrated disruptions in their migration patterns when exposed to low levels of fluoride (0.5 mg/L) before or during upstream spawning migrations, and thus should be considered when developing site-specific guidelines (CCME 2002).

Fluoride toxicity is dependent on water hardness and temperature, with higher temperatures increasing toxicity and higher water hardness reducing it. However, experiments demonstrating fluoride toxicity at higher water hardness levels should be considered with caution as the two are highly reactive and will quickly precipitate as long as free calcium is available. Thus, current guidelines incorporating water hardness are tentative and require further study (BC MOE 2011). In addition to water hardness and temperature, certain metals may influence the bioavailability of fluoride. Aluminum in particular is noted to have an adverse effect on fluoride toxicity in aquatic plants, and potentially also in aquatic animals (CCME 2002).

An exceedance of the interim CCME guideline (0.12 mg/L) is not considered indicative of a major adverse effect based on the following points:

- The CCME guideline is based on acute toxicity data, rather than more applicable chronic toxicity data, with an arbitrary safety factor of 0.01 applied to the LOEL for uncertainty.
- The CCME guideline is based on a 144-h LC50 for the caddisfly *Hydropsyche bronta* based on a water hardness of 40.2 mg/L and a temperature of 18°C (CCME 2002).
- As fluoride toxicity is positively related to temperature and inversely related to water hardness, the CCME guideline is overly conservative for watercourses like Dip and Casino Creeks which experience both higher water hardness and lower temperatures.
- The BC MOE guideline equation obtained from Pimental and Bulkley (1983) is meant to better approximate fluoride toxicity in cooler water temperatures around 12°C, which are still higher than stream temperatures in Casino and Dip Creeks, but provide a more reasonable estimate.

It should be noted that the technical documents for both guidelines recommend further research to better understand the interactions between water hardness and temperature with fluoride toxicity. Currently, there are limited data available from multifunctional experiments which strategically vary water hardness, temperature and fluoride concentrations. As such, guidelines tend to be overly conservative because (1) impacts of fluoride are better understood for low water hardness concentrations, and (2) guidelines have been developed with the aim of protecting anadromous adult fish which experience increased sensitivity to fluoride toxicity, and often migrate through soft coastal waters. However, as predicted maximum fluoride will not exceed the hardness-based BC MOE guidelines, and there is no evidence for salmon spawning in Casino and Dip Creeks, a major adverse effect on aquatic biota in either watershed is decidedly unlikely despite the uncertainty surrounding guideline development.

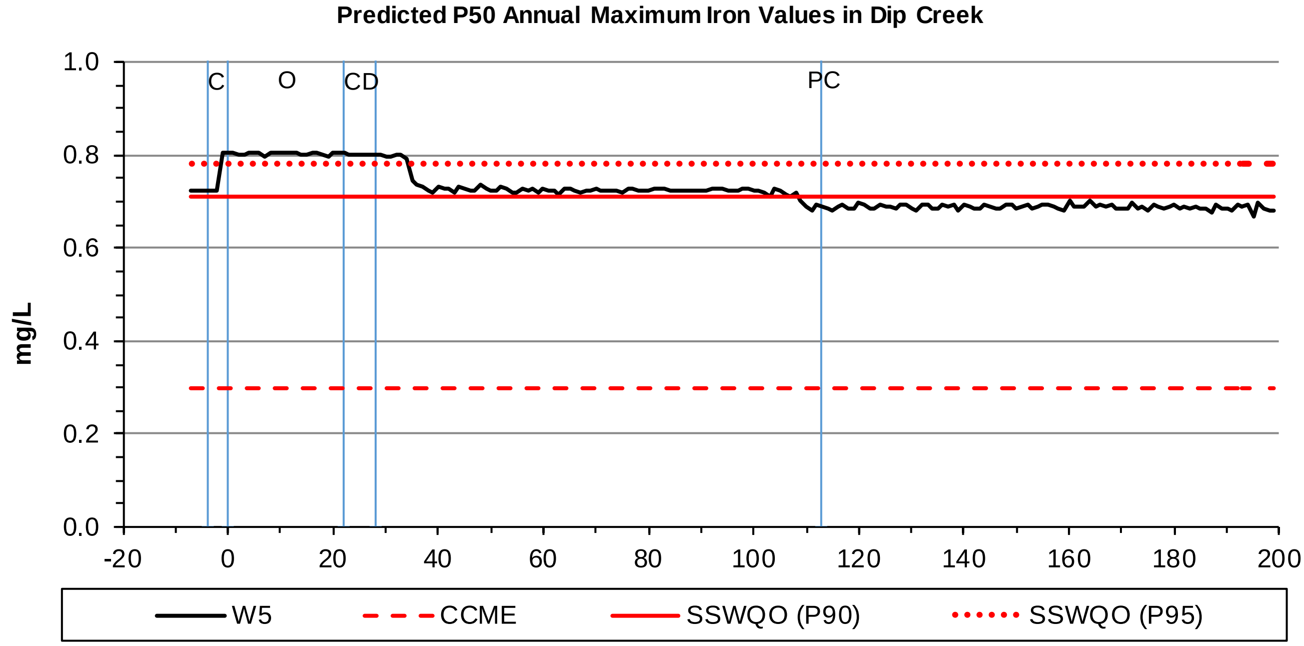
Iron

The annual maximum of the variability model monthly 50th percentile predictions for dissolved iron (Fe) concentrations at W5 in Dip Creek are presented in Figure A.7.10-7. Predicted Fe concentrations in Casino Creek are all below CCME guidelines, hence are not discussed. The water quality model predicts maximum Fe concentrations in Dip Creek to exceed CCME guidelines because the background data used for the model has naturally elevated total Fe in May. As shown on Figure A.7.10-7, Fe concentrations during operations and closure and decommissioning phases are higher than the Fe concentrations during post-closure, due to naturally elevated Fe concentrations in Dip Creek, prior to discharge from the TMF pond which has lower Fe than Dip Creek. Fe concentrations prior to operations were also lower, as the dilution from upper Casino Creek is still evident in the water chemistry. However, once the TMF is constructed and intercepting upper Casino Creek, that dilution is no longer available.

Similarly to copper, development of a site-specific water quality objective (SSWQO) to assess the impact of iron is considered to be appropriate, due to the naturally high baseline concentrations. Using the background concentration procedure (BCP) for the 90th and 95th percentile baseline values at W5 results in SSWQOs of 0.71 mg/L and 0.78 mg/L which can be applied to the construction/operations/closure and decommissioning phases, and the post-closure phase, respectively. These SSWQOs are show on Figure A.7.10-7 for comparison to the CCME guideline (0.3 mg/L).

Predicted maximum Fe concentrations are below the proposed 95th percentile SSWQO during the construction, post-closure I phases and decrease below the 90th percentile SSWQO once discharge from the open pit commences. Seasonally, it is clear that exceedance of the guidelines are restricted to May and June only. Predicted maximum Fe concentration long-term, once the open pit begins to discharge and provide dilution to the elevated Fe in Dip Creek, is predicted to be 0.70 mg/L which is below the proposed 90th percentile SSWQO of 0.71 mg/L.

As Fe is naturally elevated in Dip Creek, there are no anticipated effects on fish or aquatic resources from the predicted Fe concentrations.



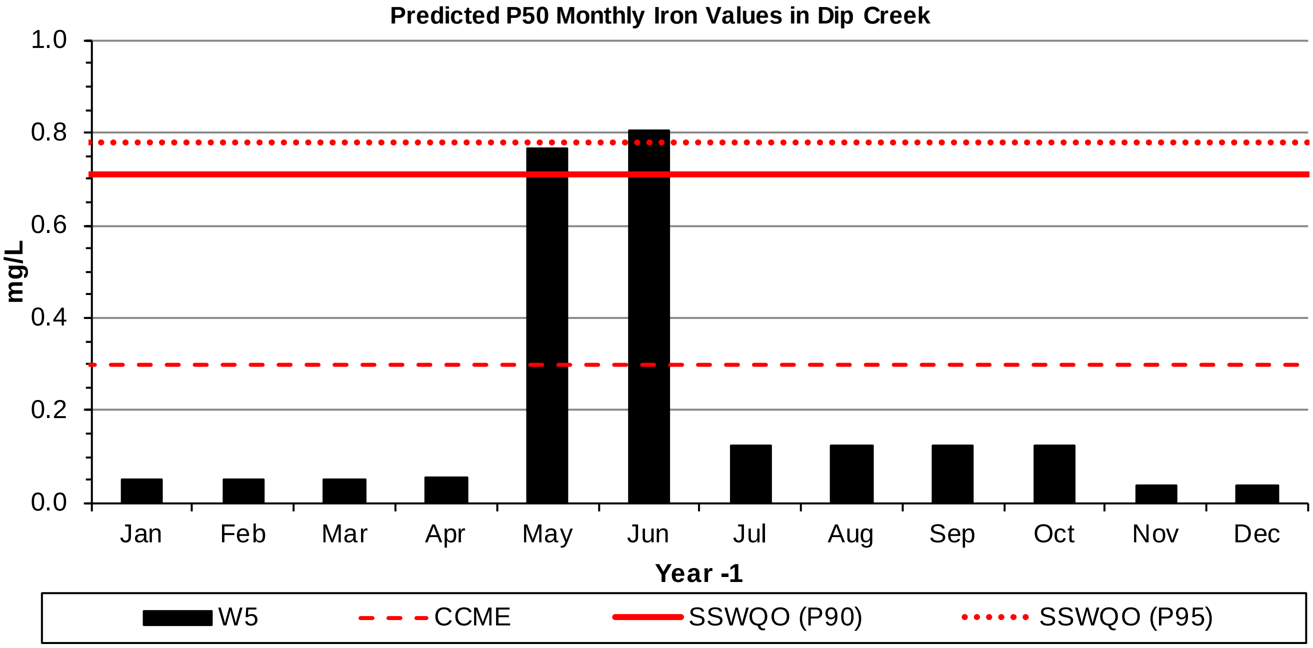


Figure A.7.10-7 Predicted Annual Maximum and Monthly Iron Concentrations for Dip Creek

Molybdenum

The annual maximum of the variability model monthly 50th percentile predictions for dissolved molybdenum (Mo) concentrations at W4 and M18 in Casino Creek are presented in Figure A.7.10-8. Water quality predictions for Mo in Dip Creek are all below the CCME guidelines (maximum Mo concentration at W5 for all phases is 0.030 mg/L), and hence are not discussed further however, water quality results are provided in Appendix A.7B. The updated model indicates that Mo concentrations at M18 and W4 will exceed the interim CCME guideline (0.073 mg/L) slightly in May and November, but will be well below the BC MOE guideline of 1 mg/L through all project phases. As British Columbia is currently the only province in Canada where Mo is mined, it is the only province with an approved molybdenum guideline. The BC MOE 30-day average for total Mo is 1 mg/L, which is almost 14 times higher than the CCME guideline of 0.073 mg/L (Fletcher et al. 1997). The maximum Mo concentration at post-closure is predicted to be 0.091 mg/L.

The water quality effects assessment of predicted molybdenum concentrations on fish and aquatic resources is provided below.

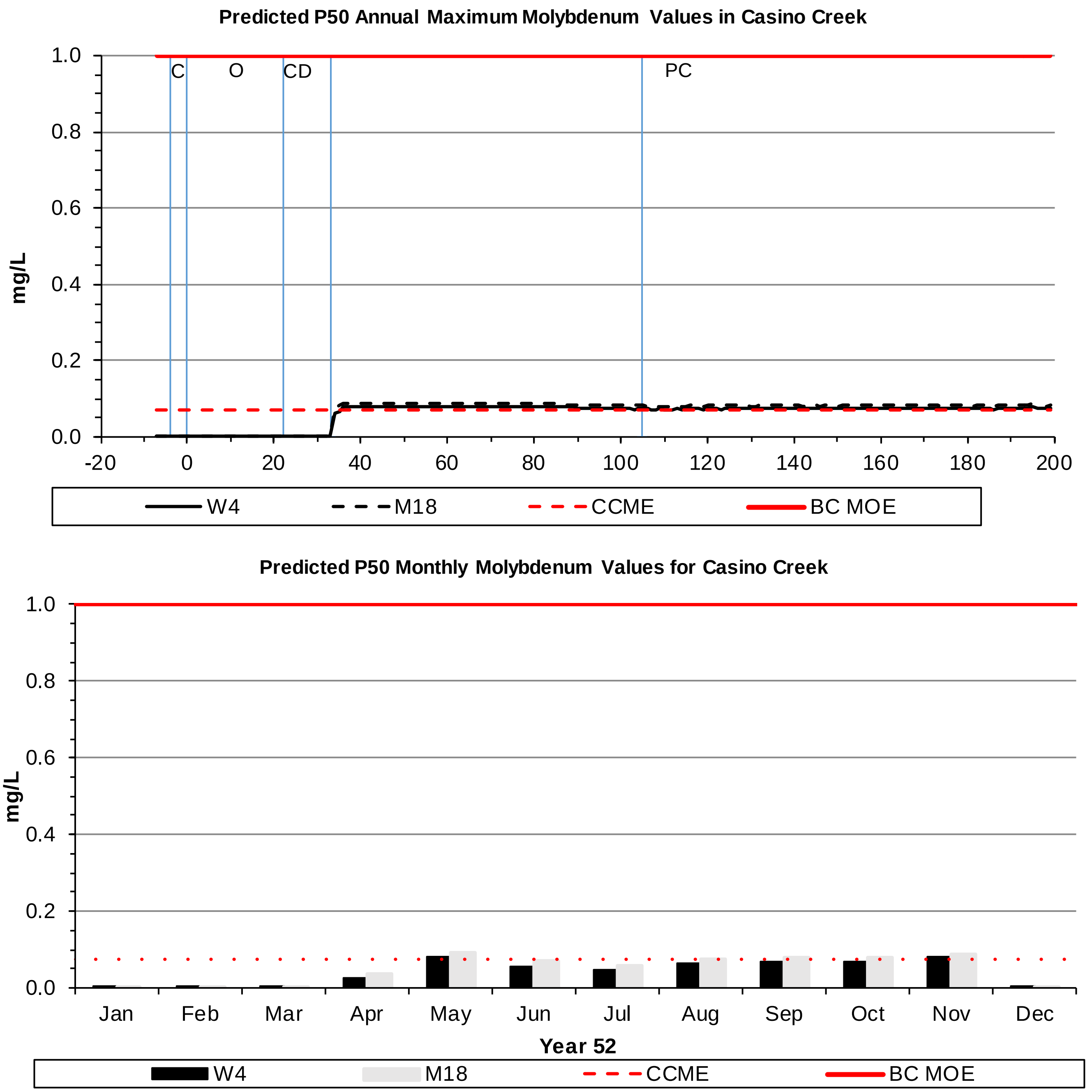


Figure A.7.10-8 Predicted Annual Maximum and Monthly Molybdenum Concentrations for Casino Creek

Molybdenum is an essential trace metal which promotes growth in periphyton, phytoplankton and macrophytes (CCME 1999). The mechanism of molybdenum toxicity is not well understood (Ricketts 2006), although chronic effects include reduced reproduction and mortality over long periods of exposure (CCME 1999). Molybdenum is relatively non-toxic to fish (Davies et al. 2005), and bioconcentration and biomagnification through the food chain is negligible (Regoli 2012).

While the interim CCME molybdenum guideline will be exceeded throughout the ice-free season, major adverse effects on fish and aquatic biota are not anticipated due to the following points:

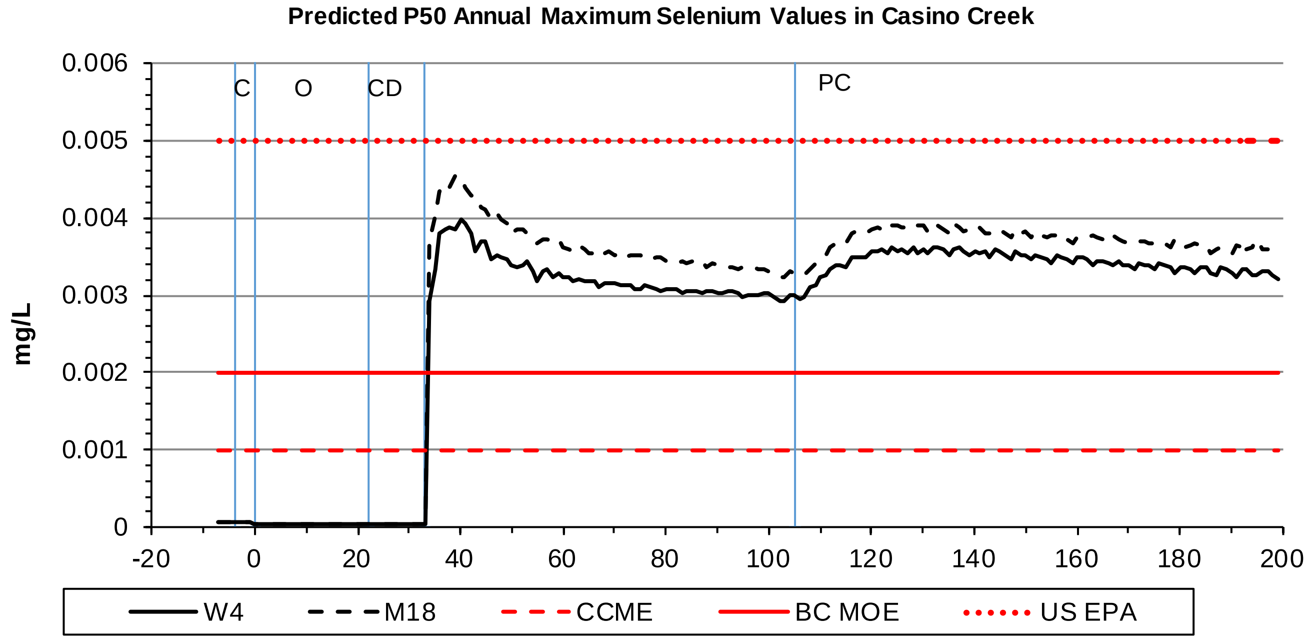
- The CCME guideline was developed using older literature (Birge 1978), and although there is a limited amount of environmental effects testing literature to-date, subsequent studies were not able to corroborate the results on which the water quality guideline was based (Davies et al. 2005).
- The guideline was derived by multiplying the lowest chronic toxicity value, the 28-d LC50 of 0.73 mg/L for rainbow trout (Birge 1978), by a safety factor of 0.1 (CCME 1999). However, the higher toxicity range reported in subsequent comparable studies (15 to >90 mg/L), and the inability to reproduce the experimental results of Birge (1978), suggests that the guideline is based on an overly conservative and potentially unrepresentative experimental artifact (Davies et al. 2005).
- Results from a newer study replicating methods in Birge (1978) were significantly higher, where molybdenum was not acutely toxic to developmental stages of rainbow trout over 32 days up to a maximum concentration of 400 mg/L, and a further 32-day experiment with a maximum molybdenum concentration of 1500 mg/L similarly did not cause sufficient mortality to allow an LC50 to be calculated (Davies et al. 2005). These molybdenum concentration experiments yielded an acute response over three orders of magnitude higher than predicted molybdenum concentrations in Casino Creek.
- Molybdenum is relatively non-toxic to fish, with acute LC50s being fairly high (70 to >2000 mg/L; Davies et al. 2005).
- Consistent with the review and experimental replication in Davies et al. (2005), there was no evidence of a cellular or physiological stress response at high concentrations (1000 mg/L) of molybdenum (Rickets 2006).
- Molybdenum bioconcentration and biomagnification through the food chain is negligible (Regoli 2012).

Selenium

The annual maximum of the variability model monthly 50th percentile predictions for dissolved selenium (Se) concentrations at W4 and M18 in Casino Creek and W5 in Dip Creek are presented in Figure A.7.10-9 and Figure A.7.10-10, respectively. The water quality model predicts Se concentrations to increase during discharge from the water management pond and TMF pond, with a maximum value in Year 40 of 0.005 mg/L at M18, 0.005 mg/L at W4 and 0.0015 mg/L at W5. Se concentrations decrease over the TMF discharge period, then increase slightly following discharge from the open pit, and the decreasing trend resumes as open pit discharge continues.

Predicted concentrations are compared to CCME (0.001 mg/L), BC MOE (0.002 mg/L) and US EPA (0.005 mg/L) guidelines in Figure A.7.10-9 and Figure A.7.10-10. During discharge from the water management pond and TMF pond (April through November), selenium concentrations at M18 and W4 are predicted to exceed CCME and BC MOE guidelines, but be less than US EPA guidelines. At W5, exceedances of the CCME guideline only occurs in May during the discharge period, and the maximum 50th percentile predicted selenium concentrations are less than the BC MOE guideline for all project phases.

The water quality effects assessment of predicted selenium concentrations on fish and aquatic resources is provided below.



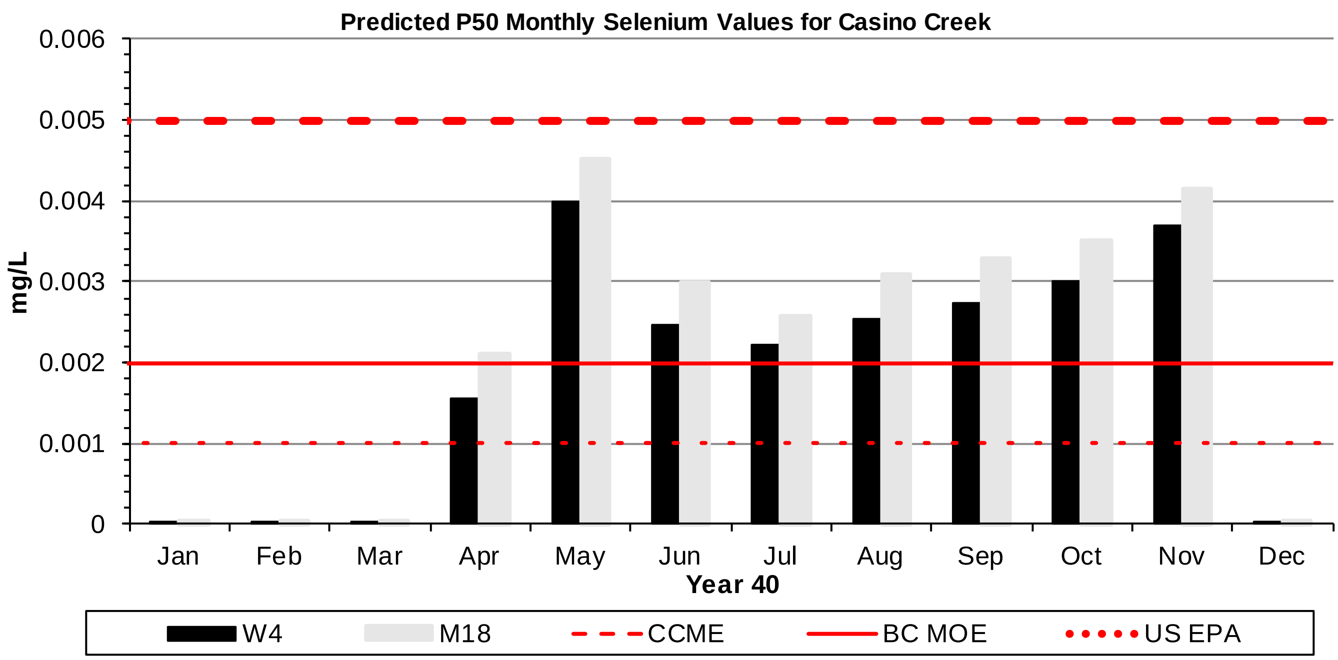
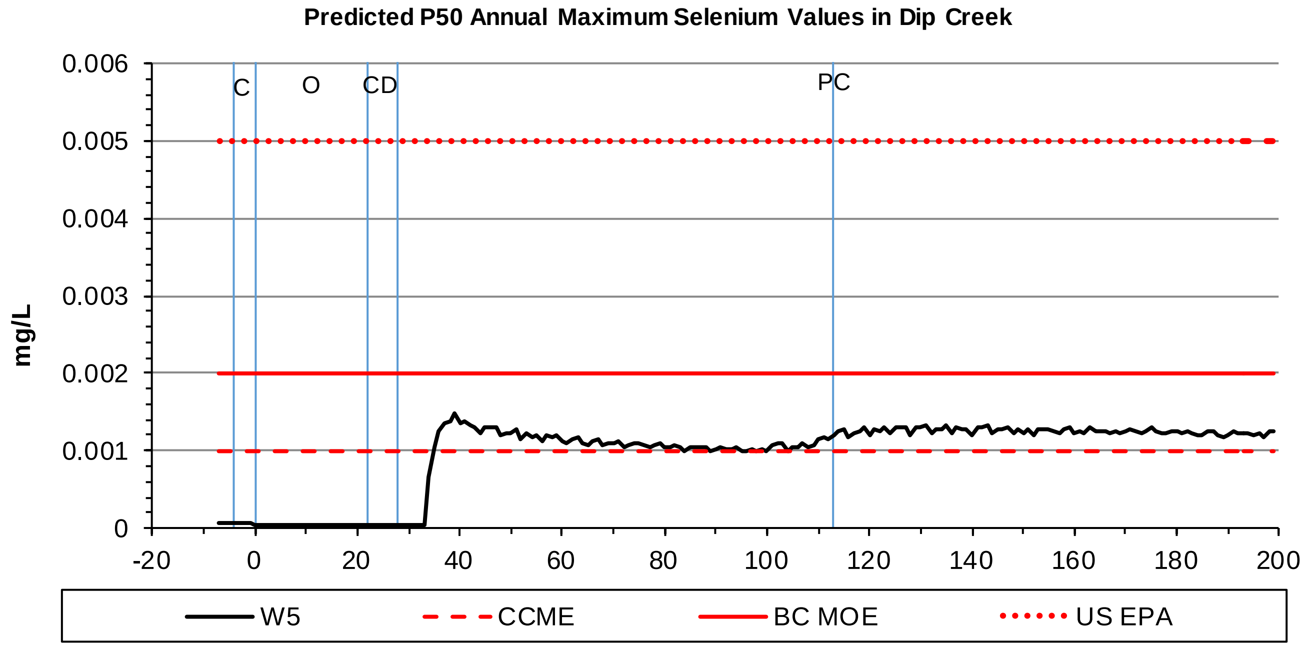


Figure A.7.10-9 Predicted Annual Maximum and Monthly Selenium Concentrations for Casino Creek



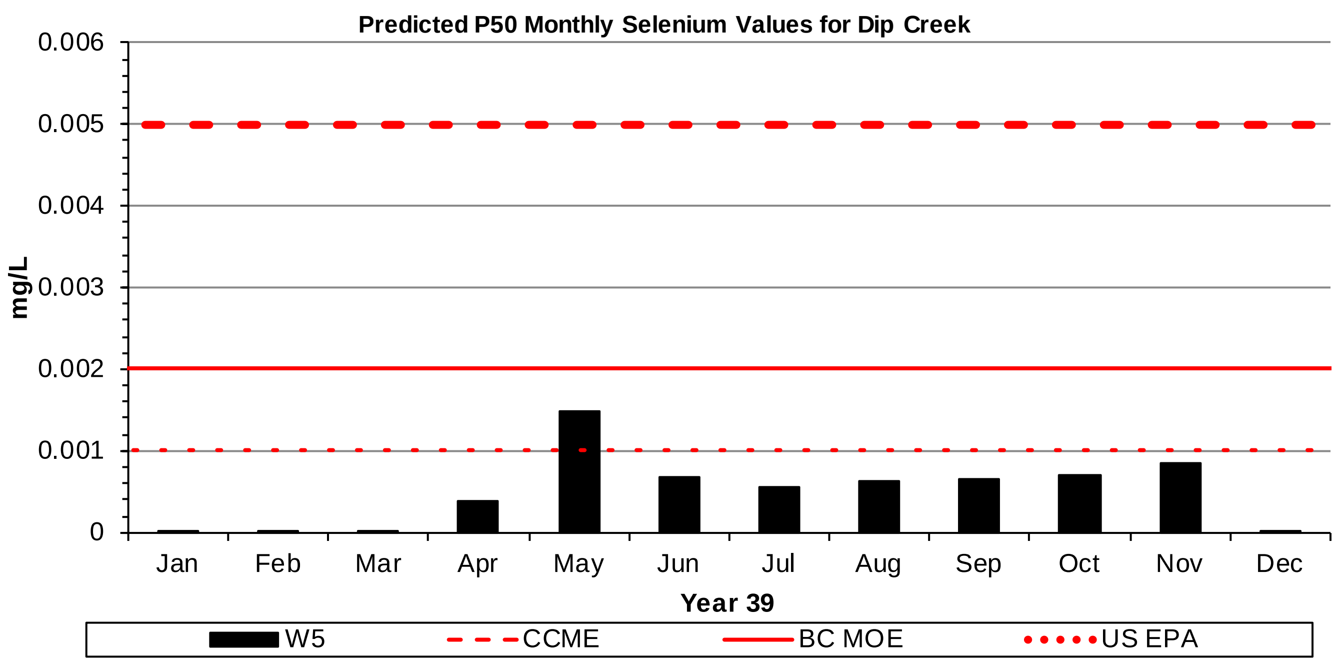


Figure A.7.10-10 Predicted Annual Maximum and Monthly Selenium Concentrations for Dip Creek

Selenium has the narrowest biological tolerance range (3-5 times difference) of all essential trace elements (Wake et al. 2004), and bioaccumulates in aquatic organisms at rates of 100-30,000 above ambient conditions (Lemly 2004). Selenium is principally transferred to aquatic biota through diet, with the initial source derived from organic-rich selenium present in stream sediments (BC MOE 2001). Selenium toxicity can produce varying effects on fish and aquatic organisms including liver and ovary abnormalities (Sorensen 1998), impaired growth (Dobbs et al. 1996), reduced reproduction (Lemly 2004), and teratogenesis during early development (Lemly and Smith

1987). In aquatic environments, the most sensitive group to selenium exposure are egg-laying vertebrates such as fish, with toxic effects typically manifested as reproductive failures and abnormalities during early development (Coyle et al. 1993; Hamilton et al. 1990; Hermanutz et al. 1996).

Selenium toxicity is arguably one of the most complex contaminants of concern due to the numerous physical and ecological properties which govern selenium bioavailability and toxicity in a given environment, and the potential for distinctly different outcomes for aquatic biota in similar waterborne selenium concentrations. Accordingly, there is ample scientific evidence indicating that traditional water-based guidelines with widespread geographical application are not appropriate for selenium, and that site-specific risk assessments incorporating critical media (e.g., fish embryonic tissues) are the most conservative means for the protection of aquatic life (Chapman et al. 2009).

Both the CCME and BC MOE water quality guidelines are based on a lowest observed effect level (LOEL) of 0.01 mg/L of Se introduced by the International Joint Commission (IJC) to protect species in the Great Lakes (IJC 1981). For the CCME guideline, a safety factor of 10 was applied to the LOEL to end up with the guidance of 0.001 mg/L Se. The BC MOE guideline of 0.002 mg/L incorporates a safety factor of 5 to recognize that Se is an essential trace element for animal nutrition and that it is bioaccumulation (chronic effects) of Se through the food chain that is the major source of risk. The US EPA guideline of 0.005 mg/L is based on the same field studies cited in IJC (1981), but differs from the CCME and BC MOE guidelines in that it employs the selenium concentration at which no effects were observed as the guideline, rather than using the LOEL multiplied by a safety factor.

Water-based guidelines for selenium have become increasingly controversial due to the growing body of literature investigating the complex mechanism of selenium transfer into aquatic food webs (Chapman et al. 2009). Foremost among literature findings is that the main source of selenium uptake into aquatic organisms is through diet, and that toxicity is further influenced by species physiology, and local hydrological and geochemical processes which ultimately regulate the bioavailability of selenium, the probability of uptake by organisms, and the potential for toxicity. Thus, the use of a water-based criterion has been increasingly criticized as an ineffective and unscientific means for ensuring that selenium concentrations remain within narrow biological tolerance ranges. Furthermore, there is ample evidence to suggest that the water-based LOEL determined by field studies in IJC (1981) is not transferrable to other systems (US EPA 1987, 2004; Chapman et al. 2009), with results from several laboratory studies indicating that similar or higher selenium concentrations did not produce any chronic effects on aquatic biota (e.g., Lemly 1982; Hamilton et al. 1990; Cleveland et al. 1993; Gissel-Nielsen and Gissel-Nielsen 1978). However, variable results over a range of selenium concentrations in both laboratory and field studies further underline the complexity of predicting adverse levels of selenium based on water concentrations in natural settings (US EPA 1987, 2004; Chapman et al. 2009). In contrast, there is mounting evidence to suggest that an alternative tissue-based criterion using the most sensitive organism and life stage in a given ecosystem is the most conservative and scientifically defensible route for ensuring protection of aquatic life from selenium exposure (Chapman et al. 2009). Both British Columbia and the US EPA have recommended that measuring the level of selenium in whole body tissue of fish is a more appropriate way to assess selenium effects, and have provided tissue-based criteria accordingly.

It is important to note that the scientific studies used to develop selenium water quality guidelines were largely in standing or slow-moving waters which demonstrate an increased risk of selenium toxicity (BC MOE 2001). In slower moving waters (e.g., lentic environments), higher organic-rich selenium concentrations accumulate in sediments and cause increased bioaccumulation in the food chain. In fast-flowing waters (e.g., lotic environments), selenium is less likely to bioaccumulate due to the lack of organic-rich sediment and rooted plants (BC MOE 2001). Various studies investigating selenium toxicity were compiled in a review by Adams et al. (2000)

to demonstrate the clear distinction between lentic and lotic systems. Selenium bioaccumulation was generally ten times greater in lentic environments in comparison to lotic environments, with bioaccumulation occurring above 0.001 mg/L and 0.013 mg/L in lentic and lotic environments, respectively (Adams et al. 2000). Thus, in the cobble-dominant fast-flowing waters of Casino Creek, the risk of selenium bioaccumulation into the aquatic food chain is likely low. Furthermore, the LOEL reported by other studies is likely an overly conservative estimate for selenium impacts in lotic systems such as Casino Creek. Several field studies have demonstrated no discernible effects on aquatic biota residing in fast-flowing waters within the receiving environment from coal mining effluent containing high (0.0133-0.0145 mg/L) waterborne selenium concentrations (e.g., McDonald and Strosher 1998; Kennedy et al. 2000).

Due to the lack of scientific support for applying a water-based criterion to Casino and Dip Creeks, a site-specific risk assessment is proposed to determine local toxicity thresholds for selenium. The assessment will facilitate the development of site-specific guidelines based on the various moderating factors including selenium speciation, hydrology, food web structure, physiology, water temperature and chemistry. As the reproductive tissues of egg-laying vertebrates have been identified as the most sensitive endpoint for determining selenium toxicity, fish eggs will be collected and analyzed where possible to develop local guidelines. Notably, previous environmental assessments have also proposed site-specific tissue-based guidelines (e.g., High Lake Project in Nunavut), which included an adaptive management approach to ensure no adverse effects.

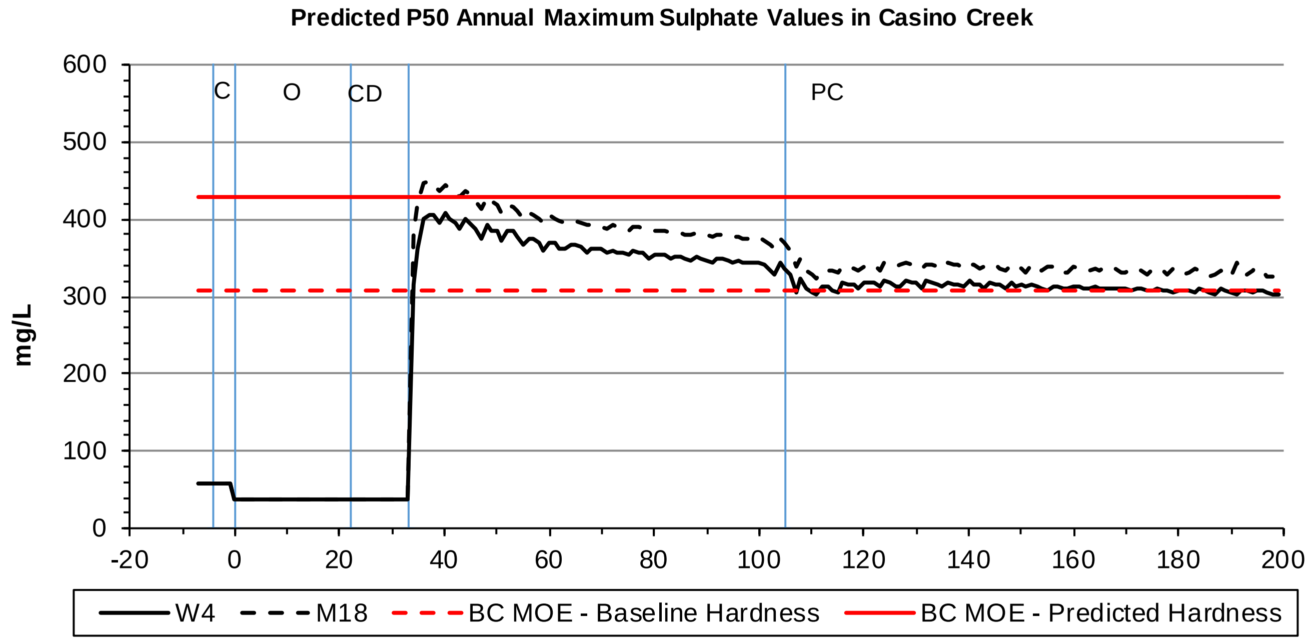
In summary, it is unlikely that any significant adverse effects will occur as a result of selenium toxicity due to the following points:

- A site-specific tissue-based assessment will be undertaken to provide the most conservative and scientifically defensible protection for local aquatic life.
- Predicted selenium concentrations will remain below the established US EPA guideline (0.005 mg/L) at all sites and under all project phases, and additionally below the BC MOE guideline (0.002 mg/L) in Dip Creek year-round and under all project phases.
- Casino and Dip Creeks are fast-flowing streams and the developed guidelines are likely overly conservative for these lotic (fast-flowing) systems as they are based on lentic (still water) systems which experience enhanced selenium bioaccumulation.

Sulphate

The annual maximum of the variability model monthly 50th percentile predictions for dissolved sulphate (SO_4) concentrations at W4 and M18 in Casino Creek are presented in Figure A.7.10-11. Water quality predictions for SO_4 in Dip Creek are all below the BC MOE guidelines (maximum SO_4 concentration at W5 for all phases is 141 mg/L, and BC MOE guideline is 309 mg/L for baseline hardness), and hence are not discussed further however, water quality results are provided in Appendix A.7B. The water quality model predicts SO_4 concentrations to be highest during initial TMF and water management pond discharge (Year 40) and to decrease over time. The maximum SO_4 concentration at initial discharge is 450 mg/L at M18 and 409 mg/L at W4. However, SO_4 remains below the BC MOE guideline for predicted hardness (429 mg/L for hardness between 181 – 250 mg/L) for all project phases, except for between years 36 – 48, when there are slight monthly exceedances in May, October and November at M18.

The drop in water quality seen in Figure A.7.10-11 below at the start of the operations period is due to the installation of the tailings dam, and the resulting interception of the poor water quality from upper Casino Creek. The spike at the commencement of the post-closure period is due to the discharge from the seepage pond and from the TMF pond. The water quality effects assessment of predicted sulphate concentrations on fish and aquatic resources is provided below.



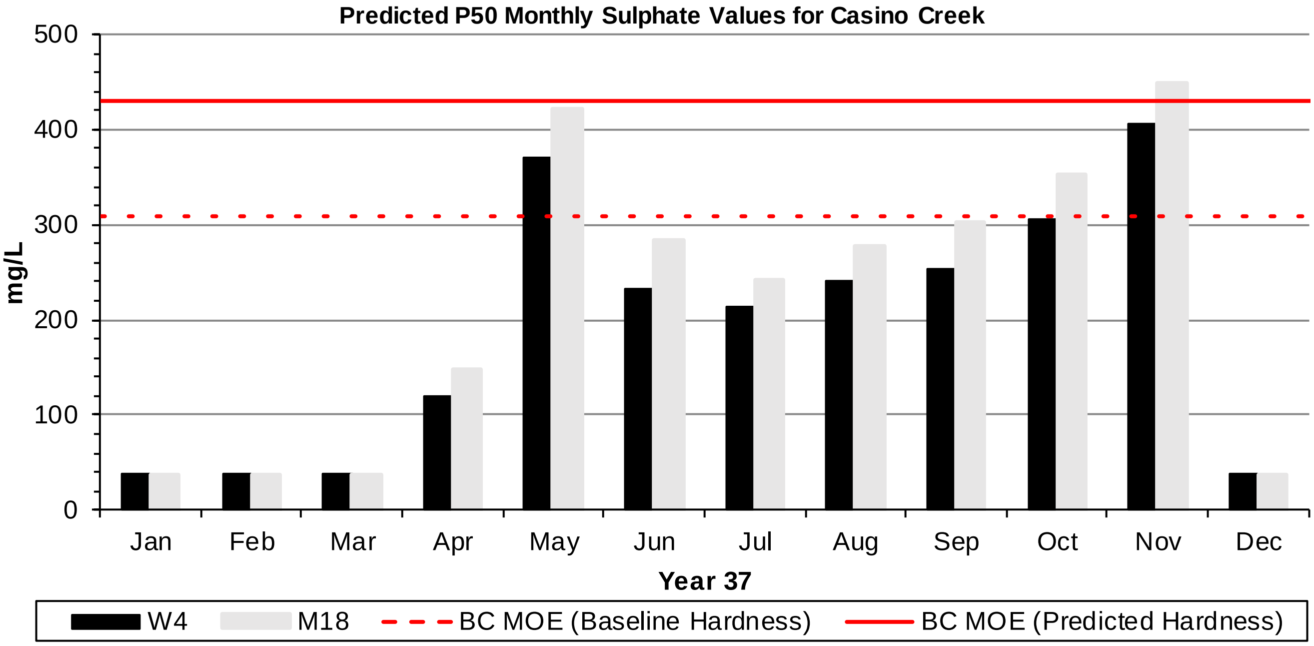


Figure A.7.10-11 Predicted Annual Maximum and Monthly Sulphate Concentrations for Casino Creek

Sulphur is an essential element used in amino acid synthesis (Meays and Nordin 2013). Numerous research has demonstrated that sulphate toxicity is ameliorated with increasing water hardness, however, there is limited data demonstrating this continuing trend in very hard waters (Meays and Nordin 2013). Invertebrate species are generally more sensitive to sulphate than fish (Davies et al. 2003). Chronic sulphate toxicity effects on aquatic biota include reduced reproduction, feeding, metabolism, and growth (Soucek 2007a, b; Elphick et al. 2011).

The only available sulphate guideline is provided by the BC MOE (Meays and Nordin 2013), which is a 30-day chronic guideline that varies with water hardness up to 250 mg/L. There are no approved federal water quality guidelines for the protection of freshwater aquatic life from sulphate in Canada, the USA or elsewhere. Application of the approved 30-day average water quality guidelines using baseline median hardness of 111 mg/L for Casino Creek results in a sulphate guideline of 309 mg/L, which is lower than the predicted maximum sulphate concentrations of 450 mg/L at M18 and 409 mg/L at W4. However, as median water hardness is predicted to increase in Casino Creek, the potential for sulphate toxicity will concurrently decrease due to the ameliorating effects of water hardness. The maximum BC MOE sulphate guideline is 429 mg/L, based on water hardness levels between 181-250 mg/L, which surpasses the predicted maximum annual sulphate value at W4 during all project phases. However, predicted maximum sulphate at M18 will exceed the maximum BC MOE sulphate guideline from Years 36-48 during the month of November only.

There is currently no sulphate guideline available for water hardness concentrations greater than 250 mg/L, and the BC MOE sulphate technical appendix recommends that site-specific toxicity testing is done for hardness >250 mg/L due to the paucity of experimental studies conducted using higher water hardness concentrations. However, the majority of this limited research has demonstrated the ameliorating influence of increased water hardness on sulphate toxicity (Meays and Nordin 2013), indicating that future research will likely provide the data to develop a higher sulphate guideline for water hardness levels >250 mg/L. Based on this anticipated interaction, it is unlikely that sulphate will cause major adverse effects on aquatic biota in Casino Creek, despite periodic exceedances of the current maximum guideline at M18.

While the BC MOE technical appendix cites one study in which increasing water hardness did not reduce sulphate toxicity, the study is unclear on the mechanism which resulted in reduced reproduction rates for *C. dubia* at lower sulphate concentrations following an increase in water hardness from 160 mg/L to 320 mg/L (Elphick et al. 2011). Further, the study authors indicated that the increased sensitivity was thought to derive from osmotic stress caused by the increasing ionic strength of the total dissolved solids, and not from sulphate (BC MOE 2011). Notably, the LOEL for mortality continued to increase with water hardness up to 320 mg/L. Thus, potential effects from high water hardness appear to be more subtle than direct impacts on individual survival. There are currently no guidelines for water hardness, however unpublished research has demonstrated that lethal effects are not experienced by either rainbow trout or *C. dubia* up to concentrations of 1000 mg/L (Kennedy *in progress*). However, more research is required in order to isolate the non-lethal thresholds of water hardness and sulphate, and to ultimately develop defensible sulphate guidelines for harder waters.

In summary, no significant adverse effects are anticipated due to sulphate toxicity due to the following points:

- Incorporating predicted water hardness, sulphate concentrations in Casino Creek remain below the BC MOE chronic 30-day guideline for water hardness of 250 mg/L for the majority of months and project phases, with the only exception being small exceedances at M18 during the month of November between Years 31 and 52.
- No guideline currently exists for water hardness above 250 mg/L, however it is likely that it will be higher based on the ameliorating effects of water hardness (BC MOE 2011).
- Although there was evidence for a lower sulphate LOEL in *C. dubia* following increased water hardness, the authors attributed the result to water hardness effects, rather than sulphate (Elphick et al. 2011).

- Any minor residual impacts will be localized to Casino Creek, with no BC MOE exceedances predicted for W5 in Dip Creek.

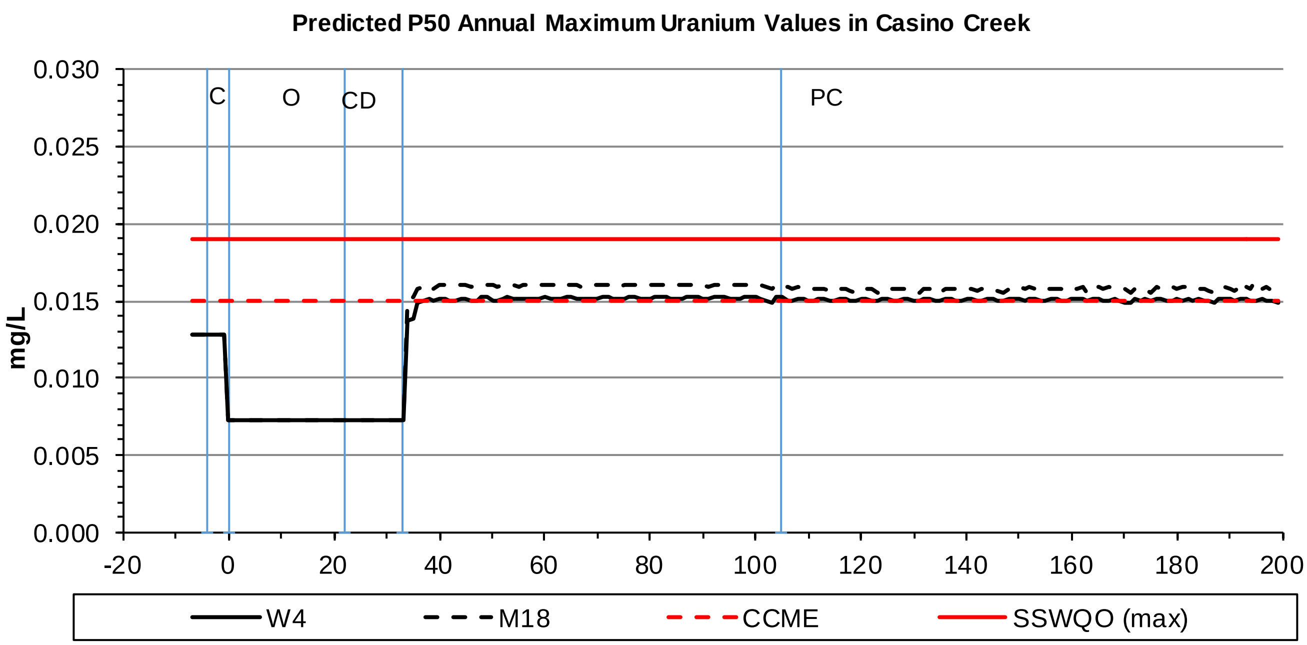
Uranium

The annual maximum of the variability model monthly 50th percentile predictions for dissolved uranium (U) concentrations at W4 and M18 in Casino Creek are provided in Figure A.7.10-12. Dip Creek values are not discussed, as they are all less than the CCME guideline (maximum U concentration at W5 for all phases is 0.010 mg/L and CCME guideline is 0.015 mg/L), however, complete water quality results are provided in Appendix A.7B.

Although not at the same intensity as copper, baseline levels of uranium are also elevated in the Casino Creek watershed. Thus, a SSWQO based on the maximum value (0.019 mg/L) was considered to be the most appropriate to evaluate the potential effects of uranium concentrations on the aquatic environment, as two out of six winter samples from the 2008-2012 water quality baseline study (Appendix 7A) exceeded the CCME long term guideline of 0.01 mg/L. Predicted 50th percentile values are compared to the CCME and SSWQO in Figure A.7.10-12.

The water quality model predicts U concentrations to remain relatively consistent throughout the period of water management pond and TMF pond discharge. The maximum U concentration is predicted to be 0.017 mg/L at M18. The CCME guideline is slightly exceeded at M18 in May, September and November and at W4 in November only (maximum value at W4 = 0.0154 mg/L in November 2076). Predicted U concentrations are below the CCME for the rest of the year and are below the SSWQO for all project phases at all modeled sites.

The drop in water quality seen in Figure A.7.10-11 below at the start of the operations period is due to the installation of the tailings dam, and the resulting interception of the poor water quality from upper Casino Creek. The spike at the commencement of the post-closure period is due to the discharge from the seepage pond and from the TMF pond. The water quality effects assessment of predicted uranium concentrations on fish and aquatic resources is provided below.



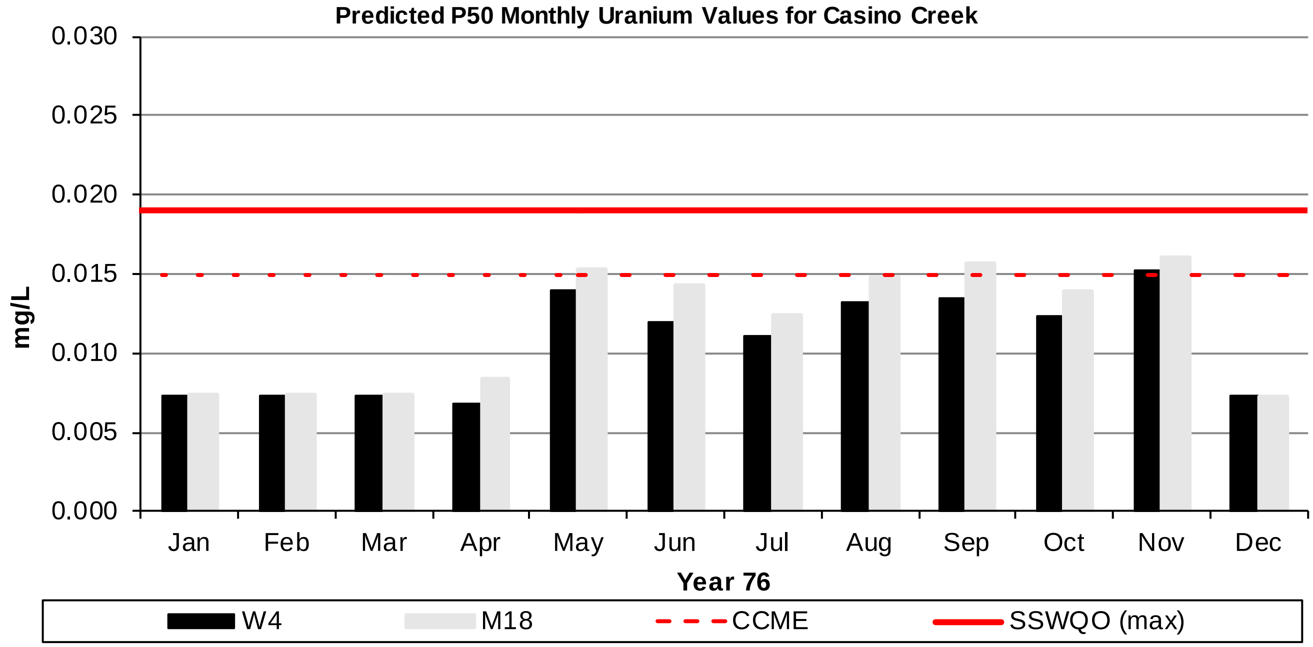


Figure A.7.10-12 Predicted Annual Maximum and Monthly Uranium Concentrations for Casino Creek

Uranium accumulation is greatest in the mineralized tissues of fish (Waite et al. 1990; Cooley and Klaverkamp 2000), although it can also build up in other organs such as the kidneys and gonads (Waite et al. 1990; Cooley and Klaverkamp 2000). In invertebrates, uranium has been shown to collect in the gills, visceral mass, stomach and digestive glands (Labrot et al. 1999; Simon and Garnier-Laplace 2004; Simon and Garnier-Laplace 2005). There is evidence for uranium bioaccumulation in aquatic ecosystems, but not for biomagnification (Swanson 1985; Environment Canada and Health Canada 2003; Simon and Garnier-Laplace 2005). In addition, trophic transfer rates of uranium are low (Simon and Garnier-Laplace 2005), with higher concentrations generally found in lower trophic organisms (Environment Canada and Health Canada 2003). Uranium toxicity may cause a range of potential chronic effects, including reduced reproduction, growth, and survival.

Natural uranium concentrations demonstrate wide variability, and may promote ecological adaptations in local aquatic life. Uranium toxicity and bioavailability varies with pH, hardness, and temperature, however the CCME guideline does not incorporate the influence of other parameters due to limited current understanding of potential interactions (CCME 2011). As there is evidence for organismal adaptation to higher natural uranium concentrations, the increase of anthropogenic uranium into an environment may be less detrimental to organisms with pre-existing high uranium tolerances (CCME 2011).

Despite the noted CCME exceedances, uranium is not anticipated to yield significant adverse effects due to the following main points:

- Aquatic life experiencing higher natural uranium concentrations such as in Casino Creek may have adapted higher tolerances for uranium; the CCME states that in these cases, a site-specific guideline may be necessary or advantageous (CCME 2011). Maximum predicted uranium concentrations at W4 and M18 will not exceed SSWQOs at any time.
- Maximum predicted uranium concentrations will not exceed short-term CCME or maximum BCWWQ guidelines at either site.

- While more exceedances of the long-term CCME guideline will occur further upstream at M18, the median value of 0.010 mg/L remains below the guideline.
- A small exceedance in the CCME guideline is considered acceptable given that: (1) uranium concentrations appear to be naturally elevated at several sites in the LSA and RSA, including upper Dip Creek and all sites on Britannia Creek, (2) British Columbian and Yukon stream levels of uranium are highest amongst all streams in Canada (Garrett 2007), and (3) elevated U concentrations at the Casino mine site appear to be ubiquitous and unrelated to the ore body.
- The CCME guideline is derived using the statistical (Type A) approach which sets the guideline at the 5th percentile, below which 95% of all taxa will not experience chronic uranium effects (CCME 2011). However, according to Figure 2 in the uranium CCME factsheet, an increase to 0.02 mg/L is still at least 2 times below the LOEL for 12 of 13 aquatic species used to derive the guideline. Furthermore, it is not significantly different from the guideline, falling below the upper 95% confidence interval of 0.025 mg/L (CCME 2011). Only one sensitive species, the amphipod *Hyalella azteca* is within the potential range of chronic effects with a LOEL of 0.012 mg/L, although notably it is also not protected by the CCME guideline of 0.015 mg/L. Finally, the lowest chronic threshold experienced by fish species used to derive the guideline is much higher, with a 30-day EC10 (non-viable embryos) of 0.350 mg/L for rainbow trout (Vizon 2004).
- Any minor residual impacts will be localized to Casino Creek, with no CCME exceedances predicted for W5 in Dip Creek.

Discussion of significance

As stated in the Proposal, predicted water quality in Casino Creek exceeds CCME guidelines (BC MOE freshwater aquatic life guideline for SO_4) for seven parameters: Cu, Cd, Mo, Se, U, SO_4 and F. Exceedances for Cd, Cu, F, Fe and Se were also predicted in Dip Creek. Completion of a variability water quality model resulted in some refinements of the water management structure for capture of seepage, and discharge in the post-closure period. These refinements resulted in improvements to the median values predicted for the parameters of concern, and overall, median water quality at station W5 is equal to or below all CCME guidelines for all parameters (Table A.7.10-2).

Some exceedances of CCME guidelines and BC MOE freshwater aquatic life guideline for SO_4 remained following the water management system refinements; however, all parameter predictions fall below either site specific water quality objectives or are considered acceptable based on literature from the development of guidelines from other jurisdictions, with only minor exceedances of sulphate at M18 early in the discharge period.

Based on this discussion, the overall residual effect of the proposed Project on surface water quality is rated as not significant, due to the low geographical extent, moderate magnitude of the anticipated effect and moderate probability of occurrence. This assessment is strengthened by the results of the variability water quality model presented above. The assessment of significance is contingent on the complete implementation of mitigation measures, including a successful water management plan and reclamation and closure plan, as refined following the results of the variability water quality model. The level of confidence applied for the residual effect is considered moderate (50% to 80%). This is based on the inherent nature of uncertainties associated with water quality modelling and the dependencies on numerous input sources.

While predictions indicate that there will be long-term changes to the water quality in the receiving environment due to the Casino Project, water quality will not pose a significant negative effect to the aquatic life in Casino and Dip creeks. Results of toxicity testwork conducted in 2014 verify these predictions (Section A.7.3.1.6 – R166), and confirm that no acute or sub-lethal toxicity is predicted based on the interaction of the various contaminants predicted to be present in the downstream environment. Based on criteria outlined in the Proposal, the changes to the baseline water quality will not amount to an effect that meets the criteria of 'significance'.

A.7.10.1.2 R239

R239. Predictions for pH in table 7.4-3 (Water Quality Model Parameters and CCME and BC MOE Guidelines) and Tables 7.4-8 through 7.4-10 (Summary of Predicted Water Quality in Casino Creek at M18 and W4 and Dip Creek at W5).

pH has been added to all output tables for the water quality model results in the Water Quality Predictions Report (Appendix A.7B).

A.7.10.2 Metal Mining Effluent Regulations

A.7.10.2.1 R240

R240. Predictions for toxicity, pH, and radium 226 in the tailings management facility pond and the winter seepage mitigation pond. Provide a discussion on how these parameters address the limits under the Metal Mining Effluent Regulations.

Toxicity of predicted water chemistry was evaluated in 2014, and is discussed in the response to R166.

pH of TMF Pond water is presented in Appendix A.7B (Water Quality Predictions Report), Sub Appendix IV (TMF Pond), Section 6.1 (Water Quality Predictions) and ranges from 6.1 – 6.9. pH of WMP water is presented in Appendix A.7B, Sub-Appendix V (WMP Water Quality), Section 6 (Results and Discussion) and ranges from 6.2 – 6.4. All values are within the MMER limits of 6.0 – 9.5.

Ra226 has not been included in the water quality model predictions, as baseline results from 2011, indicate non-detectable concentrations of Radium 226 (<0.02 Bq/l) in Casino Creek (W8 and W11), Proctor Gulch (W12), the historical adit (W43), and Canadian Creek (W7). As there is no radioactivity in the ore body at the Casino Project and non-detectable concentrations at baseline, there is no reason to suspect that there will be any Radium 226 in the receiving environment throughout the life of the project. As Radium 226 is regulated by the MMER, it will be part of the suite of parameters tested during the post-closure EEM program.

Two sources make up the discharge effluent: the TMF Spillway water and the WMP water. The WMP water will only be released between April and November in order to mix with the TMF Spillway water. This discharge effluent will be the point of discharge into the receiving environment. As discharge will not occur until >3 years post closure, the Mine will be a Recognized Closed Mine under the *Metal Mine Effluent Regulations* (*MMER*), and hence *MMER* discharge limits would not apply. However, for comparative purposes, water quality at the discharge point has been compared to *MMER* limits below. Details on the water quality of the discharge sources throughout the mine life is discussed in Appendix A.7B as this assessment focuses only on Post-Closure when water is discharged to the receiving environment.

MMER authorized limits are applied to water quality at the combined effluent discharge point, which is a mixing point at the downstream end of the TMF spillway where the flow mixes with the WSMP discharge (approximately 250 m upstream of Brynelson Creek) at mine closure. *MMER* limits were compared with the maximum annual concentrations for the parameters regulated by *MMER*, which include As, CN (total), Cu, Pb, Ni and Zn (Figure A.7.10-13). Predictions were not made for TSS as it is assumed that sediment control practices employed throughout construction and operations and ongoing monitoring will maintain TSS to less than detectable or at most <5 mg/L on a monthly basis. At closure and post-closure, TSS is assumed to remain very low in the receiving environment, which is attributable to the presence of the upstream TMF pond. Figure A.7.10-13 clearly show that none of the parameters exceed *MMER* limits.

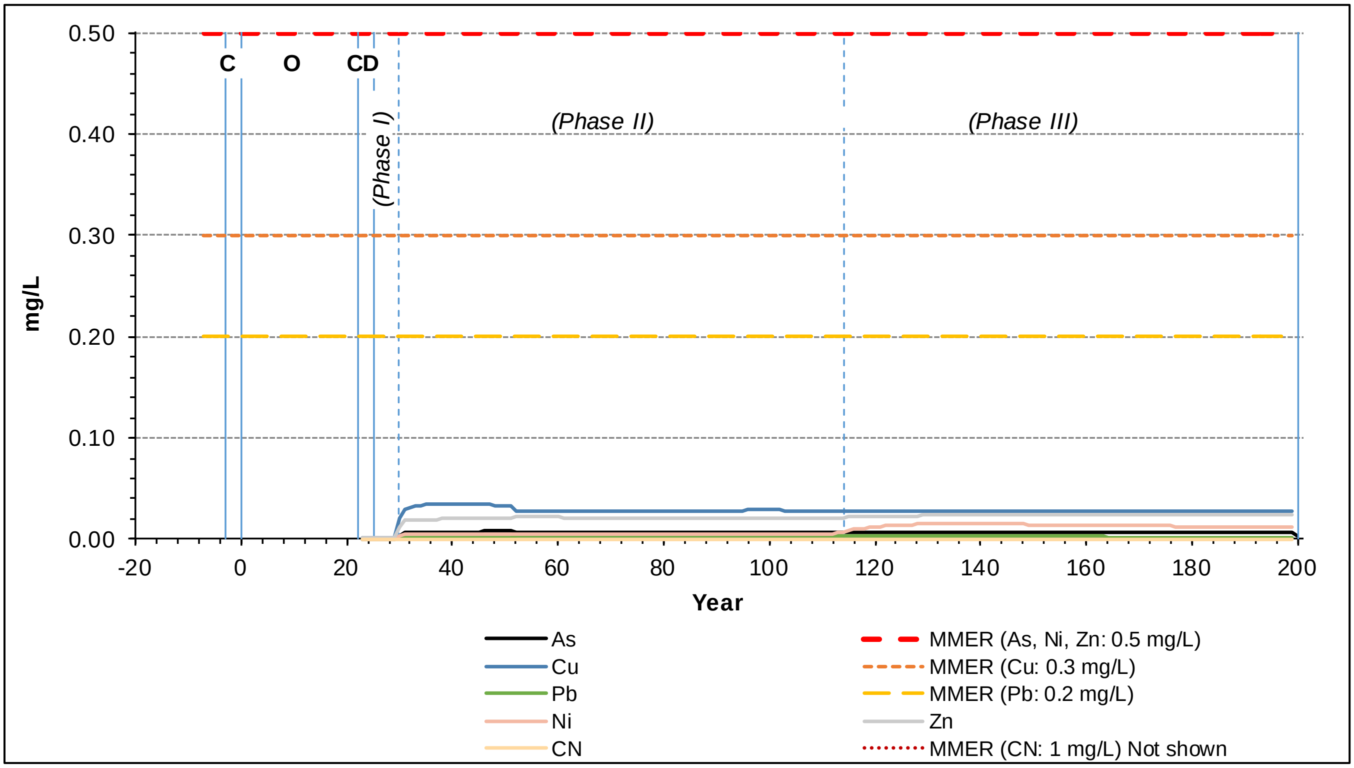


Figure A.7.10-13 Predicted Maximum Annual Values for the Discharge at the Mixing Point (update to Figure 7.4-1)

A.7.11 DOWNSTREAM EXTENT OF WATER QUALITY EFFECTS

A.7.11.1.1 R241

R241. An assessment of potential water quality effects extending downstream to include water monitoring station W16 and, if necessary, as far downstream to demonstrate no further exceedances of the CCME surface water quality objectives attributed to the mine (or 90th percentile of background for those constituents that naturally exceed CCME). The assessment should consider scenarios both with and without use of the passive treatment system.

As described in the response to R238, under the variability water quality model only copper, fluoride and selenium exceed CCME in the post-closure phase at station W5 on Dip Creek. Copper is naturally elevated in the watershed, and hence a 90th percentile site specific water quality objective approach, and hence the background concentration procedure (BCP) was selected to calculate the SSWQO (P90) values for Casino and Dip Creeks, as shown on Figure A.7.10-3 and Figure A.7.10-4. Predicted maximum copper concentrations do not exceed the SSWQO during any project phase. Predicted fluoride values in Dip Creek are less than the BC MOE guideline using baseline hardness (guidelines = 1.1 mg/L). Predicted selenium concentrations at W5 during discharge from the water management pond and TMF pond (April through November) exceed the CCME guideline only in May during the discharge period, and are less than the BC MOE guideline for all project phases.

Therefore, all parameter predictions fall below either site specific water quality objectives or are considered acceptable based on literature from the development of guidelines from other jurisdictions, by modelled station W5 on Dip Creek, and further assessment of downstream concentrations would illustrate the gradational improvement of water quality as dilution is provided along Dip Creek.

Modeling of the Project in the absence of passive treatment has not been considered, as CMC recognizes the need for certain mitigations to ensure the protection of the receiving environment and is not proposing to operate the Project without implementation of these mitigations.

A.7.11.1.2 R242

R242. Additional rationale supporting the use of station M18/W18 as the receiving environment for the Project. Consideration should be given to:

a. how this site fits within the intent of CCME; and

b. to what degree does contribution of water from Brynelson Creek provide a buffer for the project meeting CCME or site specific water quality objectives for the protection of aquatic resources.

As discussed in the response to R238, water quality is predicted in Casino Creek at model point M18 (just downstream of the confluence of Brynelson and Casino Creek, and analogous to site H18). M18 is a modeled site, although baseline hydrology was collected at M18 (hydrology station H18). M18 represents the water quality at the point of discharge to the receiving environment and represents the receiving environment as the most upstream location in Casino Creek. In other words, when the TMF (and associated water management pond) is in place, there will be no water in Casino Creek until the point where Brynelson Creek and the TMF spillway connect with Casino Creek. In recognition of the importance of the modeled water quality site M18, a water quality sampling site was added in 2014, labelled W28, shown in Figure A.11 from Appendix 4C during the TMF discharge phase. W28 will represent water quality at hydrology station H18.

Alternatively, station W18 is a water quality, sediment quality and hydrology monitoring site on lower Brynelson Creek, just upstream of the confluence with Casino Creek. Station W18 will continue to be monitored for water quality, sediment quality and hydrology, as it will be an important site to provide background flow to the discharge from the TMF and WMP.

As illustrated on Figure A.11 from Appendix 4C, flow in the ~-500 m of the Casino Creek stream bed upstream of the confluence of Brynelson will be only from discharge from the TMF spillway and from the Water Management Pond, where the Metal Mining Effluent Regulations (MMER 2002) will dictate the concentrations allowable for discharge. The Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME 1999) are "*intended to provide protection of freshwater and marine life from anthropogenic stressors such as chemical inputs or changes to physical components (e.g., pH, temperature, and debris). Guidelines are numerical limits or narrative statements based on the most current, scientifically defensible toxicological data available for the parameter of interest. Guideline values are meant to protect all forms of aquatic life and all aspects of the aquatic life cycles, including the most sensitive life stage of the most sensitive species over the long term. Ambient water quality guidelines developed for the protection of aquatic life provide the science-based benchmark for a nationally consistent level of protection for aquatic life in Canada.*"

As discussed in the response to R238, discharge from the Water Management Pond will be tied to the available flow in Brynelson Creek, and discharge from the TMF will in turn be controlled to reflect the quantity of discharge from the WMP. Therefore, Brynelson Creek will be a very important site to acquire reliable hydrology flow rates to properly control the discharge from the WMP. As station M18/H18/W28 is the first point on Casino Creek where flow will be comprised of more than just effluent from the TMF spillway and WMP, this is considered an appropriate location for the application of the CCME guidelines.

A.7.12 SUBMERSION OF PAG MATERIALS

A.7.12.1.1 R243

R243. Expected length of time PAG materials will be exposed to oxygen and water before submersion in the TMF and any expected resulting acid generation.

Waste rock produced by the Casino mine will be stored sub-aqueously in the upstream zones of the TMF. Sub-aqueous disposal of waste rock will inhibit oxidation preventing release of metals and acidity associated with sulphide mineralization. Waste rock placed in the TMF will remain unsaturated for an average of three years before saturation. During this time period, the waste will oxidize, releasing a metal load and acidity to the TMF pond. In order to assess the impact of runoff and seepage from unsaturated waste rock, geochemical source terms were developed using lab- and field- kinetic experiments of comparable materials. Notable conservative assumptions incorporated into the unsaturated waste rock source term development are as follows:

- In the first 15 years of mine life waste rock will be a mix of CAP, SUP and HYP. It is assumed that the mixed waste rock facility will produce a mildly acidic drainage characteristic of CAP material (pH 4.7) until Year 15 of mine life when the majority of the waste rock (80%) is HYP. Applying the higher acidic CAP source term rather than the pH-neutral HYP source term during the early operation years is a conservative assumption.
- Humidity cells and unsaturated columns used in source term development were selected from core collected in 1993 and 1994 drilling campaigns. The core remained at site in core boxes until collected in 2008-2009 for ML/ARD testwork as show in Table 2-4 of Casino Kinetic Testwork Update for Ore, Waste Rock and Tailings (Appendix A.7I). This core is at a relatively advanced weathering state compared to weathering of in-situ waste rock material.
- It is assumed that unsaturated waste rock does not freeze during winter months allowing oxidation to occur across the entire thickness of waste rock year round, whereas, as discussed above, the average monthly temperature is below freezing for approximately 6 months of the year at Casino.
- A final adjustment of source terms was conducted, where Se was increased to the 95th percentile values observed at other mine sites, as opposed to using the lower value produced from upscaling kinetic testwork.
- Additional kinetic testwork has become available since the time that geochemical source terms were calculated (Appendix A.7I). These results generally indicate that the loading rates and temperature effect assumptions applied to source term calculations are conservative, as described above.

A.7.12.1.2 R244

R244. An analysis of scenarios that may cause exposure of PAG materials considering variation of meteorological factors, vegetative interception, and seepage losses. Details should include:

a. an analysis of successive dry years on TMF water balance and its implications on PAG tailings and waste rock oxidizing due to low water levels;

b. the minimum annual precipitation required to maintain PAG materials below the water table in the TMF;

c. scenarios during closure that would cause the water table in the TMF to be low enough to allow oxidation of the PAG materials; and

d. the potential effects associated with metals mobilization under these scenarios.

As detailed in the Conceptual Closure and Reclamation Plan, throughout operations, waste rock will be placed at an elevation above the tailings and pond water level to provide a dry, stable placement surface. At the end of operations (Year 19 to 22), LGO will be processed with de-pyritized LGO tailings discharged over the waste rock, to an average depth of 3 m. The WSA will then be leveled to ensure that all tailings and waste rock are below the closure invert elevation of the spillway, and will therefore remain permanently submerged. All materials stored in the facility will be kept submerged with a 4 m water cover. The sequence of waste rock and tailings disposal is shown in Appendix A.4D.

The variability water balance model was evaluated to determine the effect of variable temperatures and precipitation on the water cover in the TMF. The results are provided in Figure A.7.12-1 for a single model realization. The decrease in elevation between years 20 – 40 illustrates the pumping of the tailings supernatant to the pit to allow construction of the treatment wetlands.

The model realization evaluates a 52 simulated record that includes multiple dry years and wet years, as well as subsequent dry years. As shown in Figure A.7.12-1, the water surface elevation, even at its lowest point, does not drop below 989.5 masl, or ~1 m above the surface of the tailings layer. Therefore, at no point should the tailings layer covering the PAG materials be exposed to potential oxidation conditions as a minimum water cover of 1 m will always be maintained.

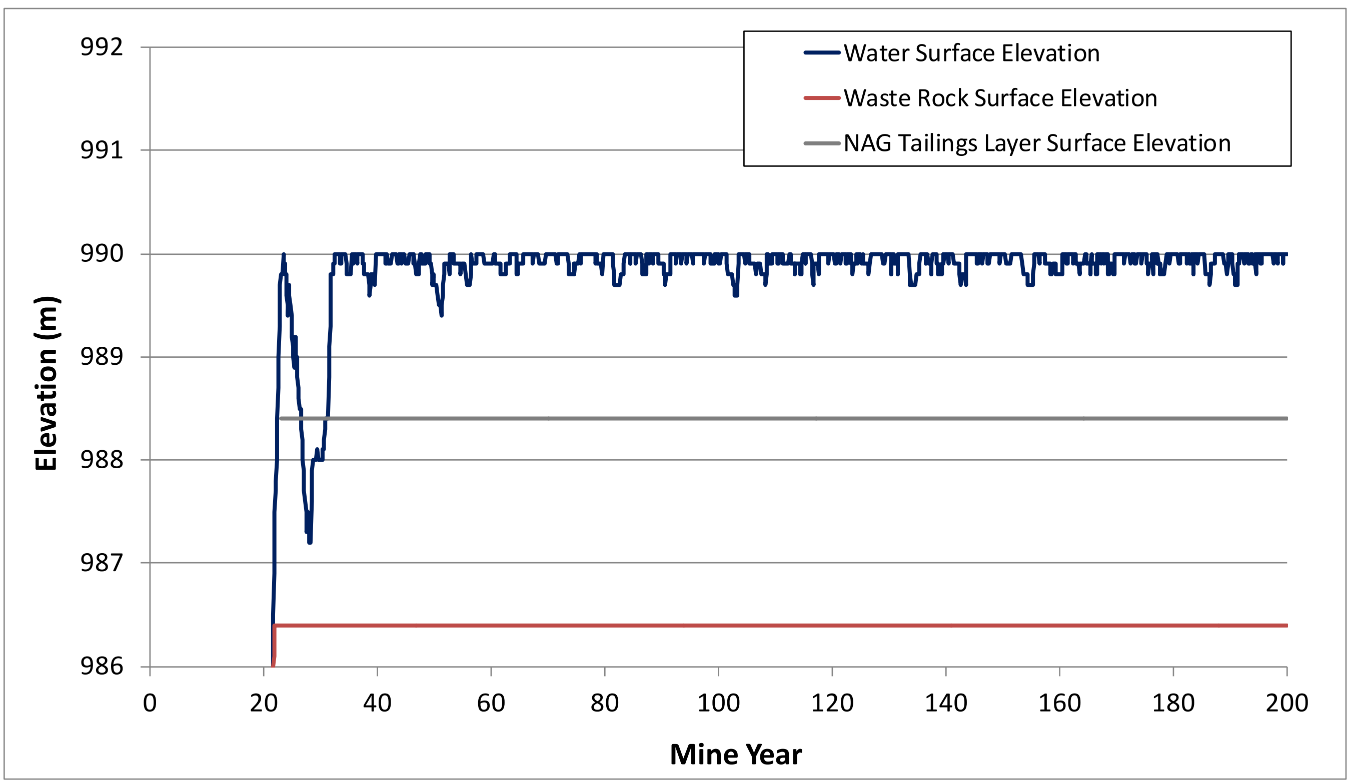


Figure A.7.12-1 Effect of Variability Water Balance Modeling on the TMF Water Cover

A.7.13 OPEN PIT WATER QUALITY

A.7.13.1.1 R245

R245. A plan describing mitigations in case unsuitable (e.g. elevated metal concentrations) water is encountered via pit dewatering (i.e. prior to sufficient storage developed on-site).

The construction of the Open Pit commences 36 months prior to mill start-up at the beginning of Year -3, with the stripping and stockpiling of overburden topsoil. Mining of the Open Pit will then produce ore that is placed on the Heap Leach Facility from mid-Year -3. Most of the water collected from the Open Pit footprint in construction (Years -3 to -1) will be surface runoff, which would have a relatively short contact with any exposed ore compared to the seepage water through the ore body. Therefore, the relative quality of the surface runoff is thought to be of better quality compared to the seepage water through the ore body that comes to surface in Proctor Gulch. This is due to the ore body protruding from the topography, and the leached cap ore zone (Figure A.7.13-1) will be mined first. So the mined ore body will not become a “pit” until the excavation progresses below the height of land.

Alternatively, if the water collected from the Open Pit footprint is not suitable for release in Year -3 (prior to when the TMF begins to store water in Year -2), it can be directed to the Freshwater Supply Pond (FWSP). The FWSP will be established prior to ore being stacked on the HLF in Year -3 as shown in Figure A.2 from Appendix 4C. Water from the FWSP will be transferred to the heap in order to supplement the HLF process, as the heap system runs in a deficit during its operation, with the need for make-up water throughout until Year 15. As of Year -2, the TMF begins to store water behind the starter embankment and water collected from the Open Pit footprint is directed to the TMF pond via the FWSP.

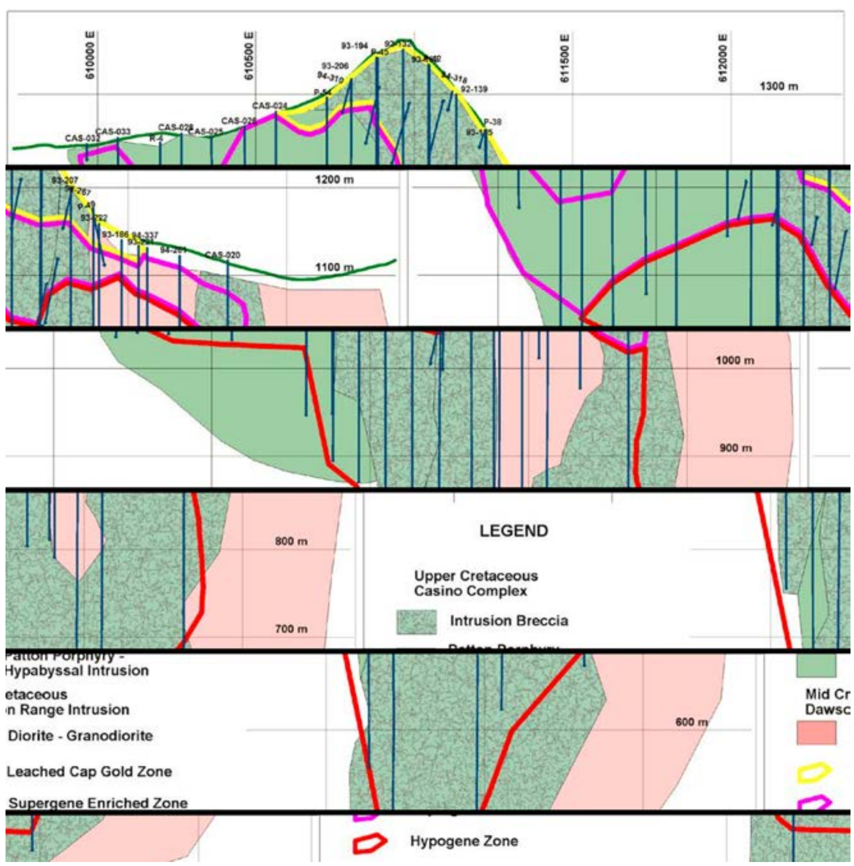


Figure A.7.13-1 Casino Property Geology – Cross Section (Figure 8-2 from M3 2013)

A.7.14 HISTORIC ADIT

A.7.14.1.1 R246

R246. Details on the characterization of groundwater and flow patterns near the adit.

Details on the current infrastructure flow rates from the historical adit are described in the response to R165.

Groundwater monitoring wells MW11-02A/B are installed near the adit ("A" in Figure A.7.14-1). Samples from the monitoring wells reported higher mean TDS values than others from the hillslope area. Slightly higher mean TDS and higher concentrations of sulphate, sodium, fluoride, and chloride were reported in water samples obtained from the shallow groundwater (B) well compared to the deep (A) well (Appendix 7C). Reported hardness, sulphate, fluoride and metal concentrations were also higher these monitoring wells than in others in the hillslope area (Appendix 7C).

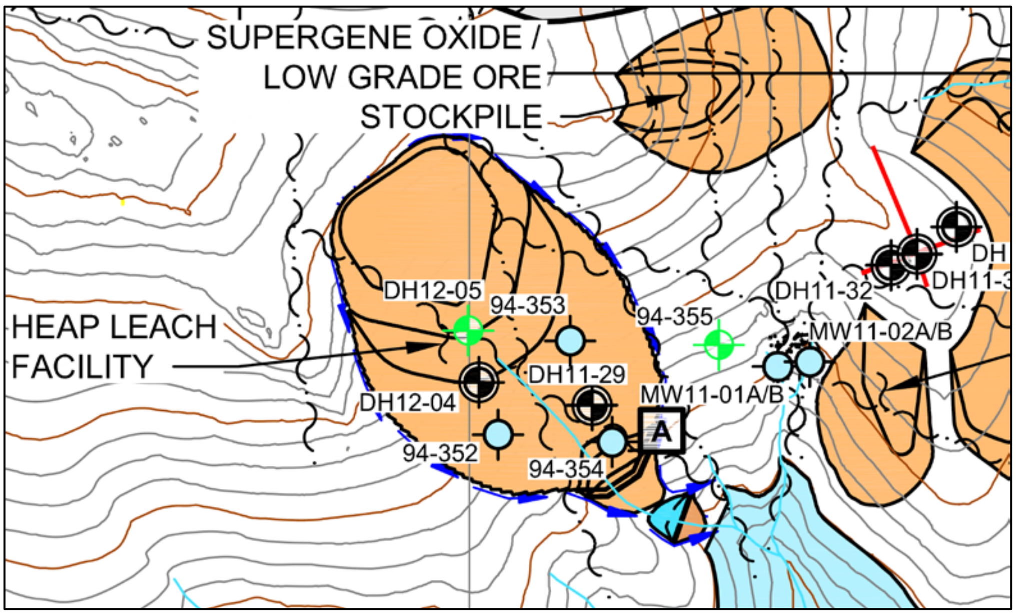


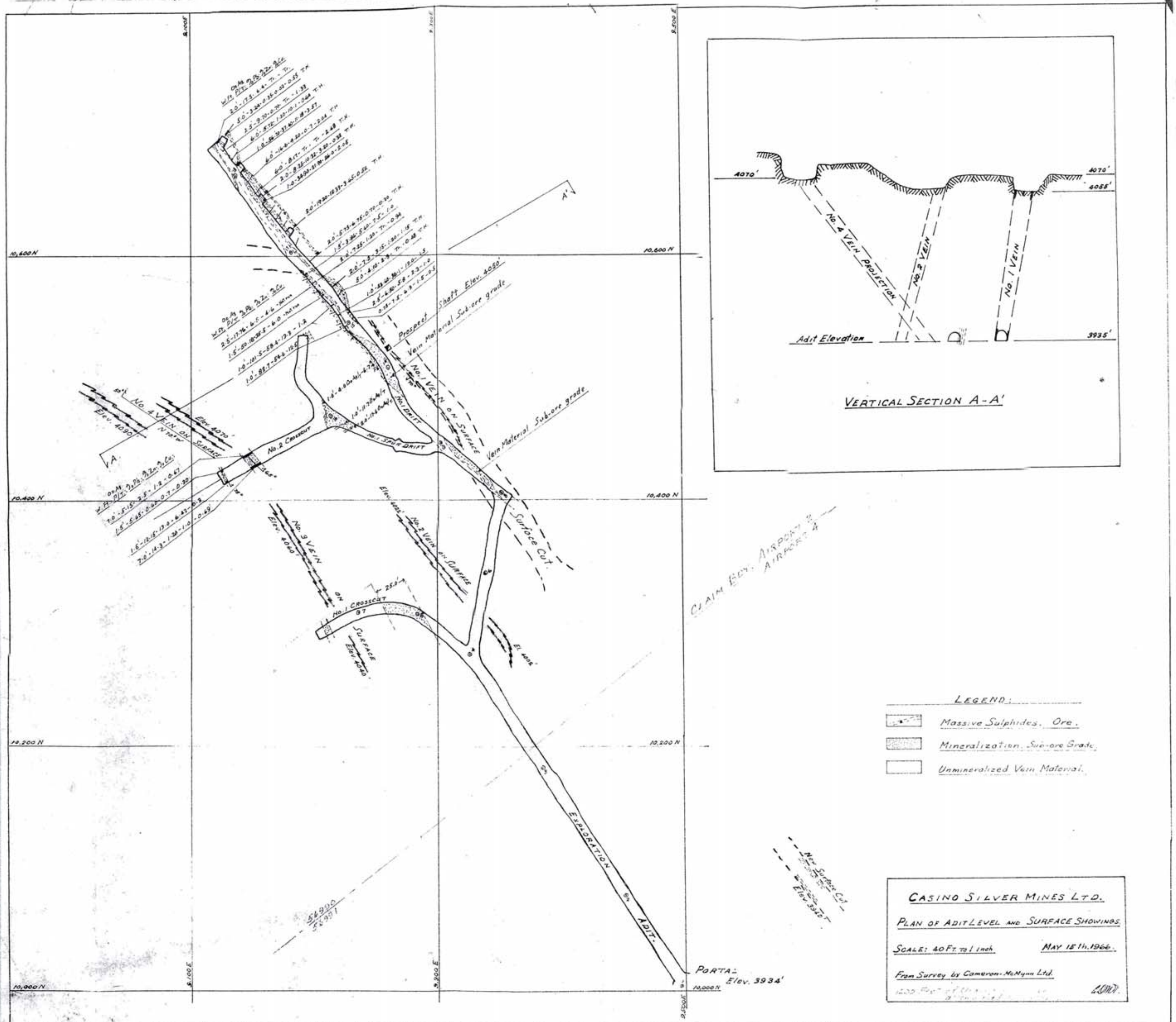
Figure A.7.14-1 Drill Hole Locations Near Historic Adit (taken from Figure 1.2 in Appendix 7C)

A.7.14.1.2 R247

R247. A comprehensive description of the adit including:
- **a. physical characteristics (e.g. incline or decline, dimensions, length); and**
- **b. extent of fracturing.**

The adit was initially constructed in 1965 by Casino Silver Mines Ltd. Between 1965 and 1980, the silver-bearing veins were explored and developed intermittently by underground and surface workings. In total, 372.5 tonnes of hand-cobbed argentiferous galena, assaying 3689 g/t Ag, 17.1 g/t Au, 48.3% Pb, 5% Zn, 1.5% Cu and 0.02% Bi, were shipped to the smelter at Trail, British Columbia. When CMC arrived on site in 2007 the adit mouth was collapsed and impassable. CMC has since re-contoured and seeded the slope around the adit workings.

A plan of adit level and surface showings from the 1966 underground work is provided in Figure A.7.14-2. As the existing workings have collapsed, CMC will re-contour the surface to accommodate construction activities at the HLF, and any visible workings will be grouted and reclaimed as per the response to R248 below.



VERTICAL SECTION A-A'
4070'
4085'
No. 4 VEIN PROJECTION
No. 2 VEIN
No. 1 VEIN
Adit Elevation
3935'
A
A'
10,600 N
10,400 N
10,200 N
10,000 N
9,100 E
9,300 E
9,500 E
No. 4 VEIN ON SURFACE
Elev. 4090'
Elev. 4070'
Prospect Shaft Elev. 4050'
Vein Material Sub-ore grade
No. 1 VEIN ON SURFACE
No. 1 DRIFT
No. 1 SPUR DRIFT
No. 2 CROSSCUT
No. 9 VEIN ON SURFACE
Elev. 4060'
No. 2 VEIN ON SURFACE
Surface Cut
No. 1 CROSSCUT
Surface Elev. 4040'
El. 4005'
EXPLORATION ADIT
PORTAL Elev. 3934'
CLAIM BDY. AIRPORT 3 AIRPORT 4
New Surface Cut
LEGEND:
Massive Sulphides, Ore.
Mineralization, Sub-ore Grade.
Unmineralized Vein Material.
CASINO SILVER MINES LTD.
PLAN OF ADIT LEVEL AND SURFACE SHOWINGS.
SCALE: 40 FT. TO 1 inch
MAY 15th, 1966.
From Survey by Cameron-McMynn Ltd.

A.7.14.1.3 R248

R248. How and when the adit will be reclaimed. Describe implications of reclamation on surrounding groundwater and infrastructure such as the HLF.

The adit is located near the edge of the heap leach facility footprint. Foundation preparation for the heap leach facility will consist of the following:

- The heap leach pad foundation will be excavated to a stable bedrock foundation.
- The bedrock surface will be graded and backfilled to ensure a positively graded slope of a minimum of 2% on which to place the pad liner system.

In the event it is determined that the adit workings extend within the footprint of the heap leach facility, and the adit workings are not fully excavated as part of the heap leach foundation preparation, additional excavation and backfilling or grouting will be required to ensure the area of the adit conforms to the heap leach foundation requirements. The extent and requirements will be assessed and undertaken during construction.

A.8 – AIR QUALITY

A.8.1 INTRODUCTION

Section 8 of the Proposal evaluated the potential effects of the Project on air quality. Air quality is defined in the Proposal for the Casino Project (the Project) as the composition of outdoor air. Air quality was selected by Casino Mining Corporation (CMC) as a Valued Component (VC) because mining activities such as fuel consumption, vehicle movement, and material transfer generate air emissions that could cause deterioration of ambient air quality. As well, clean air in the Yukon is valued unto itself, but additionally fugitive dust and particulate matter may affect receptors such as rare vegetation, wildlife, surface water quality, and soil. Major air pollutants that were assessed include sulphur dioxide, nitrogen dioxide, carbon monoxide and particulate matter, as well as Greenhouse Gases (GHG).

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). Casino Mining Corporation is providing this Supplementary Information Report (SIR) to comply with the Executive Committee's Adequacy Review Report; CMC anticipates that the information in the SIR and Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has 24 requests related to information presented in Section 8 Air Quality, Appendix 8A Baseline Climate Report, Appendix 8B Met, Dustfall, and Noise Data Summary Report 2011, Appendix 8C Air Quality Baseline Report 2013 and Appendix 20A Climate Change Report of the Proposal submitted on January 3, 2014. These requests, and the sections of the SIR where the responses can be found, are outlined in Table A.8.1-1. Some responses require detailed technical information, data, and figures. Where necessary, this additional supporting information is provided as appendices to the SIR.

Table A.8.1-1 Requests for Supplementary Information Related to Air Quality

Request #	Request for Supplementary Information	Response
R249	Reasons for missing data at regional climate stations (i.e. was the station not operated for budget considerations or did an extreme weather event destroy the station).	Section A.8.2.1.1
R250	Rationale for a linear orographic factor at the Project site for 24-hour extreme events considering available data and any terrain effects.	Section A.8.2.1.2
R251	Additional rationale for developing the precipitation return period events (e.g. extreme rainfall). Details should include the methodology for developing the 200 and 1 000-year return period events as well as rationale for using the Gumbel distribution.	Section A.8.2.1.3
R252	Discussion of the role of aspect in relation to climate variables at the Project site.	Section A.8.2.1.4
R253	Justify the use of only Pelly Ranch in building climate baseline data at the Project site for periods where data are unavailable for the Project location.	Section A.8.2.1.5
R254	Confirm that on-site meteorological data collection is ongoing. Provide raw and processed data and recalculate precipitation estimates and measures of variability.	Section A.8.2.1.6

Request #	Request for Supplementary Information	Response
R255	Clarification regarding the climate variables that have been utilized as part of project safety and design as well as an explanation for why those climate variables have been chosen.	Section A.8.2.1.7
R256	Clarification regarding the values used when considering climate change projections and their interactions with the project.	Section A.8.2.1.8
R257	Additional information on wind speed/direction sensor position and height.	Section A.8.2.1.9
R258	Develop a more robust estimate of evaporation and evapotranspiration using air temperature, relative humidity, wind speed and solar radiation.	Section A.8.2.1.10
R259	A discussion on how variability and uncertainty associated with the impacts of climate change was considered in Project safety and design and how those impacts will be mitigated, particularly with respect to permafrost thaw and hydrological changes.	Section A.8.3.1.1
R260	In planning the design and construction of the mine, a greater range of potential change should be considered (and not just the mean). For example, if the range of precipitation change is projected to be between 5 and 25 percent, design considerations should not be limited to a mean (15 percent) but should address the potential maximum (25 percent). Please clarify what values were used when considering climate change projections and their interactions with the Project.	Section A.8.3.1.2
R261	Clarification on the calculations related to the projected rate of increase of flow, including details on how historical trends for Big Creek have been taken into consideration in the projection as well as how the potential maximum increase has been addressed.	Section A.8.3.1.3
R262	The CALPUT and CALMET input files such that a recreation of the model is possible.	Section A.8.4.1.1 Appendix A.8A Emissions Inventory for Construction and Operations
R263	Details on the specifications of ambient air monitoring and meteorological equipment.	Section A.8.4.1.2
R264	An analysis of wind directions compared to other regional sites.	Section A.8.4.1.3
R265	A detailed emission inventory for construction and operational activities.	Section A.8.4.1.4 Appendix A.8A Emissions Inventory for Construction and Operations
R266	Clarification if mitigations, such as ultra-low sulphur fuel, proposed for air quality were reflected in model parameters. If not, results of the air quality model with the mitigations reflected in model parameters.	Section A.8.4.2.1
R267	If predicted air quality, after mitigations, results in exceedances, provide mitigations for identified exceedances.	Section A.8.4.2.2
R268	The raster data generated from the CALPUFF model in a standard GIS format.	Section A.8.4.3.1
R269	A description of predicted exceedances including concentrations and predicted frequency.	Section A.8.4.3.2

Request #	Request for Supplementary Information	Response
R270	Details on the compositions of dust generated by the mine and how this is expected to compare with the proposal's baseline data.	Section A.8.5.1.1
R271	Details on volumes of water required for dust management and clarification if this water was accounted for in overall water use requirements.	Section A.8.5.1.2
R272	Update to Table 22.3-2 to include a conclusive list of proposed mitigation measures for potential project effects on air quality.	Section A.8.6.1.1

Notes:

1. Request # refers to the assigned identification number in the YESAB Adequacy Review Report January 27, 2015 prepared by the Executive Committee of the Yukon Environmental and Socio-economic Assessment Board.
2. Response refers to the location of CMC's response to the YESAB request for supplementary information.

A.8.2 BASELINE CLIMATE REPORT

A.8.2.1.1 R249

R249. Reasons for missing data at regional climate stations (i.e. was the station not operated for budget considerations or did an extreme weather event destroy the station).

The operation of regional climate stations is the responsibility of Environment Canada, and as such, the continuity of their operation is subject to budgetary and other constraints that are outside the control of this Project and CMC. The site specific Casino climate station was continuously operated with data collected on an hourly basis from November 2008 to September 2012.

A.8.2.1.2 R250

R250. Rationale for a linear orographic factor at the Project site for 24-hour extreme events considering available data and any terrain effects.

The orographic factor applied is not linear, but rather is a power function. The precipitation is increased 7% per 100 m increase in elevation. For instance, as presented in the climate report, 34.8 mm at Pelly Ranch (el. 454 m) equates to 58 mm at the Casino site (el. 1200 m) according to the equation:

$$P_{Casino} = 34.8 \text{ mm x } 1.07^{((1200\text{ m }-454\text{ m})/100\text{ m})} = 58 \text{ mm}$$

This equation is typically used to translate mean annual precipitation (MAP) from one location to another, but experience has shown that it also commonly applies well to 24 hour extreme precipitation, as there is typically a strong correlation between MAP and 24 hour extreme precipitation.

The 34.8 mm value at Pelly Ranch was the largest daily rainfall event recorded in a 30 year period, giving it a return period of approximately 30 years. Accordingly, if the orographic equation is reasonably appropriate, the corresponding 58 mm value for the Casino site should also have a return period in the order of 30 years. A review of the return period 24 hour precipitation values presented in Table 2.3-3 of the Baseline Climate Report (Appendix 8A) demonstrates that this is the case, with a 24 hour precipitation of 58 mm assigned a return period of 25 years.

For the above reasons, CMC believes that the orographic factor utilized for the Project's 24-hour extreme events is appropriate.

A.8.2.1.3 R251

R251. Additional rationale for developing the precipitation return period events (e.g. extreme rainfall). Details should include the methodology for developing the 200 and 1,000-year return period events as well as rationale for using the Gumbel distribution.

The methodology for developing the return period 24 hour precipitation events for the Report on the Feasibility Design of the Tailings Management Facility (Appendix A.4D) and the Baseline Climate Report (Appendix 8A) were estimated for the Project site using a statistical method approach, as presented in the Rainfall Frequency Atlas for Canada (Atlas) (Hogg 1985). This approach involves using estimates of the mean and standard deviation of the annual 24-hour extreme precipitation, and utilizes frequency factors based on the Extreme Value Type I (Gumbel) distribution. The Gumbel distribution is a distribution of maxima that is the most commonly accepted distribution to describe the frequency of extreme rainfall events, according to the Atlas.

Estimates of the mean and standard deviation were derived directly from the Atlas. A factor of 1.2 was applied, as recommended in the Atlas, in recognition of potential orographic effects and the fact that the Atlas values are largely based on data from valley stations. The resulting mean and standard deviation values are 25 mm and 6 mm, respectively. The following equations are used to calculate the extreme event rainfall and frequency factors shown in Table A.8.2-1.

$$X_T = X_M + K_T S$$

Where the extreme event rainfall (X_T) is equal to the mean rainfall (X_M) plus the frequency factor (K_T) multiplied by the standard deviation (S).

The frequency factor (K_T) is calculated as follows:

$$K_T = \frac{-\sqrt{6}}{\pi}\left(0.5772 + \ln\ln\left(\frac{T}{T-1}\right)\right)$$

Table A.8.2-1 Extreme 24-hr Rainfall Values

Return Period (years)	Frequency Factor	Extreme Event (mm)
2	-0.164	29
5	0.719	35
10	1.305	39
15	1.635	42
20	1.866	43
25	2.044	45
50	2.592	49
100	3.137	53
200	**3.679**	**56**
500	4.395	62
1000	**4.936**	**66**
PMP	**17.973**	**159**

A.8.2.1.4 R252

R252. Discussion of the role of aspect in relation to climate variables at the Project site.

For climate-based studies conducted at both the regional and local area level, the effect of aspect was accounted for within the mean climatic conditions and extreme climatic conditions and their respective standard variations. At the regional level, vegetation, soils, and topography are related to the regional climate and the regional climate is the overriding identifier that sets the bounds for climatic characteristics in that area.

Within the context of the baseline climate study, especially considering the extents of the regional and local study areas, elevation was considered to be the main contributor to any localized climate conditions that could be attributed to slope effect. For this reason, an orographic factor was applied to the data to scale it with respect to elevation.

A.8.2.1.5 R253

R253. Justify the use of only Pelly Ranch in building climate baseline data at the Project site for periods where data are unavailable for the Project location.

The reliability of the long-term synthetic series to represent actual Project site data is measured through the coefficient of determination. The Pelly Ranch regional climate station was selected to build the climate baseline data at the Project set because the coefficient of determination indicated that the long-term synthetic series and regression relationships generated were considered to be statistically reliable; additional data sets were not incorporated because the data was considered to be statistically reliable.

Nine regional climate stations operated by the Meteorological Service of Canada (MSC) are located within 150 km of the Casino mine site, primarily within the Klondike Plateau region. These climate stations are listed in Table 2.1-1 of the Baseline Climate Report (Appendix 8A). The reliability and completeness of the long term data sets and the representativeness of elevation and proximity were taken into consideration in selecting which data set could be used to generate long-term synthetic series for climate indicators for the Project location.

The majority of these climate stations, with the exception of Pelly Ranch, had many years of incomplete data record, for reasons outside the control of this Project and CMC. For example, even though the Casino Creek Climate Station (ID 2100310) is the closest to the Project site and within the general Project area, it has measured data recorded between 1969 and 1995 but has no complete years of record and therefore could not be used. Eight regional climate stations have greater than 20 complete years of record and these stations are all situated in low-elevation settings (between 320 m to 649 m). The Pelly Ranch regional climate station is the closest to the Project site and is an active monitoring station with a reliable long term data set.

A.8.2.1.6 R254

R254. Confirm that on-site meteorological data collection is ongoing. Provide raw and processed data and recalculate precipitation estimates and measures of variability.

In 1993, Hallam Knight Piésold Ltd. (HKPL) installed a climate station near the Casino exploration camp at an elevation of 1,200 m. This climate station was used to measure temperature and precipitation and operated from 1993 to 1995. In 2008, a new Project climate station was established at approximately the same location by RWDI Air Inc. (RWDI). Casino Mining Corporation confirms that this climate station continues to be operational and continues to measure air temperature, rainfall, wind speed and direction, relative humidity, barometric pressure, and snow depth.

Casino Mining Corporation believes that the climate data that has been presented in the Proposal is of sufficient duration and seasonal variation to establish a representative precipitation baseline for the purpose of understanding the potential effects of Project. Climate data that is collected on site will be used in the future to support operational monitoring. For these reasons, CMC believes that providing additional raw and processed data beyond what was provided in the Proposal or recalculating precipitation estimates and variability is not warranted.

A.8.2.1.7 R255

R255. Clarification regarding the climate variables that have been utilized as part of project safety and design as well as an explanation for why those climate variables have been chosen.

Assuming that the question is primarily directed towards the TMF, the Project sought to ensure safety through mitigation by engineering design. Mitigation by engineering design is simply ensuring that risks are mitigated by incorporating factors of safety into the design basis that protect against foreseeable risks. This process relied on the completion of a dam hazard classification in conformance with the Canadian Dam Associations “Dam Safety Guidelines” (2007). Under the CDA a HIGH consequence dam classification was assigned to the TMF. Subsequent to this classification, CMC voluntarily chose to adopt the EXTREME dam consequence classification to incorporate an additional factor of safety to the design.

Based on the EXTREME dam classification assigned to the TMF, an appropriate IDF is an event equal to the Probable Maximum Flood (PMF). In this case, the inflow design flood is an extreme indicator rather than an average indicator. The CDA Guidelines require that an EXTREME dam classification be designed for a probabilistically derived event (defined as the Earthquake Design Ground Motion) having an annual exceedance probability (AEP) of 1/10,000. Consequently, the maximum design earthquake (MDE) selected for the TMF is the 1 in 10,000 year earthquake. Again this is an extreme indicator as opposed to an average indicator.

If the query was intended to extend beyond the TMF other water retaining structures, all building structures are anticipated to be designed and constructed to meet provincial and federal standards such as the Canadian Standards Association (CSA) Building Code that consider the effects of climate in order to ensure structural stability and safety.

A.8.2.1.8 R256

R256. Clarification regarding the values used when considering climate change projections and their interactions with the project.

Casino Mining Corporation assumes that this request for information by the Executive Committee is related to the approach taken in the Baseline Climate Report (Appendix 8A) to calculate evaporation and evapotranspiration. YG’s comments that “Department of Environment considers Thornthwaite rather rudimentary as it only considers one variable: air temperature. The simplicity of this approach is often seen as its main advantage; however more detailed methods exist” (YOR 2014-0002-252-1). YG further states that “a more robust methodology using air temperature, relative humidity, wind speed, and solar radiation are available and should be employed to develop estimates of evaporation and evapotranspiration” (YOR 2014-0002-252-1).

There are no site specific or regional evaporation or evapotranspiration data available for the Project area, so estimates of mean monthly potential evapotranspiration (PET) for the Project area were generated comparing two commonly applied empirical relationships, those developed by Hargreaves (Maidment 1993) and Thornthwaite (Thornthwaite 1948).

Hargreaves Equation

The Hargreaves equation uses mean, minimum and maximum daily temperature values, as well as site latitude, to estimate PET. For the Project site, only minimum and maximum daily temperature values are available for the 2008-2009 dataset, and therefore the 1993-1994 data were not applicable. The Hargreaves equation is as follows:

$$PET = 0.0023(T_{mean} + 17.8)(T_{\max} - T_{\min})^{0.5} R_a$$

Where:

PET = potential evapotranspiration rate (mm/day)
R_a = water equivalent of extraterrestrial solar radiation (mm/day)
T_{mean} = mean daily temperature (°C)
T_{max} = maximum daily temperature (°C)
T_{min} = minimum daily temperature (°C)

And:

$$R_a = \frac{24(60)}{\pi} G_{sc} d_r \left[\omega_s \sin(\varphi)\sin(\delta) + \cos(\varphi)\cos(\delta)\sin(\omega_s)\right]$$

Where:

Ra = extraterrestrial radiation (MJ m^{-2} day^{-1})
G_{sc} = solar constant = 0.0820 (MJ m^{-2} min^{-1})
d_r = inverse relative distance Earth-Sun (rad)
δ = solar decimation (rad)
ω_s = sunset hour angle (rad)
φ = latitude (rad)

This equation produces negative results for temperatures below -17.8 °C and any such values were removed from the estimated dataset. It was also assumed that days with a maximum daily temperature value below zero have zero PET. The 2009 temperature records were slightly warmer than the long-term synthetic temperature record; hence, the 2009 annual value of 403 mm may slightly overestimate the long-term average evapotranspiration.

Thornthwaite Equation

The Thornthwaite equation only requires mean monthly temperature as an input. This equation assumes that no PET occurs when the mean monthly temperature is below zero degrees Celsius. The mean monthly temperature values from the historical datasets recorded in 1993-1995 and 2008-2009 were used to estimate the monthly and annual PET values.

$$ET_0 = \begin{cases} 0, T < 0 \deg C \\ 16\left(\frac{10T_i}{I}\right)^a, 0 \le T \le 26.5 \deg C \\ -415.85 + 32.24T_i - 0.43T_i^2, T \ge 26.5 \deg C \end{cases}$$

Where:

PET_0 = Potential evapotranspiration (mm/month)
T_i = Mean monthly temperature (°C)
I = Heat index, sum of 12 monthly index values (*i*)
i = Monthly heat index
a = Empirically derived exponent, which is a function of I

And:

$$i = \left(\frac{T}{5}\right)^{1.514}$$

$$a = 6.75*10^{-7} I^3 - 7.71*10^{-5} I^2 + 1.79*10^{-2} I + 0.49$$

The PET estimates based on the Thornthwaite equation are lower than those provided by the Hargreaves equation, and are more in line with the regional estimates for this area of 200-300 mm based on the annual lake evaporation isolines from the Hydrological Altas of Canada produced by NRC. Accordingly, the Thornthwaite equation was selected for estimating long-term PET for the Project.

At the request of the Executive Committee, PET was re-calculated using the Penman-Montieth combination equation, which requires inputs of air temperature, relative humidity, barometric pressure, wind speed and solar radiation. The results of this re-calculation and description of how it has been incorporated into the Project is presented in the response to R258.

A.8.2.1.9 R257

R257. Additional information on wind speed/direction sensor position and height.

The instrumentation types and models installed at the Casino Climate Station are:

- Campbell Scientific CR800 Data Logger
- RM Young 05103 Wind Monitor
- Texas Electronics TE525 Tipping Bucket Rain Gauge
- RM Young 61205V Barometric Pressure Sensor
- Campbell Scientific HC-S3 Temperature and Relative Humidity Probe
- Campbell Scientific SR50A Sonic Range Snow Depth Sensor

The dominant wind direction at the Project is northerly, followed by southwesterly, as presented in the Proposal (Appendix 8A and Appendix 8B). The wind speed sensor, or anemometer, is positioned on a tower at a height of 10 m above the ground surface.

A.8.2.1.10 R258

R258. Develop a more robust estimate of evaporation and evapotranspiration using air temperature, relative humidity, wind speed and solar radiation.

PET was re-calculated using the Penman-Montieth combination equation, which requires inputs of air temperature, relative humidity, barometric pressure, wind speed and solar radiation. The data record used for this calculation is the same record that was used in Appendix 8A (Baseline Climate Report). Solar radiation is not measured at the Casino climate station, so it was estimated using calculations related to the latitude of the Project, albedo of the surface, and actual hours of sunshine. Albedo was estimated to be 0.15 for the TMF pond and Open Pit lake, while sunshine hours were assumed equivalent to those reported for Whitehorse by Environment Canada. Calculated PET for the period of May through October was summed to derive the mean annual PET estimate, in order to account for frozen conditions of the water bodies in November through April. The resultant annual potential evapotranspiration is 415 mm. It should be noted that there is a reasonable amount of uncertainty associated with this value, due to the numerous estimates and approximations required to apply the Penman-Montieth equation.

PET was assumed to equal lake evaporation in the water balance to model evaporation from the TMF and Open Pit lakes. Other methods of estimating lake evaporation in the region, including pan evaporation measurements in Alaska and scaling of the Atlas of Canada values by the underestimation factor derived for the Lupin research site in Northwest Territories, suggest that lake evaporation at the Project should be in the range of 350 mm to 400 mm. All of the above estimates are considerably greater than the previously calculated 300 mm, and therefore the evapotranspiration estimate in the water balance was updated to an average annual value of 390 mm as an estimated value in the upper range between 300 mm and 400 mm, which is considered appropriate considering the available information. The results of the updated water balance model are provided in Appendix A.7A.

A.8.3 CLIMATE CHANGE REPORT

A.8.3.1.1 R259

R259. A discussion on how variability and uncertainty associated with the impacts of climate change was considered in Project safety and design and how those impacts will be mitigated, particularly with respect to permafrost thaw and hydrological changes.

Predicted possible general increases in temperature and precipitation, as a result of global climate change, have been considered both directly and indirectly in the planning and design of the Project. Appendix 20A of the Proposal (Climate Change Report) indicates that temperatures are predicted to increase in the order of 1°C to 4°C over the next 40 to 50 years, that annual precipitation is predicted to increase in the order of 5% to 25%, and that greater atmospheric energy associated with the higher temperatures may lead to greater climatic variability, including a greater frequency and severity of extreme events.

Three key ways that the effects of these potential future changes in climate were taken into consideration in the Project design are:

- Peak design flow estimates;
- Sizing and staging of the TMF; and
- Permafrost melt susceptibility of foundation conditions.

The potential for an increase in the frequency and severity of rainfall events, snowmelt and corresponding peak flows was directly considered by applying an uplift factor of 15% to all peak design flow estimates, as stated in Appendix 7B, Hydrology Report.

The effects of variability and potential changes in hydroclimatic conditions on the sizing and staging of the TMF were considered by incorporating adaptability into the designs and operating plans for the mine. For example, tailings storage facility embankments are constructed in stages and tailings slurry and pond levels are continuously monitored, such that if conditions prove to be wetter than expected due to climate change or climate variability, appropriate adjustments can be made to the dam stage construction schedule. Furthermore, since the mine is currently expected to operate in a water deficit, the mine plan includes the ability to extract make-up water from the Yukon River. The water extraction system is currently sized with a capacity well in excess of the expected deficit, such that the make-up system has substantial contingency in place in the event that evaporation losses associated with predicted increases in temperature exceed gains from predicted increases in precipitation. Any needs to increase the make-up water extraction are not likely to have a significant effect on flows in the Yukon River, since the maximum capacity of the make-up water system is equal to less than 1% of the lowest ever recorded flow in the Yukon River. Conversely, if conditions prove to be wetter than expected, the volume of water pumped from the Yukon River can be reduced to compensate for additional water in the TMF.

Warmer temperatures could substantially alter the permafrost conditions in the Casino Project area, most notably affecting the extent of the seasonally thawed permafrost layer (active layer) and thereby altering the foundation conditions of civil infrastructure works, including buildings, roads, railways, airstrips, and pipelines. The most basic risk is the loss of mechanical strength and eventual thaw settlement or subsidence, as well as increased frost heaving potential. Accordingly, the foundation conditions for most of the major project infrastructure elements were assessed for permafrost melt susceptibility, and then appropriate measures were incorporated into the respective foundation designs. For instance, the foundation designs for the plant site, the heap leach pads and the tailings embankment all entail the excavation of overburden material to bedrock, such that all permafrost susceptible soils will be removed. A similar approach is also likely to be employed for road design but will be confirmed in detailed design. In support of future refinement in the Project design and future construction activities, ground temperature data is currently being collected at a number of locations across the mine site using thermistor strings and data loggers that were installed in vertical drillholes. Continued monitoring in the operations phase will allow for identification of real-time changes in permafrost conditions that may be connected with climate change. The need for additional mitigations for permafrost degradation will be assessed in detailed design taking into account on-going ground temperature data currently being collected or proposed to be collected.

A.8.3.1.2 R260

R260. In planning the design and construction of the mine, a greater range of potential change should be considered (and not just the mean). For example, if the range of precipitation change is projected to be between 5 and 25 percent, design considerations should not be limited to a mean (15 percent) but should address the potential maximum (25 percent). Please clarify what values were used when considering climate change projections and their interactions with the Project.

The climate at any particular location in the world is never constant, regardless of whether or not climate change, as defined by the Intergovernmental Panel on Climate Change (IPCC), is occurring, and consequently the engineering design of a mine must always consider the variability of climate and the potential magnitude of climatic and associated hydrologic extremes. The uncertainty of hydroclimatic conditions, with respect to water supply and water management, is typically considered in a Project design process through the use of factors of safety and by incorporating adaptability into the designs and operating plans for a mine. Consequently, mine structures are inherently well-suited to accommodate possible effects due to climate change. Nonetheless, in order to account for the potential climate change related increases in the variability and magnitude of hydroclimatic events, efforts are made to quantify those changes, such as described in the Climate Change report provided in Appendix 20A of the Proposal, and design factors of safety and stochastic modelling parameters are modified accordingly. For example, the peak design flow procedure for the Casino Project includes a climate change adjustment of +15%, and although this value is somewhat arbitrarily selected, it is consistent with professional practice guidelines (APEGBC 2012) and with general practices as determined through attendance at various climate change symposiums and discussions with industry experts.

In addition to water management related issues, climate change has implications for the design, operation and maintenance of civil infrastructure (Hinkel et al. 2003; Instanes 2003). Warmer temperatures could substantially alter the permafrost conditions in the Casino Project area, most notably affecting the extent of the seasonally thawed permafrost layer (active layer) and thereby altering the foundation conditions of civil infrastructure works, including buildings, roads, railways, airstrips, and pipelines. The most basic risk is the loss of mechanical strength and eventual thaw settlement or subsidence, as well as increased frost heaving potential. These factors must be considered in the design of all civil infrastructure for the Casino Project.

As the Project proceeds, CMC will rely on a planned and systematic process for continuously improving environmental management practices associated with climate change by observing actual outcomes (i.e., adaptive management). CMC will implement mitigation measures over the life of a project to address unanticipated effects resulting from climate change.

A.8.3.1.3 R261

R261. Clarification on the calculations related to the projected rate of increase of flow, including details on how historical trends for Big Creek have been taken into consideration in the projection as well as how the potential maximum increase has been addressed.

It is CMC's opinion that the peak flow values are appropriately estimated. Trends in the Big Creek flood record were not linearly extrapolated to predict future flood magnitude. Historical trends for Big Creek have been taken into consideration but not used in the projection, because the trendline indicating a 2 m^3/s per year increase in flow for Big Creek is not statistically significant, even at a 0.1 level of significance. Big Creek is considered not to be strongly representative of future peak flow trends.

The Climate Change Report (Appendix 20A) observed that the trend of increasing peak flows in Big Creek was largely influenced by the two highest flows in the record; the two noted historic flows had a disproportionate influence on the observed increasing flow trend. If these two points were removed from the 29 point dataset, the trendline would indicate a much reduced rate of increase of 0.36 m^3/s per year. The Climate Change Report highlighted the fact that the dataset is relatively short and therefore subject to being disproportionately influenced by one or two points (in sampling error).

Trendlines in data should be viewed with appropriate caution because they are very sensitive to the period of data selected for the analysis. For instance, an evaluation of the most recent 11 years of data (2001-2011), which might be argued is more reflective of future conditions than the full set containing earlier data by virtue of having occurred more recently, the trendline actually indicates a decrease in flow (0.1 m^3/s per year). On the other hand, if the time period is extended back to 1993, the trendline indicates a very dramatic increase in flow (6.3 m^3/s per year).

Despite the above observations, the historical trends in the Big Creek flood record were incorporated into the flood frequency analysis. The peak flow estimates presented in the Casino Hydrology Report (Appendix 7B) are based on the frequency analyses of historical annual peak flow series derived from long-term synthetic flow series generated for each of the streamflow gauging stations in the project area. The synthetic flow series were generated through correlations of the site gauging station data with concurrent data for Big Creek, and then those correlation equations were applied to the long-term flow series for Big Creek. Accordingly, the historical annual peak flow series for each of the site gauging stations directly incorporates the historic trends in the Big Creek dataset.

Finally, application of the 15% factor was done as a climate change contingency measure in accordance with recommendations by the Association of Professional Engineers and Geoscientists of BC (APEGBC 2012). The magnitude of this factor is not directly related to the predicted 5%-25% increase in annual precipitation presented in the Climate Change Report (Appendix 20A), as there is only a general relationship between the magnitude of extreme precipitation events and annual total precipitation (i.e. higher total annual precipitation generally corresponds to higher extreme events), rather than a direct linear correlation as suggested by the comments by Executive Committee in ARR Section 6.0 that appears to interpolate the 15% value being an average of the 5%-25% range.

A.8.4 AIR QUALITY MODELLING

A.8.4.1 Model Inputs

A.8.4.1.1 R262

R262. The CALPUT and CALMET input files such that a recreation of the model is possible.

Casino Mining Corporation is providing supporting data for the CALPUFF and CALMET models in the form of a detailed emissions inventory for the construction and operation phase Project activities with potential emissions sources (Appendix A.8A Emissions Inventory for Construction and Operations). Casino Mining Corporation anticipates that the additional information provided will be sufficient for the Executive Committee to better understand the air quality modelling inputs selected for the Proposal and that recreating the air quality dispersion model is not warranted.

A.8.4.1.2 R263

R263. Details on the specifications of ambient air monitoring and meteorological equipment.

Baseline dustfall monitoring was conducted during the summers of 2010, 2011, and 2013 using dustfall collection canisters suspended 1.5 m off the ground. Real-time dustfall monitoring was undertaken during May 2013 and June 2013 using a DustTrak DRX Aerosol Monitor. The DustTrak DRX was used to simultaneously measure size-segregated mass fraction concentrations corresponding to PM_1, $PM_{2.5}$, PM_4, PM_{10} and Total PM size fractions. Passive sampling of NO_2 and SO_2 was conducted from July 31, 2013 to September 1, 2013 at two mine site stations using an all-season Maxxam Laboratory Passive Air Sampling System (PASS).

Meteorological equipment consists of the following instrumentation types and models installed at the Casino Climate Station:

- Campbell Scientific CR800 Data Logger
- RM Young 05103 Wind Monitor
- Texas Electronics TE525 Tipping Bucket Rain Gauge
- RM Young 61205V Barometric Pressure Sensor
- Campbell Scientific HC-S3 Temperature and Relative Humidity Probe
- Campbell Scientific SR50A Sonic Range Snow Depth Sensor

A.8.4.1.3 R264

R264. An analysis of wind directions compared to other regional sites.

Casino Mining Corporation assumes that this request for information is related to the appropriateness of the dominant wind direction that was selected as an input into the air quality model. The air quality model assumed that the dominant wind direction at the Project site climate station is northerly, followed by southwesterly winds. In comparison, the predominant wind directions at the Minto Mine site are S to SE and N to NW (Capstone Mining Corp. 2013).

A.8.4.1.4 R265

R265. A detailed emission inventory for construction and operational activities.

A detailed emissions inventory for the proposed construction and operations phase activities is provided in Appendix A.8A Emissions Inventory for Construction and Operations.

A.8.4.2 Mitigations

A.8.4.2.1 R266

R266. Clarification if mitigations, such as ultra-low sulphur fuel, proposed for air quality were reflected in model parameters. If not, results of the air quality model with the mitigations reflected in model parameters.

Ultra-low sulphur fuel and all other mitigation measures identified in Table 8.4-7 in Section 8 of the Proposal were represented as model parameters in the air quality model completed for the Project.

A.8.4.2.2 R267

R267. If predicted air quality, after mitigations, results in exceedances, provide mitigations for identified exceedances.

A number of predicted air quality concentrations are anticipated to exceed the Yukon Ambient Air Quality Standards and/or Canadian Air Quality Objectives after mitigation has been applied. These exceedances are restricted to the private area surrounding the mine site and Freegold Road Extension. In all cases the residual effects were assessed to be Not Significant. The mitigation that has been proposed is considered to be consistent with industry standards and already includes the practical and achievable mitigation measures that are available to the Project.

The Air Emissions Regulations including the Yukon Ambient Air Quality Standards drafted under Yukon's Environment Act do not appear to be applicable to a mine operation. The air quality standards that do apply for the mine site and Freegold Road Extension will be those identified in the Yukon *Occupational Health and Safety Act (2002)*.

A.8.4.3 Exceedances

A.8.4.3.1 R268

R268. The raster data generated from the CALPUFF model in a standard GIS format.

The raster data generated from the CALPUFF model are available in DXF or SHP files for GIS. Casino Mining Corporation is asking for further clarification as to why these files need to be provided for the purpose of a completeness determination as the data are already represented in a standard GIS image output format in Figures 8.4-1 to 8.4-28 of the Proposal.

A.8.4.3.2 R269

R269. A description of predicted exceedances including concentrations and predicted frequency.

The predicted air quality standard and guideline exceedances during construction are summarized in Table 8.4-3 of the Proposal, the concentrations are represented on Figure 8.4-1 to Figure 8.4-14 in Section 8 of the Proposal and the predicted frequency are identified in Table 8.4-9.

The predicted air quality standard and guideline exceedances during construction are summarized in Table 8.4-4 of the Proposal, the concentrations are represented on Figure 8.4-15 to Figure 8.4-28 in Section 8 of the Proposal and the predicted frequency are identified in Table 8.4-9.

In construction and operations, the predicted frequency in Table 8.4-9 are presented as ‘occurs occasionally or less than 1% of the time’ (infrequent) or ‘occurs regularly’ (frequent).

A.8.5 DUST AND DUSTFALL

A.8.5.1.1 R270

R270. Details on the compositions of dust generated by the mine and how this is expected to compare with the proposal’s baseline data.

The baseline dust levels are those that arise naturally from relatively undisturbed landforms. In the construction period the majority of dust will be generated directly by pioneering activities related to mine construction and subsequent aeolian transport of fine particles created as a result of these activities. In general, the chemical composition of the construction-related dust would likely resemble the baseline dust, as the majority of it would be sourced from the same surficial material, with the exception of the dust that is generated through combustion.

During operations, the majority of dust will be generated directly by consumption of LNG at the power plant and aeolian transport of fine particles created through processing such as tailings fines and cyclone sand fines. The chemical composition of the operational dust would be less likely to resemble the baseline dust, as the majority of it would be sourced from consumption of LNG at the power plant and material associated with the ore body that is extracted and processed.

A.8.5.1.2 R271

R271. Details on volumes of water required for dust management and clarification if this water was accounted for in overall water use requirements.

Water required for dust management has not been incorporated into the water balance model prepared for the mine. The volume required for dust suppression is negligible within the context of the mine site water balance. The dust suppression water requirement will be included in the total water requirement applied for under the water use licence under the *Waters Act* and will be sourced from either the fresh water storage pond or the Yukon River water pipeline.

A.8.6 AIR QUALITY MANAGEMENT PLAN

A.8.6.1.1 R272

R272. Update to Table 22.3-2 to include a conclusive list of proposed mitigation measures for potential project effects on air quality.

Table 22.3-2 is included in the Conceptual Environmental Management Plans (Section 22) of the Proposal. Being conceptual, the table presents a summary of the air quality related residual effects, including a summary of the proposed mitigation measures identified in Section 8 of the Proposal. For that reason, the reviewer can rely on Table 8.4-3 and Table 8.4-4 to present the conclusive lists of proposed mitigation measures for potential project effects on air quality, which will be incorporated into the Environmental Management Plans submitted for application for a Quartz Mine Licence and Type A Water Use Licence.

A.9 – NOISE

A.9.1 INTRODUCTION

Noise was selected by Casino Mining Corporation (CMC) as a Valued Component (VC) because airborne sound and ground vibration propagation has the potential to affect sensitive receptors. The Proposal presented baseline information for ambient noise for the Casino Project (the Project) area and an assessment of potential effects on ambient noise from Project activities (Section A.9 Noise).

Potential noise impacts from Project activities were evaluated using a three-phased approach:

1. **Determination of baseline conditions**: a limited baseline ambient noise monitoring survey was completed to confirm that baseline sound levels are naturally low and that designation as a remote site according to British Columbia Oil and Gas Commission's (OGC) published standards (OGC 2009) is appropriate.
2. **Modelling**: noise modelling was completed using sound propagation software CadnaA for selected Project activities to predict noise effects. Predicted sound levels include noise attenuation achieved with proposed mitigation measures.
3. **Guideline comparison**: predicted noise levels were compared with OGC published noise guidelines to identify the potential for adverse residual effects and noise sources requiring additional noise mitigation measures.

Based on the predicted Project effects and with the implementation of the mitigation measures proposed by CMC, the Proposal concluded that noise levels are predicted to remain below existing guidelines and the potential residual effects of the Casino Project as a result of increased noise are Not Significant.

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments received from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). Casino Mining Corporation is providing this Supplementary Information Report (SIR) to comply with the Executive Committee's Adequacy Review Report; CMC anticipates that the information in the SIR and Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has six requests related to information presented in Section 9 Noise of the Project Proposal submitted on January 3, 2014. These requests are outlined in Table A.9.1-1, and responses are provided below.

Table A.9.1-1 Requests for Supplementary Information Related to Noise

Request #	Request for Supplementary Information	Response
R411	Details regarding how the noise model accounted for seasonal variability.	Section A.9.2.1.1
R412	Details how the collected baseline data informed modeling or if other sources were used.	Section A.9.2.1.2
R413	Rationale on model selection including model limitations.	Section A.9.2.1.3
R414	Rationale on why noise levels in Carmacks and the FGR were not modeled.	Section A.9.2.1.4

Request #	Request for Supplementary Information	Response
R415	Identification of reference equipment used to calculate sound pressure levels.	Section A.9.2.1.5
R416	Confirmation that the noise modeling accounts for air traffic, shovels, cycloning, blasting, the concrete batch plant, and HLF crushing operations and revised predictions if these are not included in the original proposal.	Section A.9.2.1.6

Notes:

1. Request # refers to the assigned identification number in the YESAB Adequacy Review Report January 27, 2015 prepared by the Executive Committee of the Yukon Environmental and Socio-economic Assessment Board.
2. Response refers to the location of CMC's response to the YESAB request for supplementary information.

A.9.2 NOISE

A.9.2.1.1 R411

R411. Details regarding how the noise model accounted for seasonal variability.

Casino Mining Corporation understands that meteorological conditions, including temperature and relative humidity, and ground conditions, such as the presence of snow and type of vegetation, can affect the magnitude and extent of noise propagation by affecting atmospheric absorption and ground attenuation. To account for potential increased effects due to seasonal variability, CMC chose to model a potential worst case scenario that reflects maximum noise propagation and minimal ground attenuation.

Seasonal variability was considered in the development of the noise model by taking into consideration potential worst case scenarios due to changes in ground conditions and meteorological conditions. The noise model assumed maximum reflective ground conditions of ice, which has minimal ground attenuation and would result in the highest predicted noise. Due to the fact that the Project is surrounded by medium to high density forest, wind effects at ground level are not anticipated to change dramatically between seasons, therefore a constant wind condition is considered an appropriate assumption.

Under the potentially worst case scenario used for the noise model, noise levels are predicted to remain below existing guidelines and the potential residual effects of the Casino Project as a result of increased noise are Not Significant. Likewise, CMC anticipates that noise predictions for both summer and winter conditions will not exceed established guideline limits.

Furthermore, CMC believes that accounting for seasonal variability in noise models is more applicable when sound receptors (i.e. humans and wildlife) are located near the primary noise sources. In the case of the Casino Project, CMC has established that there are no sound receptors located near the primary noise sources around the mine site.

For these reasons, the noise model and predictions have already accounted for the potential effects of seasonal variability on the magnitude and extent of noise propagation. There is good confidence that noise predictions will not exceed established guidelines throughout the year and a good understanding that the potential adverse effects of noise are Not Significant.

A.9.2.1.2 R412

R412. Details how the collected baseline data informed modeling or if other sources were used.

The baseline ambient noise monitoring survey results were used to confirm that baseline sound levels can be appropriately designated as pristine according to OGC published standards (OGC 2009) for input into the noise model. The approach of assuming a pristine baseline noise level is an acceptable common practice and is viewed as a conservative approach that overestimates potential effects rather than underestimating potential effects.

Sound levels were measured and recorded near the village of Carmacks to establish baseline conditions at the location of a potentially sensitive receptor. Noise in the area is predominantly natural (such as noise caused by cascading water), with infrequent anthropogenic noise inputs from mining and forestry activities, agriculture activities, recreational use, and local and industrial traffic. There are no known residential or industrial developments within the noise study area around the Project; therefore using the baseline established at the location of the noise monitoring survey near the village of Carmacks to determine conformance with pristine conditions is a conservative approach.

A Larson Davis 831 Sound Level Meter was used to determine ambient sound levels over a 22-hour period from August 25, 2011 to August 26, 2011 near the village of Carmacks. The results of the limited baseline ambient noise monitoring survey were comparable to typical pristine conditions described by the OGC published standards; thus, baseline sound levels used in the noise modelling were assumed to be pristine. Following this logic, baseline ambient noise for the entire noise modelling study area was conservatively estimated as pristine which is characterized as quiet and dominated by nature with night-time average rural ambient sound levels of 35 dBA Leq and a day-time adjustment of 10 dBA above the night-time level. These sound levels are also considered to be applicable as a year-round baseline noise level.

A.9.2.1.3 R413

R413. Rationale on model selection including model limitations.

Consideration was made to ensure that the model selected and the calculation method applied for the Project was the most appropriate and adhered to internationally recognized standards. A number of commercially available noise model software packages are available, including:

- Cadna/A by Datakustik GMBH;
- SoundPLAN by SoundPLAN International LLC;
- Predictor by Bruel and Kjaer;
- WindPro by EMD International A/S; and
- WindFarmer by GL Garrad Hassan.

Noise modelling for the Project was carried out according to ISO 9613-2 Attenuation of Sound During Propagation Outdoors, using the DataKustik's CadnaA outdoor sound propagation software (ISO 1996b). The CadnaA model is a practitioner and regulator recognized tool that uses integrated industrial and road noise propagation standards to predict noise levels. Representative sound levels are obtained from DEFRA 2006, Qui Hansen 2012, and VDI 2571, which are considered to be reputable sources and standards. The model allowed for presentation of A-weighted decibels to allow comparison with the OGC's published standards (OGC 2009).

The CadnaA model has a published accuracy of ±3dBA between 100 m to 1000 m, which is considered good accuracy for an environmental noise model. Accuracy levels beyond 1000 m are not published. While it is generally understood by practitioners that the accuracy diminishes at distances beyond 1000 m from the sound source, there are a number of comparative studies that indicate it is still a good assessment tool, when the model parameters are set to conservative values (MFLNRO 2012). As well, the CadnaA model is a conservative noise model because it attempts to account for uncertainties in meteorological conditions which contribute to worst-case noise propagation such as downwind propagation with a mild temperature inversion.

As with all predictions of future conditions, the model predictions have a level of uncertainty related to best available information and understanding of potential sources of noise. Some of the limitations associated with the model arise if the following factors inputted into the model differ from actual activities or circumstances:

- Operation hours;
- Vehicle size;
- Load size;
- Locations of potential sources of noise;
- Sounds level data;
- Ground cover such as grasses, shrubs and trees (sound is absorbed by the ground and ground cover that it passes over or through);
- Meteorological conditions, depending on temperature and relative humidity (sound is absorbed to varying degrees as it passes through the atmosphere);
- Sound propagation can be affected by wind and temperature gradients; and
- Sound can be attenuated by physical barriers such as buildings, hills or mountains.

The model depends on the accuracy of the sound level data used in the model. Standard sound emission data from the International Standards Organization's 9613-2:1996 (ISO 1996a, ISO 1996b) and German Guideline for Noise Protection on Streets (RLS-90) for mine site and traffic predictions were used. Conservative estimates were applied when specific data was not available.

Due to the conservative assumptions that were incorporated into the noise model, the confidence level of the predicted noise effects is high.

A.9.2.1.4 R414

R414. Rationale on why noise levels in Carmacks and the FGR were not modeled.

Two Local Study Areas (LSAs) were established for the assessment of noise: a 30 km^2 area surrounding the mine site and a 20 km^2 area surrounding Carmacks (Section 9 of the Proposal). The Regional Study Area (RSA) for noise included a 4 km buffer (2 km on each side) along the Freegold Road Extension. The spatial areas that were chosen for the noise model were expected to encompass the areas where attenuation resulting from noise from the Project has the potential to exceed thresholds.

At the time of completing the noise model, predictions were not completed for Carmacks because mine operations are not proposed within the area and Project-generated traffic would not pass through Carmacks during operations, as Project-related traffic would utilize the Carmacks by-pass.

The Yukon Government (YG) is responsible for the Carmacks by-pass and Freegold Road Upgrade portion of the access road. Casino Mining Corporation intends to work with YG to understand the timing of the construction of the Carmacks by-pass and if it will be available for use during the construction phase of the Project.

Based on the existing model and predictions, noise levels in Carmacks during construction are anticipated to be consistent with the maximum daytime and nighttime noise levels predicted for the Freegold Road Extension during construction (See Figures 9.4-1 and 9.4-2 in Proposal). These predicted noise levels are below the maximum daytime and nighttime thresholds identified in the OGC's guidelines that were adopted for the Project.

A.9.2.1.5 R415

R415. Identification of reference equipment used to calculate sound pressure levels.

The CadnaA model uses representative industrial and road noise propagation standards for equipment, components and activities from DEFRA 2006, Qui Hansen 2012, and VDI 2571, which are considered to be reputable sources. The construction and operation phase reference equipment were selected by considering material movement schedules, stocking, mine layouts, equipment list, and power plant capacities outlined in the Feasibility Study (M3 2013) and typical mine related activities and selecting the maximum noise sources for the main activities. Supplemental activities were also identified from the Feasibility Study (M3 2013) to arrive at the final list of noise sources for input into the noise model. The Octave Band Spectrum for the major noise sources are listed in Table A.9.2-1.

Table A.9.2-1 Octave Band Spectrums for the Major Sources

Noise Source	Octave Spectrum - Frequency (Hz)										
	31.5	63	125	250	500	1000	2000	4000	8000	A	lin
Work Shop	-	-	85	85	90	85	80	75	-	90.1	93.2
Watering Pump (100 hp)	38.2	52.4	63.5	73	78.4	84.6	82.8	78.6	70.5	88.2	90.1
Crusher	-	91	91	88	87	85	83	78	69	90.1	96.3
Conveyor	-	71	69	68	71	75	67	63	57	77	96.3
Screening	-	84	82	79	79	74	74	71	64	81.1	88
Excavator	-	95	95	89	89	86	82	76	74	91	99.3
Loader	-	88	88	87	85	86	83	77	70	89.9	94.4
Dozer	-	89	90	81	73	74	70	68	64	80.1	93
Grader	-	88	87	83	79	84	78	74	65	86.5	92.4
Crane	-	78	69	67	64	62	57	49	40	66.6	79.1
Loader Mid Size	-	83	89	92	80	71	69	64	58	85	94.3
Lighting Tower	-	78	71	66	62	59	55	56	49	65.5	79.2
Transformer	89	95	97	92	92	86	81	76	69	92.4	101
Incinerator Fan (stack)	56.7	55.7	55.7	54.7	7	63.1	46.7	38.7	30.7	63.4	65.6
Power Generator 6.7MW	62.4	78.8	89.7	97.2	102.6	103.8	103	99.8	92.7	108.6	109
SAG Mill	-	118	117	118	114	111	108	110	95	117.5	123.6
Ball Mill	-	113	113	115	119	111	106	98	93	117.9	122.3
Gas turbine	109.9	112.9	113.9	113.9	113.9	111.9	109.9	106.9	101.9	117.1	121.3
Steam Generator	62.5	74.7	79.8	81.3	85.7	86.9	86.1	85.9	83.8	93.4	105.9

A.9.2.1.6 R416

R416. Confirmation that the noise modeling accounts for air traffic, shovels, cycloning, blasting, the concrete batch plant, and HLF crushing operations and revised predictions if these are not included in the original proposal.

The sources of noise selected for the noise model takes into consideration noise sources that are steady and continuous, typically associated with the continuous use of stationary equipment and noise sources that are mobile. Non continuous noises, such as blasting and air traffic, cause short term noise pulses that may be of annoyance to noise receptors within close proximity; however for the Casino Project, sensitive noise receptors are not within close proximity to the maximum noise sources.

The noise model completed for the Proposal accounts for shovels and crushers, including the crushers that will be used during the operations of the Heap Leach Facility (HLF) as outlined in Table A.9.2-1.

The Casino airstrip is not located within the noise LSA, and Project-related aircrafts (consisting of airplanes and helicopters) will only land a few times a week at the Casino airstrip. An exclusive CadnaA model with a larger domain to include the airstrip would be required to account for landing aircrafts. This type of modelling would be more meaningful and warranted if sensitive noise receptors were identified within close proximity to the airstrip. For example, if ungulates are located within close proximity to the noise source, available threshold values for wildlife that would result in flight responses could be used to characterize the potential effects of predicted noise level on the noise receptor of interests. Even if noise modelling to account for aircrafts is completed, CMC anticipates that predicted noise levels will be below guidelines given the anticipated low frequency, small size of aircrafts and distance from noise receptors.

Blasting is expected to occur during the construction phase for removal of overburden and pit development and less frequently in other Project areas such as the Freegold Road Extension. Regular blasting is anticipated for pit development during the operations phase. In order to carry out an assessment to determine the change in percent highly annoyed due the specific contribution from blasting, assumptions need to be made to estimate the number of blasts per day, the number of days per year that blasting occurs and the C-weighted sound exposure levels for the blasts. Even if an assessment was completed to determine the specific contribution of blasting to noise, CMC does not anticipate a change in the percent highly annoyed above guidelines after the implementation of mitigation measures.

Cycloning is only proposed for the operations phase of the Casino Project and the operations of the concrete plant is only proposed for the construction phase. Casino Mining Corporation anticipates that noise predictions for the construction and operations phases will be below guidelines with the addition of these noise sources.

For these reasons, CMC believes that the potential adverse effects from Project-generated noise are not adversely significant and revising the noise model is not warranted.

A.10 – FISH AND AQUATIC RESOURCES

A.10.1 INTRODUCTION

Potential effects of the Project on fish and aquatic resources were evaluated in Section 10 of the Proposal. The assessment concluded that no significant habitat loss and alteration, lethal effects, sub-lethal effects, or cumulative effects on fish and aquatic organisms are predicted to occur due to the Casino Project. All residual effects were considered non-significant due to the low geographical extent, and low to medium magnitude of the anticipated impacts. The assessment of significance is contingent on the complete implementation of mitigation measures, including proposed compensation works.

While habitat loss and alteration in Casino Creek will be notable, the reduction in available habitat will be offset with new higher quality habitat in lower Britannia Creek. For example, flow reductions during winter may decrease or eliminate the low amount of overwintering habitat currently available in lower Casino Creek, however, the proposed compensation pond will more than offset this loss. Overall, the net habitat gain will ensure that there is no impact on the productive capacity of habitat on a regional scale.

Impacts from mine effluent discharge are not anticipated to be significant based on the application of alternative water quality guidelines which take into account site-specific water chemistry including high water hardness, and elevated baseline metal concentrations. The designation of non-significance is directly formulated on results from the water quality model.

Sub-lethal effects on fish and local aquatic biota are difficult to predict owing to the number of factors involved (e.g., lowered flows, temperature increases, altered channel morphology) and the uncertainty surrounding their potential interactions. Thus, monitoring of water quality and aquatic communities at near-field sites in Casino, Dip, Canadian and Britannia Creeks is required to identify and potentially mitigate/compensate any future impacts on the fitness of local fish species. Despite the uncertainty involved, potential project impacts are not predicted to yield far-reaching effects on regional productivity or diversity.

On January 27, 2015, the Executive Committee requested that Casino Mining Corporation (CMC) provide supplementary information to the proposed Casino Project (YESAB Project No. 2014-0002) to enable completion of a Draft Screening Report. The Executive Committee considered received comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). Casino Mining Corporation is providing this Supplementary Information Report (SIR) as an addendum to the Project Proposal to assist the Executive Committee in preparation of the Draft Screening Report.

The Executive Committee has 34 requests related to information presented in Section 10 Fish and Aquatic Resources of the Project Proposal submitted on January 3, 2014. These requests are outlined in Table A.10.1-1. Some responses require detailed technical information, data, and figures. Where necessary, this additional supporting information is provided as appendices to the SIR.

Table A.10.1-1 Requests for Supplementary Information Related to Fish and Aquatic Resources

Request #	Request for Supplementary Information	Response
R273	An updated Section 10 of the proposal which reflects the current *Fisheries Act* (Fisheries Protection Provisions). This updated section should include the identification of project components likely requiring a paragraph 35(2)(b) *Fisheries Act* authorization.	Section A.10.2.1.1 Appendix A.10A Updated Fish Habitat Offsetting Plan
R274	Proposed charge weights to be used for different project activities including the operation of the mine pit, and construction of infrastructure site pads and access roads. Indicate setback distances from fish-bearing waters for each activity and an analysis of potential effects based on this information.	Section A.10.3.1.1 Appendix A.10A Updated Fish Habitat Offsetting Plan Appendix A.10B Fish Habitat Evaluation: Instream Flow and Habitat Evaluation Procedure Study
R275	Baseline data for the creek intersected by the proposed airstrip, Taylor Creek, and other Casino Creek tributaries lacking baseline data including a. the existing condition, including quality and relative abundance, of the fish habitat; and b. the species and life stages of fish present.	Section A.10.4.1.1
R276	A discussion of fish populations, densities, and diversity in downstream watercourses including lower Dip Creek and the Klotassin River.	Section A.10.4.1.2
R277	Maps demonstrating fish presence, assumed absence, or observed absence by stream segment. Include the stream channel intersected by the proposed airstrip, Casino Creek tributaries such as Taylor Creek, and the Freegold Road. Where fish are assumed as absent, provide rationale.	Section A.10.4.1.3
R278	Maps demonstrating fish habitat quality and fish distribution by species for watercourses including Casino Creek and its tributaries, Dip Creek downstream of its confluence with Casino Creek, and Britannia Creek and its tributaries. Include any seasonal barriers to movement.	Section A.10.4.1.4
R279	A table or other tool identifying the location in the proposal of supporting baseline information for each of the potentially impacted watercourses.	Section A.10.4.1.5
R280	Information on the time of year each of the water bodies potentially affected by the Project are likely to be used by the various life stages of each fish species.	Section A.10.4.1.6
R281	Appendices A through E for Appendix 10 A – Casino Project Fish and Aquatic Resources Baseline Report, November 12, 2013, by Palmer Environmental Consulting Group Inc.	Section A.10.4.2.1

Request #	Request for Supplementary Information	Response
R282	A description of the detailed methods used to calculate the estimated reductions in flow and wetted area from baseline conditions in all watercourses affected. (EcoMetrix)	Section A.10.5.1.1 Appendix A.10B Fish Habitat Evaluation: Instream Flow and Habitat Evaluation Procedure Study
R283	An indication of and rationale for the selected minimum in-stream flow threshold. (EcoMetrix)	Section A.10.5.1.2 Appendix A.10B Fish Habitat Evaluation: Instream Flow and Habitat Evaluation Procedure Study
R284	The full documents cited as KPL 2013 and Normandeau, November 2013. (EcoMetrix)	Section A.10.5.1.3 Appendix A.10B Fish Habitat Evaluation: Instream Flow and Habitat Evaluation Procedure Study
R285	A discussion of the extent to which the identified overwintering and spawning habitat in the affected portion of Casino Creek is actively used by Arctic grayling for these stages, and the potential effects of the Project to this habitat.	Section A.10.5.1.4 Appendix A.10A Updated Fish Habitat Offsetting Plan Appendix A.10B Fish Habitat Evaluation: Instream Flow and Habitat Evaluation Procedure Study
R286	A discussion of the potential fish barrier proposed to be installed above the Casino- Brynelson Creek confluence. This discussion should include: a. description of the barrier proposed, and details regarding its installation; and b. identification of alternative mitigations to the physical fish barrier in this location to prevent winter kill and fish stranding.	Section A.10.5.2.1
R287	The degree of risk for fish stranding to actually occur in Casino Creek due to low water flow attributed to the operation of the tailings management facility.	Section A.10.5.2.2 Appendix A.10B Fish Habitat Evaluation: Instream Flow and Habitat Evaluation Procedure Study
R288	A discussion of and rationale for the diversion of this drainage around the airstrip. This discussion should consider alternatives, such as allowing the drainage to pass underneath the airstrip.	Section A.10.5.3.1 Appendix A.10A Updated Fish Habitat Offsetting Plan Appendix A.10B Fish Habitat Evaluation: Instream Flow and Habitat Evaluation Procedure Study
R289	A discussion of the potential for seasonal stranding of fish in the lower portion of the dewatered channel.	Section A.10.5.3.2

Request #	Request for Supplementary Information	Response
R290	An updated Fish Habitat Compensation Plan to align with the new requirements of the *Fisheries Protection Provisions* of the new *Fisheries Act*.	Section A.10.5.4.1 Appendix A.10A Updated Fish Habitat Offsetting Plan
R291	A detailed description of the physical habitat simulation model. Details should include: a. data used in the model (habitat and hydrological) and methods for field data collection; b. locations of all transects (of each mesohabitat type - riffle, pool and glide) on each watercourse; c. habitat suitability indices (HSI) curves for Arctic grayling in all life stages which consider site specific conditions; d. species and life stage periodicity chart highlighting the seasonal use of the study area by different life stages of the target species, and a discussion of whether migration patterns were considered in the model; e. discussion of whether seasonal use by life stage requirements of target species was considered in the model; f. target flow velocities for low, mid and high flows, with a comparison to the baseline and projected flows for construction, operation and closure phases, indicating and providing rationale for the selected minimum in-stream threshold; g. discussion of impacts to Britannia Creek from reduced flows in Canadian Creek as flow is redirected to the pit; and h. a comparison of percent reduction in flow for areas affected by reduced stream flows considering natural variability observed in stream.	Section A.10.5.5.1 Appendix A.10B Fish Habitat Evaluation: Instream Flow and Habitat Evaluation Procedure Study
R292	A detailed description of the habitat evaluation procedure. Details should include: a. methods and assumptions for the calculation of habitat lost; b. summary of HSI values for each variable; c. identification of and rationale for habitat types included; and d. data and methods used to calculate habitat gains, including from all proposed compensation options.	Section A.10.5.5.2 Appendix A.10B
R293	Clarification of whether the estimated habitat loss in Dip Creek was accounted for in the total habitat loss calculation for the proposed airstrip tributary diversion channel.	Section A.10.5.6.1

Request #	Request for Supplementary Information	Response
R294	Clarification of, and rationale for, the methods used to calculate the figures in Table 4-5: in-stream habitat impacts and in-stream habitat gains. This clarification should include the calculation of 4753 m^2 as identified in Table 4-5, based on the proposed airstrip diversion channel width of 2.5 m and length of 1 509 m.	Section A.10.5.6.2 Appendix A.10A Updated Fish Habitat Offsetting Plan
R295	Clarification of whether the assumed fish bearing streams (those of less than 20 percent gradient) were included in the habitat evaluation procedure analysis for habitat loss and compensation.	Section A.10.5.7.1
R296	Identification and rationale for the type(s) of habitat created by ford restoration.	Section A.10.5.8.1 Appendix A.10A Updated Fish Habitat Offsetting Plan
R297	Clarification of whether clear-span bridges are proposed for all fish-bearing watercourses. If culverts will be installed on some fish-bearing creeks, please provide rationale, mitigations, and incorporate habitat losses into the habitat compensation plan.	Section A.10.6.1.1
R298	Details on existing crossing structures no longer used for portions of the Freegold Road upgrade once the road is re-aligned.	Section A.10.6.2.1
R299	Details on when and how the Nordenskiold River bridge pier will be constructed.	Section A.10.6.3.1
R300	The quality and type of fish habitat (e.g. highly suitable spawning and/or rearing habitat, confirmed spawning habitat, and migratory channel) potentially affected by the Nordenskiold River bridge. Discussion should include identification of potential effects of the bridge and the pier, focusing on potential long-term morphological changes to the river in contrast to natural morphological changes.	Section A.10.6.3.2
R301	The fish species (and their life stages) present in the area potentially affected by the Nordenskiold River bridge. Discussion should include identification of potential effects of the bridge and the pier.	Section A.10.6.3.3
R302	A list of stream crossings for the Freegold Road including stream name, kilometre marker, crossing properties and the type of crossing, considering DFO's definition of clear-span crossing.	Section A.10.6.4.1

Request #	Request for Supplementary Information	Response
R303	An assessment of the overall erosion and sedimentation risk that will form the basis for designing and ultimately preparing an erosion and sediment control plan for the Freegold Road Upgrade, Airstrip Access Road and Casino Mine site.	Section A.10.6.5.1
R304	Identification of fish-bearing and non fish-bearing reaches of affected watercourses in the Map Series 3 (overall erosion and sedimentation risk) of the Erosion and Sedimentation Risk Assessment Report.	Section A.10.6.5.2
R305	Discussion on the methods of monitoring for erosion and sedimentation during all phases of the Project.	Section A.10.6.5.3 Appendix A.10A Updated Fish Habitat Offsetting Plan Appendix A.22C Sediment and Erosion Control Management Plan
R306	Discussion of and rationale for the exclusion of W16 or other downstream locations from monitoring throughout the life of the Project.	Section A.10.7.1.1
R307	The information related in Section 7.4.5.1 and 7.4.5.2.	Section A.10.8.1.1

Notes:

1. Request # refers to the assigned identification number in the YESAB Adequacy Review Report January 27, 2015 Prepared by Executive Committee Yukon Environmental and Socio-economic Assessment Board.
2. Response refers to the location of CMC's response to the YESAB request for supplementary information.

A.10.2 FISHERIES ACT – FISHERIES PROTECTION PROVISIONS

A.10.2.1.1 R273

R273. An updated Section 10 of the proposal which reflects the current Fisheries Act (Fisheries Protection Provisions). This updated section should include the identification of project components likely requiring a paragraph 35(2)(b) Fisheries Act authorization.

On November 25, 2013 new fisheries protection provisions were enacted under Section 35 of the *Fisheries Act*, to support the Department of Fisheries and Oceans Canada's (DFO) new focus on avoiding "serious harm to fish", and the framework for offsetting any residual harm to fish. The new *Fisheries Act* provisions alter the legislative focus from "no net loss" of habitat to the "sustainability and ongoing productivity of commercial, recreational and Aboriginal (CRA) fisheries". The Proposal was submitted during the time of transition for the *Fisheries Act* legislation, and hence was consistent with the older version of the *Fisheries Act*. Based on CMC's interpretation of the new provisions, fish and aquatic resources within the Casino project area are still protected by the updated *Fisheries Act* legislation. Further, the new *Fisheries Act* provisions do not modify the size, number or nature of potential project effects on fisheries identified in the Fish and Aquatic Resources section of the Proposal. Section 35 of the *Fisheries Act* still includes a reference to protecting fish habitat, in that the definition of serious harm to fish incorporates any destruction or permanent alteration of fish habitat. Additionally, the new provisions still allow for habitat-based approaches, commonly used under the old provisions, during the assessment of potential effects, and the development of mitigation and offsetting plans. Based on the similarities of the two Act versions, and the presence of CRA or CRA supporting species in the Casino project area, CMC has concluded that the previous Fish and Aquatic Resources effects assessment remains valid with minor terminology substitutions to the text. For clarification, the following substitutions may be made, although the intent of the text remains valid:

- ***Habitat loss*** can replace all references to Harmful Alteration, Disruption, or Destruction of Fish Habitat (***HADD***); and
- ***Sustainability and ongoing productivity of CRA fisheries*** can replace ***productive capacity of habitat***.

The Fish Habitat Compensation Plan previously submitted in the Proposal will require updating to reflect the changes in the *Fisheries Act*, as well as the finalized design of the proposed offsetting options. The initial plan submitted in the Proposal was to support DFOs review of the Proposal, with the understanding that a final detailed design for fish habitat offsetting was to be provided to DFO in association with CMC's subsequent request for *Fisheries Act* authorization. To reflect the changes to the *Fisheries Act*, as well as to update the plan with more detailed design and site selection techniques, CMC has provided the Fish Habitat Offsetting Plan (Appendix A.10A), which reflects the change in terminology of the new fisheries protection provisions.

A.10.3 CHARGE WEIGHTS

A.10.3.1.1 R274

R274. Proposed charge weights to be used for different project activities including the operation of the mine pit, and construction of infrastructure site pads and access roads. Indicate setback distances from fish-bearing waters for each activity and an analysis of potential effects based on this information.

While specific charge weights and associated setback distances are not currently available, DFO standard mitigation to prevent serious harm to fish by blasting will be considered for all blasting activities (Wright and Hopky 1998; DFO 2013). Where required, site-specific mitigation will be incorporated depending on proximity to fish habitat and sensitivity of known fish species. For example, if there is the potential for blasting activities to adversely affect fish, charge weights may be subdivided into a series of smaller charges (e.g., "decking") in blast holes with a delay between charge detonations. Examples of maximum charge weights per delay used during other open pit mining operations ranged from 630-750 kg per delay (e.g., Ekati Diamond Mine, New Prosperity). Thus, based on what has been observed as typical maximum detonation charges at other major mines, and the noted 1.2 km distance to the closest fish-bearing habitat in upper Canadian Creek, blasting activities in the Casino open pit area are not expected to have any influence on fish health (See Project Proposal Section 10, p. 10-30 for more details).

A.10.4 BASELINE DATA

A.10.4.1.1 R275

R275. Baseline data for the creek intersected by the proposed airstrip, Taylor Creek, and other Casino Creek tributaries lacking baseline data including:

a. the existing condition, including quality and relative abundance, of the fish habitat; and
b. the species and life stages of fish present.

Taylor Creek

Taylor Creek was assessed as part of the Upper Casino Creek Habitat Evaluation Procedure (HEP) study (Appendix A.10B). During this assessment, a fish barrier was identified on Taylor Creek approximately 275 m upstream of its confluence with Casino Creek. The barrier consisted of multiple vertical drops (0.35 - 0.8 m to estimated bankfull) with insufficient bankfull pool depths for Arctic grayling passage, as Arctic grayling require a minimum pool depth of 1.25x the vertical drop in order to surmount vertical barriers (Parker 2000). Fish sampling was conducted above the barrier in summer 2014 to further document and verify an absence of fish in Taylor Creek. No fish were caught using two sampling methods (overnight minnow trap sets and 587s of electrofishing) during late July 2014.

Casino Creek Unnamed Tributaries

The three unnamed Casino Creek tributaries were inferred as non-fish bearing based on undocumented field assessments during the baseline program. HEP assessments were completed during the 2014 field program to assess the habitat quality of these tributaries, and the Fish Habitat Offsetting Plan (Appendix A.10A) was modified according to results. All of the tributaries were small low quality streams that likely do not directly support fish, however, modelled habitat loss values were conservatively included in the overall habitat budget.

Dip Creek Tributary at the proposed Airstrip

Fish habitat information for the Dip Creek tributary (Crossing Site 10+330) that will be intersected by the airstrip was provided in Appendix 10B, in the following locations:

- Table 9 page 52;
- Table 10 page 53; and
- Site card in Appendix D.

In addition, fish and fish habitat assessments were completed in July 2014 on the lowermost section of the airstrip stream. Habitat was surveyed using a Habitat Evaluation Procedure (HEP) on a 750 m stretch extending upstream from Dip Creek. HEP methods applied were the same as used in other areas of the project and included documenting channel dimensions, substrate, and habitat type (Appendix A.10B). Overall, the habitat assessed was marginal shallow seasonal rearing habitat and there was evidence of major instability due to permafrost melting. Evidence of this instability included dead and unstable riparian areas, lots of woody debris, lateral stream movement, multiple shallow stream channels that were poorly defined and often flowing through flooded shrubs and trees, and turbid water. In addition, during the 2014 field program the stream outflow was providing a noticeable plume of turbid water into Dip Creek, which was noted to run several hundreds of metres downstream from its confluence.

Fish sampling in July 2014 consisted of minnow trapping (overnight set of two traps) and electrofishing (493s) in the lowermost 250 m adjacent to Dip Creek. No fish were caught and water levels were very low despite a recent rainfall event.

A.10.4.1.2 R276

R276. A discussion of fish populations, densities, and diversity in downstream watercourses including lower Dip Creek and the Klotassin River.

Fish species documented within the Yukon River Basin near the study area include Chinook and chum salmon, longnose sucker, Arctic grayling, slimy sculpin, inconnu, round whitefish, least cisco, northern pike, Arctic Lamprey, and burbot (Walker 1976). Of these species, Arctic grayling and slimy sculpin are the most widely distributed and are present throughout the majority of the RSA. There are no known stocked or enhanced fisheries within the project area, with the exception of rainbow trout stocking in Gloria Lake II (Appendix 19A, p.23). Specific information regarding species life history, distribution within the project area, and a discussion of the species contribution to CRA fisheries is provided below. In addition, Figure A.10.4-9 depicts fish species presence/absence directly adjacent to the mine site, and Figure A.10.4-1 through Figure A.10.4-8 show the Chinook salmon distribution throughout the RSA along the road routes.

Chinook Salmon

Life history

Chinook spawning occurs between late July and September, within the Yukon River Basin near the study area (Yukon River Panel 2008). Chinook salmon prefer to spawn in groundwater fed gravel beds within small tributaries or larger river systems (de Graff 2009). The young salmon hatch as fry in the spring and migrate to small non-natal streams where productivity is high and to escape predators. Fry spend their first winter in freshwater before migrating down the Yukon River to the Bering Sea to complete the marine stage of their lifecycle. As a result, overwintering habitat within smaller stream systems is critical for the success of Chinook salmon.

Distribution

Overview: The areas of known adult Chinook salmon utilization and the areas of known Chinook salmon presence at other live stages (i.e., fry and juvenile) are presented in Figure A.10.4-1. The areas shown are based on numerous historical studies conducted on Chinook habitat, presence, and spawning in the area (i.e., DFO 1985; DFO 1994; Yukon River Panel 2008a; EDI 2011). Big Creek, Selwyn River, Nordenskiold River, Klotassin River, Donjek River, and the White River are known to be utilized by adult Chinook salmon for spawning habitat (DFO 1985; Yukon River Panel 2008a), and the tributaries of Seymour Creek, Bow Creek, Stoddart Creek, Hayes Creek, and Dip Creek have all been shown to contain fry and juvenile Chinook (DFO 1994; von Finster 1998). Juvenile Chinook salmon have also been documented in the lower reaches of Britannia Creek, Isaac Creek, Mascot Creek, Crossing Creek and Murray Creek, near the confluence with the Yukon River (DFO 1994; EDI 2011). No Chinook salmon have been captured either recently or historically within Casino Creek.

Dip Creek and the Klotassin River: Within the 2008-2013 sampling program, no juvenile Chinook salmon were captured in Dip Creek. Similarly, historical sampling by Knight Piésold in 1994 yielded no Chinook salmon during 2,807s of electrofishing effort at site F14 (HKP, 1997). In contrast, Summit Environmental (2012) captured a single juvenile Chinook in Dip Creek near its confluence with Casino Creek in July 2011. Historically, there is some evidence of juvenile Chinook salmon rearing in lower Dip Creek from studies conducted by DFO in 1994 and 1998 (DFO, 1994; Otto, 1998). In DFO (1994), minnow trapping was carried out on the Klotassin River adjacent to its confluence with Dip Creek, as well as at two sites on Dip Creek located approximately 10 and 27km upstream of the Dip Creek outlet. A total of 38 young-of-the-year Chinook salmon were captured at the Dip-Klotassin site, and 25 more were captured at the intermediate Dip Creek station which is located approximately 18 linear kilometers downstream from the Casino Creek confluence. No salmon were captured at the furthest upstream site on Dip Creek. In Otto (1998), two minnow traps were set 100m upstream of the Dip-Klotassin confluence on Dip Creek, with one young-of-the-year Chinook salmon captured. No sites further upstream were assessed. Three minnow traps set on the Klotassin River within 1km downstream of Dip Creek did not capture any juvenile Chinook salmon, however juveniles were observed in the stream during trap deployment (Otto, 1998).

The first record of adult Chinook salmon spawning in the Klotassin River was during field studies conducted by DFO in 1994, where a single adult was observed approximately 8km upstream of the Klotassin-Dip confluence (DFO, 1994). Additional adult Chinook salmon were observed spawning in the summer of 1998, when two adults were observed in the lowest reaches of the Klotassin River on July 14 during a boat survey, and four adults were observed during a short aerial survey completed on the lowest 5km of the river in August (Otto, 1998).

Contribution to CRA Fisheries

The Canadian Yukon River Chinook salmon fishery has been heavily regulated in recent years due to historically low escapement counts. Commercial, domestic, and recreational fisheries have been closed or had very low captures since 1997 (JTC 2013; Yukon Salmon Sub-Committee 2014). The aboriginal fishery has also declined over the period from 1961-2011 (JTC 2013), with complete closures announced in summer 2014 (Whitehorse Daily Star 2014).

Chum Salmon

Life history

Chum salmon spawning occurs later in the season in comparison to Chinook, with migration runs into the Yukon beginning in late August, and with peak spawning occurring during late September to early October (de Graff 2009). Chum salmon tend to spawn in slow moving side channels where groundwater inputs are present (de Graff 2009). Chum salmon juveniles hatch as fry in the spring and immediately migrate downstream to estuaries (de Graff 2009).

Distribution

Adult chum salmon have been documented within the Nordenskiold River, and in Big Creek approximately 13.7 km upstream of the Yukon River confluence (DFO 1985).

Contribution to CRA Fisheries

Yukon River fall chum salmon support both commercial and aboriginal fisheries, with 63% and 37% of the catch occurring in the commercial and aboriginal fisheries, respectively (Yukon River Panel 2008). As described in the Casino Project Land Use and Tenure Baseline Report (Appendix 19A), commercial fishing accounts for less than 5% of the fish harvested in the Yukon Territory (Environment Yukon 2010). A small fishery is located in the Minto area, on the periphery of the RSA and the Canadian Commercial fishery is located in the Dawson area (Appendix 19A, p.23). These fisheries harvest summer and fall chum (Yukon Salmon Sub-Committee 2014).

Arctic Grayling

Life history

Arctic grayling typically spend the spring and summer in smaller tributary streams and migrate to the lower reaches of large river systems to overwinter (McPhail 2007). Arctic grayling spawn around the same time as ice break-up in clear, fast-flowing tributaries with temperatures between 4-16°C (Stewart et al. 2007). Adult Arctic grayling have been documented residing in water with temperatures between 0.3 - 16.7 °C, whereas juveniles have been associated with warmer waters (5-17°C; Stewart et al. 2007). Arctic grayling are opportunistic visual feeders, with varying rates of piscivory noted in fish greater than 150mm (Stewart et al. 2007). They are sensitive to changes in turbidity, which may reduce feeding success or cause habitat avoidance. Populations of Arctic grayling are particularly vulnerable to changes in habitat and water conditions, which may lead to habitat fragmentation (Stewart et al. 2007).

Distribution

Arctic grayling have been documented within the majority of waterbodies in the RSA, including Casino Creek, Dip Creek, Britannia Creek, as well as in all of the major watersheds crossing the proposed Casino roads. Larger Arctic grayling tend to distribute more widely than small juveniles and young-of-the-year (YOY), and are often the only fish species documented in upper headwater reaches. In and around the Casino mine site, young-of-the-year Arctic grayling juveniles have been captured in Dip Creek, and in lower Britannia Creek. While less fish sampling has been conducted at proposed crossing sites along the Freegold Road, it is expected that YOYs would be present in all major rivers and creeks, as well as in tributaries directly adjacent to the Yukon River of sufficient size and quality.

Contribution to CRA Fisheries

Arctic grayling is the most popular sport fish in the Yukon (Environment Yukon 2010). Arctic grayling support both recreational and Aboriginal fisheries along the Yukon River and in accessible tributaries, however, the remoteness and inaccessibility of the project area watersheds likely limits fishing activities.

Slimy Sculpin

Life history

The slimy sculpin is a bottom-dwelling species, residing under cobble or other in-stream habitat cover features. Slimy sculpins demonstrate very high site fidelity, generally remaining within a 50 m-radius home range throughout their lives (Gray et al. 2002). Thus, all life history stages, including overwintering and spawning, must be carried out within this limited home range. As a result, the presence of over wintering habitat (either in groundwater fed pools or river systems) and a lack of movement barriers is key to success of this species. In the study area, they were generally found in lower to middle reaches of watercourses, and were often associated with shallow riffle and run sections providing large substrate cover, as well as in channel edges providing cover from undercut banks, woody debris and overhanging vegetation. Spawning takes place in the spring when temperatures approach 5 to 10°C, in nests on the underside of rocks, submerged rocks or other available in-stream habitat (Roberge et al. 2002). Slimy sculpin may provide a food source for larger predatory fish such as burbot, northern pike, and Arctic grayling (McPhail and Paragamian 2000; Stewart et al. 2007).

Distribution

Slimy sculpin is one of the most widely distributed species in the RSA, with reported captures in lower Casino Creek, lower Brynelson Creek, Dip Creek, lower Britannia Creek, Isaac Creek, Selwyn River, Hayes Creek, Big Creek, Murray Creek, and the Nordenskiold River.

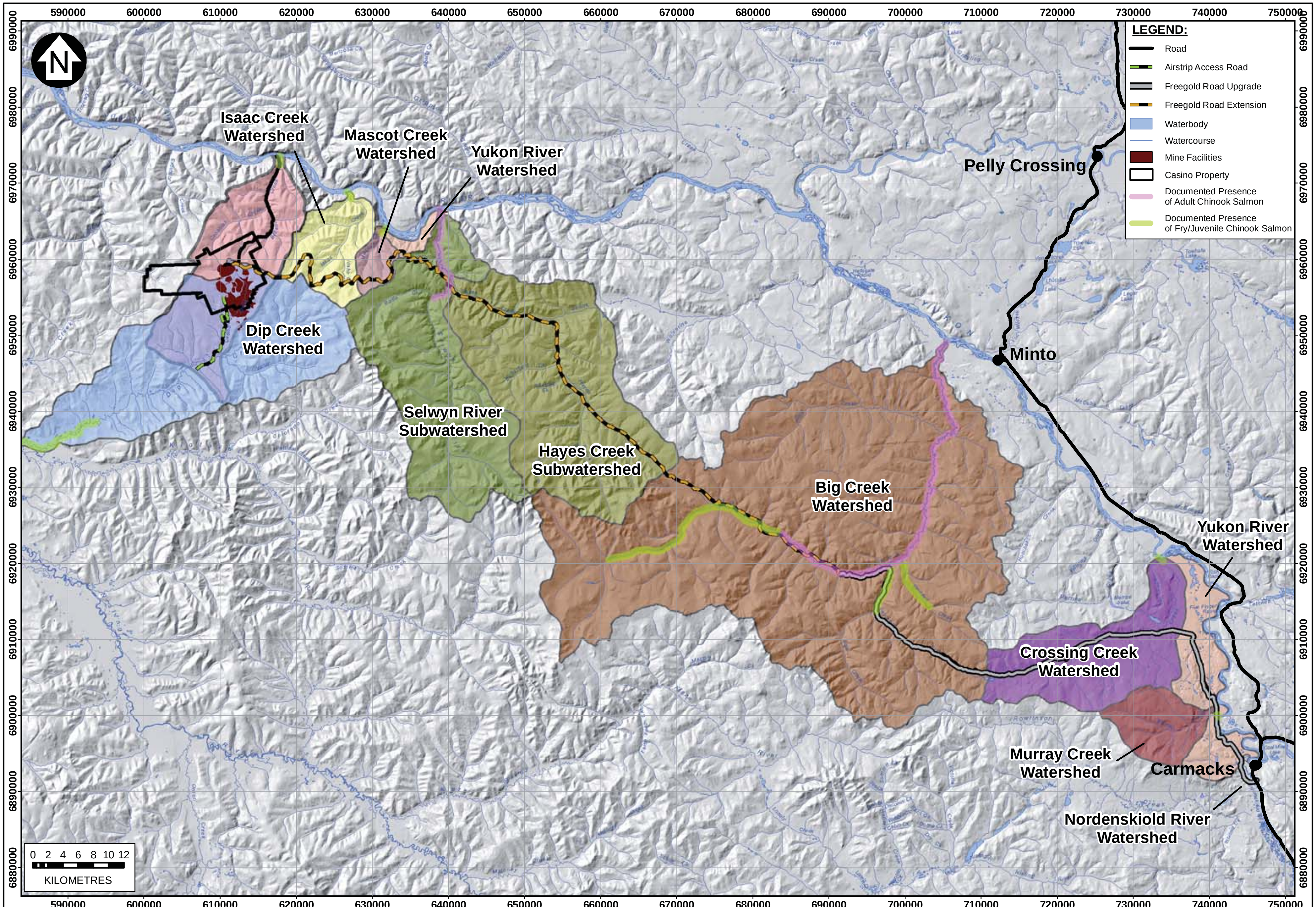
Contribution to CRA Fisheries

There are no known slimy sculpin fisheries within the RSA. However, as slimy sculpin is sometimes a prey fish for larger predatory fish species, it may be considered a species which supports a CRA fishery and would thus be protected under the *Fisheries Act*. In and around the proposed Casino mine site, both Arctic grayling and burbot may rely on slimy sculpin as a food source. Adult burbot have been captured in low densities in Dip Creek, where they subsequently may feed on low numbers of slimy sculpin. Arctic grayling may rely on slimy sculpin as a prey source in areas where they overlap, including lower Casino Creek, lower Brynelson Creek, Dip Creek, and in lower Britannia Creek. Along the proposed Freegold Road, slimy sculpin may be a prey food for northern pike, burbot, and Arctic grayling. It is not expected that salmon species would rely on slimy sculpin as a prey source. Adult Chinook salmon generally cease feeding upon their return to freshwater (Behnke 2010). Before migrating to sea, juvenile Chinook salmon feed primarily on insects, and some plankton (Healey 1991).

Unfortunately, the lack of site-specific diet information for Arctic grayling in the LSA makes it difficult to predict the contribution of slimy sculpin to their diet. However, inferences can be made from studies of Arctic grayling diet in Yukon and NWT streams and lakes which have demonstrated that sculpins and other fish generally contributed a low percentage of energy intake relative to benthic invertebrates (Bishop 1967; de Bruyn and McCart 1974; Tripp and McCart 1974; Chang-Kue and Cameron 1980; Mathers 1981; Birtwell et al. 1984; Jessop et al. 1993). Fish made up less than 4% of stomach content volume in fluvial and adfluvial Arctic grayling from various NWT streams and lakes (Bishop 1967). Occurrence of fish in Arctic grayling stomachs was generally low for the majority of studies, with occurrence of piscivory ranging from 0-2% (deBruyn and McCart 1974; Tripp and McCart 1974; Chang-Kue and Cameron 1980; Birtwell et al. 1984; Jessop et al. 1993). Higher incidences of piscivory were documented in a few select lakes in NWT, including Great Bear Lake where 10.8% of Arctic grayling stomachs had fish (Miller 1946), and in two lakes studied by deBruyn and McCart (1974) where 12.8 - 20.9% of stomachs had fish. Based on evidence for the low Arctic grayling piscivory rates in similar waterbodies elsewhere, it is likely that the contribution of slimy sculpin to the Arctic grayling fishery within the RSA is similarly low.

Other Fish Species

- Northern pike is one of the top three most targeted fish species by anglers in the Yukon (Environment Yukon 2010). The distribution of northern pike in the project area is restricted to the Nordenskiold River.
- Burbot is most commonly caught by anglers in lakes during the winter through ice (Environment Yukon 2010). In the project area, burbot has been captured in stream habitats such as lower Casino Creek, Dip Creek, Isaac Creek, and the Nordenskiold River, where fishing is less common and/or unlikely to occur due to remoteness.
- Round whitefish have been captured in Dip Creek, Murray Creek, Big Creek, and within the Nordenskiold River. Little is known about round whitefish populations in the Yukon, and they are not recognized as a popular angling species (Environment Yukon 2010). While other species of whitefish are commercially harvested in the Yukon, round whitefish are not specifically targeted due to their smaller size. However, First Nations may harvest round whitefish for subsistence (Environment Yukon 2014).
- Longnose sucker have been captured in Isaac Creek and the Nordenskiold River. Longnose sucker is not recognized as a popular angling species (Environment Yukon 2010).



PREPARED BY:

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

DESIGNED	D. Turner
DRAWN	D. Turner
CHK'D	J. Cole
APP'D	J. Cole
REV	R. Palmer
DATE	28Oct'14

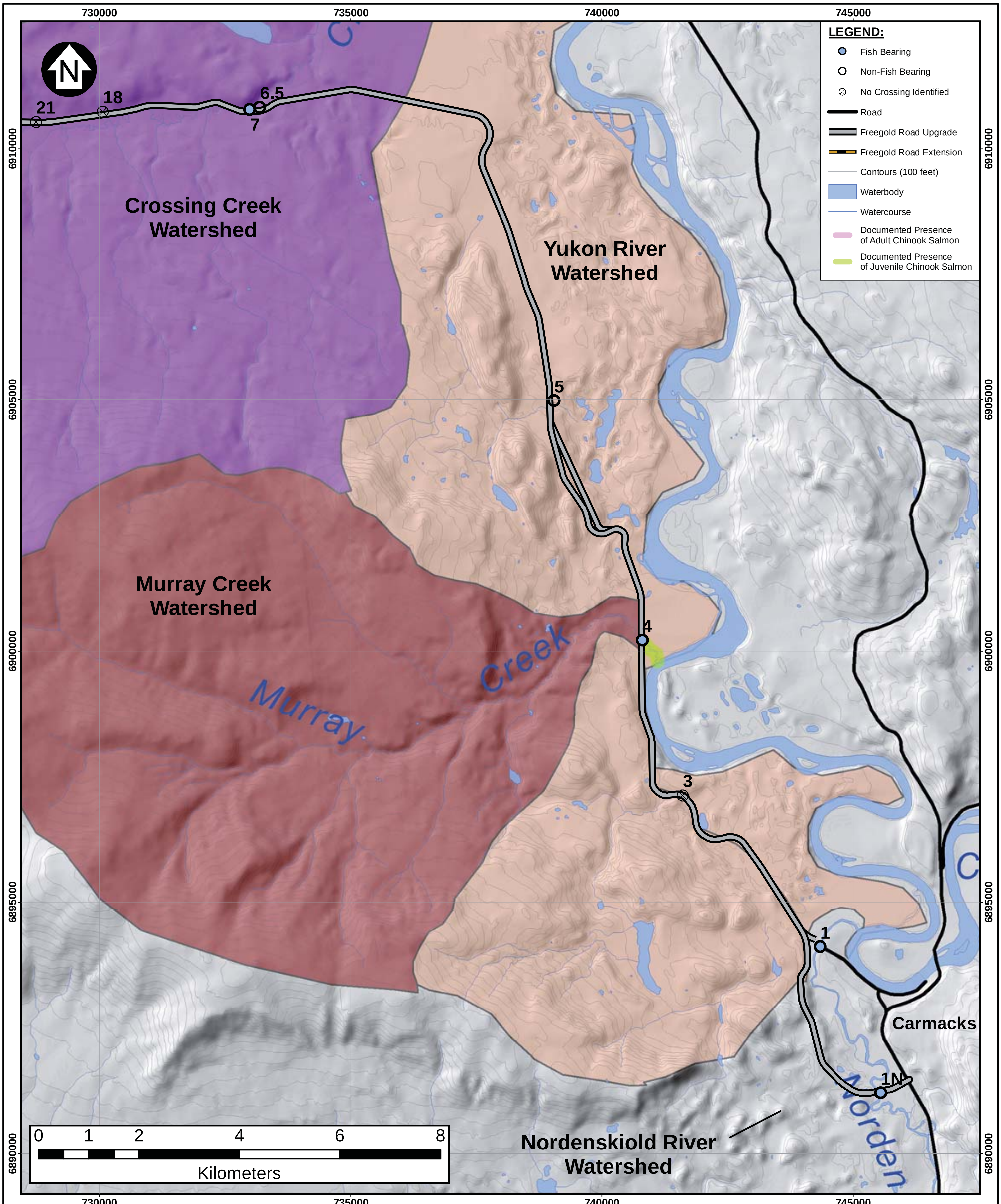
NOTES:
1. BASE MAP: Digital Elevation Model and 1:250,000 and 1:50,000 Topographic Spatial Data provided by Geomatics - Yukon Government via online source (www.geomaticsyukon.ca)
2. PROJECTION: NAD 1983 UTM Zone 7N
3. COORDINATE GRID: METRES
4. SCALE: 1:650,000
5. Documentation on the presence of adult and fry/juvenile chinook salmon provided by DFO (1985), DFO (1994), Summit (2011) and EDI (2011)

CASINO

CASINO PROJECT

Overview Map of the Casino Mine Roads and Watersheds

FIGURE A.10.4-1



PREPARED BY:

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

DESIGNED	D. Turner
DRAWN	D. Turner
CHK'D	J. Cole
APP'D	J. Cole
REV	R. Palmer
DATE	28Oct'14

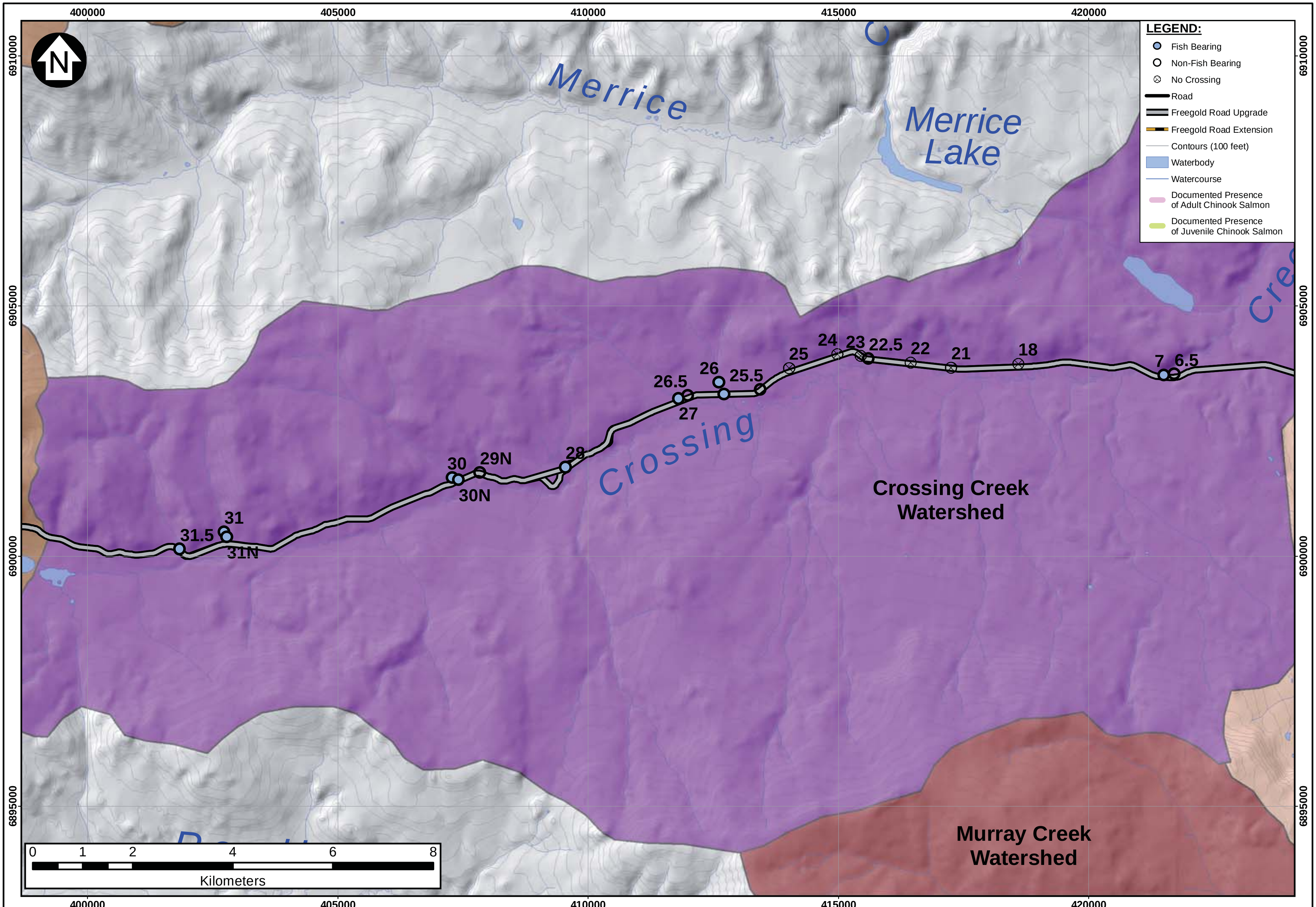
NOTES:
1. BASE MAP: Digital Elevation Model and 1:250,000 and 1:50,000 Topographic Spatial Data provided by Geomatics - Yukon Government via online source (www.geomaticsyukon.ca)
2. PROJECTION: NAD 1983 UTM Zone 7N
3. COORDINATE GRID: METRES
4. SCALE: 1:100,000
5. Documentation of presence of adult and juvenile chinook salmon provided by DFO (1985), DFO (1994), Summit (2011) and EDI (2011)

CASINO

Freegold Road Upgrade
Fish Presence / Absence
(Map 1)

CASINO PROJECT

FIGURE A.10.4-2



PREPARED BY:

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

DESIGNED	D. Turner
DRAWN	D. Turner
CHK'D	J. Cole
APP'D	J. Cole
REV	R. Palmer
DATE	28Oct'14

NOTES:

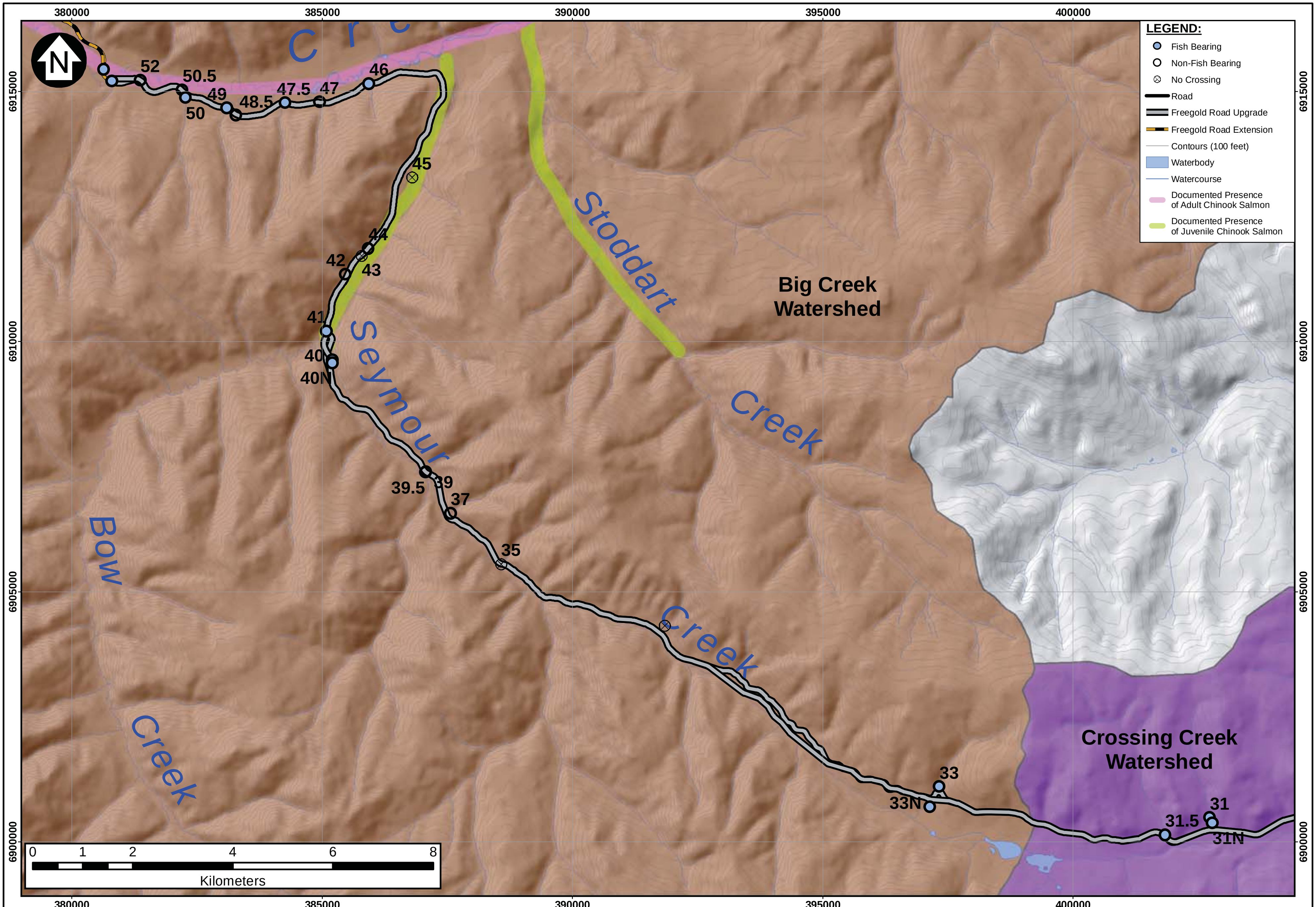
1. BASE MAP: Digital Elevation Model and 1:250,000 and 1:50,000 Topographic Spatial Data provided by Geomatics - Yukon Government via online source (www.geomaticsyukon.ca)
2. PROJECTION: NAD 1983 UTM Zone 8N
3. COORDINATE GRID: METRES
4. SCALE: 1:100,000
5. Documentation of presence of adult and juvenile chinook salmon provided by DFO (1985), DFO (1994), Summit (2011) and EDI (2011)

CASINO

CASINO PROJECT

Freegold Road Upgrade
Fish Presence / Absence
(Map 2)

FIGURE A.10.4-3



PREPARED BY:

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

DESIGNED	D. Turner
DRAWN	D. Turner
CHK'D	J. Cole
APP'D	J. Cole
REV	R. Palmer
DATE	28Oct'14

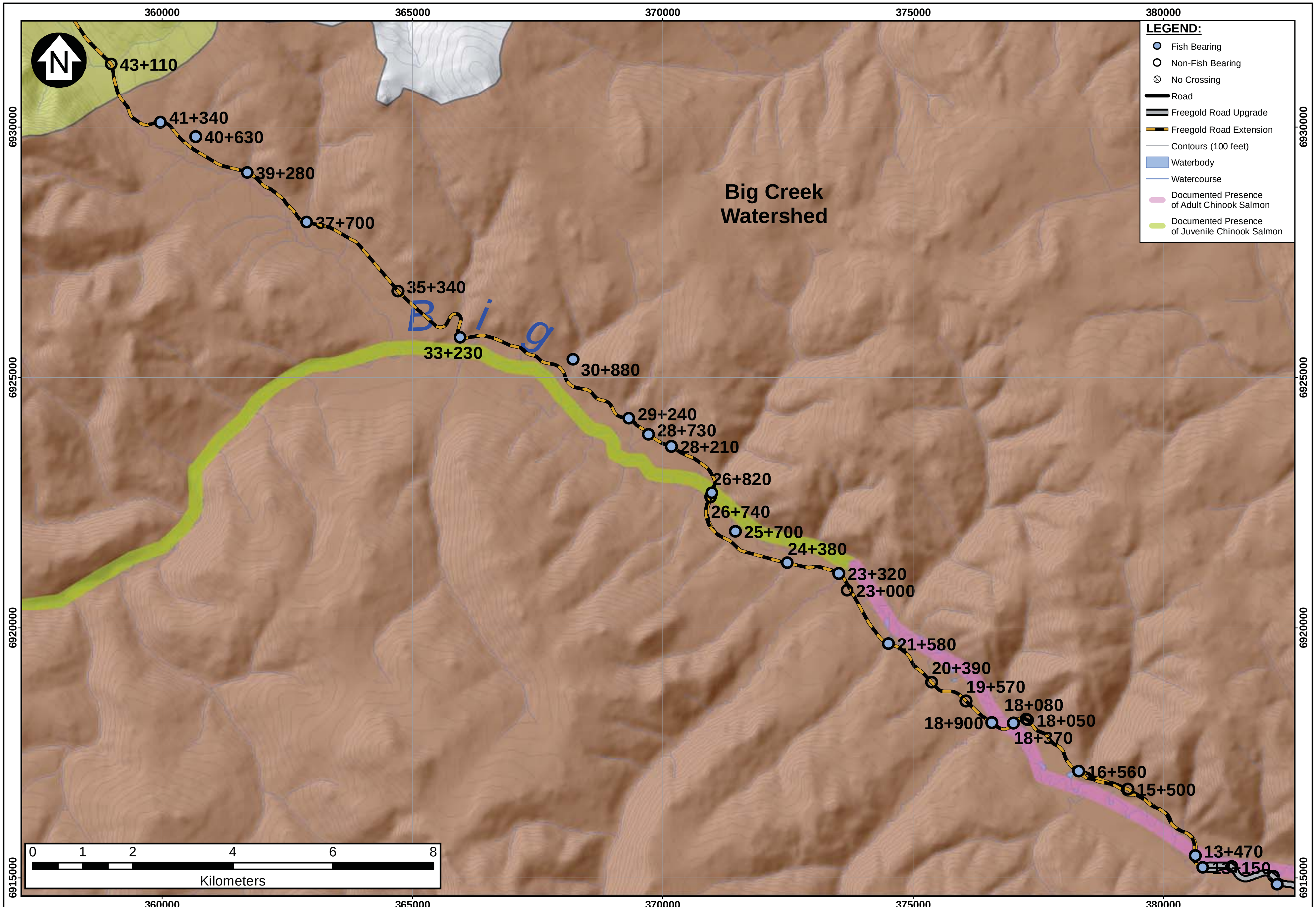
NOTES:
1. BASE MAP: Digital Elevation Model and 1:250,000 and 1:50,000 Topographic Spatial Data provided by Geomatics - Yukon Government via online source (www.geomaticsyukon.ca)
2. PROJECTION: NAD 1983 UTM Zone 8N
3. COORDINATE GRID: METRES
4. SCALE: 1:100,000
5. Documentation of presence of adult and juvenile chinook salmon provided by DFO (1985), DFO (1994), Summit (2011) and EDI (2011)

CASINO

CASINO PROJECT

Freegold Road Upgrade Fish Presence / Absence (Map 3)

FIGURE A.10.4-4



PREPARED BY:

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

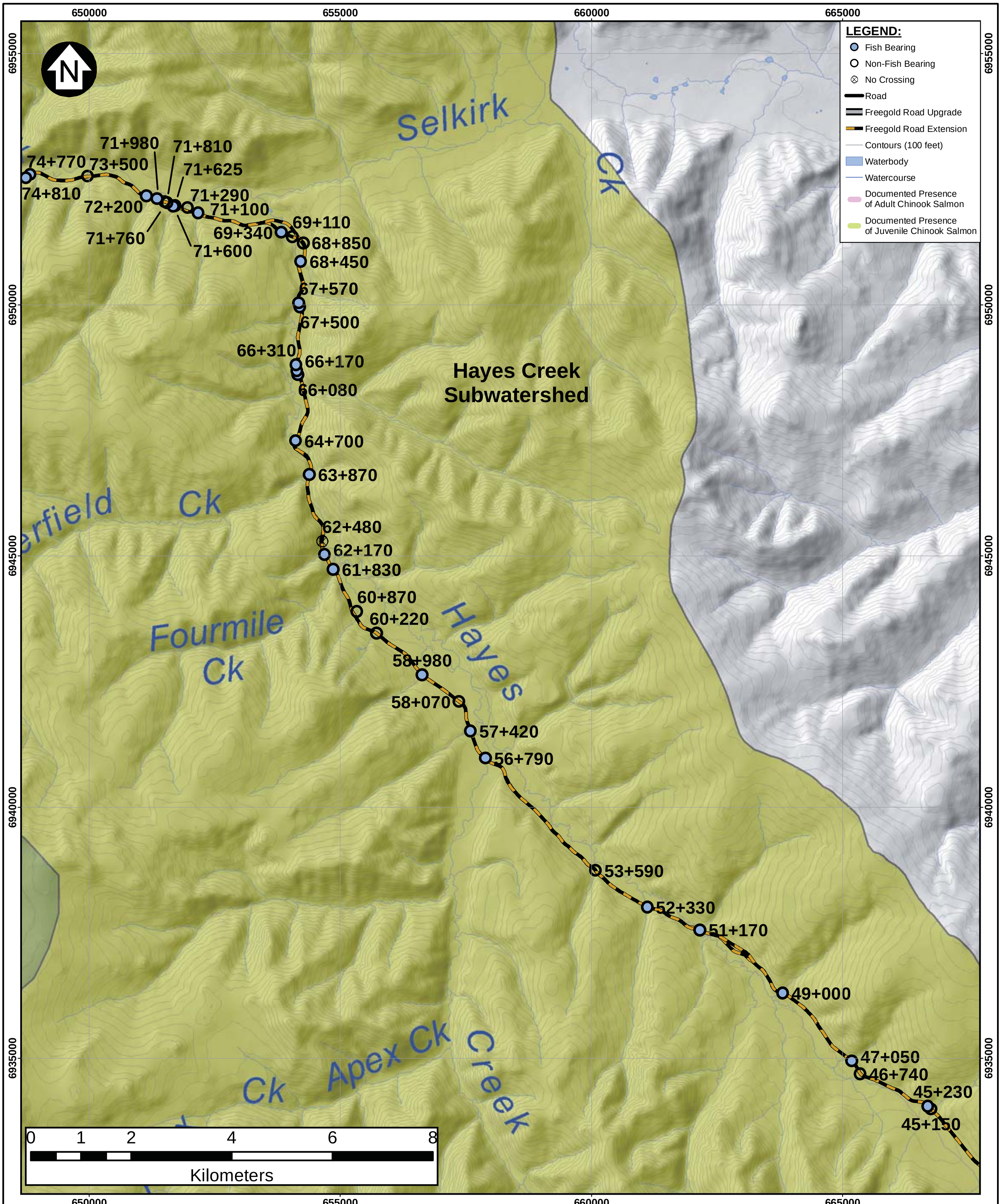
DESIGNED	D. Turner
DRAWN	D. Turner
CHK'D	J. Cole
APP'D	J. Cole
REV	R. Palmer
DATE	28Oct'14

NOTES:
1. BASE MAP: Digital Elevation Model and 1:250,000 and 1:50,000 Topographic Spatial Data provided by Geomatics - Yukon Government via online source (www.geomaticsyukon.ca)
2. PROJECTION: NAD 1983 UTM Zone 8N
3. COORDINATE GRID: METRES
4. SCALE: 1:100,000
5. Documentation on the presence of adult and fry/juvenile chinook salmon provided by DFO (1985), DFO (1994), Summit (2011) and EDI (2011)

CASINO PROJECT

Freegold Road Extension Fish Presence / Absence (Map 1)

FIGURE A.10.4-5



PREPARED BY:

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

DESIGNED	D. Turner
DRAWN	D. Turner
CHK'D	J. Cole
APP'D	J. Cole
REV	R. Palmer
DATE	28Oct'14

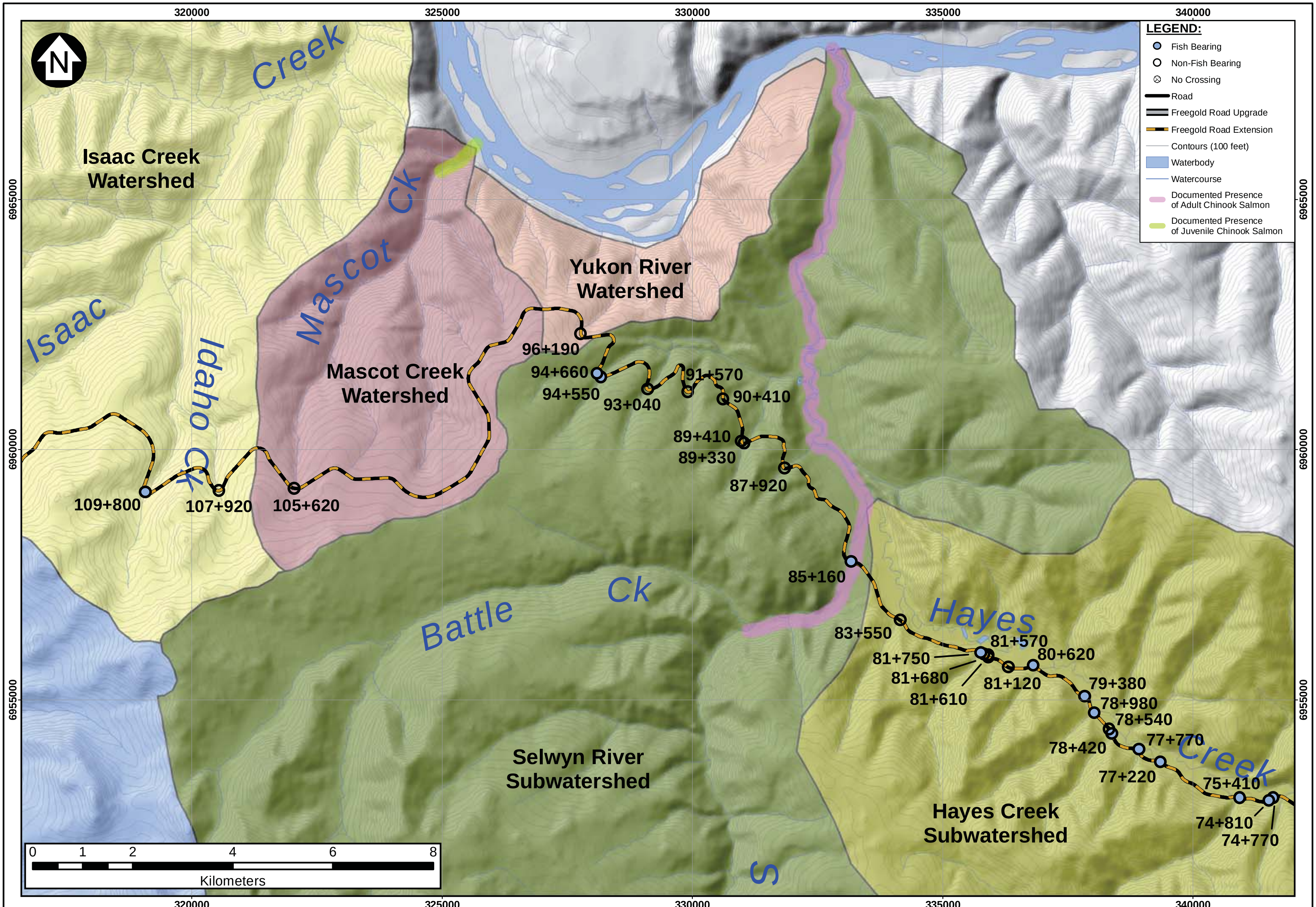
NOTES:
1. BASE MAP: Digital Elevation Model and 1:250,000 and 1:50,000 Topographic Spatial Data provided by Geomatics - Yukon Government via online source (www.geomaticsyukon.ca)
2. PROJECTION: NAD 1983 UTM Zone 7N
3. COORDINATE GRID: METRES
4. SCALE: 1:100,000
5. Documentation on the presence of adult and fry/juvenile chinook salmon provided by DFO (1985), DFO (1994), Summit (2011) and EDI (2011)

CASINO

CASINO PROJECT

Freegold Road Extension Fish Presence / Absence (Map 2)

FIGURE A.10.4-6



PREPARED BY:

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

DESIGNED	D. Turner
DRAWN	D. Turner
CHK'D	J. Cole
APP'D	J. Cole
REV	R. Palmer
DATE	28Oct'14

NOTES:

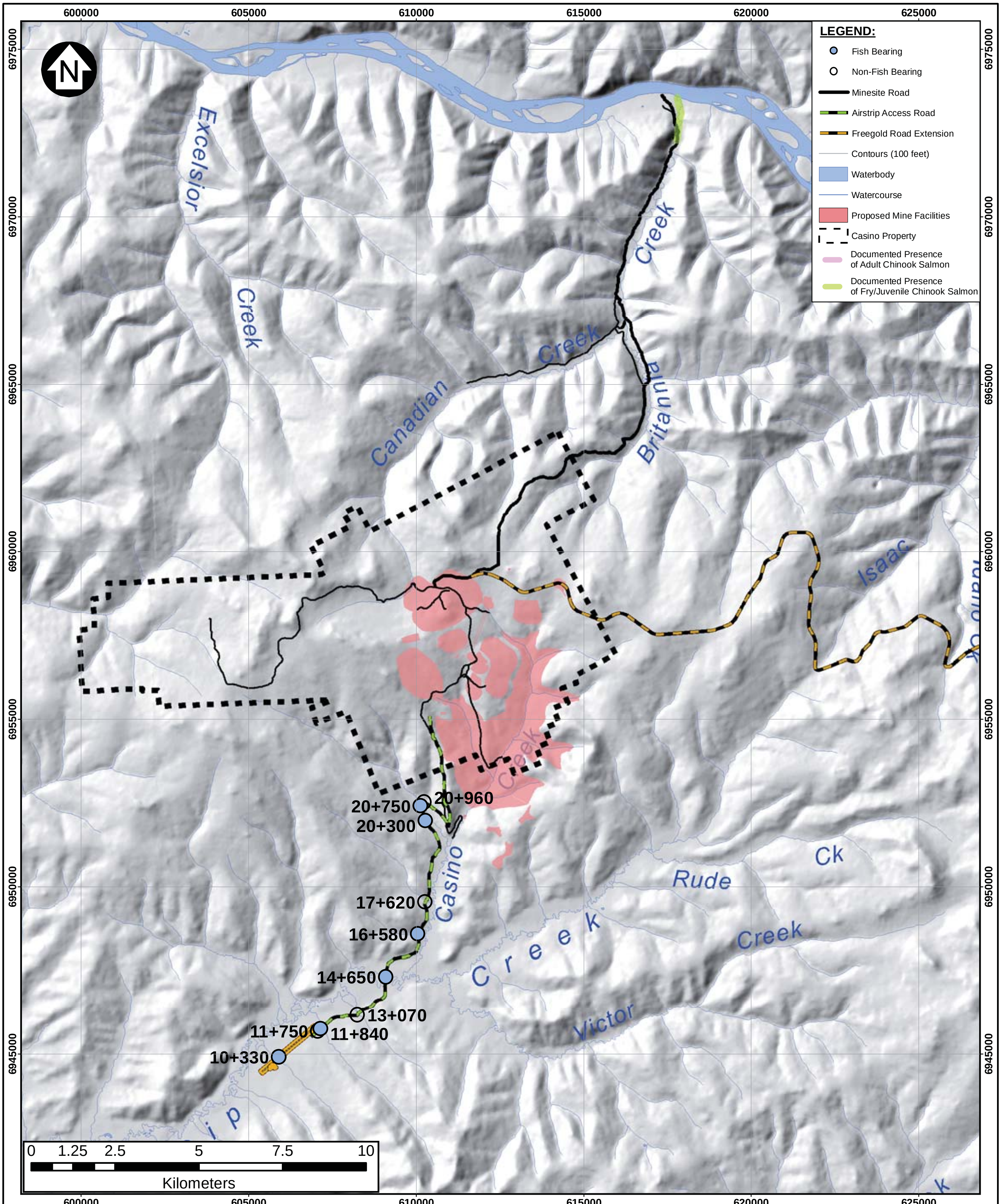
1. BASE MAP: Digital Elevation Model and 1:250,000 and 1:50,000 Topographic Spatial Data provided by Geomatics - Yukon Government via online source (www.geomaticsyukon.ca)
2. PROJECTION: NAD 1983 UTM Zone 8N
3. COORDINATE GRID: METRES
4. SCALE: 1:100,000
5. Documentation on the presence of adult and fry/juvenile chinook salmon provided by DFO (1985), DFO (1994), Summit (2011) and EDI (2011)

CASINO

CASINO PROJECT

Freegold Road Extension Fish Presence / Absence (Map 3)

FIGURE A.10.4-7



PREPARED BY:

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

DESIGNED	D. Turner
DRAWN	D. Turner
CHK'D	J. Cole
APP'D	J. Cole
REV	R. Palmer
DATE	28Oct'14

NOTES:
1. BASE MAP: Digital Elevation Model and 1:250,000 and 1:50,000 Topographic Spatial Data provided by Geomatics - Yukon Government via online source (www.geomaticsyukon.ca)
2. PROJECTION: NAD 1983 UTM Zone 7N
3. COORDINATE GRID: METRES
4. SCALE: 1:150,000
5. Documentation of the presence of adult and fry/juvenile chinook salmon provided by DFO (1985), DFO (1994), Summit (2011) and EDI (2011)

CASINO

CASINO PROJECT

Airstrip and Airstrip Access Road Fish Presence / Absence

FIGURE A.10.4-8

A.10.4.1.3 R277

R277. Maps demonstrating fish presence, assumed absence, or observed absence by stream segment. Include the stream channel intersected by the proposed airstrip, Casino Creek tributaries such as Taylor Creek, and the Freegold Road. Where fish are assumed as absent, provide rationale.

Fish species presence/absence, fish bearing designations, habitat information, and identified barriers or seasonal impediments in watercourses directly adjacent to the mine site are provided in Figure A.10.4-9. Fish bearing designations for each watercourse crossing along the proposed road routes and the Chinook salmon distribution are provided in Figure A.10.4-2 through Figure A.10.4-8. Detailed fisheries information for each watershed near the mine site was summarized in Appendix 10A, with annual data reports provided as appendices A1 – A5 of the Water and Sediment Quality Baseline Report (Appendix 7A), which correspond to appendices A through F of the Fish and Aquatic Resources Baseline Report (Appendix 10A).

Fish bearing status was determined for all watercourses around the Project study area. In upper Canadian Creek fish bearing status was assessed following the identification of a high gradient cascade which was deemed a probable barrier to fish migration (Appendix 10A, p.13). The noted barrier was a stream segment greater than 20% gradient, with no upstream perennial habitat, and no fish were captured in upstream areas over multiple seasons and years of sampling using two fishing methods (Table A.10.4-1). Assessment methods followed the standards established by the BC Ministry of Forests (BC MoF 1998). Habitat upstream of the barrier was assessed for deep pools or other habitat with potential to support overwintering fish. As the Casino project is situated in an un-glaciated area of the Yukon, no lakes are present.

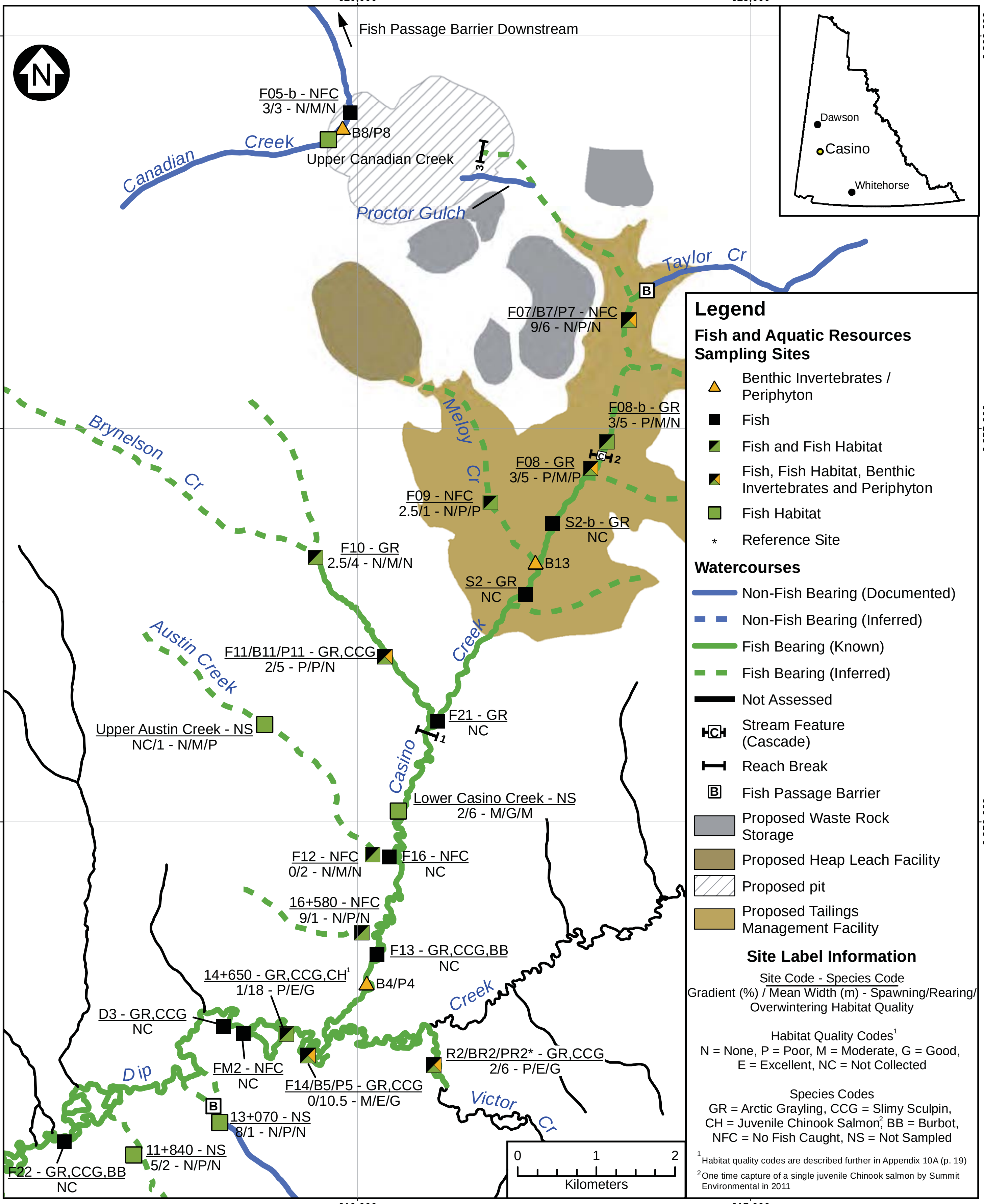
Table A.10.4-1 Fish Sampling Effort above an Identified Barrier (2008-2010)

Location	Barrier Location	Site	Reach	Date	Method	Electrofishing				Minnow Trapping	
						Section Length (m)	# Passes	Voltage (V)	Effort (s)	# Traps	Effort (h)
Canadian Creek, Britannia Creek Watershed	609,391 6,960,354	F05	3	9-Jul-08	EF	226	1	5505	577	-	-
				11-Jul-08	MT	-	-	-	-	3	72
		F05-b		12-Aug-10	EF	250	1	270-437	1278	-	-
				10-Aug-10	MT	-	-	-	-	2	83
								TOTAL	**1855**		**155**

Notes:

1. Method: EF – electrofishing; MT – minnow trapping

As stated in the response for R275, Taylor Creek was assessed as part of the Upper Casino Creek Habitat Evaluation Procedure (HEP) study (Appendix A.10B). During this assessment, a fish barrier was identified on Taylor Creek approximately 275 m upstream of its confluence with Casino Creek. The barrier consisted of multiple vertical drops (0.35-0.8 m to estimated bankfull) with insufficient bankfull pool depths for Arctic grayling passage, as Arctic grayling require a minimum pool depth of 1.25x the vertical drop in order to surmount vertical barriers (Parker 2000). Fish sampling was conducted above the barrier in summer 2014 to further document and verify an absence of fish in Taylor Creek. No fish were caught using two sampling methods (overnight minnow trap sets and 587s of electrofishing) during late July 2014.



PREPARED BY:

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

DESIGNED	D. Turner
DRAWN	D. Turner
CHK'D	A. Murdoch
APP'D	M. Quach
REV	R. Palmer
DATE	19Feb'15

NOTES:
1. BASE MAP: Digital Elevation Model and 1:250,000 and 1:50,000 Topographic Spatial Data provided by Geomatics - Yukon Government via online source (www.geomaticsyukon.ca)
2. PROJECTION: NAD 1983 UTM Zone 7N
3. COORDINATE GRID: METRES
4. SCALE: 1:65,000

CASINO

CASINO PROJECT

Casino Creek Fish and Aquatic Resources Baseline Summary Map

FIGURE A.10.4-9

For the Freegold Road Baseline Report (Appendix 10B), a wider variety of fish barrier definitions was used, including:

- Stream gradients over 20% with no perennial fish habitats available upstream (BC MoF 1998);
- Dry ephemeral stream sections only providing short-term run off during high precipitation or melt events;
- Underground flows noted preventing fish passage;
- Artificial barriers such as perched culverts or metal grates preventing fish access; and
- Vertical drops noted with insufficient pool depth to allow fish surmounting to upstream areas. Arctic grayling require a minimum pool depth of 1.25x the vertical drop (Parker 2000).

Following this assessment, crossings determined to be non-fish-bearing were identified, and are summarized in Table A.10.4-2 along with rationale for the determination. Crossing locations are provided in Figure A.10.4-2 through Figure A.10.4-8.

Table A.10.4-2 Rationale for Non-Fish-Bearing Status along the proposed Freegold Upgrade, Extension, and Airstrip and Airstrip Road

Crossing #	Rationale for Non Fish Bearing Status
Freegold Upgrade Section:	
29N	Creek flows underground downstream of crossing due to major channel disturbance
39	Dry ephemeral
39.5	Stream is not permanent and contains a series of ponds and intermittent short connector channels which originate from groundwater pool 20m above crossing
47	Dry ephemeral channel with perched culvert
48.5	Dry ephemeral channel with perched culvert
50.5	Bog habitat separated from Big Creek side channel with metal grate
Freegold Extension Section:	
15+500	dry ephemeral
19+570	disconnected shallow oxbow marsh
20+390	very small turbid runoff, channel not well defined
22+960	dry intermittent, no connection to Big Creek downstream
23+000	dry intermittent, no connection to Big Creek downstream
26+740	no visible channel, standing pools of water without connector streams
35+340	dry ephemeral
43+110	stream is not permanent: flow goes underground and dries up in several areas downstream of crossing
45+150	dry ephemeral
53+590	underground flow, small poorly defined channel, muddy flow
58+070	dry ephemeral upstream, flow goes underground downstream
60+220	stream not permanent, low flow barriers noted both upstream and downstream of crossing
60+870	dry ephemeral
69+110	dry ephemeral
71+290	no defined channel, very low flow grass swale
73+500	high gradient low flow channel (18% at crossing), 1m vertical drop noted with bankfull depth <0.4m
81+120	dry ephemeral

Crossing #	Rationale for Non Fish Bearing Status
81+570	small shallow muddy poorly defined channel, no direct fish habitat
81+680	small shallow poorly defined intermittent channel over shallow permafrost; goes underground upstream
81+610	small shallow poorly defined channel not providing direct fish habitat
83+550	gradient >20%, vertical 1m drop downstream of crossing
87+920	gradient >30% at crossing
89+330	gradient 21% at crossing
89+410	gradient 23% at crossing
90+410	gradient 50% at crossing
91+570	gradient 25% at crossing
93+040	gradient 35% at crossing
96+190	gradient 20% at crossing
107+920	downstream gradient barrier 28%
Airstrip Section:	
11+750	intermittent flow; stagnant disconnected puddles
13+070	29% gradient drop downstream of crossing
17+620	small shallow muddy flow, goes underground downstream of crossing
20+960	no surface flow downstream of crossing

A.10.4.1.4 R278

R278. Maps demonstrating fish habitat quality and fish distribution by species for watercourses including Casino Creek and its tributaries, Dip Creek downstream of its confluence with Casino Creek, and Britannia Creek and its tributaries. Include any seasonal barriers to movement.

See response to R277 above, specifically Figure A.10.4-9. No similar figures have been made for the Britannia Creek watershed, however, fisheries information for this watershed is provided in detail in Appendix 10A (P.29-30, 37-38), and in all of the annual reports which are provided as sub-appendices. In addition, the Yukon Placer Secretariat has fish habitat suitability maps available for the entire RSA found at http://www.yukonplacersecretariat.ca/.

A.10.4.1.5 R279

R279. A table or other tool identifying the location in the proposal of supporting baseline information for each of the potentially impacted watercourses.

The Fish and Aquatic Resources Baseline Reports for the mine site and road routes were provided as Proposal Appendices 10A and 10B, respectively. The Baseline Reports were generally presented in comprehensive sections (e.g., benthic invertebrates and periphyton, fish community composition, or fish habitat) and not by watercourse; however watershed specific details and summaries are provided in Table A.10.4-3.

Table A.10.4-3 Fisheries Baseline Information Locater

Watershed	Creek	Proposal Document	Pages
Casino	Casino and tributaries (Austin, Brynelson, Meloy, Taylor, Proctor Gulch)	Appendix 10A	Fish community: 28-29; watershed summary: 36-37
Dip	Dip	Appendix 10A	Fish community: 29; spawning survey: 30, watershed summary: 37
Victor	Dip	Appendix 10A	Fish community: 30; site summary: 38
Britannia	Britannia	Appendix 10A	Fish community: 29; spawning survey: 30; watershed summary: 37-38
Britannia	Canadian	Appendix 10A	Fish community: 29; barrier assessment: 30; watershed summary: 37-38
Coffee	Coffee	Appendix 10A	Fish community: 30; site summary: 38
Isaac	Isaac	Appendix 10B	30, 36
Mascot	Mascot	Appendix 10B	30, 36
Selwyn	Selwyn	Appendix 10B	28-29,35-36
Hayes	Selwyn	Appendix 10B	26-28, 35
Big	Big and tributaries (Seymour, Bow)	Appendix 10B	21-26, 34-35
Crossing	Crossing	Appendix 10B	20-21, 34
Murray	Murray	Appendix 10B	19, 34
Nordenskiold	Nordenskiold	Appendix 10B	18-19, 34
Dip	Dip, Casino Creek unnamed tributaries, and unnamed tributaries associated with the airstrip and road	Appendix 10B	30-32, 36, 52, 53

A.10.4.1.6 R280

R280. Information on the time of year each of the water bodies potentially affected by the Project are likely to be used by the various life stages of each fish species.

See response R276 for the life stages and distribution of the various fish species present in the Project area.

A.10.4.2 Missing Appendices Documenting Baseline Data

A.10.4.2.1 R281

R281. Appendices A through E for Appendix 10 A – Casino Project Fish and Aquatic Resources Baseline Report, November 12, 2013, by Palmer Environmental Consulting Group Inc.

Appendices A through F of the Fish and Aquatic Resources Baseline Report (Appendix 10A) were provided as Appendix A1 – A5 of the Water and Sediment Quality Baseline Report (Appendix 7A) and are not provided herein, but can be found in the Proposal.

A.10.5 HABITAT LOSS, ALTERATION AND COMPENSATION

A.10.5.1 Flow and Wetted Area Reduction

A.10.5.1.1 R282

R282. A description of the detailed methods used to calculate the estimated reductions in flow and wetted area from baseline conditions in all watercourses affected. (EcoMetrix)

The fish habitat evaluation procedures are summarized in the *Fish Habitat Evaluation: Instream Flow and Habitat Evaluation Procedure Study* provided in Appendix A.10B. Predictions of reductions in wetted widths and flows and associated error measurements are a product of the PHABSIM analysis, in conjunction with hydrological data obtained at site, and through long term projections provided by Knight Piésold (Appendix A.10B Section 3.1, p. 12-25) and Appendix 7H.

A.10.5.1.2 R283

R283. An indication of and rationale for the selected minimum in-stream flow threshold. (EcoMetrix)

Results produced do not recommend a single minimum in-stream threshold to avoid possible disturbance to fish and aquatic organisms, but rather generate a total area of habitat which is useable to the species and life stage modelled, at each modelled discharge. Information pertaining to potential low-flow risks in Casino Creek, such as fish stranding and effects on overwintering habitat are addressed in subsequent sections under R285 and R287.

A.10.5.1.3 R284

R284. The full documents cited as KPL 2013 and Normandeau, November 2013. (EcoMetrix)

The documents cited as KPL 2013 and Normandeau, November 2013 have been consolidated into the *Fish Habitat Evaluation: Instream Flow and Habitat Evaluation Procedure Study* provided in Appendix A.10B.

A.10.5.1.4 R285

R285. A discussion of the extent to which the identified overwintering and spawning habitat in the affected portion of Casino Creek is actively used by Arctic grayling for these stages, and the potential effects of the Project to this habitat.

Direct assessments of Arctic grayling overwintering and spawning habitat in Casino Creek have not been conducted; however, habitat assessments and summer sampling provide some information regarding the extent that these habitats support spawning and overwintering activities.

As stated in the Fish and Aquatic Resources Baseline Report (Appendix 10A, p.19), spawning and overwintering habitat potential was evaluated and rated using field-collected habitat data. Habitat ratings from highest to lowest were excellent, good, moderate, poor and none (Table A.10.5-1). For example, a site with no deep pools (>1 m) was considered to have no overwintering habitat. Spawning habitat potential was based on channel morphology, flow, depth, and substrate. For example, sites with 10 - 20% of preferred small gravel substrate were generally classified as moderate, whereas sites with <10% of small gravel were considered poor. Sites which were lacking small gravel substrate or low gradient riffle habitat, or were heavily dominated by fines or boulder substrate (>70% of total area) were generally considered to have no spawning potential. More detailed habitat assessments were completed in reaches 1 and 2 of Casino Creek as part of the in-stream flow and habitat evaluation studies (Appendix A.10B). Data recorded on suitable substrate, flow and depths were used to determine spawning habitat availability in these reaches. Habitat assessment results in Casino Creek indicated that 16% of reach 1 provided potential spawning habitat, whereas reaches 2 and 3 had virtually none (Appendix 10A, p.34). Furthermore, no young-of-the-year Arctic grayling have been captured in Casino Creek, suggesting that any spawning activities which do occur may be minimal.

Table A.10.5-1 Fish Habitat Sites and Habitat Quality Assessment

<table>
<tr><th rowspan="2">Watershed</th><th rowspan="2">Creek</th><th rowspan="2">Reach</th><th rowspan="2">Site</th><th rowspan="2">Description</th><th rowspan="2">Fish Species Caught</th><th colspan="3">Habitat Quality</th></tr>
<tr><th>Spawning</th><th>Rearing</th><th>Over-wintering</th></tr>
<tr><td rowspan="6">Britannia</td><td rowspan="5">Canadian</td><td>3</td><td>Upper Reach of Canadian Creek</td><td>Above cascade barrier (>20% gradient)</td><td>NFC</td><td>N</td><td>M</td><td>N</td></tr>
<tr><td>2</td><td>F04</td><td></td><td>GR</td><td>N</td><td>M</td><td>N</td></tr>
<tr><td>1</td><td>Placer Mine on Canadian Creek</td><td>Downstream end of placer mining area</td><td>GR</td><td>P</td><td>M</td><td>N</td></tr>
<tr><td>1</td><td>Lower Reach of Canadian Creek</td><td>Downstream of placer mining activity</td><td>GR</td><td>M</td><td>M</td><td>P</td></tr>
<tr><td>1</td><td>F03</td><td>Just upstream of confluence with Britannia Creek</td><td>GR</td><td>M</td><td>M</td><td>N</td></tr>
<tr><td>Britannia</td><td>1</td><td>Lower Reach of Britannia Creek</td><td>Upstream of F01</td><td>GR, CCG, CH</td><td>M</td><td>G</td><td>M</td></tr>
<tr><td rowspan="10">Casino</td><td rowspan="3">Casino</td><td>3</td><td>F07</td><td>In proposed TMF</td><td>NFC</td><td>N</td><td>P</td><td>N</td></tr>
<tr><td>3</td><td>(F08-b) Upper Reach of Casino Creek</td><td>In proposed TMF</td><td>GR</td><td>P</td><td>M</td><td>N</td></tr>
<tr><td>2</td><td>F08</td><td>In proposed TMF</td><td>GR</td><td>P</td><td>M</td><td>P</td></tr>
<tr><td>Meloy</td><td>n/a</td><td>F09</td><td>In proposed TMF</td><td>NFC</td><td>N</td><td>P</td><td>P</td></tr>
<tr><td rowspan="2">Brynelson</td><td>2</td><td>(F10) Upper Reach of Brynelson Creek</td><td></td><td>GR</td><td>N</td><td>M</td><td>N</td></tr>
<tr><td>1</td><td>(F11) Lower Reach of Brynelson Creek</td><td></td><td>GR, CCG</td><td>P</td><td>P</td><td>N</td></tr>
<tr><td>Casino</td><td>1</td><td>Lower Reach of Casino Creek</td><td>Upstream of site F16</td><td>GR, CCG, BB</td><td>M</td><td>G</td><td>M</td></tr>
<tr><td rowspan="2">Austin</td><td>2</td><td>Upper Reach of Austin Creek</td><td></td><td>NFC</td><td>N</td><td>M</td><td>P</td></tr>
<tr><td>1</td><td>(F12) Lower Reach of Austin Creek</td><td></td><td>NFC</td><td>N</td><td>M</td><td>N</td></tr>
<tr><td colspan="8" style="display:none"></td></tr>
<tr><td rowspan="2">Dip</td><td>Victor</td><td>n/a</td><td>R2*</td><td>Reference site</td><td>GR, CCG</td><td>P</td><td>E</td><td>G</td></tr>
<tr><td>Dip</td><td>n/a</td><td>F14</td><td></td><td>GR, CCG, RW</td><td>M</td><td>E</td><td>G</td></tr>
<tr><td>Coffee</td><td>Coffee</td><td>n/a</td><td>F19*</td><td>Reference site</td><td>GR,RW</td><td>P</td><td>G</td><td>P</td></tr>
</table>

Notes:

1. n/a = not applicable; *Reference site; Parentheses indicate proximate fish sampling site; NFC=No fish caught; GR=Arctic Grayling; CCG=slimy sculpin; CH=juvenile Chinook salmon; BB=burbot; N=None; P=Poor; M=Moderate; G=Good; E=Excellent

Overwintering habitat quantity and quality will vary from year to year and is difficult to measure based on summer conditions alone. In addition to water depth, it will depend on various factors including air temperatures, groundwater, and the timing and nature of ice and snow cover. It is apparent from habitat and fish surveys that reaches 2 and 3 of Casino Creek provide little to no overwintering based on the lack of deep pools (>1 m), the observation of anchor ice during winter, and the absence of resident fish species such as slimy sculpin. However, some deep pools have been noted in Casino Creek reach 1, and were estimated to make up approximately 20% of the total area at the lower Casino Creek fish habitat site. The presence of slimy sculpins in lower Casino Creek further indicates that there is sufficient water within this reach to maintain fish populations year-round. Thus, it is likely that depending on the year, there remains sufficient pool depths to also harbour Arctic grayling overwinter.

PHABSIM analysis provides additional insight into the potential for fish overwintering in Casino Creek. Analysis results of the winter Arctic Grayling habitat indicated that high flows would be required to create depths necessary for significant suitable habitat (pages 52-54, Appendix A.10B). Since those flows do not occur in the wintertime, the PHABSIM analysis indicates that there is only minimal winter habitat in Casino Creek (Table A.10.5-2). In order to further investigate the potential for isolated pockets of suitable habitat not captured by the PHABSIM transects and visually observe fish presence/absence, field observations were conducted in March 2013. Water was located beneath the ice cover at multiple locations in Casino Creek; however, no fish were observed using the underwater video camera. Table A.10.5-3 presents the observations from the March pool investigation in Casino Creek.

Multi-year baseline sampling in Casino Creek suggests that the primary use of the creek is by adult and sub-adult Arctic grayling for summer rearing activities. Further, Arctic grayling densities in Casino Creek are generally low, particularly in the upper watershed where habitat losses are expected. While it is difficult to predict how an increase in rearing habitat will offset any potential decreases in spawning and overwintering habitat, it is important to note that the potential and evidence for Arctic grayling spawning and overwintering in Casino Creek is low to moderate, as well as generally restricted to reach 1. Finally, the decrease in potential spawning habitat is included in the offsetting habitat budget which will contribute to provide a greater overall benefit to fisheries productivity in the local study area (Appendix A.10A). Based on our findings, effects to the limited spawning and overwintering habitat for Arctic grayling are anticipated to be minor or negligible.

Table A.10.5-2 Habitat Index values (m^2/s per 1000 m stream) versus flow for all life stages of Arctic grayling in Casino Creek including adult and juvenile winter values

Flow (m^3/s)	Adult Summer	Juvenile Summer	Fry	Spawning	Adult Winter	Juvenile Winter
0.1	2443	2404	1775	15	0.0	0.0
0.2	2693	2603	1190	156	0.0	0.0
0.3	2758	2590	835	433	0.0	0.0
0.4	2668	2460	662	667	0.0	0.0
0.5	2487	2273	546	818	0.0	0.0
0.6	2286	2079	455	922	0.0	0.0
0.7	2096	1899	401	999	0.0	0.0
0.8	1910	1726	358	1060	0.0	0.0
0.9	1742	1571	329	1111	0.0	0.0
1.0	1583	1430	304	1152	0.0	0.0
1.1	1446	1311	288	1182	0.0	0.0
1.2	1333	1206	280	1203	0.0	0.0
1.3	1235	1121	271	1214	0.0	0.0
1.4	1153	1047	256	1216	0.0	0.0

Flow (m^3/s)	Adult Summer	Juvenile Summer	Fry	Spawning	Adult Winter	Juvenile Winter
1.5	1078	979	240	1208	0.0	0.0
1.6	1011	919	222	1192	0.2	0.2
1.7	952	868	205	1164	0.9	0.8
1.8	897	819	193	1127	1.5	1.2
1.9	850	776	187	1082	1.9	1.6
2.0	803	734	183	1028	2.3	2.0
2.1	758	695	180	973	2.7	2.3
2.2	723	661	178	911	2.9	2.5
2.3	693	633	173	850	3.0	2.6
2.4	667	609	168	789	3.0	2.6
2.5	642	587	166	737	2.9	2.5
2.6	619	564	162	690	2.9	2.4
2.7	603	546	162	647	2.7	2.3
2.8	589	532	163	605	2.5	2.2
2.9	578	521	165	568	2.3	2.0
3.0	566	510	164	538	2.0	1.7

Table A.10.5-3 Results of the March 2013 Pool Investigations in Casino Creek

Site #	Coordinates	Total Depth (m)	Ice Thickness (m)	Cover	Dissolved Oxygen (mg/L)	Temp. (^oC)	Fish Present?
1	7V 609835 947576	1.14	0.53	LWD	9.84	-0.10	N
2	7V 609854 6947610	1.13	0.27	None	9.85	-0.12	N
3	7V 609856 6947651	0.83	0.18	LWD	10.20	-0.11	N
4	7V 609977 6947745	1.12	0.78	None	9.36	-0.12	N
5	7V 609958 6947779	1.24	0.73	NA	10.40	-0.14	N
6	7V 610078 6947889	0.82	0.82	NA	NA	NA	NA
7	7V 610211 6948518	0.69	0.41	None	11.15	-0.13	N
8	7V 610213 6948496	1.09	0.71	None	11.20	-0.12	N

Notes:

1. NA – Not Available due to shallow depth
2. WD – Woody Debris – mix of large and small sized debris
3. LWD – Large Woody Debris

A.10.5.2 Tailings Management Facility Fish Barrier

A.10.5.2.1 R286

R286. A discussion of the potential fish barrier proposed to be installed above the Casino- Brynelson Creek confluence. This discussion should include:

a. a description of the barrier proposed, and details regarding its installation; and

b. identification of alternative mitigations to the physical fish barrier in this location to prevent winter kill and fish stranding.

A drop fish barrier is proposed on Casino Creek, just upstream of its confluence with Brynelson Creek to prevent fish from becoming stranded in the low-flow TMF discharge channel. A basic design for a drop barrier consists of a vertical concrete wall that rises 2 m above a concrete apron on the channel bottom (Figure A.10.5-1). The crest wall typically follows the configuration of the channel bottom so that a 2 m drop extends across the entire channel bottom. The apron is designed to produce uniform water velocities that exceed fish swimming abilities, thereby precluding upstream passage. The vertical height of the barrier exceeds the leaping abilities of fishes when combined with the shallow, fast-flowing water over the apron. At high discharges, effectiveness of the vertical barrier will be lost in the center of the channel as water depths increase, but the vertical drop will be maintained at the edges of the floodwaters where current velocities are lowest. Upstream movements of fishes during floods are not expected in mid-channel because of high current velocities and sediment loads, but potential movements along the edges of floodwaters will be prevented by the maintained vertical drop.

Drop fish barriers have been used extensively by the US Department of Interior, Bureau of Reclamation as a method to protect native fish species from non-native species. Typical lifespan of such structures in the U.S. is approximately 100 years, with regular maintenance.

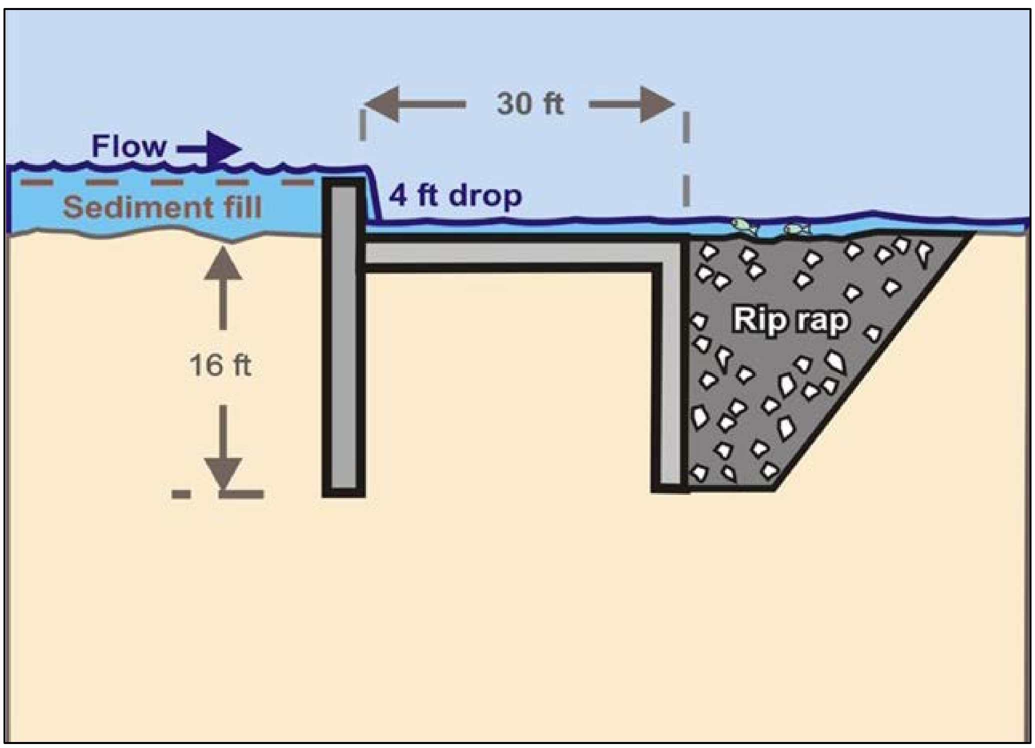


Figure A.10.5-1 Proposed drop fish barrier structure downstream of the TMF on Casino Creek

Additional mitigation measures may be considered if concerns arise surrounding the proposed physical barrier. CMC will develop and implement an adaptive monitoring plan that evaluates the effectiveness of the barrier, with the inclusion of triggers for implementing further mitigation measures to protect resident fishes. Other mitigation that may be considered may include other physical deterrents or flow management strategies.

A.10.5.2.2 R287

R287. The degree of risk for fish stranding to actually occur in Casino Creek due to low water flow attributed to the operation of the tailings management facility.

Fish passage capability can be determined by plots of riffle water surface elevations (Appendix A.10B) and depths at low flow levels. Figure A.10.5-2 depicts the average summer flow and winter flow water surface elevations for baseline, construction, operation, closure, and post-closure conditions at low gradient riffle 182 in Casino Creek Reach 1. LGR182 is the shallowest riffle transect in Casino Creek. Although fish migration was not specifically evaluated, Figure A.10.5-2 and Appendix A.10B indicates that sufficient flow will be maintained in Casino Creek to allow for fish passage in both seasons with projected riffle depths of 18 cm and 9 cm in summer and winter, respectively. In Appendix A.10B, riffle plots in Casino Creek are shown for the month of September, which is typically the month of seasonal low flow during the ice-free season. The highest flow alteration occurs in the summer season and the lowest flows occur in the winter season. The stream will be ice covered in the winter season with little fish movement; however, the winter season graph represents the lowest flow period. Very little off-channel habitat exists in Casino Creek and it was not evaluated due the paucity of this type of habitat.

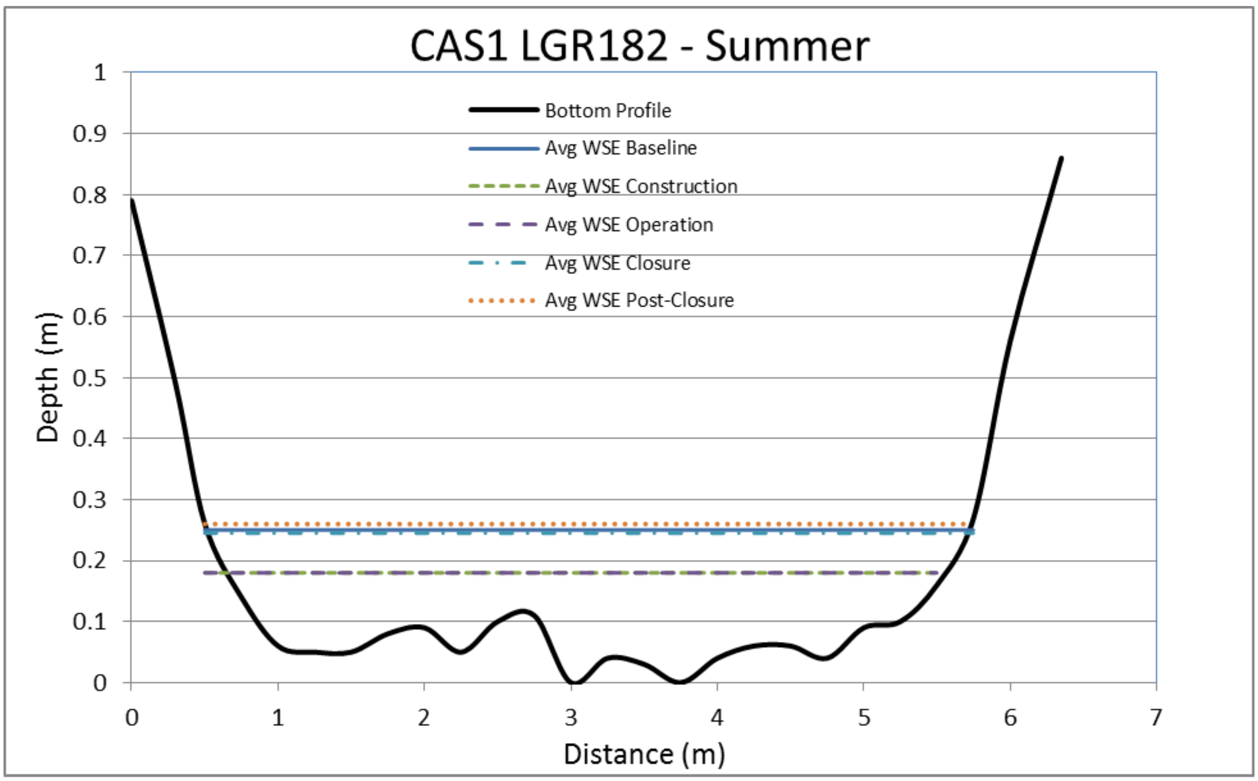


Figure A.10.5-2a Average summer water surface elevations (WSE) at Casino Creek low gradient riffle 182 during baseline, construction, operation, closure, and post-closure conditions

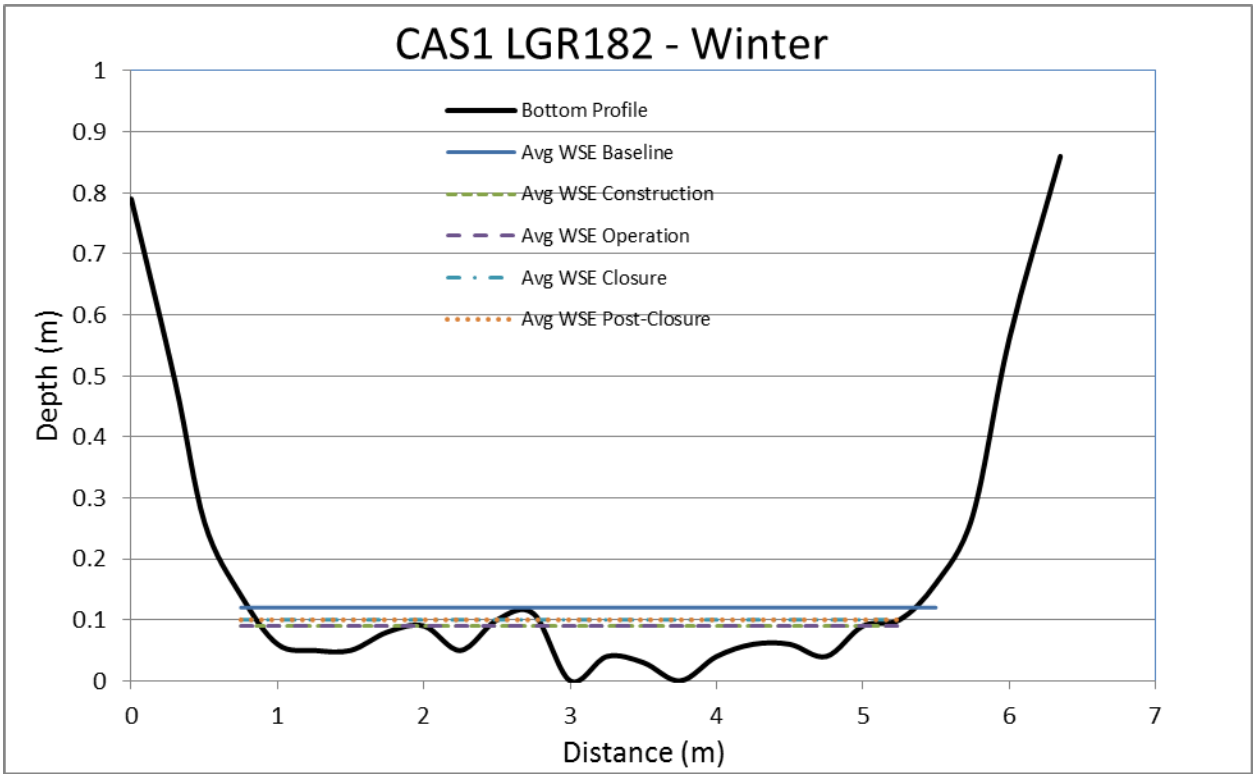


Figure A.10.5-2b Average winter water surface elevations (WSE) at Casino Creek low gradient riffle 182 during baseline, construction, operation, closure, and post-closure conditions

A.10.5.3 Airstrip Diversion Channel

A.10.5.3.1 R288

R288. A discussion of and rationale for the diversion of this drainage around the airstrip. This discussion should consider alternatives, such as allowing the drainage to pass underneath the airstrip.

The engineers are opposed to passing the tributary through a culvert beneath the airstrip because the underlying, ice-rich permafrost is susceptible to thawing while water flows across it. This could result in differential settlement and potentially blockages within the culvert. Additional maintenance would be required to ensure the airstrip surface is intact. In addition, it is likely that the culvert would become blocked with ice build-up in the winter, while cold air is able to penetrate and flow through the culvert. During the spring melt, ice blockages within the culvert could cause flooding upstream of the airstrip.

A.10.5.3.2 R289

R289. A discussion of the potential for seasonal stranding of fish in the lower portion of the dewatered channel.

The airstrip tributary is a very small channel, even at its mouth with Dip Creek. The HEP assessment carried out in July 2014 identified that under bankfull conditions, the lowermost 100m upstream from Dip Creek was on average 1.3m wide and 0.32m deep. Following the airstrip construction, all surface runoff within the creek and overland that reaches the airstrip will be diverted elsewhere, and thus the only source of water for the tributary downstream will be localized runoff from the floodplain and adjacent embankments. The small downstream tributary will receive negligible or minor flow along its approximately 500m length, reducing the drainage substantially from its already small size and likely precluding access to fish from Dip Creek. In addition, fish and fish habitat surveys completed in 2014 confirmed that the tributary had marginal fish habitat potential, and no fish were captured during a survey when conditions were most amenable to fish passage (See R275 for more detail).

A.10.5.4 Fisheries Protection Provisions of the Fisheries Act

A.10.5.4.1 R290

R290. An updated Fish Habitat Compensation Plan to align with the new requirements of the Fisheries Protection Provisions of the new Fisheries Act.

The initial plan submitted in the Proposal was to support DFOs review of the Proposal, with the understanding that a final detailed design for fish habitat offsetting was to be provided to DFO in association with CMC's subsequent request for *Fisheries Act* authorization. To reflect the changes to the *Fisheries Act*, as well as to update the plan with more detailed design and site selection techniques, CMC has provided the Fish Habitat Offsetting Plan (Appendix A.10A), which reflects the change in terminology of the new fisheries protection provisions.

A.10.5.5 Physical Habitat Simulation Model and Habitat Evaluation Procedure

A.10.5.5.1 R291

R291. A detailed description of the physical habitat simulation model. Details should include:

- **a. data used in the model (habitat and hydrological) and methods for field data collection;**
- **b. locations of all transects (of each mesohabitat type - riffle, pool and glide) on each watercourse;**
- **c. habitat suitability indices (HSI) curves for Arctic grayling in all life stages which consider site specific conditions;**
- **d. species and life stage periodicity chart highlighting the seasonal use of the study area by different life stages of the target species, and a discussion of whether migration patterns were considered in the model;**
- **e. discussion of whether seasonal use by life stage requirements of target species was considered in the model;**
- **f. target flow velocities for low, mid and high flows, with a comparison to the baseline and projected flows for construction, operation and closure phases, indicating and providing rationale for the selected minimum in-stream threshold;**
- **g. discussion of impacts to Britannia Creek from reduced flows in Canadian Creek as flow is redirected to the pit; and**
- **h. a comparison of percent reduction in flow for areas affected by reduced stream flows considering natural variability observed in stream.**

See Fish Habitat Evaluation: Instream Flow and Habitat Evaluation Procedure Study provided in Appendix A.10B.

A.10.5.5.2 R292

R292. A detailed description of the habitat evaluation procedure. Details should include:

- **a. methods and assumptions for the calculation of habitat lost;**
- **b. summary of HSI values for each variable;**
- **c. identification of and rationale for habitat types included; and**
- **d. data and methods used to calculate habitat gains, including from all proposed compensation options.**

See Fish Habitat Evaluation: Instream Flow and Habitat Evaluation Procedure Study provided in Appendix A.10B.

A.10.5.6 Habitat Loss Calculations – Airstrip Diversion Channel

A.10.5.6.1 R293

R293. Clarification of whether the estimated habitat loss in Dip Creek was accounted for in the total habitat loss calculation for the proposed airstrip tributary diversion channel.

The proposed diversion of the small tributary around the Airstrip shifts its confluence with Dip Creek approximately 3.8 km downstream. This shift is unlikely to result in any measureable or significant loss in habitat along this short section of Dip Creek, because the tributary contributes so little water to Dip Creek relative to its flow from upstream. The tributary's 10 km^2 drainage area is only 3% of the 334 km^2 drainage area of Dip Creek at the confluence with the tributary. The localized loss of flow along this short section of Dip Creek from 3% of its watershed would be unmeasurable and would have a negligible effect on available habitat. Flow conditions downstream of the new confluence would be unaffected.

Wetted habitat loss in Dip Creek due to construction of the TMF in Casino Creek is included in the total habitat loss calculation (Appendix A.10A).

A.10.5.6.2 R294

R294. Clarification of, and rationale for, the methods used to calculate the figures in Table 4-5: in-stream habitat impacts and in-stream habitat gains. This clarification should include the calculation of 4753 m² as identified in Table 4-5, based on the proposed airstrip diversion channel width of 2.5 m and length of 1 509 m.

The length of 1,509 m for the proposed Airstrip diversion channel is a typographical error, reflecting a former iteration of preliminary design configuration. The correct proposed length is approximately 1,901 m. The 4,753 m^2 of habitat indicated in Table 4-5 is correctly determined as the product of 2.5 m and 1,901 m. The updated Fish Habitat Offsetting Plan (Appendix A.10A) includes a fully updated impacts/gains table, including the application of a ‘reverse’ Habitat Evaluation Procedure (HEP) to habitat gains, where possible.

A.10.5.7 Habitat Evaluation Procedure Analysis

A.10.5.7.1 R295

R295. Clarification of whether the assumed fish bearing streams (those of less than 20 percent gradient) were included in the habitat evaluation procedure analysis for habitat loss and compensation.

All assumed fish bearing stream crossings were included in the total habitat loss calculations. Habitat losses were modelled using habitat evaluation procedure for all crossings containing suitable data for running the model.

A.10.5.8 Ford Rehabilitation

A.10.5.8.1 R296

R296. Identification and rationale for the type(s) of habitat created by ford restoration.

Details on the ford restoration in Britannia Creek is provided in Appendix A.10A. The abandoned fords were originally sited (by prospectors and placer miners) at naturally wide sections of the creeks, typically riffles, where flow depths are locally at a minimum. This eased periodic crossing by vehicles. Creation and persistence of habitat-benefiting deep pools at these natural widenings, where sediment deposition and accumulation predominate, would be inconsistent and incompatible with the natural morphology of the creeks. The intention of the preliminary design drawings is to emphasize the restoration of pre-existing channel form and function. This will generally involve localized removal of any fine sediments that have accumulated as a result of ford disturbance, returning the channel to its naturally wide, riffle morphology. Detailed design drawings will include site-specific guidance for sediment removal and preservation at each ford site.

A.10.6 WATERCOURSE CROSSINGS

A.10.6.1 Embedded Culverts on Fish Bearing Streams

A.10.6.1.1 R297

R297. Clarification of whether clear-span bridges are proposed for all fish-bearing watercourses. If culverts will be installed on some fish-bearing creeks, please provide rationale, mitigations, and incorporate habitat losses into the habitat compensation plan.

The Freegold extension section including the airstrip road is at feasibility level design and clear span bridges will be the preferred design at all fish bearing crossings. However, there will be some crossings not suitable for bridges (high fills, on sharp corners etc.) which will require another solution such as embedded culverts to be determined during detailed design. Any fish-bearing crossings requiring culverts will be designed to ensure fish passage and habitat losses will be assessed and offset accordingly. Currently, the Freegold Road Upgrade section is at the conceptual design stage. The Yukon Government will be providing the feasibility level design in the future which will clarify the location and type of crossing structures.

A.10.6.2 Existing Stream Crossings

A.10.6.2.1 R298

R298. Details on existing crossing structures no longer used for portions of the Freegold Road upgrade once the road is re-aligned.

As discussed in Section 4, the Freegold Road upgrade will be the responsibility of the Yukon Government (YG), pending an agreement with CMC and the First Nations on whose settlement land the Freegold Road crosses. CMC cannot comment on the work to be done by YG. Section A.4 outlines the discussions with YG on assessment of the Freegold Road upgrade through the YESAB process.

A.10.6.3 Nordenskiold River Bridge

A.10.6.3.1 R299

R299. Details on when and how the Nordenskiold River bridge pier will be constructed.

As discussed in Section 4, the Freegold Road upgrade, and the Carmacks bypass including construction of the Nordenskiold Bridge, will be the responsibility of the Yukon Government (YG), pending an agreement with CMC and the First Nations on whose settlement land the Freegold Road crosses. CMC cannot comment on the work to be done by YG, however, Section A.4 outlines the incorporation of the Freegold Road upgrade in the Proposal.

A.10.6.3.2 R300

R300. The quality and type of fish habitat (e.g. highly suitable spawning and/or rearing habitat, confirmed spawning habitat, and migratory channel) potentially affected by the Nordenskiold River bridge. Discussion should include identification of potential effects of the bridge and the pier, focusing on potential long-term morphological changes to the river in contrast to natural morphological changes.

The proposed Nordenskiold River Bridge is crossing number 1N on Figure A.10.4-2. As described in Appendix 10B (p.18-19), the proposed Nordenskiold River crossing has a wetted width of 53 m, an average depth of 1 m and a cobble dominated substrate. In-stream cover was low (<20%) and the channel gradient was low (2%) typical of large watercourses within the study area. The mean temperature as measured on August 9, 2013 was 15.9°C, which is warm for the Yukon River Basin but not uncommon in large watercourses.

In response to comments received during the adequacy review, a geomorphological impact assessment of the proposed Nordenskiold bridge pier was conducted using the following reference materials:

1. Historical photos of the Nordenskiold crossing;
2. Fluvial Geomorphology Hazard Assessment for Proposed Access Roads (Appendix 6E);
3. On-site field photos from 2013;
4. Google Earth imagery; and
5. Proposed bridge/pier design from *Casino Project Access Overview for Submission to YESAB* (Appendix 4B).

The proposed Nordenskiold River bridge crossing is immediately downstream of a tortuous meander that was cut-off (naturally) sometime between 1994 and 2008. A large, side- to mid-channel gravel bar formed in association with this cut-off as a result of localized erosion of the former meander 'neck'. This gravel bar has migrated and extended downstream slightly since the cut-off event, now forming a very thin bar along the channel centreline immediately upstream of the proposed crossing location. However, the bar has also shrunk appreciably as flows continue to erode its head and flanks. It is expected that continued erosion of the bar, with its current mid-channel position and full exposure to erosive flows, will remove it entirely within the next several years. The bar is thus a short-lived feature formed in direct response to the meander cut-off. Placement of the pier along the downstream limit of this thin, remnant bar is not recommended, from a fluvial geomorphological perspective, as the pier would likely be positioned in the thalweg in several years and be exposed to direct and regular impacts from rafted ice and large woody debris.

The currently proposed pier position is close to the west bank of the river, in a small 'alcove' between the main bank and a small side-channel bar (depositional area) immediately downstream, at a transition between the thalweg (on the east) and slackwater and possible back-eddy flow (on the west). The thalweg is expected to align itself closer to the channel centreline, over time, in response to continued erosion and removal of the mid-channel bar immediately upstream. Currently, the focus of erosion along the west bank, as a result of the meander cut-off and new meander pattern, is approximately 110 m upstream of the proposed pier position. The gradual alignment of the thalweg into the middle of the channel is expected to moderate and ultimately eliminate this western bank erosion, thus posing no risk to the pier position in the long-term.

The pier is anticipated to cause localized scour around and immediately downstream of its base, where flow velocities are concentrated and capable of eroding the gravelly to cobbly bed material. The pier will be constructed to withstand such scour. The head of the small side-channel bar immediately downstream may be 'trimmed' slightly by this localized scour, although the propensity for continued deposition in this point bar-like position is expected to maintain the bar and its role in protecting the west bank from significant erosion. Relatively little scour may occur around the west side of the pier, given how close it is to the west bank and its sheltering from the thalweg by the bar immediately downstream. A deep, yet small pool is expected to be formed and maintained on the east and downstream side of the pier, which may be attractive to fish species seeking deep water refuge. Ultimately, the pier is expected to cause very localized and minor changes in morphology, with no adverse effects on fish habitat or fisheries productivity.

The noted gravel bar is upstream from the currently proposed bridge alignment by 10 m. The bridge designers have chosen the proposed pier location to be as close to the normal high water mark as possible, essentially creating a clear span of the main river channel. This reduces the likelihood of debris accumulation and scour around the pier and also improves constructability by allowing easy access for pile driving equipment working from the shore. The pier is designed to take loads and impacts from ice and debris and is complete with a steel diaphragm connecting the 4 piles together that will distribute horizontal loads and prevent debris from catching between the pier piles.

The geomorphological assessment conducted also provided insight into the creation and stability of the noted gravel bar. Based on this assessment, it was not recommended to place the bridge pier on the eroding gravel bar as the pier would likely be positioned in the thalweg in several years and be exposed to direct and regular impacts from rafted ice and large woody debris.

It is expected that the proposed bridge site may support spawning and rearing habitat for any of the documented fish species in the river, including Chinook and Chum salmon. As depths are generally less than 1 m, it is unlikely that any overwintering habitat will be lost. As the total footprint of the bridge pier is small (6 m^2) relative to the estimated area of the river mainstem (estimated 1.43 km^2), it is anticipated that any potential impacts on fisheries productivity will be minor.

A.10.6.3.3 R301

R301. The fish species (and their life stages) present in the area potentially affected by the Nordenskiold River bridge. Discussion should include identification of potential effects of the bridge and the pier.

Fisheries baseline data on the area around the Nordenskiold Bridge is provided in Appendix 10B, pages 18-19 and 34.

As detailed in Section A.10.4.1.2:

- Big Creek, Selwyn River, Nordenskiold River, Klotassin River, Donjek River, and the White River are known to be utilized by adult Chinook salmon for spawning habitat (DFO 1985; Yukon River Panel

2008a), and the tributaries of Seymour Creek, Bow Creek, Stoddart Creek, Hayes Creek, and Dip Creek have all been shown to contain fry and juvenile Chinook (DFO 1994; von Finster 1998).

- Adult chum salmon have been documented within the Nordenskiold River, and in Big Creek approximately 13.7 km upstream of the Yukon River confluence (DFO 1985).
- Slimy sculpin is one of the most widely distributed species in the RSA, with reported captures in lower Casino Creek, lower Brynelson Creek, Dip Creek, lower Britannia Creek, Isaac Creek, Selwyn River, Hayes Creek, Big Creek, Murray Creek, and the Nordenskiold River.
- Northern pike is one of the top three most targeted fish species by anglers in the Yukon (Environment Yukon 2010). The distribution of northern pike in the project area is restricted to the Nordenskiold River.
- Burbot is most commonly caught by anglers in lakes during the winter through ice (Environment Yukon 2010). In the project area, burbot has been captured in stream habitats such as lower Casino Creek, Dip Creek, Isaac Creek, and the Nordenskiold River, where fishing is less common and/or unlikely to occur due to remoteness.
- Round whitefish have been captured in Dip Creek, Murray Creek, Big Creek, and within the Nordenskiold River. Little is known about round whitefish populations in the Yukon, and they are not recognized as a popular angling species (Environment Yukon 2010). While other species of whitefish are commercially harvested in the Yukon, round whitefish are not specifically targeted due to their smaller size. However, First Nations may harvest round whitefish for subsistence (Environment Yukon 2014).
- Longnose sucker have been captured in Isaac Creek and the Nordenskiold River. Longnose sucker is not recognized as a popular angling species (Environment Yukon 2010).

While no fish sampling was conducted along the Nordenskiold River, crossing 1N (Figure A.10.4-2) is considered to be fish bearing. It is known that the Nordenskiold River hosts eleven species of fish (Chinook salmon, chum salmon, lake trout (*Salvelinus namaycush*), Arctic grayling, round whitefish, lake whitefish (*Coregonus clupeaformis*), longnose sucker, burbot, northern pike, Arctic lamprey and slimy sculpin), all of which are common to the Yukon River Basin (Nordenskiold Sterring Committee 2010). Both Chinook salmon and chum salmon utilize the river for spawning and rearing habitat and the river provides suitable conditions for overwintering habitat. No barriers to fish movement were identified as part of this study, however frequent log jams within the Nordenskiold River may restrict salmon movement (Nordenskiold Sterring Committee 2010).

As stated above, it is expected that the proposed bridge site may support spawning and rearing habitat for any of the documented fish species in the river, including Chinook and Chum salmon. As depths are generally less than 1 m, it is unlikely that any overwintering habitat will be lost. As the total footprint of the bridge pier is small (6 m^2) relative to the estimated area of the river mainstem (estimated 1.43 km^2), it is anticipated that any potential impacts on fisheries productivity will be minor.

A.10.6.4 Classification of Crossings

A.10.6.4.1 R302

R302. A list of stream crossings for the Freegold Road including stream name, kilometre marker, crossing properties and the type of crossing, considering DFO's definition of clear-span crossing.

All stream crossing data is provided in the *Fish and Aquatic Resources Baseline Report: Freegold Road Extension, Freegold Road Upgrade, and Casino Airstrip and Airstrip Access Road*, provided in Appendix 10B.

Proposed clear-span bridges will have abutments above the high water mark, similar to DFO's description of clear-span bridges. However, rip rap will be placed within the high water mark where necessary to reduce slope failure in potentially unstable permafrost laden areas. If abutments were set well back from the active channel, the die-off of riparian vegetation would destabilize the banks and promote long-term bank collapses and slumping. This would have a far greater and more long-term impact than a small patch of rip-rap on the bank. Thus, the usage of rip rap is essential to minimize siltation below bridges where vegetation is unable to grow due to insufficient light. Further, rip rap will be placed flush with the stream bank to avoid changes in channel volume or flows.

The response to R297 addresses the placement of crossing structures in areas which may be more unstable and thus not suitable for a clear-span bridge.

A.10.6.5 Erosion

A.10.6.5.1 R303

R303. An assessment of the overall erosion and sedimentation risk that will form the basis for designing and ultimately preparing an erosion and sediment control plan for the Freegold Road Upgrade, Airstrip Access Road and Casino Mine site.

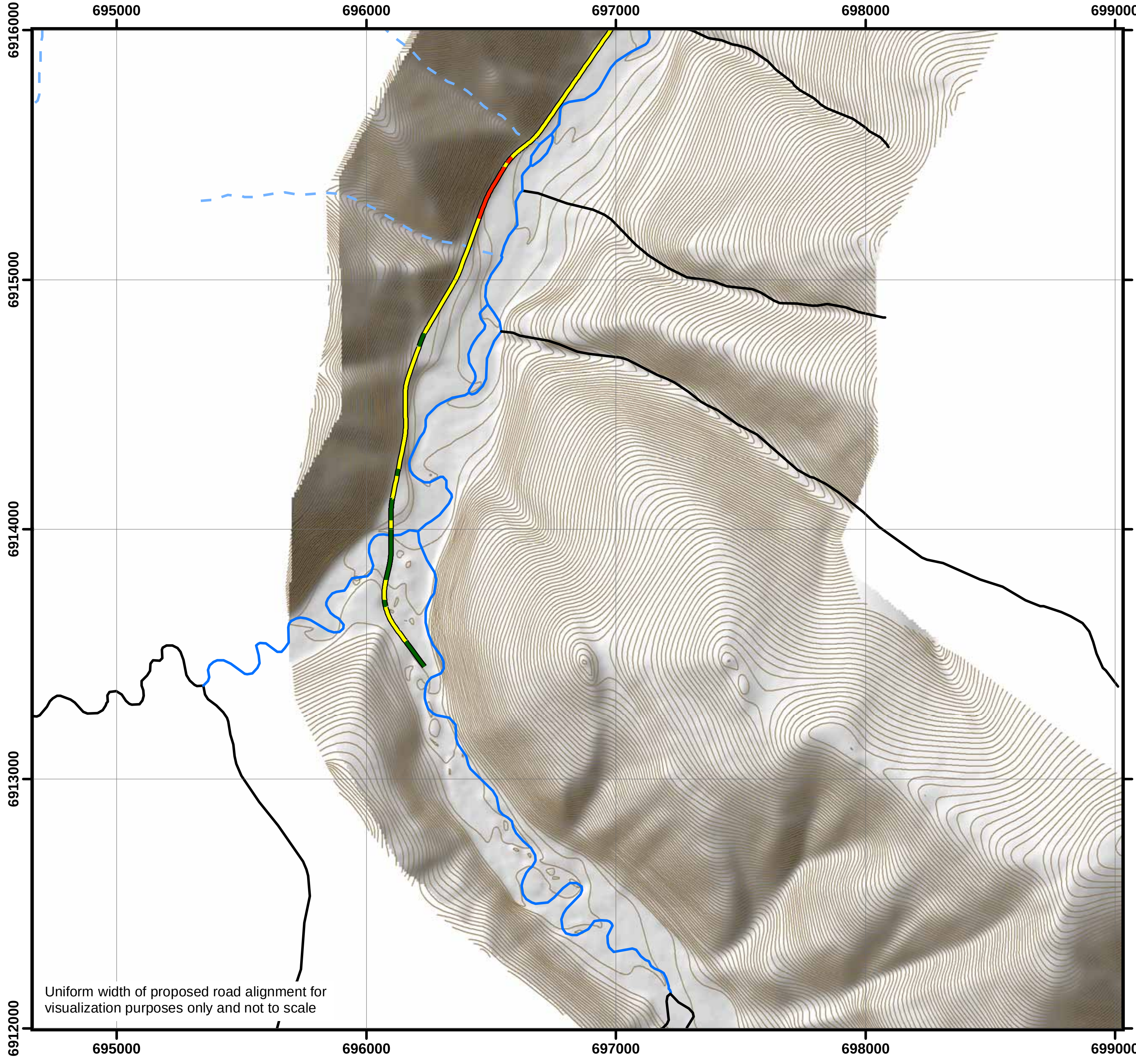
The risk assessment was completed initially along the Freegold Road Extension because its construction necessitates numerous new stream crossings and encroachments, some associated with major fish-bearing streams, and extensive linear disturbance to vegetation and soil.

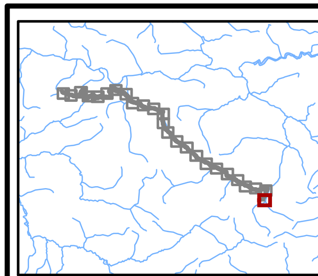
In writing the Erosion and Sediment Control Plan (for the Quartz Mining Licence application), the same overall erosion and sedimentation risk assessment will be conducted for the Freegold Road Upgrade, Airstrip Access Road and Casino Mine Site. Corresponding mitigation measures will be applied at the areas identified in the risk assessment.

A.10.6.5.2 R304

R304. Identification of fish-bearing and non fish-bearing reaches of affected watercourses in the Map Series 3 (overall erosion and sedimentation risk) of the Erosion and Sedimentation Risk Assessment Report.

The classification of relevant watercourses as fish bearing or non-fish bearing is provided in Figure A.10.4-1 through Figure A.10.4-8, and this classification has now also been added for clarity to all three map series comprising the erosion and sedimentation risk assessment. Freegold road extension erosion potential, potential ecological consequences, and overall erosion and sedimentation risk are provided in Figure A.10.6-1, Figure A.10.6-2, and Figure A.10.6-3, respectively. The presence/absence of a direct downstream connection to fish bearing watercourses has also been included in the updated map symbology, as it relates to potential downstream effects from non-fish-bearing crossings. The overall erosion and sedimentation risk (Figure A.10.6-3) may be low for non-fish-bearing crossings in gentle (low erosion potential) terrain where there is no obvious direct connection to downstream fish bearing watercourses.





Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

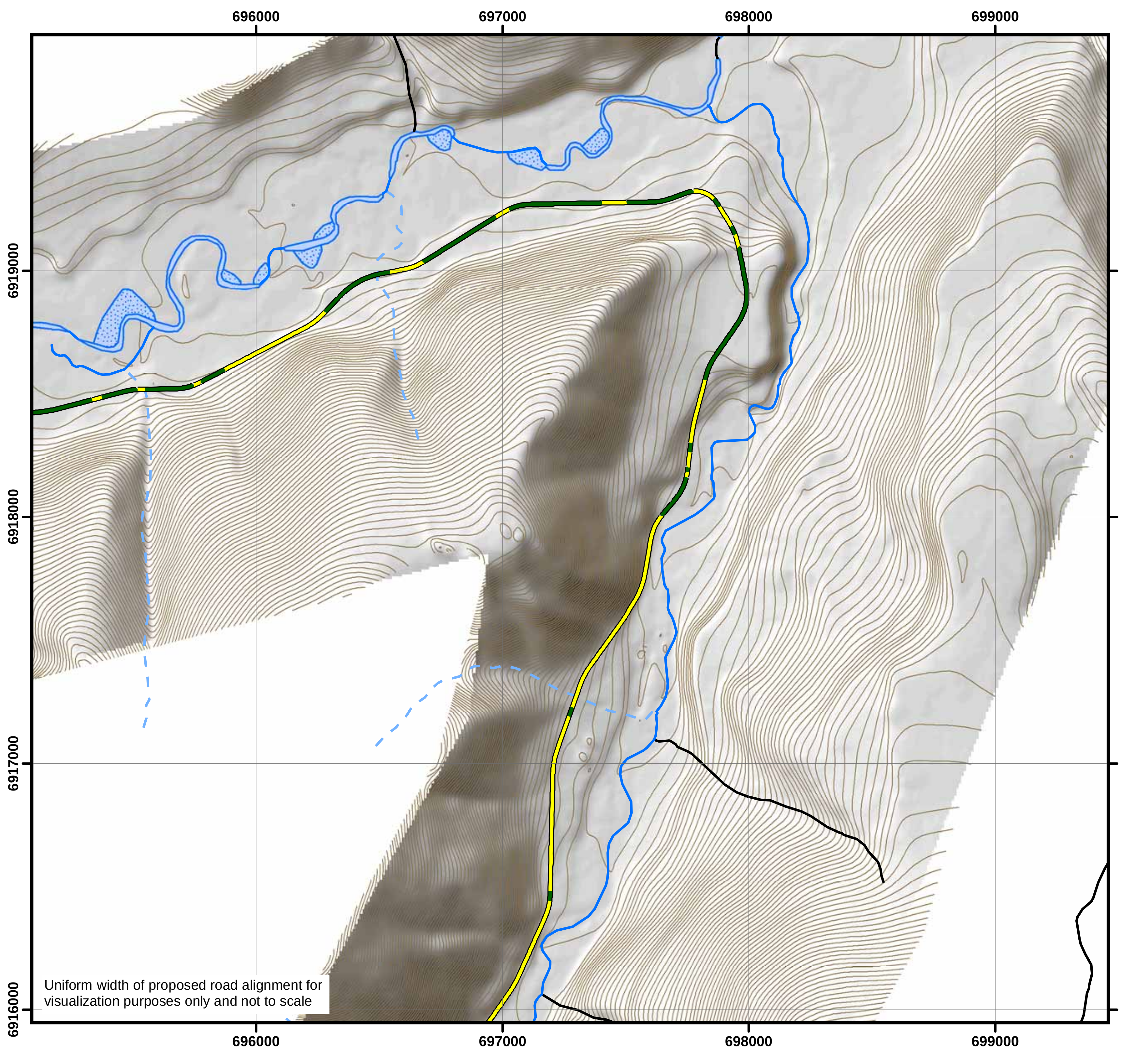
Freegold Road Extension

Map 1

Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.



Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

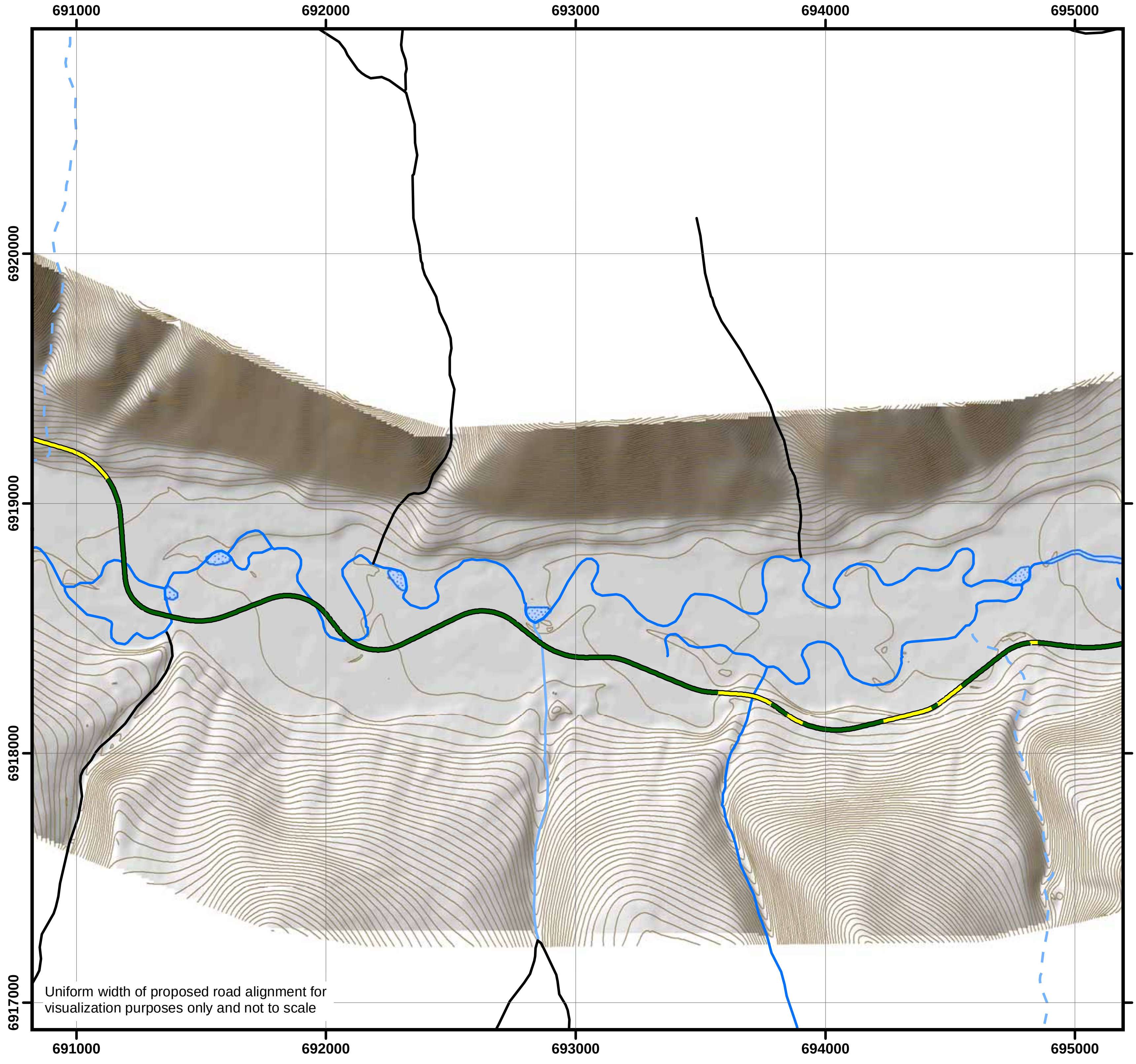
Map 1

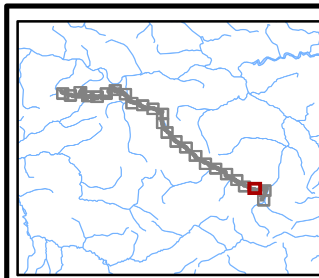
Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 2 of 25





Legend

Erosion Potential

High
Moderate
Low
Fish-bearing (known or inferred)
Non fish-bearing (known or inferred)
No direct connection to fish-bearing stream
Watercourse (Not assessed)
Non-Permanent Water
Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

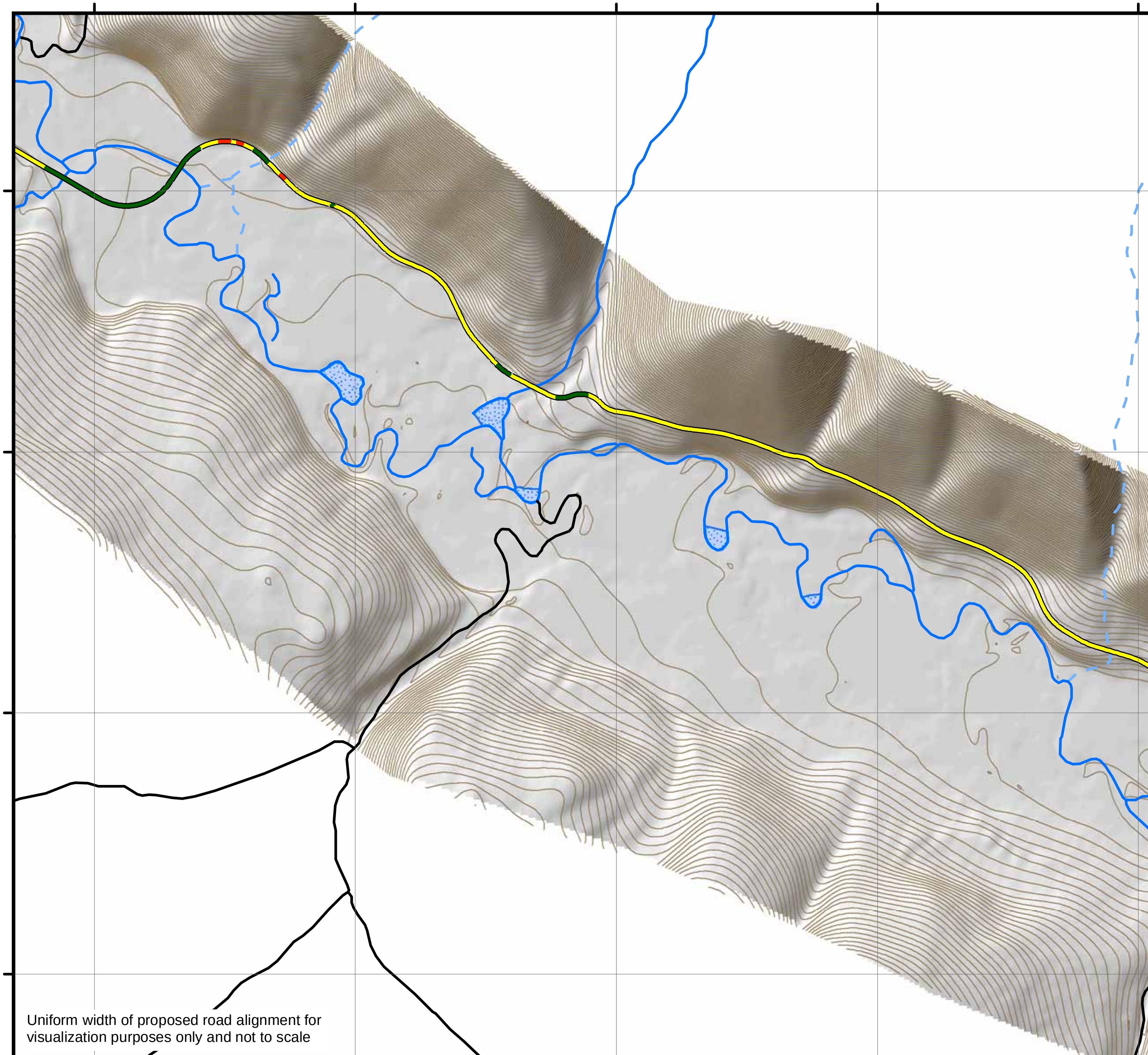
Freegold Road Extension

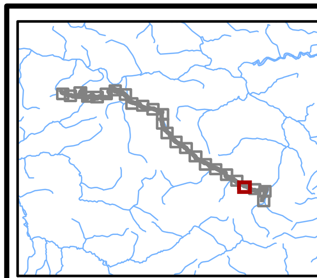
Map 1

Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

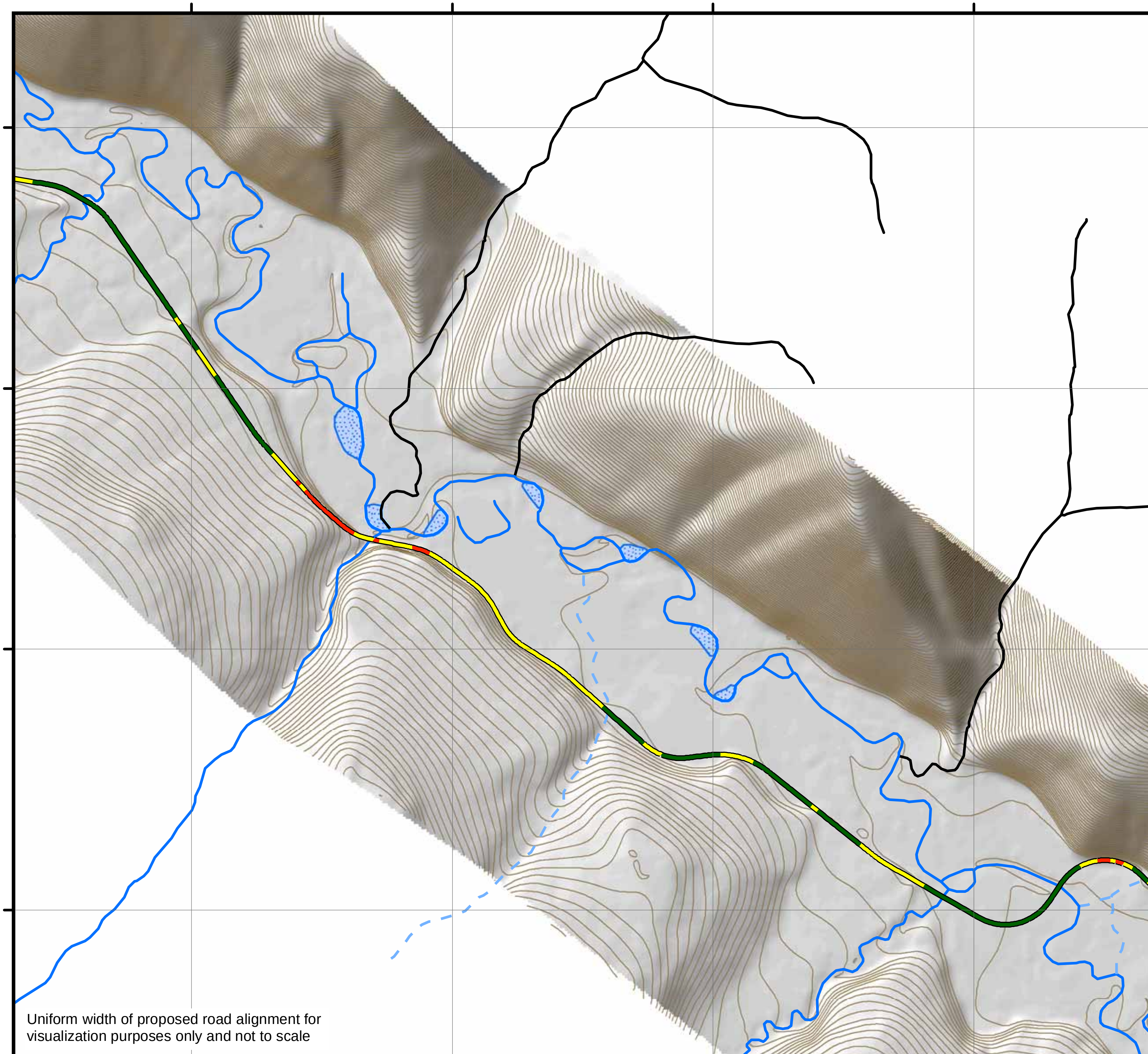
Map 1

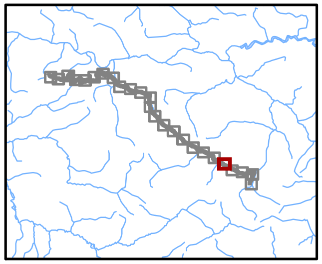
Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 4 of 25





Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

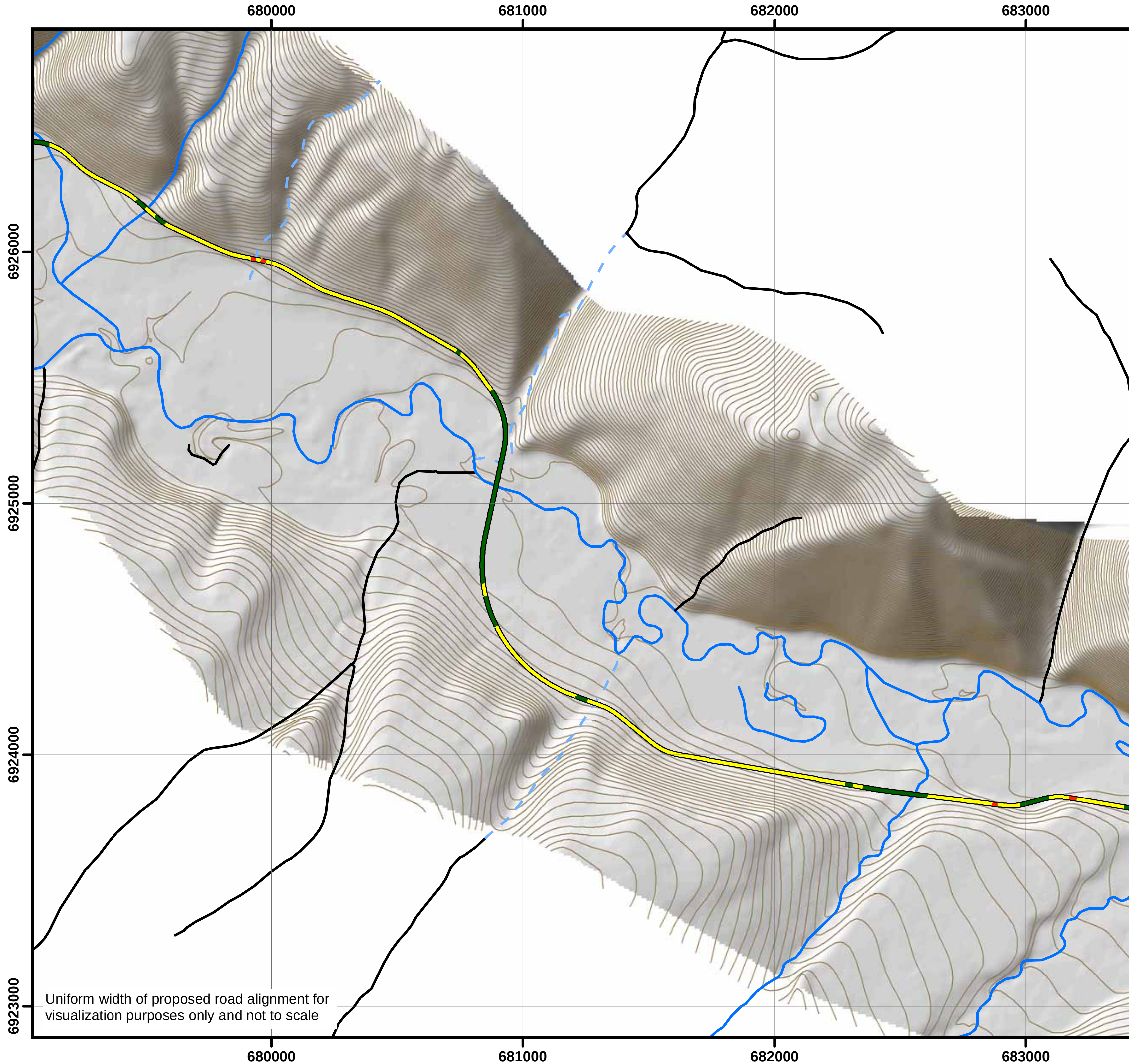
Map 1

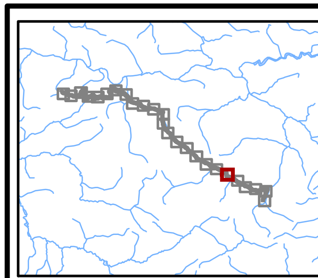
Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 5 of 25





Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

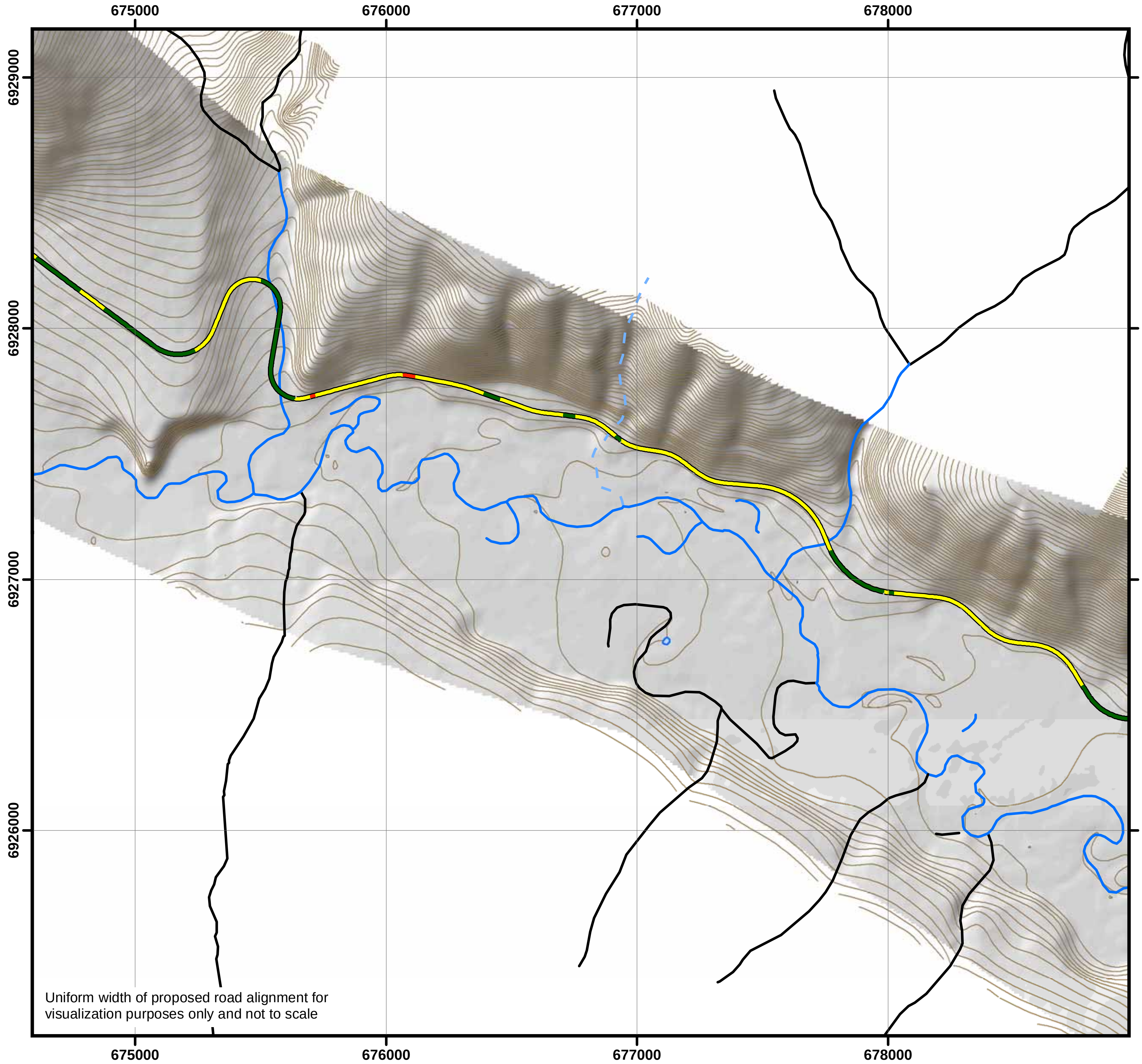
Map 1

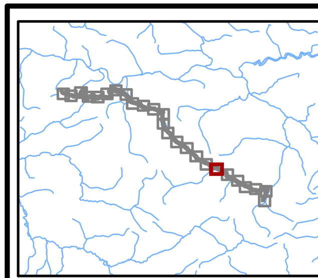
Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 6 of 25





Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

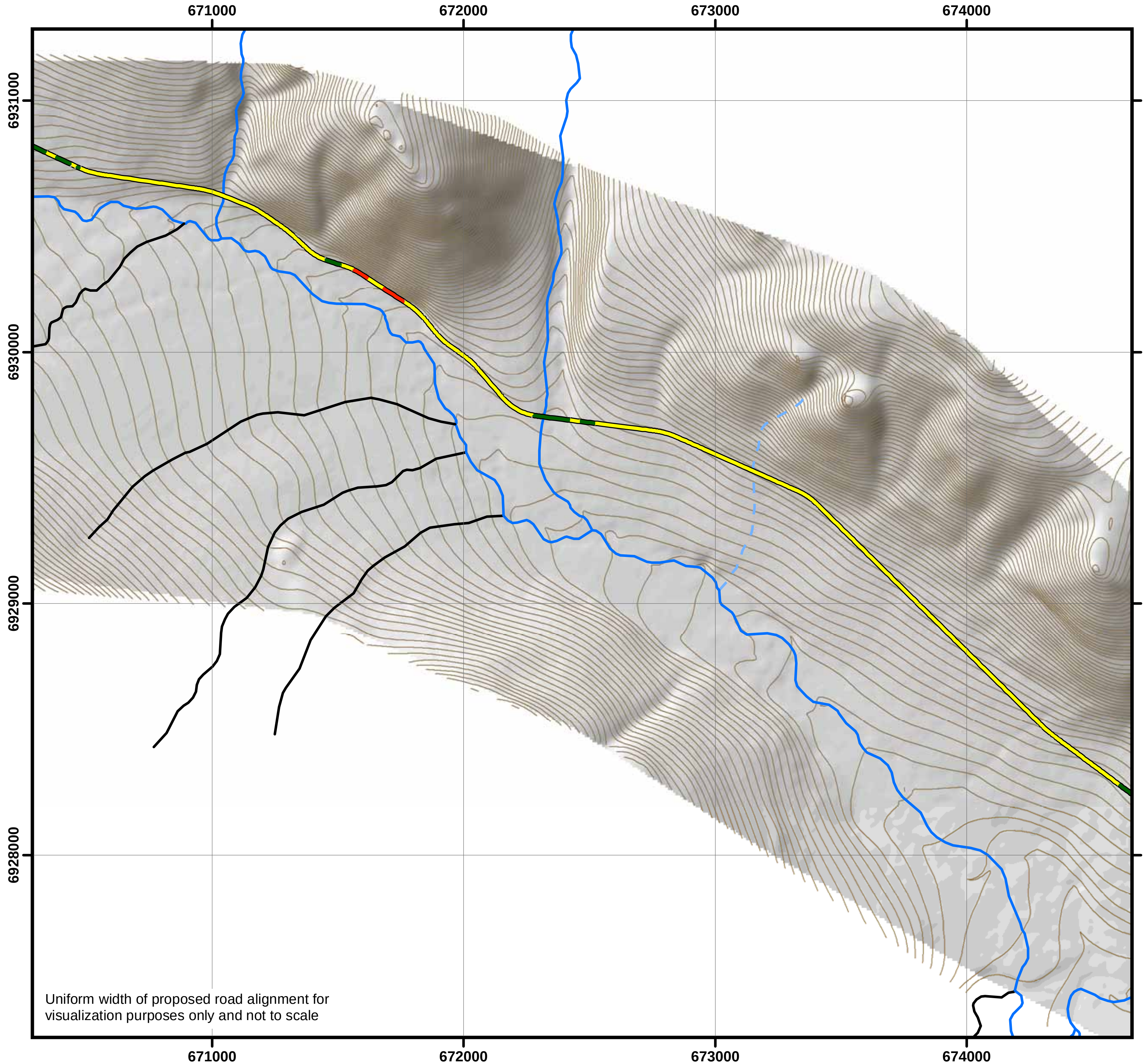
Map 1

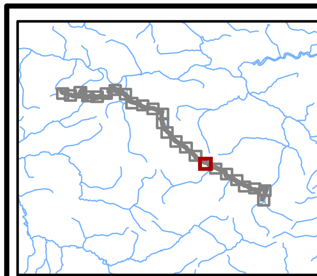
Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 7 of 25





Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

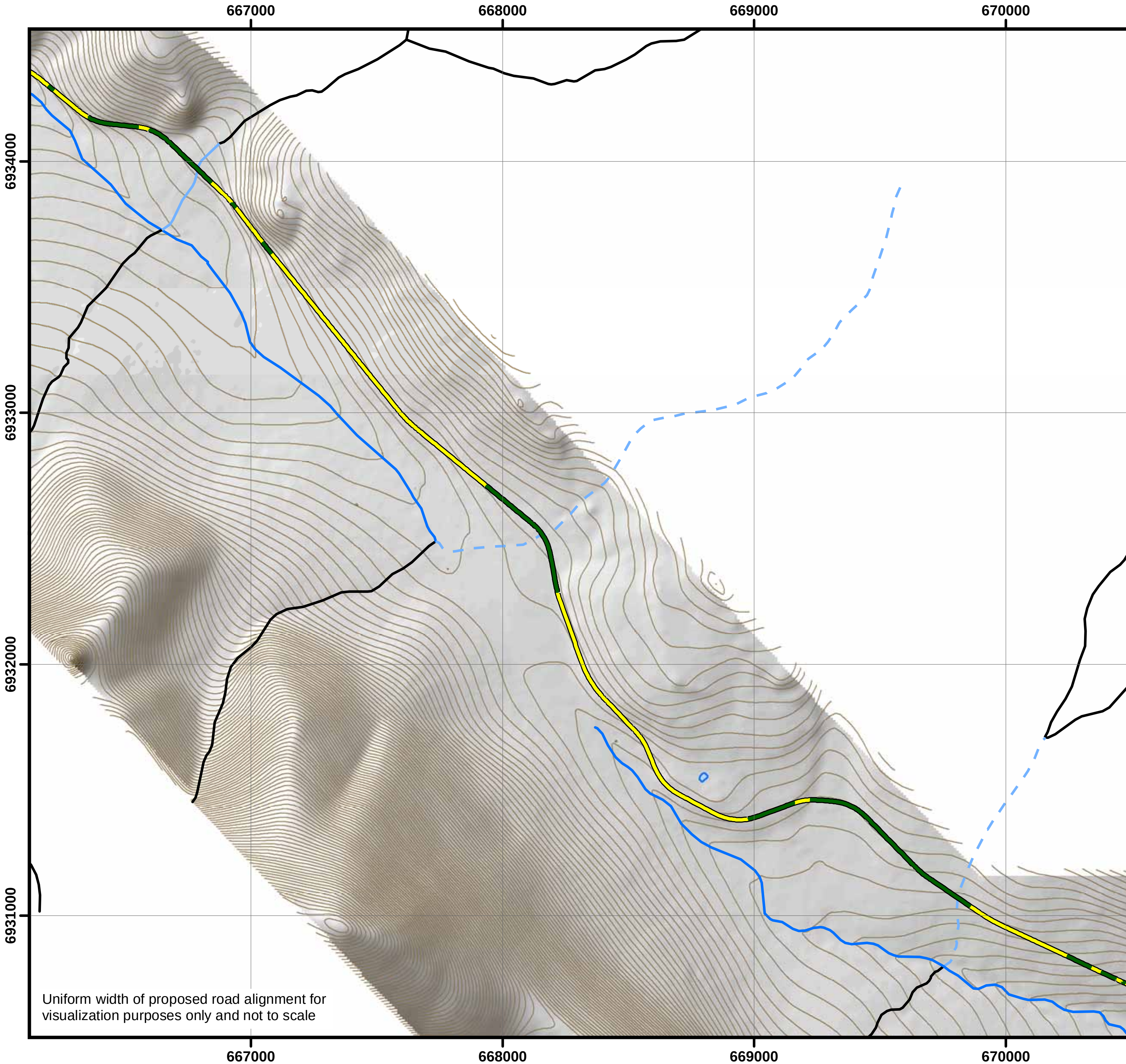
Freegold Road Extension

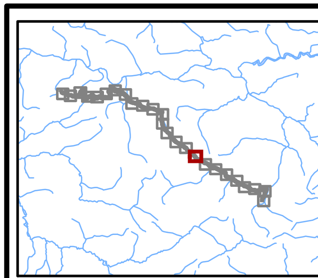
Map 1

Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

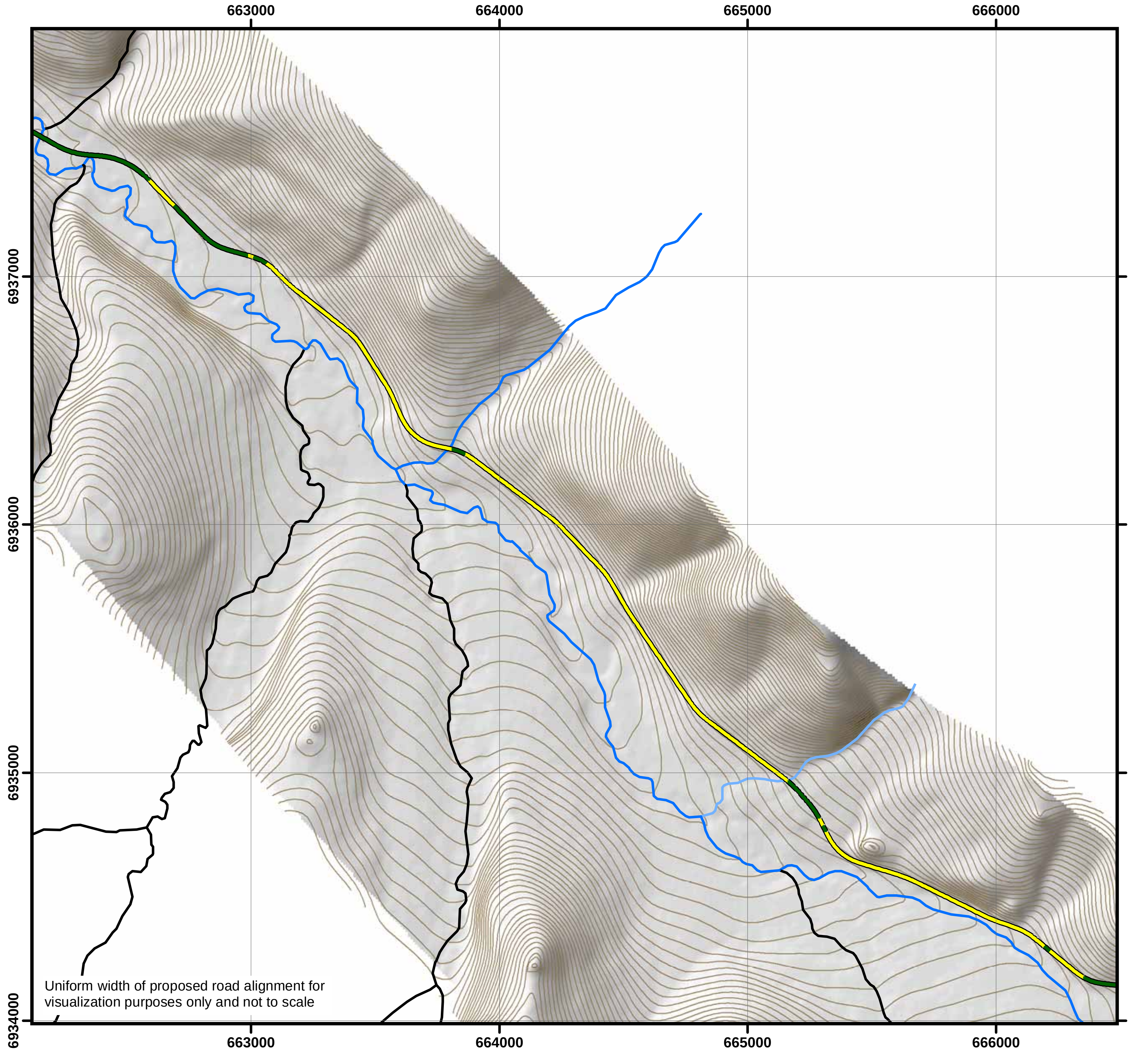
Freegold Road Extension

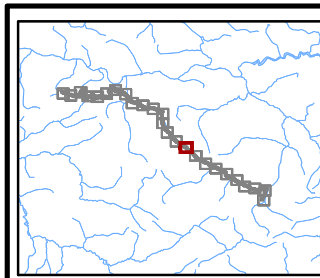
Map 1

Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

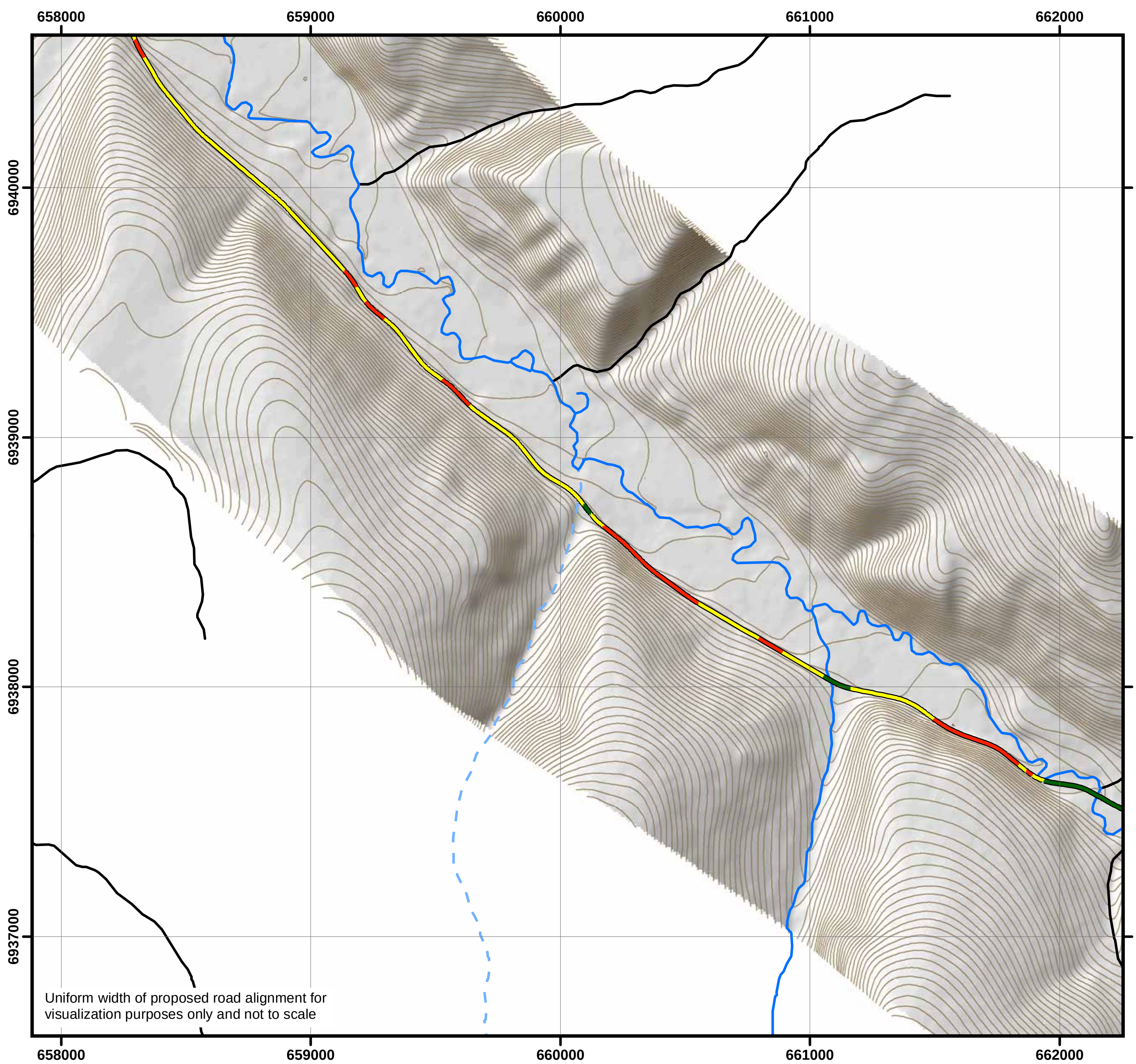
Freegold Road Extension

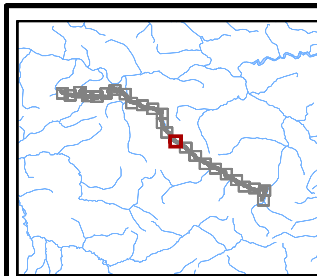
Map 1

Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

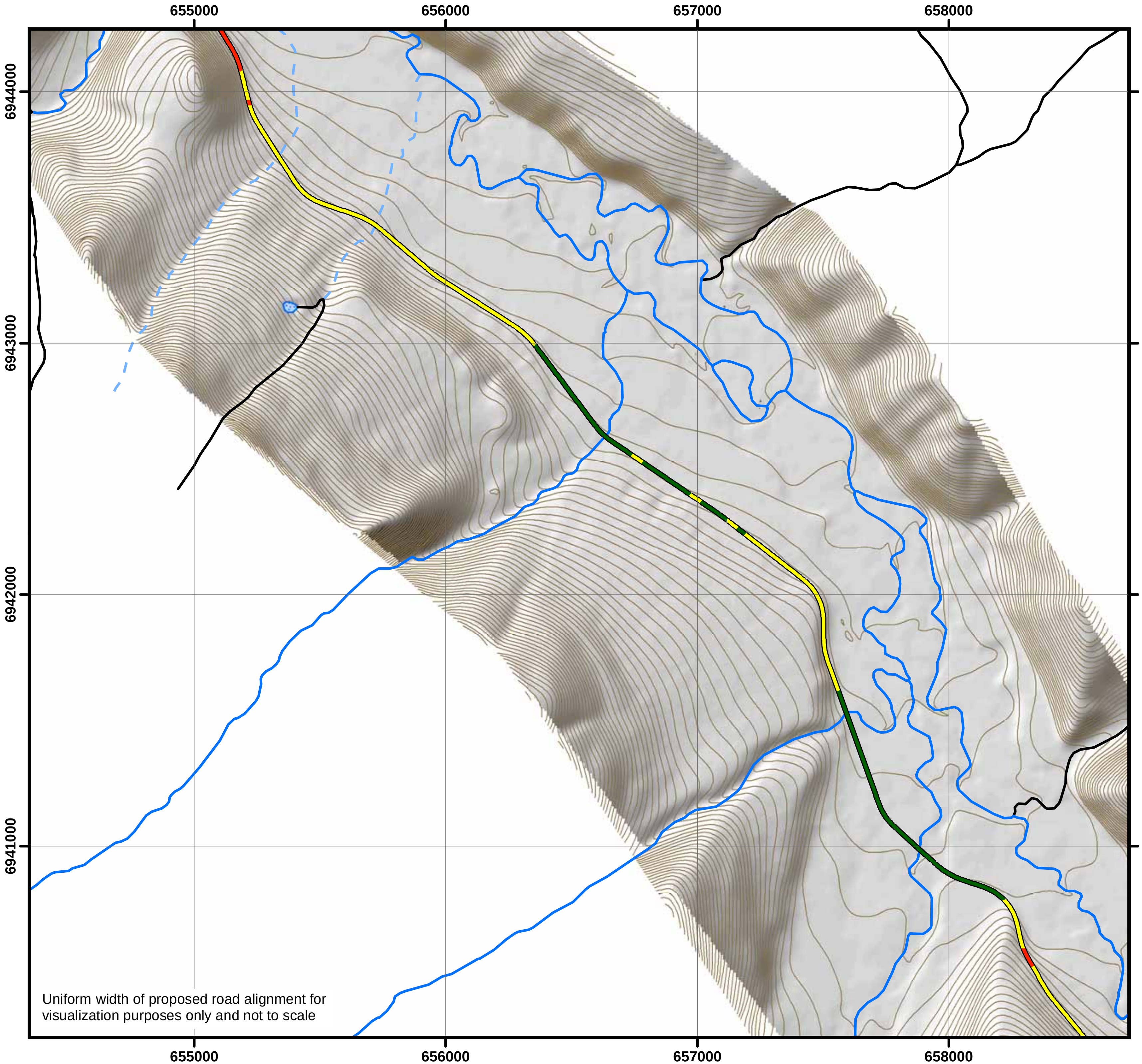
Map 1

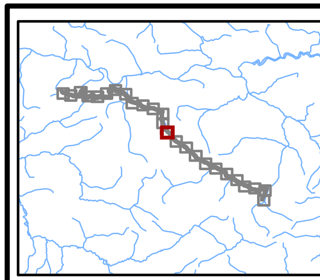
Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 11 of 25





Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

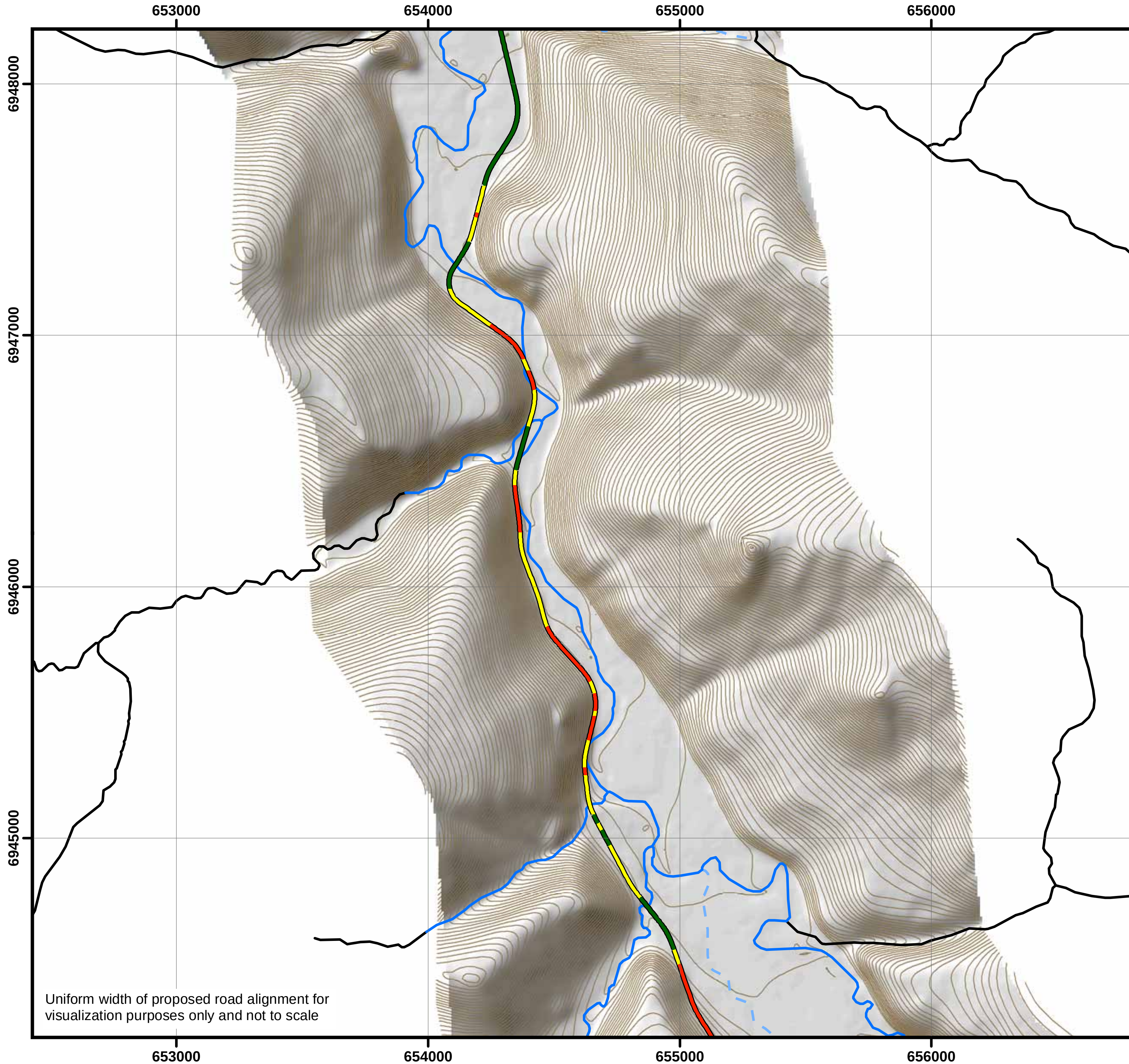
Freegold Road Extension

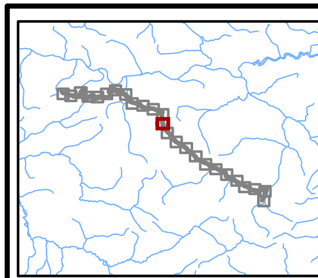
Map 1

Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

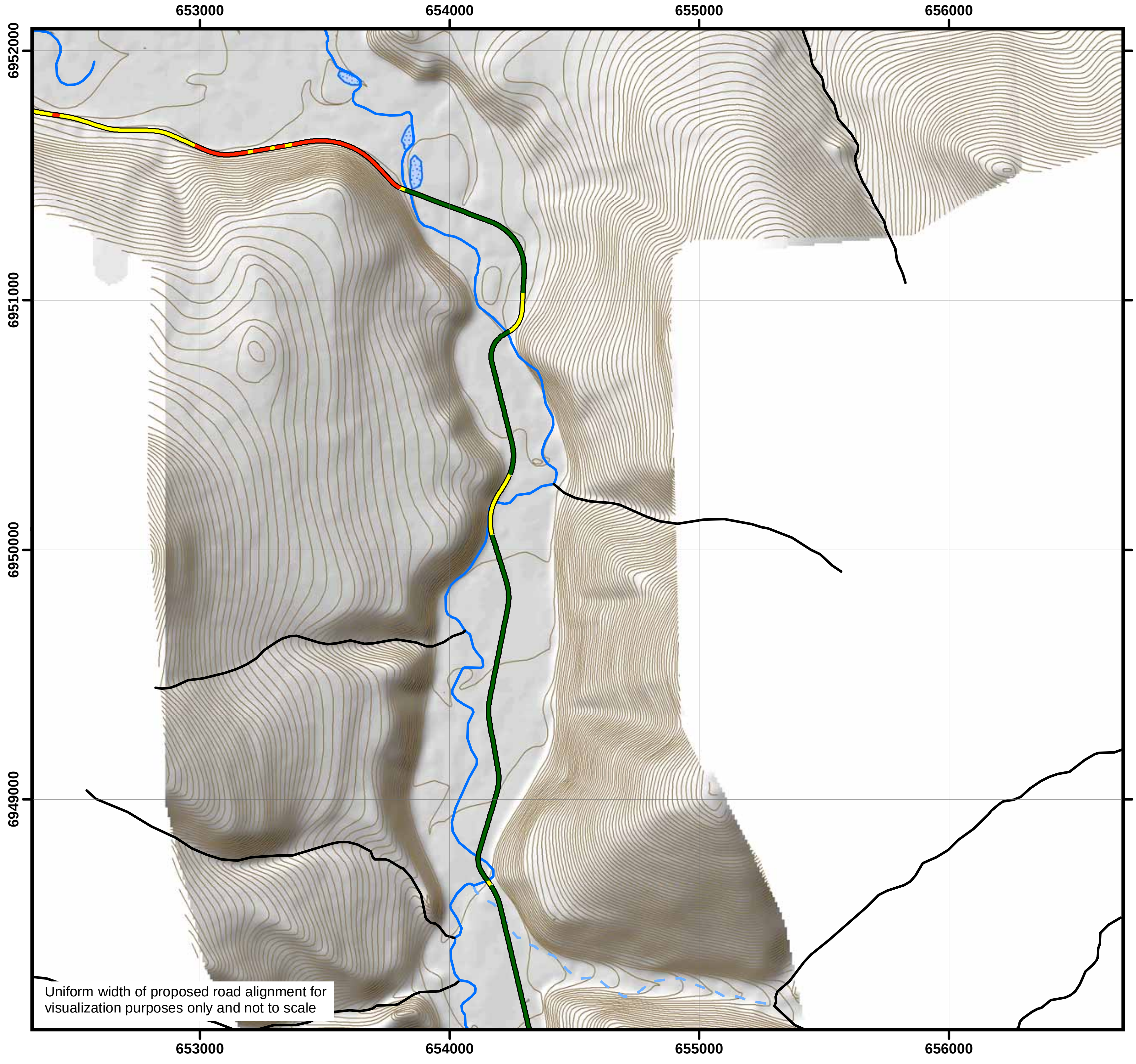
Freegold Road Extension

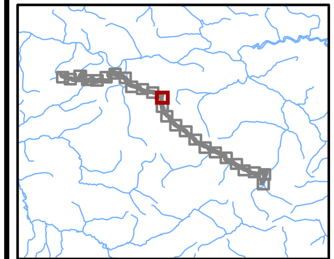
Map 1

Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

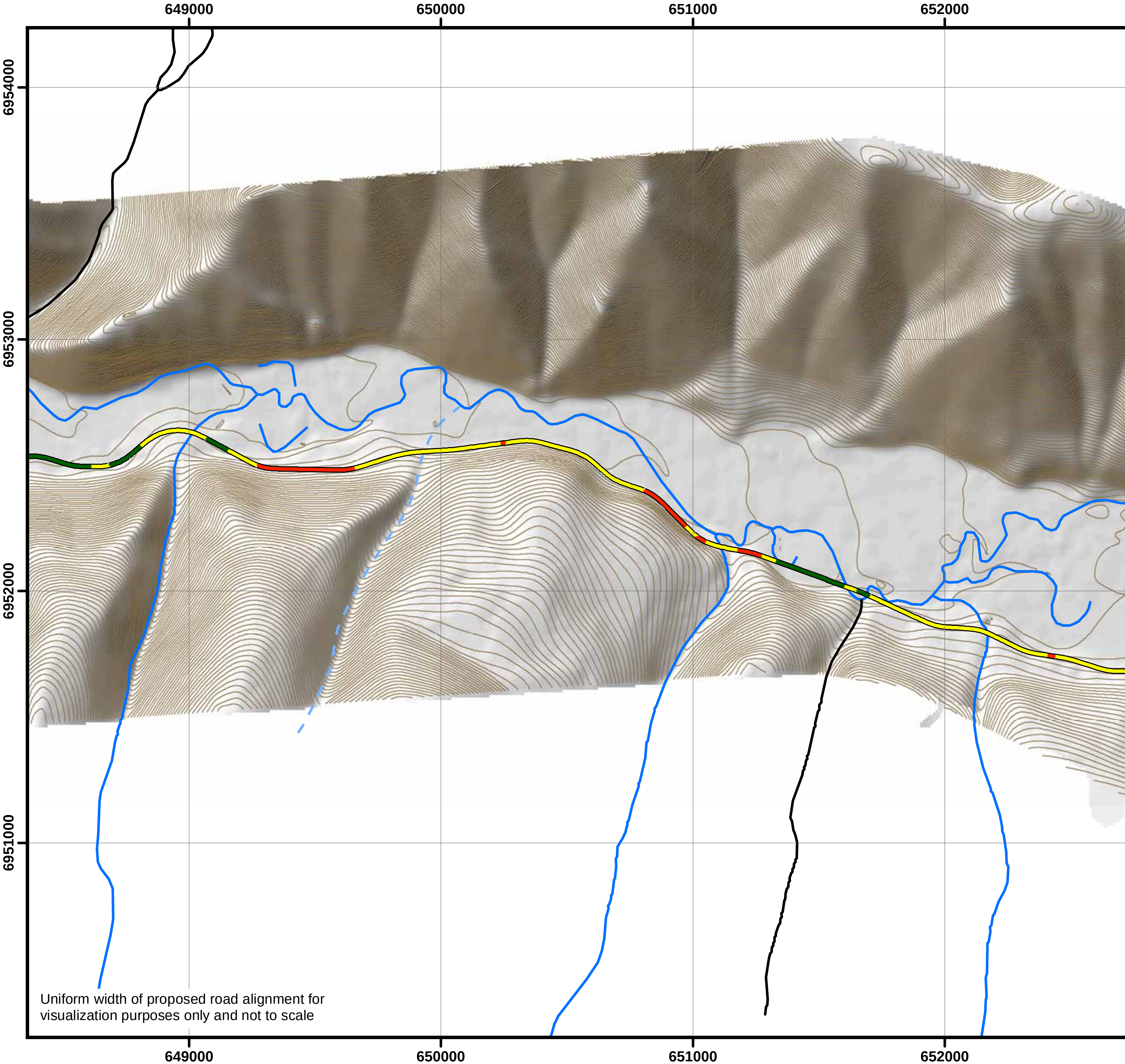
Freegold Road Extension

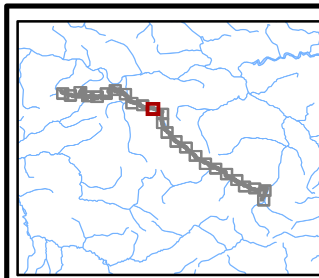
Map 1

Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Erosion Potential

High

Moderate

Low

Fish-bearing (known or inferred)

Non fish-bearing (known or inferred)

No direct connection to fish-bearing stream

Watercourse (Not assessed)

Non-Permanent Water

Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

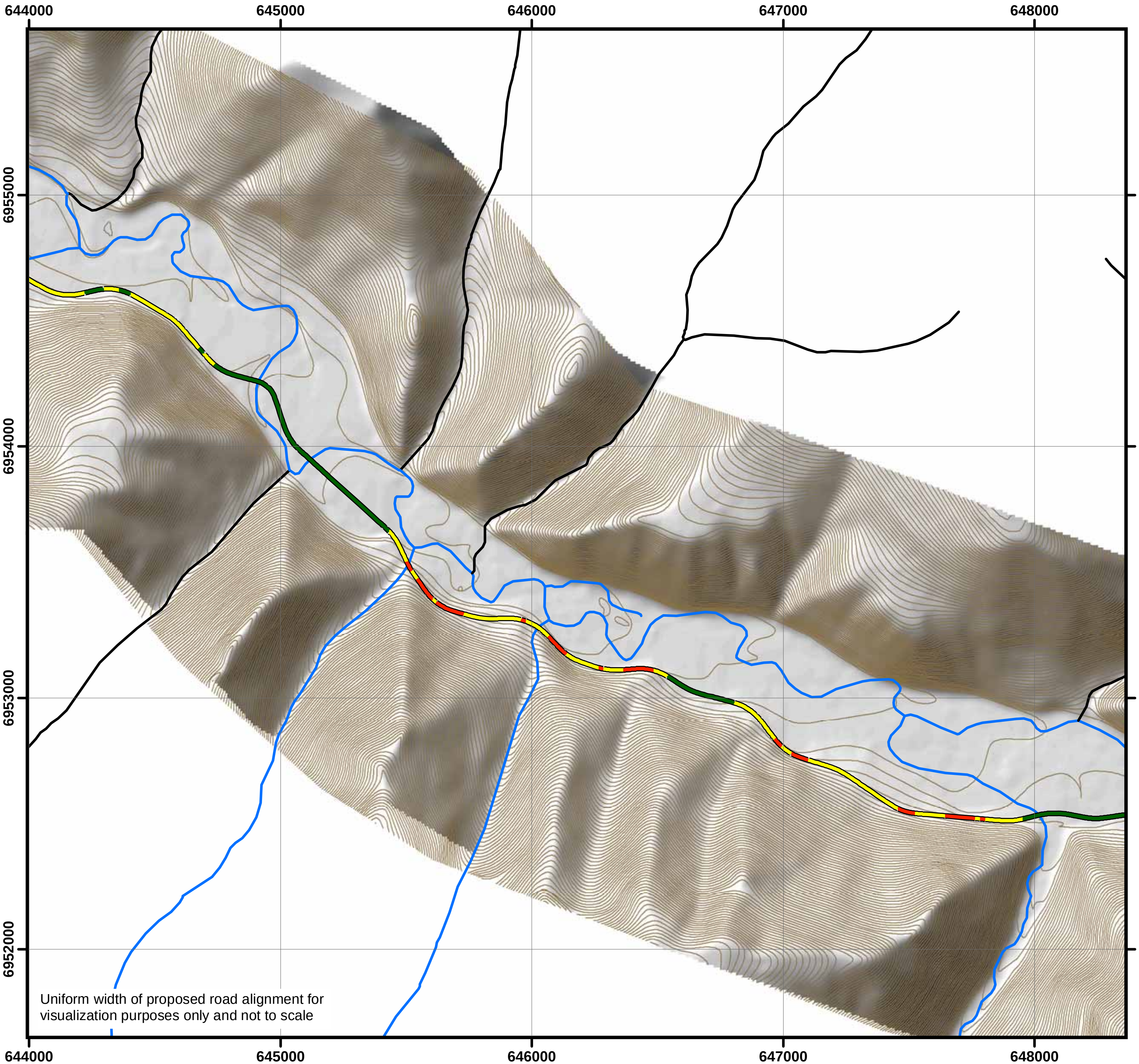
Freegold Road Extension

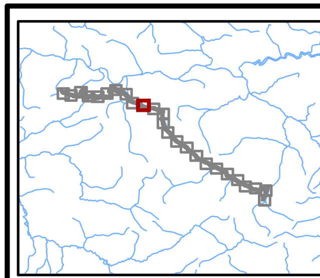
Map 1

Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

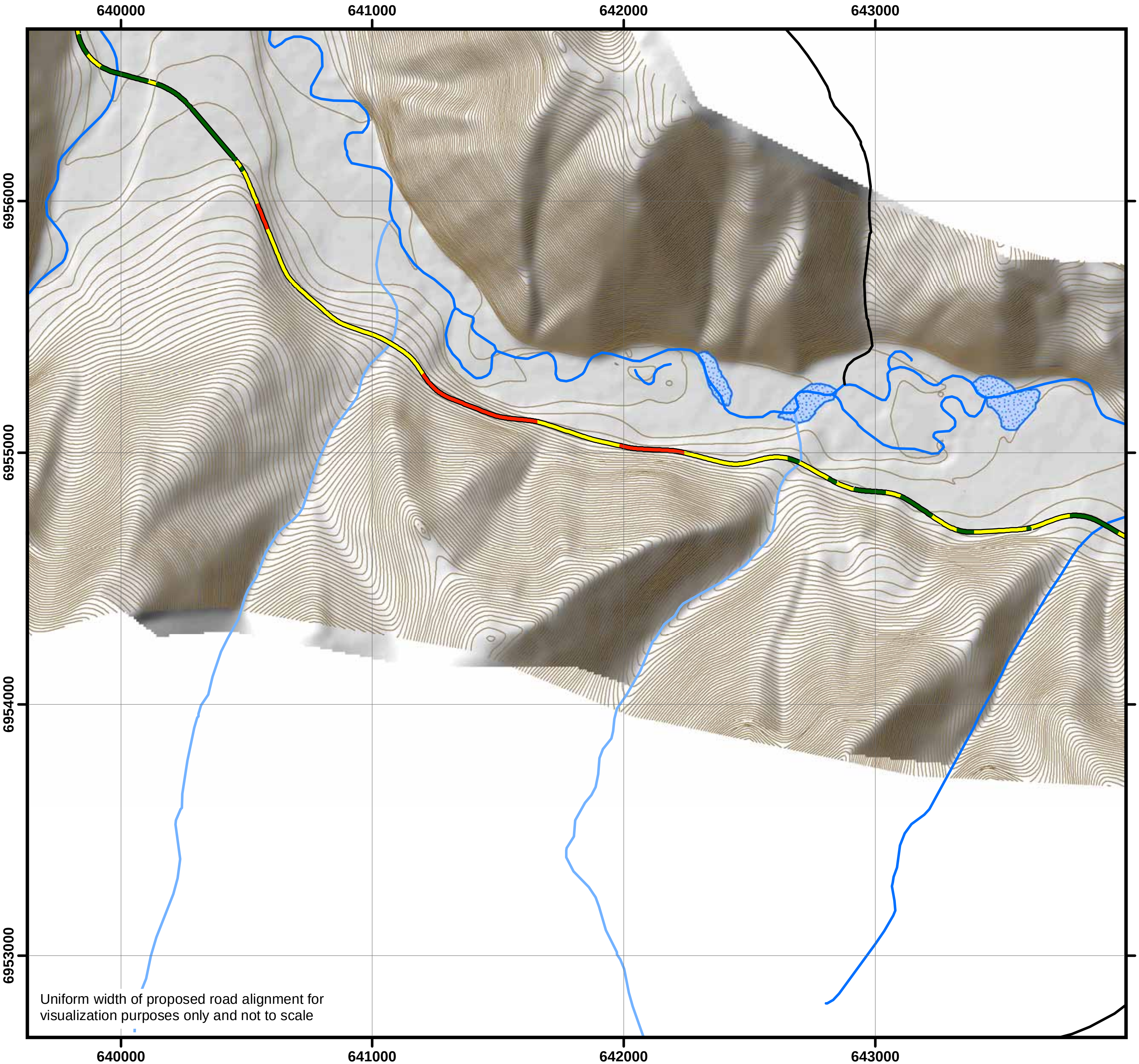
Freegold Road Extension

Map 1

Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.



Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

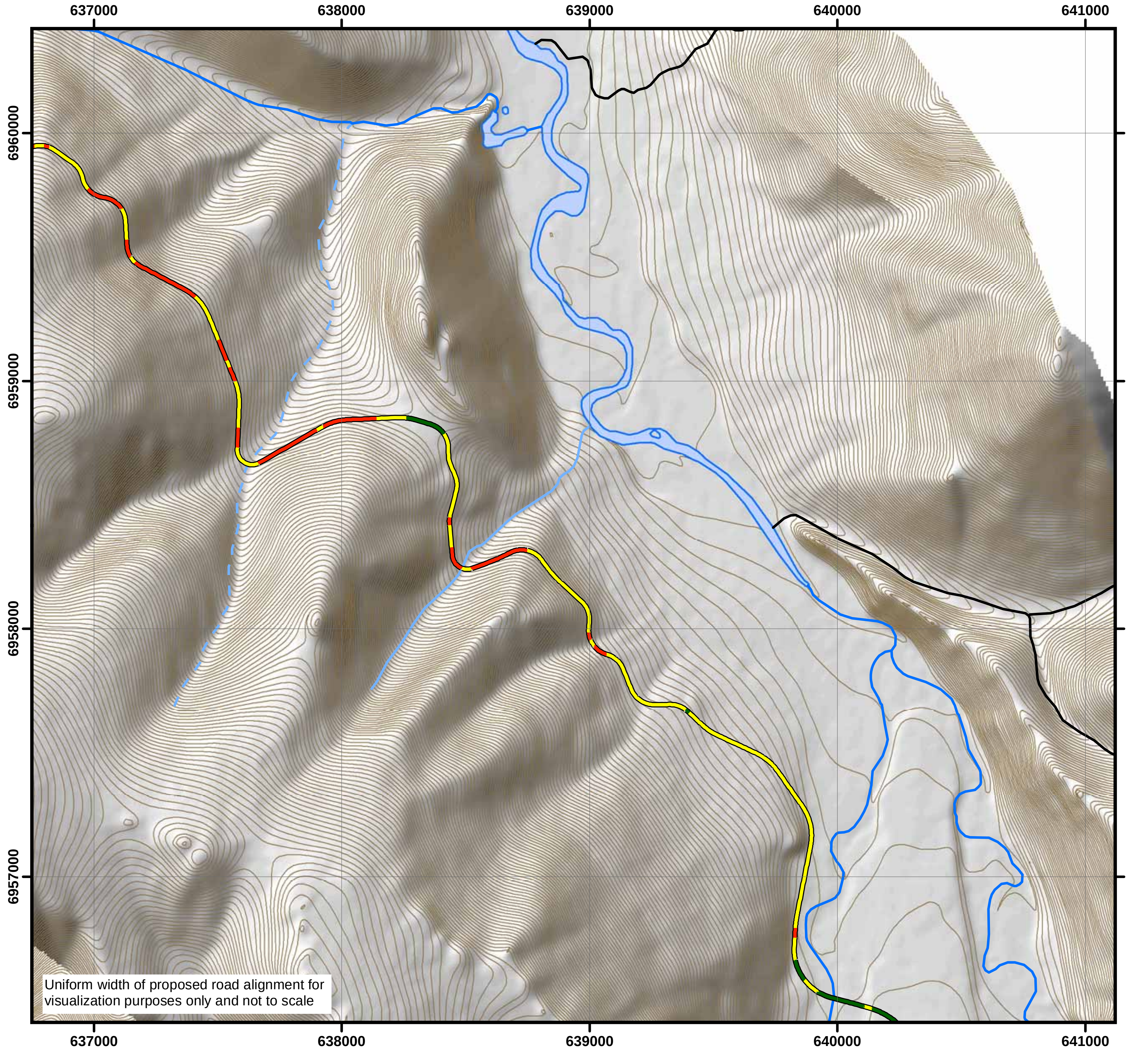
Map 1

Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 17 of 25



Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

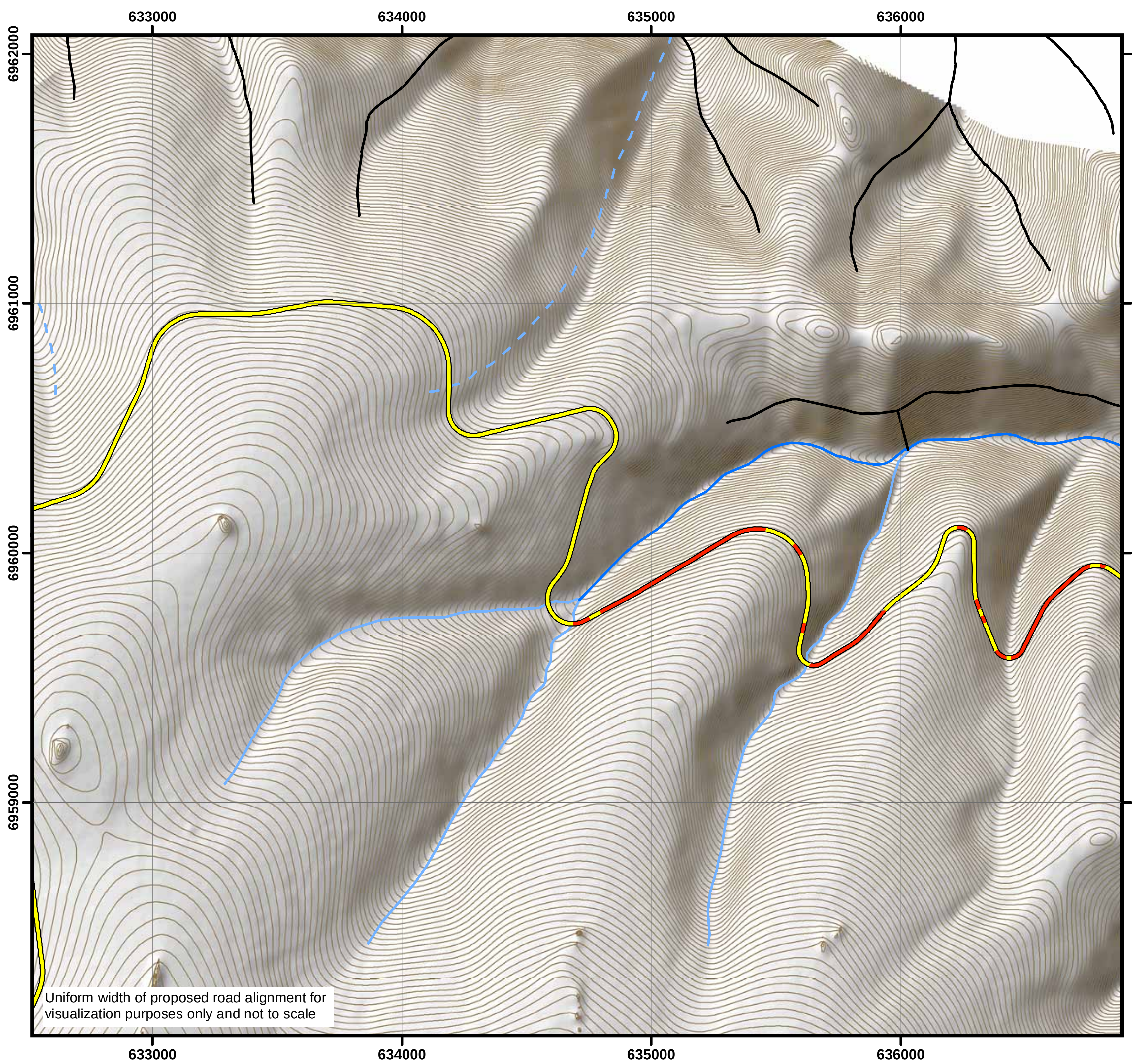
Freegold Road Extension

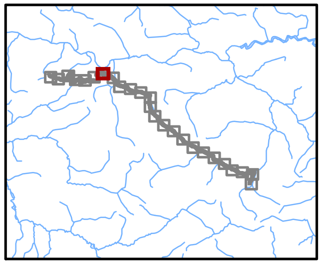
Map 1

Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

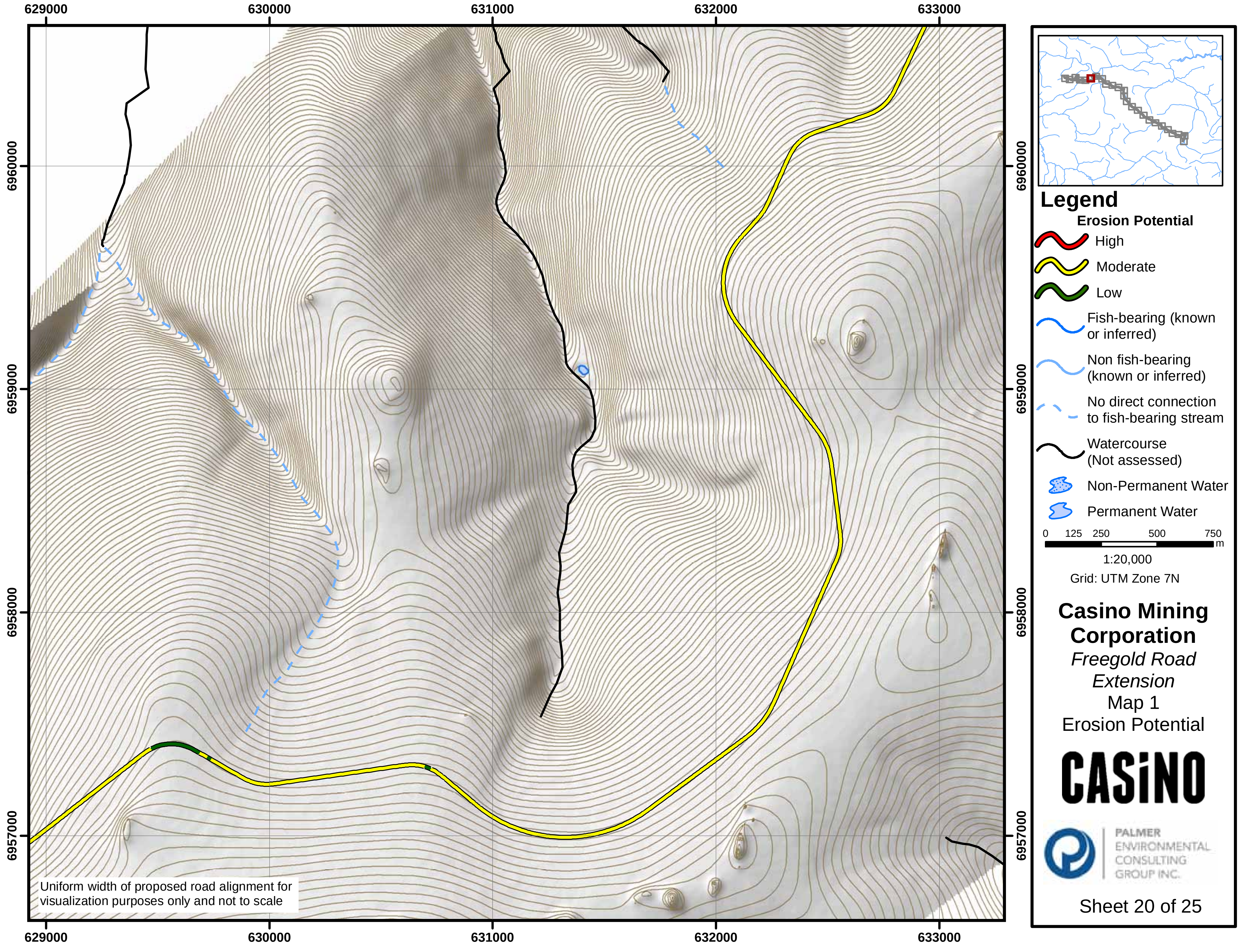
Map 1

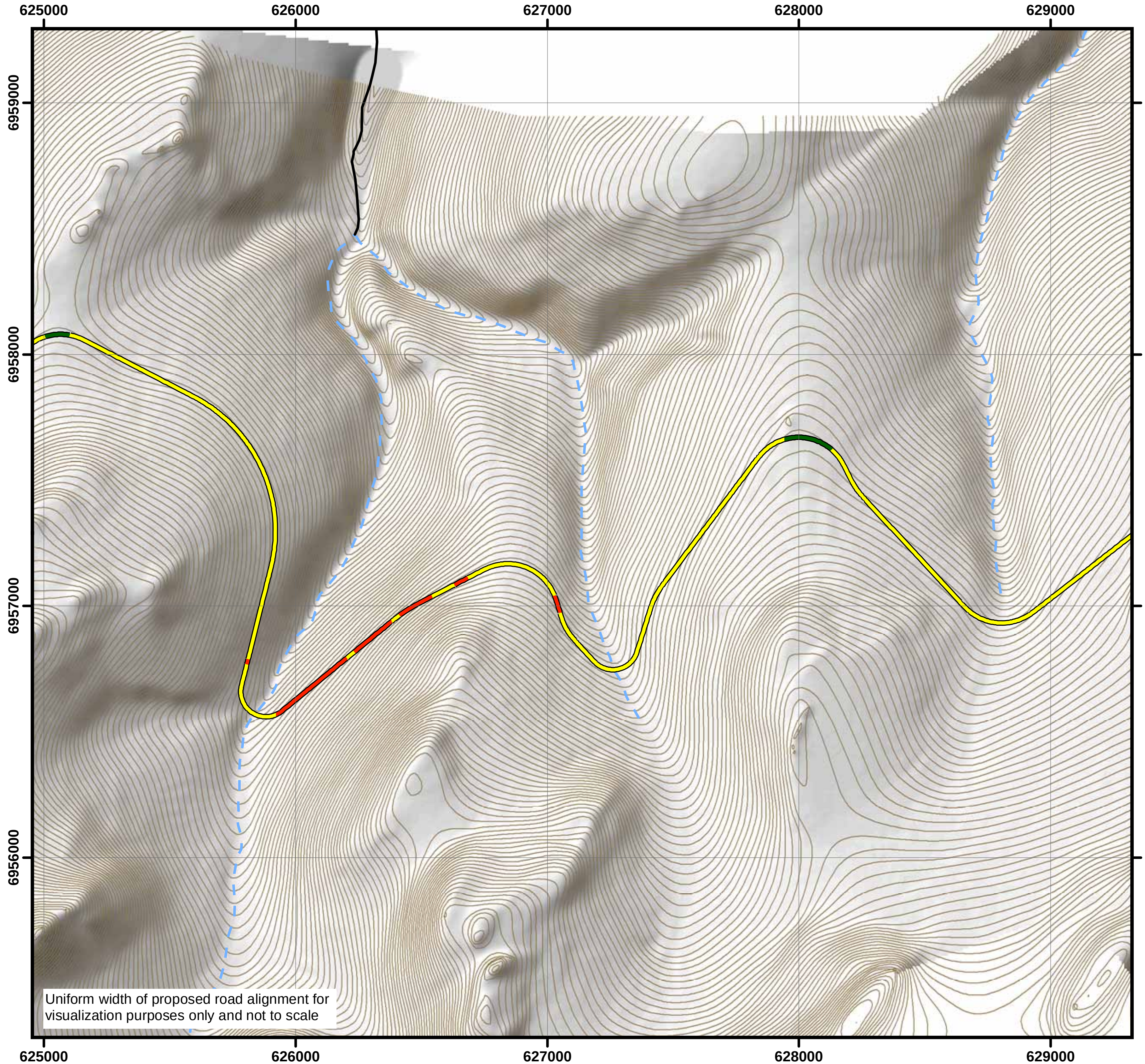
Erosion Potential

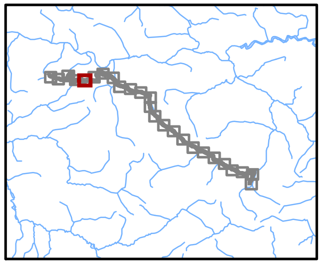
CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 19 of 25


629000
630000
631000
632000
633000
6960000
6959000
6958000
6957000
Uniform width of proposed road alignment for
visualization purposes only and not to scale
Legend
Erosion Potential
High
Moderate
Low
Fish-bearing (known or inferred)
Non fish-bearing (known or inferred)
No direct connection to fish-bearing stream
Watercourse (Not assessed)
Non-Permanent Water
Permanent Water
0 125 250 500 750 m
1:20,000
Grid: UTM Zone 7N
Casino Mining Corporation
Freegold Road Extension
Map 1
Erosion Potential
CASINO
PALMER ENVIRONMENTAL CONSULTING GROUP INC.
Sheet 20 of 25





Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

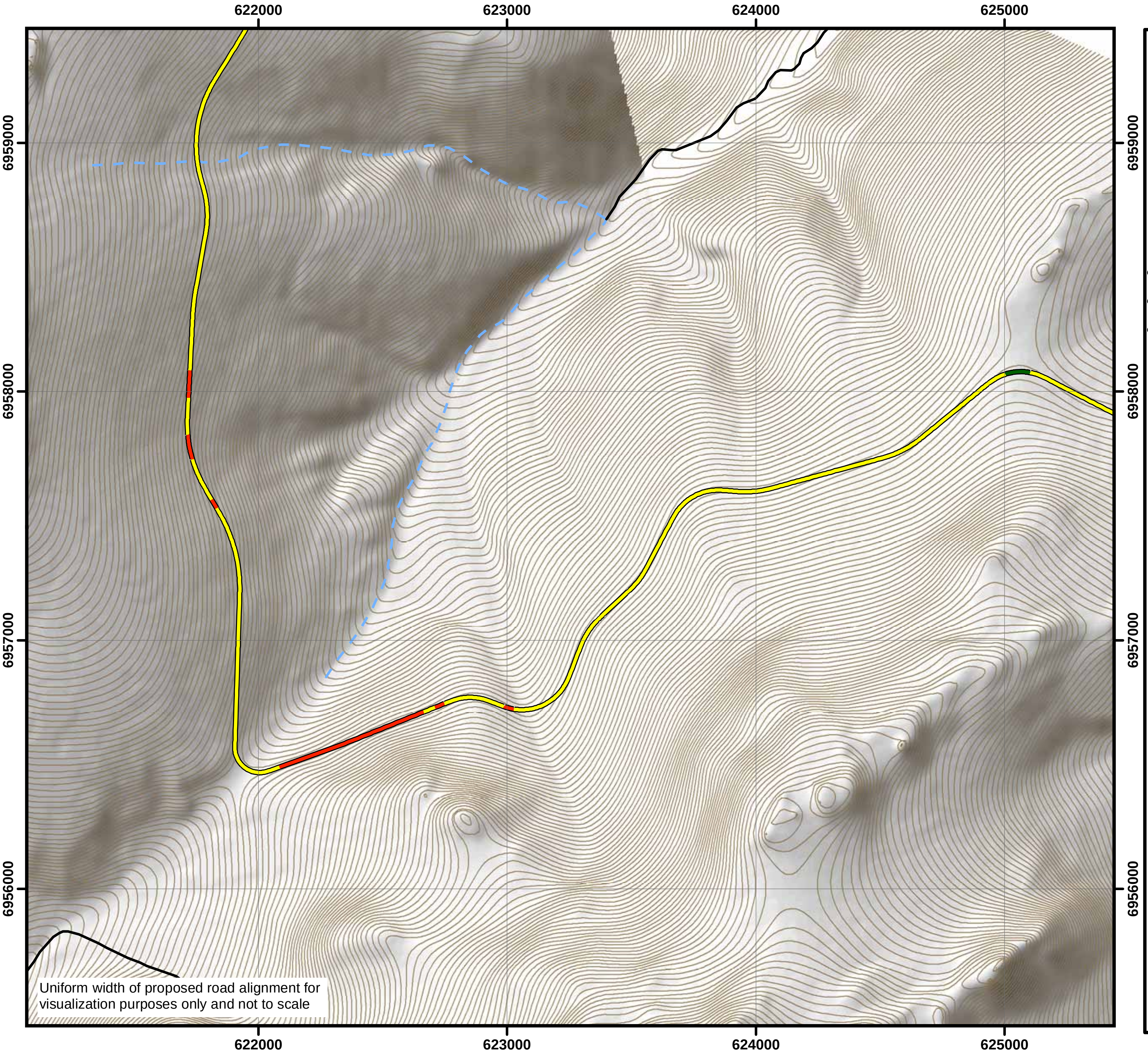
Map 1

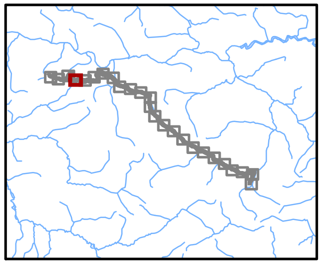
Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 21 of 25





Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

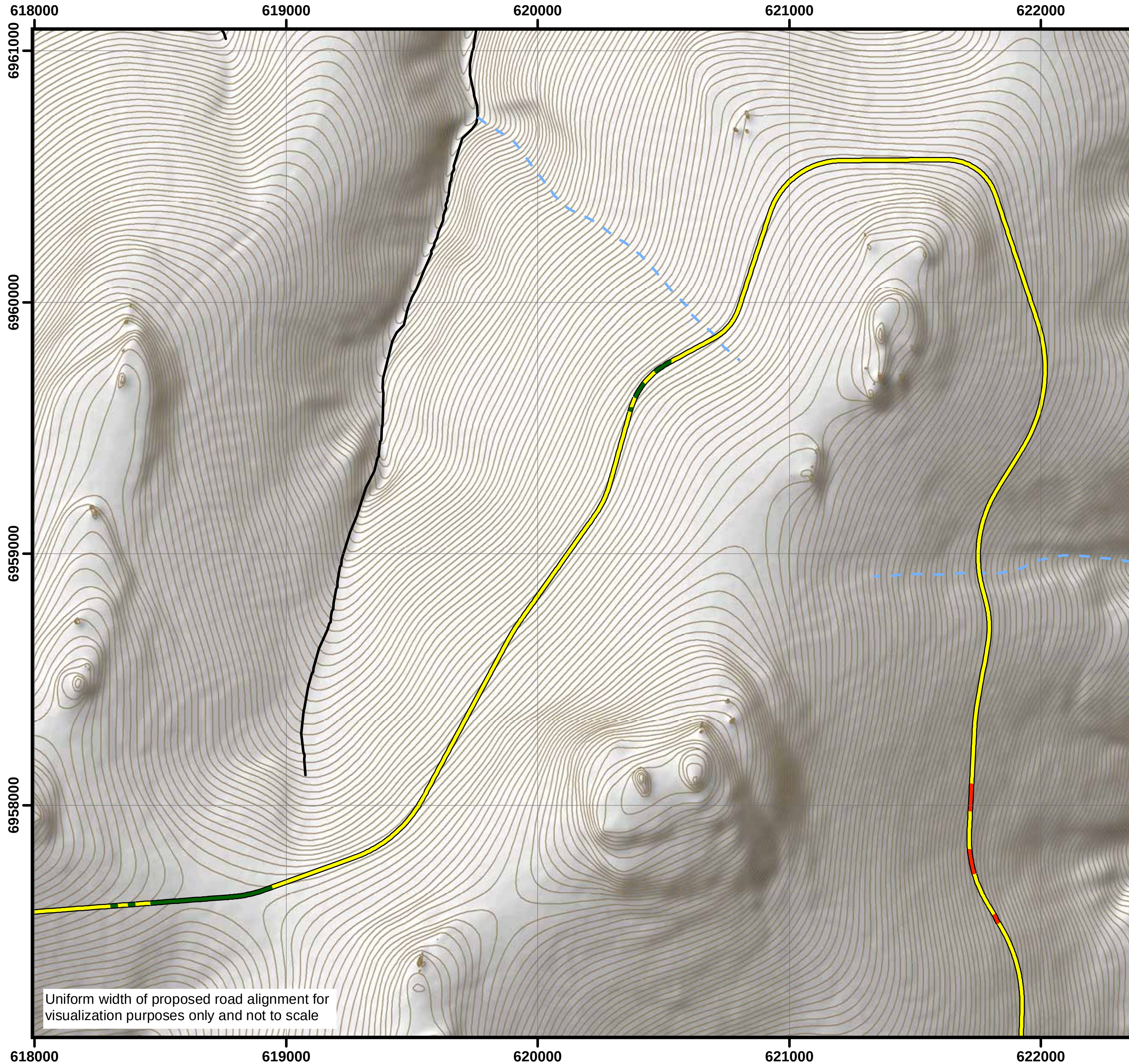
Map 1

Erosion Potential

CASiNO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 22 of 25



Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

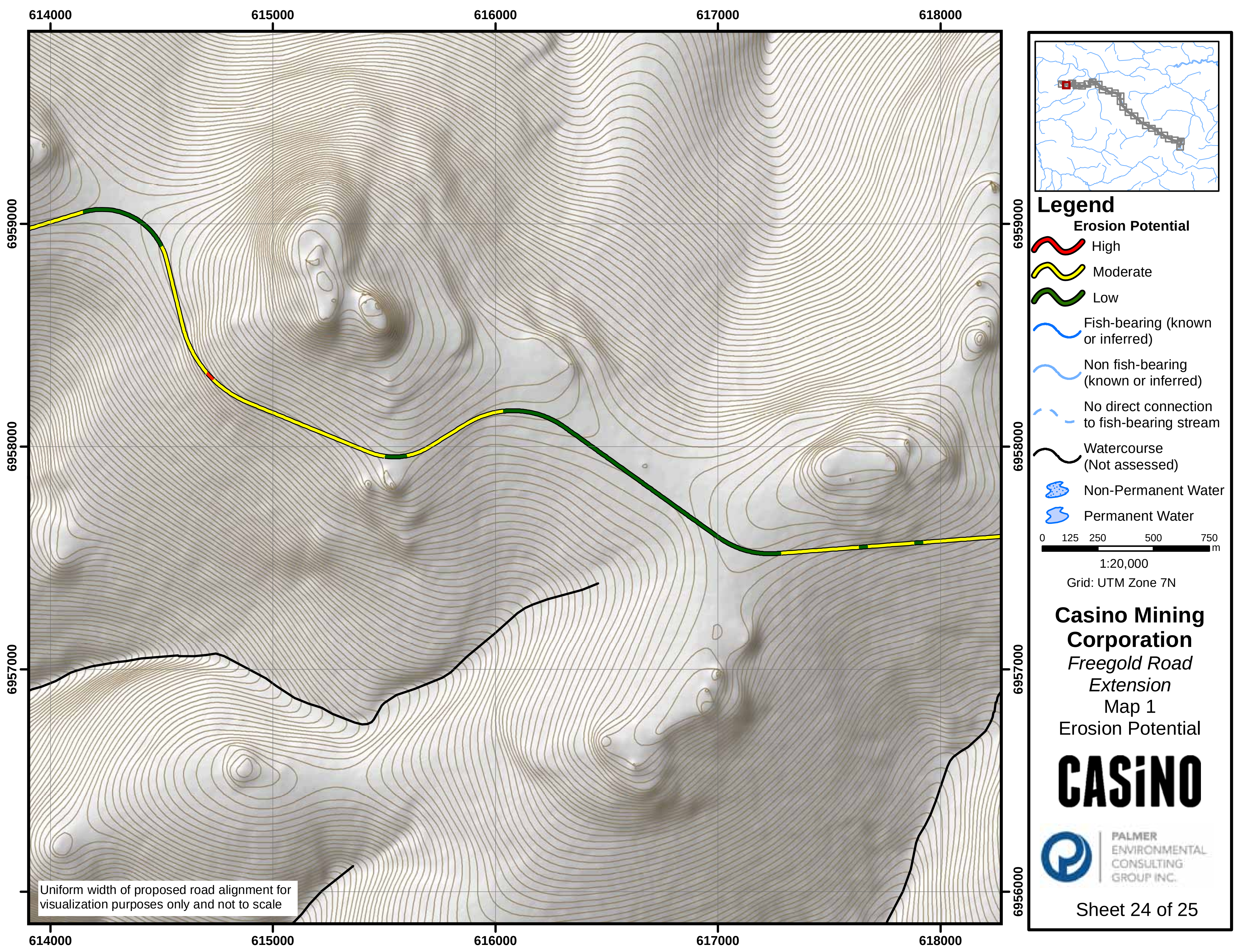
Freegold Road Extension

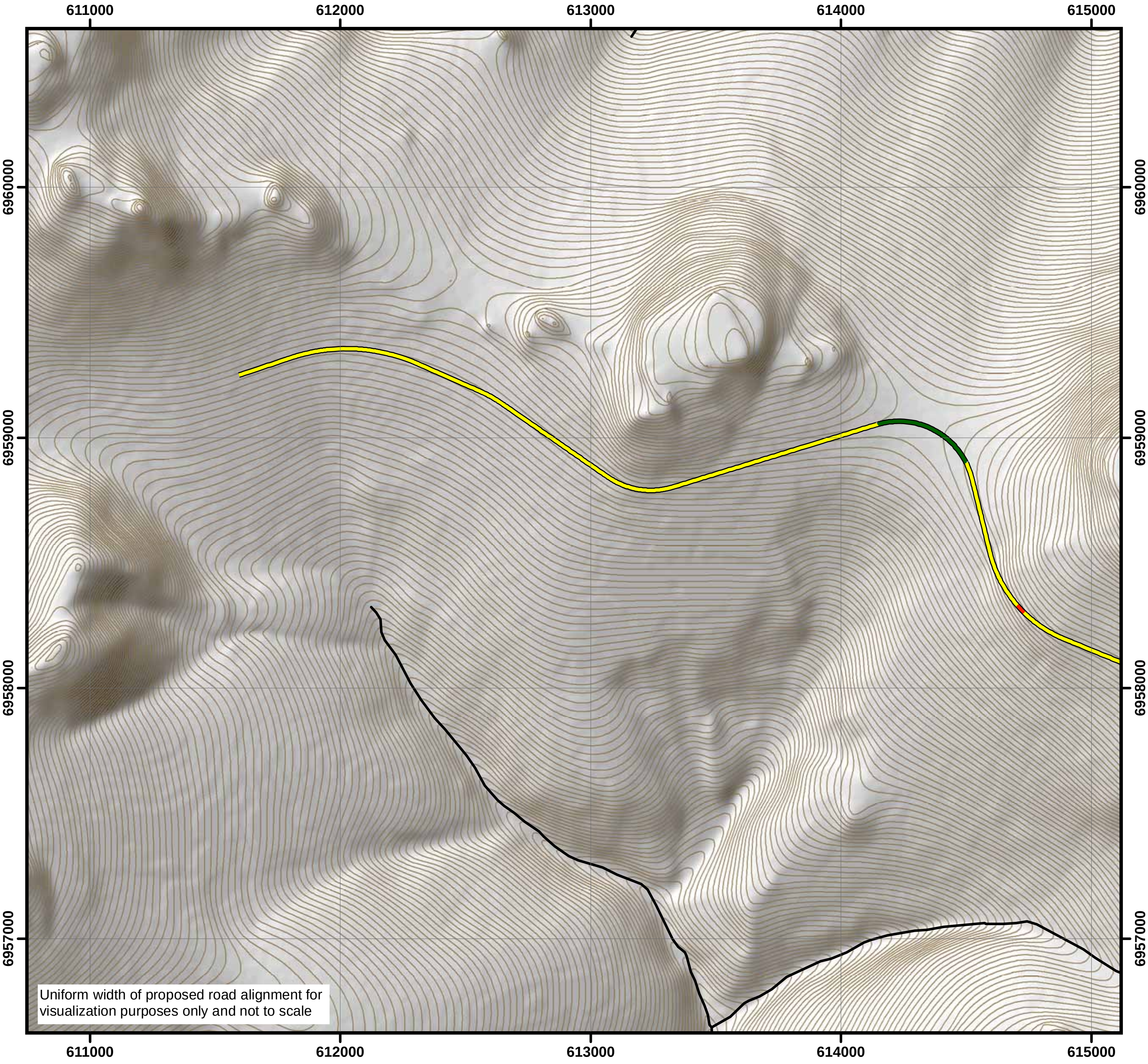
Map 1

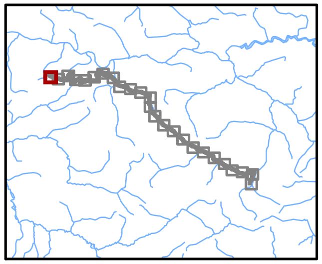
Erosion Potential

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 23 of 25


614000
615000
616000
617000
618000
6959000
6958000
6957000
6956000
Uniform width of proposed road alignment for visualization purposes only and not to scale
Legend
Erosion Potential
High
Moderate
Low
Fish-bearing (known or inferred)
Non fish-bearing (known or inferred)
No direct connection to fish-bearing stream
Watercourse (Not assessed)
Non-Permanent Water
Permanent Water
0 125 250 500 750 m
1:20,000
Grid: UTM Zone 7N
Casino Mining Corporation
Freegold Road Extension
Map 1
Erosion Potential
CASINO
PALMER ENVIRONMENTAL CONSULTING GROUP INC.
Sheet 24 of 25





Legend

Erosion Potential

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

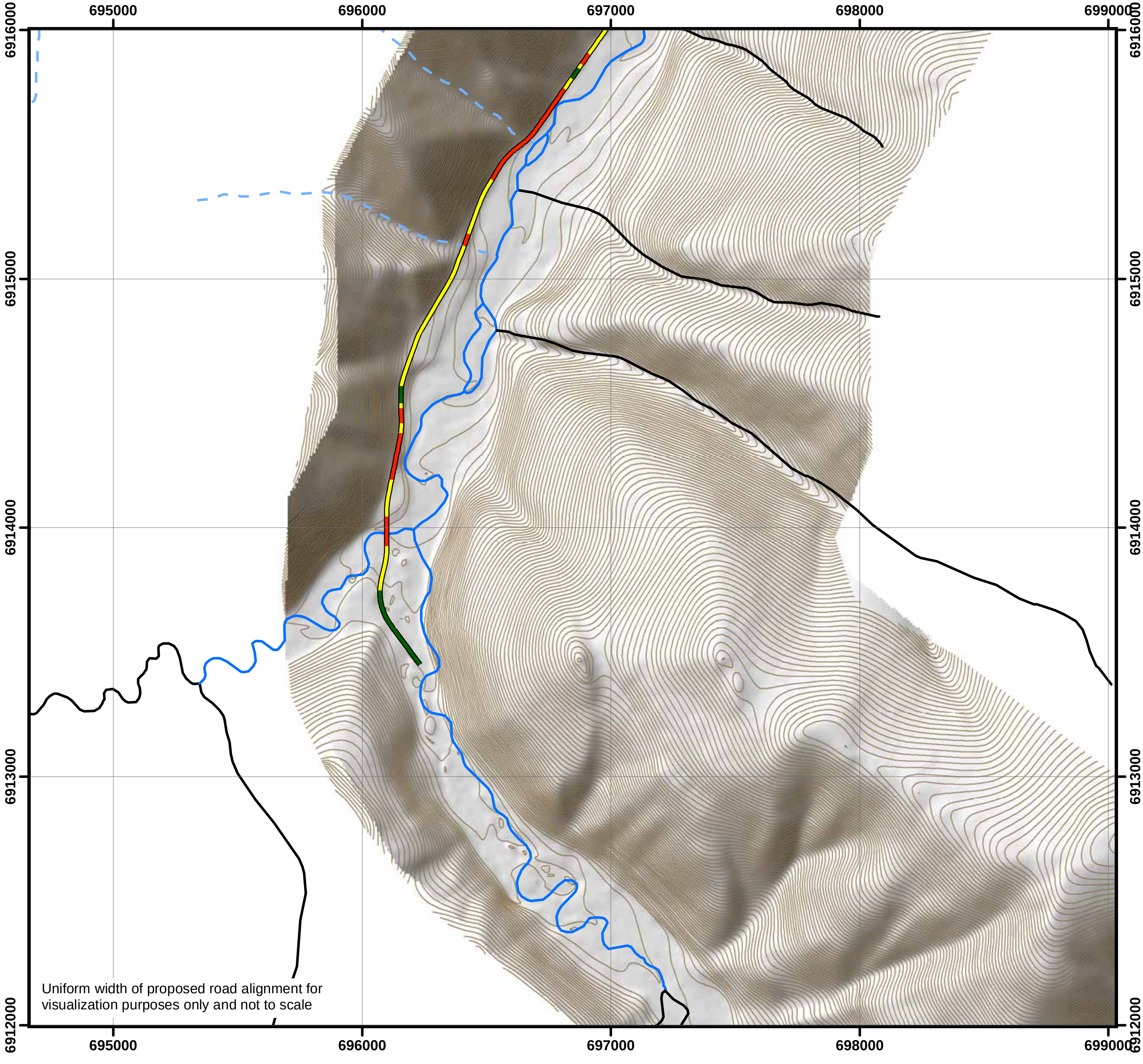
Freegold Road Extension

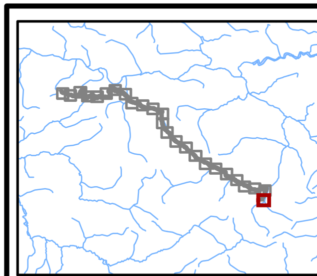
Map 1

Erosion Potential

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Potential Ecological Consequence

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

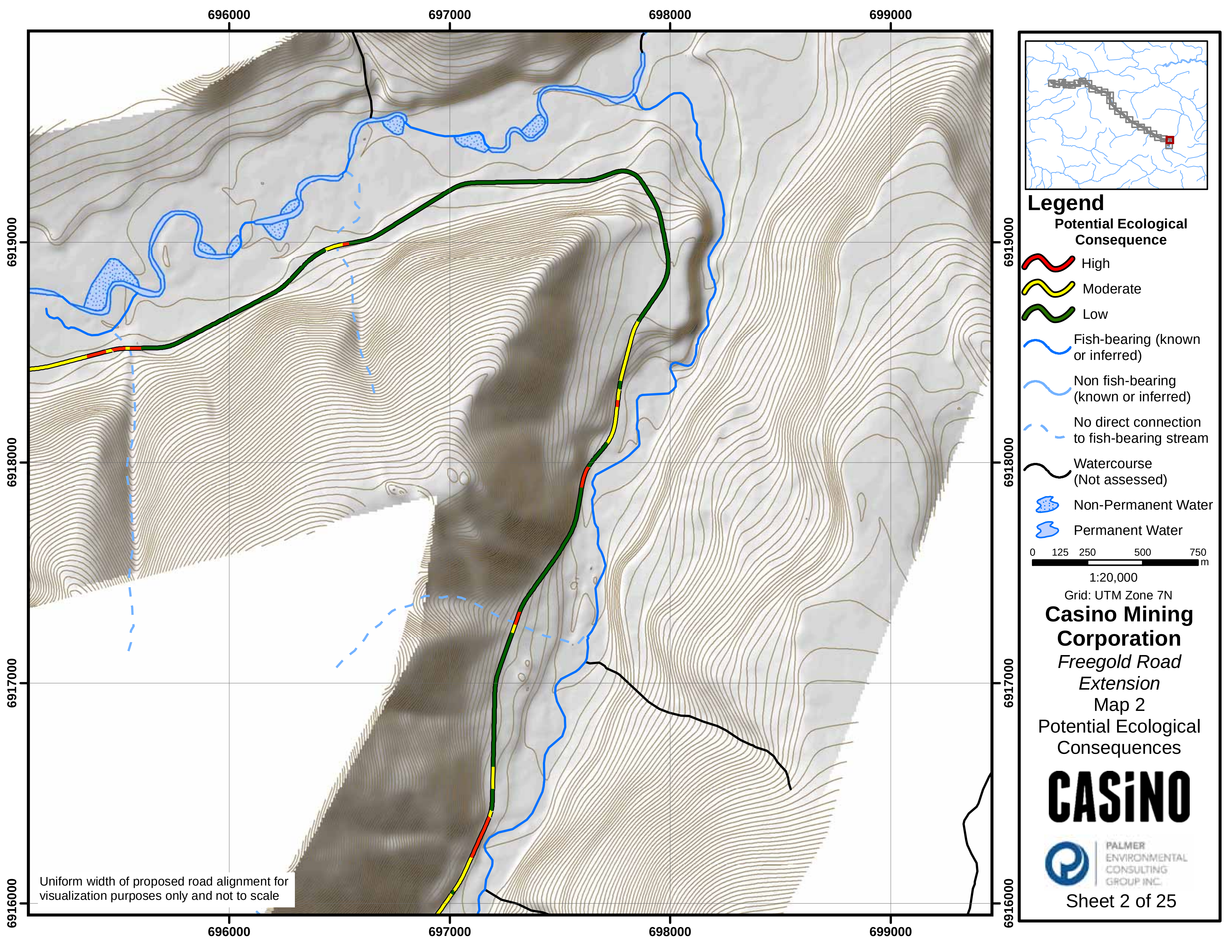
Map 2

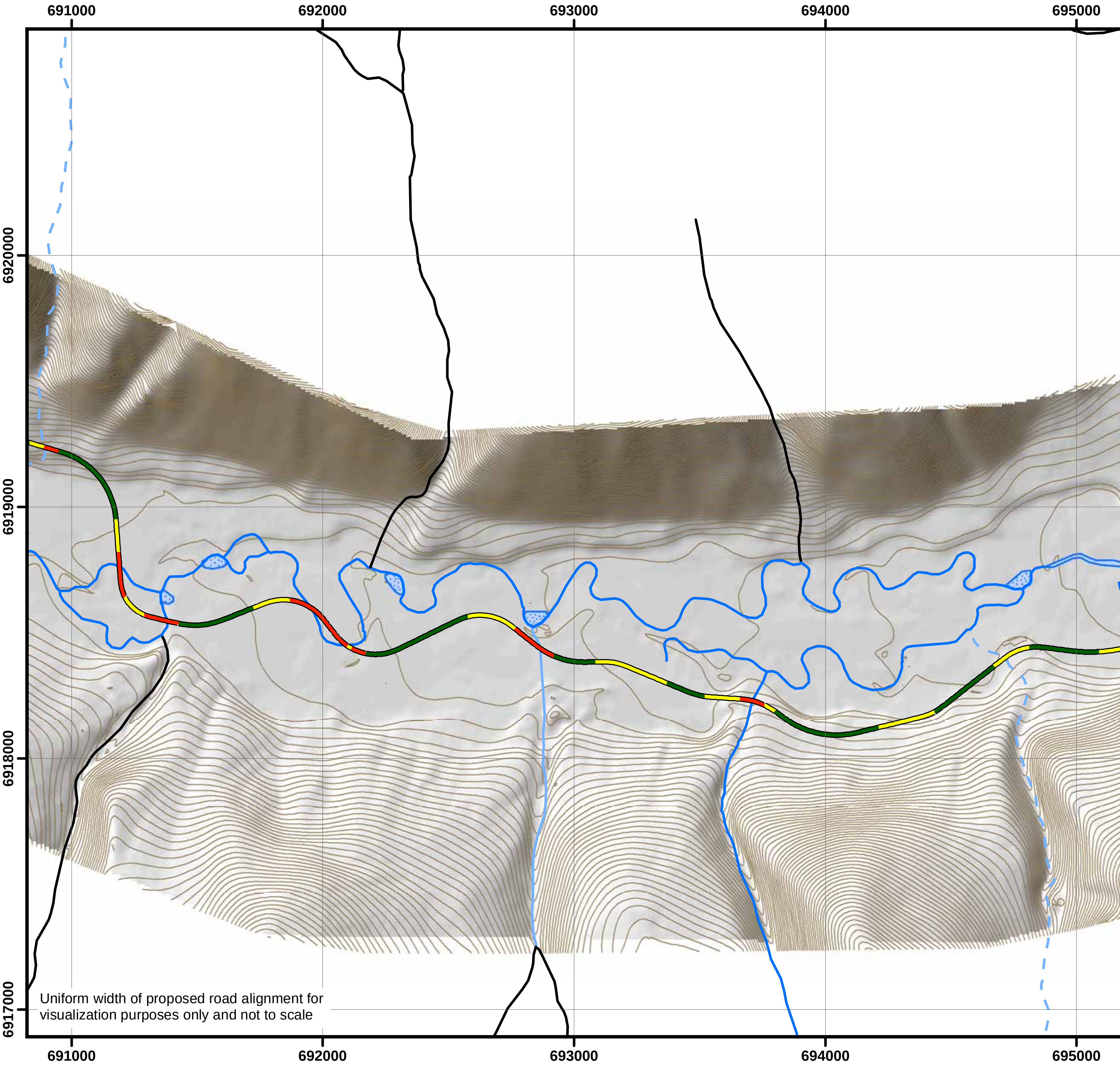
Potential Ecological Consequences

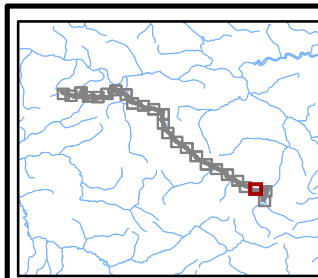
CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 1 of 25


696000
697000
698000
699000
6919000
6918000
6917000
6916000
Uniform width of proposed road alignment for
visualization purposes only and not to scale
Legend
Potential Ecological Consequence
High
Moderate
Low
Fish-bearing (known or inferred)
Non fish-bearing (known or inferred)
No direct connection to fish-bearing stream
Watercourse (Not assessed)
Non-Permanent Water
Permanent Water
0 125 250 500 750 m
1:20,000
Grid: UTM Zone 7N
Casino Mining Corporation
Freegold Road Extension
Map 2
Potential Ecological Consequences
CASINO
PALMER ENVIRONMENTAL CONSULTING GROUP INC.
Sheet 2 of 25





Legend

Potential Ecological Consequence

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

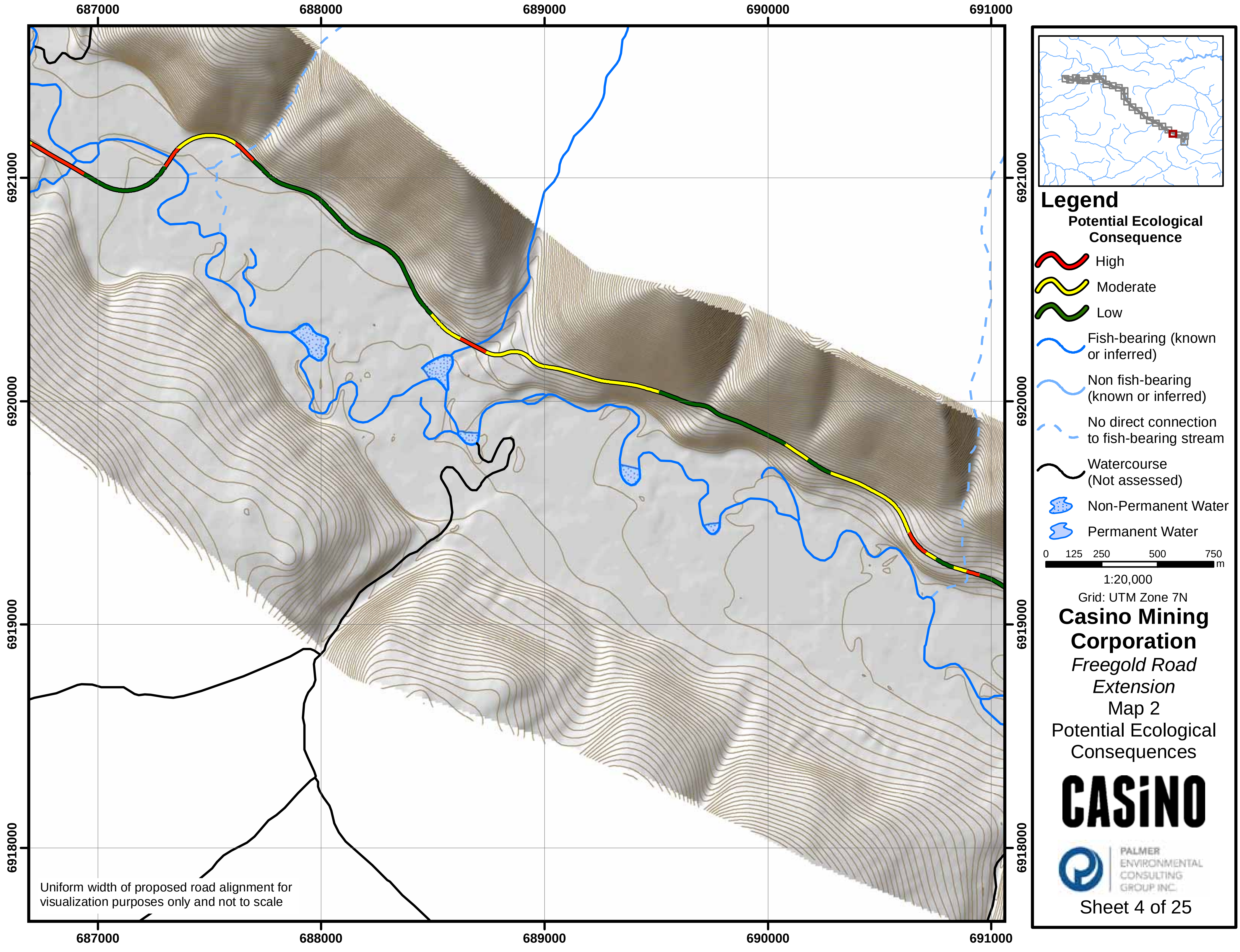
Freegold Road Extension

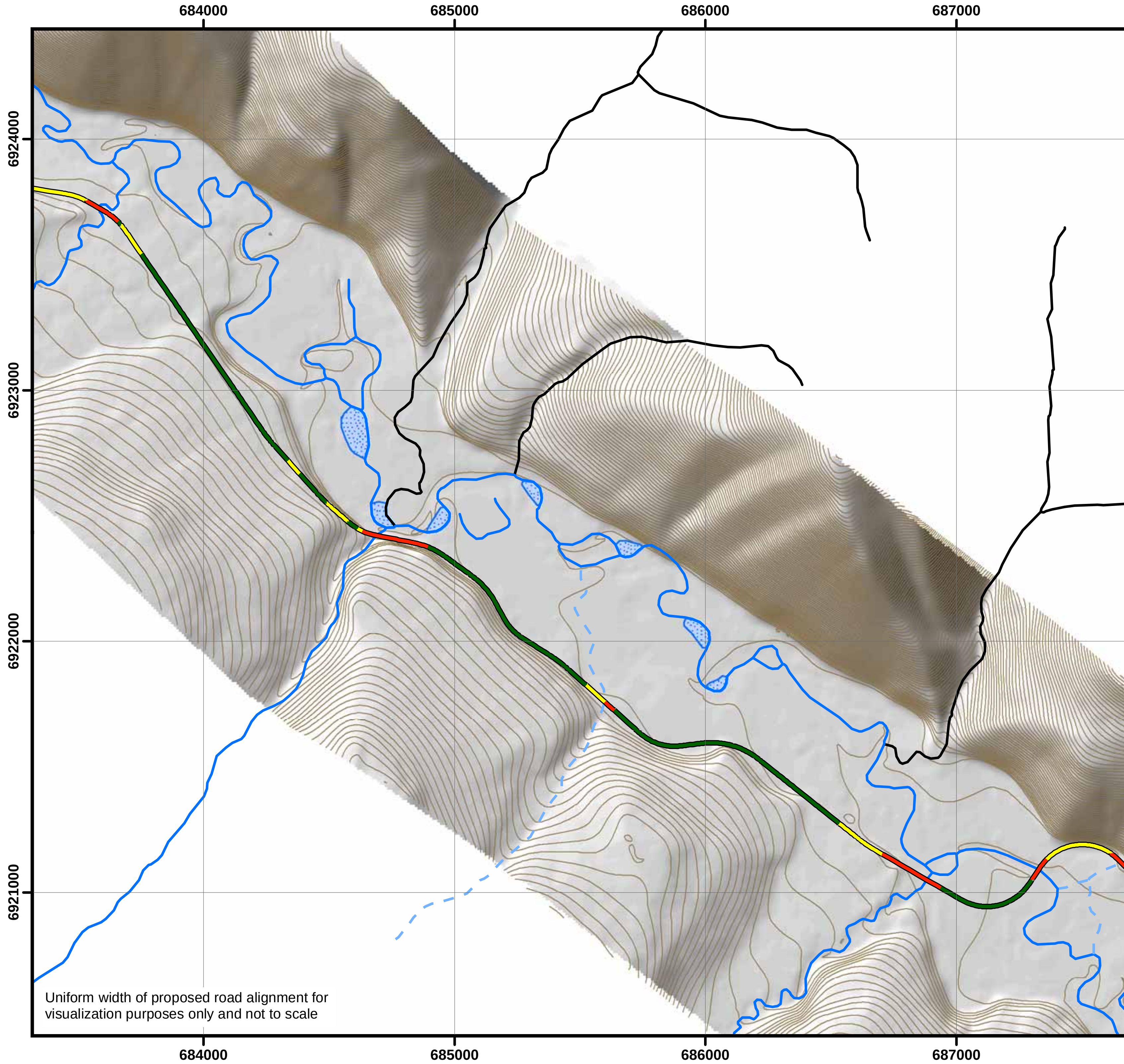
Map 2

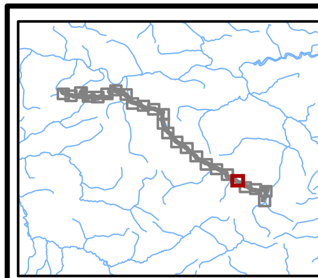
Potential Ecological Consequences

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.


687000
688000
689000
690000
691000
6921000
6920000
6919000
6918000
Uniform width of proposed road alignment for visualization purposes only and not to scale
Legend
Potential Ecological Consequence
High
Moderate
Low
Fish-bearing (known or inferred)
Non fish-bearing (known or inferred)
No direct connection to fish-bearing stream
Watercourse (Not assessed)
Non-Permanent Water
Permanent Water
0 125 250 500 750 m
1:20,000
Grid: UTM Zone 7N
Casino Mining Corporation
Freegold Road Extension
Map 2
Potential Ecological Consequences
CASINO
PALMER ENVIRONMENTAL CONSULTING GROUP INC.
Sheet 4 of 25





Legend

Potential Ecological Consequence

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

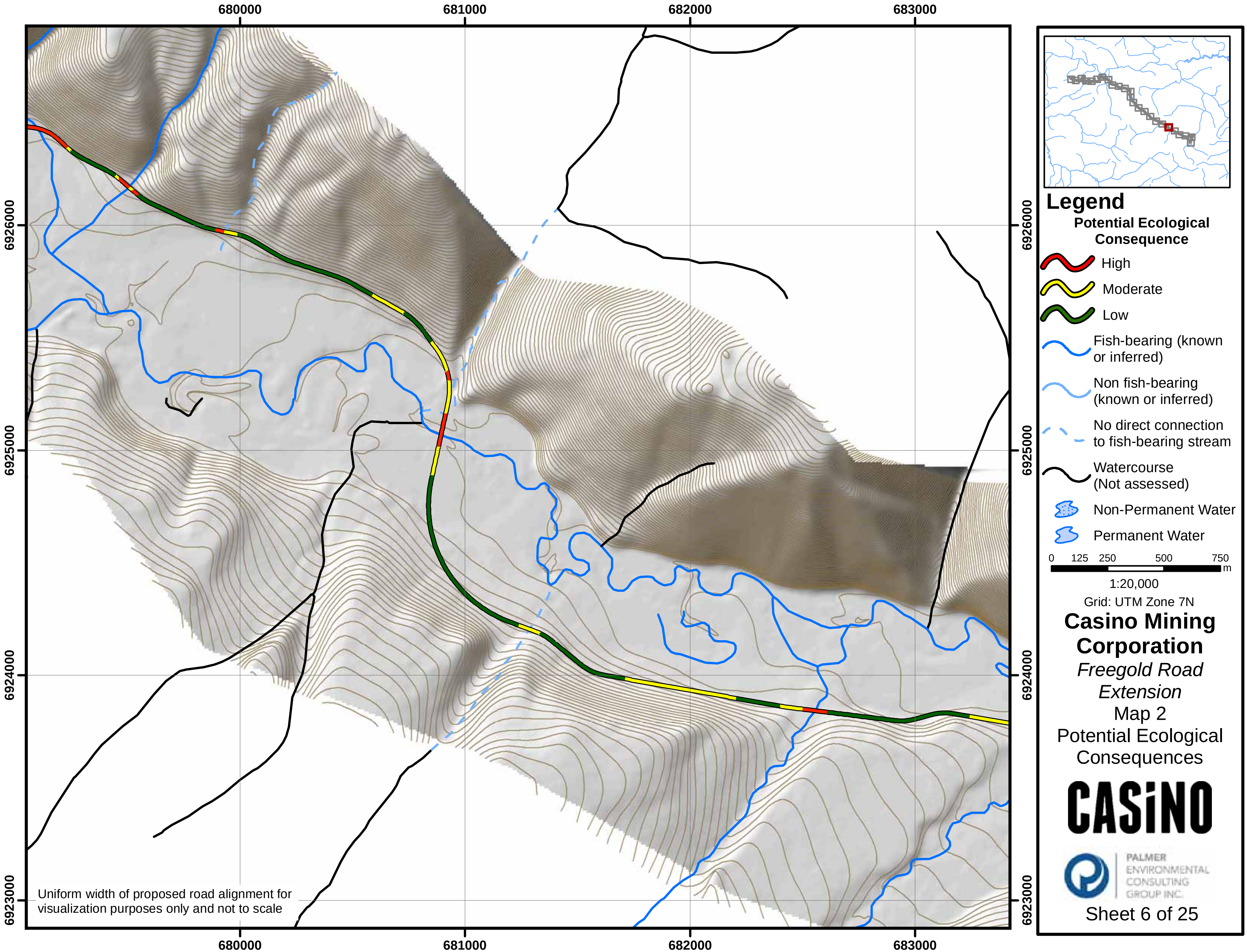
Map 2

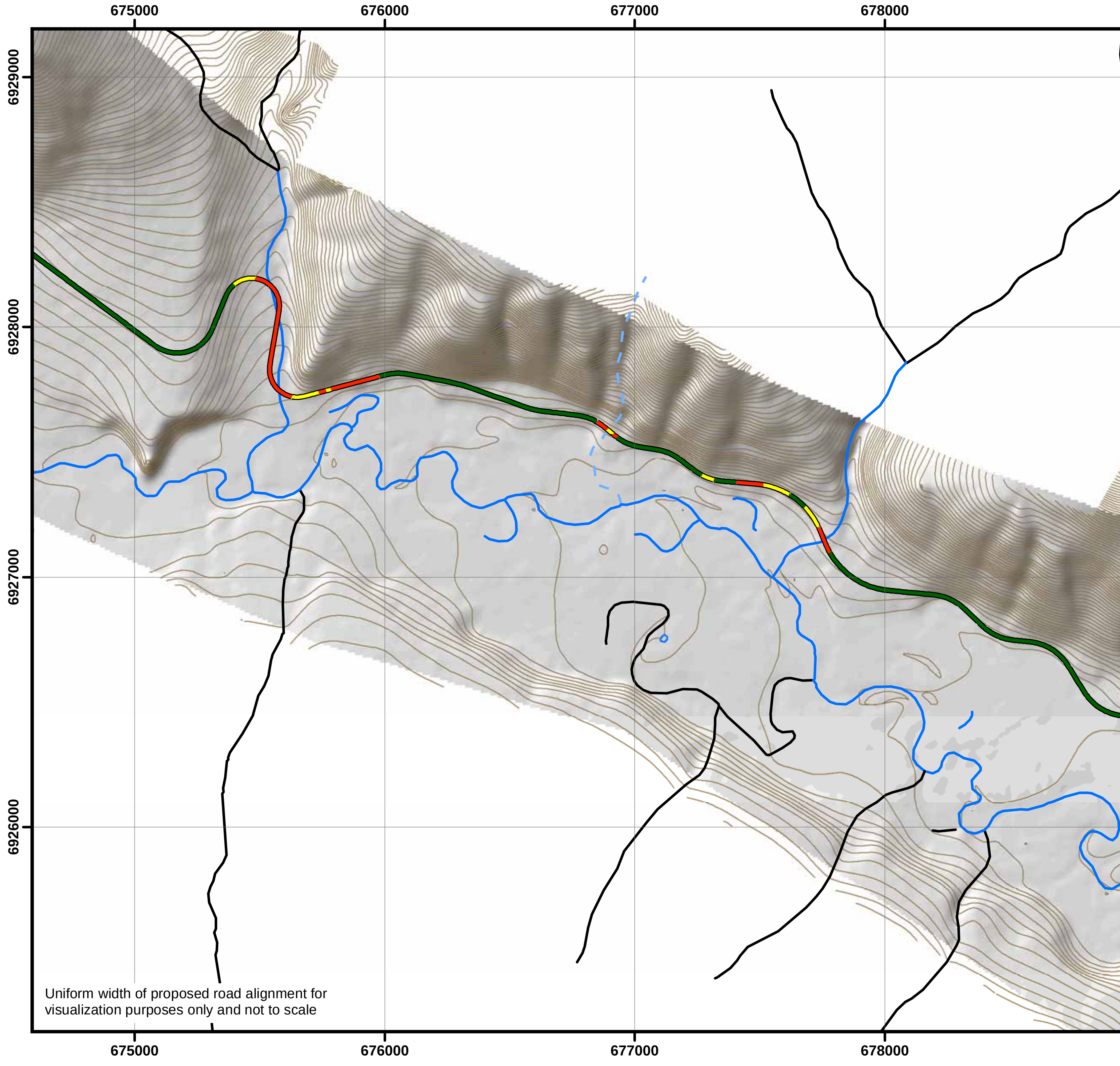
Potential Ecological Consequences

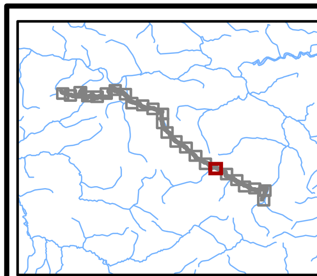
CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 5 of 25


680000
681000
682000
683000
6926000
6925000
6924000
6923000
Uniform width of proposed road alignment for visualization purposes only and not to scale
Legend
Potential Ecological Consequence
High
Moderate
Low
Fish-bearing (known or inferred)
Non fish-bearing (known or inferred)
No direct connection to fish-bearing stream
Watercourse (Not assessed)
Non-Permanent Water
Permanent Water
0 125 250 500 750 m
1:20,000
Grid: UTM Zone 7N
Casino Mining Corporation
Freegold Road Extension
Map 2
Potential Ecological Consequences
CASINO
PALMER ENVIRONMENTAL CONSULTING GROUP INC.
Sheet 6 of 25





Legend

Potential Ecological Consequence

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

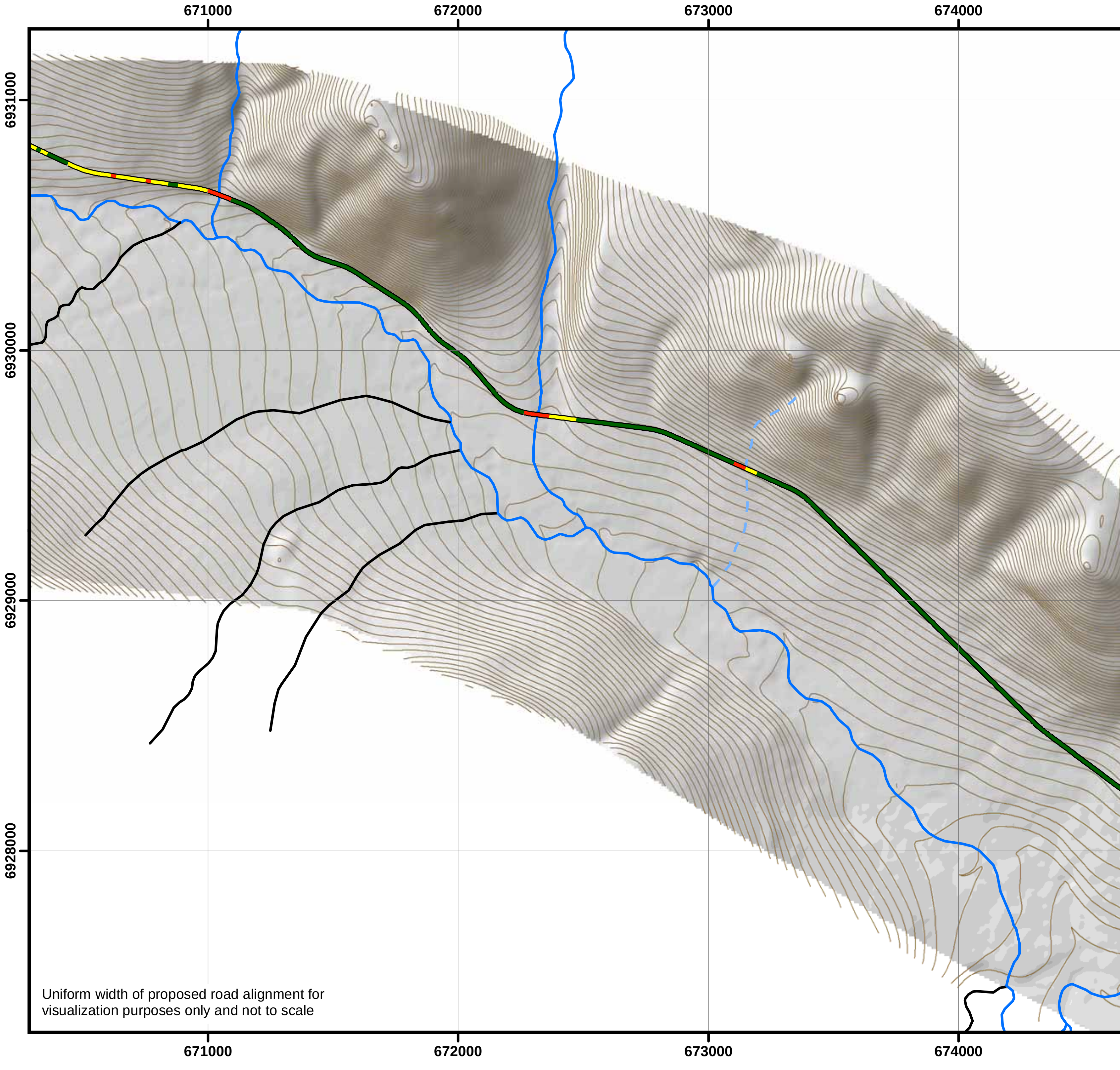
Map 2

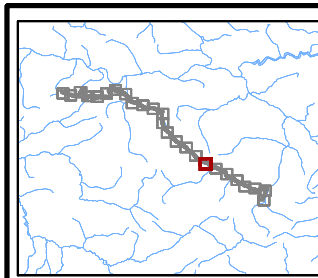
Potential Ecological Consequences

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 7 of 25





Legend

Potential Ecological Consequence

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

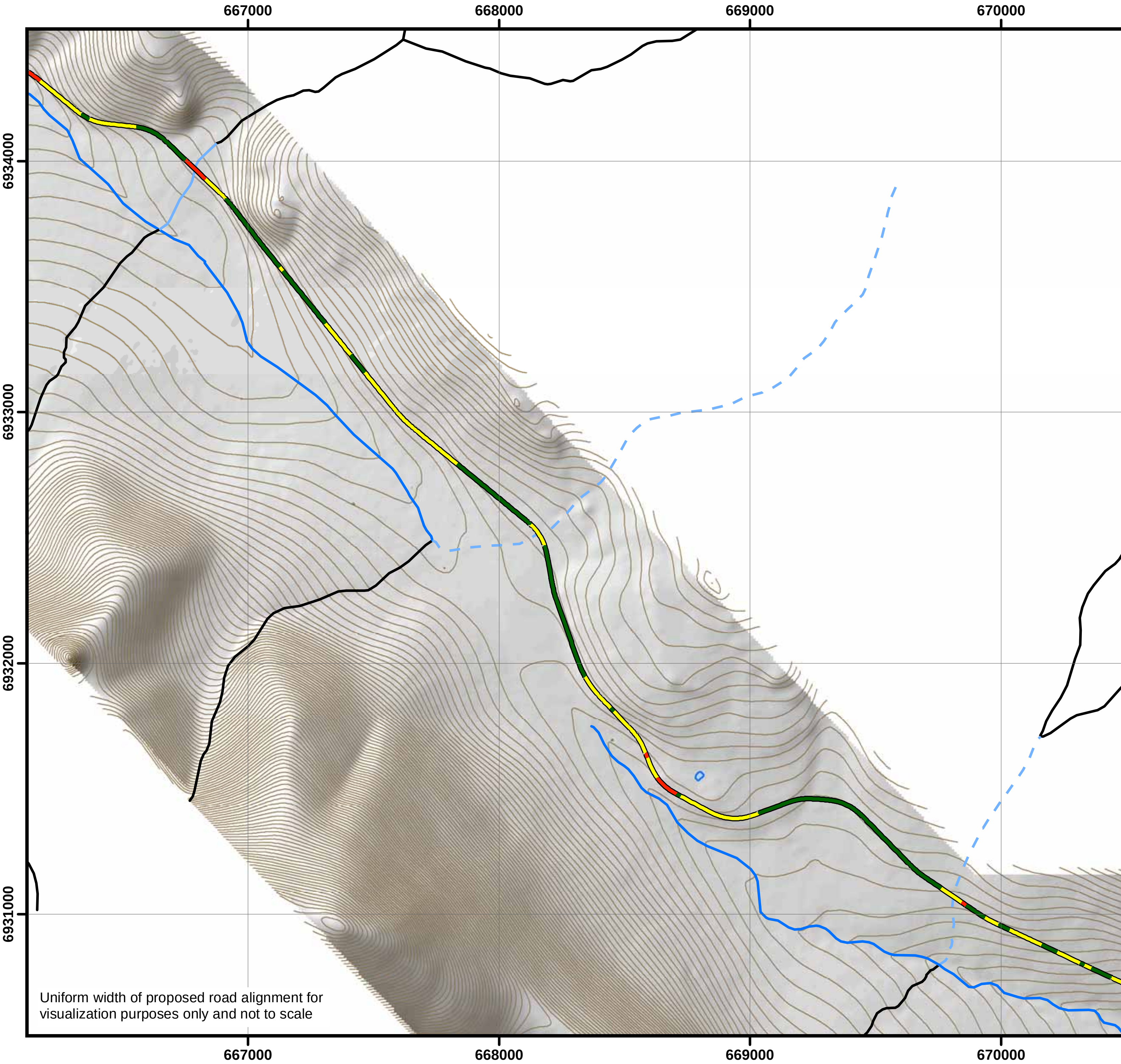
Freegold Road Extension

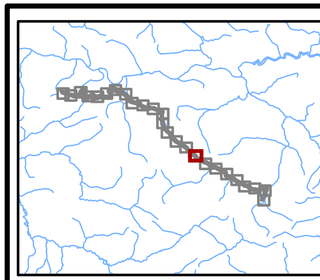
Map 2

Potential Ecological Consequences

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Potential Ecological Consequence

High
Moderate
Low
Fish-bearing (known or inferred)
Non fish-bearing (known or inferred)
No direct connection to fish-bearing stream
Watercourse (Not assessed)
Non-Permanent Water
Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

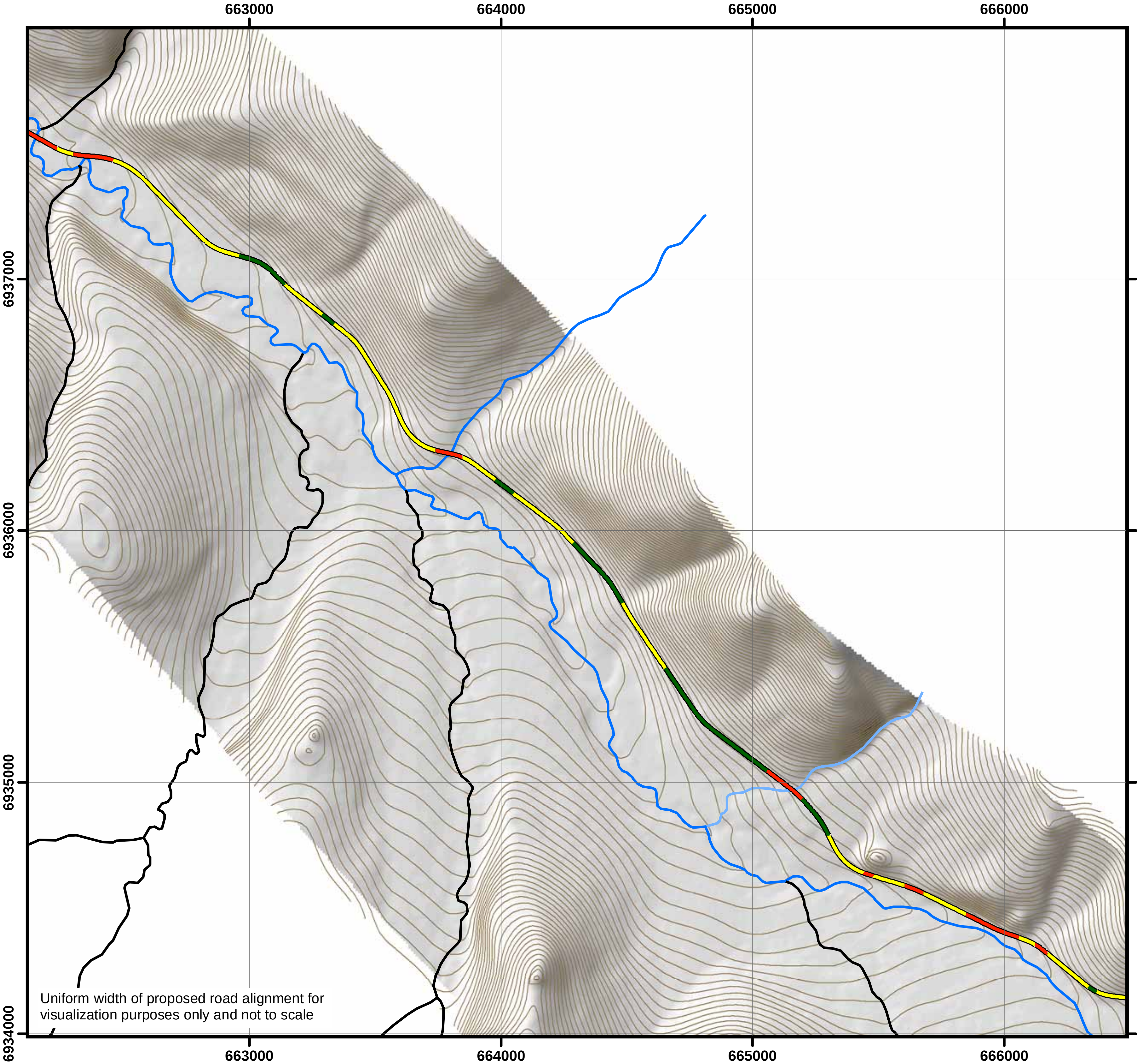
Casino Mining Corporation

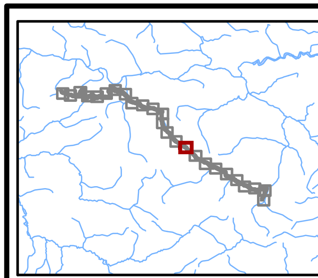
Freegold Road Extension

Map 2
Potential Ecological Consequences

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Potential Ecological Consequence

High

Moderate

Low

Fish-bearing (known or inferred)

Non fish-bearing (known or inferred)

No direct connection to fish-bearing stream

Watercourse (Not assessed)

Non-Permanent Water

Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

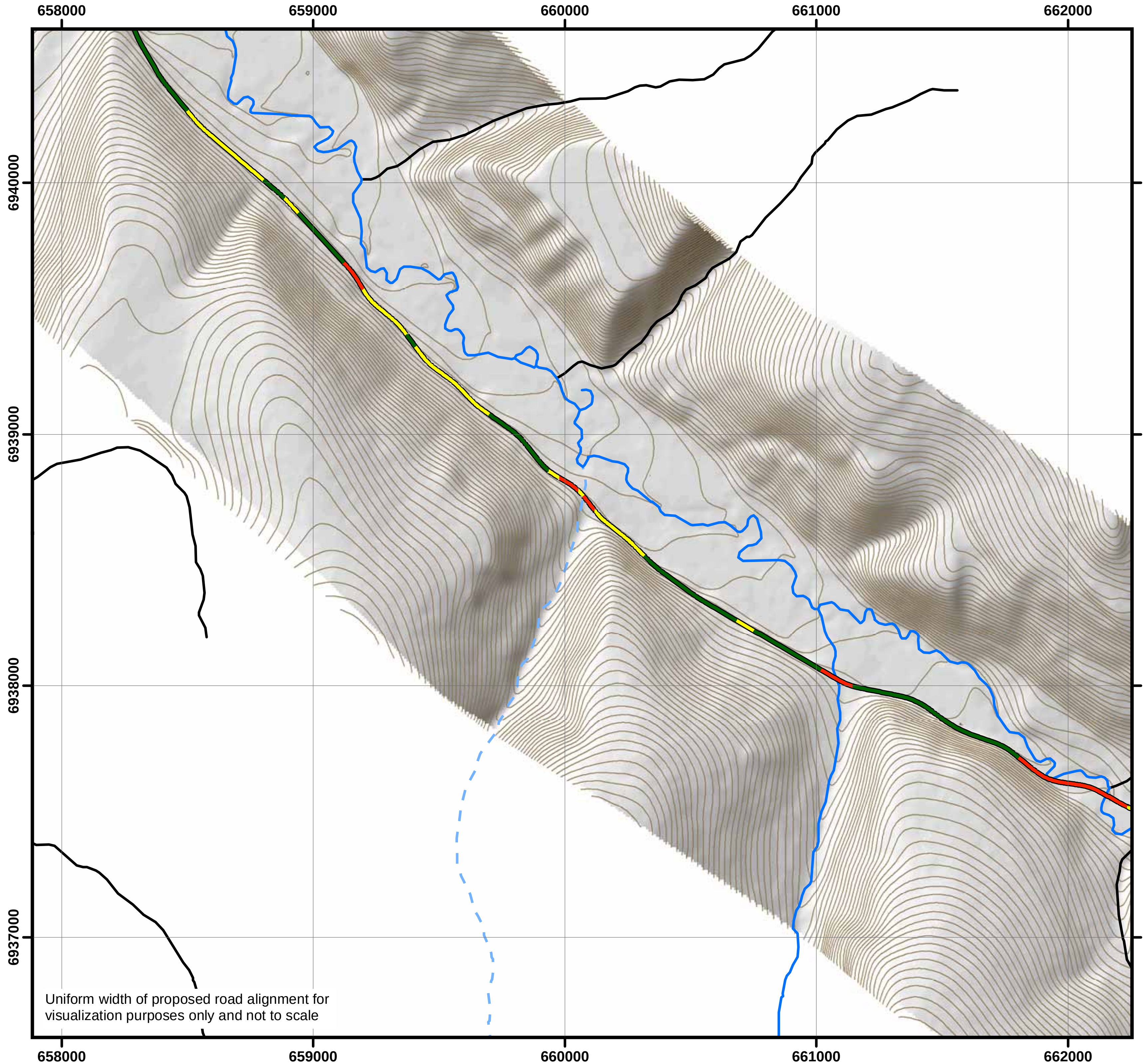
Map 2

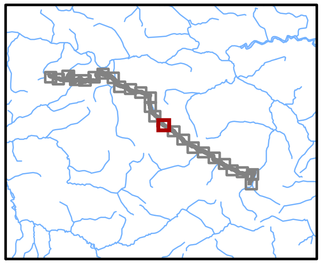
Potential Ecological Consequences

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 10 of 25





Legend

Potential Ecological Consequence

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

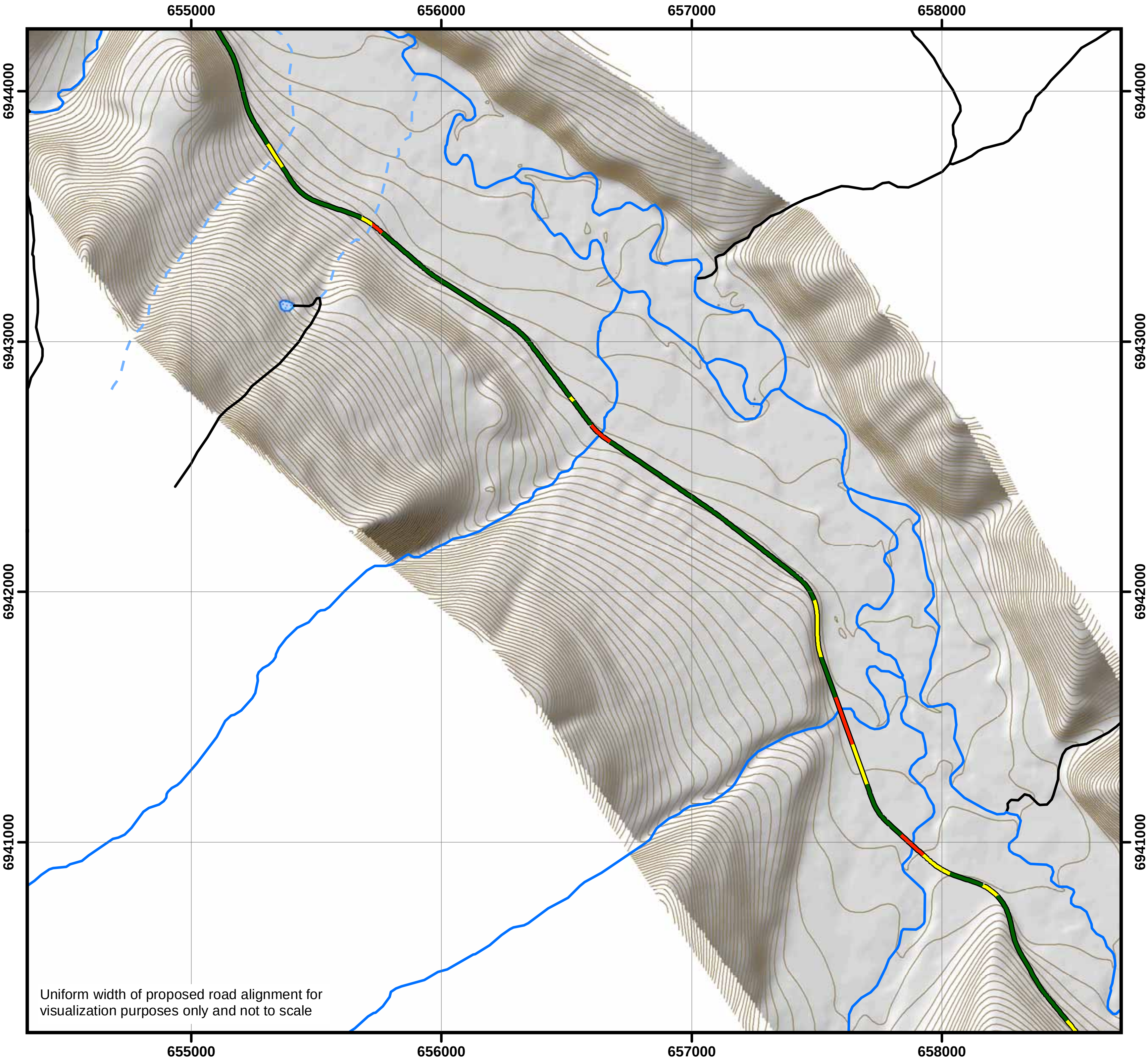
Freegold Road Extension

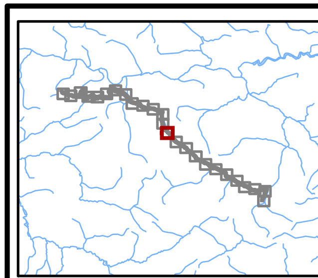
Map 2

Potential Ecological Consequences

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Potential Ecological Consequence

High
Moderate
Low
Fish-bearing (known or inferred)
Non fish-bearing (known or inferred)
No direct connection to fish-bearing stream
Watercourse (Not assessed)
Non-Permanent Water
Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

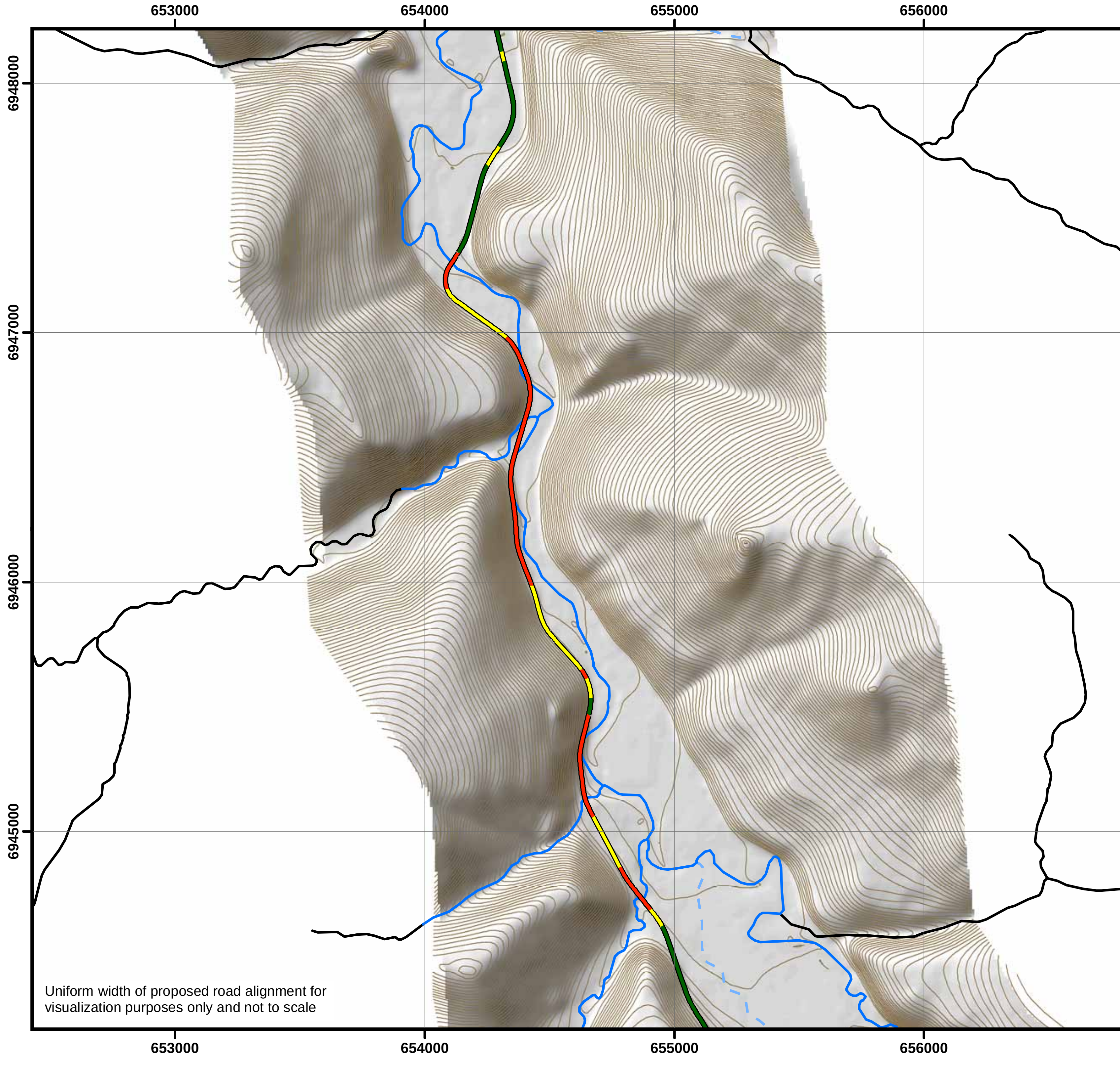
Freegold Road Extension

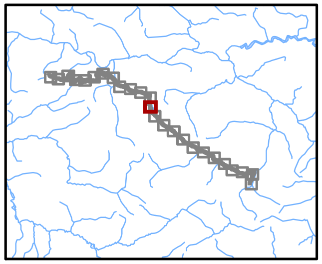
Map 2

Potential Ecological Consequences

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Potential Ecological Consequence

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

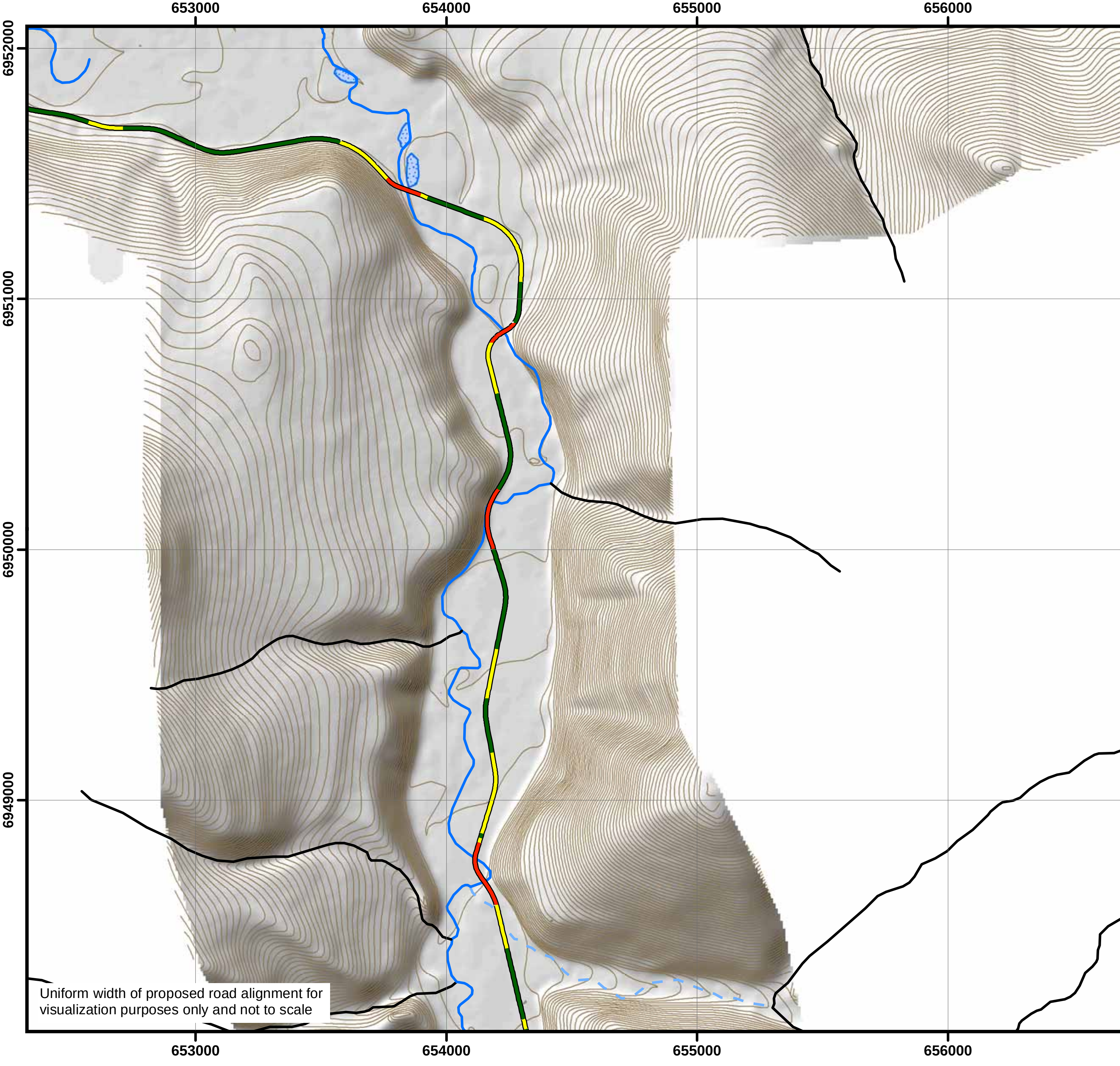
Freegold Road Extension

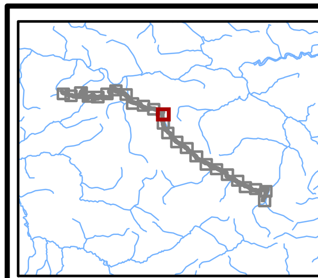
Map 2

Potential Ecological Consequences

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Potential Ecological Consequence

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

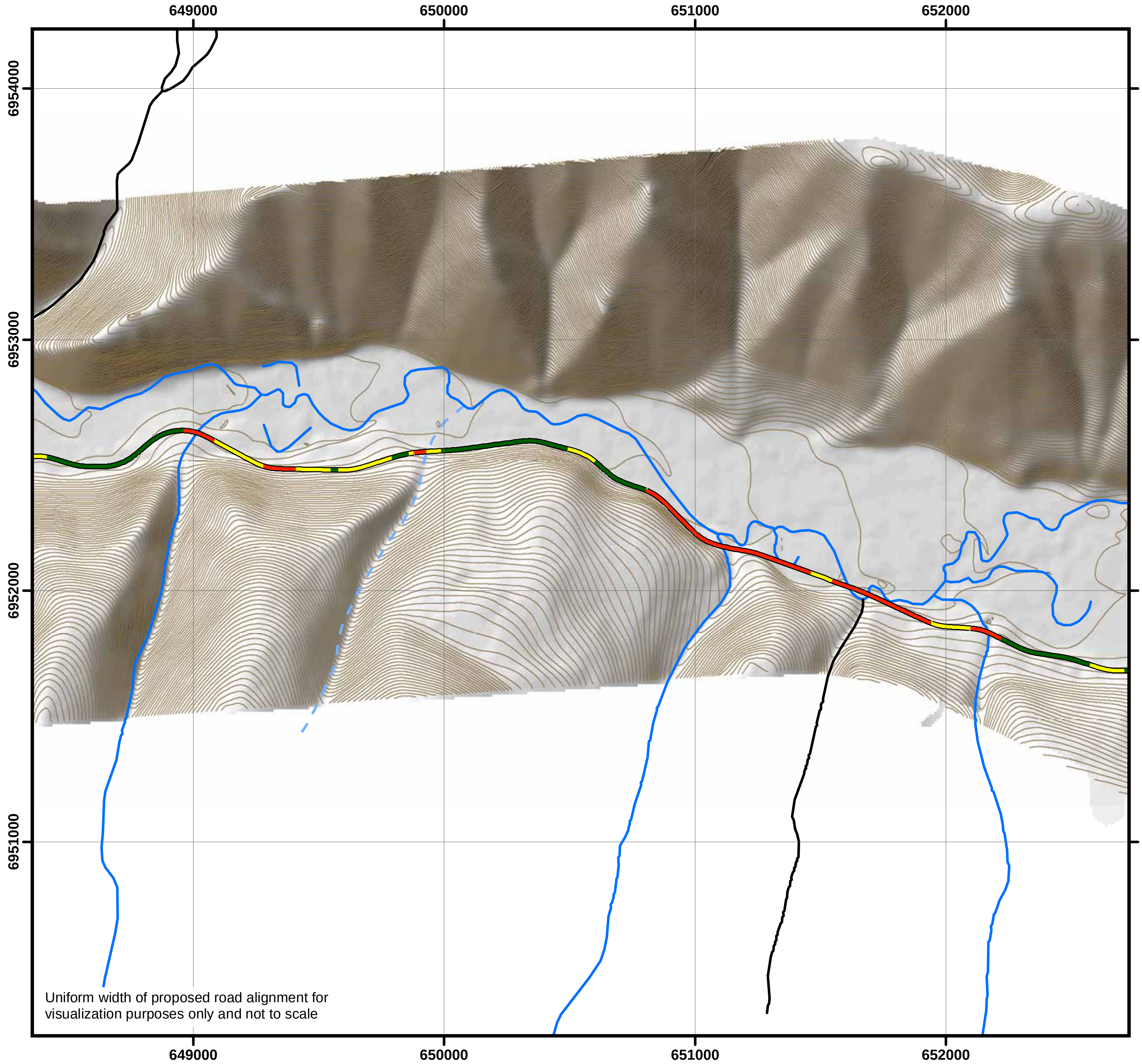
Freegold Road Extension

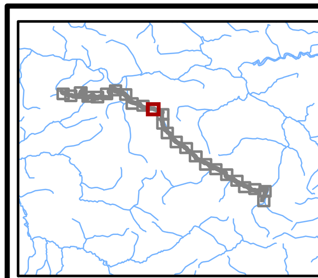
Map 2

Potential Ecological Consequences

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 14 of 25





Legend

Potential Ecological Consequence

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

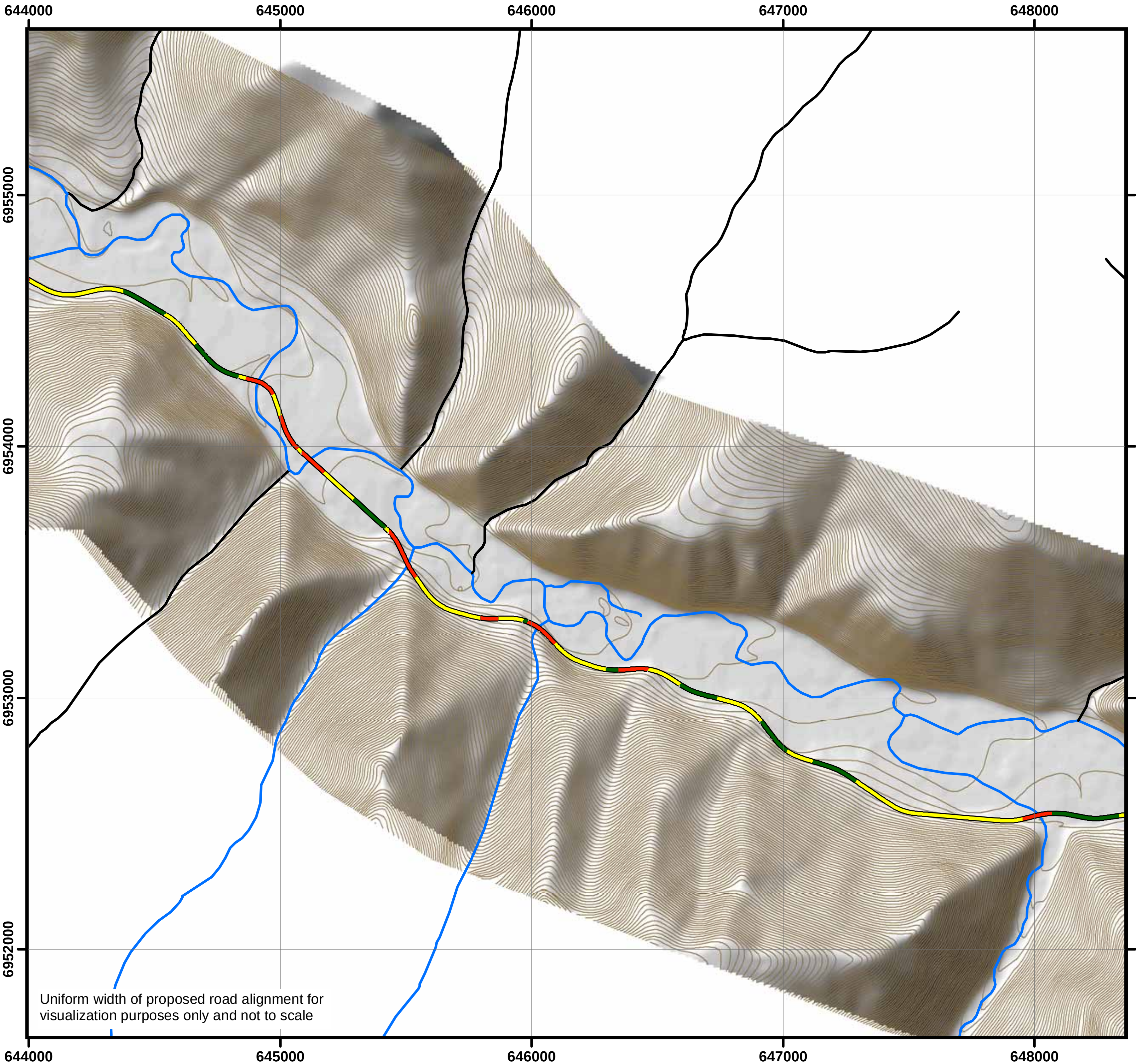
Map 2

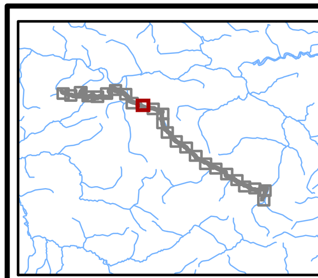
Potential Ecological Consequences

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 15 of 25





Legend

Potential Ecological Consequence

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

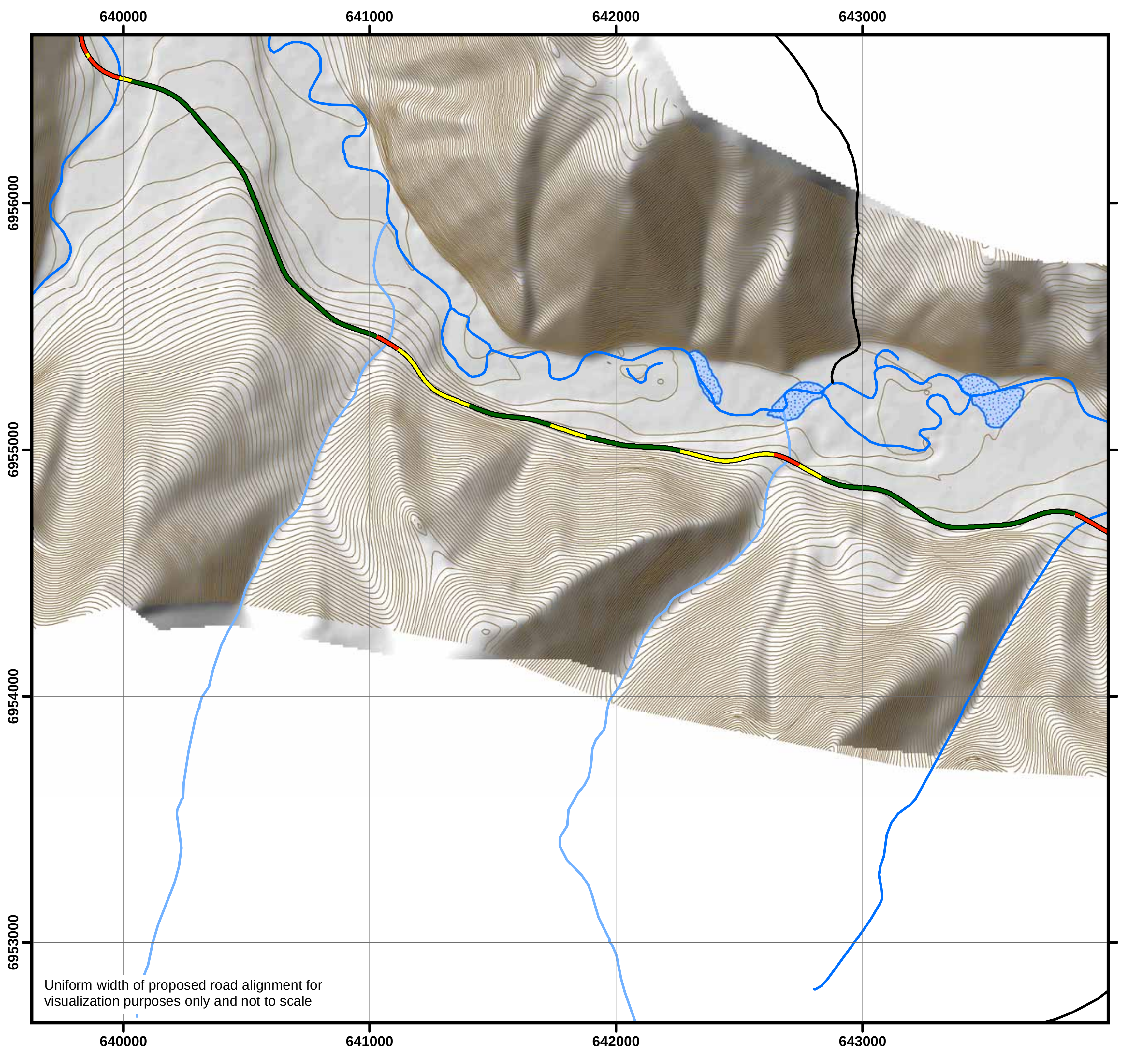
Freegold Road Extension

Map 2

Potential Ecological Consequences

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.



Legend

Potential Ecological Consequence

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

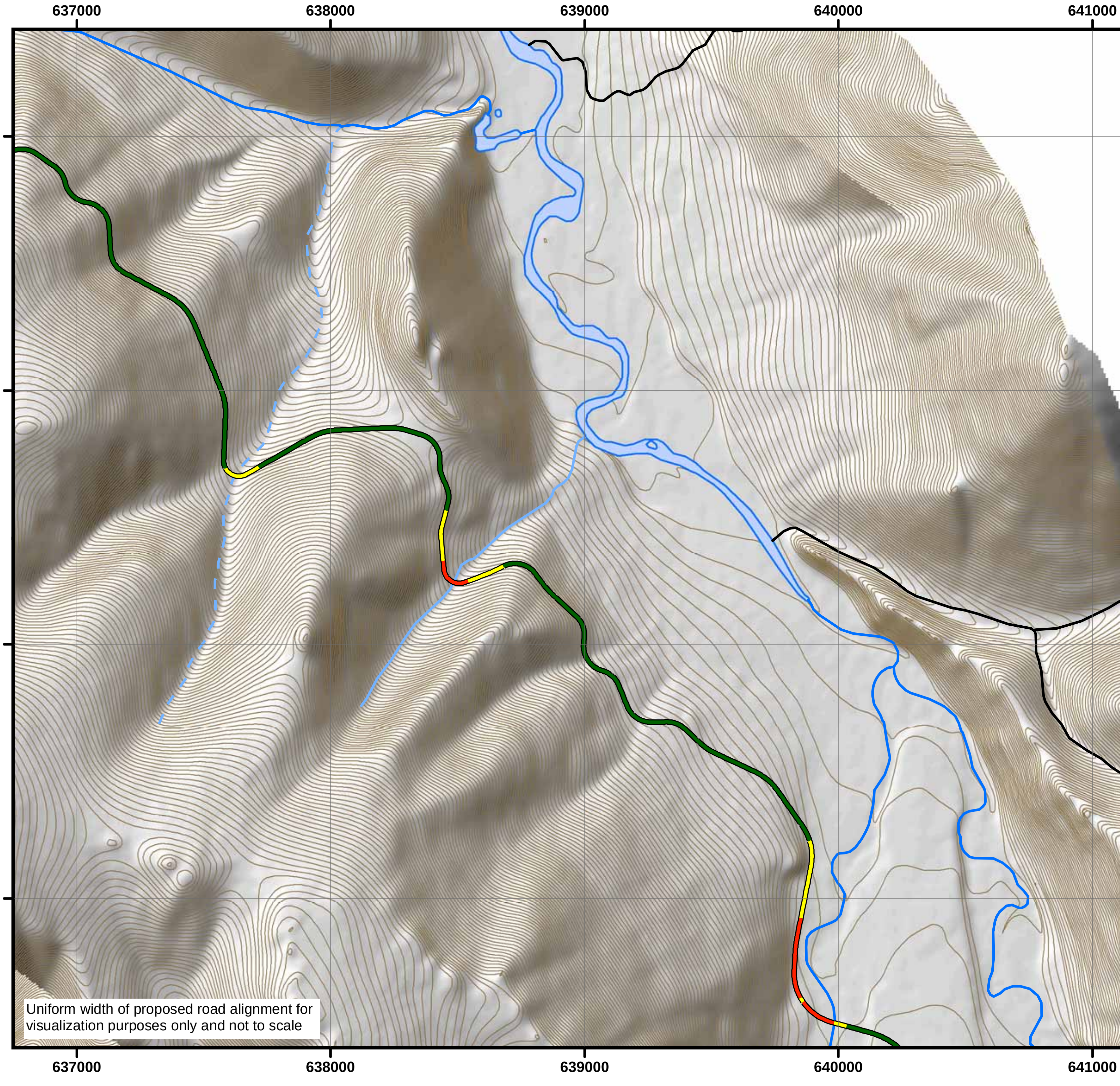
Freegold Road Extension

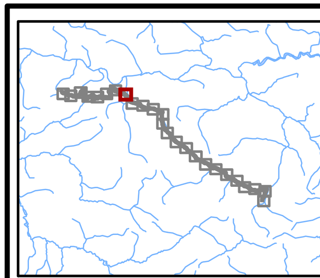
Map 2

Potential Ecological Consequences

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Potential Ecological Consequence

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

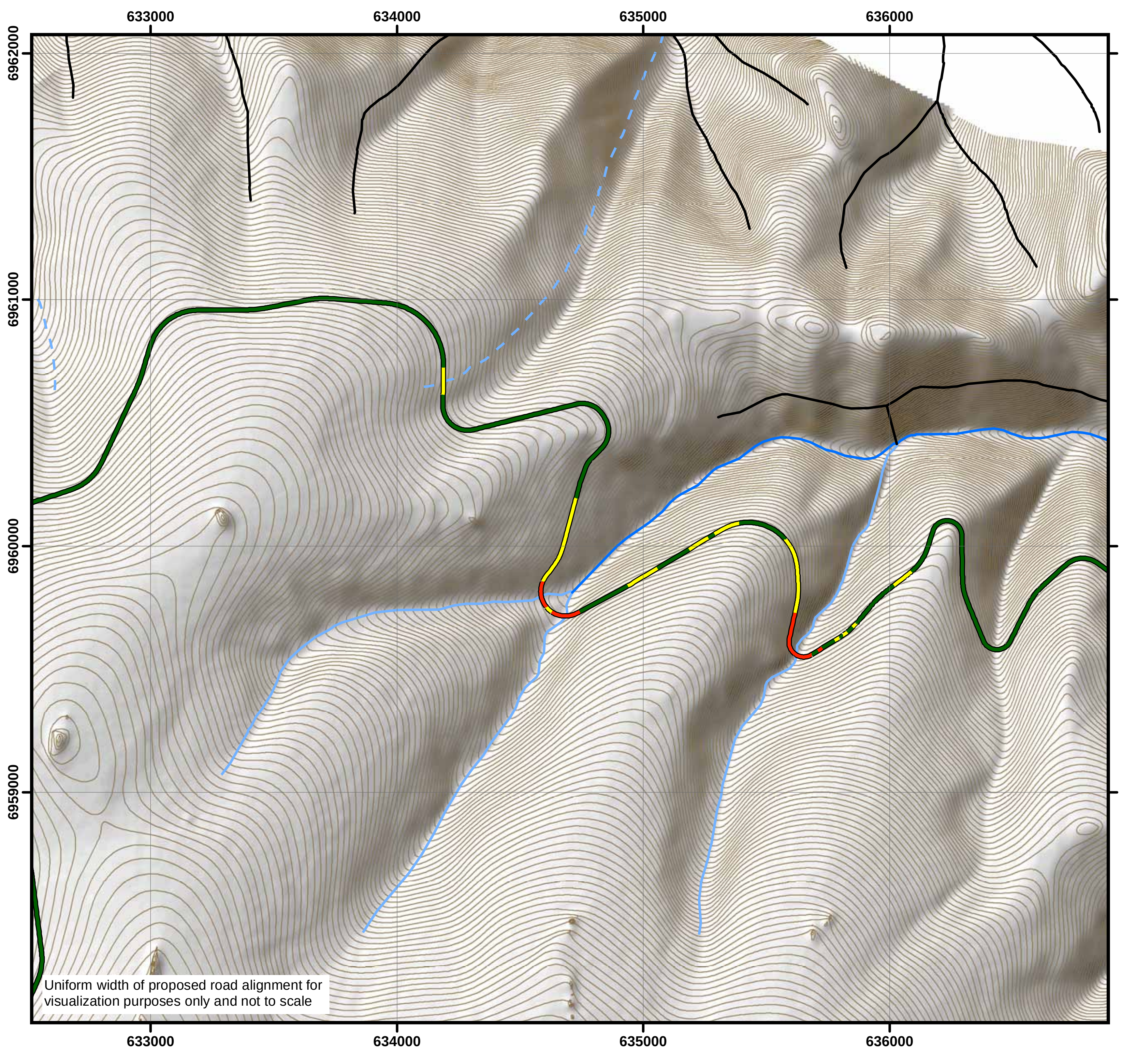
Map 2

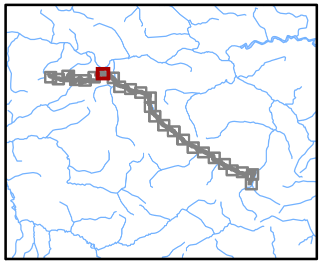
Potential Ecological Consequences

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 18 of 25





Legend

Potential Ecological Consequence

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

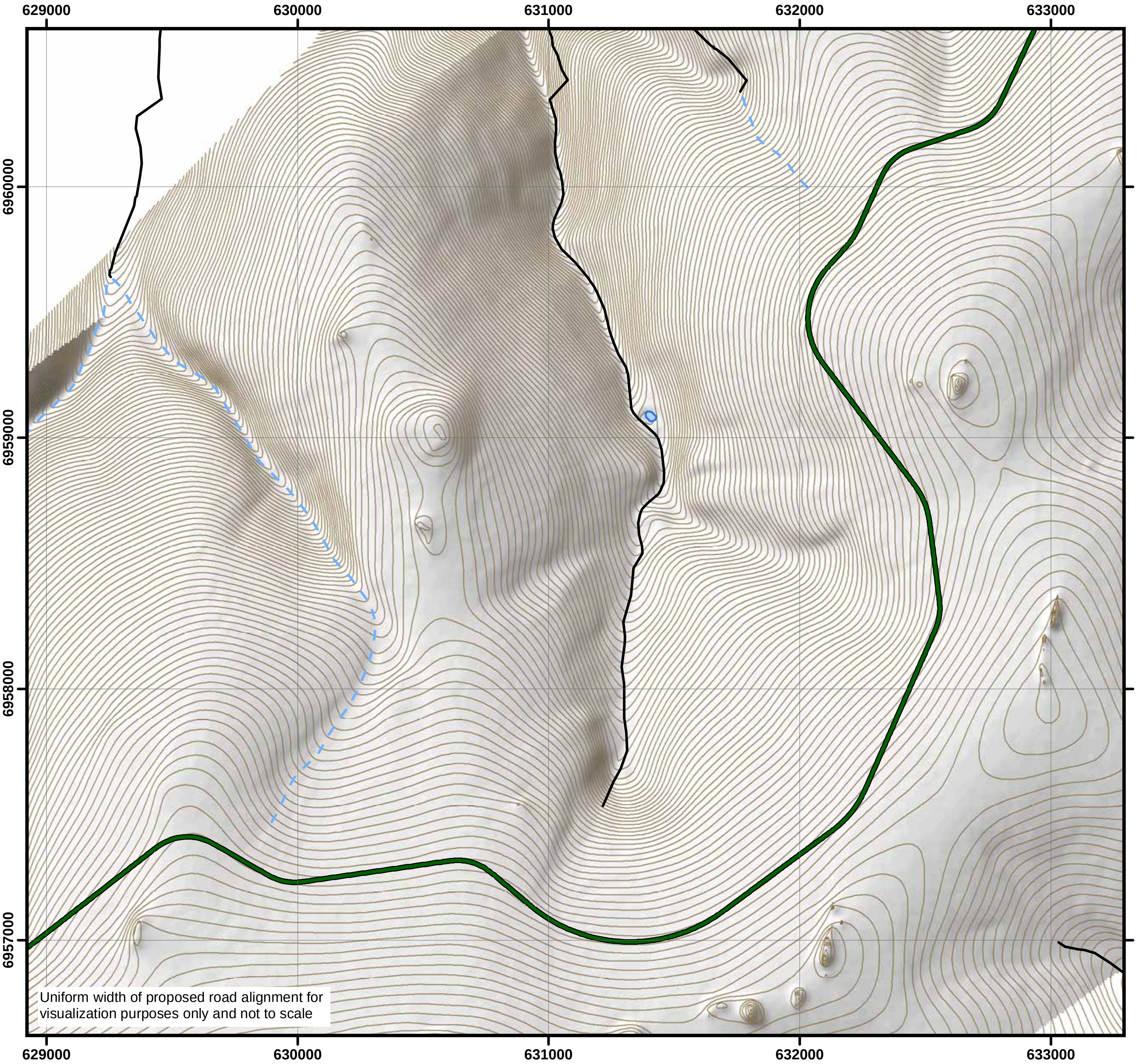
Freegold Road Extension

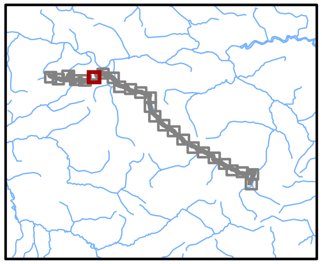
Map 2

Potential Ecological Consequences

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Potential Ecological Consequence

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

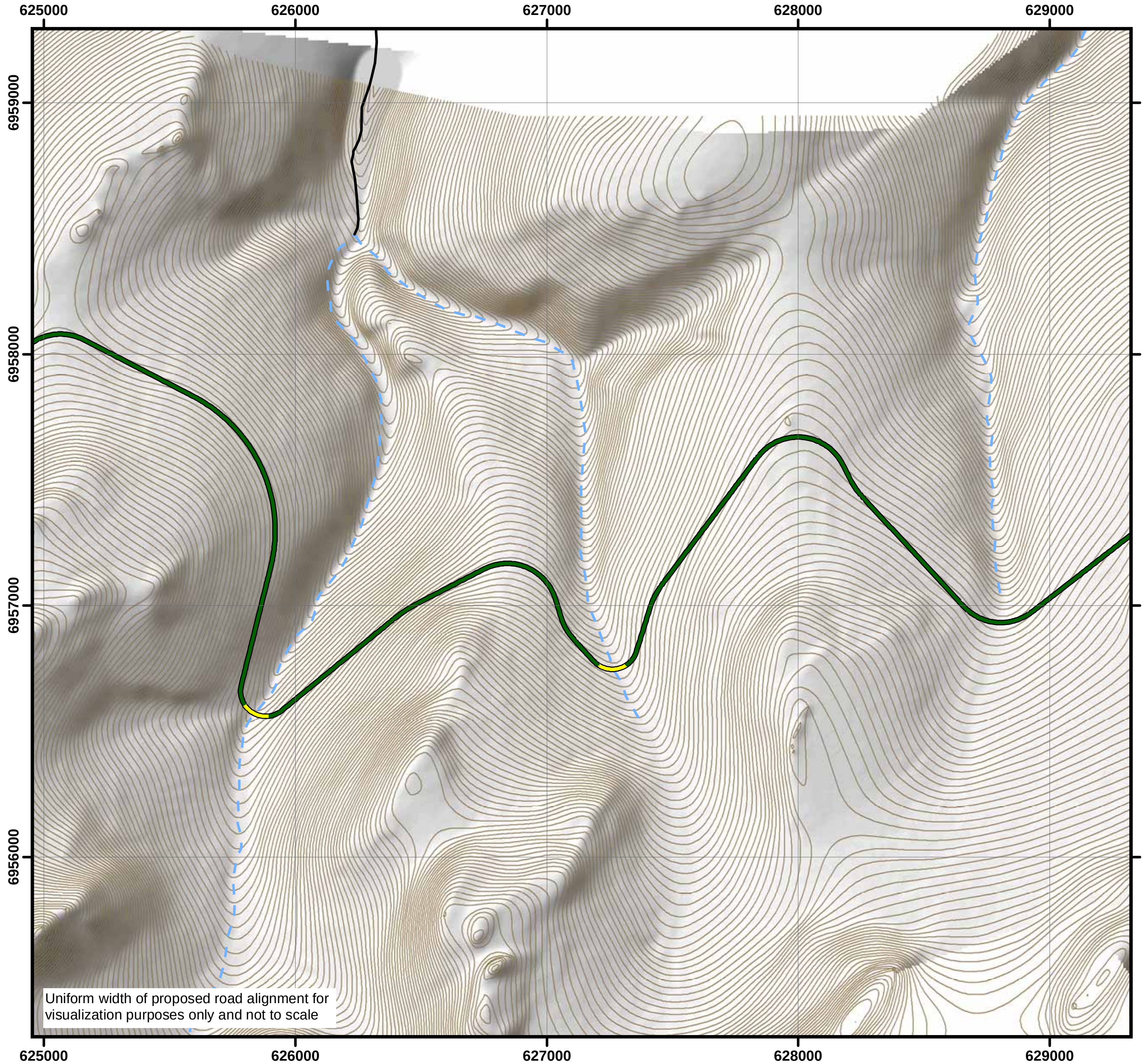
Freegold Road Extension

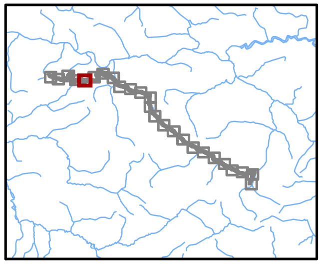
Map 2

Potential Ecological Consequences

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Potential Ecological Consequence

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

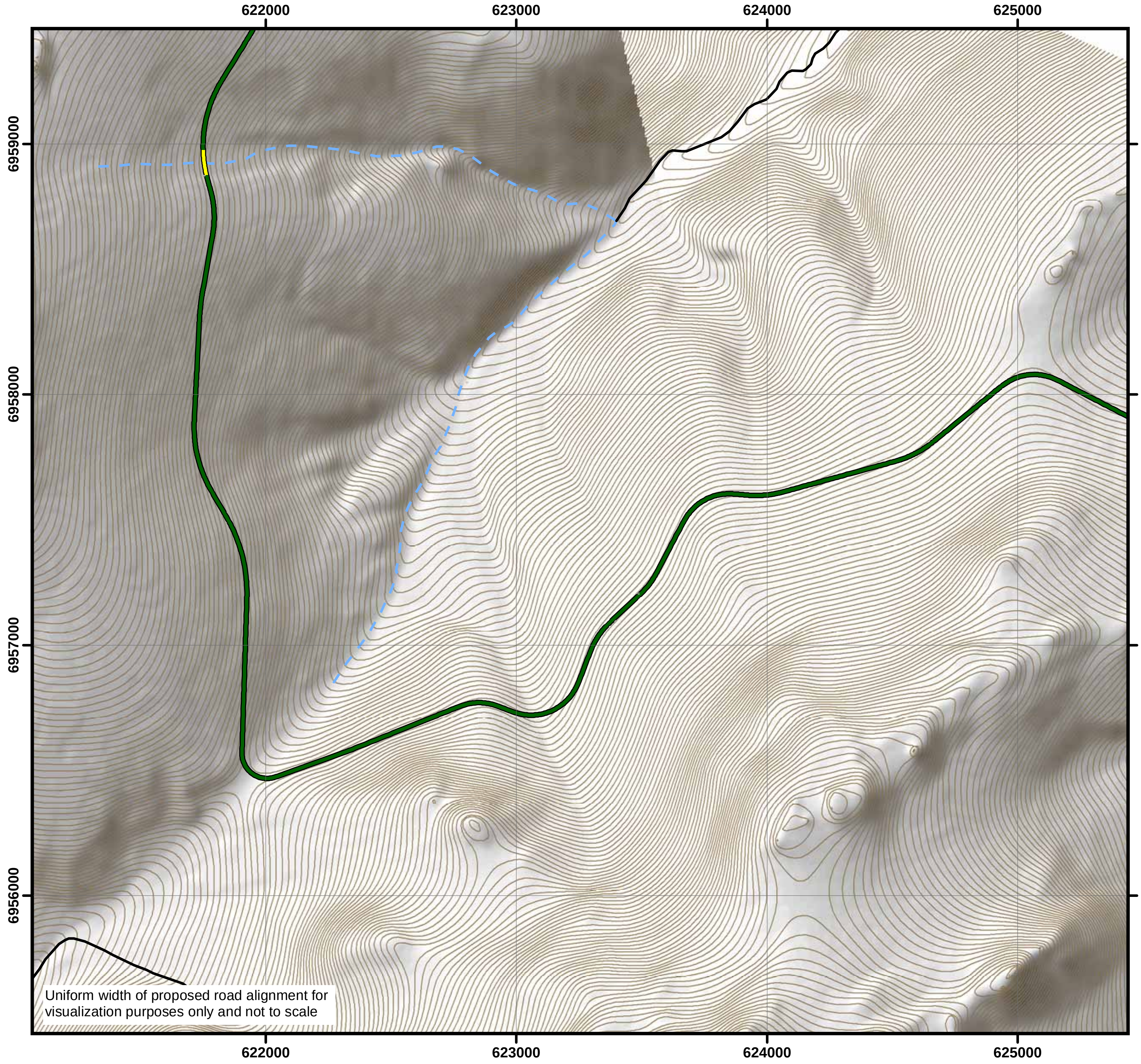
Freegold Road Extension

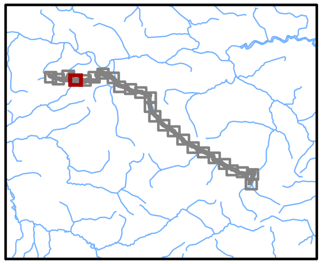
Map 2

Potential Ecological Consequences

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Potential Ecological Consequence

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

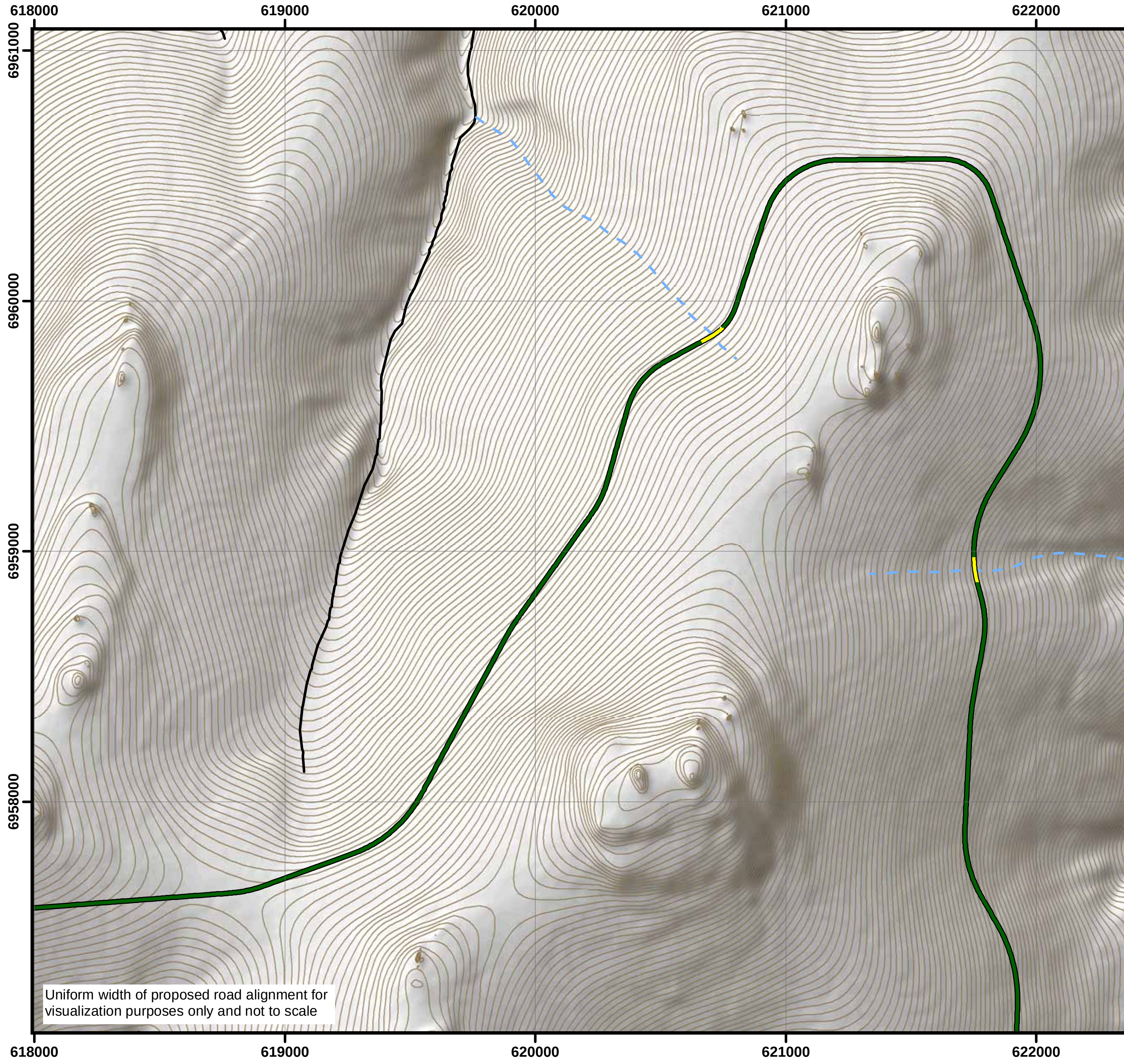
Map 2

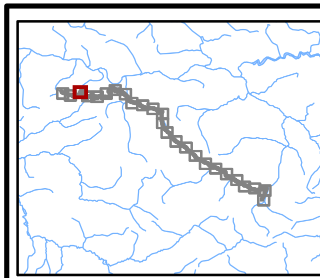
Potential Ecological Consequences

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 22 of 25





Legend

Potential Ecological Consequence

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

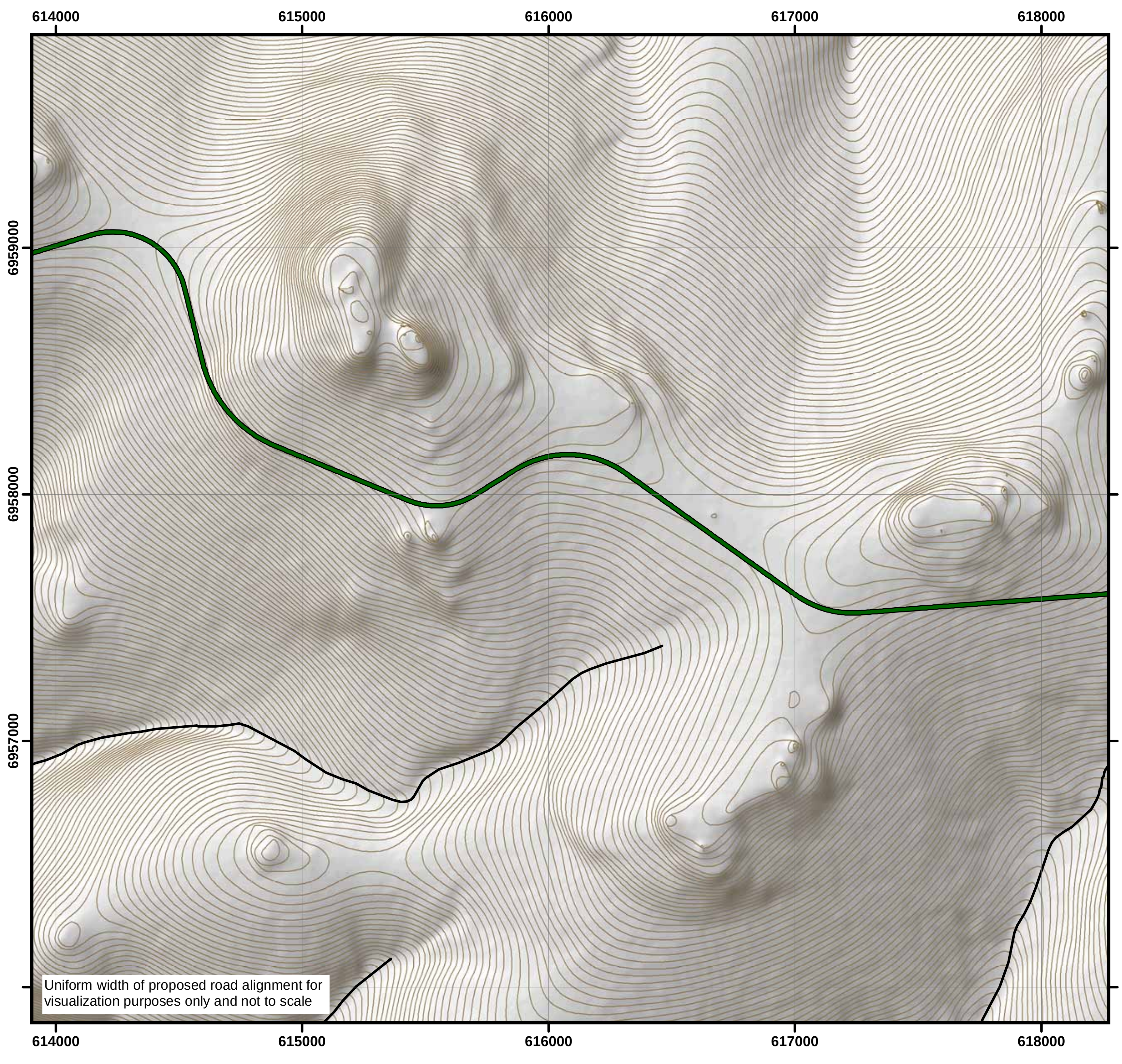
Map 2

Potential Ecological Consequences

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 23 of 25



Legend

Potential Ecological Consequence

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

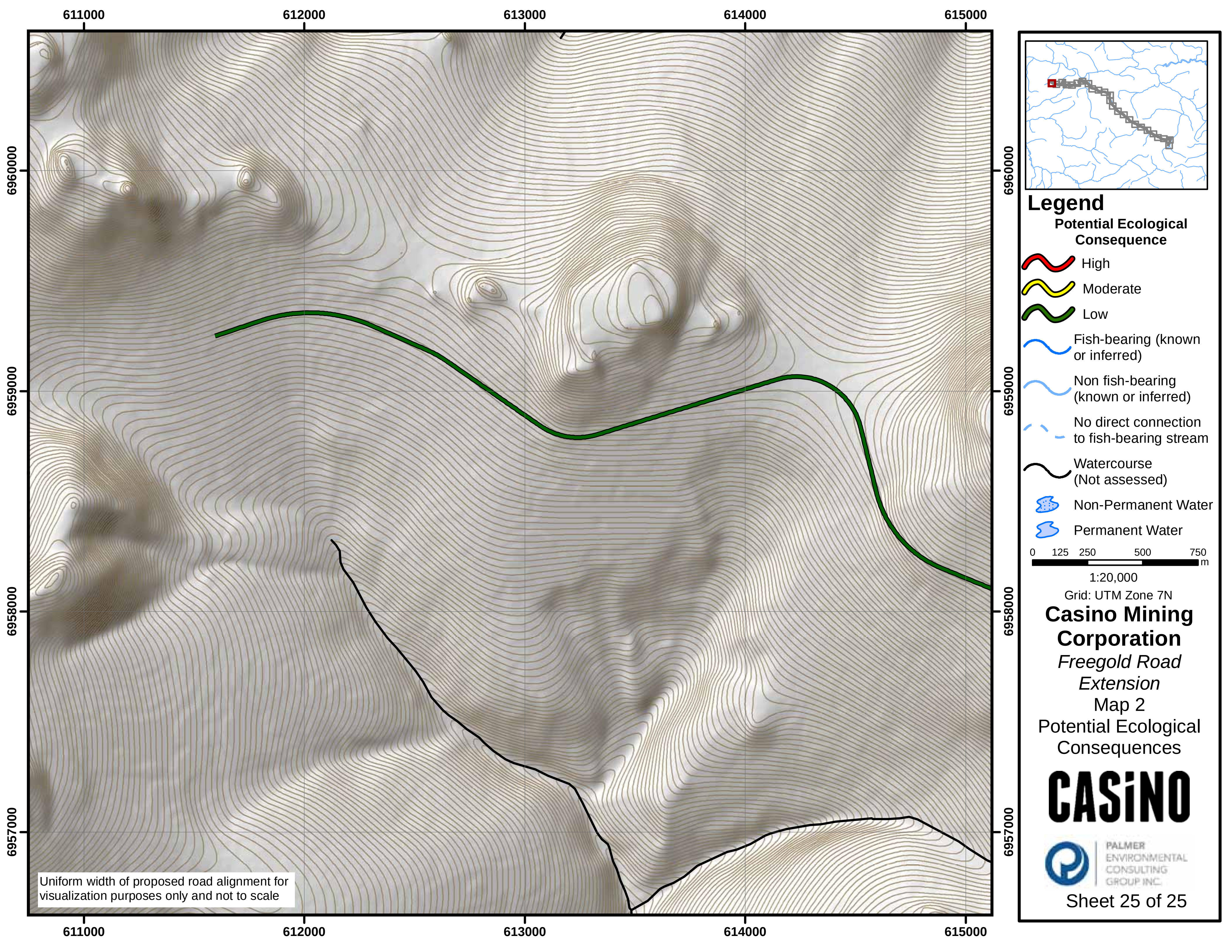
Freegold Road Extension

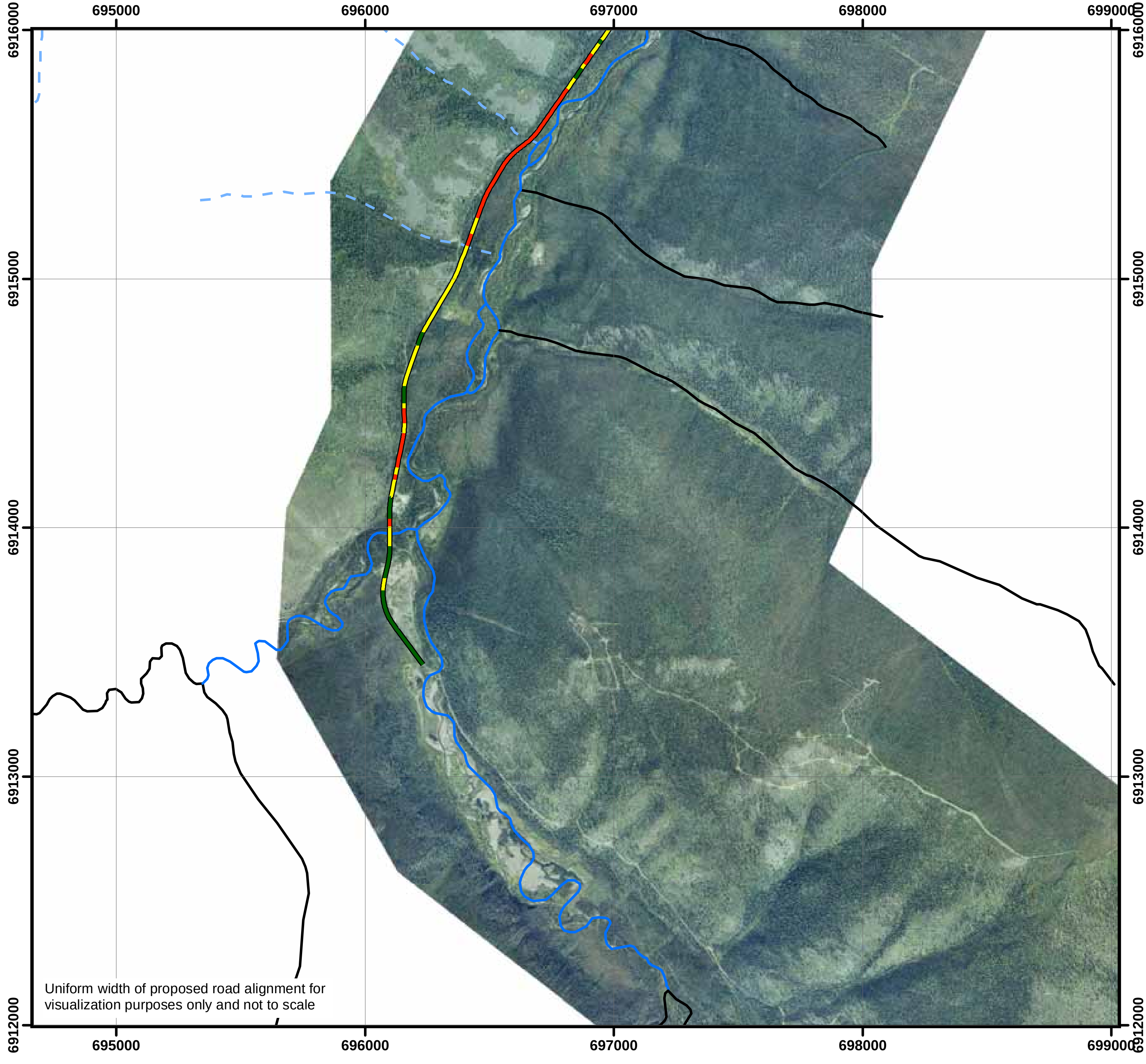
Map 2

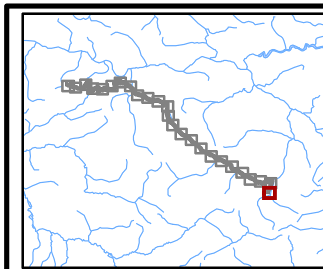
Potential Ecological Consequences

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.


611000
612000
613000
614000
615000
6960000
6959000
6958000
6957000
Uniform width of proposed road alignment for visualization purposes only and not to scale
Legend
Potential Ecological Consequence
High
Moderate
Low
Fish-bearing (known or inferred)
Non fish-bearing (known or inferred)
No direct connection to fish-bearing stream
Watercourse (Not assessed)
Non-Permanent Water
Permanent Water
0 125 250 500 750
m
1:20,000
Grid: UTM Zone 7N
Casino Mining Corporation
Freegold Road Extension
Map 2
Potential Ecological Consequences
CASINO
PALMER ENVIRONMENTAL CONSULTING GROUP INC.
Sheet 25 of 25





Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

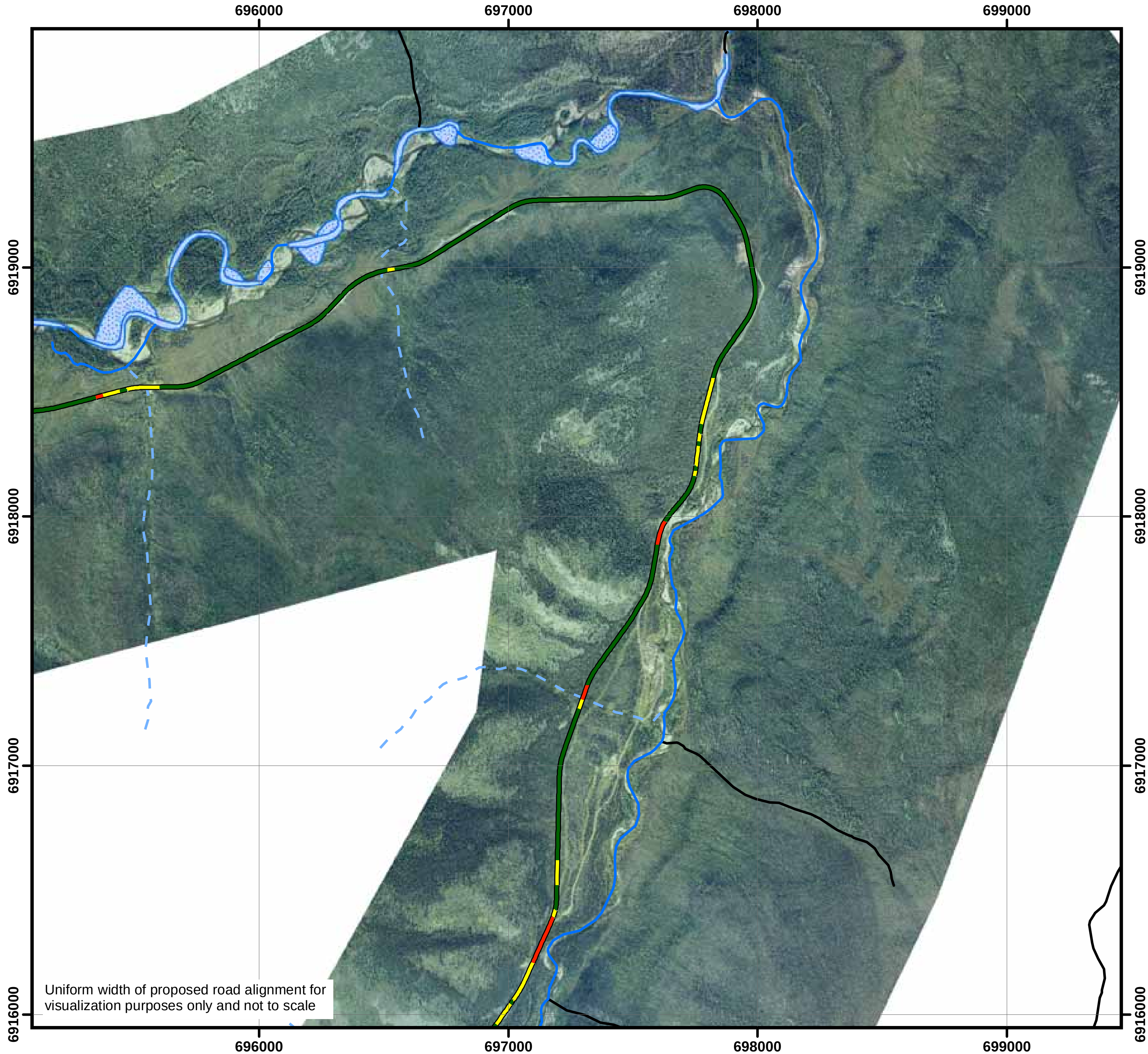
Map 3

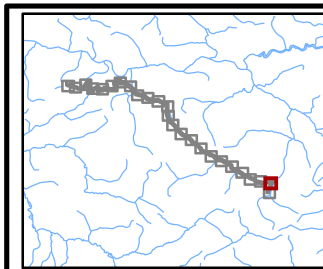
Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 1 of 25





Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

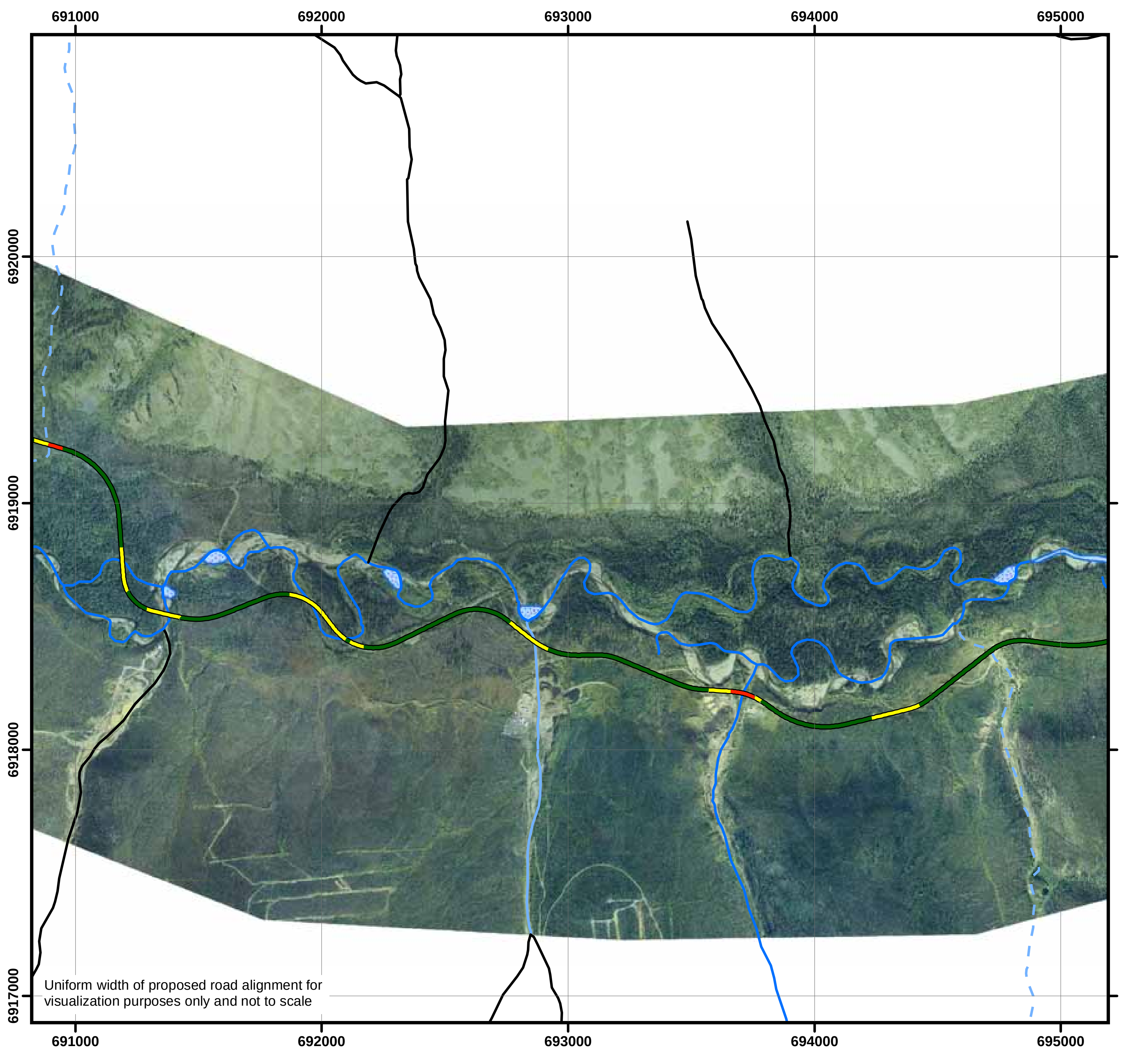
Freegold Road Extension

Map 3

Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.



Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

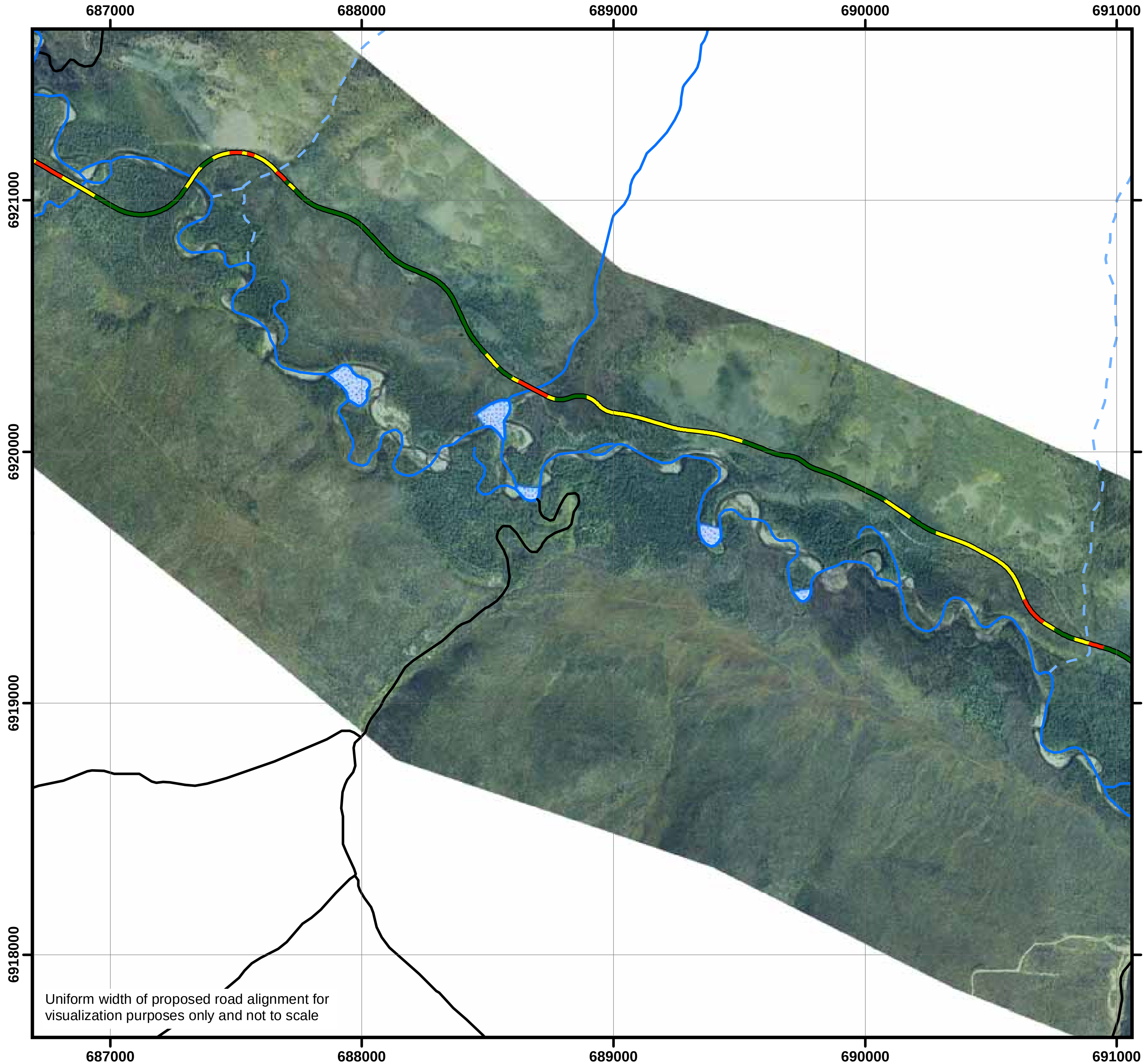
Map 3

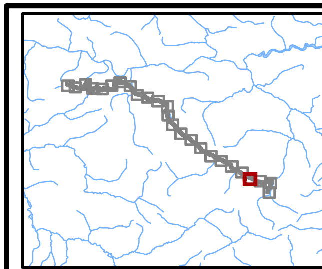
Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 3 of 25





Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000
Grid: UTM Zone 7N

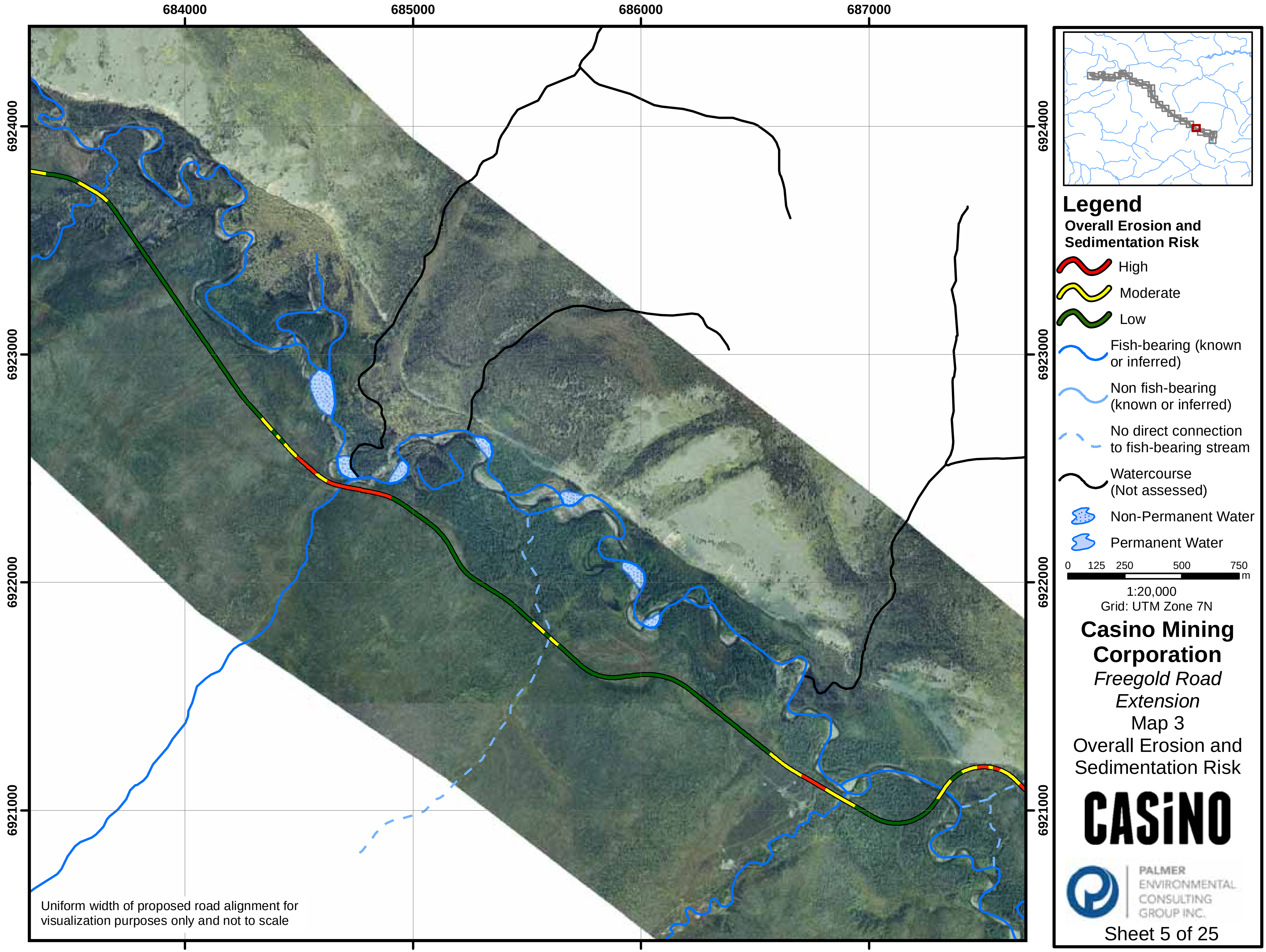
Casino Mining Corporation

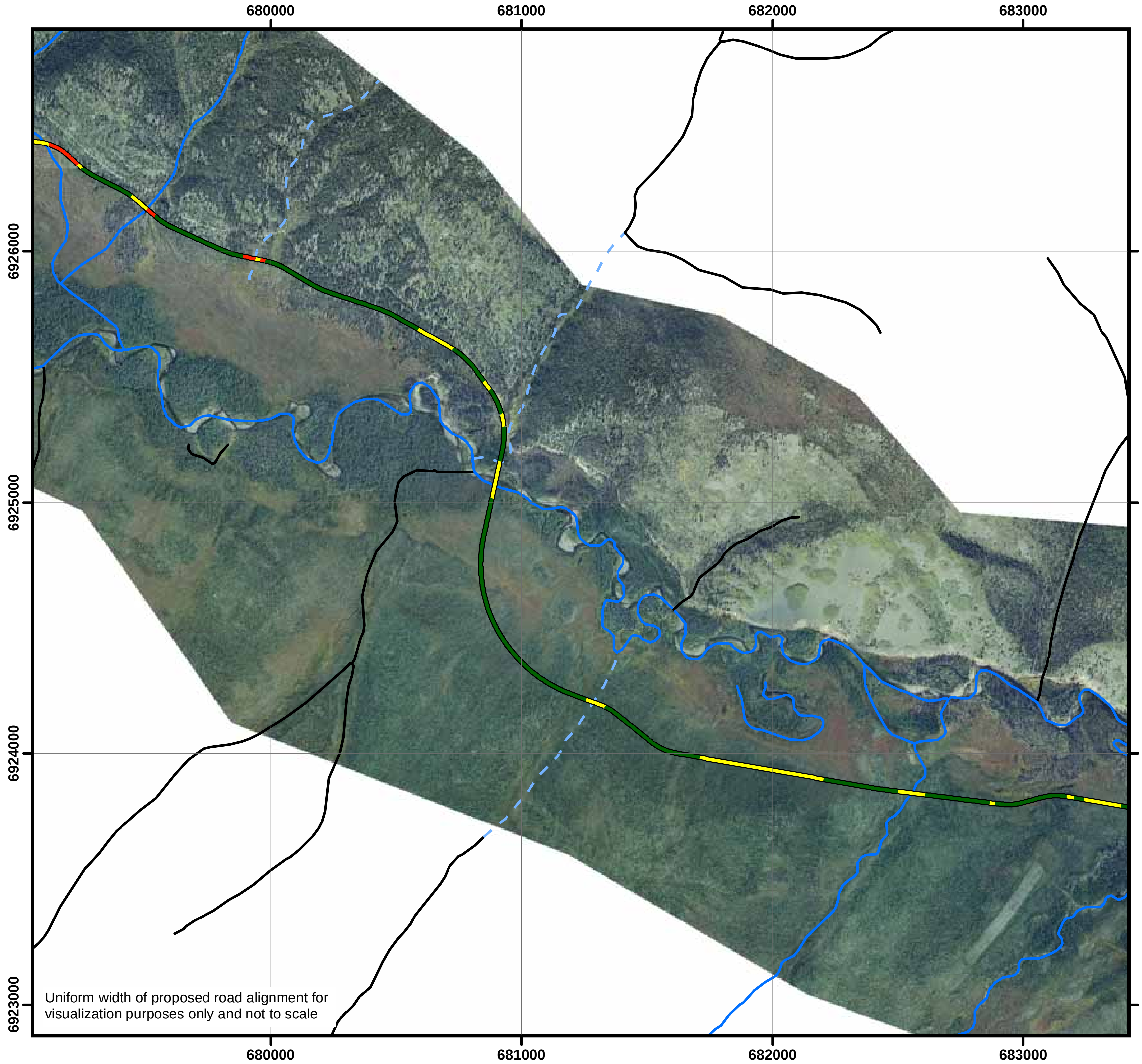
Freegold Road Extension

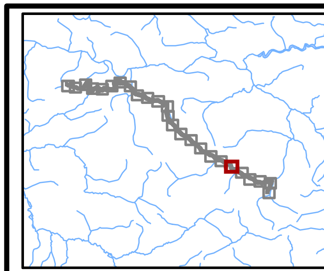
Map 3
Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.


684000
685000
686000
687000
6924000
6923000
6922000
6921000
Uniform width of proposed road alignment for
visualization purposes only and not to scale
Legend
Overall Erosion and
Sedimentation Risk
High
Moderate
Low
Fish-bearing (known or inferred)
Non fish-bearing (known or inferred)
No direct connection to fish-bearing stream
Watercourse (Not assessed)
Non-Permanent Water
Permanent Water
0 125 250 500 750 m
1:20,000
Grid: UTM Zone 7N
Casino Mining Corporation
Freegold Road Extension
Map 3
Overall Erosion and Sedimentation Risk
CASINO
PALMER ENVIRONMENTAL CONSULTING GROUP INC.
Sheet 5 of 25





Legend

Overall Erosion and Sedimentation Risk

High

Moderate

Low

Fish-bearing (known or inferred)

Non fish-bearing (known or inferred)

No direct connection to fish-bearing stream

Watercourse (Not assessed)

Non-Permanent Water

Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

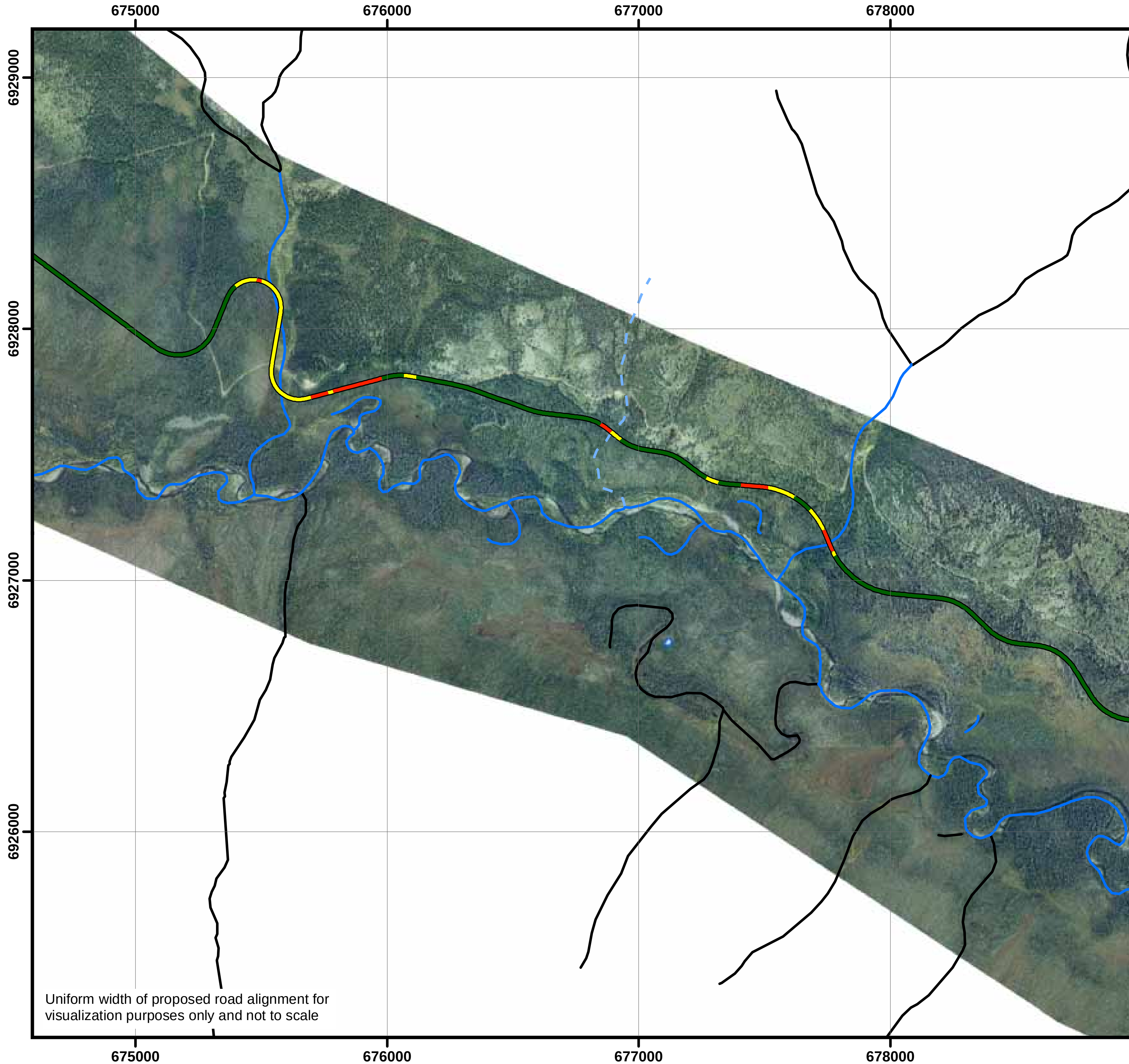
Map 3

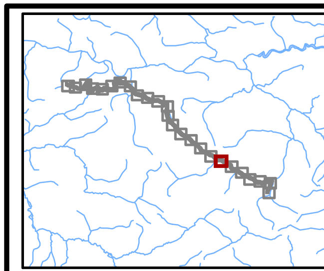
Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 6 of 25





Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

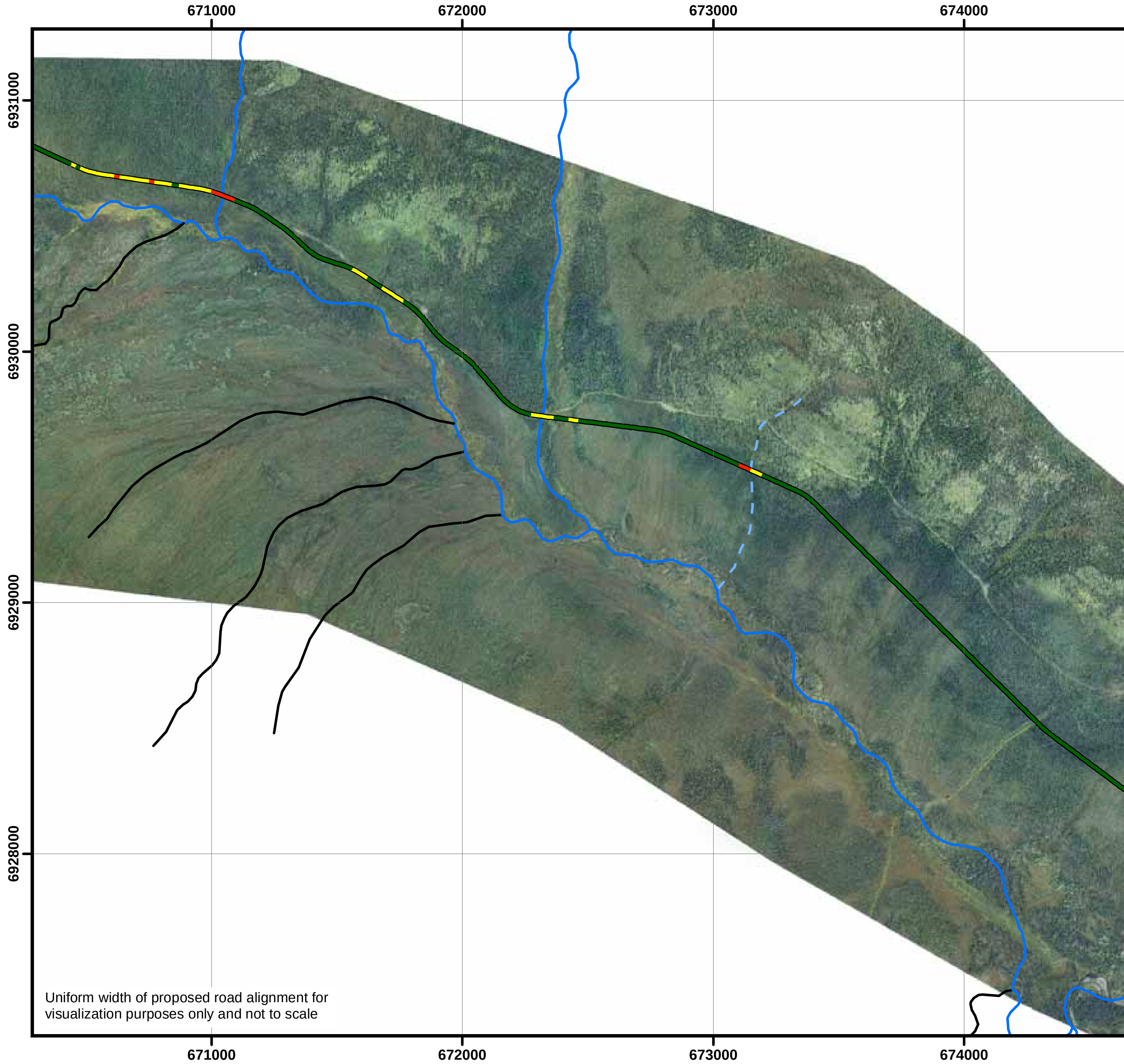
Freegold Road Extension

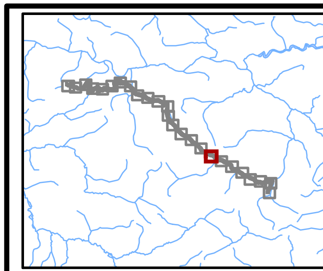
Map 3

Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

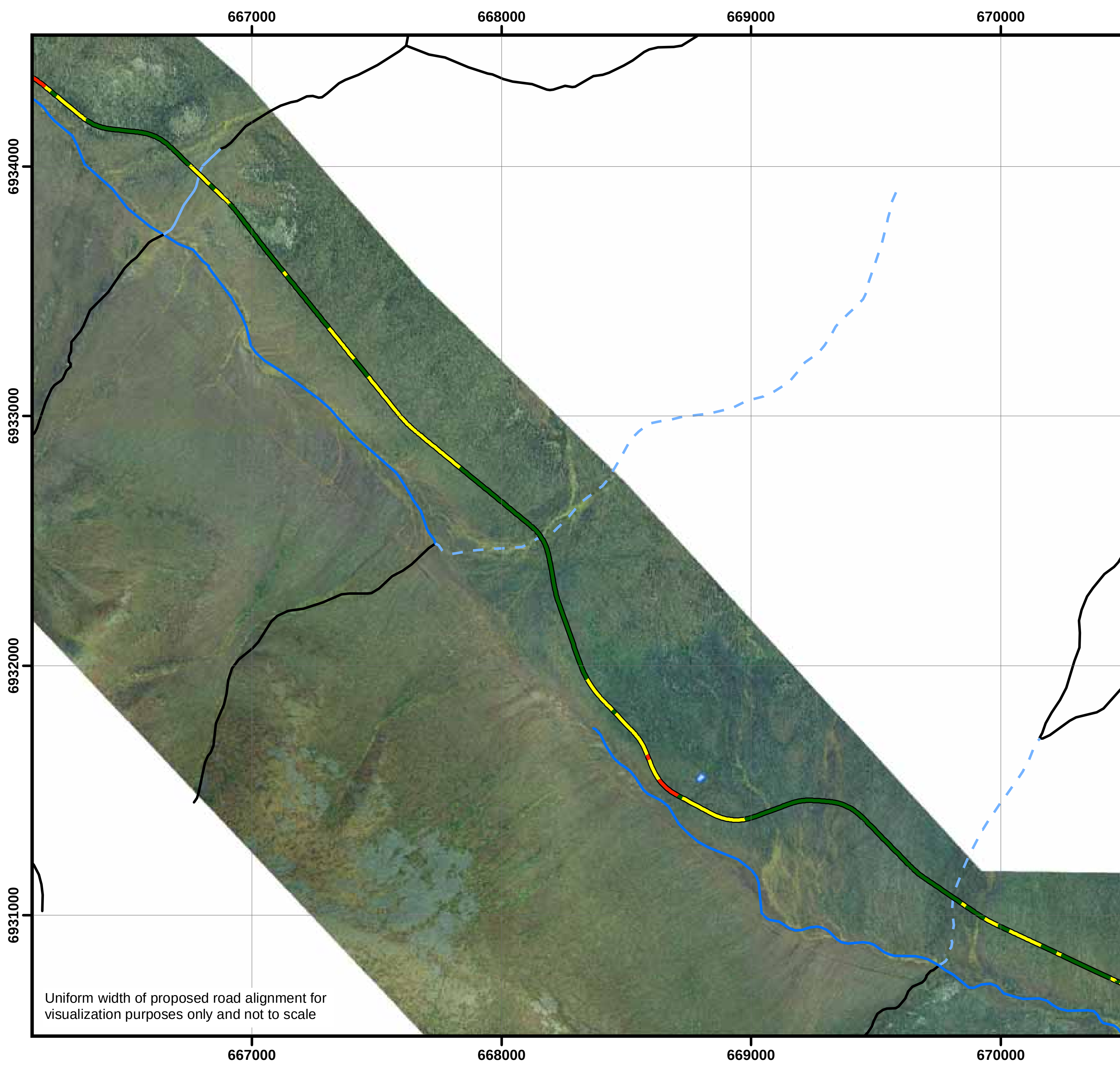
Freegold Road Extension

Map 3

Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.



Casino Mining Corporation

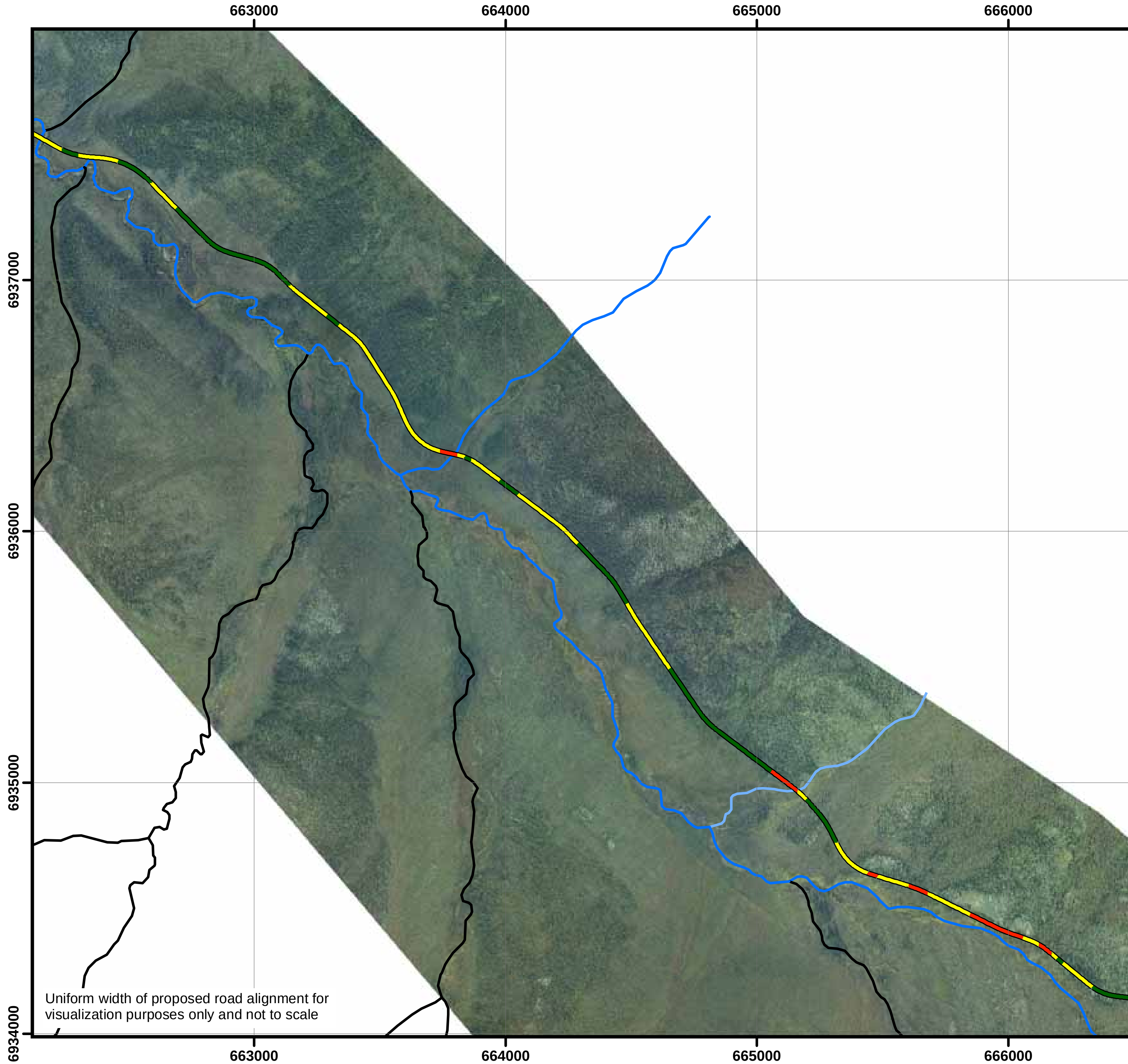
Freegold Road Extension

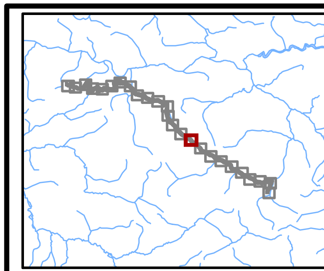
Map 3

Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

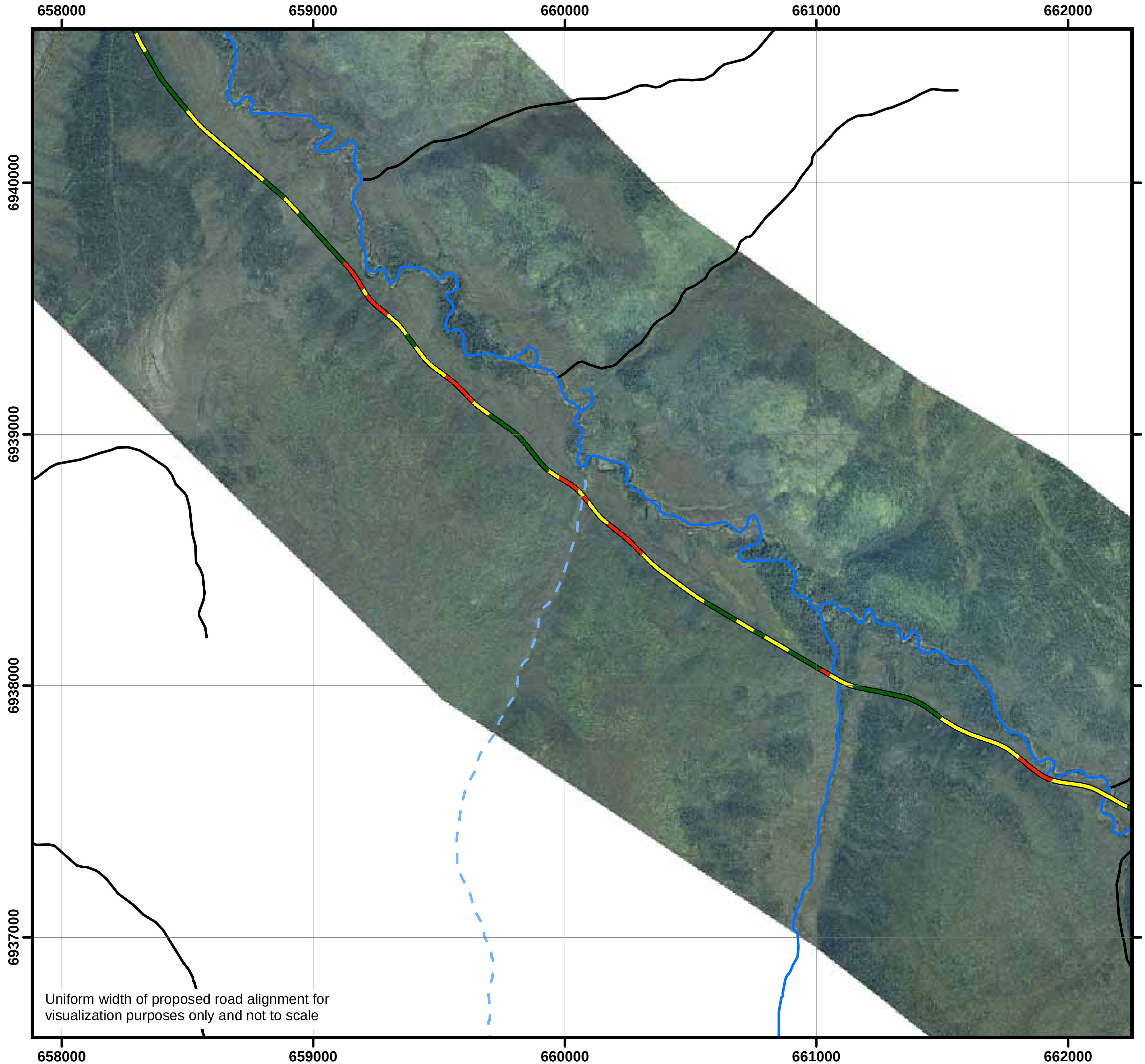
Freegold Road Extension

Map 3

Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.



Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000
Grid: UTM Zone 7N

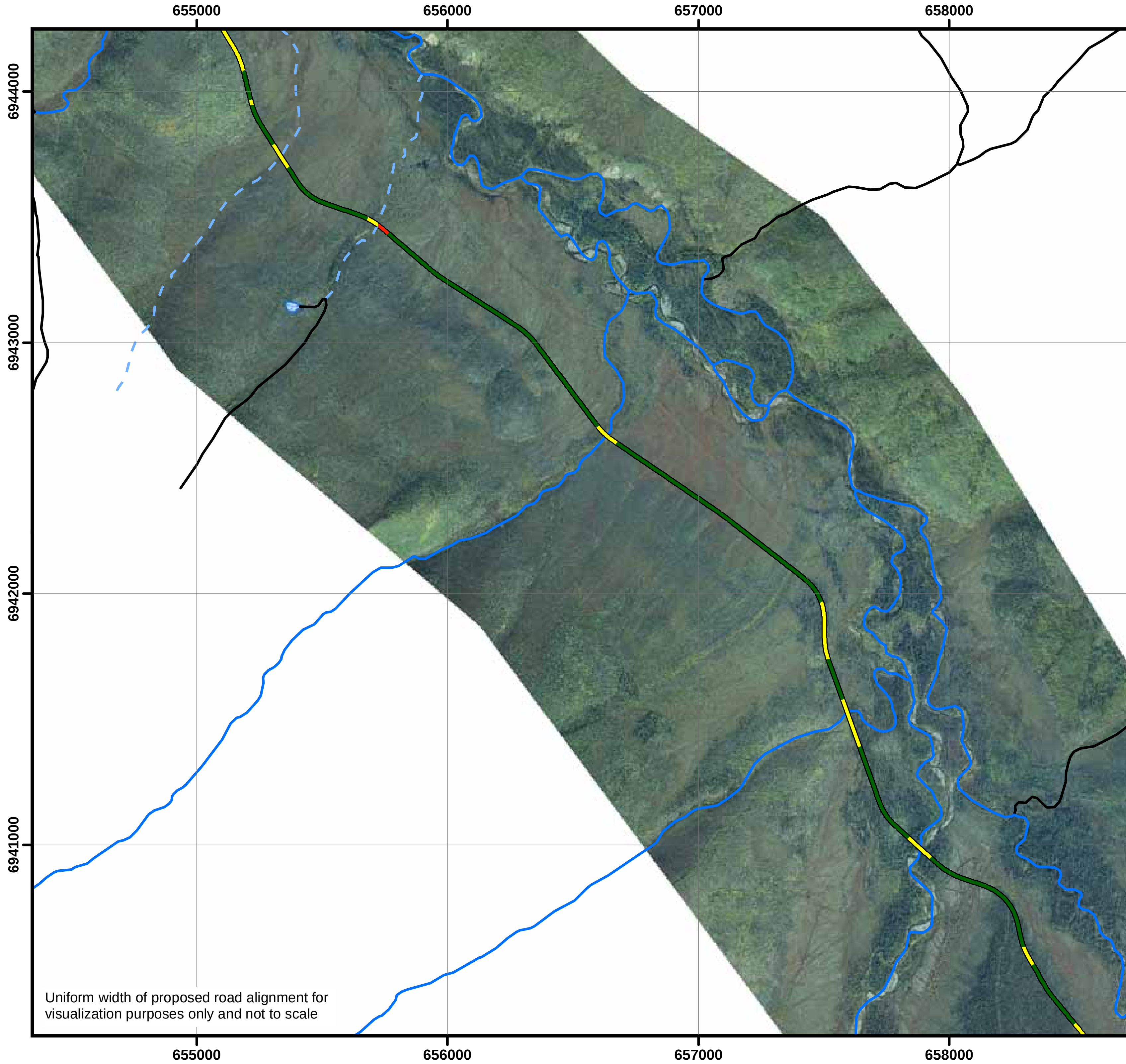
Casino Mining Corporation

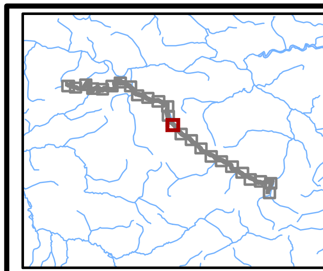
Freegold Road Extension

Map 3
Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

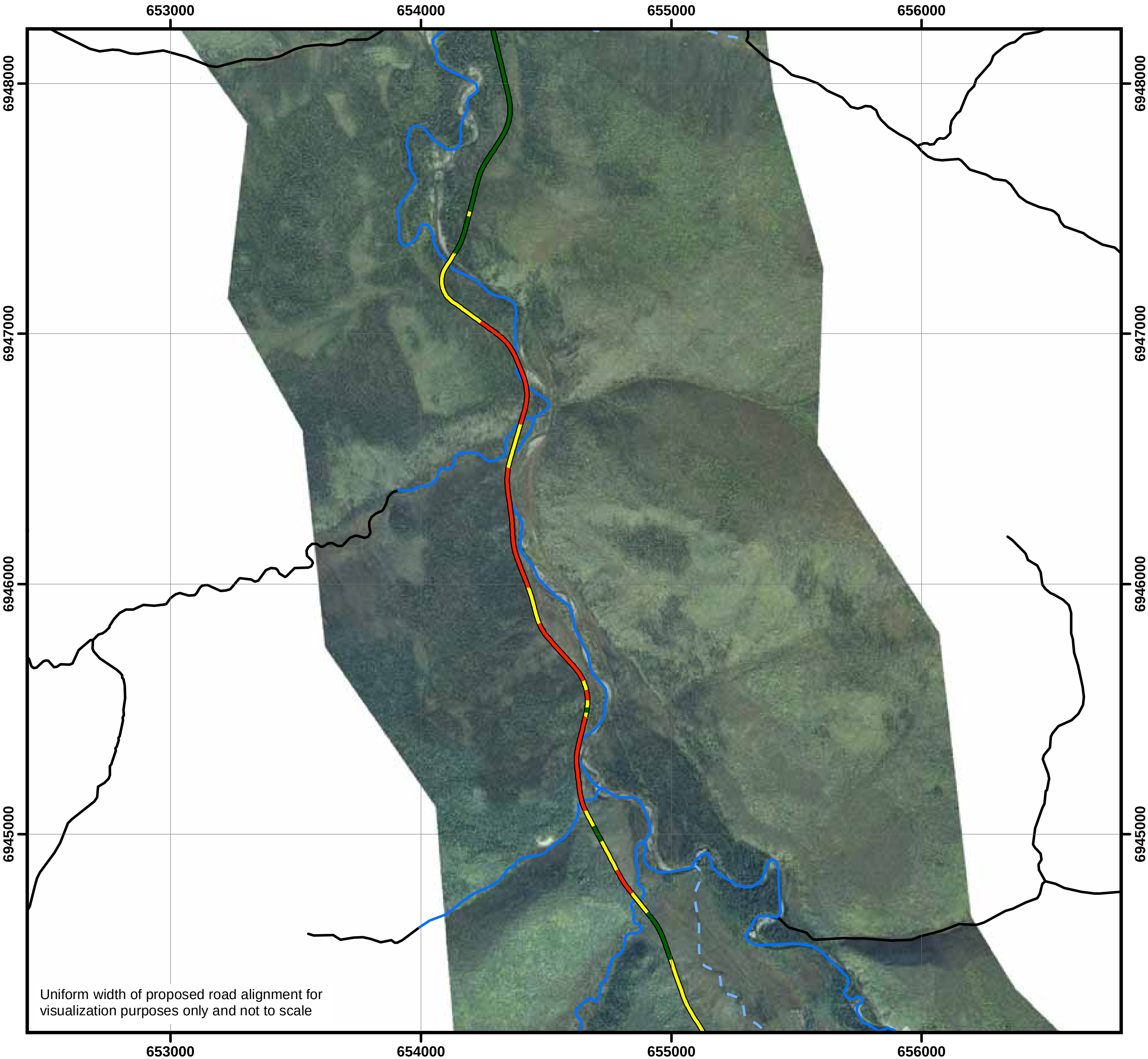
Freegold Road Extension

Map 3

Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.



Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

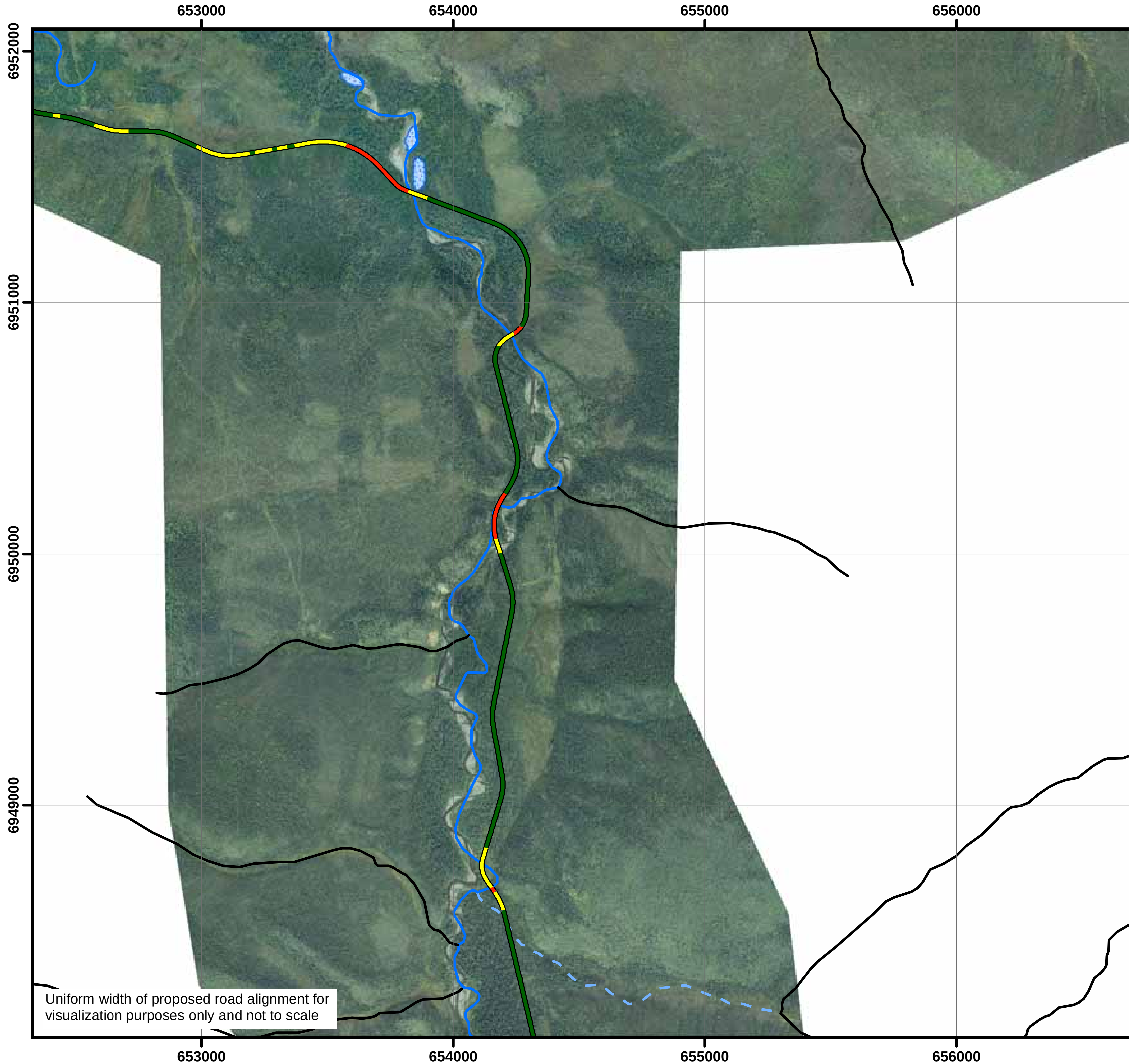
Freegold Road Extension

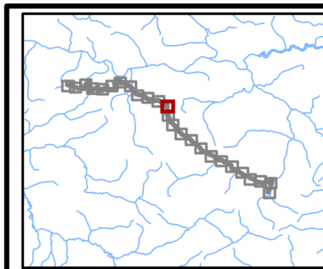
Map 3

Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000
Grid: UTM Zone 7N

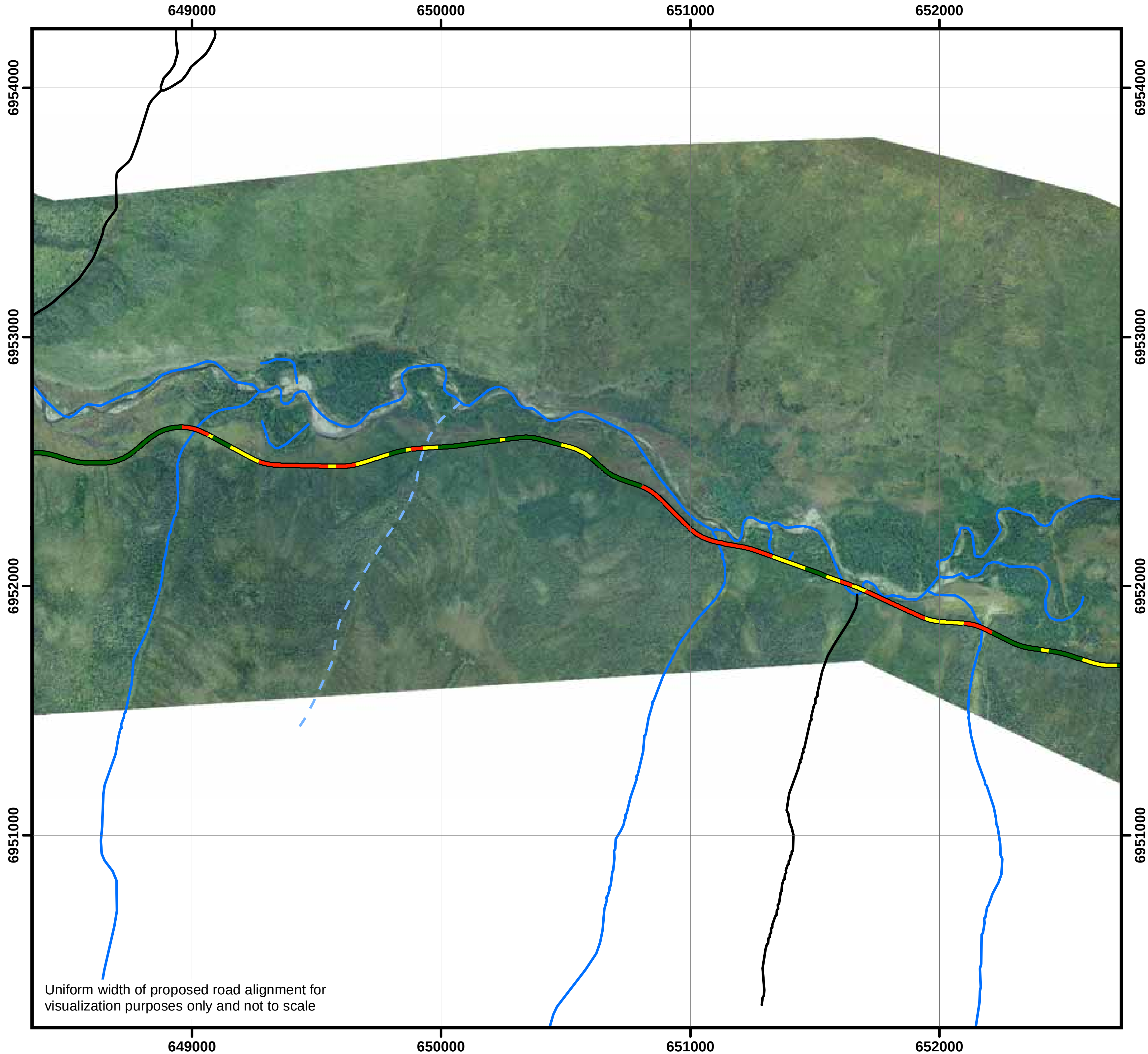
Casino Mining Corporation

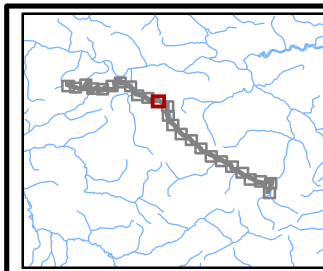
Freegold Road Extension

Map 3
Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

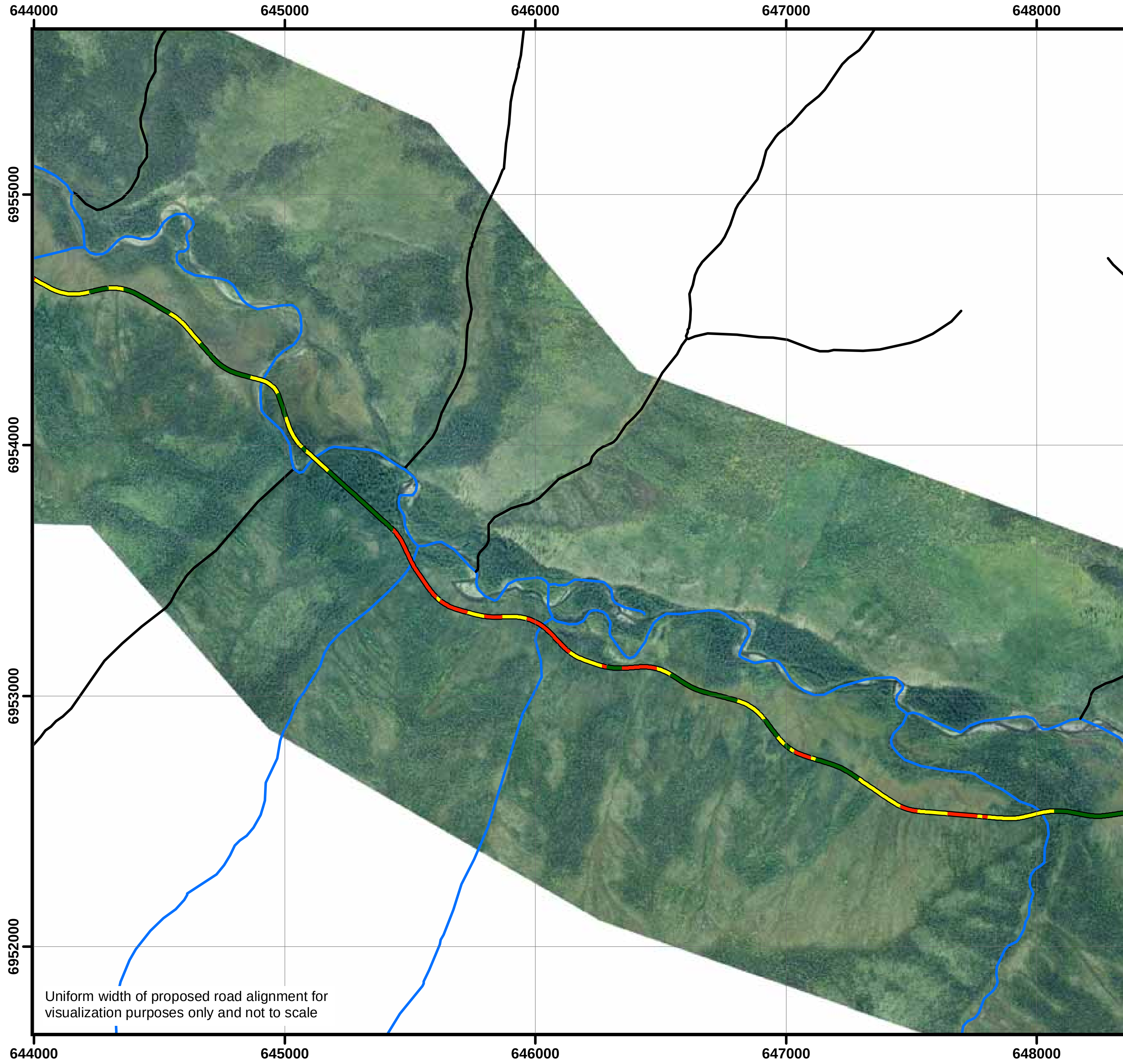
Map 3

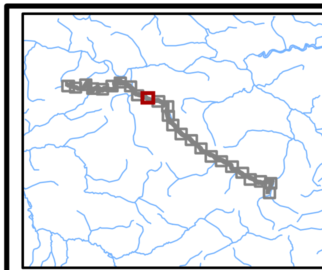
Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 15 of 25





Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000
Grid: UTM Zone 7N

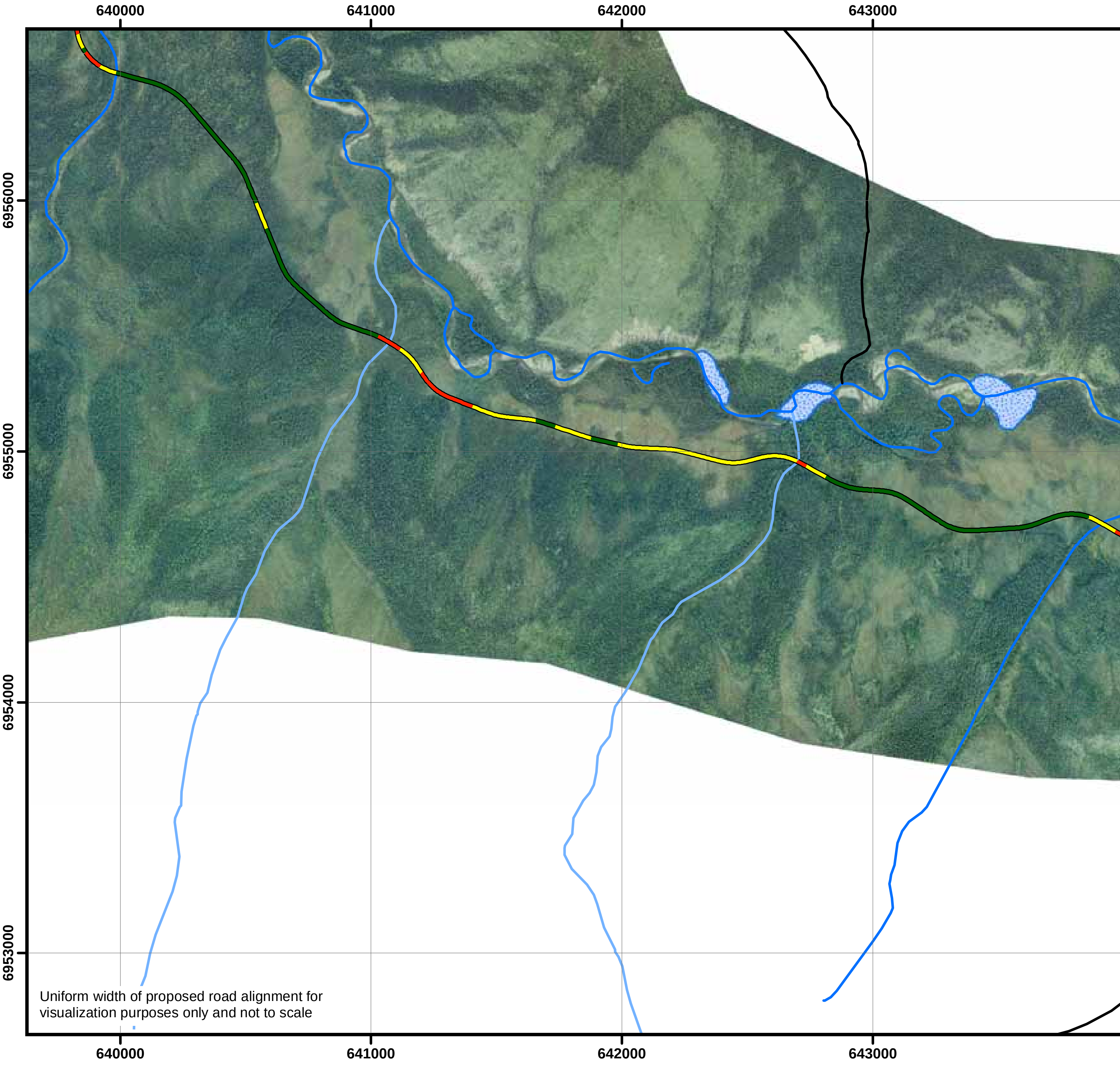
Casino Mining Corporation

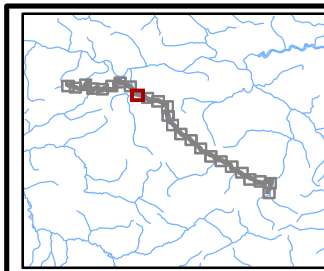
Freegold Road Extension

Map 3
Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

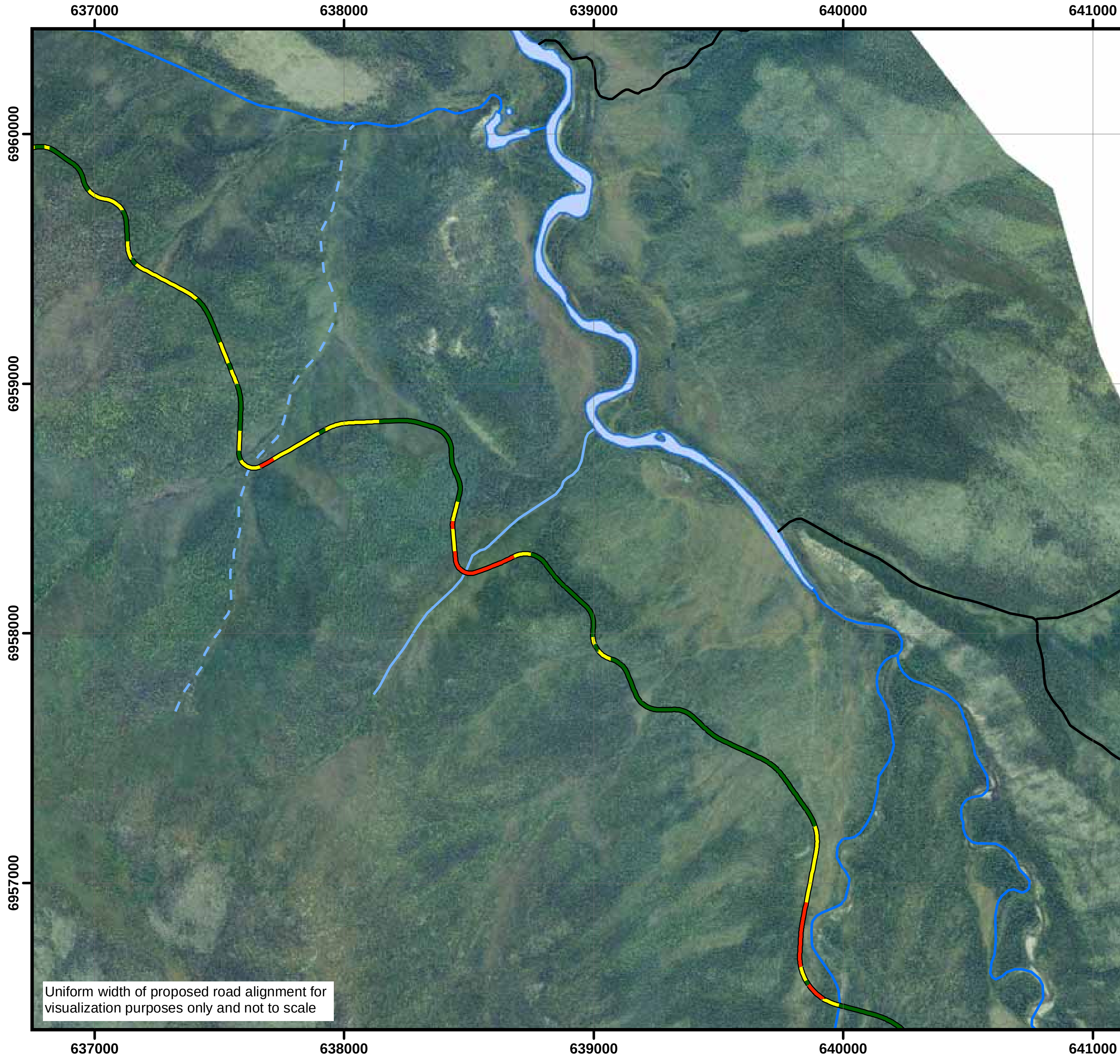
Freegold Road Extension

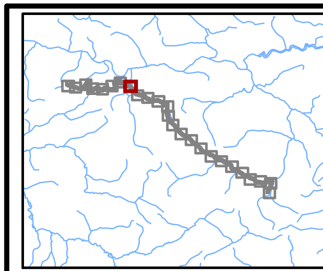
Map 3

Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

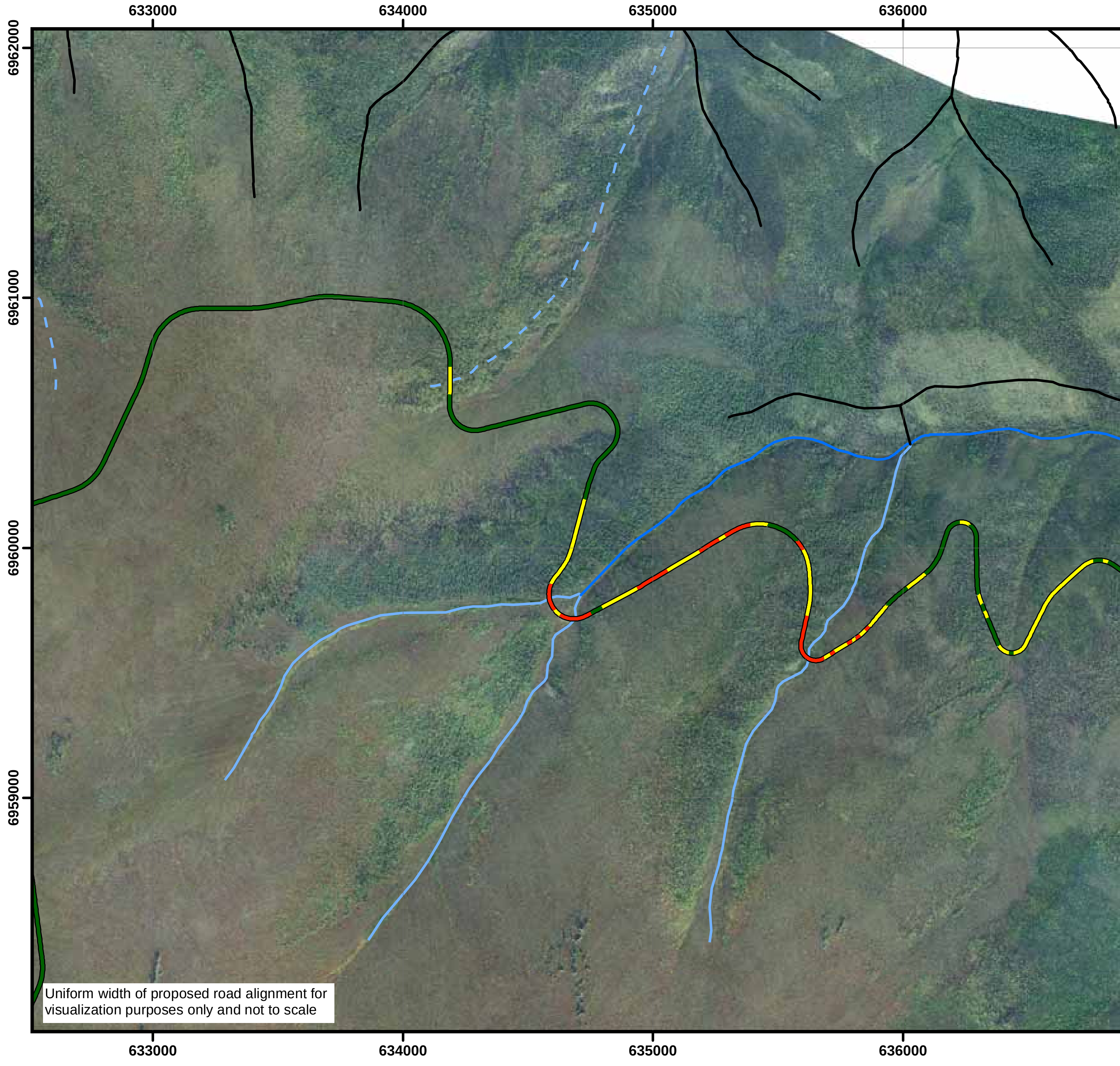
Freegold Road Extension

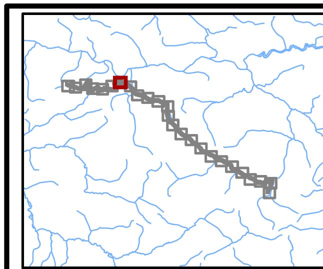
Map 3

Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

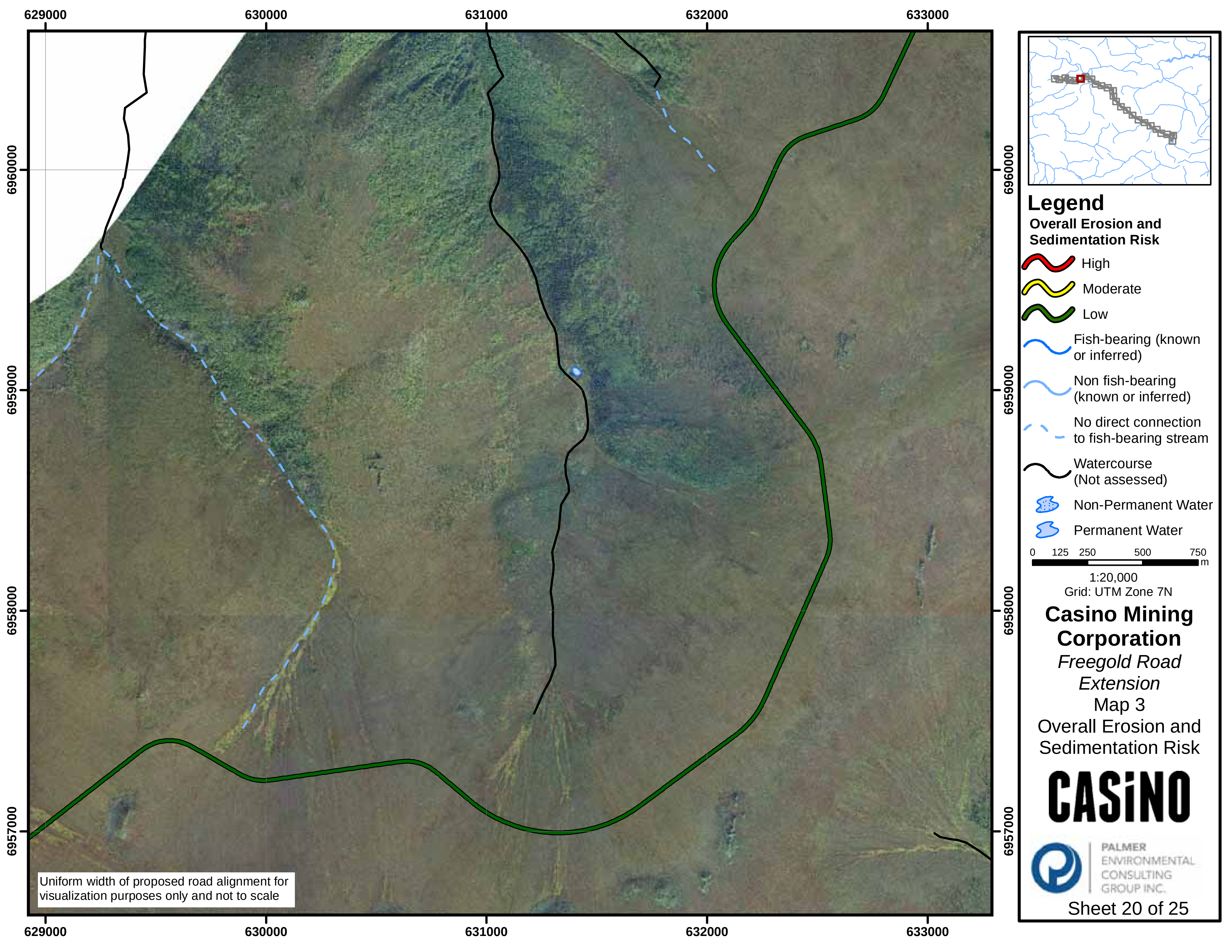
Freegold Road Extension

Map 3

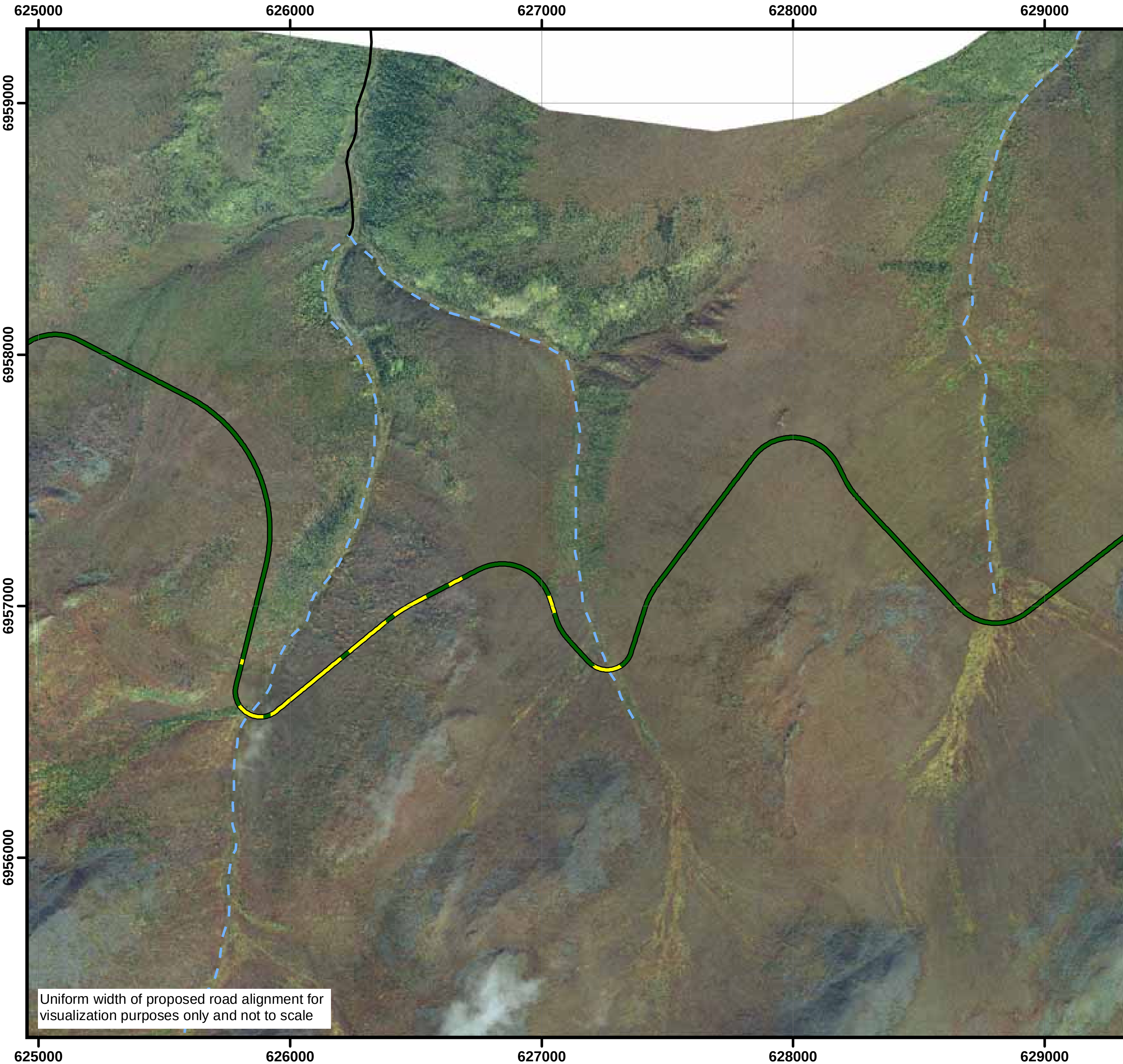
Overall Erosion and Sedimentation Risk

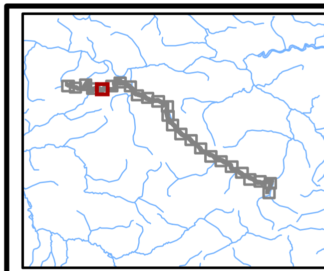
CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.



629000
630000
631000
632000
633000
6960000
6959000
6958000
6957000
Uniform width of proposed road alignment for visualization purposes only and not to scale
Legend
Overall Erosion and Sedimentation Risk
High
Moderate
Low
Fish-bearing (known or inferred)
Non fish-bearing (known or inferred)
No direct connection to fish-bearing stream
Watercourse (Not assessed)
Non-Permanent Water
Permanent Water
0 125 250 500 750 m
1:20,000
Grid: UTM Zone 7N
Casino Mining Corporation
Freegold Road Extension
Map 3
Overall Erosion and Sedimentation Risk
CASINO
PALMER ENVIRONMENTAL CONSULTING GROUP INC.
Sheet 20 of 25





Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

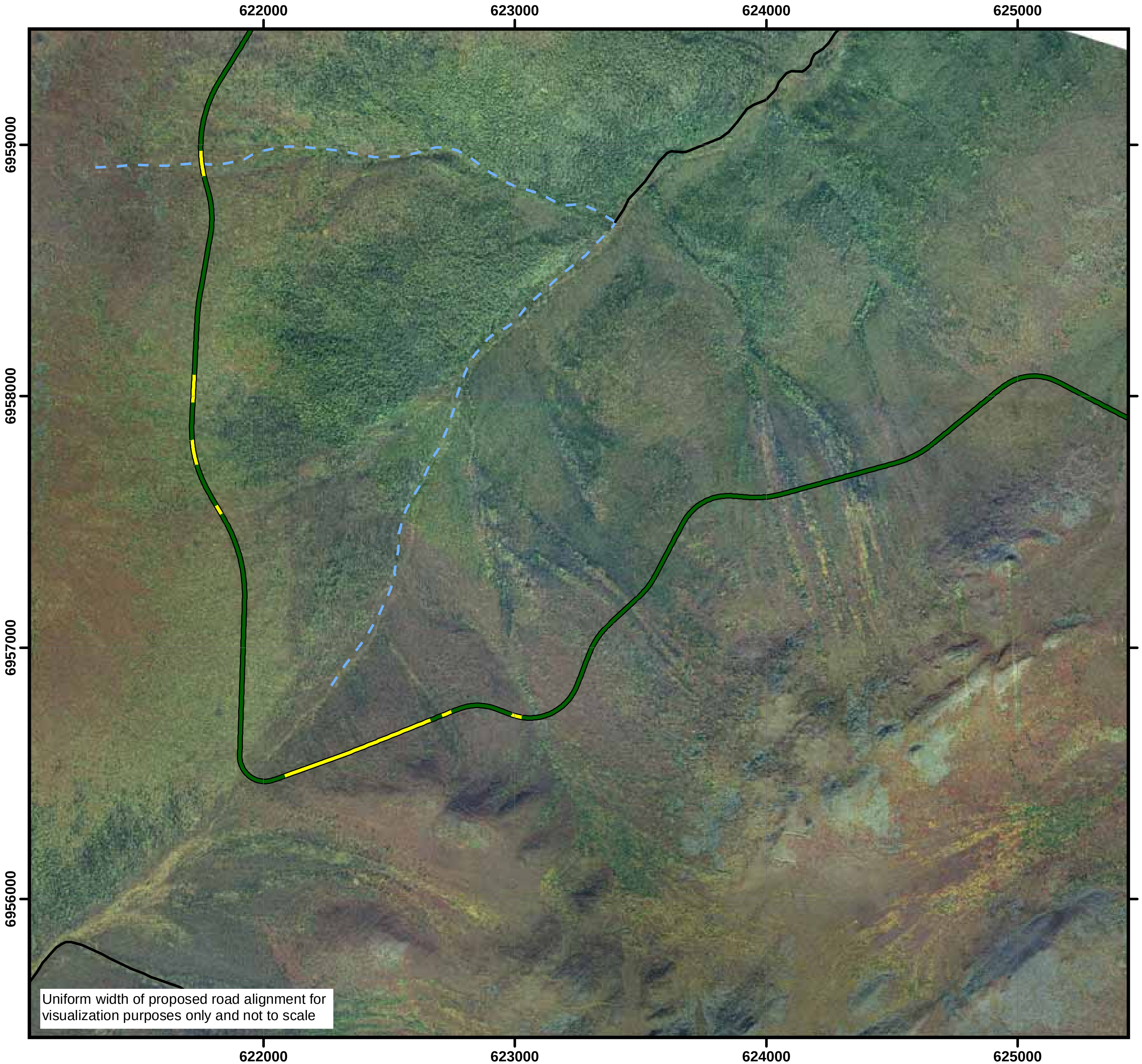
Map 3

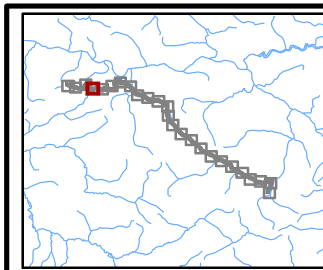
Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 21 of 25





Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

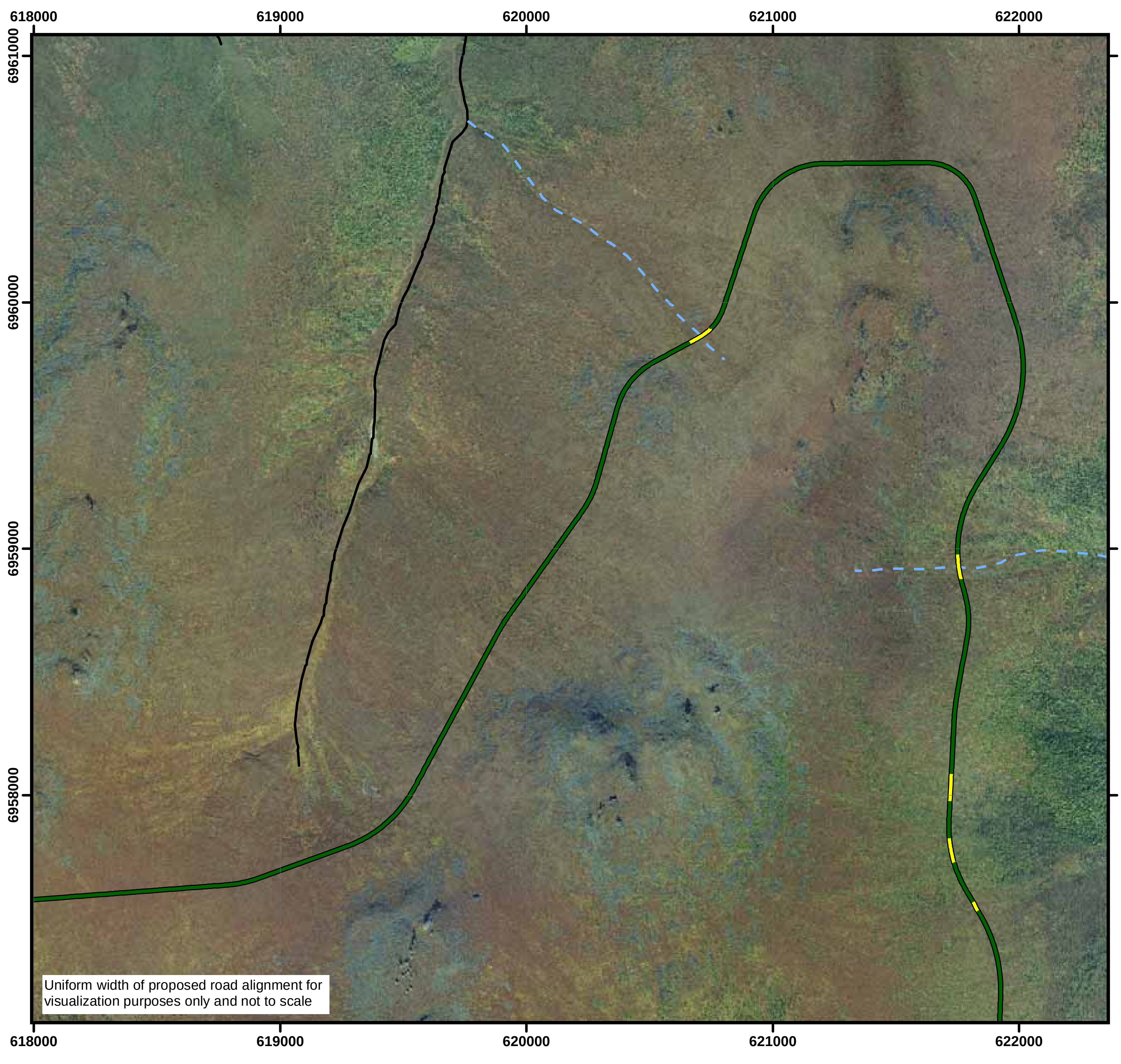
Map 3

Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 22 of 25



Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

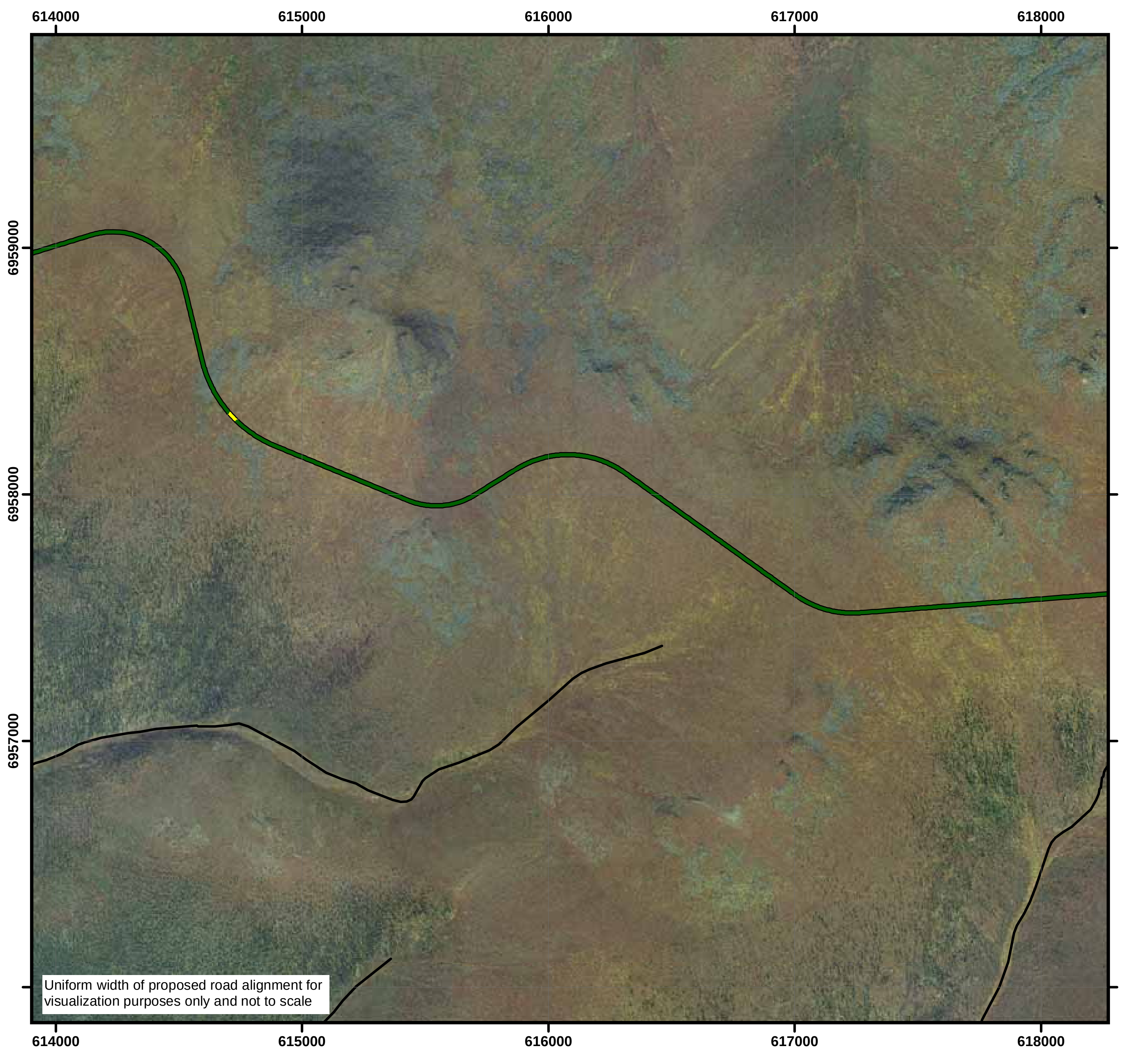
Freegold Road Extension

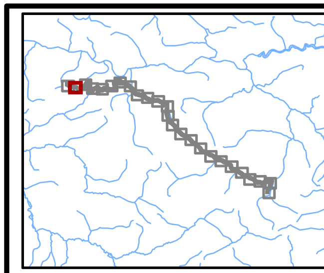
Map 3

Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.





Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

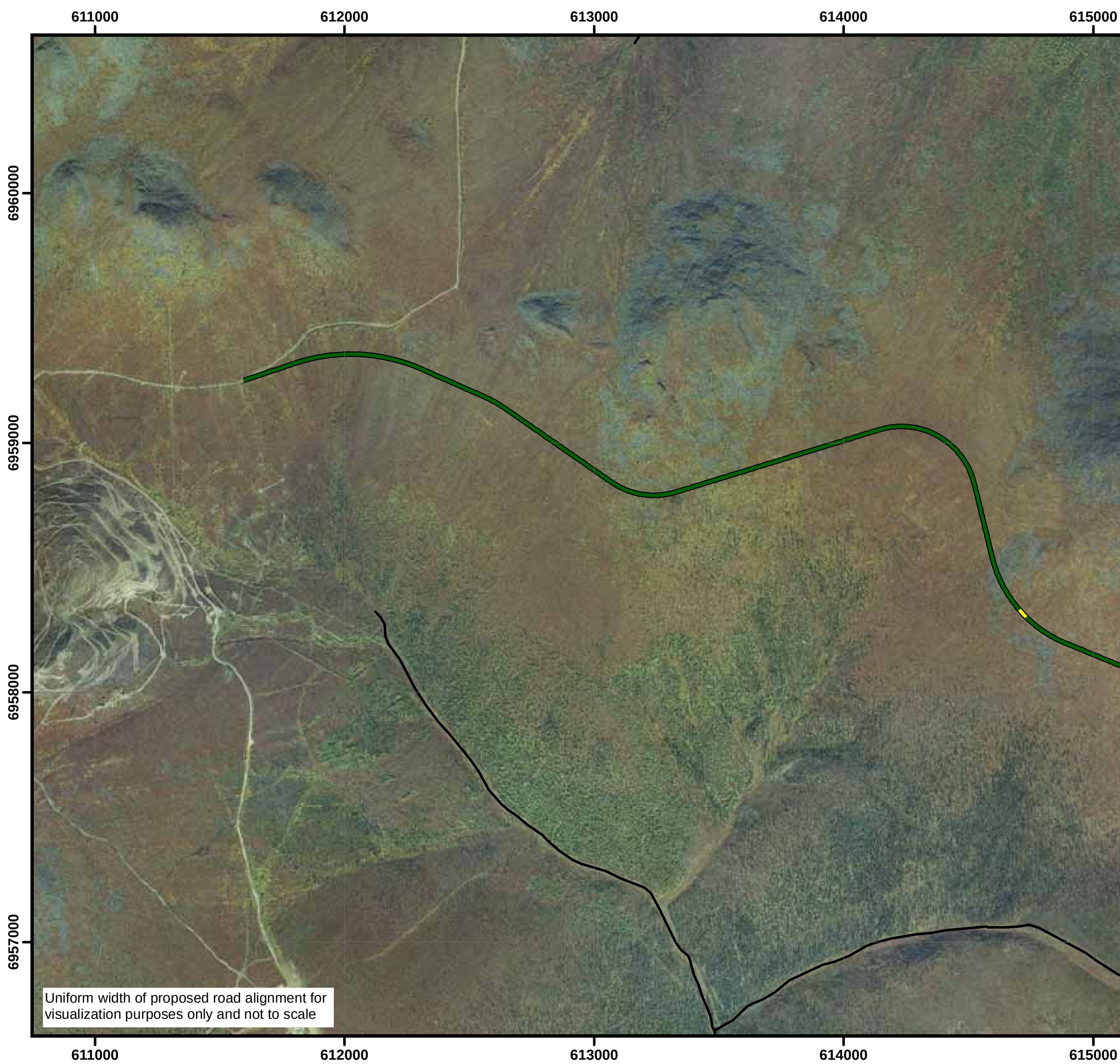
Map 3

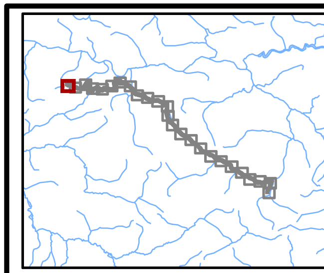
Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Sheet 24 of 25





Legend

Overall Erosion and Sedimentation Risk

- High
- Moderate
- Low
- Fish-bearing (known or inferred)
- Non fish-bearing (known or inferred)
- No direct connection to fish-bearing stream
- Watercourse (Not assessed)
- Non-Permanent Water
- Permanent Water

0 125 250 500 750 m

1:20,000

Grid: UTM Zone 7N

Casino Mining Corporation

Freegold Road Extension

Map 3

Overall Erosion and Sedimentation Risk

CASINO

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

A.10.6.5.3 R305

R305. Discussion on the methods of monitoring for erosion and sedimentation during all phases of the Project.

A preliminary Sediment and Erosion Control Management Plan is provided in Appendix A.22C. The objective of the Sediment and Erosion Control Management Plan is to control run-off, minimize erosion on exposed slopes and substrates, and prevent inputs of silt or sediment into watercourses during all phases of the Project. Erosion control measures are those designed to prevent exposed soil particles from becoming detached and transported by water or wind. Sediment is comprised of soil particles resulting from erosion; sedimentation is the deposition of the transported sediment. Best management practices will be the primary tool used to mitigate erosion and sedimentation risks. The Sediment and Erosion Control Management Plan will provide specific details on what types of erosion and sedimentation control measures will be used and where and when they will be applied. It will describe the requirements for inspection, cleaning, repair and ultimately removal of the erosion and sediment control measures.

The final Sediment and Erosion Control Management Plan will describe the measures to be undertaken to manage erosion and sedimentation during all phases of the Project. To achieve these objectives, CMC will:

- Comply with applicable federal and territorial legislation, Project permits, licences and approvals;
- Understand the potential for erosion to occur by identifying all potential erosion and sediment sources prior to undertaking any activities that will disturb ground;
- Adopt a multi-barrier approach for erosion and sedimentation control measures; and
- Inspect and maintain sedimentation control equipment and infrastructure, and remove once work is complete.

The protection of the natural environment and management of environmental risk from erosion and sedimentation in the Yukon is governed by the *Quartz Mining Act*, *Waters Act*, *Lands Act and Territorial Lands Act,* and the *Environment Act*. Additionally, sediment and sediment laden water can be considered a deleterious substance under Section 36 of the federal *Fisheries Act*.

Guidance documents relevant to the topic include:

- Environmental Code of Practice for Metal Mines (Environment Canada 2009);
- Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment (Guidelines for Canadian Drinking Water Quality, Recreational Water Quality, Protection of Aquatic Life, Agricultural Water Uses, as applicable); and
- Best Management Practices for Works Affecting Water in Yukon (Yukon Environment 2011).

Potential adverse effects from erosion and sedimentation can be minimized through project planning, following BMPs, and providing site specific controls that are commensurate with the potential risks to the natural environment. The Plan will provide a detailed description of the methods of sedimentation and erosion prevention and control that will be used, the specific situations that they will be used in, and the implementation procedures that will be followed. The Plan will include details regarding:

- The appropriate location of control measures;
- The timing of installation, inspection and maintenance of control measures; and

- The responsible parties for implementation, operation, modification, inspection and maintenance control measures.

The Sediment and Erosion Control Management Plan provided in Appendix A.22C is a preliminary draft, which will be updated as the project is refined, and has been derived from Plan Requirement Guidance for Quartz Mining Projects (Government of Yukon 2013). The final Plan will provide an overview of the project, described the areas where erosion may be a concern, and provide specific monitoring and management strategies for addressing the areas of concern. The final Plan will include a table of proponent commitments made during the environmental assessment process relevant to erosion and sedimentation management, and indicate how the Plan addresses the commitments. Terms and conditions of any applicable licences, permits and approvals required for the Project operations will also be included, once acquired.

Monitoring of relevant water quality and sediment parameters in any receiving environment is included as a component of the Casino Environmental Monitoring, Surveillance and Reporting Plan. The frequency of erosion and sedimentation control monitoring and receiving environment monitoring will be established following Project permitting in consultation with regulatory agencies.

Monitoring will generally comprise of regular monitoring of key areas identified to be at high risk for erosion or sedimentation and follow up monitoring of installed mitigation measures. Periods of high flows (e.g., during spring melt/freshet periods, or high precipitation events) will also require monitoring of implemented best management practices. Frequent and proper maintenance will allow for prolonged use instead of allowing the measures to be destroyed and in need of full replacement.

Silt fences, sediment traps/basins, ditches, culverts, exfiltration areas, and water management ponds will be visually inspected for the following:

- Excess sediment build-up;
- Structural/physical integrity; and
- Anticipated wear and tear.

Sediment removal and proper disposal shall be conducted as required.

A.10.7 AQUATIC MONITORING PLAN

A.10.7.1.1 R306

R306. Discussion of and rationale for the exclusion of W16 or other downstream locations from monitoring throughout the life of the Project.

As discussed in Section 7 and Section A.7, the water quality modeling conducted by CMC indicates that water quality at station W5 is at or below the water quality objectives. Therefore, monitoring of stations downstream of W5 will not materially affect the understanding of Project effects. However, CMC will comply with the requirements of the Environmental Effects Monitoring Program as detailed in the Metal Mine Effluent Regulations (Environment Canada 2002), which may require monitoring further downstream, depending on the results of initial monitoring studies.

A.10.8 CLARIFICATION

A.10.8.1.1 R307

R307. The information related in Section 7.4.5.1 and 7.4.5.2.

For Section 7.4.5.1, please refer to Section 7.4.1.4.1 Blasting Residues.

For Section 7.4.5.2, please refer to Section 7.4.1.4.2 Dust and Emissions.

A.11 – RARE PLANTS AND VEGETATION HEALTH

A.11.1 INTRODUCTION

The Casino Project will interact with vegetation, which includes vascular plants and lichens. Section 11 of the Proposal provided an assessment of potential Project and cumulative effects on rare plants and vegetation health. It also included proposed mitigation to reduce Project effects on vegetation. The assessment focussed on issues related to rare plants and vegetation health within the Project's Potential Disturbance Area (PDA) and larger Local Study Area (LSA). When Project effects cannot be completely mitigated, potential cumulative effects were described.

The Project will interact with rare plants by clearing vegetation, including some rare plant habitat. Potential effects of the Project on rare plants are primarily loss of habitat within the Project footprint. The footprint will disturb vegetation and fugitive dust generated from Project activities will settle on surrounding vegetation, which may affect plant health.

On January 27, 2015, the Executive Committee requested that Casino Mining Corporation (CMC) provide supplementary information to the proposed Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). Casino Mining Corporation is providing this Supplementary Information Report (SIR) to comply with the Executive Committee's ARR; CMC anticipates that the information in the SIR and Proposal, when considered together, is adequate to commence Screening.

The Executive Committee had six requests related to information presented in Section 11 Rare Plants and Vegetation Health of the Project Proposal submitted on January 3, 2014. These requests are outlined in Table A.11.1-1. Some responses require detailed technical information, data, and figures. Where necessary, this additional supporting information is provided as appendices to the SIR, as detailed in Table A.11.1-1.

Table A.11.1-1 Requests for Supplementary Information Related to Rare Plant and Vegetation Health

Request #	Request for Supplementary Information	Response
R308	Discussion of the potential effects of the construction, operation, and possible decommissioning of other project infrastructure on habitat (such as fens and tors) with elevated potential for rare species.	Section A.11.2.1.1 Appendix A.12A Wildlife Monitoring and Mitigation Plan Appendix A.22C Sediment and Erosion Control Plan
R309	Discussion of the potential effects of the construction, operation, and possible decommissioning of the airstrip and airstrip access road on proximate vegetation and wetlands. In particular, this discussion should identify impacts to downslope wetlands.	Section A.11.2.1.2 Appendix A.12A Wildlife Monitoring and Mitigation Plan Appendix A.22C Sediment and Erosion Control Plan
R310	An update to Figure 3.1 with the ecosystem types identified in the large vegetation polygon overlapping with the centre of the airstrip.	Section A.11.2.1.3

Request #	Request for Supplementary Information	Response
R311	Discussion of the use of “Loss of Vegetation Associations” and “Wetlands and Riparian Vegetation Associations” as indicators for vegetation health.	Section A.11.3.1.1 Appendix A.12A Wildlife Monitoring and Mitigation Plan Appendix A.22C Sediment and Erosion Control Plan
R312	A clear mitigation (buffer zone and avoidance) and management plan (where avoidance cannot be achieved) to support the residual effect assessment, for both the construction and operation of the project components.	Section A.11.3.1.2 Appendix A.10A Fish Habitat Offsetting Plan Appendix A.22C Sediment and Erosion Control Plan
R313	Details on a conceptual integrated management plan for project activities affecting vegetation. Details should include: a. proposed buffer zones around wetlands, valuable vegetation associations or sites, and riparian areas which also consider the needs of wildlife for movement corridors; b. species to be used for re-vegetation; c. timeframe for re-vegetation and reclamation activities; d. measures to monitor success and take corrective actions as necessary; and e. control of invasive species.	Section A.11.4.1.1 Appendix A.10A Fish Habitat Offsetting Plan Appendix A.22C Sediment and Erosion Control Plan Appendix A.22D Invasive Species Management Plan

Notes:

1. Request # refers to the assigned identification number in the YESAB Adequacy Review Report January 27, 2015 Prepared by Executive Committee Yukon Environmental and Socio-economic Assessment Board.
2. Response refers to the location of CMC’s response to the YESAB request for supplementary information.

A.11.2 PROJECT INFRASTRUCTURE AND SENSITIVE HABITATS

A.11.2.1.1 R308

R308. Discussion of the potential effects of the construction, operation, and possible decommissioning of other project infrastructure on habitat (such as fens and tors) with elevated potential for rare species.

The updated Wildlife Mitigation and Monitoring Plan (WMMP – Appendix A.12A) defines sensitive wildlife areas as site-specific features such as mineral licks, den sites, active migratory bird nest sites, raptor stick nests, cliff nests, and wetlands. Mitigation measures for reducing effects on sensitive wildlife areas are listed in the updated WMMP. Riparian setbacks for mitigating effects are defined in the Sediment and Erosion Control Management Plan (Appendix A.22C) for the protection of fish habitat and water quality, and will benefit riparian vegetation and the wildlife that use riparian habitats.

No sensitive vegetation or wildlife features have been found in the areas identified as fens or tors.

Fens and tors may contain suitable habitat for some sensitive species of plants and animals. The distribution of the rare plant species that are known and expected to occur within the LSA is not restricted to the tor and fen habitats (See Appendix 11A Vegetation Baseline Report). While no baseline studies specifically targeted fens and tors, they were included in a number of the baseline survey areas and locations. Table A.11.2-1 identifies the baseline surveys that overlap with the fen and tor habitats that intersect the Project footprint. Aerial surveys are included in the list because sightings of larger wildlife (i.e., large bird and mammals) would be documented in the incidental sighting database.

The potential disturbance area (PDA) includes roads, borrow pits and mine infrastructure. Borrow pit locations and sizes are estimates and still need to be ground thruthed. The footprints of borrow pits displayed in the Project proposal are shown with a 100 m buffer because there is still uncertainty in the exact footprint of each borrow pit, and which borrow pits will ultimately be used. The displayed borrow pits are large over-estimates of the real potential footprint. Including the additional area for borrow sources, and other Project infrastructure, is done to ensure that the assessment of Project effects is conservative (errs on the side of overestimate) and allows some flexibility in the final Project design. Furthermore, the Project does not require all the borrow sources identified in the Project proposal to construct the mine infrastructure, so borrow sources that overlap with sensitive habitats identified during pre-clearing surveys may not need to be developed.

Table A.11.2-1 Summary of baseline studies that overlapped fen and tor habitats that intersect the proposed Freegold Road upgrade alignment

ELC Feature ID	ELC Habitat Description	Overlapping Survey Type
588	Tor	2012 Late Winter Ungulate Survey (aerial)
607	Tor	2011 Fall Ungulate Survey (aerial) 2012 Late Winter Ungulate Survey (aerial)
668	Tor	2008–2012 Bird Observation
687	Tor	2008/2012 Bird Observation 2011 Fall Ungulate Survey (aerial) 2011/2012 Late Winter Ungulate Survey (aerial) 2013 Breeding Bird Point Count Plot 2013 Vegetation and Soil Sampling Site
803	Tor	2011 Late Winter Ungulate Survey (aerial)
2636	Shrubby Fen	2011/2012 Late Winter Ungulate Survey (aerial)
2912	Tor	2012 Late Winter Ungulate Survey (aerial)
3086	Tor	2013 Breeding Bird Point Count Plot 2014 Pika Monitoring Site
3087	Tor	2011 Ungulate Survey Observation (aerial) 2012–2013 Pika Monitoring Site 2013 Vegetation and Soil Sampling Site
3347	Shrubby Fen	2012 Late Winter Ungulate Survey (aerial)
3419	Shrubby Fen	ELC Ground Truthing Plot 2010/2012 Rare Plant Plot 2011 Ungulate Survey Observation (aerial)
3482	Shrubby Fen	2010/2012 Rare Plant Plot

ELC Feature ID	ELC Habitat Description	Overlapping Survey Type
3607	Shrubby Fen	2008–2012 Bird Observation 2010/2012 Rare Plant Plot 2011 Fall Ungulate Survey (aerial) 2011/2012/2014 Late Winter Ungulate Survey (aerial) 2013 Breeding Bird Point Count Plot
3616	Shrubby Fen	2012 Late Winter Ungulate Survey (aerial)
3783	Shrubby Fen	2011 Late Winter Ungulate Survey (aerial)
3977	Shrubby Fen	2012 Late Winter Ungulate Survey (aerial)
3991	Shrubby Fen	2011 Late Winter Ungulate Survey (aerial)
4099	Shrubby Fen	2012 Late Winter Ungulate Survey (aerial)
4115	Shrubby Fen	2011-2013 Late Winter Ungulate Survey (aerial) 2013 Vegetation and Soil Sampling Site
4136	Shrubby Fen	2013 Vegetation and Soil Sampling Site
4150	Shrubby Fen	2012 Late Winter Ungulate Survey (aerial)
4156	Shrubby Fen	2012 Late Winter Ungulate Survey (aerial)
4180	Shrubby Fen	2011/2012Late Winter Ungulate Survey (aerial)
4222	Shrubby Fen	2011 Late Winter Ungulate Survey (aerial) 2013 Breeding Bird Point Count Plot 2013 Vegetation and Soil Sampling Site
4265	Shrubby Fen	2011 Late Winter Ungulate Survey (aerial) 2013 Breeding Bird Point Count Plot 2013 Vegetation and Soil Sampling Site

A.11.2.1.2 R309

R309. Discussion of the potential effects of the construction, operation, and possible decommissioning of the airstrip and airstrip access road on proximate vegetation and wetlands. In particular, this discussion should identify impacts to downslope wetlands.

Quantifiable effects on vegetation and criteria for significance were identified in the Proposal vegetation effects assessment (Section 11). Key indicators used in the assessment of Project effects on vegetation are rare plant occurrence and vegetation health. Other indicators, such as loss of vegetation associations, were not brought forward during meetings with regulators or other interested governments. Additionally, no valuable vegetation conservation associations of interest were located within the PDA. Some riparian and wetland associated vegetation is within the PDA and will be removed.

Alternatively, while not specifically identified as an indicator, wetlands were assessed specifically in the assessment of potential Project effects on rusty blackbird. As rusty blackbird are typically found within shrubby habitats at the edge of ponds or lakes and shrubby wetlands, the assessment of effects on this species can be acknowledged as an acceptable assessment for wetlands in general. The model, detailed in Appendix 12B, used still water bodies based on available imagery, and a 75 m buffer was applied to the water bodies and any overlapping habitat types located within the buffer were rated as high. Additionally, all other wetland habitat types within the vegetation mapping area were rated as low under the assumption that wetland habitats without open water areas would provide some nesting opportunities but were likely not preferred. The results of the habitat model indicate that over 99% of the LSA is considered low or nil value habitats for rusty blackbird. The available high value habitat is scattered in small pockets, generally at mid- to low elevations, throughout the Project and these results can be considered comparable for wetlands in general.

Mitigation measures discussed include:

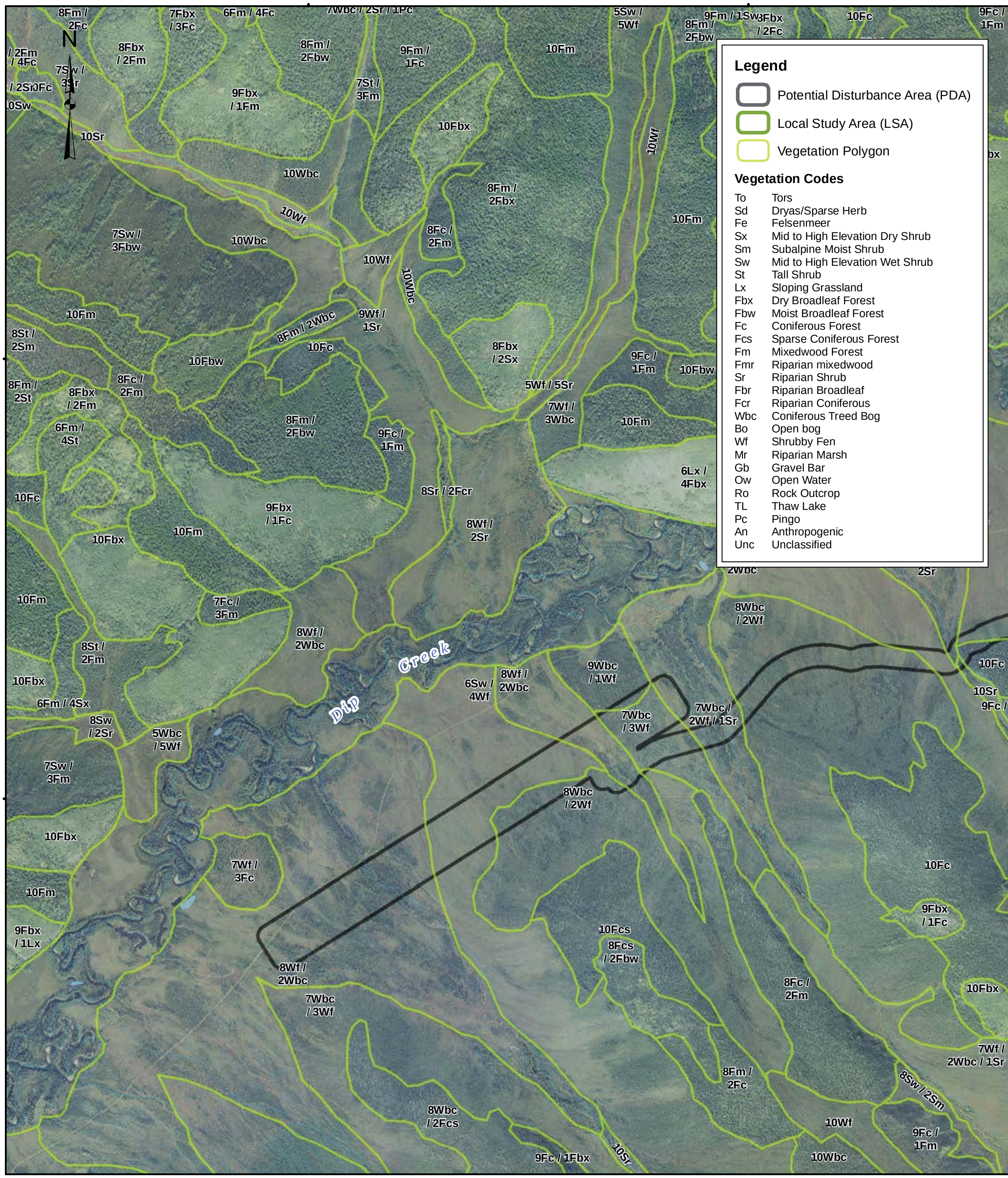
- Generally reducing the Project footprint;
- Where possible given the terrain and other site-specific features, Project design will incorporate a minimum 100 m buffer between Project infrastructure and any ponds or open-water wetlands (e.g. marsh, fen etc.). The 100 m buffer will help maintain riparian shrub and riparian forest communities which were identified as high value habitats for passerine species as a group.
- Dust suppression methods will be employed along roads during dry summer periods to reduce effects on passerine (wetland) habitat (this is a general mitigation action applicable to habitats of many wildlife Key Indicators).

Further mitigation and monitoring measures for reducing effects on wetlands and riparian areas are detailed in the WMMP (Appendix A.12A) and riparian setbacks are defined in the Sediment and Erosion Control Management Plan (Appendix A.22C) for the protection of fish habitat, riparian vegetation, users of riparian habitat and water quality.

A.11.2.1.3 R310

R310. An update to Figure 3.1 with the ecosystem types identified in the large vegetation polygon overlapping with the centre of the airstrip.

A revised Figure 3.1 with the label 6Sw /4Wf is provided in Figure A.11.2-1.

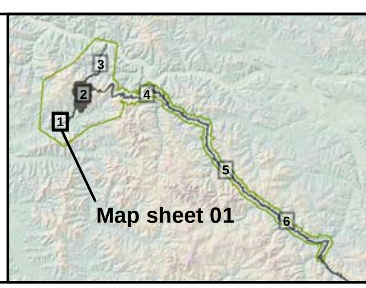


Notes:

PDA provided by Knight Piesold Ltd. 2013.

LSA developed by EDI and is based on boundary ELC vegetation data collected by AECOM and Summit Environmental Consultants and provided by Knight Piesold Ltd. 2013.

Digital Elevation Models (30 m and 90 m) provided by Yukon Government - Geomatics Yukon; online Corporate Spatial Warehouse. www.geomaticsyukon.ca



Airstrip vegetation polygons, map sheet 01

Drawn:	Checked:	Date:	Figure:
MP/LG	MAS	26/02/2015	A.11.2-1

0 200 400 600 800 1,000
Metres

Map scale 1:24,000 (printed at 8.5x11)
North American Datum 1983 CSRS Yukon Albers

CASINO COPPER AND GOLD

EDI

Path: J:\Yukon\Projects\2013\13_Y_0045_CMC_CasinoEA\Mapping\430_Vegetation\BaselineMaps\430_Fig_3_1_VegPolyAirstrip.mxd

A.11.3 SELECTION OF INDICATORS FOR THE VEGETATION HEALTH VALUED COMPONENT

A.11.3.1.1 R311

R311. Discussion of the use of "Loss of Vegetation Associations" and "Wetlands and Riparian Vegetation Associations" as indicators for vegetation health.

Effects on vegetation are quantified in the vegetation effects assessment of the proposal (Section 11). Criteria for significance were identified in the same volume. Key indicators used in the assessment of Project effects on vegetation are rare plant occurrence and vegetation health. Other indicators, such as loss of vegetation associations, were not brought forward during meetings with regulators or other interested governments. Assessing the "ecosystem value" of the vegetation association was not considered a measurable parameter of the selected indicators.

The Project effects on vegetation associations that have value as habitat for wildlife are assessed throughout Section 12. Vegetation associations are mapped within a 1 km buffer of the Freegold Road extension, and within Britannia Creek and its tributary Canadian Creek, as well as upper Dip Creek and its tributary Casino Creek. Wide ranging animals use habitats at coarser scales so the vegetation mapping only informs the assessment of Project effects on breeding birds and sedentary mammals.

Conversely, wetlands and riparian vegetation associations were assessed specifically through wetlands assessment through potential Project effects on rusty blackbird. The proposal's Bird Baseline Report (Appendix 12B) identified water bodies buffered by 75 m and all other wetland habitat types as potential habitat for rusty blackbirds. The potential loss and disturbance to that habitat were assessed in Section 12.3.7 Passerine and Bird Species at Risk Effects Assessment in the Proposal, and measures to mitigate Project effects are identified in the WMMP (Appendix A.12A). Further, the Sediment and Erosion Control Management Plan (Appendix A.22C) defines setbacks around riparian areas for mitigating Project effects on water quality and fish that will also benefit wildlife.

A.11.3.1.2 R312

R312. A clear mitigation (buffer zone and avoidance) and management plan (where avoidance cannot be achieved) to support the residual effect assessment, for both the construction and operation of the project components.

A preliminary Sediment and Erosion Control Plan (Appendix A.22C) was written for the Project, and includes details of vegetative buffers and erosion and sedimentation control systems that may be implemented for the Project. This Plan is preliminary, and will be updated as the Project design progresses, and as construction details become apparent. The primary method of preventing erosion and preventing sediment laden water from entering watercourses is to limit the footprint near waterbodies and to maintain a vegetated buffer between construction activities and the watercourse. This method also protects riparian vegetation and aquatic habitat. Wherever possible, vegetated buffers will be maintained between construction activities and waterbodies. Buffers may range from 10 m to 30 m, depending on the size of the waterbody. The Project footprint near waterbodies will also be limited to the extent possible.

Additionally, construction within riparian areas will adhere to DFO operational statements to minimize loss. Where riparian loss cannot be avoided, riparian areas will be compensated for through the Fish Habitat Offsetting Plan (Appendix A.10A).

A.11.4 SOIL EROSION, RE-VEGETATION AND INVASIVE SPECIES

A.11.4.1.1 R313

R313. Details on a conceptual integrated management plan for project activities affecting vegetation. Details should include:

a. proposed buffer zones around wetlands, valuable vegetation associations or sites, and riparian areas which also consider the needs of wildlife for movement corridors;
b. species to be used for re-vegetation;
c. timeframe for re-vegetation and reclamation activities;
d. measures to monitor success and take corrective actions as necessary; and
e. control of invasive species.

As discussed above in response to R312, a preliminary Sediment and Erosion Control Plan (Appendix A.22C) was written for the Project, and includes details of vegetative buffers and erosion and sedimentation control systems that may be implemented for the Project. This Plan is preliminary, and will be updated as the Project design progresses, and as more details of the proposed construction activities are provided. The primary method of preventing erosion and preventing sediment laden water from entering watercourses is to limit the footprint near waterbodies and to maintain a vegetated buffer between construction activities and the watercourse. This method also protects riparian vegetation and aquatic habitat. Wherever possible, vegetated buffers will be maintained between construction activities and waterbodies. Buffers may range from 10 m to 30 m, depending on the size of the waterbody.

Additionally, construction within riparian areas will adhere to DFO operational statements to minimize loss. Where riparian loss cannot be avoided, riparian areas will be compensated for through the Fish Habitat Offsetting Plan (Appendix A.10A).

The general objective for re-vegetation is to initiate the process for the return of the mine site to a condition which is similar to the existing natural vegetation. Existing vegetation in the area of the Casino Mine consists of black and white spruce in valleys and on lower slopes, with black spruce prevailing on wetter sites and white spruce on drier areas. In valley bottoms, sedge tussock fields are common. Alpine vegetation consists of scrub birch and stunted black spruce. In general, the vegetation at the Project is typical of what is present throughout the Dawson Range.

As detailed in the Conceptual Closure and Reclamation Plan (CCRP – Appendix 4A) the objective of the re-vegetation plan for the Casino mine is to control erosion of reclaimed areas and to initiate the transition to long-term or climax vegetation. Vegetation type will be adjusted for soil moisture, altitude and aspect to the sun.

Re-vegetation measures are expected to consist of:

- Placement of topsoil (taken from stockpiles developed during mine construction). In nutrient poor areas, vegetation establishment will be assisted by the use of early succession nitrogen fixers;
- Non-invasive species will be used, and use of native species will be promoted;
- Initial seeding of areas susceptible to erosion (slopes, etc.) with a native grass mix and a nurse crop to encourage rapid establishment;
- In areas less susceptible to erosion, a more natural approach to establish native species will be used, including woody species planting and local herb species establishment;

- The final phase of re-vegetation will be planting of spruce in patches or plugs to initiate the vegetation transition to climax vegetation; and
- Techniques currently being tested by the Yukon Research Centre, and those used successfully at other mines in the Yukon, will also be incorporated where appropriate.

Re-vegetation and cover trials will be carried out during operations to evaluate the performance of various cover designs and will include the composition and nutrient level of materials used for a vegetation substrate as well as consideration of erosion control to meet the objective of long-term physical stability of all final landforms. Details of the re-vegetation plan will be developed and updated throughout the mine life using the results from pilot plots and other testing at the Project, and in the larger research community.

CMC's Environmental Monitoring, Surveillance and Reporting Plan and a Vegetation Monitoring Plan will be developed to ensure successful re-vegetation of disturbed areas of the Casino Mine Project and will consider the following:

- Vegetation surveying and sampling has been completed as part of the baseline assessment (Appendix 11A). The vegetation monitoring plan will focus on rare plant species monitoring, invasive plant species monitoring and vegetative health monitoring.
- Monitoring of progressive reclamation activities will include re-vegetation monitoring.
- CMC is currently collaborating with the Yukon College to research wetland treatment. To further refine the treatment wetland design the initiation of field trials will identify optimal plants to be established in the North and South wetlands for maximum metal removal, minimal plant metal uptake (see Section A.4.11.3 for more details).
- Re-vegetation will also be guided by native species, and First Nations traditional knowledge and future land use objectives.

As shown in Table A.11.4-1, successful re-vegetation of the mine site will require field trials during operations to evaluate appropriate plant species and potential soil amendments to ensure re-vegetative success. To ensure that the re-vegetation activities meet the requirements for successful re-vegetation, research programs will be required, and may include:

- Assessing the availability of natural seed or the availability of productive seed material from local surroundings;
- Undertaking vegetation trials using native plant species;
- Assessing nutrient level deficiencies in available soils to determine necessary amendments;
- Determining appropriate seed mixes, fertilization and growth media through experimental test plots; and
- Establishing performance standards to measure re-vegetation success.

Table A.11.4-1 Adaptive Management for Re-vegetation Planning

Test Case	Implementation of Test Case	Monitoring of Test Case	Measurement of Success
Natural seed availability	Assessment of natural seed in the Project area.	Assess natural seed collection success.	Ability to collect enough natural seed to meet re-vegetation requirements.
Vegetation trials for re-vegetation	Establishment of trial plots.	Evaluation of re-vegetative success.	Achievement of 100% cover using native species.
Nutrient level deficiencies in available soils	Examination of various methods of nutrient supplementation (e.g., fertilizer, nitrogen fixing plant species, biochar, etc.)	Analysis of subsequent nutrient concentrations and successful growth of native plant species.	Maximum growth of native plant species.

The above studies will be undertaken during the early operations phase, in conjunction with a First Nations working group, as identification of preferred plant species to be available in the ultimate closure landscape will be imperative.

Control of invasive species is detailed in the preliminary Invasive Species Management Plan provided in Appendix A.22D. The Invasive Species Management Plan summarizes the management and monitoring proposed to prevent the introduction and propagation of invasive plant species at the Casino Project.

A.12 – WILDLIFE

A.12.1 INTRODUCTION

Wildlife are defined as terrestrial mammals and birds. The Project will interact with wildlife through potential effects to individuals, populations and their habitats. Wildlife are important because of their value to local people who rely on wildlife as a subsistence and economic resource, and for their intrinsic value as a symbol of wilderness and a healthy ecosystem. Potential effects of the Project on wildlife are primarily: loss of available habitat due to the Project footprint; reduced habitat effectiveness from sensory disturbance; and mortality due to collisions with vehicles, problem animal kills and increased hunter access.

Effects to wildlife were assessed in Section 12 of the Project Proposal, the assessment focused on Project effects related to wildlife populations and habitat that have a reasonable likelihood of occurring. The assessment of the Project's potential effects focussed on a number of wildlife Key Indicators (KIs), including the Klaza caribou herd, moose, grizzly bear, collared pika, cliff-nesting raptors, bird species at risk, and waterfowl. When Project effects could not be completely mitigated, potential residual effects were described and the potential for cumulative effects considered.

On January 27, 2015, the Executive Committee requested that Casino Mining Corporation (CMC) provide supplementary information to the proposed Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). Casino Mining Corporation is providing this Supplementary Information Report (SIR) to comply with the Executive Committee's ARR; CMC anticipates that the information in the SIR and Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has 61 requests related to information presented in Section 12 (Wildlife) of the Project Proposal submitted on January 3, 2014. These requests are outlined in Table A.12.1-1. Some responses require detailed technical information, data, and figures, and may be provided in Appendices outlined in Table A.12.1-1.

The Wildlife Management and Mitigation Plan has been updated from that submitted in the Proposal (Appendix 23A) based on comments received from reviewers in the adequacy review process, and the updated plan is provided in Appendix A.12A. The WMMP provided herein is a preliminary plan, and will be updated in conjunction with the Wildlife Working Group, and as required under the *Quartz Mining Act* and *Waters Act*.

Table A.12.1-1 Requests for Supplementary Information Related to Wildlife

Request #	Request for Supplementary Information	Response Section
R314	The correct references for each place in Section 12 that this error text appears.	Section A.12.2.1.1
R315	Discussion on the effects to wildlife for caribou, wood bison, and Dall sheep, related to predator-prey systems affected by the Freegold Road, airstrip and airstrip access road, through all project phases. This discussion should: a. use the most current data and information available; b. include changes to population dynamics; and c. include areas of wildlife concentration, such as mineral licks.	Section A.12.3.1.1 Appendix A.12A Wildlife Mitigation and Monitoring Plan
R316	Describe how wildlife crossing areas will be implemented. Details should include: a. the schedule and methods for data collection and analysis	Section A.12.3.2.1

Request #	Request for Supplementary Information	Response Section
	regarding the determination of high use wildlife crossing areas along the access roads; and b. how crossing areas may change seasonally and annually.	Appendix A.12A Wildlife Mitigation and Monitoring Plan
R317	Detail on road maintenance activities (e.g. road salt, road margin vegetation management for wildlife, etc.), and other mitigations (such as reducing the frequency of traffic, having periods of time with no traffic, etc.), with a particular emphasis on key wildlife areas. This discussion should include rationale for the effectiveness of mitigations.	Section A.12.3.3.1 Appendix A.22E Road Use Plan Appendix A.12A Wildlife Mitigation and Monitoring Plan
R318	Wildlife monitoring and adaptive response strategies.	Section A.12.3.3.2 Appendix A.12A Wildlife Mitigation and Monitoring Plan
R319	Alternative mitigation measures to reduce or eliminate negative effects on wildlife in the event that the Proponent does not have full legal authority to operate and manage the road.	A.12.3.3.3 Appendix A.22E Road Use Plan Appendix A.12A Wildlife Mitigation and Monitoring Plan
R320	Further discussion on the potential indirect effects to wildlife from harvesting.	Section A.12.3.3.4 Appendix A.12B Wildlife Baseline Report
R321	A discussion of noise associated with the Project in relation to the habitat suitability model using the most recent reference materials available. This discussion should include consideration of noise from all Project activities.	Section A.12.4.1.1
R322	A discussion of objectives for evaluating model assumptions for caribou disturbance, monitoring movement and potential changes in predation, and setting adaptive management thresholds to support actions which may mitigate adverse effects.	Section A.12.4.1.2 Appendix A.12A Wildlife Mitigation and Monitoring Plan
R323	A discussion of potential Project effects to the Fortymile caribou herd supported by available data.	Section A.12.4.1.3
R324	Discussion of the development of the RSF model, including all inputs. Consideration should be given to concerns raised by the Government of Yukon.	Section A.12.4.1.4
R325	Discuss how the RSF model: a. reflects the distribution of high quality habitat across the Klaza caribou herd's range; and b. accounts for the variability in caribou distribution based on environmental facts and among years.	Section A.12.4.1.5
R326	Discussion of the potential bias in the estimated winter range.	Section A.12.4.1.6

Request #	Request for Supplementary Information	Response Section
		Appendix A.12B Wildlife Baseline Report
R327	Winter range map or maps that are representative of caribou use since the late 1980s.	Section A.12.4.1.7 Appendix A.12B Wildlife Baseline Report
R328	An evaluation of the Klaza caribou herd use of the local study area during summer, using the most recent GPS radio-collar data provided by the Government of Yukon.	Section A.12.4.1.8 Appendix A.12B Wildlife Baseline Report
R329	A discussion of how the Project may affect (e.g. fire suppression) the Dawson Range's fire regime and its corresponding implications to caribou and caribou habitat.	Section A.12.4.1.9
R330	Population survey data and demographic models for moose to determine sensitivity to change from potential additional predation or hunting pressure.	Section A.12.4.2.1
R331	Moose harvest data by sex, including an estimate of First Nations harvest, as well as a population model and sensitivity analysis.	Section A.12.4.2.2 Appendix A.12B Wildlife Baseline Report
R332	Mitigation measures for displacement/mortality of moose near roads.	Section A.12.4.2.3 Appendix A.12A Wildlife Mitigation and Monitoring Plan
R333	Detailed design of the pipeline with rationale. If a final design cannot be selected at this stage, please provide detailed design alternatives, and include the potential effects associated with each. In the event that design has not been finalized, please provide the schedule and methods for moose monitoring efforts to inform development of the pipeline.	Section A.12.4.2.4 Appendix A.12A Wildlife Mitigation and Monitoring Plan Appendix A.12B Wildlife Baseline Report
R334	A discussion of and rationale for the selected model. This discussion should include: a. rationale for the ratings assigned to the subalpine and low boreal zones, as well as the selection of north-facing slopes, which considers the comments made by the Government of Yukon; and b. an explanation of Figure 4.3 in the Wildlife Baseline Report showing habitat quality class, which includes statistical support for each of the bars.	Section A.12.4.2.5 Appendix A.12C Moose Late Winter Habitat Suitability Report
R335	A discussion of and rationale for a 300 m zone of influence. This discussion should consider increasing the zone to at least 500 m.	Section A.12.4.2.6 Appendix A.12C Moose Late Winter Habitat Suitability Report
R336	Detail on baselines survey efforts, including den surveys, and including routes taken.	Section A.12.4.3.1 Appendix A.12B Wildlife

Request #	Request for Supplementary Information	Response Section
		Baseline Report
R337	Additional data (one year minimum) on bear den presence and distribution within the project area.	Section A.12.4.3.2
R338	Discussion regarding the dates provided by the Government of Yukon for grizzly bear denning and how these dates may affect or be affected by project activities.	Section A.12.4.3.3
R339	Details on the Habitat Suitability and Habitat Effectiveness models, including: a. additional clarification on why habitat types were rated as presented; for example, alpine habitat is rated as ‘low’ (0) value in the spring. For bears, alpine has high habitat value in spring; b. clarification on traffic projections; c. clarification on the dates used to define the different seasons in the HE model; d. clarification on the coefficients used to develop the HE model; and e. clarification on disturbance events considered in the development of the models.	Section A.12.4.3.4 Appendix A.12B Wildlife Baseline Report
R340	Details on the Security Areas model, including: a. rationale (including reference if possible) for the selection of the 2300 m asl as the threshold for available security areas, as opposed to 1900 m asl; b. clarification on traffic projections; and c. clarification on disturbance events considered in the development of the model.	Section A.12.4.3.5 Appendix A.12B Wildlife Baseline Report
R341	A discussion of and rationale for the use of a qualitative assessment, as opposed to quantitative, for grizzly bear mortality.	Section A.12.4.3.6
R342	Clarification of and rationale for the grizzly bear density estimate for the area.	Section A.12.4.3.7
R343	More information on Table 8.1 of the grizzly bear effects assessment, including: a. proportion of males and females harvested; b. a discussion of how the numbers relate to the population estimate; and c. a discussion of the population-level effects of direct mortality.	Section A.12.4.3.8
R344	A discussion on the mortality estimate from the mine site, Freegold Road, and airstrip and airstrip access road. Discussion should include: a. conflict kills and road kills; b. consideration of high traffic roads vs. low traffic trails and different traffic types; c. assumptions used for mortality risk assessment related to the Freegold Road and mine site; and d. clarification of and rationale for the quota identified for annual allowable human- caused mortality.	Section A.12.4.3.9 Appendix A.12A Wildlife Mitigation and Monitoring Plan
R345	Collared pika colony occupancy data to accurately predict species’ current abundance and distribution. If occupancy data is unavailable,	Section A.12.4.4.1 Appendix A.12B Wildlife

Request #	Request for Supplementary Information	Response Section
	proposed methods for collecting such data prior to habitat alteration.	Baseline Report
R346	A habitat suitability model and related analyses, which identifies potential denning habitat of wolverines in the local study area and regional study area.	Section A.12.4.5.1 Appendix A.12B Wildlife Baseline Report
R347	A risk assessment for wolverines which considers the habitat suitability model. The assessment should identify potential effects to natal and maternal den sites and proposed measures for avoiding disturbance of females with kits.	Section A.12.4.5.2 Appendix A.12A Wildlife Mitigation and Monitoring Plan Appendix A.22A Waste and Hazardous Materials Management Plan
R348	Areas of use by the little brown myotis within the LSA and RSA, particularly for roosting and foraging.	Section A.12.4.6.1 Appendix A.12B Wildlife Baseline Report
R349	If baseline data is unavailable, proposed mitigation and monitoring efforts for the species.	Section A.12.4.6.2 Appendix A.12A Wildlife Mitigation and Monitoring Plan Appendix A.12B Wildlife Baseline Report
R350	Baseline information for Dall sheep or, if unavailable, proposed mitigation and monitoring measures, particularly in relation to the Freegold Road.	Section A.12.4.7.1 Appendix A.12B Wildlife Baseline Report
R351	Discussion of alpine breeders as key indicator species, which considers their associated priority for conservation and the project's potential effects on this group.	Section A.12.5.1.1
R352	The location of alpine meadows in the local study area and regional study area.	Section A.12.5.1.2
R353	The results of baseline surveys for short-eared owl, horned grebe, and common nighthawk pre-construction surveys (i.e. dusk call playback surveys) and a description of plans for mitigation and monitoring of potential adverse effects cause by the Project.	Section A.12.5.2.1
R354	Additional detail on the mortality risk to birds including identifying areas of highest risk.	Section A.12.5.3.1 Appendix A.12A Wildlife Mitigation and Monitoring Plan
R355	Details on the rusty blackbird model. Details should include model inputs and assumptions and indicate whether and how it accounts for small wetlands.	Section A.12.5.4.1

Request #	Request for Supplementary Information	Response Section
R356	Discussion regarding the models for olive-sided flycatcher and short-eared owl, including categorization of high quality habitat types. Consideration should be given to an expanded model for the short-eared owl and olive-sided flycatcher.	Section A.12.5.4.2
R357	A map showing observation sites and potential breeding locations for horned grebes within the project footprint.	Section A.12.5.4.3
R358	Rationale behind decreasing habitat quality ratings one class, as opposed to two in some cases.	Section A.12.5.5.1
R359	Proposed mitigations for effects of chronic noise on bird species.	Section A.12.5.5.2
R360	Discussion of and rationale for buffer sizes around active bird nests.	Section A.12.5.5.3 Appendix A.12A Wildlife Mitigation and Monitoring Plan
R361	Confirmation on whether the cliff-nesting raptor survey involved re-visiting previously documented nests.	Section A.12.5.6.1
R362	A figure showing the aerial route followed during cliff-nesting raptor surveys within the local study area and regional study area.	Section A.12.5.6.2
R363	Rationale for the size of the proposed buffers around cliff-nesting raptor nests.	Section A.12.5.7.1 Appendix A.12A Wildlife Mitigation and Monitoring Plan
R364	Methods used to identify wetlands, including open-water wetlands and small ponds.	Section A.12.5.8.1
R365	Information displaying the locations of these wetlands and ponds, and their distribution across the LSA.	Section A.12.5.8.2
R366	Discussion of potential effects to these wetlands and ponds, and any associated mitigations.	Section A.12.5.8.3 Appendix A.12A Wildlife Mitigation and Monitoring Plan
R367	An effects assessment of the TMF wetlands, as they relate to waterfowl.	Section A.12.5.9.1 Appendix A.12A Wildlife Mitigation and Monitoring Plan
R368	Monitoring and mitigations to prevent waterfowl from utilizing the TMF wetlands and other mine water bodies (events pond, pit lake, etc.). Details should include effectiveness of proposed mitigations.	Section A.12.5.9.2 Appendix A.12A Wildlife Mitigation and Monitoring Plan
R369	Clarification on the meanings of “unacceptable levels of trace metals” and “limited effects” in relation to waterfowl, and rationale for the statement that despite unacceptable levels of trace metals shown by	Section A.12.5.9.3

Request #	Request for Supplementary Information	Response Section
	water quality monitoring, resulting effects to waterfowl will be limited.	
R370	Rationale for how water quality mitigation measures alone will address concerns around waterfowl exposure to elevated levels of trace metals.	Section A.12.5.9.4 Appendix A.12A Wildlife Mitigation and Monitoring Plan Appendix A.7B Water Quality Model Report
R371	Clarification as to whether Figure 8.2 in Section 12B refers to only passerine bird species or to upland birds in general.	Section A.12.5.10.1
R372	The potential effects of climate change on key indicator species over the life of the Project.	Section A.12.6.1.1
R373	Discussion of monitoring and adaptive management measures to be implemented to detect and mitigate potential effects of the Project in the context of climate change.	Section A.12.6.1.2 Appendix A.12A Wildlife Mitigation and Monitoring Plan
R374	Details on the timing, spatial boundaries, frequency, and general methods of monitoring surveys for caribou, moose, carnivore dens, pika colonies, obligate alpine breeders, waterfowl, and bird species at risk.	Section A.12.7.1.1 Appendix A.12A Wildlife Mitigation and Monitoring Plan

Notes:

1. Request # refers to the assigned identification number in the YESAB Adequacy Review Report January 27, 2015 Prepared by Executive Committee Yukon Environmental and Socio-economic Assessment Board
2. Response refers to the location of CMC's response to the YESAB request for supplementary information.

A.12.2 REFERENCES

A.12.2.1.1 R314

R314. The correct references for each place in Section 12 that this error text appears.

The error references can be replaced as follows:

- Pages 12-3, 12-6 and 12-53: replace error references with the text “Wildlife Baseline Report”.
- Page 12-20: replace error references with the text “Appendix 23A”.
- Pages 12-23, 12-26 and 12-27: replace error references with the text “Appendix 12A”.
- Page 12-56: replace error references with the text “Wildlife Mitigation and Monitoring Plan”.
- Also, references to Appendix 12C should refer to Appendix 23A (Wildlife Mitigation and Monitoring Plan). Note that the Appendix 23A has been updated by Appendix A.12A.

A.12.3 FREEGOLD ROAD AND OTHER ACCESS ROADS

A.12.3.1 Population Dynamics

A.12.3.1.1 R315

R315. Discussion on the effects to wildlife for caribou, wood bison, and Dall sheep, related to predator-prey systems affected by the Freegold Road, airstrip and airstrip access road, through all project phases. This discussion should:

a. use the most current data and information available;

b. include changes to population dynamics; and

c. include areas of wildlife concentration, such as mineral licks.

As noted in the Proposal (Appendix 12A Wildlife Baseline Report), and summarized in Table 12.1-2 (Species Known or Likely to Occur in the Project Area, but not Included as Key Indicators), the Project will not interact with Dall's sheep or wood bison populations. As such, there is no issue of potential increased predation or mortality on wood bison and Dall's sheep related to the Freegold Road extension.

Dall's sheep occur in alpine habitats within the RSA, but the PDA does not lie within any known sheep range. A potential interaction with sheep may be the increase in aircraft flying into the Mine Site. Sheep respond to aircraft noise by being vigilant, resulting in less time spent foraging and resting (Laberge Environmental Services 2002). To mitigate this potential effect, CMC will adopt the guidelines outlined in Flying in Sheep Country: How to Minimize Disturbance from Aircraft (Laberge Environmental Services 2002). Habitat loss, both direct and indirect, for sheep in the RSA will likely not occur as a result of the Project. There are no mechanisms for direct Project-related sheep mortality. If effects to sheep in the region are detected (by way of regional, government-led surveys and/or Project footprint monitoring), Project effects to sheep will be re-evaluated and adaptive management measures may be implemented if deemed necessary.

Caribou populations may experience higher predation rates indirectly from human disturbance via two mechanisms:

1. Landscape changes increase suitable habitat and the density of alternate prey species for local predators, which result in larger predator populations and, consequently, increased predation on caribou.
2. Predators, primarily wolves (Apps et al. 2013), use linear features (roads and trails) as corridors for foraging, resulting in higher caribou mortality closer to linear features.

The Project is not expected to increase numbers of alternate prey (moose and deer) as the project is not causing landscape level changes to habitat in the area. There will be changes to functional habitat due to sensory disturbance within a zone of influence, but limited physical changes to habitat that would cause an increase in the number of alternate prey. Forestry and agriculture are examples of industries that likely result in landscape-level changes that can cause increases in alternate prey population densities that could result in increased predator abundance.

Indirect mortality risk to caribou through increased predator-prey interaction was not considered in the mortality effects assessment. There is no known technique of quantifying the Project's effects on predator-prey dynamics and there is no strong evidence suggesting that the Project will have an effect on wolf access to caribou or moose in this area.

Some evaluation of predator-prey dynamics indicates that the upgrade to the existing Freegold Road and extension of the road would allow wolves to use roads and trails to travel more easily, increasing their foraging success and, consequently, increasing prey species mortality along a road. The advantage for wolves is primarily realized in winter when the roads and trails provide easier movement because of packed snow or snow removal. However, there is currently a winter road along most of the proposed Freegold Road extension that is actively used from Big Creek to the confluence of Hayes Creek and Selwyn River. The existing winter use of the extension portion of the road includes travel to placer mines using snowmobiles and heavy equipment to mobilize equipment and deliver supplies for use during the mining season; the activities occur primarily during March or April when snow depth is greatest, as conditions of the required land use permits. The Wildlife Baseline Report (Appendix A.12B) describes wolves currently using the entire length of the existing Freegold Road and winter road to travel. The portion of the proposed road from the Selwyn River to the Mine Site is the only segment of road that is currently not used by humans during winter as a travel route. Additionally, the Project area is the northern edge of the Klaza Caribou Herd's range, so the road is unlikely to result in a significant change to wolf predation on the herd.

Monitoring predator access and efficiency is not considered in the Wildlife Mitigation and Monitoring Plan (Appendix A.12A). Should there be interest in this topic from the Wildlife Working Group; the topic may be addressed as multi-party supported research-level monitoring program.

A.12.3.2 Wildlife Crossing Areas

A.12.3.2.1 R316

R316. Describe how wildlife crossing areas will be implemented. Details should include:

a. the schedule and methods for data collection and analysis regarding the determination of high use wildlife crossing areas along the access roads; and

b. how crossing areas may change seasonally and annually.

Based on the baseline information collected to date, and mitigation and monitoring discussed in the WMMP, no further surveys specific to gathering additional information on wildlife crossing areas is proposed at this time. CMC will address potential barriers to movement through fixed project design features (e.g., road embankment construction considerations) and through measures such as driver awareness training, road signage, and other forms of communication.

Baseline work conducted to determine potential wildlife high-use areas along the road extension were described in the Wildlife Baseline Report. That information was based on observed tracks in snow, and analyses of several years of caribou collar re-location data. Based on the existing information, CMC expects caribou to interact mostly between km 107 to 129 and km 160 to 203 (mine site) of the Freegold Road extension during the winter season. While those sections of the road are expected to be the most active for wildlife encounters, CMC expects that other wildlife will interact with road infrastructure overlapping with seasonal habitats. Furthermore, CMC expects that wildlife populations will change their distribution and abundance within the region during the life of the Project (e.g. the Fortymile Caribou Herd) and CMC is prepared to adaptively manage potential effects on wildlife as they are identified through implementation of the WMMP.

Other than the broad sections of the Freegold Road extension described above, there are no specific spots in the project area known to be consistently used as "wildlife crossings." However, CMC's management of effects on movement to wildlife include mitigation by design of the road embankment, and the WMMP, including the following mitigation measures:

1. The road is designed, along most of the alignment, to avoid introducing barriers (e.g., steep and roughly-constructed embankments) that could block wildlife movement (WMMP Section 4.1.2);

2. Operational practices include communicating observations and providing specific measures to vehicle operations (WMMP Section 4.3.1, Figure 4.3-1);
3. Monitoring will evaluate the accuracy of impact predictions on movement (e.g., WMMP Table 5.4-9 Caribou Monitoring: Movement; Table 5.4-11 Moose Monitoring: Movement); and
4. Should monitoring reveal an unanticipated magnitude of impact, an adaptive management process to correct unanticipated effects is described in the WMMP's Section 2.1 (Adaptive Management and Plan Updates).

The Proposal assessed the effect of the proposed Freegold Road upgrade and extension on caribou movement in Section 12.3.3. Proposal Table 12.3-3 lists caribou herds in Yukon that currently interact with roads, and Proposal Section 12.3.3.2 describes the effect mechanisms and associated management issues of Yukon's existing roads through caribou ranges.

Monitoring and mitigation for wildlife crossings is detailed in the WMMP (Appendix A.12A), and includes minimizing barriers and/or filters to wildlife movement (Section 4.1.2), road operations and access management mitigations (Section 4.3.1) and monitoring Project effects on caribou movement within the Zone of Influence (ZOI). Specifically, the program will monitor the effects of road infrastructure and operations on caribou movements through seasonal track surveys for the first 3–5 years of operation in key late-winter habitat, and remote motion-sensing cameras set up at select trails that cross or approach the road. If deemed necessary, additional monitoring of caribou movements could involve items such as having wildlife monitors visit sections of the road that interact with caribou late-winter habitat on a regular basis (e.g., twice weekly) to document recent use (to determine if caribou are crossing the transportation infrastructure).

A.12.3.3 Road Management

A.12.3.3.1 R317

R317. Detail on road maintenance activities (e.g. road salt, road margin vegetation management for wildlife, etc.), and other mitigations (such as reducing the frequency of traffic, having periods of time with no traffic, etc.), with a particular emphasis on key wildlife areas. This discussion should include rationale for the effectiveness of mitigations.

Details on road maintenance activities are presented in the Road Use Plan (Appendix A.22E), and mitigations applicable to road maintenance activities include the following:

- CMC recognizes that road salt may be an attractant to wildlife. If salt is used, there is the possibility for increased wildlife interaction with the road, and therefore extra vigilance by operators to avoid wildlife collisions and disturbance may be necessary.
- Vegetation will be managed primarily as a road safety measure with the objective of maintaining clear lines of sight where visibility is limited. Vegetation clearing will be avoided during the migratory bird nesting season.
- The potential effects and mitigation for the estimated traffic volumes and frequency identified in the Proposal were assessed as not significant. Traffic stoppages are advised when wildlife is known to be near the road and at risk of collision (e.g., as per the truck operator guidelines identified WMMP Figure 4.3-1). There are no other wildlife-related reasons for traffic stoppages to mitigate effects.
- The wildlife and bird baseline reports (Appendices 12A, 12B and A.12B) provide more detailed information on important habitats and habitat features for wildlife species in the region.

Mitigation measures as they relate to wildlife and maintenance of access roads are identified and detailed in sections 4.1 and 4.3. of the WMMP (Appendix A.12A). Examples of mitigation measures that will reduce the effect of road maintenance on wildlife include timing vegetation clearing to avoid destroying of bird nests, dust suppression to reduce the zone of influence and snow management to reduce barrier effects. Rationale for mitigation measures are provided in Section 12.3.2 of the Proposal, and species specific mitigation measures are provided in Sections 12.3.2, 12.3.3.4, 12.3.4.4, 12.3.5.4, 12.3.6.4, 12.3.7.4, 12.3.8.4 and 12.3.9.4 of the Proposal.

The monitoring framework explains how the effectiveness of the mitigation measures will be monitored (Section 5.1). For example, the program will monitor the effects of road infrastructure and operations on caribou movements through seasonal track surveys for the first 3–5 years of operation in key late-winter habitat, and remote motion-sensing cameras set up at select trails that cross or approach the road. If deemed necessary, additional monitoring of caribou movements could involve items such as having wildlife monitors visit sections of the road that interact with caribou late-winter habitat on a regular basis (e.g., twice weekly) to document recent use (to determine if caribou are crossing the transportation infrastructure).

A.12.3.3.2 R318

R318. Wildlife monitoring and adaptive response strategies.

CMC is committed to the wildlife monitoring and adaptive response strategies outlined in the WMMP (Appendix A.12A). Monitoring effects on wildlife must be relevant to the Project and to the possible effects which the Project will have on the environment. The Project's monitoring framework will inform adaptive management measures that can be effectively applied. The objectives of the monitoring framework are to:

- Develop a comprehensive and integrated environmental monitoring program.
- Incorporate an ecosystem-based approach for monitoring and management of Project related environmental effects.
- Integrate traditional knowledge, when possible and available, into the development and implementation of the environmental monitoring programs.
- Include the meaningful participation of stakeholders in all aspects of the environmental monitoring program in all phases of the development, including the decommissioning and reclamation.
- Report in an effective and timely manner on the environmental monitoring program and its results in ways that are meaningful to stakeholders.

Monitoring efforts will focus on a variety of spatial and temporal scales, depending on the focal species. Most local monitoring efforts will focus studies at the scale of the Project footprint (e.g. wildlife mortality monitoring), while others will focus on larger scales to adequately quantify and/or qualify effects (e.g. wildlife distribution).

CMC will finalize the WMMP in conjunction with the proposed Wildlife Working Group, in preparation for submission in the Quartz Mining Licence Application, and will include wildlife monitoring and adaptive response strategies.

A.12.3.3.3 R319

R319. Alternative mitigation measures to reduce or eliminate negative effects on wildlife in the event that the Proponent does not have full legal authority to operate and manage the road.

As detailed in the response to RA18, a detailed Road Use Plan will be the outcome of further discussions with Little Salmon/Carmacks First Nation, Sellkirk First Nation and Yukon Government. CMC expect this to be a regulatory requirement pursuant to the *Territorial Lands (Yukon) Act* and the Quartz Mining License. The Road Use Plan has been updated and is attached in Appendix A.22E. There are active discussions with Little Salmon Carmacks First Nation to determine an appropriate approach to authorizing use of that First Nation's settlement lands for the purposes of upgrading the existing Freegold Road. Therefore, CMC is confident that it will have full legal authority to operate and manage the proposed Freegold Road extension.

Presuming that wildlife harvest continues to be managed by harvest management authorities, the mitigation measures used to reduce or eliminate negative effects on wildlife are applicable regardless of CMC's full legal authority to operate and manage the road. Management of the access road and implementation of mitigation measures depends on the cooperation of CMC, First Nations and Yukon Government (YG). The legal authority for Casino to operate and manage the road is provided in detail in response to R19 in Section A.4.6.1.7.

CMC's Road Use Plan (Appendix A.22E) will be the primary tool by which the company will implement measures to ensure safety along the Freegold Road Extension. Some of the measures associated with the protection of wildlife identified in the Road Use Plan are components of the WMMP (Appendix A.12A). Both plans include monitoring and reporting requirements that allow adjustments to be made to the plans to ensure achievement of an appropriate level of safety and protection. Both plans have been prepared by CMC in preliminary form. Implementation of the Road Use Plan and WMMP, once finalized in consultation with SFN, LSCFN and YG and subject to YESAB recommendations, will become a commitment of CMC and an enforceable license requirement for the operators of the mine.

Additionally, as described in the WMMP (Section 3.1), a Terrestrial Ecosystem Working Group can be established to act as an advisory body to support ongoing cooperation and communication, as well as to review and provide advice on all aspects of the WMMP, including:

- Develop and finalize the WMMP Program;
- Implement the WMMP Program;
- Monitor reports and results;
- Assess potential Project impacts and effects predictions for wildlife;
- Assess effectiveness of mitigation measures; and
- Develop action plans for implementation of appropriate mitigation measures.

The working group may make recommendations to CMC and government agencies with wildlife management responsibilities on any aspects of the WMMP program or for the adoption of mitigation measures which are technically and economically feasible. This group would be responsible for monitoring the implementation of the Road Use Plan as it relates to possible effects on wildlife, including any monitoring work conducted by the company or other agencies, and making recommendations to the governments on changes to the Road Use Plan as may be required to ensure the shared management objectives are met. Participation on the working group would be determined and agreed by the three governments and would include Casino Mining Corporation.

Other matters related to the use of the road, including access and safety issues, may arise. There likely will be a need for other meetings with different participants. An adaptive management approach to ensuring emerging issues can be addressed effectively is outlined in the Section 2.1 (Adaptive Management and Plan Updates) of the WMMP (Appendix A.12A).

A.12.3.3.4 R320

R320. Further discussion on the potential indirect effects to wildlife from harvesting.

The potential indirect Project effects on wildlife populations due to potential improved harvester access are not unique to the Casino Project. The Project is not expected to change hunting pressure in the region because of current harvest management regulations and the identified mitigation measures. All available moose harvest data were presented in the Wildlife Baseline Report (updated in Appendix A.12B). Four of the seven game management areas (GMAs) that overlap with the Project are currently closed to licensed harvest of moose. The GMAs west of the Selwyn River that interact primarily with the proposed mine site facilities are currently open to licensed hunters. Licensed harvesters will not be able to access the GMAs that are open to hunting from the road extension because the Project includes gating the Freegold Road at Big Creek which will mitigate the potential increased harvest. Access to the open GMAs from the Yukon River or from current airstrips in the area remains unchanged.

Managing the cumulative effect of increased wildlife harvest risk needs to have a multi-party approach that may include CMC, communities, and governments with harvest management responsibilities. CMC will support the Yukon Government Department of Environment and affected First Nations wildlife harvest management initiatives in the Project area but does not have the ability to manage the public's rights to hunt or the actions of other businesses (e.g., outfitting, trapping, mining) operating within the RSA — this responsibility falls to the governments that have legislation allowing them to manage hunting. If there is a conservation concern now or in the future, the Yukon Government and First Nations governments are responsible for harvest management.

A.12.4 EFFECTS ASSESSMENT FOR MAMMALS

A.12.4.1 Caribou

Seasonal range maps for caribou have been revised with new information and using an alternative method that incorporates time into an estimate of use to reduce bias. This information was used to update the caribou section in the updated Wildlife Baseline Report (Appendix A.12B). A full description of revised methods used to define the seasonal ranges is provided in the updated Wildlife Baseline Report (Appendix A.12B).

A.12.4.1.1 R321

R321. A discussion of noise associated with the Project in relation to the habitat suitability model using the most recent reference materials available. This discussion should include consideration of noise from all Project activities.

Noise modelling and potential wildlife displacement was considered in the effects assessment (Section 12 of the Proposal). Noise associated with project activity was considered a disturbance activity that could affect wildlife behaviour and distribution near Project facilities. All project disturbances and potential effects on wildlife were quantified within the various zones of influence used to quantify effects on wildlife. To quantify potential behavioural changes, habitat multipliers, or "downgrading" was applied to habitat within the zone of influence (Proposal Section 12.3.3 Caribou Effects Assessment). Habitats were considered "nil" (i.e., completely avoided) within the project footprint, with varying reduced habitat uses presumed correlated with distance from Project facilities. The justification for the size and response within a zone of influence, partly determined by noise, is provided in Proposal Section 12.3.3.2 (Potential Project Interactions with the Klaza Caribou Herd). All known relevant literature on caribou response to noise was considered in that section. Mitigation measures to reduce noise levels and, consequently, reduce sensory disturbance on wildlife are listed in Proposal Section 9, Table 9.4-4.

A.12.4.1.2 R322

R322. A discussion of objectives for evaluating model assumptions for caribou disturbance, monitoring movement and potential changes in predation, and setting adaptive management thresholds to support actions which may mitigate adverse effects.

The development of the model provided in the Proposal was described in the Baseline Report (Appendix 12A).

A new caribou habitat suitability model has been developed by Yukon Environment (currently in production). The model documentation will describe Klaza caribou winter habitat selection and will discuss the development of Yukon Environment's RSF model, including all inputs, and is being made available. The report can be requested from Yukon Environment, and CMC anticipates the model will provide useful information and objectives for evaluating model assumptions.

Management thresholds and mitigations for caribou disturbance are outlined in the WMMP provided in Appendix A.12A.

A.12.4.1.3 R323

R323. A discussion of potential Project effects to the Fortymile caribou herd supported by available data.

The Fortymile Caribou Herd is a migratory herd that started to reoccupy its winter range in Yukon in 2002. The herd was estimated at approximately 51,675 animals in 2010 (Alaska Department of Fish and Game 2011) and it is expected to grow in number and reoccupy more of its historic range in Yukon. The herd range extended to the area west of the Project during the winter of 2013/2014; an area not previously used since the early to mid-1900s. The herd may return to the area during the winter of 2014/2015 or in future years. It is unknown how the distribution of the Fortymile herd will change in the coming years. The Project occupies none of the Fortymile Caribou Herd's current range. If the herd continues to grow and expand its range, then the herd will likely spatially and temporally overlap with the Project during winters. The Project's interaction with the Fortymile caribou will likely result in a minor loss of winter habitat.

The recovery of the herd has required active management by both wildlife managers in Yukon and Alaska. Early in the recovery effort, people believed that the near extirpation of the Fortymile herd was mostly due to harvest. Long-term monitoring of caribou populations and traditional knowledge suggest that large migratory caribou herds naturally cycle between periods of population highs and lows (Gunn, Russell, and Eamer 2011). The decline of the Fortymile Caribou Herd was likely a normal example of a declining herd, but the additional adverse human caused effects related to the Klondike Gold Rush may have been the reason for the near extirpation of the herd.

CMC will track Fortymile caribou presence in the RSA through communication with Yukon Government Department of Environment (Yukon Environment). CMC will be a stakeholder in the conservation of the Fortymile Caribou Herd's winter habitat if the herd continues to expand its distribution into the Dawson Range. Measures identified in the Proposal for mitigating effects on the Klaza Caribou Herd will also apply to the Fortymile Caribou Herd.

A.12.4.1.4 R324

R324. Discussion of the development of the RSF model, including all inputs. Consideration should be given to concerns raised by the Government of Yukon.

The development of the model provided in the Proposal is described in the Baseline Report (Appendix 12A).

A new caribou habitat suitability model has been developed by Yukon Environment (currently in production). The model documentation will describe Klaza caribou winter habitat selection and will discuss the development of Yukon Environment's RSF model, including all inputs, and is being made available.

A.12.4.1.5 R325

R325. Discuss how the RSF model:
- **a. reflects the distribution of high quality habitat across the Klaza caribou herd's range; and**
- **b. accounts for the variability in caribou distribution based on environmental facts and among years.**

These details are provided in the Baseline Report provided in the Proposal (Appendix 12A). CMC presumes that the caribou habitat suitability model by Yukon Environment (currently in production) will address these comments. Upon completion, Yukon Environment has stated that this report will be available.

A.12.4.1.6 R326

R326. Discussion of the potential bias in the estimated winter range.

Seasonal range maps for caribou have been revised with new information and using an alternative method that incorporates time into an estimate of use to reduce bias. That information was used to update the caribou section in the updated Wildlife Baseline Report (Appendix A.12B), and informs an updated analyses of potential project effects on caribou provided in this report. A full description of revised methods used to define the seasonal ranges is provided in the updated Wildlife Baseline Report (Appendix A.12B). The updated Wildlife Baseline Report includes the new data provided by Yukon Environment documenting use of the local study area by the Klaza Caribou Herd in the summer.

A.12.4.1.7 R327

R327. Winter range map or maps that are representative of caribou use since the late 1980s.

Seasonal range maps for caribou have been revised with new information and using an alternative method that incorporates time into an estimate of use to reduce bias. This information has been used to update the caribou section in the updated Wildlife Baseline Report (Appendix A.12B). A full description of revised methods used to define the seasonal ranges is provided in the updated Wildlife Baseline Report (Appendix A.12B). Older data is incompatible with the modern GPS relocations for analyses; however, the older collar data is displayed on maps where appropriate.

A.12.4.1.8 R328

R328. An evaluation of the Klaza caribou herd use of the local study area during summer, using the most recent GPS radio-collar data provided by the Government of Yukon.

Caribou seasonal distribution maps have been updated to include new caribou collar relocations and the comments from the Government of Yukon. A discussion of the results is provided in the updated Wildlife Baseline Report (Appendix A.12B).

A.12.4.1.9 R329

R329. A discussion of how the Project may affect (e.g. fire suppression) the Dawson Range's fire regime and its corresponding implications to caribou and caribou habitat.

Caribou movement and habitat use is subject to stochastic and dynamic processes (e.g., fire) which increase uncertainty when predicting Project effects. Forecasting of these possible effects is complex and does not increase certainty in Project or cumulative effects predictions. Wildland fires will likely occur within the herd's range during the life of the Project. The caribou habitat model indicates that Klaza caribou avoid burned habitat during winter. The recovery of winter habitat and why caribou still use some burned areas remains unclear. The Klaza Caribou Herd's response to wildland fires is currently being studied by a graduate student, partly funded by CMC, and Yukon Environment. Caribou range use is not expected to change at the scale of the herd range (Dalerum et al. 2007), but wildland fires will likely cause a habitat selection response observable at a finer scale.

The Project will not influence the Dawson Range fire regime. CMC assumes the frequency and severity of fires will be within the range of what the area has experienced in the past; however, the likely scenario is that there will be increasingly active wildland fire management in the region if the Project becomes operational. CMC understands that Yukon Environment is conducting fire regime scenario-building for the Klaza caribou range. CMC will consider reasonable scenarios and interaction with Project effects if they are developed and made available for review.

A.12.4.2 Moose

A.12.4.2.1 R330

R330. Population survey data and demographic models for moose to determine sensitivity to change from potential additional predation or hunting pressure.

An analysis of moose population demographics and demographic modelling was not required to assess the effects of the Project on moose. Assessing sensitivity of moose populations to changes from additional predation or hunting pressure is directly related to population and harvest management responsibilities and is not directly relevant to an assessment of Project effects.

A.12.4.2.2 R331

R331. Moose harvest data by sex, including an estimate of First Nations harvest, as well as a population model and sensitivity analysis.

All available moose harvest data are presented in the Wildlife Baseline Report (Appendix A.12B). In Yukon, only male moose are harvested by licensed hunters. First Nation persons are able to harvest moose of both sexes and any age. First Nations harvest is not reported to the Government of Yukon and data are not publicly available; therefore, harvest data are incomplete. Any estimates of First Nations harvest would be conjectures and not defensible; consequently, the uncertainty of any model would be very large, making any model results questionable.

As stated in the response for R330, an analysis of moose population demographics and demographic modelling was not required to assess the effects of the Project on moose. Assessing sensitivity of moose populations to changes in additional predation or hunting pressure is directly related to population and harvest management responsibilities and is not directly relevant to an assessment of Project effects.

A.12.4.2.3 R332

R332. Mitigation measures for displacement/mortality of moose near roads.

Mitigation measures as they relate to wildlife and the access roads are detailed in the WMMP (Appendix A.12A), and includes minimizing barriers and/or filters to wildlife movement (Section 4.1.2), road operations and access management mitigations (Section 4.3.1) and monitoring Project effects on wildlife movement within the Zone of Influence (ZOI). Mitigation measures to reduce moose mortality and displacement near roads are also listed in the WMMP (Appendix A.12A).

A.12.4.2.4 R333

R333. Detailed design of the pipeline with rationale. If a final design cannot be selected at this stage, please provide detailed design alternatives, and include the potential effects associated with each. In the event that design has not been finalized, please provide the schedule and methods for moose monitoring efforts to inform development of the pipeline.

The design for the fresh water pipeline from the Yukon River to the Casino mine site is still in the preliminary design phase and the Project engineers are working with the biologists to determine appropriate layout/design features to allow for wildlife passage. In general, the pipeline will be an above-ground insulted 36” or 40” diameter pipe that is 17.4 km long. This pipeline will have four or five booster stations. The design capacity of the freshwater collection system will be approximately 3,400 m^3/hour.

During the summer of 2014, a wildlife assessment was conducted along the pipeline route documenting wildlife use in the area. The information from that assessment will be used to inform where the pipeline will be buried or raised to allow for wildlife passage. The details of that assessment are found in Section 16 of the Updated Wildlife Baseline Report (Appendix A.12B).

Monitoring action details regarding moose response to the water pipeline may be developed further following final engineering details of the pipeline and the result of the baseline work conducted in 2014. Monitoring will be conducted at the wildlife crossing locations to determine effectiveness. More specific monitoring actions and methods may be identified by the Wildlife Working Group. Sections 4.1.2 and 5.3 of the WMMP contain additional details (Appendix A.12A), including the following commitments:

- Construct the water pipeline so that it does not impede wildlife movement.
- Design considerations for the pipeline could include the following components:
    - Raised sections of the pipeline will allow for wildlife movement under the pipeline. Using moose as a precedent, pipeline clearance (i.e., distance from ground to bottom of pipeline) will be a minimum of 180 cm every 400 to 700 m (depending on terrain; Dunne and Quinn 2009) for minimum section lengths of 10 m (i.e., 10 m long section of the pipeline will be raised).
    - Pipeline crossing structures (made of vegetated fill or soil) may be constructed in high density crossing/movement areas or areas where the pipeline cannot be raised or buried completely.
- Further studies to determine high probability wildlife crossing areas (e.g., trail surveys, snow track surveys, camera surveys) along the proposed pipeline route prior to construction.
- Frequent monitoring of Project facilities to determine whether effects are occurring and if mitigation is adequate. Project components that will be monitored for wildlife effects include the Yukon River water pipeline to determine if it is acting as a barrier to wildlife movement and effectiveness of mitigation actions.

A.12.4.2.5 R334

R334. A discussion of and rationale for the selected model. This discussion should include:

a. rationale for the ratings assigned to the subalpine and low boreal zones, as well as the selection of north-facing slopes, which considers the comments made by the Government of Yukon; and

b. an explanation of Figure 4.3 in the Wildlife Baseline Report showing habitat quality class, which includes statistical support for each of the bars.

The moose winter habitat model has been updated to include new habitat information and the comments from Yukon Government. The updated model is provided in Appendix A.12C.

A.12.4.2.6 R335

R335. A discussion of and rationale for a 300 m zone of influence. This discussion should consider increasing the zone to at least 500 m.

The updated late-winter habitat model for moose has been used to quantify Project effects on moose using a 500 m zone of influence as suggested. The updated model is provided in Appendix A.12C.

A.12.4.3 Grizzly Bear

A.12.4.3.1 R336

R336. Detail on baselines survey efforts, including den surveys, and including routes taken.

Grizzly bear baseline survey effort and data summaries are provided in Section 8 of the Wildlife Baseline Report (Appendix A.12B).

A.12.4.3.2 R337

R337. Additional data (one year minimum) on bear den presence and distribution within the project area.

Three 1–day grizzly bear den surveys were conducted during the spring of 2012. Although these surveys were conducted during the optimal survey period for grizzly bear den emergence surveys (early April to late May), snow conditions (i.e. minimal snow) were not favorable for this type of survey method (Figure A.12.4-1).

The purpose of conducting den emergence surveys is to determine 1) the number of active grizzly bear dens in close proximity to the Project footprint; and 2) areas with suitable denning habitat. To accurately determine the number of active dens, good snow conditions (i.e. adequate snow cover) are required that allow for tracking bears back to the den site. Low snow conditions were again observed by EDI during the spring of 2013 and 2014 (Figure A.12.4-2). The Casino area receives relatively low snowfall, can be highly windswept and south facing slopes melt sooner than other areas. Low snow and wind swept slopes do not allow for accurate documentation of the number of active bear dens within the study area. Typical snow conditions in the area do not allow for den surveys to be conducted using this method (Farnell et al. 1991). No additional den surveys prior to construction are proposed for this reason.

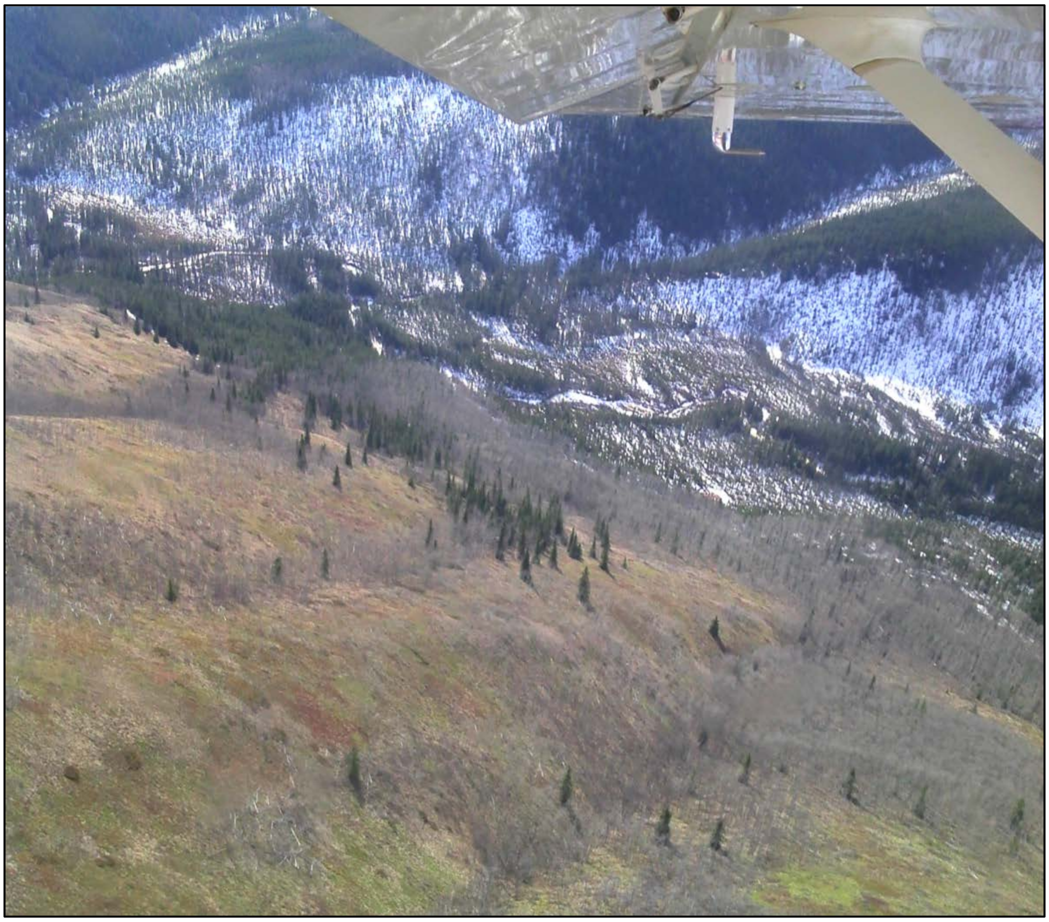


Figure A.12.4-1 Snow conditions during the first grizzly bear den survey (April 20, 2012)

Figure A.12.4-2 Snow conditions typically observed during the early spring (February 24, 2014)

A.12.4.3.3 R338

R338. Discussion regarding the dates provided by the Government of Yukon for grizzly bear denning and how these dates may affect or be affected by project activities.

The denning season reported in Section 12.3.5 is correct, though we acknowledge that there is variation in the denning period. No changes to the effects assessment or WMMP will be required because of an extended denning period.

In support of the above conclusions, the following are excerpts from Yukon Environment's current grizzly bear species profile and COSEWIC's 2012 status report on grizzly bears.

"The denning period varies depending on the regional climate. Yukon bears spend six to seven months in their winter den from October through April. Grizzly Bears in Yellowstone National Park in Wyoming spend only five months in the den." (Yukon Environment n.d.)

"The most notable aspect of Grizzly Bear physiology, in the context of assigning status to the species, is the vulnerability presented by denning (hibernation or dormancy). Although Grizzly Bears in some areas do not den every year … lack of food and harsh weather compel most bears to 'hibernate' during winter. This is not true hibernation, however, but a form of winter sleep with less metabolic depression and higher body temperature than seen in true hibernators. Duration of denning depends on the class of bear: pregnant females generally enter dens first and emerge last, and adult males usually spend the shortest time in a den …. The duration of den occupancy is related to latitude, with bears at higher latitudes entering dens earlier and remaining denned longer …. Grizzly Bears in Banff National Park spend, on average, about 4.5 months each year in dens …. In the Low Arctic tundra of Nunavut, average duration of den occupancy is 185 days (6.2 months) for males and 199 days (6.6 months) for females …. In Nunavut, Grizzly Bears hibernate from October or November to April or May; exact timing is weather-dependent …. Even at high latitudes, Grizzly Bears may be active well into December if weather permits …. In the far north there may be some recent changes in grizzly hibernation patterns, whereby bears are hibernating later in the year and emerging earlier (…. This may be due to the longer growing seasons experienced in the Arctic in recent years …." (COSEWIC 2012)

A.12.4.3.4 R339

R339. Details on the Habitat Suitability and Habitat Effectiveness models, including:

- **a. additional clarification on why habitat types were rated as presented; for example, alpine habitat is rated as 'low' (0) value in the spring. For bears, alpine has high habitat value in spring;**
- **b. clarification on traffic projections;**
- **c. clarification on the dates used to define the different seasons in the HE model;**
- **d. clarification on the coefficients used to develop the HE model; and**
- **e. clarification on disturbance events considered in the development of the models.**

Details on the grizzly bear habitat models are provided in Section 8.3 of the Wildlife Baseline Report (Appendix A.12B). And additional information in response to R339 is provided below.

Part a.

Justification for habitat ratings for each bioclimate zone is provided in Table 8.3 of the Wildlife Baseline Report (Appendix A.12B).

Part b.

In regards to the comments by YG with regards to traffic projections (YOR 2014-0002-252-1), section 12.3.5.2 of the Proposal states that "Traffic projections predict that the during construction phase, the average number of vehicles per day will be between four and 28. During operation, traffic projections estimate approximately 125 vehicles per day". To clarify, traffic projections represent the number of 'traffic events' (i.e. the number of times a vehicle will travel the Freegold Road in one direction, not return trip). The actual number of estimated vehicle events per day is 136, not 125 as stated in the Proposal (i.e. 68 northbound and 68 southbound). More details on the traffic projections are provided in Table 4.3-5 (construction) and Table 4.4-5 (Operation) in the Proposal. The information provided in those tables is loads (i.e. only loaded trucks are counted), not vehicle passes.

Part c.

The dates used to define each season are provided in Section 8.3.1 of the Wildlife Baseline Report (Appendix A.12B).

Part d.

The dates used to define the coefficients used to develop the model are provided in Section 8.3.1 of the Wildlife Baseline Report (Appendix A.12B).

Part e.

Disturbance components of the habitat suitability model are provided in Section 8.3.1 of the Wildlife Baseline Report (Appendix A.12B).

A.12.4.3.5 R340

R340. Details on the Security Areas model, including:

a. rationale (including reference if possible) for the selection of the 2300 m asl as the threshold for available security areas, as opposed to 1900 m asl;
b. clarification on traffic projections; and
c. clarification on disturbance events considered in the development of the model.

Part a.

Methods used for the security areas model followed the methods outlined in Purves and Doering (1998) which used an elevational cut-off of 2,300 m as one of the criterion for defining the grizzly bear security areas. Although not stated in the report, no areas were removed from the security areas model because they were above the elevational cut-off of 2,300 m. The highest peak in the grizzly bear study area is Apex Mountain, at a height of 2,022 m.

Part b.

As discussed above, Section 12.3.5.2 of the Proposal states that "Traffic projections predict that the during construction phase, the average number of vehicles per day will be between four and 28. During operation, traffic projections estimate approximately 125 vehicles per day". To clarify, traffic projections represent the number of 'traffic events' (i.e. the number of times a vehicle will travel the Freegold Road in one direction, not return trip). The actual number of estimated vehicle events per day is 136, not 125 as stated in the Proposal (i.e. 68 northbound and 68 southbound). More details on the traffic projections are provided in Table 4.3-5 (construction) and Table 4.4-5 (Operation) in the Proposal. It is important to note that the information provided in those tables is loads (i.e. only loaded trucks are counted), not vehicle passes.

Part c.

Disturbance events considered in the development of the model are provided in Section 8.3.2 of the Wildlife Baseline Report (Appendix A.12B).

A.12.4.3.6 R341

R341. A discussion of and rationale for the use of a qualitative assessment, as opposed to quantitative, for grizzly bear mortality.

Section 12.1.3.2 of the Project proposal describes the measurable parameters used to assess wildlife. Project effects on direct mortality risk is a qualitative discussion about likely mortality risk in the absence of detailed baseline information on current mortality (outside of licenced harvest) or predictive mortality tools. It is discussed in the context of likely interaction and risk from Project infrastructure and activities. Section 12.3.5.2 (Potential Project Interactions with Grizzly Bear: Mortality Risk) discusses the available information on grizzly bear mortality data. Section 12.3.5.3 (Effects Assessment Methods for Grizzly Bear: Mortality Risk) identifies quantitative thresholds for grizzly bear, and the methods consider the potential for the project to be an additive mortality risk. Given mitigation that CMC will implement to minimize interactions with grizzly bear, the conclusion is that the additive mortality risk will more than likely remain below sustainable harvest limits.

A.12.4.3.7 R342

R342. Clarification of and rationale for the grizzly bear density estimate for the area.

The grizzly bear density estimates for the area were provided by the Yukon Government. The Project lies mostly in the Klondike Plateau Ecoregion, with some sections of the Freegold Road in the Yukon Plateau Central Ecoregion. The Yukon Environment comment (YOR 2014-0002-252-1) states that the "…*density estimate for the area depends on the ecozone*". Both the Klondike Plateau Ecoregion and the Yukon Plateau Central Ecoregion lie within the Boreal Cordillera Ecozone.

A.12.4.3.8 R343

R343. More information on Table 8.1 of the grizzly bear effects assessment, including:

a. proportion of males and females harvested;
b. a discussion of how the numbers relate to the population estimate; and
c. a discussion of the population-level effects of direct mortality.

An analysis of grizzly bear population demographics and demographic modelling is not required to assess the effects of the Project on grizzly bears. Assessing sensitivity of grizzly bear populations to changes in hunting pressure on sex and age cohorts is directly related to population and harvest management responsibilities and is not directly relevant to an assessment of Project effects. As stated in Section 12.3.5.3 (Effects Assessment Methods for Grizzly Bear: Mortality Effects Methods), the harvest statistics are based on hunting restrictions that state that all cubs (bears less than three years old) and females with cubs are protected from hunting. In the last ten years of available harvest data, a total of 11 bears were taken in game management subzones 522–524 and 526 (Wildlife Baseline Report Appendix A.12B).

The grizzly bear effects assessment on mortality risk considers significance at the population level and is discussed in Section 12.3.5.2 of the Proposal (Potential Project Interactions with Grizzly Bear: Mortality Risk).

A.12.4.3.9 R344

R344. A discussion on the mortality estimate from the mine site, Freegold Road, and airstrip and airstrip access road. Discussion should include:

- **a. conflict kills and road kills;**
- **b. consideration of high traffic roads vs. low traffic trails and different traffic types;**
- **c. assumptions used for mortality risk assessment related to the Freegold Road and mine site; and**
- **d. clarification of and rationale for the quota identified for annual allowable human-caused mortality.**

Part a.

A discussion on conflict kills and road kills was provided in Section 12.3.5.2 of the Proposal (Potential Project Interactions with Grizzly Bear: Mortality risk, pp 12-52). That section states "…*The greatest Project related mortality risk for bears is from human-bear conflicts and vehicle collisions. If bear mortality occurs from Project activities, it will be documented and an investigation will be undertaken to determine the cause of mortality and how it can be prevented in the future… Any industrial development in bear territory has the potential to increase mortality risk of bears, both grizzly and black bear. Mortality can occur as a result of human-bear conflict, from vehicle collisions, and from hunting. The survival of grizzly bears is often limited by human-caused mortality. Mattson and Merrill (2002) and Ross (2002) all suggested that human-caused mortality may be much more likely to cause extirpation than habitat loss. Even when high quality habitat is abundant, populations can still decline if harvest rates, including kills from defense of life or property, road kills and poaching, are cumulatively unsustainable (Merrill and Mattson 2003; Maraj 2007).*" Given mitigation that CMC will implement to minimize interactions with grizzly bear (summarized in the WMMP Appendix A.12A), the conclusion is that the additive mortality risk will more than likely remain below sustainable harvest limits.

Part b.

The effects of the traffic on grizzly bears, using traffic projections for the Freegold Road were considered in the assessment of Project effects on grizzly bear. Speed limits, posted signs at high wildlife crossing areas, and the improved visibility in the design of the Freegold Road will minimize mortality. Speed restrictions and lower traffic volumes on project roads around the mine site, make the potential for collisions with bears low compared to other public roads in the Yukon.

Part c.

Section 12.3.5.2 of the Proposal (Potential Project Interactions with Grizzly Bear: Mortality risk, pp 12-52) discusses project interactions with grizzly bear.

Part d.

The information used for the grizzly bear mortality assessment was the best available at the time. The annual allowable human-caused mortality quota of 6%, as cited in *Thresholds for Addressing Cumulative Effects on Terrestrial and Avian Wildlife in the Yukon* (AXYS 2001), was used throughout the grizzly bear mortality analysis. Yukon Government's suggested allowable mortality rate of 4% does not change the conclusion of 'not significant' on grizzly bear mortality risk.

A.12.4.4 Collared Pika

A.12.4.4.1 R345

R345. Collared pika colony occupancy data to accurately predict species' current abundance and distribution. If occupancy data is unavailable, proposed methods for collecting such data prior to habitat alteration.

Preliminary pika surveys were conducted in 2013 (summarized in the Appendix 12A) and additional surveys using methods consistent with the Government of Yukon monitoring protocol (Kukka et al. 2014) were conducted in 2014. The results of the 2014 surveys are presented in the updated Wildlife Baseline Report (Appendix A.12B).

A.12.4.5 Wolverine

A.12.4.5.1 R346

R346. A habitat suitability model and related analyses, which identifies potential denning habitat of wolverines in the local study area and regional study area.

Wolverine were not selected as key indicators for the Project due to their low density and wide home range movements in the Project area. Only one wolverine was observed during baseline studies although several wolverine tracks were observed along the Freegold Road extension and upgrade. Approximately six wolverines are harvested in trapping concessions that overlap the Project footprint each year. This information and a description of wolverine life history and likely denning characteristics were described in the Wildlife Baseline Report (Appendix A.12B). As wolverine was not included as a key indicator for the effects assessment a habitat suitability map and a map of denning habitat was not produced.

A.12.4.5.2 R347

R347. A risk assessment for wolverines which considers the habitat suitability model. The assessment should identify potential effects to natal and maternal den sites and proposed measures for avoiding disturbance of females with kits.

Potential Project effects on wolverine are inferable from effects on grizzly bear because of the similar type of interactions the two species will likely have with the Project. The ecology and biology of the wolverine and grizzly bear are different, but have some important similarities that result in comparable interactions with the Project. Grizzly bear were selected as a key indicator because they have been assessed and recommended as a species of "Special Concern" by COSEWIC, have a history of adverse interactions with humans, and have a low recruitment rate, so excessive mortality can affect population size. Furthermore, there are numerous studies documenting methods of assessing human effects on grizzly bear. By comparison, wolverine is currently under assessment by COSEWIC, and their status report will likely indicate that:

- The estimated number of wolverine in Canada is at least 10,000, of which 3,500 to 4,000 reside in the Yukon (35 to 40%).
- Densities in Canada vary to a maximum of 10 per 1000 km^2, the highest densities being those documented in the Yukon (10.75 per 1000 km^2 in south-central Yukon and 9.7 per 1000 km^2 in the Old Crow Flats).
- Wolverine numbers have been stable or increasing in their northern ranges for 15 years, and may be increasing in numbers and expanding their range in Manitoba and Ontario.

- Trappers and aboriginal knowledge holders in the Yukon report wolverine to be common.
- The Yukon trapper harvest ranges from 100 to 150 wolverine per year, and the harvests are not declining relative to trapping pressure.
- The primary threat to wolverine is harvest, but forestry, hydroelectric developments, oil and gas and mineral exploration and development, and transportation corridors contribute to permanent, temporary or functional habitat loss that may destabilize populations.

In addition, the Yukon Government allows a liberal harvesting regime for wolverine, a further indication that wolverine is not threatened in the Yukon. Given that information on effects of human disturbance and methods for assessing those effects are more developed and robust for grizzly bears, that grizzly bears appear to be more at risk, and that wolverine will have similar interactions with the Project as grizzly bears (i.e., scavenging for food), it was determined that grizzly bears would be suitable as a key indicator species. In other words, the similarities between grizzly bears and wolverine in the type of Project interactions, potential effects, and resultant mitigation measures means that the assessment of project effects and proposed mitigations for grizzly bears are suitable for assessing and mitigating effects on wolverine.

The effects assessment and mitigation for one species is able to be translated meaningfully to another species as effects mechanisms are similar within groups of species. Consequently, mitigation measures to reduce effects will apply to multiple species. Application of general mitigation measures for wildlife year-round (e.g., waste management) will mitigate most potential Project effects on wolverine (e.g., avoid attraction to mine site), thereby reducing the potential for human-wildlife conflict, as outlined in the Waste and Hazardous Materials Management Plan provided in Appendix A.22A and in the WMMP (Appendix A.12A). Both documents provide mitigation measures that aim to reduce Project effects and summarize monitoring that could trigger adaptive management if unanticipated effects are detected. The Waste and Hazardous Materials Management Plan (Appendix A.22A) includes year round waste management which will reduce attractants throughout all seasons. This plan will be implemented year round and includes a number of mitigations that will reduce the potential for attracting all wildlife, including grizzly bears and wolverine. Section 5.4.6 in the updated WMMP (Appendix A.12A) includes den site monitoring for wolverine. If it becomes apparent that mitigation specific to reducing encounters with wolverine are necessary, this can be readily accommodated through the adaptive management approach described in the WMMP.

A.12.4.6 Little Brown Myotis

The little brown myotis has been considered in the Project effects assessment, but not as a key indicator, as habitat loss was not the reason for the 'endangered' designation. The designation of little brown myotis and northern long-eared bat was changed to 'endangered' by COSEWIC in 2012 after an emergency assessment (COSEWIC 2014), and the species are now listed as 'endangered' on schedule 1 of the *Species at Risk Act*. The assessment and the species' designation are the result of a white-nose syndrome epizootic originating in eastern North America. The syndrome is a highly contagious fungal disease. Transmission occurs in hibernacula. It has spread quickly since being detected in North America and is expected to reach western North America in the next two decades. White-nose syndrome has devastating effects on exposed population of bats; more than 99% of some little brown bat populations in the northeastern United States have been lost solely because of the syndrome.

A.12.4.6.1 R348

R348 Areas of use by the little brown myotis within the LSA and RSA, particularly for roosting and foraging.

The Updated Baseline Report (Appendix A.12B) outlines potential bat distribution within the LSA. Surveys for the little brown myotis were conducted at the Project site during the summer of 2014 to document bat occurrence (Appendix A.12B). Surveys did not identify bats in the area.

A.12.4.6.2 R349

R349. If baseline data is unavailable, proposed mitigation and monitoring efforts for the species.

Baseline surveys were conducted in 2014, and surveys did not identify bats in the area (Appendix A.12B).

The updated WMMP (Appendix A.12A) includes mitigations to reduce potential Project effects on bats during the construction phase of the Project, and the WMMP will be finalized in conjunction with the Wildlife Working Group. If bat roosts are detected, site-specific avoidance measures and a mitigation plan will be developed, which could include the placement of bat boxes as a replacement for potentially disturbed roost structures. Any information collected and results of any surveys completed will be submitted (if bats are located) to the Yukon Conservation Data Centre.

A.12.4.7 Dall Sheep

A.12.4.7.1 R350

R350. Baseline information for Dall sheep or, if unavailable, proposed mitigation and monitoring measures, particularly in relation to the Freegold Road.

Baseline information for Dall's sheep is provided in Section 5 of the Wildlife Baseline Report (Appendix A.12B). There are no predicted project interactions, and no project-specific mitigation or monitoring is proposed.

A.12.5 EFFECTS ASSESSMENT FOR BIRDS

A.12.5.1 Alpine Bird Species at Risk

A.12.5.1.1 R351

R351. Discussion of alpine breeders as key indicator species, which considers their associated priority for conservation and the project's potential effects on this group.

Alpine vegetation units *per se* were not identified as high quality habitats for birds. There were no "obligate" alpine breeders identified in the Project baseline surveys. The most common observations in the alpine habitats are listed in Table 6.1 of the Bird Baseline Report (Appendix 12B).

All terrestrial wildlife and birds were considered candidates for a focused effects assessment. However, the determination of effects on all species likely to interact with the Project is unrealistic, and unlikely to provide information upon which to assess effects on wildlife as a whole. Therefore, several criteria were used which identified Key Indicators (KIs) to focus the wildlife effects assessment. The key criteria for selection of KIs included the following considerations (Proposal Section 12.1.3.1 Key Indicators):

- ***Species and/or populations with a clear interaction with the Project footprint*** — for example, seasonal ranges of the Klaza caribou herd clearly overlaps with the Freegold Road Extension and there is likely to be interaction with a substantial portion of the herd;

- ***Species that are known to be sensitive to disturbance*** — for example, grizzly bear have generally been regarded as being particularly sensitive to disturbance, and human interaction with grizzly bear are often detrimental to individual bears;
- ***Habitat specialists*** — for example, cliff-nesting raptors have established long-term residences at particularly defined habitat sites (i.e., cliffs) either within or near Project infrastructure;
- **Species that are culturally important** — for example, moose are important to local communities as a food source;
- ***Species at Risk*** — the Project's effects assessment must identify the adverse effects on species listed in *SARA* that are likely to occur in the Project area. Although several species have been listed with a status of Threatened or Special Concern by COSEWIC, many of the species have not been included on *SARA* Schedule 1. Regardless, for this assessment, the COSEWIC designation is regarded here as a *SARA* designation and listed species likely to occur in the Project area are considered as KIs in this assessment; and
- ***Species identified in engagement meetings or otherwise documented as a concern*** — for example, the Klaza caribou herd is included as a KI for wildlife because the Project footprint intersects the herd's range, and the herd is part of the Northern Mountain Population of Canada's woodland caribou population and potential interactions were identified in earlier Casino Trail reports (e.g., Casino Trail Project Advisor Committee 1985; and the Yukon Government Department of Environment has had concerns about the Project's effects on the caribou since studies began on the herd in response to the Casino trial development in the late 1980s).

Based on the criteria outlined above, the Project's effects assessment is focused on several KIs, including the Klaza caribou herd, moose, grizzly bear, collared pika, cliff-nesting raptors, passerine and bird species at risk and waterfowl. These species represent the likely range of potential Project effects on wildlife (Table 12.1-1 of the Proposal). Species that were not included as KIs were those who, while they may be found in the broader Project area, are unlikely to interact with the Project in substantial numbers (e.g., Dall's sheep, mule deer), are found only in very low densities and effects may be addressed by a species that is a KI (e.g., wolverine will be largely covered by the assessment on grizzly bears), were not species at risk, were not identified as of concern to stakeholders or regulators, or are generally numerous and not susceptible to anthropogenic disturbances (Table A.12.5-1).

Finally, a preliminary assessment (Table 12.3-29 of the Proposal) determined that a habitat assessment was suitable to assess impacts to passerine bird species as a group, and to four of the potential bird species at risk: horned grebe, short-eared owl, olive-sided flycatcher and rusty blackbird. Of the remaining species at risk, the preliminary assessment determined that peregrine falcon was better assessed based on known nest sites, since Project interactions are likely to have the highest effect at active nests and because the available topographic data is not detailed enough to pick up many of the habitats that cliff-nesting raptors are nesting on within the LSA. Common nighthawk and barn swallow are considered unlikely to interact with the Project given that the species have not been documented in the LSA, and that the study area is at the northern extent of both of their ranges. Bank swallow have been observed foraging in the Project area, but no nesting colonies have been located within the LSA. There is a possible colony located just outside the LSA; however, the colony is located more than 1 km from Project infrastructure and is unlikely to significantly interact with the Project. Additionally, the available habitat data for the LSA is not detailed enough to delineate suitable nesting habitats for bank swallow (gravel, silt, or clay banks along roadsides, gravel pits, lakes and rivers). Effects on bank swallow are best addressed through site-specific mitigation measures for the protection of any nesting colonies, if any are located within the LSA.

Table A.12.5-1 Species Known or Likely to Occur in the Project Area, not Included as Key Indicators (update to Table 12.1.3-2)

Key Indicator	Species/ Population	Conservation Status	Potential Interaction with Project	Reason for Exclusion from Assessment
Dall's sheep	*Ovis dalli*	Not assessed, but assumed to be secure	Unlikely. Occurs in Project area, but PDA does not intersect sheep range.	No spatial or temporal overlap with the Project (Appendix 12A). While they may occur near site, there is expected to be little interaction with the Project, and are not considered further for effects assessment.
Wood bison	*Bison bison athabascae*	Listed as Threatened on Schedule 1 of *SARA* (2002)	Unlikely. The PDA does not intersect the current wood bison range.	No spatial or temporal overlap with the Project (Appendix 12A). While they may occur near site, there is expected to be little interaction with the Project, and are not considered further for effects assessment.
Wolverine	*Gulo gulo*	Assessed as Special Concern by COSEWIC (2003)	Occurs in the Project area. Distribution is unknown.	Low density and wide home range movements. Effects may be inferable from effects assessment on grizzly bears (e.g., security habitat). Application of general mitigation measures for wildlife year-round (e.g., waste management) will mitigate most potential Project effects on wolverine (e.g., avoid attraction to mine site). Distribution is likely prey-based rather than habitat-based.
Mule deer	*Odocoileus hemionus*	Not assessed, but assumed to be secure	Unlikely. May occur in the Project area.	Uncommon in the area, at the northern extent of range. Populations are not at risk
Black bear	*Ursus americanus*	Assessed as Not at Risk by COSEWIC (1999)	Occurs in the Project area. Distribution is assumed to include most habitat types.	Although there are habitat use differences, the assessment on grizzly bear includes overlapping issues and habitat. Mitigation included for grizzly bear should also mitigate Project effects on black bear.
Snowshoe hare	*Lepus americanus*	Not assessed, but assumed to be secure	Occurs in the Project area. Distribution is unknown.	Not a species at risk. Not raised as a valued component in stakeholder engagement meetings.
Canada lynx	*Lynx canadensis*	Assessed as Not at Risk by COSEWIC (2001)	Occurs in the Project area. Distribution is unknown	Not a Species at Risk. Project interaction is expected to be minimal. Species abundance is related more to prey (snowshoe hare) availability than to specific habitat requirements. There are little data with which to characterize baseline characteristics of a lynx "population" upon which to predict, or later to detect, population-changes due to Project effects.
Grey wolf	*Canis lupus*	Assessed as Not at Risk by COSEWIC (1999)	Occurs in the Project area. Assumed to be distributed across entire RSA.	Not a species at risk. Potential for increased mortality risk is addressed for mitigation related to reducing mortality risk for all wildlife.
Coyote	*Canis latrans*	Not assessed, but assumed to be secure	Assumed to occur in the Project area. Distribution is	Not a species at risk. Habitat effects on this species are addressed in quantification of general habitat loss.

Key Indicator	Species/ Population	Conservation Status	Potential Interaction with Project	Reason for Exclusion from Assessment
			unknown	
Red fox	*Vulpes vulpes*	Not assessed, but assumed to be secure	Likely. Assumed to occur in the Project area. Distribution is unknown	Species is adapted to many human disturbance factors. An effects assessment on this species would provide little to no knowledge about Project effects on the VC wildlife.
Porcupine	*Erethizone dorsatum*	Not assessed, but assumed to be secure	Occurs in Project area. Distribution is unknown	Not a species at risk. Habitat effects on this species are addressed in quantification of general habitat loss. There is limited existing information on human disturbance effects to porcupine.
Small mustelids	American marten (*Martes americanus*); weasels (*Mustella* spp.); American mink (*Neovison vison*).	Not assessed, but assumed to be secure	Likely. Occurs in the Project area. Distribution is unknown	Not species at risk. Habitat effects on this species are addressed in quantification of general habitat loss.
Aquatic mammals	Beaver (*Castor canadensis*); muskrat (*Ondatra zibethicus*); river otter (*Lontra canadensis*)	Not assessed, but assumed to be secure	Likely occurs in aquatic habitats in Project area.	Limited habitat within the PDA. Effects will be managed through mitigations for silt and erosion control and fish and aquatic resources.
Little brown myotis	*Myotis lucifugus*	Assessed as Endangered by COSEWIC (2014)	Likely interaction along wet areas along the Freegold Road. Interaction near mine site is assumed to be minimal because of unsuitable habitat.	This species is at risk because of White-nose Syndrome, not habitat loss. Surveys conducted at the mine site did not identify bats in the area.
Small mammals	Ground squirrel (*Spermophilus parryii*); red squirrel (*Tamiasciurus hudsonicus*); mice and voles	Not assessed, but assumed to be secure	Occurs in the Project area. Distribution is unknown	Not species at risk. Habitat effects on this species are addressed in quantification of general habitat loss.
Hoary marmot	Marmota caligata	Not assessed, but assumed to be secure	Distribution in the Project area is unknown.	Not a species at risk. Habitat effects on this species are addressed in quantification of general habitat loss.
Amphibians	Wood frog (*Lithobates sylvatica*)	Not listed	Limited distribution.	Limited habitat within the PDA, Effects will be managed through mitigations for silt and erosion control and fish and aquatic resources.
Terrestrial insects	Various	Various	Likely distributed throughout Project area. Distribution and abundance unknown.	No baseline data available. Management of aquatic resources will reduce adverse effects on breeding habitat.

A.12.5.1.2 R352

R352. The location of alpine meadows in the local study area and regional study area.

Alpine meadows, were not identified within the detailed ecological land classification study area (Section 11 Rare Plants and Vegetation Health), Appendix 11A (Vegetation Baseline Report), Table 3.1 (Ecosite Summary of the Project's LSA) of the Proposal.

A.12.5.2 Baseline Data for Species at Risk

A.12.5.2.1 R353

R353. The results of baseline surveys for short-eared owl, horned grebe, and common nighthawk pre-construction surveys (i.e. dusk call playback surveys) and a description of plans for mitigation and monitoring of potential adverse effects cause by the Project.

As discussed above, a preliminary assessment (Table 12.3-29 of the Proposal) determined that a habitat assessment was suitable to assess impacts to passerine bird species as a group, and to four of the potential bird species at risk: horned grebe, short-eared owl, olive-sided flycatcher and rusty blackbird. Of the remaining species at risk, the preliminary assessment determined that peregrine falcon was better assessed based on known nest sites since Project interactions are likely to have the highest effect at active nests and because the available topographic data is not detailed enough to pick up many of the habitats that cliff-nesting raptors are nesting on within the LSA. Common nighthawk and barn swallow are considered unlikely to interact with the Project given that the species have not been documented in the LSA, and that the study area is at the northern extent of both of their ranges.

Preliminary wildlife surveys for the Project were completed in the late 1980s by the Government of Yukon and various consultants. Recent work was initiated in 2006 and continued through 2014. The objectives of the wildlife studies were to summarize available wildlife information in the study area (abundance and distribution of key species); identify critical and sensitive habitats; and complete a baseline inventory of wildlife species to gain an understanding of regional wildlife ecology. Field studies for birds were conducted in 2010, 2011 and 2013, consisting of point count surveys for songbirds and other upland bird species, encounter transects, aerial surveys for cliff-nesting raptors, a stand-watch survey for short-eared owl, and collection of incidental sightings.

Baseline data for short-eared owl, horned grebe and upland birds (includes nighthawks) was provided in Appendix 12B.

As CMC has not identified areas with high likelihood of suitable habitat for common nighthawk and short-eared owl, CMC is not planning on conducting surveys specific for these species prior to clearing. If clearing were to occur during the active nesting season, then pre-clearing nest surveys will be undertaken.

A.12.5.3 Bird Mortality Risk

A.12.5.3.1 R354

R354. Additional detail on the mortality risk to birds including identifying areas of highest risk.

CMC acknowledges the Executive Committee's request for more information on the actual numbers used for the qualitative prediction of significance for mortality risk to birds. There are no specific numbers predicted for bird project-related mortality due to the mitigation measures suggested for multiple species in the WMMP (Appendix A.12A). CMC will use practical on-site applications of mitigations/deterrents to prevent harm to migratory birds, and will work to ensure compliance with Section 5.1 of the *Migratory Bird Convention Act* (MBCA). Areas of highest risk are likely associated with contact to project-related water, discussed further in R367.

A.12.5.4 Habitat Loss

A.12.5.4.1 R355

R355. Details on the rusty blackbird model. Details should include model inputs and assumptions and indicate whether and how it accounts for small wetlands.

An Ecological Land Classification (ELC) model was developed based on the BC Terrestrial Ecosystem Mapping inventory standard for 1:20,000 scale mapping (Appendix 11A). As outlined in the bird baseline report (Appendix 12B, Section 8 Habitat Modelling) 1:50,000 Canvec data and available high resolution imagery (approximately 0.5 m resolution) were used to supplement the ELC. Wetlands are identified in Figure 8.5 of Appendix 12B as habitat for rusty blackbird. Wetlands smaller than the high resolution imagery were not identified.

The WMMP (Appendix A.12A) identifies wetland habitats as sensitive habitat features and provides a 100 m setback of the Project footprint from wetlands, where possible. Riparian setbacks for mitigating effects are defined in the Sediment and Erosion Control Management Plan (Appendix A.22C) for the protection of fish habitat and water quality, and will benefit riparian vegetation and the wildlife that occupy the riparian areas. Monitoring actions will be implemented where the project has the potential to interact with wetland habitats; for example, the potential loss of wetland habitat in the Dip Creek area (WMMP, Appendix A.12A, Table 5.4-4 Wildlife Monitoring: Sensitive Habitat Features).

A.12.5.4.2 R356

R356. Discussion regarding the models for olive-sided flycatcher and short-eared owl, including categorization of high quality habitat types. Consideration should be given to an expanded model for the short-eared owl and olive-sided flycatcher.

The habitat models used for the effects assessment erred on the side of caution when identifying high quality habitat for both olive-sided flycatcher and short-eared owl. The habitat models recognize the potential presence of these species in a variety of habitats, and accordingly acknowledge all habitats as having potential (high, medium, low quality). Expanding the models to include broader habitat types would include a larger area, thus likely diluting the Project's potential effects on habitat when represented as percent effect on habitat (Section 12.3.7.5, Table 12.3-30). The model as presented is sufficient for determining the Project's effects assessment.

A.12.5.4.3 R357

R357. A map showing observation sites and potential breeding locations for horned grebes within the project footprint.

Baseline habitat quality for the horned grebe in the Casino Project LSA is provided in Figure 8.4 of the Bird Baseline Report (Appendix 12B). The map indicates that, at the scale of the map, all habitat within the LSA is rated as "Nil". The small size of many wetlands means that the map format is uninformative for the assessment of project effects at this stage, as very little habitat open water habitat exists in the area. For example, the horned grebe habitat model identifies that there is 0.27 km^2 of mapped suitable habitat in the LSA. As such, mitigation measures, regardless of quality of potential breeding locations, will include a minimum 100 m buffer maintained between Project infrastructure and any ponds or open-water wetlands wherever feasible given the terrain and other site-specific features. Ultimately, the identified habitat effects at the level of the LSA are not expected to result in significant effects to regional populations given the small size of the LSA in relation to the local ecoregions. Monitoring actions will be implemented where the Project has the potential to interact with wetland habitats, such as the creation of wetland habitat at the TMF or the loss of wetland habitat in the Dip Creek area.

A.12.5.5 Noise Effects

A.12.5.5.1 R358

R358. Rationale behind decreasing habitat quality ratings one class, as opposed to two in some cases.

There is limited empirical evidence to suggest a measurable change (Section 12.3.7.2 Potential Project Interactions with Passerine Species and Bird Species at Risk). Based on our review of the literature (summarized in section 12.3.7.2), we determined that decreasing habitat quality by one class — essentially a 33% reduction within 300 m — was a reasonable estimate of the effect.

A.12.5.5.2 R359

R359. Proposed mitigations for effects of chronic noise on bird species.

The Project will have persistent, chronic noise sources during the life of the Project (Section 9 Noise). The effects assessment on birds was conducted considering, among other disturbance features, noise within a zone of influence. It was acknowledged that there will be some reduced habitat quality within the zone of influence. This reduced habitat quality was considered 'not significant' within the bird regional assessment area.

A.12.5.5.3 R360

R360. Discussion of and rationale for buffer sizes around active bird nests.

The buffer distances presented in the WMMP Table 4.2-1 are CMC's recommended set-back distances based on the Yukon biologists' (the authors of the Wildlife Effects Assessment) experience using set-back distances for similar species in other Yukon operations. However, as stated in the WMMP, "*Other set-back distance guidelines may be considered should they be made publicly available.*"

A.12.5.6 Cliff-Nesting Raptor Survey

A.12.5.6.1 R361

R361. Confirmation on whether the cliff-nesting raptor survey involved re-visiting previously documented nests.

The survey methods for aerial surveys of cliff nesting raptors are described in Appendix 12B. Suitable habitats and locations of previously documented cliff nests were surveyed.

A.12.5.6.2 R362

R362. A figure showing the aerial route followed during cliff-nesting raptor surveys within the local study area and regional study area.

The locations of raptor nests were not published at the request of Yukon Environment, as nest sites must remain confidential to ensure protection of nesting raptors. A flight track from the survey would display the most likely cliff nesting raptor habitat in the project area and could be used to identify the location of many of the nests, hence is not provided. YESAB could request that Yukon Environment release the data for effects assessment purposes.

A.12.5.7 Cliff-Nesting Raptor Nest Sites

A.12.5.7.1 R363

R363. Rationale for the size of the proposed buffers around cliff-nesting raptor nests.

The rationale for a 500 m 'no disturbance' buffer was based on a review of protective buffer distances around cliff nesting raptor sites summarized in Section 12.3.8.2 (Potential Project Interactions with Cliff-Nesting Raptors). Based on that review, CMC is suggesting the 'no disturbance' buffer presented in the WMMP, summarized as follows.

- Nest-specific management plans will be developed for any cliff nests identified inside the PDA or within 500 m of the PDA.
- Wherever possible, a site-specific no disturbance, no stopping buffer of approximately 500 m will be implemented around active cliff-nesting raptor nests during the nesting period (1 April to 31 August for raptors). The selection of the setback is based on the risk of affecting nest occupancy and productivity.

A.12.5.8 Waterfowl – Presence of Wetlands

A.12.5.8.1 R364

R364. Methods used to identify wetlands, including open-water wetlands and small ponds.

As discussed in the response to R355, an Ecological Land Classification (ELC) model was developed based on the BC Terrestrial Ecosystem Mapping inventory standard for 1:20,000 scale mapping (Appendix 11A). The bird baseline report (Appendix 12B, Section 8) states that 1:50,000 Canvec data and available high resolution imagery (approximately 0.5 m resolution) were used to supplement the ELC. Wetlands are identified in Figure 8.5 of Appendix 12B as habitat for rusty blackbird. Wetlands smaller than the high resolution imagery were not identified.

A.12.5.8.2 R365

R365. Information displaying the locations of these wetlands and ponds, and their distribution across the LSA.

Wetlands in the LSA are identified in Figure 8.5 of the Bird Baseline Report (Appendix 12B) as high quality habitat for rusty blackbirds.

A.12.5.8.3 R366

R366. Discussion of potential effects to these wetlands and ponds, and any associated mitigations.

As detailed in the WMMP (Appendix A.12A), the RAMSAR Convention on Wetlands commits the federal government to maintain the ecological character of wetlands of international significance and to plan for the sustainable use of all wetlands. The Federal Wetlands Policy was established in 1991 in response to RAMSAR. The policy provides goals, guiding principles and strategies for conserving wetlands on federal lands and those significant to Canadians. There are no wetlands in the project area that meet these criteria.

The WMMP identifies sensitive habitat features as mineral licks, active den sites, wetlands, bat roosts, and re-used nest sites. Monitoring for sensitive habitat features is detailed in the WMMP (Appendix A.12A Table 5.4-4 Wildlife Monitoring: Sensitive Habitat Features).

As described in the Project Description (12.3.7.6 Significance of Residual Effects for Passerines and Bird Species at Risk), to help mitigate some of the effects of potential loss of wetland habitat, a minimum 100 m buffer will be maintained between Project infrastructure and any ponds or open-water wetlands wherever feasible given the terrain and other site-specific features. Ultimately, the identified habitat effects at the level of the LSA are not expected to result in significant effects to regional populations given the small size of the LSA in relation to the local ecoregions. Wetlands will be avoided where possible.

A.12.5.9 Waterfowl – Mine Water Bodies

A.12.5.9.1 R367

R367. An effects assessment of the TMF wetlands, as they relate to waterfowl.

Section 12.3.9 (Waterfowl Effects Assessment) of the Project proposal considers the potential positive and negative effects of the TMF for waterfowl. Section 12.3.9.2 (Potential Project Interactions with Waterfowl) specifically identifies likely interaction with the TMF. That section includes a review of empirical results from similar facilities and details on mitigation with reference to the closure plan (Appendix 4A) are discussed in that section. As detailed in the closure plan, the TMF will include the construction of a wetland, creating a large littoral zone and wetland habitat where no wetlands currently exist. It is expected that wetland-associated wildlife will be attracted to and use the area after the mine has closed and the wetland has become established. There are no toxicological effects expected from use of the wetland and no further mitigation for wildlife is expected. The water quality in the wetland is expected to meet or exceed aquatic water quality guidelines (see Section 7 and A.7), and as such will not impact any wildlife or birds that come into contact with the wetland. Additionally, studies are being conducted to confirm that contaminants will not be up taken into the wetland plants (see Section A.4), ensuring further protection of users of the TMF wetland.

CMC will use practical on-site applications of mitigations/deterrents to prevent migratory birds from contacting waters should they contain known harmful substances. This will be done to ensure compliance with Section 5.1 of the *Migratory Bird Convention Act* (MBCA). Those preliminary measures are identified in the WMMP (Appendix A.12A). CMC acknowledges that measures taken may need to be adapted through operations and closure. The adaptive management framework that allows for adjustments to mitigation measures is identified in Section 2.1 (Adaptive Management and Plan Updates) of the WMMP. Mitigation measures will be adapted should they not prove entirely effective. Through construction, operations and closure, CMC will comply with Section 5.1 of the MBCA.

A.12.5.9.2 R368

R368. Monitoring and mitigations to prevent waterfowl from utilizing the TMF wetlands and other mine water bodies (events pond, pit lake, etc.). Details should include effectiveness of proposed mitigations.

As detailed in the WMMP (Appendix A.12A), CMC expects that there will be some waterfowl and wildlife exposure to water in the Tailings Management Facility (TMF) during the Project's operation phase. It is not economically feasible, nor is it necessarily desirable to restrict all wildlife access to the TMF area when risks to animal health and mortality are relatively low — depending on constituents of potential concern (COPCs), ingestion rates, animal residency times, and individual health conditions. There is little evidence to predict what level of effect exposure to water in the TMF may have on wildlife, or the ultimate result of that exposure. Therefore, depending on animal responses to the TMF, the following mitigation options may be considered to control wildlife presence at the TMF if deemed by CMC and/or regulators to be necessary:

- CMC will use wildlife deterrence measures in portions of the TMF that are identified as high risk areas to wildlife health.
- Deterrence measures can include wildlife fencing to keep wildlife out, scare crows, cannons, or any other proven methods at the time the risk is identified.

Monitoring of the TMF and open pit lake (throughout operations and post-closure) and open pit lake (post-closure) will be conducted as part of the PDA/Facility-Specific Monitoring, and will include determination of any wildlife attraction, an assessment of the risks if wildlife are using it, and the need for deterrence measures, if required. The facility-specific monitoring program is outlined in WMMP Table 5.3-1 Summary of PDA/Facility-Specific Monitoring Programs by Project Phase.

A.12.5.9.3 R369

R369. Clarification on the meanings of "unacceptable levels of trace metals" and "limited effects" in relation to waterfowl, and rationale for the statement that despite unacceptable levels of trace metals shown by water quality monitoring, resulting effects to waterfowl will be limited.

See response to R370.

A.12.5.9.4 R370

R370. Rationale for how water quality mitigation measures alone will address concerns around waterfowl exposure to elevated levels of trace metals.

As detailed in the WMMP (Appendix A.12A), CMC expects that there will be some waterfowl and wildlife exposure to water in the Tailings Management Facility (TMF) during the Project's operation phase. It is not economically feasible, nor is it necessarily desirable to restrict all wildlife access to the TMF area when risks to animal health and mortality are relatively low — depending on constituents of potential concern (COPCs), ingestion rates, animal residency times, and individual health conditions. There is little evidence to predict what level of effect exposure to water in the TMF may have on wildlife, or the ultimate result of that exposure. Therefore, depending on animal responses to the TMF, the following mitigation options may be considered to control wildlife presence at the TMF if deemed by CMC and/or regulators to be necessary:

- CMC will use wildlife deterrence measures in portions of the TMF that are identified as high risk areas to wildlife health.
- Deterrence measures can include wildlife fencing to keep wildlife out, scare crows, cannons, or any other proven methods at the time the risk is identified.

During post-closure, when active mine operations have ceased, the water quality in the TMF is expected to improve substantially (see Appendix IV of the Water Quality Model Report, Appendix A.7B), as shown in Table A.12.5-2, and for most parameters, are below the CCME guidelines for the protection of aquatic life during the post-closure (years 35+) periods. As such, exposure of waterfowl to high concentrations of contaminants is expected to be limited to the operations period, at which point the mine will be active, and ongoing activities will naturally deter waterfowl from the area.

Table A.12.5-2 Predicted TMF Pond Water Quality Compared to CCME Guidelines

Water Quality Parameter		CCME Guideline	TMF Pond Water Quality (mg/L)		
			Operations	Initial TMF Pond Discharge	Long-Term
			(Year 15)	(Year 35)	(Year 120)
pH		6.5 - 9	6.1	6.9	6.9
Hardness		-	1,178	452	381
Sulphate	(SO_4)	309*	**1,242**	**335**	266
Fluoride	(F)	0.12	**2.1**	**0.65**	**0.63**
Aluminum	(Al)	0.005 if pH<6.5 0.1 if pH ≥6.5	**2.9**	0.096	0.12
Arsenic	(As)	0.005	**0.0066**	0.0034	0.0037
Cadmium	(Cd)	0.00006 to 0.00037 for H 30 to 290 mg/L; 0.00037 for H >290 mg/L	**0.00064**	0.00034	0.00016
Chromium	(Cr)	0.0010 for Cr(VI) 0.0089 for Cr(III)	0.0026	0.00086	0.0011
Copper	(Cu)	0.002 @ H < 90 mg/L 0.004 @ H > 180 mg/L	**0.33**	**0.11**	**0.073**
Iron	(Fe)	0.3	0.0012	0.00022	0.00023
Lead	(Pb)	0.001 to 0.007 (for H 60 to 180 mg/L)	0.0015	0.003	0.0025
Mercury	(Hg)	0.000026	0.000011	0.000012	0.000015
Molybdenum	(Mo)	0.073	**0.37**	**0.085**	0.066
Nickel	(Ni)	0.025 @ H < 60 mg/L to 0.15 @ H > 180 mg/L	0.0080	0.0033	0.012
Selenium	(Se)	0.001	**0.015**	**0.0043**	**0.0043**
Silver	(Ag)	0.0001	0.000058	0.000036	0.000059
Thallium	(Tl)	0.0008	0.00048	0.00012	0.000099
Uranium	(U)	0.015	**0.018**	**0.048**	**0.042**
Zinc	(Zn)	0.03	0.034	0.020	0.023

NOTES:

1. * BC MOE Guideline for hardness between 76-180 mg/L
2. Bold values indicate exceedances of CCME Guidelines.

A.12.5.10 Bird Baseline Clarification

A.12.5.10.1 R371

R371. Clarification as to whether Figure 8.2 [sic – ref 8.1] in Section 12B refers to only passerine bird species or to upland birds in general.

The caption for Figure 8.1 should read "Baseline habitat quality for upland bird species in the Casino Project LSA."

A.12.6 CONSIDERATION OF CLIMATE CHANGE IN RELATION TO WILDLIFE

A.12.6.1.1 R372

R372. The potential effects of climate change on key indicator species over the life of the Project.

CMC acknowledges the examples of potential effects of climate change on terrestrial wildlife provided by SLR during the Adequacy Review stage of the Casino Project (YOR 2014-0002-238-1). The Climate Change Report submitted as part of the Proposal (Appendix 20A) reviews the climate changes expected in the central Yukon during the life of the Project. The changes that could have the greatest effects on terrestrial wildlife are increased temperature and precipitation. The document states that the region may experience general warming, milder winters, fewer extreme cold temperatures, and more precipitation.

The effects of climate change on terrestrial animal populations are uncertain because of the random nature of weather and the complex interactions among factors that affect animal populations. For example, caribou populations in Yukon respond to poor spring weather associated with the Pacific Decadal Oscillations (El Niño) with reduced calf survival (recruitment); however, the effect of climate on caribou recruitment is not simple, as it is dependent on the presence of predators (i.e., reduced effect in the absence of wolves; Hegel et al. 2010). Song sparrows have been documented showing behavioural plasticity to climate variability, but again the response is dependent on a number of complex factors (e.g., environmental conditions as juveniles and population density the year birds were born) that are difficult to track in wild populations (Wilson et al. 2007). The uncertainty in how climate changes will affect wildlife is the greatest perceived management risk to wild animal populations from climate change.

Most animal populations in the region will likely be robust to changes in temperature and precipitation that could occur within the life of the Project. Potential effects on animals would occur as an indirect result of climate change. Some animal species are exhibiting range shifts north into Yukon; for example, deer, cougars, and parasites. Cougars could result in increased mortality for caribou, as they are a common predator of caribou in southern British Columbia (Apps et al. 2013). Deer could bring diseases common in southern Canada into the region or increase predator density which could affect predation on other ungulates. Ectoparasites, such as ticks, have been documented expanding their range north because milder winter temperatures allow some ticks to survive winters (Lindgren et al. 2000). In Yukon, winter ticks may now be established, though at very low numbers, and ungulates are being monitored by the Government of Yukon.

The animals in the region most at risk from climate change is collared pika. The ecology and behaviour of collared pika means that they are more sensitive to climate driven changes in habitat availability (COSEWIC 2011). Sensitivity to climate variability is the primary reason for the collared pika's status as *Special Concern* (COSEWIC 2011). There is a potential for reduced pika abundance in the region; however, the risk remains unknown as there is considerable uncertainty when making predictions about the effect of climate on Yukon's pika population.

A.12.6.1.2 R373

R373. Discussion of monitoring and adaptive management measures to be implemented to detect and mitigate potential effects of the Project in the context of climate change.

No specific mitigation actions are suggested at this time to address climate change effects. As detailed in the WMMP (Appendix A.12A), to address environmental changes through time, an adaptive management approach is proposed. It is anticipated that the WMMP will evolve and be adjusted to incorporate practical and workable solutions to minimize Project effects on wildlife and support regional wildlife research and management initiatives. An adaptive approach means that increasing monitoring or changes to the monitoring program can occur if unanticipated adverse effects are detected, to further understand effects, or to change mitigation practices. Concomitantly, if no effects are detected over a reasonable time period, some mitigation and monitoring tasks may be removed from the program so that the resources may be applied elsewhere. To facilitate adaptive management and react to changing environmental (i.e., climate change) and Project conditions, a process needs to be established to ensure regular review of the WMMP that includes regular and transparent reporting.

A.12.7 WILDLIFE MITIGATION AND MONITORING PLAN

A.12.7.1.1 R374

R374. Details on the timing, spatial boundaries, frequency, and general methods of monitoring surveys for caribou, moose, carnivore dens, pika colonies, obligate alpine breeders, waterfowl, and bird species at risk.

The updated Wildlife Mitigation and Monitoring Plan (WMMP) is provided in Appendix A.12A. The updated plan incorporates comments received from reviewers following submission of the Project Proposal on January 3, 2014 through the YESAB YOR. The purpose of the WMMP is to minimize effects to wildlife and wildlife habitat, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects given the final Project footprint and description as provided to the YESAB. The plan is intended to ensure that wildlife continue to use habitat in areas adjacent to the Project footprint and within the broader area, as well as reduce potential Project-related injury or mortality, while accounting for operational requirements and human health and safety requirements. The WMMP provides guidance to protect and limit disturbances to wildlife and wildlife habitat from Project activities.

Mitigation of Project effects on wildlife and avoidance of key habitat features were considered in the Project design and in preparation of the Project description and effects assessment. Wildlife management, monitoring, and/or protection plans from similar mining projects in the Yukon (e.g. Eagle Gold Project, Wolverine Mine, Minto Mine, Bellekeno Mine) were reviewed to provide details on mitigations and monitoring that has been implemented in the Yukon and to determine the effectiveness of those actions. This document does not provide detailed methods (i.e., study designs), cost estimates, or schedules. The WMMP is considered a “living document” and CMC anticipates that further details will be developed in continued discussion with the management agencies, Renewable Resource Councils (RRCs), working groups established to monitor Project effects, and other interested parties.

A.13 – EMPLOYMENT AND INCOME

A.13.1 INTRODUCTION

Employment and income was selected as a Valued Component (VC) by Casino Mining Corporation (CMC) because the Project will create employment and income opportunities for Yukon residents, and this component was frequently raised as an item of interest during consultations with local communities, First Nations and Yukon Government (YG). Employment and Income is a prominent factor in determining community benefits arising from the Project and changes in employment and income can affect the well-being of individuals, families, and communities in the area. The Proposal assessed labour availability in the study communities and their ability to meet Project labour demands.

The Proposal determined that the potential effects of the Project on employment and income are beneficial, as the Project would employ approximately 5.6% of Yukon's workforce and would increase average incomes by 6.9%. These beneficial effects are anticipated to reduce unemployment, increase participation, and increase the rate of migration into Yukon. Casino Mining Corporation is committed to working with First Nations, local communities and YG to maximize recruitment, training, and advancement for the Project and within the Project's anticipated workforce.

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). Casino Mining Corporation is providing this Supplementary Information Report (SIR) to comply with the Executive Committee's Adequacy Review Report; CMC anticipates that the information in the SIR and Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has one request related to information presented in Section 13 Employment and Income of the Proposal submitted on January 3, 2014. These requests are outlined in Table A.13.1-1. Some responses require detailed technical information, data, and figures. Where necessary, this additional supporting information is provided as appendices to the SIR.

Table A.13.1-1 Requests for Supplementary Information Related to Employment and Income

Request #	Request for Supplementary Information	Response
R381	The following referenced report: MNP LLP. 2013. Economic Impacts of the Casino Mine Project. March 2013. Casino Mine Corporation.	Section A.13.2.1.1 Appendix A.13A Economic Impacts of the Casino Mine Project

Notes:

1. Request # refers to the assigned identification number in the YESAB Adequacy Review Report of January 27, 2015 Prepared by the Executive Committee of the Yukon Environmental and Socio-economic Assessment Board.
2. Response refers to the location of CMC's response to the YESAB request for supplementary information.

A.13.2 SUPPORTING DOCUMENTATION

A.13.2.1.1 R381

R381. The following referenced report: MNP LLP. 2013. Economic Impacts of the Casino Mine Project. March 2013. Casino Mine Corporation.

The "Economic Impacts of the Casino Mine Project" report by MNP LLP in 2013 is provided as Appendix A.13A of the SIR.

A.14 – EMPLOYABILITY

A.14.1 INTRODUCTION

Employability was selected as a Valued Component (VC) for the Casino Project (the Project) by Casino Mining Corporation (CMC) because changes in an individual's ability to obtain employment will affect the well-being of the individual, as well as the family of the individual and the community in which he or she lives. The Project will require a large labour force with a wide range of skills and skill levels primarily during the construction and operations phases.

The Proposal concluded that all potential effects of the Project on employability are beneficial and not adverse. In addition, CMC committed to implementing enhancement measures to maximize potential beneficial effects and improve long-term employability of local and regional workforces. Substantial investments in training and capacity-development in the region will help CMC to meet the company's target for employment.

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Proposal in the preparation of the Adequacy Review Report (ARR). Casino Mining Corporation is providing this Supplementary Information Report (SIR) to comply with the Executive Committee's Adequacy Review Report; CMC anticipates that the information in the SIR and Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has seven requests related to information presented in Section 14 Employability of the Project Proposal submitted on January 3, 2014. These requests are outlined in Table A.14.1-1. Some responses require detailed technical information, data, and figures. Where necessary, this additional supporting information is provided as appendices to the SIR.

Table A.14.1-1 Requests for Supplementary Information Related to Employability

Request #	Request for Supplementary Information	Response
R382	A plan on how the Proponent intends to meet their commitment to hire within Yukon including: a. anticipated training programs; b. a monitoring mechanism including indicators; c. how the plan has or will involve communities and First Nations considering Chapter 22 of the Umbrella Final Agreement; d. implementation timelines; and e. apprenticeship and co-op opportunities.	Section A.14.2.1.1 Appendix A.22F Socio-Economic Management Plan
R383	Transportation alternatives for potential employees in Yukon communities outside of Whitehorse during each Project phase.	Section A.14.3.1.1
R384	Details of the "hiring policy that encourages the employment of workers from Yukon and in particular the rural communities of the LSA" and workforce opportunities for residents in Carmacks and Pelly Crossing and citizens of affected FNs.	Section A.14.3.1.2 Appendix A.22F Socio-Economic Management Plan

Request #	Request for Supplementary Information	Response
R385	Assumptions supporting migration estimates, including between communities in Yukon and how downward population pressures were considered.	Section A.14.4.1.1
R386	A breakdown of direct Project employment projected for each affected community. Please indicate if employees are new, existing, or returning residents or from other communities in Yukon.	Section A.14.4.1.2
R387	Clarify if the flexible rotations, counselling services, and adaptive management are the mitigation strategies for the proposed shift structure as suggested in the proposal. Please elaborate in detail for each mitigation strategy.	Section A.14.5.1.1 Appendix A.22F Socio-Economic Management Plan
R388	Details on how CMC will accommodate cultural and community events, including funerals and potlatches, in its proposed shift structure.	Section A.14.5.1.2 Appendix A.22F Socio-Economic Management Plan

Notes:

1. Request # refers to the assigned identification number in the YESAB Adequacy Review Report January 27, 2015 prepared by Executive Committee Yukon Environmental and Socio-economic Assessment Board.
2. Response refers to the location of CMC's response to the YESAB request for supplementary information.

A.14.2 TRAINING AND EDUCATION

A.14.2.1.1 R382

R382. A plan on how the Proponent intends to meet their commitment to hire within Yukon including:

- **a. anticipated training programs;**
- **b. a monitoring mechanism including indicators;**
- **c. how the plan has or will involve communities and First Nations considering Chapter 22 of the Umbrella Final Agreement;**
- **d. implementation timelines; and**
- **e. apprenticeship and co-op opportunities.**

Casino Mining Corporation will make every attempt to maximize hiring of Yukoners and resident workers to ensure that potential socio-economic benefits of the Project are maximized and remain in the Yukon. As part of this commitment, CMC has developed a preliminary Socio-Economic Management Plan (SEMP) to mitigate for potential adverse residual socio-economic effects of the Project and to enhance potentially beneficial residual socio-economic effects (Appendix A.22F). Employment commitments and hiring policies are identified in the preliminary SEMP and will be implemented to meet CMC's commitments.

It is important to note that the assessment presented in the Proposal is based on a predictive economic model of the potential economic impacts that may be realized by the Project. The projected hiring and workforce targets predicted by the economic model serve as targets for what CMC will aim to accomplish for the Project. This model, like all predictive models, represents one possible scenario that has been used for establishing hiring targets, both locally and regionally. Based on the results of the predictive model, CMC has set for itself a high target for hiring within Yukon in the operations phase. It is predicted that 20% of the operations phase workforce would be drawn from outside the Yukon (and those that are hired by the Project would relocate to the Territory given the long life of the Project) and the remaining would be composed of workers currently residing in the Territory. These are high targets, and are based on best available data. Casino Mining Corporation's ability to meet these high targets is subject to a number of intervening factors (including workforce availability) that may be beyond the control CMC or the Project.

Part a.

As part of CMC's anticipatory efforts to establish suitable training programs, CMC has engaged in discussions with Yukon College (the College), regarding educational and training opportunities for the skills required for positions that may be offered by the Project.

Yukon College, Centre for Northern Innovation in Mining

Yukon College offers a state-of-the-art trades training facility, the Centre for Northern Innovation in Mining (CNIM), located in Whitehorse. In addition to the facility, CNIM also offers mobile classrooms and high-tech simulators. The centre offers a variety of courses and programs including industrial programs, construction trades, and earth sciences (Yukon College. 2015).

Program intake is limited to a maximum of 20 students and occurs every two years. Currently, there are two full-time instructors and a number of sessional instructors. In 2013, the successful completion rate for the program was reported to be approximately 70%. The centre states that most program graduates can expect to gain employment upon program completion. The centre further notes that past graduates have found employment in all three areas of the industry, including mineral exploration, mining and project closure, and reclamation. The next program intake is scheduled for August 15, 2015 (Cubley. 2014).

In discussions with CNIM, the level of interest in the industry is reported to be quite high and entry-level programs (e.g., Introduction to Underground Mining, Surface Mining, and Introduction to Environmental Monitoring) at the College are often fully enrolled. Unlike the Geological Technology program, such courses typically do not have academic entrance requirements; the Geological Technology program requires relatively high entrance requirements (e.g., Chemistry 11, Math 11, English 12). As such, the academic program typically experiences lower enrollment compared to the entry-level programs. To date, enrolled students reside in Whitehorse or are located outside of the territory. CNIM reports that most inquiries for the next program intake are being received from individuals located in China, Japan, B.C., and Alberta.

Within the earth sciences department, the Geological Technology program provides a one-year Geological Technology Certificate and a two-year Geological Technology Diploma program. Courses include assaying/geochemistry, mineralogy and petrology, introduction to geophysics, introductory and intermediate geology field schools, introduction to hydrogeology, rock mechanics, mine surveying, and mineral processing. The certificate program is a 961.5 hour program consisting of 19 courses, including Introductory Geology Field School (45 hours) and an Intermediate Geology Field School (90 hours). The diploma program is an additional 793 hour program that consists of 13 courses, including a spring field course (mine surveying). This program has been operating since 2012 and is not yet accredited. The program has been designed to meet the educational requirements for the professional mineral resources technologist designation (Yukon College. 2014).

Casino Mining Corporation will continue to engage organizations such as the College (and CNIM) regarding educational and training opportunities in anticipation of positions that may be offered by the Project. Casino Mining Corporation will also provide a suite of training and orientation programs to its employees, with the goal of retaining staff, and promoting within the organization, as is discussed in the SEMP.

Part b.

Casino Mining Corporation is willing to work with local communities, First Nations and YG to develop a plan for monitoring potential socio-economic effects of the Project on employability. The monitoring mechanism and indicators will be detailed in the SEMP for the Project.

CMC has confirmed with Selkirk First Nation that it will adopt the scope, methodology, VC's and indicators of the *Minto Mine Socio-economic Monitoring Program* for the proposed Casino mine (subject to any site or Project specific nuances) and is interested in participating in a regional socio-economic monitoring framework if invited to join. CMC willing to work collaboratively with LSCFN to develop a similar monitoring program that reflects the VCs and indicators that arise as a result of their two recent community driven processes for community readiness planning and development of community well-being indicators.

Ideally, CMC would like to see each monitoring program as similar as possible to increase efficiencies in data sharing, and reduce redundancies and overlap. We see YESAB and YG being able to play a leadership role in ensuring that any regional cumulative effects monitoring programs are well framed. The federal and territorial governments also have responsibility to resource adequately First Nations governments that need to participate in such a framework and do not have the capacity to do so at this time.

Part c.

The "Umbrella Final Agreement (UFA) between the Government of Canada, the Council for Yukon Indians and the Government of the Yukon" was reached in 1988 and finalized in 1990 (Council of Yukon First Nations 2015). Chapter 22 of the UFA relates to Economic Development Measures (Umbrella Final Agreement 1990).

Casino Mining Corporation is aware of Chapter 22 of the UFA and has taken into consideration the individual settled land claims and self-government agreements of potentially affected First Nations. As part of ongoing discussions with potential affected First Nations with settled land claims and self-government agreement, CMC is continuing to have discussions with First Nations on impact benefit agreements.

Casino Mining Corporation and Selkirk First Nation (SFN) have entered into an initial Agreement for Co-Operation in project assessment and other matters relating to the Project. The Agreement commits the parties to work cooperatively to review, evaluate and discuss the Project, provides for the establishment of a technical working group and lays the foundation for establishing future agreements and protocols relating to the Project.

Casino Mining Corporation is taking steps to ensure First Nations are able to participate and benefit from the economic development opportunities that arise from the Project. The preliminary SEMP describes specific measures that CMC will undertake to maximize training opportunities and local hiring, including working with Yukon Government to support local businesses and strengthen backward linkages.

Part d.

Where possible and appropriate, CMC intends to undertake anticipatory efforts to implement mitigation measures for socio-economic effects. For example, CMC is engaged in early discussions with training and educational organizations in anticipation of opportunities that may be offered by the Project. For the majority of mitigation measures, the implementation schedule will be informed by the YESAB review and/or will be determined in collaboration with First Nations, local communities and YG. Casino Mining Corporation anticipates that socio-economic monitoring will commence at the start of the Project activity (likely in the construction phase) and continue for the life of the monitoring program.

Part e.

At this stage of the Project the specific number of apprenticeship and co-op type positions available has not been determined but will be determined as the Project moves closer to the construction and operation phases. Training and employment plans (as described in the preliminary SEMP in Appendix 22F) will include apprenticeship and co-op positions.

A.14.3 AFFECTED COMMUNITIES' ACCESS

A.14.3.1.1 R383

R383. Transportation alternatives for potential employees in Yukon communities outside of Whitehorse during each Project phase.

Casino Mining Corporation has committed to providing employees with free work-related round-trip transportation to the Project from the communities of Pelly Crossing, Carmacks, and Whitehorse (Appendix A.22F Socio-economic Management Plan). As part of this commitment, CMC will explore transportation options; though CMC anticipates that the primary method of transportation for the largest number of employees of the Project will be chartered aircraft from Whitehorse to the Casino Airstrip on a rotational basis. The Casino Airstrip will be able to accommodate up to 50 people per flight (Table 4.4-1 of the Proposal) using Bombardier Dash 8-100 or 200 series turbo-prop (which has between 37-39 seats) or similar aircraft are likely.

From Yukon communities outside of Whitehorse, employees are anticipated to use commercial carriers to fly to and from Whitehorse. Based on ultimately where employees are coming from, it may also be appropriate for small aircrafts operated by independent carriers on a chartered basis to transport employees from some Yukon communities directly to the Casino airstrip, or directly from larger centers (e.g., Vancouver, Calgary, Edmonton) directly to the mine site.

Transportation options for employees will be informed upon confirmation of where employees reside and will be determined when additional information is available.

A.14.3.1.2 R384

R384. Details of the "hiring policy that encourages the employment of workers from Yukon and in particular the rural communities of the LSA" and workforce opportunities for residents in Carmacks and Pelly Crossing and citizens of affected FNs.

A preliminary SEMP has been developed to mitigate for potential adverse residual socio-economic effects of the Project and to enhance potentially beneficial residual socio-economic effects (please refer to Appendix A.22F). The preliminary SEMP includes recruitment and hiring commitments that are intended to encourage the employment of as many Yukoners as possible, particularly from the communities of Pelly Crossing and Carmacks.

Casino Mining Corporation will recruit for pre-employment training and hiring of Aboriginal persons and residents of the communities of Pelly Crossing, Carmacks and Whitehorse and other communities in the Yukon. It is CMC's intention to work with community leaders to address employment barriers for women and people with disabilities. As well, a hiring policy will be established for CMC which will hire according to the following priorities, in order:

- First Nations;
- Yukoners who have been continuous resident in the Yukon Territory at least six months prior to being hired;

- Northerners who are residents in northern British Columbia and Northwest Territories; and
- Canadians across Canada.

Subject to the availability of Yukoners with the required skills, training and experience, CMC will work towards and will take all reasonable steps to meet the following goals:

- Meet a target employment of Yukoners in the construction phase of 63%;
- Meet a target employment of Yukoners in the operations phase of 78%;
- Encourage employment of First Nations by contractors throughout the Project life; and
- Pursue recruitment and employment opportunities that meet the negotiated cooperation agreements between CMC and the First Nations governments.

Casino Mining Corporation will implement various measures to meet its recruitment commitments and assist employees who reside in the North. Potential measures that could be implemented include:

- Establish a minimum of Grade school level as a standard for trainable positions;
- Develop work schedules compatible with the traditional pursuits of First Nations when possible;
- Fund and co-fund community research projects directed at gathering information and addressing barriers to successful employment;
- Actively promote and encourage careers in the mining industry to the youths in the Yukon;
- Promote and encourage partnerships with local schools for work experience and job placement programs as well as summer employment opportunities that allow students to gain experience while continuing to complete their education; and
- Provide opportunities for summer employment to Yukon post-secondary students during project operation.

A.14.4 EMPLOYMENT AND MIGRATION

A.14.4.1.1 R385

R385. Assumptions supporting migration estimates, including between communities in Yukon and how downward population pressures were considered.

Casino Mining Corporation would like to note that analysis and projections are founded on past events giving an expectation of certain future events. Future events, including migration estimates and population projections, are not guaranteed to follow past patterns and results may vary, even significantly. Based on best available data at the time of preparing the Proposal, the predicted change (or migration) in the population of communities in Yukon as a result of the Project is modest when compared to population growth as a result of natural growth and migration trends.

According to the Yukon Bureau of Statistics (YBS), the territory's population in 2021 is projected to be in the range from 40,130 to 43,188, while the City of Whitehorse population is projected to be 30,721 and 33,179. Projected population data is not available for Carmacks and Pelly Crossing, though YBS estimates that the population of Yukon's communities except for Whitehorse, Dawson City, and Watson will reach 5,600 in 2021 from 5,068 in 2011. Population projection beyond 2021 is not available from YBS.

The Millier Dickinson Blais (2014) report attributes the source of Yukon's population growth to a combination of external factors outside of the Yukon such as global demand for natural resources, and domestic factors such as the shortage of the territory's labour force in keeping up with the labour demands (p.1). Other sources of Yukon's population growth are the net natural gain in population (births exceed deaths) and net migration.

Casino Mining Corporation predicts that the change in population in the communities of Pelly Crossing, Carmacks and Whitehorse as a result of the Project is expected to be an increase of 645 individuals between 2016 and 2024 (see Table 16.4-6 in the Proposal). The years from 2016 to 2024 represent the transitional period when Project effects on the population are anticipated to be the greatest; therefore a projection beyond 2024 was not included. As stated in the Proposal, due to increasing degree of uncertainty over staffing and expenditure, any quantitative assessment on future forecast beyond 2024 may not be meaningful.

Change in population in the communities of Pelly Crossing, Carmacks and Whitehorse from the Project is the result of the following Project effects:

- staffing demands (direct and indirect migration);
- employment ('spin-off') effects from project expenditures; and
- increased income in the region from employment effects (i.e. direct, indirect and induced economic effects).

The Proposal determined that the Project is anticipated to increase population due to staffing demand and 334 people are anticipated to move to the Yukon for employment as a result of the Project. As the Proposal states, economic "spin-off" from the Project will have direct, indirect, and induced effects on employment through backward linkages such as purchase of goods and services to support project construction and operation, as well as expenditures of direct and indirect labour income on goods and services. Employment opportunities that arise from the Project are expected to increase incomes in the territory, which will attract resident migrant workers to the Yukon. Change in population is expected to be greatest in the first year of construction (2017) with 3.7% change, or 23 individuals. However, this change in migration rate is significantly reduced by 2024 at 1.2% with 111 individuals from 2016 to 2024.

A breakdown of the estimated changes in population from the three potential Project effects is summarized in Table A.14.4-1, and was also presented in the Proposal.

Table A.14.4-1 Estimated Population Changes

Year	Total Change in Population From Project Staffing	Total Change in Population From Employment Effects	Total Change in Population From Income Effects	Total Change in Population From All Effects
2024	334	200	111	645

Of the 645 net migrants anticipated in the three communities, it is expected that 95.9% of the migrants will reside in Whitehorse, 1.7% in Pelly Crossing, and 2.4% in Carmacks. This means an increase of 619 individuals in Whitehorse, 11 in Pelly Crossing, and 16 in Carmacks. In terms of percent change in population for each community, Whitehorse will experience 2% change, 2.9% in Pelly Crossing, and 2.6% in Carmacks. Table 16.4-6 of the Proposal summarizes the population change breakdown for each community.

Mining Industry Human Resources Council (MiHR) estimates of the 2012 mining labour force and forecasted labour force growth in the mining industry in Yukon up to 2023 were used to project the cumulative hiring requirements for Yukon's mining industry (Table 14.4-3 of the Proposal). An estimate for the Project's share of new workers was compared to the cumulative hiring requirements. The assumptions used to predict the migration estimates as a result of Project employment include:

- MiHR study of Yukon's labour market was used to compare the Project's anticipated hiring requirements for Yukon-based workers in 2023 to all other projects in Yukon;
- Workers for the Project will be drawn from both talent growth and the existing workforce;
- Migrants are assumed to be hired only when there is a shortage of skilled regional workers available;
- The share of migrants in the overall Project workforce is estimated at 20% based on the scarcity of local skilled labour and surveys of existing commuting workers receptivity to incentives;
- New workers can be drawn from skilled workers migrating to Yukon, from workers trained by CMC for their positions, from workers drawn from other parts of the mining industry (support services or exploration), or from new talent drawn to mining from other industries;
- Migration patterns are assumed to follow historic migration patterns for Yukon with the added assumption that these effects will be limited to the communities of Pelly Crossing, Carmacks and Whitehorse; and
- The results are approximated by the National Occupation Code (NOC).

The analysis used to generate migration estimates did not factor in downward population pressure, however, potential downward population pressure as the result of the Project on local communities is not anticipated to be large due to the fact that the predicted change in the population of communities in Yukon as a result of the Project is modest when compared to population growth a result of natural growth and migration trends. Casino Mining Corporation will minimize any potential adverse effects associated with the Project's contribution to downward population pressure in local communities (of Pelly Crossing and Carmacks) that may result from potentially concentrated economic benefits in Whitehorse through:

- Establishing a hiring policy which will establish priorities for hiring from local communities;
- Implementing a recruitment program for pre-employment training and hiring of Aboriginal persons and residents of local communities;
- Providing employees with free work-related round-trip transportation to the Project from the communities of Pelly Crossing, Carmacks, and Whitehorse;
- If warranted, and the communities approve, establishing pick up points in the communities of Carmacks and Pelly Crossing; and
- Discussing with Village of Carmacks, Pelly Crossing, and responsible government authorities on minimizing cost of living and housing shortage effects in their respective communities.

Casino Mining Corporation is willing to work with affected communities and First Nations and communities to monitor predicted changes in population on local communities due to Project effects. The monitoring program may include a component to track population changes in local communities to better understand and assess the following:

- Changes that have occurred compared to baseline conditions;
- Changes that can be attributed to the Project directly;
- Accuracy of the population changes predicted in the Proposal; and

- Unforeseen changes in population and related socio-economic effects that require additional mitigation measures.

A.14.4.1.2 R386

R386. A breakdown of direct Project employment projected for each affected community. Please indicate if employees are new, existing, or returning residents or from other communities in Yukon.

The Project will result in considerable direct employment (as well as contracted employment generated from contracting and procurement associated with Project purchases). The direct employment for each community in the Local Study Area (LSA) would depend on whether Project-related jobs are filled by residents or by non-residents; and whether non-residents relocate to the communities or commute to work. A breakdown of direct Project employment for each affected community is dependent on a number of intervening factors and circumstances including:

- Personal circumstances;
- Socio-economic context;
- Community investment and development by governments; and
- Local labour supply.

Increase in population in the communities is anticipated due to staffing demand (as discussed in R385). Casino Mining Corporation is committed to establishing a hiring policy that will establish priorities for local hire in Pelly Crossing and Village of Carmacks. However, a number of intervening factors influence workers' decisions to stay or relocate to local communities, or if they move to regional centres such as Whitehorse. An intervening factor is the "lifecycle" hypothesis, which suggests that workers' commuting patterns changes throughout their working careers. Young and single workers prefer to live in cities and commute longer, whereas employees with young families may prefer to live locally. As children get older, the parents may decide to move to cities for more lifestyle options and access to education, partner employment, health, and housing (Barclay et al. 2013: 26). Thus, while CMC will maximize local hires in the communities by establishing pick up points, local hires may either stay in the community or move to Whitehorse depending on the personal circumstances.

In addition to the Proposal's Socio-economic Baseline Report (Appendix 13A of the Proposal), the socio-economic context of Carmacks and Pelly Crossing will influence the breakdown of direct Project employment. The population of Carmacks is expected to grow and the community seeks to build a strong a solid, stable, and healthy community by encouraging economic diversification, removing barriers to entrepreneurial opportunity and offering the quality of life that makes Carmacks an attractive place to live, work and visit (Village of Carmacks 2013). The Plan reports that the housing shortage in Carmacks is an impediment to attracting skilled labour and economic stability. Similarly, community priorities identified in LSCFN Integrated Community Sustainability Plan (ICSP) are the construction of a new wellness centre; access to safe and dependable water supply and sewage treatment system; and affordable housing (LSCFN Integrated Community Sustainability Plan 2007). For Pelly Crossing, the ICSP states that the community priority is to have a diverse sustainable economy that will make the community a good place to work, live, and play (Selkirk First Nation / Pelly Crossing Integrated Community Sustainability Plan. 2007). Selkirk First Nation will work with the Yukon Government to ensure Pelly Crossing benefits directly from economic development activities within the area. The Plan acknowledges that a stable economy creates new business opportunities and increases demand for locally provided goods and services. As well as ensuring the community has the capacity and resources to fund infrastructure and level of service residents and beneficiaries desire.

Another intervening factor is community development by municipal, territorial and federal governments for investing in the socio-economic conditions of the communities as a way of attracting migrant workers to the communities, and encouraging currents residents to stay. Community investment and development by governments includes public infrastructure, social services, and economic diversification, many of which have been identified as community development goals by Village of Carmacks OCP, and LSCFN and SFN's ICSPs. For example, Carmacks OCP identified housing infrastructure and affordability as an impediment to attracting skilled labour. Increased capacity in areas of education and health in the communities will also remove impediments for attracting skilled labour outside of the Local Study Area (LSA) communities.

As shown in Table 13.4-5 of the Proposal while the number of unemployed in the communities of Pelly Crossing, Carmacks and Whitehorse is high relative to anticipated Project requirements, the local labour supply lacks the adequate mix of skill levels required to meet Project demands. As well, Census data for the rural communities (Pelly Crossing and Carmacks) indicate that labour forces in these regions are largely not oriented toward mining positions (Statistics Canada, 2013; Statistics Canada, 2012; Statistics Canada, 2007). Therefore, while most workers are anticipated to be drawn from Whitehorse, CMC will employ workers from Pelly Crossing and Carmacks as much as possible.

In the 2011 National Household Survey (Statistics Canada 2013, Statistics Canada 2007), of the reported 135 people, no workers from Pelly Crossing had experience in resource industries and 11.5% of the workforce (21 people) had experience in the construction industry. The survey also indicated that a sizable share of the labour force may be gaining experience in areas relevant to the needs of the mining sector even though they may be employed in other sectors. In addition, more recent sources show that a number of Pelly Crossing residents work at the Minto Mine that began operations in late 2007. According to a presentation made by Capstone Mining Corporation (Capstone Mining Corporation 2012), the Minto mine currently employs 22 people from Selkirk First Nation. Data for Carmacks are only available for 2006, which indicate that 7.8% of the workforce (19 people) had experience in resource industries and 5.9% (14 people) had experience in construction.

For the above reasons, CMC believes that a breakdown of employees that are new, existing, or returning residents for each affected communities is difficult to provide. These predictions are also subject to change over the course of the 22 year mine life. Casino Mining Corporation believes that the Project can contribute to the goals and visions of the communities as identified in the OCP and ICSPs, and is willing to work with governments to develop community initiatives and projects that make it more attractive for employees to stay, return and/or relocate to the communities. A key source of funding for community development is the payment of taxes and royalties from Casino Mining Corporation to YG, and YG is responsible for decisions on how resource revenues will be spent in the communities. Casino Mining Corporation would like to work with SFN and LSCFN to target citizens living outside the communities who wish to return to their respective communities.

A.14.5 FLY-IN-FLY OUT AND SHIFT STRUCTURE

A.14.5.1.1 R387

R387. Clarify if the flexible rotations, counselling services, and adaptive management are the mitigation strategies for the proposed shift structure as suggested in the proposal. Please elaborate in detail for each mitigation strategy.

Casino Mining Corporation values the health and wellness of its employees, their families, and local communities. The success of the Project depends on the support of employees and communities. Casino Mining Corporation expects the Project to foster and deliver sustainable benefits that enhances social and cultural well-being of all First Nations and community stakeholders.

The Proposal determined that Project activities, including the proposed shift structure, will have both positive and adverse residual effects. To promote a healthy, stable and vibrant workforce and gain community support, CMC will work with employees to encourage career success and will work collaboratively with communities to avoid or minimize adverse effects of the Project.

A preliminary SEMP has been developed to mitigate for potential adverse residual socio-economic effects of the Project and to enhance potentially beneficial residual socio-economic effects (please refer to Appendix A.22F). The preliminary SEMP includes commitments to mitigate for, and to monitor and adaptively manage potential adverse residual effects of the Project on employees, their families and communities.

The preliminary SEMP outlines commitments to work with agencies and parties to address potential adverse effects of the proposed shift structure:

- Provide employees with free work-related round-trip transportation to the mine site from the communities of Pelly Crossing, Carmacks, and Whitehorse;
- Introduce and maintain measures to assist First Nation and non-First Nation employees to perform well in their jobs and to help their local communities with any potential effect of the Project;
- Provide shifts to accommodate subsistence harvesting and participation in cultural activities/events;
- Provide flexible work rotation schedules, where practical, that could accommodate the needs of local hires and industry practices; and
- Work with Yukon Government, and community-based agencies to ensure there are services in the field of counselling, addiction and rehabilitation, family adjustment, and money managment for all employees and their families.

Casino Mining Corporation, in collaboration with government departments and affected First Nations, will work to establish a monitoring program to evaluate the effectiveness of the proposed mitigation measures and identify any unforeseen socio-economic effects of the Project. The monitoring program will allow CMC to revise and adaptively manage unforeseen socio-economic effects by implementing new mitigation measures.

A.14.5.1.2 R388

R388. Details on how CMC will accommodate cultural and community events, including funerals and potlatches, in its proposed shift structure.

Casino Mining Corporation would like to ensure that First Nations' cultural and traditional way-of-life are maintained and protected for employees. A preliminary SEMP has been developed to mitigate for potential adverse residual socio-economic effects of the Project and to enhance potentially beneficial residual socio-economic effects (please refer to Appendix A.22F). The preliminary SEMP includes commitments to mitigate for, and to monitor and adaptively manage potential adverse residual effects of the Project on employees, their families and communities.

Cultural preservation and protection of traditional activities is essential to the cultural well-being of First Nations. To promote, maintain and protect these important values, CMC proposes to:

- Support the promotion of traditional cultural practices of the Aboriginal Authorities;
- Work with the community, governments and educational institutions to promote use of resources in local schools that are culturally appropriate to First Nations;
- Develop and implement a cultural exchange program to provide non-Aboriginal site employees with the opportunity to spend up to three days with a First Nation employee pursuing traditional activities;
- Provide cross-cultural training to all on-site staff;
- Provide mine site visits for employees' families; and
- Provide traditional foods on site when available.

Casino Mining Corporation proposes to hire a community liaison that is a First Nation member who will work with the local communities on community well-being matters including cultural events (including funerals and potlatches). The community liaison will be responsible for engaging and consulting with potential First Nations employees and community leaders to propose practical opportunities for CMC to be able to accommodate cultural and community events in the Project's shift structure.

A.15 – ECONOMIC DEVELOPMENT AND BUSINESS SECTOR

A.15.1 INTRODUCTION

The Proposal defines Economic Development and Business Sector as economic growth, government revenues, and business opportunities in the Yukon economy. Economic development and the business sector was assessed as a Valued Component (VC) in the Proposal because the Casino Project (the Project) would generate employment, income and business opportunities throughout Yukon.

The construction of the Project is expected to require capital expenditures that will have direct, indirect, and induced effects on the regional economy. Direct effects on Yukon's GDP include direct anticipated expenditures of $261 million, leading to a projected $363 million increase in Yukon's GDP over a 4-year period. Casino Mining Corporation estimates that approximately 69% of operational spending will occur in Yukon. Indirect effects are related to the purchase of goods and services needed to construct and operate the Project, while induced effects result from expenditures of direct and indirect labour income on consumer goods and services.

The Proposal identified socio-economic enhancement measures including cultural awareness training for employees and contractors; partnering with First Nation communities and their development corporations to access additional funding for training; providing support for non-mining training and entrepreneurial initiatives; and monitoring socio-economic effects of the Project and implementing adaptive management measures where required.

The Proposal concluded that the potential effects of the Project on economic development and the business sector, as a result of the procurement of labour, goods and services are beneficial.

On January 27, 2015, the Executive Committee requested that Casino Mining Corporation (CMC) provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). Casino Mining Corporation is providing this Supplementary Information Report (SIR) to comply with the Executive Committee's Adequacy Review Report; CMC anticipates that the information in the SIR and Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has six requests related to information presented in Section 15 Economic Development and Business Sector of the Project Proposal submitted on January 3, 2014. These requests are outlined in Table A.15.1-1. Some responses require detailed technical information, data, and figures. Where necessary, this additional supporting information is provided as appendices to the SIR.

Table A.15.1-1 Requests for Supplementary Information Related to Economic Development and Business Sector

Request #	Request for Supplementary Information	Response
R375	Discussion and rationale on the Proponent's position that the boom and bust cycle to be either minimal or acceptable within the context of Yukon. Consideration should be given to the contribution of annual taxes, royalties and GDP to the Yukon economic base and the scale of the Project.	Section A.15.2.1.1 Appendix A.13A Economic Impacts of the Casino Mine Project
R376	A description of what measures will be put in place to reduce	Section A.15.2.1.2

	the effects of boom and bust cycles.	
R377	Identify specific conditions and scenarios where the Project might operate on a reduced scale.	Section A.15.2.1.3
R378	Details regarding any specific methods that the Proponent intends to use to enable local and Yukon businesses to supply or service the Project.	Section A.15.3.1.1 Appendix A.22F Socio-Economic Management Plan
R379	Details regarding any specific methods that the Proponent intends to use to enable First Nation businesses to supply or service the Project.	Section A.15.3.1.2 Appendix A.22F Socio-Economic Management Plan
R380	A detailed plan on how the proponent intends to monitor and manage socio-economic effects. This plan should include: a. objectives, indicators, and monitoring methods; b. thresholds and triggers for action; and c. adaptive management strategies.	Section A.15.4.1.1 Appendix A.22F Socio-Economic Management Plan

Notes:

1. Request # refers to the assigned identification number in the YESAB Adequacy Review Report January 27, 2015 prepared by the Executive Committee of the Yukon Environmental and Socio-economic Assessment Board.
2. Response refers to the location of CMC's response to the YESAB request for supplementary information.

A.15.2 BOOM AND BUST CYCLES

A.15.2.1.1 R375

R375. Discussion and rationale on the Proponent's position that the boom and bust cycle to be either minimal or acceptable within the context of Yukon. Consideration should be given to the contribution of annual taxes, royalties and GDP to the Yukon economic base and the scale of the Project.

Casino Mining Corporation acknowledges in the Proposal that boom and bust cycles do occur in the Yukon, and that "Yukon businesses are familiar with the cyclical nature of the mining industry" (Section 15.4.4.1 of the Proposal). The Proposal presented community population data and average individual incomes by community and gender for the period of 2002 to 2012 which show the effects of boom and bust cycles in the Yukon on population and income. The data was sourced from the Yukon Bureau Statistics, National Household Survey and Statistics Canada.

The potential effects of Project commencement and closure on employment and income, in relation to Yukon's existing economy and resource sector, may contribute to community population and average individual incomes. These potential changes may resemble boom and bust cycles; though the magnitude of these changes in the context of Yukon are difficult to predict given the large variability in potential scenarios. Furthermore, the potential effects of un-planned temporary closure or a reduced workforce scenario will affect employment, business opportunities and the economy; however, are difficult to predict due to the large variability in potential scenarios.

Casino Mining Corporation understands when considering the size and magnitude of the Project in relation to other proposed and operating mines in the Yukon, the Project will trigger a boom economy both at the micro (LSA) and macro (RSA) levels. However, the Project will also contribute proportionally large share of royalties and taxes. Over the total operations phase of the Project, it is projected that total government revenue from the

Project will be in the order of $219 million annually (PP 15-12). This includes an average of $88 million annually in royalties. Please see table 15.4-6 in the Proposal for more detail. According to Yukon Government data, royalties paid to date in the Yukon reached a peak in 2009 at $5.9 million dollars (YG 2015). Under the Umbrella Final Agreement (UFA) a proportion of that royalty is shared with self-governing First Nations. According to the MNP report the Project will increase Yukon's GDP by $363 million over the 4-year construction period and by $274 million annually during operations (Appendix A.13A Economic Impacts of the Casino Mine Project). That is equivalent to approximately 10% of the Yukon's 2011 GDP.

Casino Mining Corporation has committed to applying mitigation measures that are under its influence and that are related to the Project to minimize adverse boom and bust effects. These relate to the transition of workers in temporary closure or post closure phases of the Project. However the real ability to manage boom and bust is dependent on the diversification of the economy, specifically into non-mining activities. Boom and bust can also be mitigated by government investments in other sectors of the economy (e.g. tourism), as well as investments in education, health and social services so that communities are better able to adapt and buffer from effects of temporary and permanent Project closure and market volatility. Thus the underlying responsibility for forecasting and managing boom bust events does not rest with CMC.

Casino Mining Corporation anticipates that governments will explore opportunities to ensure that tax and royalty revenues generated from the Project will be appropriately managed and specifically directed by governments to social programs and services that will be directly and indirectly affected by the Project, including potentially allocating a proportion of the revenue for closure and post-closure programming and support at a macro and micro economic level.

A.15.2.1.2 R376

R376. A description of what measures will be put in place to reduce the effects of boom and bust cycles.

Casino Mining Corporation will put in place measures to mitigate for the potential adverse socio-economic effects of the Project, particularly at Project commencement and closure. The company has developed a preliminary Socio-Economic Management Plan (SEMP) to mitigate for potential adverse residual socio-economic effects and to enhance potentially beneficial residual socio-economic effects (Appendix A.22F Socio-economic Management Plan).

Potential Strategies to Mitigate for Adverse Effects of Construction and Operations

The Project is expected to be an important employer in Yukon but this has the potential to adversely affect other sectors that may have difficulty keeping workers. Mining companies including CMC will be actively recruiting workers in an environment where there is limited availability.

Casino Mining Corporation is committed to reducing the potential adverse effects of the Project on other sectors drawing from the existing mining workforce when recruiting for mine commencement, wherever possible. Casino Mining Corporation would work with mining companies within Yukon to attract local workers set to be laid-off as these mines reach their end-of-life. Casino Mining Corporation will use reasonable best efforts to draw workers from the existing unemployed or underemployed regional labour pool or from residents from outside Yukon if required.

Casino Mining Corporation will collaborate with YG, Yukon College and Yukon Mine Training Association (YMTA) to provide education and skills training to increase the number of apprenticeships offered. Apprentices, where reasonable, will be hired by CMC upon successful completion of apprenticeships. Education and skills training programs will focus on:

- Providing pre-employment opportunities for training in accordance with the hiring priorities;
- Enabling Yukoners to gain access to jobs;
- Giving special emphasis on training opportunities in the communities of Pelly Crossing and Carmacks;
- Facilitating employment advancement for Yukoners;
- Enabling Yukoners to fill apprenticeships, technical, technological, supervisory, managerial, and professional occupations;
- Requiring all Contractors to adhere to the goal of maximizing the employment of Yukoners; and
- Collaboration with Yukon Government in the development of pre-employment preparation, skill development training, on-the-job training, and re-training programs to better enable Yukoners to take advantage of employment opportunities from the Project.

Potential Strategies to Mitigate for Effects of Closure

At closure, the loss of operational employment by the Project would result in a large net decrease in local and regional employment. The overall effect of closure on employment and income will be negative and unavoidable, though CMC is committed to minimizing the overall adverse effects to the extent possible.

Given that the mine will operate for 29 years (this includes construction, operation, and active decommissioning and closure), it is not meaningful or appropriate to develop specific mitigation actions at this time without engagement of stakeholders and a better understanding of the context in Yukon at the time of closure; mitigation measures need to be responsive to the context in Yukon to ultimately be effective. Casino Mining Corporation is committed to ongoing investment in workers to enhance employability and to help workers find new employment after closure. A part of this commitment, CMC will work with the affected communities and YG to develop a mine closure plan that includes a strategy for minimizing to the extent possible and buffering the adverse effects of closure on employment and income. Casino Mining Corporation also commits to developing this plan within reasonable advance timing of mine closure (i.e. approximately 5 years before closure). Typical elements of these types of closure plan include such things as:

- Offering on the job training and skills upgrading to workers to provide them with increased capacity to find other jobs;
- Assisting in the development of new economic development opportunities such as by providing seed funding for local contractors to diversify into other sectors; and
- Help identify new career opportunities and out-placement services such as working with other regional employers to find new jobs for mine employees.

Casino Mining Corporation will work with the affected communities and YG to develop a mine closure plan that includes a strategy for minimizing to the extent possible and buffering the adverse effects of closure.

A.15.2.1.3 R377

R377. Identify specific conditions and scenarios where the Project might operate on a reduced scale.

The Project that is being proposed by Casino Mining Corporation is intended to operate based on the life-of-mine production schedule that has been strategically optimized for the Project. The life-of-mine production schedule determines the order of extraction of materials and their destination over the mine-life. For mining projects, any deviations from optimal life-of-mine production schedule will result in financial losses, future financial liabilities, delayed reclamation, and resource sterilization. So it is not in the interest of CMC to operate at a reduced scale for any prolonged periods of time.

Examples of unforeseen conditions and scenarios outside CMC's and the Project's control that may cause the Project to operate at a reduced scale for temporary period of time include:

- Low commodity prices (potentially from global high levels of production causing supply to outstrip global demand). Larger projects with lower production costs are more resilient to these conditions.
- Labour disputes;
- Equipment breakdown; and
- Safety reasons.

A.15.3 BUSINESS OPPORTUNITY

A.15.3.1.1 R378

R378. Details regarding any specific methods that the Proponent intends to use to enable local and Yukon businesses to supply or service the Project.

Casino Mining Corporation has developed a preliminary Socio-Economic Management Plan (SEMP) to mitigate for potential adverse residual socio-economic effects of the Project and to enhance potentially beneficial residual socio-economic effects (Appendix A.22F). The preliminary SEMP has been developed to be consistent with the Mining Association of Canada's Guiding Principles of "Towards Sustainable Mining" (MAC 2014).

At this time, the preliminary SEMP describes commitments and policies that CMC will undertake to improve the quality of life and well-being of Yukon residents. Prior to construction and throughout the life of the Project, the SEMP will be updated to include details and actions to monitor Project-specific socio-economic effects, the effectiveness of the mitigation measures, and an adaptive management framework for responding to unpredicted adverse effects. The SEMP is not intended to be a static document nor was it intended to be developed in isolation by CMC. The SEMP will be informed by suggestions and recommendations received through consultations with stakeholders during the YESAB review and in subsequent mine permitting processes; it will also be regularly updated throughout the implementation of the plan through consultations with stakeholders.

In terms of supplying or servicing anticipated Project requirements, the Proposal concluded that Whitehorse will be the largest beneficiary of Project spending, since its supplier and contractor base is best equipped to meet the Project's needs. Casino Mining Corporation anticipates that companies in local communities will not have the capacity to bid for major service contracts for the Project, but could service size-appropriate contracts. Given the small populations of local communities, even smaller contracts would have a large relative impact for local residents.

The Project has the potential to provide significant wealth in job creation and employment opportunities to both local and Yukon businesses. Casino Mining Corporation will take all reasonable steps to meet the objectives outlined in the preliminary SEMP. An overview of the objectives, commitments and measures CMC intends to implement to promote local and Yukon businesses to supply or provide services to the Project are outlined below, for additional information please refer to the preliminary SEMP (Appendix A.22F).

Purchasing of Goods and Services

Casino Mining Corporation will establish policies and practices in the SEMP to maximize the purchase of goods and services from local and Yukon businesses during the construction phase and operations phase of the Project.

Procurement Process

Casino Mining Corporation will implement a procurement process in the SEMP that gives priority to suppliers from local communities and Yukon, in particular rural communities closest to the mine site. Priority will be given to qualified businesses for procurement bids and opportunities in the following order:

1. First Nation businesses;
2. Yukon businesses; and
3. Other businesses outside the territory.

Where economically practical, CMC will give priority to contractors who hire local/Yukon residents to the greatest extent practical. If possible, CMC will manage contract components to match the capabilities of businesses in the local communities. As well, CMC will encourage joint ventures between Aboriginal businesses and other regional businesses in the procurement process.

The criteria that CMC will use for evaluating and awarding contracts for the Project could include considerations which are intended to promote contracting opportunities for local and Yukon businesses, such as the number of Yukon and First Nation staff and degree of participation by both groups.

Local Communities

Special emphasis will be placed on developing business opportunities within the communities of Pelly Crossing, Carmacks and Whitehorse, and other communities where there is an expression of interest. The SEMP will outline how CMC can provide information relating to CMC's procurement needs. Casino Mining Corporation will work closely with local communities to create long-term business and employment opportunities and increase business capacity.

Yukon

To maximize Project related business opportunities for all Yukon businesses, CMC will work closely with Yukon Government (YG) to identify goods and services that will present the best opportunities for supply by Yukon businesses. As part of that discussion, CMC would like to work with YG to identify available economic development programs and match Project related business opportunities with new entrepreneurs and existing business capabilities.

At this time, the SEMP is preliminary because it is CMC's intention to work with local and Yukon businesses, local communities, YG and First Nations to develop details regarding any specific measures that the Project will implement to meet the Project objectives and commitments. In addition, any specific mitigation that will be recommended by the Executive Committee and reflected in a Decision Document will also be incorporated into the SEMP and require implementation details. CMC expects that the SEMP will be iterative and will evolve over the course of the YESAB review, permitting applications and throughout the life of the Project.

A.15.3.1.2 R379

R379. Details regarding any specific methods that the Proponent intends to use to enable First Nation businesses to supply or service the Project.

This response builds on CMC's response for R378. The preliminary SEMP also outlines commitments and policies that CMC will undertake to promote First Nations businesses to supply or provide services to the Project (Appendix A.22F). Keeping in mind that at this time, the SEMP is preliminary and will be informed by suggestions and recommendations received through consultations with stakeholders during the YESAB review and in the subsequent mine permitting processes, CMC's objectives include:

- Working closely with First Nations businesses to plan for and maximize the participation of First Nations in the procurement process;
- Facilitating subcontracting opportunities for First Nation businesses; and
- Encouraging joint ventures between Aboriginal businesses and other regional businesses in the procurement process.

Through collaboration with First Nation businesses and the YG, CMC will develop details regarding any specific measures the Project will implement to meet its objectives and commitments towards promoting First Nation businesses to supply or provide services to the Project. The SEMP will evolve over the course of the YESAB review to include additional details on the implementation of these enhancement measures.

A.15.4 ECONOMIC EFFECTS MONITORING

A.15.4.1.1 R380

R380. A detailed plan on how the proponent intends to monitor and manage socio-economic effects. This plan should include:

a. objectives, indicators, and monitoring methods;
b. thresholds and triggers for action; and
c. adaptive management strategies.

A preliminary SEMP has been developed by CMC to mitigate for and monitor potential adverse residual socio-economic effects of the Project and to enhance potentially beneficial residual socio-economic effects (Appendix A.22F). Casino Mining Corporation is willing to work with local communities, First Nations and YG to futher develop this plan for managing and monitoring potential socio-economic effects of the Project.

At this time, the preliminary SEMP describes commitments and policies that CMC will undertake to promote positive socio-economic benefits to improve quality of life and well-being for those that live in neighbouring communities. Prior to construction and throughout the life of the Project, the SEMP will be updated to include details and actions to monitor Project-specific socio-economic effects, the effectiveness of the mitigation measures, and a framework to adaptively manage unpredicted adverse effects. The SEMP is not a static document, but will be informed by suggestions and recommendations received through consultations with stakeholders throughout the YESAB review and subsequent mine permitting processes, and also regularly throughout the implementation of the plan for the life of the Project.

CMC has confirmed to Selkirk First Nation that it will adopt the scope, methodology, VC's and indicators of the *Minto Mine Socio-economic Monitoring Program* for the Casino Project (subject to any site or Project specific nuances) and is interested in participating in a regional socio-economic monitoring framework if invited to join. Casino Mining Corporation is willing to work collaboratively with LSCFN to develop a similar monitoring program that reflects the VCs and indicators that arise as a result of their two recent community driven processes for community readiness planning and development of community well-being indicators.

Ideally, CMC would like to see each monitoring program as similar as possible to increase efficiencies in data sharing, and reduce redundancies and overlap. Casino Mining Corporation anticipates that YESAB and YG will play a leadership role in ensuring that any regional cumulative effects monitoring programs are well framed. The federal and territorial governments also have the responsibility and ability to resource First Nations governments that need to participate in such a framework and do not have the capacity to do so at this time.

Part a.

The Executive Committee has requested supplementary information on objectives, indicators and monitoring methods for the SEMP. It is CMC's intention to work collaboratively with First Nations, local communities and YG to determine appropriate and meaningful objectives, indicators and monitoring methods that will form part of the SEMP.

Potential objectives for socio-economic management and monitoring include:

- Document changes over time to socio-economic VCs;
- Test the predicted effects from the Proposal;
- Identify unforeseen socio-economic effects of the Project;
- Evaluate the effectiveness of mitigation measures in managing socio-economic effects;
- Revise and where appropriate, developing new mitigation measures to adaptively manage unforeseen socio-economic effects; and
- Confirm compliance with regulatory requirements including the terms and conditions from the YESAB review.

The indicators used for socio-economic effects monitoring will also be established in collaboration with the relevant agencies, First Nations and local communities to ensure the information collected is of greatest use in the understanding and management of socio-economic effects. This may include selecting indicators that are consistent with existing monitoring and management measures of other agencies or proponents (e.g. Minto Monitoring Framework).

The methods will be determined through discussions with agencies, First Nations and local communities. Typically, monitoring methods for the SEMP need to consider:

1. **Timing:** Monitoring may commence at the start of the Project activity (in the construction phase) and continue for the life of the monitoring program.
2. **Frequency**: Frequency of monitoring will be established in consultation with First Nations, YG and local communities.
3. **Extent:** Establish geographic area(s) that will be monitored specific to each potential effect.

Part b.

It is CMC's intention to work collaboratively with First Nations, local communities and YG to determine community specific, appropriate and meaningful triggers for action. This information will be included in the SEMP.

Part c.

The National Research Council defines adaptive management as flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process (Natural Research Council 2004). Casino Mining Corporation intends to adopt an adaptive management framework for socio-economic effects. The details of specific adaptive management strategies will be informed through consultations with First Nations, local communities and YG.

The setup phase involves framing of the problem and includes:

- Engaging the appropriate stakeholders to ensure their involvement in the process;

- Establishing clear, measurable, and agreed-upon objectives at the outset, to guide decision making and assess progress in achieving success;
- Monitoring to allow comparison of predictions against observed responses;
- Selecting adaptive management actions; and
- Comparing and contrasting actions in terms of their costs, benefits, and consequences.

The iterative phase involves selecting an action based on improved understanding, monitoring to allow for comparison against predicted results and evaluation.

A.16 – COMMUNITY VITALITY

A.16.1 INTRODUCTION

The assessment of community vitality presented in Section 16 of the Proposal for the Casino Project (the Project) focussed on the communities of Selkirk First Nation (SFN) / Pelly Crossing, Little Salmon/Carmacks First Nation (LSCFN) / Village of Carmacks and City of Whitehorse. The Proposal determined that both beneficial and adverse residual effects could potentially occur as a result of the Project, mainly through contracted employment, mine staffing, and accommodations.

On January 27, 2015, the Executive Committee requested that Casino Mining Corporation (CMC) provide supplementary information for the Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). CMC is providing this Supplementary Information Report (SIR) to comply with the Executive Committee's Adequacy Review Report; CMC anticipates that the information in the SIR and Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has three requests related to information presented in Section 16 Community Vitality of the Proposal submitted on January 3, 2014. These requests are outlined in Table A.16.1-1. Some responses require detailed technical information, data, and figures. Where necessary, this additional supporting information is provided as appendices to the SIR.

Table A.16.1-1 Requests for Supplementary Information Related to Community Vitality

Request #	Request for Supplementary Information	Response
R389	Rationale for the determination of high resilience as the context for possible effects to community vitality. In addition, provide a discussion on the implications of using a more conservative estimate of resiliency.	Section A.16.2.1.1 Appendix A.22F Socio-Economic Management Plan
R390	A plan for of how community well-being will be monitored, including: a. a clear definition of community wellbeing and community vitality, and how the community has been involved in the process of definition; b. indicators to monitor and evaluate the level of community well-being and vitality in each affected community; c. methods of monitoring each indicator; d. how the Proponent will communicate monitoring results; and e. any monitoring efforts outside of Pelly Crossing and Carmacks.	Section A.16.3.1.1 Appendix A.22F Socio-Economic Management Plan
R391	A description of how these suggested valued components can be incorporated into the Project's management, effects monitoring, and community involvement.	Section A.16.4.1.1

Notes:

1. Request # refers to the assigned identification number in the YESAB Adequacy Review Report January 27, 2015 Prepared by Executive Committee Yukon Environmental and Socio-economic Assessment Board.
2. Response refers to the location of CMC's response to the YESAB request for supplementary information.

A.16.2 METHODOLOGY

A.16.2.1.1 R389

R389. Rationale for the determination of high resilience as the context for possible effects to community vitality. In addition, provide a discussion on the implications of using a more conservative estimate of resiliency.

The Proposal considers "resilience" as the ability of communities in the Local Study Area (LSA) to respond to changes and impacts from the Project. Gibson and Klinck (2005) suggest that while communities with high resilience experience project impacts, they are better able to buffer and manage negative impacts. In instances of low resilience, impacts are likely to be greater and communities have less capacity to mitigate and manage impacts.

The challenge with socio-economic assessment is that neither guidelines nor predefined thresholds exist, so the assessment often relies on the setting, intensity, public concerns and professional judgement gained from working on similar projects. The Proposal uses seven criteria to assess the significance of potential residual effects for the Community Vitality VC. These seven criteria, rating and VC specific definitions are defined in Table 16.4-10 of the Proposal.

With respect to the criteria of "Context", two possible ratings for categorizing potential residual effects on Community Vitality include "Low Resilience" and "High Resilience". In the context of a low resilience receiving environment, the potential residual effects of the Project on Community Vitality are expected to operate outside of regional experience and represent a challenge to local socio-economic management institutions. Whereas, in the context of a high resilience receiving environment, potential residual effects on community vitality are expected to be familiar to local socio-economic management institutions.

The Proposal assumes that communities in the LSA have high resilience because:

- The institutional arrangements structured under the Umbrella Final Agreement (UFA), and the corollary negotiated Final Agreements are a key source of resilience;
- Yukon residents and in particular LSA residents are familiar with the cyclical nature and work schemes of the mining industry and can expect to be highly resilient in managing change; and
- Potential residual effects of the Project are expected to be localized and not noticeable within the context of other provinces or territories.

A key source of resilience flows from the institutional arrangements structured under the UFA, and the corollary negotiated Final Agreements that ensures First Nations concerns are represented as well as First Nation participation in the decision-making process in resource development. In Dahl et al.'s (2010) observation of devolution and self-government in the north, the outcomes have been the transfer of decision-making and control over resources from the national capital to regional governments and local First Nations (p.130). Under the Final Agreements and Self-Government Agreements, Yukon First Nations have direct control over resources in the designated settlement lands, and have the right to enact legislation and authorizations over lands in their traditional territory. Other forms of resiliency within existing institutional framework are UFA-mandated boards such as the Yukon Fish and Wildlife Management Board (YFWMB) and Renewable Resource Councils (RRCs). While the *Yukon Environmental and Socio-economic Act* (YESAA) is not UFA-mandated, it is a federal legislation negotiated to fulfill the mandate of the UFA. As pointed out by Gibson and Klinck (2005), an example of an institution that ensures impacts are addressed is the *Mackenzie Valley Resource Management Act*, the equivalent of YESAA in the Northwest Territories (NWT). Since the enactment of the UFA, there has been new laws, regulations and forms of management that give greater local control over land and resources, such as YESAA, First Nation self-governments, and RRCs.

For the assessment presented in the Proposal, CMC believes that the Project is situated in a jurisdiction, or context that is described as “high resiliency” where First Nations are represented involved in the decision-making process, have local control and varying degrees of economic self-reliance as well as control of the local economy. Casino Mining Corporation will continue to work with SFN and LSCFN and apply for authorizations for the use of the portions of the Freegold Road that overlaps their settlement lands. Under Chapter 23 of the UFA, a percentage of the resource revenues collected by Yukon Government for the Casino Project will be shared with First Nations. Resource revenues will greatly enhance First Nation’s capacity and provide more resources to mitigate potential adverse effects on community vitality. As outlined in Section 1.5 of the preliminary Socio-economic Management Plan (SEMP), further discussions with First Nations Governments and Yukon Government are required to determine funding mechanisms that will meet the needs of the communities (Appendix A.22F of the SIR).

Yukon residents and in particular LSA residents are familiar with the cyclical nature and work schemes of the mining industry and can expect to be highly resilient in managing change. For example, fly-in/fly-out schemes are a common practice in the mining industry in the Yukon and workers are familiar with these working arrangements. Based on experience and judgement, the Proposal anticipates that some workers even find it attractive to have the opportunity to spend long periods of time with their families when off rotation. Yukon Government and Whitehorse are familiar with the challenge of dealing with a rapidly growing population and can be expected to be highly resilient in managing change due to population growth as a result of the Project. Whitehorse grew at an annualized rate of 2.6% between 2006 and 2011 whereas in the 2017, the year of greatest projected population increase, total migration to Whitehorse due to the Project is expected to be 0.6% of the total population of the city.

Potential residual effects are expected to be localized and not noticeable within the context of other provinces or territories. Evidence for this includes the fact that although social residual effects will spill over into other jurisdictions, as the Project is anticipated to employ people from outside the LSA who will commute to work; however, these effects are not likely to be noticeable in the context of British Columbia or the Northwest Territories.

Casino Mining Corporation believes that the rating for context was appropriately applied; even if a more conservative estimate of resilience was applied to determine the potential effects of the Project on Community Vitality, CMC believes that the context described above as well as resource revenues to YG and First Nations Governments will provide increased capacity to mitigate potential adverse Project effects on community vitality.

A.16.3 SOCIAL AND CULTURAL EFFECTS MONITORING

A.16.3.1.1 R390

R390. A plan for of how community well-being will be monitored, including:

- **a. a clear definition of community wellbeing and community vitality, and how the community has been involved in the process of definition;**
- **b. indicators to monitor and evaluate the level of community well-being and vitality in each affected community;**
- **c. methods of monitoring each indicator;**
- **d. how the Proponent will communicate monitoring results; and**
- **e. any monitoring efforts outside of Pelly Crossing and Carmacks.**

Casino Mining Corporation is willing to work with local communities, First Nations and Yukon Government (YG) to develop a plan for monitoring potential effects of the Project to community wellbeing and community vitality as part of a socio-economic effects monitoring program. A preliminary Socioeconomic Management Plan (*SEMP)* has been developed by CMC to mitigate for potential adverse socio-economic residual effects of the Project and to enhance potentially beneficial socio-economic residual effects, it also outlines the approach for monitoring the predictions in the Proposal related to socio-economic VCs (Appendix A.22F).

CMC has confirmed with SFN that it will adopt the scope, methodology, VC's and indicators of the Minto Mine Socio-economic Monitoring Program to create a monitoring program for the Project (subject to any site or Project specific nuances) and CMC is interested in participating in a regional socio-economic monitoring framework. Casino Mining Corporation is also willing to work collaboratively with LSCFN to develop a similar monitoring program that arise as a result of their two recent community driven processes for community readiness planning and development of community well-being indicators.

Ideally, CMC would like to see each monitoring program as similar as possible to increase efficiencies in data sharing, and reduce redundancies and overlap. We see YG working with the First Nation governments in ensuring that any regional cumulative effects monitoring programs are well framed and are developed as soon as possible. The federal and territorial governments also have responsibility and ability to resource First Nations governments that need to participate in such a framework and do not have the capacity to do so at this time.

At this time, the preliminary SEMP describes commitments and policies that CMC will undertake to promote positive socio-economic benefits to improve quality of life and well-being for those that live in neighbouring communities. Prior to construction and throughout the life of the Project, the SEMP will be updated to include details and actions to monitor Project-specific socio-economic effects, the effectiveness of the mitigation measures, and a framework to adaptively manage unpredicted adverse effects. The SEMP is not a static document, but will be informed by suggestions and recommendations received through consultations with stakeholders throughout the YESAB review and subsequent mine permitting processes, and also regularly throughout the implementation of the plan for the life of the Project.

Part a.

The Executive Committee has requested supplementary information on the definition of community wellbeing and community vitality and information on how local communities have been or will be involved in determining these definitions for the monitoring plan.

The definition of community vitality that was used in the Proposal is based on the concept of social capital, which Scott (2010) at the Canadian Council on Social Development (CCSD) defines as "… strong, active and inclusive relationships between residents, private sector, public sector and civil society organizations that work to foster individual and collective wellbeing" (p.4). This definition emphasizes the quality of relationships amongst individuals and at the collective level between groups and institutions necessary to facilitate cooperation and change for the benefit of the community.

Community well-being can mean different things to different people at the individual level or at a community level; however, it is generally understood that people's satisfaction with their lives are determined by quality and opportunities available to them and can be determined by level of education, employment, income, and housing conditions.

Casino Mining Corporation has had some discussions with SFN/Pelly Crossing and LSCFN/Village of Carmacks on the selection of the socio-economic VCs including community vitality. Since the filing of the Proposal, extensive consultation has occurred in Carmacks with LSCFN and technical discussions have been held with

SFN related to the topic of the socio-economic effects assessment. As part of CMC's ongoing consultation with potentially affected First Nations, CMC is in active discussion with SFN and LSCFN to improve understanding of the comments and issues that have been identified by First Nations. This approach will involve ongoing consultations with community members and other stakeholders so that any socio-economic monitoring program will be designed to meet community expectations.

Part b.

The Executive Committee has requested supplementary information on potential indicators that CMC may use to monitor and evaluate the level of community well-being and vitality in each local community. It is CMC's intention to work collaboratively with First Nations, local communities and YG to determine appropriate and meaningful indicators for inclusion in the SEMP. As noted above, it is anticipated that for the purposes of monitoring many of those indicators will be similar to those identified under the purview of the Minto Mine Socio-economic Monitoring Program. Casino Mining Corporation is willing to work collaboratively with LSCFN to develop a similar monitoring program that reflects the VCs and indicators that arise as a result of their two recent community driven processes for community readiness planning and development of community well-being indicators.

The assessment of community vitality in the Proposal focuses on population and demographics at the micro- and household level by examining population changes and changes to family structures in each of the three LSA communities (Selkirk First Nation/Pelly Crossing, LSCFH/Village of Carmacks, and Whitehorse). Family structure is used in the assessment as an indicator for understanding social capital because the concept, as Haley and Magdanz (2008) suggest, is best understood when defined as structures in terms of families ties, rather than 'trust', which is an effect of social capital. Families and family structures also represent the most basic and fundament unit in a society (Haley and Magdanz 2008). Another potential indicator of community well-being is the Community Well-Being Index (CWBI) that utilizes data available through Aboriginal Affairs and Northern Development Canada (AANDC). The CWBI is based on levels of education, labour force activity, income and housing conditions. In the Proposal, the CWBI is used to measure quality of life of residents in the three LSA communities.

Based on the potential effects identified in the Proposal, population, demographics and CWBI may be appropriate indicators to assess the strength of ties between individuals within households. As well, family characteristics and family structure are potential indicators to describe status of social relationships. Measured changes in population and families might indicate Project-related changes to community structures as effects of contracted employment, mine staffing and accommodations and work schedule. The potential beneficial and adverse residual effects that could be monitored by these proposed indicators include:

- Family relationships due to the separation of workers' and their family;
- Behavioural activities because of an increased population in local communities from the influx of workers and their families, especially if the transient population is involved with disruptive activities such as crime and alcohol;
- Economic indicators on local family units; and
- Employment and income indicators for First Nations, women, people with disabilities and visible minorities.

Part c.

The Executive Committee has requested supplementary information on potential monitoring methods for each indicator that CMC may select. It is CMC's intention to work collaboratively with First Nations, local communities and YG to determine appropriate monitoring methods for inclusion in the monitoring program that will form part of the SEMP.

Casino Mining Corporation would like to collaborate with YG and potentially affected First Nations to collect and document data related to the socio-economic conditions of potentially affected communities. Establishing the monitoring methods could involve:

- Work with local agencies to monitor Project socio-economic effects, confirm and verify the predicted socio-economic effects of the Project;
- Identifying unforeseen socio-economic effects of the Project;
- Monitoring employment and skills training programs by CMC and other institutions;
- Evaluating the effectiveness of mitigation measures in managing socio-economic effects; and
- Revising and where appropriate, developing new mitigation measures to adaptively manage unforeseen socio-economic effects.

Casino Mining Corporation has committed to adopting the approach, methodology, VCs, and indicators of the Minto Mine Socio-economic Monitoring Program, subject to any site, or Project specific nuances. Casino Mining Corporation is willing to work collaboratively with LSCFN to develop a similar monitoring program that reflects the VCs and indicators that arise as a result of their two recent community driven processes for community readiness planning and development of community well-being indicators.

Part d.

Casino Mining Corporation believes that a formal process for communications and dialogue should be developed collaboratively with the potentially affected parties. A proposed framework for communications and reporting has been laid out in the preliminary SEMP (Appendix 22F) that could apply to all socio-economic monitoring programs.

Prior to construction, CMC plans to hire a community liaison to work with communities on potential socio-economic concerns related to the Project, including any socio-economic monitoring initiatives. The Community Liaison will also be responsible for establishing a framework for engagement, communications and reporting over the life of the Project with:

- First Nations Governments:
  - Selkirk First Nation
  - Little Salmon / Carmacks First Nation
  - Tr'ondëk Hwëch'in First Nation
- Municipal Governments:
  - Village of Carmacks
  - City of Whitehorse
- Yukon and Federal Government departments that interact with the communities.

The SEMP also describes that CMC will establish a Complaints/Grievance Management procedure for receiving complaints, grievances, suggestions, and recommendations from all parties. A formal grievance procedure will provide CMC and stakeholders an opportunity to improve overall communications and reporting efforts.

Casino Mining Corporation anticipates regular reports could be generated to summarize the monitoring program results and could include data on the socio-economic predicted effects in order to track the changes from pre-Project conditions through the operations phase of the Project. However, the generation of these reports would be sensitive to maintaining the privacy of community members, as requested.

Part e.

Casino Mining Corporation is committed to mitigating the socio-economic effects of the Project on potentially affected communities. The monitoring program for community vitality and community wellbeing will adaptively respond to the predicted adverse residual effects identified as part of the YESAB review and through consultations with YG, communities and First Nations. These processes may determine that it is appropriate and meaningful to monitor socio-economic effects outside of Pelly Crossing and the Village of Carmacks. In addition to Pelly Crossing and the Village of Carmacks, CMC anticipates that the City of Whitehorse could be incorporated in a limited fashion into the monitoring plan for socio-economic effects for the Project. Casino Mining Corporation is also willing to work with the Tr'ondëk Hwëch'in, municipalities and other First Nation governments to determine the appropriate level of monitoring socio-economic effects of the Project on their respective communities.

A.16.4 EFFECTS ASSESSMENT VALUED COMPONETS

A.16.4.1.1 R391

R391. A description of how these suggested valued components can be incorporated into the Project's management, effects monitoring, and community involvement.

Casino Mining Corporation is aware of the Minto Mine Socio-Economic Monitoring Framework (Capstone 2013) and the VCs selected for socio-economic effects monitoring for the Minto Mine Project. As part of CMC's ongoing discussions with First Nations, local communities and YG, discussions will include the details of the socio-economic effects monitoring plan including the selection of appropriate VCs to be adopted for the Project. If First Nations, local communities and YG indicate a mutual interest to adopt and apply the Minto framework and the VCs identified in the Minto Mine Socio-economic Monitoring Framework, CMC is willing to adopt it as a key component for the basis of developing future socio-economic effects monitoring and community involvement programs for the Project. Casino Mining Corporation will continue these discussions with First Nations, local communities and YG to reach a mutually-agreed upon approach in applying the suggested VCs identified in the Minto Mine Socio-economic Monitoring Framework for the Casino Project.

Casino Mining Corporation is willing to work collaboratively with LSCFN to develop a similar monitoring program that reflects the VCs and indicators that arise as a result of their two recent community driven processes for community readiness planning and development of community well-being indicators.

Casino Mining Corporation would like to see each socio-economic monitoring program as similar as possible to increase efficiencies in data sharing, and reduce redundancies and overlap. We see YG playing a role in ensuring that any regional cumulative effects monitoring programs are well framed. The federal and territorial governments also haves the responsibility and ability to resource First Nations governments that need to participate in such a framework and do not have the capacity to do so at this time.

A.17 – COMMUNITY INFRASTRUCTURE AND SERVICES

A.17.1 INTRODUCTION

Section 17 of the Proposal assessed the potential effects of the Project on community infrastructure and services in terms of six key indicators. These indicators were selected to capture concerns expressed by First Nations and communities in the study area and comprise Municipal Infrastructure (water supply, water/sewage treatment, landfills, power supply, and recreational facilities); Housing; Transportation; Educational Services; Health and Social Services; and Protective Services.

The data sources used in the analysis included both secondary and primary data. Secondary data were collected from Statistics Canada, Yukon Bureau of Statistics, and Yukon Socio-Economic Web Portal as well as individual communities. A number of other key information sources were consulted, including Canada Mortgage and Housing Corporation (CMHC), the Canadian Homelessness Research Network Press, Inukshuk Planning and Development, Natural Resources Canada, Yukon Health Care Review Committee, Official Community Plans, the Canadian Encyclopaedia, and civic and municipal websites. Other sources of secondary data included the Yukon Environmental and Socio-economic Assessment Board (YESAB).

Primary data were collected through one-on-one interviews conducted mostly in 2012 and 2013 with representatives from the Yukon Government, City of Whitehorse, Whitehorse and Yukon Chambers of Commerce, Yukon Mine Training Association, the Yukon Housing Corporation, Wildland Fire Management, Energy Mines and Resources, Whitehorse International Airport, Selkirk First Nation (SFN), Little Salmon/Carmacks First Nation (LSCFN), Village of Carmacks, Carmacks Renewable Resource Council members, and Tantalus School. Primary information was also gained from community meetings.

The potential effects of the proposed Project on community infrastructure and services in communities in the LSA ultimately depend on the extent to which proposed Project activities and Project-related population growth result in increased demands on those services. The assessment concludes that most of the population increase and associated increase in demand for Community Infrastructure and Services will be concentrated in Whitehorse.

The key residual effects of the Project are anticipated to be slightly increased demand for protective services (ambulance services, first responders, and RCMP) from the movement of workers and goods to the mine during construction and operations. In addition, any injury or illness will see workers transferred to health care services in the LSA. There will also be arrangements made to med-evac workers with life-threatening illnesses or injuries to the nearest appropriate facility within the LSA. These effects are considered Not Significant because of their relatively low magnitude and proposed mitigation. Finally, there will be an enhancement of workforce experience and skills base resulting from additional training.

On January 27, 2015, the Executive Committee requested that Casino Mining Corporation (CMC) provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR).

The Executive Committee had no requests related to information presented in Section 17 Community Infrastructure and Services of the Project Proposal submitted on January 3, 2014. As such, CMC considers that the documentation provided in the Proposal to be sufficient to deem the Proposal adequate for this Valued Component.

A.18 – CULTURAL CONTINUITY

A.18.1 INTRODUCTION

The Proposal assessed the potential effects of the Casino Project (the Project) on the ability of communities or individuals to sustain their cultural identity; this ability is dependent on having access to resources that support cultural retention and provide opportunities to participate in cultural activities. Cultural Continuity was selected as a Valued Component (VC) by Casino Mining Corporation (CMC) because this component was deemed important from consultations with local First Nation and other regional residents.

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). Casino Mining Corporation is providing this Supplementary Information Report (SIR) to comply with the Executive Committee's Adequacy Review Report; CMC anticipates that the information in the SIR and Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has three requests related to information presented in Section 18 Cultural Continuity of the Proposal submitted on January 3, 2014. These requests are outlined in Table A.18.1-1. Some responses require detailed technical information, data, and figures. Where necessary, this additional supporting information is provided as appendices to the SIR.

Table A.18.1-1 Requests for Supplementary Information Related to Cultural Continuity

Request #	Request for Supplementary Information	Response
R392	A Heritage Management Plan including: a. a description of input from First Nations including Traditional Knowledge; b. a range of mitigation measures; c. heritage resource management framework; d. definitions and objectives; and e. a monitoring and evaluation mechanism.	Section A.18.2.1.1 Appendix A.18A Heritage Resources Summary Report Appendix A.18B Heritage Sites Summary
R393	A table summarizing the number of historical and archaeological sites, their relative location in relation to the mine site, the Freegold Road Upgrade, the Freegold Road Extension, the airstrip location and associated borrow sites. Within that table include additional details such as: a. characterization of predicted disturbance; b. proposed Mitigation; c. description of the site; d. if applicable, the Project component footprint that the site overlaps; and e. site name, date of discovery, general location and traditional territory.	Section A.18.3.1.1 Appendix A.18B Heritage Sites Summary
R394	Clarification regarding whether avoidance is possible for the five historic sites located along the Freegold Road Extension. If not, a description of next steps and proposed mitigations is required.	Section A.18.4.1.1 Appendix A.18B Heritage Sites Summary

NOTES:

1. Request # refers to the assigned identification number in the YESAB Adequacy Review Report January 27, 2015 Prepared by the Executive Committee of the Yukon Environmental and Socio-economic Assessment Board.
2. Response refers to the location of CMC's response to the YESAB request for supplementary information.

A.18.2 HERITAGE MANAGEMENT PLAN

A.18.2.1.1 R392

R392. A Heritage Management Plan including:

- **a. a description of input from First Nations including Traditional Knowledge;**
- **b. a range of mitigation measures;**
- **c. heritage resource management framework;**
- **d. definitions and objectives; and**
- **e. a monitoring and evaluation mechanism.**

The Executive Committee requests additional information related to the Heritage (Resources) Management Plan for the Project in order to understand potential effects to heritage resources.

Interim Heritage Resources Management Plan

Casino Mining Corporation has developed a draft Interim Heritage Resources Management Plan (IHRMP) to ensure the immediate and ongoing protection and management of heritage resources within existing developments and planned work at CMC's property. The draft IHRMP presents action items and communication protocols to assist CMC staff with the orderly and successful management of known heritage sites and chance finds. The current scope of the IHRMP includes the mine site, Yukon River pipeline, Casino airstrip and access road. It is CMC's intention to expand the application of the plan to include the Freegold Road Extension (and possibly the Freegold Road Upgrade). The action items and communication protocols presented in the draft IHRMP are intended to be used as the basis moving forward for the entire Project until replaced by a final HRMP that will be submitted to Yukon Energy, Mines and Resources as part of the Quartz Mining License (QML) application.

The draft IHRMP document was not included in the Proposal submission and is not included in this SIR because CMC intends for it to be reviewed by First Nations and the Heritage Resources Unit of the Department of Tourism and Culture prior to implementation.

Final Heritage Resources Management Plan

Casino Mining Corporation is required to submit a HRMP to Yukon Energy, Mines and Resources as part of the QML application. Casino Mining Corporation will develop a HRMP to comply with the *Yukon Historic Resource Act* and the *Yukon Archaeological Sites Regulation*. Heritage resources in the Yukon are protected and managed under provisions of the *Yukon First Nations Umbrella Final Agreement* (UFA), Chapter 13 and the enabling legislations: the *Yukon Historic Resources Act*, and the *Inuvialuit Final Agreement*. The HRMP will also take into consideration the following applicable legislations:

- The Placer Mining Regulation (O.I.C. 2003/59) – under the Placer Mining Act specifically Schedule Operating Conditions, Section E regarding historic objects and burial grounds;
- The Quartz Mining Regulation (YOIC 2003/64) – under the Quartz Mining Act specifically Schedule 1 Operating Conditions, Section E regarding historic objects and burial grounds;
- The Land Use Regulation under the Territorial Lands (Yukon) Act – specifically Section 9 (Prohibitions); and
- Chapter 13 (Heritage) of the Selkirk First Nation Final Agreement.

In addition to meeting the QML license requirements, CMC intends to engage First Nations in developing and reviewing the HRMP so that it meets their expectations, out of respect for the intimate connection between First Nations and the area and the commitments made to First Nations.

Part a.

In the development of the draft IHRMP, CMC and its consultants engaged the SFN and Heritage Resources Unit. The proposed IHRMP action items and communication protocols incorporate communications between CMC, the Heritage Resources Unit, and the SFN on the IHRMP. CMC intends for the IHRMP to be reviewed by the SFN and Heritage Resources Unit prior to implementation.

As part of the each known heritage site or newly recorded site in the Project area has been flagged and a 30 m buffer established around each known site, which is also marked with durable signage.

The IHRMP provides for continued communications with First Nations and the Heritage Resource Unit. The purpose of these communications is to ensure that information about newly recorded heritage sites and resources, or impacts to heritage sites or resources are passed along in a timely manner to the Heritage Resources Unit and applicable First Nations. All results from the heritage assessments and mitigation efforts will be shared in a timely manner by CMC.

Casino Mining Corporation values the knowledge and expertise that is held by knowledge holders and if available and appropriate, CMC will take TK and TLU information into consideration to further the Project's understanding of potential effects, including for the development of the HRMP. It continues to be the intention of CMC to collaboratively work with First Nations to develop and agree upon approaches for TK and TLU data collection and consideration for the Casino Project.

Part b.

The Heritage Resources Summary Report (Appendix A.18A) is a summary document, prepared by CMC's consultant Ecofor Consulting Ltd. (Ecofor), for the Executive Committee. The summary document identifies the completed heritage assessment and mitigation works and the remaining work proposed to be completed for the Project.

Prior heritage resources assessments were completed on behalf of CMC under the following permits:

- Heritage Resource Impact Assessment of the Proposed Casino Trail Route Km 33-58.5, West Central Yukon, Permit No. 88-03ASR (Gotthardt 1988);
- An Archaeological Impact Assessment of Proposed Developments within Pacific Sentinel Gold Corp's Casino Exploration Property near Carmacks, West-Central Yukon Territory, Permit No. 94-09ASR (Handly, Merchant, and Rousseau 1994);
- An Archaeological Impact Assessment for Community and Transportation Services (Yukon Territorial Government) Proposed Freegold Road Upgrading and New Realignments (KM 0-20) Near Carmacks, Yukon, Permit No. 94-22ASR (Handly and Rousseau 1995);
- Freegold Road Archaeological Impact Assessment (KM 20-33) and Mount Nansen Road Overview Assessment, near Carmacks, Yukon, Permit No. 95-01ASR (Gotthardt 1995);
- Archaeological Salvage of KbVb-2 and Archaeological Impact Assessment of the Area West of KaVb-1 on the Freegold Road, near Carmacks, Central Yukon, Permit No. 95-02ASR (Hammer 1995);

- 2009 Historical Resource Assessment Western Copper Corporation Casino Project, Permit No. 09-09ASR (Soucey et al 2010a);
- Historical Resource Assessment Britannia Creek Road Re-Alignment – Casino Project Western Copper Corporation, Permit No. 10-04ASR (Soucey et al 2010b);
- Historic Resource Impact Assessment of the Proposed Freegold Road Extension km 0 to km 132 (previously known as Freegold Road km 60 to km 196), Permit No. 11-04ASR (Mooney 2011);
- Western Copperand Gold Corporation Casino Project Archaeological Resources Mitigation KdVi-1, KeVi-6, KfVi-2, KfVi-3, KfVi-4, and KfVi-5, Permit No. 13-06ASR (de Guzman et al 2014);
- Heritage Resource Impact Assessment of the Proposed Freegold Road Extension 33 km to 196 km, Permit No. 13-07ASR (Mooney 2013a); and
- Data Recovery Excavations at Site KfVi-5, Permit No. 13-18ASR (Mooney 2014).

Additional permitted work along the proposed Freegold Road Extension for another proponent includes Historic Resource Impact Assessment of the Combined Northern Freegold Resources 2011 Exploration Program (Tinta Hill, Freegold, Nucleus, and Revenue Properties), Permit No. 11-13ASR (Mooney 2012), and Historic Resource Impact Assessment of the Combined Northern Freegold Resources 2012 Exploration Program, Permit No. 12-03ASR (Mooney 2013b).

Three categories of heritage work remain to be completed for the Project, these consist of:

- Heritage impact assessment work where assessments were not previously completed;
- Management of impacts to heritage resources (such as avoiding sites, monitoring construction, and mitigating negative impacts where needed through detailed data recovery excavations); and
- Managing chance heritage finds during construction.

Casino Mining Corporation will complete the first two categories of work after final “for construction” designs are available and prior to construction. The first steps are to review the final Project design to identify any areas where heritage resource impact assessments were not previously completed. Impact assessments will be carried out to summarize the management recommendations for archaeological sites and historic resources that may be impacted by the Project development. Section 2 of Appendix A.18A describes potential areas remaining to be assessed.

A summary of the known archaeological, historic structures and resources, and First Nations use sites are provided in the following sections of the Casino Heritage Summary Report (Appendix A.18A):

- Section 3 summarizes the archaeological sites to be managed along the Freegold Road;
- Section 4 summarizes historic structures and resources to be managed along the Freegold Road;
- Section 5 presents archaeological sites to be managed near the mine site, road to the Yukon River, the Casino airstrip, and airstrip access road;
- Section 6 summarizes the historic structures and resources to be managed near the mine site, road to the Yukon River, the Casino airstrip, and airstrip access road;
- Section 7 lists some previously noted First Nation use sites along the proposed upgrading of the Freegold Road.

All potentially sensitive information has been removed from this public version of the Casino Heritage Summary Report, including the two appendices at the end of the report. Appendix I which has been removed contained the Project maps for the location of sites and Appendix II contained a detailed table listing the location of the remaining areas to be assessed, the archaeology sites to be managed, the historic structures and resources to be managed, and some previously noted First Nation use sites along the proposed Freegold Road upgrade.

Each site is presented in the Casino Heritage Summary Report with a brief summary of the available information including potential impacts and recommendations for the management of potential impacts (or mitigation measures).

Part c.

Casino Mining Corporation assumes that the Executive Committee is requesting information on the proposed policies, action items and communication protocols that will be put in place for the Project to ensure the protection of heritage resources.

Heritage Resource Protection Policy

Casino Mining Corporation will develop a Heritage Resource Protection Policy that will be the foundation for accomplishing heritage resource protection and for establishing the heritage resource management framework for the Project. The Policy and the contents of the HRMP will inform and guide Project decisions relating to heritage resources and could include commitments around:

- Developing a Heritage Resource Management Plan;
- Incorporating First Nations views and traditional knowledge in planning, development and operations;
- Incorporating heritage resource protection into all Project activities;
- Delivering heritage and cultural awareness training to CMC employees and contractors; and
- Maintaining the confidentiality of First Nations traditional knowledge and heritage sites.

Action Items and Planned Tasks

Casino Mining Corporation will outline key action items and planned tasks to ensure the protection of heritage resources. These key action items can include:

- Flagging and/or reflagging and signage of known heritage sites and establishing a 30 m buffer around each site with appropriate signage;
- Creating and placing heritage resource warning and information posters in prominent locations, followed by reviewing the information with CMC staff, camp managers, contractors and all visitors;
- Establishing a procedure for any new ground disturbing activities;
- Establishing a procedure for chance finds; and
- Establishing a communications procedure.

Part d.

The objectives of the HRMP will be informed and established by discussions between First Nations, the Heritage Resource Unit, and CMC. At this time, CMC anticipates that the HRMP will have three primary objectives: heritage resource protection, compliance with regulations and licence requirements, and First Nations involvement. Through these processes, CMC anticipates definitions for key terms within the HRMP will also be defined.

The Umbrella Final Agreement does not provide specific definitions of heritage resources but it does distinguish the types of resources. Part 6 of the Historic Resources Act does provide more detailed definitions which are presented below along with general definitions used in the common practice of heritage resource impact assessments.

A *Site* is an area or a place, or; a parcel of land which contains heritage resources or objects.

Ethnographic objects refer to an item of material culture relating to the history and traditional culture of an ethnic group.

Historic Sites contain heritage resources that are greater than 45 years in age and pose significant heritage value. By convention, historic sites date to the period for which written records are available; in this case, the historic period commences with the arrival of the Hudson's Bay Company in the early to mid-19th century. Historic sites may include cabins, caches, camps, brush camps, and any other manmade structures, features or objects that date between about 1960 and 1830.

Archaeological or Prehistoric Sites generally represent use before European contact and are found on or under the ground surface, and may consist of the remains of ancient camps, including hearths, animal bone and stone tools and debris. In this usage, an Archaeological Site equates to a Prehistoric Site (a site that dates to the period before written history). Note, however, that in heritage resource management usage, archaeological resources are viewed as resources that are in subsurface context (buried) and may also include historic period objects and features.

Proto-historic Sites can be viewed as prehistoric sites from a time period which includes the effects of foreign historic cultures but lacks the first hand written descriptions of that area. For example, in the Yukon the proto-historic period ends with the appearance of first hand written descriptions in the mid-1800s. However the proto-historic time period extends back thru time when foreign materials such as "drift-iron" from ship wrecks on the west coast, or foreign trade items were carried into the Yukon. Examples of foreign historic materials which predate the mid-1800s found in prehistoric contexts usually represent this proto-historic period.

Palaeonotological Resources include the fossilized, mummified, or skeletal remains of previous life forms. These resources may be found in sedimentary rock formations, or eroding streams and creeks and contain a great deal of information concerning past environments. The most common of these resources include the skeletal remains of ice age mammals which are often associated with dark humic deposits. These remains may date from approximately ten of thousands to many hundreds of thousands of years before present.

Human remains means non-fossilized remains of human bodies that are found outside a recognized cemetery or burial site.

Part e.

The HRMP will include mechanisms for reporting, monitoring and evaluation for the protection of heritage resources.

Reporting

The HRMP will outline the process to follow for reporting a suspected heritage site or feature. This section of the HRMP will include contact information for agencies and First Nations. As well, a schedule will be developed for training all employees and contractors to respect the Heritage Resource Protection Policy and adopt the protocol for reporting and protection of heritage resources.

Monitoring and Evaluation

Casino Mining Corporation is willing to work with affected First Nations and the Heritage Resource Unit to monitor and evaluate the success of the HRMP by establishing a monitoring framework. The mechanisms will need to be agreed upon by all parties but could include annual reports that will be generated to summarize results and include data on the number of chance finds, data recovery efforts, training on the Heritage Resource Protection Policy and other evaluative indictors.

Monitoring and evaluation of the HRMP will also inform development of adaptive management strategies as required in consultation with agencies and First Nations and help to determine effectiveness of proposed mitigations and/or adaptive measures.

A.18.3 NATURE AND NUMBER OF ARCHAEOLOGICAL AND HISTORIC SITES

A.18.3.1.1 R393

R393. A table summarizing the number of historical and archaeological sites, their relative location in relation to the mine site, the Freegold Road Upgrade, the Freegold Road Extension, the airstrip location and associated borrow sites. Within that table include additional details such as:

- **a. characterization of predicted disturbance;**
- **b. proposed Mitigation;**
- **c. description of the site;**
- **d. if applicable, the Project component footprint that the site overlaps; and**
- **e. site name, date of discovery, general location and traditional territory.**

Appendix A.18B Heritage Sites Summary presents a list of all known historical and archaeological sites, their relative location in relation to the mine site, Freegold Road, Casino Airstrip or access road. For each site information has been provided on:

- Scope of possible impacts (which characterizes the predicted disturbance due to the Project and if applicable, the Project component footprint that overlaps the site);
- Management recommendations and proposed mitigation strategy;
- Current status of the site;
- Class and features of the site;
- Borden Number or Temp Site # (site name);
- Report/Permit Number and Authors;
- General location (the sites are grouped by their location relative to the Freegold Road, Mine Site or Casino Airstrip and access road).

The Casino mine site footprint falls within the SFN traditional territory and the Freegold Road Upgrade and Freegold Road Extension fall within the SFN and LSCFN traditional territories.

The information presented in Appendix A.18B has been modified from the Casino Heritage Resources Summary Report, submitted to the Yukon Heritage Management Branch, for the purpose of responding to the Executive Committee's request for information; all potentially sensitive information has been removed to protect the sites.

A.18.4 FREEGOLD ROAD HISTORIC SITES

A.18.4.1.1 R394

R394. Clarification regarding whether avoidance is possible for the five historic sites located along the Freegold Road Extension. If not, a description of next steps and proposed mitigations is required.

The historic sites (e.g., log cabins, caches, pits) that have been identified along the proposed alignment of the Freegold Road or within the proposed borrow pit locations are listed in Appendix A.18B.

Casino Mining Corporation will determine whether avoidance is possible after final "for construction" designs are available and prior to construction. Casino Mining Corporation and its consultants will review the final Project design to identify any areas where heritage resource impact assessments were not previously completed and where impact assessments will be carried out to summarize the management recommendations for archaeological sites and historic resources that may be impacted. Only then will CMC be able to determine the appropriate management strategies for the sites (such as avoidance, monitoring construction, and mitigating adverse impacts where needed through detailed data recovery excavations). If impacts are unavoidable at the sites, then CMC will review the proposed impacts and possible mitigation measures with the Heritage Resources Unit and appropriate First Nations.

A.19 – LAND USE AND TENURE

A.19.1 INTRODUCTION

The Proposal defines Land Use as the human use of the land and Land Tenure as the legal regime governing land ownership. Land Use and Tenure was selected as a Valued Component (VC) for the Casino Project (the Project) by Casino Mining Corporation (CMC) because of the potential interactions between the Project activities with other land users in the study area.

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). Casino Mining Corporation is providing this Supplementary Information Report (SIR) to comply with the Executive Committee's Adequacy Review Report; CMC anticipates that the information in the SIR and Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has eight requests related to information presented in Section 19 Land Use and Tenure of the Proposal submitted on January 3, 2014. These requests are outlined in Table A.19.1-1.

Table A.19.1-1 Requests for Supplementary Information Related to Land Use and Tenure

Request #	Request for Supplementary Information	Response
R400	A discussion of the potential effects of the Project to commercial, recreational and Aboriginal fisheries (e.g. Arctic grayling and Chinook salmon). This discussion should include: a. a geographic scope that includes areas downstream of Dip Creek up to and including the White River; b. consideration of the changes in rearing, spawning, and overwintering habitat; c. a consideration of the migratory nature of various fish species; and d. potential fish kills and stranding.	Section A.19.2.1.1
R401	Description of any identified plant species of traditional, cultural, or economic importance within the Project footprint. Include a description of any efforts to engage First Nations or other land users in identifying plants of concern.	Section A.19.3.1.1
R402	Any ground studies that sought to identify and map plants of concern.	Section A.19.3.1.2
R403	If, during consultation with First Nations, any concerns were raised on impacts to important areas of wildlife harvest.	Section A.19.4.1.1
R404	A monitoring plan for induced hunting effects along the Freegold Road, either independently or in conjunction with First Nations.	Section A.19.4.1.2
R407	A summary of any geographically specific important areas for outfitting or trapping that overlap or may be affected by the Project and the species involved.	Section A.19.5.1.1
R409	A rationale for why tenure No. 334151 is not considered in the effects assessment.	Section A.19.5.1.2

Request #	Request for Supplementary Information	Response
R410	A mitigation strategy for the cabin located at the southern edge of a proposed borrow pit and what if any measures will be in place to ensure continued access. In addition, identify whether the owner has been contacted or not. If so, please provide information regarding the outcome of this contact.	Section A.19.5.1.3

Notes:

1. Request # refers to the assigned identification number in the YESAB Adequacy Review Report January 27, 2015 Prepared by Executive Committee Yukon Environmental and Socio-economic Assessment Board.
2. Response refers to the location of CMC's response to the YESAB request for supplementary information.

A.19.2 FISHERIES

A.19.2.1.1 R400

R400. A discussion of the potential effects of the Project to commercial, recreational and Aboriginal fisheries (e.g. Arctic grayling and Chinook salmon). This discussion should include:

- **a. a geographic scope that includes areas downstream of Dip Creek up to and including the White River;**
- **b. consideration of the changes in rearing, spawning, and overwintering habitat;**
- **c. a consideration of the migratory nature of various fish species; and**
- **d. potential fish kills and stranding.**

Potential effects of the Project on fish and aquatic resources was evaluated in Section 10 of the Proposal. As described in the response to R273, on November 25, 2013 new fisheries protection provisions were enacted under Section 35 of the *Fisheries Act*, to support the Department of Fisheries and Oceans Canada's (DFO) new focus on avoiding "serious harm to fish", and the framework for offsetting any residual harm to fish. The new *Fisheries Act* provisions alter the legislative focus from "no net loss" of habitat to the "sustainability and ongoing productivity of commercial, recreational and Aboriginal (CRA) fisheries". The Proposal was submitted during the time of transition for the *Fisheries Act* legislation, and hence was consistent with the older version of the *Fisheries Act*. Based on CMC's interpretation of the new provisions, fish and aquatic resources within the Casino project area are still protected by the updated *Fisheries Act* legislation. Further, the new *Fisheries Act* provisions do not modify the size, number or nature of potential project effects on fisheries identified in the Fish and Aquatic Resources section of the Proposal. Section 35 of the *Fisheries Act* still includes a reference to protecting fish habitat, in that the definition of serious harm to fish incorporates any destruction or permanent alteration of fish habitat. Additionally, the new provisions still allow for habitat-based approaches, commonly used under the old provisions, during the assessment of potential effects, and the development of mitigation and offsetting plans. Based on the similarities of the two Act versions, and the presence of CRA or CRA supporting species in the Casino project area, CMC has concluded that the previous Fish and Aquatic Resources effects assessment remains valid with minor terminology substitutions to the text.

The assessment presented in Section 10 of the Proposal concluded that no significant habitat loss and alteration, lethal effects, sub-lethal effects, or cumulative effects on fish and aquatic organisms (applicable to CRA fisheries as per the above) are predicted to occur due to the Casino Project. All residual effects were considered non-significant due to the low geographical extent, and low to medium magnitude of the anticipated impacts. The assessment of significance is contingent on the complete implementation of mitigation measures, including proposed compensation works.

Additionally, specific information regarding species life history, distribution within the project area, and a discussion of the species contribution to CRA fisheries is provided in the response to R276 provided in SIR Section A.10.

A.19.3 HARVESTING OF PLANTS

A.19.3.1.1 R401

R401. Description of any identified plant species of traditional, cultural, or economic importance within the Project footprint. Include a description of any efforts to engage First Nations or other land users in identifying plants of concern.

Traditional plant use was not included in the information gathered during baseline studies. Traditional plant use was not raised as a concern during engagement with LSCFN or SFN, so effects on the use of traditional plants were not assessed in the Proposal. Key indicators of rare plants and vegetation health are listed in Table 11.5-2 of the Proposal. The proposed Wildlife Working Group may provide an opportunity for local land users to participate in adaptive effects management on traditional plants, should they be identified as an issue of concern.

A.19.3.1.2 R402

R402. Any ground studies that sought to identify and map plants of concern.

As discussed in the response to R401 above, traditional plant use was not included in the information gathered during baseline studies, and hence plants of concern have not been identified or mapped.

A.19.4 HARVESTING OF ANIMALS

A.19.4.1.1 R403

R403. If, during consultation with First Nations, any concerns were raised on impacts to important areas of wildlife harvest.

Throughout the consultation process CMC has met with First Nations and communities; the consultation activities are described in Section 2 (of the Proposal) and A.2 (of the SIR). The importance of protecting locations of traditional harvest of wildlife is a consistent theme through many of these discussions and discussions are ongoing to carry out a Traditional Land Use (TLU) Study. .

Since the submission of the Proposal, CMC has considered publically available secondary sources of information and had consultation with LSCFN and SFN regarding important sites along the proposed access road. These sites and secondary information have been considered in the proposed mitigation measures identified in the Proposal and SIR.

A.19.4.1.2 R404

R404. A monitoring plan for induced hunting effects along the Freegold Road, either independently or in conjunction with First Nations.

The potential indirect Project effects on wildlife populations due to potential improved harvester access are not unique to the Casino Project. The Project is not expected to change hunting pressure in the region because of current harvest management regulations and the identified mitigation measures.

Managing the cumulative effect of increased wildlife harvest risk needs to have a multi-party approach that may include CMC, communities, and governments with harvest management responsibilities. CMC will support the Yukon Government Department of Environment and affected First Nations wildlife harvest management initiatives in the Project area but does not have the ability to manage the public's rights to hunt or the actions of other businesses (e.g., outfitting, trapping, mining) operating within the RSA — this responsibility falls to the governments that have legislation allowing them to manage hunting. If there is a conservation concern now or in the future, the Yukon Government and First Nations governments are responsible for harvest management.

Casino Mining Corporation has developed a Wildlife Mitigation and Monitoring Plan (WMMP) to mitigate for potential adverse effects of the Project to wildlife and wildlife habitat (Appendix A.12A of the SIR). The WMMP proposes to implement monitoring to ensure effectiveness of the mitigation measures and to adaptively manage for any unanticipated effects. The plan is intended to ensure that wildlife continue to use habitat in areas adjacent to the Project footprint and within the broader area, as well as reduce potential Project-related injury or mortality. The WMMP provides guidance to protect and limit disturbances to wildlife and wildlife habitat from Project activities.

The WMMP that has been developed for the purpose of the YESAB review is preliminary and does not provide detailed methods (i.e., study designs), cost estimates, or schedules for implementing the proposed actions. It is anticipated that further details will be developed in continued discussion with the management agencies, Renewable Resource Councils (RRCs), working groups established to monitor Project effects, and other interested parties.

To mitigate for this potential adverse effect to wildlife as a result of increased access, CMC has developed a Road Use Plan (Appendix A.22E of the SIR) which includes:

- No public access (access by permit only) on the Freegold Road Upgrade portion (managed by CMC);
- Chartered aircraft transportation to and from the Project site, from pre-designated locations, will be provided for Project staff;
- Controlled, gated, manned access (located at the new bridge over Big Creek — or as otherwise agreed by governments and CMC) for the Freegold Road Upgrade portion (managed by CMC);
- "No Hunting" in game management zones along the access road (the continuation of existing hunting ban in some areas can be extended to include entire length of access corridor);
- Special management provisions for Klaza caribou that include long-term and increased active monitoring (currently underway), and other measures as agreed (in Section 5 of the WMMP); and
- Identification of 'wildlife crossing' areas along the access road, that may include active monitoring (Section 4.1.2 of the WMMP), snow clearing berm management in late-winter, travel speed reductions and restrictions as defined and agreed in the management plan.

Monitoring will be conducted to enhance wildlife baseline information, to validate the predictions in the Proposal and to evaluate the success of mitigation measures. Monitoring will inform adaptive management but will also increase knowledge base of human effects on wildlife in Yukon. The following wildlife species are proposed to be included in focal species/effect monitoring:

- Cliff-nesting raptors — occupancy and productivity;
- Klaza caribou herd — distribution and habitat use in the Project area (10 km radius of mine and road);
- Moose — distribution and habitat use in the Project area (10 km radius of mine and road);

- Grizzly bear, black bear, wolverine and wolf dens — activities relative to distance from the PDA; and
- Collared pika — continued presence in the Project area.

Table summaries of suggested monitoring programs are provided in the WMMP (Appendix A.12A of the SIR).

Reporting of the results of monitoring will be provided to the Yukon Government and First Nations, who may make harvest management decisions based on the data provided.

A.19.5 TRAPPING AND OUTFITTING

A.19.5.1.1 R407

R407. A summary of any geographically specific important areas for outfitting or trapping that overlap or may be affected by the Project and the species involved.

A Land Use Baseline report was submitted as part of the Proposal (Appendix 19A) and describes the existing guide outfitting concessions and registered trapping concessions that may overlap with the Project components and activities within the Local Study Area selected for the land use assessment. The Land Use LSA was defined as the maximum area that captures potential direct disturbances from all of proposed Project components and activities including a 500 m buffer around the entire Project footprint.

Guide Outfitting Concessions

Three guide outfitter concessions are overlapped by the LSA; these are identified as OC 11, OC 13, and OC 14. Outfitter concession 11 is managed by Prophet Muskwa Outfitters, OC 13 is managed by Mervyn's Yukon Outfitting Ltd, and OC 14 is managed by Trophy Stone Outfitting Ltd. The percentage of each guide outfitting concession that overlaps with the LSA is identified in Table 1.3-6: Registered Outfitting Concessions Overlapping the Land Use LSA (in Appendix 19A of the Proposal). Figure 4 Guide Outfitting Concessions (in Appendix 19A of the Proposal) shows the spatial relation of the three guide outfitting concessions that overlap with the LSA. For the purposes of the Proposal and effects assessment, the areas of potential spatial overlap between the guide outfitting concessions and the LSA are considered to be potential areas of direct Project effects on guide outfitting concessions. It is important to note that in the potential areas of spatial overlap, the quality of habitat and game will affect the level of guide outfitting activities.

Based on the Land Use Baseline (Appendix 19A of the Proposal), the species harvested by Prophet Muskwa Outfitters (OC 11), include:

- Dall sheep;
- Moose;
- Mountain caribou; and
- Grizzly bear.

Based on the Land Use Baseline (Appendix 19A of the Proposal), the species harvested by Mervyn's Yukon Outfitting Ltd. (OC 13), include:

- Moose;
- Wild wood bison;
- Grizzly bear

- Wolverine;
- Mountain black bear;
- Dall sheep;
- Mountain caribou; and
- Wolf.

Based on the Land Use Baseline (Appendix 19A of the Proposal), the species harvested by Trophy Stone Outfitting (OC 14) include:

- Moose;
- Mountain caribou;
- Black bear;
- Grizzly bear;
- Wolf; and
- Stone sheep.

Trapping Concessions

Eleven registered trapping concessions overlap with the Land Use LSA, these are presented in the Land Use Baseline Report (Appendix 19A). The percentage of each trapping concession that overlaps with the LSA is identified in Table 1.3-3: Registered Trapping Concessions Overlapping the Land Use LSA (in Appendix 19A of the Proposal). Figure 3 Trapping Concessions (in Appendix 19A of the Proposal) shows the spatial relation of the eleven registered concessions that overlap with the LSA. For the purposes of the Proposal and effects assessment, the areas of potential spatial overlap between the trapping concessions and the LSA are considered to be potential areas of direct Project effects. It is important to note that in the potential areas of spatial overlap, the quality of habitat and species of furbearers will affect the level of trapping activities. It is estimated that less than a third of the available trapping concessions are active because the return on hides has decreased while the cost to maintain lines (increasing fuel costs) have increased (Yukon Fish and Wildlife Co-Management 2011).

In the Yukon, 14 different species of furbearing mammals are trapped. They are:

- Beaver;
- Coyote;
- Wolf;
- Fisher;
- Coloured Fox;
- Wolverine;
- Arctic Fox;
- Lynx;
- Squirrel;

- Marten;
- Mink;
- Weasel;
- Muskrat; and
- Otter.

Information regarding accessibility of the traplines, as well as trapping seasonality, activity and harvests was collected through interviews with registered trapline holders. From these interviews, the species most commonly targeted in those traplines include wolf, wolverine, lynx and marten, while the species most commonly caught include marten and lynx. An interview with a key informant revealed that Lynx, wolves, wolverines, squirrels and beaver are trapped in the area. Lynx is amongst the most valuable of the aforementioned species and is directly tied to the rabbit population, a food source for the Lynx (Registered Trapper 2013 pers. comm.).

Casino Mining Corporation intends to continue engagement with registered guide outfitters and registered trapping concession holders regarding potential effects of the Project.

A.19.5.1.2 R409

R409. A rationale for why tenure No. 334151 is not considered in the effects assessment.

Tenure 334151 was classified as a Rural Residential Land Application on Figure 19 of Water Licenses and Other Land Tenures – Carmacks Area of the Land Use Baseline (Appendix 19A of the Proposal). This parcel appears to represent YESAB Rural Residential application number 2011-2121 for rural land as primary residential use. The application was “Closed” by Authority on 21 November, 2014. This information is available online through the Yukon Government website for Energy, Mines and Resources Land Applications (Yukon Government Energy, Mines and Resources 2015).

A.19.5.1.3 R410

R410. A mitigation strategy for the cabin located at the southern edge of a proposed borrow pit and what if any measures will be in place to ensure continued access. In addition, identify whether the owner has been contacted or not. If so, please provide information regarding the outcome of this contact.

A description of the cabin and a photo is provided in the Heritage Baseline (Appendix 18B of the Proposal). The cabin is described as a “modern resource” and located on the Freegold Road Upgrade portion of the access road at what was previously known as "Mile 40". The modern cabin is located outside of the proposed Freegold Road Upgrade alignment and outside of the proposed borrow pit, though it is located on the south edge of a proposed borrow pit and access to the cabin may be affected during construction of the Freegold Road Upgrade.

The Yukon Government (YG) is responsible for the Freegold Road Upgrade portion of the access road. Casino Mining Corporation intends to work with YG to understand the construction of the Freegold Road Upgrade and any potential adverse effects and mitigation measures associated with other land users along that portion of the access road including any adverse changes in access.

A.20 – EFFECTS OF THE ENVIRONMENT ON THE PROJECT

A.20.1 INTRODUCTION

Section 20 of the Proposal characterized the likely extreme environmental conditions and long-term climate change scenarios that have the potential to affect the Casino Project and the predicted effects of those conditions and likely scenarios on the Project's components and activities. The potential effects to the Project considered the probability of occurrence as well as the potential consequences to the Project from occurrence of the event. In addition, potential sensitivities of the Project's components or activities, including the timing of operations and critical site conditions were discussed.

On January 27, 2015, the Executive Committee requested that Casino Mining Corporation (CMC) provide supplementary information to the proposed Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). Casino Mining Corporation is providing this Supplementary Information Report (SIR) to comply with the Executive Committee's ARR; CMC anticipates that the information in the SIR and Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has two requests related to information presented in Section 20 Effects of the Environment on the Project of the Project Proposal submitted on January 3, 2014. These requests are outlined in Table A.20.1-1 and responded to below.

Table A.20.1-1 Requests for Supplementary Information Related to Effects of the Environment on the Project

Request #	Request for Supplementary Information	Response
R429	Rationale for the statement in Section 20.3.4.4 that wildfire will not cause a shutdown of the mine for more than 24 hours.	Section A.20.2.1.1
R430	Implications to the Project if a wildfire results in a mine shutdown, or access road closure, for more than 24 hours.	Section A.20.2.1.2

Notes:

1. Request # refers to the assigned identification number in the YESAB Adequacy Review Report January 27, 2015 Prepared by the Executive Committee of the Yukon Environmental and Socio-economic Assessment Board.
2. Response refers to the location of CMC's response to the YESAB request for supplementary information.

A.20.2 WILDFIRE

A.20.2.1.1 R429

R429. Rationale for the statement in Section 20.3.4.4 that wildfire will not cause a shutdown of the mine for more than 24 hours.

The effects of the environment on the Project were assessed through determination of the overall risk of a possible environmental event. Risk is comprised of the combined likelihood of the potential event occurring and the consequences of the potential effect. The pre-established threshold levels for the consequences of the potential effects are described (in Table 20.2-2 of the Proposal) as:

- Negligible: no shutdown;
- Low: Complete shutdown for more than 24 hours;
- Moderate: Complete shutdown for more than one week;
- High: Complete shutdown for more than one month; and
- Extreme: Complete shutdown indefinitely.

The statement made in Section 20.3.4.4 that wildfire will not cause a shutdown of the mine for more than 24 hours alludes to the determination that the severity of the potential effect of a wildfire on the Project, while not negligible (i.e., no shutdown), would be unlikely to result in a shutdown for *more* than 24 hours but less than a complete shutdown of one week taking into consideration mitigation measures (including monitoring, early notification, and response).

Wildfires are managed by the Yukon Government (YG) through the Wildland Fire Management Program. The Wildland Fire Management Program "works to prevent personal injury and loss of life, and to minimize social and economic disruption resulting from wildfires" (Department of Community Services 2015). Casino Mining Corporation anticipates that wildfires will be detected and responded to prior to reaching the Project site. Fires in the Yukon are detected early through the USDA Forest Services via the Remote Sensing Application Centre. The Wildland Fire Management branch maintains fire crews in a state of readiness during fire season and has access to assistance from other provinces and territories as needed. The nearest fire department to the Project is in the Village of Mayo and is staffed by 15 – 20 volunteers.

Casino Mining Corporation will establish a procedure for contact with the Wildland Fire Management Program to ensure early notification of any wildfires in the area that have the potential to affect the Project. Typically wildfires are noticeable at great distances, and as the Project is located on a hilltop, the threat of fire will be identified well in advance of any risk to the Project. However, the consequence rating of "more than 24 hours" acknowledges that there is still some risk to the Project of minor damage or air quality concerns, which will be mitigated by the measures outlined in Table 20.3-15 of the Proposal.

Additionally, the approach for responding to wildfires will be incorporated into the Emergency Response Plan, and will detail the following procedures:

- Notification should a fire be detected in the area;
- Preparation details to minimize the impact of a wildfire;
- Actions to be taken should there be an immediate fire threat; and
- Actions to be taken during smoky conditions, and may include a reduction in outdoor activities.

Under the most likely scenario, wildfires in the area should not result in significant effects to the Project; CMC will protect the health of its workers, and should there be a risk of wildfire encroachment a decision will be made according to the assessment procedures outlined in the Emergency Response Plan to evacuate the mine site and temporarily shut down the Project.

A.20.2.1.2 R430

R430. Implications to the Project if a wildfire results in a mine shutdown, or access road closure, for more than 24 hours.

As discussed in Section 20.3.4, the likelihood of a wildfire event that has the potential of affect the Project during the life of the Project is moderate (i.e., it could happen), however the overall impact of wildfires on the Project is considered to be low, due to the measures that will be implemented to avoid, monitor, respond to and minimize the potential severity and consequences of a wildfire to the Project.

Under the worst case scenarios listed in Table 20.3-14, the access road and mine site could be closed for up to a month following an extremely destructive wildfire. In these scenarios essential operations at the mine could be serviced by aircraft, where possible; however, as there will only be 10 days of storage of LNG at site, power may not be available once the storage of LNG has been depleted and mining operations may have to be suspended.

Decision making processes involving the Freegold Road Upgrade and Freegold Road Extension, such as potential closures of the access road due to wildfires have the potential to affect multiple users; therefore CMC intends to work collaboratively with YG and First Nations Governments to develop a decision making and response process to incorporate into the Road Use Plan and Emergency Response Plan for the Project.

Casino Mining Corporation will always hold the health and safety of its employees and contractors in the highest regard and will temporarily shut down operations to protect worker health and ensure safety. The Emergency Response Plan will detail the procedures, decision process and mechanism in the event of a wildfire that has the potential to affect the mine site and/or access road.

Implications of a wildfire to the Project, substantial enough to result in a temporary shutdown of operations, could be:

- Temporary suspension of a portion or all employees;
- Temporary suspension of a portion or all active milling and mining;
- Minimal activities such as pumping of water to maintain basic mine operations – these activities would only be conducted assuming the site is safe for employees. Protective equipment such as ventilation masks may be required; and
- Normal activities would re-commence as soon as it is deemed safe for all employees and contractors.

A.21 – ACCIDENTS AND MALFUNCTIONS

A.21.1 INTRODUCTION

Section 21 of the Proposal for the Casino Project (the Project) presented an assessment of potential environmental or socio-economic effects that could result from accidents or malfunctions of the Project. The intent of the Proposal was to identify potential hazards associated with the Project, assess the associated risks, and identify risk reduction strategies (mitigation measures) to reduce the risks to an acceptable level on a continuous basis.

The Proposal assessed credible accidents and malfunction scenarios with the potential for moderate to major effects or consequences; the analysis of risk included the evaluation of the likelihood of occurrence of a credible incident, and the consequences should the incident occur. A qualitative risk assessment was used with descriptive terms to identify broad likelihoods and consequences of events; the accidents and malfunctions were illustrated and ranked using a risk matrix.

On January 27, 2015, the Executive Committee requested that Casino Mining Corporation (CMC) provide supplementary information to the proposed Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered received comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). Casino Mining Corporation is providing this Supplementary Information Report (SIR) to comply with the Executive Committee's Adequacy Review Report; CMC anticipates that the information in the SIR and Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has 19 requests related to information presented in Section 21 Accidents and Malfunctions of the Proposal submitted on January 3, 2014. These requests are outlined in Table A.21.1-1. Some responses require detailed technical information, data, and figures. Where necessary, this additional supporting information is provided as appendices to the SIR.

Table A.21.1-1 Requests for Supplementary Information Related to Accidents and Malfunctions

Request #	Request for Supplementary Information	Response
R417	A revision of the section on accidents and malfunctions to address worker and public health and safety.	Section A.21.2.1.1 Appendix A.22B Spill Contingency Management Plan
R418	Clarification of the procedures that will be established in the event of a Level II Emergency Event, as defined in the conceptual Emergency Response Plan, and how these procedures rely on existing infrastructure and services.	Section A.21.3.1.1 Appendix A.22B Spill Contingency Management Plan
R419	For accidents on the Freegold Road, a description of how emergency services will be coordinated, and where these services will come from.	Section A.21.3.1.2 Appendix A.22E Road Use Plan

R420	A description of any discussions between CMC and protective and emergency services regarding increases in traffic and therefore and increase in accidents on the Freegold Road, Alaska Highway or Klondike Highway?	Section A.21.3.1.3 Appendix A.22A Waste and Hazardous Materials Management Plan Appendix A.22B Spill Contingency Management Plan Appendix A.22G LNG Management Plan
R421	Details regarding on-site personnel, equipment, and services that are provided based on anticipated requirements.	Section A.21.3.1.4
R422	Describe and outline how would the mine site be evacuated in different seasons. Details should include: a. length of time an evacuation would require; and b. logistics for transportation.	Section A.21.3.2.1
R423	The rationale for two hours, or 682 m^3, as the minimum capacity for water storage for on- site firefighting capacity.	Section A.21.4.1.1 Appendix A.4M Processing Flow Sheets
R424	Confirmation of where off-site emergency fire services for the Project will come from.	Section A.21.4.1.2
R425	A description of the human element in fire suppression and equipment available including: a. the level of training will be available to workers in fire suppression; b. a description of firefighting infrastructure will be on-site; and c. a description of any equipment available for first responders.	Section A.21.4.1.3
R426	An elaboration on the need or absence of need for non-water jet firefighting methods.	Section A.21.4.1.4
R427	Description of the consideration of fire at the cyanide, LNG, or explosives facilities.	Section A.21.4.1.5 Appendix A. 22G LNG Management Plan
R428	A description of any plans to train and familiarize first responders with the Project and associated hazards, infrastructure, and layout.	Section A.21.4.1.6
R431	A description of any medical infrastructure that will be in place on-site regarding medical emergencies, and the depth of nursing, pharmaceutical, and first aid services that CMC forecasts as being available on-site.	Section A.21.5.1.1

R432	Details on the capacity to provide medical treatment planned in event of a potential delay to emergency response. Please describe this in terms of both the ability to provide emergency medical care for multiple casualties concurrently as well as in terms of overall duration and level of care.	Section A.21.5.1.2
R433	Considering the remote nature of the Freegold Road, a description of medical and communication capacity along the Freegold Road and its extension including the need or absence of need for any helipads.	Section A.21.5.1.3
R434	A description of how a destination medical facility will be chosen and the threshold for medevac.	Section A.21.5.1.4
R446	Describe how emergency and non-emergency services in Carmacks were factored into Project plans and design. Consideration should be given to health, law enforcement, conservation, and other government services.	Section A.21.6.1.1
R447	A detailed characterization of potential major mine infrastructure failures and proposed response measures to these events.	Section A.21.7.1.1
R448	An updated discussion regarding the likelihood and consequence of a TMF embankment failure considering the entire lifetime of the facility (i.e. in perpetuity) in light of updated site condition characterization and dam break/inundation analysis as outlined in other sections of the Adequacy Review Report.	Section A.21.7.1.2

Notes:

1. Request # refers to the assigned identification number in the YESAB Adequacy Review Report of January 27, 2015 Prepared by the Executive Committee of the Yukon Environmental and Socio-economic Assessment Board.
2. Response refers to the location of CMC's response to the YESAB request for supplementary information.

A.21.2 ACCIDENTS AND MALFUNCTIONS METHODOLOGY

A.21.2.1.1 R417

R417. A revision of the section on accidents and malfunctions to address worker and public health and safety.

As discussed in Section A.5, worker health and safety is protected by a legally binding government requirement that obliges mandatory compliance. While Section 42 of YESSA requires a determination of the significance of any environmental or socio-economic effects resulting from accidents or malfunctions, effects on human health and safety are not acceptable outcomes of any Project activities, and plans and procedures must be in place to avoid any such effects. Worker health and safety is protected under the *Occupational Health and Safety Act* and related regulations, and the *Quartz Mining Act* also enables the regulator to shut down the mine should the mining works be deemed a danger to public or employee safety.

All Project related activities will be conducted in a manner that minimizes risk to worker health and safety through training, awareness, and continuous improvement. Worker health and safety is the primary objective of the detailed Occupational Health and Safety Plan that will be developed by CMC and submitted to the Yukon Government for review and approval as part of the Quartz Mining License application (Yukon Water Board 2013). The detailed Occupational Health and Safety Plan will outline potential worker exposure scenarios and procedures to minimize worker exposure. The Occupational Health and Safety Plan will also outline how worker health and safety will be monitored and what measures will be utilized in exposure situations. In addition to the detailed Occupational Health and Safety Plan, CMC will be required to submit other plans for the Quartz Mining License application that are related to worker health and safety, including:

- A description of all dust control measures that will be employed to ensure worker health and safety and minimize effects on the environment;
- A Spill Contingency Management Plan (preliminary plan provided in Appendix A.22B) to communicate to staff, contractors, and workers the actions to be taken when responding to spills during mine construction, operation and closure; and
- An Emergency Response Plan (Appendix 22B) which will be reviewed for completeness by the Yukon Workers' Compensation Health and Safety Board, and will include procedures for the protection of worker and public health and safety in the event of accidents or malfunctions.

A.21.3 GENERAL EMERGENCY

A.21.3.1.1 R418

R418. Clarification of the procedures that will be established in the event of a Level II Emergency Event, as defined in the conceptual Emergency Response Plan, and how these procedures rely on existing infrastructure and services.

Spill response procedures are outlined in the Spill Contingency Management Plan (Appendix A.22B), and the plan includes details on the emergency response organization and responsibilities, as well as key external emergency contacts. R418 refers to the procedures in the event of a Level II Emergency, which is defined as:

"Level II: includes intermediate level spills requiring response by on-site or off-site trained staff but *posing no danger to the public*".

For medical emergencies, the Medical Responder on-site will assess the nature of the medical emergency and status of the patient to determine if further actions such as medevac to a hospital are required. CMC will provide first aid stations, an on-site medical clinic, and emergency vehicles with the necessary medical equipment, medications, and supplies supported by qualified and trained medical staff.

In the event of a medical emergency (i.e. major trauma cases), the Medical Responder will contact Yukon Emergency Medical Services (EMS) Dispatch (Table A.21.3-1) to provide history and an assessment of the situation. Medical support and/or evacuation is possible by air transport via the Casino Mine airstrip to support fixed-wing air ambulance.

The primary community in which off-site services will be relied on is Whitehorse. Baseline data on community services reveal capacity constraints in the ability of community health centres to provide services to meet local demand. In Pelly Crossing, the community health centre has no regular, permanent staff and specialist services are available infrequently. No emergency care is available and patients are transported to the Whitehorse General Hospital. While the health centre in Carmacks has a larger facility (two exam rooms that can be used for trauma) and staffed by two nurses, it is understaffed and is relied on to service the Minto Mine for treating injuries. Whitehorse is a feasible option with wide-range of services available at the Whitehorse General Hospital, particularly emergency care.

Casino will ensure that a number of trained personnel holding certificates of competence in Surface Mine Rescue valid in the Yukon or similar certification, will be present at the site at all times. A Medical Responder will also be on site at all times who will be responsible for providing medical attention if required and contacting/coordinating with outside medical resources if required. The Casino Health and Safety Manager will ensure that a list of names and location of all Mine Rescue and Emergency Response Personnel is posted in designated locations at all times for quick reference. This list will be updated as per shift rotations to ensure rescue and emergency response personnel are on site and available.

As noted, these emergency response procedures are generally outlined in the Emergency Response Plan (ERP - Appendix 22B); the ERP in the Proposal is a conceptual plan, and specifics on CMC's response procedures for Level II emergencies will be outlined in the detailed ERPs prior to initiation of the construction phase. CMC will incorporate Yukon Government and local first responders into the process for finalizing the conceptual ERP.

In regards to use of existing infrastructure and services, Casino will establish a Mutual Aid Agreement (MAA) in conjunction with the QML process with other mines and agencies in the surrounding area. A MAA is an agreement between agencies and/or jurisdictions in which they commit to assist one another upon request by furnishing resources.

The Emergency Response Team will be made up of CMC personnel who will be responsible for managing emergency situations. CMC will ensure that sufficient trained emergency response personnel are on site at all times. The Incident Commander or designate will assume responsibility for each incident in consultation with senior management, the Emergency Response Coordinator, and relevant Governmental Agencies. The Incident Commander is the primary decision-maker for assessing and responding to incidents at the Project site and along the Freegold Road. The incident response organizational structure is depicted in Figure A.21.3-1.

Key external emergency contacts are provided in Table A.21.3-1. This list is not intended to be all inclusive at this stage and will be updated prior to beginning the construction phase of the Project. An emergency response responsibility matrix will also be created for definition and quick reference.

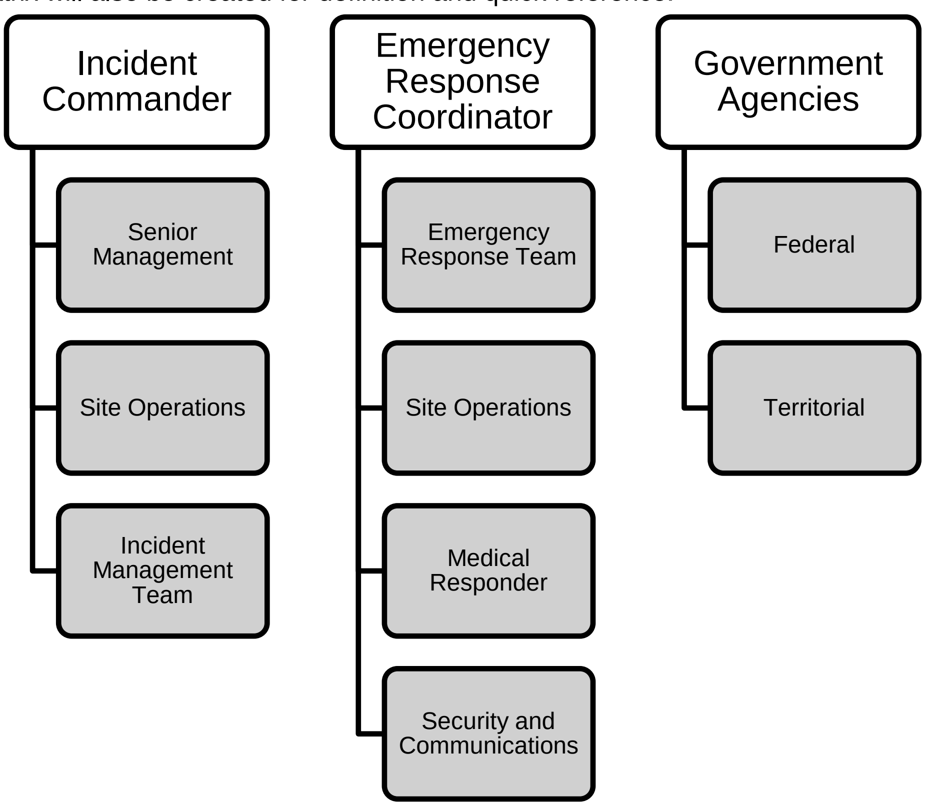


Figure A.21.3-1 Emergency Response Organizational Chart

Table A.21.3-1 External Emergency Contact List

Contact Name	Contact Number
Health Care Providers	
Whitehorse Regional Hospital	(867) 393–8700
Carmacks Health Centre	(867) 863-4444
Pelly Crossing Health Centre	(867) 537-4444
Emergency Responders	
Fire Department – Pelly (Emergency)	(867) 537-3000
Fire Department – Whitehorse	(867) 668-8699 or (867) 668-2462
Police – Pelly	(867) 537-5555
Police – Carmacks	(867) 863-2677
Police – Whitehorse	(867) 667-5555
Yukon EMS, Dispatch	(867) 667–3333
Poisonous Substance Ingestion	(867) 633–8477
Yukon Territory Government Contacts	
Yukon Dept. of Conservation	(867) 667–5317
Yukon Dept. of Fish & Game	(867) 393–6722
Yukon Spill Report Center	(867) 667–7244
Yukon Energy (afterhours)	(800) 676–2843
Yukon Workers' Compensation Health and Safety Board	(867) 667–5450
Yukon Occupational Health and Safety Mine Inspector	(800) 661–0443
Yukon Coroner's Office	(867) 667–5317
Helicopter Service Providers	
Capitol Helicopters	(867) 668-6200
HeliDynamics	(867) 668-3536
TransNorth Helicopters	(867) 668-2177 (Whitehorse) (867) 863-5551 (Carmacks)
Fixed Wing Service Providers	
Alkan Air	(867) 668-7725

A.21.3.1.2 R419

R419. For accidents on the Freegold Road, a description of how emergency services will be coordinated, and where these services will come from.

As detailed in the ERP (Appendix 22B), all traffic associated with the Project will be managed in accordance with the Road Use Plan (updated in Appendix A.22E). Radio communication will be available along all roads to allow for rapid communication with divers and reporting of incidents. Once an accident has been reported, incident response will conform to the procedures outlined in the ERP, and incident response will follow the organizational structure depicted in Figure A.21.3-1.

Anticipated requirements for on-site equipment and services will also vary based on the nature of the emergencies, and response procedures for addressing the emergency. All will be identified in the emergency-specific, comprehensive plans to be developed in consultation with relevant agencies. A standard requirement will be to maintain a mine rescue equipment inventory list that will be compiled regularly. Standard mine rescue and emergency equipment which may be maintained on-site are:

- protective gear for firefighting and hazardous material handling;
- a fully equipped rescue vehicle;
- an ambulance;
- mobile medical treatment unit;
- oxygen tanks;
- firefighting equipment (e.g. fire extinguishers) ;
- a fire truck;
- 4x4 truck with stretchers;
- Emergency kit containing wound management, burn dressings, sterile water, bandages and dressings;
- dedicated communications devices (hand-held and vehicle-mounted); and
- tools (e.g., axes, shovels, cutters, and saws).

For medical emergencies the on-site Medical Responder will assess the nature of the medical emergency and status of the patient to determine if further actions such as medevac to a hospital are required. CMC will provide first aid stations, an on-site medical clinic, and emergency vehicles with the necessary medical equipment, medications, and supplies supported by qualified and trained medical staff.

In the event of a medical emergency (i.e., major trauma cases), the Medical Responder will contact Yukon Emergency Medical Services (EMS) Dispatch (Table A.21.3-1) to provide history and an assessment of the situation. Medical support and/or evacuation is possible by air transport via the Casino Mine airstrip to support fixed-wing air ambulance.

CMC will arrange meetings with local health centres and service providers to develop a collaborative medical emergency response strategy and communication plan for sharing information related to medical protocols and the ERP. CMC will work closely on an ongoing basis with Whitehorse General Hospital, local fire departments, RCMP and Yukon Ambulance to engage on these efforts.

In the event of fire and explosion along the road, support may be requested from the Carmacks or Whitehorse emergency services (recognizing that the Fire departments cannot operate outside of municipal boundaries). CMC will be proactive in minimizing the risk of fires and explosions. The use of oil and other related fuels and fluids (i.e., diesel, lubricating oils, hydraulic fluids) will meet Yukon Government permits and Federal and Territorial codes and standards.

A.21.3.1.3 R420

R420. A description of any discussions between CMC and protective and emergency services regarding increases in traffic and therefore and increase in accidents on the Freegold Road, Alaska Highway or Klondike Highway?

Casino Mining Corporation has initiated discussions with the Yukon Government Department of Highways and Public Works in regards to increased traffic on the Freegold Road, Alaska Highway and Klondike Highway. Yukon Government has established an internal working group for CMC to inform and coordinate information about the project to all departments with responsibilities. Yukon Government Department of Highways and Public Works is conducting an internal analysis to examine future requirements for road infrastructure and upgrades in response to the increased traffic that may result from planned resource projects in the Dawson Range, including the Casino Project. One of the objectives of this analysis, and any work that may be conducted along the public highways, is to ensure design standards and maintenance are appropriate to ensure public safety. Discussions between Yukon Government related to road infrastructure requirements are expected to continue.

CMC has developed a number of elements that would be included in a *Highway Traffic Management Plan* for the management of incidents that could occur along the highway and the Freegold Road:

Spills and Emergency Response

An Emergency Response Plan (Appendix 22B of the proposal) provides a framework for developing comprehensive response plans to both traffic emergencies and spills. CMC has committed to developing these comprehensive response plans prior to construction.

The potential risk of spills during material transport will be minimized by:

- Contracting transport companies with suitable safety and training programs for their drivers;
- Contracting transport companies with vehicle tracking systems;
- Maintaining and operating vehicles consistent with the Highways Act and Regulations (Yukon); and
- Handling materials consistent with requirements set out in Transport Canada's Transportation of Dangerous Goods Act and Regulations.

A Spill Contingency Management Plan (preliminary plan provided in Appendix A.22B) will be developed prior to construction and operations and will be applied in the event of a spill to control and decrease any potential adverse effects to people and the environment. The following components will be included in the final Spill Contingency Management Plan:

- Spill categories;
- Spill prevention procedures;
- Spill response plan;
- Roles and responsibilities;
- Training;
- Internal and external reporting; and
- Monitoring.

Vehicles transporting materials for the project will be equipped with the required spill response kits and drivers trained as appropriate responders.

CMC will develop a Hazardous Materials Management Plan (preliminary plan provided in Appendix A.22A) prior to construction and operations. CMC will also develop a specific Cyanide Management Plan and Liquid Natural Gas (LNG) Management Plan (preliminary plan in Appendix A.22G). These plans will stipulate requirements for transportation contractors and identify policies around personnel and training for the management of these materials for the project. The plans will outline handling, storage and use of the material as well as risks and emergency response.

Effects of Project-related Traffic on other Highway Users

Traffic analyses completed by CMC indicate that project-related traffic will constitute a relatively small proportion of vehicles using the North Klondike, South Klondike and Alaska highways. Input received from Transportation Planning, Highways and Public Works, Yukon Government indicates that lighter project-related vehicles (Federal Highway Administration (FHWA) Classes 3-7) are unlikely to result in adverse effects to other road users.

Project-related trailer truck traffic (FHWA Classes 8-13) will also result in small proportional increases in traffic along segments of the North Klondike, South Klondike and Alaska highways. All three highways have design capacities that greatly exceed current traffic volumes and project-related traffic. CMC anticipates insignificant effects (infrequent, low magnitude, reversible) of project-related truck traffic on other highway users. CMC will work with Yukon Government Department of Highways and Public Works to monitor, and actively manage if required, potential interactions between project-related trailer truck traffic and other public highway users.

A.21.3.1.4 R421

R421. Details regarding on-site personnel, equipment, and services that are provided based on anticipated requirements.

The emergency responses identified in the ERP (Appendix 22B) will be further developed in the comprehensive plans. The personnel, equipment and services requirements will be developed and scaled relative to the size of workforce on site and scope of project activities that are appropriate for the different emergencies identified.

However, at a preliminary scoping level, the Casino Mine Project will have the following on-site personnel, equipment and services:

Medical Response

- Medical responder
- First aid stations
- On-site medical clinic
- Emergency vehicles with the necessary medical equipment
- medications and supplies for First Aid
- Basic Life Support equipment supported by qualified and trained medical staff

Emergency Response

As per the ERP, an Emergency Response Team (Figure A.21.3-1) made up of CMC staff will be responsible for managing the following anticipated emergencies: spill response, fire and explosion, mine infrastructure failure, medical, extreme weather, natural disaster, missing persons, bear encounters, traffic, and site evacuation. The Incident Commander will be responsible for decision-making for managing and responding to emergencies at any given time, and will be in consultation with the Emergency Response Coordinator and appropriate regulatory agencies. The Incident Commander will also be responsible for following the response procedures contained in the comprehensive plans developed specifically for each emergency.

Anticipated requirements for on-site equipment and services will also vary based on the nature of the emergencies, and response procedures for addressing the emergency. All will be identified in the emergency-specific, comprehensive plans to be developed in consultation with agencies. A standard requirement will be to maintain a mine rescue equipment inventory list that will be compiled regularly. Standard mine rescue and emergency equipment which may be maintained on-site are:

- protective gear for firefighting and hazardous material handling;
- a fully equipped rescue vehicle;
- an ambulance;
- mobile medical treatment unit;
- oxygen tanks;
- firefighting equipment (e.g. fire extinguishers) ;
- a fire truck;
- 4x4 truck with stretchers;
- Emergency kit containing wound management, burn dressings, sterile water, bandages and dressings;
- dedicated communications devices (hand-held and vehicle-mounted); and
- tools (e.g., axes, shovels, cutters, and saws).

A.21.3.2 Evacuation

A.21.3.2.1 R422

R422. Describe and outline how would the mine site be evacuated in different seasons. Details should include:

a. length of time an evacuation would require; and

b. logistics for transportation.

Evacuations may be required in the event of danger to worker health and/or safety, including natural disasters such as earthquake, wildfire or extreme weather. A general Site Evacuation Plan will be prepared for the Casino mine site for emergency situations where the Emergency Response Coordinator and/or the Incident Commander deem that an evacuation is necessary. A site wide notification either by radio, phone, or alarm system will be established and all staff and contractors on the site will be made aware of its use. Muster station(s) will be set up at the mine site and all personnel will be made aware of the locations. The key element of the mine evacuation plan will be to ensure that all staff, contractors and visitors are accounted for and that all personnel are evacuated in a rapid and safe manner.

As per the ERP (Appendix 22B), an Emergency Response Team made up of CMC staff will be responsible for dictating when evacuation is necessary and subsequently managing the evacuation. The Incident Commander will be responsible for decision-making for managing and responding emergencies at any given time, and will be in consultation with the Emergency Response Coordinator and appropriate regulatory agencies (Figure A.21.3-1). The Incident Commander will also be responsible for following the response procedures contained in the comprehensive plans developed specifically for each emergency.

Off-site infrastructure and emergency services will be needed in the event of fire, explosion, and medical emergencies that require an evacuation. Evacuation would be possible via the following methods and arrangements will be made by the designated travel coordinator:

1. Road evacuation: This could include transportation by coach, or on-site vehicles, depending on the capacity of the on-site vehicles. If on-site vehicles are not sufficient, coaches may need to be brought in

from Whitehorse (~47 passengers/bus). The trip from the Project to Whitehorse will be approximately 4 hours one direction, once the Freegold Road extension is constructed.

2. Fixed wing: During operations, the airstrip will be able to accommodate a fixed wing aircraft that can transport up to 50 people per flight as well as smaller aircraft that can accommodate from 2 to 14 passengers. Fixed wing transportation is dependent on weather conditions, especially during extreme weather events. The flight from the Project to Whitehorse is approximately 1.5 hours one way.

Evacuation procedures, emergency exit routes, and muster points for each building will be posted throughout the mine buildings, including each individual room in the camp.

A.21.4 FIRE

A.21.4.1 Mine Infrastructure and Fire

A.21.4.1.1 R423

R423. The rationale for two hours, or 682 m³, as the minimum capacity for water storage for on-site firefighting capacity.

The Emergency Response Plan (Appendix 22B of the Proposal) states that fresh water for firefighting will be provided from the Yukon River Valley Pipeline. On-site water requirement for firefighting is satisfied by ensuring a reserve capacity of in the lower portion of the freshwater pond that is unavailable for other uses. Fire water storage and distribution is shown on flow sheet 000-FS-014 in Appendix A.4M.

Prior to the completion and commissioning of the Yukon River Valley Pipeline at the start of Year 1, emergency firefighting water requirements of the Casino mine site will be met using fresh water retained within the Temporary Freshwater Supply Pond (TFSP).

The fire water requirement was dictated by the Feasibility Study (M3 2013), which stated that "*The fire water requirement is 341 m^3/hr for two hours. This demand is satisfied by a fire reserve capacity of 682 m^3 in the lower portion of the freshwater pond that will be unavailable for other uses"*.

A.21.4.1.2 R424

R424. Confirmation of where off-site emergency fire services for the Project will come from.

In the event of a fire that cannot be managed by on-site services alone (i.e., along the road), support may be requested from the Carmacks or Whitehorse emergency services (Table A.21.3-1). CMC will be proactive in minimizing the risk of fires and explosions. The use of oil and other related fuels and fluids (i.e diesel, lubricating oils, hydraulic fluids) will meet Yukon Government permits and Federal and Territorial codes and standards.

Typically, remote mine sites with a large number of employees and contractors establishes a Mutual Aid Agreement (MAA) (e.g., Minto Mine (Capstone 2014) and Eagle Gold Mine (StrataGold Corporation 2013)), that establishes an agreement between agencies and/or jurisdictions in which they commit to assist one another in the event of an emergency. CMC would likely establish MAAs with other operations in the area, including the Minto Mine, as well as with YG and the Village of Carmacks.

While the Village of Carmacks has limited fire protection services (12 volunteer personnel, two tanker trucks and radio communication), the municipal fire departments cannot operate outside of municipal boundaries. Therefore, the Casino Mine would rely on support from the Yukon Government, Department of Community Services, Wildland Fire Management Program (867-456-3845; seasonal offices in Carmacks: 867-863-2408).

A.21.4.1.3 R425

R425. A description of the human element in fire suppression and equipment available including:

a. the level of training will be available to workers in fire suppression;

b. a description of firefighting infrastructure will be on-site; and

c. a description of any equipment available for first responders.

Part a.

Typical training provided to members of the Emergency Response Team includes:

- Standard First Aid;
- Surface Mine Rescue;
- Industrial Fire Brigade under NFPA 1081;
- Spill Response;
- Hazardous Materials Handling; and
- Workplace Hazardous Material Information System.

Part b.

Typical firefighting infrastructure will be dictated by requirements in the *Building Standards Act* and *Regulations*, and may include:

- Camp infrastructure:
- Fire water storage tank and associated distribution system with hydrants
- Hoses at appropriate intervals
- Fire extinguishers
- Mill and mine infrastructure:
- Fire water storage tank and associated distribution system with hydrants
- Fire suppression system (sprinklers)
- Fire extinguishers

Part c.

Anticipated requirements for on-site equipment will also vary based on the nature of the emergencies, and response procedures for addressing the emergency. All will be identified in the emergency-specific, comprehensive plans to be developed in consultation with agencies. A standard requirement will be to maintain a mine rescue equipment inventory list that will be compiled regularly. Standard mine rescue and emergency equipment which may be maintained on-site are:

- protective gear for firefighting and hazardous material handling;
- a fully equipped rescue vehicle;
- an ambulance;
- mobile medical treatment unit;

- oxygen tanks;
- firefighting equipment (e.g. fire extinguishers) ;
- a fire truck;
- 4x4 truck with stretchers;
- Emergency kit containing wound management, burn dressings, sterile water, bandages and dressings;
- dedicated communications devices (hand-held and vehicle-mounted); and
- tools (e.g., axes, shovels, cutters, and saws).

Again, the emergency responses identified in the ERP will be further developed in the comprehensive plans. The personnel, equipment and services requirements will be developed and scaled relative to the size of workforce on site and scope of project activities that are appropriate for the different emergencies identified.

A.21.4.1.4 R426

R426. An elaboration on the need or absence of need for non-water jet firefighting methods.

Non-water based fire suppression systems will be required in areas where water exacerbates fires, for example:

- Reagents storage;
- Electrical rooms – designed as non-combustible structures or vaults, chemical suppression system; may include inert gas suppression systems;
- LNG – chemical suppression system;
- Kitchen – chemical fire extinguishers;
- Vehicles and equipment – chemical fire extinguishers;
- Remote out buildings - chemical fire extinguishers; and
- Fuel storage – chemical fire extinguishers.

All fire-fighting protocols will be tailored to the needs of the Project during detailed design, and as required by the *Building Standards Act and Regulations*.

A.21.4.1.5 R427

R427. Description of the consideration of fire at the cyanide, LNG, or explosives facilities.

The Emergency Response Plan (ERP) submitted for the final configuration of the Casino Project under the *Quartz Mining Act* and the *Waters Act* will contain procedures for firefighting of specific areas of the mine site. At this time, specific details of the firefighting components at the mine are not yet determined, but will be dictated by requirements in the *Building Standards Act and Regulations* and by insurance provider requirements. Typical responses for cyanide, LNG and explosive facilities are detailed below.

Generally, the Emergency Response Team will be trained on emergency response procedures, and will be aware of the need to consult the material safety data sheets (MSDS) for each potentially hazardous material stored and used in the mill processing facilities. A fire suppression system may be installed within the mill, and may consist of a sprinkler system, or of a water distribution system with hydrants.

Cyanide

Cyanide is delivered as sodium cyanide briquettes, and will be stored with other chemical reagents in the mill processing building. While sodium cyanide is generally non-combustible, it can decompose upon exposure to heat, and produce potentially toxic fumes of hydrogen cyanide and ammonia. Only if it is safe to do so, therefore, the sodium cyanide briquettes should be removed from the path of the fire. Because sodium cyanide can result in acute toxicity via inhalation, dermal, and oral exposure, it is important that fire fighting methods do not result in the spread of the material. Therefore, fire suppression through a water fog system is required instead of carbon dioxide or water jet extinguishers.

LNG

The LNG Management Plan (Appendix A.22G) details emergency response procedures for a vapor-cloud ignition/explosion jet fire following a leak from piping, flash fire following a release, pool fire in the secondary containment following a release, and a boiling liquid expanding vapor explosion (BLEVE). Generally, the response for an LNG fire is to:

1. *Assess the situation* – determine the wind direction and park vehicles in an upwind position. Eliminate sources of ignition such as cars and trucks (i.e. do not leave engines running or start stalled engines).
2. *Protect the area* – secure the area around the leak to limit non-essential personnel to a safe distance from the leak. Enter with caution, erect barricades, and evacuate people if needed. Establish a command site at the area to ensure proper communications between emergency response personnel. Try to prevent the spread of the fire itself. Avoid forced ventilation of structures and excavations as that can increase the likelihood of a flammable atmosphere.
3. *Contact Emergency Responders* – to secure the area.
4. *Work together* – ensure that the local, the operator, and emergency responders have proper communications and are working to resolving the emergency.

Explosive Facilities

The explosives facility is an explosives magazine located northeast of the Open Pit. Explosives will be prepared and stored in accordance with the explosives license issued by Natural Resources Canada to a licensed explosives contractor hired by CMC; explosives and blast caps will be stored in separate facilities, away from operational areas. CMC will obtain an Explosives Act magazine license requirements with respect to storage and handling of explosives, and necessary permits including Blasting Permit, Magazine license, Factory license, ANFO Certificate, Purchase and Possession Permit, Explosives and Hazardous Materials Transport Permit.

Explosive storage areas are necessarily located away from camp and other facilities, and a qualified explosives contractor will be retained to provided blasting services and will mix and dispense explosives into the blast holes. Strict safety protocols will be observed during blasting operations.

As detailed in Section 4, CMC will engage in discussions with potential licensed explosives contractors to determine final requirements for the explosives facility. The explosives facility will be located at the north end of the Casino mine site, taking into consideration Natural Resources Canada (NRCan) requirements for siting. All materials will be stored in accordance with the applicable regulations and standards and are managed by an NRCan licensed explosives contractor.

Prior to construction of the explosives facilities, the soils in the footprint of the buildings will be salvaged and stockpiled locally in windrows adjacent to the disturbance sites or in designated soil stockpile areas. The designated areas will be graded and surrounded by a perimeter berm with a minimum height of 1.2 m, and a single gated lockable entry point, as per requirements of the explosive‘s license.

The specifications of the explosives facility will be determined by the explosives contractor to match the anticipated rate of use for the Casino Project. In general, an explosives facility consists of:

- Bulk ammonium nitrate outdoor storage area (silos);
- Bulk fuel area;
- Magazine for storage of detonators, detonating cord, boosters ;
- Emulsion manufacturing facility;
- Wash bay;
- Maintenance facility; and
- Trucks.

The licensed blasting contractor will supply all the surface facilities for the explosives magazines and for storage of blasting supplies.

Under the NRCan Guidelines for Bulk Explosives Facilities Minimum Requirements a Fire Safety Plan must be developed. The Explosive Regulatory Division provides guidelines (NRCan 2014) on what the plan must contain, including:

- licensee information;
- measures to be taken to minimize the likelihood of a fire at the site and to control the spread of any fire;
- emergency procedures for responding to a fire;
- procedures for determining if a fire should be fought; and
- measures to be taken to train employees in the measures, procedures, and circumstances described in the plan.

CMC will develop all plans required under the *Explosives Act and Regulations (2013)*.

A.21.4.1.6 R428

R428. A description of any plans to train and familiarize first responders with the Project and associated hazards, infrastructure, and layout.

As discussed above, remote mine sites with a large number of employees and contractors typically establish a Mutual Aid Agreement (MAA) (e.g., Minto Mine (Capstone 2014) and Eagle Gold Mine (StrataGold Corporation 2013)), that establishes an agreement between agencies and/or jurisdictions in which they commit to assist one another in the event of an emergency. CMC would likely establish MAAs with other operations in the area, including the Minto Mine, as well as with YG and the Village of Carmacks. Casino will provide Emergency Response Plans to all MAA partners. Additionally, a document containing hazards, infrastructure, layout, Emergency Response organization chart, etc. will be updated regularly and provided to MAA partners. Quarterly meetings with MAA partners may be proposed to be held to inform of any new hazards or provide any updates. Site visits may also be completed upon entering into MAA partnerships, and may also occur on a quarterly or bi-annual basis if necessary.

A.21.5 MEDICAL AND HEALTH

A.21.5.1.1 R431

R431. A description of any medical infrastructure that will be in place on-site regarding medical emergencies, and the depth of nursing, pharmaceutical, and first aid services that CMC forecasts as being available on-site.

CMC will provide an on-site health clinic staffed by a full-time registered nurse. On-site health services will include drug and alcohol testing, STI testing, physical exams, patient referrals, and general health care. Given the challenges and costs associated with providing full time physicians and specialized health care providers on site, some care may be provided by satellite (satellite health care). The primary community in which off-site specialized services (those not available on-site) will be relied on is Whitehorse.

For medical emergencies the Medical Responder on-site will assess the nature of the medical emergency and status of the patience to determine if further actions such as medevac to a hospital are required. CMC will provide first aid stations, an on-site medical clinic, and emergency vehicles with the necessary medical equipment, medications, and supplies at First Aid, Basic Life Support supported by qualified and trained medical staff.

In the event of a medical emergency (i.e., major trauma cases), the Medical Responder will contact Yukon Emergency Medical Services (EMS) Dispatch at 867-667-3333 to provide history and an assessment of the situation. Medical support and/or evacuation is possible by air transport via the Casino Mine airstrip to support fixed-wing air ambulance. Helicopter services may be utilized if Yukon EMS Dispatch is unable to provide support necessary for medical emergency evacuations.

CMC will arrange meetings with local health centres and service providers to develop a collaborative medical emergency response strategy and communication plan for sharing information related to medical protocols and the Emergency Response Plan (ERP). CMC will work closely on an ongoing basis with Whitehorse General Hospital, local fire departments, RCMP and Yukon Ambulance to engage on these efforts.

Standard emergency medical equipment that will be maintained on-site includes:

- An ambulance;
- Mobile medical treatment unit;
- Oxygen tanks;
- 4x4 truck with stretchers;
- Emergency kit containing wound management, burn dressings, sterile water, bandages and dressings; and
- Dedicated communications devices (hand-held and vehicle-mounted).

A.21.5.1.2 R432

R432. Details on the capacity to provide medical treatment planned in event of a potential delay to emergency response. Please describe this in terms of both the ability to provide emergency medical care for multiple casualties concurrently as well as in terms of overall duration and level of care.

The Casino Mine must comply with the *Yukon Occupational Health and Safety Regulations*, which includes, at a minimum that CMC:

- Assess the risks that workers are likely to encounter at the workplace;
- Provide and maintain equipment, supplies, facilities, first-aid attendants and services that enable the prompt rendering of first aid to workers and emergency transportation;
- For an isolated workplace with 200 or more workers under Class A type work, for any shift at all times, provide:
  - Level 3 first-aid kit;
  - One advanced first-aid attendant;
  - Two standard first-aid attendants;
  - One standard first-aid attendant for each additional increment of 1 to 100 workers; and
  - A first-aid room (requirements for a first-aid room are also outlined in the *Yukon Occupational Health and Safety Regulations – Part 18*).

CMC will provide first aid stations, an on-site medical clinic, and emergency vehicles with the necessary medical equipment, medications, and supplies supported by qualified and trained medical staff.

CMC will provide an on-site health clinic staffed by a full-time registered nurse. Emergency Response Team members will also be trained in First Aid. As per the *Yukon Occupational Health and Safety Regulations – Part 18*, the first-aid attendant is responsible for all first-aid treatment of an injured worker until "responsibility for treatment is accepted at a medical facility; by an ambulance service; or by a person whose credentials in first-aid treatment are equivalent or superior to those of the first-aid attendant".

A Medical Responder (MR) and Emergency Response Team (ERT) will be on site at all times. The MR will be a certified Emergency Medical Technology (EMT) Paramedic. Triage decisions will be made by the ERT and MR, and will be based on patient condition and medical capacity of MR and ERT to provide patient care.

As discussed in the response to R422, medical evacuation will be arranged by the Yukon Emergency Medical Services (EMS) Dispatch. EMS typically arranges for medical support and/or evacuation via fixed-wing air ambulance. Helicopter services may be utilized if Yukon EMS Dispatch is unable to provide support necessary for medical emergency evacuations. If access by aircraft is not possible due to weather, the on-site ambulance may be driven along the Freegold Road to Carmacks (an estimated three hour drive), with support from the first-aid attendant and/or nurse. Carmacks has a government funded nursing station.

CMC will arrange meetings with local health centres and service providers to develop a collaborative medical emergency response strategy and communication plan for sharing information related to medical protocols and the Emergency Response Plan (ERP). CMC will work closely on an ongoing basis with Whitehorse General Hospital, local fire departments, RCMP and Yukon Ambulance to engage on these efforts.

A.21.5.1.3 R433

R433. Considering the remote nature of the Freegold Road, a description of medical and communication capacity along the Freegold Road and its extension including the need or absence of need for any helipads.

Radio communication will be available along all roads to allow for rapid communication with drivers and reporting of incidents. CMC will create a communications protocol with respect to the road, which will inform road users with timely information as it pertains to road access, conditions, wildlife etc. The Emergency Response Plan (ERP) will be created in collaboration with regional emergency responders, and will include details of emergency response procedures along the Freegold Road extension. All emergency response protocols details in the Proposal and herein will apply to the Freegold Road. The absence or need for helipads will be evaluated when the ERP is written; although, as the Freegold Road will be 8.2 m wide with maximum grades of 8% the road clearance may be sufficiently wide to allow landing a helicopter on the roadway surface (minimum clearance for a helicopter ~12 m). These may also be incorporated into the detailed design requirements for the Freegold Road design.

All project personnel will have access to hand-held or stationary radios. Additionally, the Health and Safety Manager, Medical Responder, and the Emergency Response Team will be equipped with satellite phones.

Given the length of the road and the remoteness of any emergency response capabilities CMC will enter into discussions with Yukon Government Emergency Medical Services department and Community Services department to discuss and agree upon any potential staging grounds for emergency response along the road, where appropriate.

A.21.5.1.4 R434

R434. A description of how a destination medical facility will be chosen and the threshold for medevac.

Casino will have an onsite Medical Responder (MR) at all times. The MR will have established a medical emergency protocol with Yukon Emergency Medical Services (YEMS), in addition to a General Physician (GP) who will be available on a 24 hour basis to provide assistance with patient care in serious medical emergencies. The GP and/or MR will undertake a patient assessment and determine if a medical evacuation is necessary. If so, the MR will contact YEMS and provide the patient’s medical history and assessment. In consultation with the YEMS dispatch, CMC will be responsible for determining the appropriate transportation method for the medical evacuation.

The MR will be responsible for developing a patient care strategy during the time prior to the patient being transported, which will include the following assessment criteria:

- Non-urgent – Non-critical, stable patients that require further medical assessment or treatment but do not require medical attention during transfer will be transported to offsite medical care facilities by a designated employee via fixed wing aircraft.
- Urgent – Non-critical, stable patients that require further medical assessment or treatment but do require medical attention during transfer will be transported to offsite medical care facilities by air ambulance.
- Immediate - Critical, unstable patients will be transported to the appropriate medical care facility by air ambulance. CMC will coordinate the evacuation and ensure that the receiving medical care facility is prepared to accept the patient, with the appropriate medical team.

The primary community in which off-site services will be relied on is Whitehorse. Baseline data on community services reveal capacity constraints in the ability of community health centres to provide services to meet local demand. In Pelly Crossing, the community health centre has no regular, permanent staff and specialist services are available infrequently. No emergency care is available and patients are transported to the Whitehorse General Hospital. While the health centre in Carmacks has a larger facility (two exam rooms that can be used for trauma) and staffed by two nurses, it is understaffed and is relied on to service the Minto Mine for treating injuries. Whitehorse is a feasible option with wide-range of services available at the Whitehorse General Hospital, particularly emergency care.

A.21.6 EMERGENCY SERVICES AND OTHER USERS

A.21.6.1.1 R446

R446. Describe how emergency and non-emergency services in Carmacks were factored into Project plans and design. Consideration should be given to health, law enforcement, conservation, and other government services.

As discussed above, the primary community in which off-site services will be relied on is Whitehorse. Baseline data on community services reveal capacity constraints in the ability of community health centres to provide services to meet existing local demand. In Pelly Crossing, the community health centre has no regular, permanent staff and specialist services are available infrequently. No emergency care is available and patients are transported to the Whitehorse General Hospital. While the health centre in Carmacks has a larger facility (two exam rooms that can be used for trauma) and staffed by two nurses, it is understaffed and is relied on to service the Minto Mine for treating injuries. Whitehorse is a feasible option with wide-range of services available at the Whitehorse General Hospital, particularly emergency care.

A.21.7 ACCIDENTS AND MALFUNCTIONS

A.21.7.1.1 R447

R447. A detailed characterization of potential major mine infrastructure failures and proposed response measures to these events.

As detailed in Section A.4, dam inundation mapping will be conducted to evaluate the proposed design, and determine credible modes of failure, tailings outflow volume, peak discharge, maximum downstream distance for the initial water driven flood wave, maximum downstream distance for tailings slumping, and the width of the zone of influence resulting from the dam break analysis. The risk assessment process enables a quantitative assessment of potential risks and their effects and provides for the development of appropriate mitigation and management plans, as well as emergency response measures.

A.21.7.1.2 R448

R448. An updated discussion regarding the likelihood and consequence of a TMF embankment failure considering the entire lifetime of the facility (i.e. in perpetuity) in light of updated site condition characterization and dam break/inundation analysis as outlined in other sections of the Adequacy Review Report.

As detailed in Section A.4, dam inundation mapping will be conducted to determine credible modes of failure, and the resultant report will discuss the likelihood and consequence of a TMF embankment failure.

A.22 – ENVIRONMENTAL MANAGEMENT PLANS

A.22.1 INTRODUCTION

All quartz mining projects in the Yukon, including the Casino Project, will require the submission of comprehensive environmental management and monitoring plans as part of an application for a *Quartz Mining Act* permit after the completion of the YESAB review and prior to development and operation of the mine. Typically, conceptual-level environmental management and monitoring plans are provided as part of the Project Proposal during the YESAB review and these preliminary plans are refined into comprehensive plans after the YESAB review, for submission for regulatory approvals including a Quartz Mining License and/or Water Use License. Moreover, during construction and operation of the mine, management and monitoring plans are continuously refined based on project particulars. Figure A.22.1-1 represents the development of preliminary plans into comprehensive plans for mining projects in the Yukon.

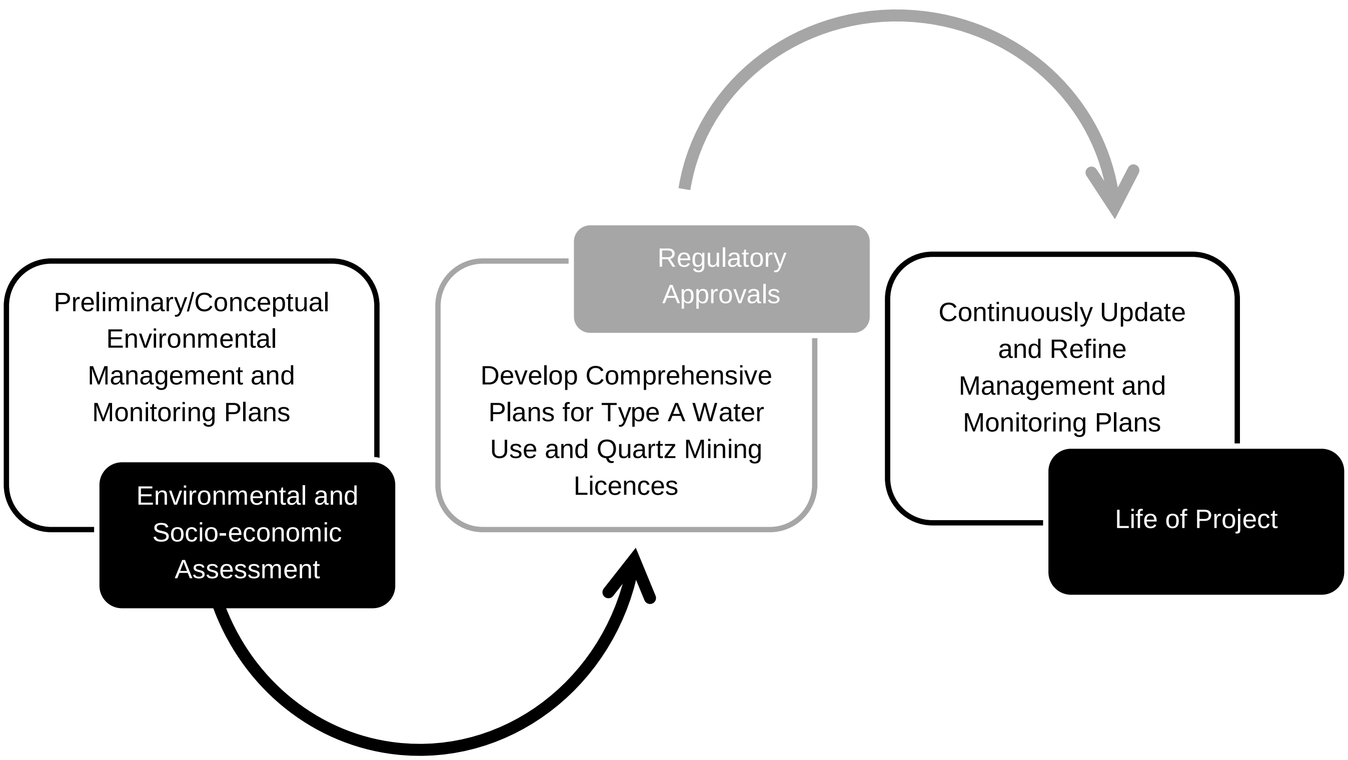


Figure A.22.1-1 Development of Management and Monitoring Plans

YESAB's review of the Project Proposal identified additional information that could be provided during the Adequacy Review phase of the YESAB review. In response, CMC has updated many of the conceptual environmental management and monitoring plans original provided in the Project Proposal, appended to this section. CMC's objective for providing preliminary plans during the YESAB review is to describe in a general manner how the Project's activities will be carried out in an environmentally and socially responsible way throughout all Project phases.

The final management and monitoring plans for the Project will be established in accordance with best management practices (BMPs) and will include commitments identified in the YESAA decision document, Quartz Mining Licence (QML), Type A Water Use Licence (Type A WUL) and other regulatory approvals that will be required for the construction and operation of the Project. Plans required by the QML and Type A WUL as well as other plans to be prepared for the Project, and the timing of final plan development are summarized in Figure A.22.1-2. While conceptual plans have been submitted in the Project Proposal, in deference to the scope of the Project, some environmental management plans have been updated to a preliminary level in response to reviewers comments and concerns. The following preliminary plans are found in the following Appendices to support supplementary information provided throughout this report:

- Appendix A.22A Preliminary Waste and Hazardous Materials Management Plan
- Appendix A.22B Preliminary Spill Contingency Management Plan
- Appendix A.22C Preliminary Sediment and Erosion Control Management Plan
- Appendix A.22D Preliminary Invasive Species Management Plan
- Appendix A.22E Preliminary Road Use Plan
- Appendix A.22F Conceptual Socio-Economic Management Plan
- Appendix A.22G Liquefied Natural Gas Management Plan
- Appendix A.22H ML/ARD Management Plan

On January 27, 2015, the Executive Committee requested that Casino Mining Corporation (CMC) provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). Casino Mining Corporation is providing this Supplementary Information Report (SIR) to comply with the Executive Committee's Adequacy Review Report; CMC anticipates that the information in the SIR and Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has 11 requests related to information presented in Section 22 Environmental Management Plans of the Project Proposal submitted on January 3, 2014. These requests are outlined in Table A.22.1-1. Some responses require detailed technical information, data, and figures. Where necessary, this additional supporting information is provided as appendices to the SIR.

Preliminary Plans

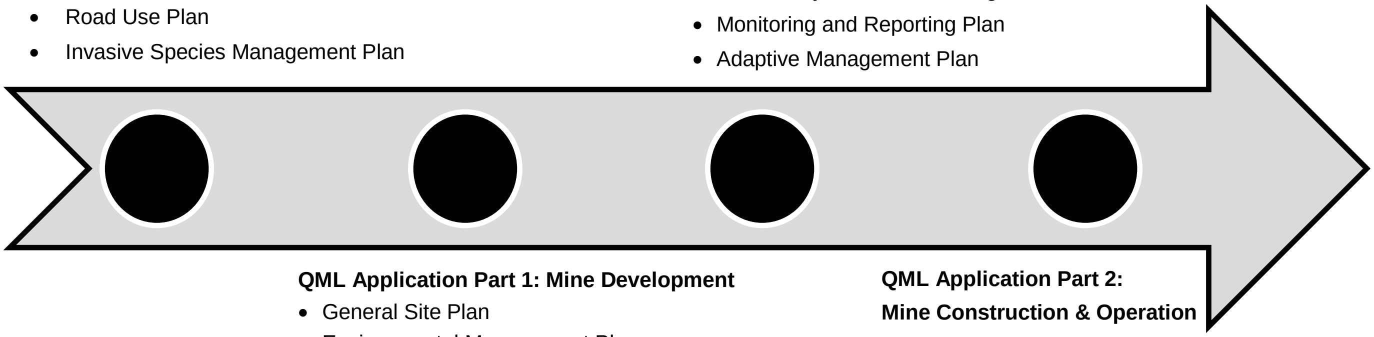
- Waste and Hazardous Materials Management Plan
- Wildlife Protection Plan
- Spill Contingency Plan
- Sediment and Erosion Control Plan
- Emergency Response Plan
- Human Health and Safety Plan
- Heritage Resource Protection Plan
- Environmental Monitoring, Surveillance and Reporting Plan
- Air Quality Management Plan
- Road Use Plan
- Invasive Species Management Plan

QML Application Part 1: Mine Development

- General Site Plan
- Environmental Management Plan
- Sediment and Erosion Control Plan
- Environmental Monitoring Plan
- Emergency Response Plan
- Wildlife Protection Plan
- Heritage Resource Protection Plan
- Worker Health & Safety Plan
- Reclamation and Closure Plan

Type A WUL Application

- Water and Waste Management Plans
- Hazardous Material Management Plan
- Preliminary Decommissioning and Reclamation Plan
- Monitoring and Reporting Plan
- Adaptive Management Plan



QML Application Part 2:
Mine Construction & Operation

Project Specific Mine Plans

- Transportation Infrastructure Plan
- Cyanide Management Plan
- Open Pit Development and Operation Plan
- Mill Construction and Operation Plan
- Tailings and Water Infrastructure Management
- Waste Rock Management Plan

Environmental Protection Plans

- Sediment and Erosion Control Plan
- Environmental Monitoring and Surveillance Plan
- Hazardous Materials Management Plan
- Spill Contingency Plan
- Heritage Resources Protection Plan
- Wildlife Protection Plan
- Waste Management Plan
- Emergency Response Plan
- Invasive Species Management Plan

Figure A.22.1-2 Environmental Management Plan Submission Sequence

Table A.22.1-1 Requests for Supplementary Information Related to Environmental Management Plans

Request #	Request for Supplementary Information	Response
R435	Details of a Human Health Monitoring Plan.	Section A.22.2.1.1
R436	Any description of spill infrastructure along public highways or the Freegold Road upgrade and extension.	Section A.22.3.1.1 Appendix A.22B Spill Contingency Management Plan
R437	A complete list of floatation circuit and heap leach chemicals with their anticipated on-site storage capacities and rates of use.	Section A.22.3.2.1 Appendix A.4M Processing Flow Sheets Appendix A.22B Spill Contingency Management Plan
R438	A detailed Cyanide Transportation Management Plan. Details should be Yukon-focused, and in particular the Freegold Road to the Project site.	Section A.22.3.3.1 Appendix A.22B Spill Contingency Management Plan
R439	Clarification regarding handling, storage, and use of cyanide at the Project site. Details should include: a. description of unloading process and area for solid sodium cyanide (NaCN); b. details on storage of solid NaCN in bulk bags; c. the process for moving: the solid NaCN from the unloading area to the storage area in the adsorption, desorption and recovery building; the solid NaCN from the storage area to the NaCN mix tank; and the NaCN from the mix tank to the liquid NaCN storage tank; d. use of level indicators and high-level alarms for the liquid NaCN mix and storage tanks; e. ventilation requirements for the solid NaCN in the cyanide storage area within the adsorption, desorption and recovery building; and f. ambient air monitoring requirements within the solid NaCN storage area, liquid NaCN mixing area and liquid NaCN storage area to protect workers.	Section A.22.3.3.2 Appendix A.4M Processing Flow Sheets
R440	A detailed management plan for LNG.	Section A.22.3.3.3 Appendix A.22G LNG Management Plan
R441	A detailed management plan for explosives and its constituents.	Section A.22.3.3.4 Appendix A.22A Waste and Hazardous Materials Management Plan
R442	An assessment of risk for the transportation of LNG, cyanide, ammonium nitrate, and other hazardous materials with focus on sensitive areas such as major bridge and culvert crossings.	Section A.22.3.3.5 Appendix A.22C Sediment and Erosion Control Plan Appendix A.22B Spill

Request #	Request for Supplementary Information	Response
		Contingency Management Plan
R443	A more detailed description of what will be included in the Emergency Response Plan for emergencies related to cyanide. Details should include: a. potential cyanide failure scenarios appropriate for the site-specific environmental and operating circumstances; b. specific response actions such as clearing site personnel and advising potentially-affected communities; c. use of cyanide antidotes and first aid measures for cyanide exposure; and d. control of releases at their source and containment, assessment, mitigation and future prevention of releases.	Section A.22.3.3.6
R444	A comprehensive Human Health Risk Assessment for each stage of the Project.	Section A.22.4.1.1
R449	A Mine Infrastructure Failure Response Plan that includes consideration of updated site condition characterization and dam break/inundation analysis as outlined in other sections of the Adequacy Review Report.	Section A.22.5.1.1

Notes:

1. Request # refers to the assigned identification number in the YESAB Adequacy Review Report January 27, 2015 Prepared by Executive Committee Yukon Environmental and Socio-economic Assessment Board.
2. Response refers to the location of CMC's response to the YESAB request for supplementary information.

A.22.2 MEDICAL AND HEALTH

A.22.2.1.1 R435

R435. Details of a Human Health Monitoring Plan.

As discussed in Section 5, worker health and safety is protected by a legally binding government requirement that requires mandatory compliance. Existing regulations and guidelines ensure the protection of worker health and safety and have been developed based on information and knowledge regarding potential effects. By definition, monitoring plans are generally created to monitor the effects of a predicted impact on a receptor (i.e., discharge of mine effluent on the aquatic ecosystem, or mine operation on affected communities), and detail adaptive management should impacts to those receptors be detected. Human Health Monitoring Plans are generally created to monitor the health of sensitive populations to potential source(s) of contamination (e.g., Alberta Health 1999, Health Canada 2014).

As discussed below, in R444, toxicological or physiological risks from a set of activities or environmental release are only plausible to the extent that there is a simultaneous co-occurrence in space and time of three key elements: a stressor or contaminant source, a human or other living 'receptor' organism that is of interest from an effects assessment perspective, and an environmental transport pathway or exposure route that connects the source to the receptor (Figure A.22.2-1).

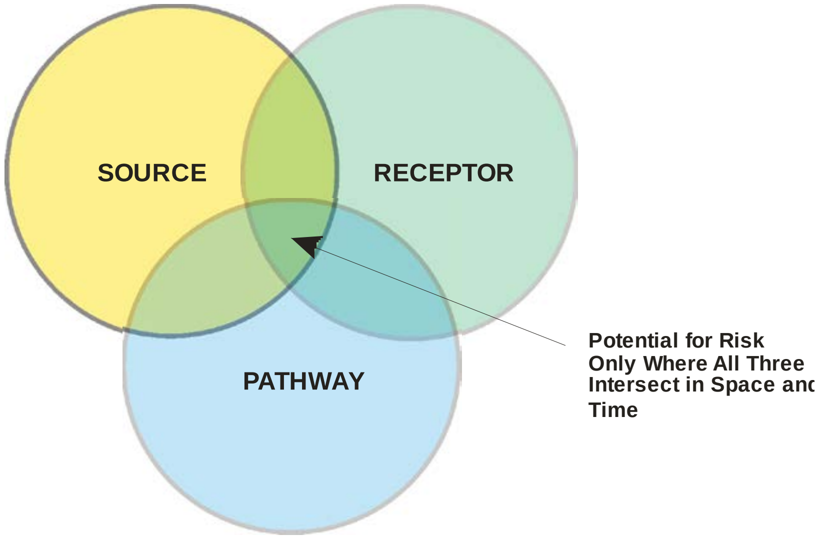


Figure A.22.2-1 Pre-conditions for Environmental Risk Potential

Within the mine site, which would be the area of greatest impact to human health, only workers employed by the Project will be exposed to potential sources of contaminants, as the mine and Freegold Road extension will be privately run, and the public will be excluded. The health of workers is protected under the *Occupational Health and Safety Act* and its supporting regulations. All Project related activities will be conducted in a manner that minimizes risk to worker health and safety through training, awareness, and continuous improvement. Worker health and safety is the primary objective of the detailed Occupational Health and Safety Plan that will be developed by CMC and submitted to the Yukon Government for review and approval as part of the Quartz Mining License application (Yukon Water Board 2013). The detailed Occupational Health and Safety Plan will outline potential worker exposure scenarios and procedures to minimize worker exposure. The Occupational Health and Safety Plan will also outline how worker health and safety will be monitored and what measures will be utilized in exposure situations. In addition to the detailed Occupational Health and Safety Plan, CMC will be required to submit other plans for the Quartz Mining License application that are related to worker health and safety, including:

- A description of all dust control measures that will be employed to ensure worker health and safety and minimize effects on the environment;
- A Spill Contingency Plan to communicate to staff, contractors, and workers the actions to be taken when responding to spills during mine construction, operation and closure; and
- An Emergency Response Plan which will be reviewed for completeness by the Yukon Workers' Compensation Health and Safety Board.

As the Project is located in an isolated area there are no sensitive human receptors predicted to be affected by potential contaminants generated by the Project outside of the Project area (i.e., workers). Air quality and noise were evaluated for effects along the road route and in Carmacks, (Section 8 and 9 of the Proposal), and found to be lower than guidelines at all areas evaluated. As no impacts to human health are predicted, human health monitoring is not required, although, sources with the potential to impact human health (e.g., water, air, noise, wildlife, vegetation) will be monitored to ensure consistency with predictions.

A.22.3 DANGEROUS GOODS, SPILLS AND LEAKS

A.22.3.1.1 R436

R436. Any description of spill infrastructure along public highways or the Freegold Road upgrade and extension.

As described in the Spill Contingency Management Plan (Appendix A.22B), transportation of goods and materials will be in accordance with all applicable regulations and legislation, as well as the Explosives and Hazardous Materials Transport Permit required for the Project. All carriers and suppliers to the Casino Project will be certified under Transport Canada, and, as required, under the *Transportation of Dangerous Goods Act*. It is expected that external carriers and suppliers will have their own emergency response plans and training for their personnel, as they will be transporting supplies in their own vehicles with their own drivers.

Transportation of cyanide (as sodium cyanide) will be conducted in a manner to protect communities and the environment in accordance with the International Cyanide Management Code (International Cyanide Management Institute 2012). Additionally, preventative maintenance along the access route will include regular maintenance and inspections for safe operation of vehicles, snow clearing, and the application of dust suppressants as required.

Shipping documents travel with hazardous materials, and are kept in the cab of the motor vehicle. Shipping documents provide vital information regarding the hazardous materials/dangerous goods to initiate protective actions, as per the Emergency Response Guidebook (Transport Canada 2012). An example of information provided in the Emergency Response Guidebook is provided in Appendix B of the Spill Contingency Management Plan for sodium cyanide and LNG.

Spill response equipment will be stationed along the access road at appropriate intervals. Spill kits typically contain oil sorbents (pads, socks, and granular), shovels, and protective equipment including gloves, goggles and protective suits. Heavy equipment, such as front-end loaders and haul trucks will be available for larger spills near the mine site, and pumps, suction hoses and portable storage tanks or drums will also be located at the mine site to assist with spill recovery and cleanup.

Spills along public highways and roads in Yukon are addressed by federal, territorial and municipal governments through the Yukon Spill Report Line (867-667-7244) (Government of Yukon 2015). Spills involving dangerous goods will also be reported to CANUTEC (613-996-6666).

A.22.3.2 Flotation and Heap Leach Constituents

A.22.3.2.1 R437

R437. A complete list of floatation circuit and heap leach chemicals with their anticipated on-site storage capacities and rates of use.

Proposed reagents for use in the floatation circuit and heap leach circuit were detailed in the Feasibility Study (M3 2013), and summarized in Section 4.4.1 of the Proposal. On-site storage capacities and rates of use for each are outlined in Table A.22.3-1, and flow sheets outlining the distribution systems in the flotation and heap leach systems are show in drawings 000-FS-011, 000-FS-012 and 050-FS-010 provided in Appendix A.4M. MSDS sheets for all reagents listed below are provided in Appendix A of the Spill Contingency Management Plan provided in Appendix A.22B. Spill response for chemical spills is outlined in Section 6.2.6 of the Spill Contingency Management Plan.

Table A.22.3-1 Rates of Use of Reagents for Sulphide Ore and Oxide Ore Circuits

Reagent	Delivered form	On-site Storage	Usage Rate
Sodium-diisobutyl dithiophosphinate (Aerophine 3418A)	Liquid (totes)	Totes and as 10% water solution	1,000 kg/day
Sodium diethyl dithiophosphate (Aerofloat 208)	Liquid (totes)	Totes and as 10% water solution	2,000 kg/day
Methyl Isobutyl Carbinol (MIBC)	Liquid (totes)	Totes and in tank, undiluted	1,200 kg/day
Pebble Lime	Bulk truck	8,000 t lime silo	270 tonnes/day
Fuel Oil (#2 Diesel fuel)	Liquid (trucks)	Liquid in tank, undiluted	880 kg/day
Sodium Hydrosulfide (NaHS)	Dry powder bags or super sacks	Bags or sacks on pallets	6,700 kg/day
Flocculant	Dry powder bags or super sacks	Bags or sacks on pallets	3,200 kg/day
Potassium amyl xanthate (PAX)	Solid (drums)	Drums on pallets and as 10% water solution	4,800 kg/day
Sodium Cyanide (NaCN)	1,000 kg bag boxes	Bag boxes on pallets	12.5 tonnes/day
Caustic (sodium hydroxide, NaOH)	1,000 kg bag boxes	Bag boxes on pallets	325 kg/day
Hydrochloric Acid (HCl)	Drums	Drums on pallets	250 kg/day
Sulphuric acid (H_2SO_4)	Bulk truck	Storage tank	8,200 kg/day
Activated Carbon	Super sacks	Sacks on pallets	12.5 kg/day
Antiscalant	Bulk truck	Storage tanks	75 kg/day

A.22.3.3 Materials Management Plans

A.22.3.3.1 R438

R438. A detailed Cyanide Transportation Management Plan. Details should be Yukon-focused, and in particular the Freegold Road to the Project site.

Pending further design and operational decisions, the Cyanide Management Plan (which includes details on cyanide transportation) has not been updated from the Project Proposal. However, CMC has outlined specific requirements in the Spill Contingency Management Plan (Appendix A.22B), which includes ensuring the protection of communities and the environment during transport of cyanide to the Casino Project, through compliance with the International Cyanide Management Code (International Cyanide Management Institute 2012) standards as follows:

- Responsibility for safety, security, release prevention, training, and emergency response will be established in written agreements with producers, distributors and transporters; and
- Emergency response plans and management measures will be implemented by cyanide transporters.

Casino Mining Corporation will require that contractors retained for delivery of cyanide to the Project will develop and implement a Cyanide Transportation Plan that is consistent with the Cyanide Code, as well as the Casino Cyanide Management Plan and component plans of the Environmental Management Plan.

The following industry best management practices will be described and implemented:

- Vehicles used for transportation of the cyanide and all containers and packaging comply with all applicable prescribed safety standards and display all applicable prescribed safety marks in accordance with the Dangerous Goods Transportation Act.
- Chain of custody documentation (including Material Safety Data Sheets) to track inventory and movement of cyanide.
- Methods to minimize the potential for contact of solid cyanide with water (e.g., covered trucks, sealed containers).
- Use of escort vehicles or convoys for cyanide shipments as necessary (e.g., inclement weather, change in road conditions).
- Regular maintenance of transportation equipment including containers, vehicles, loading and unloading machinery and storage systems.
- Training of all personnel operating cyanide handling and transport equipment.
- Emergency response plans for potential cyanide releases during transportation including:
    - Designate appropriate response personnel and commit necessary resources for emergency response.
    - Emergency response training of appropriate personnel.
    - Descriptions of the specific emergency response duties and personnel responsibilities.
    - A detailed list of all emergency response equipment available during transport or along the transportation route.
    - A detailed list of all emergency response and personal protective equipment during transport including self-contained breathing apparatus and oxygen gas.
    - Initial and periodic refresher training in emergency response procedures including implementation of the Emergency Response Plan and Spill Contingency Plan.
    - Develop procedures for internal and external emergency notification and reporting.
    - Periodically evaluate response procedures and capabilities and revise them as needed.

The final Cyanide Transportation Plan developed by the contractor responsible for transportation of cyanide the mine site will include a risk assessment of the transportation route that will consider water crossings, population centres, road characteristics, weather characteristics, and public infrastructure.

Information provided in the Emergency Response Guidebook for sodium cyanide is provided in Appendix B of the Spill Contingency Management Plan and a spill response procedures should a chemical spill occur is outlined in the plan in Section 6.2.6.

A.22.3.3.2 R439

R439. Clarification regarding handling, storage, and use of cyanide at the Project site. Details should include:

a. description of unloading process and area for solid sodium cyanide (NaCN);
b. details on storage of solid NaCN in bulk bags;
c. the process for moving: the solid NaCN from the unloading area to the storage area in the adsorption, desorption and recovery building; the solid NaCN from the storage area to the NaCN mix tank; and the NaCN from the mix tank to the liquid NaCN storage tank;
d. use of level indicators and high-level alarms for the liquid NaCN mix and storage tanks;
e. ventilation requirements for the solid NaCN in the cyanide storage area within the adsorption, desorption and recovery building; and
f. ambient air monitoring requirements within the solid NaCN storage area, liquid NaCN mixing area and liquid NaCN storage area to protect workers.

As detailed in the Feasibility Study (M3 2013), sodium cyanide solution will be mainly added to the pregnant leach solution just before it enters the carbon adsorption tanks. Lesser amounts of cyanide solution will also be added to the barren solution sump before this solution is applied to the ore pile at the heap leach facility. Sodium cyanide solution will be made up by dissolving sodium cyanide pellets or briquettes in water. Sodium cyanide will be added to the process at the barren solution tank and in the pregnant solution fed to the CIC circuit. Sodium cyanide solution will also be used in the carbon cold strip circuit and alternatively in the carbon elution circuit of the Carbon/SART area.

Sodium cyanide pellets will be delivered in 1,361-kg (3,000-lb) flow bins or 1,000-kg (2,205-lb) bag boxes. The pellets will be dissolved in the cyanide mix tank (850-TK-001) agitated by an agitator (850-AG-001), as shown in flowsheet 050-FS-008 (Appendix A.4M). The cyanide mix tank (850-TK-001) will be a covered, flat bottom tank with an opening for bag boxes or flow-bins to be dumped into the tank. The cyanide transfer pumps (850-PP-005/015) will forward the cyanide solution to the cyanide storage tank (850-TK-003). Cyanide distribution pumps (850-PP-001/002) will pump cyanide solution from tank (850-TK-003) to various destinations.

The details of the handling, storage and use of cyanide at the Project site will be determined during the detailed design phase of the project, and will be incorporated into the Cyanide Management Plan (Figure A.22.1-2).

A.22.3.3.3 R440

R440. A detailed management plan for LNG.

A preliminary LNG Management Plan is provided in Appendix A.22G. A detailed management plan for LNG will be provided in addition to the detailed management plans required for the Project as part of the QML and Type A WUL applications (Figure A.22.1-2).

A.22.3.3.4 R441

R441. A detailed management plan for explosives and its constituents.

Management of dangerous goods and hazardous materials, including explosives, is described in a preliminary level in the Waste and Hazardous Materials Management Plan (Appendix A.22A). Generally, an explosives magazine permit will be required under the *Explosives Act* for the storage of explosives. The use and storage of explosives on mineral claims in the Yukon is regulated by the *Yukon Blasting Regulations* (part of the *Yukon Occupational Health and Safety Regulations*). This includes provisions for the issuance of blasting permits and magazine permits, limitations on the transport of blasting agents, the handling of blasting material and the control of the blasting area. This regulation does not govern the mixing or manufacturing of explosives. If manufacturing or mixing of explosives is required for blasting activities, a Factory Licence must be obtained from Natural Resources Canada.

As described in Section A.21, the explosives facility is an explosives magazine located northeast of the Open Pit. Explosives will be prepared and stored in accordance with the explosives license issued by Natural Resources Canada to a licensed explosives contractor hired by CMC; explosives and blast caps will be stored in separate facilities, away from operational areas. CMC will obtain an Explosives Act magazine license requirements with respect to storage and handling of explosives, and necessary permits including Blasting Permit, Magazine license, Factory license, ANFO Certificate, Purchase and Possession Permit, Explosives and Hazardous Materials Transport Permit.

Explosive storage areas are necessarily located away from camp and other facilities, and a qualified explosives contractor will be retained to provided blasting services and will mix and dispense explosives into the blast holes. Strict safety protocols will be observed during blasting operations.

As detailed in Section 4, CMC will engage in discussions with potential licensed explosives contractors to determine final requirements for the explosives facility. The explosives facility will be located at the north end of the Casino mine site, taking into consideration Natural Resources Canada (NRCan) requirements for siting. All materials will be stored in accordance with the applicable regulations and standards and are managed by an NRCan licensed explosives contractor.

Prior to construction of the explosives facilities, the soils in the footprint of the buildings will be salvaged and stockpiled locally in windrows adjacent to the disturbance sites or in designated soil stockpile areas. The designated areas will be graded and surrounded by a perimeter berm with a minimum height of 1.2 m, and a single gated lockable entry point, as per requirements of the explosive‘s license.

The specifications of the explosives facility will be determined by the explosives contractor to match the anticipated rate of use for the Casino Project. In general, an explosives facility consists of:

- Bulk ammonium nitrate outdoor storage area (silos);
- Bulk fuel area;
- Magazine for storage of detonators, detonating cord, boosters ;
- Emulsion manufacturing facility;
- Wash bay;
- Maintenance facility; and
- Trucks.

The licensed blasting contractor will supply all the surface facilities for the explosives magazines and for storage of blasting supplies.

Under the NRCan Guidelines for Bulk Explosives Facilities Minimum Requirements a Fire Safety Plan must be developed. The Explosive Regulatory Division provides guidelines (NRCan 2014) on what the plan must contain, including:

- Licensee information;

- Measures to be taken to minimize the likelihood of a fire at the site and to control the spread of any fire;
- Emergency procedures for responding to a fire;
- Procedures for determining if a fire should be fought; and
- Measures to be taken to train employees in the measures, procedures, and circumstances described in the plan.

CMC will develop all plans required under the *Explosives Act and Regulations (2013)*.

A.22.3.3.5 R442

R442. An assessment of risk for the transportation of LNG, cyanide, ammonium nitrate, and other hazardous materials with focus on sensitive areas such as major bridge and culvert crossings.

The Proposal details potential interactions between Project components and activities and identified valued components (VCs). Three of the potential interactions were concentrate transport and loading, hazardous materials storage, transport and disposal and LNG transport to site. Each of these three project components were evaluated for effect on each of the 14 valued components, as outlined in Table A.22.3-2. For VCs where there is a predicted effect (i.e., a ‘Y’ in the ‘Potential Interaction’ column), mitigation measures are proposed to eliminate, reduce or control the potential effect. Potential interactions during the transportation of hazardous materials were identified for VCs of water quality, air quality, noise, fish and aquatic resources, rare plants and vegetation health, wildlife and land use and tenure due to impacts from chemical spills, dust and emissions and noise. These impacts will be mitigated through implementation:

1. Traffic Management Plan, which will include details on speed limits and communications protocol to minimize the potential for spills;
2. The Sediment and Erosion Control Plan (Appendix A.22C), which will include details on prevention and control of sedimentation from transportation; and
3. The Spill Contingency Management Plan (Appendix A.22B), which details procedures to mitigate effects from spills of hazardous materials at all areas of the Project, including the road route.

Table A.22.3-2 Potential Interactions between Transportation of Hazardous Materials and Value Components

Proposal Section	Project Components and Activities	Project Phase (C, O, CD, PC)	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
Terrain Features Section 6.5.1 Table 8.5-1	Concentrate Transport and Loading	O	N	No physical disturbance to terrain features outside of clearing footprint, which is addressed in the PDA
	Hazardous Materials Storage, Transport, and Disposal	C,O	N	Disturbance occurred during construction, no additional footprint clearing required
	LNG Transport to site	C,O	N	No physical disturbance to terrain features

Proposal Section	Project Components and Activities	Project Phase (C, O, CD, PC)	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
Water Quality Section 7.4.1 Table 7.4-1	Concentrate Transport and Loading	O	Y	Concentrate or chemical spills
	Hazardous Materials Storage, Transport, and Disposal	C, O	Y	Chemical spill
	LNG Transport to site	C, O	N	An interaction is not anticipated as in the event of a spill, LNG would rapidly vaporize and therefore in its gaseous state would not affect a watercourse
Air Quality Section 8.4.1 Table 8.4-5	Concentrate Transport and Loading	O	Y	Vehicle emissions during transportation and fugitive dust from unpaved roads
	Hazardous Materials Storage, Transport, and Disposal	C, O	Y	Fuel use during transportation
	LNG Transport to site	C, O	Y	Diesel equipment use and fugitive dust on unpaved roads
Noise Section 9.4.1 Table 9.4-2	Concentrate Transport and Loading	O	Y	Vehicle noise
	Hazardous Materials Storage, Transport, and Disposal	C, O	Y	Transportation-related noise such as loading, unloading and traffic
	LNG Transport to site	C, O	Y	Transportation-related noise such as loading, unloading, and traffic
Fish and Aquatic Resources Section 10.4.1 Table 10.4-1	Concentrate Transport and Loading	O	N	≥30 m away from nearest watercourse, or, addressed in Casino Emergency Response Plan (Appendix 22B)
	Hazardous Materials Storage, Transport, and Disposal	C, O	N	≥30 m away from nearest watercourse
	LNG Transport to site	C, O	Y	Dust, emissions and road runoff
Rare Plants and Vegetation Health Section 11.5.1 Table 10.5-1	Concentrate Transport and Loading	O	Y	Generation of dust and emissions
	Hazardous Materials Storage, Transport, and Disposal	C,O	N	No additional clearing outside of footprint that is addressed in the PDA

Proposal Section	Project Components and Activities	Project Phase (C, O, CD, PC)	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
	LNG Transport to site	C,O	Y	Generation of dust and emissions
Wildlife Section 12.3.1 Table 12.3-1	Concentrate Transport and Loading	C, O	Y	Noise, traffic, clearing of Project footprint
	Hazardous materials storage, transport, and disposal	C,O	N	No ecological disturbance outside of the existing footprint.
	LNG transport to site	O	Y	Noise, traffic
Employment and Income, Employability, Economic Development and Business Sector, Community Vitality, Community Infrastructure and Services, Cultural Continuity Sections 13.4.1 – 18.4.1	Concentrate Transport and Loading	O	N	No specific interaction with this socio-economic VC
	Hazardous Materials Storage, Transport, and Disposal	C, O	N	No specific interaction with this socio-economic VC
	LNG Transport to Site	C, O	N	No specific interaction with this socio-economic VC
Land Use and Tenure Section 19.4.1 Table 19.4-1	Concentrate Transport and Loading	O,	Y	Included in Maximum Disturbance Area
	Hazardous Materials Storage, Transport, and Disposal	C, O,	Y	No interaction expected with implementation of mitigation Addressed in Accidents and Malfunctions Section
	LNG Transport to site	C, O,	Y	No interaction expected with implementation of mitigation Addressed in Accidents and Malfunctions Section

Notes:

1. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.

A.22.3.3.6 R443

R443. A more detailed description of what will be included in the Emergency Response Plan for emergencies related to cyanide. Details should include:

- **a. potential cyanide failure scenarios appropriate for the site-specific environmental and operating circumstances;**
- **b. specific response actions such as clearing site personnel and advising potentially-affected communities;**
- **c. use of cyanide antidotes and first aid measures for cyanide exposure; and**
- **d. control of releases at their source and containment, assessment, mitigation and future prevention of releases.**

Pending further design and operational decisions, the Cyanide Management Plan has not been updated from the Project Proposal. The details of the handling, storage and use of cyanide at the Project site will be determined during the detailed design phase of the project, and will be incorporated into the Cyanide Management Plan, required as a component of the Quartz Mining Licence (Figure A.22.1-2). As detailed in the Cyanide Management Plan (Appendix 22C), prior to the start of operation, a comprehensive Cyanide Management Plan for the Casino Project will be developed to ensure worker safety and to prevent release of cyanide to the environment and will be developed in consideration of the principles and standards of practice of the International Cyanide Management Code (International Cyanide Management Institute 2012).

A.22.4 HUMAN HEALTH RISK ASSESSMENT

A.22.4.1.1 R444

R444. A comprehensive Human Health Risk Assessment for each stage of the Project.

Human Health Risk Assessment (HHRA) is an analytical/interpretative tool that formalizes interpretations about risks to the health of humans from measured or predicted exposures associated with changes in environmental quality (for example, based on changes in the acoustic environment, air quality, soil quality, or water and sediment quality). The Proposal includes an implicit and quantitative screening evaluation of human health risks in the effects assessment for air quality (Section 8 of the Proposal) and noise (Section 9 of the Proposal).

Toxicological or physiological risks from a set of activities or environmental release are only plausible to the extent that there is a simultaneous co-occurrence in space and time of three key elements: a stressor or contaminant source, a human or other living ‘receptor’ organism that is of interest from an effects assessment perspective, and an environmental transport pathway or exposure route that connects the source to the receptor. Figure A.22.2-1 serves as an initial basis for either discounting various contaminant and stressor related effects hypotheses for Valued Components (VCs) or alternatively nominating them for further (typically more quantitative) scrutiny.

This aspect of HHRA was incorporated into the evaluation of project interactions and potential effects (Section 5.3.1 of the Proposal). While the terminology used in classical HHRA and environmental impact assessments are different, decisions about whether there is a potential interaction from a project component serves the same purpose as qualitative screening-level risk assessment, as discussed above. The scope of such screening for HHRA will almost invariably be more narrow than for environmental impact assessment, for which the interest in also on potential for ecological effects, socio-economic effects, and the broader determinants of human health. Below follows a discussion of the human health risk assessment as it fits within the Project, and the assessment outlined in the Proposal.

Once the plausibility of contaminant or stressor risk potential to humans is established, the next step in a formalized HHRA approach is to examine the probability of adverse effect potential, or significance of adverse effects for various exposure and effects hypotheses. This is achieved by the simple comparison of the quantitative estimate of the magnitude of human exposure with the best estimate from the state of scientific knowledge about the threshold of exposure beyond which various negative health effects might occur (threshold of effects, toxicity reference value, *etc.*).

The comparison of predicted exposure levels to relevant threshold of effects levels (ideally as adopted by authoritative health agencies and regulators based on extensive peer review) constitutes a quantitative "risk characterization". Based on standardized HHRA practice, the risk characterization must also explicitly consider the degree of confidence in the estimated magnitude of exposure and threshold of effects values used, as well as in the underlying conceptual models for the Project – health VC interaction (i.e. the HHRA should include a formalized uncertainty analysis, and the conclusions from the HHRA should explicitly account for important stochastic and other uncertainties in the assessment). Nonetheless, the risk quotients and incremental life time cancer risk (ILCR) estimates that are produced in a quantitative HHRA are a credible basis for assessing significance of health effects for those determinants of health that are amenable to description using valid quantitative exposure – health response models.

HHRA for Airborne Contaminants

The assessment of human health risks for airborne contaminants associated with Casino Project was carried out by comparing the concentrations of criteria air contaminants (CACs) predicted from the project related emissions (particularly NO_2, SO_2, CO, $PM_{2.5}$, PM_{10}, dustfall) with Yukon Ambient Air Quality Standards or other relevant ambient air quality objectives (Table 8.4-1). Since such standards and objectives are *de facto* risk-based thresholds derived from the best available epidemiological and toxicological knowledge, and subjected to prior regulatory and scientific peer review, the comparison of predicted airborne exposures concentrations with ambient air quality standards and objectives comprises three of the major components of standardized HHRA approaches; i.e., exposure characterization, effects (or toxicity) characterization, and risk characterization. The CACs included in the health effects assessment, with the exception of dustfall, plausibly affect human health only through the pulmonary (inhalation) exposure route. This is the exposure scenario considered in the derivation of ambient air quality standards and objectives. For the CACs, other exposure scenarios such as wet and dry deposition to soils or plant surfaces, followed by direct (dermal, incidental soil ingestion) or dietary exposures are not plausible, and concerns about health risks via these other pathways can be discounted based on a qualitative screening level approach.

HHRA for Project Noise

The assessment of human health risks from noise exposures associated with the Casino Project was carried out by comparing the predicted project-related a-weighted noise levels (expressed as L_{EQ}, including L_{DAY}, L_{NIGHT}, but not L_{DN}) to the British Columbia Oil and Gas Commission (BC OGC) *Noise Control Best Practices Guideline* (BC OGC 2009).

The Proposal assumed an ambient sound level ≤ 35 dBA L_{EQ} during the night time and ≤ 45 dBA L_{EQ} during the day time (BC OGC 2009) in wilderness areas around the proposed minesite and along the transportation route, which is a reasonable estimate and assumptions to the contrary would not appreciably affect any determinations about the significance of adverse effects from noise.

The noise-related project effects were assessed from a significance perspective using the BC OGC permissible sound levels (PSLs), which state that "*new facilities should meet a PSL of 40 dBA L_{EQ} (nighttime) at the nearest dwelling, or at 1.5 km from the facility fence line, whichever is the lesser distance*" (BC OGC 2009). For sensitive receptor locations (e.g residences) within a distance from a noise-generating project component that is less than 1.5 km, and for chronic noise exposure (operations phase as opposed to construction phase), the night time PSL is 40 dBA L_{EQ} in relatively unpopulated areas, and 50 dBA L_{EQ} during the day time (Proposal Section 9.3).

The assessment of health risks from noise can also be completed based on preferred approaches by Health Canada, the World Health Organization, and other international health agencies. Health Canada, in 2010, circulated a "Useful Information" document (Health Canada 2010) that provided a brief summary of noise-induced health effects along with recommended definitions of acceptable effects. In April of 2011, Health Canada released draft "Guidance for Evaluating for Evaluating Human Health Impacts in Environmental Assessments: Noise" (Health Canada 2011), which further advanced the recommended approach. This draft guidance has since been temporarily withdrawn by Health Canada pending official publication. Nonetheless, World Health Organization and United States regulatory guidance describe very similar methodologies and thresholds of effects levels beyond which the health effects may be significant.

The available scientific information on the human health effects of noise is focussed around a large number of epidemiological studies of especially transportation-related noise (aircraft, road, rail). Several clinical trials have been completed of noise effects on sleep disturbance and sleep patterns. Overall, there is compelling epidemiological evidence that human noise exposures increase self-reported feeling of stress and annoyance. Based on the meta-analysis of a large number of epidemiological studies, a quantitative relationship has been developed between the magnitude of noise exposure, as day-night noise levels (L_{DN}) and percentage of an exposed sub-population that is highly annoyed (percent highly annoyed: %HA). This quantitative relationship, and %HA, forms the primary basis for the major portion of contemporary noise health risk assessments. Important secondary assessment endpoints include sleep disturbance based especially on the frequency of occurrence and or intensity of shorter duration, higher noise events, speech interference and learning deficits arising from the effects of noise on learner attention in early childhood learning settings. Based on the current state of research internationally, these are the direct health effects endpoints for which there is compelling evidence. Both stress (captured as %HA) and sleep disturbance can result in hypertension and subsequently the possibility of cardiovascular disease; however, the epidemiological studies have been more equivocal in the evidence for a relationship between noise exposure and either hypertension or cardiovascular diseases.

The primary criteria for assessing human health effects of noise based on the current state of HHRA practice include the following:

- A change in %HA for the with-project case in comparison to the without-project case should not exceed 6.5%. Impulsive and tonal characteristics of source noise are accounted for with adjustments in the %HA calculations since their presence can increase the potential annoyance of sound;
- Sleep disturbance potential is evaluated against a threshold nighttime sound level (L_N) of 30 dBA (indoor) or 45 dBA (outdoor);
- In schools, preschools, and similar early learning centres, effects are considered to be significant for project-related noise during the day time associated with a sound level (L_D) greater the 35 dBA (indoor) or 50 dBA (outdoor) during class time.
- If any of these thresholds are predicted to be exceeded, the effects are considered to be significant and require mitigation. In the context of these criteria for significance of adverse health effects, note that the BC OGC (2009) guidelines would generally provide the same degree of health protection as these alternative indicators – which were applied in the Proposal.

Therefore, as the risk assessment outlined in the Proposal demonstrates that the air quality and noise effects generated by the Project will not exceed acceptable guidelines, CMC maintains that the risk to air quality and noise to human health provided in the Proposal is sufficient to demonstrate that no impacts to human health would result from the Project activities, and no further risk assessment is warranted.

A.22.5 ACCIDENTS AND MALFUNCTIONS

A.22.5.1.1 R449

R449. A Mine Infrastructure Failure Response Plan that includes consideration of updated site condition characterization and dam break/inundation analysis as outlined in other sections of the Adequacy Review Report.

As discussed in Section A.4, dam inundation mapping is conducted to support detailed emergency response planning. Casino Mining Corporation will conduct an inundation study during the YESAB process in order to evaluate the proposed design, and corresponding credible modes of failure, tailings outflow volume, peak discharge, maximum downstream distance for the initial water driven food wave, maximum downstream distance for tailings slumping, and the width of the zone of influence resulting from the dam break analysis. The risk assessment process enables a quantitative assessment of potential risks and their effects and provides for the development of appropriate mitigation and management plans. However, a detailed Emergency Response Plan will not be provided until the detailed design of the tailings management facility is completed, which is typical of Environmental Impact Assessments (Seabridge 2013; Avanti Mining Inc 2011).

The risk of a tailings impoundment failure is very low, provided that the design is carried out by qualified professionals and all details of construction and maintenance are followed. Details of monitoring and inspections required to maintain the integrity of the Tailings Management Facility (TMF) will be detailed in the details construction design, and may include inspections following extreme precipitation or runoff events, high level alarms on the seepage recovery pond, and containment of any spills and the water returned to the TMF.

A.23 – ENVIRONMENTAL MONITORING PLANS

A.23.1 INTRODUCTION

Environmental protection through adherence to applicable legislation and Best Management Practices (BMPs) is considered an important component of constructing, operating and reclaiming the Casino mine and access road. Proper planning and implementation contributes to ongoing environmental site protection and greatly reduces the potential for adverse environmental effects. Mitigation measures such as delineation of environmentally and culturally sensitive areas, establishment of communications and reporting protocols, and implementation of environmental compliance monitoring and reporting programs will be integral to the program.

Casino Mining Corporation is committed to conducting its operations and activities in a manner that protects the natural and social environments, protects the environmental health and welfare of its employees and contractors, meets or exceeds requirements of all applicable environmental acts, regulations and permitting requirements, and keeps employees and the public informed about its environmental plans through its internal and external communication programs.

To achieve these objectives, an Environmental Monitoring, Surveillance and Reporting Plan (EMSRP) will be developed in accordance with the Plan Requirement Guidance for Quartz Mining Projects (Yukon Government 2013) to monitor the predicted residual effects of the Project and the effectiveness of implemented mitigation measures. The Plan will identify any variances from predictions that occur and whether such variances require action, including any additional mitigation measures. A conceptual EMSRP was submitted in Section 23 of the Proposal.

On January 27, 2015, the Executive Committee requested that Casino Mining Corporation (CMC) provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). The Executive Committee had no requests related to information presented in Section 23 Conceptual Environmental Monitoring Plan of the Project Proposal submitted on January 3, 2014. As such, CMC considers that the documentation provided in the Proposal to be sufficient to deem the Proposal adequate for this Valued Component.

A.24 – CONCLUSION

Supplementary information has been provided to support the Executive Committee's determination of adequacy for the Casino Project (YESAB Project No. 2014-0002) and to enable the commencement of the screening phase of the Executive Committee review pursuant to the *Yukon Environmental Socio-economic Assessment Act* (YESAA) 2003. Casino Mining Corporation (CMC) anticipates that the information in this Supplementary Information Report (SIR) and in the Proposal submitted on January 3, 2014, when considered together, is adequate to commence Screening.

All 449 requests outlined in the Adequacy Review Report (ARR) prepared by the Executive Committee of the Yukon Environmental and Socio-economic Assessment Board (YESAB) have been responded to in the SIR. Several new commitments have been made by CMC in addition to the commitments previously provided in Table 24.1-2 of the Proposal; an updated table of commitments is presented as Table A.24-1.

Commitments previously made in the Proposal that have been replaced by new commitments made in the SIR are indicated by a strike-through. New commitments are listed at the end of the table of commitments. Where supplementary information has been provided that complements information previously provided in the Proposal, it has been added to the table of commitments and is indicated by the prefix 'A', and also is **bold** in Table A.24-1.

Table A.24-1 Updated Table of Commitments

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
Consultation			
1	CMC will develop management and monitoring plans, as described in Sections 22 and 23.	• Access management to reduce negative effects on caribou populations. • Access road route needs to consider known heritage resources. • Clarification of buffer distance requirements for heritage sites. • Effects on ability to practice traditional activities.	2
2	CMC intends to continue to discuss collection and consideration of traditional knowledge.	• Baseline information collection needs to be complemented by significant traditional knowledge of the area. • Establishment of a TK policy/protocol to ensure protection for Selkirk First Nation Elders' knowledge.	2
3	CMC intends to continue to engage with First Nations to discuss topics of interest.	• Benefits agreements should consider social and health impacts. • Concern about heap leach cover and stabilization with revegetation. • Concern about the cyanide treatment process and the duration of this part of the closure process. • Concerned about encumbering rights that allow mining companies to proceed with activities that may damage heritage sites without doing impact assessment studies. • Consultation with Selkirk First Nation regarding access points for the project.	2

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
		• Effects on increased access on subsistence hunting, fishing and harvesting. • Engagement of the whole Selkirk First Nation community in the preparation of the environmental assessment, including the socioeconomic effects assessment. • Have you yet performed a Failure Modes Effects Analysis (FMEA)?	
4	CMC will monitor project socio-economic effects and adapt management measures where required.	• Development and use of spur roads off of the primary Casino project access road.	2
5	CMC intends to continue discussions with First Nations regarding agreements and funding to participate in the review of the Project Proposal.	• First Nations need capacity to participate in the assessment process.	2
6	CMC will work with First Nations to arrange for access as appropriate consistent with the access road management plan as approved by First Nations and Yukon Government.	• Increased traffic and spur roads.	2
Environmental Management Plans			
7	Erosion and Sediment Control Management Plan • CMC will develop a final plan prior to construction and operations. • The Plan will describe the measures to be undertaken to manage erosion and sedimentation during all phases.	• As described in Section 7.4.	22.3 **Appendix A.22C Spill Contingency Management Plan**
8	Air Quality Management Plan • CMC will develop a final plan prior to construction and operations. • The final plan will include a table of commitments with mitigation measures developed through the environmental assessment process, and terms and conditions of any applicable licences, permits	• As described in Section 8.4.	22.3

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	and approvals required for Project operation.		
9	Waste Management Plan • CMC will develop a final plan prior to construction and operations. • The Waste Management Plan will describe the type of waste generated and related management strategies to responsibly handle, store, transport, and dispose of waste.	N/A	22.3 **Appendix A.22A Waste and Hazardous Materials Management Plan**
10	Wildlife Management Plan • CMC will develop a final plan prior to construction and operations. • The final plan will include a table of commitments with mitigation measures developed through the environmental assessment process, and terms and conditions of any applicable licences, permits and approvals required for Project operation.	• As described in Section 12.4	22.3.2 ~~Appendix 23A~~ **Appendix A.12A Wildlife Mitigation and Monitoring Plan**
11	Heritage Resource Protection Plan • CMC will develop a final plan prior to construction and operations. • Key components of the Heritage Resources Protection Plan will include: • Heritage resource protection policy; • Heritage resource overview; • Summary of the heritage resource impact assessment conducted as part of this Proposal; • Methods for identification, reporting, and protection of heritage resources; • Reporting requirements and contact list; and • Employee training.	• As described in Section 18.4	22.3
12	Spills Contingency Management Plan	N/A	22.3

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	• CMC will develop a final plan prior to construction and operations; • The following components will be included in the Spills Contingency Management Plan: o Spill categories o Spill prevention procedures o Spill response plan o Roles and responsibilities o Training o Internal and external reporting o Monitoring		~~Appendix 22B~~ **Appendix A.22B Spill Contingency Management Plan**
13	Occupational Health and Safety Management Plan • CMC will develop a final plan prior to construction and operations. • The Occupational Health and Safety Management Plan will be developed in accordance with all applicable Acts and Regulations, as well as terms and conditions of all required licences, authorizations, and approvals. • The final plan will include a table of commitments pertaining to health and safety arising from the environmental assessment review, and indicate how the commitments are addressed within the plan.	N/A	22.3
14	Emergency Response Plan • CMC will develop a final plan prior to construction and operations.	N/A	22.3 **Appendix 22A Emergency Response Plan**
15	Hazardous Materials Management Plan • CMC will develop a final plan prior to construction and operations. • The final plan will include a table of commitments	N/A	22.3 ~~Appendix 22B~~ Appendix A.22A Waste and Hazardous

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	with mitigation measures developed through the environmental assessment process, and terms and conditions of any applicable licences, permits and approvals required for Project operation. • A separate Cyanide Management Plan will be developed and implemented in recognition of the higher level of public concern associated with this substance.		Materials Management Plan
16	Road Use Plan • CMC will develop a final plan prior to construction and operations. • The final plan will include a table of commitments with mitigation measures developed through the environmental assessment process, and terms and conditions of any applicable licences, permits and approvals required for Project operation. • It is the intent of CMC to negotiate a Freegold Road Extension Access Management Agreement with the Government of Yukon, SFN and LSCFN to address how the private road and access control could be managed to meet the Project requirements with consideration of existing tenure holders and individuals.	N/A	22.3 ~~Appendix 22A~~ **Appendix A.22E Road Use Plan**
Monitoring Programs			
17	An Environmental Monitoring Plan will be developed in accordance with the Plan Requirement Guidance for Quartz Mining Projects (Yukon Energy, Mines and Resources 2013) to monitor the predicted residual effects of the Project and the effectiveness of implemented mitigation measures. The Plan will identify any variances from predictions that occur and whether such variances require action, including any additional		23

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	mitigation measures. The Plan will be comprised of the following components: • Water Monitoring Program • Air Quality and Fugitive Dust Monitoring • Geochemical Monitoring Program • Meteorological Monitoring Program • Aquatic Monitoring Program • Permafrost Monitoring Program • Wildlife Monitoring Program • Reclamation Monitoring Program.		
Surface, Geology Terrains and Soils			
18	Where possible, CMC will realign or relocate footprint features to avoid removing/destroying thaw lakes, tors, and pingos.	• Loss, damage to terrain features	6
Water Quality			
19	All construction activities will adhere to CMC's Erosion and Sediment Control Plan, Air Quality Management Plan and Water Management Plan and Transport Canada Aerodrome Standards and Recommended Practices.	• Effects on water quality (general)	7.4 **Appendix A.22C Sediment and Erosion Control Management Plan**
20	CMC will incorporate Best Management Practices (BMPs) such as: • Minimizing disturbances in and near watercourses (e.g., clearing, grubbing, grading) • Monitoring of TSS and turbidity during construction to ensure compliance with applicable guidelines and permit conditions • Stabilizing and re-vegetating disturbed areas following construction	• Effects on water quality (general)	7.4

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	• Designing appropriate sediment settling ponds that conform to applicable guidelines • Designing appropriate diversion ditching system upstream of ore stockpiles • Sediment control fencing installed around down-gradient perimeter sections of the ore stockpiles • Dust suppressants and enforced traffic speed limits along all access roads.		
21	An environmental monitoring plan will be designed and implemented to monitor water quality, fish habitat, and biological communities in the Water Quality LSA.	• Effects on water quality (general)	7.4
22	CMC will include design criteria for the various sediment control elements that will be based on industry standard guidance documents (BC MELP, 2001; MEMNG, 1998). Sediment mobilization and erosion will be managed throughout the site by installing sediment controls prior to construction activities, limiting the disturbance as much as possible and reducing water velocity across the ground.	• Effects on water quality (general)	7.4 **Appendix A.22C Sediment and Erosion Control Management Plan**
23	During operations, CMC will: establish diversion ditches and implement progressive rehabilitation of disturbed land to minimize erosion; construct drainage controls and sediment control devices; and restrict access to rehabilitated areas.	• Effects on water quality (general)	7.4 **Appendix A.22C Sediment and Erosion Control Management Plan**
24	A coffer dam will be constructed within the TMF starter footprint to capture all runoff from the upstream areas and route it to the sediment pond downstream.	• Water quality	7.4
25	Typical BMPs that will be used at the project are runoff collection ditches, energy dissipaters, sediment traps, slope drains, surface roughening, filter bags, water bars, diversion structures, silt fences, sediment basins,	• Effects on water quality (general)	7.4 **Appendix A.22C Sediment and Erosion Control Management Plan**

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	temporary seeding, and mulching.		
26	Temporary sediment settling ponds will be constructed downstream of all construction activities to treat sediment laden water and discharge to existing channels via energy dissipating structures.	• Effects on water quality (general)	7.4
~~27~~ Replaced by Commitment 143	~~A water management pond will be constructed that will collect surface runoff and seepage from the TMF embankments during operations and pump the water back to the TMF.~~	~~• Change in surface water quality in Casino Creek and Dip Creek due to unrecovered seepage~~	~~7.4~~
~~28~~ Replaced by Commitment 143	~~A winter seepage pond will be constructed at closure to hold back water during the winter months (December to April).~~	~~• Change in surface water quality in Casino Creek and Dip Creek due to project discharge~~	~~7.4~~
29	The Reclamation Plan will include construction of two engineered wetlands: North TMF wetland and South TMF wetland.	• Change in surface water quality in Casino Creek and Dip Creek due to project discharge	Table 7.4-5
30	CMC will divert all contact water to the TMF and implement BMPs for drilling, handling and loading ore; traffic speed limits, dust suppressants.	• Changes in surface water quality due to atmospheric deposition	Table 7.4-5
31	CMC will implement water management measures and BMPs for sediment mobilization and erosion as outlined in the Erosion and Sediment Control Plan; and modify culvert and bridge design for areas with increased sensitivity to disturbances.	• Change in surface water quality from increased erosion and sedimentation	Table 7.4-5 **Appendix A.22C Sediment and Erosion Control Management Plan**
32	Control contaminated discharge from the historic adit in upper Casino Creek.	• Reduced water quality in Casino Creek due to adit discharge and TMF discharge	7.5 Table 7.5.4
Air Quality			
33	Adhere to Occupational Health and Safety Act.	• Exceedance of Yukon Ambient Air Quality Standards for SO_2, NO_2, CO	8.4. Table 8.4-7
34	Use ultra-low sulphur content fuel.	• Exceedance of Yukon Ambient Air Quality Standards for SO_2, NO_2, CO	8.4 Table 8.4-7

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
35	Use construction and mining equipment that meets the latest applicable Canadian emissions standards at the time of purchase.	• Exceedance of Yukon Ambient Air Quality Standards for SO_2, NO_2.	8.4 Table 8.4-7
36	Ensure regular equipment maintenance recommended by manufacturers.	• Exceedance of Yukon Ambient Air Quality Standards for SO_2, NO_2, CO.	8.4 Table 8.4-7
37	Institute a policy for all equipment and vehicles to reduce and limit idling.	• Exceedance of Yukon Ambient Air Quality Standards for SO_2, NO_2, CO.	8.4 Table 8.4-7
38	Cover or use water sprays at dust generating areas.	• Exceedance of Yukon Ambient Air Quality Standards for TSP, PM_{10}, $PM_{2.5}$.	8.4 Table 8.4-7
39	Reduce drop heights for process plants.	• Exceedance of Yukon Ambient Air Quality Standards for TSP, PM_{10}, $PM_{2.5}$.	8.4 Table 8.4-7
40	Cover or use water sprays at dust generating areas.	• Exceedance of BC Air Quality Objectives for dustfall.	8.4 Table 8.4-7
41	Minimize wind exposure at conveyors, drop-off points and truck load/unload locations.	• Exceedance of BC Air Quality Objectives for dustfall.	8.4 Table 8.4-7
42	Establish blasting procedures for open pit activities to minimize dust.	• Exceedance of BC Air Quality Objectives for dustfall.	8.4 Table 8.4-7
43	Reduce drop heights for process plants.	• Exceedance of BC Air Quality Objectives for dustfall.	8.4 Table 8.4-7
44	Use construction and mining equipment that meets the latest applicable Canadian emissions standards at the time of purchase. Ensure regular equipment maintenance.	• Contribute to global greenhouse gasses.	8.4 Table 8.4-7
Noise			
45	Ensure regular equipment maintenance, including lubrication and replacement of parts.	• Increase in baseline noise level conditions.	9.4 Table 9.4-4
46	Keep noisy equipment inside of buildings and sheds whenever possible.	• Increase in baseline noise level conditions.	9.4 Table 9.4-4
47	Equipment will be operated with covers, shields, and	• Increase in baseline noise level conditions.	9.4

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	hoods if provided by their manufacturer.		Table 9.4-4
48	Adhere to a blasting plan developed by an explosives contractor that implements controlled blasting procedures.	• Increase in baseline noise level conditions.	9.4 Table 9.4-4
49	Optimisation of blasting operations by licensed staff which maximise localised rock breakage within the ore body of interest, while minimising non-productive noise, vibration.	• Increase in baseline noise level conditions.	9.4 Table 9.4-4
50	Impose speed limits for all vehicles.	• Increase in baseline noise level conditions.	9.4 Table 9.4-4
51	Institute a policy for all equipment and vehicles to reduce and limit idling.	• Increase in baseline noise level conditions.	9.4 Table 9.4-4
52	Wherever practicable, noisy equipment will be located near ground level to minimize noise propagation.	• Increase in baseline noise level conditions.	9.4 Table 9.4-4
Fish and Aquatic Resources			
53	All construction activities will adhere to CMC's Erosion and Sediment Control Plan, Environmental Management Plan and Water Management Plan.	• Lethal and non-lethal effects to fish and aquatic organisms.	10.4 Table 10.4-10 Table 10.4-11 Table 10.4-12 **Appendix A.22C Spill Contingency Management Plan**
54	CMC will incorporate BMPs into all work, including: • Minimizing disturbances in and near watercourses (e.g., clearing, grubbing, grading) • The use of cofferdams or stream diversions to de-water construction areas • Diverting clean water around stream and river crossings during construction to maintain sufficient flows downstream	• Lethal and non-lethal effects to fish and aquatic organisms .	10.4 Table 10.4-11 Table 10.4-12

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	• Monitoring of TSS and turbidity during construction to ensure compliance with regulatory requirements • Stabilizing and re-vegetating disturbed areas following construction • Dust suppressants and enforced traffic speed limits along all access roads to reduce any potential contamination of nearby watercourses • Best Management Practices for dust and other air contaminants as outlined in the Air Quality Management Plan • Completing fish salvages prior to any in-stream activities in fish-bearing watercourses • Following DFO guidelines for: o Timing windows for the protection of fish and fish habitat during critical life history stages o Freshwater Intake End-of-Pipe Fish Screen (DFO 1995), to avoid fish impingement and entrainment while pumping water during construction o The Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky 1998)		
55	An environmental monitoring plan will be designed and implemented to monitor water quality, fish habitat, and aquatic biological communities in the LSA. Additional mitigation or compensation measures will be incorporated on an as-needed basis. A site-specific risk assessment is proposed to determine local toxicity thresholds for selenium: fish eggs will be collected and analyzed where possible to develop local guidelines.	• Lethal and non-lethal effects to fish and aquatic organisms .	10.4

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
56	• Bridges will be installed on all fish-bearing creeks where reasonably possible. • Single-lane clear-span bridges designed for a minimal footprint within the stream channel will be used at all crossings with the exception of the Nordenskiold River Bridge, which will be two-span with a pier located in the river channel. • Clear-span bridge installation on fish-bearing watercourses will avoid any stream bed alteration, and rip rap will be installed below bridges to minimize the risk of slope failure. • Rip rap will be placed flush with the stream bank to avoid changes in channel volume or flows. • Any required temporary crossing structures will comply with measures outlined in DFO operational statements. • Bridge construction will occur in the winter, where technically and economically feasible and reasonably practical. • All major culvert construction will be completed during the summer months. • Any temporary ice bridges will be removed prior to full spring break-up to prevent unnatural ice jamming and flooding. • Final crossing structure sites, orientations and spans will be designed for sensitive sites to mitigate any potential impacts on aquatic habitat.	• Lethal effects on fish and aquatic organisms.	10.4 Table 10.4-10 Table 10.4-11 Table 10.4-12
57	TMF spillway overflow to Casino Creek will follow a discharge schedule that will distribute flow increases across the summer months to limit downstream impact.	• Fish habitat – increased flows	10.4 Table 10.4-10
58	Site-specific surveys will be conducted during detailed	• Fish habitat – increased flows	10.4

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	design to determine whether any minor channel modifications are needed in Casino Creek to mitigate increased flow from the TMF spillway.		Table 10.4-10
59	Erosion and suspended sediment will be monitored within the Project area watercourses to ensure control measures have been effectively implemented as outlined in the Erosion and Sediment Control Plan.	• Increased erosion and sedimentation causing habitat loss and alteration and potential changes to habitat productive capacity.	10.4 **Appendix A.22C Sediment and Erosion Control Management Plan**
60	A water quality monitoring plan will be designed and implemented to ensure that water quality threshold objectives are met downstream of the TMF. Mitigation as built into design of the TMF, including the construction of wetlands both upstream and downstream of the TMF pond, a winter seepage mitigation pond (WSMP), strategic placement of waste rock in TMF, and protection of the dam shell with rip rap.	• Changes to Water quality - Lethal effects on fish and aquatic organisms	10.4 Table 10.4-11 Table 10.4-12
61	Monitoring of biological communities in the Fish and Aquatic Resources LSA to identify any changes relative to baseline conditions. Mitigation may include habitat remediation or additional compensation.	• Lethal effects on fish and aquatic organisms due to stranding or winter kill following reduced flows	Table 10.4-11 Table 10.4-12
62	CMC will provide a ~~Fish Habitat Compensation Plan~~ **Fish Habitat Offsetting Plan** for serious harm to Arctic grayling habitat. CMC will ensure post construction monitoring of compensation works to assess the effectiveness of the compensation measures.	• Fish-bearing in-stream and riparian habitat loss ; Reduced stream flows, winter kills, fish stranding	10.4 Table 10.4-10 **Appendix A.10A Updated Fish Habitat Offsetting Plan**
63	CMC will work to minimize effects of instream works in fish and aquatic habitats: • Isolate all instream works where there is potential to affect downstream habitats	• Lethal effects to fish and aquatic organisms • Sub-lethal effects on fish and aquatic	Table 10.4-11 Table 10.4-12

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	• Limit duration and time activities to avoid high risk fisheries windows, weather or flow conditions • Structures and materials will be placed in a manner that does not impede fish passage or migration • Manage flow diversions and water abstraction to ensure adequate flows for fish • Conduct fish salvages before instream work is undertaken in areas where fish stranding could occur.	organisms due to change in habitat productive capacity	
64	CMC will adhere to Fisheries and Oceans Canada (DFO) Freshwater Intake End-of-Pipe Fish Screen Guideline when using pumps or intake structures in fish bearing waters.	• Lethal and sub-lethal effects to fish and aquatic organisms	Table 10.4-11
65	CMC will adhere to Fisheries and Oceans Canada (DFO) guidelines for the Use of Explosives in or near Canadian Fisheries Waters when blasting in or near fish bearing waters.	• Lethal and non-lethal effects to fish and aquatic organisms	Table 10.4-11 Table 10.4-12
66	CMC will implement a No fishing policy for CMC workforce.	• Lethal effects on local fish populations due to increased fishing pressure	Table 10.4-11
67	Instream and riparian construction will be within working windows established by DFO to avoid destroying incubating fish eggs.	• Direct mortality of periphyton, benthic invertebrates, and fish eggs due to infilling	Table 10.4-11 Table 10.4-12
68	CMC will implement traffic speed limits, dust suppressants, sediment and erosion control plan; Best Management Practices for dust and other air contaminants as outlined in the Air Quality Management Plan.	• Lethal effects on fish and aquatic organisms due to contamination from dust, emissions, and road runoff	10.4 Table 10.4-10 Table 10.4-11 Table 10.4-12
69	ML/ARD risk assessment and management plan.	• Lethal effects on fish and aquatic organisms due to ML/ARD	Table 10.4-11 Table 10.4-12

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
			Appendix A.22H ML/ARD Management Plan
70	Divert contaminated water from the open pit into the TMF; Best Management Practices for explosives selection, drilling, handling and loading; environmental effects monitoring.	• Lethal effects on fish and aquatic organisms due to blasting residue contamination	Table 10.4-11 Table 10.4-12
~~71~~ Repeat of Commitment 32	~~Control contaminated discharge from the historic adit in upper Casino Creek.~~	• ~~Cumulative effects~~	~~10.5~~
~~72~~ Replaced by Commitment 150	~~CMC will construct the Lower Britannia Creek Compensation Channel~~ • ~~reinstatement of the historical channel, to provide 13,643 m2 of in-stream habitat and 116,940 m2 of riparian habitat~~ • ~~restoration of natural morphology free of obstructions~~ • ~~re-introduction of flow~~ • ~~permanent diversion at the divergence of the existing and historical channel~~ • ~~fill and re-vegetate existing channel~~	• ~~Habitat loss~~	~~4.3~~ ~~Fish Habitat Compensation Plan~~ ~~Appendix 10C~~
~~73~~ Replaced by Commitment 150	~~CMC will construct a Groundwater-fed Pool near the mouth of Britannia Creek - pond will be excavated up to 3 m below the observed groundwater table to provide 2.5 m deep pool beneath a 0.5 m ice cover.~~	• ~~Habitat loss~~	~~4.3~~ ~~Fish Habitat Compensation Plan~~ ~~Appendix 10C~~
~~74~~ Replaced by Commitment 150	~~CMC will conduct Channel Restoration at seven historical fords:~~ • ~~accumulations of bar sediment will be removed and used to re-build natural bank morphology~~ • ~~Brush layers will be constructed in both banks~~	• ~~Habitat loss~~	~~4.3~~ ~~Fish Habitat Compensation Plan~~ ~~Appendix 10C~~

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	• ~~adjacent areas of floodplain will be replanted using live stakes of native willows.~~		
~~75~~ Replaced by Commitment 150	~~CMC will construct a naturalized airstrip diversion channel:~~ • ~~diversion of a small, unnamed tributary of Dip Creek around the Project airstrip~~ • ~~habitat area will be increased to 4,753 m^2, compared to the existing 1,509 m^2~~ • ~~average gradient will be approximately 2%.~~ • ~~placement of gravel-cobble substrates and boulder groups along the straight riffle sections~~ • ~~Brush layers will be installed just below the tops of banks~~ • ~~Root wads will be embedded in the outer banks of meanders and secured with an anchor logs~~ ~~The existing channel will be filled and replanted upstream of the airstrip~~ • ~~Specifications on the alignment, dimensions and construction of the airstrip diversion channel will be finalized during detailed design.~~	• ~~Habitat loss~~	~~4.3~~ ~~Fish Habitat Compensation Plan~~ ~~Appendix 10C~~
~~76~~ Replaced by Commitment 150	~~Chinook Project Contribution~~ • ~~CMC is in the process of consulting with SFN and Yukon-based organizations including the Yukon Salmon Sub-Committee and the Yukon River Panel to identify potential opportunities for off-site compensation specifically aimed at restoring, enhancing or creating Chinook habitat for the benefit of current and future generations~~ • ~~CMC commits to identifying, designing, constructing and monitoring at least 9,756 m^2 of~~	• ~~Habitat loss~~	~~4.3~~ ~~Fish Habitat Compensation Plan~~ ~~Appendix 10C~~

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	new, enhanced or restored Chinook spawning and rearing habitat, with the option of introducing or re-introducing Chinook salmon to this habitat as appropriate • CMC is also exploring complementary measures, such as investments in data collection and scientific research related to maintaining or enhancing the productivity of commercial, recreational or Aboriginal fisheries.		
77 Replaced by Commitment 150	Riparian Habitat Compensation • Reinstatement of lower Britannia Creek - 116,940 m^2 of existing mature forest adjacent to historical channel (assumes 30 m buffer) • Groundwater-fed pool near Britannia Creek mouth - 16,200 m^2 of existing mature forest and replanted shoreline embankments, with large woody debris structures, around perimeter of pool (assumes 30 m buffer) • Britannia Creek ford restoration - 2,400 m^2 of Replanted riparian vegetation with live willow stakes and brush layers, and native tree seedlings (assumes 15 m buffer) • Naturalized airstrip diversion channel - 57,030 m^2 of existing mature forest encompassing area of proposed naturalized channel diversion (assumes 15 m buffer) • Chinook project contribution - 163,400 m^2 of riparian habitat, details TBD in consultation with Selkirk First Nation, DFO and other organizations.	• Habitat loss	4.3 Fish Habitat Compensation Plan Appendix 10C
78 Replaced by Commitment	• Proposed habitat restoration and enhancement measures will be completed in accordance with the applicable “reduced risk timing window” for in-	• Habitat loss	5.1 Fish Habitat Compensation Plan

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
150	~~water work~~ • ~~All channel works will be completed "in the dry", either by conducting work along sections of channel that are dry or completely frozen or by isolating the work area from flowing water~~ • ~~Any fish that become stranded in isolated work areas will be captured, identified and released upstream by a qualified fisheries technician with a collection license~~ • ~~Erosion and sediment control measures will be established around the work area of the Groundwater-fed Pool near Britannia Creek Mouth~~ • ~~Erosion and sediment control measures will be established along the length of the proposed naturalized airstrip diversion channel~~		~~Appendix 10C~~
79	An erosion and sediment control plan will be developed as part of an overall environmental management plan, prior to initiation of habitat compensation activities.	• Habitat loss	5.2 ~~Fish Habitat Compensation Plan~~ ~~Appendix 10C~~ **Fish Habitat Offsetting Plan Appendix A.10A** **Appendix A.22C**
80	Two main types of monitoring will be conducted to ensure success of the Fish Habitat Compensation Plan: • Construction monitoring • Effectiveness monitoring: A monitoring program will be established that focuses on the biological effectiveness of compensation works (channel morphology and fish habitat features, water quality monitoring, fish sampling, assessment of	• Habitat loss	5.1 ~~Fish Habitat Compensation Plan~~ ~~Appendix 10C~~ **Fish Habitat Offsetting Plan Appendix A.10A**

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	riparian vegetation)		
Rare Plants and Vegetation Health			
81	• Planning and conducting Project activities such that the Project footprint will be minimized to the extent possible. • Using established roads within the PDA during operation thereby limiting new disturbance to the PDA.	• Loss of vegetation	11.4
82	• Using equipment clean of soils from other sites; • For reclamation, using only local soil and rock material, or ensure that it is clean fill; • Re-vegetating terrestrial habitat naturally, unless it is determined during progressive rehabilitation studies that re-seeding with native species is preferable and can be accomplished without introducing invasive, non-native plant species; and • Establishing a program for invasive plant detection on-site with a follow-up control and removal program, if required, in accordance with the recommendations of the Yukon Invasive Species Council for invasive plant control.	• Establishment of invasive species	11.4 **Appendix A.22D Invasive Species Management Plan**
83	Implementing dust control measures, as per the air quality management guidelines.	• Dust deposition on vegetation, particularly rare plants	11.4
84	Site selection to consider potential for rare plants, realign or in extreme circumstances transplant.	• Loss of rare plants and rare plant habitat	11.4
85	• Use clean equipment. • Allow vegetation to re-establish naturally or by using native seed mixes. • Establish a program for invasive plant detection.	• Loss of rare plant habitat due to introduction or expansion of invasive species	11.4
Wildlife			

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
86	CMC commits to all of the mitigations listed in the Wildlife Mitigation and Monitoring Plan (~~Appendix 23A~~).	• Loss of wildlife habitat • Restrictions on wildlife movement • Wildlife mortality	~~Appendix 23A~~ **Appendix A.12A Wildlife Mitigation and Monitoring Plan**
87	To minimize effects on wildlife from mine site infrastructure and activity, CMC will: • Minimize the Project footprint; • Not damage or interfere with active dens of any species; • Implement a no-hunting policy for Project employees while working on site, mitigating mortality risk; • Implement a zero tolerance policy for wildlife harassment by Project-related employees and contractors, mitigating mortality risk and habitat loss; • Suppress dust on the road and at mine site during dry conditions to reduce the extent of dispersal into adjacent environments, mitigating habitat loss; • Give wildlife the right-of-way when on all roads, mitigating mortality risk and habitat loss; and • Freshwater pipeline to well system will be constructed to allow animal movement across (over or under).	• Loss of wildlife habitat • Restrictions on wildlife movement • Wildlife mortality	12.3
88	To mitigate potential effects on wildlife from construction, operation and closure and decommissioning of the Freegold Road upgrade and extension, CMC will: • Design road embankment heights and materials to allow for wildlife movement;	• Loss of wildlife habitat • Restrict wildlife movement • Increased wildlife mortality	12.3

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	• Manage snow embankments along the road to allow wildlife easier crossing of the Freegold road and reduce the likelihood of wildlife getting trapped between embankments, mitigating potential barrier effects and mortality risk; • Control access of non-project personnel to the road by installing and manning a gate, mitigating mortality risk; • Radio communication among drivers to warn others when wildlife are observed along the road, mitigating mortality risk; and • Implement measures to prevent and manage spills to reduce the potential for wildlife exposure to contaminants, mitigating reduced health.		
89	CMC will partially mitigate the risk of reduced caribou habitat availability within the winter range of the KCH by: • Timing road construction activities to minimize or avoid disturbance during the late-winter period (1 February to 30 April) within the KCH winter range high quality habitat; • Implementing a policy to ensure caribou approaching the road are given the right-of-way; • Implementing snow bank management measures to facilitate caribou movement across the roadway; • Designing road embankment heights and materials to allow for caribou movement; and • Placing construction camps and borrow pits to minimize or avoid disturbance to the KCH.	• Loss of caribou habitat • Restrict caribou movement	12.3
90	CMC will partially mitigate the risk of increased caribou mortality due to collisions with vehicles travelling the	• Increased caribou mortality	12.3

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	road by: • Installing signage that warns drivers of known caribou crossing or foraging areas along the road; • Reducing speed limits where caribou interact with the road during the winter; • Enforcing road speed limits by remotely tracking (e.g., GPS tracing) truck traffic; • Snow plowing escape routes for caribou; • Reporting of caribou sightings along the road to a wildlife monitor; • Ensuring constant radio communication among trucks to identify wildlife locations on an ongoing basis; • Employing a seasonal wildlife monitor to coordinate implementing caribou mitigations; • Reporting and investigating all Project-related caribou near-misses and mortalities; and • Triggering adaptive management strategies if there is a Project-related caribou mortality.		
91	CMC will mitigate the risk of increased caribou mortality from harvest by managing the Freegold Road extension as a private industrial road by: • Restricting access to the road during operation by installing a continuously manned gate at Big Creek; • Decommissioning the road during the reclamation and closure phase; and • Development of a wildlife management working group, including regulators and stakeholders, to provide advice to governments on mitigation, monitoring and adaptive management strategies.	• Increased caribou mortality	12.3

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
92	To reduce Project effects on moose, CMC will: • Manage roadside vegetation along Project roads to discourage moose foraging (e.g., cutting roadside vegetation in spring, not mid-summer; and • The 17 km long water pipeline will be designed to allow for moose, and other wildlife to move across the pipeline (i.e. pipeline clearance (distance from bottom of pipeline to ground) will be a minimum of 180 cm every 400 to 700 m to allow for moose passage under the pipeline or will be completely buried to allow for moose passage over the pipeline. Pipeline crossing structures may be constructed in high density/movement areas where the pipeline cannot be raised or buried sufficiently.	• Loss of moose habitat • Reduced movement	12.3
93	To reduce Project effects on grizzly bears, such as loss of habitat or increased mortality, CMC will: • Assess any new den sites identified during construction or operation to determine if they are currently utilized; • Avoid blasting within 500 m of known den sites when bears are likely to be present; • Avoid known, active bear dens during the denning season November through to mid-April; and • Incorporate Best Management Practices for food, waste and fuel management into the design on the Project.	• Loss of grizzly bear denning habitat • Increased grizzly bear mortality	12.3
Employment and Income			
94	CMC commits to the continued recruitment, training, and advancement of Yukon workers and will work to increase the number of Yukon resident workers over the	• Project workforce demands would increase local and regional employment	13.4

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	lifetime of the mine CMC will enhance these positive effects by: • Implementing a hiring policy that encourages the employment of workers from Yukon and in particular the rural communities within the LSA; • Implementing a procurement process that, where economically feasible, gives preferences to suppliers from the RSA and in particular from rural communities within the LSA; • Requiring cultural awareness training for Project-related employees and contractors; • Monitoring Project socio-economic effects and adapting management measures where required; • Providing on-the-job training to assist local and regional workers to develop mining-specific skills; • Providing training and education for potential employees from Yukon and in particular the rural communities within the LSA; • Partnering with First Nation communities to access additional funding for training; • Supporting non-mining training and entrepreneurial initiatives; and • Implementing career training and development opportunities for employees once hired.	• Increased employment during construction and operations would positively affect labour income for LSA and RSA residents	
95	CMC will work with other mining companies within the RSA to attract local workers set to be laid-off as other mines reach their end-of-life.	• Project competition for local labour may result in shortages in other sectors and industries	13.4
96	CMC will use reasonable best efforts to draw workers from the existing unemployed or underemployed regional labour pool.	• Project purchases would generate employment opportunities for LSA and RSA residents	13.4

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
~~97~~ Repeat of Commitment 94	~~CMC commits to the continued recruitment, training, and advancement of Yukon workers and will work to increase the number of Yukon resident workers over the lifetime of the mine by:~~ • ~~Implementing a hiring policy that encourages the employment of workers from Yukon and in particular the rural communities within the LSA;~~ • ~~Implementing a procurement process that, where economically feasible, gives preferences to suppliers from the RSA and in particular from rural communities within the LSA;~~ • ~~Requiring cultural awareness training for Project-related employees and contractors;~~ • ~~Monitoring Project socio-economic effects and adapting management measures where required;~~ • ~~Providing on-the-job training to assist local and regional workers to develop mining-specific skills;~~ • ~~Providing training and education for potential employees from Yukon and in particular the rural communities within the LSA;~~ • ~~Partnering with First Nation communities to access additional funding for training;~~ • ~~Supporting non-mining training and entrepreneurial initiatives; and~~ • ~~Implementing career training and career advancement opportunities for employees once hired.~~	• ~~Project workforce demands would increase local and regional employment~~ • ~~Increased employment during construction and operations would positively affect labour income for LSA and RSA residents~~	~~13.4~~
~~98~~ Repeat of Commitment 85	~~CMC will work with other mining companies within the RSA to attract local workers set to be laid-off as other mines reach their end-of-life.~~	• ~~Project competition for local labour may result in shortages in other sectors and industries~~	~~13.4~~

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
Employability			
99	After Project production ends CMC will, for a reasonable amount of time, assist Project-related employees to enhance their employability and find new employment in the mining industry.	• Loss of operational employment at closure resulting in a large net decrease in local and regional employment	14.4
100	CMC will implement a Recruitment, Training, and Employment Plan to encourage recruitment and retention of local/regional/territorial residents for Project-related employment.	• Training programs during operations would enhance the local and regional skills profile and employment levels • Employment opportunities will increase incentive for educational attainment and training of local residents • Project employment will improve capacity and industry experience of workers	14.4
101	CMC will implement a procurement process that, where feasible, gives preference to suppliers from the RSA and LSA; Contractors would be encouraged to hire local/regional/territorial residents to the extent practical.	• Improved capacity and industry experience of contractors	14.4
Economic Development and Business Sector			
102	CMC will encourage contractors to hire local/regional residents to the extent practical.	• Project purchases of goods and services would increase Yukon GDP and employment	15.4
103	CMC will seek to recruit local/regional/territorial residents to the extent practical for Project-related employment.	• Project workforce demands would increase Yukon GDP and employment • Re-spending by households of additional income that has been derived directly or indirectly from the mine employment will increase economic activity and businesses • Direct and indirect taxes paid by Project, contractors and individuals will positively contribute to the Yukon tax revenues and will increase government revenues	15.4

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
104	CMC will use local and regional suppliers when these suppliers can provide products and services at competitive prices and timeframes.	• Re-spending by households of additional income that has been derived directly or indirectly from the mine employment will increase economic activity and businesses • Proposed Project purchases will create contract and business opportunities across the Yukon • Direct and indirect taxes paid by Project, contractors and individuals will positively contribute to the Yukon tax revenues • Additional direct and indirect taxes paid by Project employees will increase government revenues	15.4
Community Vitality			
105	CMC commits to: • Priority hiring for qualified local residents • Encourage workers hired from outside Yukon to re-locate into the territory • Employing a community liaison staff member who focuses on community relationships and working with community staff on housing/planning issues related to mine staff.	• Population changes from out-of-territory mine workers and their dependents moving residency to RSA	16.4
106	CMC commits to: • Implementing a hiring policy that encourages the employment of workers from Yukon and in particular the rural communities within the LSA • Implementing a procurement process that gives preference to suppliers from the RSA and LSA.	• Population changes from migration to the RSA to take advantage of higher incomes and employment rates generated by the Project	16.4
107	CMC commits to: • Pursuing employment opportunities in negotiation of cooperation agreements with First Nations.	• Potential lack of employment and income equity for women, Aboriginal peoples, people with disabilities, and visible	16.4

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	• Implementing a hiring policy that encourages the hiring of Project-related employees from rural communities within the LSA.	minorities	
108	CMC commits to: • Offer to deposit employees' salaries directly into their bank accounts • Assist Project-related employees to find counseling services where needed • Facilitate money management training as required to those employees who do not have experience with high wage earnings and working in mines • Implement a zero tolerance policy with respect to drug and alcohol at the Project site for Project employees and contractors • Work with local agencies in monitoring Project socio-economic effects and to take corrective actions where appropriate.	• Spending decisions in relation to disposable income could affect family and community well-being	16.4
109	CMC commits to: • A self-contained camp on site to house workers • Implementing a zero tolerance policy with respect to drug and alcohol use at the Project site for Project employees and contractors • CMC will help identify counseling services to its employees if needed • CMC will provide money management training as required to those employees who do not have experience with high wage earnings and working in mines • CMC will work with local agencies to monitor	• Influx of workers and their families could create negative behavioural changes and reduce family and community well-being	16.4

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	Project socio-economic effects and to develop and implement corresponding measures as appropriate.		
Community Infrastructure and Services			
110	To decrease potential Project effects on community infrastructure and services in the LSA, CMC will: • Provide a local fresh water supply, sewage treatment plant and power supply at the mine site • A permanent waste management facility will be established at the mine site during the construction phase • The camp will have indoor and outdoor recreation services • All construction activities will follow best practices and will be outlined in the Environmental Health and Safety (EHS) Management System • CMC will provide, at the site and the camp, health and medical equipment and personnel as well as arrangements to med-evac workers with life-threatening illnesses or injuries to the nearest appropriate facility.	• Population change will alter demand for health and social services.	17.4.2
111	CMC will work closely on an ongoing basis with Whitehorse General Hospital, local fire departments, RCMP and Yukon Ambulance to ensure that the appropriate information on the changes in area transportation volumes, mine operations and the change to the local population are considered.	• Population change will alter demand for Protective Services	17.4.2
112	CMC will provide contracted security services that will focus on ensuring a secure and safe work site.	• Infrastructure and service capacity	17.4.2
113	CMC will provide a fly in/fly out camp to offset project demands for housing and temporary accommodation.	• Population change will alter demand for housing and temporary accommodation	17.4.2

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
114	Casino Mining Corporation will provide on-the-job training to assist local and regional workers to develop mining-specific skills. CMC will support programs and initiatives at local schools and Yukon College. CMC will implement a Recruitment, Training and Employment Plan.	• Increase demand for educational services	17.4.2
115	CMC will implement a Road Use Plan and an Emergency Response and Spill Management Plan. CMC will enforce speed limits on roads under its control. CMC will perform regular vehicle maintenance on its own vehicles and will perform regular road maintenance to reduce risk to motor vehicle safety. CMC will consult with Transport Branch of YG to ensure compliance with transport regulations.	• Increased traffic and risk for motor vehicle collisions on the Klondike Highway and Freegold Road	17.4.2
116	CMC will discuss Worker Transportation Plan with Whitehorse Airport authority i.e. evaluate peak passenger/aircraft volumes and, as necessary, schedule work rotation schedules to minimize airport and passenger congestion.	• Demands on air transportation infrastructure	17.4.2 Table 17.4-3
117	CMC will work with communities in the LSA to develop a mine closure plan that identifies strategies and actions to help minimize the potential adverse effects of closing the mine.	• decrease demand for housing and temporary accommodation and local services	17.4.2
Cultural Continuity			
118	CMC will develop a socio-economic monitoring plan jointly with community and regional partner organizations such as training institutions, economic development agencies, and municipal and provincial/territorial government agencies.	• General cultural effects	18.4

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
119	CMC will design the Project to have as compact a mine site footprint as practicable.	• General cultural effects	18.4 Table 18.4-4
120	CMC commits to progressive reclamation of the Maximum Disturbance Area (with the exception of the open pit and TMF).	• General cultural effects	18.4
121	A Heritage Resource Protection Plan will be developed to detail the methods for avoiding, mitigating, reporting, and recovering any heritage resources that are found during Project development activities.	• General cultural effects	18.4 22
122	Mitigation measures include avoidance of known or suspected historical, cultural, or archaeological places; if avoidance is not possible, archaeological mitigation will be completed following the Yukon Heritage Policy.	• General cultural effects in Maximum Disturbance Area	18.4 Table 18.4-4
123	Access Mitigation - A Road Use Plan (Section 22) will be developed for the Project in coordination with First Nations and the Yukon Government which will include: • No public access on the Freegold Road Extension or access by permit, as directed and agreed by the Yukon and First Nation governments. • Controlled, gated, manned access at the new bridge over Big Creek or as otherwise agreed. • A stakeholder communication /engagement plan to ensure concerns are identified and addressed.	• General cultural effects related to access as the result of the use of the Freegold Road Extension.	18.4 22 **Appendix A.22E Road Use Plan**
124	A traffic communication bulletin /update will be circulated in local communities and to key stakeholders on a routine basis to inform users of current road status.	• General cultural effects related to access	18.4 Table 18.4-4
125	An information line will also be established to answer questions regarding the Project status.	• General cultural effects related to access	18.4
126	A monitoring program will be implemented to ensure that local land users are not gaining access to the Freegold Road Extension via alternative routes.	• General cultural effects related to access	18.4

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
127	At closure, public health and safety assessment will be conducted for the mine site to identify potential risks and develop appropriate, specific long-term mitigation and management measures (such as fencing and signage).	• General cultural effects related to access	18.4 Table 18.4-4
128	Change in local ambience, such as traffic, noise and emissions, and related wilderness experience will be mitigated by: • Implement Environmental Management Plans • Minimizing traffic noise and emissions by incorporating accepted best management practices • Ensuring on-site equipment is regularly maintained to control noise and emissions • Proper sound buffering of the ore processing facility on site • Implement an Air Quality Management Plan • On-going communications and engagement with First Nations to document potential effects associated with traffic, emissions and noise along the Freegold Road corridor.	• General cultural effects related to ambience	18.4.2 & Table 18.4-4
129	Mine employees and contractors will be restricted from harvesting within the mine site footprint and while on shift at any time.	General cultural effects related to loss of plant/animal resources	18.4.2 & Table 18.4-4
130	To minimize effects associated with employment at the mine CMC will include: • Shift flexibility, when possible, to accommodate subsistence harvesting and participation in cultural activities/events • Supporting efforts to revitalize Northern Tutchone language and incorporate Northern	General cultural effects related to opportunities to participate in cultural activities	18.4.2 & Table 18.4-4

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	Tutchone language into mine signage in consultation with the SFN and LSCFN; • Incorporating Aboriginal ceremonies at the mine site in consultation with the SFN and LSCFN; • Providing support for community cultural events based on input from SFN and LSCFN and other local communities; and • Conduct cultural awareness training for all employees and contractors working at the mine site.		
Land Use and Tenure			
131	CMC will limit the mine footprint; implement appropriate best management practices and reclamation and closure measures; ensure ongoing communication with FN and local stakeholders.	• Loss of available area for FN traditional land use activities • Loss of available area for quartz and placer mining • Loss of available area for trapping and outfitting	19.4.2
132	To mitigate against changes to access to traditional land, mineral tenures, and recreational lands CMC commits to: • Working with First Nation and Yukon Government to ensure management of the Freegold Road Extension does not interfere with the rights of other existing tenure holders. • Implement access management measures and associated monitoring and communication plans. • ongoing communication with FN and local stakeholders.	• Changes to access to Traditional Territories, mineral tenures, trapping areas, guide outfit concessions and recreational areas	19.4.2
133	CMC will	• Reduced wilderness experiences for First	19.4.2

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	• limit mine footprint; • implement appropriate EMPs (e.g., Air Quality Management Plan) and reclamation and closure measures; • maintain ongoing communication with local stakeholders.	Nations, trappers, outfitters and recreational land users	
134	CMC will limit this potential cumulative effect by: • Implementing a no public access policy unless directed by the Yukon and First Nations Governments • Manned access at control points • Explore a cooperative approach to management of access to the Freegold Road Extension involving the Casino Mining Corporation, the Yukon government, Selkirk First Nation and Little Salmon/Carmacks First Nation.	• Overall increase in existing and future permitted placer and quartz exploration and mining activities along the Freegold Road Upgrade	19.4.2
Supplementary Information Report - March 16, 2015			
135	CMC will voluntarily establish an Independent Geotechnical Review Panel for the Casino Project to review and consider the Project's Tailings Management Facility and Heap Leach Facility with a focus on their structural stability and integrity.	N/A	A.4
136	Casino Mining Corporation will establish Quality Assurance/Quality Control (QA/QC) procedures to maintain an effective quality control program for the Project prior to commencement and during execution of all works.	N/A	A.4
137	A Professional Engineer representing CMC will carry out periodic independent inspection and testing throughout	N/A	A.4

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	the construction of the works. For quality assurance the Professional Engineer representing CMC will approve QA/QC testing results prior to proceeding with works. The QA/QC testing results will be recorded and available for inspection on site by regulatory inspectors.		
138	CMC will undertake a dam breach analysis and inundation modelling consistent with the Canadian Dam Association's dam safety guidelines.	N/A	A.4
139	CMC will conduct additional site investigations during detailed design, including test pits and laboratory testing, to further characterize foundation soils for the TMF embankment.	• Embankment deformation or weakening due to thaw of frozen foundation materials.	A.4
140	CMC will conduct appropriate laboratory or field scale studies during operations to finalize the design of the treatment wetlands.	• Uncertainty and a lack of confidence in the proposed treatment system.	A.4
141	CMC will conduct a geotechnical site investigation for the Freegold Road Extension which will include the installation of thermistors to monitor ground temperature.	N/A	A.6
142	CMC will complete additional site investigation and thermal analysis, if the foundations of critical infrastructure are identified as potentially susceptible to the effects of thermal erosion.	• Thermal erosion from Project activities and climate change.	A.6
143 Replaces Commitments 27 and 28	The winter seepage management pond and associated seepage collection system will be installed during construction to collect surface runoff and seepage from the TMF embankments during operations and pump the water back to the TMF. A controlled discharge system will control discharge to Casino Creek.	• Change in surface water quality in Casino Creek and Dip Creek due to unrecovered seepage. • Change in surface water quality in Casino Creek and Dip Creek due to project discharge.	A.7

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
144	If future field investigations conducted as part of design engineering identify additional structures beneath the TMF, the effect on TMF seepage rates will be assessed.	• Change in surface water quality in Casino Creek and Dip Creek due to unrecovered seepage.	A.7
145	CMC will conduct information sessions following the determination of adequacy in the YESAB process to inform interested parties of details of the water balance modelling.	N/A	A.7
146	CMC will update the water balance model in support of the reclamation and closure plan updates as may be required.	• Change in surface water quality in Casino Creek and Dip Creek due to unrecovered seepage. • Change in surface water quality in Casino Creek and Dip Creek due to Project discharge.	A.7
147	Additional mitigation measures may be considered if concerns arise surrounding the proposed physical barrier to prevent fish passage. CMC will develop and implement an adaptive monitoring plan that evaluates the effectiveness of the barrier, with the inclusion of triggers for implementing further mitigation measures to protect resident fish. Other mitigation that may be considered may include other physical deterrents or flow management strategies.	• Fish stranding downstream of the water management pond.	A.10
148	Any fish-bearing crossings requiring culverts will be designed to ensure fish passage and habitat losses will be assessed and, if required, offset accordingly in the Fish Habitat Offsetting Plan.	• Lethal effects on fish and aquatic organisms. • Habitat loss.	A.10 Appendix A.10A Fish Habitat Offsetting Plan
149	In writing the Erosion and Sediment Control Plan (for the Quartz Mining Licence application), the same overall erosion and sedimentation risk assessment will be	• Change in surface water quality from increased erosion and sedimentation.	A.10

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	conducted for all of the Freegold Road Upgrade, Airstrip Access Road and Casino Mine Site. Corresponding mitigation measures will be applied at the areas identified in the risk assessment.		
150 Replaces Commitments 72, 73, 74, 75, 76, 77 and 78	CMC will implement the compensation measures outlined in the Fish Habitat Offsetting Plan, once approved by DFO, and once the decision has been made to proceed with the Project.	• Fish and aquatic species habitat loss.	A.10 Appendix A.10A Fish Habitat Offsetting Plan
151	CMC understands that YG Environment is conducting fire regime scenario-building for the Klaza caribou range. CMC will consider reasonable scenarios and interaction with Project effects if they are developed and made available for review.	• Wildlife habitat loss.	A.12
152	CMC will work with SFN to adopt the scope, methodology, VCs and indicators of the Minto Mine Socio-Economic Monitoring Framework and to develop the Socio-economic Effects Monitoring Program for the Project, if mutually-agreed to by First Nations, local communities and Yukon Government.	• Effects of the Project to community wellbeing and community vitality.	A.16 Appendix A.22F Socio-economic Management Plan
153	CMC is willing to work collaboratively with LSCFN to develop a similar monitoring program (to the program in commitment #154) that reflects the VCs and indicators that arise as a result of their two recent community driven processes for community readiness planning and development of community well-being indicators.	• Effects of the Project to community wellbeing and community vitality.	A.16 Appendix A.22F Socio-economic Management Plan
154	CMC is willing to work with the Tr'ondëk Hwëch'in, other First Nations and municipalities to determine the appropriate level of monitoring socio-economic effects of the Project on their respective communities.	• Effects of the Project to community wellbeing and community vitality.	A.16 Appendix A.22F Socio-economic Management Plan

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
155	CMC will incorporate YG and local first responders into the process for finalizing the conceptual Emergency Response Plan.	N/A	A.21
156	CMC will work with Yukon Government Department of Highways and Public Works to monitor, and actively manage if required, potential interactions between Project-related trailer truck traffic and other public highway users.	• Effects of Project-related traffic on other highway users.	A.21

A.25 – REFERENCES

Adams, W. J., Toll, J. E., Brix, K. V., Tear, L. M., and DeForest, D. K. 2000. Site-specific approach for setting water quality criteria for selenium: Differences between lotic and lentic systems. Proceedings of the 24th Annual BC Mine Reclamation Symposium. Williams Lake, BC: The Technical and Research Committee on Reclamation.

AERCB (Alberta Energy Resource Conservation Board). 2007. Directive 038: Noise Control

Alberta Environmental Protection. 1996. Alberta Water Quality Guideline for the Protection of Freshwater Aquatic Life – Copper (Draft). Standards and Guidelines Branch. Alberta Environmental Protection. Edmonton, Alberta; 122.

Alberta Health. 1999. Northern River Basins Human Health Monitoring Program. http://www.health.alberta.ca/documents/Northern-River-Health-Mon-1999.pdf

Apps, C. D., B. N. Mclellan, T. A. Kinley, R. Serrouya, D. R. Seip, and H. U. Wittmer. 2013. Spatial factors related to mortality and population decline of endangered mountain caribou. The Journal of Wildlife Management 77:1409–1419.

Apps, C. D., McLellan, B. N., Woods, J. G., and Proctor, M. F. 2004. Estimating Grizzly Bear Distribution and Abundance Relative to Habitat and Human Influence. Journal of Wildlife Management, 68(1), 138-152.

Apps, C., McLellan, B., Kinley, T., Serrouya, R., Seip, D., and Wittmer, H. 2013. Spatial factors related to mortality and population decline of endangered mountain caribou. Journal of Wildlife Management, 77, 1409-1419.

Associated Engineering (BC) Ltd. 2012. Casino Mine. Feasibility Access Study. August 31, 2012.

Avanti Mining Inc. 2011. Kitsault Mine Project Environmental Assessment. Section 11.2.6.6.9: Tailings Management Facility Failure.

AXYS. 2001. Thresholds for addressing cumulative effects on terrestrial and avian wildlife in the Yukon. Prepared by AXYS Environmental Consulting Ltd,. Calgary AB for Department of Indian and Northern Affairs, Environmental Directorate and Environment Canada, Whitehorse Yukon. March 2001. 92 pp + app.

Baldwin, D.H., Sandahl, J.F., Labenia, J.S. and N.L. Scholz. 2003. Sublethal effects of copper on coho salmon: impacts on non-overlapping receptor pathways in the peripheral olfactory nervous system. Environmental Toxicology and Chemistry, 22, 2266–2274.

Barclay, M.A., Harris, J., Everingham, J., Kirsch, P., Arend, S., Shi, S. and Kim, J. 2013. Factors Linked to to the Well-Being of Fly-In Fly-Out (FIFO) workers. Research Report, CSRM and MISHC, Sustainable Minerals Institute, University of Queensland: Brisbane, Australia.

Barker, J and Thomas, H 2013, 'Geotechnical Engineering in Cold Regions', in ISCORD 2013, pp. 204-14.

Barrera, Valenzuela and Campana, 2011, “Sand Tailings Dams: Design, Construction and Operation”, Proceedings of Tailings and Mine Waste 2011, Vancouver, B.C.

BC Ministry of Environment, Lands, and Parks. 2001. Guidance for Assessing the Design, Size and Operation of Sedimentation Ponds used in Mining. http://www.env.gov.bc.ca/epd/industrial/mining/pdf/settling_ponds.pdf

BC MOE. 2001. Ambient Water Quality Guidelines for Selenium, Overview Report. British Columbia Ministry of Environment.

BC MOE. 2009. Manual of British Columbia Hydrometric Standards. Resources Information Standards Committee. March 12, 2009.

BC MOE. 2011. Ambient Water Quality Guidelines for Fluoride, Technical Appendix. September 2011.

BC Oil and Gas Commission (BC OGC). 2009. British Columbia Noise Control Best Practices Guideline. March 2009.

Behnke, R. 2010. Trout and Salmon of North America. NY: Simon and Shuster.

Belyaeva, E. A., Dymkowska, D., Wieckowski, M. R., and Wojtczak, L. 2006. Reactive oxygen species produced by the mitochondrial respiratory chain are involved in Cd2+- induced injury of rat ascites hepatoma AS-30D cells. Biochimica et Biophysica Acta, 1757, 1568–1574.

Benn, B., and Herrero, S. 2002. Grizzly bear mortality and human access in Banff and Yoho National Parks, 1971-98. Ursus, 13, 213-222.

Bent, H. 2009. Kemess South Mine – Reclamation & Closure Preparation. Minerals North Conference, 2009. http://mineralsnorth.ca/files/Kemess-South-Mine-Reclamation-and-Closure.pdf

Bertin, G. and D. Averbeck. 2006. Cadmium: cellular effects, modifications of biomolecules, modulation of DNA repair and genotoxic consequences (a review). Biochimie, 88, 1549–1559.

Beširović, H., Alić, A., Prašović, S., and Drommer, W. 2010. Histopathological Effects of Chronic Exposure to Cadmium and Zinc on Kidneys and Gills of Brown Trout (Salmo trutta m. fario). Turkish Journal of Fisheries and Aquatic Sciences, 10, 255-262.

Birge,W.J. 1978. Aquatic toxicology of trace elements of coal and fly ash. In Energy and environmental stress in aquatic systems. Edited by J.H. Thorp and J.W. Gibbons. Department of Energy Symposium Series. CONF 771114.

Birtwell, I. K., Harman, G., Anderson, B., McLeay, D. J., & Malick, J. G. 1984. A brief investigation of Arctic grayling (Thymallus arcticus) and aquatic invertebrates in the Minto Creek drainage, Mayo, Yukon Territory: an area subjected to placer mining. Can. Tech. Rep. Fish. Aquat. Sci., 1287, 57.

Bishop, F. G. 1967. The biology of the Arctic grayling, Thymallus arcticus (Pallas), in Great Slave Lake. Edmonton, Alberta: M.Sc. Thesis, Department of Zoology, Univerisity of Alberta.

Bovee, K.D. 1978. The Incremental Method of assessing habitat potential for coolwater species, with management implications. American Fisheries Society Special Publication 11:340-346.

British Columbia Ministry of Forests (BC MoF). 1998. Fish-Stream Identification Guidebook. Second Edition, Version 2.1. Victoria, BC: Forest Practices Branch, Ministry of Forests, Victoria, BC. Forest Practices Code of British Columbia Guidebook.

Butcher, G. A. 1952. Water quality criteria for aluminum. Technical Appendix. March 1988: British Columbia Ministry of Environment and Parks. Water Quality Unit.

Camargo, J.A. 2003. Fluoride toxicity to aquatic organisms: a review. Chemosphere, 50 (3), 251-264.

Canadian Council of Ministers of the Environment (CCME). 1999. Canadian Water Quality Guidelines for the Protection of Aquatic Life: Molybdenum. Canadian Environmental Quality Guidelines. Winnipeg.

Canadian Council of Ministers of the Environment (CCME). 2002. Inorganic fluorides factsheet, Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment, Winnipeg

Canadian Council of Ministers of the Environment (CCME). 2007. Canadian Environmental Quality Guidelines. Winnipeg: Canadian Council of Ministers of the Environment.

Canadian Council of Ministers of the Environment (CCME). 2011a. Protocols manual for water quality sampling in Canada. Canadian Council of Ministers of the Environment. Winnipeg.

Canadian Council of Ministers of the Environment (CCME). 2011b. Uranium factsheet, Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment, Winnipeg.

Canadian Council of Ministers of the Environment (CCME). 2014. Canadian Water Quality Guidelines for the Protection of Aquatic Life: Cadmium. Canadian Environmental Quality Guidelines. Winnipeg.

Canadian Council of Ministers of the Environment. 1999. Canadian water quality guidelines for the protection of aquatic life: Introduction. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

Canadian Dam Association (CDA), 2014. Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams

Canadian Dam Association (CDA). 2007. Dam Safety Guidelines.

Capstone Mining Corp – Minto Mine. 2013. Project Proposal: Phase V/VI Expansion of Mining and Milling. Minto Mine. Version 1. July 2013

Capstone Mining Corp, 2012. Yukon Producers Group Presentation: November 20th, 2012. Presentation made at the 40th Annual Yukon Geoscience Forum and Trade Show Whitehorse, Yukon. Selkirk First Nation, Yukon Government, Capstone Mining Corp. 2013. Minto Mine Socio-Economic Monitoring Program Framework

Capstone. 2013. Minto Mine Socio-Economic Monitoring Program. Prepared in collaboration by: Selkirk First Nation, Yukon Government, Capstone Mining Corp – Minto Mine. September 10, 2013 Revision. http://www.emr.gov.yk.ca/mining/pdf/mml_minto_socioeconomic_monitoring_program.pdf

Capstone. 2014. Minto Mine Emergency Response Plan. http://www.emr.gov.yk.ca/mining/pdf/mml_minto_20140301_emergency_response_plan.pdf

Casino Silver Mines Ltd. 1966. Report on Lead-Silver Property, Casino Silver Mines Ltd (N.P.L) Casino Creek Area, Yukon Territory. http://yma.gov.yk.ca/019141.pdf.

CCME. 2007. Canadian Environmental Quality Guidelines. Winnipeg: Canadian Council of Ministers of the Environment.

Center for Chemical Process Safety. 2012. Guidelines for Engineering Design for Process Safety (Second ed.). Hoboken, NJ, USA.: John Wiley & Sons, Inc.

Chang-Kue, K. J., & Cameron, R. T. 1980. A survey of the fish resources of the Great Bear River, Northwest Territories, 1974. Can. Fish. Mar. Serv. Manuscr. Rep, 1510, 59.

Chapman, M., Adams, W. J., Brooks, M. L., Delos, C. G., Luoma, S. N., Maher, W. A., et al. 2009. Ecological assessment of selenium in the aquatic environment: Summary of a SETAC Pellston Workshop. Society of Environmental Toxicology and Chemistry.

Cleveland, L., Little, E. E., Buckler, D. R., and Wiedmeyer, R. H. 1993. Toxicity and bioaccumulation of waterborne and dietary selenium in juvenile bluegill (Lepomis macrochirus). Aquatic Toxicology, 27(3-4), 265-279.

Cooley, H.M. and J.F. Klaverkam. 2000. Accumulation and distribution of dietary uranium in lake whitefish (Coregonus clupeaformis). Aquatic Toxicology, 48, 477-494.

COSEWIC. 1999. COSEWIC assessment and status report on the black bear Ursus americanus in Canada. Ottawa: Committee on the Status of Endangered Wildlife in Canada.

COSEWIC. 2001. COSEWIC assessment and status report on the Canada Lynx Lynx canadensis. Ottawa: Committee on the Status of Endangered Wildlife in Canada.

COSEWIC. 2003. COSEWIC assessment and update status report on the wolverine Gulo gulo in Canada. Ottawa: Committee on the Status of Endangered Wildlife in Canada.

COSEWIC. 2011. COSEWIC assessment and status report on the barn swallow Hirundo rustica in Canada. Ottawa: Committee on the Status of Endangered Wildlife in Canada.

COSEWIC. 2011. COSEWIC assessment and status report on the Collared Pika Ochotona collaris in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 50 pp.

COSEWIC. 2012. COSEWIC assessment and status report on the Grizzly Bear Ursus arctos in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xiv + 84 pp. Available at http://www.sararegistry.gc.ca/default.asp?lang=En&n=8D03FF1B-1#_docInfo. Accessed 6 February 2015.

COSEWIC. 2014. COSEWIC assessment and status report on the little brown myotis Myotis lucifugus, northern myotis, Myotis septentrionalis, tri-colored bat, Perimyotis subflavus in Canada . Ottawa: Committee on the Status of Endangered Wildlife in Canada.

Council of Yukon First Nations. 2003. Understanding the Yukon Umbrella Final Agreement: A Land Claim Settlement Information Package. 4th edition.

Coyle, J.J., Buckler, D.R., Ingesoll, C.G., Fairchild, J.F. and T.W. May. 1993. Effect of dietary selenium on the reproductive success of bluegills Lepomis macrochirus. Environmental Toxicology and Chemistry, 12(3), 551-565.

Cubley, J. Instructor/Coordinator. Centre for Northern Innovation in Mining. Email. 17, 20 August 2014.

Dahl, J., G. Fondahl, A. Petrov, and R.S. Fjellheim. 2010. “Fate Control.” *Arctic Social Indicators – A Follow-up to the Arctic Human Development Report.* Ed. Joan Nymand Larsen, Peter Schweitzer, and Gail Fondahl. Copenhagen: Nordic Council of Ministers. Pp. 129-146.

Dalerum, F., S. Boutin, and J. Dunford. 2007. Wildfire effects on home range size and fidelity of boreal caribou in Alberta, Canada. Canadian Journal of Zoology 85:26–32.

Davies, T. D., Pickard, J. and K.J. Hall. 2005. Acute molybdenum toxicity to rainbow trout and other fish. Journal of Environmental Engineering and Science, 4, 481–485.

Davies, T.D., Pickard, J.S. and K.J. Hall. 2003. Sulphate toxicity to freshwater organisms and molybdenum toxicity to rainbow trout embryos/alevins. As cited in: Proceedings, 26th Annual British Columbia Mine Reclamation Symposium, Kamloops, BC.

de Graff, N. M. 2009. Identification of chinook and fall chum salmon spawning habitat in the Yukon River mainstem between Tatchun Creek and Minto, Yukon Territory. Prepared for the LIttle Salmon/Carmacks First Nation, Carmacks, Yukon Territory.

De Guzman, Margarita, Kristin Soucey, Braedy Chapman, Elsa Perry. 2014. Western Copper and Gold Corporation Casino Project Archaeological Resources Mitigation, KdVi-1, KeVi-6, KfVi-2, KfVi-3, KfVi-4, and KfVi-5. Permit No. 13-06ASR. Report prepared for Government of Yukon, Heritage Resources Unit, Yukon Cultural Services Branch, Department of Tourism and Culture, Whitehorse, YT.

deBruyn, M., & McCart, P. 1974. Life history of the grayling (Thymallus arcticus) in Beaufort Sea drainages in the Yukon Territory. Canadian Arctic Gas Study Limited (Calgary, AB), Biological Report Series, 15, 41.

Department of Community Services. 2015. About Yukon Wildland Fire Management. http://www.community.gov.yk.ca/firemanagement/about.html

Department of Fisheries and Oceans (DFO). 1985. Distribution and abundance of Chinook Salmon in the Upper Yukon River Basin as determined by radio-tagging and spaghetti tagging program, 1982-1983. Canadian Technical Report of Fisheries and Aquatic Sciences, 1352.

Department of Fisheries and Oceans (DFO). 1994. Overview: Waters which may be affected by the Casino Project or by infrastructure associated with it. Whitehorse, Yukon: Department of Fisheries and Oceans Canada.

Department of Fisheries and Oceans (DFO). 2013. Measures to avoid causing harm to fish and fish habitat. DFO, Winnipeg, Ontario. Website: http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/index-eng.html. Accessed February 20, 2015.

Dobbs, M.G., D.S. Cherry, and J. Cairns Jr. 1996. Toxicity and bioaccumulation of selenium to a three-tropic level food chain. Environmental Toxicology and Chemistry, 15, 340-347.

Dunne, B. M., and Quinn, M. S. 2009. Effectiveness of above-ground pipeline mitigation for moose (Alces alces) and other large mammals. Biological Conservation, 142, 332–343.

EBA. 2011. Case Study of Brewery Creek. Retrieved November 4, 2014, from Government of Yukon - Energy, Mines and Resources: http://www.emr.gov.yk.ca/mining/pdf/mml_brewerycreek_case_study_of_brewery.pdf

Eisler, R. 1985. Cadmium Hazards to Fish, Wildlife, and Invertebrates: a Synoptic Review. US Department of the Interior Biological Report 85(1.2), Contaminant Hazard Reviews Report 2.

Eisler, R. 1998. Copper hazards to fish, wildlife, and invertebrates: a synoptic review. Prepared for US Geological Survey, Biological Resources Division, Reston, Virginia. Biological Science Report USGS/BRD/BSR--1998-0002.

Elphick, J.R., Davies, M., Gilron, G., Canaria, E.C., Lo, B. and H. C Bailey. 2011. An aquatic toxicological evaluation of sulfate: The case for considering hardness as a modifying factor in setting water quality guidelines. Environmental Toxicology and Chemistry, 30(1), 247-53.

Environment Canada and Health Canada. 2003. Priority Substances List Assessment Report: Releases of Radionuclides from Nuclear Facilities (Impact on Non-human Biota). Her Majesty the Queen in Right of Canada (Environment Canada).

Environment Canada. (2002, June 6). *Metal Mine Effluent Regulations.* Ottawa: Government of Canada.

Environment Canada. 1997. Biological test method: test for survival and growth in sediment using the larvae of freshwater midges (Chironomus tentans and Chrironomus riparius). EPS 1/RM/32. December 1997. Method Development and Application Section, Environmental Technology Centre, Ottawa, ON.

Environment Canada. 2007a. Biological test method: test of reproduction and survival using the cladoceran Ceriodaphnia dubia. EPS 1/RM/21, Second Edition, February 2007. Environment Canada, Method Development and Application Section, Environmental Science and Technology Centre, Science and Technology Branch, Ottawa, ON.

Environment Canada. 2007b. Biological test method: growth inhibition test using the freshwater alga. EPS 1/RM/25. Second Edition, March 2007. Environment Canada, Method Development and Application Section, Environmental Science and Technology Centre, Science and Technology Branch, Ottawa, ON.

Environment Yukon. 2010. Status of Yukon Fisheries. Retrieved September 28, 2014, from http://www.env.gov.yk.ca/publicationsmaps/documents/status_yukon_fisheries2010.pdf

Environment Yukon. 2014. Yukon Game Fish Species. Retrieved September 28, 2014, from http://www.env.gov.yk.ca/animals-habitat/fish/fishspecies.php

Environmental Dynamics Inc (EDI). 2008. The Impact of Roads on Wildlife and Metrics for Assessment. Prepared for Ministry of Environment, Caribou Region.

Environmental Dynamics Inc. (EDI). 2011. Little Salmon/Carmacks First Nation Knowledge Study. CRE-141N-10. EDI Project #10-YC-0058.

Farnell, R., Sumanik, R., McDonald, J., and Gilroy, B. 1991. The distribution, movements, demography, and habitat characteristics of the Klaza caribou herd in relation to the casino trail development, Yukon Territory. Yukon Renewable Resources Technical Report TR-91-3. Whitehorse: Yukon Renewable Resources.

Fletcher, T., Stephenson, G. L., Muncaster, B., Wren, C. D., and Spry, D. J. 1997. Scientific criteria document for the development of an interim provincial water quality objective for molybdenum. Toronto: Ontario Ministry of Environment and Energy, Standards Development Branch.

Gibeau, M. L., Herrero, J. L., Kansas, J. L., and Benn, B. 1996. Grizzly bear population and habitat status in Banff National Park: A Report to the Banff-Bow Valley Task Force. Eastern Slopes Grizzly Bear Project, University of Calgary, Alberta. Retrieved November 10, 2014, from http://www.canadianrockies.net/grizzly/pophab_banff96.html

Gibson, G., and Jason Klinck. 2005. “Canada’s Resilient North: The Impact of Mining on Aboriginal Communities.” *Pimatisiwin: A Journal of Aboriginal and Indigenous Community Health* 3(1).

Gissel-Nielsen, G., and Gissel-Nielsen, M. 1978. Sensitivity of trout to chronic and acute exposure to selenium. Agriculture and Environment, 4, 85-91.

Golder Associates (Golder). 2013. Nico Mine Project Conceptual Closure and Reclamation Plan. Report No. 12-1373-0057. October 2013.

Gotthardt, R.M. 1988. Heritage Resource Impact Assessment of the Proposed Casino Trail Route Km 33 – 58.5, West Central Yukon. Permit No. 88-3ASR. Report prepared for the Casino Trail Local Resources Group.

Gotthardt, R.M. 1995. Freegold Road Archaeological Impact Assessment (KM 20-33) and Mount Nansen Road Overview Assessment, near Carmacks, Yukon. Permit No. 95-1ASR. Report prepared for the Government of Yukon, Community and Transportation Services, Whitehorse, YT.

Government of Yukon. 2015. Spill Reporting and Cleanup. Environment Yukon. http://www.env.gov.yk.ca/environment-you/spills.php

Gray, M. A., Cunjak, R. A., & Munkittrick, K. R. 2004. Site fidelity of slimy sculpin (Cottus cognatus): Insights from stable carbon and nitrogen analysis. Canadian Journal of Fisheries and Aquatic Sciences, 61(9), 1717-1722.

Gunn, A., Russell, D., and Eamer, J. 2011. Northern caribou population trends in Canada. Retrieved from http://www.biodivcanada.ca/default.asp?lang=Enandn=137E1147-1

Hamilton, S.J., Buhl, K.J., Faerber, N.L., Wiedmeyer, R.H. and F.A. Bullard. 1990. Toxicity of Organic Selenium in the Diet to Chinook Salmon. Environmental Toxicology and Chemistry, 9(3), 347-358.

Hammer, T.J. 1995. Archaeological Salvage of KbVb-2 and Archaeological Impact Assessment of the Area West of KaVb-1 on the Freegold Road, near Carmacks, Central Yukon.. Permit No. 95-2ASR. Report prepared for the Government of Yukon, Community and Transportation Services, Transportation and Engineering Branch, Whitehorse, YT.

Handly M.J and M. Rousseau. 1995. An Archaeological Impact Assessment for Community and Transportation Services (Yukon Territorial Government) Proposed Freegold Road Upgrading and New Realignments (KM 0-20) Near Carmacks, Yukon. Permit No. 99-22ASR. Report prepared for Heritage Branch - Yukon Tourism, Whitehorse.

Handly, Martin J., Peter Merchant, Mike Rousseau. 1994. An Archaeological Impact Assessment of Proposed Developments within Pacific Sentinel Gold Corp's Casino Exploration Property near Carmacks, West-Central Yukon Territory. Permit No. 94-9ASR. Manuscript on file, Yukon Heritage Branch, Whitehorse, Yukon.

Hansen, J. A., Marr, J. C. A., Lipton, J., Cacela, D. and H.L. Bergman. 1999a. Differences in neurobehavioral responses of chinook salmon (Oncorhynchus tshawytscha) and rainbow trout (Oncorhynchus mykiss) exposed to copper and cobalt: behavioral avoidance. Environmental Toxicology and Chemistry, 18, 1972–1978.

Hansen, J. A., Rose, J. D., Jenkins, R. A., Gerow, K. G. and H.L. Bergman. 1999b. Chinook salmon (Oncorhynchus tshawytscha) and rainbow trout (Oncorhynchus mykiss) exposed to copper: neurophysiological and histological effects on the olfactory system. Environmental Toxicology and Chemistry, 18, 1979–1991.

Hatfield, T., & Bruce, J. 2000. Predicting salmonid habitat-flow relationships for streams from western North America. North American Journal of Fisheries Management 20:1005-1015.

Hayley, S., and J. Magdanz. 2008. "The Impacts of Resource Development on Social Ties: Theories and Methods for Assessment." *Earth Matters: Indigenous Peoples, the Extractive Industries and Corporate Social Responsibility.* Ed. Ciaran O'Faircheallaigh, and Saleem Ali.Green Leaf Publishing

Healey, M. C. 1991. Life history of Chinook salmon (Oncorhynchus tshazwytscha). In C. Groot, & L. Margolis, Pacific salmon life histories (pp. 313-393). Vancouver: UBC Press.

Health Canada. 2010. Useful Information for Environmental Assessments. http://www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/eval/environ_assess-eval/environ_assess-eval-eng.pdf

Health Canada. 2011. Guidance for Evaluating Human Health Impacts in Environmental Assessments: Noise. Health Canada: Ottawa, ON.

Health Canada. 2014. Evaluation of the Action Plan to Protect Human Health from Environmental Contaminants 2008-2009 to 2012-2013. Prepared by Evaluation Directorate Health Canada and the Public Health Agency of Canada. February 2014. http://www.hc-sc.gc.ca/ahc-asc/alt_formats/pdf/performance/eval/contaminants-eng.pdf

Hegel, T. M., A. Mysterud, F. Huettmann, and N. C. Stenseth. 2010. Interacting effect of wolves and climate on recruitment in a northern mountain caribou population. Oikos 119:1453–1461.

Hermanutz, R.O., Allen, K.N., Detenbeck, N.E. and C.E. Stephan. 1996. Exposure to bluegill (Lepomis macrochirus) to selenium in outdoor experimental streams. U.S. EPA Report. Mid-Continent Ecology Division. Duluth, MN.

Hinkel, K.M., F.E. Nelson, W. Porter, V. Romanovsky, O. Smith, W. Tucker, T. Vinson and L.W. Brigham. 2003. Climate Change, Permafrost, and Impacts on Civil Infrastructure, United States Arctic Research Commission Permafrost Task Force Report, Special Report 01-03, Dec. 2003.

Hoekstra, G. 2014. Geotechnical Inspections Pinpoint Concerns at Mine Dams: Documents. Vancouver Sun. December 11, 2014. http://www.vancouversun.com/business/Geotechnical+inspections+pinpoint+concerns+mine+dams+documents/10461730/story.html#ixzz3RMu4gFHA

Hogg, W.D. and Carr, D.A., 1985. Rainfall Frequency Atlas of Canada. Ministry of Environment, Canadian Climate Program.

Horowitz, A. J. 1991. A primer on sediment-trace element chemistry (Second ed.). Michigan, USA: Lewis Publishers, Inc.

Howes, D.E. and Kenk, E. 1997. Terrain Classification System for British Columbia (Version 2). Surveys and Resource Mapping Branch, Ministry of Crowns land, Victoria, BC. APEGBC. 2012. Professional Practice Guidelines – Legislated Flood Assessments in a Changing Climate in BC. The Association of Professional Engineers and Geoscientists of British Columbia.

Hsu, T.S., Yang, P.M., Tsai, J.S. and L.Y. Lin. 2009. Attenuation of cadmium-induced necrotic cell death by necrostatin-1: potential necrostatin-1 acting sites. Toxicology and Applied Pharmacology, Vol. 235, p.153–162.

Hustrulid W., Kuchta M., and Martin R. 2013. Open Pit Mine Planning and Design, Third Edition.

INAP. 2014. Global Acid Rock Drainage Guide.

Inikshuk Planning and Development. 2009. Little Salmon Carmacks Integrated Community Sustainability Plan 2007. April 2009. http://www.infrastructure.gov.yk.ca/pdf/icsp_lscfn.pdf

Instanes, A.. 2003. Climate Change and Possible Impact on Arctic Infrastructure. Permafrost. Phillips, Springman & Arenson (eds), Swets & Zeitlinger, Lisse, ISBN 90 5809 582 7, 461-466.

International Cyanide Management Institute. 2012. The International Cyanide Management Code. Retrieved from http://www.cyanidecode.org/sites/default/files/pdf/thecode.pdf

International Joint Commission (IJC). 1981. Report of the aquatic ecosystem objectives committee. Windsor, Ontario: Great Lakes Science Advisory Board, International Joint Commission.

International Standards Organization (ISO). 1996a. 9613-2 Acoustics - Description, measurement and assessment of environmental noise - Part 2: Determination of environmental noise levels

International Standards Organization (ISO). 1996b. 9613-2 Attenuation of Sound During Propagation Outdoors – Part 2: General method of calculation

Jeffrey personal comm. 2014. Traffic Summary – Whitehorse Corridor (2011). Spreadsheet provided electronically in Adobe Acrobat format by Ken Jeffrey, Transportation Analyst, Transportation Planning & Programming, Highways and Public Works, Yukon Government, September 2014.

Jessop, E. F., Chang-Kue, K. J., & MacDonald, G. 1993. Fish resource data from Indin Lake, Northwest Territories. Can. Data. Rep. Fish. Aquat. Sci., 907, 52.

Johnson, T.C., R.L. Berg, E.J. Chamberlain, and D.M. Cole. 1986. Frost Action Predictive Techniques for Roads and Airfields: A Comprehensive Survey of Research Findings. U.S. Army Cold Regions Research and Engineering Laboratory CRREL Report 86-18.

Joint Technical Committee of the Yukon River US/Canada Panel (JTC). 2013. Yukon River salmon 2012 season summary and 2013 season outlook. Anchorage: Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A13-02.

Jowett, I. G., Payne, T. R., & Milhous, R. T. 2014. SEFA System for Environmental Flow Analysis Software Manual, Version 1.21, February 2014. 226pp.

Kennedy, C. J., McDonald, L. E., Loveridge, R., and Strosher, M. M. 2000. The effect of bioaccumulated selenium on mortalities and deformities in the eggs, larvae, and fry of a wild population of cutthroat trout (Oncorhychus clarki lewisi). Archives of Environmental Contamination and Toxicology, 39, 46-52.

Kukka, P. M., A. McCulley, M. Suitor, C. D. Eckert, AND T. S. Jung. 2014. Collared pika (Ochotona collaris) occupancy in Tombstone Territorial Park, Yukon: 2013 survey results. Fish and Wildlife Branch Report SR-14-01. Whitehorse, Yukon, Canada.

Kunkel, K. E., and Pletscher, D. H. 2000. Habitat factors affecting vulnerability of moose to predation by wolves in southeastern British Columbia. Canadian Journal of Zoology, 78, 150-157.

Laberge Environmental Services. 2002. Flying in sheep country: how to minimize disturbance from aircraft. Whitehorse, Yukon: Prepared for the Mining Environment Research Group (MERG).

Labrot, F., Narbonne, J.F., Ville, , Saint Denis, M. and D. Ribera. 1999. Acute toxicity, toxicokinetics, and tissue target of lead and uranium in the clam Corbicula fluminea and the worm Eisenia fetida: Comparison with the fish Brachydanio rerio. Arch. Environmental Contamination and Toxicology, 36, 167-178.

Lee, W.K., Torchalski, B. and F. Thevenod. 2007. Cadmium-induced ceramide formation triggers calpain dependent apoptosis in cultured kidney proximal tubule cells. American Journal of Physiology – Cell Physiology, Vol. 293, p.C839–C847.

Lemly, A. D. 1982. Response of juvenile centrarchids to sublethal concentrations of waterborne selenium. Uptake, tissue distribution, and retention. Aquatic Toxicology, 2, 235-252.

Lemly, A.D. 2004. Aquatic selenium pollution is a global environmental safety issue. Ecotoxicology and Environmental Safety, 59, 44-56.

Lemly, A.D. and G.J. Smith. 1987. Aquatic cycling of selenium: Implications for fish and wildlife. Fish Wildlife Service/ Fish Wildlife Leaflet 12. U.S. Fish and Wildlife Service, Washington DC.

Lewis, A., Hatfield, T., Chilibeck, B., & Roberts, C. 2004. Assessment methods for aquatic habitat and instream flow characteristics in support of applications to dam, divert, or extract water from streams in British

Columbia. Report prepared for Ministry of Water, Land & Air Protection and Ministry of Sustainable Resource Management. March 2004. 103pp.

Lindgren, E., L. Tälleklint, and T. Polfeldt. 2000. Impact of climatic change on the northern latitude limit and population density of the disease-transmitting European tick *Ixodes ricinus*. Environmental health perspectives 108:119.

Little Salmon / Carmacks Integrated Community Sustainability Plan. 2007. Prepared by Inukshuk Planning & Development. Avaialble at: http://www.infrastructure.gov.yk.ca/pdf/icsp_lscfn.pdf

Little Salmon/Carmacks Fish and Wildlife Planning Team. 2011. Community based-fish and wildlife work plan for the Little Salmon/Carmacks First Nation Traditional Territory (2012 – 2017). Environment Yukon, Whitehorse (36 pages).

Liu, J., Qu, W. and M.B. Kadiiska. 2009. Role of oxidative stress in cadmium toxicity and carcinogenesis. Toxicology and Applied Pharmacology, 238, 209–214.

Lysay G.J., Davidson S.C. and Martin T.E. 2007. Design and Construction Evolution of the Kemess Mine Tailings Dam Montreal Energy & Mines, Montreal, April 29- May 2, 2007

M3 Engineering and Technology Corporation. (2013, January 25). Casino Project Feasibility Study Volume II. Retrieved October 24, 2014, from SEDAR: http://www.sedar.com/GetFile.do?lang=EN&docClass=24&issuerNo=00023684&fileName=/csfsprod/data138/filings/02014531/00000001/v%3A%5CWesternCopper%5CSEDAR%5C0026826_tech_Feb8_2013%5Corig%5CTechReport.pdf

Maidment, D. R. 1993. *Handbook of Hydrology*, McGraw-Hill Inc.

Maraj, R. 2007. Evaluating the ecological consequences of human land-use on grizzly bears in southwest Yukon., Canada. University of Calgary, AB: PhD dissertation, Faculty of Environmental Design.

Markel, R. L., and Larsen, D. G. 1988. Moose population characteristics in the Casino Trail area — November 1987. Whitehorse, Yukon: Department of Renewable Resources.

Martin, T. 2011. Mine Waste Management in Wet, Mountainous Terrain: Some British Columbia Perspectives. From: Proceedings Tailings and Mine Waste 2011. http://www.infomine.com/library/publications/docs/Martin2011b.pdf

Mathers, J. S., West, N. O., & Burns, B. 1981. Aquatic and wildlife resources of seven Yukon streams subject to Placer mining. DFO, Vancouver; DIAND, Ottawa; DOE, Whitehorse.

Mattson, D. J., and T. Merrill. 2002. Extirpations of Grizzly Bears in the Contiguous United States, 1850–2000. Conservation Biology 16:1123–1136.

McConnachie, J., Johns, C., Evans, J., Lysay, G. J. 2010. Kemess South Mine reclamation and closure. In: British Columbia Mine Reclamation Symposium 2010.

McDonald, L. E., and Strosher, M. M. 1998. Selenium mobilization from surface coal mining in the Elk River basin, British Columbia: A survey of water, sediment and biota. Cranbrook, BC: Ministry of Environment, Lands and Parks, Kootenay Region.

McIntyre, J.K., Baldwin, D.H., Meador, J. and N.L. Scholz. 2008. Chemosensory deprivation in juvenile coho salmon exposed to dissolved copper under varying water chemistry conditions. Environmental Science and Technology, 42, 1352–1358.

McLean, D. 2013, September 26. Phone discussion with L. Pigage.

McLellan, B. N., and Shackleton, D. M. 1988. Grizzly Bears and Resource Extraction Industries: Effects of Roads on Behavior, Habitat Use and Demography. Journal of Applied Ecology , 24, 451-460.

McPhail, J. D. 2007. The freshwater fishes of British Columbia. Edmonton, Alberta: University of Alberta Press.

McPhail, J. D., & Paragamian, V. L. 2000. Burbot Biology and Life History. In V. L. Paragamian, & D. W. Willis, Burbot: Biology, Ecology and Management. Bethesda, Maryland, USA: American Fisheries Society, Fisheries Management Section, Publication number 1.

Meays, C. and R. Nordin. 2013. Ambient Water Quality Guidelines For Sulphate – Technical Appendix Update. Water Protection and Sustainability Branch, Environmental Sustainability and Strategic Policy Division, BC Ministry of Environment

Merrill, T., and D. J. Mattson. 2003. The extent and location of habitat biophysically suitable for grizzly bears in the Yellowstone region. Ursus 14:171–187.

Metal Mining Effluent Regulations (MMER). SOR/2002-222.

Meyer, J. S. and W.J. Adams. 2010. Relationship between biotic ligand model-based water quality criteria and avoidance and olfactory responses to copper by fish. Environmental Toxicology and Chemistry, 29, 2096–2103.

Miller, R. B. 1946. Notes on the Arctic grayling Thymallus signifer Richardson, from Great Bear Lake. Copeia, 227-236.

Millier Dickson Blais. 2014. Yukon Labour Market Supply and Migration Study. Prepared for the Yukon Skills Table. Final Report. Available at: http://www.education.gov.yk.ca/pdf/Yukon_Labour_Market_Supply_and_Migration_Study_April_10_2014.pdf

Mining and Petroleum Environmental Resource Group (MPERG). 2008. Guidelines for Industrial Activity in Bear Country: for the mineral exploration, placer mining and oil and gas industries. Retrieved November 10, 2014, from http://www.geology.gov.yk.ca/pdf/Guidelines_for_Industrial_Activity_in_Bear_Country-web.pdf

Mining Association of Canada. 2011. A Guide to the Management of Tailings Facilities. Retrieved November 4, 2014, from The Mining Association of Canada: http://mining.ca/sites/default/files/documents/GuidetotheManagementofTailingsFacilities2011.pdf

Ministry of Forest Lands and Natural Resource Operations (MFLNRO). 2012. The Best Practice for Wind Power Project Acoustic Assessment. Victoria. BC

MNP LLP. 2013. Economic Impacts of the Casino Mine Project. March 2013. Casino Mine Corporation.

Mooney, James M. 2011. Historic Resource Impact Assessment of the Proposed Freegold Road Extension km 0 to km 132 (previously known as Freegold Road km 60 to km 196). Permit No. 11-04ASR. Report prepared for Western Copper and Gold Corporation, Vancouver, BC and Heritage Resources Unit Department of Business Tourism, and Culture Government of Yukon, Whitehorse YT.

Mooney, James M. 2012. Historic Resource Impact Assessment of the Combined Northern Freegold Resources 2011 Exploration Program (Tinta Hill, Freegold, Nucleus, and Revenue Properties. Permit No. 11-13ASR. Prepared for Northern Freegold Resources Ltd. On file with the Yukon Heritage Branch.

Mooney, James M. 2013a. Heritage Resource Impact Assessment of the Proposed Freegold Road Extension 33 km to 196 km. Permit No. 13-07ASR. Report Prepared for Casino Mining Corporation, Vancouver, BC.

Mooney, James M. 2013b. Historic Resource Impact Assessment of the Combined Northern Freegold Resources 2012 Exploration Program. Permit No. 12-03ASR. Prepared for Northern Freegold Resources Ltd. On file with the Yukon Heritage Branch. Permit No. 12-03ASR.

Mooney, James M. 2014. Final Report: Data Recovery Excavations at Site KfVi-5. Permit No. 13-18ASR. Report prepared for Casino Mining Corporation, Vancouver, BC.

Morrison, S., and Wong, M. 2013. Late winter habitat selection by moose in the Dawson land use planning region. Yukon Fish and Wildlife Branch Report TRC-12-01. Prepared by Dryas Research Ltd. and Mark Wong Consulting for Yukon Department of Environment. Whitehorse: Yukon Environment.

Mueller, C. S., Herrero, S., and Gibeau, M. L. 2004. Distribution of Subadult Grizzly Bears in Relation to Human Development in the Bow River Watershed, Alberta. Ursus, 15(1), 35-47.

Nagpal, N. K. 1987. Water quality criteria for lead. Technical Appendix. British Columbia Ministry of Environment and Parks. Water Management Branch.

National Research Council, 2004. Adaptive Management for Water Resources Planning. The National Academies Press, Washington, DC.

Natural Resources Canada (NRCan). 2014. Fire Safety Plan Guideline. April 8, 2014. http://www.nrcan.gc.ca/explosives/13969

NOAA, 1999. Hydrometeorology Report No. 59, US Department of Commerce, National Oceanic and Atmospheric Administration, US Department of Army Corps of Engineers. February 1999.

NOAA, 2012. NOAA Atlas 14: Precipitation-Frequency Atlas of the United States. Volume 7 Version 2.0: Alaska. Silver Spring, Maryland, 2012.

Nordenskiold Sterring Committee. 2010. Tsawnjik Chu Nordenskiold Habitat Protection Area Management Plan.

Oil and Gas Commission's (OGC). 2009. British Columbia Noise Control Best Practices Guideline

Parker, M. A. 2000. Fish Passage - Culvert Inspection Procedures. Ministry of Environment, Lands and Parks.

Pathak, N. and S. Khandelwal. 2006. Oxidative stress and apoptotic changes in murine splenocytes exposed to cadmium. Toxicology, 220, 26–36.

Payne, T. R., & Bremm, D. J. 2003. The influence of multiple velocity calibration sets on the PHABSIM habitat index. Paper presented to International IFIM User's Workshop, June 1-5, 2003, Ft. Collins, CO.

Pearse, T., D., and M. Weinstein. 1988. Opening the Land: A Study of the Impacts of the Casino Trail on the Northern Tutchone of Pelly Crossing and Carmacks, Yukon Territory.

Phippen, B. C., Horvath, R., Nordin, R., and Nagpal, N. 2008. Ambient water quality guidelines for iron. Ministry of Environment, Water Stewardship Division, Science and Information Branch.

Pimentel, R. and R.V. Bulkley. 1983. Influence of water hardness on fluoride toxicity to rainbow trout. Environmental Toxicology and Chemistry, 2, 381–386.

Price W. 1997 Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia.

Price, W. 2009 Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. CANMET Mining and Mineral Sciences Laboratories. MEND Report 1.20.1 pp. 579.

Proctor, M., McLellan, B. N., Strobeck, C., and Rowland, M. M. 2002. Population Fragmentation of Grizzly Bears in Southwestern British Columbia, Canada. Ursus, 13, 153-160.

Purves, H., and Doering, C. 1998. Grizzly bear habitat effectiveness: Assessing cumulative effects of human use in Jasper National Park. San Diego, California: ESRI International User Conference proceedings.

Rasmussen G., Hoffert J., Tucker G., Kinch J., Colwell D., 2004. The Kemess Mines Ltd. Tailings Dam Construction Using Tailings Construction Sand. Proceedings of the 36th Annual Meeting of the Canadian Mineral Processors: Paper 4.

Regoli, L., Van Tilborg, W., Heijerick, D., Stubblefield, W. and S. Carey. 2012. The bioconcentration and bioaccumulation factors for molybdenum in the aquatic environment from natural environmental concentrations up to the toxicity boundary. Science of the Total Environment, 435–436, 96–106.

Reid, S.S. and D.G. McDonald. 1991. Metal Binding Activity of the Gills of Rainbow Trout (Oncorhynchus mykiss). Canadian Journal of Fisheries and Aquatic Sciences 48, 1061-1068.

Reiser, D.W., T.A. Wesche, and C. Estes. 1989. Status of instream flow legislation and practices in North America. Fisheries 14(2):22-29.

Rescan. 2012. Ekati Diamond Mine: Literature Review - Exclusion Barriers and Wildlife. Prepared for BHP Billiton Canada Inc. by Rescan Environmental Services Ltd.: Yellowknife, Northwest Territories.

Ricketts, C. D. 2006. The effects of acute waterborne exposure to sub-lethal concentrations of molybdenum on the stress response in rainbow trout (Oncorhynchus mykiss). MSc Okanogan College, B. C.

Risso-de Faverney, C., Devaux, A., Lafaurie, M., Girard, J., Bailly, B. and R. Rahmani. 2001. Cadmium induces apoptosis and genotoxicity in rainbow trout hepatocytes through generation of reactive oxygene species. Aquatic Toxicology, 53, 65-76.

RLS. 1990. Richtlinien für den Lärmschutz an Strassen. BM für Verkehr, Bonn (German Guideline for Noise Protection on Streets (RLS-90).

Roberge, M., Hume, J. B., Minns, C. K., & Slaney, T. 2002. Life history characteristics of freshwater fishes occurring in British Columbia and the Yukon, with major emphasis on stream habitat characteristics. Canadian Manuscript Reports of Fisheries and Aquatic Sciences, 261(1), 248.

Ross, P. I. 2002. Update COSEWIC status report on the grizzly bear Ursus arctos in Canada, in COSEWIC assessment and update status report on the Grizzly Bear Ursus arctos in Canada. Ottawa: Committee on the Status of Endangered Wildlife in Canada.

Scott, K. 2010. Community Vitality: A Report of the Canadian Index of Wellbeing. Retrieved October 2014: http://www.worktogether.ca/sites/worktogether.ca/files/CommunityVitality_DomainReport.sflb_.pdf

Seabridge Gold Inc. 2013. Application for an Environmental Assessment Certificate/Environmental Impact Statement. Section 26.9.1.4.12: Water Storage Dam or Tailing Management Facility Failure.

Selkirk First Nation / Pelly Crossing Integrated Community Sustainability Plan. 2007. Prepared by Inukshuk Planning & Development. Available at: http://www.infrastructure.gov.yk.ca/pdf/selkirk_fn_pelly_crossing_icsp_final.pdf

Selkirk First Nation, Yukon Government, Capstone Mining Corp. 2013. Minto Mine Socio-Economic Monitoring Program Framework

SGS. 2013. Lime Treatment of Waste Rock Humidity Cell HC12. November 29, 2013.

Shandro, J.A., Veiga, M.M., Koehoorn, M., Shoveller, J., Scoble, M. 2011. "Perspectives on Community Health Issues and the Mining Boom-Bust Cycle." *Resources Policy* 36: 178-186.

Simon, O. and J. Garnier-Laplace. 2004. Kinetic analysis of uranium accumulation in the bivalve Corbicula luminea: effect of pH and direct exposure levels. Aquatic Toxicology, 68, 95-108.

Simon, O. and J. Garnier-Laplace. 2005. Laboratory and field assessment of uranium trophic transfer efficiency in the crayfish Orconectes limosus fed the bivalve C. fluminea. Aquatic Toxicology, 74, 372-383.

Simonsen, L., Clarke, M.J., Schonberger, L.B., Arden, N.H., Cox, N.J., and Fukuda, K. 1998. "Pandemic versus Epidemic Influenza Mortality: A Pattern of Changing Age Distribution." *Journal of Infectious Diseases* 178: 53-60.

Simpson, K. 1987. Impacts of a hydro-electric reservoir on populations of caribou and grizzly bear in southern British Columbia. B.C. Ministry of Environment and Parks, Wildlife Branch. Wildlife Working Rep. No. WR-24, Nelson. 37pp.

Sorensen, E.M.B. 1988. Selenium accumulation, reproductive status, and histopathological changes in environmentally exposed redear sunfish. Toxicology, 61, 324-329.

Soucek, D.J. 2007a. Bioenergetic effects of sodium sulfate on the freshwater crustacean, Ceriodaphnia dubia. Ecotoxicology, 16, 317–325.

Soucek, D.J. 2007b. Sodium sulfate impacts feeding, specific dynamic action, and growth rate in the freshwater bivalve Corbicula fluminea. Aquatic Toxicology, 83, 315-322.

Soucey, Kristin, Bruce Ball, Alice Storey, and Sheila Greer. 2010a. 2009 Historical Resource Assessment Western Copper Corporation Casino Project. Permit No. 9-09ASR. Prepared on behalf of Western Copper Corporation by Altamira Consulting Ltd., Edmonton.

Soucey, Kristin, Bruce Ball, and Sheila Greer. 2010b. Historical Resource Assessment Britannia Creek Road Re-Alignment – Casino Project Western Copper Corporation. Permit No. 10-04ASR. Prepared on behalf of Western Copper Corporation by Altamira Consulting Ltd., Edmonton. Registered Trapper, 2013. Personal Communication through one-one interview.

Species at Risk Act, 29 (Statutes of Canada 2002).

SRK Consulting (SRK). 2013. NI 43-101 Technical Report for the Kemess Underground Project, British Columbia, Canada. Prepared for AuRico Gold Inc. April 1, 2013.

SRK Consulting (SRK). 2013. NI 43-101 Technical Report for the Kemess Underground Project, British Columbia, Canada. Prepared for AuRico Gold Inc. April 1, 2013.

Statistics Canada 2013. 2011 National Household Survey Profile. Statistics Canada Catalogue no. 99-004-XWE. Ottawa. Available at: http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E. Accessed July 2013.

Statistics Canada. 2007. 2006 Community Profiles. Statistics Canada Catalogue no. 92-591-XWE. Ottawa. Released 13 March 2007. Available at: http://www12.statcan.gc.ca/census-recensement/2006/dp-pd/prof/92-591/index.cfm?Lang=E. Accessed November 2012.

Statistics Canada. 2012. Census Profile. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released October 24, 2012. Available at http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E. Accessed July 2013.

Stewart, D. B., Monchnacz, N. J., Reist, J. D., Carmichael, T. J., & Sawatzky, C. D. 2007. Fish life history and habitat use in the Northwest Territories: Arctic grayling (Thymallus arcticus). Can. Manuscr. Rep. Fish. Aquat. Sci., 2797, 55.

StrataGold Corporation. 2013. Eagle Gold Project Emergency Response Plan Version 2013-01. http://www.emr.gov.yk.ca/mining/pdf/mml_eg_emergency_response_plan_may2013.pdf

Swanson, S.M. 1985. Food-chain transfer of U-series radionuclides in a northern Saskatchewan aquatic system. Health Physics, 49, 747-770.

Tharme, R.E. 1996. Review of international methodologies for the quantification of the instream flow requirements of rivers. Freshwater Research Unit, University of Cape Town, report commissioned by the Department of Water Affairs and Forestry. November 1996. 82pp.

Tharme, R.E. 2002. A global perspective on environmental flow assessment: emerging trends in the development and application of environmental flow methodologies for rivers. *In* Proceedings of the International Conference on Environmental Flows for River Systems, incorporating the 4th International Ecohydraulics Symposium. Cape Town, South Africa. March 2002.

The Mining Association of Canada (MAC). 2014. *Towards Sustainable Mining*. Retrieved November 13, 2014, from The Mining Association of Canada: http://mining.ca/towards-sustainable-mining

The Municipality of Skagway, Alaska. Skagway's Yukon Port Project. January 2010.

The Municipality of Skagway. 2015. Port of Skagway. http://www.skagway.org/index.asp?SEC=21FD65B5-E64D-488B-9F51-51B650B9D6DE&Type=B_BASIC

Thornthwaite, C.W. 1948. *An approach toward a rational classification of climate,* Geographical Review (American Geographical Society) 38 (1): 55–94.

Transport Canada. 2012. Emergency Response Guidebook: A Guidebook for First Responders During the Initial Phase of a Dangerous Goods/Hazardous Materials Transportation Incident. Ottawa: Transport Canada.

Tripp, D. B., & McCart, P. J. 1974. Life histories of grayling (Thymallus arcticus) and longnose suckers (Catostomus catostomus) in the Donnelly River system, N.W.T. In P. J. McCart, Life histories of anadromous and freshwater fish in the western Arctic. Arctic Gas Biological Report Series 15.

US EPA. 1987. Ambient water quality criteria for selenium. EPA-440/5-87-006. National Technical Information Service.

US EPA. 2000. Methods for measuring the toxicity and bioaccumulation of sediment-associated contaminants with freshwater invertebrates. EPA 600/R-99/064. March 2000.

US EPA. 2001. Update of ambient water quality criteria for cadmium. EPA-822-R-01-001. Washington, D.C.: Office of Water, US Environmental Protection Agency.

US EPA. 2004. Draft aquatic life water quality criteria for selenium. EPA-822-D-04-001. Washington, D.C.: Office of Water, US Environmental Protection Agency.

US EPA. 2007. Aquatic Life Ambient Freshwater Quality Criteria – Copper. 2007 Revision. EPA-822-R07-001. Washington D.C.

VDI. 1976. Standard 2571: Sound Radiation From Industrial Buildings

Viau, M., Gastaldo, J., Bencokova, Z., Joubert, A. and N. Foray. 2008. Cadmium inhibits non-homologous end joining and over-activates the MRE11-dependent repair pathway. Mutation Research, 654, 13-21.

Village of Carmacks Official Community Plan. 2013.

Vizon SciTec Inc. 2004. Final report on the toxicity investigation of uranium to aquatic organisms. CNSC Project No.: R205.1.

von Finster, A. 1998. Fisheries resources of the mid-reaches of Big Creek, tributary to the Yukon River near Minto. Memorandum to file: Habitat and Enhancement Branch, DFO.

Waite, D.T., Joshi, S.R., Sommerstad, H., Wobeser, G. and A.A. Gajadhar. 1990. A toxicological examination of whitefish (Coregonus clupeaformis) and Northern Pike (Esox lucius) exposed to uranium mine tailings. Environmental Contamination and Toxicology, 19, 578-582.

Wake, B.D., Bowie, A.R., Butler, E.C.V. and R. Haddad. 2004. Modern preconcentration methods for the determination of selenium species in environmental water samples. Trends in Analytical Chemistry, 23(7), 491-500.

Walker, C. E. 1976. Studies on the freshwater and anadromous fishes of the Yukon River within Canada. Fish. Mar. Serv. Tech. Rep. PAC/T-76-7, 99.

Weber, Sascha. Executive Director. Yukon Mining Training Association. Conversation. 20 August 2014.

Whitehorse Daily Star. 2014. Yukon River chinook run is proving robust. Retrieved September 28, 2014, from http://www.whitehorsestar.com/News/yukon-river-chinook-run-is-proving-robust

Wilson, S., D. R. Norris, A. G. Wilson, and P. Arcese. 2007. Breeding experience and population density affect the ability of a songbird to respond to future climate variation. Proceedings of the Royal Society B: Biological Sciences 274:2539–2545.

World Meteorological Organization (WMO). 2009. Manual of Estimation of Probable Maximum Precipitation (PMP). http://www.wmo.int/pages/prog/hwrp/publications/PMP/WMO%201045%20en.pdf

World Meteorological Organization (WMO). 2009. Manual of Estimation of Probable Maximum Precipitation (PMP). http://www.wmo.int/pages/prog/hwrp/publications/PMP/WMO%201045%20en.pdf

Wright D.G., & Hopky G.E. 1998. Guidelines for the use of explosives in or near Canadian fisheries waters. Canadian technical report of fisheries and aquatic sciences 2107. DFO, Winnipeg, MB, Canada.

Yang, D.Y., Mercer, R.A., Brouwer, K.J., and Tomlinson, C. 2011). Managing pit slope stability at the Kemess South Mine - changes over time. In Proceedings of Slope Stability 2011: International Symposium on Rock Slope Stability in Open Pit Mining and Civil Engineering. Canadian Rock Mechanics Association, Vancouver, BC.

Yang, P.M., Chen, H.C., Tsai, J.S. and L.Y. Lin. 2007. Cadmium induces Ca2+- dependent necrotic cell death through calpain-triggered mitochondrial depolarization and reactive oxygen species-mediated inhibition of nuclear factor-kappaB activity. Chemical Research in Toxicology, Vol. 20, p. 406–415.

YESAB (Yukon Environmental and Socio-economic Assessment Board). 2005. Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions. Whitehorse, Yukon V 2005.11.

YESAB. 2005. Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions. Whitehorse: YESAB.

Yukon College. 2012. About CNIM. Available at: http://www.yukoncollege.yk.ca/programs/cnim/about_cnim. Accessed March 2015.

Yukon Energy, Mines and Resources. 2006. Yukon Mine Site Reclamation and Closure Policy. Whitehorse: Yukon Government, Department of Energy, Mines and Resources.

Yukon Energy, Mines and Resources. 2014. Yukon Mine Site and Reclamation Closure Policy: Financial Guidelines. Whitehorse: Yukon Government.

Yukon Environment. (n.d). Grizzly Bear, full mammal description. Available at http://www.env.gov.yk.ca/animals-habitat/mammals/documents/Grizzly_bears.pdf. Accessed 6 February 2015.

Yukon Environment. 2013, April. Fish and Wildlife Branch Project Summaries 2013-2014. Retrieved November 10, 2014, from http://www.env.gov.yk.ca/publications-maps/documents/FWProjectSummaries2013-14.pdf

Yukon Environment. 2013. Personal communication with Harvest Coordinator.

Yukon Environmental and Socio-economic Assessment Act. 2005. Available: http://laws-lois.justice.gc.ca/eng/acts/Y-2.2/index.html. (Accessed October 2013).

Yukon Environmental and Socio-economic Assessment Board (YESAB). 2014. Geohazards and Risk: A Proponent’s Guide to Linear Infrastructure: Environment & Water – Draft for Review. Retrieved February 2015: http://www.yesab.ca/wp/wp-content/uploads/2014/10/YESAB-DRAFT-Geohazards-Guide-for-Review-2014-10-21.pdf

Yukon Fish and Wildlife Co-Management (YFWCM). 1996, July. Woodland Caribou management decision guidelines. Retrieved October 2013, from Yukon Fish and Wildlife Co-Management : http://www.yfwcm.ca/species/caribou/guidelines.php

Yukon Fish and Wildlife Co-Management, 2011. (Accessed June 2013) Hunting and Trapping Wolves in Yukon. http://www.yfwcm.ca/YukonWolfPlanReview/going/documents/Trappingfactsheet FINALApr_11_207.pdf.

Yukon Government 2011. Yukon Traffic Data Summary 2011 (170pp)

Yukon Government 2012. Updated (2012) Summary of Yukon Traffic Data. Spreadsheets provided electronically in MSExcel format by Bibiana Zavadova, Data Management & Systems Support Technician, Transportation Planning & Programming, Highways and Public Works, Yukon Government.

Yukon Government 2014. Traffic Summary – Whitehorse Corridor (2011). Spreadsheet provided electronically in Adobe Acrobat format by Ken Jeffrey, Transportation Analyst, Transportation Planning & Programming, Highways and Public Works, Yukon Government, September 2014.

Yukon Government Energy, Mines and Resources. 2015. Government of Yukon. Department of Energy, Mines and Resources: Land Services: Current Land Applications: Land Applications. (Accessed on March 3, 2015) http://www.emr.gov.yk.ca/lands/yukon_land_applications.html

Yukon Government, Energy Mines and Resources. 2015. Royalties. Available at: www.emr.gov.yk.ca/mining/royalty_narrative.html. (Accessed February 26 2015)

Yukon Government. 2006. Yukon Mine Site Reclamation and Closure Policy. Whitehorse: Yukon Government, Department of Energy, Mines and Resources.

Yukon Government. 2013, August. Plan Requirement Guidance for Quartz Mining Projects. Retrieved from http://www.yukonwaterboard.ca/forms/quartz/Plan%20Requirement%20Guideline%20for%20

Yukon Government. 2013. *Plan Requirement Guidance for Quartz Mining Projects.* Retrieved from http://www.yukonwaterboard.ca/forms/quartz/Plan%20Requirement%20Guideline%20for%20

Yukon Government. 2013. Resource Access Roads Framework. Department of Highways and Public Works. Whitehorse, Yukon. http://www.emr.gov.yk.ca/lands/pdf/WEB_English_ResourceAccessRoadFramework.pdf

Yukon Government. 2014. Resource Access Road Regulation: Discussion Paper. Department of Energy, Mines and Resources, Land Management Branch. http://www.emr.gov.yk.ca/lands/pdf/resource_access_road_discussion_paper_june2014.pdf

Yukon Mining Training Association. No date. No title. Available at http://ymta.org/wp/. Accessed August 2014.

Yukon River Panel. 2008. Yukon River Salmon Fisheries Harvest Information. Retrieved September 28, 2014, from http://yukonriverpanel.com/salmon/fisheries-menagement/yukon-riversalmon-fisheries-harvest

Yukon Salmon Sub-Committee. 2014. Retrieved September 28, 2014, from http://yssc.ca/issues/item/commercial-fishing-along-the-yukon-riverAlaska Department of Fish and Game. 2011. Caribou management report of survey-inventory activities, 1 July 2008 - 30 June 2010. Alaska Department of Fish and Game.

Yukon Tourism and Culture. 2010. Operational Policy for Heritage Resources Management on Yukon Lands. http://www.tc.gov.yk.ca/pdf/operational_policy_on__yukon_lands_her_2010_02_17.pdf

Yukon Water Board. (2013). Reclamation and Closure Planning for Quartz Mining Projects. Whitehorse: Yukon Energy, Mines and Resources.

Yukon Water Board. Yukon Energy, Mines and Resources. 2013. Plan Requirement Guidance for Quartz Mining Projects. Whitehorse, Yukon.