

# APPENDIX 7F: WATER BALANCE REPORT

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- 6B Terrain Hazards Assessment for Proposed Access Roads and Airstrip
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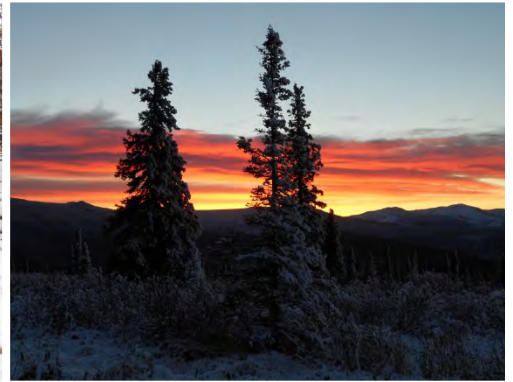
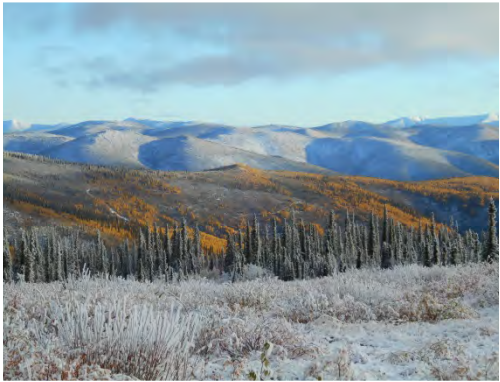
- 11A Vegetation Baseline Report

### 12 Wildlife

- 12A Wildlife Baseline Report
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# CASINO MINING CORPORATION CASINO PROJECT



## YESAB WATER BALANCE MODEL REPORT

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# CASINO MINING CORPORATION CASINO PROJECT

## YESAB WATER BALANCE MODEL REPORT VA101-325/14-10

Rev	Description	Date	Approved
1	Issued in Final	December 13, 2013	<i>KJB</i>

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## EXECUTIVE SUMMARY

A water balance model integrating groundwater, surface water, and mine water operations was developed for the Casino Project. The purpose of the model was to evaluate the quantity and flow of water in the ground, in the streams and in various mine facilities to support the Yukon Environmental and Socio-Economic Assessment Board proposal. The water balance also provided the platform on which water quality modelling was completed by Source Environmental Associates Inc. This report outlines the modelling methodology, assumptions and input parameters used to develop the water balance and presents results of the modelling for various mine facilities.

The water balance is a deterministic model based on average monthly hydrometeorological conditions, which are repeated every year for the mine life. Multiple models, which were created for the Project to evaluate surface runoff, groundwater flows and pathways, and operational flows, are integrated in the water balance. The timeline represented in the water balance is for the pre-production, operations, closure and post-closure of the Project.

The results of the water balance for average hydrometeorological conditions are as follows:

- The Project mine operations will operate in a deficit; therefore, makeup water from the Yukon River freshwater pipeline will be required to supplement the mill process. Makeup water requirements will range from 11.5 Mm<sup>3</sup>/yr at the start of operations to 0.2 Mm<sup>3</sup>/yr at the end of operations, with an average of approximately 6.2 Mm<sup>3</sup>/yr throughout operations.
- The heap leach facility (HLF) will also operate in a water deficit; for all months during operations when ore is being stacked (Years -3 to 15) and then for most months during additional gold recovery (Years 16 to 18) and closure rinsing (Years 19 to 23). Makeup water will be required to supplement the leach irrigation system as well as to bring stacked ore up to the leaching moisture content, and requirements will range from 1,900 m<sup>3</sup>/day in Year 2 to 484 m<sup>3</sup>/day in Year 15, but will generally average about 1000 m<sup>3</sup>/day before Year 15 and 600 m<sup>3</sup>/day after Year 15.
- The HLF will operate in a water surplus condition during certain months in the additional gold recovery and closure rinsing phases, and in all months during closure draindown. Excess water generated from the heap during operations (Years -3 to 18) will be recycled to inactive areas of the heap for temporary storage. Excess water during closure (Years 19 to 28) rinsing and draindown will be routed to the open pit to aid in pit filling. In post-closure of the heap, as of Year 29, infiltration through and runoff from the closure cover will be routed downstream to the Tailings Management Facility (TMF) pond.
- The TMF pond will be pumped to the Open Pit at the end of operations for a period of 5 years at a rate of approximately 1200 m<sup>3</sup>/hr, which will draw down the pond level to approximately 0.75 m above the tailings surface.
- The TMF will then take approximately three years to fill and begin spilling through the constructed spillway.
- Annual average flows from the TMF spillway will be approximately 130 L/s following the TMF reaching its maximum capacity, and approximately 190 L/s once the Pit Lake is discharging.
- The Open Pit will take approximately 95 years to establish the Pit Lake with an outlet elevation of 1095 masl.

- The controlled overflow from the Pit Lake to the North TMF Wetland will have to average 180 L/s during June through September in order to maintain a Pit Lake elevation at or below 1095 masl.
- The Winter Seepage Mitigation Pond (WSMP) constructed downstream of the TMF will begin releasing flows when the TMF has reached its maximum capacity and begins spilling. The WSMP will release at a constant rate of 130 L/s from May through August and at reduced rates ranging from approximately 50 to 120 L/s from September through November. There will be no flow release and the pond will collect water during the winter months of December through April.

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**ABBREVIATIONS**

CMC.....	Casino Mining Corporation
Casino Project.....	the Project
FWSP.....	freshwater supply pond
HLF.....	heap leach facility
KP.....	Knight Piésold Ltd.
Non-PAG.....	non-potential acid generating
PAG.....	potentially acid generating
TMF.....	tailings management facility
WMP.....	water management pond
WRMF.....	waste rock management facility
WSMP.....	winter seepage mitigation pond
YESAB.....	Yukon Environmental and Socio-Economic Assessment Board

## 1 – INTRODUCTION

### 1.1 SCOPE OF REPORT

This report outlines the integrated water balance developed for the Yukon Environmental and Socio-Economic Assessment Board (YESAB) proposal for the Casino Project (the Project). The YESAB water balance combines groundwater, surface water, and mine water operations to evaluate the quantity and flow of water in the ground, in the streams and in various mine facilities. The water balance also provided the platform on which water quality modelling was completed by Source Environmental Associates Inc. This report outlines the modelling methodology, assumptions and input parameters used to develop the water balance and presents results of the modelling.

### 1.2 MODELLING PHILOSOPHY

The YESAB water balance is a deterministic model created using the GoldSim© software package. The model consists of a series of integrated containers that represent the various components of the surface water and groundwater systems, and the mine water operations, for the Project.

The water management plan developed for the Project was used to define the water management strategy used in the YESAB water balance. Detailed information on the overall Casino water management approach is outlined in the Casino Project Water Management Plan Report (KP, 2013a). A summary of the water management plan is presented in Section 3.2 of this report for reference. Additional models created for the Project were also integrated into the YESAB water balance to further define flow quantities and pathways. These models include:

- The watershed model outlined in KP's letter "Baseline and Mine Operations Watershed Model, Casino Project" (see Appendix A)
- The numerical groundwater model outlined in "Numerical Groundwater Modelling" (KP, 2013b), and
- The feasibility level operational water balance model (KP, 2012a).

Climate conditions (e.g. net precipitation and groundwater infiltration) were determined from the watershed model, while groundwater flow paths and magnitudes (e.g. groundwater upwelling into the TMF and bypassing the TMF) were determined from the numerical groundwater model. Operational water management and production methodology (e.g. ore/waste rock production rates, mill operations and cyclone sand operations) were based on the operational water balance model and the feasibility design of the Project.

## 2 – PROJECT DESCRIPTION

### 2.1 GENERAL

The Casino Project is a venture by Casino Mining Corporation (CMC) to develop an open pit copper-gold-molybdenum mine in the Yukon. The project is located in the Dawson Range Mountains of the Klondike Plateau, approximately 300 km northwest of Whitehorse, Yukon, Canada, as shown on Figure 2.1. The deposit is hosted by the Prospector Mountain Suite, a suite of igneous intrusive rocks with an intense hydrothermal alteration overprint. The deposit will be mined using open pit methods, with a nominal mill throughput of approximately 120,000 tonnes/day (tpd) of ore over a 22 year operating life.

The general layout of the project site is shown on Figure 2.2. The proposed project facilities include ore stockpiles, a Plant Site, a Heap Leach Facility (HLF), an Open Pit, and a Tailings Management Facility (TMF). The Pit will be up to 600 meters deep and contain a mineable reserve of approximately 965 million tonnes of mill ore. The TMF has been sized to provide sufficient capacity to store approximately 956 million tonnes of tailings (including cyclone sand tailings used as embankment fill) and co-disposal of up to 649 million tonnes of potentially reactive waste rock and overburden materials.

Approximately 157.5 million tonnes of additional mined ore will be processed at the HLF located south of the Open Pit. HLF operations will commence in Year -3 during pre-production stripping of the Pit and continue until Year 15 for active ore stacking on the heap, with three years of additional gold recovery from Years 16 to 18.



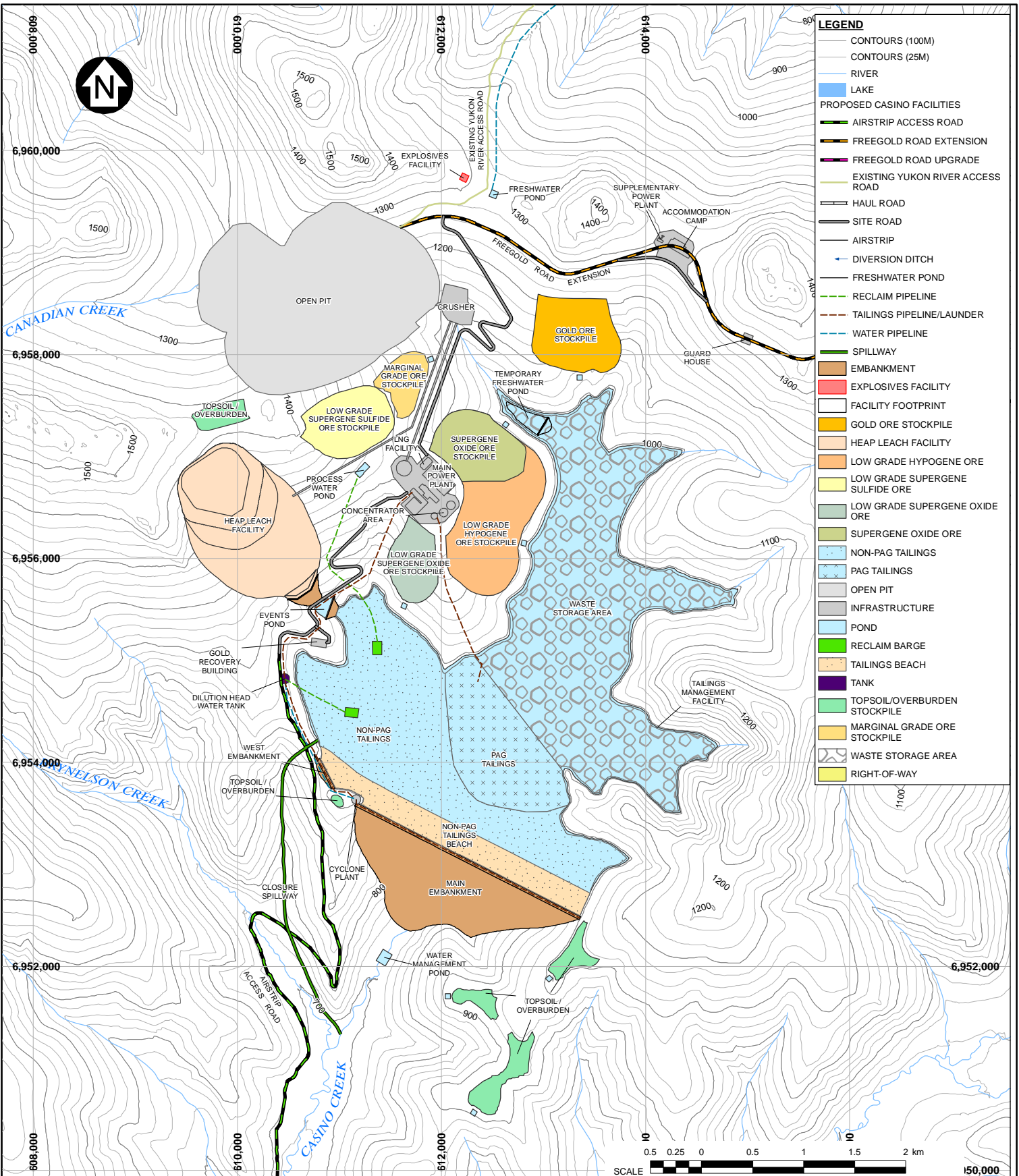
- LEGEND**
- PROJECT LOCATION
  - CITY / TOWN
  - EXISTING ROAD
  - PROPOSED ACCESS ROAD

- NOTES:**
1. BASE MAP: (C) MICROSOFT BING MAPS AND NATIONAL ROAD NETWORK.
  2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: WGS 1984 WEB MERCATOR AUXILIARY SPHERE.
  3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:12,000,000 FOR 8.5x11 (LETTER) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

<b>CASINO MINING CORPORATION</b>	
<b>CASINO PROJECT</b>	
<b>PROJECT LOCATION MAP</b>	
<b><i>Knight Piésold</i></b> CONSULTING	P/A NO. VA101-325/14 REF NO. 10 <b>FIGURE 2.1</b> REV 0

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0	30OCT'13	ISSUED WITH REPORT	CC	CC	AS1	KJB



- LEGEND**
- CONTOURS (100M)
  - CONTOURS (25M)
  - RIVER
  - LAKE
  - PROPOSED CASINO FACILITIES
  - AIRSTRIP ACCESS ROAD
  - FREEGOLD ROAD EXTENSION
  - FREEGOLD ROAD UPGRADE
  - EXISTING YUKON RIVER ACCESS ROAD
  - HAUL ROAD
  - SITE ROAD
  - AIRSTRIP
  - DIVERSION DITCH
  - FRESHWATER POND
  - RECLAIM PIPELINE
  - TAILINGS PIPELINE/LAUNDER
  - WATER PIPELINE
  - SPILLWAY
  - EMBANKMENT
  - EXPLOSIVES FACILITY
  - FACILITY FOOTPRINT
  - GOLD ORE STOCKPILE
  - HEAP LEACH FACILITY
  - LOW GRADE HYPOGENE ORE
  - LOW GRADE SUPERGENE SULFIDE ORE
  - LOW GRADE SUPERGENE OXIDE ORE
  - SUPERGENE OXIDE ORE
  - NON-PAG TAILINGS
  - PAG TAILINGS
  - OPEN PIT
  - INFRASTRUCTURE
  - POND
  - RECLAIM BARGE
  - TAILINGS BEACH
  - TANK
  - TOPSOIL/OVERBURDEN STOCKPILE
  - MARGINAL GRADE ORE STOCKPILE
  - WASTE STORAGE AREA
  - RIGHT-OF-WAY

**NOTES:**

1. BASE MAP: LAKES FROM NTS, RIVERS FROM CANVEC, CONTOURS FROM EAGLE MAPPING.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 7N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:50,000 FOR 8.5x11 (LETTER) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

**CASINO MINING CORPORATION**

**CASINO PROJECT**

**GENERAL ARRANGEMENT  
MAXIMUM FOOTPRINT**

***Knight Piésold***  
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P/A NO. VA101-325/14	REF NO. 10
<b>FIGURE 2.2</b>	
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### 3 – MODEL INPUTS AND ASSUMPTIONS

#### 3.1 MODEL OVERVIEW

Baseline hydrologic and water quality sampling locations within the Project study area were represented in the YESAB water balance using model nodes. The model nodes in the water balance are shown on Figure 3.1 and include:

- W3 – Canadian Creek
- W14 – Britannia Creek
- W11 – Upper Casino Creek
- W18 – Brynelson Creek
- H18 – Casino Creek below Brynelson
- W4 – Lower Casino Creek
- W9 – Upper Dip Creek
- W5 – Dip Creek below Casino Creek, and
- W16 – Lower Dip Creek.

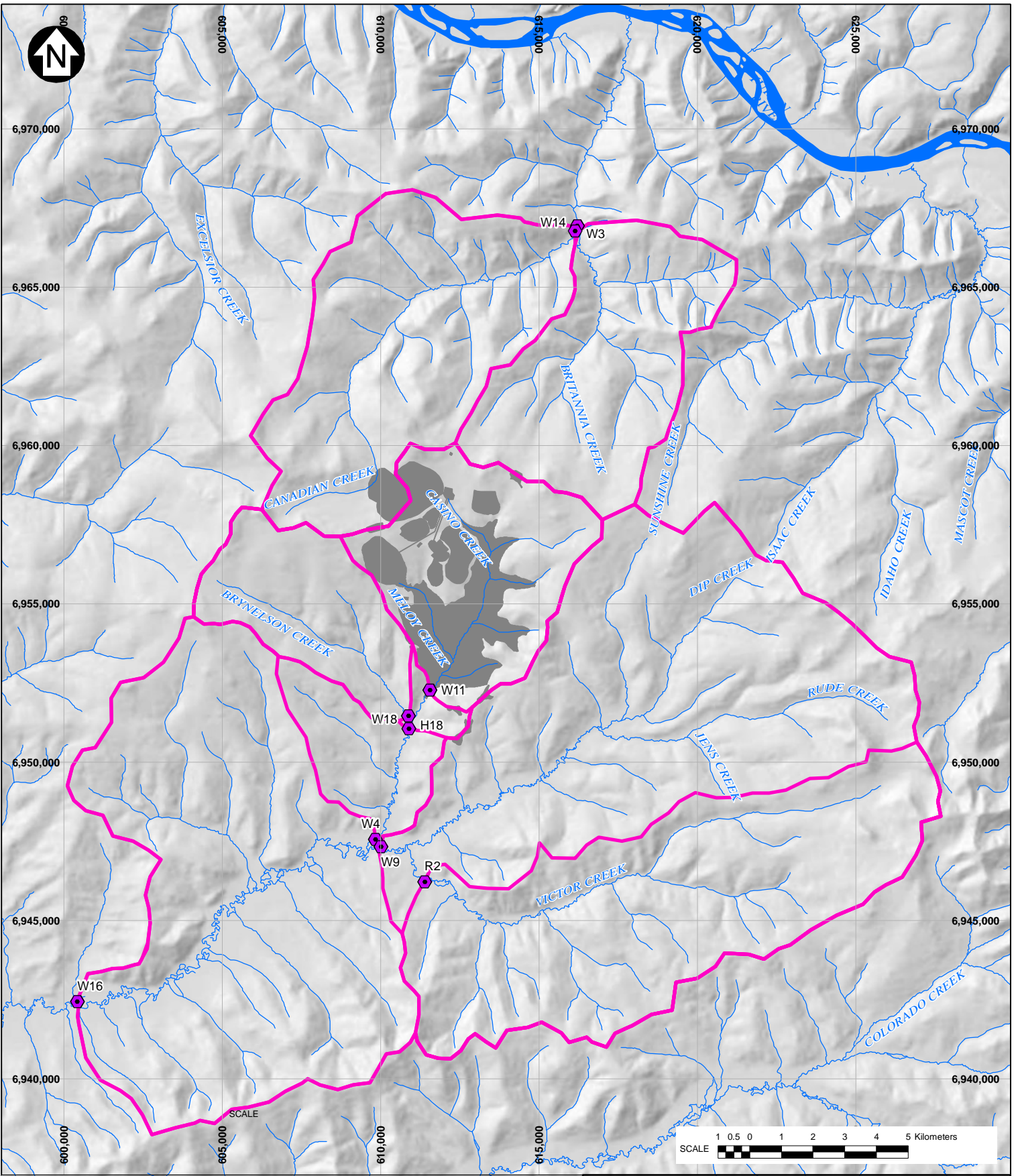
Major project components in the water balance were also modelled and are shown on Figure 2.2, for the maximum project footprint:

- Open Pit
- Mill Site
- Tailings Management Facility (TMF) including the supernatant pond, beaches and embankment
- Waste Rock Management Facility (WRMF)
- Water Management Pond (WMP)
- Winter Seepage Mitigation Pond (WSMP)
- Cyclone Sand Plant
- Heap Leach Facility (HLF)
- Gold Ore Stockpile, and
- Low Grade Ore Stockpiles.





The modelling timeline included:

- Four years of baseline conditions (Year -8 through Year -5)
- Four pre-production years (Year -4 through Year -1)
- 22 years of operations (Year 1 through Year 22)
- 8 years of active water management following operations (Closure Water Management Phase I: Year 23 through Year 30)
- Approximately 80 years of passive water management after discharge from the TMF but prior to discharge from Pit Lake (Closure Water Management Phase II (Year 31 through Year 113)), and
- Approximately 100 years of passive water management after discharge from the Pit Lake (Closure Water Management Phase III: Year 114 through Year 220).

Staged project footprints showing the general water management are shown on Figures B-1 through B-12 in Appendix B. The interaction of modelled flow paths for various phases of the Project are identified schematically on Figures C-1 through C-6 and in Table C-1 in Appendix C.



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- LEGEND:**
-  HYDROLOGIC AND WATER QUALITY NODE
  -  RIVER/CREEK
  -  SUB-CATCHMENT BOUNDARY
  -  PROPOSED MINE SITE FACILITIES

- NOTES:**
1. BASE MAP: ESRI ARCGIS ONLINE YUKON SHADED RELIEF AND CANVEC DATA.
  2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 7N.
  3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:160,000 FOR 8.5x11 (LETTER) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

CASINO MINING CORPORATION

CASINO PROJECT

**REGIONAL HYDROLOGIC AND WATER QUALITY NODES**

***Knight Piésold***  
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P/A NO. VA101-325/14	REF NO. 10
<b>FIGURE 3.1</b>	
	REV 0

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## 3.2 WATER MANAGEMENT PLAN

The Casino Project Water Management Plan (KP 2013a) contains detailed information on the overall water management approach for the Project. The water management strategy for the mine facilities presented in the water management plan has been incorporated into the YESAB water balance and is summarized in the following sections. Staged project footprints showing the general water management strategy and structures are shown on Figures B-1 through B-12 in Appendix B.

### 3.2.1 Construction Water Management

Construction of the TMF will commence approximately 36 months prior to mill start-up in order to collect enough surface water runoff for mill start-up. Water will be managed onsite before the TMF embankment is fully built by establishing cofferdams, pumping systems and temporary runoff collection ditches to route sediment laden water to sediment control measures for primary treatment prior to discharge to Casino Creek. Surface water runoff from the ore stockpiles, plant site and upstream waste rock storage area will be collected behind the TMF once the embankment is constructed. A Water Management Pond (WMP), established in Year -3 and located downstream of the TMF main embankment, will collect runoff from the TMF coffer dam and starter embankment. This water will be treated for sediments then discharged to Casino Creek during Year -3, and pumped back to the TMF pond in Years -2 and -1. Prior to mill start up in Year 1, approximately 11 Mm<sup>3</sup> of water from the Yukon River pipeline will be pumped to the TMF to supplement the accumulated 4 Mm<sup>3</sup> pond, in order to establish a minimum start up pond of 15 Mm<sup>3</sup>.

Ore stacking on the heap and active irrigation of placed ore with cyanide leach solution will commence in the Heap Leach Facility (HLF) in Year -3. Pregnant (containing gold) leach solution from the heap will be routed through Carbon ADR Plant/SART for metals recovery. Barren solution will then be discharged to the barren solution tank before cyanide is added and the solution is recirculated back onto the heap through the irrigation system. Water in and around the HLF will be managed by event ponds, in-heap storage behind the confining embankment, cofferdams, pumping systems, runoff collection ditches and clean water diversion ditches. The HLF will require additional makeup water to supplement the irrigation system and bring the incoming ore up to the leaching moisture content; therefore, water will be drawn from the Fresh Water Supply Pond, located in the upper TMF valley, and from the events pond to supply the HLF during operations in Years -3 to -1.

### 3.2.2 Operations Water Management

Operations water management will include tailings actively being discharged to the TMF with the tailings supernatant water reclaimed via the reclaim system for either reuse at the mill head pond or for the cyclone sand dilution. Additional required water will be pumped from the Yukon River to the Plant Site through the Yukon River freshwater pipeline. Process water from sulphide ore processing will be discharged into the TMF with the tailings. The WMP, located downstream of the TMF main embankment, will collect and pump-back the TMF embankment runoff and seepage to the TMF pond.

Runoff collection ditches downstream of the final footprints of the ore stockpiles will be established to route water to local collection ponds, which will then be directed to the TMF pond. The water quality of the groundwater from the low grade supergene oxide ore stockpile was identified as being a potential issue to downstream water quality; accordingly, groundwater seepage from this stockpile

will be mitigated using a groundwater collection or infiltration suppression system that will direct the water to the TMF pond.

Non-contact upslope runoff will be allowed to flow into the Open Pit. Pit dewatering systems will be established to collect the surface runoff and groundwater seepage flows from the Pit sump for use in the process. In Year 10, when the Open Pit footprint intercepts Canadian Creek, flow in the creek will be diverted around the Open Pit to the lower reaches of the creek.

Ore stacking will continue on the heap until the end of Year 15. The heap will be actively irrigated with cyanide solution via the irrigation pumping systems, with pregnant solution being routed through the Carbon ADR Plant/SART for metals recovery until the end of Year 18. Makeup water required during operations (Years 1 to 18) will be sourced from the Yukon water pipeline and/or the TMF pond for the remainder of HLF operations. Any excess water generated during operations will be recycled back onto inactive areas (not being irrigated) of the heap for storage.

### 3.2.3 Closure Water Management Phase I

The closure plan is to flood any exposed waste rock and tailings stored in the TMF and to allow the Open Pit to flood to create a Pit Lake. Closure Water Management Phase I will consist of active water management. Passive treatment systems in the form of wetlands will be constructed in the northern reaches of the TMF footprint (North TMF Wetland) and adjacent to the TMF Main embankment (South TMF Wetland). The TMF pond will be pumped to the Open Pit for five years following operations to draw down the TMF pond elevation to allow for the construction of the TMF wetlands.

A Winter Seepage Mitigation Pond (WSMP) will be constructed in the valley bottom downstream of the TMF main embankment but upstream of the TMF spillway outlet. During Closure Water Management Phase I the WSMP will act to intercept any groundwater seepage from the TMF and surface runoff from the TMF embankment and pump it back to the TMF pond. Closure Water Management Phase I will end when the TMF pond has reached its maximum capacity and discharges down the spillway.

Closure of the HLF will commence in Year 19 with rinsing of the stacked ore, using the irrigation system with detoxified water and/or freshwater in order to rinse the heap of any remaining cyanide solution. In Year 24, rinsing will cease and the heap will be allowed to drain in order to allow water accumulated in the heap during operations to drain to the estimated long-term moisture content of the stacked ore. All excess water exiting the heap system during closure will be pumped to the open pit to aid in pit filling. Grading, covering and revegetation of 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.

As of Year 29, the draindown flow from the heap will be reduced to manageable levels and toe discharge from the heap will be allowed to flow naturally downstream to the TMF pond. Final heap closure activities will consist of decommissioning all pipes and pumps associated with the irrigation system and the events pond.

### 3.2.4 Closure Water Management Phase II

Closure Water Management Phase II will consist of passive water management once the TMF pond begins spilling and prior to discharge of the Pit Lake. A spillway will be required at closure to pass the discharge of excess water accumulating within the TMF and to provide safe passage of stormwater volumes from the TMF.

Pump-back from the Winter Seepage Mitigation Pond (WSMP) will cease, and instead it will store TMF groundwater seepage and TMF main embankment runoff during the winter low flow months (December through April). The collected seepage and surface water will then be discharged from the WSMP during the summer months when TMF spillway discharges are higher.

### 3.2.5 Closure Water Management Phase III

Closure Water Management Phase III is defined as the period when the Pit has been flooded and is discharging to the TMF pond via the North TMF Wetland. Pit water will be stored in winter and only released to the North TMF Wetland during the summer when passive treatment is most effective. The TMF continues to discharge via the closure spillway, and the WSMP continues to discharge only during May through November.

## 3.3 HYDROMETEOROLOGICAL PARAMETERS

### 3.3.1 Baseline Net Precipitation

The YESAB water balance was developed using average monthly net precipitation values from the calibrated watershed model described in Appendix A. Net precipitation is the water available for runoff from the total amount of rainfall and snowmelt after considering evapotranspiration and soil moisture losses. The incremental monthly and annual net precipitation values for each model node are summarized in Table 3.1.

**Table 3.1 Baseline Net Precipitation Values from Watershed Model**

Node ID	Node Name	Incremental Catchment Area (km <sup>2</sup> )	Incremental Annual Net Precipitation (mm/yr)	Monthly Net Precipitation Distribution (%/month)											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
W3	Canadian Creek	64	160	0	0	0	10	36	10	18	13	12	1	0	0
W14	Britannia Creek	45	150	0	0	0	11	33	9	19	13	13	2	0	0
W11	Upper Casino Creek	39	190	0	0	0	6	39	12	18	12	12	1	0	0
W18	Brynelson Creek	25	200	0	0	0	10	35	11	18	13	12	1	0	0
H18	Casino Creek below Brynelson	3	160	0	0	0	17	25	8	20	14	14	2	0	0
W4	Lower Casino Creek	15	160	0	0	0	14	29	8	20	14	13	2	0	0
W9	Upper Dip Creek	194	180	0	0	0	9	35	11	19	13	12	1	0	0
W16	Lower Dip Creek	114	170	0	0	0	9	35	11	19	13	12	1	0	0

**NOTES:**

1. Net Precipitation = Rainfall + snowmelt – evapotranspiration – soil moisture change.
2. There is no net precipitation during the winter months. The precipitation is assumed to be accumulating as snow and is then considered available as net precipitation during the spring freshet.

### 3.3.2 Operations Net Precipitation

Net precipitation values for each of the mine facilities were calculated in the watershed model presented in Appendix A. The monthly and annual net precipitation values for each of the mine facilities are summarized in Table 3.2.

**Table 3.2 Operational Net Precipitation Values for Mine Facilities**

Mine Facility	Net Precipitation (mm/month)												Annual (mm/yr)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Open Pit	0	0	0	5	170	46	64	45	37	0	0	0	367
Pit Lake (closure)	0	0	0	-1	147	8	13	-3	8	-1	0	0	171
Gold Ore Stockpile	0	0	0	15	92	35	64	44	37	1	0	0	288
Low Grade Ore Stockpile - Supergene Sulfide	0	0	0	4	118	38	64	45	36	0	0	0	306
Low Grade Ore Stockpile - Supergene Oxide	0	0	0	15	92	35	64	44	37	1	0	0	288
Low Grade Ore Stockpile - Hypogene	0	0	0	15	92	35	64	44	37	1	0	0	288
Supergene Oxide Stockpile	0	0	0	15	92	35	64	44	37	1	0	0	288
Marginal Grade Ore Stockpile	0	0	0	15	92	35	64	44	37	1	0	0	288
Heap Leach Facility	0	0	0	15	92	35	64	44	37	1	0	0	288
TMF Beach	0	0	0	18	52	8	23	16	18	2	0	0	138
TMF Embankment	0	0	0	29	61	33	62	43	36	3	0	0	268
TMF Pond	0	0	0	23	49	-11	13	-3	9	1	0	0	82
TMF Waste Rock	0	0	0	23	75	34	64	44	36	2	0	0	279

The undisturbed surfaces within the Project footprint (i.e. upstream areas that do not have a stockpile, mill facility or that are not part of the Open Pit or TMF pond) were assumed to have the same net precipitation values as in baseline conditions.

### 3.3.3 Lake Evaporation

Mean monthly lake evaporation was not calculated in the watershed model in Appendix A; therefore, evaporation from the pond surfaces, (e.g. TMF pond, Pit Lake during Closure Water Management Phase I, II and II and TMF wetlands), were determined from the baseline climate report (KP, 2013c). The long term estimated mean monthly lake evaporation is summarized in Table 3.3.

**Table 3.3 Estimated Mean Monthly Lake Evaporation**

	Evaporation (mm)												Annual
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Long-term Estimated	0	0	0	2	43	72	79	68	37	1	0	0	302

### 3.4 CATCHMENT AREAS AND FOOTPRINT AREAS

Total natural catchment areas for each model node in the water balance are shown on Figure 3.1 and summarized below:

- Canadian Creek (W3): 64 km<sup>2</sup>
- Britannia Creek (W14): 45 km<sup>2</sup>
- Brynelson Creek (W18): 25 km<sup>2</sup>
- Casino Creek (H18): 67 km<sup>2</sup>
- Casino Creek (W4): 82 km<sup>2</sup>
- Upper Dip Creek (W9): 194 km<sup>2</sup>
- Dip Creek (W5): 276 km<sup>2</sup>, and
- Lower Dip Creek (W16): 391 km<sup>2</sup>.

Mine facility footprint areas used in the water balance for Year -1, Year 1, Year 4, Year 19 and Year 22 are summarized in Table 3.4.

**Table 3.4 Mine Facility Footprint Areas**

Mine Facility	Footprint Area (km <sup>2</sup> )					
	Year -1	Year 1	Year 4	Year 10	Year 19	Year 22
Open Pit	1.4	1.7	2.2	2.6	3.1	3.1
Gold Ore Stockpile	0.4	0.5	0.5	0.5	0	0
Low Grade Ore Stockpile - Supergene Sulfide	0.03	0.1	0.3	0.4	0.3	0
Low Grade Ore Stockpile - Supergene Oxide	0.03	0.08	0.2	0.3	0.3	0
Low Grade Ore Stockpile - Hypogene	0	0.05	0.3	0.9	1.0	0
Supergene Oxide Stockpile	0.4	0.4	0.4	0.2	0	0
Marginal Grade Ore Stockpile	0.1	0.1	0.2	0.2	0.2	0.2
Heap Leach Facility	0.8	0.9	1.2	1.3	1.3	1.3
TMF Beach	0	0.3	0.4	0.5	0.7	0.7
TMF Total Embankment	0	0.2	0.5	0.8	1.2	1.2
TMF Pond	0.2	0.3	1.0	1.9	4.9	8.0
TMF Waste Rock	0	0	1.5	3.0	4.2	0
TMF Acidic Supergene Waste Rock	0.03	0.07	0.2	0	0	0

Areas were linearly interpolated between the values presented in Table 3.4 for years other than those shown, to represent the changing footprint.

### 3.5 GROUNDWATER

A series of numerical groundwater models were developed for the Project to evaluate potential effects on hydrogeological conditions at various stages of the Project. A three-dimensional steady-state, regional-scale numerical groundwater model was developed using MODFLOW-SURFACT for Year 4, Year 10, Year 19, Year 22 and post-closure of the Project (KP, 2013b). The model was calibrated to baseline information, then modified to include proposed mine facilities to assess hydrogeological conditions during mine operations. The results of the groundwater numerical model were incorporated into the YESAB water balance to represent the following:

- Seepage rates from, and groundwater inflow to, various components of the TMF.
- The rate of groundwater inflow to the Open Pit during operational dewatering and the rate of seepage from the Pit Lake.
- Potential groundwater flow pathways from the major mine components to the TMF, Open Pit or receiving environment.

The inputs to the YESAB water balance based on the groundwater modelling are summarized in Table 3.5, Table 3.6, and Table 3.7. Results from the numerical groundwater modelling were linearly interpolated between the years presented to provide continuous seepage rates in the YESAB water balance.

**Table 3.5 Simulated Seepage Losses from TMF**

	Simulated Seepage Outflow (L/s)				
	Year 4	Year 10	Year 19	Year 22	Post-Closure
Seepage through TMF foundation under embankment	4.8	13.2	21.7	22.9	22.0
Seepage through TMF embankment	4.7	7.3	13.3	15.4	14.0
Water flux through Waste Rock to TMF Pond	22.3	26.7	26.8	22.9	22.5

**Table 3.6 Simulated Seepage Inflows and Outflows for the Open Pit**

	Water Surface Elevation in Open Pit (m)		
	700	995	1100
Seepage Inflows (from Casino Creek and Canadian Creek) (L/s)	33	-	12
Seepage Losses (to TMF pond) (L/s)	0	0	12
Seepage Inflow Fraction from Canadian Creek (%)	56	-	83
Seepage Inflow Fraction from Casino Creek (%)	44	-	17

**NOTES:**

1. "-" denotes that values were not provided from the numerical groundwater model.

**Table 3.7 Groundwater Flow Paths from Ore Stockpiles**

Ore Stockpile	Operations	
	Fraction to Open Pit (%)	Fraction to TMF (%)
<b>Gold Ore</b>	20	80
<b>Low Grade Supergene Sulfide Ore</b>	100	0
<b>Supergene Oxide Ore</b>	0	100
<b>Marginal Grade Ore Stockpile</b>	100	0
<b>Low Grade Hypogene Ore</b>	0	100
<b>Low Grade Supergene Oxide Ore</b>	0	100

The seepage collection efficiency of the WMP downstream of the TMF main embankment was estimated from the numerical groundwater modelling. It was estimated that the WMP would collect 100% of the TMF embankment seepage and 90% of the seepage passing below the TMF (KP, 2013b). The efficiency of the WMP will vary depending on its operation. If poorly maintained, for example the pond is not drawn down to the proper operating level, the seepage collection efficiency may decrease.

### 3.6 PROCESS WATER REQUIREMENTS

#### 3.6.1 Mill Water Requirements

Water requirements at the mill were calculated based on the specified mill production rate and the tailings properties. The mine production rate is approximately 120,000 tpd, with a tailings solid content of 55% by weight. The total mill water requirements are approximately 4,000 m<sup>3</sup>/hr, with a fresh water demand of 135 m<sup>3</sup>/hr. The majority of the mill water will be reclaimed from the TMF via the reclaim system and from Open Pit dewatering. Mill water will also be sourced from the Yukon River freshwater pipeline.

#### 3.6.2 Cyclone Sand Plant

The non-potentially acid generating (non-PAG) tailings (80% of total tailings by weight) will be used to produce cyclone sand for the TMF embankment fill over a period of approximately 9 months each year. Cycloning operations were assumed to typically take place from February to October and be suspended during the coldest winter months (November through January). Cyclone sand production was also assumed to reduce during the last few years of TMF operations when there will be a reduction in the demand for sand fill for the embankment construction.

The non-PAG tailings will be directed to the cyclone sand plant as slurry at 55% solids by weight. The cyclone underflow (sand fraction) will be discharged from the sand plant as slurry at 65% solids by weight to construction cells along the upstream and downstream shells of the TMF embankment. The cyclone overflow material (fine fraction) will be discharged directly to the TMF impoundment as slurry at approximately 25% solids by weight. Water will be recovered from the sand cells to the

extent possible and pumped back to the TMF pond. Residual moisture draining from the sand fraction in the construction cells will be collected in the downstream seepage collection system and pumped back to the TMF pond. Water required for operation of the sand plant will be supplied from the TMF pond via the reclaim system. The sand plant is assumed to operate for 90% of the time during the period when it is active. Bulk non-PAG tailings will be directed to the TMF impoundment when the sand plant is not in operation. The assumed months of sand plant operation during each year of the mine life are summarized in Table 3.8.

**Table 3.8 Cyclone Sand Plant Operation**

<b>Mine Year</b>	<b>Operating Months</b>	
<b>1 through 17</b>	9 months	February to October
<b>18 through 20</b>	4 months	May to September
<b>21 through 22</b>	3 months	June to August

3.6.3 Tailings

The TMF is designed on the assumption that approximately 80% of the tailings will be non-PAG following pyrite separation and removal. The remaining 20% of the tailings comprises Potentially Acid Generating (PAG) tailings that will be discharged by a separate pipeline and contained within the central region of the TMF, remote from the embankments. The PAG tailings will be directed to the TMF impoundment as slurry at 55% solids by weight.

3.6.4 Water Retained in Tailings and Waste Rock Voids

The amount of water retained in the tailings and waste rock voids is a function of the mine production schedule and the dry density and specific gravity of both the tailings and waste rock. The initial settled dry density values for the tailings and waste rock were assumed to be 1.1 t/m<sup>3</sup> and 2.0 t/m<sup>3</sup>, respectively (KP, 2012b). Water released due to consolidation of the tailings mass was estimated based on tailings consolidation studies (KP, 2012b). The resulting tailings consolidation water release rates are summarized in Table 3.9.

**Table 3.9 Tailings Consolidation Seepage Rates**

<b>Mine Year</b>	<b>Consolidation Seepage Rate (L/s)</b>
<b>Year 1</b>	180
<b>Year 5</b>	300
<b>End of Operations</b>	400
<b>1 year following Closure</b>	100
<b>5 years following Closure</b>	50
<b>30 years following Closure</b>	10

### 3.6.5 Heap Leach Facility

A monthly water balance was created for the Heap Leach Facility (HLF) as a component of the YESAB Water Balance Model. The intent of the HLF modelling was to estimate the magnitude and extent of any water surplus or deficit conditions in the HLF, as well as makeup water requirements for a range of possible climatic conditions. The modelling timeline included three pre-production years (Years -3 to -1), 18 years of operation (Years 1 to 18), and 10 years of HLF closure (Years 19 to 28).

The heap pad will be developed in 5 stages over the 18 year mine life (Years -3 to 15), with ore stacking on the pad for 300 days each year. The stacked ore will be irrigated with cyanide solution (solution) year round for a total of 21 years: 18 years during ore stacking (Years -3 to 15) and 3 years (Years 16 to 18) of additional gold recovery once ore stacking has ceased. The HLF model incorporates the following components:

- Heap leach pad
- In-heap pond
- Freshwater Supply Pond (FWSP), and
- Events pond.

Details of the HLF water balance parameters and assumptions are presented in Appendix D, with results of the model summarized in Section 4.5.

### 3.6.6 Temporary Ore Stockpiles

Temporary ore stockpiles will be used during the construction and operations phase of the Project. These include gold ore, low grade supergene sulfide, low grade supergene oxide, low grade hypogene, supergene oxide and marginal grade ore stockpiles. The gold ore stockpile will be used to feed the HLF while the low grade ore stockpiles will be run through the mill for processing during the final years of operations. Approximately 5% of the total low grade ore stockpiles volume was assumed to be hauled to the Open Pit after operations, while 100% of the marginal grade ore stockpile will be hauled to the Open Pit and 100% of the supergene oxide stockpile will be processed at the mill.

The water quality of the groundwater from the low grade supergene oxide ore stockpile was identified as being a potential issue to downstream water quality. Seepage of groundwater from this stockpile will be mitigated using a groundwater collection or infiltration suppression system that will collect and direct the water to the TMF pond. The system was assumed to have an efficiency of 90%.

### 3.6.7 Fresh Water Requirements

The assumed total fresh water requirements for the Project used in the YESAB water balance are:

- Mill (operations) – 135 m<sup>3</sup>/hr, and
- Potable water for the camp – 5 m<sup>3</sup>/hr during operations.

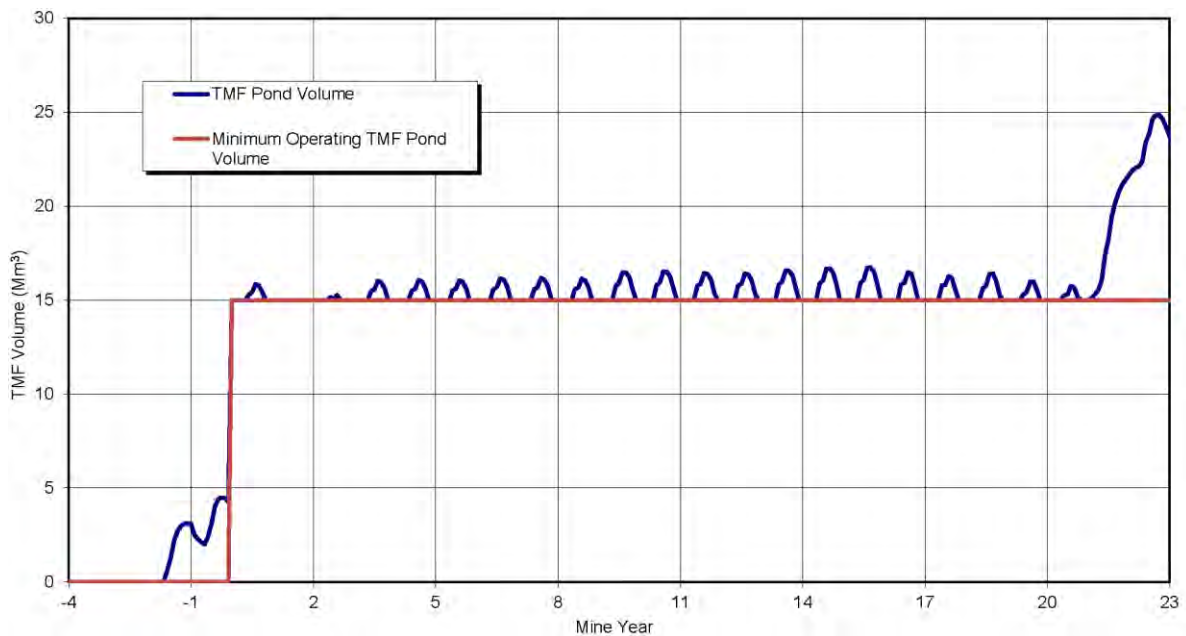
## 4 – WATER BALANCE MODEL RESULTS AND SUMMARY

### 4.1 OVERVIEW

The results of the water balance for average hydrometeorological conditions are presented in the following sections. Results are for surface water and groundwater quantities only. Water quality results are presented in a separate report authored by Source. Annual inflows and outflows for pre-production, operations, and closure phases of the Project are summarized in Appendix E Table E.1 through E.3 for the major mine facilities (TMF, open pit, and water management pond and winter seepage mitigation pond).

### 4.2 TAILINGS MANAGEMENT FACILITY RESULTS

The water balance was used to determine the likelihood of having a surplus or deficit water condition for the Project. A deficit condition was defined as when the TMF pond volume was insufficient to maintain mill operations for a minimum of three months, therefore a minimum TMF pond volume of 15 Mm<sup>3</sup> was required. Makeup water from the Yukon River was used to supplement the mill process water during deficit conditions through mill operations (Years 1 to 22). Prior to mill start up in Year 1, approximately 11 Mm<sup>3</sup> of water from the Yukon River is required to supplement the TMF pond to establish the minimum pond volume at the start of operations. The Yukon River freshwater pipeline has been adequately sized to convey the makeup water requirements for all phases of the Project. Figure 4.1 presents the possible pond volumes in the TMF for pre-production and operations of the mine under average hydrometeorological conditions. Annual makeup flow requirements are summarized in Table 4.1.



**Figure 4.1 Tailings Management Facility Simulated Pond Volume for Operations**

**Table 4.1 Annual Process Water Makeup Requirements for Mill**

<b>Mine Year</b>	<b>Process Water Makeup Requirements (m<sup>3</sup>/yr)</b>
-2	0
-1	0
1	5,591,000
2	11,470,000
3	8,806,000
4	6,390,000
5	6,300,000
6	6,428,000
7	6,166,000
8	6,290,000
9	6,514,000
10	5,502,000
11	5,468,000
12	5,913,000
13	6,133,000
14	5,606,000
15	5,119,000
16	5,093,000
17	7,690,000
18	8,134,000
19	5,590,000
20	5,361,000
21	5,639,000
22	212,000

The TMF pond will be pumped to the Open Pit for five years at a rate of 1200 m<sup>3</sup>/hr during Closure Water Management Phase I. The pond water surface will be lowered to a depth of approximately 0.75 m above the tailings to allow for the construction of the North TMF Wetland. The TMF pond will then fill at its natural inflow rate, (average annual net inflow of approximately 4 Mm<sup>3</sup>/yr), and will begin spilling approximately 10 years following operations.

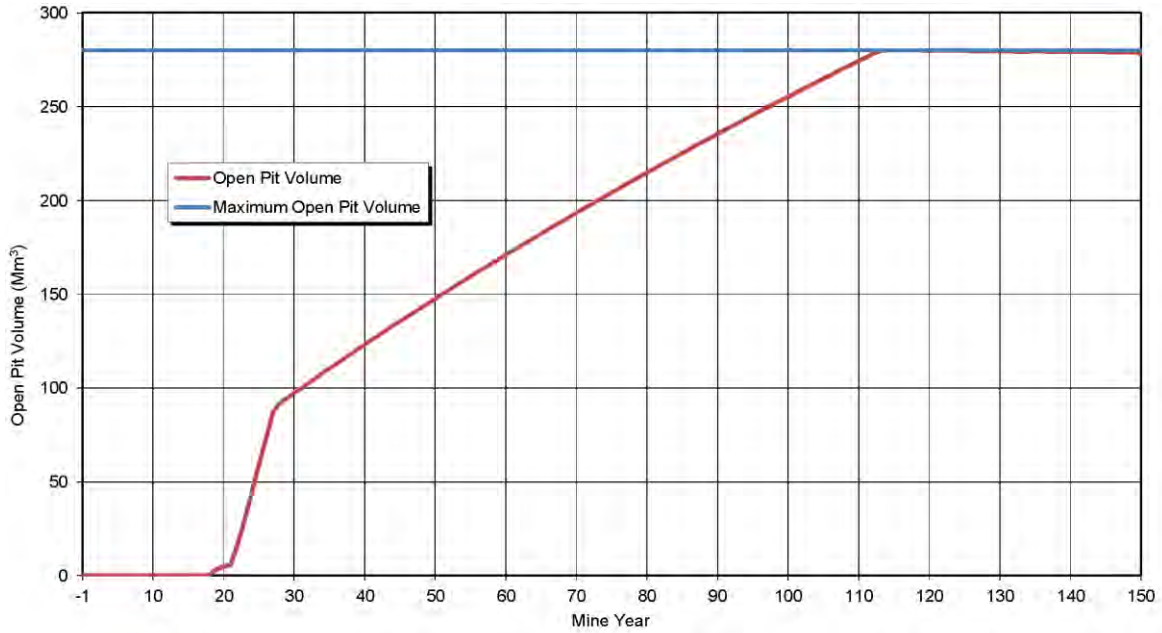
The constructed TMF spillway will convey the discharge of water from the TMF to Casino Creek. Average monthly discharges through the TMF spillway are summarized in Table 4.2 for average hydrometeorological conditions.

**Table 4.2 Average TMF Spillway Flow**

	Average TMF Spillway In-Flow (L/s)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
<b>Closure Water Management Phase II (prior to Open Pit spilling)</b>	4	1	0	88	438	233	387	180	137	62	9	4	129
<b>Closure Water Management Phase III (after Open Pit spilling)</b>	4	1	0	89	438	413	567	360	314	62	9	4	188

**4.3 OPEN PIT RESULTS**

The Open Pit will be transformed into a Pit Lake at closure. The annual Pit Lake discharge volume will be released to the North TMF Wetland at a controlled rate through a gravity controlled discharge system during the warmest months of the year (June through September). The water balance was used to determine the Pit Lake filling time under average climatic conditions. The water balance simulation shows that under average hydrometeorological conditions the Pit Lake would take approximately 95 years to reach its maximum capacity. Once this is achieved a controlled release flow averaging 180 L/s (June through September) would be required to maintain lake levels in the Pit at or below an elevation of 1095 masl. The pit lake filling schedule for average climatic conditions is shown on Figure 4.2.



**Figure 4.2 Simulated Pit Lake Volume**

**4.4 WINTER SEEPAGE MITIGATION POND**

The Winter Seepage Mitigation Pond (WSMP) will be constructed during the closure phase of the Project downstream of the TMF main embankment. The WSMP will include a groundwater cutoff wall keyed into bedrock, and will collect TMF seepage and embankment runoff. Once constructed, water collected in the pond will continue to be pumped back to the TMF Pond for the remainder of Closure Water Management Phase I. Once the TMF begins discharging, flows collected in the WSMP will be stored during the low flow months (December through April) and discharged during the spring coincident with periods of high flows in the TMF spillway (May through November). Flow will be released through a gravity controlled discharge pipe from May through August at a constant rate of 130 L/s and at reducing rates from September through November once the WSMP has drained (120 to 50 L/s). The flow releases from the cut-off and collection system are summarized in Table 4.3 for average hydrometeorological conditions.

**Table 4.3 Winter Seepage Mitigation Pond Flow Releases**

	Average Outflows (L/s)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
<b>WSMP</b>	0	0	0	0	130	130	130	130	121	57	48	0	62

#### 4.5 HEAP LEACH FACILITY RESULTS

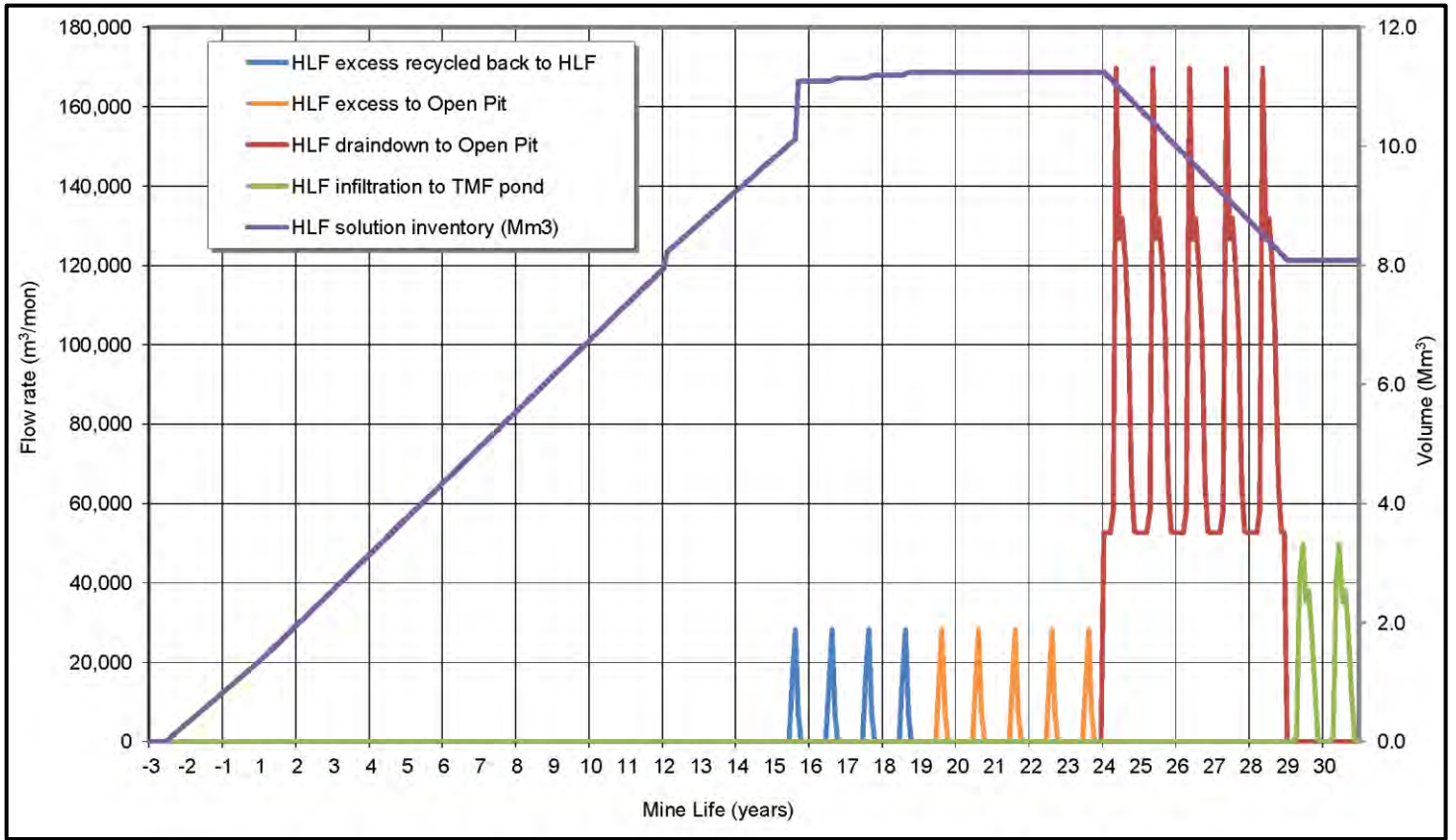
The results of the HLF water balance indicate that the HLF operates in a water deficit condition during all months of operations when ore stacking is active (Years -3 to 15), due to the amount of water required to bring the incoming ore moisture content (3% by mass) up to the leaching ore moisture content (9.5% by mass). Once ore stacking ceases in Year 16, all the stacked ore is assumed to be at a short-term residual moisture content of 7% by mass, and therefore less makeup water is required to bring it up to the leaching moisture content. In addition, during this phase the HLF is in a surplus condition during the freshet months, when environmental contributions exceed the heap water requirements, and hence excess water is generated from the heap. Table 4.4 summarizes the annual makeup water requirements during operations when ore is being actively irrigated with cyanide solution. As shown in Table 4.4, the makeup water requirements decrease each year as water released from inactive areas becomes available and the environmental contributions increase due to the increasing heap footprint. The excess water is recycled to inactive areas on the heap for temporary storage until Year 19, after which the excess will be pumped to the open pit, as shown on Figure 4.3.

Figure 4.3 presents the surplus water generated from the heap (left axis) and the accumulated inventory of water stored in the heap (right axis) through operations to post-closure of the HLF. The purple line represents the water inventory in the heap; as shown on the figure, water accumulates in the heap from Years -3 to 18 as ore is added to the heap and surplus water is recycled back to inactive areas (previously leached) of the heap. Ore stacking on the pad is assumed to occur from April of Year -3 to June of Year 15. The water volume stored in the heap increases at a relatively rapid rate from Years -3 to 15, during months when ore stacking and leaching occur, compared to the rate in July Year 15 to the end of Year 18, when ore stacking has ceased but ore is still irrigated with cyanide solution. The heap is in a surplus condition on a seasonal basis (July to September) as of Year 15 to 18 because the environmental inputs exceed the leaching water requirements. 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 as indicated by the slight increase in the purple line during this phase. During the rinsing phase, no additional water accumulates in the heap because the surplus water (orange line) is assumed to leave the heap and be pumped to the Open Pit to aid in pit filling.

The heap draindown phase is assumed to commence in Year 24, when heap rinsing and detoxification are complete and 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 m<sup>3</sup>/mon (1726 m<sup>3</sup>/day) plus whatever environmental inputs occur (rain plus snowmelt), which results in the seasonal discharge pattern illustrated by the red line on Figure 4.3. As a result, the water inventory in the heap decreases from 11 Mm<sup>3</sup> to just over 8 Mm<sup>3</sup>. 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 50% of net precipitation, and accordingly the water discharged from the heap is 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 are assumed to be routed naturally downstream to the TMF pond.

**Table 4.4 Annual Process Water Makeup Requirements for HLF**

Mine Year	Total Process Water Makeup Requirements (m <sup>3</sup> /day)	Makeup Water Sources		
		Events Pond (m <sup>3</sup> /day)	Freshwater Supply Pond (m <sup>3</sup> /day)	Yukon River (m <sup>3</sup> /day)
-3	1,842	365	1,477	0
-2	1,866	0	1,866	0
-1	1,631	0	1,631	0
1	1,372	0	0	1,372
2	1,284	0	0	1,284
3	1,197	0	0	1,197
4	1,136	0	0	1,136
5	1,103	0	0	1,103
6	1,070	0	0	1,070
7	1,038	0	0	1,038
8	1,007	0	0	1,007
9	974	0	0	974
10	956	0	0	956
11	956	0	0	956
12	795	0	0	795
13	1,010	0	0	1,010
14	1,010	0	0	1,010
15	484	0	0	484
16	575	0	0	575
17	575	0	0	575
18	575	0	0	575
19	575	0	0	575
20	575	0	0	575
21	575	0	0	575
22	575	0	0	575



**Figure 4.3 HLF Accumulated Water and Monthly Discharge**

## 5 – SUMMARY

A water balance model integrating groundwater and surface water flow patterns and mine operations water requirements was developed for the Casino Project. The purpose of the model was to evaluate the quantities and rates of flow of water in the ground, in the streams and in various mine facilities. The water balance results were also used by Source Environmental Associates Inc. to develop a water quality model for the Project. The water quantity and quality results will be part of the YESAB proposal for the Project.

The results of the water balance for average hydrological conditions are as follows:

- The Project mine operations will operate in a deficit; therefore, makeup water from the Yukon River freshwater pipeline will be required to supplement the mill process. Makeup water requirements will range from 11.5 Mm<sup>3</sup>/yr at the start of operations to 0.2 Mm<sup>3</sup>/yr at the end of operations, with an average of approximately 6.2 Mm<sup>3</sup>/yr throughout operations.
- The heap leach facility (HLF) will also operate in a water deficit; for all months during operations when ore is being stacked (Years -3 to 15) and then for most months during additional gold recovery (Years 16 to 18) and closure rinsing (Years 19 to 23). Makeup water will be required to supplement the leach irrigation system as well as to bring stacked ore up to the leaching moisture content, and requirements will range from 1,900 m<sup>3</sup>/day in Year 2 to 484 m<sup>3</sup>/day in Year 15, but will generally average about 1000 m<sup>3</sup>/day before Year 15 and 600 m<sup>3</sup>/day after Year 15.
- The HLF will operate in a water surplus condition during certain months in the additional gold recovery and closure rinsing phases, and in all months during closure dewatering. Excess water generated from the heap during operations (Years -3 to 18) will be recycled to inactive areas of the heap for temporary storage. Excess water during closure rinsing and dewatering (Years 19 to 28) will be routed to the Open Pit to aid in pit filling. In post-closure of the heap, as of Year 29, infiltration through and runoff from the closure cover will be routed downstream to the Tailings Management Facility (TMF) pond.
- The TMF pond will be pumped to the Open Pit at the end of operations at a rate of approximately 1200 m<sup>3</sup>/hr, which will drawdown the pond level over a period of five years to approximately 0.75 m above the tailings surface.
- The TMF will then take approximately three years to begin spilling through the constructed spillway.
- Annual average flows from the TMF spillway will be approximately 130 L/s following the TMF reaching its maximum capacity in closure, and approximately 190 L/s once the Pit Lake begins discharging.
- The Open Pit will take approximately 95 years to establish the Pit Lake with an outlet elevation of 1095 masl.
- The controlled overflow from the Pit Lake to the North TMF Wetland will have to average 180 L/s during June through September in order to maintain a Pit Lake elevation at or below 1095 masl.
- The Winter Seepage Mitigation Pond (WSMP) constructed downstream of the TMF will begin releasing flows when the TMF has reached its maximum capacity and begins spilling. The WSMP will release at a constant rate of 130 L/s from May through August and at reduced rates ranging from approximately 50 to 120 L/s from September through November. There will be no flow releases and the WSMP will collect water during the winter months of December through April.

## 6 – REFERENCES

- Knight Piésold (KP) (2012a). Casino Copper-Gold Project – Report on Feasibility Design of the Tailings Management Facility. Ref. No. VA101-325/8-10 Rev 0, December 20, 2012.
- KP (2012b). Casino Copper-Gold Project – Report on revised Tailings Management Facility Seepage Assessment, Ref. No. VA101-325/8-13 Rev 0, December 19, 2012.
- KP (2013a). Casino Project - Water Management Plan, Ref. No. VA101-325/14-2 Rev 0, October 30, 2013.
- KP (2013b). Casino Project – Numerical Groundwater Modelling, Ref. No. VA101-325/14-6 Rev 0, October 25, 2013.
- KP (2013c). Casino Project – Baseline Climate Report, Ref. No. VA101-325/14-7 Rev 0, June 14, 2013.

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**APPENDIX A**

**CASINO PROJECT - BASELINE AND MINE OPERATIONS WATERSHED MODEL**

(Pages A-1 to A-16)

September 9, 2013

File No.:VA101-325/14-A.01  
Cont. No.:VA13-01614



Mr. Jesse Duke  
Senior Consultant  
Casino Mining Corporation  
2050 - 1111 West Georgia St.  
Vancouver, BC V6E 4M3

Dear Jesse,

**Re: Baseline and Mine Operations Watershed Model, Casino Project**

## 1 – Introduction

Knight Piésold Ltd. (KPL) was requested by Casino Mining Corporation (CMC) to conduct modelling of surface and groundwater flows for the proposed Casino Project to support a proposal to the Yukon Environmental and Socio-economic Assessment Board (YESAB). In fulfilling this request, a baseline watershed model was developed for the Casino Project area to assess components of the watershed water balance. The baseline model was then modified to create a simplified mine operations watershed model representing hydrologic conditions during mine operations. The Casino baseline and mine operations watershed models were developed to:

- Improve the understanding of local baseline hydrologic and hydrogeological conditions
- Quantify the groundwater flow regime for development of a groundwater flow model
- Provide a baseline condition from which to assess potential effects of the planned mine development and operations to surface water and groundwater systems in the project area
- Provide mean monthly net precipitation values specific to key on-site mine facilities for stochastic modelling in the mine operations water balance model, and
- Provide runoff and infiltration rates for geochemical source term modelling.

## 2 – Baseline Model

### Method

The baseline watershed model uses a spreadsheet user interface (Microsoft Excel) to distribute on-site water between various components of the hydrological cycle (i.e. runoff, groundwater, surface water, snowpack, etc.). The Casino Project area was divided into sub-catchments based on hydrogeological conditions and proposed development of the mine. The general approach for modelling each sub-catchment was as follows:

- Inputs to each sub-catchment include precipitation and inflow (groundwater and surface water) from up-gradient sub-catchments.
- Precipitation as rainfall is distributed amongst the following components:
  - Evapotranspiration and sublimation
  - Soil moisture
  - Groundwater recharge, and
  - Surface runoff.
- Precipitation as snowfall was retained as snowpack accumulation until temperatures increased sufficiently to melt the snow and generate snowmelt, at which time it was distributed into the appropriate components as defined above.
- Evapotranspiration is modelled after the Thornthwaite method (1948).
- Groundwater and surface water accumulation in storage and discharge from storage were modelled using a linear reservoir model approach.

- Outputs from each sub-catchment included groundwater and surface water discharge to down-gradient sub-catchments.

Hydrologic processes considered in the model were:

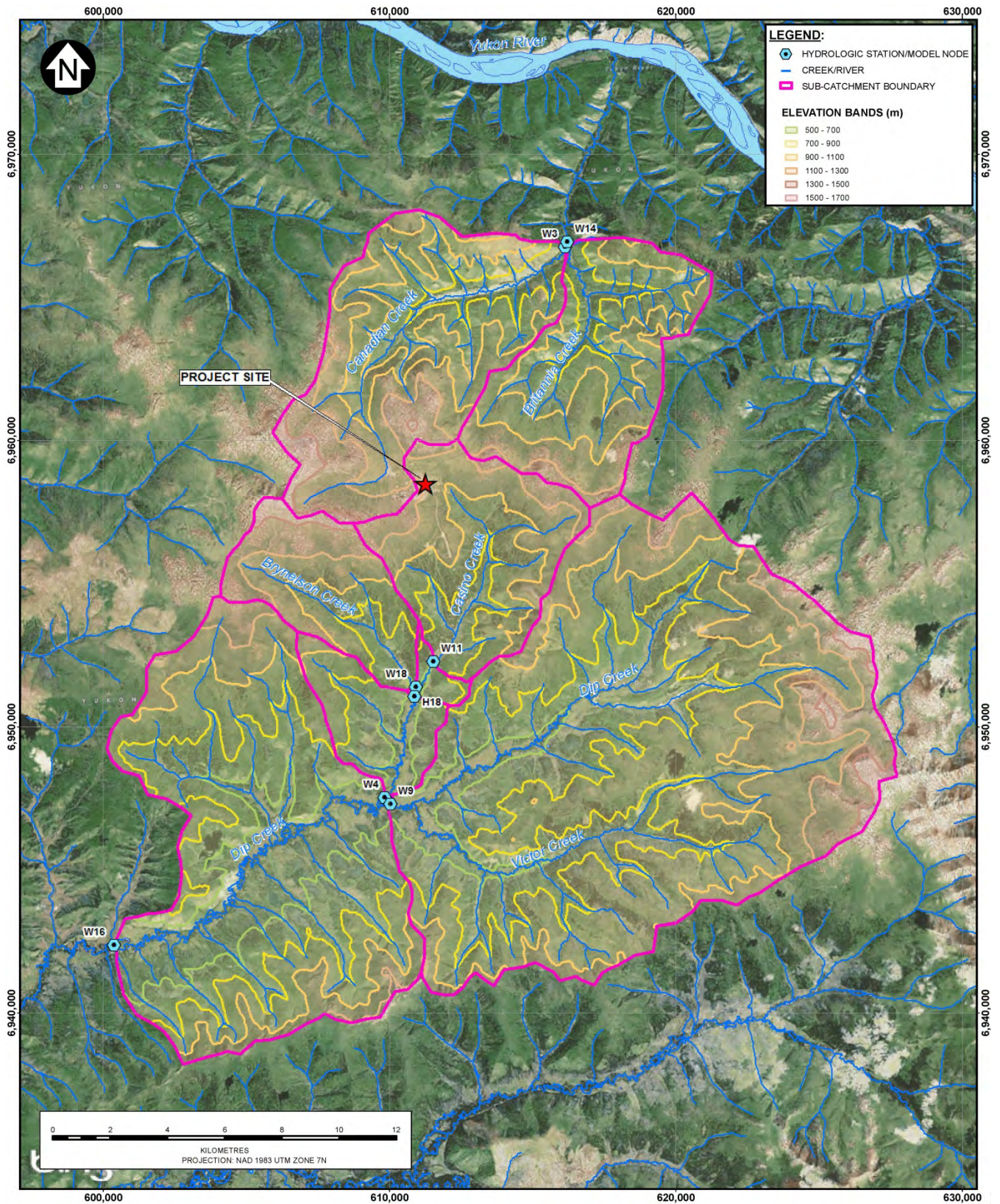
- Snow accumulation and melt
- Sublimation, which was modelled at a specified rate during snow accumulation
- Rainfall and snowmelt, which were distributed amongst evapotranspiration, soil moisture, recharge to groundwater, and surface runoff
- Inflow from up-gradient sub-catchments, for both surface runoff and groundwater flow
- Groundwater recharge (a combination of meteoric recharge and stream leakage), which was accumulated in groundwater storage
- Groundwater storage
- Groundwater discharge, which was determined according to the amount of groundwater in storage
- Surface water detention, which considered delay due to permafrost, and
- Surface water discharge, which was determined according to the amount of surface water in detention.

### **Model Discretization**

The Casino Project study area was divided into eight sub-catchment areas for the watershed model, as shown on Figure 1. Six sub-catchments contribute hydrologic flows to the Dip Creek watershed (hydrology stations W11, W18, H18, W4, W9, and W16). Two sub-catchments contribute hydrologic flows to the Canadian Creek watershed (hydrology stations W3 and W14).

Each of the sub-catchment areas were further discretized by elevation using 200 m elevation bands, starting at 500 m above sea level (masl) and ending at 1,700 masl. A small portion of the study area (0.006 km<sup>2</sup>) exists above 1,700 masl and this area was included in the 1,500 – 1,700 masl elevation band. Representative climate conditions (temperature and precipitation) were calculated based on the average elevation for each band. The calculated elevation band areas for each sub-catchment are presented in Table 1. The primary data inputs for each sub-catchment in the model are:

- Sub-catchment area (discretized into 200 m elevation bands)
- Monthly precipitation (falling as both rain and snow)
- Monthly average temperature, and
- Aquifer transmissivity, width, and hydraulic gradient at the hydrology stations.



**Figure 1 Watershed Model Sub-Catchments**

**Table 1 Sub-Catchment Elevation Band Areas**

	Area [km <sup>2</sup> ]						
Lower [masl]	500	700	900	1,100	1,300	1,500	Total
Upper [masl]	700	900	1,100	1,300	1,500	1,700	
Average [masl]	600	800	1,000	1,200	1,400	1,600	
Dip Creek							
W11	0.00	6.15	13.68	14.51	5.00	0.02	39.36
W18	0.09	4.35	6.00	6.86	6.26	1.54	25.11
H18	0.35	12.29	20.15	21.37	11.26	1.56	66.97
W4	3.10	20.23	23.86	22.14	11.26	1.56	82.14
W9	9.45	51.06	76.64	38.25	16.12	2.94	194.46
W16	39.96	110.16	130.01	75.58	30.36	4.52 <sup>1</sup>	390.58
Canadian Creek							
W3	5.28	14.20	16.10	13.72	11.77	2.69	63.75
W14	4.62	14.49	16.15	7.88	1.82	0.00	44.97

**NOTES:**

1. Includes 0.006 km<sup>2</sup> between 1,700 and 1,900 masl.

**Climate Calculations**

*Temperature and Precipitation*

Primary meteorological inputs to the watershed model were long-term monthly temperature and precipitation values. The data set was generated by correlating the available Project site climate data with temperature and precipitation data from the Environment Canada (EC) climate station at Pelly Ranch (ID 2100880). The Pelly Ranch climate station is located approximately 75 km east of the project site at an elevation of 454 masl. The Pelly Ranch climate record is available from January 1957 to December 2012. The Casino Project climate station was operated from 1993 to 1995 and from 2008 to 2012 and is at an approximate elevation of 1,200 masl.

Eight years of temperature measurements are available from the on-site climate station, of which three years are complete. Six years of on-site precipitation measurements are available from the on-site climate station, for the months of May through September. Precipitation data from the on-site climate station were correlated to the Pelly Ranch precipitation record for months with an available record. Precipitation in winter months was calculated using the September monthly correlation factor. Pelly Ranch precipitation records were incomplete for the years 1963 and 1996 and were excluded from the watershed model. The synthetic climate record input to the model extended from 1957 to 2012, excluding the years 1963 and 1996. The Baseline Climate Report (KPL, 2013a) presents further details of the temperature and precipitation regressions and datasets.

Temperature and precipitation data were adjusted to the project site based on the average elevation of each elevation band in the project area. Temperature was adjusted using an adiabatic lapse rate of -6.5°C/1000 m of elevation. Precipitation was adjusted using a 5% increase in precipitation per 100 m elevation rise for winter months (September 31 to May 1) with no adjustments in summer months. The rationale for applying different winter and summer orographic rates is based on a general understanding of the drivers of regional precipitation patterns, which suggests that frontal storm systems are dominant in winter and produce stronger orographic

precipitation effects. The winter precipitation data series calculated for the Project site was not well constrained, and the best fit to modelled data was obtained by reducing winter precipitation by 25%.

#### *Snow and Rain*

The distribution of precipitation between rainfall and snowfall assumed precipitation fell as rain for all months with an average temperature greater than 2°C and as snow for all months with an average temperature less than -2°C. For temperatures in between -2°C and 2°C, the ratio of precipitation as snow varied linearly with temperature.

Environment Canada (EC) maintains a snow course survey (09CD-SC01) in the headwaters of Casino Creek. Maximum snow water equivalents are available for February through May of each year between 1977 and 2011. Snow water equivalents were not input to the watershed model but were used to assess model fit during the calibration process. The snow survey data are briefly reported and discussed in the Baseline Climate Report (KPL 2013a).

#### *Sublimation and Snowmelt*

Sublimation was modelled at an assumed rate of 0.25 mm/day. This sublimation rate falls within ranges reported at regional research stations (KPL 2013a). Snowmelt was estimated using a temperature index method. The potential snowmelt for each month was calculated using a snowmelt factor of 65 mm/°C above a base temperature of 1°C. The actual monthly snowmelt was the lesser of the potential snowmelt and the available snow after considering losses to sublimation.

#### *Potential and Actual Evapotranspiration*

Potential evapotranspiration (PET) was calculated using the Thornthwaite method (1948). The PET for each month was estimated based on the corresponding average monthly temperature. Typically, PET represents the evapotranspiration for a full vegetation cover on relatively flat tilled ground with no shortage of water. Actual evapotranspiration (AET) is limited by the availability of water and soil moisture conditions; therefore, AET is calculated as part of the soil water balance in the watershed model.

#### *Water Available for Recharge and Runoff*

The water available for groundwater recharge and runoff was calculated as the sum of the rainfall and snowmelt for the month, less the evapotranspiration and soil moisture change. This unit value of water (net precipitation) was multiplied by the area for each elevation band in each sub-catchment to provide input to the water balance calculation.

### **Sub-Catchment Calculations**

#### *Groundwater*

Groundwater recharge was estimated by adjusting the portion of water available for runoff to allow for variability dependent on surface conditions, soil and subsurface permeability, and available storage capacity. The surplus water that was not recharged remained as surface water to be either stored or runoff.

A linear reservoir model was used to simulate the storage and release of groundwater. Water assumed to recharge into storage in each sub-catchment was accumulated within the subsurface and was released at a rate determined by the product of the average volume of water in storage and a groundwater discharge factor. The volume of water in storage was calculated as equal to the sum of the storage in the preceding month, plus the volume of water entering the system, less the quantity discharged. A lower discharge factor resulted in larger accumulated storage and a more uniform discharge rate.

Groundwater can flow into the next down-gradient sub-catchment or can discharge within the sub-catchment as surface water. Groundwater leaving the sub-catchment was estimated using Darcy's Law multiplying estimated values for transmissivity, width, and hydraulic gradient. Groundwater flow directions were assumed to

approximate surface flow directions (i.e., the down-gradient sub-catchment was assumed to be the same as the downstream sub-catchment). The remainder was added to surface water reporting to the down-gradient catchment.

#### *Surface Water*

The volume of water reporting to the surface water domain was calculated as the difference between net precipitation and groundwater recharge. A portion of the surface water manifested as immediate runoff and the remainder was detained in surface storage. Within this water balance methodology, any small scale detention features, such as small ponds and permafrost, are managed with the same type of linear reservoir model as groundwater recharge, storage, and discharge. The discharge factor is typically higher for surface water than groundwater.

Streamflows measured on-site indicate baseflows are lower in the spring and early summer compared to the late summer and fall (KPL 2013b). Additionally, summer peak flows are higher than flows observed during the snowmelt (freshet) period. As discussed in the Baseline Hydrology Report (KPL 2013b), these flow characteristics are believed to be the result of snowmelt infiltrating into and becoming trapped within the shallow permafrost "active layer" during the spring. This meltwater is then released from storage and conveyed toward the stream late in the summer when the active layer thaws. Thermistor data collected on-site suggest that the base of the active layer may not reach its maximum thawed depth until early July (thermistor CAS-034; KPL 2013c).

The influence of permafrost on surface runoff and streamflow was represented in the watershed model by incorporating a delay in the release of snowmelt from near-surface storage through spring and early summer until July. The delay was incorporated into the model using a step function to reduce the amount of water available to be released from surface storage during winter and spring. The value of the step function was determined by incorporating the ratio of permafrost area to total area within a sub-catchment. Areas of discontinuous permafrost were estimated based on terrain and slope aspect and are reported in the Baseline Hydrogeology Report (KPL 2013c). The percent of permafrost area was determined from the permafrost distribution map presented in KPL (2013c) for sub-catchments W11, W18, H18, W3, and W14. The remainder of the sub-catchments include area that extends beyond the delineated portion of the permafrost distribution map and the area of permafrost within these sub-catchments was estimated.

#### **Calibration**

The baseline watershed model was calibrated to long-term synthetic streamflow records for hydrology stations W11, W18, H18, W4, W9, W16, W3, and W14. Long-term synthetic records were developed based on a ranked regression modelling approach, which involved regressing flows recorded at the respective Project station against flows from the Big Creek regional hydrology station. The Big Creek streamflow record extends from 1974 to 2012. Regressions were developed on a monthly basis. The September regression was applied to all winter months to calculate synthetic winter streamflows. Winter regressions were then checked with available spot streamflow measurements. Overall, the synthetic streamflow records are not well constrained for winter conditions. Regression calculations and further details of sub-catchment characteristics are described in the Baseline Hydrology Report (KPL 2013b).

Groundwater and surface water recharge and discharge factors were adjusted to obtain a match between the long-term mean monthly calculated (modelled) streamflows and synthetic streamflows for each sub-catchment. Calculated and synthetic long-term cumulative mass balances were also reviewed during calibration. Mean monthly and cumulative streamflows were calculated for data between 1974 and 2012, corresponding to the available long-term synthetic record.

A channel losses function was added to the water balance calculation for sub-catchment W16. The channel losses function allows surface water to infiltrate into and be transported within the subsurface alluvial aquifer

beneath the hydrology station. The losses function allowed a better fit between modelled and synthetic flows in sub-catchment W16 and is supported by observations that:

- 1) Streamflow measured at hydrology station W16 is only slightly higher than the sum of the streamflow measured at the hydrology stations of its two main tributaries (W4 and W9). This low net increase in streamflows within the W16 sub-catchment is evidenced by a mean annual unit runoff (MAUR) that is approximately 25% lower than the MAUR of upstream catchments (KPL 2013b).
- 2) Published surficial geology maps suggest that the alluvial aquifer almost doubles in width immediately downstream of W16 (Bond and Lipovsky, 2012; Lipovsky and Bond, 2012). An increase in alluvial aquifer width has the potential to accommodate a greater volume of subsurface flow and supports the concept of surface water losses.

Results from the watershed model were used to develop a mine site water balance model (KPL 2013e). The water balance model uses average monthly climate inputs to stochastically model water flows. The parameters for the W11 and W18 sub-catchments were adjusted to optimize the calibration between both long-term synthetic climate input and average monthly climate input. The calibration using average monthly climate input focused on matching average monthly low streamflows (December through March).

## **Results**

The total average annual precipitation calculated within the watershed model was 460 mm at the site reference elevation of 1,200 masl based on the combined, correlated, and adjusted climate data from January 1958 through December 2012. Approximately two thirds of the precipitation in the watershed model fell as rain and one third fell as snow. The calculated average annual PET is estimated to be approximately 450 mm/yr and the corresponding AET approximately 210 mm/yr at an elevation of 1,200 masl. The calculated average annual sublimation is approximately 60 mm/yr at an elevation of 1,200 masl.

The nearby EC snow survey station reports an average May snow pack equivalent to 120 mm of water averaged between 1977 and 2011 at an elevation of 1,165 masl. The watershed model calculates an average May snow pack equivalent of 80 mm over the same time period within the corresponding 1,100–1,300 masl elevation band. The EC snow survey station is located on shrub-covered terrain that is flatter than areas of corresponding elevation within the modelled area. The majority of the area in the watershed model 1,100–1,300 masl elevation band is more treed than the EC snow survey site. Based on the vegetation and terrain at the EC snow survey site, more snow is expected to be trapped at the EC snow survey site than at the corresponding elevation band in the remainder of the watershed.

Streamflow and groundwater flow results from the baseline watershed model are summarized in Table 2. Comparisons of synthetic and calculated mean monthly streamflows, cumulative streamflows, and flow duration curves are shown for hydrology station W11 in Figures 2 through 4, respectively. Plots for all stations are presented in Appendix A.

The match between simulated and synthetic streamflows along the Dip Creek sub-catchments was more satisfactory than the fits within Canadian Creek (W3) and Britannia Creek (W14). In general, the Canadian Creek (W3) and Britannia Creek (W14) sub-catchments have a greater portion of north-facing slopes than sub-catchments feeding the Dip Creek watershed. As a result of the increased northerly aspect and associated high slopes, the W3 and W14 sub-catchments are anticipated to receive slightly less solar radiation, which may in turn influence permafrost melt.

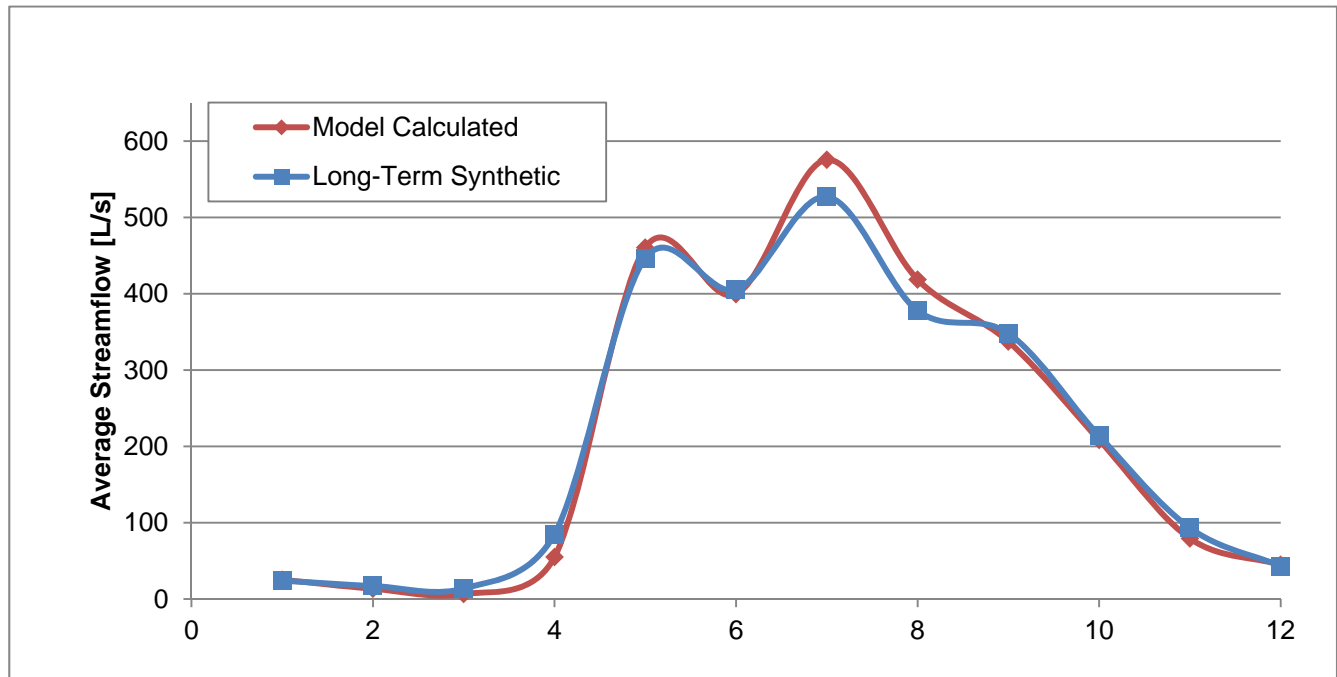
Comparison between the simulated and synthetic flow duration curves suggests that the model calibration does not perform as well at simulating the very low range of streamflows (Appendix A). The synthetic record is not well calibrated for low streamflows and is based on limited winter flow measurements. Additional low flow measurements (particularly in March) are recommended to improve the model calibration.

**Table 2 Summary of Baseline Watershed Model Results**

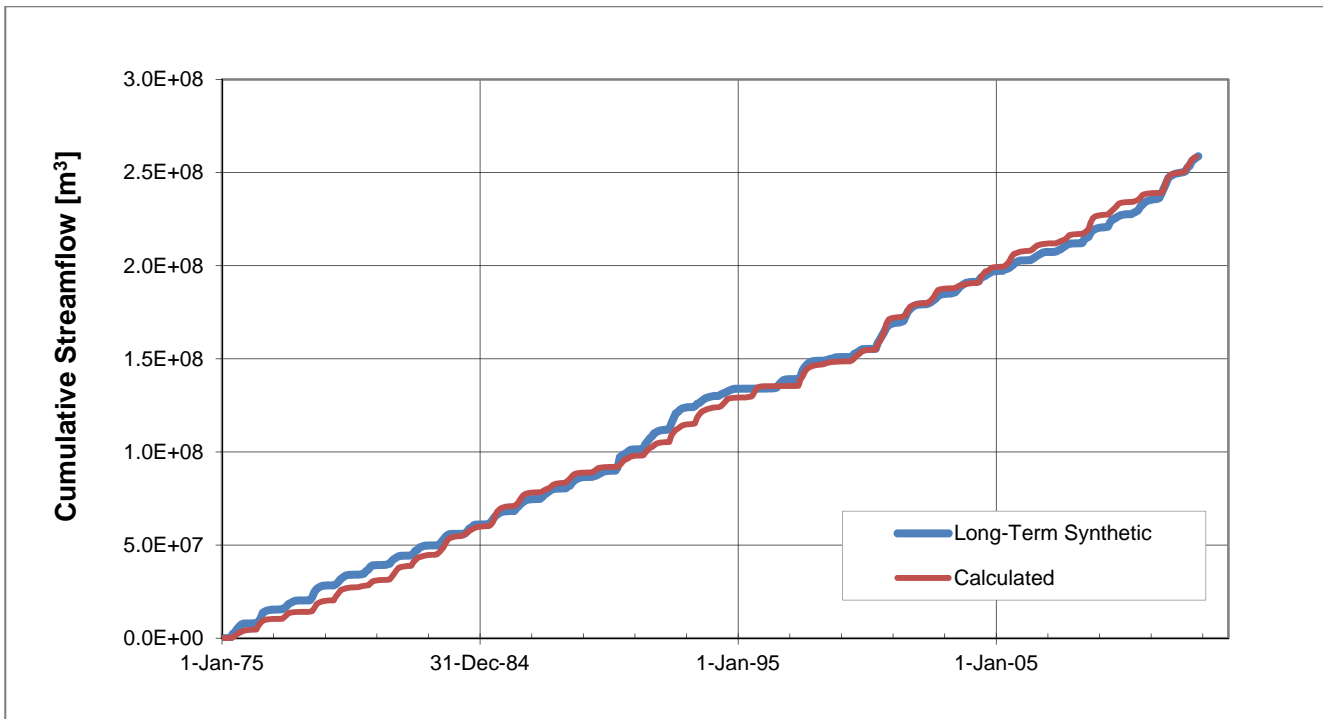
Hydrology Station	Total Area	Net Precipitation <sup>1</sup>	MAUR	Mean Annual Groundwater Flow to Downstream Sub-Catchment <sup>2</sup>	Mean Annual Groundwater Recharge as Percent of Precipitation <sup>2</sup>	Mean Annual Groundwater Discharge to Surface in Sub-Catchment <sup>2</sup>
	[km <sup>2</sup> ]	[mm/yr]	[L/s/km <sup>2</sup> ]	[L/s]	[%/yr]	[L/s]
W11	39	190	5.3	26	17%	72
W18	25	200	5.4	19	13%	29
H18	67	160	5.5	32	16%	19
W4	82	160	5.2	53	9%	0
W9	194	180	5.6	14	10%	264
W16	391	170	4.1	551	19%	0
W3	64	160	4.1	55	10%	40
W14	45	150	4.3	28	7%	28

**NOTES:**

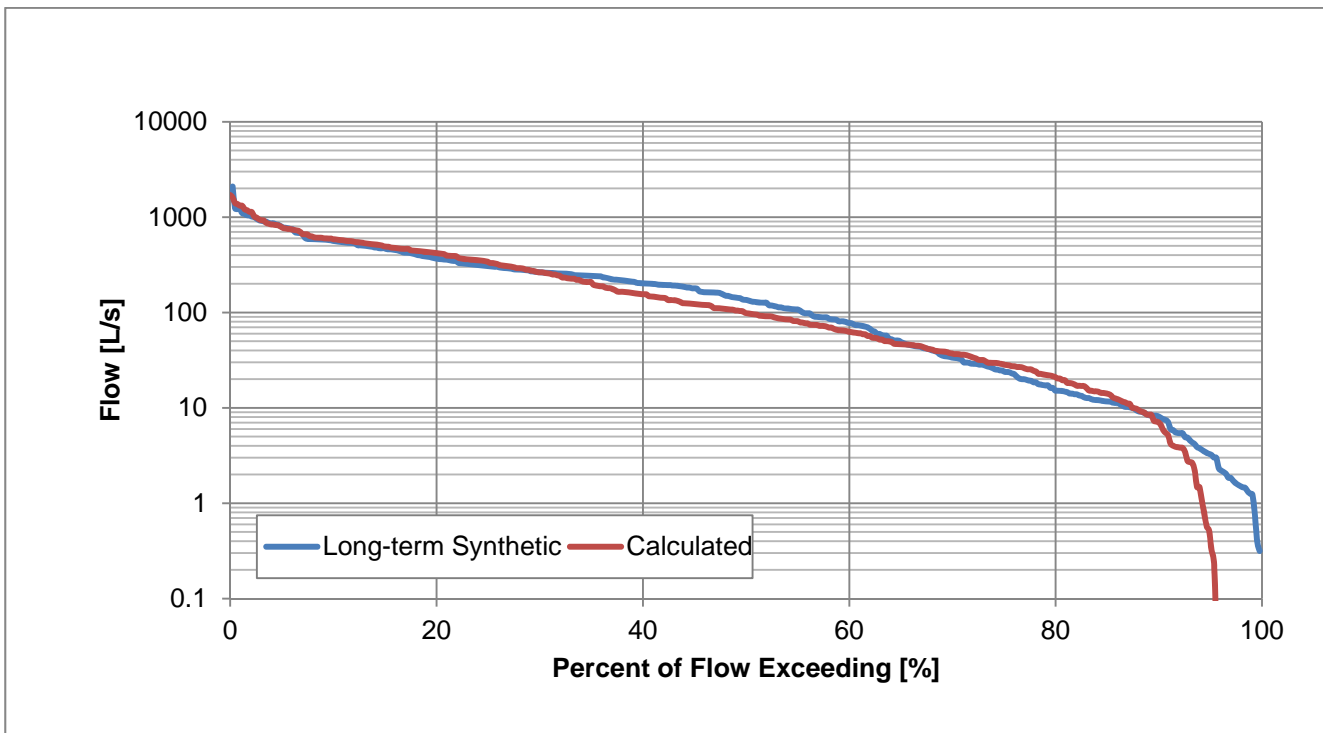
1. Net Precipitation = Rainfall + snowmelt – evapotranspiration – soil moisture change.
2. Mean annual values are calculated between 1958 and 2012.



**Figure 2 Synthetic and Calculated Average Monthly Streamflows – Station W11**



**Figure 3 Synthetic and Calculated Cumulative Streamflows – Station W11**



**Figure 4 Synthetic and Calculated Flow Duration Curves – Station W11**

Although the long-term climate record has been correlated to closely match the on-site temperature and precipitation trends, discrete precipitation and temperature events within the record may not correspond exactly to the climatic conditions experienced on-site during the same time interval (for example, a severe precipitation event that occurs at the Pelly Ranch climate station but does not occur on-site or a severe storm at site may not occur at Pelly Ranch). Because of the likelihood of discrete discrepancies between the on-site and synthetic climate conditions, the calibration of the model to discrete streamflow measurements varies over the period of record. For this reason, the calibration process includes consideration of the total measured flow over the calibration period and the distribution of monthly flows so that the calibrated record includes an understanding of the flow regime, even though individual months may vary.

### **3 – Mine Operations Model**

#### **Approach/Method**

A mine operations watershed model was constructed to assess the net precipitation at the proposed mine facilities and to determine the associated runoff and infiltration at each facility. The mine operations watershed model was built upon the baseline watershed model with modifications to include the following key mine facilities:

- Open Pit
- Low Grade Ore (LGO) stockpile
- Supergene Oxide stockpile
- Waste rock placed within the Tailings Management Facility (TMF)
- TMF beach
- TMF embankment, and
- Open water.

Facilities were modelled per unit area based on the estimated project footprint at the end of mine operations.

The mine operations model uses the same long-term historic temperature and precipitation record as input to the baseline watershed model. Estimates of average annual net precipitation, runoff, and infiltration at each mine facility were calculated based on this historic climate series. Net precipitation is the sum of water from rainfall and snowmelt minus evapotranspiration and change in soil moisture storage.

Surficial properties of project facilities are expected to differ from properties of the natural watershed. Evapotranspiration, runoff, and infiltration factors were modified to account for this difference. Climate input values developed during calibration of the baseline watershed model remained unchanged for the mine operations model with a few exceptions:

- Evapotranspiration – facilities will not be vegetated during operations, and will not lose water to transpiration. Evapotranspiration was lowered for all facilities with the exception of the TMF Beach. A significant portion of the TMF Beach will be saturated during its development. Evaporation from the saturated portion of the beach is expected to approach the potential evaporation rate. Evaporation from the non-saturated portion of the beach is expected to be half of the potential evaporation of open water. The TMF beach was assigned a higher evapotranspiration rate than the natural catchment.
- Soil moisture - stockpiles and the TMF embankment were assigned a lower soil moisture storage than natural catchment areas.

Parameters controlling runoff and infiltration in the watershed model were adjusted during calibration to achieve the anticipated percent of net precipitation that occurs as runoff.

#### **Results**

A summary of the average annual net precipitation at each mine facility is provided in Table 3. Average annual values at each operations facility were calculated from long-term net precipitation strings generated using the

same long-term synthetic climate data as the baseline watershed model. The average monthly net precipitation values at each operations facility were provided to the mine site water balance model for stochastic modelling (KPL 2013e). The percent of average annual runoff at each mine facility is also included in Table 3. Average runoff and infiltration estimates were provided as inputs for geochemical source-term modelling (Lorax Environmental Services Ltd).

**Table 3 Summary of Estimated Annual Net Precipitation on Facilities**

Facilities	Elevation Range	Net Precipitation	Runoff / Net Precipitation
	[masl]	[mm/yr]	[%]
Open Pit	1100-1400	370	N/A
LGO Stockpile <sup>1</sup>	1025-1150	290	10%
Supergene Stockpile <sup>1</sup>	1200-1400	310	10%
TMF Waste Rock	1000	280	10%
TMF Beach	1000	140	35%
TMF Embankment	710-1000	280	25%
Open Water	1000-1400	N/A	N/A

**NOTES:**

1. Placement and elevation of these operations facilities are based on the mine plan dated April 23, 2013.

**4 – Summary**

A baseline watershed model has been developed for the Casino Project to represent pre-mine hydrologic conditions. The calibrated baseline watershed model was used to estimate groundwater and surface water flows within eight sub-catchments surrounding the Project site. Water balance results from the baseline watershed model were provided as inputs to the mine site water balance model (KPL 2013e) and were considered during development of the numerical groundwater flow model (KPL 2013d).

The baseline watershed model was modified to create a simplified mine operations model to estimate the long-term mean monthly net precipitation on mine operations facilities. Calculated mean monthly net precipitation values on each mine facility were supplied to the mine site water balance model for stochastic modelling (KPL 2013e). Runoff and infiltration rates from the mine operations model were provided to the geochemical source term modelling team (Lorax Environmental Services Ltd).

**5 – References**

Bond, JD and Lipovsky, PS., 2012. Open File 2012-2 Surficial Geology of Colorado Creek (NTS 115J/10) Yukon (1:50000 scale). Yukon Geological Survey. Energy, Mines and Resources, Government of Yukon.

Knights Piésold Ltd. (KPL), 2013a. Baseline Climate Report (ref: VA101-325/14-7), issued June 14, 2013.

KPL, 2013b. Baseline Hydrology Report (ref: VA101-325/14-5), issued July 11, 2013.

KPL, 2013c. 2012 Baseline Hydrogeology Report (ref: VA101-325/14-4), issued July 18, 2013.

KPL, 2013d. Numerical Groundwater Modelling Report (ref:VA101-325/14-6), in progress.

KPL, 2013e. Mine Water Balance Modelling Report, in progress.

Lipovsky, PS and Bond, JD., 2012. Open File 2012-3 Surficial Geology of Doyle Creek (NTS 115J/11) Yukon (1:50000 scale). Yukon Geological Survey. Energy, Mines and Resources, Government of Yukon.

Thornthwaite CW., 1948. An Approach to the Rationale Classification of Climate. American Geophysical Review Volume 38.

We trust this meets your needs at the present time. Please feel free to contact us if you have any questions or require any further information.

Yours truly,  
**KNIGHT PIESOLD LTD.**

Attachments:

Appendix A    Watershed Model Calibration Plots

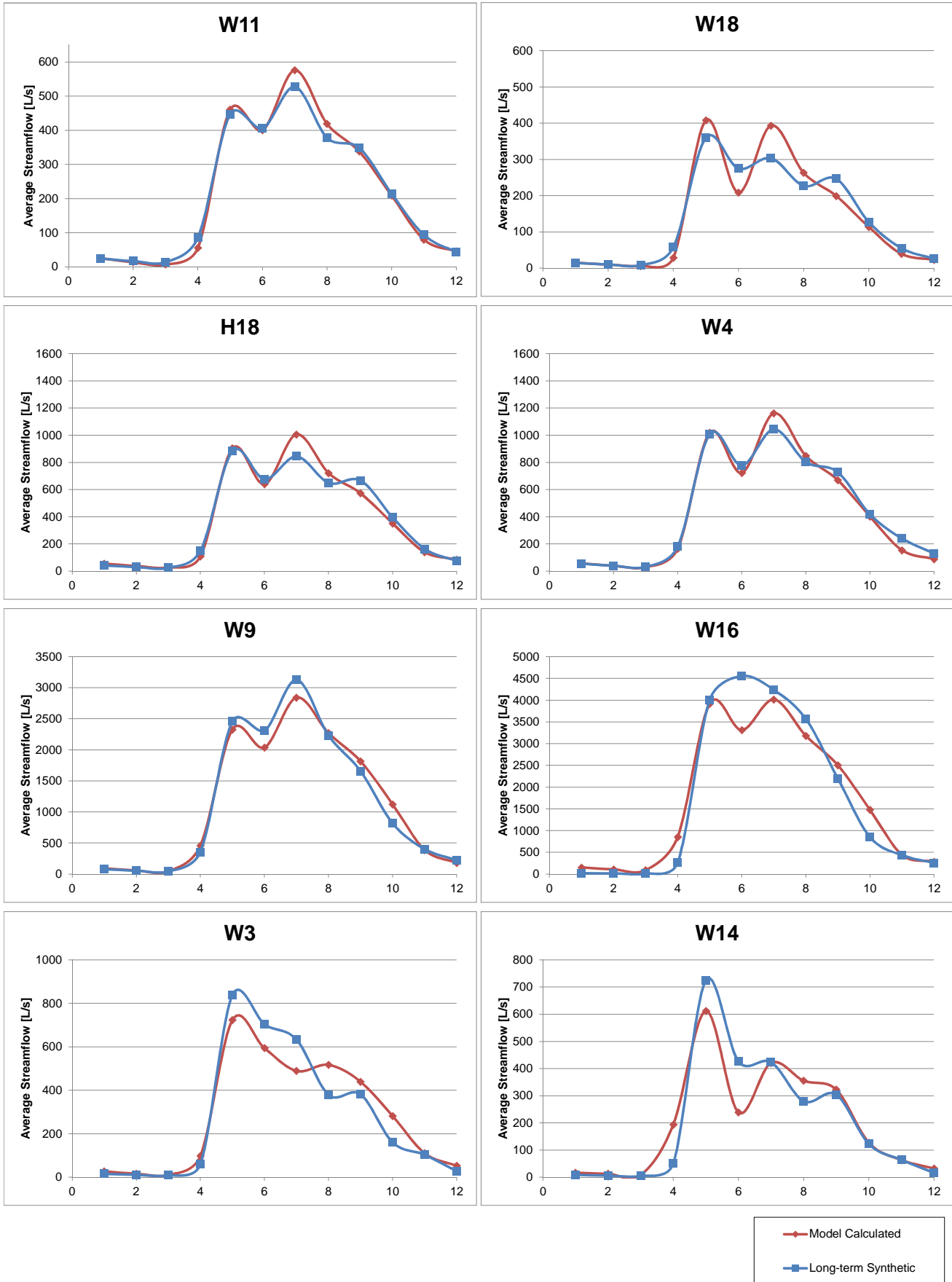
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**APPENDIX A**

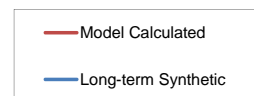
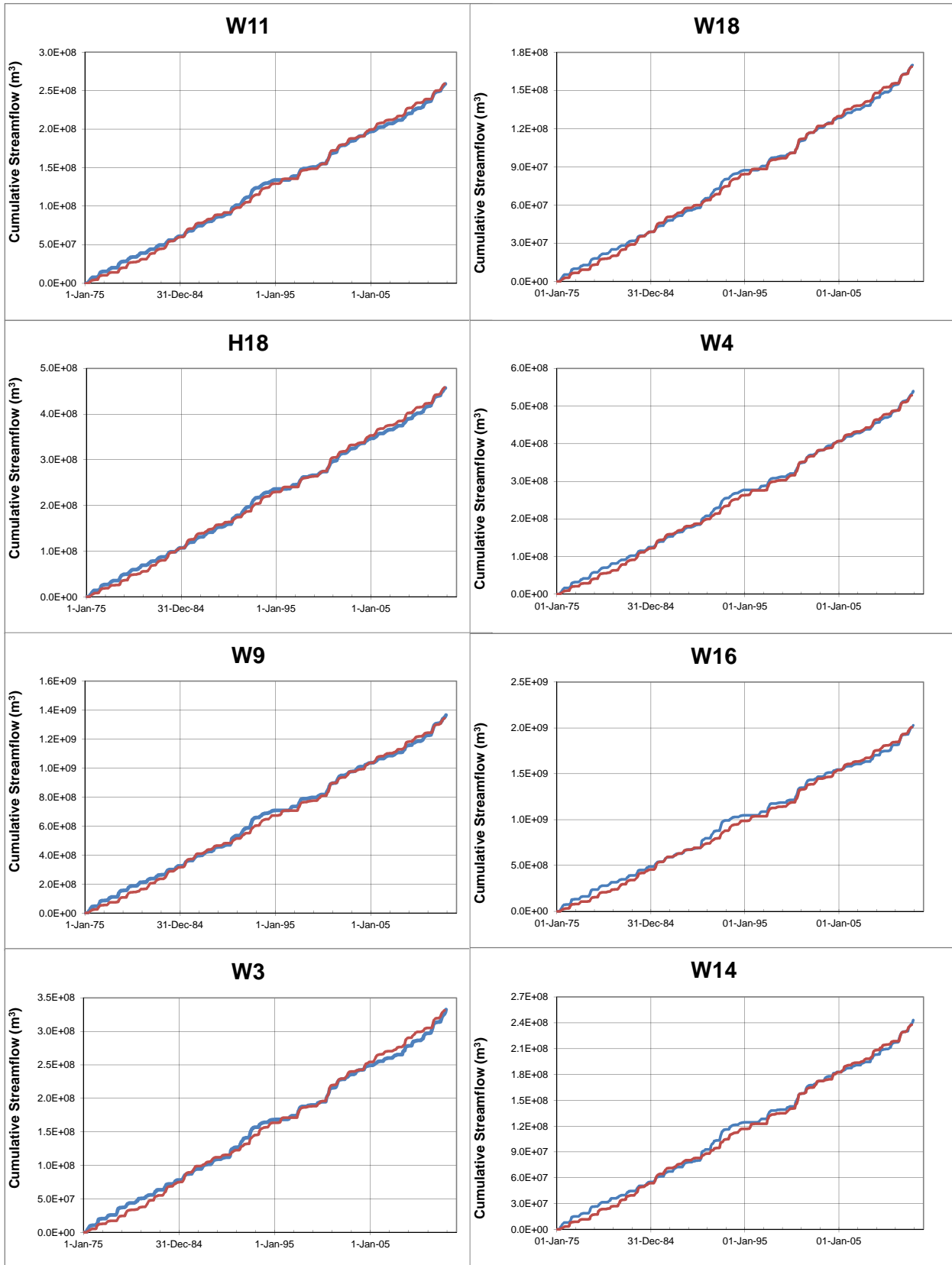
**WATERSHED MODEL CALIBRATION PLOTS**

(Pages A-1 to A-3)

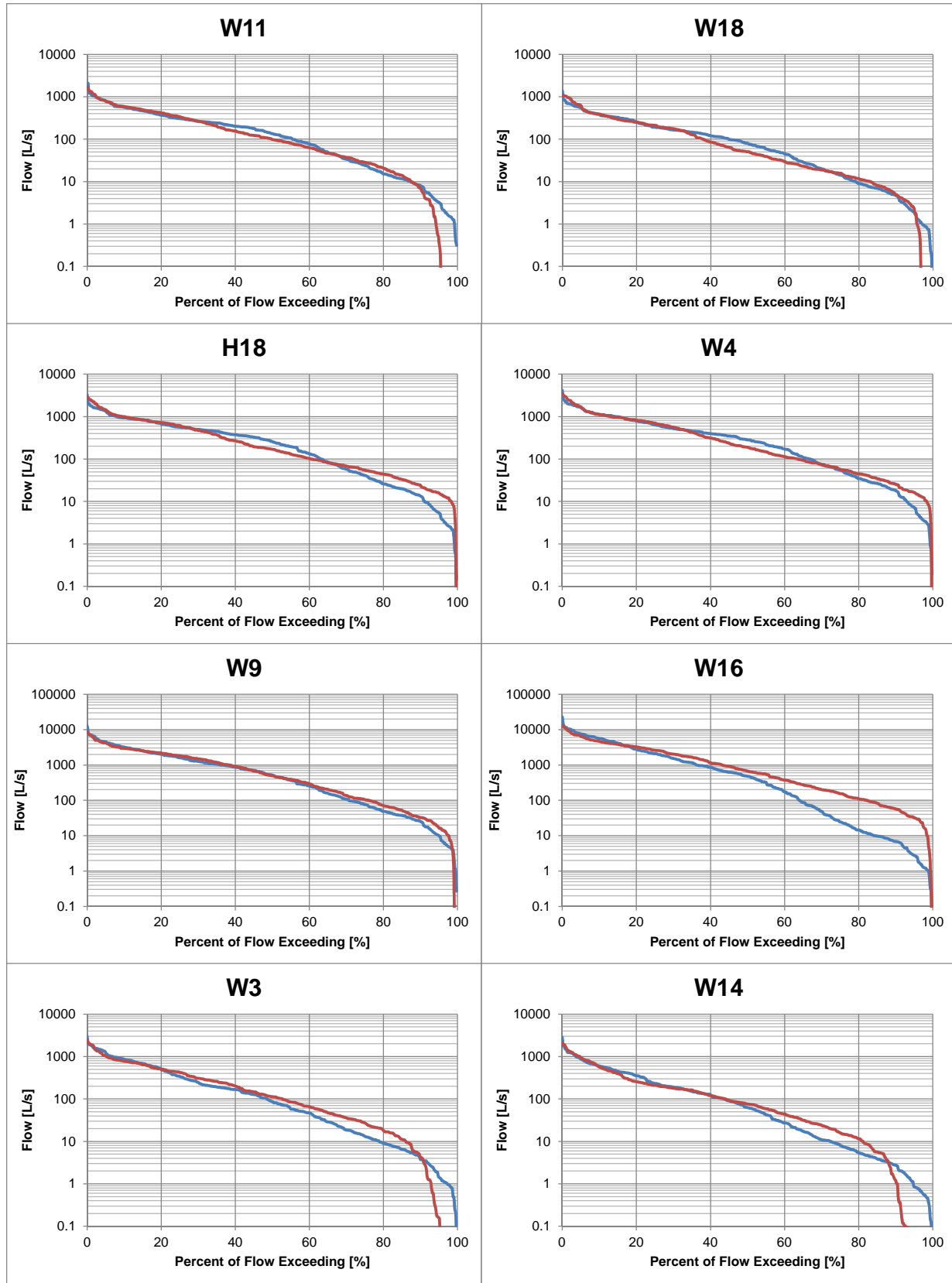
APPENDIX A-1 AVERAGE MONTHLY STREAMFLOWS



APPENDIX A-2 CUMULATIVE STREAMFLOWS



APPENDIX A-3 FLOW DURATION CURVES

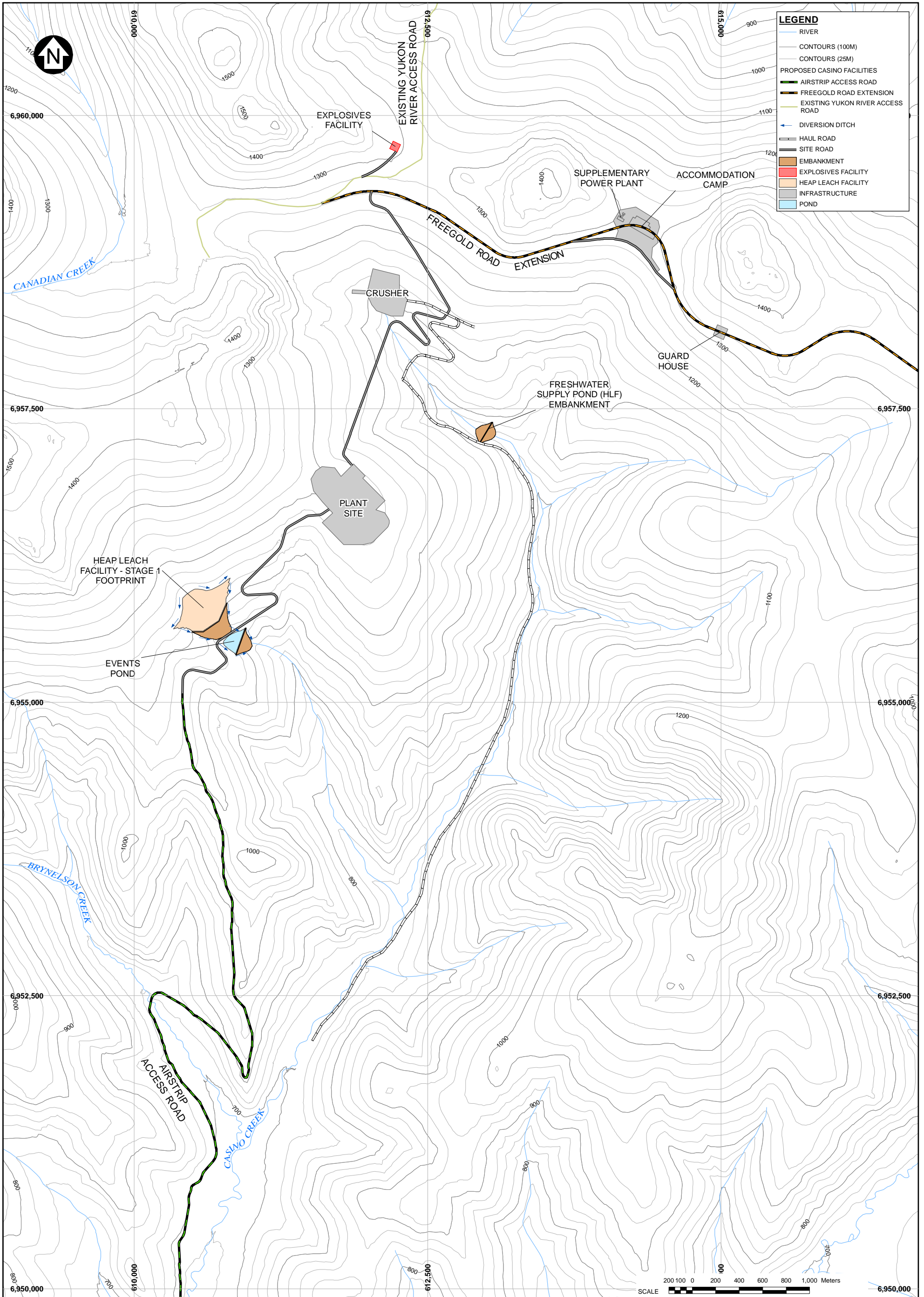


— Long-term Synthetic  
— Model Calculated

**APPENDIX B**

**CASINO PROJECT STAGED WATER MANAGEMENT FIGURES**

(Pages B-1 to B-12)



**LEGEND**

- RIVER
- CONTOURS (100M)
- CONTOURS (25M)
- PROPOSED CASINO FACILITIES
- AIRSTRIP ACCESS ROAD
- FREGOLD ROAD EXTENSION
- EXISTING YUKON RIVER ACCESS ROAD
- DIVERSION DITCH
- HAUL ROAD
- SITE ROAD
- EMBANKMENT
- EXPLOSIVES FACILITY
- HEAP LEACH FACILITY
- INFRASTRUCTURE
- POND

**NOTES:**

1. BASE MAP: LAKES FROM NTS, RIVERS FROM CANVEC, CONTOURS FROM EAGLE MAPPING.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 7N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:30,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

CASINO MINING CORPORATION

CASINO PROJECT

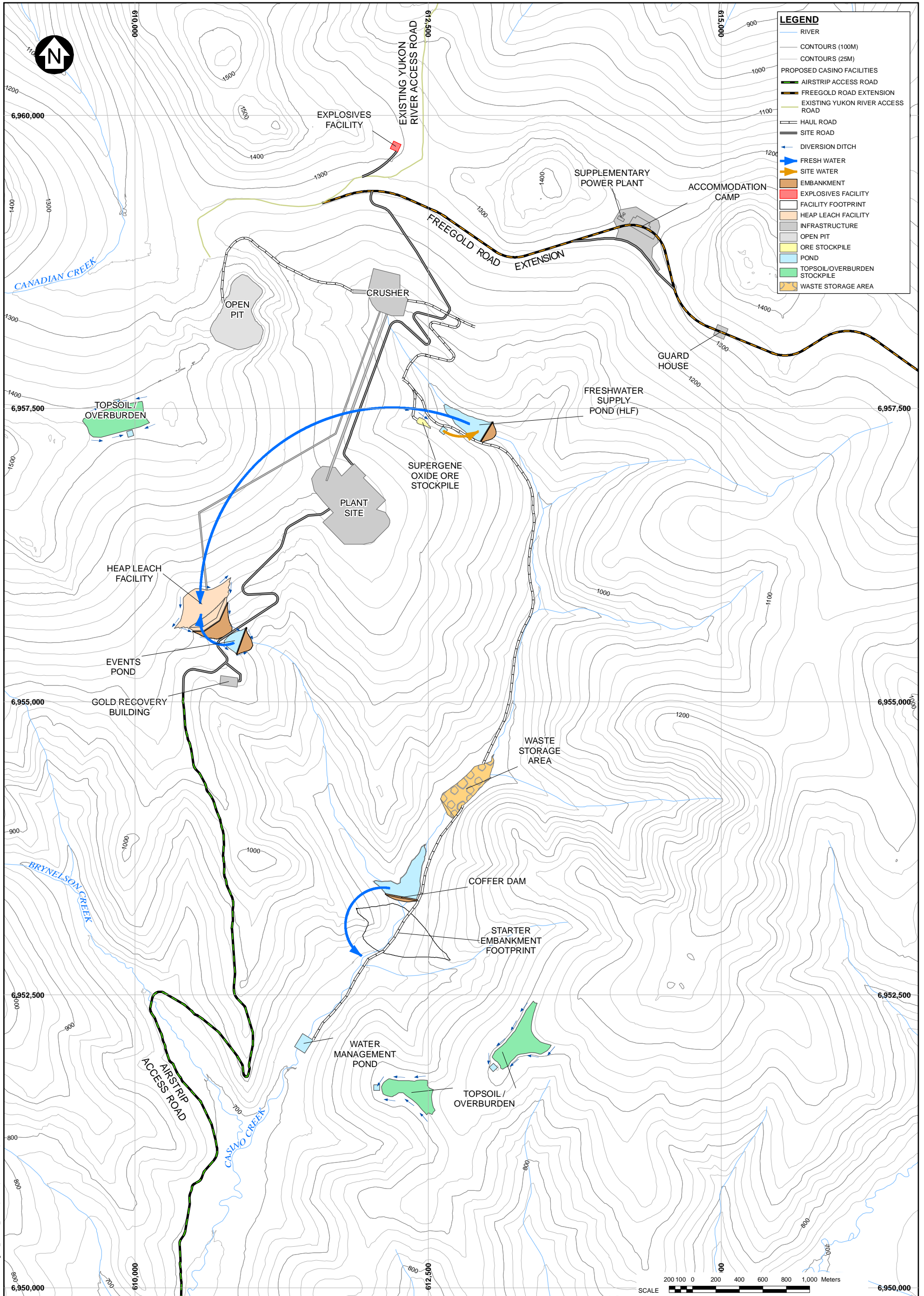
**WATER MANAGEMENT  
YEAR -4**

***Knight Piésold***  
CONSULTING

P/A NO. VA101-325/14	REF NO. 10
<b>FIGURE B.1</b>	
REV	0

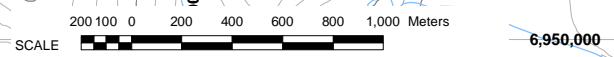
REV	DATE	ISSUED WITH REPORT	DESCRIPTION	CC DESIGNED	CC DRAWN	AS1 CHKD	KJB APPD
0	30OCT13	ISSUED WITH REPORT					

SAVED: M:\1101\00325114\GIS\Figures\Report10\_WaterBalance\FigB-1\_GAYear-4.mxd, Oct 30, 2013 2:40 PM, cczembor



**LEGEND**

- RIVER
- CONTOURS (100M)
- CONTOURS (25M)
- PROPOSED CASINO FACILITIES
- AIRSTRIP ACCESS ROAD
- FREGOLD ROAD EXTENSION
- EXISTING YUKON RIVER ACCESS ROAD
- HAUL ROAD
- SITE ROAD
- DIVERSION DITCH
- FRESH WATER
- SITE WATER
- EMBANKMENT
- EXPLOSIVES FACILITY
- FACILITY FOOTPRINT
- HEAP LEACH FACILITY
- INFRASTRUCTURE
- OPEN PIT
- ORE STOCKPILE
- POND
- TOPSOIL/OVERBURDEN STOCKPILE
- WASTE STORAGE AREA



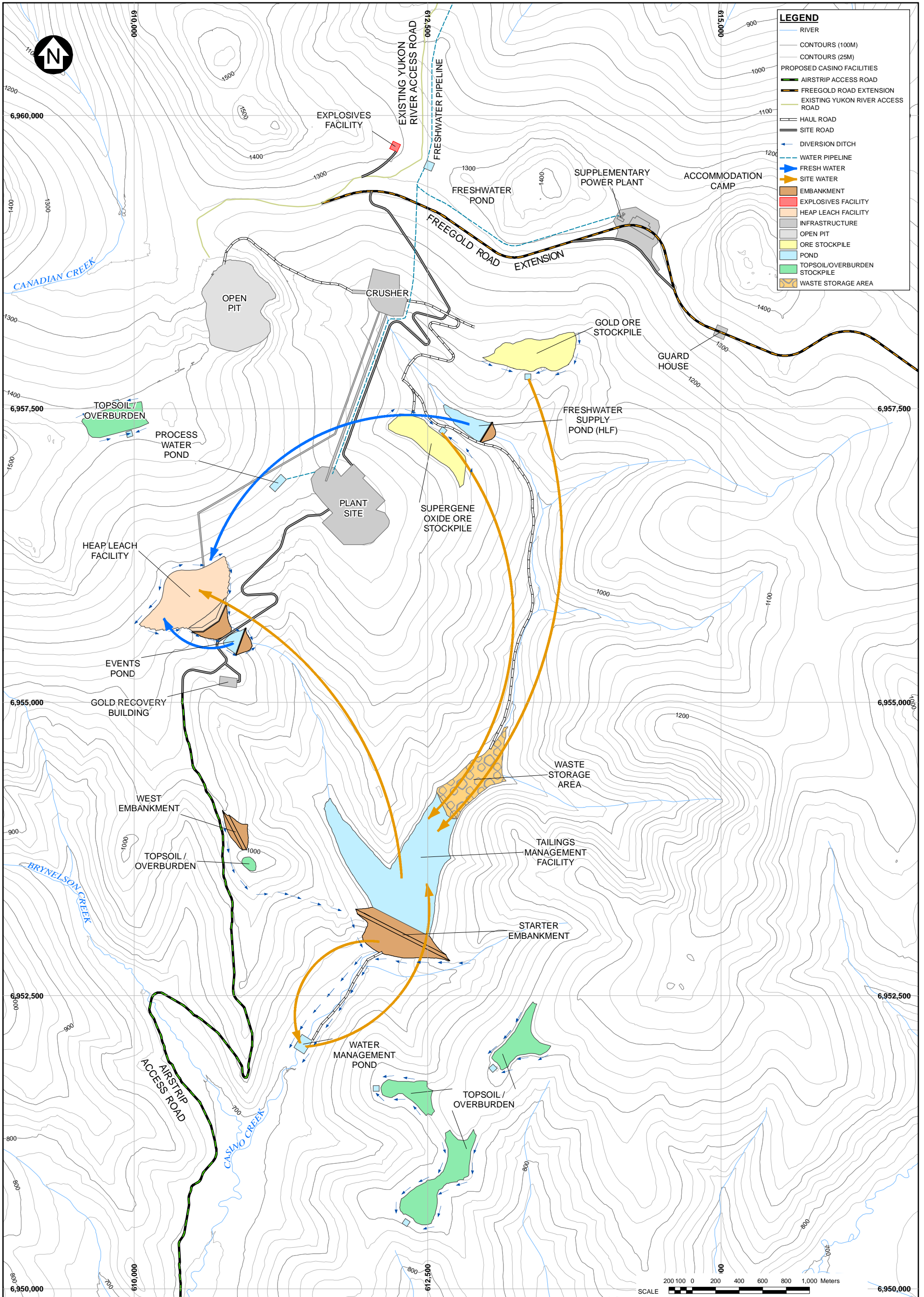
**NOTES:**

1. BASE MAP: LAKES FROM MTS, RIVERS FROM CANVEC, CONTOURS FROM EAGLE MAPPING.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 7N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:30,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

CASINO MINING CORPORATION	
CASINO PROJECT	
WATER MANAGEMENT YEAR -3	
<b><i>Knight Piésold</i></b> CONSULTING	P/A NO. VA101-325/14 REF NO. 10 REV 0
<b>FIGURE B.2</b>	

SAVED: M:\101\00325114\GIS\Figures\Report10\_Va101-325\FigB2\_GAYear\_-3.mxd, Oct 30, 2013 2:40 PM, cczembor

REV	DATE	ISSUED WITH REPORT	DESCRIPTION	CC DESIGNED	CC DRAWN	AS1 CHKD	KJB APPD
0	30OCT13	ISSUED WITH REPORT					



**NOTES:**

1. BASE MAP: LAKES FROM NTS, RIVERS FROM CANVEC, CONTOURS FROM EAGLE MAPPING.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 7N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:30,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

CASINO MINING CORPORATION

CASINO PROJECT

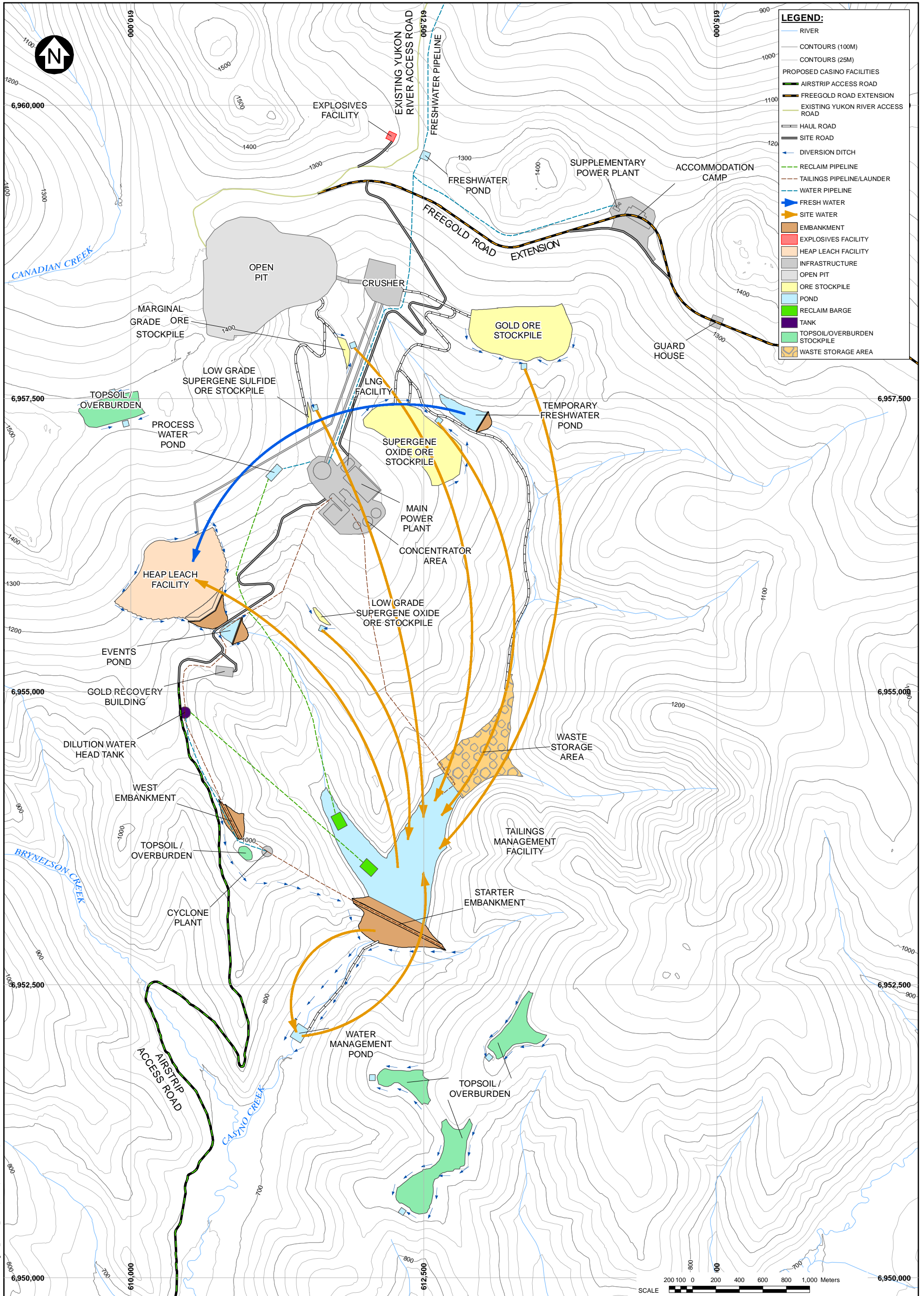
**WATER MANAGEMENT  
YEAR -2**

**Knight Piésold  
CONSULTING**

P/A NO. VA101-325/14	REF NO. 10
<b>FIGURE B.3</b>	
REV 0	

SAVED: M:\101\003251\4\GIS\Figures\Report10\_VaierBalance\FigB-3\_GAYear\_-2.mxd, Oct 30, 2013 2:40 PM, cczembor

REV	DATE	ISSUED WITH REPORT	DESCRIPTION	DESIGNED	DRAWN	CHKD	APPD
0	30OCT13	ISSUED WITH REPORT		CC	CC	AS1	KJB



**LEGEND:**

- RIVER
- CONTOURS (100M)
- CONTOURS (25M)
- PROPOSED CASINO FACILITIES
- AIRSTRIP ACCESS ROAD
- FREEGOLD ROAD EXTENSION
- EXISTING YUKON RIVER ACCESS ROAD
- HAUL ROAD
- SITE ROAD
- DIVERSION DITCH
- RECLAIM PIPELINE
- TAILINGS PIPELINE/LAUNDER
- WATER PIPELINE
- FRESH WATER
- SITE WATER
- EMBANKMENT
- EXPLOSIVES FACILITY
- HEAP LEACH FACILITY
- INFRASTRUCTURE
- OPEN PIT
- ORE STOCKPILE
- POND
- RECLAIM BARGE
- TANK
- TOPSOIL/OVERBURDEN STOCKPILE
- WASTE STORAGE AREA

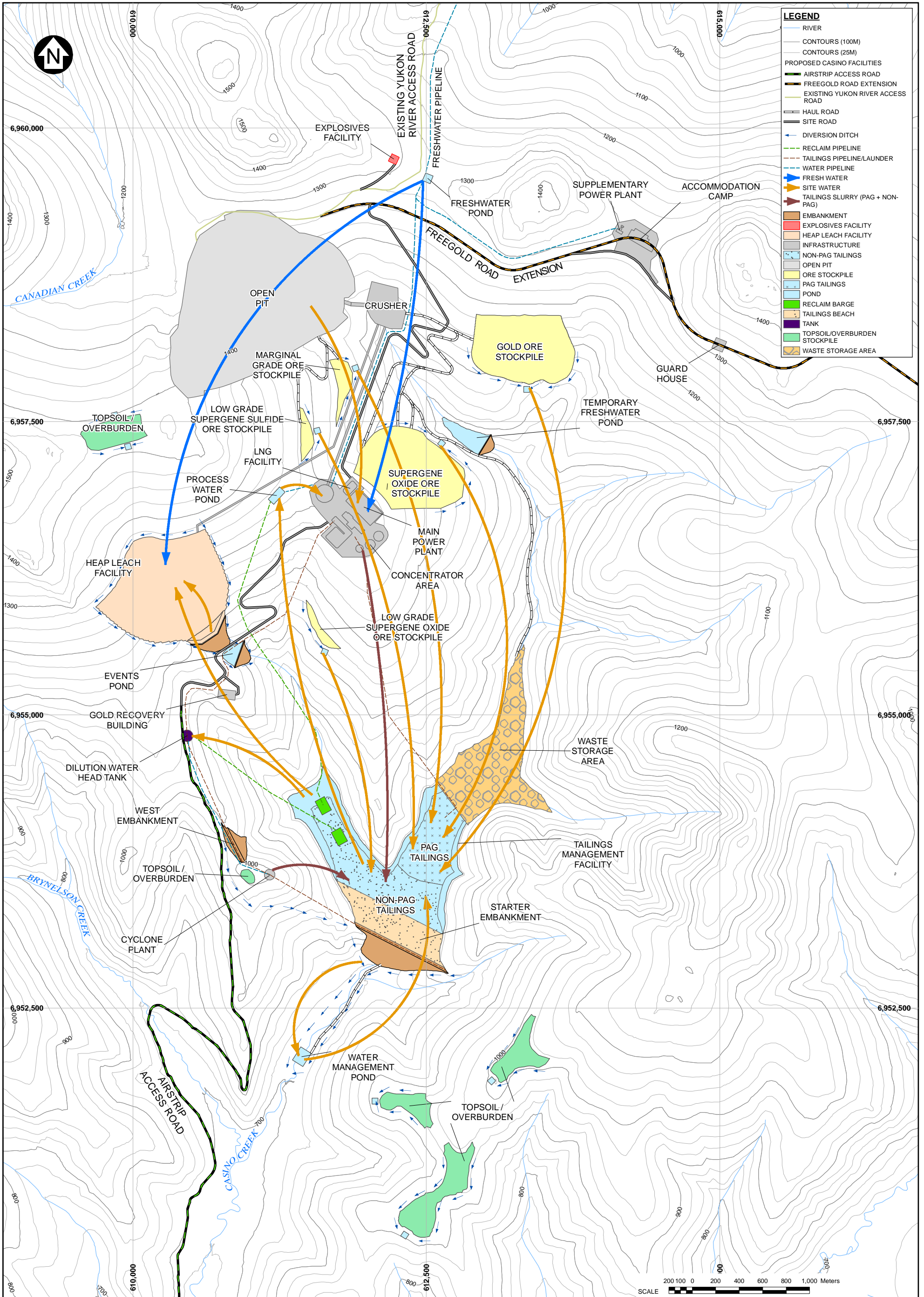
**NOTES:**

1. BASE MAP: LAKES FROM NTS, RIVERS FROM CANVEC, CONTOURS FROM EAGLE MAPPING.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 7N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:30,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

CASINO MINING CORPORATION	
CASINO PROJECT	
WATER MANAGEMENT YEAR -1	
<b><i>Knight Piésold</i></b> CONSULTING	P/A NO. VA101-325/14
REF NO. 10	REV 0
<b>FIGURE B.4</b>	

SAVED: M:\101\003251\4A\GIS\Figures\Report10\_WaterBalance\FigB-4\_GAYear-1.mxd; Oct 30, 2013 2:40 PM; cczembor

REV	DATE	ISSUED WITH REPORT	DESCRIPTION	CC DESIGNED	CC DRAWN	AS1 CHKD	KJB APPD
0	30OCT13	ISSUED WITH REPORT					



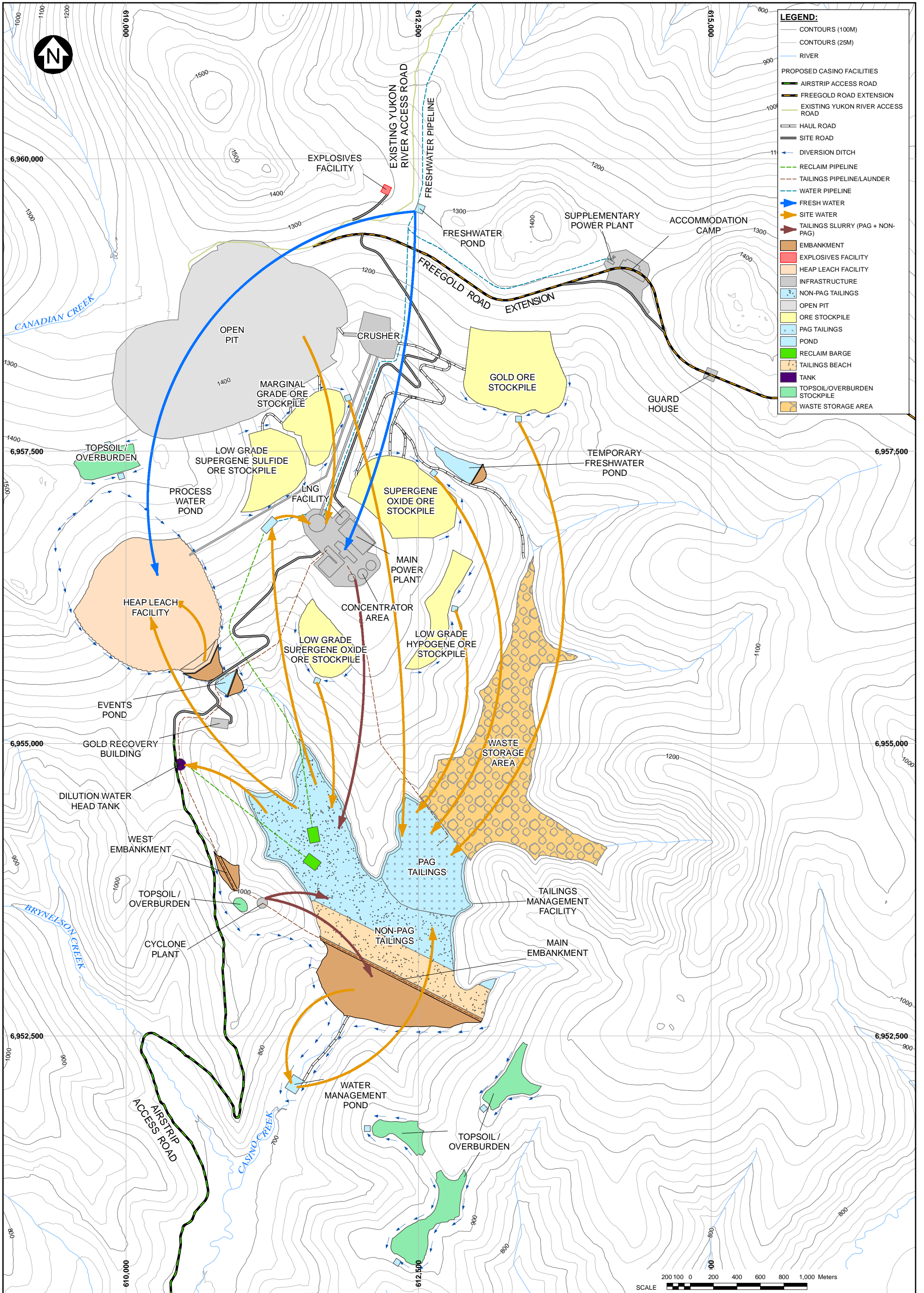
**NOTES:**

1. BASE MAP: LAKES FROM NTS, RIVERS FROM CANVEC, CONTOURS FROM EAGLE MAPPING.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 7N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:30,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

CASINO MINING CORPORATION	
CASINO PROJECT	
<b>WATER MANAGEMENT YEAR 1</b>	
<b><i>Knight Piésold</i> CONSULTING</b>	
P/A NO. VA101-325/14	REF NO. 10
<b>FIGURE B.5</b>	
REV	APPD

SAVED: M:\101\003251\4A\GIS\Fig\Report10\_WaterBalance\FigB5\_GAYear01.mxd, Oct 30, 2013 2:40 PM, cczembar

0	30OCT13	ISSUED WITH REPORT	CC	CC	AS1	KJB
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHKD	APPD



**LEGEND:**

- CONTOURS (100M)
- CONTOURS (25M)
- RIVER
- PROPOSED CASINO FACILITIES
- AIRSTRIP ACCESS ROAD
- FREEGOLD ROAD EXTENSION
- EXISTING YUKON RIVER ACCESS ROAD
- HAUL ROAD
- SITE ROAD
- DIVERSION DITCH
- RECLAIM PIPELINE
- TAILINGS PIPELINE/LAUNDER
- WATER PIPELINE
- FRESH WATER
- SITE WATER
- TAILINGS SLURRY (PAG + NON-PAG)
- EMBANKMENT
- EXPLOSIVES FACILITY
- HEAP LEACH FACILITY
- INFRASTRUCTURE
- NON-PAG TAILINGS
- OPEN PIT
- ORE STOCKPILE
- PAG TAILINGS
- POND
- RECLAIM BARGE
- TAILINGS BEACH
- TANK
- TOPSOIL/OVERBURDEN STOCKPILE
- WASTE STORAGE AREA

SCALE 200 100 0 200 400 600 800 1,000 Meters

**NOTES:**

1. BASE MAP: LAKES FROM NTS, RIVERS FROM CANVEC, CONTOURS FROM EAGLE MAPPING.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 7N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:30,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

CASINO MINING CORPORATION

CASINO PROJECT

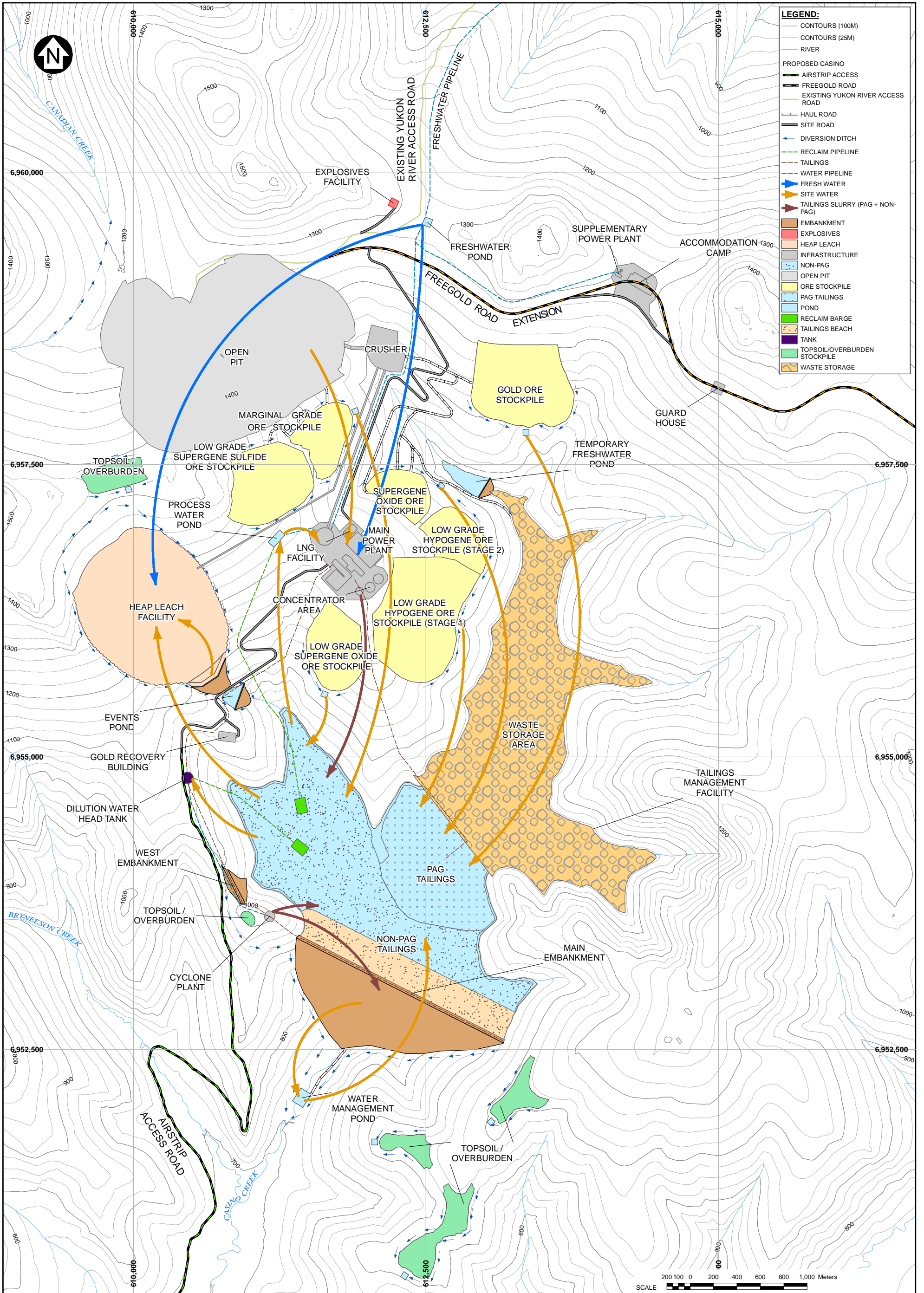
**WATER MANAGEMENT  
YEAR 4**

***Knight Piésold***  
CONSULTING

P/A NO. VA101-325/14	REF NO. 10
<b>FIGURE B.6</b>	
REV 0	

REV	DATE	ISSUED WITH REPORT	DESCRIPTION	DESIGNED	DRAWN	CHKD	APPD
0	30OCT13	ISSUED WITH REPORT		CC	CC	AS1	KJB

SAVED: M:\1101\00325114\GIS\Figures\Report10\_WaterBalance\FigB6\_GAYear04.mxd; Oct 30, 2013 2:40 PM; cczembor



**LEGEND:**

- CONTOURS (100M)
- CONTOURS (25M)
- RIVER
- PROPOSED CASINO AIRSTRIP ACCESS
- FREEGOLD ROAD
- EXISTING YUKON RIVER ACCESS ROAD
- HAUL ROAD
- SITE ROAD
- DIVERSION DITCH
- RECLAIM PIPELINE
- TAILINGS
- WATER PIPELINE
- FRESH WATER
- SITE WATER
- TAILINGS SLURRY (PAG + NON-PAG)
- EMBANKMENT
- EXPLOSIVES
- HEAP LEACH
- INFRASTRUCTURE
- NON-PAG
- OPEN PIT
- ORE STOCKPILE
- PAG TAILINGS
- POND
- RECLAIM BARGE
- TAILINGS BEACH
- TANK
- TOPSOIL/OVERBURDEN STOCKPILE
- WASTE STORAGE

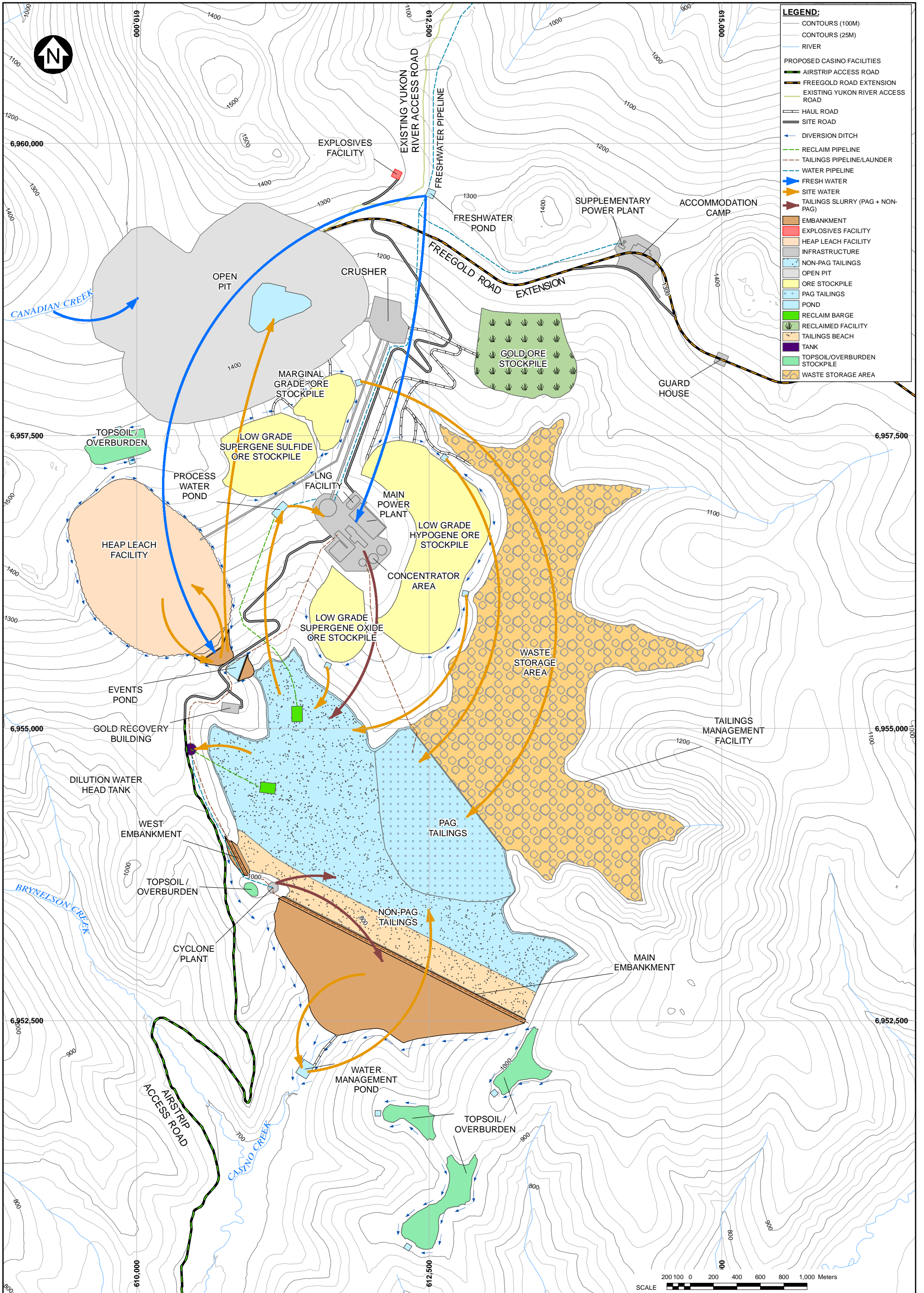
**NOTES:**

1. BASE MAP: LAKES FROM NTS, RIVERS FROM CANVEC, CONTOURS FROM EAGLE MAPPING.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 7N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:30,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

CASINO MINING CORPORATION							
CASINO PROJECT							
WATER MANAGEMENT YEAR 10							
<b>Knight Piésold</b> CONSULTING	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="font-size: small;">P/A NO. VA101-325/14</td> <td style="font-size: small;">REF NO. 10</td> </tr> <tr> <td colspan="2" style="text-align: center;"><b>FIGURE B.7</b></td> </tr> <tr> <td style="font-size: x-small;">REV</td> <td style="font-size: x-small;">0</td> </tr> </table>	P/A NO. VA101-325/14	REF NO. 10	<b>FIGURE B.7</b>		REV	0
P/A NO. VA101-325/14	REF NO. 10						
<b>FIGURE B.7</b>							
REV	0						

SAVED: M:\101\0032514\GIS\Figures\Report10\_WaterBalance\FigB7\_GAYear10.mxd; Oct 30, 2013 2:41 PM; cczembor

REV	DATE	ISSUED WITH REPORT	DESCRIPTION	DESIGNED	DRAWN	CHKD	APPD
0	30OCT13	ISSUED WITH REPORT		CC	CC	AS1	KJB



**LEGEND:**

- CONTOURS (100M)
- CONTOURS (25M)
- RIVER
- PROPOSED CASINO FACILITIES
- AIRSTRIP ACCESS ROAD
- FREEGOLD ROAD EXTENSION
- EXISTING YUKON RIVER ACCESS ROAD
- HAUL ROAD
- SITE ROAD
- DIVERSION DITCH
- RECLAIM PIPELINE
- TAILINGS PIPELINE/LAUNDER
- WATER PIPELINE
- FRESH WATER
- SITE WATER
- TAILINGS SLURRY (PAG + NON-PAG)
- EMBANKMENT
- EXPLOSIVES FACILITY
- HEAP LEACH FACILITY
- INFRASTRUCTURE
- NON-PAG TAILINGS
- OPEN PIT
- ORE STOCKPILE
- PAG TAILINGS
- POND
- RECLAIM BARGE
- RECLAIMED FACILITY
- TAILINGS BEACH
- TANK
- TOPSOIL/OVERBURDEN STOCKPILE
- WASTE STORAGE AREA

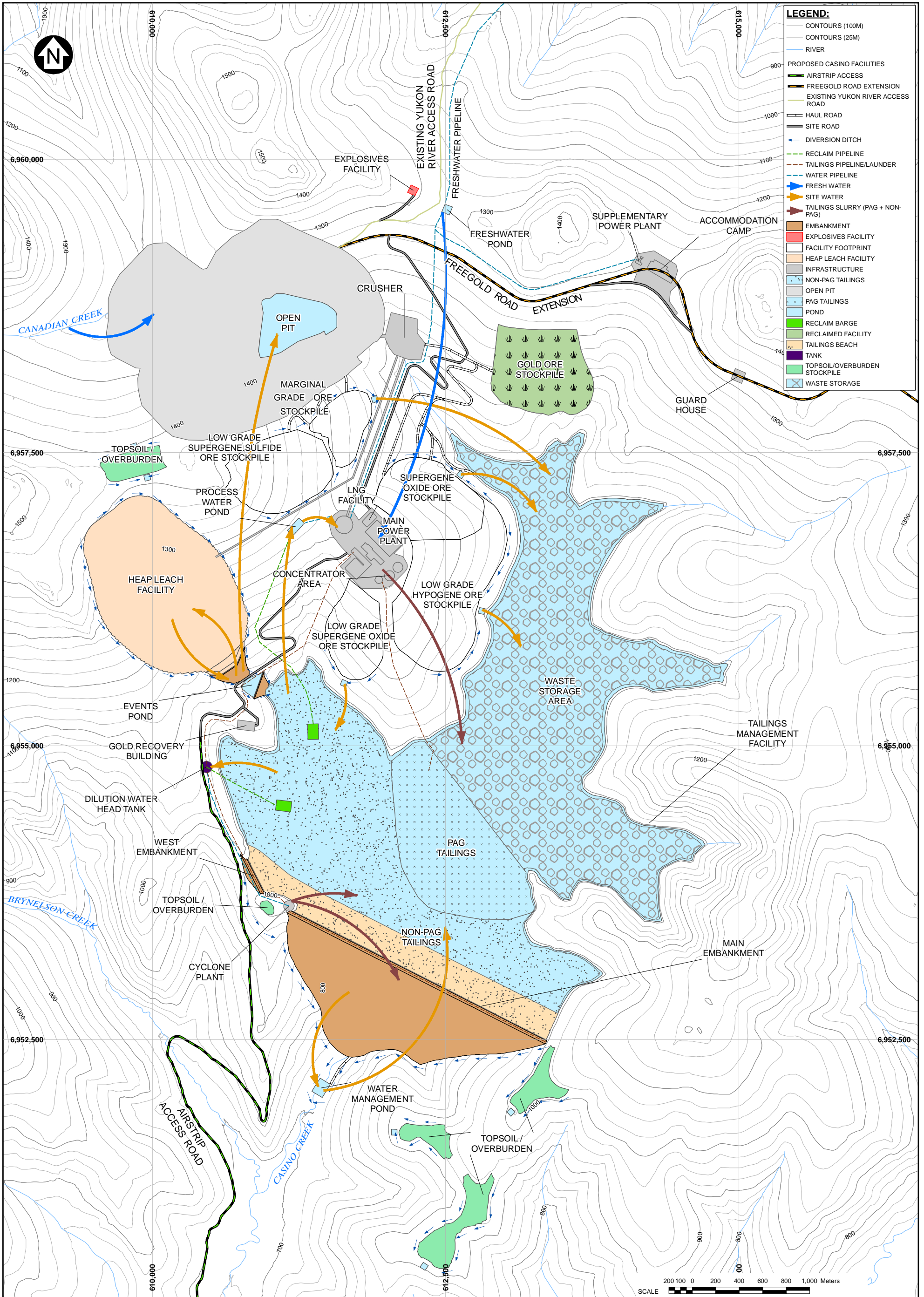
**NOTES:**

1. BASE MAP: LAKES FROM NTS, RIVERS FROM CANVEC, CONTOURS FROM EAGLE MAPPING.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 7N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:30,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

CASINO MINING CORPORATION	
CASINO PROJECT	
WATER MANAGEMENT YEAR 19	
<b><i>Knight Piésold</i></b> CONSULTING	P/A NO. VA101-325/14 REF NO. 10 <b>FIGURE B.8</b>
REV 0	REV 0

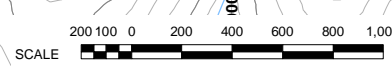
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REV	DATE	ISSUED WITH REPORT	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	30OCT13	ISSUED WITH REPORT		CC	CC	AS1	KJB



**LEGEND:**

- CONTOURS (100M)
- CONTOURS (25M)
- RIVER
- PROPOSED CASINO FACILITIES
- AIRSTRIP ACCESS
- FREEGOLD ROAD EXTENSION
- EXISTING YUKON RIVER ACCESS ROAD
- HAUL ROAD
- SITE ROAD
- DIVERSION DITCH
- RECLAIM PIPELINE
- TAILINGS PIPELINE/LAUNDER
- WATER PIPELINE
- FRESH WATER
- SITE WATER
- TAILINGS SLURRY (PAG + NON-PAG)
- EMBANKMENT
- EXPLOSIVES FACILITY
- FACILITY FOOTPRINT
- HEAP LEACH FACILITY
- INFRASTRUCTURE
- NON-PAG TAILINGS
- OPEN PIT
- PAG TAILINGS
- POND
- RECLAIM BARGE
- RECLAIMED FACILITY
- TAILINGS BEACH
- TANK
- TOPSOIL/OVERBURDEN STOCKPILE
- WASTE STORAGE



**NOTES:**

1. BASE MAP: LAKES FROM NTS, RIVERS FROM CANVEC, CONTOURS FROM EAGLE MAPPING.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 7N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:30,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

CASINO MINING CORPORATION

CASINO PROJECT

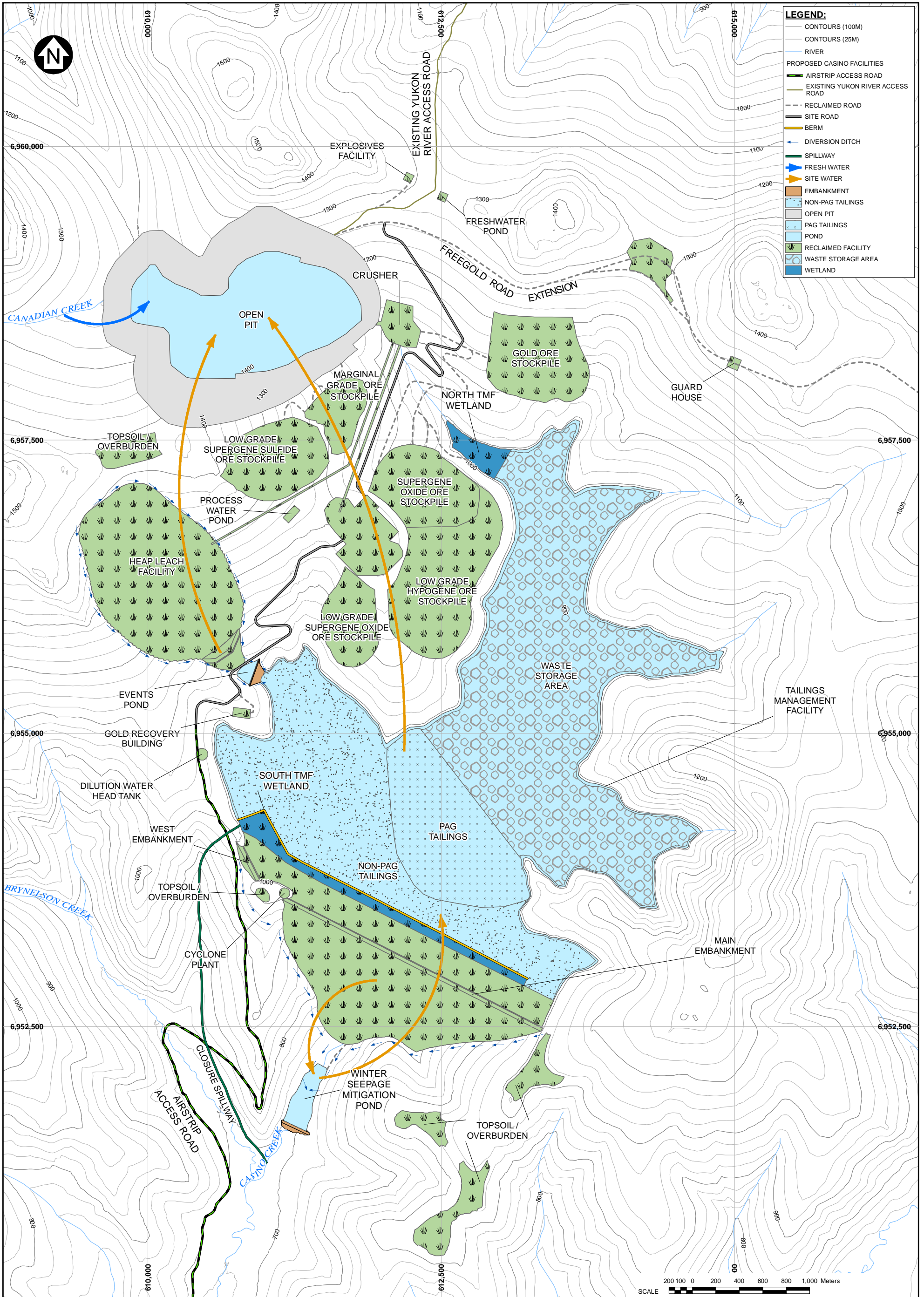
WATER MANAGEMENT  
YEAR 22

**Knight Piésold**  
CONSULTING

P/A NO. VA101-325/14	REF NO. 10
<b>FIGURE B.9</b>	
REV	0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHKD	APPD
0	30OCT13	ISSUED WITH REPORT	CC	CC	AS1	KJB

SAVED: M:\1101\00325114\GIS\Figures\Report10\_WaterBalance\FigB.9\_GAYear22.mxd, Oct 30, 2013 2:41 PM, cczembor



**NOTES:**

1. BASE MAP: LAKES FROM NTS, RIVERS FROM CANVEC, CONTOURS FROM EAGLE MAPPING.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 7N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:30,000 FOR 11X17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.
4. PHASE 1: ACTIVE WATER MANAGEMENT PRIOR TO THE DISCHARGE OF THE TMF POND.

CASINO MINING CORPORATION

CASINO PROJECT

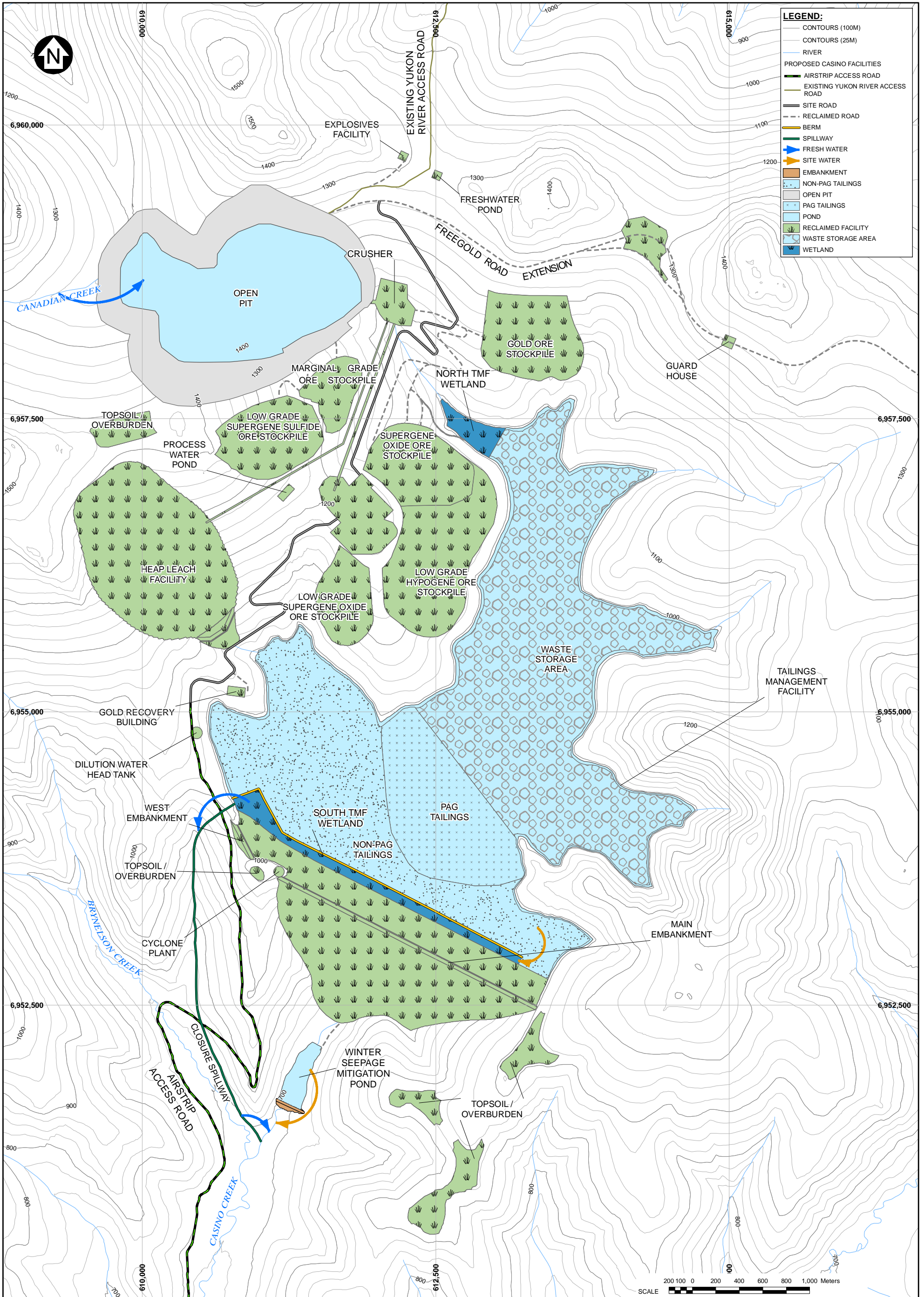
CLOSURE WATER MANAGEMENT PHASE I

**Knight Piésold**  
CONSULTING

P/A NO. VA101-325/14	REF NO. 10
<b>FIGURE B.10</b>	
REV 0	

REV	DATE	ISSUED WITH REPORT	DESCRIPTION	CC DESIGNED	CC DRAWN	AS1 CHK'D	KJB APP'D
0	2DEC13	ISSUED WITH REPORT					

SAVED: M:\1101\03025114\GIS\Figs\Report10\_WaterBalance\Fig-10\_GAClosure1.mxd; Dec 02, 2013 3:34 PM; czember



**NOTES:**

1. BASE MAP: LAKES FROM NTS, RIVERS FROM CANVEC, CONTOURS FROM EAGLE MAPPING.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 7N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:30,000 FOR 11X17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.
4. PHASE II: PASSIVE WATER MANAGEMENT AFTER DISCHARGE OF THE TMF POND BUT PRIOR TO DISCHARGE OF THE OPEN PIT LAKE.

CASINO MINING CORPORATION

CASINO PROJECT

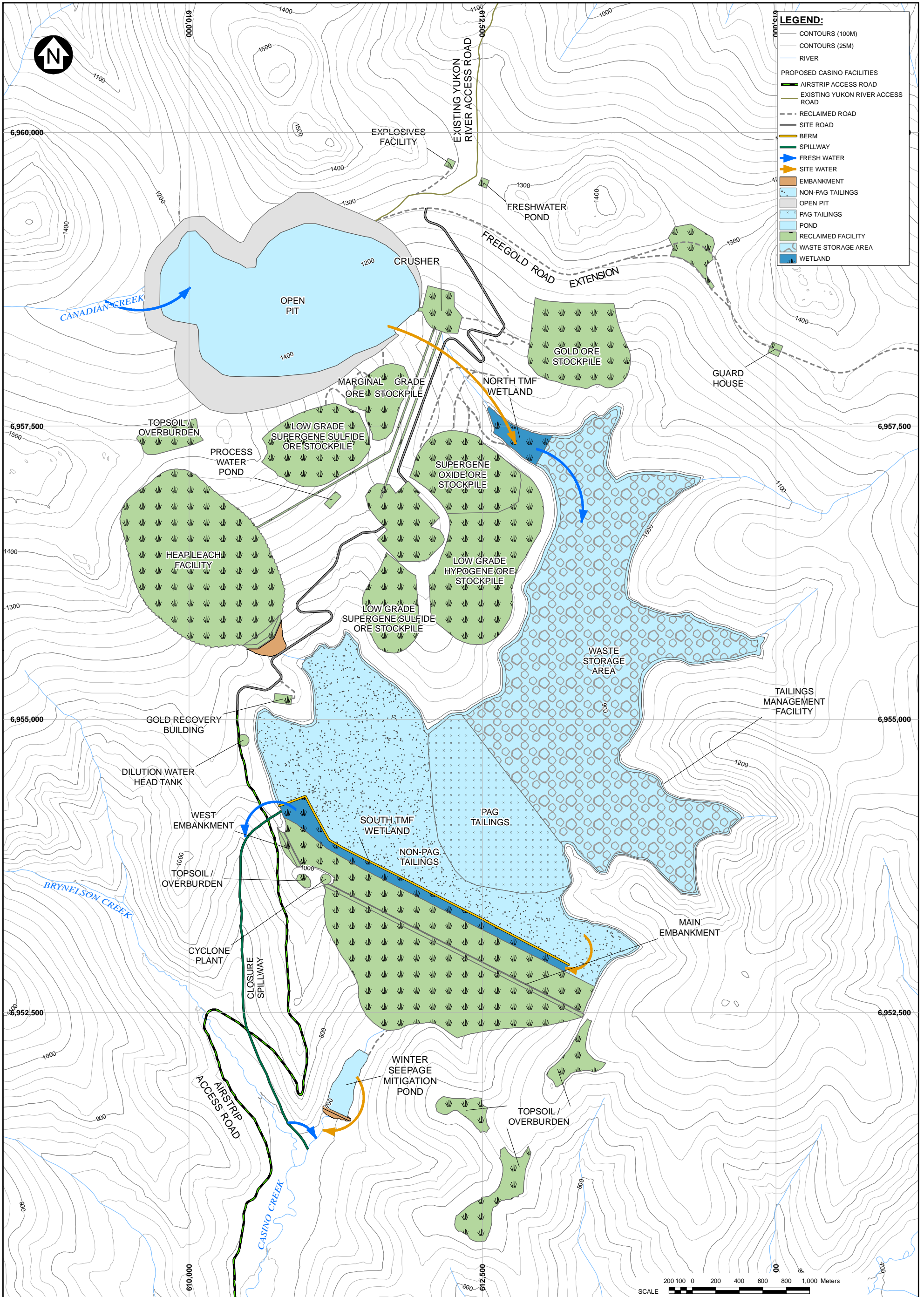
CLOSURE WATER MANAGEMENT PHASE II

**Knight Piésold**  
CONSULTING

P/A NO. VA101-325/14	REF NO. 10
FIGURE B.11	
REV 0	

SAVED: M:\1101\03025114\GIS\Figs\Report10\_WaterBalance\FigB-11\_GA Closure2.mxd; Dec 02, 2013 3:35 PM; czember

REV	DATE	ISSUED WITH REPORT	DESCRIPTION	CC DESIGNED	CC DRAWN	AS1 CHK'D	KJB APP'D
0	2DEC13	ISSUED WITH REPORT					



**NOTES:**

1. BASE MAP: LAKES FROM NTS, RIVERS FROM CANVEC, CONTOURS FROM EAGLE MAPPING.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 7N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:30,000 FOR 11X17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.
4. PHASE III: PASSIVE WATER MANAGEMENT AFTER DISCHARGE OF THE OPEN PIT LAKE.

CASINO MINING CORPORATION

CASINO PROJECT

CLOSURE WATER MANAGEMENT PHASE III

**Knight Piésold**  
CONSULTING

P/A NO. VA101-325/14	REF NO. 10
<b>FIGURE B.12</b>	
REV	0

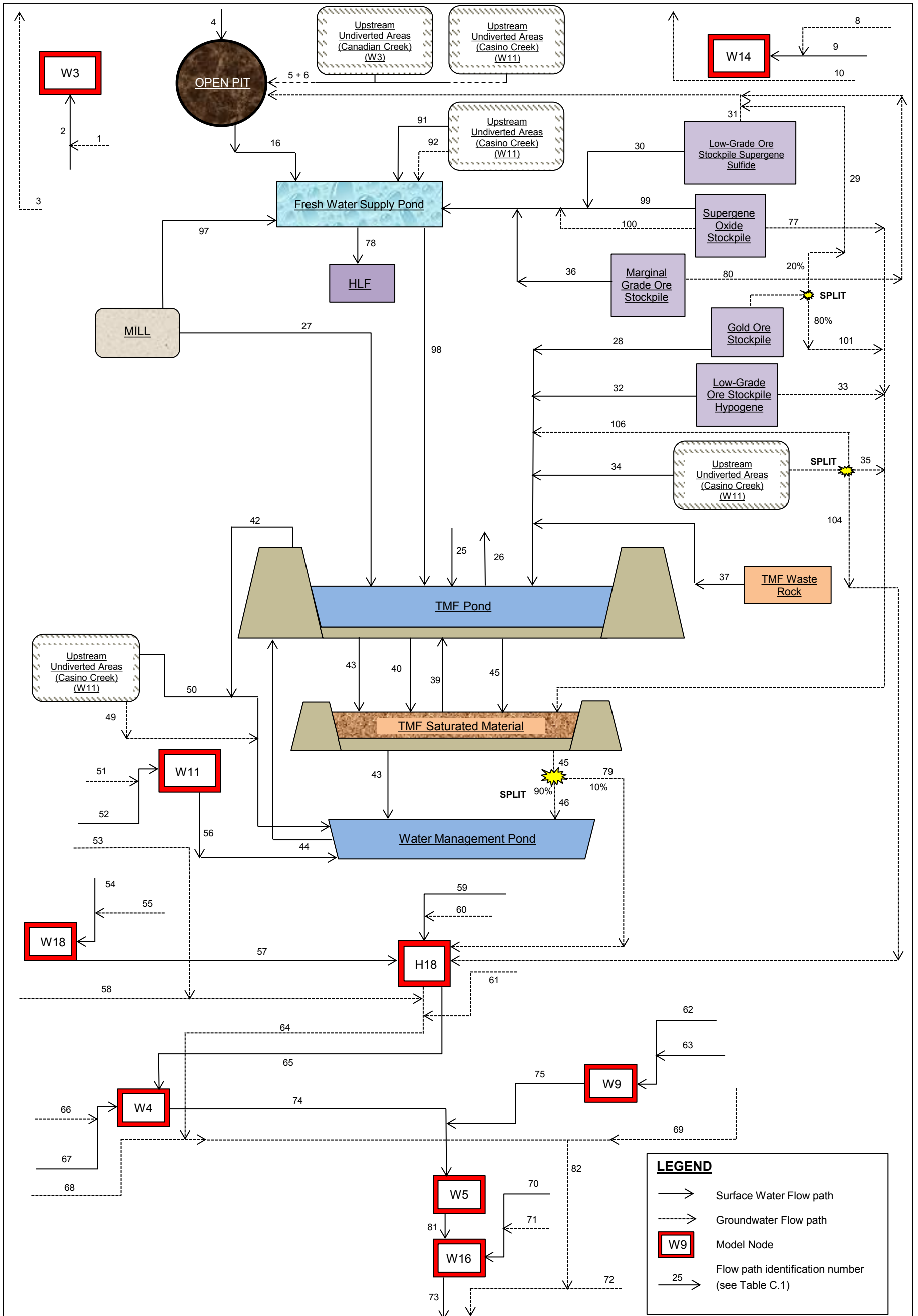
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REV	DATE	ISSUED WITH REPORT	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	2DEC13	ISSUED WITH REPORT		CC	CC	AS1	KJB

**APPENDIX C**

**YESAB WATER BALANCE MODEL FLOW SCHEMATICS**

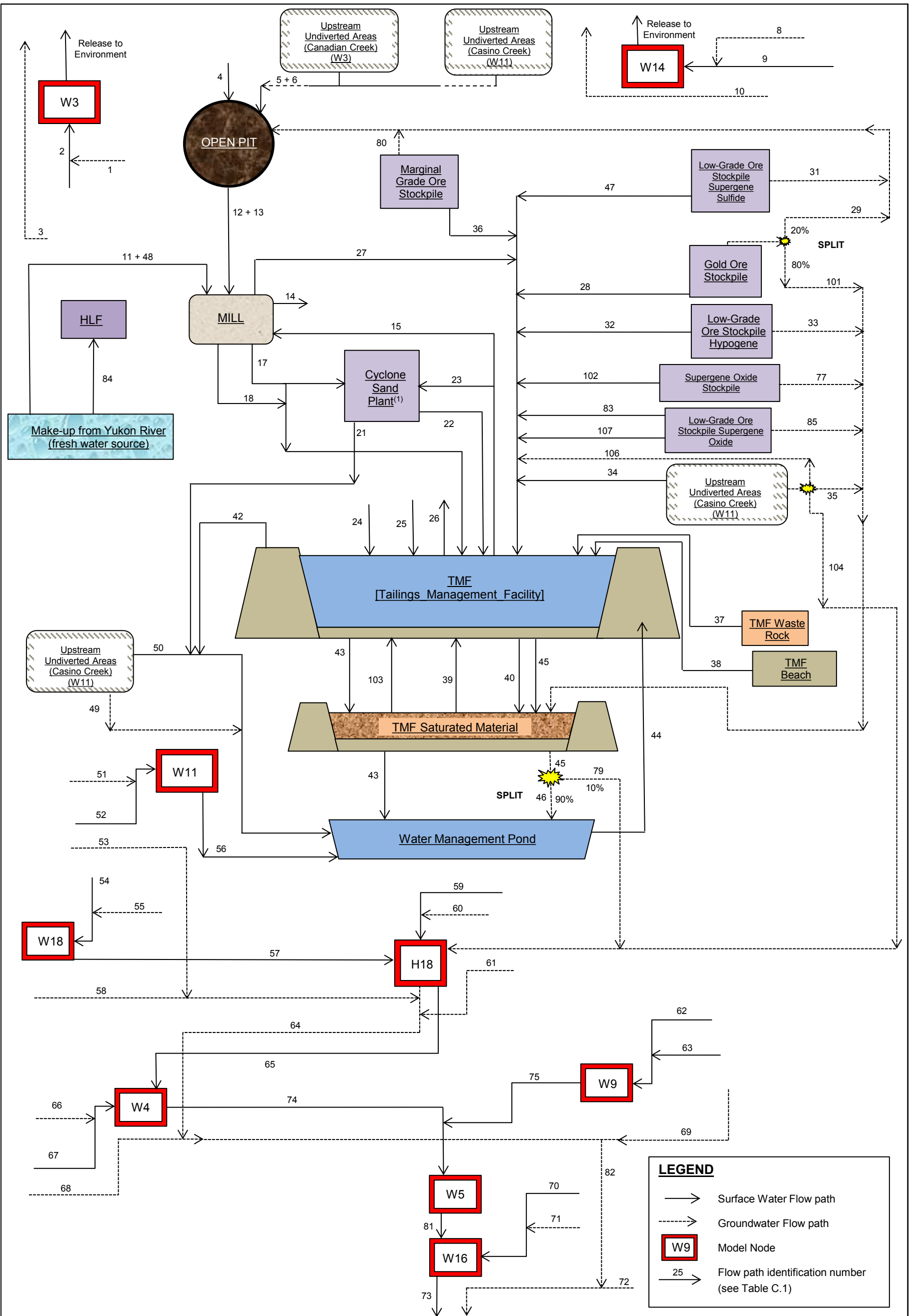
(Pages C-1 to C-7)



**NOTES:**  
1. TMF AS SHOWN IS ASSUMED TO INCLUE FRESH WATER SUPPLY POND CONTRIBUTIONS.

0	30OCT'13	ISSUED WITH REPORT	HS	AS	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

CASINO MINING CORPORATION	
CASINO COPPER-GOLD PROJECT	
<b>SITE WATER MANAGEMENT YEAR -1</b>	
<b><i>Knight Piésold</i> CONSULTING</b>	P/A NO. VA101-325/14
	REF. NO. 10
<b>FIGURE C.1</b>	
	REV 0

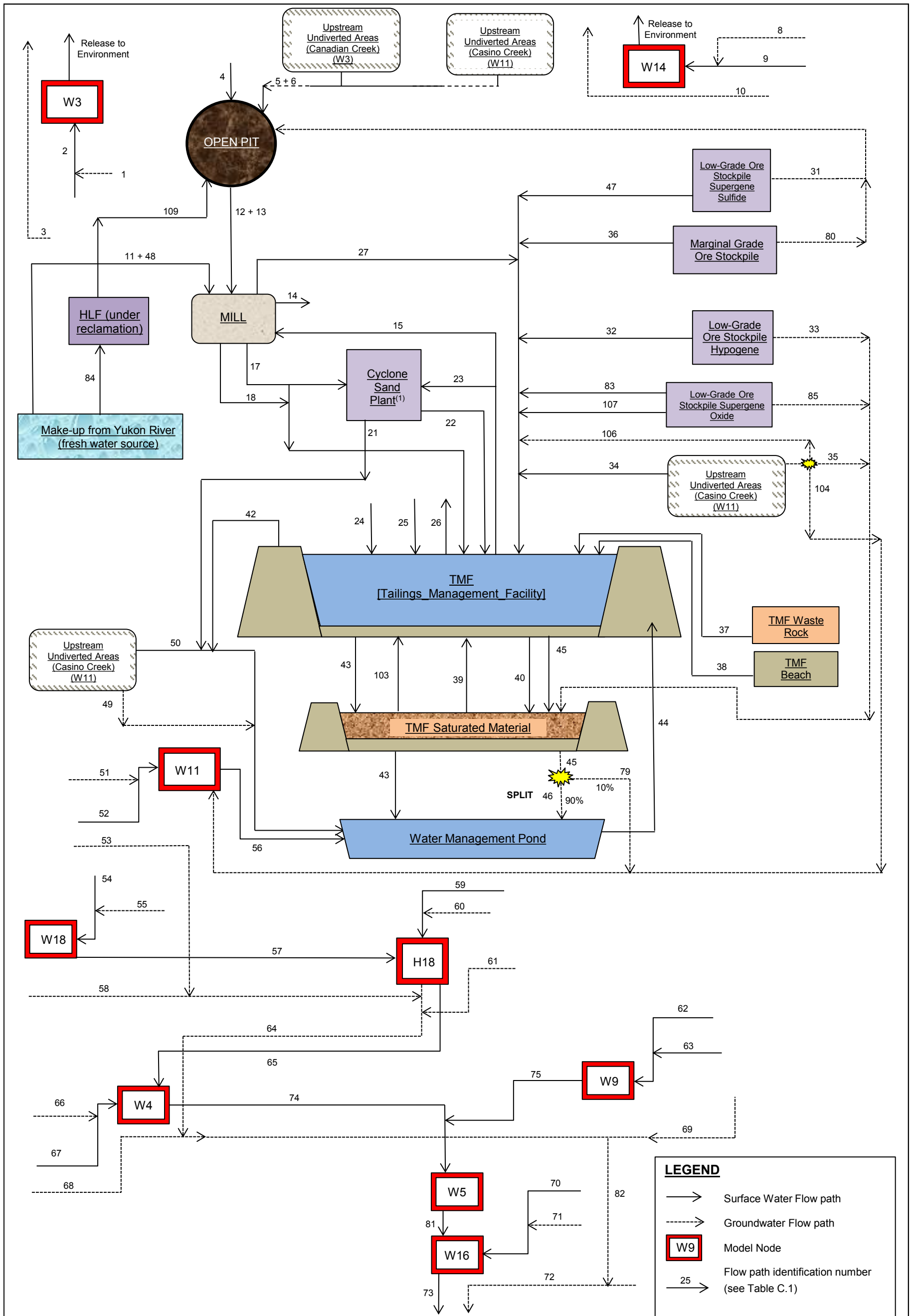


**NOTES:**

1. THE CYCLONE SAND PLANT IS OPERATIONAL OVER A PERIOD OF 9 MONTHS DURING EACH YEAR OF OPERATIONS (TYPICALLY FROM FEBRUARY TO NOVEMBER). CYCLONING OPERATIONS ARE ASSUMED TO BE SUSPENDED OR REDUCED DURING THE COLDEST WINTER MONTHS (IN PARTICULAR DECEMBER AND JANUARY).

CASINO MINING CORPORATION	
CASINO COPPER-GOLD PROJECT	
<b>WATER BALANCE MODEL SCHEMATIC YEAR 10 OF OPERATIONS</b>	
<i><b>Knight Piésold</b></i> CONSULTING	P/A NO. VA101-325/14
REF. NO. 10	REV 0
<b>FIGURE C.2</b>	

REV	DATE	DESCRIPTION	HS PREP'D	AS CHK'D	KJB APP'D
0	30OCT'13	ISSUED WITH REPORT	HS	AS	KJB

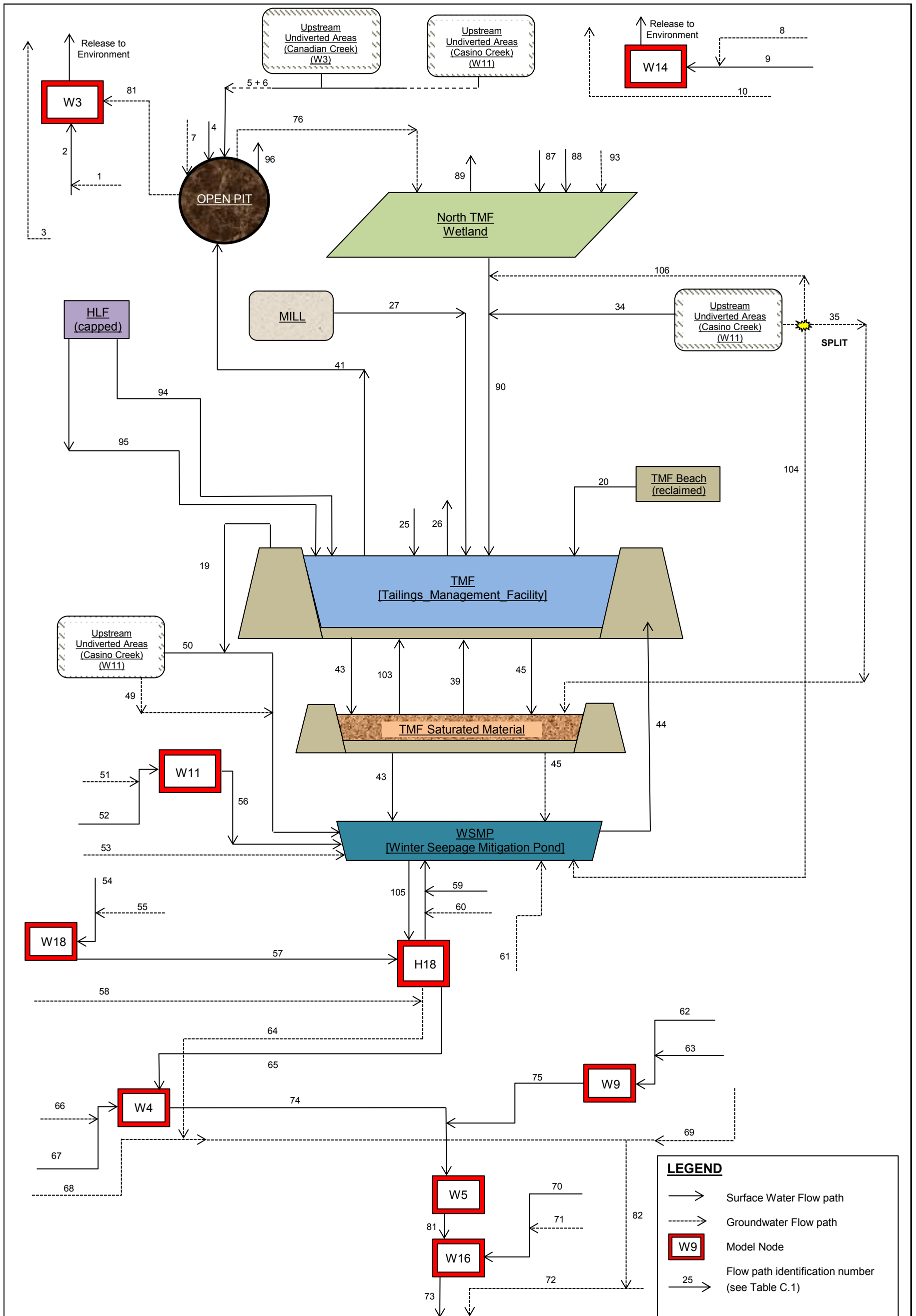


**NOTES:**

1. THE CYCLONE SAND PLANT IS OPERATIONAL OVER A PERIOD OF 9 MONTHS DURING EACH YEAR OF OPERATIONS (TYPICALLY FROM FEBRUARY TO NOVEMBER). CYCLONING OPERATIONS ARE ASSUMED TO BE SUSPENDED OR REDUCED DURING THE COLDEST WINTER MONTHS (IN PARTICULAR DECEMBER AND JANUARY).

0	30OCT'13	ISSUED WITH REPORT	HS	AS	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

CASINO MINING CORPORATION	
CASINO COPPER-GOLD PROJECT	
<b>WATER BALANCE MODEL SCHEMATIC YEAR 21 OF OPERATIONS</b>	
<b><i>Knight Piésold</i></b> CONSULTING	P/A NO. VA101-325/14
	REF. NO. 10
<b>FIGURE C.3</b>	
REV 0	

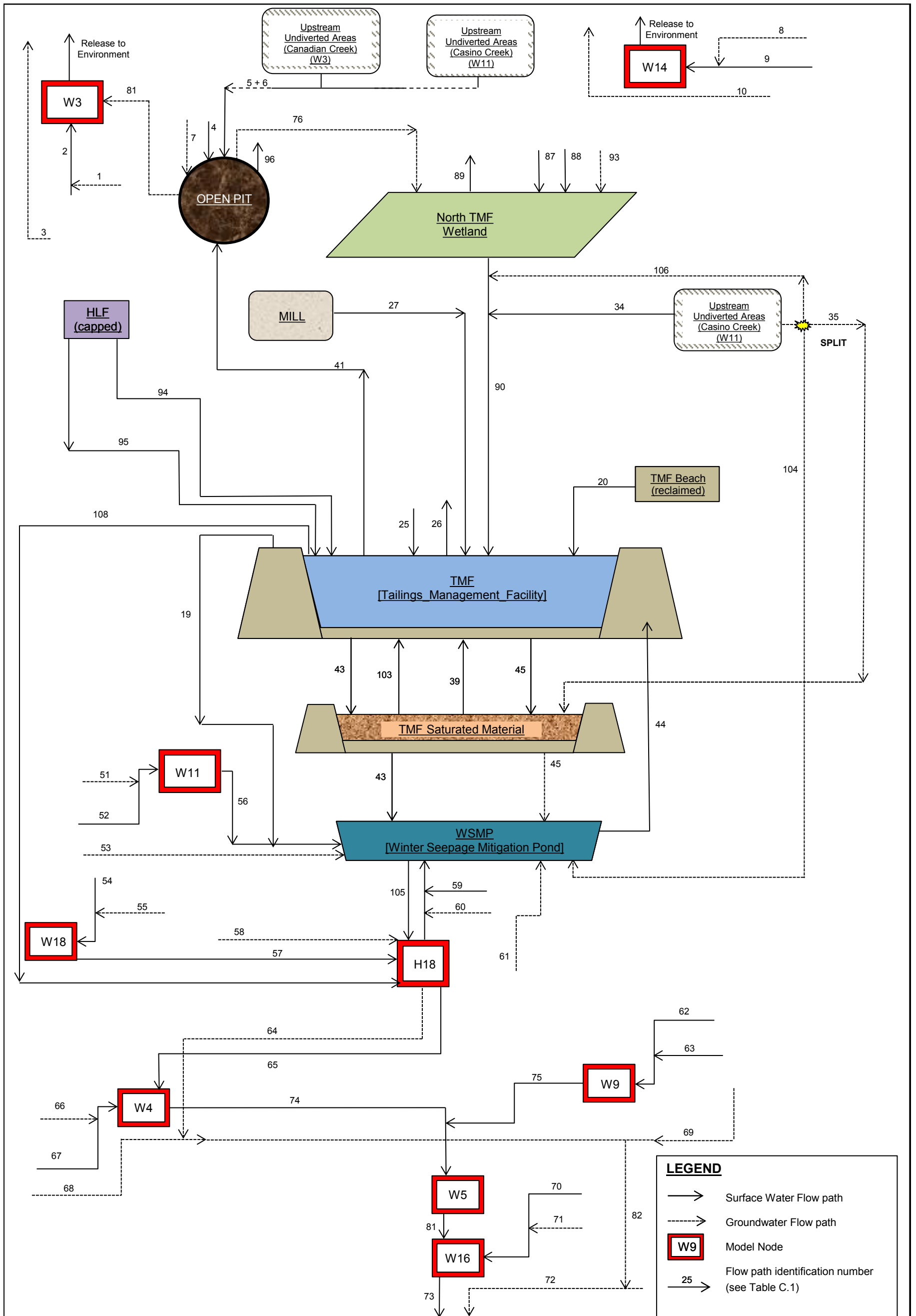


**NOTES:**

1. THE MARGINAL GRADE ORE STOCKPILE WILL BE HAULED TO THE OPEN PIT AT CLOSURE.
2. WATER FROM THE TMF POND WILL BE PUMPED TO THE OPEN PIT FOR THE FIRST 10 YEARS OF CLOSURE.

0	30OCT'13	ISSUED WITH REPORT	HS	AS	KJB
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

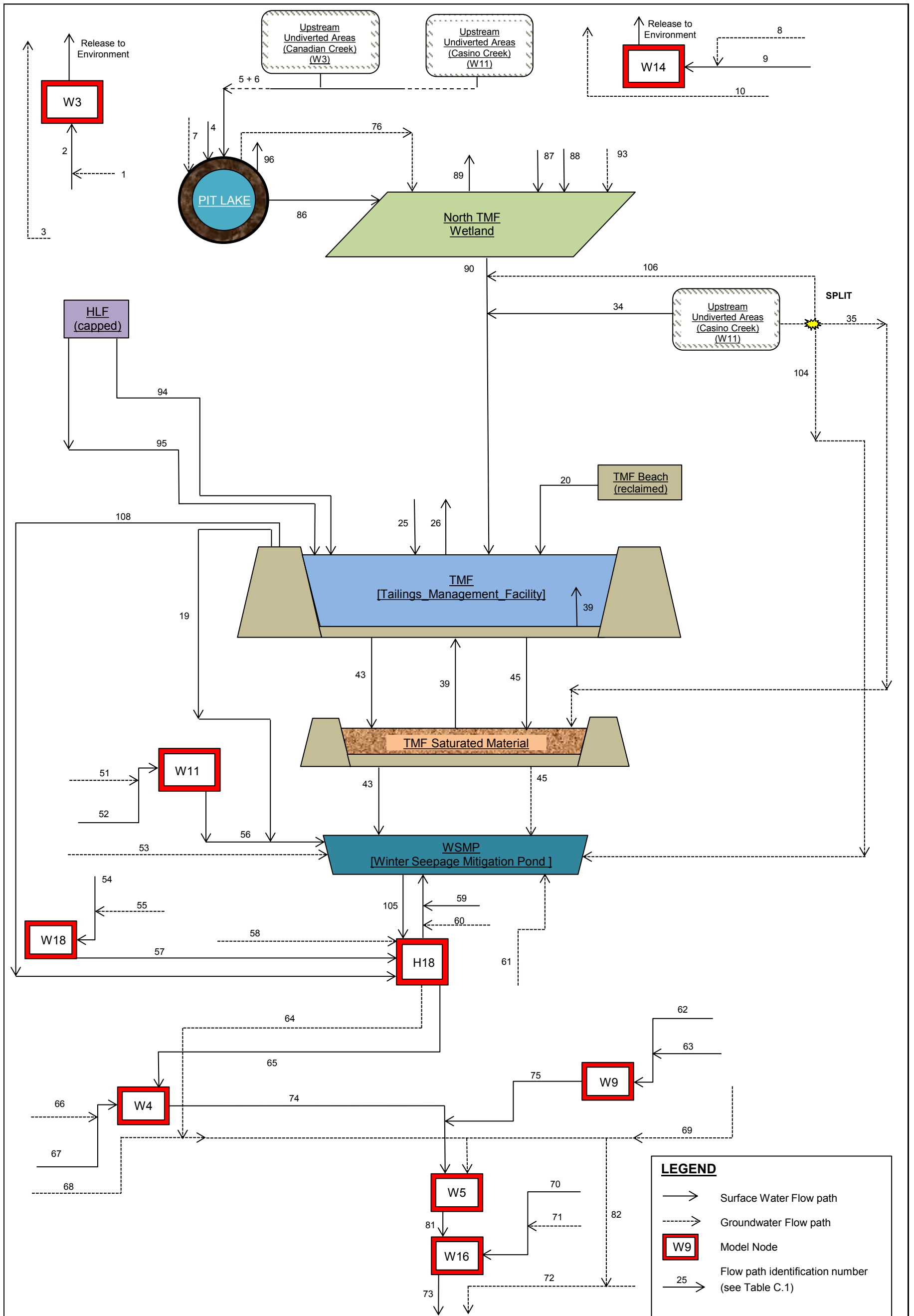
CASINO MINING CORPORATION	
CASINO COPPER-GOLD PROJECT	
<b>WATER BALANCE MODEL SCHEMATIC CLOSURE WATER MANAGEMENT PHASE I</b>	
<b>Knight Piésold CONSULTING</b>	P/A NO. VA101-325/14
	REF. NO. 10
<b>FIGURE C.4</b>	
REV 0	



**NOTES:**  
 1. THE MARGINAL GRADE ORE STOCKPILE WILL BE HAULED TO THE OPEN PIT AT CLOSURE.

CASINO MINING CORPORATION	
CASINO COPPER-GOLD PROJECT	
<b>WATER BALANCE MODEL SCHEMATIC CLOSURE WATER MANAGEMENT PHASE II</b>	
<b><i>Knight Piésold</i></b> CONSULTING	P/A NO. VA101-325/14
	REF. NO. 10
<b>FIGURE C.5</b>	
REV 0	

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	30OCT'13	ISSUED WITH REPORT	HS	AS	KJB



**NOTES:**  
 1. THE SEEPAGE COLLECTION SYSTEM IS MAINTAINED UNTIL THE SEEPAGE WATER QUALITY IS ACCEPABLE FOR DISCHARGE DOWNSTREAM INTO CASINO CREEK. AT THIS POINT THE WATER MANAGEMENT POND WILL BE DECOMMISSIONED AND ALL FLOWS WILL BE RELEASED DIRECTLY INTO CASINO CREEK.

CASINO MINING CORPORATION	
CASINO COPPER-GOLD PROJECT	
<b>WATER BALANCE MODEL SCHEMATIC CLOSURE WATER MANAGEMENT PHASE III</b>	
<b><i>Knight Piésold</i></b> CONSULTING	P/A NO. VA101-325/14
	REF. NO. 10
<b>FIGURE C.6</b>	
REV 0	

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	30OCT'13	ISSUED WITH REPORT	HS	AS	KJB

TABLE C.1

**CASINO MINING CORPORATION  
CASINO COPPER-GOLD PROJECT**

**WATER BALANCE MODEL  
MODEL SCHEMATIC FLOW PATHS**

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Schematic Number	Flow Routing Description
1	Shallow groundwater discharge to surface water at W3
2	W3 upstream surface runoff + diverted water at W3
3	Deep groundwater to environment at W3
4	Direct precipitation on Open Pit walls
5	Surface runoff from W3 and W11 basins to Open Pit
6	Undiverted upstream catchment groundwater inflows from W3 and W11 basins to Open Pit
7	Direct precipitation on Pit Lake
8	Shallow groundwater discharge to surface water at W14
9	Surface water runoff at W14
10	Deep groundwater to environment at W14
11	Fresh water source to Mill via Yukon River pipeline
12	Open Pit dewatering to Mill
13	Water in ore
14	Water retained in concentrate
15	Reclaim water from TMF to Mill
16	Open Pit dewatering - during pre-production to FWSP
17	NAG Slurry water
18	PAG Slurry water
19	Runoff from reclaimed TMF embankment to Water Management Pond
20	Runoff from reclaimed TMF beach
21	Water in cyclone sand underflow slurry to WMP via TMF embankment
22	Water in cyclone sand overflow to TMF pond
23	Water required for sand plant during cycloning operation from TMF pond
24	Domestic waste water from camp to TMF pond
25	Direct precipitation on TMF pond
26	TMF pond evaporation
27	Mill site runoff to TMF pond
28	Surface runoff from Gold Ore stockpile to TMF Pond
29	Groundwater from Gold Ore stockpile to Open Pit
30	Surface water runoff from Low Grade Ore Supergene Sulfide stockpile to FWSP
31	Groundwater from Low Grade Ore Supergene Sulfide stockpile to Open Pit
32	Surface runoff from Low Grade Ore Hypogene stockpile to TMF pond
33	Groundwater from Low Grade Ore Hypogene stockpile to TMF saturated materials
34	Surface runoff from Casino Creek undiverted catchment to TMF pond
35	Undiverted upstream groundwater to TMF saturated material
36	Surface runoff from Marginal Grade Ore Stockpile
37	Runoff from TMF waste rock to TMF pond
38	TMF beach runoff to TMF pond
39	TMF saturated material pore water to TMF pond
40	Water lost from TMF pond to TMF saturated material voids
41	TMF Pond pumped to Open Pit
42	TMF embankment runoff to Water Management Pond
43	TMF embankment seepage
44	Water Management Pond recycle to TMF (pumped)
45	TMF foundation seepage
46	TMF Foundation seepage collected in Water Management Pond
47	Surface water runoff from Low Grade Ore Stockpile Supergene Sulfide to TMF
48	Make-up water from Yukon River to Mill
49	Casino Creek undiverted upstream catchment groundwater to Water Management Pond
50	Casino Creek undiverted upstream catchment surface runoff to Water Management Pond
51	Shallow groundwater discharge to surface water to W11
52	Upstream surface runoff and diverted site flows to W11
53	Deep groundwater from W11 to downstream
54	Upstream surface runoff to W18
55	Shallow groundwater discharge to surface water at W18
56	Surface water from W11 to WMP
57	Surface water from W18 to H18
58	Deep groundwater from W18 to downstream
59	Upstream surface runoff from H18
60	Shallow groundwater discharge to surface water from H18
61	Deep groundwater from H18 to downstream
62	Upstream surface runoff to W9
63	Shallow groundwater discharge to surface water to W9
64	Deep groundwater from H18 to downstream
65	Surface Water from H18 to W4
66	Shallow groundwater discharge to surface water at W4
67	Upstream surface runoff to W4
68	Deep groundwater from W4 to downstream
69	Deep groundwater from W9 to downstream
70	Upstream surface runoff to W16
71	Shallow groundwater discharge to surface water at W16
72	Deep groundwater from W16 to downstream
73	Release to environment/surplus from W16
74	Surface water from W4 to W5
75	Surface water from W9 to W5
76	Pit Lake seepage losses to TMF Wetland - Closure and Post-Closure
77	Groundwater from Supergene Oxide stockpile to TMF saturated material
78	FWSP to HLF - Year -1 only
79	TMF foundation and embankment seepage that bypasses Water Management Pond and shows up as surface water at H18
80	Groundwater from Marginal Grade Ore Stockpile to Open Pit
81	Surface water from W5 to W16
82	Deep groundwater from W5 to downstream
83	Surface water runoff from Low Grade Ore Supergene Oxide stockpile to TMF pond
84	Fresh water source to HLF
85	Groundwater collection well bypass from Low Grade Ore Supergene Oxide
86	Pit Lake discharge to TMF wetland - Post Closure only
87	Upstream catchment runoff to TMF wetland
88	Direct precipitation on TMF wetland
89	Evaporation from TMF wetland
90	TMF wetland overflow to TMF pond
91	Runoff from Casino Creek undiverted catchment to FWSP - Year -1 only
92	Shallow groundwater from Casino Creek undiverted catchment to FWSP - Year -1 only
93	Shallow groundwater from undiverted catchment to wetland - Closure and Post-Closure
94	Non-contact surface runoff from reclaimed HLF - Closure and Post-Closure
95	HLF drain down water (Closure), HLF infiltration discharge (Post-Closure)
96	Evaporation from Pit Lake surface - Closure and Post-Closure
97	Runoff from Mill to FWSP - Year -1 only
98	Overflow from FWSP to TMF pond - Year -1 only
99	Surface runoff from Supergene Oxide stockpile to FWSP
100	Shallow groundwater from Supergene Oxide stockpile to FWSP
101	Groundwater from Gold Ore stockpile to TMF saturated material
102	Surface runoff from Supergene Oxide stockpile to TMF pond
103	Tailings pore water from TMF saturated material to TMF pond
104	Undiverted upstream groundwater that bypasses the TMF
105	Controlled release from Winter Seepage Mitigation Pond to H18
106	Undiverted upstream groundwater to TMF Pond
107	Groundwater collection well from Low Grade Ore Supergene Oxide to TMF Pond
108	TMF Spillway flows to H18
109	HLF surplus rinse water to Open Pit

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**NOTES:**

- FRESH WATER SUPPLY POND IS ASSUMED PART OF TMF.
- HIGHLIGHTED SCHEMATIC NUMBERS REPRESENT FLOW ROUTINGS THAT ARE TO BE INCLUDED IN FUTURE GOLDSIM MODEL REVISIONS.
- TMF - TAILINGS MANAGEMENT FACILITY, WMP - WATER MANAGEMENT POND, FWSP - FRESH WATER SUPPLY POND, WSMP = WINTER SEEPAGE MITIGATION POND.

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REV	DATE	DESCRIPTION	PREPD	CHKD	APPD

**APPENDIX D**

**HEAP LEACH FACILITY WATER BALANCE MODEL**

(Pages D-1 to D-6)

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## 1 – APPENDIX D HEAP LEACH WATER BALANCE MODEL

### 1.1 GENERAL

A monthly water balance was created for the Heap Leach Facility (HLF) as a component of the YESAB Water Balance Model. The intent of the HLF modelling was to estimate the magnitude and extent of water surplus or deficit conditions in the HLF, as well as any makeup water requirements under a range of possible climatic conditions. The modelling timeline included three pre-production years (Years -3 to -1), 18 years of operation (Years 1 to 18) and 10 years of closure (Years 19 to 28).

The heap pad will be developed in 5 stages over the 18 year mine life (Years -3 to 15), with ore stacking on the pad for 300 days each year. The stacked ore will be irrigated with cyanide solution (solution) year round for a total of 21 years: 18 years during ore stacking (Years -3 to 15) and 3 years (Years 16 to 18) of additional gold recovery once ore stacking has ceased. The HLF model incorporates the following components:

- Heap leach pad
- In-heap pond
- Freshwater Supply Pond (FWSP)
- Events pond

The model parameters and assumptions are discussed in the following sections.

### 1.2 ASSUMPTIONS

#### 1.2.1 Operations

The objectives of the HLF water balance during operations (Years -3 to 18) were to determine if makeup water is required to support leaching operations and to provide a detailed accounting of water and/or leach solution inventory in the heap. The operational water balance considers the inputs from the leach solution application, environmental contributions (rainfall plus snowmelt) and losses (evaporation), as well as the sequence of ore loading and leaching.

The parameters used to develop the HLF water balance are listed below:

- |   |  |
|---|--|
| • Total ore tonnage on pad                              | 157.5 Mt   |
| • Ore stacking schedule                                 | 300 days/year  |
| • Ore leaching schedule                                 | 365 days/year  |
| • Nominal annual stacking tonnage                       | 9,125,000 tonnes/year  |
| • Mine-run ore specific gravity                         | 2.65   |
| • Dry density of ore heap                               | 1.75 t/m <sup>3</sup>  |
| • Incoming ore moisture content                         | 3% (by mass)   |
| • Leach pile ore operating moisture content             | 9.5% (by mass)   |
| • Leach pile ore residual moisture content (short-term) | 7% (by mass)   |
| • Leach pile ore residual moisture content (long-term)  | 5% (by mass)   |
| • Ore irrigation rate per area                          | 0.29 m <sup>3</sup> /day/m <sup>2</sup> (12 L/h/m <sup>2</sup> ) |
| • Solution irrigation rate                              | 1312 m <sup>3</sup> /day   |
| • Maximum irrigation area (constant)                    | 109,333 m <sup>2</sup>   |

- Irrigation emitter evaporation losses 3% of irrigation rate
- In-heap pond operational storage capacity 90,000 m<sup>3</sup>
- Events pond operational capacity (Years -3 to -1 only) 50,000 m<sup>3</sup>

The ore properties and sequence of ore loading and leaching are based on the Feasibility Study (FS) design for the HLF completed by KPL in December 2012 (KPL, 2012). The operational capacity of the in-heap pond has been refined by KPL since the 2012 FS to the current 90,000 m<sup>3</sup>, which is believed to be a more realistic estimate of storage capacity for excess solution during operations. The design basis and details of the water management structures for the HLF are included in the KPL report "Water Management Plan" (KPL, 2013). The ore moisture content values and percent of irrigation emitter evaporation were also refined from the FS based professional experience (per. comm. J. Marsden, 2013).

The HLF will be developed in 5 stages, and for all stages the ore will be stacked on a composite geotextile liner in eight meter lifts. Ore will be stacked on the heap 300 days/year and leaching will occur year round in 2 month (60 day) cycles. For all stages, runoff from the upstream contributing catchment area is assumed to be diverted around the pad.

The HLF water balance assumptions during operations are detailed below:

- HLF ore stacking is modelled at a steady rate over ten months each year (January to October). The annual stacking rate in Year -3 is 6.58 Mt/year, and increases to 9.13 Mt/year in Years -2 to 14, and then drops to 4.87 Mt/year in Year 15. Ore mined from the open pit during the non-stacking months of November and December will be sent to the Gold Ore Stockpile for storage until the following year.
- Ore stacked on the HLF (incoming ore) was assumed to have an initial moisture content of 3% (by mass), whether it came directly from the open pit or from the Gold Ore Stockpile.
- Once ore loading to the heap is complete in Year 15, the stacked ore will continue to be leached via the recirculation of solution through previously leached areas of the heap, until the residual leaching gold recovery no longer becomes profitable. For modelling purposes, the duration of the additional gold recovery leaching was assumed to be three years (Years 16 to 18).
- Each column of ore under leach is assumed to be irrigated on a two-month cycle. In Years -3 to 15, it was assumed that it will take approximately one month to bring the moisture content of the raw ore up from its incoming level of 3% to the optimum leaching level of 9.5% (by mass), and one additional month to complete the leaching process. Similarly, for Years 16 to 18, it was assumed that it takes approximately one month to raise the moisture content of previously leached ore from its residual level of 7% (by mass) to the optimum leaching level of 9.5% (by mass), and one additional month to complete the leaching process.
- Once a column of ore has been irrigated and leached for 60 days, it was assumed that it takes one month for the ore to drain to the short-term residual moisture content of 7% (by mass). The water released from the pores of inactive areas on the pad is assumed to be available for recycle.
- It is assumed that the leach solution applied to the heap each month will be routed through Carbon ADR Plant/SART for metals recovery. Barren solution will then be discharged to the barren solution tank before cyanide is added, and then the solution will be recirculated back onto the heap through the irrigation system. The only loss considered in the metals recovery and

irrigation circuit is evaporative losses from the irrigation emitters (3% of the irrigation rate); otherwise, the system is treated as a closed loop.

- A fresh water supply pond (FWSP) is required to supply water to the HLF in Years -3 to -1, prior to construction of the Yukon River pipeline. The FWSP will be constructed prior to Year -3, and will supply all makeup water requirements to the HLF in Years -3 to -1, with the exception of Year -3, when a portion of makeup water will be supplied by the events pond. Starting in Year 1, the FWSP its associated catchments were incorporated in the Tailings Management Facility (TMF) water balance.
- The HLF events pond has been designed to attenuate the design storm event for the maximum heap footprint (~1.34 km<sup>2</sup>) at Year 15. During Years -3 to -1, runoff from the undeveloped portion of the heap pad catchment is diverted. As a result, approximately 50,000 m<sup>3</sup> of storm capacity will be available to store excess runoff from the heap pad for recycling until the TMF is constructed. It was assumed that the events pond will be used in Year -3 to provide additional makeup water for heap operations.
- During operations (Years -3 to 18), surplus water will be stored in the in-heap pond up to its operating capacity of 90,000 m<sup>3</sup> in months that inflows exceed the leaching water requirements of the HLF. In the event of excess water above the capacity of the in-heap pond, the excess water is assumed to be recycled to inactive areas of the heap for temporary storage. Conversely in months where leaching water requirements exceed inflows, makeup water is added to the HLF system.
- The solution inventory during operations in the heap was based on the planned sequence of leaching and ore placement, with the moisture content of the ore under leach assumed to be at 9.5% (by mass), and the moisture content of the remainder of the stacked ore on the heap (inactive areas) split between ore that had been previously leached, at 7 % (by mass), and newly stacked ore yet to be leached, at 3% (by mass). Therefore, the water balance accounts for inactive areas of the heap that are assumed to release solution on a monthly basis.

The water inputs to the HLF during operations are:

- Environmental contributions (rainfall + snowmelt)
- Water released from the pores of previously leached ore, and
- Recycled leach solution applied to ore under leach.

The outputs from the HLF are:

- Water lost through irrigation emitter evaporation
- Water required to bring ore under leach to optimum leaching moisture content, and
- Water required for leach solution.

The differences between the HLF outputs and inputs determine the makeup water requirements, where makeup water during operations is assumed to be provided from the following sources, in preferential order:

1. Water accumulated in the in-heap operating storage (up to 90,000 m<sup>3</sup>) – all years of operations
2. Freshwater supply pond and events pond – Years -3 to -1, and
3. Yukon River pipeline and TMF pond – Years 1 to 18.

### 1.2.2 Closure

Upon cessation of additional gold recovery at the end of Year 18, the heap will be detoxified through cyanide removal by rinsing with treated solution and/or freshwater for 5 years (Years 19 to 23) via the solution irrigation system. Following the end of rinsing, the water accumulated in the heap will be allowed to draindown until all the ore on the heap reaches the long-term estimated moisture content of 5% (by mass). Once the draindown flows reach manageable levels (Year 29), the heap surface will be reclaimed with a closure cover to reduce infiltration and all surface and heap discharge will be directed to the downstream TMF pond, in perpetuity.

The HLF water balance assumptions in closure are detailed below:

- The HLF rinsing rate is assumed to be based on the operational leaching rate of 1312 m<sup>3</sup>/hr.
- The duration of rinsing (5 years) was based on assuming that approximately 5 pore volumes (based on 36% saturation of pores) could be flushed during this phase, assuming an annual rinse volume applied to the heap of 11.5 Mm<sup>3</sup> (1312 m<sup>3</sup>/hr x 24 hrs x 365 days). The total pore volume and saturated pore volume of the heap were estimated as follows:
  - Total heap pore volume (m<sup>3</sup>) = (157.5 Mt/1.75 tonne/m<sup>3</sup> – 157.5 Mt/2.65 kg/m<sup>3</sup>) x 1 tonne/m<sup>3</sup>  
= 30.6 Mm<sup>3</sup>
  - Saturated pore volume (m<sup>3</sup>) = 30.6 Mm<sup>3</sup> x 36%  
= 11 Mm<sup>3</sup>
- In closure (Years 19 to 28), any excess water generated from the heap is pumped to the open pit to aid in pit filling.
- The cumulative solution volume stored in the heap at closure was equal to approximately 11 Mm<sup>3</sup>, based on all stacked ore (157.5 Mt) being at the short-term residual moisture content of 7% (by mass).
- The total solution draindown volume from the heap was based on the assumption that the heap will have a long-term moisture content of 5% (by mass), which equates to 7.9 Mm<sup>3</sup> of water retained in the heap in the long-term; therefore, the resulting total solution volume to leave the heap was 3.1 Mm<sup>3</sup> (11 Mm<sup>3</sup> – 7.9 Mm<sup>3</sup>).
- The draindown volume is assumed to be released at a constant rate of 1726 m<sup>3</sup>/day (3.1 Mm<sup>3</sup>/(5 years x 365 days)), in addition to environmental contributions to the heap pad. A total volume of approximately 5.2 Mm<sup>3</sup> is assumed to be discharged from the heap over the five years of heap draindown. The draindown water will be pumped to the open pit until Year 28.
- Once the heap draindown flows have reduced to manageable levels, as of Year 29, the heap will be reclaimed and all pumping systems will be decommissioned.
- A closure cover is assumed to be effective on the heap pad as of Year 29 and will reduce the infiltration through the heap to 50% of net precipitation.
- All upstream diversion ditches will be decommissioned and any excess infiltration and runoff from the HLF will discharge naturally to the TMF pond.

### 1.3 RESULTS

The HLF water balance results are presented and discussed in the main report text in Section 4.5.

## 2 – REFERENCES

Knight Piésold Ltd. (KPL), 2013. *Casino Mining Corporation, Casino Copper-Gold Project – Water Management Plan*. Ref no. VA101-325/14-2 Rev 0, October 2013.

Knight Piésold Ltd. (KPL), 2012. *Casino Mining Corporation, Casino Copper-Gold Project – Feasibility of the Heap Leach Facility*. Ref no. VA101-325/8-9 Rev 0, December 19, 2012.

Marsden, J., B. Sc. (Eng) Hons, P.E. Metallurgim. Conversation. August 28, 2013.

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**APPENDIX E**

**ANNUAL WATER BALANCE MODEL RESULTS**

(Pages E-1 to E-3)

TABLE E.1

CASINO MINE CORPORATION  
CASINO PROJECT

YESAB WATER BALANCE  
AVERAGE ANNUAL INFLOW AND OUTFLOW OF WATER TO THE TMF SUPERNATANT POND

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Water Management Phase	Mine Year	Average Annual Inflows (L/s)														Average Annual Outflows (L/s)							Change in Storage		
		Direct Pond Precipitation	Undiverted Runoff	Plant Site Runoff	Domestic Waste Water	Overflow from FWSP	Runoff from Ore Stockpiles	Waste Rock Runoff	Tailings Beach Runoff	HLF Runoff	Tailings Slurry Water	Tailings Consolidation Seepage	Waste Rock Upwelling	Recycle Water from WMP	North TMF Wetland Discharge	Total Inflows	Pond Evaporation	Reclaim Water to Process	Reclaim Water to Sand Plant	Tailings and Waste Rock Voids	Embarkment Seepage	Foundation Seepage		Water Pumped to Open Pit	Spillway Discharge
Construction	-3	0	95	0	0	0	0	1	0	0	0	0	0	0	96	0	0	0	0	0	0	0	0	0	96
	-2	0	94	0	0	2	0	2	0	0	0	0	0	0	98	0	0	0	0	0	0	0	0	0	98
	-1	1	90	0	0	20	1	4	0	0	0	3	0	0	119	1	0	0	87	0	0	0	0	0	88
Operations	1	5	102	2	2	18	7	6	1	0	1285	195	8	145	0	1776	4	612	556	602	1	1	0	0	1776
	2	9	100	2	2	0	9	8	1	0	1711	227	14	200	0	2283	7	697	740	834	2	2	0	0	2283
	3	12	97	2	2	0	10	11	2	0	1707	259	19	203	0	2324	9	771	738	798	4	4	0	0	2324
	4	14	96	2	2	0	11	13	2	0	1701	290	22	204	0	2357	10	835	736	766	4	5	0	0	2357
	5	15	94	2	2	0	12	15	2	0	1686	309	23	204	0	2364	11	828	729	784	5	7	0	0	2364
	6	16	93	2	2	0	13	17	2	0	1684	315	23	206	0	2374	12	822	728	798	6	8	0	0	2374
	7	17	91	2	2	0	13	20	2	0	1683	321	23	209	0	2384	13	828	728	799	6	10	0	0	2384
	8	19	90	2	2	0	14	22	2	0	1704	326	24	213	0	2418	14	838	737	812	6	11	0	0	2418
	9	21	88	2	2	0	15	24	2	0	1717	332	25	216	0	2444	16	838	743	828	7	12	0	0	2444
	10	22	87	2	2	0	15	26	2	0	1668	338	25	213	0	2400	17	834	721	808	7	13	0	0	2400
	11	23	87	2	2	0	14	28	2	0	1665	343	25	214	0	2405	17	832	720	814	8	14	0	0	2405
	12	23	86	2	2	0	13	31	2	0	1709	349	24	221	0	2463	18	843	739	839	9	15	0	0	2463
	13	25	85	2	2	0	13	32	2	0	1723	354	25	224	0	2488	19	847	745	851	10	16	0	0	2488
	14	26	85	2	2	0	12	34	3	0	1706	359	25	224	0	2478	20	852	738	841	10	17	0	0	2478
	15	28	84	2	2	0	12	36	3	0	1683	365	24	223	0	2462	21	845	728	839	11	18	0	0	2462
	16	29	83	2	2	0	12	37	3	0	1679	370	24	225	0	2466	22	844	726	844	12	19	0	0	2466
	17	33	83	2	2	0	12	38	3	0	1380	376	24	123	0	2075	25	753	320	944	12	20	0	0	2075
	18	37	83	2	2	0	12	38	3	0	1385	381	24	125	0	2092	28	742	321	967	13	21	0	0	2092
	19	48	84	2	2	0	10	32	3	0	1406	387	24	128	0	2126	38	908	326	820	13	22	0	0	2126
	20	68	84	2	2	0	6	20	3	0	1331	392	23	108	0	2039	53	902	242	806	14	22	0	0	2039
	21	88	85	2	2	0	2	7	3	0	1329	397	22	109	0	2046	69	891	241	807	15	23	0	0	2046
	22	100	84	2	2	0	0	0	3	0	588	402	21	46	0	1248	77	522	0	401	15	23	0	0	1038
Wetland Construction	23	88	81	0	0	0	0	3	0	0	267	21	45	0	505	68	0	0	0	14	22	336	336	776	
	24	88	81	0	0	0	0	3	0	0	98	21	45	6	342	68	0	0	0	14	22	336	336	776	
	25	88	82	0	0	0	0	3	0	0	85	21	45	10	334	68	0	0	0	14	22	336	336	776	
	26	87	82	0	0	0	0	3	0	0	73	21	62	10	339	68	0	0	0	14	22	336	336	776	
	27	87	82	0	0	0	0	3	0	0	60	21	62	10	326	67	0	0	0	14	22	336	336	775	
	28	87	82	0	0	0	0	3	0	0	53	21	62	10	319	67	0	0	0	14	22	0	0	103	
	29	88	82	0	0	0	0	3	13	0	51	21	62	10	330	68	0	0	0	14	22	0	0	104	
	30	88	81	0	0	0	0	3	13	0	50	21	55	10	321	68	0	0	0	14	22	0	9	113	
TMF Discharge		88	81	0	0	0	0	3	13	0	12	22	0	14	234	68	0	0	0	14	22	0	130	234	
Pit Discharge		88	81	0	0	0	0	3	13	0	4	22	0	82	292	68	0	0	0	14	22	0	189	293	

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REV	DATE	DESCRIPTION	PREP	CHKD	APPD
0	03DEC13	ISSUED WITH REPORT VA101-325/14-10	AS	EER	KJB

TABLE E.2  
CASINO MINE CORPORATION  
CASINO PROJECT  
YESAB WATER BALANCE  
AVERAGE ANNUAL INFLOWS AND OUTFLOWS TO THE OPEN PIT

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Water Management Phase	Mine Year	Average Annual Inflows (L/s)								Average Annual Outflows (L/s)						Change in Storage
		Direct Pond Precipitation	Groundwater Inflows from Undiverted Catchments	Groundwater Seepage from Ore Stockpiles	Pit Wall Runoff	Undiverted Runoff	Pumping from TMF Pond	Pumping from HLF	Total Inflows	Open Pit Dewatering	Pond Evaporation	Groundwater Seepage	Pit Lake Discharge	Waste Rock Voids	Total Outflows	
Construction	-3	0	0	0	2	5	0	0	7	7	0	0	0	0	7	0
	-2	0	0	0	6	5	0	0	10	10	0	0	0	0	10	0
	-1	0	3	0	13	4	0	0	21	21	0	0	0	0	21	0
Operations	1	0	9	1	21	3	0	0	33	33	0	0	0	0	33	0
	2	0	15	1	21	3	0	0	40	40	0	0	0	0	40	0
	3	0	21	1	22	3	0	0	47	47	0	0	0	0	47	0
	4	0	24	2	27	3	0	0	55	55	0	0	0	0	55	0
	5	0	24	2	27	3	0	0	55	55	0	0	0	0	55	0
	6	0	24	2	27	3	0	0	56	56	0	0	0	0	56	0
	7	0	24	2	27	3	0	0	56	56	0	0	0	0	56	0
	8	0	24	2	27	3	0	0	56	56	0	0	0	0	56	0
	9	0	24	2	27	3	0	0	56	56	0	0	0	0	56	0
	10	0	25	2	31	3	0	0	61	61	0	0	0	0	61	0
	11	0	25	2	32	3	0	0	62	62	0	0	0	0	62	0
	12	0	26	2	32	3	0	0	63	63	0	0	0	0	63	0
	13	0	27	2	32	3	0	0	64	64	0	0	0	0	64	0
	14	0	27	2	33	3	0	0	65	65	0	0	0	0	65	0
	15	0	28	2	33	3	0	0	66	66	0	0	0	0	66	0
	16	0	28	2	34	3	0	0	67	67	0	0	0	0	67	0
	17	0	29	2	34	3	0	0	68	68	0	0	0	0	68	0
	18	0	29	2	34	3	0	0	69	69	0	0	0	0	69	0
	19	1	28	2	37	33	0	0	101	0	1	0	0	0	1	100
	20	2	28	1	36	33	0	0	100	0	1	0	0	61	1	99
21	2	28	0	36	33	0	0	99	0	1	0	0	52	1	98	
22	4	25	0	35	33	0	0	97	0	3	0	0	0	3	94	
Wetland Construction	23	5	24	0	34	33	336	0	432	0	3	0	0	0	3	429
	24	7	23	0	33	33	336	33	463	0	4	0	0	0	4	459
	25	8	21	0	31	33	336	33	462	0	5	0	0	0	5	457
	26	10	20	0	30	33	336	33	462	0	7	0	0	0	7	455
	27	12	19	0	28	33	336	33	461	0	8	0	0	0	8	453
	28	14	19	0	27	33	0	33	125	0	9	0	0	0	9	116
	29	14	18	0	27	33	0	0	92	0	9	0	0	0	9	83
	30	14	18	0	27	33	0	0	92	0	9	0	0	0	9	83
TMF Discharge		23	15	0	20	33	0	0	91	0	14	4	0	0	19	72
Pit Discharge		30	13	0	14	33	0	0	90	0	19	11	60	0	90	0

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TABLE E.3

CASINO MINE CORPORATION  
CASINO PROJECT

YESAB WATER BALANCE  
AVERAGE ANNUAL INFLOWS AND OUTFLOWS TO THE WATER MANAGEMENT POND AND WINTER SEEPAGE MITIGATION POND

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Water Management Phase	Mine Year	Average Annual Inflows (L/s)							Average Annual Outflows (L/s)		
		Undiverted Runoff	Upstream Undiverted Groundwater	TMF Embankment Runoff	TMF Embankment Seepage	TMF Foundation Seepage	Sand Plant Underflow	Total Inflows	Recycled back to TMF	Release to Downstream	Total Outflows
Construction	-3	0	0	0	0	0	0	0	0	0	0
	-2	0	0	0	0	0	0	0	0	0	0
	-1	0	0	0	0	0	0	0	0	0	0
Operations	1	0	0	2	1	1	142	145	145	0	145
	2	0	0	3	2	2	192	200	200	0	200
	3	0	0	4	4	4	191	203	203	0	203
	4	0	0	4	5	5	189	204	204	0	204
	5	0	0	5	5	6	187	204	204	0	204
	6	0	0	5	6	7	188	206	206	0	206
	7	0	0	6	6	9	187	208	208	0	208
	8	0	0	6	7	10	189	212	212	0	212
	9	0	0	7	7	11	191	216	216	0	216
	10	0	0	7	8	12	185	213	213	0	213
	11	0	0	7	8	13	185	214	214	0	214
	12	0	0	8	9	14	189	220	220	0	220
	13	0	0	8	10	15	191	224	224	0	224
	14	0	0	9	10	16	189	224	224	0	224
	15	0	0	9	11	17	186	223	223	0	223
	16	0	0	9	12	17	186	225	225	0	225
	17	0	0	10	12	18	82	123	123	0	123
	18	0	0	10	13	19	83	125	125	0	125
	19	0	0	10	14	20	84	128	128	0	128
	20	0	0	10	14	20	63	108	108	0	108
	21	0	0	11	15	20	63	109	109	0	109
	22	0	0	11	15	20	0	46	46	0	46
	Wetland Construction	23	0	0	11	14	20	0	45	45	0
24		0	0	11	14	20	0	45	45	0	45
25		0	0	11	14	20	0	45	45	0	45
26		5	9	11	14	23	0	62	62	0	62
27		5	9	11	14	23	0	62	62	0	62
28		5	9	11	14	23	0	62	62	0	62
29		5	9	11	14	23	0	62	62	0	62
30		5	9	11	14	23	0	62	62	0	62
TMF Discharge			5	9	11	14	23	0	62	0	62
Pit Discharge		5	9	11	14	23	0	62	0	62	62

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REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

