Final

Schematic Design Report, Faro Water Treatment Plant, Faro Mine Remediation Project

Prepared for

Government of Canada as represented by Aboriginal Affairs and Northern Development Canada and the Government of Yukon

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CH2MHILL®

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Executive Summary

The Faro Mine Complex is located in south-central Yukon, 15 kilometres north of the town of Faro. As part of the Faro Mine Remediation Project, the replacement Faro Water Treatment Plant (WTP) is designed to be a new, permanent replacement for the existing Faro Mill WTP because of the increasing risk of major equipment failure. The operational life of the new plant is designed for longevity, durability, and future flexibility. The design life of the structure, with individual equipment and component maintenance and replacement, could provide up to 100 years of operation.

The schematic design is the second phase in the CH2M HILL Canada Limited (CH2M HILL) four-phase design process and provides additional detail after the first phase, the project design definition (PDD). The WTP Design Definition Report (CH2M HILL, 2012b) describes decisions regarding process development. This schematic design report provides the treatment facility design basis for all design disciplines for YG endorsement prior to entering the detailed engineering (DE) phase of the project. With complete endorsement, the likelihood of changes during the DE phase will be minimized, which will increase the efficiency of the design work so that construction can begin in 2014, with site clearing and leveling. The goal is to have WTP construction substantially complete by fall 2015.

The replacement WTP will treat acid mine drainage by using a lime high-density sludge (HDS) process. The treatment system will be designed to treat an HDS-2 influent quality design flow of 44 megalitres per day (ML/day) and a maximum hydraulic throughput capacity of 55 ML/day.

Influent water will be supplied to the WTP from six pipe systems. Tie-ins will be provided to the three existing supply pipes to the Faro Mill WTP. These existing supply pipes are from Faro Pit, Intermediate Pond, and the Emergency Tailings Area. Provisions will be made for three future water supplies. These include the twinning of the Faro Pit pipeline, and the Cross Valley Dam seepage interceptor system, and the Vangorda and Grum Pits.

The replacement WTP will consist of three main facilities: the Lime Facility with accompanying Booster Pump and Grit Building for lime grit handling, the Process Building, and the Thickener. Filters will not be provided at this time, but the design will include provision for future implementation.

The Process Building and the Booster Pump and Grit Building will be designed with R-30 walls and R-40 roof insulation. Below grade construction will consist of a concrete slab and walls that support the building. There will be no areas that are classified as hazardous electrical locations.

Process areas consist of the following: polymer room, compressor and blower room, mechanical and janitor’s room, electrical room, Booster Pump and Grit Building, and the Thickener, including the tunnel. The Thickener will have with a dome cover.

Administrative areas consist of the following: control room with server room, washroom, laboratory, and break room. The future expansion of the administrative area would occur west of the replacement WTP.

WTP processes include the following: a lime system; Reactors A, B1, and B2; sludge wasting pumps, sludge recycle pumps, the Thickener (55 metres in diameter), a polymer system, and an overhead bridge crane.

The plant will have automated and manual controls. The power supply for the WTP will be from the existing substation and will terminate at a new transformer near the WTP. Power supply in the WTP will be 600 volts and 208/120 volts, with grounding systems.

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Acronyms and Abbreviations

µg/L	microgram(s) per litre
°C	degrees Celsius
µm	micrometer(s)
A	ampere(s)
AC	alternating current
ACI	American Concrete Institute
ARD	acid rock drainage
ASD	adjustable-speed drive
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
AWG	American wire gauge
CD	construction development
CEC	Canadian Electrical Code
CH2M HILL	CH2M HILL Canada Limited
CISD	chemical industry severe-duty
CSA	Canadian Standards Association
CVD	Cross Valley Dam
CVP	Cross Valley Pond
DC	direct current
DD	design development
DE	detailed engineering
DR	diameter ratio
ETA	Emergency Tailings Area
FM	Factory Mutual
FMC	Faro Mine Complex
FRP	fibreglass-reinforced plastic
HDPE	high-density polyethylene
HDS	high-density sludge
HMI	human machine interfaces
hp	horsepower
HRT	hydraulic residence time
HVAC	heating, ventilation, and air conditioning
I&C	instrumentation and control
I/O	inputs/output

ICEA	Insulated Cable Engineers Association
ICP	instrument control panel
ID	inside diameter
ISA	International Society of Automation
kg/day	kilogram(s) per day per square metre
km	kilometre(s)
km^2	square kilometre(s)
kPa	kilopascal(s)
kPag	kilopascal(s) gauge
kV	kilovolt
kVA	kilovolt ampere(s)
L/O/R	LOCAL/OFF/REMOTE
L/R	LOCAL/REMOTE
L/sec	litre(s) per second
L/sec/m^2	litre(s) per second per square metre
L/sec/person	litre(s) per second per person
LCP	local control plant
LCS	local control station
m	metre(s)
m^2	square metre(s)
m^3/d	cubic metre(s) per day
m^3/hr	cubic metre(s) per hour
m^3/hr/valve	cubic metre(s) per hour per valve
mA	milliampere(s)
MCC	motor control centre
mg/L	milligram(s) per litre
ML/day	megalitre(s) per day
mm	millimetre(s)
MMER	metal mining effluent regulations
NBC	National Building Code
NEMA	National Electrical Manufacturers Association
NFC	National Fire Code
NFPA	National Fire Protection Association
NGR	neutral ground resistor
OD	outside diameter
P&ID	process and instrumentation diagrams

PEX	copper pipe, cross-linked polyethylene
PID	proportional integral derivative
PLC	programmable logic control
POS	polymer solution
RIO	remote input/output
SCADA	supervisory control and data acquisition
SCR	silicon control rectifier
SIS	seepage interception system
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
TC	tray cable
TEFC	totally enclosed, fan-cooled
TSS	total suspended solids
ULC	Underwriters Laboratories Canada
ULS	ultimate limit state
UPS	uninterruptible power supply
V	volt(s)
VA	volt ampere(s)
VFD	variable-frequency drive
VoIP	voice over Internet protocol
WTP	water treatment plant
XLPE	cross-linked polyethylene
YG	Government of Yukon

SECTION 1

Introduction

1.1 Project Description

Faro Mine Complex (FMC) is located in south-central Yukon Territory, 15 kilometres (km) north of the town of Faro and almost 350 km northeast of the city of Whitehorse. This is a remote area with climatic extremes. The Mine is located in the traditional territory of the Kaska Nation and upstream from the traditional territory of the Selkirk First Nation.

The FMC was in operation for about 30 years, starting in the 1960s, until 1998. The mine produced primarily lead and zinc. Within that period, the mine operated under several owners. When the last owner went bankrupt in 1998, the Government of Yukon (YG) and the federal government jointly took responsibility for mine closure planning.

The FMC includes three areas:

- Faro Mine Area, which includes the Faro Pit open pit extraction area and mineral processing facility
- Rose Creek Tailings Area
- Vangorda/Grum Area, which includes two open-pit extraction areas: Grum Pit and Vangorda Pit

As a result of past mining activities, there are now approximately 70 million tonnes of tailings and 376 million tonnes of waste rock subject to acid generation and release of heavy metals into the environment. The tailings and exposed rock are exposed to water and oxygen and experience oxidation. The oxidation process creates acidic conditions and contributes to the release of dissolved metals. The acid rock drainage (ARD) has a low pH and contains dissolved metals. The ARD is toxic to plants and animals and can cause environmental devastation downstream from the mine.

Several years of studies for mine closure planning have been completed by various consultants. In 2011, CH2M HILL Canada Limited (CH2M HILL) was engaged and is currently providing engineering, regulatory, and management support to YG. As part of this work, the existing Faro Mill Water Treatment Plant (WTP) was assessed and documented in the Faro Mill Water Treatment Plant Evaluation (CH2M HILL, 2012a). The assessment determined that there is an increasing risk of major equipment failure in the WTP and recommended that the design of a new, permanent WTP should proceed as soon as possible. YG agreed with this recommendation.

The replacement Faro WTP will treat the ARD to remove the dissolved metals and neutralize the acid. The new WTP will use a lime high-density sludge (HDS) process; lime will be used to neutralize and precipitate metals. The HDS process generates denser sludge and lower sludge volumes than conventional lime neutralization. Waste sludge will be pumped to the Faro Pit. Over time, the waste rock and tailings will be capped, and water diversion plans will be implemented to reduce the contact of mine wastes with water.

The treatment system will be designed to treat a maximum flow of 44,000 cubic metres per day (m^3/d) of water having the characteristics of the "HDS-2" water tested in the recent pilot test. The system will have a maximum hydraulic throughput capacity of 54,500 m^3/d. The WTP will initially treat flows from Faro Pit, the Intermediate Pond, and the Emergency Tailings Area (ETA) during the treatment season (approximately from May to September). In the future, flows from the Vangorda/Grum Area and Cross Valley Dam (CVD) seepage interception system (SIS) will be treated.

Treatment of the mine water will be required for the foreseeable future. Therefore, the WTP will be designed with longevity in mind for structure, equipment, material selection, operation, and maintenance. Generally, longevity is indicated by an operating life of 100 years. This does not mean that all equipment and structures will be designed to last 100 years without maintenance; proper and regular maintenance, repairs, replacement, and climate control will be required to achieve 100 years of operation. Equipment and structure durability is a high priority during design and selection. Fixed vessels (e.g., reactors, thickener, pipes, and buildings) will be designed to use materials that protect against corrosion and erosion.

The schematic design is the second phase in the CH2M HILL four-phase design process and provides additional detail after the first phase, project design definition (PDD). The WTP Design Definition Report (CH2M HILL, 2012b) describes decisions regarding process development. This schematic design report provides the treatment facility design basis for all design disciplines with the aim of receiving endorsement from YG prior to entering the detailed engineering (DE) phase of the project. With complete endorsement, the likelihood of changes during the DE phase will be minimized, which will increase the efficiency of design work so that construction can begin in 2014. In accordance with the Medium Term Plan (YG, 2012) 5b Schedule, the goal is to have the WTP construction substantially complete by fall 2015, with start up of the WTP in spring 2016.

As part of this report, preliminary drawings show the progress of each of the design disciplines with respect to contract documentation. The preliminary drawings can be found under Appendix A. A list of drawings anticipated for the design development (DD) and construction development (CD) phases of the project are listed under Appendix B.

Specifications and other contract documentation will not be provided until the DD phase of the project. A list of specifications anticipated for the DD and CD phases of the project are listed under Appendix C.

The capital estimate work will be performed as a separate report.

The value engineering (VE) assessment took place in February 2013. The VE alternatives evaluated and to be incorporated into the detailed design are listed below; the findings were summarized in the VE Report (CH2M HILL, 2013a):

- Establish a fixed design life for the plant: The recommendation was accepted and a 100-year design life established, as previously discussed.
- Extend the duration of annual WTP operation: The recommendation was accepted and the design of a winterized plant with heated and insulated thickener dome has been incorporated into this report. The assumption is that the WTP will be able to discharge on a year-round basis if needed. Limitations pertaining to receiving water regulatory conditions were evaluated outside of the VE process.
- Extend the tunnel to eliminate confined space and consider using DuroMaxx pipe: The recommendation to extend the tunnel was accepted and incorporated into this report. The use of DuroMaxx was not accepted because of the limitations of the DuroMaxx material. Concrete will be used instead.
- Consider using wall insulation R-30 rather than R-20: The recommendation was accepted and incorporated into this report.
- Include an electrical and maintenance shop and warehouse: The recommendation was accepted with modification, but the design was not incorporated into this report because of cost issues and design requirements that require further discussions.
- Include a weigh scale for lime trucks: The recommendation was accepted, but further discussions are required, and the design was not incorporated into this report.
- Install windows in the process area: The recommendation was accepted and incorporated into this report.

1.2 Assumptions

The following are the main assumptions made during the preparation of this schematic design report.

- The PDD report provides major design assumptions.
- The existing Faro Mill WTP will be decommissioned and demolished as part of the overall Faro Mine Remediation Project and is not part of the replacement WTP design.
- Where applicable, facilities will be designed in compliance with building code requirements for accessibility by persons with disabilities. The following areas are the only areas designed to be barrier free: control room with server room, washroom, laboratory, and the break room.

- Sprinklers and standpipe are not required.
- An electric forklift will be used. The ventilation system has not been designed for use with gas-powered forklifts.
- The WTP will be designed for year round operation by winterizing (e.g., heating and insulation) although the duration of the treatment season will depend on the amount of inflow that requires treatment. Winter caretaker access to the WTP (e.g., snow plowing) will be needed even though the WTP may not be operating at that time. Winterization or modification of the existing influent and effluent pipelines are not part of this design.
- The existing barge pumps and pipelines have capacity and are in satisfactory condition for future operation.
- The potable water supply is currently trucked in and will continue. A connection will be made in the tankhouse downstream from the distribution pump. An additional storage tank will be provided in the replacement WTP for demand buffering.
- The existing septic system and spread field north of the guardhouse has adequate capacity to accept sanitary wastewater from the replacement WTP.

1.3 Design Issues Requiring Further Information

The following are required for the design development phase. CH2M HILL will coordinate the acquisition of this information:

- Confirmation of the fire plan for the FMC. Currently, the Thickener is an available supply of water for fire protection during the summer when the WTP is in operation. However, when the plant is shut down during winter, the Thickener will no longer have a supply of water for fire protection.
- Conditions of the existing site electrical system should be further assessed. The existing system is aging and may need to be replaced. An assessment and recommendations were made in a previous electrical assessment report (Dorward Engineering Services Ltd., 2009).
- Existing pit/pond pump condition and operating procedure.
- Existing potable water system and seepage system details and capacities will be verified.
- A determination regarding the requirement for automated effluent sampling or if the current practice of manually obtaining bottle samples is adequate.
- Details of the Booster pump package system, controls and operations in order to design the Booster Pump and Grit Building and booster system.

SECTION 2
Civil

This section describes the civil design criteria and requirements for the new Faro WTP.

2.1 Approach

In developing the civil detailed design, CH2M HILL will perform site design and grading by using available data from a LiDAR survey performed by Terra Remote Sensing, Inc., in 2011 (Horizontal Datum: NAD83, UTM Zone 8; Vertical Datum: CGVD28 [Geoid model HTv2.0]), confirm the preferred facility location, and determine the configuration of the pipe connections and associated piping. The following sections discuss the availability of information and the proposed design basis for civil works for the replacement WTP. The site experiences severe winter conditions, including a design Freeze Index of 3,380 Celsius degree-days.

2.2 Site Information

The FMC is located at 62°18'N and 133°18'W in south-central Yukon, 15 km north of the town of Faro and almost 350 km northeast of the city of Whitehorse. The FMC is in the traditional territory of the Kaska Nation, upstream from the traditional territory of the Selkirk First Nation. The FMC has a footprint of more than 25 square kilometres (km^2) and consists of three distinct areas:

- The Faro Mine Area, which includes the Faro Pit, a disused mill, and associated structures and buildings
- The Rose Creek Tailings Area and its impoundment, which is located in Rose Creek Valley
- The Vangorda/Grum Area, which is located on the Vangorda Plateau and includes the Grum Pit and Vangorda Pit

A 10-km, heavy-haul road, which is oriented northwest -southeast, connects the Faro Mine Area and the Vangorda/Grum Area. This road was used to truck ore from the Vangorda and Grum Pits to the Faro Mill for processing.

2.3 Faro Mine Area

The Faro Mine Area includes the Faro Pit, the mill, and associated buildings. The Faro Pit, which is approximately 1,675 metres (m) long and 975 m wide, covers an area of 1.06 km^2, with a maximum depth of 335 m below the highest point on the pit wall. Surrounding the pit are piles of waste rock and unprocessed ore. This amounts to more than 260 million tonnes of material, which covers approximately 3.3 km^2 of land. Faro Creek flows around the northeastern edge of the pit in a constructed diversion channel. The disused mill and associated buildings are located south of the pit.

Access to the Faro Pit is via existing access roads (see Appendix A, Drawing 500-C-0001).

2.4 Existing Plant Site Conditions

The proposed WTP site is located on three stepped levels of an equipment and material storage yard and a sloping hillside west of existing Faro Mill facilities. Piping, unused equipment, and debris are scattered across the surface. Active overhead and underground power lines run east-west across the site.

As shown on Drawing 500-C-0002 (see Appendix A), stormwater runoff, snowmelt, and groundwater flow overland from the north through the FMC. Stormwater is directed along roadway ditches, cascading berms, and ponding areas across the proposed WTP site.

The existing Faro Mill facilities site is accessible via the original mine access roads.

The detailed Geotechnical Design Report (CH2M HILL, 2012c) provides information regarding subsurface conditions and foundation criteria. The subsurface materials comprise fill and native soils overlaying moderately to highly weathered phyllite bedrock. Depth to bedrock ranges from 0.9 to 6.1 m. The fill contains sand and gravel with varying cobbles and fines. The thickness of the fill ranges from 0.2 to 4.3 m.

2.5 Existing Facility Piping

Most existing pipes at the FMC are made of high-density polyethylene (HDPE) and are generally aboveground. There are three main existing pipes routed to the existing Mill WTP with known sizing:

1. From Faro Pit to the Faro Mill:
   - 340 m of SDR21 HDPE; pipe outside diameter (OD) 762 millimetres (mm); inside diameter (ID) 685 mm
   - 599 m of SDR26 HDPE; pipe OD 762 mm; ID 700 mm
   - 715 m of SDR21 HDPE; pipe OD 762 mm; ID 685 mm
   - 125 m of SDR17 HDPE; pipe OD 600 mm; ID 553 mm
   - Total = 1,779 m from Faro Pit to Faro Mill
2. From Intermediate Pond to Faro Mill:
   - 300 m of SDR9 HDPE pipe; OD 355 mm; ID 272 mm
   - 900 m of SDR11 HDPE pipe; OD 355 mm; ID 287 mm
   - 1,650 m of SDR13.5 HDPE pipe; OD 355 mm; ID 300 mm
   - Total = 2,850 m from Intermediate Pond to Faro Mill
3. From ETA to Faro Mill:
   - 500 m of 200-mm HDPE pipe; ID is uncertain because there are mixed sizes

The proposed design will intersect existing pipes and redirect them to the replacement WTP. The proposed routings and connection points for these pipes are shown on the site plan (see Appendix A, Drawing 500-C-0002).

2.6 Proposed Facility Site Conditions

The preliminary facility site plan is shown in on Drawing 500-C-0003 (see Appendix A). The gravel access area will loop around the facility and connect to the main haul road at both ends. Inlet and outlet piping will extend from the facility to the existing piping and to the outfall location, as shown on Drawing 500-C-0002 (see Appendix A). Refer to Section 5.2 for proposed process pipelines.

Site-specific stormwater management will be limited to local site drainage for the replacement WTP. Stormwater drainage flows will be diverted around the facility via ditches and culverts designed in accordance with the *Best Management Practices for Works Affecting Water in Yukon* (Environment Yukon, 2011). The WTP will be protected during high storm events by implementing required stormwater quantity controls, including grading the site so that the WTP area will be above design flood elevations. All perimeter ditches and culverts for the plant area will be designed for a 100-year storm event. This requirement is in accordance with the planning and design guidelines for permanent culverts (Environment Yukon, 2011). All surface flow from the area of the WTP will match existing conditions, discharging overland via surface flow to the existing ditches to the west (the North Wall Interceptor Ditch and Lower Guardhouse Creek) and to the south (Old Faro Creek), as shown on Drawing 500-C-0001 (see Appendix A).

With respect to overall stormwater management, including quality and quantity control, an overall stormwater management study will be performed for the entire Faro Mine Complex (FMC) including (1) the Faro Mine Area, the Faro open-pit extraction area and mineral processing facility, (2) the Rose Creek Tailings Area, and (3) the Vangorda/Grum Area. This study will be completed in the near future as part of the requirements under the Yukon Environmental and Socio-economic Assessment Act (YESAA) for the overall Faro Mine Remediation Project.

2.7 Codes and Standards

The civil basis of design, design criteria, and requirements for the Faro WTP will comply with the latest edition of (but not be limited to) the following codes and standards:

- National Building Code (NBC) 2010
- National Fire Protection Association (NFPA)
- National Fire Code (NFC) 2010
- Yukon Building Standards Act 2002
- Best Management Practices for Works Affecting Water in Yukon (Environment Yukon, 2011)

2.8 Land Disturbance and Excavation

Excavations will be performed in a manner that prevents the discharge of sediment to surface water, and erosion. Sediment control measures (including run-on and runoff controls) will be implemented in areas that are disturbed during soil sampling and for the construction of equipment working pads and access roads. Excess excavated material will be spread out within the FMC site; the exact location will be verified during the detailed design.

2.9 Sediment Control and Stormwater Management

Sediment control for the disturbed portion of the WTP site will be implemented to protect downstream areas and creeks. Controls may include silt fences, drainage swales, rock check dams, and other measures (as required) to mitigate environmental impacts.

2.10 Entrance, Roads and Security

Existing roads will be used to access the WTP and for deliveries. A gravel surface will be placed around the facility to allow easy access and turnarounds.

The road turning radius and access within the WTP site will be designed to accommodate a WB-15M AAHSTO semitractor-trailer (12.95-m trailer). A truck access and turning area will be provided at the east end of the facility for deliveries. Parking spaces, including one handicap parking space, will be provided at the west end of the building.

Ditch drainage, culverts, and storm inlets will be provided where needed to capture roof and road drainage. All storm drainage will be discharged south of the facility.

Additional fencing or gates at roadway entrances are currently not planned for the facility. An existing guardhouse provides overall site security.

2.11 Utilities

Currently, potable water for the WTP is trucked in; this will continue. A storage tank will be provided for demand buffering.

Sanitary sewage will be discharged to the existing septic field north of the existing guardhouse and proposed WTP site. Floor drainage will be collected in separate sumps will be pumped to the HDS treatment train or pumped out when necessary. The existing septic system capacity is assumed to be adequate. Refer to Section 6 for details.

The existing overhead power lines and some of the poles may need to be relocated for construction of the replacement WTP. Power and communication lines are anticipated to be connected to existing overhead power supply and fibre optic communication systems. Refer to Section 6 for details.

2.12 Construction Vehicle Access and Staging and Laydown Areas

During construction, vehicles will access the site mainly via the existing access road. A staging area will be established at a site to the east of the replacement WTP for construction parking, trailers, material storage, and other construction equipment.

Construction trailers will be located adjacent to the staging area. Temporary electrical, water, and sanitary services will be the contractor’s responsibility.

Security fencing during construction will be the contractor’s responsibility.

2.13 Restoration

Restoration of disturbed areas will include regrading and placement of gravel. No landscaping or planting features are planned for the Faro WTP.

SECTION 3
Architectural

This section describes the architectural basis of design, design criteria, and requirements for the new Faro WTP.

3.1 Design Intent

The building structures for the Faro WTP will be designed to be practical and functional, with emphasis on long service life and minimum maintenance requirements.

3.1.1 Design Codes and Standards

The building design will comply with the latest edition of codes and industry standards referenced herein:

- National Building Code (NBC) 2010
- National Fire Protection Association (NFPA), including the following:
  - NFPA 101 Life Safety Code
  - NFPA 10 Portable Fire Extinguishers
- National Fire Code (NFC) 2010
- Yukon Building Standards Act 2002
- FM Global (as appropriate)

3.1.2 Building Code Classification

All facilities will be designed in accordance with applicable codes for life safety, fire protection, and occupational health and safety. Where applicable, facilities will be designed in accordance with building code requirements for accessibility by persons with disabilities.

Building code classification will be based on building use, building area, number of storeys, and the fire access route to the building:

- **Building use:** The Process Building is considered a 1-storey building and will house the following occupancies:
  - A process area classified as Industrial Low Hazard F-3
  - An office portion classified as Business and Personal Occupancies Group D
  - Fire separation between the two areas is not required according to Table 3.1.3.1 of the NBC

  The Lime Facility is considered a 2-storey building and will house an Industrial Low Hazard F-3 occupancy.

  The Booster Pump and Grit Building is considered a 1-storey building and will house an Industrial Low Hazard F-3 occupancy.
- **Building area:** defined as the building footprint.
- **Number of storeys:** The classification of the Process Building is based on a 1-storey structure with elevated, open grating platforms and walkways.
- **Fire access route:** The buildings are classified as facing one "street." The road to the main entrance is considered a fire access route. The following are the basic requirements for a fire access route:
  - A minimum width of 6 m
  - A minimum clear headroom of 5 m
  - A turning radius of 12 m
  - A maximum slope of 1:12.5 over minimum of 15 m
  - Located a minimum of 3 m from the building face

3.1.3 Fire Protection

Sprinklers: Because of the building areas and occupancy classifications, the NBC does not require sprinklers, and none will be provided.

Standpipe: A standpipe will not be required for fire protection for either building.

Portable Fire Extinguishers: Portable fire extinguishers are required and will be provided in accordance with NBC 2010.

3.2 Building Occupancy and Classification

Reference Code: NBC – 2010

3.2.1 Process Building

Design in accordance with NBC 3.2.2.83, Group F, Division 3, 1 storey (see Table 3-1).

TABLE 3-1
Process Building Use and Occupancy: Group F-3 – Low-hazard Industrial
Faro Mine Remediation Project

Area	Proposed	Allowed
Building Height	1 storey	1 storey maximum allowed
Building Area	1,025 m^2	5,600 m^2 maximum allowed
Streets Faced	One	One minimum
Construction Type	Noncombustible	Heavy timber or noncombustible
Floor Assemblies	Not applicable	Fire separation
Roof Assemblies	Noncombustible	Noncombustible
Occupant Load	Maximum four people, based on operations	4.60 m^2 per person (1,200 people)
Sprinklers	Not provided	Not required
Standpipe System	Not provided	Not required
Fire Alarm	Provided	Not required

Fire-rated separation will be designed between following areas and the remainder of the building as shown in Table 3-2.

TABLE 3-2
Process Building Fire Separation Required
Faro Mine Remediation Project

Area	Fire Separation Required
Exits	1-hour fire resistance rating
Mechanical and Janitor’s Room	1-hour fire resistance rating
Electrical Room	1-hour fire resistance rating
Unoccupied Pipe Tunnel	1-hour fire resistance rating

Note:
Maximum travel distance to at least one exit must not exceed 30 m (NBC 3.4.2.5.(1).(f)).

3.2.2 Lime Facility

Design in accordance with NBC 3.2.2.83, Group F, Division 3, up to 2 storeys (see Table 3-3).

TABLE 3-3
Lime Facility Use and Occupancy: Group F-3 – Low-hazard Industrial
Faro Mine Remediation Project

Area	Proposed	Allowed
Building Height	2 storey	2 storeys maximum allowed
Building Area	144 m^2	800 m^2 maximum allowed
Streets Faced	One	One minimum
Construction Type	Noncombustible	Combustible or noncombustible
Floor Assemblies	Fire separation	Fire separation
Roof Assemblies	Noncombustible	Noncombustible
Load-Bearing Walls and Columns	Noncombustible	Noncombustible
Occupant Load	Maximum 4 people, based on operations	4.60 m^2 per person (170 people)
Sprinklers	Not provided	Not required
Standpipe System	Not provided	Not required
Fire Alarm	Provided	Not required

Note:

Separation of the Lime Facility from adjacent structures exceeds the minimum spatial separation required in Table 3.2.3.1 of the NBC. (Lime is an irritant but is nonflammable, noncombustible, and low hazard.)

3.2.3 Booster Pump and Grit Building

The design is in accordance with NBC 3.2.2.83, Group F, Division 3, for up to 2 storeys (see Table 3-4).

TABLE 3-4
Booster Pump and Grit Building Use and Occupancy: Group F-3 – Low-hazard Industrial
Faro Mine Remediation Project

Area	Proposed	Allowed
Building Height	1 storey	2 storeys maximum allowed
Building Area	100 m^2	800 m^2 maximum allowed
Streets Faced	One	One minimum
Construction Type	Noncombustible	Combustible or noncombustible
Floor Assemblies	Fire separation	Fire separation
Roof Assemblies	Noncombustible	Noncombustible
Load-Bearing Walls and Columns	Noncombustible	Noncombustible
Occupant Load	Maximum 4 people, based on operations	4.60 m^2 per person (170 people)
Sprinklers	Not provided	Not required
Standpipe System	Not provided	Not required
Fire Alarm	Provided	Not required

3.3 Building Components

3.3.1 Exterior Treatment and Materials

Structure exteriors will be designed to be practical and functional, with emphasis on long service life and minimum maintenance. Priority will be given to the use of local construction materials and techniques where practical and complementary to the structural systems.

3.3.2 Exterior Walls

Exterior walls will be designed of exterior, prefinished metal wall panels on steel framing with a metal liner on the interior face and insulation in between. Stone or precast concrete accent features at grade will be added as an additional architectural feature, but it will also serve as impact protection for the wall at the base of the exterior cladding. Exterior wall assemblies will be designed to achieve a minimum R-factor of 30. This also applies to the exterior walls of the thickening tank.

3.3.3 Roofs

The design of roofs, canopies, fascias, or other roof elements will be in harmony with the massing and materials of the structures and arranged to control runoff and direct drainage away from equipment, doorways, sidewalks, ramps, or other occupied areas. The sloped roofs will have snow guards and ice deflectors over the entire surface at the eaves. Heat tracing will be provided for the eaves. Canopies will be provided over doors for snow protection. The sloped metal roof system will cover the entire facility. Roof assemblies will be designed to achieve a minimum R-factor of 40.

3.3.4 Exterior Doors, Windows, and Louvers

Exterior doors, windows, and storm-proof louvers will be designed of extruded aluminum sections with factory-applied protective coatings. Sills, thresholds, flashing, and trim will prevent water penetration to the interior of the building. All doors, windows, and louvers will be installed with corrosion-resistant hardware, accessories, fasteners, and operating mechanisms. Windows will be openable. Exterior glazing will consist of double-pane, insulated, tempered glass.

Door units and hardware will be designed for heavy-duty use. Locksets and a keying arrangement acceptable to the owner will be provided.

Where applicable, equipment and vehicle doors for motorized operation will be controlled from an interior control panel. Doors will have manual backup for emergency hand operation.

Louver assemblies will be designed complete with bird screens, filters, dampers, blank-off panels, acoustical treatment, and other required features. Louver assemblies will be designed to prevent infiltration of rain and provide positive drainage to the exterior.

3.3.5 Interior Treatment and Materials

Structure interiors will be designed to be practical and functional, with emphasis on long service life and minimum maintenance. Priority will be given to the use of local construction materials and techniques where practical, and final selection will be made during the detailed design. Interior components and finishes will be designed of noncombustible materials, with minimum flammability and smoke-developed characteristics.

The interior walls will be designed of concrete masonry and gypsum board partitions. Where required for fire separation, the walls will be designed in accordance with recognized and tested assemblies.

Floor and base materials will be designed for long service life with minimum maintenance. Porcelain ceramic tiles will be used for flooring and base finish in the washroom. Stairs will have abrasive nosing inserts. Resilient flooring with rubber base will be used in the control room, server room, break room, laboratory, and corridors. All other floors will have either clear concrete sealer or hardener.

Interior doors, frames, sidelights, transoms, and windows will be designed of steel or aluminum. Where required for fire or smoke separation, steel doors and frames, window frames, and appropriately sized wired glass (with testing agency labels) will be used.

All doors will be designed and installed with corrosion-resistant hardware. Locksets and a keying system acceptable to the owner will be provided. Clear tempered glazing will be used for all interior glazing that is not required to be a fire-rated separation.

Ceilings will be integrated with the building service and lighting systems. Ceiling materials and finishes that enhance the acoustic properties will be used. A suspended acoustic tile ceiling will be used in all nonprocess rooms, such as the control room, server room, washroom, break room, laboratory, vestibules, electrical room, and corridors.

Built-in furnishings such as cabinets, counters, and shelving will be designed of factory-assembled modular components. Custom design or fabrication and field fabrication will be minimized. Durable low-maintenance finishes to all surfaces and heavy-duty, corrosion-resistant hardware will be used.

Where practical, the design will include factory finishes of interior items. Finishes and protective coatings will be applied to all other building elements that are not supplied with factory-applied protective coatings. The use of factory- or field-applied coatings that provide long-term service and minimum maintenance will be considered wherever possible.

Chemical-resistant coating systems will be used in all secondary containment areas to provide a minimum of 72-hour immersion protection against spills or leaks of stored chemicals. Coating systems will include a primer, fibreglass mat, saturant, and two trowel-applied coats of vinyl ester resin with silica filler. A non-slip finish will be applied to all horizontal surfaces in the polymer room and polymer containment area in the process room.

Safety items such as signage, eyewash stations, fire extinguishers, and exit signs will be installed where required.

3.3.6 Administration Area

The administrative portion of the building comprises the following areas:

- Laboratory: area housing small sample-testing equipment
- Control room: area housing two computer desks
- Server room
- Break room: area with kitchenette counter (microwave oven, stove, refrigerator, and sink) and a table with chairs to accommodate four people
- Unisex washroom
- Mechanical and janitor’s room
- Compressor and blower room
- Polymer room

All of these areas, with the exception of the polymer room, compressor and blower room, mechanical and janitor’s room, and the main process rooms will be designed to allow barrier-free access. Job prerequisites require operators in the process areas to be able-bodied and physically fit because those areas are not barrier free.

The administration area layout is designed for a future office addition on the west side of the building.

The client is self insured and is not governed by FM Global.

SECTION 4

Structural Design Criteria

This section describes the structural design criteria and requirements for the new Faro WTP.

4.1 Design Loads

Loads will be based on actual loads or CH2M HILL best practice standards and NBC 2010.

To determine specified loads for snow, wind, and earthquake design, the facilities will be designed as normal with an Importance Factor of 1.0.

4.2 Dead Loads

Loads will be the actual weight of structures and fixed equipment. Dead loads will be based on the standards and CH2M HILL best practices.

4.3 Process Building Dead Loads

- Roofing, insulation, and roof deck 0.5 kilopascal (kPa)
- Structural framing Actual weight
- Ceiling, mechanical, and electrical 0.5 kPa (for office area)

4.4 Floor Live Loads

Floor live loads will be in accordance with the aforementioned building codes and the following minimums:

- Process rooms 15 kPa
- Electrical room 15 kPa
- Compressor and blower room 10 kPa
- Mechanical and janitor's room 15 kPa
- Stairs and walkways 5 kPa
- Platforms 7.50 kPa
- Loading bay 15 kPa
- Laboratory 7.5 kPa
- Control room 7.5 kPa
- Polymer room 10 kPa
- Service tunnel connecting Thickener and pump area 7.50 kPa
- Pump area 10 kPa

4.5 Partition Loads

Unless otherwise noted, partition loads are included in the live-load allowances.

4.6 Roof Live Loads

The roof live load for construction will be 1.0 kPa (non-reducible). Although the design construction live load will be 2.0 kPa (reducible), the roof live load will be independent of snow and wind loads.

4.7 Wind Loads

Wind loads will be as follows:

- Hourly wind pressures at 1/50 year return = 0.38 kPa
- Exposure factor C_e = 0.9 for open terrain
- Importance factor I_w = 1.0 for ultimate limit state (ULS) and 0.75 for service limit state (SLS)
- In accordance with NBC 2010

4.8 Snow Loads

The ground snow load at 1/50 year return shall be 2.30 kPa with the associated rain load at 0.1 kPa, I_s = 1.0 for ULS and I_s = 0.9 for SLS, in accordance with Table C2, Appendix C of NBC 2010.

4.9 Rain Loads

Rain load will not be considered. The minimum roof slope will be 2 percent from the peak at the centre of building. Rain will drain off the roof to each side of building; Gutter and downspout will be provided.

4.10 Earthquake Loads

Earthquake loads for town of Faro are referenced to NBC 2010 for 2 percent probability of exceeding in 50 years, with the following seismic data:

- S_a(0.2): 0.21
- S_a(0.5): 0.13
- S_a(1.0): 0.067
- S_a(2.0): 0.040
- Peak Ground Acceleration: 0.11
- Site classification: C
- Importance factor (I_E) – building structures: 1.0 unless noted
- Ductility-related force modification factor (R_d): Varies; see drawings
- Over strength-related force modification factor (R_o): Varies; see drawings

4.11 Thermal Loads

The local temperature variance is -47 degrees Celsius ($^{\circ}$C) in winter to 25°C in summer. The facility will be designed to be operational during winter. The minimum temperature maintained for equipment will be 5°C.

4.12 Load Combinations

Load combinations will be in accordance with NBC 2010 and ACI 350, depending on the type of structure. Working stress or limit state design will be selected based on type of structural elements.

4.13 Vibration Loads

Centrifugal pumps, fans, compressors, and engine generators produce vibrations. These vibrating machines require special considerations in the design of their supports.

The natural frequency of machinery support structures must be significantly different from the frequency of the disturbing force. If the two frequencies approach each other, resonant vibration will be set up. To minimize resonant vibrations, the ratio of the natural frequency of the structure to the frequency of the machinery should be either less than 0.5 or greater than 1.5 (preferably greater than 1.5).

The following are general principles for designing for vibration:

- Mount all rotating equipment that produces vibrations on concrete foundations or concrete support systems.
- Use vibration isolators or dampeners, where appropriate.

- Consult with manufacturers to obtain recommendations, frequencies, and unbalanced loads.
- Where possible, provide a concrete base on grade with a mass equal to 10 times the rotating parts of the equipment or a minimum of 3 times the gross weight of the machine, whichever is greater. Where this is not possible or practical, perform a vibration analysis.
- Anchor vibration-sensitive equipment to concrete foundations by using embedded anchor bolts (with sleeves for alignment). Do not use drilled anchors.
- Bolt connections used in steel framing support systems by using high-strength, bolted connections.
- Steel support beam depths should be greater than 1/20 of the span to minimize perceptible transient vibrations.

4.14 Impact Loads

For structures carrying live loads that induce impact, the assumed live loads will be increased by a factor of 1.25.

4.15 Cranes

A 3,000-kg capacity, top-running bridge crane will be provided for operation and maintenance in the process room. The largest pieces of equipment that the crane would need to lift are the sludge pumps. The reactor mixers and motors would need to be removed in parts because of head room restrictions.

This crane may not be used during construction because of the construction sequence. There is a 1 m vertical space allowance for the bridge crane, including the crane girder.

4.16 Forklift

A forklift or similar vehicle will be used to move media and equipment in all process areas. Slabs on ground will be designed for forklift loads. Specific forklift data will be obtained from the owner during the DD phase to determine the design loads on the slab.

4.17 Guardrails

Guardrails will have a uniform load of 0.75 kilonewton per metre applied in any direction, or a concentrated load of 1.0 kilonewton applied at any point and in any direction along the top rail, whichever produces greater stress. The uniform and concentrated loads will not be applied simultaneously.

4.18 Geotechnical and Subsurface Consideration for Site

The proposed WTP site is located on three stepped levels of an equipment and material storage yard, on a sloping hillside west of the existing Faro Mill Area. The subsurface profile at the proposed WTP site is random fill and native soils overlying moderately to highly weathered phyllite bedrock. The rock quality designation is less than 26 percent.

The fill consists of sands and gravels with varying cobble and fines content. The thickness of the fill in the soil boreholes ranges from 0.2 to 4.3 m. The native soils include organic topsoil and silty to clayey sands and gravels.

The native soils are medium- dense to very dense. Some of the native soils are interpreted to be glacial till and residual soils. Residual soils derived from completely weathered phyllite bedrock were encountered in several boreholes.

Depth to sound bedrock in the WTP boreholes ranged from 0.90 to 6.1 m. The rock quality number is very low and does not consistently increase with depth in the limited depths explored in the WTP borings.

Piezometers detected water at depth during borehole monitoring. It was not determined if it is groundwater, trapped water, or perched water. Further monitoring is required and will be done in the future.

Using future data, the appropriate design groundwater table will be determined. The information available so far is not sufficient to determine design ground water table.

Based on the design groundwater table, there are four options to prevent flotation of all the structures addressed in this report:

1. Increase the total gravitational weight of structure to account for groundwater uplift forces.
2. Provide rock anchors to hold down the structure against uplift forces.
3. Provide a permanent under drainage system to lower the groundwater table and thereby reduce uplift forces.
4. Provide a combination of the first three alternates.

The most appropriate alternate will be selected after the design groundwater table value is established.

The structure will be designed for summer operation and for the winter shut down period for variations in groundwater levels.

4.19 Frost Mitigation

The geotechnical design report states the recommended frost depth is 3.5 m. The recommended frost depth can be reduced by ground insulation. Foundation support will be below the maximum frost depth. Insulation may also be required beneath floor slabs and behind retaining walls.

4.20 Lateral Earth Pressures

Design for lateral earth pressure will be in accordance with recommendation in the geotechnical report.

4.21 Waterproofing

Waterproofing concepts will be reviewed in detail and provided where determined necessary.

4.22 Pipe Supports and Platforms

Concrete pipe supports will be designed and shown on contract drawings where applicable. Service platforms will meet the process requirements. Where concrete pipe supports are needed, pipe supports will be provided for all pipe sizes. The performance specification for pipe supports will be provided for pipe sizes less than 600 mm in diameter. Pipe supports will be designed and shown on contract drawings for pipes that are greater than 600 mm in diameter. Aluminum platforms or fibreglass-reinforced plastic (FRP) platforms will be provided, based on process requirements; nonslip grating will be used.

4.23 Process Building

The process room floor will be constructed on a concrete raft slab that supports reactors, pumps, and motors. The wall will support the structural steel superstructure. The floor will be located below grade so that it meets frost criteria and process needs. The pump room and access to the tunnel will be located below the process room floor and will be accessible by a stair.

The polymer room, electrical room, control room, server room, mechanical room, and other rooms will be located at grade level. These rooms will be on a concrete slab on grade and encompassed by a foundation wall on north side and west side and by concrete walls for the process room on the other two sides. The foundation of these walls will be below the frost depth. Rigid insulation around the perimeter and maintaining the minimum temperature inside the building for equipment will protect the belowgrade slab from freezing.

The superstructure for the process building will be structural steel construction. The typical bay size will vary from 5 m to 8 m, with a clear span of 22.60 m.

CH2M HILL will design the main structural steel for the building including the roof, decking, and walls. Current project construction requires quick construction because there is a very limited time for construction. Local construction practice will affect the feasibility and cost. Platforms will suit process needs around the reactors.

The roof will be an insulated standing-seam system supporting on purlins, with a slope to drain rain water.

The exterior walls will be insulated wall panels on a girt system.

4.24 Tunnel

The tunnel will provide access to the underside of the cone for the Thickener from the pump area of the process building. The tunnel will be cast-in-place concrete. The tunnel floor will be sloped across the axis of the tunnel, with gutters on the sides. The entire tunnel will be located below frost depth, thus rigid insulation is not necessary.

The roof of the tunnel will be sloped across the axis of the tunnel to drain water away from the centre of the roof.

4.25 Lime Facility

The Lime Facility floor will be an on-grade slab. The concentrated column point loads from the lime silo will be supported by caissons. The caissons will be separated from the on-grade slab by a joint and founded down to sound rock. The final design concept may vary depending on the bearing capacity of the soil and the silo load configuration.

The platform and stair will suit process needs. The building will be enclosed from bottom to suit the process requirement. The building will be located at least 5 to 8 m east of the Process Building. Construction materials for the superstructure can be steel, concrete, or a combination of both.

4.26 Booster Pump and Grit Building

The Booster Pump and Grit Building floor will be constructed on a concrete raft slab. The wall will support the structural steel for superstructure. Rigid insulation around the perimeter and maintaining the minimum temperature inside the building for equipment will protect the below grade slab from freezing.

The superstructure for the process building will be structural steel construction. CH2M HILL will design the main structural steel for the building including the roof, decking, and walls. The roof will be an insulated standing-seam system supported on purlins, with a slope to drain rain water. The exterior walls will be insulated wall panels on a girt system. Foundation depths will be coordinated with the geotechnical engineer during detailed design.

4.27 Thickener

The Thickener will be constructed of cast-in-place concrete. The diameter and height of the Thickener will meet the process requirement. The structural walls and slab will be designed for earth load, the liquid loads in the tank, and forces generated by the roof structure. The aluminum Thickener roof will be pre-engineered by the equipment supplier.

4.28 Future Construction

The Process Building will have a corridor that can be connected to a future administration area expansion. This corridor is located between the mechanical room and the break room. The future administration expansion will be on west side of process building.

A separate Filter Building will be constructed in the future. This building will be south of the Thickener. Currently, it is planned that the Thickener walkway would be extended to the south and connected to the Filter Building. This walkway would be enclosed.

SECTION 5

Process Mechanical

This section describes the process mechanical design criteria and requirements for the new Faro WTP

5.1 Design Approach

5.1.1 Process Design Basis

The quantity and quality of water needing treatment will vary over time and by water source. CH2M HILL completed extensive engineering analysis and water quality modelling to estimate the contaminant flow volume and metals loading to the Faro WTP. Analyses included estimating (1) the annual volume of contaminated water requiring treatment and the contaminant characteristics of the water and (2) the change in flow volume and contaminant concentrations over time. The flow rates are affected by short-term weather cycles, long-term climate change, storage, and closure activities that alter flow paths. The contaminant concentrations will change as the waste piles and tailing impoundments mature to produce increased acidity and dissolved metals.

Based on consideration of the FMC complexity, engineering analyses, and GoldSim modelling, CH2M HILL recommended construction of a WTP at the Faro Mill Area with a nominal-rated flow capacity equal to 44 megalitres per day (ML/day), with a water chemistry equivalent to the "HDS-2" water quality used in the recent HDS pilot test. Table 5-1 summarizes key design parameters for the WTP.

TABLE 5-1
Summary of Key Design Parameters for Faro HDS WTP Sizing
Faro Mine Remediation Project

Design Parameter	Design Value
Plant Rated Influent Flow (ML/day)	44
Influent Quality at Rated Influent Flow	Pilot test HDS-2
Plant Maximum Hydraulic Capacity (ML/day)	55
Lime Consumption at Rated Flow and Water Quality (tonnes/day)	34
Lime Consumption at Average Start Up Flow and Water Quality (tonnes/day)	3.1
Lime Silo Capacity (tonnes)	340
Thickener Sizing Basis (m^2/t/day)	1.7
Thickener Diameter (m)	55
Solids Recycle Ratio	20
Reactor Tank Total HRT (minutes)	30
Reactor Tank Volume Total (m^3)	540
Filtration Loading Rate (m/h)	9.8
Total Filtration Area (m^2)	220
Influent Manganese (mg/L)	60
Influent Ferrous Iron (mg/L)	180

Notes:
HRT = hydraulic residence time
m = metres
m^2 = square metres
m^3 = cubic metres
m^2/t/day = square metres per tonne per day
mg/L = milligrams per litre
m/h = metres per hour
tonnes/day = tonnes per day

5.1.2 Effluent Quality

It is anticipated that new effluent quality objectives will be established for the new WTP and that, in addition to Canadian metal mining effluent regulations (MMER), surface water quality in Rose Creek at Station X14 will be considered when they are. A description of the approach for establishing a surface water quality objective for zinc in Rose Creek was provided in a technical memorandum prepared by Bill Slater dated June 17, 2013 (Bill Slater Environmental Consulting and CH2M HILL, 2013). The final quality objective is to be developed as part of the submission to the YESAA Designated Office submission scheduled for January 2014. The current MMER maximum authorized monthly mean concentration for total zinc is 0.5 mg/L; this limit may be lowered to 0.25 mg/L in the near future (Environment Canada, 2012).

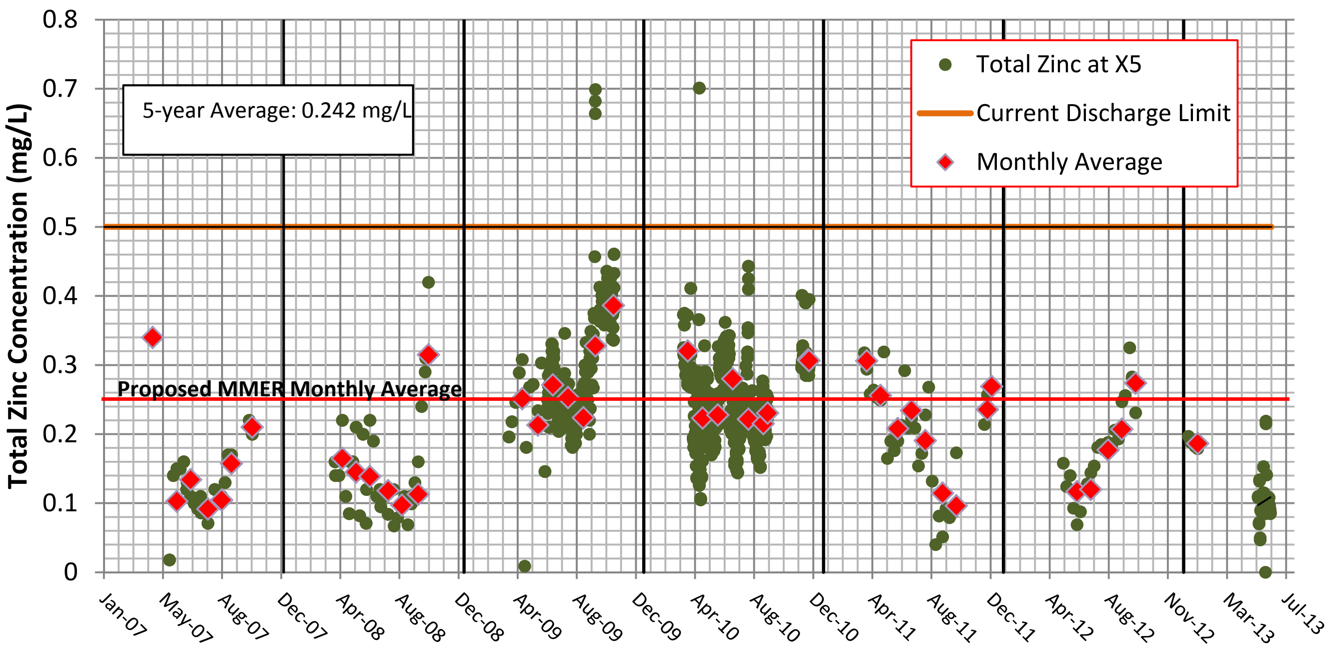
Pilot testing of the HDS process was conducted by CH2M HILL during the summer of 2012. The average dissolved zinc concentration obtained for treatment of HDS-1 water, which is the water quality expected to be similar to that treated by the new WTP until addition of new sources, was 50.3 µg/L at a pH of 9.7, and 22.5 µg/L at a pH of 10.2. The corresponding total zinc concentrations were 2,900 and 2,360 µg/L, respectively, and the corresponding total suspended solids (TSS) concentrations were 22 and 32.2 mg/L. These total zinc and TSS concentrations are relatively high because, as described in the pilot test report, the pilot plants use small 2-foot-diameter thickeners, and are run without polymer addition or filters.

The new WTP is expected to achieve similar dissolved concentrations as the pilot, but lower total zinc and TSS concentrations, due to use of polymer and improved settling in the full-scale thickener. When filters are added, the new WTP will produce even lower total zinc concentrations due to enhanced suspended solids removal. The effluent total zinc concentration discharged to Rose Creek will be the summation of the dissolved and suspended concentrations. The suspended concentration will result from the efficiency of settling in the thickener and in the Cross Valley Pond (CVP) prior to construction of filters, and then from the efficiency of the filters once they become operational and the CVP is no longer used for polishing thickener discharge.

Based on CH2M HILL's experience, the thickener overflow is estimated to contain between 5 and 20 mg/L suspended solids. Using this range, the expected total zinc of the overflow is estimated between 0.39 and 1.5 mg/L (based on calculations using pilot test data), and will require polishing in the CVP or by filters to achieve a monthly average total zinc of less than 0.25 mg/L, which is the expected revised MMER monthly average.

Use of well-designed filters is expected to provide total zinc averaging less than 0.25 mg/L because this concentration correlates to 3.1 mg/L of TSS (calculated using pilot test data), and CH2M HILL's experience is that filter discharge will average less than this.

Use of the CVP for polishing is also expected to provide monthly average discharge concentrations of total zinc less than 0.25 mg/L as long as the pond pH is maintained high enough to preclude resolubilization of zinc from sediment as well as to precipitate zinc which may be present in seepage into the CVP, and as long as suspended zinc is controlled.



The above plot shows historic concentrations over the last 5 years of total zinc measured at Station X5, which is the monitoring location for CVP discharge to Rose Creek. Also shown are calculated monthly average values. Average concentrations in 2011 and 2012 are somewhat lower than the previous years. It is CH2M HILL's understanding that this resulted from the addition of supplemental lime to the Mill WTP discharge. It is also CH2M HILL's understanding that the CVP is subject to wind stirring, which can temporarily increase turbidity, TSS, and total zinc, as well as temperature-related turnovers that affect TSS and turbidity.

CH2M HILL expects that a monthly average total zinc of less than 0.25 mg/L will be obtained at X5 when the new WTP is discharging through the CVP, as long as additional lime is added to thickener overflow as performed in the last few years, and as long as discharge of suspended solids are controlled. Control of the discharge of suspended solids may require improvements to enhance settling such as relocation of the inlet from the WTP further away from the CVP outlet and/or the addition of baffle curtains to reduce wind-induced stirring as well as hydraulic short-circuiting. The new WTP will have the capability to add lime to thickener overflow. Because of the factors discussed above, the accumulation of treatment sludge in the polishing pond, and the potential for groundwater seepage containing dissolved zinc from the Intermediate Dam Pond, the short and long-term performance of the polishing pond to settle total metals is uncertain. This factor complicates the ability to reliably predict the discharge quality from Monitoring Station X5.

5.1.3 Design Flows

The WTP hydraulic flow and loading characteristics are defined in the WTP Design Definition Report (CH2M HILL, 2012b). Four influent flows are considered for WTP design: average at startup, nominal maximum, nominal minimum, and maximum hydraulic.

The average design flow at startup is defined as the average flows anticipated during the first years of operation (until additional sources of water are added such as flow from the CVD SIS, which could be 5 or more years after plant startup). Additional flows will be pumped to the WTP after this time, which establishes the nominal maximum. The nominal minimum is the lowest influent flow rate anticipated to the WTP during the startup period. The hydraulic maximum influent flow assumes 25 percent more flow to the WTP than the nominal maximum but with no additional loading.

5.1.4 Equipment Sizing

Influent rates increase significantly from when the facility starts up to when the design capacity is ultimately achieved, which could be 20 to 25 years. With the range of flow rates, it is not possible to select single pieces of equipment that can operate over the entire future range. It is possible to install both large and small equipment to cover the entire range of flows; however, this requires a larger process area, more equipment maintenance, and the larger equipment may no longer be operable in 20 to 25 years when they are needed. Therefore, where efficient, this schematic design is based on installing smaller process equipment to satisfy startup conditions and replacing that equipment with larger equipment when the hydraulic maximum is reached.

The static equipment (e.g., tanks, thickener, silo, and pipes) are sized for the maximum hydraulic flow. Mechanical equipment such as pumps (e.g., polymer, sludge recirculation, lime feed) and some associated piping systems are sized for the startup flows with the intent of replacing this equipment when the hydraulic maximum is achieved. It is anticipated that at that time, these pieces of equipment will be near the end of their lifespan and will require replacement. The schematic equipment layout is based on the future equipment dimensions so that there is sufficient space for the larger equipment.

Variable-frequency drives (VFD) will be provided on equipment where flows need to be manipulated. This includes the aeration blowers, sludge recycle pumps, polymer volumetric feeder, polymer metering pumps, and lime slaker. VFDs have additional capital costs and may require occasional maintenance; however, VFDs reduce energy consumption compared to flow control valves. Two or three reputable VFD manufacturers (e.g., ABB, Allen Bradley, and Eaton) will be listed as acceptable manufacturers.

The equipment list attached to Appendix D provides a summary of the equipment. The actual size of mechanical equipment may vary from those shown in the following sections, depending on results of the detailed design, supplier availability, and supplier recommendations.

5.1.5 Design Safety Factor

The hydraulic maximum incorporates a 25 percent design safety factor over the nominal maximum. Therefore, no additional safety factors are added to sizing of tanks, pipes, and equipment to avoid over sizing equipment. Oversized equipment may result in poor plant performance at the normally lower hydraulic conditions.

5.1.6 Operational Season

To provide maximum operational flexibility for treating a range of potentially changing flow conditions, the WTP is designed for year-round operations. Over the near term (5 to 10 years), it is likely that the duration of operations will be similar to existing operations (typically May through September).

Faro Pit provides a large storage volume to collect year-round influent sources during nonoperational periods.

5.2 Overall Process Description

5.2.1 Influent Water

5.2.1.1 Pond and Pit Water

Influent water will be supplied to the WTP from a six-pipe system. There will be connections to the three water supply pipes to the existing Faro Mill WTP. The Faro Pit pipeline will be intercepted northeast of the Faro Mill. The new 500-mm ID HDPE pipe will be located north of the mill to minimize the number of low points. The Intermediate Pond and ETA feeds will be intercepted north of the mine access road and south of the existing WTP. The new 350-mm and 200-mm ID HDPE pipes will run west to the replacement WTP. To allow vehicular traffic, the pipes will be aboveground except near the WTP. The new feed lines will enter the WTP approximately 2.5 m below grade. Frost protection may be required to protect the buried pipe sections. Pipe routing and connection locations are shown on Drawing 500-C-0002 (see Appendix A).

In addition to connecting to the existing water supply pipes, there will be provisions for three future water supplies. These include the twinning of the Faro Pit pipeline (500 mm), pumping of water from the CVD SIS (400 mm), and pumping of water from the Vangorda Pit and Grum Pit (350 mm). Yard piping and Process Building piping for these future connections are not part of this work; however, wall penetrations into the Process Building and allocation of space within the building for the pipe layout will be provided.

Water from Influent 1 and Influent 2 will be combined into a common 750-mm pipe immediately upstream from the Process Building to simplify layouts within the building. Table 5-2 presents the design assumptions for existing and future influent piping systems.

TABLE 5-2
WTP Influent Connections Pumping and Piping Systems
Faro Mine Remediation Project

Influent	Description	Existing/ Future	Diameter (mm)	Tie-In Location	Existing Pipe [a]	Comment
Influent 1	Faro Pit	Existing	500	East of Faro Mill	750 mm SDR21 (685 mm ID)	
Influent 2	Faro Pit	Future	500	N/A	N/A	Common 750-mm wall penetration for Influent 1
Influent 3	Intermediate Pond	Existing	350	North of mine access road	350 mm SDR13.5 (300 mm ID)	
Influent 4	ETA	Existing	200	North of mine access road	200 mm HDPE	
Influent 5	CVD SIS	Future	400	N/A	N/A	Wall penetration provided at WTP only
Influent 6	Vangorda/Grum Pit	Future	350	N/A	N/A	Wall penetration provided at WTP only
Filter Backwash	Filter backwash	Future	250	N/A	N/A	Wall penetration provided at WTP only

[a] Information as provided
Note:
N/A = not applicable

For the existing pumping and piping systems it is assumed that the existing pumps are of sufficient capacity and are in satisfactory condition to supply the design flow rates to the WTP. Assessment and replacement of the existing pumps are not included in this scope. The existing piping is also assumed to be of sufficient diameter and in satisfactory condition to supply water up to the tie-in locations. Replacement of these pipes is not included in this scope of work. Assessment of existing pumps and piping is planned for summer 2013. Design of the future pumping and piping systems are also not part of this scope of work, and sizes are based on the flow data provided.

5.2.1.2 Filter Backwash

Filters are proposed for future effluent polishing with backwash pumped from the future Filter Building to Reactors B1 and B2. Yard piping and Process Building piping for the future filter backwash will not be provided as part of the current scope of work; however, wall penetrations into the Process Building, Reactor B flanges, and space within the building for the pipe layout will be provided.

5.2.2 Reactor B

Influent water will enter the Process Building through below grade wall penetrations. Influent piping within the Process Building will be constructed of stainless steel to reduce the effect of corrosion. Each source will be independently metered before discharging into Reactor B where it will be rapidly mixed with lime-coated sludge from Reactor A. Process piping will only be provided for the three existing sources; however, space will be allocated for the future installation of process influent piping from three sources. In addition to the raw water influent, Reactors B1 and B2 will receive process sump return and future filter backwash.

Reactor B will consist of two tanks (B1 and B2) in series, either of which can be bypassed for maintenance or to allow only one to operate during periods of low influent flow. Valves to redirect influent water from Reactor B1 to B2 will be manually operated. Flows will be to the top of the reactors; the effluent flange will be located at the static water level, with an upcomer inside the tank to draw water from mid-depth. Flow between the reactors will be by gravity. Piping downstream from Reactor B1, where acid has been neutralized, will be constructed of stainless steel.

Air will be introduced at the bottom of Reactors B1 and B2 through a distribution cone and sheared by the mixers to create small bubbles that increase the dissolved oxygen concentration. The reactors will have 100-mm drains and 600-mm manways at the bottom and an emergency overflow connection at the top. Emergency overflows will be directed to the ground outside the Process Building. Reactors B1 and B2 are sized to provide a combined hydraulic residence time of approximately 30 minutes at the nominal maximum flow.

Table 5-3 lists the design criteria for Reactors B1 and B2.

TABLE 5-3
Reactor B Design Criteria
Faro Mine Remediation Project

Parameter	Nominal Maximum	Maximum Hydraulic	Average Startup	Nominal Minimum
Raw Influent Flow Rate (m^3/d)	44,100	54,500	23,400	11,700
Filter Backwash (m^3/d)	3,350	4,870	1,760	1,370
Reactor A Flow Rate (m^3/d)	4,370	4,370	970	490
Effluent Flow Rate (m^3/d)	51,870	63,750	26,170	13,570
Effluent Solids Concentration (mg/L)	25,100	20,400	8,500	8,200
Total Retention Time (minutes)	30.0	24.4	59.5	114.6
Number of Reactors	2 duty (series)			
Volume/Reactor (m^3)	540			
Side Wall Depth (m)	10			
Diameter (m)	8.8			
Number of Mixers per Reactor	1			
Mixer Power (kW) (to be confirmed by vendor)	80			
Drive Type	Constant speed			

Note:
m^3/d = cubic metres per day

5.2.3 Thickener

Reactor effluent discharges by gravity and flows to the centre of the Thickener. A 280-minute hydraulic retention time at the nominal maximum flow provides the quiescent conditions for the floc to settle. Clarified water discharges from the top of the Thickener via an effluent launder on the outer circumference of the vessel. Thickener effluent will be discharged on the south side where the future filters would be located. A level indicator transmitter will monitor the liquid level in the Thickener.

Solids will settle to the bottom of the Thickener to form a blanket and thicken to about a 20 to 25 percent (by weight) sludge. The bottom of the Thickener will contour at a 12 percent slope to the centre, and a rake mechanism will rotate through the Thickener to draw the solids to the middle. The sludge blanket can vary in depth depending on the wasting rate but generally it is desirable to keep the blanket below the base of the sidewall. The rake mechanism is designed to sense the torque required to move through the sludge blanket and lift the rake as required without torque overload. The thickened sludge withdrawn from the centre cone of the Thickener will be recycled to Reactor A; the excess sludge will be pumped to Faro Pit.

The Thickener rake drive will be located centrally above the tank. A bridge from the process building will provide access to the drive for maintenance and extend to the far side of the tank for a secondary means of egress and access to the future Filter Building. The influent pipe will be suspended from the Bridge. An aluminum dome will provide protection from snow and ice during winter and minimize wind-induced turnover. The bridge will also be covered, allowing the operators sheltered access to the drive. Lighting and ventilation will be required for the interior; heating will be considered for the space. Table 5-4 presents the design criteria for the Thickener.

TABLE 5-4
Thickener Design Criteria
Faro Mine Remediation Project

Parameter	Nominal Maximum	Maximum Hydraulic	Average Startup	Nominal Minimum
Influent Flow Rate (m^3/d)	51,870	63,750	26,170	13,570
Polymer Flow Rate (m^3/d)	524	540	79	41
Average Sludge Discharge Flow Rate (m^3/d)	4,150	4,150	960	480
Thickened Solids Concentration (%)	26	26	20	20
Effluent Flow Rate (m^3/d)	48,250	60,140	25,290	13,140
Total Retention Time (minutes)	280	225	568	1,099
Maximum Solids Loading Rate (kg/day/m^2)	600	600	96	48
Number of Thickeners	1			
Side Wall Depth (m)	4.3			
Bottom Slope (%)	12			
Diameter (m)	55			
Number of Rakes	1			
Rake Power (kW) (to be confirmed by the vendor)	37			
Drive Type	Constant speed with 0.60-m lift			

Note:
kg/day/m^2 = kilogram per day per square metre

5.2.4 Effluent Discharge

Thickener effluent will be discharged from the south side near the future filter location to minimize hydraulic losses. A flowmeter will be installed on the WTP effluent pipe. Effluent will be conveyed in a new 750-mm ID aboveground, HDPE pipe to the existing discharge pipe located near the Mine Access Road. It is assumed that the existing pipe is of sufficient capacity and in satisfactory condition to accept the WTP effluent at least until future flow sources are added. Replacement of the existing pipe is not part of this scope of work. New effluent pipe and connection locations are shown on Drawing 00-C-0002 (see Appendix A).

5.2.5 Sludge Wasting and Recycle

Thickened sludge will be collected from the bottom of the Thickener and conveyed to the process building. Two sludge pipes will be connected to the bottom cone of the Thickener and run through an access tunnel below the Thickener to the Process Building. A tunnel provides access to the cone and sludge pipes in the event of plugging or if replacement is required. The tunnel will be accessible from the Process Building and extend to a stairwell at the south side of the Thickener to provide access to the future Filter Building. No equipment will be located in the tunnel or below the Thickener, with the exception of isolation valves and cleanouts at the cone. Plant service water and compressed air will be supplied in the tunnel for flushing of the Thickener cone and sludge lines.

Two pipes (100- and 150-mm diameter) will provide redundancy. The 100-mm diameter pipe will provide desirable sludge velocities for initial flows. In the future, when the nominal maximum operating condition is reached, the 100-mm pipe will be replaced with a 150-mm pipe. Two 150-mm pipes are anticipated to be required for this future flow; however, the redundancy will allow operation at partial capacity if maintenance on one pipe is required.

The sludge pipes will be installed with a 1 percent slope towards the Process Building to permit draining. The pipes will enter a lower pump room that will house the wasting pumps and recycle pumps and combine into a common 200-mm header. Both the recycle flow and the waste flow will draw through the same pipe to provide sufficient continuous velocity to minimize solid settling and reduce the potential for blockage.

5.2.5.1 Sludge Wasting

The sludge wasting pumps will be located in the lower pump room so that they are below the lowest point in the Thickener. Although the low elevation is not required for wasting during the operating season, it is required during the seasonal plant shut down so that the contents of the Thickener can be drained and pumped back to the pit.

The wasting pumps are sized to waste the daily sludge accumulation in 4 hours at the hydraulic maximum. With lower sludge accumulation, the wasting time will be adjusted to maintain the sludge balance. The sludge bed depth in the Thickener can also be used to determine the sludge wasting duration. This design does not require replacement of the wasting pumps for capacity reasons once the hydraulic maximum is achieved, and it is easier to control. Duty and standby wasting pumps will be installed.

The wasting pumps will have a LOCAL/OFF/REMOTE (L/O/R) selector switch in the local control station (LCS). Local control will allow the operator to manually operate the pumps. Under remote control the operator will be able to set the wasting duration and the supervisory control and data acquisition (SCADA) system will show the estimated volume of sludge to be wasted. Alternatively, the operator will be able to set the wasting volume. In both modes (duration or volume) the operator will be able to set the time wasting will commence on a daily basis. A discharge flowmeter will measure the actual volume wasted.

Waste sludge will be conveyed to Faro Pit through a new 100-mm ID HPDE pipe where it will be discharged near the pit bottom and allowed to settle. The new pipe will be buried near the Process Building to limit interference with traffic. Beyond this area it will be located abovegrade and follow a similar route as the Faro Pit water supply pipeline. Design of this pipe will consider cleanout options and air/vacuum relief requirements. The impact of ice on the pipe in the Faro Pit will also be considered.

Plant influent water will be provided to the wasting pumps for flushing the pipe after discharge. Flush water will be drawn from the influent pipe and boosted with the wasting pumps to flush sludge from the pipe. One pig launcher will be located downstream from the sludge wasting pumps to flush the sludge wasting pipe to Faro Pit.

Table 5-5 presents the design criteria for the sludge waste pumps.

TABLE 5-5
Sludge Wasting Pump Design Criteria
Faro Mine Remediation Project

Parameter	Nominal Maximum	Maximum Hydraulic	Average Startup	Nominal Minimum
Flow Rate (total)	197 m^3/d	197 m^3/d	23 m^3/d	12 m^3/d
Flow Rate (instantaneous)	1,185 m^3/d	1,185 m^3/d	1,185 m^3/d	1,185 m^3/d
Discharge Duration (minutes per day)	240	240	28	14
Total Dynamic Head	100	100	100	100
Quantity	2 (1 duty and 1 standby)			
Pump Type	Centrifugal			
Drive Type	Constant speed			
Power (kW)	30			

5.2.5.2 Sludge Recycle

The sludge recycle pumps will recycle sludge from the Thickener to Reactor A. To prevent the thickened sludge in the Thickener from becoming difficult to pump, piping will also return recycle to the influent of the Thickener if the reactors are out of service.

The recycle ratio and flow rate will depend on the WTP influent flow rate and influent quality and will, therefore, increase significantly under future conditions. A single pump will not suffice for the entire range. Initially, the pumps will be sized for the startup conditions and then replaced with larger pumps when the hydraulic maximum is reached. It is anticipated that the pumps will be near the end of their operating life when the maximum conditions are reached. The facility design will include the necessary area to accommodate the future equipment dimensions. Initial and future pumps will be VFD pumps. A duty pump and a standby recycle pump will be installed.

The recycle pumps will have an L/O/R selector switch in the LCS. Local control will allow the operator to manually operate the pumps. There will be a flowmeter on the common pump discharge, and the recycle flow rate will be set by the operator locally or remotely. The recycle rate will be set by the operator, based on influent water quality.

Table 5-6 provides the design criteria for the sludge recycle pumps.

TABLE 5-6
Sludge Recycle Pump Design Criteria
Faro Mine Remediation Project

Parameter	Nominal Maximum	Maximum Hydraulic	Average Startup	Nominal Minimum
Flow Rate (m^3/hr)	165	165	39	20
Total Dynamic Head	12	12	6	6
Quantity	2 (1 duty and 1 standby)			
Pump Type	Centrifugal			
Drive Type	Variable speed			
Power (kW)	15			

5.2.6 Reactor A

Reactor A will receive recycled sludge from the Thickener and blend it with lime slurry from the slaking system. A vertical mixer will rapidly mix the sludge and lime before it overflows by gravity through a 250-mm discharge pipe to Reactors B1 and B2. Reactor B2 will be fed only if Reactor B1 is offline. To allow easy access for tank maintenance, the tank will not be covered.

Table 5-7 presents the design criteria for Reactor A. The dimensions shown are being evaluated and may change during the detailed design.

TABLE 5-7
Reactor A Design Criteria
Faro Mine Remediation Project

Parameter	Nominal Maximum	Maximum Hydraulic	Average Startup	Nominal Minimum
Lime Feed Flow Rate (m^3/d)	423	423	39	20
Sludge Recycle Flow Rate (m^3/d)	3,950	3,950	930	470
Effluent Flow Rate (m^3/d)	4,370	4,370	970	490
Total Retention Time (minutes)	0.8	0.8	3.7	7.5
Number of Reactors	1			
Volume/Reactor (m^3)	2.5			
Side Wall Depth (m)	2.4			
Diameter (m)	1.5			
Number of Mixer/Reactor	1			
Mixer Power (kW)	1.5			
Drive Type	Constant speed			

5.2.7 Lime Slaking and Metering System

Quicklime (i.e., calcium oxide) will be delivered by truck and blown into a silo sized for 10 days of storage capacity at the nominal maximum conditions. The quicklime will be metered with a screw feeder into the lime slaker where it will be wetted with process water. The slaked lime will then pass through a vibratory screen to remove grit. The grit will be conveyed to a grit hopper located in the building, and the slaked lime will flow by gravity to a lime slurry tank where it will be diluted to a 10 percent solids by weight solution. The lime slurry tank will have a vertical mixer to blend the slaked lime and water. Water from Faro Pit or from plant effluent can be used for slaking and dilution.

The slaking system will be sized initially for the startup conditions and then replaced with larger system when the hydraulic maximum is reached. It is anticipated that the slaking system will be near the end of its operating life when the maximum conditions are reached. The facility design will provide the necessary area to accommodate the future equipment dimensions.

There will not be a standby slaker system; therefore, a spare parts inventory will be maintained for timely repairs. A lime slurry tank retention time of 2.5 hours at the nominal maximum flow rate will allow time to complete repairs.

The slaking system will have an L/O/R selector switch in the LCS. Local control will allow the operator to manually operate the system. Lime will be slaked as a semicontinuous batch when the batch tank level indicator calls for more solution. A VFD on the volumetric feeder and a control valve on the slaking water and dilution water will manipulate the slaking rate. The desired slaking rate will be set by the operator at the programmable logic controls (PLC) or through the SCADA system.

The lime slaking equipment will be located below the silo to reduce the complexity of conveying dry lime, to simplify the health and safety design requirement, and to keep the process in a dedicated area. The dry lime storage, slaking, and slurry tank systems will be a vendor-supplied package.

Lime solution will be delivered to Reactor A through a recirculation loop. The loop is designed to maintain a sufficient flow in the pipe to limit the deposition of solids. A portion of the flow will be metered into Reactor A, and the remainder will return to the lime slurry tank. The feed rate of lime slurry to Reactor A will be controlled by a pneumatic pinch valve based on a pH set point control loop.

The feed rate will automatically adjust with the WTP influent to maintain the pH measured in the Reactor B discharge. A pH meter with temperature sensor will be installed in the upcomers of Reactors B1 and B2. The probe for the discharge from Reactor B2 will only be used for automatic control if Reactor B1 is offline. The pH will be monitored and that information used by the operator to adjust the set point in Reactor B1. The operator will adjust the lime slurry feed rate through the PLC/SCADA system.

Table 5-8 presents the design criteria for lime storage, slaking and metering. The dimensions shown may be revised during the detailed design.

TABLE 5-8
Lime Slaker System Design Criteria
Faro Mine Remediation Project

Parameter	Nominal Maximum	Maximum Hydraulic	Average Startup	Nominal Minimum
Lime Dose (mg/L)	1,016	823	177	177
Lime Consumption (kg/day)	33,952	33,952	3,146	1,573
Lime Storage Volume (days)	10	10	108	216
Number of Lime Slaker Systems	1 duty			
Product	Slake lime			
Lime Storage Volume (m^3)	340			
Silo Diameter (m)	6.5			
Silo Side Wall Height (m)	11			
Lime Makedown Concentration (%)	25	25	25	25
Slaking Water (m^3/hr)	6.1	6.1	0.6	0.3
Number of Vibratory Screens	1			
Batch Tank Concentration (%)	15	15	10	10
Batch Tank Dilution Water (m^3/hr)	11.0	11.0	1.6	0.8
Batch Tank Retention Time (minutes)	150	150	1,100	2,200
Number of Batch Tanks	1			
Batch Tank Volume (m^3)	30			
Batch Tank Diameter (m)	4			
Batch Tank Side Wall Height (m)	3			
Number of Batch Tank Mixers	2			
Lime Solution Flow Rate (m^3/hr)	11.4	11.4	1.6	0.8
Total Dynamic Head (m)	30	30	30	30
Number of Pump Skids	1			
Number of Lime Recirculation Pumps	2 (1 duty and 1 standby)			
Pump Type	Centrifugal			
Drive Type	Variable speed			
Power (kW)	3.7			

5.2.8 Polymer Makedown System

Dry polymer (delivered in bulk bags) will be used to enhance solids settling in the Thickener. The polymer will be delivered by truck to the polymer storage room, which will also house the polymer makedown system. Storage will be provided for 30 bags. The makedown system includes a bulk bag handling system, dry polymer feeder, wetting chamber, and a mixing tank. The makedown system will produce a solution between 0.50 and 0.25 percent (field adjustable) active polymer solution (POS) by mixing the dry polymer with process water. The polymer solution will be aged in the mixing tank and discharged by gravity to the holding tank. The makedown system will have a package control panel to operate the system automatically.

Polymer makedown is a batch process; therefore, the makedown system will be designed for the maximum hydraulic conditions.

One post-dilution skid will be provided. The system includes a polymer solution holding tank and two polymer solution feed pumps (duty and standby) in a containment area. The containment area will be 110 percent the volume of the holding tank. Process water will be used to post dilute the solution to 0.10 percent. The post dilution skid will have a packaged control panel to operate the system automatically.

The metering pumps will have an L/O/R selector switch in the LCS. Local control will allow the operator to manually operate the pumps. PLCs will be used in the package control panels to communicate with the WTP. The POS concentration can be set at the makedown system local control panel (LCP). The plant PLC will initialize each makedown batching cycle. A full tank of aged POS will be stored in the mixing tank until an automatic control valve is opened and the mixing tank contents discharge to the holding tank.

The mixing tank is about 75 percent of the volume of the holding tank. When the holding tank level falls below 20 percent, the mixing tank contents will be transferred to the holding tank. If the level falls below 10 percent, the POS pumps will stop and an alarm will be activated. If the holding tank level is above 95 percent to makedown, the LCP will close the mixing tank discharge valve. The plant PLC will also provide analog signals to the appropriate skid LCP to control the speed of each POS feed pump and adjust the solution concentration. The skid LCP will calculate the POS concentrations of each POS feed pump and deliver the concentrations to the WTP.

The metering pumps will be sized for the startup WTP flow and replaced with larger units when the hydraulic maximum is reached. It is not anticipated that the PLC will need replacement; however, larger piping will be required. Table 5-9 presents the design criteria for the polymer system.

TABLE 5-9
Polymer Makedown System Design Criteria
Faro Mine Remediation Project

Parameter	Nominal Maximum	Maximum Hydraulic	Average Startup	Nominal Minimum
Number of Polymer Makedown Systems	1 duty			
Product	Magnafloc 338 Anionic Polymer or equivalent			
Polymer Dose (mg/L)	10.0	8.4	3.0	3.0
Polymer Consumption (kg/day)	524	540	79	41
Polymer Storage (bags)	30			
Polymer Storage (days)	39	38	263	506
Minimum Mixing Time (minutes)	90			
Polymer Makedown Concentration (%)	0.40	0.40	0.40	0.40
Number of Mixing Tanks	1			
Number of Mixing Tank Mixers	1			
Polymer Mixing Tank Volume (m^3)	8.2			
Number of Holding Tanks	1			
Polymer Holding Tank Volume (m^3)	10.2			
Number of Pump Skids	1			
Number of Polymer Metering Pumps	2 (1 duty and 1 standby)			
Pump Type	Progressive cavity			
Drive Type	Variable speed			
Power (kW)	2.2			
Polymer Dosage (m^3/hr)	5.5	5.6	0.8	0.4
Total Post Dilution Water (m^3/hr)	16.4	16.9	2.5	1.3
Polymer Dosage Concentration (%)	0.10	0.10	0.10	0.10
Total Dynamic Head (m)	22	22	22	22

5.2.9 Plant Service Water

The lime slaking system, polymer makedown, pipe flushing, and hose bibs require plant water. Plant service water can be obtained from three sources: groundwater, Faro Pit influent water, and effluent water. Ideally, the water should be as clean and low in total dissolved solids as possible for optimal polymer and lime utilization effectiveness.

Table 5-10 presents the process water requirements.

TABLE 5-10
Process Water Design Criteria
Faro Mine Remediation Project

Parameter	Nominal Maximum	Maximum Hydraulic	Average Startup	Nominal Minimum
Lime Slaking (m^3/hr) – Continuous	17.3	17.3	1.6	0.8
Polymer Makedown (m^3/hr) – Continuous	21.8	22.5	3.3	1.7
Pipe Flushing (m^3/hr) – Intermittent	50	50	50	50
Hose Bibs (m^3/hr) – Intermittent	9 (2 hoses)	9 (2 hoses)	9 (2 hoses)	9 (2 hoses)

5.2.9.1 Groundwater

For chemical makedown groundwater is the cleanest and has the least detrimental impact on chemical utilization effectiveness. However, the groundwater source at the FMC has insufficient flow capacity for process needs. Therefore, plant service water will be obtained from one of two other sources. The existing potable water system will be used for plant potable water needs, eye washes, and showers. A backflow-protected connection will be provided where potable water is used for plant service water during emergency situations and limited plant start up and shut down situations when normal plant service water is not available. However, the supply will not be sufficient for the entire WTP.

In the future, a higher-capacity groundwater source or surface water source may be provided for plant service water; however, this is outside the scope of this project.

5.2.9.2 Influent Water

Faro Pit water, which has the lowest total dissolved solids, will be the primary source of influent water. Water from Faro Pit has the best quality of the influent sources and is suitable for the chemical makedown systems. A pump (duty and standby) will draw water from this influent line upstream from the flowmeter and boost the pressure for distribution in the service water header for use in the WTP. To maintain system pressure, excess water will return to the influent line upstream from the flowmeter.

Table 5-11 presents the process water booster pump design criteria. Polymer makedown is sensitive to water quality and suspended solids will result in precipitation of polymer within the aging or holding tank. Therefore, polymer makedown water will be filtered prior to use.

TABLE 5-11
Plant Service Water Booster Pump Design Criteria
Faro Mine Remediation Project

Parameter	Nominal Maximum	Maximum Hydraulic	Average Startup	Nominal Minimum
Quantity	2 (1 duty and 1 standby)			
Pump Type	Centrifugal			
Drive Type	Variable speed			
Power (kW)	7.5			
Flow Rate (m^3/d)	938	954	117	60
Total Dynamic Head (m)	80			

5.2.9.3 Effluent Water

Effluent water will be a secondary source of plant service water. Clarified water will be collected from the Thickener and supplied to the inlet of the booster pump. Excess effluent water will return to the inlet of the Thickener. The operator will manually select the primary or secondary plant service water supply.

5.2.9.4 Plant Service Water Storage

The design will not include plant service water storage. Because of the volume of plant service water required, a tank with a hydraulic capacity for 1 day of operation at maximum conditions would be very large. However, Influent Pipe 1 has a total volume of approximately 700 m^3 and the available storage capacity will be 300 to 400 m3, depending on the routing. In addition, the effluent plant service water will draw directly from the Thickener rather than the launder. An inverted bell intake located approximately 0.5 m below the water surface will provide approximately 1,000 m^3 of storage even if no influent flows to the WTP. Effluent water collected from the Thickener launder will potentially be cleaner; however, water would only be available when influent enters the WTP.

A dedicated booster pump will supply effluent water to the hose bibs to provide the cleanest water available for washdown. The system will consist of a duty pump (and a spare pump) with a bladder tank to maintain system pressure.

5.2.10 Aeration

Aeration is required in Reactors B1 and B2 to oxidize ferrous iron and manganese; a sparge-turbine system will be used for aeration. Air will be provided by blowers, one per reactor, with crossover capability.

Each blower package will have an air filter, relief valve, differential pressure sensor, and intake silencer. Each blower will have an acoustic enclosure and a powered cooling fan. The blowers will be the variable-speed type. An LCP will be provided for both blowers. REMOTE/ON/FAIL (motor overload, high discharge temperature, high enclosure temperature), and high differential pressure indications will be delivered to the WTP PLC. The PLC at the WTP will provide permission (when not all tanks are at low level) when the blower control is on REMOTE.

Table 5-12 presents the design criteria for the aeration system.

TABLE 5-12
Aeration Design Criteria
Faro Mine Remediation Project

Parameter	Nominal Maximum	Maximum Hydraulic	Average Startup	Nominal Minimum
Flow Rate (Sm^3/hr)	751	751	63	32
Equipment	Blower		Blower	
Quantity	2 (1 duty, 1 standby)		2 (1 duty, 1 standby)	
Pump Type	Positive displacement lobe		Positive displacement lobe	
Drive Type	Variable speed		Variable speed	
Power (kW)	50		22.4	
Total Dynamic Head (m)	15		15	

Note:
Sm^3/hr = standard cubic metres per hour

5.2.11 Compressed Air

A compressed air system will be supply air for the various pneumatic valves, silo air pads, silo filter, and Thickener cone blow out. The system will include one rotary screw air compressor, one wet receiver, one dry receiver, air filters, and air dryers.

Table 5-13 presents the design criteria for the air compressor.

TABLE 5-13
Compressor Design Criteria
Faro Mine Remediation Project

Parameter	Nominal Maximum	Maximum Hydraulic	Average Startup	Nominal Minimum
Pneumatic Valve Flow Rate (Sm^3/hr)	17 m^3/hr/valve at 552 kPag – intermittent	17 m^3/hr/valve at 552 kPag – intermittent	17 m^3/hr/valve at 552 kPag – intermittent	17 m^3/hr/valve at 552 kPag – intermittent
Silo Air Pads	40 m^3/hr at 35 kPag – continuous	40 m^3/hr at 35 kPag – continuous	40 m^3/hr at 35 kPag – continuous	40 m^3/hr at 35 kPag – continuous
Silo Filter	17 m^3/hr at 620 kPag – intermittent	17 m^3/hr at 620 kPag – intermittent	17 m^3/hr at 620 kPag – intermittent	17 m^3/hr at 620 kPag – intermittent
Equipment	Compressor			
Quantity	1			
Pump Type	Rotary screw			
Drive Type	Constant speed			
Power (kW)	22.4			
Storage Capacity	120 L			
Discharge Pressure (kPag)	860			

Notes:

kPag = kilopascal gauge
m^3/hr/valve = cubic metres per hour per valve

5.2.12 Process Overflows

5.2.12.1 Reactor B

Emergency process overflows from Reactors B1 and B2 will be directed outside the Process Building where it will be directed to a swale. With the volume of the water entering the WTP, it is not practical to construct an overflow tank and install overflow pumps of sufficient capacity to handle the potential flow. Piping would also be required to transfer overflows back to Faro Pit, which would significantly increase costs.

5.2.12.2 Reactor A

Discharge from Reactor A to Reactors B1 and B2 will be by gravity; therefore, no overflow will be provided for Reactor A. Provided that both Reactor A discharge valves are not closed at the same time, an overflow situation is very unlikely to occur.

5.2.12.3 Thickener

Discharge from the Thickener to the CVP will be by gravity; therefore, no additional emergency overflow will be provided. Provided that the discharge flowmeter is not isolated, an overflow situation is very unlikely to occur.

5.2.12.4 Other Overflows

Other minor overflows and flushing and washing water will be directed to process floor drains that will drain to a process sump in the lower pump room.

5.2.13 Process Sump

The process sump and sump pump will be sized to accommodate the anticipated minor process overflows and washdown water from the hose bibs. The sumps will not be sized for catastrophic failures of major pipes or equipment. Collected water will be pumped to Reactor B1 or Reactor B2. The sumps will be equipped with level switches for pump operation. A high-level switch will activate the pump and a low-level switch will stop the pump. A high-high-level switch will start the lag pump. The high-high-level switch and a low-low-level switch will alarm the WTP PLC. One lead and one lag pump will be installed with a local lead-lag selector switch.

Table 5-14 presents the design criteria for the process sump and pumps.

TABLE 5-14
Process Sump Design Criteria
Faro Mine Remediation Project

Parameter	Value
Tank	
Quantity	1
Tank Material	Concrete
Discharge Time (minutes)	5
Tank Length (m)	1.2
Tank Width (m)	1.2
Tank Depth (m)	1.2
Working Depth (m)	0.8
Working Volume (m^3)	0.9
Pumps	
Quantity	2 (1 lead and 1 lag)
Pump Type	Submersible
Drive Type	Constant speed
Drain Pump Flow Rate (L/sec per pump)	3
Drain Pump Total Dynamic Head (m)	24

Note:
L/sec = litres per second

5.2.14 Sampling

A sample station and sink will be provided in the Process Building to monitor recycled sludge density. Individual sampling ports will be provided on each influent pipe in a common area.

An automatic process sampler at the south end of the Thickener bridge will collect samples from the Thickener discharge. The sampler will be housed in a heated all-weather enclosure for protection. Effluent pH and turbidity will be continuously monitored and displayed on the HMI in the control room.

5.2.15 Interim Water Storage and Booster Pump Package System

Deteriorating structural conditions have created unsafe work conditions, and the existing Faro Mill WTP will not be operated in 2013. Faro Pit has sufficient storage capacity, but the Intermediate Dam Pond (ID Pond) and Emergency Tailings Area (ETA) do not have storage capacity; water will need to be pumped to Faro Pit. Currently, the ID Pond and ETA are pumped to the existing Faro Mill WTP, however a pipe must be extended to Faro Pit. This requires approximately 53 m additional head. Although the existing pumps could potentially be retrofitted with larger motors to increase the discharge pressure, the existing HDPE pipes do not have a sufficient pressure rating. Therefore, the water will be pumped (using existing pumps) to a break tank located next to the Faro Mill WTP; a second pump will discharge the break tank to Faro Pit via a new HDPE pipe. The pump will have a variable-speed drive and an approximate capacity of 126 to 158 L/sec at 53 m. The break tank, pump and controls will be installed on a skid. Once the new Faro WTP is commissioned, the skid will be moved to a heated building adjacent to the new facility. The basis of design and selection for the ID Pond pumping system is provided in detail in the *Basis of Design Pumping Intermediate Dam Pond to Faro Pit Lake, Faro Mine Remediation Project* (CH2M HILL, 2013b).

5.3 Preliminary Control Philosophy

The preliminary control philosophy for the WTP will be as follows:

1. Influent will enter the WTP from multiple sources. The operator will determine the sources that feed the WTP at any given time. Each source flow will be measured as it enters the WTP.

2. Raw water will normally enter Reactor B1. If Reactor B1 is offline for maintenance, the flow will be redirected manually to Reactor B2. Limit switches on the inlet valves from each source will allow the operator to monitor which reactor is receiving influent from the WTP SCADA system.
3. Recycled sludge will enter Reactor A along with lime slurry and mix at a constant speed. The flow rate of the sludge will be adjustable. However, the recycle ratio will be limited by the turndown ratio on the recycle pump.
4. Lime slurry and recycled sludge will be blended in Reactor A and normally discharge by overflow to the top of Reactor B1. If Reactor B1 is offline for maintenance, the flow will be redirected to Reactor B2. Liquid levels should remain relatively constant during operation.
5. Reactor B1 will be continuously mixed at a constant speed. Effluent will discharge through an upcomer at the middle of the reactor and flow by gravity to Reactor B2. If Reactor B2 is offline, effluent from Reactor B1 will be sent by gravity to the thickener. A level-indicator transmitter will monitor the liquid level and alert the operator if a significant change occurs. Liquid levels should remain relatively constant during operation.
6. Reactor B2 will be continuously mixed at a constant speed. Effluent will discharge through an upcomer at the middle of the reactor and flow by gravity to the thickener. A level-indicator transmitter will monitor the liquid level and alert the operator if a significant change occurs. Liquid levels should remain relatively constant during operation.
7. The effluent pH will be measured in the discharge from Reactors B1 and B2. The discharge from Reactor B1 will be used to automatically manipulate the lime slurry feed rate through the PLC at the WTP. The pH measured in Reactor B2 (if in operation) will be used by the operator to adjust the set point in Reactor B1.
8. Polymer solution will have dosing points to the effluent from Reactors B1 and B2 and immediately before the flow enters the Thickener. Multiple injection points will allow selection of the optimal dosing point for mixing and contact time; typically, only one dosing point will be used for operation. The polymer feed rate will be proportional to the influent rate and will both manually and automatically adjustable. The operator will set the dosing rate (in mg/L) through the WTP PLC.
9. The flow will enter the Thickener, where solids will settle and clarified water will upflow to the effluent launders, and be discharged by gravity to the CVP. A level-indicator transmitter will monitor the liquid level. Liquid levels should remain relatively constant during operation. The sludge blanket elevation will be monitored near the centre of the Thickener and near the wall. The rake mechanism will operate continuously at a constant speed. The rake mechanism will automatically lift as the torque increases. Overload protection will stop the rake and send an alarm if the torque is excessive, even with the rake arm fully lifted. The rake will be reversible at the drive but not from the PLC at the WTP.
10. The sludge recycle ratio will be set by the operator through the PLC at the WTP. The recycle pumps will have VFDs to adjust the flow rate to the desired recycle ratio and the WTP influent flow rate.
11. The sludge wasting pumps will be constant speed. The operator will set the sludge wasting duration or wasting volume at the PLC at the WTP and when wasting is to commence on a daily basis. The operator will need to monitor the percent solids and the sludge blanket within the Thickener to determine the volume of sludge that should be wasted.
12. In an emergency (as determined by the operators), the operators will close the inlet valves to the WTP. Hardwire interlocks with the influent pumps are not included under this scope. Interlocks will be considered during the existing pump and piping assessment in summer 2013. When the inlet valves close, the pumps will be deadheaded. Until the pump and pipe assessment is performed, it is assumed that adequate pump and pipeline protection are provided at the pumps. Valve actuation may take several minutes because of the pipe diameter. In addition, the pipes will contain a significant volume of water that will continue to flow to the WTP if the pumps shut off without closing the WTP inlet valves.

13. The vendor-supplied storage and slaking system will have a dedicated PLC, with controls tied into the main plant PLC. The operator can manually adjust the slaking concentration by manipulating the dilution water flow rate. The operator will enter the dry lime feed rate and slurry concentration into the PLC for system control. The system will also be able to operate in manual mode.
14. The polymer makedown system will be a vendor-supplied system. The operator will be able to adjust the system operation, including batch size and polymer makedown concentration, from the polymer PLC and the post-dilution water flow control device.
15. The process sump will provide for spill and washdown water collection. The process sump will normally discharge to Reactor B1, but the operator can direct it to Reactor B2 if Reactor B1 is offline. This will be a manual change.

5.4 Corrosion and Erosion Control and Materials Selection

The design will account for corrosion and erosion of equipment. Equipment will be selected to provide longevity under the expected operating conditions. The additional cost for superior, durable materials may reduce maintenance and replacement frequency.

5.4.1 Yard Piping

Yard piping will consist of HDPE, which has the chemical resistance for the acidic properties of the influent water quality. Corrosion of HDPE is anticipated to be negligible.

Design flow rates will typically range from 0.9 and 1.8 metres per second (m/sec) to minimize erosion by suspended solids and maintain the solids in suspension. Erosion of the influent and effluent pipes is anticipated to be minimal because the suspended solids will not be particularly abrasive and the concentration will be low. The pressure rating, indicated by the diameter ratio (DR), will be primarily a function of the system pressure. Erosion of the sludge wasting pipe may be more significant because of the suspended solids concentrations. The internal pressure and erosion allowance will be considered when selecting the wall thickness of the sludge wasting pipe.

5.4.2 Process Sump

Process sump discharge piping will be constructed of polyvinyl chloride because corrosion and erosion will be minimal.

5.4.3 Reactor B Influent Pipes

Influent pipes entering the Process Building that supply source water to Reactors B1 and B2 will be constructed of stainless steel. Stainless steel provides greater corrosion protection than carbon steel under acidic conditions, and is easier to support than HDPE. Glass-lined ductile iron would also provide the necessary corrosion protection, but it may be more expensive and difficult to work with.

5.4.4 Reactor B Effluent Pipes

Effluent pipe from Reactors B1 and B2 will be constructed of stainless steel. The pH will be neutralized by using lime in Reactors B1 and B2. Solids concentrations of up to 25 grams per litre (g/L) at moderate velocities will result in low to moderate erosion. Stainless steel has greater corrosion resistance while the WTP is in operation.

5.4.5 Thickener Effluent Pipe

The Thickener effluent pipe will be stainless steel. This will be a short section of pipe connecting the Thickener launder to the HDPE yard piping. The effluent pH is anticipated to be nearly neutral and slightly basic at a suspended solids concentration of no more than 15 mg/L. Therefore, corrosion and erosion will be minimal. Stainless steel is selected for the greatest longevity.

5.4.6 Sludge Recycle and Wasting Pipe

Sludge recycle and wasting pipes will be concrete-lined ductile iron or stainless steel, which is easier and less expensive to install than glass-lined ductile iron. This will be reviewed during detailed design. The concrete lining is proposed for erosion protection. Thick-walled pipe is proposed with a 250-pound rating to provide the greatest longevity.

5.4.7 Lime Slurry Pipe

Lime slurry pipes will be carbon steel with Victaulic couplings to allow easy disassembly and cleaning.

5.4.8 Polymer Pipe

Polymer solution pipes will be PVC. The polymer will not corrode or erode pipe, and PVC has greater longevity than steel pipe.

5.4.9 Reactor A

Reactor A will be constructed of stainless steel to provide chemical resistance and erosion protection. The suspended solids concentration will be up to 300 g/L and the slurry solution will have a basic pH. An erosion allowance of 1.6 mm will be provided.

5.4.10 Reactor B1 and B2

Reactors B1 and B2 will be constructed of stainless steel. An erosion allowance of 1.6 mm will be provided for the tank walls, and a thicker plate is recommended for the tank bottom.

5.4.11 Thickener

The Thickener will be concrete construction. The pH will be basic. No coatings will be provided for corrosion and erosion protection.

5.4.12 Thickener Mechanism

The Thickener mechanism will be supplied by a vendor. The support column and rake mechanism will be normally submerged. Wetted parts will be constructed of coated carbon steel. Erosion is anticipated to be minimal because the speed will be slow.

The Thickener effluent launder weir will be stainless steel.

5.4.13 Thickener Dome

The Thickener dome will be constructed of aluminum for light weight durability. FRP is susceptible to ultraviolet degradation over long periods. An access hatch will allow removal of the thickener drive if needed. Options for insulating the dome will be discussed with the supplier during detailed design.

5.4.14 Lime Slurry Tank

The vendor-supplied lime slurry tank will be constructed of carbon steel.

5.4.15 Polymer Tank

The vendor-supplied polymer makedown tank and feed tanks will be constructed of stainless steel.

5.4.16 Mixers

Mixer shafts and impellers will be constructed of either stainless steel or carbon steel after consulting with potential suppliers.

5.4.17 Pumps

Sludge pumps will use hardened materials or rubber liners, or both, to minimize erosive wear.

5.4.18 Corrosion Monitoring Inspection and Replacement

Corrosion and erosion will occur over the lifespan of the WTP. Materials will be selected to minimize corrosion and erosion; however, regular inspection of equipment and monitoring or replacement of coatings will be required. It is recommended that a corrosion monitoring program be implemented. Ultrasonic testing of piping wall thicknesses should be performed periodically.

The Process Piping Schedule attached in Appendix D lists the pipe size, material and pressure rating. Table 5-15 lists the preliminary pipe corrosion allowances.

TABLE 5-15
Preliminary Pipe Corrosion Allowances
Faro Mine Remediation Project

Material	Corrosion Allowance (mm)	Class	Size Range (mm)	Design Pressure (kPag)	Design Temperature (°C)
Carbon Steel	1.5	150	20–1060	1,030	50
Carbon Steel	1.5	150	20–300	1,030	50
Carbon Steel	1.5	150	20–300	350	200
Carbon Steel	3	150	20–900	350	50
Stainless Steel	None	150	20–900	690	200
Stainless Steel	None	150	20–150	1,030	50
Carbon Steel	3	300	20–900	2,580	50
Copper	None	N/A	15–150	1,030	50
HDPE	None	DR 32.5	100–1060	690	25
HDPE	None	DR 17	25–150	690	25
PVC	None	150	20–200	650	38

Note:
N/A = not applicable

5.5 Process Mechanical Procurement

Procurement of the mechanical systems will be as follows:

- Thickener mechanism – preselect and prepurchase from the vendor before completion of the detailed design. The mechanism will be a long-lead item, and preselection will allow additional construction and review time. Preselection will also simplify the detailed design because the design can be completed for a single manufacturer’s system. This will simplify construction and reduce delays that may result from incorporating vendor-specific requirements.
- Thickener cover – preselect and prepurchase from the vendor before completion of the detailed design. The cover will be a long-lead item, and preselection will allow additional construction and review time. Preselection will also simplify the detailed design because the design can be completed for a single manufacturer’s system. This will simplify construction and reduce delays that may result from incorporating vendor-specific requirements.
- Thickener mechanism and cover – award both items to the same vendor to simplify design and construction coordination.
- Lime slaking system – preselect and prepurchase from the vendor before completion of the detailed design. The system will be a long-lead item, and preselection will allow additional construction and review time. Preselection will also simplify the detailed design because the design can be completed for a single manufacturer’s system. This will simplify construction and reduce delays that may result from incorporating vendor-specific requirements.
- Other mechanical equipment – The contractor will purchase the mechanical equipment not listed above.

5.6 Assumptions

Table 5-16 lists the schematic design assumptions.

TABLE 5-16
Assumptions
Faro Mine Remediation Project

System	Assumption
Influent Pumps	Feed pumps are assumed to be in satisfactory condition and have sufficient head to supply the replacement WTP. Assessment of the existing pumps will be performed in summer 2013 under a separate scope. Construction of new feed pumps is not part of this work.
Influent Pumps	Influent pumps will not be controlled from the replacement WTP control room. No interlocks will be provided to shut down the pumps. If an influent isolation valve is closed because of the lack of interlocks, the pump will not shut off. It is assumed that the pumps have adequate controls to prevent pump and pipe damage. Assessment of the existing pumps will be performed in summer 2013 under a separate scope.
Influent Pipe	Existing influent pipes will be intercepted, and pipe sizes are assumed as previously noted. It is assumed that the existing pipes that will remain in service are in satisfactory condition to supply the replacement WTP. Assessing and refurbishing the existing pipes is not part of this design scope, but an assessment may be performed in summer 2013 under a separate scope. Design of new pipes from future water sources is not part of this work.
Effluent Pipe	The existing effluent pipe will be intercepted as noted. It is assumed that the portion of the existing pipe that will remain in service is in satisfactory condition and has capacity for the replacement WTP discharge flow rate. Assessing and refurbishing the existing pipe is not part of this design scope, but an assessment may be performed in summer 2013 under a separate scope.
Operating Procedures	It is assumed that operating procedures for the existing Faro Mill WTP, pit, and pond feed pumps, and seasonal start up and shut down will be provided for integration into the replacement WTP operating strategy prior to commencement of the detailed design. Assumptions of existing operations will be made if those procedures are not provided.
Flushing Connections	Flushing connections will be provided for piping systems inside the WTP and below the Thickener. There will be one pig launcher downstream from the sludge wasting pumps to flush the sludge wasting pipe to Faro Pit.
Plant Water	Groundwater flow capacity is insufficient for use as process water. Plant water will be obtained from Faro Pit influent water (service water) and Thickener effluent (process water). It is assumed that the WTP water quality is satisfactory for the intended uses (e.g., lime slaking, polymer makedown, and hose bibs)
Process Water Storage	Process water storage will not be provided as part of the design. Because of the volume of process water required, a tank with a hydraulic capacity for 1 day of operation at maximum conditions would be very large. Storage will be provided in Influent Pipe 1 and the top 0.5 m of the Thickener.
Fire Water	A dedicated fire water tank will not be provided. There will be a fire department connection to the Thickener effluent plant service water. No fire water pumps will be installed.
Overflows	In the event of process overflows from Reactors B1 and B2 and the Thickener, excess water will be directed to the ground surface outside the WTP.

SECTION 6

Building Mechanical

This section describes the building mechanical systems design criteria and requirements for the Faro WTP.

6.1 Approach

The building mechanical design includes ventilation and heating for the WTP. The control room, break room, laboratory, and corridor will not be air-conditioned. The design will also address plumbing systems and the fire protection system for the WTP.

6.2 Codes, Regulations, Standards, and References

Heating, ventilation, and air conditioning (HVAC); plumbing; and fire protection design will incorporate, at a minimum, the requirements of the following codes, standards, and regulations:

- Applicable codes:
  - Yukon Building Standards Act 2002
  - National Building Code 2010
  - National Fire Code 2010
  - National Plumbing Code 2010
- Standards and regulations:
  - American Conference of Governmental Industrial Hygienists—Industrial Ventilation
  - American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)
  - American National Standards Institute
  - Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
  - National Fire Protection Association
  - America Industrial Hygiene Association
  - Air Movement and Control Association
  - Associated Air Balance Council

6.3 Design Criteria

6.3.1 Outdoor Design Conditions

Table 6-1 presents climatic design data used in the design of HVAC systems.

TABLE 6-1
Climatic Design Data
Faro Mine Remediation Project

Condition	Data
Cooling	2.5% design 25°C (dry bulb) 16°C (mean wet bulb)
Heating	99.6% design -47°C (dry bulb)

Note:

National Building Code weather data for Faro, Yukon.

6.3.2 Indoor Design Conditions

Table 6-2 presents the indoor design conditions used in the design of the Faro WTP.

TABLE 6-2
Indoor Design Conditions
Faro Mine Remediation Project

Space	Heating Design Temperature (°C)		Cooling Design Temperature (°C)
	Normal Operation	Winterized [a]	
Process Areas	20	5	40 [b]
Booster Pump and Grit Building	20	5	40 [b]
Polymer Room	20	5	NA
Tunnel	15	5	NA
Electrical Room	18	5	40 [b]
Corridors	22	5	NA
Control Room	22	5	NA
Server Room	22	5	35
Laboratory	22	5	NA
Break Room	22	5	NA
Washroom and Janitor’s Room	22	5	NA
Compressor and Blower Room	15	5	40 [b]
Stairs	15	5	NA
Lime Facility	15	5	40 [b]

[a] For the winter, normal ventilation systems will be shut down and local thermostats can be adjusted to the winter setting. The local thermostats can be adjusted to higher temperature settings if required during maintenance.

[b] Electrical equipment is generally rated for a maximum ambient temperature of 40°C. Ventilation-cooling fans will be sized on the basis of the temperature difference between inside and outside for summer. Occasional periods of higher temperatures can be expected.

Note:

NA = not applicable

6.3.3 Ventilation Design Criteria

Ventilation rates for HVAC systems will comply with the following standards and requirements:

- Building and fire codes (as noted)
- NFPA codes
- ASHRAE Standard 62, *Ventilation for Acceptable Indoor Air Quality* (for instances not specifically addressed by codes)

6.3.4 HVAC Design Concept for Water Treatment Plant Facilities

The administrative area will house a control room, server room, break room, laboratory, corridors, washroom, and mechanical and janitor’s room. The ventilation for the administrative area will include a supply fan with air distribution ductwork, return air ceiling plenum, and minimum outside air ventilation. An electric duct heater interlocked with the supply fan will maintain supply air at a comfortable temperature. The server room will have a ceiling-mounted exhaust fan controlled by a room thermostat. This fan draws warm air from the server room and discharges it to the return-air ceiling plenum when the room temperature is above the setting of 25°C. Supplementary heating for each exterior space will be provided by electric baseboard heaters with built-in thermostats.

Ventilation for the washroom will be provided by a ceiling-mounted, cabinet-exhaust fan ducted to an exterior exhaust louver. The exhaust fan will be controlled by a local On/Off switch with an integrated manual timer.

There will be heat relief ventilation in the compressor and blower room, Lime Facility, and electrical room. Each system includes a ducted exhaust fan and an outside air intake louver with a motorized damper. The system will be controlled by a room thermostat initially set at 30°C. Electric unit heaters with built-in thermostats will maintain rooms at the minimum design temperature during the heating season.

There will be normal intermittent ventilation in the process room, polymer room, and the mechanical and janitor's room. Each of these systems consist of an exhaust fan and distribution ductwork to capture air, and an outside air intake louver with an electrically interlocking motorized damper. The system will be controlled by an electronic timer for adequate air exchange while minimizing electrical energy consumption. The timer can be bypassed manually to provide continuous ventilation, particularly, during the nonheating season. Heating for these rooms will be provided by electric unit heaters strategically located to temper outside ventilation air and minimize local cold spots.

The tunnel will have an outside air supply ventilation system that consists of a supply fan and supply air distribution ductwork, with an electric duct heater to temper supply air. The system will draw outside air from an intake louver (with a motorized damper) and discharge the tempered air uniformly along the tunnel. A transfer air opening will provide supply air back to the general area of the process room. The system will be controlled by a local On/Off switch at the entrance to the tunnel. The switch will normally be in the off position and can be switched on when required. An electric unit heater with built-in thermostat will maintain the design temperature in the equipment area of the tunnel.

Options for heating and insulating the thickener dome for year round operations will be reviewed during detailed design.

6.3.5 Noise Control

Equipment noise is inevitable and noise levels are an important criterion in the design of the HVAC systems. HVAC systems serving occupied areas will be designed to meet the average noise criteria recommended by ASHRAE. If efficient HVAC equipment does not result in acceptable maximum noise level of 80 decibels, sound attenuation devices, such as duct silencers, will be installed to reduce noise levels.

Duct velocities will be maintained in accordance with the recommendations in the *2011 ASHRAE Handbook—HVAC Applications* (ASHRAE, 2011).

6.3.6 Corrosion Protection

HVAC equipment, ductwork, and air distribution devices in corrosive areas will have protective coatings or will be constructed of corrosion-resistant materials.

6.3.7 Air Filtration Criteria

All supply air systems equipped with a supply fan will have an air filter that is rated MERV8. Outside air intakes will have face-mounted insect screens.

6.4 Specific HVAC Equipment Selection Criteria

6.4.1 Heating Systems

Electrical heating equipment will be used for heating and ventilation.

6.4.2 Cooling Systems

An air conditioning cooling system is not required for the Faro WTP. CH2M HILL believes that air ventilation will be sufficient for cooling the server room; however, this will be investigated further during the detailed design.

6.4.3 Ventilation Systems

Table 6-3 presents minimum ventilation rates for the various areas.

TABLE 6-3
Ventilation Requirements
Faro Mine Remediation Project

Ventilation Requirements			
Space	**Governing Standard/Requirement**	**Required Ventilation Rate**	**NEC Area Classification**
Process Area	Good engineering practice	5.0 L/sec/m^2 and heat relief	Unclassified
Lime Facility	Good engineering practice	5.0 L/sec/m^2 and heat relief	Unclassified
Booster Pump and Grit Building	Good engineering practice	5.0 L/sec/m^2 and heat relief	Unclassified
Polymer Room	ASHRAE Standard 62	5.0 L/sec/m^2	Unclassified
Tunnel	Good engineering practice	5.0 L/sec/m^2 (when accessed)	Unclassified
Electrical Room	Good engineering practice	Heat relief ventilation	Unclassified
Corridors	ASHRAE Standard 62	0.3 L/sec/m^2	Unclassified
Control Room	ASHRAE Standard 62	2.5 L/sec/person plus 0.3 L/sec/m^2	Unclassified
Laboratory	ASHRAE Standard 62	2.5 L/sec/person plus 0.3 L/sec/m^2	Unclassified
Break Room	ASHRAE Standard 62	2.5 L/sec/person plus 0.3 L/sec/m^2	Unclassified
Washroom	ASHRAE Standard 62 and NBC	35 L/sec	Unclassified
Mechanical and Janitor's Room	ASHRAE Standard 62 and NBC	5.0 L/sec/m^2	Unclassified
Compressor and Blower Room	Good engineering practice	Heat relief ventilation	Unclassified
Stairs	Not applicable	None	Unclassified

Notes:
L/sec = litres per second
L/sec/m^2 = litres per second per square metre
L/sec/person = litres per second per person

6.4.4 Ductwork

6.4.4.1 General

Metal ductwork will conform to the latest SMACNA standards.

6.4.4.2 Duct Materials

Ductwork will be FRP construction for the general process area, Lime Facility, Booster Pump and Grit Building and tunnel, where high humidity level is anticipated. Ductwork will be galvanized steel construction for the remaining areas in the facility.

6.4.4.3 Ductwork Insulation

Insulation of 40-mm fibreglass duct wrap will be used for (1) outside air ductwork from the exterior intake plenum to the electric duct heater and (2) the exhaust air ductwork from the exterior exhaust plenum and a 1 m duct length from the plenum.

6.4.5 Room Air Diffusion

Air distribution systems will be arranged for complete air circulation to avoid stagnant areas.

6.4.6 Starters and Disconnects

In general, motor starters and contactors for HVAC equipment will be as follows:

- Factory-installed by equipment manufacturer, when available
- Installed in a MCC by the electrical contractor, where practical
- Otherwise, wall-mounted by electrical contractor as provided by Division 16 – Electrical

6.4.7 Control Systems

Heating and ventilation systems will generally have simple thermostatic or electrical interlock controls. Control systems will include local control panels for equipment, either with packaged equipment or free standing, to serve one or more pieces of equipment.

6.4.8 Safety Alarms

There will be a high-temperature alarm in the electrical room and Lime Facility. If the room temperature exceeds the temperature setting, an alarm will be sent to the SCADA system and annunciated at a panel located in an area that is manned throughout the year, presumably the guardhouse.

Similarly, there will be a low-temperature alarm in the process area, Lime Facility, compressor and blower room, and similar spaces where freeze damage can occur. If the room temperature is lower than the temperature setting, an alarm will be sent to the SCADA system and annunciated as previously described.

6.5 Plumbing Systems

6.5.1 Plumbing System Concepts

NBC and applicable design standards will be used as the basis for the design and installation of drainage system and potable water systems (W1 – cold water, HW – hot water, and TW – tempered water).

The potable water supply will be trucked in as is the current practice. It is assumed that the water distribution system and tank house described by Denison Environmental Services (2010) was constructed. A new water line will be tapped between the tankhouse and the replacement WTP. A new potable water tank will provide for demand buffering and a continuous potable water supply for the facility. Space for a future reverse osmosis system will be provided in the mechanical and janitor’s room. An electric water heater and tank will supply hot water for the plumbing fixtures and the tempering water system, which supplies tempered water for safety eyewash stations. It is anticipated that there will be five eyewash stations in the WTP, one on each level of the process area and Lime Facility and one in the polymer room. The tempering valve and recirculating pump for the tempering water system will be located in the mechanical and janitor’s room.

Sanitary wastewater from plumbing fixtures (including water closets, lavatories, sinks, service sinks, and floor drains) will be directed by gravity to a sanitary sump equipped with a duplex pumping system. It is assumed that the existing septic system and spreading field north of the guardhouse has adequate capacity to accept wastewater from the sanitary sump pumping system. All floor drains and hub drains that are infrequently used will have p-traps that are primed by an electronic automatic trap primer system.

Floor drains and hub drains in process area will be directed by gravity to a separate process sump and pumping system. Refer to Section 5 for additional information regarding this pumping system.

Table 6-4 presents a summary of the septic and process drainages from areas.

Hose stations with 25-mm hose valves and 15-m hoses will provide for specific process needs, and general floor washing in the process area. Hose stations in non-process areas will have 20 mm hose valves. The water supply for all hose stations will be nonpotable WTP service water. Refer to Section 5 for additional information regarding the nonpotable WTP service water system.

A roof drainage system is not required because of the sloped roofing. Refer to Section 3 for additional information regarding the roofing.

TABLE 6-4
Sewer and Plant Drain Systems
Faro Mine Remediation Project

Areas	To Septic System	To Process Sump
Process Area	No	Yes
Polymer Room	No	Yes
Electrical Room	No	No
Control Room	No	No
Laboratory	Yes	No
Break Room	Yes	No
Washroom and Janitor’s Room	Yes	No
Compressor and Blower Room	No	Yes
Stairs	No	No

6.5.2 Piping Materials

The following piping materials will be used:

- Potable Cold Water W1 – all; copper pipe, cross-linked polyethylene (PEX)
- Potable Hot Water (HW) – all; copper pipe, PEX
- Tempered Water (TW) – all; copper pipe, PEX
- Potable Recirculation Hot Water (RHW) – all; copper pipe, PEX
- Sanitary Drain (D) – all; cast iron soil or PVC pipe
- Sanitary Vent (V) – all; cast iron soil or PVC pipe

6.5.3 Insulated Plumbing Piping

The following pipe systems will be insulated:

- Potable cold water (W1)
- Potable hot water (HW)
- Potable recirculated hot water (RHW)
- Tempered water (TW)

6.5.4 Barrier-free Plumbing Fixtures

Plumbing fixtures including toilets, lavatories, and counter-mounted sinks will be barrier-free types. Toilets and lavatories will be wall-hung type.

6.5.5 Emergency Safety Equipment

Safety eyewash stations will be located so that they are readily accessible from each process task area. Each station will have a flow switch and local visual and audible alarm that activates when the water turns on. The alarm will annunciate at a remote PLC panel in the SCADA system.

6.5.6 Water Conservation

Low-water-use plumbing fixtures and trim will be specified and installed in accordance with requirements of the NBC.

6.5.7 Cross-connection Control

Cross-connection control will be provided in accordance with the National Plumbing Code.

6.5.8 Plumbing Equipment

Plumbing equipment will include a reverse osmosis system, electric water heater, tempered water recirculating pump, and duplex sump pumps.

6.5.9 Safety Alarms

All safety eyewash stations will use magnetic switches. If a switch is activated, an alarm will be sent to the SCADA system.

All sumps will have high-water-level (HWL) alarms. If the water level in the sump is higher than the HWL setting, an alarm will be sent to the SCADA system.

6.6 Fire Protection Systems

Because of the type of occupancy (described in Section 3), an automatic fire suppression system and standpipe fire protection system are not required for the Faro WTP. Fire extinguishers will be provided at strategic locations in accordance with the NBC.

Exterior fire hydrants will be provided. Refer to Sections 2 and 6 for additional information regarding the exterior fire hydrants.

SECTION 7
Electrical

This section describes the electrical design criteria and requirements for the Faro WTP.

7.1 Approach

7.1.1 Primary System

Power to the facility will be supplied from an existing spare (abandoned) breaker at Substation T2 (subject to field verification) in 4.16 kilovolt (kV) (5-kV nominal voltage system). New 4.16-kV overhead power lines will connect the substation to the Faro WTP.

The existing 4.16-kV circuit breaker will be tested and recommissioned. Approximately 1 kilometer of 4.16kV overhead line will terminate at the fused load break switch on the pole near the proposed transformer. The 5-kV line will continue underground from the pole to the Primary of transformer in the concrete encased duct bank.

A secondary duct bank will carry the secondary conductors at 600 volts (V) to the new MCC in the electrical room.

The preliminary estimated load is approximately 1,500 kVA (subject to final load calculations). Subsequently, one 1,500 kVA, 4.16 kV-600 V outdoor, pad-mounted transformer will provide power; however, the 4.16 kV power line will be sized to carry 2,000 kVA for future loads.

7.1.2 Secondary System

A 600-V, 1,600 ampere (A) indoor MCCs and power distribution panelboards will distribute the power at 600 V for process and HVAC equipment. Dry-type distribution transformers and lighting panelboards will provide power to process equipment, instrumentation devices, the lighting system, and other fractional horsepower motors that are rated 208/120 V.

A 100 A, 600 V, 3-phase feeder line in a concrete-encased duct bank from the MCC will serve the Lime Facility.

7.1.3 Emergency Power Distribution System

A standby power generator will not be provided.

7.1.4 Telephone System

The FMC currently uses a voice over Internet protocol (VoIP) telephone system, which will be maintained.

7.1.5 Electronic Security System

An electronic security system will not be provided.

7.1.6 Fire Alarm Systems

An automatic fire alarm system will be provided.

7.1.7 Building Lightning Protection System

The frequency of lightning strikes does not warrant a lightning protection system; therefore, a lightning protection system will not be provided.

7.1.8 Transient Surge Protection

Transient voltage surge suppression will be provided in the MCC and panelboards, and at the ends of all conductors extending outside the building.

7.1.9 Lightning Arrestors

Lightening arrestors will be provided on the electrical system to protect against high-voltage switching surges.

7.2 Codes and Standards

The design will be based on the following codes and standards:

- Codes:
  - Canadian Electrical Code (CEC) 2012
  - Canadian Standards Association (CSA) C22.2 No. 0 General Requirements – CEC – Part 2
  - CAN-C235 Preferred Voltage Levels for alternating current (AC) Systems, 0–50,000 V
- Standards:
  - CSA
  - American National Standards Association
  - National Electrical Manufacturers Association (NEMA)
  - Institute of Electrical and Electronic Engineers
  - Insulated Cable Engineers Association (ICEA)
  - Occupational Safety and Health Administration
  - Underwriters Laboratories Canada (ULC)
  - National Fire Protection Association
  - FM Global
- Standardization will be considered to facilitate operations and maintenance

7.2.1 Hazardous and Corrosive Area Classification

None of the areas are classified as hazardous areas. Therefore the area classifications will only be as follows, and all materials and methods used will be rated for use in such areas:

- Nonhazardous and wet – Outdoor areas
- Nonhazardous and dry – Controlled environment areas within the WTP

7.2.2 Design Criteria

The following are basic goals of the design criteria:

- Develop safe, reliable, and maintainable electrical systems that comply with applicable codes and standards.
- Promote a consistent and uniform design approach and standardize the types and quality for specified equipment.
- Establish a uniform basis for specifications and drawings.
- Provide a means of incorporating client input regarding items of preference and experience.

7.2.3 Listed and Labelled Equipment

Electrical equipment, materials, or services to be provided will have an attached label, symbol, or other identifying mark of a nationally recognized testing laboratory that regularly performs product evaluations, verifies compliance with appropriate standards, and tests equipment performance. Typically, this is the CSA or ULC label or listing. In situations where a CSA or ULC label or listing cannot be provided for equipment because of the lack of ULC standards, testing will be performed by an organization that is acceptable to the authority having jurisdiction.

7.2.4 Voltage Selection

The following standard system voltages will be used:

- 5 kV, grounded wye, 3-phase, 3-wire
- 600 V, grounded wye, 3-phase, 3-wire
- 208Y/120 V grounded wye, 3-phase, 4-wire
- Neutral ground resistor (NGR) is not planned; however, NGR can be incorporated if it is the client's preference.

7.2.5 Equipment Voltages

The equipment voltages listed in Table 7-1 will be used.

TABLE 7-1
Equipment Voltages
Faro Mine Remediation Project

Use	Voltage
LED Lighting	120 V
Convenience Outlets	120 V
Motor Control	120 V
Motors (less than 0.5 horsepower)	120 V
Motors (0.5 horsepower and larger)	600 V, 3-phase

7.2.6 Voltage Drop

Steady-state voltage drop calculations will be prepared for all heavily loaded or long branch circuits and feeders. Calculations for motor circuits will be based on an 80 percent power factor and loading consistent with the maximum expected peak load. A 5 percent total voltage drop from the transformer secondary to the point of utilization (including feeder, branch circuit, and transformation) will not be exceeded for the following:

- Lighting
- Motors
- Receptacles
- Electric heaters

7.2.7 Demand Factors

The demand factors listed in Table 7-2 will be used for sizing power switchboards, MCCs, panelboards, and transformers. Connected load will be used for circuit and equipment sizing, in accordance with CEC requirements.

TABLE 7-2
Demand Factors
Faro Mine Remediation Project

Service	Demand Factor
Lighting	1 x connected load
Emergency Lighting	1 x connected load
Climate Control Equipment	1 x connected load
Ventilation Equipment	1 x connected load
Drainage Pumps and Ejectors	0.50 x connected load
Convenience Receptacles	180 VA each duplex strap
Process Loads	1 x full load amperes of non-standby loads plus 25% of largest motor

Note:

VA= volt amperes

MCCs and panelboards will have a spare capacity of approximately 20 percent.

7.2.8 Metering

Digital 600-V power meters will be provided at the MCC.

7.2.9 Branch Circuits

Connected load and CEC requirements will be used for sizing branch circuit breakers and conductors.

At a minimum, No. 12 American wire gauge (AWG) copper will be used for lighting and receptacle branch circuits. No. 10 AWG will be used when the voltage drop requires a larger conductor on lighting circuits and when receptacle circuits are longer than 25 m.

In general, lighting branch circuit loads will be limited to 1,500 watts.

Lighting and receptacle branch circuits will not be shared.

The number of convenience receptacles on any branch circuit will be limited to five duplex receptacles in process areas and six duplex receptacles in finished areas.

7.2.10 Panelboards

Branch circuits or feeders on the drawings will identify the panelboard and device protecting the individual circuit or feeder.

Each panelboard will be equipped with a minimum of 25 percent spare breakers with spaces, bus work, and terminations to complete the standard size panelboard.

Panelboard schedules will be prepared that indicate the following:

- Circuit identifications
- Protective device trip ratings
- Number of poles
- Load in volt-amperes by phase
- Rating of main lugs or main circuit breaker
- Integrated short circuit rating of the panelboard

There will be a separate panelboard for instrumentation and control (I&C) devices and field panels, as needed. Schneider Electric (Square-D), Eaton, and Siemens will be listed as acceptable manufacturers.

7.2.11 Motor Control

Elementary (ladder type) control diagrams will be prepared at the contract documents design level.

7.2.12 Equipment Identification

Instrumentation and control (I&C) process and instrumentation diagrams (P&ID) tag numbers will be used for motors, I&C devices, and other process equipment shown on electrical drawings. This same numbering method will be used to create unique tags for major electrical distribution equipment.

7.2.13 Distribution System Equipment

Distribution equipment criteria include the following:

- 600-V MCCs with combination motor starters of the motor circuit protector type rated for the available fault current. Starters for motors 25 horsepower (hp) and larger will be the solid-state, soft-start type. Variable frequency drives (VFD) with integral bypass will be provided as required for the process. MCCs will be sized to accept future loads and either allow for space in the structures or floor space for future sections.

- 600-V and 208Y/120-V power distribution and lighting panelboards with moulded cases, bolt-on circuit breakers, and individual short-circuit rating suitable for the available fault current. The 600-V loads that do not require motor starters will be supplied from a 600-V power distribution panelboard to minimize the number of MCC sections.

7.2.14 Raceway Systems

To minimize the possibility of interference, special consideration will be made to separate raceways involving low-level process control signal wiring and power system wiring.

The following are general guidelines for raceway sizing, selection, and installation:

- Where feasible, cable trays will be used for routing control and power cables. Power, discrete, and analog control conductors will be routed in separate trays or sections of trays.
- Conduit sizing will be based on CEC fill limitations. The following minimum conduit sizes will be used:
  - 21 mm minimum diameter for conduit installed exposed on walls and ceilings
  - 21 mm minimum diameter for conduit concealed in frame construction and finished ceilings
  - 27 mm minimum diameter for conduit embedded in masonry, encased in concrete, and underground
- Raceways will be exposed in process areas.
- Raceways will be concealed in walls and ceilings in areas that have finished interiors.
- PVC-coated, rigid galvanized steel ells and conduit will be used for the transition from underground to abovegrade routing. The transition section will extend from the burial depth of the horizontal conduit to 6 inches above finished floor, slab, or grade.
- The number of conduit bends will be limited to an equivalent of 270 degrees on long runs without pull boxes.
- Rigid PVC schedule 40 conduit will be used above grade in corrosive areas.
- PVC-coated, rigid, galvanized steel conduit will be used for underground analog signal circuits.
- PVC schedule 40 conduit and fittings will be used for underground and under-slab, straight-run 4.16 kV feeders.
- Rigid galvanized steel conduit and fittings will be used in interior and outdoor process areas.
- Flexible, nonmetallic, liquid-tight conduit will be used for connections where flexibility is required (e.g., motors and transformers).
- Flexible, steel, liquid-tight conduit will be used for connections where flexibility is required.
- Underground conduit routes will be identified by using detectable warning tape.
- Spare raceways will be tagged with a nonferrous metal tag attached to the raceway with a nylon strap. Raceway tags with approved tag numbers will identify the raceway and will be located at each terminus, near the midpoint, and at minimum intervals of every 50 feet on exposed raceways.

7.2.15 Wire and Cable

Stranded copper conductors will be used for all except lighting and receptacle wiring. Solid conductors #10 AWG and smaller will be used for lighting and receptacle wiring.

A minimum conductor size of No. 12 AWG solid copper will be used for power and lighting branch circuits:

- Low-voltage, unarmoured wire and cable (1,000 V or less): Stranded, annealed copper conductors, 600-V minimum rating for #14, #12, and #10 AWG, and 1,000-V rating for conductors larger than #10 AWG will be RW90 cross-linked polyethylene (XLPE), 90°C maximum conductor temperature, limited flame.
- Low-voltage armoured wire and cable (1,000 V or less): stranded, annealed copper conductors, 1,000-V rating RW90 XLPE, 90°C maximum conductor temperature, limited flame, 1,000-V minimum rating; power and control cabling will be TECK90 construction.

For low-voltage cables for VFD applications (1,000 V or less), multiconductor adjustable-frequency drive power cable specifically manufactured for use on VFDs will be provided. A minimum conductor size of No. 14 AWG will be used for discrete control circuits.

A minimum conductor size of No. 12 AWG will be used for 120-V control circuits routed in a common conduit with the power conductors to the motor circuit controls. Combining individual motor power and control conductors in a common conduit will be allowed up to a maximum power conductor size of #2 AWG.

Power and control conductors will be colour-coded. No. 8 AWG conductors and smaller will have coloured insulation. No. 6 AWG conductors and larger will be colour-coded with tape at each end and at accessible intermediate points.

Conductors and control cables will be tagged with a permanent sleeve or nylon marker plate attached with a nylon strap. Conductor tags with an approved tag number will be provided by the contractor and will be located at each termination and in accessible locations.

The maximum wire size will be limited to 750 thousand circular mil. Parallel conductors will be used for circuits requiring greater capacity.

Discrete control circuits of the same voltage may be combined with tray cable (TC)-type control cables in the same raceway.

Multicircuit 600-V-type TC control cable will be used where grouping control circuits is practical or routing is in a cable tray. When selecting control cable size, 25 percent spare (±10 percent) conductors will be used.

Multiconductor control cable colour coding will be in accordance with ICEA S-61-402.

Low-voltage status/control (less than 100 V) and analog signal circuits may be routed in 600-V single twisted shielded pair instrumentation control cables. The cables will consist of #16 AWG stranded copper conductors with combination PVC/nylon insulation, drain wire, shield, and PVC outer jacket. Signal circuits will be combined in multitwisted shielded pair instrumentation control cables with common overall shield. The cables will consist of #18 AWG stranded copper conductors, with a combination PVC/nylon insulation, pair and common drain wires, pair and common shields, and a PVC outer jacket. Instrumentation control cables will be in accordance with ICEA S-82-552. Low-voltage status/control and analog signal circuits will not be routed in the same control cable or conduit with 120-V control or power circuits. Low-voltage status/control and analog signal circuits will be routed in the same conduit but not in the same control cable.

Adequate separation of power and I&C wiring will be provided to avoid signal interference. Long parallel runs will be avoided and analog wiring will be installed in steel conduit.

7.2.16 Colour Coding

Conductor insulation colours will be as shown in Table 7-3:

TABLE 7-3
System Colour Coding
Faro Mine Remediation Project

System	Conductor	Colour
All Systems	Ground	Green
208Y/120 V	Neutral	White
	Phase A	Black
	Phase B	Red
	Phase C	Blue
600 V	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow

7.2.17 Circuit Identification

Circuit names will be based on the tag number of the device or served. Circuits will be identified at each termination and in accessible pull boxes and other locations using printed plastic sleeves for conductor #3 AWG or smaller and plastic marker plates for larger conductors.

7.2.18 Enclosures

NEMA-250 Type-12 enclosures will be used for equipment in electrical rooms and other controlled environment areas. NEMA Type-12 enclosures will be used for electrical equipment in dry industrial locations. NEMA Type-3R enclosures will be used outdoors and in wet locations, and NEMA Type-4X enclosures will be used where equipment is exposed to corrosive locations.

7.2.19 Fibre Optic Cabling

Fibre optic cable is not anticipated; however, it may be used when the length of the cable exceeds the maximum allowable length for copper conductors.

7.2.20 Convenience Receptacles

General service duplex receptacles will be spaced not more than 7.6 m apart in the process area. Receptacles will be surface-mounted on walls or columns.

Waterproof receptacles will be installed in damp areas or areas subject to washdowns.

Ground-fault, circuit-interrupter-type receptacles will be provided where required by the CEC. Panelboard or feed-through-type devices will not be used. Car block heaters will be supplied by one duplex, split-wire receptacle (each with dedicated branch circuit) for each two adjacent parking spaces.

7.2.21 Distribution System Protection

7.2.21.1 General

Equipment will be selected with adequate momentary and interruption capacity for the point in the system where it is used. Series-rated equipment will not be used.

Phase and ground fault protective devices will be provided for the MCC main breaker.

7.2.21.2 Preliminary Fault and Coordination Analysis

To produce a design that can be accurately priced, CH2M HILL will perform a preliminary analysis of short circuit fault duty.

The maximum fault duty will be analyzed with sufficient accuracy to establish the required interrupting ratings of circuit protective devices. The general contractor will perform a final short circuit analysis and protective device coordination study. The study will include an arc flash study that will provide the specific personal protective equipment requirements for maintaining the associated equipment.

7.2.22 Motor Protection and Control

7.2.22.1 General

Each motor will have a suitable controller and devices that will protect the equipment and perform the functions required.

MCC-type construction will be used. MCC enclosures will be NEMA 12. Circuit breakers that are 225 amps and less, and motor starters that are NEMA Size 4 and smaller will be the plug-in type.

MCCs will include motor starters and feeder circuit breakers for distribution panelboards and other non-motorised loads. Starters for motors up to 20 kW will be a full-voltage, non-reversing, combination-types with a magnetic-only circuit breaker. Starters for motors larger than 20 kW will be a solid-state, soft-start, reduced voltage, combination-types.

Motor starters will include an ON/OFF/REMOTE or HAND/OFF/REMOTE selector switch with control devices (START/STOP pushbuttons) for operation in the HAND mode, red motor ON light, green motor OFF light, and amber abnormal condition or blue fault or alarm lights, as required. Lights will be an LED push-to-test types.

7.2.22.2 Overload Protection

Each constant-speed motor and adjustable-frequency drive motor will have overload protection in each ungrounded phase. Controller-mounted relays will have an external manual reset.

7.2.22.3 Motor Control

Oil-tight pilot devices will be specified for mounting on unit starters.

Motor control circuits will be designed for 120 V. An individual control power transformer with 120-V control will be provided in each motor starter.

Electrical motor starter controls will consist of red and green lights; pushbuttons or switches; devices, such as timers and auxiliary relaying connected with process control, as required; safety interlock logic; and other non-process controls (e.g., motor protection shutdowns and trouble alarm), as required.

7.2.23 Alternating Current Induction Motors

Horizontal and vertical 18-kW motors and smaller will have totally enclosed, fan-cooled (TEFC), severe-duty enclosures for indoor and outdoor locations. In wet or corrosive locations, TEFC motors will be used. Motors larger than 18 kW will be open drip-proof, unless TEFC or chemical industry severe duty (CISD)-TEFC is required for specific conditions (evaluated on a case-by-case basis considering cost and required physical protection). Submerged motors will be air- or oil-sealed motors that are totally submersible. Bearings will be rated for 100,000-hour Anti-Friction Bearings Manufacturers' Association B-10 life.

AC induction motors will be the premium efficiency types:

- Motors will have a 1.15 service factor for sinusoidal service and 1.0 for inverter duty.
- NEMA design letter to fit the application (usually NEMA Design B), and locked rotor kilovolt-amperes (kVA) Code G or lower.
- Motor end bells will be cast iron.
- Bearings for horizontal and vertical motors will be grease-lubricated, with grease and relief fittings. Serviceable ball bearings with labyrinth-sealed end bells and removable grease relief plugs will be provided.
- Motor windings will be copper wire. Aluminum windings will not be permitted.
- Motors 12 kW and larger located in damp or wet areas will have 115-V space heaters to prevent moisture condensation.
- TEFC motors will be equipped with weep holes and drain plugs to withdraw condensed moisture.

Motors operated by VFDs will be rated for inverter duty.

7.2.24 Grounding

7.2.24.1 Electrodes

A grounding system will be installed throughout the Faro WTP. Around the WTP, there will be a ground ring consisting of a bare copper ground wire and ground rods at each corner and at a maximum of 30-m intervals. The ground ring will be connected to the steel columns of the buildings and metallic equipment to provide an overall grounding system. Conductors from the ground grid will be connected to the ground point of the service transformers and other low-voltage distribution transformer secondaries, and to each end of the MCC ground bus. The overall facility grounding layout will be finalized after a completion of a grounding study.

Grounding electrodes and conductors will be designed for a maximum resistance to ground of 3 ohms. Where more than one rod is required, rods will be installed at least 3 m apart. A minimum of 4/0 AWG stranded bare copper cable will be used to connect to ground rods and footing rebar.

7.2.24.2 Equipment Grounding

A separate ground conductor sized in accordance with CEC requirements will be installed in raceways for power feeders and branch circuit raceways for motor control, lighting, and receptacle loads.

Shields of shielded instrumentation cables will be grounded to the ground bus at the power supply for the analog or low-voltage discrete signal circuit. Shielded instrumentation cables will not be grounded at more than one point.

7.2.25 Lighting

7.2.25.1 General

Interior LED lighting will be used in finished and low-bay areas with open ceilings. Interior metal halide lighting will be used in high-bay areas if they cannot be adequately lighted with LED.

Emergency and exit lights will include a battery. LED-type exit signs will be installed.

Exterior, wall-mounted lights will be an LED type, with sharp-cut-off luminaires to minimize spill light.

Process area lighting will be multilevel and manually switched locally.

Lighting levels (maintained foot-candles) will be designed to meet recommendations in the *IES Lighting Handbook, Eighth Edition* (Illuminating Engineering Society of North America, 1993) and the guidelines provided herein.

7.2.25.2 Interior Lighting

Recessed LED luminaires will be used in finished areas with acoustical tile or gypsum wallboard ceilings.

Open, industrial-type LED luminaires will be used in dry interior, low-bay areas with open ceilings.

Gasketed vapour-tight LED luminaires of non-metallic-type construction will be used in wet and corrosive areas.

7.2.25.3 Emergency Lighting

Emergency lighting will be provided by battery-powered lighting units in appropriate spaces, as required by code, to protect life, safety, property, and equipment.

Lighting levels will be adequate to maintain safe building egress and allow critical process plant functions. Emergency lighting will be located near MCCs and equipment that need to be continually monitored.

7.2.25.4 Exterior Lighting

Outdoor security lighting will be controlled by photocells.

Only light fixtures mounted on the building exterior walls will be used to illuminate the building surroundings. Pole-mounted fixtures will not be used.

SECTION 8

Instrumentation and Control Design

This section describes the instrumentation design criteria and requirements for the new Faro WTP

8.1 General

This section describes the proposed works related to the I&C system, including the SCADA system. The I&C system is intended to continuously and reliably control and monitor all facility treatment processes. The major functions of the I&C system are as follows:

- Continuous closed-loop control (analog proportional integral derivative [PID] control)
- Sequential/logic control (discrete equipment control)
- Alarm and event annunciation and status monitoring

8.2 Design and Implementation Approach

Detailed P&IDs will be prepared as part of the DD effort. The contractor (I&C supplier) will prepare interconnecting wiring drawings as part of the shop drawings package. After the facility is constructed, the design drawings will be updated and final record set of as-built drawings will be prepared.

8.3 Control System Requirements

The control system requirements will govern the selection and configuration of the PLCs and all other I&C equipment. Unless specifically stated otherwise, all processes will be fully automated for unattended operation. All processes will also be capable of manual operation.

8.3.1 Control System Operating Philosophy

The control philosophy is based upon a network of distributed control systems with PLCs and a central SCADA system. The proposed network of distributed control systems will be an Allen-Bradley, PLC-based system on the ControlLogix platform. PLCs will also be used for package system control and monitoring. Allen-Bradley PLCs will be specified; however, because of the lower number of inputs/outputs (I/O), the CompactLogix platform is proposed. The recommended control system configuration includes two operator workstations in the control room. The proposed SCADA system will allow operators to control and monitor the process from the control room. It may be desirable to limit the control functions on the basis of the operator's security level. All major control algorithms will be implemented in the PLCs.

8.3.1.1 Control Hierarchy

The standard control hierarchy for the WTP will comprise four levels:

- Level 1: Field device control
- Level 2: Local control station
- Level 3: SCADA manual
- Level 4: SCADA automatic

However, all levels may not apply to all devices or systems. Specific levels will be depicted on the P&IDs and further explained in the control narratives.

Level 1: Each piece of process equipment will have local control for maintenance and troubleshooting operations. These controls, however, are not intended for long-term equipment operation. Local controls will allow operations and maintenance staff to completely bypass any automatic remote control system. If the SCADA system fails, all equipment may be operated in local manual control mode. In general, these local controls will be on or very close to the equipment being controlled. There will be a LOCAL/REMOTE (L/R) selector switch at the field device. If LOCAL is selected, operation from a higher level will be disabled. If REMOTE is selected, control of the device will be passed to the next higher level.

For motorized valves, the control at the valve actuators will be Level 1. These can be integrated with the actuator or a remote station when integral controls are not accessible.

Level 2: This level will provide an L/O/R control selector switch in the LCS. If LOCAL is selected at this level, the device will operate from this station and operation from higher levels is disabled. If REMOTE is selected, the control passes to the next higher level, and the commands from the SCADA system take effect. If OFF is selected, the device is not operable at LCS or remotely.

Level 3: This level will provide a simple graphics operator interface (via the networked SCADA workstation) to the process control system and will handle data storage and retrieval needs for trend computations, historical reporting, and report generation. Plant operators may select various control schemes and “manually” control the process equipment from the workstation. The SCADA system will provide the following functionality (and the database to support that functionality):

- Level 1 or Level 2 local or remote selected status
- Manual command
- Equipment operating status
- Process parameter values

Level 4: This level is the normal mode of WTP operation. All major control algorithms and functions, including continuous-loop control and sequential control, will be performed in the PLC. The SCADA system will provide the following functionality:

- Level 1 or Level 2 local or remote status
- Auto command
- Equipment operating status
- Process parameter values

8.3.1.2 Modulating Valve Control

Modulating valves will be electrically actuated with integral electronic controllers complete with local L/O/R control selector switch and OPEN/CLOSE push buttons, and a 4- to 20-milliampere (mA) direct current (DC) position transmitter. Modulating valves will receive a 4 to 20 mA DC control signal. The following control and monitoring functions will be provided and performed by SCADA when the control selector switch is in the REMOTE position:

- L/O/R switches in remote status will be monitored by the SCADA system
- 4 to 20 mA DC valve position set point control will be generated by the PLC
- 4 to 20 mA DC valve position (feedback)
- Valve failure alarm

When the L/O/R switch is in the LOCAL position, valve control will be manually performed by OPEN/CLOSE push buttons at the valve actuator.

8.3.1.3 Open/Close Valve Control

Large open/close valves will be electrically actuated and controlled and monitored by the PLC. Both the OPEN limit switch and the CLOSE limit switch will provide feedback at the end of travel. Reversing starters, control power transformers, and all auxiliary controls required for electrically operated valves must be part of the valve package. The following control and monitoring functions will be provided and performed by the SCADA system when the control selector switch is in the REMOTE position:

- L/R selector switch in REMOTE position will be monitored by the SCADA system
- Open and close commands will be generated by the PLC
- Opened and closed valve positions will be monitored
- Valve failure alarm

When the L/O/R switch is in the LOCAL position, valve control will be manually performed by depressing the OPEN/CLOSE push buttons at the valve actuator.

8.3.1.4 Pump Control

Motor-driven equipment energized by the MCC starter and controlled by the SCADA system must have the following MCC interface and control features.

All motor control devices such as START/STOP push buttons and L/O/R control selector switches, regardless of their location, will be energized from the MCC starter control power transformer. Generally, control hand switches will be located at the equipment rather than at the MCC. The following control and monitoring functions will be performed by SCADA when the control selector switch is in REMOTE position:

- L/O/R selector switch in remote status will be monitored by the SCADA system
- RUN status will be monitored
- Start and Stop command will be generated by the PLC
- Pump failure alarm

When the L/O/R switch is in the LOCAL position, pump control will be manually performed by depressing the START/STOP push buttons located near the pump equipment.

Pump suction and discharge pressures will be measured and displayed locally and by the SCADA system.

8.3.1.5 Pump and Equipment Motor Drive Monitoring and Control

ASD systems may be VFD or DC silicon control rectifier (SCR) type. The following control and monitoring functions will be performed by the SCADA system when the selector switch is in the REMOTE position for ASD units:

- Status monitoring function to the SCADA system including L/R selector switch in REMOTE position and RUN status
- 4 to 20 mA DC speed control signal
- Common drive failure alarm signal to SCADA
- START/STOP control from remote location (SCADA) when selector switch is in the REMOTE position
- Special alarms (e.g., high temperature alarms and pump or equipment alarms) to SCADA, as required for specific application

There will be an L/O/R selector switch, START/STOP switch, and speed control device near the driven equipment. When the switch is in the LOCAL position, start/stop and speed adjustment will be performed locally at the equipment for maintenance and testing functions.

8.3.2 Local Control Stations

The local control devices or stations will be located on or close to the equipment being controlled. In some cases local control devices may be grouped together in a common station near the equipment. LCSs will be provided if the process cannot be adequately controlled from the control device located at the equipment for the short periods when the SCADA system may not be available or during maintenance activities.

8.3.3 Instrument Control Panels

The instrument control panel (ICP) will be equipped with an adequate number of I/O modules. Thus, the I/O capacity of a PLC will be governed by the various types of equipment and devices. An Allen-Bradley ControlLogix PLC will be provided. Controllers must be relatively small (300 I/O or less) for increased reliability and easy programming and start up.

The controller processor will be protected from power surges and disruptions. The PLC will be powered via dedicated surge suppressor and an uninterruptible power supply (UPS), all located within the corresponding control panel. Design will take into account the heat load generated in the ICP so that overheating does not affect system functions. To protect equipment, the panel will have a louver, forced ventilation, or air conditioning, as required, to limit temperatures to a maximum of 40˚C.

8.3.4 Programmable Logic Controllers

All PLCs should be manufactured by the same manufacturer – Allen-Bradley. The proposed PLC platform is ControlLogix, although CompactLogix may also be used for smaller number of I/O (i.e., the polymer system). Package PLCs will likely be supplied for the lime and polymer processes. The PLC, which serves multiple plant processes, will be based on the ControlLogix platform.

8.3.5 Human Machine Interface

Two personal computer-based human machine interfaces (HMI) are proposed, as described in the following sections.

8.3.5.1 Main View Node HMI

This graphical interface workstation will be used for plant monitoring and control and will be located in the Process Building control room.

8.3.5.2 Secondary View Node HMI and Engineering Workstation

This HMI will be primarily used for daily automated reporting and will also serve as an engineering workstation. As an engineering workstation, this HMI will be used for PLC and SCADA software configuration maintenance. This workstation may be also used for monitoring and control.

8.3.6 Servers

Two database servers will serve the two client HMIs and automated reporting and data storage. One server will run as the primary server and the other will operate as the secondary server (or “hot back-up”). The two servers will continuously synchronize. If the primary server is offline, the secondary server will allow normal SCADA operations until the primary server is back online.

8.3.7 Alarm Handling

Plant alarms will be automatically generated by SCADA and displayed at the HMI in the control room. It is currently anticipated that remote (or offsite) plant alarm monitoring is not required.

8.3.8 Networking Requirements

Data communications between plant PLCs and HMIs will be accomplished by means of an Ethernet network. CAT 6 copper cable will be used for Ethernet connectivity within the process building. Fibre optic cable is generally used for outdoor routing between buildings and when the Ethernet segment exceeds 100 m (the maximum length).

8.3.9 Other Communications

CH2M HILL proposes to use the existing Internet connectivity available onsite, subject to the speed and bandwidth considerations for the following uses:

- VoIP phones at the facility
- General Internet browsing
- Remote connections for trouble shooting by package vendors after plant start up

8.3.10 SCADA Software

The following software packages will be provided under the contract and loaded on equipment as indicated:

- **Primary Server:**
  - Security key – M4 USB
  - GE iFIX Professional SCADA Unlimited Server
  - GE Industrial Gateway Server – Basic driver for M4 key
  - GE Historian – Acquisition, storage, and retrieval of process information and report generation

- **Secondary Server:**
  - Security key – M4 USB
  - GE iFIX Professional SCADA Unlimited Server
  - GE Industrial Gateway Server – Basic driver for M4 key
- **Main View Node:**
  - Security key – M4 USB
  - GE iFIX iClient Runtime
- **Secondary View Node and Engineering Workstation:**
  - PLC programming software, Rockwell Automation RSLogix5000
  - Security key – M4 USB
  - GE iFIX Professional SCADA Unlimited Development (for SCADA operator interface software development, configuration, and maintenance)
  - Microsoft Office Professional
  - Antivirus software

8.4 Instrumentation and Control

The major components of the instrumentation and control system within the Faro WTP will be interconnected to provide a complete, functional, automated system. The control system design will provide process parameters, status indications, and control, as required.

8.4.1 Field Instruments

Field instrumentation will depend on the process requirements. Field transmitters will have local displays. Instruments will be installed in accordance with standard guidelines and will have adequate access for safe operation and calibration. Discrete and analogue device I/O will be wired to the PLC (ICP) through hard-wired connections.

The instrument schedule, electrical control schematics, and typical control panel layout will be provided during the detailed design. The construction contractor will provide loop diagrams and a detailed control panel layout during the construction phase.

8.4.2 Numbering System

8.4.2.1 Equipment, Control valves, and Instrument Numbering System

A standard numbering scheme has been developed for this project that will include unit processes, equipment, instrumentation, and control loops. This scheme is for identifying essentially everything shown on the P&ID. These numbers are not necessarily based on the physical location of the equipment.

The tag number consists of unit process, device identification letters, a sequential “loop” number, and an optional letter suffix in the following format:

NNDDDLLLLLS

Where:

NN = 2-digit unit process number, 01 to 99. The proposed unit process numbers have been assigned, as shown in Section 8.4.2.2.

DDD = 3-digit device identifier for equipment or 2 to 4 digits for instruments (e.g., PMP for pump, TNK for tank, FIT for flow indicating transmitter [remote mounted], FET for flow element and integral transmitter, PI for pressure gauge, LSHH for level switch high-high).

LLLLL **=** 5-digit loop number. Loop numbers are assigned sequentially to a group of functionally related devices. The last 2 digits of the loop number identify the unit number (e.g., 10001 for Pump 1 and 10002 for Pump 2). If there is only one element, this number is always 00.

S = Optional suffix letter (A to Z) for multiple devices of the same type in the same loop (e.g., two hand switches controlling a same pump).

Table 8-1 shows example pump numbers.

TABLE 8-1
Example Pump, Pressure Gauge, and Hand Switch Numbers
Faro Mine Remediation Project

Pump	Pump Number	Pressure Gauge	Associated Hand Switches
Pump 1	PMP20101	PI20201	HS20101A HS20101B
Pump 2	PMP20102	PI20202	HS20102A HS20102B

8.4.2.2 Unit Process Numbers

The following are the unit process numbers and names:

- 11 Influent flow to Reactors B1 and B2
- 12 Reactor B1
- 13 Reactor B2
- 14 Reactor A
- 15 Thickener
- 16 Lime system
- 17 Air blowers
- 18 Polymer system and feed pumps
- 19 Plant water
- 20 Miscellaneous
- 30 Filters (future)

8.4.2.3 Numbering Guideline

Loop numbers will be assigned sequentially within a facility along the route of the process flow. For multiple units within the loop, the units will be numbered sequentially, starting with the unit nearest the device or in the order of the process flow; for example:

- For multiple selector switches related to a pump; the HS at the pump would be assigned Unit Number 01A.
- For multiple float switches related to a tank, the level switch first touched by the process flow fluid would be assigned Unit Number 01; the second switch would be assigned Unit Number 02, and so forth.

Valve limit switch tagging will use “ZSC” and “ZSO” for limit OPENED and limit CLOSED to prevent confusion in design, implementation, and long-term maintenance.

8.4.2.4 Instrument Numbering

Instruments (e.g., flowmeters, pressure gauges, and analyzers), control valves, and relief valves will have tags with letters based on International Society of Automation (ISA) standards or as noted below. The ISA standard table for letter descriptors is shown on the P&ID legend sheet. On P&IDs, the tags will be shown inside a circle. On other drawings, specifications, and lists, the tags will be shown as a string of characters (e.g., as 11FIT10001).

Examples of instrument identifiers (DDDD = two- to four-character alpha) are presented below; additional components will be added as needed during detailed design:

- AE Analytical element
- AET Analytical element and transmitter
- AIT Analytical indicating transmitter
- FCV Flow control valve
- FE Flow element
- FET Flow element and transmitter
- FI Flow indicator
- FIT Flow indicating transmitter
- LE Level element
- LET Level element and transmitter
- LIT Level indicating transmitter
- LSHH Level switch high-high
- PIT Pressure indicating transmitter
- TE Temperature element
- TET Temperature element and transmitter
- TIT Temperature indicating transmitter
- ZSC Position switch – Closed
- ZSO Position switch – Opened

8.4.2.5 Equipment Numbering

Process equipment (e.g., tanks, pumps, and mixers) will generally have a three character alpha identifier. Example equipment identifiers (DDD = three-character alpha) are presented below; additional components will be added as needed during detailed design:

- ASD Adjustable-speed drive
- BLW Blower
- MIX Mixer
- ICP Instrument control panel
- PMP Pump
- SCR Screen
- TNK Tank
- UPS Uninterruptible power supply
- VFD Variable-frequency drive

8.4.2.6 Panel Numbers

LCPs associated with specific equipment, such as a polymer system, will be assigned a tag number in the following format:

NNLCPLLLLL

Where:

NN = Unit process number

LLLLL = Loop number (same as the equipment [e.g., 16LCP10001])

Control panels that serve multiple equipment or processes such as PLC panels will be assigned a tag number in the following format:

XXXICPYY

Where:

XXX **=** Facility number ("500" is assigned for this project)

YY = Loop unit number (e.g., 500ICP01)

8.4.2.7 Programmable Logic Controller Numbers

PLCs associated with specific equipment, such a polymer system, will be assigned a tag number in the following format:

NNPLCLLLLL

Where:

NN = Unit process number

LLLLL = Loop number (same as the equipment [e.g., 16PLC10001])

PLCs that serve multiple equipment or processes will be assigned a tag number in the following format:

XXXPLCYY

Where:

XXX = Facility number ("500" is assigned for this project)

YY = Loop unit number (e.g., 500PLC01)

8.4.3 Control Narratives

Control narratives will be developed to describe in detail the automation and control of the equipment and devices. The narratives will include descriptions for operating the system in (1) local, (2) remote manual, and (3) remote automatic modes. The control narrative will also describe reactions to component failure and power failure situations. A process narrative will be the starting point for developing the control narrative.

8.4.4 Instrumentation and Control Design Criteria and Standard Practices

This section describes standard I&C practices for this project. These standards will be followed as much as possible throughout the design process.

8.4.4.1 Reliability and Redundancy

The failure of a single component of the I&C system should not cause the overall SCADA system to fail. Likewise, the failure of a single PLC should not affect the operation of other PLCs in the SCADA system.

Redundant processor controllers are not required. Each processor will have a separate UPS system, and each UPS will have a separate power feed.

8.4.4.2 Equipment Control

All equipment controlled by the SCADA system will have a local L/O/R switch. In the LOCAL position, START/STOP or OPEN/CLOSE will be manually initiated at the equipment or the associated LCS. In the OFF position the equipment will not run; in the REMOTE position the equipment will be controlled by the SCADA system. The REMOTE switch status will be monitored by the SCADA. Enable and permissive interlock functions will be in the PLC software. However, personnel safety and equipment safety functions will be hardwired. Emergency stop push buttons will be provided for each of the B Reactor mixers and on the Thickener bridge to stop the rake.

8.4.4.3 Equipment Protection

The controls and interlocks for protecting equipment (e.g., pump low-low level shutdown, high discharge pressure, and high tank levels) must use conventional control hardware, such as electromechanical relays. The interlocks should be hardwired to the equipment starter or controller rather than depending on the SCADA system or other electronic or programmable devices to operate safely. Local RESET pushbuttons will be provided to reset alarm-lockout functions, as required, at the MCCs or locally at the equipment.

8.4.4.4 Personnel Safety

All controls and interlocks provided for personnel safety will use conventional control hardware, such as electromechanical relays. The interlocks will be hardwired to the equipment starter or controller, rather than depending on the SCADA or other electronic or programmable devices to operate safely. Local reset push buttons will reset lockout functions, as required, at the MCCs or locally at the equipment.

8.4.4.5 Pilot-Light Colours

Red lights will be used to indicate RUN for motors, OPENED for valves, and TRIPPED for circuit breakers; green lights will be used to indicate OFF for motors, CLOSED for valves, and CLOSED for circuit breakers. Amber lights will indicate alarms.

8.4.4.6 Standard and Failsafe Alarms

In general, alarms will be generated by using “normally open” contacts that close under the alarm condition.

Critical alarms will employ “normal closed” contacts, which open on alarm condition.

8.4.4.7 Package Control Systems

Package control systems will be used where appropriate for skid-mounted or field-assembled process equipment with integral I&C systems. Examples of package equipment include lime and polymer systems.

PLCs will be used for package system control and monitoring. Allen-Bradley PLCs will be specified for overall uniformity at the plant, provided that the lime and polymer package manufacturers are familiar and comfortable with Allen-Bradley PLCs. The SCADA architecture drawing shows lime and polymer package PLCs connected to the plant Ethernet network; however, if the quantity of I/O is small, we will consider individual I/O wiring instead of Ethernet connections to the lime and polymer packages. This approach will be further analyzed during the detailed design. Package control system interface signals must conform to the standards for PLC I/O signals described in this document. The package control system supplier will program the PLC in their package.

All PLCs will be manufactured by Allen-Bradley, if possible. Interface requirements between the PLC and SCADA system vendors will be coordinated.

8.4.4.8 Installation Requirements for Programmable Logic Control and Remote Input/Output Units

The PLC and remote input/output (RIO) control panels will be installed in the Process Building PLC room (which is adjacent to the electrical room). The PLC room will be environmentally clean. There will be an opening in the dividing wall between the PLC room and the electrical room to allow equipment access after the Process Building is constructed. Package PLCs located in the field may be placed on skids; these details will be finalized during the detailed design.

8.4.4.9 Programmable Logic Control Input/Output Signals

PLCs will monitor and, in most cases, control all major process parameters and equipment. Monitoring and control signals will interface to the PLCs at the various PLC and RIO control panels. Wherever possible, the following standard signal types should be used:

- Digital inputs: Dry contact in field rated for 120 V AC, powered from 120-V AC source in the cabinet.
- Digital outputs: 16 points per card, with interposing relays in the control panel rated for 10 A at 120 V AC
- Analog inputs: 4 to 20 mA DC at 24 V DC into 750 ohms, powered from the PLC panel or field
- Analog outputs: 4 to 20 mA DC at 24 V DC into 750 ohms, powered from the PLC output module

8.4.4.10 Instrumentation

``Smart'' microprocessor-based field transmitters will be installed wherever possible. If hand-held programmers are required for configuring and calibrating instruments and transmitters, there will be a minimum of two of each type.

All field transmitters will have a local signal indicator calibrated in actual engineering units. The signal indicator will be integral to the field instrument.

Listed below are instrument types that will be used whenever possible:

- Liquid flow: Magnetic flowmeters.
- Level:
  - Ultrasonic level measurement
  - Radar and differential pressure will be considered if ultrasonic is not suitable
- Sludge interface level: Ultrasonic techniques will be used. Alternatively, this task can also be performed manually. The final approach will be developed in detailed design.
- Pressure (continuous monitoring): “Smart” diaphragm version; “diaphragm” seals will be used to keep solids out of pressure instruments.
- pH will be monitored with immersion-type probes and at Reactors B1 and B2. The pH measured at Reactor B2 will be used to automatically manipulate the lime slurry feed rate via programmed logic in the plant PLC.

8.4.4.11 Control Panels

LCSs will be installed when required for proper system operation. Area control panels and local backup control panels generally are not required for this project.

There will be 25 percent spare capacity in all ICPs to allow for future additions. There will be a minimum of 20 percent spare terminal blocks for future connections.

8.4.4.12 Uninterruptible Power Systems

Online UPS units will power I&C equipment to maintain reliable operation during power system disturbances and power outages.

UPS units will power all PLC equipment, including interface cabinets, operator stations, engineering stations, process controllers, and major field sensors and elements. UPS battery backup should have capacity to energize the system for 20 minutes after a power failure.

8.4.4.13 Surge Suppressors

There will be surge suppressors for all analog signals that originate outside of buildings. There will be 120-V surge suppressors for all field instruments that are located outside of buildings and require a 120-V power source. All control panels will have power line surge suppressors.

8.4.5 Field Networks

Field networks are device-level networks that connect multiple signals from devices, such as variable-speed drives and electric motor operators, to the PLC via a serial data communications link instead of hardwired I/Os. Field networks are not planned for this project because of the special expertise required to maintain that infrastructure. All I/Os (4 to 20 mA and digital signals) will be hardwired instead of being networked. This approach will simplify installation, make the control system less complex, and mitigate a need for more highly qualified maintenance personnel.

8.4.6 Instrumentation and Control Procurement

Procurement of the I&C system will be as follows:

- PLCs – The contractor will purchase and install PLCs and related equipment.

- HMI software, personal computers, and standard hardware items – CH2M HILL proposes that YG provide an allowance for the purchase of computer subsystem equipment. Because computer subsystem equipment features are frequently upgraded, YG would be at a significant disadvantage if the components were specified and purchased far in advance of the time they are actually needed. The allowance would allow YG to acquire the most current hardware at the time it is needed.
- Control system application software – It is anticipated at this time that the engineer will develop the applications software.
- Process instrumentation and control system supplier – This supplier will perform the following work:
  - Select equipment based on specifications and prepare shop drawings for the I&C system.
  - Furnish and install field elements.
  - Fabricate, wire, and factory test control panels.
  - Perform operational readiness tests onsite, assist with startup, and check the complete I&C system.

SECTION 9
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Appendix A
Drawings

FARO WATER TREATMENT PLANT

FARO MINE REMEDIATION PROJECT

SCHEMATIC DESIGN REPORT

JUNE 2013

DRAWING INDEX

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PREPARED FOR:

GOVERNMENT OF CANADA
AS REPRESENTED BY
ABORIGINAL AFFAIRS AND
NORTHERN DEVELOPMENT
CANADA AND THE
GOVERNMENT OF YUKON

CH2MHILL®

ABBREVIATIONS

A	AMMETER, AMPERES, AWNINGS
AB	ANCHOR BOLT, ABOVE
ABDN	ABANDON
AC	ACOUSTICAL, ACOUSTICAL CEILING
AC	ALTERNATING CURRENT
AC	ASPHALTIC CONCRETE
ACFL	ACCESS FLOORING
ACI	AMERICAN CONCRETE INSTITUTE
ACMU	ACOUSTICAL CONCRETE MASONRY UNIT, ACOUSTICAL CMU
ACP	ACOUSTICAL PANELS
ACST	ACOUSTICAL
ACT	ACOUSTICAL TILE
AD	AREA DRAIN
ADDL	ADDITIONAL
ADJ	ADJACENT
ADW	DRY WEATHER AVERAGE
AFD	ADJUSTABLE FREQUENCY DRIVE
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AG	ACOUSTICAL, ACOUSTICAL GLASS
AGGR	AGGREGATE
AHR	ANCHOR
AISC	AMERICAN INSTITUTE OF STEEL CONSTRUCTION
AJ	ADJUSTABLE
AL	ALUMINUM
ALKY	ALKALINITY
ALTN	ALTERNATE
AM	AUTO-MANUAL
AMRD	ACOUSTICAL METAL ROOF DECKING
ANDZ	ANODIZE
APPROX	APPROXIMATE
APVD	APPROVED
ARCH	ARCHITECTURAL
AR	ANALOG RELAY
AS	AS SELECTED
ATS	AUTOMATIC TRANSFER SWITCH
AUTO	AUTOMATIC
AUX	AUXILIARY
AVG	AVERAGE
AWW	WET WEATHER AVERAGE
@	AT
B	BELL
BAL	BALANCE
BETW	BETWEEN
BF	BLIND FLANGE, BOTTOM FACE
BFV	BUTTERFLY VALVE
BL	BASELINE
BFP	BACKFLOW PREVENTER
BLDG	BUILDING
BLK	BLOCK
BM	BEAM, BENCHMARK
BO	BOTTOM OF
B.O.B.	BOTTOM OF BEAM
BOD	BOTTOM OF DUCT
BOP	BOTTOM OF PIPE
BOT	BOTTOM
BRG	BEARING
BRK	BRICK
BRKR	BREAKER
BSP	BLACK STEEL PIPE
BV	BALL VALVE, BLOCK VENT
BVC	BEGINNING OF VERTICAL CURVE
C	CONDUIT, CASEMENT
°C	DEGREE CELSIUS
C TO C	CENTER TO CENTER
CAB	CABINET
CB	CATCH BASIN, CIRCUIT BREAKER
CC	CENTER OF CIRCLE
CC	CONTROL CABLE
CCP	CENTRAL CONTROL PANEL
CCS	CENTRAL CONTROL SYSTEM
CDF	CONTROLLED DENSITY FILL
CE	CONSTRUCTION ENTRANCE
CFM	CUBIC FEET PER MINUTE
CFS	CUBIC FEET PER SECOND
CHEM	CHEMICAL
CHKD	CHECKERED
CI	CAST IRON
CIP	CAST IRON PIPE, CAST IN PLACE
CIP	CULVERT INLET PROTECTION
CISP	CAST IRON SOIL PIPE
CJ	CONSTRUCTION JOINT
CKT	CIRCUIT
CL	CENTERLINE
CLDI	CEMENT LINED DUCTILE IRON
CLSF	CONTROLLED LOW STRENGTH FILL
CLG	CEILING
CLR	CLEAR, CLEARANCE
CLSM	CONTROLLED LOW STRENGTH MATERIAL
CMP	CENTRAL MONITORING PANEL
CMP	CORRUGATED METAL PIPE
CMU	CONCRETE MASONRY UNIT
CNTR	COUNTER
CO	CLEANOUT, CARBON MONOXIDE
COL	COLUMN, COLOR
CONC	CONCRETE
COND	CONDENSATE
CONDTN	CONDITIONED
CONN	CONNECTION
CONSTR	CONSTRUCTION
CONT	CONTINUED, CONTINUOUS, CONTINUATION
CONTR	CONTRACTOR
COORD	COORDINATE
COP	COPPER
CP	CENTER PIVOT
CP-X	CONTROL PANEL NO. X
CPLG	COUPLING
CPRSR	COMPRESSOR
CPT	CONTROL POWER TRANFORMER, CARPET
CPVC	CHLORINATED PVC
CR	CONTROL RELAY
CRS	COLD ROLLED STEEL
CRS	CONSTRUCTION ROAD STABILIZATION
CT	CERAMIC TILE
CT	CURRENT TRANSFORMER
CTC	COMPUTER TERMINAL CABINET
CTR	CENTER
CTRD	CENTERED
CTSK	COUNTERSUNK
CU	CUBIC
CU FT	CUBIC FOOT
CU IN	CUBIC INCH
CUH	COPPER TUBING, HARD DRAWN
CV	CHECK VALVE
CWR	CABINET DOOR MOUNTED WASTE RECEPTACLE
CY, CU YD	CUBIC YARD
CWS	CLEAN WATER SERVICES
D	DEEP, DRAIN
d	PENNY NAIL SIZE
DA	DUAL ACTION
DAS	DATA ACQUISTION SYSTEM
DBA	DEFORMED BAR ANCHOR
DBL	DOUBLE
DC	DIRECT CURRENT
DEG	DEGREE
DET	DETAIL
DF	DOUGLAS FIR, DRINKING FOUNTAIN
DDI	DROP INLET
DH	DOUBLE HUNG
DI	DUCTILE IRON
DIA	DIAMETER
DIAG	DIAGONAL
DIP	DUCTILE IRON PIPE
DIR	DIRECTION
DISCH	DISCHARGE
DN	DOWN
DO	DISSOLVED OXYGEN
DOL	DIRECT-ON-LINE
DP, DPNL	DISTRIBUTION PANEL
DR	DOOR
DS	DOWNSPOUT
DWG	DRAWING
DWL	DOWEL
△	DELTA
E	EAST, EMPTY
EA	EACH, EXHAUST AIR
EB, EBCT	EMPTY BED CONTACT TIME
ECC	ECCENTRIC
EE	EMERGENCY EYEWASH
EDF	EGG-SHAPED DIGESTER FACILITY
EF	EACH FACE, EXHAUST FAN
EFF	EFFICIENCY, EFFICIENT
EFL	EFFLUENT
EIFS	EXTERIOR INSULATION AND FINISH SYSTEM
EL	ELEVATION
ELB	ELBOW
ELC	ELECTRICAL LOAD CENTER
ELEC	ELECTRIC, ELECTRICAL
ENGR	ENGINEER
EOP	EDGE OF PAVEMENT
ESC	EROSION AND SEDIMENT CONTROL
EP	EXPLOSION PROOF, EDGE OF PAVING
EQL	EQUAL
EQL SP	EQUALLY SPACED
EQPT	EQUIPMENT
ESC	EROSION AND SEDIMENT CONTROL
ETM	ELAPSED TIME METER
EVC	END OF VERTICAL CURVE
EW	EACH WAY
EWC	ELECTRIC WATER COOLER
EXH	EXHAUST
EXP	EXPANSION, EXPOSED
EXP AB	EXPANSION ANCHOR BOLT
EXP JT	EXPANSION JOINT
EXST, EXIST	EXISTING
EXT	EXTERIOR
°F	DEGREE FAHRENHEIT
FB	FLAT BAR
F, FU	FUSE
F, FX	FIXED
FAP	FIRE ALARM PANEL
FC	FLEXIBLE CONDUIT
FCA	FLANGED COUPLING ADAPTER
FCL2	FREE CHLORINE RESIDUAL
FCO	FLOOR CLEANOUT
FCTY	FACTORY
FD	FLOOR DRAIN
FDN	FOUNDATION
FDR	FEEDER
FEXT	FIRE EXTINGUISHER
FF	FINISHED FLOOR
FG	FINISH GRADE, FLOAT GLASS
FH	FLAT HEAD
FHY	FIRE HYDRANT
FIG	FIGURE
FL	FLOW LINE
FLG	FLANGE
FL	FLOOR
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FLUOR	FLUORESCENT
FNSH	FINISH
FOB	FLAT ON BOTTOM
FOT	FLAT ON TOP
FP	FIELD PANEL
FPM	FEET PER MINUTE
FR	FORWARD REVERSE
FRP	FIBERGLASS REINFORCED PLASTIC
FSHS	FOLDING SHOWER SEAT
FT	FOOT OR FEET
FTG	FOOTING
FU	FIXTURE UNIT
FVNR	FULL VOLTAGE NON-REVERSING
FVR	FULL VOLTAGE REVERSING
FWD	FORWARD
G, GND	GROUND
GA	GAUGE
GAL	GALLON
GALV	GALVANIZED
GB	GYPSUM BOARD
GC	GROOVED COUPLING
GCMU	GLAZED CONCRETE MASONRY UNITS
GFA	GROOVED FLANGE ADAPTER
GFI	GROUND FAULT INTERRUPTER
GFR	GROUND FAULT RELAY
GH	GREENHOUSE
GL	GLASS
GPD	GALLONS PER DAY
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
GPS	GLOBAL POSITION SYSTEM
GRTG	GRATING
GSB	GYPSUM SOFFIT BOARD
GSP	GALVANIZED STEEL PIPE
GV	GATE VALVE
GVL	GRAVEL
GWB	GYPSUM WALLBOARD
GYP	GYPSUM
H	HIGH, HORN OR HOWLER
H2S	HYDROGEN SULFIDE
H.A.S.	HEADED ANCHOR STUD
HC	HOLLOW CORE WOOD
HCL	HYDROCHLORIC ACID
HDNR	HARDENER
HDNS	HARDNESS
HDR	HEADER
HDW	HARDWARE
HGL	HYDRAULIC GRADE LINE
HK	HOOK
HGT	HEIGHT
HH	HANDHOLE
HID	HIGH INTENSITY DISCHARGE
HK	HOOK
HM	HOLLOW METAL
HOA	HAND-OFF-AUTO
HOR	HAND-OFF-REMOTE
HORIZ	HORIZONTAL
HP	HORSEPOWER
HPT	HIGH POINT
HPU	HYDRAULIC POWER UNIT
HR	HOSE RACK, HANDRAIL
HV	HOSE VALVE
HVAC	HEATING, VENTILATING AND AIR CONDITIONING
HWL	HIGH WATER LEVEL
IC	INTERRUPTING CAPACITY
ID	INDUCED DRAFT, INSIDE DIAMETER
IE	INVERT ELEVATION
I.F.	INSIDE FACE
IG	INSULATING, INSULATING GLASS
IN	INCH
INCAND	INCANDESCENT
INFL	INFLUENT
INJS	INJECTIONS
INST	INSTANTANEOUS
INSTM	INSTRUMENT, INSTRUMENTATION
INSUL	INSULATION
INVT	INVERT
IP	INLET PROTECTION, INSTRUMENTATION PANEL
IRRIG	IRRIGATION
ITG	INSULATED TEMPERED GLASS
ITX	ISOLATION TRANSFORMER
IU	INTAKE UNIT
IW	IRRIGATION WELL
J	JALOUSIE
JA	JAL-AWNING
JB	JUNCTION BOX
JAN	JANITOR
JCT	JUNCTION
JT	JOINT
K	KEY GROUP, KEY INTERLOCK
KIP	THOUSAND POUNDS
KIT	KITCHEN
K-PL	KICKPLATE
KSK	KITCHEN SINK
KV	KILOVOLTS
KVA	KILOVOLT AMPERES
KVAR	KILOVOLT AMPERES REACTIVE
KW	KILOWATT
L	ANGLE, LENGTH
LA	LIGHTNING ARRESTER
LAB	LABORATORY
LAM	LAMINATE
LAT	LATITUDE
LB	POUND
LC	LIGHTING CONTACTOR
LD	COMBINATION LOUVER/DAMPER
LDG	LOADING DOCK
LEL	LOWER EXPLOSIVE LIMIT
LF	LINEAR FEET
LG	LONG
LH	LEFT HAND
LHR	LEFT HAND REVERSE
LLH	LONG LEG HORIZONTAL
LLV	LONG LEG VERTICAL
LNTL	LINTEL
LONG	LONGITUDINAL
LOS	LOCK-OUT STOP PUSHBUTTON
LP	LIGHT POLE, LIGHTING PANEL, LOCAL PANEL
LPT	LOW POINT
LR	LATCHING RELAY
LR	LOCAL-REMOTE
LR	LONG RADIUS
LS	LABORATORY SINK
LT	LEFT
LTG, LTS	LIGHTS OR LIGHTING
LTX	LIGHTING TRANSFORMER
LWL	LOW WATER LEVEL
MA	MANUAL-AUTO
MAS	MASONRY
MATL	MATERIAL
MAX	MAXIMUM
MB	MACHINE BOLT
MC	MASONRY CLEARANCE
MC	MODULATE-CLOSE
MCC	MOTOR CONTROL CENTER
MCJ	MASONRY CONTROL JOINT
MDO	MEDIUM DENSITY OVERLAY
MECH	MECHANICAL
MFD	MANUFACTURED
MFR	MANUFACTURER
MGD	MILLION GALLONS PER DAY
MH	MANHOLE, MOUNTING HEIGHT
MIN	MINIMUM
MISC	MISCELLANEOUS
MJ	MECHANICAL JOINT
MLO	MAIN LUGS ONLY
MMDW	DRY WEATHER MAXIMUM MONTH
MMP	MECHANICAL MOUNTING PANEL
MMWW	WET WEATHER MAXIMUM MONTH
MO	MANUAL OPERABLE, MASONRY OPENING
MP	METAL PANEL
MPU	MULTIPURPOSE UNIT
MS	MANUFACTURER'S STANDARD
MSC	MANUFACTURER SUPPLIED CABLE
MSR	GROUPED MOTOR CONTROL
MT	MOUNT
MTD	MOUNTED
MTG	MOUNTING
MTS	MANUAL TRANSFER SWITCH
MTS	MILL TYPE STEEL PIPE
MU	MULCHING
MV	MERCURY VAPOR
MWS	MAXIMUM WATER SURFACE
N	NORTH, NEUTRAL
NA	NOT APPLICABLE
NA	NON-AUTOMATIC
NC	NORMALLY CLOSED
NEUT	NEUTRAL
NG	NATURAL GAS
NGVD	NATIONAL GEODETIC VERTICAL DATUM
NIC	NOT IN CONTRACT
N.O.	NORMALLY OPEN
NO., #	NUMBER
NOM	NOMINAL
NP	NON-PROTECTED
NPT	NATIONAL PIPE THREADS
NS	NON-SHRINK
NTS	NOT TO SCALE
O2	OXYGEN
O TO O	OUT TO OUT
OA	OVERALL, ODOROUS AIR
OC	ON CENTER
OC	OPEN-CLOSE (O)
OCA	OPEN-CLOSE-AUTO
OCR	OPEN-CLOSE-REMOTE
OD	OUTSIDE DIAMETER, OVERFLOW DRAIN
O.F.	OUTSIDE FACE
OFCI	OWNER FURNISHED, CONTRACTOR INSTALLED
OFOI	OWNER FURNISHED, OWNER INSTALLED
OL	OVERLOAD RELAY
OO	ON-OFF
OOA	ON-OFF-AUTO
OOR	ON-OFF-REMOTE
OP	OPAQUE PANEL, OUTLET PROTECTION
OPER	OPERATOR
OPNG	OPENING
OPP	OPPOSITE
OSA	OUTSIDE AIR
OSC	OPEN-STOP-CLOSE
OSD	OPEN SITE DRAIN
OWSJ	OPEN WEB STEEL JOIST
OZ	OUNCE
P	PROJECTED
P	PILASTER, PIPE
PAVT	PAVER TILE
PB	PUSHBUTTON SWITCH
PC	POINT OF CURVE, PHOTOCELL
PC	PRECAST CONCRETE PANEL
PCCP	PRECAST CONCRETE CYLINDER PIPE
PCV	PRESSURE CONTROL VALVE
PE	PLAIN END
PED	PEDESTAL, PEDESTRIAN
PEP	POLYETHYLENE PIPE
PEN.	PENETRATION
PFC	POUNDS PER CUBIC FOOT
PH	PENTHOUSE
pH	HYDROGEN ION CONCENTRATION
PH	PHASE
PI	POINT OF INTERSECTION
PIT	PILOT TUBE TEST STATION
PJF	PREMOULDED JOINT FILLER
PL	PLATE (STEEL)
PL	PROPERTY LINE
PLAM	PLASTIC LAMINATE
PLAS	PLASTER, PLASTIC
PLC	PROGRAMMABLE LOGIC CONTROLLER
PLYWD	PLYWOOD
PNL	PANEL
PP	POWER POLE
P-P	PUSH-PULL
PPL	POLYPROPYLENE LINED
PR	PAIR
PRC	POINT OF REVERSE CURVE
PRCST	PRECAST
PREFAB	PREFABRICATION
PRES	PRESSURE
PRI	PRIMARY
PRM	PERMANENT REFERENCED MARKER
PROJ	PROJECTION
PROP	PROPERTY
PS	PLASTIC SHEET, POLYCARBONATE SHEET
PS	PAINT SYSTEM
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PSIG	POUNDS PER SQUARE INCH, GAUGE
PT	POINT OF TANGENCY
PT	POTENTIAL TRANSFORMER
PT	PRESSURE TREATED
PTD	PAPER TOWEL DISPENSER
PTN	PARTITION
PV	PLUG VALVE
PVC	POLYVINYL CHLORIDE
PVI	POINT OF VERTICAL INTERSECTION
PVMT	PAVEMENT
PVT	POINT OF VERTICAL TANGENCY
QAA	AVERAGE FLOW
QMM	MAXIMUM 30 DAY FLOW
QPI	PEAK INSTANTANEOUS FLOW
QPP	PEAK PUMPING FLOW
QT	QUARRY TILE
R	RISER
R OR RAD	RADIUS
RA	RETURN AIR
RC	REINFORCED CONCRETE
RCP	REINFORCED CONCRETE PIPE
RCPT	RECEPTACLE
RD	ROAD, ROOF DRAIN
RDCR	REDUCER
RDW	REDWOOD
RECIR	RECIRCULATION
REF	REFER OR REFERENCE
REFR	REFRIGERATE, REFRIGERANT
REINF	REINFORCED, REINFORCING, REINFORCE
REQD	REQUIRED
RESIL	RESILIENT
RFS	ROLL-UP FIRE SHUTTER
RH	RIGHT HAND
RH	RODHOLE
RHR	RIGHT HAND REVERSE
RL	RAIN LEADER
RLS	RUBBER LINED STEEL
RM	ROOM
RO	ROUGH OPENING
ROL	RAISE-OFF-LOWER
RPM	REVOLUTIONS PER MINUTE
RR	RIPRAP

NOTES:

1. CONTACT ENGINEER FOR ABBREVIATIONS USED BUT NOT SHOWN ON THIS DRAWING.

GENERAL NOTE:

1. THIS IS A STANDARD LEGEND SHEET. THEREFORE, NOT ALL OF THE INFORMATION SHOWN MAY BE USED ON THIS PROJECT.

NO.	DATE	REVISION	BY	APVD

DSGN G GERMAN | DR G GERMAN | CHK | APVD

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

GENERAL

ABBREVIATIONS (1)

NTS
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

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SHEET	

ABBREVIATIONS

RRUB	RADIAL RUBBER
RS	RIGID STEEL
RST	REINFORCING STEEL
RT	RIGHT
RTN	RETURN
RTO	REGENERATIVE THERMAL OXIDIZER
RUB	RUBBER
RUBC	RUBBER CUSHIONED FLOORING
RUBS	RUBBER ESD CONTROL FLOORING
R/W	RIGHT OF WAY
S	I-BEAM
S	SLOPE, SOUTH, SWITCH
SA	SUPPLY AIR
SATC	SUSPENDED ACCUSTICAL TILE CEILING
SB	SEDIMENT BASIN
SC	SHOWER CURTAIN, SOLID CORE WOOD
SCADA	SUPERVISORY CONTROL AND DATA ACQUISITION
SCC	SOLID CORE
SCFM	STANDARD CUBIC FEED PER MINUTE
SCHED	SCHEDULE
SCU	SPEED CONTROL UNIT
SDP	SUB-DISTRIBUTION PANEL
SDWK	SIDEWALK
SEC	SECONDARY
SECT	SECTION
SED	SEDIMENTATION
SEW	SEWAGE
SG	LAMINATED SAFETY GLASS, SAFETY
SGWB	SUSPENDED GYPSUM WALL BOARD
SH	SHEET
SHA	SURFACE HARDENING AGENT
SHS	SOLIDS HANDLING SYSTEM
SIM	SIMILAR
SK	SINK
SLR	SEALER
SMLS	SEAMLESS EPOXY
SOI	SPRAY- ON INSULATION
SOLN	SOLUTION
SP	SPACE OR SPACES, SPANDREL PANEL, STORMPROOF
SPEC, SPECS	SPECIFICATIONS
SPD	SUMP PUMP DISCHARGE
SPG	SPACING
SPLY	SUPPLY
SQ	SQUARE
SQ FT	SQUARE FOOT, FEET
SQ IN	SQUARE INCH
SR	SHORT RADIUS
SS	START-STOP
SST	STAINLESS STEEL
SSC	SUPERVISORY SET POINT CONTROL
ST	STORM DRAIN
ST	STRAIGHT
STA	STATUS, STATION
STD	STANDARD
STIF	STIFFENER
STIRR	STIRRUP
STL	STEEL
STRL	STRUCTUAL
STRUCT	STRUCTURE
SUBFL	SUBFLOOR
SUSP	SUSPENDED
SV	SOLENOID VALVE
SVIN	SHEET VINYL
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
SYMM	SYMMETRICAL
T	THERMOSTAT, TREAD
T&B	TOP AND BOTTOM
T&G	TONGUE AND GROOVE
TA	TRANSFER AIR
TAN	TANGENT
TB	TERMINAL BOARD
TBG	TUBING
TC	TIME TO CLOSE
TC	TURBIDITY CURTAIN
TCAD	TIME CLOSE AFTER DE-ENERGIZATION
TCAE	TIME CLOSE AFTER ENERGIZATION
TDH	TOTAL DYNAMIC HEAD
TDR	TIME DELAY RELAY
TECH	TECHNICAL
TEL	TELEPHONE
TEMP	TEMPORARY, TEMPERATURE
TF	TOP FACE
TFG	TEMPERED FLOAT GLASS
TG	TEMPERED
TH	TOP-HINGED
THD	THREAD
THK	THICKNESS
THRU	THROUGH
TJB	TERMINAL JUNCTION BOX
TL	TEFLON LINED PIPE
T.O.	TIME TO OPEN, TOP OF
TOAE	TIME OPEN AFTER ENERGIZATION
TOC	TOP OF CONCRETE
TOC	TOP OF CURB
TOD	TIME ON DELAY, TOP OF DUCT TOTAL OXYGEN DEMAND
TOF	TOP OF FOOTING
TOG	TOP OF GROUT, TOP OF GRATE
T.O.P.	TOP OF PARAPET
TOS	TOP OF SLAB
TOW	TOP OF WALL
TP	TURNING POINT
TR	TRANSOM, TRUSS
TRANS	TRANSFORMER, TRANSITION
TRANSV	TRANSVERSE
TRD	TREAD
TS	TEMPORARY SEEDING, TUBE STEEL
TSHT	THRESHOLD
TSS	TOTAL SUSPENSION SOLIDS
TST	TOP OF STEEL
TTC	TELEPHONE TERMINAL CABINET
TTD	TOILET TISSUE DISPENSER
TU-X	TREATMENT UNIT NO. X
TURB	TURBIDITY
TWP	TRANSLUCENT WALL PANEL
TX	TRANSFORMER
TYP	TYPICAL
UON	UNLESS OTHERWISE NOTED
UNO	UNLESS NOTED OTHERWISE
UPS	UNINTERRUPTIBLE POWER SUPPLY
USB	UNIT SUBSTATION
UVR	UNDER VOLTAGE RELAY
V	VENT, VALVE
V	VOLTMETER, VOLTS
VB	VAPOR BARRIER (RETARDER)
VC	VERTICAL CURVE
VCP	VITRIFIED CLAY PIPE
VCT	VINYL COMPOSITION TILE
VEL	VELOCITY
VERT	VERTICAL
VHC	VOLATILE HYDROCARBONS
VIB	VIBRATION
VIF	VERIFY IN FIELD
VIN	VINYL
VINT, VT	VINYL TILE
VP	VERTICAL PIVOTED
VPS	VENEER PLASTER SYSTEM
VPC	POINT OF VERTICAL CURVATURE
VPI	POINT OF VERTICAL INTERSECTION
VPT	POINT OF VERTICAL TANGENT
VS	VERTICAL SLIDE
VTR	VENT THRU ROOF
VWC	VINYL WALL COVERING
W	WEST
W/	WITH
WC	WATER COLUMN
WEASTRIP	WEATHERSTRIP
WG	WIRE, WIRE GLASS
WH	WATTHOUR METER
WHD	WATTHOUR DEMAND METER
WP	WATERPROOF, WEATHERPROOF, WORKPOINT
WR	WASTE RECEPTACLE
WRB	WATER RESISTANT GWB
WS	WATER SURFACE, WATERSTOP, WELDED STEEL
WWF	WELDED WIRE FABRIC
WWPH	WET WEATHER PEAK HOUR

NOTE:

1. CONTACT ENGINEER FOR ABBREVIATIONS USED BUT NOT SHOWN ON THIS DRAWING.

SECTION / DETAIL DESIGNATIONS

SECTION (LETTER) OR DETAIL (NUMERAL) DESIGNATION — A

DRAWING NUMBER (REPLACED WITH A LINE IF TAKEN AND SHOWN ON SAME SHEET)

1 — 100-A-10010A1 — ON DRAWING WHERE SECTION OR DETAIL IS TAKEN: DRAWING NUMBER WHERE SHOWN

B SECTION SCALE — 100-S-3001 — ON DRAWING WHERE SECTION IS SHOWN: DRAWING NUMBER(S) WHERE TAKEN

2 DETAIL SCALE — 200-M-10B10A — ON DRAWING WHERE DETAIL IS SHOWN: DRAWING NUMBER(S) WHERE TAKEN

DRAWING TITLE SCALE — ON DRAWING WHERE ONLY A TITLE IS REQUIRED WITH NO REFERENCE (eg: ELEVATIONS)

B — SECTION CALLOUT WHERE SECTION IS ON THE SAME SHEET AND CUT EXTENDS TO A FIXED LIMIT

B 450-S-1002 / B 450-S-1002 — SECTION CALLOUT WHERE SECTION IS ON ANOTHER SHEET AND CUT EXTENDS THROUGHOUT ENTIRE SHEET

1 — GRID LINE INDICATOR

1 — KEYNOTE NUMBER

1 — REVISION / ADDENDA NUMBER

N — NORTH ARROW; CAN BE MODIFIED TO INCLUDE MAGNETIC NORTH ALONG WITH PROJECT NORTH

DESIGN DETAIL DESIGNATION

DESIGN DETAIL DESIGNATION (NUMERAL) SHOWN ON DESIGN DETAIL DRAWING(S) — 1234-567

NOTES:

1. ALL DESIGN DETAILS ARE TYPICAL AND MUST BE USED IF DESIGN DETAIL DESIGNATION IS NOT SHOWN
2. THE TERM STANDARD DETAIL, OR A FORM OF IT, IS SYNOMONOUS WITH DESIGN DETAIL. THE DESIGN DETAILS REPRESENT THE CHARACTER AND NATURE OF THE WORK REQUIRED THROUGHOUT THE PROJECT. ALL ASSOCIATED WORK SHALL BE IN ACCORDANCE WITH THE DESIGN DETAILS SHOWN WHETHER THE DETAILS ARE SPECIFICALLY REFERENCED OR NOT.

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NO.	DATE	REVISION	BY	APVD

DSGN G GERMAN | DR G GERMAN | CHK | APVD

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

GENERAL
ABBREVIATIONS (2)

NTS
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING. 0 25mm

DATE	
PROJ	436662
DWG	000-G-0003
SHEET	

FILENAME: 000-G-0003_436662.dgn PLOT DATE: 2013\06\07 PLOT TIME: 9:37:03 AM

GENERAL SITE NOTES:

1. SOURCE OF TOPOGRAPHY SHOWN ON THE CIVIL PLANS ARE BASE MAPS PROVIDED BY ________________. ADDITIONAL MAPPING HAS BEEN ADDED FROM AS-BUILT DATA AND SUPPLEMENT SURVEY FROM__________. EXISTING CONDITIONS MAY VARY FROM THOSE SHOWN ON THESE PLANS. THE CONTRACTOR SHALL VERIFY EXISTING CONDITIONS AND ADJUST WORK PLAN ACCORDINGLY PRIOR TO BEGINNING CONSTRUCTION.
2. EXISTING TOPOGRAPHY, STRUCTURES, AND SITE FEATURES ARE SHOWN SCREENED AND/OR LIGHT-LINED. NEW FINISH GRADE, STRUCTURES, AND SITE FEATURES ARE SHOWN HEAVY-LINED.
3. HORIZONTAL DATUM: NAD33, UTM ZONE 8
4. VERTICAL DATUM: CGVD28 (GEOID MODEL HT V2.0
5. MAINTAIN, RELOCATE, OR REPLACE EXISTING SURVEY MONUMENTS, CONTROL POINTS, AND STAKES WHICH ARE DISTURBED OR DESTROYED. PERFORM THE WORK TO PRODUCE THE SAME LEVEL OF ACCURACY AS THE ORIGINAL MONUMENT(S) IN A TIMELY MANNER, AND AT THE CONTRACTOR'S EXPENSE.
6. FOR LOCATION OF CONTROL POINT ON STRUCTURES, SEE STRUCTURAL DRAWINGS.
7. COORDINATES AND DIMENSIONS SHOWN FOR ROADWAY IMPROVEMENTS ARE TO FACE OF CURB OR EDGE OF PAVEMENT.
8. STAGING AREA SHALL BE FOR CONTRACTOR'S EMPLOYEE PARKING, CONTRACTOR'S TRAILERS AND ON-SITE STORAGE OF MATERIALS.
9. PROVIDE TEMPORARY FENCING AS NECESSARY TO MAINTAIN SECURITY AT ALL TIMES.
10. ELEVATIONS GIVEN ARE TO FINISH GRADE UNLESS OTHERWISE SHOWN.
11. SLOPE UNIFORMLY BETWEEN CONTOURS AND SPOT ELEVATIONS SHOWN.
12. UNLESS SHOWN ON THE LANDSCAPING PLANS, ALL DISTURBED AREAS NOT RECEIVING A HARD SURFACE SHALL BE COVERED WITH GRASS.
13. CONTRACTOR SHALL BE RESPONSIBLE FOR IMPLEMENTING AND MAINTAINING EROSION CONTROL DEVICES DURING CONSTRUCTION. EROSION CONTROL DEVICES (X), (X) AND (X) ARE THE MINIMUM REQUIRED.
14. CONTRACTOR SHALL TAKE ALL OTHER MEASURES TO POSITIVELY PRECLUDE EROSION MATERIALS FROM LEAVING THE SITE. CONTRACTOR TO SUBMIT EROSION CONTROL PLAN.

GENERAL YARD PIPING AND UTILITIES NOTES:

1. EXISTING UNDERGROUND UTILITIES OBTAINED FROM AS-BUILTS AND FROM FIELD SURVEY. CONTRACTOR SHALL FIELD VERIFY DEPTH AND LOCATION PRIOR TO EXCAVATION. PROTECT ALL EXISTING UTILITIES DURING CONSTRUCTION.
2. FOR PIPING FLOW STREAM IDENTIFICATION, SEE DRAWING ______.
3. EXISTING PIPING AND EQUIPMENT ARE SHOWN SCREENED AND/OR LIGHT-LINED. NEW PIPING AND EQUIPMENT ARE SHOWN HEAVY-LINED.
4. UNLESS OTHERWISE SHOWN ALL PIPING SHALL HAVE A MINIMUM OF ____ COVER.
5. ALL PIPES SHALL HAVE A CONSTANT SLOPE BETWEEN INVERT ELEVATIONS UNLESS A FITTING IS SHOWN.
6. ALL NEW WATER PIPES MUST BE PROPERLY FLUSHED, PRESSURE TESTED, CHLORINATED AND BACTERIOLOGICALLY TESTED, AS SPECIFIED.
7. FOR TRENCHING AND BACKFILL, SEE (X).
8. FOR SURFACE RESTORATION OF ASPHALT CONCRETE, SEE (X), FOR GRAVEL ROADS, SEE (X), AND FOR GRASS, SEE SPECIFICATION_______.
9. MINIMUM ALLOWABLE CLEARANCE BETWEEN PIPES AT CROSSINGS SHALL BE 3". CONTROLLED DENSITY FILL SUPPORT IS REQUIRED AS SHOWN ON (X).

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CIVIL LEGEND

EXISTING | THIS CONTRACT

- 157.7 / 158.5 — SPOT ELEVATION
- 155 — CONTOUR LINE
- 3:1 — EMBANKMENT AND SLOPE
- DRAINAGEWAY OR DITCH
- CB OR CB — CATCH BASIN OR INLET
- TRENCH DRAIN
- OR — SIGN
- D OR S — MANHOLE
- E — ELECTRICAL MANHOLE
- H — ELECTRIC HANDHOLE
- POST OR GUARD POST
- GUY ANCHOR
- FIRE HYDRANT
- UTILITY POLE
- LIGHT POLE
- BM — BENCH MARK
- SURVEY CONTROL POINT OR POINT OF INTERSECTION
- BRUSH/TREE LINE
- TREE
- PROPERTY LINE
- CENTER LINE, BUILDING, ROAD, ETC.
- STAGING OR WORK AREA LIMITS
- N 1000.00 E 1000.00 — STRUCTURE, BUILDING OR FACILITY LOCATION POINT - COORDINATES
- B-1 — BORING LOCATION AND NUMBER
- TP-2 — TEST PIT LOCATION AND NUMBER
- P-3 — PIEZOMETER LOCATION AND NUMBER
- OR / OR — DEMOLITION
- OR — STRUCTURE, BUILDING OR FACILITY
- ASPHALT CONCRETE PAVEMENT
- GRAVEL SURFACING
- CONCRETE PAVEMENT
- CURB
- CURB AND GUTTER
- SINGLE SWING GATE
- DOUBLE SWING GATE
- SLIDING GATE
- GUARD RAIL
- CHAIN LINK FENCE
- ARCHITECTURAL FENCE
- WIRE FENCE
- CULVERT

YARD PIPING LEGEND

EXISTING | THIS CONTRACT

- 8" PE — NOMINAL PIPE DIAMETER; PIPE USE IDENTIFICATION
- PIPING < 30" DIAMETER
- PIPING ≧ 30" DIAMETER
- EXISTING PIPE TO BE ABANDONED
- EXISTING PIPE TO BE REMOVED
- NON-FREEZE HOSE VALVE (V-X) X = NO. IN SPECIFICATIONS
- NON-FREEZE HOSE VALVE WITH HOSE RACK (V-X) X = NO. IN SPECIFICATIONS
- INDICATOR POST VALVE
- GATE VALVE AND VALVE BOX
- BUTTERFLY VALVE AND VALVE BOX
- PLUG VALVE AND VALVE BOX
- FLEXIBLE COUPLING
- 90° ELBOW UP
- 90° ELBOW DOWN
- BEND < 90° UP
- BEND < 90° DOWN
- CONCENTRIC REDUCER
- CAP OR PLUG
- CLEANOUT
- FIRE HYDRANT

EROSION CONTROL LEGEND

COVER PRACTICES	SYMBOL
TEMPORARY SEEDING	TS
MULCHING AND MATTING	MU
CLEAR PLASTIC COVERING	CPC
BUFFER ZONES	BZ
PERMANENT SEEDING AND PLANTING	PS
CONSTRUCTION ENTRANCE	
INTERCEPTOR DIKE	ID
INTERCEPTOR SWALE	IS
CHECK DAMS	
OUTLET PROTECTION / RIPRAP	
FILTER FENCE	
STRAW BALE BARRIER (BIOFILTER)	
SEDIMENT TRAP (OR SUMP)	
SEDIMENT POND OR BASIN	

NO.	DATE	REVISION	BY	APVD

DSGN A RIOLO | DR A RIOLO | CHK | APVD

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

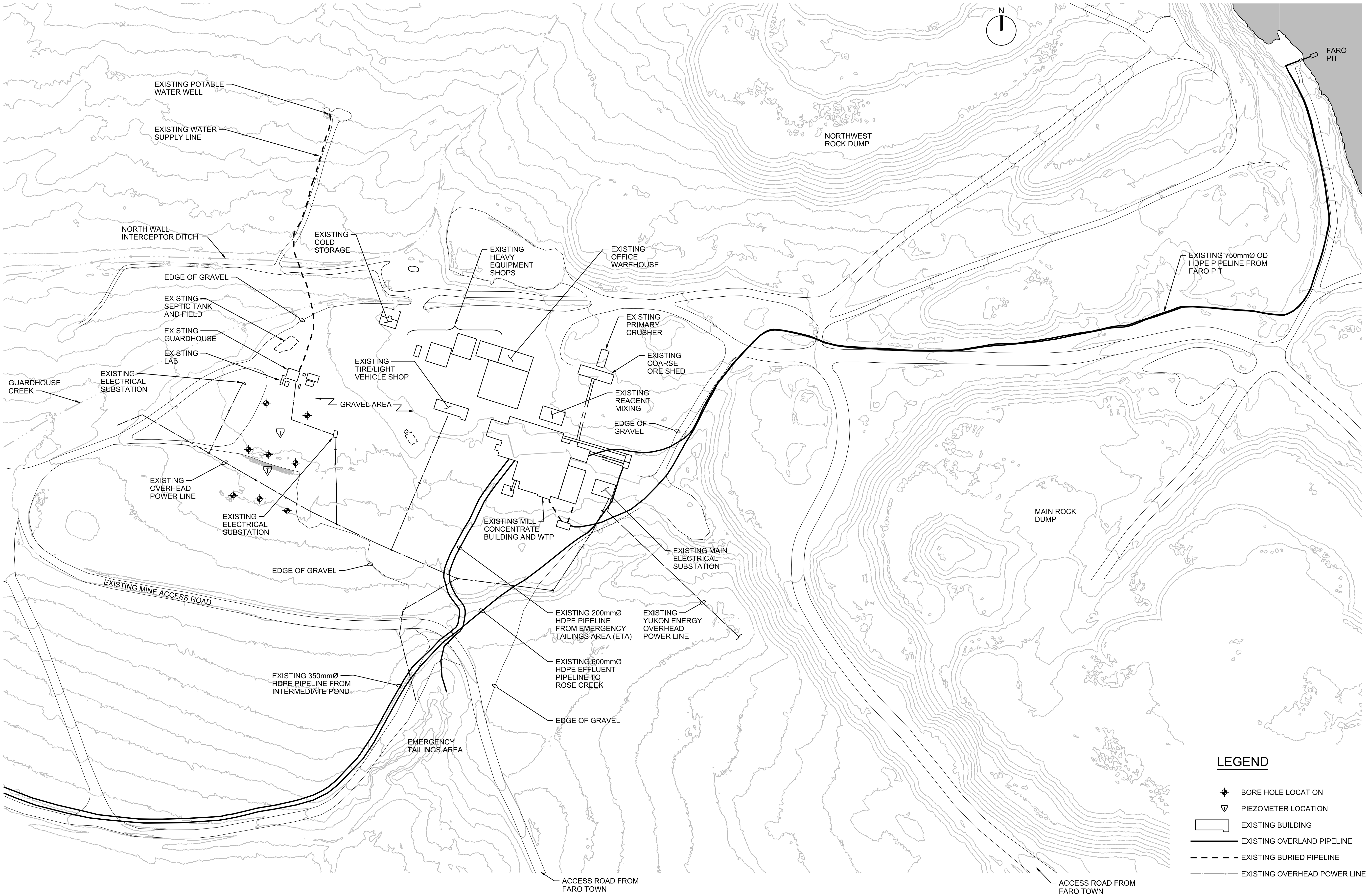
CH2MHILL®

CIVIL
GENERAL LEGEND, SYMBOLS AND ABBREVIATIONS

NTS
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE
PROJ 436662
DWG 000-C-0001
SHEET

FILENAME: 000-C-0001_436662.dgn PLOT DATE: 2013\06\07 PLOT TIME: 9:37:11 AM



EXISTING SITE PLAN

1:3000

0 25 50 75m

NO.	DATE	REVISION	BY	APVD

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FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

CIVIL
EXISTING SITE PLAN

1:3000
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

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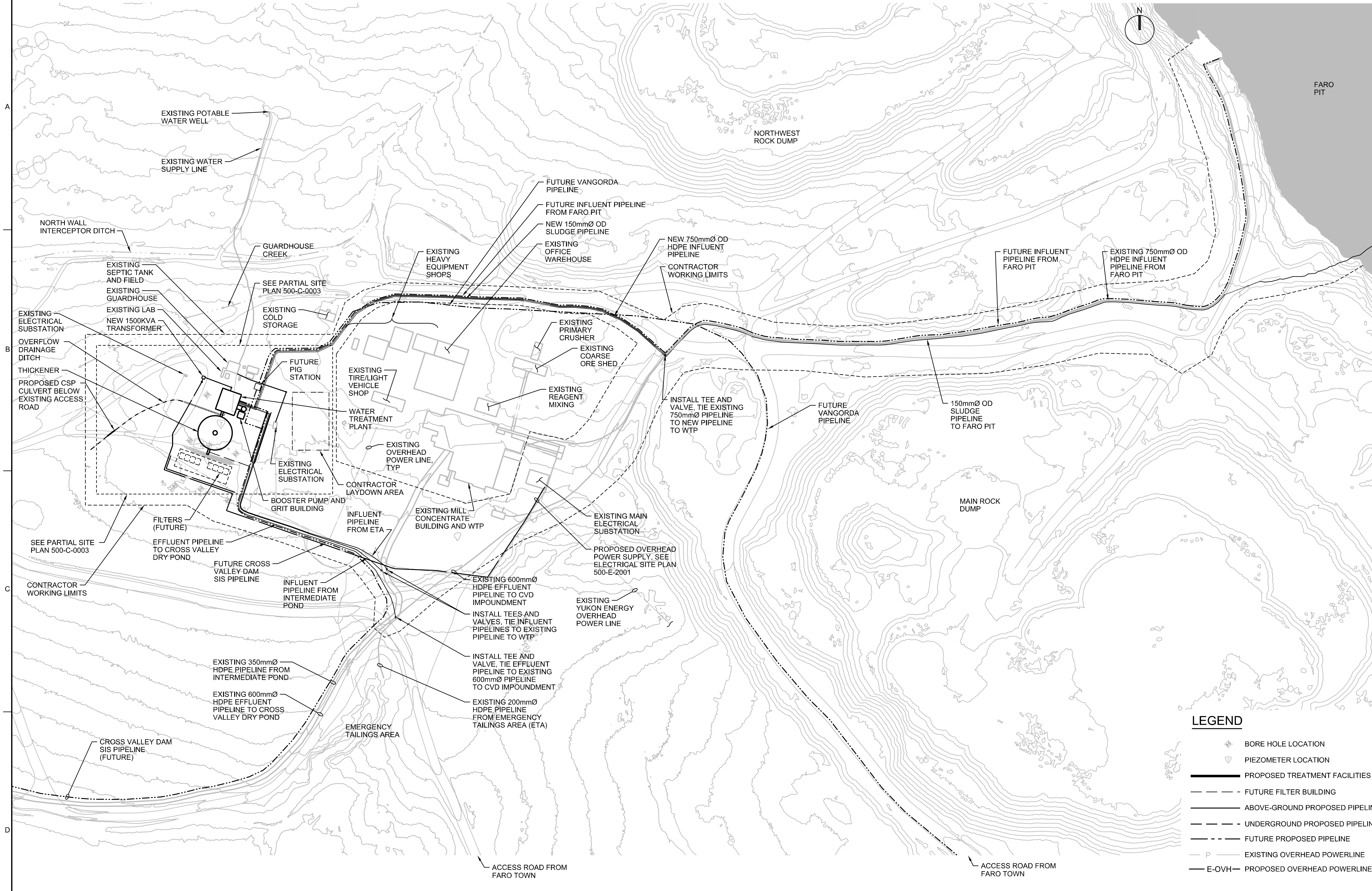

PROPOSED OVERALL SITE PLAN

1:3000

0 25 50 75m

NO.	DATE	REVISION	BY	APVD

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FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

CIVIL
PROPOSED OVERALL SITE PLAN

1:3000
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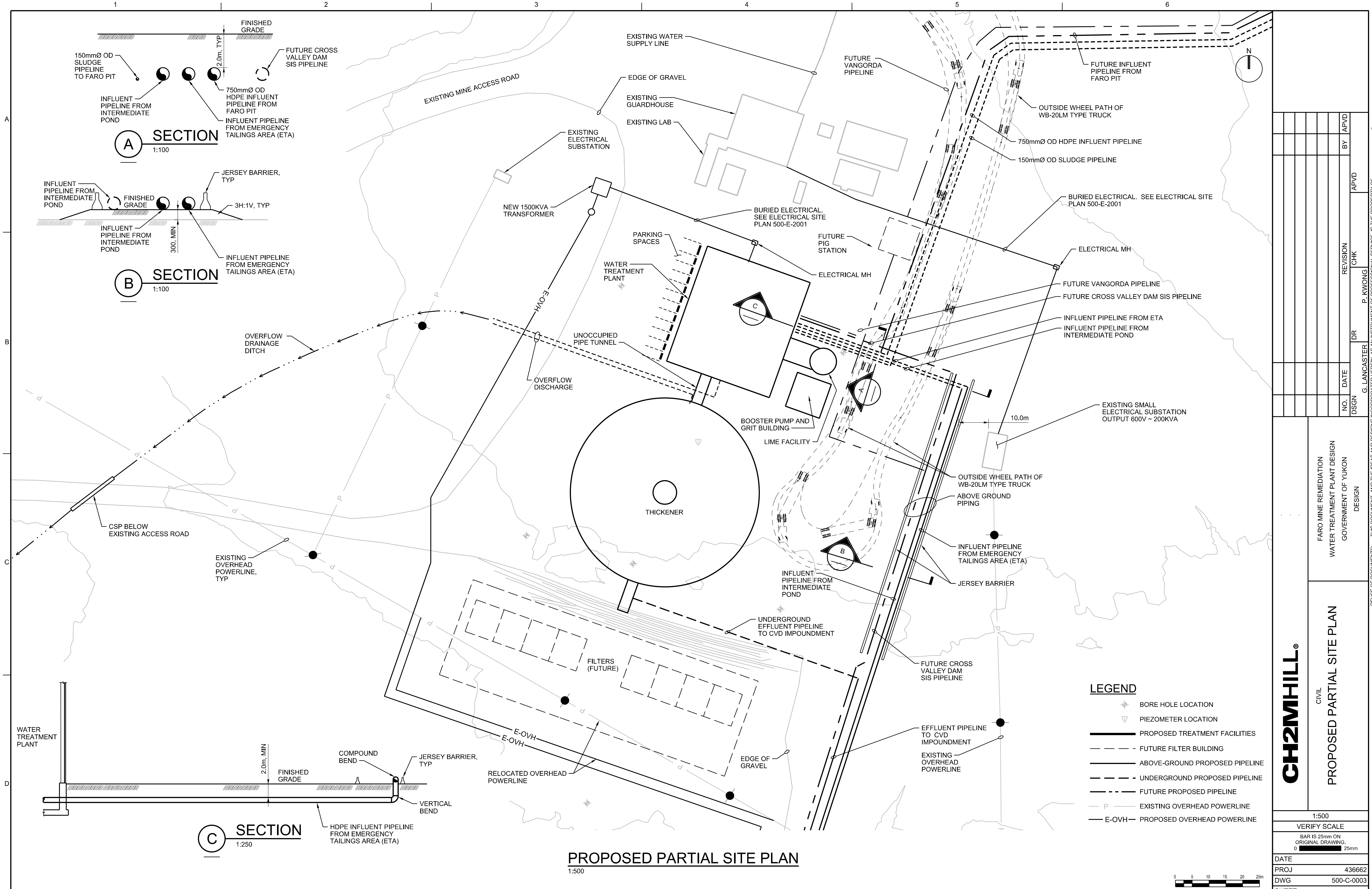

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GENERAL ARCHITECTURAL NOTES

1. UNLESS OTHERWISE INDICATED, PLAN DIMENSIONS ARE TO COLUMN GRID ON CENTERLINES, NOMINAL SURFACE OF MASONRY, FACE OF STUDS AND FACE OF CONCRETE WALLS.
2. "FLOOR LINE" REFERS TO TOP OF CONCRETE SLABS. FINISH FLOORING IS INSTALLED ABOVE THE FLOOR LINE. FOR DEPRESSED FLOORS AND CURBS, SEE STRUCTURAL DRAWINGS.
3. REPETITIVE FEATURES ARE NOT DRAWN IN THEIR ENTIRETY AND SHALL BE COMPLETELY PROVIDED AS IF DRAWN IN FULL.
4. WHERE DOOR IS LOCATED NEAR CORNER OF ROOM AND IS NOT LOCATED BY DIMENSION ON PLAN OR DETAILS, DIMENSION SHALL BE 3-INCHES FROM FACE OF STUD (WALL) TO FACE OF ROUGH OPENING. DIMENSION SHALL BE 6" FROM FACE OF WALL TO EDGE OF ROUGH OPENING AT CONCRETE WALLS, 8" AT CMU WALLS.
5. AT SOUND INSULATED WALLS, FULL HEIGHT PARTITIONS SHALL BE SEALED BOTH SIDES WITH ACOUSTIC SEALANT; TOP, BOTTOM, INTERSECTION, DOOR FRAMES, GLAZED OPENING FRAMES, AND OTHER PENETRATIONS.
6. LINE OF EXISTING GRADES, AS SHOWN ON THE BUILDING ELEVATIONS AND SECTIONS ARE APPROXIMATE. THEY ARE AT THE BUILDING FACE, OR ON THE SECTION END EXCEPT AS NOTED.
7. VERIFY ALL ROUGH-IN DIMENSIONS FOR EQUIPMENT PROVIDED IN THIS CONTRACT, OR BY OTHERS.
8. REFER TO ARCHITECTURAL, STRUCTURAL, MECHANICAL, ELECTRICAL AND OTHER CATEGORIES OR DRAWINGS FOR ADDITIONAL NOTES.
9. VERIFY SIZE AND LOCATION OF, AND PROVIDE; REQUIRED OPENINGS THROUGH FLOORS AND WALLS, ACCESS DOORS, FURRING, CURBS, ANCHORS AND INSERTS. PROVIDE ALL BASES AND BLOCKING REQUIRED FOR ACCESSORIES, MECHANICAL, ELECTRICAL AND OTHER EQUIPMENT.
10. FOR ARCHITECTURAL LEGEND SEE DRAWING X-X-XX.
11. FOR APPLICABLE CODES AND LIFE SAFETY PLAN, SEE DRAWING X-X-XX.
12. FOR DOOR AND HARDWARE DESCRIPTIONS SEE SPECIFICATION SECTION 08 06 01. FOR WINDOW DESCRIPTIONS SEE SPECIFICATION SECTION 08 06 50.
13. FOR FINISH SCHEDULE SEE SPECIFICATION SECTION 09 00 00.
14. FOR ADA DESIGN REQUIREMENTS, SEE DRAWING X-X-XX.
15. FOR PARTITION/WALL TYPES, SEE DRAWING X-X-XX.
16. FOR LIFE SAFETY SIGN LOCATIONS SEE DRAWING X-X-XX.
17. FOR LOUVERS DESCRIPTION SEE SPECIFICATION SECTION 08 90 00.
18. NIC MEANS "NOT IN CONTRACT".
19. SEE DRAWING X-X-XX FURNITURE PLAN FOR APPLIANCES TO BE PROVIDED.
20. FOR 8" GUARD POSTS LOCATIONS, SEE STRUCTURAL DRAWINGS.
21. FOR INFORMATION ON VIDEO MONITORS, SEE CCTV BLOCK DIAGRAM ON DRAWING X-X-XX.
22. THE GYPSUM WALL BOARD ON THE INTERIOR FACE OF THE EXTERIOR WALLS FOR TOTAL PERIMETER AND HEIGHT IS TO ACT AS AN AIR BARRIER. ALL JOINTS BETWEEN PANELS SHALL BE TAPED, SPACKLED AND SANDED. JOINTS AT FLOOR AND CEILING SHALL BE CAULKED.

ARCH/STRUCT MATERIAL SYMBOLS

SYMBOL	LEGEND
	GRATING, SPAN DIRECTION INDICATED
	CHECKERED PLATE
	GROUT
	GRANULAR FILL
	EARTH OR FINISH GRADE
	CONCRETE
	CMU WALL (PLAN)
	CMU WALL (SECTION)
	MASONRY WALL
	METAL STUD WALL (PLAN)
	WOOD STUD WALL (PLAN)
	RIGID INSULATION
	BATT INSULATION
	STEEL
	ALUMINUM
	PLYWOOD
	GYPSUM WALLBOARD
	ACOUSTICAL TILE
	WOOD, ROUGH CONTINUOUS
	WOOD, ROUGH NON-CONTINUOUS
	WOOD, FINISHED

ARCHITECTURAL/STRUCTURAL LEGEND

SYMBOL	LEGEND
A	GRID / COLUMN INDICATOR
ROOM NAME XX101 OR ROOM NAME 101	ROOM IDENTIFIER
"XX" = FACILITY INDICATOR (IF SHOWN); XX101A; DOOR LETTER; ROOM NUMBER	DOOR IDENTIFIER
XXW-1 OR W-1	WINDOW IDENTIFIER
XXR-1 OR R-1	RELIGHT IDENTIFIER
XXL-1 OR L-1	LOUVER IDENTIFIER
A	WALL TYPE INDICATOR
S-1	SIGNAGE IDENTIFIER
QUANTITY AND DIRECTION OF POINTERS AS REQUIRED; A, B, C, D, E; 1 XX-A-301	INTERIOR ELEVATION INDICATOR
110.50	SPOT ELEVATION INDICATOR (IN FEET)
XXXX EL XX.XX	ELEVATION DATUM (IN FEET)
	DIRECTION OF SLOPE DOWN
HINGE SIDE	HATCH SWING INDICATOR
ACTIVE; XX101A; INACTIVE	INDICATES PAIR OF DOORS (DOOR # ON ACTIVE)
F.EXT-X (IN CABINET); F.EXT-X (ON BRACKET)	FIRE EXTINGUISHER "X" = NUMBER IN SPECIFICATIONS
CJ	CONTROL JOINT
X" EJ	EXPANSION JOINT X" = DIMENSION
POST	RAILINGS
P-1	PRECAST PANEL IDENTIFIER
S-X	SLAB INDICATOR
X	COLUMN INDICATOR
W-X	WALL INDICATOR
B-X	BEAM INDICATOR

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DSGN D IANNETTA DR D IANNETTA CHK APVD

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL CANADA Architects Inc.

ARCHITECTURAL
GENERAL LEGEND, SYMBOLS AND ABBREVIATIONS

NTS
VERIFY SCALE
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0 25mm

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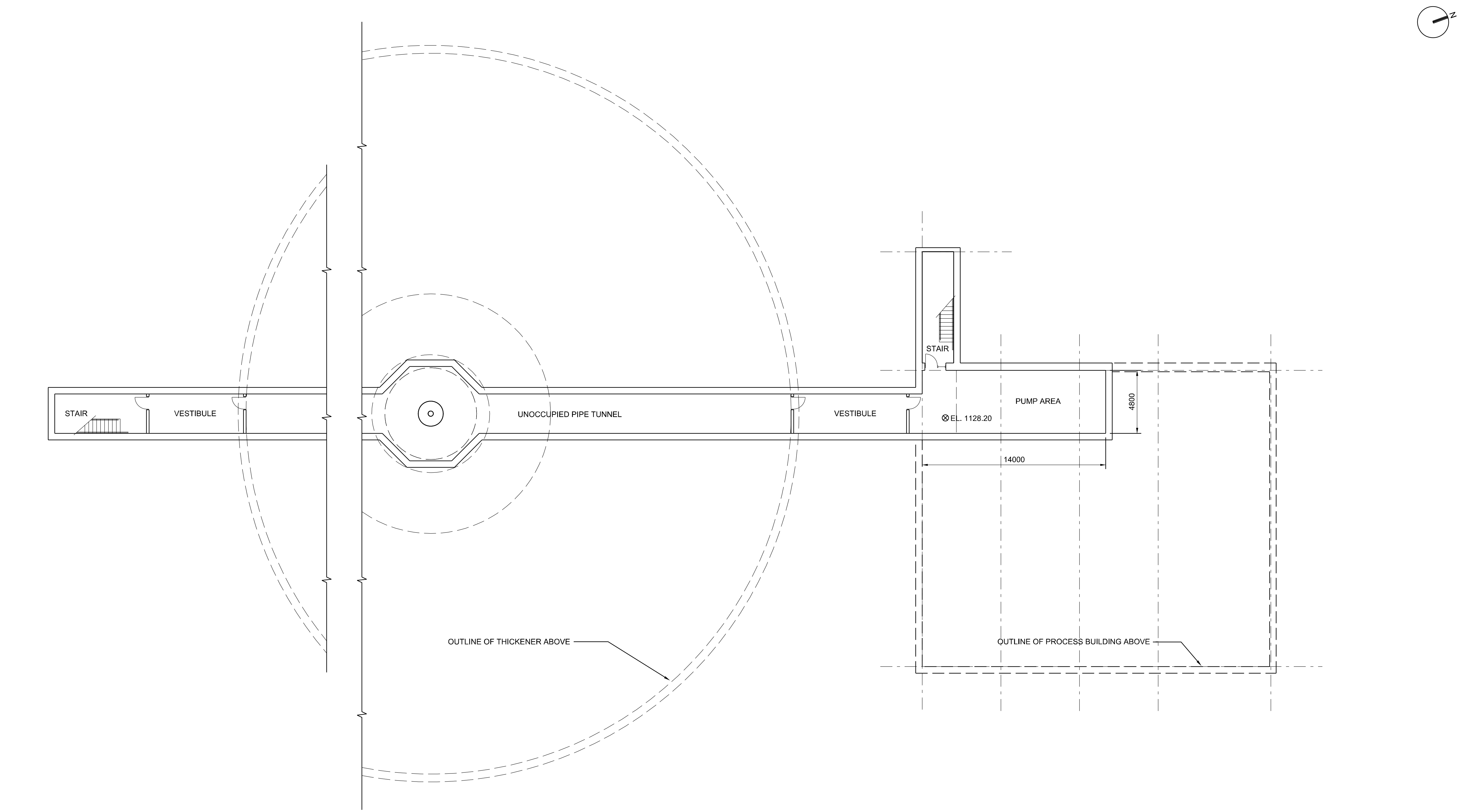

PUMP AREA AT EL 1128.20

SCALE 1:150

0 1500 3000 4500 6000 7500

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ARCHITECTURAL
PUMP AREA AT EL 1128.60

1:150
VERIFY SCALE
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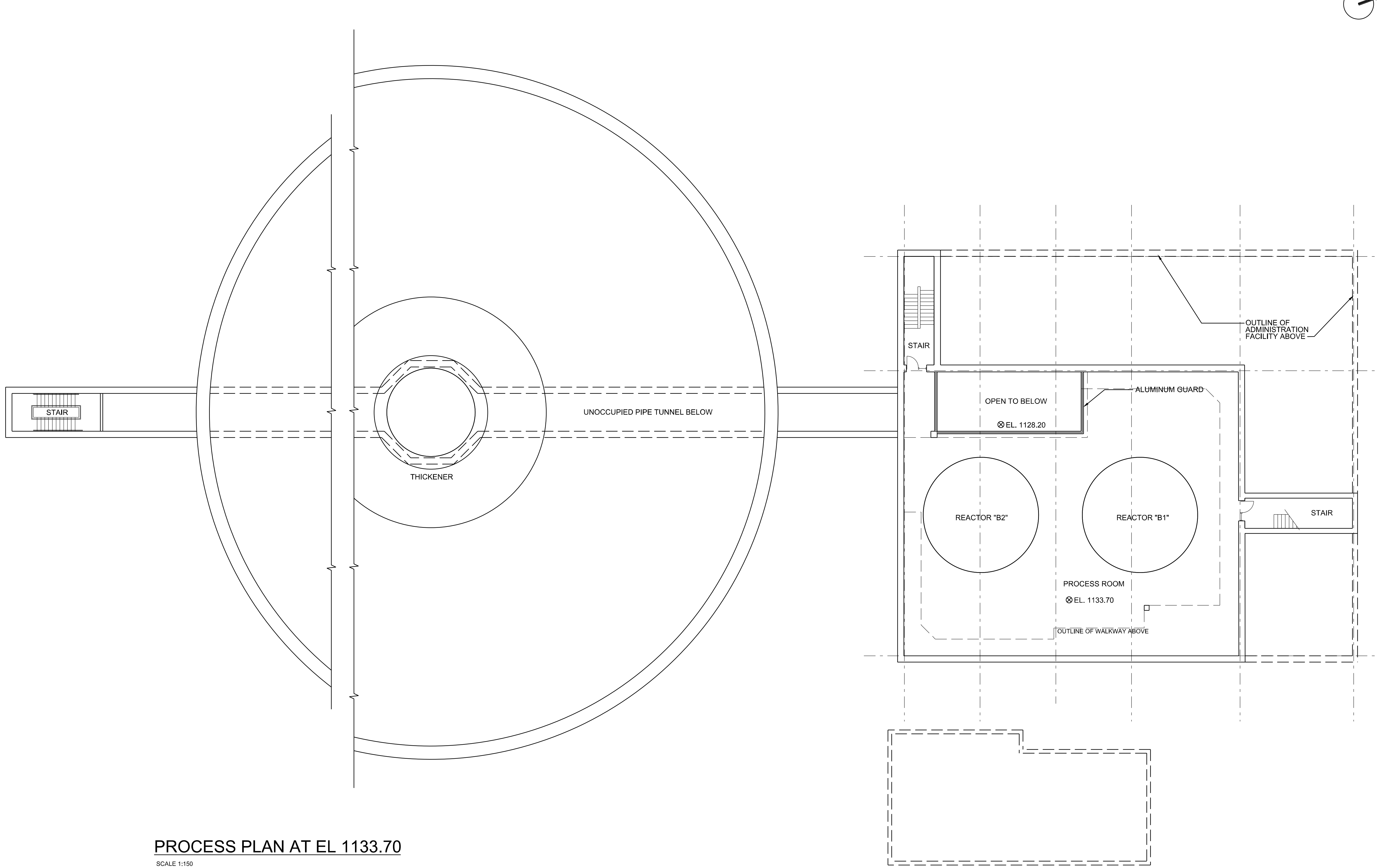

PROCESS PLAN AT EL 1133.70

SCALE 1:150

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FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

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ARCHITECTURAL
PROCESS PLAN AT EL 1133.70

1:150
VERIFY SCALE
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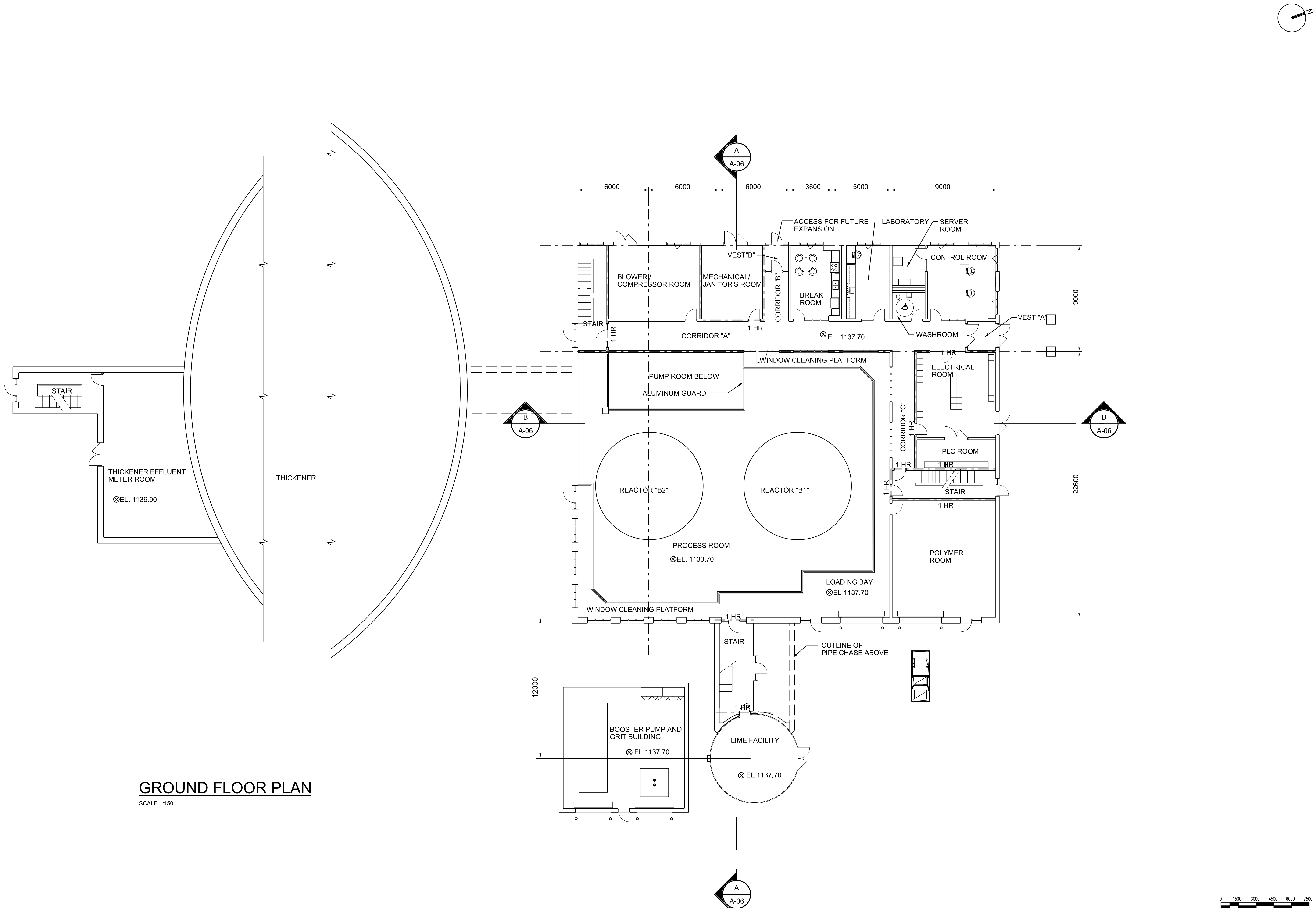

GROUND FLOOR PLAN

SCALE 1:150

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WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

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ARCHITECTURAL
GROUND FLOOR PLAN

1:150
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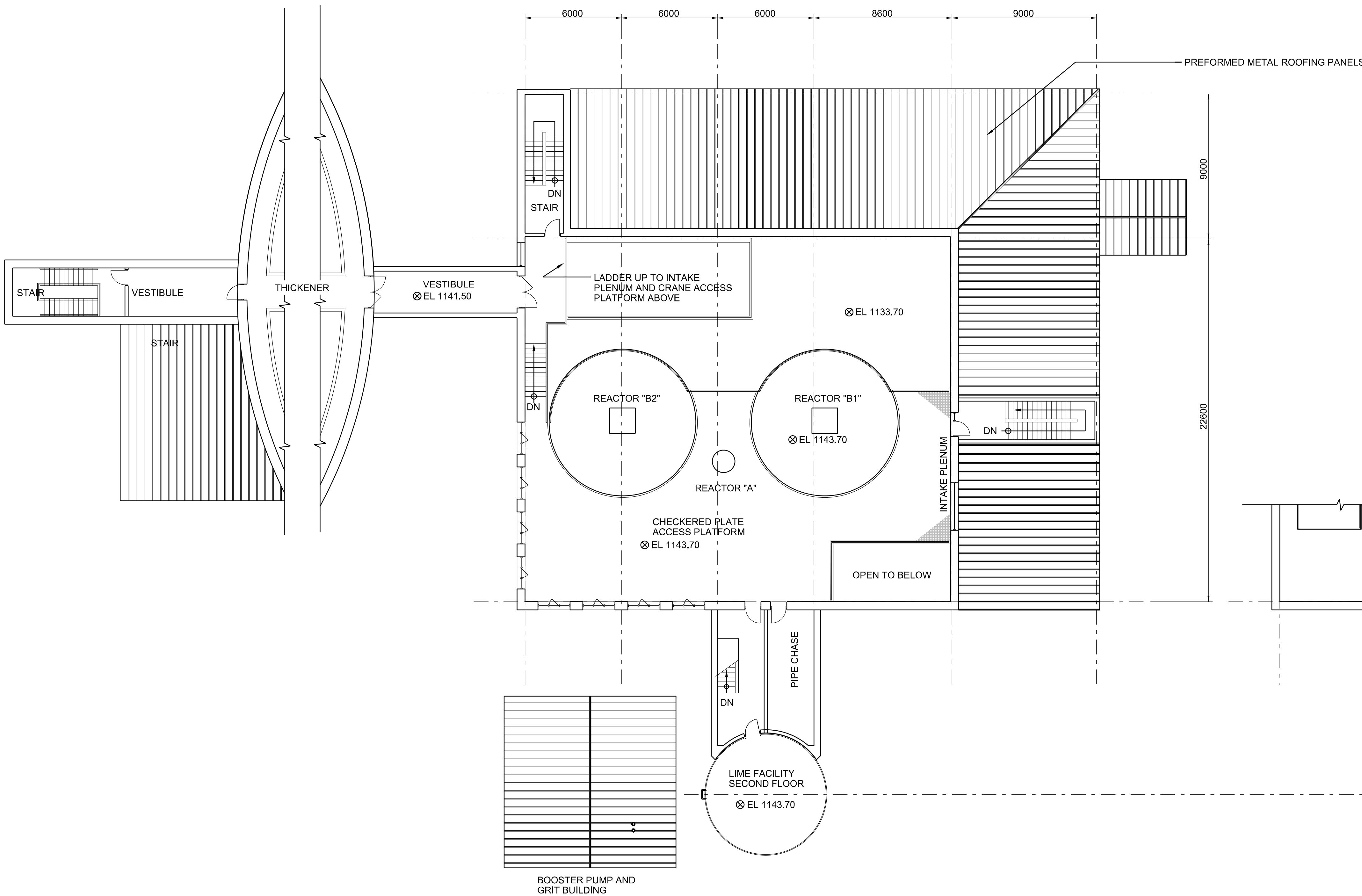
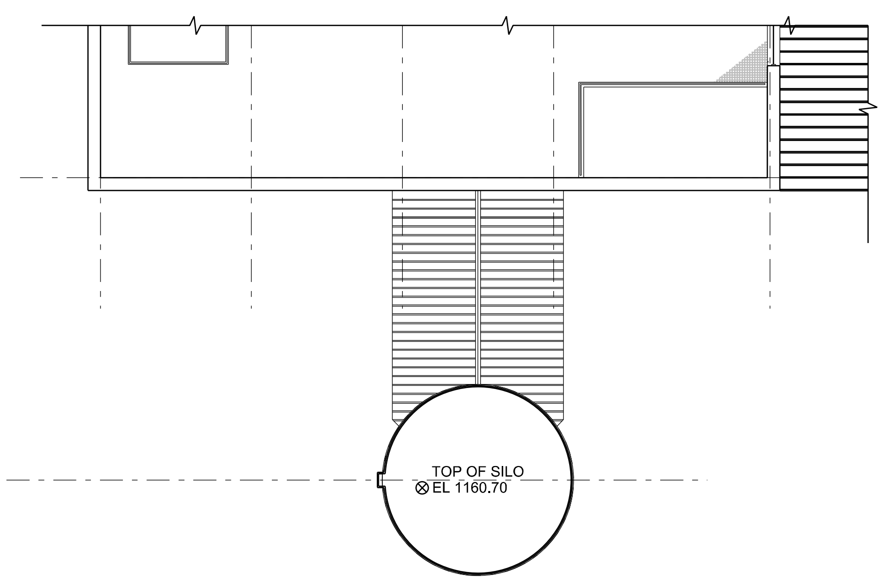


PLATFORM PLAN AT EL 1143.70

SCALE 1:150



ROOF PLAN

LIME FACILITY

0 1500 3000 4500 6000 7500

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WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

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ARCHITECTURAL
PLATFORM PLAN AT EL 1143.70
AND LIME SLAKER BLDG ROOF PLAN

1:150
VERIFY SCALE
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DATE	
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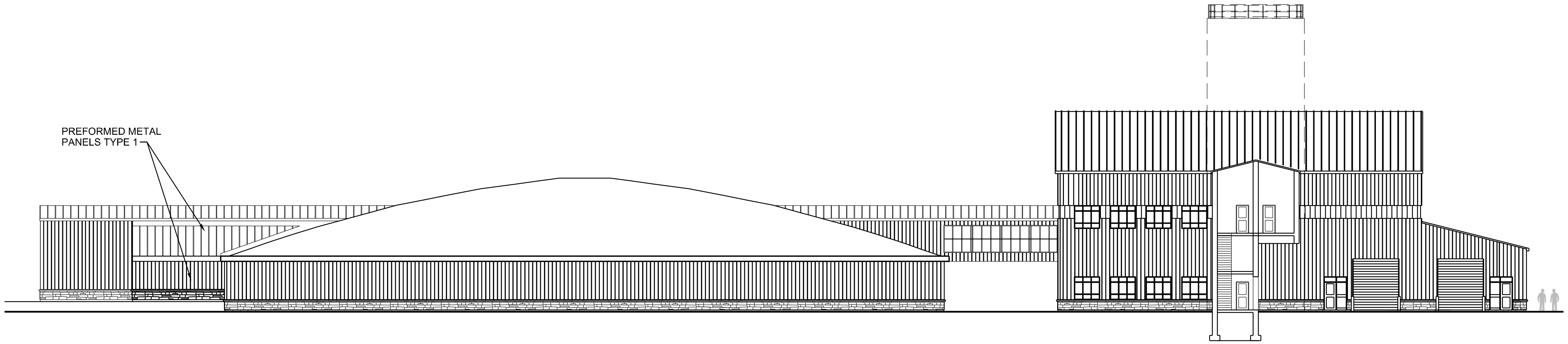
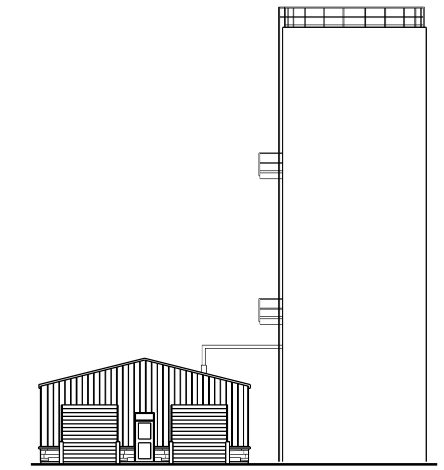
SHEET	

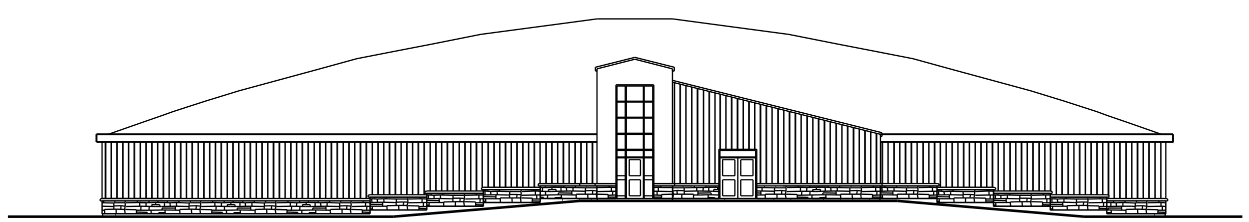
FILENAME: PLOT DATE: 2013\06\07 PLOT TIME: 9:38:44 AM



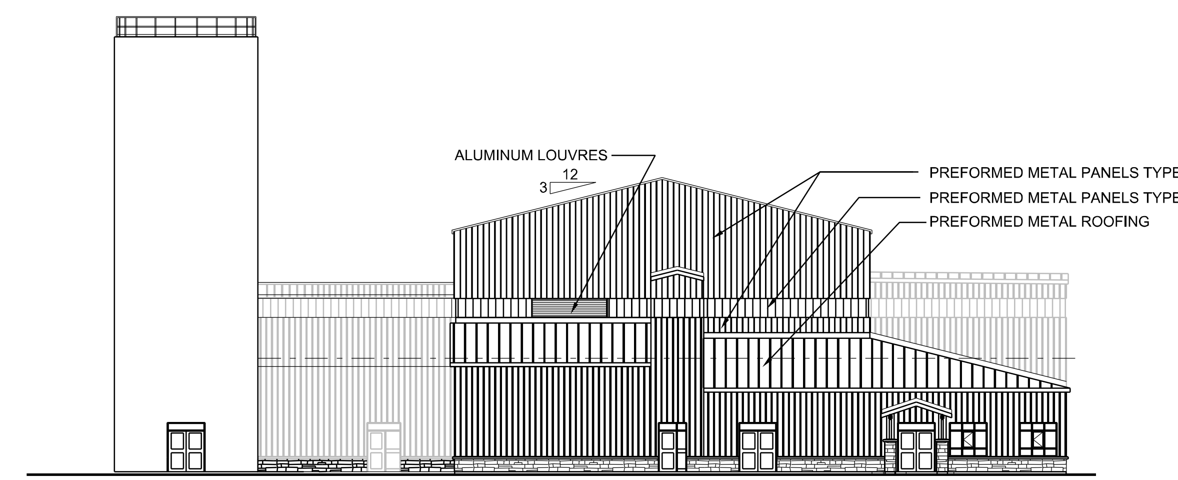
EAST ELEVATION
SCALE 1:150



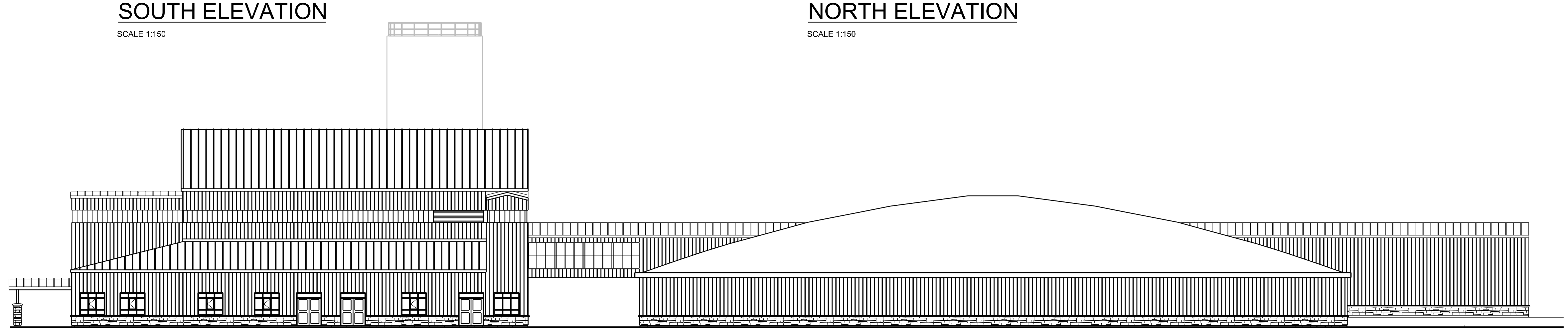
EAST ELEVATION
SCALE 1:150



SOUTH ELEVATION
SCALE 1:150



NORTH ELEVATION
SCALE 1:150



WEST ELEVATION
SCALE 1:150

0 1500 3000 4500 6000 7500

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ARCHITECTURAL
ELEVATIONS

1:150
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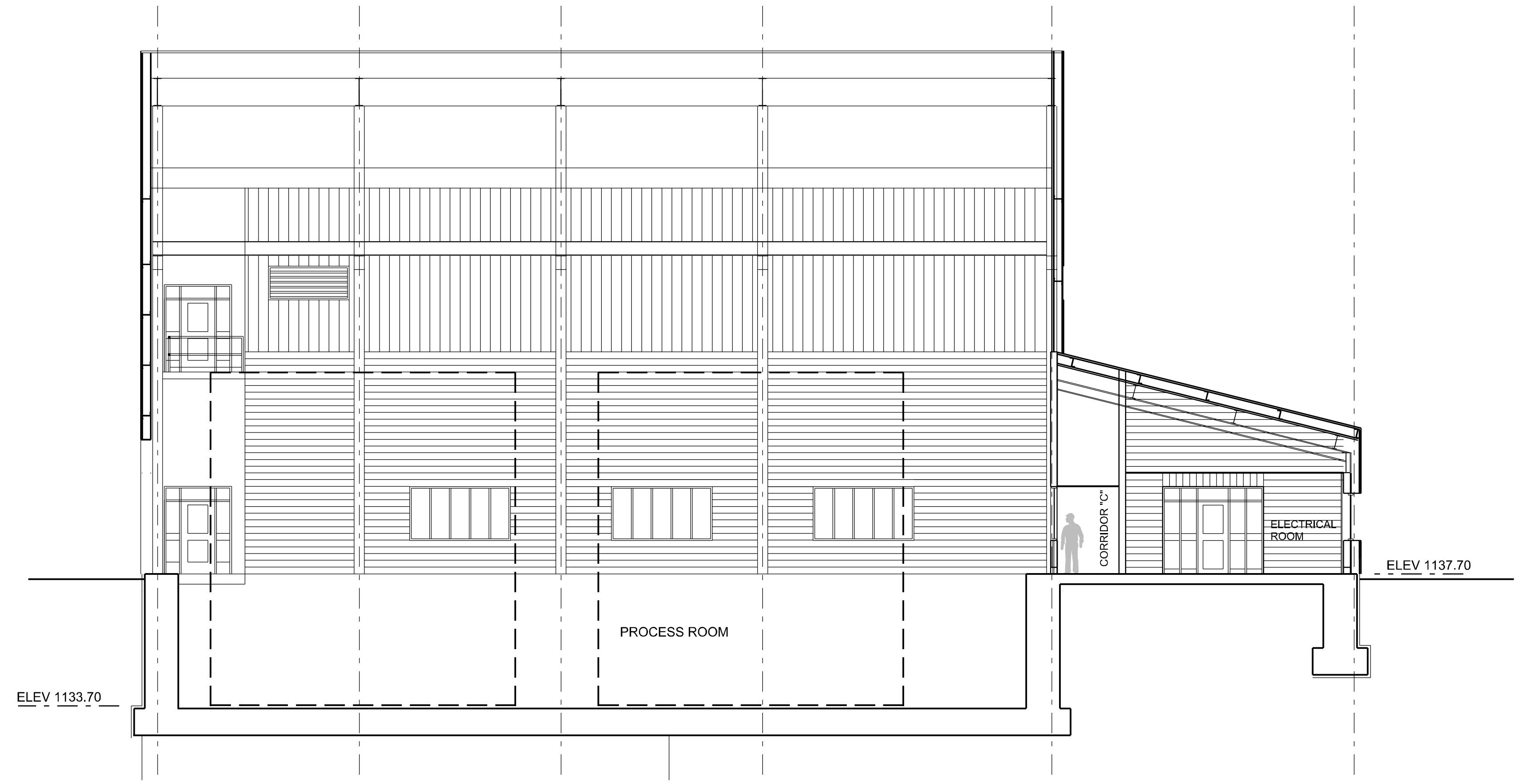
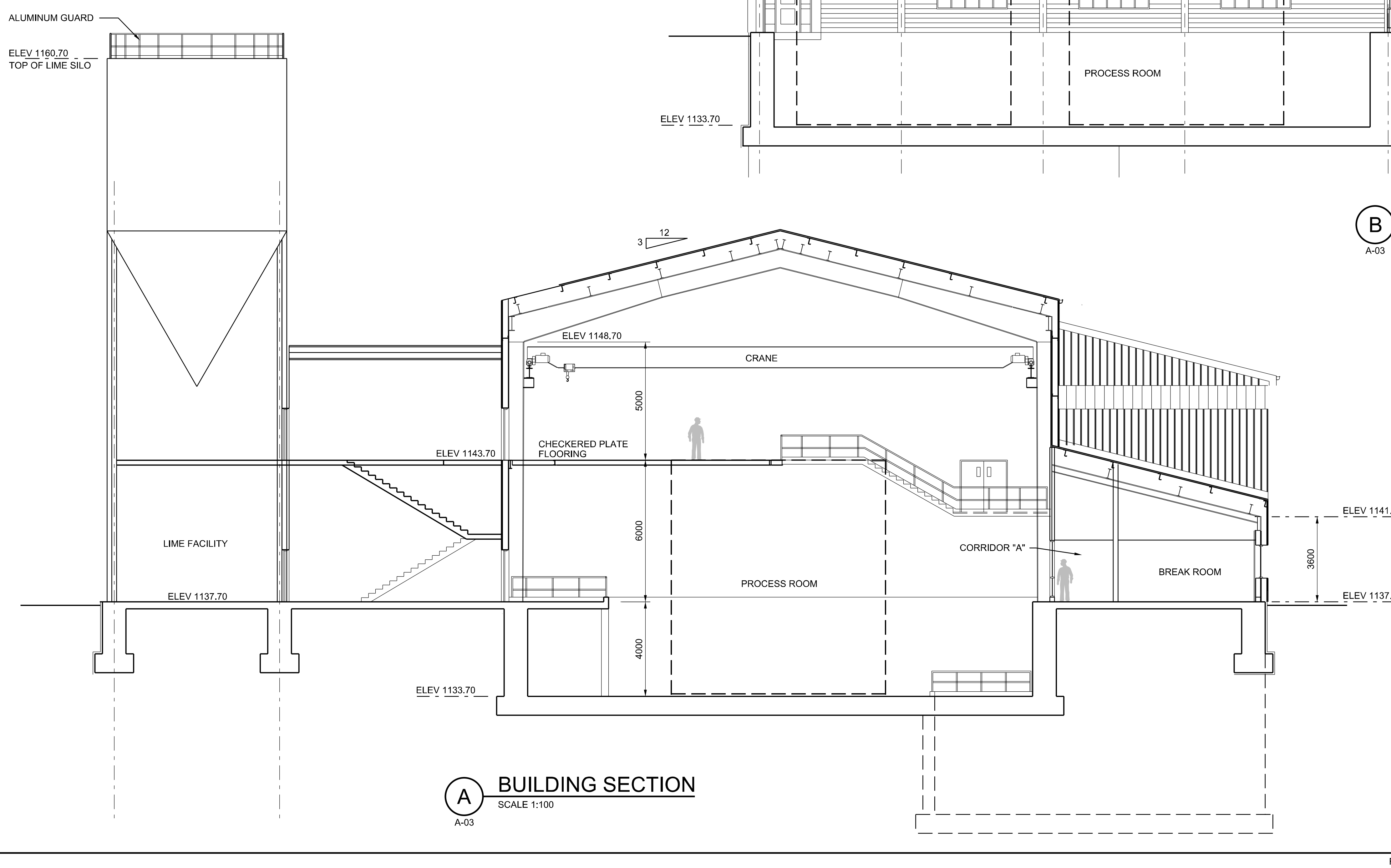


B LONGITUDINAL SECTION
SCALE 1:100
A-03



A BUILDING SECTION
SCALE 1:100
A-03

0 1500 3000 4500 6000 7500

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GOVERNMENT OF YUKON
DESIGN

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ARCHITECTURAL
SECTIONS

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MECHANICAL LEGEND AND NOTES

GENERIC PIPING NOTES

1. LAY PIPE TO UNIFORM GRADE BETWEEN INDICATED ELEVATION POINTS.
2. SIZE OF FITTINGS SHOWN ON DRAWINGS SHALL CORRESPOND TO ADJACENT STRAIGHT RUN OF PIPE, UNLESS OTHERWISE INDICATED. TYPE OF JOINT AND FITTING MATERIAL SHALL BE THE SAME AS SHOWN FOR ADJACENT STRAIGHT RUN OF PIPE.
3. LOCATION AND NUMBER OF PIPE HANGERS AND PIPE SUPPORTS SHOWN IS ONLY APPROXIMATE. CONTRACTOR SHALL DESIGN SUPPORTS AS SPECIFIED.
4. ALL JOINTS SHALL BE WATERTIGHT. WALL PIPES SHALL BE USED WHEREVER PIPING PASSES FROM A STRUCTURE TO BACKFILL.
5. ALL FLEXIBLE CONNECTORS AND COUPLING ADAPTERS SHALL BE PROVIDED WITH THRUST PROTECTION AS SPECIFIED, UNLESS OTHERWISE NOTED. THRUST PROTECTION SHALL BE ADEQUATE FOR TEST PRESSURES SPECIFIED.
6. SYMBOLS, LEGENDS, AND PIPE USE IDENTIFICATIONS SHOWN SHALL BE FOLLOWED THROUGHOUT THE DRAWINGS, WHEREVER APPLICABLE. NOT ALL OF THE VARIOUS PIPING COMPONENTS ARE NECESSARILY USED IN THE PROJECT.
7. ALL BURIED PIPING SPECIFIED TO BE PRESSURE TESTED, EXCEPT FLANGED, WELDED, OR SCREWED PIPING, SHALL BE PROVIDED WITH THRUST PROTECTION AS SPECIFIED, UNLESS OTHERWISE NOTED.
8. NUMBER AND LOCATION OF UNIONS SHOWN ON DRAWINGS IS ONLY APPROXIMATE. PROVIDE ALL UNIONS NECESSARY TO FACILITATE CONVENIENT REMOVAL OF VALVES AND MECHANICAL EQUIPMENT.
9. WHERE A GROOVED END COUPLING IS SHOWN, IT SHALL BE THE RIGID JOINT TYPE, UNLESS OTHERWISE SPECIFIED. WHERE A FLANGED COUPLING ADAPTER IS SHOWN, A STANDARD FLANGE SHALL BE JOINED TO THE COUPLING ADAPTER.

PIPE SUPPORT SYMBOLS

DOUBLE LINE | SINGLE LINE

- HORIZONTAL PIPE ANCHOR
- HORIZONTAL PIPE GUIDE
- VERTICAL SUPPORT FOR HORIZONTAL PIPING (WITH OR WITHOUT SPRING HANGER)
- VERTICAL PIPE GUIDE

PIPE AND FITTING SYMBOLS

DOUBLE LINE | SINGLE LINE

- EXISTING PIPE
- EXISTING PIPE TO BE ABANDONED
- EXISTING PIPE TO BE REMOVED
- NEW PIPE
- SCREWED JOINT
- WELDED JOINT
- GROOVED END JOINT
- FLANGED JOINT
- BELL & SPIGOT JOINT
- BALL JOINT
- FLANGED COUPLING ADAPTER
- FLEXIBLE COUPLING
- FLANGED METAL BELLOWS EXP JOINT
- FLANGED ELASTOMER BELLOWS EXPANSION JOINT
- FLANGED ELBOW UP
- FLANGED ELBOW DOWN
- FLANGED TEE UP
- FLANGED TEE DOWN
- FLANGED LATERAL UP
- FLANGED LATERAL DOWN
- FLANGED CONCENTRIC REDUCER
- FLANGED ECCENTRIC REDUCER
- SCREWED REDUCING BUSHING
- SCREWED UNION

DOUBLE LINE | SINGLE LINE

- SCREWED CAP
- WELDED CAP
- FLANGED ELBOW, 90 DEGREE
- FLANGED CROSS
- FLANGED TEE
- FLANGED ELBOW, 45 DEGREE
- FLANGED WYE
- FLANGED TRUE WYE
- FUTURE PIPE
- FLEXIBLE COUPLING WITH THRUST TIES
- BELLOWS EXPANSION JOINT WITH THRUST TIES
- TRI-CLAMP FITTING
- FLANGED FLEXIBLE BRAIDED COUPLING
- FLANGED ELBOW, 90 DEGREE LONG RADIUS (LR)
- FLANGED ELBOW, 90 DEGREE REDUCING (RED)
- FLANGED CROSS, REDUCING
- FLANGED TEE, REDUCING

VALVE SYMBOLS

SINGLE LINE | DOUBLE LINE

- GATE
- KNIFE GATE (K)
- BUTTERFLY
- GLOBE
- BALL
- SEATING PORT
- ECCENTRIC PLUG
- PLUG OR COCK
- NEEDLE
- DIAPHRAGM
- PINCH
- SWING CHECK
- BALL CHECK
- VEE-BALL (V)
- HOSE VALVE (HV- X) OR (V-X) X = NO. IN SPECS

- REGULATED SIDE
- PRESSURE CONTROL (INTERNAL PILOT)
- REGULATED SIDE
- PRESSURE CONTROL (EXTERNAL PILOT)
- MULTI-PORT VALVE, ARROWS INDICATE FLOW PATTERN. SEATING PORTS ARE IMPLIED BY INDICATED FLOW PATTERN.
- BACKPRESSURE REGULATOR SELF CONTAINED
- BACKPRESSURE REGULATOR WITH EXTERNAL PRESSURE TAP
- BACKFLOW PREVENTER
- ROTARY
- MULTI-PORT VALVE (GATE VALVE SHOWN. FOR OTHER VALVE TYPES, APPROPRIATE VALVE SYMBOL SHOWN.) SEAT PORTS ARE IMPLIED BY INDICATED FLOW PATTERN.
- ANGLE GATE

- MUD
- PRESSURE RELIEF
- AIR AND/OR VACUUM RELEASE
- EXPLOSION RELIEF
- THERMAL
- TELESCOPING SCUM VALVE
- SUCTION GUIDE C/W STRAINER
- FLOW CONTROL VALVE
- RELIEF VALVE (PRESSURE & TEMPERATURE) (DR)
- 'Y' STRAINER
- DRAIN VALVE C/W HOSE END CONNECTION
- PIPE TO NEAREST DRAIN
- SAMPLE (S)
- CIRCUIT BALANCING VALVE

PIPING SYMBOLS

- PULSATION DAMPNER, WATER HAMMER ARRESTOR
- CALIBRATION COLUMN
- LEAK DETECTION
- REDUCER
- BLIND FLANGE
- DIELECTRIC UNION (D)
- EXPANSION JOINT
- AIR/ VACUUM RELEASE
- AUTOMATIC AIR VENT (AV)
- AIR SEPARATOR (S)
- PIPE PLUG
- DOUBLE CONTAINMENT PIPING
- INSULATED PIPING
- DOUBLE CONTAINED AND INSULATED PIPING
- INSULATED ELECTRIC TRACED PIPE X = INSULATION THICKNESS (X", ET)
- INSULATED STEAM TRACED PIPE X = INSULATION THICKNESS (X", STM)
- DUST COLLECTION HOSE
- REMOVABLE SPOOL (RS)

IN LINE DEVICE SYMBOLS

- STRAINER
- BLOW OFF STRAINER
- DUPLEX STRAINER
- SIGHT GLASS
- FLEXIBLE (ELASTOMER) PIPE CONNECTION
- CAPILLARY TUBE
- BASKET STRAINER
- BASKET STRAINER
- WAFER SIGHT GLASS
- STEAM TRAP X = IDENTIFICATION NO. (T, X)
- STEAM TRAP ASSEMBLY X = TRAP IDENTIFICATION NO. (X)
- FILTER/ REGULATOR/ LUBRICATOR
- STERILE SAMPLE PORT (SP-) (S)
- RESIN TRAP
- GRAVITY FLOW DRAINAGE PIPING WITH AIR GAP
- HOUSE VACUUM PORT (SHEMATIC)
- HOUSE VACUUM PORT (PLAN & ELEVATION)
- ORIFICE PLATE (PRESSURE REDUCING)
- LOAD CELL
- FILTER

- IN-LINE MIXER
- DAMPER
- EJECTOR/ EDUCTOR
- T-TYPE STRAINER
- CONE STRAINER
- TEMPORARY STRAINER
- DESUPERHEATER (DS)
- ROTATING SPRAY BALL
- FIXED SPRAY BALL
- BASKET STRAINER W/ DRAIN VALVE
- AIR INLET FILTER
- LOOP SEAL
- DETONATION ARRESTOR (D)
- FLAME ARRESTOR (F)
- IN-LINE SILENCER (S)
- VENT SILENCER (S)
- VENT COVER
- BREATHER

NO.	DATE	REVISION	BY	APVD

DSGN JP NYWENING | DR P KWONG | CHK | APVD

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

PROCESS MECHANICAL
GENERAL STANDARD NOTES
LEGEND & ABBREVIATION

NTS
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING. 0 25mm

DATE	
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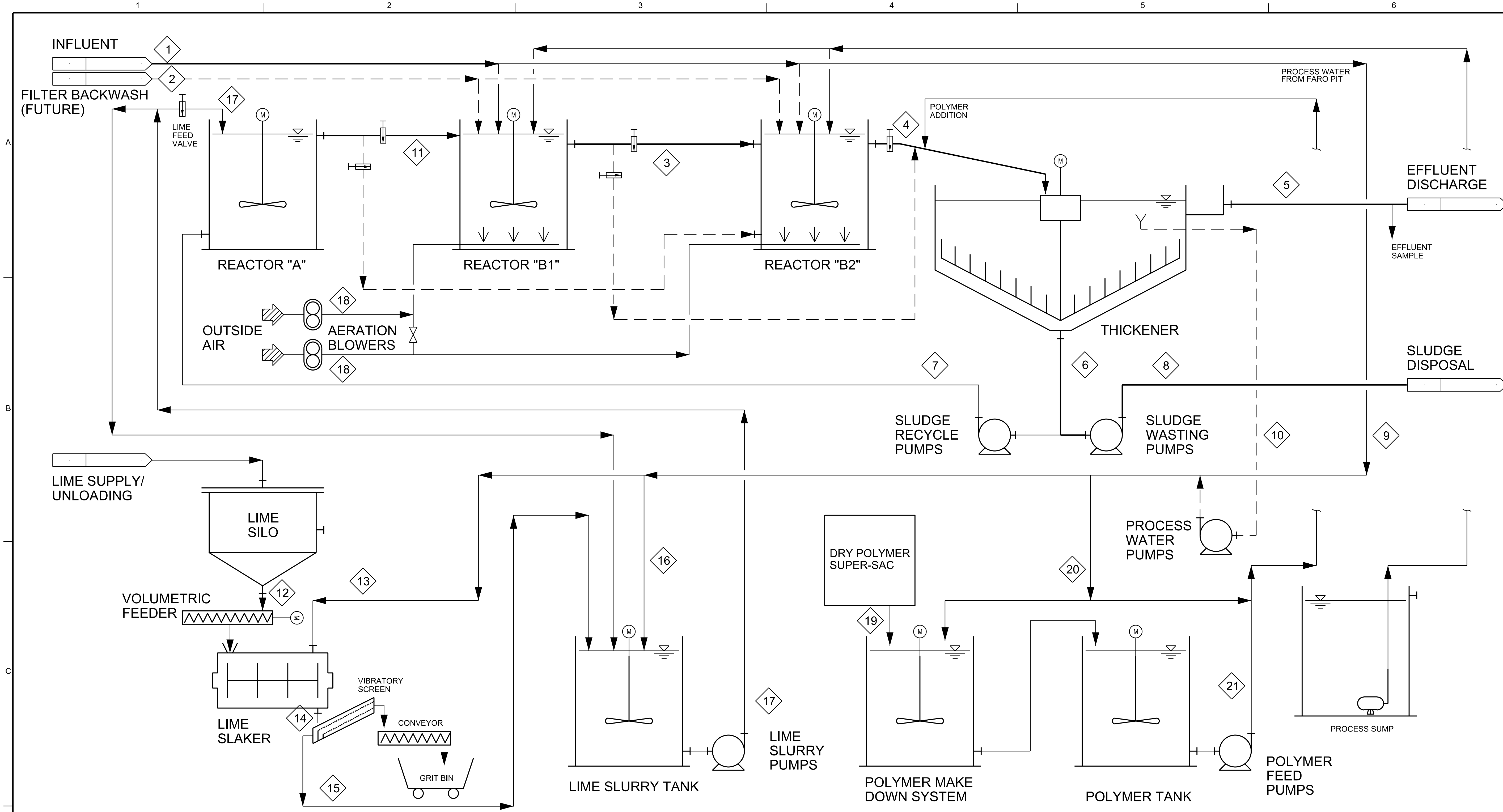


MASS BALANCE TABLE

STREAM No. AND DESCRIPTION

FLOW CONDITION	DESCRIPTION	UNITS	1 TOTAL INFLUENT	2 FILTER BACKWASH	3 REACTOR B1 DISCHARGE	4 REACTOR B2 DISCHARGE	5 THICKENER EFFLUENT	6 THICKENER UNDER FLOW	7 SLUDGE RECYCLE	8 SLUDGE WASTING (1)	9 PRIMARY PROCESS WATER	10 ALTERNATE PROCESS WATER	11 REACTOR A EFFLUENT	12 BULK LIME (2)	13 SLAKER WATER	14 SLAKED LIME TO CLASSIFIER	15 SLAKED LIME (3)	16 LIME SLURY DILUTION WATER	17 LIME SLURRY FEED (4)	18 BLOWERS (EACH)	19 DRY POLYMER	20 DILUTION WATER	21 POLYMER SOLUTION (5)
HYDRAULIC MAX	FLOW	m3/day	54,500	4,870	63,750	63,750	60,140	5,140	3,950	1,180	938	0	4,370	35	146	154	152	269	421	18,000	0.78	523	524
	SOLIDS CONCN	mg/L	-		20,400	20,400	15	317,000	317,000	317,000	15	15	297,000	-	15	292,000	273,000	15	106,000	-	-	15	1,000
	SPECIFIC GRAVITY		1.00	1.00	1.01	1.01	1.00	1.22	1.22	1.22	1.00	1.00	1.21	0.96	1.00	1.17	1.17	1.00	1.06	-	0.69	1.00	1.00
NORMAL MAX	FLOW	m3/day	44,100	3,350	51,870	51,870	48,250	5,140	3,950	1,180	938	0	4,370	35	146	154	152	269	421	18,000	0.76	523	524
	SOLIDS CONCN	mg/L	-		25,100	25,100	15	317,000	317,000	317,000	15	15	297,000	-	15	292,000	273,000	15	106,000	-	-	15	1,000
	SPECIFIC GRAVITY		1.00	1.00	1.02	1.02	1.00	1.22	1.22	1.22	1.00	1.00	1.21	0.96	1.00	1.17	1.17	1.00	1.06	-	0.69	1.00	1.00
AVERAGE AT START UP	FLOW	m3/day	23,400	1,760	26,170	26,170	25,290	1,070	930	140	117	0	970	3.3	13	14	14	25	39	1,500	0.11	79	79
(FIRST 20-25 YRS OF	SOLIDS CONCN	mg/L	-		8,500	8,500	15	233,000	233,000	233,000	15	15	228,000	-	15	292,000	273,000	15	106,000	-	-	15	1,000
OPERATION)	SPECIFIC GRAVITY		1.00	1.00	1.01	1.01	1.00	1.17	1.17	1.17	1.00	1.00	1.16	0.96	1.00	1.17	1.17	1.00	1.06	-	0.69	1.00	1.00
NORMAL MIN	FLOW	m3/day	11,700	1,370	13,570	13,570	13,140	540	470	70	60	0	490	1.6	6.7	7.1	7.0	12	19	800	0.06	41	41
	SOLIDS CONCN	mg/L	-		8,200	8,200	15	233,000	233,000	233,000	15	15	228,000	-	15	292,000	273,000	15	106,000	-	-	15	1,000
	SPECIFIC GRAVITY		1.00	1.00	1.01	1.01	1.00	1.17	1.17	1.17	1.00	1.00	1.16	0.96	1.00	1.17	1.17	1.00	1.06	-	0.69	1.00	1.00

NOTES :
(1) @ 4 HOURS/DAY
(2) ASSUMING 95% ACTIVE CaO
(3) @ 25 WEIGHT %
(4) @ 10 WEIGHT %
(5) @ 0.1 WEIGHT %

FILENAME: 500-D-0002_436662.dgn PLOT DATE: 2013\06\07 PLOT TIME: 9:39:18 AM

NO. DATE REVISION BY APVD
DSGN JP NYWENING DR R THORLEY CHK APVD

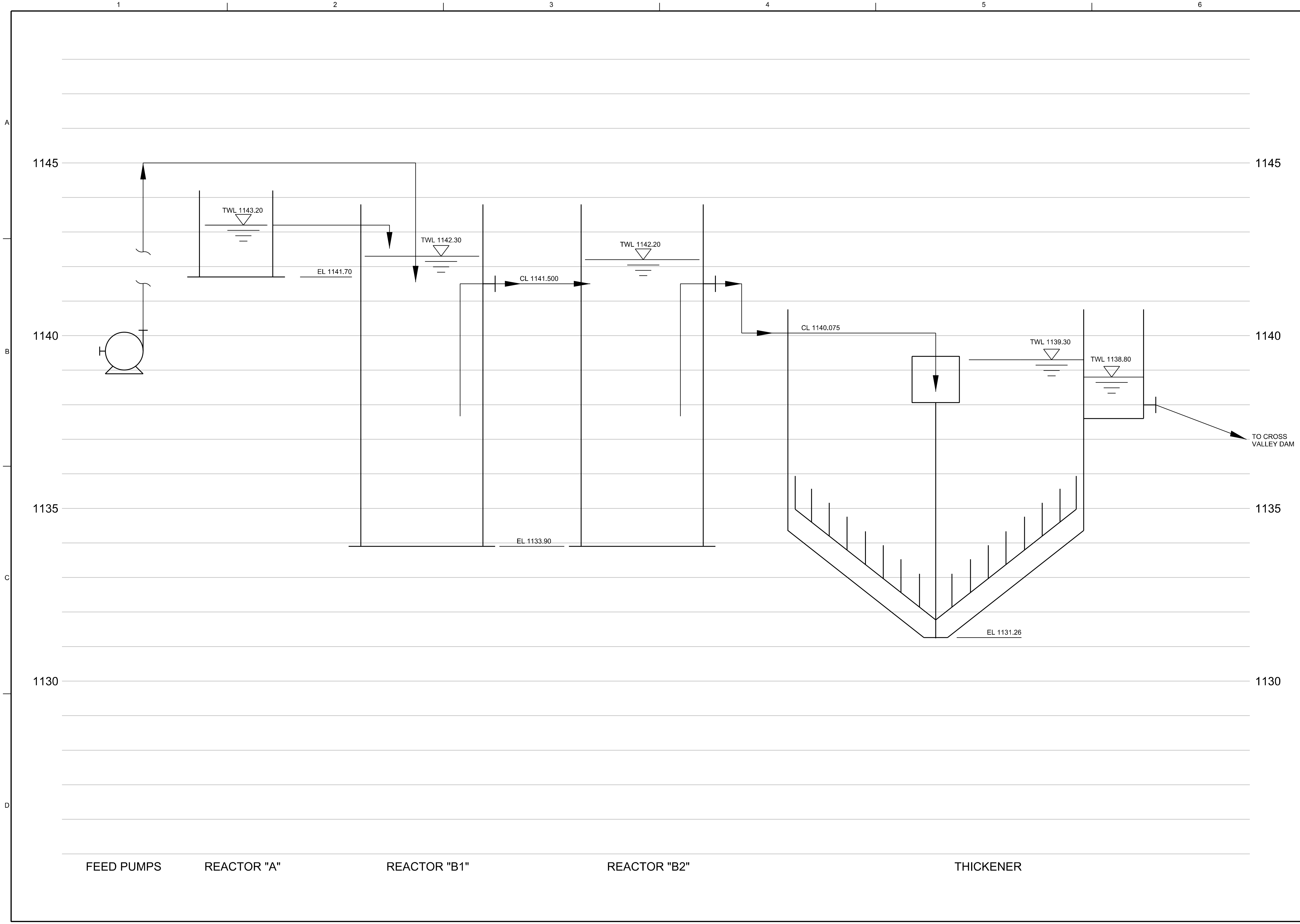
FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

PROCESS MECHANICAL
PROCESS FLOW DIAGRAM AND MASS BALANCE

NTS
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE
PROJ 436662
DWG 500-D-0002
SHEET



NO.	DATE	REVISION	BY	APVD

DSGN JP NYWENING
DR R THORLEY
CHK
APVD

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

PROCESS MECHANICAL
HYDRAULIC PROFILE

NTS
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
PROJ	436662
DWG	500-D-0003
SHEET	

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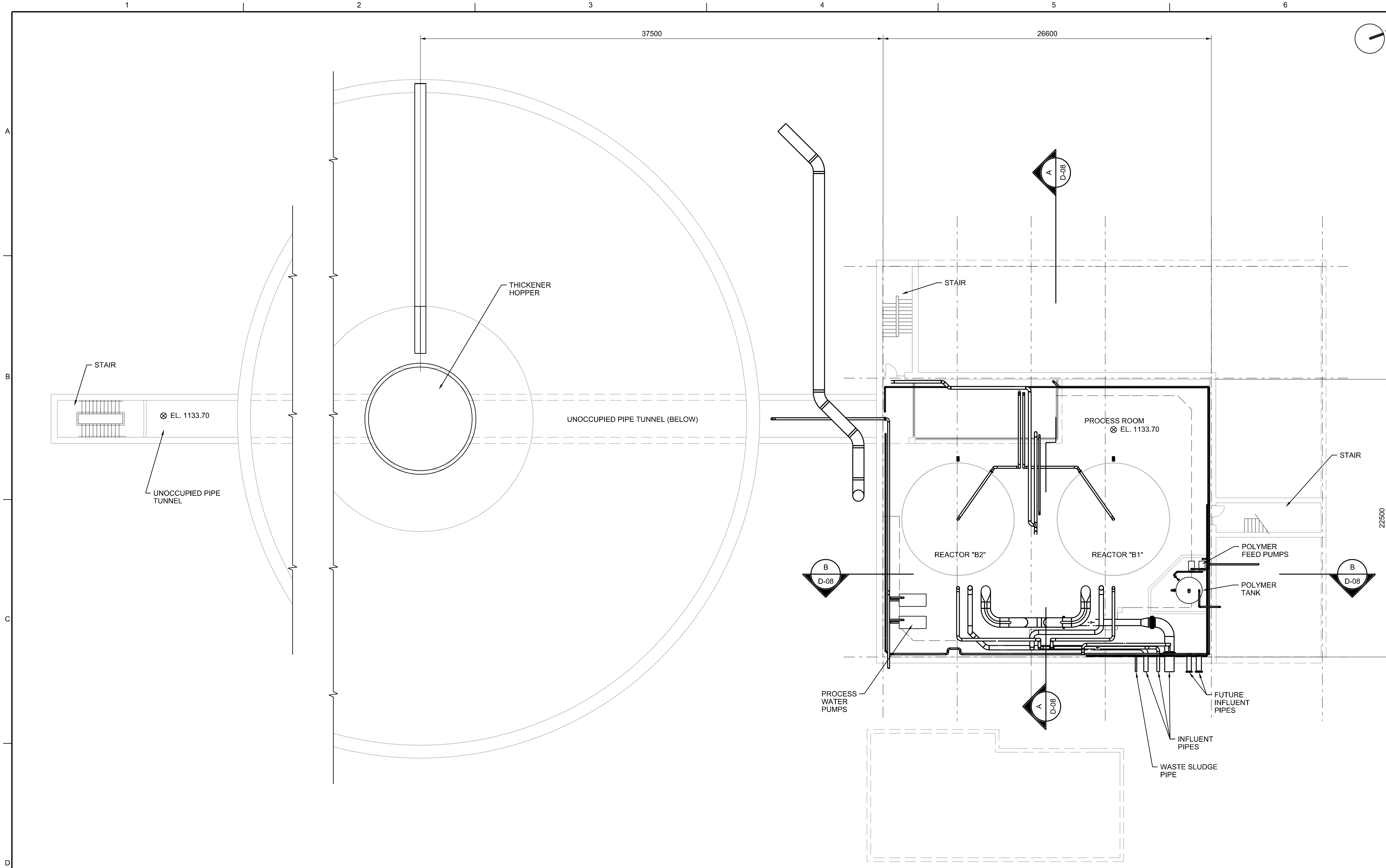

PROCESS AREA AT EL 1133.70

1:150

0 1500 3000 4500 6000 7500

NO.	DATE	REVISION	BY	APVD

DSGN JP NYWENING | DR | R THORLEY | CHK | APVD

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

PROCESS MECHANICAL
PROCESS BUILDING
PROCESS AREA AT EL 1133.70

1 : 150
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
PROJ	436662
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SHEET	

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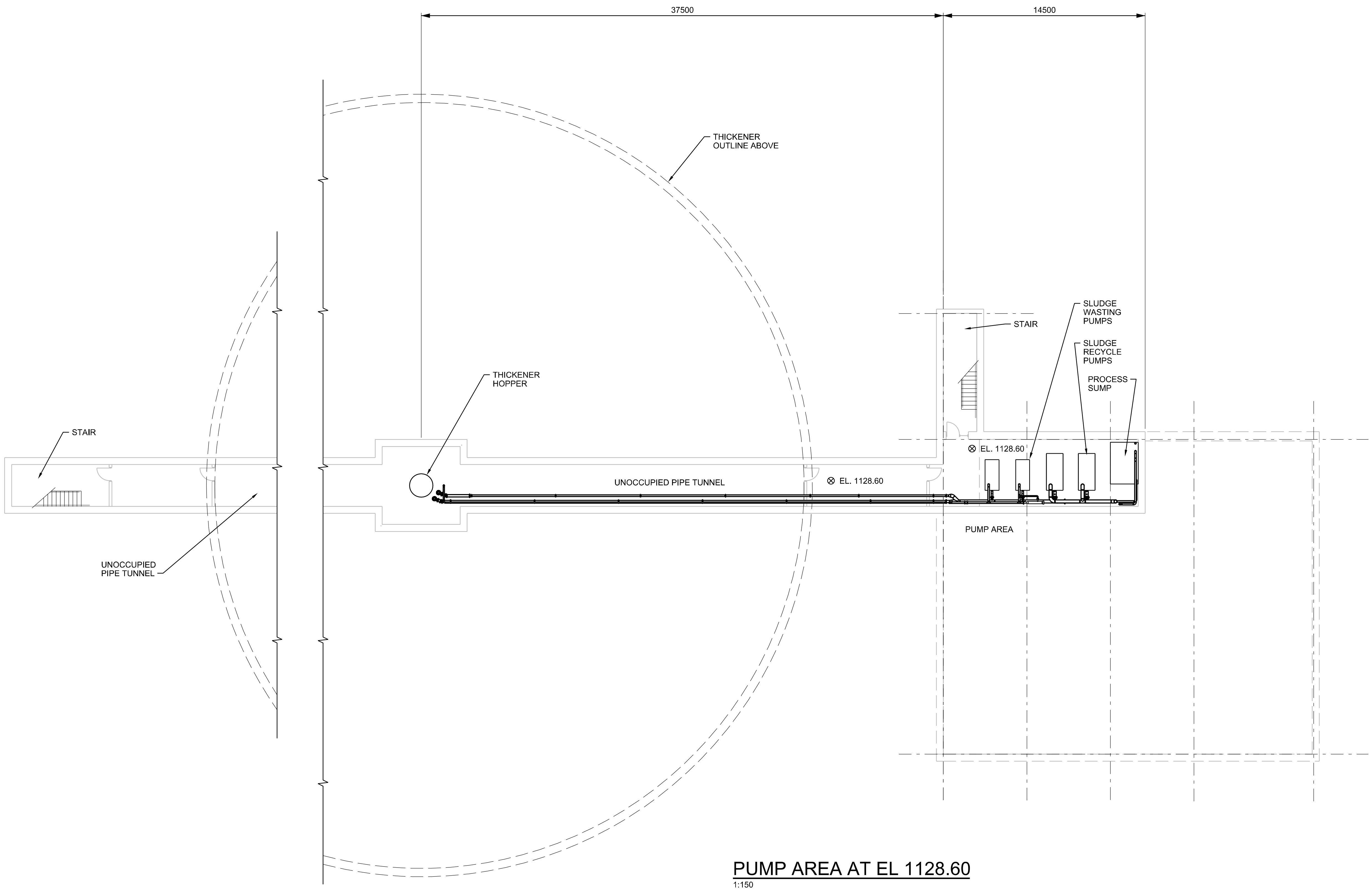

PUMP AREA AT EL 1128.60

1:150

NO.	DATE	REVISION	BY	APVD

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DR R THORLEY
CHK
APVD

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

PROCESS MECHANICAL
PROCESS BUILDING
PUMP AREA AT EL 1128.60

1 : 150
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
PROJ	436662
DWG	500-D-0004
SHEET	

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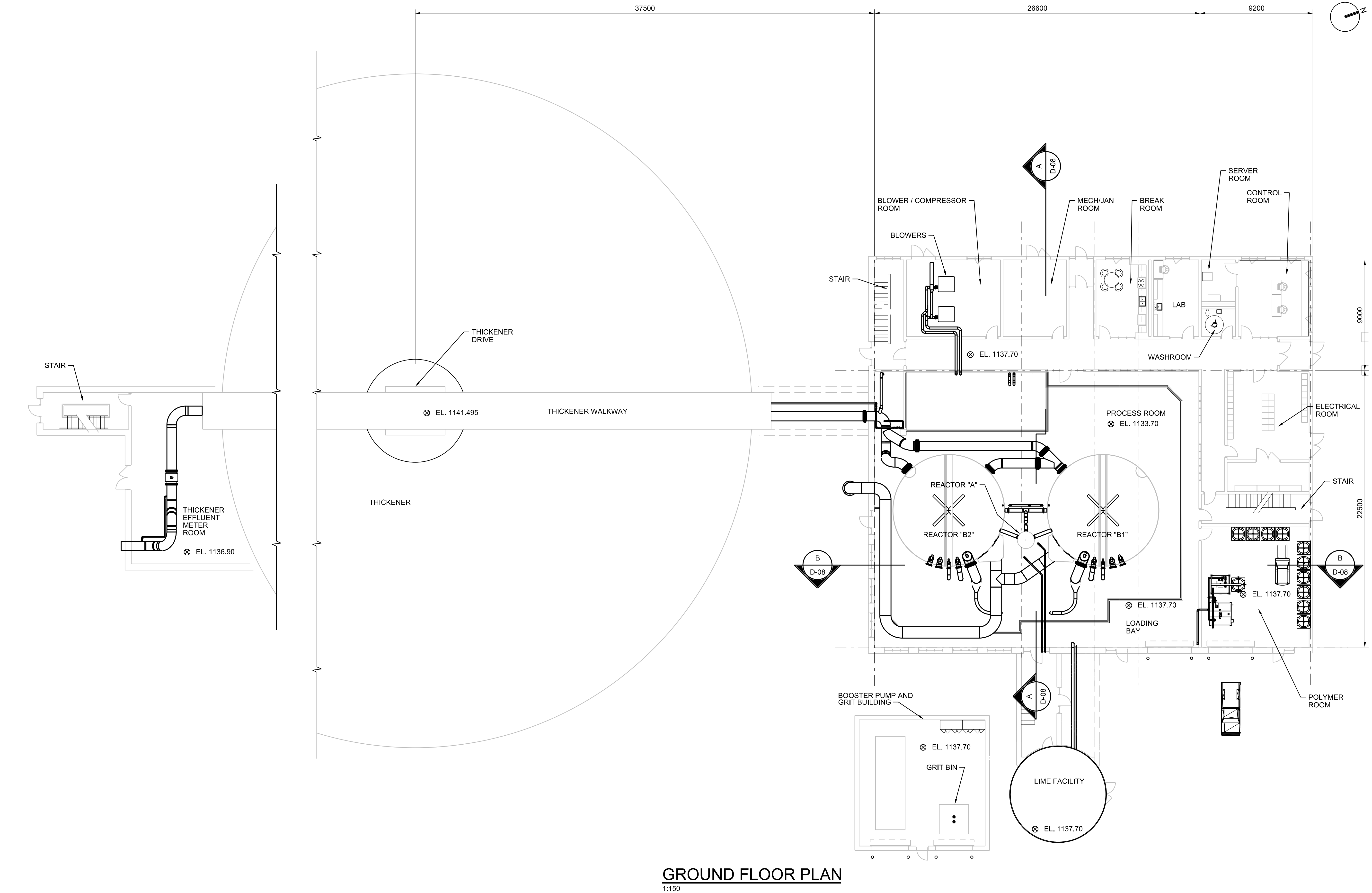

NO.	DATE	REVISION	BY	APVD

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FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

PROCESS MECHANICAL
PROCESS BUILDING
GROUND FLOOR PLAN

1 : 150
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
PROJ	436662
DWG	500-D-0006
SHEET	

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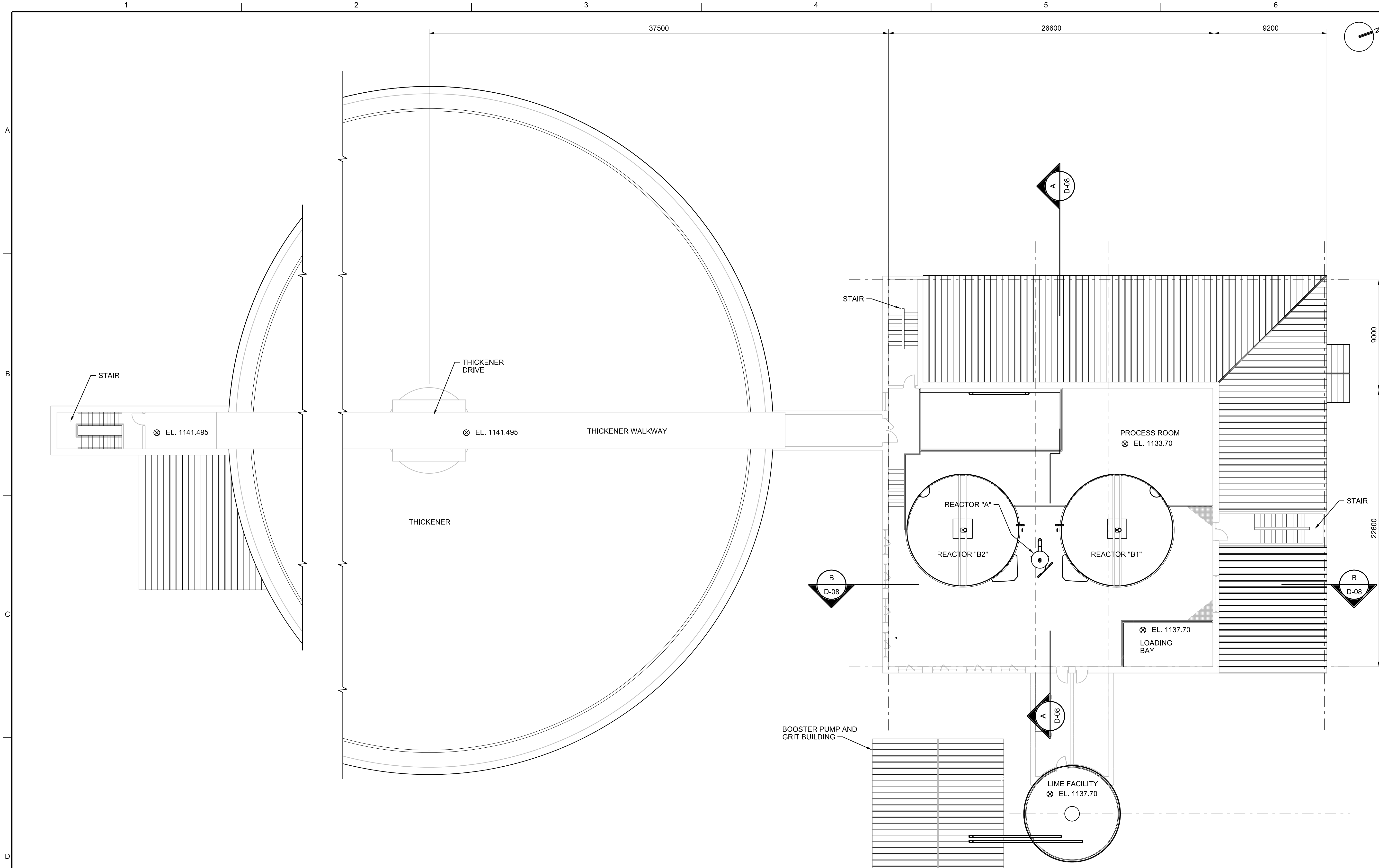

GROUND FLOOR PLAN

1:150

NO. | DATE | REVISION | BY | APVD

DSGN JP NYWENING | DR | CHK R THORLEY | APVD

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

PROCESS MECHANICAL
PROCESS BUILDING
PLATFORM FLOOR PLAN

1 : 150
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
PROJ	436662
DWG	500-D-0007
SHEET	

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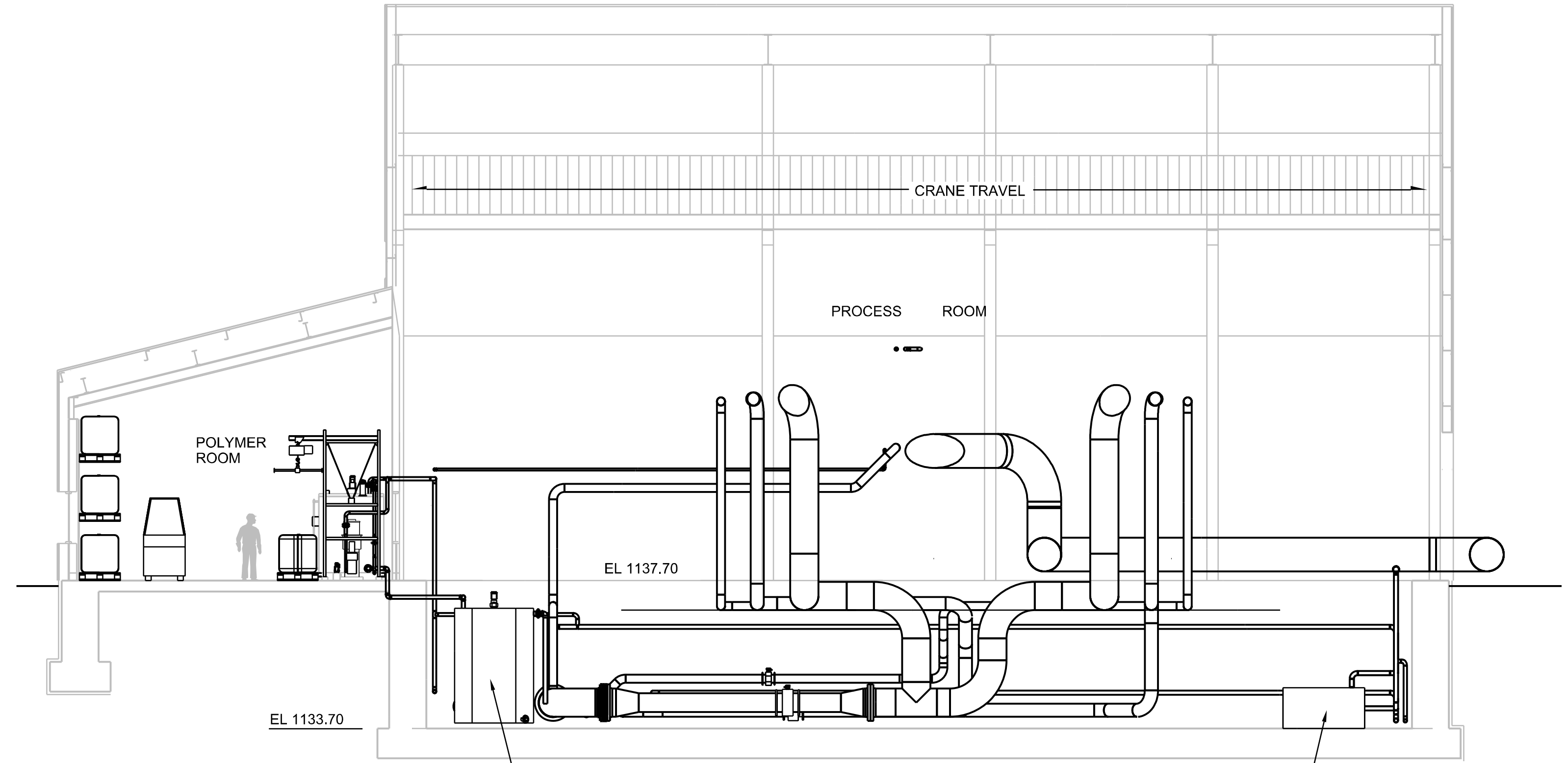
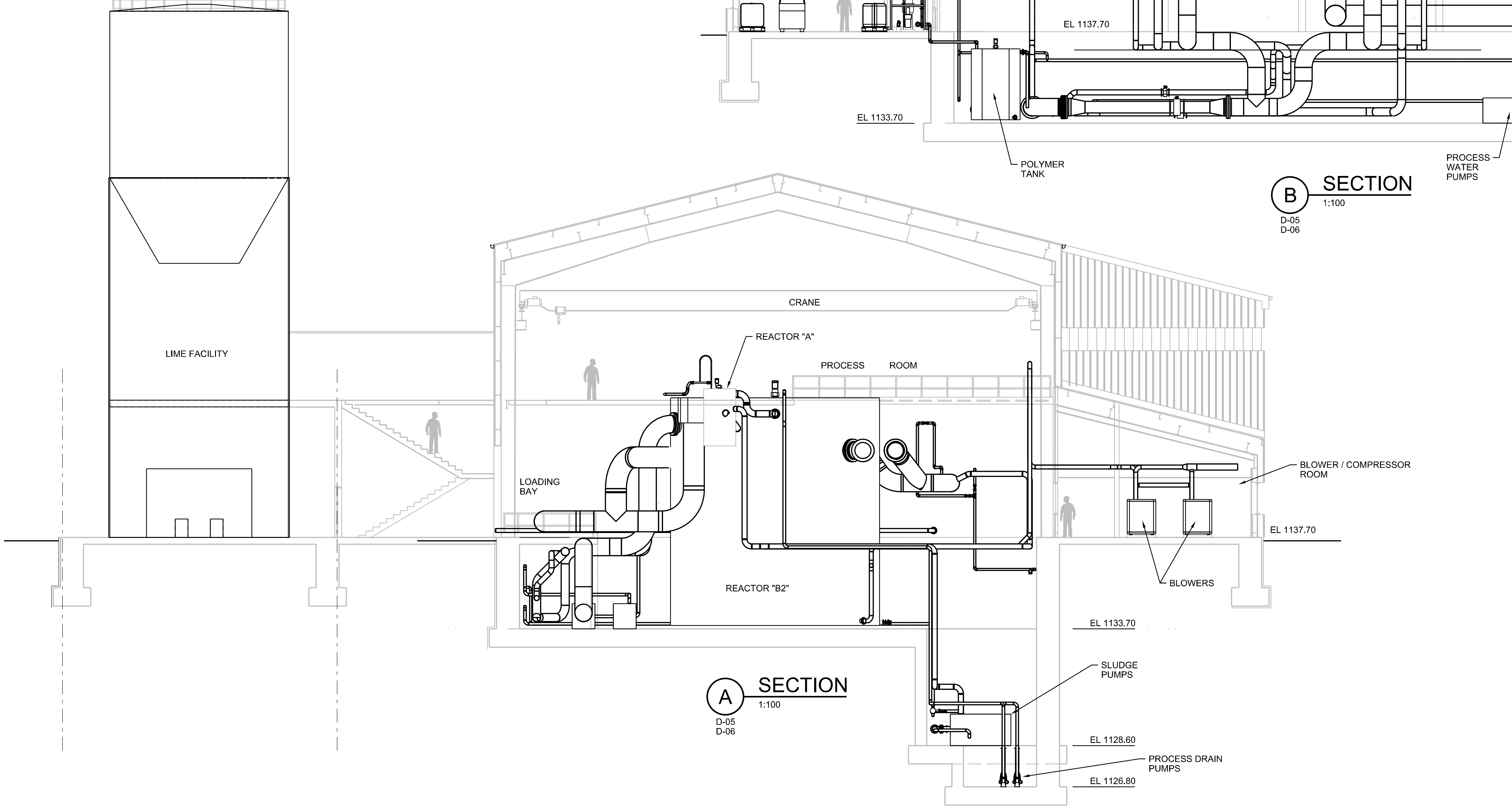


B SECTION
1:100
D-05
D-06



A SECTION
1:100
D-05
D-06

0 1000 2000 3000 4000 5000

NO.	DATE	REVISION	BY	APVD

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DR R THORLEY
CHK
APVD

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

PROCESS MECHANICAL
PROCESS BUILDING
SECTIONS

1 : 100
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE
PROJ 436662
DWG 500-D-0008
SHEET

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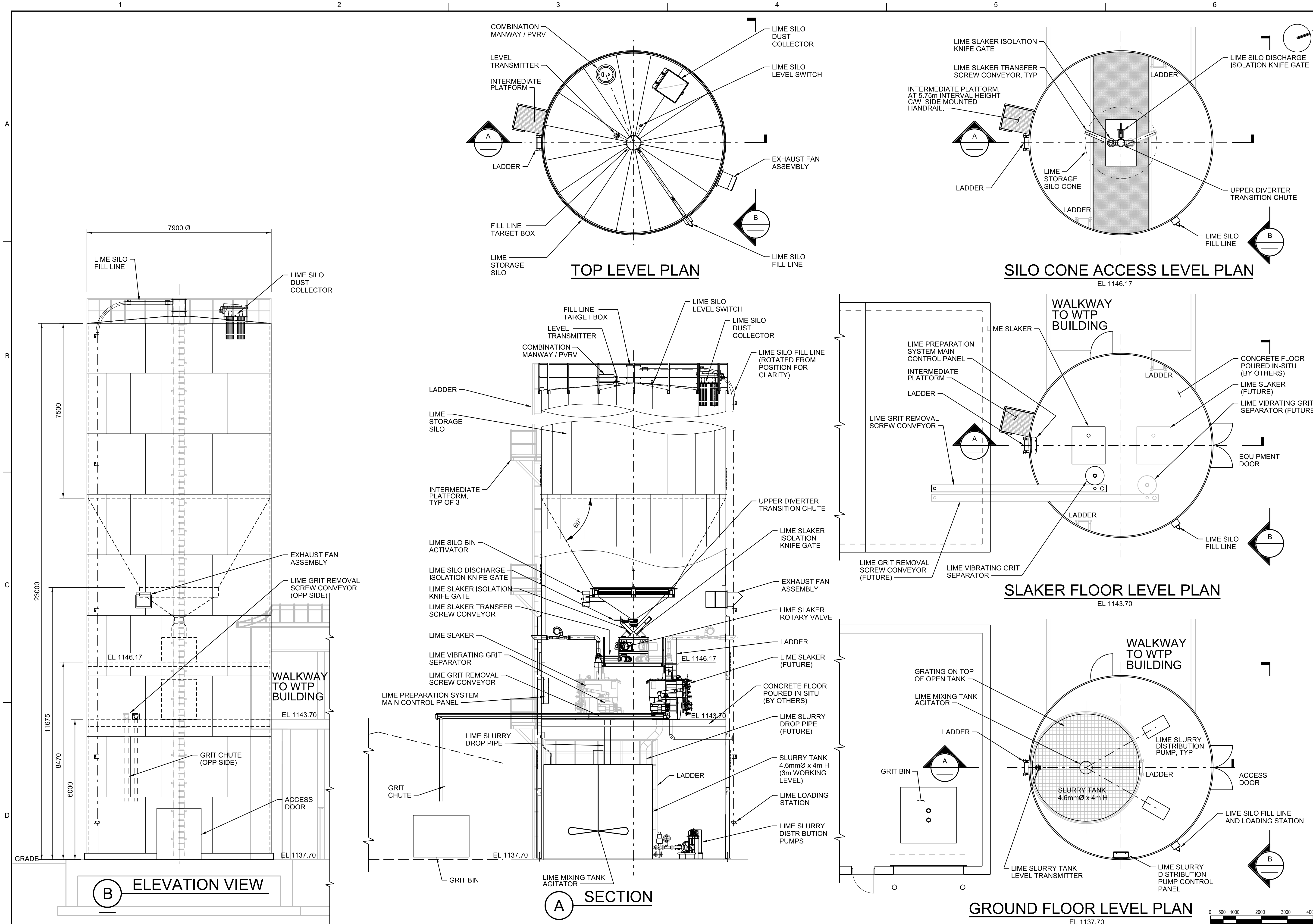

NO.	DATE	REVISION	BY	APVD

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FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL

PROCESS MECHANICAL
PROCESS BUILDING
LIME FACILITY DETAILS

1 : 75
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
PROJ	436662
DWG	500-D-0009
SHEET	

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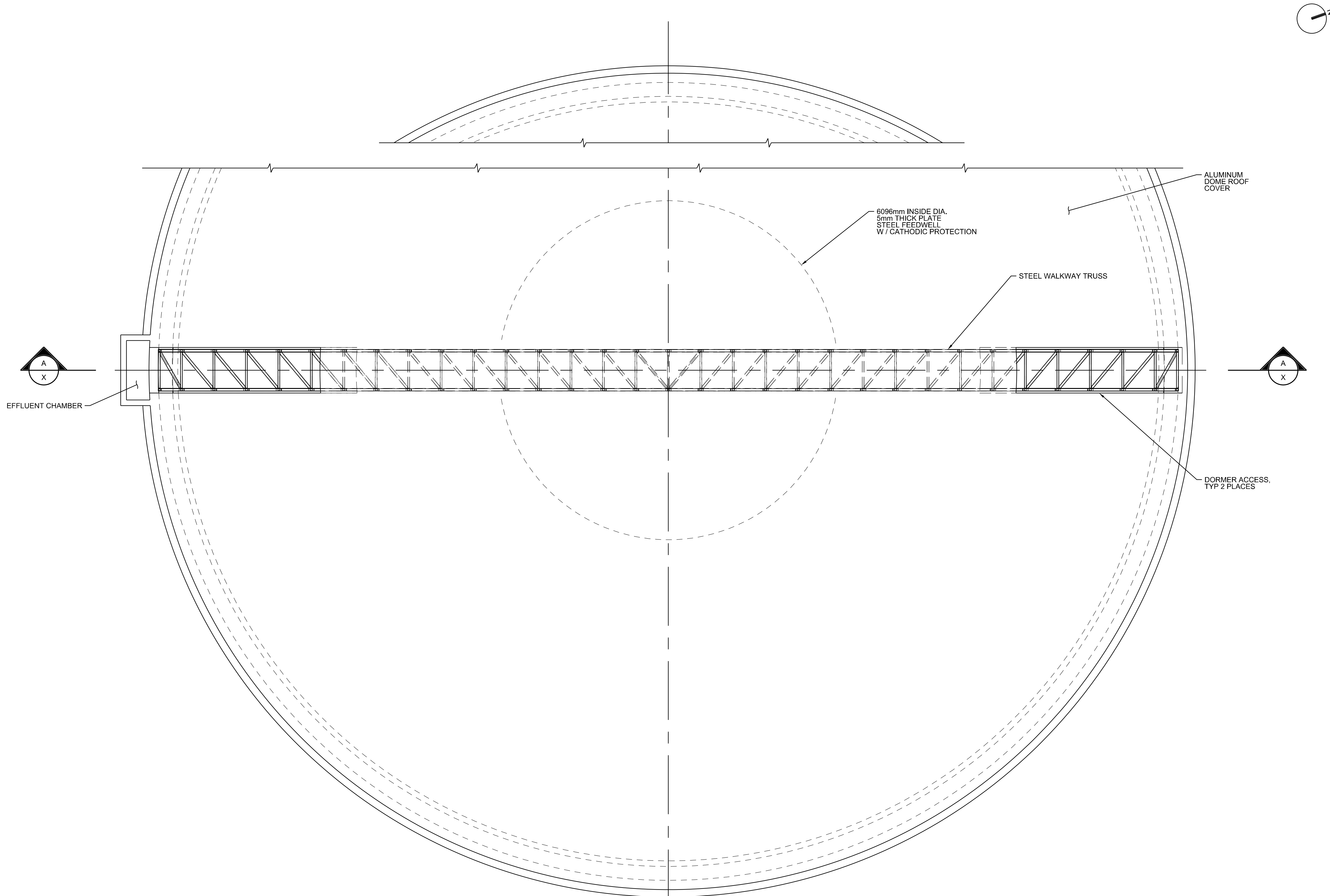

THICKENER - PLAN

0 1000 2000 3000 4000 5000

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DSGN	R CHIN	DR	P KWONG	CHK	APVD

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

PROCESS MECHANICAL
THICKENER
PLAN

1:100
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
PROJ	436662
DWG	500-D-0010
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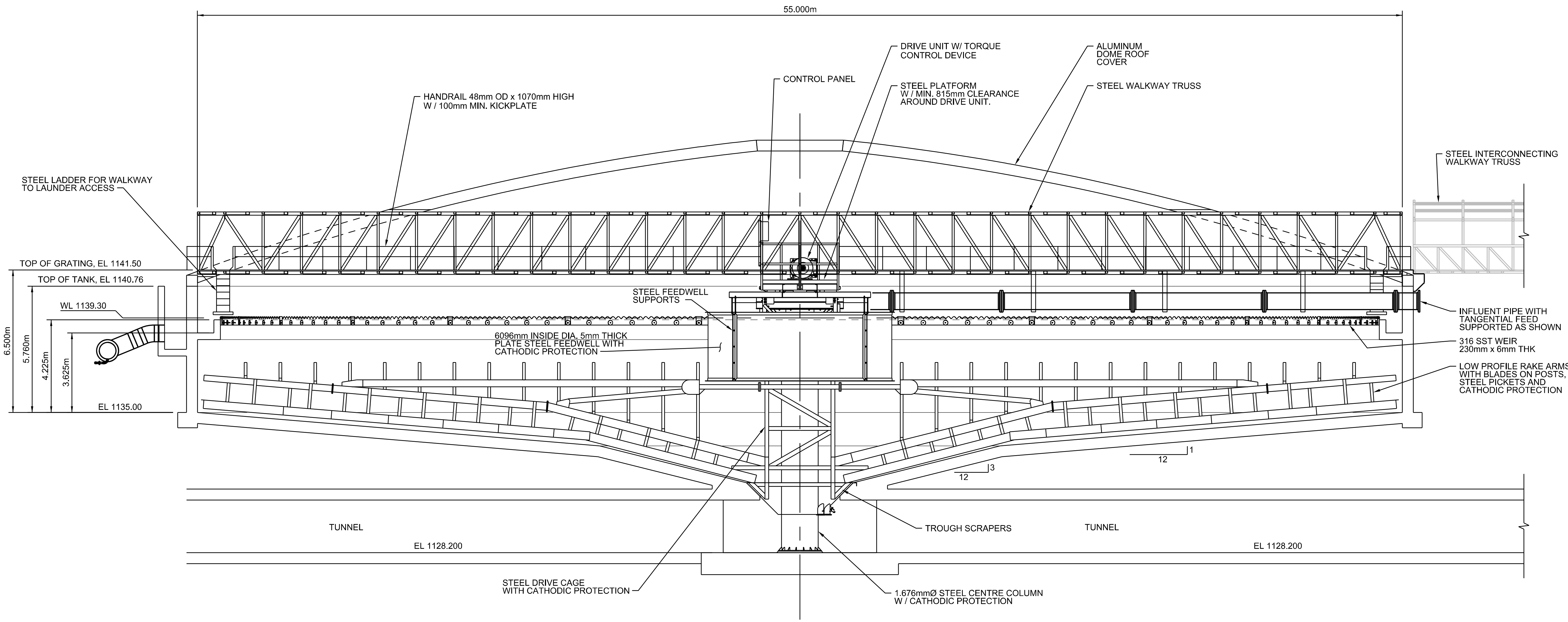

A SECTION

0 1000 2000 3000 4000 5000

NO.	DATE	REVISION	BY	APVD

DSGN	DR	CHK	APVD
	R CHIN	P KWONG	

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

PROCESS MECHANICAL
THICKENER
SECTION

1:100
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
PROJ	436662
DWG	500-D-0011
SHEET	x

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HVAC ABBREVIATIONS

ACU	AIR CONDITIONING UNIT
ACCU	AIR-COOLED CONDENSING UNIT
ACD	ACCESS DOOR
ACV	AUTOMATIC CONTROL VALVE
AFF	ABOVE FINISHED FLOOR
AHU	AIR HANDLING UNIT
AL	ALUMINUM
AS	AIR SEPARATOR
B/D	BALANCING DAMPER
BDD	BACKDRAFT DAMPER
BO	BOILER
BOD/BOG	BOTTOM OF DUCT/ BOTTOM OF GRILLE
B/V	BALANCING VALVE
C	COIL
CA	COMBUSTION AIR
CD	CEILING DIFFUSER
CGD	COMBUSTIBLE GAS DETECTION SYSTEM
CF	CEILING FAN
CG	CEILING GRILLE
CHWP	CHILLED WATER PUMP
CRP	CONDENSATE RETURN PUMP
CRU	CONDENSATE RETURN UNIT
CT	COOLING TOWER
CTP	COOLING TOWER PUMP
CUH	CABINET UNIT HEATER
CV	CONTROL VALVE
C/W	COMPLETE WITH
CWP	CONDENSER WATER PUMP
DG	DOOR GRILLE
DN	DOWN
DX	DIRECT EXPANSION
EA	EXHAUST AIR
EC	ELECTRIC CONVECTOR
EBH	ELECTRIC BASEBOARD HEATER
EDH	ELECTRIC DUCT HEATER
EF	EXHAUST FAN
EG	EXHAUST GRILLE
ER	EXHAUST REGISTER
ERH	ELECTRIC RADIANT HEATER
ESS	EMERGENCY SWITCH
ET	EXPANSION TANK
EUH	ELECTRIC UNIT HEATER
EWH	ELECTRIC WATER HEATER
FC	FAIL IN CLOSED POSITION
FD	FIRE DAMPER
FA	FRESH AIR
FFH	FORCE FLOW HEATER
FO	FAIL IN OPEN POSITION
FOB	FLAT ON BOTTOM
FOT	FLAT ON TOP
GA	GALVANIZED STEEL
GIV	GRAVITY INTAKE VENTILATOR
GRV	GRAVITY RELIEF VENTILATOR
HCG	HIGH CAPACITY GRILLE
HCP	HVAC CONTROL PANEL
HRU	HEAT RECOVERY UNIT
HU	HUMIDIFIER
HWH	HOT WATER HEATER
HWP	HEATING WATER PUMP
HHS	HOT WATER SUPPLY
HHR	HOT WATER RETURN
HX	HEAT EXCHANGER
LD	LINEAR DIFFUSER
M	MOTOR
MAU	MAKE-UP AIR UNIT
MD	MOTORIZED DAMPER
OBD	OPPOSED BLADE DAMPER
OED	OPEN END DUCT
OA	OUTSIDE AIR
PCG	PERFORATED CEILING GRILLE
PCD	PERFORATED CEILING DIFFUSER
PEF	PORTABLE EXHAUST FAN
RA	RETURN AIR
RAC	ROOM AIR CONDITIONER
RF	RETURN FAN
RG	RETURN GRILLE
RR	RETURN REGISTER
RTU	ROOF TOP UNIT
SA	SUPPLY AIR
SD	SLOT DIFFUSER
SF	SUPPLY FAN
SG	SUPPLY GRILLE
SR	SUPPLY REGISTER
SS	STAINLESS STEEL
TAC	TERMINAL AIR CONDITIONER
TCU	TERMINAL CONTROL UNIT
TCV	TEMPERATURE CONTROL VALVE
TG	TRANSFER GRILLE
TR	TIMER
UH	UNIT HEATER
VD	VOLUME DAMPER
WG	WALL RETURN GRILLE
WR	WALL RETURN REGISTER
WSG	WALL SUPPLY GRILLE
WSR	WALL SUPPLY REGISTER

HVAC GENERAL NOTES:

1. THIS IS A STANDARD LEGEND THEREFORE, SOME SYMBOLS AND ABBREVIATIONS MAY APPEAR ON THIS SHEET AND NOT ON THE DRAWINGS.
2. DUCT AND PIPING ELEVATIONS SHOWN ARE APPROXIMATE, FIELD VERIFY ELEVATIONS PRIOR TO INSTALLATION. EXCEPT WHERE DIMENSIONS ARE SPECIFICALLY INDICATED, MECHANICAL DRAWINGS ARE GENERALLY DIAGRAMMATIC AND SHALL NOT BE SCALED. SIZE AND LOCATION OF EQUIPMENT IS SHOWN TO SCALE WHERE POSSIBLE. DRAWINGS INDICATE THE REQUIRED SIZE AND ROUTES OF SYSTEM ELEMENTS. IT IS NOT INTENDED TO INDICATE ALL OFFSETS, RISERS, OR FITTINGS. IT IS THE CONTRACTOR'S RESPONSIBILITY TO INSTALL SYSTEM ELEMENTS IN A MANNER TO CONFORM TO BUILDING STRUCTURE AND TO AVOID OBSTRUCTIONS.
3. THE CONTRACTOR SHALL PROVIDE OFFSETS IN THE PIPING AND DUCT RUNS WHERE REQUIRED TO CLEAR STRUCTURES AND OTHER PIPING SYSTEMS.
4. REFER TO ARCHITECTURAL DRAWINGS FOR EXACT LOCATION OF LOUVERS AND ROOF OPENINGS.
5. COORDINATE FINAL LOCATIONS OF FLOOR AND HUB DRAINS THAT RECEIVE CONDENSATE DRAINAGE FROM HVAC EQUIPMENT.
6. TRANSITIONS TO ALL EQUIPMENT SHALL BE VERIFIED AND PROVIDED FOR EQUIPMENT FURNISHED.
7. ARRANGE EQUIPMENT INTO THE AVAILABLE SPACE IN A MANNER TO MAKE ALL WORKING PARTS ACCESSIBLE FOR MAINTENANCE AND SERVICE.

HEATING, VENTILATING, AND AIR CONDITIONING SYMBOLS

	WALL REGISTER OR GRILLE (SUPPLY)
	CEILING DIFFUSER OR REGISTER (SUPPLY)
	CEILING REGISTER OR GRILLE (RETURN AND EXHAUST)
	WALL REGISTER OR GRILLE (RETURN AND EXHAUST)
	TURNING VANES
	45 DEGREE ENTRY
	CONICAL TEE
	BELLMOUTH
SD	SMOKE DAMPER
FD	FIRE DAMPER
FSD	COMBINATION FIRE AND SMOKE DAMPER
	MANUAL DAMPER
MD	MOTORIZED DAMPER
	SOUND ATTENUATED DUCT
	FLEXIBLE CONNECTION
	FLEXIBLE DUCTWORK (SINGLE LINE) WITH SPIN-IN COLLAR AND BALANCING DAMPER
	FLEXIBLE DUCTWORK (DOUBLE LINE) WITH SPIN-IN COLLAR AND BALANCING DAMPER
R	INCLINED RISE IN DUCT
D	INCLINED DROP IN DUCT
H	DUCT-MOUNTED HUMIDITY SENSOR
F	DUCT-MOUNTED AIRFLOW MONITORING STATION
I	DUCT-MOUNTED SMOKE DETECTOR
P	DUCT-MOUNTED STATIC PRESSURE SENSOR
DP	DUCT-MOUNTED DIFFERENTIAL PRESSURE SENSOR
T	DUCT-MOUNTED TEMPERATURE SENSOR
	EXISTING ITEMS TO BE REMOVED
	SUPPLY DUCT (SECTION)
	INTAKE, RETURN, OR EXHAUST DUCT (SECTION)
	RETURN GRILLE
T	ROOM TEMPERATURE SENSOR
S	ON/OFF SWITCH
LS	LIGHT SWITCH
(200)	200 CFM
U	UNDER CUT DOOR
L	LOUVERED DOOR
800	VAV BOX WITH AIR FLOW IN CFM

SUPPLY, RETURN, EXHAUST, OR TRANSFER GRILLE/REGISTER IDENTIFICATION

600x600 EG (275)

- AIRFLOW IN CFM
- SPECIFICATION DESCRIPTION
- DIMENSIONS IN MILLIMETRES

SUPPLY DIFFUSER IDENTIFICATION

CD1 (275)

- AIRFLOW IN CFM
- SPECIFICATION DESCRIPTION

HVAC DUCT IDENTIFICATION

600x300 - EA - AL

- MATERIAL
- SERVICE
- SIZE IN MILLIMETRES

HVAC EQUIPMENT IDENTIFICATION

SF-01

- SEQUENTIAL UNIT NUMBER
- HVAC EQUIPMENT IDENTIFICATION

HVAC CONTROLS SYMBOLS

MD	MOTORIZED DAMPER
TS	SPACE TEMPERATURE SENSOR
TBS	TIMER PUSH BUTTON STATION
TT	DUCT TEMPERATURE SENSOR AVERAGING TYPE
TT	DUCT TEMPERATURE SENSOR
24V V	2-WAY MOTORIZED VALVE/ ACTUATOR
V	3-WAY MOTORIZED VALVE/ACTUATOR
DP	DIFFERENTIAL PRESSURE SWITCH/GAUGE
TSL	LOW TEMPERATURE DETECTOR
TSH	HIGH TEMPERATURE DETECTOR
R	ELECTRIC RELAY
H O A	HAND-OFF-AUTO SELECTOR SWITCH
H O	ON-OFF SELECTOR SWITCH
AI	ANALOGUE INPUT
AO	ANALOGUE OUTPUT
DI	DIGITAL INPUT
DO	DIGITAL OUTPUT
TS	OUTDOOR TEMPERATURE SENSOR
VFD	VARIABLE FREQUENCY DRIVE
FT	FLOW TRANSMITTER
FS	DUCT FLOW SENSOR
SD	SMOKE DETECTOR
DM	MOTORIZED DAMPER W/INTEGRAL END SWITCH
FS	FAN FLOW SENSOR

NO.	DATE	REVISION	BY	APVD

DSGN: T. TRAN | DR: | CHK: P. KWONG | APVD:

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

BUILDING MECHANICAL
GENERAL LEGEND, SYMBOLS AND ABBREVIATIONS

NTS
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
PROJ	436662
DWG	000-M-0001
SHEET	SHEET-NO TOTAL

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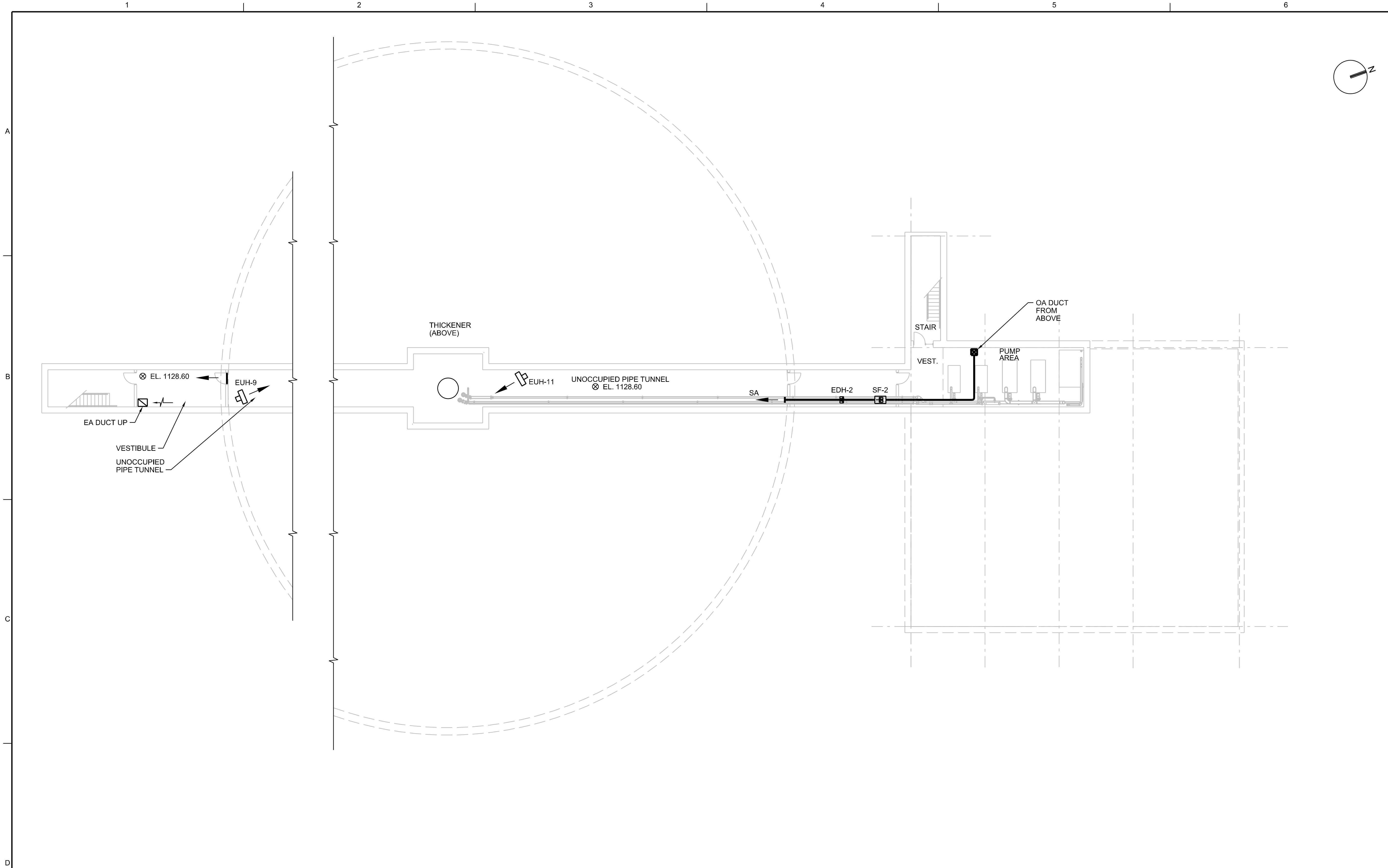

FLOOR PLAN AT EL 1128.60

1:150

NO.	DATE	REVISION	BY	APVD

DSGN T. TRAN
DR
CHK P. KWONG
APVD

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL

BUILDING MECHANICAL
FLOOR PLAN AT EL 1128.60

1:150
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
PROJ	436662
DWG	500-M-0002
SHEET	SHEET_NO.

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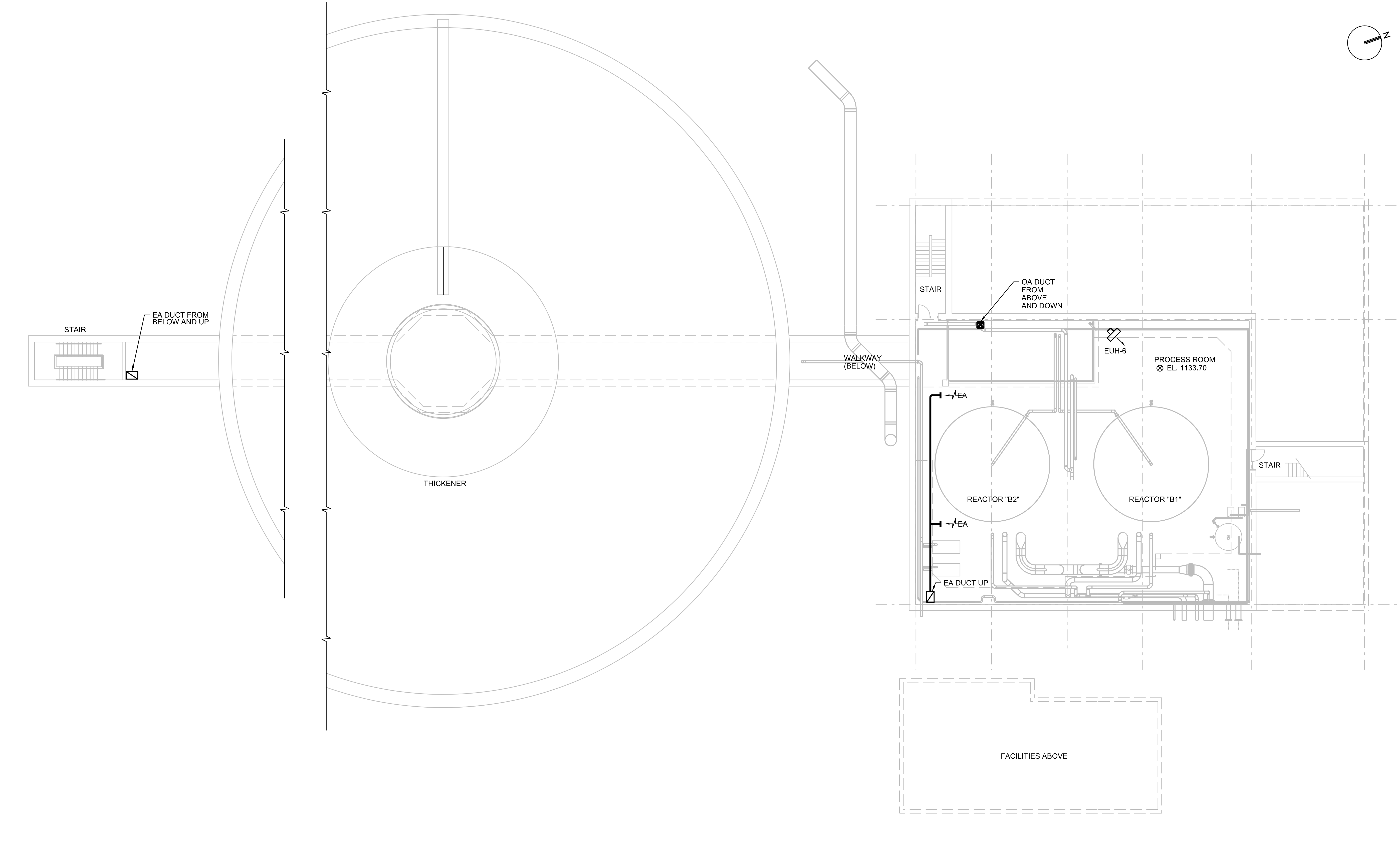

FLOOR PLAN AT EL 1133.70

1:150

0 1500 3000 4500 6000 7500

NO.	DATE	REVISION	BY	APVD

DSGN	DR	CHK	APVD
T. TRAN		P. KWONG	

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

BUILDING MECHANICAL
FLOOR PLAN AT EL 1133.70

1:150
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
PROJ	436662
DWG	500-M-0003
SHEET	SHEET_NO.

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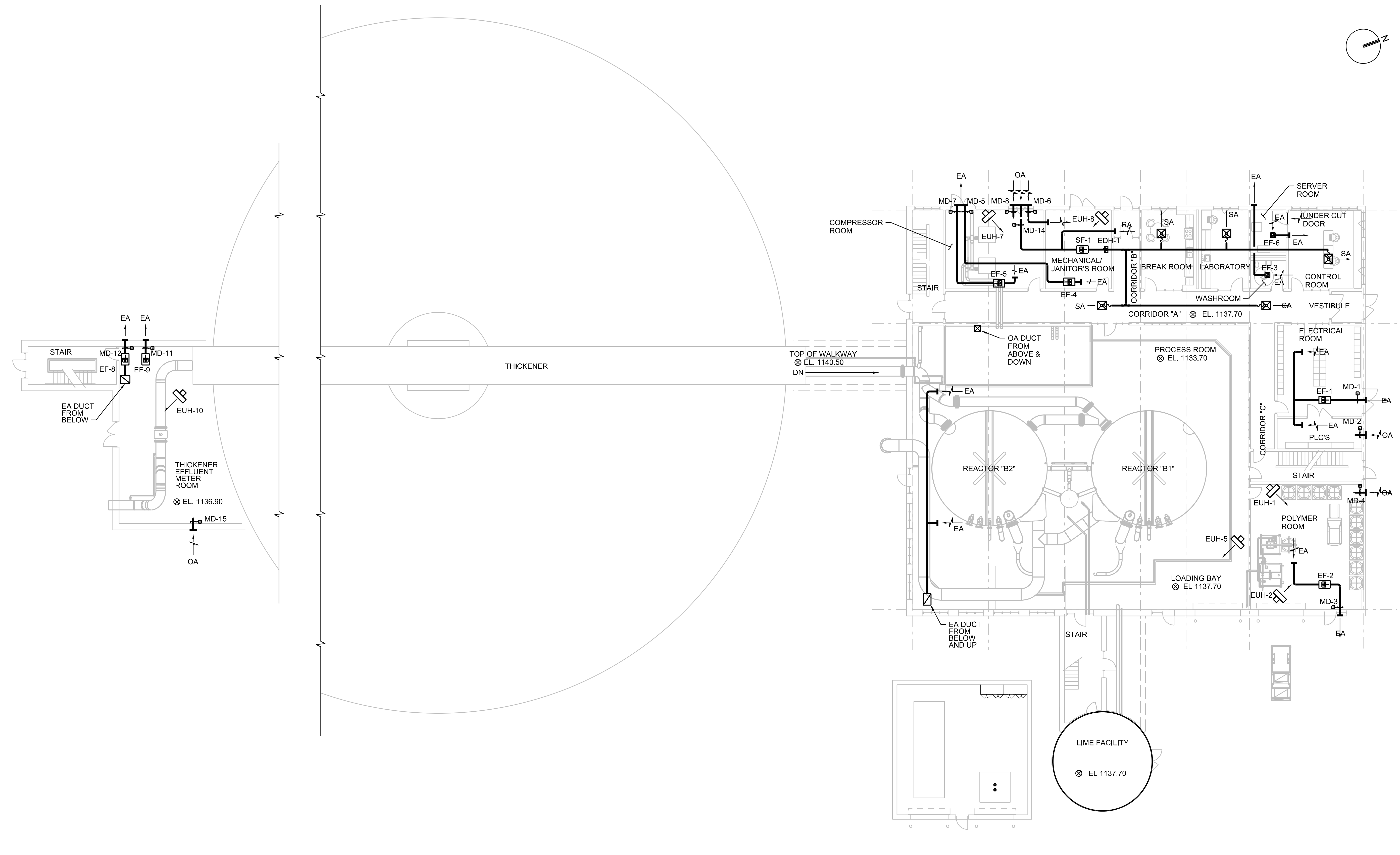

GROUND FLOOR PLAN

1:150

NO.	DATE	REVISION	BY	APVD

DSGN	DR	CHK	APVD
T. TRAN		P. KWONG	

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

BUILDING MECHANICAL
GROUND FLOOR PLAN

1:150
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
PROJ	436662
DWG	500-M-0004
SHEET	SHEET_NO.

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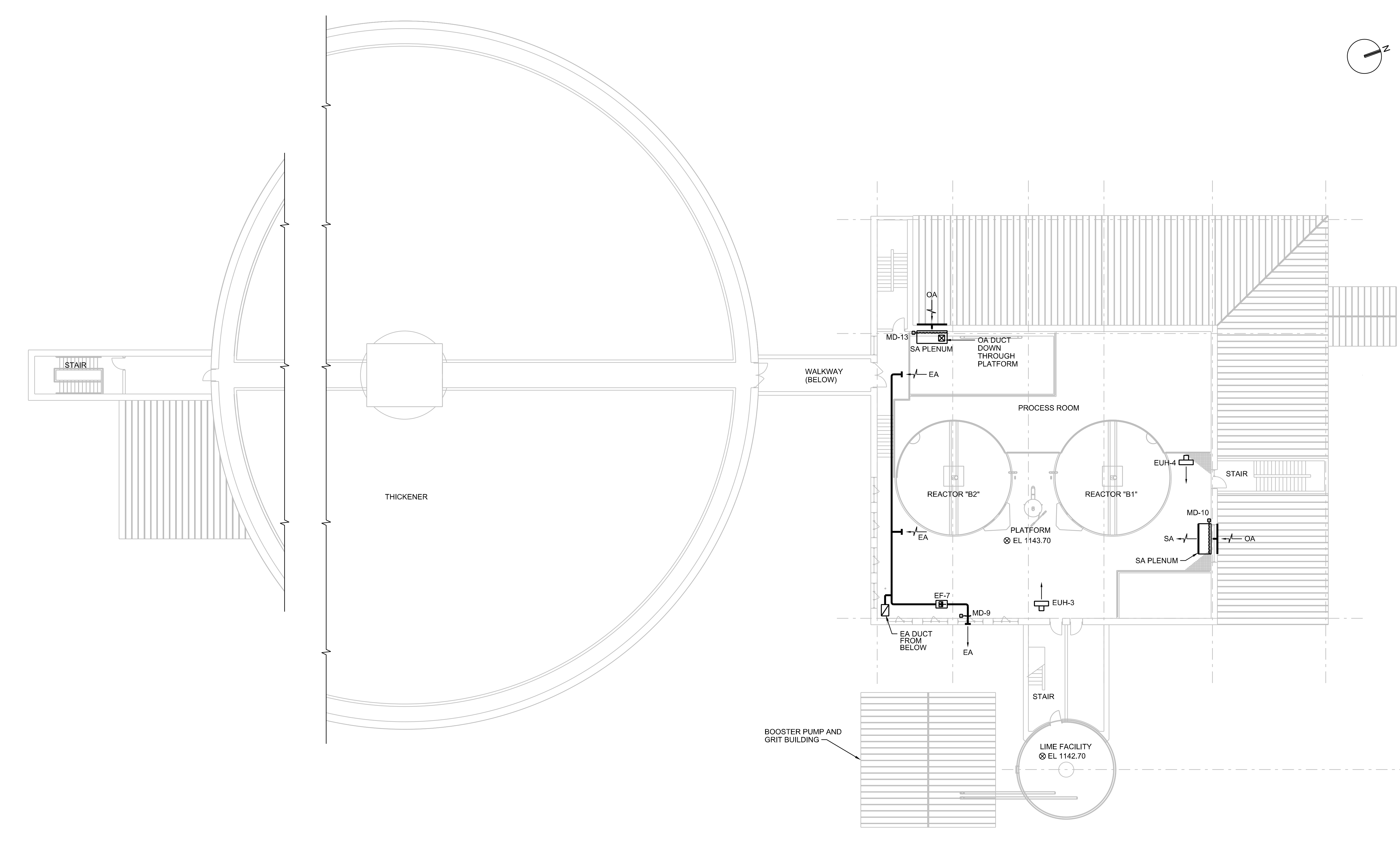

UPPER PLATFORM PLAN

1:150

NO.	DATE	REVISION	BY	APVD

DSGN	DR	CHK	APVD
T. TRAN		P. KWONG	

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL

BUILDING MECHANICAL
UPPER PLATFORM PLAN

1:150
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
PROJ	436662
DWG	500-M-0005
SHEET	SHEET_NO.

SYMBOL	DESCRIPTION

ONE-LINE DIAGRAM-1

SYMBOL	DESCRIPTION
	DRAWOUT AIR CIRCUIT BREAKER, LOW VOLTAGE
400	CIRCUIT BREAKER, THERMAL MAGNETIC TRIP SHOWN, 3 POLE, UNO
AS/AF or AT/AF	CIRCUIT BREAKER, STATIC TRIP UNIT, SENSOR AMP TRIP AND FRAME RATINGS SHOWN, 3 POLE, UNO
100/M	CIRCUIT BREAKER, MAGNETIC TRIP ONLY, TRIP RATING SHOWN, 3 POLE, UNO
400 400	CIRCUIT BREAKER WITH CURRENT LIMITING FUSES, TRIP AND FUSE RATING INDICATED, 3 POLE, UNO
400 225	FUSED SWITCH, SWITCH AND FUSE CURRENT RATING INDICATED, 3 POLE, UNO
100	SWITCH, CURRENT RATING INDICATED, 3 POLE, UNO
60 (3)	FUSE, CURRENT RATING AND QUANTITY INDICATED
1	MAGNETIC STARTER WITH OVERLOAD, NEMA SIZE INDICATED, FVNR UNO
AFD	ELECTRONIC STARTER/SPEED CONTROL RVSS = REDUCED VOLTAGE SOFT STARTER AFD = AC ADJUSTABLE FREQUENCY DRIVE DC = DC ADJUSTABLE SPEED DRIVE RVAT = REDUCED VOLTAGE AUTO TRANSFORMER TYPE RVRT = REDUCED VOLTAGE REACTOR TYPE
	CABLE OR BUS CONNECTION POINT
K	KEY INTERLOCK
	SURGE ARRESTER (GAP TYPE)
10	CAPACITOR - KVAR INDICATED, 3 PHASE
3	AC MOTOR, SQUIRREL CAGE INDUCTION - HORSEPOWER INDICATED
G 500/625	GENERATOR, KW/KVA RATING SHOWN
VS V 0-600V	ANALOG METER WITH SWITCH - SCALE RANGE SHOWN V = VOLTAGE KW = KILOWATTS A = AMPERAGE KVAR = KILOVARS PF = POWER FACTOR
DPM	DIGITAL POWER METER (MULTIFUNCTION)
	UTILITY REVENUE METER
	GROUND
15 KVA 480-120/240V 1 PH	TRANSFORMER, SIZE, VOLTAGE RATINGS, AND PHASE INDICATED
	SHIELDED ISOLATION TRANSFORMER
480-120V (3)	POTENTIAL TRANSFORMER, VOLTAGE RATING AND QUANTITY INDICATED
100:5 (3)	CURRENT TRANSFORMER, RATIO(100:5) AND QUANTITY INDICATED (3)
	CONNECTION POINT TO EQUIPMENT SPECIFIED IN OTHER DIVISIONS. RACEWAY, CONDUCTOR AND CONNECTION IN THIS DIVISION
TVSS	TRANSIENT VOLTAGE SURGE SUPPRESSOR

ONE-LINE DIAGRAM-2

SYMBOL	DESCRIPTION
	DRAWOUT POWER CIRCUIT BREAKER, MEDIUM VOLTAGE
	NON DRAWOUT FUSED SWITCH, MEDIUM VOLTAGE
	DRAWOUT FUSED SWITCH AND CONTACTOR, MEDIUM VOLTAGE
	DRAWOUT FUSED SWITCH AND VACUUM CONTACTOR, MEDIUM VOLTAGE
	DRAWOUT VACUUM CONTACTOR, MEDIUM VOLTAGE
	MEDIUM VOLTAGE CABLE STRESS CONE TYPE TERMINATION, OPEN TERMINATOR OR ELBOW
	SWITCH - LOAD BREAK, GROUP OPERATED, MEDIUM VOLTAGE
	SWITCH W/ARCING HORNS, MEDIUM VOLTAGE
	DISCONNECTING FUSE - SOLID MATERIAL, MEDIUM VOLTAGE
	SWITCH - HOOK STICK OPERATED, SINGLE POLE, MEDIUM VOLTAGE
	FUSE - EXPULSION, HOOK STICK OPERATED, SINGLE POLE, MEDIUM VOLTAGE
	GROUND SWITCH, GANG OPERATED
	TERMINAL BLOCK LUG
	DELTA CONNECTION
	WYE GROUNDED CONNECTION, SOLID GROUND
R or Z	WYE NEUTRAL GROUND RESISTOR OR IMPEDANCE CONNECTION
86	RELAY OR DEVICE, FUNCTION NUMBER AS INDICATED
50:5 (1)	CURRENT TRANSFORMER, ZERO SEQUENCE, RATIO AND QUANTITY INDICATED
800/1200:5 (3)	BUSHING CURRENT TRANSFORMER, MULTI-RATIO AND QUANTITY INDICATED
MO	MOTOR OPERATOR, BREAKER OR SWITCH
EUM	ENERGY MONITORING UNIT
MRP	MOTOR PROTECTION RELAY

NOTES:

1. THESE ARE STANDARD LEGEND SHEETS. SOME SYMBOLS AND ABBREVIATIONS MAY APPEAR ON THE LEGEND AND NOT ON THE DRAWINGS.
2. FOR ADDITIONAL ABBREVIATIONS OF OTHER DIVISIONS (HVAC, MECHANICAL, AND STRUCTURAL/ARCHITECTURAL) SEE OTHER LEGENDS.

CONTROL DIAGRAM-1

SYMBOL	DESCRIPTION
	PUSH-BUTTON SWITCH, MOMENTARY CONTACT, NORMALLY OPEN
	PUSH-BUTTON SWITCH, MOMENTARY CONTACT, NORMALLY CLOSED
	PUSH BUTTON SWITCH, MAINTAINED CONTACTS WITH MECHANICAL INTERLOCK
	3 POSITION SELECTOR SWITCH MAINTAINED CONTACT
HAND OFF REMOTE	SELECTOR SWITCH - MAINTAINED CONTACT - CHART IDENTIFIES OPERATION WHEN NEEDED FOR CLARITY:

CKT	POSITION HAND	OFF	REMOTE
1	X	O	O
2	O	O	X

X - CLOSED CONTACT
O - OPEN CONTACT

SYMBOL	DESCRIPTION
	TOGGLE SWITCH, ON-OFF TYPE
ON OFF	SELECTOR SWITCH, ON-OFF TYPE
	MUSHROOM HEAD PUSHBUTTON SWITCH
A	INDICATING LIGHT, PUSH-TO-TEST, LETTER INDICATES COLOR
A	INDICATING LIGHT - LETTER INDICATES COLOR A - AMBER G - GREEN S - STROBE B - BLUE R - RED C - CLEAR W - WHITE
ETM	ELAPSED TIME METER
M	MOTOR STARTER CONTACTOR COIL
CRX	CONTROL RELAY, X INDICATES NUMERICAL ORDER IN CIRCUIT
TDR X	TIME DELAY RELAY, X INDICATES NUMERICAL ORDER IN CIRCUIT
SV X	SOLENOID VALVE, X INDICATES NUMERICAL ORDER IN CIRCUIT
	CONTACT - NORMALLY OPEN
	CONTACT - NORMALLY CLOSED
	REMOTE DEVICE
	TIME DELAY RELAY CONTACT, NORMALLY OPEN, CLOSES WHEN ENERGIZED AND TIMED OUT
	TIME DELAY RELAY CONTACT, NORMALLY CLOSED, OPENS WHEN ENERGIZED AND TIMED OUT
	TIME DELAY RELAY CONTACT, CLOSES WHEN ENERGIZED, OPENS WHEN DE-ENERGIZED AND TIMED OUT
	TIME DELAY RELAY CONTACT, OPENS WHEN ENERGIZED, CLOSES WHEN DE-ENERGIZED AND TIMED OUT
	MOTOR SPACE HEATER
	TERMINAL BLOCK, REMOTE
	TERMINAL BLOCK, INTERNAL
	FUSED TERMINAL BLOCK
	FUSE, RATING INDICATED
CPT 120V	TRANSFORMER, CONTROL POWER
	THERMOCOUPLE

CONTROL DIAGRAM-2

SYMBOL	DESCRIPTION
	CAPACITOR
+ -	BATTERY
	LIMIT SWITCH, NORMALLY OPEN, CLOSES AT END OF TRAVEL
	LIMIT SWITCH, NORMALLY CLOSED, OPENS AT END OF TRAVEL
	TEMPERATURE SWITCH, OPENS ON TEMPERATURE RISE
	TEMPERATURE SWITCH, CLOSES ON TEMPERATURE RISE
	FLOAT SWITCH, NORMALLY OPEN, CLOSES ON DESCENDING LEVEL
	FLOAT SWITCH, NORMALLY OPEN, CLOSES ON RISING LEVEL
	PRESSURE SWITCH, NORMALLY CLOSED, OPENS ON RISING PRESSURE
	PRESSURE SWITCH, NORMALLY OPEN, CLOSES ON RISING PRESSURE
	FLOW SWITCH, CLOSES ON INCREASED FLOW
	FLOW SWITCH, OPENS ON INCREASED FLOW
NGR	NEUTRAL GROUND CURRENT LIMITING RESISTOR
RES	CALIBRATING RESISTOR
T GEN	TACHOMETER GENERATOR
GFS	GROUND FAULT SENSOR
	FLASHER
	SEALED CONTACT
	BUZZER
	POTENTIOMETER
	RESISTOR
	BLOWN FUSE INDICATOR
	COAXIAL CABLE
	MULTICONDUCTOR SHIELDED CABLE
	DUPLEX RECEPTACLE
L U	RELAY, WITH MECHANICAL LATCH
	FULLWAVE DIODE BRIDGE (AC TO DC)

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DR J ZAHIR
CHK
APVD

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

ELECTRICAL
ELECTRICAL LEGEND
(1)

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SYMBOL	DESCRIPTION

POWER SYSTEM PLAN-1

SYMBOL	DESCRIPTION
	CONNECTION POINT TO EQUIPMENT SPECIFIED. RACEWAY, CONDUCTOR,TERMINATION AND CONNECTION IN THIS DIVISION.
MCC-A	MAJOR ELECTRICAL COMPONENT OR DEVICE - NAME OR IDENTIFYING SYMBOL AS SHOWN.
LPXXA	PANELBOARD - SURFACE MOUNTED PANELBOARD LETTER OR NUMBER FACILITY NUMBER LP - LOW VOLTAGE PANEL DP - DISTRIBUTION PANEL
	PANELBOARD - FLUSH MOUNTED
	TERMINAL JUNCTION BOX
M	MOTOR, SQUIRREL CAGE INDUCTION
G	GENERATOR, VOLTAGE AND SIZE AS INDICATED.
LPXXA	HOME RUN - DESTINATION SHOWN
or G	EXPOSED CONDUIT AND CONDUCTORS*
or G	CONCEALED CONDUIT AND CONDUCTORS*

NOTE:
ALL UNMARKED CONDUIT RUNS CONSIST OF TWO NO. 12, ONE NO. 12 GROUND CONDUCTORS IN 3/4" CONDUIT. RUNS MARKED WITH CROSSHATCHES INDICATE NUMBER OF NO. 12 CONDUCTORS. CROSSHATCH WITH SUBSCRIPT "G" INDICATES GREEN GROUND WIRE.

SYMBOL	DESCRIPTION
G	CROSSHATCHES WITH BAR INDICATE NO.10 CONDUCTOR. SIZE CONDUIT ACCORDING TO SPECIFICATIONS AND APPLICABLE CODE.
[A1]	CONDUIT AND CONDUCTOR CALLOUT, SEE LEGEND.
	CONDUIT DOWN
	CONDUIT UP
	CONDUIT, STUBBED AND CAPPED
	CONDUIT TERMINATION AT CABLE TRAY
EX	EXISTING CONDUIT/ DUCT BANK
BD	BUS DUCT - SEE SPECIFICATIONS
CE	CONCRETE ENCASED CONDUIT
DB	DIRECT BURIED CONDUIT
FO	FIBER OPTIC CONDUIT
XXXX	CONCRETE ENCASED DUCT BANK WHERE XXXX IS THE DUCT BANK NAME. SEE CIRCUIT AND RACEWAY CODING DEFINITION
	CONCEALED CONDUIT ROUTING AREA
	CONDUIT ROUTING AREA
	CABLE TRAY
T	TRANSFORMER
J or HH	GENERAL CONTROL OR WIRING DEVICE. LETTER SYMBOLS OR ABBREVIATIONS INDICATE TYPE OF DEVICE
CS	CONTROL STATION, SEE CONTROL DIAGRAMS FOR CONTROL DEVICE(S) REQUIRED.
30	NONFUSED DISCONNECT SWITCH, CURRENT RATING INDICATED, 3 POLE
60/40	FUSED DISCONNECT SWITCH, CURRENT RATING INDICATED (60/40, 60=SWITCH RATING / 40=FUSE RATING) 3 POLE
2	COMBINATION CIRCUIT BREAKER AND MAGNETIC STARTER, NEMA SIZE INDICATED

POWER SYSTEM PLAN-2

SYMBOL	DESCRIPTION
100/40	BREAKER, SEPARATELY MOUNTED, CURRENT RATING INDICATED (100/40, 100 = FRAME SIZE; 40 = TRIP RATING) 3 POLE
C 2	CONTACTOR, MAGNETIC, NEMA SIZE INDICATED
L 30	LIGHTING CONTACTOR, CURRENT RATING INDICATED
2	STARTER, MAGNETIC NEMA SIZE INDICATED
XX 2	CONVENIENCE RECEPTACLE - DUPLEX UNLESS NOTED OTHERWISE WP - WEATHERPROOF C - CLOCK HANGER TL - TWIST LOCK CRE - CORROSION RESISTANT GFCI - GROUND FAULT CIRCUIT INTERRUPTER SUBSCRIPT NUMBER AT RECEPTACLE INDICATES CIRCUIT
	240V RECEPTACLE
	CONVENIENCE RECEPTACLE - QUADRUPLEX
	MULTI OUTLET ASSEMBLY
	DUPLEX CONVENIENCE RECEPTACLE - FLUSH IN FLOOR
	CONVENIENCE RECEPTACLE, PEDESTAL, DUPLEX SINGLE FACE UNLESS INDICATED OTHERWISE
L20R 20	RECEPTACLE, SPECIAL PURPOSE-NEMA CONFIGURATION AND AMPERAGE INDICATED
T	THERMOSTAT
	UTILITY REVENUE METERING FACILITY
EUH	ELECTRIC UNIT HEATER
AC	ELECTRIC AIR CONDITIONER (SELF CONTAINED UNIT)
	UTILITY POLE

LIGHTING SYSTEM PLAN

SYMBOL	DESCRIPTION
1 or 1	LUMINAIRE, SEE SCHEDULE
1	LUMINAIRE, SEE SCHEDULE
1 or	LUMINAIRE WITH INTERNAL BATTERY BACKUP, SEE SCHEDULE
1	STRIP LUMINAIRE, SEE SCHEDULE
4 or 4	LUMINAIRE AND POLE, SEE SCHEDULE
5 or 5	WALL MOUNTED LUMINAIRE, SEE SCHEDULE
1	FLOOD LIGHTS - AIM IN THE DIRECTION SHOWN
	STANDBY LIGHTING UNIT, SURFACE MOUNTED, SEE SCHEDULE
XX or	EXIT LIGHTS - FILLED SECTION INDICATES LIGHTED FACE, ARROW INDICATES EGRESS DIRECTIONAL INDICATORS, XX = FIXTURE NUMBER, SEE SCHEDULE
$a or 2a	SMALL LETTER SUBSCRIPT AT SWITCH AND LUMINAIRE INDICATES SWITCHING. SUBSCRIPT NUMBER AT LUMINAIRE INDICATES CIRCUIT
$3	WALL SWITCH: 2- DOUBLE POLE 3- THREE WAY 4- FOUR WAY WP- WEATHERPROOF EX- EXPLOSIONPROOF M- MOTOR RATED P- PILOT LIGHT K- KEY OPERATED D- DIMMER CRE- CORROSION RESISTANT L- MOMENTARY 3-WAY MS- MANUAL STARTER WITH OVERLOADS
OS	OCCUPANCY SENSOR
LC	LIGHTING CONTACTOR
MD	MOTION DETECTOR
PC	PHOTOCELL

FIRE ALARM SYSTEM PLAN AND RISER

SYMBOL	DESCRIPTION
F P	FIRE ALARM STATION, MANUAL
	FIRE ALARM SYSTEM, AUTOMATIC SMOKE DETECTOR
HD	FIRE ALARM SYSTEM, AUTOMATIC, HEAT DETECTOR
F	FIRE ALARM BELL
F	FIRE ALARM HORN
	FIRE ALARM HORN/STROBE LIGHT
	FIRE ALARM STROBE LIGHT
	AIR DUCT DETECTOR
FS	FIRE SPRINKLER FLOW SWITCH
TS	FIRE SPRINKLER TAMPER SWITCH
D	DOOR HOLDER

TELEPHONE SYSTEM PLAN AND RISER

SYMBOL	DESCRIPTION
TTC	TELEPHONE TERMINAL CABINET
	TELEPHONE RECEPTACLE FLOOR BOX
	TELEPHONE RECEPTACLE
T	TELEPHONE SYSTEM RACEWAY

COMPUTER SYSTEM (DATA) PLAN AND RISER

SYMBOL	DESCRIPTION
CTC	COMPUTER SYSTEM TERMINAL CABINET
	COMPUTER NETWORK CONNECTION
	COMPUTER NETWORK CONNECTION, FLUSH IN FLOOR
D	DATA SYSTEM RACEWAY

COMBINED TELEPHONE/COMPUTER SYSTEM PLAN AND RISER

SYMBOL	DESCRIPTION
4	COMBINATION TELEPHONE/DATA RECEPTACLE, WALL MOUNTED, NUMBER OF PORTS INDICATED
4	COMBINATION TELEPHONE/DATA RECEPTACLE, FLOOR BOX, NUMBER OF PORTS INDICATED

CLOSED CIRCUIT/TELEVISION CABLE PLAN AND RISER

SYMBOL	DESCRIPTION
	COMBINATION CLOSED CIRCUIT TELEVISION RECEPTACLE (CCTV) AND DUPLEX CONVENIENCE RECEPTACLE IN TWO GANG BOX WITH BARRIER, 12" DOWN FROM CEILING
	COMBINATION TELEVISION CABLE RECEPTACLE (TV) AND DUPLEX CONVENIENCE RECEPTACLE IN TWO GANG BOX WITH BARRIER, 12" DOWN FROM CEILING
	CLOSED CIRCUIT TELEVISION RECEPTACLE, FLOOR BOX
	TELEVISION CABLE RECEPTACLE, FLOOR BOX

SOUND SYSTEM PLAN AND RISER

SYMBOL	DESCRIPTION
S	SPEAKER, CONE TYPE, RECESSED IN CEILING, SEE ARCHITECTURAL DRAWINGS FOR CEILING TYPE
S	SPEAKER, CONE TYPE, WALL MOUNTED
S	SPEAKER, CONE TYPE, SURFACE MOUNTED
V	VOLUME CONTROL, WALL MOUNT 5'-0" AFF
S	INTERIOR PAGING TRUMPET SOUND REPRODUCER WITH REMOTE AMPLIFIER, SURFACE MOUNTED
M	MICROPHONE OUTLET
S	SOUND SYSTEM RACEWAY
S	COMMUNICATION STATION

SECURITY SYSTEM PLAN AND RISER

SYMBOL	DESCRIPTION
CR	CARD KEY ACCESS
CS	CONTROL STATION
DS	DOOR SWITCH
EP	EGRESS PUSHBUTTON
	ELECTRONIC LOCK M = MAGENITIC S = STRIKE
	INTERCOM
	MONITOR
	MOTION SENSOR
	VIDEO CAMERA PTZ = PAN/TILT/ZOOM F = FIXED

GROUND SYSTEM PLAN

SYMBOL	DESCRIPTION
	GROUND ROD
	GROUND ROD IN TEST WELL
G	GROUNDING CONDUCTOR, SIZE AS INDICATED
	PIGTAIL FOR CONNECTION TO EQUIPMENT CABINET OR FRAME
G	EQUIPMENT GROUND BUS
N	EQUIPMENT NEUTRAL BUS

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FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

ELECTRICAL
ELECTRICAL LEGEND
(2)

NTS
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0 25mm

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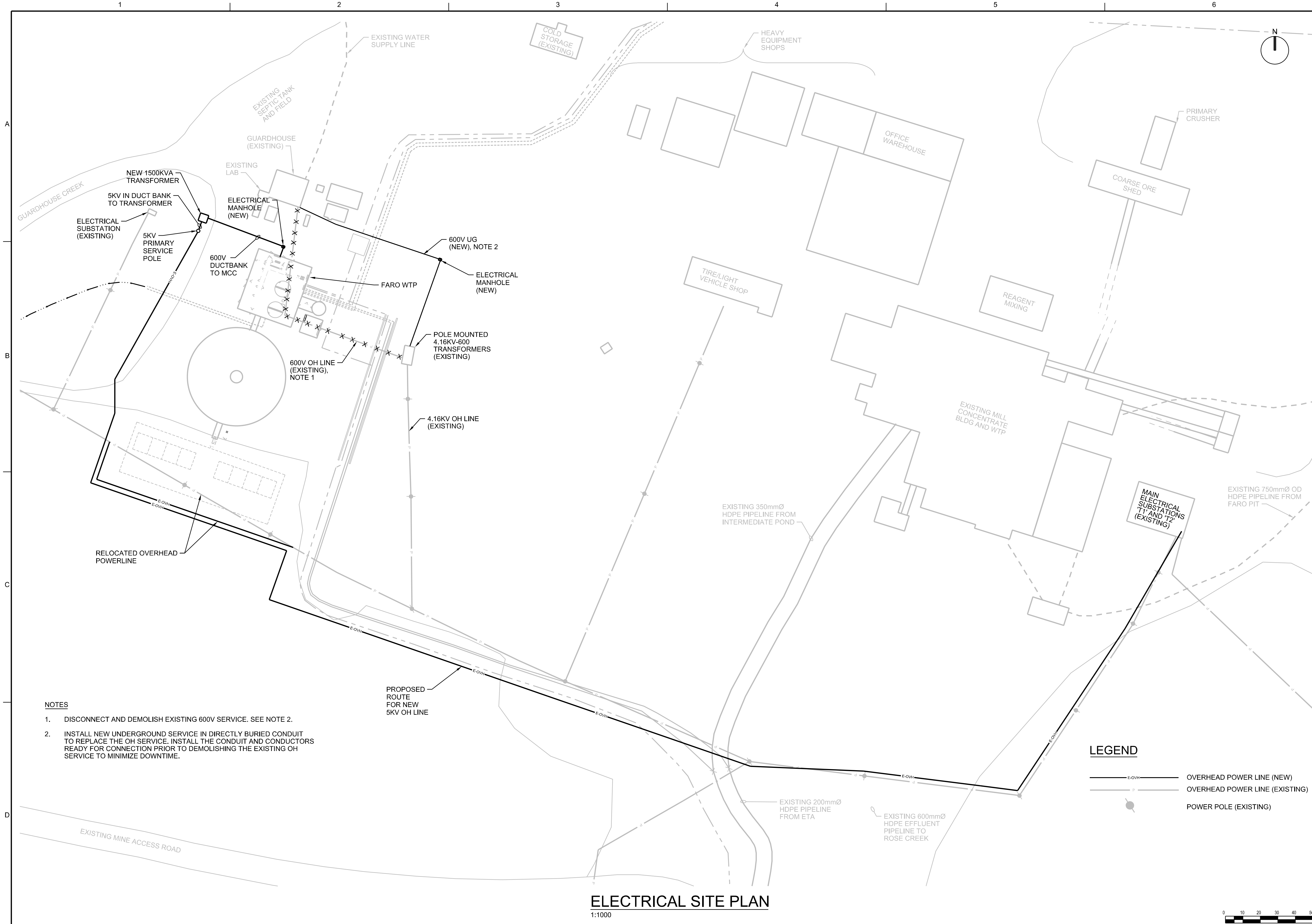
FILENAME: 000-E-0002_436662.dgn PLOT DATE: 2013\06\07 PLOT TIME: 9:42:40 AM



NOTES

1. DISCONNECT AND DEMOLISH EXISTING 600V SERVICE. SEE NOTE 2.
2. INSTALL NEW UNDERGROUND SERVICE IN DIRECTLY BURIED CONDUIT TO REPLACE THE OH SERVICE. INSTALL THE CONDUIT AND CONDUCTORS READY FOR CONNECTION PRIOR TO DEMOLISHING THE EXISTING OH SERVICE TO MINIMIZE DOWNTIME.

LEGEND

- OVERHEAD POWER LINE (NEW)
- OVERHEAD POWER LINE (EXISTING)
- POWER POLE (EXISTING)

ELECTRICAL SITE PLAN

1:1000

0 10 20 30 40 50m

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WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
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ELECTRICAL
SITE PLAN
PROPOSED ELECTRICAL OH LINES

1:1000
VERIFY SCALE
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0 25mm

DATE
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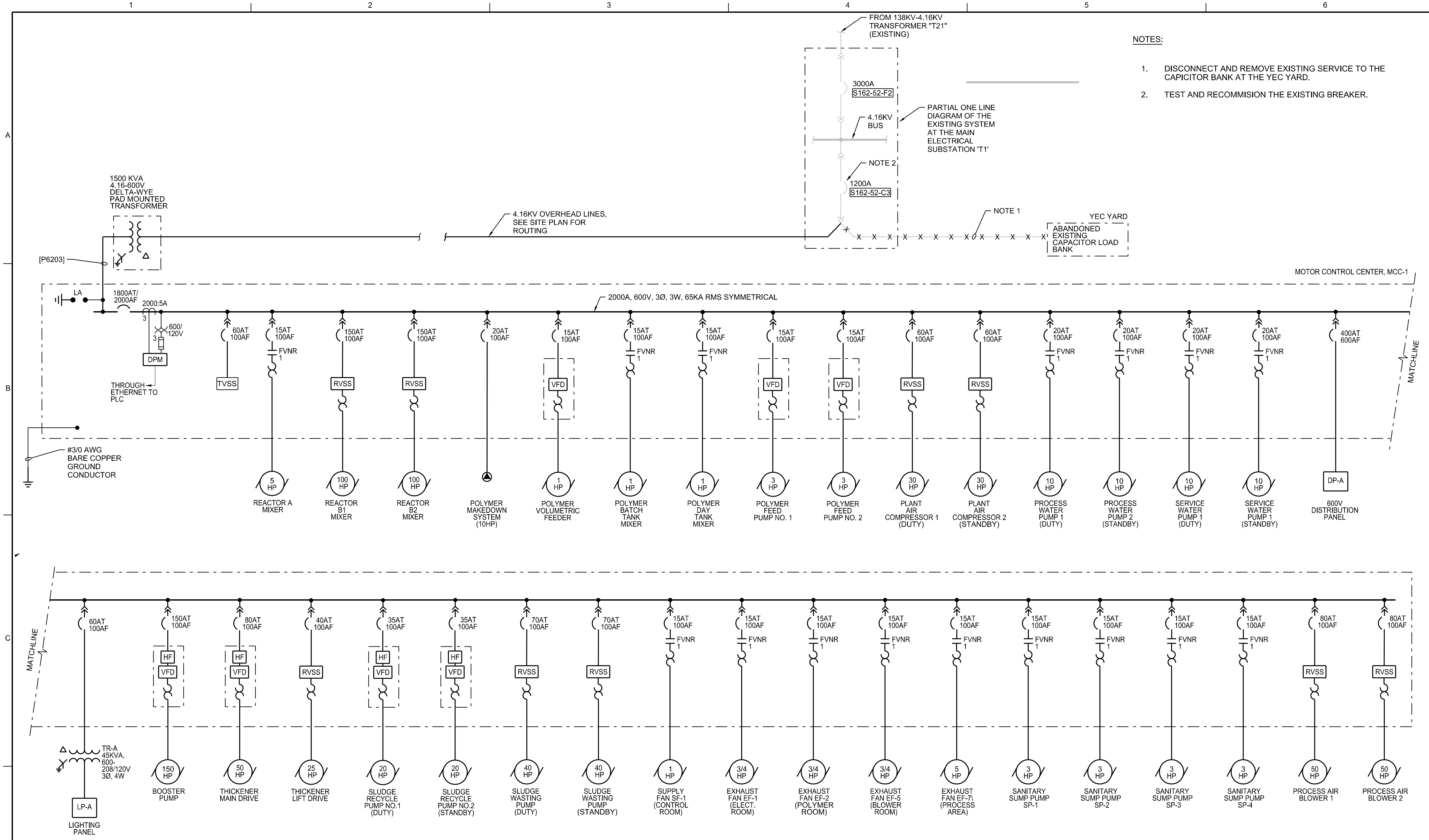
SHEET

NOTES:

1. DISCONNECT AND REMOVE EXISTING SERVICE TO THE CAPICITOR BANK AT THE YEC YARD.
2. TEST AND RECOMMISION THE EXISTING BREAKER.



PRELIMINARY ESTIMATED LOAD = 1500KVA

ONE LINE DIAGRAM

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ELECTRICAL
ONE LINE DIAGRAM

NTS
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DATE	
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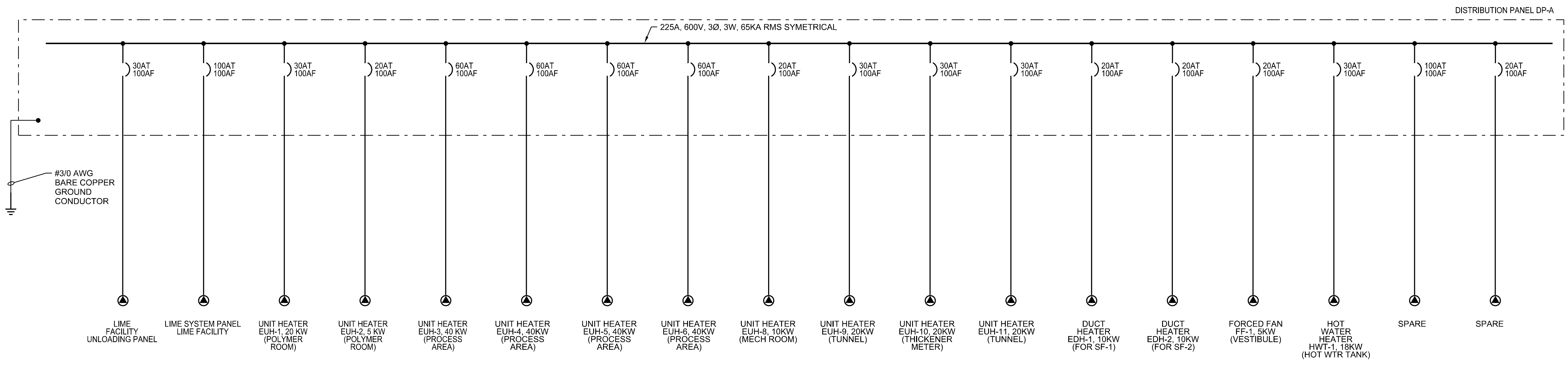

DISTRIBUTION PANEL DP-A

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WATER TREATMENT PLANT DESIGN
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ELECTRICAL
ONE LINE DIAGRAM (CONTINUED)

NTS
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

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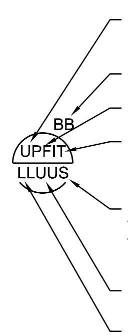
FILENAME: 500-E-0003_436662.dgn PLOT DATE: 2013\06\07 PLOT TIME: 9:43:09 AM

INSTRUMENT IDENTIFICATION

EXAMPLE SYMBOLS



- UNIT PROCESS NUMBER
- CLARIFYING ABBREVIATIONS
- FIRST LETTER(S)
- SUCCEEDING LETTER(S)
- SET LETTER (USED WHEN THERE ARE MULTIPLE DEVICES WITH THE SAME UNIT NUMBER)
- UNIT NUMBER
- LOOP NUMBER

INSTRUMENT IDENTIFICATION LETTERS TABLE

LETTER	FIRST-LETTER: PROCESS OR INITIATING VARIABLE	FIRST-LETTER: MODIFIER	SUCCEEDING-LETTERS: READOUT OR PASSIVE FUNCTION	SUCCEEDING-LETTERS: READOUT OR PASSIVE FUNCTION	SUCCEEDING-LETTERS: READOUT OR PASSIVE FUNCTION
A	ANALYSIS (+)		ALARM		
B	BURNER, COMBUSTION		USER'S CHOICE (*)	USER'S CHOICE (*)	USER'S CHOICE (*)
C	USER'S CHOICE (*)			CONTROL	
D	DENSITY (S.G.)	DIFFERENTIAL			
E	VOLTAGE		PRIMARY ELEMENT, SENSOR		
	FLOW RATE	RATIO (FRACTION)			
G	USER'S CHOICE (*)		GLASS, GAUGE VIEWING DEVICE	GATE	
H	HAND (MANUAL)				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOTION	MOMENTARY			MIDDLE, INTERMEDIATE
N	TORQUE		USER'S CHOICE (*)	USER'S CHOICE (*)	USER'S CHOICE (*)
O	USER'S CHOICE (*)		ORIFICE, RESTRICTION		
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION		
Q	QUANTITY	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD OR PRINT		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTI VARIABLE		MULTI FUNCTION	MULTI FUNCTION	MULTI FUNCTION
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED (*)	X AXIS	UNCLASSIFIED (*)	UNCLASSIFIED (*)	UNCLASSIFIED (*)
Y	EVENT, STATE OR PRESENCE	Y AXIS		RELAY, COMPUTE, CONVERT	
Z	POSITION	Z AXIS		DRIVE, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

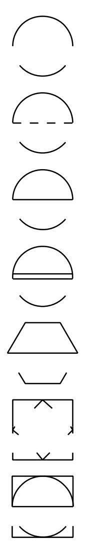
TABLE BASED ON THE INSTRUMENTATION, SYSTEMS, AND AUTOMATION SOCIETY (ISA) STANDARD.

(+) WHEN USED, EXPLANATION IS SHOWN ADJACENT TO INSTRUMENT SYMBOL. SEE ABBREVIATIONS AND LETTER SYMBOLS.
(*) WHEN USED, DEFINE THE MEANING HERE FOR THE PROJECT.

DIGITAL SYSTEM INTERFACES

- ▲ ANALOG INPUT
- ▼ ANALOG OUTPUT
- $\triangle_X$ DISCRETE INPUT
- ∇_X DISCRETE OUTPUT

GENERAL INSTRUMENT OR FUNCTIONAL SYMBOLS



- FIELD MOUNTED
- REAR-OF-PANEL MOUNTED (OPERATOR INACCESSIBLE)
- PANEL MOUNTED (OPERATOR ACCESSIBLE)
- MCC MOUNTED
- COMPUTER FUNCTION
- PLC FUNCTION
- SHARED DISPLAY, SHARED CONTROL

TRANSDUCERS

A	ANALOG	I	CURRENT
D	DIGITAL	P	PNEUMATIC
E	VOLTAGE	PF	PULSE FREQUENCY
F	FREQUENCY	PD	PULSE DURATION
H	HYDRAULIC	R	RESISTANCE

EXAMPLE

I/P FY — CURRENT TO PNEUMATIC TRANSDUCER (BACK OF PANEL, IN A FLOW LOOP)

ACCESSORY DEVICES

- A ALARM
- C CONTROLLER
- I INDICATOR
- R RECORDER
- S SWITCH
- T TRANSMITTER
- X UNCLASSIFIED

EXAMPLE

FIT T — TRANSMITTER AS AN ACCESSORY TO A FLOW ELEMENT

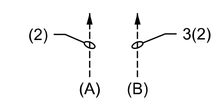
SPECIAL CASES

- YL OO — ON AND OFF EVENT LIGHTS
- HS OO — ON-OFF HAND SWITCH, MAINTAINED CONTACT SWITCH (CONTROLLED DEVICE WILL RESTART ON RETURN OF POWER AFTER POWER FAILURE).
- HS SS — STOP-START HAND SWITCH MOMENTARY CONTACT SWITCHES (CONTROLLED DEVICE WILL NOT RESTART ON RETURN OF POWER AFTER POWER FAILURE).

LINE LEGEND

- PRIMARY PROCESS (CLOSED CONDUIT, DASHED LINE INDICATES ALTERNATE FLOW STREAM)
- SECONDARY PROCESS
- BYPASS PROCESS
- PROCESS (OPEN CHANNEL)
- ANALOG SIGNAL (4 TO 20 mAdc, ETC.)
- DISCRETE (ON/OFF, ETC.)
- PNEUMATIC SIGNAL
- FILLED SYSTEM SIGNAL
- HYDRAULIC SYSTEM SIGNAL
- DATA LINK
- BUILDING OR FACILITY BOUNDARY
- PACKAGE SYSTEM EQUIPMENT
- TYPICAL BREAK

PARALLELING LINES

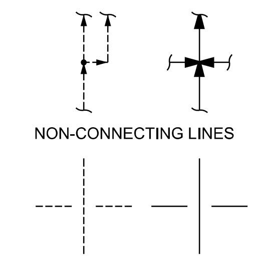


(A) TOTAL OF 2 SIGNALS

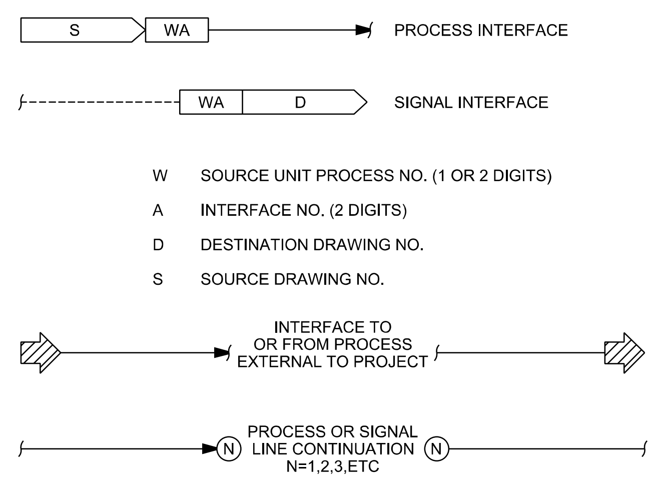
(B) 3 TYPICAL SETS OF 2 SIGNALS EACH. TOTAL OF 6 SIGNALS.

CONNECTING LINES

NON-CONNECTING LINES



INTERFACE SYMBOLS



PROCESS INTERFACE

SIGNAL INTERFACE

- W SOURCE UNIT PROCESS NO. (1 OR 2 DIGITS)
- A INTERFACE NO. (2 DIGITS)
- D DESTINATION DRAWING NO.
- S SOURCE DRAWING NO.

INTERFACE TO OR FROM PROCESS EXTERNAL TO PROJECT

PROCESS OR SIGNAL LINE CONTINUATION N=1,2,3,ETC

SELF CONTAINED VALVE & EQUIPMENT TAG NUMBERS

W-D-X-Y

- W UNIT PROCESS NUMBER
- D
  - ARV AIR RELEASE VALVE
  - AVRV AIR AND VACUUM RELEASE VALVE
  - E EJECTOR
  - G GATE
  - M MECHANICAL EQUIPMENT
  - P PUMP
  - T TANK
- X LOOP NUMBER
- Y UNIT NUMBER

ABBREVIATIONS & LETTER SYMBOLS

AC	ALTERNATING CURRENT
AM	AUTO-MANUAL
CAM	COMPUTER-AUTO-MANUAL
CCS	CENTRAL CONTROL SYSTEM
CL_2 etc.	CHLORINE (TYPICAL: USE STANDARD CHEMICAL ELEMENT ABBREVIATIONS)
CM	COMPUTER-MANUAL
COD	CHEMICAL OXYGEN DEMAND
CP-X	CONTROL PANEL NO. X
DC	DIRECT CURRENT
DCS	DISTRIBUTED CONTROL SYSTEM
DCU	DISTRIBUTED CONTROL UNIT
DO	DISSOLVED OXYGEN
FCL_2	FREE CHLORINE RESIDUAL
FOS	FAST-OFF-SLOW
FOSA	FAST-OFF-SLOW-AUTO
FOSR	FAST-OFF-SLOW-REMOTE
FP-W-X	FIELD PANEL NO. WX (W=UNIT PROCESS NUMBER X=PANEL NUMBER)
FR	FORWARD-REVERSE
HOA	HAND-OFF-AUTO
HOR	HAND-OFF-REMOTE
ISR	INTRINSICALLY SAFE RELAY
LEL	LOWER EXPLOSIVE LIMIT
LOS	LOCKOUT STOP
LR	LOCAL-REMOTE
MA	MANUAL-AUTO
MC	MODULATE-CLOSE
MCC-X	MOTOR CONTROL CENTER NO. X
MSC	MANUFACTURER SUPPLIED CABLE
OC	OPEN-CLOSE(D)
OCA	OPEN-CLOSE-AUTO
OCR	OPEN-CLOSE-REMOTE
OO	ON-OFF
OOA	ON-OFF-AUTO
OOR	ON-OFF-REMOTE
ORP	OXIDATION REDUCTION POTENTIAL
OSC	OPEN-STOP-CLOSE
pH	HYDROGEN ION CONCENTRATION
PLC	PROGRAMMABLE LOGIC CONTROLLER
RIO	REMOTE I/O UNIT
RM-X	REMOTE MULTIPLEXING MODULE NO. X
RTU-X	REMOTE TELEMETRY UNIT NO. X
SF	SLOWER-FASTER
SS	START-STOP
SSC	SUPERVISORY SET POINT CONTROL
TCL_2	TOTAL CHLORINE RESIDUAL
TOC	TOTAL ORGANIC CARBON
TOD	TOTAL OXYGEN DEMAND
TURB	TURBIDITY
VHC	VOLATILE HYDROCARBONS
VIB	VIBRATION
$\triangle$	DIFFERENCE
Σ	SUM
x	MULTIPLY
÷	DIVIDE
F(X)	CHARACTERIZED
X^n	RAISED TO THE Nth POWER
$\sqrt{}$	SQUARE ROOT
AVG	AVERAGE
1:1	REPEAT OR BOOST
>	SELECT HIGHEST SIGNAL
<	SELECT LOWEST SIGNAL
}	BIAS
%	GAIN OR ATTENUATE

GENERAL NOTES

1. COMPONENTS AND PANELS SHOWN WITH A SINGLE ASTERISK (∗) ARE TO BE PROVIDED AS PART OF A PACKAGE SYSTEM.
2. COMPONENTS AND PANELS SHOWN WITH A DOUBLE ASTERISK (∗∗) ARE TO BE PROVIDED UNDER DIVISION 16, ELECTRICAL.
3. THIS IS A STANDARD LEGEND. THEREFORE, NOT ALL OF THIS INFORMATION MAY BE USED ON THE PROJECT.

NO.	DATE	REVISION	BY	APVD

DSGN J BOGDANIC | DR J.A MENDOZA | CHK | QC CHECKER | APVD | PROJ MNGR

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

INSTRUMENTATION AND CONTROLS
INSTRUMENTATION LEGEND (1) AND GENERAL NOTES (1)

SCALE
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
PROJ	436662
DWG	N-001
SHEET	SHEET_NO.

VALVE SYMBOLS

- GATE
- KNIFE GATE
- BUTTERFLY
- GLOBE
- BALL
- VEE-BALL
- PLUG
- SEAT PORT ECCENTRIC PLUG
- DIAPHRAGM
- PINCH
- NEEDLE
- SWING CHECK
- BALL CHECK
- BACKFLOW PREVENTER
- ROTARY
- TELESCOPE
- SAMPLE
- MUD
- PRESSURE RELIEF
- AIR AND/OR VACUUM RELEASE
- REGULATED SIDE PRESSURE CONTROL
- PRESSURE REGULATION (CLAY-TYPE)
- MULTI-PORT VALVE (GATE VALVE SHOWN. FOR OTHER VALVE TYPES, APPROPRIATE VALVE SYMBOL SHOWN.) SEAT PORTS ARE IMPLIED BY INDICATED FLOW PATTERN.
- ANGLE GATE

GATE SYMBOLS

- SLUICE
- BUTTERFLY
- FABRICATED SLIDE
- FLAP
- STOP LOG
- SHEAR

ACTUATOR SYMBOLS

- PNEUMATIC DIAPHRAGM SPRING-OPPOSED, SINGLE OR DOUBLE ACTING
- PNEUMATIC CYLINDER SINGLE OR DOUBLE ACTING ACTUATED BY ONE INPUT
- ELECTRIC MOTOR
- SOLENOID
- VALVE POSITIONER
- HYDRAULIC
- DIAPHRAGM, DIFFERENTIAL PRESSURE
- ELECTROHYDRAULIC
- MANUAL

NOTE:
ON LOSS OF PRIMARY POWER (PNEUMATIC, ELECTRICAL, OR HYDRAULIC)

XX: FO FAIL OPEN
FC FAIL CLOSED
FLP FAIL TO LAST POSITION

PRIMARY ELEMENT SYMBOLS

- PARSHALL FLUME
- WEIR
- ORFICE PLATE
- FLOW TUBE
- PITOT-STATIC
- VORTEX METER
- ULTRASONIC FLOWMETER
- ELECTROMAGNETIC FLOWMETER
- PROPELLER OR TURBINE METER
- THERMAL FLOWMETER
- LEVEL (BUBBLER TUBE)
- LEVEL (FLOAT) (LS)
- ROTAMETER (FI)
- DENSITY METER (DE)
- GENERIC (XX)
- LEVEL (LE)

MISCELLANEOUS SYMBOLS

- VENT TO ATMOSPHERE
- AIR GAP
- DRIP TRAP
- PIG INSERT POINT
- PIG CATCH POINT
- SELF CONTAINED AIR SUPPLY
- AIR PURGE SET
- FLUSHING CONNECTION
- SEAL WATER SET
- WATER PURGE SET
- FLEXIBLE CONNECTION
- AERATOR
- DIAPHRAGM SEAL
- ANNULAR DIAPHRAGM SEAL
- COMPOSITE SAMPLER
- FLAME TRAP
- CALIBRATION COLUMN
- INLINE SILENCER
- BLIND FLANGE
- PIPE CAP
- STRAINER
- BASKET STRAINER
- FILTER
- PULSATION DAMPENER
- EXPANSION CHAMBER
- FFLCPLLLX — PANEL CONTINUED ON SAME OR OTHER DRAWING; PANEL OUTLINE; PANEL NAME
- 120V — 120 VOLT, 60 HZ POWER
- 480V — 480 VOLT, 60 HZ POWER
- XX — AIR SET, XX = SUPPLY PRESSURE IN PSIG.
- PLUG
- RECEPTACLE
- RUPTURE DISK (VACUUM)
- RUPTURE DISK (PRESSURE)
- TV MONITOR
- TV CAMERA
- LOGIC ELEMENT: IF A AND NOT B THEN C
- LOGIC ELEMENT: IF A OR B THEN C
- RADIO ANTENNA
- INTERLOCK, SEE CONTROL DIAGRAMS
- VOICE COMMUNICATION POINT
- SKIMMING MECHANISM
- SCREW CONVEYOR
- MIXER
- ELECTRIC MOTOR

PUMP AND COMPRESSOR SYMBOLS

- CENTRIFUGAL PUMP (DRY PIT)
- CENTRIFUGAL WET PIT PUMP OR TURBINE PUMP
- RECIPROCATING OR METERING PUMP (POSITIVE DISPLACEMENT)
- DIAPHRAGM PUMP
- GEAR PUMP OR BLOWER (POSITIVE DISPLACEMENT)
- PROGESSING CAVITY PUMP
- COMPRESSOR (CENTRIFUGAL)
- COMPRESSOR (PISTON)
- BLOWER OR FAN (CENTRIFUGAL)
- EJECTOR
- PISTON PUMP
- SUBMERSIBLE SUMP PUMP
- ROTARY PUMP
- VACUUM PUMP
- SCREW PUMP

XX: AS ADJUSTABLE SPEED
CS-1 CONSTANT SPEED (SINGLE SPEED)
CS-2 CONSTANT SPEED (TWO SPEED)

LINE SIZE AND MATERIAL IDENTIFICATION

(FOR REFERENCE ONLY. SEE SITE AND MECHANICAL DRAWINGS)

18CLDI — PIPE DIAMETER IN INCHES; PIPE MATERIAL ABBREVIATION

CISP	CAST IRON SOIL PIPE
CLDI	CEMENT LINED DUCTILE IRON
CLSTL	CEMENT LINED STEEL
CU	COPPER
FRP	FIBERGLASS REINFORCED PLASTIC
PVC	POLYVINYL CHLORIDE
SST	STAINLESS STEEL
STL	STEEL

FLOW STREAM IDENTIFICATION

AHP	AIR, HIGH PRESSURE PROCESS
AI	AIR, INSTRUMENT
AL	ALUM
ALP	AIR, LOW PRESSURE PROCESS
ASH	SODA ASH
B	BRINE
BA	BLOWER AIR
BDS	BLENDED DIGESTED SLUDGE
BFW	BRINE FEEDWATER
BS	BRINE SLUDGE
BW	BACKWASH
BYP	BYPASS
C	CARBON SLURRY
CA	COMPRESSED AIR
CD	CARBON DIOXIDE GAS
CG	CHLORINE GAS (PRESSURE)
CGV	CHLORINE GAS (VACUUM)
CHS	CHEMICAL SLUDGE
CL	CHLORINE LIQUID
CO	CONDENSATE DRAIN
CS	CHLORINE SOLUTION
CWR	COOLING WATER RETURN
CWS	COOLING WATER SUPPLY
D	DRAIN (SANITARY)
DAS	DIGESTED ACTIVATED SLUDGE
DG	DIGESTER GAS
DIW	DEIONIZED WATER
DR	DRAIN
DS	DIGESTED SLUDGE
DW	DISTILLED WATER
ED	EFFLUENT DISCHARGE
F	FILTRATE
FC	FERRIC CHLORINE
FE	FILTER EFFLUENT
FI	FILTER INFLUENT
FW	FEED WATER
G	NATURAL GAS
GAS	GASOLINE
GR	GRIT SLURRY
HPS	HIGH PRESSURE STEAM
HS	HEAVY SOLIDS
HWR	HEATING WATER RETURN
HWS	HEATING WATER SUPPLY
LD	DRY LIME
LPO	LIQUID POLYMER
LPR	LOW PRESSURE RETURN (CONDENSATE)
LPS	LOW PRESSURE STEAM
LS	LIME SLURRY
LSD	LIME SLUDGE
MPS	MEDIUM PRESSURE STEAM
NA	SODIUM HYDROXIDE
NT	NITROGEN TRICHLORIDE
OF	OVERFLOW
P	PROPANE GAS
PDS	PRIMARY DIGESTED SLUDGE
PE	PRIMARY EFFLUENT
PI	PRIMARY INFLUENT
PLE	PLANT EFFLUENT
POS	POLYMER SOLUTION
PS	PROCESS SUMP
PSD	PRIMARY SLUDGE
PSM	PRIMARY SCUM
RAS	RETURN ACTIVATED SLUDGE
RB	RAW BRINE
RCS	RECARBONATION SLUDGE
RCY	RECYCLE
RD	REACTOR DISCHARGE
RHW	RECIRCULATED HOT WATER
RS	RECYCLED SLUDGE
RSD	RECIRCULATED SLUDGE
S	SANITARY SEWER (GRAVITY)
SA	SAMPLE
SAS	SODA ASH SOLUTION
SB	SPENT BRINE
SC	COLD SLUDGE
SDG	SULFUR DIOXIDE GAS
SDL	SULFUR DIOXIDE LIQUID
SDS	SULFUR DIOXIDE SOLUTION
SDV	SULFUR DIOXIDE GAS (VACUUM)
SE	SECONDARY EFFLUENT
SH	HEATED SLUDGE
SSD	SECONDARY DIGESTED SLUDGE
SSM	SECONDARY SCUM
SW	SERVICE WATER
TAS	THICKENED ACTIVATED SLUDGE
TB	TREATED BRINE
TBS	THICKENER BOTTOM SLUDGE
TDS	THICKENED DIGESTED SLUDGE
TPS	THICKENED PRIMARY SLUDGE
TUF	THICKENER UNDERFLOW
UD	UNDERDRAIN
V	VENT
VAC	VACUUM
W1	NO. 1 (POTABLE) WATER
W2	NO. 2 (NON-POTABLE) WATER
W3	NO. 3 WATER
W4	NO. 4 WATER
WW	WELL WATER

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DSGN J BOGDANIC
DR J.A MENDOZA
CHK
QC CHECKER
APVD
PROJ MNGR

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

INSTRUMENTATION AND CONTROLS
INSTRUMENTATION LEGEND (2) AND GENERAL NOTES (2)

SCALE
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
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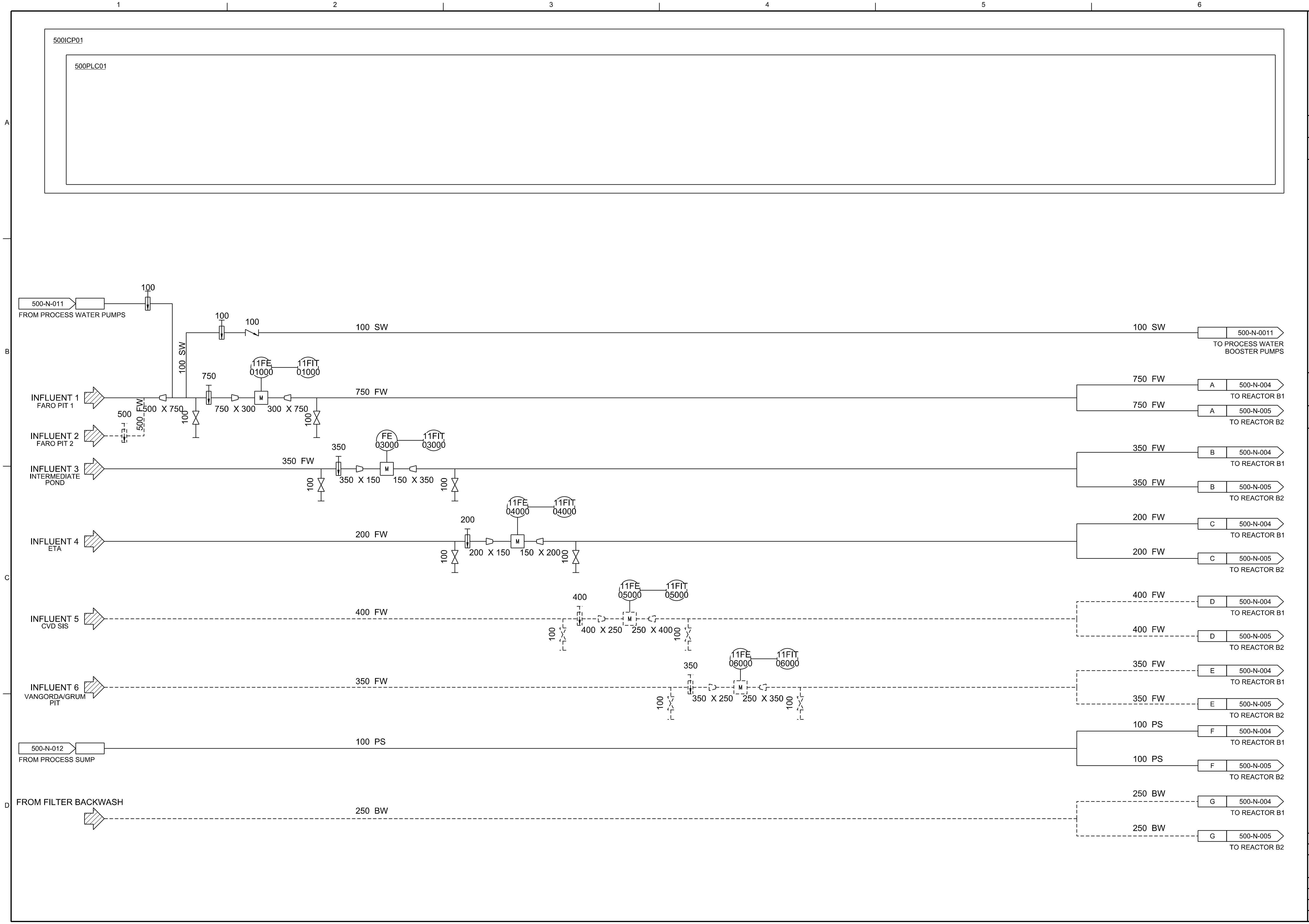
DWG	N-002
SHEET	SHEET_NO.



NO.	DATE	REVISION	BY	APVD

DSGN J.P. NYWENING | DR J.A MENDOZA | CHK | QC | APVD | PM

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

INSTRUMENTATION AND CONTROLS
UNIT PROCESS 11
INFLUENT TO REACTORS B1 AND B2
P&ID

NTS
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
PROJ	436662
DWG	500-N-0003
SHEET	SHEET_NO.

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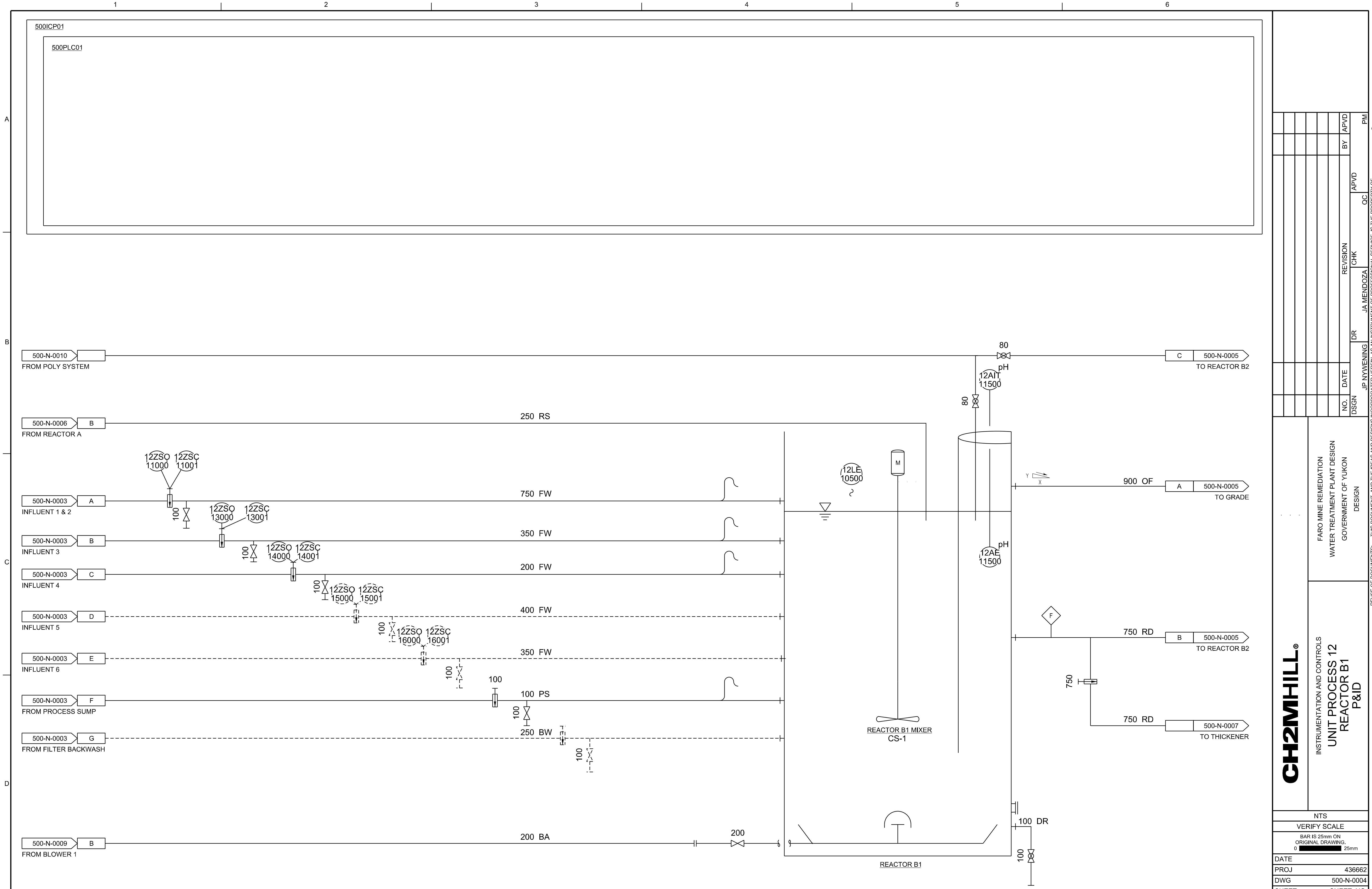

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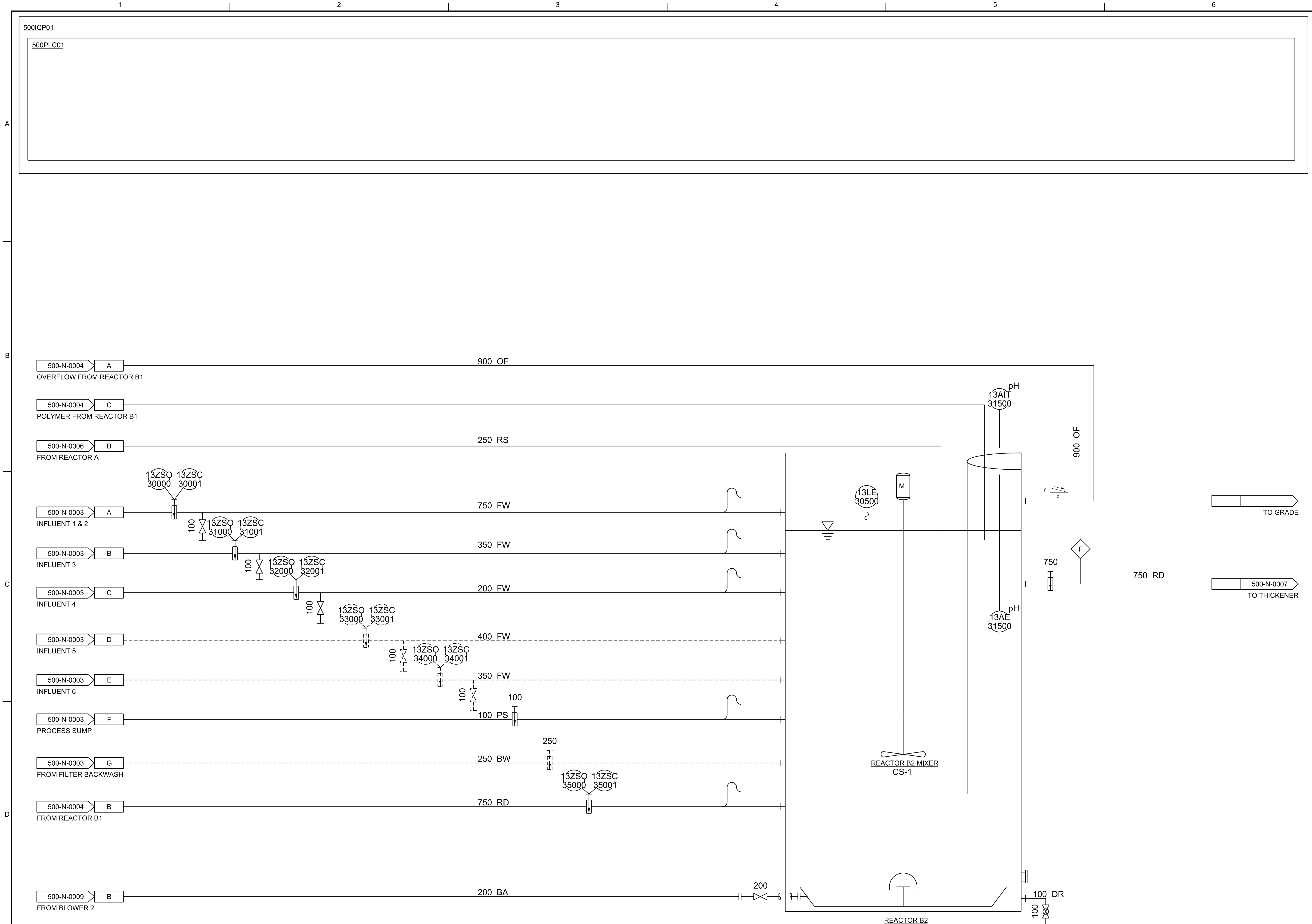

NO.	DATE	REVISION	BY	APVD
DSGN	JP NYWENING	DR	JA MENDOZA	CHK	QC	APVD	PM

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

INSTRUMENTATION AND CONTROLS
UNIT PROCESS 13
REACTOR B2
P&ID

NTS
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
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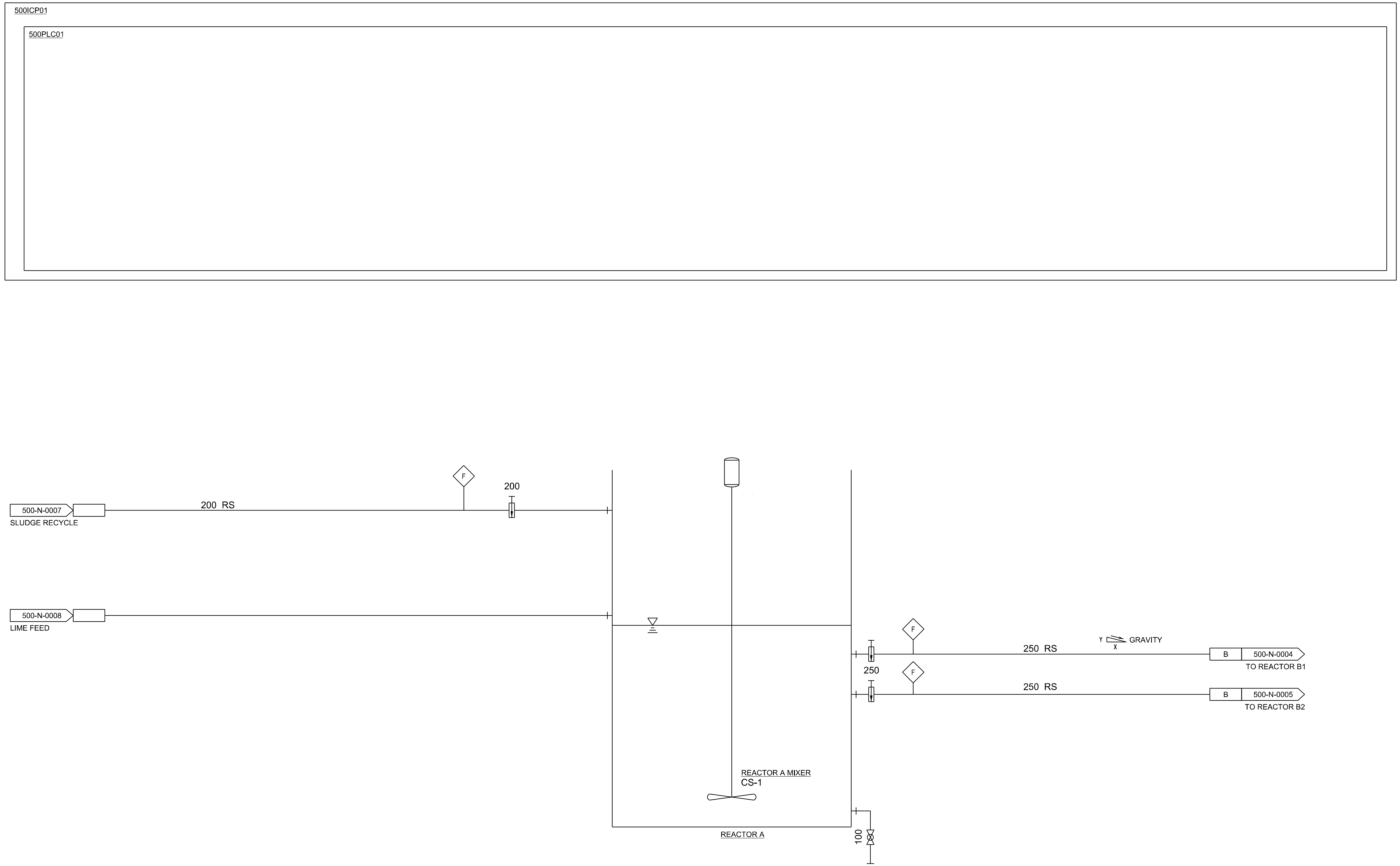

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DR JA MENDOZA
CHK
APVD
QC
PM

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

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INSTRUMENTATION AND CONTROLS
UNIT PROCESS 14
REACTOR A
P&ID

NTS
VERIFY SCALE
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DATE
PROJ 436662
DWG 500-N-0006
SHEET SHEET_NO.

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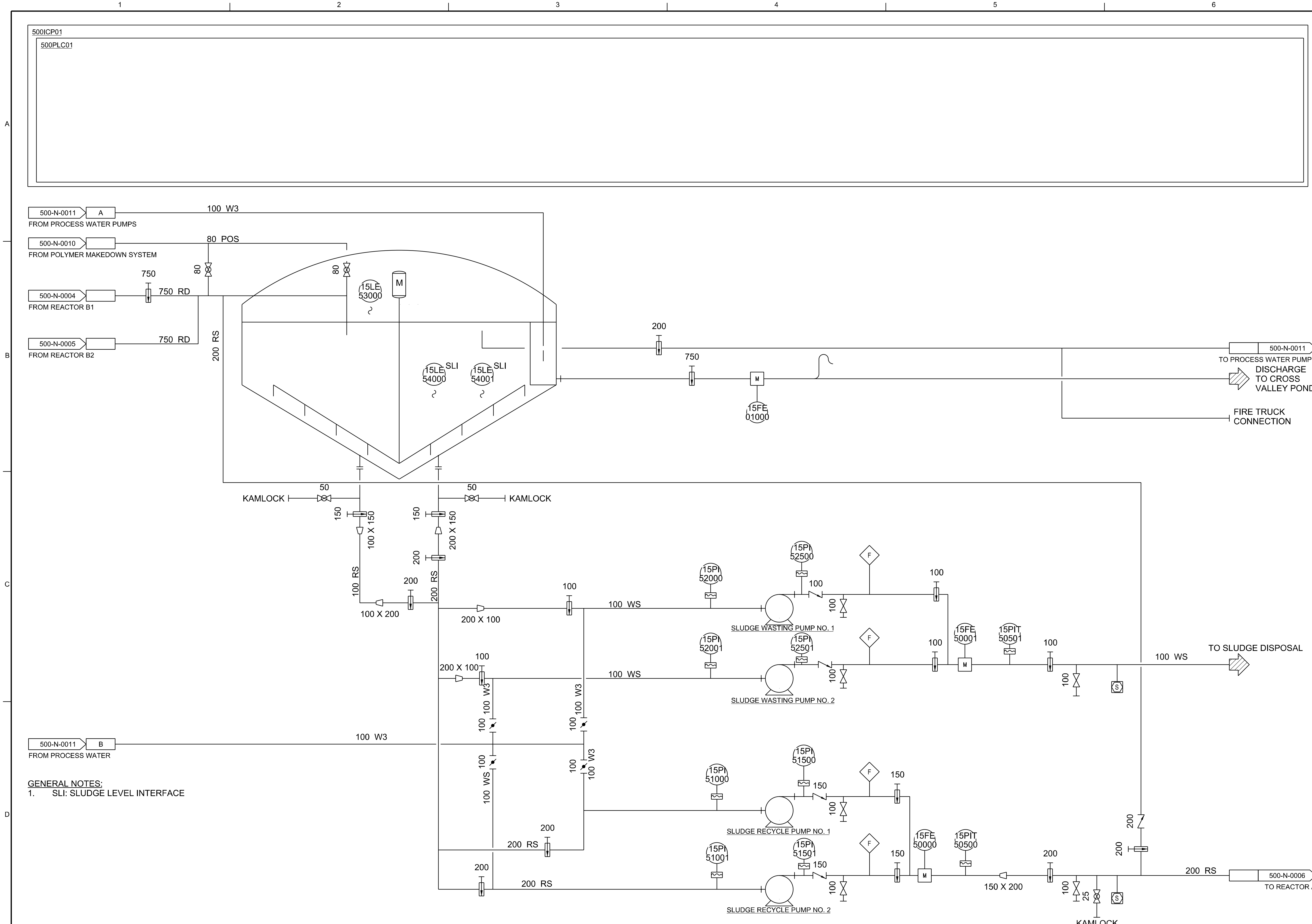

GENERAL NOTES:

1. SLI: SLUDGE LEVEL INTERFACE

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FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

INSTRUMENTATION AND CONTROLS
UNIT PROCESS 15
THICKENER
P&ID

NTS
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
PROJ	436662
DWG	500-N-0007
SHEET	SHEET_NO.

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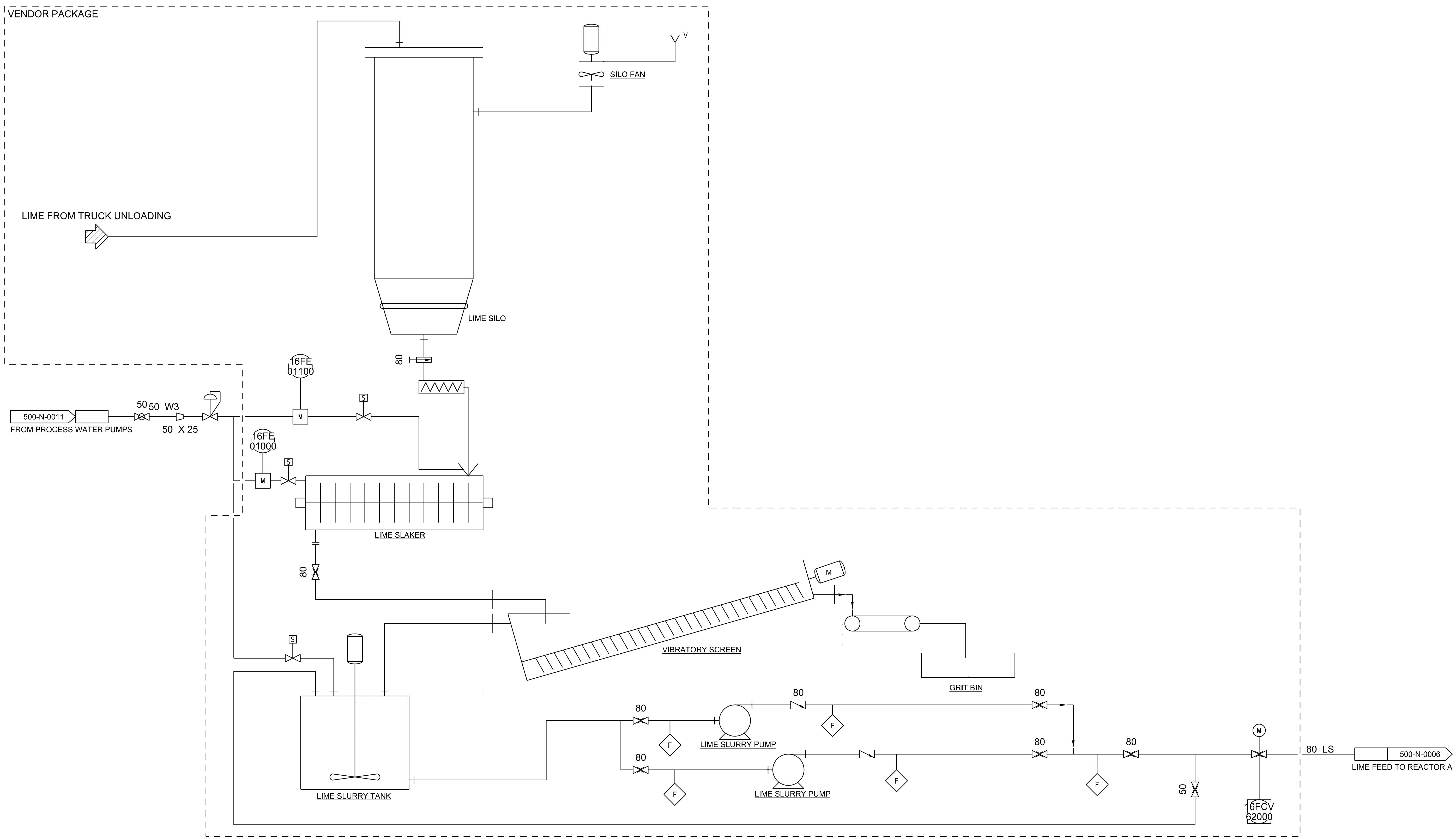

NO.	DATE	REVISION	BY	APVD

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FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

INSTRUMENTATION AND CONTROLS
UNIT PROCESS 16
LIME SYSTEM
P&ID

NTS
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
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DATE	
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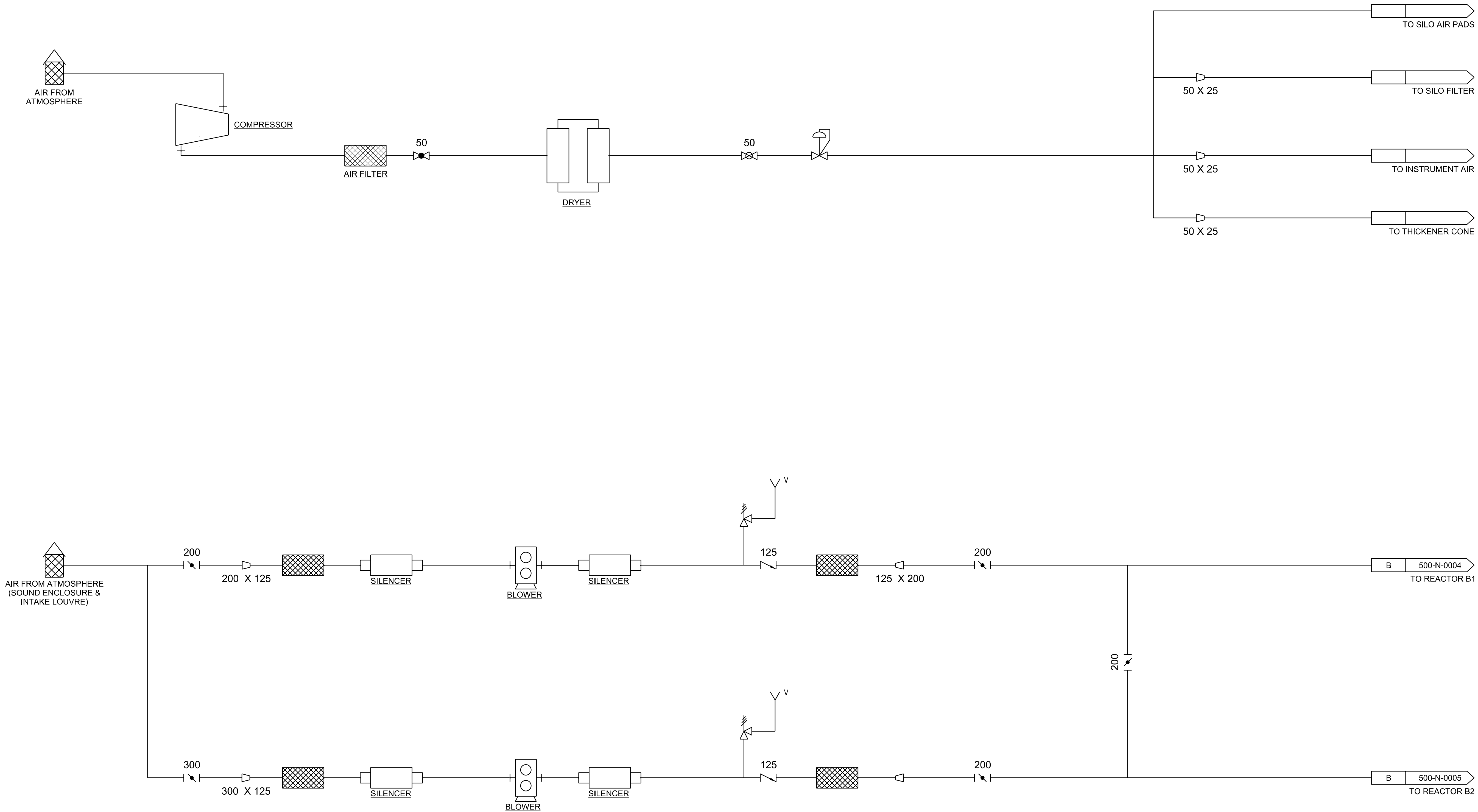
SHEET	SHEET_NO.



NO.	DATE	REVISION	BY	APVD

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FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

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INSTRUMENTATION AND CONTROLS
UNIT PROCESS 17
AIR BLOWERS
P&ID

NTS
VERIFY SCALE
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DATE	
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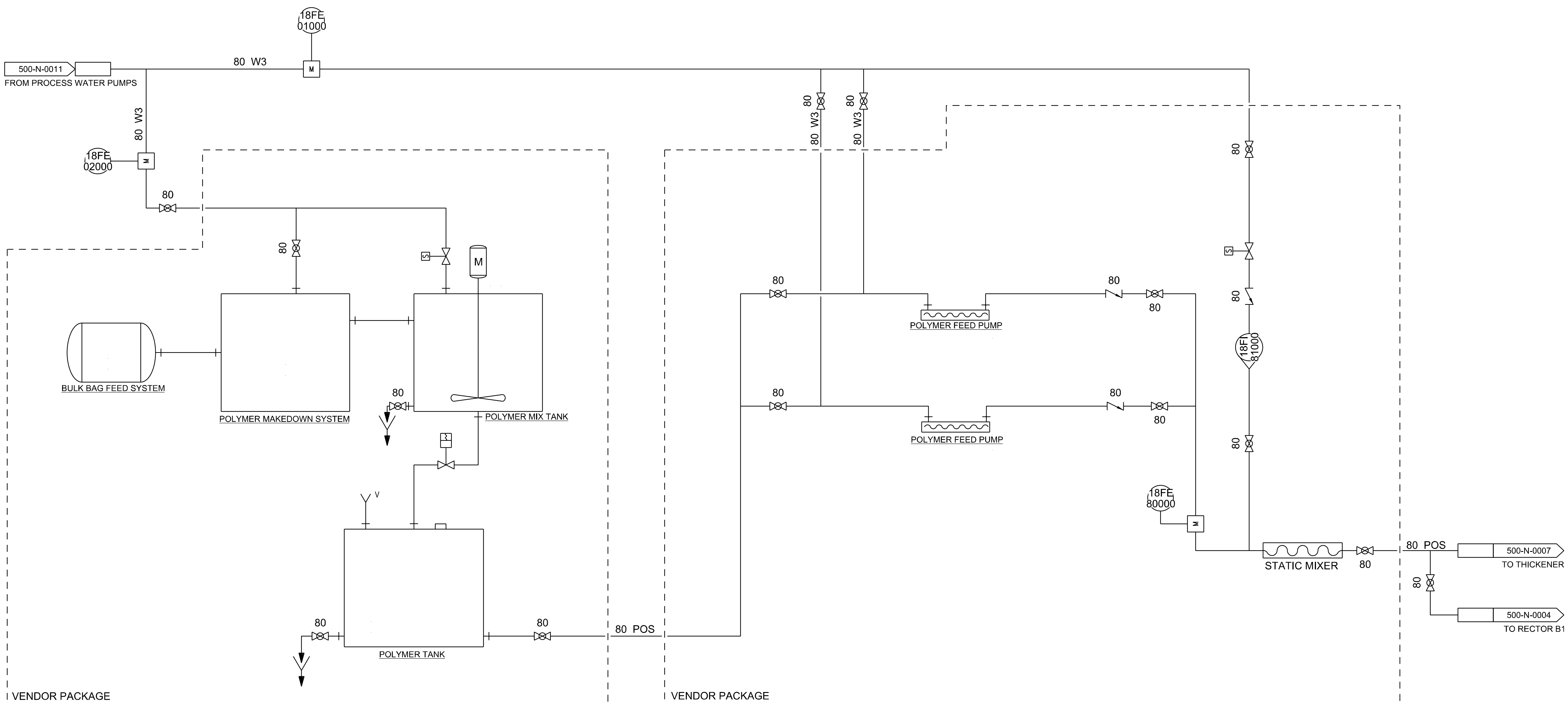

NO.	DATE	REVISION	BY	APVD

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FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

INSTRUMENTATION AND CONTROLS

UNIT PROCESS 18
POLYMER SYSTEM AND FEED PUMPS
P&ID

NTS

VERIFY SCALE

BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
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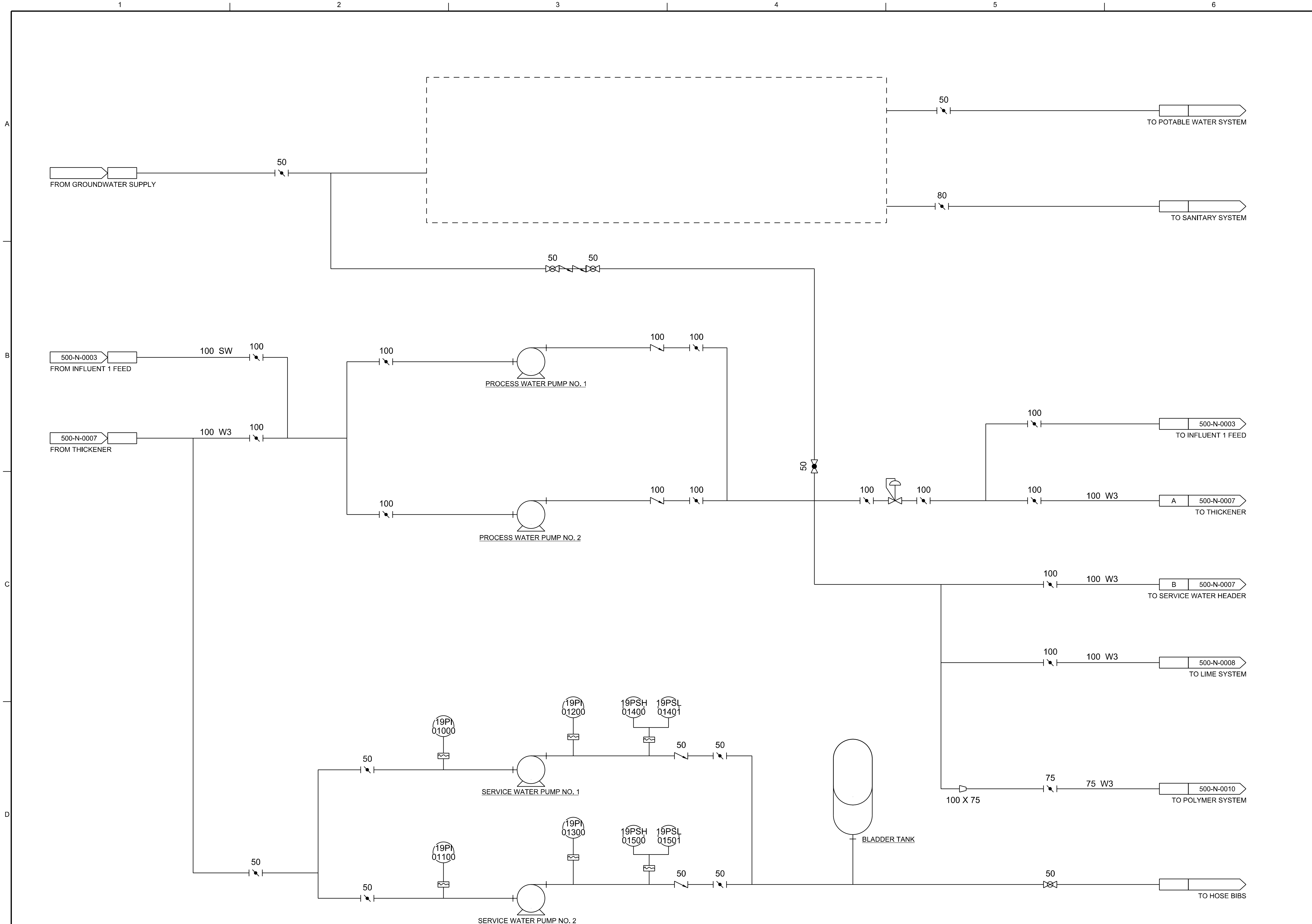
SHEET	SHEET_NO.



NO. | DATE | REVISION | BY | APVD

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FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

INSTRUMENTATION AND CONTROLS
UNIT PROCESS 19
PLANT WATER
P&ID

NTS
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
PROJ	436662
DWG	500-N-0011
SHEET	SHEET_NO.

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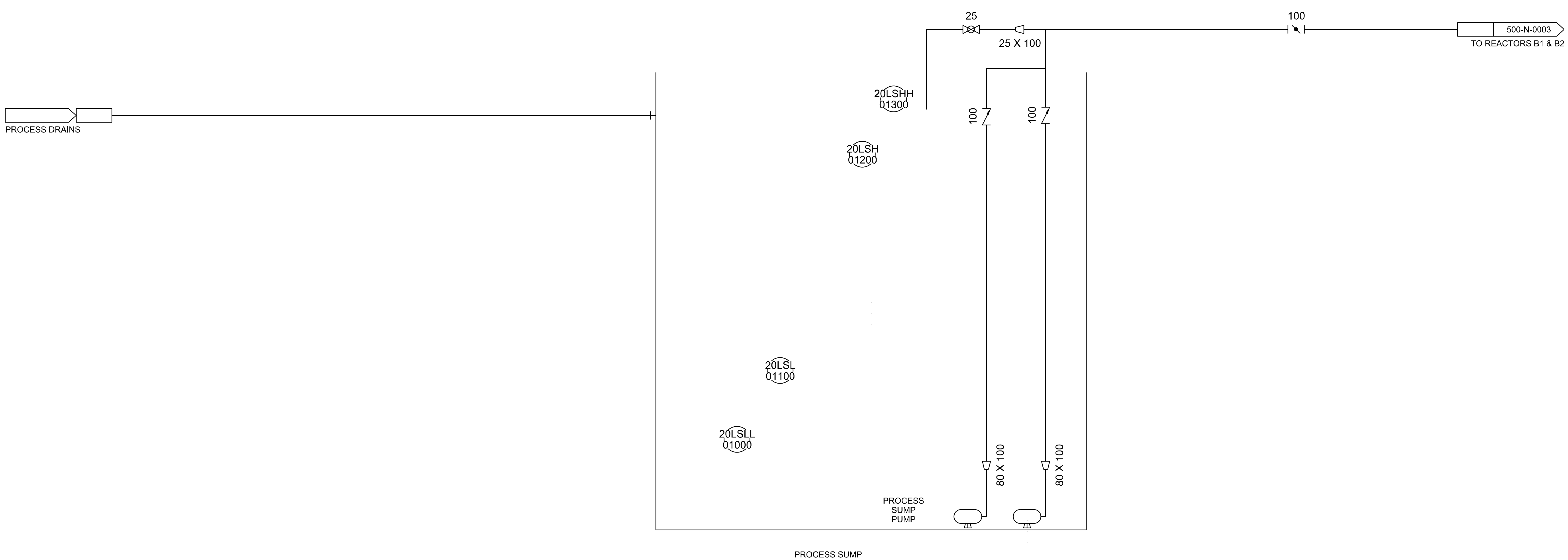

NO.	DATE	REVISION	BY	APVD

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FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL®

INSTRUMENTATION AND CONTROL
UNIT PROCESS 20
MISCELLANEOUS
P&ID

NTS
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
PROJ	436662
DWG	500-N-0012
SHEET	SHEET_NO.

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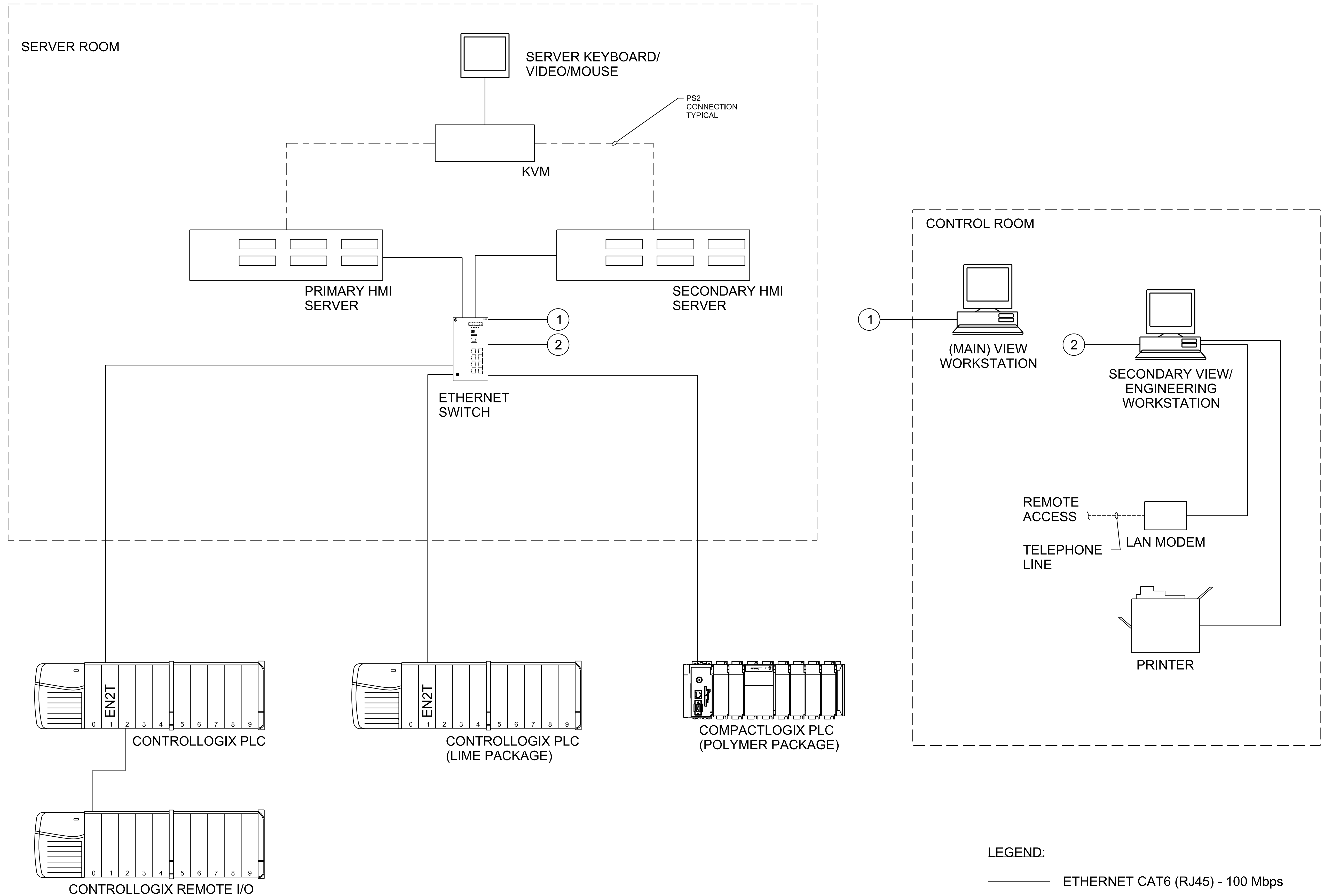

NO.	DATE	REVISION	BY	APVD

DSGN J BOGDANIC | DR JA MENDOZA | CHK | APVD | QC | PM

FARO MINE REMEDIATION
WATER TREATMENT PLANT DESIGN
GOVERNMENT OF YUKON
DESIGN

CH2MHILL

INSTRUMENTATION AND CONTROLS
SCADA ARCHITECTURE

NTS
VERIFY SCALE
BAR IS 25mm ON ORIGINAL DRAWING.
0 25mm

DATE	
PROJ	436662
DWG	500-N-0016
SHEET	SHEET_NO.

Appendix B
Drawing List

Faro WTP Drawing List

	GENERAL		
1	500-G-0001		PROJECT LOCATION AND VICINITY MAP
2	500-G-0002		INDEX OF DRAWINGS - 1
3	500-G-0003		INDEX OF DRAWINGS - 2
4	500-G-0004		GENERAL LEGENDS AND SYMBOLS
5	500-G-0005		GENERAL ABBREVIATIONS
	CIVIL		
1	500-C-0001		CIVIL GENERAL NOTES AND LEGENDS
2	500-C-0002		EXISTING OVERALL SITE PLAN
3	500-C-0003		SITE PLAN
4	500-C-0004		PLANT SITE PLAN
5	500-C-0005		DEMOLITION PLAN AND DETAILS
6	500-C-0006		PLANT SITE GRADING PLAN
7	500-C-0007		PLANT SITE GRADING PLAN -DETAILS
8	500-C-0008		OVERALL SITE EROSION AND SEDIMENTATION CONTROL PLAN
9	500-C-0009		PLANT SITE EROSION AND SEDIMENTATION CONTROL PLAN
10	500-C-0010		EROSION AND SEDIMENTATION NOTES AND DETAILS
11	500-C-0011		OVERALL YARD PIPING LAYOUT
12	500-C-0012		PLANT SITE YARD PIPING LAYOUT
13	500-C-0013		PROCESS PLAN AND PROFILES 1
14	500-C-0014		PROCESS PLAN AND PROFILES 2
15	500-C-0015		PROCESS PLAN AND PROFILES 3
16	500-C-0016		PROCESS PLAN AND PROFILES 4
17	500-C-0017		PROCESS PLAN AND PROFILES 5
18	500-C-0018		PROCESS PLAN AND PROFILES 6
19	500-C-0019		PROCESS PLAN AND PROFILES 7
20	500-C-0020		PROCESS PLAN AND PROFILES 8
21	500-C-0021		PROCESS PLAN AND PROFILES 9
22	500-C-0022		PROCESS PLAN AND PROFILES 10
23	500-C-0023		PROCESS PLAN AND PROFILES 11
24	500-C-0024		PROCESS PLAN AND PROFILES 12
25	500-C-0025		SANITARY SEWER PLAN AND PROFILES
26	500-C-0026		PLANT SECTION 1
27	500-C-0027		PLANT SECTION 2
28	500-C-0028		PLANT SECTION 3
29	500-C-0029		PLANT SECTION 4
30	500-C-0030		GENERAL STANDARD DETAILS (CIVIL) - 1
31	500-C-0031		GENERAL STANDARD DETAILS (CIVIL) - 2
32	500-C-0032		GENERAL STANDARD DETAILS (CIVIL) - 3
33	500-C-0033		GENERAL STANDARD DETAILS (CIVIL) - 4
	ARCHITECTURAL		
1	500-A-0001		ARCHITECTURAL LEGEND AND CODE DATA
2	500-A-0002		ARCHITECTURAL GENERAL NOTES
3	500-A-5001		GENERAL STANDARD DETAILS (ARCHITECTURAL) - 1
4	500-A-5002		GENERAL STANDARD DETAILS (ARCHITECTURAL) - 2
5	500-A-5003		GENERAL STANDARD DETAILS (ARCHITECTURAL) - 3
6	500-A-5004		GENERAL STANDARD DETAILS (ARCHITECTURAL) - 4
7	500-A-5005		GENERAL STANDARD DETAILS (ARCHITECTURAL) - 5
8	500-A-5006		INTERIOR FINISH AND DOOR SCHEDULES
9	510-A-0001	PROCESS BUILDING	PIT/TUNNEL LEVEL FLOOR PLAN
10	510-A-0002	PROCESS BUILDING	LOWER LEVEL PLAN
11	510-A-0003	PROCESS BUILDING	GROUND FLOOR PLAN
12	510-A-0004	PROCESS BUILDING	ACCESS PLATFORM PLAN
13	510-A-0005	PROCESS BUILDING	ROOF PLAN
14	510-A-0006	PROCESS BUILDING	FIRST FLOOR REFLECTED CEILING PLAN
15	510-A-0007	PROCESS BUILDING	NORTH AND WEST ELEVATIONS
16	510-A-0008	PROCESS BUILDING	SOUTH AND EAST ELEVATIONS
17	510-A-0009	PROCESS BUILDING	BUILDING SECTION
18	510-A-0010	PROCESS BUILDING	BUILDING SECTION
19	510-A-0011	PROCESS BUILDING	WALL SECTIONS
20	510-A-0012	PROCESS BUILDING	ENLARGED FLOOR PLANS
21	510-A-0013	PROCESS BUILDING	ENLARGED FLOOR PLANS
22	510-A-0014	PROCESS BUILDING	PLAN AND SECTION DETAILS
23	510-A-0015	PROCESS BUILDING	PLAN AND SECTION DETAILS
24	510-A-0016	PROCESS BUILDING	PLAN AND SECTION DETAILS
25	510-A-0017	PROCESS BUILDING	INTERIOR ELEVATIONS

26	510-A-0018	PROCESS BUILDING	INTERIOR ELEVATIONS
27	510-A-0019	PROCESS BUILDING	INTERIOR DETAILS
28	510-A-0020	PROCESS BUILDING	INTERIOR DETAILS
29	510-A-0021	PROCESS BUILDING	DOOR DETAILS
30	510-A-0022	PROCESS BUILDING	WINDOW/LOUVER DETAILS
31	510-A-0023	PROCESS BUILDING	GROUND FLOOR SIGNAGE PLAN
32	520-A-0001	LIME FACILITY	GROUND, SECOND AND ROOF PLANS
33	520-A-0002	LIME FACILITY	ELEVATIONS
34	520-A-0003	LIME FACILITY	BUILDING SECTIONS
35	520-A-0004	LIME FACILITY	DETAILS
36	520-A-0005	LIME FACILITY	DETAILS
37	540-A-0001	GRIT BUILDING	PLANS AND SECTIONS
38	540-A-0002	GRIT BUILDING	DETAILS
	STRUCTURAL		
1	500-S-0001		STRUCTURAL GENERAL NOTES 1
2	500-S-5001		GENERAL STANDARD DETAILS (STRUCTURAL) - 1
3	500-S-5002		GENERAL STANDARD DETAILS (STRUCTURAL) - 2
4	500-S-5003		GENERAL STANDARD DETAILS (STRUCTURAL) - 3
5	500-S-5004		GENERAL STANDARD DETAILS (STRUCTURAL) - 4
6	500-S-5005		GENERAL STANDARD DETAILS (STRUCTURAL) - 5
7	500-S-5006		GENERAL STANDARD DETAILS (STRUCTURAL) - 6
8	500-S-5007		GENERAL STANDARD DETAILS (STRUCTURAL) - 7
9	500-S-5008		GENERAL STANDARD DETAILS (STRUCTURAL) - 8
10	500-S-5009		GENERAL STANDARD DETAILS (STRUCTURAL) - 9
11	500-S-5010		GENERAL STANDARD DETAILS (STRUCTURAL) - 10
12	500-S-5011		GENERAL STANDARD DETAILS (STRUCTURAL) - 11
13	500-S-5012		GENERAL STANDARD DETAILS (STRUCTURAL) - 12
14	500-S-5013		GENERAL STANDARD DETAILS (STRUCTURAL) - 13
15	500-S-5014		GENERAL STANDARD DETAILS (STRUCTURAL) - 14
16	500-S-5015		GENERAL STANDARD DETAILS (STRUCTURAL) - 15
17	510-S-0001	PROCESS BUILDING	TRANSFORMER PAD PLAN AND DETAILS
18	510-S-0002	PROCESS BUILDING	PROCESS ROOM PLAN AT 1133.70 LEVEL
19	510-S-0003	PROCESS BUILDING	PLAN AT PLATFORM LEVEL
20	510-S-0004	PROCESS BUILDING	ROOF FRAMING PLAN
21	510-S-0005	PROCESS BUILDING	PLAN AT GRADE ELVEL
22	510-S-0006	PROCESS BUILDING	LIME SILO FOUNDATION PLAN AND DETAILS
23	510-S-0007	PROCESS BUILDING	FRAMING ELEVATIONS
24	510-S-0008	PROCESS BUILDING	FRAMING ELEVATIONS
25	510-S-0009	PROCESS BUILDING	FRAMING ELEVATIONS
26	510-S-0010	PROCESS BUILDING	FRAMING ELEVATIONS
27	510-S-0011	PROCESS BUILDING	SECTIONS
28	510-S-0012	PROCESS BUILDING	SECTIONS
29	510-S-0013	PROCESS BUILDING	SECTIONS
30	510-S-0014	PROCESS BUILDING	SECTIONS
31	510-S-0015	PROCESS BUILDING	SECTIONS
32	510-S-0016	PROCESS BUILDING	SECTIONS
33	510-S-0017	PROCESS BUILDING	SECTIONS
34	510-S-0018	PROCESS BUILDING	FRAMING DETAILS
35	510-S-0019	PROCESS BUILDING	FRAMING DETAILS
36	510-S-0020	PROCESS BUILDING	FRAMING DETAILS
37	510-S-0021	PROCESS BUILDING	FRAMING DETAILS
38	510-S-0022	PROCESS BUILDING	STAIRS SECTION
39	510-S-0023	PROCESS BUILDING	PLATFORM ELEVATIONS
40	510-S-0024	PROCESS BUILDING	CRANE DETAILS
41	510-S-0025	PROCESS BUILDING	PIPE RACK FRAMING DETAILS
42	510-S-0026	PROCESS BUILDING	PIPE RACK FRAMING DETAILS
43	510-S-0027	PROCESS BUILDING	STRUCTURAL DETAILS
44	510-S-0028	PROCESS BUILDING	STRUCTURAL DETAILS
45	530-S-0001	THICKENER	THICKENER PUMP PIT AND TUNNEL PLAN
46	530-S-0002	THICKENER	THICKENER BASE PLAN
47	530-S-0003	THICKENER	TUNNEL ROOF PLAN
48	530-S-0004	THICKENER	THICKENER TOP PLAN
49	530-S-0005	THICKENER	BRIDGE WALKWAY FRAMING PLANS
50	530-S-0006	THICKENER	SECTIONS
51	530-S-0007	THICKENER	SECTIONS
52	530-S-0008	THICKENER	SECTIONS
53	530-S-0009	THICKENER	SECTIONS
54	530-S-0010	THICKENER	BRIDGE WALKWAY SECTIONS AND DETAILS
55	530-S-0011	THICKENER	BRIDGE WALKWAY DETAILS
56	530-S-0012	THICKENER	DETAILS

57	540-S-0001	GRIT BUILDING	PLANS AND SECTIONS
58	540-S-0002	GRIT BUILDING	DETAILS
	PROCESS MECHANICAL		
1	500-D-0001		GENERAL MECHANICAL NOTES, SYMBOLS AND VALVES
2	500-D-0002		HYDRAULIC PROFILE
3	500-D-5001		GENERAL STANDARD DETAILS (PROCESS MECHANICAL) - 1
4	500-D-5002		GENERAL STANDARD DETAILS (PROCESS MECHANICAL) - 2
5	500-D-5003		GENERAL STANDARD DETAILS (PROCESS MECHANICAL) - 3
6	500-D-5004		GENERAL STANDARD DETAILS (PROCESS MECHANICAL) - 4
7	510-D-0001	PROCESS BUILDING	MECHANICAL PLAN - 1128.6
8	510-D-0002	PROCESS BUILDING	MECHANICAL PLAN - 1133.70
9	510-D-0003	PROCESS BUILDING	MECHANICAL PLAN - 1137.70
10	510-D-0003	PROCESS BUILDING	MECHANICAL PLAN - 1143.80
11	510-D-0004	PROCESS BUILDING	MECHANICAL PLAN AND SECTIONS - POLYMER
12	510-D-0005	PROCESS BUILDING	MECHANICAL SECTIONS
13	510-D-0006	PROCESS BUILDING	MECHANICAL SECTIONS
14	510-D-0007	PROCESS BUILDING	MECHANICAL SECTIONS
15	510-D-0008	PROCESS BUILDING	MECHANICAL SECTIONS
16	510-D-0009	PROCESS BUILDING	MECHANICAL DETAILS
17	510-D-0010	PROCESS BUILDING	MECHANICAL DETAILS
18	510-D-0011	PROCESS BUILDING	MECHANICAL DETAILS
19	510-D-0012	PROCESS BUILDING	MECHANICAL DETAILS
20	520-D-0001	LIME SLAKER BUILDING	MECHANICAL PLAN AND SECTIONS - LIME
21	530-D-0001	THICKENER	MECHANICAL PLAN
22	530-D-0002	THICKENER	MECHANICAL PLAN - TUNNEL
23	530-D-0003	THICKENER	MECHANICAL SECTIONS
24	530-D-0004	THICKENER	MECHANICAL SECTIONS
25	530-D-0005	THICKENER	MECHANICAL DETAILS
26	530-D-0006	THICKENER	MECHANICAL DETAILS
	BUILDING MECHANICAL		
1	500-H-0001		HVAC AND FIRE PROTECTION LEGEND, SYMBOLS AND NOTES
2	500-H-0002		AIRFLOW SCHEMATIC
3	500-H-0003		AIRFLOW SCHEMATIC
4	500-H-5001		GENERAL STANDARD DETAILS (HVAC) - 1
5	500-H-5002		GENERAL STANDARD DETAILS (HVAC) - 2
6	500-H-5003		GENERAL STANDARD DETAILS (HVAC) - 3
7	510-H-0001	PROCESS BUILDING	PLAN - 1128.6
8	510-H-0002	PROCESS BUILDING	PLAN - 1133.70
9	510-H-0003	PROCESS BUILDING	PLAN - 1137.70
10	510-H-0004	PROCESS BUILDING	SECTIONS
11	510-H-0005	PROCESS BUILDING	SECTIONS
12	510-H-0006	PROCESS BUILDING	SECTIONS
13	520-H-0001	LIME SLAKER BUILDING	PLANS AND SECTIONS
14	530-H-0001	THICKENER	TUNNEL PLAN
15	540-H-0001	GRIT BUILDING	PLAN AND SECTIONS
	PLUMBING		
1	500-J-0001		PLUMBING GENERAL NOTES, LEGEND AND SYMBOLS
2	500-J-0001		PLUMBING FIXTURE CONNECTION SCHEDULE AND DETAILS
3	500-J-5001		GENERAL STANDARD DETAILS (PLUMBING) - 1
4	500-J-5002		GENERAL STANDARD DETAILS (PLUMBING) - 2
5	510-J-0001	PROCESS BUILDING	FLOOR PLAN - GROUND FLOOR
6	510-J-0002	PROCESS BUILDING	FLOOR PLAN - LOWER PLAN
7	510-J-0003	PROCESS BUILDING	ENLARGED PLAN - OFFICE AND LAB AREA
8	520-J-0001	LIME FACILITY	PLANS
9	530-J-0001	THICKENER	TUNNEL PLAN
10	540-J-0001	GRIT BUILDING	PLAN
	ELECTRICAL		
1	500-E-0001		ELECTRICAL LEGEND SHEET 1 OF 2
2	500-E-0002		ELECTRICAL LEGEND SHEET 2 OF 2
3	500-E-0003		OVERALL ELECTRICAL ONE-LINE DIAGRAM
4	500-E-0004		OVERALL ELECTRICAL SITE PLAN
5	500-E-0005		SITE POWER PLAN
6	500-E-0006		SITE POWER PLAN
7	500-E-0007		SITE POWER PLAN
8	500-E-0008		SITE LIGHTING PLAN
9	500-E-0009		ELECTRICAL DETAILS - MISCELLANEOUS
10	500-E-0010		ELECTRICAL DETAILS - MISCELLANEOUS

11	500-E-0011		ELECTRICAL DETAILS - MISCELLANEOUS
12	500-E-0012		ELECTRICAL DETAILS - GROUNDING
13	500-E-0013		ELECTRICAL DETAILS - SUPPORTS
14	500-E-0014		ELECTRICAL DETAILS - OVERHEAD LINES
15	500-E-0015		ELECTRICAL DETAILS - OVERHEAD LINES
16	500-E-0016		ELECTRICAL DETAILS - CABLE TRAY
17	500-E-0017		ELECTRICAL DETAILS - CABLE TRAY
18	500-E-0018		CABLE BLOCK DIAGRAM
19	500-E-0019		CABLE BLOCK DIAGRAM
20	500-E-0020		CONTROL SCHEMATICS
21	500-E-0021		CONTROL SCHEMATICS
22	500-E-0022		CONTROL SCHEMATICS
23	500-E-0023		CONTROL SCHEMATICS
24	500-E-0024		CONTROL SCHEMATICS
25	500-E-0025		POWER CABLE SCHEDULE
26	500-E-0026		CONTROL CABLE SCHEDULE
27	500-E-0027		PANEL SCHEDULES
28	500-E-0028		PANEL SCHEDULES
29	500-E-0029		PANEL SCHEDULES
30	500-E-0030		PANEL SCHEDULES
31	500-E-5001		GENERAL STANDARD DETAILS (ELECTRICAL) - 1
32	500-E-5002		GENERAL STANDARD DETAILS (ELECTRICAL) - 2
33	500-E-5003		GENERAL STANDARD DETAILS (ELECTRICAL) - 3
34	500-E-5004		GENERAL STANDARD DETAILS (ELECTRICAL) - 4
35	500-E-5005		GENERAL STANDARD DETAILS (ELECTRICAL) - 5
36	510-E-0001	PROCESS BUILDING	ONE-LINE DIAGRAM
37	510-E-0002	PROCESS BUILDING	ONE-LINE DIAGRAM
38	510-E-0003	PROCESS BUILDING	ONE-LINE DIAGRAM
39	510-E-0004	PROCESS BUILDING	ONE-LINE DIAGRAM
40	510-E-0005	PROCESS BUILDING	MCC ELEVATIONS
41	510-E-0006	PROCESS BUILDING	LIGHTING PLAN
42	510-E-0007	PROCESS BUILDING	LIGHTING PLAN
43	510-E-0008	PROCESS BUILDING	POWER PLAN
44	510-E-0009	PROCESS BUILDING	POWER PLAN
45	510-E-0010	PROCESS BUILDING	ELECTRICAL ROOM LAYOUT
46	510-E-0011	PROCESS BUILDING	CABLE TRAY PLAN (1ST FLOOR)
47	510-E-0012	PROCESS BUILDING	CABLE TRAY PLAN (1ST FLOOR)
48	510-E-0013	PROCESS BUILDING	PROCESS MECH POWER PLAN (1ST FLOOR)
49	510-E-0014	PROCESS BUILDING	PROCESS MECH POWER PLAN (1ST FLOOR)
50	510-E-0015	PROCESS BUILDING	GROUNDING PLAN
51	520-E-0001	LIME FACILITY	LIGHTING PLAN
52	520-E-0002	LIME FACILITY	POWER PLAN
53	520-E-0003	LIME FACILITY	CABLE TRAY PLAN
54	520-E-0004	LIME FACILITY	GROUNDING PLAN
55	530-E-0001	THICKENER	LIGHTING PLAN - TUNNEL
56	530-E-0002	THICKENER	LIGHTING PLAN
57	530-E-0003	THICKENER	POWER PLAN - TUNNEL
58	530-E-0004	THICKENER	POWER PLAN
59	530-E-0005	THICKENER	CABLE TRAY PLAN - TUNNEL
60	530-E-0006	THICKENER	CABLE TRAY PLAN
61	530-E-0007	THICKENER	GROUNDING PLAN
62	540-E-0001	GRIT BUILDING	PLANS
	INSTRUMENTATION AND CONTROL		
1	500-N-0001		I&C LEGEND SHEET 1 OF 2
2	500-N-0002		I&C LEGEND SHEET 2 OF 2
3	500-N-0003		UNIT PROCESS NO. 11 INFLUENT FLOW TO REACTORS B1 AND B2 P&ID
4	500-N-0004		UNIT PROCESS NO. 12 REACTOR B1 P&ID
5	500-N-0005		UNIT PROCESS NO. 13 REACTOR B2 P&ID
6	500-N-0006		UNIT PROCESS NO. 14 REACTOR A P&ID
7	500-N-0007		UNIT PROCESS NO. 15 THICKENER P&ID
8	500-N-0008		UNIT PROCESS NO. 16 LIME SYSTEM P&ID
9	500-N-0009		UNIT PROCESS NO. 17 AIR BLOWERS P&ID
10	500-N-0010		UNIT PROCESS NO. 18 POLYMER SYSTEM AND FEED PUMPS P&ID
11	500-N-0011		UNIT PROCESS NO. 19 PLANT WATER P&ID
12	500-N-0012		UNIT PROCESS NO. 20 PROCESS SUMP P&ID
13	500-N-0013		CONTROL PANEL POWER DISTRIBUTION
14	500-N-0014		TYPICAL PLC I/O WIRING SHEET 1 OF 2
15	500-N-0015		TYPICAL PLC I/O WIRING SHEET 2 OF 2
16	500-N-0016		SCADA ARCHITECTURE
17	500-N-0017		MISCELLANEOUS

18	500-N-0018		CONTROL PANELS
19	500-N-5001		INSTALLATION DETAILS SHEET 1 OF 5
20	500-N-5002		INSTALLATION DETAILS SHEET 2 OF 5
21	500-N-5003		INSTALLATION DETAILS SHEET 3 OF 5
22	500-N-5004		INSTALLATION DETAILS SHEET 4 OF 5
23	500-N-5005		INSTALLATION DETAILS SHEET 5 OF 5

Appendix C
Specification List

Project: **Faro Water Treatment Plant**

Division 7 - Thermal And Moisture Protection

07_14_00	Fluid Applied Waterproofing
07_16_00	Cementitious Waterproofing
07_21_00	Thermal Insulation
07_41_10	Preformed Metal Roofing
07_42_10	Preformed Metal Panels
07_92_00	Joint Sealants

Division 8 - Openings

08_11_00	Metal Doors and Frames
08_13_10	Rolling Metal Doors
08_41_13	Aluminum-Framed Entrances and Storefronts
08_51_13	Aluminum Windows
08_71_00	Door Hardware
08_80_00	Glazing
08_90_00	Louvers

Division 9 - Finishes

09_29_00	Gypsum Board
09_30_00	Tiling
09_51_13	Acoustical Panel Ceilings
09_65_00	Resilient Flooring
09_80_00	Acoustical Treatment
09_90_00	Painting and Coatings
09_96_35	Chemical Resistant Coatings
09_97_00	Special Coatings

Division 10 - Specialties

10_28_13	Toilet Accessories
10_44_00	Portable Fire and Safety Equipment
10_80_00	Miscellaneous Specialties

Division 13 - Special Construction

13_34_23	Fabricated Structures

Division 22 - Plumbing

22_07_00	Plumbing Piping Insulation
22_10_01	Plumbing Piping and Accessories
22_10_01.01	Plumbing Piping Schedule (Supplement)
22_10_01.02	Polyvinyl Chloride Drain Waste and Vent Pipe And Fittings (Data Sheet)
22_10_01.03	Cast Iron Soil Pipe and Fittings (Data Sheet)
22_10_01.08	High-Density Polyethylene Pipe and Fittings (Data Sheet)
22_10_01.09	High Purity Polypropylene Pipe and Fittings (Data Sheet)
22_30_00	Plumbing Equipment
22_40_00	Plumbing Fixtures

Division 23 - Heating, Ventilating, and Air Conditioning (HVAC)

23_05_48	Vibration Controls for HVAC
23_05_48.01	Vibration Controls for Plumbing and Equipment
23_05_93	Testing, Adjusting, and Balancing for HVAC
23_31_13	Metal Ducts and Accessories
23_31_13.01	Schedules for HVAC
23_34_00	HVAC Fans
23_34_00.01	HVAC Fans (Supplement)

Division 26 - Electrical

Division 31 - Earthwork

Division 32 - Exterior Improvements

Division 33 - Utilities

Division 40 - Process Integration

40_27_00.10	Polyvinyl Chloride (PVC) Pipe and Fittings
40_27_00.13	Copper and Copper Alloy Pipe Tubing and Fittings Data Sheet
40_27_00.14	High Density Polyethylene (HDPE) Pipe and Fittings
40_27_01	Process Piping Specialties
40_27_02	Process Valves and Operators
40_27_02.01	Process Valve Checklist Menu and Guide
40_27_02.02	Motorized and Manual Valve Schedule
40_41_13	Pipe Heat Tracing
40_42_13	Process Piping Insulation
40_80_01	Piping Leakage Testing
40_90_00	Instrumentation and Control for Process Systems
40_91_00	Instruments and Control Components
40_95_80	Structured Cabling System (Copper/Fibre Optic Communication)
40_96_00	Application Software
40_99_90	Package Control Systems

Division 41 - Material Processing And Handling Equipment

41_12_23.23	Screw Conveyor Systems
41_22_13.13	Overhead Cranes
41_22_23_19	Monorail Hoists

Division 43 - Process Gas and Liquid Handling, Purification, And Storage Equipment

43_11_15.14	Single Stage Centrifugal Aeration Blower System
43_12_01	Compressors Air Systems
43_21_13.23	Horizontal End Suction Centrifugal Pumps
43_21_13.16	Horizontal Split Case Centrifugal Pumps
43_21_26	Progressive Cavity Pumps
43_21_29.13	Submersible Pumps
43_21_39.13	Submersible Pumps
43_22_56.01S	Submersible Mixers
43_22_56.02	Vertical Mixers/Agitators
43_22_68.16	Automatic Composite Sampler (Diverter Type)
43_40_03	Welded Steel Tanks

Division 44 - Pollution Control Equipment

44_42_19.04	Aeration Blowers
44_42_56.16	Peristaltic Hose Pumps
44_44_13.04	Lime slaking system
44_44_63.02	Polymer System
44_46_25.01	Aluminum Cover
44_46_26.01	Thickener

Division 46 - Water and Wastewater Equipment

46_33_33.03	Polymer Feed System, Dry
46_33_42	Chemical Metering Pumps
46_43_16.20	Thickener/Clarifier
46_43_61S	Sludge Blanket-Type Clarification System
46_51_21.16	Fine Bubble Air Diffuser System
46_71_13B	Gravity Thickener Mechanisms

Appendix D
Equipment List and Pipe List

PROJECT NO: 436662
PROJECT: Faro WTP
CLIENT: Government of Yukon
TITLE: Major Equipment and Electrical Load List

Revision No.:	Prepared By:	Revision Date:	Checked By:	Checked Date:
0	Ray Chin			
1	S Larocque	30-Nov-12		

OPERATION DEFINITION
(C) Critical:
(S) Stand-by:

	General Information				Tracking		Sizing Requirements			Electrical Requirements and Information									
Major Equipment Item	**Location (Building)**	**Process**	**Equipment Tag No.**	**Description**	**Facility Provide**	**Update Date**	**Capacity**	**Power kW**	**Power hp**	**Voltage**	**Phases**	**Motor Speed Fixed (F) / Two (T) / Variable (V)**	**Rotation Non-Rev (N) / Reversing (R)**	**Duty C, I, or S**	**Operation C, E, or N**	**Control Panel ELEC SUB.(ES) or VENDOR SUPP.(VS)**	**MCC location**	**Enclosure Rating**	**Comments**
Lime Slaking System			14																Vendor Supplied System
Lime Truck Unloading Panel	Lime Facility			Truck unloading control			30 A feed			600	3								This panel powers dust collector and silo instrumentation
Lime System Panel	Lime Facility			Lime system control panel			100 A feed			600	3								Control panel includes all starters for lime system equipment
Lime Facility Auxillary			16																
Roll-up Door	Lime Facility								3	600	3	F	R	I					
Sump Pump	Lime Facility								1			F	N	I					
Lime Facility Exhaust Fan	Lime Facility		EF-8						0.75	600	3	F	N						
Lime Facility Upper Level Unit Heater	Lime Facility		EUH-9					5		600	3	F	N						
Lime Facility Lower Level Unit Heater	Lime Facility		EUH-10					5		600	3	F	N						
Lime Facility Exhaust Motorized Damper	Lime Facility		MD-11						0.2	120	1	F	R						
Lime Facility Intake Motorized Damper	Lime Facility		MD-12						0.2	120	1	F	R						
Reactors Area			11																
Reactor A Mixer	Process Building								5	600	3	F	N	C					
Reactor B1 mixer	Process Building								100	600	3	F	N	C					estimate 75 hp will suffice
Reactor B2 mixer	Process Building								100	600	3	F	N	C					
Lime Feed Valve	Process Building																		Motorized Valve
Influent 1 Feed Valve	Process Building																		Motorized Valve
Influent 3 Feed Valve	Process Building																		Motorized Valve
Influent 4 Feed Valve	Process Building																		Motorized Valve
Influent 5 Feed Valve	Process Building			Future															Motorized Valve
Influent 6 Feed Valve	Process Building			Future															Motorized Valve
Polymer System			16																Vendor Supplied System
Polymer makedown system	Process Building							10											
Polymer Volumetric Feeder	Process Building								1	600	3	V	N	I					
Polymer Batch Tank Mixer	Process Building								1	600	3	F	N	I					
Polymer Day Tank Mixer	Process Building								1	600	3	F	N	I					
Polymer Feed Pump 1	Process Building								3	600	3	V	N	C					
Polymer Feed Pump 2	Process Building								3	600	3	V	N	S					
Blowers and Compressors			15																
Process Air blower 1 (duty)	Process Building			Future					50	600	3	F	N	C					The air flow at startup is too low to warrant blowers
Process Air blower 2 (duty)	Process Building			Future					50	600	3	F	N	S					Air will be taken from air compressors
Plant air compressor 1 (duty)	Process Building								30	600	3	F	N	C					
Plant air compressor 2 (standby)	Process Building								30	600	3	F	N	S					
Process Building Utilities			13																
Overhead travelling crane	Process Building								5	600	3	F	R	I					
Rollup door	Process Building								3	600	3	F	R	I					
Process Sump Pump	Process Building								3	600	3	F	N	I					
Process Water Pump 1 (duty)	Process Building								10	600	3	F	N	C					
Process Water Pump 2 (standby)	Process Building								10	600	3	F	N	S					
Service Water Pump 1 (duty)	Process Building								10	600	3	F	N	C					
Service Water Pump 2 (standby)	Process Building								10	600	3	F	N	S					
Control Room, Lab, Break Room and Corridor Supply Fan	Process Building		SF-1						1	600	3	F	N						
Tunnel Supply Fan	Process Building		SF-2						0.5	120	1	F	N						
Electrical Room Exhaust Fan	Process Building		EF-1						0.75	600	3	F	N						
Polymer Room Exhaust Fan	Process Building		EF-2						0.75	600	3	F	N						
Washroom Exhaust Fan	Process Building		EF-3					80	0.1	120	1	F	N						
Mechanical Room Exhaust Fan	Process Building		EF-4						0.2	120	1	F	N						
Compressor / Blower Room Exhaust Fanst	Process Building		EF-5						0.75	600	3	F	N						
Server Room Exhaust Fan	Process Building		EF-6					129	0.15	120	1	F	N						
Process Area Exhaust Fan	Process Building		EF-7						5	600	3	F	N						
Tunnel Exhaust Fan	Process Building		EF-8						0.5	120	1	F	N						
Thickener Effluent Flow Meter Room Exhaust Fan	Process Building		EF-9						0.5	120	1	F	N						
Polymer Room Unit Heater	Process Building		EUH-1					20		600	3	F	N						
Polymer Room Unit Heater	Process Building		EUH-2					5		600	3	F	N						
Process Area Unit Heater	Process Building		EUH-3					40		600	3	F	N						
Process Area Unit Heater	Process Building		EUH-4					40		600	3	F	N						
Process Area Unit Heater	Process Building		EUH-5					40		600	3	F	N						
Process Area Unit Heater	Process Building		EUH-6					40		600	3	F	N						

CH2MHILL

PROJECT NO: 436662
PROJECT: Faro WTP
CLIENT: Government of Yukon
TITLE: Major Equipment and Electrical Load List

Revision No.:	Prepared By:	Revision Date:	Checked By:	Checked Date:
0	Ray Chin			
1	S Larocque	30-Nov-12		

OPERATION DEFINITION
(C) Critical:
(S) Stand-by:

Compressor / Blower Room Unit Heater	Process Building		EUH-7						0.5		120	1	F	N						
Mechanical / Janitor Room Unit Heater	Process Building		EUH-8						10		600	3	F	N						
Tunnel Unit Heater	Process Building		EUH-9						20		600	3	F	N						
Thickener Effluent Flow Meter Room Unit Heater	Process Building		EUH-10						20		600	3	F	N						
Tunnel Unit Heater	Process Building		EUH-11						20		600	3	F	N						
Control Room Electric Heater	Process Building		EC-1						1		120	1	F	N						
Laboratory Electric Heater	Process Building		EC-2						0.5		120	1	F	N						
Break Room Electric Heater	Process Building		EC-3						0.5		120	1	F	N						
Mechanical Room Electric Heater	Process Building		EC-4						0.3		120	1	F	N						
Stair (east) Electric Heater	Process Building		EC-5						0.3		120	1	F	N						
Stair (north) Electric Heater	Process Building		EC-6						0.3		120	1	F	N						
Electric Duct Heater for SF-1	Process Building		EDH-1						10		600	3	F	N						
Electric Duct Heater for SF-2	Process Building		EDH-2						20		600	3	F	N						
Vestibule Electric Heater	Process Building		FF-1						5		600	3	F	N						
Electrical Room Exhaust Motorized Damper	Process Building		MD-1							0.2	120	1	F	R						
Electrical Room Intake Motorized Damper	Process Building		MD-2							0.2	120	1	F	R						
Polymer Room Exhaust Motorized Damper	Process Building		MD-3							0.2	120	1	F	R						
Polymer Room Intake Motorized Damper	Process Building		MD-4							0.2	120	1	F	R						
Mechanical / Janitor Room Exhaust Motorized Damper	Process Building		MD-5							0.2	120	1	F	R						
Mechanical / Janitor Room Intake Motorized Damper	Process Building		MD-6							0.2	120	1	F	R						
Air Compressor / Blower Room Exhaust Motorized Damper	Process Building		MD-7							0.2	120	1	F	R						
Air Compressor / Blower Room Intake Motorized Damper	Process Building		MD-8							0.2	120	1	F	R						
Process Area Exhaust Motorized Damper	Process Building		MD-9							0.2	120	1	F	R						
Process Area Intake Motorized Damper	Process Building		MD-10							0.2	120	1	F	R						
Thickener Effluent Flow Meter Room Exhaust Motorized Damper	Process Building		MD-11							0.2	120	1	F	R						
Tunnel Exhaust Motorized Damper	Process Building		MD-12							0.2	120	1	F	R						
Tunnel Intake Motorized Damper	Process Building		MD-13							0.2	120	1	F	R						
Thickener Effluent Flow Meter Room Intake Motorized Damper	Process Building		MD-15							0.2	120	1	F	R						
Electric Hot Water Tank	Process Building		HWT-1						18		600	3	F	N						
Sanitary Sump Pump	Process Building		SP-1							3	600	3	F	N						
Sanitary Sump Pump	Process Building		SP-2							3	600	3	F	N						
Process Sump Pump	Process Building		SP-3							3	600	3	F	N						
Process Sump Pump	Process Building		SP-4							3	600	3	F	N						
Tempered Water Recirculating Pump	Process Building		TWRP							0.5	120	1	F	N						
RO system (Future)	Process Building		RO-1							0.5	120	1	F	N						
Water Storage Tank	Process Building									0	-	-	-	-						
Trap Primer	Process Building		ETP-1						80	0.1	120	1	F	N						
Thickener Area			12																	
Thickener basin	Thickener																			
Thickener basin cover	Thickener																			
Thickener main drive	Thickener									50	600	3	V	N	C					
Thickener lift drive	Thickener									25	600	3	F	R	I					
Sludge Recycle Pump Valve	Thickener									1/3	600	3	F	N	I					Motorized Valve
Sludge recycle pump 1 (duty)	Thickener									20	600	3	V	N	C					
Sludge recycle pump 2 (standby)	Thickener									20	600	3	V	N	S					
Sludge Wasting Pump Valve	Thickener									1/3	600	3	F	N	I					
Sludge Wasting Pump 1 (duty)	Thickener									40	600	3	F	N	I					
Sludge Wasting Pump 2 (standby)	Thickener									40	600	3	F	N	S					
Thickener Cover Ventilation	Thickener																			
Thickener Cover Lighting	Thickener																			
Booster Pump and Grit Building																				
Booster Pump	Booster Pump									150	600	3	V	N	I					
Other																				
TOTAL CONNECTED LOAD																				
TOTAL ESSENTIAL LOAD																				

Faro Mine

Process Piping Schedule

Service Abbrev. [Note 1]	Service Description	Size(s) (mm) [Note 2]	Exposure [Note 3]	Piping Material [Note 4]	From	To	Spec. Section	P&ID	Joints [Note 5]	Normal Operating Pressure (kPag)	Normal Operating Temp. Range (deg C)	Design Maximum Operating Pressure (kPag)	Design Temp. Range (deg C)	Test Pressure and Type (kPag) [Note 6]	ASME Piping Code and Fluid Service Category	Lining/ Coating [Note 7]	Insulation	Heat Trace	Remarks [Note 8]
FW	Influent 1	750	EXP, BUR	SST	Faro Pit Yard Pipe	Reactor B1/B2			BW, FL	1550	15	2400	2 to 25	3600, H		None			
FW	Influent 1	500 (ID)	EXP, BUR	HDPE	Existing Faro Supply at Mill	Process Building			TBF, FL	TBD	15	TBD	2 to 25	TBD		None			
FW	Influent 2	N/A	EXP, BUR	SST	Faro Pit Yard Pipe	Reactor B1/B2			BW, FL	1550	15	2400	2 to 25	3600, H		None			Future with exception of wall penetration
FW	Influent 2	500 (ID)	EXP, BUR	HDPE	Faro Pit	Process Building			TBF, FL	TBD	15	TBD	2 to 25	TBD		None			Future
FW	Influent 3	350	EXP, BUR	SST	Intermediate Pond Yard Pipe	Reactor B1/B2			BW, FL	1550	15	2400	2 to 25	3600, H		None			
FW	Influent 3	350	EXP, BUR	HDPE	Intermediate Pond Pipe at Access Road	Process Building			TBF, FL	TBD	15	TBD	2 to 25	TBD		None			
FW	Influent 4	200	EXP, BUR	SST	ETA Yard Pipe	Reactor B1/B2			BW, FL	1550	15	2400	2 to 25	3600, H		None			
FW	Influent 4	200	EXP, BUR	HDPE	ETA Pipe at Access Road	Process Building			TBF, FL	TBD	15	TBD	2 to 25	TBD		None			
FW	Influent 5	400	EXP, BUR	SST	CVD SIS Pipe	Reactor B1/B2			BW, FL	1550	15	2400	2 to 25	3600, H		None			Future with exception of wall penetration
FW	Influent 5	400 (ID)	EXP, BUR	HDPE	CVD SIS	Process Building			TBF, FL	TBD	15	TBD	2 to 25	TBD		None			Future
FW	Influent 6	350	EXP, BUR	SST	Yard Pipe	Reactor B1/B2			BW, FL	1550	15	2400	2 to 25	3600, H		None			Future with exception of wall penetration
FW	Influent 6	350 (ID)	EXP, BUR	HDPE	Vangorda/Grum Pipe	Process Building			TBF, FL	TBD	15	TBD	2 to 25	TBD		None			Future
BW	Filter Backwash	250	EXP	TBD	Filter Backwash Sump	Reactor B1/B2			BW, FL	240	15	515	2 to 25	830, H		None			Future
RS	Reactor A Discharge	250	EXP	SST	Reactor A	Reactor B1/B2			BW, FL	100	15	350	2 to 25	830, H		None	No	No	
RD	Reactor B1 Discharge	750	EXP	SST	B1	B2, Thickener			BW, FL	100	15	350	2 to 25	830, H		None			
RD	Reactor B2 Discharge	750	EXP	SST	B2	Thickener			BW, FL	100	15	350	2 to 25	830, H		None			
OF	Reactor B Overflow	900	EXP	SST	Reactor B1/B2	Outside			BW, FL	100	15	350	2 to 25	830, G		None	No	No	
ED	Thickener Effluent	750	EXP	SST	Thickener	Yard Pipe			BW, FL	100	15	350	2 to 25	830, H		None			
ED	Thickener Effluent	750 (ID)	EXP	HDPE	Thickener	Existing Effluent Pipe			TBF, FL	100	15	350	2 to 25	830, H		None			
RS	Thickener Underflow 1	150	EXP	CLDI	Thickener	Sludge Pump Header			BW, FL	275	15	515	2 to 25	830, H		None			
RS	Thickener Underflow 2	100	EXP	CLDI	Thickener	Sludge Pump Header			BW, FL	275	15	515	2 to 25	830, H		None			
WS	Sludge Wasting	100 (ID)	EXP	HDPE	Process Building	Faro Pit			BW, FL	1030	15	1030	2 to 25	1550, H		None			
WS	Sludge Wasting	100	EXP	CLDI	Sludge Pump Header	Yard Pipe			TBF, FL	1030	15	1030	2 to 25	1550, H		None			
RS	Sludge Recycle	200	EXP	CLDI	Sludge Pump Header	Reactor A			BW, FL	275	15	515	2 to 25	830, H		None			
W3	Process Water	100	EXP	SST	Thickener	Process Header 1	15200-03		BW, FL	690	15	1030	2 to 25	1550, H		None	Yes	Yes	Exterior Piping insulated and heat traced.
SW	Influent Water	100	EXP	SST	Influent 1	Process Header 2	15200-03		BW, FL	690	15	1030	2 to 25	1550, H		None	No	No	
SW	Slaker Water Feed	40	EXP	SST	Process Header 2	Slaker	15200-03		BW, FL	690	15	1030	2 to 25	1550, H		None	No	No	
SW	Slaker Effluent	50	EXP	SST	Slaker	Lime Slurry Tank	15200-03		BW, FL	515	15	860	2 to 50	1550, H		None	No	No	To be finalized by vendor
SW	Lime Slurry Tank Water Feed	75	EXP	SST	Process Header 2	Lime Slurry Tank			BW, FL	690	15	1030	2 to 25	1550, H		None	No	No	
LS	Lime Slurry Recirculation	50	EXP	CS	Lime Slurry Tank	Lime Slurry Tank			BW, FL	515	15	860	2 to 50	1550, H		None	No	No	To be finalized by vendor
LS	Lime Slurry Reactor A Feed	50	EXP	CS	Lime Slurry Recirculation	Reactor A			BW, FL	515	15	860	2 to 50	1550, H		None	No	No	To be finalized by vendor
W3	Polymer Makedown Water Feed	50	EXP	SST	Process Header 1	Polymer Makedown Tank	15200-03		BW, FL	690	15	1030	2 to 25	1550, H		None	No	No	
W3	Polymer Post Dilution Water Feed	65	EXP	SST	Process Header 1	Polymer Feed Tank	15200-03		BW, FL	690	15	1030	2 to 25	1550, H		None	No	No	
POS	Polymer Feed Pipe	75	EXP	PVC	Polymer Feed Tank	Thickener Feed Pipe	15200-10		SV	350	15	690	2 to 25	830, H		None	No	No	
PS	Process Water Sump	100	EXP	PVC	Process Sump	Reactor B1/B2			BW, FL	350	15	690	2 to 25	830, H		None	No	No	
BA	Blower Air	200	EXP	SST	Blower	Reactor B1/B2			BW, FL	100	180	200	180	300, H		None	Yes	No	
CA	Compressed Air	All	EXP	CS	Compressor	All	15200-10		SC, GR	690	-50 to 80	690	-50 to 80	1035, P		None	None	None	
WW	Well Water	All	EXP	CS	Groundwater Supply				BW, FL, SC	690	15	1030	2 to 25	1550, H		None	Yes	Yes	
V	Vent	ALL	ALL	PVC			15200-10		SV				2 to 25			--/--			
DR	Drain	ALL	ALL	PVC			15200-10		SV, FL			690	2 to 25	1035, H		--/--			
SAM	Sample	25	EXP	PVC			15200-10		SV			100	2 to 25	150, H		--/--			
PW	Potable Water	ALL	ALL	PVC			15200-10		SV, FL			690	2 to 25	1035, H		--/--			

Notes:

1. Where piping carries more than one service designation, the piping material shall conform to the requirement of the first service listed (e.g., CGW/OF would require the material used for CGW piping).

2. Size Designations:
   < = Less than — ≤ = Less than or equal to — ALL = All sizes
   > = Greater than — ≥ = Greater than or equal to

3. Exposure:
   EXP = Exposed (indoors or outdoors) — ENC = Concrete encased — ALL = all exposures
   BUR = Buried — SUB = Submerged

4. Material Abbreviations:
   CLDI = Cement mortar-lined ductile iron — CU = Copper — GS = Galvanized steel
   CPP = Concrete pressure pipe — DI = Ductile iron — HDPE = High density polyethylene
   CPVC = Chlorinated polyvinyl chloride — PVDF = PVDF — PVC = Polyvinyl chloride
   CS = Carbon steel — GLDI = Glass-lined ductile iron — SST = Stainless steel

5. Joint Types (as specified in Section 15200, Process Piping - General and in the Piping Data Sheets)
   BS = Bell and spigot — MJ = Mechanical joint — SD = Soldered
   BW = Butt welded — PO = Push-on — SV = Solvent welded
   FL = Flanged — PRJ = Proprietary restrained (push-on type) — TBF = Thermal butt fusion
   GR = Grooved — SC = Screwed (threaded)

6. Pressure Tests (as specified in Section 15955, Piping Leakage Testing)
   H = Hydrostatic
   P = Pneumatic
   G = Gravity (if test pressure is not shown, test under the highest static head that the pipe can be subjected to)

7. Lining:
AS = Asphaltic
CM = Cement mortar
GL = Glass
FBE = Fusion-bonded epoxy

Coating:
Paint = Prepare surface, prime and finish coat per Section 09900, Painting
Poly = Polyethylene encasement as specified
Wrap = Tape wrap/heat shrink as specified
FBE = Fusion-bonded epoxy

8. Remarks:
(1) Provide insulation as specified in Section 15080, Process Piping Insulation
(2) Provide cathodic protection as specified.
(3) All joints shall be restrained.
(4) Provide flanged joints at valves and equipment.
(5) See specification section 15200 for PVDF tubing spec. PVDF tubing shall be laid inside a 50 mm clear PVC sched 40 PVC pipe.
(6) Provide heat tracing for piping outside building envelop as specified in Section 16055 - Piping Heat Tracing, Section 11015 - Fiberglass Reinforced Plastic Tank, and as shown in Contract Drawings
(7) Joints to be suitable for the application as recommended by the tubing and fittings manufacturers
(8) Piping registration required by local authorities
(9) Pressure test not required on gravity piping.
(10) Pipes not listed in the Table above shall be in stainles steel per section 15200-08

9 Service:
BA = Blower Air
BR = Backwash Recycle
CA = Compressed Air
DR = Drain
ED = Effluent Discharge
FW = Feed Water
LS = Lime Slurry
OF = Overflow
RD = Reactor Discharge
RS = Recycled Sludge
SW = Service Water (Influent)
V = Vent
W1 = Potable Water
W3 = Process Water (Effluent)
WS = Waste Sludge
WW = Well Water