REPORT

Tailings, Waste Rock, Overburden and Water Management Facility Preliminary Engineering Design

James Bay Lithium Mine Project, Quebec

Submitted to:

Galaxy Lithium

Submitted by:

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Executive Summary

Galaxy Lithium Canada Inc. (Galaxy) engaged Golder Associates Ltd. (Golder) to complete Preliminary Engineering design of tailings, waste rock, overburden and associated surface water management facilities for the James Bay Lithium Mine Project, Quebec. The following studies and analyses were completed to support the preliminary engineering design:

- Establishment of design criteria for mine waste and water management facilities.
- Preliminary engineering design of mine waste and water management facilities.
- Site wide water balance considering average, wet and dry climate conditions and conceptual water management plan.
- Construction quantities for the mine waste and water management facilities over the life of mine.

The James Bay Lithium Mine Project will produce approximately 31.4 Mt (~18.5 Mm^3) of tailings over the 18.5 year mine life at a production rate of 5,500 tpd. Filtered tailings was selected as the preferred level of dewatering. Filtered tailings will be co-disposed with waste rock in four Waste Rock Tailings Storage Facilities (WRTSFs). The overall design objective of the WRTSFs is to provide stable rockfill structures that will store tailings solids during both operations and long term (post-closure). Mine waste rock from open pit development will be the primary embankment construction material. The WRTSF embankments will have a 2.3H:1V slope with a maximum height of 83 m. The WRTSF embankments will be raised continuously during mine operation to provide the necessary tailings storage during the life of mine. Closure of the WRTSFs will involve placing a vegetated cover over the tailings and waste rock embankment slopes. Limited geotechnical investigations have been completed to date at the site. A review of available geotechnical investigation data was carried out to develop the preliminary design.

Runoff from the WRTSFs will be captured by perimeter collection ditches which drain to one of two Water Management Ponds (WMPs). Water will be transferred from the East Water Management Pond (EWMP) to the North Water Management Pond (NWMP) where it will be either recycled to the process plant or treated (if a treatment is required) and discharged to the environment at the final effluent point. Emergency discharge spillways will be provided from the WMPs. Groundwater from the open pit dewatering will be pumped to the NWMP. The EWMP will have a storage capacity of 0.18 Mm^3 and the North WMP will have a storage capacity of 1.36 Mm^3, which is required to contain the design flood ("crue de projet") defined in Directive 019 without spillage to the environment.

The following activities are recommended to support the design of the WRTSF as it advances to Pre-Feasibility Study (PFS) and Feasibility Study (FS) level designs:

- Supplemental geotechnical site investigation of the WRTSF, WMP and OPSF areas to characterize the foundation conditions.
- Geotechnical investigations to identify potential granular borrow sources.
- In-situ permeability tests of the overburden soils and bedrock beneath the WRTSFs to confirm compliance with Quebec Directive 19 and water management plan assumptions.
- Develop a groundwater model to evaluate potential impacts of the WRTSFs on the local environment.

- Tailings laboratory testing to determine the filterability (dewatering) and geotechnical characteristics.
- Additional tailings and waste rock geochemical characterization to determine acid generation potential and metal leaching in accordance with Quebec Directive 19.
- Optimization of the proposed WRTSF design and construction staging based on additional geotechnical site investigation data including consideration of the Global Industry Standard on Tailings Management (GISTM) on WRTSF design.
- Further refinement of the site wide water balance.
- Optimize the locations and designs of the WMPs.
- Hazard assessment to determine the Consequence Classification of the WRTSF slopes and WMP dykes in accordance with CDA guidelines.
- A dam breach and inundation study to support the WMP dam classification.
- Fish sampling in the proposed WRTSF and WMP areas should be conducted to confirm fish presence/absence in the waterbodies of interest that may be impacted by the proposed development.
- Advancement of the mine closure plan.
- Confirmation of mine plan and material balance to confirm availability of construction materials for development of the WRTSFs over the life of mine including pre-production and closure periods.
- Condemnation drilling for the WRTSF sites to verify the absence of mineralization.
- Water treatment requirements for effluent discharge from the NWMP.

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1.0 INTRODUCTION

Galaxy Lithium Canada Inc. (Galaxy) engaged Golder Associates Ltd. (Golder) to complete Preliminary Engineering design of the mine waste and associated surface water management facilities for the proposed James Bay Lithium Mine Project located approximately 380 km north of the town of Matagami, in the province of Quebec, Canada. G-Mining Services Inc. (G-Mining) was responsible for mine planning, design of the process plant and mine site infrastructure.

In 2020, Golder carried out a Value Engineering (VE) exercise, reviewing the previously completed Feasibility Study conducted by Stantec in 2019 to identify opportunities to refine the engineering of the mine waste and water management facilities to reduce initial and sustaining capital expenditures for development. Subsequent to the completion of VE studies, Galaxy revised the project schedule to re-evaluate engineering at the Preliminary Economic Assessment (PEA) level and incorporate the results of VE studies.

The following studies and analyses were completed during Preliminary Engineering design of the mine waste and water management facilities to support the PEA:

- Establishment of design criteria for mine waste and water management facilities
- Preliminary engineering design of mine waste and associated surface water management facilities
- Updated site-wide water balance considering average, wet and dry climate conditions and conceptual water management plan
- Construction quantity estimates for the mine waste and water management facilities over the life of mine

Initial and sustaining capital cost estimates over the life of mine (LOM) for the PEA were the responsibility of G-Mining.

2.0 SITE AND PROJECT INFORMATION

The James Bay Lithium Mine Project is located approximately 10 km south of the Eastmain River, and 100 km east of James Bay. There are two mine waste streams; waste rock and filtered “dry” tailings. The mine will produce approximately 31.4 Mt (~18.5 Mm^3) of tailings over the 18.5 year mine life at a production rate of 5,500 tonnes per day (tpd). Filtered tailings was selected by Galaxy as the preferred level of tailings dewatering. Filtered tailings will be co-disposed with waste rock in four Waste Rock Tailings Storage Facilities (WRTSFs). The overall design objective of the WRTSFs is to provide stable waste rockfill structures that will store tailings solids during both operations and long term (post-closure). Peat and organic materials along with mineral soil overburden waste will be contained in a separate storage area referred to herein as the Overburden and Peat Storage Facility (OPSF).

The project components and activities at the site will include the construction, operation and eventual decommissioning and closure of the following key elements:

- Open pit
- Run-of-Mine (ROM) pad and stockpile
- Mineral processing infrastructure and site buildings
- Spodumene concentrate warehouse
- Truck shop and fuel station

- Overburden and Peat Storage Facility (OPSF)
- Four Waste Rock Tailings Storage Facilities (WRTSFs)
- North Water Management Pond (NWMP), East Water Management Pond (EWMP), Process Plant Raw Water Pond (RWP) and water collection ditches
- Propane and explosives storage facilities
- Access roads
- 69kV substation and power transmission lines
- Other ancillary infrastructure and equipment

Figure 1 illustrates the proposed site plan configuration at the ultimate stage of the life of mine. The mine site will be accessible from the existing James Bay Road, which runs along the east perimeter of the site. The Run-of-Mine (ROM) stockpile and spodumene concentrate warehouse will be located adjacent to the process plant. A total of four WRTSFs will be constructed around the open pit. The WRTSF locations were selected to minimize haul distance from the open pit. The currently proposed WRTSF locations will have to be confirmed to minimize their environmental impact during future studies. All runoff water generated by precipitation which falls on areas impacted by mining activities is considered “contact water”. A surface water drainage network will be built to collect and convey contact water from the ROM, WRTSFs, OPSF and process plant area to one of two WMPs. The same strategy will be used to manage the contact water for all disturbed land. After settling of sediment in the North WMP, excess water will be discharged to the CE2 Creek. Most on-site work and the locations of the various infrastructure and buildings will comply with the required minimal setback distance of 60 m from the high-water mark of any lake or watercourse. The exception are the two haul roads required to cross the CE3 Creek, and the East WRTSF, which overlaps a segment of the intermittent CE4 Creek.

3.0 DESIGN CRITERIA

3.1 WRTSF Design Criteria

WRTSF design criteria are summarized in Appendix A. Measured infiltration rates beneath the West and Northeast WRTSFs were identified to be lower than 3.3. L/m^2/day (WSP, 2020), which will meet the requirements of a low permeability soil in accordance with Québec Directive 019 (MDDELCC, 2012). The infiltration rate beneath the other proposed WRTSFs is assumed to be similar for the current PEA.

The key WRTSF operating data are listed below:

- Life of mine is 18.5 years
- Total tonnage of tailings produced is ~31.4 million tonnes (Mt)
- Nominal mill production rate is 5,500 tonnes per day (tpd) or 2,000,000 tonnes per annum (tpa)
- Deposited dry density of filtered tailings in the WRTSF is 1.7 t/m^3
- Total volume of tailings is ~18.5 million cubic metres (Mm^3)
- Annual required storage volume of tailings solids is ~1 Mm^3

- Total tonnage of waste rock produced is 129.9 Mt
- Waste rock dry density is 2.2 t/m^3
- Total volume of waste rock is ~59.0 Mm^3

It is anticipated that the tailings will be fairly coarse grained with a maximum particle size of 15 mm and a grain size distribution of 51.5% gravel sized particles, 44% sand sized particles and 4.5% fines (i.e., silt and clay sized particles). The waste rock is expected to consist of particles ranging from 30 mm to a maximum of 900 mm in diameter with a D50 of about 200 mm (average size).

4.0 MINE WASTE STORAGE FACILITY DESIGN

4.1 Design Assumptions

The following additional general assumptions were made for the preliminary WRTSF and OPSF design:

- Limited geotechnical information is available for the site. Based on available investigation information, the foundation of the WRTSFs has been assumed to be primarily granular till over bedrock. Additional geotechnical investigation will be required (during future studies) to confirm this assumption.
- The WRTSF embankment slopes will be constructed primarily with waste rock from open pit development.
- The tailings and waste rock are considered non-PAG, "Low Risk" under Directive 019, but leachable for various metals species over the short-term only.
- Tailings storage will be distributed amongst all four of the WRSTFs.
- The East WRTSF will extend into the southeast end of the open pit after it is mined out for in-pit disposal of waste rock only. Low permeable waste overburden sourced from WMP excavation can be used as fill to construct the WMP perimeter dykes.
- Excess tailings process water, seepage and runoff contact water from the WRTSFs and OPSF will be collected in perimeter ditches that drain to the WMPs or to the open pit. Collected contact water will be transferred from the EWMP and open pit to the NWMP by pumping.
- The site water management will be developed in a staged approach. Phase 1 (constructed in Year -1 pre-production) would be required to manage the run-off associated with mine infrastructure footprint up to the end of Year 3. The Phase 2 expansion would then manage run-off up to the end of mining (LOM).
- Water in the NWMP will be reclaimed back to the mill for process use on a year-round basis. Excess water that is not required by the process plant will be treated (if required) and discharged to the environment from the NWMP.

4.2 Water Management

4.2.1 Water Balance

A deterministic site wide water balance was developed with a Microsoft Excel spreadsheet to simulate operational conditions (Appendix B). The monthly accumulation of water in the WMPs, for a range of climate conditions (average, 1:25 year dry, 1:25 year wet and projected-climate change average), is the basis for developing the water management plan for the facility. The water balance model includes the following:

- Flows associated with processing the ore, including loss of water retained in the deposited tailings
- Flows associated with runoff from precipitation
- Flows associated with dewatering of the open pit
- Evapotranspiration from WRTSFs and OPSF
- Evaporation from pond surfaces
- Seepage from WRTSF and OPSF
- Infiltration losses and other water uses/losses (e.g., dust control)

Run-off from WRTSFs and OPSF will be captured by perimeter collection ditches that drain to either the East or North WMP or open pit. Water from open pit dewatering will be pumped to the NWMP. The water balance assumes that the excess water (not required for mineral processing) is treated and discharged to the CE2 Creek from the NWMP. The water balance has assumed the following:

- Effluent can be discharged to the environment all year long.
- An average effluent discharge capacity (i.e., water treatment capacity) of about 150,000 m^3/month assuming that effluent discharge is not allowed during winter months (i.e., December to April).
- Spring freshet is fixed in May (month when average temperature is positive).
- Freeboard of 1.0 m between Directive 019 flood level and WMP dam crest.
- 2.0 m of ice thickness.
- Minimum water reserve for Mill Supply in case of a late spring freshet equal to 52 days of water demand.

The results from the water balance model determined that the NWMP can provide all the mill's make-up water requirements. The annual water balance is positive even under the 1:25 year dry scenario, and the process plant demand could be supplied by the site runoff and pit dewatering flows. Effluent is expected to be discharged to the environment even under 1:25 year dry scenario.

4.2.2 Water Management Ponds

The two WMPs will collect seepage and runoff from WRTSFs as well as from the OPSF. Figure 2 illustrates WMP construction required to support for the first 3 years of operation (Phase 1). Construction of the EWMP is required during pre-production. Figure 1 illustrates the ultimate expansion of the NWMP that is required after Year 3 (Phase 2). During the mine's operational phase, water will be pumped from the NWMP via a reclaim pump system for the operation of the processing plant. The water balance assumes that water will be recycled from the NWMP to the mill at an assumed rate of 13,870 m^3/month. Under mean annual precipitation conditions, annual inflows to the WMPs exceed the annual process plant water requirements. Excess water will be pumped from the NWMP, treated with a Water Treatment Plant if required, and discharged to the environment.

Under normal conditions, the WMPs are sized to collect and contain runoff and contact water. The NWMP, with a maximum storage capacity of 1.36 Mm^3, has been sized to contain the design flood ("crue de projet") defined in Directive 019 without spillage to the environment and meet process water requirements year-round. The EWMP will have a maximum storage capacity of 0.18 Mm^3 sufficient to contain the design flood. Both WMPs will have an emergency spillway to prevent embankment overtopping under extreme climate conditions. The emergency spillways shall be designed to pass the Probable Maximum Flood (PMF).

4.2.2.1 Water Management Pond (WMP) Dyke Design

The WMPs will be constructed in cut, with perimeter dykes constructed of low permeable fill material sourced from cutting excavation. The perimeter dykes will be constructed primarily of clayey material sourced from the waste overburden from open pit stripping and/or WMP excavation. The internal slopes of the WMPs will be protected with erosion protection. A crest width of 6 m has been assumed for the WMP dykes to allow for vehicle and equipment movement. The slopes for the WMP dykes will be 3H:1V upstream and downstream for stability. The upstream slope will have a 0.3 m thick layer of rip-rap underlain by non-woven geotextile. The downstream slope will be vegetated with a thin layer of topsoil to reduce erosion. A typical cross-section of the WMP dykes is shown in Figure 4.

4.2.3 Perimeter Water Collection Ditches

Water collection ditches will be constructed along the toe of the WRTSFs and OPSF areas. The perimeter water collection ditches will collect run-off and seepage contact water from the WRTSFs and OPSF. The ditches will direct flow to the WMPs or the open pit, where water will be pumped to the NWMP. Figure 2 and Figure 1 illustrate the proposed perimeter collection ditching alignments in plan over the first 3 years of operation (Phase 1) and remaining years of operation (Phase 2), respectively. The typical cross-section for the perimeter collection ditches considered for material construction quantities at this stage of the project is trapezoidal with a minimum base width of 1.0 m, minimum depth of 1.5 m, 2.3H:1V side slopes and 0.3 m thick erosion protection over non-woven geotextile. Figure 4 illustrates the typical perimeter collection ditch in cross-section. The design of perimeter water collection ditches will be refined during future phases of the project’s development.

4.3 Waste Rock Tailings Storage Facility Development

Tailings and the waste rock will be co-disposed of within the WRTSF areas, with filtered tailings placed and compacted into cells contained within a waste rock embankment. The combined waste rock and filtered tailings storage will be divided into four (4) distinct management areas designated as the “West”, “Northeast”, “Southwest” and “East” WRTSFs as indicated on Figure 1. Progressive development (staged construction) of the mine waste and water management facilities has been considered in the preliminary design. Table 1 presents the cumulative production volumes of waste rock and tailings over the life of the project, using dry density parameters outlined in Section 3.1. Table 1 also designates which WRTSF will receive tailings during each year of mine operation and the WMP that will collect contact water. Figure 2 illustrates the WRTSF and WMP development over the first 3 years of operation (Phase 1). Figure 1 illustrates the ultimate WRTSF development at the end of the LOM. Construction of the fully expanded NWMP (as shown in Figure 1) will be required after the end of Year 3 to accommodate increased runoff from the larger WRTSF and OPSF catchment areas.

Table 1: Waste Rock and Tailings Volumes by Year

Year	Waste Rock Volume (m3)	Tailings Volume (m3)	Active WRTSF Receiving Tailings	WMP Receiving Runoff from Active WRTSF	Completed WMP Construction
-1	835,313	0	-	-	EWMP and NWMP (Phase 1)
1	2,284,233	1,000,000	East	EWMP	-
2	2,748,020	1,000,000	East	EWMP	-
3	2,339,979	1,000,000	East	EWMP	-
4	2,402,750	1,000,000	East	EWMP	North NWMP (Phase 2)
5	2,720,712	1,000,000	West	NWMP (Phase 1)	-
6	2,401,705	1,000,000	West	NWMP (Phase 1)	-
7	2,433,218	1,000,000	West	NWMP (Phase 1)	-
8	3,545,455	1,000,000	West	NWMP (Phase 1)	-
9	3,838,761	1,000,000	West	NWMP (Phase 1)	-
10	4,103,404	1,000,000	West	NWMP (Phase 1)	-
11	4,023,522	1,000,000	Southwest (JB1)	Open Pit	-
12	4,276,935	1,000,000	Southwest (JB1)	Open Pit	-
13	4,193,224	1,000,000	Southwest (JB1)	Open Pit	-
14	4,122,835	1,000,000	Northeast	NWMP (Phase 2)	-
15	3,069,970	1,000,000	Northeast	NWMP (Phase 2)	-
16	3,165,301	1,000,000	Northeast	NWMP (Phase 2)	-
17	2,727,273	1,000,000	Northeast	NWMP (Phase 2)	-
18	3,223,644	1,000,000	Northeast	NWMP (Phase 2)	-
19	591,191	450,860	Northeast	NWMP (Phase 2)	-
Total	**59,047,447**	**18,450,860**	-	-	-

The following is a summary of development and operation of the WRTSFs and WMPs:

Pre-Production (Year -1): Under the proposed development plan, the EWMP and Phase 1 of the NWMP will need to be constructed in the pre-production period (i.e., Year -1). All waste rock mined during the pre-production period will be used to construct the base drainage layer and perimeter containment berms for the East WRTSFs. Overburden from pit stripping and site development will be placed in the OPSF with runoff being collected in the NWMP (Phase 1).

Start-up (Years 1 through 4): In Years 1 through 4 of mine operation, waste rock placement will occur at both the East WRTSF and West WRTSF. Tailings will be placed within waste rock cells at the East WRTSF only during the first 4 years of mine operation. During this period, waste rock placement at the West WRTSF will be used to construct the base drainage layer and perimeter containment berms. Contact water from the East WRTSF (containing both waste rock and tailings) will be collected in the EWMP where it will be pumped to the NWMP.

Runoff from the OPSF and West WRTSF (containing waste rock only) will be collected in Phase 1 of the NWMP during this initial operating period.

Years 5 through 10: During Years 5 through 10 of mine operation, tailings will be placed within waste rock cells at the West WRTSF. During this period, waste rock placement will continue in the West WRTSF (during placement of filtered tailings) and begin in the Northeast WRTSF (to construct the base drainage layer). There may be some final waste rock placement in the East WRTSF to cover any exposed tailings and achieve the required external waste rock embankment slopes. Phase 2 of the NWMP will need to be constructed prior to Year 5 to collect runoff from both the OPSF, West WRTSF (containing both waste rock and tailings) and North WRTSF (containing waste rock only) during this period. The EWMP will continue to collect contact water from the East WRTSF.

Years 11 through 13: During Years 11 through 13 of mine operation, tailings will be placed within waste rock cells at the Southwest (JB1) WRTSF. During this period, waste rock placement will continue in the West WRTSF (to cover any exposed tailings and achieve the required external waste rock embankment slopes) and Northeast WRTSF (to construct the base drainage layer and perimeter containment berms prior to tailings deposition). Runoff from the Southwest (JB1) WRTSF will drain to the open pit where it will be pumped to the NWMP. The NWMP (Phase 2) will continue to collect runoff from the West WRTSF and Northeast WRTSF. The EWMP will continue to collect contact water from the East WRTSF.

Years 14 through 18.5: During the final years of mine operation, tailings will be placed within waste rock cells at the Northeast WRTSF. Waste rock placement during this period will be primarily in the mined out open pit (i.e., East WRTSF extension). There will also be some waste rock placement in the WRTSFs to cover any exposed tailings and achieve the required external waste rock embankment slopes. Runoff from the OPSF, West WRTSF and Northeast WRTSF will drain to the NWMP (Phase 2). The EWMP will continue to collect contact water from the East WRTSF. Runoff from the Southwest (JB1) WRTSF will continue to drain to the open pit and be pumped to the NWMP.

After the planned footprint of each WRTSF has been developed to the full extent (i.e., completion of the base waste rock drainage layer) and initial perimeter containment berm, waste rock will then be used to construct internal tailings disposal cells in successive lifts across the entire WRTSF plateau surface to the maximum design elevations. WRTSF development and raising will have to be carried out carefully to prevent localized failure of any underlying clayey soil foundation, if present. Stability analyses indicate that a 2.3H:1V overall slope will provide stable external WRTSF slopes (Section 4.5). The benching design and inter-bench slopes for progressive development of the WRTSFs should be optimized during the next phase of study, following completion of additional site characterization work (e.g., field and laboratory investigations). The ultimate WRTSF development plan is illustrated on Figure 1.

4.4 Waste Rock Tailings Storage Facility (WRTSF) Design

The overall design objective of the WRTSFs is to protect the regional groundwater and surface water resources during both operations and long term (post-closure), and to achieve effective reclamation upon mine closure.

Co-disposal of filtered tailings and waste rock offers the following advantages:

- Free draining waste rock embankment that does not impound water
- Waste rock embankment zones that improve the physical slope stability of the WRTSF
- Accelerated consolidation and improved shear strength of tailings

- Reduced risk of embankment failure and loss of tailings containment
- Reduced potential for metal leaching from the waste rock (if tailings and waste rock are mixed)
- Reduced total footprint area for mine waste disposal facilities
- Reduced freeze-drying, dusting and erosion of tailings (due to encapsulation in waste rock)
- Improved opportunities for progressive closure

The WRTSFs are located within the project site limits positioned around the open pit to reduce waste rock haul distance. The WRTSFs occupy a combined footprint of approximately 172.5 ha. Table 2 summarizes the proposed geometry of the WRTSFs.

Table 2: WRTSF Geometry

WRTSF	Ultimate Footprint Area (ha)	Ultimate Crest Elevation (masl)	Maximum Final Height (m)	Slope Overall Grade (X H:1V)
West	29.0	260	53	2.3
Northeast	54.4	290	83	2.3
Southwest (JB1)	31.0	270	62	2.3
East	58.1	280	68	2.3

Preliminary design of the four WRTSFs considered applicable regulations and current government recommendations, including Directive 019 sur l'Industrie Minière (MDDEFP, 2012) and the Guidelines for preparing mine closure plans in Québec (MERN, 2017). One of the criteria is that mine waste management facilities must be located 60 m from the high water mark of natural water courses and water bodies. The exception is the East WRTSF, which overlaps a segment of an intermittent creek that drains from Kapisikama Lake. However, it is understood that Kapisikama Lake will become dry during operation of the open pit (i.e., so this creek will already be impacted by pit development). The suitability of proposed mine infrastructure locations and compliance with applicable environmental requirements (e.g., 60 m distance from high-water mark) will need to be confirmed during future studies.

The WRTSF preliminary design assumes that the foundation soil has sufficiently low permeability to meet the maximum infiltration requirements of Québec Directive 019 without the need for a geomembrane liner. Measured infiltration rates beneath the West and North WRTSFs were identified to be lower than 3.3. L/m^2/day (WSP, 2020), indicating that a geomembrane liner will not be required. Additional site investigations are being carried out to further evaluate this assumption, including investigations at the Southwest and East WRTSFs.

The WRTSF embankment slopes will be constructed using mine waste rock materials. The WRTSFs will receive waste rock trucked from the open pit and filtered tailings trucked from the process plant. A typical cross-section of the WRTSFs is shown on Figure 4. The embankment design concept consists primarily of pit run rockfill to create tailings cells that will retain the filtered tailings solids. The WRTSF external embankment slopes will be 2.3H:1V overall for stability with 8.75 m wide benches every 5 m vertical. Peat will be excavated from a 25 m wide strip along the perimeter of the WRTSFs to improve slope stability. There will be a minimum 3 m thick layer of waste rock placed across the bottom of the WRTSF areas to provide drainage to the perimeter water collection ditching.

Tailings containment cells should be a maximum of 5 m deep and 50 m wide at the base with 10 m wide internal waste rock separator berms that will provide haul truck access to the tailings cells. It is envisioned that the tailings placement in each cell will be carried out by dozers spreading in thin lifts followed by compaction with smooth drum vibratory compaction. Each tailings containment cell should be covered with a 5 m thick lift of waste rock to ensure the WRTSF maintains an overall free-draining property and global slope stability. For the purposes of the preliminary engineering, it is assumed that the tailings leaving the process plant will be filtered to a 75% solids content (by mass). For the tailings to achieve long term strength parameters and not be susceptible to liquefaction, it is critical that the tailings be sufficiently filtered to permit adequate compaction during placement in the WRTSFs.

4.5 Overburden Peat Storage Facility (OPSF) Design

The overall design objective of the OPSF is to safely store overburden and peat excavated from open pit development while protecting surface water from sediment and allowing for reclamation upon mine closure.

Site preparation work, pre-stripping for the open pit, and excavation of the WMP's will generate overburden soil materials to be managed and stockpiled. All overburden will be stored in the OPSF located immediately North of the West WRTSF.

Organic soils (primarily peat) and non-organic mineral soil waste are to be stored separately in distinct zones within the OPSF to achieve stable slopes and to support potential reuse at closure. The OPSF will be located immediately upstream of the North WMP, with the overall surface drainage directed to the latter.

For preliminary engineering, Golder carried out an update to the waste material soil balance over the life of mine and it is estimated that the OPSF will need to store a total of approximately 2.9 Mm^3 of waste (5.8 Mt at 2.0 t/m^3). Based on the footprint area, the OPSF will reach a final elevation at 220.0 masl or a maximum height of 16 m with a total capacity of approximately 1.4 million m^3 at Phase 1 (End of Year 3) and 3.4 million m^3 at Phase 2 (LOM). The total storage capacity accounts for an assumed credit of 750,000 m^3 of waste material that is utilized for progressive reclamation of the WRTSFs instead of being stored at the OPSF.

Typical cross-sections of the OPSF slopes are shown on Figure 5.The OPSF will have a 16 m wide perimeter waste rock haul road toe berm. Peat will be excavated from a 15 m wide strip around the perimeter of the OPSF. A perimeter haul road will be constructed at the toe of the OPSF for access prior to waste deposition. The haul road will also act as a toe berm for slope stability purposes. The haul road / toe berm is proposed to be constructed of waste rock with dimensions of 16 m width and 4 m height. The slope of the OPSF has been designed at 5H:1V. The slope will be protected with a layer of waste rock erosion protection material. The OPSF will be zoned with fine grained clay / silt waste material being stored internally and granular waste peripherally. The finer clay / silt waste is to be stored a minimum 15 m offset from the slope crest to maintain stability. The peat waste will be stored in its own designated area, separate from the mineral soil overburden waste (clay / silt and granular material).

4.6 Subsurface Conditions and Slope Stability

Two-dimensional limit equilibrium slope stability analyses were performed using the commercially available program SLOPE/W 2019 R2, developed by GEOSLOPE International Ltd., employing the Morgenstern Price method of analysis. Slope stability was analysed for a representative critical section of the ultimate WRTSF slopes, OPSF slopes and WMP dykes. Slope stability analysis results and geotechnical parameters used in the analyses are summarized in Figures C-1 to C-10 and Table C-1 in Appendix C. The foundation stratigraphy for the representative design sections modelled in the slope stability analyses were developed based on findings from geotechnical investigations undertaken at the site by WSP Inc. in 2018, Stantec in 2019 (Stantec, 2019)[1] and SNC Lavalin (SNC) in 2020 (SNC, 2020)[2]. The 2018 investigation included fifty-three boreholes. The 2019 investigation by Stantec advanced a total of four boreholes and eight Cone Penetration Tests (CPTs). The 2020 investigation by SNC advanced a total of 4 boreholes and 31 test pits. The existing site investigation locations are shown on Figure 3.

The general stratigraphy of the site consists of, in descending stratigraphic order: peat/organic soil, clay, granular till, and bedrock. The organic soil/peat layer consists of fibrous peat to silty peat and is typically greater in thickness in areas that are relative topographic lows. The clay and silt layer has liquid limit ranging from 28% to 61% and plasticity index ranging from 7% to 35% (Stantec, 2019 and SNC, 2020). In-situ vane shear testing conducted on the clay layer measured undrained shear strength values ranging from approximately 31 kPa to 128 kPa indicating a firm to very stiff consistency (Stantec, 2019). The clay was only encountered in the northwestern area of the site, in the foundations of the proposed NWMP and OPSF. The native granular till is typically composed of silty sand to sandy silt with some gravel and contains boulders and cobbles. The bedrock typically ranges from fair to excellent quality.

The stratigraphic layers for the analyses have been simplified for the purposes of the preliminary engineering assessment. The existing ground surface and foundation layers are assumed to be horizontal. Table C-1 summarizes the simplified soil stratigraphic foundation layers overlying bedrock used for each model. The piezometric groundwater level used in the analyses was assumed to be at the existing ground surface. For the OPSF slope stability (i.e., peat, clay foundation and waste clay overburden fill), total stress parameters were employed in the analyses of the undrained conditions. The undrained shear strengths for the foundation units were represented using the Stress History and Normalized Soil Engineering Properties (SHANSEP) model with an undrained shear strength ratio ($Su/\sigma'v$). Construction induced excess porewater pressure generation and dissipation within the clay foundation was modelled using a b-bar coefficient. For long-term conditions, effective stress shear strength parameters were employed for the cohesive soil and peat. The OPSF will require a 16 m wide rockfill toe berm for stability purposes (as illustrated in Figure 5). The NWMP undrained clay foundation was modelled with an undrained strength (Su) for the end of construction loading condition. Non-cohesive soil including waste rock and native granular till was modelled using effective stress parameters (i.e., the Mohr-Coulomb failure criteria).

Based on available geotechnical investigations, this analysis assumed that no continuous layers of clay are present in the foundation material at the EWMP or WRTSFs. Some lenses of silt and clay material were observed within the footprint of the Northeast WRTSF during the 2020 investigation. For the preliminary engineering level stability analysis, the clay and silt lenses were not included in the simplified model. Consideration for the lenses should be taken during the next design stage following completion of additional site investigations.

Based on review of available geotechnical investigation data the surface organic layer for the WRTSF locations ranges in thickness from 0 to 2.6 m, with an average thickness of 0.7 m. The glacial till layer for the WRTSF locations ranges in thickness from 0.8 to 16.7 m, with an average thickness of 3.9 m. The preliminary slope stability analyses assumed a 5 m, 4 m, and 3 m thick layer of glacial till over bedrock for the West, Northeast and East WRTSF,

[1] Stantec (2019). “Geotechnical Investigation Report, Waste Rock and Tailings Storage Facility (WRTSF), James Bay Lithium Project”. Project No. 121622255. August 9, 2019.
[2] SNC Lavalin (2020). “James Bay Lithium Mine Project Detailed Geotechnical Investigation - Phase 2”. Report No. 673356-EG-L01-00. October 21, 2020

respectively. The preliminary slope stability analyses assumed a 1 m thick layer of surficial organics / peat for the West and Northeast. The East WRTSF slope stability analysis assumed a 0.5 m thick surficial layer of organics. No geotechnical soil investigations have been carried out in the Southwest WRTSF area therefore it was assumed to have similar foundation conditions as the West WRTSF (to be confirmed during future investigations). Additional geotechnical investigation of foundation conditions at the proposed Southwest and East WRTSFs and East WMP is recommended for the next stage of study to validate the preliminary stability analyses. The stability analysis assumes that the WRTSF's will be constructed on peat foundations material except for stripping of peat over a 25 m width along the toe. The undrained shear strength for the peat was represented using the SHANSEP model. For the WRTSF, construction induced excess porewater pressure generation and dissipation within the peat was modelled using a b-bar coefficient of 0.1 for the long-term condition and 0.4 for the shot-term end of construction condition.

Pseudo-static slope stability analyses of the WRTSF, OPSF and WMP dykes were carried out using the 1/2,475 return earthquake with a PGA = 0.038g corresponding to a "high" consequence classification in the event of slope failure (CDA, 2019)[3] and a horizontal seismic coefficient equal to ½ the PGA (Hynes-Griffin, 1984)[4]. Preliminary slope stability analyses indicate that the minimum target factors of safety (FoS) can be met (i.e., 1.3, 1.5 and 1.0 for end of construction, long-term and pseudo-static conditions respectively).

4.7 Conceptual WRTSF Closure

The major closure and reclamation activities planned for the WRTSF are expected to occur during the first two years of closure. The WRTSFs will be designed for long-term stability. Thus, no additional re-grading of the side slopes will be required at closure. A vegetation cover will be placed over the WRTSF crest surface and slope benches at closure. Placement of topsoil and revegetation of the lower WRTSF benches may occur as progressive reclamation closure during operations. The proposed closure vegetative cover is a 0.5 m thickness of overburden soil that will be hydroseeded. The WRTSF closure cover design will be finalized during detailed design and field trials during mine operation.

Initially after closure, runoff from the WRTSFs will continue to be collected in the WMPs. Water will continue to be treated before discharge, if required, until water quality monitoring demonstrates that water collected in the pond is acceptable for direct release to the environment. At that time, the WMP dykes will be breached and regrading will be carried out to restore natural drainage and encourage natural revegetation.

5.0 CONSTRUCTION MATERIAL QUANTITY ESTIMATES

Construction material quantities were estimated by Golder for the development of the WRTSFs and related water management infrastructure over the life of mine (Appendix D). G-Mining was responsible for estimating unit rate costs (for consistency throughout the PEA) and compiling the PEA cost estimate (both initial and sustaining CAPEX and OPEX).

Golder did not design or estimate quantities/costs for the following items (i.e., designed and costed by others):

---

[3] Canadian Dam Association (CDA, 2019) "Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams", update of the original 2014 version.

[4] Hynes-Griffin ME, Franklin AG. (1984) "Rationalizing the seismic coefficient method." U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi, 1984, Miscellaneous Paper GL-84-13, 21 pp.

- Tailings dewatering/filtration systems at the process plant
- Water reclaim pipelines and pumping system from the WMP to the process plant
- Water management transfer pipelines/pumps
- Effluent water treatment
- Access and haul roads
- Engineering, Procurement and Construction Management (EPCM)
- Post-closure monitoring, maintenance and water treatment

6.0 PATH FORWARD

The following activities are recommended to support the design of mine waste and water management facilities as the project advances to Pre-Feasibility Study (PFS) and Feasibility Study (FS) level:

- Supplemental geotechnical site investigation of the WRTSF, WMP and OPSF areas to characterize the foundation conditions.
- Geotechnical investigations to identify potential granular borrow sources.
- In-situ permeability tests of the overburden soils and bedrock beneath the WRTSFs to confirm compliance with Quebec Directive 19 and water management plan assumptions.
- Develop a groundwater model to evaluate potential impacts of the WRTSFs on the local environment.
- Tailings laboratory testing to determine the filterability (dewatering) and geotechnical characteristics.
- Additional tailings and waste rock geochemical characterization to determine acid generation potential and metal leaching in accordance with Quebec Directive 19.
- Optimization and further evaluation of the proposed WRTSFs and construction staging based on the findings of the geotechnical site investigations.
- Further refinement of the site wide water balance.
- Optimize the locations and designs of the WMPs.
- Hazard assessment to determine the Consequence Classification of the WRTSF slopes and WMP dykes in accordance with CDA guidelines.
- A dam breach and inundation study to support the WMP dam classification.
- Fish sampling in the proposed WRTSF and WMP areas should be conducted to confirm fish presence/absence in the waterbodies of interest that may be impacted by the proposed development.
- Advancement of the mine closure plan.
- Confirmation of mine plan and material balance to confirm availability of construction materials for development of the WRTSFs over the life of mine including pre-production and closure periods.
- Condemnation drilling for the WRTSF sites to verify the absence of mineralization.
- Water treatment requirements for effluent discharge from the NWMP.

7.0 CLOSURE

We trust that this report meets your project requirements. If you have any questions or require further information, please do not hesitate to contact the undersigned.

Golder Associates Ltd.

Orignal Signed By

Joao Paulo Lutti, Ing (QC)

Senior Water Resources Engineer

Orignal Signed By

Matt Soderman, PEng (ON)

Geotechnical Engineer

Orignal Signed By Darrin Johnson, PEng (ON)

Associate

DCJ/JPL/GK/MAS

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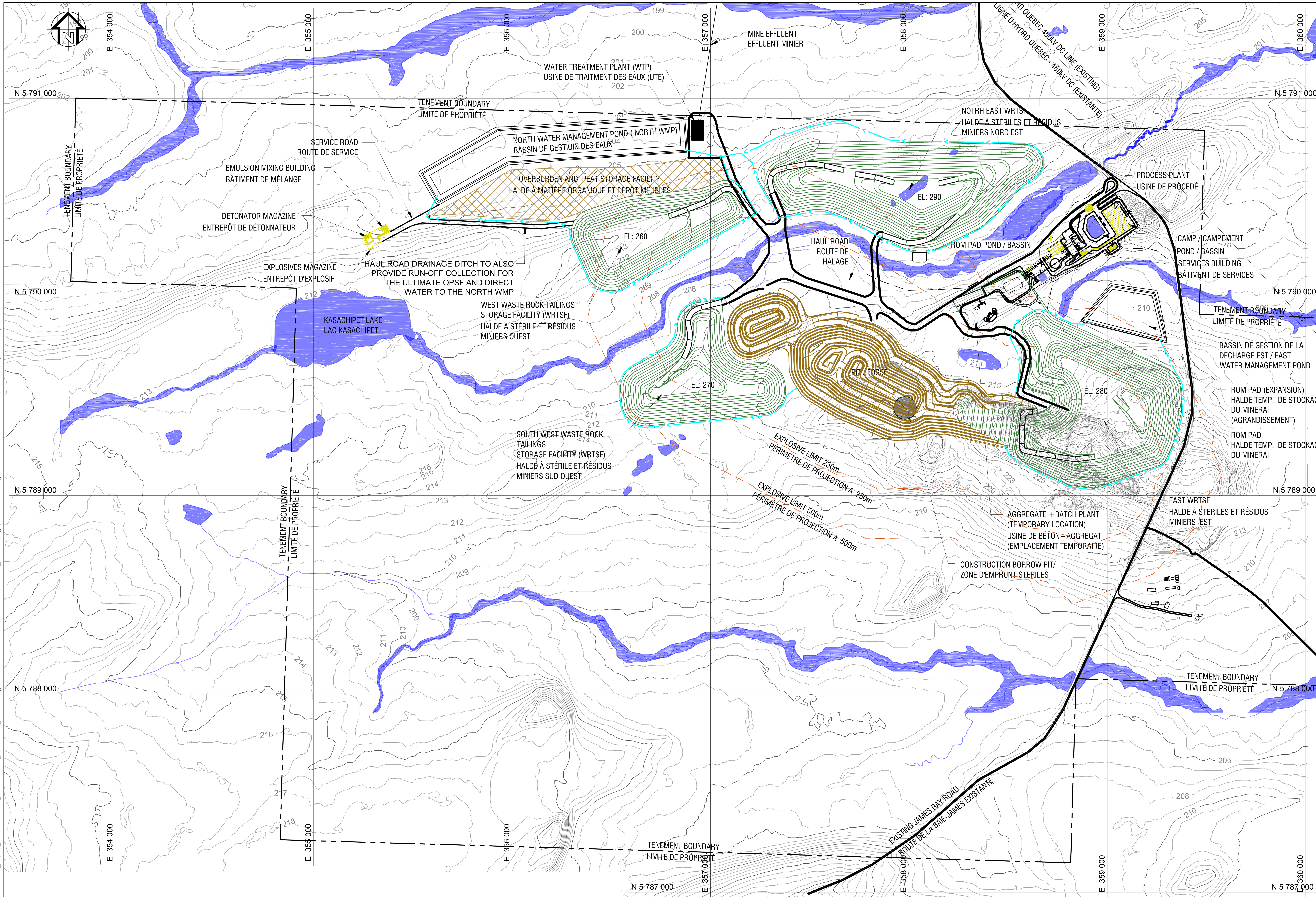
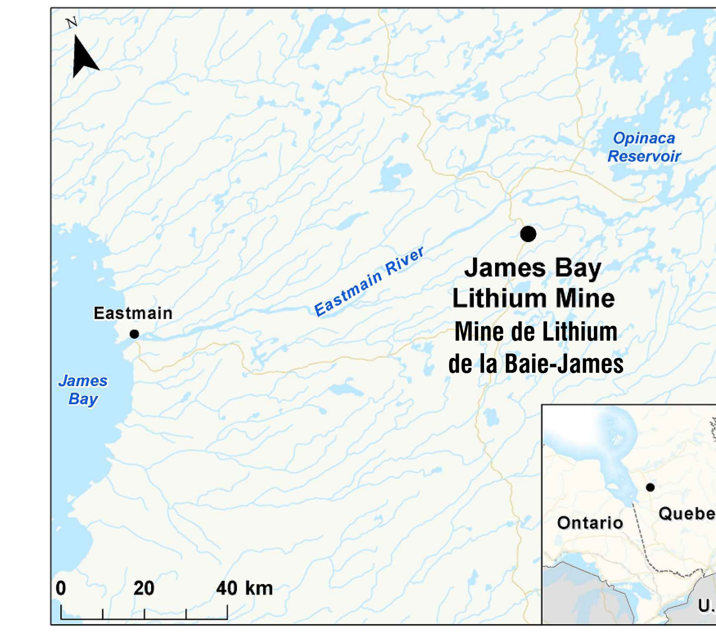
https://golderassociates.sharepoint.com/sites/119892/project files/6 deliverables/6. preliminary engineering design report/final/19135464 galaxy mw and wmf prelim design report_final_22mar2021.docx

FIGURES





KEY PLAN / PLAN CLÉ

REFERENCES:
1. BASE FILES AND LAYOUT PLAN PROVIDED BY G-MINING.

1 PLAN VIEW / VUE EN PLAN
1:10 000

0 500 1,000
1:10,000 METRES

CLIENT		PROJECT	
GALAXY LITHIUM CANADA INC.		JAMES BAY LITHIUM PROJECT	
CONSULTANT	YYYY-MM-DD 2021-03-22	TITLE	
GOLDER	DESIGNED -	GENERAL ARRANGEMENT PLAN - ULTIMATE LOM	
	PREPARED FZG		
	REVIEWED MS	PROJECT NO. 19135464	CONTROL 11000 · REV. A · FIGURE 1
	APPROVED DCJ		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

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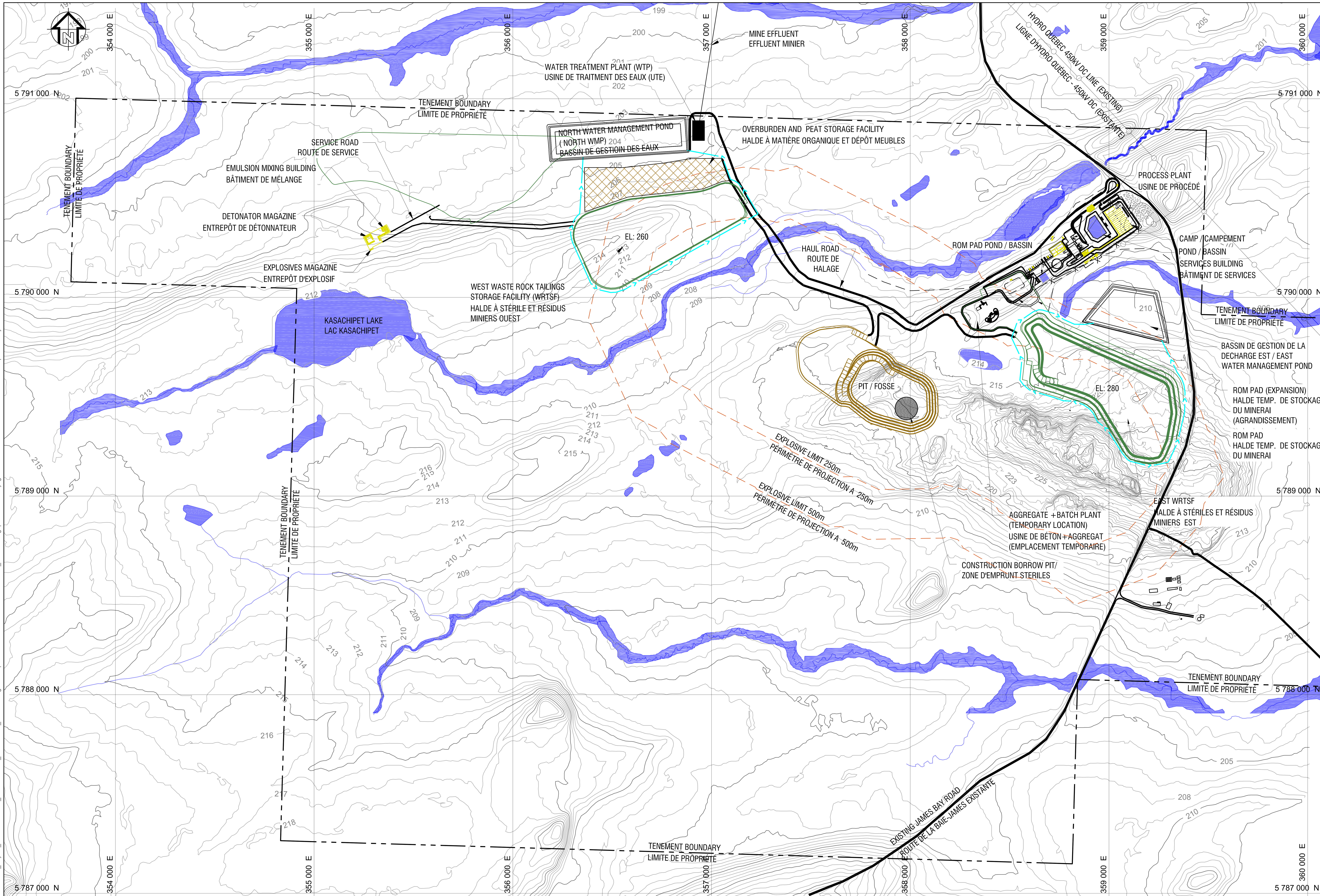

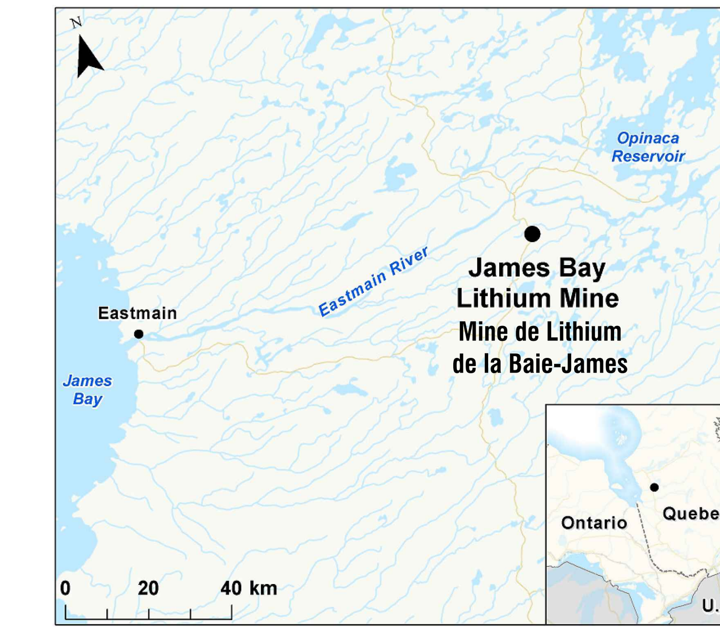

KEY PLAN / PLAN CLÉ

REFERENCES:
1. BASE FILES AND LAYOUT PLAN PROVIDED BY G-MINING.

1 PLAN VIEW / VUE EN PLAN 1:10 000

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1:10,000 METRES

CLIENT	GALAXY LITHIUM CANADA INC.
PROJECT	JAMES BAY LITHIUM PROJECT
CONSULTANT	GOLDER
YYYY-MM-DD	2021-03-22
DESIGNED	-
PREPARED	FZG
REVIEWED	MS
APPROVED	DCJ
TITLE	GENERAL ARRANGEMENT PLAN - PHASE 1
PROJECT NO.	19135464
CONTROL	11000
REV.	A
FIGURE	2

NOTE(S)

1. INVESTIGATION LOCATIONS SHOWN ARE REFERENCED FROM THE FOLLOWING SOURCES:
   Stantec (2019). "Geotechnical Investigation Report, Waste Rock and Tailings Storage Facility (WRTSF) James Bay Lithium Project". Project No. 121622255. August 9, 2019

   SNC Lavalin (2020). "James Bay Lithium Mine Project Detailed Geotechnical Investigation - Phase 2". Report No. 673356-EG-L01-00. October 21, 2020

0 250 500
1:7,500 METRES

CLIENT
GALAXY LITHIUM CANADA INC.

CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-19
DESIGNED	-
PREPARED	FZG
REVIEWED	MS
APPROVED	DJ

PROJECT
JAMES BAY PROJECT

TITLE
EXISTING SITE INVESTIGATION LOCATION PLAN

PROJECT NO.	CONTROL	REV.	FIGURE
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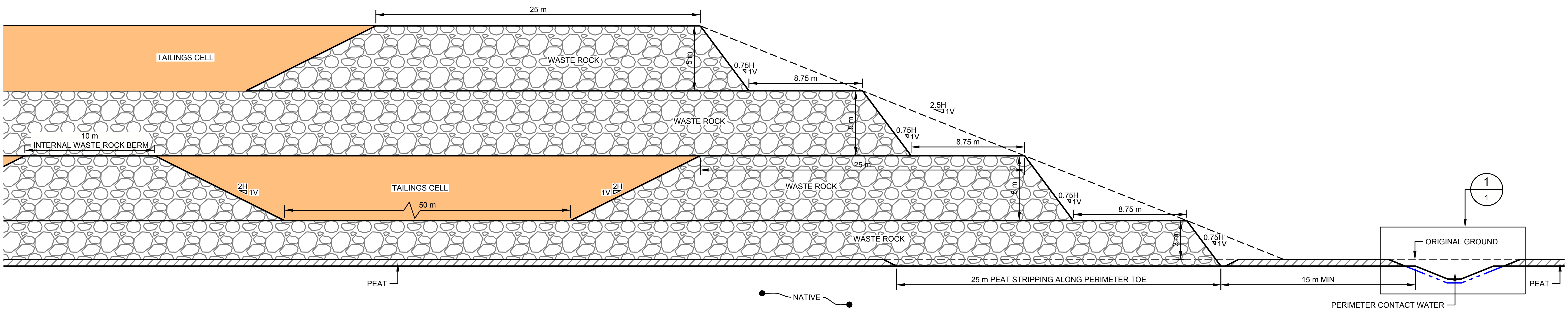

TYPICAL WTRSF SECTION
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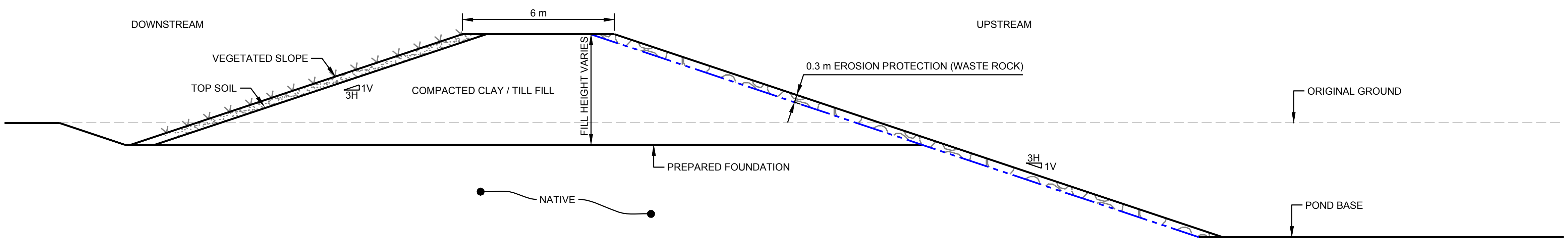

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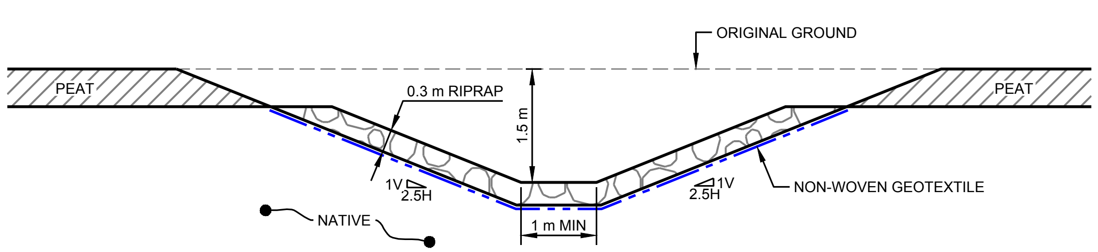
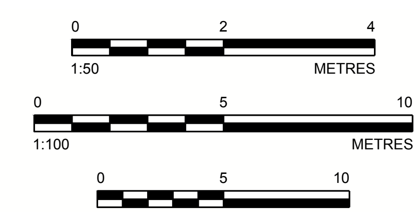


SCALE 1:50 m (1/1) TYPICAL PERIMETER COLLECTION DITCH



CLIENT
GALAXY LITHIUM CANADA INC.

CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-11
DESIGNED	MS
PREPARED	FZG
REVIEWED	MS
APPROVED	DJ

PROJECT
JAMES BAY LITHIUM PROJECT
PRELIMINARY ENGINEERING DESIGN

TITLE
TYPICAL WRTSF, WMP AND DITCH CROSS-SECTIONS

PROJECT NO.	CONTROL	REV.	FIGURE
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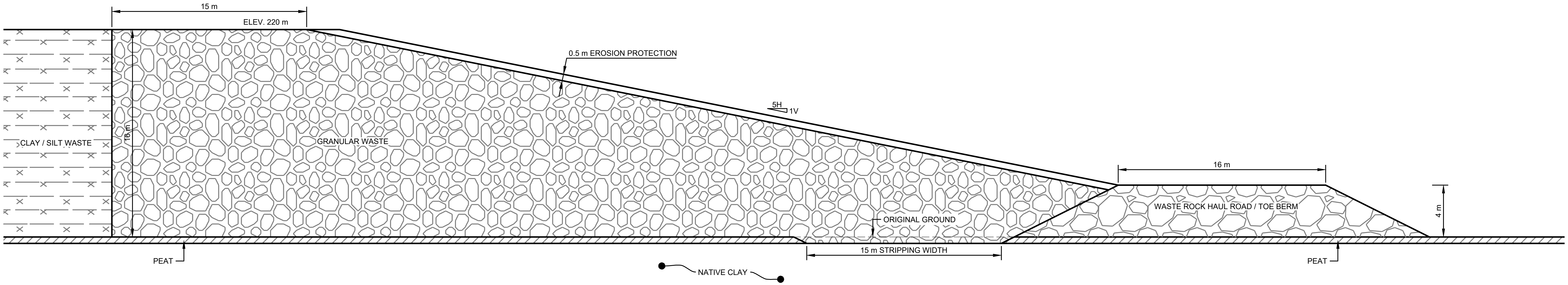

TYPICAL OPSF SLOPE SECTION - OVERBURDEN SOIL ZONE
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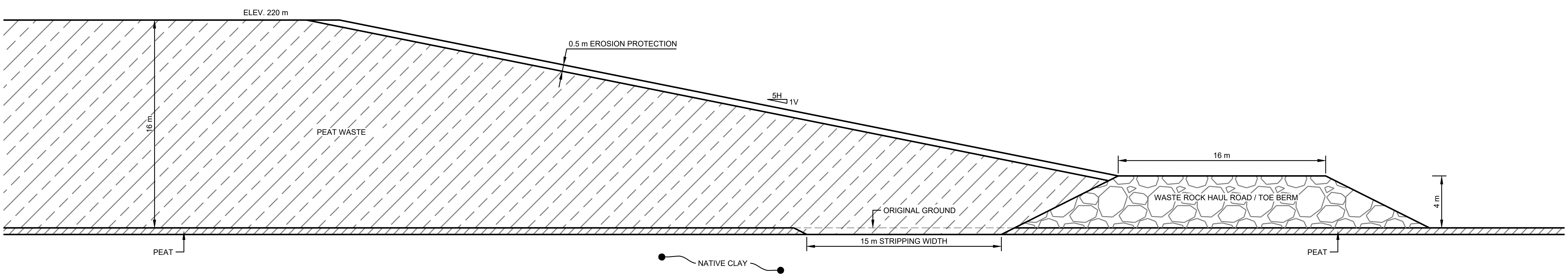

TYPICAL OPSF SLOPE SECTION - PEAT ZONE
SCALE 1:150 m

0 5 10
1:150 METRES

CLIENT		PROJECT			
GALAXY LITHIUM CANADA INC.		JAMES BAY LITHIUM PROJECT			
CONSULTANT	YYYY-MM-DD: 2021-03-11	TITLE			
GOLDER	DESIGNED: MS	**TYPICAL OPSF SLOPE SECTIONS**			
	PREPARED: FZG				
	REVIEWED: MS	PROJECT NO.	CONTROL	REV.	FIGURE
	APPROVED: DJ	20391077	11000	A	5

APPENDIX A

Design Criteria

TECHNICAL MEMORANDUM

DATE December 16, 2020 **Project No.** 19135464-9000-Rev0

TO Patrick Gince
Galaxy Lithium

FROM Darrin Johnson **EMAIL darjohnson@golder.com**

WASTE ROCK TAILINGS STORAGE FACILITY DESIGN CRITERIA

JAMES BAY LITHIUM MINE PROJECT PRELIMINARY ENGINEERING

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Galaxy Lithium (Canada) Inc. (GLCI) to complete Preliminary Engineering Design of the Waste Rock Tailings Storage Facility (WRTSF) and related water management systems for the proposed James Bay Lithium Mine Project in Québec. This memorandum outlines design criteria based on applicable regulatory standards and guidelines, project information provided by Galaxy, and assumptions based on Golder's experience with similar projects, which will serve as the basis for the Preliminary Engineering Design. Golder is also providing input into the stockpile geotechnical slope stability (stockpiles to be designed by G-Mining).

2.0 MINE PRODUCTION SCHEDULE

G-mining is responsible for developing the mine plan for the project. Proposed production rates and mine waste produced by year are summarized in Table 1. The information is sourced from G-mining's updated mine schedule for the project which has been provided to Golder (MS Excel file titled "Galaxy Schedule_2020-12-03_Shared").

Table 1: Proposed Mine Production Rates (GMS, 2020e)

Year	Ore Milled (t)	Tailings Generated (t)	Waste Rock (t)	Overburden (t)
-1	0	0	1,837,688	478,724
1	2,000,000	1,700,000	5,025,313	967,923
2	2,000,000	1,700,000	6,045,645	0
3	2,000,000	1,700,000	5,147,954	830,390
4	2,000,000	1,700,000	5,286,049	656,616
5	2,000,000	1,700,000	5,985,567	14,433
6	2,000,000	1,700,000	5,283,752	252,004

Year	Ore Milled (t)	Tailings Generated (t)	Waste Rock (t)	Overburden (t)
7	2,000,000	1,700,000	5,353,079	646,590
8	2,000,000	1,700,000	7,800,002	1,048,884
9	2,000,000	1,700,000	8,445,275	190,565
10	2,000,000	1,700,000	9,027,489	1,842
11	2,000,000	1,700,000	8,851,748	148,252
12	2,000,000	1,700,000	9,409,258	0
13	2,000,000	1,700,000	9,225,094	0
14	2,000,000	1,700,000	9,070,236	0
15	2,000,000	1,700,000	6,753,935	246,065
16	2,000,000	1,700,000	6,963,663	319,143
17	2,000,000	1,700,000	6,000,000	0
18	2,000,000	1,700,000	7,092,017	0
19	901,720	766,462	1,300,620	0
Total	**36,901,720**	**31,366,462**	**129,904,382**	**5,801,431**

Note: 1. Tailings produced at a rate of 85% of ore milled.

3.0 PROPOSED MINE WASTE STORAGE FACILITIES

3.1 Mine Waste Storage Facilities

The general arrangement (GA) drawing for the Preliminary Economic Assessment has been developed by G-Mining (GMS, 2020d). Waste rock and tailings will be co-disposed in the WRTSF. The WRTSF will receive waste rock trucked from the open pits and filtered tailings trucked from the production plant. The tailings will be filtered to an approximate solids content of 75% (by mass). In addition, overburden and peat excavated from open pit development will be stockpiled adjacent to the West WRTSF in the Overburden and Peat Storage Facility (OPSF). Mine operating data and calculated tailings design parameters are summarized in Table 2 (attached).

It is currently envisioned that mine waste will be placed in the following storage facilities:

1. OPSF (overburden and peat from open pit stripping)
2. West WRTSF (co-disposed waste rock and tailings with OPSF to the north)
3. North East WRTSF (co-disposed waste rock and tailings)
4. South West WRTSF (co-disposed waste rock and tailings)

5. East WRTSF (co-disposed waste rock and tailings)
6. In-pit waste rock disposal

3.2 Mine Waste Volumes

Table 3 summarizes the total tailings, overburden and waste rock in tonnes (provided by G-Mining) and estimated volumes over the life of the mine.

Table 3: Mine Waste Material Quantities

Mine Waste Material	Tonnes	Density (t/m^3)	Volume (m^3)
Tailings	31,366,462	1.7	18,450,860
Total Overburden	5,801,431	2.0	2,900,716
Waste Rock	129,904,382	2.0	64,952,191

4.0 PHYSICAL SETTING

4.1 Monthly Precipitation and Evaporation

Table 4 summarizes average monthly and annual total precipitation and lake evaporation for the project site.

Table 4: Monthly Total Precipitation and Evaporation

Month	Average Total Precipitation1 (mm)	25-year-wet Total Precipitation1 (mm)	25-year-dry Total Precipitation1 (mm)	Average Total Precipitation – Climate Change2 (mm)	Evaporation1 (mm)
January	33	41.1	25.4	39.6	2
February	24	29.9	18.5	28.9	3
March	32	39.6	24.5	33.8	6
April	34	41.7	25.8	35.6	15
May	40	49.2	30.4	42.1	48
June	65	80.7	49.9	67.5	77
July	79	97.1	60.0	81.2	88
August	91	112.7	69.7	94.3	68
September	111	137.2	84.8	121.3	36
October	89	109.6	67.8	96.9	18

Month	Average Total Precipitation1 (mm)	25-year-wet Total Precipitation1 (mm)	25-year-dry Total Precipitation1 (mm)	Average Total Precipitation – Climate Change2 (mm)	Evaporation1 (mm)
November	72	89.0	55.0	78.7	7
December	46	57.0	35.3	55.0	3
Total Annual	**715.2**	**885.0**	**547.0**	**774.9**	**370**

[1]Stantec, 2019.
[2]Golder, 2020b.

4.2 Extreme Climate Variables

Table 5 summarizes extreme climate variables to be considered during the design of water management structures.

Table 5: Extreme climate variables to be considered during design of water management infrastructure

Parameter	Unit	Value	Source
1:100 year snow cover water equivalent	mm	388.5	WSP, 2018b
24-hr 1:100 year rainfall	mm	80.8	Stantec, 2019
24-hr 1:1000 year rainfall	mm	101.6	WSP, 2018b
24-hr Probable Maximum Precipitation (PMP)	mm	330.0	Golder, 2020b
Ice thickness during winter operations	m	2.0	Stantec, 2019

4.3 Runoff Coefficients

For water balance purposes, the monthly runoff coefficients for each catchment based on Thornthwaite equation as presented by Stantec (Stantec, 2019) will be assumed.

Volumetric runoff coefficients considered for the design of water management ponds are summarized in Table 6.

Table 6: Volumetric Runoff Coefficients Considered for the Design of Water Management Ponds

Type of surface	Volumetric runoff coefficient
WRTSF	0.44
OPSF	0.65

Type of surface	Volumetric runoff coefficient
Haul roads	0.65
Open Pit	0.65
Industrial (plant) area	0.65
Pond surface	1.00

4.4 Seismic Hazard

Peak ground acceleration (PGA) values for the James Bay Lithium Mine Project site obtained from the National Building Code of Canada seismic hazard database (NRCC, 2015) are summarized in Table 7.

Table 7: Peak Horizontal Ground Acceleration (NRCC, 2015)

Return Period (years)	100	475	1000	2475
Peak Horizontal Ground Acceleration (g)	0.004	0.014	0.022	0.038

Note: If required (i.e., depending on the dam hazard classification), the PGA of a 1:10,000 year earthquake will be estimated based on a linear extrapolation of available NRCC data in the absence of a site-specific seismic hazard assessment.

5.0 DESIGN CRITERIA

5.1 Guidelines

Recommendations from five different guidelines will be taken into account in the design of the mine waste storage facilities for the project. Table 8 summarizes the applicable references.

Table 8: Guidelines for Mine Waste Storage Facility Preliminary Design

Guideline	Comments
MDDELCC “Directive 019” (MDDELCC, 2012)	2012 version
Ministère de l’Énergie et de Ressources Naturelles “Guide de préparation du plan de réaménagement et restauration des sites miniers au Québec” (MERN, 2017)	2017 version
CDA “Dam Safety Guidelines” (CDA Guidelines)	2013 version
Technical bulletin of the CDA on the “Application of Dam Safety Guidelines to Mining Dams”	2014 version
Environment Canada Environmental code of practice for metal mines	2009 version

5.2 Water Management

The WRTSF and stockpiles will have perimeter water collection ditches draining to water management ponds (WMPs). The WMP dams will be designed as a water retaining structure. Table 9 lists proposed design criteria for the water management infrastructure.

Table 9: Water Management Pond Design Criteria

Component	Design Criteria	Design Comments	Source
Water Storage Volume	Normal operating water level (NOWL) based on water balance results for average climate conditions	NOWL considered from the maximum water storage for an average climate year	Standard practice
	Environmental Design Flood (EDF): 24-hr precipitation with a return period of 2,000 years and the snowmelt from a snow accumulation with a return period of 100-yr over 30 days.	EDF contained (no spillway discharge)	Directive 019
Emergency Spillway	Inflow Design Flood (IDF): Probable Maximum Flood (PMF)	IDF/PMF discharged through spillway	Directive 019
Freeboard	Freeboard (measured between the EDF water level and the dike crest): 1.0 m	Minimum freeboard assuming that downstream environment is not sensitive.	Directive 019
	Freeboard (measured from IDF water level and the dike crest): 0.5 m	Propose for current PEA level design to account for wave height.	Standard practice

5.3 Dam Classification

The WRTSF slopes and WMP dams will be classified using the Canadian Dam Association (CDA) "Dam Safety Guidelines" (2013) and "Application of Dam Safety Guidelines to Mining Dams" (2014). Dam classification will be used to determine the design criteria for slope stability, design floods and design earthquake levels.

The WMP dams will likely be classified as having a "Significant" consequence of failure because there is no downstream population at risk (i.e., temporary workers only), failure would not result in significant loss of important fish or wildlife habitat and that restoration or compensation of fish or wildlife habitat would be possible. The Quebec Directive 019 design storm requirements outlined above (in Section 5.2) exceed the CDA requirements for a "Significant" dam hazard classification

5.4 Slope Stability

Table 10 presents the factors of safety for slope stability from the CDA guidelines and/or Québec Directive 019, where applicable.

Table 10: Factors of Safety for Slope Stability

Loading Condition	Minimum Factor of Safety
Short-term	1.3
Long-term	1.5
Pseudo-static	1.1
Post earthquake (if required)	1.3

5.5 Design Earthquake Levels

Table 11 presents design earthquake levels based on CDA guidelines. Per Quebec Directive 019, the recurrence of the design earthquake must not be less than the annual exceedance probability of 1/2,475 years, which exceeds the CDA requirement for a "Significant" dam hazard classification.

Table 11: CDA (2013) Design Earthquake Levels for Dams

Dam Consequence Classification	Earthquake Design Ground Motion (EDGM) Annual Exceedance Probability (AEP)
Low	1/100
Significant	Between 1/100 and 1/1000
High	1/2475[1]
Very High	½ between 1/2475 and 1/10000 or MCE[2]
Extreme	1/10000 or MCE

[1] This level has been selected for consistency with seismic design levels given in the National Building Code of Canada
[2] MCE is the Maximum Credible Earthquake and has no associated AEP

5.6 Geochemistry

5.6.1 Waste Rock

Waste rock was previously geochemically characterized (WSP, 2018a) to determine how it should be managed according to Québec Directive 019 (MELCC). The classification serves to define design parameters of the WRTSF and waste rock stockpile to ensure aquifer protection prescribed by D019.

The waste rock appears to be non-PAG but metal leaching over the short-term only, therefore **Level A** groundwater protection measures will have to be applied. Based on the available geotechnical and hydrogeological investigation information the preliminary design will assume that the in-situ overburden will meet Québec Directive 019 (MDDELCC, 2012) requirements (i.e., no geomembrane liner will be required).

5.6.2 Tailings

James Bay Lithium Project tailings samples were geochemically characterized (WSP, 2018a) and are non-PAG but metal leaching. Based on the results of the geochemical testing completed to date, the WRTSFs will require a low permeability liner in accordance with Québec Directive 019 (MDDELCC, 2012). For the purposes of the preliminary design, we will assume that the in-situ overburden will meet the requirements of Québec Directive 019 (MDDELCC, 2012) and no geomembrane liner will be required beneath the WRTSFs. Furthermore, the infiltration rate beneath the West and North WRTSFs was identified to be lower than 3.3. L/m^2/day (WSP, 2020), indicating that a geomembrane liner will not be required in accordance with Québec Directive 019. Additional field investigation and hydrogeological analyses is required to confirm this assumption for the next phase of study.

5.7 Buffer Distances

The following constraints and buffer distances will be applied to the WRTSF and stockpile footprints:

- No destruction of Schedule 2 fish habitat areas.
- 60 m from natural water courses and identified fish habitat areas.
- Additional 30 m allowance for perimeter access roads and water collection ditches.

5.8 Additional Design Assumptions

The following additional general assumptions will be adopted for the James Bay Lithium Mine Project mine waste storage facility preliminary design:

- The mine waste infrastructure will be developed in a staged approach with respect to the water management strategy, with “Phase 1” being constructed to manage water up to End of Year 3, and “Phase 2” being the remaining balance of the Life of Mine (LOM).
- Phase 1 and Phase 2 mine infrastructure footprints will be provided by G-Mining.
- Limited geotechnical information is available for the site. Additional geotechnical investigation will be required during future studies to confirm foundation conditions.
- The WRTSF slopes will be constructed with waste rock from pit development.
- It is assumed that waste overburden will be used to construct the low permeability WMP dams. Geotechnical investigation will be required (during future studies) to confirm this assumption.
- Excess tailings process water and runoff will be collected in a WMP equipped with a pump to reclaim process water back to the mill (reclaim pump and pipeline designed/costed by G-Mining). Reclaim water from the WMP to the process plant will occur year-round.
- All seepage and runoff from the WRTSFs and OPSF will be collected in perimeter ditches and/or trenches and directed to the WMP (i.e., no net seepage loss).

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TABLE 2
TAILINGS MANAGEMENT FACILITY DESIGN PARAMETERS
GALAXY LITHIUM JAMES BAY PROJECT

Design Parameter	Symbol	Source or Calculation	Value	Unit
Mineral extracted			Lithium	
PRODUCTION				
Resources and Production				
Resources **(Note 1)**				
Included in PEA	A	**Galaxy**	36,901,720	t (metric)
Potential Future (not included in PEA)	B	**Galaxy**	3,898,280	t (metric)
Mill design rate **(Note 2)**				
annually	C	D * 365	2,100,000	t/year
daily	D	**Galaxy**	5,753	t/day
hourly	E	D / 24	240	t/hour
Process plant availability	F	G / C	95.2%	%
Nominal (average) ore processing rate **(Note 3)**				
annually	G	H * 365	2,000,000	t/year
daily	H	**Galaxy**	5,479	t/day
hourly	I	H / 24	228	t/hour
Mine life	J	A / G	18.5	years
Tailings				
Tailings : Ore ratio	K	**Galaxy**	85%	% by weight
Nominal (average) tailings production				
annually	N	G * K	1,700,000	t/year
daily	O	N / 365	4,658	t/day
hourly	P	O / 24	194	t/hour
Total tailings production	Q	N * J	31,366,462	t
DEPOSITED TAILINGS DENSITY & REQUIRED STORAGE VOLUME				
Specific Gravity of tailings solids	G_s	**Galaxy**	2.70	-
Deposited void ratio (volume voids / volume solids)	e	**Assumed**	0.59	-
Deposited dry density	ρ_d	$G_s/(1 + e)$	1.70	t/m^3
% solids of deposited tailings	R	$G_s / (G_s+e)$	82.1%	% solids by weight
Required storage volume of tailing solids				
annually	S	N / ρ_d	1,001,111	m^3/year
daily	T	S / 365	2,743	m^3/day
hourly	U	T / 24	114	m^3/hour
Total required storage volume of tailing solids	V	$N / \rho_d \times J$	18,471,361	m^3
PROCESS WATER				
Discharged tailings solids content	W	**Galaxy**	75%	% solids by weight
Volume of water in tailings from mill (nominal)				
annually	X	(N / W) - N	566,667	m^3/year
daily	Y	X / 365	1,553	m^3/day
Saturated water content of deposited tailings	w	e / G_s	21.9%	% by weight
Volume of water retained in deposited tailings				
annually	Z	N x w	371,481	m^3/year
daily	AA	Z / 365	1,018	m^3/day
Volume of water released from deposited tailings				
annually	BB	X - Z	195,185	m^3/year
daily	CC	Y - AA	535	m^3/day

NOTES:

1. Based on reported resource by Galaxy and mine plan by G-Mining.
2. The design rate is used for design of the mill equipment, pumps, and pipelines. It considers the mill to be at full operational availability and is always larger than the nominal rate.
3. The nominal (average) rate is used to size the tailings storage facility. It accounts for planned shutdowns and the operational availability of the mill.

APPENDIX B

Site Wide Water Balance

TECHNICAL MEMORANDUM

DATE March 19, 2021

N° de projet 19135464-11000

TO Galaxy Lithium (Canada) Inc.

C.C

FROM Joao Paulo Lutti and Vlad Rojanschi

EMAIL ADDRESS
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APPENDIX B - JAMES BAY LITHIUM MINE PROJECT – PRELIMINARY ENGINEERING DESIGN – WATER MANAGEMENT PONDS DESIGN AND SITE-WIDE WATER BALANCE UPDATE

1.0 INTRODUCTION

Galaxy Lithium (Canada) Inc. (GLCI) undertook preliminary engineering design studies for the James Bay Lithium Mine Project (JBLMP) in support to the project Preliminary Economic Assessment (PEA). The project is presently an undeveloped lithium mine property located in northwestern Quebec, approximately 380 km north of the town of Matagami.

Golder Associates Ltd. (Golder) was commissioned to complete preliminary engineering design of the water management ponds (WMPs) associated to the mine waste rock and tailings storage facilities (WRTSF), and to update an initial site-wide water balance model, which was developed in support of the JBLMP previous feasibility study, to account for the new site arrangement and water management plan.

This appendix details the design of the two WMPs, and the results of the updated site-wide water balance model as part of the JBLMP preliminary engineering design study.

2.0 SITE SURFACE WATER MANAGEMENT STRATEGY

The proposed surface water management strategy for the site has been developed in conjunction with the WRTSF and overburden and peat storage facilities (OPSF) design and considering the preliminary site layout for the JBLMP. All runoff water generated by precipitation, which falls on areas impacted by mining activities, is considered “contact water.” Contact water will be collected and retained prior to being treated (if required) and released to the environment.

The surface water management strategy for the JBLMP includes the following:

- Divert natural runoff (i.e., non-contact water) around areas impacted by mining activities to limit mixing of natural runoff with contact water (i.e., reduce the volume of contact water requiring management).
- Limit the risk of discharging contact water to the environment.

- Collect all runoff and seepage from the WRTSFs and OPSF. Contact water from the WRTSFs and OPSF will be collected in perimeter ditches that drain to either the North WMP (NWMP), East WMP (EWMP) or the open pit. Water collected in the EWMP and in the open pit mine will be pumped to the NWMP, which is the main water management pond for the site.
- Prioritize reuse (i.e., reclaim) of contact water from the NWMP to the process plan to minimize fresh water requirements (i.e., fresh water taking).
- Have one single effluent point (CE2 Creek).

3.0 WATER MANAGEMENT PONDS – PRELIMINARY DESIGN

This section presents the design of the two water management ponds; the EWMP and NWMP.

East Water Management Pond

The EWMP will collect seepage and runoff from the East-WRTSF only. Water collected in this pond will be pumped towards the NWMP. This pond is designed to operate at a low water level (or empty) most time, except during the spring freshet. In spring, snowmelt and rainfall seepage and runoff will be stored until the complete melt of the snow cover. Once the snowmelt ends, water will be pumped to the NWMP.

North Water Management Pond

The NWMP is designed to function as the main WMP of the site and will ultimately collect seepage and runoff from the entire mine site. At the beginning of winter, the pond will store enough water to supply the mill with process water during the winter. At the beginning of spring, the water level will be maintained at a low water level to preserve storage capacity to contain the spring freshet volume. Once the spring freshet ends, the excess of water will be treated (if required) and released to the environment.

3.1 Design Criteria

As recommended by the Directive 019 (MDDEP, 2012), both WMPs are designed to contain a design flood (“crue de projet”) without spillage of non-treated water to the environment, ensuring a minimal freeboard of 1.0 m (measured between the design flood water level and the dyke crest). The design flood is a combination of a 24-hour precipitation with a return period of 1,000 years and the snowmelt over 30 days from a snow accumulation with a return period of 100 years.

Table 1 lists the proposed design criteria selected for the design of the WMPs.

Table 1: Water Management Pond – Hydrological and Hydrotechnical Design Criteria

Description	Unit	Value	Comments
Minimum pond water storage for plant water supply. Applied at the beginning of the freshet for the NWMP only. (note 1)	m^3	48 700	Includes a 30% contingency. Accounts for a 30 m^3/h plant water demand for 52 days, based on the historical variation of the snowmelt date (Stantec, 2009).

Description	Unit	Value	Comments
Ice thickness during winter operations (note 1)	m	2.0	The ice thickness has an impact on the overall pond volume and, especially, for the required plant water supply winter reserve.
Volumetric runoff coefficient for WRTSF		0.44	Assumes a very permeable surface, even during flood events, including spring flood events (e.g. no increased runoff on a frozen surface)
Volumetric runoff coefficient for OPSF		0.65	The 0.65 coefficient considers that the ground surface maintains a reasonable infiltration capacity even under extreme spring freshet conditions; for the open pit area, it considers that a small amount of accumulation is acceptable during very wet conditions.
Volumetric runoff coefficient for the open pit		0.65	
Volumetric runoff coefficient for roads		0.65	
Volumetric runoff coefficient for the industrial (plant) area		0.65	
Volumetric runoff coefficient for the pond surface		1.00	No significant pond seepage losses. Pond evaporation losses are negligible during short-term flood events.

Note 1: These criteria apply only for the design of the North Water Management Pond

3.2 Extreme Climate Input

Table 2 summarizes extreme climate input used in the preliminary design of the WMPs.

Table 2: Extreme Climate Input Used in the Preliminary Design of Water Management Ponds

Parameter	Unit	Value	Source
1:100 year snow cover water equivalent	mm	388.0	WSP, 2018
24-hr 1:1000 year rainfall	mm	101.6	WSP, 2018

3.3 Design Flood

Other than the extreme climate input, the assessment of WMPs design flood uses the catchment area draining towards each pond. Figures B-1 and B-2 (attached at the end of the memo) present the catchment limits considered for each of the two project phases.

Table 3 presents the WMPs estimated design flood volumes.

Table 3: Water Management Ponds Design Flood Volumes

Pond	Project Phase	Catchment Area (km²)	Volumetric Runoff Coefficient (area-weighted)	Design Flood Volume (m³)
NWMP	Phase 1	1.20	0.64	376,200
	Phase 2	2.72	0.60	792,700
EWMP	Phase 1	0.43	0.56	117,100
	Phase 2	0.67	0.51	168,600

3.4 Preliminary Design

The EWMP will have a maximum storage capacity of 0.18 Mm³ sufficient to contain the design flood with a minimal freeboard of 1.0 m between the design flood water level and the dyke crest.

The NWMP will have a storage capacity of 1.36 Mm³, as detailed in Table 4.

Table 4: North Water Management Pond Preliminary Design - Phase 2

Elevation (m)	Storage Volume (m)	Description
198.2	0	Pond base
198.5	48,700	Plant water supply needs (end-of-winter minimum allowance)
200.5	359,700	Top of late winter ice layer (2 m)
204.9	1,152,400	Maximum water level during the Design Flood (Directive 019 “crue de projet”)
205.9	1,358,800	Minimum dyke crest, 1.0 m above the maximum Design Flood water level

4.0 SITE-WIDE WATER BALANCE UPDATE

The objective of the site-wide water balance review is to:

- estimate the effluent discharge to CE2 Creek; and
- define a water management strategy for the North Water Management Pond (NWMP) that is in accordance with the NWMP design while providing a year-long process plant water supply.

The initial site-wide water balance was developed by Stantec (2019) using a Microsoft Excel spreadsheet to simulate monthly water fluxes. For the current update, GLCI provided Golder with a copy of the initial model spreadsheet. As instructed by GLCI, Golder kept the model's structure along with unchanged assumptions, as much as possible. For this reason, this technical memorandum should be considered a complement of the Stantec (2019) report; reading both documents is required to understand the site-wide water balance model as the current memorandum does not document all Stantec (2019) model details.

The following sections document:

- Golder's updates to the Stantec (2019) water balance model;
- the results of the updated model; and
- Golder's recommendations for future project phases.

4.1 Initial Water Balance Model

A flow logic diagram of the initial model (Stantec, 2019) is presented in Figure B-3:

- The model calculates monthly evaporation, runoff, and infiltration for each catchment based on precipitation and temperature climate data and the Thornthwaite equation (Stantec, 2019).
- The site-wide runoff was collected in two ponds. The water is being reused as process water at the ore process plant. The surplus is being discharged to the environment to two natural creeks (i.e., CE2 Creek and CE3 Creek).

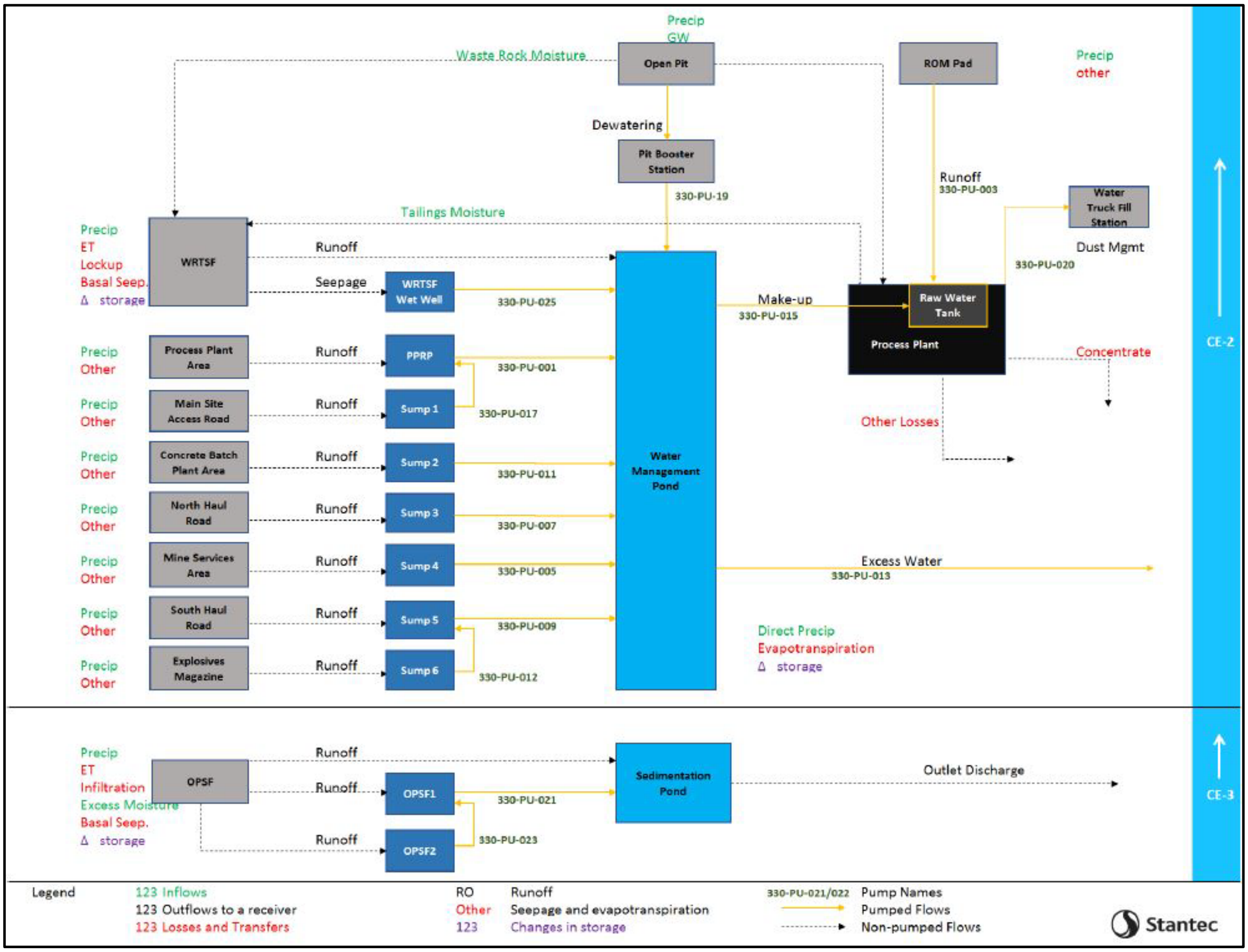


Figure B-3: Site Wide Water Balance Flow Diagram From Initial Water Balance Model (Stantec, 2019)

4.2 Changes to the Initial Water Balance Model

This section describes the updates made by Golder to the initial water balance model (Stantec, 2019) in the current study.

4.2.1 Updated Water Management Plan and Flow Logic Diagram

Golder updated the initial water balance model (Stantec, 2019) to reflect the preliminary engineering design study changes. The main updates to the water management plan are:

- All site runoff will be ultimately managed at the NWMP.
- Runoff from infrastructure located north of CE3 Creek will be conveyed to the NWMP mostly by gravity.
- Runoff from the open pit and infrastructure located south of the CE3 Creek will be collected in the EWMP or in a sump in the open pit, and will be pumped to NWMP.

The preliminary engineering design staged the water management plan in two phases, Phase 1 until the end of Year 3 of operations and Phase 2 for the remaining life of the mine. The site layouts for the two phases are presented in the main body of the Tailings, Waste Rock, Overburden and Water Management Facility Preliminary Engineering Design Report.

The updated flow logic diagrams for the site-wide water balance model and for the two development phases are presented in Figures B-9 and B-10 (in Section 4.3).

4.2.2 Climate Scenarios

Climate inputs to the initial water balance model and the updated model are precipitation and pond evaporation. Pond evaporation was kept constant, using monthly average values for all climate scenarios; precipitation alone was varied between the scenarios. Stantec (2019) defined three climate (precipitation) scenarios:

- Average conditions
- 1:25 year wet
- 1:25 year dry

Stantec (2019) developed precipitation statistics were calculated based on records from the La Grande Rivière climate station (operated by Environment and Climate Change Canada - ECCC).

For the current water balance update, Golder defined a new climate (precipitation) scenario accounting for potential climate change impact on the average climate conditions. Average seasonal change ratios were applied to the historical average monthly precipitation based on (Ouranos 2020) 2041-2070 Moderate Emission Scenario climate change predictions. According to the selected scenario, mean precipitation is predicted to increase by 19.3% in winter, 5.7% in spring, 3.5% in summer, and 9.4% in fall. Golder applied these change percentages to the Stantec (2019) average monthly precipitation values, as shown in Table 5.

Table 5: Average Total Precipitation Values for Current and Future Climate Conditions

Month	Average Precipitation – Historical Climate (Stantec, 2019) (mm)	Average Precipitation – Climate Change Scenario (note 1) (mm)
January	33.2	39.6
February	24.2	28.9
March	32.0	33.8
April	33.7	35.6
May	39.8	42.1
June	65.2	67.5

Month	Average Precipitation – Historical Climate (Stantec, 2019) (mm)	Average Precipitation – Climate Change Scenario (note 1) (mm)
July	78.5	81.2
August	91.1	94.3
September	110.9	121.3
October	88.6	96.9
November	71.9	78.7
December	46.1	55.0
ANNUAL TOTAL	**715.2**	**774.9**

Note 1: Developed by applying changes extracted from Ouranos (2020) 2041-2070 Moderate Emission Scenario to Stantec (2019) historical average values.

4.2.3 Catchment Areas

Catchments areas were updated relative to Stantec (2019) based on the updated site layout from the preliminary engineering design study. Table 6 presents the updated catchment area values. Figures B-1 and B-2 (attached at the end of the memo) present the catchment limits considered for each of the two project phases.

Table 6: Catchment Areas Considered on the Site Wide Water Balance Update

Facility	Year of Operation	Area (ha)
Water Management Ponds	-1 to 3	22.1
	4 to 19	34.9
Waste Rock and Tailings Storage Facility (WRTSF)	-1 to 3	61.2
	4 to 19	172.5
Overburden and Peat Storage Facility (OPSF)	-1 to 3	11.4
	4 to 19	25.4
Process Plant	-1 to 19	9.6
Concrete Batch Plant	-1 to 19	6.2

Facility	Year of Operation	Area (ha)
North Haul Roads (north of CE3 Creek)	-1 to 19	10.9
South Haul Roads (south of CE3 Creek)	-1 to 19	18.1
Explosives Magazine	-1 to 19	0.9
ROM Pad	-1 to 19	4.2

4.2.4 Production Rates

Preliminary engineering design updated ore, tailings and waste rock production rates are presented in Table 7.

Table 7: Ore, Tailings and Waste Rock Production Rates

Year of Operation	Ore Production (t)	Tailings Production (t)	Waste Rock Production (t)
-1	0	-	1,837,688
1	2,000,000	1,700,000	5,025,313
2	2,000,000	1,700,000	6,045,645
3	2,000,000	1,700,000	5,147,954
4	2,000,000	1,700,000	5,286,049
5	2,000,000	1,700,000	5,985,567
6	2,000,000	1,700,000	5,283,752
7	2,000,000	1,700,000	5,353,079
8	2,000,000	1,700,000	7,800,002
9	2,000,000	1,700,000	8,445,275
10	2,000,000	1,700,000	9,027,489
11	2,000,000	1,700,000	8,851,748
12	2,000,000	1,700,000	9,409,258
13	2,000,000	1,700,000	9,225,094
14	2,000,000	1,700,000	9,070,236
15	2,000,000	1,700,000	6,753,935
16	2,000,000	1,700,000	6,963,663
17	2,000,000	1,700,000	6,000,000
18	2,000,000	1,700,000	7,092,017
19	901,720	766,462	1,300,620
TOTAL	**36,901,720**	**31,366,462**	**129,904,384**

4.2.5 Site-Wide Soil Balance

The preliminary engineering design study updated the site-wide soil balance. The updated volumes are presented in Table 8.

Table 8: Site Wide Soil Balance

Operation Year	Organic Soil / Peat (m^3)	Clay (m^3)	Granular Soil (m^3)
-1	32,224	363,525	505,696
1	15,302	0	732,583
2	0	0	0
3	10,587	122,188	701,209
4	10,381	0	496,968
5	944	1547	10,924
6	3,984	0	190,732
7	1	0	489,379
8	16,582	0	793,860
9	3,013	0	144,231
10	29	0	1,394
11	0	0	112,206
12	0	0	0
13	0	0	0
14	0	0	0
15	3,890	0	186,237
16	5,045	0	241,547
17 to 19	0	0	0
TOTAL	**101,983**	**487,259**	**4,606,966**

4.2.6 North Water Management Pond Operating Rules

The following NWMP operating rules were implemented in the updated water balance model:

- The pond water level is lowered before the spring freshet to accommodate the Directive 019 Project Flood without overflow as recommended by (MDDEP, 2012).
- No water is discharged from the NWMP to the environment during the spring freshet.
- After the spring freshet, the contact water from the site is pumped to the NWMP while maintaining a minimum 1 m freeboard below the pond's spillway invert.
- From November to March, the minimal NWMP operational water volume is defined considering a maximum process plant demand of 30 m^3/h (Stantec, 2019)[1] for the remainder of the winter season. The monthly timestep model assumes the spring freshet starts on May 1. If the available water storage in the pond is below the minimal operational storage, no water is pumped from the NWMP to the final effluent.
- The NWMP maximum and the minimal operational water volumes, as they were implemented in the updated water balance models, are presented on Tables 9 and 10.

The NWMP operating rules influence the monthly effluent discharge, but change little the annual effluent volume.

[1] The VE study did not define an updated process plant demand.

Table 9: North Water Management Pond Maximum Operational Water Volumes (m^3)

Month of the Year	Year of Operation			NWMP Operational Strategy to Maintain the Pond Volume below the Maximum Operational Water Volumes
	-1	1 to 3	4 to 17	
1	386,700	386,700	756,000	Progressive level drawdown to provide capacity to store a D019 Design Flood in spring
2	326,300	326,300	623,900	Progressive level drawdown to provide capacity to store a D019 Design Flood in spring
3	265,800	265,800	491,800	Progressive level drawdown to provide capacity to store a D019 Design Flood in spring
4	205,300	205,300	359,700	Maintain process plant water supply (late freshet allowance) + allow for late winter icepack thickness (2 m)
5	609,600	609,600	1,186,500	Reaches maximum capacity in the event of a Directive 019 Design Flood
6	558,600	558,600	1,103,300	Progressive level drawdown after spring freshet
7	507,700	507,700	1,020,200	Maintain level 1 m below spillway invert
8	507,700	507,700	1,020,200	Maintain level 1 m below spillway invert
9	507,700	507,700	1,020,200	Maintain level 1 m below spillway invert
10	507,700	507,700	1,020,200	Maintain level 1 m below spillway invert
11	507,700	507,700	1,020,200	Maintain level 1 m below spillway invert
12	447,200	447,200	888,100	Progressive level drawdown to provide capacity to store a D019 Design Flood in spring

Table 10: North Water Management Pond Minimum Target Operational Water Volumes (m³)

Month of the Year	Year of Operation			NWMP Operational Strategy to Maintain the Pond Volume above the Minimum Operational Water Volumes
	-1	1 to 3	4 to 17	
1	270 700	270 700	425 000	Maintain 3 months of process plant supply + Allow for late winter icepack thickness (2 m) + Maintain process plant supply in case of late freshet
2	248 900	248 900	403 300	Maintain 2 months of process plant supply + Allow for late winter icepack thickness (2 m) + Maintain process plant supply in case of late freshet
3	227 100	227 100	381 500	Maintain 1 month of process plant supply + Allow for late winter icepack thickness (2 m) + Maintain process plant supply in case of late freshet
4	205 300	205 300	359 700	Maintain process plant water supply (late freshet allowance) + Allow for late winter icepack thickness (2 m)
5	205 300	205 300	359 700	Maintain at least 1 month of process plant supply
6	205 300	205 300	359 700	Maintain at least 1 month of process plant supply
7	205 300	205 300	359 700	Maintain at least 1 month of process plant supply
8	205 300	205 300	359 700	Maintain at least 1 month of process plant supply
9	205 300	205 300	359 700	Maintain at least 1 month of process plant supply
10	205 300	205 300	359 700	Maintain at least 1 month of process plant supply
11	314 200	314 200	468 600	Maintain 5 months of process plant supply + Allow for late winter icepack thickness (2 m) + Maintain process plant supply in case of late freshet
12	292 500	292 500	446 800	Maintain 4 months of process plant supply + Allow for late winter icepack thickness (2 m) + Maintain process plant supply in case of late freshet

4.3 Water Balance Results

The following summarizes the main results of the updated water balance model:

- The annual water balance is positive even under the 1:25 year dry scenario, and the process plant demand could be supplied by the site runoff and pit dewatering flows. Effluent is expected to be discharged to the environment even under 1:25 year dry scenario. Under historical average climate conditions, the average monthly effluent discharge for the second phase of the mining operation is about 160,000 m³/month, with a peak discharge of about 320,000 m³/month in October, as presented in Figure B-4. The operational rules impose that there is no effluent discharge during the snowmelt period (May and June).

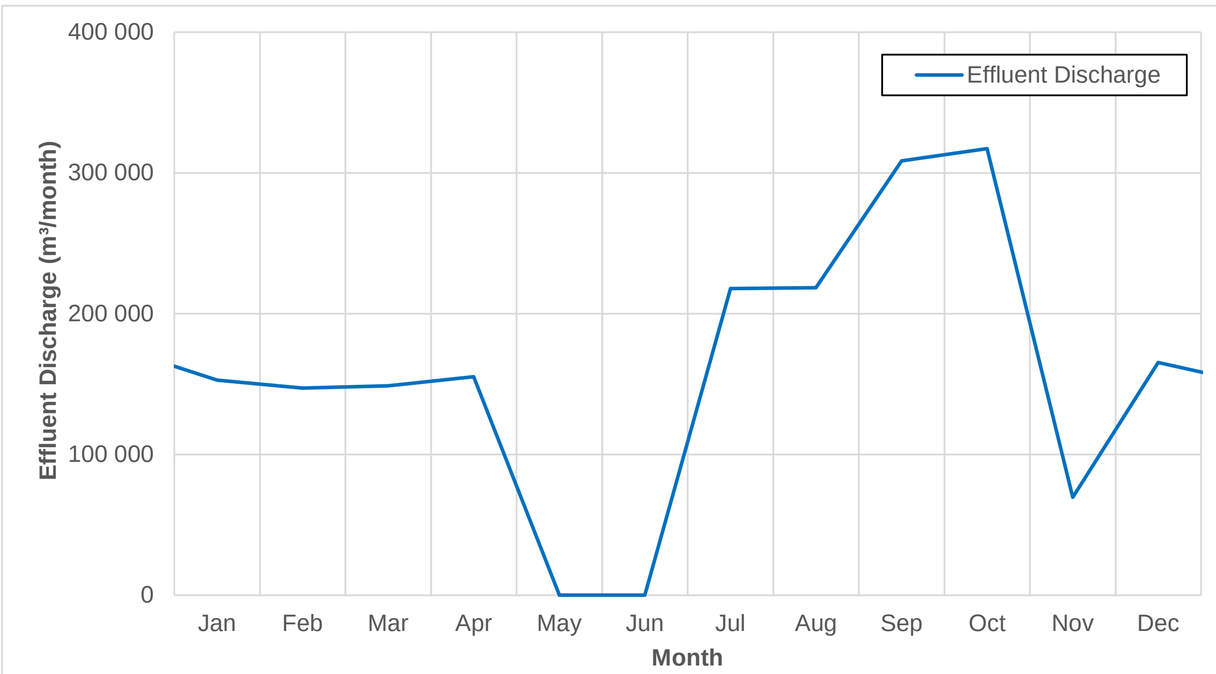


Figure B-4: Monthly Discharge Flows from the North Water Management Pond to Creek CE-2 under Normal Climate Conditions – Year 9 of Mine Operation

- For all 4 modelled climate scenarios, the water level in the NWMP remains below the spillway invert. This is expected because the NWMP was sized to contain the Directive 019 flood event, which is larger than the 1:25 year wet runoff.
- Figures B-5, B-6, B-7, and B-8 present the calculated NWMP monthly storage volumes and effluent discharge for the average, 1:25 year dry, 1:25 year wet, and climate change scenarios.
- Table 11 presents the annual effluent discharge values.
- Tables 12 and 13 present the monthly effluent discharge for Year 3 and Year 9, which are representative of the project's two operational phases.
- Figures B-9 and B-10 present the flow diagram including annual average flows for Year 3 and Year 9 for the simulated average (historical) climate conditions.

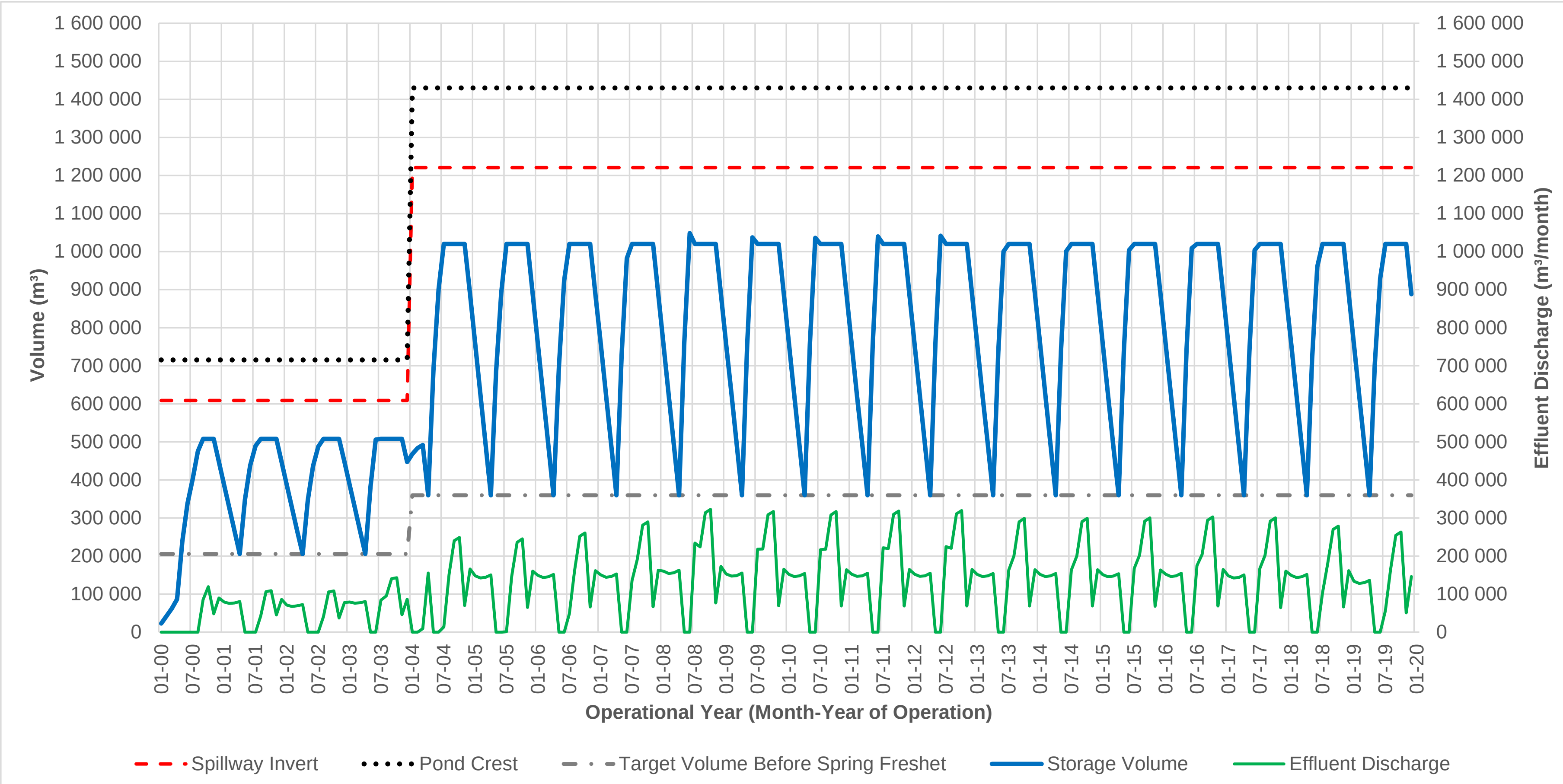


Figure B-5: North Water Management Pond Stored Water Volume and Effluent Discharge for Historical Average Climate Conditions

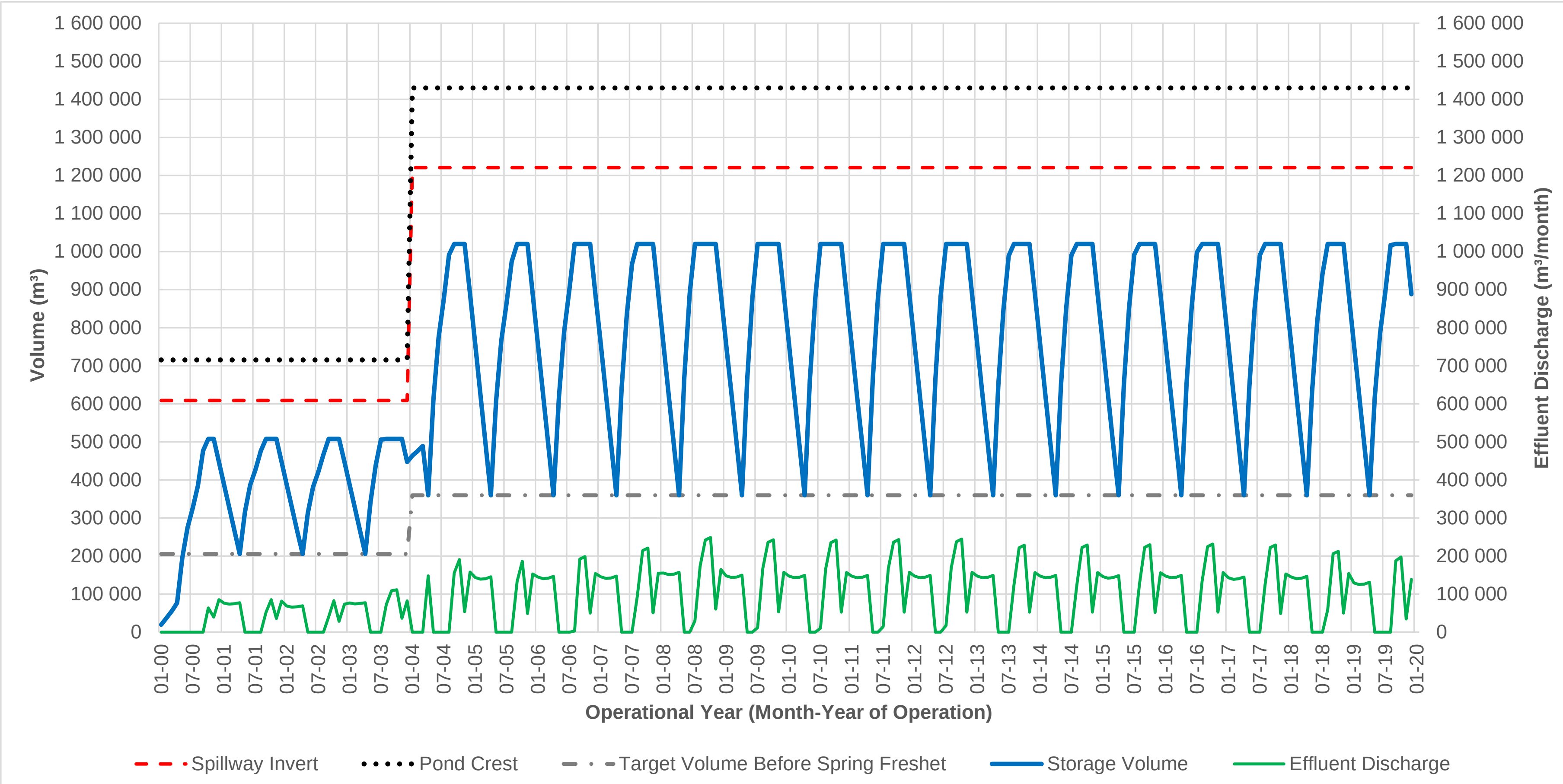


Figure B-6: North Water Management Pond Stored Water Volume and Effluent Discharge for 1:25 year Dry Climate Conditions.

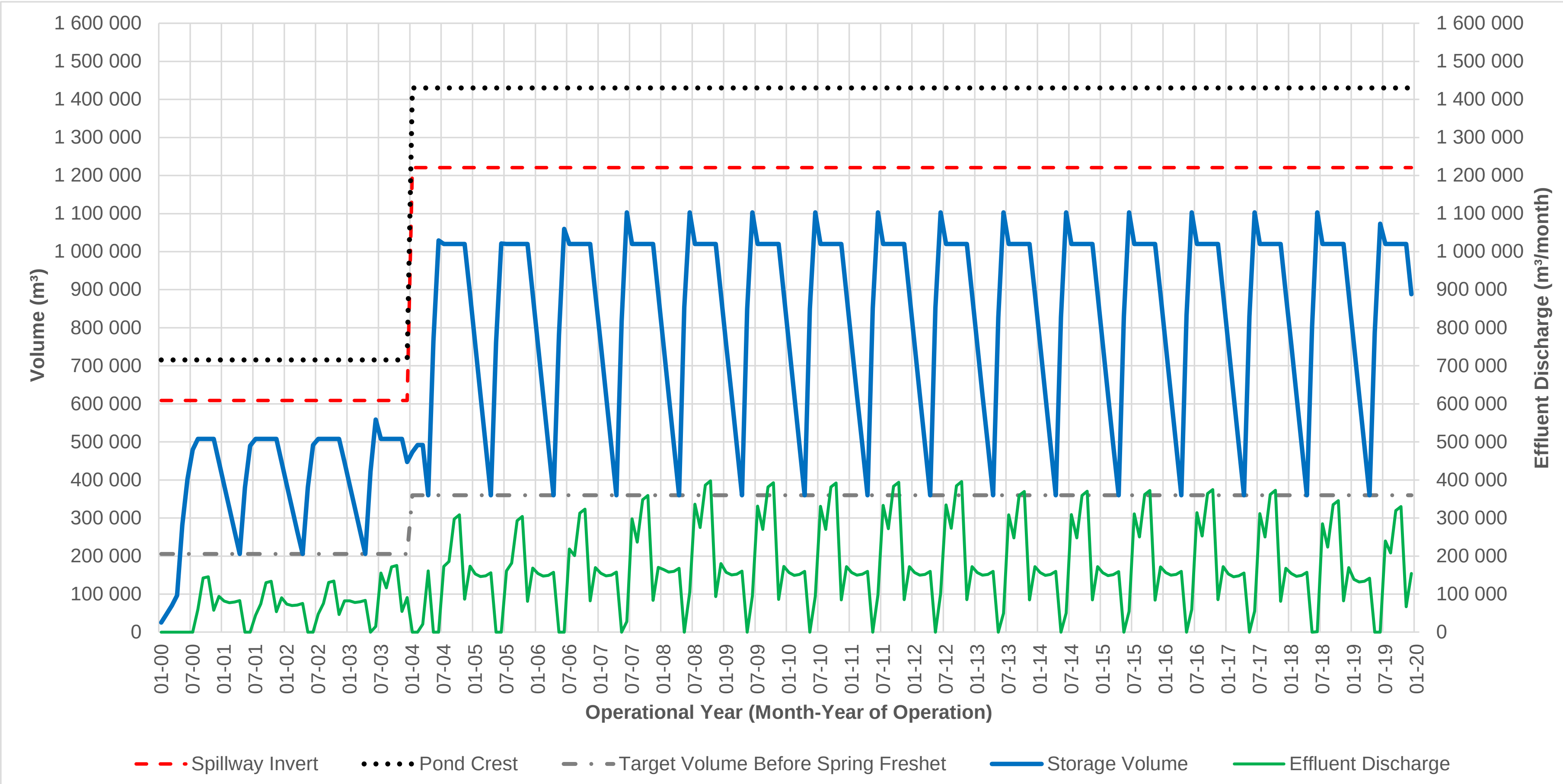


Figure B-7: North Water Management Pond Stored Water Volume and Effluent Discharge for 1:25 year Wet Climate Conditions.

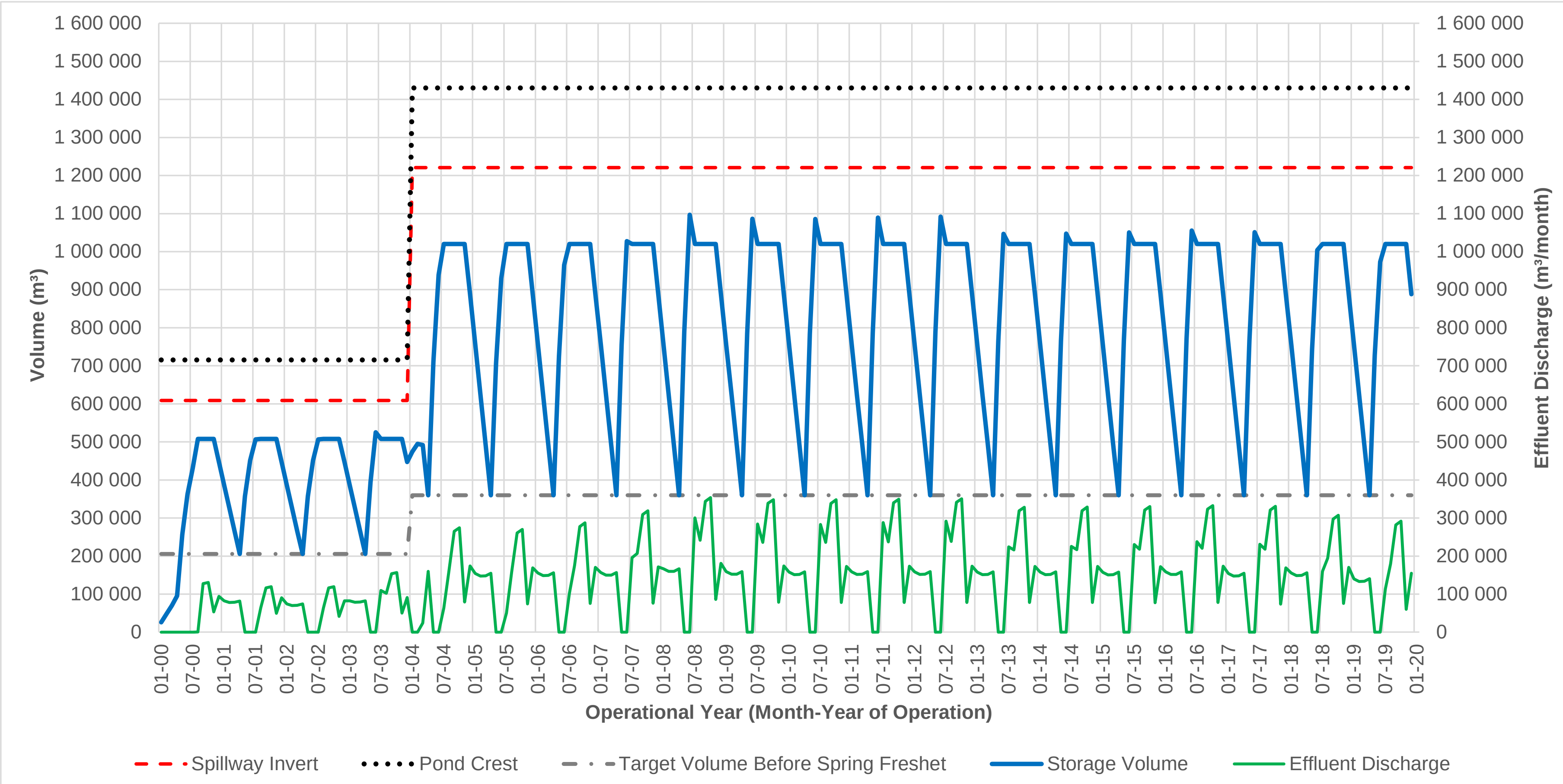


Figure B-8: North Water Management Pond Stored Water Volume and Effluent Discharge for Average Climate Conditions Considering the Potential Effects of Climate Change on Average Monthly Precipitation

Table 11: Annual Effluent Discharge from the North Water Management Pond

Year of Operation	Effluent Discharge (m^3) for Each Climate Scenario			
	Average Historical Conditions	1:25 Year Dry	1:25 Year Wet	Average Conditions Considering Potential Climate Change Effects
1	702,400	556,900	849,300	761,900
2	650,500	495,600	807,500	713,400
3	909,100	716,300	1,103,600	985,300
4	1,054,600	705,900	1,406,600	1,202,400
5	1,439,700	1,090,000	1,792,800	1,587,900
6	1,541,500	1,171,100	1,915,500	1,697,100
7	1,721,500	1,311,200	2,135,600	1,891,200
8	1,978,000	1,535,300	2,424,900	2,159,200
9	1,900,800	1,455,400	2,350,500	2,083,000
10	1,891,700	1,447,300	2,342,200	2,074,200
11	1,904,700	1,456,800	2,356,800	2,087,700
12	1,911,500	1,463,700	2,365,100	2,094,900
13	1,785,400	1,366,700	2,209,700	1,958,500
14	1,786,300	1,366,800	2,211,400	1,959,700
15	1,791,300	1,367,200	2,219,500	1,966,000
16	1,811,200	1,385,100	2,241,300	1,986,500
17	1,770,800	1,344,100	2,203,300	1,946,800
18	1,649,300	1,255,000	2,049,000	1,813,800
19	1,464,500	1,070,200	1,864,200	1,629,000

Table 12: Year 3 Monthly Effluent Discharge from the North Water Management Pond

Month of the Year	Effluent Discharge (m^3)			
	Average Historical Conditions	1:25 Year Dry	1:25 Year Wet	Average Conditions Considering Potential Climate Change Effects
1	79,570	76,830	82,340	82,650
2	76,140	74,210	78,100	78,560
3	77,540	75,280	79,820	79,160
4	80,670	77,670	83,700	82,470
5	0	0	0	0
6	0	0	15,040	0
7	84,000	0	155,360	109,540
8	95,520	73,220	116,430	101,990
9	140,300	109,060	171,840	153,310
10	143,260	111,320	175,500	156,540
11	45,510	36,560	54,550	50,100
12	86,540	82,160	90,960	90,960

Table 13: Year 9 Monthly Effluent Discharge from the North Water Management Pond

Month of the Year	Effluent Discharge (m^3)			
	Average Historical Conditions	1:25 Year Dry	1:25 Year Wet	Average Conditions Considering Potential Climate Change Effects
1	152,790	148,060	157,560	158,920
2	147,110	143,710	150,540	152,150
3	148,800	145,010	152,630	152,650
4	155,250	149,940	160,610	159,470
5	0	0	0	0
6	0	0	94,620	0
7	217,850	11,700	331,330	284,130
8	218,420	167,190	270,140	236,120
9	308,530	236,100	381,640	338,700
10	317,280	242,800	392,470	348,270
11	69,560	53,340	85,930	78,790
12	165,240	157,580	172,970	173,780

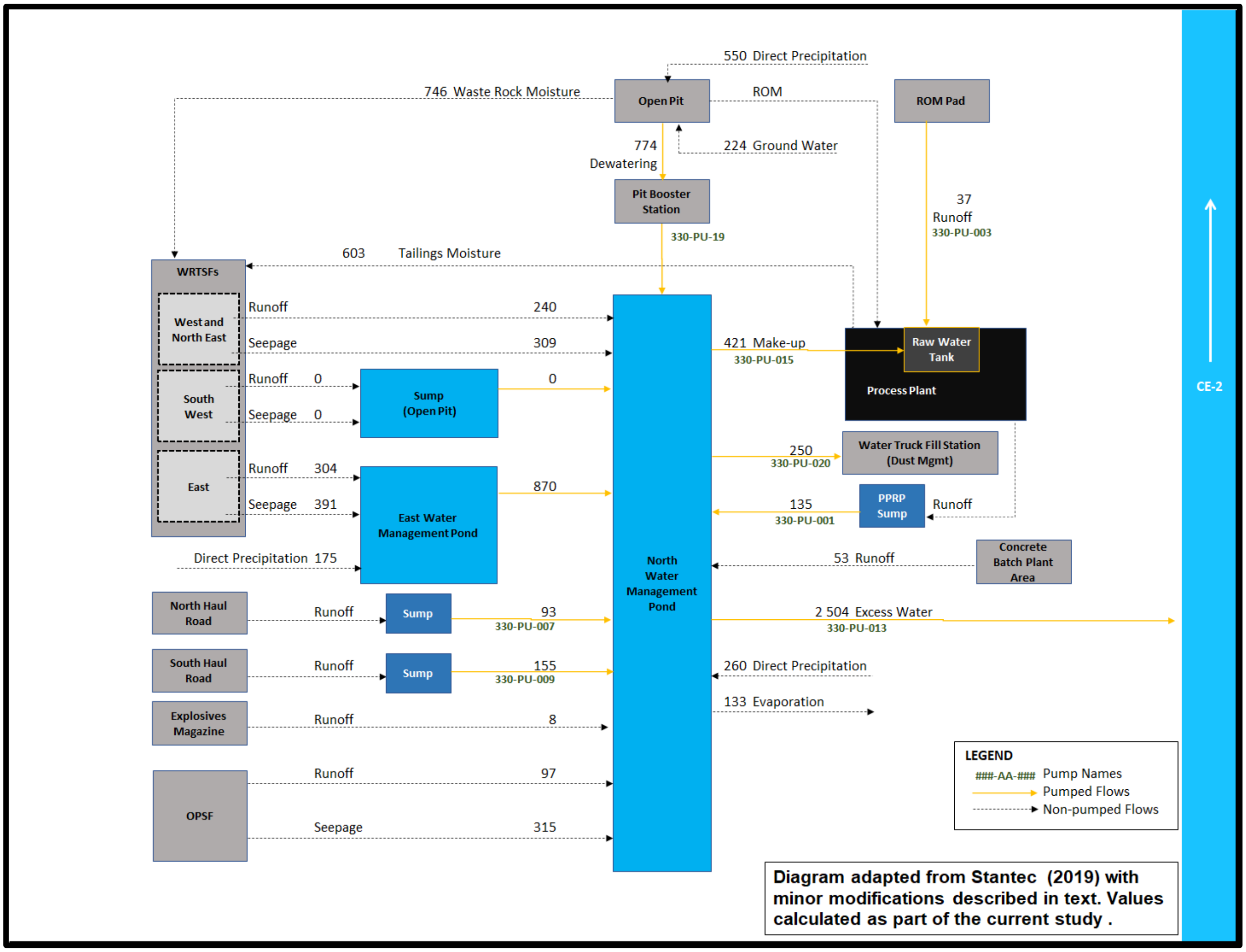


Figure B-9: Water Balance Flow Diagram and Average Flows (m³/day) for Operational Year 3 under Historical Average Climate Conditions

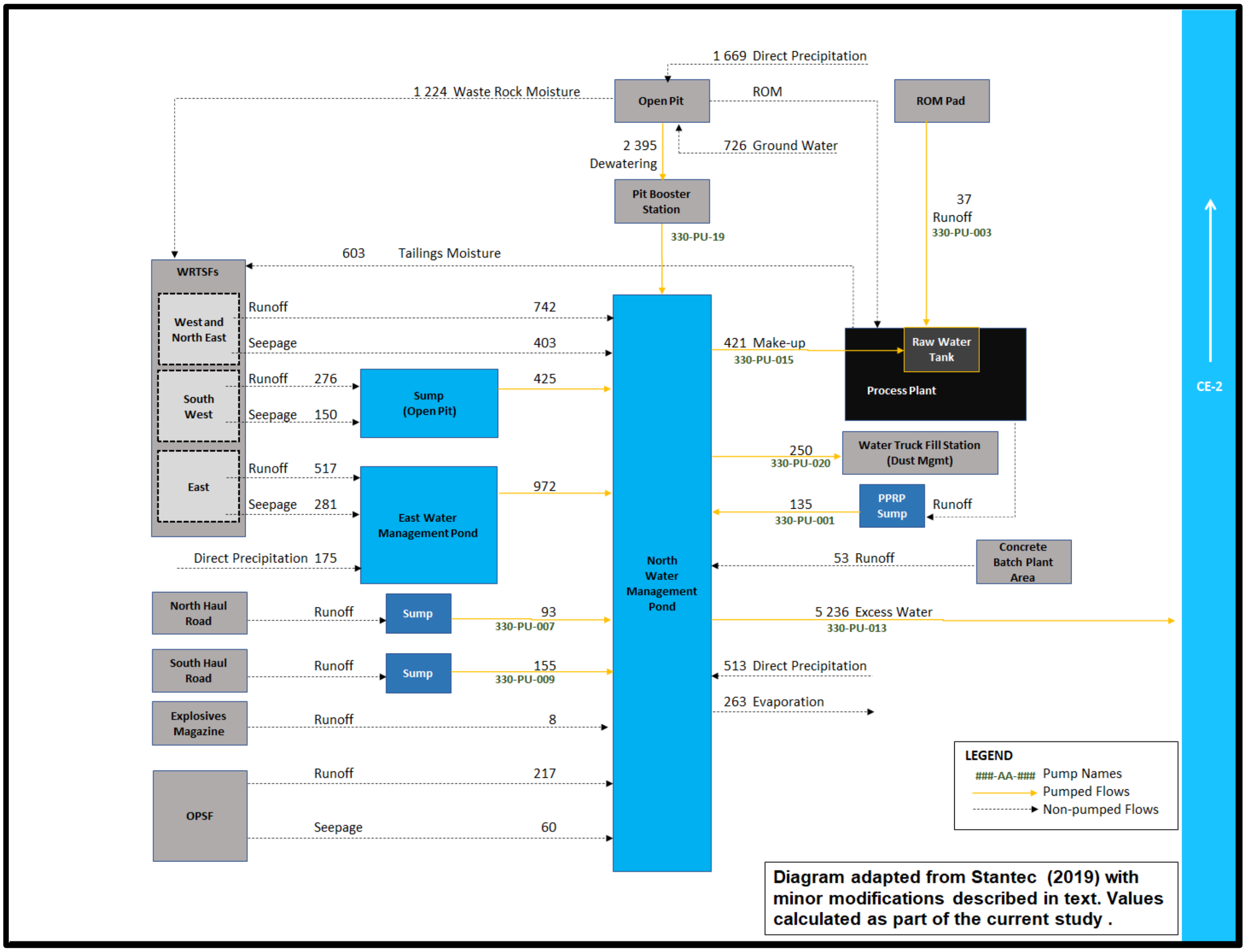


Figure B-10: Water Balance Flow Diagram and Average Flows (m³/day) for Operational Year 9 under Historical Average Climate Conditions

5.0 CONCLUSION

The current study presents the preliminary design of WMPs and the updated water balance modelling results for the JBLMP Project.

5.1 Design of Water Management Ponds

The NWMP, with a maximum storage capacity of 1.36 Mm³, has been sized to contain the design flood ("crue de projet") recommended by Directive 019 without spillage to the environment and meet process water requirements year-round. The EWMP will have a maximum storage capacity of 0.18 Mm³ sufficient to contain the design flood.

5.2 Water Balance Model

An initial model was developed by Stantec (2019) in support of the JBLMP previous project's feasibility study. Golder updated the model to incorporate the changes to the site footprint and to the water management strategy following the completion of the preliminary engineering design studies.

As instructed by GLCI, Golder used the spreadsheet model developed by Stantec (2019) and limited to a minimum the changes to the model. The Stantec (2019) model structure and many assumptions were preserved. The main changes to the Stantec (2019) model include:

- Inclusion of a new average climate scenario, which accounts for potential climate change effect on precipitation.
- Update of the site general arrangement plan (that is, the catchment areas) following the preliminary engineering design study.
- Use of the updated ore and tailings production rates, and site-wide soil balance.
- Use of the updated North Water Management Pond operational rules.

The main results of the updated model are:

- The site's annual water balance is positive even under the 1:25 year dry scenario, and the process plant demand can be supplied by the site runoff and pit dewatering flows. Effluent is expected to be discharged to the environment even under 1:25 year dry scenario.

6.0 RECOMMENDATIONS

The design of the NWMPs and the site-wide water balance model should be updated during future project's engineering phases.

A detailed water management plan should be prepared including a refined water balance and detailed design for water management infrastructure.

Design of Water Management Ponds

- The design of both WMPs should be reviewed during future phases of design of JBLMP.
- Both WMPs will require an emergency spillway to prevent embankment overtopping under extreme climate conditions. The emergency spillways shall be designed to pass the Probable Maximum Flood (PMF), and the design of WMPs should be adjusted if required.
- Verify with provincial government the Directive 019 environmental flood design event containment criteria (i.e. would the government accept water discharge during the flood event as part of the event's management strategy).

Site-wide water balance model:

- Account for a more detailed site development plan, incorporating the sequence of development of the open pit, WRTSFs and OPSF.
- Update catchment areas based on the design of the site drainage infrastructure (ditches, sumps and pump capacities), which is planned to be completed at future engineering design phase of the JBLMP.
- Update of the open pit dewatering plan accordingly to the sequence of development of the pit.
- Simulate a wider range of climate conditions and climate variability, including a spectrum of climate change scenarios, to evaluate required WMPs pump capacities based on daily effluent discharge rates.
- Account for variability in evapotranspiration and evaporation rates in runoff generation.

7.0 REFERENCES

Ministère du Développement Durable, de l'Environnement et des Parcs, 2012 – Directive 019 sur l’industrie minière.

Ouranos, 2020 – *Consortium sur la climatologie régionale et l'adaptation aux changements climatiques.* https://www.ouranos.ca/portraits-climatiques. Date of last access : May 20, 2020.

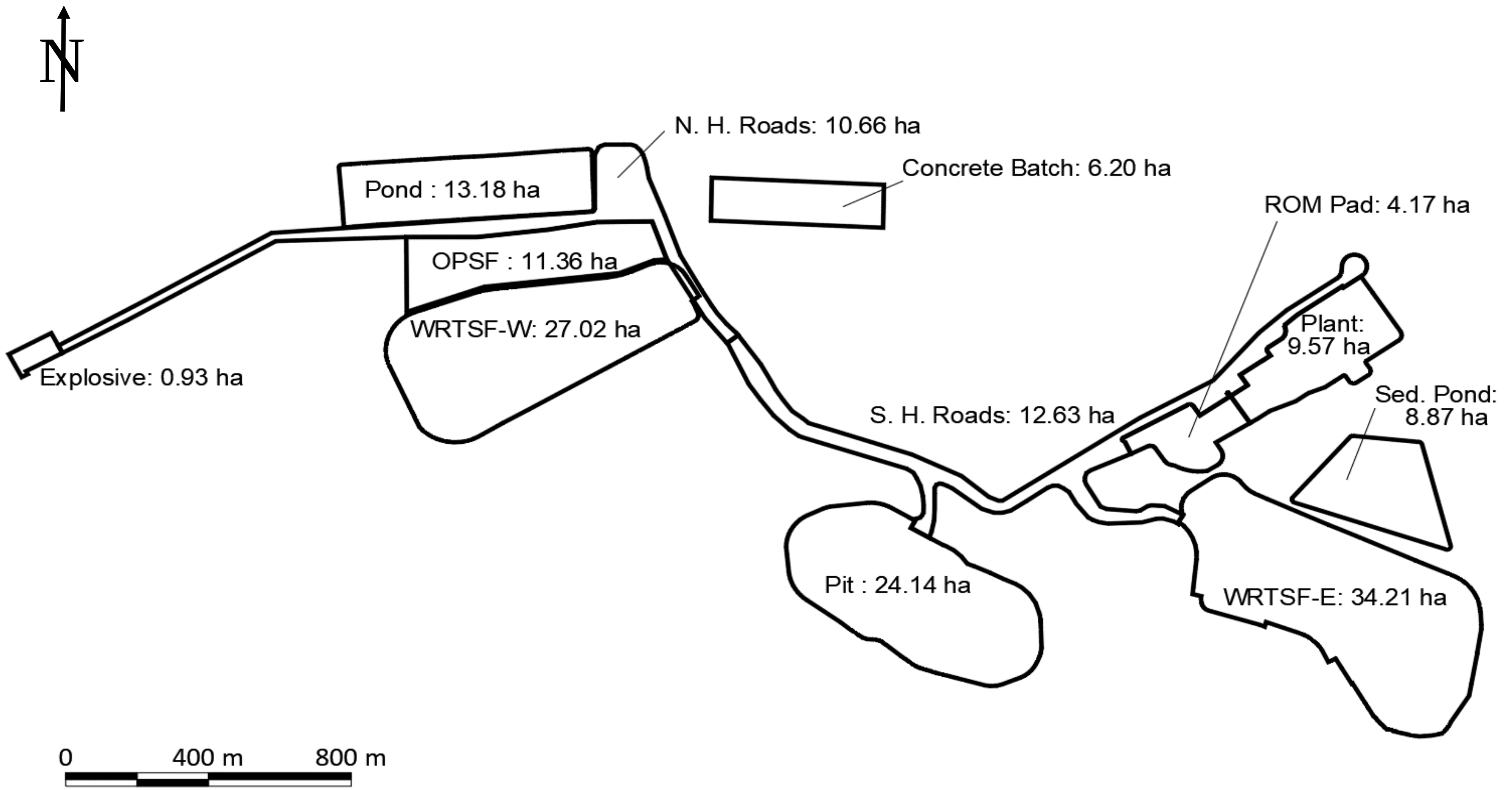
Stantec, 2019 – Report: *Galaxy Lithium - Mine Wide Water Balance, In support of the Feasibility study for the James Bay Project.,* N°121622255

WSP (2018). James Bay Lithium, Feasibility Study, James Bay, Quebec, N°171-02562-01.

JPL/VR/

Attachments:

- Figures B-1 and B-2. Delineation of the watersheds, whose runoff is managed in the Water Management Pond for Phase 1 (Year -1 to Year 3) and Phase 2 (Year 4 to Year 19) of the site development, respectively.



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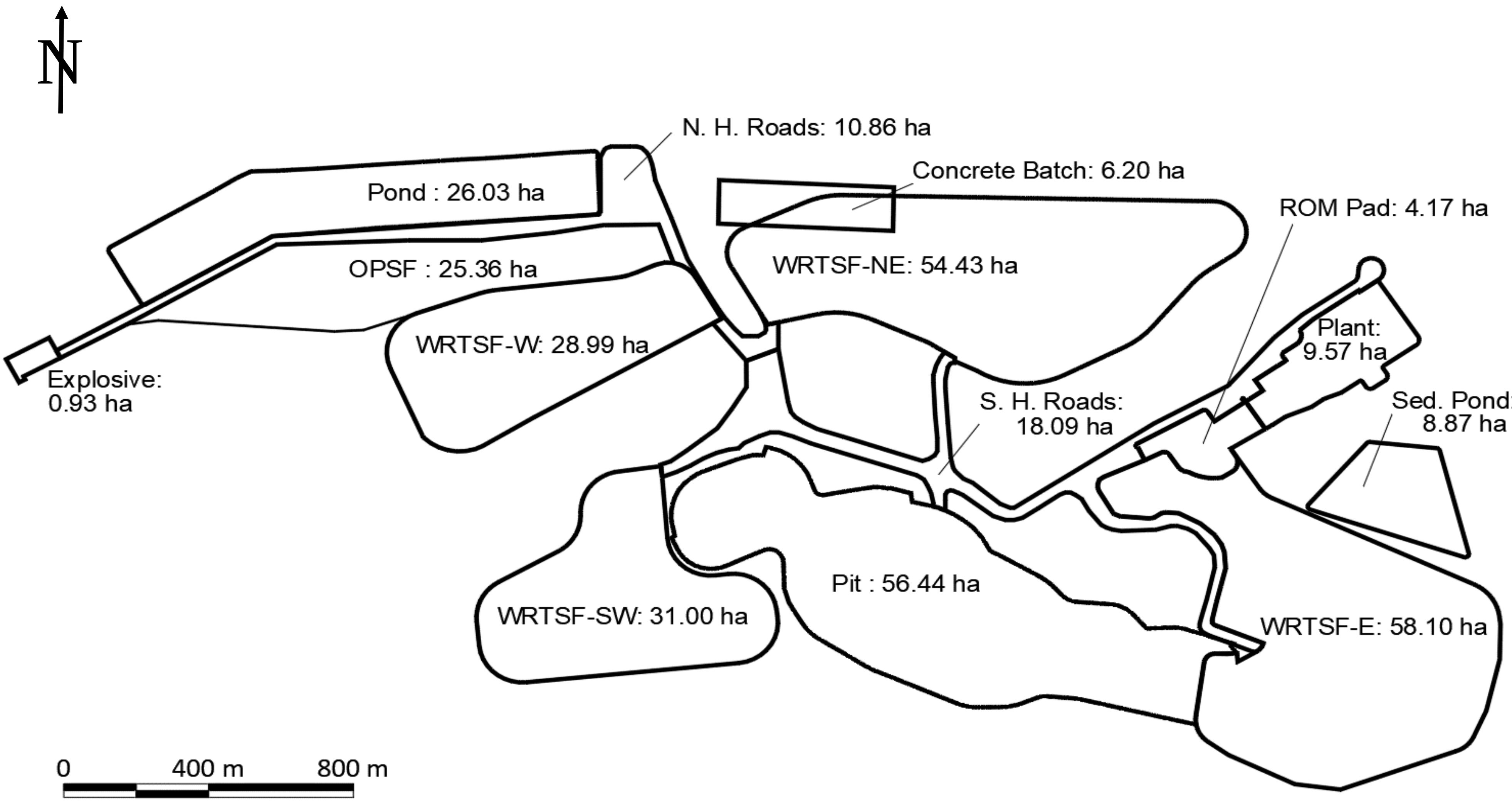
CONSULTANT	YYYY-MM-DD	2021-03-19	TITLE		
GOLDER	DESIGNED	-	**Catchment Areas - Phase 1 (End of Year 3)**		
	PREPARED	JPL			
	REVIEWED	VR	PROJECT N°	PHASE	REV / FIGURE
	APPROVED	JPL	**19135464**	**11000**	**A** / **B-1**



NOTES:

CONCRETE BATCH PLANT WILL BE RELOCATED, BUT THE FOOTPRINT WILL REMAIN THE SAME AS PHASE 1

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REVIEWED	VR
APPROVED	JPL

GOLDER

PROJECT

JAMES BAY PROJECT - PEA 2021
SITE WIDE WATER BALANCE UPDATE

TITLE

Catchment Areas - Phase 2 (Full site development)

PROJECT N°	PHASE	REV	FIGURE
19135464	**11000**	**A**	**B-2**

APPENDIX C

Slope Stability Analyses

Table C-1: Slope Stability Summary

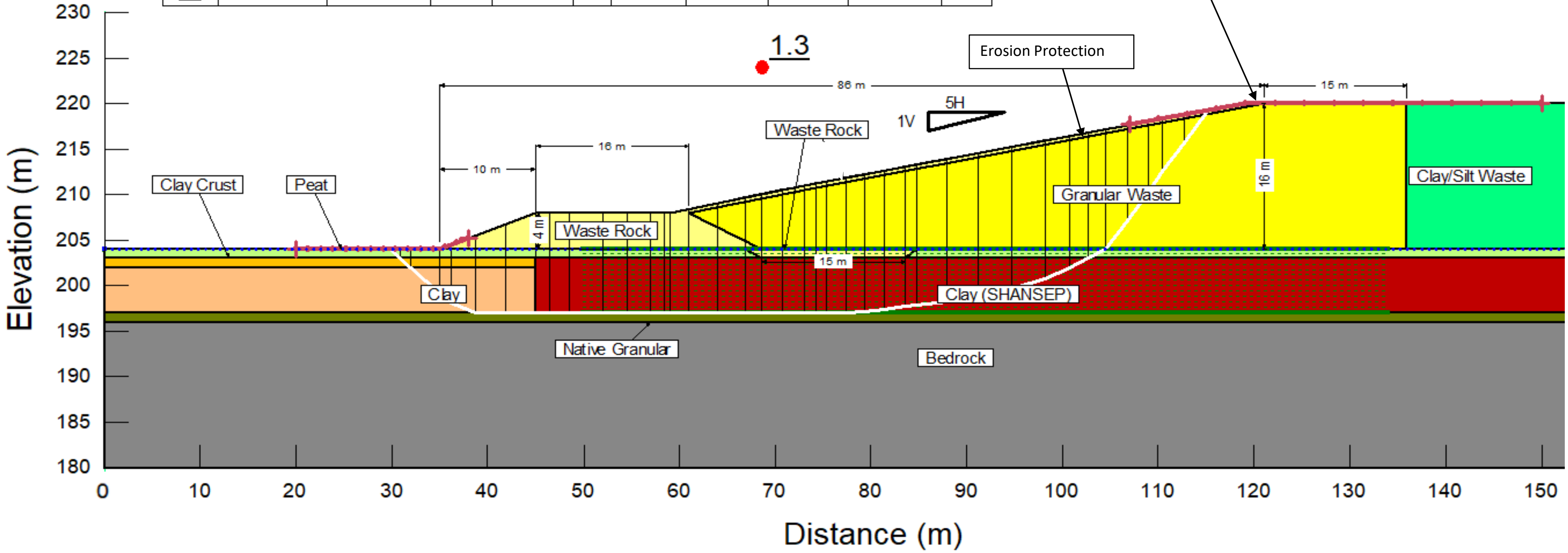
Model	Crest Elevation (m)	Maximum Height (m)	Overall Slope (XH:1V)	Foundation Thickness (m)			Minimum Factor of Safety			Figure No.
				Peat	Clay	Till	Loading Condition	Target	Calculated	
OPSF – Overburden Mineral Soil	220	16	5	1	6	1	Short-term Static (EoC)	1.3	1.3	C-1
							Long-term Static	1.5	2.9	-
							Long-term Pseudo-static	1.0	2.6	-
OPSF – Peat	220	16	5	1	6	1	Short-term Static (EoC)	1.3	1.3	C-2
							Long-term Static	1.5	1.6	-
							Long-term Pseudo-static	1.0	1.5	-
North WMP – High Fill	206.2	8	3	1	4.7	1	Short-term Static U/S (EoC)	1.3	1.7	C-3
							Long-term Static U/S	1.5	1.7	-
							Long-term Pseudo-static U/S	1.0	1.6	-
North WMP – Deep Cut	206.2	8	3	3	3.6	3	Short-term Static U/S (EoC)	1.3	1.8	C-4
							Long-term Static U/S	1.5	1.8	-
							Long-term Pseudo-static U/S	1.0	1.7	-
East WMP – High Fill	213	4	3	0.1	-	9	Short-term Static U/S (EoC)	1.3	1.9	-
							Long-term Static D/S	1.5	1.8	C-5
							Long-term Pseudo-static D/S	1.0	1.6	-

Model	Crest Elevation (m)	Maximum Height (m)	Overall Slope (XH:1V)	Foundation Thickness (m)			Minimum Factor of Safety			Figure No.
				Peat	Clay	Till	Loading Condition	Target	Calculated	
East WMP – Deep Cut	213	4	3	0.1	-	9	Short-term Static U/S (EoC)	1.3	1.3	C-6
							Long-term Static U/S	1.5	1.9	-
							Long-term Pseudo-static U/S	1.0	1.7	-
West WRTSF	260	53	2.3	1	-	5	Short-term Static (EoC)	1.3	1.3	-
							Long-term Static	1.5	1.5	C-7
							Long-term Pseudo-static	1.0	1.4	-
Northeast WRTSF	290	83	2.3	1	-	4	Short-term Static (EoC)	1.3	1.3	-
							Long-term Static	1.5	1.5	C-8
							Long-term Pseudo-static	1.0	1.4	-
East WRTSF	290	73	2.3	0.5	-	3	Short-term Static (EoC)	1.3	1.3	-
							Long-term Static	1.5	1.5	C-9
							Long-term Pseudo-static	1.0	1.4	-
Southwest WRTSF	270	60	2.3	1	-	5	Short-term Static (EoC)	1.3	1.3	-
							Long-term Static	1.5	1.5	C-10
							Long-term Pseudo-static	1.0	1.4	-

Notes:

1. OPSF = "Overburden Peat Storage Facility"; WMP = "Water Management Pond", WRTSF = "Waste Rock Tailings Storage Facility"; EoC = "End of Construction"; D/S = "downstream"; U/S = "upstream"
2. WMPs – maximum height is equal to pond depth; crest width = 6 m; 3H:1V berm and excavation slopes U/S and D/S
3. Southwest WRTSF - No geotechnical investigations completed, assumed foundation conditions based on general site conditions.
4. The general stratigraphy of the site consists of, in descending stratigraphic order: peat/organic soil, clay, till, and bedrock. Stratigraphic layers are based on available geotechnical investigations to date and have been simplified for the purposes of the preliminary stability analysis.

Color	Name	Model	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Minimum Strength (kPa)	Tau/Sigma Ratio	Cohesion (kPa)	Piezometric Line	B-bar
	Clay Crust	Undrained (Phi=0)	18.5					100	1	0
	Bedrock	Bedrock (Impenetrable)							1	0
	Clay	Undrained (Phi=0)	18					30	1	0
	Clay SHANSEP	SHANSEP	18			30	0.22		1	0.4
	Clay/Silt Waste	Undrained (Phi=0)	18					25	1	0
	Granular Waste	Mohr-Coulomb	19	0	32				1	0
	Native Granular	Mohr-Coulomb	19	0	32				1	0
	Peat	SHANSEP	14			10	0.3		1	0.4
	Waste Rock	Mohr-Coulomb	22	0	40				1	0



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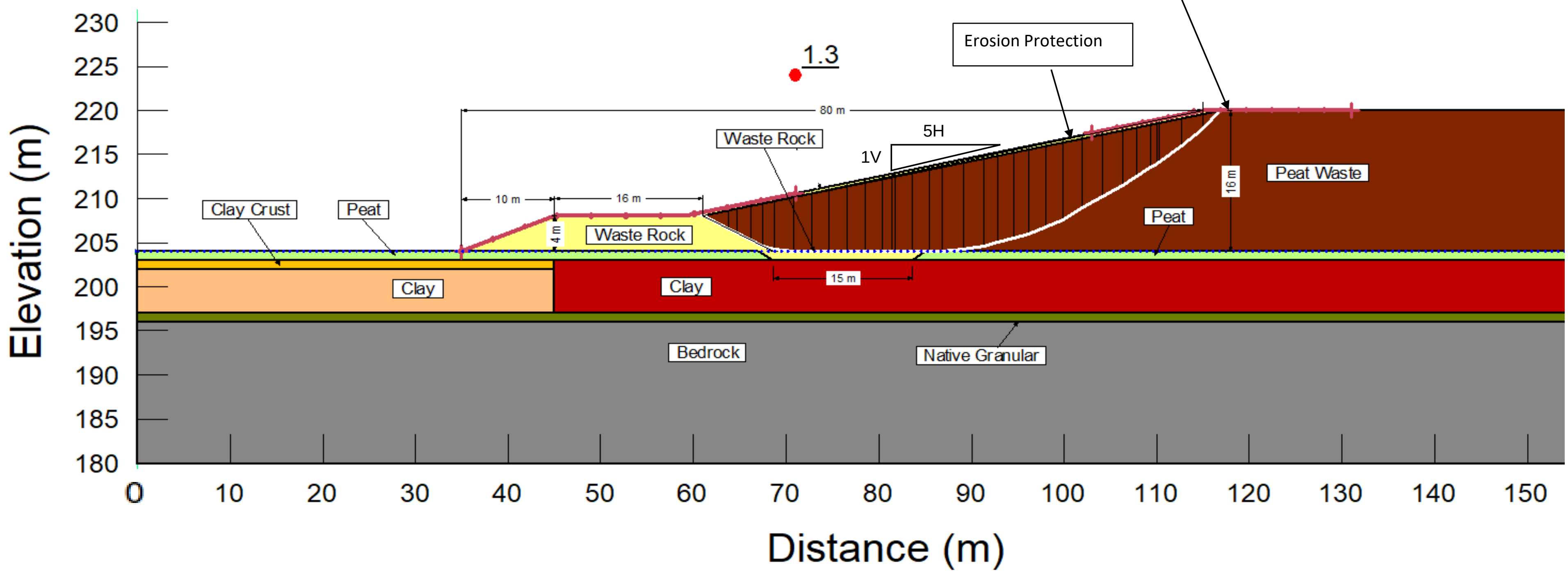
PREPARED	GK
REVIEWED	MAS
APPROVED	DJ

TITLE

OPSF - OVERBURDEN - TYPICAL SECTION - SHORT TERM STATIC CONDITIONS

TITLE	PHASE	REV	FIGURE
19135464	**11000**	**A**	**C-1**

Color	Name	Model	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Minimum Strength (kPa)	Tau/Sigma Ratio	Cohesion (kPa)	Piezometric Line	B-bar
	Clay Crust	Undrained (Phi=0)	18.5					100	1	0
	Bedrock	Bedrock (Impenetrable)							1	0
	Clay	Undrained (Phi=0)	18					30	1	0
	Clay SHANSEP	SHANSEP	18			30	0.22		1	0.4
	Native Granular	Mohr-Coulomb	19	0	32				1	0
	Peat	SHANSEP	14			10	0.3		1	0.4
	Peat Waste	SHANSEP	14			5	0.3		1	0.4
	Waste Rock	Mohr-Coulomb	22	0	40				1	0



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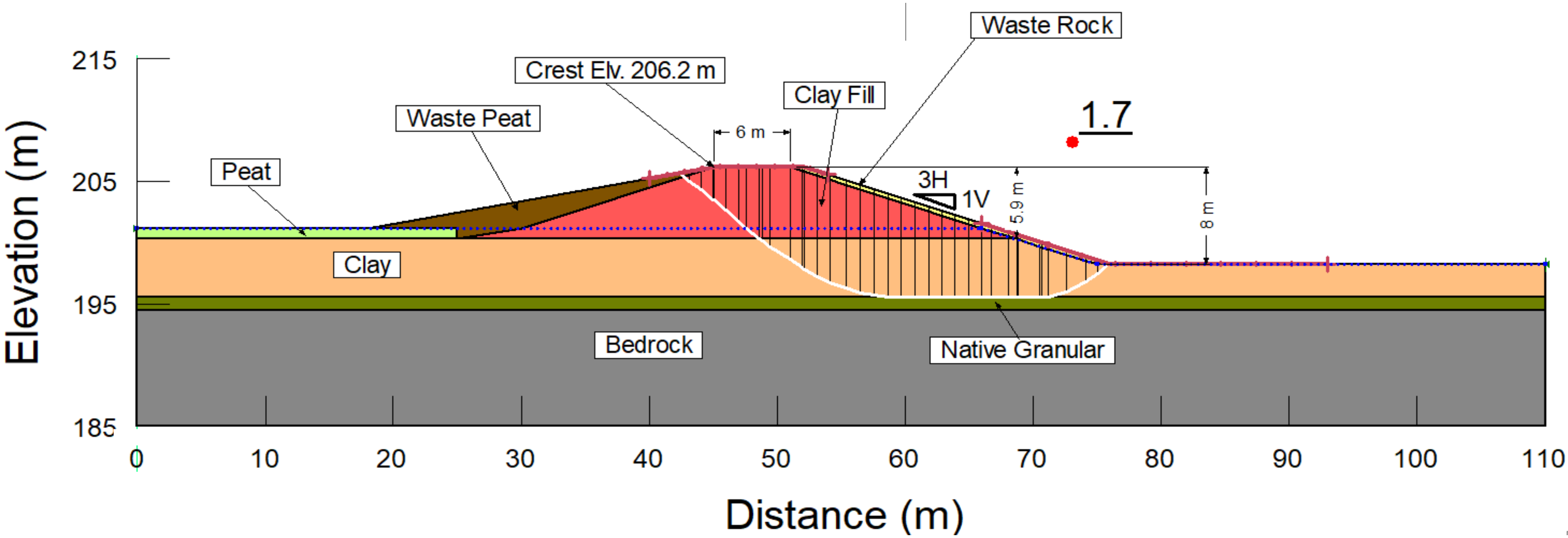
TITLE

OPSF - PEAT - TYPICAL SECTION - SHORT TERM STATIC CONDITIONS

TITLE	PHASE	REV	FIGURE
19135464	**11000**	**A**	**C-2**

Color	Name	Model	Unit Weight (kN/m³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)	Cohesion (kPa)	Piezometric Line
	Bedrock	Bedrock (Impenetrable)							1
	Clay	Undrained (Phi=0)	18					30	1
	Clay Fill	Undrained (Phi=0)	18					45	1
	Native Granular	Mohr-Coulomb	19			0	32		1
	Peat	SHANSEP	14	10	0.3				1
	Peat Waste-ES	Mohr-Coulomb	14			0	28		1
	Waste Rock	Mohr-Coulomb	22			0	40		1



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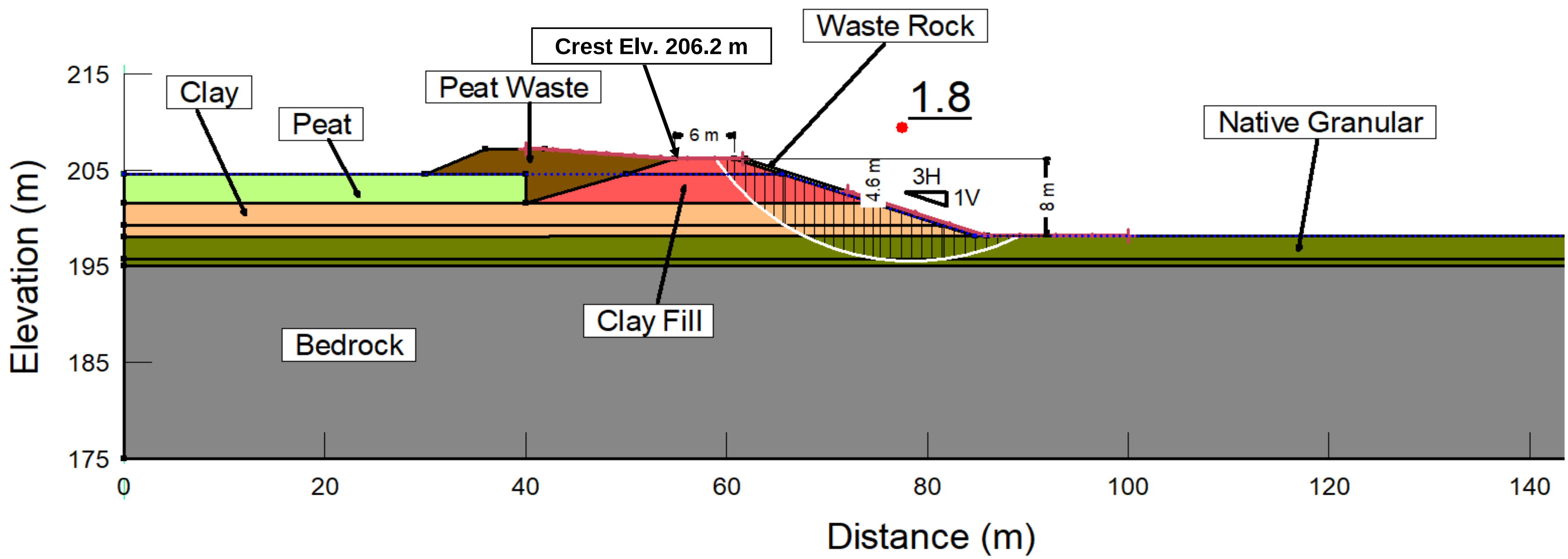
REVIEWED	MAS
APPROVED	DJ

TITLE
NORTH WMP - TYPICAL SECTION - HIGH FILL- SHORT TERM STATIC CONDITIONS

TITLE	PHASE	REV	FIGURE
19135464	**11000**	**A**	**C-3**

Color	Name	Model	Unit Weight (kN/m³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)	Phi-B (°)	Cohesion (kPa)	Piezometric Line
	Bedrock	Bedrock (Impenetrable)								1
	Clay	Undrained (Phi=0)	18						30	1
	Clay Fill	Undrained (Phi=0)	18						45	1
	Native Granular	Mohr-Coulomb	19			0	32	0		1
	Peat	SHANSEP	14	10	0.3					1
	Peat Waste-ES	Mohr-Coulomb	14			0	28	0		1
	Waste Rock	Mohr-Coulomb	22			0	40	0		1



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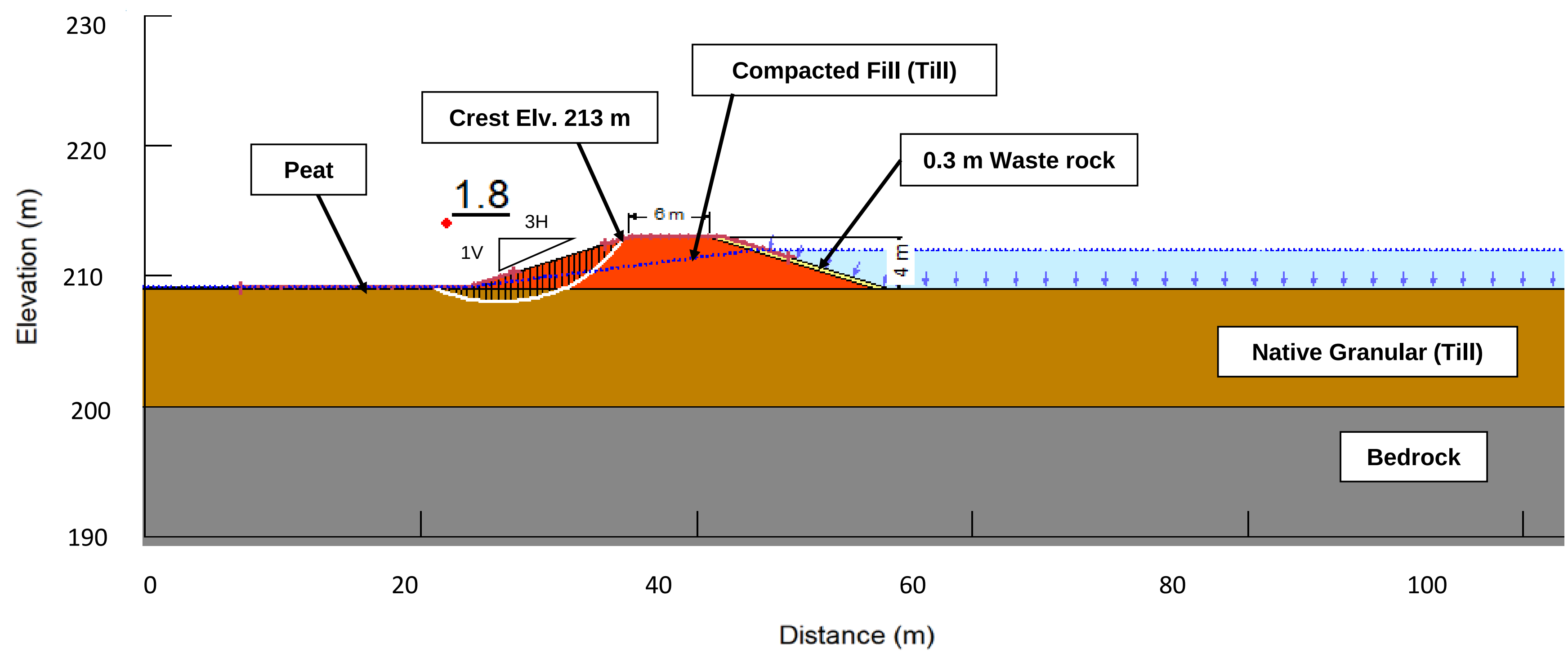
PREPARED	GK
REVIEWED	MAS
APPROVED	DJ

TITLE
NORTH WMP - TYPICAL SECTION - DEEP CUT - SHORT TERM STATIC CONDITIONS

TITLE	PHASE	REV	FIGURE
19135464	**11000**	**A**	**C-4**

Color	Name	Model	Unit Weight (kN/m³)	Minimum Strength (kPa)	Tau/ Sigma Ratio	Cohesion' (kPa)	Phi' (°)	B-bar
	Bedrock	Bedrock (Impenetrable)						0
	Compacted Fill (Till)	Mohr-Coulomb	19			0	32	0
	Native Granular (Till)	Mohr-Coulomb	19			0	32	0
	Peat	SHANSEP	14	10	0.3			0.4
	Waste Rock	Mohr-Coulomb	22			0	40	0



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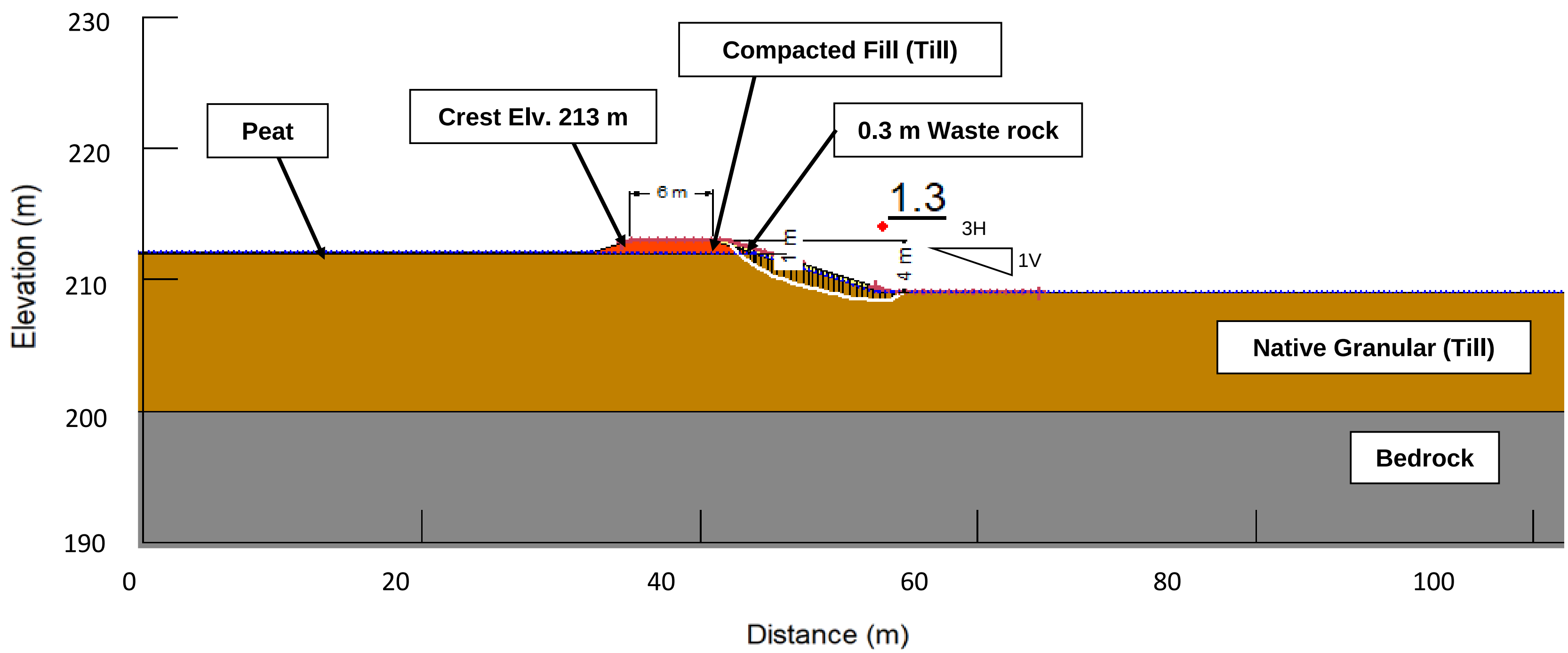
DESIGNED	MAS
PREPARED	GK
REVIEWED	MAS
APPROVED	DJ

TITLE

EAST WMP - TYPICAL SECTION - HIGH FILL- LONG TERM STATIC CONDITIONS

TITLE	PHASE	REV	FIGURE
19135464	**11000**	**A**	**C-5**

Color	Name	Model	Unit Weight (kN/m³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)	B-bar
(grey)	Bedrock	Bedrock (Impenetrable)						0
(red)	Compacted Fill (Till)	Mohr-Coulomb	19			0	32	0
(brown)	Native Granular (Till)	Mohr-Coulomb	19			0	32	0
(light green)	Peat	SHANSEP	14	10	0.3			0.4
(yellow)	Waste Rock	Mohr-Coulomb	22			0	40	0



CLIENT
GALAXY LITHIUM (CANADA) INC.

PROJECT
JAMES BAY PROJECT - 2021 PEA

CONSULTANT

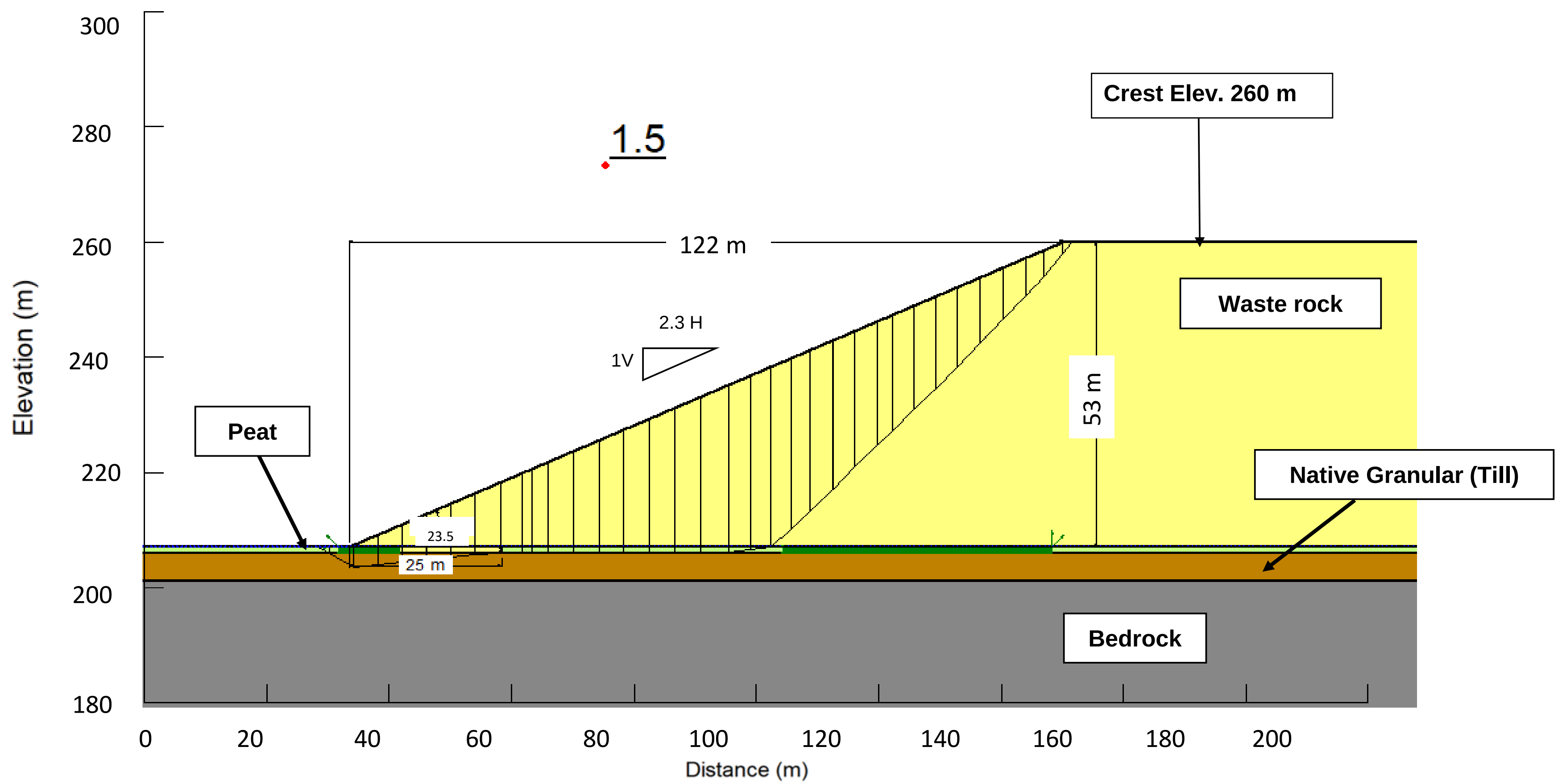
GOLDER

YYYY-MM-DD	2021-03-17
DESIGNED	MAS
PREPARED	GK
REVIEWED	MAS
APPROVED	DJ

TITLE
EAST WMP - TYPICAL SECTION - DEEP CUT - SHORT TERM STATIC CONDITIONS

TITLE	PHASE	REV	FIGURE
19135464	**11000**	**A**	**C-6**

Color	Name	Model	Unit Weight (kN/m³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)	B-bar	Add Weight
	Bedrock	Bedrock (Impenetrable)						0	No
	Native Granular (Till)	Mohr-Coulomb	19.5			0	32	0	No
	Peat (SHANSEP)	SHANSEP	14	10	0.3			0.4	No
	Waste Rock	Mohr-Coulomb	22			0	40	0	Yes



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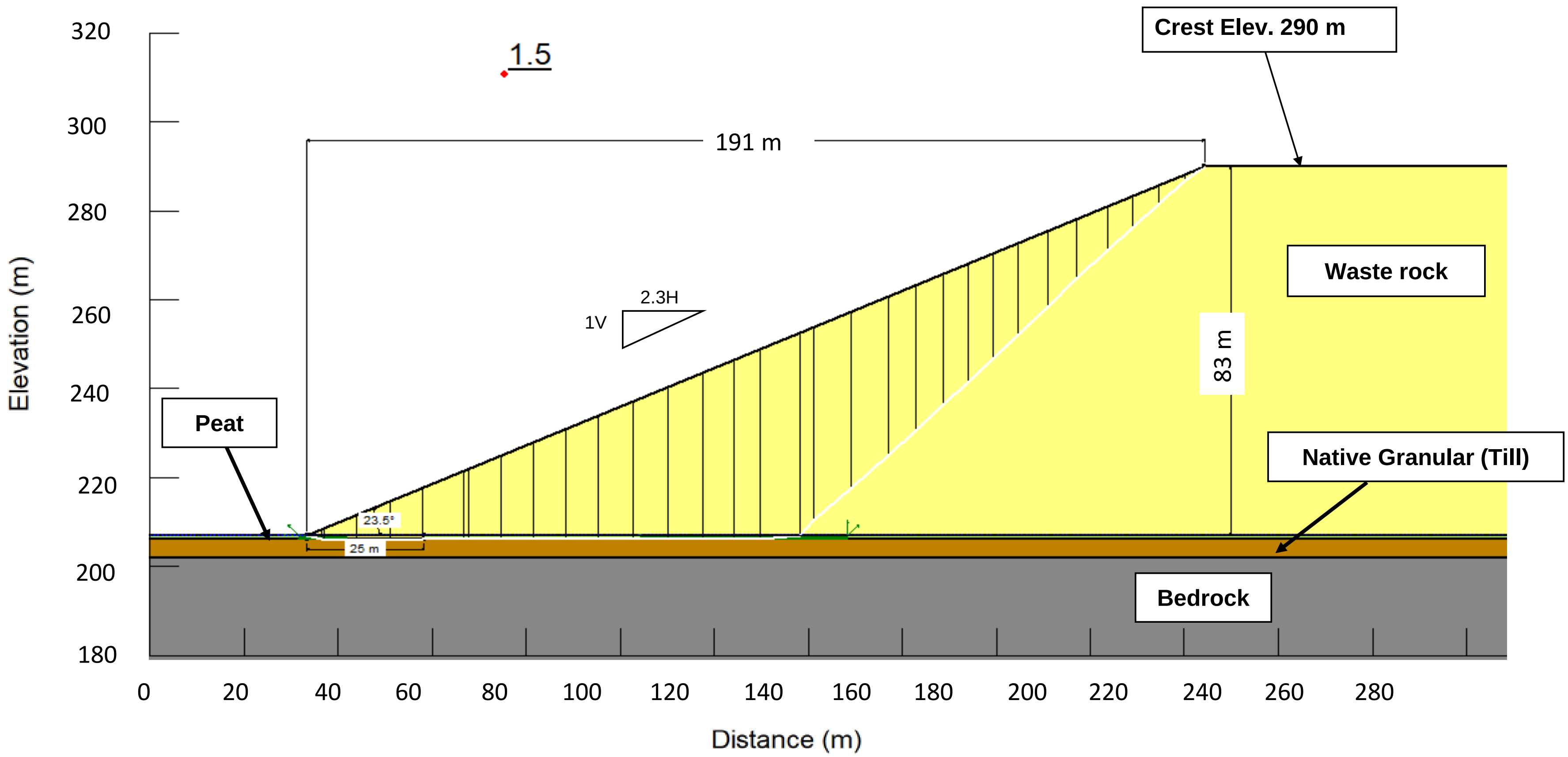
DESIGNED	MAS
PREPARED	GK
REVIEWED	MAS
APPROVED	DJ

TITLE
WEST WRTSF - TYPICAL SECTION - LONG TERM STATIC CONDITIONS

TITLE	PHASE	REV	FIGURE
19135464	**11000**	**A**	**C-7**

Color	Name	Model	Unit Weight (kN/m³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)	B-bar	Add Weight
	Bedrock	Bedrock (Impenetrable)						0	No
	Native Granular (Till)	Mohr-Coulomb	19.5			0	32	0	No
	Peat (SHANSEP)	SHANSEP	14	10	0.3			0.4	No
	Waste Rock	Mohr-Coulomb	22			0	40	0	Yes



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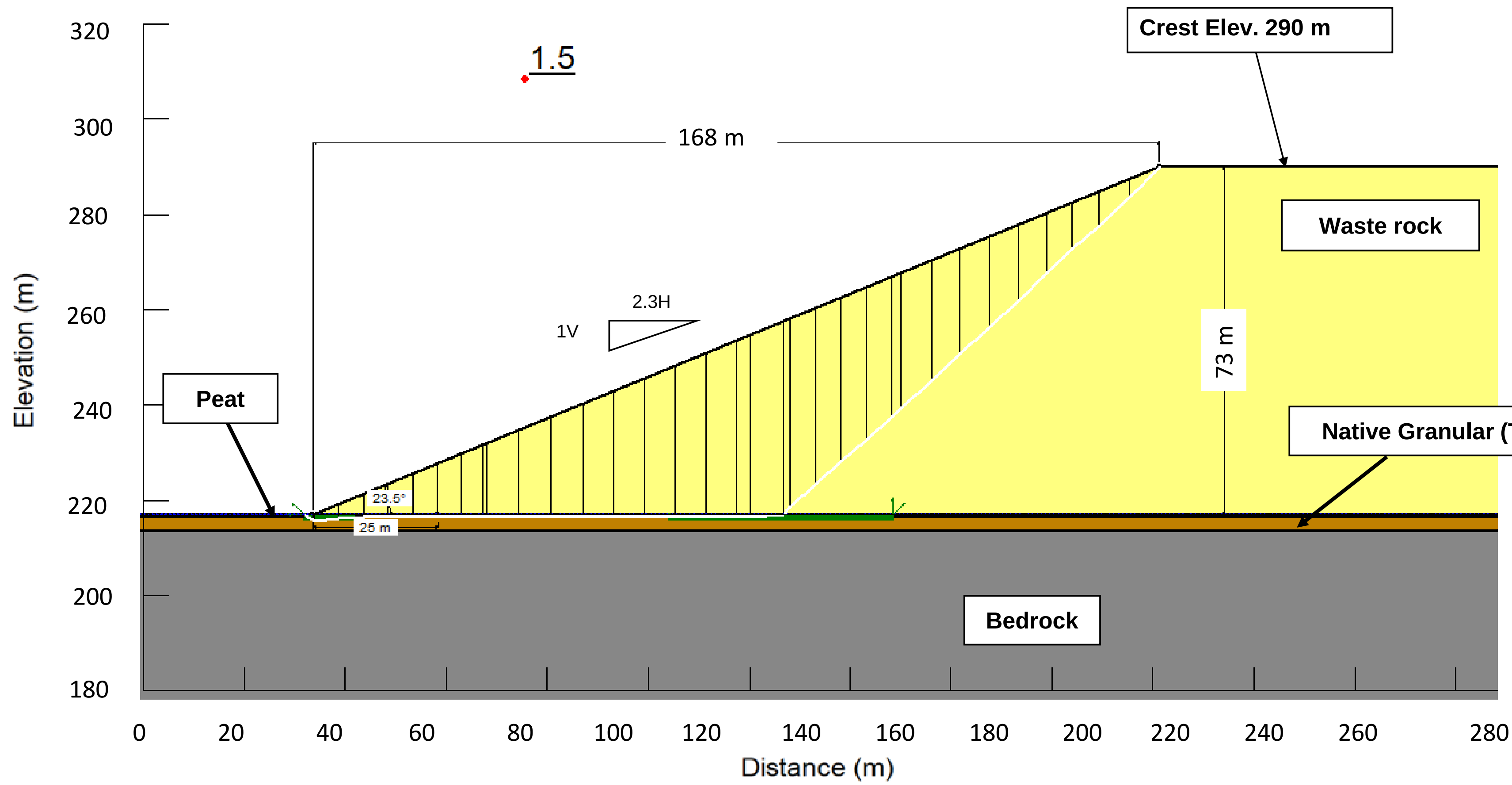
PREPARED	GK
REVIEWED	MAS
APPROVED	DJ

TITLE

NORTHEAST WRTSF - TYPICAL SECTION - LONG TERM STATIC CONDITIONS

TITLE	PHASE	REV	FIGURE
19135464	**11000**	**A**	**C-8**

Color	Name	Model	Unit Weight (kN/m³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)	B-bar	Add Weight
	Bedrock	Bedrock (Impenetrable)						0	No
	Native Granular (Till)	Mohr-Coulomb	19.5			0	32	0	No
	Peat (SHANSEP)	SHANSEP	14	10	0.3			0.4	No
	Waste Rock	Mohr-Coulomb	22			0	40	0	Yes



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DESIGNED	MAS
PREPARED	GK
REVIEWED	MAS
APPROVED	DJ

PROJECT

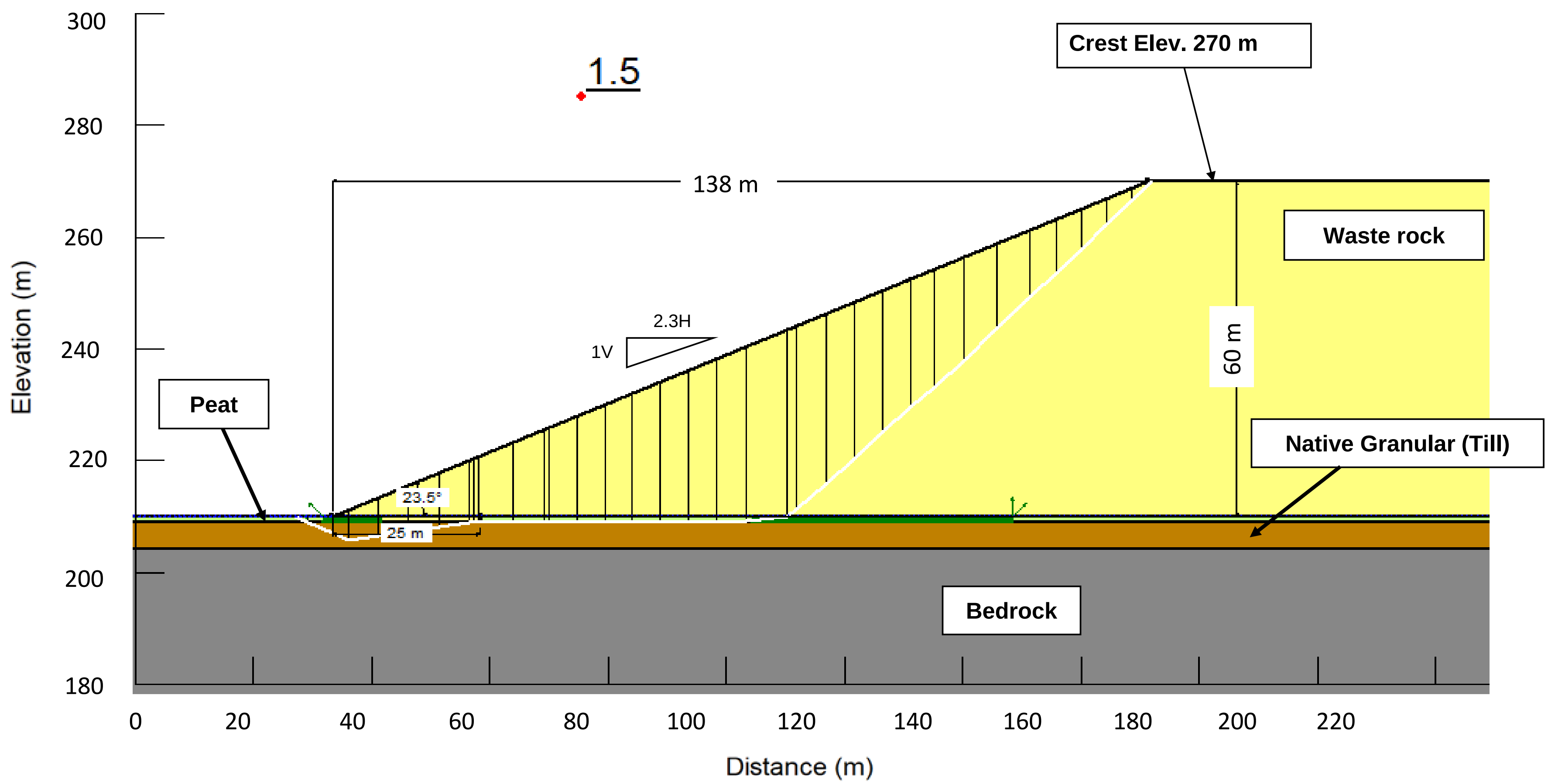
JAMES BAY PROJECT - 2021 PEA

TITLE

EAST WRTSF - TYPICAL SECTION - LONG TERM STATIC CONDITIONS

TITLE	PHASE	REV	FIGURE
19135464	**11000**	**A**	**C-9**

Color	Name	Model	Unit Weight (kN/m³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)	B-bar	Add Weight
	Bedrock	Bedrock (Impenetrable)						0	No
	Native Granular (Till)	Mohr-Coulomb	19.5			0	32	0	No
	Peat (SHANSEP)	SHANSEP	14	10	0.3			0.4	No
	Waste Rock	Mohr-Coulomb	22			0	40	0	Yes



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GALAXY LITHIUM (CANADA) INC.

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PREPARED	GK
REVIEWED	MAS
APPROVED	DJ

TITLE

SOUTHWEST WRTSF - TYPICAL SECTION - LONG TERM STATIC CONDITIONS

TITLE	PHASE	REV	FIGURE
19135464	**11000**	**A**	**C-10**

APPENDIX D

Quantity Estimates

Appendix D - PEA Level Quantities and Capital Cost Estimate
Waste Rock Tailings Storage Facility, Water Management Ponds and Overburden Peat Stockpile
James Bay Lithium Mine Project

Prepared by: MAS
Checked by: DCJ

Item / Description	Unit	Unit Cost	Total Quantity	Phase 1 (Year -1)		Phase 2 CAPEX (Ultimate)		Total (including closure)	
				Quantity	Cost	Quantity	Cost	Quantity	Cost
Earthworks contractor mobilization	Lump sum		1	1	$0	0	$0	1	$0
Site preparation									
Tree clearing (full footprints)									
North WMP (including toe berm footprint)	m^2		260,327	131,762	$0	128,565	$0	260,327	$0
East WMP	m^2		81,053	81,053	$0	0	$0	81,053	$0
East WRTSF	m^2		543,750	347,309	$0	196,441	$0	543,750	$0
Northeast WRTSF	m^2		552,323	0	$0	552,323	$0	552,323	$0
West WRTSF	m^2		292,520	292,520	$0	0	$0	292,520	$0
Southwest WRTSF	m^2		313,080	0	$0	313,080	$0	313,080	$0
OPSF	m^2		252,584	112,502	$0	140,082	$0	252,584	$0
Foundation Preparation (for slope stability purposes)									
North WMP (toe berm footprint only)	m^3		92,169	41,830	$0	50,339	$0	92,169	$0
East WMP (toe berm footprint only)	m^3		2,633	2,633	$0	0	$0	2,633	$0
East WRTSF (25 m wide overburden stripping)	m^3		39,323	28,963	$0	10,360	$0	39,323	$0
Northeast WRTSF (25 m wide overburden stripping)	m^3		59,063	0	$0	59,063	$0	59,063	$0
West WRTSF (25 m wide overburden stripping)	m^3		33,200	33,200	$0	0	$0	33,200	$0
Southwest WRTSF (25 m wide overburden stripping)	m^3		43,103	0	$0	43,103	$0	43,103	$0
OPSF (15 m wide overburden stripping)	m^3		27,784	4,256	$0	23,528	$0	27,784	$0
WMP Construction									
North WMP									
Excavate WMP - Peat	m^3		130,465	74,107	$0	56,358	$0	130,465	$0
Excavate WMP - Soil	m^3		694,412	394,444	$0	299,968	$0	694,412	$0
Perimeter Berm Fill - Place, Compact clay (0.3m lifts, moisture condition, compact, trim)	m^3		245,718	98,616	$0	147,102	$0	245,718	$0
Supply and install non-woven geotextile on slopes and crest	m^2		86,307	45,184	$0	41,123	$0	86,307	$0
Anchor trench - non-woven geotextile	lin. m		3,184	1,704	$0	1,480	$0	3,184	$0
Erosion protection - 300 mm minus Rip-rap	m^3		38,344	20,119	$0	18,225	$0	38,344	$0
East WMP									
Excavate WMP - Peat	m^3		7,904	7,904	$0	0	$0	7,904	$0
Excavate WMP - Soil	m^3		92,817	92,817	$0	0	$0	92,817	$0
Perimeter Berm Fill - Place, Compact clay (0.3m lifts, moisture condition, compact, trim)	m^3		30,883	30,883	$0	0	$0	30,883	$0
Supply and install non-woven geotextile on slopes and crest	m^2		16,796	16,796	$0	0	$0	16,796	$0
Anchor trench - non-woven geotextile	lin. m		1,138	1,138	$0	0	$0	1,138	$0
Erosion protection - 300 mm minus Rip-rap	m^3		8,084	8,084	$0	0	$0	8,084	$0
WRTSF Construction									
East WRTSF Perimeter Access Road	lin. m		3,053	2,147	$0	906	$0	3,053	$0
Northeast WRTSF Perimeter Access Road	lin. m		3,907	0	$0	3,907	$0	3,907	$0
West WRTSF Perimeter Access Road	lin. m		2,127	2,127	$0	0	$0	2,127	$0
Southwest WRTSF Perimeter Access Road	lin. m		2,148	0	$0	2,148	$0	2,148	$0
OPSF Construction									
Waste rock berm / perimeter haul road	m^3		167,549	85,610	$0	81,939	$0	167,549	$0
Erosion protection - 1000mm minus rockfill	m^3		44,836	4,400	$0	40,435	$0	44,836	$0
Surface course for haul road	m^3		5,452	2,589	$0	2,863	$0	5,452	$0
Perimeter Collection Ditch Construction									
East WRTSF (D1, D2, D8 and D9)									
Ditch length	lin. m		3,053	2,147	$0	906	$0	3,053	$0
Excavation Volume (1m base width, 1.5m depth, 2.5H:1V)	m^3		30,225	21,255	$0	8,969	$0	30,225	$0
Supply and install Non-woven geotextile	m^2		27,721	19,495	$0	8,226	$0	27,721	$0
Rip-Rap - 0.3 m thick	m^3		7,510	5,282	$0	2,229	$0	7,510	$0
West WRTSF (D3 and D4)									
Ditch length	lin. m		2,127	2,127	$0	0	$0	2,127	$0
Excavation Volume (1m base width, 1.5m depth, 2.5H:1V)	m^3		21,057	21,057	$0	0	$0	21,057	$0
Supply and install Non-woven geotextile	m^2		19,313	19,313	$0	0	$0	19,313	$0
Rip-Rap - 0.3 m thick	m^3		5,232	5,232	$0	0	$0	5,232	$0
Northeast WRTSF (D7)									
Ditch length	lin. m		3,907	0	$0	3,907	$0	3,907	$0
Excavation Volume (1m base width, 1.5m depth, 2.5H:1V)	m^3		38,679	0	$0	38,679	$0	38,679	$0
Supply and install Non-woven geotextile	m^2		35,476	0	$0	35,476	$0	35,476	$0
Rip-Rap - 0.3 m thick	m^3		9,611	0	$0	9,611	$0	9,611	$0
Southwest WRTSF (D5, D6)									
Ditch length	lin. m		2,148	0	$0	2,148	$0	2,148	$0
Excavation Volume (1m base width, 1.5m depth, 2.5H:1V)	m^3		21,265	0	$0	21,265	$0	21,265	$0
Supply and install Non-woven geotextile	m^2		19,504	0	$0	19,504	$0	19,504	$0
Rip-Rap - 0.3 m thick	m^3		5,284	0	$0	5,284	$0	5,284	$0
WRTSF Intermediate Pump Stations									
Excavate/Construct Sump and Supply/Install Pump Station	each		4	2	$0	2	$0	4	$0
MINE WASTE MANAGEMENT CAPEX SUBTOTAL	**$ Cdn**	-	-	-	**$0**	-	**$0**	-	**$0**
Mine Waste Facility Design and CQA (assume EPCM is included elsewhere in PEA)	Allowance	15%	-	-	$0	-	$0	-	$0
Mine Waste Storage Facility Closure									
West WRTSF (0.5 m thick overburden cover on top and benches)	ha		29.3					29.3	$0
Northeast WRTSF (0.5 m thick overburden cover on top and benches)	ha		55.2					55.2	$0
East WRTSF (0.5 m thick overburden cover on top and benches)	ha		54.4					54.4	$0
Southwest WRTSF (0.5 m thick overburden cover on top and benches)	ha		31.3					31.3	$0
OPSF vegetation/seeding (full surface)	ha		25.4					25.4	$0
Drainage system modifications for closure (spillway and ditch modifications)	Allowance		1					1	$0
Infrastructure decommissioining (pipelines and pump stations)	Allowance		1					1	$0
Closure design and CQA (assume EPCM factor included elsewhere in PEA)	Allowance	15%	1					1	$0
MINE WASTE CAPEX GRAND TOTAL (Including Closure)		-	-	-	**$0**	-	**$0**	-	**$0**

Notes:
1) Material quantities have been calculated based on PEA level design.
2) Unit rates (shaded blue) to be estimated by G-Mining and Galaxy Lithium.
3) No contingency has been included in the above cost estimates.
4) All costs are in 2021 $CDN dollars and exclude taxes.
5) Pipelines and pumping costs (shaded blue) to be estimated by G-Mining.
6) Waste rock and overburden haul costs are included under mining.

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