Benga Mining Limited operating as Riversdale Resources

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October 16, 2017

Alberta Energy Regulator
Suite 1000, 250 – 5 Street SW
Calgary, Alberta T2P 0R4
Attn: Africa Geremew <email address removed>

Dear Mr. Geremew:

RE: Benga Mining Ltd., Grassy Mountain Coal Project, *Water Act* "Fence-line" Approval (Appendix 1D)

Benga Mining Limited (Benga), a wholly owned subsidiary of Riversdale Resources Limited, is proposing to develop a 4.5 million clean metric tonnes (CMT) per year steelmaking coalmine, referred to as the Grassy Mountain Coal Project (the Project). Benga filed a technical application and accompanying environmental impact assessment report (EIA) on August 12, 2016, which addresses the technical, environmental and social aspects of the proposed Project.

Benga is submitting this Application to the AER for a *Water Act* "Fence-line" Approval as Appendix 1D which is an addendum to the August 12, 2016 submission.

Correspondence regarding this application should be directed to the attention of:

Name: Cal Clark, Manager Sustainability
Phone: <contact information removed>
E-Mail: <email address removed>

Sincerely,

<Original signed by>

Cal Clark, Manager Sustainable Development
Benga Mining Ltd.

cc. Nadia Haider, AER

Grassy Mountain Coal Mine Project

Appendix 1D:

Water Act Fence-line Approval Application

October 2017

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1.0 INTRODUCTION

Benga Mining Limited (Benga), a wholly owned subsidiary of Riversdale Resources Limited (Riversdale), is proposing to develop a nominal 4.5 million clean metric tonnes (CMT) per year metallurgical coal mine (for steel production), referred to as the Grassy Mountain Coal Project (the Project). The Project is located in southwest Alberta, approximately 150 km southwest of Calgary, in the Crowsnest Pass, and will cover areas within Townships 08 and 09 and Ranges 03 and 04, West of the 5th Meridian. The proposed metallurgical coal processing facility is planned to be located approximately 7 km north of the community of Blairmore.

The Project will involve a surface metallurgical coal mine, a coal preparation plant (CPP) with associated infrastructure, an overland conveyor system, which will parallel an existing high grade access corridor and connect to a rail load-out facility, and a new section of rail track. For the purpose of this Fence-line *Water Act* Application, the proposed Mine Permit Boundary is deemed to the "fence-line area" (Figure 1-1).

The intention of the Project is to re-establish a historical coal mine on Grassy Mountain, to ship high quality coking metallurgical coal to overseas steel producing markets. To do this, the projected labour requirements will involve approximately 700 person-years of construction labour and 400 full time positions during operation. The Project is expected to provide significant economic stimulus to the Municipality of Crowsnest Pass and the Municipal District of Ranchland#66, as well as to the neighbouring communities to the west (*e.g.*, Sparwood, Elkford, and Fernie).

Water is needed to operate the mine, including the coal wash plant which is the major user of water and wash water. Water collected on the site as part of the Fence-line approval will be used to supply the project needs.

The collection of surface runoff water and the management of pit water are required for the removal of total suspended solids (TSS). Management and mitigation of potential selenium laden water, from water infiltrating through the excavated rock placed in the ex-pit rock disposal areas, is also of primary importance. The main objective is to control selenium and TSS levels to meet wastewater guidelines and objectives.

Pit dewatering operations involve the removal of surface water (from rainfall and snow melt) and groundwater that enters the pits. The groundwater level is typically at greater depths in the mining area. As mining operations drop below the natural groundwater levels, continual dewatering of pit

areas will be required. Pit dewatering is conducted by directing all water to containment sumps using pumps to transfer the water to a settling pond for treatment and release.

A series of collection ditches, sumps, pumps and settling ponds will be established to manage all surface water on the mine site. Surface runoff from mining areas and haul roads is collected and directed to settling ponds for treatment or will be pumped to the raw water pond for storage and use in the coal cleaning process. Water collected at the toes of disposal areas is expected to contain elevated levels of selenium that will be sent to surge ponds before being directed to saturated zones for selenium attenuation. Benga will control all surface runoff from disturbed areas.

The water model developed for the Grassy Mountain Project indicates the potential for some metals, such as cobalt, zinc and cadmium, to be found at the discharge of the saturated zones at levels above the water quality guidelines. Secondary water treatment may be required before release back to the environment. The following is a list of activities that will be included in the fence-line *Water Act* approval:

- construction and operation of sedimentation (release) ponds;
- construction and operation of surge (further management is required, no direct release) ponds;
- construction and operation collector drainage ditches;
- construction and operation clean water diversion ditches;
- construction and operation assorted sumps and pumping ponds;
- use of high density plastic pipelines for conveyance of water;
- construction and operation of a raw water/freshwater storage pond;
- construction and operation of saturated backfill areas for the semi-passive treatment of selenium enriched water;
- collection of surface run-off and groundwater that reports into the pit and subsequent pit dewatering;
- water monitoring sites;
- end of mine lake; and
- possible metals treatment facility.

2.0 WATER MANAGEMENT

The Grassy Mountain Coal Project has developed a water management strategy that facilitates both the management and use of water from the Project. There will be interaction with both surface water

and groundwater resources during the construction, operation and reclamation of the Project. The Project has been designed to manage the surface water and groundwater efficiently and to minimize the impact on the environment.

A key component of mine development is the surface water management program. This program is primarily focused on capture, treatment and release of all surface run-off and water pumped out of the pit (which also includes a groundwater component) for the removal of suspended sediment. The Project has also identified a geochemical component that requires additional management beyond the typical sediment removal.

The results of the long term kinetic testing reveal that selenium leaching can be expected from the overburden rock found at Grassy Mountain. An assumption has been made that the selenium can be expected to materialize approximately one year after rock placement. All potential selenium affected water from the rock disposal areas will be directed to the three surge ponds. From here, the water will be directed to the various saturated zones for treatment.

In general, the mine progression begins at the southern limit of the Grassy Mountain resource and progresses north into higher elevations. Backfilling the previously mined out pit begins as soon as is practicable and follows the mine progression. This backfilling sequence allows for the creation of an ever-expanding backfill zone by constructing a series of east-west dikes across the northern limit of the in-pit backfill. These dikes will hold the water occupying the void space in the backfill back to the south to keep it from impacting the active working face to the north. Selenium attenuated water will be pumped from the saturated zone by a dewatering well located at the very south end of SZ1465.

An overall schematic of the water balance and management has been included in Figure 2-1.

3.0 WATER TREATMENT

Water management is required for all components of the Grassy Mountain Project from the initial site disturbance through to final reclamation. Water management is a priority consideration throughout the mine planning and development. Minimizing surface disturbance and completing timely reclamation are essential considerations that can affect water management. The water management strategy aims to minimize water diverted from streams, maximize the separation of clean and contact water, and pump water with high selenium and nitrate concentrations to saturated zones for attenuation. The planned water management infrastructure is shown in Figure 3-1.

Water collected in the pits during mining will be pumped to sedimentation ponds for treatment and discharge. Water seeping from waste rock (placed in-pit or ex-pit) will either percolate naturally or be actively managed to pass through the saturated zones.

3.1 Capture and Release – Total Suspended Solids Removal (TSS) (Sedimentation Ponds)

The collection of surface runoff water and the management of pit water are required for the removal of total suspended solids (TSS). The main objective is to control TSS levels to meet wastewater guidelines and objectives.

Pit dewatering operations involve the removal of surface water (from rainfall and snow melt) and groundwater that enters the pits. The groundwater level is typically at greater depths in the mining area. As mining operations drop below the natural groundwater levels, continual dewatering of pit areas will be required. Pit dewatering is conducted by directing all water to containment sumps established within the active benches of the pit and using pumps to transfer the water to a settling pond for treatment and release.

A series of collection ditches, sumps, pumps and settling ponds will be established to manage all surface water on the mine site. Surface runoff from mining areas and haul roads is collected and directed to settling ponds for treatment or will be pumped to the raw water pond for storage and use in the coal cleaning process. Benga will control all surface runoff from disturbed areas.

Activities that result in the removal of surface vegetation have the potential to cause erosion and sedimentation. Soil erosion is reduced by minimizing the time that disturbed surfaces are left without vegetation. Temporary measures to control erosion before a vegetation cover is established include:

- diversion ditches;
- drainage control;
- check dams;
- sediment ponds;
- sumps; and
- mulch.

Construction activities related to the major stream crossings are carried out during periods of lowest potential impact, typically during the winter months. A 100 m undisturbed buffer zone, maintaining existing vegetation, will be retained between development activities and Blairmore Creek to the west

and Gold Creek to the east. Construction techniques will be employed that protect the integrity of the streams as well as the quality of water.

Five figures have been prepared that show the progress of the mining development and the water management activities for five key years of the Project. These include:

- Figure 3-2 – EOY – Year 4;
- Figure 3-3 – EOY – Year 9;
- Figure 3-4 – EOY – Year 14;
- Figure 3-5 – EOY – Year 20;
- Figure 3-6 – EOM – Year 24; and
- Figure 3-7 – Loadout Sedimentation Pond.

The source of the water directed to the sedimentation ponds will be from surface runoff and groundwater interception from the pit and will not be exposed to selenium enrichment, so they do not require selenium management efforts. This water may contain suspended solids that will require removal prior to release to the environment. The six settling/release ponds will treat and release water back into the environment. These ponds are shown on Figures 3-1 to 3-6 and are listed below:

- Plant Site Sediment Pond (PSSP) (constructed in Year 0) - water from the plant and shop area will be directed to this pond for TSS treatment and released to Blairmore Creek;
- Loadout Sediment Pond (LSP) (constructed in Year 0) - water from the rail loadout and rail loop area will be directed to this pond for TSS treatment and released to Blairmore Creek (Figure 3-7);
- South West Surge Pond (SWSP) (constructed in Year 1) - water collected at the mining face during the initial years of mining will be directed here before transfer to the West Sediment Pond and release to Blairmore Creek;
- West Sediment Pond (WSP) (constructed in Year 2) - water collected at the mining face along the western pit extents will be directed here before release to Blairmore Creek;
- East Sediment Pond (ESP) (constructed in Year 6) - water collected at the mining face along the eastern pit limit will be directed here before release to Gold Creek; and
- Northeast Sediment Pond (NESP) (constructed in Year 14) - water collected in the final area of mining in the northeast will be directed here before release to Gold Creek.

Surface runoff from the railroad and loadout areas will be captured and sent to a settling pond along the western edge of the rail loop. This water will be treated and released into Blairmore Creek.

3.2 Capture and Management - Selenium Treatment and Removal

Selenium can be removed from water by making the water anoxic (free of oxygen) and electrochemically reducing. Under reducing conditions, selenium can precipitate or adsorb to mineral particles. The saturated backfill areas planned for the Grassy Mountain Mine can be managed as reducing zones and used for removal of selenium from mine contact water. Nitrate is removed from the mine water by a similar process.

Removal of selenium in saturated backfill zones has been observed to occur naturally in backfilled pits at active or closed mines. The removal process is well understood. The majority of active selenium water treatment plants rely on the same process.

Uncertainty around passive selenium removal in saturated backfills can to an extent be mitigated by actively managing and operating the backfill zones. Full-scale treatment campaigns and pilot trials have demonstrated that mine water can quickly be electrochemically reduced by adding nutrients and sources of easily degradable carbon, such as methanol, to the water. The nutrients and carbon source feed microorganisms that scavenge oxygen and generate reducing conditions.

The operation of the saturated backfill consists of a system for injecting a carbon source and nutrients to contact water that is pumped to, or flowing through, the saturated backfills. Reducing conditions in the backfill can be monitored with a network of monitoring wells where the oxidation-reduction potential (ORP) of water within the backfill can be measured. The saturated zones will be engineered and constructed to facilitate removal of the selenium, and operated as an effective semi-passive "bioreactor".

3.2.1 Surge Ponds

Based on the results of kinetic testing it is expected that selenium concentrations will increase in the water that percolates through the rock dumps. This water will be directed to the selenium management surge ponds which have been strategically located to accept water that will impacted by the external rock disposal areas. These surge ponds will not release water and will require additional management that includes storage and transfer of water. These ponds are also shown on Figures 3-1 to 3-6 and are listed below:

- Raw Water Pond (RWP) (constructed in Year 0) – This pond accepts the majority of the south rock disposal area (SRDA) affected water and will be the source of the plant process water;
- South East Surge Pond (SESP) (constructed in Year 0) – This pond is also in place to accept water that has been impacted by the SRDA. It will be connected to the RWP; and
- Northwest Surge Pond (NWSP) (constructed in Year 6) – This pond accepts water from the north rock disposal area (NRDA).

3.2.2 Saturated Zones for Selenium Attenuation

Selenium impacted water will be directed to a few selenium attenuation zones located within mined out and backfilled portions of the open pit. Three saturated rock zones will be developed during the mine life (SZ1, SZ2, and SZ3). SZ1 will be engineered and constructed to function as a semi-passive bioreactor for selenium attenuation. Saturated zones are assumed to attenuate 99% of selenium loading. In the absence of oxygen, these zones will cause the selenium to drop out of solution.

Figures 3-1 to 3-6 shows the locations of the saturated fill zones and the timelines when they will be available for selenium attenuation. The saturated fill zones include the following:

- 1,465 m Saturated Zone (SZ1465) – Initial attenuation volume by end of Year 3;
- 1,636 m Saturated Zone (SZ1636) – Year 20; and
- 1,700 m Saturated Zone (SZ1700) – EOM.

To establish the first selenium attenuation zone the northern end of the first in-pit disposal area will be compacted (essentially an in-pit dike) to maintain containment and prevent the pore water from flowing north towards the active mining area. As mining and backfilling progresses, north additional capacity is added through the construction of additional dikes.

SZ1465 is constructed in five phases. As mining progresses, north the pit is backfilled creating opportunities for an ever expanding attenuation zone. Phase 1 involves constructing a dike across the southern pit extent and creating a zone up to the 1,440 m elevation. The Phase 2 dike is built 150 m north of the Phase 1 dike up to the 1,450 m elevation. The Phase 3 zone is created by extending the Phase 2 dike upwards to the 1,460 m elevation. The final Phase 4 dike is built 350 m north of Phase 3 up to an elevation of 1,465 m. Once the pit has been mined and completely backfilled, Phase 5 will fill to the 1,465 m elevation increasing the total volume available to 4,390,000 m^3. The 1,465 m elevation was chosen as the open pit is expected to intersect the legacy underground workings. A review of the as-built underground maps, coal geology and field sampling of hillside seepages has indicated that the surface interaction of the legacy workings occurs at an access portal located at the 1,468 m

elevation. A dewatering well will be drilled into the Phase 1 zone in order to keep the attenuation zone below this elevation to prevent the early escape of selenium affected water. A cross section showing the five phases of SZ1465 has been included on Figure 3-8.

The saturated zones created within backfilled portions of the open pit include:

- SZ1465 (Figure 3-1):
  - This zone is made up of a number of in-pit dikes built over the first 9 years of mining.
  - A dewatering well will be drilled into the southern end of the saturated zone to decant the treated water and to return it to either Blairmore or Gold Creeks.
  - The zone is limited to the 1,465m elevation, as mining will intersect the underground workings. Water from the legacy underground workings is currently seeping out a mine portal at the 1,468 m elevation.
- SZ1636 (Figure 3-1):
  - The zone is created simply through the backfilling the open pit in the north-west corner. Once the saturated zone reaches the 1,636 m elevation the water will spill south towards SZ1465 for further attenuation. No in-pit dikes are required to be constructed.
- SZ1700 (Figure 3-1):
  - Once mining has been completed, a third zone is created in the backfill on the eastern side of the pit. Horizontal dewatering wells will be drilled from the 1,700 m elevation to the west to allow the water from SZ1700 to make it to SZ1465.

The compacted areas of the in-pit disposal areas (in-pit dikes) have been nominally designed at a downstream slope of 1.5:1 (angle of repose). Detailed designs will be submitted as part of future dam safety applications.

The timing of the various saturated zone structures has been included below.

Years -1 to Year 1 - Pre-development activities and the initial mining area are not expected to generate selenium-impacted water. All water is sent to the sediment ponds, treated for TSS and released to the environment.

Years 2-3 - Water from the south rock disposal area now has the potential to contain selenium. No discharge from the RWP or SESP directly back to the environment will be allowed. The PSSP will treat and discharge water back to the Blairmore creek during this time period. Mining has progressed far enough in the very southwest corner of the pit by year 3 to allow the construction of Phase 1of the

saturated zone. This zone will be created by constructing a dike across the north end of the pit up to the 1,440 m elevation (Phase 1 - SZ1440 – 170,000 m^3). This dike (compacted fill) will prevent water from heading north toward the active mining face and will create a saturated zone to the south. Selenium affected water from the RWP and SESP (*via* the RWP) will be sent to this zone for attenuation.

Year 4 – Phase 2 of SZ1465 is created by building a second dyke across the northern limit of the in-pit backfill up to the 1,450 m elevation (Phase 2 - SZ1445 – 300,000 m^3). Excess water from the RWP continues to be pumped to the saturated zone for attenuation. Attenuated water is pumped from the southern end of the saturated zone and returned to either Blairmore or Gold Creeks.

Year 5 – Phase 3 builds up the Phase 2 dyke up to the 1,460 m elevation (Phase 3 - SZ1460 – 180,000 m^3). RWP water continues to be pumped here for attenuation. Attenuated water is pumped from the southern end of the saturated zone and returned to either Blairmore or Gold Creeks.

Year 7 – Phase 4 completes SZ1465 by building a dike up to the 1465 m elevation (Phase 4 - SZ1465 – 900,000 m^3). The overall zone is now capable of treating 1.6 million m^3 of water annually. Attenuated water continues to be pumped from the southern end of the saturated zone and returned to either Blairmore or Gold Creeks.

Year 12 - 14 – Phase 5 is now mined out and backfilled and the water elevation can rise up to the back of the Phase 4 dike up to the 1,465 m elevation (Phase 5 - SZ1465 – 2,840,000 m^3). Attenuated water continues to be pumped from the southern end of the saturated zone and returned to either Blairmore or Gold Creeks.

Year 20 – Once mining is completed in the northeast corner of the pit a second zone is created in the pit bottom. Water will rise within the backfill (SZ1636) up to the 1,636 m elevation before it follows the pit bottom toward the south.

End of Mining and Completion of Reclamation – Final mining occurs in the very northeast corner of the pit. In order to create an end-of-mine (EOM) lake which will be largely free from the effects of selenium, all waste will be placed south into the pit bottom outside of the lake's drainage area. A rise in the pit floor at the 1,700 m elevation creates an in-situ high point between the northern EOM Lake and the 1,700 m saturated zone located to the south. To prevent mixing of the water in SZ1700 with the water in the EOM Lake, the water elevation will be limited to the 1,700 m elevation with the use of horizontal drainage holes. On the saturated backfill side (south side), the horizontal drainage holes will be drilled towards the west so that the selenium affected water can makes its way towards the

SZ1465 zone. Horizontal drainage holes will also be drilled from the EOM Lake east towards Gold Creek. This will allow water that accumulates in the EOM Lake to augment flows in Gold Creek after closure.

The three saturated zones will eventually discharge into Blairmore Creek. Water from the EOM Lake will discharge into Gold Creek. All three disposal area surge ponds (NWSP, RWP, SESP) will remain in service after closure as it has been assumed that selenium will continue to leach out of the rock for a time period that extends beyond completion of reclamation. These three ponds will continue to pump water into the saturated zones until selenium levels reach acceptable limits. The remainder of the ponds will be pulled from service and reclaimed.

3.2.3 Water Management Summary

A description and timeline of the water balance and attenuation plan has been provided below and summarized in Table 3.2-1.

Table 3.2-1 Summary of Water Management Plan

Water Management Feature	Year of Operation	Comments
Blairmore Creek Drainage – Release Ponds		
Plant Site Sediment Pond (PSSP) 20,000 m^3 capacity	Year 1 to Year 27	Surface water collected around the site infrastructure (coal wash plant, office buildings, maintenance shop) is directed here. All water discharges to Blairmore Creek all the time.
Loadout Sediment Pond (LSP) 6,350 m^3 capacity	Year 1 to Year 27	Surface water collected around the coal loadout, rail loop and infrastructure is directed here. All water discharges to Blairmore Creek all the time.
West Sediment Pond (WSP) 109,000 m^3 capacity	Year 2 to Year 27	Water collected at the western active mine faces is directed here and discharges to Blairmore Creek (includes water being forwarded from SWSP)
Blairmore Creek Drainage – Surge Ponds requiring Management		
Southwest Surge Pond (SWSP)	Year 1 to Year 27	Water collected at the active mine faces in the south-western portion of the pit will be directed to this pond. Water will be directed to RWP if required in the CPP or

Table 3.2-1 Summary of Water Management Plan

Water Management Feature	Year of Operation	Comments
34,000 m³ capacity		else directed north to WSP for treatment/release into Blairmore Creek.
Northwest Surge Pond (NWSP) 35,300 m³ capacity	Year 1 to Year 5	Pond does not exist, natural flows only to Blairmore Creek
	Year 6	This pond is constructed in advance of rock placement in the North Rock Disposal Area (NRDA). Water is not expected to contain selenium from the NRDA during its first year and is released to Blairmore Creek.
	Year 7 to 23	Water from the NRDA is expected to contain selenium and therefore there will be no discharge directly to Blairmore Creek. All water is instead pumped to the nearest saturated zone for selenium attenuation.
	EOM to Closure	Water will continue to have the potential for elevated levels of selenium beyond the end of mining. Water will be pumped into SZ1636 saturated zone for as long as selenium levels in the pond dictate. Once levels subside to acceptable levels, this pond will be removed from service and water will be allowed to flow directly to Blairmore Creek.
Raw Water Pond (RWP) 1,200,000 m³ capacity	Year -1 to Year 2	This pond collects water from the South Rock Disposal Area (SRDA) and is constructed in the year prior to plant production. This pond is used to supply the coal wash plant. Water collected during the first couple of years from the SRDA is not expected to contain elevated levels of selenium and therefore is discharged to Blairmore Creek.
	Year 3 to 23	Water is collected directly from the SRDA and also transferred from the Southeast Surge Pond (SESP). Plant process water is sourced from this pond. Excess water is pumped to the saturated zones for selenium attenuation and then released.

Table 3.2-1 Summary of Water Management Plan

Water Management Feature	Year of Operation	Comments
	EOM to Closure	Water will continue to be pumped into the saturated zones for as long as selenium levels in the pond require attenuation. Once levels subside to acceptable levels, this pond will be removed from service and water will be allowed to flow directly to Blairmore Creek.
Blairmore Creek Drainage – Saturated Backfill Zones		
Saturated Backfill Zone 1,465m (SZ1465) 4,390,000 m^3 capacity	Year 1 to Year 2	Mining activity is occurring in the southern limit of the open pit that will be backfilled to create the first saturated backfill (Phase 1) zone for selenium attenuation.
	Year 3 – Phase 1 +170,000 m^3	The Phase 1 dike is built across the open pit up to the 1,440 m elevation that allows for water to be directed into the backfill located to the south of the dike. Excess water from the RWP is directed here in Year 3. Treatment capacity of 170,000 m^3 is created.
	Year 4 – Phase 2 +300,000 m^3	The Phase 2 dike is built to the north up to the 1,450m elevation. Total zone capacity is increased to 470,000 m^3. Excess water from the RWP is pumped here for selenium attenuation.
	Years 5 and 6 – Phase 3 +180,000 m^3	The Phase 2 dike is extended vertically upward to the 1,460 m elevation (Phase 3). This increases the saturated zone capacity to 650,000 m^3.
	Years 7 through 9 – Phase 4 +900,000 m^3	The Phase 4 dike is built to the north that increases the total saturated zone capacity to 1,550,000 m^3.
	Years 12 – 23 – Phase 5 +2,840,000 m^3	Once mining has progressed far enough north the water will be allowed to rise up the north side of the Phase 4 Dike (inside the in-pit backfill). This will result in a total saturated zone capacity of 4,390,000 m^3. This zone is large enough to treat all the expected selenium affected

Table 3.2-1 Summary of Water Management Plan

Water Management Feature	Year of Operation	Comments
		water for the remainder of the mine life and also past closure.
	Years 23 +	Water will continue to be directed to this zone for as long as the water percolating through the external disposal areas shows elevated levels of selenium.
	Post Closure	Pumping from the dewatering well cease and water levels inside the zone will be allowed to rise to 1,468m where the water will discharge out the underground mine portal as is currently the case.
Saturated Backfill Zone 1,636m (SZ1636) 2,600,000 m^3 capacity	Year 20 to Closure	Once in-pit backfilling has been completed in the northwest corner, a second saturated zone is created in the pit bottom. Water from the NWSP will be re-routed here. Once the zone reaches the 1,636m elevation, the water will naturally spill south towards SZ1465.
Saturated Backfill Zone 1,700m (SZ1700) 3,220,000 m^3 capacity	Year 1 to Year 23	Not available
	EOM to Closure	At the end of mining the remainder of the in-pit backfill creates an extremely large selenium attenuation zone. Horizontal drainage wells will be drilled at the 1,700m elevation towards the west to direct the water from the east side of the open pit into the west side and into SZ1465. This water will eventually discharge into Blairmore Creek.
Gold Creek Drainage – Release Ponds		
Northeast Sediment Pond (NESP) 115,000 m^3 capacity	Year 1 to Year 13	Pond does not exist. Natural drainage occurs to Gold Creek
	Year 14 to Year 23	Water collected at the mine face (surface runoff and gw) is directed to this pond prior to release to Gold Creek.
East Sediment Pond (ESP) 125,000 m^3 capacity	Year 6 to Year 23	Water collected at the mine face (surface runoff and gw) is directed to this pond prior to release to Gold Creek

Table 3.2-1 Summary of Water Management Plan

Water Management Feature	Year of Operation	Comments
Gold Creek Drainage – Surge Ponds requiring Management		
Southeast Surge Pond (SESP) 280,000 m^3 capacity	Year 1 to Year 2	Water is collected from the SRDA dump and is discharged directly to Gold Creek during this initial period.
	Year 3 to 23	Water is collected from the SRDA and then pumped across the SRDA powerline corridor split to the RWP. This pond will not discharge to Gold Creek during this period.
	EOM to Closure	This pond will pump the collected water into the end-of-mine saturated zone for as long as selenium levels dictate. Once the quality of the water in the pond is acceptable this pond will be removed from service and the water will flow directly to Gold Creek.

3.3 Metals Treatment Plant

The GoldSim water model developed for the Grassy Mountain project has indicated the potential for some metals, such as cobalt, zinc and cadmium, to be found in the discharge of the saturated zones at levels above the water quality guidelines. Direct discharge of this water may cause constituent concentrations in the receiving creeks to exceed provincial and federal guidelines. Monitoring of the discharge will confirm if water treatment is required and the timing of such treatment.

The proposed method for removal of metals and nitrite is conventional lime treatment, also known as a high-density sludge (HDS) process. Selenium is not removed in an HDS process. In the process, the process water is mixed with lime, which increases the pH to between 9 and 10. In this pH range, metals precipitate as solid metal hydroxide. Precipitated metals are collected as sludge in a clarifier. HDS water treatment is the most common type of treatment method for removal of metals from mine water.

3.4 End-of-Mine Lake

Final mining will occur in the northeast corner of the Grassy Mountain open pit and no in-pit backfilling is available. The remaining excavation will fill with water forming a lake. The conceptual

physical characteristics for the end pit lake are provided in Table 3.4-1. The lake is expected to discharge, east toward Gold Creek.

Table 3.4-1 Lake Characteristics

Water level (m)	1700
Lake Surface Area (ha)	18.0
Maximum Depth (m)	105
Average Depth (m)	36
Lake Volume (x 1000 m^3)	6,500
Littoral Zone (ha)	1.8
Littoral Zone (%)	10.0
Drainage Area including lake (km^2)	1,032
Mean Annual Outflow (mm/yr)[1]	738

4.0 WATER MANAGEMENT STRUCTURE DESIGN SPECIFICATIONS

4.1 Sedimentation Ponds

Three sedimentation ponds (WSP, ESP, NESP) (Figure 3-1) will be located downstream of the active mining areas during the operating life of the mine to receive and treat dewatering flows for suspended solids prior to release into Blairmore and Gold Creeks. A fourth sedimentation pond (PSSP) (Figure 3-1) will be located in the vicinity of the plant areas to manage storm water runoff from access roads, the clean coal stockpile, the CPP, the Mine Infrastructure Area (MIA) and the ROM pad. A fifth sedimentation pond (LSP) (Figure 3-7) will be located near the rail loadout and rail loop facilities to manage storm water runoff from these areas and will discharge into Blairmore Creek. Water from the sedimentation ponds is intended to be captured, treated and released. If the quality does not meet the release criteria, it can be directed towards the saturated backfill zones as needed.

Geotechnical foundation drilling has also been completed in support of future Dam Safety applications. The WSP is a cross-valley structure while the other two active mining area ponds are constructed with side-hill dams. Tables 4.1-1 and 4.1-2 summarize the design criteria for the sediment ponds.

Table 4.1-1 Sedimentation Pond Design Criteria

Description	Criterion
Water Storage Volume and Discharge Pipe	
Water quality design flood	10 year
Retention time for sediment control	12 hours
Minimum Permanent pool depth	3 m
Embankment	
Embankment Slopes	3H:1V (downstream face) 2.5H:1V (upstream face)
Minimum embankment crest width	4 m (for vehicular traffic)
Emergency Overflow Spillway	
Inflow design flood (IDF) – for dam safety	Based on preliminary dam classification based on CDA (2014)
Minimum freeboard above IDF level	0.3 m
Channel Side Slope	2H:1V
Maximum channel bed slope	20%
Minimum freeboard in channel	0.3 m
Maximum slope in cut	1.5H:1V (overburden) 0.25H:1V (bedrock)
Maximum slope in fill	2.5H:1V

Table 4.1-2 Preliminary Dam Classification and Inflow Design Floods

Pond Name	Classification Based on Incremental Losses			Overall Classification[1]	Inflow Design Flood
	Loss of Life	Environmental and Cultural	Infrastructure and Economics		
West Sediment Pond	Low	Significant	Low	Significant	200 year
East Sediment Pond	Low	Very High	Low	Very High	2/3 between 1,000 year and PMF[2]
Northeast Sediment Pond	Low	Very High	Low	Very High	2/3 between 1,000 year and PMF[2]

1. Recommended inflow design floods based on overall dam classification are:
   - Low – 100 year
   - Significant – Between 100 year and 1000 year selected on a basis of incremental flood analysis, exposure and consequence of failure
   - High – 1/3 between 1000 year and probable maximum flood (PMF)
   - Very High – 2/3 between 1000 year and PMF
2. PMF = probable maximum flood

Key design parameters for the sedimentation ponds and the emergency overflow spillways can be found in Tables 4.1-3 and 4.1-4. Figure 4-1 shows a section through a typical sediment pond dam.

Table 4.1-3 Sedimentation Pond Parameters

Operating Years	Pond Name	Water Quality Design Flood (m^3/s)	Water Storage Volume (m^3)	Dam Crest (masl)	Maximum Dam Height (m)	Dam Length (m)	Diameter of Discharge Pipe (mm)
1 to 27	West Sediment Pond	13	109,000	1,600.5	20.5	456.5	500
6 to 27	East Sediment Pond	13	125,000	1,581.5	11.5	626	500
14 to 27	Northeast Sediment Pond	11	115,000	1,645.4	17	429.5	600
1 to 27+	Plant Site Sediment Pond	-	20,000	1,461	8.5	430	350
1 to 27+	Load Out Settling Pond	1.32	6,350	n/a	n/a	n/a	1,000

Table 4.1-4 Sedimentation Pond Emergency Overflow Spillways

Operating Years	Pond Name	Inflow Design Flood – Dam Safety (m^3/s)	Discharge Channel				Energy Dissipation Basin		
			Bottom Width (m)	Depth (m)	Length (m)	Slope (m/m)	Length (m)	Maximum Bottom Width (m)	Depth (m)
1 to 27	West Sediment Pond	33	5	2	479	0.089	9	15	2
6 to 27	East Sediment Pond	36	5.5	2	148	0.045	5.5	16.5	2
14 to 27	Northeast Sediment Pond	59	8	2	73	0.083	9	24	2
1 to 27+	Plant Site Sediment Pond	-	1.5	1.5	192	0.052	4.5	4.5	1.5
1 to 27+	Load Out Settling Pond	n/a	1	0.77	125	0.02	4.5	4.5	1.5

4.2 Surge Ponds

Three surge ponds (NWSP, RWP, SESP) (Figure 3-1) will be located downstream of the ex-pit waste dumps to collect toe seepage which is likely to contain elevated levels of selenium. An additional surge pond (SWSP) (Figure 3-1) will be located immediately north of the plant site to collect dewatering flows from the active mining areas during the first nine years of mining. Due to the local relief, this pond will be constructed with side hill dams and will not have the required storage volume to settle out suspended solids. This pond will transfer the water to the raw water pond for use in the coal wash plant or else it will direct water north to the west sediment pond prior to discharge back to Blairmore Creek. Geotechnical foundation drilling has also been completed for these structures ahead of future Dam Safety applications.

Tables 4.2-1 and 4.2-2 summarize the design criteria for the surge ponds. Currently no criterion has been assigned for the active water storage volumes in the surge ponds since the sizes of the ponds are constrained by local relief, other mine infrastructure and private property. For dam safety, the surge ponds will have emergency overflow spillways sized to convey the inflow design flood, which was estimated for the largest catchment area reporting to each of the ponds during its operating life.

Table 4.2-1 Surge Pond Design Criteria

Description	Criterion
Water Storage Volume	
Active storage volume	None
Minimum depth of dead storage	3 m
Embankment	
Embankment Slopes	3H:1V (downstream face) 2.5H:1V (upstream face)
Minimum embankment crest width	4 m (for vehicular traffic)
Emergency Overflow Spillway	
Inflow design flood (IDF) – for dam safety	Based on preliminary dam classification based on CDA (2014)
Minimum freeboard above IDF level	0.3 m
Channel Side Slope	2H:1V
Maximum channel bed slope	20%
Minimum freeboard in channel	0.3 m
Maximum slope in cut	1.5H:1V (overburden) 0.25H:1V (bedrock)
Maximum slope in fill	2.5H:1V

Table 4.2-2 Preliminary Dam Classification and Inflow Design Floods

Pond Name	Classification Based on Incremental Losses			Overall Classification[1]	Inflow Design Flood
	Loss of Life	Environmental and Cultural	Infrastructure and Economics		
Northwest Surge Pond	Low	Significant	Low	Significant	200 year
Southwest Surge Pond	Low	Low	Low	Low	100 year
Raw Water Pond	Significant	High	Low	High	1/3 between 1,000 year and PMF[2]
Southeast Surge Pond	Low	Very High	Low	Very High	2/3 between 1,000 year and PMF[2]

1. Recommended inflow design floods based on overall dam classification are:
   - Low – 100 year
   - Significant – Between 100 year and 1000 year selected on a basis of incremental flood analysis, exposure and consequence of failure
   - High – 1/3 between 1000 year and probable maximum flood (PMF)
   - Very High – 2/3 between 1000 year and PMF
2. PMF = probable maximum flood

Key design parameters for the surge ponds and the emergency overflow spillways can be found in Tables 4.2-3 and 4.2-4. Figure 4-2 shows a section through a typical surge pond dam.

Table 4.2-3 Surge Pond Parameters

Operating Years	Pond Name	Water Storage Volume (m^3)	Dam Crest (masl)	Maximum Dam Height (m)	Dam Length (m)
8 to 27+	Northwest Surge Pond	35,000	1,600.5	12.5	129
1 to 27	Southwest Surge Pond	34,000	1,495	10	475
0 to 27+	Raw Water Pond	1,200,000	1,503	23	330
0 to 273+	Southeast Surge Pond	280,360	1,509.2	9.2	390

Table 4.2-4 Surge Pond Emergency Overflow Spillways

Operating Years	Pond Name	Inflow Design Flood – Dam Safety (m^3/s)	Discharge Channel				Energy Dissipation Basin		
			Bottom Width (m)	Depth (m)	Length (m)	Slope (m/m)	Length (m)	Maximum Bottom Width (m)	Depth (m)
8 to 27+	Northwest Surge Pond	24	5	2	289	0.108	9	15	1.5
1 to 27	Southwest Surge Pond	12	2.5	2	498	0.07	6.5	7.5	1.5
0 to 27+	Raw Water Pond	37	5.5	2	1,231	0.059	7	16.5	2
0 to 27+	Southeast Surge Pond	21	4.5	2	140	0.047	4.5	13.5	1.5

4.3 Collection Ditches & Diversion Channels

Collection ditches will be located downstream of active mining areas, as required, during the operating life of the mine to receive and convey dewatering flows to the sediment ponds. Additional collection ditches will be required to perform the following:

- collect and convey toe seepage from the SRDA to the SESP in Year 5 when a portion of the dump is placed outside the natural pond catchment;
- collect and convey toe seepage from the NRDA back into the dump when a portion of the dump extends outside the natural pond catchment; and
- collect and convey stormwater runoff from the topsoil stockpile located south of the plant site to the RWP starting in year 1.

Diversion channels will also be used to minimize inflows to the RWP and SESP throughout their operation and to the NESP in the early years of its operation. Table 4.3-1 presents the design criteria for the collection ditches and diversion channels. Due to the steep terrain, the channels will generally be constructed along the contour. Typical channel sections are shown in Figure 4-3.

Table 4.3-1 Collection Ditch and Diversion Channel Design Criteria

Description	Criterion
Design Flood	25 year
Channel side slopes	2H:1V
Maximum channel bed slope	20%
Minimum freeboard in channel	0.3 m
Minimum width of access road	4.0 m
Maximum sustained grade of access road	10%
Maximum slope in cut	1.5H:1V(overburden) 0.25H:1V(bedrock)
Maximum slope in fill	2.5H:1V

4.4 Diversion Dams & Ex-Pit Berms

Diversion Dams will be constructed as part of collection ditches and diversion channels where these cross perennial streams. Design criteria for the diversion dams and berms is provided in Table 4.4-1. These structures will be constructed with similar section to the sediment pond dams.

Table 4.4-1 Diversion Dam and Berm Design Criteria

Description	Criterion
Maximum embankment height	6.0 m
Embankment slopes	3H:1V (downstream face) 2.5H:1V (upstream face)
Minimum embankment crest width	4 m (for vehicular traffic)

4.5 Water Management Construction Schedule

All three surge ponds will be developed within the first six years of the project development. The raw water pond, located immediately east of the plant and administration area, and the southeast pond will be constructed during the pre-development stage and are designed to immediately capture water that has percolated through the south rock disposal area which will be utilized in Year 1 (2019). A pipeline connecting the RWP and the SESP will be constructed in Year 2 (2020). The northwest surge pond will be constructed in Year 6 (2026) which will collect water from the NRDA. During the first year of operation of the NRDA, it is expected that the water will be allowed to be released to Blairmore Creek once treated for TSS. Once selenium levels in the runoff from the NRDA show elevated levels of selenium, expected sometime in Year 7, all water will be captured and then pumped to the in-pit saturated zones where the water will be semi-passively treated for selenium attenuation.

In Year 3, a portion of the pit will be backfilled (Figure 3-2). At the northern edge of the backfill, the first dike will be constructed across the pit to define Phase 1 of the first saturated backfill zone (SZ1465). Excess water from the raw water pond will be pumped into the in-pit waste rock for passive selenium attenuation. As the mine progresses, north additional pit areas will be backfilled and additional dykes constructed across the pit to increase the overall selenium zone capacity.

Additional sediment ponds are constructed along the eastern and western flanks as mining progresses to the north. Table 4.5-1 presents a summary of the water management infrastructure and timing.

Table 4.5-1 Water Management Feature Construction Schedule

Item #	Structure	Type	Capacity (m^3)	Dam Height (masl)	Year of Construction	Discharges to:
1	Raw Water Pond	Surge Pond	1,200,000	1,503.0	Pre-production period	Plant feed water or saturated zone
2	South East Surge Pond	Surge Pond	280,000	1,509.2	Pre-production period	Gold Creek in year 1 then to RWP
3	Plant Site Sediment Pond	Sediment Pond	20,000	1,461.0	Pre-production period	Blairmore Creek
4	Loadout Sediment Pond	Sediment Pond	6,350	n/a	Pre-production period	Blairmore Creek
5	South West Surge Pond	Surge Pond	34,000	1,495.0	Year 1	transfers water to either RWP or WSP
6	SZ1465*	Phase 1 Dike	170,000	1,440.0	Year 2	decanted *via* dewatering well and pumped to either Blairmore/Gold Creeks
7		Phase 2 Dike	470,000	1,450.0	Year 4	
8		Phase 3 Dike	650,000	1,460.0	Year 5 and 6	
9		Phase 4 Dike	1,550,000	1,465.0	Years 7,8,9	
10		Phase 5	2,840,000	1,465	Year 12	
11	West Sediment Pond	Sediment Pond	109,000	1,600.5	Year 2	Blairmore Creek
12	East Sediment Pond	Sediment Pond	125,000	1,581.5	Year 6	Gold Creek
13	Northwest Surge Pond	Surge Pond	35,300	1,600.5	Year 6	Pumped to Saturated Zones
14	Northeast Sediment Pond	Sediment Pond	115,000	1,645.4	Year 13	Gold Creek
15	SZ1636	Saturated Zone	2,600,000	1,636m**	year 20	Drains south to SZ1465
16	SZ1700	Saturated Zone	3,220,000	1,700m**	end-of-mine	Drains west and then south into SZ1465
17	End-of-mine Lake (1700m)	Closure Lake			Full 15 years after closure	Drains east into Gold Creek

* – Capacities are the total capacity as each dike is added
** – Denotes the maximum height the water will rise inside an in-pit rock disposal area. No engineered structure required.

5.0 CONCORDANCE TABLE TO INTEGRATED APPLICATION

Additional information that relates to the Fence-line *Water Act* application can be found in the integrated application. A concordance table has been provided in Table 5.0-1 that shows the locations of the information required to support this application.

Table 5.0-1 Fence-line *Water Act* Application Concordance Table

Description	Reference Section in Application	Reference Section in Consultants Reports
Project Description		
Project Description	Sec A.1, Sec A.6, Sec C.1, Sec C.2	-
Project Proponent	Sec A.3	-
Application for Approval	Sec A.5.1	-
Location – Fence-line Approval	Figure A.1.0-2, Table A.4.0-1	-
Concurrent Applications		
EPEA Operating Approval Application	Appendix 1B	-
Coal Conservation Act Licence Applications	Appendix 1C	-
Water Act – Transfer and Diversion Licences	Appendix 1E	-
Public Lands Application	Appendix 1F	-
Water Requirements and Source		
Water Supply and Source	Sec C.5.1, October 2017 Errata	-
Water Licencing	Sec C.5.2, October 2017 Errata	-
Water Treatment	Sec C.5.3, Appendix 1D – Sec 3 October 2017 Addendum2	-
Water Balance and Management	Sec C.5.4, Appendix 1D – Sec 4 October 2017 Addendum2	-
Water Management Structure Design Specifications	Sec C.5.5, Appendix 1D – Sec 4 October 2017 Addendum2	-

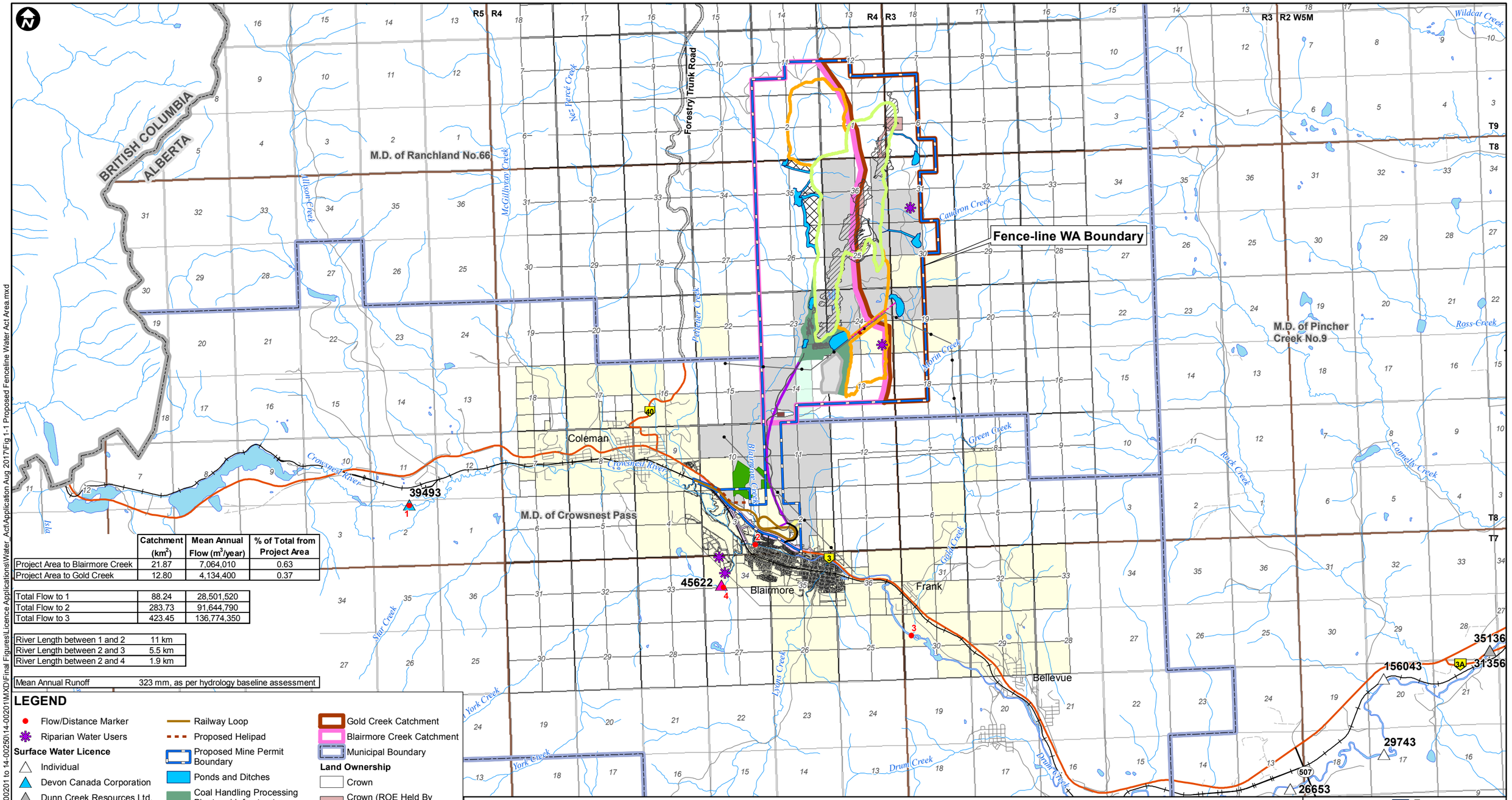
Table 5.0-1 Fence-line *Water Act* Application Concordance Table

Description	Reference Section in Application	Reference Section in Consultants Reports
Water Management Construction Schedule	Sec C.5.6, Appendix 1D Figs 3-1 to 3-8 and Tables 3.2-1 and 4.5-1 October 2017 Addendum2	-
Water Management at Closure	Sec F.4.4	-
Surface Drainage, Diversion and Water Management		
Water Treatment Approach	Sec C.5, Appendix 10A and 10B Appendix 1D and Appendix 1E October 2017 Addendum2	
Operational Approach	Sec C.5.3, Figs. C.5.3-1 to C.5.3-6, Appendix 10A and 10B Appendix 1D and Appendix 1E October 2017 Addendum2	
Capture and Release	Sec C.5.3.3, Appendix 10A and 10B Appendix 1D and Appendix 1E October 2017 Addendum2	
Capture and Management	Sec C.5.3.4, C.8.3, Fig C.5.3-6, Appendix 10A and 10B Appendix 1D and Appendix 1E October 2017 Addendum2	
End-of-mine Lake	Sec C.5.3.6, Sec F.4.5.7, Fig F.4.4-1, Fig F.4.1-3, Fig F.4.1-5, Appendix 1D and Appendix 1E October 2017 Addendum2	CR 3, Sec 5, CR 4, Sec 7, CR 5, Sec 4; CR 6, Sec 5
Water Balance/Water Management Sequence	Sec C.5.4, Fig C.5.4-1, Appendix 1D and Appendix 1E October 2017 Addendum2	CR 4, Sec 5
Water Management Structure Construction Specifications	Sec C.5.5, Tables C.5.5-1 to C.5.5-10, Appendix 1D and Appendix 1E October 2017 Addendum2	CR 4, Sec 5

Table 5.0-1 Fence-line *Water Act* Application Concordance Table

Description	Reference Section in Application	Reference Section in Consultants Reports
Water Management Feature Construction Schedule	Sec C.5.6, Table C.5.6-1, Appendix 1D and Appendix 1E October 2017 Addendum2	-
Project Effects		
Effects on Other Users	E.10.3	CR 10, Sec 5
Effects on Aquatic Environment	E.3.3, E.4.3, E.5.3, E.6.3	CR 3, Sec 5, CR 4, Sec 7, CR 5, Sec 4; CR 6, Sec 5
Effects on Instream or Water Conservation Objectives	E.3.3, E.4.3, E.5.3, E.6.3	CR 3, Sec 5, CR 4, Sec 6, CR 5, Sec 4; CR 6, Sec 5
Hydraulic, Hydrological Effects	E.3.3, E.4.3, E.5.3, E.6.3	CR 4, Sec 6
Hydrogeological Effects	E.3.3	CR 3, Sec 5
Effects on Neighbouring Lands	E.10.3	CR 10, Sec 5
Effects on Wetlands	E.8.3.7	CR 8, Secs 4.7, 5.1
Consultation		
First Nations	Section H, Appendix 7	-
Stakeholders	Section G, Appendix 6	-
Land Ownership		
Public Lands Act	E.10, Appendix 1F	-

Figures



	Catchment (km^2)	Mean Annual Flow (m^3/year)	% of Total from Project Area
Project Area to Blairmore Creek	21.87	7,064,010	0.63
Project Area to Gold Creek	12.80	4,134,400	0.37

Total Flow to 1	88.24	28,501,520
Total Flow to 2	283.73	91,644,790
Total Flow to 3	423.45	136,774,350

River Length between 1 and 2	11 km
River Length between 2 and 3	5.5 km
River Length between 2 and 4	1.9 km

Mean Annual Runoff	323 mm, as per hydrology baseline assessment

LEGEND

- Flow/Distance Marker
- Riparian Water Users

Surface Water Licence

- Individual
- Devon Canada Corporation
- Dunn Creek Resources Ltd.
- Municipality of Crowsnest Pass
- Railway
- Primary Highway
- Secondary Highway
- Existing Access
- Existing Powerline
- CHPP Facilities
- Proposed Water Pipeline/ Service Road
- Railway Loop
- Proposed Helipad
- Proposed Mine Permit Boundary
- Ponds and Ditches
- Coal Handling Processing Plant and Infrastructure
- Covered Conveyor, Access Road and Powerline ROW
- Proposed Golf Course
- Undisturbed
- Legacy Mine Disturbance
- Ultimate Pit Extent
- Ultimate Rock Disposal Area Extent
- Topsoil Storage
- Construction Camp
- Gold Creek Catchment
- Blairmore Creek Catchment
- Municipal Boundary

Land Ownership

- Crown
- Crown (ROE Held By Devon)
- Crown (MLL Held By Benga)
- Freehold - Benga
- Freehold - Benga 50%, CNP Golf & Country Club 50%
- Freehold - Other
- Registered Roadway

PROJECT

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

TITLE

PROPOSED FENCE-LINE WATER ACT AREA

NOTES

AltaLIS, 2017; MEMS, 2017; NRCAN, 2015; SRK, 2017
Datum/Projection: UTM NAD 83 Zone 11

0 1.5 3 6
Kilometres

MILLENNIUM EMS Solutions Ltd.

PROJECT: 14-00201-01
DRAWN BY: SL
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DATE: OCTOBER 5, 2017

FIGURE
1-1

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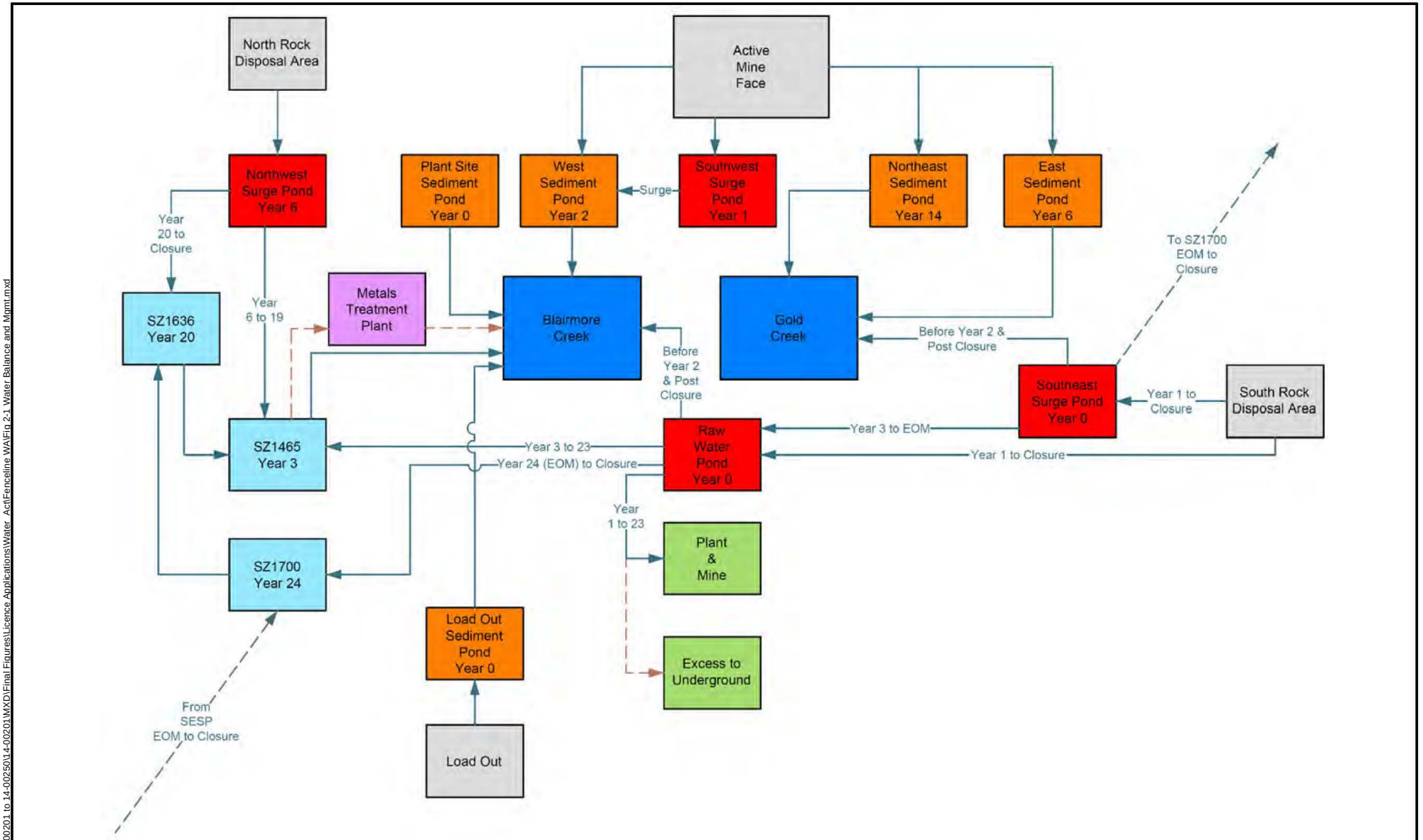

LEGEND

- Surge Pond
- Release Pond
- Saturated Backfill Zone
- Water Use
- Metals Treatment Plant
- Contingency

PROJECT

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

TITLE

WATER BALANCE AND MANAGEMENT

NOTES

MEMS, 2015

SCALE BAR: N/A

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FIGURE

2-1

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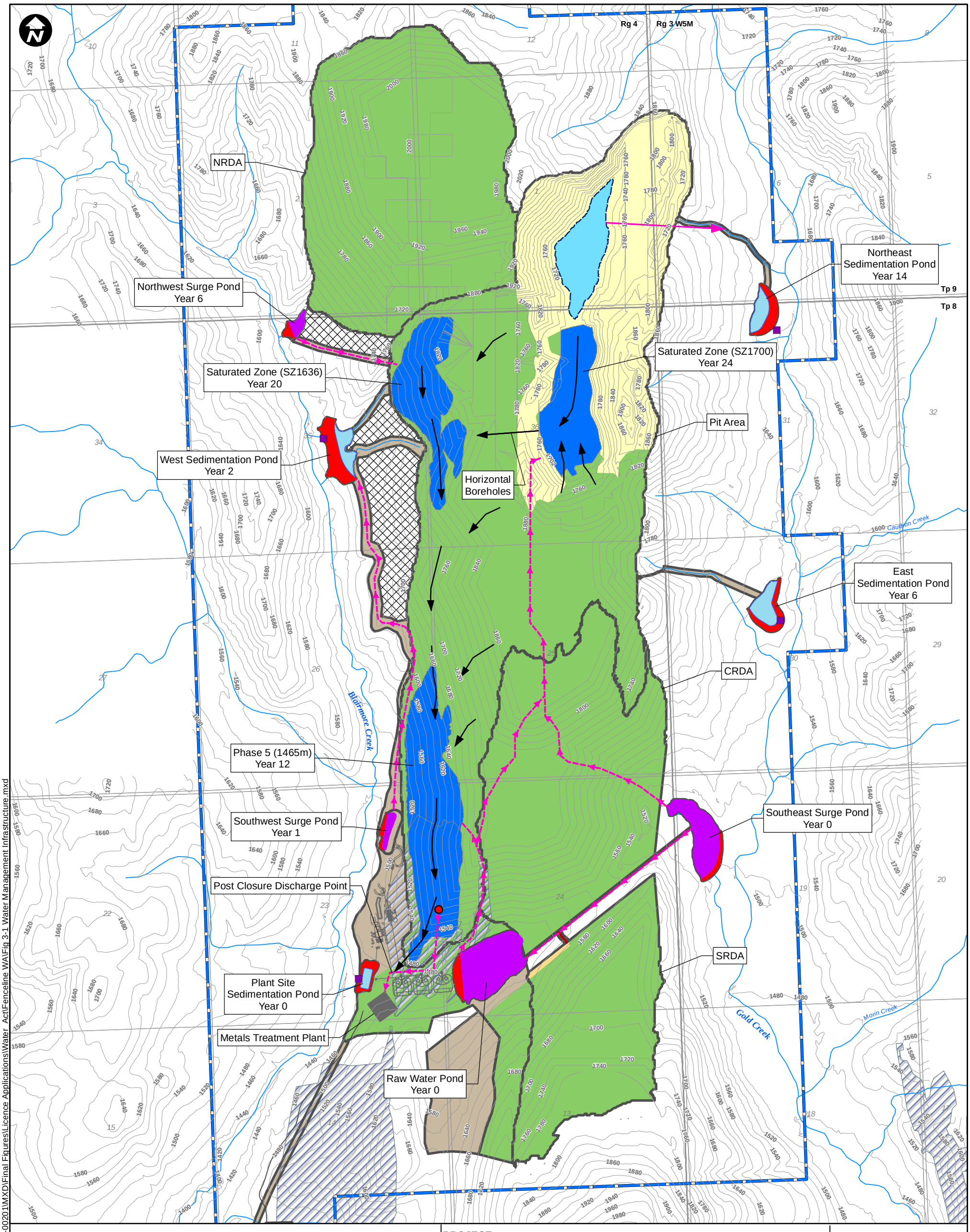

LEGEND

- Dewatering Well
- Release Point
- Post Closure Discharge Point (1468m)
- CHPP Facilities
- Subsurface Flow
- Subsurface Lake Discharge
- Water Transfer Pipeline
- Surface Water Drainage
- Reclaimed Topographic Contour (20m interval)
- Proposed Mine Permit Boundary - WA Fence-line Boundary
- Project Footprint
- Undisturbed Area
- Release Pond
- Dam
- Surge Pond (No Release)
- Saturated Fill Zone
- End-Pit Lake
- Rock Disposal Area
- Active Mining Area
- Topsoil Replacement
- Disturbed Area
- Legacy Underground Mine

PROJECT

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

MILLENNIUM EMS Solutions Ltd.

TITLE

WATER MANAGEMENT INFRASTRUCTURE

NOTES

AltaLIS, 2016; Deswik, 2016; Golder 2016; MEMS, 2016;
NRCAN, 2015; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

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PROJECT: 14-00201-01
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FIGURE
3-1

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NRDA
Pit Area
CRDA
SRDA
Southwest Surge Pond Year 1
Phase 2 Dike (1450m) Year 4
Phase 1 Dike (1440m) Year 3
Dewatering Well
Plant Site Sedimentation Pond Year 0
Metals Treatment Plant
Raw Water Pond Year 0
Southeast Surge Pond Year 0
Rg 4
Rg 3 W5M
Tp 9
Tp 8
Caudron Creek
Bidrimore Creek
Gold Creek
Morin Creek

LEGEND

- Dewatering Well
- Release Point
- Existing Powerline
- CHPP Facilities
- Surface Water Drainage
- Water Transfer Pipeline
- Subsurface Flow
- Topographic Contour (20m interval)
- Proposed Mine Permit Boundary - WA Fence-line Boundary
- Project Footprint
- Future Pond
- Undisturbed Area
- Release Pond
- Dam
- Surge Pond (No Release)
- Dike
- Saturated Fill Zone
- Rock Disposal Area
- Active Mining Area
- Topsoil Replacement
- Disturbed Area
- Legacy Underground Mine

PROJECT

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

MILLENNIUM EMS Solutions Ltd.

TITLE

WATER MANAGEMENT - EOY 2022 (YEAR 4)

NOTES

AltaLIS, 2016; Deswik, 2016; Golder 2016; MEMS, 2016; NRCAN, 2015; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

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FIGURE
3-2

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NRDA

Northwest Surge Pond
Year 6

West Sedimentation Pond
Year 2

Pit Area

East
Sedimentation Pond
Year 6

CRDA

Southwest Surge Pond
Year 1

Phase 4 Dike (1465m)
Year 7

Southeast Surge Pond
Year 0

Phase 2&3 Dikes
(1450m, 1460m)
Year 4 & 5

Dewatering Well

Phase 1 Dike (1440m)
Year 3

SRDA

Plant Site
Sedimentation Pond
Year 0

Metals Treatment Plant

Raw Water Pond
Year 0

Rg 4
Rg 3 W5M
Tp 9
Tp 8
Caudron Creek
Blairmore Creek
Gold Creek
Morin Creek

LEGEND

- Dewatering Well
- Release Point
- Existing Powerline
- CHPP Facilities
- Surface Water Drainage
- Water Transfer Pipeline
- Subsurface Flow
- Topographic Contour (20m interval)
- Proposed Mine Permit Boundary - WA Fence-line Boundary
- Project Footprint
- Future Pond
- Undisturbed Area
- Release Pond
- Dam
- Surge Pond (No Release)
- Dike
- Saturated Fill Zone
- Rock Disposal Area
- Active Mining Area
- Topsoil Replacement
- Disturbed Area
- Legacy Underground Mine

PROJECT

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

MILLENNIUM EMS Solutions Ltd.

TITLE

WATER MANAGEMENT - EOY 2027 (YEAR 9)

NOTES

AltaLIS, 2016; Deswik, 2016; Golder 2016; MEMS, 2016; NRCAN, 2015; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

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PROJECT: 14-00201-01
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DATE: MAY 8, 2017

FIGURE

3-3

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NRDA
Northwest Surge Pond Year 6
Northeast Sedimentation Pond Year 14
West Sedimentation Pond Year 2
Pit Area
East Sedimentation Pond Year 6
CRDA
Phase 5 (1465m) Year 12
Phase 4 Dike (1465m) Year 7
Southwest Surge Pond Year 1
Southeast Surge Pond Year 0
Phase 2&3 Dikes (1450m, 1460m) Year 4 & 5
Dewatering Well
Phase 1 Dike (1440m) Year 3
SRDA
Plant Site Sedimentation Pond Year 0
Metals Treatment Plant
Raw Water Pond Year 0

Rg 4
Rg 3 W5M
Tp 9
Tp 8
Blairmore Creek
Caudron Creek
Gold Creek
Morin Creek

LEGEND

- Dewatering Well
- Release Point
- Existing Powerline
- CHPP Facilities
- Surface Water Drainage
- Water Transfer Pipeline
- Subsurface Flow
- Topographic Contour (20m interval)
- Proposed Mine Permit Boundary - WA Fence-line Boundary
- Project Footprint
- Undisturbed Area
- Release Pond
- Dam
- Surge Pond (No Release)
- Dike
- Saturated Fill Zone
- Rock Disposal Area
- Active Mining Area
- Topsoil Replacement
- Disturbed Area
- Legacy Underground Mine

PROJECT

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

MILLENNIUM EMS Solutions Ltd.

TITLE

WATER MANAGEMENT - EOY 2032 (YEAR 14)

NOTES

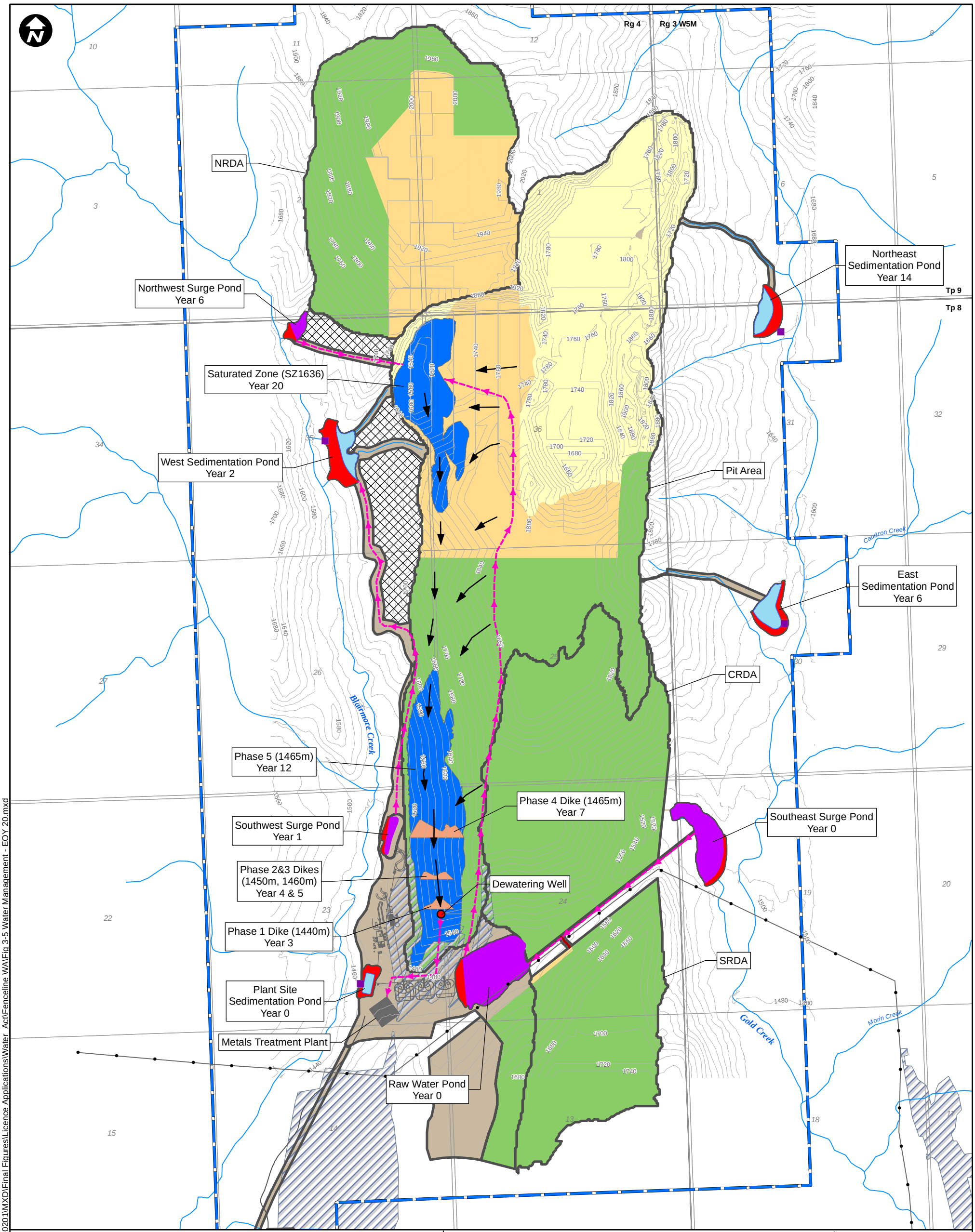
AltaLIS, 2016; Deswik, 2016; Golder 2016; MEMS, 2016; NRCAN, 2015; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

0 0.5 1 2
Kilometres

PROJECT: 14-00201-01
DRAWN BY: CP/SL
CHECKED BY: DM
DATE: MAY 8, 2017

FIGURE
3-4

Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\Licence Applications\Water_ActFenceline WA\Fig 3-4 Water Management - EOY 14.mxd



LEGEND

- Dewatering Well
- Release Point
- Existing Powerline
- CHPP Facilities
- Surface Water Drainage
- Water Transfer Pipeline
- Subsurface Flow
- Topographic Contour (20m interval)
- Proposed Mine Permit Boundary - WA Fence-line Boundary
- Project Footprint
- Undisturbed Area
- Release Pond
- Dam
- Surge Pond (No Release)
- Dike
- Saturated Fill Zone
- Rock Disposal Area
- Active Mining Area
- Topsoil Replacement
- Disturbed Area
- Legacy Underground Mine

PROJECT

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

MILLENNIUM EMS Solutions Ltd.

TITLE

WATER MANAGEMENT - EOY 2038 (YEAR 20)

NOTES

AltaLIS, 2016; Deswik, 2016; Golder 2016; MEMS, 2016; NRCAN, 2015; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

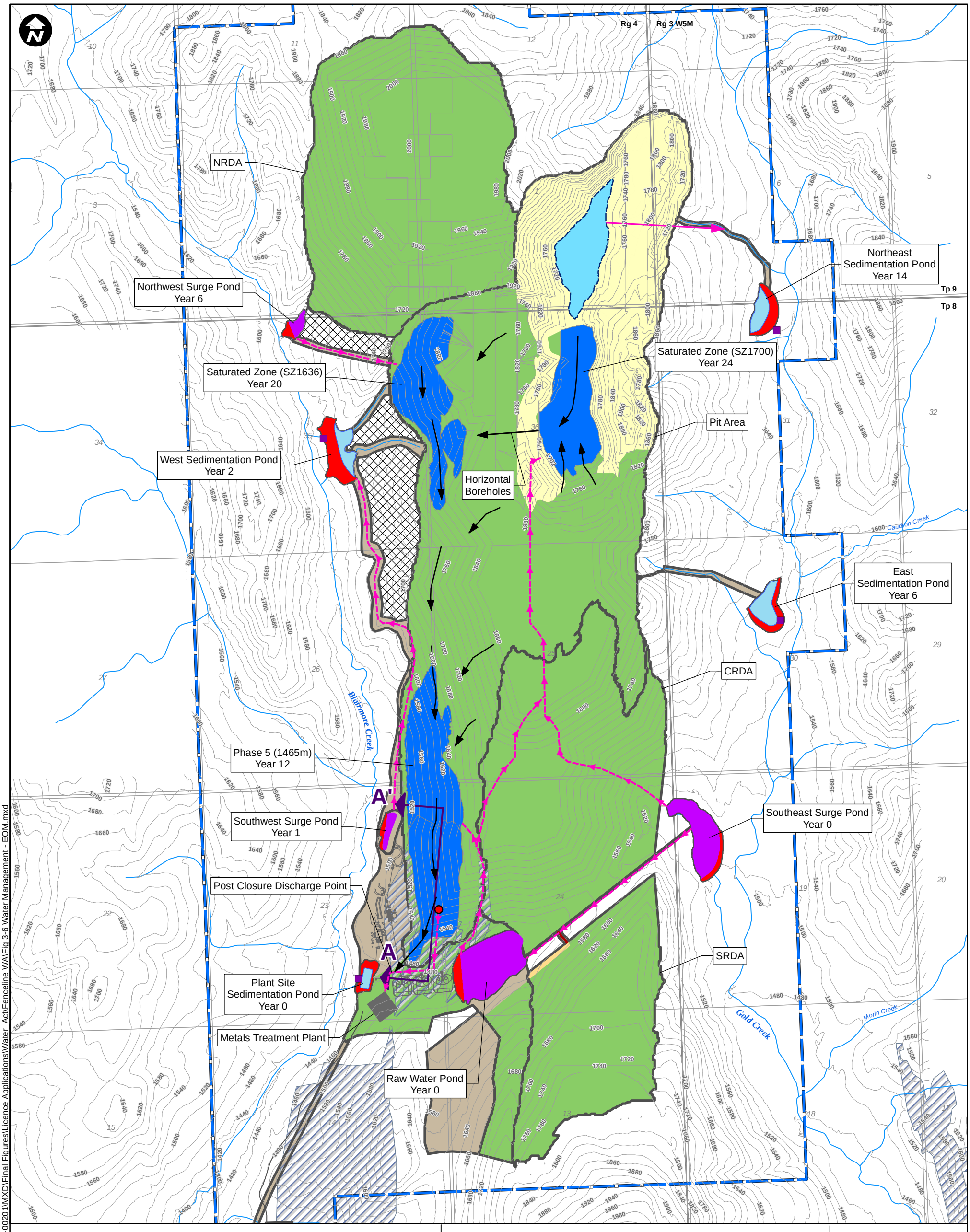
0 0.5 1 2
Kilometres

PROJECT: 14-00201-01
DRAWN BY: CP/SL
CHECKED BY: DM
DATE: MAY 8, 2017

FIGURE

3-5

Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201MXD\Final Figures\Licence Applications\Water Mgmt\WaterMgmt_EOY20_ActFenceline WA\Fig 3-5 Water Management - EOY 20.mxd



LEGEND

- Dewatering Well
- Release Point
- Post Closure Discharge Point (1468m)
- Cross-Section Location
- CHPP Facilities
- Subsurface Flow
- Subsurface Lake Discharge
- Water Transfer Pipeline
- Surface Water Drainage
- Reclaimed Topographic Contour (20m interval)
- Proposed Mine Permit Boundary - WA Fence-line Boundary
- Project Footprint
- Undisturbed Area
- Release Pond
- Dam
- Surge Pond (No Release)
- Saturated Fill Zone
- End-Pit Lake
- Rock Disposal Area
- Active Mining Area
- Topsoil Replacement
- Disturbed Area
- Legacy Underground Mine

PROJECT

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

MILLENNIUM EMS Solutions Ltd.

TITLE

WATER MANAGEMENT - EOM (YEAR 24)

NOTES

AltaLIS, 2016; Deswik, 2016; Golder 2016; MEMS, 2016; NRCAN, 2015; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

0 0.5 1 2
Kilometres

PROJECT: 14-00201-01
DRAWN BY: CP/SL
CHECKED BY: DM
DATE: MAY 8, 2017

FIGURE

3-6

Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\Licence Applications\Water_ActFenceline WA\Fig 3-6 Water Management - EOM.mxd

Temporary HWY 3 Diversion

Proposed Golf Course

Rail Underpass

Rg 4 W5M

View From Highway 3 - Closest to Proposed Loadout Location

Overland Conveyor

Tp 8

Proposed Helipad Access

Proposed Rail Loop

Road Access

Loadout Sediment Pond

Rail Loadout

LEGEND

- Existing Access Road
- Temporary HWY 3 Diversion
- Railway Loop
- Proposed Helipad Access
- Existing Railway
- Primary Highway
- Proposed Cut Area
- Proposed Fill Area
- Stormwater Detention Pond
- Covered Conveyor, Access Road and Powerline ROW
- Proposed Golf Course Area
- Proposed Mine Permit Boundary - WA Fence-line Boundary

PROJECT

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

MILLENNIUM EMS Solutions Ltd.

TITLE

RAIL LOADOUT SEDIMENTATION POND

NOTES

AltaLIS, 2016; Hatch Mott MacDonald, 2016; MEMS, 2016
Datum/Projection: UTM NAD 83 Zone 11

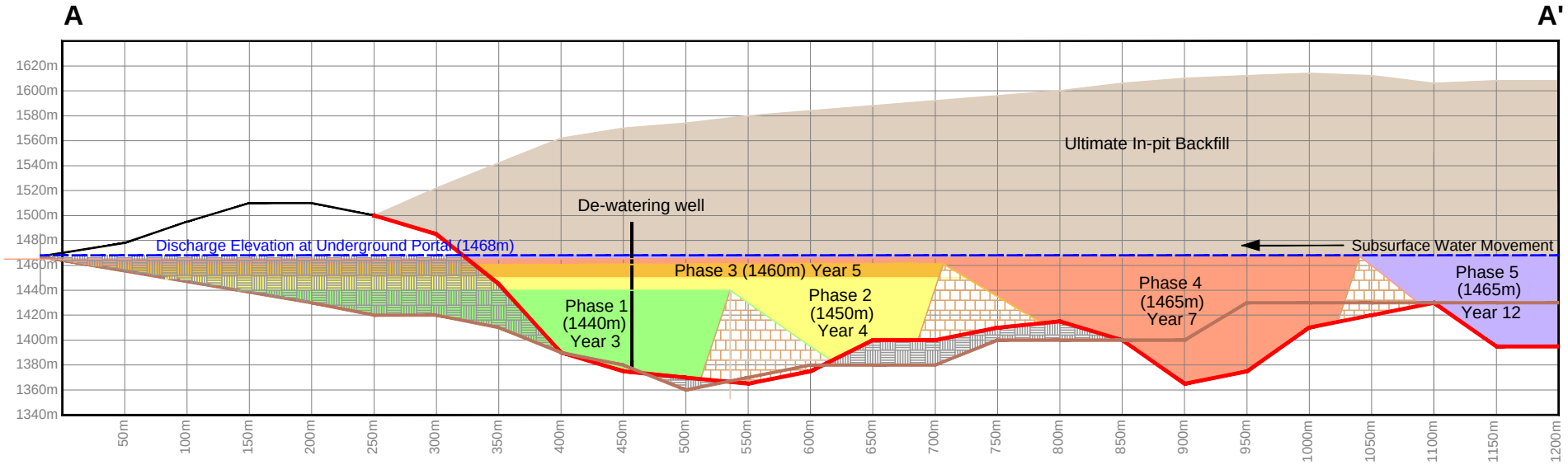
0 150 300 600
Metres

PROJECT: 14-00201-01
DRAWN BY: CP/SL
CHECKED BY: JM
DATE: MAY 8, 2017

FIGURE

3-7

Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\Licence Applications\Water_Act\Fenceline WA\Fig 3-7 Rail Loadout Sedimentation Pond.mxd



LEGEND

- Original Ground
- Open Pit Limit
- Downdip Projection of Underground Mine
- Elevation at Underground Discharge Point
- Underground Workings
- Dike (Compacted Fill)
- Saturated Backfill Phases
- In-pit Backfill

PROJECT

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

MILLENNIUM EMS Solutions Ltd.

TITLE

SATURATED ZONE 1465m (SZ1465) - CROSS-SECTION A-A'

NOTES

MEMS, 2016

PROJECT: 14-00201-01

DRAWN BY: JM/SL

CHECKED BY: DM

DATE: MAY 8, 2017

FIGURE

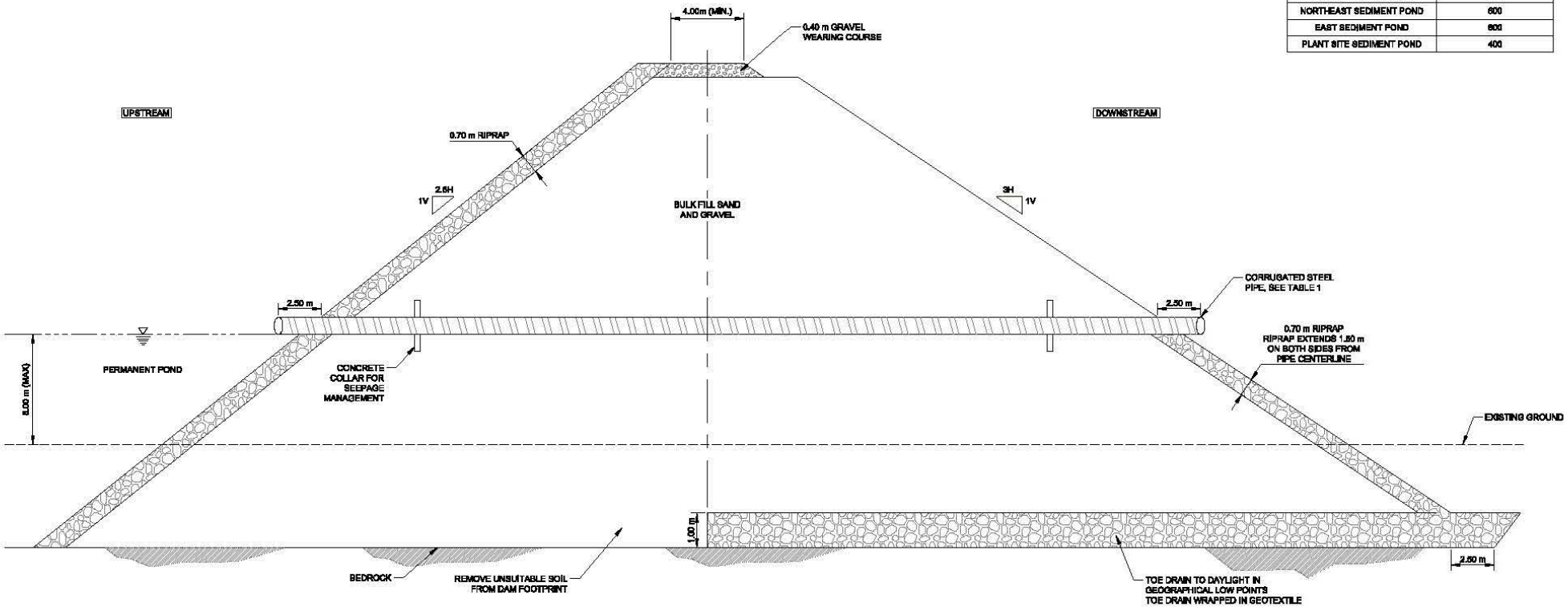
3-8

0 50 100 200

Metres

Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\Licence Applications\Water_Act\Fenceline WA\Fig 3-8 Saturated Zone 1465m.dwg

TABLE 1	
SEDIMENT POND	CSP PIPE DIAMETER (mm)
WEST SEDIMENT POND	500
NORTHEAST SEDIMENT POND	600
EAST SEDIMENT POND	800
PLANT SITE SEDIMENT POND	400



SCALE 1:250 (A) SECTION - TYPICAL SEDIMENT POND DAM

0 5 10
1:250 METRES
2x VERT. EXAGGERATION

CLIENT
BENGA MINING LIMITED
RIVERSDALE RESOURCES

PROJECT
GRASSY MOUNTAIN COAL PROJECT
ALBERTA, CANADA

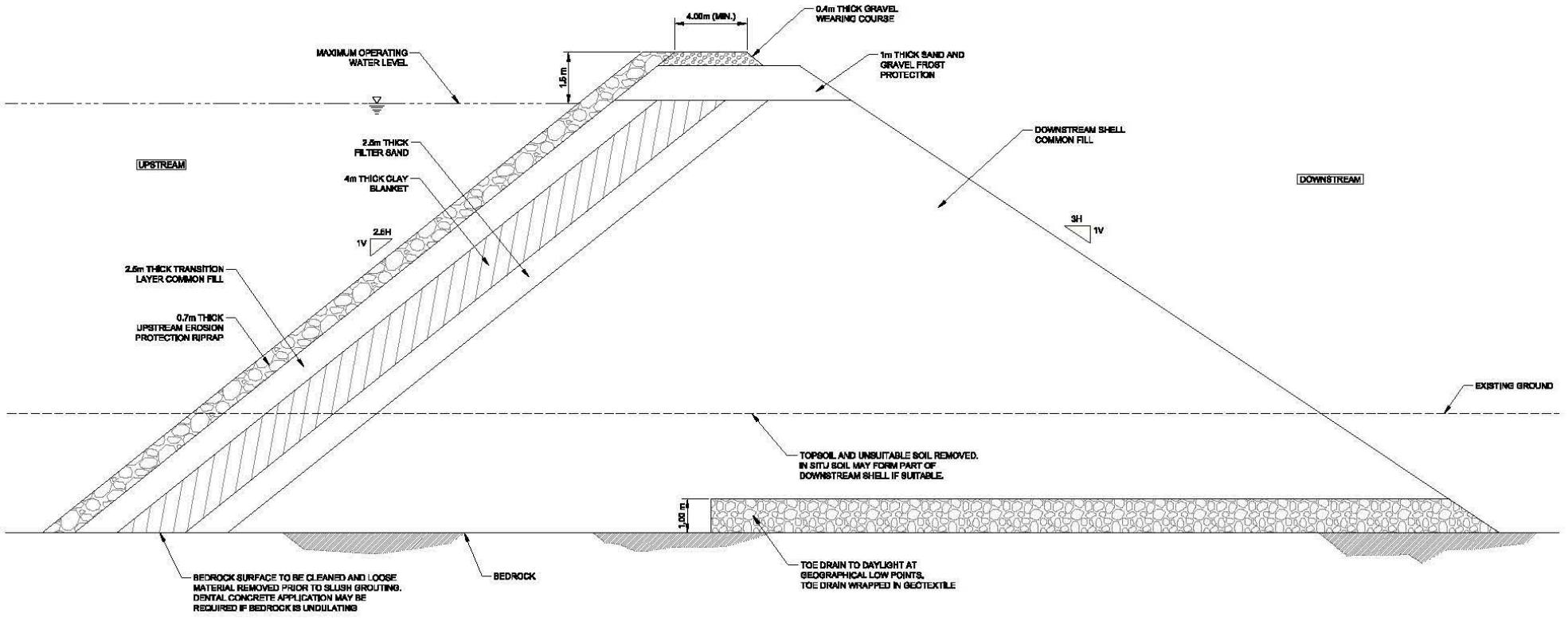
TITLE
SECTION - TYPICAL SEDIMENT POND DAM

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-10-06
PREPARED	CV
DESIGN	PA
REVIEW	RA
APPROVED	MF

PROJECT No. 1406422 | Rev. A | FIGURE 10B.24

29 mm



SCALE 1:250 B SECTION - TYPICAL SURGE POND DAM

0 5 10
1:250 METRES
2x VERT. EXAGGERATION

CLIENT
BENGA MINING LIMITED
RIVERSDALE RESOURCES

RIVERSDALE RESOURCES

PROJECT
GRASSY MOUNTAIN COAL PROJECT
ALBERTA, CANADA

TITLE
SECTION - TYPICAL SURGE POND DAM

CONSULTANT
Golder Associates

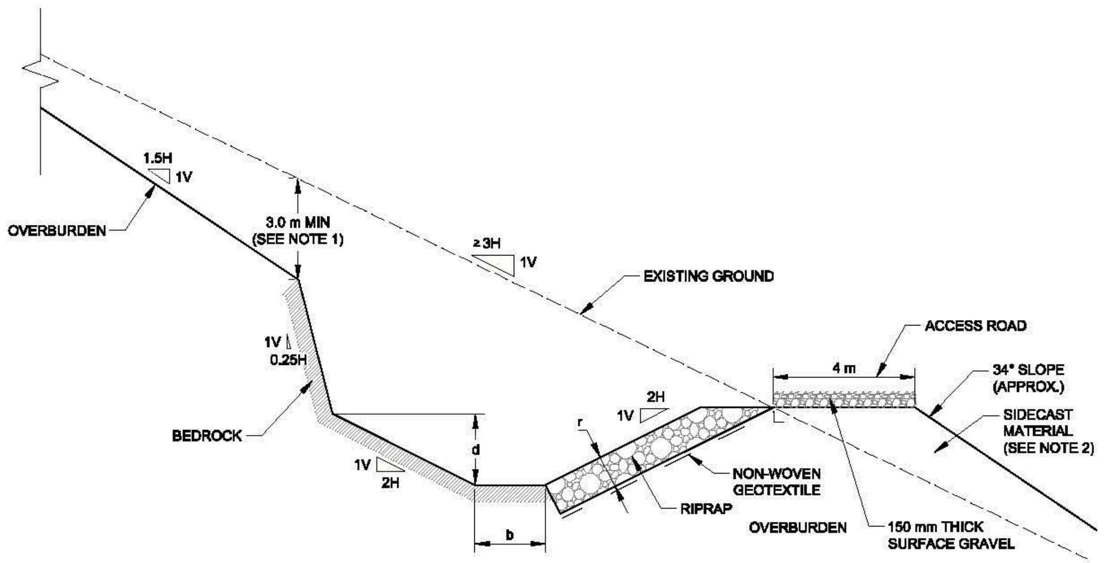
YYYY-MM-DD	2015-10-06
PREPARED	CV
DESIGN	PA
REVIEW	RA
APPROVED	MF

PROJECT No. 1406422 | Rev. A | FIGURE 10B.25

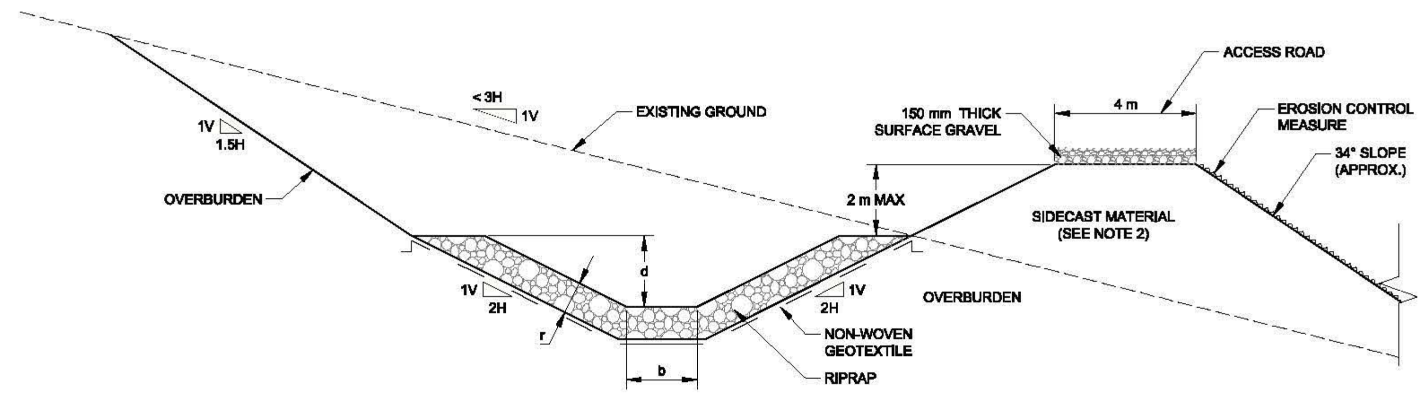
Addendum Me
TA and EIA Menu
Main Menu
Previous View

NOTES

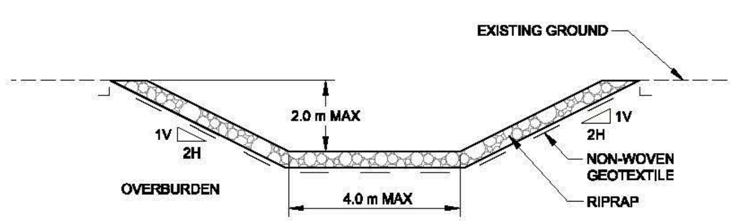
1. AVERAGE DEPTH TO BEDROCK ASSUMED TO BE 3 TO 4 m
2. SIDECAST MATERIAL TO BE USED TO CONSTRUCT ACCESS ROADS WHERE POSSIBLE.
3. RIPRAP LINING ONLY REQUIRED FOR CHANNEL SECTIONS CUT IN OVERBURDEN.



SCALE 1:200 (A) TYPICAL SECTION - CHANNEL PARTIALLY EXCAVATED IN BEDROCK



SCALE 1:200 (B) TYPICAL SECTION - CHANNEL EXCAVATED IN OVERBURDEN



SCALE 1:200 (C) TYPICAL SECTION - CHANNEL TYPE C FOR FLAT NATURAL CROSS SLOPES

Channel Dimensions

Construction Year	Ditch ID	Length (m)	Base width, b (m)	Channel depth, d (m)	Riprap D50 (mm)	Riprap thickness, r (mm)
1	CL1-01	1020	2	2.0	150	300
1	CL1-02	800	1	1	150	300
1	CL1-03	3680	2	2	150	300
1	CL1-04-1	1820	2	2	305	610
1	CL1-04-2	310	2	2	rip rap or stepped chute	
1	DV1-01	2140	2	2	305	610
1	DV1-02-1	520	1	1	150	300
1	DV1-02-2	80	1	1	305	610
1	DV1-03	580	1	1	150	300
1	DV1-04	440	2	2	150	300
4	CL4-01-1	530	2	2	150	300
4	CL4-01-2	280	2	2	rip rap or stepped chute	
6	CL6-01	690	1	1	305	610
6	CL6-02	390	2	2	915	1830
7	DV7-01	1780	2	2	305	610
8	DV8-01-1	680	2	2	305	610
8	DV8-01-2	90	2	2	rip rap or stepped chute	
8	DV8-01-3	120	2	2		
8	DV8-02	1020	2	2	150	300
9	CL9-01	500	2	1.5	305	610
13	SZ1495	100	1	1	305	610
14	CL14-01	1130	2	2	150	300
14	CL14-02	210	2	2	305	610
14	DV14-01	390	1	1	150	300
19	CL19-01	640	1	1	150	300

0 5 10
1:200 METRES

CLIENT
BENGA MINING LIMITED
RIVERSDALE RESOURCES

RIVERSDALE RESOURCES

PROJECT
GRASSY MOUNTAIN COAL PROJECT
ALBERTA, CANADA

TITLE
SECTION - TYPICAL CHANNELS

CONSULTANT

Golder Associates

YYYY-MM-DD	2015-10-08
PREPARED	CV
DESIGN	PA
REVIEW	RA
APPROVED	MF

PROJECT No. 1406422 | Rev. A | FIGURE 10B.26

Attachment 1

Application under the Water Act for Approvals and/or Licences

Application under the *Water Act* for Approvals and/or Licences

Alberta Energy Regulator

This application form is for activities regulated under the *Water Act*.

Check one or more of the following to indicate type of application

Licence for Diversion of Water ☒	Renewal of Diversion Licence ☐	Approval for Constructing Works ☒
Licence Amendment ☐	Approval Amendment ☐	Preliminary Certificate Amendment ☐
Water Act File No. (if applicable)		

Applicant

Name or Business Name:	Benga Mining Limited	Business Contact:	Cal Clark
Address: (include city, province and postal code)	PO Box 660 12331 20th Ave Blairmore, Alberta T0K 0E0	Cell No.:	<contact information removed>
		Phone No.:	<contact information removed>
		Fax No.:	
		E-mail:	<email address removed>

Are you the owner of the land or undertaking? ◉ Yes ○ No

If no, please attach a copy of the written consent of the owner of the land or the undertaking. If working in "public land" administered under the Public Lands Act, include the disposition number obtained to undertake this activity."

Consent attached? ○ Yes ○ No

Disposition No. disposition has been applied for

Authorized Representative*

☐ Same as Applicant

Name or Business Name:	Millennium EMS Solutions Ltd.	Business Contact:	Dane McCoy
Address: (include city, province and postal code)	6111 – 91 Street Edmonton, AB T6E 6V6	Cell No.:	
		Phone No.:	<contact information removed>
		Fax No.:	<contact information removed>
		Email:	<email address removed>

* Name of representative submitting application on behalf of applicant

Project Description

Tentative Construction Start Date:	mid-2017	Duration of Construction:	23 years
Tentative Water Diversion Start Date:	mid-2017	Duration of Water Diversion/Use:	27 years

Application under the *Water Act* for Approvals and/or Licences

Provide a detailed description, including location of works and activities, relating to the project and attach plans:
Details are provided in Water Act Application for "Fence-line Approval" and include: The following is a list of activities that will be included in the fence-line Water Act approval: • construction and operation of sedimentation (release) ponds; • construction and operation of surge (further management is required, no direct release) ponds; • construction and operation collector drainage ditches; • construction and operation clean water diversion ditches; • construction and operation assorted sumps and pumping ponds; • use of high density plastic pipelines for conveyance of water; • construction and operation of a raw water/freshwater storage pond; • construction and operation of saturated backfill areas for the semi-passive treatment of selenium enriched water; • collection of surface run-off and groundwater that reports into the pit and subsequent pit dewatering; • water monitoring sites; and • end of mine lake; and possible metals treatment facility.

Application under the *Water Act* for Approvals and/or Licences

Water Sources (Location of Works and Activities): (•) Surface Water ( ) Groundwater

Surface Water – Point of Diversion or Activity
(if constructing works only, complete the first three columns)

+	Water Body e.g., lake, stream, or name of source, if known	Water Diversion/Activity Location					Is Construction Required?	Annual Volume of Water Required (cubic metres)	Maximum Pumping Rate (show units)	Purpose (for diversion only)
		1/4	Sec	Twp	Rge	M				
x	Crowsnest River Basin	NE	23	8	4	5	Yes			
	Plan/Block/Lot						UTM Coordinates	Zone:	Easting (m)	Northing (m)

+ - add additional row
x - remove current row

Indicate the "Point of Use " if different than the "Water Diversion Location(s)" ☒ same location as source(s)

To ensure your application is complete, please refer to the *Guidelines for Licensing Water Diversion Projects* (http://environment.alberta.ca/03222.html).

Amendment Description

☐ **Approval Amendment**

Please provide description of amendment required and attach plan if necessary

☐ **Licence Amendment**

☐ **Preliminary Certificate Amendment**

Complete applicable information below:

☐ Increase or decrease rate of diversion.

Please specify

☐ Add a rate of diversion of water if none specified on the licence or preliminary certificate.

Please specify

☐ Add terms or conditions to the licence or preliminary certificate.

Please specify

☐ Add/change the timing of diversion or water specified in the licence or preliminary certificate.

Please specify

☐ Add/change the point of use

Please specify

Application under the *Water Act* for Approvals and/or Licences

☐ Move the point of diversion of water or add another point of diversion of water. (Licences only)
Please specify
☐ Notice of disposition of land or undertaking. (Change of ownership)
Please specify
☐ Other amendments requested.
Please specify

Statement of Confirmation:

The information given on this form is true to the best of my knowledge.

If you wish to sign the form with an electronic signature you are bound with the same force as though you had a fixed signature on paper.

Signature	Date of Signing	Printed Name	Company Name
<Original signed by>	05-Aug-2016	Cal Clark	Benga Mining Ltd.

Application under the *Water Act* for Approvals and/or Licences

For projects under ESRD jurisdiction, submit the completed form to the following address:

Alberta Environment and Sustainable Resource Development
Regulatory Approval Centre
Main Floor, Oxbridge Place
9820 106 Street NW
Edmonton AB T5K 2J6
Telephone: 780 427-6311
Fax: 780 422-0154

or e-mail the completed and signed form to one of the following e-mail addresses:
~ AENV.NorthWaterApprovals@gov.ab.ca
~ AENV.CentralWaterApprovals@gov.ab.ca
~ AENV.SouthWaterApprovals@gov.ab.ca

For projects under AER jurisdiction, e-mail the completed form to the *EPEA* and *Water Act* Authorizations Centre at EPEA.WA.Applications@aer.ca.

PERSONAL INFORMATION COLLECTION AND USE NOTIFICATION

Personal information on this form is collected under the authority of section 33(c) of the Freedom of Information and Protection of Privacy (FOIP) Act and will be used to administer the Water Act and its associated regulations. ***This form is a public record and is available to anyone****. All information contained on this form (including personal information) is disclosed by Alberta Environment and Water to anyone requesting a copy in accordance with Section 15(1)(a) of the Water (Ministerial) Regulation. For further information about the collection and use of this information, please contact Alberta Environment and Water's Regulatory Approvals Centre at RAC.Environment@gov.ab.ca or call (780) 427-6311.*

WATER (MINISTERIAL) REGULATION **- REQUEST FOR CONFIDENTIALITY**

As identified in Section 15(4) of the *Water (Ministerial) Regulation,* If the applicant wishes that a trade secret, process or technical information in the application be kept confidential, the applicant may make a written request to the Director within 30 days after the information is submitted, identifying the information, and requesting that the information be kept confidential and not be disclosed. The written request must identify the specifics of the information to be kept confidential and not to be disclosed. Ultimately, it is the Director who makes the decision regarding the confidentiality of the identified information.

If you are submitting a request to assure confidentiality of certain information such as a trade secret, process or technical information for the Directors consideration, ***submit this information in a separate attachment to the application form.***

Protect Fields