



Five-Year Operations Plan In conformity to Milepost 7 Master Permit Years 2024 to 2028

Milepost 7 Tailings Storage Facility

Prepared for
Cleveland-Cliffs, Inc.
Northshore Mining Company
Silver Bay, Minnesota

November 2023

Five-Year Operations Plan
In conformity to Milepost 7 Master Permit
Years 2024-2028
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Certification

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly licensed Professional Engineer under the laws of the State of Minnesota.

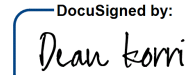


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November 10, 2023

Date

Cleveland-Cliffs, Inc./Northshore Mining Company:

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November 10, 2023

Date

1.0 Introduction

1.1 Introduction

Cleveland-Cliffs, Inc. - Northshore Mining Company (Northshore) operates a tailings storage facility (TSF) west of Silver Bay, Minnesota, where it transports fine tailings and plant aggregate/filter sands from its processing plant for long-term storage. This "Northshore Milepost 7 Tailings Storage Facility Five-Year Operations Plan, Years 2024-2028" (Operations Plan) includes a discussion of relevant information, recent construction activities, and then describes the tailings storage facility operations for the TSF. The design and engineering and TSF closure sections of this Operations Plan address the design of the TSF through the life of operations.

1.2 Background

The Mile Post 7 Master Permit (Master Permit) from the Minnesota Department of Natural Resources (MNDNR) authorizes engineering and operational activities conducted at the Mile Post 7 TSF at Northshore Mining Company. The Master Permit, collectively, includes requirements for the TSF, provides for continued construction and operation through the approved Operational and Engineering Design Plan, and incorporates the requirements of a number of water appropriations and Public Waters Work Permits. The Master Permit, by incorporating the plans and permits, is thus updated through revisions to these instruments.

The Master Permit was originally issued on July 27, 1977, to Reserve Mining Company, Armco Steel Corporation and Republic Steel Corporation by order of the Minnesota District Court of Lake County on January 28, 1977. The order directing issuance of permits was upheld by the Minnesota Supreme Court by order dated April 8, 1977, followed by an opinion filed on May 27, 1977. On August 17, 1989, the permit was amended and transferred to Cyprus Minerals Company and Cyprus Northshore Mining Company as joint co-permittees. On September 30, 1994, the stock of Cyprus Northshore Mining Corporation was purchased by Cliffs Minnesota Minerals Company, a wholly owned subsidiary of Cleveland-Cliffs, Inc. Cyprus Northshore Mining Company was then renamed Northshore Mining Company and continues to operate under the same ownership today.

The Master Permit specifically authorizes construction and operation of a taconite TSF and associated tailings containment dams, seepage recovery dams, diversion dikes and facilities, splitter dikes, a tailings transport system, water reclamation facilities, stream crossings, and other facilities and systems. The authorization is effected through the renewable five-year operations plan submitted to and approved by the Commissioner of the MNDNR. Northshore submitted its initial Five-Year Operations Plan (Operations Plan) that was approved in August 1997 by the DNR and the Minnesota Pollution Control Agency (MPCA) and remained in effect through 2003. The Operations Plan has been subject to subsequent five-year renewals. In addition to the requirements in the Master Permit, Northshore's NPDES Permit MN0055301 also requires review and approval of the Operations Plan. Submittal of this Five-Year Operations Plan thus satisfies the requirements described above found in Northshore's Master Permit and NPDES Permit MN0055301.

1.3 Objectives of Operations Plan

The Operations Plan is intended to meet the following major objectives:

1. Providing storage of all fine tailings in the TSF with emphasis on supplementing the fine tailings blankets upstream of Dams 1 and 2 as a normal, ongoing practice of tailings discharge for sealing the dams and the bottom of the pond.
2. Raising all dams, as necessary, to maintain adequate freeboard to contain the probable maximum precipitation (PMP) flood. Dam construction will include dam stability and safety considerations addressed during the design process for each dam raise.
3. Managing plant aggregate material for dam construction and stockpiling for TSF closure.
4. Controlling the TSF water level and volume by diverting runoff away from the TSF, discharging water from the TSF (via water treatment plant), and managing net plant water.
5. Management of fugitive dust at the TSF.
6. Raising and/or relocating the railroad grades of the TSF for tailings placement.
7. Performing TSF reclamation as appropriate during operations to minimize activities required for closure.

1.4 Summary

The Master Permit provides for the handling and disposal of tailings at the TSF and the continued construction and operations through the submittal of an Operations Plan. The Northshore's 2024-2028 Operations Plan is the latest submittal providing operations through the life of the facility as consistently presented in previous contiguous and sequential Five-Year Operations Plans. The implementation process of this Operations Plan is provided in the Summary section at the end of this report which presents the action items required for 2024-2028. Northshore is providing this Operations Plan to the Minnesota Department of Natural Resources (DNR) and Minnesota Pollution Control Agency (MPCA) for approval of the continued construction and operation of the TSF consistent with the terms of the current Master Permit and plans and permits incorporated therein.

2.0 Recent Accomplishments

The following accomplishments were completed during the previous 2019-2023 operations period.

- Submittal of necessary permitting documents and ongoing discussions with regulators to facilitate construction of the ultimate railroad configuration
- Construction of initial portions of the railroad on the East Ridge of the TSF
- Long- and short-range TSF planning
- Bear Lake Outlet construction and project closeout
- Amendment of Solid Waste Permit (landfill) to accommodate future TSF construction
- Dam 1 dam raise design, updated/advanced geotechnical investigations, and construction
- Dam 1 East geotechnical investigation for dam design
- Dam 2 geotechnical investigations for dam design
- Dam 2 dam raise design and construction
- Dam 2 relief well study
- Dam 5 dam raise design and construction
- Reclaim dike raises and weir relocation
- Dam instrumentation installation and upgrades and near real-time monitoring/reporting dashboard
- Construction of confined beaches upstream of Dams 1 and 2 and evaluation of extended period of vegetation establishment
- Seepage Recovery Dam updated geotechnical investigations, instrumentation installations, and geotechnical studies

Consistent with ongoing operations and long-range goals, significant projects have been completed at the TSF to maintain a safe, stable storage facility. Main perimeter Dams 1, 2, and 5 have been raised using typical plant aggregate and filter sands to maintain adequate dam freeboard requirements. Fine tailings have been nearly continuously discharged (with the exception of two plant idle periods between 2020-2023) into the TSF on the beaches upstream of the dams and splitter dike to both fill and seal the bottom of the pond. The seepage collection ditches on Dams 1 and 2 just upstream of the glacial till cutoff continue as designed to collect and route seepage around the glacial till cutoff towards the toe of the dams where designated collection ponds are located to store the seepage water. The seepage collection ditch flow is monitored by weirs located at each end of the ditches. These features are shown on Figure 1.

Dams 1 and 2 are being raised to a minimum dam crest elevation of 1,250 feet as planned. The current minimum elevation of Dam 5 is 1,270 feet. The Reclaim dike was raised to elevation 1,245 feet. A weir with a drop structure is located on the north end of the Reclaim dike near Dam 5.

Overall, the operation of the WTP has been successful, and benefits have been seen from the increased flow through the WTP since the expansion in 2007. The water volume in the TSF was reduced to its lowest level in 2021.

Railroad grades and tracks, required for transport of plant aggregate and filter sands to the TSF and to facilitate dam construction, were raised on Dams 1, 2, and 5 in the last 5 years.

An updated Emergency Action Plan (EAP) including a state of engineering practice dam break analyses was completed and submitted to the DNR in 2022. The current EAP includes many of the changes that have occurred at the TSF since the original development of the plan as part of Northshore's ongoing commitment to safe operation of the TSF. Furthermore, a desktop simulation exercise utilizing the submitted EAP with external emergency response personnel was held in the fall of 2022.

3.0 Relevant Information

3.1 Introduction

This section presents information on the status of the TSF and anticipated future production levels that are relevant for this Operations Plan.

3.2 Current Status – October 2023

- Figure 1 shows the general arrangement of the TSF in 2023.
- The pond levels in the main pond and interior reclaim pond were about elevation 1,231.8 and 1,206.3 feet, respectively as of August 17, 2023.
- Based on the results of a bathymetric survey performed in June 2023 the volume of water was approximately 17,603 acre-feet at the corresponding water elevation of 1,231.8 feet. The free water volume of the reclaim pond, based on the results of the bathymetric survey, was approximately 2,066 acre-feet at the corresponding elevation of 1,206.5 feet.
- Fine tailings are being discharged from Dams 1 and 2 to maintain the beaches as needed and seal the bottom of the pond. The tailings are also being discharged along the north side of Dam 5.
- The crests of Dams 1 and 2, as defined by the minimum elevation of the plant aggregate dam fill just downstream of the dam centerline will have been completed by year end 2023 to a minimum crest elevation of 1,250 feet on both Dam 1 and Dam 2 in accordance with the design.
- The existing Dam 5 minimum crest elevation was 1,270 feet as of year-end 2021. It has been constructed using a compacted glacial till cutoff and centerline construction methods with a 6H:1V downstream slope. Construction above elevation 1,270 feet is not anticipated until about 2030 and submitted for agency review through the future 2029-2033 Operating Plan.
- The Dam 5 northern abutment footprint construction will begin within the next three years under this plan, raising this portion of the dam to elevation 1,270 feet.
- The Bear Lake Outlet has been completed, and water no longer flows from Bear Lake into the TSF fulfilling a long-range planning goal of the past.
- The latest instrumentation readings and 2022 dam safety inspection have been completed. The dam performance was found to be satisfactory and acceptable for continued operation.
- The fine tailings handling system (including plant clarifier and slurry transport pipelines) from the processing plant to the TSF is acceptable as reported by Northshore for continued operation as indicated in the previous operations plan. The verification program includes regular periodic fine tailings pipeline testing, a rolling maintenance and replacement plan, and semiannual tailings pipeline inspection and report to MPCA.

- The Reclaim containment dike was raised to elevation 1,245 feet. A new weir structure has been constructed near the existing weir and will be transitioned and activated in 2023. The existing weir structure is still functioning and will be abandoned shortly after activation of the new structure.
- Instrumentation was updated on Dam 1, Dam 2, Dam 5, and the Reclaim dike from 2019-2023 including nearly fully automating all the instruments for near-real-time dashboard monitoring. Plans have been developed and will be implemented to replace or abandon any malfunctioning instrumentation and install new instrumentation on all the dams, as needed, to support ongoing monitoring and design. Monitoring devices nearing end of functional life, depending on location, will be assessed for need and replaced, if necessary.

3.3 Anticipated Tailings Production Levels

Northshore expects to operate at an average three-furnace throughput rate during the 5-year period. While this is the expected plan for production, the Northshore plan may be impacted by changing economics unforeseen at this time. Expected annual tailings production rates for the Operations Plan and the Water Balance are presented in Table 1.

Table 1 Estimated Annual Rates of Tailings Production for Anticipated Operations

Material	Three Furnace Operations (MLT)
Dry Cobb Aggregate	1,532,743
Filter Sands	606,060
Total Plant Aggregate ⁽¹⁾	2,138,803
Fine Tailings	5,287,271

Notes:

MLT = Million Dry Long Tons

Data estimated by Northshore Mining Company on 7/25/2023.

(1) Total Plant Aggregate is the sum of Dry Cobb Aggregate and Filter Sands

Actual production rates for the plant aggregate and fine tailings may vary depending on ore grade and plant performance. The Agencies will be notified in the event of major production changes and the proposed Operations Plan will be adjusted as necessary.

3.4 Anticipated Pond Levels and Dam Raising Schedule

The historical water level within the TSF is shown in Figure 2. The predictive water balance analysis is discussed in Section 4.5 of this report. The anticipated TSF pond levels for the period of this Operations Plan are listed in Table 2. These water levels are based on an estimated pond water surface elevation of 1233.0 feet at the end of 2023 and an estimate of pond level rise of about 2.9 feet per year for years 2024, 2026-2028 and 7.4 feet per year for year 2025.

Table 2 Milepost 7 Anticipated Dam Construction

Year	Anticipated year-end Water Elevation ⁽¹⁾ (feet)	Dam 1 Elevation/Freeboard (feet)	Dam 2 Elevation/Freeboard (feet)	Dam 5 Elevation/Freeboard (feet)	Construction Plan
2023	1231.8 (8/18/2023) 1233	1,250/17	1,250/17	1,270/37	Completed
2024	1,235.9	1,255/19.1	1,255/19.1	1,270/34.1	- Construct Dam 1 -1,255 feet - Construct Dam 2 – 1,255 feet - Construct dam slopes: Dam 1, Dam 2, Dam 5
2025	1,243.3	1,255/11.7	1,255/11.7	1,270/26.7	- Construct Reclaim dike – 1,250 feet - Construct dam slopes: Dam 5 and Reclaim dike
2026	1,246.2	1,265/18.8	1,265/18.8	1,270/23.8	- Construct Dam 1 – 1,265 feet - Construct Dam 2 – 1,265 feet - Construct Reclaim dike – 1,255 feet - Construct dam slopes: Dam 1, Dam 5
2027	1,249.1	1,265/15.9	1,265/15.9	1,270/20.9	- Construct dam slopes - Construct Dam 5 extension – 1,250 feet - Construct Dam 2 railroad – 1,270 feet
2028	1,252	1,265/13.0	1,265/13.0	1,270/18.0	- Construct Reclaim dike – 1,260 feet - Construct Dam 5 extension – 1,260 feet - Construct dam slopes: Dam 1, Dam 2

(1) A pond level rise based on a rate of 2.9 feet per year for 2024, 2026-2028 and 7.4 feet per year for 2025.

4.0 Tailings Storage Facility Operations

The Milepost 7 tailings storage facility operations follow the general philosophy developed in the Closure Consensus Plan (Klohn, 1988) and all previous approved Milepost 7 Tailings TSF Five-Year Operations Plans. The Disposal System Operations section of the Operations Plans includes the handling and storage of plant aggregate and fine tailings, water management, and requirements for the dams related to flood storage and monitoring. The tailing clarifiers, tailings pipeline, tailings pipeline testing, maintenance and replacement plan are not addressed in this Operations Plan because the schedule and processes have not changed and are documented in the NPDES Permit required semi-annual report to MPCA. This Operations Plan represents the updates in operations from the previous operations plan.

4.1 Proposed Operation Plan

The proposed Operations Plan follows the previous operations plan in the way dams are constructed, material is stored for closure, and dust emissions are suppressed. Section 4.4 describes the current dust suppression plans. The dams will be continually constructed with plant aggregate and filter sands. A centrally located glacial till cutoff and filter sands will also be constructed in sequence on Dam 5 to control seepage. By the end of 2023, Dams 1 and 2 will have been raised to the minimum elevation of 1,250 feet. Although the elevation of the plant aggregate dam fill just downstream of the centerline is in principle considered the reference dam crest on the upstream edge of the dam, for purposes of long-term seepage control, Dams 1 and 2 more robustly have surface elevations that exceed this elevation across the section. The higher elevation is due to the construction of railroad grades downstream directionally of the dam crests which allow material to be unloaded and transported to each dam for use in construction. Therefore, the dam crests exceed those elevations (along most of the dam alignment) presented as the top of the plant aggregate fill just downstream of the dam centerline. The current minimum Dam 5 crest elevation is 1,270 feet.

Ongoing construction will involve leveling of the crest of the dams, stockpiling plant aggregate and/or placing the remaining aggregate on the dams and construction of the West Ridge Railroad, when applicable. Figure 3 shows the planned activities during this proposed Operations Plan.

The upper dam slopes for Dams 1 and 2 will be graded and reclaimed with vegetation so the overall downstream slope is roughly 6H:1V to a point where a 4H:1V slope extending up from the seepage collection ditch meets the 6H:1V slope. Dam 5, constructed as a glacial till cutoff dam, has been graded to an overall downstream slope of 6H:1V. Figure 4 shows the proposed long-term dam configurations subject to ongoing instrumentation and performance monitoring, analyses, and design. The following sections describe the features of the Operations Plan.

4.2 Handling and Storage of Plant Aggregate

Plant aggregate is the coarse portion of the tailings stream produced from the concentrating process, defined as the combined dry cobb aggregate (approximately 60% to 80%) and filter sands (approximately 20% to 40%).

The plant aggregate is hauled by rail from the plant to the TSF and used to construct the perimeter containment dams (Dams 1, 2 and 5) and other structures. When required, the dry cobb aggregate and filter sands are separated at the plant and transported by rail separately to the TSF for specific areas such as the filter berm in the dams. At the TSF, the plant aggregate is unloaded from railcars (side-dumped) and placed by dozers, loaders, trucks, and/or scrapers to meet design execution. Excess plant aggregate not used for the dams, depending on the timeframe/season, is placed within the TSF limits to build roads, dikes, and railroad grades, or stored for future use to provide material for closure-related activities as defined herein, in Section 5.0 TSF Closure and in general accordance with the Closure Consensus Plan. Approximately 0.3 to 0.4 MLT of plant aggregate is returned to the mine each year, if available, for use as road covering and blast hole stemming.

4.2.1 Schedule for Plant Aggregate Storage

Plant aggregate is delivered via rail to the planned construction areas for the dams, dikes, roads, railroads, and stockpiles. The TSF Supervisor or his designee works with the Railroad Dispatcher and Concentrating Department to schedule the daily delivery of the plant aggregate rail cars. The amount of material delivered to the TSF depends on the operation of the processing plant and could vary significantly depending on ore grade and/or changing production rates.

4.2.2 Plant Aggregate for Perimeter Dam Construction

Construction of Dams 1, 2, and 5 will continue to utilize plant aggregate for dam construction. Filter sands will be used for the filter berm construction on Dams 1 and 2 and plant aggregate will be used downstream of the filter berms. Filter sands will also be used downstream of the central cutoff in Dam 5.

Normally, dam construction takes place in the summer months. However, a single lift less than about 4 feet thick may be placed on the dams in the winter (freezing conditions), provided all snow has been removed from the area being covered and the layer is compacted after thawing and before any further lifts are placed.

The placement of plant aggregate in the dams and any associated foundation work within the dams will be monitored by Northshore's tailings engineer. Adequate testing for quality assurance on materials such as the glacial till used for seepage cutoffs will continue to be performed as needed during construction of features around the TSF.

4.2.3 Plant Aggregate for Railroads and Roads

The railroad track spurs on Dam 1, Dam 2, and Dam 5 were completed to facilitate hauling plant aggregate to stockpile areas and then for use in dam construction. A railroad alignment is being constructed on the east side of the TSF on top of the existing perimeter access roads and connecting north to Dam 2 for coarse tailings distribution. A new TSF progression alignment called the West Ridge Railroad, for the ultimate TSF configuration, has been developed along the western perimeter of the TSF. Permitting is currently underway.

Small amounts of plant aggregate will also be required each year to build and maintain roads for access within the TSF. Plant aggregate will not be used for roads outside of the TSF, except within the plant area in a covered or bonded state or as otherwise allowed by regulatory agencies.

4.2.4 Plant Aggregate for Splitter Dike and the Reclaim Dike

Plant aggregate material will be used for Reclaim dike construction which separates the main pond from the initial treatment step of the Reclaim pond. The Reclaim dike is raised as the water level rises in the TSF to maintain operational freeboard only. The dike is configured with a 4H:1V slope downstream and crest wide enough (greater than 50 feet) for access by the haul trucks. Additional sacrificial material is frequently placed along the upstream face of the dike to replenish any material loss from wave action within the main pond. This interior dike has been reconfigured in the near-term using plant aggregate and constructing in a manner that widens the dike and increases the global stability by flattening the overall downstream slope. A plan has been developed for filling the unfilled bottom of the reclaim pond with fine tailings for additional fine tailing storage and increased Reclaim dike stability during this five-year plan. In the past, the cross-TSF bisector Splitter Dike was raised using plant aggregate as the center portion of the dikes. As approved by MPCA in 2015, there are no plans within this operating period to maintain construction of the splitter dikes because the deep bottom portions of the central TSF have been successfully filled with fine tailings.

4.2.5 Plant Aggregate Stockpiles

Excess plant aggregate not required at the TSF (for dams, railroads, roads, or dikes) or at the mine will be stockpiled within the ultimate TSF limits for future closure activities. Records will be kept of stockpiled plant aggregate and reported in the Milepost 7 Annual Report to MPCA. Additionally, significant stockpiles of plant aggregate have been placed along the western side of the TSF within the existing West Ridge Railroad. The railroad grades on both Dams 1 and 2 have been constructed to elevations greater than the filter berms and also represent a significant amount of potential material for closure activities.

4.2.6 Contingencies

The projected yearly plant aggregate volumes for 2024 through 2028 are listed in Section 3.3. Variations in ore grade and plant performance will cause the actual amounts delivered to the TSF to vary. Such normal variations average out in the long term, and no alterations to the Operations Plan are required unless conditions change significantly from those assumed.

In the case of a major disruption or reduction in operations due to reduced plant operating levels, outages, or other causes, the following steps will be taken:

1. The regulating Agencies will be notified of the disruption.
2. Plant aggregate deliveries to the mine may be temporarily curtailed or suspended as required to provide material to raise the dams or otherwise protect the integrity and safety of the TSF.
3. Plant aggregate will be utilized as required from the plant aggregate stockpiles at the TSF to provide material to raise the dams or to otherwise protect the integrity and safety of the TSF.

4. Detailed contingency plans will be developed to deal with the duration and extent of the situation.
5. Modifications will be made to this Operations Plan as needed for MPCA & DNR approval.

4.3 Handling and Storage of Fine Tailings

Fine tailings are defined by Northshore as the minus -#200 mesh (<75 micron size) product of the concentrating process. On Dams 1 and 2, the fine tailings provide a seal for the dams reducing seepage flow and are an integral part of the dam and TSF design. During the period of this Operations Plan, the fine tailings will continue to be discharged as slurry pipeline discharge deltas upstream of Dams 1 and 2 to create subaerial beaches to provide a suitable seal for limiting seepage through the dams.

The fine tailings handling and storage facility consists of clarifying/thickening equipment at the plant, fine tailings storage within the TSF proper, and the tailings slurry transport pipeline system between the plant and TSF. Clarifying equipment at the plant consists of two launder systems feeding four, 400-foot-diameter clarifiers. The fine tailings slurry pumping system consists of two, parallel, above-ground pipelines and two stages of pumping. One pipeline serves as a standby. The pipeline is inspected and tested according to the NPDES permit and the results summarized in a report to MPCA. Operation of the tailings clarifiers and the pipeline system is the responsibility of the Plant Concentrating Section Manager. Fine tailings storage at the TSF is the responsibility of the TSF Site Supervisor at the TSF facility.

4.3.1 Fine Tailings Operations and Monitoring

The fine tailings slurry pumping system, including the fine tailings clarifiers, pumphouses, and pipeline, will be operated and monitored consistent with internal operating procedures derived from the following document:

"The Revised Plan for Operation and Monitoring of the Fine Tailings Handling System (dated January 25, 2002)."

4.3.2 Schedule for Fine Tailings Storage

Fine tailings will be discharged at Dam 1 and Dam 2 to further establish the relatively impervious blanket upstream of the filter berm creating a seepage cutoff. Coordination of future fine tailings discharge on the ends of the dams will be required to provide a direct cutoff of seepage water between the interface of the filter berm and plant aggregate and the pond water. A plan has been developed for the new West Ridge Railroad which sets the western limit of the ultimate tailings TSF.

4.4 Fugitive Dust Emissions

Northshore intends to control dust emissions to the extent practical with normal operation practices. Dust emissions are generally from the fine tailings beaches, filter sand, and plant aggregate surfaces of the TSF. The following sections describe the Best Management Practices implemented at the TSF to control fugitive dust emissions.

4.4.1 Dust Control on Plant Aggregate Surfaces

All plant aggregate surfaces at the TSF will be vegetated, covered, or otherwise treated as described below.

1. Total exposed plant aggregate surfaces at the TSF will be limited as much as practical and consistent with current designs.
2. Plant aggregate used for road construction will be adequately covered with native soils or other suitable natural or artificial barriers.
3. Untreated plant aggregate surfaces will be limited to 300 acres (treatment includes precipitation and other methods).

These treatments and operating constraints are intended to maintain essentially zero visible dust emissions, except under extreme meteorological conditions.

4.4.2 Dust Control on Fine Tailing Beaches (above Pond)

Exposed fine tailings beaches will be vegetated where longevity permits, mulched and crimped with hay, and/or otherwise treated to the maximum extent possible under the conditions at the time to control fugitive dust. The optional use of the constrained beach limits the pond water from encroaching on the beach for longer periods of time. This approach limits re-saturation of the tailings or flooding of the beach which can kill the vegetation and lead to dust generation when the beaches are dry. If constrained beaches are used, the practice will be balanced with dedication to dam construction and maintaining consistent adequate freeboard requirements.

4.5 Water Management (including Water Quality and Quantity)

The Silver Bay plant and Milepost 7 TSF was designed to operate as a closed water system with no direct discharge of water except through the WTP or as otherwise authorized by the Agencies. Because the TSF is a closed system, it is necessary to recycle treated water back to the processing plant, treat and discharge water to the Beaver River, and build dams to contain the excess water in the pond at the TSF.

A key goal of this Operations Plan is to regulate the pond water level and provide for safe, efficient storage of tailings. Properly controlling the pond water level will minimize the need to raise dams and provide more construction material for closure. As a Northshore operational goal, the total water volume within the TSF has been reduced to current levels, down from a historical high of about 26,000 acre-feet. Northshore continues to maintain design freeboard by periodic reviews of aggregate mass balance (construction material), dam construction plans (elevations), and the TSF water balance.

In general, Northshore controls the water within the TSF by the following:

1. Net inflow—Controlling the net slurry inflow to the pond from the plant;
2. TSF diversions—Diverting (potential) surface runoff away from the TSF;

3. WTP—Discharging treated water from the TSF through the WTP;
4. Upstream seepage control blanket (fine tailings beach)—Reducing seepage by continued sealing the pond perimeter with fine tailings.

These methods of water control and contingencies are discussed in the following sections.

4.5.1 Net Inflow

The tailings pipeline slurry and density are tracked and recorded daily. All the process water from plant operations and runoff from within the plant area is collected and pumped to the TSF with the fine tailings. The tailings settle or are filtered out at the TSF and clearer water is reclaimed and pumped back to the plant for process needs.

Under normal conditions this reclaim water supply is sufficient and additional makeup water for process water at the plant is not required. Under certain conditions, such as starting a tailings pipeline, makeup water is required and an automatic valve opens to add fresh makeup water to the system. Indirectly, makeup water is also added to the system through other plant uses, such as dust control and cleaning processes. This makeup water addition is regulated by the NPDES permit and DNR water appropriations permits. The Concentrator Section Manager is responsible for monitoring the net water pumped to the TSF and makeup water additions and is responsible for taking corrective action as needed to keep net water flow within normal ranges.

4.5.2 TSF Diversions

The TSF diversions consist of the headwater diversions for Big Thirty-Nine Creek, Little Thirty-Nine Creek, and the west diversions, which are west of Dams 1 and 2. The TSF diversions reduce the volume of water from surface runoff that could report to the TSF from watersheds outside of the diversions. The diversions are monitored periodically by the Basin Supervisor.

Construction of the western extent of Dam 2 requires filling and crossing the diversion ditch on the northwest side of the current tailings pond area. To meet construction SWPPP (storm water pollution prevention plan) requirements, overland runoff water from the north/northwest areas and previously diverted outside the TSF will be temporarily directed through ditches to seepage recovery pond 2-3. Once construction of the new diversion ditch alignment is complete, the overland runoff water from the north/northwest will again be directed outside the TSF.

4.5.3 Water Treatment Plant

In 1985, the water treatment plant was permitted at the TSF to allow water to be treated and discharged to the Beaver River. This discharge reduces the need for creating water storage capacity in the TSF. The water treatment plant reduces the volume of free water accumulating in the TSF, minimizes the pond level rise, and limits the need to raise the dams.

In 2007, the water treatment plant was upgraded to a 50% higher design capacity with the permitted construction of additional treatment lines. The normal water treatment rate now ranges from 2,500 to

3,500 gpm; however, rates as high as 4,200 have been measured over extended periods of time. For 2024-2028, it is anticipated that the water treatment plant will be operated within the normal operating range.

According to the water balance report, under normal meteorological conditions and at current plant operating rates, the water in the tailings pond will increase. Due to anticipated operating conditions, it is expected the pond will continue to rise (average conditions) at about 2.9 feet per year in 2024 and in 2026-2028 because of fine tailings displacing the water and the creation of the beaches. During 8 months of water year 2025, fine tailings will be placed in the reclaim pond, in order to ensure continued integrity of the Reclaim dike. During the entire year, the WTP is expected to be shut down or run at reduced rates. Reclaim water for plant operations will be pulled from the TSF and makeup water supplied from Lake Superior. As a result, under normal meteorological conditions, it is expected that the pond will experience a 7.4-foot rise over the course of the 2025 water year.

The Concentrator Section Manager is responsible for operation and control of the water treatment plant.

4.5.4 Water Quality Control at Water Treatment Plant

Based on historical data, the turbidity of the influent water to the treatment plant should be targeted to be less than 50 NTUs to meet plant operational requirements as well as Best Available Technology (BAT) as defined by MPCA for this water treatment plant. As originally constructed, the TSF water was previously filtered through splitter dikes and a filter dike, now referred to as the Reclaim dike, surrounding the reclaim pond before being pumped to the processing plant and water treatment plant. After successfully filling the deep portions of the TSF there was little use for the splitter dikes. Over time the water levels have risen and the splitter dikes are underwater. The Reclaim dike became blinded with fine tailings, reducing the through-seepage, and has become ineffective to filter the water through it as originally intended, requiring an overflow intake weir to allow water to flow from the main TSF pond into the reclaim pond. The water is no longer filtered by flowing through the Reclaim dike and a higher turbidity (suspended solids) exists in the reclaim water for the concentrator processing facilities and the water treatment plant.

During previous operating plans, methods have been refined for the use of flocculants and coagulants to minimize the influent turbidity (suspended solids) to the concentrator processing facilities and into the water treatment plant to maintain TSF discharge rates. Since 2014, a floating turbidity curtain has also been used to manage particle settling near the weir discharge radius into the reclaim pond.

Another method to reduce the turbidity of the water into the water treatment plant has been the construction of a pipeline from Seepage Collection Pond 1A to the water treatment plant. This water is visibly clearer, must go through treatment anyway, and tests show reduced turbidity. This cleaner water is being piped into the Seepage Recovery Pond 1B to improve the overall turbidity level. Through this betterment of the treatment process, higher throughput was expected and achieved allowing better control of the TSF water volumes.

4.5.5 Seepage Cutoff/Upstream Blanket

Seepage from the pond will continue to be managed with the fine tailing blanket (beach) in the main pond upstream of Dam 1 and Dam 2 and the central seepage cutoff core at Dam 5. Seepage flowing through the fine tailings and/or dam cross sections is collected in the seepage recovery facilities and returned to the TSF as described in the following section.

4.5.6 Seepage Recovery Facilities

Each of the three major containment structures (Dams 1, 2, and 5) has its own downstream seepage recovery facility (In the case of Dam 1, there are two seepage collection ponds identified as 1A and 1B.) Each of the dam's collection facilities consist of a pond, pumping facilities, a pipeline, and in the cases of Dam 1 and Dam 2 seepage recovery facilities, and an emergency spillway. The seepage recovery systems collect any seepage through the dams via seepage collection ditches, seepage under the dams, plus any runoff from the dams and adjacent direct watershed. The seepage water is rerouted back to the tailings pond to complete the closed water system at the TSF. The seepage recovery systems were originally designed as described in the August 1976 Klohn-Leonoff Consultants Ltd. report "Volume I Engineering Report On Geotechnical, Hydrologic, and Hydraulic Design For Tailings Disposal Milepost No. 7 Site" including Drawing 292-0069, "Seepage Recovery Dams – Reservoir Volume Curves & Mass Curves." A memo developed by Barr in 2023 entitled "Task 1 - Data Review Results for Interim Water Balance Updates" discusses the differences between the current operation of the seepage recovery ponds and the original 1976 design. Seepage collection pond 1B requires an adjusted operating range different than originally designed due to its additional functions related to the water treatment plant. As further discussed in the 2023 data review memo, seepage collection pond 2-3 has a temporarily larger drainage area to the pond than originally designed for; therefore, this pond is operating at a higher pumping capacity.

The seepage collection pond water levels are monitored with remote sensors which report to the Concentrator Control Room for improved monitoring and response. The Basin Supervisor is responsible for the operation and control of the seepage recovery systems.

4.6 Requirements for the Dams for Flood Storage Freeboard and Dam Monitoring

TSF operations monitoring and reporting will be conducted to provide adequate information and related metrics to measure the performance of the dams. The primary reporting and monitoring requirements relevant to the dams are flood storage and freeboard requirements, as well as dam instrumentation as discussed in the following sections. An updated water balance was completed in 2023 to evaluate anticipated near term main pond level rise projections.

4.6.1 Flood Storage and Freeboard Requirements

The determination of the appropriate freeboard for the TSF is not only dictated by the results of the normal operating and average hydrologic conditions, but primarily by a combination of upset operating conditions and hydrologic events of infrequent recurrence, such as a Probable Maximum Precipitation

event. The freeboard requirement for the MP7 TSF has been 10 feet (based on Barr's 1997 report *Probable Maximum Flood Analysis for the MP7 Tailings Basin*). Following the additional watershed area gained in 2021, the freeboard requirement was reanalyzed. The recent analysis indicates that if a 3-day Probable Maximum Flood (PMF) event occurs (32.2 inches of precipitation over 72 hours) less infiltration of 3.6 inches, the pond has the potential to bounce 7.8 feet from this isolated event. Including a wave runup of 3 feet, the required minimum freeboard is now 10.8 feet. After construction begins on the West Ridge Railroad, a portion of the watershed on the west will be removed from the overall basin watershed by construction of an earth berm to facilitate rail bed construction. At that time, the resulting freeboard will be reduced to a PMF bounce of 7.6 feet from the isolated PMP event and the minimum freeboard will be 10.6 feet for future operations.

Rise in water surface elevation of the TSF is calculated based on the following assumptions:

- A three-furnace operation is expected in 2024-2028.
- Discharge rates to and from the TSF that Northshore controls (tailings slurry water, water reclaimed to the concentrator, water discharged through the water treatment plant).
- Volume of water displaced by tailings deposition and voids losses from tailing settling and consolidation (water trapped between tailings particles).
- The combined effect of the following hydrological variables which is called watershed net yield: surface runoff from the upstream watershed, direct precipitation onto and evaporation from the TSF, and groundwater inflows to and outflows from the TSF.
- The total watershed area at the current status with inclusion of the West Ridge Basin progression project is 4,336 acres, and the main pond water surface area is about 1,677 acres estimated from available mapping. It is assumed that the construction of Dam 1 and Dam 2 extensions expected to occur during the 2024-2028 period will result in a total drainage area of 4,783 acres to the pond.
- Reclaim pond bottom will be filled during 2025 for approximately an 8-month period.

Scenarios of possible pond water rise use Northshore's expected annual operating rates for 2024-2028 and present some worst-case scenarios in terms of pond rise for wet years assuming planned production values. Results of the scenarios considered are listed below and are also summarized in Table 3.

1. The predicted annual rise in water surface elevation assuming average annual watershed net yield:
 - o 2.9 feet for 2024, 2026-2028, which accounts for the creation of beaches along Dam 1 and Dam 2, assuming 95% of fine tailings are placed under water.
 - o 7.4 feet for 2025, which accounts for the assumptions: an 8-month period of filling the Reclaim Pond, assuming all fine tailings are placed in the Reclaim Pond during those 8 months; the WTP is shut down for the entire year; the additional water from the filled

Reclaim Pond is displaced to the TSF; and 1,000 gpm below typical reclaim water rate to the Plant (1,000 gpm is assumed to be make-up water from Lake Superior).

- o The resulting total estimated average conditions net pond level rise from 2024 to 2028 is 19.0 feet assuming average annual watershed net yield.
2. Table 3The predicted annual rise in water surface elevation assuming an annual watershed net yield with a 10% probability of exceedance (i.e., the event with a return period of 10 years) is 20.0 inches, or 8.8 inches more than the annual average watershed net yield observed from 2018–2022:
- o 4.8 feet for 2024, 2026-2028, which accounts for the creation of beaches along Dam 1 and Dam 2, assuming 95% of fine tailings are placed under water.
 - o 9.3 feet for 2025, which accounts for the assumptions: an 8-month period of filling the Reclaim pond, assuming all fine tailings are placed in the Reclaim pond during those 8 months; the WTP is shut down for the entire year; the additional water from the filled Reclaim pond is displaced to the TSF; and 1,000 gpm below typical reclaim water rates is pumped from the main pond to the plant.
 - o The resulting hypothetical (10%) total estimated pond level rise from 2024 to 2028 is 28.5 feet assuming an annual watershed yield with a 10% probability of exceedance.
3. The predicted annual rise in water surface elevation assuming the 5-year, extreme hypothetical wet annual watershed net yield with a 1% probability of exceedance (i.e., the event with a return period of 100 years, which will likely include annual events with probability of exceedance greater than 1%) is 17.7 inches, or 6.5 inches more than the annual average watershed net yield observed in 2018–2022 over a period of five years:
- o 4.3 feet for 2024, 2026-2028, which accounts for the creation of beaches along Dam 1 and Dam 2, assuming 95% of fine tailings are placed under water.
 - o 8.8 feet for 2025, which accounts for the assumptions: an 8-month period of filling the Reclaim Pond, assuming all fine tailings are placed in the Reclaim pond during those 8 months; the WTP is shut down for the entire year; the additional water from the filled Reclaim pond is displaced to the TSF; and 1,000 gpm below typical reclaim water rate to the Plant.
 - o The resulting extreme conditions total estimated pond level rise from 2024 to 2028 is 26.0 feet assuming the 5-year, wet annual watershed net yield with a 1% probability of exceedance.
4. The predicted annual rise in water surface elevation assuming the water treatment plant is shut down for a period of 2 months in a given year (e.g. for major unanticipated maintenance work)

with average watershed net yield during normal operation conditions (2024, 2026-2028):

Table 3

- o 3.4 feet for 2024, 2026-2028, which accounts for the creation of beaches along Dam 1 and Dam 2, assuming 95% of fine tailings are placed under water.
- o 7.4 feet for 2025, which assumes the WTP is shut down for the entire water year for the Reclaim filling.
- o The resulting total estimated average conditions pond level rise from 2024 to 2028 is 21.0 feet assuming average annual watershed net yield with a 2-month shutdown each year.

The TSF water balance affects the required rate of dam raise to contain the pond water and, to some degree, the seepage from the pond. The pond level also affects the minimum dam elevation required for containing infrequent precipitation events such as a PMP, possible wave run-up, and the amount of beach above surface water that may require mitigation to minimize fugitive dust emissions. The water balance analysis shows that:

- For the period 2024-2028, the dam build schedule is adequate to meet freeboard requirements.
- If average conditions occur until 2028, and the Reclaim pond is filled in 2025, pond levels would be expected to rise approximately 2.9 feet per year in 2024, 2026-2028 and 7.4 feet per year in 2025.
- The rise in water level at the end of water year 2028 could be up to 19.0 feet under average conditions.

Table 3 Pond Level Rise Summary

	Scenario 1. Average Net Watershed Yield	Scenario 2. 10% Probability of Exceedance Each Year	Scenario 3. 5yr-1% Prob. Event Each Year	Scenario 4. Average Net Watershed Yield with WTP Off for 2 Mo.
Predicted Annual Rate of Rise (2024, 2026-2028) (ft/yr)	2.9	4.8	4.3	3.4
Predicted Annual Rate of Rise During Reclaim Pond Fill Year (2025) (ft/yr)	7.4	9.3	8.8	7.4
Total Predicted Rise (2024-2028) (feet)	19.0	28.5	26.0	21.0

4.6.2 Contingencies

Water management contingencies are needed for two scenarios:

1. Decreased water availability due either to significantly less direct precipitation (and resulting runoff) or more plant production (water use) occurs than assumed in this Operations Plan.

2. Increased water volume due either to significantly more direct precipitation (and resulting runoff) or less plant production (water use) occurs than assumed in this Operations Plan.

If less water than assumed is available at the TSF, the discharge of water through the water treatment plant will be reduced or curtailed as required and the additional beach that becomes exposed will be mulched, vegetated, or otherwise treated to control dust emissions.

If more water than assumed is available at the TSF, the crest heights of the perimeter containment dams (Dams 1, 2, and 5) will be increased as necessary by construction to provide adequate flood storage freeboard as dictated, and the water level will be drawn down over time through increased flow at the water treatment plant, if possible, and reduced or minimized lake water augmentation at the plant until conditions return to normal.

Northshore can raise the freeboard on the dams by placing additional plant aggregate along the downstream portion of the filter berms, thus increasing the elevation of the dam to protect for wave run up, etc. Furthermore, Northshore has provided another level of protection with the seepage collection ditches along Dams 1 and 2 which have the capacity to collect increased seepage in the very unlikely event that pond levels exceed the top of the filter berms, which represents hypothetically the worst upset condition. With the availability of plant aggregate along the dams, Northshore could also place plant aggregate immediately adjacent to or on top of the filter berms, further limiting the encroachment of water near the dam structure.

4.7 Design and Engineering

Northshore has retained Barr as the Engineer of Record (EOR) to provide ongoing engineering assistance at the TSF in addition to internal resources. Projects recently completed were dam raises, periodic geotechnical investigations, dam stability evaluations, seepage cutoff construction, and railroad grades on each dam. These projects are addressed in the following sections and are shown in Appendix A.

4.7.1 Perimeter Dam Performance

A yearly dam safety inspection has been completed by Barr to evaluate dam performance and to record progress since 2003. The associated dams and diversions of the TSF are inspected annually, which include Dam 1, Dam 2, Dam 5, Seepage Recovery Dams (SRD) 1A, 1B, and 23, the Reclaim dike, and diversion dams. Observations made during the inspections indicate each of the dams are stable, well maintained, and acceptable for continued operation and construction per plan. The annual tailings dam inspections, while pointing out routine maintenance items, did not identify any unresolved issues or concerns with the condition or integrity of the dams.

Dam construction during 2019 to 2023 included placing plant aggregate on Dam 1, Dam 2, Dam 5, and the Reclaim dike. Fine tailings were deposited upstream of Dam 1, Dam 2, the Reclaim dike, and the former Splitter Dike. Foundation preparation was started along the western portions of Dam 1 and Dam 2 as outlined in the TSF progression design in anticipation for the next dam raise. Elevated beaches were constructed adjacent to the upstream slope of Dam 1 and Dam 2.

A plan for the continued maintenance and operations of the dams for 2024 to 2028 follows:

- Install VW piezometers at the toe of Dam 1 near stations 43+00 and 45+00.
- Monitor instrumentation on Dams 1, 2, and 5 on a biannual basis.
- Perform interim site visits for construction observation and monitoring.
- Develop action levels for piezometers on the downstream slope and toe of each dam relative to dam stability when sufficient data becomes available.
- Raise Dams 1, 2, and 5 as necessary to maintain freeboard.
- Monitor pond and beach elevations to prevent water from coming in direct contact with the Dam 1 and Dam 2 filter berms and construct beaches in a manner to prevent fine tailings from overtopping the filter berm.
- Clear vegetation and algae from seepage collection ditches, from around weirs, and from ditches downstream of weirs.
- Continue to maintain traffic close to the center of the Reclaim dike.
- Continue vegetating exposed areas of dams as they are regraded and raised. In areas where there is not vegetation and erosion has occurred previously, regrade by placing new material into the eroded areas and revegetate. This process will reduce damage from regrading by larger equipment.
- Monitor any wet areas that appear at the toes of dams for evidence of seepage.
- Continue to remove brush along the core of each of the tailings dams and from the slopes of the diversion dams. Remove cleared vegetation to allow safe pedestrian access.

4.7.2 Dam Raises

Updated geotechnical design analyses have been performed for Dams 1, 2, 5, and the Reclaim dike within the period of the last Operations Plan. The updated results represent the current design at the elevation analyzed and supersede the preliminary analyses performed previously because additional information had been collected. The results of the stability analyses are summarized in the evaluation report in terms of the factor of safety for the limit-equilibrium method.

Typical (consistent with the current standard of practice) minimum required safety factors chosen for the project were 1.5 for the drained strength or effective stress stability analysis (ESSA) and 1.3 for the undrained shear strength analysis (USSA). A safety factor of 1.05 was used for the fine tailings liquefied strength analysis, assuming ALL fine tailings liquefied (regardless of exhibiting dilative behavior) from some unknown triggering event which is considered a conservative assessment.

The minimum safety factors used for design were based on confidence in the strength parameters due to years of testing and studies performed by several consultants consistent with industry state of practice. The average strength parameters were used for liquefied strengths of the fine tailings and the 33rd percentile strength parameters for all other materials evaluated in the studies.

4.7.2.1 Dam 1 Stability Analyses

The stability of Dam 1 was updated and analyzed in 2022/2023 using recent observations from instrumentation information and the existing and proposed dam geometry shown on Figure 4 . Analyses were conducted for cross sections at stations 28+40 and 35+00, located near the middle of the dam in the highest potential raise areas, also identified as the lowest natural ground foundation areas where soft lacustrine clay deposits are present. Analyses were performed for each cross section for the short-term undrained conditions (undrained strength stability analysis, $USSA_{yield}$ and $USSA_{liquefied}$) and long-term conditions (effective stress stability analysis, ESSA). Scenarios for each of these conditions were also reviewed considering a block failure (BF) along the surface between the lacustrine clay and foundation till soils.

Two tailings pond elevations under steady state conditions were included in the models. A tailings pond elevation of 1,255 ft, representing 10 feet of freeboard, and 1,263 feet, representing 3 feet of freeboard, were included in the analyses for the future crest elevation during the Operations Plan timeframe of 1,265 feet. The incorporation of 10 feet of freeboard within the analyses is more conservative than the minimum required freeboard of 10.8 feet. The inclusion of 3 feet of freeboard remains the same as historically considered for the minimum freeboard for PMP conditions.

Analyses were also performed to evaluate stability at the end of the construction of the next dam raise, when materials that can potentially consolidate and gain strength (such as fine tailings and clay) have not had enough time for strength gain immediately following construction. The tailings pond with steady state conditions for these analyses was set to an elevation anticipated to be the approximate level at the end of construction.

Table 4 to Table 7 present the results of stability analyses for Dam 1. The computed factors of safety are adequate under the planned conditions. Figure 5 presents a typical Dam 1 cross section.

Table 4 Computed Factors of Safety for Dam 1 Sta. 28+40 Under Various Scenarios

Slope Location and Material Configuration (Dam Crest - 1,265 ft)	Factor of Safety for Steady-State Pond Scenarios		Minimum Acceptable FOS
	Tailings Pond at 1,255 ft	Tailings Pond at 1,262 ft	
ESSA	2.35	2.33	1.5
ESSA Block Failure	2.05	2.03	1.5
USSA, Fine Tailings Yield Strength	1.51	1.48	1.3
USSA, Fine Tailings Yield Strength, Block Failure	1.32	1.3	1.3
USSA, Fine Tailings Liquefied Strength	1.43	1.41	1.05
USSA, Fine Tailings Liquefied Strength, Block Failure	1.21	1.19	1.05

Table 5 Computed Factors of Safety for Dam 1 Sta. 35+00 Under Various Scenarios

Slope Location and Material Configuration (Dam Crest - 1,265 ft)	Factor of Safety for Steady-State Pond Scenarios		Minimum Acceptable FOS
	Tailings Pond at 1,255 ft	Tailings Pond at 1,262 ft	
ESSA	2.34	2.3	1.5
ESSA Block Failure	2.1	2.05	1.5
USSA, Fine Tailings Yield Strength	1.5	1.48	1.3
USSA, Fine Tailings Yield Strength, Block Failure	1.35	1.31	1.3
USSA, Fine Tailings Liquefied Strength	1.43	1.41	1.05
USSA, Fine Tailings Liquefied Strength, Block Failure	1.24	1.2	1.05

Table 6 Computed Factors of Safety for Dam 1 Sta. 28+40 For End of Construction

Material Scenario	Factor of Safety		Minimum Acceptable FOS
	USSA	USSA BF	
EOC with Fine Tailings Yield Strength	1.50	1.39	1.3
EOC with Fine Tailings Liquefied Strength	1.45	1.30	1.05

BF – Block Failure mode of analysis

Table 7 Computed Factors of Safety for Dam 1 Sta. 35+00 For End of Construction Conditions

Material Scenario	Factor of Safety		Minimum Acceptable FOS
	USSA	USSA BF	
EOC with Fine Tailings Yield Strength	1.56	1.42	1.3
EOC with Fine Tailings Liquefied Strength	1.50	1.31	1.05

BF – Block Failure mode of analysis

4.7.2.2 Dam 2 Stability Analyses

The stability of Dam 2 was analyzed for the configuration expected during the timeframe for this Operations Plan using the existing and proposed geometry with a dam crest elevation of 1,270 feet as shown on Figure 4. Analyses were conducted for cross sections at two station locations, 34+75 and 42+00. These cross sections are near the middle of the dam in the highest potential dam raise areas, also identified as the lowest natural ground foundation areas where soft lacustrine clay deposits are present. Peat exists under a portion of the dam in these areas, as well. Similar to Dam 1, analyses were performed for each cross section for the short-term undrained conditions (USSA_{yield} and USSA_{liquefied}) and long-term conditions (ESSA). For each of these conditions, scenarios were also reviewed considering a block failure along the surface between the lacustrine clay and foundation till soils.

Similar to Dam 1, two tailings pond elevations under steady state conditions were included in the models. A tailings pond elevation representing 10 feet of remaining freeboard of 1,260 feet, and an elevation representing 3 feet of freeboard, 1,267 feet, were incorporated into the Dam 2 analyses for the future target crest elevation within the Operations Plan timeframe. As noted for Dam 1, inclusion of 10 feet of freeboard is consistent with the historical minimum freeboard for normal operating conditions and incorporation of 3 feet of freeboard remains the same as historically considered for the minimum freeboard for PMP conditions. Since the recently updated normal operating conditions target minimum freeboard is 10.8 feet, the analyses including 10 feet of freeboard for normal operating conditions are conservative.

Analyses were also performed to evaluate stability at the end of the construction of the next dam raise, when materials that can potentially consolidate and gain strength (such as fine tailings, peat, and clay) have not had enough time for strength gain immediately following construction. The tailings pond elevation with steady state conditions for these analyses was set to that anticipated to be present at the end of construction.

The results of the seepage and stability analyses presented in Table 8 to Table 11 show the computed factors of safety are adequate under the planned conditions. Figure 6 depicts a typical dam cross section.

Table 8 Computed Stability Factors of Safety for Dam 2 Sta. 34+75 Under Various Scenarios

Slope Location and Material Configuration	Factor of Safety for Steady-State Pond Scenarios		Minimum Acceptable FOS
	Tailings Pond at 1,260 feet	Tailings Pond at 1,267 feet	
Downstream Slope, ESSA	2.67	2.66	1.5
Downstream Slope, ESSA Block Failure	2.76	2.47	1.5
Downstream Slope, USSA, Fine Tailings Yield Strength	1.69	1.68	1.3
Downstream Slope, USSA, Fine Tailings Yield Strength, Block Failure	1.71	1.70	1.3
Downstream Slope, USSA, Fine Tailings Liquefied Strength	1.69	1.68	1.05
Downstream Slope, USSA, Fine Tailings Liquefied Strength, Block Failure	1.71	1.70	1.05

Table 9 Computed Stability Factors of Safety for Dam 2 Sta. 42+00 Under Various Scenarios

Slope Location and Material Configuration	Factor of Safety for Steady-State Pond Scenarios		Minimum Acceptable FOS
	Tailings Pond at 1,260 feet	Tailings Pond at 1,267 feet	
Downstream Slope, ESSA	2.71	2.56	1.5
Downstream Slope, ESSA Block Failure	2.46	2.44	1.5
Downstream Slope, USSA, Fine Tailings Yield Strength	1.77	1.75	1.3
Downstream Slope, USSA, Fine Tailings Yield Strength, Block Failure	1.69	1.68	1.3
Downstream Slope, USSA, Fine Tailings Liquefied Strength ⁽⁴⁾	1.77	1.75	1.05
Downstream Slope, USSA, Fine Tailings Liquefied Strength, Block Failure	1.69	1.68	1.05

Table 10 Computed Factors of Safety for Dam 2 Sta. 34+75 For End of Construction Conditions

Material Scenario	Factor of Safety		Minimum Acceptable FOS
	USSA	USSA BF	
EOC with Fine Tailings Yield Strength	1.70	1.72	1.3
EOC with Fine Tailings Liquefied Strength	1.70	1.72	1.05

BF – Block Failure mode of analysis

Table 11 Computed Factors of Safety for Dam 2 Sta. 42+00 For End of Construction Conditions

Material Scenario	Factor of Safety		Minimum Acceptable FOS
	USSA	USSA BF	
EOC with Fine Tailings Yield Strength	1.82	1.74	1.3
EOC with Fine Tailings Liquefied Strength	1.82	1.74	1.05

BF – Block Failure mode of analysis

4.7.2.3 Dam 5 Stability Analyses

Stability analyses and design for raising the Dam 5 crest to an elevation of 1,270 feet with 6H:1V downstream slopes were completed. Analyses were conducted for a cross section located at station 14+00, identified as the highest dam raise area and lowest natural ground foundation area where soft lacustrine clay deposits are present. Analyses were performed for the short-term undrained conditions (USSA) and long-term conditions (ESSA); note no fine tailings are present in the area of Dam 5. For each of these conditions, scenarios were also reviewed considering a block failure along the surface between the lacustrine clay and foundation till soils.

Similar to Dams 1 and 2, two tailings pond elevations under steady state conditions were included in the models. A tailings pond elevation of 1,270 feet, representing 10 feet of freeboard, and an elevation representing 3 feet of freeboard, 1,267 feet, were incorporated into the Dam 5 analyses for a crest elevation of 1,270 feet. As noted previously, inclusion of 10 feet of freeboard is consistent with the historical minimum freeboard for normal operating conditions and incorporation of 3 feet of freeboard remains the same as historically considered for the minimum freeboard for PMP conditions. Since the recently updated normal operating conditions target minimum freeboard is 10.8 feet, the analyses including 10 feet of remaining freeboard for normal operating conditions are conservative.

Analyses were also performed to evaluate stability at the end of the construction of the next dam raise, when materials that can potentially consolidate and gain strength (in this case, clay) have not had enough time for strength gain immediately following construction. The tailings pond elevation with steady state conditions for these analyses was set to that anticipated to be present at the end of construction.

The results of the seepage and stability analyses presented in Table 12 to Table 13 show the computed factors of safety are adequate under the planned conditions. Figure 7 depicts a typical Dam 5 cross section.

Table 12 Computed Factors of Safety for Dam 5 Sta. 14+00 Under Various Scenarios

Slope Location and Material Configuration	Factor of Safety for Steady-State Pond Scenarios		Minimum Acceptable FOS
	Tailings Pond at 1,260 feet	Tailings Pond at 1,267 feet	
Downstream Slope, ESSA	2.6	2.5	1.5
Downstream Slope, ESSA Block Failure	2.3	2.2	1.5
Downstream Slope, USSA	1.8	1.7	1.3
Downstream Slope, USSA, Block Failure	1.5	1.5	1.3

Table 13 Computed Factors of Safety for Dam 5 Sta. 15+00 For End of Construction Conditions

Material Scenario	Factor of Safety		Minimum Acceptable FOS
	USSA	USSA BF	
End of Construction	1.9	1.5	1.3

BF – Block Failure mode of analysis

4.7.2.4 Dam Stability Related Objectives

The following presents the objectives that Northshore will follow based on the conclusions of the recent dam evaluations. Northshore will:

- Continue the monitoring program at each of the dams to provide background information and compare to the stability models.
- Monitor groundwater indicators at the toe of all the dams and compare the monitoring data to the calculated model values to evaluate the effects of changes. Additional piezometers have been installed at the toe of Dams 1, 2, SRD 1A, SRD 1B, and SRD 23 to monitor seepage pressures. The instrumentation includes data loggers to obtain more frequent observations and store the data for use.
- Continue to measure the shear strength of the fine tailings. This includes characterization of dilative or contractive behavior of the fine tailings relevant to the ongoing process of liquefaction assessment. This will allow the evaluation of the tailings' liquefied strength to continue over time.
- Increase the knowledge and understanding of the current physical properties now and the potential future changes within the lacustrine clays under the dam footprints by geotechnical field investigations. A geotechnical investigation with in-situ laboratory testing is planned.

4.7.3 Instrumentation Monitoring

Instruments have been installed within Dams 1, 2, and 5, inclinometers, seepage weirs, and piezometers. The seepage weirs, piezometers, and inclinometers are monitored mostly in near real time and data

reported biannually by Barr. The monitoring instruments are used to measure the performance of the dams and their foundations as the dams are raised and the elevation of adjacent ponds increases. The two major geologic features monitored for the dams that significantly affect stability are the lacustrine clay and glacial till layers that comprise the dam foundations.

The most recent biannual monitoring event was completed in the spring of 2023. Data collected from piezometers, relief wells and inclinometers installed on Dams 1, 2, 5, and the Reclaim dike are summarized in the monitoring report.

Most piezometer readings for Dam 1, Dam 2, Dam 5, the Reclaim dike, and the seepage recovery dams are generally higher than the fall 2022 readings as expected due to the rising dam and pond within the tailings storage facility or due to precipitation. As has been noted for previous monitoring events early generation pneumatic piezometers at both Dam 1 and Dam 2, installed during the initial dam construction through 1997, appear to be deteriorating and near end of life for this type of device. Pneumatic piezometers and the device used to read them are considered outdated technology at this time for the purposes of automated monitoring program that Northshore has developed. Many of the pneumatic piezometers with non-functional and/or of suspect functionality have been replaced with new vibrating wire piezometers that are the current state of practice devices used at many facilities. Plans have been developed and implemented to update all important and significant instrument locations with new vibrating wire piezometers including data loggers to acquire readings more frequently. Data from the relief wells appeared to be within the historical data range.

Algae and cattails should be cleared out of the weirs at Dam 1 and Dam 2 to accommodate measurements and prevent water build-up in the seepage collection ditches. The east weir at Dam 1 should be repositioned in a horizontal or level orientation to channel water through the v-notch for accurate measurements. New V-notch weirs have been designed and will be installed at the existing weir locations in 2024 to allow for installation of remote sensors to monitor water levels in the seepage collection ditches in near real-time. Seepage channel measurements from the spring 2023 event were higher than the general range of historical data.

No significant movement was recorded for inclinometers considering data compared between the fall 2022 and spring 2023 monitoring events. The upper portion of inclinometer I04-2 had been damaged, and a replacement inclinometer is in progress. Inclinometer I13-2 has been damaged to the point where it is inoperable, and a MEMS-based in-place inclinometer was installed in the adjacent I18-2 casing in October 2022. Apparent casing drift, likely due to freeze-thaw and/or absence of grout when instruments were raised for dam raises, was observed for the upper portion of several other inclinometers.

Biannual or more frequent monitoring events, including downloading of data from data loggers not connected to the near real-time monitoring system, will continue unless instrumentation or observations indicate potential for instability, at which point more frequent monitoring should occur. Nearly all of the deformation and groundwater instruments are currently connected to a near real-time monitoring system and data dashboard for stakeholder review.

4.7.4 Railroad Construction

Plant aggregate is a necessary component for dam construction and other projects at the TSF. As part of the TSF storage practices, plant aggregate is hauled by rail to both Dams 1 and 2 every day of production. To efficiently place the material, the rail lines cross both dams. As the dams are raised, the railroad grades are also raised in advance or higher elevation than the upstream portion of the actual dam. Dam 1 railroad grade was raised in 2017 and 2018 to an elevation of 1,265 feet. The Dam 2 railroad grade is currently at 1,250 feet, with portions of grade for the next raise constructed in 2022 and 2023 in preparation for the railroad raise to 1,270 feet in 2024 or 2025. The rail grade is currently being prepared at an elevation of 1,270 feet for subsequent track placement in late 2023 on Dam 5, with future connection to Dam 1 and Dam 2 rail segments. The new West Ridge Railroad alignment that will be the final railroad grade and will allow access to both Dam 1 and Dam 2 at their ultimate design at elevation of 1,315 feet.

4.7.5 Engineering Controls for WRRR Construction

Several erosion and sediment control measures are incorporated into the SWPPP and erosion control plans for future construction. For example, ditches will be constructed on the outside of the West Ridge railroad embankment to collect any runoff. Erosion control blankets will be placed in the bottom of the ditch to prevent erosion until vegetation becomes established. Near the downstream portion of the ditch at the west end of Dam 1, a temporary sedimentation basin will be constructed, which will be maintained until all disturbed contributing areas have adequate vegetative cover. Best management practice elements such as silt fence, ditch checks, and biorolls will also be installed to capture sediment in areas adjacent to wetlands and/or in areas where water may be directed offsite as allowed per the SWPPP. In areas of exposed plant aggregate where precipitation may cause offsite runoff to occur, the plant aggregate will be covered to limit precipitation contact with exposed plant aggregate surfaces.

4.7.6 Site Survey Control

The annual TSF activity record historically has been documented as part of the NPDES permit requirements, and site survey control is available within the TSF. The control is checked intermittently against points used frequently for survey and layout however Northshore has installed a survey GPS system at the TSF with a base station located near the landfill. The control is used for the construction of the TSF only and not for long-term deformation monitoring. An aerial survey was completed in May of 2023. The results of the survey will be used for future design and water balance work. Northshore generally performs its own construction staking using GPS with a base station located on a control point at the landfill. Bathymetry of the main pond and reclaim pond was completed in June of 2023.

5.0 TSF Closure

5.1 Introduction

When the 2004-2008 Five Year Operating Plan was developed, introducing significant changes to the operations and construction of the TSF, it included a planned closure approach, consistent with the spirit of the Closure Consensus Plan (CCP) and has been carried through each subsequent Five Year Operating Plans.

The CCP was developed when Reserve Mining Company closed in 1986. At that time, the TSF was left with a significant amount of excess stored water, minimal plant aggregate to construct any additional required features, threatening the long-term stability of the containment dams (Dams 1, 2, and 5). The facility also had limited means for treating and discharging TSF water and, therefore, an inability to control the overall water balance of the TSF in the event of storms or wet years. Issues related to the need for a closure plan that were addressed in the CCP were the needs for maintenance or improvement of dam stability, provisions for flood storage, treatment of water for release until direct release is authorized, ongoing dust control, revegetation of reclaimed surfaces, and long-term erosion control.

In general, a TSF closure plan should include the following items:

- General descriptions of plans (both planned and unplanned closures)
- Programs for perpetual maintenance and safety of the TSF including adequate monitoring
- Management of ponded waters
- Monitoring and mitigation of surface and groundwater pollution
- Vegetation and landscaping plans

This Operating Plan encompasses these objectives which were also embodied in the 1988 Closure Consensus Plan with details updated as noted to reflect existing conditions and information. This updated Operations Plan supersedes in full the CCP and all obligations contained therein.

5.2 Recent Initiatives

The Dam 5 crest was recently constructed to elevation 1270 with a downstream slope of 6:1. The slope was fully reclaimed with established vegetation. Dams 1 and 2 have been raised including foundation preparation, filter and drain placement, and seepage cutoffs.

A near-real time instrumentation and monitoring system was developed and implemented. Nearly all instruments at the site can be monitored remotely and a database has been developed to store and present the data graphically for the stakeholders.

A plan was continued to discharge tailings onto the beach within a "training" or sacrificial upstream dike enclosure to create "elevated beaches." These beaches were raised 10 to 20 feet above the pond surface

in 2019, depending on the height of the filter berm above the pond surface, and were constructed 200 to 400 feet in width running the length of the dam face. The configuration was created so the tailings could dewater after discharge on the beach and within the dikes and support equipment for grading and vegetation that can develop, grow, and stabilize the tailings over a number of years until it is necessary to discharge over the beach again. This process addressed the concern in the CCP that the beaches would stay wet and were undulating, thereby trapping water on the surface. This approach also did not require plant aggregate cover, use of which has proven to make it more difficult to achieve a stabilized surface in short periods of time.

The use of elevated beaches may be considered in the future with the potential benefits in closure being minimized resuspension of tailings due to additional water depth over the wave zone; maximized the use of vegetation on the fine tailings surfaces, which is the current successful practice for achieving interim and final cover at Northshore (and other northern Minnesota mining facilities); minimized demand on plant aggregate resource at the TSF, which could be used for other construction and mining activities; maintained adequate distance of the TSF pool away from the crest of the dam, and minimized overall dust generation during closure from hauling aggregate and placing it over fine tailings beaches.

The CCP stated that the water treatment plant would be used to treat and release water until such time that direct release could occur and that an increase in capacity would be required. In 1989, following 8 years of reduced or no production, it was determined that additional discharge capacity was needed to reduce the volume of water in the TSF. Limited by 40 CFR 440, a maximum discharge rate was chosen by MPCA and DNR based on the highest net precipitation that had been calculated, equating to 8.64 MGD in 1985. The water treatment plant was upgraded in 2007 to average/maximum design flow of 6.0/7.5 MGD by adding rapid-mix, flocculation and filtration treatment capacity. In recent years, flow rates have been achieved up to about 4,200 gpm. The water treatment plant has effectively managed the TSF water volume over time, keeping water levels below the elevations required for the design and flood conditions. As a result of the upgrades to the water treatment plant, the reduced water pond, and stable dams described previously, the closure plan updates proposed in the following section align with the limited wet closure goals of smaller, less voluminous ponds and eliminate the need for a substantial overflow channel unless otherwise deemed necessary by further water balance studies.

5.3 Closure Conditions

Closure is defined as the cessation of operations of the concentrating plant in Silver Bay and the resulting cessation of tailings deposition at the TSF. Closure can occur in several forms, including:

- Temporary closure, defined as a short-term shutdown of the plant and TSF operations for a period that may last several years, as experienced between 1986 and 1990. A temporary closure becomes a permanent closure when the plant in Silver Bay is no longer maintained in a condition to restart operations.
- Premature closure, defined as an unplanned permanent cessation of operations with little or no prior notice.

- Planned final closure, defined as permanent cessation of operations with sufficient prior notice to accomplish much of the TSF closure construction during the last years of plant operation.

In all three cases, the closure would follow the concepts established in this plan, with the main differences related to timing and the source and placement of the materials.

As defined by Minnesota state law, the planned final closure and demolition of a taconite plant must include a two-year holding period, during which the facilities are sufficiently maintained to allow operations to restart. Any final closure can only proceed after this holding period. The effect is that any planned final closure is treated as a temporary closure for at least 2 years.

The following sections contain general closure plans for each of the scenarios listed above. In all cases, detailed plans including the final pond level to be achieved, the location and design of spillways, perpetual maintenance requirements, and other details would be finalized at the time of closure.

5.3.1 Temporary Closure

In the event of a temporary cessation of operations at Milepost 7, the following steps will be taken:

1. The MPCA and DNR will be notified.
2. The Operations Plan will be adjusted to reflect the cessation of operations and detailed plans developed to maintain operability of the TSF for the required two-year period.
3. The freeboard and stability of the containment dams (Dams 1, 2, and 5) will be evaluated and corrective action will be taken as required to protect public health and safety.
4. Water treatment plant operations will continue as required to control the pond level and maintain adequate freeboard for the dams.
5. Areas of exposed, untreated plant aggregate and fine tailings will be treated or covered with mulch minimizing dust emissions.
6. Monitoring and instrumentation of air and water quality will continue, as required.
7. Operation of the seepage recovery facilities will continue as designed.
8. Stream diversions will continue to be inspected and maintained.

5.3.2 Premature Closure

In the event of a premature closure of the TSF, the following steps will be taken:

1. The TSF will be maintained, following the steps listed in the temporary closure section, for a period as defined by Minnesota State Law (2 years) to allow operations to resume if appropriate.

-
2. Details of the closure plan will be refined to define the final closed configuration of the TSF including updated water balance, spillway design, water treatment operation, a vegetation plan, perpetual maintenance requirements, and a closure schedule.
 3. Although the dams are currently stable under a variety of conditions, Northshore has committed to ongoing evaluations of dam seepage, stability, and material characterization and to evaluate the stability of the proposed conditions for the containment dams (Dams 1, 2, and 5) and adjust the configurations if needed to meet the goals of the closure plan.
 4. There is currently approximately 10,217,853 cubic yards (Jan.2023) of plant aggregate available that can be used for the construction activities such as raising freeboard of the dams.
 5. At the end of the two-year temporary closure period, based on a schedule developed by Northshore and approved by the agencies, the following will occur:
 - a. Remaining exposed fine tailings will be vegetated to prevent erosion and dust emissions .
 - b. Wave erosion zones on the fine tailings will be addressed to minimize re-disturbance; this could be achieved through cover with plant aggregate or other suitable materials to produce a reclaimable surface.
 - c. Buildings, pipelines, and other structures not required for future maintenance will be removed.
 - d. All roads, railroad grades, dikes, borrow pits, building sites, or other disturbed areas not required for future maintenance will be contoured and vegetated.
 - e. An emergency spillway will be designed and constructed to handle runoff and protect the integrity of the containment dams (Dams 1, 2, and 5).
 6. Northshore will continue to operate the water treatment plant to control the pond level until such time as the pond water quality allows direct discharge of pond water outside of the TSF.
 7. With the improvement in water quality, direct discharge will be used to control the pond level in the following manner:
 - a. An operating spillway will be excavated to control the TSF surface-water level.
 - b. The stream diversions and seepage recovery dams will be breached according to plans set forth in the CCP.
 - c. The water treatment plant will be shut down.
 - d. All remaining structures and roads not required for future access will be reclaimed.
 8. Periodic monitoring and inspections will continue until the TSF is deemed to be reclaimed to a natural, self-sustaining condition.

5.3.3 Planned Final Closure

For a planned closure of the TSF, the following steps will be taken:

1. Upon cessation of operations, closure will continue, following the steps listed for temporary and premature closures.
2. Prior to final closure:
 - a. The TSF will be managed to minimize the pond water volume and the pond will be filled with fine tailings in a manner that will force the water to the west shore of the TSF.
 - b. Exposed beaches will be shaped to form a surface capable of reclamation and vegetated. Plant aggregate will be placed in wave erosion zones to minimize erosion and wave resuspension of fine tailings.
 - c. The water treatment plant will operate as required to control the pond level and minimize the pond water volume.

One difference between the current closure plans detailed above and the Closure Consensus Plan is that, in the current plan developed in 2004, the fine tailings stored underwater below wave erosion zones will not be covered with plant aggregate. At the time of the Closure Consensus Plan, it was thought that the fine tailings covering the pond bottom would be continually re-suspended and not allow the pond to clarify. To cover and contain all fine tailings, a 1-foot layer of plant aggregate was to be placed over the entire pond bottom. However, observations during the temporary plant closure (1986 to 1990) showed that TSF water clarity improved dramatically during the first few months after operations ceased, indicating that a layer of plant aggregate over the underwater fine tailings is unnecessary. Studies and experience since 1988 have corroborated this finding.

The uncompacted plant aggregate unit weight is about 134 pounds per cubic foot and the fine tailings in the center of the TSF can weigh as little as 75 pounds per cubic foot. Because the plant aggregate is much heavier than the fine tailings, it would be difficult to place a layer of plant aggregate under water on top of the soft, fine tailings without displacing, disrupting, or co-mingling the two, resulting in inefficient stabilization and resuspension of fines. The difficulty of placing aggregate would be compounded by the long-term differential settlement of fine tailings that would occur with the added weight of the aggregate. Even if a thin layer of plant aggregate could be established on the fine tailings, the differential settlement would likely expose other fine tailings, rendering the cover ineffective. Based on this scenario, placing plant aggregate cover over the entire pond bottom is not part of the current plan.

6.0 Summary

6.1 General Considerations, 2024 through 2028

The analyses show that the dams, if constructed as proposed and shown in Section 4.0, will provide adequate freeboard for normal variations in precipitation and the PMP flood event. The dam safety inspection, along with the ongoing testing, instrumentation, and stability analyses, will continue to demonstrate safe, reliable dam design. The ongoing approach for the dams is to prepare plans and specifications for construction along with construction inspection to verify that the dams are constructed as designed and within acceptable margins of safety. The ongoing evaluations of the long-range plan for dam construction including slopes, access routes and West Ridge Railroad alignments, material delivery, and material stockpiling, will occur during this Operations Plan cycle to provide long-term guidance for operations of the facility. The plans presented in this report will provide the basis for the final details of construction. Treated water will continue to be discharged from the TSF to Beaver River to allow for control of water levels within the TSF.

Figures



TAILING BASIN CONTROL DATA

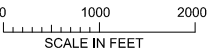
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16	HV-16	615676.6820	3054865.0750	1214.85

LAYOUT NOTES:

1. LAYOUT BASED ON CONTOURS DEVELOPED FROM LIDAR BY NV5 GEOSPATIAL COMBINED WITH BATHYMETRY BY J.F. BRENNAN. LIDAR COMPLETED MAY 2023. BATHYMETRY COMPLETED JUNE 2023. MAPPING BASED ON THE FOLLOWING DATUM:

- VERTICAL DATUM: TWO FOOT CONTOUR
INTERVAL BASED ON NORTH AMERICAN
VERTICAL DATUM OF 1988.

- HORIZONTAL DATUM: MINNESOTA STATE PLANE
COORDINATE SYSTEM, NORTH ZONE,
NAD 83/96



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NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	BID	CONSTRUCTION	RELEASED TO/FOR	DATE RELEASED



Corporate Headquarters:
Minneapolis, Minnesota
Ph: 1-800-632-2277

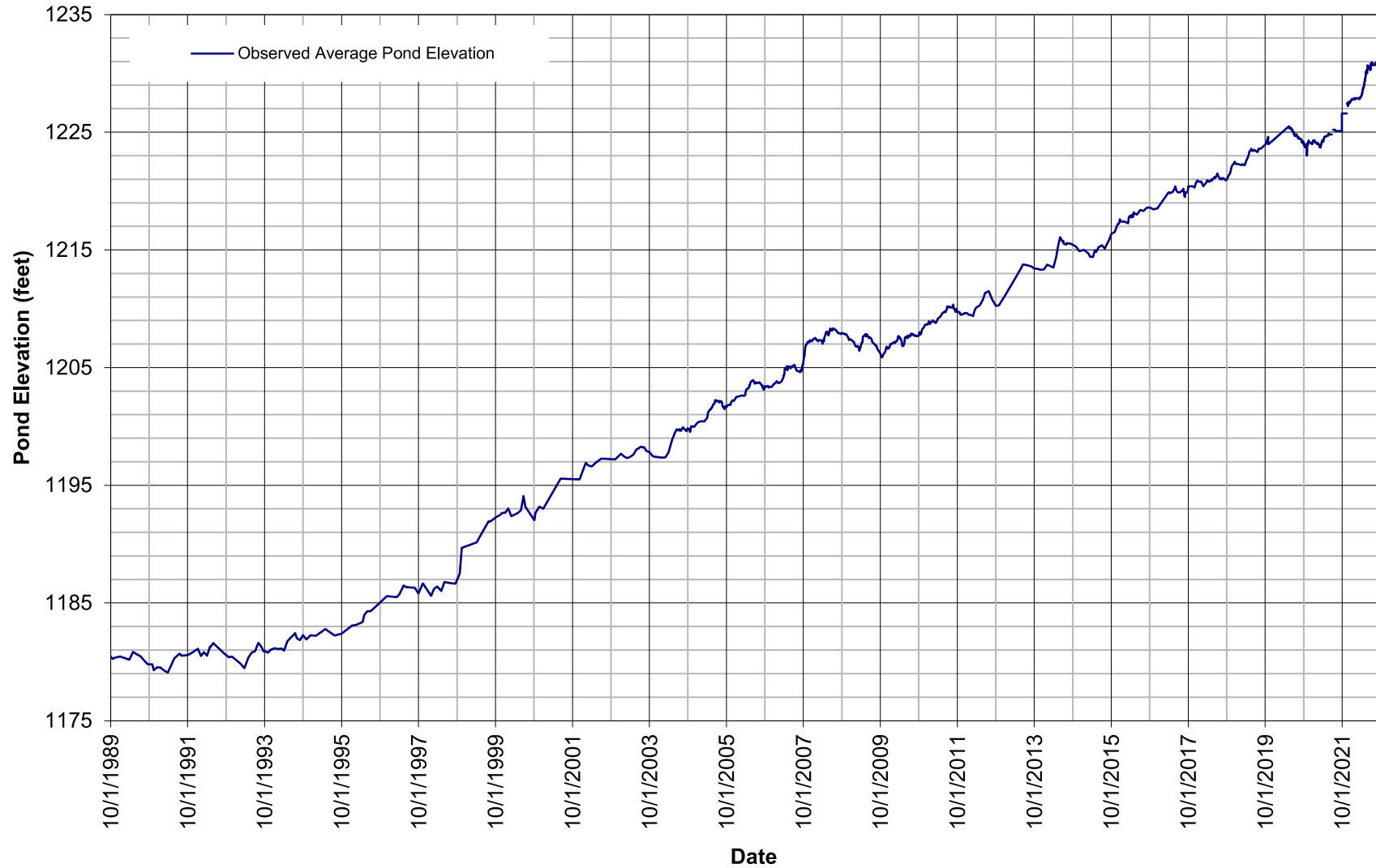
Project Office:
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
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MINNEAPOLIS, MN 55435
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Fax: (952) 832-2601
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Checked	ATG
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Approved	

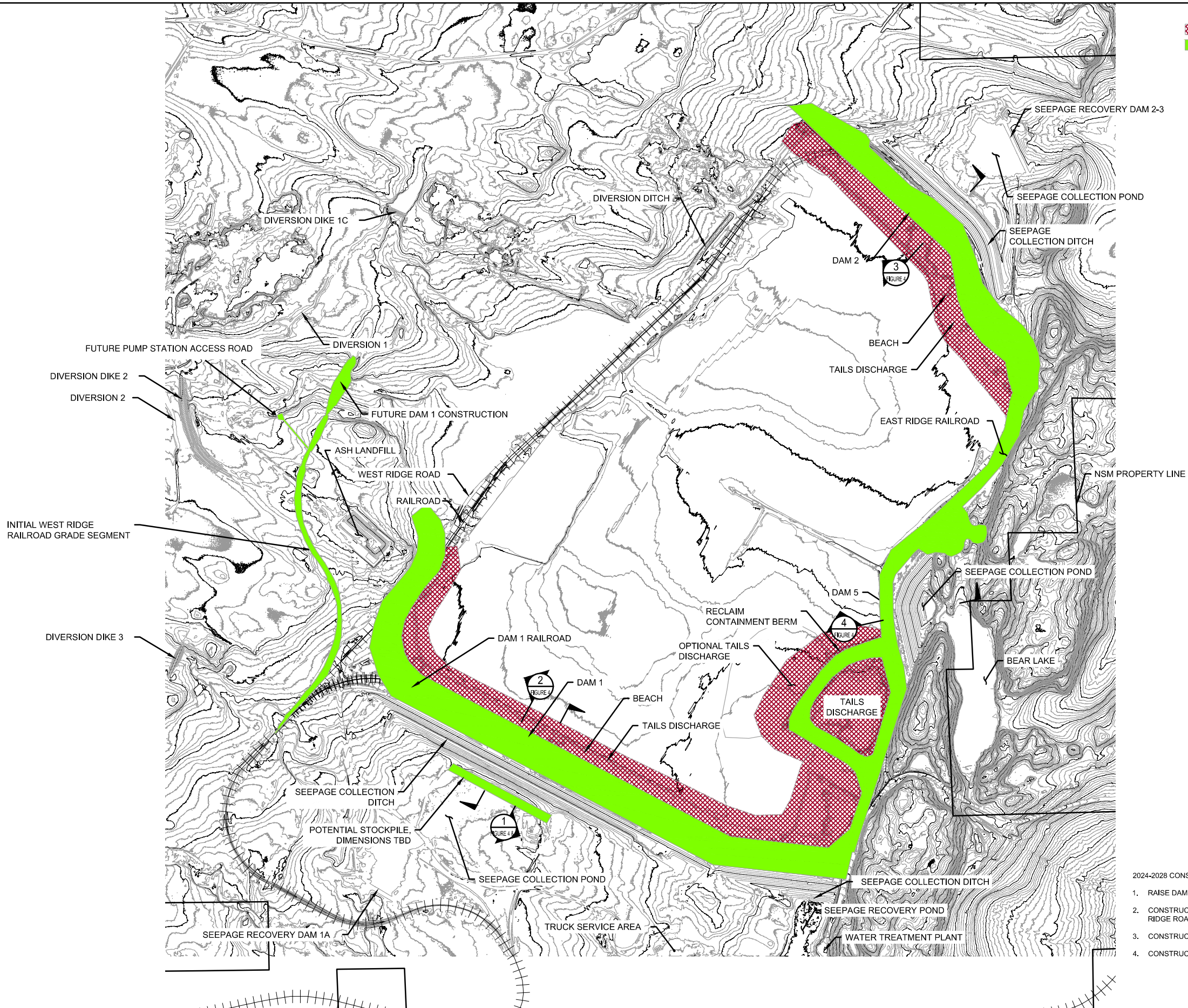
NORTHSHORE MINING COMPANY
SILVER BAY, MINNESOTA

MP-7 TAILINGS BASIN SILVER BAY, MINNESOTA		BARR PROJECT No. 23/38-086	
FIVE YEAR OPERATING PLAN 2023 BASIN CONDITIONS		CLIENT PROJECT No.	
DWG. No. FIGURE 1	REV. No. A		

**Figure 2: MP7 Tailings Basin Pond Elevation
Northshore Mining MP7 Water Balance
1989-2022 Historical Data**



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FINE TAILING DEPOSITION
PLANT AGGREGATE CONSTRUCTION

- 2024-2028 CONSTRUCTION
1. RAISE DAM 1, DAM2, AND RECLAIM DAM.
 2. CONSTRUCT RAILROAD GRADES ON DAM 1, 2, 5, AND EAST RIDGE ROAD.
 3. CONSTRUCT INITIAL PORTION OF DAM 5 EXTENSION.
 4. CONSTRUCT INITIAL PORTION OF WEST RIDGE RAILROAD.

0 1000 2000
SCALE IN FEET



NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT	PERMIT	BID	CONSTRUCTION	RECORD

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Corporate Headquarters:
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Scale	AS SHOWN
Date	09/29/2023
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Approved	---

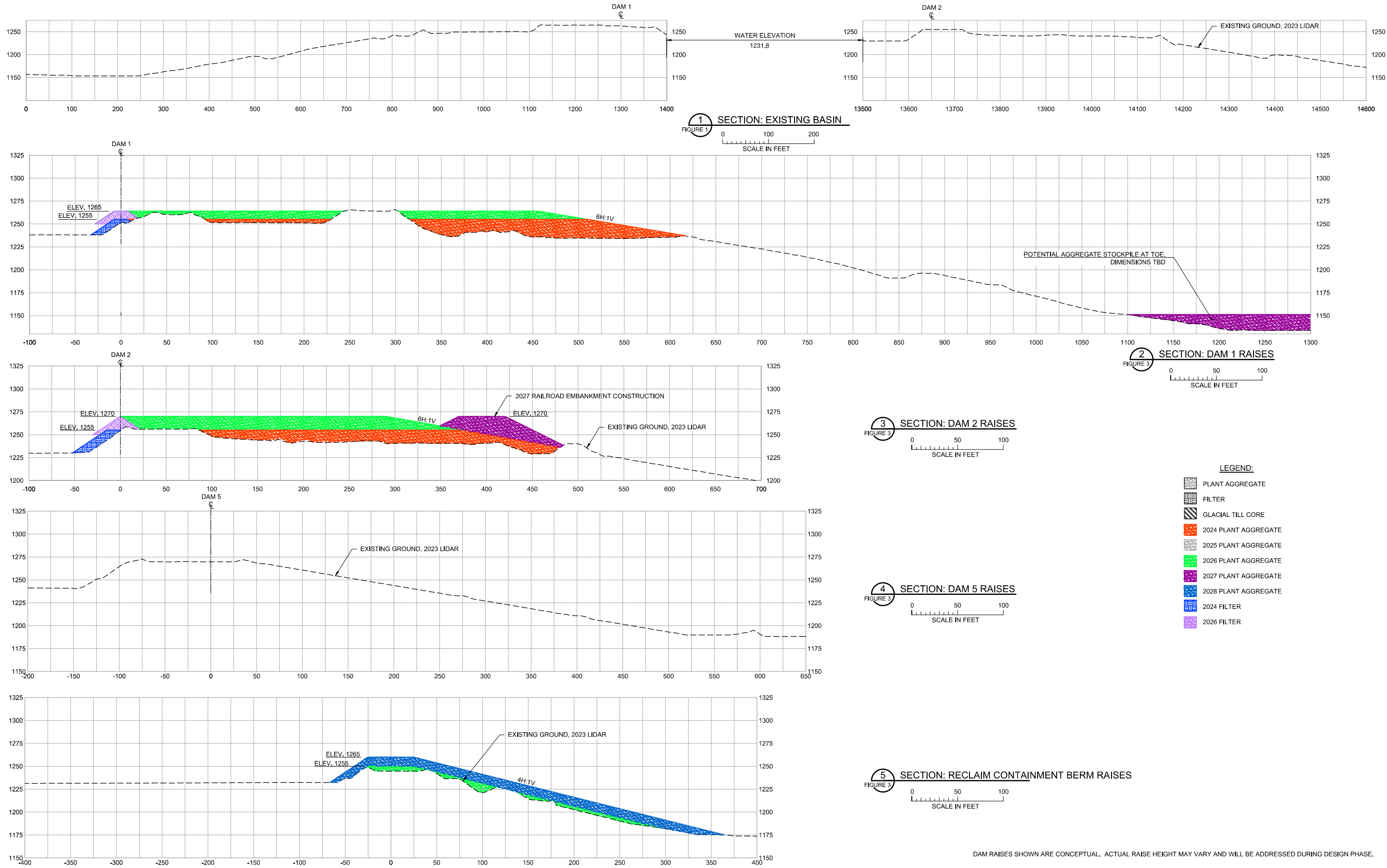
NORTHSHORE MINING COMPANY
SILVER BAY, MINNESOTA

MP-7 TAILINGS BASIN
SILVER BAY, MINNESOTA
FIVE YEAR OPERATING PLAN
PROPOSED CONSTRUCTION 2024-2029

BARR PROJECT No.	23/38-086
CLIENT PROJECT No.	
DWG. No.	FIGURE 3
REV. No.	A

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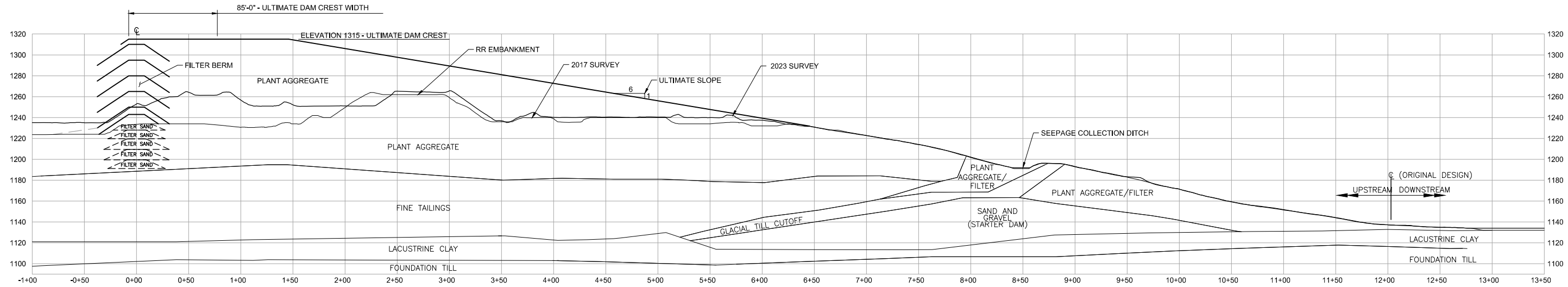
BARR
Corporate Headquarters:
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Ph: 1-800-632-2277

Project Office:
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Scale	AS SHOWN
Date	09/29/2023
Drawn	GSJ
Checked	ATG
Designed	---
Approved	---

NORTHSHORE MINING COMPANY SILVER BAY, MINNESOTA	MP-7 TAILINGS BASIN SILVER BAY, MINNESOTA		BARR PROJECT No. 23/38-086	
	FIVE YEAR OPERATING PLAN TYPICAL CROSS-SECTIONS		CLIENT PROJECT No.	
			DWG. No. FIGURE 4	REV. No. A

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1 SECTION: DAM 1 TYPICAL STRATIGRAPHY STATION

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SCALE IN FEET

DAM RAISES SHOWN ARE CONCEPTUAL. ACTUAL RAISE HEIGHT MAY VARY AND WILL BE ADDRESSED DURING DESIGN PHASE.

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

CLIENT							
PERMIT							
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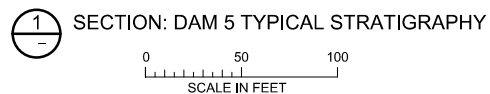
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MINNEAPOLIS, MN 55435
Ph: 1-800-632-2277
Fax: (952) 832-2601
www.barr.com

Scale	AS SHOWN
Date	09/29/2023
Drawn	GSJ
Checked	ATG
Designed	---
Approved	---

NORTHSHORE MINING COMPANY
SILVER BAY, MINNESOTA

MP-7 TAILINGS BASIN SILVER BAY, MINNESOTA		BARR PROJECT No. 23/38-086	
DAM 1 CONCEPTUAL DAM RAISES TYPICAL CROSS-SECTION		CLIENT PROJECT No.	
		DWG. No. FIGURE 5	REV. No. A

[illegible]

Appendices

Appendix A

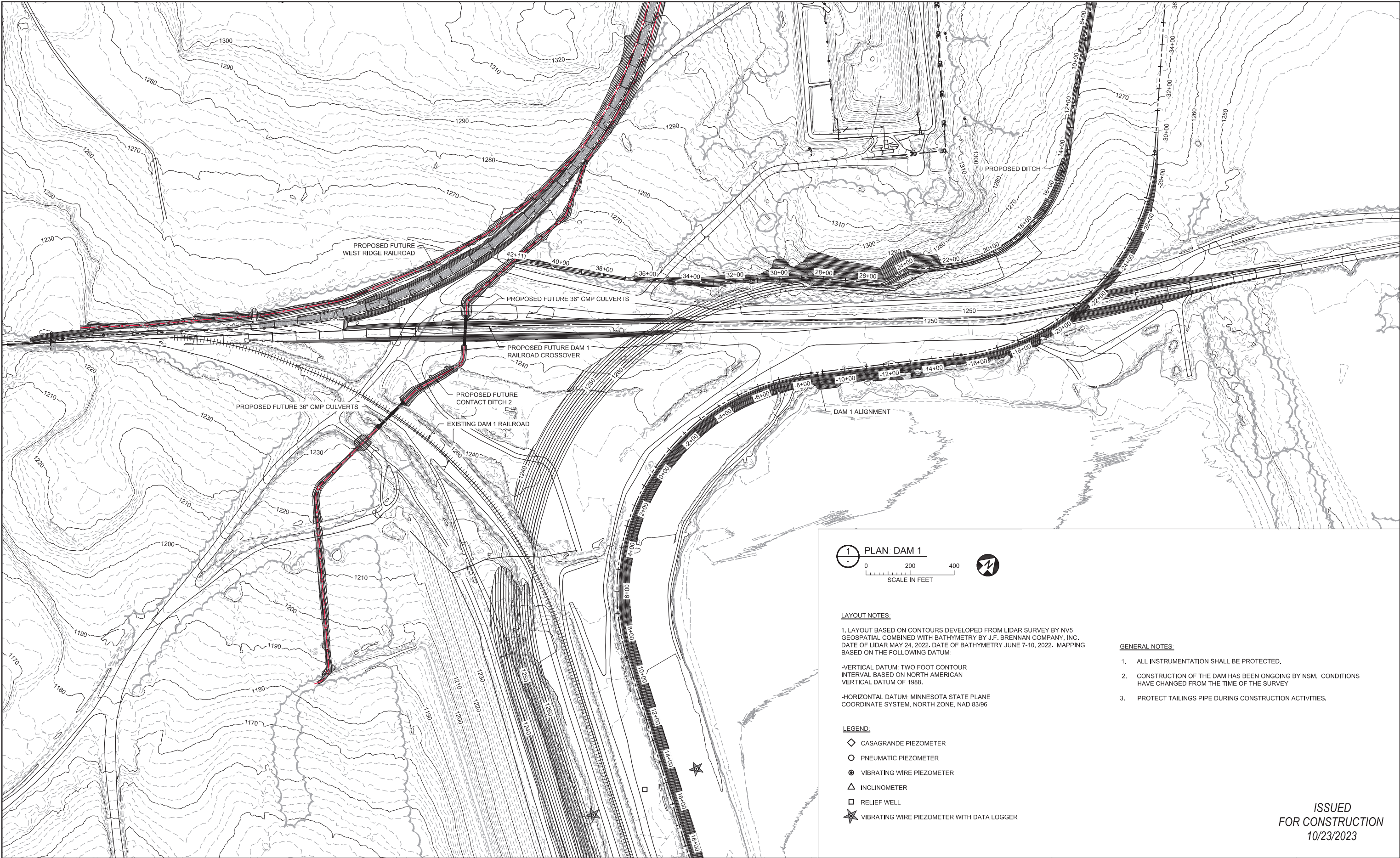
Recent Construction Plans

Dam 1
Dam 2
Dam 5

Dam 1

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1 PLAN DAM 1
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LAYOUT NOTES

1. LAYOUT BASED ON CONTOURS DEVELOPED FROM LIDAR SURVEY BY NV5 GEOSPATIAL COMBINED WITH BATHYMETRY BY J.F. BRENNAN COMPANY, INC. DATE OF LIDAR MAY 24, 2022. DATE OF BATHYMETRY JUNE 7-10, 2022. MAPPING BASED ON THE FOLLOWING DATUM:

-VERTICAL DATUM: TWO FOOT CONTOUR INTERVAL BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988.

-HORIZONTAL DATUM: MINNESOTA STATE PLANE COORDINATE SYSTEM, NORTH ZONE, NAD 83/96

LEGEND

- ◇ CASAGRANDE PIEZOMETER
- PNEUMATIC PIEZOMETER
- VIBRATING WIRE PIEZOMETER
- △ INCLINOMETER
- RELIEF WELL
- ★ VIBRATING WIRE PIEZOMETER WITH DATA LOGGER

GENERAL NOTES

1. ALL INSTRUMENTATION SHALL BE PROTECTED.
2. CONSTRUCTION OF THE DAM HAS BEEN ONGOING BY NSM. CONDITIONS HAVE CHANGED FROM THE TIME OF THE SURVEY
3. PROTECT TAILINGS PIPE DURING CONSTRUCTION ACTIVITIES.

ISSUED
FOR CONSTRUCTION
10/23/2023

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME: SARA L. LEOW
SIGNATURE:
DATE: 10/23/23 LICENSE #: 47103

CLIENT
BID
CONSTRUCTION

RELEASED TO/FOR

A	B	C	0	1	2	3

DATE RELEASED

BARR
Project Office:
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
Suite 200
MINNEAPOLIS, MN 55435
Corporate Headquarters:
Minneapolis, Minnesota
Ph: 1-800-632-2277
Fax: (952) 832-2601
www.barr.com

Scale	AS SHOWN
Date	10/23/23
Drawn	GSJ
Checked	ATG
Designed	GSJ
Approved	SLL

NORTHSHORE MINING COMPANY
SILVER BAY, MINNESOTA

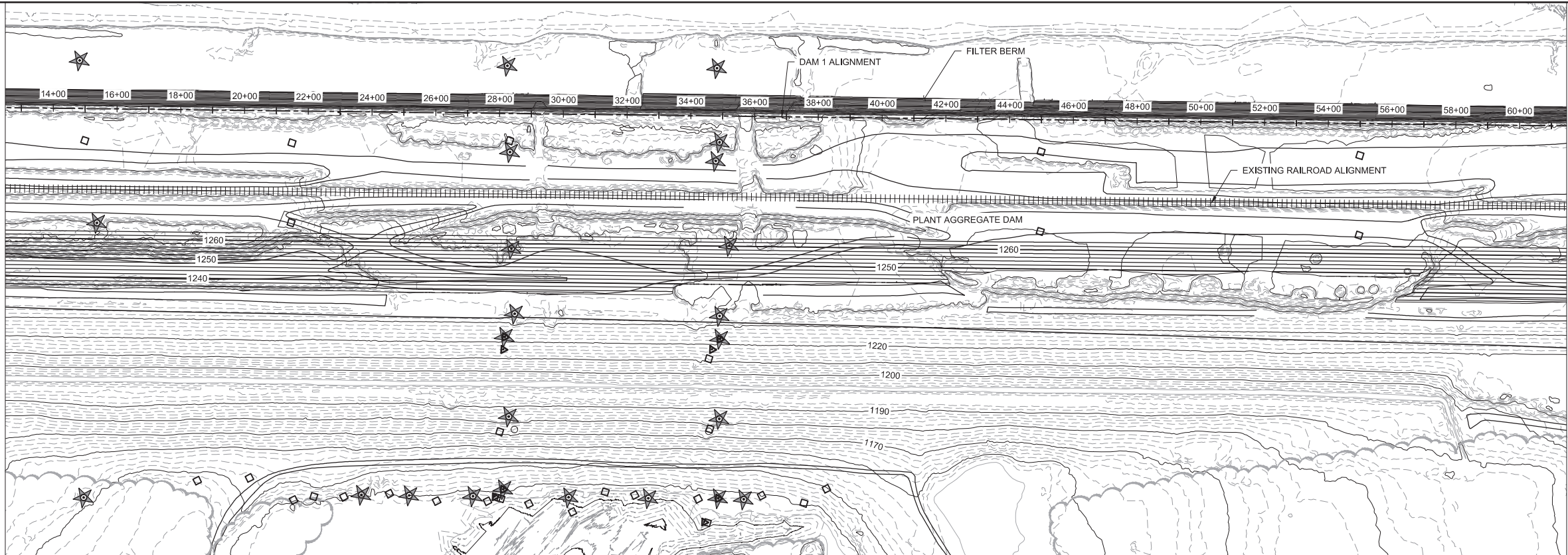
PROPOSED DAM CONSTRUCTION
MILEPOST SEVEN TAILINGS BASIN

DAM 1 RAISE - ELEVATION 1265
CONSTRUCTION PLAN

BARR PROJECT No. 23381132	REV. No. A
CLIENT PROJECT No.	
DWG. No. CC-004	

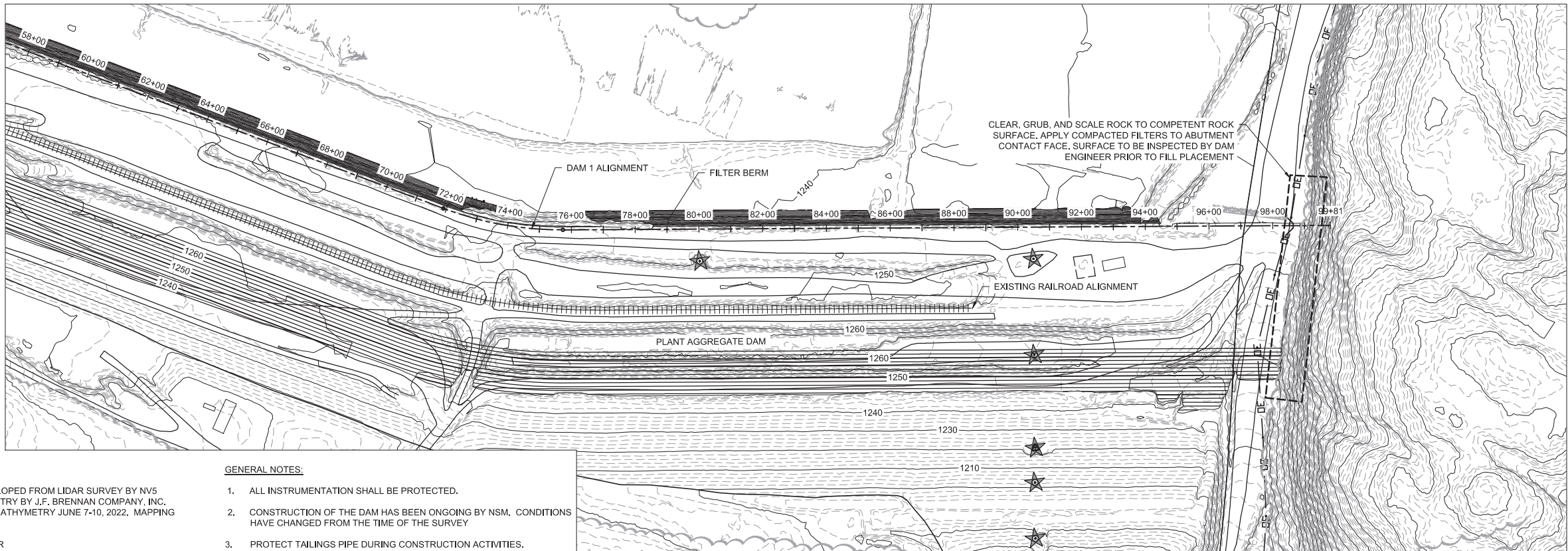
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BARR M:\AutoCAD 2011\AutoCAD 2011 Support\enu\Template\Bar_2011_Template.dwt Plot at 1 10/05/2010 14:03:50



1 PLAN: DAM 1

0 200 400
SCALE IN FEET



2 PLAN: DAM 1

0 200 400
SCALE IN FEET



LAYOUT NOTES:

1. LAYOUT BASED ON CONTOURS DEVELOPED FROM LIDAR SURVEY BY NV5 GEOSPATIAL COMBINED WITH BATHYMETRY BY J.F. BRENNAN COMPANY, INC. DATE OF LIDAR MAY 24, 2022. DATE OF BATHYMETRY JUNE 7-10, 2022. MAPPING BASED ON THE FOLLOWING DATUM:

-VERTICAL DATUM: TWO FOOT CONTOUR INTERVAL BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988.

-HORIZONTAL DATUM: MINNESOTA STATE PLANE COORDINATE SYSTEM, NORTH ZONE, NAD 83/96

GENERAL NOTES:

- ALL INSTRUMENTATION SHALL BE PROTECTED.
- CONSTRUCTION OF THE DAM HAS BEEN ONGOING BY NSM. CONDITIONS HAVE CHANGED FROM THE TIME OF THE SURVEY
- PROTECT TAILINGS PIPE DURING CONSTRUCTION ACTIVITIES.

LEGEND:

- CASAGRANDE PIEZOMETER
- PNEUMATIC PIEZOMETER
- VIBRATING WIRE PIEZOMETER
- INCLINOMETER
- RELIEF WELL
- VIBRATING WIRE PIEZOMETER WITH DATA LOGGER

ISSUED
FOR CONSTRUCTION
10/23/2023

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

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PRINTED NAME	SARA L. LEOW
SIGNATURE	
DATE	10/23/23
LICENSE #	47103

CLIENT	BID
CONSTRUCTION	
RELEASED TO/FOR	

A	B	C	0	1	2	3	
DATE RELEASED							

BARR
Corporate Headquarters: Minneapolis, Minnesota Ph: 1-800-632-2277

Project Office: BARR ENGINEERING CO. 4300 MARKETPOINTE DRIVE Suite 200 MINNEAPOLIS, MN 55435 Ph: 1-800-632-2277 Fax: (952) 832-2601 www.barr.com

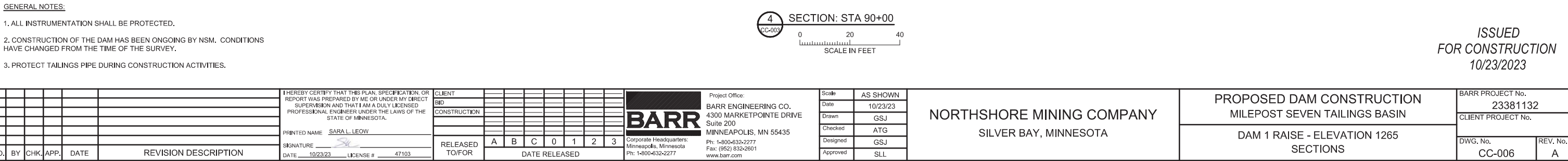
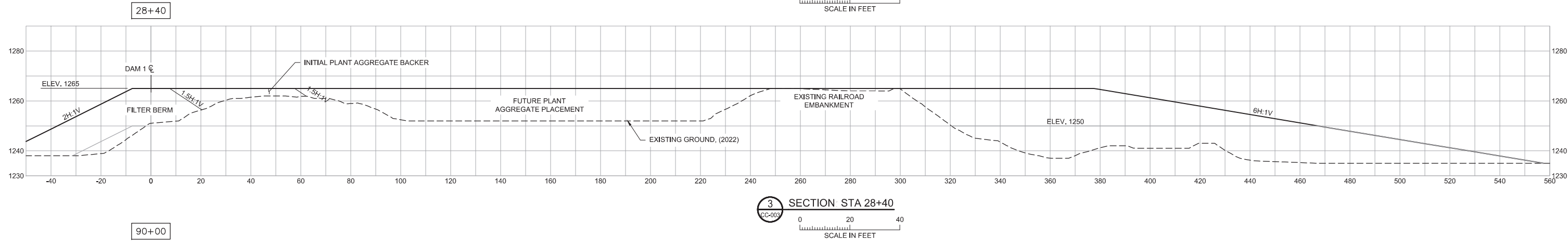
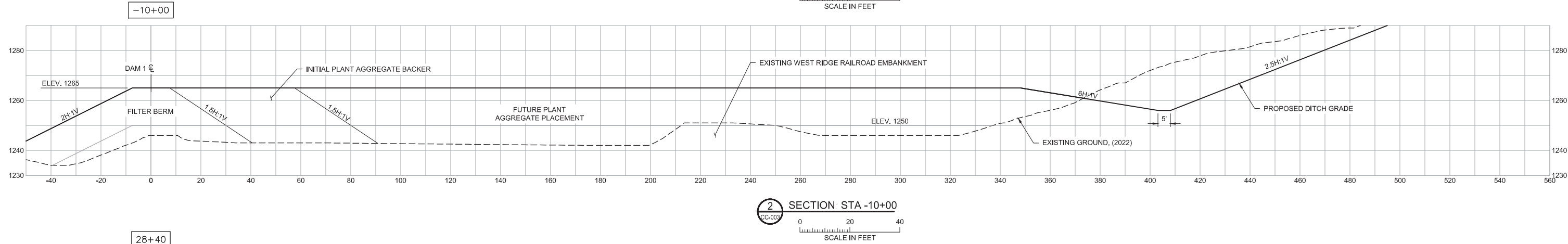
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Date	10/23/23
Drawn	GSJ
Checked	ATG
Designed	GSJ
Approved	SLL

NORTHSHORE MINING COMPANY
SILVER BAY, MINNESOTA

PROPOSED DAM CONSTRUCTION
MILEPOST SEVEN TAILINGS BASIN

DAM 1 RAISE - ELEVATION 1265
CONSTRUCTION PLAN

BARR PROJECT No. 23381132	REV. No. A
CLIENT PROJECT No.	
DWG. No. CC-005	



ISSUED
FOR CONSTRUCTION
10/23/2023

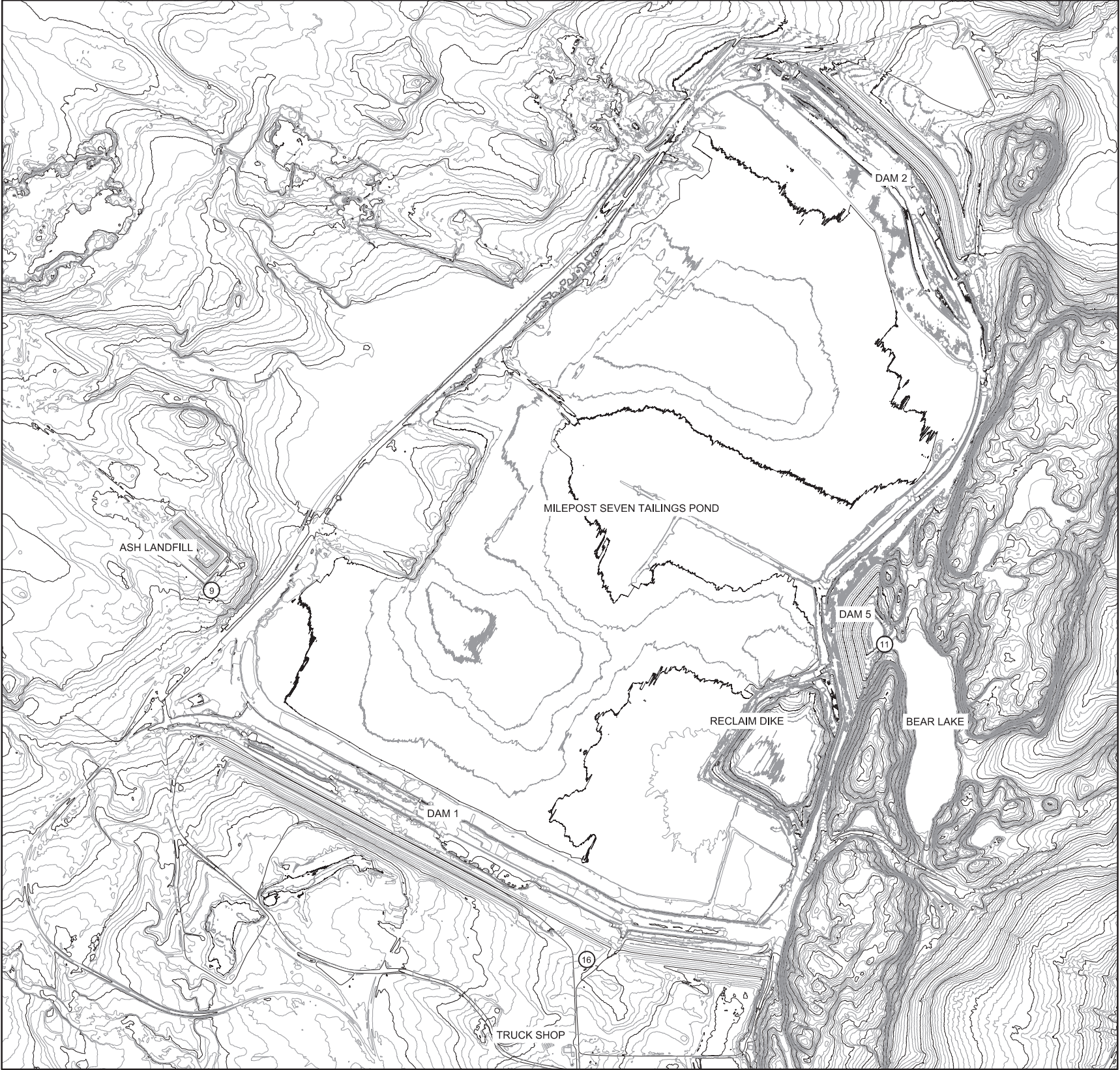
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Dam 2

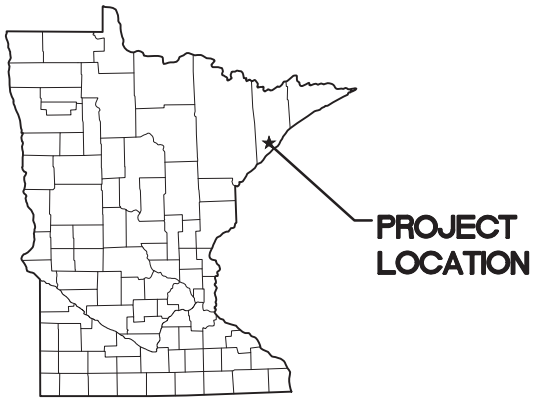
NORTHSHORE MINING COMPANY

DAM 2 RAISE - ELEVATION 1270



TAILING BASIN CONTROL DATA

BASIN CONTROL				
NUMBER	NAME	NORTHING	EASTING	ELEVATION
1	HV-9	621587.4510	3048856.4250	1308.69
2	HV-11	620725.2580	3059623.2150	1201.82
3	HV-16	615676.6820	3054865.0750	1214.85

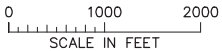
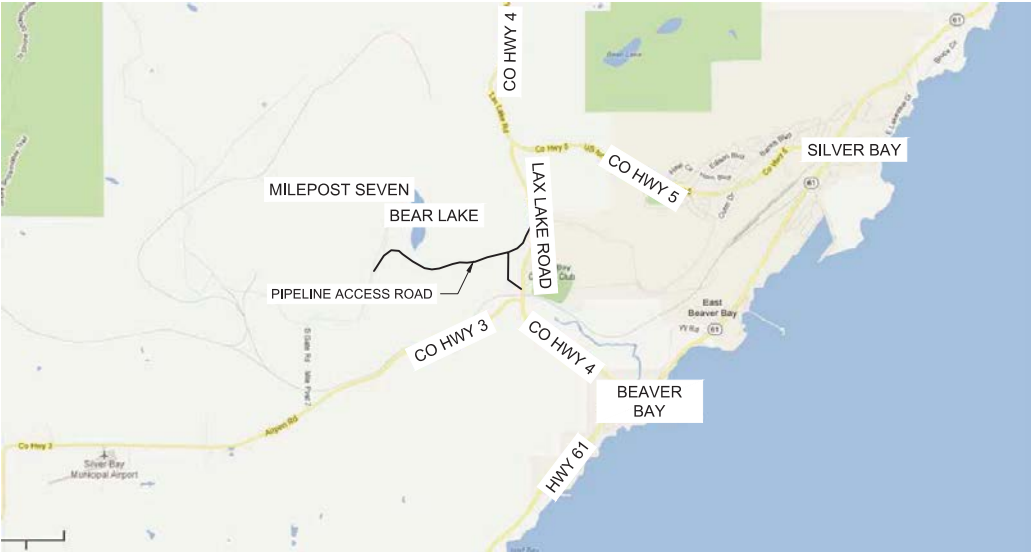


LOCATION MAP



INDEX OF SHEETS

CC-001		DAM 2 RAISE - ELEVATION 1270 - TITLE SHEET, SITE PLAN, AND SHEET INDEX
CC-002		DAM 2 RAISE - ELEVATION 1270 - CONSTRUCTION LOCATION MAP
CC-003		DAM 2 RAISE - ELEVATION 1270 - EXISTING CONDITIONS, PLAN AND PROFILE
CC-004		DAM 2 RAISE - ELEVATION 1270 - CONSTRUCTION PLAN
CC-005		DAM 2 RAISE - ELEVATION 1270 - SECTIONS
CC-006		DAM 2 RAISE - ELEVATION 1270 - DAM 2W PLAN



ISSUED
FOR CONSTRUCTION
10/20/2023

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PRINTED NAME SARA L. LEOW

SIGNATURE [Signature]

DATE 10/20/23 LICENSE # 47103

CLIENT	BID	CONSTRUCTION	RECORD

RELEASED TO/FOR

DATE RELEASED

A B C 0 1 2 3

BARR

Project Office:
BARR ENGINEERING CO.
3128 14TH AVENUE EAST
HIBBING, MN 55746

Corporate Headquarters:
Minneapolis, Minnesota
Ph: 1-800-632-2277

Ph: 1-800-225-1966
Fax: (218) 262-3460
www.barr.com

Scale	AS SHOWN
Date	10/20/23
Drawn	GSJ
Checked	ATG
Designed	GSJ
Approved	SLL

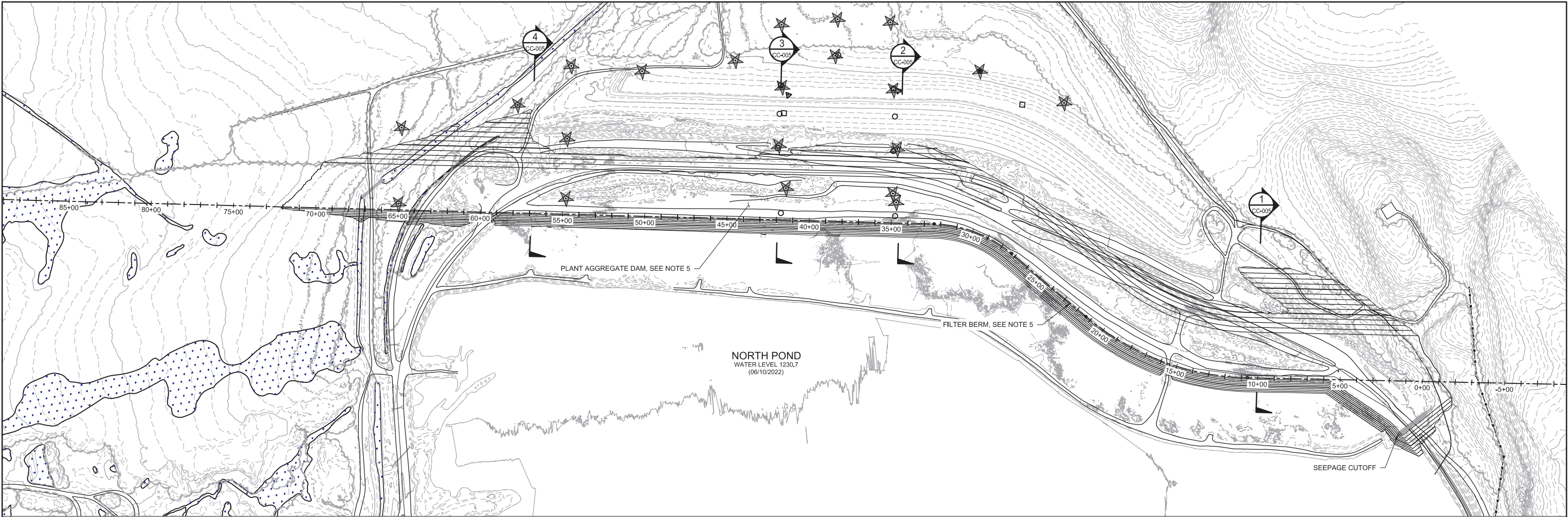
NORTHSHORE MINING COMPANY
SILVER BAY, MINNESOTA

PROPOSED DAM CONSTRUCTION
MILEPOST SEVEN TAILINGS BASIN

DAM 2 RAISE - ELEVATION 1270
TITLE SHEET, SITE PLAN, AND SHEET INDEX

BARR PROJECT No. 23381132	
CLIENT PROJECT No.	
DWG. No. CC-001	REV. No. A



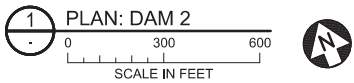


LAYOUT NOTES:

1. LAYOUT BASED ON CONTOURS DEVELOPED FROM LIDAR BY NV5 GEOSPATIAL COMBINED WITH BATHYMETRY BY J.F. BRENNAN COMPANY, INC. DATE OF LIDAR MAY, 24 2022. DATE OF BATHYMETRY JUNE 7-10, 2022. MAPPING BASED ON THE FOLLOWING DATUM:

- VERTICAL DATUM: TWO FOOT CONTOUR INTERVAL BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988.

- HORIZONTAL DATUM: MINNESOTA STATE PLANE COORDINATE SYSTEM, NORTH ZONE, NAD 83/96

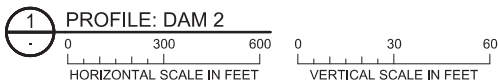
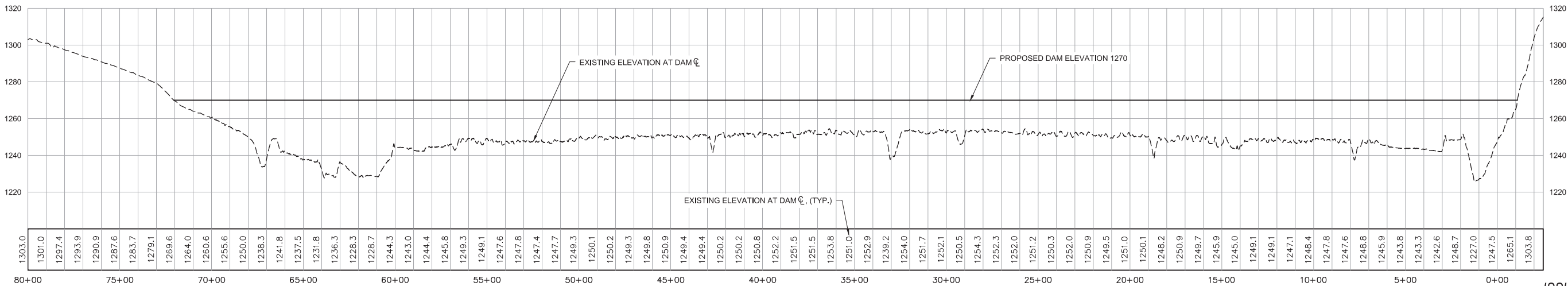


LEGEND:

- CASAGRANDE PIEZOMETER
- PNEUMATIC PIEZOMETER
- VIBRATING WIRE PIEZOMETER
- INCLINOMETER
- RELIEF WELL

GENERAL NOTES:

- ALL INSTRUMENTATION SHALL BE PROTECTED.
- CONSTRUCTION OF THE DAM HAS BEEN ONGOING BY NSM. CONDITIONS HAVE CHANGED FROM THE TIME OF THE SURVEY.
- PROTECT TAILINGS PIPE DURING CONSTRUCTION ACTIVITIES.
- PROVIDE, PLACE, AND COMPACT MATERIALS IN DAMS IN GENERAL ACCORDANCE WITH MATERIALS AND METHODOLOGIES DESCRIBED IN UPDATE OF ENGINEERING DESIGN FOR THE RESERVE MINING COMPANY ON-LAND TAILINGS DISPOSAL FACILITY, MAY 1985, DISCUSSED IN THE MEMO TITLED "DAM 2 RAISE CONSTRUCTION RECOMMENDATIONS."
- DAM CONSTRUCTION SHOWN DEPICTS FULL DAM CONSTRUCTION EXTENTS TO ELEVATION 1270



ISSUED
FOR CONSTRUCTION
10/20/2023

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PRINTED NAME SARA L. LEOW

SIGNATURE [Signature]

DATE 10/20/23 LICENSE # 47103

CLIENT	BID	CONSTRUCTION	RELEASED TO/FOR	DATE RELEASED

Project Office:
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
Suite 200
MINNEAPOLIS, MN 55435

Corporate Headquarters:
Minneapolis, Minnesota
Ph: 1-800-632-2277
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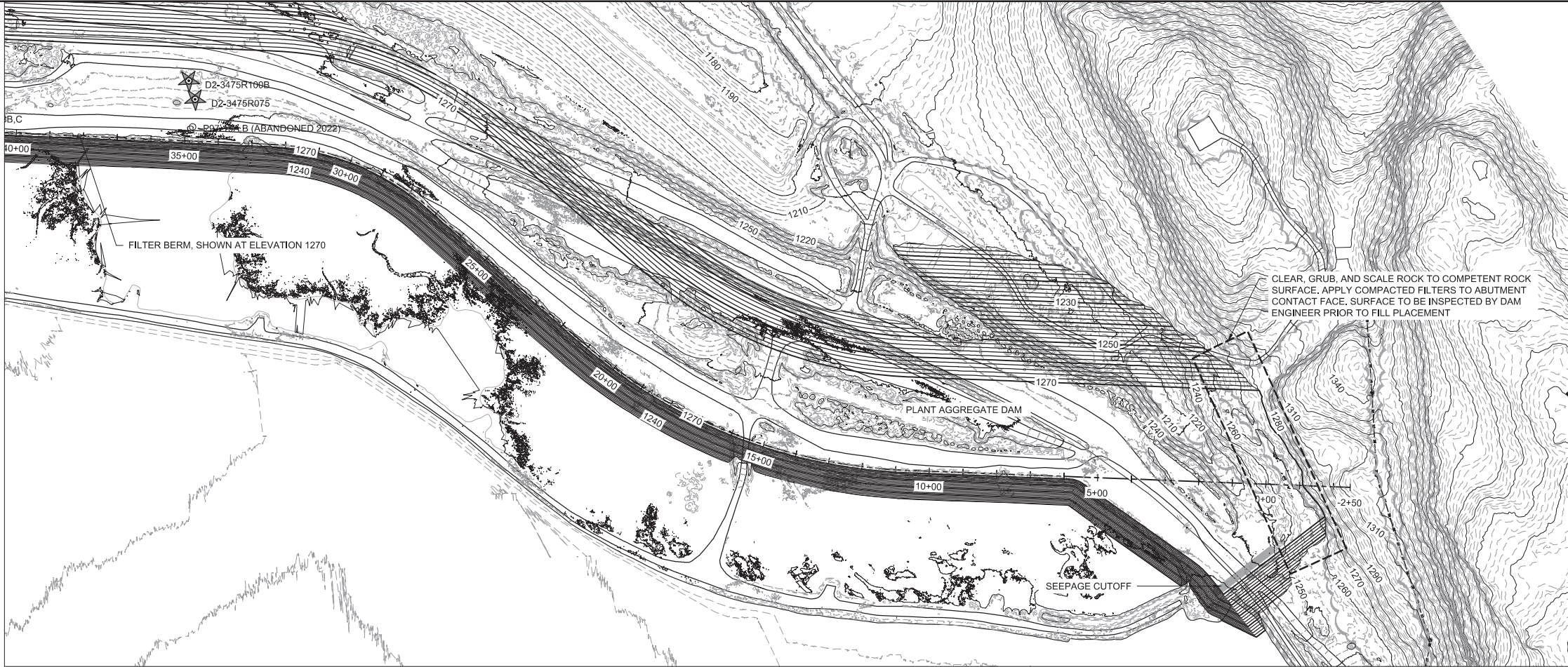
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Date	10/20/23
Drawn	GSJ
Checked	ATG
Designed	GSJ
Approved	SLL

NORTHSHORE MINING COMPANY
SILVER BAY, MINNESOTA

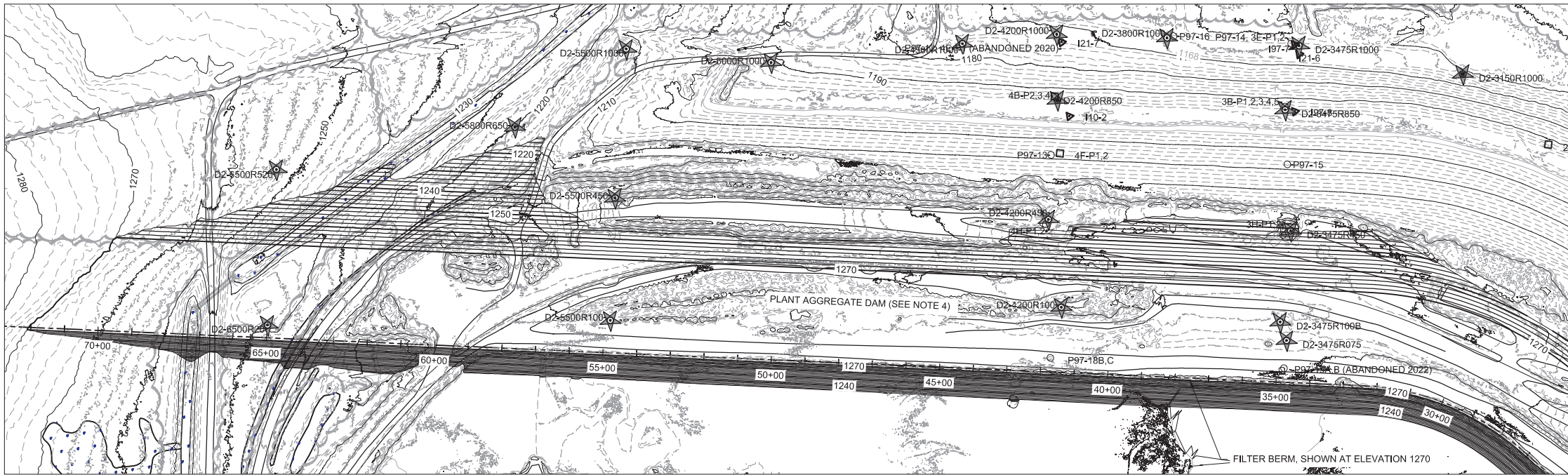
PROPOSED DAM CONSTRUCTION
MILEPOST SEVEN TAILINGS BASIN

DAM 2 RAISE - ELEVATION 1270
EXISTING CONDITIONS PLAN AND PROFILE

BARR PROJECT No. 23381132	REV. No. A
CLIENT PROJECT No.	
DWG. No. CC-003	



1 PLAN: DAM 2
0 200 400
SCALE IN FEET



2 PLAN: DAM 2
0 200 400
SCALE IN FEET

LAYOUT NOTES:

1. LAYOUT BASED ON CONTOURS DEVELOPED FROM LIDAR BY NV5 GEOSPATIAL COMBINED WITH BATHYMETRY BY J.F. BRENNAN COMPANY, INC. DATE OF LIDAR MAY, 24 2022. DATE OF BATHYMETRY JUNE 7-10, 2022. MAPPING BASED ON THE FOLLOWING DATUM:

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- HORIZONTAL DATUM: MINNESOTA STATE PLANE COORDINATE SYSTEM, NORTH ZONE, NAD 83/96

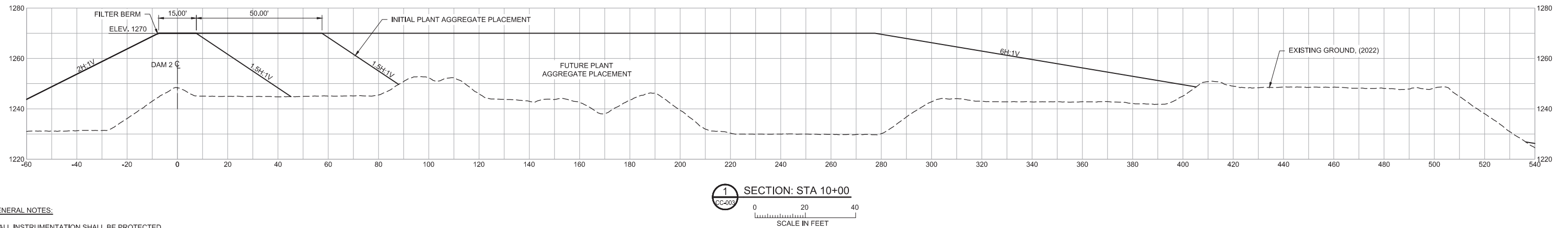
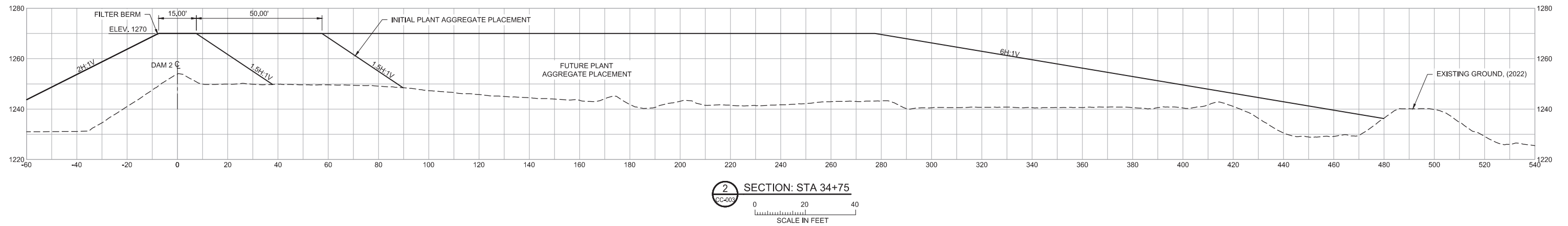
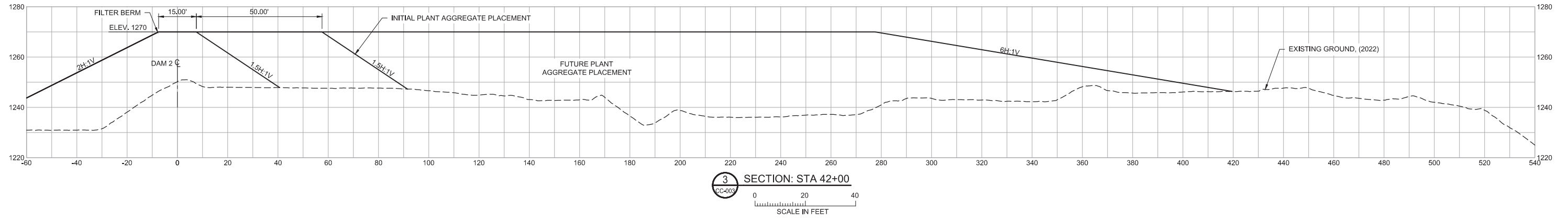
GENERAL NOTES:

1. ALL INSTRUMENTATION SHALL BE PROTECTED.
2. CONSTRUCTION OF THE DAM HAS BEEN ONGOING BY NSM. CONDITIONS HAVE CHANGED FROM THE TIME OF THE SURVEY.
3. PROTECT TAILINGS PIPE DURING CONSTRUCTION ACTIVITIES.

ISSUED
FOR CONSTRUCTION
10/20/2023

					I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.					CLIENT BID CONSTRUCTION					Project Office: BARR ENGINEERING CO. 4300 MARKETPOINTE DRIVE Suite 200 MINNEAPOLIS, MN 55435 Corporate Headquarters: Minneapolis, Minnesota Ph: 1-800-632-2277 Fax: (952) 832-2601 www.barr.com					Scale Date Drawn Checked Designed Approved					AS SHOWN 10/20/23 GSJ ATG GSJ SLL					PROPOSED DAM CONSTRUCTION MILEPOST SEVEN TAILINGS BASIN					BARR PROJECT No. 23381132 CLIENT PROJECT No.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
					PRINTED NAME <u>SARA L. LEOW</u>																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																

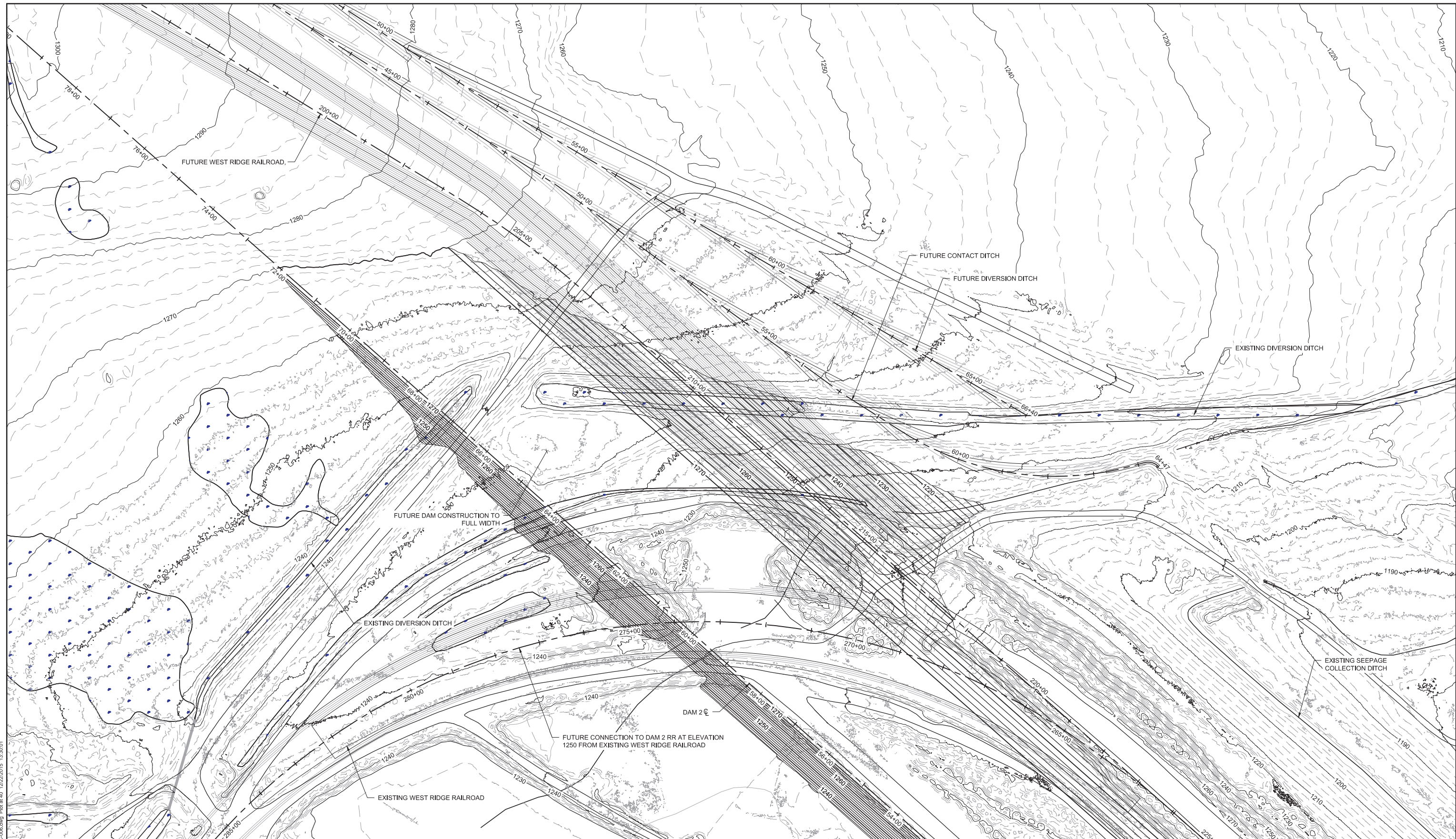
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1. ALL INSTRUMENTATION SHALL BE PROTECTED.
2. PROTECT TAILINGS PIPE DURING CONSTRUCTION ACTIVITIES.

ISSUED
FOR CONSTRUCTION
10/20/2023

[illegible][illegible]



1 PLAN: DAM 2W



NOTE: "FUTURE WORK TO BE COMPLETED" SHALL BE REQUIRED TO BE COMPLETED WHEN THE WATER LEVEL IS WITHIN 10' OF THE DAM CREST, WHEN RUNOFF FROM THE WEST RIDGE RAILROAD WOULD ENTER THE DIVERSION DITCH, OR WHEN RUNOFF FROM THE DAM WOULD ENTER THE DIVERSION DITCH - WHICHEVER OCCURS FIRST.

ISSUED
FOR CONSTRUCTION
10/20/2023

ARR PROJECT No.
23381132
LIENT PROJECT No.

WG. No. CC-006	REV. No. A
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NORTHSHORE MINING COMPANY
SILVER BAY, MINNESOTA

Scale	AS SHOWN
Date	10/20/23
Drawn	GSJ
Checked	SLL
Designed	GSJ
Approved	SLL

Project Office:
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
Suite 200
MINNEAPOLIS, MN 55435
Ph: 1-800-632-2277
Fax: (952) 832-2601
www.barr.com

BARR
Corporate Headquarters:
Minneapolis, Minnesota
Ph: 1-800-632-2277

CLIENT							
BID							
CONSTRUCTION							
RELEASED TO/FOR	A	B	C	0	1	2	3
	DATE RELEASED						

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR
REPORT WAS PREPARED BY ME OR UNDER MY DIRECT
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PROFESSIONAL ENGINEER UNDER THE LAWS OF THE
STATE OF MINNESOTA.

PRINTED NAME SARA L. LEOW

SIGNATURE 

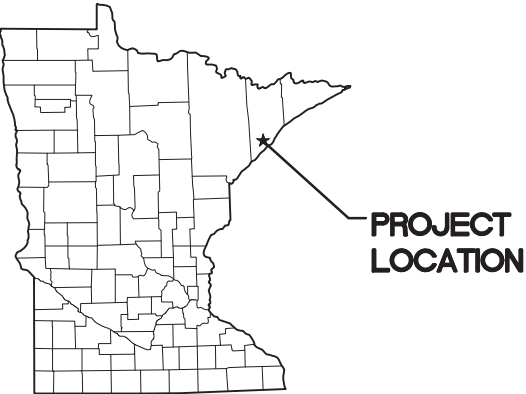
DATE 10/20/23 LICENSE # 47103

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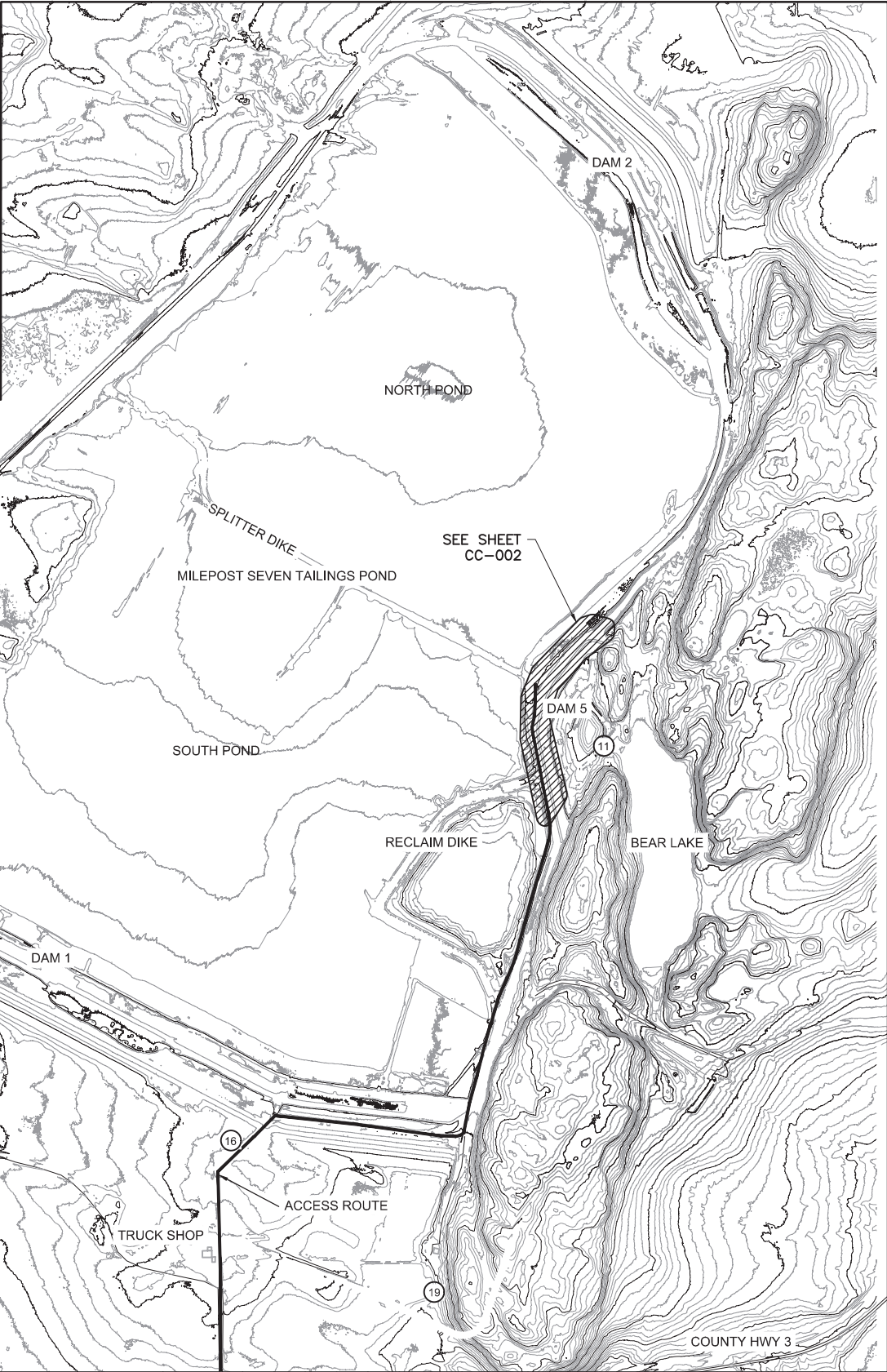
Dam 5

NORTHSHORE MINING COMPANY

DAM 5 RAISE



LOCATION MAP

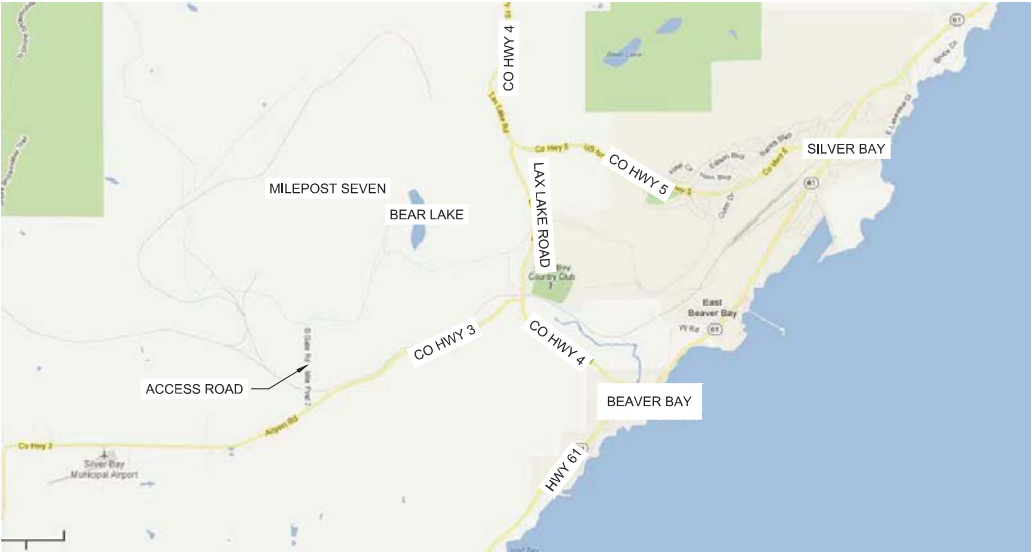


TAILING BASIN CONTROL DATA

BASIN CONTROL					
NUMBER	NAME	NORTHING	EASTING	ELEVATION	DESCRIPTION
9	HV-9	621587.451	3048856.425	1308.69	
11	HV-11	620725.258	3059623.215	1201.82	
16	HV-16	615676.682	3054865.075	1214.85	
19	HV-19	613756.377	3057456.304	1180.18	REVISED COORDS

INDEX OF SHEETS

- CC-001 TITLE SHEET, SITE PLAN, AND SHEET INDEX
- CC-002 EXISTING CONDITIONS PLAN/PROFILE
- CC-003 CONSTRUCTION PLAN
- CC-004 DAM PROFILE
- CC-005 SECTIONS - STATION 8+00 AND 14+00
- CC-006 SECTIONS - STATION 14+00 AND 24+00



ISSUED
FOR CONSTRUCTION
12/28/2021

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PRINTED NAME	SARA L. LEOW
SIGNATURE	
DATE	12/28/21
LICENSE #	47103

CLIENT	BID
CONSTRUCTION	
RELEASED TO/FOR	

A	B	C	0	1	2	3

Project Office:
BARR ENGINEERING CO.
3128 14TH AVENUE EAST
HIBBING, MN 55746

Corporate Headquarters:
Minneapolis, Minnesota
Ph: 1-800-632-2277

Ph: 1-800-225-1966
Fax: (218) 262-3480
www.barr.com

Scale	AS SHOWN
Date	12/28/21
Drawn	GSJ
Checked	GSJ
Designed	SLL
Approved	SLL

NORTHSHORE MINING COMPANY
SILVER BAY, MINNESOTA

MILEPOST 7 TAILINGS BASIN SILVER BAY, MINNESOTA		BARR PROJECT No. 23381132	
DAM 5 RAISE - ELEVATION 1270 TITLE SHEET, SITE PLAN, AND SHEET INDEX		CLIENT PROJECT No.	
DWG. No.	CC-001	REV. No.	A

LAYOUT NOTES:

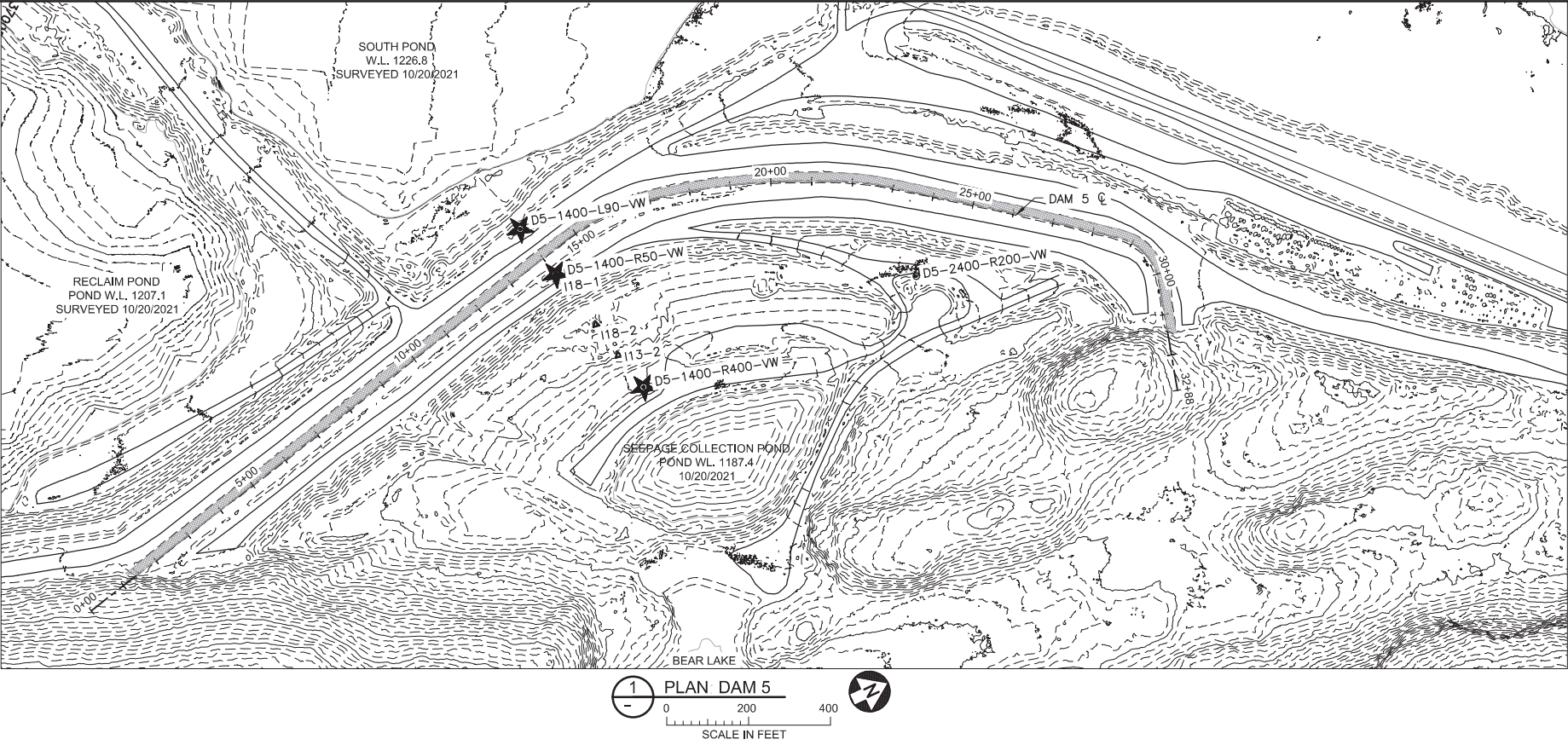
1. LAYOUT BEYOND DAM 5 FOOTPRINT BASED ON CONTOURS DEVELOPED FROM AERIAL SURVEY BY QUANTUM SPATIAL OF LEXINGTON, KENTUCKY. DATE OF LIDAR JUNE 1, 2021. MAPPING BASED ON THE FOLLOWING DATUM:
- VERTICAL DATUM: FIVE FOOT CONTOUR INTERVAL BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988.
- HORIZONTAL DATUM: MINNESOTA STATE PLANE COORDINATE SYSTEM, NORTH ZONE, NAD 83/96.

GENERAL NOTES:

1. ALL INSTRUMENTATION SHALL BE PROTECTED.
2. PROPOSED DESIGN BASELINE DETERMINED FROM FIELD INVESTIGATION AND SHALL BE MODIFIED IN FIELD BASED ON ACTUAL CONDITIONS.
3. CONSTRUCTION OF THE DAM HAS BEEN ONGOING BY NSM. CONDITIONS HAVE CHANGED FROM THE TIME OF SURVEY.

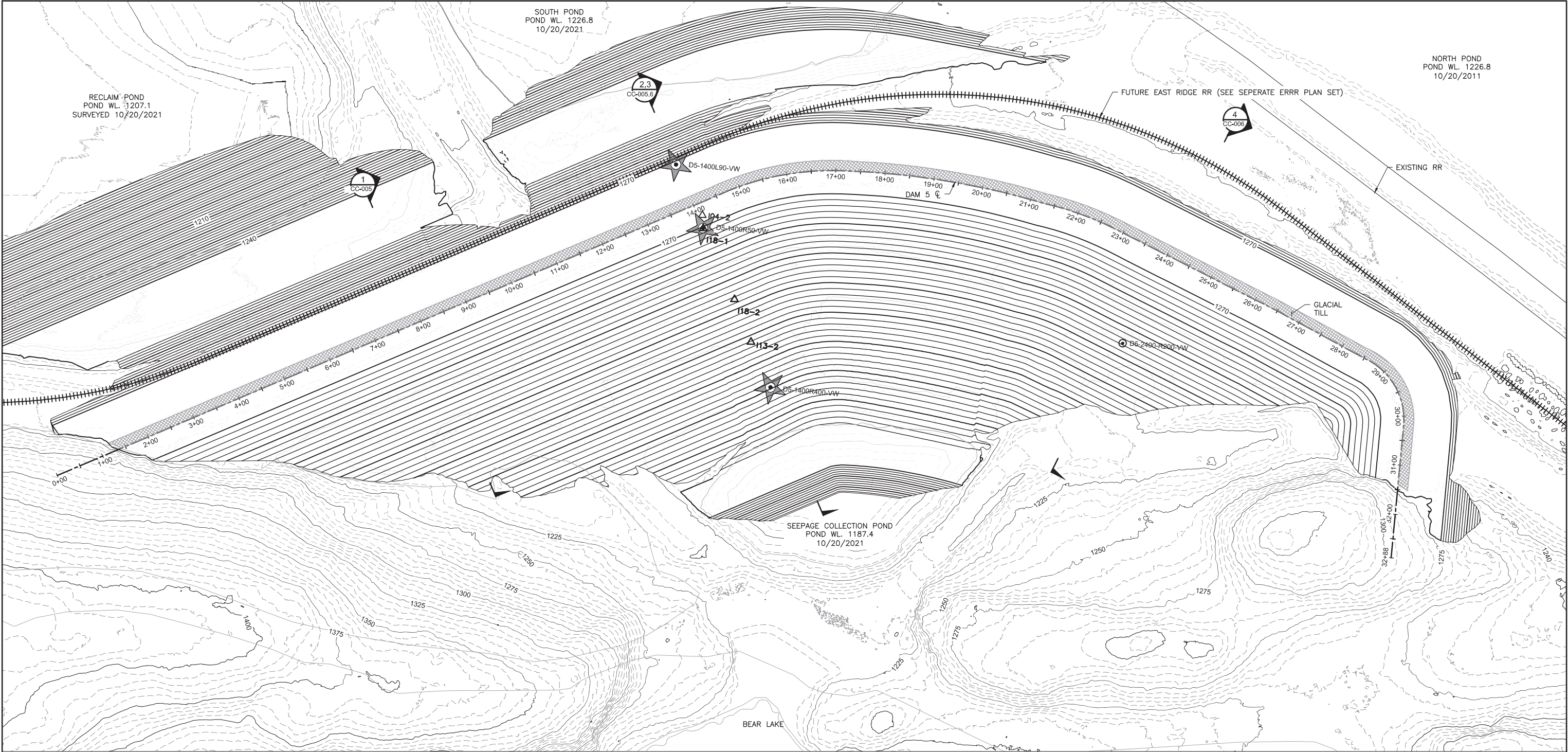
LEGEND:

- EXISTING 25' MAJOR CONTOUR
- - - - - EXISTING 5' MINOR CONTOUR
- — — — — DAM CENTERLINE
- ||||| EXISTING RR
- ▲ INCLINOMETER
- VIBRATING WIRE PIEZOMETER
- ★ VIBRATING WIRE PIEZOMETER WITH DATA LOGGER



CADD USER: Greg Johnson FILE: M:\DESIGN\23380086.DAM_5_CC-003_2021.DWG PLOT SCALE: 1/2"=1' PLOT DATE: 12/28/2021 9:41 AM

BARR MicroCAD 2011 AutoCAD 2011 Support\enu\Template\Bar_2011_Template.dwt Plot at 1 10/05/2010 14:03:50



LAYOUT NOTES:

- LAYOUT BASED ON CONTOURS DEVELOPED FROM LIDAR BY QUANTUM SPATIAL OF LEXINGTON, KENTUCKY. DATE OF LIDAR JUNE 1, 2021. MAPPING BASED ON THE FOLLOWING DATUM:
 - VERTICAL DATUM: FIVE FOOT CONTOUR INTERVAL BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988.
 - HORIZONTAL DATUM: MINNESOTA STATE PLANE COORDINATE SYSTEM, NORTH ZONE, NAD 83/96.

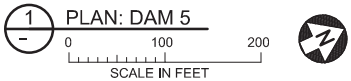
GENERAL NOTES:

- ALL INSTRUMENTATION SHALL BE PROTECTED.
- PROPOSED DESIGN BASELINE DETERMINED FROM FIELD INVESTIGATION AND SHALL BE MODIFIED IN FIELD BASED ON ACTUAL CONDITIONS.
- CONSTRUCTION OF THE DAM HAS BEEN ONGOING BY NSM. CONDITIONS HAVE CHANGED FROM THE TIME OF SURVEY.

APPROXIMATE FILL QUANTITIES (CY IN-PLACE)

D/S FILTER	GLACIAL TILL	SELECT COARSE AGGREGATE	PLANT AGGREGATE
15,000	26,000	45,000	502,000

NOTE: QUANTITY OF FILL SHOWN REFLECTS AMOUNT OF FILL REQUIRED TO CONSTRUCT DAM TO DESIGN CREST ELEVATION AND ASSOCIATED SLOPES ABOVE ESTIMATED EXISTING CONDITION.



LEGEND

- EXISTING 25' MAJOR CONTOUR
- EXISTING 5' MINOR CONTOUR
- DAM CENTERLINE
- CLAY CORE
- EXISTING RR
- FUTURE EAST RIDGE RAILROAD
- INCLINOMETER
- VIBRATING WIRE PIEZOMETER
- VIBRATING WIRE PIEZOMETER WITH DATA LOGGER

STATIONING COORDINATES: DAM 5 AS-BUILT ALIGNMENT

STATION	NORTHING	EASTING
0+00	619352.39	3059138.00
PC14+52.81	620768.09	3058811.75
PCC17+33.63	621045.94	3058811.14
PCC21+26.54	621415.38	3058941.86
PT22+80.63	621549.03	3059017.81
PC28+49.84	622001.20	3059363.74
PT30+22.54	622055.70	3059515.38
32+88.38	621984.99	3059771.65

ISSUED
FOR CONSTRUCTION
12/28/2021

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME: SARA L. LEOW

SIGNATURE:

DATE: 12/28/21 LICENSE #: 47103

CLIENT	BID	CONSTRUCTION	RELEASED TO/FOR	DATE RELEASED

BARR

Corporate Headquarters:
Minneapolis, Minnesota
Ph: 1-800-632-2277

Project Office:
BARR ENGINEERING CO.
3128 14TH AVENUE EAST
HIBBING, MN 55746
Ph: 1-800-225-1966
Fax: (218) 262-3480
www.barr.com

Scale	AS SHOWN
Date	12/28/21
Drawn	GSJ
Checked	GSJ
Designed	SLL
Approved	SLL

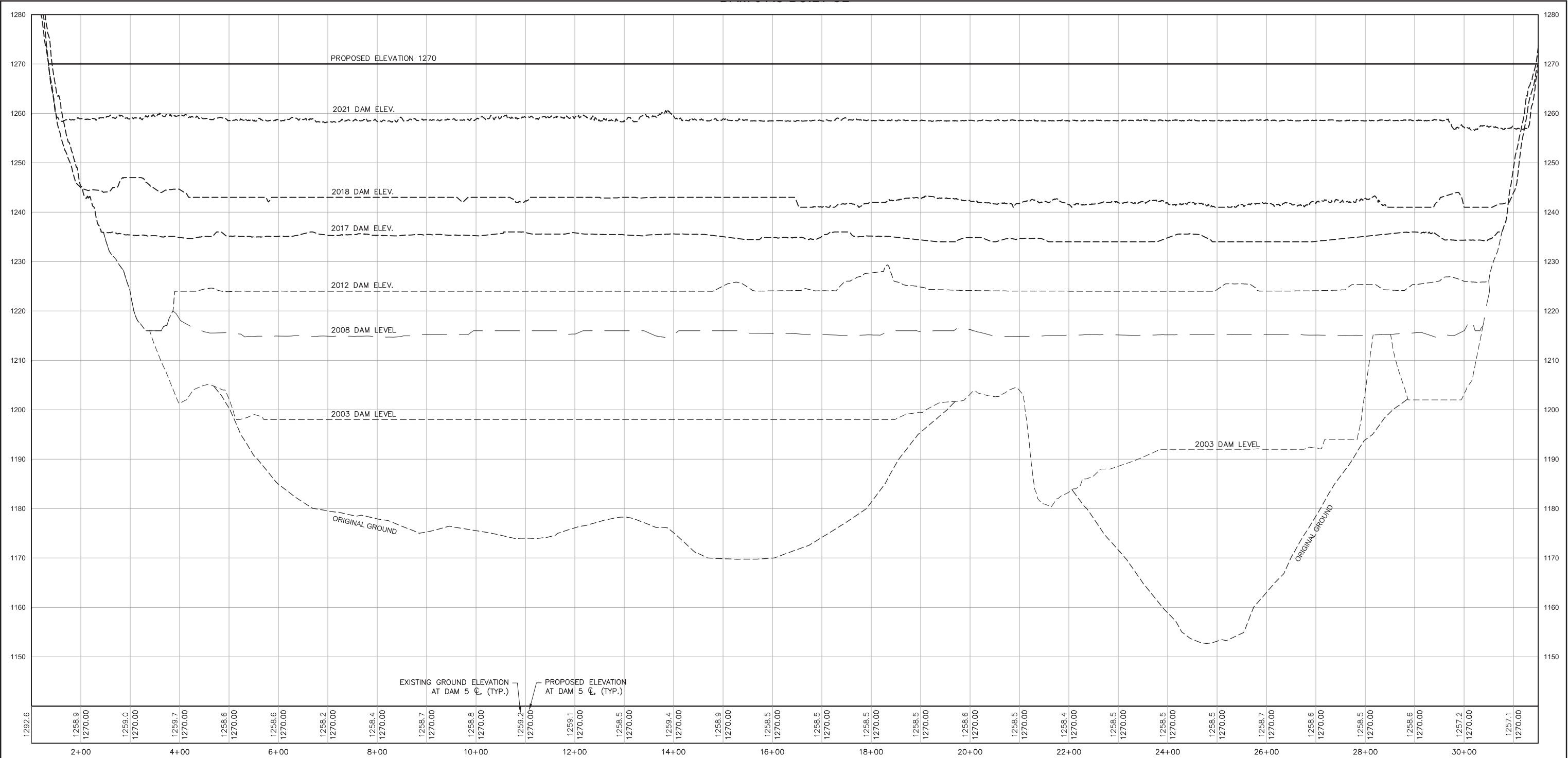
NORTHSHORE MINING COMPANY
SILVER BAY, MINNESOTA

MILEPOST 7 TAILINGS BASIN
SILVER BAY, MINNESOTA

DAM 5 RAISE - ELEVATION 1270
CONSTRUCTION PLAN

BARR PROJECT No. 23381132	REV. No. A
CLIENT PROJECT No.	
DWG. No. CC-003	

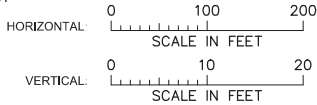
CADD USER: Greg Johnson FILE: M:\DESIGN\23380086\0023380086 DAM 5_CC-004_2021.DWG PLOT SCALE: 1:2 PLOT DATE: 12/28/2021 12:20 PM
BARR \X\AutoCAD 2011\AutoCAD 2011 Support\enu\TemplateBar_2011_Template.dwt Plot at 1 10/05/2010 14:03:50



LAYOUT NOTES:

- LAYOUT BASED ON CONTOURS DEVELOPED FROM LIDAR BY QUANTUM SPATIAL OF LEXINGTON, KENTUCKY. DATE OF PHOTOGRAPHY JUNE 1, 2021. MAPPING BASED ON THE FOLLOWING DATUM:
 - VERTICAL DATUM: TWO FOOT CONTOUR INTERVAL BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988.
 - HORIZONTAL DATUM: MINNESOTA STATE PLANE COORDINATE SYSTEM, NORTH ZONE, NAD 83/96.

1 PROFILE: DAM 5
CC-004



LEGEND

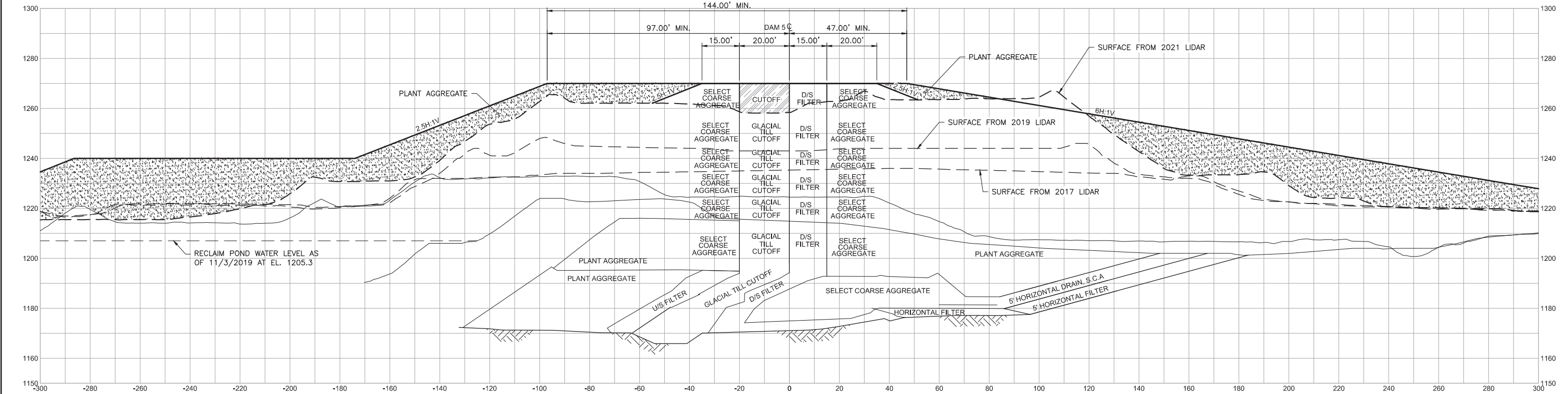
- ORIGINAL GROUND -- ADAPTED FROM DIGITIZED 1976 DRAWING TEST HOLE LOCATION PLAN BY KLOHN LEONOFF CONSULTANTS LTD.
- EXISTING GROUND, 2017 & 2019 CONTOURS FROM QUANTUM SPATIAL, SEE LAYOUT NOTES
- PROPOSED DAM RAISE

ISSUED
FOR CONSTRUCTION
12/28/2021

					I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.					CLIENT BID CONSTRUCTION					Project Office: BARR ENGINEERING CO. 3128 14TH AVENUE EAST HIBBING, MN 55746 BARR Corporate Headquarters: Minneapolis, Minnesota Ph: 1-800-632-2277					Scale AS SHOWN					NORTHSHORE MINING COMPANY SILVER BAY, MINNESOTA					MILEPOST 7 TAILINGS BASIN SILVER BAY, MINNESOTA					BARR PROJECT No. 23381132					CLIENT PROJECT No.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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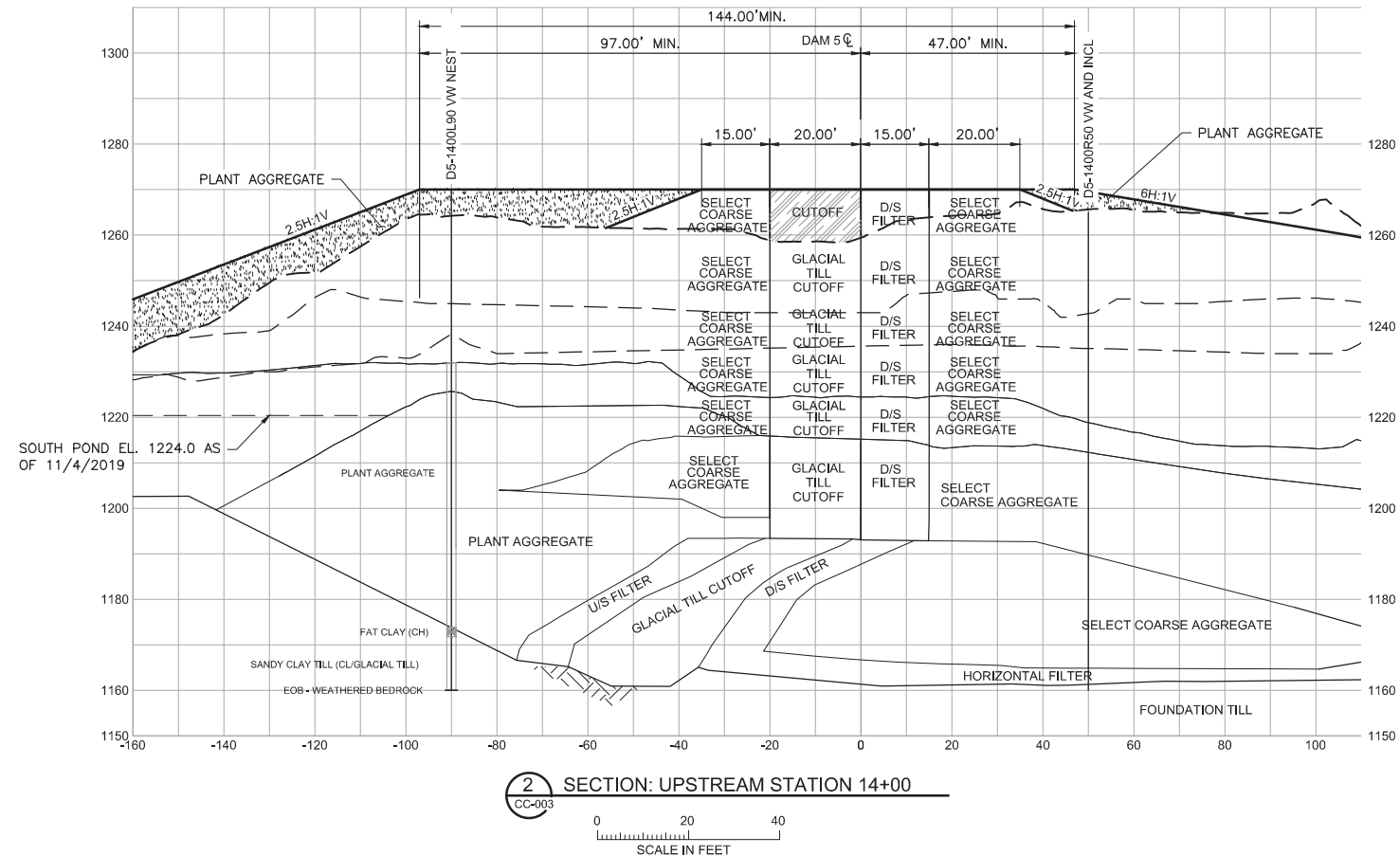
CADD USER: Greg Johnson FILE: M:\DESIGN\23380086.DAM_5_CC-005_2021.DWG PLOT SCALE: 1/2" = 1' PLOT DATE: 12/28/2021 12:59 PM

BARR 10/10/2010 10:05:20 10/05/2010 14:03:50



CONSTRUCTION NOTES:

1. SCARIFY, MOISTURE CONDITION, AND RE-COMPACT SURFACE OF EXISTING SEEPAGE CUTOFF PRIOR TO PLACEMENT OF NEW LAYER.
2. COMPACT ALL FILL MATERIALS FOR RAISE TO A MINIMUM 95% STANDARD PROCTOR (ASTM D698)
3. REFER TO ASSOCIATED CONSTRUCTION MEMO FOR MORE MATERIALS INFORMATION.



ISSUED
FOR CONSTRUCTION
12/28/2021

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION

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PRINTED NAME: SARA L. LEOW

SIGNATURE:

DATE: 12/28/21 LICENSE #

CLIENT	BID	CONSTRUCTION	RELEASED TO/FOR	DATE RELEASED

BARR

Corporate Headquarters:
Minneapolis, Minnesota
Ph: 1-800-632-2277

Project Office:
BARR ENGINEERING CO.
3128 14TH AVENUE EAST
HIBBING, MN 55746

Ph: 1-800-225-1966
Fax: (218) 262-3460
www.barr.com

Scale	AS SHOWN
Date	12/28/21
Drawn	GSJ
Checked	GSJ
Designed	SLL
Approved	SLL

NORTHSHORE MINING COMPANY

SILVER BAY, MINNESOTA

MILEPOST 7 TAILINGS BASIN

SILVER BAY, MINNESOTA

DAM 5 RAISE - ELEVATION 1270

SECTIONS - STATION 8+00 AND 14+00

BARR PROJECT No.
23381132

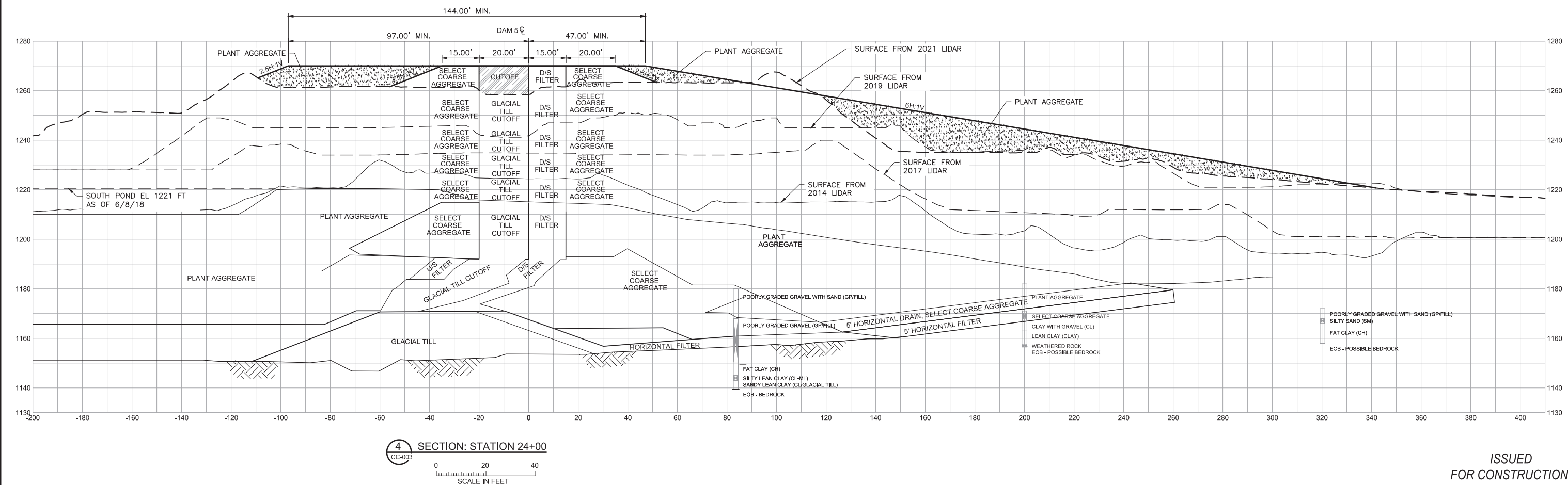
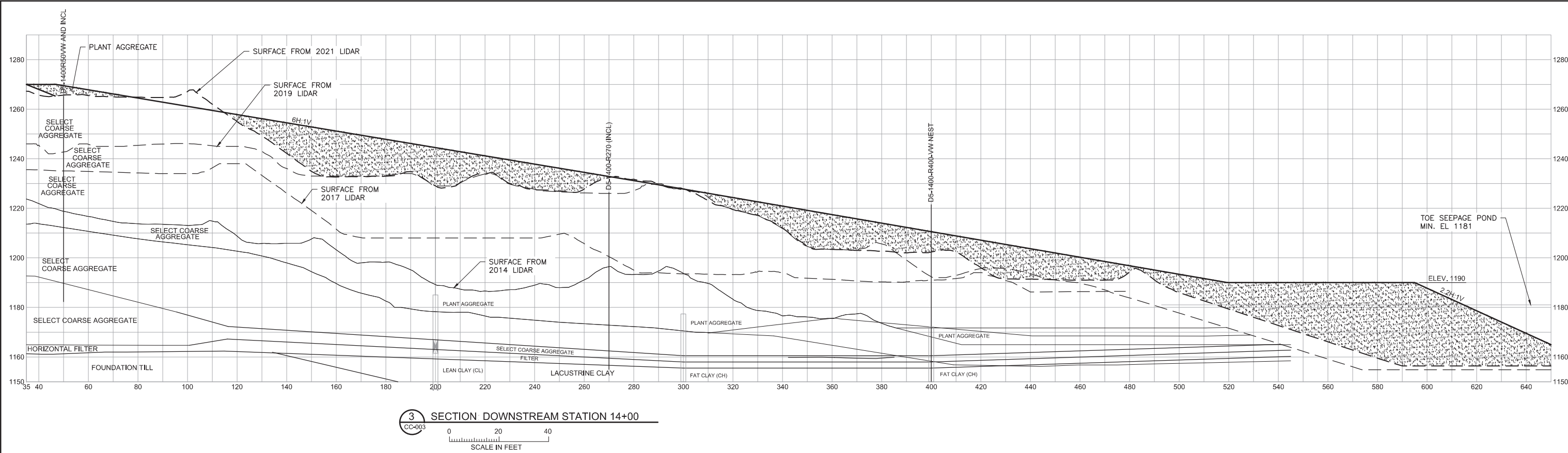
CLIENT PROJECT No.

DWG. No.
CC-005

REV. No.
A

CADD USER: Greg Johnson FILE: M:\DESIGN\23380086 DAM 5_CC-006_2021.DWG PLOT SCALE: 1:2 PLOT DATE: 12/28/2021 1:32 PM

BARR 14:AutoCAD 2011:AutoCAD 2011:Support\enu\Template\Bar_2011_Template.dwt Plot at 1:10/05/2010 14:03:50



ISSUED
FOR CONSTRUCTION
12/28/2021

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PRINTED NAME: SARA L. LEOW
SIGNATURE:
DATE: 12/28/21 LICENSE #: 47103

CLIENT	BID	CONSTRUCTION	RELEASED TO/FOR	A	B	C	0	1	2	3	DATE RELEASED

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Minneapolis, Minnesota
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Designed	SLL
Approved	SLL

NORTHSHORE MINING COMPANY
SILVER BAY, MINNESOTA

MILEPOST 7 TAILINGS BASIN
SILVER BAY, MINNESOTA
DAM 5 RAISE - ELEVATION 1270
SECTIONS - STATION 14+00 AND 24+00

BARR PROJECT No. 23381132	REV. No. A
CLIENT PROJECT No.	
DWG. No. CC-006	