Nyrstar Myra Falls Mine Topsoil Management Plan

Nyrstar Myra Falls Mine, British Columbia
Project # NX14001K1.7

Prepared for:

Nyrstar Myra Falls Ltd.
Campbell River, BC

21 December 2018

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21 December 2018

Nicole Pesonen
Environmental Advisor
Nyrstar Myra Falls Ltd.
P.O. Box 8000
Campbell River, BC V9W 5E2

Dear Ms. Pesonen,

Please find enclosed three copies of the Nyrstar Myra Falls Mine Topsoil Management Plan. If you have any questions or would like to discuss the report, please contact the undersigned at (604) 295-6106.

Sincerely,

Wood Environment and Infrastructure Solutions, a Division of Wood Canada Limited

Christine Peters

Christine Peters, PEng
Project Manager

DP/cp

c: Nyrstar DL

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Executive Summary

Purpose of this report

This report has been prepared to provide a strategy for the use of limited soil resources available at the Nyrstar Myra Falls Mine. The soil resources can most effectively be used to address conditions where a lack of soil or fine textured material is preventing ecosystem recovery. In addition, it will be most beneficial to have areas at the mine where a healthy vegetation cover will contribute to the ecological integrity of the area. The effective use of the soil materials at the mine will provide the foundation of important ecosystems and the ecological services they provide.

Report Structure

This report is structured to provide the most beneficial uses of the limited soil resources. In addition, the report presents a system of soil treatment that will control erosion and provide a context for the effective revegetation of mine site disturbances. The report concludes with a section on the monitoring of the treatments applied so that the effectiveness of the treatments can be demonstrated to regulators.

Table of Contents

List of Figures

List of Tables

List of Photographs

List of Appendices

List of Acronyms and Abbreviations

ARD	Acid Rock Drainage
ML	Metal Leaching
PAG	Potentially Acid Generating
NAG	Non-Acid Generating
TDF	Tailings Disposal Facility
WRD	Waste Rock Dump

1.0 Introduction

In 2018, the BC Ministry of Energy, Mines & Petroleum Resources (MEMPR) issued a *Mines Act* Permit M-26 Amendment (the Permit) to Nyrstar Myra Falls Ltd. to continue mining activities within a specified Permit Area located in Strathcona-Westmin Provincial Park on Vancouver Island. In support of meeting the environmental conditions of the Permit, Wood Environment & Infrastructure Solutions (Wood) was retained by Nyrstar Myra Falls Ltd. to prepare a Topsoil Management Plan for the mine. This plan details how reclamation materials, including topsoil, overburden and organic material, will be managed on site. Upon eventual closure of all mining activities in Strathcona-Westmin Provincial Park, the overall goal is to re-establish the natural capabilities of the affected land with respect to soil and vegetation as much as possible and practicable.

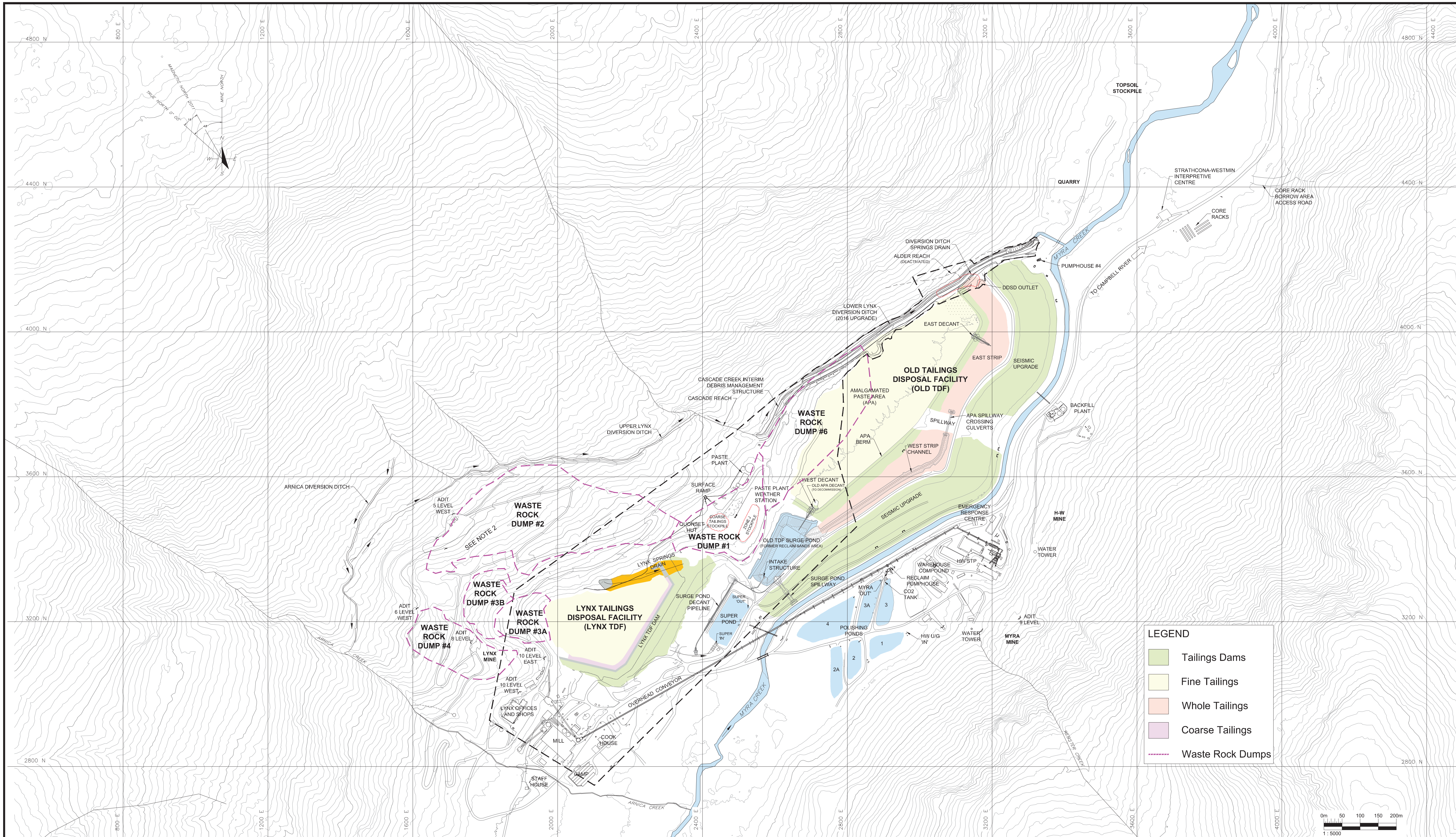
1.1 Scope of Work

Soils are an important part of ecosystems. The soils that are available at the Myra Falls Mine will need to be used sparingly to address sites where the lack of soils or fine textured soil materials will limit ecosystem recovery. The mine is particularly constrained by its location in a mountainous area where soil resources tend to be limited (Polster 1977). The following sections provide recommendations for the most effective use of the limited soil resources at the Myra Falls Mine.

This plan includes methods and patterns that are recommended for the application of the soils at the Myra Falls Mine. These are designed to control erosion while promoting the natural recovery of the disturbed sites and to provide the pioneering species that will build additional soil resources (Polster 2015).

1.2 Site Description

Myra Falls Mine is an underground polymetallic base metal mine located within Strathcona-Westmin Provincial Park, approximately 60 km southwest of Campbell River, British Columbia. The land was given special designation because of mineral values and the decision by the provincial government to allow exploration and mining in this area. This park was separated out of Strathcona Park in 1965 and designated as a Class B Provincial Park. It has a milling operation, two tailings disposal facilities (TDFs), waste rock dumps (WRDs), a water collection and treatment system, and other support infrastructure.



NOTES:

1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH WOOD ENVIRONMENT & INFRASTRUCTURE SOLUTIONS REPORT NO. NX14001K1.7 "MYRA FALLS MINE TOPSOIL MANAGEMENT PLAN", DATED DECEMBER 2018.
2. SURVEY SURFACE TOPOGRAPHY SUPPLIED BY CLIENT. REFERS TO JUNE 2015 LIDAR SURVEY OUTSIDE THE DASHED LINE AND A COMBINATION OF 2015/2016 AS-BUILT SURVEYS INSIDE THE DASHED LINE.
3. THIS SURVEY IS REFERENCED TO MINE DATUM (MASL + 3047.5 m).
4. CONTOUR INTERVAL: 10 m.

Client: nyrstar

wood.

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DATUM:	MINE
PROJECTION:	MINE
DRAWN BY:	KL / TH
REVIEWED BY:	DHG
SCALE:	1:8000

PROJECT: MYRA FALLS TOPSOIL MANAGEMENT PLAN

TITLE: GENERAL SITE PLAN

PROJECT NO.:	NX14001K1.7
REVISION NO.:	0
DATE:	DECEMBER 2018
DRAWING NO.:	1
SHEET NO.:	1 of 1

2.0 Soil Characteristics

Table 1 provides details of the physical and chemical characteristics of salvaged and stockpiled soils that are available for reclamation use based on a single sample that was supplied by Nyrstar personnel. Note that in addition to the salvaged and stockpiled soils described in Table 1, soil materials can be developed on suitably textured substrates, such as fine-textured non-PAG material or native till, by the pioneering species proposed for the revegetation of mine disturbances.

Table 1: Physical and Chemical Characteristics of Soils Available for Reclamation Use[1]

Soil Texture	%		Metal	Detection Limit (mg/kg)	Concentration (mg/kg)
Cobbles (>3 in.)	<1.0		Antimony (Sb)	0.20	0.30
Gravel (4.75 mm - 3 in)	41.1		Arsenic (As)	0.20	4.09
Coarse Sand (2.0 mm - 4.75 mm)	14.9		Barium (Ba)	5.0	48.9
Medium Sand (0.425 mm - 2.0 mm)	16.2		Beryllium (Be)	1.0	<1.0
Fine Sand (0.075mm - 0.425mm)	12.7		Cadmium (Cd)	0.50	<0.50
Fines (<0.075mm)	15.1		Chromium (Cr)	0.50	22.6
			Cobalt (Co)	1.0	12.6
			Copper (Cu)	2.0	44.7
			Lead (Pb)	5.0	7.5
			Mercury (Hg)	0.0050	0.0341
			Molybdenum (Mo)	1.0	<1.0
			Nickel (Ni)	2.0	14.3
			Selenium (Se)	0.50	<0.50
			Thallium (Tl)	0.50	<0.50
			Tin (Sn)	5.0	<5.0
			Uranium (U)	2.0	<2.0
			Vanadium (V)	1.0	84.7
			Zinc (Zn)	5.0	80.2

1. Values correspond to the results of 1 sample.

3.0 Soil Application Areas

3.1 Myra Creek Channel

The Myra Creek Channel (see Figure 1) currently consists of a rip-rap lined channel designed to safely transport Myra Creek through the mine site area. Although the channel has operated effectively in this regard for a number of years, it fails to provide riparian benefits to Myra Creek or the surrounding area. Treatment of the rip-rap areas with soil materials to enhance the revegetation efforts is recommended from an ecological perspective. The rip-rap would remain in place and soil materials would be placed on the rip-rap above the winter flow elevation. The soils would provide a substrate where riparian vegetation could be established, while the rip-rap will continue its function of safe transport of Myra Creek. In addition, the ecological benefits such as wildlife habitat, of the riparian vegetation would accrue to the wider mine site area (Goodwin et al. 1997). Suggested vegetation to be applied to the soil-enhanced areas would be riparian willows or allowing red alder to naturally seed the areas.

This treatment would be applied at the end of mine life when the final configuration of the creek channel is realized. It would only be applied to riprap areas outside the toe of the Old TDF and those areas of the creek that have the hydraulic capacity to handle vegetation. All treatments and designs are conceptual at this point and would be further detailed in conjunction with engineering designs if applied to engineered structures. The current armoured configuration of Myra Creek does not have the hydraulic capacity to withstand vegetation that will further reduce the hydraulic capacity.

3.1.1 Application Techniques

Applying soil materials so that they create a heterogeneous surface (lumpy) will enhance the recovery of the riparian ecosystem (Larkin et al. 2008). An excavator can place buckets full of soil in a staggered pattern approximately one bucket width from pile crest to pile crest, so the bottoms of the piles are just touching each other (Photograph 1). The bucket loads of soil should be placed on the rip-rap slope of the Myra Creek banks above the winter flow level to enhance the natural establishment of pioneering vegetation (Polster 2016). The loose mounds of soil that result from placing buckets of soil on the slopes should be retained so that erosion is prevented (see Section 4.0 Control of Erosion). Care should be taken to avoid smoothing and compacting the soils as this will reduce the micro-sites available for the natural establishment of vegetation on the slopes and will allow erosion to occur.

Photograph 1: Example of making a surface rough and loose

3.2 Tailings Disposal Facilities

The Old TDF will have a geomembrane liner over most of its area to aid in control of ML/ARD. For this reason and for geotechnical stability reasons, creating rough and loose conditions in the soil cover overlying the geomembrane are not advised. The permit-level cover design calls for 0.7 m to 1 m of soil materials applied to the surface of the engineered cover, with seeding of natural vegetation species on the surface for erosion control (Amec Foster Wheeler, 2016b).

The Lynx TDF dam face permit-level closure cover design currently calls for:

- a 450 mm seepage collection layer of non-PAG quarry run blast rock having less than 5% fines, placed on the PAG Zone "A" dam fill;
- a 700 mm layer of compacted till to promote runoff; and
- a 300 mm top layer of growth medium that will be allowed to naturally vegetate supplemented with planting (Amec Foster Wheeler, 2016a).

One amendment to the existing permit-level design could be to scatter woody debris (100 m^3/ha) across the rough and loose uncompacted top layer to promote building additional soils at the mine.

An alternative to the existing permit-level design that would enhance revegetation could be to place coarse non-PAG waste rock from the active underground mine or salvaged from the waste rock dumps (Photograph 2) in the progressive reclamation works on the surface of the 700 mm layer of compacted till. Once the Lynx TDF dam face is covered by the coarse waste rock, fine-textured waste rock materials from the underground mine or salvaged during progressive reclamation works can be used to cap the coarse materials (Photograph 3). By making this material rough and loose (de-compacting) and scattering woody debris (100 m^3/ha), the fine textured materials can be used to build additional soils at the mine. Note that due to the steep slopes (2H:1V), the surficial materials will need to be keyed into the compacted till cover.

If the bottom lift of the dam is constructed to the closure envelope during mine operations, multiple alternative closure cover options could be constructed across the lift (e.g. split the lift into 2 or 3 zones) and monitored for success prior to subsequent lift construction.

Photograph 2: Coarse textured waste rock could be obtained from the toe of WRD2 if it is non-PAG (left)

Photograph 3: Fine textured non-PAG material could be obtained from the upper dump slopes (right)

The closure cover for the Lynx TDF surface has not yet been designed, but the methods included in this plan would all be considered during the design process.

3.3 Potentially Acid Generating (PAG) Waste Rock Dumps

The second general area where the soil resources should be applied are sites where potentially acid generating (PAG) materials occur, which includes waste rock dumps (WRDs). These waste rock dumps and other sites have the potential to become acid producing, carrying metals with the acid to aquatic and terrestrial systems (Farmer et al. 1976). Sulphuric acid is produced by the reaction of sulphide minerals (e.g. iron pyrite or chalcopyrite) when mixed with oxygen and water (Richardson 1980). Treatments designed to restrict that reaction are based on limiting the amount of air and/or water entering the WRD and reaching the reactive rock (O'Kane et al. 2001). Among the methods used to reduce metal leaching and acid rock drainage (ML/ARD) are underwater storage and engineered soil covers, which must be properly designed for the mine in accordance with an ML/ARD program (MEM, 1998). It is understood that WRD6, just upstream of the Old Tailings Disposal Facility (Old TDF), is acid generating and will have an engineered geomembrane cover to limit ML/ARD generation. The remaining WRDs will require soil covers only.

In addition to treatments to limit air and water reaching the reactive waste rock, limestone can be used to increase the pH of water, thus reducing the reactivity of the water with the sulphur containing minerals (Sorensen et al. 1980). The calcium carbonate in the limestone reacts with the sulphides to produce a metal-oxyhydroxide coating on the waste rock that seals the sulphur containing minerals from further oxidation (Morin and Hutt 1997). An application of dolomitic limestone on the site before the soil covering may be a prudent precaution against future ARD (O'Kane et al. 2001).

The soil covering at this point could include engineered materials (geomembrane and geotextile) or could consist of layers of natural materials designed for filter compatibility to limit erosion. Some WRDs may only require a simple soil application placed directly on the final surface of the dump, with erosion and sediment control measures installed as required.

Sufficient soil materials must be applied on top of the cover to support forest growth or significant erosion and/or upward migration of ML/ARD reaction products may result. This could consist of a total of about 1 m of growth material consisting of 70 cm of fine textured non-PAG waste rock and 30 cm of soil material. On non-PAG waste rock sites, the fines from the tops of the waste rock dumps can be used as a growth media. The surface soils can be made rough and loose (taking care to prevent damage of the engineered cover) to promote the establishment of pioneering species (e.g. Red Alder (*Alnus rubra* Bong.) or Balsam Poplar (*Populus balsamifera* L.) that will initiate forest development.

3.4 Other Disturbed Sites and Waste Rock Dump Slopes

Soil resources could aid in the restoration of other mine site disturbances if they are available. Soil resources include the fine textured materials that collect at the top of waste rock dumps or other fine textured materials and with suitable pioneering vegetation can form a productive soil. Additional soil materials cannot be obtained from outside Strathcona-Westmin Provincial Park for permit reasons, so it is expected that the soils that are available on site will be the only materials available for the restoration. If there are sufficient soil materials available following treatment of the Myra Creek riparian area and the PAG areas, the restoration materials can be applied to other disturbed sites as well, such as on re-sloped non-PAG waste rock dump areas. Many of the historical waste rock dumps on site require geotechnical stabilization, which in most cases will remove the waste rock entirely for use in Lynx TDF dam construction. Any remaining rock would be sloped to 2H:1V. Re-sloping any remaining non-acid generating waste rock dump areas will allow the fines that are at the top of the slopes to be spread down the slope covering the coarse materials on the slopes. These fine textured materials can then be used as a growth media for forest development. By creating conditions (rough and loose) that promote the growth of pioneering species, soils can be developed naturally on the non-acid generating waste rock slopes while controlling erosion and soil enhancements should not be needed.

4.0 Control of Erosion

Erosion can be a significant feature at mines and other large disturbed areas (USDA. 1977). Erosion can be defined by the Universal Soil Loss Equation (Wischmeier and Smith 1965):

X = R*K*S*L*C*P

Where:

X = the computed soil loss in tons (dry weight) per acre from a given storm period (can be converted to metric, e.g. tonnes)
R = the rainfall erosion index
K = the soil erodibility index
S = the slope gradient factor
L = the slope length factor
C = the cropping (vegetation) factor
P = erosion control practice factor

Understanding the implications of the Universal Soil Loss Equation can help with the design of systems that control erosion. It should be noted that all of the elements listed in the Universal Soil Loss Equation are multiplied together so the larger the number, the higher the rate of erosion. The rainfall erosion index is a number generated for a specific area, so an area with historically high rainfall such as Vancouver Island will have a high rainfall erosion index (about 200) while an area with traditionally lower rainfall events, such as Calgary or the east slope of the Rocky Mountains, will have a lower rainfall erosion index (about 50). The mine site is located in a high rainfall area. Erosion can be visually detected by looking for silt laden water or sediment accumulations at the bottom of slopes.

The soil erodibility index is another condition that cannot be changed; the soil is what it is. It is interesting here that the finest soils, clays, are not as erosive as slightly coarser silts, since clay particles have an electrostatic attraction to one another while the silt does not have this attribute. Regardless, elements of the Universal Soil Loss Equation that cannot be changed by humans are called indices, while the elements that can be changed by humans are called factors.

Modification of the factors associated with the Universal Soil Loss Equation can result in the control of erosion (Polster 2015). For instance, a smooth slope will have a relatively high rate of erosion, while making that same slope rough and loose (increasing topographic heterogeneity) will control erosion as it mimics the natural process of trees falling in a forest with large root balls coming up as the tree falls. This creates a rough and loose forest floor, so water does not flow across the ground in a forest; it is injected into the near surface ground water system by the rough and loose ground and a variety of plants such as swordferns (*Polystichum munitum* (Kaulf.) C. Presl) and salal (*Gaultheria shallon* Pursh), two important species in the rainiest part of Canada (Polster 2017).

Making the ground surface rough and loose is relatively easy and inexpensive and can be done on slopes up to 2H:1V, as has been done at the nearby Heber Dam site, as long as the overlying materials are keyed into the underlying layer. Spreading materials with bulldozers creates compaction in the soils and prevents healthy growth of vegetation. Using an excavator to prepare the surface of the compacted area can be an effective way of alleviating compaction. The excavator can make rough and loose configurations by opening holes on the site, dumping the material that is generated from the holes in mounds between the holes. The excavator, using a digging bucket (not a clean-up bucket), takes a large bucket full of material and places it to the left of the hole that was just opened; half a bucket width from the hole so it is half in and half out of the hole. Rocks are fine to include as these tend to create additional heterogeneity. A second hole is then excavated half a bucket width to the right of the first hole taking care to shatter the material between the holes as the second bucket full of material is removed. Material from this hole is then placed between the first and second holes. A third hole is now opened half a bucket width to the right of the second hole, with the excavated soil placed between the second and third holes. The process of making holes and dumping soil is continued until the reasonable operating swing of the excavator is reached. The excavator then backs up the width of a hole and repeats this process, being sure to line up the holes in the new row with the space between the holes (mounds) on the previous row. Photograph 1 shows an example of this technique.

Rough and loose surface configurations can be used on re-contoured waste dump slopes to control erosion and provide suitable sites for vegetation establishment. An elevational difference of 1.0 to 1.5 m should be established between the tops of the mounds and the bottoms of the holes of the rough and lose ground. Costs at a large northern mine for making sites rough and loose were found to be $712/ha.

There are a variety of erosion control practices that have been designed to control erosion and to initiate the recovery of the eroding site, with an aim to control erosion in the medium term (1 year to 18 months) until sufficient vegetation has established. Many of these are soil bioengineering treatments that are designed to deal with flowing water, steep slopes and other erosive issues (Polster 2006). By understanding how erosion occurs, effective solutions can be found.

All erosion control techniques suggested in this plan will be further detailed in conjunction with engineered designs and will consider design surface runoff coefficients and groundwater modelling and loading assumptions.

5.0 Enhancement of Revegetation Programs

Soil resources are used to enhance revegetation programs, but care must be taken to avoid the trap of seeding with agronomic grasses and legumes. Agronomic grasses and legumes are a traditional treatment for mine reclamation, but it has been found that this treatment stalls recovery for many years (Polster 1991). At the Island Copper Mine, grass and legume seeding is killing the woody vegetation that was planted (Polster and Howe 2006) and is causing metals that are in the underlying waste rock to migrate to the surface.

Making sites rough and loose is an effective erosion control technique that avoids the problems of grass and legume seeding. It creates conditions that foster the natural establishment of pioneering species such as Red Alder (*Alnus rubra* Bong.) (Polster 2009). The natural pioneering species that are currently being used at Myra Falls Mine are designed to start the growth of the Coastal Western Hemlock forests that are the natural ecosystem for the area. Costs are minimal as the pioneering species establish free of cost and create conditions that move the site along successionally. Alder is a great pioneering species and would establish at Myra Falls Mine on suitably prepared sites (Peterson et al. 1996). By following the natural successional trajectory for the site being restored, the problems of invasive species can be avoided (Polster 2003). Seeding with agronomic grasses and legumes is discouraged, as it sets the reclamation site up for invasion by weedy species. Alternative measures to enhance revegetation will be required on engineered surfaces such as the Old TDF closure cover, to maintain the engineered function of the cover. Willows are a suitable plant species, as they have root systems that are three times the strength of spruce roots and are pioneering species. Cuttings can be installed in sensitive areas, keeping in mind that a cutting must be installed with 3/4 to 7/8 of the stem underground.

Establishment of vegetation on non-acid generating waste dump slopes requires that the dump slopes be reduced from the angle-of-repose to a reasonable slope for revegetation, often about 26.6 degrees (2H:1V). Pushing the fine materials from the top of the slope over the face to bury the coarser materials that are found in the mid-slope and at the bottom of the slope is a simple task with a large bulldozer. Fine materials collect at the top of colluvial slopes (Polster and Bell 1980). Since this material makes an excellent rooting medium for pioneering species such as Red Alder, making the re-sloped waste dump rough and loose (method described above) and adding woody debris (100 m^3/ha) is all that is needed to facilitate the establishment of an effective vegetation cover on the slope. However, in some locations, additional erosion control measures will be required until the vegetation is fully established.

There are Red Alder growing all around the mine so there will be an ample supply of seed to treat suitably prepared sites. Coarse woody debris is stockpiled at site for this use. If insufficient volumes have been stockpiled, coarse woody debris can often be obtained from local logging operations for the cost of hauling the material away as this saves the logging company the cost of burning the piles of scrap.

6.0 Monitoring

Monitoring is an essential part of any reclamation program (Gaboury and Wong 1999). Monitoring can be conducted on completed restoration work to determine progress of the restoration or on sites that have been specifically established to test a restoration procedure. In many cases where the restoration treatment is well known locally, providing trial sites that actually perform some useful restoration can be very effective as restoration work is done at the same time trials are established. Monitoring the performance of the restoration conducted on these sites can be used to demonstrate the suitability of the applied treatment in the Myra Falls area. Monitoring of vegetation can be used to reflect the soil conditions that the vegetation is growing in. Evidence of soil erosion can be identified visually by noting muddy water during rainstorms or by looking at pebble pavements forming on the soils (fine textured soils wash away while the stones remain on the surface) (Wischmeier and Smith 1965).

Samples will be collected from potential growth medium sources such as mine waste or till for texture, metal concentrations, and pH to determine the suitability of the material as a growth medium. A composite sample every 1,000 cubic metres of material to be used would be a sufficient density to determine suitability of a new potential growth medium source.

Prior to the development of a full vegetative cover, small trenches the depth of a hand-trowel will be dug to monitor the rate of organic soil development. One shallow trench every 10 ha should be assessed on each reclaimed area every 5 years in a similar location each time. A GPS point should be taken at the time of sampling to ensure that the same area be visited for comparative sampling to occur. Care must be taken to ensure the material is placed back into the trench, and that subsequent trenches not directly overlap previous trenches. A photo of the trench should be taken, and notes prepared on the presence (and depth if present) of the O, A, and E horizons as they develop on the mineral growth medium placed at closure (artificial B horizon). It should be noted that development of native podzol soils is a long-term process that will take over 100 years.

Vegetation reflects the conditions of the soil it is growing in (Buckman and Brady 1969), so one effective way of monitoring soil conditions indirectly is to monitor the vegetation growing in the soil in question. Evidence of excessive erosion can be visually identified as described in Section 4.0 above, while chemical conditions (like excessive metals) may be visually identified by the aspect of the vegetation (Photographs 4 and 5).

Photograph 4: Interveinal chlorosis in the vegetation at the Island Copper Mine in Port Hardy (left)

Photograph 5: Interveinal chlorosis in the vegetation at the Vale Mine in Sudbury, ON (right)

There are a wide variety of monitoring systems that have been developed; however, simple systems that can be understood by all are particularly useful as these can build confidence in the systems being monitored. In the case of the Myra Falls Mine site, establishment of transects through the restored areas with appropriately sized plots at regular intervals along the transect can be used. The transect should follow along the disturbed site so that uniform conditions are sampled. For instance, sampling along the treated Myra Creek would follow the shoreline of the creek. If circular plots that are 1/100 of a hectare (5.64 m in radius) are used, then the analysis of data allows simple comparisons based on a per hectare basis (Orloci and Pillar 1989). There is a benefit in marking the start of transects with a post that can be found in subsequent years as this will allow the same areas to be sampled repeatedly so that the progress of the restoration can be clearly documented. At each site, plot a complete list of the species present along with an estimate of their cover and abundance (Mueller-Dombois and Ellenberg 1974). This will allow the identification of any invasive species as well as the change in vegetation cover in the future.

7.0 Reporting

Soil placement and salvage activities will be reported annually in the Reclamation Report, to be submitted to the MEMPR by March 31 of each year.

This report will include the volume in cubic metres, origin, number of samples collected, and location of soils salvaged and placed. The information will be presented in “Table 5: Quantities of Soil and Overburden Salvaged and Stockpiled for Reclamation Use as of December 31, 20XX” as required by the MEMPR and included in Appendix B.

The annual Reclamation Report will also include:

- Summary of results of suitability sampling;
- Sediment and erosion control measures implemented; and
- Summary of vegetation inspection results.

Soil development profile work and learning experiences will be reported in the Five Year Mine and Reclamation Plans to be submitted every fifth year on January 31, starting in 2021.

8.0 Closing Remarks

This report has been prepared for the exclusive use of Nyrstar Myra Falls Ltd. for specific application to the area within this report. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. Wood Environment & Infrastructure Solutions accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. It has been prepared in accordance with generally accepted ecological practices. No other warranty, expressed or implied, is made.

Respectfully submitted,

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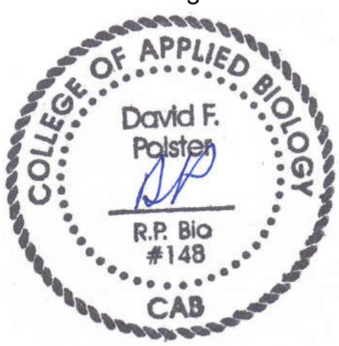

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Appendix A

Table 5: Quantities of Soil and Overburden Stockpiled for Reclamation

TABLE 5

QUANTITIES OF SOIL AND OVERBURDEN SALVAGED AND STOCKPILED FOR RECLAMATION USE AS OF DECEMBER 31, 20xx

COMPANY: ____ PERMIT NO.:_____________

Use the space below to enter information for salvage program and soil/overburden stockpile. All volumes should be given in m^3.

Area Salvaged (Location and Area in ha)	Salvage Volumes to Stockpile Locations (m^3)						Total Salvage Volumes (m^3)	# of Samples for Suitability
	Stockpile 1	Stockpile 2	Stockpile 3	Stockpile 4	Stockpile 5	Stockpile 6		
Totals								

** Please modify this table as needed, or submit in a different format, to accommodate the specific soil salvage and stockpile activities for the project site.

Appendix B

Report Limitations

Limitations

1. The work performed in the preparation of this report and the conclusions presented are subject to the following:
    a. The Standard Terms and Conditions which form a part of our Professional Services Contract;
    b. The Scope of Services;
    c. Time and Budgetary limitations as described in our Contract; and
    d. The Limitations stated herein.

2. No other warranties or representations, either expressed or implied, are made as to the professional services provided under the terms of our Contract, or the conclusions presented.

3. The conclusions presented in this report were based, in part, on visual observations of the Site and attendant structures. Our conclusions cannot and are not extended to include those portions of the Site or structures, which are not reasonably available, in Wood's opinion, for direct observation.

4. The environmental conditions at the Site were assessed, within the limitations set out above, having due regard for applicable environmental regulations as of the date of the inspection. A review of compliance by past owners or occupants of the Site with any applicable local, provincial or federal bylaws, orders-in-council, legislative enactments and regulations was not performed.

5. The Site history research included obtaining information from third parties and employees or agents of the owner. No attempt has been made to verify the accuracy of any information provided, unless specifically noted in our report.

6. Where testing was performed, it was carried out in accordance with the terms of our contract providing for testing. Other substances, or different quantities of substances testing for, may be present on-site and may be revealed by different or other testing not provided for in our contract.

7. Because of the limitations referred to above, different environmental conditions from those stated in our report may exist. Should such different conditions be encountered, Wood must be notified in order that it may determine if modifications to the conclusions in the report are necessary.

8. The utilization of Wood's services during the implementation of any remedial measures will allow Wood to observe compliance with the conclusions and recommendations contained in the report. Wood's involvement will also allow for changes to be made as necessary to suit field conditions as they are encountered.

9. This report is for the sole use of the party to whom it is addressed unless expressly stated otherwise in the report or contract. Any use which any third party makes of the report, in whole or the part, or any reliance thereon or decisions made based on any information or conclusions in the report is the sole responsibility of such third party.

Wood accepts no responsibility whatsoever for damages or loss of any nature or kind suffered by any such third party as a result of actions taken or not taken or decisions made in reliance on the report or anything set out therein.

10. This report is not to be given over to any third party for any purpose whatsoever without the written permission of Wood.
11. Provided that the report is still reliable, and less than 12 months old, Wood will issue a third-party reliance letter to parties that the client identifies in writing, upon payment of the then current fee for such letters. All third parties relying on Wood's report, by such reliance agree to be bound by our proposal and Wood's standard reliance letter. Wood's standard reliance letter indicates that in no event shall Wood be liable for any damages, howsoever arising, relating to third-party reliance on Wood's report. No reliance by any party is permitted without such agreement.

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