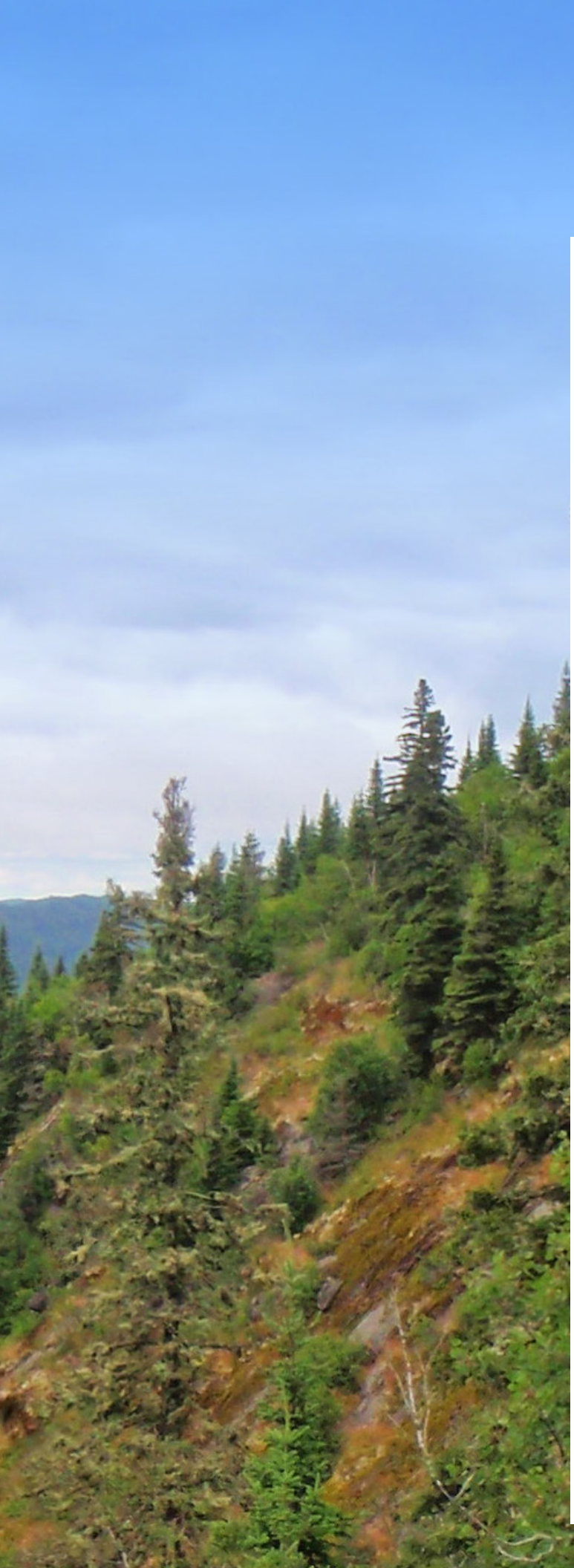


Marathon Palladium Project Environmental Impact Statement Addendum

VOLUME 2 OF 2

6.2.5 Terrain and Soils

Prepared for:

GENERATIONPGM

Prepared by:

Stantec

Ecometrix Environmental INTELLIGENCE

NORTHERN BIOSCIENCE ECOLOGICAL CONSULTING

Knight Piésold CONSULTING

Date: April 2021
Environmental Assessment by Review Panel under CEAA 2012
Reference Number 54755

Table of Contents

LIST OF TABLES

LIST OF FIGURES

Abbreviations

AIRs	Additional information requests
CIAR	Canadian Impact Assessment Registry
EIS	Environmental Impact Statement
GenPGM	Generation PGM Inc.
IR	Information Request
LSA	Local Study Area
MRSA	Mine Rock Storage Area
OB	overburden
PAG	Potentially Acid Generating
PSMF	Process Solids Management Facility
ROM	Run of Mill
RSA	Regional Study Area
SIRs	Supplemental Information Request
SSA	Site Study Area
VEC	Valued Ecosystem Component

6.2.5 Terrain and Soils

6.2.5.1 Summary of Original Terrain and Soils Assessment

6.2.5.1.1 Assessment of Residual Effects in Original EIS

Section 6.2.5 of the original EIS (2012) and subsequent responses to information requests from the Panel provided an assessment of the following effects to terrain and soils as result of the Project:

- change in soil / overburden

Additional information on the assessment of effects on terrain and soils was provided in responses to the following IRs:

- Responses to IR14.1 (clarification of surficial geology) and IR14.2 (overburden grain size) (CIAR #376).

Potential interactions between the Soil and Terrain VEC and project activities were identified during each project phase. It was estimated that a total of approximately 3.7 M tonnes of soil and overburden (OB) would be excavated within the SSA during site preparation and construction to develop site-related infrastructure. Excavated materials were to be stockpiled and, with the expectation that a small proportion would be utilized as borrow material for construction purposes, the majority of these materials would be used for site rehabilitation.

The majority of excavated topsoil and OB would remain in stockpiles over the duration of the operational phase of the Project. Geochemical testing of these materials indicated that they were non-potentially acid generating (PAG) and did not pose a water quality management concern. Stockpiled materials were identified as a source of potential fugitive dust emissions through air quality modelling but no material changes in soil quality were expected at or beyond the site boundary. Stockpiled materials were identified with reference to stability and erosion risks; however, stockpile construction would be completed in such a way to minimize these risks.

During the decommissioning and closure stages, stockpiled materials would be utilized for reclamation purposes and, therefore, stockpiles would be fully depleted eliminating erosion and slide risks. As indicated, geochemical testing of these materials indicated that they were non-PAG and no concerns with using stockpiled soil and OB for reclamation purposes was identified.

Key mitigation measures originally proposed to avoid, reduce and/or offset potential effects of the Project on terrain and soils included measures associated with or inherent in the mine plan/design such as:

- Minimizing the project development footprint to the extent possible
- Stockpiling excavated materials for use as borrow and reclamation material
- Designing and maintaining stockpile slopes to mitigate erosion and slide risks

- Providing surface runoff management infrastructure to mitigate loss of potentially eroded materials into local watercourses

6.2.5.1.2 Determination of Significance in Original EIS

For terrain and soils, the original EIS (2012) concluded that there would be no significant adverse effects.

6.2.5.2 Approach to Update the Assessment

The following subsections provide an update to the assessment of residual environmental effects of the Project, including a determination of their significance based on the following:

- Updated environmental conditions within the SSA, LSA and RSA, as appropriate
- Recognition of updated standards, criteria, guidelines, or other thresholds that inform the determination of significance
- Consideration and recognition of project refinements, including changes to the project components and activities, that may affect potential project interactions, mitigation measures and residual effects

Any changes to the results of the previous assessment have been highlighted and discussed below, as appropriate. Supplementary rationale and explanation for the conclusions of the assessment have been provided based on the previous responses to the information requests (IRs, SIRs, AIRs) and additional input from the various technical discipline leads based on the current assessment.

6.2.5.3 Scope of the Assessment

6.2.5.3.1 Regulatory and Policy Setting

There are no regulatory requirements, policies, nor guidance, *per se*, that are specifically associated with characterization of effects on the Terrain and Soils VEC. For reference purposes, soil chemistry data can be screened against average crustal abundance concentrations according to Faure (1998) and the MOE (2011) full depth background site condition standards, which are based on typical background concentrations found in non-contaminated Ontario soils. These standards have not changed since the original EIS (2012) submission.

Section 2.6.1.1. of the EIS Guidelines (Appendix B of the EIS Addendum [Vol 2]) describes the reporting requirements associated with the discussion of existing conditions on the site as it pertains to soils, surficial and bedrock geology of the deposit, host rocks, and overburden units.

6.2.5.3.2 Influence of Consultation and Engagement on the Assessment

Consultation for the Project has been ongoing since 2004 and will continue throughout the life of the Project. Chapter 4 of the original EIS (2012) and Chapter 5 of this EIS Addendum (Vol 2) covers the consultation processes and activities undertaken by GenPGM and formerly by Stillwater. Comments and feedback received throughout the consultation process pertaining to soils and terrain are summarized below:

- Information was requested on the source of construction materials (e.g. aggregate, soils) including the reuse of mine rock for aggregate
- Concern relating to existing erosion along the Pic River and potential mitigation measures to be implemented through the Project development

6.2.5.3.3 Potential Effects, Pathways and Measurable Parameters

Two potential effects on the soil and overburden VEC have been identified including “change to soil and overburden” and “change to soil quality”.

With reference to “change to soil and overburden” this effect refers to the potential loss of soils and overburden (quantity) through the development of mine-related infrastructure. As described in Section 1.5.2.1 of the EIS Addendum (Vol 1) (CIAR #727), soil and overburden will be excavated and subsequently stockpiled in this process. Approximately 3.7 M tonnes (2.0 M m^3) of overburden will be excavated within the SSA. This material will be relocated to a single stockpile south of the mine rock storage area (MRSA) within subwatershed 102 (refer to Figure 1.5-1 of EIS Addendum [Vol 1]) (CIAR #727). An additional 1.2 M tonnes (674,000 m^3) will be excavated and stockpiled in several small stockpiles along the western margin of the process solids management facility (PSMF) (refer to Figure 1.5-1 of EIS Addendum [Vol 1]) (CIAR #727). Stockpiled soil and overburden material may be subject to erosion and sliding, such that the quantity of material stockpiled would be reduced, leaving less material available for rehabilitation purposes.

With reference to “change in soil quality”, this effect refers to the potential change in concentrations of soil constituents that could result primarily from project-related air emissions, principally fugitive dust emissions. Such an effect is relevant to consider since changes to soil quality may affect soil productivity.

These potential effects and effect pathways are similar to those presented in the original EIS (2012).

Table 6.2.5-1: Potential Effects, Effects Pathways and Measurable Parameters for Terrain and Soils

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in soils and overburden quantity	• Removal and relocation of soil and overburden through the development of the project site • Erosion or sliding of stockpiles	• Quantity (tonnes / m^3) of soils and overburden
Change in soil quality	• Air emissions and fugitive dust deposited on surface within the LSA	• Concentrations of constituents in soil

6.2.5.3.4 Assessment Boundaries

In general, the spatial boundaries for the assessment of environmental effects are presented in Section 2.4 (EIS Addendum [Vol 1]) (CIAR #727), while the LSA and RSA are defined based on the extent of potential effects specific to each Valued Ecosystem Component (VEC).

- **Site Study Area**: The SSA is the direct footprint of the Project, and is consistent across all VECs. The SSA has been revised from the original EIS to reflect changes and refinements to the Project design.
- **Local Study Area**: The Terrain and Soils LSA represent the maximum area within which effects from changes to soils by Project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence.

  For the purpose of the Terrain and Soils VEC, the LSA consists of the SSA and adjacent areas where Project-related environmental effects are reasonably expected to occur based on available information and professional judgment. The LSA for soil is depicted on Figure 6.2.5-1. The area corresponds to that of the atmospheric environment LSA, as the primary pathway of potential effects on soils outside the SSA would be from project-related emissions to air. The LSA used in this baseline reports in similar to the LSA used in the original EIS (2012).

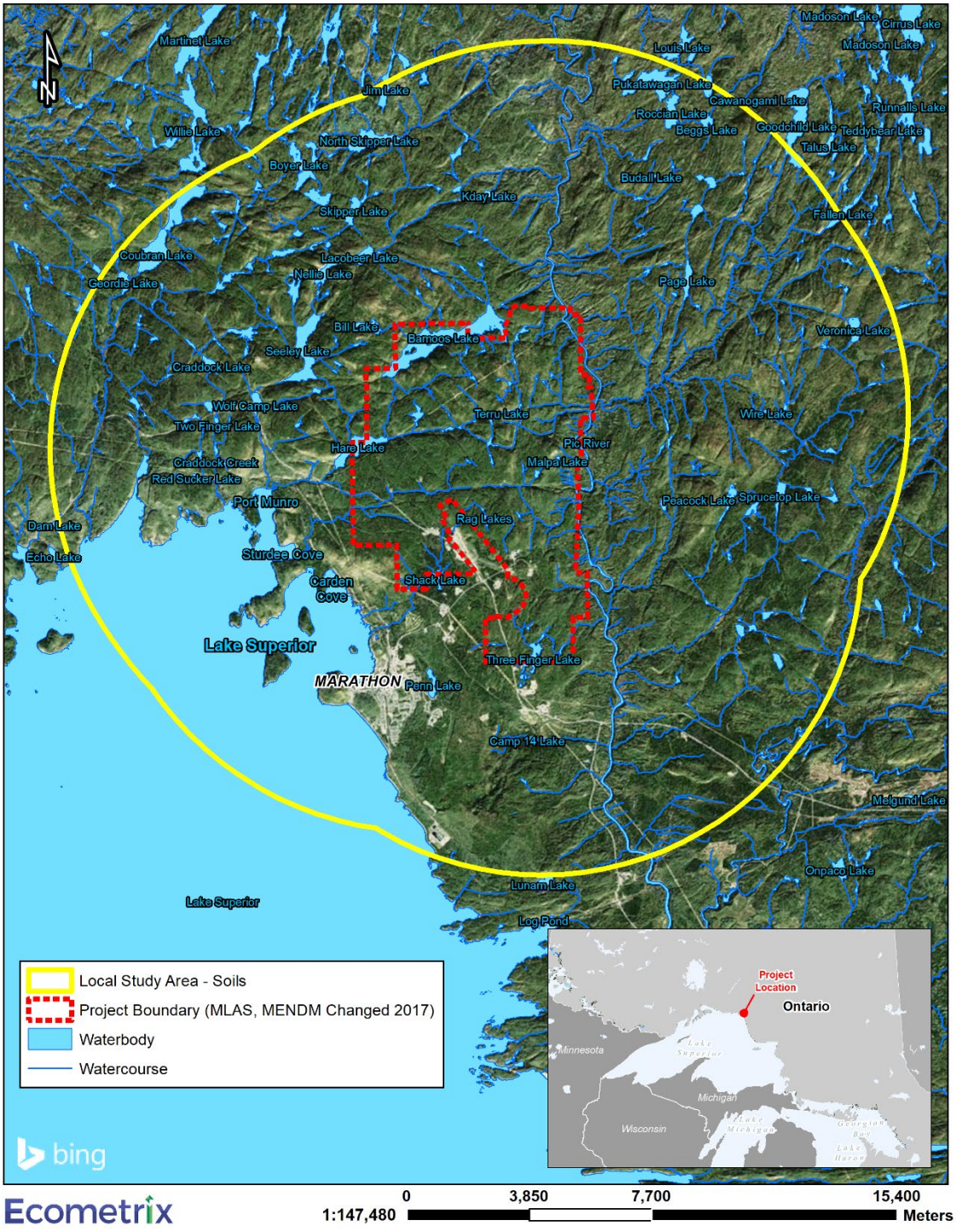
- **Regional Study Area**: The Terrain and Soils RSA is the area within which residual environmental effects from Project activities and components may interact cumulatively with the residual environmental effects of other past, present and future (i.e., certain or reasonably foreseeable) physical activities. The RSA is based on the potential for interactions between the Project and other existing or future potential projects in regard to changes terrain and soils.

  It is not anticipated that effects that may be associated with the Project would act cumulatively with others outside the LSA. For this reason, the RSA for the Soil and Terrain VEC is the same as the LSA.

The modified and original Terrain and Soils LSA and RSA boundaries are included on Figure 6.2.5-1.

The temporal boundaries for the Project that have been considered in the determination of environmental effects are described in Section 2.5 of the EIS Addendum (Vol 1) (CIAR #727). The temporal boundaries used to assess potential effects on the soils and terrain VEC span all phases of Project life.

Figure 6.2.5-1: Terrain and Soils Spatial Boundaries



6.2.5.3.5 Residual Effects Characterization

Table 6.2.5-2 summarizes how residual environmental effects are characterized in terms of direction, magnitude, geographic extent, timing, frequency, duration, reversibility, and ecological and socio-economic context. The characterization of residual effects is consistent with the original EIS, which were qualitative definitions, and have been further defined to include quantitative measures, where applicable, as part of this EIS amendment.

Table 6.2.5-2: Characterization of Residual Effects on Terrain and Soils

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Positive** – Effect moves measurable parameters in a direction beneficial to terrain soils relative to baseline conditions. **Adverse** – Effect moves measurable parameters in a direction detrimental to terrain and soils relative to baseline conditions.
Magnitude	The amount of change in measurable parameters of the VEC relative to existing conditions	**For Soil Quantity** **Negligible –** no measurable change in the quantity of soil on the site **Low –** a measurable change in the quantity of soils on the site but not to the extent that potential soil productivity is lost. **Medium –** a measurable change with regard to the quantity of soils on the site with some potential loss of soil productivity on the site. **High –** Singly or as a substantial contributor in combination with other sources causing substantial loss of soil productivity on the site. **For Soils Quality** **Negligible –** no measurable change in soil quality. **Low –** a measurable change in soil quality but within normal variability of baseline conditions. **Medium –** a measurable change in soil quality with regard to the baseline but within applicable regulatory criteria. **High –** Singly or as a substantial contributor in combination with other sources causing exceedances of applicable regulatory criteria beyond the SSA.
Geographic Extent	The geographic area in which a residual effect occurs	**Negligible (SSA) –** the residual effect is limited to SSA **Low –** the residual effect is restricted to the SSA or immediate surroundings **Medium (LSA) –** the residual effect extends into the LSA **High (RSA) –** the residual effect extends into the RSA
Timing	Considers when the residual effect is expected to occur, where relevant to the VEC.	Not Applicable (N/A) – seasonal aspects are unlikely to affect the residual effect on soil quantity and/or quality. Applicable – seasonal aspects may affect the residual effect on soil quantity and/or quality.

Table 6.2.5-2: Characterization of Residual Effects on Terrain and Soils

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Duration	The time required until the measurable parameter or the VEC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Negligible –** residual effect is limited to a single event **Low (short-term) –** the residual effect is limited to short term events (a few years or less) **Medium –** the residual effect is limited to the operational/decommissioning phases (years to decades) **High (Long-term) –** the residual effect extends beyond the life of the project (centuries)
Frequency	Considers whether the residual effect is expected to occur once, at regular or irregular intervals or continuously	**Negligible –** the condition of phenomena causing the effect rarely occurs **Low (Multiple irregular event) –** occurs at no set schedule and are unlikely to occur **Medium (Multiple regular event) –** occurs at regular intervals (i.e. >1% of the time) **High (Continuous) –** occurs continuously
Reversibility	Considers whether the residual effect is reversible or irreversible.	**Negligible –** effect ceases immediately once source or stressor is removed **Low –** effect ceases once source or stressor is removed **Medium –** effect persists for some time after source or stressor is removed **High (Irreversible) –** the residual effect is unlikely to be reversed
Ecological/Societal Value	Considers the magnitude that the residual effect is expected to have on the ecological or societal community, as determined through consultation and engagement.	**Negligible –** the VEC has no value from a cultural or societal context **Low –** the VEC is common in the LSA and/or has little to no value from a cultural or societal context **Medium –** the VEC is abundant in the RSA, though may be less so in the LSA, and/or has moderate cultural or societal value **High –** the VEC is rare and/or of high cultural or societal value

Note: Timing was not included in the original EIS.

6.2.5.3.6 Significance Definition

For the purpose of the assessment, a significant residual adverse effect for the Soil and Terrain VEC is one where there is a change in soil quantity and/or quality that results in a reduction in soil capability, which cannot be offset through mitigation or compensation measures.

6.2.5.4 Existing Conditions for Terrain and Soils

Existing conditions are described in Section 4 of the EIS Addendum (Vol 1) (CIAR #727). The Soils Baseline Update Report (Ecometrix 2020a) (CIAR #722) provides an overview of how baseline conditions

have changed since the original EIS (2012) and/or how the understanding of the baseline conditions has evolved.

6.2.5.5 Determining Project Interactions with Terrain and Soils

Table 6.2.5-3 identifies, for each potential effect, the project's physical activities that might interact with the VEC and result in the identified effect. This table is based on a similar table from the original EIS and has been updated to reflect changes to the Project.

Table 6.2.5-3: Project Interactions with Terrain and Soils

Physical Activities	Effects	
	Change in soils quantity	Change in soil quality
Site Preparation/ Construction		
Clearing, grubbing and stripping of vegetation, topsoil and other organic material	✓	✓
Grading with topsoil	✓	✓
Drilling and blasting to develop the open pits and plant site area	–	✓
Excavation and pre-stripping to remove mine rock and overburden	✓	✓
Preparation of construction surfaces and installation of temporary construction facilities	✓	✓
Site preparation for waste management	✓	✓
Construction of administration buildings, storage buildings, other ancillary structures and site services such as parking lots, area fencing, and security systems	✓	✓
Construction of explosives facilities	✓	✓
Construction of PSMF containment dams and MRSA	✓	✓
Management of surface water and groundwater on the site, including seepage and run-off	–	–
Maintenance and management of mine rock stockpiles, overburden, and PSMF	–	✓
Construction of water management facilities and drainage works (including but not limited to pipelines, dewatering facilities, stormwater management, control ponds, and water management pond)	✓	–
Dewatering of natural water bodies in the project area	–	–
Construction of new mine site access and haul roads, including any water crossings and water body shoreline works or undertaking	✓	✓
Upgrading of the existing mine access road(s) and entrance(s) to the project area including any water crossings and water body shoreline works or undertakings	✓	✓
Construction of a 115kV electrical transmission line within a new right-of-way from the M2W Transmission corridor	–	–

Table 6.2.5-3: Project Interactions with Terrain and Soils

Physical Activities	Effects	
	Change in soils quantity	Change in soil quality
Aggregate sources and amounts	✓	✓
Management of waste	–	–
Any works or undertakings associated with upgrading a rail load-out facility for mine concentrate and off-site accommodations complex	✓	✓
Operating vehicles	–	–
Hiring and management of workforce	–	–
Taxes, contracts and purchases	–	–
Operation		
Drilling, blasting, loading and hauling of mine rock from the pits to ROM stockpile pad, crusher or the MRSA	✓	✓
Operation of explosives facilities	–	–
Handling, transportation, use and disposal of explosives	–	–
Transportation of crushed material to coarse ore stockpile	–	–
Transportation of mill feed (ore) to the grinding section of the processing facility	–	–
Process Plant operation	✓	–
Transportation of filtered concentrate	–	–
Management and maintenance of the entire mine waste stream, including but not limited to process solids and mine rock	✓	✓
Decommissioning of the temporary process water pond (proposed during mine operations), including removal or breaching of dams	–	–
Dewatering activities (e.g. open pit)	–	–
Management of surface water and groundwater on the site; including seepage, run-off, contact water, process water and storm water	–	–
Management of surface water on site during dam removal or breaching	–	–
Management of domestic waste from the mine site	✓	–
Management of hazardous waste	–	–
Environmental safety procedures	–	–
Operating vehicles	–	–
Hiring and management of workforce	–	–
Taxes, contracts and purchases	–	–
Decommissioning and Closure/Post-Closure		
Installation of barriers around the pit perimeters	–	
Management of inputs from groundwater and surface water run-off into pits	–	–

Table 6.2.5-3: Project Interactions with Terrain and Soils

Physical Activities	Effects	
	Change in soils quantity	Change in soil quality
Decommissioning, dismantling and/or disposal of equipment	–	–
Demolition/removal of surface buildings and associated infrastructure and disposal of resulting rubble	✓	✓
Decommissioning/removal of explosives facilities	✓	
Removal of power lines and electrical equipment	–	–
Decommissioning of the potable water and sewage treatment systems (e.g. water treatment plant and membrane bioreactor)	–	–
Maintenance and management of mine rock stockpiles and PSMF	–	✓
Following removal of infrastructure, soil, groundwater, and surface water testing for residual contamination, and disposal of contaminated soils and treatment of groundwater and surface water, as required	✓	✓
Reclamation and restoration of landscape (including water bodies) to productive capacity including management and monitoring	✓	✓
Management of flooded pits to protect groundwater and surface water quality during flooding and pit overflow	–	–
Operating vehicles	–	–
Hiring and management of workforce	–	–
Taxes, contracts and purchases	–	–

Notes:

✓ = Potential interaction

– = No interaction

* minor wording changes to the physical activities list have been made to better align with the updated Project description covered in Chapter 1 (EIS Addendum [Vol 1])

Generally, for the soils and terrain VEC, interactions are indicated where ground disturbance is required to develop site infrastructure, and where project-related air emissions, such as fugitive dust, are likely. In the former case, soils would be excavated and stockpiled to prepare surfaces for development. In the latter case, project-related air emissions could contain constituent levels that, when deposited, could result in changes in the concentrations of those constituents in soils.

Project components and activities that are not likely to interact with the Soil and Terrain VEC include those related to:

- employment and expenditure, since they will not directly result in changes to the physical environment during any Project phase
- the operation and management of water management related infrastructure and activities, since these interactions are expected to be associated with the surface and groundwater environments

- the routine operation and management of ancillary facilities, such as fuel storage, explosives and waste management, as interactions would likely be limited to non-routine events (i.e., accidents and malfunctions) that are assessed elsewhere in this report

6.2.5.6 Assessment of Residual Effects on Terrain and Soils

As described below, no significant residual adverse effects of the Project on the Soil and Terrain VEC are predicted. That is, no change in soil quantity and/or quality that will result in a reduction in soil capability, which cannot be offset through mitigation or compensation measures, is expected.

6.2.5.6.1 Change to Terrain and Soils

Analytical Assessment Techniques

Effects on the Terrain and Soils VEC have been assessed by way of two indicators – change in soil quantity and change in soil quality.

Specifically, as it pertains to changes in soil quantity, estimates have been derived to determine the quantity of soil (including overburden materials) that will be excavated to facilitate the development of site infrastructure, where it is assumed excavation is for the entire soil profile. Information regarding the nature of soils on the site and the thickness of the soil/overburden layer have been obtained from baseline soils investigation and from the extensive drilling records (borehole logs) that provide depth profiles of the surficial geology of the site.

As it pertains to changes in soil quality, baseline soils investigations characterized chemical constituent levels and air quality modelling has been completed that considers routine project-related emissions that could affect soil quality through deposition. The modelling included conservative assumptions so that emission rates can be considered representative of an upper bound emissions scenario (worst-case).

Project Pathways

As described above, changes in soil quantity will occur in association with removal, relocation and stockpiling of soil and OB through the development of the SSA. Such changes are expected to primarily be associated with the construction phase of the Project. During operations, excavated materials will be stored in stockpiles – slumping and erosion of these stockpiles could result in losses of material volumes in the stockpiles. During site closure, stockpiled materials will be used for site rehabilitation purposes.

Changes in soil quality would be associated with air emissions and the subsequent deposition of such emissions. Air emissions are more likely associated with the construction and operations phases of the Project, rather than during closure. During construction, fugitive emissions would principally result from land clearing, site development activities and operation of mobile equipment on disturbed land and roads; whereas during operations, fugitive emissions would principally result from the PSMF and to a lesser extent the MRSA, as well as the operation of mobile equipment on disturbed land and roads.

Mitigation and Enhancement Measures

Proposed mitigation measures are largely, though not exclusively, design and operational in nature. The following mitigation measures are proposed to avoid or reduce Project-related effects on the terrain and soil VEC:

- Limiting the construction footprint (i.e., SSA) to the extent possible to minimize the need for soil/overburden excavation.
- Committing to stockpiling soil and overburden materials for later use in site rehabilitation activities.
- Ensuring that soil/overburden stockpiles that are created to facilitate development of the site have appropriate slopes, and maintaining the piles to prevent erosion and slide hazard.
- Limiting potential erosion of disturbed areas and / or soil stockpiles by implementing appropriate erosion and sediment control measures (i.e., seeding) to stabilize these areas
- Limiting fugitive dust emissions on the PSMF and MRSA by incorporating design features such as wind breaks.
- Limiting fugitive emissions by watering construction areas in development, as well as roads and throughways used by mobile equipment and trucks.
- Limiting fugitive dust emissions by progressively rehabilitating disturbed areas of the project site as quickly as is practical.

In addition to the mitigation measures to reduce potential effects, GenPGM is also committed to follow-up monitoring and adaptive management related to the Terrain and Soils VEC as outlined in Chapter 7 of this EIS Addendum (Vol 2).

Project Residual Effect

As indicated above, changes in soil quantity may be associated with each project phase but are principally associated with construction, and to a lesser extent operations. During construction, topsoil and overburden will be removed to clear and excavate the Project site (SSA). As indicated above, it is estimated that approximately 2.0 M m^3 of soil and overburden will be excavated and stockpiled to facilitate site development. This material will be relocated to a single stockpile south of the MRSA. An additional 674,000 m^3 will be excavated and placed in several small stockpiles along the western margin of the PSMF. It is noted that since the soil and overburden are not considered acid-generating (Ecometrix, 2020a) (CIAR #722), it would be suitable for stockpiling on site during all phases of the Project and can be used as reclamation material without concern for effects on water quality.

Once created, the soil and overburden stockpiles have the potential to present a slide hazard due to erosion. Soil and overburden stockpiles created during construction will continue to be maintained during operations to prevent erosion and slide hazard. Such events could lead to a loss of material and have the effect of making less material available for rehabilitation purposes. To prevent or limit erosion and ensure the preservation of the overburden stockpiles for future reuse, design-related mitigation will ensure that stockpiles will be maintained to reduce the susceptibility of the soil to erosion. The stockpiles will be constructed to side slopes equal to the natural angle of repose (~1:1 (height:width)), which is suitable for short- to medium-term stability and erosion protection. Seeding of these stockpiles to stabilize soils and provide erosion protection will be implemented where natural regeneration does not occur (i.e., given the nature of these material stockpiles from a growth medium perspective, it is assumed that they will revegetate naturally to some extent).

Material in the soil and overburden stockpiles that remains at closure will be used for site reclamation purposes. Baseline soil quality characterization indicates that overburden material would be suitable for reclamation purposes (Ecometrix 2020a) (CIAR #722).

Within the context of the factors utilized to characterize residual environmental effects, and in consideration of proposed mitigations, the following is noted with respect to soil quantity. The residual effect can be considered to be adverse (soil disturbance will occur), of medium magnitude (reflecting the potential for some loss), of negligible geographic extent (limited to the SSA), of medium duration (associated with project phases), of medium frequency, of medium reversibility (though the materials will be stockpiled for some time they will be used to aid in reclamation) and low with respect to ecological and socio-economic context (“soils” are common in the LSA).

As indicated above, changes in soil quality may be associated with each Project phase, but are principally associated with construction and operations as the likelihood and rates of fugitive air emissions are greater during these periods. During construction, fugitive emissions would principally result from land clearing, site development activities and operation of mobile equipment on disturbed land and roads; during operations, fugitive emissions would principally result from the PSMF and to a lesser extent the MRSA, as well as the operation of mobile equipment on disturbed land and roads. Air quality modelling has been completed that includes the characterization of fugitive air emissions (refer to Section 6.2.1.6.1 of this EIS Addendum [Vol 2]). The results of this modelling predict low levels of fugitive emissions below applicable criteria that are expected to be protective of human and ecological health and, by association, material changes in the concentrations of soil constituents are not expected to accrue in the LSA. In keeping with those predictions, no quantitative predictions of changes in soil quality were considered warranted since, as indicated, there is no expectation that constituents associated with fugitive emissions would accumulate in soils in the study area. Within the context of the factors utilized to characterize residual environmental effects, and in consideration of proposed mitigations, the following is noted with respect to changes in soil quality. The residual effect can be considered to be adverse (potential changes if they were to occur would see an incremental increase in soil constituent concentrations, of negligible to low magnitude (not material constituent accumulation is expected), of medium geographic extent (limited to the LSA), of medium duration (associated with project phases), of medium frequency, of negligible reversibility (effect would cease upon site reclamation) and low with respect to ecological and socio-economic context.

Determination of Significance

The residual adverse environmental effects on terrain and soils are predicted to be not significant. Consistent with the original EIS (2012), these residual adverse effects are a result of potential changes in soil/overburden quantity and soil quality. Potential effects on soil/overburden quantity are associated with all Project phases but, principally, the construction phase as the development of site infrastructure proceeds. Soil quality effects are primarily associated with fugitive dust emissions.

The threshold for significance as defined herein relates to a reduction in soil capability, which cannot be offset through mitigation or compensation measures. With the proposed mitigation and environmental protection measures, little net loss of soil/overburden is expected since the material to be excavated will be stockpiled and used for site reclamation purposes. Further, air quality modelling results predict low fugitive emissions and, by extension, low fugitive deposition rates that would affect soil quality. This determination of not significant is consistent with the original EIS (2012).

6.2.5.7 Prediction Confidence

With respect to the soil/overburden quantity indicator, the prediction of no significant effects is provided with a high degree of confidence. GenPGM is committed to stockpiling excavated materials, maintaining these stockpiles, and subsequently utilizing the stockpiled materials for site reclamation purposes. The estimates of material quantities presented herein are reasonable estimates that have been derived utilizing available baseline data, as well as data that have been collected by various drilling campaigns that have been implemented on the Project site. While there is some expectation that the quantity of material that is actually excavated will differ somewhat from that estimated, the overall outcome of the analysis would remain unchanged since GenPGM is committed to a no net loss approach as it concerns soils and overburden; that is, as indicated above, the volume of material that is excavated will be stockpiled, the stockpiles will be maintained and then used for reclamation purposes.

With respect to the soil quantity indicator, the prediction of no significant effects is also provided with a high degree of confidence. As described, various practices and procedures will be implemented to mitigate fugitive air emissions to low levels. Air quality modelling predictions demonstrate this to be the case. As outlined in Section 6.2.1 of the EIS Addendum (Vol 2), the assumptions on which the air quality modelling has been completed are conservative in nature and, therefore, the air quality predictions presented can be considered upper bound predictions.

6.2.5.8 Summary of Project Residual Effects

A summary of residual environmental effects on terrain and soil that are likely to occur as a result of the Project is presented in Table 6.2.5-4.

Table 6.2.5-4: Project Residual Effects on Terrain and Soils

Residual Effect	Residual Effects Characterization									
	Project Phase	Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Ecological/ Societal Value	Significance Determination
Change to soils and overburden (quantity)	C, O, D	A	M	N	NS	M	M	M	L	NS
Change to soils and overburden (quality)	C, O, D	A	N	M	NS	M	N	M	L	NS

KEY

See Section 2.5 of the EIS Addendum (Vol 1) and Table 6.2.5-2 for detailed definitions

Project Phase:
C: Site Preparation / Construction
O: Operation
D: Decommissioning

Direction:
P: Positive
A: Adverse

Magnitude:
N: Negligible
L: Low
M: Medium
H: High

N/A: Not applicable

Geographic Extent:
N: Negligible
L: Low
M: Medium
H: High

Timing:
NS: No sensitivity
MS: Medium sensitivity
HS: High sensitivity

Duration:
N: Negligible
L: Low
M: Medium
H: High

Significance Determination
S: Significant
NS: Not Significant

Frequency:
N: Negligible
L: Low
M: Medium
H: High

Reversibility:
N: Negligible
L: Low
M: Medium
H: High

Ecological / Societal Value:
N: Negligible
L: Low
M: Medium
H: High

Note: Timing was not included in the original EIS.

6.2.5.9 References

Ecometrix Inc. 2020a. Marathon Palladium Project – Soils Baseline Report Update. (CIAR #722) Prepared for Generation PGM Inc. 9 November 2020.

Faure. 1998. Principles and Applications of Geochemistry: a comprehensive textbook for geology students (2nd ed.). Englewood Cliffs, New Jersey: Prentice Hall. ISBN 0- 02-336450-5.