Environmental and Social Impact Assessment for the Troilus Mine Project

LANDSCAPE

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Acronyms and abbreviations

ESIA	Environmental and Social Impact Assessment
IPS	Invasive plant species
MTMD	Ministère des Transports et de la Mobilité durable
MEPPRA	Méthode d'étude paysagère pour route et autoroute (Landscape study method for roads and highways)
PDA	Project Development Area
LSA	Local Study Area
RSA	Regional Study Area
VC	Valued Component

23. Landscape

23.1 Scope of Assessment

23.1.1 Regulatory and Policy Setting

The Eeyou Istchee James Bay Regional Government has no regulatory framework for assessing the impact of the Troilus mine project on the landscape, nor does it have a land-use plan defining regulatory principles. However, various landscape documents, methodologies and best practice guides have been considered in this analysis for the purposes of the Environmental and Social Impact Assessment (ESIA).

It should be considered that, given the location of the mining project on an already disturbed territory, the project's landscape impacts will mainly affect members of the Cree community who use the territory for their customary and traditional activities. A few related landscape criteria are dealt with in greater detail in the impact study, including the Hydrological Regime (Chapter 11), Vegetation, Riparian and Wetland Environments (Chapter 16) and Land and Resources Use (Chapter 19).

23.1.1.1 Guides and tools consulted

The Guide de gestion des paysages au Québec, produced by the Chaire en paysage et environnement de l'Université de Montréal in collaboration with the Quebec government (Paquette *et al*. 2008), and the Charte du paysage québécois (Belgue, 2000), offer a number of strategic guidelines and operational tools for landscape conservation and enhancement. These documents highlight the importance of landscape and the need to recognize it as a public asset to be preserved, managed and developed, implying a redistribution of rights and responsibilities. They emphasize the need for voluntary public support and concerted partnership action, as well as recognition of the evolving nature of landscape actions. The Ministère des Transports du Québec's visual analysis method for the integration of transportation infrastructures was also used as a reference for the landscape analysis and impact assessment.

23.1.2 Influence of Consultation and Engagement

From the outset of the project, Troilus Gold Corp (Troilus) engaged in an extensive consultation and communication process with various project stakeholders, as presented in Chapter 4 of the ESIA report.

The following Table 23.1 presents the main comments received from land users, stakeholders and members of the Cree communities of Oujé-Bougoumou and Mistissini regarding the landscape, and how these comments have been addressed in this section.

Table 23.1 Summary of Key Information, Indigenous Knowledge, and Concerns for the Project related to Landscape

Topic	Key Information, Indigenous Knowledge and Concerns	Influence on the Assessment	Where Information is Addressed in the ESIA
Landscape	Changes to the landscape: • Cree land users express concern about two major issues: • The slopes are too steep for infrastructures such as the existing waste rock piles. • The height of the stockpiles, which will be like that of the adjacent hill (landscape landmark).	Highlight the key elements of their perception of the territory and what influences them.	Refer to section 23.4.1.2

23.1.3 Potential Impacts, Pathways and Measurable Parameters

Potential impacts and measurable parameters were defined based on of professional judgment and the landscape analysis carried out on the site. Table 23.2 summarizes the project's potential impacts on the landscape.

Table 23.2 Potential Impacts, Impact Pathways and Measurable Parameters for the Landscape

Potential Impact	Impact Pathway	Measurable Parameter and Units of Measurement
Change in topography	Construction, operation and/or closure work could result in: • Alteration of the topography of the site, the creation of stockpiles, etc.	Disturbance of the terrain, modifying users' interaction with the land. Loss or modification of landmarks and orientation points, altering users' perception of the territory.
Changes in the diversity of terrestrial plant communities and species.	Construction, operation and/or closure work could result in: • Encroachment, disturbance and direct loss of vegetated areas. • Vegetation disturbance through the introduction and proliferation of invasive alien plant species.	Loss or disturbance of terrestrial plant communities, leading to changes in the landscape (creation of visual breakthroughs and new vantage points, loss of natural forest landscape, etc.).
Changes to the hydrographic environment	Construction, operation and/or closure work could result in: • Encroachment, disturbance and direct loss of wetlands due to watercourse modification.	Wetland and riparian plant communities lost or disturbed, resulting in landscape modifications (loss of natural wetland landscape).

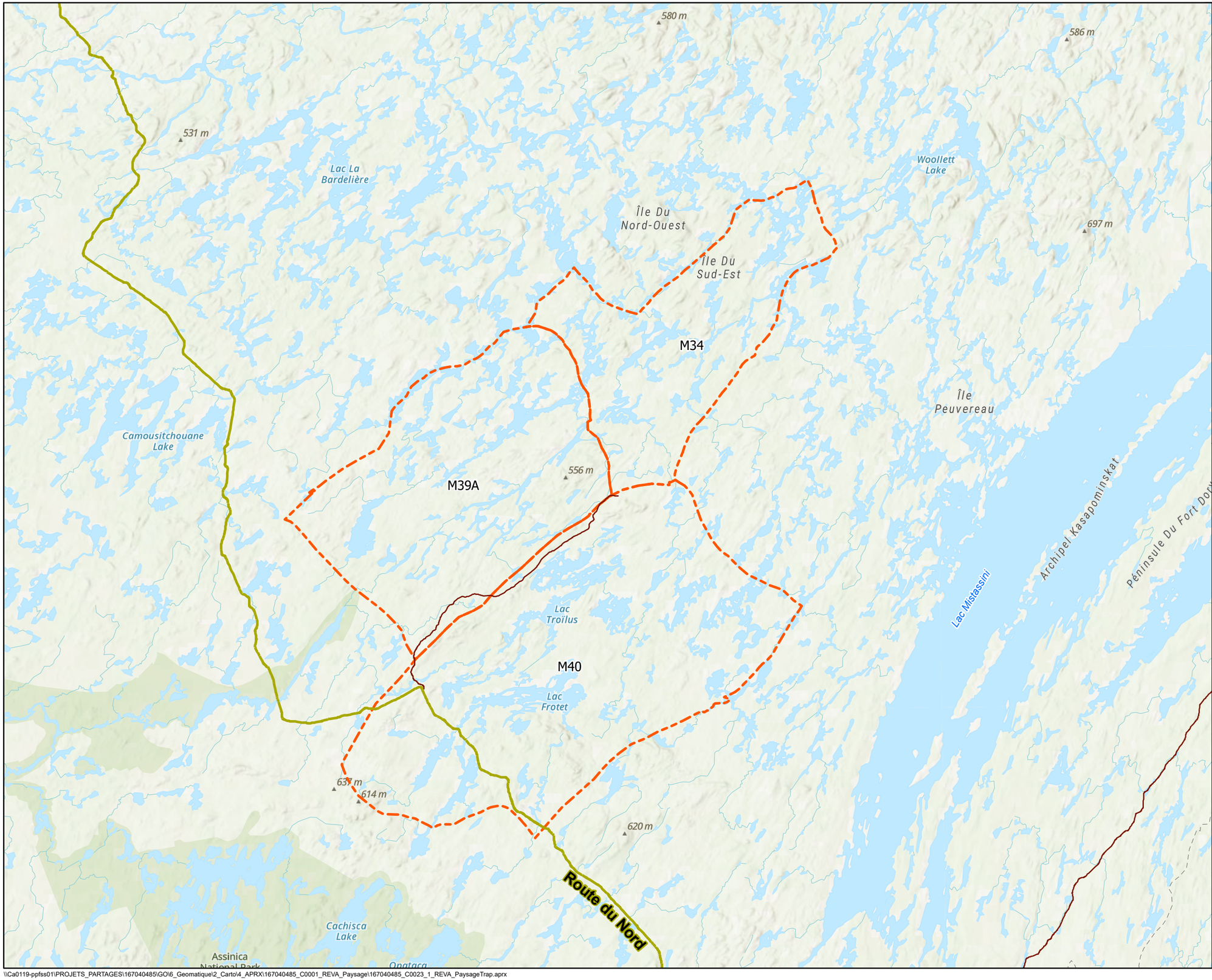
23.1.4 Boundaries

23.1.4.1 Spatial Boundaries

For the Valued Component (VC) of the landscape, the Project Study Area (PSA) encompasses the project footprint and is the predicted area of physical disturbance associated with mine construction, operation and decommissioning/closure. It corresponds to the pits, stockpiles, tailing storage facility, industrial complex and other mining infrastructure, as well as the relocation of the access road and power line. The Local Study Area (LSA) covers all areas where the impacts of Troilus Mine project activities are most likely to be visible. Its spatial limits are aligned, in this case, with the boundary of the viewshed. The

viewshed is delimited by the surrounding terrain. The mining area is therefore contained within a hilly environment, making it barely perceptible to observers outside the viewshed. The LSA is shown on Map 23.1.

As the Troilus mine site is located in an isolated area with only one road leading to the mining facilities, there are very few observers who have access to these landscapes. The main observers are mine workers and users of the Cree territory who move through the area. Based on this land use, we determined the Regional Study Area (RSA) for the landscape component. This corresponds to the boundaries of traplines M34, M39A and M40, as shown on Map 23.1.



Composante de projet / Project Component

- Zone d'étude locale / Local Study Area
- Zone d'étude régionale / Regional Study Area
- Route du Nord
- Réseau routier

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RÉFÉRENCES/REFERENCES

Éléments de paysage - Landscape Elements : Stantec 2025

NOTES

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Troilus Gold Corp.

PROJET/PROJECT

Étude d'impact sur l'environnement et le milieu social pour le projet de mine Troilus / Environmental and Social Impact Assessement for the Troilus Mine Project

TITRE/TITLE

Zones d'étude du paysage / Landscape Study Areas

BluMetric Stantec

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23.1.4.2 Temporal Boundaries

The temporal boundary of the assessment includes all phases of the project, from the start of construction to the end of closure. Based on the current Project schedule, the project phases include:

- Construction (Year -3 to Year -1)
- Operations
  - Operations phase 1 (Year 1 to Year 21): milling with ore extraction
  - Operations phase 2 (Year 22): milling with no ore extraction
- Decommissioning and closure
  - Active closure (Year 22 to Year 24)
  - Passive closure (Year 24+)

Refer to Chapter 3 of the ESIA (Project Description) for a detailed description of activities planned during each phase.

23.1.5 Residual Impacts Characterization

Table 23.3 presents measures for characterizing residual impacts on the landscape.

Table 23.3 Characterization of Residual Landscape Impacts

Characterization	Description	Quantitative Measure or Definition of Qualitative Category
Direction	Long-term trend of residual impact	**Positive -** a residual impact that moves measurable parameters in a direction beneficial to landscape relative to baseline. **Adverse** - a residual impact that moves measurable parameters in a direction detrimental to landscape relative to baseline. **Neutral -** no net change in measurable landscape parameters relative to baseline.
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions.	**No Measurable Change -** no measurable change in landscape can be noted. **Low** – a measurable change in landscape but residual impacts cannot be distinguished from existing conditions within normal range of variability. **Moderate – a** measurable change but not likely to pose a serious risk or benefit to landscape.

Characterization	Description	Quantitative Measure or Definition of Qualitative Category
		High - measurable change that is likely to pose a serious risk or benefit to landscape.
Geographic extent	The geographical area in which a residual impact occurs.	**PDA -** residual impacts are restricted to the PDA **LSA -** residual impacts extend to the LSA **RSA -** residual impacts extend to the RSA
Timing	Considers when the residual impact is expected to occur, where relevant to the VC.	**Not applicable (N/A**) - seasonal aspects are not likely to affect the landscape.
Duration	The time required until the measurable parameter or the VC returns to its existing condition, or the residual impact can no longer be measured or otherwise perceived	**Short term -** the residual impact is restricted to construction (<3 years) **Medium-term** - the residual impact extends through the operations phase (3 to 24 years) **Long term -** the residual impact extends beyond the life pf the Project (>25 years)
Frequency	Identifies how often the residual impact occurs and how often during the project or in a specific phase.	**Single event** - the residual impact on the landscape occurs once during the project. **Multiple irregular events (no set schedule)** - the residual impact on landscape occurs sporadically, at irregular intervals, and is not predictable. **Multiple regular events** - the residual impact on landscape occurs regularly, at predictable intervals or at specific timings. **Continuous** - the residual impact on landscape occurs continuously.
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible -** the residual impact is likely to be reversed after activity completion and reclamation. **Irreversible** - the residual impact is unlikely to be reversed.

23.1.6 Significance Definition

The threshold for determining the significance of landscape impacts considers several elements of residual impact characterization, as detailed in Table 23.3. The direction of residual impacts is particularly significant, as the project's adverse impacts on the landscape may alter the way the land is perceived by its users. The extent of the changes to the landscape is also analysed to determine whether the residual impact is likely to threaten landscapes. Geographic extent is considered in significance thresholds, by assessing residual project impacts that lie beyond the PDA. Duration, reversibility and frequency are also

considered when long-term irreversible impacts threaten landscape deterioration. Timing is not an applicable landscape characteristic.

Negligible or low: A residual adverse impact on the landscape is likely to be of negligible or lesser magnitude if it is small in scale, of short duration, infrequent, of small spatial extent, reversible or easily avoidable. Mitigation measures will allow existing conditions to remain largely unchanged.

Moderate: A residual adverse impact on the landscape is likely to be moderate if it is moderate in magnitude, moderate in duration, occasional, moderate in extent and possibly or partially reversible. Mitigation measures may not fully eliminate, reduce, control or compensate for impacts, but they should prevent the modification or loss of key landscape elements.

High: A residual adverse landscape impact of high significance is likely to be of high magnitude if it is large, permanent or long-term, frequent, irreversible and extends over a large area. There is a high degree of uncertainty as to the effectiveness of mitigation measures, with the result that some significant landscape components are altered or lost.

23.2 Existing Conditions

23.2.1 Methods

The description of the anthropogenic character of the territory is the result of a field visit carried out in the fall of 2023, from October 2 to 6, 2023. It allowed for a nuanced and objective understanding of the territory with a photographic report, which made it possible to delimit the study area that will be impacted by modifications to the visual landscape and to characterize the landscape units present on the territory.

The inventory was completed by analysis of existing cartographic data, bibliographical documents and landscape analysis.

The methodological approach used for the landscape inventory is based on the concepts proposed in the Méthode d'analyse visuelle pour l'intégration des infrastructures de transport (Gaudreau, 1994) and the Méthode d'étude paysagère pour route et autoroute (MEPPRA, 2007) developed by the ministère des Transports et de la mobilité durable (MTMD). These concepts were applied and adapted to the nature of the project. The regional landscape was subdivided into landscape units, which are actually specific sectors within the viewshed, each with its own character. Landscape units are determined by examining relief, hydrography, vegetation, land use, views and perspectives, orientation features and landscapes of interest.

By assessing these criteria, we can determine the attractiveness and vulnerability of the landscape, as well as areas of visual resistance. This will help identify the impact of the project on the landscape.

23.2.2 Overview

23.2.2.1 Regional Landscape

The regional landscape is characterized by boreal forest vegetation. It is characterized by a vegetation cover dominated by conifers, such as spruce, fir, pine and larch, adapted to cold, dry climatic conditions.

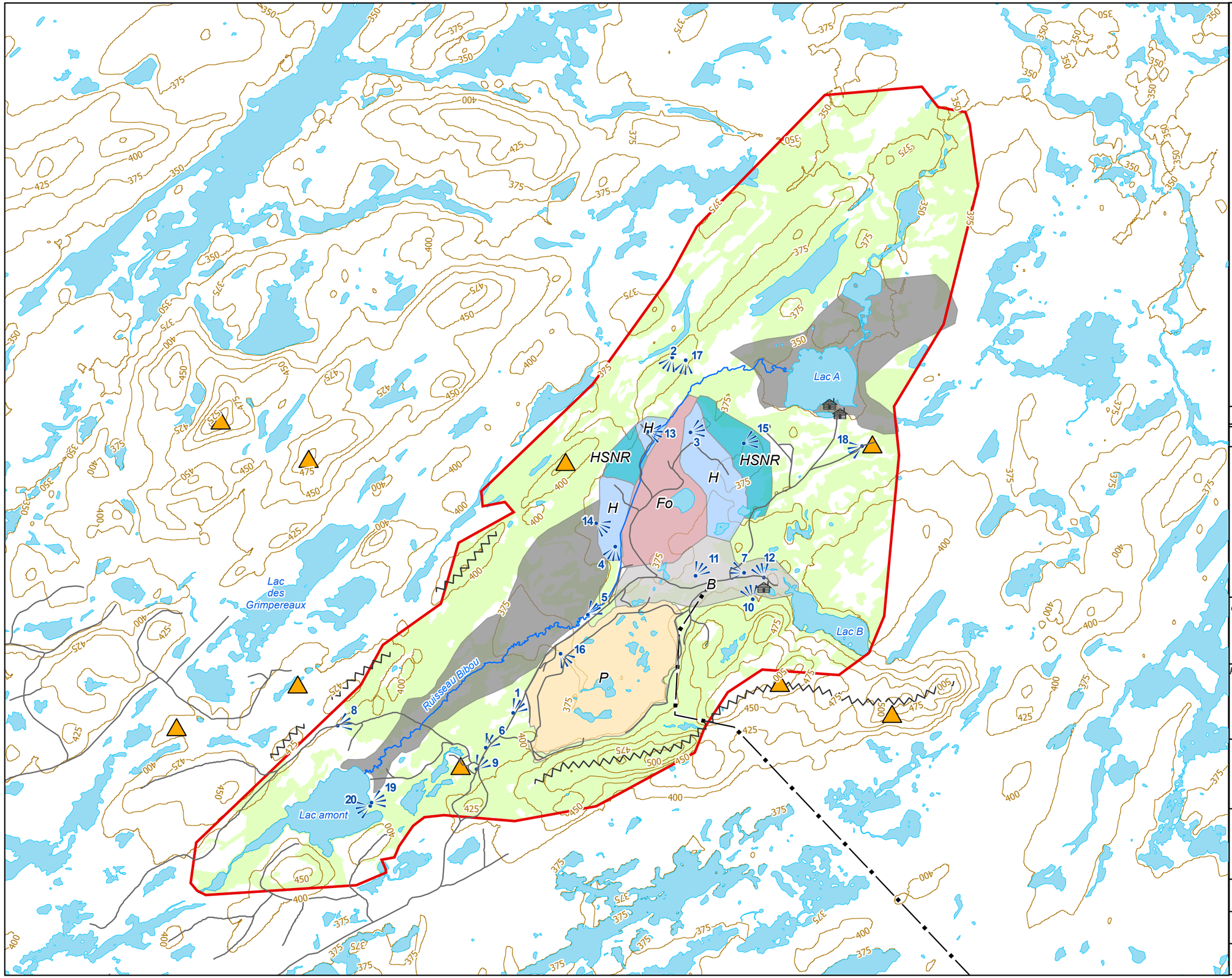
A few deciduous trees, such as birch, willow, poplar and mountain ash, are found mainly along watercourses or in disturbed areas. The soil of the boreal forest is acidic and not very fertile, which limits tree growth and favours the formation of peatlands (P. Blancher, S. Bradbury, T. Cobb, C. Fisher, K. C. Hannah, B. Johns, J. Lane, D. MacIsaac, C. Paszkowski, G. Scrimgeour and S.J. Song, 2006). The territory is criss-crossed by numerous lakes and rivers, formed by the action of glaciers during the ice ages (The Canadian Encyclopedia). The observer's views are often limited by vegetation; however, some high points offer an extended horizon. Rivers, lakes and wetlands that cross the territory also provide open views.

Photo 23.1 Troilus Mine Site, Stantec, October, 2 023

In the viewshed, which is the LSA (Map 23.2), the territory is marked by pieces of the industrial mining landscape, including the built environment, the stockpiles, the tailing storage facility (TSF) and the pits. Now that the mine has closed, it has been restored, and vegetation is recovering as a result of seeding and planting. Observers of the area include mine workers and Cree land users using camps located in the vicinity of the area. An important landmark in the study area is the mountain to the southeast of the site, which is the highest point within the viewshed. Located at the threshold of mining development, it serves as landmark for land users and helps with orientation. Apart from this elevated view, which helps to understand the extent of the mining installations, the scale of the territory is difficult to determine on the site, as there is no overall view showing the totality of the mining installations in the territory. They remain invisible outside the visual catchment area, hidden by the relief, including that around the mine, which is one of the highest formations in the area, and the dense vegetation composed mainly of conifers. Only occasional human intervention along access roads offers views of certain portions of the mining installations.

Photo 23.2 Boreal Forest in the Study Area, Stantec, October 2023

Photo 23.3 Lake A (PE43), Stantec, October 2023



Composante de projet / Project Component

- Zone d'étude locale / Local Study Area

Unité de paysage / Landscape Unit

- B- Cadre bâti / Built Environment
- Fo – Fosse / Pit
- H- Halde / Waste Rock Pile
- HSNR- Halde à stérile non restauré / Unrested Waste Rock Dump
- P- Parc à résidus / Tailings Facility
- T- Tourbière - Peatland
- F- Forestier - Forest
- Point haut / High Point
- Obstacle visuel / Visual Obstacle
- Campement / Camp
- Numéro de photo / Photo number
- Ligne électrique / Powerline
- Étendue d'eau / Waterbody
- Réseau routier / Roads
- Courbes 25m / Contours 25m

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RÉFÉRENCES/REFERENCES

Éléments de paysage - Landscape Elements : Stantec 2025

NOTES

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ÉCHELLE (m) / SCALE (m)

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PROJET/PROJECT

Étude d'impact sur l'environnement et le milieu social pour le projet de mine Troilus / Environmental and Social Impact Assessement for the Troilus Mine Project

TITRE/TITLE

Unités de paysage / Landscape Units

BluMetric Environnement — Stantec

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23.2.2.2 Local Landscape

The LSA covers approximately 60 km^2 within the Eeyou Istchee James Bay Municipality. It is bounded by hydrographic features, Lake Amont (PE2) to the southwest and Lake A (PE43) to the northeast, and by topographic features, with a hill to the southeast having an elevation of approximately 510 m above sea level (about 110 m relative to the LSA), and a series of hills to the north and northwest with an elevation of approximately 430 m above sea level (about 80 m relative to the LSA). These relief and hydrographic features define the study area's visual catchment area.

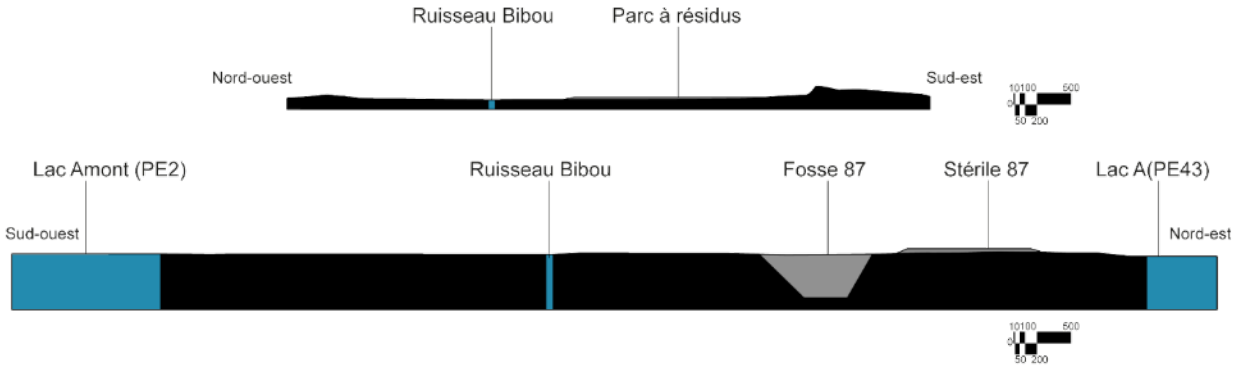

Figure 23.1 Relief and Viewshed Component

General landscape features

Relief

Relief is a key element in shaping the visual aspects of the landscape. The viewshed of the Troilus mine operation is characterized by numerous low-lying, undulating pre-existing landforms, considerably limiting the visual impacts of industrial operations on a defined territory. The footprints of the previous operation mark the viewshed, with several elevations made of waste rocks of similar height to those present in the territory. However, the slopes of these elevations are steeper than the natural relief and are sparsely vegetated, which contrasts with the landscape.

Photo 23.4 Relief Forming a Bowl in the Study Site, Stantec, October 2023

Hydrography

Hydrography stems from the characteristics of relief and has a major influence on the visual environment. It is a major issue for the area, not only because of its importance to the local landscape, but also because of its impact on users of the area and on the sensitive and ecological environment associated with it. It has already been marked by the previous operation, with the partial canalisation of the Bibou stream (CE2) winding through the middle of the valley. The two existing pits are partly filled with water. A pond is also present in the TSF. Lac Amont (PE2) and Lac A (PE43) are two natural bodies of water that are important in the landscape and for land users.

Bibou Creek (CE2) is important to the landscape, as it meanders through the heart of the valley over much of the study area. It links two lakes and was partially canalized during the previous operation. This feature manifests itself in a watercourse that is more ditch-like in relation to the surrounding level, with relatively steeply sloping banks. The wet area is limited to the banks, where the vegetation consists of shrubs and bushes adapted to the environment. The views offered provide open and closed perspectives depending on the surrounding elevation, framing or limiting the view with vegetation and gradually revealing the landscape. The watercourse plays an important role in the valley's hydrography. It feeds the lake downstream and is an essential habitat for aquatic life. Because of its presence throughout the viewshed, the stream is a key element in orientation on the territory, serving as a landmark on the south-west/north-east axis. It also serves as a hunting and trapping ground for land users.

Photo 23.5 Ruisseau Bibou (CE2) Canalised Section, Stantec, October 2023

Vegetation

The inventory includes vegetation as a significant parameter in landscape analysis. The height, shape and density of the vegetation cover are characteristics linked to the visual accessibility of landscapes.

The LSA territory is in the Central Canadian Shield Forest ecoregion, whose biome is that of the boreal forest, with black spruce as the dominant species. There is a dense stand of jack pine and black spruce, with some white birch. The sunny slopes are predominantly composed of birch, trembling aspen, white spruce and balsam fir. Wetlands are composed of low plantations, mostly sphagnum moss and sparsely larch.

The natural environment in the Troilus mine area has been significantly altered. The area is mainly covered with herbaceous vegetation, particularly on the waste rock piles, with shrubs forming a sparse tree cover, which constitutes a tundra biome.

Photo 23.6 Vegetation and Infrastructure, Stantec, October 2023

Land use

The study site includes various natural elements (vegetation, watercourses) and artificial ones (infrastructure). Currently, the site is primarily used for industrial mining purposes, with all the associated infrastructure: transportation systems (road and electrical), a set of temporary buildings and various services related to resource exploitation site (water treatment plant, waste disposal site, materials storage, etc.). The study area is divided into three traplines (M34, M39A and M40). Several camps in the area and testimonials confirm that the study site is used for hunting and trapping.

Photo 23.7 Marks of Industrial Infrastructures on the Territory, Stantec, October 2023

In the viewshed, there are two types of transport network, road and power, which cross different landscape units. Both networks follow the relief of the area. The road network must, however, follow a relief adapted to its use, as it cannot cross rugged area, unlike the power transmission network. In our viewshed area, the main access road runs alongside a few lakes, but does not cross any wetlands. On secondary roads, traffic occasionally crosses the Bibou stream (CE2), which meanders through the valley, and the associated wetlands. These are disturbed areas, with vegetation bordering the land and composed of pioneer species with a dominant herbaceous stratum and deciduous trees. In the background, the boreal forest is predominantly coniferous. The available views are limited, revealing a sequence of perspectives, with occasional distant openings made possible by elevated terrain and framed clearings through the vegetation over wetlands and the stream. Orientation on the site is facilitated by mining infrastructures, which serves as landmarks and helps users locate themselves. Due to their function, the roads provide access to the territory. However, a gravel forest road limits the type of users frequenting the area to workers and Cree land users.

Photo 23.8 View from Access Road, Stantec, October 2023

View types

There are six types of view in the landscape. These are determined by the depth and quality of the visual field and described below:

- Panoramas offer a view accessible from all sides, over a field of vision wider than human vision. They are mostly located at the highest points of the visual field.
- Vistas are made possible by transportation infrastructures, which provides framed, distant views.
- Closed views are present in natural environments, due to dense vegetation of coniferous trees, forming visual obstacles; the site's relief favours this type of view.
- Screened views, which are partially masked, are mainly found in lake and wetland areas, where low-lying vegetation and sparse trees are the norm.

- Open views, which offer a wide, unobstructed view, are mainly found in industrial mining areas. They provide unobstructed views across the area.
- Directed views, directed towards points of visual interest, are mainly offered by the various transport infrastructures, on the mining infrastructures, which stand out from the territorial landscape.

Orientation elements

This parameter refers to landscape components that can be identified and selected by the observer for orientation. These include main views, landmarks, visual intersections and landscape guidelines. The various mining infrastructures and lake areas are orientation elements that will mark the territory. The relief also serves as a landmark. The mountain to the southeast of the mine, near the TSF, has the highest elevation in the area, and is an important landmark, particularly for hunters and trappers.

Photo 23.9 Marks of Industrial Infrastructures on the Landscape, Stantec, October 2023

Environmental preferences

This parameter objectively describes the subjective preferences of landscape observers. It is used to determine the value attributed to the material organization of landscape elements by the various users of the territory. The land has already been reorganized and fragmented by previous use, and its character has already been modified. These changes will be amplified in the future. In this sector, the two main users are mine workers and users of the Cree territory. Each user has different preferences regarding their place in the landscape. Users of the Cree territory have a stronger bond with the natural landscape, as they pass through it during their activities, than workers, who interact more with the anthropogenic landscape associated with the mine.

23.2.3 Description of Landscape units

The viewshed features six landscape units, which can be grouped into two types:

- Anthropogenic, industrial mining landscape units.
- Natural landscape units.

23.2.3.1 Anthropic landscape

Landscape unit Built environment (B)

Within the viewshed, there are two types of built-up areas with different vocations.

The living environment built-up area, located away from the main infrastructure, consists of a flat, wooded hilltop. The vegetation in the vicinity comprises a stratum of herbaceous and deciduous shrubs, with the conifers of the boreal forest in the background. Due to the vegetation and relief, the view is confined. The landscape, composed of mobile homes, remains "utilitarian" in nature. It consists of infrastructures dedicated to workers' daily life.

Photo 23.10 Buildings Used for Living environments, Stantec, October 2023

The industrial built environment is at the heart of the viewshed, occupying a significant amount of space for functional reasons. The buildings are larger, and an electrical transformer stands out on the site. The relief, whether natural or man-made, is more perceptible, especially as vegetation is sparce in this sector. Vegetation is low, scattered and limited. A few coniferous forest patches are visible, and the forest appears in the background on elevated terrain. The landscape is utilitarian, with construction materials and machinery spread across the ground in an orderly and accessible manner. Views in this area are generally open and unobstructed.

Photo 23.11 Warehouses for Workplaces, Stantec, October 2023

Within the built environment landscape unit, there are transitional areas of wasteland. These areas are awaiting vocations in future operations. They are either unused or used as open storage areas. These are areas with little relief in the foreground, and the region's typical forest landscape with its elevations in the background. These areas are often very mineralized, with rock dust acting as soil.

There is little vegetation on the site itself, except in a few places, where we find grasses and the growth of a few shrubs. At the edges, there is a more extensive herbaceous stratum, including a few shrubs and deciduous trees, and at the bottom of the edge, the conifers of the boreal forest.

Views are open over the whole area, limited by the background of boreal forest and built-up elements.

Photo 23.12 Industrial Wasteland, Stantec, October 2023

Landscape unit Pits (F)

The pits are among the structuring elements of this territory; their size and relief put into perspective by the fact that they are currently filled with water and form lakes. The banks thus created are relatively steep and craggy. The depth of the pits is around 100 to 200 m. This relief is not visible due to the presence of water.

Given the shape of the banks, the lakes lack the characteristic features of other natural lakes, associated with the typology of the terrain and vegetation. Due to the harshness of the pit edges and the rocky nature of the soils, vegetation remains relatively sparse in these areas. Pioneer plants with low herbaceous vegetation and a few deciduous trees are present.

Due to their geomorphological characteristics, and their location within the study area, the pits provide an unobstructed panoramic view, where natural and man-made elevations mark the area. By their very appearance, pits are part of the territory's orientation elements, allowing us to situate ourselves in space.

Photo 23.13 Flooded Pits, Stantec, October 2023

Landscape unit Waste Rock Pile (H)

The various waste rock piles, constitute the main landforms of the area. Their dimensions, in terms of span and height, are like those observed in the rest of the territory. Their steep slopes, rocky ground and shapes betray their human origins. Because of their relief, these areas are devoid of water. However, water remains as a backdrop to the territory, where lakes appear.

Given the nature of the soils, significant tree growth is not possible. The vegetation is tundra-like, with a significant presence of moss and lichen, as well as a few grasses. A few small conifers and deciduous trees stand out in the landscape.

Taken together, these features offer a rare panoramic view of the entire area. These elements are major landmarks for orientation and help the observers to situate themselves on the territory.

Photo 23.14 Revegetated Waste Rock Pile, Stantec, October 2023

Landscape sub-unit Unrestored Waste Rock Stockpile (HSNR)

Within the waste rock piles landscape unit, a variant exists: an unrestored waste rock pile. Although some characteristics of the waste rock piles landscape are similar, significant differences require its inclusion in a separate landscape sub-unit. The relief is extremely rugged, composed of rocks of large granulometry. Land movements are regular, revealing human intervention. Due to the soil's characteristics, water is automatically drained. The soil is devoid of organic matter and vegetation is absent. In the long term, only a few mosses and lichens manage to grow on the rock. These parts of the territory form an artificial formation with a very mineral landscape.

Photo 23.15 Artificial Landscape of Unrestored Waste Rock Pile, Stantec, October 2023

Landscape unit Tailing Storage Facility (P)

The TSF is an artificial formation, characterized by steep slopes topped by a plateau, which backs onto a hill. The plateau is marked by the presence of a vast, shallow body of water, whose level is artificially regulated by a pump.

The site's vegetation is primarily composed of an herbaceous layer, complemented by deciduous shrubs and a few scattered small conifers. The boreal forest forms the area's background.

The area is mainly frequented by migratory birds and a few large mammals that feed on the berries found on the shrubs. The area is also used by Indigenous peoples for hunting.

The panorama offers an unobstructed view of the valley on one side of the plateau, while on the other, the view is blocked by the hill. Due to its size, the TSF is the most prominent feature within the viewshed. It serves as the main point of orientation in the area, aided by its location near the edge of the viewshed.

Photo 23.16 Tailing Storage Facility, Stantec, October 2023

23.2.3.2 Natural landscape

Forest landscape unit (F)

The forest landscape is the most important landscape unit in the LSA, borrowing characteristics from the boreal forest. The rolling, undulating topography is perceptible in the immediate vicinity, but becomes difficult to discern with distance, hidden by dense evergreen vegetation.

This vegetation consists mainly of tall, narrow coniferous trees. Areas of foliage stand out here and there in a landscape dominated by the dark green of conifer needles. Leafy shrubs are scattered throughout. The ground is covered with moss and grasses, with rocky outcrops appearing from time to time.

Depending on their position in the landscape, water is practically non-existent in the higher elevations, but almost omnipresent in the middle of the valleys, either in the form of streams, lakes or, more frequently, in the waterlogged spongy soil of moss and sphagnum moss.

Because they are so difficult to access, these areas are rarely exploited. This allows wildlife to take refuge and feed. These areas are therefore ideal for traditional Cree hunting, fishing and trapping activities.

The view offered by these areas is generally closed, or at best filtered when the observer is high up and can observe the expanse through the foliage. Openings are provided by wetland areas in the valleys.

Photo 23.17 Forest Area Unaffected by Mining Activities, Stantec, October 2023

Within the forest landscape, there are a few sandpit areas defined by a gentle, undulating relief, marked by human activities. Many different types of human waste are found in these areas. Animal tracks testify to a recent and repeated presence, during the field visit.

There is little vegetation in the sandpit areas. Some undisturbed areas have an herbaceous layer. A few small deciduous shrubs are scattered here and there, more concentrated at the edges of this landscape unit. In the background, there is the presence of the boreal forest with its conifers in undisturbed areas.

The sandpits are located away from the main access roads, forming physical and visual cul-de-sacs. Because of their small size, they do not play a major role as landmarks. They offer open views, limited by relief and vegetation.

Photo 23.18 Sandpit Area, Stantec, October 2023

Peatland landscape unit (T)

The peatland landscape is characterized by its flat relief, bordered by the hills that delimit the valley and are visible above the treetops.

The vegetation reflects the typical characteristics of peatland, with a soil composed of a significant layer of mosses and sphagnum mosses, as well as an herbaceous stratum. Conifers are scattered across the land at regular intervals. Their modest height and spread reflect the harshness of the territory

The view offered is a panorama filtered by the trees, limiting the depth of the view of the territory. Orientation is only possible thanks to the territory's external elements, such as the surrounding hills or lakes, which can be glimpsed through the vegetation.

Photo 23.19 Filtered view of Peatland landscapes, Stantec, October 2023

The lake areas of Lac Amont (PE2) and Lac A (PE43) are integrated into the peatland landscape unit. They are characterized by their flat terrain, framed by the surrounding relief. The gently sloping banks gently submerge into the water.

Vegetation creates a demarcation between bog and lake, with banks composed of deciduous shrubs and coniferous trees.

These environments are used by Cree land users for fishing and other water-based activities. They are important areas for the local ecology, sustaining the territory's hydrography.

Views of the lakes offer a panorama that is obstructed by shoreline vegetation and surrounding relief, limiting depth of field. The lakes are major features of the area, providing important landmarks when viewed from elevated vantage points, thereby aiding in orientation.

Photo 23.20 Lac Amont (PE-2), Stantec, October 2023

23.3 Project Interactions with Landscape

Table 23.4 identifies, for each potential impact, the activities likely to interact with the VC, landscape and result in the identified impact. These interactions are indicated by a check or dash and are discussed in detail in section 23.4, in the context of impact pathways, standard and project-specific mitigation/enhancement measures, and residual impacts.

Table 23.4 Project Interactions with the landscape

Physical Activities	Impacts		
	Change in topography	Change in terrestrial plant species	Change in hydrographic environment
Construction			
Labour, equipment and materials transport to the site.	-	-	-
Vehicles and equipment operation and maintenance within the PDA.	-	-	-
Tree cutting, vegetation clearing, soil stripping and earthworks.	√	√	√
Handling and use of explosives, including blasting	√	√	√
Construction of temporary and permanent buildings, including wastewater treatment system and drinking water collection and distribution system.	√	√	√
Construction of mining infrastructures such as stockpiles, pits and the raising of tailings management facility.	√	√	√

Physical Activities	Impacts		
	Change in topography	Change in terrestrial plant species	Change in hydrographic environment
Construction of roads and preparation of construction surfaces including the crushing of material used for construction. Relocation of a section of the access road and power line.	√	√	√
Construction of water management systems including ditches, diversion channel, sedimentation ponds and the water treatment plant.	√	√	√
Dewatering of natural water bodies and pits, lowering water level in tailings management facility and management of contact water.	√	√	√
Diversion of Bibou Creek (CE2).	√	√	√
Management of waste materials, including hazardous waste.	-	-	-
Purchases of goods and services.	-	-	-
Employment and expenditures.[1]	-	-	-
Operation			
Labour, equipment and materials transport to the site.	-	-	-
Vehicles and equipment operation and maintenance within the PDA.	-	-	-
Handling and use of explosives, including blasting.		-	-
Ore extraction from pits including drilling and hauling of waste rock.	√	-	√
Ore, waste rock and tailings storage.	√	-	√
Ore processing including conveyor, crushing, loading and hauling on site.	-	-	√
Transportation of concentrate to a smelter or a wharf.	-	-	-
Management and treatment of water on the mine site and to the environment, including drainage and contact water.	-	-	√
Progressive reclamation of disturbed areas.	-	√	-
Management of waste materials, including hazardous waste.	-	-	-
Purchases of goods and services.	-	-	-
Employment and expenditures.[1]	-	-	-
Decommissioning and Closure			
Labour, equipment and materials transport to the site.	-	-	-
Vehicles and equipment operation and maintenance within the PDA.	-	-	-
Decommissioning, dismantling and disposal of buildings and equipment.	-	-	√
Pits flooding, surface and groundwater management.	√	√	√
Reclamation of disturbed areas, including earthworks, placement of overburden and revegetation.	√	√	√
Management of waste materials, including hazardous waste.	-	-	-
Purchases of goods and services.	-	-	-
Employment and expenditures[1].	-	-	-

NOTES:
√ = Possible interaction
- = No interaction

Interactions will occur throughout the project but will mainly be felt during the construction and closure phases. During the construction phase, a number of site development activities will have a localized impact on landscape components. As construction progresses and the operating phase begins, the main activity likely to interact with the landscape is the storage of ore, waste rock piles and mine tailings, as well as the development of new pits. These elements will result in a larger footprint for anthropogenic landscape units at the expense of natural landscape units, making it likely that views will change with the new site configuration and the different components of the landscape units. The peatland landscape unit (T), located to the west of the previous operation, will be particularly affected by the expansion of the mine components.

23.4 Assessment of Residual Impacts on Landscape

23.4.1 Change in Topography

23.4.1.1 Project Pathways

During the various phases of operation, from construction to closure, the topography of the LSA will undergo constant change.

The elevation of existing stockpiles, the addition of new stockpiles, the enlargement of pits and the installation of new mining structures will all contribute to modifying the site's topography. These transformations will have an impact on the perception of land users and their immediate environment. The new topography will take on an artificial appearance, characterized, among other things, by steep slopes. These transformations will also result in the obstruction, opening up or displacement of certain viewpoints within the viewshed.

These changes will affect the way users perceive and interact with their territory. They will have a significant impact on Cree users' visual cues, which play a crucial role in their orientation and perception of the territory, influencing their ability to locate and navigate in their environment.

23.4.1.2 Mitigation and Enhancement Measures

The proposed mitigation measures are designed to avoid or reduce the project's impact on topography, to limit the mine's footprint in the natural environment in which it is located. The following actions are suggested:

- During operation, the shape of pits and stopes should, as far as possible, follow that of the surrounding landforms, to better integrate them into the local topography.
- Progressively restore and rehabilitate the site for various developments such as the TSF, certain waste rock piles and open pits. The various facilities will be restored and revegetated at the end of operations to facilitate final site restoration.
- At the end of the work, reprofile disturbed surfaces to soften slopes where possible, so that they blend in as harmoniously as possible with the environment.

- Revegetate landforms with a variety of dense local vegetation, adapted to the specific conditions of the site, to conceal the artificial topography and make it less noticeable in the landscape.

The following mitigation measures are primarily aimed at engaging with land users to address their concerns:

- Elevations and important viewpoints serving as landmarks on the territory should, as far as possible, be maintained.
- Avoid the creation of waste rock piles higher than existing topographic high points. Piles could alter views and compete with existing landmarks, including the mountain on the southeastern edge of the mine near the TSF.

23.4.1.3 Project Residual Impacts

The characterization of residual impacts on topography is provided for the construction, operation and closure phases of the project.

Due to the topography of the area, these impacts are limited to the viewshed, i.e. the LSA.

Construction

Site preparation during construction will quickly lead to changes in the site's topography. These changes will continue throughout the site's operation. Since the natural site has already been affected by activities related to the former mine, the impact of construction is more moderate.

Operation

Impacts on topography will continue during the operational phase due to ongoing construction activities, such as the expansion of mine components. This will result in ongoing modification of the topography, with changes in landmarks and views that will evolve throughout operations until closure.

During the first years of operation, the expansion of pits J and 87 will result in a gradual elevation of waste rock pile 87. These changes will have an impact on visual landmarks in the area. Given the anthropogenic nature of this area, devoid of tree vegetation, the topographical changes will be particularly noticeable.

Installation of the southwest pit will involve the creation of a new haul-out in an area initially characterized by relatively flat peat bog terrain. The accumulation of material in this area will create a new, artificial relief that contrasts with the initial state of the site. In the years to follow, waste rock pile 87 will continue to expand, increasing its footprint and altering the topography visible from the access road leading to the Lake A camp.

From the fourth year onwards, the pace of operations will accelerate, leading to a significant expansion of the TSF, which will physically segment the operating area between the northeast and southwest sectors.

By the sixth year, the expansion of the various mining infrastructures reached a certain stability, with the exception of a final expansion of the southwestern tailings pile, which closed the former topographical

access to the site. Until then, topographical transformations had been mainly related to the expansion of ground rights-of-way. From the seventh year onwards, the topography of the halls will gradually begin to rise.

From year 7 to year 14, the landform will continue to change gradually. From year 15 onwards, mining to the southwest will take a new direction: the pit will be filled in and replaced by an extension of the TSF, forming a plateau whose elevation will be higher than the tailings facility, reaching 439.76 m. Another plateau, higher to the northwest of the TSF, will rise to 499.76 m. Another plateau, higher to the northwest of the TSF, will rise to 499.76 m. These will gradually form a series of vast plateaus, which will mark the final physiognomy of the site at the end of operations. The increased elevation of the TSF will alter the internal topography of the viewshed, affecting views of the high points to the southeast of the LSA. However, these changes should not be perceptible outside the viewshed, except for the topographic fill between the two high points of the TSF, whose final elevation should be 399.76 m. The final elevation of the northeast pad is expected to be 479.76 m, compared with the natural topography to the south of 499 m.

Figures 23.22 and 23.23 show the evolution of topography during operation and simulation, as seen from above. The pit has little impact on the perception of topography. On the other hand, the height of waste rock pile 87 could obstruct the view to the north of the viewshed.

Figures 23.24 and 23.25 show the evolution of the topography. Viewed from the north of the TSF towards the south-west, the natural topography remains unchanged. The expansion of the TSF creates a plateau that obstructs the view to the outside.

Photo 23.21 Visual Simulation of Pit 87 Operation

Photo 23.22 Visual Simulation of the Flooding of Pit 87 at the end of Operation

Photo 23.23 Visual Simulation at the end of Tailing Storage Facility Operation

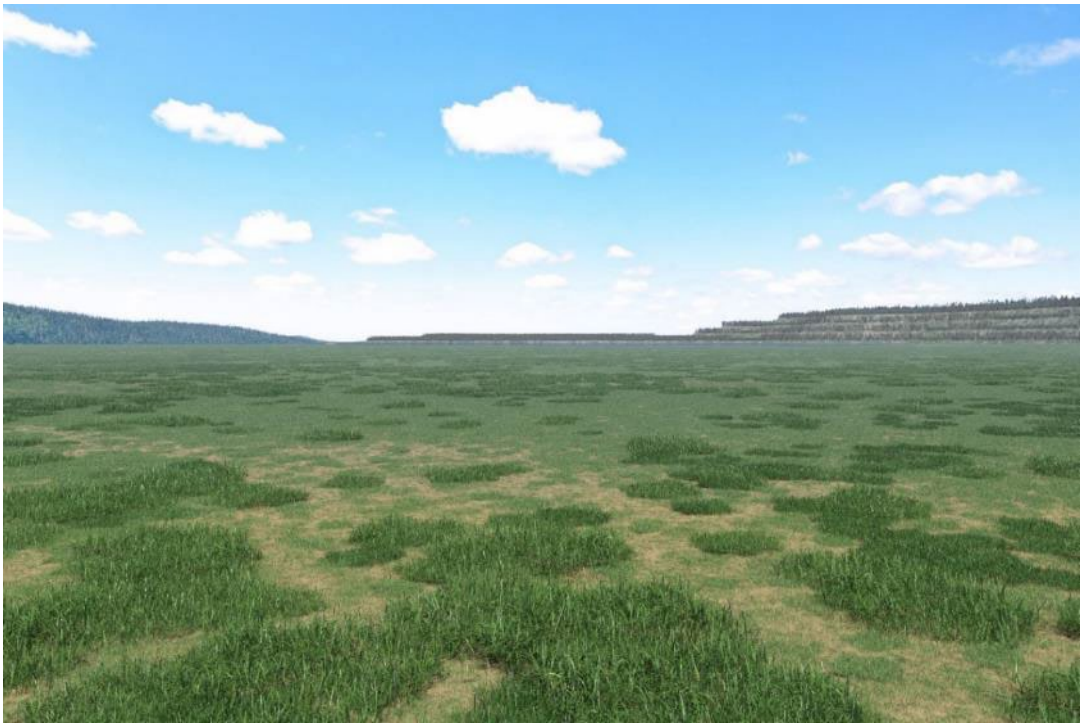

Photo 23.24 Visual Simulation of Tailings Facility Operation

Decommissioning and Closure

During closure, no adverse changes to landforms and landmarks are anticipated, as significant topographic modifications in the LSA will already have been made.

Summary

Over the life of the project, changes to landforms and landmarks are expected to be adverse and of high magnitude in the LSA. Residual impacts will be long-term and irreversible, as it would be impossible to restore the site to its original state, and these changes will occur on an ongoing basis.

23.4.2 Changes in the Diversity of Terrestrial Plant Communities and Species

23.4.2.1 Project Pathways

The mining activity as a whole will have an impact on the landscape units identified. The first to be affected will be those classified as natural (forest [F] and peatland [T] landscape units), as the industrial infrastructures will encroach on these areas, irreversibly modifying them. On the other hand, impacts on anthropogenic units (landscape units Built Environment [B], Pits [F], Waste Rock Piles [H], Unrestored Waste Rock Pile [HSNR] and Tailing Storage facility [P]) will be more limited, as operations will take place in areas already disturbed by similar activities.

Changes in the diversity of terrestrial plant communities and species, linked to the clearing of vegetation in the PDA during the construction phase, may directly result in modifications to the natural landscape of the area. A loss of vegetated areas and the possibility of the introduction or spread of IPS will increase the footprint associated with human activity on the site.

23.4.2.2 Mitigation and Enhancement Measures

The mitigation measures proposed to limit impacts on the diversity of terrestrial plant communities and species are described in greater detail in the section on vegetation, riparian and wetland environments (section 16). The main measures to limit the loss of vegetated areas and landscape modification are as follows:

- Wherever possible, reuse mining infrastructure, thereby reducing newly developed and impacted areas.
- Limit clearing to the areas required for operations as far as possible and provide fencing to clearly mark clearing limits prior to site preparation in order to keep clearing activities within the approved project area.
- Prevent the introduction of IPS during all stages of the project.
- Progressively restore and rehabilitate the site for various developments such as the TSF, certain waste rock piles and open pits. The various facilities will be restored and revegetated at the end of operations to facilitate final site reclamation.
- Plan to revegetate and reclaim the site at the end of the operating period. Re-vegetate with local species adapted to the site's specific conditions, based on natural species identified prior to the start of operations. Ensure that all surfaces denuded and affected during construction are revegetated with native plant species. Plan for different vegetation strata: trees and shrubs, seeding.
- Monitor the long-term evolution of vegetation and plan any necessary maintenance.

23.4.2.3 Residual Impacts of the Project

The characterization of residual impacts on change in terrestrial plant community and species diversity is provided for the construction, operation and closure phases of the project.

Due to the topography of the area, these impacts are limited to the viewshed represented by the LSA.

Construction

Site preparation during the construction phase will result in changes to the vegetation found in the area, due to the loss of natural environments, the project's permanent encroachment on terrestrial plant communities, and the potential for the introduction and spread of IPS. These changes will mainly affect natural landscape units. Anthropogenic units, on the other hand, will be less impacted due to their industrial character linked to previous mining operations.

Operation

The potential for change in the diversity of terrestrial plant communities and species associated with natural landscape units during the operational period is low, since most of the clearing and infrastructure installation will have been carried out during the construction phase and initial operations.

Decommissioning and Closure

Restoration and closure activities, as well as the impacts of mining activities, should aim to rehabilitate natural areas affected by the construction and operation phases. Consequently, certain natural landscape units should be rehabilitated and gradually regain importance regarding man-made landscape units.

As the impacts of mining activities are very significant, site reclamation will be a long-term process.

Summary

Over the life of the project, changes in the diversity of terrestrial plant communities and species will result in modifications to landscape units that are expected to be adverse and of high magnitude in the LSA. Residual impacts will be long term, and many will be irreversible, as it would be impossible to completely restore the site to its original state. However, progressive reclamation during and after the operational phase will limit the impact on a number of environments and could enable the rehabilitation of sites disturbed during operation.

23.4.3 Changes to the Hydrographic Environment

23.4.3.1 Project Pathways

In order to maintain the local hydrological system, the Bibou stream (CE2) will be diverted during construction, moved out of its natural bed and relocated further north of the operating area. This change will have an impact on the landscape by modifying the wetlands and vegetation along the creek, in particular the peat bogs. This creek diversion will result in the creek being channelled in a more direct line, eliminating the meandering and natural flow of the creek. The slopes will be steeper than in its natural state, and the vegetation will be streambank rather than bog vegetation.

The rehabilitation of Bibou Creek (CE2) during the closure phase will allow some return to the pre-mining ecosystem by reconfiguring and revegetating the creek. This relocation will restore the creek's course and reference hydrological conditions, but the natural landscape will still be altered from existing conditions. Details of the pathways are provided in the Hydrological Regime VC (section 11).

23.4.3.2 Mitigation and Enhancement Measures

The mitigation measures proposed to limit impacts related to changes in the hydrological environment are as follows:

- When rehabilitating Bibou Creek (CE2), it is imperative to plan for a configuration of the creek that is as close as possible to its original natural course.

- When rehabilitating Bibou Creek (CE2), revegetate with native plant species to rehabilitate the existing peat bogs. Revegetate with local species adapted to the site's specific conditions, based on the natural species identified prior to the start of operations.

23.4.3.3 Residual Impacts of the Project

The closure phase will include dismantling activities, relocation of the creek and flooding of the pits.

The hydrological regime will inevitably be altered locally, impacting wetlands. This disruption will have consequences for the fragile and sensitive landscapes associated with them.

Changes to the water regime may lead to a reduction in biological diversity in the affected areas. Plant species requiring a stable aquatic environment may see their populations decline. Some wetland species may experience high water stress. These changes could also favor the emergence of new IPS that could further disrupt the ecological balance. In addition, changes in the hydrological regime could alter soils, increasing the risk of erosion and loss of essential nutrients for local vegetation.

Construction

During the construction phase, activities such as deforestation, vegetation removal, soil stripping, excavation and the use of explosives (including blasting) will directly transform the land surface and disrupt natural drainage patterns. With regard to VC, the Bibou Creek diversion (CE2) will result in changes to the hydrological regime, with an impact on associated wetlands, particularly peat bogs, which are likely to dry out, altering the vegetation present in these environments.

Operation

During operation, no additional impact on the landscape component is expected compared to the construction phase, since the Bibou Creek diversion (CE2) is planned for the construction activity phase. Although mining operations will result in the disappearance of certain watercourses and bodies of water, particularly in the Lake PE5 area, the filling in of these hydrological features will have a limited impact on the landscape. Most of these areas are surrounded by dense forest vegetation, reducing their visibility and accessibility from both inside and outside the site.

On the other hand, the Bibou stream presents a special situation. This watercourse runs through a peat bog environment, whose morphology is strongly influenced by hydrological conditions. Consequently, any modification to this stream will have a greater impact on the visual and structural aspect of the landscape in this area, due to the open, more sensitive nature of the surrounding vegetation.

Decommissioning and Closure

Project closure includes site restoration through dismantling of mining infrastructure, revegetation and relocation of Bibou Creek (CE2). The objective is to replicate natural flow patterns as closely as possible after operations have ended.

Although some hydrological functions will be restored, semi-permanent modifications to the local water balance, such as flooding of pits and changes in drainage and evaporation pathways, will have a

moderate impact. These modifications will reduce peak flows and increase water retention, thus influencing vegetation. Peatland recovery will therefore be affected.

Summary

Over the life of the project, activities related to the Bibou Creek diversion (CE2) to enable mine construction will result in significant modifications to landscape units that are expected to be adverse and of high magnitude in the LSA. Residual impacts will be long-term, even after mine closure, and many will be irreversible, as it would be impossible to restore the environment to its original state.

23.4.4 Summary of Project Residual Impacts

Table 23.5 summarizes the residual impacts on the landscape.

Table 23.5 Residual impacts of the project on landscape

Residual impact	Characterization of residual impacts							
	Project phase	Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
Change in topography	C/ O/ D	A	H	LSA	N/A	LT	C	I
Change in terrestrial plant species	C/ O/ D	A	H	LSA	N/A	LT	C	I
Change in hydrological environment	C/ O/ D	A	H	LSA	N/A	LT	C	I

Project phase:
C: Construction
O: Operation
D: Decommissioning and closure

Direction:
P: Positive
A: Adverse

Magnitude:
NMC: No Measurable Change:
L: Low
M: Moderate
H: High

Geographic extent:
PDA: Project Development Area
LSA: Local Study Area
RSA: Regional Study Area

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

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term

N/A Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

The various impacts identified are physically durable over time. Their significance in the landscape, however, is limited to Cree users, who will see their visual landmarks on the LSA disrupted, while the morphology of the land and viewing angles will be altered. Given the topography of the mine site, which is set between hills, this disturbance will remain limited in the LSA.

The loss of vegetation will be compensated for by progressive reclamation during and after operation. Vegetation will be rehabilitated as the mine closes.

In terms of hydrography, the water regime will be modified, and despite the transformation of a controlled system towards a natural state, the latter will remain incomplete, leaving impacts that will influence the quality and regulation of water flows, impacting wetland types and associated vegetation.

23.5 Confidence in Predictions

The assessment of residual impacts on landscapes relies on the effective implementation of planned mitigation measures. The predictions made as part of this assessment are based on assumptions that involve a degree of uncertainty. These uncertainties stem from a variety of factors, including operational hazards, which may marginally influence the anticipated impacts, and larger-scale environmental dynamics. The latter can lead to greater deviations between forecasts and reality, due to input variables that are sometimes difficult to predict, particularly in the context of a long-term project.

For example, the evolution of vegetation can be affected by climate change, which influences the ability to accurately predict the future state of the landscape.

Given the dependence of the assessment on complex external factors that are difficult to control, the level of confidence attributed to the predictions of residual impacts on the landscape is considered moderate.

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