Wetland Assessment Report – Area 2 Addendum

Montague Gold Mines, Nova Scotia

Final Report

Project #: TV183013

November 2021

Prepared for:

Intrinsik Corporation on Behalf of Nova Scotia Lands

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GLOSSARY OF TERMS

DFO	Fisheries and Oceans Canada
ESA	Environmental Site Assessment
GPS	Global Positioning System
ha	hectares
m	metres
masl	metres above sea level
NS	Nova Scotia
PSPC	Public Services and Procurement Canada
WAM	Wet Areas Mapping
WESP-AC	Wetland Ecosystem Services Protocol for Atlantic Canada
Wood	Wood Environment & Infrastructure Solutions, a Division of Wood Canada Limited

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1.0 INTRODUCTION

Wood Environment & Infrastructure Solutions, a Division of Wood Canada Limited (Wood) was retained by Intrinsik Corporation (Intrinsik), on behalf of Nova Scotia Lands Inc. (a Crown Corporation), to complete wetland assessments, including boundary delineation and functional assessments for wetlands potentially impacted by historic mining activity in Montague Gold Mines, Nova Scotia (Figure 1 in Appendix A). A wetland assessment report was generated in May 2021 (Wood 2021a), supported by a desktop study and reconnaissance survey conducted in Fall 2019 (Wood, 2020a) and Summer field surveys in 2020 to assess wetland functions and confirm wetland boundaries in the field. However, Area 2 (Figure 2 in Appendix A) was not completed at that time; therefore, a follow-up wetland survey was conducted in 2021 to verify the wetland boundary and characteristics and conduct a functional assessment. This addendum presents new information for the Area 2 wetland following the same assessment format as the other wetlands.

Historic gold mining activities have left a legacy of contaminated mine tailings and associated water quality impacts in and adjacent to wetlands and watercourses. As part of ongoing planning (lead by Intrinsik) for the remediation of identified contaminated areas, an assessment of potential impacts on wetlands was conducted. Wood has reviewed results of numerous supplementary surveys (water quality, risk assessment, etc.) conducted by Study Team partners (composed of Intrinsik, Wood, EcoMetrix, and Klohn Crippen Berger) in 2019, 2020 and 2021 and conducted summer field surveys of selected wetland areas on Crown and Municipal Land (and land owned by Halifax Water). This report provides an assessment of the Area 2 wetland (with summarized results for the other identified wetlands) in the context of potential remediation of contaminated historic mine tailings.

1.1 Purpose

The purpose of the wetland assessment is to respond to two basic information needs required to support decision making by NS Lands in regard to the need for remediation and selection of the most appropriate site management options, including:

- What is the condition and sensitivity of wetlands which will be directly impacted by the current conceptual remediation plans (either through removal of tailings and consolidation in a containment cell; or, through use of a geomembrane/capping approach, which would cover the wetland); and
- What is the condition and sensitivity of wetlands nearby and down gradient within the historic zone of mining related impacts and will they be affected by remediation activities; particularly, are they currently "significantly impacted", "in recovery", or "healthy".

This information will be used by the Study Team to develop reasonable objectives for final site condition in each wetland and to refine the remediation plan and footprint. For example, where a wetland is found to contain contaminated material, a risk assessment would evaluate exposure of the biological environment. If risk is considered relatively low in the context of identified sensitivities, then a monitor and recovery approach may be acceptable compared with the potential effects of physical remediation.

The assessment results can also be used for preparation of environmental permits that may be required related to physical activities, associated with remediation planning and implementation, in the wetlands.

2.0 METHODS

2.1 Approach

The Study Area and the wetlands selected for assessment were developed in discussion with the Study Team and based on the currently proposed conceptual remediation plan footprint. The Study Area is divided into four parts, Areas 1, 2, 3, and 4 (Figure 1, Appendix A). Wood reviewed available data and conducted a reconnaissance field program for all wetlands in late fall of 2019 (Wood, 2020a), followed by a detailed assessment of selected wetland areas in 2020 (Figures 1 and 2 in Appendix A). The detailed surveys were completed in Areas 1, 3 and 4 in Summer 2020 and included comprehensive vegetation & wildlife surveys and delineation and functional assessment of potentially impacted wetlands.

Area 2 was excluded in 2020 from the field surveys and functional assessment as it was determined to be a low priority due to the minor reported impacts (some coarse waste rock). Based on available information, and water/sediment sampling showed relatively low metals concentrations in the main Mitchell's Brook channel; there was no rationale to consider mitigation specifically for the Mitchell's Brook part of the wetland. However, there is an area of fine tailings deposited in the north-central portion of the Area 2 wetland and a series of academic studies by Saint Mary's University have shown the presence of significant arsenic and mercury contamination associated with historic mine tailings deposits (C. Moore, Pers. Comm, 2021, http://www.ap.smu.ca/~lcampbel/Gold.html). Therefore, a field survey of the Area 2 wetland was conducted in 2021 to supplement information already provided.

This addendum report presents results of the Area 2 wetland survey and functional assessment. The summary tables include results and conclusions for all the studied wetlands at the Montague Gold Mines site (Areas 1, 2, 3, and 4).

2.2 Background Review

Prior to the field survey, aerial photos of the survey area were overlaid with wetlands and streams as shown in provincial mapping, Crown Land areas, and tailings areas as reported in Nova Scotia Lands Inc. (2019). For the reporting, the boundaries of the "Lake Major Protected Water Area" were added. Depth to water table mapping was used to identify areas with an elevated likelihood for presence of wetlands not previously identified in provincial mapping or the desktop review of aerial photos.

In addition to basic mapping, and results of the wetland reconnaissance and wetland assessment studies (Wood 2021a, Wood 2020a), Wood reviewed other ongoing supplementary studies during the assessment. The review included reference to the following documents and map resources:

- NSDLF Significant Species and Habitats Database (Provincial Landscape Viewer);
- Aerial Imagery (Google Earth, and historical photos going back to 1931);
- Topographical Elevation Data (provincial mapping, 1 m interval, imported as .KMZ to Google Earth);
- NSDLF Wet Areas Mapping (WAM)(i.e., depth-to-water-table);
- Selected map resources associated with the Wetland Ecosystem Services Protocol – Atlantic Canada (WESP-AC) evaluation system and supporting files (NBDELG, 2018);
- Species At Risk Data Report (ACCDC, 2019); and

- Site condition data reported in recent "Conceptual Closure Plan" final report (Nova Scotia Lands Inc., 2019).
- Human Health Risk Assessment (HHRA) for Barry's Run (Intrinsik, 2020).
- Wetland Reconnaissance Study Report, Montague Gold Mines & Goldenville, Nova Scotia - Draft Report (Wood, 2020a).
- Wetland Assessment Report, Montague Gold Mines, Nova Scotia - Final Report (Wood, 2021a).
- Breeding Bird Surveys (Memo), Montague Gold Mines, Nova Scotia (Wood, 2021b).
- Sediment Quality Data Summary (by Ecometrix), unpublished memo dated May 29, 2020.
- Water Quality Data Summary (by Ecometrix), unpublished memo dated May 29, 2020.
- Site visit summaries from Ecometrix field program (July 23-29, 2020)(Unpublished).
- Phase I Environmental Site Assessment (DRAFT)(Wood, 2020b).

The listed resources were used in combination with field observations to complete the functional assessment and identify risks and sensitivities in the Area 2 wetland.

2.3 Wetland Field Survey

The wetland field survey was conducted (during the vegetation growing season) to *confirm* wetland conditions on-site including:

- Wetland type and approximate boundary/area, as compared to provincial mapping;
- Apparent surface hydrology (presence of standing water and flow direction);
- Apparent impacts on the wetland, both historic and recent;
- Apparent altered hydrology, such as ditching, barriers, excavations, etc;
- Signs of diminished wetland health or function, caused by legacy mining impacts, may include:
    - Unvegetated or sparsely vegetated areas;
    - Dead or dying vegetation;
    - Reduced species diversity or dominance by one or a few species (such as cattails);
    - Waste-rock or tailings deposits in the wetland;
    - Excessive sedimentation, particularly ongoing sediment loading;
    - Iron stained ground or iron floc/algae in the water;
    - Dead fish or other wildlife, not obviously from natural causes;
- Signs of wetland uses by people for recreation, subsistence food gathering, or other uses; and
- Incidental wildlife observations, such as tracks, scat, nests, dens, browsed vegetation, migratory birds or mammals present.

The Site was traversed on foot, focussing on the areas adjacent to the core tailings deposits (Area 2 in this addendum) and downgradient for several hundred metres. Access was limited to Crown Land and some municipal land; however, to the extent possible, subject areas on non-Crown land were observed from adjacent Crown Land or public rights-of-way. Wetland functions were assessed using the Wetland Ecosystem Services Protocol for Atlantic Canada (WESP-AC), detailed in Section 2.3.2, below. Field observations were collected as required to complete the field forms. In addition, dominant habitat types and vegetation located within the Study Area were identified and documented. Representative site photos

are presented in Appendix C. Notable ecological features such as watercourses, cavity trees, and potential bat hibernacula were recorded, as well as any incidental observations and evidence of fauna.

2.3.1 Wetland Delineation

The wetlands were surveyed by a trained Wetland Delineator and Functional Assessor: Ms. Elizabeth Robinson (5+ years' experience). The wetland boundary determination was conducted according to the US Army Corps of Engineers wetland delineation method, following the USACE Northcentral and Northeast Regional Supplement guidelines. The wetland determination is based on a three-part test that requires the presence of wetland vegetation (i.e., majority of dominant species must be wetland associated), hydric soil, and signs of wetland hydrology resulting in periods of flooding, ponding, or saturation. Indicators of wetland hydrology considered include water marks, drift lines, sediment deposition, drainage patterns, stained leaves, and visual observation of inundation. Wetland boundaries were delineated during the vegetation growing season. Boundaries were delineated in detail in areas that will likely be subject to ground disturbing activities during remediation planning or implementation. Wetland areas where physical disturbance by remediation efforts are not currently anticipated have been field verified by spot-checking provincially mapped boundaries and aerial photo interpretation was used to refine the mapping where justified by field observations. The field verified wetland locations were recorded using a GPS and Project wetland mapping has been revised accordingly. Access permission was obtained for all parts of the Area 2 wetland.

2.3.2 Wetland Functional Assessment

The functions, benefits, and sensitivity of each wetland was assessed using the Wetland Ecosystem Services Protocol - Atlantic Canada (WESP-AC) wetland evaluation technique. The process involves the completion of three forms; a desktop review of aerial imagery that examines the landscape level conditions within which the wetland is situated, and two field forms. The WESP-AC values system provides a framework for identifying potential high value functions based on available information. WESP-AC defines 17 specific functions that wetlands may provide (Table 2-1), categorized into five grouped wetland functions and evaluated for "Function" and "Benefit". Wetland function relates to inherent properties of a wetland based on physical, chemical, and/or biological processes (e.g., water storage). Functions have potential value to users when opportunity is present, i.e., when the function provides a valuable service to a user that is capable of receiving the value. Wetland benefits reflect the *relative* value of the functions based on site-specific circumstances, which determine how important the function is to the users that are present, and whether that is of ecological, social, or economic importance. For example, the ability to trap sediment is of no value to fish in a wetland without surface water. The highest valued (i.e., most sensitive) wetlands are those that have both high 'Function' and 'Benefit' values for a given function. A functional assessment was completed for the Area 2 wetland and the score sheet is presented in Appendix B.

Table 2-1: Wetland Function Parameters

Grouped Wetland Function	Specific Wetland Functions
Hydrologic Function	Surface Water Storage
Water Quality	Sediment Retention & Stabilization
	Phosphorus Retention
	Nitrate Removal & Retention
	Carbon Sequestration
Aquatic Support	Aquatic Invertebrate Habitat
	Stream Flow Support
	Organic Nutrient Export
	Water Cooling
Aquatic Habitat	Anadromous Fish Habitat
	Resident Fish Habitat
	Waterbird Feeding Habitat
	Waterbird Nesting Habitat
	Amphibian and Turtle Habitat
Transitional Habitat	Songbird, Raptor, & Mammal Habitat
	Pollinator Habitat
	Native Plant Habitat

3.0 RESULTS

A wetland survey was carried out in Area 2 on October 7th, 2021. Observed wetland types and significant features are shown on Figure 2, in Appendix A. The wetland functional assessment score is presented in Appendix B. Representative site photos are provided in Appendix C. Following is a general description of all studied wetlands at Montague Gold Mines, including confirmation of similar conditions in Area 2. A detailed description of site-specific information in Area 2 is presented in Section 3.1, below.

The descriptions of wetland areas have been organized according to the Tailings Areas identified by the Study Team in the Conceptual Closure Plan in order to reflect the observed local wetland conditions/impacts relative to the currently proposed remediation methods. In the following sections, the term "Project wetlands" is used to refer to wetlands that may be subject to remediation activities. The term is used conceptually since the precise location and extent of the remediation footprint has not yet been determined.

Field surveys and wetland delineations in 2020/21 have confirmed the provincial wetland mapping (presence/absence and area) is considered relatively accurate. The vegetation communities within each wetland are generally much more varied and complex than mapping would indicate. There is also a dimension of evolving recovery within post-disturbance wetland areas such that the current vegetation community may change significantly as natural restoration continues to develop.

The tailings deposits in the impacted wetland areas (confirmed for Area 2) were observed to be light grey, fine grained, dense or compacted sand (stamp mill tailings) which were frequently saturated to the surface. The grey colour could interfere with normal wetland delineations and was considered a "problem soil" in the terminology of the US Army Corps delineation methodology (USACE, 2012). Wetlands that have developed on this substrate were delineated based on hydrophytic vegetation and hydrology (acknowledging the "problem soil") as defined in the delineation guidelines. However, it is a highly disturbed form of wetland and not considered "normal". Where the wetland soil is composed largely of fine tailings, the vegetation is low growing (30-60 cm) and herbaceous species are more abundant. In more naturally developed wetland areas, the vegetation is much taller (60 cm – 2.5 m) and woody species are co-dominant with taller herbaceous species.

Stunted vegetation was observed in more severely impacted wetland areas, mainly apparent as low growing woody and herbaceous vegetation (below 1 m height). Around wetland edges there are a few dead and dying trees which is typical in wetlands with variable water levels. Conifer trees with yellowing needles were observed at a few locations but were not wide-spread or concentrated in zones, so these do not appear to be indicative of a site-specific condition. Stunted growth often occurs naturally, particularly in wetlands. For example, high flood levels / prolonged wetness, low nutrient levels in bogs or some mineral soil, compacted soil, thin soil layers, and locations exposed to strong wind often result in stunted vegetation, particularly woody vegetation. These apparent impacts could reflect suboptimal conditions including too much water (trees), compacted soil, lack of nutrients, as well as the possible presence of elevated metals concentrations (mainly arsenic) in the tailings. Recurring disturbances by off-road vehicles also impedes vegetation recovery in some areas (but not in Area 2).

In more impacted areas associated with dense sand substrate (confirmed in Area 2), the vegetation is predominantly cattails, Canada rush (*Juncus canadensis*), water horsetail (*Equisetum fluviatile*), marsh fern

(*Thelypteris palustris*), and scattered stunted alder (*Alnus incana*). In Areas 1A and 3C, during the latter part of the season (September) two herbaceous species became abundant on fine tailings deposits, purple gerardia (G*erardia purpurea*) and nodding lady's-tresses (*Spiranthes cernua*), with colourful flowers conspicuous in the low-growing vegetation. These two species were not verified in Area 2, possibly due to increased long term wetness. It is unknown if there is a chemical component of species dominance on the fine tailings or if it is purely physical characteristics (i.e., openness, compaction, hydrology, etc), but there seems to be a somewhat predictable vegetation pattern on local fine tailings deposits.

The identified riparian wetlands are integral to the health and function of Mitchell's Brook (confirmed in Area 2) and Flat Barren Brook (which is located in Area 3), contributing water flow moderation (storage, stream flow support, flood attenuation) and water quality benefits (sediment retention, chemical purification, nutrient export, and cooling). Aquatic vegetation supports benthic and fish communities, water bird feeding and nesting, and amphibians and reptiles. Many terrestrial wildlife and avian species (bats, migratory birds, raptors) will use wetland habitats such as these for foraging or breeding (nesting). Many invertebrates, including pollinators, depend on wetlands and aquatic habitats for some part of their lifecycle. There is potential for some Species at Risk (SAR) to be present in the Montague Gold Mines wetlands, including in Area 2, described further in the following sections. A supplementary breeding bird survey and terrestrial habitat assessment was conducted in late-June and early July 2021 in which two protected bird SAR were identified (Wood, 2021b) No other SAR were observed in Project wetlands during the field surveys. Common terrestrial wildlife observed included chipmunk, red squirrel, beaver, white-tailed deer, and racoon.

In this report, the potential for SAR to be present has been based mainly on ACCDC reports for the general area (within 5 km of the site) and the confirmed presence of suitable habitat. Two SAR birds were identified onsite during breeding bird surveys (Wood, 2021b) which are wetland associated, including Olive-sided Flycather (*Contopus cooperi*) in/near Area 2 and Canada Warbler (*Cardellina canadensis*) in/near Area 3. No other SAR were observed during field surveys. Also, no "critical habitat" (protected by law) was identified for any SAR in the surveyed wetlands.

Signs of wildlife usage were observed in several wetlands (confirmed for Area 2), including a beaver lodge, dam and trails, beaver cut-marks, an old song-bird nest, deer tracks and rabbit pellets. No moose tracks were observed.

Despite warning signs indicating the potentially dangerous nature of the soil/sediments, there were signs of use of certain tailings areas by humans. In particular, the tire tracks and presence of remnants of a campfire in Area 1A and 1C indicate activities that could negatively impact human health. Also, an angling float found in the fen along Barry's Run (Area 4A) indicates that angling is taking place either in Barry's Run where sediments have been reported to contain elevated concentrations of arsenic, or further upstream in contributor streams with potentially elevated levels of arsenic from the upstream tailings areas east of the Highway 107. Presence of ATV tracks in and near the wetland at Barry's Run appear to indicate regular use of this area. There are several well-worn trails and improvised foot-bridges near the edges of Barry's Run (Area 4A and 4B). There was no sign of human interaction with Area 2 except for scientific monitoring by Saint Mary's University.

3.1 Area 2

At Area 2 (Figure 2, Appendix A), fine grain stamp mill tailings have been deposited directly into the riparian wetland associated with Mitchell's Brook, and there is coarse waste rock and historic mine foundations around the western and northern edge of the area. The core deposit is fully vegetated and does not show indications of significant erosion or human disturbance recently. Based on water and soil quality testing, this deposit may be an ongoing source of contaminated water and sediment loading to adjacent wetlands and aquatic habitats downstream. The site is surrounded by residential suburbs of Dartmouth and local roadways. Local drainage has been modified by historic mining activity and the main channel flows through a jumble of coarse rock rubble at the main outlet, and a second outlet identified in the field appears to be of human origin (ditch or old road). A paved road (Lochmoor Lane) crosses Mitchell's Brook at the inlet which separates Loon Lake from the Area 2 wetland.

Area 2 has a single large wetland, approximately 7.2 hectares. The majority of the open middle of the wetland is deep marsh/fen habitat with a deep organic soil composed of sphagnum moss and a dense herbaceous cover of sedges and peatland associated low shrubs. The edges of the wetland and eastern and southern extremities are characterized by taller woody vegetation (1-2 m) including tall shrubswamp and some forest swamp habitat. Predominant species in the open parts of the wetland are scattered tamarack (*Larix laricina*), leather-leaf (*Chamaedaphne calyculata*), Labrador tea (*Rhododendron Groenlandicum*), soft rush (*Juncus effuses*), Canada rush (*Juncus canadensis*), some cattails (*Typha latifolia*), and blue-joint grass (*Calamagrostis canadensis*). Predominant species in the southeast and southwest extremities of the wetland are black spruce (*Picea mariana*), speckled alder (*Alnus incana*), meadow sweet (*Spirea alba*), wild rose (*Rosa virginiana*), red maple (*Acer rubra*) and grey birch (*Betula populifolia*) saplings, cattails, royal fern (*Osmunda regalis*), cinnamon fern (*Osmunda cinnamomea*), water horsetail (*Equisetum fluviatile*), multiple common *Juncus* and *Carex* sedges, and blue-joint grass and spreading bent grass (*Agrostis stolonifera*). Overall diversity in the wetland is relatively low with variation mainly in local abundance of dominant species and size and condition of individuals.

The central wetland area north of Mitchell's Brook is essentially growing on fine tailings (dense coarse grey sand with relatively low organic content). Technically it is wetland based on hydrophytic vegetation, hydrology, and what is considered a "problem soil" as defined in the delineation guidelines. However, it is a highly disturbed form of wetland and not considered "normal". The soil condition may be suboptimal but despite this, vegetation present is apparently composed of native species consistent with local wetland habitats. Where the wetland soil is composed largely of mine tailings, the vegetation is low growing (30-60 cm) and herbaceous species are more abundant. In more naturally developed wetland areas, the vegetation is much taller (60 cm – 2.5 m) and woody species are co-dominant with taller herbaceous species. Near to the watercourse and south of the watercourse, the wetland appears to be more natural in its development (i.e., fewer disturbances and "normal" organic soil and more typical vegetation growth pattern). The low-growing nature may indicate poor soil conditions, which could be improved over time by natural soil development processes. However, the current condition has reduced the relative functional value for habitat due to lower species diversity, and uniform low vegetation structure. The proximity to the adjacent watercourse and other more natural wetland areas within Area 2 impart benefits to the impacted area thus minimizing the overall negative effects. In other words, the wetland is impacted here but the negative effects are somewhat mitigated by the nearby presence of higher functioning wetland elements and the impacted wetland itself may be providing significant value to downstream habitats.

The southern boundary of the wetland extends considerably further than currently depicted on provincial mapping, including a black spruce forest swamp in the southeast. A man-made drainage trench or old road has been created historically (Figure 2) which serves as a second drainage path out of the southwest part of the wetland (described further in Section 3.2 below). Review of historic aerial imagery shows that this area has been subject to periodic flooding (presumably by beaver damming) as indicated by dead trees around the wetland edge.

In addition to the relatively large fine tailings deposit in the wetland, there are some coarse waste rock deposits and former mine works (foundations and pits) around the eastern and norther edge of the wetland.

The surrounding upland is uniformly mixed forest with white spruce (*Picea glauca*), red spruce (*Picea rubens*), white pine (*Pinus strobus*), tamarack (*Larix laricina*), white birch (*Betula papyrifera*), yellow birch (*Betula allegheniensis*), red maple, grey birch and heart-leaved birch (*Betula cordifolia*), and a few white ash (*Fraxinus americana*). Upland shrubs include beaked hazelnut (*Corylus cornuta*), low-bush blueberry (*Vaccinium angustifolium*), and service-berry (*Amelanchiar* sp.). Herbaceous species include wild sarsaparilla (*Arallia nudicaulis*), bunch-berry (*Cornus canadensis*), bracken fern (*Pteridium aquilinum*), star-flower (*Trientalis borealis*), and false-lilly-of-the-vally (*Maianthemum canadense*). Past timber harvesting and severe blow-down (root-throws) have created areas of open canopy forest with dense understory. Where the forest is more mature, the canopy is closed and the understory and ground cover is sparsely vegetated.

Table 3-1 summarizes wetland survey observations for Area 2.

Table 3-1: Wetland Conditions in Area 2

Study Area	Land Ownership	Provincial Wetland Map		Observed Wetland		Observed Impacts				Observed Hydrology	Dominant Vegetation Species	Species At Risk Present[1]	Special Features
		Wetland Type	Vegetation	Wetland Type	Vegetation	Waste Rock	Sediment	Supressed Vegetation	Non-vegetated				
2	Crown	Swamp	Tall shrub	Swamp	Tall shrub, trees	x	x	x		Large WC flow-through in tailings	Alder, mixed saplings, cattails	None observed	Confirmed habitat for bird SAR (Olive-sided Flycatcher), Collins Park/BoMont protected water supply

Notes:
1. In this report, the potential for SAR to be present has been based mainly on ACCDC reports for the general area (within 5 km of the site) and the confirmed presence of suitable habitat. Two SAR birds were identified in/near Project wetlands, including Olive-sided Flycatcher in/near the Area 2 wetland. No other SAR were observed during field surveys, including a breeding bird survey conducted in late-June and early July (Wood, 2021b).

3.2 Drainage

Area 2

All drainage flows generally to the northwest and west. The source of most water in the Area 2 wetland appears to be the single inlet at the east end of the Area 2 wetland where Mitchell Brook enters from Loon Lake through a single large culvert under the paved road. The main channel flows northwest until it exits from the west end of the Area 2 wetland into Area 1. The main channel outlet appears to percolate swiftly through coarse rock rubble (suspected waste rock) and/or an historic (now derelict) water control structure. Some parts of the drainage channel are lined with stone block walls but generally there is now just an incoherent jumble of rocks remaining. There was also a significant beaver dam at the outlet further restricting flow. It is unknown if this channel structure and beaver damming presents any barrier to fish passage. It seems likely that there has been an effect on natural drainage volumes and that perhaps higher water levels prevail in the Area 2 wetland due to this condition. The main channel is relatively deep (~2 m) and broad and slow moving with a mixed but mainly fine substrate and abundant aquatic vegetation.

There is a second (previously unmapped) channel draining from the southwest part of the wetland which appears to be a mad-made channel (straight path and uniform width). Possibly this is an old road or a ditch. This drainage is of significant size, perhaps equal in volume to the main channel at Mitchell Brook. It is a permanently flowing open channel with no apparent barrier to fish passage. This second channel originates in the centre of the Area 2 wetland at Mitchell Brook, just south of the historic tailings deposit (Figure 2, Appendix A), and is characterized by a wide network of braided small channels flowing south through the southwest extremity of the wetland until they become concentrated at the outlet at the edge of the wetland. The second channel is generally shallow and fast flowing with variable width and rocky substrate.

It should be noted that the identified historic tailings area was covered by shallow water at the time of the survey and appears to be subject to longer periods of high water table than in other tailings areas at the Montague Gold Mines site. Possibly this prolonged wetness may explain the predominance of horsetail and sedge species over ferns and shrubs noted in other tailings areas and the lack of certain plants found in common at other tailings areas such as purple gerardia and nodding lady's-tresses.

3.3 Significant Wetland Features

As part of the desktop review, an Atlantic Canada Conservation Data Centre report was requested for the site, the provincial significant habitats interactive website was reviewed, and the regional biologist was contacted to provide additional context. During the site visit within the Crown Land portion of the wetlands, species at risk were actively searched for. No species at risk were observed.

The ACCDC Data Report (ACCDC, 2019) indicates a number of SAR are recorded in the area which may use wetland habitat of the types present within the impacted areas. In particular, Canada Warbler (*Cardellina canadensis*) and Snapping Turtle (*Chelydra serpentina*) are likely wetland residents, while Common Nighthawk (*Chordeiles minor*) and Monarch Butterfly (*Daneus plaxippus*) could inhabit disturbed portions of the site, taking advantage of open canopy regenerating tall shrub and forest areas, adjacent to the riparian zone.

Of particular note, the ACCDC report identified the presence of Black Ash (*Fraxinus nigra*) and bat hibernacula as "location sensitive" species (meaning that the precise location was not given in the report to protect the species). A follow-up discussion with the Nova Scotia Lands & Forestry (NSL&F) regional biologist confirmed the approximate locations of the recorded Black Ash and bat hibernacula to be at least 2 to 3 km from

proposed remediation sites (Donald Sam, Pers. Comm., February 24, 2020). There remains a general potential for unrecorded occurrences to be present in Project wetlands.

The region of the upper Shubenacadie River is a well-known bird migration flyway with relatively high nesting densities for Black Duck (*Anas rubripes*) and other waterfowl species. A recent study in north-west Nova Scotia found that almost half of the migratory birds in the province are using tall shrub and forested wetlands for breeding, although not exclusively (Brazner et al, 2019).

Birds and bats may be foraging within the Project wetlands and would be exposed to metal contamination accumulating through the food web. Many of the flying insects which are a large part of aerial feeder's diets begin their lifecycle as aquatic predators.

Snapping Turtles have a diverse diet and could be ingesting contaminated material from a number of sources within the wetlands, such as elevated metals in vegetation or fish. They may also be nesting in the fine tailings deposits which would superficially resemble ideal streamside sand bars that are the preferred natural nesting areas. If this were to happen, this would expose the eggs, young, and adults to buried contaminants. Hibernation may also involve Snapping Turtles burrowing into substrates. Thus, if Snapping Turtles are present then the potential for exposure to historic mining contaminants would be high, especially where tailings remain unvegetated.

A review of the provincial Significant Species and Habitats Database, reviewed on November 29, 2021, using the online Provincial Landscape Viewer (https://nsgi.novascotia.ca/plv/) did not reveal any Significant Habitat Areas, apart from wetlands, in close proximity to the site (including Area 2). The potential species identified are similar for all Areas (1, 2, 3 and 4); however, the likelihood of SAR in Area 3 may be somewhat higher due to a higher diversity of wetland types and aquatic habitat. Also, Area 3 is more remote from roads and developed areas with fewer disturbances within the wetlands. A supplementary breeding bird survey and terrestrial habitat assessment was conducted in late-June and early July 2021 in which two protected bird SAR were identified (Wood, 2021b) No other SAR were observed in Project wetlands during the field surveys. One, Olive-sided Flycatcher, was heard calling in/near the Area 2 wetland.

In the western part of the Site, within Areas 1, 2 and 4, the Project wetlands are within the Collin's Park and BoMont protected watershed areas. These water sources provide drinking water to local communities on the outskirts of Dartmouth. It should be noted that Halifax Water carefully monitors drinking water quality, and source water quality in all areas.

Area 3 wetlands (A-D) and Flat Barren Brook are within the Lake Major protected watershed area. This is a major source of drinking water for the Dartmouth area. It should be noted that Halifax Water carefully monitors drinking water quality, and source water quality in all areas.

3.4 Water Quality Results

The impacts on local water and sediment quality from historic mining at Montague Gold Mines has been investigated in the "Conceptual Closure Plan" final report (Nova Scotia Lands Inc., 2019) and follow-up sampling conducted in late 2019 and 2020 (by EcoMetrix and Wood) which indicate elevated mercury concentrations in proximity to the core tailings deposit in Area 1A and parts of Area 3 and high arsenic in sediment and water

within Areas 1 (A-E), 2, 3C, and 4A. Additional sediment data from Saint Mary's University studies indicate high mercury and arsenic in Area 2 (e.g., LeBlanc et al, 2019).

Both arsenic and mercury attached to solids are being trapped and stabilized in local wetlands. To a lesser extent water chemistry in the wetlands may be transforming and ultimately purifying water quality for downstream environments. There is also a potential for wetlands to transform elemental mercury to a more bioavailable form, methylmercury, which can then bioaccumulate through the food web (LeBlanc et al 2019). The ongoing investigations by the Study Team will assess levels of methylmercury in aquatic biota.

Currently, acid rock drainage does not appear to have a significant impact, with very low pH values detected at just a few locations within the core tailings areas. However, there is a potential for further oxidation of the tailings to generate significant acid runoff that could have negative effects on adjacent wetlands and aquatic environments downstream. This potential is considered high enough to justify active remediation (Nova Scotia Lands Inc., 2019). No evidence of acid rock drainage was observed in the field at Montague Gold Mines during surveys in 2019, 2020, or 2021 and there was no indication of acid drainage impacts on terrestrial or wetland vegetation communities near the tailing's areas (including Area 2).

3.5 Wetland Functions

Table 3-4 summarizes the results of the wetland functional assessments (including Area 2). A summary score sheet for the Area 2 wetland is presented in Appendix B (the full-length form is available upon request). The WESP-AC methodology assesses a wide range of aspects which have been aggregated into groups of complimentary functions for discussion. Two additional categories are Wetland Condition and Wetland Risk which evaluates the effects on the wetland of past or ongoing impacts and adjacent land use, and the current quality of habitat compared to unimpacted wetlands of the same type. It is important to note all values are assessed relative to the range of wetlands in Nova Scotia.

The Project wetlands have a generally low hydrologic and water quality support function, but in the local context, the benefits are considered relatively high. Areas 3B and 3D stand out as having lower values, due to their small size, little to no inflow, and minor influence on downstream waters. All other wetlands (including Area 2) provide low magnitude but locally significant functions in support of flow maintenance and water quality.

Aquatic support and aquatic habitat functions are generally high in all wetlands with surface water (most of them), providing nutrient input, cooling (shade), and shelter for anadromous and resident fish, invertebrates, amphibians & turtles, and waterfowl feeding and breeding habitat, particularly in the context of known high density waterfowl migration in the area.

Table 3-2: Summary of Wetland Functional Assessment

Study Area	HYDROLOGIC Group		WATER QUALITY SUPPORT Group		AQUATIC SUPPORT Group		AQUATIC HABITAT Group		TRANSITION HABITAT Group		WETLAND CONDITION		WETLAND RISK		Average Function	Average Benefits
	Function	Benefits	Function	Benefits	Function	Benefits	Function	Benefits	Function	Benefits	Function	Benefits	Function	Benefits		
1 (A-G)	1	3	1	3	2	3	3	3	3	3		3		2	2	3
2	1	3	1	3	3	3	3	3	3	3		1		2	2	3
3A	1	1	1	3	3	3	3	3	2	3		3		2	2	3
3B	1	1	1	3	1	2	2	3	2	3		2		2	1	2
3C	1	2	1	3	3	3	3	3	3	3		3		2	2	3
3D	1	1	1	3	2	2	2	3	3	3		3		1	2	2
4A	1	3	1	3	3	3	3	3	3	3		2		1	2	3
4B	1	3	1	3	3	3	3	3	2	3		2		2	2	3
4C	1	3	1	3	3	3	3	3	3	3		3		2	2	3
4D	1	3	1	3	3	3	3	3	2	3		3		2	2	3
Average (all wetlands)	1	3	1	3	3	3	3	3	3	3		3		2		

1 = Low
2 = Moderate
3 = High

Transition habitat (value of wetlands to terrestrial wildlife, pollinators, and plant species diversity) scores moderate to high in function and uniformly high in benefits for all wetlands. The Project wetlands provide unique structural diversity in the regional landscape, especially in consideration of high rates of local land development and fragmentation by infrastructure.

Wetland Condition scores moderate to high for most wetlands, indicating that where historic impacts have occurred, the current state of recovery is advanced. Essentially, the Project wetlands are fully functional, despite the past and potentially ongoing mine tailings related impacts. Area 2 alone scored "low" in Wetland Condition, based on apparent man-made influences on both identified outlets (impacts on hydrology) and the presence of a paved road crossing at the inlet (associated road salt and sediment input), as well as a significant fine tailings deposit within the wetland. However, it should not be interpreted as an indication of low quality, but rather that there is a level of unnatural influence that is more regular, widespread, or recent than in other areas.

Wetland Risk evaluates the level of stress on wetlands due to human related factors that degrade its ecological condition and/or reduce its ability to provide functions. Most of the Project wetlands have moderate stress levels (including Area 2), due to both historic and current human activities, including past mining (tailings deposits, excavation, infilling, drainage manipulation), recreational off-road vehicle disturbance, and inputs from local road run-off and adjacent unvegetated land. Area 2 did not have any indications of recent human activities within the wetland (no ATVs or trails) other than scientific monitoring conducted by Saint Mary's University.

3.5.1 Location Specific Benefits

One significant conclusion from the functional assessment results is that all of the Project wetlands have elevated benefits scores due to location specific cumulative factors including:

- Landscape within 5 km is at least 40% developed, causing remaining habitat to be more critical for local wildlife populations.
- Proximity to coastal areas provides unique access for shore birds and other migratory species and coastal associated plants.
- Known high density waterfowl migration route associated with upper Shubenacadie River watershed; and
- Proximity to other complimentary open water and diverse wetland types within 5 km and 1 km radius.

These have a relatively large influence on overall benefits values which would not be true if these wetlands were located further inland in undeveloped landscapes and lower diversity of nearby wetlands and waterbodies.

The implication of this is that the Project wetlands (including Area 2) may provide higher level benefits which are relatively insensitive to the historic mining related impacts and would also be relatively insensitive to potential contaminated site remediation activities (in close proximity to core tailings deposits). In other words, limited remediation of historic mining impacts in wetlands that are considered "In Recovery" will likely not significantly affect the overall wetland functions and benefits in a positive or negative fashion. This assumes that remediation is conducted following appropriate best management practices to ensure that hydrological changes and physical disturbances do not destabilize sediments or release contaminants downgradient.

3.6 Discussion of Wetland Health and Sensitivity

3.6.1 Health and Health-Risk

Follow-up field surveys in summer of 2020 and the functional assessments have confirmed that all Project wetlands may be considered fully functional. Where historic mining related metals concentrations are below guidelines, wetlands should be considered "healthy" (i.e., unimpacted or fully recovered). Where wetlands are fully vegetated, but metals concentrations are above guidelines, they may be considered "in recovery" and have been shown to provide high value functions and benefits. Wetland areas that are sparsely vegetated or non-vegetated, so long after the cessation of mining activities, are "currently impacted" by historic tailings deposits and are not yet "in recovery". In other words, where wetland vegetation is unhealthy or absent, it is likely that historic mining related impacts are currently ongoing and are actively preventing natural recovery.

At the Montague Gold Mines location, no wetland area was observed in which recovery is being prevented by legacy historic mining impacts. No large areas of dead or dying vegetation were observed. It is not clear if there is a causation related to metals contamination but likely the physical properties of the coarse sand substrate are a major factor.

It is recognized that some wetland areas may themselves be potential sources of further impacts to downstream wetlands and aquatic systems, wildlife populations, and humans. Any wetland area that is identified as an ongoing source of impacts to human or SAR populations (including downstream wetlands that support SAR) should be considered a high priority for further study to determine the need for risk management or remediation treatment. Remediation measures to protect SAR will also reduce risk of significant impacts on common wildlife populations.

Preliminary results of the human health risk assessment and a draft Phase I environmental site assessment indicate a relatively low risk to human populations, subject to further specific study components (Intrinsik 2020, Wood 2020b). Obviously, any risk to human health would justify remediation activities in wetlands, regardless of other ecological considerations.

No SAR had been previously recorded in Project wetlands (ACCDC, 2019) and none were observed during the 2020 summer field surveys. In 2021, a breeding bird survey was conducted which confirmed the presence of two bird SAR in the area including Olive-sided Flycatcher and Canada Warbler, which are both wetland associated birds. The functional values and benefits provided by Project wetlands are in the higher part of the spectrum of Nova Scotia wetlands. Therefore, remediation of historic mining impacts to protect SAR and/or facilitate recovery in downgradient aquatic and wetland habitats is apparently not needed. However, should wetland areas be selected for remediation, the functions they provide are now better understood which will help to mitigate or offset potential negative impacts caused by the remediation work. There is a need for continuing risk management to address the presence of metals contamination above guidelines and background levels. A program of monitored recovery would be ideal for the Montague Gold Mines wetland areas, since recovery seems to be progressing naturally and potential benefits of intervention are relatively low.

Some wetland areas that are "in recovery" may also be a source of low-level metals contamination. However, in such wetlands, the value of functions provided may outweigh the risks of further impacts. Subject to confirmatory monitoring, it is reasonable to assume that recovery will continue, and contaminated material will become stabilized and pose a smaller risk over time. It is a natural function of wetlands to stabilize sediment and purify water quality, so long as the sources of continuing impacts are identified and mitigated. The potential of Project Wetlands to be continuing sources of significant export of contaminated material will be the topic of further study as the remediation design concept is developed.

The Study Team is currently investigating the possibility that some Project Wetlands which are receiving mercury species produced by tailings areas, may transform it into more bioavailable methylmercury in a way that could amplify the negative effects of mining contamination. An increased risk to human health due to methylmercury concentrations would potentially elevate the wetland area to the "currently impacted" category and further study would be warranted to assess risk factors and the need for mitigation such as monitoring and/or in-situ remediation. A complete mitigation plan must include an approved monitoring program.

The functional values and benefits provided by Project Wetlands that are "in recovery" are in the higher part of the spectrum of Nova Scotia wetlands. Therefore, remediation of historic mining impacts to protect SAR and/or facilitate recovery in downgradient aquatic and wetland habitats may not be needed (barring outcomes of site-specific risk assessment studies). However, should "in recovery" wetland areas be selected for remediation, the functions they provide are now better understood which will help to mitigate or offset potential negative impacts caused by the remediation work. There is a need for continuing risk management to address the presence of metals contamination above guidelines and background levels. A program of monitored recovery would be ideal for the Montague Gold Mines wetland areas since recovery appears to be progressing naturally in most Project Wetlands and the potential benefits of intervention are relatively low. Installation of piezometers would be a typical approach to establishing baseline hydrological conditions and water quality, and for future monitoring (subject to regulatory review and approval). Future monitoring should include the establishment of local unimpacted "reference" wetlands to provide a baseline for comparison with recovering vegetation communities. In addition, quantitative surveys should be included, such as vegetation sample plots or transects.

3.6.2 Sensitivity

Sensitive wetlands are wetlands which exhibit certain high value functions during wetland functional assessments. In addition, wetland classes that are easily damaged and hard to restore, such as bogs and fens, or wetland classes that are regionally rare, are considered sensitive by wetland practitioners. In Nova Scotia, wetlands that are classified under the Nova Scotia Wetlands Policy as "Wetlands of Special Significance" (NSE, 2019) have to be considered "sensitive".

The location of the Montague Gold Mines wetlands within identified public watershed protection areas could lead to a designation as Wetlands of Special Significance (WSS) under the Nova Scotia Wetland Conservation Policy. According to the Policy:

> *"Government will not support or approve alterations proposed for a WSS or any alterations that pose a substantial risk to a WSS, except:*
>
> - *alterations that are required to maintain, restore, or enhance a WSS;*

- *alterations deemed to provide necessary public function, based on an Environmental Assessment (if required) with public review or other approvals (e.g., Wetland Alteration Approval) as appropriate."*

Since the historic mining related impacts at the Montague Gold Mines main tailings site pose a potential risk to humans (risk management signage is in place to reduce potential risks), and assumed SAR, and threatens further ongoing impacts on potential SAR habitat and adjacent and downstream WSS, the proposed remediation of the core tailings area meets both exceptional conditions for which alterations of WSS would be permitted.

It should be noted that the designation of the wetland as WSS and the conclusion that SAR or their habitat is present based on indirect evidence and the associated sensitivity of those features is subject to final decision by NS Environment and Climate Change.

The known or likely presence of SAR counter-intuitively may be considered a strong rationale to apply mitigation. While the value of SAR habitat would ordinarily be seen as a high concern, which would cause the wetland to be considered "sensitive", the presence of significant metal contamination and other man-made risk factors change the wetland into a "population sink". Such areas will lure SAR to them having the appearance of ideal habitat but will ultimately cause more harm than good by reducing health and fecundity or direct mortality. The Project wetlands at Montague Gold Mines are not known to provide critical habitat for any SAR. Additional field surveys during the growing season in 2020 and 2021 revealed the presence of two bird SAR populations, including olive-sided Flycatcher (in/near Area 2) and Canada Warbler (in Area 3). All Project wetlands contain potential habitat for some SAR, particularly certain migratory birds (e.g., Canada Warbler, Olive-sided Flycatcher) which is generically true of all forested and shrubby wetlands (Brazner et al, 2019). This would elevate the potential risk to local SAR within "currently impacted" wetlands from exposure to elevated metals concentrations, if present, and would warrant further study to determine the need for mitigation or monitoring. The incidental loss of some habitat area due to physical remediation methods may be considered justifiable for the protection of the local SAR populations.

Experience from earlier studies has shown the behaviour of wetland located tailings (anoxic tailings), once disturbed, creates a situation wherein arsenic is highly mobilized into the environment and should be avoided to the extent possible. Thus "sensitivity" to physical disturbance must be considered when developing options for monitoring, mitigation and/or remediation of historic mining impacts (Nova Scotia Lands Inc. 2019, Cukrowska et al 2017, Selvinderan et al 2007, CCME 2003). An Ecological Risk Assessment of the wetland areas is in progress, and will provide a quantitative assessment of sediment, surface water, and soil chemistry data and potential for effects to both aquatic and terrestrial wildlife using the area.

Remediation and site control measures designed to isolate the core tailings deposits and prevent or reduce soil disturbance severity and frequency will help to lower the risk level. Lower risk will lead to generally better vegetation recovery, improved water quality, and minimize potential impacts on SAR populations.

In Area 2, a loss of significant temporary water storage may represent a significant impact since the site lies in the upper reaches of the watershed with many downstream stakeholders. Providing an engineered solution could be expensive and difficult to maintain. However, the WESP-AC analysis indicates a relatively low function

for wetland storage and delay (low function, moderate benefits). In comparison, Area 3 has few downstream stakeholders, so this is would not be a major concern.

4.0 CONCLUSIONS

Table 4-1 summarizes results of the wetland surveys, boundary delineations and functional assessments for Project wetlands including current condition, and distribution within the study area and identified key issues of concern related to impacts caused by historic mine tailings.

Table 4-1: Wetland Assessment Summary

Study Area	Confirmed Wetland	Size (ha)	Recovery Status	Species At Risk Presence	Average Function	Average Benefits	Key Issues
WL1 (A-E, G)	Yes	16.5	In Recovery	None Observed	Moderate	High	1, 2
1F	No	Area 1F was field verified to have no wetland within it.					
2	Yes	7.2	In Recovery	None Observed	Moderate	High	1, 2
3A	Yes	0.60	In Recovery	None Observed	Moderate	High	1
3B	Yes	0.29	In Recovery	None Observed	Low	Moderate	1
3C	Yes	13.03	In Recovery	None Observed	Moderate	High	1, 2, 3
3D	Yes	1.61	In Recovery	None Observed	Moderate	Moderate	
4A	Yes	10.63	In Recovery	None Observed	Moderate	High	2, 3
4B	Yes	1.43	In Recovery	None Observed	Moderate	High	2, 3
4C	Yes	0.23	In Recovery	None Observed	Moderate	High	3
4D	Yes	1.29	In Recovery	None Observed	Moderate	High	3

Key Issues:
1. Potential source of continuing metals and sediment releases to adjacent and downstream wetlands (including WSS) and aquatic habitat.
2. Sensitivity to remobilization of potentially contaminated stream sediments by changes in hydrology.
3. Exposure to contaminated surface water or sediments transported from upstream sources

Major conclusions of the assessment, relative to risk management and planning of remediation design and implementation are:

- At the Montague Gold Mines location (including Area 2) all wetland areas subject to historic mining impacts are considered "In Recovery" and no wetland area was observed in which recovery is being prevented by legacy historic mining impacts.
- Remediation of historic mining impacts (near the core tailings deposits) will likely not significantly affect the overall wetland functions and benefits in a positive or negative fashion (assuming appropriate mitigation measures are employed).
- Potential for impacts on Species At Risk in Study Areas due to historic mining impacts or potential remediation activities are relatively low (no clear interaction identified); however, reducing risk related to historic mine tailings could benefit both potential SAR and common wildlife.
- Hydrodynamic regime and risk of erosion-sedimentation needs to be better understood in all Project Wetlands to ensure mitigation planning addresses potential downstream impacts from project related activities.

- A program of monitored recovery would be ideal for the Montague Gold Mines wetland areas (including Area 2), since recovery seems to be progressing naturally and the potential benefits of intervention are relatively low.

In addition, the potential implications of various mitigation and remediation options must be carefully weighed. For each possible remediation area being considered, it will be necessary to clearly understand the potential health risk represented by contaminated wetlands to human and SAR populations and whether the risk is acceptable both from existing exposure levels or from impacts that might be caused by remediation itself. Intrusive remedial techniques may mobilize contaminants which are reasonably stable in undisturbed wetland sediments, based on earlier studies (Nova Scotia Lands Inc. 2019, Cukrowska et al 2017, Selvinderan et al 2007, CCME 2003). Similarly, the implications of intrusive remediation or development of an engineered channel on water storage and downstream peak flow attenuation (i.e., flooding, scouring) will need to be evaluated to inform program design and mitigation planning. The following principles should be considered when developing remediation plans in the Project wetlands:

- Minimize the area of physical disturbance to the extent possible;
- Consider potential downstream effects of changes in hydrology as a result of lost storage capacity or alteration of the stream channel; and
- Consider potential for tailings runoff characteristics (mainly acid rock drainage) to change over time or to be altered by unintended consequences of remediation.

4.1 Next Steps

The following suggestions are offered for consideration in the overall mine tailings risk management program development. The planning and design requirements for advancing the study program should include:

- Assess the potential for Project wetlands to amplify mercury related impacts by the production of more bio-available methylmercury (currently ongoing by Study Team);
- Evaluate sensitivity of wetland areas and associated aquatic environments to changes in stream hydrology, including changes in peak flows downgradient (i.e., potential flooding and/or scouring), that may result from invasive remediation techniques such as displacement/infilling of wetland areas or engineered channel modifications. Installation of piezometers would be a typical approach to establishing baseline hydrological conditions and water quality, and for future monitoring (subject to regulatory review and approval). Note that some piezometers are already in place, associated with Project assessment activities (particularly in Area 1A).
- An Ecological Risk Assessment of the wetland areas is in progress, and will provide a quantitative assessment of sediment, surface water, and soil chemistry data and potential for effects to both aquatic and terrestrial wildlife using the area.
- Establish a "monitored recovery" program (in consultation with regulators) for wetlands potentially impacted by remediation activities, and relative to final mine site closure criteria. Consideration of innovative techniques to reducing toxicity of wetland sediments could be explored in conjunction with monitored recovery. Future monitoring should include the establishment of local unimpacted "reference" wetlands to provide a baseline for comparison with recovering vegetation communities. In addition, quantitative surveys should be included, such as vegetation sample plots or transects.

- Impacts on wetlands by remediation activities should be fully mitigated by compensation for area loss, consistent with Provincial policy. A complete mitigation plan must include an approved monitoring program. It should be noted that the requirement for and nature of compensation is subject to final decision by NS Environment and Climate Change. Should the mitigation of historic mining impacts be regarded by NSCC as an enhancement project, compensation may not be required.

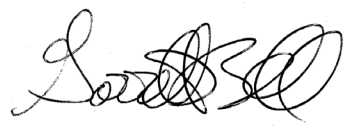
Closing

Please do not hesitate to contact the undersigned if you have any questions or require additional information regarding this study.

Regards,

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

Prepared by:



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APPENDIX A
Figures

457000.000000 458000.000000 459000.000000 460000.000000

4953000.000000 4952000.000000 4951000.000000

Lake Major Watershed

318 107 Montague Road

3C 3D 3A 3B

Main Tailings Area

1D 1E 1A 1C 1F 1B 1G 2

Barry's Run

Lake Charles

Wetland 4A Wetland 4B Wetland 4C Wetland 4D

Mitchell's Brook

Loon Lake

Montague Road

107

N W E S

LEGEND:

- Field Verified Flow to Southwest (multiple braided channels)
- Barry's Run
- Mitchell's Brook
- Intermittent Drainage
- Manmade Trench
- Streams/Creeks
- Highway
- Local Road
- Lakes
- Crown Parcel
- Lake Major Watershed
- Wetlands - Field Verified

Tailings

- Crown
- Non-Crown
- Possible Tailings Traces

CLIENT:

NOVA SCOTIA LANDS INC.

wood.

TITLE:

FIELD WETLANDS MAPPING OVERVIEW

PROJECT:

MONTAGUE GOLD MINES WETLAND ASSESSMENT ADDENDUM

PROJECT NO:	DATE:
TV183013	OCTOBER 2021
REV NO:	DWN/CHK'D BY:
0	CM/GB
DATUM:	PROJECTION:
NAD83 CSRS 2010	UTM ZONE 20 N

FIGURE: **FIGURE 1**

SCALE: 1:12,500

0 62.5 125 250 375 500

Metres

Path: G:\5300 PROJECTS\2018\TV183013 Intrinsik Corporation Montague and Goldenville Mine\Task 7 - Wetlands - Field Support\GIS\MXD\MONTAGUE_GOLD_MINES_WETLAND_ASSESSMENT_ADDENDUM\TV183013_FIGURE_1_Wetlands_Mapping_Overview.mxd User: candace.macdonald Date: 10/20/2021

459000 000000

1A

No open channel; flows through rock rubble debris

1F

Old road runs through edge of wetland

1B

Historic shallow excavations observed in wetland

1G

Wetland 2
Area = 72,046 m2

2

Mitchell's Brook

Permanent surface flow in broad shallow ditch (possibly an old road)

4951000 000000

N
W
E
S

459000 000000

LEGEND:

- Field Verified Flow to Southwest (multiple braided channels)
- Mitchell's Brook
- Manmade Trench
- Lakes
- Wetlands
- Approximate Dense Sandy Soil

CLIENT:

NOVA SCOTIA LANDS INC.

wood.

TITLE:

FIELD WETLANDS MAPPING AREA 2

PROJECT:

MONTAGUE GOLD MINES WETLAND ASSESSMENT ADDENDUM

PROJECT NO:	DATE:
TV183013	OCTOBER 2021
REV NO:	DWN/CHK'D BY:
0	CM/GB
DATUM:	PROJECTION:
NAD83 CSRS 2010	UTM ZONE 20 N

FIGURE:

FIGURE 2

SCALE:

1:2,000

0 12.5 25 50 75 100

Metres

Path: G:\5300 PROJECTS\2018\TV183013 Intrinsik Corporation Montague and Goldenville Mine\Task 7 - Wetlands - Field Support\GIS\MXD\MONTAGUE_GOLD_MINES_WETLAND_ASSESSMENT_ADDENDUM\TV183013_FIGURE_2_Wetlands_Mapping_Area2.mxd User: candace.macdonald Date: 10/20/2021

APPENDIX B

Wetland Functional Assessment Summary Table

Wetland ID: WL 2
Date: October 07, 2021
Latitude & Longitude (decimal degrees): 44.712584, -63.518372

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	2.45	Lower	7.78	Higher	3.78	3.45
Stream Flow Support (SFS)	7.59	Higher	6.61	Higher	6.11	4.32
Water Cooling (WC)	5.88	Higher	7.66	Higher	3.92	4.09
Sediment Retention & Stabilisation (SR)	4.94	Moderate	10.00	Higher	6.06	10.00
Phosphorus Retention (PR)	2.83	Lower	10.00	Higher	5.52	10.00
Nitrate Removal & Retention (NR)	3.14	Moderate	10.00	Higher	5.12	10.00
Carbon Sequestration (CS)	3.98	Moderate			7.08	
Organic Nutrient Export (OE)	6.13	Moderate			5.11	
Anadromous Fish Habitat (FA)	6.05	Higher	3.46	Moderate	3.96	2.20
Resident Fish Habitat (FR)	8.91	Higher	3.36	Moderate	4.72	2.10
Aquatic Invertebrate Habitat (INV)	5.55	Higher	9.12	Higher	5.80	5.95
Amphibian & Turtle Habitat (AM)	6.05	Moderate	7.42	Higher	6.25	8.01
Waterbird Feeding Habitat (WBF)	8.48	Higher	10.00	Higher	6.52	10.00
Waterbird Nesting Habitat (WBN)	9.35	Higher	10.00	Higher	6.78	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	8.70	Higher	10.00	Higher	7.50	10.00
Pollinator Habitat (POL)	7.73	Moderate	10.00	Higher	6.41	10.00
Native Plant Habitat (PH)	5.75	Higher	7.97	Higher	6.20	7.97
Public Use & Recognition (PU)			8.32	Higher		6.01
Wetland Sensitivity (Sens)			4.16	Moderate		4.01
Wetland Ecological Condition (EC)			3.04	Lower		6.67
Wetland Stressors (STR) (higher score means more stress)			5.74	Moderate		2.94
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	2.45	Lower	7.78	Higher	3.78	3.45
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	4.34	Lower	10.00	Higher	6.51	10.00
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	6.94	Higher	8.46	Higher	5.67	5.37
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	8.56	Higher	8.42	Higher	6.21	8.23
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	8.05	Higher	9.66	Higher	7.10	9.66
WETLAND CONDITION (EC)			3.04	Lower		6.67
WETLAND RISK (average of Sensitivity & Stressors)			4.95	Moderate		3.47

APPENDIX C

Site Photos

Areas 2

Photo 1. Area 2 – Looking southeast toward Loon Lake from the inlet of the Area 2 wetland at Lochmoor Lane.

Photo 2. Area 2 – Looking northwest from the location above, toward the Area 2 wetland along Mitchell Brook. This part of the wetland is upstream of apparent historic mining impacts.

Photo 3. Area 2 – The eastern half of the wetland is a broad shrubby meadow with a wide slow flowing channel in the middle.

Photo 4. Area 2 – The water is relatively deep (1-2 m) with abundant aquatic vegetation.

Photo 5. Area 2 – Along the south edge of the wetland there are areas of forest swamp dominated by black spruce and cinnamon fern.

Photo 6. Area 2 – The forest swamp gradually transitions into more open emergent wetland further north toward the middle of the wetland. Tamarack becomes co-dominant with black spruce in the open areas.

Photo 7. Area 2 – Looking north from the south shore of Mitchell Brook across the large open centre of the Area 2 wetland.

Photo 8. Area 2 – At this location, dominant vegetation includes a thick mat of sphagnum moss (fully saturated) with a dense cover of typical "bog" shrubs such as leather-leaf, Labrador-tea, and bayberry, with scattered patches of speckled alder and cattails.

Photo 9. Area 2 – The south-central part of the wetland drains south from the main Mitchell Brook through a broad swampy area with multiple small, braided channels.

Photo 10. Area 2 – There is no "main channel" but rather flow is evenly distributed in small rocky channels and only concentrates again near the southern edge of the wetland. This drainage path may have resulted from historic mining water manipulation.

Photo 11. Area 2 – In the southwest part of the wetland, a permanently flowing man-made channel was discovered that drains out of Area 2. It could possibly be an old road.

Photo 12. Area 2 – Looking northwest along the man-made channel flowing out of Area 2 toward Area 1B. This channel is a significant second drainage path from Area 2 that may rival the main mapped Mitchell Brook drainage in flow volumes.

Photo 13. Area 2 – A historically disturbed area is present where fine tailings were deposited into the north-central part of the wetland from a stamp mill. Similar to other tailings impacted wetlands, the vegetation is low-growing and relatively low diversity.

Photo 14. Area 2 – The impacted wetland in Area 2 is wetter than in Area 1A and the vegetation is indicative of longer periods of inundation (more horsetails and sedges), but on humps (bottom centre) the vegetation s very comparable to the Area 1A plant community. The yellow flags are associated with an academic study program that is ongoing.

Photo 15. Area 2 – Looking southeast in the historically disturbed part of the wetland. Vegetation near the edge transitions sharply from low growing (30-60 cm) at far right up to more robust sizes (> 1 m) at bottom left, coincident with changing substrate from dense sand to soft organics.

Photo 16. Area 2 – Looking northwest from the location above; the wide deep-marsh/meadow occupies the majority of the wetland centre.

Photo 17. Area 2 – A large deposit of coarse waste rock (bottom centre-left) was observed at the edge of the wetland, southwest of the main Mitchell Brook outlet.

Photo 18. Area 2 – The Mitchell Brook outlet was partially impounded by a significant beaver dam (far centre) and flowed through a jumbled pile of rock rubble.

Photo 19. Area 2 – Typical mixed forest upland habitat around the wetland.

Photo 20. Area 2 – The ground cover is variable, sometimes sparse, with a thick layer of accumulated conifer needles.