Wetland Reclamation Guide for Placer Mining

Prepared by EDI Environmental Dynamics


Yukon


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Acknowledgments

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Acronyms and abbreviations

Acronym/Abbreviation	Definition
BC	British Columbia
cm	centimetre
EDI	EDI Environmental Dynamics Inc.
YG-EMR	Yukon Government's Department of Energy, Mines and Resources
ESC	erosion and sediment control
KPMA	Klondike Placer Miners' Association
m	metre
project	placer mining project
project area	the full extent of the disturbance footprint of a placer mining project
the Guide	Weland Reclamation Guide for Placer Mining
the Planning Tool	the tool developed to accompany the Wetland Reclamation Guide for Placer Mining
the Wetland Policy	A Policy for the Stewardship of Yukon's Wetlands (Government of Yukon 2022)
YESAB	Yukon Environmental and Socio-economic Assessment Board

1 Introduction

Placer mining is an important industry in the Yukon, with a long history of development and varied practices that have evolved over time. Placer mine deposits often occur near or within river valleys and low-lying areas; which can result in direct and indirect effects on wetlands. Where wetland disturbance cannot be avoided, wetland reclamation, or the re-establishment of wetland following disturbance, is a key mitigation measure and strategy for environmental stewardship.

The Yukon government's Department of Energy, Mines and Resources (YG-EMR) is developing guidance documents to support licensing for the placer mining industry, including formalization of a Wetland Reclamation Plan Template (Government of Yukon 2023). EDI Environmental Dynamics Inc. (EDI) was retained to develop the following Wetland Reclamation Guide for Placer Mining (hereafter the Guide) and associated Planning Tool (hereafter the Planning Tool) to augment the Wetland Reclamation Plan Template. The use of the Guide and Planning Tool will support proponents to describe potential adverse effects on wetlands, demonstrate adherence to the mitigation hierarchy, outline a clear wetland reclamation plan, and develop an associated monitoring plan and reporting schedule.

This Guide and associated Planning Tool outlines guidance and best practices for implementation of the wetland mitigation hierarchy during the life cycle of a placer mine with an industry-specific focus on wetland reclamation. These documents have been developed in the context of:

- A Policy for the Stewardship of Yukon's Wetlands (hereafter "the Wetland Policy"; Government of Yukon 2022);
- The Wetland Reclamation Guide for the Ruby Creek and Indian River East Block Placer Mine (Government of Yukon 2017);
- The Wetland Reclamation Plan Template (Government of Yukon 2023); and,
- Wetland Reclamation for Placer Mining: Recommendations and Guidelines (Chevreux and Clarkson 2017).

Other documents that have been reviewed while creating the Guide and Planning Tool include:

- the Yukon Wetland Field Guide (Ducks Unlimited Canada 2024);

- the Guidebook of Mitigation Measures for Placer Mining in the Yukon (Yukon Placer Secretariat 2010);
- Runoff, Erosion and Sediment Control Best Management Practices for Yukon Placer Mining Operations (EDI Environmental Dynamics Inc. 2003);
- BC Placer Mining Best Management Practices Technical Guide (BC Ministry of Energy, Mines and Petroleum Resources 2019);
- An Ecological Framework for Wildlife Habitat Design for Oil Sands Mine Reclamation (Eaton et al. 2014);
- Handbook for Mineral and Coal Exploration in British Columbia (BC Ministry of Energy, Mines and Petroleum Resources and BC Ministry of Environment 2008);
- Best Management Practices for Placer Mining Technical Report (Entrix Inc. 1986); and,
- Wetland Restoration and Construction: A Technical Guide (Biebighauser 2011).

1.1 Wetlands in the Yukon

Wetlands are areas that typically have water at, or near, the ground surface during some or all of the year, however water is not necessarily present at the surface in all years or through all seasons. These areas can be considered wetlands if the water is present long enough for poorly drained soils to form, and for water-loving plants to become the dominant type of plant in the area (Government of Yukon 2022). Five wetland classes are defined in the Yukon, including bogs, fens, marshes, swamps, and shallow water wetlands (Ducks Unlimited Canada 2024). Wetland classes and the presence of surface water within them are further described in Appendix B; a full list of definitions is provided in Appendix C.

Wetlands provide a variety of ecological and cultural benefits, depending on their ecological characteristics and the biological, hydrological, and chemical processes that occur within them (refer to Section 6.2 of the Wetland Policy; Government of Yukon 2022). Presently, the area extent (size) and class (type) of wetland is used to characterize wetland function and associated ecological benefits. Therefore, this Guide and Planning Tool centers on wetland disturbance in terms of total affected wetland area(s) and wetland class(es).

1.2 Effects of placer mining on wetlands

Potential adverse effects on wetland hydrology, vegetation, soils, and wildlife are possible during the life cycle of a placer mine. Potential effects may be direct or indirect, and permanent or temporary.

Direct effects: Direct effects refer to areas and activities where wetland vegetation and soils are expected to be physically disturbed by a project; they can be differentiated in terms of temporary or permanent effects.

- Temporary direct effects occur within areas where wetland vegetation and soils may be disturbed; however, mitigation measures and reclamation planning are expected to minimize these disturbances with the intent to restore these areas post-construction (e.g., temporary access during exploration).
- Permanent direct effects are areas where disturbance to vegetation and soils will persist through operations (e.g., permanent access, mining excavations, settling ponds).

Indirect Effects: Indirect effects refer to areas and activities that are not directly disturbed by the project (as defined above), but can result in changes in the proximal environment due to emission or discharge, such as:

- changes to water flow (e.g., resulting from the construction of roads, ditches)

Proactive planning for preventing and reversing direct and indirect effects on wetlands will reduce costs and provide the most flexibility for the successful management of wetlands.

1.3 The mitigation hierarchy

Per the Wetland Policy (Government of Yukon 2022), the effects of human activities on wetlands are managed by implementing a mitigation hierarchy. The mitigation hierarchy is comprised of four sequential and prioritized steps:

1. **Avoiding adverse effects on wetlands and their benefits.** Avoidance (Section 2) is the preferred method of mitigation for all wetlands, and siting of project activities to avoid disturbance to wetlands can decrease efforts and expenses required at the end of placer exploration or mining operations.

2. **Minimizing adverse effects on wetlands and their benefits that cannot be fully avoided.** Where adverse effects on wetlands cannot be avoided, Minimization of Effects (Section 3) is emphasized through preferential project design and the implementation of construction techniques, mitigation measures, and best practices. These mitigation measures can reduce the level of effort and increase the likelihood of wetland reclamation success where adverse effects on wetlands cannot be avoided or minimized.
3. **Reclaiming adversely affected wetland benefits.** Wetland Reclamation (Section 4) should target re-instating functioning and self-sustaining wetland ecosystems.
4. **If required, offsetting residual adverse effects on wetland benefits**. Offsetting may be considered under special circumstances where wetland loss is unavoidable; however, offsetting guidance is in development and is not addressed in this Guide.

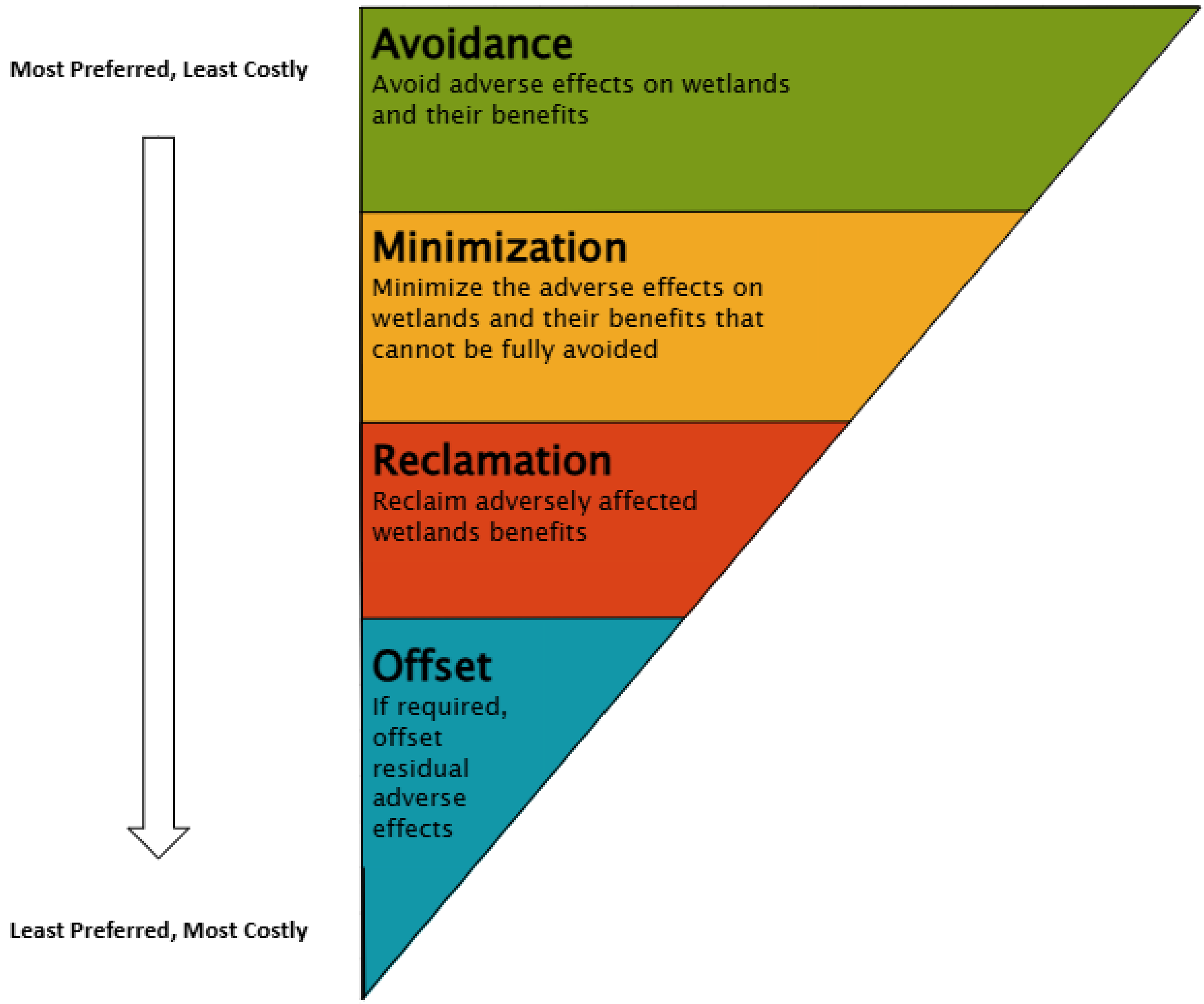

Figure 1. The mitigation hierarchy.

1.4 Mine and reclamation planning

Early planning is an integral component of reclamation success, and careful mine design is important for wetland mitigation hierarchy implementation, and can reduce reclamation effort and cost. Ultimately, appropriate mine planning addresses the mitigation hierarchy through wetland avoidance during the design process, developing mitigation measures to minimizing effects on wetlands that cannot be avoided, and facilitating no net loss of wetland area through wetland reclamation (and offset, if necessary).

Development of a logical sequence and placement of all mining activities during initial reclamation planning allows for effective avoidance and minimization of potential adverse project-related effects on wetlands. This includes describing and mapping:

- the locations of roads and associated borrow sources (as applicable);
- the locations and sizes of cuts, direction of progress, timing;
- the locations and sizes/volumes of stockpiles, including topsoil, peat and organic material, fine soils, subsoils (overburden), and the length of storage time;
- the locations, sizes, and depths of settling ponds, diversion channels, and intake and outlet channels; and,
- the locations, sizes, and depths of reclaimed wetlands.

Progressive reclamation, or reclamation that progresses alongside mining activities, is recommended as it can:

- be more cost-effective, as it uses equipment that may already be on site during mining activities;
- allow for early monitoring and adaptive management should deficiencies be observed within progressively reclaimed areas;
- increase the amount of time for reclamation and revegetation to be successful, thereby reducing the amount of time it will take to achieve final reclamation; and,
- reduce the time lag between loss of wetland functions during wetland disturbance and reinstatement of wetland functions during wetland reclamation.

It is understood that reclamation activities and best practices can change as mining activity progresses; as such, a reclamation plan is considered to be a “living document”, to be updated periodically.

1.5 How to use the guide

Effective use of the Guide is contingent on characterization of existing conditions prior to project development. Appropriate wetland identification, delineation, and classification is necessary within the project area to address the mitigation hierarchy. Identification, delineation, and classification of wetlands within the project area will inform implementation of the mitigation hierarchy during project planning and design. All wetlands within the project area must be identified and delineated as per a project’s license and approval, including the size and wetland classification of each wetland (as per Appendix B). Wetland mapping must follow the most recent Digital Mapping Standards (e.g., Government of Yukon 2021).

Once the presence and extent of wetlands is understood within the project area, mine planning should be undertaken with the use of the best practices provided within this Guide, in order of the mitigation hierarchy priority, as shown in Figure 2.

1.5.1 The planning tool

Proponents must demonstrate adherence to the four steps of the mitigation hierarchy (and associated best practices) in their project applications. This includes developing a logical sequence and placement of all mining activities, which involves describing and mapping specific project features such as roads, cuts, stockpiles, settling ponds, and the planned locations, sizes, and depths of reclaimed wetlands.

The Planning Tool provided in Appendix A has been developed to streamline the mine planning process, with the goal of providing sufficient information to enable a placer mining proponent to prepare a complete application for a placer mining land use approval under the *Placer Mining Land Use Regulation*, submission to the Yukon Environmental and Socio-economic Assessment Board (YESAB), and licencing under the Yukon Water Board (YWB). The use of the Planning Tool will support proponents to describe potential adverse effects on wetlands, demonstrate adherence to the mitigation hierarchy, outline a clear wetland reclamation plan, and develop an associated monitoring plan and reporting schedule. The reclamation plan is considered a "living document" that should be updated periodically as mining activities progress and conditions change.

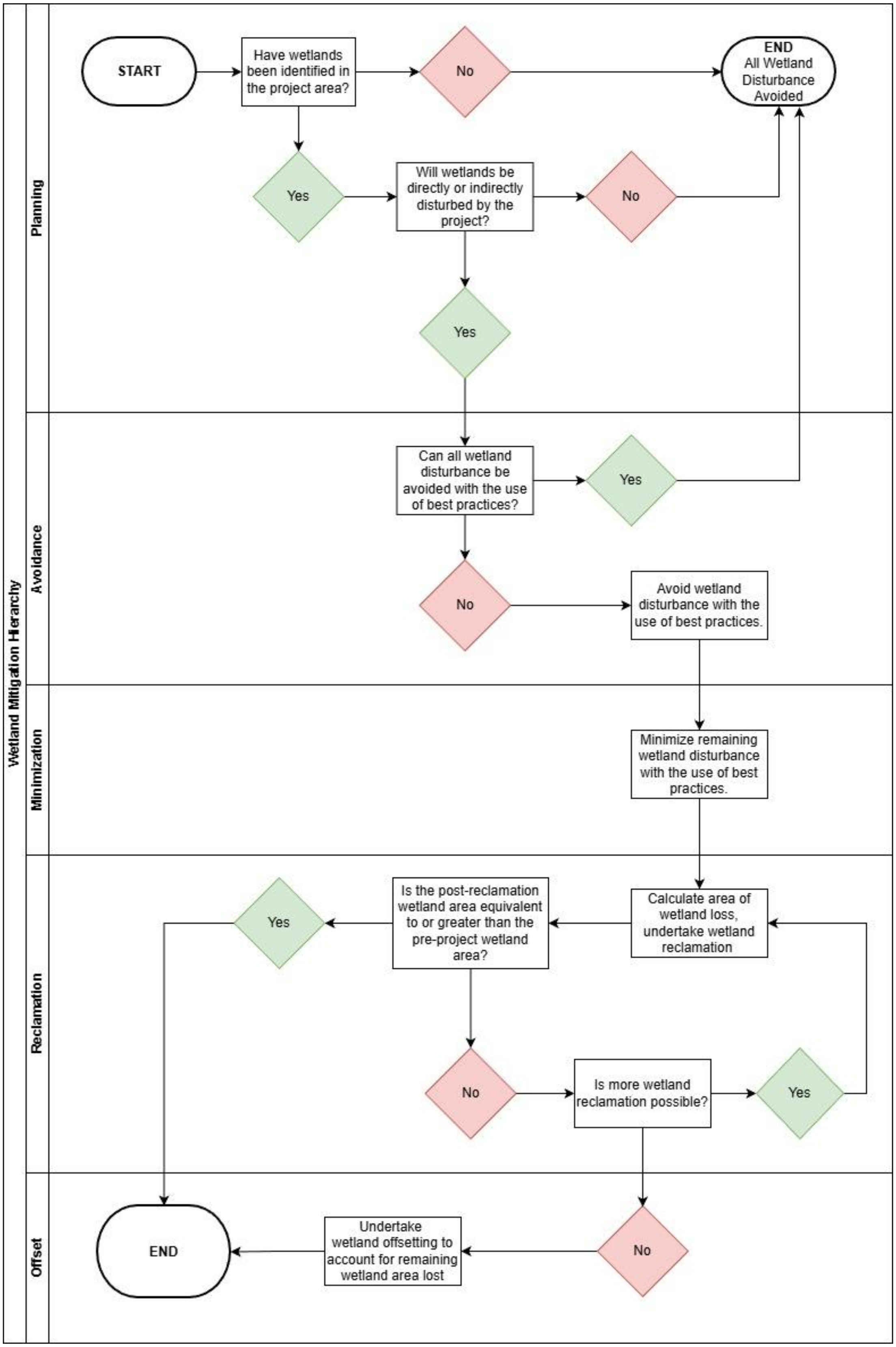

Figure 2. How to use this Guide.

2 Avoidance

Wetland avoidance is the preferred and most effective method of reducing adverse effects on wetlands (Government of Yukon 2022). Avoidance typically involves readjusting or realigning project activities to avoid wetlands. This section provides best practices by activity to support the goal of wetland avoidance during all placer mining activities.

2.1 Planning and design

Project planning and design, as informed by the characterization of wetlands, should emphasize wetland avoidance. This may involve readjusting or realigning project activities to avoid wetland areas where possible. The best practices provided in Table 2-1 facilitate wetland avoidance during the planning and design phase of a project.

Table 2-1. Best practices for wetland avoidance during planning and preliminary design.

Consideration	Best Practice(s)
Size of project area	• Keep the project area as small as required to complete the work.
Work within wetland areas	• Plan project activities outside of wetland areas. • Plan access to avoid wetland crossings. • Plan stockpile locations outside of wetland areas.
Use existing access	• Use existing access routes (e.g., roads, trails).
Permafrost	• Identify whether permafrost soils are present within the project area. • If permafrost is anticipated to be encountered, o Consider a potential increase in sediment mobilization/ice thaw when designing the size and shape of settling ponds. o Plan to direct thawed permafrost sediment to low spots or settling facilities outside of wetland areas.

2.2 Access development

Access development refers to the initial project steps required to establish access trails, routes, and/or roads into the project area for exploration. The best practices provided in Table 2-2 facilitate wetland avoidance during project access development.

Table 2-2. Best practices for wetland avoidance during access development.

Consideration	Best practice(s)
Unauthorized access within wetland areas	• Restrict movement of vehicles and equipment to designated access routes.
Duplicate access	• Avoid duplicate access; where available, use existing access.
Access extends into wetlands	• Narrow the width of the access within wetland areas (consistent with safety and traffic needs) to reduce the extent of wetland disturbance.
Stockpiled materials within wetlands	• Avoid storing and/or depositing gravel, fill, or other stockpiled materials within wetland areas during access construction.

2.3 Exploration

Exploration activities occur during the early stages of a project, providing valuable information on the characteristics of a given deposit. The best practices provided in Table 2-3 facilitate wetland avoidance during exploration.

Table 2-3. Best practices for wetland avoidance during exploration.

Consideration	Best practice(s)
Work within wetland areas	• Avoid undertaking exploration within wetland areas (e.g., test pitting, hand shafting, test trenching, rotary air blast drilling, auger drilling, sonic drilling). • Avoid placing stockpiles within wetland areas. • Avoid establishing temporary work areas and/or camps within wetland areas.
Water released from drill holes	• Where water is released from drill holes (i.e., artesian flow), it will be plugged and managed to avoid erosion or direct drainage into wetlands and water bodies.
Tree clearing in wetland areas	• Where trees must be cleared, fall and yard them away from wetland areas, not into wetland areas.

2.4 Excavation and stockpiling

Mining excavations and stockpiles are the primary activities resulting in changes to topography and wetland disturbance for placer mining projects. As such, the selection of excavation and stockpile locations can support wetland avoidance. The best practices provided in Table 2-4 facilitate wetland avoidance during excavation and stockpiling.

Table 2-4. Best practices for wetland avoidance during excavations and stockpiles.

Consideration	Best practice(s)
Work within wetlands	• Avoid vegetation clearing, soil stripping, and excavation activities within wetland areas. • Establish project facilities and storage away from wetland areas. • Prior to excavation, clearly delineate the project footprint with physical markers (e.g., stakes, flags, or other means) to reduce the chance of inadvertent wetland disturbance related to project activities outside of the footprint. Consider the visibility of signage for all equipment used in the project area. • Avoid storing salvaged soil/overburden stockpiles, fill, or sources of hazardous materials (e.g., fuel, lubricants) within wetlands.
Stockpiling	• Site stockpiles in areas that are stable, on level ground and protected from areas prone to surface flow such as wetlands, stream channels, runoff, flood waters etc.

2.5 Water management and settling ponds

Water management infrastructure and associated mitigation measures are critical to reduce the potential for soil erosion and sedimentation, or contamination of surface water entering wetlands. Settling ponds are effective for redirecting and treating 'process water' (e.g., laden with sediment resulting from erosion and/or seepage, effluent produced by project operation) and preventing potential adverse effects on the adjacent environment. The best practices provided in Table 2-5 facilitate wetland avoidance during water management and settling pond development.

Table 2-5. Best practices for wetland avoidance during water management and settling ponds.

Consideration	Best practice(s)
Effluent entering wetlands	• Ensure water used during mining activities is not released into wetland areas.
Wetland contamination	• Avoid the storage/use of equipment, hazardous materials within or near wetland areas. This includes the following: o Establish mine camp and refueling facilities away from wetland areas (no less than 30 m from the ordinary high-water mark of any water body as per the Placer Mining Land Use Regulation (Yukon Government 2003) and avoid refuelling within wetland areas. o Stockpile overburden, pay gravels, and hazardous materials outside of wetland areas on level ground or on surfaces sloping away from wetland areas.

	◦ Store vehicles and immobile machinery, equipment, fuel barrels, lubricants, and other materials away from wetland areas.
Settling pond development in wetland areas	• Avoid establishing settling ponds in wetland areas. • Prior to construction of settling ponds: ◦ Select an area for construction away from wetland areas, on a large, flat portion of land outside flooding areas and/or areas adjacent to a streambed to avoid flooding or high flows washing out the settling pond. ◦ Verify that the underlying material of the settling pond and related dykes in the area are made up of a sufficiently thick enough layer of fine materials to reduce seepage into surrounding areas. An area with an impervious underlying material such as bedrock will reduce water loss from the settling pond.
Wetland sedimentation	• Store sediment removed from settling ponds away from wetland areas.

2.6 Closure

Site closure occurs once mining has ceased and involves project deactivation and removal/demobilization of project-related equipment from the site. The best practices provided in Table 2-6 facilitate wetland avoidance during closure.

Table 2-6. Best practices for wetland avoidance during closure.

Consideration	Best practice(s)
Incidental wetland disturbance	• Clearly delineate the project footprint with physical markers (e.g., stakes, flags or other means) to reduce the chance of incidental wetland disturbance related to project activities outside of the footprint. Consider the visibility of signage for all equipment used in the project area.
Waste removal	• Remove all refuse from the project site. • Waste must be disposed of in accordance with the Solid Waste Regulation (Yukon Government 2000).

3 Minimization

If, after all reasonable efforts to avoid wetland areas have been undertaken, effects on wetlands should be further minimized via mitigation measures intended to reduce and/or control adverse effects on wetlands by modifying project activities or undertaking them under specific conditions (Government of Yukon 2022).

3.1 Planning and design

Project planning and design include the development of mitigation measures and contingency planning for environmental management. Where possible, mitigation measures should be integrated into the design and construction of project features (e.g., construction of ditches and berms for the management of surface water and mitigation of erosion and sedimentation). The best practices provided in Table 3-1 facilitate wetland minimization during planning and design.

Table 3-1. Best practices for wetland minimization during planning and design.

Consideration	Best practice(s)
Wetland contamination	• Develop an Emergency Response or Fuel Spill Contingency Plan in accordance with existing guidelines. • Use vehicles and equipment that is mechanically sound with no oil leaks, fuel or fluid leaks. Inspect vehicles and equipment daily and immediately repair any leaks. • Inspect equipment arriving on site is clean and free of soil and plant material.
Erosion and sedimentation	• Design a system of diversion ditches or channels and drains to control runoff and slow down erosion. These ditches or channels must not dewater/drain adjacent wetlands.

3.2 Access development

The best practices provided in Table 3-2 facilitate wetland minimization during access development.

Table 3-2. Best practices for wetland minimization during access development.

Consideration	Best practice(s)
New access construction	• Cross wetlands at right angles to reduce the area of disturbance. • Maintain appropriate surface drainage (e.g., with the use of ditches, culverts) in the crossing. • Employ Erosion and Sediment Control (ESC) measures as warranted to reduce the potential for sediment deposition into wetland areas. Inspect and repair ESC measures periodically to verify they are functioning as intended. • Use vehicles and equipment adapted for low ground pressure at wetland crossings (e.g., wide tires, dual tires, bogies, tracks, central tire inflation). • Minimize heavy equipment and vehicle traffic at wetland crossings to reduce disturbance and soil compaction.

Permafrost	• Avoid areas of permafrost, particularly areas that are sensitive to thawing (e.g., south-facing slopes in areas of discontinuous permafrost). • Where permafrost is unavoidable, select routes that are upslope or on ridges where bedrock is closer to the surface.
Off-road vehicle use	• Use low-impact all-terrain vehicles (ATV) for exploration and to access the work site. • Use existing trails to access wetland areas.
Work timing	• Plan access development during dry and/or frozen conditions. • Move heavy equipment when the ground surface is frozen with good snow cover.
Winter access roads	• Verify adequate frost penetration and snow cover to support vehicles and equipment prior to use. • Raise bulldozer blades to avoid cutting organic soils during travel.
Maintenance	• Repair access frequently, as warranted, to avoid erosion and limit the potential for increased disturbance area should access users develop alternate pathways to avoid the damage (e.g., flooding, rutting).

3.3 Exploration

The best practices provided in Table 3-3 facilitate wetland minimization during exploration.

Table 3-3. Best practices for wetland minimization during exploration.

Consideration	Best practice(s)
Exploration techniques	• Use exploration methods with limited potential effects on wetlands (e.g., electrical resistivity, ground penetrating radar, seismic refraction surveys) to focus exploration efforts and associated surface disturbance.

Ground disturbance	• Minimize the footprint of exploration activities in wetland areas (e.g., avoid stripping surficial soils, reduce drill pad size, follow minimal disturbance practices).
	• If exploration within wetland areas (e.g., test pitting, hand shafting, test trenching, rotary air blast drilling, auger drilling, sonic drilling) is required within wetland areas, utilize minimal disturbance practices:
	    o Reduce drill pad size.
	    o Leave the topsoil and existing vegetative mat and roots intact on drill pads within wetland areas.
	    o Reduce ground disturbance with the use of hand excavation or appropriately sized excavators.
	    o Strip and stockpile topsoil (i.e., vegetation and soils enriched with organic matter) separately from subsoils for later use in reclamation.
	    o Use low-impact drilling equipment (e.g., tracked).

Consideration	Best practice(s)
	◦ Limit or delay grubbing (e.g., removing the roots of trees and shrubs) on drill pads within wetland areas. ◦ Backfill and reclaim test pits as soon as possible following exploration activities. • If work in the winter is required, clear snow in a manner that leaves the ground surface as undisturbed as possible.
Exposure to contaminants	• No equipment refuelling or servicing to be undertaken within 30 metres of wetlands, water bodies, or watercourses. • Where wetland areas cannot be avoided, use drip trays under immobile machinery (e.g., water pumps) to contain all fuel or oil leaks.

3.4 Excavation and stockpiling

Table 3-4 details minimization best practices for mining excavations and stockpiling activities.

Table 3-4. Best practices for wetland minimization during excavation and stockpiling.

Consideration	Best practice(s)
General	• Limit access within wetland areas.
Preconstruction/site preparation activities	• Clearly delineate the project footprint with physical markers (e.g., stakes, flags or other means) to reduce the chance of inadvertent wetland disturbance related to project activities outside of the footprint. Consider the visibility of signage for all equipment used in the project area.
Vegetation clearing, soil stripping, salvaging and stockpiling	• Conduct vegetation clearing and soil stripping within wetland areas only where necessary. • Salvage the vegetative mat, topsoil (i.e., soil within the plant rooting zone), and other organic material prior to excavation and store them separately for later use in reclamation. Store wetland materials in separate piles from upland materials. Minimize vegetation clearing and soil stripping in upland areas adjacent to wetlands (particularly areas uphill from wetlands) to reduce the risk of wetland sedimentation. • Minimize the distance that soils travel for storage. • Pile vegetation, such as shrubs, grasses, and small trees, with stockpiles of organic material to reduce wind erosion. • Consider installing geotextile materials on stockpiled and salvaged soils (particularly topsoil and organic surface material) to prevent sedimentation, erosion and establishment of undesirable vegetation (e.g., weed species). • Stockpile large trees and vegetation for later use in reclamation (e.g., stabilization of reclaimed slopes).
Stockpiling	• Stockpile organics, topsoil, and fine soils separately from subsoil (overburden).

	• Do not stockpile overburden on top of topsoil. • Store stockpiles in stable, readily accessible piles for later use. • Stockpile small trees, shrubs, and grasses with the top layer of organic soil to protect the organic soil from erosion and improve the survival of vegetation during closure. • If stockpiles are anticipated to encounter surface flow (e.g., wetlands, stream channels, runoff, flood waters), armour the lower slopes of the stockpiles with large rocks/riprap to reduce soil mobilization. • Place containment berms around the perimeter of stockpiles with high moisture content (e.g., organic material, settling pond fines) to reduce the potential for erosion.
Permafrost	• Excavate exposed permafrost as a near-vertical cut face to minimize the surface area of permafrost exposed to ambient temperatures and precipitation and minimize disturbance to insulating vegetation on top of the cut bank. • Push overburden up against permafrost cut faces as soon as possible following completion of mining at that location.

Erosion	• Minimize disturbance to vegetation and soils in areas near wetlands, to reduce the potential for erosion and subsequent wetland sedimentation.
	• Protect stockpiles from wind and water erosion by:
	    o maintaining shallow angled slopes, and,
	    o Stockpile small trees, shrubs, and grasses with the top layer of organic soil to protect the organic soil from erosion and improve the survival of vegetation during closure, and,
	    o revegetating them with native, non-invasive quickly growing species (where available).
	• Stabilize areas where construction is complete to reduce the potential for erosion; see additional detail for revegetation in Section 4.2.5.
	• Use coarse material (i.e., rock) to reduce the potential for water erosion (e.g., covering slopes that are difficult to revegetate, lining ditches).

Mining activities	• Complete work within wetland areas under dry or frozen conditions. • Limit access within areas of the project where soil stripping has not yet been conducted to avoid soil compaction.
Introduction of weed	• Verify that equipment/machinery has been cleaned and is free of pre-existing soil or vegetative matter prior to arrival on site to reduce the chance of weed species spread in the project area. • Actively monitor for and remove weed species (YISC 2023). • Properly dispose of weeds to reduce the risk of spread.

3.5 Water management and settling ponds

Table 3-5 below outlines best practices for minimization related to water management and settling ponds.

Table 3-5. Best practices for wetland minimization during water management and settling ponds.

Consideration	Best practice(s)

Surface water diversion	• Divert surface water away from areas of disturbance where practical by:
	  o Constructing diversion channels and/or berms capable of handling seasonal floods; and,
	  o Avoiding storing stockpiles or sources of hazardous materials (e.g., fuel, lubricants) near ditches, bypass channels, or wetlands.
	• In the case of multi-year mining operations, assess the project area for locations that may seasonally flood, and enact seasonal closures to protect land features from flooding.
	• Maintain connectivity between upstream catchment areas and receiving wetlands, design natural drainage areas throughout the project area.

Hazardous materials and contaminant containment	• When equipment must operate within wetlands:
	  o Verify equipment and vehicles are in good operating condition prior to, and during project activities;
	  o Use large spill trays or impermeable berms for the storage of non-mobile equipment to protect the wetland; and,
	  o Conduct daily leak inspections on equipment such as containers, hoses and nozzles. Damaged or leaking equipment should be labelled and put out of commission until repaired.
	• A spill kit will be readily available in all areas where spills have the potential to occur, and all staff trained appropriately regarding its use.

Settling pond construction	• Construct settling ponds in previous mine excavations to limit site disturbance. • Implement a water recycling system to reduce water use requirements.
Settling pond maintenance	• Regularly inspect settling ponds for damage or leaking/seeping, erosion, instability, or overtopping. • To reduce the risk of erosion and/or failure, repair damages to settling ponds promptly after they have been identified.

3.6 Closure

Table 3-6 below outlines best practices for minimization related to site closure.

Table 3-6. Best practices for wetland minimization during closure.

Consideration	Best practice(s)
Remove infrastructure, buildings, equipment, materials, and debris from the site.	• Decommission/deactivate and remove all equipment, infrastructure, utilities, drain fields, holding tanks, and garbage/debris existing in the project area and properly recycle or dispose of them. • Recycle materials (e.g., tires, scrap metal), if possible. • Safely remove and properly dispose of petroleum products and any other chemicals used in the mining operation. Utilize local disposal and recycling facilities and comply with local landfill requirements. Alternative disposal at appropriate facilities must be arranged if materials cannot be properly disposed of locally.
De-activate or reclaim roads and trails as required	• Remove road infrastructure, such as bridges and culverts. • Reduce compaction by scarifying/roughening, excavating, and/or ripping road surfaces. • Re-contour access to tie-in to the predominant topography and pull back side-cast materials to establish natural drainage patterns and boost vegetation establishment and stability. • Re-establish natural surface drainage patterns by introducing surface features such as gullies and swales.
Weed species control	• Replace salvaged wetland topsoil within wetlands, and upland topsoil on uplands. • Implement weed species control measures as warranted; additional detail on weed species management is included in Section 4.2.5.

4 Wetland reclamation

When required by your license and approval, a project-specific reclamation plan must be developed before project activities can begin. Following the Wetland Policy (Government of Yukon 2022), the plan must outline how the proponent will limit (avoid and minimize) wetland disturbance during project activities (e.g., access development, exploration, excavation and stockpiling, and water management) as well as reclaim all disturbed areas during and/or at the completion of operations.

The objective of wetland reclamation is to re-instate biophysical conditions, including terrain, topography and surface drainage patterns, hydrologic regime, surface soil, and vegetation, for the establishment of stable and self-sustaining wetland ecosystem over time (Government of Yukon 2022). To the extent possible, the reclaimed environment should target similar wetland attributes as existed prior to disturbance by project activities. At this time, the document is focused on restoration of marsh and shallow water wetlands.

The following sections provide practical considerations of wetland reclamation for placer mining, and best practices for re-instating target biophysical conditions to support wetland reclamation.

4.1 Practical considerations

Planning and design can be undertaken to promote favourable biophysical conditions for wetland reclamation to maximize efficiency of these reclamation and closure activities, through progressive reclamation, use of typical post-mining landscape features, and targeting for pragmatic wetland attributes.

4.2 Progressive reclamation

Due to the nature of placer mining and its propensity to move along a deposit, landscape features created during mining activities provide ample opportunities for progressive wetland reclamation (i.e., where disturbed areas are progressively reclaimed while project operations proceed in other areas). For example, reducing soil handling by immediately replacing soil rather than stockpiling soil will prevent the need to protect soil stockpiles, create drainage channels, etc. Progressive reclamation is a recommended best practice as it:

- provides return of wetland functions and benefits more quickly than if wetlands are reclaimed all at once at the end of the project lifecycle;
- reduces the length of time organic material and topsoil is stored, which can increase the viability of the natural seedbank and reduce revegetation timelines;
- uses personnel and equipment already on-site during mining activities;
- provides time for the successful establishment of wetland vegetation, soils, and hydrology; and,
- provides time for adaptive management, should issues be identified.

4.3 Use of post-mining landscape features in wetland reclamation

Excavations, settling ponds, drainage ditches, and other features remaining after placer mining operations may be reclaimed into marsh and shallow water wetland ecosystems depending on their characteristics. The benefits and challenges of using these post-mining landscape features during wetland reclamation are summarized in Table 4-1.

Table 4-1. Benefits and challenges of using post-mining landscape features during wetland reclamation.

Landscape feature	Wetland reclamation	
	Benefits	Potential challenges
Settling ponds	• Existing depressional areas already created during mining operations. • Known ability of settling ponds to retain water. • The fine sediment that has settled out from process water can create an impermeable layer at the bottom of a settling pond that can retain water and promote the development of wetland conditions.	• Size, shape, and depth of settling ponds may need to be modified to create suitable wetland areas. • Deeper ponds may need to be backfilled entirely or partially so that surface water is 2 m deep or less. • Hydrology of settling pond inflows and outlets will need to be adjusted. • Compaction of fine-textured materials may inhibit plant growth if it is not capped by coarser, less compacted soils.
Excavations	• Existing depressional areas already created during mining operations.	• Size, shape, and depth of excavations may need to be modified to create suitable wetland areas. • Deeper excavations may need to be backfilled entirely or partially so that surface water is 2 m deep or less. • Coarse soil textures do not retain water well. If the excavation does not

		naturally fill with water, retaining water to promote the development of wetland conditions may be challenging.
Drainage ditches	• Existing depressional areas already created during mining operations. • Can provide connectivity among other reclaimed wetland areas (e.g., settling ponds, other excavations). • Shallow channels can contribute to habitat diversity.	• If not designed appropriately, drainage ditches can remove water from other reclaimed wetland areas. • Flood planning and erosion prevention should be considered.

4.4 Wetland classes

Some wetland classes are more readily reclaimed than others. The ability to reclaim specific wetland classes is dependent on the type, intensity, and extent of existing disturbance. Wetland reclamation becomes more challenging with the type and duration of disturbance (i.e., it is more likely to be successful following short-term and low-intensity disturbance). Additional planning is required for successful wetland reclamation for areas that have been disturbed more severely (i.e., longer durations / high intensity).

4.4.1 Peatlands

At this time, the document is focused on the restoration of marsh and shallow water wetlands. Peatland reclamation (i.e., bogs and fens) has been studied extensively throughout North America (Chimner et al. 2017) as well as globally (Convention on Wetlands 2021). A key challenge surrounds maintaining suitable water conditions and the long timescales required to develop the deep peat deposits characteristic of these wetland classes (Chimner et al. 2017). Generally, existing peatlands that have experienced limited, short-term disturbance (e.g., tree thinning/clearing during frozen conditions, one season of vehicle access during frozen conditions) can be more easily reclaimed; whereas reclamation of more intensive peatland disturbances (e.g., deep excavation of organic material, addition of mineral fill material, persistent all-season access) and/or where historic wetland areas have been entirely removed is not readily achievable (even with modest to high reclamation efforts and after-care). These challenges are amplified in permafrost areas due to the interactions between ice and water and their effects on hydrologic processes. Due to the cost, complexity, and timeframes to reclaim peatlands within disturbed areas, it is often more practical (and achievable) to target the reclamation of peatlands to swamps, marshes, or shallow water wetlands (Section 4.1.1.2). This is especially true in permafrost areas, where areas of open water and organic material associated with marsh and shallow water wetlands may act as insulators and support permafrost formation (Woo et al. 2008).

4.4.2 Swamps, marshes and shallow water wetlands

Swamp, marsh, and shallow water wetlands are typically characterized by mineral soils[1] and defined by variable water depths throughout the year (2 m deep or less; Appendix B). The shallow margins along the perimeters of wetlands tend to support higher plant abundance and density, with the shallowest areas (i.e., with the least inundation) often support woody vegetation such as shrubs and trees which define swamps. As inundation increases, the increased soil saturation limits the growth of shrubs and trees leading to more grass-like vegetation, which defines marshes. Deeper wetland areas may then be characterized by open water where only aquatic plants can grow, which defines shallow water wetlands. Areas with water depths greater than 2 m deep are classified as lakes and are not considered wetland ecosystems (Ducks Unlimited Canada 2024).

By implementing the best practices in this Guide, reclaimed wetlands are expected to develop over time into wetland complexes comprised of swamp, marsh, and shallow water wetlands to promote habitat complexity, biodiversity, and natural vegetation re-establishment.

[1] Swamp wetlands can occasionally be peatlands with >30 cm of organic soil; however, for the purposes of the Guide swamps are considered to be mineral wetlands.

Table 4-2. Biophysical considerations for wetland reclamation design and planning.

Biophysical consideration	Description
Terrain and landscape position	Wetlands associated with placer mining projects are typically associated with the fluvial and glaciofluvial gravel deposits of river valleys or gulches. The characteristics of these different types of terrain features affect the types and locations of wetlands that may be present. Wetlands are often located on level or depressional areas on the landscape (e.g., at the bottom of river valleys); however, some wetlands (i.e., bogs, fens, and swamps) can occur on sloping terrain where they are associated with permafrost or drainage barriers (Ducks Unlimited Canada 2024). Bogs are often elevated above the surrounding terrain due to permafrost upheaval and the long-term accumulation of undecomposed plant matter, which forms peat.
Water source	Development of appropriate hydrologic conditions to support self-sustaining wetland ecosystems can be challenging. Wetlands can be fed through precipitation, subsurface flow, surface flow, flooding, springs, or a combination of these methods. • Bogs receive all water from precipitation. • Fens are influenced by groundwater, with surface water and precipitation inputs. • Marshes and shallow water wetlands receive water from a combination of precipitation, surface water flows, groundwater, and/or flooding. • Swamps receive water from precipitation, subsurface flow, and flooding. Understanding the wetland classes present and the movement of water within the project area is important to support reclamation planning. Generally, low, relatively flat areas adjacent to existing water bodies (e.g., watercourses) are more likely to exhibit a water table close to the ground surface, which can provide sufficient water to achieve self-sustaining wetland function.
Water fluctuations	The frequency and intensity of water level fluctuations experienced by wetlands vary in accordance with wetland class. Bogs and fens rarely experience water level fluctuations, and their consistent saturation/inundation contributes to the accumulation of peat within these wetland types as it inhibits decomposition. Swamps, marshes, and shallow water wetlands experience varying levels of water fluctuations over time, allowing for the decomposition of organic material during dry periods.
Permafrost	The presence and location of permafrost influences the formation and distribution of wetlands on the landscape. In the Yukon, the majority of placer mining takes place in the extensive discontinuous zone (with permafrost beneath 50 to 90% of the surface), with smaller components in the sporadic discontinuous zone (with permafrost beneath 10 to 50% of the surface; Yukon Placer Secretariat 2010). Permafrost restricts the movement of water into the soil, which can confine water flow to the upper active layers of wetland soils, and often results in excess ice forming within wetlands as wedges, lenses or layers. Thawing of permafrost can cause subsidence, thermokarst (i.e., surface depressions resulting in the formation of wetlands or lakes), or other hydrologic changes.
Soils	Pay gravel can be located underneath a variety of soil types, including: • Large quantities of fine inorganic material such as deep loess deposits. • Mineral wetland soils, often with a dark, well-decomposed organic accumulations at the surface. • Organic soils comprised of partially decomposed plant matter (i.e., peat).
Plant communities	The amount of organic material available to act as a growing medium within reclaimed wetland areas (e.g., organic wetland soils, salvaged native vegetation cleared during excavation) directly contributes to wetland revegetation success. Revegetation of reclaimed wetland areas is important to achieve wetland reclamation goals, stabilize exposed soils, prevent erosion, and to create wildlife habitat. Typically, revegetation can be achieved via natural regeneration from the native seedbank present within salvaged organic material; however, supplemental seeding and/or planting may be required on a site-specific basis.
Wildlife habitat	In general, wildlife habitat within reclaimed wetlands can be improved by providing a variety of habitat types within a single reclaimed wetland to allow for enhanced habitat diversity and distribution. Designing wetlands with a variety of water depths, irregularly shaped shorelines, and small islands, with a variety of coarse woody debris provides opportunity for future vegetation structure complexity and diversity.

4.5 Best practices

Biophysical constraints for wetland reclamation design and planning are important to consider in reclamation planning. A summary of biophysical considerations is provided in Table 4-2. Best practices for use during wetland reclamation, including considerations for progressive reclamation, are provided in the subsequent sections based on the targeted post-mining environment. In addition to these best practices, the information provided in Section 2 and Section 3 above for wetland avoidance and minimization also applies to the construction of reclaimed wetlands.

4.6 Terrain and landscape position

Best practices related to terrain and landscape position during wetland reclamation are provided in Table 4-3. Additional guidance on recommended slope design based on soil characteristics and ice content is provided in Section 4.2.3.

Table 4-3. Best practices related to terrain and landscape position during wetland reclamation.

Consideration	Best practice(s)
Terrain and landscape	• Preferentially select level or depressional areas for wetland reclamation as these areas are more likely to have groundwater close to the ground surface. • Contour the reclaimed landscape to tie-in to the surrounding natural topography. • Restore natural drainage patterns and limit potential risk of sediment entering wetlands and water bodies (e.g., remove culverts, cut through roads and dikes with potential to fail, install water-diversion means such as slope drains). • Grade all disturbed areas to shallow final slopes (generally 2:1or gentler), blending the contours into the surrounding natural topography. Wetland areas should be graded to 7:1 or gentler.

4.6.1 Water source and fluctuations

Best practices related to water during wetland reclamation, including water supply and associated fluctuations, are provided in Table 4-4.

Table 4-4. Best practices related to water during wetland reclamation.

<table>
<tr><th>Consideration</th><th>Best practice(s)</th></tr>
<tr><td>Water source and fluctuations- general</td><td>
Reclaimed wetlands require adequate water supply interacting with the plant rooting zone during the growing season. To achieve this, the wetland reclamation design may include some or all of the following:

Identify the water table elevation during the driest time of year (e.g., late summer), and use this information to inform excavation depths. If groundwater is present near the ground surface, soil texture is typically not a limiting factor for water retention, and the water table which will supply water for the wetland.
Allow for passive overland flow to enter reclaimed wetlands with appropriate site contouring (e.g., gentle slopes).
Disable ditches to avoid draining water away from the reclaimed wetland (e.g., with the use of fill, dams).
Install a staff gauge within the deepest portion of reclaimed wetlands for water level measurements during monitoring.
Install perpendicular berms, check dams, or small retention dikes to slow surface runoff and promote wetland forming conditions.

Reclaim wetland areas to a maximum resultant water depth of less than 2 m.
Utilize excess sediment to seal off outlets or any edges bordering the active channel to retain water in the wetland, prevent wetland sediment from entering the active channel, and prevent fish from the active channel becoming trapped within the reclaimed wetlands.
Prevent sediment from entering the downstream waters with appropriate erosion and sediment control measures.
Install a staff gauge within the deepest portion of reclaimed wetlands for water level measurements during monitoring.
Use existing drainage ditches and connecting settling ponds to create multiple wetlands connected via a shallow channel. Modify existing ditches (i.e., partially filled with excavated fine materials and stabilized with rock and/or vegetation) to avoid drainage of reclaimed wetlands.
</td></tr>
</table>

4.6.2 Permafrost and soils

Best practices related to permafrost and soils during wetland reclamation are provided in Table 4-5. For the purposes of the Guide, the term “topsoil” is inclusive of the vegetative mat, upper surface material, and organic soils. Additional considerations for selecting appropriate slope design (i.e., the ratio of run over rise) based on soil characteristics[2] and ice content are provided in Table 4-6, and a description of how to determine slope is provided in Appendix D.

Table 4-5. Best practices for soils and permafrost during wetland reclamation.

Consideration	Best Practice(s)
Topsoil stripping, handling and storage	• Plan the sequence of events of the progressive reclamation to minimize material handling and movement, placing stockpiles in readily accessible areas that minimize travel and will not result in excess traffic travelling over top of material after it has been placed. • Avoid travelling over soil stockpiles with vehicles or equipment and limit traffic within recontoured areas to prevent soil compaction. • Stockpile large trees for later placement during reclamation to limit site access, promote revegetation, and provide wildlife habitat.
Backfilling pits and trenches	• Backfill and stabilize soil within trenches or ditches to avoid draining reclaimed wetlands. • Verify that material used to backfill is free from contaminants (e.g., hydrocarbons, treated wood).
Topsoil and organic material	• Spread salvaged topsoil and/or organic material over the recontoured wetland areas to provide a growing medium for vegetation. • Replace vegetative mat, topsoil and/or organic material to a depth of approximately 30 to 100 cm within reclaimed wetland areas, as available. • Replace topsoil and/or organic materials as quickly as possible to limit loss from erosion and improve success of revegetation from native seedbanks. • Replace salvaged topsoil and/or organic materials in a rough and loose fashion and incorporate roots, brush, stumps and other woody debris to create microsites and protect against erosion. • Where topsoil and/or organic materials are limited, prioritize swamp and marsh wetland habitats to receive greater depths of this material than the deeper portions of shallow water wetlands that may be able to tolerate less organic material. • Cap fine-textured materials with vegetative mat, topsoil and/or organic material, where available. If organic materials are not available, cap fine-textured materials with coarser materials to avoid compaction and increase revegetation success. • Avoid leaving extensive areas of exposed coarse substrates (e.g., washed gravel), as this can impede revegetation success.
Erosion Control	• Establish vegetation cover as soon as possible to control erosion with the use of plant and organic materials stockpiled during stripping. • Schedule soil stripping to minimize the time that soils will be exposed. • Prior to the commencement of works that may mobilize sediment into wetlands and water bodies (e.g., steep slopes, ditches which may easily

[2] Fine textured soils erode more easily than coarse soils.

Consideration	Best Practice(s)
	erode, outlet areas which may experience scour), implement erosion and sediment control measures as described in the Best Management Practices for Works Affecting Water in Yukon (Government of Yukon 2011) . • Do not leave exposed slopes smoothly graded and compacted as this can increase erosion potential. A roughened ground surface reduces erosion potential, promotes water infiltration, and provides microsites for natural revegetation. • Roughen the ground surface by: o creating grooves, furrows or steps, o using tracked equipment along the slope, and/or o incorporating coarse materials such as woody debris. • Surface roughening methods must be completed perpendicular to the slope direction, as grooves parallel to the hill will accelerate runoff and increase erosion. • Avoid excavating, moving, or replacing soil materials during excessively windy or wet conditions. • Prevent sediment from entering downgradient wetlands and water bodies with appropriate erosion and sediment control measures. • Divert surface drainage away from erodible slopes and surfaces to reduce the risk of soil, silt and sediments entering wetlands and water bodies. • Avoid diverting sediment-laden water into wetland areas. • Search drainage ditches and other channels for evidence of headward erosion in an upstream direction, also known as headcuts. All headcuts must be remedied as soon as possible as they have the potential to result in sedimentation and/or drainage of reclaimed wetlands.

Table 4-6. General recommended procedures for slope design based on soil characteristics and ice content.

Slope	Soil characteristics	Ice content	Recommended procedure
Side slope	Fine, poorly drained soil	Ice rich	Leave the cut face vertical with an overlapping mat of vegetation if possible.
		Ice present but less than 5%	Grade slope to 7:1 or gentler. Leave an overlapping mat of vegetation if possible.
		Ice not present	Grade slope to 7:1 or gentler.
	Coarse, well-drained soil	Ice not present	Grade slope to 2:1 or gentler. Bench or terrace if the slope is over 15m high.
Pile	Coarse, well-drained soil	Ice not present	Grade slope to 2:1 or gentler. Round off the top of the pile.
	Fine, poorly drained soil	Ice not present	Grade slope to 3:1 or gentler. Round off, reshape, re-contour top of pile.

Adapted from the Guidebook of Mitigation Measures for Placer Mining in the Yukon (Yukon Placer Secretariat 2010).

4.6.3 Plant communities and wildlife habitat

Best practices to support diverse plant communities and wildlife habitat during wetland reclamation are provided in Table 4-7.

Table 4-7. Best practices for wetland reclamation planning and design.

Consideration	Best practice(s)
Plant communities	• Retain areas of natural, undisturbed vegetation in and around the project area to promote the natural ingress of native species. • Replace topsoil and organic material as soon as possible (within one year of stockpiling) to improve seed germination success from the seedbank. • Use salvaged topsoil and organic material during wetland reclamation to use of the native seed bank during natural revegetation. • Create an irregular bottom surface (not smooth) with variable depths of shallow and deeper pools where different types of vegetation can establish. In general, deeper zones should be near the centre of the wetland, with the bottom sloping gradually shallower towards the wetland edges (design slopes of reclaimed wetlands with gentle slopes [i.e., 7:1 or gentler]. • Clean and inspect all equipment and vehicles to verify they are free of soil and plant material prior to arrival at the project area to minimize the potential for the introduction of weed species. • Create a rough and loose ground surface to provide microsites that help retain water and provide shelter to promote vegetation germination, growth, and establishment.

	• Use a backhoe to salvage 'islands' of soil and vegetation (i.e., the size of the bucket) from wetland areas anticipated to be disturbed by project activities. Store these 'islands' root side down on the stockpiles for topsoil/organic material until reclamation. During wetland reclamation, directly place salvaged 'islands' into prepared depressional areas within the reclaimed wetlands. • Natural regeneration from the native seedbank present within salvaged topsoil and organic material is preferred. Consultation with a professional experienced with reclamation is encouraged to improve the chances of successful natural revegetation.
Wildlife habitat	• Create wetland complexes with a diversity of wetland and upland habitats, including swales, depressions, ponds, and islands. • Modify the shorelines of reclaimed wetlands to create gently sloped, irregularly shaped, complex and variable shorelines with bays and peninsulas (maximizing the shoreline length to surface area ratio). • Create small, shallowly sloped islands to provide habitat and protect against erosion. • Distribute coarse woody debris across the site to provide microsites, increase biodiversity, and protect against erosion, including standing dead trees. • Distribute various sized rocks and boulders for microsites and wildlife habitat.

Revegetation of cleared areas is critical for stabilizing exposed soils, reducing potential for erosion and sedimentation, and facilitating a trajectory for the re-establishment of wildlife habitat.

4.6.4 Monitoring and adaptive management

Reclaimed wetlands must be monitored throughout the life of the license to evaluate their recovery and inform the need for adaptive management. Monitoring is conducted annually during the growing season throughout the life of the project to evaluate changes in vegetation and soil conditions (e.g., erosion) over time within reclaimed wetlands to determine whether they are developing along a trajectory towards self-sustaining ecosystems.

Best practices for monitoring and adaptive management of reclaimed wetlands are provided in Table 4-8. Performance indicators should be carefully documented for the duration of the license and reported to evaluate wetland recovery toward self-sustaining ecosystems.

Table 4-8. Performance indicators, monitoring methods, and reporting requirements for reclaimed wetlands.

<table>
<tr><th>Consideration</th><th>Performance indictor</th><th>Monitoring method</th><th>Reporting requirement</th></tr>
<tr><td rowspan="2">Water</td><td>Area</td><td>• Area of water (in hectares).
• Permanent, georeferenced photo documentation points to show change over time.</td><td>• Description of the area of water observed relative to previous monitoring years.
• Clearly labelled photo documentation.</td></tr>
<tr><td>Depth</td><td>• Measurement of water level (with the use of a staff gauge)</td><td>• Documentation of water level relative to previous monitoring years.</td></tr>
<tr><td rowspan="3">Soils and permafrost</td><td>Lack of turbidity in water column</td><td rowspan="2">• Delineated areas of soil erosion.
• Documented presence/absence of visible water turbidity</td><td rowspan="2">• Description of areas of soil erosion observed relative to previous monitoring years.
• Description of water turbidity (if present).
• Clearly labelled photo documentation.</td></tr>
<tr><td>Lack of soil erosion</td></tr>
<tr><td>Areas of exposed soil and gravel</td><td>• Area of exposed soil (in hectares).
• Area of exposed gravel (in hectares).
• Permanent, georeferenced photo documentation points to show change over time.</td><td>• Description of the area of exposed soil observed relative to previous monitoring years.
• Description of the area of exposed gravel observed relative to previous monitoring years.</td></tr>
<tr><td rowspan="2">Revegetation</td><td>Plant cover</td><td>• Permanent, georeferenced photo documentation points to show change over time.
• Documentation of the location and extent of areas of low plant cover.</td><td>• Description of bare areas and lack of vegetation.
• Clearly labelled photo documentation.</td></tr>
<tr><td>Presence, abundance, and distribution of weed species</td><td>• Permanent, georeferenced photo documentation points to show change over time.</td><td>• Weed species identification and description of infestation including area, density, and distribution.</td></tr>
</table>

		• Documentation of the location and extent of weed species occurrences.	• Clearly labelled photo documentation.

A summary of issues that may be identified during monitoring that may trigger adaptive management is provided in Table 4-9, and an example wetland monitoring worksheet is provided in Appendix E. Any observation during monitoring that triggers adaptive management must be reported in the annual monitoring report, along with the action that was undertaken to address it.

Revegetation of cleared areas is critical for stabilizing exposed soils, reducing potential for erosion and sedimentation, and facilitating a trajectory for the re-establishment of wildlife habitat. Typically, the most cost-effective method of revegetation is via natural regeneration from native seedbanks present within salvaged topsoil and organic material.

Table 4-9. Adaptive management of reclaimed wetlands.

Trigger	Potential action/response
Lack of sufficient water within reclaimed wetland areas	• Divert additional water into wetland areas. • Undertake additional excavation. • Consider implementing perpendicular berms, check dams, or small retention dikes across slopes to slow surface runoff, encouraging water retention.
Too much water within reclaimed wetland areas	• Divert surface water from wetland areas. • Add stockpiled soils and organic materials to reduce water depth.
Evidence of erosion within reclaimed wetland areas	• Implementation of additional erosion and sediment control measures. • Slope stabilization. • Soil revegetation. • Slow water movement within reclaimed wetlands.
Reduced stability of wetland edges.	• Slope stabilization with the use of gravel or woody debris.
Evidence of sedimentation of reclaimed wetland areas	• Reduce erosion into reclaimed wetlands.
Poor growth of native vegetation within reclaimed wetland areas	• If required, assisted revegetation should be implemented in accordance with the Yukon Revegetation Manual (Matheus and Omtzigt 2013); or, Natural Revegetation and Sustainable Reclamation at Yukon Mine and Mineral Exploration Sites (Withers 1999). • Revegetation activities should occur during late spring to early summer for a greater chance of successful establishment and survival (Entrix Inc. 1986).

	• Increase availability of microsites (e.g., rough and loose application of topsoil). • Supplement with additional topsoil/organic soils if cover is deemed to be insufficient. • Use fertilizer sparingly and in accordance with aquatic safety guidelines.
Presence of new weed species or occurrences	• Consider whether the presence of weeds may be worsened by other factors (e.g., poor growth of native vegetation, low availability of topsoil/organic material, fertilizer). • Undertake control of weed species to minimize potential effects on wetlands and water bodies. Base the treatment option for a weed occurrence on the identity of the weed species, the size and extent of the occurrence, time of year, the proximity of the occurrence to sensitive areas (e.g., wetlands, water bodies), and the available control options. Control weed species using mechanical control (involves the physical removal of the plants).
Increase in the abundance or extent of weed species occurrences	

Annual wetland reclamation monitoring reports provide documentation of the status of reclaimed wetlands throughout the life of a project in the context of site-specific constraints that may be present and demonstrates the adaptive management techniques that have been undertaken to support reclaimed wetlands along their development into self-sustaining wetland ecosystems over time.

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Appendices

Appendix A: Planning tool

Appendix B: Wetland classification

Appendix Table 1. Wetland classes in the Yukon.

Wetland class	Description
Bog	Characterized by poorly decomposed organic soils (peat) at least a 30 cm deep, bogs receive water only rainfall and snowmelt. The surface of a bog is often raised above the surrounding landscape and does not typically exhibit surface water. Soils are generally limited in nutrients resulting in low plant diversity. (Ducks Unlimited Canada 2024)
Fen	Characterized by poorly decomposed organic soil (peat) at least 30 cm deep, fens are influenced by ground water, with additional inputs from precipitation and surface runoff. Compared to bogs, fens are typically more nutrient rich and have a higher plant diversity. (Ducks Unlimited Canada 2024).
Marsh	Marsh wetlands are characterized by mineral soil and dominated by grass-like vegetation, such as sedges, grasses, rushes, and reeds. The water in marsh wetlands will fluctuate and surface water may dry out in the summer; however, the soil will still be saturated and water will still present within the plant rooting zone (Ducks Unlimited Canada 2024). It may not be obvious when marsh wetlands dry out in the summer due to the dominance of grass-like plants. Marshes receive water from ground water, surface water, and/or precipitation.
Shallow water	Shallow water wetlands are often also called ponds or sloughs and are characterized by mineral soils and deeper water levels than marsh wetlands. Despite their deeper water levels, these wetlands may still dry out in the summer revealing mud flats in drought years. Plant species common to shallow water wetlands are aquatic, living in the water (Ducks Unlimited Canada 2024).
Swamp	Swamp wetlands are characterized by mineral soils (with some swamps exhibiting organic soils) and are dominated by woody plants such as trees and shrubs. The ground surface is variable, with surface water present within the lower areas (i.e., hollows), and trees and shrubs growing in the higher areas (i.e., hummocks). Swamps are often observed as transitional ecosystems between upland ecosystems and other wetland types (Ducks Unlimited Canada 2024).

Appendix C: Glossary of terms

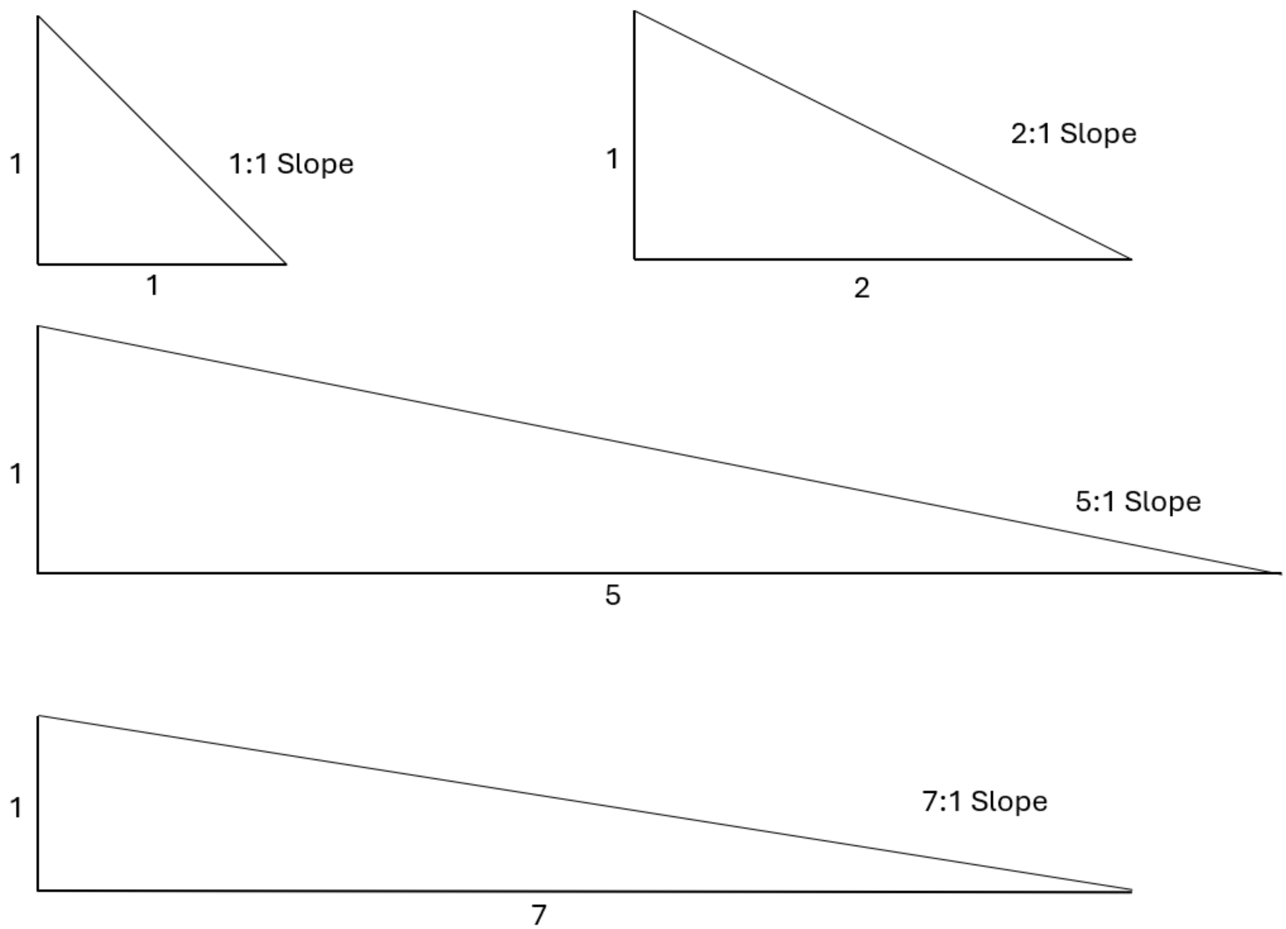
Appendix table 2. Glossary of terms

Term	Definition
Artesian flow	The natural movement of groundwater to the land surface, or even a significant height above it, due to pressure within a confined aquifer.
Avoidance	Measures that are proactively implemented to prevent adverse effects on wetlands and loss or reduction of wetland benefits (Government of Yukon 2022).
Erosion	The process where soil is detached, transported, and deposited elsewhere by agents like water, wind, and/or gravity.
Minimization	Reducing effects on wetland benefits through the planning, design, construction, and operational stages (Government of Yukon 2022).
Mitigation hierarchy	A set of sequential and prioritized steps that must be followed to manage the loss or reduction of wetland benefits. The mitigation hierarchy starts with avoidance, followed by minimization, reclamation, and offset (if required) (Government of Yukon 2022).
Offsetting	Measurable conservation outcomes applied to areas not disturbed by the project that compensate for the permanent loss or reduction in wetland loss (Government of Yukon 2022).
Peatland	In the Yukon, a Peatland is a wetland that has accumulated 30 cm or more of partially decayed organic matter. The national standard is 40 cm or more. (Government of Yukon 2022)
Placer mining	Includes any method of earthworks to obtain gold or other precious metals, but does not include working of rock on site (Government of Yukon 2003).
Progressive reclamation	The process of reclaiming areas of a mine that are no longer active while other parts of the mine are still in operation. This process creates patches of mature and early pioneer vegetation across the mine (Chevreux and Clarkson 2017).
Reclamation	The return of a site disturbed by mining and or exploration activities to a condition where it will make a suitable environment for the re-establishment of the site (Indian and Northern Affairs Canada 1999).
Sedimentation	The process of when soil particles are suspended in a fluid and are deposited in a low-lying area.
Vegetative mat	The organic surface of soil, characterized by the accumulation of organic matter, derived mainly from leaves, twigs, and woody materials, includes the root mass of living vegetation. (Yukon Government 2003)
Wetland	Areas that have water present long enough to create water-altered soils and for water-loving vegetation to establish (Government of Yukon 2022).
Wetland benefit	A characteristic of a wetland that results in an ecological or cultural benefit (Government of Yukon 2022).
Wetland class	A process of grouping wetlands based on ecological characteristics and formation. In Canada, these are classed as: bog, fen, marsh, swamp, and shallow water (Government of Yukon 2022).

Appendix D: Slope calculations

Slope calculations

Slopes are measured as a ratio of horizontal distance to vertical distance. For example, a 2:1 slope is two units longer from a horizontal distance than the vertical distance. As slopes become shallower, the horizontal distance becomes larger in relation to the vertical distance.



Appendix E: Example wetland monitoring worksheet

Example Wetland Monitoring Worksheet

Property name:		Approval/License number:	
Applicant name:		Reclaimed wetland ID:	
Company name:		Reclaimed wetland location:	
Company address:		Wetland reclamation date:	
Contact email:		Previous monitoring date(s):	
Property location:		Current monitoring date:	

Parameter	**Monitoring observations**	**Previous monitoring observations**	**Georeferenced photos attached?**	**Adaptive management implemented? (Yes/No)**	**Describe adaptive management actions. If no adaptive management was determined to be necessary, explain.**
Total reclaimed wetland area (ha)					
Area of water (ha)					
Water level measurement (m)					
Turbidity observed in water column? (Yes/No)					
Soil erosion observed? (Yes/No)					
Description of observed soil erosion					
Area of exposed gravel (ha)					
Area of exposed soil (ha)					
Areas of low plant cover observed? (Yes/No)					
Description of areas of low plant cover					
Weeds observed? (Yes/No)					
Description of location, area, density and distribution of weeds					