14. Mine Closure and Reclamation

Mine development and operation at Galore Creek will incorporate techniques to both minimize surficial disturbance and progressively reclaim areas affected by mining during the operations phase. Progressive reclamation is the cornerstone to maintaining a healthy environment and reducing closure-related capital costs at the cessation of mining activities. The conceptual closure and reclamation approaches outlined in this section of the EA are designed to ensure that the operations and post-closure phases of the project are compatible with the surrounding natural environment. As required under the *British Columbia Mines Act* and its accompanying Health, Safety and Reclamation Code, detailed mine and reclamation plans and specifications will be submitted at a later date as part of the Mine Plan and Reclamation Program Permit application.

The environmental management and monitoring systems at the Galore Creek operation will ensure that terrestrial and aquatic as well as heritage and archaeological resources are sufficiently protected on an ongoing basis during mine construction, operations and post-closure. Environmental management and mitigation plans are provided in Chapter 8 of this EA. Concurrent with the initiation of mining, wildlife and aquatic effects monitoring programs will be implemented to measure any potential changes in either the terrestrial or aquatic environments. The results from such monitoring programs will be used to improve environmental management systems as appropriate. Further information related to the environmental monitoring program is provided in Chapter 10.

The mine closure and reclamation program plan outlined in this chapter comprises the following sections:

- Regulatory Framework and Requirements
- Closure and Reclamation Objectives
- Reclamation Components
- Description of Closure Works
- Socio-Economic Issues
- Closure Cost Estimate
- Post-Closure Monitoring

The first section provides an overview of the regulatory framework and associated requirements under the *British Columbia Mines Act* and its accompanying Health, Safety and Reclamation Code. The second section lists the closure and reclamation objectives for the mine operation thereby forming the basis for more detailed plans and specifications listed the next two sections (reclamation followed by descriptions of closure works). The final three sections deal with socio-economic issues, presentation of a preliminary closure cost estimate and finally, post-closure monitoring requirements.

The intention is to outline NovaGold's conceptual closure and reclamation plans in order to provide a feasible basis for detailed permitting- and bonding-related discussions to be held with the British Columbia Ministry of Energy, Mines and Petroleum Resources and other regulatory agencies as required. Review of the permit application is normally conducted through an integrated regulatory review Committee process.

14.1 Regulatory Framework and Requirements

The following provides an overview of requirements for the approval of mining projects with respect to the *British Columbia Mines Act* and its accompanying Health, Safety and Reclamation Code for Mines. Both are administered by the Mines Branch of the Ministry of Energy, Mines and Petroleum Resources. Galore Creek will meet all stipulated requirements through a process of concurrent permitting harmonized with the provincial and federal environmental assessment processes. The information requirements for a Major Mine Permit Application include:

- a map or airphoto showing the location and extent of the mine
- details of the design, construction, operation and closure of mine components, taking into consideration the safety of the public and mine workers, and protection of the environment
- a listing of the nature and present uses of the land to be used for the mine
- details of the nature of the mine and the extent of the area to be occupied
- a program for the protection and reclamation of the land and watercourses during the construction and operations phases of the mine
- a conceptual final reclamation plan for the closure or abandonment of the mining operation
- an estimate of the annual cost of outstanding reclamation obligations over the planned life of the mine, including the cost of long-term monitoring and abatement
- any other relevant information that may be required by an Inspector.

14.1.1 Mine Plan and Reclamation Program Submission

To obtain a Permit approving the mine plan and associated reclamation program, a detailed *Mine Plan and Reclamation Program* document must be submitted to the Mines Branch Regional Manager. The following provides a list of the areas that will be addressed in the *Galore Creek Mine Plan and Reclamation Program* submission:

- pre-mine land uses and proposed end land use objectives
- pre-mine land capability or productivity and proposed post-mine capability or productivity objectives for all significant land uses. This information is required to create the proposed reclamation program and is used to measuring reclamation success.
- characterization of the soils and overburden resource for reclamation purposes
- plans for salvaging, stockpiling and replacing soils and other suitable growth media

- consideration of future erosion and mass wasting for long-term stability
- resloping and reclamation of waste rock dumps
- reclamation plans for watercourses
- open pit reclamation, where applicable
- details for sealing of any potential underground workings
- tailings impoundment reclamation strategy
- linear infrastructure closure and reclamation (*i.e.*, roads)
- pre-mine trace element concentrations in soils and vegetation
- the general composition, size, shape and location of all consolidated and unconsolidated geological units disturbed by the project
- prediction of the geochemical performance of the various geological units in the forms in which they will be exposed, and a determination of the potential for deleterious effects
- estimates of the time to onset of acidic conditions or metal leaching in materials for which there is an anticipated delay in the application of remedial measures
- programs for prevention, treatment and control of acid rock drainage and/or metal leaching
- monitoring requirements for ore extraction, waste rock handling and disposal operations
- hazardous waste disposal plan
- terrestrial and aquatic environments monitoring program
- preliminary characterization of surficial and bedrock materials for geotechnical assessments
- preliminary designs of:
  - open pits
  - ore processing facilities
  - tailings impoundment facility
  - waste rock dumps
  - access roads
  - water storage facilities and conveyance systems
  - other significant transportation and/or utilities infrastructure.

14.1.2 Permit Amendments

As the mine and associated reclamation plans evolve during the course of mine operations, applications for amendments to the *Mines Act* Permit are required under the Code. Approved amendments are subsequently attached to the original Mine Permit.

The requirement to submit an updated *Mine Plan and Reclamation Program* every five years is normally a condition of a *Mines Act* Permit. These updated plans, frequently called "Permit Renewal Applications" or "Closure Plans," are normally referred to an integrated regulatory review Committee in a similar manner as the original *Mines Act* Permit application. Following the Committee review process, a new Permit is issued titled "Amended Permit," which contains the applicable conditions of the previous *Mines Act* Permit, applicable conditions of previous Amendments to Permit and any additional conditions determined to be necessary based on the Committee review. The "Amended Permit" becomes the applicable *Mines Act* Permit and supersedes all previous permits.

14.1.3 Reclamation Cost Reporting

The policy for reporting in British Columbia is intended to provide "reasonable assurance" that government funds will not be used for mine reclamation. For new mines, the policy is to set the reclamation security annually at a level that reflects all outstanding decommissioning and closure obligations existing at that time. Consideration is also given to costs associated with:

- public health
- safety
- reclamation
- maintenance
- long-term treatment
- monitoring requirements.

As part of the application for a *Mines Act* Permit, a detailed projection of reclamation costs, including provisions for long-term monitoring, maintenance and mitigation of environmental impacts, is required. At a minimum, detailed costing will be provided for the first five years of mine operation, the projected point of maximum reclamation liability during the life-of-mine, mine closure and following mine closure. Costing projections may also be requested for every fifth or tenth year through the projected life of the mine. Preliminary costing is required as part of the Environmental Assessment report.

Where sufficiently justified, the applicant can request that cost projections and any other financial information required by the Chief Inspector be submitted in a separate confidential report.

14.2 Closure and Reclamation Objectives

The closure and reclamation program planned for the Galore Creek mine has four main objectives:

- Provision of Stable Landforms
- Re-establishment of Productive Land Use
- Protection of Terrestrial and Aquatic Resources

- Protection of Heritage and Archaeological Resources

The following sections describe the approaches set out to achieve these objectives.

14.2.1 Provision of Stable Landforms

Design of permanent mine-related landforms such as the open pits, containment dams, waste rock and tailings management areas has been undertaken to ensure long-term stability both during mine operation and after mine closure and reclamation works have been completed. Each containment structure, including the tailings and waste rock impoundment dam, has been designed to be fully compliant with Canadian Dam Association Safety Guidelines.

Geotechnical and hydrogeological field investigations were undertaken by BGC Engineering during the summer field seasons of 2004 and 2005 to enable feasibility level design of the tailings and waste rock impoundment facility, open pits, waste rock storage areas, plant site foundations and water diversions. Details of the field program and the geotechnical engineering for all mine areas are provided in Appendix 5-H and Appendix 14-A, *Feasibility – Geotechnical and Hydrogeological Site Investigation Report*. Geotechnical and hydrogeological investigations included:

- geotechnical drilling
- geological mapping
- permeability testing
- test pit excavations and sampling
- outcrop mapping
- seismic refraction surveys
- shear wave surveys.

14.2.2 Re-establishment of Productive Land Use

A complex variety of terrestrial and aquatic wildlife species depend on the Stikine River watershed and associated valleys to support their life cycles. Galore Creek itself is one of dozens of valleys within the lower Stikine system that support species such as the Pacific salmon, grizzly bear and mountain goat. Rescan developed extensive environmental baseline study programs in consultation with both Canadian and U.S. regulatory agencies and members of the Tahltan Nation. Information on traditional Tahltan knowledge of the region was related to field scientists and engineers during the course of the 2004 and 2005 field programs in an effort to ensure Tahltan traditions were respected and incorporated into project permitting as appropriate. Information related to the consultation program is presented in Chapter 3 of this EA.

Environmental and socio-economic baseline studies were initiated in the winter of 2004 and completed in early 2006 that helped provide an understanding of the present land uses within the Galore Creek valley. Presented in detail in the appendices, the results of these studies are summarized in Chapter 6 of this EA, Environmental and Socio-Economic Setting. Following is a précis of study aspects related to Galore Creek Valley land uses.

14.2.2.1 Ecosystem Mapping

Terrestrial Ecosystem Mapping (TEM) was used to characterize the Galore Creek Valley ecosystem over an area of approximately 9,600 ha (691 polygons). The mapping extent covers the Galore Creek Valley to the height of land containing all mine facilities. As outlined in the environmental setting, a total of four biogeoclimatic (BEC) units are present within the mine area. More than half of this area is covered by the Alpine Tundra (ATp) and Engelmann Spruce – Subalpine Fir wet very cold parkland (ESSFwvp) subzones. Approximately one third of the Galore Valley is covered by the ESSFwvp subzone.

Mapping resulted in the identification of 29 ecosystem units, 9 of which were forested units and the rest were non-forested. Field surveys identified a total of 34 different ecosystem units, 7 of which were forested and 27 of which were non-forested and are largely undescribed in the Cassiar Forest District. No rare ecological communities tracked by the British Columbia CDC were identified on ecosystem maps or in the field within the mine area.

Much of the mine area itself is unvegetated (barren) land (3,775 ha or 39%), and a substantial portion consists of herb and shrub vegetation stages (2,851 ha or 30%). Mature and old forest covers 1,741 ha (18%), and the rest of the area is young forest or waterbodies.

14.2.2.2 Terrestrial and Aquatic Wildlife

Comprehensive wildlife surveys conducted in 2004 and 2005 identified a range of terrestrial wildlife species present within the Galore Creek Valley that may be affected by mine development activities. Wildlife habitat suitability mapping was carried out to assess wildlife habitat in the study area for six focal species: grizzly bear (*Ursus arctos*), moose (*Alces alces*), mountain goat (*Oreamnos americanus*), American marten (*Martes americanus*), hoary marmot (*Marmota caligata*) and western toad (*Bufo boreas*). These species were selected based on input from regulatory agencies, Tahltan community members and the Cassiar Iskut-Stikine Land and Resource Management Plan (MSRM, 2000), as well as results of consultation with the Tahltan First Nation. Habitat suitability ratings for the Galore Creek Valley were based on the TEM program summarized above.

The baseline aquatic surveys identified no fish presence or adequate fish habitat above the Galore Canyon, which is approximately 1,800 m upstream from the confluence with the Scud River.

14.2.2.3 Traditional and Current Human Use

Historic hunting and trapping in the region by Tahltans is a critical component when considering area land use. Review of existing ethnographic and ethnoarchaeological studies in combination with studies conducted as part of the Galore Creek Project baseline program found no evidence of significant traditional use associated with the Galore Creek Valley itself.

There are multiple traplines within the project area. In addition, two hunting guide outfitters have tenures that fall within the study area: Golden Bear Outfitting Ltd. and Northwest Ranching and Outfitting. Trapline and guide outfitting information is provided in Appendix 6-S.

Interviews conducted in late 2004 and early 2005 indicated that many of the traplines within the study area have not been active since the 1950s, and that some have been leased and trapped by individuals other than the registered owners. Representatives from Golden Bear Outfitting Ltd. have stated that although their hunting area falls within the Galore Creek study area, it is not in use. Representatives from Northwest Ranching and Outfitting have stated that the Galore Creek Project site is an area of overlap between the two companies.

14.2.3 Protection of Terrestrial and Aquatic Resources

The environmental management and monitoring systems that will be in place at the start of mine construction are designed to ensure the protection of terrestrial and aquatic resources. Consistent with the ISO principle of continual improvement, NovaGold will ensure that management and monitoring systems are updated regularly through a program of adaptive management coordinated with regulatory agencies and stakeholders such as the Tahltan Nation. Environmental Monitors will be assigned to various project stages to ensure compliance with applicable permits and NovaGold environmental policies.

14.2.4 Protection of Heritage and Archaeological Resources

Heritage and archaeological resources identified during the baseline field studies (Appendix 6-R) will be protected through all phases of the mine development. Any additional sites that are located adjacent to the access corridor or other locations will be properly marked and managed in consultation with members of the Tahltan Central Council and the Heritage Branch in Victoria as required under the *Heritage Conservation Act* of British Columbia.

14.2.5 Progressive Reclamation

Soils and till material excavated from the surface of the mine area during the construction and operations phases will be stockpiled where feasible for use in both progressive reclamation and ultimately mine closure activities. During mine operations, potentially reactive waste rock and tailings materials will be fully submerged within the main Galore Valley tailings and waste rock impoundment facilities designed by BGC Engineering for long-term geotechnical and geochemical stability.

As detailed in the Mine Site ML/ARD Prediction and Prevention Management Plan in Chapter 11, waste rock geochemistry will be continuously evaluated during regular mining operations to ensure that potentially reactive material is segregated and stored within containment structures for subsequent submergence. Non-reactive waste rock dumps will be progressively contoured and covered as required by the Mine Permit with a suitable growth medium, then seeded with endemic pioneer plant species. At the cessation of mining activities, all tailings and potentially reactive waste rock will be fully submerged. Engineered hydraulic controls will be installed to ensure long-term submergence of these materials. Any aerially exposed non-reactive waste rock dumps will be suitably contoured and seeded to promote long-term stability and compatible wildlife use.

14.3 Reclamation Components

The general goal of reclamation is to restore, where possible, the equivalent capability so that a variety of appropriate end land uses can be achieved. To this end, the materials suitable for reclamation purposes in the disturbed areas must be conserved and the resultant landforms designed, where possible, to accommodate the desired end land use objectives. It follows that the reclamation efforts will be directed toward the development of appropriate and functional ecosystems. These efforts will be supported by appropriate soil handling and revegetation strategies.

Closure and site reclamation strategies to be implemented in support of establishment of productive land uses post-mine closure include:

- *Disassembly and Disposal of Mine Infrastruture:* All buildings not required for long-term post-closure monitoring will be decommissioned and disposed of either on or off site as required under permit. All hazardous materials will be decontaminated and removed from site for permitted off-site disposal. Opportunities for reuse or recycling of materials will be pursued wherever possible. Facility foundations will be levelled to grade and covered with suitable overburden materials to enable the establishment of a vegetative cover.
- *Re-contouring:* Waste rock piles and cut-and-fill slopes associated with diversions, access roads and laydown areas will be recontoured to blend with the surrounding natural topography. The detailed requirements for recontouring will be developed as part of the mine permitting phase.
- *Watercourses:* All water diversions and sedimentation ponds will be decommissioned so as to re-establish natural drainage patterns consistent with long-term geotechnical stability. Open pits will be allowed to flood and overflow sequentially into one another with re-establishment of a surface hydraulic connection between the West Fork of Galore Creek to allow water movement into the main portion of the Galore Creek Valley.

Each of these strategies will be developed in greater detail as part of the detailed *Mine Plan and Reclamation Program* document described above.

The reclamation and closure plan developed to meet these objectives is described below. It includes the end land use objectives, the soil handling plan, the staging of reclamation, the capability of the mine site upon closure, the closure of ancillary facilities and the access road, and a reclamation assessment plan.

14.3.1 General End Land Use and Capability Objectives

The pre-development land use and conditions form the basis of the end land use and capability objectives. Currently, pre-development forested and parkland ecosystems function to provide a range of values relative to traditional use, wildlife habitat and possibly forestry. The primary end land use for the area is wildlife habitat supported by a functioning, though low-productivity, forest. It should be noted that water will cover extensive areas of the post-mine landscape, approximately 36% of the footprint, compared to less than 1% prior to mining. This represents a

net loss of terrestrial ecosystem to this area. There is potential for developing/enhancing littoral and riparian values within the aquatic area, primarily within the reservoir area and, much less so, within the pit lakes.

14.3.1.1 Post-Mine Wildlife Habitat Objectives

Reclamation objectives for wildlife habitat were developed based upon the existing habitat types within the mine site area that will be directly affected by project activities. Habitat reclamation will focus on four target species:

- grizzly bear
- mountain goat
- American marten
- western toad.

Late spring, summer and fall habitat for grizzly bear occurs within the Galore Creek Valley. Late spring (mid-June to mid-July) habitat includes the wet meadows and herbaceous avalanche paths associated with the ESSFwv and ESSFwvp BEC subzones found throughout the valley. Grizzly bears prefer higher elevations during mid-July to early August. Important summer habitats associated with the valley include herbaceous avalanche paths, alder thickets and alpine sedge meadows within the ESSFwv and ESSFwvp zones, with further value provided by areas of suitable hoary marmot habitat. Suitable fall habitat in the Galore Creek Valley includes avalanche paths, swamps with vegetative forage such as lupine and cow parsnip, and late-producing berry areas.

The presence of escape cover for predator avoidance, which includes steep precipitous terrain, is the most important feature of mountain goat habitat. Escape terrain was found associated with the avalanche paths and high-elevation areas within the Galore Creek Valley. Some of this high and very high suitability winter habitat will be directly disturbed by mining activities.

Marten winter habitat includes mature to old growth conifer forests, with a closed canopy (>40%) and coarse woody debris within the understory. Within the Galore Creek Valley, highly suitable marten habitat was associated with mature and intermediate forest (structural stages 5 and 6) within the lower elevations of the ESSFwv subzone.

Suitable western toad terrestrial habitat occurs throughout the area of direct disturbance. Toad observations and potential breeding habitat were identified within the non-forested wetland habitats associated with the ESSFwv subzone within the Galore Creek Valley.

The wildlife reclamation objective is to restore habitat for these species to be as close to pre-disturbance conditions as possible.

14.3.1.2 Post-Mine Forest Productivity Objectives

The potential for forestry use of these lands is limited by the extreme climate and its effect on productivity, and the remoteness of the site. Mature, low-productivity forest stands do, however, occur in the valley, and their replacement and the values that they represent, in terms of both a

potential fibre resource and as habitat, are recognized. An objective of the reclamation plan is to restore a portion of the reclaimed lands with capability for forest productivity equivalent to that of the pre-disturbance levels.

14.3.2 Soil Handling Plan

The soils in the study area have been assessed for their suitability for reclamation to meet the desired end land use. They must be salvaged and conserved according to their nature, source, volume and intended final location.

During construction, soils will be removed to make way for construction of facilities. Provision will be made for the salvage and stockpiling of the surface, organic/nutrient enriched humus and upper mineral topsoil layer (variable thickness but assumed to approximate 0.3 m thick). This thinner salvage layer, relative to mine area root zone salvage, assumes that the post-disturbance, the ripped, recontoured surface will primarily comprise the original, subsoil material. In areas where potentially unsuitable spoil is placed, such as waste rock dumps, thicker soil may be salvaged and replaced. The identification of these areas will be developed as part of permitting. The primary mitigative process is to salvage the soil and store it for later re-application on a reconfigured surface as part of final site reclamation.

Following soil replacement, the surface will be seeded, typically as part of a hydromulch application, to provide for initial fertilizer requirements and surface stabilization through revegetation. These areas will then be planted with suitable wildlife habitat species and forestry planting stock (mixed tree and shrubs).

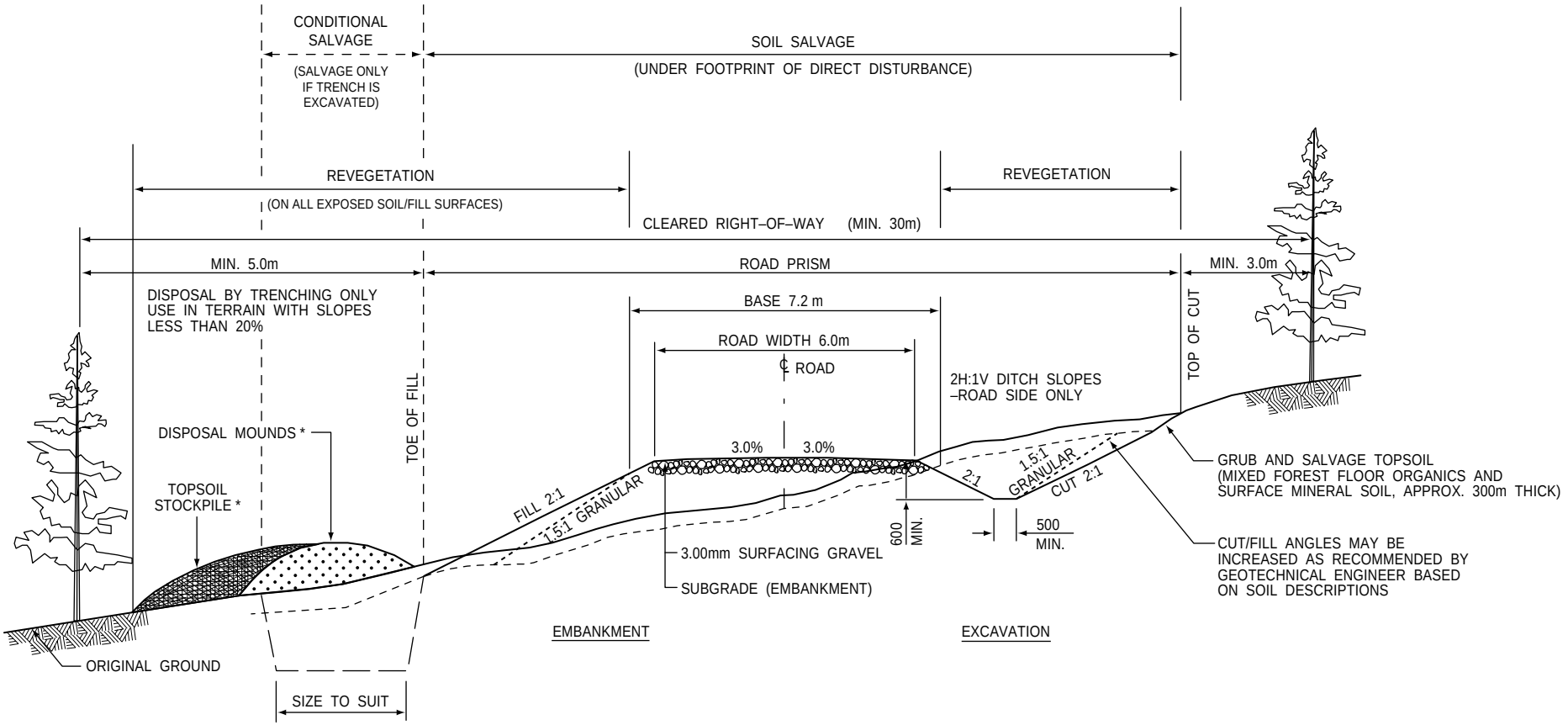
Rehabilitation guidelines for many of the land disturbances associated with the project's ancillary facility developments are outlined in the "Soil Rehabilitation Guidebook" (B.C. Ministry of Forests, 1999).

Soil salvage (0.3 m of combined humus and upper mineral horizons) and stockpiling is planned for the length of the road footprint. The approximate width of stripping and tentative stockpile locations are noted in Figure 14.3-1. Exceptions to this general practice will occur in areas where soils are not present (areas previously disturbed, bedrock-dominated terrain or areas of recent surficial material deposition, *i.e.*, moraines and talus) or where soils will not be excavated (*i.e.*, wetlands). At closure, these areas will be recontoured to fit the natural landscape/drainage, and the stored topsoil will be replaced and revegetated (seeded/planted). Special management, including the use of non-standard equipment (wide-tracked or long-armed equipment), and care will be taken in areas of weakly trafficable soils (moist or wet) to avoid excessive disturbance and rut formation.

Restoration of lands affected by road development includes four main stages:

- planning and inventory
- field assessments and prescriptions
- implementation
- effectiveness evaluation.

PRIMARY LANE – TYPICAL ROAD SECTION (MINERAL SOILS)



*Note: * Provide openings in mound/stockpile to allow for surface drainage.*

Source: McElhanney Consulting Services Ltd.

General Soil Handling and Revegetation Management Along Road during Construction

FIGURE 14.3-1

NovaGold Canada Inc.

Rescan™

Soils will be salvaged, usually to their full root zone depth (closer to 0.5 m), over the proposed borrow areas. This thicker salvage/replacement material is required where the nature/suitability of the soils in the borrow pit base are not known, or if waste rock is to be placed in these areas, potentially creating an unfavourable subsoil layer.

A reference of particular note on the subject of site restoration and forest roads is the "Best Management Practices Handbook: Hillslope Restoration in British Columbia" (B.C. Ministry of Forests, 2001). Techniques of forest soil rehabilitation are continuing to evolve in B.C., and recent study results may be applicable to the conditions encountered at the time of road closure (B.C. Ministry of Forests, 2002).

14.3.2.1 Stripping Sequence and Methods

As a general rule, soils will be salvaged progressively ahead of the disturbance associated with mining activities. NovaGold will maximize the potential for direct replacement of soil materials to areas no longer required for mining or other disturbances. Where direct replacement is not possible, as is the case for the majority of the site, soils will be stockpiled in stable areas and temporarily vegetated. For linear disturbances the salvaged soil materials will be stored, where practical, in windrows adjacent to the disturbance or in stockpiles in nearby stable terrain.

Soil Handling Lifts

The soil salvage plan calls for a number of different handling strategies, including so-called two-lift, one-lift and special handling of organic soils; and areas of no salvage. Differentiation is made between topsoil, organic soil and overburden (non-bedrock waste).

Separate stockpiles/storage areas will be developed, as required, to maintain the integrity of each material, defined as follows:

- Topsoil – includes forest litter and the developed mineral horizons to the depth of common rooting (typically includes the A and B horizons)
- Overburden – includes the unweathered soil parent material and other unconsolidated materials (strata) above bedrock
- Organic soils – limited in extent to wet depressions or very poorly drained toe slopes and composed of organic material, defined as having a minimum of 17% organic carbon.

In a two-lift system, topsoil is salvaged separately from the overburden and both materials are stored and/or replaced separately. In a one-lift system, there is no differentiation between the topsoil and the overburden. The resulting material is treated as overburden in terms of storage and/or replacement. Organic soils present special handling requirements because of their high water content and associated trafficability and storage problems. They are handled/stored and replaced separately. Areas of no salvage include bedrock, ice and permanent snow.

Soil Salvage Volumes

Salvage thickness for each soil type is indicated in the baseline soil survey report and typically ranges from 0.4 m to 0.5 m for the forest mineral soils and 0.7 m for most of the organic soils (Appendix 6-K). The soil thickness groupings are summarized in Table 14.3-1. A number of

exceptions where no topsoil is present (bedrock, ice and recently deposited soils) are also indicated.

Table 14.3-1
Summary of Preliminary Soil Suitability Ratings for Reclamation

Soil Group	Rating	Limitations (typical)	Topsoil salvage	Topsoil thickness (m)	Topsoil handling issues
Colluvial (Podzol / Brunisol): Ca2, Cp1, Cp2, Cw1, Cw2; Uw2	Poor-Unsuitable	Coarse fragments Low pH Bedrock	Yes	0.5	Excess/complex slope; shallow to bedrock; sometimes bouldery and/or excessively stony
Morainal (Podzol / Brunisol): Ma1, Ma2, Mp1, Mp2, Mw1, Mw2	Poor-Unsuitable	Coarse fragments Low pH Consistence (C horizon)	Yes	0.5	Sometimes bouldery and/or excessively stony
Regosolic and Undifferentiated: Ma3, Mp3, Fw3, Gp3, Ca3, Cp3, Cw3, Uw3	Poor-Unsuitable	Coarse fragments Coarse texture (Fw3, Gp3) Free carbonates (Mp3) Consistence (Ma3, Mp3)	No	0	Sometimes bouldery and/or excessively stony
Gleysolic: Lw4, Mw4, Mp4, Uw4	Poor-Unsuitable	Coarse fragments (except Lw4) Consistence (Lw4 only)	Yes	0.4	Poor trafficability; excess wetness; variable organic layer thickness
Glaciolacustrine: (Lw1, Lw2)	Poor	Consistence	Yes	0.5	Excess slope
Organic: (Ow1, Ow2, Op1)	Not rated	Special handling	No	Less than 1.0	Poor trafficability; excess wetness; use as an amendment

As shown in Figure 14.3-2, potential topsoil salvage volumes are calculated based on the distribution of soils affected by the proposed mine facilities.

Each polygon in Figure 14.3-2 is interpreted for the appropriate numbered soil lift method (2 – topsoil separate from overburden or organic soil separate from overburden; 1 – topsoil mixed with overburden; 0 – no topsoil or overburden salvage). The soil polygon colours are based on the dominant lift type. Within complex soil polygons, where some topsoil is salvageable, cross-hatching is used to indicate that variation in lift methods are to be anticipated within this area.

Topsoil is salvageable, separate from overburden, in terrain with slopes with gradients of 50% or less. Where topsoil is present in steeper terrain, it will be salvaged in a one-lift system in combination with overburden, but separate from bedrock, and will be placed in the overburden stockpile. Topsoil placed in the overburden pile is not included in the calculated topsoil salvage numbers. On linear facilities, where it is common to use backhoes, topsoil will be salvaged and windrowed nearby or, if conditions are unsuitable for windrowing, be hauled to a local stockpile area. All stockpile areas will be located by GPS and reported in the annual reclamation report. Organic soils (>0.4 m thick, though typically ranging up to 1 m thick) are present in the few wetlands within the project footprint. These materials will be salvaged for use as an amendment on replaced soils and/or overburden and/or in wetland restoration, if any. It is usually preferred to salvage these materials when frozen. Some pre-stripping and site drainage improvements (especially perimeter drains) may be required to increase the potential for frost penetration into these materials prior to salvage.

Overburden, excluding bedrock materials, will be routinely removed from the pit areas and stockpiled or used for dam construction. Some of these materials may be suitable for use in

development of reclaimed soil profiles, either as a deep subsoil layer or as a separating layer from less favourable waste materials (not-PAG waste rock). It may also be a potential substitute root zone material, if adequately amended. The results of a preliminary overburden suitability assessment report, primarily in the pit areas, indicate a significant thickness (potential volumes) of variable quality overburden in the Central pit area and lesser amounts in the other pits (Rescan, 2006). Potential overburden volumes have not been calculated as part of this report, although information of this type has been calculated for the combined open pits (166 Mt of "till" or mixed glacial materials) and for potential borrow areas by others (BGC, March 27, 2006, Dwg 37).

The total potential topsoil resource in the 2,200 ha area of the project footprint is estimated to be approximately 5.034 Mm^3. Topsoil is to be salvaged from approximately 1,083 ha, or 50%, of the footprint, in all areas where pre-stripping excavation activities are proposed (mine pits, borrow areas and linear facilities such as roads, drainage diversion channels and ditches), as shown in Figure 14.3-3. The total amount of salvageable topsoil within this "excavation" area is estimated to be 3.539 Mm^3 of mineral topsoil and 0.106 Mm^3 of organic soil. The approximate volumes available from salvage over each mine facility component are summarized in Table 14.3-2

Table 14.3-2
Salvageable Topsoil

Mine Development Component	Extent (ha)	Salvageable Topsoil Volume (000 m^3)	Comments
Pit Areas			
Central (10, 7)	237.4	762.6	Includes main and satellite pit
Southwest (2)	65.3	242.4	
West Fork (1)	26.5	0	
North Junction (13)	62.9	139.0	
Valley Borrow Areas			
Northeast (25)	141.5	545.5	
Northwest (24)	97.5	412.8	
Southwest (23)	100.8	357.1	
Southeast (22)	61.9	224.9	
Junction Dumps (3, 4, 5, 6, 8, 11, 12)	135	411.9	
Other			
Plant / Stockpile Area (9)	54.0	231.7	
Main dam (14)	74.3	209.8	
Diversion channels	33.2	107.3	Locally available
Other	520.4	Local salvage (undefined)	Numerous undefined disturbances

14.3.2.2 Stockpile Locations, Volumes and Configuration

The approximate locations of 10 potential topsoil stockpiles are indicated in Figure 14.3-2. These piles are located in close proximity to either their point of salvage or the site where they will be required for use in capping final surfaces. The total volume of topsoil stored from the excavated areas is estimated to be 3.645 Mm^3. Of this total, approximately 0.107 Mm^3 will be stored along linear facilities (net 3.538 Mm^3 to the 10 stockpiles). This volume does not include mixed topsoil/overburden or overburden (non-waste rock) material. Individual topsoil stockpile volumes are indicated in Figure 14.3-3.

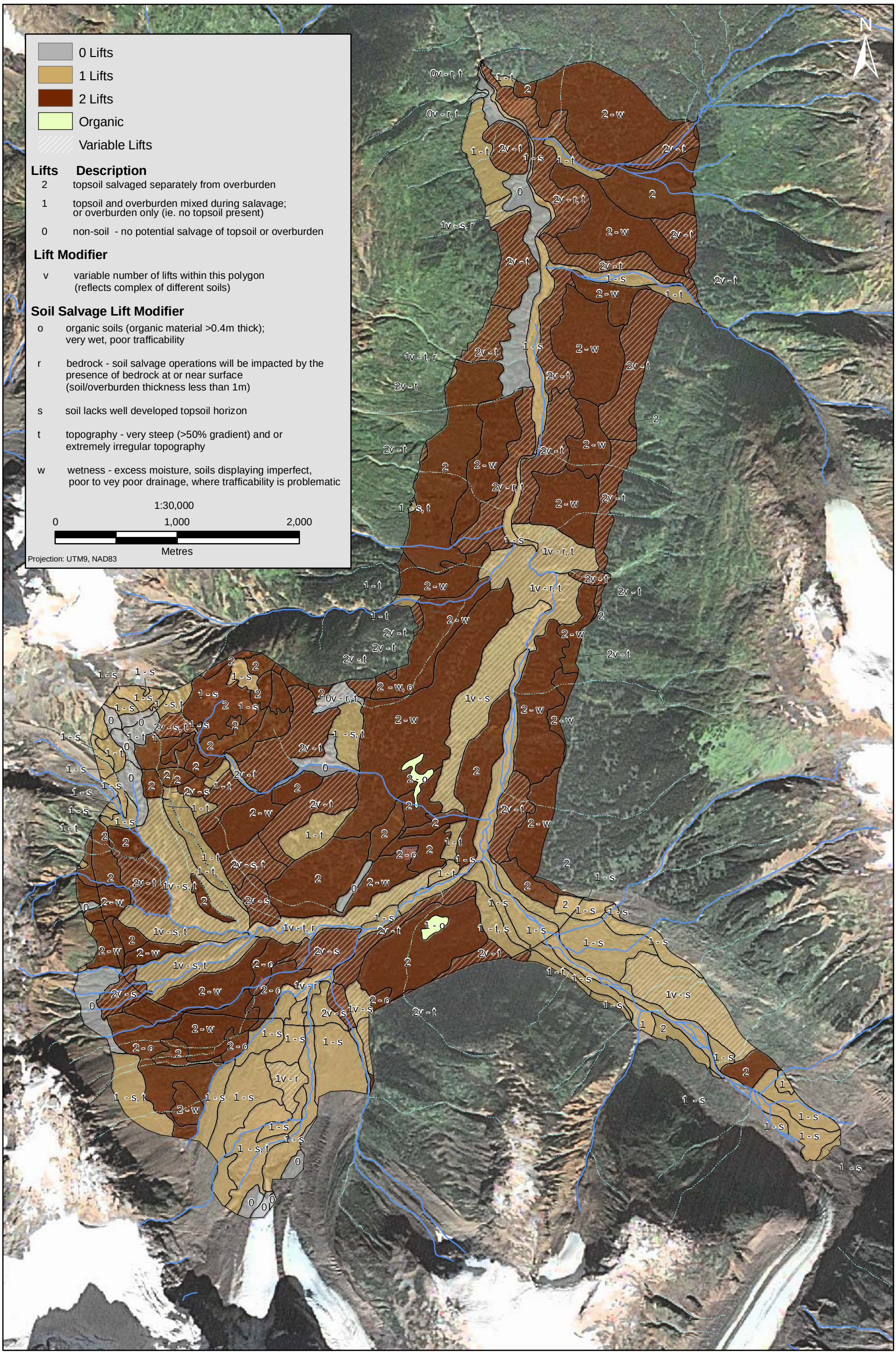


FIGURE 14.3-2

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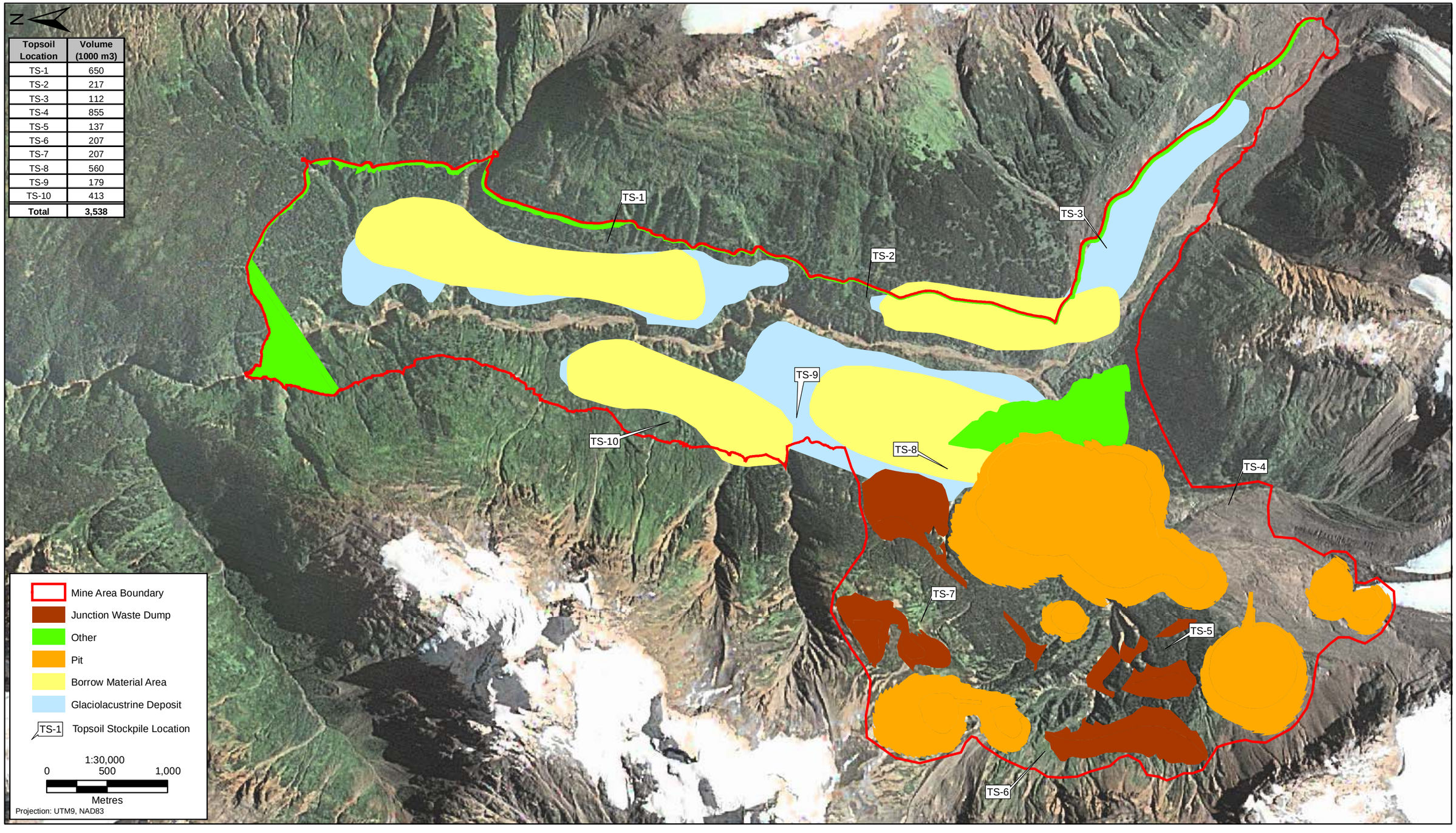
Soil Salvage Potential, Galore Creek Valley Mine Area

Rescan™

Topsoil Location	Volume (1000 m3)
TS-1	650
TS-2	217
TS-3	112
TS-4	855
TS-5	137
TS-6	207
TS-7	207
TS-8	560
TS-9	179
TS-10	413
Total	**3,538**



NovaGold Canada Inc.

Areas of Probable Soil Excavation Associated with the Mine Facility Development

FIGURE 14.3-3

Rescan™

Topsoil salvage is associated with pre-stripping activities and as such will be conducted primarily in the preproduction years, when reclaimable areas are generally not available for direct replacement. It is assumed that all salvaged soil in these early years will be placed in stockpiles.

The Project Description does not address the detailed movement of soil material into and out of stockpiles throughout the life of the mine. Instead, simple comparisons are made of total topsoil volumes salvaged to total volumes required for reclamation through closure. If some topsoil is to remain in stockpiles post-closure, then the stockpiles will be graded to local contours and revegetated.

Protection of soil storage stockpiles will include a number of practices that can be grouped and described according to the following general categories: siting, configuration, revegetation and timing.

Siting:

- areas that will not be disturbed by other mining activities before the soil is needed for reclamation purposes
- areas of good trafficability (good drainage and level to moderately sloping)
- setback for drainage course (permanent and ephemeral)
- away from areas of geohazards (slides, avalanches, flooding)
- preference for areas of past disturbance, if available, to minimize additional disturbance.

Configuration:

- slope gradients that provide geotechnical stability
- slopes that can be readily revegetated (gradients or slope alteration that reduce the potential for sheet erosion and rill erosion)
- benching to reduce slope lengths
- surface drainage to convey concentrated runoff safely to the toe of the stockpile
- perimeter toe ditch with basins to capture initial sediment “flush.”

Revegetation:

- progressive revegetation of the exposed soil surface to minimize the extent of bare or exposed soil (as soon as stockpiles activities cease, or at the initiation of the growing season)
- use of “hydromulching” on relatively steep, non-trafficable slopes and to provide immediate protective cover where sensitive receptors are nearby.

Timing:

- undertake activities during periods of “relatively” dry weather (late summer, when soil moisture is at its lowest)

- handle soils when unsaturated (provide pre-stripping drainage to decrease water content in soils that are naturally imperfectly to poorly drained) before salvage and placement in stockpiles
- consider salvaging soil when frozen (but with low snow content), when runoff and soil seepage may be at a maximum, but keep snow entrainment to a minimum in the stockpile(s).

14.3.3 Reclamation

One objective of the reclamation plan is to reclaim surfaces in a progressive manner. During operations, the land surfaces available for temporary reclamation (stabilization with vegetation) will include linear developments, road and diversion channel cuts-and-fills and the topsoil stockpiles. Final reclamation will be undertaken as activity ceases at the various project facility areas. The following includes a description of the closure schedule, the amount of soil required per area of disturbance and the soil replacement requirements for each.

14.3.3.1 Reclamation Schedule

Dump surfaces account for nearly 80% of the upland area to be reclaimed. The development and closure of the waste dumps determine the timing of the permanent reclamation of most of the mine site disturbances. Information on the timing of waste dump closure is available in the mine plan (NovaGold and Hatch). The two major dump areas are the valley dump (BGC, 2006) and the Junction waste dumps (PEA, Oct. 2005). Reclamation revegetation activities will generally begin in the first growing season following dump closure. The main valley waste dump, totalling 435 ha, will be closed in the sequence noted in Table 14.3-3.

Table 14.3-3
Closure Schedule and Extent of the Valley Dump and North Junction Dump Areas

Mine Year of Final Waste Deposition	Extent (ha)	Area Identifier	Dump
10	52.9	not-PAG 2[1]	Valley
14	36.2	not-PAG 4[1]	Valley
16	135	Junction (1-6)[2]	Junction
19	69.9	not-PAG 5T[1]	Valley
20	56.2	not-PAG 6[1]	Valley
Post 20	220.0	Remainder of surface[2]	Valley

[1] NovaGold Mine Production Series 5.10 (spreadsheet March 2, 2006); revised to include modified BGC (March, 2006) layout
[2] Rescan as derived from BGC (Dwg. 40)

Completion of the Junction waste dumps (1 to 6) is related to development of the Junction pit. As currently scheduled, waste from the Junction pit would begin to be deposited in Year 5 and end in Year 16 and cover a combined total area of approximately 135 ha. Sequencing for closure of the six Junction waste dumps is not provided. It should be noted that development of these

dumps is not a certainty, and waste generated from the Junction pit may be disposed of in the main valley dump.

14.3.3.2 Soil Material Replacement

The concept is to replace soil material on the reclaimed landscape to support vegetation appropriate for the habitat being developed and to suit local conditions. Soil replacement strategies include the use of topsoil in combination with overburden. The replacement thickness assumes that trees will be grown where climate conditions permit.

The replacement root zone thickness of 0.5 m is based on results of the soil investigations undertaken within this area (Rescan, 2005). An additional thickness of 0.5 m of overburden, to act as a buffer or barrier, is assumed for areas where the quality of mine substrates is not known and may be unsuitable for root development. A total thickness of 1 m (0.5 m of topsoil overlying 0.5 m of overburden) is to be replaced in the upland, reclaimed terrain overlying exposed bedrock or waste rock. The need for the 0.5 m buffer of overburden material on various post-mine landforms will be further investigated in a series of reclamation test plots during mine operations.

The major post-mine landscape conditions under consideration at present are described below.

Pit Areas

There is limited opportunity to reclaim the pit areas, primarily because the pit highwalls, made up of narrow benches and extremely steep inter-bench slopes will be subject to failure and as such are not reclaimable. However, within the Central pit, reclamation efforts may be put toward specific surfaces including:

- wide, main in-pit haul roads (approximate running surface 20 to 30 m wide)
- low-gradient terrain at the edge of the pit pond.

Root zone material could be placed and revegetation initiated on the abandoned single- or dual-lane main haul roads above the ultimate pit pond elevation (675 m amsl). A 1 m layer of suitable overburden or combined topsoil/overburden would be placed directly onto the abandoned, possibly scarified, not-PAG based road surface in a manner that would not interfere with established drainage. These revegetated areas would act as islands of potential seed sources for voluntary distribution to other receptive areas within the pit that could develop sufficiently to provide temporary shelter for wildlife transecting these areas.

The low-lying, eastern perimeter of the Central pit, near the proposed pit discharge point (to be excavated through the plant site fill), may potentially represent an area for the development of a littoral edge to the pit pond. A narrow strip, less than the width of a haul road (approximately 15 m wide), could be developed in the shallow water (less than 2 m) along the pit edge. Re-sloping would create a shallow, gently sloping or undulating zone ranging from slightly above the outlet elevation (normal high water) to a maximum water depth of 1 to 2 m.

Suitable overburden, 0.5 m thick, would be placed overtop the re-sloped pit edge to provide a suitable sediment for the development of littoral vegetation. It is likely that these areas would

initially be well above the pit pond water level. Initial revegetation would be aimed at stabilizing the surface and developing a layer of organic litter (debris). The concept assumes that pit water quality will be adequate for vegetation establishment and potential use by wildlife.

Waste Dumps

As indicated previously, the waste dumps represent the most significant areas of potential revegetation. BGC has estimated a total waste dump surface area for revegetation of approximately 7.05 km^2 (5.70 km^2 valley dump, 1.35 km^2 upper dumps) at closure. Typical waste dump configurations (cross-sections) for the valley dump and Junction dumps are indicated in the BGC report (Dwg. 12 and Dwg. 40, respectively). The waste dumps are shown to have level or near-level tops, with final maximum gradient side slopes of 2H:1V (50% gradient) in most areas, except the north slope of the valley dump (4H:1V above the tailings pond).

Different objectives have been developed for soil replacement depth based on anticipated mature ecosystem vegetation rooting requirements. The principal assumption is that the forested ecosystems of the ESSFwv subzone may require a deeper rhizosphere to accommodate deep, stabilizing tree roots than the non-forested areas of the parkland and alpine. The associated soil replacement treatment would include 0.5 m of topsoil over 0.5 m of overburden to overlie the scarified, not-PAG waste rock. For the purposes of this assessment, it is assumed that the waste rock will be unsuitable as a deep root zone material in this wet environment. Field trials using a variety of test plots (combinations of topsoil, overburden and spoil on various slope gradients) will be undertaken during operations to develop proven site-specific treatments. Above the treeline, in the parkland (ESSFwvp) and alpine (ATu), a shallower capping of 0.5 m topsoil, directly overlying not-PAG waste rock, is anticipated to be adequate to meet the root zone requirements of the proposed revegetation type, which will be dominated by shrubs and herbs.

The practicality of placing separate lifts of topsoil and overburden on the steep (2H:1V) slopes of waste rock of irregular particle size will be tested during operations. An alternative may be to place 1.0 m of overburden instead of the preferred topsoil/overburden combination. The overburden would need to be amended with commercial fertilizers and/or organic materials to make up for the initially reduced fertility. During operations, field test plots will be established to test various methods of applying soil materials to slopes.

The current slope lengths, as noted in the BGC report (Dwg 40), range from approximately 85 m to 480 m. These are excessive when considering the potential for water erosion and difficulty in spreading topsoil over such long distances. It is more likely that a series of narrow terraces, associated with lift stages in the development of these dumps, will be preserved to some extent to reduce the effective slope length and its potential erosivity. Some reconfiguration of the dump slope crest may be preferred for visual protection of wildlife and slope habitat diversification (*i.e.*, drainage/exposure differences in draws relative to exposed outer slopes).

Other Areas

General Disturbances

In areas other than the waste rock dumps or pits, it is generally assumed that the local surface materials are suitable for use as deep root zone material. Typical disturbances are associated with diversion channels, access roads, pipelines and local laydown areas. In these areas, locally salvaged and stockpiled topsoil will be replaced (approximately 0.3 to 0.5 m thick) over these recontoured and scarified surfaces to depths equivalent to those prior to disturbance.

Riparian (Channel Crossings and Re-established Creeks) and Littoral Areas

A series of stream courses (potential riparian areas) may be developed in the post-mine landscape to link the discharges from the pit lakes to the impoundment lake; to convey upper hillslope runoff across the waste dumps; and to link the south end lake to the north end lake in the main valley bottom impoundment. Development of these features will require special handling of soil, rock and coarse woody debris to create the diverse micro-landforms appropriate for this landscape type. The soil types and volumes required to develop these features will be determined during operations.

The cross-valley movement of animals will be restricted by the waterbody created by the flooded impoundment. It may be preferred to create terrestrial/riparian crossing(s) with suitable vegetation cover (including visual protection) to allow for this type of movement. At least three cross-valley, riparian "bridges" may be developed in the impoundment channel during closure. Enhancement of these features, including shallow drainageways (creeks) for fording, may be considered. These riparian crossings would require special placement of soil root zone material (1 m in thickness) above the water level and protective rock in the zone of potential wave/current erosion.

The post-mine lake created in the impoundment behind the main dam, at elevation 674 m amsl, will have two main cells. The north end cell, overlying the former tailings (420 ha lake surface), will have a relatively steep shoreline, and the south end cell (68 ha, upstream end in the East Fork valley), is estimated to have a relatively shallow gradient shoreline. The relatively low-gradient lake edge may present an opportunity to develop a productive littoral zone from high water to the depth of normal light penetration, approximately 1.0 m to 1.5 m depth in these turbid waters. Soil handling requirements, if any, for these areas will be developed during operations.

If it is an objective to create additional areas of littoral habitat in the post-mine landscape, then the south shore of the north cell of the impoundment lake, composed of end-dumped, not-PAG waste rock, could be contoured to achieve relief of suitable configuration. The main component is a shallow gradient beach of sufficient width to create various water depths (to a maximum depth of approximately 1.5 m), and with a suitable lake bottom substrate, within which a diversity of littoral plants could establish. The substrate applied over the waste rock could include topsoil and/or overburden (estimated to be approximately 0.3 m thick). Some selective not-PAG waste placement and/or resloping may be required to develop this useable shoreline bathymetry (*i.e.*, 5% gradient extending 10 to 15 m into the lake).

It is assumed that no soil will be replaced on the main dam, as it will be armed with a thick layer of riprap on the upstream and downstream sides for long-term protection. Revegetation, particularly tree cover, will be discouraged.

14.3.3.3 Materials Handling Balance

The amount (volume) of topsoil available for salvage from the areas of potential excavation (Figure 14.3-3) is summarized by mine development component in Table 14.3-2. As described above, the total salvageable topsoil resource from the 1,083 ha area of proposed excavations is estimated to be 3.645 Mm^3 (including the 0.105 Mm^3 of organic soils). The volumes of topsoil required to reclaim the available surfaces throughout the mine life and/or at closure are summarized by reclaimed mine component in Table 14.3-4.

Table 14.3-4
Soil Replacement Requirements by Reclaimed Mine Component

Reclaimed Mine Component	Extent (ha)	Topsoil Thickness (m)	Topsoil Volume (000 m^3)	Comments
Valley Waste Dump	435	0.5	2,176	
Junction Dumps (1-6)	134	0.5	675	
Plant /Stockpile Area	54	0.5	270	
Diversion Channels	37	As salvaged	Approximately 107	Locally available
Diversion Dams/Structure	17	0.5	83	
Other Areas	520 (only partial disturbance expected)	As salvaged	As salvaged	Locally available
Pit Littoral Areas	1.5 (15 m *1000 m)	0.5	7.5	
Riparian Channel	3.7 (150 m * 225 m)	0.5	18.5	(channel through valley dump); 3 crossings 75 m wide

The total volume of topsoil required for the 646 ha upland dump area to be reclaimed is estimated to be approximately 3.204 Mm^3; this does not include the 0.107 Mm^3 of salvaged material to be replaced along the diversion channel. These replacement estimates also do not include volumes of topsoil salvaged and replaced within the "other" areas of miscellaneous disturbance. It is assumed that topsoil salvaged along these (often linear) disturbed areas will be available at the time of final site reclamation. No topsoil volume estimate has been made for these areas.

The net balance of topsoil is positive, 0.128 Mm^3, indicating that slightly more soil will be salvaged than is currently anticipated to be required through closure. The difference in volume will be held in reserve as a stockpile at closure. If not required, it will be graded to match local contours and be reclaimed and revegetated similarly to the adjacent lands.

The preliminary topsoil balance, comparing salvaged quantities to replacement requirements, suggests that additional salvage is not required from the other areas that will be affected but not excavated, *i.e.*, submerged areas of the tailing/waste rock impoundment. However, as mine plans evolve, calculations of the project soil balance must be kept up-to-date. If topsoil deficits are

shown to arise, then salvage from these other affected areas may have to be considered along with alternatives such as using amended, suitable overburden as a root zone replacement material.

It is assumed, based on the information presented in the overburden report (Appendix 6-F) and work by BGC (Appendix 5-H), that sufficient, suitable overburden volumes are available from within the proposed excavated areas to provide for the deep waste separation layer that will underlie the topsoil layer on the waste dumps. The current estimate of overburden required for use in reclamation is approximately 2.757 Mm^3.

14.3.4 Post-Mine Capability and Suitability

Upon reclamation, the post-mine landforms should have capability that matches the desired objectives. The conceptual post-mine capability is described below.

14.3.4.1 Post-Mine Ecosystem Units

The reclaimed areas will constitute a series of landscapes of varying slope gradient, aspect and length and a range of slope positions across primarily two BEC subzones, the forested ESSFwv and the non-forested ESSFwvp. These site characteristics will influence the soil moisture regime and ultimately the reclaimed ecosystem likely to develop in particular areas. Figure 14.3-4 provides a post-mine ecosystem map of the Galore Valley based on the current conceptual plans for the site. The aerial extent of the various post-mine units is summarized in Table 14.3-5.

As noted above, end land use objectives include the establishment of both suitable wildlife habitat and productive forest lands. The following subsections provide a summary of the wildlife suitability and forest productivity ratings of the conceptual reclaimed land units described above and noted on Figure 14.3-4.

Post-Mine Wildlife Suitability

The post-mine wildlife habitat suitability ratings for the targeted species are summarized in Table 14.3-5 for each of the reclaimed landscape ecosystem units indicated in Figure 14.3-4. The four key wildlife species, grizzly bear, mountain goat, American marten and western toad, were selected for wildlife assessment. There is an opportunity to provide connectivity between the west and east sides of the valley for wildlife movement through development of a series of narrow, approximately 75 m wide, riparian lands, bridging the channel between the east and west valley bottom waste dumps. Further development of this concept and its benefits will be the subject of ongoing reclamation planning at the operational phase.

Reclamation activities required to meet wildlife land use suitability objectives are as follows:

- planting diverse native tree (conifer and deciduous) and shrub species; consider sub-zone characteristics and plant species use by target wildlife species
- varying planting densities and composition, including browse species
- early testing of preferred species planting success on reclamation plots

- spreading coarse woody debris (large logs and stumps) in forest areas to provide microhabitats
- creating a final surface form with minor undulations to create variable soil moisture regimes
- developing hiding habitat with the use of rockpiles
- for erosion protection, applying grass-legume erosion protection mixes with mulch and tackifier on lands deemed erodible (steep gradient lands, inaccessible for conventional seeding); plant these areas at first available planting window (locally late spring–early June to early July; or late fall–mid September).

Post-Mine Forest Productivity

As noted previously, potential forest productivity is low in these areas, limited by the extreme climate. The soil handling plan and post-mine landform development are directed toward the re-establishment of site series similar to those currently present, although the total extent and the relative amount of one site series to the next will likely differ. The conceptual reclamation plan, Figure 14.3-4, provides some guidance to the potential for site series development in the post-mine landscape and shows relatively more mesic sites than subhygric sites than currently exists.

It should be understood that, because of the variable nature of soil materials and moisture movement, it is difficult to quantify the final outcome in terms of site series distribution and extent in the reclaimed areas.

The general expectation is that the 03 and 01 site series will display relatively higher productivity than the 06 site series, which are limited by excessive moisture.

14.3.5 Facility-Specific Post-Mine Capability

The post-mine capabilities of landforms to be developed at each facility are described in general terms of the major conditions at each facility that affect its potential relative to wildlife suitability and forest productivity.

14.3.5.1 Open Pits

Except for a small portion of the Central pit, most of the pit areas will be either water–filled lakes/ponds or extremely steep bedrock outcrops with shallow rubble on narrow terraces. These areas will be extremely limited in their capability except, as noted above, for mountain goat escape terrain. The area will have no forest productivity. A minor area of littoral habitat may be created in the shallow water and gentle terrain near the pit lake outlet of the Central pit.

14.3.5.2 Waste Rock Dumps

The waste rock dumps provide the most significant areas of potentially higher capability lands with values for both wildlife habitat and forestry. With proper soil handling and land preparation planning, the combination of near-level to steep terrain, variable aspect and variable moisture regimes makes for a diversity of potential habitats. The connection to the adjacent valley side-slopes introduces both moisture inputs (several streams will discharge onto the valley dump area) and vegetation altering avalanche activity.

Table 14.3-5
Post-Mine Forest Index and Wildlife Habitat Suitability Ratings for Targeted Species

Map Code	Biogeoclimatic Subzone	Site Series	Map code	Forest Index	Description	Extent (ha)[1]	Grizzly Bear		Mountain Goat (winter)		American Marten (winter)		Western Toad	
							Year 1 (stage 2-3)	Year 100+ (mature)	Year 1 (stage 2-3)	Year 100+ (mature)	Year 1 (stage 2-3)	Year 100+ (mature)	Year 1 (stage 2-3)	Year 100+ (mature)
1	ESSFwv	00	AS	None	Avalanche shrub: (in run-out area in existing avalanche path); imperfectly to poorly drained (subhygric to hygric SMR)	32	Late Spring: High. Summer: Moderate Fall: Moderately High	Late Spring: High Summer: Moderate Fall: Moderately High	Very Low	Very Low	Nil	Nil	Terrestrial: Useable	Terrestrial: Useable
1,2	ESSFwv	01		Low	Forest: Near level to moderately sloping (0 to 25% gradient); moderately well drained (mesic soil moisture regime 'SMR")	427	Late Spring: Moderately High Summer: Low Fall: Very Low	Late Spring: Low Summer: Moderate Fall: Low	Very Low	Very Low	Nil	Closed canopy: High	Terrestrial: Useable	Terrestrial: Useable
1,2	ESSFwv	06		Low	Forest: Toe slopes subject to seepage from adjacent slopes; imperfectly to poorly drained (subhygric to hygric SMR)	35	Late Spring: Moderately Hig Summer: High Fall: Moderately High	Late Spring: Low Summer Moderate Fall: Low	Low	Low	Nil	Open canopy: Moderate	Terrestrial: Useable	Terrestrial: Useable
3	ESSFwv	03		Low	Forest: Dry steep slopes (50% gradient; East and west aspect); rapidly to well drained (subxeric to submesic SMR)	166	Late Spring: Moderate Summer: Moderate Fall: Low	Late Spring: Low Summer and Fall: Very Low	Moderate	Moderately High	Nil	Moderate	Terrestrial: Useable	Terrestrial: Useable
4	ESSFwv	00	AT	None	Riparian Alder thicket: (coarse rubble or gravel at/or above channel water level); fluctuating, generally high groundwater level	<5	Late Spring and Summer: Low Fall: Very Low	Late Spring and Summer: Low Fall: Very Low	Very Low	Very Low	Nil	Nil	Terrestrial: Useable	Terrestrial: Useable
5	ESSFwv	00	WH	None	Littoral Wetland Herb (shallow water at lake edge)	<5	Low	Low	Nil	Nil	Nil	Nil	Breeding: Low	Breeding: Low
6	ESSFwvp	00	TI	None	Tree Island: near level; modeartely well drained (mesic SMR)	24	Late Spring: Very Low Summer: Moderate Fall: Low	Late Spring: Very Low Summer: Moderate Fall: Low	Nil	Nil	Nil	Moderate	Terrestrial: Useable	Terrestrial: Useable
7	ESSFwvp	00	HH	None	Heather–Heath: Dry steep slopes (50% gradient); northeast to south aspect); rapidly to well drained (subxeric to submesic SMR)	21	Late Spring and Summer: Moderate Fall: Low	Late Spring and Summer: Moderate Fall: Low	Moderate	Moderate	Nil	Nil	Terrestrial: Useable	Terrestrial: Useable
8	ESSFwv	00	TA	None	Riprap covered, steep Main Dam face; rubble-like riprap; very xeric SMR	33	Very Low / Nil	Very Low / Nil	Low	Low	Nil	Nil	Nil	Nil
9	ESSFwv	00	RO	None	Bedrock outcrop: Steep bedrock (former pit highwalls); very xeric SMR	105	Very Low / Nil	Very Low / Nil	Moderate	Moderate	Nil	Nil	Nil	Nil
9	ESSFwvp	00	RO	None	Bedrock Outcrop: Steep bedrock (former pit highwalls); very xeric SMR	68	Very Low / Nil	Very Low / Nil	Low	Low	Nil	Nil	Nil	Nil
10	ESSFwv	00	LA	None	Lake: Tailings reservoir and channel (568), Pit lake / Pond (219)	787 less ponds	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
10	ESSFwvp	00	PD	None	Pit pond (Junction Pit; Southwest, West Fork and Central Pit Satellite)	219 less Central	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

[1] **Based on distribution of site series within Reclaimed Ecosystem Units as presented in Figure 14.3-4.**

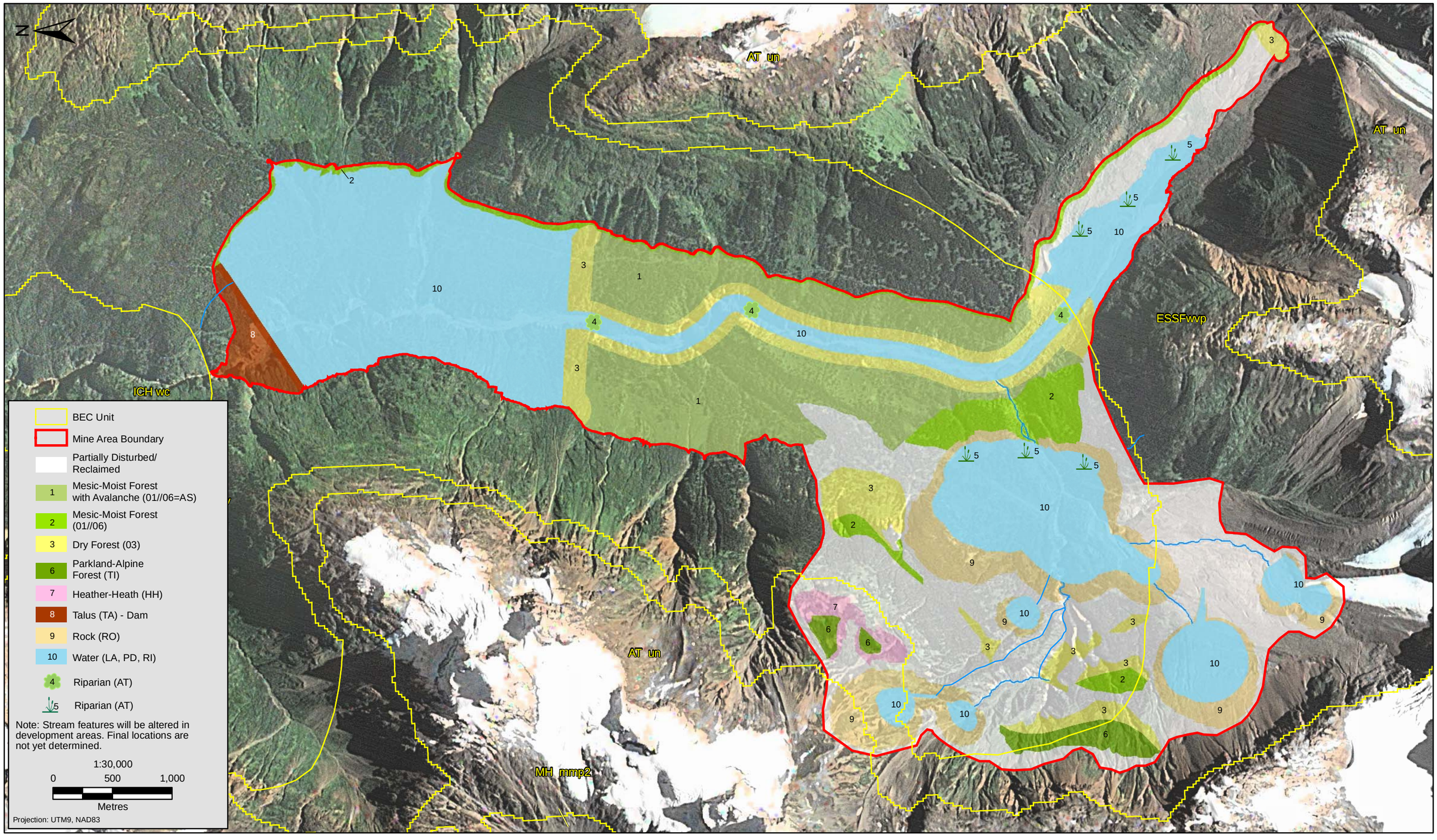


FIGURE 14.3-4

Post-Mine Reclaimed Landscape Ecosystem Units

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Development of riparian zones as creeks to allow water to move across the waste dump, and /or as wetlands to allow water to infiltrate through the waste dump, will be undertaken as part of operations planning.

14.3.5.3 Tailings Storage Facility

At closure, the tailings will be water capped and the tailings storage facility will have no terrestrial suitability (wildlife) or forest productivity. The options for shoreline habitat development will be tempered by the need to develop a stable, non-eroding lake edge to minimize the potential for sediment release to the lake reservoir.

14.3.5.4 Plant Site Crusher and Maintenance/Office

The plant site area will have similarly high capability as the waste rock dump, with values for both wildlife habitat and forestry. Once process buildings and potentially contaminated soils have been removed and soil-handling and land-preparation treatments are completed, the site should be suitable for revegetation. A relatively deep channel will be cut through a portion of the overburden base in the area of the Central Pit discharge to allow water to flow from the pit (elevation 675 m amsl) to the post-mine impoundment reservoir (elevation 674 m amsl). The site will display a range of slope and moisture gradients.

14.3.5.5 Water Management Structures and Reservoirs

Most of the water management structures (diversion channels, dams and structures) will be deactivated and reclaimed for terrestrial habitat. These facilities will be breached and recontoured to gradients required for long-term slope stability and configurations that meet long-term objectives for soil moisture and surface flow. Topsoil will be replaced on these surfaces, followed by various degrees of ripping or scarification. The reclaimed diversion channel areas will likely display a similar, though generally drier, array of soil moisture conditions than existed prior to development, representing the cumulative result of permanent redirection of minor pre-development surface flows. Capability will be similar to pre-mining conditions.

Alternate Impoundment Use Objectives

Figure 14.3-4 indicates an extensive water surface in the impoundment area with limited or no enhanced wildlife values. This water-covered area could be considered for use as a relatively benign water storage area for a potential “run-of-river” hydroelectric development. By developing or maintaining such a facility, the long-term monitoring of the dam and outlet maintenance issues could be shared between past and present users.

14.3.6 Assessment of Reclamation

Reclamation should be assessed on an appropriate time basis to allow for re-treatment where required and to insure the objectives have been attained. The following is a description of the assessment process.

14.3.6.1 Assessment Parameters

Parameter selection to determine if the reclamation objectives are being achieved includes an evaluation of specific characteristics of both the replaced soil and landscape and the established vegetation.

Soils:

To characterize the post-replacement landscape the following parameters will be evaluated:

- slope gradient and site drainage conditions (internal and external) and erosion assessment
- achievement of topsoil thickness and overburden thickness replacement objectives
- assessment of topsoil suitability parameters such as organic carbon, pH, texture, fertility
- trace metal concentrations similar to pre-development levels.

Vegetation:

- productivity, community composition (bio-diversity)
- sustainability – stand density, species presence (growth, height and/or biomass)
- assess wildlife habitat food production, including foliar tissue sampling nutrient analyses
- browse species metal analyses.

14.3.6.2 Reclamation Monitoring

Immediately after the reclamation activities of surface recontouring, soil replacement, ripping and revegetation have been completed, monitoring will be conducted to assess the initial site conditions and the extent of the revegetation effort (seeding and planting targets). Effectiveness of the revegetation effort is best measured at least one growing season post-seeding/planting.

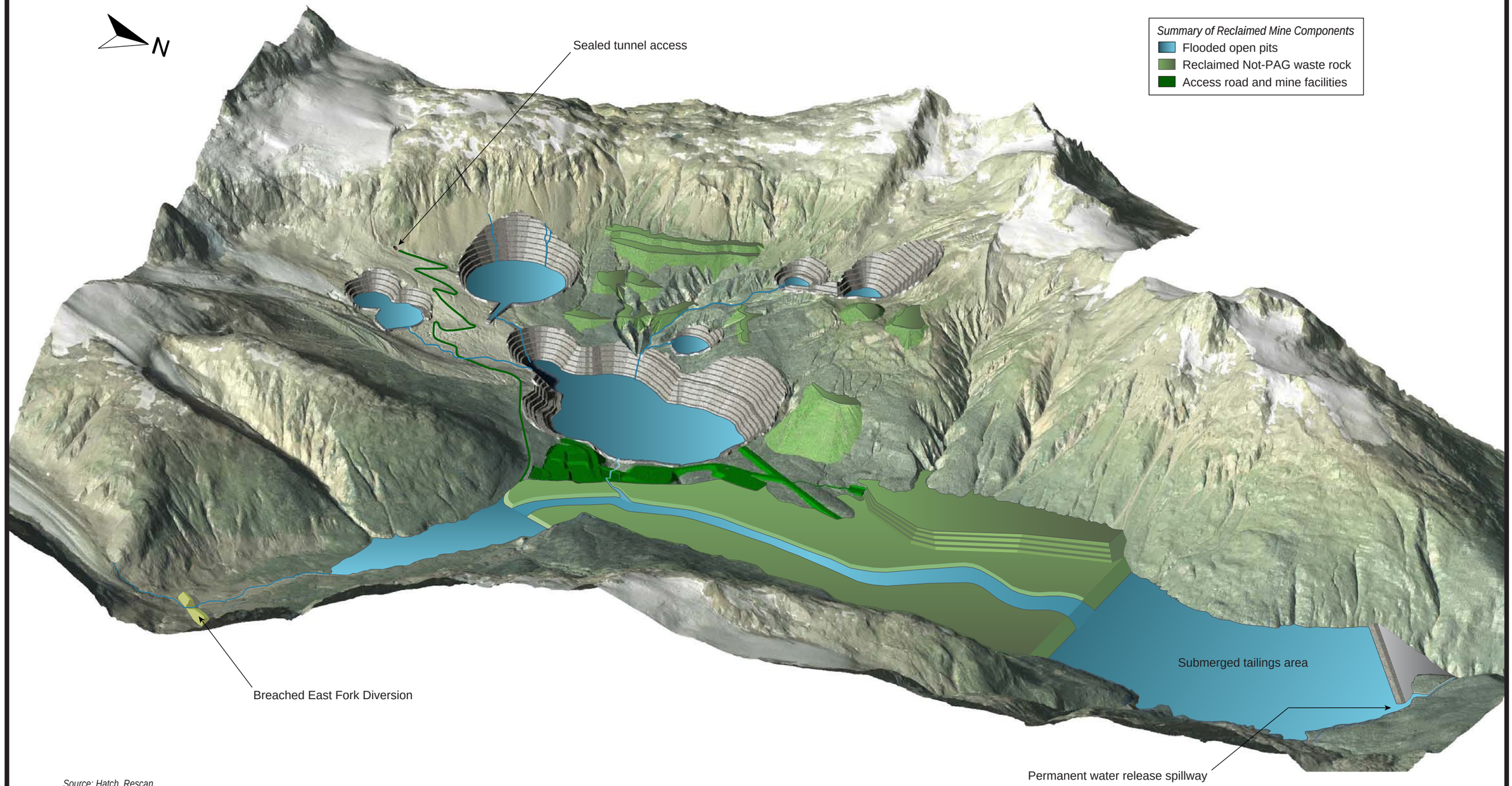
Later surveys of the same areas will assess the sustainability of the reclaimed land vegetation cover in terms of diversity and productivity to confirm that equivalent land capability and land use objectives are being achieved. With confirmation of these objectives, an application will be made for release of the reclamation security.

14.4 Description of Closure Works

The closure and decommissioning information presented here is intended to provide an overview of the closure approaches to be implemented as part of the completion of mining activities within the Galore Creek Valley. The present timeline for operation of the mine will see closure activities begin in the year 2031 and extend over a two-year period, with annual monitoring conducted thereafter. A conceptual representation of the Galore Creek Valley years after the completion of closure and reclamation is shown in Figure 14.4-1.

14.4.1 Mine Infrastructure

As part of mine decommissioning and closure, all buildings and infrastructure not required for long-term post-closure site monitoring will be disassembled and either disposed of at a permitted on-site facility or removed from the Galore Creek Valley for reuse or recycling elsewhere.



Source: Hatch, Rescan.

Galore Creek Valley Conceptual Post Mine Closure and Reclamation Plan
View Looking South-West

FIGURE 14.4-1

NovaGold Canada Inc.

Rescan™

Decommissioning of mine infrastructure and associated site clean-up activities will be carried out in a way that minimizes any potential impact on areas that have been previously reclaimed during the operations phase. All facilities and infrastructure associated with the access corridor will also be decommissioned and removed from the site. The access road and tunnel will be deactivated and reclaimed consistent with both the Special Use Permit and *Mines Act* stipulations and associated permits. Closure and decommissioning of the Porcupine aerodrome will be concurrent with decontamination of the concentrate, diesel and filter plant treated effluent pipelines.

In all cases, closure and reclamation programs will be assigned a suitable number of Environmental Monitors whose responsibility will be to ensure compliance with applicable permits and best management practices.

As in the construction and operations phases, the Environmental Monitor(s) will have the ability to halt site works in instances where there is the potential for environmental compliance to be compromised.

14.4.1.1 Mine Buildings

With the exception of a single post-closure storage facility building that will remain within the Galore Creek Valley, all mine-related buildings including the mill, administration, truck shop, explosives facilities and accommodation complex will be decommissioned. Foundation areas will be regraded to a level compatible with the surrounding natural environment.

The general sequence of mine infrastructure disassembly will be as follows:

Equipment Decontamination

Equipment used for storage, processing and conveyance of mill reagents and concentrate will be fully decontaminated prior to dismantling and subsequent removal from site for permitted disposal. Facilities with equipment requiring decontamination include:

- mill
- reagent storage area
- truck shop
- bulk emulsion plant.

Removal of Salvagable Equipment

It is expected that a large amount of residual site equipment will have salvage value at the cessation of mining activities. Equipment and materials with salvage value will be removed from site for re-sale.

14.4.1.2 Open Pits

As part of mine operations, pit wall stability will be maintained through the use of standard engineering controls as required under the *Mines Act* and its accompanying Health, Safety and Reclamation Code. Once in-pit closure activities have been completed and surrounding permanent water conveyance systems constructed, each of the open pits will be allowed to fill with water. A preliminary estimate of the time to fill each pit is presented in Table 14.4-1.

Table 14.4-1
Estimated Time to Fill Open Pits

Open Pit	Volume (m^3)	Estimated Time to Fill (Years)
Central	294,451,442	7.0 – 10.0
Central (small)	1,571,550	1.1 – 2.0
North Junction	4,922,617	0.6 – 1.0
Southwest	48,150,447	8.5 – 11.0
West Fork	6,213,295	0.3 – 0.5

14.4.1.3 Waste Rock

All waste rock storage areas will be recontoured to a slope compatible with the surrounding natural topography, as stipulated in the Mine Permit and associated reclamation requirements. The closure approach for waste rock storage areas includes:

- All exposed waste rock storage areas will have stable final contours consistent with the surrounding natural topography.
- Waste rock will be covered with suitable overburden as required to ensure an end land use that does not impair the surrounding natural environment.
- All potentially acid generating (PAG) waste rock will be fully submerged within the tailings and waste rock impoundment facility in the central Galore Creek Valley, with permanent engineered hydraulic controls installed, as required.

14.4.1.4 Tailings and Waste Rock Containment Facility

As part of site closure, all tailings and PAG waste rock within the impoundment facility will be fully submerged under a cover of fresh water supplied from natural valley precipitation and associated runoff. The level of the water cover will be controlled by the elevation of the permanent impoundment spillway (see below), currently designed at 674 m amsl. All structures and laydown areas not required for long-term stability of the facility will be decommissioned and landfilled at approved on-site facilities. Foundations will be levelled to the surrounding topography datum and covered.

To protect the physical integrity of the impoundment, a permanent spillway will be installed on the eastern abutment. The spillway will be designed to handle the probable maximum precipitation and will remain in operation as long as the dam exists. The spillway will be kept clean through regular maintenance to ensure that water can be released un-impeded year round.

Based on the results of analytical test programs conducted on representative tailings and waste rock materials, NovaGold anticipates that the chemistry of the water cover will be suitable for discharge to the downstream receiving aquatic environment both during the operations phase and at the end of mining. As a result, the final configuration of the containment facility will be constructed to passively release all excess water via the permanent spillway without collection and treatment.

As listed in the Canadian Dam Association guidelines, a separate Operation, Maintenance and Surveillance (OMS) manual will be developed for the main tailings dam as part of the closure program. This document will include requirements to ensure an acceptable level of dam safety after the mine is decommissioned, and will describe procedures for annual inspection and regular maintenance of the dam and auxiliary facilities such as the operating spillway and seepage collection system.

14.4.1.5 Diversions and Associated Dams

All freshwater diversions and associated dams will be decommissioned. The East Fork and West Fork diversion dams, as well as any major energy dissipater structures along the diversion channels, will be breached. Exposed portions of structures above post-closure water levels will be recontoured to levels compatible with the surrounding natural topography. These exposed areas will be revegetated as required under the Mine Permit stipulations.

To facilitate water flows through the waste dump, a channel will be constructed between the East Fork aqueduct and the waste dump divider as part of the dump development. Similarly, in the area of the pits, water from the upper pits will be controlled and channelled to cascade down from the higher elevation pits to the lower elevation pits.

14.4.2 Ancillary Facilities and Access Road

Procedures for closure of the various ancillary facilities will be similar to those for the mine area, wherein salvaged soil will be replaced over recontoured, prepared surfaces. General practices and those for specific sites are described below.

14.4.2.1 Filter Plant

Initial site development is likely to require extensive levelling earthworks in the currently ridged terrain of the filter plant. Root zone salvage, including the enriched humus to the common depth of rooting of approximately 0.4 m to 0.6 m, will be stored separately. Some organic soils, being of very limited extent, may be salvaged for use as an amendment to the overburden. Local stockpiling of salvaged topsoil is planned for the duration of the facility operating period. Site recontouring and soil replacement, followed by revegetation (seeding and planting), will be part of the final site cleanup.

All equipment and buildings will be decommissioned and removed from the filter plant site. Equipment recycling will be pursued where feasible. Concentrate and diesel fuel storage tanks and conveyance systems will be appropriately decontaminated and removed for either off-site disposal or recycling. Foundations at the site will be levelled and the area recontoured to ensure natural surface drainage patterns are maintained. Special attention will be paid to ensuring that

there are no impacts to the nearby fish-bearing Thomas Creek. Erosion and sediment control measures are described in Chapter 11.

14.4.2.2 Pipelines

The three pipelines required for the project – concentrate slurry, diesel fuel and treated filter plant effluent – will be drained and cleaned of residues according to standard industry practice. All aerially exposed pipeline sections will be removed and either landfilled at approved facilities or disposed of off site at permitted facilities. The pumping station near the headwaters of Sphaler Creek will also be fully decommissioned and removed from the area. Foundations in this area will be levelled and covered to ensure consistency with the surrounding topography.

14.4.2.3 Aerodrome and Heliport

The soils in the footprint of the Porcupine aerodrome area are generally very weakly developed, recent fluvial material. Topsoil salvage is generally not required except in areas of deeper soil development along the east end of the runway and along most of the access road, from the turnoff at the main access road.

The soils in the area of the West More heliport are characteristically weakly developed, pebbly to gravelly material formed in a near-level fluvial fan. Salvage will be restricted to the surface organically enriched layer (approximately 0.15 cm).

As with other facilities, all buildings, storage tanks, *etc.*, will be removed from the Porcupine aerodrome and West More heliport areas. Foundations in these areas will be levelled to enable covering and regrading to acceptable datum levels that will ensure long-term stability of surface materials and reduce the potential for mobilization of sediments into surrounding surface waters. The Porcupine aerodrome is of special concern because of its proximity to the Porcupine River and associated fish-rearing side channels.

14.4.2.4 Access Road and Tunnel

Once all the other project components have been closed and reclaimed and there is no need for road access to the Galore Creek Valley, closure and reclamation of the access corridor and associated tunnel will begin with regrading of the road cut-and-fill areas as required to meet Special Use Permit closure requirements. Removal of smaller bridges and culverts will be undertaken sequentially along the alignment as the regrading equipment pulls back from the tunnel approach, eventually reaching the filter plant site and Highway 37. Decommissioning of large bridges will be undertaken in consultation with regulatory agencies and stakeholders.

Each of the tunnel portals will be made inaccessible to ensure the safety of humans and animals, but the overall integrity of the tunnel will be retained in case it is required for future use.

The access road gatehouse will be the last component of the access road to be removed to ensure that access to the area is restricted throughout the closure and reclamation process.

14.5 Socio-Economic Issues

To address the impacts of mine closure on the people and communities of northwestern B.C., NovaGold will, in concert with the Tahltan Nation:

- provide advance notification of impending closure and termination of employment
- assist employees find alternative employment
- implement with the Tahltan Nation an employee assistance plan oriented toward developing successor employment.

NovaGold commitments to education, training, skills development and apprenticeship training will, after years of implementation, have significantly enhanced employability and labour mobility of the Tahltan nation. Similarly, capacity building will have advanced such that alternative sources of employment could be generated locally.

For contractors, NovaGold will similarly provide advance notification of closure. NovaGold's participation with the Tahltan Nation Development Corporation (TNDC) over the course of mine operations will also have had the effect of enhancing capacity such that Tahltan businesses will be better positioned to provide service to other companies. This achievement will facilitate the TNDC's object of building a sustainable economic base for its people.

14.6 Closure Cost Estimate

The total estimated closure and monitoring costs associated with the Galore Creek Project is $19.75 million Canadian dollars (2006). Table 14.6-1 provides a summary of estimated closure costs. Development of this estimate was consistent with the costing methods outlined in the guidelines provided by the British Columbia Ministry of Energy, Mines and Petroleum Resources. NovaGold will be submitting a more detailed estimate of anticipated closure costs as part of the *Mine Plan and Reclamation Program* document concurrent with the permitting process.

14.7 Post-Closure Monitoring

Post-closure monitoring will be conducted within the project area to ensure closure and associated reclamation efforts remain effective in the longer term. Post-closure monitoring will therefore include:

- surface and groundwater quality monitoring within and downstream of the mine area
- periodic sampling of aquatic biota such as benthic invertebrates and fish
- terrestrial habitat use assessments
- geotechnical monitoring of mine waste containment structures and water management systems.

Table 14.6-1
Preliminary Closure and Reclamation Cost Estimate

Mine Activity Category		Total Cost
AREA DISTURBANCE		
Dump Face Resloping		6,850,000
	subtotal	**$6,850,000**
LUMP SUM ITEMS		
ARD Capital Costs		250,000
Mill Building		500,000
Administration Building		100,000
Mill		1,000,000
Structures		500,000
Power line		1,990,000
Stockpiles		100,000
Sealing of Openings		100,000
Hauling-Surface Materials		1,000,000
Access Road		500,000
Aquaduct & East Fork bridging		1,260,000
Mine Haul Road		600,000
	subtotal	**$7,900,000**
POST CLOSURE COSTS		
Pit Lake Earthworks Drainage		4,000,000
Geotechnical and Environmental Monitoring		1,000,000
	subtotal	**$5,000,000**
	TOTAL	**$19,750,000**