The City of Penticton

Spiller Road / Reservoir Road Area
NEIGHBOURHOOD CONCEPT PLAN

February 2014

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URBAN systems

ACKNOWLEDGEMENTS

This Neighbourhood Concept Plan (NCP) was prepared by Urban Systems for and under the direction of the Spiller Road / Reservoir Road Area NCP Steering Committee. We would like to acknowledge the Steering Committee members for their participation in the planning process, as well as the City of Penticton planning and engineering staff, and the remainder of the NCP planning team: Cascadia Biological Services; Catherine Berris Associates; Interior Testing; and, Swanson Forestry Services.

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1.0 INTRODUCTION

1.1 Purpose of Plan

The Spiller Road / Reservoir Road Neighbourhood Concept Plan (NCP) establishes the direction for the future development of the Spiller Block and the Reservoir Block, both identified in the City of Penticton 2005 North East Sector Plan. Along with the North East Sector Plan, the NCP will be used to provide the City of Penticton with the policy framework to guide future development within the Plan area and provide the basis for evaluating development applications. This report provides a detailed description of the site context, land use designations, development permit area guidelines, and servicing approaches and standards. It also includes a discussion of development phasing and cost-sharing approaches for servicing and infrastructure.

The preparation of this NCP was endorsed by the City of Penticton Council, and it follows the guidelines and process established by the City for the completion of Neighbourhood Concept Plans. This Plan was carried out under the guidance of a steering committee, which engaged Urban Systems Ltd. as technical advisors in the completion of the NCP. Once the City of Penticton adopts this Plan, it will incorporate relevant components and policies of this NCP into the Penticton Official Community Plan.

1.2 Plan Area Context

The Neighbourhood Concept Plan (NCP) study area is 298 ha in area and it is shown in **Figure 1.1** (Site Context). As illustrated, the plan area is located to the east of Upper Bench Road and Naramata Road, on the hillsides above the Naramata bench. The study area coincides with areas defined as the Spiller Road block and the Reservoir Road block in the North East Sector Plan.

To the north, the study area reaches Riddle Road. To the south, the study area continues beyond Reservoir Road to the area located above Hillside Avenue. The study area extends up towards the City boundary and the Campbell Mountain Sanitary Landfill in the east, and the Agricultural Land Reserve (ALR) forms the main westerly boundary of the study area. While the Naramata bench is primarily located within the Agricultural Land Reserve, the NCP study area contains only non-ALR lands.

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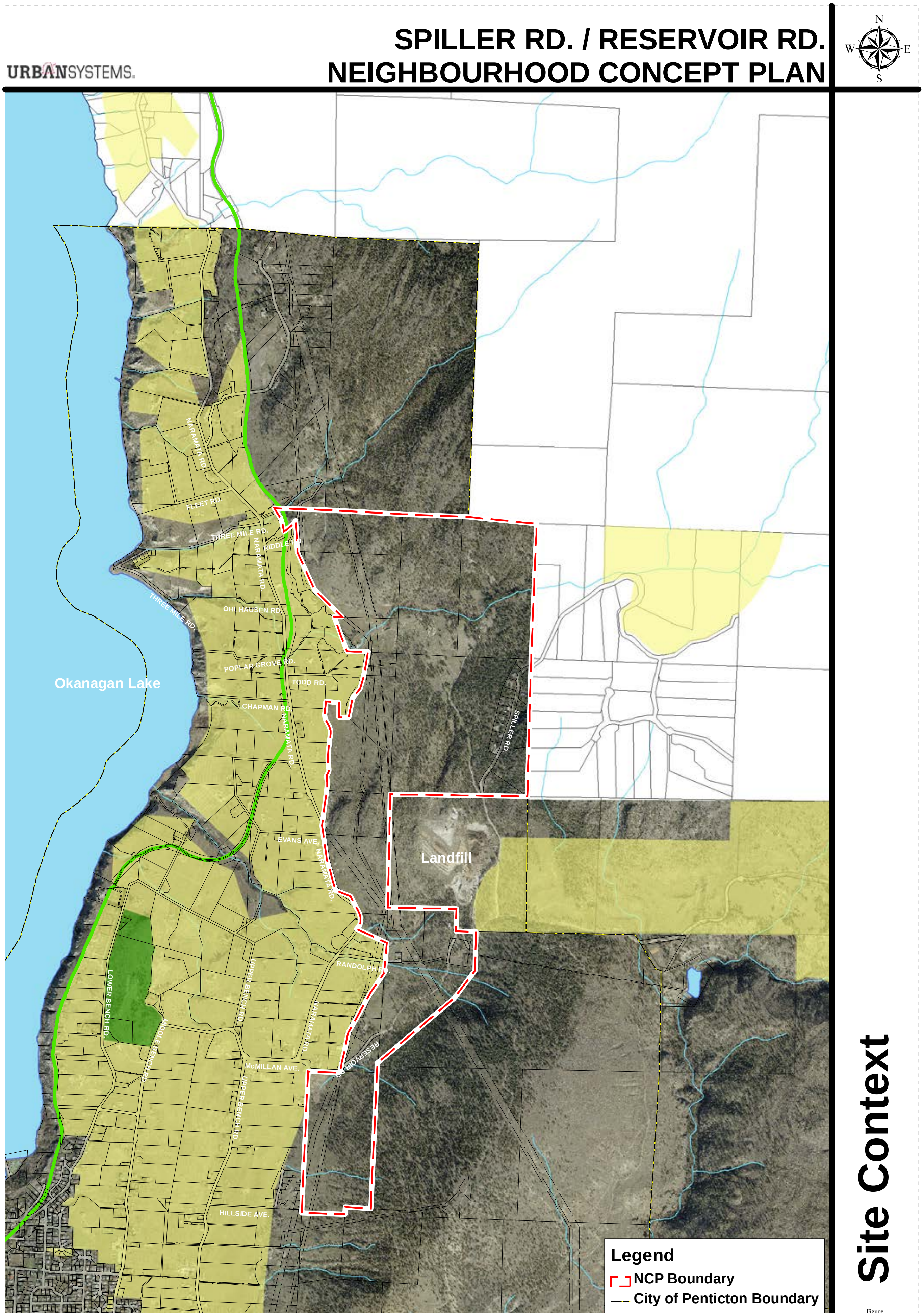

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Site Context

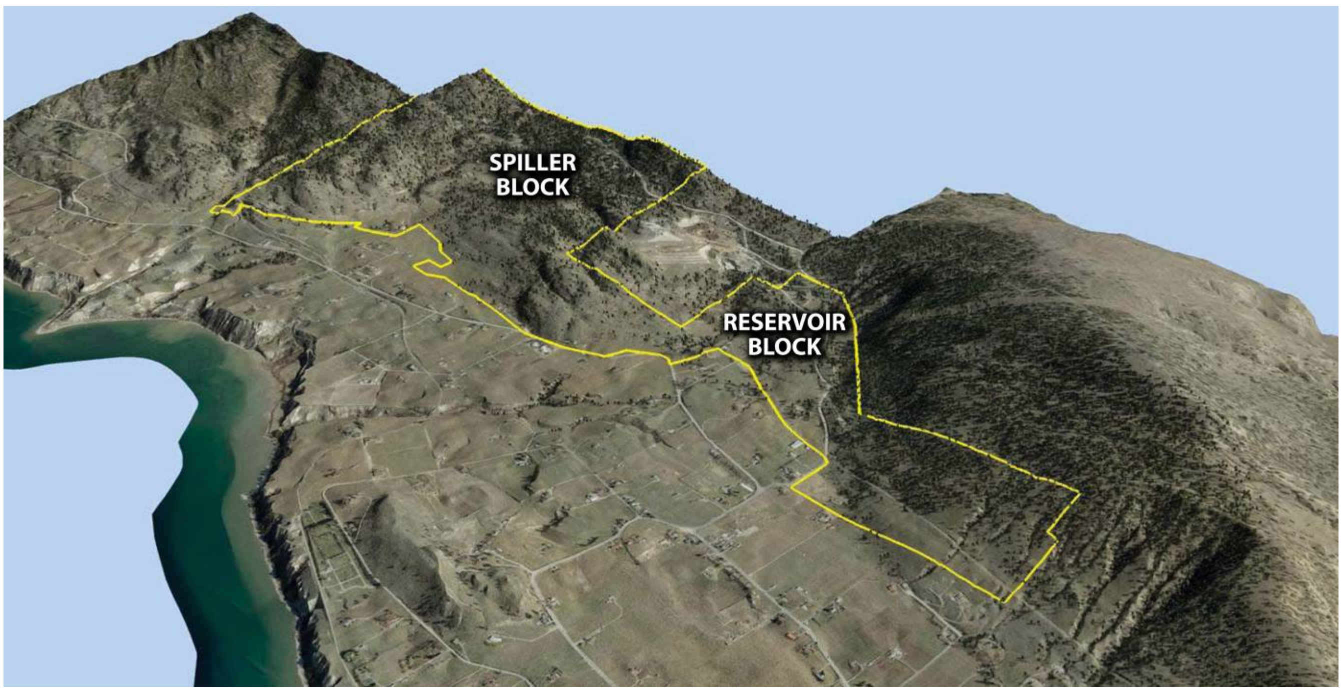
Figure

1.1

Figure 1.2 (Aerial Perspective) shows the NCP study area from an aerial perspective, illustrating the site context. As shown, most study area parcels are currently vacant or occupied by rural residential land uses. Much of the study area is characterized by steep hillsides, and there are also a number of draws and gullies. **Figure 1.2** also illustrates the interface of the site with the Campbell Mountain Landfill to the east, and the agricultural activities on the Naramata Bench to the west.

The study area land ownership pattern is illustrated on **Figure 1.3** (Land Ownership Pattern). As shown, the majority of the study area is privately held. However, there is one Crown parcel, located along Reservoir Road to the south of the landfill.

Figure 1.2: Aerial Perspective



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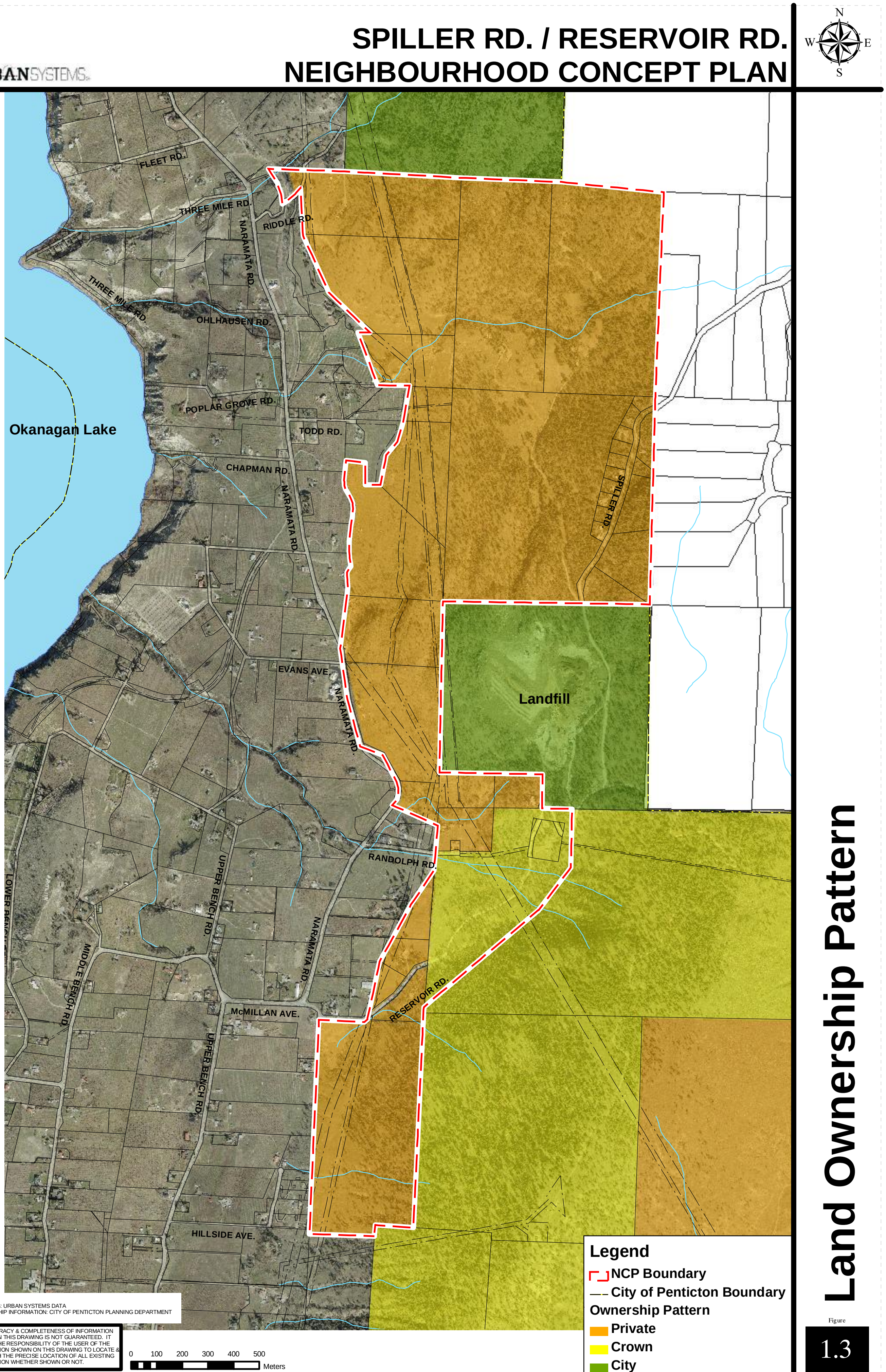

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Land Ownership Pattern

Figure
1.3

1.3 Policy Context

A number of existing plans and regulations set the framework for future land use and development in the Neighbourhood Concept Plan (NCP) study area. These include:

- Official Community Plan – sets the policy framework for the management of future land use throughout the City of Penticton.
- Comprehensive Development Plan – non-statutory plan that is intended to inform decisions about land use, servicing, and financing of infrastructure required to support growth and development.
- North East Sector Plan – statutory sector plan that sets the policy framework for the management of future land use within Penticton's North East Sector. This Plan is incorporated into the City of Penticton Official Community Plan.
- Zoning Bylaw – regulates land use through provisions related to use, density, siting of buildings, parking, etc.

The Spiller Road / Reservoir Road NCP provides the most detailed level of planning that the City authorizes. Building on the policy framework that is contained in the Official Community Plan and the North East Sector Plan, the NCP provides detailed guidance on specific land use, infrastructure, transportation, parks, and development permit area guidelines for hillside development, wildfire interface, environmental protection, and multiple-family and commercial form and character.

The City's existing plans and regulations are summarized below, along with the relevant policy considerations.

Official Community Plan:

The City of Penticton's current Official Community Plan (OCP) was adopted in 2002, and developed upon a foundation of sustainability and smart growth. Recognizing that the City has a limited supply of developable land, the OCP directs approximately two-thirds of new development into existing urban areas, while identifying potential for about 5,500 dwellings in three main new growth areas: 1) Upper Columbia; 2) Upper Wiltse; and, 3) the North East Sector. In the 2002 OCP, most lands in the North East Sector were designated as a Future Planning Area, to provide for future growth on the hillsides, while protecting the agricultural lands below from development.

A Sector Plan was completed for the North East Sector in 2005, and it was subsequently incorporated into the OCP. The NCP study area is wholly contained within the North East Sector Plan area.

The OCP does not identify any existing Development Permit Area designations in the NCP area. These designations are established as part of this NCP process.

Comprehensive Development Plan:

The City's 2005 Comprehensive Development Plan (CDP) is a non-statutory plan intended to inform policy decisions about land use, servicing needs, and the means to finance capital works required to support growth and development. The CDP identifies development potential in the Reservoir Road and Spiller Road blocks, which are located within the NCP study area. Overall, the CDP notes the potential of the North East Sector to accommodate close to one-third of all new residential units in the City over a 20-year horizon, and the CDP articulates strategies to provide road access and city water and sewer services to all potential development blocks within the North East Sector.

North East Sector Plan:

Completed in 2005 and adopted by Council, the North East Sector Plan sets out a strategy for the future development and servicing of the City's North East Sector, which includes the study area for this NCP. The Sector Plan was undertaken with the intent to open up a new development front on the North East Sector hillsides, while protecting agricultural lands from development. Overall, the Sector Plan addresses land use, environmental protection, urban design, and the provision of infrastructure services.

The North East Sector Plan identifies a number of key issues relevant to the NCP area. These include:

- **Access/Roadway Connections.** The Sector Plan notes that the plan area presents significant challenges in terms of road access primarily due to topography. In addition to planning for road access into development areas, there is also a need to plan for emergency access.

- **The Landfill Site.** The Campbell Mountain Landfill presents an important planning challenge in two respects. First, there is concern that development in the area may impact landfill operations due to the concerns of local residents. Second, there is concern that landfill operations may impact local development due to issues such as migration of landfill gases, visual impact, noise, odour, and litter.

- **Sensitive Ecosystems and Species at Risk.** Within the broader North East Sector area, sensitive ecosystem elements include grasslands, mature and old growth forests, and riparian areas. The Sector Plan also identifies a number of potential species at risk, including White-headed Woodpeckers, Western Screech Owls, Gopher Snakes, and Western Rattlesnakes. As identified in the Sector Plan, ecologically sensitive planning and development will provide a number of benefits, including the preservation of ecological integrity, better quality of life, payback from increased property values, and potential savings in infrastructure costs.

- **Other Environmental Values.** The Sector Plan identifies additional environmental issues such as wildfire risk management, invasive plant and weed management, and water conservation.

- **Hillside Development and View Protection.** As the plan area contains areas of steep topography, the Sector Plan encourages cluster development and the protection of steep slopes in excess of 30 percent, in order to maintain visual and habitat values and to reduce hazards. The Sector Plan also identifies the need to minimize the visual impact of development, given the visibility of the North East Sector from the Naramata Bench and the City as a whole.

- **The ALR.** The Sector Plan identifies the need to address agricultural interface issues.

- **Commercial Development.** The Sector Plan acknowledges that new development will be somewhat removed from existing city services and commercial conveniences, and it encourages the allocation of some land in the North East Sector for retail commercial uses.

Based on study area analysis, the North East Sector Plan identifies the following four potential development blocks: 1) the North Block; 2) the Spiller Block; 3) the Reservoir Block; and, 4) the Campbell Block. The Spiller Block and the Reservoir Block are located within the study area for this NCP. Based on preliminary site analysis, the Sector Plan identifies the potential for over 1,200 residential units in the Spiller Block and the Reservoir Block. However, detailed study area planning indicates that yields will likely be lower than identified within the North East Sector Plan, due to the many topographic, environmental, and other constraints on development.

The North East Sector Plan provides the framework for the completion of this NCP to further define environmental values, residential land use, densities, neighbourhood services, roads and trails network, parks and servicing requirements, and impacts on existing uses and adjoining land uses. The NCP generally follows the future land use policies set out in the Sector Plan, and it is considered to be a refinement of the North East Sector Plan, based on more detailed planning for the study area.

Crown Land Planning

The Reservoir Block contains Crown Land that is designated for development in the North East Sector Plan. The Provincial Integrated Land Management Bureau (ILMB – formerly Lands and Water BC) was a participant in the North East Sector Plan exercise, and representatives from the ILMB have indicated that Crown Land disposition may be a possibility to accommodate future development as demand warrants it. NCP planning has accounted for future development potential on Crown lands, to ensure that development on private lands will logically tie into any future development on Crown lands. Should disposition of Crown lands occur in the future, ILMB will work closely with the City to manage this process. This process would include consultations with local First Nations.

Zoning Bylaw:

Within the NCP area, lands are currently zoned: a) FG – Forestry Grazing; b) A – Agricultural; c) RC – Country Residential; or, d) RSM – Mobile Home Park. As necessary, Zoning Bylaw amendments will be required to facilitate development in the NCP area. For reference, current Zoning within the NCP area is shown in **Figure 1.4** (Current Zoning).

1.4 Plan Process

Since the City of Penticton Council provided authorization to complete this NCP, the planning process involved a number of key milestones. These included the following:

- Plan initiation with the City of Penticton and Steering Committee;
- Plan area analysis and completion of a Background Report;
- Review of Background Report with City and Steering Committee;
- Meetings with individual landowners in study area to identify development objectives and plans for study area;
- Public open house to present land use and servicing concepts and to provide opportunity for feedback on plan directions;
- Plan refinement and preparation of draft NCP; and,
- Steering committee review of the draft NCP;
- Submission of the draft NCP to the City of Penticton in May 2010;
- Plan refinement and finalization; and,
- Submission of the final NCP to the City of Penticton in February 2013.

1.5 Objectives

Based on the direction that was set in the North East Sector Plan and the views of the City, landowners, and residents, as articulated through the Plan process, there are a number of objectives for this Neighbourhood Concept Plan (NCP). These include the following:

- Provide a mix of dwelling types for a variety of future residents.
- Utilize design approaches that are sensitive to the hillside context.
- Ensure compatibility between landfill operations and surrounding residential uses.
- Protect sensitive ecosystems and species at risk.

- Protect views to and from the hillside.
- Manage wildfire risk.
- Address any agricultural interface issues and protect the Agricultural Land Reserve.
- Develop complete neighbourhoods with access to park spaces and other neighbourhood amenities.

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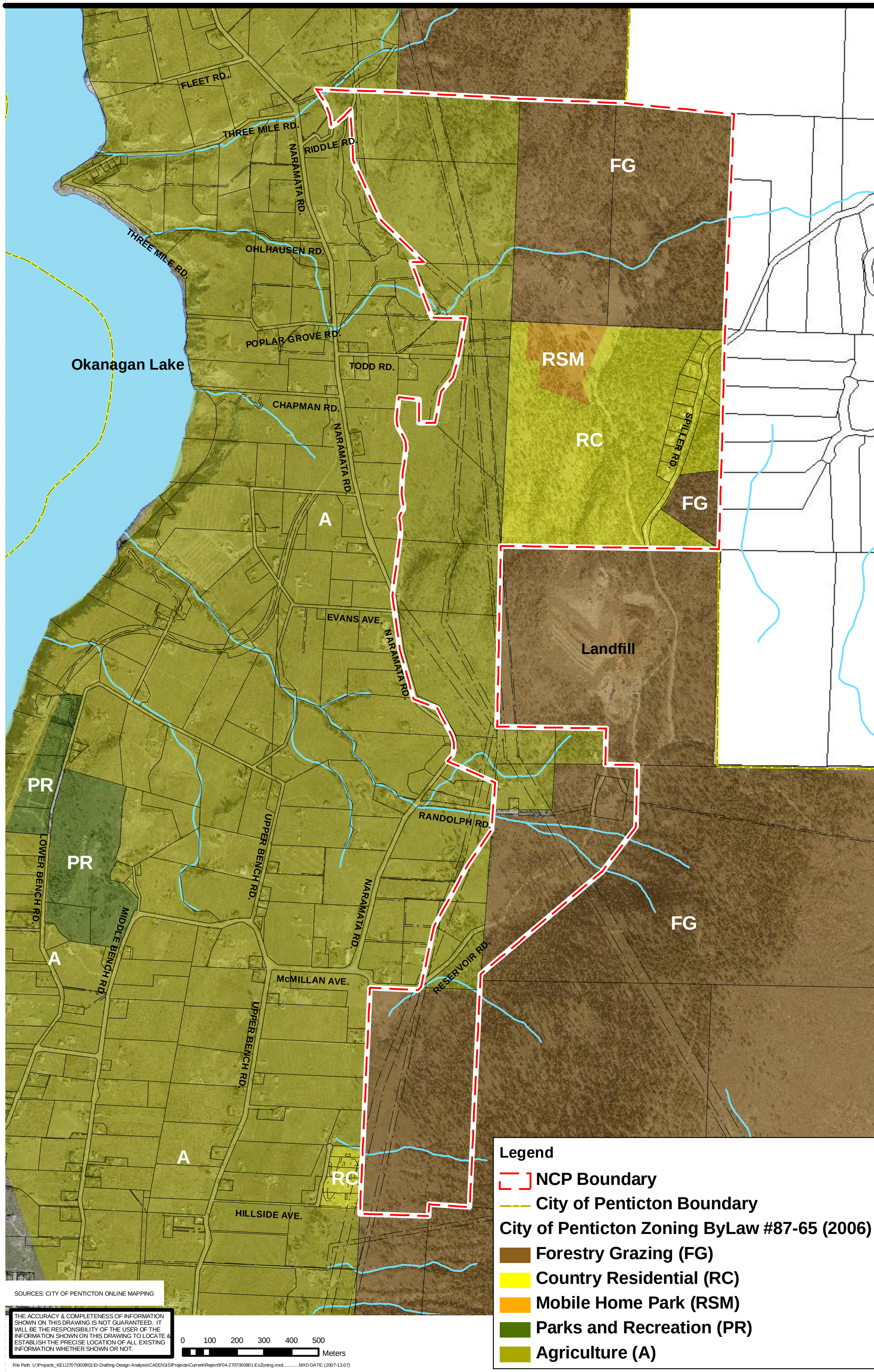

Current Zoning Map

Figure 1.4

2.0 PHYSICAL AND COMMUNITY CONTEXT

2.1 Topography

The Neighbourhood Concept Plan (NCP) study area topography is illustrated in **Figure 2.1** (Topography) while the outcome of the slope analysis is shown in **Figure 2.2** (Slope Analysis). The study area rises from an elevation of approximately 430 metres in the lowest point of the study area to an elevation of approximately 760 metres in the highest point of the study area. As shown, the study area is characterized by steep slopes, and approximately 171 ha, or 57 percent of the study area has slopes of 30 percent or more.

Generally, development is most feasible on slopes of less than 30 percent. In environmentally sensitive areas, the North East Sector Plan articulates policy to direct development away from major slope areas, averaging 30 percent or greater, unless sensitive integration with the natural environment can be demonstrated. Limited development on 30 percent and higher slopes may be considered if carried out in a sensitive manner, subject to geotechnical, visual, and grading considerations. As part of this NCP, a Hillside Development Permit Area is established for the study area to provide guidelines on the form and character of hillside development.

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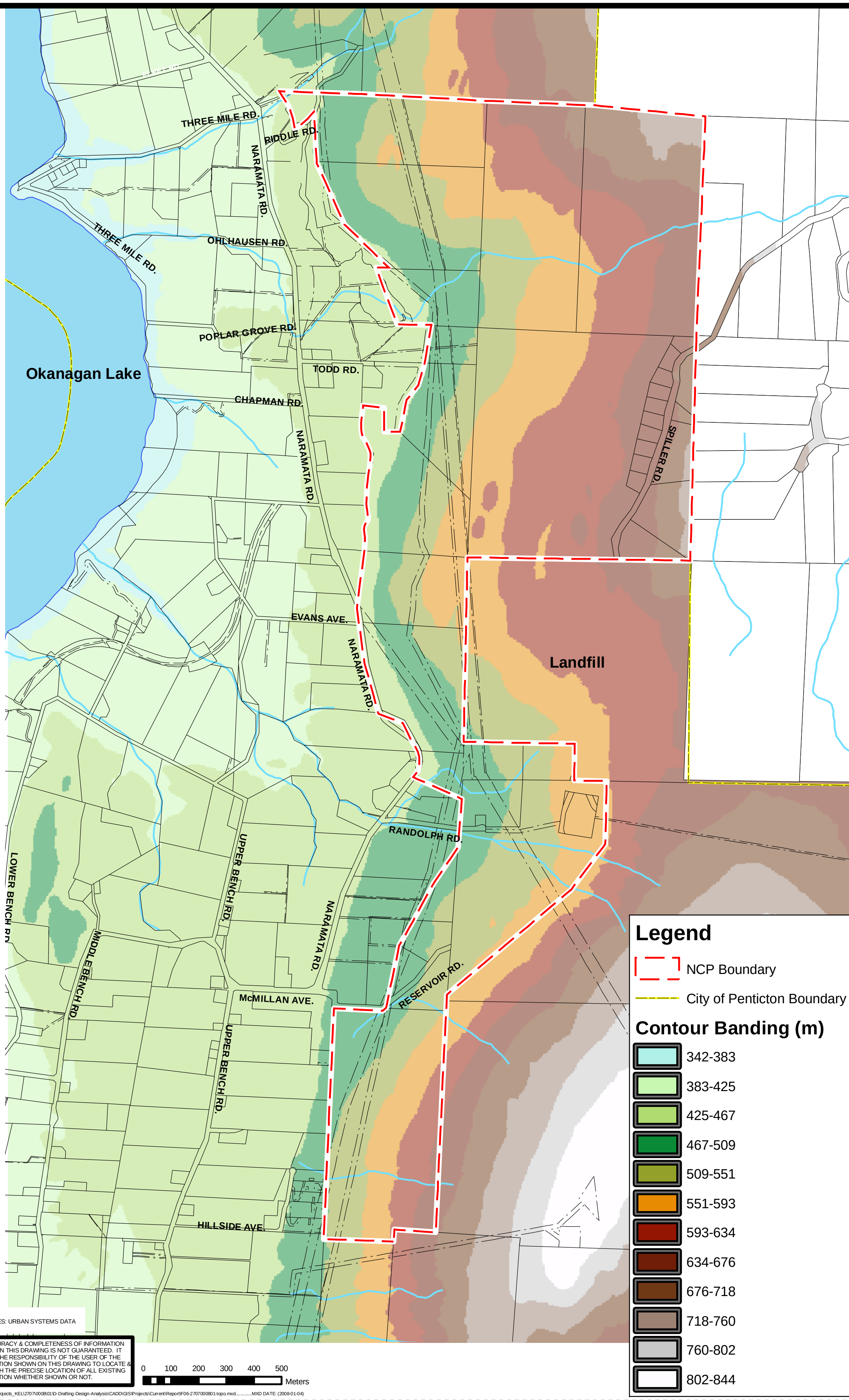

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Topography

Figure

2.1

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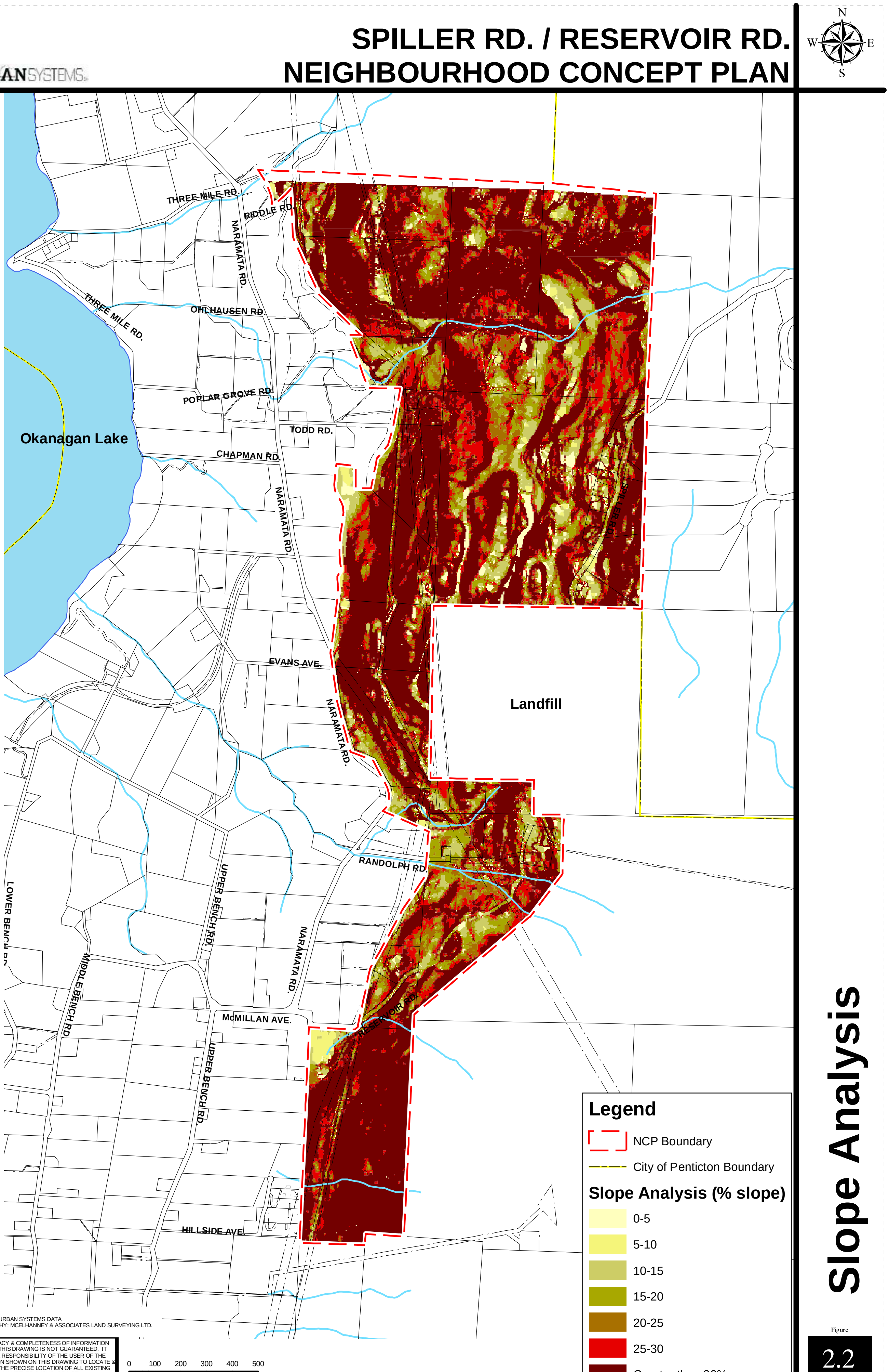

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Slope Analysis

Figure
2.2

2.2 Geotechnical Context

Interior Testing Services Ltd. was retained to undertake a geotechnical overview of the Neighbourhood Concept Plan (NCP) area. The geotechnical overview highlights the following general observations:

- Bedrock is typically visible within steeper portions of the site, and it is frequently visible in moderately sloping areas.
- Flatter portions of the site are likely underlain by dense, till-like silts, or in some circumstances, local sand and gravel deposits. This is based on a limited number of site exposures, and in part on test holes dug on the Spiller Road (Westview) site.
- There are no major zones of rock hazard other than local, easily avoided, or easily remediated areas.
- Drainage issues are related primarily to consideration of surface runoff as it relates to local draws or gullies.

Based on these observations, the geotechnical overview identifies the following impacts to potential development:

- Flatter areas within the site will be reasonably easy to develop, as the depth to bedrock is typically greater, making roadway and service construction easier to accomplish.
- In steeper bedrock areas, site stability is satisfactory and development is generally feasible. However, cost is typically an issue due to the presence of bedrock, which may require blasting for removal.
- The local bedrock is normally of volcanic origin, and it is frequently sufficiently fractured or weathered in the top 0.5 metres to be excavated mechanically. At greater depths, it is commonly necessary to blast the bedrock to remove it.
- Local drainage channels exist, and are best left as undisturbed, undeveloped areas except where crossings are required, or where engineering designs to manage the drainage are provided.
- No areas of significant rock hazards are expected on the site. There are local areas of steeper rock slopes, but it is expected that any rock hazards can be easily addressed by local avoidance or remedial measures.

Interior Testing Services Ltd.'s report is contained in **Appendix A** to this NCP.

2.3 Utility Rights-of-Way

As shown on **Figure 2.3** (Utility Rights-of-Way), there are a number of hydro and gas rights-of-way through the Neighbourhood Concept Plan (NCP) study area. These rights-of-way are a constraint to development, and they also impact the alignment of services. It will be necessary to ensure that roads and services cross the gas right-of-way at or near ninety degree angles, in order to alleviate the need for gas line replacement, service disruptions, and related costs. Likewise, roads will be best situated to cross hydro rights-of-way at or near ninety degree angles. BC Hydro and the BC Transmission Corporation have published Guidelines for Compatible Rights-of-Way Uses. This document outlines a limited range of permitted uses, such as recreation corridors, that will be permitted in hydro rights-of-way subject to site-specific approvals.

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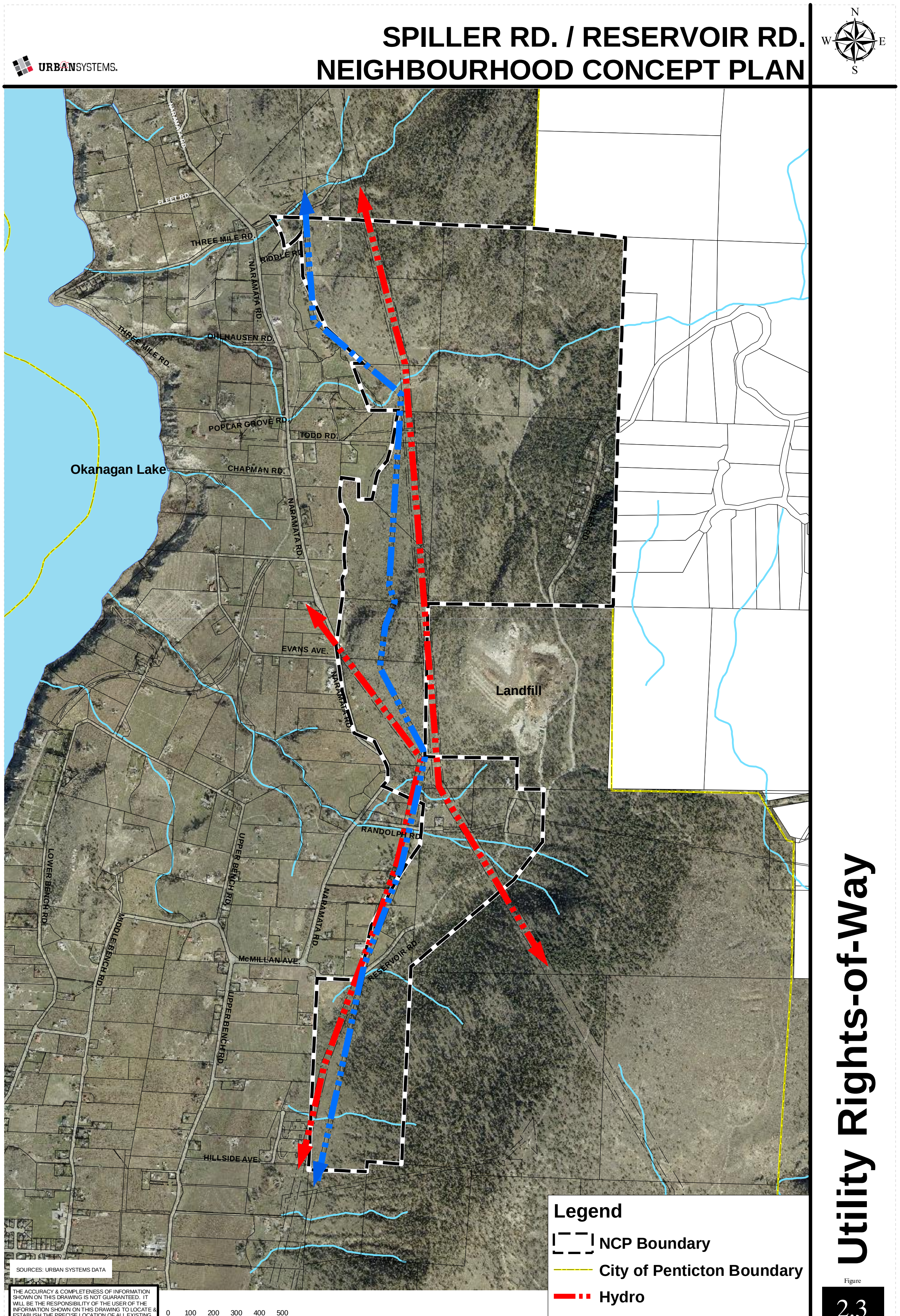

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Utility Rights-of-Way

Figure

2.3

2.4 Environment

The North East Sector Plan identifies a number of environmental values in the Neighbourhood Concept Plan (NCP) study area. According to the Sector Plan, sensitive areas include grasslands, mature and old growth forests, and riparian areas, many of which provide important habitat areas for an array of species. Overall, the North East Sector Plan area contains the largest contiguous tract of natural land within the City.

Cascadia Biological Services was retained to provide a more detailed review of environmental constraints and opportunities, as well as guidelines for development within the NCP study area. The purpose of this review was to further identify environmentally sensitive areas and potential development areas based on past biological reports, detailed air photo typing and interpretation, site investigations, and the acquisition of new baseline data including wildlife/ecosystem distribution and sensitivity analysis.

Cascadia Biological Services' Biophysical and Environmental Assessment is contained within **Appendix B**. As noted in the study, the NCP area is home to over 66 blue and red listed animal species, and 30 plant species listed by the British Columbia Conservation Data Centre. Given the study area location within a rare ecosystem found at the northern most limits of a desert like climate, there are a number of plants and animals that would more commonly be found to the south of the Canada/United States border. The Cascadia report documents these unique environmental features, and provides a number of best management practices to ensure that environmentally sensitive species and ecosystems are protected. These best management practices are incorporated into Development Permit Area guidelines for protection of the environment.

To consolidate information related to topography, hydrology, sensitive ecosystems, and recommended buffers, Cascadia Biological Services prepared an Environmental Sensitive Areas Map, provided in **Figure 2.4**, below. This map provides a detailed summary of physical constraints and identified conservation values, and it is intended to summarize both previous environmental findings, and observations from the biophysical assessment that was undertaken for this NCP. This map was used to guide the conceptual planning and design of the NCP area, and it also provides a framework for more detailed environmental work to be completed as part of the Development Permit process for new development.

Figure 2.4 identifies three levels of environmentally sensitive areas. These areas are summarized as follows:

ESA 1 (High)

These lands include locally and provincially significant ecosystems, extremely rare and/or of critical importance to rare wildlife species. These areas may also represent a diverse range of habitats and contribute significantly to the overall connectivity of the habitat and ecosystems. Avoidance and conservation of ESA-1 designations is the primary objective.

If development is required and justified within these areas, mitigation to reduce or eliminate environmental impact shall be required. If permanent loss of habitat is unavoidable, compensation will be considered. Compensation should promote a not net loss to habitat, and be used only after it proves impossible or impractical to maintain the same level of ecological function.

ESA 2 (Moderate)

These lands include locally or provincially significant ecosystems, uncommon and important to rare wildlife species. In general, it is preferable to avoid development in ESA-2 areas. Where development is pursued, portions of the habitat must be retained and integrated to maintain the contiguous nature of the landscape.

Any area given this rank is of only slightly lower priority for preservation than ESA-1 areas. Therefore, clear rationale and criteria for distinction between High and Moderate values shall be provided. Some degree of development may be considered as long as this does not have any potential impact on High ESA's on the site. Some loss to these ESAs can be offset by habitat improvements to the remaining natural areas found on the property.

ESA 3 (Low)

These lands include ecosystems that may have low to moderate conservation values because of importance to wildlife (e.g. disturbed or fragmented ecosystems or habitat features). These areas may contribute to the diversity to the landscape, although based on the condition and adjacency of each habitat the significant function within the landscape is limited. Lands rated low to moderate can generally accommodate development more so than other ESA categories.

Throughout all plan areas, environmental protection will occur through the designation of the Environmental Protection Development Permit Area, provided in **Section 4.3** of this Plan.

Based on its study findings, Cascadia Biological Services also recommended the "Protected Areas" identified in **Figure 3.1** (Future Land Use Plan). Further detail on the "Protected Areas" designation is provided in **Section 3.4** of this Plan. These areas were identified based on factors such as ecosystem type, functionality associated with wildlife movement, aspect, rock formation, and rare element occurrences. Additionally, the Biophysical and Environmental Assessment (**Appendix B**) provides a wildlife corridor map that will be used to assist with the evaluation of Environmental Protection Development Permit Area applications.

Within the Spiller Road/Reservoir Road NCP Area, all Zoning Bylaw Amendment applications will be accompanied by a detailed environmental assessment completed by a registered professional biologist (RPBio), as defined in the College of Applied Biology Act, and with input from other qualified environmental professionals (QEPs) of specific expertise where required.

The environmental assessment will be based on the City of Penticton's approved terms of reference (TOR) and make provisions for long term sustainable management of areas designated as open space and parks or as natural areas for conservation purposes. Management tools may include dedication as park, covenant registered on title, and zoning for environmental management purposes. Protection of such lands will be implemented at the time of zoning and not be deferred to subsequent phases of development. In most cases, residential development has been clustered when adjacent to ESA 1 and 2 areas and sustainable management of environmental values may come through dedication to the City or incorporation of the open space lands within a common strata lot.

The Biodiversity Conservation Strategy for the South Okanagan Similkameen completed in 2012, titled **Keeping Nature in our Future,** will be used to guide and inform any rezoning and subdivision application in the future.

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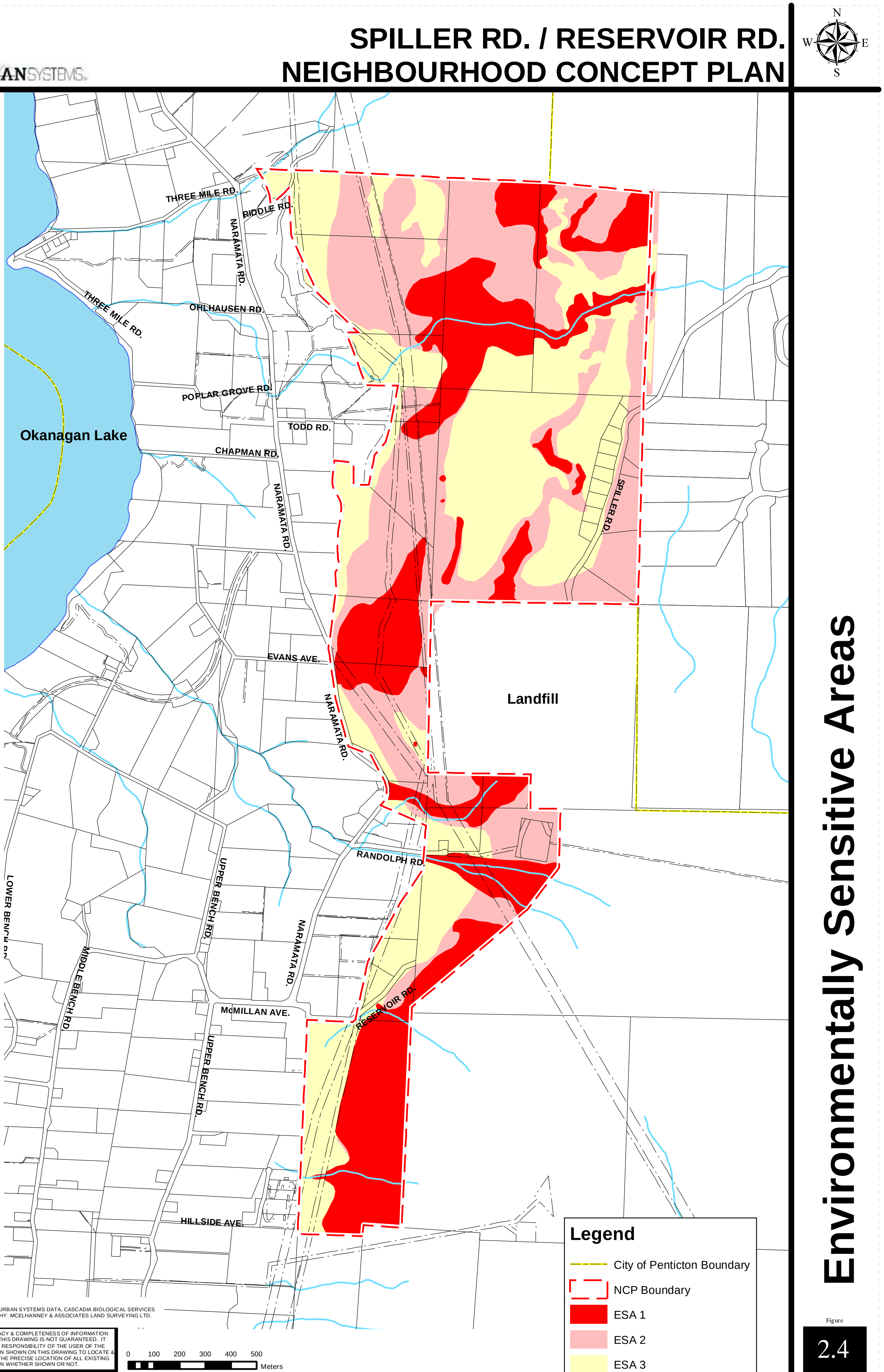

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Environmentally Sensitive Areas

Figure
2.4

2.5 Wildfire Interface and Fire Protection

Swanson Forestry Services was retained to undertake an overview of wildfire interface issues and to recommend measures to mitigate the risks to life and property from wildfire in the Neighbourhood Concept Plan (NCP) study area. The wildfire interface review noted that the study area is within the Very Dry Hot Ponderosa Pine (PPxh1) biogeoclimatic subzone. To assess fire hazard ratings, representative study area plots were established. All plots had a high fire hazard rating, noting factors such as the steep terrain, pine stands, bunchgrass and rock, presence of gas and hydro lines, etc.

To mitigate wildfire risks to life and property, a Wildfire Interface Development Permit Area has been established for the NCP study area. Swanson Forestry Services' investigation is used as the basis for this Development Permit Area designation, and the Development Permit Area provides guidelines regarding building locations and the use of FireSmart principles in building construction and site landscaping. The full Swanson Forestry Services report is contained in **Appendix C**.

Fire protection services are provided to this area by the Penticton Fire Department, serviced by the Fire Hall at 250 Nanaimo Avenue West. This hall is located approximately 4 km from the intersection of Reservoir Road and Naramata Road, which is located within the NCP boundary. However, the location constitutes a more than 10 minute response time to development areas within the NCP and to adjacent lands. This response time is not adequate according to Penticton Fire Department standards and BC Building Code requirements. The City is encouraged to investigate a location either within the Plan area or along Naramata Road to service the North East Sector and currently underserviced areas adjacent to the Plan area. This issue should be addressed by the City and developer(s) prior to any rezoning or subdivision applications receiving Final Approval. If a new fire hall is not provided, there may be a requirement for sprinkling all structures within the Plan area to help address concerns over current fire department response times to the area.

2.6 Agricultural Interface

As illustrated on Figure 1.1, the Neighbourhood Concept Plan (NCP) study area is located adjacent to the Agricultural Land Reserve (ALR) boundary. As a result, there is a need to consider agricultural interface issues in planning. Agricultural interface areas present a number of challenges to both agricultural users and non-agricultural neighbours. From the perspective of non-agricultural neighbours, issues can include noise, odours, chemical spray drift, dust, farm traffic, debris on roads, etc. From the perspective of agricultural users, issues can include complaints about agricultural practices, trespassing, theft of crops, vandalism, competition for water, pollutants from subdivisions, flooding and/or soil erosion from urban development stormwater runoff, lack of urban weed control, and spread of noxious weeds.

Should development occur at or near the edge of agricultural lands, there are a number of options to improve land use compatibility. Examples include the following:

- **Subdivision Layout.** Parcel size, configuration, setbacks, road patterns, and drainage patterns should be carefully considered to ensure compatibility between urban and agricultural neighbours. The Ministry of Agriculture and Lands' "Subdivision Near Agricultural" publication provides guidance on subdivision design that is sensitive to its agricultural context. Buffering is also an important consideration. The Agricultural Land Commission "Landscaped Buffer Specifications" provide guidance on appropriate buffering types for various situations.

- **Stormwater Management.** Design should ensure that water contamination, particularly from road runoff, will not be an issue. As well, drainage considerations should be taken into account to ensure that agricultural lands are not affected by flood, erosion or siltation damage.

- **Covenants.** Covenants can be used on development properties to ensure adequate buffering or separation from development. Covenants may include provisions for no build areas, vegetative screening, fencing, berming, retention of existing vegetation, user restrictions, etc.

2.7 Landfill Interface

The regional landfill adjoins the eastern boundary of the plan area, and it is operated by the Regional District of Okanagan Similkameen (RDOS) on land owned by the City of Penticton. The City of Penticton also operates a bio-solids compost operation on the site. The RDOS Solid Waste Management Plan, completed in 2011, states that the Campbell Mountain landfill is estimated to reach capacity and close between the years 2036 and 2047. However, discussions are ongoing as to future plans for the landfill site, and it is possible that upgrades could extend the operating lifespan of the landfill. Landfill impacts on adjacent properties include gas migration, leachate, dust, noise, litter, odour, vectors and visual impacts.

The North East Sector Plan identifies the landfill as an important consideration in the future planning of the area, laying out various policies that relate specifically to the landfill.

The NCP identifies the following policies as an important consideration in the future planning of the area:

- Developers are to educate and inform prospective lot purchasers in the vicinity of the Campbell Mountain Landfill regarding the proximity of the landfill, the length of time that the landfill is planned to be open, and what type of nuisance they can expect.

- Individual developments should be phased such that areas immediately adjacent to the Campbell Mountain Landfill are developed in later phases or when the buffer to the active landfill operation is sufficient for development to proceed.
- The Developers are to work with the City of Penticton to develop land use policies that support/protect waste management infrastructure, including providing and protecting lands that act as a buffer surrounding the Campbell Mountain Landfill.

Under the Landfill Criteria for Municipal Solid Waste of the Province of B.C, the distance between the discharge municipal solid waste and the nearest residence, water supply well, water supply intake, hotel, restaurant, food processing facility, school, church or public park is to be a minimum of 300m. Greater or lesser landfill separation distances may be approved by the Ministry of Environment where justified through the appropriate analysis. Ministry approvals will be required prior to any development proceeding within the Neighbourhood Concept Plan Area that is impacted by the landfill.

Since the completion of the North East Sector Plan, work has been ongoing to define landfill setback requirements. Initially, the RDOS commissioned Golder Associates Ltd. to prepare a report identifying the preliminary extent of the required buffer. This preliminary landfill buffer, identified in 2006, is illustrated in **Figure 2.5** (Preliminary Landfill Buffer Areas). This buffer addresses landfill gas, litter, and visual impacts. Following the completion of the Golder Report, the City and the RDOS agreed to undertake a more detailed analysis of landfill gas migration. As a result of this study, completed in 2009, a proposed new northern landfill gas setback was identified, as shown in **Figure 2.6** (Landfill Gas Setback), based on the more detailed review of landfill gas migration. As well, as part of this NCP process, Catherine Berris and Associates conducted a visual impact assessment of the landfill, further refining the findings of the 2006 Golder report. All of these studies were used in the preparation of the NCP land use plan to assist with the siting of development cells.

It is understood that a revised Operational Certificate is currently being prepared for the landfill under the provisions of the Environmental Management Act and in accordance with the approved RDOS Solid Waste Management Plan. The revised Certificate would establish a buffer zone between the landfill operation and the property boundary, as well as any required setback distance from landfill operations. The purpose of the setback is to mitigate various impacts associated with landfill operations including litter, migration of landfill gases, and visual impacts. These issues are reviewed in more detail, below.

2.7.1 Litter

Figure 2.5 (Preliminary Landfill Buffer Areas) identifies a limit for wind blown litter that extends approximately 150 meters north of the landfill into the Spiller Block. The Landfill Operating Permit stipulates measures for litter control such as: compacting the waste; minimizing the work face area; applying cover; providing litter control fences; and, instituting a regular litter pick-up and general good housekeeping program. Successful implementation of these measures should resolve most wind blown litter issues. Nevertheless, development phasing will take this concern into account and Spiller Block lands immediately adjacent to the landfill will not be developed until later phases.

2.7.2 Landfill Gas Migration

A Northern Landfill Gas Setback Assessment was completed by Conestoga-Rovers & Associates in July 2009, and provided as **Appendix D** to this NCP. The Assessment was prepared to meet the following objectives:

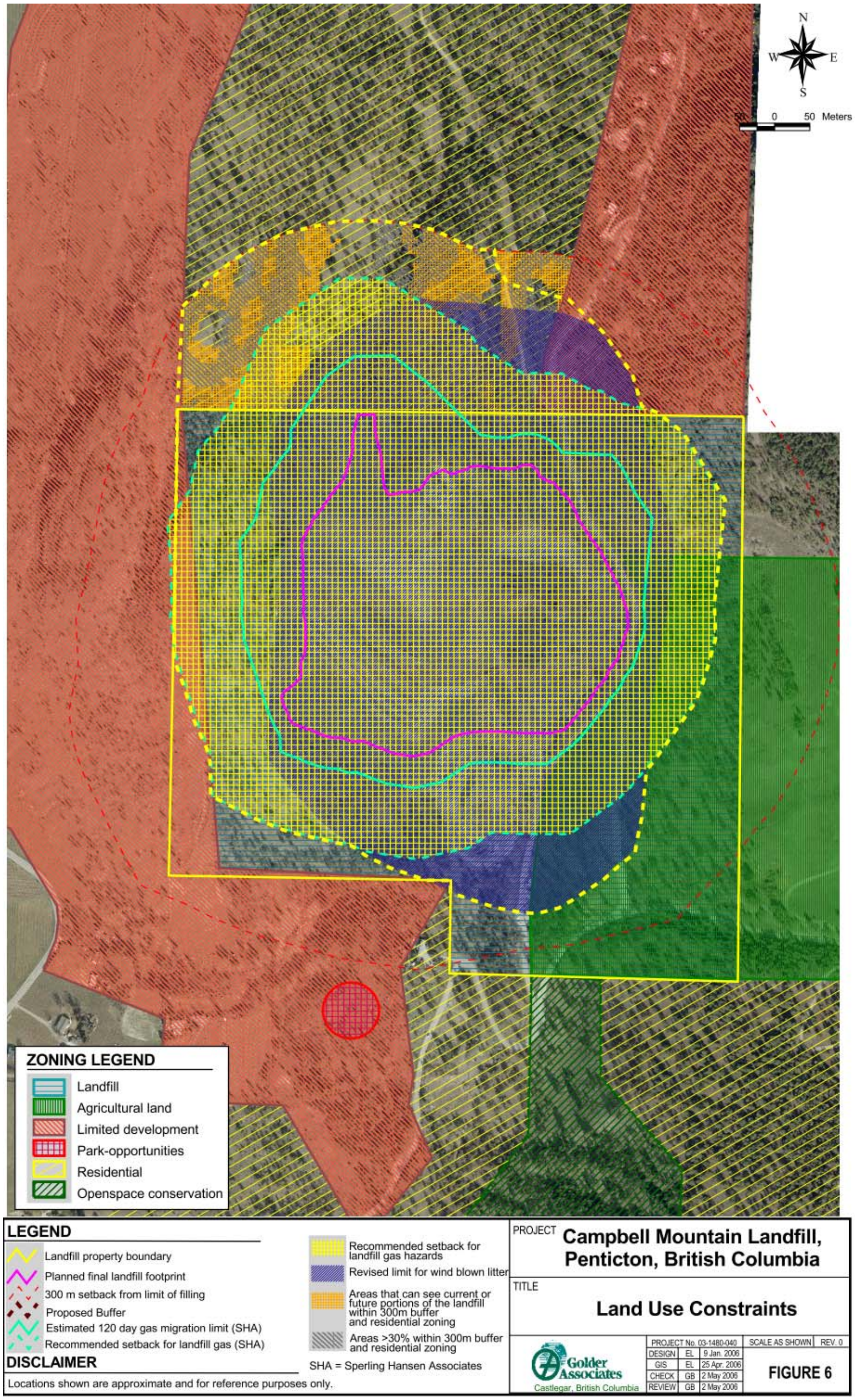
- Further characterization of the geologic/hydrogeologic conditions along the northern property boundary;
- Establishment of site-specific landfill gas and soil gas database;
- Evaluation of landfill gas production;
- Assessment of the landfill gas migration potential north of the landfill; and,
- Establishment of an appropriate landfill gas setback to the north of the landfill, to minimize the risk to residential development with respect to landfill gas migration.

Based on detailed monitoring assessments and modeling, a northern landfill gas setback is recommended as illustrated in **Figure 2.6** (Landfill Gas Setback). As proposed, the recommended setback is not expected to have an impact on the urban residential areas included within the NCP. The assessment report recommends additional monitoring to evaluate seasonal trends and other conditions as landfill operations change over time. As of late 2012, a landfill gas capture system was being designed for the landfill. Implementation of the gas capture system may result in a further reduction of proposed landfill gas setback. It is expected that a revised setback for landfill gas migration will be incorporated into a new Operational Certificate for the landfill, as noted above.

2.7.3 Visual Impact

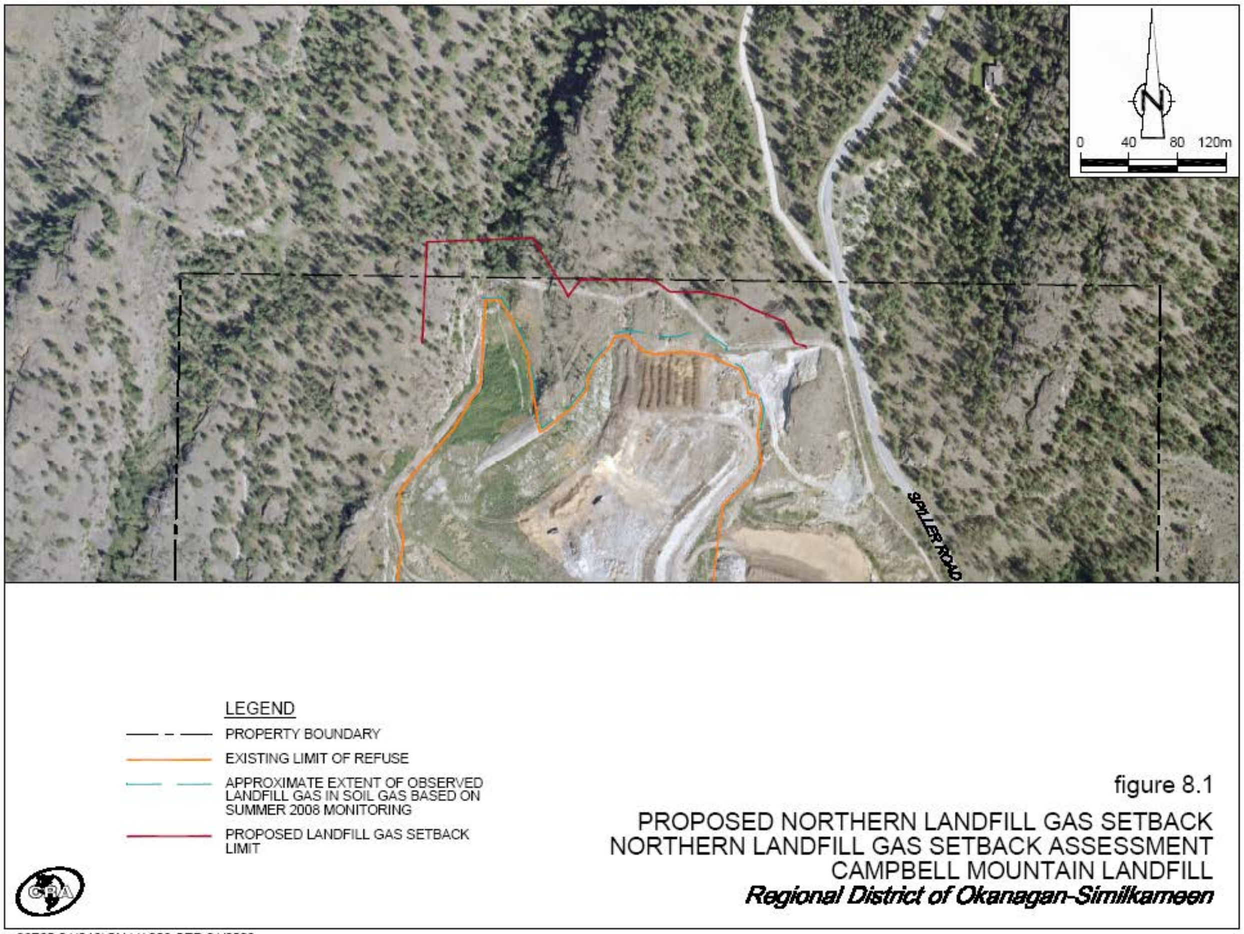
A further issue that has been addressed in the context of this NCP is the visual impact of the landfill operations. Early in the planning process, visual impact analysis was carried out by Catherine Berris Associates to review the visual impacts of the landfill from a number of potential development locations within the plan area. This analysis is presented in **Figure 2.7** (Landfill Viewshed Analysis) and **Figure 2.8** (Landfill View Impacts). **Figure 2.8** considers site topography and vegetation, and based on early planning concepts for the study area, it also considers the visual impact of potential building sites in select locations. The preliminary analysis shows that within the NCP study area, landfill visibility is greatest from sites immediately to the north and south of the landfill site. However, through most of the study area, the landfill is effectively screened. This visual analysis was taken into consideration in the development of the NCP Land Use Concept.

Figure 2.5: Preliminary Landfill Buffer Areas



Source: Golder Associates. “Setback Requirements, Campbell Mountain Landfill.” May 3, 2006.

Figure 2.6: Landfill Gas Setback



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Source: Conestoga-Rovers & Associates

Figure 2.7: Landfill Viewshed Analysis

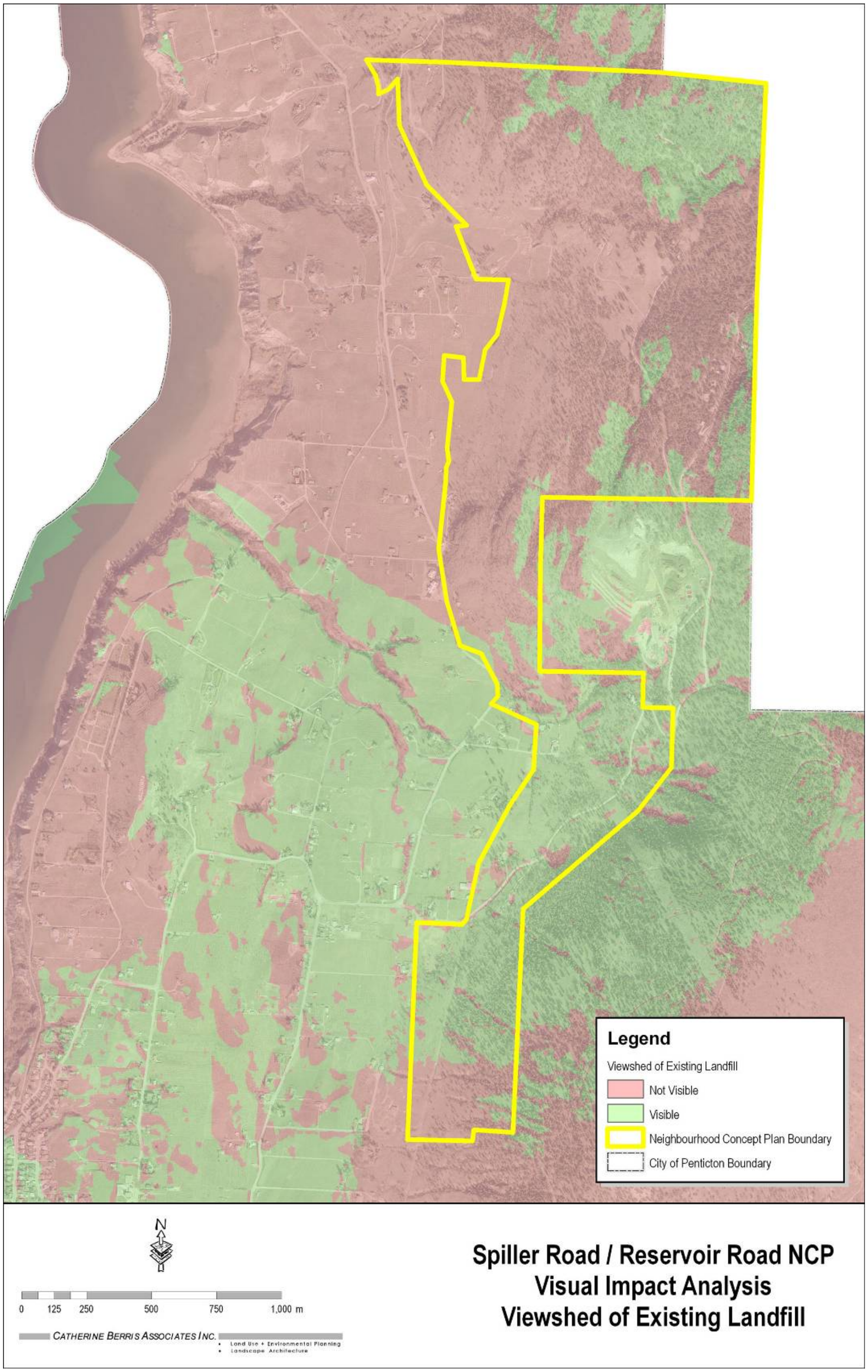
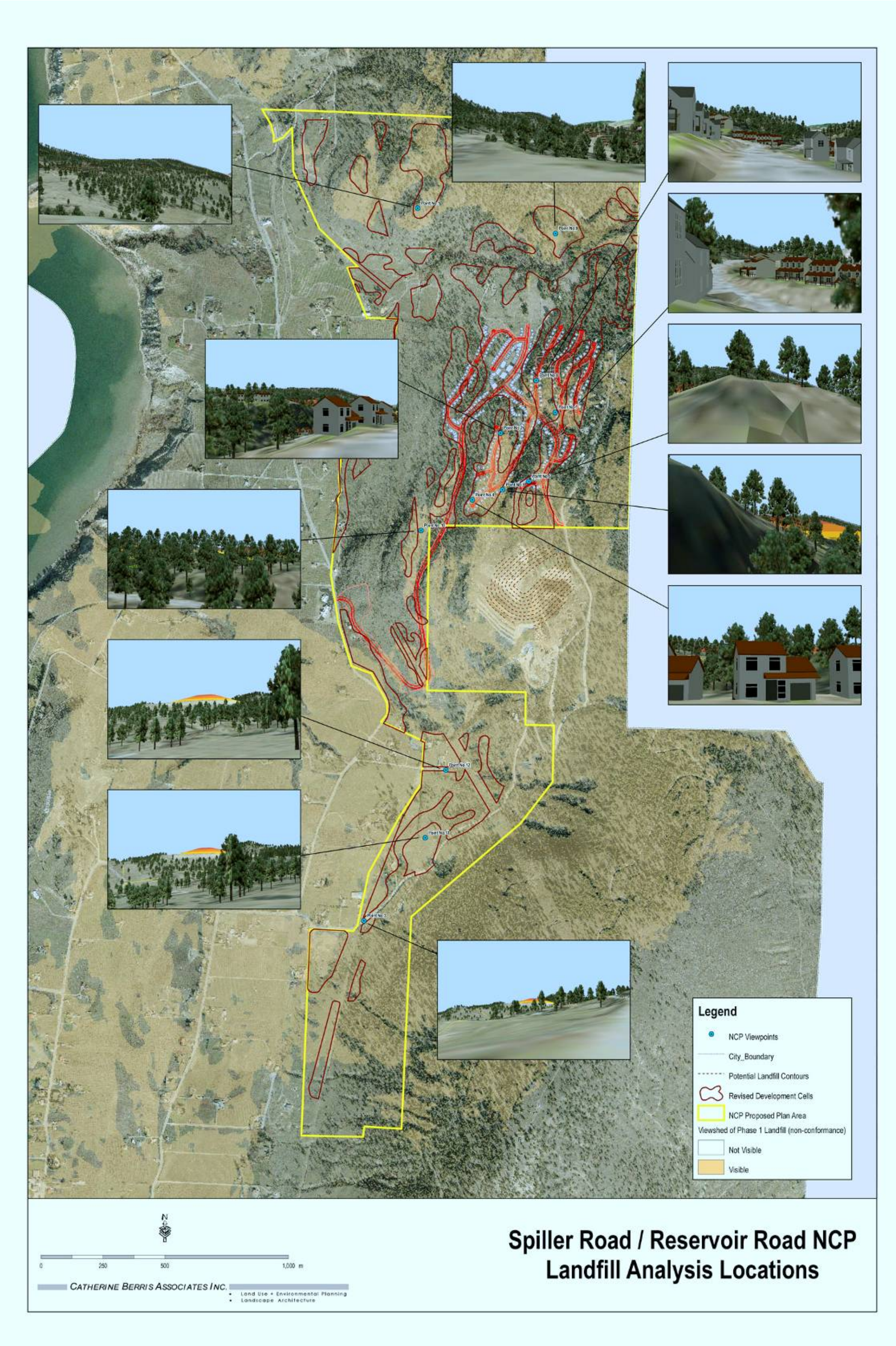


Figure 2.8: Landfill View Impacts



2.8 School Planning

In discussions with School District No. 67 (Okanagan Skaha) it was indicated that elementary students in the NCP area will be directed Uplands Elementary School (145 Middle Bench Road South). This school has experienced a slight decline in student population over recent years, and it is anticipated that the current facility will accommodate elementary aged school children from the NCP area.

3.0 FUTURE LAND USE

3.1 Introduction

This section describes the future land uses proposed within the Spiller Road / Reservoir Road Neighbourhood Concept Plan (NCP) area. **Figure 3.1** (Future Land Use Plan) identifies the overall development strategy for the NCP area. Through a set of land use designations and supporting policies, the Plan provides the City with a guide for future decisions about land use and density within the Plan area.

3.2 Future Land Use Plan

Within the NCP area, the future proposed land uses are described on the basis of the following designations:

- Hillside Holdings 1
- Hillside Holdings 2
- Hillside Estate
- Neighbourhood Residential
- Gateway Commercial (Overlay Designation)
- Village Centre
- Neighbourhood Centre
- Parks
- Protected Area (Overlay Designation)

Section 3.4 describes the permitted land uses, densities, lot sizes and design guidelines for each of these land uses.

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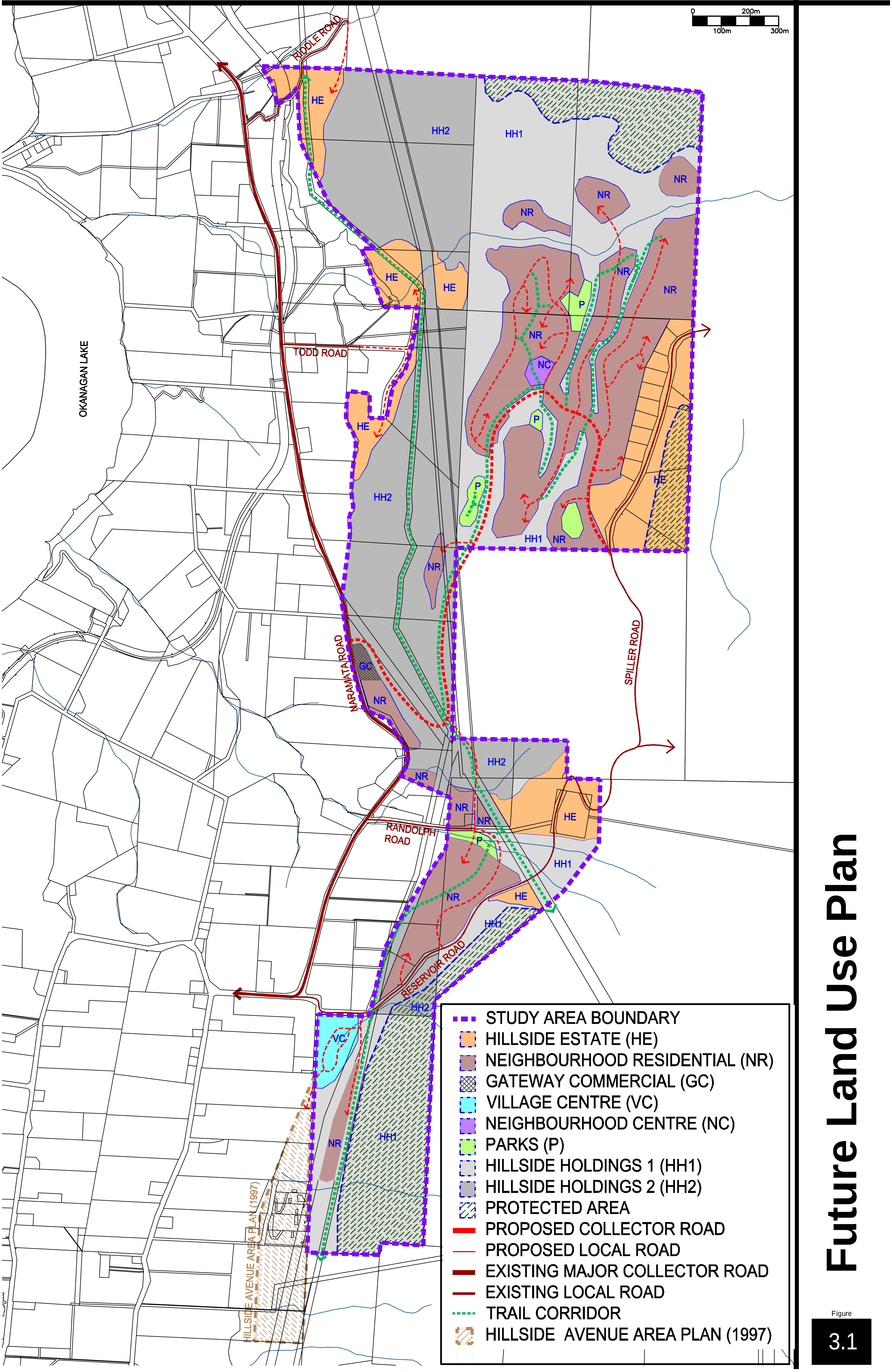

Future Land Use Plan

Figure 3.1

3.3 Potential Development Yield

Based on concept planning throughout the study area, it is projected that the NCP area could achieve the following development yield at full build-out:

Table 3.1: Potential Development Yield

Land Use	Yield (Units)
Single Detached & Duplex (Neighbourhood Residential)	700-800
Residential Estate Lots (Hillside Estate/Hillside Holdings)	20-50
Multiple Unit Residential (Village/Neighbourhood Centre)	80-200
Total Residential Units	**800-1,050**

Based on a yield of 800 to 1,050 residential units and an average household size of 2.1 (according to the 2006 Census for the City of Penticton), it is projected that the NCP population will be in the range of 1,680 to 2,205 at full build-out.

In addition to the residential population identified in **Table 3.1**, there is potential for small scale neighbourhood and tourist commercial uses in the Village and Neighbourhood Centre areas, as noted in **Section 3.4** below.

3.4 Land Use Designations

3.4.1 Hillside Holdings 1

The Hillside Holdings 1 (HH1) designation applies to large, contiguous blocks of land that are subject to steeper topography, are difficult to access by public road, are difficult to service with water, sanitary sewer or other municipal services or are located within areas that exhibit high environmental values as described in **Section 2.4** of this plan. The extent of the lands designated as Hillside Holdings 1 is shown in **Figure 3.1** (Future Land Use Plan).

Policies Applicable to Hillside Holdings 1:

The following policies apply to lands that are designated as Hillside Holdings 1:

<u>Permitted Uses</u>

Within the Hillside Holdings 1 designation, permitted uses include:

- Agriculture, including vineyards, orchards and other agricultural uses excluding intensive livestock or horticultural operations;
- Parks, open space, and trail corridors;
- Single family residential uses; and,
- Bed and breakfasts and accessory residential uses including secondary suites and carriage houses.

Density/Minimum Lot Area

Within the area designated as Hillside Holdings 1, the minimum lot area shall be 8 hectares (20 acres).

Notwithstanding the above, clustering of development will be permitted to preserve natural features or improve servicing efficiency. Where development is clustered, the minimum lot area shall be 2 hectares (5 acres), subject to successful rezoning of the property and provided that the overall density does not exceed 1 unit per 8 hectares (20 acres) for the parent parcel to be developed.

Required Levels of Service

Single family residential lots shall be served by community water systems and shall have frontage on a public road. Shared driveway accesses may be permitted subject to the City's Subdivision and Development Bylaw regulations. Onsite sewage disposal is permitted subject to the systems meeting all regulations and requirements of the City of Penticton and the Interior Health Authority/Ministry of Health.

3.4.2 Hillside Holdings 2

As with the Hillside Holdings 1 designation, the Hillside Holdings 2 (HH2) designation applies to large, contiguous blocks of land that are subject to steeper topography, are difficult to access by public road, are difficult to service with water, sanitary sewer or other municipal services or are located within areas that exhibit high environmental values as described in **Section 2.4** of this plan. However, unlike the Hillside Holdings 1 designation, all Hillside Holdings 2 lands are currently zoned Agricultural, with a minimum permitted lot area of 2 hectares (5 acres). The extent of the lands designated as Hillside Holdings 2 is shown in **Figure 3.1** (Future Land Use Plan).

Policies Applicable to Hillside Holdings 2:

The following policies apply to lands that are designated as Hillside Holdings 2:

Permitted Uses

Within the Hillside Holdings 2 designation, permitted uses include:

- Single family residential uses;
- Agriculture and agri-tourism, including vineyards, orchards and other agricultural uses excluding intensive livestock or horticultural operations;
- Parks, open space, and trail corridors; and
- Bed and breakfasts and accessory residential uses including secondary suites and carriage houses.

Density/Minimum Lot Area

Within the area designated as Hillside Holdings 2, the minimum lot area shall be 2 hectares (5 acres).

Notwithstanding the above, clustering of development will be permitted to preserve natural features or improve servicing efficiency. Where development is clustered, the minimum lot area shall be 600 m2 (6,458 ft^2) if community water and sewer services are provided, subject to successful rezoning of the property and provided that the overall density does not exceed 1 unit per 2 ha (5 acres) for the parent parcel to be developed. Cluster developments utilizing on-site sewer may also be permitted provided that the minimum lot area requirements of the City of Penticton and the Interior Health Authority/Ministry of Health are met (see Required Levels of Service below), and that the overall density does not exceed 1 unit per 2 ha (5 acres) for the parent parcel to be developed.

Required Levels of Service

Single family residential lots shall be served by community water systems and shall have frontage on a public road. Shared driveway accesses may be permitted subject to the City's Subdivision and Development Bylaw regulations. Onsite sewage disposal is permitted subject to the systems meeting all regulations and requirements of the City of Penticton and the Interior Health Authority/Ministry of Health. For any sites with on-site sewer, minimum lot area is generally 1 ha (2.5 acres) for sites with acceptable soils and a Type 1 system, tank and tile field. However, provided that the site is serviced with City water, a minimum lot area of less than 1 ha (2.5

acres) may be acceptable for a site using on-site sewer. Approval of on-site sewage disposal is contingent on a site assessment of percolation capacity, type and depth of available soils, slope and soil stability, and other relevant factors as determined by a Registered Onsite Wastewater Practitioner/Professional (ROWP). All development shall implement a comprehensive approach to storm drainage.

3.4.3 Hillside Estate

The Hillside Estate (HE) designation applies to lands that are generally not suitable for urban residential densities due to topographical constraints and difficulty in providing public road access and/or extending municipal services. They provide a transition from urban uses to the areas designated for Hillside Holdings. The extent of lands designated as Hillside Estate is shown in **Figure 3.1** (Future Land Use Plan).

Policies Applicable to Hillside Estate:

The following policies apply to lands that are designated as Hillside Estate:

<u>Permitted Uses</u>

Within the Hillside Estate designation, permitted uses include:

- Single family residential uses;
- Agriculture and agri-tourism, including vineyards, orchards and other agricultural uses excluding intensive livestock or horticultural operations;
- Parks, open space, and trail corridors; and
- Bed and breakfasts and accessory residential uses including secondary suites and carriage houses.

<u>Density/ Minimum Lot Area</u>

The minimum lot area within the area designated as Hillside Estate shall be 0.4 hectares (1 acre). However, where development can be clustered to preserve natural features or improve servicing efficiency, the minimum lot size may be reduced to 600 m^2 (6,458 ft^2), subject to successful rezoning of the property and provided that the overall density does not exceed 1 unit per 0.4 hectares (1 acre) for the parent parcel to be developed. All development shall implement a comprehensive approach to storm drainage.

Required Levels of Service

Development within the area designated as Hillside Estate must be serviced by community water and all road systems within the development must connect with a public road. All development in a cluster format must be connected to a community sewer system. For larger lots, onsite sewage disposal may be permitted subject to the systems meeting all regulations and requirements of the City of Penticton and the Interior Health Authority/Ministry of Health. For sites with on-site sewer, minimum lot area is generally 1 ha (2.5 acres) for sites with acceptable soils and a Type 1 system, tank and tile field. However, provided that the site is serviced with City water, a minimum lot area of less than 1 ha (2.5 acres) may be acceptable for a site using on-site sewer. Approval of on-site sewage disposal is contingent on a site assessment of percolation capacity, type and depth of available soils, slope and soil stability, and other relevant factors as determined by a Registered Onsite Wastewater Practitioner/Professional (ROWP). All development shall implement a comprehensive approach to storm drainage.

3.4.4 Neighbourhood Residential

Neighbourhood Residential uses are designated for all areas that demonstrate characteristics suitable for urban residential densities. These areas are generally not subject to steep topography or other physical constraints. They are generally not located within areas that have been designated with high environmentally sensitivities. A range of residential uses will be permitted within the areas designated for Neighbourhood Residential use in order to respond to the housing needs of a wide variety of residents. The extent of lands designated as Neighbourhood Residential is shown in **Figure 3.1** (Future Land Use Plan).

Policies Applicable to Neighbourhood Residential Uses:

The following policies apply to areas designated Neighbourhood Residential:

Permitted Uses

Within the Neighbourhood Residential designation, permitted uses include:

- Single family residential uses;
- Two family residential (duplexes);
- Triplex;
- Townhouses;

- Parks, open space, and trail corridors; and,
- Accessory residential uses including secondary suites and carriage houses.

Density/Minimum Lot Area

The maximum densities and the minimum lot areas and frontages for permitted residential uses are as follows:

Use	Maximum Density	Minimum Lot Area	Minimum Frontage
Single Family		315 square metres	10 metres
Two Family		390 square metres	13 metres
Triplex		670 square metres	18 metres
Townhouses	0.7 FAR (floor area ratio)		

Required Level of Service

Within areas designated Neighbourhood Residential, all development shall be serviced with public road access, community water and community sewer, and implement a comprehensive approach to storm drainage.

For Neighbourhood Residential areas to the north of Strutt Creek, in view of the requirement to cross Strutt Creek, as well as the difficult topography, more detailed analysis is required (beyond the scope of this NCP) to assess the ability to access cells by public road, extend community water and sanitary sewer services, and provide adequate storm drainage services. Development to Neighbourhood Residential uses is conditional on the provision of an urban level of services as described above.

Mix of Housing Forms Encouraged

To provide a variety of housing options within Neighbourhood Residential areas, the provision of various housing forms (e.g. single detached homes, duplexes, townhouses) is encouraged.

3.4.5 Gateway Commercial (Overlay Designation)

At the intersection of Naramata Road and the new access road to the Spiller Block there is potential for a small commercial node that would service both the NCP area and the broader Naramata Bench and North East Sector area. The node could provide tourist-oriented uses (e.g. wine sales, eating and drinking establishments) and/or neighbourhood serving retail uses. The exact location and configuration of such uses is yet to be determined, and this area is identified with a Gateway Commercial overlay designation, which would also permit the underlying Neighbourhood Residential land uses (e.g. single detached homes, duplexes, townhouses).

Policies Applicable to Gateway Commercial (Overlay Designation):

The following policies apply to lands that are designated as Gateway Commercial (Overlay Designation):

Permitted Uses

Within the Gateway Commercial Overlay Designation, permitted uses include:

- Neighbourhood commercial or shopping centre uses as defined in City of Penticton Zoning By-law;
- Tourist oriented commercial uses including gift shops, eating and drinking establishments, hotels, wineries, and wine sales; and,
- All residential uses permitted within the Neighbourhood Residential designation.

Maximum Height

The height of buildings and structures shall not exceed two storeys.

Required Level of Service

Within areas designated Gateway Commercial, all development shall be serviced with public road access, community water and community sewer, and implement a comprehensive approach to storm drainage.

3.4.6 Village Centre

The development of a Village Centre is proposed southeast of the intersection of Naramata Road and Reservoir Road. The Village Centre will contain a variety of commercial and medium density residential uses including mixed use developments. Commercial uses will be limited to those uses that provide for the immediate commercial needs of the residents of the plan area and the surrounding rural areas as well as serving visitors drawn to the vineyards and wineries of the area. Residential uses will generally take the form of medium density townhouses, apartment buildings, or above commercial mixed use residential units. The extent of the Village Centre designation is illustrated in **Figure 3.1** (Future Land Use Plan).

Policies Applicable to Village Centre:

The following policies apply to lands that are designated as Village Centre:

Permitted Uses

Within the Village Centre designation, permitted uses include:

- Neighbourhood commercial or shopping centre uses as defined in City of Penticton Zoning By-law;
- Tourist oriented commercial uses including gift shops, eating and drinking establishments, hotels, wineries, and wine sales;
- Institutional uses;
- Medium Density Multiple family residential uses including townhouses, apartment buildings, and above commercial mixed use residential units;
- Live/work residential units; and,
- Parks, open space, and trail corridors.

Maximum Density

Maximum multiple family residential density shall be 87 uph (35 upa).

Maximum Height

The height of buildings and structures shall not exceed four storeys.

Required Level of Service

Within areas designated for Village Centre use, all development shall be serviced with public road access, community water and community sewer, and implement a comprehensive approach to storm drainage.

3.4.7 Neighbourhood Centre

The development of a neighbourhood centre is proposed for the Spiller block and provides opportunity for medium density residential uses as well as potential for convenience type neighbourhood commercial uses that serve the needs of the immediate neighbourhood. The

Neighbourhood Centre is centrally located, as shown in **Figure 3.1** (Future Land Use Plan), so as to function as the gathering space and focal point for the neighbourhood.

Policies Applicable to Neighbourhood Centre:

The following policies apply to lands that are designated as Neighbourhood Centre:

Permitted Uses

Within the Neighbourhood Centre designation, permitted uses include:

- Neighbourhood commercial or shopping centre uses as defined in City of Penticton Zoning By-law;
- Institutional uses;
- Medium Density Multiple Family Residential uses including townhouses, apartment buildings, and above commercial mixed use residential units;
- Live/work residential units; and,
- Parks, open space, and trail corridors.

Maximum Density

Maximum multiple family residential density shall be 87 uph (35 upa).

Maximum Height

The height of buildings and structures shall not exceed four storeys.

Required Level of Service

Within the area designated as Neighbourhood Centre, all development shall be serviced with public road access, community water and community sewer, and implement a comprehensive approach to storm drainage.

3.4.8 Parks

The Parks designation applies to all areas that are proposed for publicly owned, active park spaces. The extent of the Parks designation is illustrated in **Figure 3.1** (Future Land Use Plan). Additional land for trails and passive park areas will generally be dedicated to the City to enhance the linear park system along the trail network.

Policies Applicable to Parks:

The following policies apply to lands that are designated as Parks:

Permitted Uses

Within the Parks designation, permitted uses include:

- Public parks;
- Public open space; and,
- Trail corridors.

3.4.9 Protected Area (Overlay Designation)

Within the NCP study area, there are several areas that are identified as Protected Areas. In these areas, it is expected that there will be no development, in order to protect sensitive ecological areas and steep slope areas. Lands will remain primarily in a natural state. Nevertheless, it is recognized that there may be a need to have roads traverse these areas to access lands beyond, or that limited development or infrastructure may infringe on these lands. In such cases, further study will be required to determine the suitability of such infringements, or to refine the boundaries of Protected Areas.

Policies Applicable to Protected Areas:

- Protected Areas are to generally remain free of development. In cases were lands may be required for roads, limited development, or infrastructure, infringements should generally constitute no more than 5% of the area, unless an Environmental Impact Assessment indicates that a higher level of development would be suitable.
- An Environmental Impact Assessment must be completed for any potential infringement on a Protected Area.
- Within underlying Hillside Holdings or Hillside Estate land use designations, development may be clustered in locations that are not identified as a Protected Area. The land area identified as Protected Area may be included in the density calculation for cluster developments, as per the policies for the Hillside Holdings and Hillside Estate land use designations.

3.5 Phasing of Development

Within all NCP areas, development phasing will be contingent on:

- provision of community water;
- provision of community sewer or approved on-site sewer systems;
- provision of suitable access from public roads; and,
- provision of adequate stormwater services.

As illustrated in the water and wastewater servicing plans, development will be sequenced to facilitate an orderly extension of urban services to the study area. Should property owners wish to develop their lands prior to the extension of infrastructure to their lands, infrastructure extensions will be required to provide the required levels of service described in **Section 3.4**, above. As well, in accordance with this phasing plan, lots adjacent to the Campbell Mountain Landfill should be developed in later phases or when the buffer to the active landfill operation is sufficient for development to proceed.

4.0 DEVELOPMENT PERMIT AREAS

In accordance with Section 919.1 of the *Local Government Act,* an Official Community Plan may designate Development Permit Areas within the City. Unless otherwise specified, a Development Permit must be approved and issued by City Council prior to any development, subdivision, construction, or alteration within a Development Permit Area. Through the adoption of the Spiller Road / Reservoir Road Area Neighbourhood Concept Plan (NCP) into the Official Community Plan, the City of Penticton specifies the following Development Permit Areas:

- Hillside Development Permit Area;
- Wildfire Interface Development Permit Area;
- Environmental Protection Development Permit Area; and,
- Village and Neighbourhood Centre Development Permit Area.

These Development Permit Areas are established to ensure that development responds to the unique site conditions in the Spiller Road / Reservoir Road Area. Pursuant to Section 919.1(1) of the *Local Government Act,* the Development Permit Areas are established for the following purposes:

1. protection of the natural environment, its ecosystems and biological diversity;
2. protection of development from hazardous conditions;
3. establishment of objectives for the form and character of intensive residential development;
4. establishment of objectives for the form and character of commercial and multi-family residential development; and,
5. establishment of objectives to promote water conservation.

For all development permit areas, submission requirements will be as per the City of Penticton Development Permit application requirements, except where additional requirements are noted below.

4.1 Hillside Development Permit Area

Guidelines

The Hillside Development Permit Area applies to all properties identified on **Figure 4.1** (Hillside and Wildfire Interface Development Permit Areas). For all of these properties, Development Permits shall be issued in accordance with the following guidelines:

Site Planning and Development Guidelines

1. Preserve unique natural characteristics such as rock outcrops, watercourses, and ravines.
2. Maintain the views of ridgelines by minimizing grading works, planting screening vegetation, and/or designing buildings sensitively to ensure that development has a low profile on ridgelines.
3. Ensure that manufactured slopes blend well with existing slope conditions.
4. Generally locate development in areas with natural slopes of less than 30%, and preserve open space in areas with natural slopes of 30% or more.
5. Consider limited development in areas with natural slopes of more than 30%, under the following conditions: a geotechnical study demonstrates the feasibility of development; a site grading plan demonstrates that works will sensitively replicate the hillside environment; flat yards and large retaining features are avoided; pre-development slopes of less than 30% are predominant in the general area; and, visual impact assessment demonstrates the sensitive integration of development into the hillside.
6. On steeper sites, ensure that it is feasible to construct individual driveways with slopes of less than or equal to 20%.
7. Site parks to capitalize on scenic view opportunities.
8. Align roads along natural site contours where possible.
9. Consider increased cul-de-sac lengths where connectivity to the road network is not possible due to topographic conditions, provided that appropriate emergency access is constructed. Emergency vehicle access lanes shall generally have a minimum hard packed surface width of 4.5 metres. Emergency vehicle access lanes should generally be designed to achieve a maximum grade of 11%. In steeper areas the City may consider varying this requirement to allow stretches with grades of up to 15%.
10. Consider reduced pavement widths and right-of-way widths where service levels can be maintained, the reduced widths provide demonstrably less slope disturbance, and the reduced widths contribute to the overall neighbourhood character.
11. Consider reduced front yard setbacks as a means to alleviate the need for steep driveways. Along street frontages, a generally consistent front building line should be maintained.
12. Predominantly maintain yard areas in a natural slope condition, and avoid large cuts and fills to achieve flat yards.
13. Where retaining materials are necessary, use materials that evoke a sense of permanence and reflect natural qualities through the use of context-sensitive materials, colours, and textures.

14. Where possible, use systems of smaller, terraced retaining walls rather than single, large, uniform walls.

Building Form Guidelines

1. Encourage “stepping” of building foundations to reduce site grading and retaining requirements.
2. Where possible, set buildings into the hillside and integrate with natural slope conditions.
3. Avoid unbroken expanses of wall.
4. Encourage building articulation to reduce apparent mass.

Submission Guidelines

In support of Hillside Development Permit Area applications, the following submissions will be required:

- Site Features Inventory identifying:
  - Property lines, easements, rights-of-way;
  - Natural pre-development site contours;
  - Geotechnical assessment;
  - Existing human-made features such as roads, curbs, sidewalks, utilities, trails, buildings, structures, fences, and retaining walls;
  - Natural physical features including knolls, ridgelines, rock outcrops, watercourses, ravines, and cliffs;
  - Prominent views;
  - Identification of significant environmental attributes; and,
  - Potential hazards and hazard areas.

- Development Concept Plan identifying:
  - Proposed site plan outlining the location of roads, shared driveways, lanes, major utility features (mains, pump stations, reservoirs, detention ponds, etc.), lots, building envelopes, parks, trails;
  - Grading concept plan including identification of large cut and fill areas, significant retaining feature locations and heights, and building envelopes; and,
  - Identification of site features to be retained (from Site Features Inventory).

URBANSYSTEMS

SPILLER RD. / RESERVOIR RD. NEIGHBOURHOOD CONCEPT PLAN

Hillside and Wildfire Interface Development Permit Areas

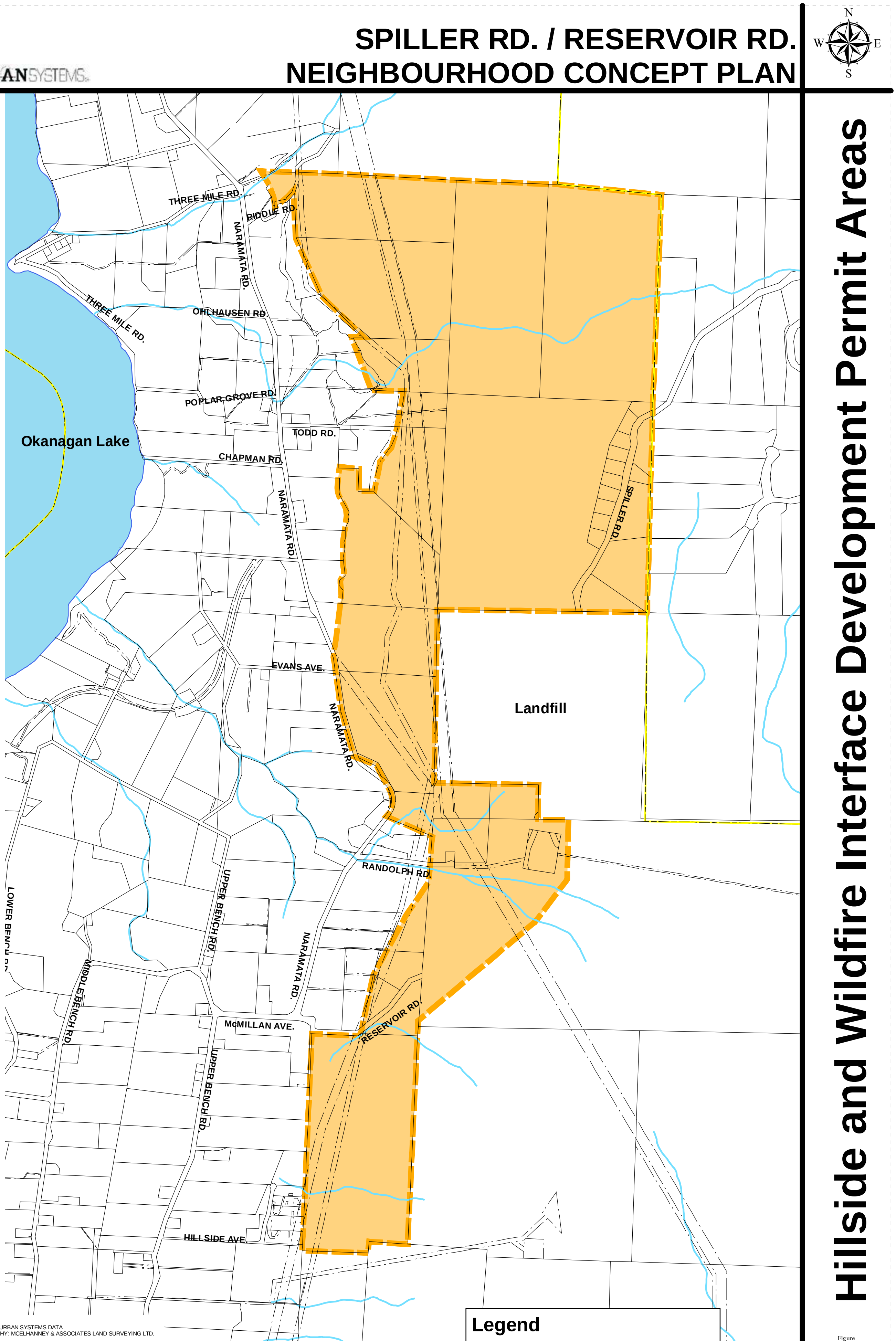

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Figure
4.1

4.2 Wildfire Interface Development Permit Area

Guidelines

Within the areas identified on **Figure 4.1** (Hillside and Wildfire Interface Development Permit Areas), Development Permits shall be issued in accordance with the following guidelines:

Building Locations

1. Where possible, homes and buildings should be located on the flattest portions of properties, so that buildings are not constructed above or in gullies or draws that can accumulate fuel and funnel winds, worsening fire behaviour.

Building Construction

Buildings shall be constructed using FireSmart[1] principles, including but not limited to the following:

1. Roofing materials should be non-combustible and fire resistant as defined in the BC Building Code. Encouraged materials include composite (asphalt and fibreglass) shingles, concrete or clay tile, or metal roofing.
2. Exterior wall finishes should be fire resistant, using materials such as stucco, metal siding, brick, cement shingles, concrete block, poured concrete, logs or heavy timbers as defined in the BC Building Code, and rock. Construction grade vinyl soffit material is not acceptable.
3. Windows should be double paned or tempered glass.
4. All crawl spaces, the underside of porches and decks and sheds must be sealed.
5. Decks and balconies should be constructed of heavy timber as defined by the BC Building Code, be rated to have 1-hour fire resistance, or be made of, or covered by non-combustible material, such as the exterior wall finishing material.
6. All chimneys should have spark arrestors made of 12 gauge or better-welded or woven wire mesh with mesh openings of less than 12 millimeters.
7. All screens for attic and basement vents must be metal and have small enough openings to prevent sparks from passing into the building (i.e. 3 millimeter non-combustible wire mesh as a minimum).

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[1] "FireSmart: Protecting Your Community from Wildfire" (BC Edition – Ministry of Forests, Protection Branch, 2004) provides guidelines to reduce the risk of loss from wildfire.

8. Exterior irrigation systems are encouraged as additional means of protection on any properties that have difficult private driveway access.
9. All land clearing debris should be removed within 3 months of accumulation or before the start of the fire season.
10. Combustible waste materials should be removed from development sites, as soon as possible, once construction is completed.

Landscaping

All landscaping shall be provided using FireSmart principles, including but not limited to the following:

1. Due to the risk of fire in forest interface areas, a 10-meter fuel modified space around homes and buildings is recommended (Priority Zone 1 from the FireSmart Manual). The main objective of vegetation within this space is to create an environment that will not support fire of any kind. Within this area, recommendations are as follows:
    a. Plant low-growing (<0.5 meter tall) shrubs around buildings. Landscaping on the property within 10 meters of a building shall not include coniferous shrubs such as junipers, mugo pines or coniferous hedges.
    b. Deciduous trees and shrubs are favoured for landscaping.
    c. No additional or new coniferous evergreen trees are to be planted within 10 meters of buildings.
    d. Watered and mowed lawns are recommended close to buildings. It is also recommended that pea gravel, lava rock or other non-combustible material be used as ground cover rather than bark mulch.
    e. Fencing should be constructed from non-combustible material.
    f. Healthy trees within 10 meters of homes and buildings can be retained; however, branches should not be within 3 meters of buildings or projections, such as balconies.
    g. Remove trees with mistletoe brooms found close to homes.

2. Where space allows on large sized lots, for a distance greater than 10 meters and up to 100 meters from homes and buildings (Priority Zones 2 and 3 from the FireSmart Manual), recommendations are as follows:
    a. Where possible, space conifers to a distance of 2-3 meters between crowns. Healthy conifers in groups can be retained provided there is a space of 2-3 meters between adjacent tree crowns and the group of conifers to be retained.

b. On conifers that are to be retained, remove ladder fuels to a height of 2.5 meters or higher on steep slopes.

c. Remove any Douglas-fir trees with mistletoe brooms growing more than 3 meters up the trunk.

3. In all development areas, remove standing dead and dying trees and root damaged trees. This is particularly important because of mountain pine beetle attacks to ponderosa pines in the area. Snags identified as valuable wildlife habitat can be retained where they do not pose a fire or safety hazard.

Alternative Approaches

1. Where a Wildfire Interface Development Permit is required and a development is proposed that varies the above Guidelines, a report must be provided by a registered professional forester or a professional engineer with experience in fire safety, indicating that the susceptibility to wildfire has not increased.

4.3 Environmental Protection Development Permit Area

Guidelines

Figure 4.2 (Environmental Protection Development Permit Area) identifies three categories of Environmentally Sensitive Areas. These are summarized as follows:

ESA 1 (High)
These lands include locally and provincially significant ecosystems, extremely rare and/or of critical importance to rare wildlife species. These areas may also represent a diverse range of habitats and contribute significantly to the overall connectivity of the habitat and ecosystems. Avoidance and conservation of ESA-1 designations is the primary objective.

If development is required and justified within these areas, mitigation to reduce or eliminate environmental impact shall be required. If permanent loss of habitat is unavoidable, compensation will be considered. Compensation should promote a not net loss to habitat, and be used only after it proves impossible or impractical to maintain the same level of ecological function.

ESA 2 (Moderate)
These lands include locally or provincially significant ecosystems, uncommon and important to rare wildlife species. In general, it is preferable to avoid development in ESA-2 areas. Where development is pursued, portions of the habitat must be retained and integrated to maintain the contiguous nature of the landscape.

Any area given this rank is of only slightly lower priority for preservation than ESA-1 areas. Therefore, clear rationale and criteria for distinction between High and Moderate values shall be provided. Some degree of development may be considered as long as this does not have any potential impact on High ESA's on the site. Some loss to these ESAs can be offset by habitat improvements to the remaining natural areas found on the property.

ESA 3 (Low)
These lands include ecosystems that may have low to moderate conservation values because of importance to wildlife (e.g. disturbed or fragmented ecosystems or habitat features). These areas may contribute to the diversity to the landscape, although based on the condition and adjacency of each habitat the significant function within the landscape is limited. Lands rated low to moderate can generally accommodate development more so than other ESA categories.

Within the areas identified on **Figure 4.2** (Environmental Protection Development Permit Area), Development Permits shall be issued in accordance with the following guidelines:

Guidelines for ESA 1 (High Sensitivity) and ESA 2 (Moderate Sensitivity) Areas

1. Development within an ESA 1 or ESA 2 area requires an Environmental Assessment (EA), carried out by a registered professional biologist (RPBio), as defined in the College of Applied Biology Act, and with input from other professionals of specific expertise where required. The EA must be based on the City of Penticton's approved terms of reference (TOR), and include two phases of assessment (which can be completed together or separate) as follows:
   - Ecological Assessment Phase, the intention of which is to assess both the biological conditions and physical conditions of a site, should be carried out in advance of any preliminary layout plan and prior to any preparatory site disturbances. The Ecological Assessment Phase determines a development footprint respectful of sensitive ecosystems and helps streamline the development approval process.
   - Impact Assessment and Mitigation Phase is generally carried out after the preliminary layout plan and outlines the impact, if any, of the development footprint on sensitive ecosystems and recommends mitigation measures to minimize or cause no impact.
2. On any given property, for areas within the ESA 1 or ESA 2 classification, ensure that a minimum of 80% of lands remain free of development and in their natural condition except for fencing (that allows for wildlife movement), or works to preserve the natural habitat.
3. Recognizing that development may occur on up to 20% of ESA 1 or ESA 2 lands on a given property, plan, design and construct development to avoid encroachment on the most sensitive ecosystems identified in the environmental assessment. This includes, but is not exclusive to, habitat values for federally listed Species at Risk (endangered, threatened, or special concern), provincially ranked (Red or Blue) and regionally significant species, as well as connectivity between habitats including wildlife travel corridors. Wherever possible, buffer sensitive ecosystems (based on provincial Best Management Practices (BMPs) from the development area and adjacent lands having sensitive ecosystems.
4. In accordance with the environmental assessment, lands deemed environmentally sensitive must be designated in the development permit as 'non- disturbance areas' and could involve lands on the periphery of the development footprint as well as some lands within the development area itself. These areas are to be cordoned off or fenced during construction and where and when else deemed necessary in accordance with the development permit.
5. Applicants must submit a copy of their development plans, including an Environmental Management Plan, delineating the 'non-disturbance areas', erosion and sediment control measures, wildlife tree assessment and tree protection measures within the development envelope, and other pertinent recommendations from the EA, to direct environmental management during construction.

6. Designated Streamside Protection and Enhancement Areas (SPEA) as defined by the Riparian Areas Regulations (RAR) legislation should all be protected by a Section 219 Covenant or through dedication to the City. If a covenant is used, this covenant will allow for road crossings of the watercourse.
7. Where an ESA 1 or 2 area is adjacent to an area where development is pursued, portions of the habitat must be retained and integrated to maintain the contiguous nature of the landscape (e.g. buffer). Designated 'non-disturbance' areas as well as the buffers between them and the development envelope, should be protected by dedication as park, covenant registered on title, or zoning for environmental management purposes.
8. Wildlife corridors determined in the EA will be accommodated during the planning of development to allow adequate width for migration based on provincially accepted Best Management Practices.
9. A stormwater management plan should demonstrate that within the disturbance areas, development will not adversely increase or decrease the amount of surface and/or groundwater or adversely affect the quality of water available unless specified otherwise in the development permit.
10. Erosion and sediment impacts should be managed during and after construction according to measures prescribed in the most current provincial Best Management Practices (BMPs), and amendments thereto, or other standards or guidelines of the City of Penticton.
11. Avoid any disturbance of native vegetation in the non-disturbance areas and wherever possible retain existing native vegetation within the development area(s) and encourage the planting of native and dryland plant landscaping in disturbed areas.
12. Control invasive plant species using site and species appropriate methods (e.g. hand pulling, digging, cutting and mowing). For invasive plant management resources, refer to the Invasive Plant Council of BC website or the most current provincial Best Management Practices (BMPs).
13. A detailed Habitat Compensation and Enhancement Plan may be required to mitigate against residual impacts of the development within ESA 1 and ESA 2 areas. This plan should be a recommendation of the RPBio in the EA and may include a nest box program, reptile/wildlife community monitoring program, or reptile basking/rearing platforms.
    - Next box programs calculate the potential loss of nesting cavities based on calculations derived from existing conditions within the total proposed disturbed areas. The cavities are then replaced with nesting boxes at select sites in consultation with the designated QEP.
    - Reptile/wildlife monitoring programs assess overall reptile/wildlife response to disturbances associated with the proposed works as they progress. If required,

recommendations identified by the QEP are forwarded to construction managers and municipal staff for review and implementation.

- Reptile basking/rearing platforms are generally to be constructed at ratios equivalent to one platform for every 20 ha (50 acres) disturbed. Basking platforms consist of a 100 square meter area (1m in height) made of various rock including boulders, cobble and other material that allow for various sized voids. All platforms must face south and have less than 20% canopy closure to allow for maximum solar heating.

Guidelines for ESA 3 (Low Sensitivity) Areas

1. Development within ESA 3 areas will require an Environmental Assessment (EA), carried out by a registered professional biologist (RPBio), as defined in the College of Applied Biology Act and in accordance with the Penticton's approved terms of reference (TOR). The intention of the EA is to assess both the biological and physical conditions of a site at an appropriate scale (minimum 1:500 and maximum 1:5,000) to confirm the low environmental sensitivity of the area and verify that the area does not contain important habitat values for wildlife. If the EA determines that the area contains High or Moderate ESA areas or other important habitat features that support locally significant species or species at risk, then the above stated 'Guidelines for ESA 1 (High Sensitivity) and ESA 2 (Moderate Sensitivity) Areas' will apply.

Guidelines for Aquatic Resources

Within the NCP area, Strutt Creek meets the definition of a stream as identified in the Fish-Stream Identification Guidebook (1998) as well as the Provincial Riparian Areas Regulation (RAR). Any works in the Riparian Assessment Area are required to meet the requirements of the City of Penticton Riparian Assessment Area Development Permit Area (found in the City's Official Community Plan), and the Provincial Riparian Areas Regulation, as amended from time to time. As identified in the City's Development Permit Area, the Riparian Assessment Area means:

- For a stream, the 30 meter strip on both sides of the stream, measured from the high water mark;
- For a ravine less than 60 meters wide, a strip on both sides of the stream measured from the high water mark to a point that is 30 meters beyond the top of the ravine bank;
- For a ravine that is 60 meters wide or greater a strip on both sides of the stream measured from the high water mark to a point that is 10 meters beyond the top of the ravine bank.

In addition to the City's Development Permit Area requirements, the following guidelines will also apply to tree cuts, construction, and soil deposit/removal within 30m of a waterbody:

1. Areas designated as the Streamside Protection and Enhancement Area (SPEA) shall be flagged with high visibility flagging tape and temporary fencing.
2. Prior to construction, a detailed sediment and erosion control plan shall be developed to prevent the discharge of sediment laden water into the SPEA or any watercourses identified on-site. This will include the installation of sediment fencing/hay bales as determined by on-site biologist prior to the initiation of construction activities.
3. No works shall be undertaken within areas designated as SPEA unless Ministry of Environment (MoE) approval is acquired through a Section 9 Instream Works permit.
4. All works scheduled within 30m of a watercourse and outside of the SPEA shall adhere to all recommendations as outlined in the BMP - Develop with Care: Environmental Guidelines for Urban and Rural Land Development in British Columbia. As well, it will be ensured that construction proceeds smoothly without harmful alteration of habitat, and long-term monitoring for disturbed sites will be provided until green-up is established and the soils at the site are stable.
5. Heavy equipment (excavators etc.) working outside the SPEA and within 30m of a waterbody shall be monitored for leaks (oil, hydraulic fluid etc.).
6. Disturbed areas outside the SPEA and within 30m of a waterbody shall be revegetated with native plants of a size that will quickly re-establish riparian cover when construction activities are deemed complete.
7. Detailed direction to contractors shall be given to ensure that no erosion or sediment movement will occur and that no silt will be released to the SPEA during the construction and post construction phase.
8. The site shall be monitored by the designated QEP (once every two weeks or as required due to high rainfall events with >30mm/24 hour period) during the construction period. Any contraventions of the RAR shall be communicated to the construction manager as well as local municipal and Ministry of Environment RAR staff.
9. A post construction report generated by the designated QEP shall be submitted to RAR and local municipal staff when activities are deemed complete.

Bonding and Environmental Monitoring

1. The City may require security in accordance with Section 925 of the Local Government Act to pay for remediation if:
   - a condition in a permit respecting landscaping has not been satisfied;
   - an unsafe condition has resulted as a consequence of contravention of a condition in a permit; or,
   - damage to the natural environment has resulted as a consequence of a contravention of a condition in a permit.

2. Where the City requires bonding as a condition of the development permit approval, the applicant must provide a bond for up to a value of 125% of the estimated cost of any remediation works, as prepared by a QEP.
3. During construction and until “green-up” of the area is established, the City may require monitoring reports prepared by a QEP, the purpose of which are to confirm the required conditions of the development permit have been met.
4. The bond shall remain in effect until the City has been notified, in writing, by a QEP and City staff are satisfied that the conditions of the development permit have been met. However, to confirm that the remedial works, such as successful plant establishment, have been completed, the City will withhold 10% of the bond for two years.

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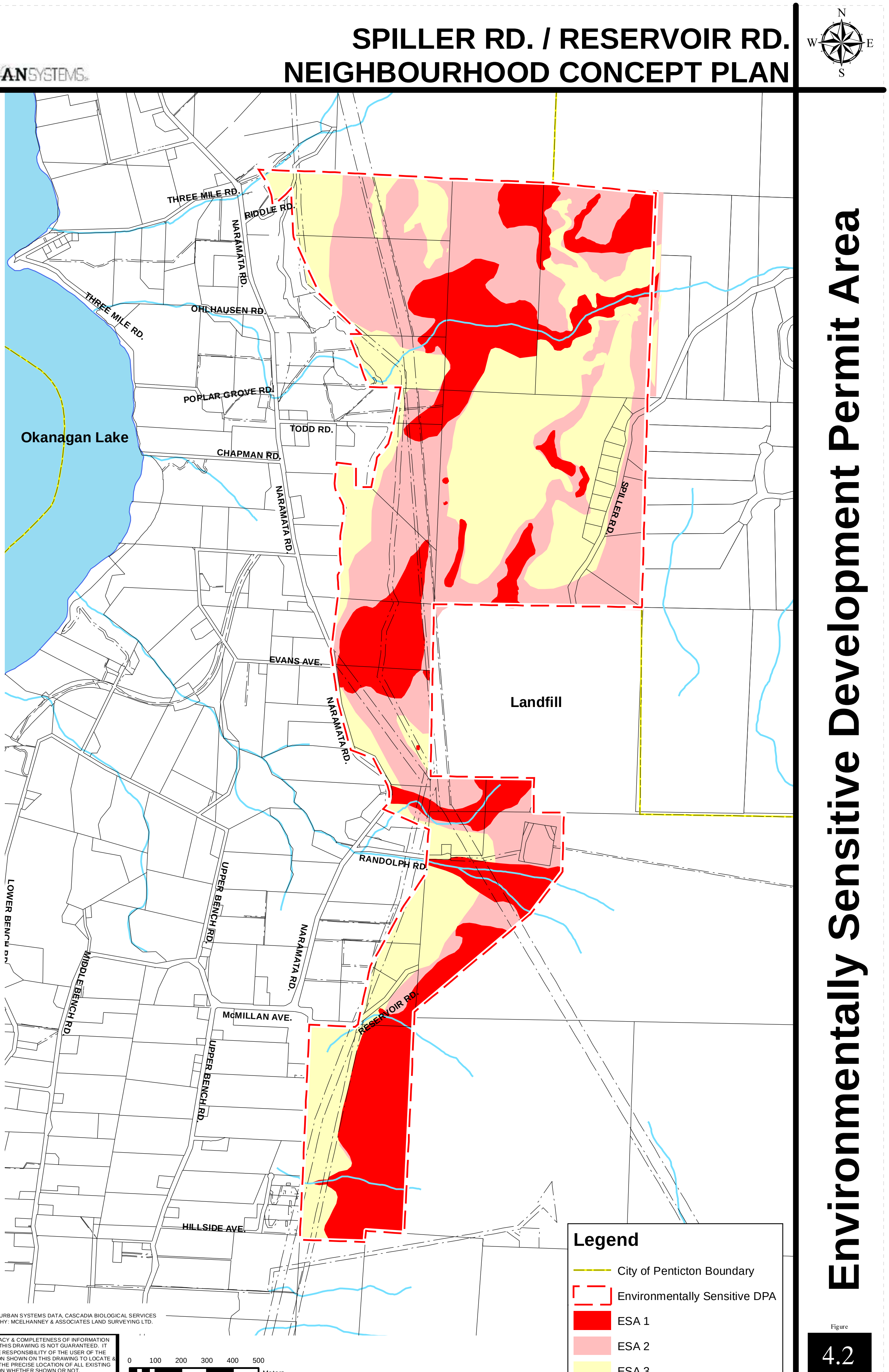

Environmentally Sensitive Development Permit Area

SOURCES: URBAN SYSTEMS DATA, CASCADIA BIOLOGICAL SERVICES
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Figure
4.2

4.4 Village / Neighbourhood Centre and Multi-Family Residential Development Permit Area

Guidelines

Within areas designated as Village Centre or Neighbourhood Centre on the Future Land Use Plan (**Figure 3.1**), and for all multi-family residential developments throughout the NCP study area, Development Permits shall be issued in accordance with the following guidelines:

Parking and Access

1. Large surface parking facilities are discouraged.
2. Whenever possible, required off-street parking shall be provided under buildings or internally located, rather than being adjacent to street frontages.
3. Townhouse developments are encouraged to use rear lane access where possible.

Pedestrian Orientation and Focus

1. Development should be pedestrian oriented. Buildings containing commercial uses shall not be set back from front or flanking lot lines but should form an active street edge. Commercial buildings should also define a pedestrian oriented first floor with canopies, window and door trim, and varied building facades.
2. All commercial and multi-family residential buildings should front or appear to front onto adjacent roadways. This may be achieved through appropriate treatment of the building exteriors and through the provision of pedestrian entrance-ways and walkways to the street.
3. Developments shall give priority to pedestrian circulation and ensure that sidewalks and other pedestrian facilities are of ample width.
4. Efforts should be made to create informal and formal pedestrian gathering spaces that create interest for the pedestrian and contribute to community building and socializing.

Preservation of Views

1. Buildings and structures should be sited to ensure the protection of views, particularly from public gathering spaces.

Building Design

1. Large buildings should be designed in a way that creates the impression of smaller units and less bulk by using building jogs and irregular faces.
2. Building shape, roof lines, architectural features and exterior finish should be sufficiently varied to create interest and avoid a monotonous appearance.
3. Where townhouse units have attached garages or carports, the units should be wide enough to allow the creation of attractive entrances to the individual units between garages. The garage or carport should not dominate the dwelling unit.
4. For commercial buildings, outdoor eating areas and street-side plazas are encouraged.
5. Front entrances should provide a focal point to buildings.

Landscaping and Signage

1. Landscape design plans prepared by a landscape professional will be required for all new multi-family and commercial developments.
2. Landscaped areas should include an underground irrigation system, which should be programmed to optimize water use for efficiency.
3. Waste disposal bins and outdoor storage areas should be completely screened within an enclosure.
4. Free standing signage should be low, front lit or unlit, and provided with a landscaped base.
5. The general character of signs should positively relate to the character of associated buildings.

5.0 NEIGHBOURHOOD INFRASTRUCTURE

Consistent with the policies of the North East Sector Plan (NESP) adopted by Council in 2005, the development of urban uses within the Spiller Road and Reservoir Road Blocks will require the provision of an urban level of services including community water, community sanitary sewer, and storm drainage. Since the adoption of the NESP, the City of Penticton has prepared various engineering studies that are intended to assist the City in establishing a comprehensive, City-wide infrastructure servicing strategy including the extension of infrastructure services to new urban areas such as the Spiller Road and Reservoir Road Blocks. In developing servicing strategies and policies for the Spiller Road and Reservoir Road Blocks, the general concepts and policies established within the NESP were taken into account. However, since the adoption of the NESP, the City has changed or further refined its infrastructure serving strategies based on the additional analysis and assessments that have taken place in the context of the engineering studies carried out sine the adoption of the NESP.

These revised infrastructure strategies and proposals are reflected in the servicing concepts and policies that are contained in this NCP. Where possible, to facilitate an orderly extension of urban services to the study area, staging plans have been prepared for infrastructure investments. This is in accordance with **Section 3.5** of this NCP.

5.1 Water

The extension and upgrading of the City's water system will be required to supply water to the Spiller Road and Reservoir Blocks as set out in the NESP. This upgrading will be required to accommodate both proposed new development as well as providing community water to existing development within the plan area given that many residents not connected to the City's water system are presently experiencing water shortages or water quality problems.

In addition to extending the system to and throughout the Spiller Road and Reservoir Road Blocks, the City's existing water system will require upgrading to provide the required capacity for both existing and new development. Various studies have been completed to address the provision of water to the Naramata Bench area in general and the Spiller Road and Reservoir Road Blocks in particular. These studies include:

- The Naramata Road Water and Sewer System Pre-design Report prepared in 2004.
- The 2005 City of Penticton Water Study.
- February 2010 AECOM North East Sector Optional Water Servicing Plan.
- June 2010 City of Penticton Water Master Plan Addendum – Final Report.

- January 2013 Urban Systems Preliminary Water and Waste Water Servicing Strategy (Appendix E to this NCP).

These studies indicate that the provision of water to the North East Sector poses the following two challenges:

- The length of the service area results in increased friction losses along the water mains.
- The elevation ranges throughout the area require significant boosting (pumping) and storage (reservoirs).

At present, treated water for the Naramata Bench area is supplied from the City's water treatment plant (WTP). Water from the WTP is pumped to the Ridgedale reservoir where it is stored and gravity-fed to the existing Northeast sector service area.

5.1.1 Proposed Upgrading Outside of Plan Area

The proposed upgrading and extension of the City's water system to enable the supply of water required for both domestic consumption and fire flow is shown in **Figure 5.1** (Water Servicing Concept). Upgrades identified in the Water Master Plan consist of the following:

- Construction of a dedicated water supply main from the Water Treatment Plant to the booster pump station (PZ 502) as described above by the construction of a 350 mm main along Upper Bench Road, MacMillan Avenue and Naramata Road; and
- The addition of pumps and control equipment to the booster station at the Water Treatment Plant.

In order to avoid the requirement for the dedicated supply main to support the first phase of development it is possible to construct a new reservoir (PZ 502) and booster station located near one of the major access points to the plan area (opposite the intersection of Evans Road and Naramata Road).

5.1.2 Proposed Extension of Water System within Plan Area

In addition to the improvements to the City's existing water supply system, a plan has also been established for the extension of the water system throughout the plan area. The proposed plan for extending the water system throughout the plan area itself is also shown in **Figure 5.1** (Water Servicing Concept). Improvements include:

- The construction of a booster station at the reservoir proposed to be constructed at one of the main entrances to the plan area (PZ 502) located opposite the intersection of Evans Road and Naramata Road.
- The construction of a new reservoir just below Spiller Road (PZ 644) to service proposed development located within PZ 644 as shown in **Figure 5.1**.
- The installation of a second booster station at the reservoir serving PZ 644 to feed a new reservoir east of Spiller Road.
- The construction of a new reservoir at the northeastern corner of the landfill (PZ 705) to service lands above PZ 644 and to the north end of Spiller Road. The PZ 705 reservoir will have sufficient pressure to supply all homes below 675m elevation. This will be sufficient for all proposed new homes and for most existing homes along Spiller Road. Any existing homes on the upper east side of Spiller Road that are above 675m elevation who desire to be connected to the City water systems would need to install individual booster pump stations.[2]
- The construction of water mains throughout the plan area based on the proposed system of local and collector roads as established in **Section 6** of this NCP.

5.1.3 Proposed Improvements Required To Service Lands beyond Plan Area

Further improvements to the water system will be required to provide service to lands beyond the plan area to the east. These include:

- The construction of a pressure reducing station to provide water service to the parcels located between Todd Road and Riddle Road.
- Construction of a booster station at the west end of Randolph Road to allow future development in the Campbell Mountain area.
- Construction of additional reservoirs and booster stations as required to service the Campbell Mountain area.

5.1.4 Staging of Water System Improvements

The proposed staging plan for the water system improvements are shown in **Figure 5.1** (Water Servicing Concept). To a degree, the staging of water system improvements within the plan area itself will depend on the timing of proposed developments as determined by the various landowners although there is a logical sequence of improvements.

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[2] It is noted that the City's preference is for a reservoir to be located at PZ 715. However, this reservoir is proposed at the PZ 705 location in order to allow for the greatest amount of looping within the proposed distribution and to avoid property acquisition.

Stage 1 Improvements

The first stage of improvements include all improvements required to extend the City's system to the plan area and provide for the upgrading of system components to enable sufficient capacity within the system to service existing and new development within the plan area. These include all improvements described in **Section 5.1.1** above. The Stage 1 improvements could be phased as growth progresses and would lessen the initial financial burden to allow development within the NCP area. A suggested phasing plan for the Stage 1 improvements is shown in **Table 5.1** below. The City has indicated a preference for avoiding the construction of Phase 1 and Phase 2 and moving straight to Phase 3, if financially feasible, in order to avoid the need for additional infrastructure.

Table 5.1: Phasing of Stage 1 Water Improvements

Phase	Description	Resultant flow available under MDD conditions
1	Construct booster station near Evans Road	5 L/s
2	Construct reservoir near Evans Road	25-37 L/s
3	Construct 350mm twin main from Evans Road reservoir to Water Treatment Plant and upgrade booster station at WTP	NE Sector Buildout

Stage 2 Improvements

Stage 2 improvements include all required improvements to extend the water system throughout the plan area itself in order to service individual parcels proposed for development. The precise staging of improvements within the plan area will be determined to some degree by the plans of individual property owners for the development of their lands. The logical sequence will be to extend the water system from the reservoir serving PZ 502 to the parcels located south of the landfill and to the proposed reservoirs serving PZ 644 and PZ 705 in order to facilitate the development located north of the landfill within PZ 644 and PZ 705.

Stage 3 Improvements

Stage 3 Improvements relate to lands beyond the plan area and would be undertaken if and when such lands are designated for development by the City of Penticton.

5.1.5 Standards and Specifications

All water system improvements undertaken to extend and upgrade the water system to the plan area would be required to meet all applicable standards and specifications of the City of Penticton.

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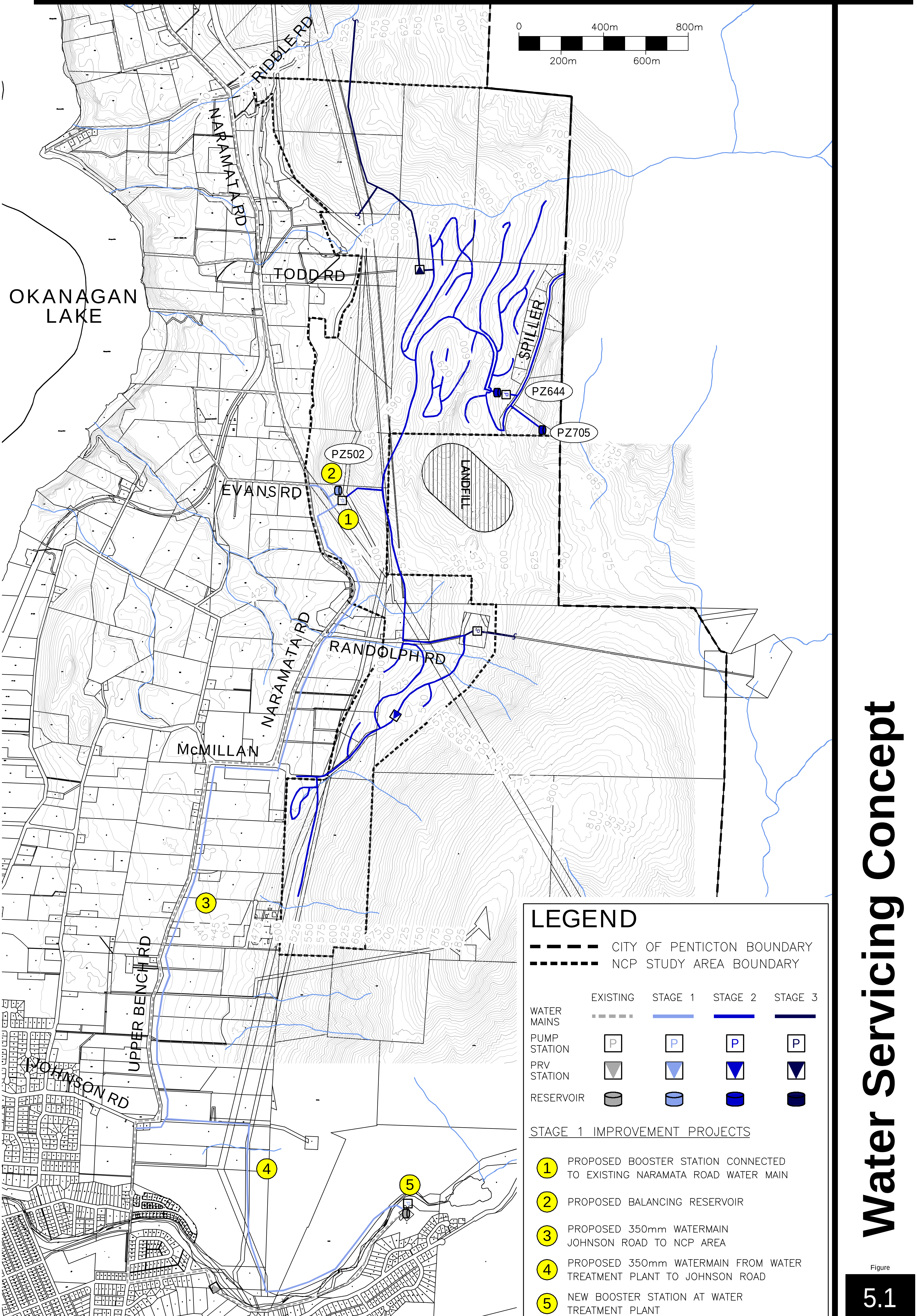

Water Servicing Concept

Figure 5.1

5.2 Sanitary Sewer

The extension of the City's sanitary sewer system will be required to those parts of the plan area that are designated for a full urban level of services. These areas include Village and Neighbourhood Centres, and all Neighbourhood Residential lands. On other lands, on-site wastewater disposal is a permitted option provided that the Interior Health Authority's (IHA) minimum lot area requirements are met.[3] The Naramata Road Water and Sewer System Pre-design Report, completed in September of 2005, indicated that the limit of the existing gravity sewage collection system was located at the intersection of Wade Avenue and Braid Street. Since that time, the gravity collection trunk has been extended along Johnson Road to a point immediately east of Middle Bench Road.

5.2.1 Proposed Upgrading Outside of Plan Area

The proposed upgrading and extension of the City's sanitary sewer system to enable the provision of sanitary sewer system is shown in **Figures 5.2a** (Sewer Servicing Concept #1) and **5.2b** (Sewer Servicing Concept #2) and consists of the following:

- Construction of a 3.4 km 375mm diameter trunk main from the present terminus of the gravity trunk on Middle Bench Road along Upper Bench Road, McMillan Road and Naramata Road to the high point on Naramata Road.
- Construction of the Penticton Creek diversion (creek crossing) as identified in project 14 of the 2005 Sanitary Sewer Study, prepared by EarthTech.
- Upsizing of the Wade Avenue/Johnson Road trunk sewer once flows from the Northeast Sector reach approximately 25 Litres per second.

Servicing Concept #1 provides the necessary infrastructure to the high point along Naramata Road only. It requires the use of localized pumping stations and forcemains to convey flows from surrounding pockets of development, restricted by topography, to the Naramata Road gravity main.

Servicing Concept #2 provides an additional gravity collection trunk from the high point of Naramata Road, northward to Todd Road, at which point, a community pump station would be

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[3] For sites with on-site sewer, minimum lot area is generally 1 ha (2.5 acres) for sites with acceptable soils and a Type 1 system, tank and tile field. However, provided that the site is serviced with City water, a minimum lot area of less than 1 ha (2.5 acres) may be acceptable for a site using on-site sewer. Approval of on-site sewage disposal is contingent on a site assessment of percolation capacity, type and depth of available soils, slope and soil stability, and other relevant factors as determined by a Registered Onsite Wastewater Practitioner/Professional (ROWP).

installed. This new pump station would lift flows southward to the high point along Naramata Road via pressure forcemain and would alleviate the need for localized pump stations on the East side of the road within the NCP area. It would also permit future servicing of the North Block without additional pumping.

In order to set the stage for future development of the North Block, the City has indicated a preference for Servicing Concept #2, which is consistent with the overall servicing concept presented in the Master Plan and North East Sector Plan. However, this concept would result in additional pumping for the Spiller Road/Reservoir Road area. As well, property rights would be required for a minimum 6 meter wide easement or right-of-way between the Spiller Block and Todd Road.

5.2.2 Proposed Extension of Sanitary Sewer System within Plan Area

In addition to upgrading of the gravity trunk as well as other improvements to the City's sanitary sewer system, two plans have also been developed for extending the sewer system within the plan area itself. The components of the sanitary sewer system within the plan area are shown in **Figures 5.2a** (Sewer Servicing Concept #1) and **5.2b** (Sewer Servicing Concept #2) and consist of the following:

- The areas in the Reservoir Block and a significant portion (approximately 2/3) of the Spiller Block can be serviced through connections to the gravity sewer trunk along Naramata Road.

- The remaining development areas within the Spiller Block cannot connect to the Naramata Road trunk by gravity flow. These areas would be serviced via a gravity system that would flow to an on-site lift station as shown in **Figure 5.2a** (Sewer Servicing Concept #1) or a community lift station near Todd Road as shown in **Figure 5.2b** (Sewer Servicing Concept #2). A force main would then be constructed to connect to the gravity system flowing into the Naramata Road gravity trunk (Concept #1) or to the Naramata gravity trunk sewer itself (Concept #2).

- The development area adjacent to the Evans Road and Naramata Road intersection will either be collected via a localized lift station and forcemain to the terminus of the Naramata Road gravity trunk (Concept #1) or by a new gravity trunk sewer flowing north, to a community lift station near Todd Road (Concept #2).

- The Todd Road gravity collection main (Servicing Concept #2) may require land acquisition as the existing road right-of-way varies between full and half-width between Naramata Road and the development site.

- Servicing Concept #2 would allow for the provision of sanitary sewer service on Todd Road and on Naramata Road from Todd Road to the Naramata Road high point.

5.2.3 Proposed Improvements Required to Service Lands beyond the Plan Area

The extension of the sanitary sewer system beyond the plan area to Campbell Mountain would require a localized pump station and trunk main connecting to the gravity system within the plan area.

Sewer Servicing Concept #2 provides additional servicing flexibility for lands to the north of Todd Road.

5.2.4 Staging of Sanitary Sewer System Improvements

As in the case of water, staging of sanitary sewer system improvements within the plan area itself will depend to a certain extent on the timing of development of the various parcels within the plan area, although there is a logical sequence to be followed. The proposed staging is shown in **Figure 5.2a and 5.2b** (Sewer Servicing Concept).

Stage 1 Improvements
Fundamental to the servicing of the plan area with sanitary sewer is the extension of the gravity trunk along Upper Bench Road, McMillan and Naramata Road from the existing terminus of the City's system to the high point on Naramata Road. In addition, the Penticton Creek diversion (identified as part of the City's Wade Ave / Johnson Road Trunk Replacement Project in the 2005 Sanitary Sewer Study) must also be completed prior to any development within the Northeast sector. These improvements are common to both Sewer Servicing Concepts.

Stage 2 Improvements
Stage 2 improvements would consist of extending the gravity system from Naramata Road to the developable areas within the Spiller and/or Reservoir Blocks. The construction of the proposed pump station to service the lands adjacent to the Evans Road and Naramata Road intersection could also occur as a Stage 2 improvement if Sewer Servicing Concept #1 is selected. In addition, once peak flows from the Northeast Sector reach a rate of approximately 25 litres per

second, the Wade Avenue/Johnson Road trunk sewer must be upgraded from Railway Street to Upper Bench Road.

Stage 3 Improvements

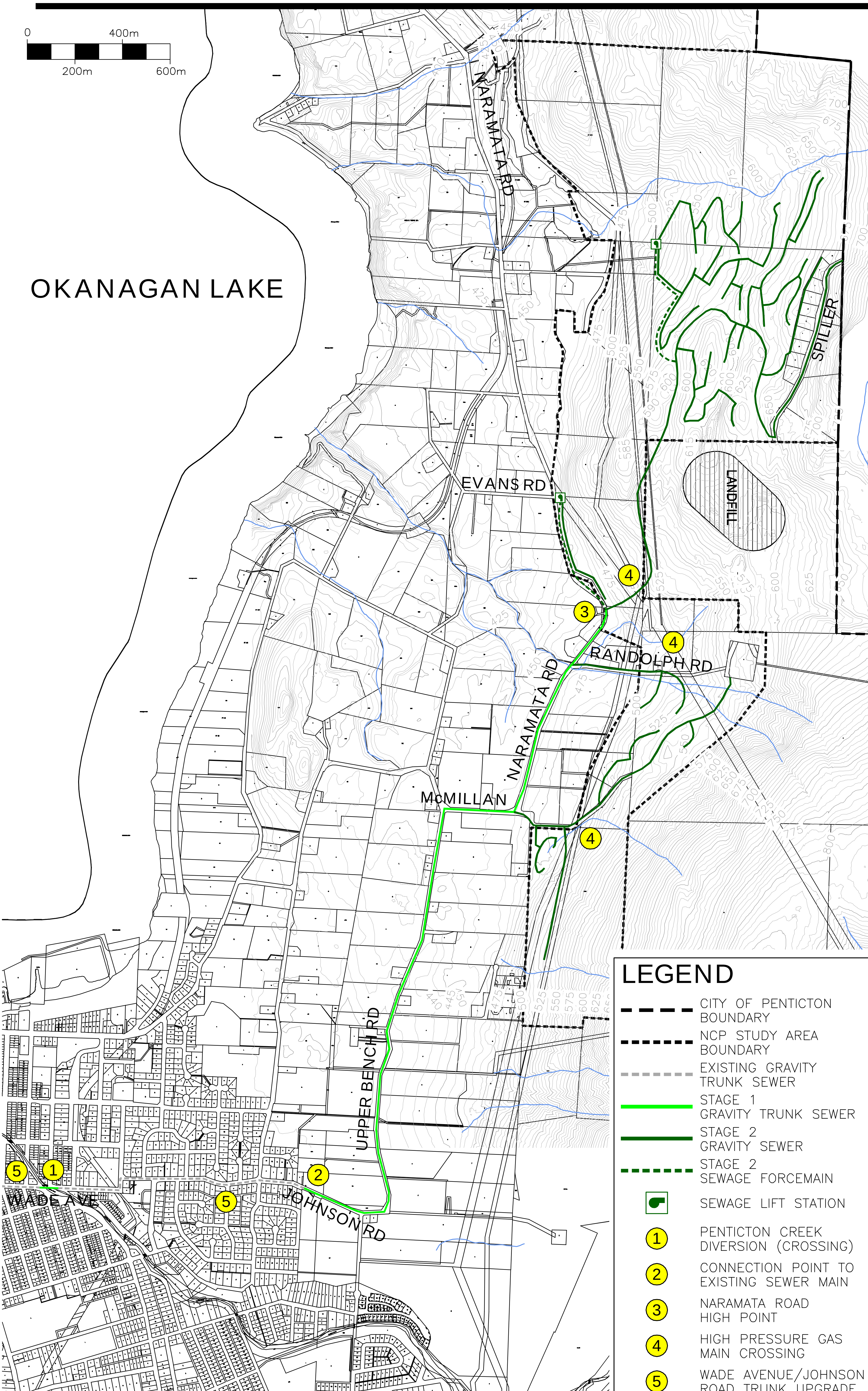
Stage 3 improvements would consist of the construction of the lift station and force main on the Spiller Block parcel (Sewer Servicing Concept #1) and the extension of the system to the remainder of the Spiller Block parcels. Alternately, if Sewer Servicing Concept #2 is chosen, then a new community lift station would be constructed at Todd Road complete with forcemain and gravity collection trunk to the high point along Naramata Road (from Stage 1), and extension of the system to the remainder of the Spiller Block parcels. Extension of the system to service the properties west of the Spiller Block (at lower elevations) would also form part of the Stage 3 improvements if property owners wish to pursue cluster developments with lot sizes less than 0.4 hectares.

5.2.5 Standards and Specifications

All upgrading and extension of the City's sanitary sewer system would be required to meet the standards and specifications of the City of Penticton.

URBANSYSTEMS.

SPILLER RD. / RESERVOIR RD. NEIGHBOURHOOD CONCEPT PLAN



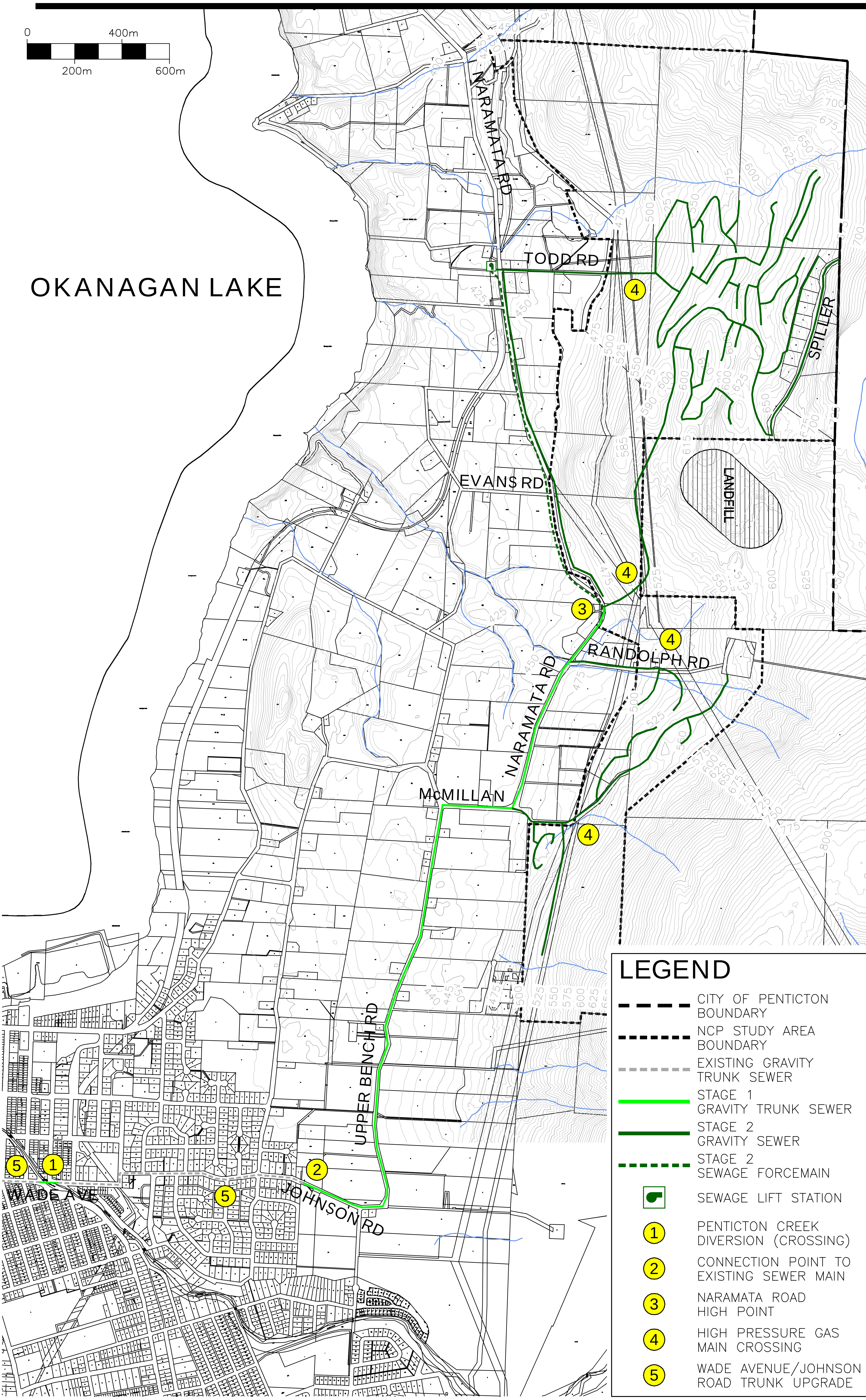
Sewer Servicing Concept #1

Figure

5.2a

SPILLER RD. / RESERVOIR RD. NEIGHBOURHOOD CONCEPT PLAN

URBANSYSTEMS.



Sewer Servicing Concept #2

Figure

5.2b

5.3 Storm Drainage

Development of urban uses within the Spiller Road and Reservoir Road blocks will require the development of a storm drainage system consistent with the City of Penticton's plans and bylaws. Various plans have been prepared by the City of Penticton related to stormwater management within the North East Sector of the City. These include:

- **North East Sector Plan** that adopts the approach that post development flows within the plan area must not exceed pre-development flows.

- **City of Penticton Master Drainage Plan** that establishes various standards and sets out various improvements to the City's stormwater drainage system within the North East Sector including Campbell Mountain. Definitions and criteria are also established including the definition of mean annual rainfall.

The City's **Subdivision and Development By-law** also establishes various criteria for the development and design of storm drainage facilities. These include:

- The requirement for all developments larger than 5 hectares to be served by both a minor system (managing runoff from more frequent events) and a major system (in cases where the capacity of the minor system is exceeded).

- The establishment of the following return periods for the analysis and design of both minor and major systems:
  - Minor system: 5 year
  - Major system: 100 year
  - 200 year return where required by the Provincial Ministry of Environment or for major structures such as bridges.

- The requirement for runoff from development to be limited to the five year pre-developed runoff conditions.

- With respect to infiltration systems, that French drains shall only be used where topography and soil conditions are proven adequate and accepted by the City and, where lands have acceptable soils, alternative on-site disposal systems such as rock pit drywells will be encouraged.

In addition to the plans and the City's Subdivision and Development By-law, various studies were carried out to assist in the development of the stormwater management plan for the Spiller Road and Reservoir Road blocks. These include:

- Stormwater Infiltration Evaluation – Proposed Development on Spiller Road, Penticton, B.C. by Summit Environmental Consultants, 2007.
- Geotechnical Overview of Site, North East Sector Plan, Spiller Road/Reservoir Road Area, Penticton, B.C. by Interior Testing Services Ltd., 2007.
- Preliminary Stormwater Management Plan, Spiller Road/Reservoir Road Development, Urban Systems Ltd. 2009

These studies served to provide the necessary background information to assess key soil characteristics to assess the degree of surface runoff during rainfall or snowmelt events as well as the potential for infiltration and ground disposal.

5.3.1 Strategies for Stormwater Management

Typically, stormwater management can occur at the source of runoff (e.g. roof leaders, driveways, parking lots, road surfaces) or at the outlet of a conventional drainage system. The strategies for managing stormwater within the plan area are based on the following:

- **Conventional approach** where source control is optional. This strategy proposes use of a conventional drainage system, either because there are limited opportunities to use source controls, or because there is an opportunity to use a larger, downstream facility to treat, attenuate, and/or dispose of collected runoff.

- **Source controls** where significant opportunities for source control present themselves or are required. Opportunities could include suitable conditions for source controls or situations where conventional systems are either not practical or should be avoided.

- **Combined approach** where some source control is required and where conventional systems are used in select locations or coupled with modified source control at the system outlet. The use of a combined approach may be required in situations where the amount of runoff must be managed downstream.

5.3.2 Catchment Plans

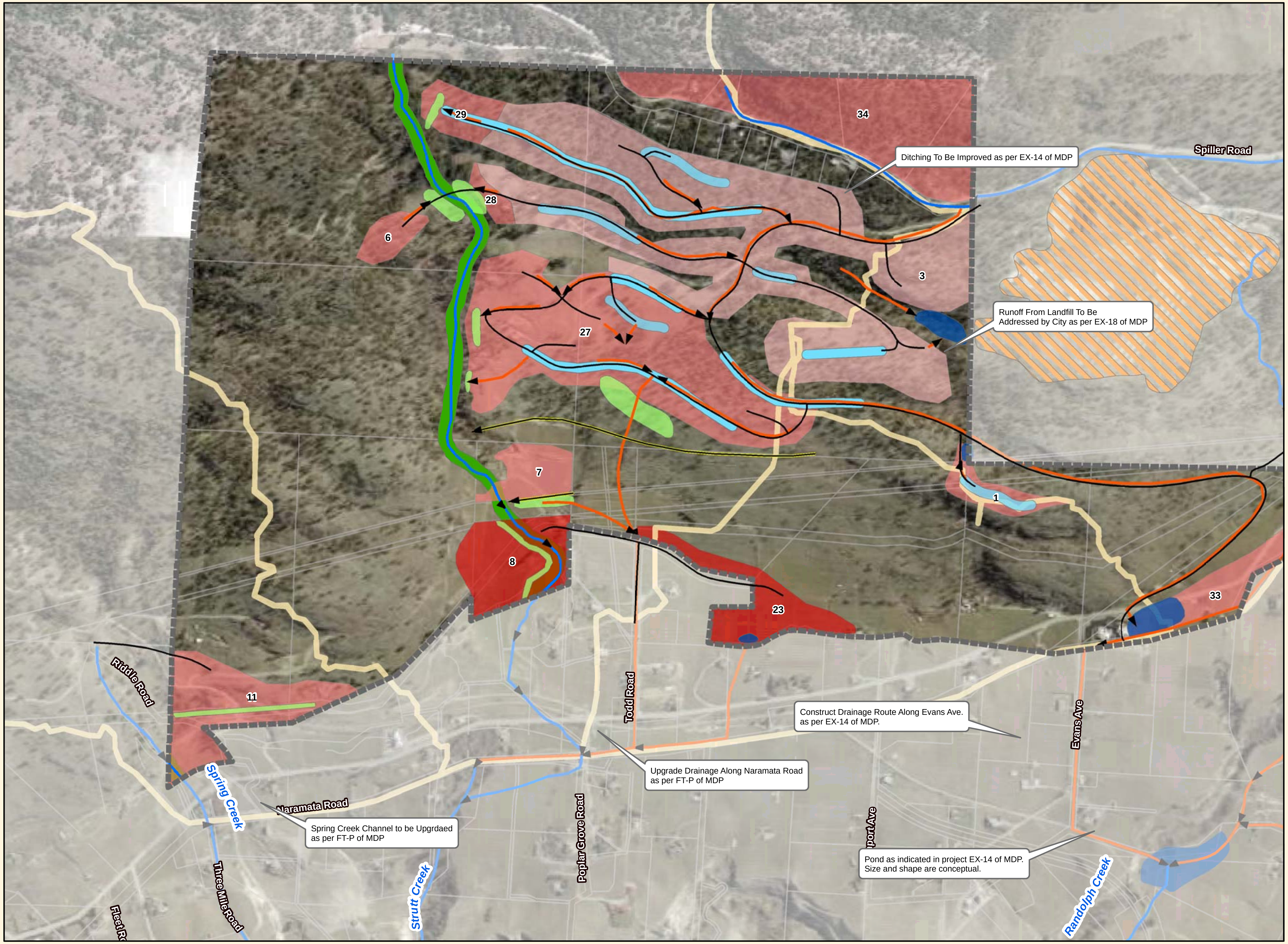
The plan area consists of five catchment areas which serve as the basis for development of the stormwater management plan. These catchment areas are shown in **Figure 5.3** (Stormwater Servicing Concept). Each of these catchments were analyzed on the basis of:

- Existing development;
- Soils;
- Existing hydrology and drainage;
- Potential future development consistent with the provisions of this plan;
- Potential impacts of proposed future development including:
  - increased surface runoff from impervious surfaces;
  - increased magnitude, duration and frequency of flows within natural and man-made drainage routes;
  - erosion and sediment deposition within natural and constructed routes; and,
  - increased pollutant loads; and,
- Key issues related to drainage.

Detailed stormwater management plans were prepared for each catchment based on the analysis as well as the criteria and overall drainage plans established by the City of Penticton. It is noted that the City is currently embarking on a review of its Master Drainage Plan with a specific mandate to consider the impacts of climate change both on design criteria and how any revised criteria will impact previously identified project. While the Master Drainage Plan update was not available at the time of completion of this Neighbourhood Concept Plan, any revised design criteria would need to be considered in detailed stormwater servicing plans at time of development.

5.3.3 Detailed Catchment Plans

Detailed stormwater management plans were developed for proposed development cells shown within each of the catchment areas located in the plan area based on the factors and criteria established in the previous sections. The proposed improvements are shown in **Figure 5.3** (Stormwater Servicing Concept). More detailed descriptions of the proposed storm drainage improvements are presented in the Preliminary Stormwater Management: Spiller Road and Reservoir Road Development prepared by Urban Systems Ltd as **Appendix F** to this NCP.



Spiller Rd/Reservoir Rd. Neighbourhood Concept Plan

Legend

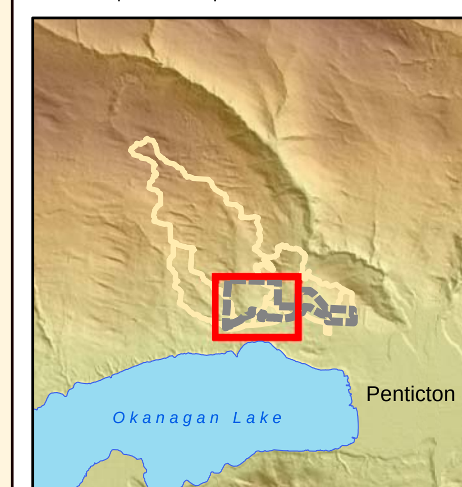
- Proposed Road Network
- Existing Major Drainage Routes
- Optional Major Drainage Route
- Proposed Major Drainage Routes
- Subject Site Boundary
- Sanitary LandfillLandfill
- Potential Distributed Discharge Site*
- Potential Linear Storage Area*
- Potential Pond Site*
- Riparian Zone
- Primary Catchment Boundaries

Development Cells

Stormwater Management Strategy

- Source Control is Optional
- Limited Source Control Recommended
- Significant Source Control Recommended
- 99 Development Cell ID

* Size & Shape are Conceptual



Spiller Road Development Stormwater Management

Proposed SWM Strategy - North

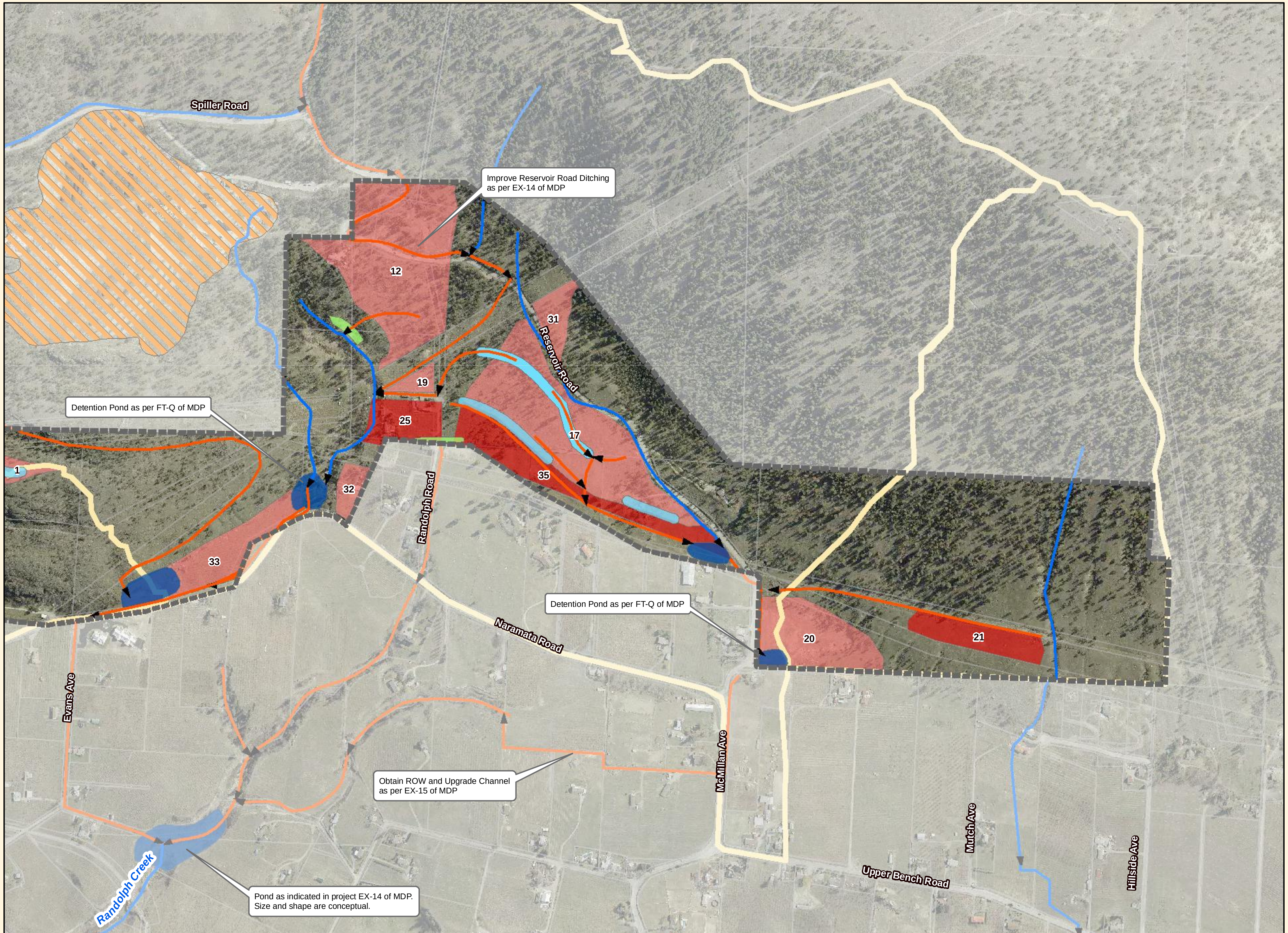
0 112.5 225 450

Meters

Figure 5.3a

URBANSYSTEMS.

Spiller Rd/Reservoir Rd Neighbourhood Concept Plan



Legend

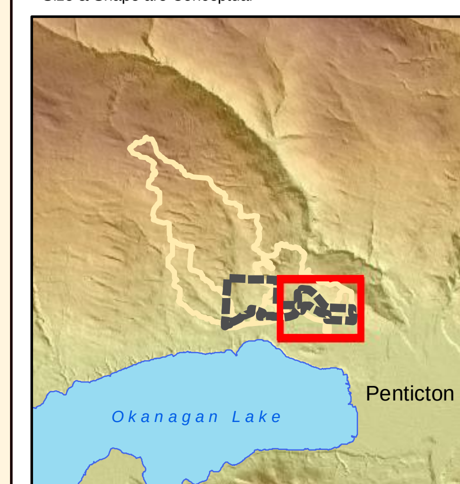
- Proposed Road Network
- Existing Major Drainage Routes
- Proposed Major Drainage Routes
- Potential Distributed Discharge Site*
- Potential Linear Storage Area*
- Potential Pond Site*
- Subject Site Boundary
- Landfill
- Catchment Boundaries

Development Cells

Stormwater Management Strategy

- Source Control is Optional (Conventional)
- Some Source Control Required
- Significant Source Control Required
- **99** Development Cell ID

* Size & Shape are Conceptual



Spiller Road Development Stormwater Management

Proposed SWM Strategy - South

0 125 250 500
Meters

Figure 5.3b

URBANSYSTEMS.

6.0 ROADS AND TRANSPORTATION

The development of the Spiller Road and Reservoir Road Blocks to an urban use will require upgrading of the City's current road system as well as the development of an internal road system within the plan area itself.

6.1 Upgrading of City's Current Road System

Primary access to and from the plan area will be along Naramata Road and into the centre of Penticton via two routes:

- Upper Bench Road to Eckhardt Avenue; or
- Munson/Tupper/Lower Bench Roads to Front Street.

At present, these roads are predominantly two lane roads constructed to a rural standard with a speed limit of 50 km per hour. Upgrading of the existing road system will be required to accommodate the vehicular traffic that will be generated by development within the NCP area. An off-site traffic impact analysis was carried out to assess the impact of traffic generated by development within the NCP area, and to identify required upgrading to the City's road system.

The following key intersections along the two routes described above were analyzed to review impacts and upgrading requirements:

- Naramata Road and Todd Road
- Naramata Road and Evans Road
- Naramata Road and Randolph Road
- Naramata Road/McMillan Road and Reservoir Road
- Vancouver Avenue/Front Street and Ellis Street
- Front Street/Westminster Avenue and Main Street
- Eckart Avenue and Government Street
- Eckart Avenue and Main Street

In general terms, the traffic impact assessment suggests that there is capacity in the road network in the North East Sector of the City to accommodate growth, particularly growth of the nature and scale being proposed for the NCP area. Despite visual images of congestion during extreme peaking conditions related to tourism in the summer months, background traffic volumes are generally low and rural in nature when considered on a 24 hour and 365 day basis.

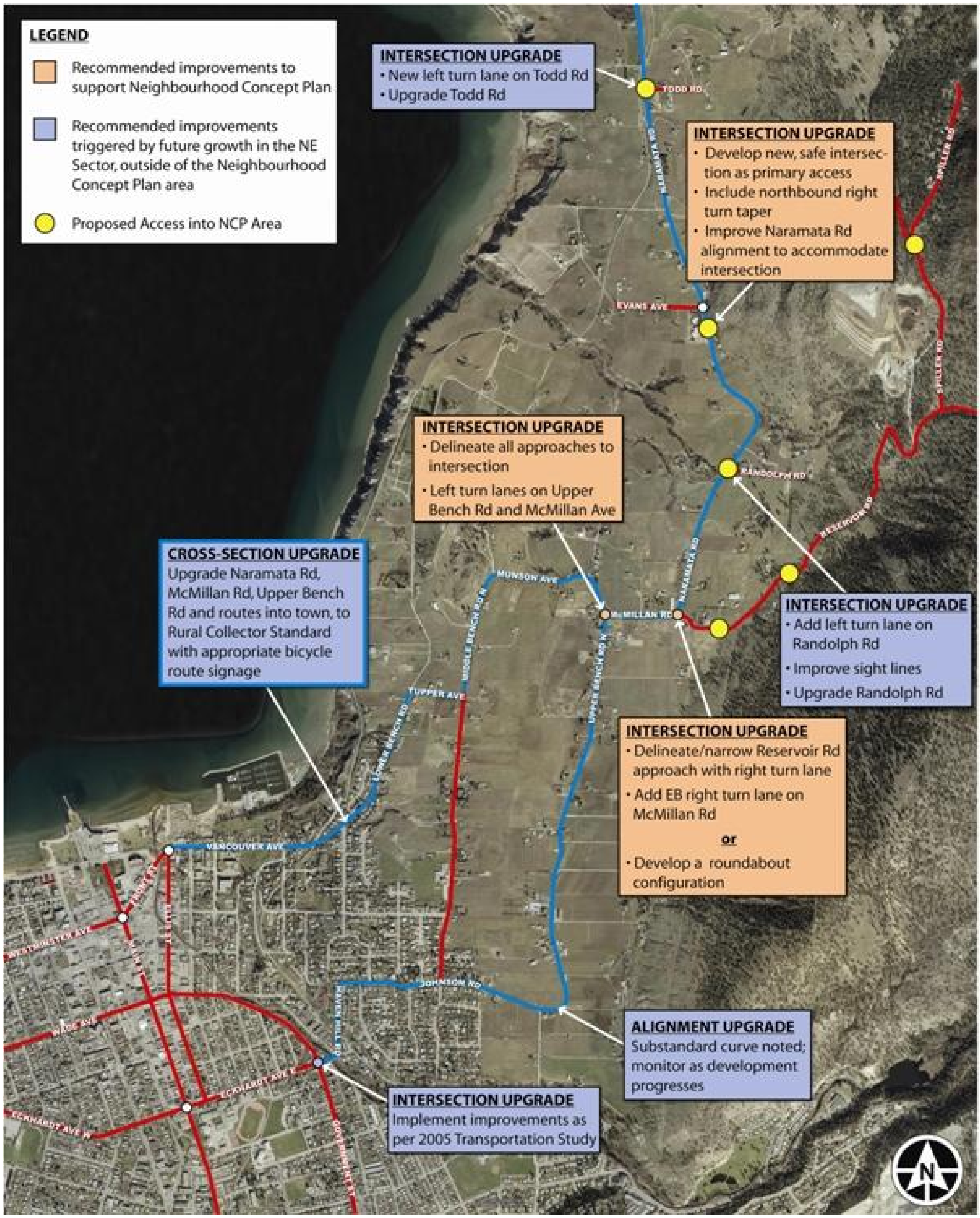
As a result, development within the NCP area would not trigger the need for capacity upgrades, such as four-laning, along the Naramata Road corridor. The projected peak hour traffic volumes along the road corridors serving the site are not beyond what could typically be accommodated by a two lane rural cross section. However, some upgrades are required to the road system providing access to the NCP area. These upgrades, shown in **Figure 6.1** (Proposed Off-Site Upgrades), are as follows:

- Upgrading of Naramata Road, Lower Bench Road, Middle Bench Road, Munson Avenue and Tupper Avenue over time to a Rural Collector Road standard as defined in the City's Subdivision and Development By-law as well as enhancing provisions for vulnerable roadway users such as bicyclists.

- Upgrading of various intersections along the two primary routes from the plan area to City centre. The recommended upgrading of these intersections is shown in **Figure 6.1** (Proposed Off-Site Upgrades).

The Off-Site Traffic Impact Study contained in **Appendix G** provides a more detailed description of the analysis undertaken as well as the recommended road system improvements.

Figure 6.1: Proposed Off-Site Upgrades



URBAN systems

6.2 Development of Road System within Plan Area

The internal roadway network concept is presented in **Figure 6.2** (Road Network Concept). In principle, the roadway network has been developed to service the residential and park cells, while respecting the natural contours, topography, and environmental features of the site. Specific road alignments are conceptual and subject to refinement at time of subdivision.

6.2.1 Access Routes

Primary access from the City's existing road system to the plan area itself will be provided at three points including:

- New route from the intersection of Evans Road and Naramata Road
- A new route from Reservoir Road to the development areas south of the RDOS landfill.
- A new route from Spiller Road

Secondary access would be provided through:

- The extension of Todd Road.
- A new route serving the property to the south of the Reservoir Road / McMillan Avenue intersection.
- A new route providing secondary access to the developable areas south of the RDOS landfill site.

6.2.2 Hierarchy of Road System within Plan Area

The constituent elements of the roadway network have been classified to include a 'trunk' system of hillside collector roadways as well as a network of local roadways. In general terms, the form and function of these two roadway classifications is consistent with typical TAC (Transportation Association of Canada) and City of Penticton (Subdivision and Development Servicing Bylaw 2004-81) definitions, and may be summarized as follows:

- Local Roads – The primary function of the identified local roadways is to provide access to adjacent lands, and efficient traffic movement is a secondary consideration. In addition to land access, the local roadways provide the common sense of place and a platform for interaction; they are the social backbone of the neighbourhood. On-street parking opportunity will generally be provided where the adjacent land uses might benefit from this amenity.

- Collector Roads – The primary function of the collector roadway network is to provide for land access but with consideration given to traffic (vehicle, pedestrian and cyclist) distribution throughout the neighbourhood as well as connectivity to the Greater Penticton and Naramata community via Naramata Road, Spiller Road and Reservoir Road. The collector roadway network essentially functions as the neighbourhood's mobility distribution system, and as a result will be expected to possess more significant accommodation of appropriate design elements and features related to mobility safety and efficiency.

Road network classifications are illustrated in **Figure 6.2** (Road Network Concept).

URBANSYSTEMS.

SPILLER RD. / RESERVOIR RD. NEIGHBOURHOOD CONCEPT PLAN

Road Network Concept

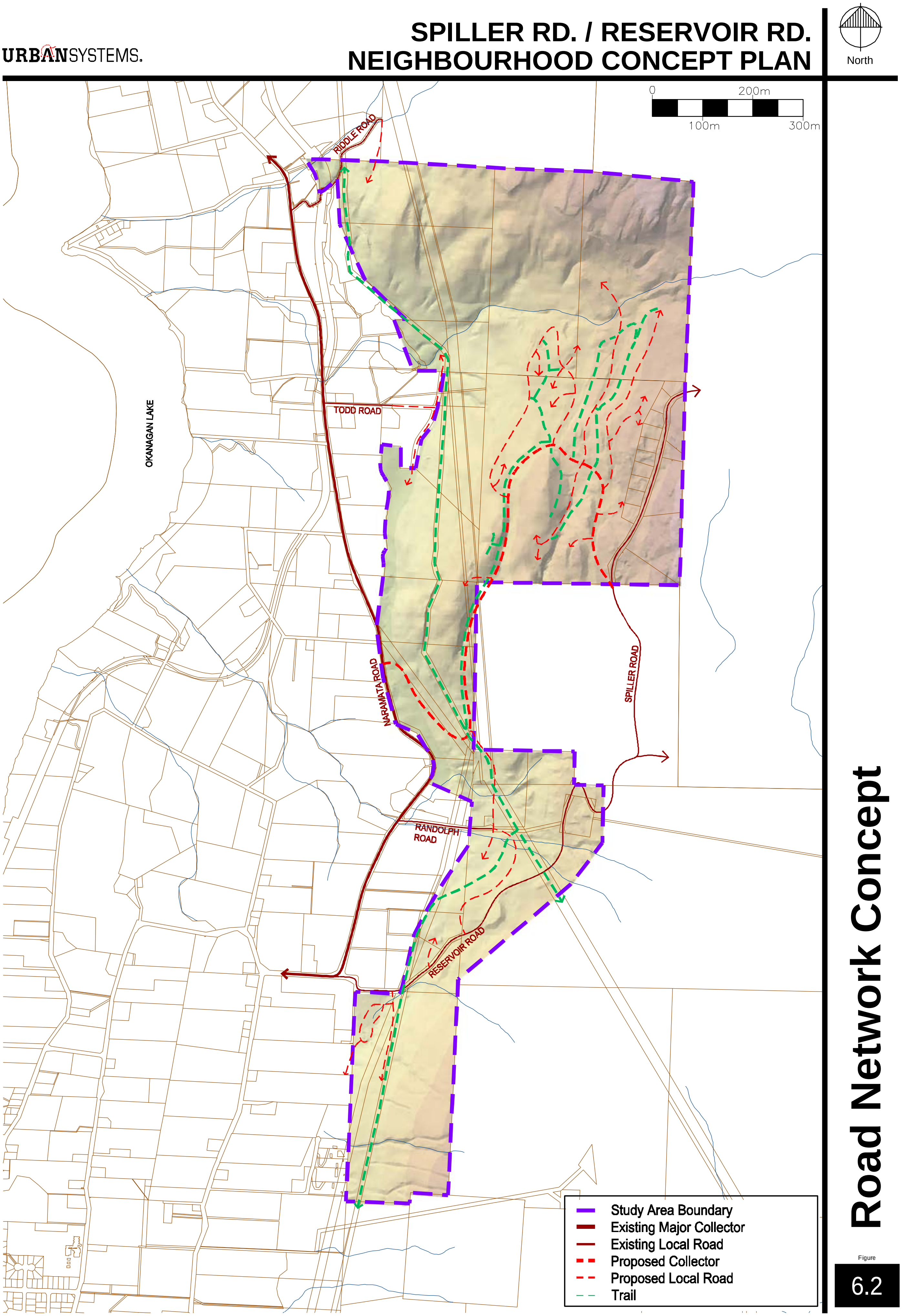


Figure 6.2

6.3 Road Standards within Plan Area

The roadway network concept has been developed to satisfy the technical requirements of the City of Penticton *Subdivision & Development Servicing By-Law – Schedule G Section 00500 – Hillside Developments.* The salient components from Table 11 of that document are reproduced in **Table 6.1** for ease of reference. Also, cross-section drawings S-HS1 and S-HS2 from that document are reproduced below in **Figures 6.3** (Hillside Local Cross-Section) and **6.4** (Hillside Collector Cross-Section).

Table 6.1: Hillside Roadway Network Design Guidelines
As Per City of Penticton Bylaw 2004-81

Classification	Design Speed	Max Grade	ROW Width	Pavement Width	Parking Bays	C&G	Sidewalk	Trees
Hillside Local								
Development Both Sides	40	15%	14	6.0	Both Sides	Rollover	1	Optional
Development One Side	40	15%	12	6.0	One Side	Rollover	1	Optional
No Fronting Development	40	15%	10	6.0	None	Barrier	1	Optional
Hillside Collector								
Development Both Sides	50	11%	18	8.6	Both Sides	Rollover	2	Both Sides
Development One Side	50	11%	15	8.6	One Side	Rollover	1	Both Sides
No Fronting Development	50	11%	14	8.6	None	Barrier	1	Both Sides

With respect to the City's Subdivision and Development Servicing Bylaw standards, there are a number of key considerations specifically related to the Spiller Road / Reservoir Road Area NCP. These include the following:

- **Grades (Hillside Local) –** On hillside local roads, long sections of 13% to 15% grades will be avoided.

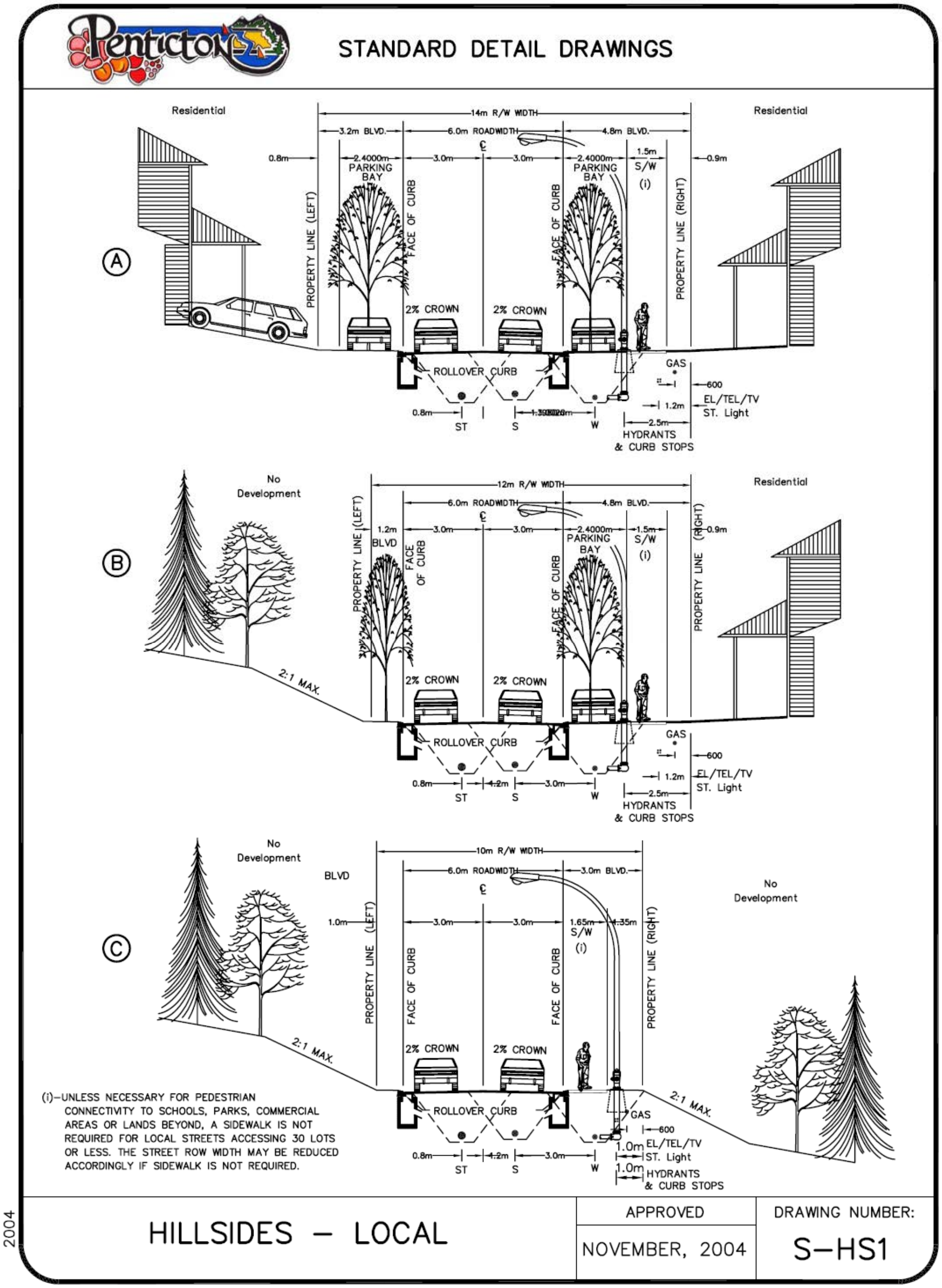
- **Grades (Hillside Collector)** – On the primary hillside collector access from Naramata Road, there may be a need for stretches of road with grades of up to 12%. However, the hillside collector roads will otherwise possess varying vertical profiles that range up to a maximum of 11% grades.

- **Cul-de-Sac Length –** As is necessarily the case in developable areas on steep topography, the roadway layout concept includes a number of long cul-de-sac configurations. These roadway elements are included as a means to provide direct access to residential cells, but are not reconnected to the roadway network as the grades and topography would not permit it to occur without significant topographical and environmental impacts. While the City's Subdivision and Development Servicing Bylaw provides for a maximum cul-de-sac length of 150 metres (where no alternate access is provided) or 210 metres (where emergency access is provided), longer cul-de-sac lengths are illustrated on the Future Land Use Plan, and will be permitted provided that adequate emergency trail network access is developed.

- **Cul-de-sac Configuration –** In steep areas, convenient hammerheads may be considered to reduce the impacts of cul-de-sacs on the hillside.

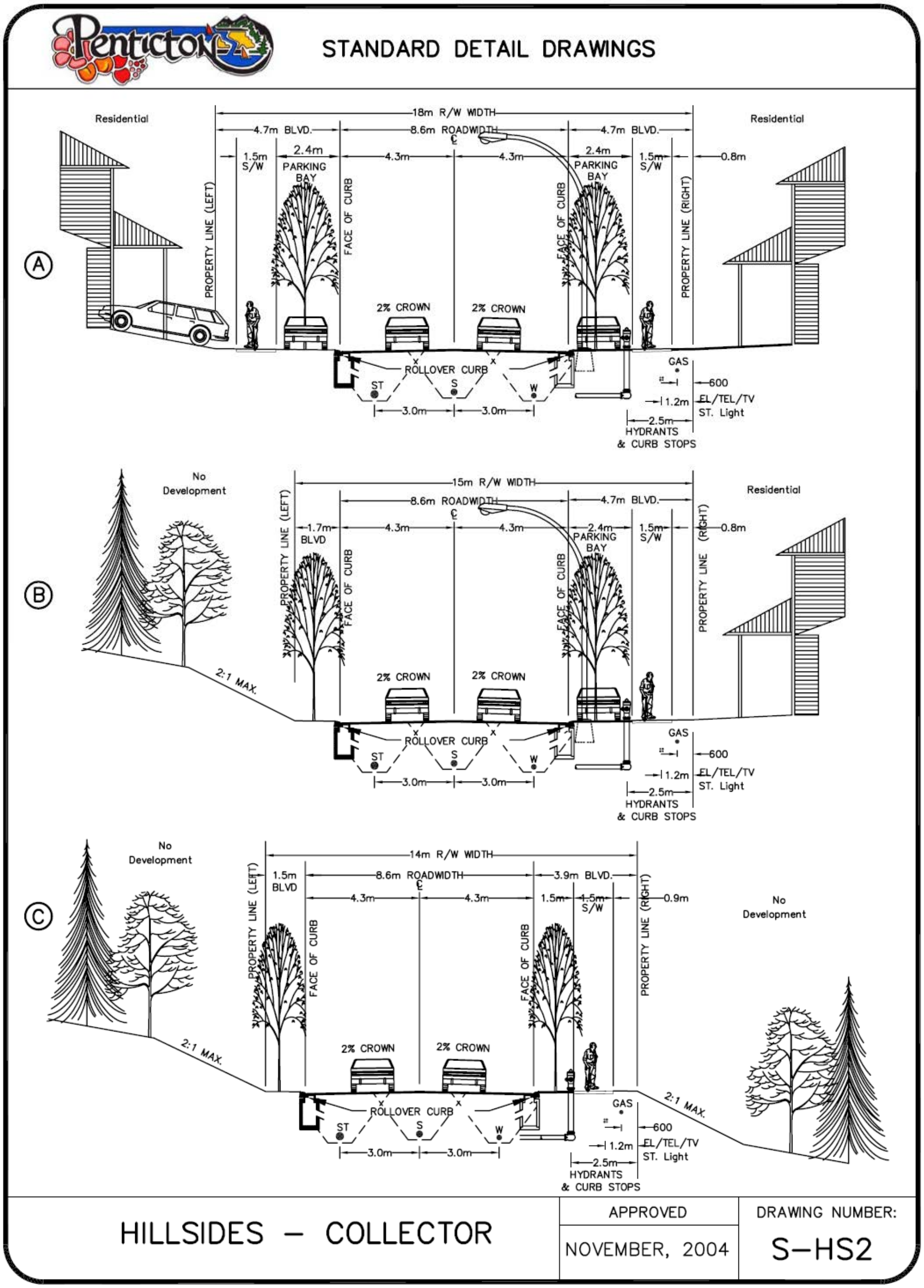
- **Road Cross-Sections –** Generally, hillside local roads and hillside collector roads will reflect the hillside cross-sections illustrated in Subdivision and Development Servicing Bylaw drawings S-HS1 and S-HS2. However, bylaw variances will be considered to accommodate progressive hillside road sections that vary from those that are currently suggested in the Subdivision and Development Servicing Bylaw. As well, on single-loaded roads, bylaw variances will be encouraged to permit on-street parking on the opposite side of the street from homes. Road design will be finalized at time of subdivision.

Figure 6.3: Hillside Local Cross-Section



Source: City of Penticton Subdivision and Development Bylaw 2004-81

Figure 6.4: Hillside Collector Cross-Section



Source: City of Penticton Subdivision and Development Bylaw 2004-81

6.4 Pedestrians and Cyclists

Within the NCP area, all roads will be designed to safely accommodate pedestrians and cyclists. On hillside collector roads, cyclists will be accommodated by wide shared bicycle/travel lanes or marked bicycle lanes. On hillside local roads, bicycles can comfortably share the roadway with automobiles due to low traffic volumes. On all public roads, sidewalks will be provided for pedestrians, as per the Subdivision and Development Servicing Bylaw requirements. A network of trails will complement these on-street facilities, as described in **Section 7.1**.

6.5 Transit

The road network in the NCP area will allow for future transit services on hillside collector roads and to Village Centre locations. The City will work with BC Transit to encourage the provision of future transit services to key study area locations.

7.0 PARKS AND TRAILS

The park and trail network concept for the Spiller Road / Reservoir Road Area Neighbourhood Concept Plan (NCP) is presented in **Figure 7.1** (Park and Trail Network Plan). In principle, the park and trail network has been developed to service and connect the residential cells with each other and to parks, and to provide recreational opportunities and access to surrounding natural areas and existing trail networks. Consideration of topography, significant natural features, road networks and residential/commercial cell locations informed the layout and location of the park and trail concept.

7.1 Park Classifications

Parks have been classified as Neighbourhood and Community Level parks. These two park classifications are consistent with City of Penticton (City of Penticton Official Community Plan Bylaw 2002-20) definitions and are summarized below.

7.1.1 Neighbourhood Level Parks

- Neighbourhood Park – Neighbourhood Parks are multi-purpose park areas providing opportunities for passive recreation, playgrounds and informal active play and sports activities for the entire neighbourhood. Neighbourhood Parks are centrally located within the development cells, adjacent to major roads and trails and on areas of reasonably level terrain.

- Lookout Park – The Lookout Park is a passive park node with significant vistas, and it is associated with trail development. This type of park may act as rest areas for active trails, pedestrian destinations and provide opportunities for environmental and landscape interpretation.

7.1.2 Community Level Parks

- Community Park – The Community Park provides opportunities for organized active recreation activities within the community. The Community Park requires large areas of level terrain and should be easily accessible from major roads and trails.

- Civic Plaza –The Civic Plazas are a central urban gathering place for the larger community, providing opportunities for civic events, concerts, passive recreation and urban beautification.

7.1.3 Trails and Pedestrian/Bicycle Routes

Trails and pedestrian/bicycle routes have been designated according to their location and function and are summarized as follows:

- Pedestrian and Bicycle Route – The pedestrian and bicycle routes form the central spine of the alternate transportation network, providing connections within the development itself, and to the Greater Penticton and Naramata community via Naramata Road, Spiller Road and Reservoir Road. The pedestrian and bicycle routes will follow the collector road network and are intended to be designed to the Subdivision and Development Servicing Bylaw standards developed for bicycle lanes, sidewalks and shared use pathways. These routes may be physically separated from the road surface, as topography permits, to minimize the potential for vehicular conflicts and to provide an additional level of comfort for users. These routes may also consist of a combination of bike lanes, concrete sidewalks and/or shared pedestrian and bicycle asphalt pathways as permitted.

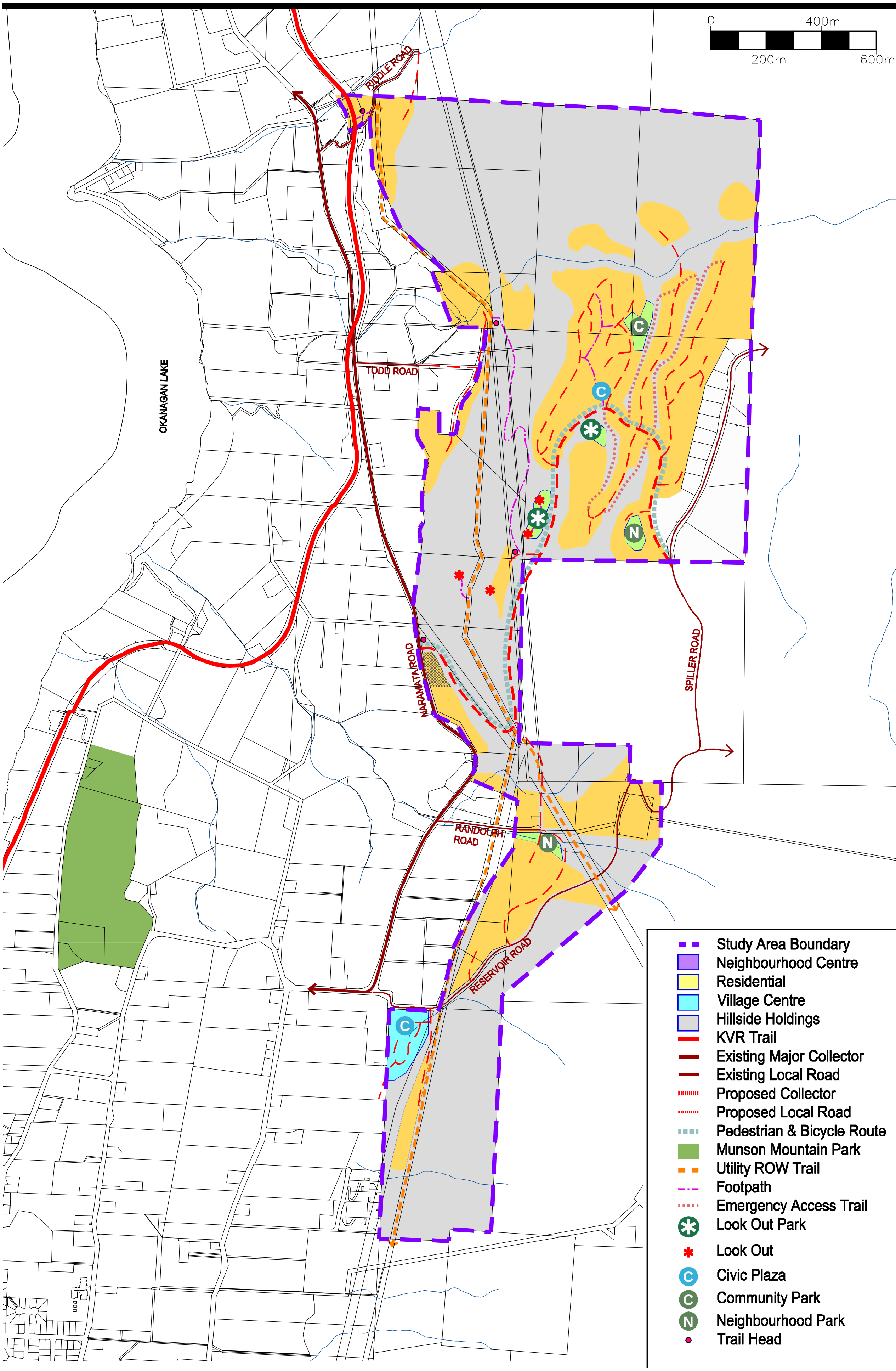
- Emergency Access Trails – The multi-use emergency access trails function both as a pedestrian link to adjacent neighbourhoods and an emergency access route from closed cul-de-sac streets to adjacent development cells and roads. These multi-use paths will be designed to emergency vehicle route standards (i.e. minimum hard packed surface width of 4 metres and a cleared width of 5 metres) and closed to traffic with removable bollards or gates.

- Footpath – Footpaths are narrow, unpaved pedestrian only paths for use in areas of steep slopes and areas of low to moderate environmental significance where access is desired. The footpaths provide connections between residential cells and access to wilderness areas and lookouts. Trails will be developed using BC Park standards for trail development on steep slopes.

- Right-of-Way Trail – Pending approval for recreational use, the hydro and gas rights-of-way provide an important link from the development area to the Trans Canada Trail, Munson Mountain Park, and other surrounding areas. Trails will be developed to standards approved by the utilities.

As noted in **Section 3.4.8** of this NCP, trails and any adjacent passive park areas will generally be dedicated to the City at time of subdivision to enhance the linear park system along the trail network.

SPILLER RD. / RESERVOIR RD. NEIGHBOURHOOD CONCEPT PLAN



Park and Trail Network Plan

Figure 7.1

7.2 Parkland Requirements

The park and trail network concept for the Spiller Road / Reservoir Road NCP has been developed in consultation with the guidelines of the City of Penticton's *Official Community Plan By-Law 2002-20, section 2.2.5.* The calculations for the provision of parkland required per approximate population are illustrated below in **Table 7.1**.

Table 7.1: Provision of Parkland Guidelines
As Per City of Penticton Bylaw 2002-20

Classification	Acres	Population
City of Penticton Official Community Plan Guidelines		
Neighbourhood Parks	2.5	1,000
Community Parks	7.5	1,000
Spiller Rd / Reservoir Rd Community Plan Concept Requirement		
Neighbourhood Parks	4.2 – 5.25	1680 - 2100
Community Parks	12.6 – 15.75	1680 - 2100

The amount of parkland provided in the NCP is illustrated below in **Table 7.2**.

Table 7.2: Parkland Provision

Classification	Acres	Population
Spiller Rd / Reservoir Rd Community Plan Concept Provision		
Neighbourhood Parks	6.20	1680 - 2100
Community Parks	2.75	1680 - 2100

Topographic challenges of hillside development limit opportunities for Community Park development within the Spiller Road/Reservoir Road NCP. A portion of Community Park needs are met on site through parkland dedication and Civic Plaza development, with the majority provided by existing City recreational facilities and resources within the community. Compensation for the deficit in Community Park acreage is provided on site through the provision of additional Neighbourhood Park land and by the extensive network of pedestrian and cycling trails, located on lands that could be dedicated to the City. At time of development, should it be warranted that additional lands are required for Community Park facilities, the City may require the provision of cash in lieu of parkland as compensation so that the City can purchase lands to create Community Parks in a more suitable area.

Parkland Design Guidelines

Design guidelines for the park and trail network concept have been developed in accordance with the relevant municipal, provincial and professional facility standards. Facility details are outlined in **Table 7.3** below.

Table 7.3: Park and Trail Network Facility Design Guidelines

Classification	Rest Stop	Bench	Litter Receptacle	Lighting	Dog Bylaw Sign	Dog Bag Dispenser	Picnic Table	Rec. Equip.	Trees	Shrub Planting	Automatic Irrigation	Surface Material	Trail Width	% Slope
Neighbourhood Parks														
Neighbourhood Park		4	2	yes	yes	1	2	2	yes	yes	yes	Gravel or asphalt	2.5m	2-5%
Lookout Park		1	1	no	yes	0	0	0	no	no	no	Gravel	1.5m	15% max
Community Parks														
Community Park		Bench / bleacher	2	yes	yes	1	4	Sports field	yes	yes	yes	Gravel or asphalt	3.0m	2-5%
Civic Plaza		4	2	yes	no	0	0	0	yes	yes	yes	Enhanced concrete	3.0m	2-5%
Trails														
Shared Pedestrian and Cyclist Pathway	500m	1 per rest stop	1 per rest stop	yes	trailhead	trailhead	0	0	Rest stop	no	no	Asphalt or concrete	3.0m	2-12%
Emergency Access Trail	0	0	0	no	no	no	0	0	0	no	no	Asphalt or gravel	4.0m drive 6.0m clear	12% max
Foot Path	300m	1 per rest stop	1 per rest stop	no	trailhead	trailhead	0	0	0	no	no	Gravel or native soil	1.0m	15% max
Right-of-Way Trail	0	0	trailhead	no	trailhead	trailhead	0	0	0	no	no	Gravel or native soil	2.0m or as permitted	15% max

Additional design considerations include the following:

- Recreation equipment may include fitness stations and playgrounds.
- A comprehensive directional (wayfinding) and interpretive signage program is to be developed in association with trailhead, viewpoint/rest stop and similar nodes for the park and trail network.
- Lookout parks may require wheel stops or guardrails.
- Switchbacks will be required on some trails to achieve appropriate grades.
- Stairs and retaining walls may be required.
- Neighbourhood and Community Parks, Civic Plazas, Pedestrian and Bicycle Routes and Emergency Access Trails will be designed to universally accessible grades; Footpaths, Right-of-way Trails and Lookout Parks may require stairs and steeper trail slopes.

8.0 IMPLEMENTATION

8.1 Funding of Infrastructure Improvements

8.1.1 Development Finance Principles

The City and developers each have a variety of interests related to the development finance approach for the NCP. For example, the City needs to ensure that development contributes to the cost of growth-related infrastructure, and that infrastructure servicing plans result in cost-effective infrastructure for the City in the long-term. From the developers' perspective, there is a need to ensure overall feasibility of infrastructure servicing plans and the development finance approach. Reflecting these interests, there are a variety of development finance principles that will guide the development finance approach for the Spiller Road/Reservoir Road Area NCP. These principles are as follows:

Fairness and Equity
Benefiting parties should share in infrastructure costs, and appropriate mechanisms should be used to distribute costs in a fair manner, commensurate with value or benefits received.

Administrative Ease
The development finance approach should be as straight-forward to administer as possible, making cost recovery easy and predictable.

Transparency
The development finance approach should be transparent, and all relevant information should be accessible and understandable by stakeholders.

Financial Feasibility
The development finance approach and infrastructure phasing strategy should be financially workable for both the City and developers, enabling development to commence within the NCP area.

Value
There should be a recognition that the implementation of the NCP creates value for both the City and developers, and the development finance approach should be constructed accordingly.

Acceptable Level of Risk
The development finance approach should be based upon levels of risk that are acceptable to both the City and developers.

Certainty
There should be stability in the development finance approach, allowing for consistent, predictable cost recovery and orderly construction of infrastructure.

8.1.2 Potential Development Finance Tools

In the context of the Spiller Road/Reservoir Road Area NCP, there are a number of potential development finance approaches available to the City and developers. These tools are summarized below:

Off Site Costs:

- **Development Cost Charges (DCCs) and DCC Credits:**
  DCCs assist local governments in recovering costs associated with the provision of growth-related infrastructure, including roads, water, sewer, stormwater, and parks acquisition and improvement. In many cases, the municipality typically constructs projects identified in a DCC program. However, if eligible projects are included in the DCC program and the developer constructs the required infrastructure, there would be an expectation that the developer would receive DCC credits for those projects.

  Additionally, the municipality could forward future DCC funds to the front-ending developer through a DCC Front-Ender Agreement. A Front-Ender Agreement is a legal contract between the municipality and the developer, stating that the municipality will pass on DCCs collected up to the value of the specific works in the DCC program. Front-Ender Agreements are used in numerous communities throughout British Columbia as a means for developers to advance off-site infrastructure projects, and for the municipality to collect and pass along future DCC revenues towards those front-ended projects, thus assisting the developer in recouping a share of the infrastructure costs from benefiting properties.

- **Development Works Agreement:**
  A development works agreement is an agreement between a municipality and a developer for the provision of infrastructure services such as off-site roads, water, sewer, stormwater, and/or parkland. Typically, works are provided by the developer as a

condition of development approval. When the developer provides the works, the municipality in turn allocates part of the cost of the works to a development works area (i.e. the property owners in the area who are subject to the agreement). Costs are collected through the imposition of a one-time charge to property owners, who must pay the charge, including any interest that may have accrued, before they can obtain the various approvals and permits necessary for development. The municipality is also responsible for paying the developer the charges that it collects under the development works agreement.

- **All Landowners Share Front-End Cost:**
  Potentially, all benefitting property owners could share the front-end cost of off-site infrastructure required to service the NCP area and the broader North East Sector. However, it is recognized that this approach would require a significant capital investment on the part of multiple property owners, some of whom may not realize development for years to come. As a result, this approach is unlikely, and there will be a need to ensure that infrastructure costs are recovered by other property owners at time of development.

- **Latecomer Agreements (for 15-Year Period):**
  When excess or extended services are provided (beyond those needed by a single property owner/developer), there is an opportunity to collect latecomer charges to cover the cost of providing excess or extended services. Latecomer charges are collected by the local government and forwarded to the developer. A significant constraint of latecomer charges is that they can only be collected for a maximum of fifteen years (extended from ten years under previous legislation) from the date on which excess or extended services are completed. As a result, there is a risk that not all of the costs associated with the excess or extended services will be recovered. Also, latecomers can only be used to finance roads, water, sewer, and stormwater infrastructure.

On Site Costs:

- The City's **Subdivision and Development Services By-law** sets out the requirements for the construction of infrastructure as a condition of final subdivision approval. The City may be prepared to establish latecomer charges for those on site services that require additional capacity in order to provide for the development of other lands beyond the initial development.

8.1.3 Development Finance Approach

Currently, the City's 2007 DCC program (contained in Penticton By-law No. 2007-79) includes some major off-site infrastructure costs for the North East Sector, while other major off-site costs are excluded from the DCC program. The DCC program currently includes:

- Naramata Road upgrades from Middle Bench Road to the City limits;
- Naramata Road watermain that was built in 2006; and,
- Sewer projects, including the Wade Avenue/Johnson Road trunk replacement and Naramata Bench/Upper Bench Road sewer.

The current DCC program specifically does not include:

- Parks within the NE Sector;
- New water projects within the NE Sector; and,
- New stormwater projects within the NE Sector.

The City's DCC program is split into two sub-areas: 1) the core; and, 2) the periphery. The Spiller Road/Reservoir Road NCP Area falls into the periphery area, as does the remainder of the North East Sector.

Currently, the City's position is to not be responsible for the upfront funding of growth-related infrastructure. To this end, there is a need to review the current DCC Bylaw in the context of the infrastructure projects identified in the NCP to ensure that benefiting parties contribute towards infrastructure costs and that the overall finance approach is viable for both the City and the developers. In many cases, a DCC front-ender approach could be used to allow development to advance infrastructure required to service the NCP area, while providing a mechanism for cost recovery. In addition to DCCs, potential additional development finance tools could include a Development Works Agreement and Latecomer Agreements.

From the developers' perspective, there are several limiting factors to the overall development finance approach. Within the NCP area, land ownership is fragmented and it is likely that those who are first to develop will be responsible for the front-end infrastructure costs associated with servicing the NCP area. Other developers may follow once infrastructure has been extended to their properties. Also, due to build-out timeframes, there may be implications for cost-recovery tools, such as latecomer agreements, that have fixed timeframes associated with them. Finally, due to the nature of the off-site improvements required for this project, significant capital investment is required to get the first residential unit in the ground.

As a result of these considerations, and in keeping with the development finance principles identified above, the preferred development finance approach includes the use of Development Cost Charges used in tandem with Front-Ender Agreements and DCC Credits, where appropriate. In this approach, developers would construct required growth-related infrastructure, receive DCC credits for infrastructure components included in the City's DCC program, and recover costs through enactment of the Front-Ender Agreement. Generally, latecomer agreements are not preferred due to the 15-year time limitation associated with the agreements.

This development finance approach would involve a review of the City's current DCC Bylaw based on the NCP servicing plans. Within the DCC program, potential additional infrastructure items may include:

- Off-site intersection upgrades;
- Off-site water projects;
- Off-site stormwater sewer projects; and,
- Parks.

As noted above, Naramata Road cross-section upgrades and off-site sanitary sewer projects are currently included within the City's 2007 DCC program.

8.1.4 Development Finance Policies

The following policies are proposed to guide the funding of infrastructure services within the Spiller and Reservoir blocks.

Review of Development Cost Charge By-law:

- That the City of Penticton review its Development Cost Charge By-law to include additional infrastructure projects that will benefit the entire North East Sector and/or areas outside of the NCP study area, based on the analysis carried out in the context of the Spiller Road and Reservoir Road NCP; and,
- That the City continue to provide DCC credits where such DCC projects are constructed by the developer, and enter into DCC Front-Ender Agreements as a mechanism for future cost recovery for the developers.

Construction of Non DCC Projects

Where off site projects are not designated DCC projects, it is the policy to ensure an equitable distribution of such costs to all landowners benefitting from such infrastructure projects including:

- The opportunity to stage improvements whenever possible so that the initial developers are not required to pay for significant over sizing of infrastructure improvements; and,
- The opportunity to establish latecomer agreements for both off site infrastructure projects as well as on site projects where over sizing of infrastructure is required to service lands beyond the initial development areas.

It is noted that benefiting areas may include lands that are outside of the NCP study area.

8.2 City Initiatives

A number of City initiatives will be required to ensure implementation of this NCP. These initiatives include:

- Amendments to the Official Community Plan to reflect any changes to sections dealing with the Northeast Sector Plan;
- Designation of the Development Permit Areas identified in this NCP;
- Review of Zoning Bylaw to provide hillside residential zones that meet the standards identified in this NCP;
- Ongoing assessment of the hillside standards that are included in the City Subdivision and Servicing Bylaw;
- Review and revision of the City's Development Cost Charge program to include projects that provide benefit on a sector-wide basis; and,
- Finalization of infrastructure funding strategies for the NCP area, as outlined above.

8.3 Development Process

Subsequent to City adoption of this NCP, the City will consider Zoning Bylaw Amendment and Subdivision applications that are in conformance with this Plan. The development process will also include requirements for the relevant Development Permits, where applicable.

As part of the first Rezoning Application /Subdivision received by the City in the NCP area, the developer will include an initial Cost of Growth Analysis as part of the application. The Cost of Growth Analysis will be a collaborative exercise between the developer and the City with the goal of informing Council and the community on how development will occur and the short and long term costs for the development.

The Cost of Growth Analysis will specifically address the following items:

- Financial analysis supporting how the proposed development and phasing will be funded.
- Proposed Developer and City contributions to the development.
- Capital cost review including electrical and fire services and impacts on the City's long term Capital Budgets.
- Operating cost review and impact analysis for providing annual services and maintenance to the new development area.
- Analysis as to the City payback over time for the growth with tax revenue generated from the development of this area.
- The impacts of the landfill buffer and future approval by MOE.

APPENDIX A

Geotechnical Overview Report
(Interior Testing)

- INTERIOR -
TESTING SERVICES
- LTD. -

MATERIALS TESTING • SOILS
CONCRETE • ASPHALT • CORING
GEOTECHNICAL ENGINEERING

1 - 1925 KIRSCHNER ROAD
KELOWNA, B.C. V1Y 4N7
PHONE: 860-6540
FAX: 860-5027

Urban Systems Ltd.
Suite 500 – 1708 Dolphin Avenue
Kelowna, BC V1Y 9S4

November 20, 2007
Job 6.107B

Attention: Mr. Gerry Tonn

Dear Sir,

Re: **GEOTECHNICAL OVERVIEW OF SITE, NORTH-EAST SECTOR PLAN, SPILLER ROAD/ RESERVOIR ROAD AREA, PENTICTON, BC**

As requested, Interior Testing Services Ltd. has carried out a preliminary geotechnical review of the lands within the North-East Sector Plan development area. A copy of our two page "Terms of Engagement", applicable to our work, is attached, along with an overall site plan, and four more detailed, partial site maps covering the area.

INTRODUCTION

The area under consideration occupies an area of hillside on the North-East corner of the City of Penticton. It lies uphill of Naramata Road, from an area uphill of Hillside Avenue on the south, to an area uphill of Three Mile Road on the north.

This area is on the order of 4km long in the north-south direction. The east-west length varies but is typically less than 1km wide across most of the site.

The area is under consideration for development for which some preliminary geotechnical comments are desired to assist in planning.

SITE DESCRIPTION

As noted, the site occupies an area of partially developed sloping land or mountainside in the North-East corner of Penticton, BC.

The site plan shows the overall area, which lies to the south and north of the existing Penticton landfill. There is little development in the area, which is mostly large parcels of range land. Reservoir Road crosses the south part of the site, with Spiller Road crossing a small portion of the larger north part of the site. There is essentially no other road access within the site.

Several service corridors cross the site, including power lines and a major gas line.

PREVOUS SITE INFORMATION

Two portions of the site have already been reviewed, and reports are available as follows.

a) A preliminary (overview) report of May 8, 2006 by Interior Testing Services Ltd., regarding the Spiller Road property.

b) A follow-up report of September 20, 2006 for the Spiller Road site by Interior Testing Services Ltd., including some test holes to further assess site conditions.

c) A hydrology report of June 13, 2007 for the Spiller Road site by Summit Environmental Consultants Ltd., which also included some test pits on the site.

d) A preliminary (overview) report for 1530 Reservoir Road by Interior Testing Services Ltd.

SITE GEOLOGY

Geologic mapping by Naismith indicates that the lower flatter reaches of the site, which are typically near Naramata Road, are expected to be "Kame terraces and melt-water channels", dating from the stage of glacial retreat.

The upper reaches of the site, where there are steeper grades, are typically composed of BEDROCK.

SITE REVIEW

Reviews of the site were carried out on November 2, and November 15, 2007, at which time the remaining areas of the site were examined.

General comments as follows can be made with respect to site conditions.

a) BEDROCK is typically visible within the steep portions of the site, and is frequently visible in the moderately sloping areas.

b) Flatter portions of the site are likely underlain by dense till-like SILTS, or in some circumstances local SAND and GRAVEL deposits. This is based on a limited number of site exposures, and in part on the test holes dug on the Spiller Road site.

c) There are no major zones of rock hazard other than local, easily avoided, or easily remediated areas.

d) Some drainage issues can be expected in the north end of the property, where there is an existing small creek and some associated springs at the uphill end of the creek.

Otherwise, drainage issues are related primarily to consideration of surface runoff as it relates to local draws or gullys.

e) Much of the area is steep enough that servicing issues would represent the prime difficulty in developing the site. The steep areas are typically BEDROCK, so that stability of the sites would not be a significant issue, but the costs of developing roads and services would be a significant issue.

SPECIFIC NOTES ON SITE CONDITIONS

For the purpose of identifying specific, more detailed observations made during our site review, the site plan has been subdivided into the four more detailed sections as shown on the attached plans, drawings 6.107B-2 to 6.107B-5. The sections will be discussed from the north-most to the south-most area.

a) Area A, Drawing 6.107B-2.

In general, the north half of this area is forested, steeper lands that typically show BEDROCK exposures at shallow depths.

The south half of this area is separated from the steeper north half by a small stream with flowing water.

Soil exposures in the upper and lower areas of the stream indicate the soils are SILTS to SANDS, with some GRAVELS, and these areas may represent cleaner areas that have been selectively excavated.

At the upper end of the stream, there is a dug in well or spring associated with the stream. There is also a damp area at the uphill edge of a recently developed vineyard area, near the south-west corner of this site.

The lowest section of the stream appears to represent a delta deposit of soils deposited onto the flatter lower area.

b) Area B, Drawing 6.107B-3

This area is primarily composed of the large center parcel that was the subject of the May 8, 2006, September 20, 2006, and June 13, 2007 reports previously noted.

One additional observation within this area was the presence of a shallow dug pit containing water in the upper center of the site. It is not clear if this is surface or subsurface drainage.

On the very east edge of the site, there are the most significant rock slopes of the area, which would require some consideration of rock hazard for construction in the immediate area.

The western section of the site is typically underlain by BEDROCK at shallow depth. A draw at the north end is slightly damp, indicating surface drainage may occur under some conditions. (rain fall, snow melt, spring drainage).

c) Area C, Drawing 6.107B-4

In this area, the northern end of this portion (west of the landfill) is typically underlain by BEDROCK exposures.

Towards the south end, the area uphill of Reservoir Road appears likely to be underlain by BEDROCK at relatively shallow depth. This is based on the numerous boulders shown in the area, which suggest the BEDROCK is at shallow depth. Slope cuts along Spiller Road do not expose BEDROCK, but do show a dense till-like soil consisting of SAND and GRAVEL in a dense SILT matrix.

Downhill of Spiller Road, it appears that the flatter overall slopes will likely mean that the depths of soils are greater, and BEDROCK less likely to be found at shallow depth.

d) Area D, Drawing 6.107B-5

This area is the subject of the previously noted April 2, 2007 report.

In general, shallow BEDROCK is expected across the steeper sections of the site, with soil on the flatter extreme north-west corner.

The drainage associated with the shallow draws on the site may be an issue where downhill development has been located at the end of each draw. This has occurred at three draws near Hillside Avenue.

DEVELOPMENT CONSTRAINTS

1. Flatter areas within the site can be expected to be reasonably easy to develop, as the depth to BEDROCK should typically be greater, therefore roadway and service construction should be easier to accomplish.

2. Even within the steeper BEDROCK areas, development would generally be feasible as stability of the site would be satisfactory. However, cost issues would typically be an issue, due to the presence of BEDROCK, which would typically require blasting for removal.

3. The local BEDROCK is normally of volcanic origin, and is frequently sufficiently fractured or weathered in the top 0.5 meters of less to be excavated mechanically. At greater depths it is commonly necessary to blast the BEDROCK to remove it.

4. Local drainage channels exist in the areas of the site, and these might be left as undisturbed, undeveloped areas except where crossings are required, or where engineering design to manage the drainage is provided.

   It is also assumed that existing streams, where they exist, will be left undisturbed, unless engineering designs to address these are provided.

5. No areas of significant rock hazards are expected on the site. These are local areas of steeper rock slopes, but it is expected any rock hazards could be easily addressed by local avoidance or remedial measures.

CONCLUSIONS AND RECOMMENDATIONS

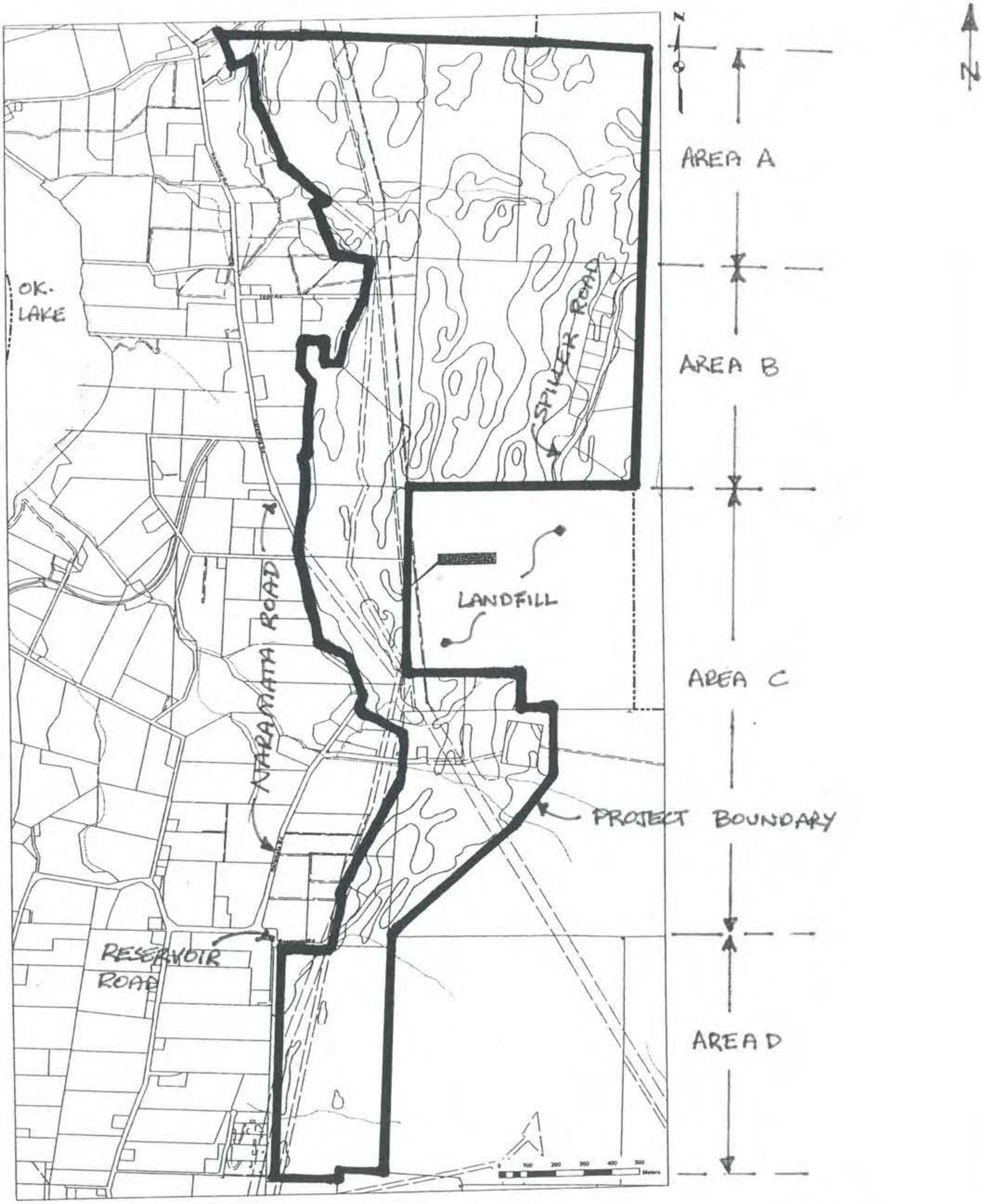
1. Development of the overall site is expected to be feasible, with the primary constraints due to the site grades and servicing issues.

I trust this will assist you. If you have any questions, please call.

Yours truly,

Norman K. Williams

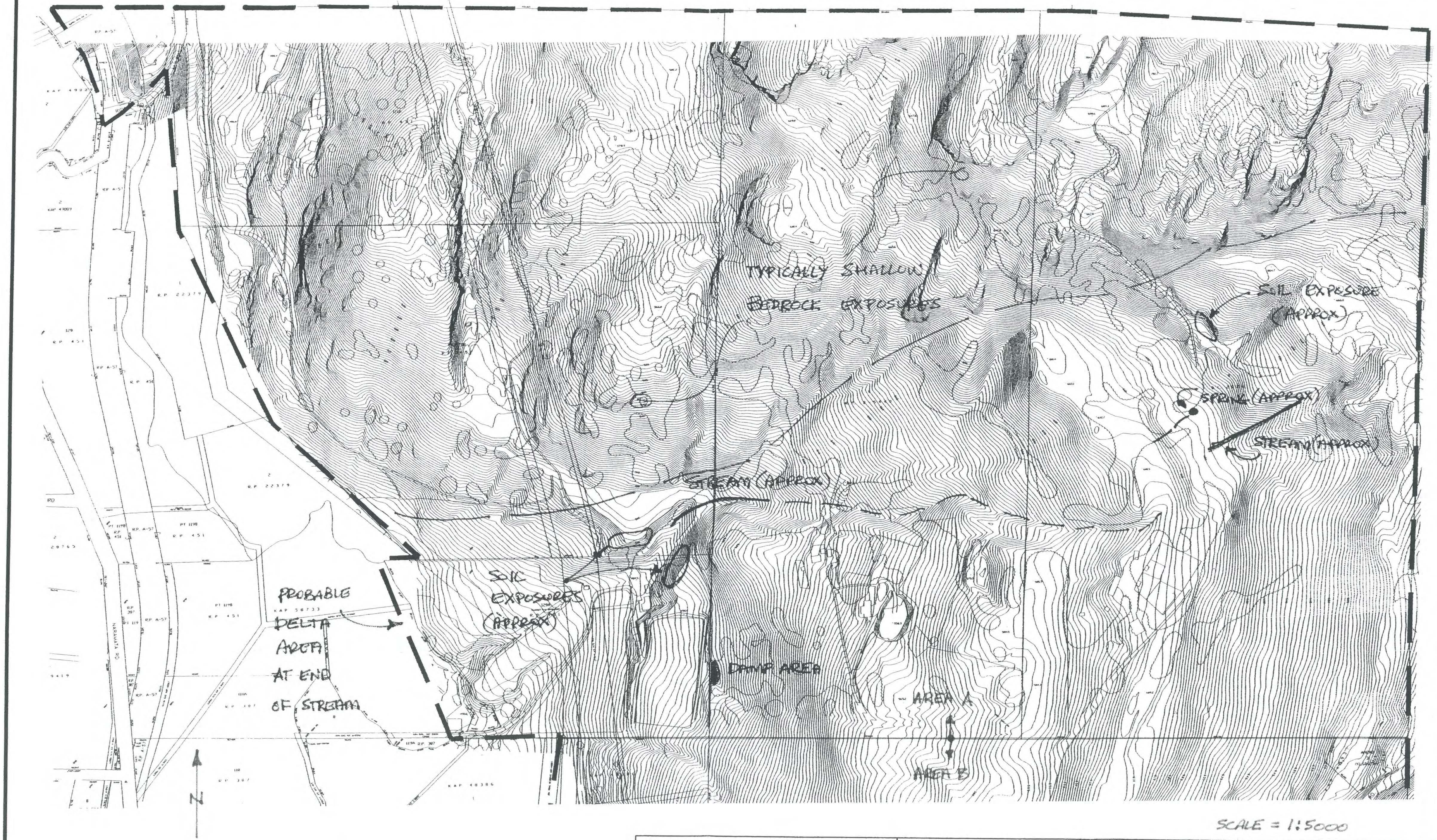
Norman K. Williams, P, Eng.



REFERENCE PLANS PROVIDED BY URBAN SYSTEMS LTD.

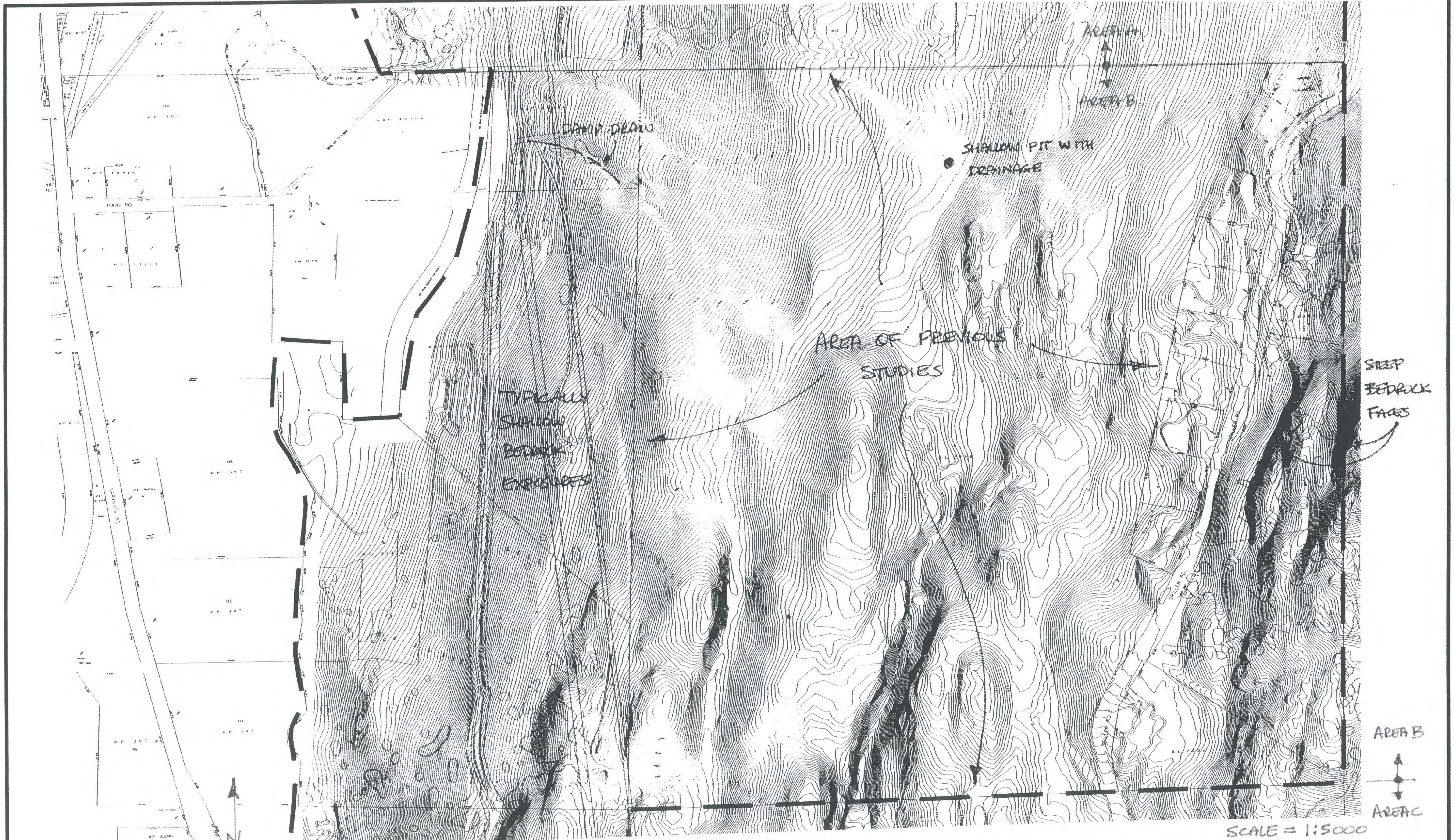
SCALE = 1:20,000

Urban Systems Ltd.	SITE PLAN	INTERIOR TESTING SERVICES LTD. 1-1925 KIRSCHNER ROAD, KELOWNA, BC V1Y 4N7 PH: 250-860-6540 FAX: 250-860-5027
North-East Sector Plan Spiller Road/Reservoir Road		DATE OF INVESTIGATION: November 2007
Penticton, BC		JOB NUMBER: 6.107B / DRAWING NUMBER: 6.107B-1



Urban Systems Ltd. North-East Sector Plan Spiller Road/Reservoir Road Penticton, BC	AREA A	INTERIOR TESTING SERVICES LTD. 1-1925 KIRSCHNER ROAD, KELOWNA, BC V1Y 4N7 PH: 250-860-6540 FAX: 250-860-5027 DATE OF INVESTIGATION: November 2007 JOB NUMBER: 6.107B — DRAWING NUMBER: 6.107B-2

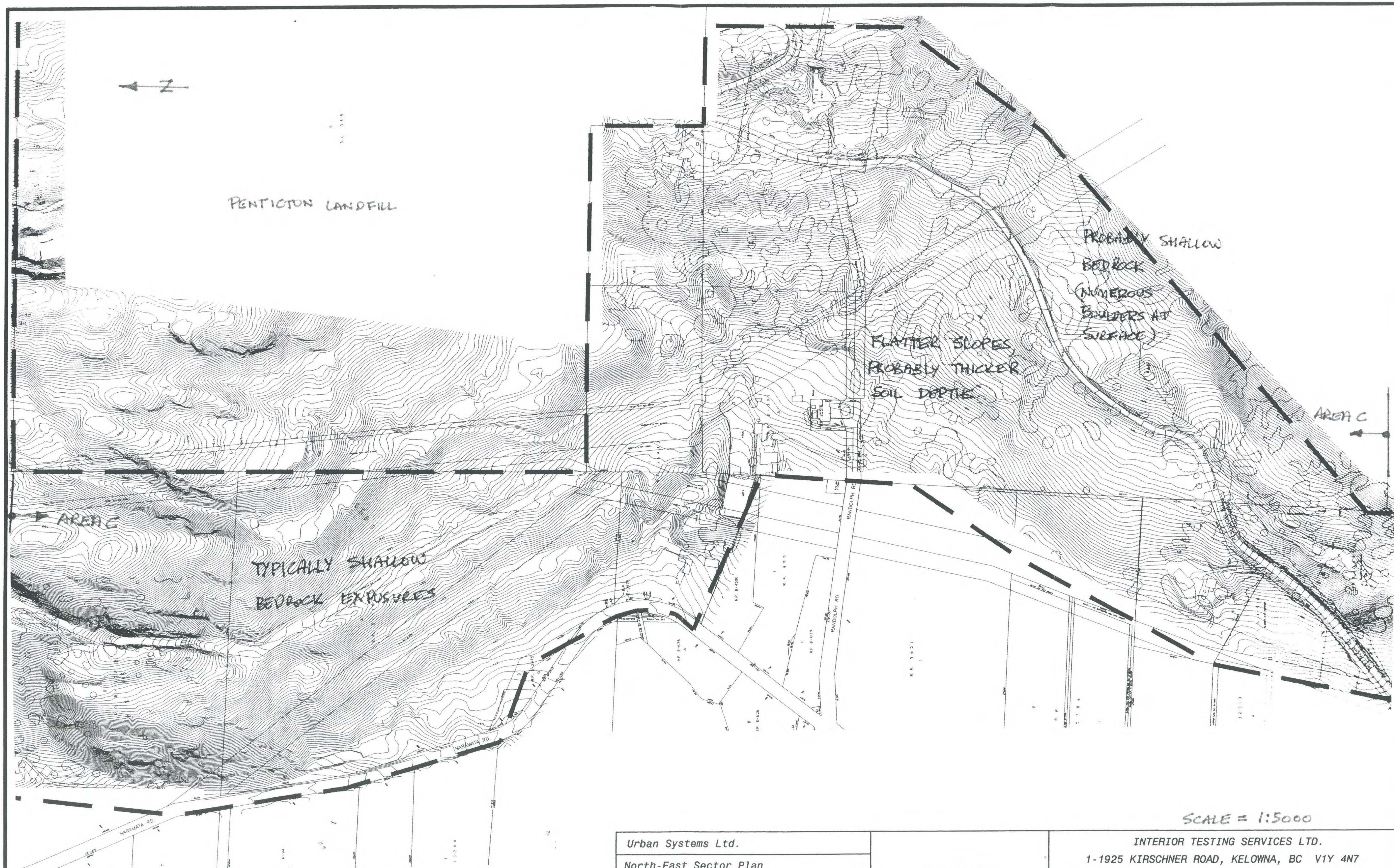
REFERENCE DRAWINGS PROVIDED BY URBAN SYSTEMS LTD.



SCALE = 1:5000

Urban Systems Ltd. North-East Sector Plan Spiller Road/Reservoir Road Penticton, BC	AREA B	INTERIOR TESTING SERVICES LTD. 1-1925 KIRSCHNER ROAD, KELOWNA, BC V1Y 4N7 PH: 250-860-6540 FAX: 250-860-5027 DATE OF INVESTIGATION: November 2007 JOB NUMBER: 6.107B DRAWING NUMBER: 6.107B-3

REFERENCE DRAWINGS PROVIDED BY URBAN SYSTEMS LTD



SCALE = 1:5000

Urban Systems Ltd.	AREA C	INTERIOR TESTING SERVICES LTD. 1-1925 KIRSCHNER ROAD, KELOWNA, BC V1Y 4N7 PH: 250-860-6540 FAX: 250-860-5027
North-East Sector Plan Spiller Road/Reservoir Road Penticton, BC		DATE OF INVESTIGATION: November 2007
		JOB NUMBER: 6.107B — DRAWING NUMBER: 6.107B-4

REFERENCE DRAWINGS PROVIDED BY URBAN SYSTEMS LTD.

SCALE = 1:5000

Urban Systems Ltd.	AREA D	INTERIOR TESTING SERVICES LTD. 1-1925 KIRSCHNER ROAD, KELOWNA, BC V1Y 4N7 PH: 250-860-6540 FAX: 250-860-5027
North-East Sector Plan Spiller Road/Reservoir Road Penticton, BC		DATE OF INVESTIGATION: November 2007 JOB NUMBER: 6.107B DRAWING NUMBER: 6.107B-5

REFERENCE DRAWINGS PROVIDED BY URBAN SYSTEMS LTD.

APPENDIX B

Environmental Overview Report
(Cascadia Biological Services)

The Spiller Road/Reservoir Road Area Neighbourhood Concept Plan (NCP) Penticton BC

Biophysical and Environmental Assessment

Prepared for:
the Spiller Road / Reservoir Road Area NCP Steering Committee

Prepared by:
Cascadia Biological Services
1442 White Pine Terrace
Victoria, BC
V9B 6J3

November 2010

EXECUTIVE SUMMARY

Cascadia Biological Services was retained by Urban Systems to complete a biophysical inventory and environmental overview assessment on lands within an area referred to as the Spiller Road/Reservoir Road Area Neighbourhood Concept Plan (NCP) within the City of Penticton. Located to the Northeast of the downtown city centre along the Naramata bench, the NCP measures approximately 750 acres and is made up of a various land owners and parcel sizes (primarily large) and was designated in 2002 as a "Future Planning Area".

Home to over 66 blue and red listed animal species and 30 plant species listed by the British Columbia Conservation Data Centre (BC CDC), the NCP is unique in that it lies within a rare ecosystem forming the northern most limits of a desert like climate and its associated rare ecosystems. The dominant ecosystem found within the NCP consists of bunchgrass grassland and ponderosa forest, having intermixed boundaries, characteristics and species. The ecological community defined by B.C. Conservation Data Centre (CDC) as ponderosa pine / bluebunch wheatgrass - rough fescue best represents this area. This community in itself is rare and considered to be of special concern to the CDC. Within 2000 meters of the study site, historical records show the presence of Lewis's Woodpecker, Yellow Breasted Chat, Spadefoot Toad, and the invertebrate, Vivid Dancer. There are also records of 2 plant species; Flat-topped Broomrape and Giant Helleborine. The main reason for the large number of listed species is due to the area's warm dry summers and low annual precipitation. These elements result in a unique bioclimatic zone and result in the presence of many plants and animals that would more commonly be found south of the Canada/United States border.

The environmental assessment of the property was initiated in the fall of 2007 and ended in the summer of 2010. Overall, a total of 15 field days were dedicated to the project and involved completing vegetation assessments, wildlife assessments as well as biophysical mapping of environmentally significant attributes including passerine nest sites, wildlife dens as well as all watercourses within the study area. Our assessments resulted in the documentation/mapping of five distinct ecosystems and one stream, over sixty-two wildlife trees, forty-two species of plants as well as over 30 species of birds and 8 mammals. Further to the species observations above, we have determined that there are various environmentally significant attributes as well as rare element occurrences within the NCP Study Area. Overall, impacts to these environmentally sensitive species and ecosystems as a result of the proposed NCP are expected to be minimal, if the proposed best management practices identified in this report are adhered to. These include the designation of proposed build areas (development pods), adjusting road locations to minimize impacts to sensitive attributes as well as reducing the overall impervious surface over roads and community parking/trail areas.

CONTRACTOR INFORMATION

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Report prepared by:	*Names:*	T. Roy, Robert Hollingshead
Maps prepared by:	*Names:*	Thomas Roy, R.P. Bio., QEP
	Address:	Cascadia Biological Services
	Phone:	(250) 474-0102
GIS services:	*Company:*	Thomas Roy, R.P. Bio., QEP
	Address:	Cascadia Biological Services
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1.0 INTRODUCTION

Urban Systems tasked Cascadia Biological Services with conducting an environmental assessment (EA) to assist in the overall planning process related to the land use within the Spiller Road/Reservoir Road Area Neighbourhood Concept Plan (Study Area) as well as identify, map and evaluate environmentally sensitive attributes related to wildlife, vegetation and watercourses. The assessments would evaluate these attributes based on their environmental significance both at a regional as well as at a local scale. Fieldwork for the project was initiated in the fall of 2007 and was completed in summer of 2010 involving over 15 days of data collection with both a Registered Professional Biologist (R.P.Bio) and a certified wildlife technician. Assessments completed during this time period included vegetation, wildlife as well as stream and fish habitat surveys.

This report therefore presents the findings of the EA activities and is organized into three main sections. Section 1 includes the introduction and summarizes the scope of work, project goals and objectives, general methods, as well as describes the project area and environmental setting. Section 2 describes the results of the EA and further defines the methods used to each particular assessment. Section 3 details development considerations including a discussion and summary of the EA.

1.1 SCOPE OF WORK

The scope of this EA included conducting environmental assessments at two different scales. The first was to ground truth ecosystem polygons delineated in air photo typing. These polygons were ground truthed at select locations within the study area which provided easy access and allowed for the sampling of a variety of ecosystems. The second was to assess the potential occurrence of select species listed by the BC Conservation Data Centre (BC CDC) in relation to habitat suitability within the NCP as well as to extrapolate the findings of our ecosystem delineation and ground truthing exercise on the areas sampled to the rest of the NCP. The extrapolation was then further refined through field visits to the adjacent properties within the NCP

1.2 OBJECTIVES OF THE WORK

The overall objectives of these assessments were to assess the lands referred to as the NCP (refer to Figure 1), for sensitive environments and species. Surveys would focus on but not be limited to the documentation of sensitive ecosystems, watercourses that met the definition under the Riparian Areas Regulations (RAR) as well as locate other environmentally sensitive attributes including wildlife trees, dens, nest sites as well as other rare element occurrences. In particular:

- Map all wildlife trees including nest sites;
- Map wildlife dens and hibernacula;
- Document rare plants and ecosystems through a detailed bio-inventory; and
- Map all waterbodies including RAR watercourses and collect biophysical data that would allow for the determination of the Streamside Protection and Enhancement Areas (SPEA) setback.

1.3 ENVIRONMENTAL AND GEOGRAPHIC SETTING

The Study Area measures 737 acres in area and is located to the northeast of Penticton, BC. Located on 1:20,000 TRIM Mapsheet #082E.053, the Study Area is located between Spiller Road and Naramata Road and to the north of the city’s landfill. The only waterbody within the study area is Strutt Creek which runs in a westerly direction through the northern half of the study area. Refer to figure 1 below outlining the Study Area as well as the surrounding land uses.

1.4 PHYSIOGRAPHY, HYDROLOGY AND CLIMATE

The Penticton area has an ecodivision classified as semi-arid steppe highland. This is due to being situated between the two large mountain chains of the Coastal Mountains and Columbia Range, and therefore creating lower level of precipitation due to the effects of rain shadowing. These barriers to the east and west also act as a funnel for warm dry air from the Great Basin to the south in the summer and cold air from the Artic in the winter. These attributes lead to warm dry summers and cold dry winters.

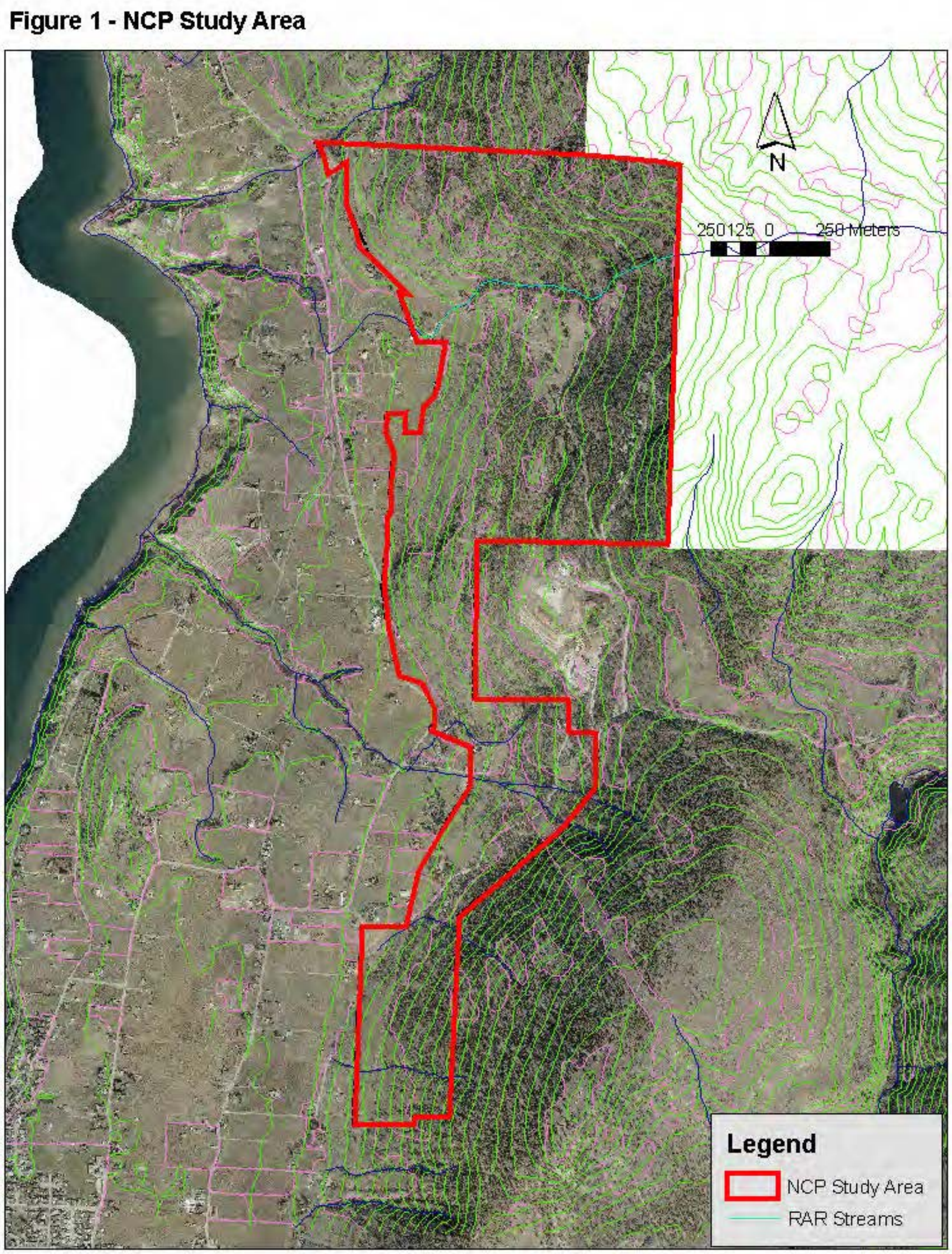
Climate data for the Study Area is available from Environment Canada's National Climate Data and Information Archives) and Ministry of Environment (MoE). Environment Canada's data is attained at the Penticton airport at an elevation of 344 meters. The data records include temperature and precipitation. The following summarizes the weather data obtained from this climate station in bullet form:

- The mean daily temperatures are above freezing throughout the year except in December and January when temperatures are slightly below zero;
- Mean daily minimum temperatures below freezing occur from November through March;
- The mean daily temperature difference between the coldest winter month and the warmest summer month is approximately 22.1°C.

Precipitation data shows the following patterns:

- Precipitation is low and spread out throughout the year with a trend for higher precipitation in the summer months.
- Snow can occur any time from October through April; and
- The driest months are February and October.

Figure 1. Spiller Road/Reservoir Road Neighbourhood Concept Plan



1.5 METHODOLOGY

1.5.1 OFFICE STUDY: Identification and Review of Environmental Data

Prior to actual on site investigations of vegetation, wildlife and aquatic communities within the delineated Study Area, a detailed office based investigation on all three environmental components (aquatic resources, wildlife and vegetation) to be studied was undertaken. For the most part, this involved researching government databases, including the Department of Fisheries and Oceans (DFO) and the Ministry of Environment (MoE), as well as related reports. Please find below a detailed lists of material used and interpreted for our assessments on vegetation, wildlife, and aquatic habitat.

- Aerial photos, reports and Study Area boundaries (Urban Systems Ltd.);
- Concept Sketch 1m contour Planning Map (Urban Systems Ltd, 2008);
- BC Conservation Data Centre – Rare Wildlife (Appendix A) and Vascular Plants (Appendix B) of the Okanagan Shuswap Forest District;
- BC Conservation Data Centre – Rare Plant Communities Tracking List of the Okanagan Shuswap Forest District - BC Conservation Data Centre (Appendix C);
- FISS (fish information summary system) databases;
- FWSR (fish wizard stream report) databases;
- BC Conservation Data Center http://a100.gov.bc.ca/pub/eswp;
- Sensitive Habitat Inventory Mapping (SHIM) web site. http://www.shim.bc.ca/shim/main.htm;
- Sensitive Ecosystem Inventory http://www.env.gov.bc.ca/

1.6 FIELDWORK

Fieldwork related to the detailed biophysical assessment of the Study Area was conducted between the fall of 2007 and the summer of 2010 and encompassed sampling dates throughout the spring and summer months. For all aspects of our assessment including vegetation, aquatic habitat and wildlife, delineated transects were laid down over various locations within the study area to ensure maximum coverage (*Appendix D Biophysical Assessment Map*). Results from these transects were then extrapolated to the rest of our study area and formed a baseline of wildlife/vegetation presence which was added to through incidental sightings as the rest of the study area was assessed. Upon completion, a total of 8 biophysical assessment transects measuring 50m in width were assessed thoroughly as well as a complete walk through resulting in over 65% coverage of the delineated Study Area. In addition, various biophysical assessments of the Study Area were conducted including a vegetation survey, a reptile and amphibian surveys, small mammal survey, large mammal survey, fish and fish habitat survey, raptor surveys and bird inventory. Specific methods relevant to each survey including a breakdown of field equipment are discussed in greater detail in Section 2 of this report.

2.0 BIOPHYSICAL ASSESSMENT - METHODS & RESULTS

2.1 VEGETATION

2.1.1 Biogeoclimatic Zones

The Study Area lies within the Ponderosa Pine (PPxh1) subzone variant phase. The PPxh1 phase experiences warm, dry summers and cold, dry winters. Forests on zonal sites are dominated Ponderosa Pine with some Douglas-fir which is mainly attributed to draws and northern aspects. Major understory species include tall Oregon grape, bluebunch wheatgrass. dalmation toad-flax, rocky mountain juniper, yarrow, big sagebrush. Vegetation identified in the study area during our assessment is presented below in Table 1:

Table 1. Vegetation found within the NCP

Douglas-fir	Rabbit-Brush
Ponderosa Pine	Big Sage Brush
Trembling Aspen	Saskatoon
Birch Spp.	Great Mullein
Black cottonwood	Clasping Twisted Stalk
Red –osier Dogwood	Black Hawthorn
Rocky Mountain Maple	Field Mint
Tall Oregon Grape	Common Thistle
Kinnikinnick	Pearly Everlasting
Baldhip Rose	Prickly Lettuce
Prickly Rose	Daisy Spp.
Brown-eyed Susan	Woolly Groundsel
Snowberry	Red Raspberry
Dalmation Toad-flax	Round Leaved Alumroot
Yarrow	Wild Blue Flax
Wooly vetch	Evening Primrose (yellow)
Rocky Mountain Juniper	Prairie cinquefoil
Diffuse Knapweed	Rocky Mountain Woodsia
Squaw Currant	Prickly Pear Cactus
Douglas Aster	Smooth Summac

2.1.2 Vegetation Communities

The information required for the environmental inventory was obtained through a review of secondary source information and a 15-day field program.

2.1.2.1 Methodology

2.1.2.1.1 Office Study

The office study included a review of available maps and plans related to the Study Area including two wildlife reports completed by Ophiuchus Consulting (wildlife habitat assessment) as well as one completed by Daryl Stepaniuk (California Bighorn Sheep). Where either of these reports documented no SEI concerns (moderate to high rating), the area was assessed only at a cursory level and assigned a low habitat value. This information was used to assist in aerial photograph interpretation of vegetation, drainages, landform and any other prominent features located on the property. The Study Area (refer to Figure 1) consisted of the NCP plus a special 20m assessment area along the outside perimeter of the Study Area. This 20m area was assessed where feasible due to topographical constraints and focused primarily on mapping adjacent waterbodies that may be subject to the Riparian Assessment Regulations (RAR) as they pertain to projected buffer zones including the Streamside Protection and Enhancement Areas (SPEA) into the property. Detailed wildlife and vegetation assessments were completed at various locations within the Study Area. Maps and aerial photographs reviewed included:

- Air Photo Mosaic (Urban Systems, 2007)
- 1:20,000 TRIM Mapsheets
- Concept Sketch 1m contour Planning Map (Urban Systems 2007)

In addition to map and aerial photograph interpretation, an Element Occurrence Report (EOR) was requested from the BC Conservation Data Centre, and a review of environmental databases from the Ministry of Environment, Environmental Stewardship Division [formerly known as the Ministry of Water, Land and Air Protection (MWLAP)]. Internet addresses for these databases are as follows:

- SHIM (Sensitive Habitat Inventory Mapping) - http://www.shim.bc.ca/shim/main.htm

- BC Conservation Data Center: Rare Plant Community Tracking List; Okanagan Shuswap Forest District) (Appendix B). http://a100.gov.bc.ca/pub/eswp/

- BC Conservation Data Center: Rare Vascular Plant Tracking List; Okanagan Shuswap Forest District http://a100.gov.bc.ca/pub/eswp/

2.1.2.1.2 Field Program

Cascadia Biological Services conducted field reconnaissance of the Study Area between the fall of 2007 and the summer of 2010 during which time the following tasks were completed:

- Complete list of plant species found and an assessment for the presence of rare and endangered species.
- Identification and classification of ecological communities

Overall, a total of 5 distinct vegetation communities were identified within the NCP study area:

Quadrat #1 – Bluebunch wheatgrass, rough fecue grassland ecosystem;
Quadrat #2 – Douglas Fir, Ponderosa Pine Woodland Ecosystem;
Quadrat #3 – Ponderosa Pine Ecosystem;
Quadrat #4 – Riparian Ecosystem
Quadrat #5 – Rocky Outcrop

The 5 ecosystem types above were delineated for further study based on overall size and importance within the Study Area.

2.1.3 Assessment Results

Vegetation communities within the delineated Study Area consisted primarily of shrubs, coniferous and deciduous species in the young forest stage, several old growth vegetative polygons and herbaceaous communities. Generally speaking, the vegetative composition of the NCP Study Area can be summarized, by ecosystem type; as follows in Table 2:

Table 2. Ecosystem Summary Table (Entire Study Area)

Vegetation Community	% Area of Site
Douglas Fir Woodland Ecosystem	43.6% (1343264 m^2)
Bunchgrass Ecosystem	27.6% (851379m^2)-
Ponderosa Pine Ecosystem	19.3% (593661 m^2)
Disturbed Ecosystem	6.2% (189852 m^2)
Riparian Ecosystem	2.3% (69208 m^2)
Rocky Outcrop Ecosystem	1.0% (33291 m^2)

Of the individual plant species encountered within the ecosystems identified above, none were listed on the *Conservation Data Centre: Rare Vascular Plant/Vegetative Communities Tracking List – Okanagan Shuswap Forest District (*Refer to *Appendix C).* For an overview of the ecosystems present within the NCP study area, please refer to Appendix E (Ecosystems Map).

2.1.4 Rare and Endangered Vascular Plants and Plant Communities

2.1.4.1 Rare and Endangered Vascular Plants

The Conservation Data Centre (CDC) reports the occurrence of 237 taxa of rare and endangered vascular plants within the Okanagan Shuswap Forest District, including 122 blue-listed and 115 red-listed species *(*Refer to *Appendix B – BCCDC Rare Vascular Plant.* Rare and endangered species are categorized into 'red'and 'blue' lists. Red listed species include species that are extirpated in British Columbia, in danger of becoming extirpated, or threatened. Blue listed species are species that are sensitive or vulnerable to human activity or habitat encroachment. Yellow-listed taxa are those species or subspecies that are not red or blue listed. Based on Study Area observations, no red/blue listed plant species were observed.

2.1.4.2 Rare and Endangered Plant Communities

The CDC reports the occurrence of 13 rare and endangered plant communities in the Okanogan Shuswap Forest District within the PPxh1, including 9 red-listed and 4 blue-listed plant communities (Refer to *Appendix C – BCCDC Rare Plant Communities).* Based on Study Area observations, the blue-listed ponderosa pine, bluebunch wheatgrass-rough fescue ecological community was identified. Refer to *Appendix E Ecosystem Map)* for polygon locations.

2.2 WILDLIFE

2.2.1 Survey Methodology

All wildlife surveys conducted on the Study Area were performed using the Resource Inventory Committee and/or Canadian Wildlife Service standards. Secondary source information was collected using various government databases and internet searches.

2.2.1.1 Raptors and Breeding Bird Inventory

The raptor and breeding bird surveys used a two-part methodology:

- An office background information search; and
- A field study preparation with Study Area inspections.

Presented below are the detailed methodologies used to assess the potential red/blue/yellow listed passerine and raptor habitat use of the delineated Study Area.

2.2.1.1.1 Office Study

The following office preparation was performed prior to the field surveys:

- Review of BC Ministry documents *"Standard Inventory Methodologies for Components of British Columbia's Biodiversity: Raptors"(Version 1.1);*
- Review of *"Inventory Dataforms for Raptors Standards for Components of British Columbia's Biodiversity No. 11 [Forms]";*
- Review of relevant mapping for the Study Area (i.e. topographic mapping, aerial photography); and
- Review of target species including those identified by the British Columbia Conservation Data Centre (BC CDC) as red and/or blue

listed as well as related habitat use, feeding behaviour, breeding behaviour, and species vocalizations.

2.2.1.1.2 Field Study

Sample Design

The study design followed the:

- Resource Inventory Committee's (RIC) presence/not detected protocols of "*Standard Inventory Methodologies for Components of British Columbia's Biodiversity: Raptors (Version 1.1) Sections 3.3.3, 3.3.4, 3.3.6 and 3.3.7;*
- Canadian Wildlife Service's (CWS) *"Forest Bird Monitoring Program (FBMP)";*and
- Environment Canada's (Env. Can.) *"Breeding Bird Survey (BBS)"*.

To ensure adequate detection of all species present, our Study Area was delineated into eight separate transects which were equally spaced. (Refer to *Appendix D– Biophysical Assessment Map*). Transects were labelled from 1- 8 starting from the south to the northern boundary. Further to the assessments along these transects, individual point count stations were set up at key locations along the length of the transect ensuring that the majority of the Study Area would be surveyed/inventoried and therefore thoroughly covered using protocols of "standwatch" and roadside call playback methodology. Transects also sampled the different vegetational structure and their structural stages. Additionally, the methodology ensured that the Study Area would be thoroughly covered including possible building locations as well as future roads having the greatest potential impact on the target species.

Any passerine and raptor visual encounters along with auditory accounts (songs/calls) were recorded during each point count survey, roadside call playbacks as well as throughout the site inventory survey as incidental sightings.

Foot (transect) surveys followed the procedures outlined in "*Standard Inventory Methodologies for Components of British Columbia's Biodiversity: Raptors (Version 1.1) Section 3.3.6*. This method was used to supplement point count, roadside and call playback surveys in order to verify any presence/not detected (but possible) occurrence of breeding raptors, nests or any other significant passerine activity.

Most survey effort to locate raptor (hawk, owl, eagle) and passerine nest presence was focused on areas in the woodlots. This included observing all tree tops of older second generation conifer trees found on site with a high powered and anchored spotting scope.

Stand Watch (Point Count) and Nocturnal Call Playback Surveys

"Stand Watch" (Point Counts) Methodology

Procedures used in the survey are outlined in "*Standard Inventory Methodologies for Components of British Columbia's Biodiversity: Raptors (Version 1.1) Section 3.3.7", CWS FBMP and Env. Can. BBS.*

Point counts were spaced approximately 100m apart along transects and covered all of the Study Area where the proposed development pod footprints and roads were the highest. Each involved a five-minute survey at their stop location using the following:

- standing and watching the surrounding area for bird species; followed by
- recording the number of all birds seen (visuals) and heard (song/call) within a radius of approximately 100 m.

Results of these surveys are presented in Tables 3-5

Nocturnal Roadside Call Playback Survey Methodology

The roadside call playback surveys for nocturnal raptors followed procedures outlined in "Standard Inventory Methodologies for Components of British Columbia's Biodiversity: Raptors (Version 1.1) Section 3.3.3".

Calls and songs of five target species potentially occurring in the Study Area were played at Owl Calling Stations (OCS) 1, 2 and 3, (Refer to *Appendix D*). Call playbacks were played at each station using a tape recorder for a period of three minutes/target species for a total of fifteen minutes. Following the call/song vocalisations, the observer looked and listened for a visual and/or vocal response of that target species, both during and after each call and song was played. All call playback surveys were conducted by foot.

Target species songs and calls used at the OCS station were played in a specific order ensuring that the smallest birds were first and the largest birds called last as per standards.

2.2.1.2 Amphibian Survey

The aim of this inventory was to sample the Study Area by conducting a herpetifaunal survey of reptiles and amphibians along any watercourse on the property. Additionally, areas of greatest sensitivity (adjacent to waterbodies) with respect to herpetifaunal habitat were surveyed with greater intensity.

This survey involved a two-part methodology:

- An office background information search; and
- A field study preparation with Study Area visit.

Presented below are the details to the methodologies used to assess the presence/not-detected status potential of the red/blue-listed herpetifauna in the delineated Study Area.

Office Preparation

The following office preparation was performed prior to the field surveys:

- Review of the introductory manual, *Species Inventory Fundamentals (No. 1);*
- Review of 1:20,000 and 1:5,000 scale maps of the project area;
- Review of BC Ministry documents *"Standard Inventory Methodologies for Snakes Standards for Components of British Columbia's Biodiversity No. 38: Snakes"(Version 2.0);*
- Review of BC Ministry documents *Inventory Methods for Pond-breeding Amphibians and Painted Turtle Standards for Components of British Columbia's Biodiversity No. 37 (Version 2.0);*
- Relevant mapping for the Study Area i.e. topographic mapping, aerial photography); and
- Review of target species including habitat use, feeding behaviour, and breeding behaviour.

Field Study

Sample Design for Amphibians

The amphibian surveys focused on identifying the presence/not-detected status of any herpetifauna but special focus was on the blue listed species the Columbian Spotted frog, Northern Leopard frog and the Great Basin Spadefoot.

Although these blue listed species and their habitat identifications were of focus, all incidental amphibian sightings during the survey period were recorded.

The presence/not-detected inventory status of herpetifuauna within the Study Area followed methodologies outlined in *"Inventory Methods for Pond-breeding Amphibians and Painted Turtle Standards for Components of British Columbia's Biodiversity No. 37 (Version 2.0).*" Survey methodologies followed RIC protocol and included:

- Auditory surveys;
- Road/Transect Surveys;
- Time-constrained searches; and
- Systematic surveys.

Further, following the review of aerial photo interpretation amphibian survey habitat inventory locations were identified along the transect. These focused on wetted areas and ponded water habitat along riparian edges of all watercourses as well as on accessible roads with characteristic habitat for the target and other herpetifaunal species.

Auditory Surveys

Auditory surveys were only conducted during evening hours at dusk along with the nocturnal raptor survey. This method of survey involved listening for the calls of male frogs and toads along wetted areas accessible during evening/night times.
This survey followed the methodology outlined in Canadian Wildlife Service's *"North American Amphibian Monitoring Program (NAAMP)*". Surveys were conducted during the evening at all wetted areas. The following methodology was used as part of the RIC protocols:

- A stratified, randomized approach was used for all sites;
- Areas of systematic sampling along the roads accessing the property, roads or around any associated watercourses, the listening stations were set at regular intervals of approximately 100m apart and were incorporated as part of the nocturnal raptor survey;
- Each survey stop lasted fifteen minutes and followed NAAMP guidelines;
- Surveys were carried out after dark; approximately one hour after dusk; and
- All species heard were recorded.

Roadside Transect Surveys

The road surveys were conducted during the evening in conjunction with the nocturnal raptor surveys. Survey structure was consistent with RIC protocols and was designed as follows:

- All stations were incorporated periodically along the road's length (50m apart);
- Where possible, as a process of random stratified sampling, point count locations included areas of small potential breeding ponds and any encountered waterbody areas;
- Where accessible, all roadside ditches were checked during daylight and evening hours;
- Access for the surveys was foot;
- Access to each point was walked at slow speeds (approximately 2 km/h), using flashlights; and
- Attention was paid to potential road kills and any herpetifauna/animal moving across or from the road.

Time-constrained searches

Time-constrained searches involved searching areas of the Study Area that are likely to contain the target species. Searches were performed primarily during the day, following the review of aerial photo interpretation. The amphibian survey was stratified based on their expected occurrence at selected locations. Search effort focused on areas where they were most likely to occur (wetted depressions, streams etc.).

Systematic Searches

Searches for salamanders' larvae and any adult forms were performed along all wetted drainages/ponds within the Study Area. Randomly chosen sections of Strutt Creek were surveyed for any metamorphosed salamanders. As well, all potential rocks (hiding sites) were overturned where possible around the perimeter of all wetted areas.

For the identification of any larval stage of salamander and/or Great Basin Spadefoot, Northern Leopard Frog and the Columbia Spotted Frog, along wetted areas, the following survey methodologies were employed:

- foot searches uncovering any woody debris or aquatic vegetation were performed and all vegetation was assessed for egg masses during the foot searches of the ponds;
- 5 MT sites for a period of 72 hrs, 25 Gee traps (minnow traps) baited with cat food were placed in all waterbodies and in depressions that where wet at the time of our survey and checked daily. Each trap was recovered and checked for the presence of any larval salamanders and/or tadpoles.
- any shallow pools and areas of warm water in the ponds and sections of ephemeral drainages were examined for tadpoles and salamanders; and
- All species seen or heard were recorded, together with any necessary habitat information.

2.2.1.3 Small Mammal Survey

This survey focused on the entire Study Area and followed the MoE Inventory Branch for the Terrestrial Ecosystems Task Force Resource Inventory Committee (RIC) protocols.

Office Procedures

The following office preparation was performed prior to the field surveys:

- Review of the *"Inventory Methods for Small Mammals : Shrews, Voles, Mice & Rats", Standards for Components of British Columbia's Biodiversity, No. 31 (1998);*
- Review the introductory manual No. 1 *Species Inventory Fundamentals;*
- Determine species to be studied;
- Obtain maps for project and Study Area (1:20 000 TRIM maps, 1:5,000 planning maps);
- Determine approximate location of Study Area(s) within this project area;
- Stratify Study Areas based on habitats; and

- Determine sampling area dimensions, trap spacing, trapping intervals.

Field Sampling Procedures

Sample Design

This study involved determining the presence/non-detected status of species by establishing randomly located traps sites along a transect (index lines) within the Study Area (Small Mammal Trap 15 locations – SMT 1 -15). The number of traps along the transect was dependent on the potential species, estimated population levels and the objectives of the study (to find presence/non-detected status of small mammals). Live traps were used to provide a means of live-capturing individuals whereas snap traps result in the permanent removal of captured individuals. The following methodology was used during the survey:

- All traps were placed in areas where rodents and small to medium sized mammals were expected to occur in the project Study Area;
- Five small traps (mice, shrews etc.) and two larger traps (used at one location for weasels, raccoons, cats etc,) were used.
- Each type of vegetation unit on the Study Area was sampled using this methodology and traps were placed in homogeneous habitat (*Appendix D*);
- GPS datapoints units were taken for each trap location;
- All traps were flagged with flagging tape at capture stations;
- Traps were placed >2m apart in microclimate sites that would attract shrews and mice, etc. These included positions along or under woody debris or rocks, under bushes, along travel trails;
- Each trap was baited with peanut butter (mice, shrews) and sardines (larger traps);
- Traps were set in the late afternoon and checked the following afternoon to minimize mortalities and trap stress;
- Captured individuals were identified to species;
- Trapping sessions occurred over a period of 72 hrs.
- On completion of the study all traps were removed;

2.2.1.4 Large Mammal Survey

The purpose of the large mammal ground survey was to:

- Assess the presence/not detected (possible) status of any mammals in habitat identified through topographic mapping;
- Identify areas for potential habitat use; and
- Record observations of any mammal presence (incidental sightings).

The following ground-based survey protocol was conducted for this phase of the large mammal survey:

Office Study

- Review of BC Ministry documents Section 2 “Conducting Wildlife Inventory” in the introductory manual, *Species Inventory Fundamentals (No.1).;*
- Review of mapping for the area (i.e. air photo, 1:5,000 scale and topographic mapping, 1:20,000 scale TRIM mapping);
- Identify areas for potential habitat use and
- Identify all transects to be performed for field study.

Sample Design

This survey involved the assessment of large mammals using presence/not-detected surveys. There were two goals of using this inventory methodology:

To make a list of observed species for the Study Area; and to determine species/habitat associations.

This was made based on the identification of the following:

- Scat sign;
- Track sign;
- Forage/browse sign;
- Scrapings;
- Historical information compilation and
- Direct field observation.

The method of ground-based sampling used for the survey was structured using *Transect Methodology (Encounter Transects).* Protocol for this ground-based survey followed the procedures as outlined in *Species Inventory Fundamentals Standards for Components of British Columbia's Biodiversity No.1*. The ground-based surveys were performed during the day and evening (during the nocturnal raptor survey). During the day ground surveys commenced as soon as it was light enough to classify animals on the ground (0630 hrs.). Using binoculars transects were walked as well as along the existing trails and roads.

Species Ratings and Accounts

Background

Attached in Appendix A, is a list of BC Conservation Data Centre's Rare Animal Tracking List for the Okanagon- Shuswap Regional District (2010). Red and Blue rated vertebrates and invertebrates potentially occurring within this Forest District are listed. All species habitat requirements were reviewed and taken into consideration for in field survey techniques.

The COSEWIC and British Columbia's Red, Blue and Yellow rating status definition for each species identified are presented below.

COSEWIC ratings for species have been defined the following ways:

Extinct - A species that no longer exists.

Extirpated - A species that no longer exists in the wild in Canada, but occurring elsewhere (for example, in captivity or in the wild in the United States).

Endangered - A species facing imminent extirpation or extinction.

Threatened - A species likely to become endangered if limiting factors are not reversed.

Vulnerable - A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.

Not At Risk - A species that has been evaluated and found to be not at risk.

Indeterminate - A species for which there is insufficient scientific information to support status designation.

Red, Blue and Yellow status as defined by the B.C. Conservation Data Centre's Red, Blue and Yellow definitions are as follows:

Red list:

Includes any indigenous species or subspecies (taxa) considered to be Extirpated, Endangered, or Threatened in British Columbia. Extirpated taxa no longer exist in the wild in British Columbia, but do occur elsewhere. Endangered taxa are facing imminent extirpation or extinction. Threatened taxa are likely to become endangered if limiting factors are not reversed. Red-listed taxa include those that have been, or are being, evaluated for these designations.

Blue List:

Includes any indigenous species or subspecies (taxa) considered to be Vulnerable in British Columbia. Vulnerable taxa are of special concern because of characteristics that make them particularly sensitive to human activities or natural events. Blue-listed taxa are at risk, but are not Extirpated, Endangered or Threatened.

Yellow list:

Any indigenous species or subspecies (taxa), which is not at risk in British Columbia. The CDC tracks some Yellow listed taxa, which are vulnerable during times of seasonal concentration (eg. breeding colonies).

2.2.2 Assessment Results

2.2.2.1 Bird Inventory

The bird survey was conducted on various dates in between September and October 2007 and June 2010. The night/nocturnal surveys were completed on the evening of October 16th 2007 and April 16th 2010. A total of 61 bird species (passerines and raptors) were encountered on the Study Area during the transect survey and as incidental sightings. As point count stations/owl calling stations were aligned along designated transects, the summary table below incorporates all birds identified to the nearest transect location and number. The following tables (Table 3-5) summarizes the results of the transect/point count and roadside call playback surveys performed on the delineated Study Area over a three year period.

Table 3 Summary Table of Passerine Bird Survey

Transect #	Date	Total Species Encountered Along Each Transect	Red/Blue Species Encountered
1	Various 2008	9	0
2	Various 2008	3	0
3	Various 2008	8	0
4	Various 2008	9	0
5	Various 2008	11	
6	Various 2008	9	0
7	Various 2008	7	0
8	Various 2008	8	0
TOTAL		**64**	**0**

Detailed information on species observed is presented below in Table 4 through 7 below;

Table 4 Species Abundance and Diversity Along Each Transect (Entire Study Area)

Transect	No. of Individuals Observed at Each Station
1	11
2	20
3	12
4	15
5	22
6	13
7	28
8	14
Total	**135**

Table 5 Avian Species List

Sharp-shined hawk	Yellow-rumped warbler
brewers blackbird	Pileated wood pecker
downy wood-pecker	Bald eagle
mountain chickadee	Dark-eyed junco
house finch	pileated wood-pecker
yellow rumped warbler	black-capped chickadee
magpie black-billed	red-tailed hawk
northern shrike	ruby-crowned kinglet
clark's nutcracker	European starling
chipping sparrow	western blue bird
californian quail	American robin
ring-billed gull	Hutton's vireo
californian gull	white breasted nuthatch

Northern Flicker	Common Raven
Northwestern Crow	Stellar's jay

Diurnal Stand Watch/Point Counts

The greatest number of individuals and species diversity was observed along transect 7 and the lowest was along transect 11. No raptor nests were noted within the Study Area during the survey despite meticulous searching with a high powered/anchored spotting scope. The Study Area does however have moderate-high foraging opportunities as well as good resting/perching opportunities for diurnal raptors.

Nocturnal Stand Watch/Point Counts

The nocturnal raptors (owls) survey was conducted the evening of January 15th 2008 and April 16th 2010 at three raptor/owl calling station (OCS #1- #3) within the Study Area (*Appendix D*). The site proved to be successful in luring in 3 Great Horned-Owls. The arrival of the owls from the west (approximately 25 minutes after the initiation of calls – Owl Calling Station #2) in the Study Area and 15 minutes from the east North of Strutt Creek suggests that they are most probably nesting outside of the Study Area.

2.2.2.3 Small Mammal Survey

Fifteen (Havahart™) traps (Small Mammal Traps – SMT 1 - 15) were set at various homogeneous vegetative areas within the Study Area *(Appendix D, Biophysical Assessment Map)* and each habitat type was sampled, where feasible. Larger traps were also placed at all small mammal trap locations, with the primary intention to observe mid size mammals including squirrels, racoons etc. The traps were recovered after a period of 48 hrs. (checked every 24 hr. period). Out of all the traps, 2 raccoons, 7 chipmunks and 8 deer mice were caught. Please refer to Table 6 below:

Table 6 Results of Live Small and Medium Mammal Trapping

Trap Site Number	Species Captured
SMT #1	1 raccoon, 1 chipmunk
SMT #2	
SMT #3	1 chipmunk
SMT #4	1 deer mouse
SMT #5	1 raccoon
SMT #6	1 chip munk
SMT #7	2 deer mouse
SMT #8	1 chipmunk
SMT #9	
SMT #10	1 deer mouse, 1 chipmunk
SMT #11	1 chipmunk
SMT #12	1 chipmunk
SMT #13	1 deer mouse
SMT #14	1 deer mouse
SMT #15	1 deer mouse

2.2.2.4 Large Mammal Survey

The Study Area was walked numerous times during the course of evaluation and each time it was searched for large mammal signs. As well, a more detailed assessment involving 8 transects was performed in conjunction with the bird survey. *Table* 7 presents an overview of wildlife sightings within the Study Area.

Table 7 Results of Wildlife Sightings

Species	Evidence
Mule Deer	Visual
White-tailed deer	Visual
deer mouse	Visual
Black bear	Scat
coyote	Visual
Yellow pine chipmunk	Visual
Yellow bellied marmot	Visual
Bushy-tailed woodrat	Visual
Domestic Cat	Visual
Western skink	Visual
North Pacific Rattlesnake	Visual
Racer (snake)	Visual

2.3 AQUATIC RESOURCES

2.3.1 Watercourses

Aquatic resources within the NCP study area include one watercourse (Strutt Creek – WSC 310-639000) that meets the definition of a stream as identified in the Fish-stream Identification Guidebook (1998) as well as the provincial Riparian Areas Regulations (RAR). Current local and provincial fisheries data including a search of the FISS database (Fisheries Information Summary System) resulted in no information on fish distribution within the watershed except for Strutt Creek which is presented in Appendix G – FISS Database. An overview assessment of the creek completed by a fisheries biologist concluded fish presence within the confines of the study area was possible (seasonal usage only), although unlikely as the creek is subject to rapid dewatering and overall fish habitat is considered poor. That being said, Strutt Creek is still considered fish habitat under the Riparian Areas Regulations (RAR) as it provides nutrients to waterbodies located downstream (Okanagan Lake). A preliminary RAR assessment was conducted on Strutt Creek in October 2007 to identify both the RAR Assessment Area and the minimum SPEA requirements. From our assessment, the creek would require a 30m RAR assessment area from the high water mark (HWM) where bankfull slopes were less than 33%. Where greater than 33%, the RAR assessment area would be measured 15m from top of bank (TOB) where the distance between both TOB's are greater than 60m apart. If less than 60m apart, the RAR assessment area would extend 30m from TOB. In all cases, the designated SPEA would measure 10m based on an average channel width of 2.1m. All works proposed within the RAR assessment area and outside the designated SPEA require sign off from Qualified Environmental Professionals (QEP) that the works proposed will not negatively impact the watercourse. All other watercourses within the NE Sector Neighbourhood Plan study area that appear on the provincial 1:20,000 TRIM mapping do not meet the definition of a watercourse including an absence of a scoured channel and the presence of mineral alluvium. Refer to

Attachment F (Waterbodies Map) for a map identifying Strutt Creek and the associated 30m RAR assessment area.

2.3.3 Survey Methodology

2.3.3.1 Office Study

A review of Ministry of Environment, Environmental Stewardship Division (MoE) and the Department of Fisheries and Oceans (DFO) environmental databases was undertaken. Internet addresses for these databases are as follows:

Fisheries Data Warehouse
Fish Information Summary System (FISS)
http://www.shim.bc.ca

2.3.3.2 Field Survey

Stream Biophysical Survey
A biophysical habitat survey was conducted using parameters outlined in the MoE/DFO Stream Survey forms, which allowed information to be collected on the following:

- Channel characteristics - including floodplain description;
- Description of watercourse length, average channel width, average wetted width, average maximum depth and banks;
- Barriers to fish passage - including debris jams, culverts, weirs, beaver dams etc.;
- Substrate characteristics - including estimated percentages of materials;
- Description and percentage of pools, runs, and riffles;
- Location and description of bridges, culverts, water control, water intake and storm water discharge structures;
- Vegetation - detailed riparian overstorey, understorey, and herb layer characteristics including a species list;

- Threatened, rare and endangered species - estimated use and a detailed species list; and
- Potential salmonid spawning and rearing habitat rating (low, medium or high) with rational for rating described.

2.4 CULTURALLY MODIFIED TREES

During the overall assessment of the Study Area, a concentrated effort was made to identify culturally modified trees within the delineated study area boundaries. Observation focused primarily on larger trees including red cedar, which were customarily used by indigenous peoples for various items including baskets etc. During the biophysical assessment of the Study Area, no culturally modified trees were observed within the NCP study area.

3.0 DEVELOPMENT CONSIDERATIONS

3.1 AQUATIC RESOURCES

The following represents a list of potential impacts to aquatic life and aquatic habitat within the Study Area. Of all the waterbodies identified within the Study Area, only Strutt Creek, is considered fish habitat and therefore subject to the RAR legislation. Overall, disturbances to this watercourse are expected to be minimal through the use of Low-Impact Development (LID) techniques and other and Best Management Practices (BMP) for planning & design with respect to stormwater management. These include minimizing overall stream crossing locations, maintaining adequate riparian reserves as well as controlling strormwater to maintain overall hydrological function. All works proposed within the RAR assessment area will be monitored by a Qualified Environmental Professional (QEP) and will have to adhere to all recommendations put into the RAR report (Section 5 – Recommendations). As well, future crossings will also have to adhere to the recommendations put forward in the Section 9 Instream Works application and associated approval letter. Please refer to the Impact Summary Table below (Table 8) for a complete list of impacts and mitigation solutions as well as general guidelines for working within Environmental Sensitive Areas (ESA) outlined in Section 3.4 below.

3.2 WILDLIFE

Wildlife impacts within the delineated site boundaries include loss of habitat for various animals presently utilizing this parcel of land as identified in our assessment. Of particular importance for all wildlife however, will be to ensure connectivity between the north, south, east and west boundaries of the study area. This needs to be maintained through the establishment of wildlife corridors that link all sections of the Study Area and that are protected under Section 219 Covenant. The corridors and protected areas should try to include as many high and moderate SEI as possible as well as ensure that at least

80% of the high and moderate SEI's are protected by each of the landowners. In summary, although construction activities associated with the proposed development will undoubtedly impact habitat within select areas, the overall percentage of proposed protected areas within the Study Area is expected to be high (>40%). As a result, minimal risk is expected to the species identified in our assessments or of those species listed as having the potential to occur by the BC CDC (British Columbia Conservation Data Centre). Please refer to the Impact Summary Table below (Table 8) for a list of impacts and mitigation and enhancement recommendations as well as general guidelines for working within Environmental Sensitive Areas (ESA) outlined in Section 3.4 below.

3.3 VEGETATION

Assessments between 2007 and 2010 identified 42 plant species in 5 different vegetative communities. Assessments within quadrats resulted in the identification of numerous flowering plants (non identified by the BC CDC as red/blue listed) forming part of a larger distinct ecosystem within a Ponderosa Bunch-grass ecosystem. As this polygon forms one of the largest ecosystems within the Study Area, this area will undoubtedly be affected by construction activities as it has most of the buildable land within the Study Area. As a means to reduce the overall disturbances to this ecosystem as well as the other ecosystems identified on-site, environmental mitigation strategies such as clustering of the development (building pods), delineation of "disturbance envelopes" and identification of designated "environmental management areas" within clustered development areas, and landscape design and construction guidelines to address concerns surrounding extent of clearing and potential introduction of exotic/invasive species. Please refer to the Impact Summary table below (Table 8) for a list of potential impacts and mitigation and enhancement recommendations as well as general guidelines for working within Environmental Sensitive Areas (ESA) outlined in Section 3.4 below.

Table 8 Impact Summary Table

Environmental Parameter	Potential Impacts	Mitigative Measures	Residual Impacts
Vegetation	Potential loss of natural vegetation currently existing on site within development areas	Limit disturbances to high and moderate sensitive environmental polygons (Appendix F) to no more than 20% of total area for each landowner Reclamation of disturbed areas with native trees and shrubs.	Loss of vegetation in the area immediately required to accommodate the development footprint Positive impacts resulting from revegetation with native species.
Aquatic Life and Habitat	Potential loss of riparian buffers along low-moderate value habitat within development areas.	Minimize disturbances to riparian reserves as per RAR recommendations.	Increase in stormwater runoff and instream flows
Wildlife	Loss of habitat resulting from vegetation clearing. Changes in wildlife movements.	Construction of nesting boxes with old growth attributes to accommodate the loss of older second generation forest Maintain undisturbed 3-5m buffer around select wildlife trees . Ensure connectivity through wildlife corridors and provide underpasses at select locations for lizards, snakes etc.	Loss of habitat for some species where vegetation is permanently removed to accommodate building footprints Minimal changes to wildlife movements

	Sensory disturbance to sensitive species.	No potentially sensitive species found to breed within 100 m of the proposed roads, driveway or building sites.	Potential disturbance to some wildlife species
	Stress to wildlife caused by increases in human encounters including foot and road traffic	Improve signage and provide educational material to local residences	Minimal/short term stress associated with increases in traffic

3.4 ENVIRONMENTAL MANAGEMENT RECOMMENDATIONS

Due to the environmentally sensitive nature of this project, the following recommendations are to be followed if subdivision is to proceed in order to ensure minimal impacts to the environment.

3.4.1 Environmental Monitoring

Works associated with tree cuts, construction and soil deposit/removal within 30m of a waterbody

- Areas designated as the SPEA will be flagged with high visibility flagging tape and temporary fencing.
- Prior to construction, a detailed sediment and erosion control plan will be developed to prevent the discharge of sediment laden water into the SPEA or any watercourses identified on-site. This will include the installation of sediment fencing/hay bales as determined by on-site biologist prior to the initiation of construction activities.
- No works shall be undertaken within areas designated as SPEA unless Ministry of Environment (MoE) approval is acquired through a Section 9 Instream Works permit.

- All works scheduled within 30m of a watercourse and outside of the SPEA will adhere to all recommendations as outlined in the BMP - Develop with Care: Environmental Guidelines for Urban and Rural Land Development in British Columbia. As well, it will be ensured that construction proceeds smoothly without harmful alteration of habitat, and long-term monitoring for disturbed sites will be provided until green-up is established and the soils at the site are stable.
- Heavy equipment (excavators etc.) working outside the SPEA and within 30m of a waterbody will be monitored for leaks (oil, hydraulic fluid etc.).
- Disturbed areas outside the SPEA and within 30m of a waterbody will be revegetated with native plants of a size that will quickly re-establish riparian cover when construction activities are deemed complete.
- Detailed direction to contractors will be given to ensure that no erosion or sediment movement will occur and that no silt will be released to the SPEA during the construction and post construction phase.
- The site will be monitored by the designated QEP (once every two weeks or as required due to high rainfall events with >30mm/24 hour period) during the construction period. Any contraventions of the RAR will be communicated to the construction manager as well as local municipal and Ministry of Environment RAR staff.
- A post construction report generated by the designated QEP will be submitted to RAR and local municipal staff when activities are deemed complete.

3.4.2 Tree Cut Within Areas Classified as Sensitive (Moderate to High Value Ecosystems)

- Minimize disturbances to vegetation outside of those areas needed to access building pods, utilities, soil deposit area, and to safely cut, haul, and transport timber.

- Where possible, fall trees away from sensitive habitats as determined by on-site biologist.

3.4.3 Soil Deposit/Removal Within Areas Classified as Sensitive (Moderate to High Value Ecosystems)

- Minimize soil deposit within areas classified as sensitive (moderate to high) except for those areas identified as service corridors.
- Areas classified as sensitive (moderate to high) are to be protected during the construction phase of the project when construction activities are within 30m. The preferred method of protection is snow-fencing set back from the area requiring protection by at least 5m.
- Install "Tree Protection" signs.
- Take all measures necessary to prevent activities such as storage of materials or equipment, stockpiling of soil or excavated materials, burning, excavation or trenching or cutting of roots or branches within the tree protection areas.
- Restrict vehicle traffic to designated access routes and travel lanes to avoid soil compaction and vegetation disturbances.
- Avoid alterations to existing hydrological patterns to minimize impact on vegetation.

3.4.4 Sensitive Ecosystems

The sensitive ecosystems on site (moderate to high) should be protected from mechanical damage during site clearing and construction. This protection can be achieved through:

- Limiting clearing to the minimum area required for construction.
- Installing "Sensitive Ecosystem Protection" signs and any additional working space. The minimum amount of vegetation possible will be removed from environmentally sensitive areas or areas where rare or endangered plants or plant communities are identified by the environmental monitor.
- Take all measures necessary to prevent activities such as storage of materials or equipment, stockpiling of soil or excavated materials, burning, excavation or trenching or cutting of roots or branches within the sensitive ecosystem protection areas.

The following guidelines, as outlined in the Sensitive Ecosystems Inventory Conservation Manual (MELP, 2000), should be followed after site development where possible:

- Restrict recreational access to high and very high sensitive areas (rocky outcrops);
- Control the introduction or spread of invasive species;
- Prevent wildlife disturbance (especially nesting or breeding areas);
- Locate developments away from sensitive core areas (polygons rated high);
- Establish a buffer zone between the core sensitive areas and the development area; and,
- Maintain hydrologic regime.

3.4.5 Roads

In order to reduce the overall impact associated with roads, alignment should follow the natural topography and be as narrow as possible, consistent with the City's Subdivision and Development Bylaw standards, in order to reduce the total impervious surface area. Where sensitive polygons (ESA #1) must be crossed, bridges and/or box culverts (open bottom) should be placed to allow for safe passage of wildlife as determine by on-site QEP. Proper signage and speed reduction should also be considered in areas where potential conflicts may exist at the wildland interface.

3.4.6 Stormwater

A detailed stormwater management plan for the development should be developed prior to the initiation of works and include the most recent Best Management Practices (BMP) in stormwater planning. Of particular importance will be the stormwater generated adjacent to Strutt Creek as sediment input and increases in volume would negatively impact the watercourse. As a result, stormwater control including bioswales, detention ponds, etc. should be used to the fullest extent in order to reduce peak flows and runoff through the developable areas

3.4.7 Recreational Trail System

Trail systems through parks as well as areas deemed sensitive should incorporate best management practices for viable trail design. Design considerations should include proper trail surfacing, proximity to protected/sensitive areas, recommendations for dogs and other pets as well as proper signage identifying the sensitive attributes of select areas.

3.4.8 Habitat Compensation and Enhancement

In order to reduce the overall impacts associated with land use activities proposed for select areas within the NE Sector Plan study area, the following list of recommendations should be adhered to in order to reduce the overall impacts associated with the development. These include the following;

- Nest box program to be developed for the neighbourhood plan area. Nest box programs calculate the potential loss of nesting cavities based on calculations derived from existing conditions within the total proposed disturbed areas. The cavities are then replaced with nesting boxes at select sites in consultation with the designated QEP.
- Reptile/wildlife monitoring program to be developed for the neighbourhood plan. The monitoring program assesses overall reptile/wildlife response to disturbances associated with the proposed works as they progress. If required, recommendations identified by the QEP are forwarded to construction managers and municipal staff for review and implementation.
- Reptile basking/rearing platforms to be constructed at ratios equivalent to 1 platform for every 50 acres disturbed. Basking platforms consist of a 100 square metre area (1m in height) made of various rock including boulders, cobble and other material that allow for various sized voids. All platforms must face south and have less than 20% canopy closure to allow for maximum solar heating.
- One conservation reserve should be established for the NCP study area. The area should have a minimum of 25 acres (minimum) in size and restrict public access including trails, roads, services etc. This reserve should be located in an area with high environmental significance (moderate to high value SEI)

3.5 MONITORING

It is recommended that all construction activities within areas identified as “sensitive – ESA #1” (refer to *Appendix H – Environmental Constraints Map*) be monitored by a Registered Professional Biologist. This should include regular monitoring prior to and after completion of the road to assess issues and/or provide recommendations to address negative impacts. Further, it is recommended that a detailed sediment control plan be implemented prior to the beginning of construction for each individual phase/subdivision node.

3.6 PRELIMINARY DEVELOPMENT IMPACTS SUMMARY

In support of the Preliminary Development Impact Assessment, an Environmental Constraints/Opportunities Map was prepared as a means to consolidate information related to topography, hydrology, sensitive ecosystems and recommended buffers (Refer to *Appendix H– Environmental Constraints Map)*. The resultant working map provides a detailed summary of physical constraints and identified conservation values observed during the biophysical assessment stage of the project. More importantly, this map will guide the conceptual planning & design of the NCP as a means to explore alternative layouts/design scenarios that accommodate identified conservation values within the Study Area. Please refer to Appendix H, Environmental Constraints Map for a detailed site map identifying all environmentally sensitive polygons within the Study Area. The Environmentally Sensitive Areas (ESA) identified on the map are further defined below and are a result of more detailed fieldwork put in on the ground. They are to be used as additional information to the Ophiuchus Consulting report, which indentifies ESA 1, 2 and 3 designations for the NCP. For the sake of simplicity, the polygons have been classified as low, moderate and high in regards to environmental sensitivities. These classifications correlate directly to the ESA classifications outlined in the North East Sector Plan. Please refer to definitions described below;

- **High (ESA 1)**

  These lands have been identified as having critical ecological values including nesting, rearing and foraging opportunities for various species including species at risk as well as rare and endangered ecosystems. These areas are identified in Appendix F- Environmental Constraints Map. Within this category, over 80% of lands are to remain primarily in an undisturbed state, while up to 20% of the total area may include the required infrastructure, house sites, trails etc. Works and planned activities within these polygons require a detailed environmental study by a Registered Professional Biologist (R.P. Bio.) prior to development to ensure that all key areas of concern are addressed and that appropriate inventories have been conducted to substantiate the assessment. South and southeast facing talus slopes within ESA 1are to be kept intact with a 5m buffer around the mapped polygon as well as designated Streamside Protection and Enhancement Areas (SPEA) as defined by the Riparian Areas Regulations (RAR) legislation. SPEA's within the NCP should all be protected by a Section 219 Covenant. This covenant will allow for road crossings of the watercourse.

- **Moderate (ESA 2)**

  These lands are identified as having considerable ecological values given their importance for wildlife movement through the study area. The moderate designation also includes areas with slopes of greater than 30%. Moderately sensitive areas are identified in Appendix F – Environmental Constraints Map. Within this category, over 80% of lands are to remain primarily in an undisturbed state, while up to 20% of the total area may include the required infrastructure, house sites, trails etc. Works and planned activities within these polygons require a detailed environmental study by a R.P. Bio. prior to development to ensure the absence of sensitive environmental attributes, including species at risk. Wildlife corridors through ESA 2 should have a minimum width of 30m to ensure adequate area is available for migration. The primary wildlife corridors to be maintained are presented in Appendix I as concept routes. As well, Streamside Protection and Enhancement Areas (SPEA) as defined by the Riparian Areas Regulations (RAR) legislation should be protected by the registration of a Section 219 Covenant.

- **Low (ESA 3)**
  Lands not rated moderate and/or high (remainder) have some ecological values, but can generally accommodate development more so than in other ESA categories. Low ESA's generally include previously disturbed areas and/or ecosystems not considered at risk. In some cases, moderate to high rated ecosystems such as ponderosa pine were included in ESA 3 as they did not have the proper aspect and/or were outside of designated wildlife corridors. Environmental Impact Assessments are required on low ESA's by a R.P. Bio. prior to the initiation of works to verify species of concern have not moved into an area between the assessment period and the initiation of works.

Given this pro-active approach to planning & design of the NCP, an expressed intent to designate a significant portion of the Study Area as an interconnected park system, the opportunity for BMP's during project construction, as well as the proposed mitigation & enhancement strategies, overall impacts associated with development within the Study Area will be minimized. These measures, taken together, will ensure the protection and functional integrity of the NCP's natural systems and in turn, will help make it a more sustainable neighbourhood.

Other recommendations include having an environmental monitor on-site during road construction and site servicing when construction related activities are either moving through and/or adjacent to environmentally sensitive areas. While any development will impact the natural environment, the Proposed Development, if developed in keeping with the recommendations set forth herein, will result in the most positive possible outcome for the natural environment if the area is to be developed. Large tracts of land will be protected in perpetuity and these areas will be appropriately regulated and managed properly, ensuring their continued viability in terms of conservation of ecological integrity, access management and invasive species control

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Appendices

Appendix A – BCCDC Rare Vertebrates

Scientific Name	English Name	BSC Code	Global Status	Global Status Review Date	Prov Status	Prov Status Review Date	Prov Status Change Date	COSEWIC	COSEWIC Comments	BC List	Identified Wildlife	Prov Wildlife Act	SARA	National GS	Name Category	Class (English)	Species Level	Kingdom	Phylum	Class	Order	Family
Acrocheilus alutaceus	Chiselmouth	F-ACAL	G5	13-Sep-96	S3S4	12-Jan-04	10-Mar-04	NAR (May 2003)		Blue				4 - Secure (2005)	Vertebrate Animal	ray-finned fishes	Species	Animalia	Craniata	Actinopterygii	Cypriniformes	Cyprinidae
Aegolius funereus	Boreal Owl	B-BOOW	G5	27-Nov-96	S4	10-Jan-09	29-Nov-05	NAR (May 1995)		Yellow				4 - Secure (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Strigiformes	Strigidae
Aeshna constricta	Lance-tipped Darner	IO-AESCON	G5	30-Dec-85	S2	4-Jan-04	10-Mar-04			Red				4 - Secure (2005)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Odonata	Aeshnidae
Ambystoma tigrinum	Tiger Salamander	A-AMTI	G5	15-Oct-03	S2	3-Dec-07	1-Jun-96	E (Nov 2001)		Red	Y (May 2004)		1	4 - Secure (2005)	Vertebrate Animal	amphibians	Species	Animalia	Craniata	Amphibia	Caudata	Ambystomatidae
Ammodramus savannarum	Grasshopper Sparrow	B-GRSP	G5	4-Dec-96	S1S2B	10-Jan-09	23-Jan-09			Red	Y (Jun 2006)			4 - Secure (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Passeriformes	Emberizidae
Antrozous pallidus	Pallid Bat	M-ANPA	G5	5-Nov-96	S2	8-Dec-06	15-Jan-07	T (Nov 2000)		Red			1	1 - At Risk (2005)	Vertebrate Animal	mammals	Species	Animalia	Craniata	Mammalia	Chiroptera	Vespertilionidae
Aplodontia rufa rainieri	Mountain Beaver, *rainieri* subspecies	M-APRU-RA	G5T4	5-Dec-96	S3	8-Dec-06	30-Nov-95	SC (May 1999)	The special concern status reflects the status given to the whole species and not to the individual subspecies.	Blue			1		Vertebrate Animal	mammals	Subspecies	Animalia	Craniata	Mammalia	Rodentia	Aplodontiidae
Apodemia mormo	Mormon Metalmark	IL-APOMOR	G5	1-Sep-98	S1	20-Nov-06	6-Dec-99	E (May 2003)		Red			1	6 - Not Assessed (2000)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Lepidoptera	Riodinidae
Ardea herodias herodias	Great Blue heron, *herodias* subspecies	B-GBHE-HE	G5T5	31-Jan-00	S3B,S4N	10-Jan-09	24-Apr-02			Blue	Y (Jun 2006)				Vertebrate Animal	birds	Subspecies	Animalia	Craniata	Aves	Ciconiiformes	Ardeidae
Argia emma	Emma's Dancer	IO-ARGEMM	G5	22-Jun-90	S3S4	4-Jan-04				Blue				3 - Sensitive (2005)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Odonata	Coenagrionidae
Argia vivida	Vivid Dancer	IO-ARGVIV	G5	22-Jun-90	S2	4-Jan-04				Red				3 - Sensitive (2005)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Odonata	Coenagrionidae
Ascaphus truei	Coastal Tailed Frog	A-ASTR	G4	5-May-04	S3S4	3-Dec-07	27-Oct-98	SC (May 2000)		Blue	Y (May 2004)		1	3 - Sensitive (2005)	Vertebrate Animal	amphibians	Species	Animalia	Craniata	Amphibia	Anura	Ascaphidae
Asio flammeus	Short-eared Owl	B-SEOW	G5	2-Jan-08	S3B,S2N	10-Jan-09	1-Jun-96	SC (Mar 2008)		Blue	Y (May 2004)		3	3 - Sensitive (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Strigiformes	Strigidae
Botaurus lentiginosus	American Bittern	B-AMBI	G4	20-Nov-96	S3B	29-Nov-05	30-Jun-98			Blue				4 - Secure (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Ciconiiformes	Ardeidae
Bufo boreas	Western Toad	A-BUBO	G4	3-Jan-08	S4	3-Dec-07	10-Feb-94	SC (Nov 2002)		Yellow			1	3 - Sensitive (2005)	Vertebrate Animal	amphibians	Species	Animalia	Craniata	Amphibia	Anura	Bufonidae
Buteo swainsoni	Swainson's Hawk	B-SWHA	G5	22-Nov-96	S2B	10-Jan-09	30-Jun-98			Red				4 - Secure (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Falconiformes	Accipitridae
Callophrys affinis	Immaculate Green Hairstreak	IL-CALAFF	G5	30-Sep-98	S3	20-Nov-06	18-Oct-01			Blue				6 - Not Assessed (2000)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Lepidoptera	Lycaenidae
Canis lupus	Grey Wolf	M-CALU	G4	17-Feb-06	S4	8-Dec-06		NAR (May 1999)	*Occidentalis* and *Nubilus* Subspecies	Yellow				4 - Secure (2005)	Vertebrate Animal	mammals	Species	Animalia	Craniata	Mammalia	Carnivora	Canidae
Catherpes mexicanus	Canyon Wren	B-CAWR	G5	3-Dec-96	S3	29-Nov-05	1-Jun-96	NAR (May 1992)		Blue				3 - Sensitive (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Passeriformes	Troglodytidae
Catostomus platyrhynchus	Mountain Sucker	F-CAPL	G5	11-Mar-03	S3?	12-Jan-04	4-Oct-01	NAR (May 1991)		Blue				4 - Secure (2005)	Vertebrate Animal	ray-finned fishes	Species	Animalia	Craniata	Actinopterygii	Cypriniformes	Catostomidae
Charina bottae	Rubber Boa	R-CHBO	G5	30-Aug-06	S4	3-Dec-07	23-Sep-00	SC (May 2003)		Yellow			1	3 - Sensitive (2005)	Vertebrate Animal	reptiles	Species	Animalia	Craniata	Reptilia	Squamata	Boidae
Chlidonias niger	Black Tern	B-BLTE	G4	27-Nov-96	S4B	10-Jan-09	30-Jun-98	NAR (May 1996)		Yellow				4 - Secure (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Charadriiformes	Laridae
Chlosyne hoffmanni	Hoffman's Checkerspot	IL-CHLHOF	G4	1-Sep-98	S2	20-Nov-06	15-Jan-07			Red				6 - Not Assessed (2000)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Lepidoptera	Nymphalidae
Chondestes grammacus	Lark Sparrow	B-LASP	G5	17-Mar-09	S2B	29-Nov-05	30-Jun-98			Red				4 - Secure (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Passeriformes	Emberizidae
Chordeiles minor	Common Nighthawk	B-CONI	G5	17-Mar-09	S4B	29-Nov-05	29-Nov-05	T (Apr 2007)		Yellow				4 - Secure (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Caprimulgiformes	Caprimulgidae
Chrysemys picta	Western Painted Turtle	R-CHPI	G5	2-May-05	S3	3-Dec-07	2-Jan-08	E/SC (Apr 2006)	*Bellii* Subspecies. The Pacific Coast population is Endangered and the Intermountain - Rocky Mountain population is Special Concern.	No Status			1	4 - Secure (2005)	Vertebrate Animal	turtles	Species	Animalia	Craniata	Chelonia	Cryptodeira	Emydidae
Chrysemys picta pop. 2	Western Painted Turtle - Intermountain - Rocky Mountain Population	R-CHPI-02	G5TNR		S2S3	3-Dec-07	2-Jan-08	SC (Apr 2006)		Blue			1		Vertebrate Animal	turtles	Population	Animalia	Craniata	Chelonia	Cryptodeira	Emydidae
Cicindela decemnotata	Badlands Tiger Beetle	IC-CICDEC	G4	3-Jun-08	S1S3	2-Jan-08	2-Jan-08			Red				4 - Secure (2005)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Coleoptera	Cicindelidae
Cicindela parowana	Dark Saltflat Tiger Beetle	IC-CICPAR	G4	3-Jun-08	S1	2-Jan-08	2-Jan-08	E (Nov 2009)		Red				2 - May be at risk (2005)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Coleoptera	Cicindelidae
Cicindela pugetana	Sagebrush Tiger Beetle	IC-CICPUG	G4	3-Jun-08	S3	2-Jan-08	2-Jan-08			Blue				3 - Sensitive (2005)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Coleoptera	Cicindelidae
Circus cyaneus	Northern Harrier	B-NOHA	G5	3-Jan-08	S4B	10-Jan-09	30-Jun-98	NAR (May 1993)		Yellow				4 - Secure (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Falconiformes	Accipitridae
Coluber constrictor	Racer	R-COCO	G5	30-Aug-06	S3	3-Dec-07	2-Jan-08	SC (Nov 2004)		Blue	Y (Jun 2006)		1	3 - Sensitive (2005)	Vertebrate Animal	reptiles	Species	Animalia	Craniata	Reptilia	Squamata	Colubridae
Contopus cooperi	Olive-sided Flycatcher	B-OSFL	G4	3-Jan-08	S3S4B	10-Jan-09	26-Jan-09	T (Nov 2007)		Blue				4 - Secure (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Passeriformes	Tyrannidae
Corynorhinus townsendii	Townsend's Big-eared Bat	M-COTO	G4	5-Nov-96	S3	8-Dec-06	15-Jan-07			Blue				2 - May be at risk (2005)	Vertebrate Animal	mammals	Species	Animalia	Craniata	Mammalia	Chiroptera	Vespertilionidae
Cottus bairdii	Mottled Sculpin	F-COBA	G5	6-Sep-96	S2S3	20-Jan-09	20-Jan-09			Blue				4 - Secure (2000)	Vertebrate Animal	ray-finned fishes	Species	Animalia	Craniata	Actinopterygii	Scorpaeniformes	Cottidae
Cottus hubbsi	Columbia Sculpin	F-COBA-HU	G4Q	5-Feb-01	S3	12-Jan-04	9-May-01	SC (May 2000)		Blue			1	3 - Sensitive (2005)	Vertebrate Animal	ray-finned fishes	Species	Animalia	Craniata	Actinopterygii	Scorpaeniformes	Cottidae
Crotalus oreganus	Western Rattlesnake	R-CROR	G5	29-Aug-06	S3	3-Dec-07	6-Jan-03	T (May 2004)		Blue	Y (Jun 2006)		1	3 - Sensitive (2005)	Vertebrate Animal	reptiles	Species	Animalia	Craniata	Reptilia	Squamata	Viperidae
Danaus plexippus	Monarch	IL-DANPLE	G5	24-Nov-03	S3B	20-Nov-06	6-Dec-99	SC (Nov 2001)		Blue			1	6 - Not Assessed (2000)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Lepidoptera	Nymphalidae
Dolichonyx oryzivorus	Bobolink	B-BOBO	G5	18-Mar-09	S3B	29-Nov-05	30-Jun-98			Blue				4 - Secure (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Passeriformes	Icteridae
Elgaria coerulea	Northern Alligator Lizard	R-ELCO	G5	13-May-05	S4S5	3-Dec-07		NAR (May 2002)	*Principis* Subspecies	Yellow				4 - Secure (2005)	Vertebrate Animal	reptiles	Species	Animalia	Craniata	Reptilia	Squamata	Anguidae
Empidonax wrightii	Gray Flycatcher	B-GRFL	G5	2-Dec-96	S3B	29-Nov-05	24-Sep-01	NAR (May 1992)		Blue				3 - Sensitive (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Passeriformes	Tyrannidae
Eremophila alpestris merrilli	Horned Lark, *merrilli* subspecies	B-HOLA-ME	G5TU	5-Jan-97	S3S4B	10-Jan-09	29-Nov-05			Blue					Vertebrate Animal	birds	Subspecies	Animalia	Craniata	Aves	Passeriformes	Alaudidae
Erythemis collocata	Western Pondhawk	IO-ERYCOL	G5	23-Aug-00	S3	4-Jan-04	16-Oct-00			Blue				3 - Sensitive (2005)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Odonata	Libellulidae
Euderma maculatum	Spotted Bat	M-EUMA	G4	6-Aug-98	S3S4	8-Dec-06	27-Feb-03	SC (Nov 2004)		Blue	Y (May 2004)		1	3 - Sensitive (2005)	Vertebrate Animal	mammals	Species	Animalia	Craniata	Mammalia	Chiroptera	Vespertilionidae
Eumeces skiltonianus	Western Skink	R-EUSK	G5	26-Aug-05	S3	3-Dec-07	2-Jan-08	SC (Mar 2002)		Blue			1	3 - Sensitive (2005)	Vertebrate Animal	reptiles	Species	Animalia	Craniata	Reptilia	Squamata	Scincidae
Euphagus carolinus	Rusty Blackbird	B-RUBL	G4	25-Jan-08	S3S4B	29-Nov-05	29-Nov-05	SC (Apr 2006)		Blue			1	3 - Sensitive (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Passeriformes	Icteridae
Falco mexicanus	Prairie Falcon	B-PRFA	G5	22-Nov-96	S2B	29-Nov-05	30-Jun-98	NAR (May 1996)		Red	Y (Jun 2006)			3 - Sensitive (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Falconiformes	Falconidae
Falco peregrinus anatum	Peregrine Falcon, *anatum* subspecies	B-PEFA-AN	G4T4	8-Mar-06	S2B	29-Nov-05	30-Jun-98	SC (Apr 2007)		Red			1		Vertebrate Animal	birds	Subspecies	Animalia	Craniata	Aves	Falconiformes	Falconidae
Fossaria truncatula	Attenuate Fossaria	IM-FOSTRU	G5	17-Dec-08	S3S4	16-Dec-08	16-Dec-08			Blue					Invertebrate Animal	gastropods	Species	Animalia	Mollusca	Gastropoda	Basommatophora	Lymnaeidae
Gomphus graslinellus	Pronghorn Clubtail	IO-GOMGRA	G5	30-Dec-85	S2S3	4-Jan-04	28-Jan-00			Blue				3 - Sensitive (2005)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Odonata	Gomphidae
Gonidea angulata	Rocky Mountain Ridged Mussel	IM-GONANG	G3	6-Nov-07	S1	16-Dec-08	24-Nov-05	SC (Nov 2003)		Red			1	2 - May be at risk (2005)	Invertebrate Animal	bivalves	Species	Animalia	Mollusca	Bivalvia	Unionoida	Unionidae
Gulo gulo luscus	Wolverine, *luscus* subspecies	M-GUGU-LU	G4T4	18-Nov-96	S3	8-Dec-06	30-Jun-98	SC (May 2003)	Western Population Only	Blue	Y (May 2004)				Vertebrate Animal	mammals	Subspecies	Animalia	Craniata	Mammalia	Carnivora	Mustelidae
Haliaeetus leucocephalus	Bald Eagle	B-BAEA	G5	11-Mar-05	S5B,S5N	10-Jan-09	26-Jan-09	NAR (May 1984)		Yellow				4 - Secure (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Falconiformes	Accipitridae
Hemphillia camelus	Pale Jumping-slug	IM-HEMCAM	G4	3-Feb-06	S3	16-Dec-08				Blue					Invertebrate Animal	gastropods	Species	Animalia	Mollusca	Gastropoda	Stylommatophora	Arionidae
Hesperia nevada	Nevada Skipper	IL-HESNEV	G5	29-Jun-06	S3S4	20-Nov-06	15-Jan-07			Blue				6 - Not Assessed (2000)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Lepidoptera	Hesperiidae
Hirundo rustica	Barn Swallow	B-BASW	G5	2-Dec-96	S3S4B	10-Jan-09	29-Nov-05			Blue				4 - Secure (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Passeriformes	Hirundinidae

Scientific Name	Forest Dist	MOE Region	Regional Dist	BGC	Habitat Type	Origin	Presence	Breeding Bird	Endemic	Action Groups	Highest Priority	Priority Goal 1	Priority Goal 2	Priority Goal 3	CDC Maps	Mapping Status
Acrocheilus alutaceus	DAB;DCC;DCH;DCK;DCO;DCS;DKA;DMH;DNI;DOS;DQU;DRM;DSS_C	2;3;4;5;7;8;9	CSRD;Cariboo;NORD;RDCO;RDEK;RDFFG;RDKB;RDOS;TNRD	BG;ICH;IDF;PP;SBPS;SBS	LACUSTRINE;RIVERINE	Native	Regularly occurring			Inventory	2	4	2	3	Y	
Aegolius funereus	DAB;DCC;DCH;DCK;DCO;DCS;DFN;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DND;DOS;DPC;DQU;DRM;DSQ;DSS_B;DSS_C;DVA	2;3;4;5;6;7;8;9	CSRD;Cariboo;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDOS;SLRD;Stikine;TNRD	BWBS;CWH;ESSF;ICH;IDF;MH;MS;PP;SBPS;SBS;SWB		Native	Regularly occurring	Y		No New Actn	3	6	3	4	N	
Aeshna constricta	DOS	3;8	CSRD;NORD;RDCK;RDCO;RDKB;RDOS;TNRD	BG;ESSF;ICH;IDF;PP	PALUSTRINE	Native	Regularly occurring			Status Rpt; Wildlife Act; COSEWIC; Plan; Hab Protect; Hab Restore; Private Land	2	6	6	2	Y	
Ambystoma tigrinum	DAB;DOS	8	RDKB;RDOS	BG;ICH;IDF;PP	LACUSTRINE;PALUSTRINE;RIVERINE;SUBTERRANEAN;TERRESTRIAL	Native	Regularly occurring			Status Rpt; Wildlife Act; COSEWIC; Plan; Private Land; Hab Protect; Hab Restore; Species Mgmt	2	4	6	2	Y	
Ammodramus savannarum	DOS	8	NORD;RDOS	BG;CDF;IDF;PP	TERRESTRIAL	Native	Regularly occurring	Y		Inventory; Status Rpt; Wildlife Act; Plan; Private Land; Hab Restore; Private Land	1	6	6	1	Y	
Antrozous pallidus	DOS	8	RDOS	BG;PP	LACUSTRINE;PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Status Rpt; Wildlife Act; COSEWIC; Plan; Hab Protect; Hab Restore; Private Land; Species Mgmt	2	6	6	2	Y	
Aplodontia rufa rainieri	DCK;DCS;DOS	2;3;8	FVRD;RDOS;TNRD	CWH;ESSF;MH;MS	TERRESTRIAL	Native	Regularly occurring			Taxonomy	1	4	1	2	Y	
Apodemia mormo	DOS	8	RDOS	BG;ESSF;IDF;PP	TERRESTRIAL	Native	Regularly occurring		N	Status Rpt; Wildlife Act; COSEWIC; Plan; Hab Restore; Hab Protect; Private Land; Species Mgmt	1	4	6	1	Y	
Ardea herodias herodias	DAB;DCC;DCO;DCS;DHW;DJA;DKA;DKL;DMH;DOS;DPG;DQU;DRM;DVA	3;4;5;7;8	CSRD;Cariboo;NORD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDOS;SLRD;TNRD	BG;BWBS;ICH;IDF;MS;PP;SBPS;SBS	ESTUARINE;LACUSTRINE;PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring	Y		Monitor Trend; Private Land; Hab Protect; Status Rpt; Plan	2	6	2	3	Y	
Argia emma	DAB;DCK;DCS;DOS	2;3;4;8	CSRD;FVRD;GVRD;NORD;RDCK;RDCO;RDKB;RDOS	CWH;IDF	LACUSTRINE;RIVERINE	Native	Regularly occurring			No New Actn	4	6	6	4	Y	
Argia vivida	DAB;DCO;DKL;DOS;DRM;DSQ	2;4;8	CSRD;RDCK;RDCO;RDEK;RDOS;SLRD	BG;CWH;ICH;IDF;PP	RIVERINE	Native	Regularly occurring			Status Rpt; Wildlife Act; COSEWIC; Species Mgmt; Plan; Hab Restore; Hab Protect; Private Land	2	6	6	2	Y	
Ascaphus truei	DCK;DCS;DKM;DNC;DNI;DSC;DSQ;DSS	1;2;5;6	CCRD;FVRD;GVRD;PowellR;RDKS;RDMW;RDOS;SCRD;SLRD;SQCRD;SRD	CWH;ICH;IDF		Native	Regularly occurring			Monitor Trend; Status Rpt; COSEWIC; Plan; Hab Protect; Private Land	1	4	1	2	W	Not currently being mapped, however many occurrences are already mapped for this species. Due to its status as an Identified Wildlife Species and COSEWIC special concern, mapping may continue in the future.
Asio flammeus	DAB;DCC;DCH;DCK;DCO;DCR;DCS;DKA;DKL;DMH;DND;DNI;DOS;DPC;DPG;DQU;DRM;DSI;DSS_B;DSS_C	1;2;3;4;5;6;7;8;9	CRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;NORD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDN;RDOS;SRD;Stikine;TNRD	BG;BWBS;CDF;CWH;ICH;IDF;MS;PP;SBPS;SBS;SWB	ESTUARINE;PALUSTRINE;TERRESTRIAL	Native	Regularly occurring	Y		Status Rpt; COSEWIC; Hab Protect; Hab Restore; Species Mgmt; Plan; Private Land	2	6	2	3	Y	
Botaurus lentiginosus	DAB;DCC;DCK;DCO;DCS;DHW;DKL;DMH;DND;DNI;DOS;DPC;DPG;DQU;DRM;DSI	1;2;3;4;5;6;7;8;9	CRD;CSRD;Cariboo;FVRD;GVRD;NORD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDMW;RDN;RDOS;TNRD	BG;BWBS;CDF;CWH;ICH;IDF;MS;PP;SBPS;SBS	ESTUARINE;PALUSTRINE	Native	Regularly occurring	Y		Monitor Trend; Status Rpt; Plan	2	5	2	3	Y	
Bufo boreas	DAB;DCC;DCH;DCK;DCO;DCR;DCS;DFN;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DNC;DND;DNI;DOS;DPC;DPG;DQC;DQU;DRM;DSC;DSI;DSQ;DSS_B;DSS_C;DVA	1;2;3;4;5;6;7;8;9	ACRD;CCRD;CRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	BG;BWBS;CDF;CWH;ICH;IDF;PP;SBS;SWB		Native	Regularly occurring			Monitor Trend; Status Rpt; Plan; Hab Protect; Hab Restore; Private Land; Species Mgmt	2	3	2	4	N	
Buteo swainsoni	DAB;DCC;DCS;DKA;DOS;DPC;DRM;DSS_B	3;4;5;6;8;9	CSRD;Cariboo;NORD;PRRD;RDBN;RDCO;RDEK;RDKB;RDOS;TNRD	BG;BWBS;CDF;ICH;IDF;MS;PP;SBS	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring	Y		Inventory; Status Rpt	2	6	6	2	Y	
Callophrys affinis	DAB;DCS;DOS	3;4;8	NORD;RDCO;RDKB;RDOS;TNRD	BG;ESSF;IDF;MS;PP	TERRESTRIAL	Native	Regularly occurring		N	Inventory	2	6	2	3	Y	
Canis lupus	DAB;DCC;DCH;DCK;DCO;DCR;DCS;DFN;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DNC;DND;DNI;DOS;DPC;DPG;DQU;DRM;DSC;DSI;DSQ;DSS;DVA	1;2;3;4;5;6;7;8;9	ACRD;CCRD;CRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	BAFA;BG;BWBS;CDF;CMA;ESSF;ICH;IDF;IMA;MH;MS;PP;SBPS;SBS;SWB		Native	Regularly occurring			No New Actn	3	3	6	5	N	
Catherpes mexicanus	DAB;DKA;DOS	3;4;8	CSRD;NORD;RDCK;RDCO;RDKB;RDOS;TNRD	BG;ICH;IDF;PP	TERRESTRIAL	Native	Regularly occurring	Y		No New Actn	4	6	4	4	Y	
Catostomus platyrhynchus	DAB;DCK;DCO;DCS;DKA;DOS	2;3;4;8	FVRD;RDCK;RDOS;TNRD	BG;CWH;IDF;PP	RIVERINE	Native	Regularly occurring			Inventory	2	5	2	3	Y	
Charina bottae	DAB;DCC;DCH;DCK;DCS;DKA;DKL;DMH;DOS;DRM;DSQ	2;3;4;5;8	CSRD;Cariboo;FVRD;GVRD;NORD;RDCK;RDCO;RDEK;RDKB;RDOS;TNRD	BG;CWH;ICH;IDF;PP		Native	Regularly occurring			Status Rpt; Plan; COSEWIC; Private Land; Species Mgmt; Hab Restore	3	5	3	4	N	
Chlidonias niger	DAB;DCC;DCH;DCK;DCO;DFN;DHW;DKA;DKL;DMH;DND;DOS;DPC;DPG;DQU;DRM;DVA	2;3;4;5;6;7;8;9	CSRD;Cariboo;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDOS;TNRD	BG;BWBS;CDF;CWH;ESSF;ICH;IDF;MS;PP;SBPS;SBS		Native	Regularly occurring	Y		No New Actn	3	3	6	5	N	
Chlosyne hoffmanni	DCK;DCS;DOS	2;8	FVRD;RDOS	CMA;CWH;ESSF;MS	TERRESTRIAL	Native	Regularly occurring		N	Inventory	3	5	6	3	Y	
Chondestes grammacus	DAB;DCC;DKA;DOS;DPC	3;4;5;8;9	CSRD;Cariboo;NORD;PRRD;RDCO;RDKB;RDOS;TNRD	BG;BWBS;CDF;CWH;ICH;IDF;MS;PP;SBPS;SBS	TERRESTRIAL	Native	Regularly occurring	Y		Rev Status	2	6	6	2	Y	
Chordeiles minor	DAB;DCC;DCH;DCK;DCO;DCR;DCS;DFN;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DND;DNI;DOS;DPC;DPG;DQU;DRM;DSC;DSI;DSQ;DSS_B;DSS_C;DVA	1;2;3;4;5;6;7;8;9	ACRD;CCRD;CRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SRD;Stikine;TNRD	BG;BWBS;CDF;CWH;ESSF;ICH;IDF;MH;MS;PP;SBPS;SBS;SWB		Native	Regularly occurring	Y		Rev Status	2	6	2	4	N	
Chrysemys picta	DAB;DCC;DCK;DCO;DKA;DKL;DMH;DOS;DRM;DSC;DSI		ACRD;CRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;NORD;PowellR;RDCK;RDCO;RDEK;RDKB;RDN;RDOS;SCRD;SRD;TNRD	BG;CDF;CWH;ICH;IDF;MH;PP;SBS		Native	Regularly occurring			Status Rpt; COSEWIC; Plan	2	6	2	3	N	Tracked and mapped at the population level in BC.
Chrysemys picta pop. 2	DAB;DCC;DCO;DKA;DKL;DMH;DOS;DRM	3;4;5;8	CSRD;Cariboo;NORD;RDCK;RDCO;RDEK;RDKB;RDOS;TNRD	BG;ICH;IDF;PP;SBS	PALUSTRINE;RIVERINE	Native	Regularly occurring			Monitor Trend; Status Rpt; COSEWIC; Plan	2	6	6	2	Y	Tracked and mapped at the population level.
Cicindela decemnotata	DAB;DCS;DKA;DOS	4;8	CSRD;NORD;RDCO;RDKB;RDOS	BG;PP	PALUSTRINE;SUBTERRANEAN;TERRESTRIAL	Native	Regularly occurring			Inventory	2	5	6	2	Y	
Cicindela parowana	DOS	8	NORD;RDCO;RDOS	BG;IDF;PP	PALUSTRINE;SUBTERRANEAN;TERRESTRIAL	Native	Regularly occurring			Inventory; COSEWIC; Status Rpt; Plan; Hab Protect; Wildlife Act; Private Land	1	5	6	1	Y	
Cicindela pugetana	DAB;DCS;DKL;DOS	3;4;8	NORD;RDCK;RDCO;RDKB;RDOS;TNRD	BG;PP	PALUSTRINE;SUBTERRANEAN;TERRESTRIAL	Native	Regularly occurring			Inventory	2	4	2	3	Y	
Circus cyaneus	DAB;DCC;DCH;DCK;DCO;DCR;DCS;DFN;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DND;DOS;DPC;DPG;DQU;DRM;DSI;DSQ;DSS_B;DSS_C;DVA	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;GVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDN;RDOS;SLRD;SRD;Stikine;TNRD	BAFA;BG;BWBS;CDF;CMA;CWH;ESSF;ICH;IDF;IMA;MH;MS;PP;SBPS;SBS;SWB		Native	Regularly occurring	Y		Monitor Trend	2	4	2	4	N	
Coluber constrictor	DAB;DCC;DCH;DCS;DKA;DMH;DOS	3;4;5;8	Cariboo;NORD;RDCO;RDKB;RDOS;SLRD;TNRD	BG;IDF;PP	PALUSTRINE;SUBTERRANEAN;TERRESTRIAL	Native	Regularly occurring			Status Rpt; COSEWIC; Plan; Hab Protect; Hab Restore; Private Land; Species Mgmt	2	6	2	3	Y	
Contopus cooperi	DAB;DCC;DCH;DCK;DCO;DCR;DCS;DFN;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DNC;DND;DNI;DOS;DPC;DPG;DQU;DRM;DSC;DSI;DSQ;DSS_B;DSS_C;DVA	1;2;3;4;5;6;7;8;9	ACRD;CCRD;CRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	BWBS;CDF;CWH;ESSF;ICH;IDF;MH;MS;PP;SBPS;SBS;SWB	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring	Y		Monitor Trend; Status Rpt; Plan	2	5	2	3	N	Currently not mapping this species as it is still wide spread and has been listed based on declining trends.
Corynorhinus townsendii	DAB;DCC;DCH;DCK;DCR;DCS;DKA;DKL;DMH;DNI;DOS;DQU;DRM;DSC;DSI;DSQ	1;2;3;4;5;8	ACRD;CRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;NORD;RDCK;RDCO;RDEK;RDKB;RDN;RDOS;SRD;TNRD	BG;CDF;CWH;ICH;IDF;PP	PALUSTRINE;SUBTERRANEAN;TERRESTRIAL	Native	Regularly occurring			Inventory	2	5	2	3	Y	
Cottus bairdii	DAB;DCO;DCS;DHW;DKA;DKL;DOS;DPC;DRM	3;4;7;8;9	CSRD;NORD;PRRD;RDCK;RDEK;RDFFG;RDKB;RDOS;TNRD	BG;BWBS;ESSF;ICH;IDF;MS;SBS	LACUSTRINE;RIVERINE	Native	Regularly occurring			Monitor Trend	3	6	6	3	Y	
Cottus hubbsi	DAB;DCS;DKL;DOS	3;4;8	RDCK;RDCO;RDKB;RDOS;TNRD	BG;ICH;IDF;PP	RIVERINE	Native	Regularly occurring			Monitor Trend; COSEWIC; Plan; Status Rpt; Species Mgmt; Hab Restore; Hab Protect; Private Land	2	4	2	3	Y	
Crotalus oreganus	DAB;DCS;DKA;DOS	3;8	NORD;RDCO;RDKB;RDOS;TNRD	BG;IDF;PP	PALUSTRINE;RIVERINE;SUBTERRANEAN;TERRESTRIAL	Native	Regularly occurring			Monitor Trend; Status Rpt; COSEWIC; Plan; Species Mgmt; Hab Protect; Hab Restore; Private Land	2	6	2	3	Y	
Danaus plexippus	DAB;DCK;DCO;DCS;DFN;DKA;DKL;DOS;DPC;DRM;DSC;DSI	1;2;3;4;8;9	ACRD;CRD;CSRD;FVRD;GVRD;NORD;NRRD;PRRD;PowellR;RDCK;RDCO;RDEK;RDKB;RDOS;TNRD	BG;CDF;CWH;ESSF;ICH;IDF;MS;PP	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring		N	Monitor Trend; Status Rpt; COSEWIC; Hab Protect; Hab Restore; Plan; Private Land	2	6	2	3	Y	
Dolichonyx oryzivorus	DAB;DCC;DCO;DCS;DHW;DKA;DKL;DMH;DOS;DPG;DQU;DRM	3;4;5;7;8	CSRD;Cariboo;NORD;RDCK;RDEK;RDKB;RDOS;TNRD	BG;BWBS;CDF;CWH;ICH;IDF;PP;SBS	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring	Y		Monitor Trend; Status Rpt; COSEWIC; Hab Protect; Hab Restore; Plan; Species Mgmt; Private Land	2	6	2	3	Y	
Elgaria coerulea	DAB;DCK;DCR;DCS;DHW;DKL;DNI;DOS;DSC;DSI	1;2;3;4;5;8	ACRD;CCRD;CRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;NORD;PowellR;RDCK;RDCO;RDEK;RDKB;RDMW;RDN;RDOS;SCRD;SLRD;SRD;TNRD	BG;CDF;CWH;ICH;IDF;PP		Native	Regularly occurring			No New Actn	3	5	3	4	N	
Empidonax wrightii	DOS	8	RDOS	BG;IDF;PP	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring	Y		Monitor Trend; Status Rpt; COSEWIC; Plan; Private Land; Hab Protect; Hab Restore; Species Mgmt	2	6	2	3	Y	
Eremophila alpestris merrilli	DAB;DCC;DCH;DCK;DCS;DKA;DMH;DOS	3;4;5;8	CSRD;Cariboo;NORD;RDEK;RDKB;RDOS;TNRD	BG;ICH;IDF;PP;SBPS;SBS	TERRESTRIAL	Native	Regularly occurring	Y		Monitor Trend	2	5	2	3	W	Currently not mapping this species as it is still found in sufficient numbers over a great enough range.
Erythemis collocata	DCK;DOS;DSC;DSI	1;2;8	CRD;CVRD;FVRD;PowellR;RDN;RDOS;SCRD	BG;CDF;CWH;ESSF;PP	LACUSTRINE	Native	Regularly occurring			Rev Status	2	6	2	3	Y	
Euderma maculatum	DCC;DCH;DCS;DKA;DMH;DOS	3;5;8	CSRD;Cariboo;NORD;RDCO;RDOS;SLRD;TNRD	BG;IDF;PP	PALUSTRINE;SUBTERRANEAN;TERRESTRIAL	Native	Regularly occurring			Monitor Trend; Status Rpt; COSEWIC; Private Land; Hab Protect; Species Mgmt; Plan	2	5	2	3	Y	
Eumeces skiltonianus	DAB;DCS;DKL;DOS	3;4;8	CSRD;NORD;RDCK;RDCO;RDEK;RDKB;RDOS	BG;ICH;IDF;PP	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Monitor Trend; Status Rpt; Plan; COSEWIC; Private Land; Hab Protect; Hab Restore; Species Mgmt	1	6	1	2	Y	
Euphagus carolinus	DAB;DCC;DCH;DCO;DCS;DFN;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DNC;DND;DNI;DOS;DPC;DPG;DQU;DRM;DSQ;DSS_B;DSS_C;DVA	3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;NORD;NRRD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDOS;SLRD;SQCRD;Stikine;TNRD	BG;BWBS;CDF;CWH;ESSF;MS;PP;SBPS;SBS;SWB	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring	Y		Species Mgmt; Plan; Monitor Trend	2	3	2	3	N	Currently not mapping this species as it is still wide spread and has been listed based on declining trends. Mapping all breeding locations would not be possible at this point. Partial mapping that would include large colonies may be considered in the future.
Falco mexicanus	DAB;DCC;DCH;DCS;DKA;DKL;DMH;DOS;DRM	3;4;5;8	Cariboo;RDCK;RDEK;RDKB;RDOS;SLRD;TNRD	BG;BWBS;CDF;CWH;ESSF;ICH;IDF;MS;PP;SBS	TERRESTRIAL	Native	Regularly occurring	Y		Status Rpt; Wildlife Act; COSEWIC; Plan; Hab Protect; Hab Restore; Private Land	2	6	6	2	Y	
Falco peregrinus anatum	DCC;DCH;DCK;DCS;DKA;DMH;DND;DOS;DRM;DSC;DSI;DSQ;DSS_C	1;2;3;4;5;6;8	CRD;CVRD;Cariboo;FVRD;GVRD;RDBN;RDEK;RDN;RDOS;SLRD;Stikine;TNRD	BG;BWBS;CDF;CWH;ESSF;ICH;IDF;MS;PP;SBS;SWB	ESTUARINE;TERRESTRIAL	Native	Regularly occurring	Y		Status Rpt; Wildlife Act; COSEWIC; Plan; Hab Protect; Private Land; Hab Restore; Species Mgmt	2	5	6	2	Y	
Fossaria truncatula	DAB;DKL;DOS;DSS_C	4;6;8	RDCK;RDKB;RDOS;Stikine	ICH;IDF;PP;SWB	LACUSTRINE;RIVERINE	Native	Regularly occurring			Inventory	2	4	2	3	W	
Gomphus graslinellus	DAB;DOS;DRM	4;8	CSRD;NORD;RDCO;RDEK;RDKB;RDOS	BG;IDF;PP	LACUSTRINE;RIVERINE	Native	Regularly occurring			Monitor Trend; Status Rpt; Plan; Private Land; Hab Protect; Hab Restore; Species Mgmt	2	6	6	2	Y	
Gonidea angulata	DAB;DOS	4;8	NORD;RDCK;RDCO;RDKB;RDOS	BG;IDF;PP	LACUSTRINE;RIVERINE	Native	Regularly occurring			Status Rpt; Wildlife Act; COSEWIC; Hab Protect; Hab Restore; Species Mgmt; Plan; Private Land	1	2	6	1	Y	
Gulo gulo luscus	DAB;DCC;DCH;DCK;DCO;DCR;DCS;DFN;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DNC;DND;DNI;DOS;DPC;DPG;DQU;DRM;DSC;DSQ;DSS_B;DSS_C;DVA	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;FVRD;GVRD;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	BAFA;BWBS;CMA;CWH;ESSF;ICH;IDF;IMA;MH;MS;SBPS;SBS;SWB	TERRESTRIAL	Native	Regularly occurring			Monitor Trend; Status Rpt; COSEWIC; Plan; Private Land; Hab Protect; Hab Restore; Review Use	2	3	2	3	N	There are complications with defining and mapping occurrences of wide ranging carnivores; until this is resolved or a surrogate developed this species will not be mapped.
Haliaeetus leucocephalus	DAB;DCC;DCH;DCK;DCO;DCR;DCS;DFN;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DNC;DND;DNI;DOS;DPC;DPG;DQC;DQU;DRM;DSC;DSI;DSQ;DSS_B;DSS_C;DVA	1;2;3;4;5;6;7;8;9	ACRD;CCRD;CRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	CDF;CWH;ICH;IDF;MS;PP		Native	Regularly occurring	Y		No New Actn	6	6	6	6	N	
Hemphillia camelus	DAB;DCO;DCS;DKA;DKL;DOS;DRM	3;4;8	CSRD;NORD;RDCK;RDCO;RDEK;RDKB;RDOS;TNRD	CWH;ICH;IDF;MS;PP	TERRESTRIAL	Native	Regularly occurring				4	4	4	4	Y	
Hesperia nevada	DCS;DKA;DMH;DOS;DRM	3;4;8	NORD;RDCO;RDEK;RDOS;SLRD;TNRD	BG;ESSF;IDF;MS;PP	TERRESTRIAL	Native	Regularly occurring		N	No New Actn	2	4	2	3	Y	
Hirundo rustica	DAB;DCC;DCH;DCK;DCO;DCR;DCS;DFN;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DNC;DND;DNI;DOS;DPC;DPG;DQC;DQU;DRM;DSC;DSI;DSQ;DSS_B;DSS_C;DVA	1;2;3;4;5;6;7;8;9	ACRD;CCRD;CRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	BAFA;BG;BWBS;CDF;CWH;ESSF;ICH;IDF;IMA;MH;MS;PP;SBPS;SBS;SWB	ESTUARINE;LACUSTRINE;PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring	Y		Monitor Trend; Status Rpt; COSEWIC; Plan; Species Mgmt	2	6	2	3	N	Currently not mapping this species as it is still wide spread and has been listed based on declining trends. Partial mapping that would include large colonies may be considered in the future.

Scientific Name	English Name	RISC Code	Global Status	Global Status Review Date	Prov Status	Prov Status Review Date	Prov Status Change Date	COSEWIC	COSEWIC Comments	BC List	Identified Wildlife	Prov Wildlife Act	SARA	National GS	Name Category	Class (English)	Species Level	Kingdom	Phylum	Class	Order	Family	Forest Dist	MOE Region	Regional Dist	BGC	Habitat Type	Origin	Presence	Breeding Bird	Endemic	Action Groups	Highest Priority	Priority Goal 1	Priority Goal 2	Priority Goal 3	CDC Maps	Mapping Status
Hydroprogne caspia	Caspian Tern	B-CATE	G5	27-Nov-96	S3B	29-Nov-05	1-Jun-96	NAR (May 1999)		Blue				3 - Sensitive (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Charadriiformes	Laridae	DCK;DCO;DOS;DSI;DVA	1;2;3;7;8	ACRD;CRD;CSRD;ComoxVRD;GVRD;RDBN;RDOS	BG;BWBS;CDF;CWH;ICH;IDF;PP;SBS	ESTUARINE;LACUSTRINE;MARINE;PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring	Y		Inventory	2	6	2	3	W	No occurrences mapped. Populations are increasing and so not currently mapping this species.
Hypsiglena chlorophaea	Night Snake	R-HYCH	G5	14-Jul-08	S1	3-Dec-07	31-Jan-92	E (May 2001)		Red			1	1 - At Risk (2005)	Vertebrate Animal	reptiles	Species	Animalia	Craniata	Reptilia	Squamata	Colubridae	DOS	8	RDKB;RDOS	BG;IDF;PP	LACUSTRINE;RIVERINE;SUBTERRANEAN;TERRESTRIAL	Native	Regularly occurring			Status Rpt; Wildlife Act; Plan; COSEWIC; Species Mgmt; Private Land; Hab Protect; Hab Restore	1	6	6	1	Y	
Icteria virens	Yellow-breasted Chat	B-YBCH	G5	3-Dec-96	S1S2	29-Nov-05	29-Nov-05	E (Nov 2000)		Red	Y (May 2004)		1	4 - Secure (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Passeriformes	Parulidae	DAB;DCC;DCS;DKL;DOS	4;5;8	Cariboo;FVRD;NORD;RDCK;RDCO;RDKB;RDOS	BG;CDF;CWH;ICH;PP;SBS	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring	Y		Hab Protect; Status Rpt; Plan; Wildlife Act; COSEWIC; Hab Restore; Private Land	1	5	6	1	Y	
Larus californicus	California Gull	B-CAGU	G5	27-Nov-96	S3B	29-Nov-05	1-Jun-96			Blue				4 - Secure (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Charadriiformes	Laridae	DCC;DOS;DQU;DVA	3;5;7;8	CSRD;Cariboo;RDBN;RDCO;RDOS	BG;BWBS;CDF;CWH;ICH;IDF;MS;PP;SBS	ESTUARINE;LACUSTRINE;MARINE;PALUSTRINE;TERRESTRIAL	Native	Regularly occurring	Y		No New Actn	4	6	6	4	W	No occurrences mapped. Population appears to be increasing and so not currently mapping this species.
Lepus townsendii	White-tailed Jackrabbit	M-LETO	G5	5-Nov-96	SH	8-Dec-06	13-Oct-00			Red				4 - Secure (2005)	Vertebrate Animal	mammals	Species	Animalia	Craniata	Mammalia	Lagomorpha	Leporidae	DOS	8	RDOS	BG;PP	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Libellula pulchella	Twelve-spotted Skimmer	IO-LIBPUL	G5	30-Dec-85	S3	4-Jan-04				Blue				4 - Secure (2005)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Odonata	Libellulidae	DAB;DKL;DOS;DRM	4;8	CSRD;NORD;RDCK;RDCO;RDEK;RDKB;RDOS	BG;IDF;PP	LACUSTRINE	Native	Regularly occurring			Rev Status	4	6	4	4	Y	
Limenitis archippus	Viceroy	IL-LIMARC	G5	1-Sep-98	SX	20-Nov-06	6-Dec-99			Red				6 - Not Assessed (2000)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Lepidoptera	Nymphalidae	DAB;DCS;DOS	3;8	RDCK;RDOS;SLRD	BG;ESSF;ICH;IDF;MS;PP	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring		N	Status Rpt; Species Mgmt; Plan	2	5	6	2	Y	
Lycaena nivalis	Lilac-bordered Copper	IL-LYCNIV	G5	1-Sep-98	S3	20-Nov-06	6-Dec-99			Blue				6 - Not Assessed (2000)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Lepidoptera	Lycaenidae	DAB;DKL;DOS	4;8	RDCK;RDCO;RDKB;RDOS	BG;ESSF;ICH;IDF;MS;PP	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring		N	No New Actn	4	6	4	4	Y	
Macromia magnifica	Western River Cruiser	IO-MACMAG	G5	3-Nov-04	S3	4-Jan-04				Blue				3 - Sensitive (2005)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Odonata	Macromiidae	DAB;DCK;DOS	2;3;8	CSRD;FVRD;NORD;RDCO;RDKB;RDOS	IDF	LACUSTRINE;RIVERINE	Native	Regularly occurring			Monitor Trend; Status Rpt; Plan; COSEWIC; Species Mgmt; Hab Protect; Hab Restore; Private Land	2	6	2	3	Y	
Martes pennanti	Fisher	M-MAPE	G5	16-Nov-05	S2S3	8-Dec-06	21-Jan-05			Blue	Y (Jun 2006)			4 - Secure (2005)	Vertebrate Animal	mammals	Species	Animalia	Craniata	Mammalia	Carnivora	Mustelidae	DAB;DCC;DCH;DCO;DCR;DCS;DFN;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DNC;DND;DNI;DOS;DPC;DPG;DQU;DRM;DSC;DSQ;DSS_B;DSS_C;DVA	2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDOS;SCRD;SLRD;SQCRD;Stikine;TNRD	BAFA;BWBS;CDF;CMA;CWH;ESSF;ICH;IDF;IMA;MH;MS;PP;SBPS;SBS;SWB	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Monitor Trend; Status Rpt; Plan; Review Use; Private Land; Hab Restore; Hab Protect	2	4	6	2	N	There are complications with defining and mapping occurrences of wide ranging carnivores; until this is resolved or a surrogate developed this species will not be mapped.
Megascops kennicottii macfarlanei	Western Screech-Owl, *macfarlanei* subspecies	B-WSOW-MA	G5T4	24-Oct-00	S2	10-Jan-09	26-Jan-09	E (May 2002)		Red	Y (May 2004)		1		Vertebrate Animal	birds	Subspecies	Animalia	Craniata	Aves	Strigiformes	Strigidae	DAB;DCS;DKA;DKL;DOS;DRM	3;4;8	CSRD;NORD;RDCK;RDCO;RDEK;RDKB;RDOS;SLRD;TNRD	BG;ICH;IDF;PP	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring	Y		Status Rpt; Plan; Wildlife Act; COSEWIC; Hab Protect; Hab Restore; Private Land	1	4	6	1	Y	
Melanerpes lewis	Lewis's Woodpecker	B-LEWO	G4	14-Feb-01	S2B	10-Jan-09	29-Nov-05	SC (Nov 2001)		Red	Y (May 2004)		1	3 - Sensitive (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Piciformes	Picidae	DAB;DCC;DCH;DCS;DKA;DKL;DMH;DOS;DRM	3;4;5;8	CSRD;Cariboo;NORD;RDCK;RDCO;RDEK;RDKB;RDOS;SLRD;TNRD	BG;CDF;CWH;ICH;IDF;PP;SBS	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring	Y		Status Rpt; Wildlife Act; Plan; COSEWIC; Hab Protect; Hab Restore; Private Land	2	3	6	2	Y	
Myotis ciliolabrum	Western Small-footed Myotis	M-MYCI	G5	4-Aug-98	S2S3	8-Dec-06	30-Nov-95			Blue				3 - Sensitive (2005)	Vertebrate Animal	mammals	Species	Animalia	Craniata	Mammalia	Chiroptera	Vespertilionidae	DCC;DCH;DCK;DCS;DKA;DMH;DOS	3;4;5;8	Cariboo;NORD;RDCK;RDCO;RDOS;TNRD	BG;IDF;PP	PALUSTRINE;SUBTERRANEAN;TERRESTRIAL	Native	Regularly occurring			No New Actn	3	6	6	3	Y	
Myotis thysanodes	Fringed Myotis	M-MYTH	G4G5	3-Aug-98	S2S3	8-Dec-06	30-Nov-95	DD (May 2004)		Blue	Y (May 2004)		3	2 - May be at risk (2005)	Vertebrate Animal	mammals	Species	Animalia	Craniata	Mammalia	Chiroptera	Vespertilionidae	DAB;DCC;DCH;DCS;DKA;DKL;DMH;DOS	3;4;5;8	CSRD;Cariboo;NORD;RDCK;RDCO;RDKB;RDOS;TNRD	BG;ICH;IDF;PP	PALUSTRINE;SUBTERRANEAN;TERRESTRIAL	Native	Regularly occurring			No New Actn	3	5	6	3	Y	
Numenius americanus	Long-billed Curlew	B-LBCU	G5	25-Nov-96	S3B	29-Nov-05	1-Jun-96	SC (Nov 2002)		Blue	Y (May 2004)		1	3 - Sensitive (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Charadriiformes	Scolopacidae	DCC;DCH;DCO;DCS;DHW;DKA;DKL;DMH;DOS;DPG;DQU;DRM	3;4;5;7;8	CSRD;Cariboo;NORD;RDCK;RDEK;RDFFG;RDOS;SLRD;TNRD	BG;CDF;CWH;ICH;IDF;PP;SBPS;SBS	ESTUARINE;PALUSTRINE;TERRESTRIAL	Native	Regularly occurring	Y		Monitor Trend; Status Rpt; Plan; Private Land; Hab Protect; Hab Restore; Status Rpt	4	4	6	4	Y	
Oreoscoptes montanus	Sage Thrasher	B-SATH	G5	3-Dec-96	S1B	10-Jan-09	30-Jun-98	E (Nov 2000)		Red	Y (May 2004)		1	1 - At Risk (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Passeriformes	Mimidae	DCS;DKA;DOS	3;8	RDOS;TNRD	BG;CDF;CWH;ICH;IDF;PP	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring	Y		Status Rpt; Wildlife Act; Plan; COSEWIC; Hab Protect; Hab Restore; Private Land	1	4	6	1	Y	
Otus flammeolus	Flammulated Owl	B-FLOW	G4	16-Nov-00	S3S4B	29-Nov-05	30-Jun-98	SC (Nov 2001)		Blue	Y (May 2004)		1	3 - Sensitive (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Strigiformes	Strigidae	DAB;DCC;DCH;DCS;DKA;DKL;DMH;DOS;DRM	3;4;5;8	Cariboo;NORD;RDCK;RDCO;RDEK;RDKB;RDOS;SLRD;TNRD	BG;ICH;IDF;MS;PP	TERRESTRIAL	Native	Regularly occurring	Y		Monitor Trend; Status Rpt; Hab Protect; Hab Restore; COSEWIC; Plan; Private Land	2	5	2	3	W	Many occurrences have been mapped for this species. It has now moved to the "Watch list" and is not currently being mapped.
Ovis canadensis	Bighorn Sheep	M-OVCA	G4	6-Oct-08	S2S3	8-Dec-06	13-Oct-00			Blue	Y (Jun 2006)			4 - Secure (2005)	Vertebrate Animal	mammals	Species	Animalia	Craniata	Mammalia	Artiodactyla	Bovidae	DAB;DCC;DCH;DCO;DCS;DHW;DKA;DKL;DMH;DOS;DPC;DPG;DRM	3;4;5;7;8;9	CSRD;Cariboo;NORD;PRRD;RDCK;RDCO;RDEK;RDFFG;RDKB;RDOS;SLRD;TNRD	BAFA;BG;ESSF;ICH;IDF;IMA;MS;PP	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Review Use; Monitor Trend; Status Rpt; Private Land; Hab Protect; Hab Restore; Plan; Species Mgmt	3	4	6	3	Y	
Pachydiplax longipennis	Blue Dasher	IO-PACLON	G5	26-Mar-08	S3S4	4-Jan-04	10-Mar-04			Blue				4 - Secure (2005)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Odonata	Libellulidae	DCK;DCR;DOS;DSC;DSI	1;2;8	ACRD;CRD;CVRD;ComoxVRD;GVRD;PowellR;RDMW;RDN;RDOS;SCRD;SRD	CWH	LACUSTRINE;RIVERINE	Native	Regularly occurring			Rev Status	4	6	4	4	Y	
Perognathus parvus	Great Basin Pocket Mouse	M-PEPA	G5	7-Nov-96	S2	8-Dec-06	15-Jan-07			Red				2 - May be at risk (2005)	Vertebrate Animal	mammals	Species	Animalia	Craniata	Mammalia	Rodentia	Heteromyidae	DAB;DCS;DKA;DOS	3;4;8	NORD;RDCO;RDKB;RDOS;SLRD;TNRD	BG;IDF;PP	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Pholisora catullus	Common Sootywing	IL-PHOCAT	G5	1-Sep-98	S3	20-Nov-06	15-Jan-07			Blue				6 - Not Assessed (2000)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Lepidoptera	Hesperiidae	DAB;DCS;DKA;DOS	3;8	CSRD;NORD;RDCO;RDKB;RDOS;SLRD;TNRD	BG;ESSF;ICH;IDF;MS;PP	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring		N	No New Actn	4	6	4	4	Y	
Phrynosoma douglasii	Pigmy Short-horned Lizard	R-PHDO	G5	9-Sep-05	SX	3-Dec-07	23-Sep-00	XT (Apr 2007)		Red			1	.2 - Extinct (2005)	Vertebrate Animal	reptiles	Species	Animalia	Craniata	Reptilia	Squamata	Phrynosomatidae	DOS	8	RDOS	BG	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Picoides albolarvatus	White-headed Woodpecker	B-WHWO	G4	2-Dec-96	S1	10-Jan-09	6-Oct-00	E (Nov 2000)		Red	Y (May 2004)		1	1 - At Risk (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Piciformes	Picidae	DAB;DCS;DOS	8	RDKB;RDOS	BG;ICH;IDF;PP	TERRESTRIAL	Native	Regularly occurring	Y		Hab Restore; Hab Protect; Status Rpt; COSEWIC; Plan; Wildlife Act; Private Land	2	5	6	2	Y	
Pituophis catenifer deserticola	Gopher Snake, *deserticola* subspecies	R-PICA-DE	G5T5	31-Oct-96	S2S3	3-Dec-07	2-Jan-08	T (May 2002)		Blue	Y (May 2004)		1		Vertebrate Animal	reptiles	Subspecies	Animalia	Craniata	Reptilia	Squamata	Colubridae	DAB;DCC;DCH;DCK;DCS;DKA;DMH;DOS	3;4;5;8	Cariboo;NORD;RDCO;RDKB;RDOS;SLRD;TNRD	BG;IDF;PP	LACUSTRINE;PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Monitor Trend; Status Rpt; COSEWIC; Plan; Species Mgmt; Hab Protect; Hab Restore; Private Land	2	6	6	2	Y	
Polites sabuleti	Sandhill Skipper	IL-POLSAB	G5	1-Sep-98	S2	20-Nov-06	15-Jan-07			Red				6 - Not Assessed (2000)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Lepidoptera	Hesperiidae	DOS	8	NORD;RDOS	BG;ESSF;ICH;IDF;MS;PP	ESTUARINE;TERRESTRIAL	Native	Regularly occurring		N	Monitor Trend; Status Rpt; COSEWIC; Wildlife Act; Plan; Hab Restore; Hab Protect; Private Land; Species Mgmt	2	6	6	2	Y	
Polites sonora	Sonora Skipper	IL-POLSON	G4	15-May-06	S1S2	20-Nov-06	15-Jan-07	SC (Apr 2006)		Red	Y (Jun 2006)		1	6 - Not Assessed (2000)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Lepidoptera	Hesperiidae	DCK;DCS;DOS	2;8	FVRD;RDOS	BG;ESSF;IDF;IMA;MS;PP	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring		N	Inventory	2	3	6	2	Y	
Pristiloma arcticum	Northern Tightcoil	IM-PRIARC	G3G4	26-May-04	S3S4	16-Dec-08				Blue					Invertebrate Animal	gastropods	Species	Animalia	Mollusca	Gastropoda	Stylommatophora	Zonitidae	DCK;DCS;DKM;DND;DOS;DSS;DSS_C	2;3;8	FVRD;RDBN;RDCO;RDKS;RDOS;Stikine	ESSF;ICH	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring				4	4	4	4	W	No occurrences mapped.
Promenetus umbilicatellus	Umbilicate Sprite	IM-PROUMB	G4	26-Jun-00	S3S4	16-Dec-08				Blue					Invertebrate Animal	gastropods	Species	Animalia	Mollusca	Gastropoda	Basommatophora	Planorbidae	DKA;DOS;DSI	1;3;8	ACRD;CRD;CVRD;NORD;RDCO;RDN;RDOS;TNRD	BG;CDF;IDF;PP	RIVERINE	Native	Regularly occurring				4	5	4	4	W	No occurrences mapped.
Rana luteiventris	Columbia Spotted Frog	A-RALU	G4	9-Jan-08	S4	3-Dec-07	26-Jan-98	NAR (May 2000)		Yellow				4 - Secure (2005)	Vertebrate Animal	amphibians	Species	Animalia	Craniata	Amphibia	Anura	Ranidae	DAB;DCC;DCH;DCK;DCO;DCS;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DNC;DND;DNI;DOS;DPC;DPG;DQU;DRM;DSS_B;DSS_C;DVA	2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;FVRD;NORD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDOS;SLRD;SQCRD;Stikine;TNRD	BG;BWBS;CWH;ICH;IDF;PP;SBPS;SBS;SWB		Native	Regularly occurring			Monitor Trend; Status Rpt; Plan; Hab Restore; Hab Protect; Species Mgmt; Private Land	2	3	2	4	N	
Rana pipiens	Northern Leopard Frog	A-RAPI	G5	15-Apr-02	S1	3-Dec-07	1-Jun-96	E (Apr 2009)		Red	Y (May 2004)		1	4 - Secure (2005)	Vertebrate Animal	amphibians	Species	Animalia	Craniata	Amphibia	Anura	Ranidae	DCO;DKL;DOS;DRM;DSI	4;8	RDCK;RDEK;RDOS	CDF;ICH;IDF;PP	LACUSTRINE;PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Status Rpt; Wildlife Act; COSEWIC; Plan; Hab Protect; Hab Restore; Species Mgmt; Private Land	1	4	6	1	Y	
Reithrodontomys megalotis	Western Harvest Mouse	M-REME	G5	14-Oct-03	S2S3	8-Dec-06	30-Nov-95	SC (Apr 2007)	*Megalotis* subspecies.	Blue			1	2 - May be at risk (2005)	Vertebrate Animal	mammals	Species	Animalia	Craniata	Mammalia	Rodentia	Cricetidae	DOS	8	NORD;RDCO;RDOS	BG;IDF;PP	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Monitor Trend; Status Rpt; Plan; COSEWIC; Private Land; Hab Protect; Hab Restore	2	6	6	2	Y	
Rhinichthys umatilla	Umatilla Dace	F-RHUM	G4	14-Jan-92	S2	12-Jan-04	31-Jan-92	SC (May 1988)		Red			3	2 - May be at risk (2005)	Vertebrate Animal	ray-finned fishes	Species	Animalia	Craniata	Actinopterygii	Cypriniformes	Cyprinidae	DAB;DCO;DCS;DKL;DOS	4;8	RDCK;RDKB;RDOS	BG;ICH;IDF	RIVERINE	Native	Regularly occurring			Inventory; Taxonomy	2	4	6	2	Y	
Salvelinus confluentus	Bull Trout	F-SACO	G3	19-Mar-03	S3	12-Jan-04	13-Apr-94			Blue	Y (Jun 2006)			3 - Sensitive (2005)	Vertebrate Animal	ray-finned fishes	Species	Animalia	Craniata	Actinopterygii	Salmoniformes	Salmonidae	DAB;DCC;DCH;DCK;DCO;DCS;DFN;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DNC;DND;DNI;DOS;DPC;DPG;DQU;DRM;DSC;DSI;DSQ;DSS_B;DSS_C;DVA	1;2;3;4;5;6;7;8;9	CSRD;Cariboo;FVRD;GVRD;NRRD;PRRD;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	BG;BWBS;CWH;ESSF;ICH;IDF;MS;PP;SBPS;SBS;SWB	LACUSTRINE;RIVERINE	Native	Regularly occurring			Monitor Trend; Review Use; Hab Restore; Species Mgmt; Status Rpt; COSEWIC; Plan; Private Land	2	2	2	3	W	Currently the CDC is not mapping this species as it is quite wide spread.
Salvelinus malma	Dolly Varden	F-SAMA	G5	22-Feb-00	S3S4	12-Jan-04	6-Mar-00			Blue				4 - Secure (2005)	Vertebrate Animal	ray-finned fishes	Species	Animalia	Craniata	Actinopterygii	Salmoniformes	Salmonidae	DAB;DCC;DCH;DCK;DCO;DCR;DCS;DFN;DHW;DJA;DKA;DKL;DKM;DMK;DNC;DND;DNI;DOS;DPC;DPG;DQC;DQU;DRM;DSC;DSI;DSQ;DSS_B;DSS_C;DVA	1;2;3;4;5;6;7;8;9	ACRD;CCRD;CRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;PRRD;PowellR;RDBN;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine	BWBS;CDF;CWH;ESSF;ICH;MH;SBS	ESTUARINE;LACUSTRINE;MARINE;RIVERINE	Native	Regularly occurring			Monitor Trend; Review Use; Status Rpt; Plan; Hab Protect; Hab Restore; Private Land	2	4	2	3	N	Currently the CDC is not mapping this species as it is quite wide spread.
Satyrium behrii	Behr's Hairstreak	IL-SATBEH	G5	15-May-06	S1	20-Nov-06	15-Jan-07	T (Nov 2000)		Red			1	6 - Not Assessed (2000)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Lepidoptera	Lycaenidae	DOS	8	RDOS	BG;ESSF;IDF;IMA;MS;PP	TERRESTRIAL	Native	Regularly occurring		N	Status Rpt; Wildlife Act; COSEWIC; Hab Protect; Plan; Private Land	1	6	6	1	Y	
Satyrium californica	California Hairstreak	IL-SATCAL	G5	30-Sep-98	S3	20-Nov-06	6-Dec-99			Blue				6 - Not Assessed (2000)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Lepidoptera	Lycaenidae	DAB;DCS;DKA;DOS	3;8	RDKB;RDOS;SLRD;TNRD	BG;ESSF;ICH;IDF;IMA;MS;PP	TERRESTRIAL	Native	Regularly occurring		N	No New Actn	4	6	4	4	Y	
Satyrium semiluna	Half-moon Hairstreak	IL-SATSEM	G4	11-Jun-07	S1	20-Nov-06	6-Dec-99	E (Apr 2006)		Red	Y (Jun 2006)		1	6 - Not Assessed (2000)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Lepidoptera	Lycaenidae	DCS;DOS	8	RDOS	BG;ESSF;IDF;IMA;MS;PP	TERRESTRIAL	Native	Regularly occurring		N	Status Rpt; Wildlife Act; COSEWIC; Plan; Private Land; Hab Restore; Hab Protect	1	3	6	1	Y	
Sorex merriami	Merriam's Shrew	M-SOME	G5	1-Nov-96	S1	8-Dec-06	5-Mar-99			Red				2 - May be at risk (2005)	Vertebrate Animal	mammals	Species	Animalia	Craniata	Mammalia	Soricomorpha	Soricidae	DOS	3;8	NORD;RDCO;RDOS;TNRD	BG;PP	TERRESTRIAL	Native	Regularly occurring			Inventory	1	6	6	1	Y	
Sorex preblei	Preble's Shrew	M-SOPR	G4	1-Nov-96	S1S2	8-Dec-06	17-Sep-01			Red				2 - May be at risk (2005)	Vertebrate Animal	mammals	Species	Animalia	Craniata	Mammalia	Soricomorpha	Soricidae	DOS	3;8	NORD;RDCO;RDOS;TNRD	BG;IDF;PP	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Inventory	1	3	6	1	Y	
Spea intermontana	Great Basin Spadefoot	A-SPIN	G5	10-Apr-02	S3	3-Dec-07	1-Jun-96	T (Apr 2007)		Blue	Y (May 2004)		1	1 - At Risk (2005)	Vertebrate Animal	amphibians	Species	Animalia	Craniata	Amphibia	Anura	Scaphiopodidae	DAB;DCC;DCS;DKA;DMH;DOS	3;5;8	CSRD;Cariboo;NORD;RDCO;RDKB;RDOS;TNRD	BG;IDF;MS;PP	PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Monitor Trend; Status Rpt; Plan; COSEWIC; Private Land; Hab Restore; Hab Protect	1	6	1	2	Y	
Speyeria mormonia erinna	Mormon Fritillary, *erinna* subspecies	IL-SPEMOR-ER	G5T4	30-Jan-03	S1S2	20-Nov-06	15-Jan-07			Red					Invertebrate Animal	insects	Subspecies	Animalia	Mandibulata	Insecta	Lepidoptera	Nymphalidae	DAB;DOS	4;8	RDKB;RDOS	BG;IDF;MS;PP	TERRESTRIAL	Native	Regularly occurring		N	Status Rpt; Wildlife Act; COSEWIC; Plan; Hab Protect; Private Land	1	3	6	1	Y	
Sphyrapicus thyroideus thyroideus	Williamson's Sapsucker, *thyroideus* subspecies	B-WISA-TH	G5TU	5-Jan-97	S2B	29-Nov-05	29-Nov-05	E (May 2005)	Full Species	Red	Y (Jun 2006)		1		Vertebrate Animal	birds	Subspecies	Animalia	Craniata	Aves	Piciformes	Picidae	DAB;DCS;DKA;DOS	3;8	NORD;RDKB;RDOS;TNRD	BG;ICH;IDF;MS;PP	TERRESTRIAL	Native	Regularly occurring	Y		Status Rpt; Wildlife Act; COSEWIC; Plan; Hab Protect; Private Land; Hab Restore	2	4	6	2	Y	
Spizella breweri breweri	Brewer's Sparrow, *breweri* subspecies	B-BRSP-BR	G5T4	22-May-91	S2B	29-Nov-05	30-Jun-98			Red	Y (Jun 2006)				Vertebrate Animal	birds	Subspecies	Animalia	Craniata	Aves	Passeriformes	Emberizidae	DAB;DCC;DKA;DMH;DOS;DRM	3;5;8	Cariboo;NORD;RDEK;RDKB;RDOS;TNRD	BG;IDF;PP	TERRESTRIAL	Native	Regularly occurring	Y		Status Rpt; Wildlife Act; COSEWIC; Plan; Hab Protect; Hab Restore; Private Land	2	5	6	2	Y	
Stagnicola apicina	Abbreviate Pondsnail	IM-STAAPI	G5	28-May-03	S2S3	16-Dec-08	1-Jan-00			Blue					Invertebrate Animal	gastropods	Species	Animalia	Mollusca	Gastropoda	Basommatophora	Lymnaeidae	DAB;DOS	8	NORD;RDCO;RDOS	BG;IDF;PP	LACUSTRINE;RIVERINE	Native	Regularly occurring			Inventory	3	6	6	3	Y	
Strix occidentalis	Spotted Owl	B-SPOW	G3	2-Oct-07	S1	10-Jan-09	1-Jun-96	E (Mar 2008)	*Caurina* Subspecies	Red	Y (May 2004)		1	1 - At Risk (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Strigiformes	Strigidae	DCK;DCS;DSC;DSQ	2;3;8	FVRD;GVRD;RDOS;SLRD;TNRD	CWH;ESSF;IDF;MH	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring	Y		Status Rpt; Wildlife Act; COSEWIC; Hab Protect; Hab Restore; Species Mgmt; Plan; Private Land	2	5	6	2	Y	
Stylurus olivaceus	Olive Clubtail	IO-STYOLI	G4	23-Nov-98	S1S2	4-Jan-04	10-Mar-04			Red				2 - May be at risk (2005)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Odonata	Gomphidae	DAB;DKA;DOS	3;8	RDKB;RDOS;TNRD	BG;IDF	LACUSTRINE;RIVERINE	Native	Regularly occurring			Monitor Trend; Status Rpt; Wildlife Act; COSEWIC; Species Mgmt; Plan; Private Land; Hab Protect; Hab Restore	1	4	6	1	Y	
Sylvilagus nuttallii	Nuttall's Cottontail	M-SYNU	G5	5-Nov-96	S3	8-Dec-06	30-Nov-95	SC (Apr 2006)	*Nuttallii* Subspecies	Blue			1	4 - Secure (2005)	Vertebrate Animal	mammals	Species	Animalia	Craniata	Mammalia	Lagomorpha	Leporidae	DOS	8	RDCO;RDOS	BG;IDF;PP	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Monitor Trend; Status Rpt; Plan	2	4	2	3	Y	
Sympetrum vicinum	Autumn Meadowhawk	IO-SYMVIC	G5	30-Dec-85	S3S4	4-Jan-04				Blue				4 - Secure (2005)	Invertebrate Animal	insects	Species	Animalia	Mandibulata	Insecta	Odonata	Libellulidae	DCK;DKL;DOS;DSC;DSI	1;2;5;8	ACRD;CRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;RDCK;RDN;RDOS;SCRD	CDF;CWH	LACUSTRINE;RIVERINE	Native	Regularly occurring			Rev Status	4	6	6	4	Y	
Synaptomys borealis artemisiae	Northern Bog Lemming, *artemisiae* subspecies	M-SYBO-AR	G4T2T3	4-Oct-99	S2S3	8-Dec-06	30-Jun-98			Blue					Vertebrate Animal	mammals	Subspecies	Animalia	Craniata	Mammalia	Rodentia	Cricetidae	DCS;DOS	3;8	CSRD;NORD;RDCO;RDOS;TNRD	ESSF;IDF;MS	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring		N	Taxonomy	1	1	6	2	Y	
Taxidea taxus	Badger	M-TATA	G5	7-Mar-05	S1	8-Dec-06	13-Oct-00	E (May 2000)		Red	Y (May 2004)		1	3 - Sensitive (2005)	Vertebrate Animal	mammals	Species	Animalia	Craniata	Mammalia	Carnivora	Mustelidae	DAB;DCC;DCH;DCS;DKA;DKL;DMH;DOS;DQU;DRM	3;4;5;8	CSRD;Cariboo;NORD;RDCK;RDCO;RDEK;RDKB;RDOS;SLRD;TNRD	BG;ESSF;ICH;IDF;IMA;MS;PP;SBPS	TERRESTRIAL	Native	Regularly occurring			Status Rpt; Wildlife Act; Plan; COSEWIC; Hab Restore; Hab Protect; Private Land; Species Mgmt	1	6	6	1	Y	
Tyto alba	Barn Owl	B-BNOW	G5	27-Nov-96	S3	10-Jan-09	1-Jun-96	SC (Nov 2001)		Blue			1	3 - Sensitive (2005)	Vertebrate Animal	birds	Species	Animalia	Craniata	Aves	Strigiformes	Tytonidae	DCK;DCR;DOS;DSI	1;2;3;8	CRD;CSRD;CVRD;ComoxVRD;FVRD;GVRD;NORD;RDN;RDOS;SRD	BG;BWBS;CDF;CWH;ICH;IDF;PP	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring	Y		Monitor Trend; Status Rpt; COSEWIC; Hab Protect; Species Mgmt; Plan; Private Land	2	6	2	3	Y	
Ursus arctos	Grizzly Bear	M-URAR	G4	17-Feb-00	S3	8-Dec-06	30-Nov-95	SC (May 2002)		Blue	Y (May 2004)			3 - Sensitive (2005)	Vertebrate Animal	mammals	Species	Animalia	Craniata	Mammalia	Carnivora	Ursidae	DAB;DCC;DCH;DCK;DCO;DCR;DCS;DFN;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DNC;DND;DNI;DOS;DPC;DPG;DQU;DRM;DSC;DSQ;DSS_B;DSS_C;DVA	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;FVRD;GVRD;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	BAFA;BWBS;CMA;CWH;ESSF;ICH;IDF;IMA;MH;MS;SBPS;SBS;SWB	PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Monitor Trend; COSEWIC; Status Rpt; Plan; Hab Restore; Private Land; Hab Protect; Species Mgmt; Review Use	2	3	2	3	N	There are complications with defining and mapping occurrences of wide ranging carnivores; until this is resolved or a surrogate developed this species will not be mapped.
Vallonia cyclophorella	Silky Vallonia	IM-VALCYC	G5	1-Oct-04	S3	16-Dec-08	15-Mar-05			Blue					Invertebrate Animal	gastropods	Species	Animalia	Mollusca	Gastropoda	Stylommatophora	Valloniidae	DAB;DCS;DKA;DKL;DOS;DRM	3;4;8	NORD;RDCK;RDCO;RDEK;RDKB;RDOS;TNRD	BG;IDF;PP	TERRESTRIAL	Native	Regularly occurring				4	6	4	4	Y	
Zonitoides nitidus	Black Gloss	IM-ZONNIT	G5	31-Dec-03	S3S4	16-Dec-08	15-Mar-05			Blue					Invertebrate Animal	gastropods	Species	Animalia	Mollusca	Gastropoda	Stylommatophora	Zonitidae	DAB;DCK;DCR;DOS;DSI	1;2;4;8	ACRD;CRD;CVRD;ComoxVRD;FVRD;GVRD;NORD;RDCK;RDCO;RDMW;RDN;RDOS;SRD	CDF;CWH;IDF;PP	PALUSTRINE	Native	Regularly occurring				4	6	4	4	W	No occurrences mapped.

Appendix B – BCCDC Rare Vascular Plants

Scientific Name	English Name	RISC Code	Global Status	Global Status Review Date	Prov Status	Prov Status Review Date	Prov Status Change Date	COSEWIC	COSEWIC Comments	BC List	Identified Wildlife	Prov Wildlife Act	SARA	National GS	Name Category	Class (English)	Species Level	Kingdom	Phylum	Class	Order	Family
Achnatherum thurberianum	Thurber's needlegrass	ACHNTHU	G5	29-Sep-87	S1	30-Sep-08	30-Sep-08			Red					Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Poaceae
Agastache urticifolia	nettle-leaved giant-hyssop	AGASURT	G5	15-Nov-00	S3	3-Oct-01	3-Oct-01			Blue				3 - Sensitive (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Lamiales	Lamiaceae
Agoseris elata	tall agoseris	AGOSELA	G4	5-May-88	S1S2	18-Nov-04	18-Nov-04			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Asterales	Asteraceae
Agoseris lackschewitzii	pink agoseris	AGOSLAC	G4	21-Mar-97	S2S3	29-Dec-00	21-Jan-99			Blue				3 - Sensitive (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Asterales	Asteraceae
Aloina bifrons		ALOIBIF	G3	1-Dec-00	S2S3					Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Pottiales	Pottiaceae
Alopecurus carolinianus	Carolina meadow-foxtail	ALOPCAR	G5	2-Apr-86	S2	29-Dec-00	5-Apr-00			Red				4 - Secure (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Poaceae
Ammannia robusta	scarlet ammannia	AMMAROB	G5	18-Nov-93	S1	27-Sep-07	30-Apr-96	E (May 2001)		Red			1	1 - At Risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Myrtales	Lythraceae
Anemone drummondii var. *drummondii*	alpine anemone	ANEMDRU1	G4T4	17-Sep-97	S2S3	29-Dec-00	30-Apr-96			Blue					Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Ranunculales	Ranunculaceae
Antennaria flagellaris	stoloniferous pussytoes	ANTEFLA	G5?	6-Jul-93	S1	24-Mar-05	10-Mar-97	E (May 2004)		Red			1	1 - At Risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Asterales	Asteraceae
Apocynum x floribundum	western dogbane	APOCXFL	GNA	28-Oct-92	S2S3	29-Dec-00	4-Jan-00			Blue					Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Gentianales	Apocynaceae
Arabis lignifera	woody-branched rockcress	ARABLIG	G5	29-Sep-87	S2S3	29-Dec-00	30-Apr-96			Blue				3 - Sensitive (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Capparales	Brassicaceae
Arabis sparsiflora	sickle-pod rockcress	ARABSPA	G5	13-May-88	S1	29-Dec-00	30-Apr-96			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Capparales	Brassicaceae
Arnica longifolia	seep-spring arnica	ARNILON	G5	1-Aug-88	S2S3	28-Nov-01	28-Nov-01			Blue				3 - Sensitive (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Asterales	Asteraceae
Astragalus lentiginosus	freckled milk-vetch	ASTRLEN	G5	9-Aug-84	S3	10-Sep-07	30-Oct-07			Blue				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Fabales	Fabaceae
Astragalus sclerocarpus	The Dalles milk-vetch	ASTRSCL	G5	8-Feb-89	S2	29-Dec-00	30-Apr-96			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Fabales	Fabaceae
Atriplex argentea ssp. *argentea*	silvery orache	ATRIARG1	G5T5	17-Sep-97	S1	29-Dec-00	30-Apr-96			Red					Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Caryophyllales	Chenopodiaceae
Atriplex truncata	wedgescale orache	ATRITRU	G5	1-Aug-88	S1	29-Dec-00	27-Oct-99			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Caryophyllales	Chenopodiaceae
Berula erecta	cut-leaved water-parsnip	BERUERE	G4G5	23-Feb-84	S3	30-Sep-08	30-Sep-08			Blue				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Apiales	Apiaceae
Bidens vulgata	tall beggarticks	BIDEVUL	G5	29-Sep-87	S1	29-Dec-00	30-Apr-96			Red				4 - Secure (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Asterales	Asteraceae
Bolboschoenus fluviatilis	river bulrush	BOLBFLU	G5	6-Sep-84	S1S2	28-Nov-05	28-Nov-05			Red				4 - Secure (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Cyperaceae
Botrychium ascendens	upswept moonwort	BOTRASC	G2G3	6-May-03	S2	2-Jan-02	2-Jan-02			Red				2 - May be at risk (2005)	Vascular Plant		Species	Plantae	Filicinophyta	Ophioglossopsida	Ophioglossales	Ophioglossaceae
Botrychium paradoxum	two-spiked moonwort	BOTRPAR	G2	10-Nov-97	S1	29-Dec-00	30-Apr-96			Red				2 - May be at risk (2005)	Vascular Plant		Species	Plantae	Filicinophyta	Ophioglossopsida	Ophioglossales	Ophioglossaceae
Bouteloua gracilis	blue grama	BOUTGRA	G5	19-May-98	S2	10-Sep-07	30-Oct-07			Red				4 - Secure (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Poaceae
Brickellia oblongifolia ssp. *oblongifolia*	narrow-leaved brickellia	BRICOBL2	G5T5	17-Sep-97	S2S3	10-Sep-07	30-Oct-07			Blue					Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Asterales	Asteraceae
Bryoerythrophyllum columbianum	Columbian carpet moss	BRYOCOL	G3G4	5-May-08	S2S3	10-Sep-07	30-Oct-07	SC (May 2004)		Blue			1		Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Pottiales	Pottiaceae
Bryum capillare var. *barbatum*		BRYUCAP3	G5TNR		S1S3	5-Apr-00	5-Apr-00			Red					Nonvascular Plant		Variety	Plantae	Bryophyta	Bryopsida	Bryales	Bryaceae
Bryum muehlenbeckii		BRYUMUE	G4G5	18-Apr-91	S2S3					Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Bryales	Bryaceae
Bryum violaceum		BRYUVIO	G5?	10-Mar-00	S1					Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Bryales	Bryaceae
Cacaliopsis nardosmia	silvercrown	CACANAR	G4G5	1-Aug-88	S1	29-Dec-00	29-Dec-99			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Asterales	Asteraceae
Callitriche heterophylla ssp. *heterophylla*	two-edged water-starwort	CALLHET2	G5T5	30-Jun-98	S2S3	29-Dec-00	30-Apr-96			Blue					Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Callitrichales	Callitrichaceae
Calochortus lyallii	Lyall's mariposa lily	CALOLYA	G3G4	12-May-08	S2S3	10-Sep-07	30-Oct-07	T (May 2001)		Blue			1	1 - At Risk (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Liliales	Liliaceae
Calyptridium umbellatum var. *caudiciferum*	Mount Hood pussypaws	CALYUMB1	G4G5T4T5	2-Aug-02	S2S3	29-Dec-00	5-Apr-00			Blue					Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Caryophyllales	Portulacaceae
Camissonia andina	Andean evening-primrose	CAMIAND	G4	17-Jul-86	S1	29-Dec-00	30-Apr-96			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Myrtales	Onagraceae
Camissonia breviflora	short-flowered evening-primrose	CAMIBRE	G5	1-Aug-88	S1	29-Dec-00	12-Jan-99			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Myrtales	Onagraceae
Campylium radicale		CAMPRAD	G3G5	18-Apr-91	S1S3	5-Apr-00	5-Apr-00			Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Hypnales	Amblystegiaceae
Carex comosa	bearded sedge	CARECOM	G5	18-May-98	S2	28-Nov-05	28-Nov-05			Red				4 - Secure (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Cyperaceae
Carex epapillosa	blackened sedge	CAREEPA	GNR	10-May-05	SH	12-Sep-08	12-Sep-08			Red				3 - Sensitive (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Cyperaceae
Carex scopulorum var. *bracteosa*	Holm's Rocky Mountain sedge	CARESCP1	G5T3T5	2-Aug-02	S2S3	29-Dec-00	30-Apr-96			Blue					Vascular Plant	monocots	Variety	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Cyperaceae
Carex sychnocephala	many-headed sedge	CARESYC	G4	15-Dec-88	S3	12-Dec-01	11-Dec-01			Blue				4 - Secure (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Cyperaceae
Carex vallicola var. *vallicola*	valley sedge	CAREVAL1	G5T5	2-Aug-02	S1	29-Dec-00	20-Dec-00			Red					Vascular Plant	monocots	Variety	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Cyperaceae
Carex vulpinoidea	fox sedge	CAREVUL	G5	29-Feb-84	S2S3	29-Dec-00	30-Apr-96			Blue				4 - Secure (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Cyperaceae
Castilleja cusickii	Cusick's paintbrush	CASTCUS	G4G5	22-Jan-92	S1	29-Dec-00	6-Oct-00			Red				3 - Sensitive (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Scrophulariales	Scrophulariaceae
Castilleja minor ssp. *minor*	annual paintbrush	CASTMIO1	G5T5	5-Jul-95	S1	29-Dec-00	30-Apr-96			Red					Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Scrophulariales	Scrophulariaceae
Centaurium exaltatum	western centaury	CENTEXA	G5	14-Dec-83	S1	29-Dec-00	30-Apr-96			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Gentianales	Gentianaceae
Chamaesyce serpyllifolia ssp. *serpyllifolia*	thyme-leaved spurge	CHAMSER1	G5T5	1-Jan-01	S2S3	29-Dec-00	30-Apr-96			Blue					Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Euphorbiales	Euphorbiaceae
Chenopodium atrovirens	dark lamb's-quarters	CHENATR	G5	3-Aug-88	S1	29-Dec-00	30-Apr-96			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Caryophyllales	Chenopodiaceae
Collomia tenella	slender collomia	COLLTEE	G4?	29-Sep-87	S1	24-Mar-05	21-Jul-97	E (Nov 2003)		Red			1	1 - At Risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Solanales	Polemoniaceae
Coreopsis tinctoria var. *atkinsoniana*	Atkinson's coreopsis	CORETIN1	G5T5	5-Sep-00	S1	29-Dec-00	30-Apr-96			Red					Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Asterales	Asteraceae
Coscinodon cribrosus		COSCCRI	G3G4	28-Nov-00	S1					Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Grimmiales	Grimmiaceae
Crepis atribarba ssp. *atribarba*	slender hawksbeard	CREPATR1	G5T5	17-Sep-97	S1	29-Dec-00	30-Apr-96			Red					Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Asterales	Asteraceae
Crossidium seriatum		CROSSER	G2	20-Mar-00	S1	4-Feb-00	4-Feb-00			Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Pottiales	Pottiaceae
Cryptantha ambigua	obscure cryptantha	CRYPAMB	G4	24-Feb-88	S3	30-Oct-06	30-Apr-96			Blue				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Lamiales	Boraginaceae
Cryptantha celosioides	cockscomb cryptantha	CRYPCEL	G5	1-Oct-87	S1	29-Dec-00	30-Apr-96			Red				4 - Secure (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Lamiales	Boraginaceae
Cryptantha watsonii	Watson's cryptantha	CRYPWAT	G5	24-Feb-88	S1	29-Dec-00	30-Apr-96			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Lamiales	Boraginaceae
Cuscuta campestris	field dodder	CUSCPEN	G5	28-Jun-07	S2S3	29-Dec-00	30-Apr-96			Blue					Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Solanales	Cuscutaceae
Cyperus erythrorhizos	red-rooted cyperus	CYPEERY	G5	24-Apr-84	S1	29-Dec-00	30-Apr-96			Red				3 - Sensitive (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Cyperaceae
Cyperus squarrosus	awned cyperus	CYPESQU	G5	24-Jun-93	S3	3-Oct-01	3-Oct-01			Blue				4 - Secure (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Cyperaceae
Delphinium bicolor ssp. *bicolor*	Montana larkspur	DELPBIC1	G4G5T4T5	2-Aug-02	S2S3	29-Dec-00	11-Feb-00			Blue					Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Ranunculales	Ranunculaceae
Delphinium glareosum	rockslide larkspur	DELPGLA	G3G4	8-Nov-02	S1	29-Dec-00	17-Feb-99			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Ranunculales	Ranunculaceae
Descurainia sophioides	northern tansy mustard	DESCSOH	G5	29-Apr-94	S1S3	25-Oct-06	25-Oct-06			Blue				4 - Secure (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Capparales	Brassicaceae
Desmatodon cernuus		DESMCER	G3G5	18-Apr-91	S2S3					Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Pottiales	Pottiaceae
Desmatodon heimii		DESMHEI	G5	18-Apr-91	S2S3	10-Feb-00	10-Feb-00			Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Pottiales	Pottiaceae
Desmatodon obtusifolius		DESMOBT	G5	18-Apr-91	S2S3					Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Pottiales	Pottiaceae
Dicentra uniflora	steer's head	DICEUNI	G4?	18-Jan-95	S2S3	28-Nov-01	28-Nov-01			Blue				3 - Sensitive (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Papaverales	Fumariaceae
Didymodon nevadensis		DIDYNEV	G2G3	21-Jan-99	S1	27-Dec-96	27-Dec-96			Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Pottiales	Pottiaceae
Didymodon vinealis var. *brachyphyllus*		DIDYVIN1	G5TNR		S2					Blue					Nonvascular Plant		Variety	Plantae	Bryophyta	Bryopsida	Pottiales	Pottiaceae
Draba alpina	alpine draba	DRABALP	G4G5	1-Mar-01	S2S3	28-Nov-01	28-Nov-01			Blue				4 - Secure (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Capparales	Brassicaceae
Draba densifolia	Nuttall's draba	DRABDEN	G5	30-Nov-90	S2S3	28-Nov-01	28-Nov-01			Blue				3 - Sensitive (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Capparales	Brassicaceae
Draba lonchocarpa var. *thompsonii*	lance-fruited draba	DRABLON2	G5T3T4	9-Feb-00	S2S3	29-Dec-00	30-Apr-96			Blue					Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Capparales	Brassicaceae
Drepanocladus aduncus var. *kneiffii*		DREPADU	G5T4T5	19-Apr-91	S2S3					Blue					Nonvascular Plant		Variety	Plantae	Bryophyta	Bryopsida	Hypnales	Amblystegiaceae
Eleocharis coloradoensis	dwarf spike-rush	ELEOCOL	GNR		SH	30-Sep-08	30-Sep-08			Red					Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Cyperaceae
Eleocharis geniculata	bent spike-rush	ELEOGEN	G5	16-Jan-90	S1	30-Sep-08	30-Sep-08	E (Apr 2009)		Red					Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Cyperaceae
Eleocharis rostellata	beaked spike-rush	ELEOROS	G5	25-Aug-00	S2S3	29-Dec-00	5-Apr-00			Blue				3 - Sensitive (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Cyperaceae
Elodea nuttallii	Nuttall's waterweed	ELODNUT	G5	24-Apr-84	S2S3	29-Dec-00	30-Apr-96			Blue				3 - Sensitive (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Hydrocharitales	Hydrocharitaceae
Encalypta intermedia		ENCAINT	G4	7-May-04	S2S3					Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Pottiales	Encalyptaceae
Encalypta spathulata		ENCASPA	G3	8-Dec-99	S1S3	5-Apr-00	5-Apr-00			Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Pottiales	Encalyptaceae
Entosthodon rubiginosus	rusty cord-moss	ENTORUB	G1G3	11-Jun-06	S1	30-Sep-08	30-Sep-08	E (Nov 2004)		Red			1		Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Funariales	Funariaceae
Epilobium glaberrimum ssp. *fastigiatum*	smooth willowherb	EPILGLA1	G5T4T5	6-Jul-04	S2S3	29-Dec-00	30-Apr-96			Blue					Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Myrtales	Onagraceae
Epilobium halleanum	Hall's willowherb	EPILHAL	G5	4-Aug-88	S2S3	29-Dec-00	30-Apr-96			Blue				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Myrtales	Onagraceae
Epilobium leptocarpum	small-fruited willowherb	EPILLEP	G5	24-Apr-84	S2S3	29-Dec-00	30-Apr-96			Blue				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Myrtales	Onagraceae
Epilobium mirabile	hairy-stemmed willowherb	EPILMIR	G4Q	16-May-88	S1S3	28-Nov-05	28-Nov-05			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Myrtales	Onagraceae
Epipactis gigantea	giant helleborine	EPIPGIG	G4	1-Dec-06	S2S3	29-Dec-00	28-Feb-00	SC (May 1998)		Blue			3	3 - Sensitive (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Orchidales	Orchidaceae
Erigeron leibergii	Leiberg's fleabane	ERIGLEI	G3?	26-Jul-00	S1	29-Jan-02	29-Jan-02			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Asterales	Asteraceae
Erigeron poliospermus var. *poliospermus*	cushion fleabane	ERIGPOL1	G4T4	17-Sep-97	S2S3	28-Nov-01	28-Nov-01			Blue					Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Asterales	Asteraceae
Eriogonum pyrolifolium var. *coryphaeum*	alpine buckwheat	ERIOPYR1	G4T4?	2-Aug-02	S1S3	28-Nov-05	28-Nov-05			Red					Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Polygonales	Polygonaceae
Eriogonum strictum var. *proliferum*	strict buckwheat	ERIOSTR2	G5TNR		S1	29-Dec-00	30-Apr-96			Red					Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Polygonales	Polygonaceae
Festuca minutiflora	little fescue	FESTMIN	G5	11-Mar-93	S2S3	29-Dec-00	5-Apr-00			Blue				3 - Sensitive (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Poaceae
Festuca washingtonica	Washington fescue	FESTWAS	GNR		S2	30-Sep-08	30-Sep-08			Red					Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Poaceae
Floerkea proserpinacoides	false-mermaid	FLOEPRO	G5	16-May-84	S2S3	29-Dec-00	5-Apr-00	NAR (May 1984)		Blue				4 - Secure (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Geraniales	Limnanthaceae
Fontinalis hypnoides		FONTHYP	G4G5	22-Apr-91	S1S3	5-Apr-00	5-Apr-00			Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Leucodontales	Fontinalaceae
Funaria muhlenbergii		FUNAMUH	G4	3-Mar-95	S2S3	10-Feb-00	10-Feb-00			Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Funariales	Funariaceae
Gaura coccinea	scarlet gaura	GAURCOC	G5	16-Jan-90	S1	29-Dec-00	30-Apr-96			Red				4 - Secure (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Myrtales	Onagraceae
Gayophytum humile	dwarf groundsmoke	GAYOHUM	G5	16-Jan-90	S2S3	29-Dec-00	21-Jan-99			Blue				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Myrtales	Onagraceae
Gayophytum ramosissimum	hairstem groundsmoke	GAYORAM	G5	1-Oct-87	S1	29-Dec-00	30-Apr-96			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Myrtales	Onagraceae
Gentiana affinis	prairie gentian	GENTAFF	G5	12-May-99	S2S3	28-Nov-01	28-Nov-01			Blue				4 - Secure (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Gentianales	Gentianaceae
Gilia sinuata	shy gilia	GILISIN	G5	29-Sep-87	SH	29-Dec-00	30-Apr-96			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Solanales	Polemoniaceae

Scientific Name	Forest Dist	MOE Region	Regional Dist	BGC	Habitat Type	Origin	Presence	Breeding Bird	Endemic	Action Groups	Highest Priority	Priority Goal 1	Priority Goal 2	Priority Goal 3	CDC Maps	Mapping Status
Achnatherum thurberianum	DOS	8	RDOS	BGxh;PPxh		Native	Regularly occurring			Status Rpt; Wildlife Act; Plan; COSEWIC; Hab Protect; Hab Restore; Private Land	1	5	6	1	Y	
Agastache urticifolia	DAB;DOS	4;8	RDKB;RDOS	BGxh;ESSFdc;ICHdw;ICHmk;ICHmw;IDFdm;IDFxh;MSxk;PPdh;PPxh	TERRESTRIAL	Native	Regularly occurring			Inventory; Status Rpt	2	6	2	3	Y	
Agoseris elata	DCK	8	FVRD;RDOS	ESSFmw	TERRESTRIAL	Native	Regularly occurring			Taxonomy	2	5	6	2	Y	
Agoseris lackschewitzii	DAB;DCO;DCS;DHW;DKA;DOS;DRM	3;4;8	CSRD;NORD;RDCK;RDEK;RDOS;TNRD	BAFA;CMA;ESSFmw;ESSFwc;ESSFwcp;ESSFxc;ICHmw;ICHwk;IDFdk;IMA;MSdm	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring		N	Inventory	3	4	6	3	Y	
Aloina bifrons	DKA;DOS	3;4;8	RDOS;TNRD	BG;IDF;PP		Native	Regularly occurring			Inventory	2	3	6	2	N	
Alopecurus carolinianus	DCK;DCR;DCS;DSC;DSI	1;2;3;8	CRD;ComoxVRD;FVRD;GVRD;RDOS;SRD	CDFmm;CWHdm;CWHds;IDFxh	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Inventory	3	6	6	3	Y	
Ammannia robusta	DOS	8	RDOS	BGxh	LACUSTRINE;PALUSTRINE	Native	Regularly occurring			Status Rpt; Wildlife Act; COSEWIC; Plan; Hab Protect; Hab Restore; Species Mgmt; Private Land	1	6	6	1	Y	
Anemone drummondii var. *drummondii*	DCK;DCS;DOS;DSI	1;2;8	ACRD;CVRD;FVRD;RDOS	CMA;CWHvh;ESSFxc;IMA;MHmm	TERRESTRIAL	Native	Regularly occurring			No New Actn	3	4	6	3	Y	
Antennaria flagellaris	DCS	8	RDOS	IDFxh	TERRESTRIAL	Native	Regularly occurring			Status Rpt; Wildlife Act; COSEWIC; Plan; Hab Protect; Hab Restore; Private Land; Species Mgmt	1	6	6	1	Y	
Apocynum x floribundum	DAB;DCH;DCK;DCS;DKA;DMH;DMK;DOS;DPG;DRM;DSS_B	2;3;4;5;7;8	Cariboo;FVRD;NORD;PRRD;RDEK;RDFFG;RDKB;RDKS;RDOS;TNRD	BGxh;BWBSdk;CWHdm;CWHxm;ICHmc;ICHmk;IDFdm;IDFww;IDFxh;IDFxm;PPxh;SBSwk	TERRESTRIAL	Native	Regularly occurring			No New Actn	3	Not Assessed	6	3	N	
Arabis lignifera	DCH;DCS;DKA;DMH;DMK;DOS;DSS_C	3;5;6;7;8	Cariboo;NORD;RDFFG;RDKS;RDOS;Stikine;TNRD	BAFAunp;BGxh;BGxw;BWBSdk;ESSFdc;ESSFmw;ESSFxcp;ICHmk;IDFdk;IDFdw;IDFxh;SBSdw;SBSun;SBSwk	TERRESTRIAL	Native	Regularly occurring			No New Actn	3	6	6	3	Y	
Arabis sparsiflora	DCC;DCH;DCS;DJA;DKA;DOS;DPC	3;5;7;8;9	Cariboo;PRRD;RDBN;RDOS;TNRD	BGxh;BGxw;BWBSmw;IDFdk;IDFxh;MSxk;SBSdw	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Arnica longifolia	DCO;DOS	4;8	CSRD;RDOS	ESSFxcp;ICHvk;IMAun	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			No New Actn	3	6	6	3	Y	
Astragalus lentiginosus	DCS;DKA;DOS	3;8	RDCO;RDOS;TNRD	BGxh;BGxw;IDFdk;IDFxh;PPxh	TERRESTRIAL	Native	Regularly occurring			Inventory	4	6	4	4	Y	
Astragalus sclerocarpus	DOS	8	RDOS	BGxh	TERRESTRIAL	Native	Regularly occurring			Inventory	2	5	6	2	Y	
Atriplex argentea ssp. *argentea*	DCC;DCH;DCS;DKA;DOS;DRM	3;4;5;8	Cariboo;RDEK;RDOS;TNRD	BGxh;BGxw;IDFdm;IDFxh;IDFxm;PPxh	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Atriplex truncata	DCC;DCH;DCS;DKA;DOS	3;5;8	Cariboo;RDOS;TNRD	BGxh;BGxw;IDFdk;IDFxh;IDFxm	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Berula erecta	DCK;DOS	2;8	FVRD;NORD;RDOS	BGxh;CWHdm;IDFxh;PPxh	LACUSTRINE;PALUSTRINE	Native	Regularly occurring			Inventory	2	5	2	3	Y	
Bidens vulgata	DAB;DKA;DKL;DOS	3;4;8	RDCK;RDKB;RDOS;TNRD	BGxh;ICHxw	LACUSTRINE;PALUSTRINE	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Bolboschoenus fluviatilis	DOS;DSI	1;8	ACRD;RDOS	BGxh;CWHvh	LACUSTRINE;PALUSTRINE	Native	Regularly occurring			Inventory; Status Rpt; Wildlife Act; COSEWIC; Plan; Hab Protect; Hab Restore; Private Land	1	6	6	1	Y	
Botrychium ascendens	DCH;DOS;DPC;DQU;DRM;DSC;DSS_B	2;4;5;6;8;9	Cariboo;PRRD;PowellR;RDEK;RDKS;RDOS	BAFA;CMA;CWHxm;ESSFdk;ESSFmm;IDFdk;IDFxh;IMA	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Inventory	1	1	6	3	Y	
Botrychium paradoxum	DOS	8	RDOS	MSxk	TERRESTRIAL	Native	Regularly occurring			Inventory	2	3	6	2	Y	
Bouteloua gracilis	DCS;DOS;DRM	3;4;5;8	RDEK;RDOS;TNRD	BGxh;BGxw;IDFdk;IDFdm;IDFxh;IDFxw;PPdh;PPxh	TERRESTRIAL	Native	Regularly occurring			Inventory	2	4	6	2	Y	
Brickellia oblongifolia ssp. *oblongifolia*	DAB;DCS;DOS	8	RDKB;RDOS	BGxh;IDFxh;PPdh;PPxh	TERRESTRIAL	Native	Regularly occurring			Inventory	3	6	6	3	Y	
Bryoerythrophyllum columbianum	DKA;DOS	3;8	RDOS;TNRD	BG;IDF;MH;PP	TERRESTRIAL	Native	Regularly occurring			Status Rpt; COSEWIC; Wildlife Act; Plan; Private Land; Hab Protect; Hab Restore	2	2	6	2	Y	
Bryum capillare var. *barbatum*	DCK	8	RDOS	ESSF		Native	Regularly occurring			Inventory	2	5	6	2	N	
Bryum muehlenbeckii	DAB;DCK;DCR;DCS;DFN;DKA;DKL;DNC;DOS;DQC;DSI;DSQ;DSS_C	1;2;3;4;6;8;9	CRD;CVRD;FVRD;GVRD;RDCK;RDCO;RDKB;RDN;RDOS;SLRD;SQCRD;SRD;Stikine;TNRD	BAFA;CWH;ESSF;IDF;MH		Native	Regularly occurring			No New Actn	3	5	6	3	N	
Bryum violaceum	DOS;DSI	1;8	CRD;RDOS	CDF		Native	Regularly occurring			Inventory	2	4	6	2	N	
Cacaliopsis nardosmia	DCK	8	FVRD;RDOS	ESSFmw	TERRESTRIAL	Native	Regularly occurring		N	Inventory	2	5	6	2	Y	
Callitriche heterophylla ssp. *heterophylla*	DCK;DCR;DCS;DNC;DQC;DSI;DSS_C	1;2;6;8;9	CRD;FVRD;GVRD;RDKS;RDMW;RDOS;SQCRD;Stikine	BAFAunp;CDFmm;CWHdm;CWHmm;CWHxm	ESTUARINE;LACUSTRINE;PALUSTRINE	Native	Regularly occurring			No New Actn	3	6	6	3	Y	
Calochortus lyallii	DOS	8	RDOS	IDFxh	TERRESTRIAL	Native	Regularly occurring			Status Rpt; Wildlife Act; COSEWIC; Hab Protect; Hab Restore; Plan; Private Land	1	1	6	1	Y	
Calyptridium umbellatum var. *caudiciferum*	DCS;DOS	8	RDOS	BAFA;CMA;ESSFxc;IMA	TERRESTRIAL	Native	Regularly occurring			No New Actn	3	5	6	3	Y	
Camissonia andina	DOS	8	RDOS	BGxh	TERRESTRIAL	Native	Regularly occurring			Status Rpt; COSEWIC; Wildlife Act; Plan; Hab Protect; Private Land	1	5	6	1	Y	
Camissonia breviflora	DCH;DOS;DPG	5;7;8	Cariboo;RDFFG;RDOS	IDFdk;MSdk;SBSmk	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Campylium radicale	DCO;DCS;DHW;DOS	3;4;7;8	CSRD;RDFFG;RDOS;SLRD	BAFA;BG;ICH		Native	Regularly occurring			Inventory	2	3	6	2	N	
Carex comosa	DCK;DHW;DKL;DOS	2;3;4;8	CSRD;FVRD;RDOS;TNRD	BGxh;CWHdm;CWHds;ICHmw;IDFmw;IDFxh	LACUSTRINE;PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Inventory	3	6	6	3	Y	
Carex epapillosa	DOS	4;8	RDOS	ESSFxc;ESSFxcp	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Inventory	2	Not Assessed	6	2	Y	
Carex scopulorum var. *bracteosa*	DAB;DCS;DOS	4;8	RDCK;RDKB;RDOS	BGxh;ESSFdcp;ESSFxc;ESSFxcp;IDFxh;IMA	LACUSTRINE;PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Inventory	2	3	6	2	Y	
Carex sychnocephala	DCH;DCO;DCS;DKA;DOS;DRM;DVA	3;4;5;7;8	Cariboo;NORD;RDCO;RDEK;RDOS;SLRD;TNRD	BGxh;BGxw;IDFdk;IDFdm;IDFmw;IDFxh;IDFxm;MSdk;PPxh;SBPSxc;SBSdk	LACUSTRINE;PALUSTRINE;TERRESTRIAL	Native	Regularly occurring				4	5	4	4	Y	
Carex vallicola var. *vallicola*	DCS;DOS	3;8	RDOS;TNRD	ESSFxc;IDFxh;MSdm	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Carex vulpinoidea	DAB;DCK;DCS;DKL;DOS	2;3;4;8	FVRD;GVRD;NORD;RDCK;RDOS	BGxh;CWHdm;CWHxm;ICHmw;IDFmw;IDFxh	LACUSTRINE;PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Castilleja cusickii	DCS;DKA;DRM	3;4;8	RDEK;RDOS;TNRD	IDFdk;IDFun;IDFxh;MSdk	PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Inventory	2	5	6	2	Y	
Castilleja minor ssp. *minor*	DOS;DRM	4;8	RDEK;RDOS	BGxh;IDFdm	LACUSTRINE;PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Centaurium exaltatum	DKA;DOS	3;8	RDOS;TNRD	BGxh	LACUSTRINE;PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Status Rpt; Wildlife Act; COSEWIC; Plan; Hab Protect; Private Land	1	6	6	1	Y	
Chamaesyce serpyllifolia ssp. *serpyllifolia*	DCS;DKA;DMH;DOS;DSI	1;3;5;8	ACRD;CSRD;RDN;RDOS;TNRD	BGxh;BGxw;CDFmm;CWHxm;IDFmw;IDFxh	LACUSTRINE;PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Monitor Trend	2	6	6	2	Y	
Chenopodium atrovirens	DAB;DCO;DCS;DJA;DKA;DMH;DOS	3;4;5;7;8	CSRD;RDCK;RDOS;TNRD	ICHdw;ICHmk;IDFdm;IDFxh;IDFxw;MSxk;SBSdw	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Collomia tenella	DCS	8	RDOS	IDFdk;IDFxh	TERRESTRIAL	Native	Regularly occurring			Status Rpt; COSEWIC; Wildlife Act; Plan; Private Land; Hab Protect; Hab Restore	2	6	6	2	Y	
Coreopsis tinctoria var. *atkinsoniana*	DAB;DOS	4;8	RDCK;RDOS	BGxh;ICHdw	LACUSTRINE;PALUSTRINE	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Coscinodon cribrosus	DKA;DOS	3;8	RDCO;RDOS;TNRD	BG;IDF		Native	Regularly occurring			Inventory	2	2	6	2	N	
Crepis atribarba ssp. *atribarba*	DCC;DCK;DCS;DKA;DOS	3;5;8	Cariboo;RDCO;RDOS;SLRD;TNRD	BGxh;ESSFmw;PPxh	TERRESTRIAL	Native	Regularly occurring			Status Rpt; Wildlife Act; COSEWIC; Plan; Private Land; Hab Protect; Hab Restore	1	6	6	1	Y	
Crossidium seriatum	DOS	8	RDOS	PP		Native	Regularly occurring			Inventory	1	1	6	2	N	
Cryptantha ambigua	DAB;DCS;DOS;DRM	3;4;8	RDCO;RDEK;RDKB;RDOS;TNRD	BGxh;BGxw;ICHmk;IDFdk;IDFdm;MSdk;MSxk;PPdh	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Inventory	4	5	4	4	Y	
Cryptantha celosioides	DOS	8	NORD;RDOS	BGxh	TERRESTRIAL	Native	Regularly occurring			Inventory	1	6	6	1	Y	
Cryptantha watsonii	DOS	8	RDOS	BGxh	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Cuscuta campestris	DCK;DOS;DSC;DSI	1;2;8	ACRD;CRD;GVRD;NORD;RDN;RDOS;SCRD	BGxh;CDFmm;CWHdm;CWHxm;IDFxh		Native	Regularly occurring			Inventory	2	6	6	2	Y	
Cyperus erythrorhizos	DOS	8	NORD;RDCO;RDOS	BGxh;IDFxh;PPxh	LACUSTRINE;PALUSTRINE	Native	Regularly occurring			Inventory; Status Rpt; Wildlife Act; COSEWIC; Plan; Private Land; Hab Protect	1	6	6	1	Y	
Cyperus squarrosus	DAB;DKA;DOS;DSI	1;3;8	CRD;CVRD;NORD;RDCO;RDKB;RDN;RDOS;TNRD	BGxh;CDFmm;CWHxm;IDFmw;IDFxh;PPxh	LACUSTRINE;PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring				4	6	4	4	Y	
Delphinium bicolor ssp. *bicolor*	DCH;DCO;DCS;DKL;DND;DOS;DRM	3;4;6;8	FVRD;RDBN;RDEK;RDOS	ESSFdk;ESSFdkp;ESSFmcp;ICHdw;ICHmw;IDFdm;MSdk	TERRESTRIAL	Native	Regularly occurring			No New Actn	3	5	6	3	Y	
Delphinium glareosum	DCK	8	RDOS	ESSFmw	TERRESTRIAL	Native	Regularly occurring		N	Inventory	2	4	6	2	Y	
Descurainia sophioides	DCS;DSS_C	6;8	RDOS;Stikine	BWBSdk;IDFdk;MSxk	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Desmatodon cernuus	DCS;DKA;DKL;DMH;DRM	3;4;5;8	RDCK;RDEK;RDOS;TNRD	IDF;MS		Native	Regularly occurring			Inventory	3	4	6	3	N	
Desmatodon heimii	DFN;DKA;DMH;DOS	3;5;6;8;9	CSRD;NRRD;RDCO;RDOS;TNRD	IDF;SWB		Native	Regularly occurring			Inventory	2	5	6	2	N	
Desmatodon obtusifolius	DFN;DKA;DKL;DOS;DQU;DRM;DSI;DSS_B	1;3;4;5;6;8;9	CRD;Cariboo;NRRD;RDCK;RDEK;RDKS;RDOS;TNRD	BG;CDF;ICH;IDF		Native	Regularly occurring			No New Actn	3	6	6	3	N	
Dicentra uniflora	DAB;DCK;DOS	2;4;8	FVRD;RDKB;RDOS	ESSFmw;ESSFwc;ICHdw;ICHmk;IDFdm;IDFww;IDFxh	RIVERINE;TERRESTRIAL	Native	Regularly occurring			Inventory	2	5	6	2	Y	
Didymodon nevadensis	DOS	8	RDOS	BGxh		Native	Regularly occurring			Inventory	1	1	6	2	N	
Didymodon vinealis var. *brachyphyllus*	DCC;DOS	5;8	RDOS;TNRD	BG;IDF;PP		Native	Regularly occurring			Inventory	3	5	6	3	N	
Draba alpina	DCH;DFN;DHW;DOS;DPC;DSS_B	5;6;7;8;9	Cariboo;NRRD;PRRD;RDBN;RDFFG;RDOS;Stikine	BAFA;CMA;ESSFmv;IMA;SWBmk	TERRESTRIAL	Native	Regularly occurring			No New Actn	3	5	6	3	Y	
Draba densifolia	DCH;DOS;DRM	4;5;8	Cariboo;RDEK;RDOS	BAFA;CMA;ESSFdkp;ESSFxcp;IMA	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Draba lonchocarpa var. *thompsonii*	DCK;DKA;DKM;DSS_B;DSS_C	3;6;8	RDKS;RDOS;Stikine;TNRD	BAFA;CMA;IMA	TERRESTRIAL	Native	Regularly occurring		N	Inventory	3	4	6	3	Y	
Drepanocladus aduncus var. *kneiffii*	DCK;DOS	2;8	GVRD;RDOS	CDF;CWH;PP		Native	Regularly occurring			Monitor Trend	2	4	6	2	N	
Eleocharis coloradoensis	DOS	8	RDOS	BGxh		Native	Regularly occurring			Inventory	2	Not Assessed	6	2	Y	
Eleocharis geniculata	DOS	8	RDOS	BGxh		Native	Regularly occurring			Status Rpt; Wildlife Act; COSEWIC; Hab Protect; Species Mgmt; Plan; Hab Restore	1	4	6	1	Y	
Eleocharis rostellata	DCK;DCR;DOS;DRM;DSI	1;2;3;4;8	ACRD;CSRD;FVRD;GVRD;NORD;RDEK;RDOS;SRD;TNRD	CDFmm;CWHdm;CWHxm;ICHmw;IDFdm;IDFmw;MSdm;MSxk	ESTUARINE;LACUSTRINE;PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Inventory	3	6	6	3	Y	
Elodea nuttallii	DCK;DKL;DOS;DRM	2;4;8	FVRD;GVRD;RDCK;RDEK;RDOS	BGxh;CWHdm;ICHdw;ICHmk;ICHxw	ESTUARINE;LACUSTRINE;PALUSTRINE	Native	Regularly occurring			Inventory	3	6	6	3	Y	
Encalypta intermedia	DCS;DHW;DKA;DMK;DOS	3;7;8	PRRD;RDCO;RDOS;SLRD;TNRD	BG;IDF;PP;SWB		Native	Regularly occurring			Monitor Trend; Status Rpt; Plan; Hab Protect; Private Land	2	4	6	2	N	
Encalypta spathulata	DCS;DKA;DRM	3;4;8	RDEK;RDOS;SLRD;TNRD	ESSF;IDF;PP		Native	Regularly occurring			Inventory	2	4	6	2	N	
Entosthodon rubiginosus	DCH;DKA;DOS	3;8	CSRD;RDOS;TNRD	PP	PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Status Rpt; COSEWIC; Wildlife Act; Plan; Private Land; Hab Protect; Species Mgmt	1	1	6	2	Y	
Epilobium glaberrimum ssp. *fastigiatum*	DAB;DCK;DCO;DNI;DOS;DRM;DSC;DSI;DSQ	1;2;3;4;8	ACRD;CSRD;FVRD;RDCK;RDEK;RDMW;RDOS;SLRD;SRD	BAFA;CMA;CWHds;CWHvh;ESSFmw;ESSFvc;ICHdw;ICHmw;IDFun;IDFww;IMA;MSxk	PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			No New Actn	3	5	6	3	Y	
Epilobium halleanum	DCC;DCK;DCS;DKA;DKL;DOS;DPG;DQU;DSI;DSS_C;DVA	1;3;4;5;8	Cariboo;RDOS;TNRD	BGxh;BGxw;CDFmm;ESSFdcp;ICHdw;ICHwk;SBSwk;SWBun	LACUSTRINE;PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Epilobium leptocarpum	DAB;DCC;DCK;DCO;DCS;DFN;DHW;DKM;DMK;DOS;DPC;DQC;DRM;DSI;DSQ;DSS_B;DSS_C	1;2;3;4;5;6;8;9	CSRD;Cariboo;FVRD;GVRD;PRRD;RDCK;RDEK;RDKS;RDN;RDOS;SLRD;SQCRD;TNRD	BAFA;CMA;CWHdm;CWHds;CWHvm;CWHwh;CWHxm;ESSFmw;ESSFwc;ESSFwk;ESSFxv;ICHmc;ICHmw;ICHwk;IMA;MSdk;SBSwk;SWBmk	PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			No New Actn	3	5	6	3	Y	
Epilobium mirabile	DCK	2;8	RDOS	ESSFmw	TERRESTRIAL	Native	Regularly occurring			Inventory	2	4	6	2	Y	
Epipactis gigantea	DAB;DCK;DKA;DKL;DOS;DRM	2;3;4;8	CSRD;NORD;RDCK;RDCO;RDEK;RDOS;TNRD	BGxh;CWHdm;ICHdw;ICHmw;ICHxw;IDFdm;IDFmw;IDFxh;PPxh		Native	Regularly occurring			Monitor Trend; Status Rpt; COSEWIC; Plan; Private Land; Hab Protect; Hab Restore	2	5	6	2	Y	
Erigeron leibergii	DOS	8	RDOS	IDFxh	TERRESTRIAL	Native	Regularly occurring		N	Inventory	2	3	6	2	Y	
Erigeron poliospermus var. *poliospermus*	DOS	8	RDOS	BGxh	TERRESTRIAL	Native	Regularly occurring			Inventory	2	5	6	2	Y	
Eriogonum pyrolifolium var. *coryphaeum*	DOS	8	RDOS	IMA	TERRESTRIAL	Native	Regularly occurring			Inventory	2	5	6	2	Y	
Eriogonum strictum var. *proliferum*	DOS	8	RDOS	IDFdk	TERRESTRIAL	Native	Regularly occurring			Status Rpt; Wildlife Act; COSEWIC; Plan; Hab Protect; Private Land; Hab Restore	1	6	6	1	Y	
Festuca minutiflora	DCH;DHW;DOS;DRM;DSI;DSS_C	1;4;5;6;7;8	ACRD;Cariboo;RDEK;RDFFG;RDKS;RDOS	BAFA;CMAunp;ESSFdkp;ESSFdkw;IMA	TERRESTRIAL	Native	Regularly occurring			No New Actn	3	6	6	3	Y	
Festuca washingtonica	DOS	8	RDOS	IDFxh		Native	Regularly occurring			Inventory	2	Not Assessed	6	2	Y	
Floerkea proserpinacoides	DAB;DOS	4;8	RDCK;RDCO;RDKB;RDOS	ICHdw;ICHmk;IDFmw;MSxk	PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Inventory	3	6	6	3	Y	
Fontinalis hypnoides	DAB;DCK;DCO;DCS;DHW;DKA;DMH;DMK;DOS;DQC;DQU;DRM;DSS	2;3;4;5;6;7;8;9	CSRD;Cariboo;FVRD;RDCK;RDEK;RDFFG;RDOS;SQCRD;Stikine;TNRD	PP		Native	Regularly occurring			Inventory	2	5	6	2	N	
Funaria muhlenbergii	DCK;DCS;DFN;DKA;DOS;DSI	1;3;8;9	CRD;CVRD;FVRD;NRRD;RDCO;RDN;RDOS;SLRD;TNRD	BAFA;BG;CDF;CWH;IDF;MS		Native	Regularly occurring			Monitor Trend; Status Rpt; Plan; Hab Protect; Private Land	2	4	6	2	N	
Gaura coccinea	DKA;DOS;DRM	3;4;8	RDEK;RDOS;TNRD	BGxh;BGxw;IDFdm;IDFun;MSdk;PPxh	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Gayophytum humile	DCK;DCS;DKA;DOS;DRM;DSQ	2;3;4;8	RDOS;SLRD;TNRD	BGxh;ESSFmw;ICHmk;IDFxh;MSdk;MSxk	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Gayophytum ramosissimum	DAB;DOS;DRM	4;8	RDEK;RDKB;RDOS	BGxh;IDFdm;IDFxh;PPdh	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Gentiana affinis	DAB;DOS;DRM	4;8	RDEK;RDKB;RDOS	BGxh;IDFdm;IDFxh	TERRESTRIAL	Native	Regularly occurring			Inventory	3	6	6	3	Y	
Gilia sinuata	DOS	8	RDOS	BGxh	TERRESTRIAL	Native	Regularly occurring			Inventory	1	6	6	1	Y	

Scientific Name	English Name	BISC Code	Global Status	Global Status Review Date	Prov Status	Prov Status Review Date	Prov Status Change Date	COSEWIC	COSEWIC Comments	BC List	Identified Wildlife	Prov Wildlife Act	SARA	National GS	Name Category	Class (English)	Species Level	Kingdom	Phylum	Class	Order	Family	Forest Dist	MOE Region	Regional Dist	BGC	Habitat Type	Origin	Presence	Breeding Bird	Endemic	Action Groups	Highest Priority	Priority Goal 1	Priority Goal 2	Priority Goal 3	CDC Maps	Mapping Status
Gilia tenerrima	slender gilia	GILITEN	G5	16-Aug-88	S1	29-Dec-00	10-Jan-98			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Solanales	Polemoniaceae	DAB;DOS	8	RDKB;RDOS	IDFdm;PPdh	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Grimmia anomala		GRIMANM	G5	18-Aug-98	S1S3	5-Apr-00	5-Apr-00			Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Grimmiales	Grimmiaceae	DCK;DCR;DKL;DSI;DSQ	1;2;4;8	RDCK;RDN;RDOS;SLRD;SRD	CWH;MH		Native	Regularly occurring			Inventory	2	6	6	2	N	
Grimmia elatior		GRIMELA	G3G5	13-Jun-00	S2S3					Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Grimmiales	Grimmiaceae	DCK;DCS;DKL;DOS;DQC;DSC;DSI;DSQ	1;2;3;4;6;8	ACRD;CRD;CVRD;FVRD;GVRD;NORD;RDCK;RDN;RDOS;SLRD;SQCRD;SRD	CDF;CMA;CWH;ICH;IDF		Native	Regularly occurring			Inventory	2	2	6	3	N	
Grimmia incurva		GRIMINC	G4G5	23-Apr-91	S1S3	5-Apr-00	5-Apr-00			Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Grimmiales	Grimmiaceae	DCK;DSQ	2;8	RDOS;SLRD	CMA		Native	Regularly occurring			Inventory	2	5	6	2	N	
Grimmia montana		GRIMMON	G5?	13-Jun-00	S2S3					Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Grimmiales	Grimmiaceae	DAB;DCK;DHW;DKL;DOS;DSI;DSQ;DSS	1;2;3;4;7;8;9	CRD;GVRD;RDCK;RDCO;RDKB;RDOS;SLRD;Stikine;TNRD	CDF;CWH;ESSF;ICH		Native	Regularly occurring			Inventory	2	6	6	2	N	
Grimmia plagiopodia		GRIMPLA	G4G5	23-Apr-91	S1					Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Grimmiales	Grimmiaceae	DKA;DOS	3;8	RDOS;TNRD	BG;PP		Native	Regularly occurring			Inventory	2	5	6	2	N	
Halimolobos whitedii	Whited's halimolobos	HALIWHI	G3?	25-Jul-00	S2S3	10-Sep-07	30-Oct-07			Blue				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Capparales	Brassicaceae	DAB;DOS	8	RDOS	BGxh	TERRESTRIAL	Native	Regularly occurring			Inventory	2	2	6	2	Y	
Hesperostipa spartea	porcupinegrass	HESPSPA	G5	10-Dec-84	S2	26-Nov-02	26-Nov-02			Red				4 - Secure (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Poaceae	DAB;DCC;DCH;DKA;DOS;DPC;DQU	3;4;5;8;9	Cariboo;NORD;PRRD;RDCK;RDOS;TNRD	BGxh;BWBSmw;ICHdw;ICHmw;IDFmw;IDFxm	TERRESTRIAL	Native	Regularly occurring			Inventory	3	6	6	3	Y	
Heterocodon rariflorum	heterocodon	HETERAR	G5	16-May-88	S3	15-Mar-02	7-Mar-01			Blue				3 - Sensitive (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Campanulales	Campanulaceae	DCK;DKL;DOS;DRM;DSC;DSI	1;2;4;8	CRD;CVRD;FVRD;PowellR;RDCK;RDEK;RDKB;RDOS	CDFmm;CWHds;CWHxm;ICHdw;IDFdm;IDFxh;PPdh	PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring				4	6	4	4	Y	
Hutchinsia procumbens	hutchinsia	HUTCPRO	G5	16-Jan-90	S1	29-Dec-00	30-Apr-96			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Capparales	Brassicaceae	DCS;DKA;DOS	1;3;4;8	CRD;RDEK;RDOS;TNRD	BGxh;BGxw;CDFmm;CWHxm;IDFxh	LACUSTRINE;PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Hygrohypnum duriusculum		HYGRDUR	G3G5	6-Jun-00	S2S3					Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Hypnales	Amblystegiaceae	DAB;DCO;DKL;DOS;DQC;DQU;DSS;DSS_C	3;4;5;6;8;9	CSRD;Cariboo;RDCK;RDEK;RDKS;RDOS;SQCRD;Stikine	BAFA;ESSF;ICH;IMA		Native	Regularly occurring			No New Actn	2	2	6	3	N	
Hygrohypnum styriacum		HYGRSTY	GU	23-Oct-00	S2S3					Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Hypnales	Amblystegiaceae	DAB;DCK;DCS;DKL;DMK;DPG;DSQ;DSS;DSS_C	1;2;3;4;6;7;8;9	FVRD;PRRD;RDCK;RDFFG;RDKS;RDOS;SLRD;SRD;Stikine	BAFA;CMA;CWH;ESSF;ICH;IDF;SBS		Native	Regularly occurring			No New Actn	3	Not Assessed	6	3	N	
Hypnum pratense		HYPNPRA	G5	3-Apr-96	S2S3					Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Hypnales	Hypnaceae	DAB;DCC;DCO;DCS;DFN;DHW;DJA;DKA;DND;DNI;DOS;DPG;DQU;DRM;DSI;DSS;DSS_C;DVA	1;3;4;5;6;7;8;9	CRD;CSRD;Cariboo;NORD;NRRD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;Stikine;TNRD	BAFA;BWBS;CWH;ESSF;ICH;IDF;MS;SBPS;SBS;SWB		Native	Regularly occurring			No New Actn	3	6	6	3	N	
Iva axillaris ssp. *robustior*	poverty-weed	IVA AXI1	G5TNR		S1	29-Dec-00	30-Apr-96			Red					Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Asterales	Asteraceae	DCS;DKA;DOS	3;8	RDOS;TNRD	BGxh;BGxw	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Juncus confusus	Colorado rush	JUNCCON	G5	1-Oct-87	S1	29-Dec-00	12-Jan-99			Red				3 - Sensitive (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Juncales	Juncaceae	DAB;DCS;DKA;DKL;DOS;DRM	3;4;8	RDOS;TNRD	BGxh;ICHdw;ICHmk;IDFxh;MSdm	PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Inventory; Status Rpt; Wildlife Act; COSEWIC; Plan; Private Land; Hab Protect; Hab Restore	1	6	6	1	Y	
Lappula occidentalis var. *cupulata*	western stickseed	LAPPOCC1	G5T5	19-Aug-98	S1	29-Dec-00	30-Apr-96			Red					Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Lamiales	Boraginaceae	DAB;DOS	8	RDKB;RDOS	BGxh;ICHmk	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Lepidium densiflorum var. *pubicarpum*	prairie pepper-grass	LEPIDEN4	G5T4	23-Jan-96	S1	29-Dec-00	30-Apr-96			Red					Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Capparales	Brassicaceae	DAB;DKA;DOS;DRM	3;4;8	RDKB;RDOS	BGxh;IDFdm;IDFxh	TERRESTRIAL	Native	Regularly occurring			Inventory	2	5	6	2	Y	
Lewisia columbiana var. *columbiana*	Columbia lewisia	LEWICOL1	G4T4	6-Sep-85	S2S3	28-Nov-05	28-Nov-05			Blue					Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Caryophyllales	Portulacaceae	DCK;DCS	2;8	FVRD;RDOS	IDFdk;MHmm	TERRESTRIAL	Native	Regularly occurring			Inventory	2	5	6	2	Y	
Lewisia triphylla	three-leaved lewisia	LEWITRI	G4?	12-Jun-91	S2S3	28-Nov-01	28-Nov-01			Blue				3 - Sensitive (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Caryophyllales	Portulacaceae	DAB;DCR;DCS;DKL;DRM	1;4;8	RDCK;RDEK;RDOS;SRD	BAFA;CMA;ESSFdcp;ESSFwc;ICHdw;IDFdm;IMA	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Inventory	2	5	6	2	Y	
Lewisia tweedyi	Tweedy's lewisia	LEWITWE	G3	30-Jun-04	S1	29-Dec-00	30-Apr-96			Red					Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Caryophyllales	Portulacaceae	DCK	8	RDOS	ESSFmw	TERRESTRIAL	Native	Regularly occurring			Inventory	2	3	6	2	Y	
Linanthus septentrionalis	northern linanthus	LINASEP	G5	16-Jan-90	S1	30-Oct-06	6-Oct-00			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Solanales	Polemoniaceae	DAB;DCS;DKA;DKL;DOS;DRM	3;4;8	RDCK;RDCO;RDEK;RDKB;RDOS;TNRD	BGxh;BGxw;ESSFdk;ICHdw;ICHmk;IDFdm;IDFxh;MSdk;PPdh	PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring				4	6	4	4	Y	
Lindernia dubia var. *anagallidea*	false-pimpernel	LINDDUB1	G5T4	30-Jul-97	S2S3	15-Oct-01	17-Oct-01			Blue					Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Scrophulariales	Scrophulariaceae	DCK;DKA;DOS	2;3;8	CSRD;GVRD;RDCO;RDOS	BGxh;CWHdm;CWHxm;IDFxh	ESTUARINE;LACUSTRINE;PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Inventory	3	5	6	3	Y	
Lipocarpha micrantha	small-flowered lipocarpha	LIPOMIC	G5	10-Sep-02	S1	29-Dec-00	30-Apr-96	E (Nov 2002)		Red			1	1 - At Risk (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Cyperaceae	DOS	8	RDOS	BGxh	LACUSTRINE;PALUSTRINE	Native	Regularly occurring			Monitor Trend; Status Rpt; Wildlife Act; COSEWIC; Plan; Hab Protect; Species Mgmt; Private Land; Hab Restore	1	6	6	1	Y	
Lomatium brandegeei	Brandegee's lomatium	LOMABRA	G3?	26-Jul-00	S2S3	29-Dec-00	30-Apr-96			Blue				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Apiales	Apiaceae	DCK;DCS;DOS	8	FVRD;RDOS	ESSFdc;ESSFmw;ESSFxc;IDFdk;IDFxh	TERRESTRIAL	Native	Regularly occurring			Inventory	2	3	6	2	Y	
Lomatium triternatum ssp. *platycarpum*	nine-leaved desert-parsley	LOMATRI1	G5T3T5	2-Aug-02	S2	25-Oct-01	25-Oct-01			Red					Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Apiales	Apiaceae	DCO;DCS;DOS;DRM	3;4;8	CSRD;RDEK;RDOS;SLRD;TNRD	BGxh;IDFdk;IDFdm;IDFun;IDFxh;MSdk;PPdh;PPxh	TERRESTRIAL	Native	Regularly occurring			Inventory	3	4	6	3	Y	
Lupinus wyethii	Wyeth's lupine	LUPIWYE	G5	28-Dec-92	S1	29-Dec-00	30-Apr-96			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Fabales	Fabaceae	DOS	8	RDOS	ESSFxc;IMA	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Madia minima	small-headed tarweed	MADIMIN	G4	5-Aug-91	S1	29-Dec-00	14-Sep-99			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Asterales	Asteraceae	DOS;DSI	1;8	CRD;RDOS	BGxh;CWHxm	TERRESTRIAL	Native	Regularly occurring			Inventory	2	5	6	2	Y	
Marsilea vestita	hairy water-clover	MARSVES	G5	8-Apr-86	S1	29-Dec-00	30-Apr-96			Red				2 - May be at risk (2005)	Vascular Plant	ferns	Species	Plantae	Filicinophyta	Filicopsida	Marsileales	Marsileaceae	DCS;DKA;DOS	3;8	CSRD;NORD;RDCO;RDOS;TNRD	BGxh;IDFmw;IDFxh;PPxh	LACUSTRINE;PALUSTRINE	Native	Regularly occurring			Inventory	1	6	6	1	Y	
Melica bulbosa var. *bulbosa*	oniongrass	MELIBUL1	G5TNRQ		S2	29-Dec-00	15-Sep-01			Red					Vascular Plant	monocots	Variety	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Poaceae	DAB;DCK;DCS;DOS;DSS_B	3;6;8	RDBN;RDCO;RDKB;RDOS;TNRD	BGxw;ESSFdc;ESSFmw;ESSFxc;IDFdm;IDFxh;MSxk;PPxh	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Melica fugax	little oniongrass	MELIFUG	G4	23-Feb-88	S2	28-Nov-05	28-Nov-05			Red					Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Poaceae	DCK	8	FVRD;RDOS	ESSFmw	TERRESTRIAL	Native	Regularly occurring			Inventory	3	5	6	3	Y	
Melica spectabilis	purple oniongrass	MELISPE	G5	24-Feb-88	S2S3	29-Dec-00	30-Apr-96			Blue				3 - Sensitive (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Poaceae	DAB;DCH;DCS;DKA;DKL;DND;DOS;DRM	3;4;5;6;8	Cariboo;RDBN;RDCK;RDCO;RDEK;RDKB;RDOS;TNRD	ESSFdcp;ESSFdk;ESSFdkp;ESSFdkw;ESSFwc;ESSFmm;ESSFwc;ESSFvc;ESSFvcp;ICHmk;ICHmw;IDFdk;IDFdw;IMA;MSdk;MSdm;MSxk;SBSdk	PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Inventory	3	6	6	3	Y	
Microbryum vlassovii	nugget moss	MICRVLA	G2?	17-Jul-97	S1			E (Nov 2006)		Red			1		Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Pottiales	Pottiaceae	DCH;DKA;DOS	3;8	RDOS;TNRD	BG;PP		Native	Regularly occurring			Inventory	1	1	6	1	Y	
Mimulus breviflorus	short-flowered monkey-flower	MIMUBRV	G4	2-Nov-84	S1	10-Jan-03	9-Jul-02			Red				3 - Sensitive (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Scrophulariales	Scrophulariaceae	DAB;DCS;DKA;DOS;DRM	2;3;4;8	GVRD;RDEK;RDKB;RDOS;TNRD	ICHdw;ICHmk;IDFdm;MSdm	PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Monitor Trend; Status Rpt; Wildlife Act; COSEWIC; Plan; Hab Protect; Private Land	1	5	6	1	Y	
Mimulus breweri	Brewer's monkey-flower	MIMUBRW	G5	22-Jan-99	S2S3	29-Dec-00	30-Apr-96			Blue				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Scrophulariales	Scrophulariaceae	DAB;DCH;DCK;DOS;DSQ	2;4;5;8	Cariboo;RDCK;RDKB;RDOS;SLRD	ESSFdcp;ESSFwc;ESSFxc;ICHdw;ICHmk;ICHmw;IDFdm;IDFww	PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Monitor Trend	2	6	6	2	Y	
Nicotiana attenuata	wild tobacco	NICOATT	G4	8-Feb-94	S1	29-Dec-00	30-Apr-96			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Solanales	Solanaceae	DCS;DOS	8	RDKB;RDOS	BGxh	TERRESTRIAL	Native	Regularly occurring			Inventory	2	3	6	2	Y	
Oenothera pallida ssp. *pallida*	pale evening-primrose	OENOPAL1	G5T4Q	5-Aug-91	S1	28-Nov-05	28-Nov-05			Red					Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Myrtales	Onagraceae	DOS;DSQ	2;8	RDOS	BGxh;CWHds	TERRESTRIAL	Native	Regularly occurring			Inventory	2	5	6	2	Y	
Orobanche corymbosa ssp. *mutabilis*	flat-topped broomrape	OROBCOR1	G4T3?	17-Oct-00	S1	10-Sep-07	30-Oct-07			Red					Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Scrophulariales	Orobanchaceae	DCS;DKA;DOS;DRM	3;4;8	NORD;RDEK;RDOS	BGxh;ICHmk;IDFdk;IDFxh;PPdh	TERRESTRIAL	Native	Regularly occurring			Inventory	3	3	4	4	Y	
Orthocarpus barbatus	Grand Coulee owl-clover	ORTHBAR	G2G3	30-Jan-08	S2	10-Sep-07	30-Oct-07	E (May 2005)		Red			1	2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Scrophulariales	Scrophulariaceae	DOS	8	RDOS	BGxh;IDFxh;PPxh	TERRESTRIAL	Native	Regularly occurring			Status Rpt; COSEWIC; Wildlife Act; Plan; Private Land; Hab Protect; Hab Restore	2	3	6	2	Y	
Orthotrichum alpestre		ORTHALP	G4G5	26-Apr-91	S2S3					Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Orthotrichales	Orthotrichaceae	DCK;DCO;DFN;DHW;DKA;DPC;DRM;DSS;DSS_C;DVA	2;3;4;6;7;8;9	CSRD;FVRD;NRRD;PRRD;RDBN;RDEK;RDFFG;RDKS;RDOS;TNRD	BWBS;CWH;ESSF;ICH;IDF;SBS		Native	Regularly occurring			No New Actn	3	5	6	3	N	
Orthotrichum cupulatum		ORTHCUP	G4G5	17-Sep-97	S1					Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Orthotrichales	Orthotrichaceae	DAB;DCK;DCO;DOS;DSI	2;4;8	GVRD;RDCK;RDCO;RDKB;RDOS	CDF;CWH;ESSF;IDF;PP		Native	Regularly occurring			Inventory	2	5	6	2	N	
Orthotrichum hallii		ORTHHAL	G4	27-Feb-02	S1					Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Orthotrichales	Orthotrichaceae	DOS	3;8	RDOS;TNRD	PP		Native	Regularly occurring			Inventory	2	5	6	2	N	
Pectocarya penicillata	winged combseed	PECTPEN	G5	16-Jan-90	S1	29-Dec-00	30-Apr-96			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Lamiales	Boraginaceae	DCS;DOS	3;8	RDOS;TNRD	BGxh;PPxh	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Persicaria punctata	dotted smartweed	POLYPUN	G5	11-May-85	S2S3	29-Dec-00	21-Jan-99			Blue				4 - Secure (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Polygonales	Polygonaceae	DCK;DKA;DOS	2;3;8	CSRD;GVRD;RDOS;TNRD	BGxh;CWHdm;CWHxm;PPxh	PALUSTRINE	Native	Regularly occurring			Monitor Trend	2	6	6	2	Y	
Phacelia ramosissima var. *ramosissima*	branched phacelia	PHACRAM	G5TNR		S1	28-Jan-04	28-Jan-04	E (May 2005)		Red			1		Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Solanales	Hydrophyllaceae	DOS	8	RDOS	BGxh;IDFxh;PPxh	TERRESTRIAL	Native	Regularly occurring			Monitor Trend; Status Rpt; COSEWIC; Wildlife Act; Plan; Hab Restore; Hab Protect; Private Land	1	6	6	1	Y	
Philonotis fontana var. *americana*		PHILFON1	G5TNR		S2S3					Blue					Nonvascular Plant		Variety	Plantae	Bryophyta	Bryopsida	Bryales	Bartramiaceae	DCS;DHW;DOS	3;8	NORD;RDOS;TNRD	CDF;ESSF;ICH		Native	Regularly occurring			Monitor Trend; Status Rpt; Plan; Hab Protect; Private Land	2	5	6	2	N	
Phlox speciosa ssp. *occidentalis*	showy phlox	PHLOSPE1	G5TNR		S2	30-Sep-08	30-Sep-08	T (Nov 2004)		Red			1		Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Solanales	Polemoniaceae	DOS	8	RDOS	BGxh;IDFxh;PPxh	TERRESTRIAL	Native	Regularly occurring			Status Rpt; COSEWIC; Wildlife Act; Plan; Private Land; Hab Protect; Hab Restore	2	6	6	2	Y	
Physaria didymocarpa var. *didymocarpa*	common twinpod	PHYSDID1	G5T4	8-Feb-94	S2S3	29-Dec-00	30-Apr-96			Blue					Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Capparales	Brassicaceae	DCO;DOS;DRM	4;8	RDEK;RDOS	ESSFdk;ESSFwc;ESSFwmp;IDFdm;IDFun;IMA;PPdh	TERRESTRIAL	Native	Regularly occurring			No New Actn	3	5	6	3	Y	
Poa fendleriana ssp. *fendleriana*	mutton grass	POA FEN1	G5T5	17-Sep-97	S1	29-Dec-00	30-Apr-96			Red					Vascular Plant	monocots	Subspecies	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Poaceae	DCC;DCS;DKA;DMH;DOS	3;5;8	RDOS;TNRD	BGxh;BGxw;ESSFdcp;IDFxw	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Poa suksdorfii	Suksdorf's bluegrass	POA SUK	G4	31-Oct-95	S1	23-Jul-02	23-Jul-02			Red				2 - May be at risk (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Poaceae	DOS	8	RDOS	IMA	TERRESTRIAL	Native	Regularly occurring			Inventory; Status Rpt; Wildlife Act; COSEWIC; Plan; Hab Protect; Hab Restore	1	4	6	1	Y	
Pohlia atropurpurea		POHLATR	G4G5	29-Apr-91	S2S3					Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Bryales	Bryaceae	DAB;DCH;DCO;DCS;DFN;DHW;DKA;DKL;DOS;DRM;DSS_C	2;3;4;6;7;8;9	CSRD;FVRD;NRRD;RDCK;RDEK;RDFFG;RDKS;RDOS;TNRD	BWBS;CWH;ICH;IMA;MS		Native	Regularly occurring			Inventory	2	5	6	2	N	
Pohlia bolanderi		POHLBOL	G3G4	3-Sep-04	S2S3					Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Bryales	Bryaceae	DAB;DCK;DCO;DKL;DOS;DSQ	2;4;8	CSRD;FVRD;RDCK;RDKB;RDOS;SLRD	ESSF;ICH;IDF;IMA;MH		Native	Regularly occurring			Inventory	2	3	6	2	N	
Pohlia filum		POHLFIL	G4G5	1-May-91	S2S3					Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Bryales	Bryaceae	DAB;DCK;DCO;DOS;DHW;DKL;DMK;DNC;DQU;DRM;DSQ;DSS_C	2;4;5;6;7;8	CSRD;Cariboo;FVRD;PRRD;RDCK;RDEK;RDFFG;RDOS;SLRD;SQCRD;Stikine	CMA;ESSF;ICH;MH		Native	Regularly occurring			No New Actn	3	5	6	3	N	
Pohlia ludwigii		POHLLUD	G5?	14-Jun-00	S2S3					Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Bryales	Bryaceae	DAB;DCC;DCK;DCO;DCR;DCS;DFN;DHW;DKL;DOS;DPC;DSQ;DSS;DSS_B	1;2;3;4;6;8	CSRD;FVRD;PRRD;RDCK;RDEK;RDKS;RDOS;SLRD;SRD;TNRD	CMA;CWH;ESSF;ICH;MH		Native	Regularly occurring			Monitor Trend	2	6	6	2	N	
Pohlia vexans		POHLVEX	G3G5	23-Oct-00	S2S3					Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Bryales	Bryaceae	DAB;DCO;DFN;DOS;DPC;DSS	4;6;8;9	CSRD;NRRD;PRRD;RDCK;RDEK;RDKS;RDOS;Stikine	ESSF;SWB		Native	Regularly occurring			No New Actn	2	2	6	3	N	
Polemonium elegans	elegant Jacob's-ladder	POLEELE	G4	16-May-88	S2S3	29-Dec-00	30-Apr-96			Blue				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Solanales	Polemoniaceae	DCH;DCK;DCS;DJA;DNI;DOS;DQU;DRM;DSC;DSS_B;DVA	2;3;4;5;6;7;8	CCRD;Cariboo;FVRD;RDBN;RDEK;RDOS;SCRD;SLRD	BAFA;CMA;CWHxm;ESSFdkp;ESSFdv;ESSFmv;ESSFxc;ESSFxcp;IDFdw;IDFww;IMA;MSxk;SBSdw	TERRESTRIAL	Native	Regularly occurring			No New Actn	3	4	6	3	Y	
Polemonium occidentale ssp. *occidentale*	western Jacob's-ladder	POLEOCC1	G5?T5?	9-Nov-94	S2S3	29-Dec-00	11-Feb-00			Blue					Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Solanales	Polemoniaceae	DAB;DCH;DCK;DCS;DFN;DMK;DND;DOS;DPC;DSS_C	2;3;4;5;6;7;8;9	NRRD;PRRD;RDKS;RDOS;Stikine;TNRD	BGxh;BWBSmw;BWBSwk;ESSFmv;ESSFmw;ESSFwc;ICHdw;ICHmc;IDFdk;IDFxh;MSdm;SBPSxc;SBSmc;SWBun	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Monitor Trend	2	5	6	2	Y	
Polygonum polygaloides ssp. *confertiflorum*	close-flowered knotweed	POLYPOL2	G4G5T3T4	27-Feb-96	S1	29-Dec-00	30-Apr-96			Red					Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Polygonales	Polygonaceae	DCS;DOS	8	RDOS	ICHmk;MSdk	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Inventory	2	4	6	2	Y	
Polygonum polygaloides ssp. *kelloggii*	Kellogg's knotweed	POLYPOL1	G4G5T3T5	25-Feb-01	S2S3	29-Dec-00	21-Jan-99			Blue					Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Polygonales	Polygonaceae	DAB;DCC;DCS;DKA;DKL;DOS	3;4;5;8	Cariboo;RDCK;RDOS;TNRD	ESSFwc;ICHdw;ICHmk;IDFdk;IDFww;IDFxh;IDFxm;MSdm;MSxk	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Inventory	2	4	6	2	Y	
Polygonum sawatchense ssp. *oblivium*	Sawatch knotweed	POLYSAW1	GNRTNR		S1	29-Dec-00	30-Nov-06			Red					Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Polygonales	Polygonaceae	DCK	8	RDOS	ESSFmw	TERRESTRIAL	Native	Regularly occurring		N	Inventory	2	Not Assessed	6	2	Y	
Polystichum kruckebergii	Kruckeberg's holly fern	POLYKRU	G4	16-Sep-93	S2S3	29-Dec-00	30-Apr-96			Blue				3 - Sensitive (2005)	Vascular Plant	ferns	Species	Plantae	Filicinophyta	Filicopsida	Filicales	Dryopteridaceae	DCK;DCS;DJA;DQU;DSS_C	2;3;5;6;7;8	Cariboo;FVRD;RDBN;RDOS;SLRD	ESSFdv;ESSFmw;ESSFwk;IDFdc;IDFdk;IDFxc;IMAun;MSdc;MSmw;MSxk;PPxh;SBSwk	TERRESTRIAL	Native	Regularly occurring			No New Actn	3	5	6	3	Y	
Polystichum lemmonii	Lemmon's holly fern	POLYLEM	G4	8-Feb-89	S2	30-Sep-08	30-Sep-08	T (May 2003)		Red			1	1 - At Risk (2005)	Vascular Plant	ferns	Species	Plantae	Filicinophyta	Filicopsida	Filicales	Dryopteridaceae	DAB;DOS	8	RDKB;RDOS	ESSFdc	TERRESTRIAL	Native	Regularly occurring			Status Rpt; COSEWIC; Wildlife Act; Plan; Hab Protect; Private Land; Hab Restore	1	2	6	1	Y	
Polystichum scopulinum	mountain holly fern	POLYSCP	G5	29-Sep-87	S2	30-Sep-08	30-Sep-08	T (May 2005)		Red			1	1 - At Risk (2005)	Vascular Plant	ferns	Species	Plantae	Filicinophyta	Filicopsida	Filicales	Dryopteridaceae	DCS	8	RDOS	ESSFmw;IDFdk	TERRESTRIAL	Native	Regularly occurring			Status Rpt; COSEWIC; Wildlife Act; Plan; Hab Protect	2	4	6	2	Y	
Polytrichum longisetum		POLYLOG	G5	29-Apr-91	S2S3					Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Polytrichales	Polytrichaceae	DAB;DCC;DCK;DCO;DFN;DHW;DKL;DKM;DMH;DMK;DOS;DPG;DQU;DSC;DSS;DSS_C	2;3;4;5;6;7;8;9	CSRD;Cariboo;FVRD;GVRD;NORD;PRRD;RDCK;RDFFG;RDKS;RDOS;SCRD;Stikine;TNRD	CDF;CWH;ESSF;ICH;MH;MS;SBS;SWB		Native	Regularly occurring			Monitor Trend	2	6	6	2	N	
Potamogeton nodosus	long-leaved pondweed	POTANOD	G5	25-Jun-84	S1	27-Dec-01	27-Dec-01			Red				4 - Secure (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Najadales	Potamogetonaceae	DCK;DOS	2;3;8	CSRD;FVRD;RDOS	BGxh;CWHdm;ICHmw;IDFmw	LACUSTRINE;PALUSTRINE;RIVERINE	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Potentilla diversifolia var. *perdissecta*	diverse-leaved cinquefoil	POTEDIV2	G5T4	8-Feb-94	S2S3	29-Dec-00	30-Apr-96			Blue					Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Rosales	Rosaceae	DAB;DCH;DCS;DMH;DND;DOS;DRM	3;4;5;8	Cariboo;RDEK;RDOS;SLRD;TNRD	BAFA;CMA;ESSFdk;ESSFdkp;IDFdk;IMA;MSdc	TERRESTRIAL	Native	Regularly occurring			No New Actn	3	5	6	3	Y	
Potentilla nivea var. *pentaphylla*	five-leaved cinquefoil	POTENIV2	G5T4	18-Nov-88	S2S3	29-Dec-00	30-Apr-96			Blue					Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Rosales	Rosaceae	DAB;DCC;DCH;DCS;DMH;DMK;DNI;DOS;DRM;DSS_C	3;4;5;6;7;8	CCRD;Cariboo;RDEK;RDOS;Stikine;TNRD	BGxh;BGxw;BWBSdk;ESSFdkp;IDFdk;IDFdw;MHmm;MSdc;SWBun	TERRESTRIAL	Native	Regularly occurring			Inventory	3	5	6	3	Y	
Potentilla paradoxa	bushy cinquefoil	POTEPAR	G5	10-Apr-85	S1	29-Dec-00	30-Apr-96			Red				4 - Secure (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Rosales	Rosaceae	DCS;DOS	3;8	RDOS;SLRD;TNRD	BGxh;IDFxh	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Pottia bryoides		POTTBRY	G5?	21-May-96	S1					Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Pottiales	Pottiaceae	DOS	8	RDOS	IDF		Native	Regularly occurring			Inventory	2	4	6	2	N	
Pottia nevadensis		POTTNEV	G4	31-Dec-94	S1					Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Pottiales	Pottiaceae	DOS	3	RDOS	CWH		Native	Regularly occurring			Inventory	2	4	6	2	N	
Pottia wilsonii		POTTWIL	G3G5	14-Jun-00	S1					Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Pottiales	Pottiaceae	DOS	8	RDOS	PP		Native	Regularly occurring			Inventory	2	2	6	2	N	
Psilocarphus brevissimus var. *brevissimus*	dwarf woolly-heads	PSILBRE1	G4T4?	2-Aug-02	S1	29-Dec-00	10-Mar-97	E (Apr 2006)	Full Species	Red			1		Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Asterales	Asteraceae	DCS	8	RDOS	IDFxh	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Status Rpt; COSEWIC; Wildlife Act; Plan; Hab Protect; Species Mgmt; Private Land	1	3	6	1	Y	
Pterygoneurum kozlovii	alkaline wing-nerved moss	PTERKOZ	G2G3	11-Jun-06	S2			T (Nov 2004)		Red			1		Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Pottiales	Pottiaceae	DCC;DKA;DOS;DRM	3;4;5;8	Cariboo;RDEK;RDOS;TNRD	BG;IDF;PP	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Status Rpt; COSEWIC; Wildlife Act; Plan; Private Land; Hab Protect; Hab Restore	1	1	6	3	Y	
Pterygoneurum lamellatum		PTERLAM	G3G5	18-Apr-00	S1					Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Pottiales	Pottiaceae	DOS	3;8	CSRD;RDOS	PP		Native	Regularly occurring			Inventory	2	4	6	2	N	
Pyrola elliptica	white wintergreen	PYROELL	G5	16-Apr-84	S2S3	29-Dec-00	21-Jan-99			Blue				4 - Secure (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Ericales	Pyrolaceae	DAB;DCC;DCK;DCS;DKA;DNI;DOS;DPC;DPG;DQU;DSI	1;3;5;7;8;9	CSRD;FVRD;PRRD;RDFFG;RDMW;RDN;RDOS;TNRD	BWBSmw;CWHvm;ESSFmw;ICHmw;IDFww;IDFxm;MHmm;MSxk;SBSdw;SBSmh	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			No New Actn	3	6	6	3	Y	
Racomitrium pygmaeum		RACOPYG	GU	23-Oct-00	S1S3	5-Apr-00	5-Apr-00			Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Grimmiales	Grimmiaceae	DCK;DKL;DRM;DSQ;DSS_C	2;4;6;8	FVRD;RDCK;RDEK;RDOS;SLRD;Stikine	BAFA;ESSF;MH		Native	Regularly occurring			Inventory	2	Not Assessed	6	2	N	
Ranunculus pedatifidus ssp. *affinis*	birdfoot buttercup	RANUPED1	G5T5	1-May-91	S2S3	29-Dec-00	11-Feb-00			Blue					Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Ranunculales	Ranunculaceae	DCC;DCH;DCO;DCS;DMH;DMK;DOS;DPC;DSS_C	3;4;5;6;7;8;9	CSRD;Cariboo;PRRD;RDBN;RDFFG;RDKS;RDOS;SLRD;TNRD	BAFA;BWBSdk;BWBSmw;CMA;ESSFxv;ICHwk;IDFdk;IMA;SBPSxc	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			No New Actn	3	5	6	3	Y	
Rhizomnium punctatum		RHIZPUN	G5	26-Apr-91	S1S3	5-Apr-00	5-Apr-00			Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Bryales	Mniaceae	DAB;DCC;DCK;DCO;DCR;DCS;DFN;DHW;DJA;DKA;DKL;DMH;DMK;DND;DOS;DPC;DPG;DQU;DRM;DSI;DSQ;DSS;DSS_B;DSS_C	1;2;3;4;5;6;7;8;9	ACRD;CRD;CSRD;Cariboo;FVRD;GVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDN;RDOS;SLRD;SRD;Stikine;TNRD	BAFA;BWBS;CWH;ESSF;ICH;IDF;MH;MS;SBPS;SBS		Native	Regularly occurring			Inventory	2	6	6	2	N	
Ribes oxyacanthoides ssp. *cognatum*	northern gooseberry	RIBEOXY1	G5T4	19-Apr-94	S1	29-Dec-00	30-Apr-96			Red					Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Rosales	Grossulariaceae	DAB;DCC;DOS	8	RDKB;RDOS	IDFdm;PPdh;SBSdk	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Inventory	2	5	6	2	Y	
Rotala ramosior	toothcup meadow-foam	ROTARAM	G5	29-Aug-84	S1	27-Sep-07	30-Apr-96	E (May 2000)		Red			1	1 - At Risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Myrtales	Lythraceae	DKA;DOS	3;8	RDOS;TNRD	BGxh	LACUSTRINE;PALUSTRINE	Native	Regularly occurring			Status Rpt; Wildlife Act; COSEWIC; Plan; Hab Protect; Hab Restore; Private Land	1	6	6	1	Y	
Rubus lasiococcus	dwarf bramble	RUBULAS	G5	16-Jan-90	S2S3	29-Dec-00	30-Apr-96			Blue				3 - Sensitive (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Rosales	Rosaceae	DCK;DSI	1;2;8	CVRD;FVRD;RDOS	CDFmm;CWHds;CWHmm;CWHxm;ESSFmw;MHmm	TERRESTRIAL	Native	Regularly occurring			Inventory	3	6	6	3	Y	
Rumex paucifolius	alpine sorrel	RUMEPAU	G5	6-May-04	S2S3	28-Nov-01	28-Nov-01			Blue				3 - Sensitive (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Polygonales	Polygonaceae	DAB;DOS;DPC	8;9	RDKB;RDOS	BAFA;ESSFdcp;ESSFxcp;IMA	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Salix amygdaloides	peach-leaf willow	SALIAMY	G5	29-Aug-84	S2	29-Dec-00	30-Apr-96			Red				4 - Secure (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Salicales	Salicaceae	DKA;DOS	3;8	NORD;RDCO;RDOS;TNRD	BGxh;IDFxh	LACUSTRINE;PALUSTRINE	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Salix boothii	Booth's willow	SALIBOO	G5	29-Jun-93	S2S3	29-Dec-00	30-Apr-96			Blue				4 - Secure (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Salicales	Salicaceae	DAB;DCC;DCS;DKA;DMH;DOS;DQU;DRM	3;4;5;8	Cariboo;RDEK;RDKB;RDOS;SLRD;TNRD	ICHmk;ICHmw;IDFdk;IDFdm;IDFun;IDFxh;IDFxw;MSdk;MSdm;MSxk;SBSdw	LACUSTRINE;PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Monitor Trend	2	6	6	2	Y	
Salix tweedyi	Tweedy's willow	SALITWE	G4	31-May-05	S3	30-Sep-08	30-Sep-08			Blue				3 - Sensitive (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Salicales	Salicaceae	DKA;DOS	3;8	CSRD;NORD;RDOS;TNRD	ESSFdc;ESSFxc;ICHmw;IDFdk;MSdm;MSxk	LACUSTRINE;PALUSTRINE;RIVERINE	Native	Regularly occurring				4	5	4	4	Y	
Schistidium frigidum		SCHIFRI	GNR		S2S3					Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Grimmiales	Grimmiaceae	DCK;DCO;DCS;DHW;DKA;DKL;DMK;DOS;DQU;DSS;DSS_C	2;3;4;5;6;7;8	CSRD;Cariboo;FVRD;PRRD;RDCK;RDKS;RDOS;Stikine;TNRD	BAFA;BG;ESSF;MH;PP		Native	Regularly occurring			Inventory	2	Not Assessed	6	2	N	
Schistidium heterophyllum		SCHIHET	G3	17-Jul-97	S1S3					Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Grimmiales	Grimmiaceae	DCC;DCS;DKA;DOS	3;5;8	Cariboo;NORD;RDOS;TNRD	BG;IDF;PP		Native	Regularly occurring			Inventory	2	3	6	2	N	
Schoenoplectus americanus	Olney's bulrush	SCHOAME	G5	6-Sep-84	S1	29-Dec-00	7-Nov-00			Red				3 - Sensitive (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Cyperaceae	DCR;DOS;DSI;DSQ	1;2;8	ComoxVRD;RDN;RDOS;SLRD	BGxh;CDFmm;CWHds;PPxh	LACUSTRINE;PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Inventory; Status Rpt; Wildlife Act; COSEWIC; Plan; Hab Protect; Hab Restore; Private Land	1	6	6	1	Y	
Schoenoplectus saximontanus	Rocky Mountain clubrush	SCHOSAX	G5	16-Jan-90	S1	29-Dec-00	30-Apr-96			Red				2 - May be at risk (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Cyperaceae	DOS	3;8	CSRD;RDOS	BGxh;IDFmw	LACUSTRINE;PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Inventory; Status Rpt; Wildlife Act; Wildlife Act; Plan; Private Land; Hab Protect	1	4	6	1	Y	
Senecio integerrimus var. *ochroleucus*	white western groundsel	SENEINT3	G5T4T5	7-Mar-03	SH	29-Dec-00	30-Apr-96			Red					Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Asterales	Asteraceae	DCS	3;8	RDOS;TNRD	IDFxh	TERRESTRIAL	Native	Regularly occurring			Inventory	2	5	6	2	Y	
Smelowskia ovalis	short-fruited smelowskia	SMELOVA	G5	19-Jan-96	S2S3	29-Dec-00	30-Apr-96			Blue				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Capparales	Brassicaceae	DCK;DOS	2;8	FVRD;RDOS	CMA;IMA	TERRESTRIAL	Native	Regularly occurring			No New Actn	3	6	6	3	Y	
Solidago gigantea ssp. *serotina*	smooth goldenrod	SOLIGIG2	G5TNR		S1	29-Dec-00	5-Mar-01			Red					Vascular Plant	dicots	Subspecies	Plantae	Anthophyta	Dicotyledoneae	Asterales	Asteraceae	DAB;DCO;DHW;DOS	3;4;7;8	CSRD;FVRD;RDFFG;RDKB;RDOS	ICHdw;ICHmk;ICHmw;IDFdk;IDFdm;IDFxh	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	

Scientific Name	English Name	RISC Code	Global Status	Global Status Review Date	Prov Status	Prov Status Review Date	Prov Status Change Date	COSEWIC	COSEWIC Comments	BC List	Identified Wildlife	Prov Wildlife Act	SARA	National GS	Name Category	Class (English)	Species Level	Kingdom	Phylum	Class	Order	Family	Forest Dist	MOE Region	Regional Dist	BGC	Habitat Type	Origin	Presence	Breeding Bird	Endemic	Action Groups	Highest Priority	Priority Goal 1	Priority Goal 2	Priority Goal 3	CDC Maps	Mapping Status
Sphaeralcea coccinea	scarlet globe-mallow	SPHACOC	G5?	28-Feb-03	S1	29-Dec-00	8-Jul-98			Red				4 - Secure (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Malvales	Malvaceae	DAB;DKA;DOS;DRM	3;4;8	RDEK;RDOS;TNRD	BGxh;IDFun;IDFxh;MSdk	TERRESTRIAL	Native	Regularly occurring			Inventory	2	6	6	2	Y	
Sphaeralcea munroana	Munroe's globe-mallow	SPHAMUN	G4	29-Sep-87	SH	30-Sep-08	30-Sep-08			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Malvales	Malvaceae	DOS	8	RDOS	BGxh	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Inventory	2	5	6	2	Y	
Sphenopholis obtusata	prairie wedgegrass	SPHEOBT	G5	10-Apr-85	S1	29-Dec-00	2-Jan-01			Red				4 - Secure (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Poaceae	DKA;DKL;DOS;DRM	3;4;8	RDCK;RDEK;RDOS;TNRD	BGxh;ICHdw;IDFdm	LACUSTRINE;PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Status Rpt; Wildlife Act; Plan; COSEWIC; Hab Protect; Private Land; Hab Restore	1	6	6	1	Y	
Spiranthes diluvialis	Ute lady's tresses	SPIRDIL	G2G3	6-May-08	S1	30-Sep-08	30-Sep-08			Red					Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Orchidales	Orchidaceae	DOS	8	RDOS	BGxh;PPxh		Native	Regularly occurring			Inventory; Status Rpt; Wildlife Act; Plan; COSEWIC; Hab Protect; Hab Restore; Private Land	1	2	6	1	Y	
Sporobolus airoides	hairgrass dropseed	SPORAIR	G5	24-Feb-88	S2S3	10-Sep-07	30-Oct-07			Blue				2 - May be at risk (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Poaceae	DOS	8	RDOS	BGxh	TERRESTRIAL	Native	Regularly occurring			Inventory	3	4	6	3	Y	
Sporobolus compositus var. *compositus*	rough dropseed	SPORCOM1	G5T5	13-Feb-95	S3	28-Nov-05	28-Nov-05			Blue					Vascular Plant	monocots	Variety	Plantae	Anthophyta	Monocotyledoneae	Cyperales	Poaceae	DAB;DCS;DKA;DOS;DRM	3;4;8	RDEK;RDKB;RDOS;TNRD	BGxh;IDFdm	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Monitor Trend; Status Rpt; COSEWIC; Plan; Hab Protect; Hab Restore; Private Land	2	6	2	3	Y	
Stuckenia vaginata	sheathing pondweed	STUCVAG	G5	29-Jun-95	S2S3	28-Nov-01	28-Nov-01			Blue				4 - Secure (2005)	Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Najadales	Potamogetonaceae	DCC;DCS;DJA;DKA;DMH;DPC;DRM;DSS_C	3;4;5;6;7;8;9	Cariboo;PRRD;RDBN;RDEK;RDOS;Stikine;TNRD	BGxw;BWBSdk;BWBSmw;IDFdk;IDFdm;IDFun;IDFxh;IDFxm;MSdk;SBSdw;SWBun	LACUSTRINE;RIVERINE	Native	Regularly occurring			No New Actn	3	6	6	3	Y	
Symphyotrichum frondosum	short-rayed aster	ASTEFRO	G4	29-Sep-87	S1	29-Dec-00	30-Apr-96	E (Apr 2006)		Red			1	2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Asterales	Asteraceae	DOS	8	RDOS	BGxh;PPxh	LACUSTRINE;PALUSTRINE	Native	Regularly occurring			Status Rpt; COSEWIC; Wildlife Act; Plan; Hab Protect; Species Mgmt; Private Land	1	5	6	1	Y	
Thelypodium laciniatum var. *laciniatum*	thick-leaved thelypody	THELLAC1	G5T5	7-Jul-95	S2S3	29-Dec-00	30-Apr-96			Blue					Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Capparales	Brassicaceae	DCS;DOS	8	RDKB;RDOS	BGxh;IDFdm;IDFxh	TERRESTRIAL	Native	Regularly occurring			Monitor Trend	2	6	6	2	Y	
Timmia megapolitana		TIMMMEG	G5	30-Apr-91	S2S3	15-Feb-00	15-Feb-00			Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Bryales	Timmiaceae	DAB;DCS;DFN;DHW;DKA;DKL;DKM;DMK;DOS;DRM;DSI;DSS;DSS_C;DVA	1;3;4;6;7;8;9	NRRD;PRRD;RDBN;RDCK;RDEK;RDFFG;RDKS;RDOS;SLRD;Stikine;TNRD	BWBS;CWH;ESSF;ICH;IDF;MS;SBS;SWB		Native	Regularly occurring			Monitor Trend	2	6	6	2	N	
Tortula subulata		TORTSUB	G5?	5-Jun-00	S2S3					Blue					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Pottiales	Pottiaceae	DAB;DCK;DCS;DKL;DOS;DSI	1;2;3;4;8;9	CRD;ComoxVRD;FVRD;GVRD;RDCK;RDCO;RDOS;TNRD	CDF;CMA;CWH;ESSF;ICH;IDF;PP		Native	Regularly occurring			Monitor Trend; Status Rpt; Plan; Hab Protect; Private Land	2	6	6	2	N	
Trifolium cyathiferum	cup clover	TRIFCYA	G4	16-Jan-90	S1	29-Dec-00	30-Apr-96			Red				2 - May be at risk (2005)	Vascular Plant	dicots	Species	Plantae	Anthophyta	Dicotyledoneae	Fabales	Fabaceae	DAB;DCO;DOS;DSI	1;3;4;8	CRD;CVRD;RDKB;RDOS	BGxh;CDFmm;CWHmm;CWHxm;ICHdw;ICHmw;IDFdm;IDFxh;PPdh	PALUSTRINE;RIVERINE;TERRESTRIAL	Native	Regularly occurring			Inventory	2	5	6	2	Y	
Triglochin debilis	slender arrowgrass	TRIGDEB	G4	2-Oct-87	S2?	30-Sep-08	30-Sep-08			Red					Vascular Plant	monocots	Species	Plantae	Anthophyta	Monocotyledoneae	Najadales	Juncaginaceae	DOS	3;5;8	CSRD;RDOS	BGxh;IDFmw		Native	Regularly occurring			Inventory	2	4	6	2	Y	
Ulota curvifolia		ULOTCUR	G3G5	30-Apr-91	S1S3	5-Apr-00	5-Apr-00			Red					Nonvascular Plant		Species	Plantae	Bryophyta	Bryopsida	Orthotrichales	Orthotrichaceae	DCC;DCO;DCS;DHW;DOS;DSS;DSS_C	3;4;5;6;7;8;9	CSRD;Cariboo;RDFFG;RDKS;RDOS;Stikine	BAFA;ICH;IDF		Native	Regularly occurring			Inventory	2	2	6	2	N	
Verbena hastata var. *scabra*	blue vervain	VERBHAS1	G5T5	21-Aug-02	S2	29-Dec-00	11-Feb-00			Red					Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Lamiales	Verbenaceae	DCK;DOS;DSI	1;2;3;8	ACRD;CSRD;FVRD;GVRD;NORD;RDCO;RDOS	BGxh;CWHdm;CWHxm;IDFxh	PALUSTRINE;TERRESTRIAL	Native	Regularly occurring			Inventory	3	6	6	3	Y	
Viola purpurea var. *venosa*	purple-marked yellow violet	VIOLPUR1	G5T4T5	2-Aug-02	S1S3	28-Nov-05	28-Nov-05			Red					Vascular Plant	dicots	Variety	Plantae	Anthophyta	Dicotyledoneae	Violales	Violaceae	DCK	8	FVRD;RDOS	CMA;IMA	TERRESTRIAL	Native	Regularly occurring			Inventory	2	5	6	2	Y	

Appendix C – BCCDC Rare Plant Communities

Scientific Name	English Name	Global Status	Global Status Review Date	Prov Status	Prov Status Review Date	Prov Status Change Date	BC List	Identified Wildlife	Biogeoclimatic Units	Ecosection	Forest District	MOE Region	Regional Dist	Ecosystem Group	Endemic	Action Groups	Highest Priority	Priority Goal 1	Priority Goal 2	Priority Goal 3	CDC Maps	Mapping Status
Abies amabilis - Tsuga mertensiana / Gymnocarpium dryopteris Moist Maritime 2	amabilis fir - mountain hemlock / oak fern Moist Maritime 2	GNR		S4	31-Mar-01	29-Sep-94	Yellow		MHmm2/03	BUR;CCR;CPR;CRU;EPR;HOR;KIM;KIR;LPR;MEM;NAM;NPR;NWC;SBR;SCR;SPR;WCR	DCH;DCK;DCR;DCS;DKM;DNC;DND;DNI;DSC;DSQ;DSS	1;2;3;5;6	CCRD;Cariboo;ComoxVRD;FVRD;PowellR;RDBN;RDKS;RDMW;RDOS;SCRD;SLRD;SRD;TNRD	Forest	Y	No New Actn	3	3	4	5	N	
Abies amabilis - Tsuga mertensiana / Streptopus lanceolatus	amabilis fir - mountain hemlock / rosy twistedstalk	G4G5		S4	19-Sep-05	29-Sep-94	Yellow		MHmm1/05;MHmm2/05	BUR;CCR;CPR;CRU;EPR;HEL;HOR;KIM;KIR;LIM;LPR;MEM;NAM;NIM;NPR;NWC;NWL;OUF;SBR;SCR;SPR;WCR;WIM	DCH;DCK;DCR;DCS;DKM;DNC;DND;DNI;DSC;DSI;DSQ;DSS	1;2;3;5;6	ACRD;CCRD;CRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;PowellR;RDBN;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;TNRD	Forest		No New Actn	4	4	4	5	N	
Abies lasiocarpa - Abies amabilis / Athyrium filix-femina	subalpine fir - amabilis fir / lady fern	GNR		S4	31-Mar-01	17-Mar-93	Yellow		ESSFmw/07	CCR;CPR;EPR;HOR;KIM;LPR;NEU;NPR;SCR;WCR	DCH;DCK;DCS;DNI;DSC;DSQ	2;3;5;8	CCRD;Cariboo;ComoxVRD;FVRD;RDMW;RDOS;SLRD;SRD;TNRD	Forest		No New Actn	4	4	4	5	N	
Abies lasiocarpa - Abies amabilis / Rhododendron albiflorum	subalpine fir - amabilis fir / white-flowered rhododendron	GNR		S5	31-Mar-01	17-Mar-93	Yellow		ESSFmw/01	CCR;CPR;EPR;HOR;KIM;LPR;NEU;NPR;SCR;WCR	DCH;DCK;DCS;DNI;DSC;DSQ	2;3;5;8	CCRD;Cariboo;ComoxVRD;FVRD;RDMW;RDOS;SLRD;SRD;TNRD	Forest		No New Actn	6	6	6	6	N	
Abies lasiocarpa - Abies amabilis - Tsuga mertensiana / Menziesia ferruginea	subalpine fir - amabilis fir - mountain hemlock / false azalea	GNR		S5	31-Mar-01	17-Mar-93	Yellow		ESSFmw/05	CCR;CPR;EPR;HOR;KIM;LPR;NEU;NPR;SCR;WCR	DCH;DCK;DCS;DNI;DSC;DSQ	2;3;5;8	CCRD;Cariboo;ComoxVRD;FVRD;RDMW;RDOS;SLRD;SRD;TNRD	Forest		No New Actn	6	6	6	6	N	
Abies lasiocarpa / Equisetum spp. */ Mnium* spp.	subalpine fir / horsetails / leafy mosses	GNR		S4	31-Mar-01	29-Sep-94	Yellow		ESSFdc1/06;ESSFdv/06;ESSFmc/09;ESSFmc/10;ESSFmv1/05;ESSFwc1/04;ESSFwc4/06;ESSFwk1/06;ESSFwv/08;ESSFxc/08;ESSFxv1/08;ESSFxv2/08	BAU;BOV;BUB;BUR;CAM;CAP;CBR;CCM;CCR;CHP;CPR;CRU;ESM;GUU;HOR;KIM;LPR;MAP;MCP;MEM;NAB;NAM;NAU;NBR;NEU;NIB;NKM;NOH;NOM;NSM;NTU;OKR;PAR;QUH;QUL;SBP;SBR;SCM;SCR;SFH;SHB;SRH;SSM;STH;TAG;TEP;THH;TRU;UFT;WCR;WCU;WOU	DAB;DCC;DCH;DCO;DCS;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DNC;DND;DNI;DOS;DPG;DQU;DSQ;DSS;DVA	2;3;4;5;6;7;8	CCRD;CSRD;Cariboo;NORD;PRRD;RDBN;RDCK;RDCO;RDFFG;RDKB;RDKS;RDOS;SLRD;Stikine;TNRD	Forest, Riparian		No New Actn	3	3	4	5	N	
Abies lasiocarpa / Gymnocarpium dryopteris - Equisetum spp.	subalpine fir / oak fern / horsetails	GNR		S5	21-Jun-04	21-Jun-04	Yellow		ESSFmw/08;ESSFwc2/08;ESSFwk2/06	BBT;CAM;CAP;CCR;CPK;CPR;EPR;FRR;HAF;HOR;KIM;LPR;MCP;MIR;NEL;NEU;NHR;NKM;NPK;NPR;NSH;NTU;PAT;PEF;QUH;SCR;SHR;SRH;UFT;WCR	DCH;DCK;DCO;DCS;DHW;DKA;DMK;DNI;DOS;DPC;DPG;DSC;DSQ	2;3;4;5;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;PRRD;RDFFG;RDMW;RDOS;SLRD;SRD;TNRD	Forest		No New Actn	5	5	6	6	N	
Abies lasiocarpa / Juniperus communis / Cladonia spp.	subalpine fir / common juniper / clad lichens	GNR		S4	11-Jul-02	11-Jul-02	Yellow		ESSFmc/02;ESSFmw/02	BAU;BUB;BUR;CCR;CPR;EPR;ESM;HOR;KIM;LPR;MAP;NAU;NEU;NOM;NPR;NSM;SBP;SCR;SSM;WCR	DCH;DCK;DCS;DJA;DKM;DMK;DND;DNI;DSC;DSQ;DSS	2;3;5;6;7;8	CCRD;Cariboo;ComoxVRD;FVRD;PRRD;RDBN;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Woodland, Forest		Classification; Monitor Trend	2	3	2	4	N	
Abies lasiocarpa / Ledum glandulosum / Vaccinium scoparium	subalpine fir / trapper's tea / grouseberry	GNR		S5	31-Mar-01	22-Sep-94	Yellow		ESSFdc1/05;ESSFdc2/08	CAP;HOR;NOH;NSH;OKR;PAR;SFH;WOU	DAB;DCK;DCS;DHW;DKA;DMH;DOS	3;4;5;8	Cariboo;FVRD;NORD;RDCK;RDCO;RDKB;RDOS;TNRD	Forest		No New Actn	5	5	6	6	N	
Abies lasiocarpa / Rhododendron albiflorum / Barbilophozia lycopodioides	subalpine fir / white-flowered rhododendron / common leafy liverwort	GNR		S4S5	31-Mar-01	22-Sep-94	Yellow		ESSFvc/02;ESSFvv/03	CPK;NKM;NSH	DAB;DCO;DHW;DOS	2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Woodland, Forest		Classification	4	4	6	5	N	
Abies lasiocarpa / Rhododendron albiflorum / Gymnocarpium dryopteris	subalpine fir / white-flowered rhododendron / oak fern	GNR		S5	31-Mar-01	4-Mar-93	Yellow		ESSFdc2/06;ESSFwc1/01;ESSFwc2/01;ESSFwc3/01;ESSFwc4/01	BBT;BOV;CAM;CAP;CCM;CPK;FRR;HAF;HOR;MIR;NHR;NKM;NOH;NPK;NSH;NTU;OKR;PAR;PEF;QUH;SCM;SFH;SHR;SRH;WMR;WOU	DAB;DCC;DCK;DCO;DCS;DHW;DKA;DKL;DMH;DMK;DOS;DPC;DPG;DQU	3;4;5;7;8;9	CSRD;Cariboo;FVRD;NORD;PRRD;RDCK;RDCO;RDFFG;RDKB;RDOS;TNRD	Forest		No New Actn	5	5	6	6	N	
Abies lasiocarpa / Rhododendron albiflorum / Tiarella trifoliata	subalpine fir / white-flowered rhododendron / three-leaved foamflower	GNR		S5	31-Mar-01	15-Jun-00	Yellow		ESSFvv/01;ESSFwc4/04	CCM;CPK;NKM;NOH;SCM;SFH;SRH	DAB;DCO;DHW;DKL;DOS	2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Forest		Classification	5	5	6	6	N	
Abies lasiocarpa / Rhododendron albiflorum / Vaccinium scoparium	subalpine fir / white-flowered rhododendron / grouseberry	GNR		S5	31-Mar-01	22-Sep-94	Yellow		ESSFdc1/01;ESSFdc2/01;ESSFxc/06;ESSFxv1/06;ESSFxv2/06	CAP;CCR;CHP;CPR;GUU;HOR;NAU;NIB;NOH;NSH;NTU;OKR;PAR;SFH;SHB;TRU;WCR;WCU;WOU	DAB;DCC;DCH;DCK;DCS;DHW;DKA;DMH;DNI;DOS;DQU;DVA	3;4;5;6;8	CCRD;CSRD;Cariboo;FVRD;NORD;RDBN;RDCK;RDCO;RDKB;RDOS;SLRD;TNRD	Forest		No New Actn	5	5	6	6	N	
Abies lasiocarpa / Rhododendron albiflorum / Valeriana sitchensis	subalpine fir / white-flowered rhododendron / sitka valerian	GNR		S3	21-Jun-04	31-Mar-01	Blue		ESSFdc1/04;ESSFdc2/07	CAP;HOR;NOH;NSH;OKR;PAR;SFH;WOU	DAB;DCK;DCS;DHW;DKA;DMH;DOS	3;4;5;8	Cariboo;FVRD;NORD;RDCK;RDCO;RDKB;RDOS;TNRD	Forest		Classification; Inventory; Review Use	2	3	2	4	N	
Abies lasiocarpa / Ribes lacustre / Valeriana sitchensis	subalpine fir / black gooseberry / Sitka valerian	GNR		S5	31-Mar-01	17-Mar-93	Yellow		ESSFmw/06	CCR;CPR;EPR;HOR;KIM;LPR;NEU;NPR;SCR;WCR	DCH;DCK;DCS;DNI;DSC;DSQ	2;3;5;8	CCRD;Cariboo;ComoxVRD;FVRD;RDMW;RDOS;SLRD;SRD;TNRD	Forest		No New Actn	5	5	6	6	N	
Abies lasiocarpa / Vaccinium membranaceum / Barbilophozia floerkei	subalpine fir / black huckleberry / mountain leafy liverwort	GNR		S5	31-Mar-01	31-Mar-01	Yellow		ESSFvv/02	CPK;NKM	DCO;DHW	2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Woodland, Forest		Classification	6	6	6	6	N	
Abies lasiocarpa / Vaccinium membranaceum - Paxistima myrsinites	subalpine fir / black huckleberry - falsebox	GNR		S5	31-Mar-01	17-Mar-93	Yellow		ESSFmw/04	CCR;CPR;EPR;HOR;KIM;LPR;NEU;NPR;SCR;WCR	DCH;DCK;DCS;DNI;DSC;DSQ	2;3;5;8	CCRD;Cariboo;ComoxVRD;FVRD;RDMW;RDOS;SLRD;SRD;TNRD	Forest		No New Actn	4	4	4	5	N	
Abies lasiocarpa / Vaccinium membranaceum / Pleurozium schreberi	subalpine fir / black huckleberry / red-stemmed feathermoss	GNR		S5	31-Mar-01	22-Sep-94	Yellow		ESSFdc2/05;ESSFmm1/02;ESSFmv1/03;ESSFmv1/04;ESSFwk1/02	BAU;BBT;BOV;BUB;CAM;CAP;CPK;HOR;MCP;NAU;NPK;NSH;OKR;PAR;QUH;QUL;SHR;UFT;WOU	DCC;DCK;DCO;DCS;DHW;DJA;DKA;DMH;DND;DOS;DPG;DQU;DVA	3;4;5;6;7;8	CSRD;Cariboo;FVRD;NORD;RDBN;RDCO;RDFFG;RDOS;TNRD	Woodland, Forest		No New Actn	5	5	6	6	N	
Abies lasiocarpa / Vaccinium scoparium / Cladonia spp.	subalpine fir / grouseberry / clad lichens	GNR		S5	31-Mar-01	22-Sep-94	Yellow		ESSFdc1/03;ESSFdc2/04;ESSFxc/05	CAP;CCR;GUU;HOR;NIB;NOH;NSH;NTU;OKR;PAR;SCR;SFH;SHB;TRU;WOU	DAB;DCC;DCK;DCS;DHW;DKA;DMH;DOS	3;4;5;8	CSRD;Cariboo;FVRD;NORD;RDCK;RDCO;RDKB;RDOS;SLRD;TNRD	Forest		Classification	5	5	6	6	N	
Abies lasiocarpa / Vaccinium scoparium - Tiarella trifoliata	subalpine fir / grouseberry - three-leaved foamflower	GNR		S4	22-Jun-04	22-Jun-04	Yellow		ESSFxc/07	CCR;GUU;HOR;NIB;NOH;NTU;OKR;PAR;SHB;TRU;WOU	DCC;DCS;DKA;DMH;DOS	3;5;8	CSRD;Cariboo;NORD;RDCO;RDOS;SLRD;TNRD	Forest							N	
Abies lasiocarpa / Vaccinium scoparium - Valeriana sitchensis	subalpine fir / grouseberry - Sitka valerian	GNR		S3	7-Jun-04	7-Jun-04	Blue		ESSFxc/01	CCR;GUU;HOR;NIB;NOH;NTU;OKR;PAR;SCR;SHB;TRU;WOU	DCC;DCS;DKA;DMH;DOS	3;5;8	CSRD;Cariboo;NORD;RDCO;RDOS;SLRD;TNRD	Forest		Classification; Eco Restore; Inventory; Monitor Trend; Rev Status; Review Use	2	2	2	3	N	
Abies lasiocarpa / Valeriana sitchensis - Senecio triangularis	subalpine fir / Sitka valerian - arrow-leaved groundsel	GNR		S3S4	22-Jun-04	17-Mar-93	Yellow		ESSFvv/04	CPK;NKM	DCO;DHW	2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Forest		No New Actn	2	2	4	4	N	
Achnatherum richardsonii Herbaceous Vegetation	spreading needlegrass Herbaceous Vegetation	G3		S3	31-Oct-04	31-Jul-02	Blue		BGxw2/00;IDFdk1a/93;IDFdk4/00;IDFxm/00	CAB;CCR;CHP;FRB;GUU;NIB;OKR;PAR;QUL	DCC;DCH;DCS;DKA;DMH;DOS;DQU	3;5;8	Cariboo;RDOS;TNRD	Grassland, Herbaceous	Y	Eco Restore; Inventory; Plan; Private Land; Review Use; Status Rpt	2	2	2	3	N	
Alnus incana / Spiraea douglasii / Carex sitchensis	mountain alder / hardhack / Sitka sedge	GNR		S3S4	30-Jul-04	30-Jul-04	Yellow		CWHwm/Ws02;ESSFwv/Ws02;ICHmc2/Ws02;ICHvc/Ws02;ICHwk1/Ws02;MSdm1/Ws02;MSmw1/Ws02;SBSmc2/Ws02;SBSwk1/Ws02	BAU;BBT;BOV;BUB;BUR;CAM;CBR;CCM;CPK;CRU;EPM;ESM;HOR;KIM;KIR;MAP;MCP;MEM;NAB;NAM;NAU;NBR;NCF;NEL;NEU;NHR;NKM;NOB;NOH;NPK;NSH;NSM;QUH;QUL;SBP;SBR;SFH;SHR;SPM;SRH;SSM;STH;TAB;TAG;TEP;THH	DAB;DCC;DCO;DCS;DHW;DJA;DKA;DKL;DKM;DMK;DNC;DND;DNI;DOS;DPG;DQU;DSS;DVA	2;3;4;5;6;7;8	CSRD;Cariboo;FVRD;NORD;RDBN;RDCK;RDCO;RDFFG;RDKB;RDKS;RDOS;SQCRD;Stikine;TNRD	Wetland, Shrub		Monitor Trend	3	3	4	4	N	
Amelanchier alnifolia / Arctostaphylos uva-ursi	saskatoon / kinnikinnick	G4		S4	22-Jun-04	22-Jun-04	Yellow		BAFA;ESSFdk;ESSFdv;ESSFwm;IMA	BBT;CCM;COC;CPK;ELV;EPM;FLV;LPR;MCR;NKM;SCM;SCR;SPK;SPM;UCV	DAB;DCO;DCS;DKL;DRM;DSQ;UNK	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Shrub, Alpine, Herbaceous	Y	No New Actn	3	3	4	5	N	
Antennaria lanata - Vaccinium scoparium	woolly pussytoes - grouseberry	GNR		SNR			Yellow		BAFA;CMA;ESSFdc1;IMA	NOH;SFH	DAB;DOS;UNK	1;2;3;4;5;6;7;8;9	ACRD;CCRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	Alpine, Herbaceous	Y						N	
Antennaria lanata Herbaceous Vegetation	woolly pussytoes Herbaceous Vegetation	GNR		SNR			Yellow		BAFA;CMA;ESSFdc1;ESSFdv;ESSFwc2;IMA;MHmmp	BBT;CAM;CAP;CPK;CRU;HEL;KIM;KIR;LPR;MEM;NAM;NEU;NKM;NOH;NPK;NSH;NTU;QUH;SBR;SCR;SFH;SRH	DAB;DCO;DCS;DHW;DKA;DKM;DNC;DND;DNI;DOS;DSQ;DSS;UNK	1;2;3;4;5;6;7;8;9	ACRD;CCRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	Alpine, Herbaceous		No New Actn	4	4	4	5	N	
Arctostaphylos alpina var. *rubra* Dwarf Shrubland	alpine bearberry Dwarf Shrubland	GNR		SNR			Yellow		BAFA;ESSF;ESSFwv;ICHmk;IMA	BBT;BOV;BUR;CAM;CAP;CBR;CPK;CRU;ELV;EPM;ESM;FLV;MCR;MEM;NAB;NAM;NBR;NOH;NSH;NSM;NTU;QUH;SBP;SBR;SFH;SHB;SPK;SPM;SRH;SSM;STH;TAG;TEP;THH;TRU;UCV;WOU	DAB;DCC;DCO;DHW;DJA;DKA;DKL;DKM;DMH;DNC;DOS;DQU;DRM;DSS;UNK	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Alpine, Shrub, Herbaceous	Y	No New Actn	3	3	4	5	N	
Artemisia tridentata / Hesperostipa comata	big sagebrush / needle-and-thread grass	G4		S4	31-Jul-02	31-Jul-02	Yellow		BGxh1/01MS;BGxh2/05	GUU;NOB;OKR;PAR;SOB;THB	DCS;DKA;DOS	2;8	RDOS;TNRD	Shrub, Herbaceous, Grassland	Y	Eco Protect; Eco Restore; Inventory; Plan; Private Land; Review Use; Status Rpt	2	3	2	4	N	
Artemisia tridentata / Pseudoroegneria spicata	big sagebrush / bluebunch wheatgrass	G2		S2	31-Oct-04	22-Sep-94	Red		BGxh1/01;BGxh2/01;BGxh3/01;BGxw1/04;BGxw2/00;PPxh1/00;PPxh2/05	FRB;GUU;NIB;NOB;OKR;PAR;SCR;SOB;THB;TRU	DCC;DCH;DCS;DKA;DMH;DOS	2;3;5;8	Cariboo;RDCO;RDOS;SLRD;TNRD	Shrub, Grassland, Herbaceous	Y	Eco Protect; Eco Restore; Inventory; Plan; Private Land; Review Use; Status Rpt	1	1	6	2	Y	
Artemisia tridentata / Pseudoroegneria spicata - Balsamorhiza sagittata	big sagebrush / bluebunch wheatgrass - arrowleaf balsamroot	G2		S2	31-Oct-04	31-Jul-02	Red		IDFdm1/00;IDFxh1a/92;IDFxh1a/94;PPxh1/03	NOB;NOH;OKR;PAR;SFH;SHB;SOB;THB	DAB;DCS;DKA;DOS	3;8	CSRD;NORD;RDCO;RDKB;RDOS;TNRD	Shrub, Grassland, Herbaceous	Y	Eco Protect; Eco Restore; Plan; Private Land; Review Use; Status Rpt	1	1	6	2	Y	
Artemisia tridentata var. *vaseyana / Calamagrostis rubescens*	Vasey's big sagebrush / pinegrass	GNR		S1	31-Oct-04	15-Jun-00	Red	Y (Jun 2006)	ESSFxc/04;MSxk/04	CAB;CAP;CCR;GUU;HOR;NIB;NOH;NTU;OKR;PAR;SCR;SHB;TRU;WOU	DCC;DCS;DKA;DMH;DOS	3;5;8	CSRD;Cariboo;NORD;RDCO;RDOS;SLRD;TNRD	Shrub, Grassland, Herbaceous		Eco Protect; Eco Restore; Inventory; Monitor Trend; Plan; Review Use; Status Rpt	1	1	6	1	N	
Artemisia tripartita / Pseudoroegneria spicata - Balsamorhiza sagittata	threetip sagebrush / bluebunch wheatgrass - arrowleaf balsamroot	G1		S1	31-Oct-04	31-Jul-02	Red		PPxh1/00	NOB;OKR;SOB	DCS;DOS	8	RDCO;RDOS	Shrub, Grassland, Herbaceous	Y	Inventory	1	1	6	1	N	

Scientific Name	English Name	Global Status	Global Status Review Date	Prov Status	Prov Status Review Date	Prov Status Change Date	BC List	Identified Wildlife	Biogeoclimatic Units	Ecosection	Forest District	MOE Region	Regional Dist	Ecosystem Group	Endemic	Action Groups	Highest Priority	Priority Goal 1	Priority Goal 2	Priority Goal 3	CDC Maps	Mapping Status
Betula nana / Carex aquatilis	scrub birch / water sedge	G4		S4	30-Jul-04	30-Jul-04	Yellow		BWBSdk1/Wf02;BWBSmw1/Wf02;BWBSmw2/Wf02;ESSFdc1/Wf02;ESSFdc3/Wf02;ESSFdv d/Wf02;ESSFdv/Wf02;ESSFmv2/Wf02;ESSFwc3/Wf02;ESSFwk2/Wf02;ESSFxc/Wf02;ESSFxv2/Wf02;ICHmc2/Wf02;ICHvk2/Wf02;ICHwk2/Wf02;ICHwk3/Wf02;ICHwk4/Wf02;IDFdk1/Wf02;IDFdk3/Wf02;IDFdk4/Wf02;IDFdm2/Wf02;MSdc2/Wf02;MSdk/Wf02;MSdm1/Wf02;MSxk/Wf02;MSxv/Wf02;SBPSdc/Wf02;SBPSmc/Wf02;SBPSmk/Wf02;SBPSxc/Wf02;SBSdk/Wf02;SBSdw1/Wf02;SBSmc2/Wf02;SBSmm/Wf02;SBSvk/Wf02;SBSwk1/Wf02;SBSwk2/Wf02	BAU;BBT;BOV;BUB;BUR;CAB;CAM;CAP;CAR;CCR;CHP;CLH;COC;CPK;CRU;EKT;ELV;EMR;EPM;ESM;ETP;FLV;FNL;FRB;FRR;FRT;GUU;HAF;HAP;HOR;HYP;KEM;KIM;KIP;KLR;KRT;LPR;MAP;MAU;MCP;MEM;MIR;MUF;MUU;NAB;NAM;NAU;NEL;NEU;NHR;NIB;NOB;NOH;NOM;NPK;NSH;NSM;NTU;OKR;PAR;PAT;PEF;PEL;PEP;QUH;QUL;RAP;SBP;SCR;SCU;SFH;SHB;SHR;SOB;SOM;SPK;SPM;SRH;SSM;STH;STP;TAB;TAG;TEB;TEP;THB;THH;TLP;TRU;TUR;UCV;UFT;WCR;WCU;WHU;WMR;WOU	DAB;DCC;DCH;DCO;DCS;DFN;DHW;DJA;DKA;DKM;DMH;DMK;DND;DNI;DOS;DPC;DPG;DQU;DRM;DSQ;DSS;DVA	2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;NORD;NRRD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDOS;SLRD;Stikine;TNRD	Wetland, Shrub	Y	No New Actn	3	3	4	5	N	
Betula nana / Menyanthes trifoliata - Carex limosa	scrub birch / buckbean - shore sedge	GNR		S3S4	14-Mar-08	14-Mar-08	Yellow		IDFdk3/Wf07;MSmw1/Wf07;SBPSdc/Wf07;SBSdk/Wf07;SBSmc2/Wf07;SBSvk/Wf07;SBSwk1/Wf07;SBSwk2/Wf07;SBSwk3/Wf07	BAU;BOV;BUB;BUR;CAB;CAM;CAP;CCR;CHP;CRU;ESM;FRB;HAF;HOR;KIM;MAP;MCP;MIR;NAU;NEL;NEU;NHR;NPK;NSM;PAR;PAT;PEF;PEL;QUL;SCR;SHR;SOM;SSM;TRU;UFT;WCU	DCC;DCH;DCS;DHW;DJA;DKA;DKM;DMH;DMK;DND;DNI;DPC;DPG;DQU;DSS;DVA	2;3;5;6;7;8;9	Cariboo;FVRD;PRRD;RDBN;RDFFG;RDKS;RDOS;SLRD;Stikine;TNRD	Wetland, Shrub	Y	No New Actn	2	2	4	4	N	
Betula occidentalis / Rosa spp.	water birch / roses	G3G4		S1	2-Apr-09	30-Mar-94	Red	Y (Jun 2006)	BGxh1/Fl07;BGxh3/Fl07;BGxw2/Fl07;PPxh1/Fl07;PPxh2/Fl07	FRB;GUU;NIB;NOB;OKR;PAR;SCR;SOB;THB;TRU	DCC;DCH;DCS;DKA;DMH;DOS	3;5;8	Cariboo;RDCO;RDOS;SLRD;TNRD	Riparian, shrub		Eco Protect; Eco Restore; Inventory; Monitor Trend; Plan; Private Land; Status Rpt	1	3	6	1	Y	
Carex aquatilis / Sphagnum spp.	water sedge / peat-mosses	GNR		S3S4	30-Jul-04	30-Jul-04	Yellow		ESSFdc1/07;ESSFdc1/Wf03;ESSFdc2/09;ESSFdc2/Wf03;ESSFmc/Wf03;ESSFmw/Wf03;ESSFvc/06;ESSFvc/Wf03;ESSFwc1/05;ESSFwc1/Wf03;ESSFwc2/10;ESSFwc2/Wf03;ESSFwc3/Wf03;ESSFwv/Wf03;ESSFxc/Wf03;ESSFxv2/Wf03;SBSwk1/Wf03	BAU;BBT;BOV;BUB;BUR;CAB;CAM;CAP;CBR;CCM;CCR;CHP;CPK;CPR;CRU;EPR;ESM;FRR;GUU;HAF;HOR;KIM;LPR;MAP;MCP;MEM;MIR;NAB;NAM;NAU;NBR;NEL;NEU;NHR;NIB;NKM;NOH;NOM;NPK;NPR;NSH;NSM;NTU;OKR;PAR;PEF;QUH;QUL;SBP;SBR;SCM;SCR;SFH;SHB;SHR;SRH;SSM;STH;TAG;TEP;THH;TRU;WCR;WMR;WOU	DAB;DCC;DCH;DCK;DCO;DCS;DHW;DJA;DKA;DKL;DKM;DMH;DNC;DND;DNI;DOS;DPC;DPG;DQU;DSC;DSQ;DSS	2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Wetland, Herbaceous		No New Actn	2	2	4	4	N	
Carex engelmannii Herbaceous Vegetation	Engelmann's sedge Herbaceous Vegetation	GNR		SNR			Yellow		CMA;ESSFdc1;IMA;MHmmp	CRU;HEL;KIM;KIR;MEM;NAM;NEU;NOH;SBR;SFH	DAB;DKM;DNC;DND;DNI;DOS;DSS;UNK	1;2;3;4;5;6;7;8	ACRD;CCRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;NORD;PRRD;PowellR;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	Alpine, Herbaceous	Y	No New Actn	3	3	4	5	N	
Carex lasiocarpa / Drepanocladus aduncus	slender sedge / common hook-moss	G3		S3	31-Oct-04	31-Jul-02	Blue		BWBSdk1/Wf05;ICHdk/Wf05;ICHmc1/Wf05;ICHmc2/Wf05;ICHmw1/Wf05;ICHmw3/Wf05;ICHvk1/Wf05;ICHwk1/Wf05;ICHwk2/Wf05;IDFdk1/Wf05;IDFdk3/Wf05;IDFdk4/Wf05;IDFdm2/Wf05;MSdk/Wf05;MSdm1/Wf05;MSdm2/Wf05;MSdm3/Wf05;MSdm3w/Wf05;SBPSdc/Wf05;SBPSmk/Wf05;SBPSxc/Wf05;SBSdk/Wf05;SBSmc2/Wf05;SBSmk1/Wf05;SBSwk1/Wf05	BAU;BBT;BOV;BUB;BUR;CAB;CAM;CAP;CAR;CCM;CCR;CHP;COC;CPK;CRU;EKT;ELV;EMR;EPM;ESM;FLV;FRB;FRT;GUU;HOR;KEM;KIM;KLR;KRT;MAP;MCP;MCR;NAB;NAM;NAU;NEL;NEU;NHR;NIB;NKM;NOB;NOH;NOM;NPK;NSH;NSM;NTU;OKR;PAR;PAT;QUH;QUL;RAP;SBP;SCR;SFH;SHB;SHR;SOB;SOM;SPK;SPM;SRH;SSM;STH;STP;TAB;TAG;TEB;TEP;THB;THH;TRU;TUR;UCV;WCR;WCU;WHU;WMR;WOU	DAB;DCC;DCH;DCK;DCO;DCS;DFN;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DND;DNI;DOS;DPG;DQU;DRM;DSS;DVA	3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDOS;SLRD;Stikine;TNRD	Wetland, Herbaceous	Y	Monitor Trend; Rev Status	2	2	4	4	N	
Carex limosa - Menyanthes trifoliata / Drepanocladus spp.	shore sedge - buckbean / hook-mosses	G3		S3	30-Jul-04	30-Jul-04	Blue		ESSFwc3/Wf08;ESSFxc/Wf08;ESSFxv1/Wf08;MSdc1/Wf08;MSdc1d/Wf08;MSdm3/Wf08;MSdm3w/Wf08;MSmw1/Wf08;MSxk/Wf08;MSxv/Wf08;SBPSdc/Wf08;SBSdk/Wf08;SBSmc2/Wf08;SBSmk2/Wf08;SBSwk1/Wf08	BAU;BOV;BUB;BUR;CAB;CAM;CAP;CCR;CHP;CPR;CRU;ESM;FRR;GUU;HAF;HOR;KIM;LPR;MAP;MCP;MIR;NAU;NEL;NEU;NHR;NIB;NOH;NPK;NSM;NTU;OKR;PAR;PAT;PEF;QUH;QUL;SCR;SHB;SHR;SOM;SSM;TRU;WCR;WCU;WMR;WOU	DCC;DCH;DCS;DHW;DJA;DKA;DKM;DMH;DMK;DND;DNI;DOS;DPC;DPG;DQU;DSS;DVA	2;3;5;6;7;8;9	CCRD;CSRD;Cariboo;FVRD;NORD;PRRD;RDBN;RDCO;RDFFG;RDKS;RDOS;SLRD;Stikine;TNRD	Wetland, Herbaceous	Y	Monitor Trend	2	2	4	4	N	
Carex nardina Herbaceous Vegetation	spikenard sedge Herbaceous Vegetation	GNR		SNR			Yellow		CMA;ESSF;MHmmp	CRU;HEL;KIM;KIR;MEM;NAM;NEU;SBR	DKM;DNC;DND;DNI;DSS;UNK	1;2;3;4;5;6;7;8;9	ACRD;CCRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;NORD;PRRD;PowellR;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	Alpine, Herbaceous		No New Actn	3	3	4	5	N	
Carex nigricans Herbaceous Vegetation	black alpine sedge Herbaceous Vegetation	GNR		SNR			Yellow		BAFA;CMA;ESSFdc1;ESSFdk;ESSFdv;ESSFwm;IMA;MHmmp;SBSwk2	BAU;BBT;CCM;COC;CPK;CRU;ELV;EPM;FLV;HAF;HEL;KIM;KIR;LPR;MAP;MCP;MCR;MEM;MIR;NAM;NEL;NEU;NHR;NKM;NOH;PAT;PEF;PEL;SBR;SCM;SCR;SFH;SHR;SOM;SPK;SPM;UCV	DAB;DCO;DCS;DKL;DKM;DMK;DNC;DND;DNI;DOS;DPC;DRM;DSQ;DSS;UNK	1;2;3;4;5;6;7;8;9	ACRD;CCRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	Alpine, Herbaceous		No New Actn	3	3	4	5	N	
Carex phaeocephala Herbaceous Vegetation	dunhead sedge Herbaceous Vegetation	GNR		SNR			Yellow		BAFA;CMA;ESSFdc1;ESSFwv;IMA;MHmmp	BUR;CBR;CRU;ESM;HEL;KIM;KIR;MEM;NAB;NAM;NBR;NEU;NOH;NSM;SBP;SBR;SFH;SSM;STH;TAG;TEP;THH	DAB;DJA;DKM;DNC;DND;DNI;DOS;DSS;UNK	1;2;3;4;5;6;7;8;9	ACRD;CCRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	Herbaceous, Sparsely Vegetated, Alpine	Y	No New Actn	4	4	4	5	N	
Carex podocarpa Herbaceous Vegetation	graceful mountain sedge Herbaceous Vegetation	GNR		SNR			Yellow		BAFA;ESSF;SBSwk2;SWBmk	BAU;CAR;EMR;ESM;HAF;HAP;HYP;KEM;KRT;LIP;MAP;MCP;MIR;MUF;MUU;NEL;NHR;NOM;NSM;PAT;PEF;PEL;RAP;SBP;SCU;SHR;SIU;SOM;STP;TEB;TEP;TUR;WMR	DFN;DJA;DMK;DPC;DSS;UNK	2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Alpine, Herbaceous	Y	Monitor Trend	2	2	4	4	N	
Carex spectabilis Herbaceous Vegetation	showy sedge Herbaceous Vegetation	G5		SNR			Yellow		CMA;ESSFdc1;IMA;MHmmp	CRU;HEL;KIM;KIR;MEM;NAM;NEU;NOH;SBR;SFH	DAB;DKM;DNC;DND;DNI;DOS;DSS;UNK	1;2;3;4;5;6;7;8	ACRD;CCRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;NORD;PRRD;PowellR;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	Herbaceous, Alpine		No New Actn	4	5	4	5	N	
Carex spp. */ Aulacomnium palustre*	sedges / glow moss	GNR		SNR			Yellow		MS		UNK	2;3;4;5;8	CCRD;CSRD;Cariboo;FVRD;NORD;RDBN;RDCO;RDEK;RDKB;RDOS;SLRD;TNRD	Herbaceous, Wetland	Y						N	
Carex utriculata - Carex aquatilis	beaked sedge - water sedge	G4		S4	24-Jun-04	24-Jun-04	Yellow		BWBSdk1/Wm01;BWBSdk2/Wf01;BWBSmw2/Wm01;ESSFdc3/Wf01;ESSFdk1/Wf01;ESSFdk2/Wf01;ESSFdv d/Wm01;ESSFdv/Wm01;ESSFmc/Wf01;ESSFmc/Wm01;ESSFmw/Wf01;ESSFmw/Wm01;ESSFwc1/Wf01;ESSFwk1/Wf01;ESSFxc/Wf01;ESSFxc/Wm01;ESSFxv1/Wf01;ESSFxv2/Wf01;ESSFxv2/Wm01;ICHmc1/Wm01;ICHmc2/Wm01;ICHmk1/08;ICHmk1/Wf01;ICHvc/Wf01;ICHwc/Wf01;ICHwk1/Wm01;ICHwk2/Wm01;IDFdk1/Wm01;IDFdk2/Wm01;IDFdk3/Wf01;IDFdk3/Wm01;IDFdk4/Wf01;MHmm2/Wf01;MSdc1/Wf01;MSdc1/Wm01;MSdc1d/Wf01;MSdc1d/Wm01;MSdc2/Wm01;MSdk/Wm01;MSdm1/Wf01;MSdm1/Wm01;MSdm2/Wf01;MSdm2/Wm01;MSdm3/Wm01;MSdm3w/Wm01;MSmw1/Wf01;MSmw2/Wf01;MSxk/Wf01;MSxk/Wm01;MSxv/Wf01;MSxv/Wm01;PPxh1/Wm01;SBPSdc/Wm01;SBPSxc/Wm01;SBSdk/Wm01;SBSdw1/Wm01;SBSdw3/Wm01;SBSmc2/Wm01;SBSmk1/Wm01;SBSmk2/Wm01;SBSvk/Wm01;SBSwk1/Wm01	BAU;BBT;BOV;BUB;BUR;CAB;CAM;CAP;CAR;CBR;CCM;CCR;CHP;CLH;COC;CPK;CPR;CRU;EKT;ELV;EMR;EPM;EPR;ESM;ETP;FLV;FNL;FRB;FRR;FRT;GUU;HAP;HOR;HYP;KEM;KIM;KIR;KLR;KRT;LIP;LPR;MAP;MAU;MCP;MCR;MEM;MIR;MUF;MUU;NAB;NAM;NAU;NEL;NEU;NHR;NIB;NKM;NOB;NOH;NOM;NPK;NPR;NSH;NSM;NTU;NWC;OKR;PAR;PAT;PEP;QUH;QUL;RAP;SBP;SBR;SCM;SCR;SCU;SFH;SHR;SIU;SOB;SOM;SPK;SPM;SPR;SRH;SSM;STH;STP;TAB;TAG;TEB;TEP;THB;THH;TLP;TRU;TUR;UCV;UFT;WCR;WCU;WHU;WMR;WOU	DAB;DCC;DCH;DCK;DCO;DCR;DCS;DFN;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DNC;DND;DNI;DOS;DPC;DPG;DQU;DRM;DSC;DSQ;DSS;DVA	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SCRD;SLRD;SRD;Stikine;TNRD	Wetland, Herbaceous		Monitor Trend	4	4	4	5	N	
Cassiope mertensiana Herbaceous Vegetation	white mountain-heather Herbaceous Vegetation	GNR		SNR			Yellow		BAFA;CMA;ESSFmc;ESSFmv;ESSFwv;ESSFxv;IMA;MHmmp;SWBmk	ALR;BAU;BOV;BUB;BUR;CAM;CAR;CBR;CCM;CCR;CHP;COC;CPK;CPR;CRU;ELV;EMR;EPM;EPR;ESM;FLV;FRR;FRT;HAF;HAP;HEL;HYP;KEM;KIM;KIP;KIR;KLR;KRT;LIM;LIP;LPR;MAP;MEM;MIR;MUF;MUU;NAB;NAM;NAU;NBR;NEL;NEU;NHR;NIM;NKM;NOH;NOM;NPK;NPR;NSH;NSM;NTU;NWC;NWL;OKR;OUF;PAR;PAT;PEF;QCR;QUH;RAP;SBP;SBR;SCU;SHR;SIU;SKP;SOM;SPK;SPM;SRH;SSM;STH;STP;TAB;TAG;TEB;TEP;THH;TUR;WCR;WCU;WIM;WMR	DAB;DCC;DCH;DCK;DCO;DCR;DCS;DFN;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DNC;DND;DNI;DOS;DPC;DPG;DQU;DRM;DSC;DSI;DSQ;DSS;DVA	1;2;3;4;5;6;7;8;9	ACRD;CCRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	Alpine, Shrub, Herbaceous							N	

Scientific Name	English Name	Global Status	Global Status Review Date	Prov Status	Prov Status Review Date	Prov Status Change Date	BC List	Identified Wildlife	Biogeoclimatic Units	Ecosection	Forest District	MOE Region	Regional Dist	Ecosystem Group	Endemic	Action Groups	Highest Priority	Priority Goal 1	Priority Goal 2	Priority Goal 3	CDC Maps	Mapping Status
Cetraria nivalis - Cetraria cucullata	ragged paperdoll - furled paperdoll	GNR		SNR			Yellow		BAFA;ESSFmc;ESSFwk1;ESSFwv;IMA	BAU;BOV;BUB;BUR;CAM;CAP;CBR;CRU;ESM;KIM;MAP;MCP;MEM;NAB;NAM;NAU;NBR;NEU;NOM;NSM;QUH;QUL;SBP;SBR;SSM;STH;TAG;TEP;THH;UFT;WCR	DCC;DHW;DJA;DKM;DMH;DMK;DNC;DND;DNI;DPG;DQU;DSS;UNK	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Herbaceous, Alpine	Y	No New Actn	2	2	4	4	N	
Cetraria nivalis - Dryas octopetala	ragged paperdoll - white mountain-avens	GNR		SNR			Yellow		BAFA;BWBSdk1;ESSF;ESSFdk;ESSFdv;ESSFwm;IMA;SWB	BBT;CAR;CCM;COC;CPK;ELV;EMR;EPM;FLV;FRT;KEM;KLR;KRT;LPR;MAP;MCR;NKM;NOM;NSM;PAT;RAP;SBP;SCM;SCR;SOM;SPK;SPM;STH;STP;TAB;TAG;TEB;TEP;THH;TUR;UCV;WHU;WMR	DAB;DCO;DCS;DFN;DJA;DKL;DMK;DRM;DSQ;DSS;UNK	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Alpine, Herbaceous	Y	No New Actn	2	2	4	4	N	
Chamaecyparis nootkatensis - Tsuga mertensiana / Lysichiton americanus	yellow-cedar - mountain hemlock / skunk cabbage	G4		S4	23-Jun-04	23-Jun-04	Yellow		MHmm1/09;MHmm2/09;MHwh1/09;MHwh2/09	BUR;CCR;CPR;CRU;EPR;HEL;HOR;KIM;KIR;LIM;LPR;MEM;NAM;NIM;NPR;NWC;NWL;OUF;QCR;SBR;SCR;SKP;SPR;WCR;WIM	DCH;DCK;DCR;DCS;DKM;DNC;DND;DNI;DQC;DSC;DSI;DSQ;DSS	1;2;3;5;6	ACRD;CCRD;CRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;PowellR;RDBN;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;TNRD	Forest, Shrub, Wetland	Y	No New Actn	3	3	4	5	N	
Chamaecyparis nootkatensis - Tsuga mertensiana / Veratrum viride	yellow-cedar - mountain hemlock / Indian hellebore	GNR		S4	23-Jun-04	23-Jun-04	Yellow		MHmm1/07;MHmm2/07;MHwh1/07;MHwh2/07	BUR;CCR;CPR;CRU;EPR;HEL;HOR;KIM;KIR;LIM;LPR;MEM;NAM;NIM;NPR;NWC;NWL;OUF;QCR;SBR;SCR;SKP;SPR;WCR;WIM	DCH;DCK;DCR;DCS;DKM;DNC;DND;DNI;DQC;DSC;DSI;DSQ;DSS	1;2;3;5;6	ACRD;CCRD;CRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;PowellR;RDBN;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;TNRD	Forest, Shrub	Y	No New Actn	2	2	4	4	N	
Danthonia intermedia Herbaceous Vegetation	timber oatgrass Herbaceous Vegetation	G2G3		SNR			Yellow		ESSFdk;ESSFdkp;ESSFwc1;ESSFwcp;ICHmk1;IMA;MHmmp;MSdk	BBT;BOV;CAM;CCM;COC;CPK;CRU;EKT;ELV;EPM;FLV;FRR;HAF;HEL;KIM;KIR;MCR;MEM;MIR;NAM;NEU;NHR;NKM;NOH;NPK;NSH;NTU;PEF;QUH;SBR;SCM;SFH;SHB;SHR;SPK;SPM;SRH;UCV;WMR;WOU	DAB;DCC;DCO;DHW;DKA;DKL;DKM;DMH;DMK;DNC;DND;DNI;DOS;DPC;DPG;DQU;DRM;DSS;UNK	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SQCRD;SRD;TNRD	Alpine, Grassland, Herbaceous		Monitor Trend	1	1	6	3	N	
Deschampsia cespitosa Community	tufted hairgrass Community	G4		S3	23-Jun-04	23-Jun-04	Blue		IDFdk1/Gs04;IDFdk2/Gs04;IDFdk3/Gs04;IDFdk4/Gs04;IDFdm1/Gs04;IDFdm2/Gs04;IDFdw/Gs04;MSdc1/Gs04;MSdc2/Gs04;MSdk/Gs04;MSdm1/Gs04;MSdm2/Gs04;MSdv/Gs04;SBPSdc/Gs04;SBPSxc/Gs04;SBPSxc/W3	BBT;CAB;CAP;CCR;CHP;COC;CPK;CPR;EKT;ELV;EPM;FLV;FRB;GUU;HOR;LPR;MCR;NAU;NIB;NOB;NOH;NTU;OKR;PAR;SCR;SFH;SHB;SOB;SPK;SPM;THB;TRU;UCV;WCR;WCU;WOU	DAB;DCC;DCH;DCK;DCO;DCS;DKA;DMH;DNI;DOS;DPG;DQU;DRM;DVA	3;4;5;7;8	CCRD;CSRD;Cariboo;FVRD;NORD;RDCO;RDEK;RDKB;RDOS;SLRD;TNRD	Herbaceous, Grassland, Wetland		Eco Restore; Inventory; Plan; Private Land; Review Use; Status Rpt	2	3	2	3	N	
Dryas octopetala - Festuca altaica	white mountain-avens - Altai fescue	GNR		SNR			Yellow		BAFA;ESSFdk;ESSFdv;ESSFwm;IMA	BBT;CCM;COC;CPK;ELV;EPM;FLV;LPR;MCR;NKM;SCM;SCR;SPK;SPM;UCV	DAB;DCO;DCS;DKL;DRM;DSQ;UNK	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Alpine, Shrub, Herbaceous	Y	No New Actn	3	3	4	5	N	
Dryas octopetala var. *hookeriana* Dwarf Shrubland	white mountain-avens Dwarf Shrubland	GNR		SNR			Yellow		BAFA;BWBSdk1;CMA;ESSFdk;ESSFdkp;ESSFwc1;ESSFwcp;ESSFxv1;ESSFxv2;ICHmk1;IMA;MHmmp;MSdk;SBSwk2;SWB;SWBmk	BAU;BBT;BOV;CAM;CAR;CCM;CCR;CHP;COC;CPK;CPR;CRU;EKT;ELV;EMR;EPM;ESM;FLV;FRR;FRT;HAF;HAP;HEL;HYP;KEM;KIM;KIR;KLR;KRT;LIP;MAP;MCP;MCR;MEM;MIR;MUF;MUU;NAM;NAU;NEL;NEU;NHR;NKM;NOH;NOM;NPK;NSH;NSM;NTU;PAT;PEF;PEL;QUH;RAP;SBP;SBR;SCM;SCU;SFH;SHB;SHR;SIU;SOM;SPK;SPM;SRH;STH;STP;TAB;TAG;TEB;TEP;THH;TUR;UCV;WCR;WCU;WHU;WMR;WOU	DAB;DCC;DCH;DCO;DCS;DFN;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DNC;DND;DNI;DOS;DPC;DPG;DQU;DRM;DSS;DVA;UNK	1;2;3;4;5;6;7;8;9	ACRD;CCRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	Alpine, Shrub, Herbaceous	Y	No New Actn	3	3	4	5	N	
Eleocharis quinqueflora / Drepanocladus spp.	few-flowered spike-rush / hook-mosses	GNR		S2	30-Jul-04	30-Jul-04	Red		ESSFmc/Wf09;ESSFxc/Wf09;ESSFxv1/Wf09;MSdm2/Wf09;MSxv/Wf09;SBPSxc/Wf09;SBSmc2/Wf09	BAU;BUB;BUR;CAB;CCR;CHP;CPR;CRU;ESM;GUU;HOR;KIM;MAP;NAU;NEL;NEU;NIB;NOB;NOH;NOM;NSM;NTU;OKR;PAR;SBP;SCR;SHB;SSM;TRU;WCR;WCU;WOU	DCC;DCH;DCK;DCS;DJA;DKA;DKM;DMH;DMK;DND;DNI;DOS;DPG;DQU;DSS;DVA	3;5;6;7;8	CCRD;CSRD;Cariboo;FVRD;NORD;PRRD;RDBN;RDCO;RDKS;RDOS;SLRD;Stikine;TNRD	Wetland, Herbaceous		Monitor Trend	1	1	6	3	N	
Equisetum fluviatile - Carex utriculata	swamp horsetail - beaked sedge	G4		S3	30-Jul-04	30-Jul-04	Blue		BGxh2/Wm02;BWBSdk1/Wm02;ESSFmw/Wm02;ICHmw3/Wm02;ICHwk4/Wm02;IDFdm2/Wm02;MSdc2/Wm02;MSdm3/Wm02;MSdm3w/Wm02;MSmw2/Wm02;MSxk/Wm02;MSxv/Wm02;SBPSdc/Wm02;SBPSmk/Wm02;SBPSxc/Wm02;SBSdk/Wm02;SBSdw3/Wm02;SBSmk2/Wm02;SBSwk1/Wm02	BAU;BOV;BUB;CAB;CAM;CAP;CAR;CCM;CCR;CHP;CPR;EKT;ELV;EMR;EPM;EPR;FLV;FRT;GUU;HOR;KEM;KIM;KLR;KRT;LPR;MAP;MCP;MCR;MIR;NAU;NEL;NEU;NHR;NIB;NKM;NOM;NPR;NSH;NSM;NTU;OKR;PAR;PAT;QUH;QUL;RAP;SBP;SCR;SHR;SOM;SPK;SPM;SRH;STH;STP;TAB;TAG;TEB;TEP;THB;THH;TRU;TUR;UCV;WCR;WCU;WHU;WMR;WOU	DAB;DCC;DCH;DCK;DCO;DCS;DFN;DHW;DJA;DKA;DMH;DMK;DND;DNI;DOS;DPG;DQU;DRM;DSC;DSQ;DSS;DVA	2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDEK;RDFFG;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Wetland, Herbaceous		Monitor Trend; Rev Status	4	4	4	4	N	
Eriophorum angustifolium - Caltha leptosepala	narrow-leaved cotton-grass - white mountain marsh-marigold	G3G4		S3S4	14-Jul-04	14-Jul-04	Yellow		ESSFdc1/Wf12;ESSFdvd/Wf12;ESSFdv/Wf12;ESSFmc/Wf12;ESSFmw/Wf12;ESSFwc4/Wf12;ESSFxc/Wf12;MSdm1/Wf12;MSxk/Wf12	BAU;BUB;BUR;CAB;CAP;CCM;CCR;CPR;EPR;ESM;GUU;HOR;KIM;LPR;MAP;NAU;NEU;NIB;NKM;NOB;NOH;NOM;NPR;NSM;NTU;OKR;PAR;SBP;SCM;SCR;SFH;SHB;SRH;SSM;TRU;WCR;WOU	DAB;DCC;DCH;DCK;DCO;DCS;DJA;DKA;DKL;DKM;DMH;DMK;DND;DNI;DOS;DSC;DSQ;DSS	2;3;4;5;6;7;8	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;PRRD;RDBN;RDCK;RDCO;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Wetland, Herbaceous	Y	No New Actn	2	2	4	4	N	
Eriophorum angustifolium - Carex limosa	narrow-leaved cotton-grass - shore sedge	G3		S3	14-Jul-04	14-Jul-04	Blue		ESSFdc1/Wf13;ESSFdc3/Wf13;ESSFmc/Wf13;ESSFmw/Wf13;ESSFwc2/Wf13;ESSFxc/Wf13;MSdm1/Wf13;SBSwk2/Wf13	BAU;BBT;BUB;BUR;CAM;CAP;CCR;CPK;CPR;EPR;ESM;GUU;HAF;HOR;KIM;LPR;MAP;MCP;MIR;NAU;NEL;NEU;NHR;NIB;NKM;NOB;NOH;NOM;NPK;NPR;NSH;NSM;NTU;OKR;PAR;PAT;PEF;PEL;QUH;SBP;SCR;SFH;SHB;SHR;SOM;SRH;SSM;TRU;WCR;WOU	DAB;DCC;DCH;DCK;DCO;DCS;DHW;DJA;DKA;DKM;DMH;DMK;DND;DNI;DOS;DPC;DSC;DSQ;DSS	2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Wetland, Herbaceous	Y	Monitor Trend	2	2	4	4	N	
Festuca altaica - Festuca brachyphylla	Altai fescue - alpine fescue	GNR		SNR			Yellow		BAFA;ESSFdk;ESSFdv;ESSFwm;IMA	BBT;CCM;COC;CPK;ELV;EPM;FLV;LPR;MCR;NKM;SCM;SCR;SPK;SPM;UCV	DAB;DCO;DCS;DKL;DRM;DSQ;UNK	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Alpine, Grassland, Herbaceous	Y	No New Actn	3	3	4	5	N	
Festuca altaica Herbaceous Vegetation	Altai fescue Herbaceous Vegetation	GNR		SNR			Yellow		BAFA;BWBS;ESSFmc;ESSFmv;ESSFxv;IMA;SWBdk	BAU;BUB;BUR;CAR;CCR;CHP;CPR;EMR;ESM;FRR;FRT;HAF;HAP;KIM;KIP;KLR;MAP;MIR;MUF;NAU;NBR;NEL;NEU;NOM;NSM;PAT;PEF;SBP;SHR;SOM;SSM;TAB;WCR;WCU;WMR	DCC;DCH;DCS;DJA;DKM;DMK;DND;DNI;DPC;DPG;DQU;DSS;DVA;UNK	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Alpine, Grassland, Herbaceous	Y	No New Actn	4	4	4	5	N	
Festuca brachyphylla - Phleum alpinum	alpine fescue - alpine timothy	GNR		SNR			Yellow		BAFA;ESSFdk;ESSFdv;ESSFwm;IMA	BBT;CCM;COC;CPK;ELV;EPM;FLV;LPR;MCR;NKM;SCM;SCR;SPK;SPM;UCV	DAB;DCO;DCS;DKL;DRM;DSQ;UNK	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Alpine, Grassland, Herbaceous	Y	No New Actn	2	2	4	4	N	
Festuca brachyphylla Herbaceous Vegetation	alpine fescue Herbaceous Vegetation	GNR		SNR			Yellow		BAFA;ESSFdk;ESSFdv;ESSFwm;IMA	BBT;CCM;COC;CPK;ELV;EPM;FLV;LPR;MCR;NKM;SCM;SCR;SPK;SPM;UCV	DAB;DCO;DCS;DKL;DRM;DSQ;UNK	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Alpine, Grassland, Herbaceous		No New Actn	2	2	4	4	N	
Festuca campestris - Pseudoroegneria spicata	rough fescue - bluebunch wheatgrass	G4		S2	31-Oct-04	31-Jul-02	Red		BGxh2/06;BGxw1/06;IDFdk1a/91;IDFxh2a/91;PPdh2/00	EKT;GUU;NIB;OKR;PAR;SHB;THB	DCS;DKA;DOS;DRM	2;3;4;8	CSRD;RDEK;RDOS;SLRD;TNRD	Grassland, Herbaceous		Eco Protect; Inventory; Plan; Private Land; Review Use; Status Rpt	2	3	6	2	Y	
Festuca idahoensis - Pseudoroegneria spicata	Idaho fescue - bluebunch wheatgrass	G4		S2	31-Oct-04	31-Jul-02	Red		IDFxh1a/91	NOB;OKR;PAR;SHB;SOB;THB	DCS;DKA;DOS	3;8	CSRD;NORD;RDCO;RDOS;TNRD	Grassland, Herbaceous		Eco Protect; Eco Restore; Plan; Private Land; Review Use; Status Rpt	2	3	6	2	Y	
Juncus balticus - Carex praegracilis	Baltic rush - field sedge	G3G4		S3	24-Jun-04	24-Jun-04	Blue		BG/Gs03;IDFdk1/Gs03;IDFdk2/Gs03;IDFdk3/Gs03;IDFdk3/W3;IDFdk4/Gs03;IDFdm1/Gs03;IDFdm2/Gs03;IDFdw/Gs03;PP/Gs03;SBPSdc/Gs03;SBPSxc/Gs03;SBPSxc/W2	CAB;CAP;CCR;CHP;CPR;EKT;ELV;EPM;FLV;FRB;GUU;HOR;MCR;NAU;NIB;NOB;NOH;NTU;OKR;PAR;SCR;SFH;SHB;SOB;SPK;SPM;THB;TRU;UCV;WCR;WCU;WOU	DAB;DCC;DCH;DCK;DCS;DKA;DMH;DNI;DOS;DPG;DQU;DRM;DVA;UNK	2;3;4;5;7;8	CCRD;CSRD;Cariboo;NORD;RDCO;RDEK;RDKB;RDOS;SLRD;TNRD	Wetland, Herbaceous		Eco Protect; Eco Restore; Inventory; Plan; Private Land; Review Use; Status Rpt	2	2	2	3	N	
Juncus balticus - Potentilla anserina	Baltic rush - common silverweed	GNR		S2	31-Oct-04	31-Jul-02	Red		BGxw1/Wm07;PPxh1/Wm07	NIB;NOB;OKR;SOB;THB	DCS;DKA;DOS	3;8	RDCO;RDOS;TNRD	Wetland, Herbaceous		Eco Protect; Eco Restore; Inventory; Plan; Private Land; Review Use; Status Rpt	1	1	6	2	N	
Juncus parryi Herbaceous Vegetation	Parry's rush Herbaceous Vegetation	GNR		SNR			Yellow		ESSFdc1;IMA	NOH;SFH	DAB;DOS;UNK	1;2;3;4;5;7;8	CSRD;Cariboo;ComoxVRD;FVRD;NORD;PRRD;RDCK;RDEK;RDFFG;RDKB;RDMW;RDOS;SLRD;SRD;TNRD	Alpine, Herbaceous	Y	No New Actn	2	2	4	4	N	
Juniperus communis / Pseudoroegneria spicata	common juniper / bluebunch wheatgrass	GNR		S2	31-Oct-04	21-Jun-02	Red		ESSFdc2/02;MSdm2/02	CAP;HOR;NIB;NOB;NSH;OKR;PAR;SHB;WOU	DCK;DCS;DHW;DKA;DMH;DOS	3;5;8	CSRD;Cariboo;FVRD;NORD;RDCO;RDOS;TNRD	Shrub, Herbaceous, Grassland		Monitor Trend	2	2	6	3	N	
Juniperus communis Shrubland	common juniper shrubland	GNR		SNR			Yellow		BAFA;ESSFdc1;IMA;SWBmk	CAR;EMR;ESM;HAP;HYP;KEM;KRT;LIP;MUF;MUU;NOH;NOM;NSM;PEF;RAP;SBP;SCU;SFH;SIU;SOM;STP;TEB;TEP;TUR;WMR	DAB;DFN;DJA;DMK;DOS;DPC;DSS;UNK	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Shrub, Alpine	Y	No New Actn	2	2	4	4	N	
Kobresia myosuroides Herbaceous Vegetation	Bellard's kobresia Herbaceous Vegetation	GNR		SNR			Yellow		BAFA;CMA;ESSF;IMA;MHmmp;SWB	CRU;HEL;KIM;KIR;MEM;NAM;NEU;SBR	DKM;DNC;DND;DNI;DSS;UNK	1;2;3;4;5;6;7;8;9	ACRD;CCRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	Herbaceous, Alpine	Y	No New Actn	2	2	4	4	N	
Koeleria macrantha Herbaceous Vegetation	junegrass Herbaceous Vegetation	GNR		SNR			Yellow		BAFA;ESSFdk;ESSFdv;ESSFwm;IMA	BBT;CCM;COC;CPK;ELV;EPM;FLV;LPR;MCR;NKM;SCM;SCR;SPK;SPM;UCV	DAB;DCO;DCS;DKL;DRM;DSQ;UNK	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Alpine, Grassland, Herbaceous	Y	Monitor Trend	2	2	4	4	N	

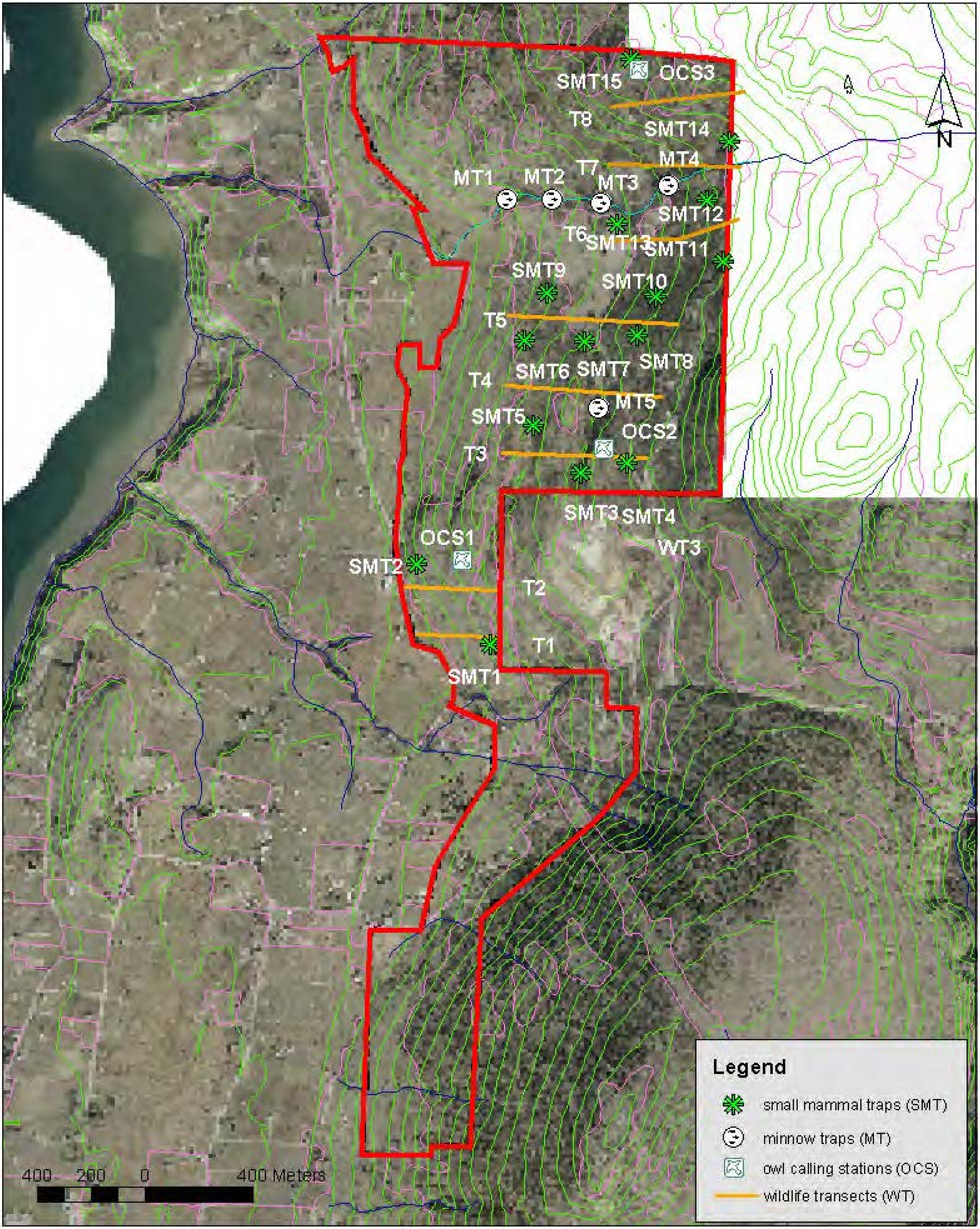
Scientific Name	English Name	Global Status	Global Status Review Date	Prov Status	Prov Status Review Date	Prov Status Change Date	BC List	Identified Wildlife	Biogeoclimatic Units	Ecosection	Forest District	MOE Region	Regional Dist	Ecosystem Group	Endemic	Action Groups	Highest Priority	Priority Goal 1	Priority Goal 2	Priority Goal 3	CDC Maps	Mapping Status
Luetkea pectinata Herbaceous Vegetation	partridge-foot Herbaceous Vegetation	GNR		SNR			Yellow		ESSFdk;ESSFdkp;ESSFwc1;ESSFwcp;ICHmk1;IMA;MSdk	BBT;BOV;CAM;CCM;COC;CPK;EKT;ELV;EPM;FLV;FRR;HAF;MCR;MIR;NHR;NKM;NOH;NPK;NSH;NTU;PEF;QUH;SCM;SFH;SHB;SHR;SPK;SPM;SRH;UCV;WMR;WOU	DAB;DCC;DCO;DHW;DKA;DKL;DMH;DMK;DOS;DPC;DPG;DQU;DRM;UNK	1;2;3;4;5;7;8;9	CSRD;Cariboo;ComoxVRD;FVRD;NORD;PRRD;RDCK;RDCO;RDEK;RDFFG;RDKB;RDMW;RDOS;SLRD;SRD;TNRD	Herbaceous, Alpine, Shrub	Y	No New Actn	3	3	4	5	N	
Marsilea vestita - Schoenoplectus americanus	hairy water-clover - Olney's bulrush	G3Q		S1	31-Oct-04	26-Sep-94	Red		BGxh1/00	NOB;OKR;SOB	DOS	8	RDOS	Wetland, Riparian, Herbaceous		Classification	1	2	6	1	Y	
Menyanthes trifoliata - Carex lasiocarpa	buckbean - slender sedge	G3		S3	31-Oct-04	31-Jul-02	Blue		CDFmm/Wf06;CWHws1/Wf06;ICHwk1/Wf06;IDFdk2/Wf06;SBSdk/Wf06	BAU;BBT;BUB;CAM;CCM;CPK;EPM;FRL;GEL;HOR;MEM;NAL;NAM;NAU;NCF;NEL;NEU;NIB;NKM;NOB;NPK;NSH;NTU;OKR;PAR;QUH;SBR;SGI;SHB;SOG;SPM;SRH;THB;TRU;WOU	DAB;DCC;DCK;DCO;DCR;DCS;DHW;DJA;DKA;DKL;DKM;DNC;DND;DOS;DQU;DSC;DSI;DSS;DVA	1;2;3;4;5;6;7;8	CRD;CSRD;CVRD;Cariboo;ComoxVRD;GVRD;NORD;PowellR;RDBN;RDCK;RDCO;RDFFG;RDKS;RDN;RDOS;SCRD;SRD;TNRD	Wetland, Herbaceous	Y	Monitor Trend	2	2	4	4	N	
Phleum alpinum - Carex phaeocephala	alpine timothy - dunhead sedge	GNR		SNR			Yellow		BAFA;ESSFdk;ESSFdv;ESSFwm;IMA	BBT;CCM;COC;CPK;ELV;EPM;FLV;LPR;MCR;NKM;SCM;SCR;SPK;SPM;UCV	DAB;DCO;DCS;DKL;DRM;DSQ;UNK	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Herbaceous, Sparsely Vegetated, Alpine	Y	No New Actn	2	2	4	4	N	
Phyllodoce empetriformis - Cassiope mertensiana	pink mountain-heather - white mountain-heather	GNR		SNR			Yellow		BAFA;ESSFdc1;IMA;SBSwk2	BAU;HAF;MAP;MCP;MIR;NEL;NHR;NOH;PAT;PEF;PEL;SFH;SHR;SOM	DAB;DMK;DOS;DPC;UNK	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Alpine, Shrub, Herbaceous		No New Actn	3	3	4	5	N	
Phyllodoce empetriformis Dwarf Shrubland	pink mountain-heather Dwarf Shrubland	GNR		SNR			Yellow		BAFA;BWBSdk1;CMA;ESSFdc1;IMA;MHmmp;SWB	CAR;CRU;EMR;FRT;HEL;KEM;KIM;KIR;KLR;KRT;MAP;MEM;NAM;NEU;NOH;NOM;NSM;PAT;RAP;SBP;SBR;SFH;SOM;STH;STP;TAB;TAG;TEB;TEP;THH;TUR;WHU;WMR	DAB;DFN;DJA;DKM;DMK;DNC;DND;DNI;DOS;DSS;UNK	1;2;3;4;5;6;7;8;9	ACRD;CCRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	Alpine, Shrub, Herbaceous	Y	No New Actn	3	3	4	5	N	
Phyllodoce glanduliflora Dwarf Shrubland	yellow mountain-heather Dwarf Shrubland	GNR		SNR			Yellow		CMA;ESSFdc1;IMA;MHmmp	CRU;HEL;KIM;KIR;MEM;NAM;NEU;NOH;SBR;SFH	DAB;DKM;DNC;DND;DNI;DOS;DSS;UNK	1;2;3;4;5;6;7;8	ACRD;CCRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;NORD;PRRD;PowellR;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	Alpine, Shrub, Herbaceous	Y	No New Actn	3	3	4	5	N	
Picea engelmannii x glauca / Equisetum spp.	hybrid white spruce / horsetails	GNR		S5	31-Mar-01	3-Mar-93	Yellow		ICHdk/09;ICHmk1/07;ICHmk2/06;ICHvc/06;ICHwc/08;IDFdk1/06;IDFdk2/06;IDFdm1/07;IDFdm2/07;IDFdw/10;IDFxh2/08;IDFxm/09;MSdk/06;SBPSmc/05;SBSdh1/07;SBSdk/07;SBSdw2/10;SBSmc2/10;SBSmc3/08;SBSmh/09;SBSmk1/09;SBSmk2/06;SBSmm/08;SBSmw/09;SBSvk/06;SBSwk1/09;SBSwk2/06;SBSwk3/08	BAU;BBT;BOV;BUB;BUR;CAB;CAM;CAP;CBR;CCR;CHP;COC;CPK;CPR;CRU;EKT;ELV;EPM;ESM;FLV;FRB;GUU;HAF;HOR;KIM;MAP;MCP;MCR;MEM;MIR;NAB;NAU;NEL;NEU;NHR;NIB;NOB;NOH;NPK;NSH;NSM;NTU;OKR;PAR;PAT;PEF;PEL;QUH;QUL;SBP;SCR;SFH;SHB;SHR;SOB;SOM;SPK;SPM;SRH;SSM;THB;TRU;UCV;UFT;WCR;WCU;WMR;WOU	DAB;DCC;DCH;DCK;DCO;DCS;DHW;DJA;DKA;DKL;DKM;DMH;DMK;DND;DNI;DOS;DPC;DPG;DQU;DRM;DSS;DVA	3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;NORD;PRRD;RDBN;RDCO;RDEK;RDFFG;RDKB;RDKS;RDOS;SLRD;Stikine;TNRD	Forest, Riparian		Monitor Trend	6	6	6	6	N	
Picea engelmannii x glauca / Equisetum spp. */ Mnium* spp.	hybrid white spruce / horsetails / leafy mosses	GNR		S3	25-Jun-04	7-May-96	Blue		MSdc2/08;MSdm2/07;MSxk/09	CAB;CAP;CCR;CHP;GUU;HOR;NIB;NOB;NTU;OKR;PAR;TRU;WCR;WOU	DCC;DCH;DCK;DCS;DKA;DMH;DNI;DOS	3;5;8	CCRD;CSRD;Cariboo;FVRD;NORD;RDCO;RDOS;SLRD;TNRD	Forest		Classification; Monitor Trend	3	3	4	4	N	
Picea engelmannii x glauca / Ledum glandulosum / Equisetum spp.	hybrid white spruce / trapper's tea / horsetails	GNR		S4	31-Mar-01	22-Sep-94	Yellow		MSdm1/07	NOB;NOH;SFH	DAB;DOS	8	NORD;RDCO;RDKB;RDOS	Forest		No New Actn	4	4	4	5	N	
Picea engelmannii x glauca / Ledum glandulosum / Vaccinium scoparium	hybrid white spruce / trapper's tea / grouseberry	GNR		S3S4	7-Jun-04	7-Jun-04	Yellow		MSdm1/05;MSxk/07	CAB;CAP;CCR;GUU;HOR;NIB;NOB;NOH;NTU;OKR;PAR;SCR;SFH;TRU;WOU	DAB;DCC;DCS;DKA;DMH;DOS	3;5;8	NORD;RDCO;RDKB;RDOS;SLRD;TNRD	Forest		Classification; Inventory	2	2	2	3	N	
Picea engelmannii x glauca / Paxistima myrsinites / Pleurozium schreberi	hybrid white spruce / falsebox / red-stemmed feathermoss	GNR		S4	31-Mar-01	31-Mar-01	Yellow		MSdm1/01;MSdm2/01	HOR;NIB;NOB;NOH;OKR;PAR;SFH;SHB;WOU	DAB;DCK;DCS;DKA;DOS	3;8	CSRD;FVRD;NORD;RDCO;RDKB;RDOS;TNRD	Forest		Plan; Review Use	2	4	2	4	N	
Picea engelmannii x glauca - Pseudotsuga menziesii / Ribes lacustre	hybrid white spruce - Douglas-fir / black gooseberry	GNR		S3S4	8-Jun-04	8-Jun-04	Yellow		IDFdk1/05;IDFdk2/05;IDFdm1/06	CAB;GUU;HOR;NIB;NOB;NOH;NTU;OKR;PAR;SCR;SFH;SHB;SOB;THB;TRU;WOU	DAB;DCK;DCS;DKA;DOS	3;8	CSRD;NORD;RDCO;RDKB;RDOS;SLRD;TNRD	Forest		Classification; Inventory; Review Use	2	3	2	3	N	
Picea engelmannii x glauca / Ribes lacustre	hybrid white spruce / black gooseberry	GNR		S3	7-Jul-04	31-Mar-01	Blue		MSdc1/04;MSdc2/07;MSdm1/06	CCR;CHP;LPR;NOB;NOH;SCR;SFH;WCR	DAB;DCH;DCS;DNI;DOS	3;5;8	CCRD;Cariboo;NORD;RDCO;RDKB;RDOS;SLRD;TNRD	Forest		Inventory; Review Use	2	3	2	3	N	
Picea engelmannii x glauca / Ribes lacustre / Gymnocarpium dryopteris	hybrid white spruce / black gooseberry / oak fern	GNR		S4	31-Oct-04	31-Oct-04	Yellow		MSdm1/08	NOB;NOH;SFH	DAB;DOS	8	NORD;RDCO;RDKB;RDOS	Forest		Classification; Inventory	4	4	4	5	N	
Picea engelmannii x glauca / Ribes lacustre - Oplopanax horridus	hybrid white spruce / black gooseberry - devil's club	GNR		S2S3	31-Mar-01	31-Mar-01	Blue		MSdm2/06	HOR;NIB;NOB;OKR;PAR;SHB;WOU	DCK;DCS;DKA;DOS	3;8	CSRD;FVRD;NORD;RDCO;RDOS;TNRD	Forest		Classification; Eco Protect; Inventory; Review Use	2	4	6	2	N	
Picea engelmannii x glauca / Ribes lacustre / Vaccinium scoparium	hybrid white spruce / black gooseberry / grouseberry	GNR		S3S4	7-Jul-04	21-Jun-02	Yellow		MSdm2/05;MSxk/08	CAB;CAP;CCR;GUU;HOR;NIB;NOB;NTU;OKR;PAR;SCR;TRU;WOU	DCC;DCK;DCS;DKA;DMH;DOS	3;8	CSRD;FVRD;NORD;RDCO;RDOS;SLRD;TNRD	Forest		Classification; Review Use	2	3	2	3	N	
Pinus contorta / Calamagrostis rubescens - Arctostaphylos uva-ursi	lodgepole pine / pinegrass - kinnikinnick	GNR		S4	31-Mar-01	31-Mar-01	Yellow		MSdm1/04	NOB;NOH;SFH	DAB;DOS	8	NORD;RDCO;RDKB;RDOS	Forest		Classification; Monitor Trend; Review Use	2	3	2	4	N	
Pinus contorta / Calamagrostis rubescens - Lupinus arcticus	lodgepole pine / pinegrass - arctic lupine	GNR		S3S4	7-Jul-04	22-Sep-94	Yellow		MSxk/01;MSxk/06	CAB;CAP;CCR;GUU;HOR;NIB;NTU;OKR;PAR;SCR;TRU;WOU	DCC;DCS;DKA;DMH;DOS	3;5;8	RDOS;SLRD;TNRD	Forest		Inventory; Monitor Trend; Plan; Review Use	2	3	2	3	N	
Pinus contorta / Carex aquatilis / Sphagnum spp.	lodgepole pine / water sedge / peat-mosses	G3		S3	24-Apr-07	24-Apr-07	Blue		ESSFdv d/Wb07;ESSFdv/07;ESSFdv/Wb07;ICHmk3/08;ICHmk3/Wb07;ICHwc/10;ICHwc/Wb07;ICHwk2/09;ICHwk2/Wb07;ICHwk3/08;ICHwk3/Wb07;MSxk/10;MSxk/Wb07	BOV;CAB;CAM;CAP;CBR;CCR;GUU;HOR;LPR;NIB;NPK;NSM;NTU;OKR;PAR;QUH;SBP;SCR;SHR;TRU;UFT;WOU	DCC;DCS;DHW;DKA;DMH;DOS;DPG;DQU;DSQ;DSS	2;3;5;6;7	Cariboo;RDFFG;RDKS;RDOS;SLRD;TNRD	Wetland, Forest, Woodland	Y	Monitor Trend	2	2	4	4	N	
Pinus contorta / Juniperus communis / Calamagrostis rubescens	lodgepole pine / common juniper / pinegrass	GNR		S4	30-Jun-04	30-Jun-04	Yellow		ESSFdc1/02	NOH;SFH	DAB;DOS	4	NORD;RDCK;RDKB;RDOS	Woodland, Forest		Classification; Monitor Trend	2	4	2	4	N	
Pinus contorta / Juniperus communis / Lupinus arcticus	lodgepole pine / common juniper / arctic lupine	GNR		S4	30-Jun-04	30-Jun-04	Yellow		ESSFxc/02	CCR;GUU;HOR;NIB;NOH;NTU;OKR;PAR;SCR;SHB;TRU;WOU	DCC;DCS;DKA;DMH;DOS	3;5;8	CSRD;Cariboo;NORD;RDCO;RDOS;SLRD;TNRD	Woodland, Forest		Monitor Trend	2	3	2	4	N	
Pinus contorta / Juniperus communis - Paxistima myrsinites	lodgepole pine / common juniper - falsebox	GNR		S3	30-Jun-04	30-Jun-04	Blue		ESSFdc2/03	CAP;HOR;NSH;OKR;PAR;WOU	DCK;DCS;DHW;DKA;DMH;DOS	3;5;8	Cariboo;FVRD;NORD;RDCO;RDOS;TNRD	Forest		Classification; Monitor Trend	2	2	2	3	N	
Pinus contorta / Vaccinium membranaceum / Cladonia spp.	lodgepole pine / black huckleberry / clad lichens	GNR		S5	31-Mar-01	10-Mar-93	Yellow		ESSFmv1/02;ESSFwc2/02;MSdm1/03;SBSmc2/02;SBSmk1/02;SBSmm/02	BAU;BBT;BOV;BUB;BUR;CAM;CAP;CPK;CRU;ESM;KIM;MAP;MCP;NAU;NEL;NEU;NKM;NOB;NOH;NPK;NSH;NSM;NTU;PAT;QUH;QUL;SFH;SOM;SRH;SSM;TRU	DAB;DCO;DHW;DJA;DKA;DKM;DMH;DMK;DND;DNI;DOS;DPG;DQU;DSS;DVA	3;4;5;6;7;8	CSRD;Cariboo;NORD;PRRD;RDBN;RDCO;RDFFG;RDKB;RDKS;RDOS;Stikine;TNRD	Woodland, Forest	P	Monitor Trend	5	5	6	5	N	
Pinus contorta / Vaccinium scoparium - Calamagrostis rubescens	lodgepole pine / grouseberry - pinegrass	GNR		S5	31-Mar-01	22-Sep-94	Yellow		MSdm2/03;MSdm2/04	HOR;NIB;NOB;OKR;PAR;SHB;WOU	DCK;DCS;DKA;DOS	3;8	CSRD;FVRD;NORD;RDCO;RDOS;TNRD	Forest		Classification; Monitor Trend	5	6	6	5	N	
Pinus ponderosa / Aristida purpurea var. *longiseta*	ponderosa pine / red three-awn	GNR		S3	31-Oct-04	22-Sep-94	Blue		BGxh1/04;BGxh2/03;PPxh1/02	GUU;NOB;OKR;PAR;SOB;THB	DCS;DKA;DOS	2;8	RDCO;RDOS;TNRD	Woodland, Forest		Eco Restore; Plan; Private Land; Review Use; Status Rpt	2	2	2	3	Y	
Pinus ponderosa - Populus balsamifera ssp. *trichocarpa / Toxicodendron rydbergii*	ponderosa pine - black cottonwood / poison ivy	GNR		S1	31-Oct-04	17-Jun-93	Red		BGxh1/06	NOB;OKR;SOB	DOS	8	RDOS	Riparian, Forest		Eco Protect; Eco Restore; Plan; Private Land; Status Rpt	1	1	6	1	Y	
Pinus ponderosa / Pseudoroegneria spicata - Festuca campestris	ponderosa pine / bluebunch wheatgrass - rough fescue	GNR		S3	31-Oct-04	21-Jun-02	Blue		BGxw1/05;PPxh1/05;PPxh2/01	GUU;NIB;NOB;OKR;PAR;SCR;SOB;THB;TRU	DCS;DKA;DOS	3;8	RDCO;RDOS;SLRD;TNRD	Woodland, Forest		Eco Restore; Plan; Private Land; Review Use; Status Rpt	2	4	2	3	Y	
Pinus ponderosa / Pseudoroegneria spicata - Festuca idahoensis	ponderosa pine / bluebunch wheatgrass - Idaho fescue	GNR		S3	8-Jul-04	15-Jun-00	Blue		PPxh1/01	NOB;OKR;SOB	DCS;DOS	8	RDCO;RDOS	Woodland, Forest		Eco Restore; Plan; Private Land; Review Use; Status Rpt	2	4	2	3	N	
Pinus ponderosa / Rhus glabra	ponderosa pine / smooth sumac	GNR		S2	31-Oct-04	22-Sep-94	Red		BGxh1/05	NOB;OKR;SOB	DOS	8	RDOS	Woodland, Forest		Monitor Trend; Plan; Status Rpt	1	1	6	2	Y	
Populus balsamifera ssp. *trichocarpa - Betula occidentalis*	black cottonwood - water birch	GNR		S1	31-Oct-04	11-Jul-02	Red		BGxh1/07;PPxh2/07	GUU;NIB;NOB;OKR;PAR;SCR;SOB;THB;TRU	DCS;DKA;DOS	3;8	RDOS;SLRD;TNRD	Riparian, Forest		Eco Protect; Eco Restore; Plan; Private Land; Review Use; Status Rpt	1	1	6	1	Y	
Populus balsamifera ssp. *trichocarpa - Pseudotsuga menziesii / Symphoricarpos albus - Cornus stolonifera*	black cottonwood - Douglas-fir / common snowberry - red-osier dogwood	G1G2		S1S2	31-Oct-04	26-Jul-02	Red		IDFxh1/00	HOR;NIB;NOB;NOH;OKR;SHB;SOB;SRH;WOU	DCS;DOS	3;8	CSRD;NORD;RDCO;RDKB;RDOS;TNRD	Riparian, Forest	Y	Eco Protect; Private Land	1	1	6	1	N	
Populus tremuloides / Symphoricarpos albus / Osmorhiza berteroi	trembling aspen / common snowberry / mountain sweet-cicely	G3?		S1	31-Oct-04	25-Jul-02	Red		IDFxh1/00	HOR;NIB;NOB;NOH;OKR;SHB;SOB;SRH;WOU	DCS;DOS	3;8	CSRD;NORD;RDCO;RDKB;RDOS;TNRD	Riparian, Forest		Eco Protect; Eco Restore; Plan; Private Land; Status Rpt	1	2	6	1	N	
Populus tremuloides / Symphoricarpos albus / Poa pratensis	trembling aspen / common snowberry / Kentucky bluegrass	GNR		S2	31-Oct-04	21-Apr-95	Red		BGxw1/08;IDFdk1a/94;IDFxh1a/98;IDFxh2a/95	GUU;NIB;NOB;OKR;PAR;SHB;SOB;THB	DCS;DKA;DOS	3;8	CSRD;NORD;RDCO;RDOS;SLRD;TNRD	Riparian, Forest		Eco Protect; Eco Restore; Inventory; Plan; Private Land; Review Use; Status Rpt	2	3	6	2	N	
Pseudoroegneria spicata - Balsamorhiza sagittata	bluebunch wheatgrass - arrowleaf balsamroot	G2		S2	31-Oct-04	21-Jun-02	Red		IDFxh1a/93;IDFxm/00;PPdh1/03;PPxh1/00K	CAB;CHP;FRB;NOB;NOH;OKR;PAR;QUL;SHB;SOB;THB	DAB;DCC;DCH;DCS;DKA;DMH;DOS;DQU	3;5;8	CSRD;Cariboo;NORD;RDCO;RDKB;RDOS;TNRD	Grassland, Herbaceous		Eco Protect; Eco Restore; Inventory; Plan; Private Land; Review Use; Status Rpt	1	1	6	2	Y	
Pseudoroegneria spicata - Koeleria macrantha	bluebunch wheatgrass - junegrass	G2		S2	31-Oct-04	31-Jul-02	Red		BGxh1/00;BGxh3/00;BGxw1/01;BGxw2/01;IDFdk1a/92;IDFdk3/00;IDFdm1/02;IDFun/00;IDFxh2a/00;IDFxh2a/92;IDFxm/00;MSxk/03;PPdh2/02a;PPdh2/02b	CAB;CAP;CCR;CHP;EKT;ELV;FRB;GUU;HOR;NIB;NOB;NOH;NTU;OKR;PAR;QUL;SCR;SFH;SOB;THB;TRU;WOU	DAB;DCC;DCH;DCS;DKA;DMH;DOS;DQU;DRM	3;4;5;8	CSRD;Cariboo;NORD;RDCK;RDCO;RDEK;RDKB;RDOS;SLRD;TNRD	Grassland, Herbaceous		Eco Protect; Eco Restore; Inventory; Plan; Private Land; Review Use; Status Rpt	1	1	6	2	Y	
Pseudoroegneria spicata - Selaginella densa	bluebunch wheatgrass - compact selaginella	G4		S4	31-Mar-01	26-Sep-94	Yellow		BGxh1/03;BGxh2/02;BGxw1/02	GUU;NIB;NOB;OKR;PAR;SOB;THB	DCS;DKA;DOS	2;3;8	RDOS;TNRD	Grassland, Herbaceous	Y	No New Actn	3	3	4	5	Y	
Pseudotsuga menziesii - Abies lasiocarpa / Calamagrostis rubescens	Douglas-fir - subalpine fir / pinegrass	GNR		S4	5-Jul-04	5-Jul-04	Yellow		MSxk/05	CAB;CAP;CCR;GUU;HOR;NIB;NTU;OKR;PAR;SCR;TRU;WOU	DCC;DCS;DKA;DMH;DOS	3;5;8	RDOS;SLRD;TNRD	Forest		Classification; Monitor Trend; Review Use	2	3	2	4	N	
Pseudotsuga menziesii - Abies lasiocarpa / Paxistima myrsinites / Calamagrostis rubescens	Douglas-fir - subalpine fir / falsebox / pinegrass	GNR		S5	27-Apr-07	27-Apr-07	Yellow		ESSFmw/03	CCR;CPR;EPR;HOR;KIM;LPR;NEU;NPR;SCR;WCR	DCH;DCK;DCS;DNI;DSC;DSQ	2;3;5;8	CCRD;Cariboo;ComoxVRD;FVRD;RDMW;RDOS;SLRD;SRD;TNRD	Forest		Monitor Trend	5	5	6	6	N	
Pseudotsuga menziesii / Acer glabrum - Cornus stolonifera	Douglas-fir / Douglas maple - red-osier dogwood	GNR		S2	8-Jul-04	8-Jul-04	Red		IDFxh1/08	HOR;NIB;NOB;NOH;OKR;SHB;SOB;SRH;WOU	DCS;DOS	3;8	CSRD;NORD;RDCO;RDKB;RDOS;TNRD	Riparian, Forest		Classification; Eco Protect; Eco Restore; Monitor Trend; Plan; Private Land; Review Use; Status Rpt	2	4	6	2	N	
Pseudotsuga menziesii - Betula occidentalis / Acer glabrum	Douglas-fir - water birch / Douglas maple	GNR		S1	31-Oct-04	15-Jun-00	Red		PPxh1/08	NOB;OKR;SOB	DCS;DOS	8	RDCO;RDOS	Forest, Riparian		Classification; Eco Protect; Eco Restore; Plan; Private Land; Status Rpt	1	1	6	1	N	

Scientific Name	English Name	Global Status	Global Status Review Date	Prov Status	Prov Status Review Date	Prov Status Change Date	BC List	Identified Wildlife	Biogeoclimatic Units	Ecosection	Forest District	MOE Region	Regional Dist	Ecosystem Group	Endemic	Action Groups	Highest Priority	Priority Goal 1	Priority Goal 2	Priority Goal 3	CDC Maps	Mapping Status
Pseudotsuga menziesii / Calamagrostis rubescens - Arctostaphylos uva-ursi	Douglas-fir / pinegrass - kinnikinnick	GNR		S3	7-Jun-04	7-Jun-04	Blue		IDFdm1/04	NOB;NOH;SFH;SOB	DAB;DOS	8	NORD;RDCO;RDKB;RDOS	Woodland, Forest		Eco Restore; Inventory; Review Use	2	4	2	3	N	
Pseudotsuga menziesii / Calamagrostis rubescens - Linnaea borealis	Douglas-fir / pinegrass - twinflower	GNR		S3	7-Jun-04	7-Jun-04	Blue		ICHmk1/03;IDFdm1/01;IDFdm2/01	BBT;CPK;EKT;ELV;EPM;FLV;MCR;NOB;NOH;SFH;SHB;SOB;SPK;SPM;SRH;UCV;WOU	DAB;DCO;DKL;DOS;DRM	3;4;8	CSRD;NORD;RDCO;RDEK;RDKB;RDOS	Forest		Eco Restore; Inventory; Plan; Review Use; Status Rpt	2	4	2	3	N	
Pseudotsuga menziesii / Calamagrostis rubescens / Pleurozium schreberi	Douglas-fir / pinegrass / red-stemmed feathermoss	GNR		S4	31-Mar-01	22-Sep-94	Yellow		IDFdk1/04;IDFdk2/04;IDFmw1/04;IDFmw2/03;IDFxh2/06;IDFxm/01;IDFxw/05	CAB;CAP;CHP;FRB;GUU;HOR;NIB;NOB;NOH;NSH;NTU;OKR;PAR;QUH;QUL;SCR;SHB;SOB;SRH;THB;TRU;WOU	DCC;DCH;DCK;DCS;DHW;DKA;DMH;DOS;DQU	3;5;8	CSRD;Cariboo;NORD;RDCO;RDOS;SLRD;TNRD	Forest, Woodland		Monitor Trend; Plan	2	4	2	4	N	
Pseudotsuga menziesii / Juniperus communis / Calamagrostis rubescens	Douglas-fir / common juniper / pinegrass	GNR		S4	21-Jun-04	22-Sep-94	Yellow		ICHmk2/02;IDFdk1/03;MSdc1/02;MSxk/02	CAB;CAP;CCR;GUU;HOR;LPR;NIB;NOB;NSH;NTU;OKR;PAR;SCR;SOB;THB;TRU;WOU	DCC;DCS;DHW;DKA;DMH;DOS	3;5;8	CSRD;Cariboo;NORD;RDCO;RDOS;SLRD;TNRD	Woodland, Forest		Classification	4	4	4	5	N	
Pseudotsuga menziesii / Penstemon fruticosus - Calamagrostis rubescens	Douglas-fir / shrubby penstemon - pinegrass	GNR		S3	8-Jul-04	31-Mar-01	Blue		ICHmk1/02;IDFmw1/03;MSdm1/02	BBT;CPK;ELV;EPM;FLV;MCR;NOB;NOH;SFH;SHB;SPK;SPM;SRH;UCV;WOU	DAB;DCO;DKL;DOS;DRM	3;4;8	CSRD;NORD;RDCO;RDEK;RDKB;RDOS	Woodland, Forest		Classification; Monitor Trend	2	2	2	3	N	
Pseudotsuga menziesii - Pinus contorta / Calamagrostis rubescens / Pleurozium schreberi	Douglas-fir - lodgepole pine / pinegrass / red-stemmed feathermoss	GNR		S4S5	31-Mar-01	16-Mar-93	Yellow		ICHmk2/03;ICHmw3/03;IDFdk1/01;IDFdk2/01;IDFdk3/01;IDFdk4/01;SBSdh1/03;SBSdw1/03	CAB;CAM;CAP;CCM;CCR;CHP;FRB;GUU;HOR;NAU;NIB;NKM;NOB;NPK;NSH;NTU;OKR;PAR;QUH;QUL;SCR;SHB;SOB;SRH;THB;TRU;UFT;WOU	DAB;DCC;DCH;DCK;DCO;DCS;DHW;DKA;DMH;DOS;DPG;DQU	3;4;5;7;8	CSRD;Cariboo;NORD;RDCO;RDFFG;RDOS;SLRD;TNRD	Forest, Woodland		Monitor Trend	4	5	4	5	N	
Pseudotsuga menziesii - Pinus ponderosa / Calamagrostis rubescens	Douglas-fir - ponderosa pine / pinegrass	GNR		S3	8-Jul-04	31-Mar-01	Blue		IDFdk2/03;IDFxh1/01;IDFxh2/01;IDFxh2/05	CAB;GUU;HOR;NIB;NOB;NOH;NTU;OKR;PAR;SHB;SOB;SRH;THB;TRU;WOU	DCK;DCS;DKA;DMH;DOS	3;8	CSRD;NORD;RDCO;RDKB;RDOS;SLRD;TNRD	Woodland, Forest		Eco Restore; Inventory; Plan; Private Land; Status Rpt	2	5	2	3	Y	
Pseudotsuga menziesii - Pinus ponderosa / Ceanothus velutinus	Douglas-fir - ponderosa pine / snowbrush	GNR		S3	7-Jun-04	31-Mar-01	Blue		IDFxh1/04	HOR;NIB;NOB;NOH;OKR;SHB;SOB;SRH;WOU	DCS;DOS	3;8	CSRD;NORD;RDCO;RDKB;RDOS;TNRD	Forest, Woodland		Classification; Eco Restore; Plan; Private Land; Status Rpt	2	5	2	3	N	
Pseudotsuga menziesii - Pinus ponderosa / Festuca idahoensis	Douglas-fir - ponderosa pine / Idaho fescue	GNR		S3	7-Jun-04	15-Jun-00	Blue		IDFxh1/05	HOR;NIB;NOB;NOH;OKR;SHB;SOB;SRH;WOU	DCS;DOS	3;8	CSRD;NORD;RDCO;RDKB;RDOS;TNRD	Forest, Woodland		Eco Restore; Plan; Private Land; Status Rpt	2	4	2	3	Y	
Pseudotsuga menziesii - Pinus ponderosa / Pseudoroegneria spicata	Douglas-fir - ponderosa pine / bluebunch wheatgrass	GNR		S2	5-Jul-04	5-Jul-04	Red		IDFxh1/02;IDFxh2/02;IDFxh2/03;IDFxw/04	CAB;FRB;GUU;HOR;NIB;NOB;NOH;NTU;OKR;PAR;SHB;SOB;SRH;THB;TRU;WOU	DCC;DCS;DKA;DMH;DOS	3;5;8	CSRD;NORD;RDCO;RDKB;RDOS;SLRD;TNRD	Woodland, Forest		Eco Protect; Eco Restore; Inventory; Plan; Private Land; Review Use; Status Rpt	2	3	6	2	N	
Pseudotsuga menziesii - Pinus ponderosa / Pseudoroegneria spicata - Calamagrostis rubescens	Douglas-fir - ponderosa pine / bluebunch wheatgrass - pinegrass	GNR		S3	5-Jul-04	5-Jul-04	Blue		IDFdk2/02;IDFdm1/03;IDFxh1/03;IDFxh2/04;IDFxw/02	CAB;FRB;GUU;HOR;NIB;NOB;NOH;NTU;OKR;PAR;SFH;SHB;SOB;SRH;THB;TRU;WOU	DAB;DCC;DCK;DCS;DKA;DMH;DOS	3;5;8	CSRD;NORD;RDCO;RDKB;RDOS;SLRD;TNRD	Woodland, Forest		Eco Restore; Inventory; Plan; Private Land; Status Rpt	2	3	2	3	N	
Pseudotsuga menziesii / Pseudoroegneria spicata - Selaginella densa	Douglas-fir / bluebunch wheatgrass - compact selaginella	GNR		S4	31-Mar-01	22-Sep-94	Yellow		PPxh2/02	GUU;NIB;PAR;SCR;THB;TRU	DCS;DKA;DOS	3	NORD;RDCO;RDEK;RDKB;RDOS	Woodland, Forest		No New Actn	3	3	4	5	N	
Pseudotsuga menziesii / Symphoricarpos albus / Calamagrostis rubescens	Douglas-fir / common snowberry / pinegrass	GNR		S2	7-Jun-04	7-Jun-04	Red		PPxh1/06	NOB;OKR;SOB	DCS;DOS	8	RDCO;RDOS	Forest		Classification; Eco Protect; Eco Restore; Plan; Private Land; Status Rpt	2	6	6	2	N	
Pseudotsuga menziesii / Symphoricarpos albus / Pseudoroegneria spicata	Douglas-fir / common snowberry / bluebunch wheatgrass	GNR		S4	8-Jun-04	8-Jun-04	Yellow		IDFdk1/02;IDFmw1/02;IDFmw2/02	CAB;CAP;GUU;NIB;NOB;NOH;NSH;NTU;OKR;PAR;QUH;SCR;SHB;SOB;SRH;THB;TRU;WOU	DCS;DHW;DKA;DMH;DOS	3;5;8	CSRD;Cariboo;NORD;RDCO;RDOS;SLRD;TNRD	Woodland, Forest		No New Actn	4	5	4	5	N	
Pseudotsuga menziesii / Symphoricarpos albus - Spiraea betulifolia	Douglas-fir / common snowberry - birch-leaved spirea	GNR		S2	31-Oct-04	31-Mar-01	Red		IDFxh1/06;IDFxh1/07;PPxh1/07	HOR;NIB;NOB;NOH;OKR;SHB;SOB;SRH;WOU	DCS;DOS	3;8	CSRD;NORD;RDCO;RDKB;RDOS;TNRD	Forest		Eco Protect; Eco Restore; Plan; Private Land; Review Use; Status Rpt	2	5	6	2	N	
Puccinellia nuttalliana - Hordeum jubatum	Nuttall's alkaligrass - foxtail barley	G3?		S2	3-Jul-04	3-Jul-04	Red		IDFdk1/Gs02;IDFdk2/Gs02;IDFdk3/Gs02;IDFdk4/Gs02;IDFdm1/Gs02;IDFdm2/Gs02;IDFdw/Gs02;MSdc1/Gs02;MSdc2/Gs02;MSdk/Gs02;MSdm1/Gs02;MSdm2/Gs02;MSdv/Gs02;MSxv/Gs02;SBPSdc/Gs02;SBPSxc/Gs02	BBT;CAB;CAP;CCR;CHP;COC;CPK;CPR;EKT;ELV;EPM;FLV;FRB;GUU;HOR;LPR;MCR;NAU;NIB;NOB;NOH;NTU;OKR;PAR;SCR;SFH;SHB;SOB;SPK;SPM;THB;TRU;UCV;WCR;WCU;WOU	DAB;DCC;DCH;DCK;DCO;DCS;DKA;DMH;DNI;DOS;DPG;DQU;DRM;DVA	3;4;5;6;7;8	CCRD;CSRD;Cariboo;FVRD;NORD;RDBN;RDCO;RDEK;RDKB;RDOS;SLRD;TNRD	Herbaceous, Wetland, Grassland		Eco Protect; Eco Restore; Inventory; Plan; Private Land; Review Use; Status Rpt	2	2	6	2	N	
Purshia tridentata / Hesperostipa comata	antelope-brush / needle-and-thread grass	G2		S1	31-Oct-04	21-Jun-02	Red	Y (Jun 2006)	BGxh1/02	NOB;OKR;SOB	DOS	8	RDOS	Shrub, Grassland, Herbaceous		Eco Protect; Eco Restore; Inventory; Monitor Trend; Plan; Private Land; Review Use; Status Rpt	1	1	6	1	N	
Rosa woodsii / Festuca idahoensis	prairie rose / Idaho fescue	GNR		S2	31-Oct-04	15-Jun-00	Red		IDFxh1a/97	NOB;OKR;PAR;SHB;SOB;THB	DCS;DKA;DOS	3;8	CSRD;NORD;RDCO;RDOS;TNRD	Shrub, Grassland, Herbaceous		Eco Protect; Eco Restore; Plan; Private Land; Review Use; Status Rpt	1	1	6	2	N	
Salix arctica Dwarf Shrubland	arctic willow Dwarf Shrubland	GNR		SNR			Yellow		BAFA;ESSF;SBSwk2;SWBmk	BAU;CAR;EMR;ESM;HAF;HAP;HYP;KEM;KRT;LIP;MAP;MCP;MIR;MUF;MUU;NEL;NHR;NOM;NSM;PAT;PEF;PEL;RAP;SBP;SCU;SHR;SIU;SOM;STP;TEB;TEP;TUR;WMR	DFN;DJA;DMK;DPC;DSS;UNK	2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Shrub, Alpine, Herbaceous	Y	No New Actn	3	3	4	5	N	
Salix barclayi / Carex aquatilis / Aulacomnium palustre	Barclay's willow / water sedge / glow moss	GNR		S4	18-Jul-08	27-Apr-07	Yellow		BWBSdk2/Wf04;ESSFdc3/Wf04;ESSFmc/Wf04;ESSFmw/Wf04;ESSFwc2/Wf04;ESSFwc3/Wf04;ESSFwv/Wf04;ESSFxc/Wf04;MSdc1/Wf04;MSdc1d/Wf04;MSdm2/Wf04;MSdm3/Wf04;MSdm3w/Wf04;MSmw2/Wf04;MSxk/Wf04;SBSvk/Wf04;SBSwk1/Wf04	BAU;BBT;BOV;BUB;BUR;CAB;CAM;CAP;CBR;CCR;CPK;CPR;CRU;EMR;EPR;ESM;FRR;GUU;HAF;HOR;HYP;KEM;KIM;LIP;LPR;MAP;MCP;MEM;MIR;MUF;NAB;NAM;NAU;NBR;NEL;NEU;NHR;NIB;NKM;NOB;NOH;NOM;NPK;NPR;NSH;NSM;NTU;OKR;PAR;PAT;PEF;QUH;QUL;RAP;SBP;SBR;SCR;SHB;SHR;SIU;SRH;SSM;STH;TAG;TEP;THH;TRU;TUR;UFT;WCR;WMR;WOU	DCC;DCH;DCK;DCO;DCS;DFN;DHW;DJA;DKA;DKM;DMH;DMK;DNC;DND;DNI;DOS;DPC;DPG;DQU;DSC;DSQ;DSS	2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD			No New Actn	3	3	4	5	N	
Salix barclayi / Carex spp.	Barclay's willow / sedges	GNR		SNR			Yellow		BAFA;ESSFdk;ESSFdv;ESSFwm;IMA	BBT;CCM;COC;CPK;ELV;EPM;FLV;LPR;MCR;NKM;SCM;SCR;SPK;SPM;UCV	DAB;DCO;DCS;DKL;DRM;DSQ;UNK	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Alpine, Shrub	Y						N	
Salix barclayi / Senecio triangularis	Barclay's willow / arrow-leaved groundsel	G4		S4	14-Jul-04	14-Jul-04	Yellow		ESSFdc2/Sc03;ESSFxc/Sc03	CAP;CCR;GUU;HOR;NIB;NOH;NSH;NTU;OKR;PAR;SCR;SHB;TRU;WOU	DCC;DCK;DCS;DHW;DKA;DMH;DOS	3;5;8	CSRD;Cariboo;FVRD;NORD;RDCO;RDOS;SLRD;TNRD	Wetland, Shrub	Y	No New Actn	3	3	4	5	N	
Salix barrattiana - Salix barclayi	Barratt's willow - Barclay's willow	GNR		SNR			Yellow		BAFA;ESSFdk;ESSFdv;ESSFwm;IMA	BBT;CCM;COC;CPK;ELV;EPM;FLV;LPR;MCR;NKM;SCM;SCR;SPK;SPM;UCV	DAB;DCO;DCS;DKL;DRM;DSQ;UNK	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Alpine, Shrub, Riparian	Y	No New Actn	3	3	4	5	N	
Salix barrattiana Dwarf Shrubland	Barratt's willow Dwarf Shrubland	GNR		SNR			Yellow		BAFA;ESSFdk;ESSFdkp;ESSFwc1;ESSFwcp;IMA;SBSwk2;SWBmk	BAU;BBT;BOV;CAM;CAR;CCM;COC;CPK;ELV;EMR;EPM;ESM;FLV;FRR;HAF;HAP;HYP;KEM;KRT;LIP;MAP;MCP;MCR;MIR;MUF;MUU;NEL;NHR;NKM;NOH;NOM;NPK;NSH;NSM;NTU;PAT;PEF;PEL;QUH;RAP;SBP;SCM;SCU;SFH;SHR;SIU;SOM;SPK;SPM;SRH;STP;TEB;TEP;TUR;UCV;WMR	DAB;DCC;DCO;DFN;DHW;DJA;DKA;DKL;DMH;DMK;DOS;DPC;DPG;DQU;DRM;DSS;UNK	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Alpine, Shrub, Herbaceous	Y	No New Actn	3	3	4	5	N	
Salix brachycarpa / Festuca spp.	short-fruited willow / fescues	GNR		SNR			Yellow		BAFA;ESSFdk;ESSFdv;ESSFwm;IMA	BBT;CCM;COC;CPK;ELV;EPM;FLV;LPR;MCR;NKM;SCM;SCR;SPK;SPM;UCV	DAB;DCO;DCS;DKL;DRM;DSQ;UNK	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Alpine, Shrub, Wetland	Y	Monitor Trend	2	2	4	4	N	
Salix brachycarpa / Phleum alpinum	short-fruited willow / alpine timothy	GNR		SNR			Yellow		BAFA;ESSFdk;ESSFdv;ESSFwm;IMA	BBT;CCM;COC;CPK;ELV;EPM;FLV;LPR;MCR;NKM;SCM;SCR;SPK;SPM;UCV	DAB;DCO;DCS;DKL;DRM;DSQ;UNK	1;2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Alpine, Shrub, Wetland	Y	Monitor Trend	2	2	4	4	N	
Salix cascadensis Dwarf Shrubland	Cascade willow Dwarf Shrubland	GNR		SNR			Yellow		BAFA;CMA;ESSFdk;ESSFdv;ESSFwm;IMA;MHmmp	BBT;CCM;COC;CPK;CRU;ELV;EPM;FLV;HEL;KIM;KIR;LPR;MCR;MEM;NAM;NEU;NKM;SBR;SCM;SCR;SPK;SPM;UCV	DAB;DCO;DCS;DKL;DKM;DNC;DND;DNI;DRM;DSQ;DSS;UNK	1;2;3;4;5;6;7;8;9	ACRD;CCRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	Shrub, Herbaceous, Alpine	Y	No New Actn	3	3	4	5	N	
Salix drummondiana / Calamagrostis canadensis	Drummond's willow / bluejoint reedgrass	G3		S2S3	30-Jul-04	30-Jul-04	Blue		MSdk/Fl05;MSdm1/Fl05;MSmw2/Fl05;SBPSdc/Fl05;SBSdk/Fl05;SBSdw3/Fl05	BAU;BBT;BUB;CAB;CHP;COC;CPK;EKT;ELV;EPM;FLV;LPR;MCR;NAU;NEL;NEU;NOB;NOH;QUL;SCR;SFH;SPK;SPM;UCV;WCU	DAB;DCC;DCH;DCO;DCS;DJA;DND;DOS;DPG;DQU;DRM;DSQ;DSS;DVA	2;3;4;5;6;7;8	CSRD;Cariboo;FVRD;NORD;RDBN;RDCO;RDEK;RDFFG;RDKB;RDOS;SLRD;TNRD	Riparian, Wetland, Shrub		Monitor Trend	3	4	6	3	N	
Salix exigua - Salix amygdaloides	narrow-leaf willow - peach-leaf willow	G1Q		S1	29-Aug-06	21-Jun-06	Red		BGxh1/00	NOB	DOS	8	RDOS	Riparian, Shrub		Eco Protect; Eco Restore; Inventory; Plan; Private Land; Status Rpt	1	1	6	1	Y	
Salix maccalliana / Carex utriculata	MacCalla's willow / beaked sedge	G3		S3	31-Oct-04	31-Jul-02	Blue		ESSFdv d/Ws05;ESSFdv/Ws05;ESSFxc/Ws05;IDFdk1/Ws05;IDFdk3/Ws05;IDFdk4/Ws05;MSdm1/Ws05;SBPSmk/Ws05;SBPSxc/Ws05;SBSdh1/Ws05;SBSdk/Ws05	BAU;BUB;CAB;CAM;CAP;CCR;CHP;FRB;GUU;HOR;LPR;NAU;NEL;NEU;NIB;NOB;NOH;NPK;NTU;OKR;PAR;SCR;SFH;SHB;SOB;THB;TRU;UFT;WCR;WCU;WOU	DAB;DCC;DCH;DCS;DHW;DJA;DKA;DMH;DND;DOS;DPG;DQU;DSQ;DSS;DVA	2;3;5;6;7;8	CCRD;CSRD;Cariboo;NORD;RDBN;RDCO;RDFFG;RDKB;RDOS;SLRD;TNRD	Wetland, Shrub, Herbaceous	Y	Inventory	2	2	4	4	N	
Salix nivalis Dwarf Shrubland	dwarf snow willow Dwarf Shrubland	GNR		SNR			Yellow		CMA;ESSFwc1;ESSFwc2;ESSFwcp;ESSFwk1;ICHmk1;IMA;MHmmp;MSdk	BBT;BOV;CAM;CAP;CCM;COC;CPK;CRU;EKT;ELV;EPM;FLV;FRR;HAF;HEL;KIM;KIR;MCP;MCR;MEM;MIR;NAM;NEU;NHR;NKM;NOH;NPK;NSH;NTU;PEF;QUH;QUL;SBR;SCM;SFH;SHB;SHR;SPK;SPM;SRH;UCV;UFT;WMR;WOU	DAB;DCC;DCO;DHW;DKA;DKL;DKM;DMH;DMK;DNC;DND;DNI;DOS;DPC;DPG;DQU;DRM;DSS;UNK	1;2;3;4;5;6;7;8;9	ACRD;CCRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;NORD;PRRD;PowellR;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	Alpine, Shrub, Herbaceous	Y	No New Actn	3	3	4	5	N	
Salix polaris Dwarf Shrubland	polar willow Dwarf Shrubland	GNR		SNR			Yellow		BAFA;ESSF;SWB		UNK	2;3;4;5;6;7;8;9	CCRD;CSRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDOS;SLRD;SRD;Stikine;TNRD	Shrub, Alpine, Herbaceous	Y	No New Actn	3	3	4	5	N	

Scientific Name	English Name	Global Status	Global Status Review Date	Prov Status	Prov Status Review Date	Prov Status Change Date	BC List	Identified Wildlife	Biogeoclimatic Units	Ecosection	Forest District	MOE Region	Regional Dist	Ecosystem Group	Endemic	Action Groups	Highest Priority	Priority Goal 1	Priority Goal 2	Priority Goal 3	CDC Maps	Mapping Status
Salix sitchensis / Carex sitchensis	Sitka willow / Sitka sedge	G3		S3	14-Jul-04	14-Jul-04	Blue		CWHvm1/Ws06;CWHvm2/Ws06;ICHvk1/Ws06;MSdc1/Ws06;MSdm1/Ws06;MSmw2/Ws06;SBSvk/Ws06;SBSwk1/Ws06	BBT;BOV;CAM;CCM;CPK;CPR;EPR;FRL;GEL;HEL;KIR;LIM;LPR;MCP;MIR;NAM;NCF;NEL;NHR;NIM;NKM;NOB;NOH;NPK;NPR;NSH;NWC;NWL;OUF;PAT;QCT;QUH;QUL;SCR;SFH;SHR;SOG;SPR;SRH;UFT;WIM	DAB;DCC;DCK;DCO;DCR;DCS;DHW;DKM;DMK;DNC;DNI;DOS;DPG;DQU;DSC;DSI;DSQ	1;2;3;4;5;6;7;8	ACRD;CCRD;CRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;NORD;PowellR;RDCO;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;TNRD	Wetland, Shrub, Riparian	Y	Monitor Trend	2	2	4	4	N	
Salix spp. / *Menyanthes trifoliata*	low willows / buckbean	GNR		S3	31-Oct-04	31-Jul-02	Blue		IDF		UNK	2;3;4;5;8	CCRD;CSRD;Cariboo;FVRD;NORD;RDCK;RDCO;RDEK;RDKB;RDMW;RDOS;SLRD;TNRD	Wetland, Shrub, Herbaceous		Classification; Monitor Trend; Rev Status	4	Not Assessed	4	4	N	
Sibbaldia procumbens Herbaceous Vegetation	sibbaldia Herbaceous Vegetation	GNR		SNR			Yellow		BAFA;CMA;ESSF		UNK	1;2;3;4;5;6;7;8;9	ACRD;CCRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;NORD;NRRD;PRRD;PowellR;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;Stikine;TNRD	Herbaceous, Alpine		Monitor Trend	2	2	4	4	N	
Thuja plicata - Picea engelmannii x glauca / Lonicera involucrata / Carex disperma	western redcedar - hybrid white spruce / black twinberry / soft-leaved sedge	GNR		S2	31-Oct-04	31-Mar-01	Red		IDFdk2/07	HOR;NIB;NOB;NTU;OKR;PAR;SHB;THB;TRU;WOU	DCK;DCS;DKA;DOS	3;8	CSRD;NORD;RDCO;RDOS;TNRD	Wetland, Forest		Classification; Eco Protect; Inventory; Review Use	2	2	6	2	N	
Thuja plicata - Pseudotsuga menziesii / Maianthemum racemosum	western redcedar - Douglas-fir / false Solomon's seal	GNR		S1	31-Oct-04	26-Jul-02	Red		IDFxh1/00	HOR;NIB;NOB;NOH;OKR;SHB;SOB;SRH;WOU	DCS;DOS	3;8	CSRD;NORD;RDCO;RDKB;RDOS;TNRD	Forest, Riparian		Eco Protect; Plan; Private Land; Status Rpt	1	1	6	2	N	
Trichophorum cespitosum / Campylium stellatum	tufted clubrush / golden star-moss	G2G3		S2S3	14-Jul-04	14-Jul-04	Blue		BWBSdk1/Wf11;ESSFdc1/Wf11;ESSFdc2/Wf11;ESSFdc3/Wf11;ESSFdvd/Wf11;ESSFdv/Wf11;ESSFwc2/Wf11;ESSFwc3/Wf11;ESSFwk1/Wf11;ESSFxc/Wf11;ICHmc2/Wf11;ICHmw1/Wf11;ICHmw3/Wf11;ICHvk1/Wf11;MSdm2/Wf11;SBSdk/Wf11;SBSwk1/Wf11	BAU;BBT;BOV;BUB;CAM;CAP;CAR;CCM;CCR;CPK;CRU;EMR;EPM;FRR;FRT;GUU;HAF;HOR;KEM;KLR;KRT;LPR;MAP;MCP;MIR;NAB;NAM;NAU;NEL;NEU;NHR;NIB;NKM;NOB;NOH;NOM;NPK;NSH;NSM;NTU;OKR;PAR;PAT;PEF;QUH;QUL;RAP;SBP;SCR;SFH;SHB;SHR;SOM;SPK;SRH;SSM;STH;STP;TAB;TAG;TEB;TEP;THH;TRU;TUR;UCV;UFT;WHU;WMR;WOU	DAB;DCC;DCK;DCO;DCS;DFN;DHW;DJA;DKA;DKM;DMH;DMK;DND;DOS;DPC;DPG;DQU;DRM;DSQ;DSS;DVA	2;3;4;5;6;7;8;9	CSRD;Cariboo;FVRD;NORD;NRRD;PRRD;RDBN;RDCK;RDCO;RDEK;RDFFG;RDKB;RDKS;RDOS;SLRD;Stikine;TNRD	Wetland, Herbaceous	Y	Monitor Trend	1	1	6	3	N	
Tsuga mertensiana - Abies amabilis / Phyllodoce empetriformis Moist Maritime 2	mountain hemlock - amabilis fir / pink mountain-heather Moist Maritime 2	G5		S4	19-Sep-05	29-Sep-94	Yellow		MHmm2/02	BUR;CCR;CPR;CRU;EPR;HOR;KIM;KIR;LPR;MEM;NAM;NPR;NWC;SBR;SCR;SPR;WCR	DCH;DCK;DCR;DCS;DKM;DNC;DND;DNI;DSC;DSQ;DSS	1;2;3;5;6	CCRD;Cariboo;ComoxVRD;FVRD;PowellR;RDBN;RDKS;RDMW;RDOS;SCRD;SLRD;SRD;TNRD	Woodland, Forest		No New Actn	4	5	4	5	N	
Tsuga mertensiana - Abies amabilis / Rubus pedatus	mountain hemlock - amabilis fir / five-leaved bramble	G4G5		S4S5	19-Sep-05	29-Sep-94	Yellow		MHmm1/04;MHmm2/04	BUR;CCR;CPR;CRU;EPR;HEL;HOR;KIM;KIR;LIM;LPR;MEM;NAM;NIM;NPR;NWC;NWL;OUF;SBR;SCR;SPR;WCR;WIM	DCH;DCK;DCR;DCS;DKM;DNC;DND;DNI;DSC;DSI;DSQ;DSS	1;2;3;5;6	ACRD;CCRD;CRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;PowellR;RDBN;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;TNRD	Forest		No New Actn	4	4	4	5	N	
Tsuga mertensiana - Abies amabilis / Vaccinium alaskaense	mountain hemlock - amabilis fir / Alaskan blueberry	G4G5		S3S4	19-Sep-05	22-Jul-02	Yellow		MHmm1/01;MHmm2/01	BUR;CCR;CPR;CRU;EPR;HEL;HOR;KIM;KIR;LIM;LPR;MEM;NAM;NIM;NPR;NWC;NWL;OUF;SBR;SCR;SPR;WCR;WIM	DCH;DCK;DCR;DCS;DKM;DNC;DND;DNI;DSC;DSI;DSQ;DSS	1;2;3;5;6	ACRD;CCRD;CRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;PowellR;RDBN;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;TNRD	Forest		Inventory; Plan; Review Use	2	4	2	3	N	
Tsuga mertensiana - Chamaecyparis nootkatensis / Blechnum spicant	mountain hemlock - yellow-cedar / deer fern	GNR		S4	31-Mar-01	31-Mar-01	Yellow		MHmm1/06;MHmm2/06;MHwh1/06;MHwh2/06	BUR;CCR;CPR;CRU;EPR;HEL;HOR;KIM;KIR;LIM;LPR;MEM;NAM;NIM;NPR;NWC;NWL;OUF;QCR;SBR;SCR;SKP;SPR;WCR;WIM	DCH;DCK;DCR;DCS;DKM;DNC;DND;DNI;DQC;DSC;DSI;DSQ;DSS	1;2;3;5;6	ACRD;CCRD;CRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;PowellR;RDBN;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;TNRD	Forest, Shrub		No New Actn	2	2	4	4	N	
Tsuga mertensiana - Chamaecyparis nootkatensis / Sphagnum capillifolium	mountain hemlock - yellow-cedar / common red peat-moss	GNR		S5	31-Mar-01	25-Mar-93	Yellow		MHmm1/08;MHmm2/08;MHwh1/08;MHwh2/08	BUR;CCR;CPR;CRU;EPR;HEL;HOR;KIM;KIR;LIM;LPR;MEM;NAM;NIM;NPR;NWC;NWL;OUF;QCR;SBR;SCR;SKP;SPR;WCR;WIM	DCH;DCK;DCR;DCS;DKM;DNC;DND;DNI;DQC;DSC;DSI;DSQ;DSS	1;2;3;5;6	ACRD;CCRD;CRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;PowellR;RDBN;RDKS;RDMW;RDN;RDOS;SCRD;SLRD;SQCRD;SRD;TNRD	Forest, Shrub, Wetland		No New Actn	6	6	6	6	N	
Typha latifolia Marsh	common cattail Marsh	G5		S3	31-Oct-04	31-Jul-02	Blue		BGxh1/Wm05;BGxh2/Wm05;BGxw1/Wm05;CDFmm/Wm05;CWHdm/Wm05;CWHxm1/Wm05;CWHxm2/Wm05;IDFdk1/Wm05;IDFdk2/Wm05;IDFdk3/Wm05;IDFdm1/Wm05;IDFdm2/Wm05;IDFdm2n/Wm05;IDFmw1/Wm05;IDFmw2/Wm05;IDFxh1/Wm05;IDFxh2/Wm05;IDFxk/Wm05;PPdh2/Wm05;PPxh1/Wm05;PPxh2/Wm05	CAB;CAP;CCR;CHP;CPR;EKT;ELV;EPM;EPR;FLV;FRB;FRL;GEL;GUU;HOR;LIM;MCR;NAL;NIB;NIM;NOB;NWC;OKR;OUF;PAR;QUH;SCR;SFH;SGI;SHB;SOB;SOG;SPK;SPM;SPR;THB;TRU;UCV;WIM;WOU	DAB;DCC;DCK;DCR;DCS;DHW;DKA;DMH;DNI;DOS;DQU;DRM;DSC;DSI;DSQ	1;2;3;4;5;8	ACRD;CRD;CSRD;CVRD;Cariboo;ComoxVRD;FVRD;GVRD;NORD;PowellR;RDCO;RDEK;RDKB;RDMW;RDN;RDOS;SCRD;SLRD;SRD;TNRD	Wetland, Herbaceous		Eco Protect; Eco Restore; Plan; Private Land; Status Rpt	1	5	1	2	N	

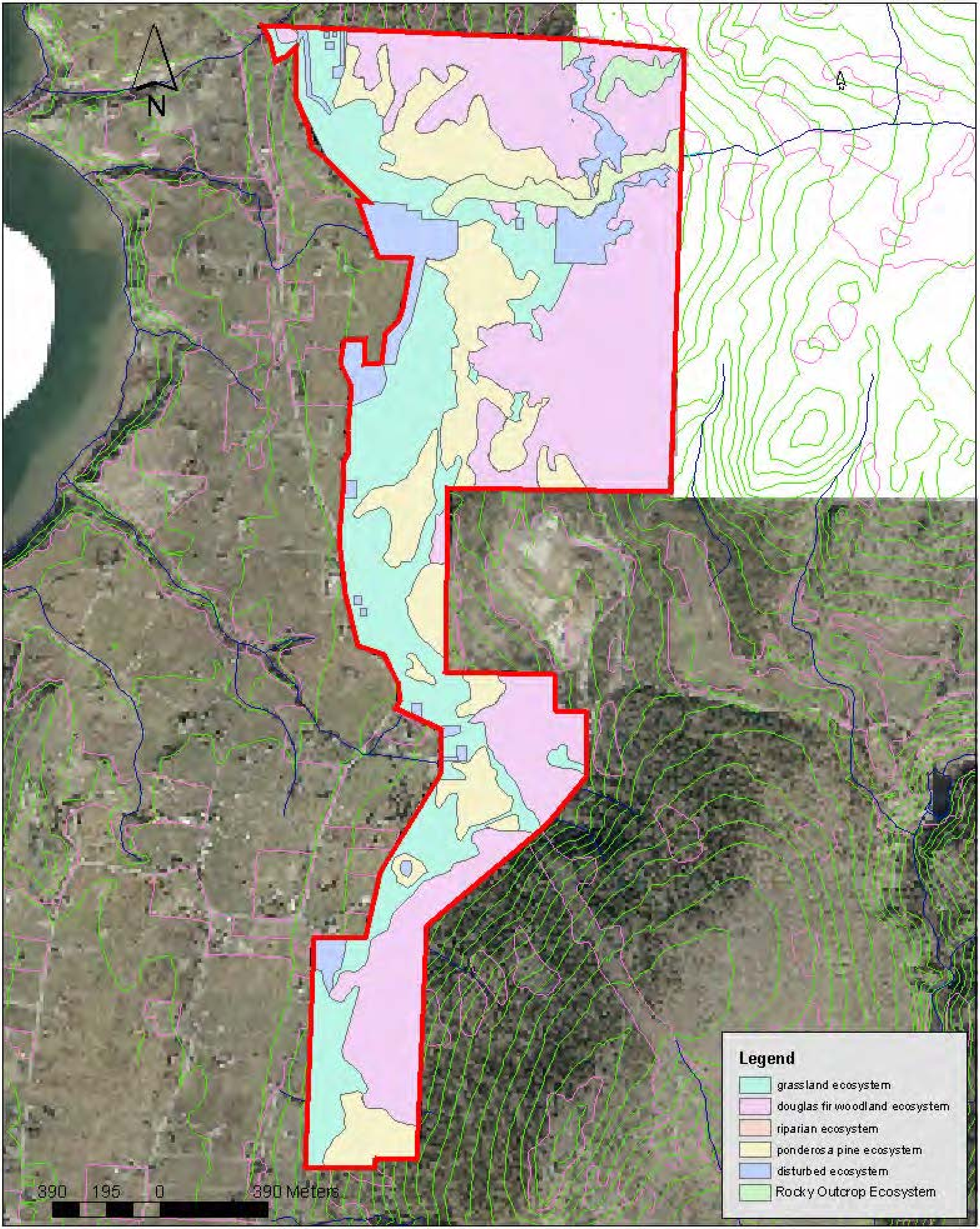
Appendix D – Biophysical Assessment Map

Appendix D - Biophysical Map



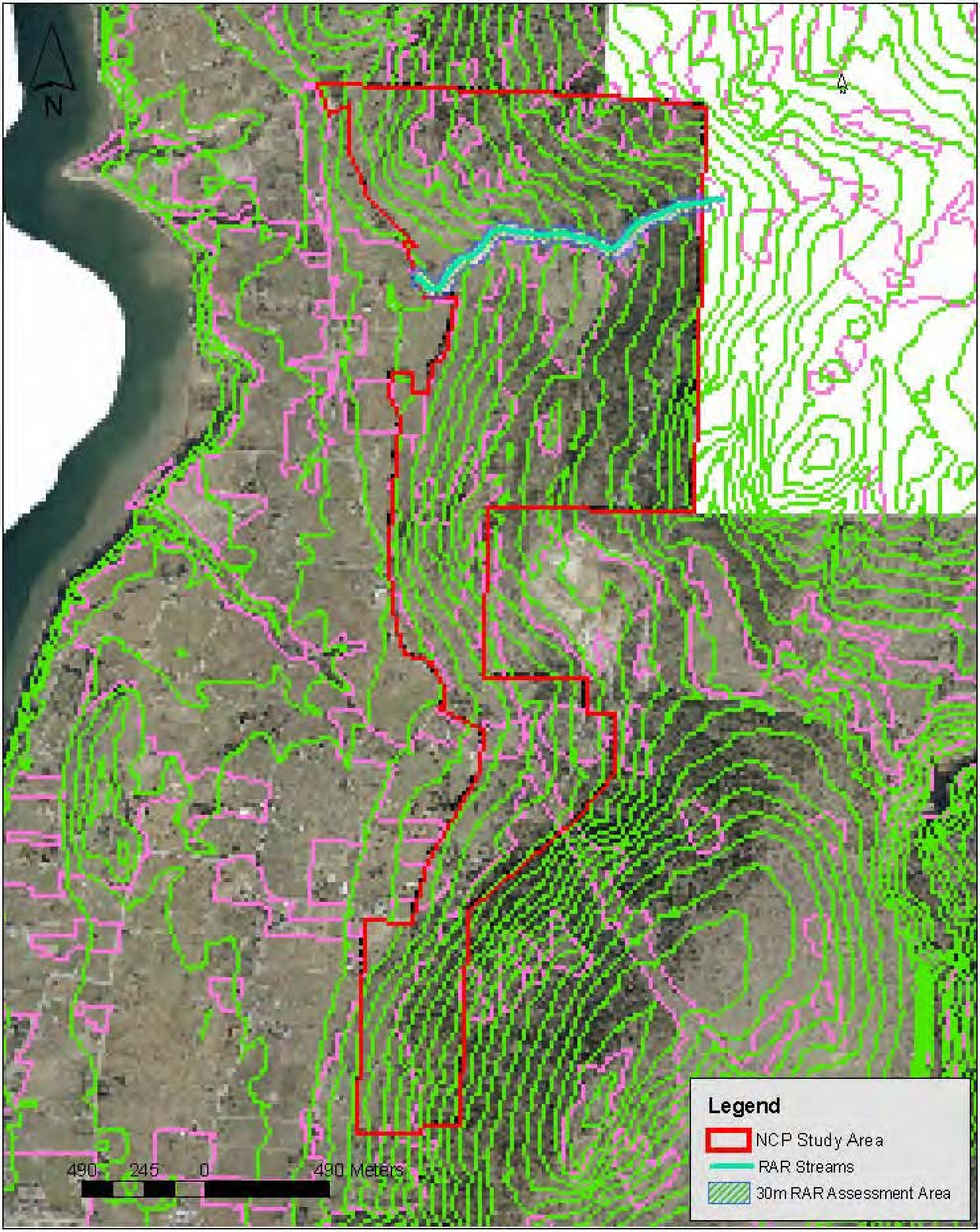
Appendix E – Ecosystem Map

Appendix E - Ecosystem Map



Appendix F – Waterbodies Map

Appendix F - Waterbody Map



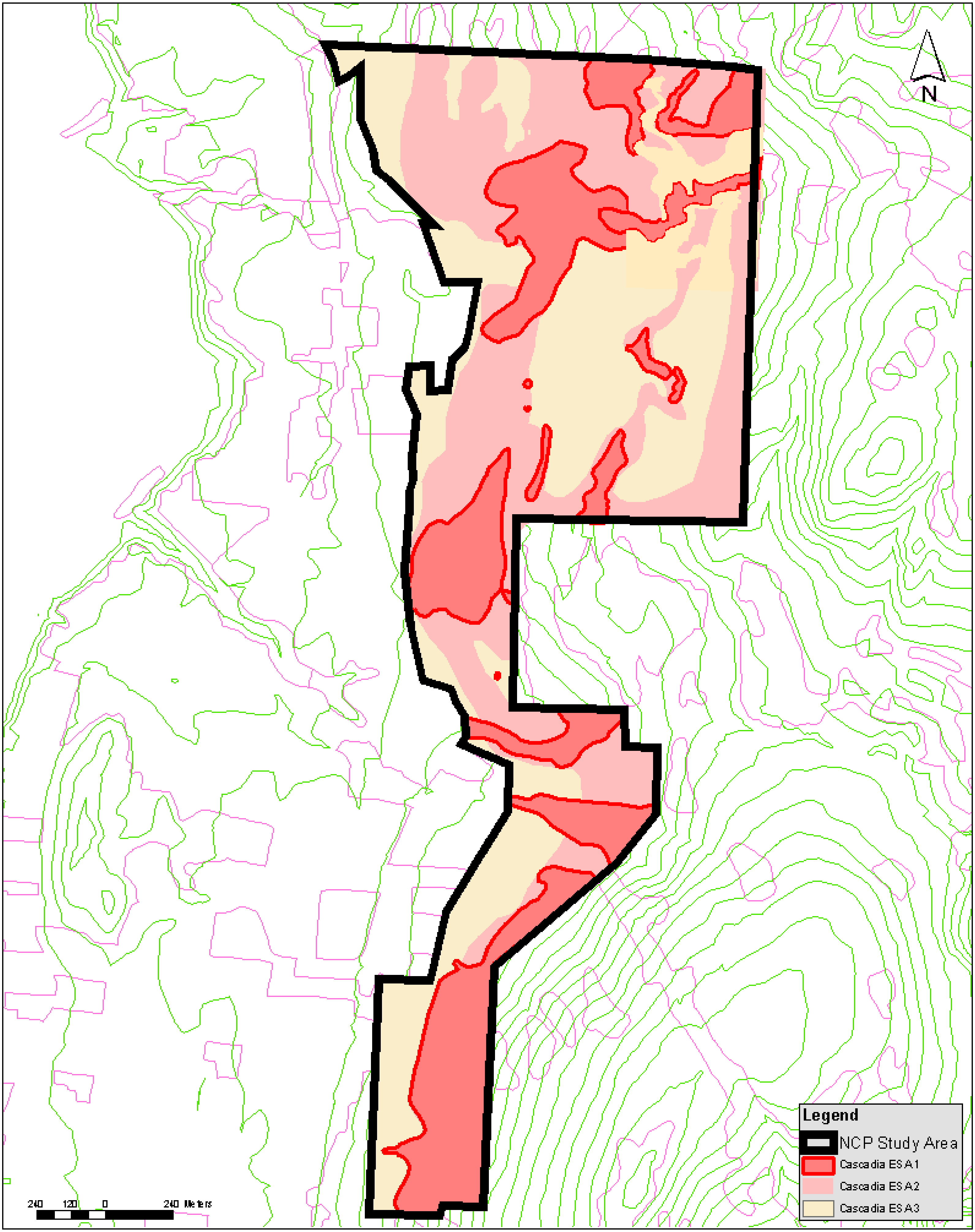
Appendix G – FISS Database Records

/* Exported on Fri Jan 08 22:56:08 PST 2010 */

GAZETTED_NAME	WATERSHED_CODE	WATERBODY_IDE	TYPE	PRIMARY_I	UTM_ZONI	UTM_EAST	UTM_NOR	ALIAS_1	PRIMARY_I	INTERNAL_
STRUTT CREEK	310-639000	00000OKAN	S	8.20E+13	11	313932	5490230		8	175455

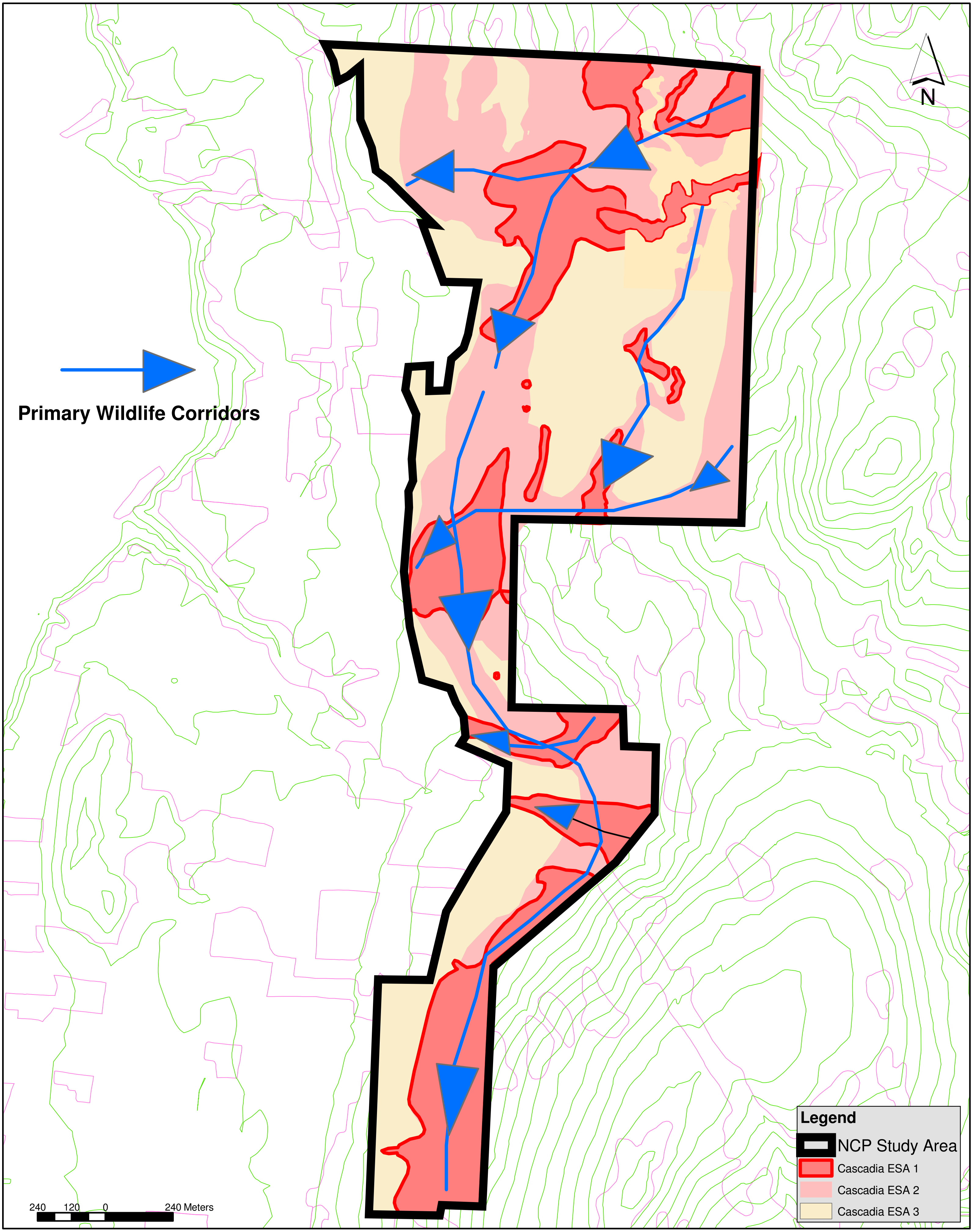
Appendix H – Environmental Constraints Map

Appendix H - Environmental Constraints Map



Appendix I – Proposed Wildlife Corridor Map

Appendix I - Wildlife Corridor Map



APPENDIX C

Wildfire Interface Report
(Swanson Forestry Services)

RECOMMENDATIONS FOR POLICIES AND GUIDELINES TO MITIGATE THE RISK FROM WILDFIRE WITHIN THE NEIGHBOURHOOD CONCEPT PLAN FOR THE SPILLER ROAD / RESERVOIR ROAD AREA.

Prepared for:
Urban Systems Ltd.
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November 16th, 2007.

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November 16, 2007

James Klukas, M.Pl.
Community Planner
Urban Systems Ltd.
Suite 500 - 1708 Dolphin Avenue
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Dear Sir:

Attached is my report with recommendations for policies and guidelines to be included within the Neighbourhood Concept Plan to mitigate the risk to life and property from wildfire within the Spiller Road / Reservoir Road Area of the City of Penticton.

If any further information or clarification is required, please contact me at 250-764-2820 or 862-7112 (cell).

Yours truly,

Richard Swanson, B.Sc. Forestry, R.P.F.

Table of Contents

Objectives

This report has been commissioned by Urban Systems Ltd. in order to determine measures to manage and mitigate the risk of wildfire within the Spiller Road / Reservoir Road Area Neighbourhood of the City of Penticton. Guidelines and policy recommendations are provided for the consideration to include in the Spiller Road / Reservoir Road Area Neighbourhood Concept Plan.

Property Description

The Neighbourhood Concept Plan study area is located in the northeast portion of the City of Penticton and contains part of the Naramata Benchlands. The location is shown in the attached maps in the Appendix.

The topography for the Spiller Road / Reservoir Road area varies from gently rolling to steep and rocky. Most of the area has a south west to west aspect. The elevation varies from 500 to 670 meters. Portions of the flatter areas along Naramata Road have been developed with vineyards and orchards. The undeveloped areas to the east between Naramata and Spiller Roads have open grassland and forested areas. The Trans-Canada Trail is located in the northwest portion. There are gas line and hydro right of ways running through the western portion of the Neighbourhood Concept Plan area. The portion south of the Campbell Mountain Waste Disposal Site is mostly undeveloped.

The Spiller Road / Reservoir Road area falls within the biogeoclimatic subzone classified as the Very Dry Hot Ponderosa Pine (PPxh1) biogeoclimatic subzone which occurs in the low elevations along dry valleys within the southern interior of BC. This subzone is characterized by very warm and dry summers with common moisture deficits during the growing season contributing to the risk of wildfire.

Vegetation complexes found in the Ponderosa Pine zone consist of a combination of grassland and open forest communities. Ponderosa pine (*Pinus ponderosa*) dominates most forest stands with minor components of Douglas-fir (*Pseudotsuga menziesii*). Forests range in structure from open grasslands with scattered ponderosa pine trees on dry, south facing slopes to dense stands with Douglas-fir as the climax stand species on cooler and wetter exposures. Deciduous dominated stands are sparse and generally found in riparian areas and on floodplains (Guide to Site Identification and Interpretation for the Kamloops Forest Region, Land Management Handbook 23, February 1990, BC Ministry of Forests).

Bunchgrass and open ponderosa pine forest dominate the ground cover in the Neighbourhood Concept Plan study area. There are a few patches of deciduous trees, mostly trembling aspen, found in the northeast portion of the study area. These draws are riparian areas with small intermittent creeks flowing during part of the year. These sites are an important part of the ecosystem providing biodiversity such as habitat for birds and small mammals. There are shrubs, consisting of tall Oregon grape, saskatoon, and snowberry on these moister sites.. The draws have some aspen in the tree layer with shrub layers consisting of such shrubs as nootka rose, birch leaved spirea, Douglas maple and water birch. The herb cover on most of the property consists of domestic and natural grasses, blue bunch wheat grass, yarrow, knapweed and some scattered arrow-leafed balsamroot on the drier sites. Pine grass, violets and star-flowered Solomon's seal can be found on the wetter sites. Portions of the central area of the area are open rocky sites with little to no tree cover. These sites contain ground cover consisting of sumac and sage brush. The southern portion is located on the west slopes of Mount Campbell. Here the upper elevation forests contain a high portion of Douglas-fir mixed in with the ponderosa pine and bunchgrass. The ground cover becomes more open with less tree cover at the lower elevations.

There are signs of recent attack by bark beetles, such as Western pine beetle and Turpentine beetle on the pine trees throughout the Neighbourhood Concept Plan study area. Some of the pine trees may also have died from stress due to lack of water and subsequent attack by bark beetles. Mountain pine beetle will also be moving through the Penticton pine forests in the near future. Dead pine trees will create problems by increasing the risk from wildfire in areas with poor access, as well as areas close to residences. In addition to the pine bark beetles, Douglas-fir bark beetle is also having an effect on the forests in the Spiller Road / Reservoir Road area.. The west slopes of Mount Campbell show signs of these bark beetles recent attacks on Douglas-fir. Access to recently killed trees is poor and this contributes to the risk of wildfire.

Methodology

Assessing the Risk from Wildfire

This report will undertake to describe the fire hazard risk rating in the Spiller Road / Reservoir Road Neighbourhood Concept Plan area. This area was originally surveyed in 2006 by Swanson Forestry Services as part of a Community Wildfire Protection Plan for the City of Penticton. The areas to the north of the Neighbourhood Concept Plan area were determined to have an extreme fire hazard rating. The area to the east of the Neighbourhood Concept Plan area was also surveyed by Swanson Forestry Services in 2005 for a wildfire hazard assessment completed for the Regional District of Okanagan Similkameen. This area was also found to have an extreme hazard rating. The Okanagan Park fire in 2003 showed the danger of high winds from adjacent forest interface areas. Winds can carry sparks over a distance of two kilometers and can change direction during the late afternoon, blowing downhill from adjacent forests located at higher elevations and endangering residential areas located in valley bottoms.

For this report the Spiller Road / Reservoir Road area was revisited. In assessing the fire hazard, the Neighbourhood Concept Plan boundaries were located, and a traverse through the area determined if there was any variation in fire hazard rating. Seven plots were established on the property representative of site conditions. By establishing these plots, a fire hazard risk rating can be measured. This hazard rating has four classes: low (indicating a low risk of fire, with a low number of points), moderate, high, and extreme. An Interface Community Fire Hazard Form was filled out for each plot. Copies of the plots are provided in the Appendix along with the plot locations and photos. Here is a summary of the data collected at the plots.

The community description provides a point rating affected by the following conditions:

- The Fire Weather Danger Rating - in this case the property has long periods of Danger Class 3 and above (a high rating).
- The property has a coniferous tree cover for most of the area. The central portion has open grassland with scattered tree cover.
- Where there is tree cover, the depth of pine needles is thin, usually less than 5 cm. Thicker accumulations can be found under the larger pine trees. Most of the property has a thin or non-existent duff layer.
- The stand description is a coniferous forest.
- There is almost no coarse woody debris.
- The vegetation consists of wild and domestic grasses and weeds.
- The topography for most of the property varies from gently rolling along the northern and southern portions, to extremely steep and rocky in the central portion.
- The property has infrequent use as a recreational area. There are a few trails through the property.
- The values protected are residences within the forest interface areas.
- There is a high possibility of fire from adjacent areas.

The fire suppression capabilities are also rated. These conditions would affect the rating:

- Penticton Fire and Rescue services the area.
- Water is available for properties close (within 500 meters) to Naramata Road. The areas to the west do not have access to water other than wells. These are not considered adequate for fire fighting purposes.
- In the event of a fire the response time should be within 15 minutes.
- There would also be mutual aid from other fire departments if required.

- Access for fire trucks and personnel varies throughout the Neighbourhood Concept Plan area. The hydro line provides some access as well as the gas pipeline where roads are non-existent.
- The Garnet fire in 1998 was a major fire in the area. Smaller fires have occurred in the Mount Campbell area to the south and north of the Neighbourhood Concept Plan Area.

Other factors that would affect the rating are:

- The area has frequent winds over 30 km/hr.
- The aspect and steepness of the terrain is also considered. Rocky areas make fire fighting difficult. The plan area has a predominantly western aspect.
- The property may have a large industrial development or schools.
- The area will have increased use as a recreational area following development.
- Fuel loading will not increase after house construction.

The plots all have a high hazard rating. This rating can be reduced by following the recommendations in this report.

Policies Available to Reduce the Risk from Wildfire in the Neighbourhood Concept Plan Area:

Wildland Fire Policy

The following information and policy statements is taken from the Official Community Plan Amendment Project, Wildland Fire Policy Discussion Paper, February 2006 supplied to the Thompson- Nicola Regional District by the TRUE Consulting Group, Pages 4 - 9. Many communities have attempted to develop wildland fire policies to deal with the risk from wildfire following the 2003 fire season. This information is relevant because it provides an up to date and concise synopsis of policies and guidelines that are directly applicable to the Neighbourhood Concept Plan Area.

"Planning Tools

The TNRD has approached the issue of wildfire risk from a variety of perspectives including: education, servicing, emergency planning and land use planning. Land use planning initiatives, however, have typically been limited to the review of conditions involving new development. The TNRD has initiated a review of Wildland Fire Policy to provide a broader strategy to addressing wildfire risks. The potential policy tools reviewed as part of this exercise include:

- Official Community Plans
- Development Permits
- Development Approval Information – Hazard Risk Assessments
- Restrictive Covenants
- Subdivision Review
- Building Permit Reviews
- Education and Awareness

Official Community Plans and Wildfire Risk

The Local Government Act, Part 26 provides for Official Community Plans (OCP) to address hazardous conditions including areas subject to wildfire risk.
On a more general basis the OCP can also provide policies relating to:

- compatible land uses
- transportation corridors and access (right of way width, travel surface,
- emergency access)
- servicing (including fire protection)
- long term phasing of development
- development approval requirements including Wildland Fire Risk Assessment
- directions regarding further planning initiatives including Community Wildfire Protection Planning

Development Permits

Section 919.1(1) of the Local Government Act provides for a municipality or Regional District to establish Development Permit Areas for areas designated through the OCP Bylaw process, for the protection of development from hazardous conditions. A Development Permit can:

- Include requirements respecting the character of the development, including landscaping, and the site, form, exterior design and finish of buildings and other structures, and
- Establish restrictions on the type and placement of trees and other vegetation in proximity to the development.

Development permit applications can be initiated by subdivision, rezoning and building permit applications. At the subdivision stage information on the following can be used to address wildfire risk, such as:

- Information on the movement of emergency vehicles through the subdivision and to lands beyond.
- Information from a Registered Professional Forester licensed in BC, or equivalent specializing in forest wildfire assessment to provide recommendations on actions to reduce risk (Hazard Risk Assessment). Information should include design recommendations for the subdivision and recommendations to the homeowner.

At the rezoning stage land use is reviewed in terms of the relationship between proposed land uses and wildfire risk. The Development Permit may address such issues as outdoor storage or potential fuels (e.g. tires) but the Permit cannot vary use or density.

At the building construction stage information can be reviewed in terms of building materials, design, parking, setbacks, access and snow storage. Accessibility for emergency vehicles can also be reviewed. Landscaping is also a consideration including density of tree cover, under story attributes and forest debris.

Development Permits are registered to the title of subject properties and provide awareness of the wildfire risk over the long term.

Development Approval Information

The Local Government Act, Part 26, provides for municipalities and regional districts to collect development approval information necessary to consider applications for zoning amendments, development permits, subdivisions, or special use permits. A Hazardous Risk Assessment, relating to wildfire risk is considered relevant approval information. Collection of this information, while an additional responsibility for the applicant, provides clear direction for lowering risk that can direct development in the short term and guide long term use of land and buildings.

Restrictive Covenants

Section 219 of the Land Title Act, provides local governments with the authority to use Restrictive Covenants for the purpose of preventing any use of the lands unless certain conditions have been complied with. The presence of the Restrictive Covenant as a registered charge on the title of the property also alerts potential purchasers to the presence of the potential hazard.

Many local governments have used the Restrictive Covenant as a tool to regulate new development within high risk wildfire interface areas for subdivision and rezoning applications. A requirement for a Restrictive Covenant does not involve a lengthy review process and registration is relatively straightforward, particularly with a new subdivision registration. The TNRD currently requires a covenant for small lot subdivisions to provide notification of location within a Wildland Fire Interface area. Registration is slightly more cumbersome when it is attached to a building permit application.

Restrictive Covenants also present challenges as a policy tool because they are not usually tracked nor are they prepared in standardized formats.

Subdivision Review

The subdivision review process provides an opportunity for a comprehensive approach to assessing new development in relation to the natural wild land conditions. Development conditions can be required by the Approving Officer to ensure that public interest and safety are addressed in relation to wildfire risk. Development approval information (Hazard Risk Assessments) and Development Permits are two of the main tools that can be applied at the subdivision stage.

Building Permit Review

The Building Permit Application process provides an opportunity to review site conditions and introduce and distribute FireSmart information. The Building Code does not require non-combustible building materials; therefore, application of FireSmart guidelines may mean that it is necessary to have additional regulatory mechanisms in place. The Development Permit is the principle tool that can be used to apply FireSmart design guidelines for new or renovated buildings. Since different building permit applications will be facing different degrees of risk (e.g. new buildings in existing developed areas with fire protection and natural fire guards will have lower wild land fire risk), it is recommended that a waiver provision and an expedited Development Permit Application process be introduced to provide for policy flexibility.

Education and Awareness

All of the policy approaches and tools presented in this section provide opportunities for the TNRD to raise awareness of the Wildland fire issue. In particular it is recommended that Development Permit Area guidelines be prepared as an information handout and FireSmart information (prepared by the Ministry of Forests and Range) distributed at every reasonable opportunity.

Policy Objectives

The following objectives were established to guide development of TNRD policies on the Wildland Fire issue:

- Ensure wild land fire protection planning policies are considered for development in High Risk Interface and Buffer areas.
- Consider the impact of land uses that may accentuate wild land fire risks, recognizing that the major causes of wild land fire in the TNRD are railway sparks, discarded cigarettes and arson.
- Implement FireSmart building design and siting recommendations for High Risk Interface areas.
- Raise awareness of FireSmart practices throughout all OCP areas.
- Obtain acknowledgement of wild land fire risk conditions and/or save harmless statement in favor of the TNRD wherever possible.
- Support the use of non-combustible roofing materials, consistent with the FireSmart specifications for new buildings, renovations and additions in High Risk Interface and Buffer areas."

Spiller Road / Reservoir Road Area Neighbourhood Concept Plan Recommendations

Policies for Implementation during the Development Plan Review Process

Education:

1. Property owners should be made aware that if they own the fuel they own the fire. They may be liable for subsequent costs for fire fighting in the event of a fire starting on their property and spreading to adjacent property.
2. Make sure people living in the study area are aware of the high to extreme hazard rating for the forest interface areas.
3. Continue to make the FireSmart manual available from the local fire department.
4. Have an education program in place to teach people about the recommendations in the FireSmart manual.
5. Legislate the FireSmart (priority zone 1) in a fire prevention bylaw. The high to extreme fire hazard risk for most of the area should make this a priority.

Access:

1. Emergency access to homes for fire fighting apparatus and emergency vehicles can be a problem where there are narrow driveways and a narrow turnaround area. Driving into the driveway could result in an emergency response vehicle being trapped if a fire were to spread to fuel and trees along the driveway. Responding to residential fires in these areas may mean parking on a side street and running fire hoses to the residence down a driveway. Driveways that are too steep can also limit access during the winter when roads are slippery. Make sure that access to residences is constructed to a standard that will allow access for fire department and emergency vehicles.
2. Have a preplanned, alternate escape route out of the area in case of emergency evacuations. Alternate routes would provide quicker response times in the event of an emergency.
3. Alternate escape routes should be provided in new subdivisions.

Signage:

1. Parks and private property with a high use for recreation should have signs posted informing users of the high or extreme risk of fire in the area.

Recommendations for Subdivisions and Rezoning Applications

Provide additional protection to residences by requiring the following in subdivision and rezoning applications:

1. Ensure there is an adequate supply of water for fire suppression. Hydrants should be located close to the forest interface.
2. Provide a plan for removal of land clearing debris that may pose a fire hazard risk within 3 months of construction completion or before the fire season starts.
3. When considering subdivision submissions, have the developer incorporate fuel breaks, such as roads and cleared park areas with maintained grassy areas. If forested lands surround the subdivision, ring roads should be part of the subdivision design. These roads could provide access to the forest interface for emergency vehicles and act as a fuel break between the forested area and the subdivision.
4. Trails in woody areas should be constructed wide enough for access by emergency vehicles. Thinning of the forest and removal of ladder fuels along trail networks would limit the spread of wildfire and improve fire suppression capability.
5. Have a plan to treat interface areas on crown land within interface areas to reduce the risk from wild fires. Adequate setbacks from Crown land should be included in the planning process. Setback distances can vary with the type of terrain and slope.
6. Park areas that are provided within the subdivision should be treated to reduce the risk from wildfire before they become the property of the City. These treatments can include spacing of standing trees and removing ladder fuels. Quite often developers can use these treated areas as a benefit to potential purchasers.
7. Underground hydro service in developments can provide protection to the supply of power for sprinkler systems.
8. Ensure that there are alternate exit routes in the event of an emergency.

Prior to and during construction of subdivisions, here are some recommendations to make in a review of existing bylaws that will help reduce the fire hazard in the residential areas:

Incorporate FireSmart principles into building permit bylaws, including:

1. Combustible roofing material such as wood shakes should be prohibited.
2. Locate homes and buildings on the flattest portion of the property, with an adequate setback, so that buildings are not constructed above or in gullies or draws that can accumulate fuel and funnel winds, worsening fire behavior.
3. Use non-combustible materials for roofs and exterior walls.

4. Use of construction grade vinyl soffit material is not acceptable. Fire resistant materials are to be used.
5. All windows must be double paned or tempered glass.
6. All crawl spaces, the underside of porches and decks and sheds must be sealed.
7. Decks and balconies should be constructed of heavy timber as defined by the BC building code, be rated to have 1-hour fire resistance, or be made of, or covered by noncombustible material, such as the exterior wall finishing material.
8. All chimneys should have spark arrestors made of 12 gauge or better-welded or woven wire mesh with mesh openings of less than 12 millimeters.
9. All screens for attic and basement vents must be metal and have small enough openings to prevent sparks from passing into the building (3-millimetre noncombustible wire mesh as a minimum).
10. Additional protection to homes with only one access route can have exterior sprinkler systems to provide protection from wildfires.

Buffer areas such as roads and open uninhabited areas can provide protection of homes from wildfires. Construction of homes adjacent to areas that have a high to extreme hazard rating are more likely to have fire spreading from adjacent forest interface areas from spotting from airborne embers. Embers can spread to a distance of 2 km from a high intensity wild fire. Additional protection to residences can be provided by including FireSmart landscape recommendations surrounding homes in local bylaws, such as:

1. Due to the risk of fire in forest interface areas, a 10-meter fuel modified space around homes and buildings is recommended (Priority Zone 1 from the FireSmart Manual). The main objective of vegetation within this space is to create an environment that will not support fire of any kind. Here are the recommendations within 10 meters of homes and buildings:
    - Plant low-growing (<0.5 meter tall) shrubs around buildings. Landscaping on the property within 10 meters of a building shall not include coniferous shrubs such as junipers, muhgo pines or coniferous hedges.
    - Deciduous trees and shrubs are favored for landscaping.
    - No additional or new coniferous evergreen trees are to be planted within 10 meters of buildings.
    - Watered and mowed lawns are also recommended close to buildings. It is also recommended that pea gravel, lava rock or other non-combustible material be used as groundcover rather than bark mulch.
    - Fencing should also be constructed from non-combustible material.

- Healthy trees within 10 meters of homes and buildings can be retained; however branches should not be within 3 meters of buildings or attachments, such as balconies.
- Remove trees with mistletoe brooms found close to homes.

2. Where space allows on large sized lots, for a distance greater than 10 meters and up to 100 meters from homes and buildings (Priority Zones 2 and 3 from the FireSmart Manual):
    - Remove all conifers less than 15 cm in diameter at breast height. Cut the trees at a right angle, as low as possible to the ground to reduce the risk of injury to people and animals moving through the area.
    - Where possible, space all trees to a distance of 2-3 meters between crowns. Healthy trees in clumps can be retained provided there is a space of 2-3 meters between adjacent tree crowns and the clump of trees to be retained.
    - On trees that are to be retained, remove ladder fuels to a height of 2.5 meters or higher on steep slopes.
    - Remove any Douglas-fir trees with mistletoe brooms growing more than 3 meters up the trunk.
3. Remove standing dead and dying trees and root damaged trees. Snags identified as valuable wildlife habitat can be retained where they do not pose a fire or safety hazard.
4. Clean up all combustible materials as soon as new construction is completed.

Long Term Maintenance Recommendations within the Spiller Road / Reservoir Road Neighbourhood Concept Plan Area

The Okanagan Valley has fire maintained ecosystems that would normally have naturally occurring wildfires every 10-20 years. The resulting forest would have an open stand structure allowing for the growth of natural grasses and flowers. With the elimination of natural fires, these stands can become overstocked, leading to a reduction in the growth of natural grasses and plants, and an increase in the fire hazard due an increase in fine and coarse fuel loads. Natural fires would remove these fuels on a regular basis. The long-term action recommendations for the property should assure that this natural stand structure is maintained and these fuels are removed. Adjacent forest interface areas should also be maintained to reduce the fire hazard risk.

Following construction of homes and buildings, here are some recommendations that will help to reduce the fire hazard in the future:

1. The area has signs of bark beetles attacking pine trees in the area. There is a good chance that there will be a major loss of pine trees killed by bark beetles in the future. As well as creating a fire hazard, these trees also pose a hazard if they fall close to homes or roads. These trees should be

removed once they show signs of bark beetle attack. This will help to reduce the spread of beetles to trees in the adjacent area. Trees killed by bark beetles rot quickly and may fall over within 2 years. A program for continuing removal of trees attacked by bark beetles should be initiated to help control the spread of the beetles to healthy trees in the area. The City of Kamloops has been dealing with the bark beetle infestation and could provide additional information on dealing with this problem.

2. Make sure that property owners know that dumping or storage of prunings and yard waste on their property or adjacent property is prohibited.

3. Landowners should monitor the area for fuel accumulations under the larger pine trees and clean up excessive needle accumulations when they get over 5 cm in depth. Leave a thin layer to prevent encroachment of weeds on bare mineral soil.

4. Remove some small trees that occur naturally from seed sources. These trees could encroach on open areas and lead to increased fuel loads and an increased fire hazard. Some small tree could be retained if they are well spaced as replacement trees for trees killed by bark beetles.

5. Roads are important since they act as a fuel break in the event of a wildfire. Fine fuel loads such as grasses and weeds along roadsides are high and pose a hazard, especially in the later part of the summer. These fuels are easily ignited. The road right of way clearing usually amounts to mowing a narrow meter wide strip along the roadside, leaving the adjacent right of way untreated. Fire could easily spread to the adjacent forest with high ground fuel loads. The width of right of way treated should be widened to reduce the risk of fire igniting from thrown cigarettes or any other source of fire on a roadside. Treating the roadside fuels makes a wider fuel break and decreases the risk of fire spreading across the roads into adjacent areas. Having a safe escape route could be important in the event of a major wildfire.

Community Involvement

It is important that lot owners within subdivisions communicate to:

- Make a joint commitment to minimize the risk to their neighborhood by following fire-smart practices; and
- Meet with the local Fire Department on items of concern such as:
    1. Fuel management.
    2. Public education.
    3. Burning bylaws.
    4. Water source contracts.
    5. Access problems.

List of Sources

Brown, R. 2000. Thinning Fire and Forest Restoration: A science-based approach for National Forests in the interior northwest, for Defenders of Wildlife. West Linn, Oregon.

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Stone, Joseph E., Thomas E. Klolb, and Wallace Covington. Effects of Restoration on Presettlement in *Pinus ponderosa* in Northern Arizona. 1999. Society for Ecological Restoration.

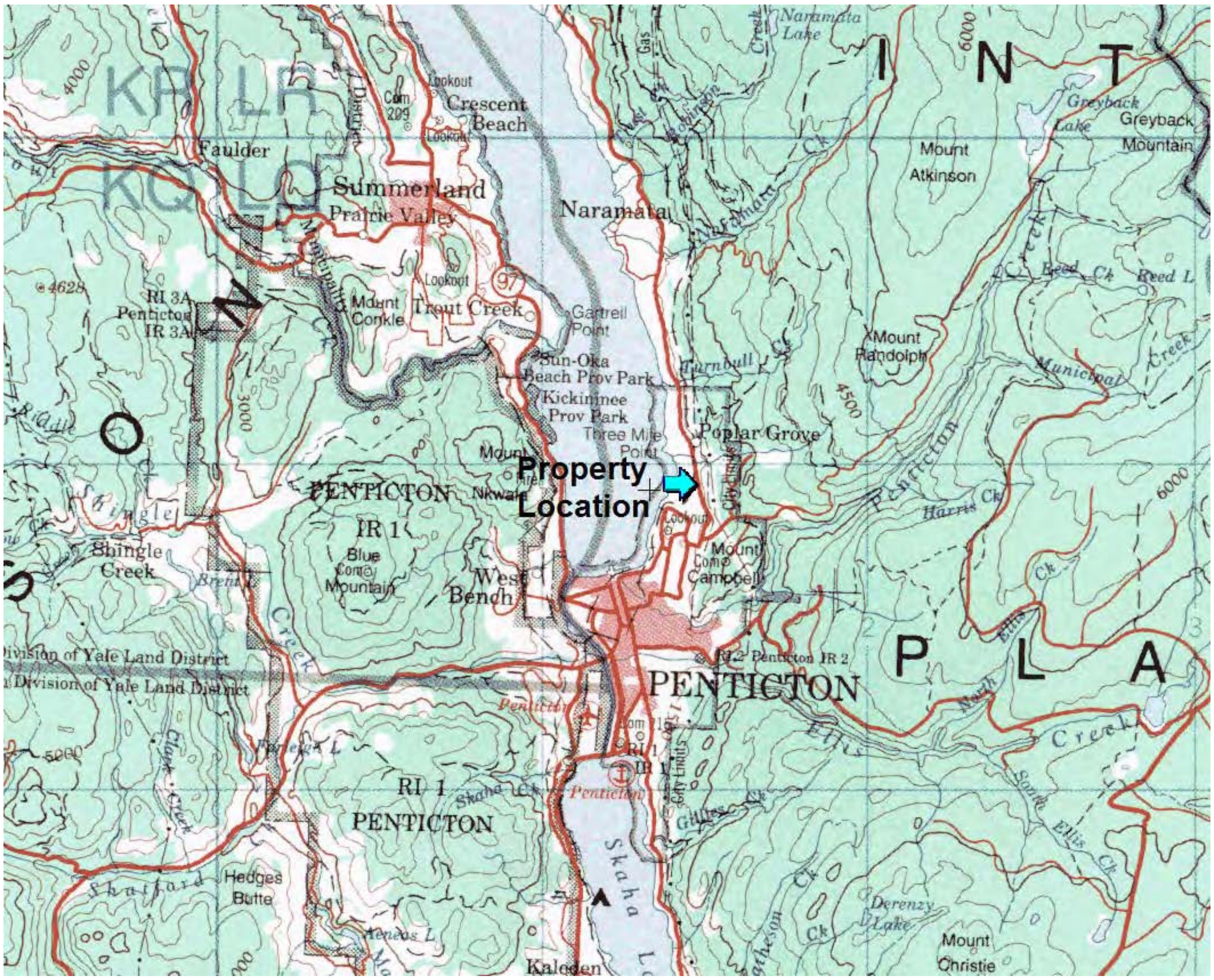
The FireSmart Manual, BC Edition, 2004, Ministry of Forests, Protection Branch. The manual is available from the local fire department and is a helpful source of information to property owners.

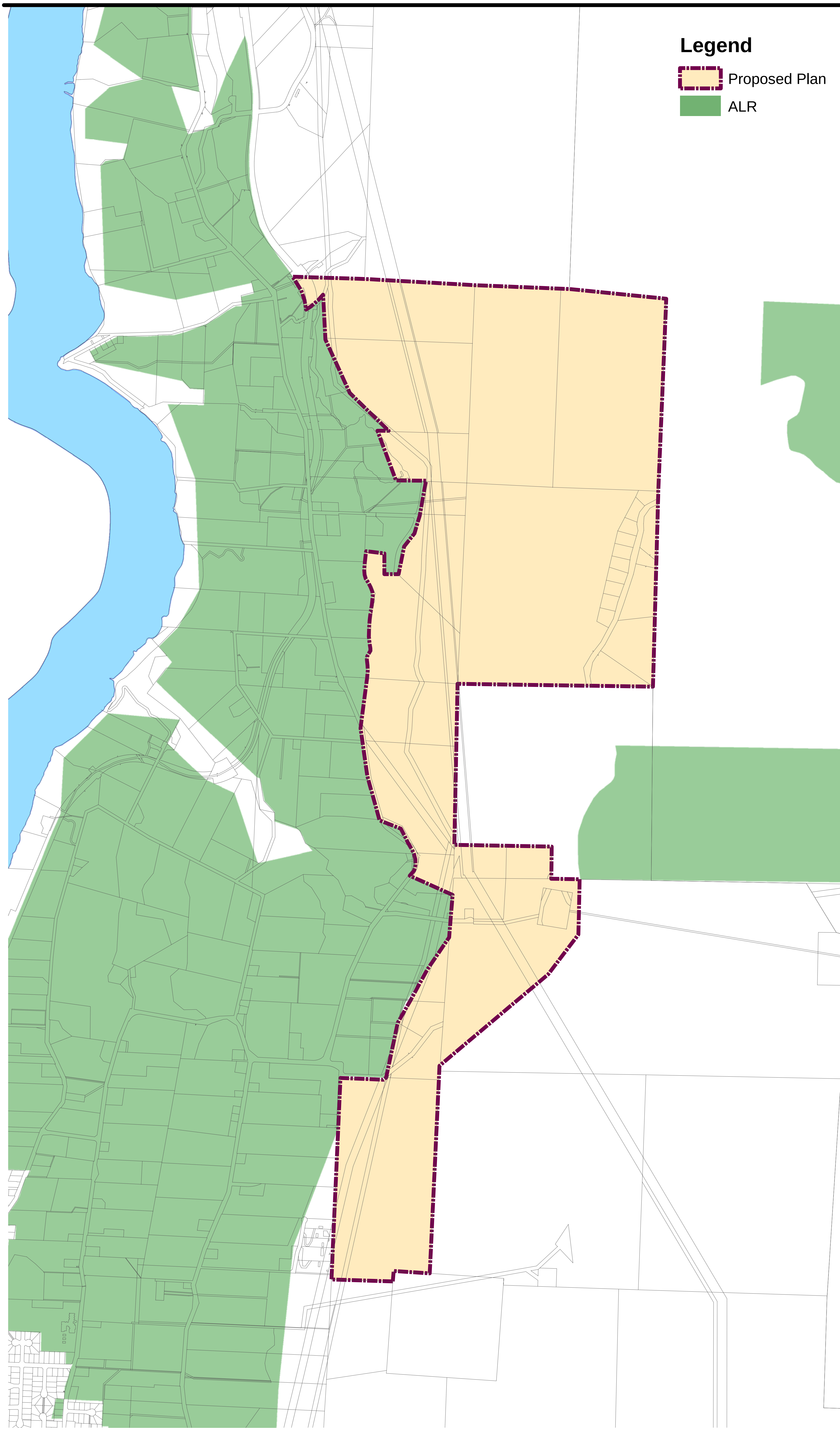
Weatherspoon, C.P. and Skinner, C.N. 1996. Landscape-level strategies for forest fuel management. In Sierra Nevada Ecosystem Project: Final reports to Congress ll Assessments and scientific basis for management options. pp. 1471-1492.

Appendix

Spiller Road / Reservoir Road Area Neighbourhood Concept Plan Location and Map

Spiller Road / Reservoir Road Area Neighbourhood Concept Plan Location





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DATE: 2006-12-13

PROPOSED PLAN AREA - NEIGHBOURHOOD CONCEPT PLAN
SPILLER ROAD AND RESERVOIR ROAD BLOCKS

URBANSYSTEMS.

Naramata Neighbourhood Plan

2007-09-17

Canadian Horizons Land Investment

North

1:500

Base Map

FIGURE

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Photos and Fire Hazard Plots

Photo 1. The topography in the Northwest corner is rolling with some steep rocky outcrops. The vineyards help to lower the risk from wildfire by acting as an open area between the forest interface and residences.

Photo 2. There is some access with narrow four wheel drive roads in this portion of the Neighbourhood Concept Plan area.

FHA Plot 1. There is an open pine forest in this area, with scattered pine trees and bunchgrass.

Photo 3, the Trans-Canada Trail runs through this portion of the study area.

Photo 4 shows the Inland Natural gas right of way that runs through the western portion of the property.

Photo 5. The northern portion of the Neighbourhood Concept Plan area is open pine forest with some aspen in the draws.

Photo 6. The lot in the northeast portion is used by cattle. The lack of ground fuels and ladder fuels would lower the risk from wildfire.

Plot 3. This photo shows the pine forest with bunchgrass. This area is not used by cattle.

Photo 7 shows the view to the south from the northern portion of the Neighbourhood Concept Plan area.

Photo 8 shows the open pine forest. A portion of the private property has been selectively logged.

Photos 8 and 9 show the open grassland and forest as well as the vineyards in western portion of the plan area along Naramata Road. The open areas and vineyards help to lower the risk of fires around the homes.

Plot 2 shows the steep rocky area located to the east of Spilller Road. This area has the highest hazard due to the denser forest conditions, steep rocky ground and western aspect.

Photo 10 shows the forest conditions to the west of Spiller Road, below the residential area. This forest could be cleaned up to reduce the risk from wildfire.

Photo 11 shows the Mount Campbell Waste Disposal Site. The open area around the site helps to lower the risk from wildfire.

Photo 12 shows the open pine forest in the middle of the plan area to the west of the Mount Campbell disposal site. The vineyards to the west help to lower the risk from wildfire in the forest interface.

Photo 13 shows the steep rocky area to the east of Naramata Road. The vineyards help to lower the risk to homes in the area.

Plot 7 has open grassland with scattered pine trees.

This photo shows a few pine trees that have been killed by bark beetles. The pine beetles will continue to move through the Penticton area. More red trees should start to show in the spring of 2008.

This photo shows the large pitch tubes on the base of a pine tree, a sign of attack by Turpentine beetles. Other bark beetles may also be in the area.

Photo 14 shows the hydro line right of way that runs through the western portion of the Neighbourhood Concept Plan area. The right of way would provide some access in the event of a wild fire.

FHA Plot 5 shows the young pine forest in this area.

Photo 15 shows the gas pipeline in this area. The line would provide four wheel drive access.

Plot 6 shows the open pine forest in this area. Portions of the area are used by cattle, helping to lower the fire hazard rating by reducing fine fuel loads.

Photo 16 shows the open forest the southern portion of the proposed development. Mount Campbell is located to the east.

Fire Hazard Assessment Plots

INTERFACE COMMUNITY FIRE HAZARD FORM

Location: Spiller Road / Reservoir Road Neighbourhood Concept Plan Area

Jurisdictional Area: City of Penticton Map Reference: Plot 1

Completed By: R. Swanson, RPF No GPS

Community Description: Rural Points: 79

Fire Weather Potential	Rarely Class 3 and above 0 Points	Sometimes Class 3 and above 2 Points	Often Class 3 and above 10 points	Long Periods Class 3 and above 20 Points	20
Area Description	Strictly Urban 0 Points	Suburban; Scattered Forest 2 Points	Rural; Scattered Forest 4 Points	Rural; Continuous Forest 6 Points	4
Thickness of Duff/Litter	<5 cm 1 Point	≥ 5cm to < 13 cm 3 Points	≥ 13 cm to < 20 cm 5 Points	≥ 20 cm 6 Points	1
Fine And Coarse Debris	None or spread >5 m apart; Not elevated 1 Point	Scattered branches and tops; Not elevated 2 Points	Scattered branches; grouped, crossed; < 1 m high 5 Points	Continuous; grouped, crossed, > 1m high 6 Points	1
Forest Stand Description	Generally Deciduous 0 Points	Mixed Deciduous and Coniferous 3 Points	Generally Coniferous 6 Points	Dense Pine Stand 8 Points	6
Other Vegetation	Primarily Domestic 0 Points	Domestic or Wildland Grasses 2 Points	Primarily Wildland Brush, Salal etc. 4 Points	Primarily Broom or Gorse 6 Points	2
Topographic Features	Generally Flat 0 Points	Gently Rolling 2 Points	Rolling and Gullied 4 Points	Many steep areas Or rock outcrops 6 Points	6
Values Protected	No significant dev.; Wildland values only 2 Points	Complete dev.; fire potential perimeter 4 Points	Incomplete dev.; fire potential throughout 6 Points	Lot sizes larger than one hectare 6 Points	6
Recreational Use	No signs obvious use 2 Points	Infrequent use 4 Points	Frequent use 6 Points	High use 8 Points	6
Fire Potential on Adjacent Lands	No significant fire potential 0 Points	Low fire potential 2 Points	Medium fire potential 4 Points	High fire Potential 6 Points	4

FIRE SUPPRESSION CAPABILITIES:

Fire Protection	Fully paid Fire dept. 0 Points	Volunteer fire dept; Multiple halls 2 Points	Volunteer fire dept; Single hall 6 Points	No local fire Protection 10 points	0
Available Water	Good hydrant coverage 1 Point	Partial coverage; water within 350 m 2 Points	No Hydrants; good water supply in 500m 4 Points	No hydrants and poor water supply 6 Points	4
Mutual Aid	Multi-dept. mutual Aid agreements 0 Points	Limited mutual aid with fire depts. 2 Points	Only Prov./National aid through agreement 4 points	No agreement with any agency 6 Points	0
Response Time To Fire	15 minutes 0 Points	30 minutes 2 Points	60 minutes 4 Points	90 minutes 10 Points	0
Access for Emergency Vehicles	Area generally fully Accessible (tank truck) 2 Points	Some areas have access problems (mini pumper) 4 Points	Narrow winding road; Bridge load limit (mini-pumper) 5 Points	Significant areas of inaccessibility (air/foot) 6 Points	4
Fire History of Area	0-2 Fires 0 Points	2-5 Fires 3 Points	5-15 Fires 8 Points	15+ Fires 11 Points	3

OTHER FACTORS:

Frequent high winds over 30 km/hr	Extensive areas of steep south or west exposure slopes	Large scale Industrial project anticipated	Large scale recreational project anticipated	Fuel loading increase due to logging or land clearing activity	Railway activity within interface zone	Utilities within the interface area	**Total Points**
0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6	**79**

Interface Community Fire Hazard Rating: High

0-55	Low	Green
56-70	Moderate	Yellow
71-85	High	Orange
86+	Extreme	Red

Notes: Extremely steep terrain with limited access. Scattered ponderosa pine stands with a western aspect. Bunchgrass and rock outcrops. The Trans-Canada trail runs through the area as well as a gas line and power line.

INTERFACE COMMUNITY FIRE HAZARD FORM

Location: Spiller Road / Reservoir Road Neighbourhood Concept Plan Area

Jurisdictional Area: City of Penticton Map Reference: Plots 2 and 3

Completed By: R. Swanson, RPF No GPS

Community Description: Rural Points: 82

Fire Weather Potential	Rarely Class 3 and above 0 Points	Sometimes Class 3 and above 2 Points	Often Class 3 and above 10 points	Long Periods Class 3 and above 20 Points	20
Area Description	Strictly Urban 0 Points	Suburban; Scattered Forest 2 Points	Rural; Scattered Forest 4 Points	Rural; Continuous Forest 6 Points	4
Thickness of Duff/Litter	<5 cm 1 Point	≥ 5cm to < 13 cm 3 Points	≥ 13 cm to < 20 cm 5 Points	≥ 20 cm 6 Points	1
Fine And Coarse Debris	None or spread >5 m apart; Not elevated 1 Point	Scattered branches and tops; Not elevated 2 Points	Scattered branches; grouped, crossed; < 1 m high 5 Points	Continuous; grouped, crossed, > 1m high 6 Points	1
Forest Stand Description	Generally Deciduous 0 Points	Mixed Deciduous and Coniferous 3 Points	Generally Coniferous 6 Points	Dense Pine Stand 8 Points	6
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Topographic Features	Generally Flat 0 Points	Gently Rolling 2 Points	Rolling and Gullied 4 Points	Many steep areas Or rock outcrops 6 Points	6
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Mutual Aid	Multi-dept. mutual Aid agreements 0 Points	Limited mutual aid with fire depts. 2 Points	Only Prov./National aid through agreement 4 points	No agreement with any agency 6 Points	0
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OTHER FACTORS:

Frequent high winds over 30 km/hr	Extensive areas of steep south or west exposure slopes	Large scale Industrial project anticipated	Large scale recreational project anticipated	Fuel loading increase due to logging or land clearing activity	Railway activity within interface zone	Utilities within the interface area	**Total Points**
0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6	**82**

Interface Community Fire Hazard Rating: High

0-55	Low	Green
56-70	Moderate	Yellow
71-85	High	Orange
86+	Extreme	Red

Notes: Steep terrain with limited access. Pine and Douglas-fir forest with some ladder fuels. Thick pine needle accumulations under large pines. Bunchgrass and rock. No hydrants within 500 meters.

INTERFACE COMMUNITY FIRE HAZARD FORM

Location: Spiller Road / Reservoir Road Neighbourhood Concept Plan Area

Jurisdictional Area: City of Penticton Map Reference: Plots 4, 5 and 6

Completed By: R. Swanson, RPF No GPS

Community Description: Rural Points: 81

Fire Weather Potential	Rarely Class 3 and above 0 Points	Sometimes Class 3 and above 2 Points	Often Class 3 and above 10 points	Long Periods Class 3 and above 20 Points	20
Area Description	Strictly Urban 0 Points	Suburban; Scattered Forest 2 Points	Rural; Scattered Forest 4 Points	Rural; Continuous Forest 6 Points	4
Thickness of Duff/Litter	<5 cm 1 Point	≥ 5cm to < 13 cm 3 Points	≥ 13 cm to < 20 cm 5 Points	≥ 20 cm 6 Points	1
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OTHER FACTORS:

Frequent high winds over 30 km/hr	Extensive areas of steep south or west exposure slopes	Large scale Industrial project anticipated	Large scale recreational project anticipated	Fuel loading increase due to logging or land clearing activity	Railway activity within interface zone	Utilities within the interface area	**Total Points**
0 1 2 3 4 <u>5</u> 6	0 1 2 3 <u>4</u> 5 6	<u>0</u> 1 2 3 4 5 6	<u>0</u> 1 2 3 4 5 6	<u>0</u> 1 2 3 4 5 6	<u>0</u> 1 2 3 4 5 6	0 1 2 3 4 <u>5</u> 6	**81**

Interface Community Fire Hazard Rating: High

0-55	Low	Green
56-70	Moderate	Yellow
71-85	High	Orange
86+	Extreme	Red

Notes: Steep terrain with limited access. Pine and Douglas-fir forest with some ladder fuels. Thick pine needle accumulations under large pines. Bunchgrass and rock. Gas and hydro right of ways through this area.

INTERFACE COMMUNITY FIRE HAZARD FORM

Location: Spiller Road / Reservoir Road Neighbourhood Concept Plan Area

Jurisdictional Area: City of Penticton   Map Reference: Plot 7

Completed By: R. Swanson, RPF   No GPS

Community Description: Rural   Points: 80

Fire Weather Potential	Rarely Class 3 and above 0 Points	Sometimes Class 3 and above 2 Points	Often Class 3 and above 10 points	Long Periods Class 3 and above 20 Points	20
Area Description	Strictly Urban 0 Points	Suburban; Scattered Forest 2 Points	Rural; Scattered Forest 4 Points	Rural; Continuous Forest 6 Points	4
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OTHER FACTORS:

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0 1 2 3 4 <u>5</u> 6	0 1 2 3 <u>4</u> 5 6	<u>0</u> 1 2 3 4 5 6	<u>0</u> 1 2 3 4 5 6	<u>0</u> 1 2 3 4 5 6	<u>0</u> 1 2 3 4 5 6	0 1 2 3 4 <u>5</u> 6	**80**

Interface Community Fire Hazard Rating: High

0-55	Low	Green
56-70	Moderate	Yellow
71-85	High	Orange
86+	Extreme	Red

Notes: Steep terrain with limited access. Open area with very scattered pine trees. Bunchgrass and rock. This area has a gas and hydro lines increasing the risk from wildfires.

APPENDIX D

Northern Landfill Gas Setback Assessment
(Conestoga-Rovers & Associates)

NORTHERN LANDFILL GAS SETBACK ASSESSMENT

CAMPBELL MOUNTAIN LANDFILL
PENTICTON, BRITISH COLUMBIA

JULY 2009
REF. NO. 33765 (16)
This report printed on recycled paper

CONESTOGA-ROVERS
& ASSOCIATES

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Richmond, British Columbia, Canada V6X 2W2
Telephone: 604·214·0510 Facsimile: 604·214·0525
www.CRAworld.com

July 13, 2009

Reference No. 033765-21

Mr. Andrew Reeder
Environmental Services Manager
Regional District of Okanagan-Similkameen
101 Martin Street
Penticton, BC
V2A 5J9

Dear Mr. Reeder:

Re: Northern Landfill Gas Setback Assessment – Final Report
Campbell Mountain Landfill
Regional District of Okanagan-Similkameen

Conestoga-Rovers & Associates (CRA) is pleased to enclose one (1) hardcopy and one (1) electronic copy of the above mentioned report for the Campbell Mountain Landfill (Site).

This report has been prepared to provide the Regional District of Okanagan-Similkameen (RDOS) with a rationale and technical basis for ensuring that an adequate setback for landfill gas management exists from the adjacent property development to the north of the Site. The scope of work to be completed was documented in CRA's letter dated April 15, 2008 to the RDOS.

Should you have any questions or comments regarding the above report, please do not hesitate to contact the undersigned.

Yours truly,

CONESTOGA-ROVERS & ASSOCIATES

Gregory D. Ferraro, P. Eng.

ZF/kn/03

Encl.

cc. Liisa Bloomfield, RDOS
Bentley Harris, Canadian Horizons Land Investment Corp.
Mike Reiner, Ministry of Environment
Mitch Moroziuk, City of Penticton
Gary Leobold, City of Penticton

NORTHERN LANDFILL GAS SETBACK ASSESSMENT

CAMPBELL MOUNTAIN LANDFILL
PENTICTON, BRITISH COLUMBIA

Prepared For:

Regional District of Okanagan-Similkameen

Prepared by:
Conestoga-Rovers & Associates

110-3851 Shell Road
Richmond, British Columbia
Canada V6X 2W2

Office: (604) 214-0510
Fax: (604) 214-0525

web: http:\\www.CRAworld.com

JULY 2009
REF. NO. 33765 (16)

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SYMBOLS AND ABBREVIATIONS

BC	British Columbia
CF	Composting Facility
cfm	cubic feet per minute
CHLI	Canadian Horizons Land Investment
CRA	Conestoga-Rovers and Associates
Golder	Golder Associates Ltd.
k	landfill gas generation constant (year^{-1})
kg	kilogram
km	kilometer
LEL	lower explosive limit
LFG	landfill gas
Lo	refuse methane generation potential
LWF	Liquid Waste Facility
m	metre
MOE	BC Ministry of Environment
MSW	municipal solid waste
NMOCs	non-methane organic compounds
OC	Draft Operational Certificate PR 15274
OFC Plan	Campbell Mountain Landfill Operations/Filling/Closure Plan (SHA, January, 1997)
Permit	Permit No. PR 1597
P.E.O.P.L.E.	Population Extrapolation for Organizational Planning with Less Error (BC Stats, Ministry of Finance and Corporate Relations)
RDOS	Regional District of Okanagan-Similkameen
RFP	Request for Proposal (RDOS, May 2007)
SHA	Sperling Hansen Associates Inc.
Site	Campbell Mountain Landfill
USCS	Unified Soil Classification System

1.0 INTRODUCTION

The following report entitled "Northern Landfill Gas Setback Assessment", has been prepared by Conestoga-Rovers and Associates (CRA) on behalf of the Regional District of Okanagan-Similkameen (RDOS) for the Campbell Mountain Landfill (Site). The scope of work to be completed was documented in the CRA letter dated April 15, 2008 to the RDOS.

1.1 REPORT OBJECTIVE

It is understood that Canadian Horizons Land Investment (CHLI) is proposing to construct a residential development on the adjacent lands to the north of the Site. This report is intended to provide the RDOS with a rationale and technical basis for ensuring that adequate set back for landfill gas (LFG) management exists from the adjacent property development to the north.

This report has been prepared to meet the following objectives:

- Further characterization of the geologic/hydrogeologic conditions along the northern property boundary
- Establishment of site-specific LFG and soil gas database
- Evaluation of LFG production
- Assessment of the LFG migration potential north of the landfill
- Establishment of an appropriate LFG setback to the north of the landfill that will provide information in addition to other buffer constraints (i.e., wind blown litter, screening, etc.) to determine the final northern buffer area
- Provide a LFG setback that would minimize risk to the residential development to the north with respect to LFG migration

1.2 SITE DESCRIPTION

The Site is operated by the RDOS and located approximately 5 kilometres (km) northeast of the City of Penticton, British Columbia (BC) with Spiller Road to the east. A Site location map is provided on Figure 1.1.

The Site is situated on a 59.5 hectare parcel of land leased to the RDOS by the City of Penticton legally defined as District Lot 368, Similkameen Division of Yale District. The adjacent lands are currently zoned as country residential to the north, agriculture to the west, and agriculture/forestry grazing to the south by the City of Penticton. The lands to the east are owned by the RDOS and are zoned as small holdings and resource area zones.

Figure 1.2 presents a Site plan illustrating existing conditions. The Site entrance is located in the southeast quadrant of the Site and is secured by a lockable gate. A Composting Facility (CF) and Liquid Waste Facility (LWF) are also located at the Site as shown on Figure 1.2 which are currently owned and operated by the City of Penticton.

1.3 ENVIRONMENTAL RECEPTOR OF CONCERN

The North East Sector Plan (NES Plan) has been prepared by the City of Penticton (2005) to provide for additional development opportunities in the Northeast Sector of the City of Penticton. This area has been considered for future urban uses and expansion for several years, but long range planning has been limited until the mid 2000s.

Four projected development blocks were included in the NES Plan, however only the Spiller Block will be discussed in further detail with respect to LFG migration potential and establishment of an adequate LFG setback to the north of the Site property. The Spiller Block is owned by CHLI and is located immediately to the north of the Site with a total area of approximately 350 acres as shown in Figure 1.3.

1.4 REGULATORY SETTING

Landfill operations commenced at the Site in 1977 as a natural control facility by the RDOS under Permit No. PR 1597 (Permit) included in Appendix A. It is understood a draft Operational Certificate PR 15274 (OC) is currently being prepared for the Site under the provisions of the Environmental Management Act and in accordance with the approved RDOS Solid Waste Management Plan.

Landfill gas collection requirements are currently stipulated in Section 6.4 of the Landfill Criteria for Municipal Solid Waste (1993). Landfills expected to exceed 150 tonnes/year of non-methane organic compounds (NMOCs) are required to install and operate LFG recovery and management systems.

Due to the adverse air emissions resulting from the generation and presence of LFG, the BC Ministry of Environment (MOE) has developed the LFG Regulation to facilitate in reducing GHG emissions by at least 33 percent (%) below 2007 levels by 2020 to safeguard the environment and tackle climate change. The proposed LFG Regulation was promulgated by the MOE in January 2009 under the Environmental Management Act and includes requirements for the capture of LFG under provincial jurisdiction to meet provincial reduction targets.

The following are key components of the LFG Regulation are:

- Existing landfills with an excess of 100,000 tonnes of waste in place and/or a waste discharge rate exceeding 10,000 tonnes/year must undertake a LFG assessment. LFG assessments must be submitted to the MOE by January 1, 2010.
- Landfills generating methane in excess of the threshold of 1,000 tonnes/year, will be required to submit an appropriate gas collection system design plan by a qualified professional to the MOE before January 1, 2012.
- Landfills must install LFG collection systems, if required, by January 1, 2016 with a capture efficiency target of 75% of generated gas.
- The LFG collection systems must remain in operation following closure until methane emissions are below 500 tonnes/year. A report confirming the decrease in LFG production over time must be reported to the MOE at least 90 days prior to the planned shutdown of the collection system.
- Reporting requirements will be based on the size of the landfill and amount of methane gas generated.

The MOE is currently developing the guideline for conducting the required LFG assessments.

1.5 LANDFILL GAS MANAGEMENT OVERVIEW

A detailed assessment of LFG generation has been completed by Golder Associates Ltd (Golder, 1994), and Sperling Hansen Associates (SHA, 1997 and 2001a). The most recent study concluded a LFG management system was not required for the Site based on peak potential emissions of non-methane organic compounds (NMOCs) calculated at 73.9 tonnes/year using site-specific parameters. The existing criteria currently stipulated in the Landfill Criteria for Municipal Solid Waste of 150 tonnes/year was not exceeded, thus implementation of a LFG collection system would be voluntary. As a result, there are currently no LFG recovery or management systems in place at the Site.

The potential for LFG utilization has been discussed in previous reports (SHA, 2001a), however opportunities available to the RDOS considering recent goals established by the MOE (2007 Speech from the Throne) regarding greenhouse gas emissions have not been explored. It is understood that landfill development by the RDOS has progressed assuming LFG would not be collected (i.e., an impermeable cover to assist in gas collection has not being considered at this time).

To address LFG migration concerns, a shallow gas survey was conducted using temporary gas probes by Golder (1994). It was concluded that LFG was venting upward through the top of the landfill cells during the spring season. Additional monitoring was recommended to establish temporal trends and confirm results. In 2000, a total of 12 monitoring probes were installed adjacent to the northern and southern property boundary to assess LFG migration towards existing/proposed residential developments (SHA, 2001a). A one-dimensional model that's considered both advective and dispersive principles was used to estimate LFG migration from the Site (SHA, 1997) and was later revised based on actual field data (SHA,2001a), however assumptions were made in the absence of site-specific data representing worst case conditions. The modeling carried out demonstrated that LFG could theoretically migrate up to 90 m north of the property, with an additional 100 m recommended as a safety measure. Previous LFG monitoring events conducted in 2000 (SHA, 2001a) indicate, however, that no significant amount of LFG has been measured along the northern property boundary to date, based on the monitoring program implemented at the Site.

1.6 REPORT ORGANIZATION

This report has been organized into the following sections:

Section 1.0 Introduction
Section 2.0 Landfill Gas Overview
Section 3.0 Field Investigation Summary
Section 4.0 Evaluation of Landfill Gas Production
Section 5.0 Landfill Gas Migration Assessment
Section 6.0 Future Development
Section 7.0 Conclusions
Section 8.0 Recommendations

2.0 LANDFILL GAS OVERVIEW

2.1 LANDFILL GAS COMPOSITION

LFG is produced as a result of the biological decomposition of organic wastes placed in a landfill. The composition of LFG is highly variable, and depends upon a number of site-specific conditions including solid waste composition, density, moisture content, and age. However in general, LFG is composed of primarily of methane and carbon dioxide (CO_2), 50 % v/v, with trace quantities of other gases such as hydrogen sulphide (H_2S), mercaptans, and NMOC.

2.1.1 BIOLOGICAL DECOMPOSITION

Methane and carbon dioxide are produced by biological decomposition, which occurs when organic wastes are broken down by anaerobic bacteria present in the waste. Organic wastes include food, garden waste, textiles, wood and paper products.

A primary process of LFG production is the decomposition of cellulose by bacterial action according to the following simplified chemical reaction (Augenstein and Pacey, 1991):

$$\underset{\text{(cellulose)}}{nC_6H_{10}O} + \underset{\text{(water)}}{nH_2O} \rightarrow \underset{\text{(methane)}}{3nCH_4} + \underset{\text{(carbon dioxide)}}{3nCO_2}$$

Hence, LFG is generally composed of approximately 50% methane and 50% carbon dioxide by volume.

2.1.2 PHYSICAL DECOMPOSITION

Gases can be generated within the refuse mass when certain wastes, particularly organic compounds, physically alter from the liquid or solid state into the vapor state. This process is commonly referred to as volatilization or physical decomposition. The physical decomposition of some chemicals disposed of in landfills may result in the release of trace gases into the LFG stream.

2.1.3 CHEMICAL DECOMPOSITION

Chemical decomposition involves chemical change arising from oxidation, reduction, change in pH, dissolution, precipitation, complexation, and other chemical reactions with materials in the refuse mass (McBean et al; 1995). Hence, trace gases can be created by the reactions of certain chemicals present in waste. The proportions of these compounds are phase dependent and will vary over time. As a result, LFG contains a number of trace constituents, attributable to chemical products and reactions within the refuse, which may affect the impact of LFG. Typical components of LFG are presented in Table 2.1.

2.2 NON-METHANOGENIC ORGANIC COMPOUNDS

NMOCs are produced in the refuse mass by either physical or chemical processes. NMOCs are contained in items such as household cleaning products, paint, and adhesives. During the decomposition process, NMOCs can be stripped from the refuse by methane and carbon dioxide, and carried in the LFG stream (USEPA, 2003).

NMOCs include hazardous air pollutants (HAPs), such as benzene, toluene, ethyl benzene, and vinyl chloride. Exposure to these compounds can lead to adverse health effects. Furthermore, certain NMOCs can react with light to form ground-level ozone.

Typical NMOC compounds present in LFG are listed in Table 2.2.

2.3 VOLATILE ORGANIC COMPOUNDS

Volatile organic compounds (VOCs) are a subset of NMOCs which include a large group of chemicals containing carbon and hydrogen atoms that can react to form other chemicals in the atmosphere. VOCs are an important environmental issue due to their ability to react with oxides of nitrogen in the presence of sunlight to form ozone and photochemical smog, and toxicity to humans, animals and vegetation. The effects of VOCs on human health can range from nuisance to hazardous levels.

2.4 POTENTIAL LANDFILL GAS IMPACTS

Due primarily to pressure gradients, LFG may migrate through either the landfill cover or the adjacent soil and enter the atmosphere. Impacts of LFG are largely dependent upon the pathway by which the gas is exposed to humans or introduced into the environment. The generation and presence of LFG can result in adverse impacts related to either air emissions or subsurface migration.

2.4.1 AIR EMISSION ISSUES

Adverse air emissions issues include the following:

- GHG issues
- Health and toxic effects issues
- Nuisance odour

Carbon dioxide and methane are considered to be GHGs. These gases permit solar radiation to pass through the atmosphere while absorbing part of the infrared radiation that is reflected back from the Earth's surface. Methane is a potent GHG, which has 21 times the global warming potential of carbon dioxide. Combustion of LFG at high temperatures oxidizes methane to carbon dioxide thereby reducing the impact on the atmosphere.

LFG has the potential to create toxic conditions or cause asphyxiation. In a confined space, LFG will displace oxygen in the area thereby creating an oxygen-deficient atmosphere. Health effects associated with LFG exposure are generally related to the trace gases such as vinyl chloride. Some trace compounds in LFG are toxic at high exposure concentrations while other trace compounds are considered carcinogenic over long-term exposure.

The release of LFG into the atmosphere may contribute to odours in the vicinity of the landfill. LFG odours are caused primarily by the hydrogen sulphide and mercaptan compounds which are present in trace quantities in LFG. These compounds may be detected by sense of smell at very low concentrations, i.e., 0.005 and 0.001 parts per million (ppmv), respectively. Although hydrogen sulphide and mercaptan present health concerns at much higher exposure concentrations, their impact in LFG is generally related to nuisance odours.

2.4.2 SUBSURFACE ISSUES

A potential also exists for the migration of LFG through the subsurface soil surrounding the landfilled areas of the Site. The migration of LFG through the soil poses two primary concerns both of which are related to build-up of gases within or below structures near the landfill. Firstly, accumulation of LFG in a subsurface structure or confined space (e.g., basement, buried manhole, etc.) may expose those required to enter the structure to an oxygen-deficient environment created by the presence of LFG.

Secondly, accumulation of LFG in low-lying areas or within buildings introduces the risk of an explosion if a source of ignition is present. Depending upon the proportions of the two major constituents of LFG (i.e., methane and carbon dioxide), it can either be lighter or heavier than air and, therefore, may accumulate in structures or low lying areas. Should there be a continuing source of LFG, the hazard may be significant given that methane is explosive in the range between approximately 5 to 15 % by volume in air.

Potential subsurface LFG migration impacts include the following:

- Explosive hazard
- Vegetative stress

The risk of explosion occurs when the concentration of methane in air exceeds its lower explosive limit (LEL). Due to the fact that the LEL of methane is approximately 5% by volume in air, only a small proportion of LFG (containing approximately 50% methane by volume) is necessary to create explosive conditions. This risk is present in confined spaces with limited ventilation.

LFG explosions have occurred in structures on or near landfill sites. These occurrences are generally attributed to LFG migrating through the soil and accumulating within structures. It is important to note that LFG can be lighter or heavier than air depending upon the proportions of gases present. It is also important to note that an older landfill site (or older sections of a landfill) may still pose a significant LFG migration hazard. The quantity of LFG produced at a site commences to decline after closure, however, the general gas composition remains essentially the same.

Additional LFG impacts include vegetative stress. Vegetative stress is a sign of LFG migration through the subsurface and occurs due to the displacement of oxygen in the soil and the resultant oxygen deprivation of the plant roots. Deterioration of vegetation on or near landfills may present both an aesthetic and a practical issue. In areas where vegetative cover is diminished, erosion of the cover may occur. This may result in a "cascade" effect resulting in increased LFG emissions.

3.0 FIELD INVESTIGATION ACTIVITIES

CRA personnel conducted field activities from May 5 to May 10, 2008 to meet the objectives presented in Section 1.1. The following field activities were carried out:

- Overview of existing Site conditions
- Bedrock mapping
- Test pit program
- Soil gas probe installation
- Soil sample collection and analysis

A LFG monitoring program was also developed for the Site to develop a database for Site-specific LFG and soil gas measurements. A field investigation plan presenting field activity locations within the northern portion of the Site is presented on Figure 3.1.

3.1 OVERVIEW OF EXISTING SITE CONDITIONS

A Site overview was conducted prior to the start of intrusive field activities with the following observations noted:

- Site surrounded by ponderosa pine primarily on steep, rocky soils. Ravine area is dominated by grasses/shrubs.
- Evidence of leachate breakouts was not visible.
- High winds were noted in the region, with prevalent winds from the south blowing in a south-north direction.
- Interim cover material generally composed of a silty sand material from the existing borrow area.
- Commercial vehicles end dumping at active face in northern area of landfill as shown on Figure 3.1.
- Borrow soil material excavated to a depth of approximately 5 m within a distance of approximately 4 m south of GP1.
- GP10-1, and GP11-1, GP12-1 were compromised and require decommissioning (i.e., no seal, poor construction).
- The Gas Extraction Well and monitoring probe nest 15-1 were located centrally in the Site. Monitoring probed nests 45-3 and 30-2 could not be found.

- Refuse limits along the northern portion of the landfill were estimated using a hand held etrex Garmin© Global Positioning System (GPS) Unit. Existing refuse limits along the northern portion of the landfill extend beyond the preliminary design footprint limits by 15 to 45 m but are still within landfill property boundary as shown in Figure 3.1.

3.2 BEDROCK OUTCROPS

Bedrock outcrops were identified based on field observations and augmented with aerial photographs along the northern property limits and on a portion of the proposed residential development. Locations of bedrock outcrops are presented in Figure 3.1 and are discussed further in Section 5.5.1.

3.3 TEST PIT PROGRAM

A total of 19 test pits (TP1-08 to TP19-08) were identified to investigate historical refuse placement, to further characterize underlying soils, and to collect soil samples. Test pit locations are presented on Figure 3.1 and were established based on a grid pattern methodology. Test pit logs are included in Appendix B. Test pit depths ranged from 0 to 4.25 metres (m). TP1-08, TP2-08, TP3-08, and TP4-08 were located on bedrock outcrops areas, thus could not be advanced. Test pits TP12-08, TP14-08, and TP15-08 were not advanced due to their location within the refuse limits.

3.4 SOIL GAS PROBE INSTALLATION

A total of five (5) single or nested soil gas probes were installed in the northern half of the Site by Beck Drilling and Environmental Services Ltd. under the direction and supervision of CRA field personnel. Probes were strategically placed to ensure the most susceptible LFG migration pathways were intercepted and that long-term monitoring could be conducted to address Site compliance at the property boundary.

A track mounted drill rig was used and boreholes were advanced using air rotary drilling techniques due to the nature of the subsurface conditions. The probes were constructed of 13 mm Schedule 80 PVC pipe with 6 mm diameter perforations, spaced at approximately 25 mm on-center intervals. The perforated interval was backfilled with 10 mm pea gravel. Each probe was completed with a hydrated bentonite seal and a steel riser casing was placed in approximately 0.3 m of concrete.

The perforated interval for each probe location was selected based upon the soil/bedrock stratigraphy encountered during the field program. The perforated interval was selected to intersect high permeability layers within the soil stratigraphy. At locations which exhibited multiple potentially high permeability zones, nested probes were installed. A summary of the gas probe depths and perforated intervals is presented in Table 3.1. The borehole logs and probe as-built details are presented in Appendix C.

3.5 SOIL SAMPLE COLLECTION AND ANALYSIS

Soil sample collection was completed in conjunction with test pit advancement discussed in Section 3.1.

Select soil samples were submitted for grain size analysis under chain of custody protocol to Maxxam Analytical Inc. (Maxxam) to further characterize and document the surficial soil characteristics. The laboratory report and field sample key are included in Appendix D. A total of 7 soil samples were submitted. Soil property analysis results are summarized in Table 3.2 and represent the smaller grain size portion of the analysed sample due to laboratory standard operating procedures. TP8-08 #1 and TP10-08 #1 collected at 1.3 and 1.5 m bgs were submitted to further characterize the fine grained deposit. The remaining samples were submitted to further characterize the fine grained portion of the more non-homogeneous, coarser grained deposits encountered during the test pit program. Further discussion is provided in Section 5.1.

3.6 SOIL GAS AND LANDFILL GAS MONITORING PROGRAM

A monitoring program was developed to assess the presence, migration, and extent of LFG. Monthly monitoring is in progress for a one year period, from May 2008 to April 2009 by CRA personnel to establish seasonal trends and build a scientific case for an appropriate northern LFG setback. Monitoring and sampling of soil gas/LFG is conducted at seven (7) gas monitoring wells located in the North Ravine area, eight (8) soil gas probe locations with a total of 14 gas probes, and one (1) LFG extraction well and 3 observation ports as shown on Figure 3.1. Borehole logs are included in Appendix C.

3.6.1 MONITORING METHODOLOGY AND RESULTS

Monitoring was conducted in accordance with CRA's LFG Monitoring Standard Operating Procedures. The following general monitoring methodology was used:

i. Probe identification/inspection
ii. Pressure measurement
iii. Gas concentration measurement following pumping of purge volume requirements
iv. Water level measurement
v. Field note completion, review, and check
vi. Documentation filing

A Landteck GEM 2000 was used to measure gas concentrations and a SKC pump was used when necessary to facilitate purging. In addition, environmental factors that can affect the migration of LFG were also recorded, specifically ambient air temperatures, barometric pressures, changes in barometric pressure, and local precipitation events.

LFG monitoring field results are presented in Appendix E and discussed further in Sections 4.6 and 5.3.

3.7 LANDFILL GAS TEMPERATURE MEASUREMENTS

Gas monitoring wells installed in the North Ravine in 2000 were equipped with thermistor strings, which consist of a series of temperature sensors spaced approximately 5 m apart and connected to a terminal box. Thermistor strings were originally installed to help determine the effectiveness of the Phase 1 clay cover completed as part of the Fire Suppression Plan for the North Ravine area documented in the "Subsurface Landfill Fire Monitoring Program, North Ravine, Campbell Mountain Landfill" (SHA, 2000). Gas monitoring well locations and the extents of the clay cap are presented on Figure 3.1.

Temperature readings were obtained by connecting a digital thermometer (Omega Model 866) to the thermistor terminal box. Temperature measurements at the gas monitoring wells recorded by RDOS personnel and historical data collected by others are summarized in Appendix F.

4.0 EVALUATION OF LANDFILL GAS PRODUCTION

The following section provides a discussion and overview of significant factors that effect LFG generation considering Site-specific conditions. The purpose of this section is to provide an assessment of LFG production to provide further information regarding the potential for LFG migration.

4.1 WASTE CHARACTERIZATION AND TONNAGE

The quantity of LFG generated by a unit mass of refuse is dependent upon the quality of the organic material present in the waste stream. Waste composition represents one of the most important factors affecting the rate of LFG generation.

The Site currently accepts residential, commercial, and light industrial waste from the City of Penticton and surrounding area. On-Site waste diversion activities and the City of Penticton's recycling program, CF, and LWF have been implemented to divert waste from the landfill. The local recycling program consists of the collection of household recyclables include corrugated cardboard, mixed paper, newspaper, milk jugs, tin cans and glass. The on-Site waste diversion program includes collection and storage areas for agricultural plastic, agricultural tree stumps, batteries, concrete, Freon units, gyproc, mattresses, metal, propane tanks, tires, white goods, wood, and yard/garden waste. Recycled wood waste is chipped and blended with soil for use as landfill cover material. Composted material (e.g. yard and garden waste) is used as interim cover on the landfill.

A summary of waste composition and tonnage received at the Site since 2003 is summarized in Table 4.1. The Site total refuse landfilled on an annual basis ranged from 34,400 to 38,000 tonnes based on available tonnage data. In 2007, a total of approximately 35,400 tonnes of refuse was landfilled. From Table 4.1, commercial waste comprises a majority of the waste landfilled.

Operational statistics from 2003 to 2007 are presented in Table 4.2 and show waste diversion/recycling efforts have increased from 15 to 24 percent over the four year period. The diversion of organic materials from the landfill to the CF and LWF will decrease the potential for LFG generation at the Site. It is also believed that historical landfill fires in the existing landfill on the northwest side, referred to as the North Ravine by SHA, may have significantly reduced the organic content of the refuse in that area.

4.2 WASTE GENERATION AND SITE LIFE

A lifespan analysis was completed previously by SHA (2001a) to provide projected population estimates and resultant tonnage data until landfill closure as per the existing development plan at that time, however subsequent revisions have been made by Golder in 2002 and 2006. A review of more recent information is provided below to revise the waste generation estimates and site life previously completed by others.

Project population figures reported by SHA were based on data from the BC Ministry of Finance and Corporate Relations. A growth rate of 1% to 1.8% per year was assumed from 2000 through to 2025 with a growth rate of 0.9 percent estimated to continue until closure. Table 4.3 presents a comparison of 2001 to 2006 Census published figures of population for the service area. An average population growth of 3 % occurs over the 5 year period, resulting in an average growth rate of 0.6 % per year for the entire area, indicating conservative population projections by SHA. Population projections from Population Exptrapolation for Organizational Planning with Less Error 32 (P.E.O.P.L.E. 32) produced by BC Stats, Ministry of Labour and Citizen's Services predict the region will likely continue to receive strong net inflows of people, particularly since it is a popular retirement centre with a maximum annual growth rate of 0.76% predicted for the regional district area. An estimated 1 percent annual growth rate was assumed to provide a conservative estimate for the revised waste generation and Site life.

It was assumed by SHA the historic waste disposal rate (pre-1990) was approximately 1.2 tonnes per person per year and the future waste disposal rate (post-1997) would be 0.88 tonnes per person per year. As presented in Table 4.2, the yearly tonnage landfilled at the Site has varied from approximately 34,400 to 38,300 tonnes since 2003 to 2007. The resultant waste generation rates based on a review of updated population statistics ranged from 0.83 to 0.92 tonnes per person per year. Therefore, the future waste disposal rate of 0.88 tonnes per person per year estimated by SHA (SHA, 2001a) is comparable with the four year average of 0.87 tonnes per person per year and deemed reasonable.

The most recent conceptual fill plan for further development of the Site by Golder (2006) consists of two phases as discussed in more detail in Section 6.1. Phase 1 and Phase 2 provide respectively for approximately 962,000 m^3 and 715,300 m^3 of available airspace, for a total of 1,677,300 m^3.

An updated lifespan analysis based on historic and future population forecasts, waste landfilled rates, conceptual total available airspace volume, waste density, and cover ratio is provided in Table 4.4. An apparent waste density of 600 kilograms (kg) per m^3

and a cover ratio of 6:1 was assumed based on professional judgement. It is CRA's understanding efforts have been made by the RDOS since 2002 to quantify cover material usage (borrow material weighed at the scale house) and estimate airspace volume consumption (annual aerial photos). This information should be incorporated into future annual operation and monitoring reports to provide Site-specific values of waste density and cover ratio.

From Table 4.4, based on the available information relative to waste densities and cover soil ratios, the lifespan of the Site is estimated to extend to 2020 with the completion of the revised Phase 1. Implementation of the revised Phase 2 could extend the life of the Site to 2032.

4.3 NORTHERN REFUSE LIMITS DELINEATION

As discussed in Section 3.1, the existing refuse limits along the northern portion of the landfill was estimated using a hand held GPS unit as shown on Figure 1.3. Along the northern portion of the Site, refuse placement has occurred in the North Ravine area and at a higher elevation to the east approximately parallel to the property boundary.

The existing North Ravine area is located in the northwest quadrant of the Site and is approximately 40 m wide and approximately 130 m long from the northern refuse limits to GM98-1. Using a topographic survey map generated from aerial photography completed in 1964, Golder interpreted the former ravine to be 50 m wide and extend from the northwest to the southeast through the central portion of the Site (Golder, March 2002). Based on stratigraphy log information and recent field data for the gas monitoring wells, refuse thickness is greater than 34 m at GM98-1 and decreases to approximately 17 m at GM98-3 suggesting the ravine bottom slopes in a southerly direction at a grade of approximately 18 percent (i.e., GM98-1 surface 606 m AMSL, refuse thickness 34 m, GM98-3 598 m, overburden thickness 17 m, distance 50 m, therefore ravine bottom gradient equals (34–8-17)/50). This gradient is significantly different compared to the approximately 5 percent grade estimated in the "Interim Report, Additional Tasks – Campbell Mountain Landfill" prepared by Golder in March 1995. The refuse limits in the North Ravine is approximately 15 m from the northern property boundary. Historical placement of refuse within the North Ravine area may increase the risk of LFG migration at the Site due to the steep gradient and confined conditions, however refuse placement in the North Ravine area has been discontinued since the mid 1990's due to the occurrences of historical subsurface fires. Thus, refuse age is greater than 15 years and the organic content has been reduced due to the historic occurrence of intermittent landfill fires.

Refuse to the east of the North Ravine area has been placed beyond the most recent preliminary design footprint limits (Golder, 2006) by 30 to 60 m but is still within landfill property boundary as shown in Figure 3.1. The shortest distance from the existing refuse limits to the northern property boundary is about 45 m, but is generally 60 m for a majority of the northern landfill footprint. Based on a comparison of 2004 and 2007 contours from aerial photography, refuse thickness is estimated to range from 5 m immediately outside of the preliminary design footprint and decrease in a northerly direction. The refuse thickness is estimated to be at least 10 m thick at TP12-08 and TP15-08 and 5 m thick at TP14-08. Based on existing information, the majority of the refuse on the northern half of the property has been placed on overburden material ranging from silty sand to glacial till up to 4 m thick. Refuse has also been placed where exposed bedrock has been identified by others (SHA, 2001a) as shown in Figure 3.1.

4.4 NORTH RAVINE COVER SYSTEM

Due to the occurrences of landfill fires in the North Ravine, a three-phase fire suppression plan was developed and involved the installation of a cover system in conjunction with shotcrete seals along the landfill edge in May 1998. The cover system consisted of topsoil and vegetation underlain by a clay layer and geogrid.

Low permeable covers such as clay soils inhibit infiltration of moisture into the landfill. This type of cover can result in a lower rate, and extended duration of LFG production. Low permeable covers can reduce fugitive emissions to the atmosphere by inhibiting venting. This may result in increased gas pressures within the portion of the landfill capped with clay which could lead to increased subsurface migration.

Stress crack development has historically occurred at the interface of the clay cover system and the geogrid as a result of differential stress caused by refuse settlement (SHA, 2003). Repairs are completed as cracks are identified as part of the landfill maintenance program.

4.5 REVISED LANDFILL GAS PRODUCTION ESTIMATE

The Scholl Canyon model, a first-order kinetic function, is the accepted industry standard model to evaluate LFG production and emission rates for the purpose of assessing potential LFG impacts.

The Scholl Canyon model is used to estimate LFG production over time as a function of the LFG generation constant (k), the methane generation potential (Lo), historic filling records, and future projections for waste filling rates. Typical values of k range from 0.006 per year for dry sites to 0.07 per year for wet sites. Depending upon the regional precipitation and waste composition, production of LFG may continue for more than 50 years after closure and can result in total yields ranging from approximately 10 to 350 m^3 of methane per tonne of waste.

The formula for the Scholl Canyon model can be expressed as follows:

$$Q_T = \sum_{t=1,n} 2L_o\, k\, M_t\, e^{-kt}$$

Where:

Q_T = total LFG emissions (50 percent methane and 50 percent CO_2 by volume)

k = LFG generation constant ($year^{-1}$)

L_o = refuse methane generation potential (m^3 CH_4/tonne of refuse)

M = mass of refuse (tonnes) placed in year t

t = time in years

4.5.1 MODEL INPUT PARAMETERS

The main input parameters include k, L_o, and the total annual refuse mass projections. LFG production calculations based on numerical models are estimates and, therefore, may vary from actual production rates. Due to the uncertainty, appropriate numerical modeling relies upon various standard parameters to define a range for LFG production.

As a preliminary estimate of LFG production potential, a k of 0.027 yr^{-1} was selected based on results from on-Site LFG pumping test and empirical data extrapolation completed by SHA (2001a).

A L_o of 136.5 m^3 per tonne of MSW was selected to represent a conservative methane production estimate. This value reflects the combined decomposition conditions within the landfill calculated by SHA (2001a). It is noted that there is a potential for reduced organic content in the refuse mass along the northern property boundary in the North Ravine area due to intermittent landfill fires.

Updated total annual refuse mass projections discussed in Section 4.2 were used in the model.

4.5.2 LANDFILL GAS PRODUCTION CALCULATIONS

Figure 4.1 presents the estimated LFG production rates for completion of Phase 1 and Phase 2. With the completion of Phase 1, the peak estimated rate of LFG production is approximately 480 cubic feet per minute (cfm), which will occur the year following closure in 2021. Approximately 125 cfm will continue to be produced 50 years after closure. If additional filling is provided with the Phase 2 design, the peak estimated rate of LFG will increase to approximately 600 cfm in 2039, with approximately 130 cfm being produced 50 years after closure.

Typically, LFG production under 100 cfm is considered relatively low for LFG collection purposes. Therefore, model results based on the current conceptual fill plan indicate there is a significant amount of LFG production potential at the Site during operation and after closure. However, based on the semi-arid environment of the Site, it is believed refuse at the Site will have a low moisture content and conditions will likely not develop such that field capacity is exceeded to create favourable conditions for accelerated LFG generation.

4.6 LANDFILL GAS MONITORING EVALUATION

As discussed in Section 1.3, gas monitoring wells were installed in the North Ravine in 1998. Locations are presented on Figure 1.3. Gas monitoring wells have been equipped with a series of temperature sensors connected at approximately 5 m intervals, as well as sampling ports to monitor LFG composition.

4.6.1 TEMPERATURE READINGS

Temperature profiles over time for each gas monitoring well are presented in Appendix F. It is noted that thermistor monitoring port Pt 4 at GM98-1 has failed, however sufficient data is available from the remaining points.

Temperature profiles provided in Appendix F generally show that temperatures continue to slowly decrease since 2003 due to the cover system installation in 1998. The most discernable decreasing temperature trends are noted at GM98-2, GM98-3, GM98-4 and GM98-7. Temperature measurements generally range from 20° to 50° C, which is typical for refuse undergoing a combination of aerobic and anaerobic decomposition. Temperature fluctuations were noted at Pt 1 GM98-2, likely due to it's location near the ground surface and in response to seasonal temperature fluctuations.

4.6.2 GAS CONCENTRATIONS

Historical gas concentration measurements summarized in the "Subsurface Landfill Fire Suppression and Monitoring" document (SHA) and more recent 2008 field data are presented in Table 4.5. Methane and carbon dioxide concentrations are typical for LFG. From Table 4.5, the methane concentration appears to be decreasing at GM98-4 based on a lower range measured in 2008. GM98-4 is the northern most gas monitoring well in the North Ravine area. Conversely, methane concentrations appear to be stable or slightly increasing at GM98-1, GM98-2, and GM98-6 which are located closest to the southern limits of the clay cover and to the northwest of the North Ravine Berm.

From Appendix E, monthly monitoring results show a decrease in methane concentrations and pressure readings at GM98-4 during the winter monitoring events (December, January and February), which is likely attributed to the age of the refuse in the area and decreased biological activity due to lower ambient temperatures discussed in Section 5.1. Lower methane concentrations differences occur at GM98-3, GM98-5, and GM98-7 during the winter months as compared to rest of the monitoring events. Methane concentrations do not appear to change significantly at GM98-1, GM98-2, and GM98-6 likely due to their location closer to existing fill areas.

4.6.3 PRESSURE READINGS

Pressure readings presented in Appendix E ranged from -1.5 to 2.2 inches of water column at GM98-5 but were generally less than 0.5 inches of water at the remaining gas monitoring wells based on existing field data, indicating minimal pressure build-up within the North Ravine. The highest pressures were measured at GM98-5 which is south of the North Ravine area and closer to the existing fill areas. One would expect a zone of high pressure relative to atmospheric conditions to develop as LFG accumulates within the refuse mass. Differential pressure would result in LFG movement from areas of high pressure to areas of low pressure by means of convection. Negative pressure readings at GM98-5 could be attributed to some air intrusion due to well construction.

The following factors have been identified to explain the minimal pressure build-up noted within the North Ravine area:

- Migration through cracks developed in the North Ravine cover system
- Migration through the adjacent subsurface soils/fractured rock
- Minimal generation of LFG due to historical landfill fires, lack of moisture, lack of organics, and/or impermeable soil cover placement

4.6.4 LEACHATE LEVELS

Field measurements presented in Appendix E, indicate a majority of the gas monitoring wells were dry or had very little leachate during the monthly monitoring events. However, it is noted that levels were collected from the shallow installation in the gas monitoring wells due to difficulties in accessing the deeper installation due to the thermistor cable set-up. The extent of refuse moisture is still unknown.

5.0 LANDFILL GAS MIGRATION ASSESSMENT

The purpose of this section is to present a review Site conditions pertaining to interfaces with potential migrational pathways and assess LFG migration along the northern property boundary based on field investigation activities.

5.1 CLIMATE

In general, the Site is situated in the rainshadow of the Coast and Cascade mountains and is one of the warmest and driest areas in BC. The Site is located in a semiarid environment, characterized by relatively low annual precipitation and high potential for evapotranspiration. Moisture from local precipitation is likely to accumulate in the refuse during the early spring when a combination of rain and snowmelt exceed the potential evapotranspiration (Golder, 2002). This section presents climate data specific to the monitoring period to determine how it relates to soil gas monitoring results.

Environment Canada climate data measured at the Penticton Airport, BC (Climate ID: 1126150) was used to review daily climate data during the monitoring period. The Penticton Airport climate station is located approximately 7.5 km southwest of the Site at an elevation of 344 m AMSL.

Daily readings for average temperature, rainfall, and snowfall as recorded at the Penticton Airport for the monitoring period are presented on Figure 5.1. From Figure 5.1, average temperature readings increase from approximately 10°C to 25°C in May and August 2008 respectively and then start to decrease in the fall season. Temperatures were below 0°C for a majority of the second half of December, with temperatures as low as -17°C. Temperatures began to increase in mid March and reached 10°C near the end of April 2009.

A total of 365 mm of precipitation has fallen during the monitoring period (May 2008 to April 2009), which is below the yearly normal of 332 mm. The first snowfall event occurred on November 28, 2008. It is noted that snowfall occurred for several consecutive days after a decrease in temperature in mid December.

The climatic data confirms low annual precipitation levels that will result in a lower rate of LFG generation and frozen surface soil conditions typically less than three (3) months per year.

5.2 NORTHERN PROPERTY GEOLOGICAL SETTING

5.2.1 BEDROCK

Based on geological information available from the Geological Survey of Canada Maps, the bedrock underlying the Site consists predominantly of layered gneiss together with local zone of less-metamorphosed sedimentary bedrock belonging to the Monashee Group within the Shuswap terrain. The bedrock generally dips in a south and westerly direction with a bedrock trough identified along the western limits of the landfill (Golder, 1994).

Exposed bedrock locations presented on Figure 3.1 were identified by CRA personnel as discussed in Section 3.6. The ravine area north of the property limits contains fragmented bedrock/boulders with vegetation bounded by 30 to 40 m sided bedrock slopes that are steep and heavily fractured. The ravine area widens further to the north with less boulders and more overburden deposits with occasional built up areas to provide a pathway for crossing.

To the east of the ravine area, an undulating bedrock surface is apparent based on several outcrops noted in between overburden deposit areas. The tops of the bedrock outcrops identified in Figure 3.1 are generally rounded and lightly fractured. A geologic cross section parallel to the northern property line is presented in Figure 5.2 to illustrate the steep gradients, areas of bedrock outcrops, and overburden deposits described above.

5.2.2 OVERBURDEN DEPOSIT

The Site is situated within kame/outwash terraces and/or meltwater channel deposits with shallow bedrock subcrops and exposed bedrock outcrops. The overburden deposit at the Site has been previously characterized by Golder (March 2002) as a loose upper granular deposit of medium to fine sand and well graded sand and gravel with a varying cobble content. In the general area near TP5-08, TP7-08, TP8-08, TP10-08, and TP11-08 a fine grained, poorly graded sand and silt layer was encountered for approximately the first metre below ground surface. Grain size analysis results presented in Table 3.2 indicate a silt content of approximately 50 percent.

This upper unit is generally underlain by a more dense lower granular deposit consisting of well graded gravelly sand with some silt grading to a silt/sand/gravel (glacial till). The lower unit was generally found overlying fractured to competent bedrock.

It was inferred from a shallow seismic refraction survey that the overburden along the northern portion of the Site and east of the North Ravine varies between 2.0 to 4.4 m (Golder, 1994). The overburden thickness generally increases from Strutt Creek ravine to the east along the Site northern boundary within the bedrock depressions from 2.44 m (GP15), to 3.51 m (GP18), to 9.1 m (GP-1). The overburden thickness increases in a northerly direction from 3.05 to 3.51 m along the bedrock depression where GP17 and GP18 are located.

Based on stratigraphy data for BH-106 and GM98-3, located within the North Ravine area, refuse overlies a thin layer approximately 1 to 2 m thick of dense silty, sandy gravel followed by bedrock described as soft to hard with a fractured surface.

5.2.3 PERMEABILITY

Permeability has a significant impact on LFG migration due to a liquid or gases propensity to move via the "path of least resistance". Permeability is a function only of the medium. Refuse and geologic strata both contain void spaces within their matrices (porosity). These voids are generally interconnected and, hence provide a corridor for LFG to travel. Medium to coarse-grained soils or fractured rock tend to act as preferential pathways for migration of LFG, while fine grained or cohesive soils tend to impede the movement of LFG. Site-specific values of permeability associated with the on-Site geologic units based on previous investigation is as follows with expected valued provided in parenthesis (Freeze and Cherry, 1979):

- Silty sand – 9×10^{-8} cm^2 (SHA, 2001a) (1×10^{-6} to 1×10^{-10} cm^2)
- Glacial till - BH2000-4 1×10^{-10} cm^2 (SHA, 2001b) (1×10^{-9} to 1×10^{-15} cm^2)
- Fractured bedrock – BH102 1.1×10^{-6} cm^2 (Golder, 1994) (10^{-6} to 1×10^{-11} cm^2)

As discussed in Section 4.3, the majority of the refuse on the northern half of the property has been placed on overburden material ranging from silty sand to glacial till based on existing information. Refuse has also been placed over a small area where exposed bedrock has been identified by others (SHA, 2001a) as shown in Figure 3.1. Based on the above, downward vertical LFG migration may be restricted by the glacial till unit and most definitely by the water table at the overburden/bedrock interface. Where the refuse is in contact with bedrock, LFG migration is most susceptible via the unsaturated fractured bedrock unit pathway in between the glacial till and water table. Glacial till has a lower permeability range, thus could potentially act as a semi-confining to confining layer which would constrain upward vertical movement and promote lateral LFG migration. During the winters, ice layers or snow cover that could potentially remain on the ground for up to 120 days (SHA, 2001a), would increase the potential for LFG migration in the subsurface.

5.3 HYDROGEOLOGY

LFG migration potential is precluded by saturated soils which act as a barrier to gas migration through voids in the soil matrix. As a result, in areas which exhibit significant seasonal variation in the elevation of the groundwater table, LFG migration potential may also vary.

Groundwater at the Site is typically encountered within the upper 1 to 2 m of the bedrock surface suggesting flow occurs primarily in the upper fractured/weathered bedrock zone and in the unconsolidated materials above (Golder, 1994). Water level data summarized in Table 5.1 for groundwater monitoring wells BH104, BH105, BH2000-3, and BH2000-4 along with GP1-3 were used to evaluate the hydrogeology within the northern half of the property boundary. From Table 5.1, groundwater is typically encountered in the northern half of the Site at approximately 5 (BH105) to 20 (BH2000-4) m bgs in the bedrock or overburden/bedrock interface unit. Seasonal variation in groundwater levels varies from 0.06 m at BH104 to 1.60 m at BH105. The vadose zone thickness in the North Ravine area is approximately 10.5 m based on water level measurements at BH104. To the east of the ravine along the northern property boundary, the vadose zone varies from approximately 4 to 8 m based on the test pit logs and water level measurements at GP1-3.

The groundwater elevation along the northern property line varies from approximately 575 m AMSL at BH104 to 626 m AMSL at GP1-3 with a general groundwater flow direction to the southwest.

Site hydraulic conductivity testing results ranged from 9×10^{-8} to 1.1×10^{-4} cm/s for wells screened within the bedrock unit (Golder, 1994), indicating variable bedrock conditions ranging from competent to fractured. Hydraulic conductivity testing for BH104 was 1.1×10^{-4} cm/s, indicating a fractured bedrock formation. Hydraulic conductivity testing at BH 103, screened along the soil/bedrock interface, was 7×10^{-5} cm/s. No testing was completed on abandoned BH106.

5.4 EVALUATION OF SOIL GAS MONITORING RESULTS

An evaluation of soil gas monitoring results was conducted considering regulatory standards, climatic conditions, and site-specific monitoring results. Soil gas monitoring results are summarized in Table 5.2.

5.4.1 TRIGGER LEVELS

The LEL for combustible gas concentrations is five (5) percent (%) by volume (v/v). Methane monitoring results measured at the gas probes were compared to 25% of the LEL (i.e., 1.25 % v/v) for assessment purposes. Methane concentrations in excess of 25% of the LEL are considered to indicate potential LFG impacts. This trigger level is above that of the Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills (MOE, 1993) (100 percent of the LEL), resulting in a conservative estimate of the required northern LFG setback.

5.4.2 SOIL GAS CONCENTRATIONS

As shown in Table 5.2, methane was detected at only one soil gas probe location. Preliminary results show methane concentrations ranged from approximately 20 to 50 %v/v at GP17 for both gas probes. Methane concentrations at GP17 exceed the trigger level of 25% LEL likely attributed to its' location approximately 5 m from the toe of the northern refuse limits. Methane was not detected at the remaining soil gas probe locations located 7 to 60 m from the limit of refuse, indicating LFG is not readily migrating to the northern Site limits and likely venting into the atmosphere.

From Appendix E, monthly monitoring results show methane concentrations increasing at GP17-1(S) and GP17-2(D) during the winter monitoring months likely attributed to frozen surface conditions that prevent venting of LFG to the atmosphere and promote lateral movement. At GP14, carbon dioxide concentrations decreased, particularly at GP14-3(D) where concentrations decreased from 16% v/v to 8% v/v in September to March respectively. LFG migration does not appear to occur at GP14 from the refuse in the North Ravine area likely attributed to refuse age and the lack of LFG generation.

5.4.3 PRESSURE READINGS

Pressure readings summarized in Table 5.2 ranged from -0.06 to 0.05 inches of water column based on existing field data, indicating minimal LFG pressure build-up.

6.0 FUTURE DEVELOPMENT

6.1 LANDFILL DEVELOPMENT PLANS

The configuration of the Site may be significant when assessing the potential for LFG related impacts. Sites which are predominantly above-ground may have increased potential for fugitive air emissions while sites located predominantly below ground may have a greater potential for impacts associated with subsurface gas migration. The existing and proposed volume of material within the Site as well as the time of placement are used to accurately estimate the LFG production rate at the Site.

It is understood the Site was formerly used for gravel extraction prior to landfill operations commencing at the Site in 1972. It is reported that both solid and liquid wastes were placed centrally within the Site followed by filling of the former ravine area from 1975 until the mid 1980's. The LWF was constructed at the Site in the mid 1980s, and liquid waste disposal to the landfill ceased at that time. Operational management of the landfill has been provided in the "Campbell Mountain Landfill Operations Filling/Closure Plan" (OFC Plan) (SHA, 1997) with subsequent revisions made by Golder.

An Operations/Filling/Closure (OFC) Plan was developed for the Site in 1997. The OFC Plan was modified by Golder with changes that included the phased filling plan, extraction of borrow resources, relocation of Spiller Road and the CF (2002). Alternative closure options were provided following further investigation of borrow material resources at the toe of the southwest face (Golder, 2005). As discussed in Section 4.2, a conceptual filling plan for the Site has been outlined by Golder (June, 2006) identifying two filling phases with no additional refuse placement in the North Ravine area. Conceptual plans were based on August 2005 aerial photography and include filling to an elevation of 645 m AMSL with 3H:1V side slopes. The revised Phase 1 includes filling to an elevation of 645 m AMSL to provide 962,000 m^3 of airspace capacity. A revised Phase 2 has also been identified, however completion will depend on the availability and economics of acquiring borrow resources. The revised Phase 2 can provide an additional 715,300 m^3 of airspace, for a cumulative airspace availability of 1,677,300 m^3. The proposed final footprint is presented in Figure 1.2.

Future landfill development is predominantly planned above-ground with no potential filling of former soil borrow areas. It is CRA's understanding that final contours and detailed filling plans have not been finalized for the Site. The report "Interim Filling Plan" (Golder, February 2, 2009) and subsequent letter Re: Interim Filling Plan (Golder, February 9, 2009) was prepared to provide an interim filling plan for Phase I development. Details regarding an interceptor drain, borrow cover, final slope configuration requirements, surface run-off/on water control, and progressive closure were provided. The preferred interim Phase I filling concept as well as interceptor drain details are provided in Appendix G. Based on CRA's review of the preferred Phase I interim filling plan the following points were noted:

- The preferred interim Phase I filling plan concept is limited to the northern half of the Site. As a result landfill development along the northern half of the Site will reach final grade and steady-state conditions prior to the completion of Phase I. This will provide additional field information to confirm the adequacy of the northern LFG setback sooner than later.
- An interceptor drain is recommended by Golder to intercept groundwater and reduce the potential for leachate generation. The preliminary concept of the interceptor drain is shown in Appendix G. An ancillory benefit of constructing the interceptor drain will be passive venting of any LFG potentially migrating to the north towards the interceptor drain.
- Progressive closure consisting of an evaporative cover is proposed as the north and east slopes reach final grade. Installation of an evaporative cover system will minimize the build up of gas pressures within the Site and reduce the potential for subsurface migration.
- Future refuse placement along the northern half of the Site will be within the footprint limits proposed in the conceptual Golder fill plan dated June 9, 2009 and is at least 100 m from the northern property boundary.

6.1.2 FINAL COVER

It is understood, a progressive closure using an evaporative cover has been proposed by Golder (March 2002) due to the semi-arid environment and an understanding that active LFG collection will not be required at the Site. The aforementioned cover tends to promote infiltration of precipitation, however this is anticipated to be minimal based on climatic conditions at the Site. In addition, permeable covers tend to allow more rapid venting of LFG to the atmosphere. This may result in lower gas pressures within the Site and consequently reduce the potential for subsurface migration.

6.1.3 FINAL LANDFILL DESIGN

Finalization of development and closure plans for the landfill are pending further discussion with main stakeholders including the RDOS, City of Penticton, and the MOE. Land use plans for the City of Penticton include areas of residential development adjacent to the Site, thus plans for the long-term operation of a landfill in this location may be subject to change. In addition, the recently promulgated LFG Regulation discussed in Section 1.4.1 would subject the Site to a LFG assessment. If this assessment is required and it is subsequently determined that methane is generated in excess of regulatory limits, a LFG collection and control system may be required resulting in the use of an impermeable final cover in lieu of the currently proposed evaporative cover. Development of a LFG collection and control system would mitigate concerns over the potential for LFG migration off-Site as well as the need for additional infrastructure and land purchase to manage any LFG migration.

6.2 PROPOSED RESIDENTIAL DEVELOPMENT

As discussed in Section 1.3, the Spiller Block area of concern is located north of the landfill with a total area of 350 acres as shown in Figure 1.3. Preliminary projections of 875 residential units have been estimated at the sector planning stage level. Approximately 150 acres are developable lands due to the challenging topography and presence of the Strutt Creek ravine. As shown on Figure 6.1, major slope areas (i.e., greater than 30 percent) will not be developed to maintain visual and habitat values and to reduce hazards.

Civil works related to the residential development adjacent to the landfill may impact migration potential. Paved areas provide a barrier to venting LFG. This causes sub-surface gas pressures to build-up and increases the potential for lateral migration of LFG. Furthermore, utility corridors, backfilled with porous pipe bedding material, may provide a conduit for migration. Granular bedding materials and pipelines in underground service corridors may also provide preferential pathways for LFG migration.

6.2.1 ROAD NETWORK

The road network concept plan for the Spiller Block is presented in Figure 6.2. Generally, the roads occupy some of the flatter lands or cut across hillsides to meet grade requirements. The undulating topography of the Spiller Block may result in a road system which involves considerable cuts and fills, including rock removal. Proposed road networks are greater than 50 m north of the Site property.

6.2.2 UTILITY CORRIDORS

The NES Plan includes an extension of the gravity sewers from the existing City sanitary sewer system to the proposed Spiller Road development block as shown in Figure 6.3. Two sewer alignments were identified to service the development with eventual discharge to a new sewer at point C and point E along Naramata Road. Therefore, utility corridors could be located to the west and east of the Site. Stormwater sewers were not detailed in the NES Plan.

Upgrades to the City's current water system will be required to service the Spiller Block. The preliminary servicing strategy includes two options that require pumping water uphill into several narrow pressure zones which extend along the hillside to a storage tank followed by distribution. Option A includes a watermain along the eastern side of Spiller Road as shown in Figure 6.3 which would be approximately 65 to 70 m from the final limit of refuse based on either Phase 1 or Phase 2 development scenarios.

7.0 CONCLUSIONS

The following conclusions are summarized based on the finding of this report:

- The northern property is characterized by steeply sloping and heavily fractured bedrock outcrops reported to be layered gneiss along the Strutt Creek ravine with gently undulating bedrock with rounded and lightly fractured surfaces to the east along the northern property boundary.
- Refuse in the North Ravine area overlies a dense silty, sandy, gravel layer approximately 1 to 2 m thick, followed by bedrock described as soft to hard with a variable fractured surface.
- The overburden unit along the northern portion of the Site and east of the North Ravine area varies between 2.2 m (TP13-08) to 9.1 m (GP1) and bedrock outcrops were observed to be rounded and lightly fractured.
- Groundwater was present along the northern property boundary occurring primarily in the upper fractured/weathered bedrock and overlying unconsolidated material. The depth to the water table varied from approximately 9 m bgs (GP1-3) to 11.5 (BH104) with a general groundwater flow direction to the southwest.
- Based on stratigraphy log information, refuse thickness is greater than 34 m at GM98-1 and decreases to approximately 17 m at GM98-3. The refuse limits in the North Ravine is approximately 15 m from the northern property boundary.
- Refuse to the east of the North Ravine area has been placed beyond the most recent preliminary design footprint limits (Golder, 2006) by 30 to 60 m but is still within the landfill property boundary. The shortest distance from the existing refuse limits to the northern property boundary is about 45 m, but is generally 60 m for a majority of the northern landfill footprint.
- The most recent conceptual fill plan for further development of the Site by Golder (2006) consists of two phases. Phase 1 and Phase 2 provide respectively for approximately 962,000 m^3 and 715,300 m^3 of available airspace, for a total of 1,677,300 m^3. An interim fill plan (February 2, 2009) has been developed to address landfilling along the northern half of the Site.
- Based on revised calculations, the peak estimated rate of LFG production is approximately 480 cfm with completion of Phase 1 in 2020. If additional filling is provided with the Phase 2 design, peak LFG production will increase to 600 cfm in 2039.

- Pressure reading at LFG monitoring locations within the refuse limits in the North Ravine were generally less than 0.5 inches of water column, indicating minimal pressure build-up.
- Methane concentrations exceeded 25% of the LEL at one location (GP17) over the one year monitoring period. GP17 is within approximately 5 m from the limit of refuse and approximately 50 m from the property line. No methane was present at gas probes located adjacent to the northern property line (GP14-1, GP14-2, GP14-3, GP15-1, GP18-1, and GP18-2).
- Pressure readings were less than 0.05 inches of water column at all gas probe locations.

8.0 RECOMMENDATIONS

8.1 NORTHERN LANDFILL GAS SETBACK RECOMMENDATION

A northern LFG setback from the existing refuse limits as shown on Figure 8.1 is recommended with the following rational based on existing information:

- No methane was present at gas probes located adjacent to the northern property line (GP14-1, GP14-2, GP14-3, GP15-1, GP18-1, and GP18-2).
- Pressure readings were less than 0.05 ″ of water column at all gas probe locations.
- It is anticipated that LFG migration through the fractured bedrock unit in the North Ravine area will be limited since refuse overlies a dense glacial till unit and the water table is found near the overburden/bedrock interface. The Strutt Creek ravine area north of the property limits is bounded by 30 to 40 m sided bedrock slopes that are heavily fractured, however LFG migration is believed to be limited due to the steep gradient.
- To the east of the ravine area, a majority of refuse has been placed on overburden material ranging from a silty sand to glacial till up to 4 m thick. Where the refuse is in contact with bedrock, LFG migration is most susceptible via the unsaturated fractured bedrock unit pathway in between the glacial till and water table. It is anticipated LFG migration will be limited in this area due to the undulating bedrock surface, which has rounded and lightly fractured outcrops features, that are expected to act as natural barriers that will prevent lateral migration due to the lack of penetrating features.
- Methane concentrations appear to be decreasing at GM98-4 based on a lower range measured in 2008. GM98-4 is the northern most gas monitoring well in the North Ravine area.
- Refuse placement in the North Ravine area has been discontinued since the mid 1990's. Refuse age is greater than 15 years and the organic content has been reduced due to the historic occurrence of intermittent landfill fires, limiting LFG generation and potential off-Site LFG migration.
- Based on the semi-arid environment of the Site, the refuse at the Site will have a low moisture content and as a result the rate of LFG generation will be low.
- All future landfilling near the northern half of the Site will be completed in accordance with the preferred interim Phase I filling plan (Golder, February 2, 2009) and all future refuse placement being above ground.

- It is understood a progressive closure using an evaporative cover has been proposed by Golder (March 2002) due to the semi-arid environment and an understanding that active LFG collection will not be required at the Site. This will result in more rapid venting of LFG to the atmosphere and lower gas pressures within the Site, consequently reducing the potential for subsurface migration. The LFG setback could be reduced if a low permeability cover is required to facilitate LFG collection at the Site. Installation of an active LFG collection and disposal system would reduce the potential for LFG migration given that the system is properly designed, installed, operated, and monitored.

The recommended northern LFG setback provides sufficient buffer to allow safe development of the residential sub-division to the north of the Site with respect to impacts from the subsurface migration of landfill gas.

8.2 FUTURE ACTIONS

The following actions are recommended based on the findings of this report to support the recommended northern LFG setback as defined above:

- Continue visual inspection of the clay cover in the North Ravine during the fall/winter to assess the integrity of the cover and identify any potential areas where LFG is venting which may result in lack of pressure build-up.
- Continue monthly LFG monitoring to evaluate seasonal trends. The monitoring frequency can be reduced once sufficient data has been collected to identify key monitoring periods.
- Establish baseline on-Site vegetative conditions along the northern property limits for future comparison purposes.
- As refuse thickness increases over time, the upward migration of LFG gases will become progressively restricted by the overlying compacted refuse, thus development of a LFG monitoring program and contingency plan will be required.

The appropriateness of the recommended northern LFG setback can be monitored and evaluated based on the results of these additional actions. The LFG setback will be used in determining the final northern buffer area in addition with other buffer constraints.

All of Which is Respectfully Submitted,
CONESTOGA-ROVERS & ASSOCIATES

Zidra Ferreira, E.I.T.

Gregory D. Ferraro, P. Eng.

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FIGURES

SOURCE: B.C. INTERIOR CITIES STREET MAP
MAPART PUBLISHING

figure 1.1

SITE LOCATION MAP
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUNTAIN LANDFILL
Regional District of Okanagan-Similkameen

33765-21(016)GN-VA003 JUN 23/2008

LEGEND

EXISTING FENCE

PROPERTY BOUNDARY

EXISTING LIMIT OF REFUSE

PROPOSED BORROW LIMITS

PLANNED FINAL FUTURE DEVELOPMENT FOOTPRINT (GOLDER ASSOCIATES, JUNE 9, 2006)

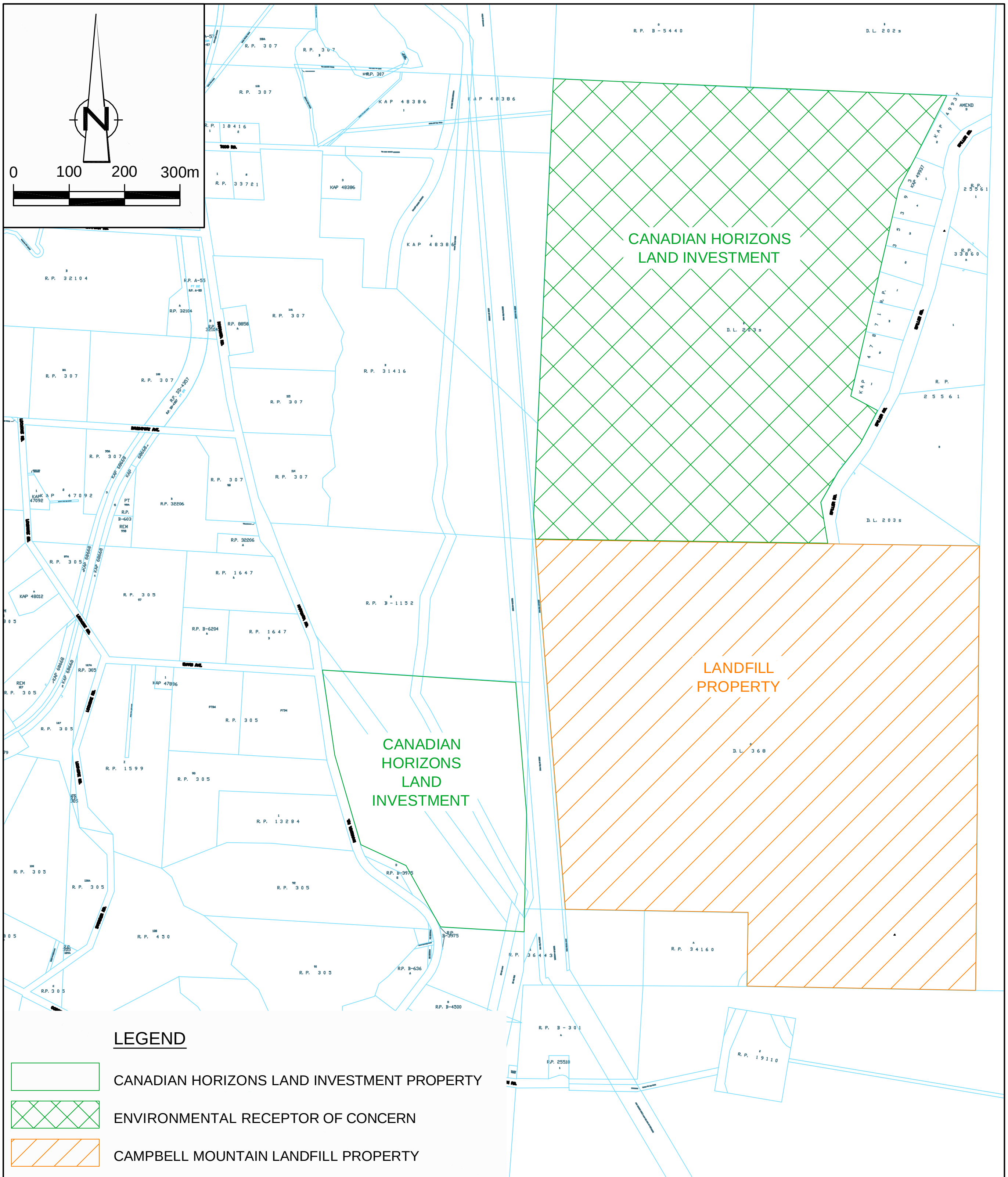
PROPOSED PHASE 1 DEVELOPMENT LIMITS

PROPOSED PHASE 2 DEVELOPMENT LIMITS

figure 1.2

SITE PLAN
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUNTAIN LANDFILL
Regional District of Okanagan-Similkameen

33765-21(016)GN-VA001 JUN 23/2008



LEGEND

CANADIAN HORIZONS LAND INVESTMENT PROPERTY

ENVIRONMENTAL RECEPTOR OF CONCERN

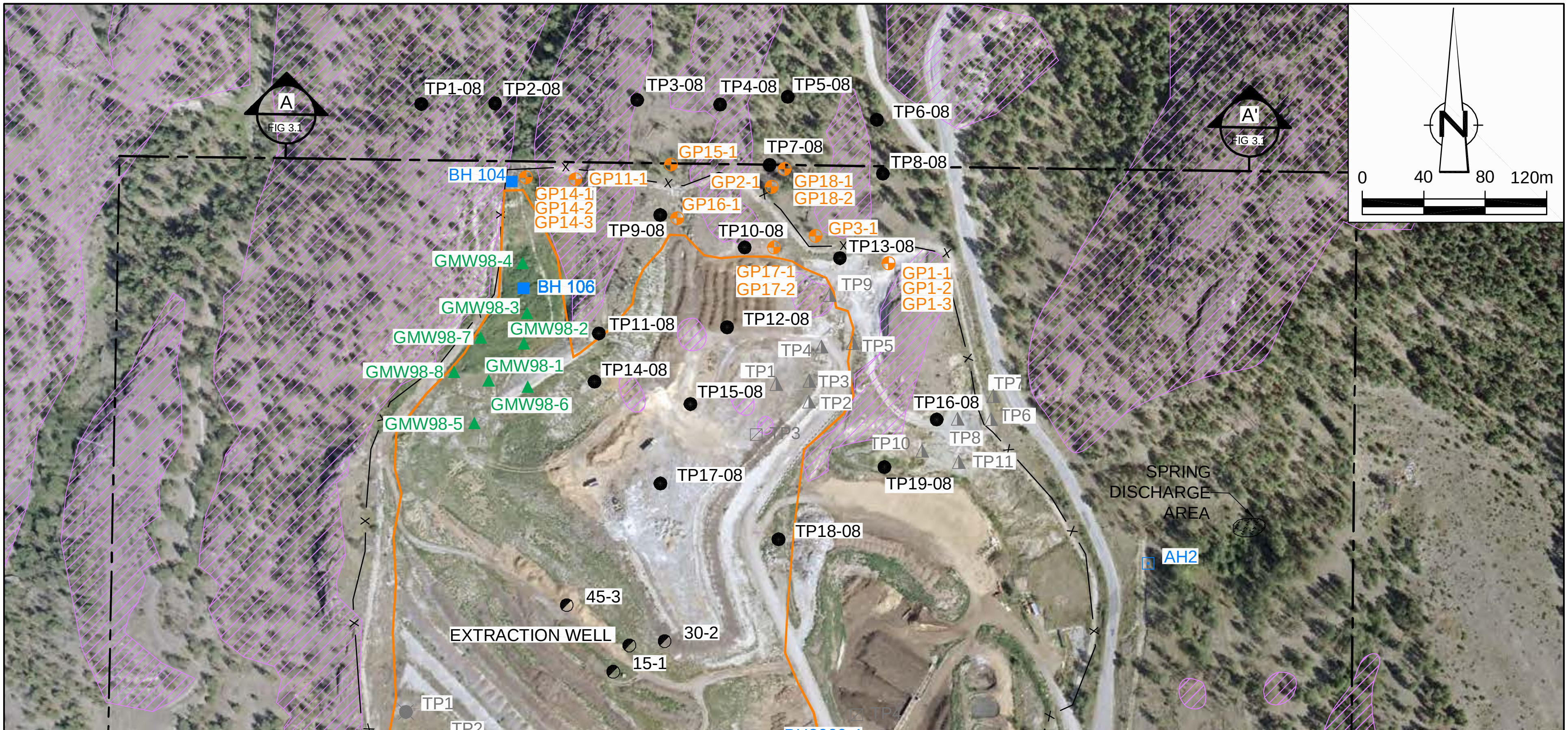
CAMPBELL MOUNTAIN LANDFILL PROPERTY

SOURCE: CADASTRAL MAP
URBAN SYSTEMS

figure 1.3

SPILLER BLOCK DEVELOPMENT CONCEPT
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUNTAIN LANDFILL
Regional District of Okanagan-Similkameen

33765-21(016)GN-VA007 JUN 24/2008



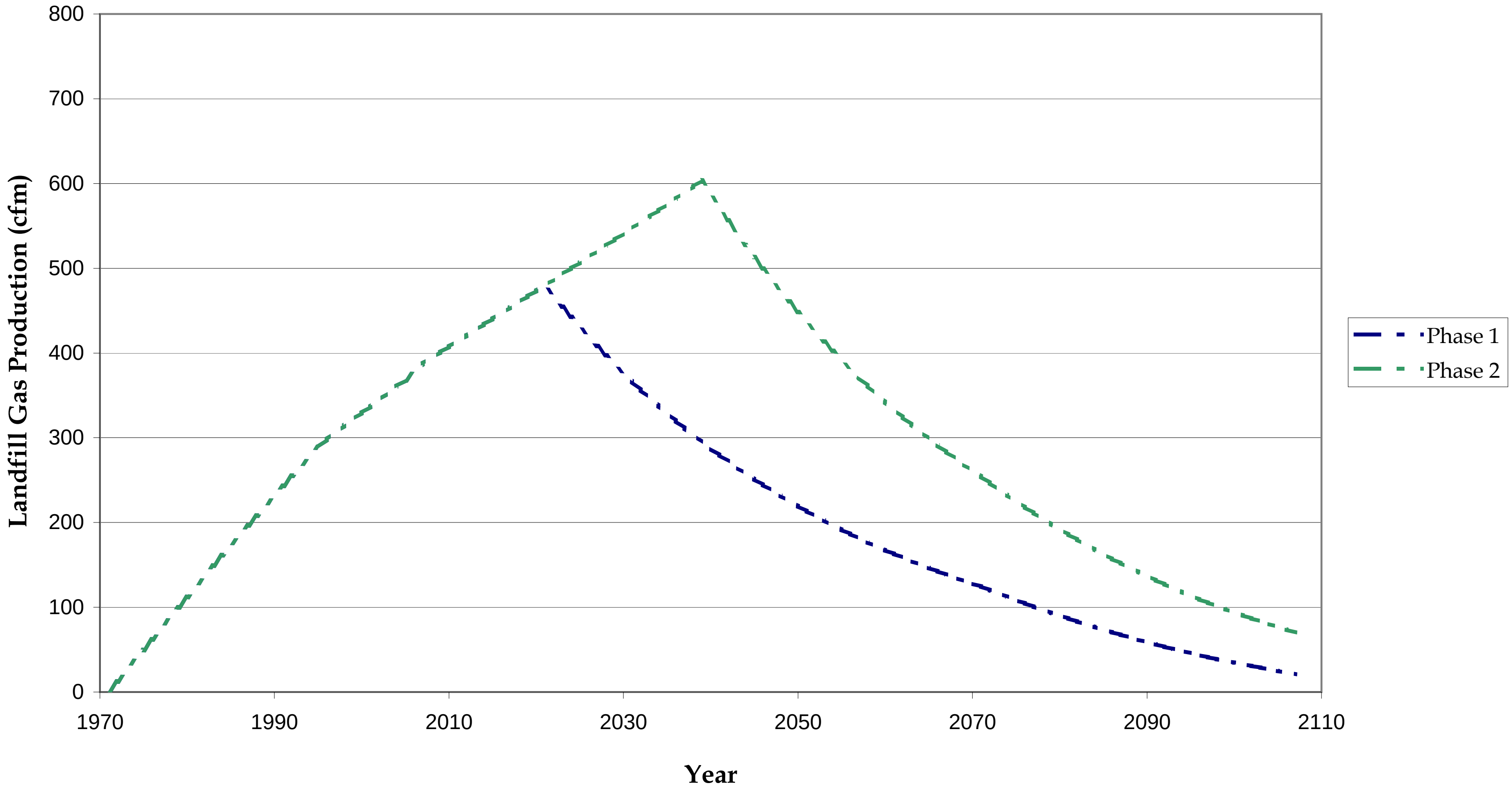
LEGEND

TP17-08	TEST PIT LOCATION (CRA, 2008)
BH 103	EXISTING GROUNDWATER MONITORING WELL LOCATION (GOLDER ASSOCIATES, 1994) (SPERLING HANSEN, 2001)
GMW98-4	EXISTING LANDFILL GAS MONITORING WELL LOCATION (SPERLING HANSEN, 2001)
BH103	BOREHOLE/AUGER HOLE LOCATION (GOLDER ASSOCIATES, 1994)
GP 8-1	EXISTING GAS PROBE LOCATION (SPERLING HANSEN, 2001)
TP2	EXISTING TEST PIT LOCATION (GOLDER, 2004)
15-1	PUMPING TEST SYSTEM INSTALLATION (SPERLING HANSEN, 2001)
TP17	EXISTING TEST PIT LOCATION (GOLDER, 2005)
	EXISTING LIMIT OF REFUSE
x	EXISTING FENCE
	PROPERTY BOUNDARY
	BEDROCK OUTCROP LOCATION

figure 3.1

FIELD INVESTIGATION PLAN
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUNTAIN LANDFILL
Regional District of Okanagan-Similkameen

33765-21(016)GN-VA004 FEB 10/2009

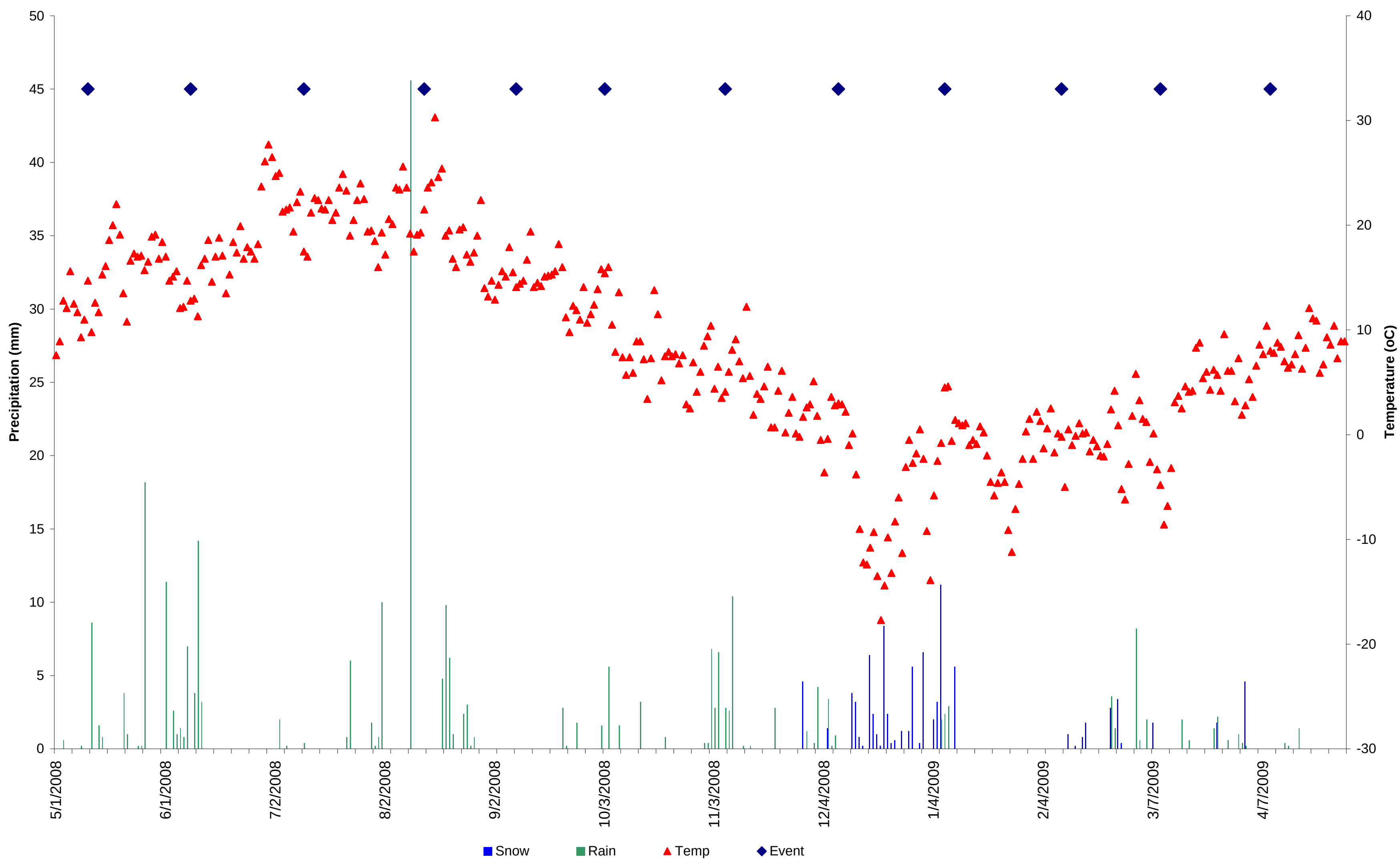


Notes:

$k=0.027\ yr^{-1}$, $Lo=136.5\ m^3/tonne$

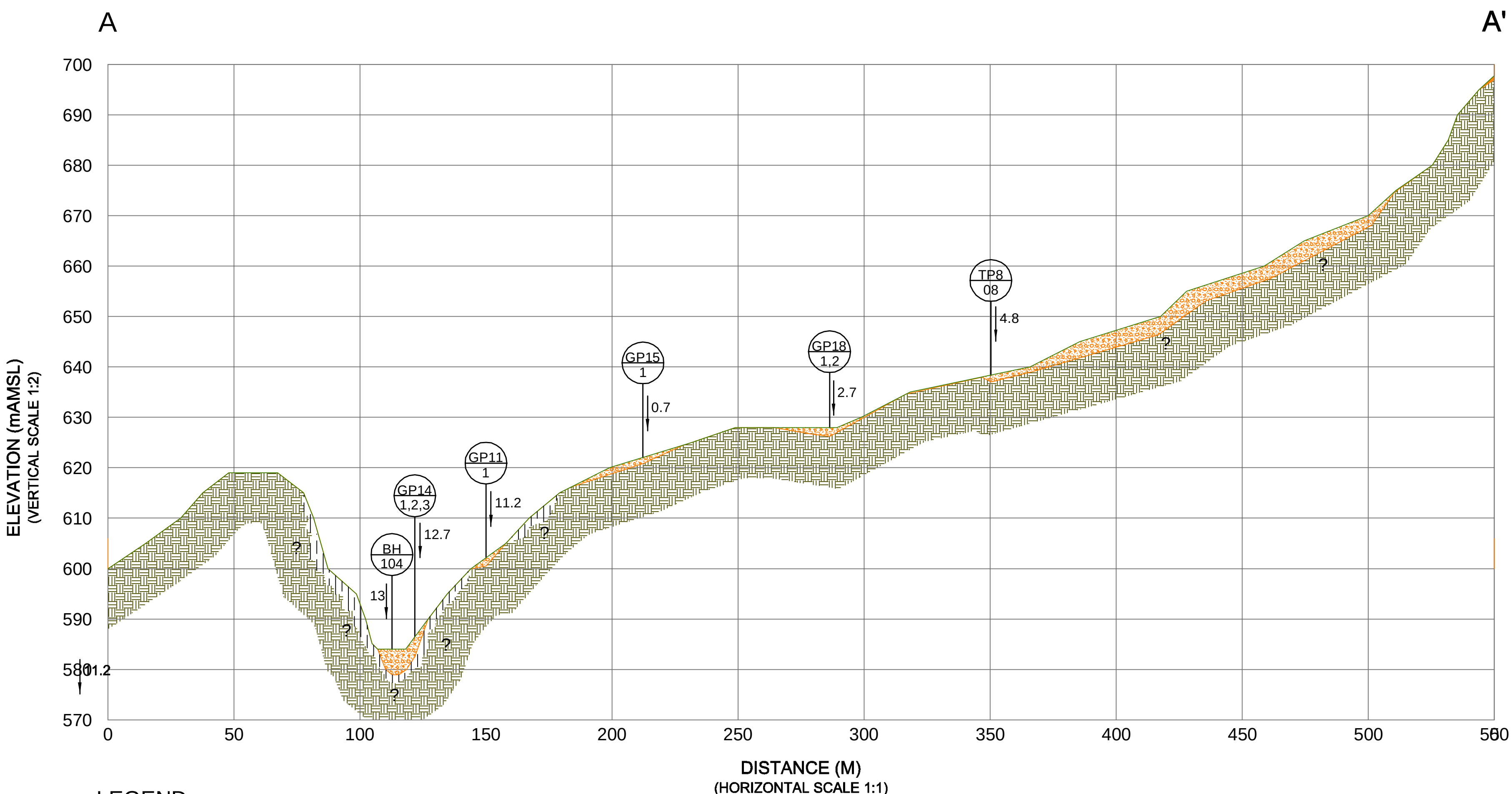
figure 4.1

REVISED LANDFILL GAS PRODUCTION ESTIMATE
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUNTAIN LANDFILL
Regional District of Okanagan-Similkameen



Notes:
(1) Source: Environment Canada: Penticton A (Climate Station No. - 1126150)

figure 5.1
DAILY CLIMATE SUMMARY
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUNTAIN LANDFILL
Regional District of Okanagan-Similkameen



LEGEND

TP8 08 4.8

TP-TEST PIT
BH-BOREHOLE
GP-GAS PROBE
4.8 m TO THE SOUTH OF THE CROSS-SECTION

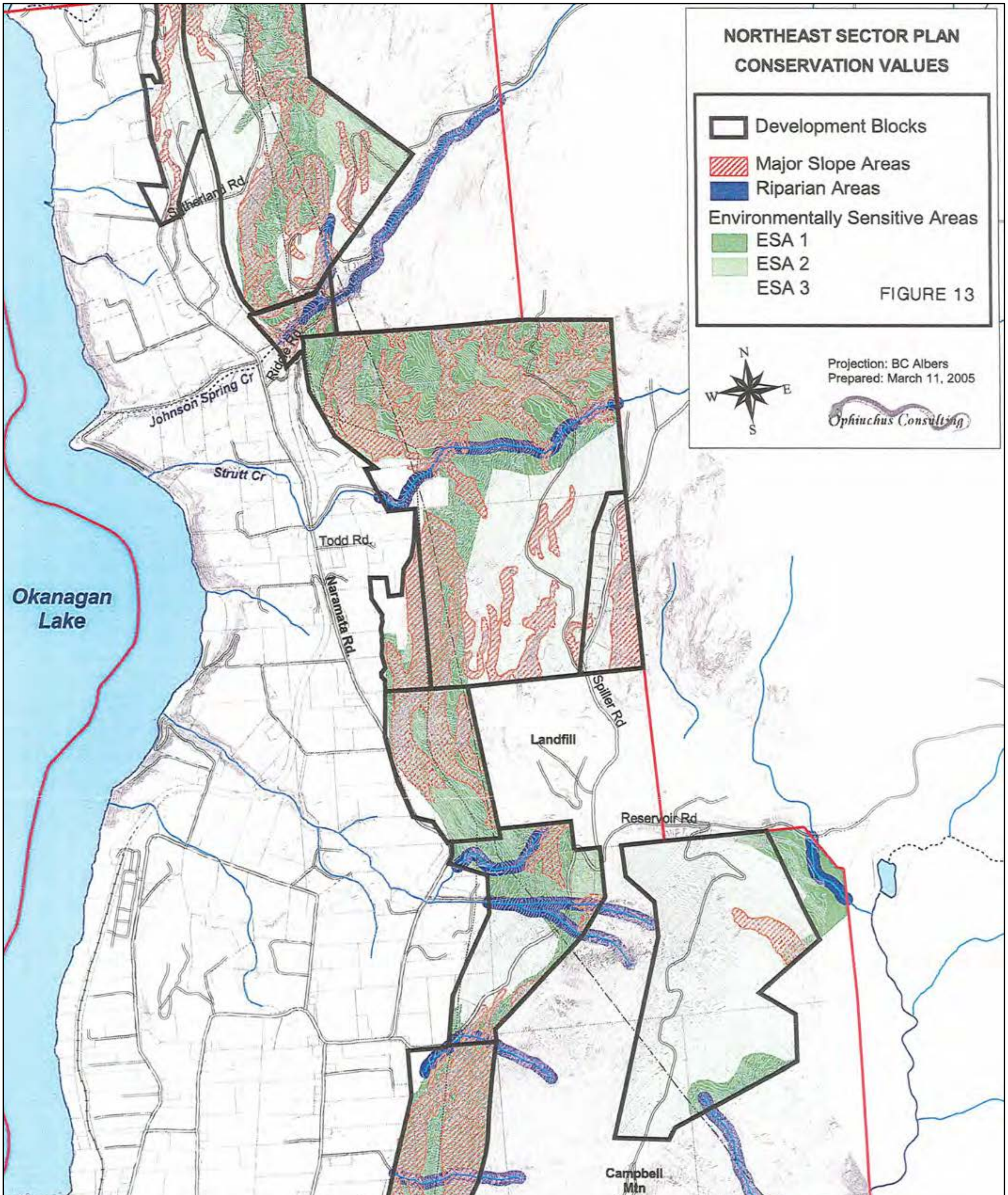
OVERBURDEN

BEDROCK

figure 5.2

NORTHERN PROPERTY BOUNDARY - GEOLOGICAL CROSS SECTION
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUNTAIN LANDFILL
Regional District of Okanagan-Similkameen

33765-21(016)GN-VA004 FEB 10/2009

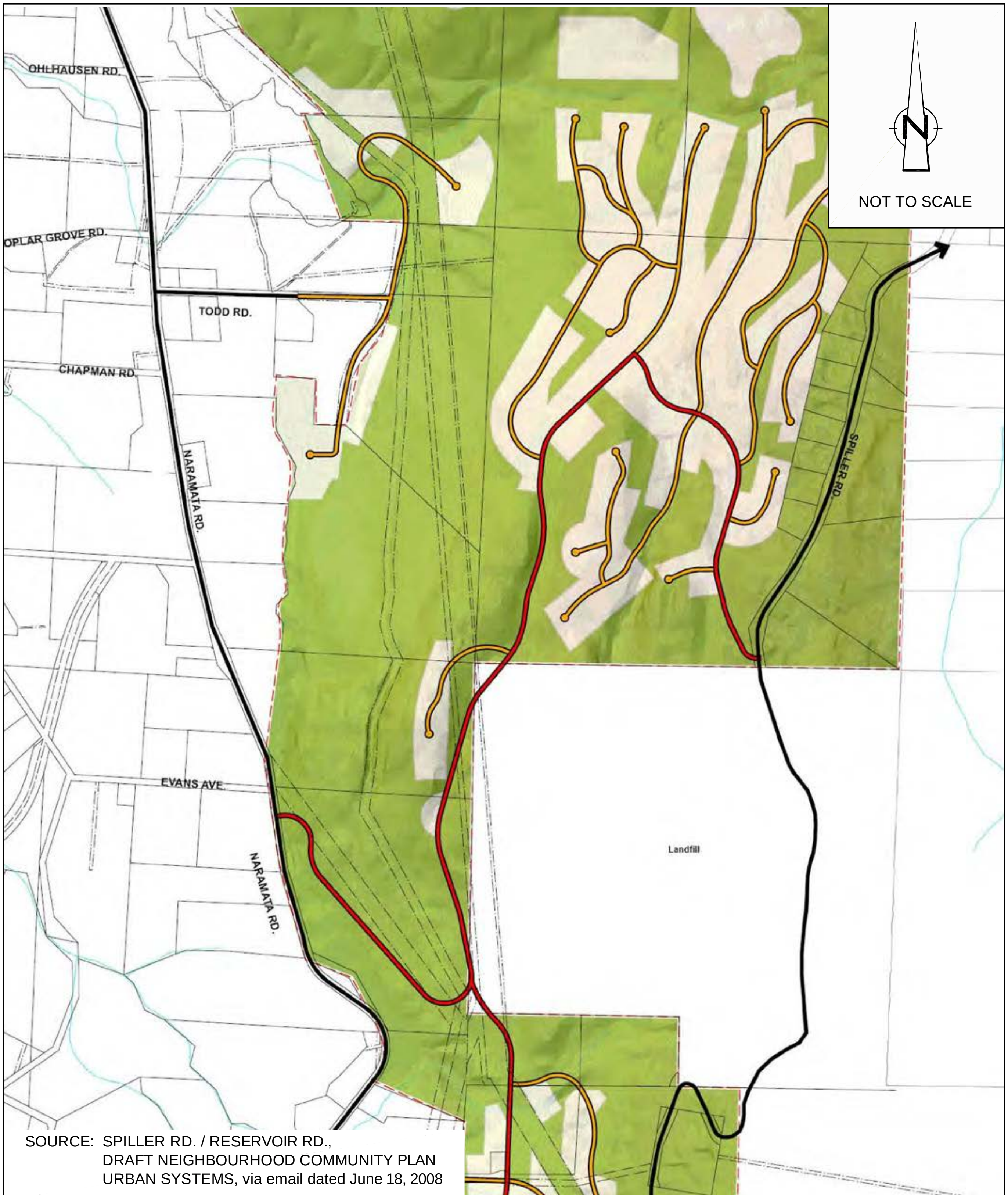


SOURCE: OPHIUCHUS CONSULTING
PROJECTION: BC ALBERS
PREPARED: MARCH 11, 2005

figure 6.1

SPILLER BLOCK MAJOR SLOPE AREAS
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUNTAIN LANDFILL
Regional District of Okanagan-Similkameen

33765-21(016)GN-VA009 NOV 05/2008



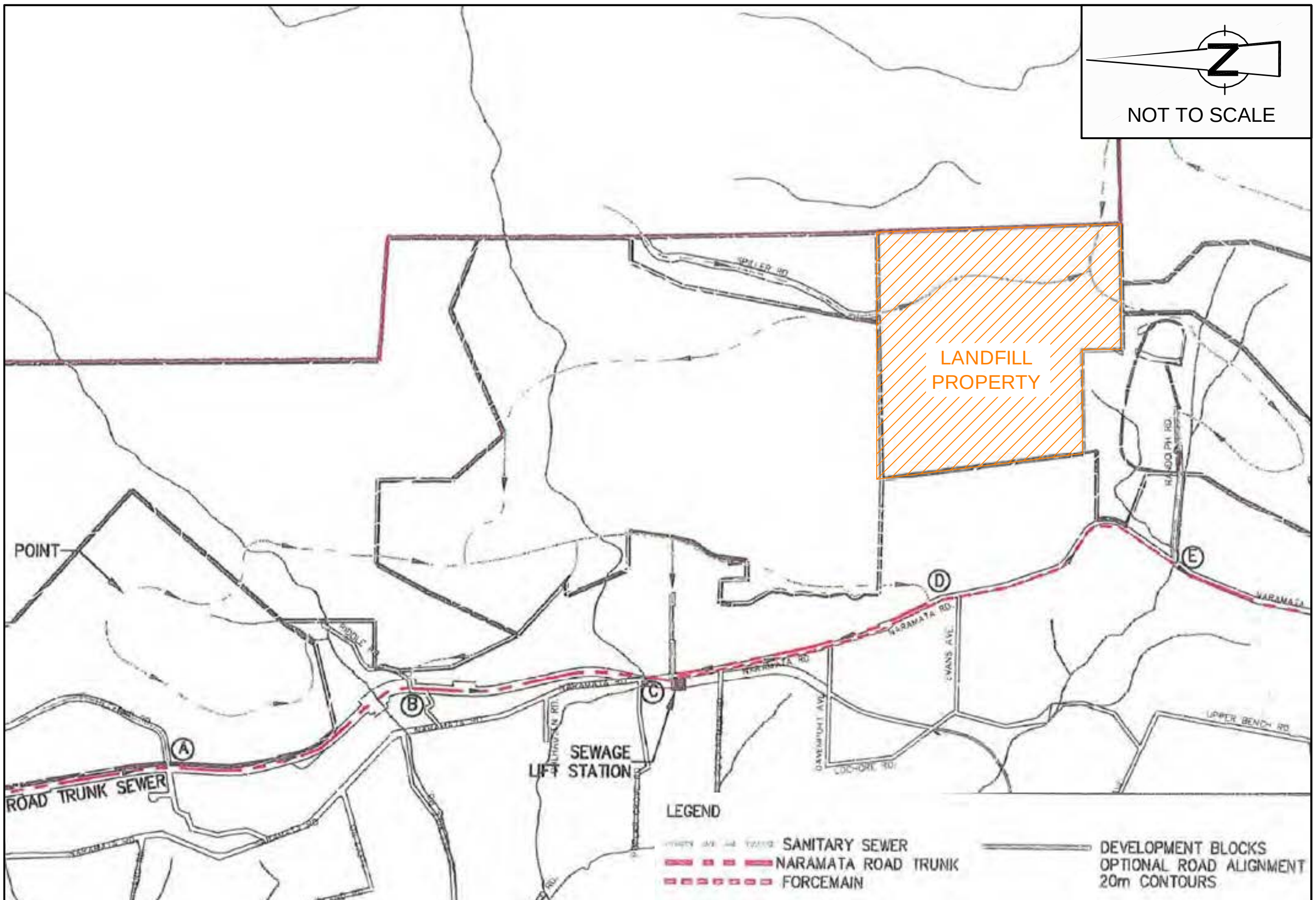
SOURCE: SPILLER RD. / RESERVOIR RD.,
DRAFT NEIGHBOURHOOD COMMUNITY PLAN
URBAN SYSTEMS, via email dated June 18, 2008

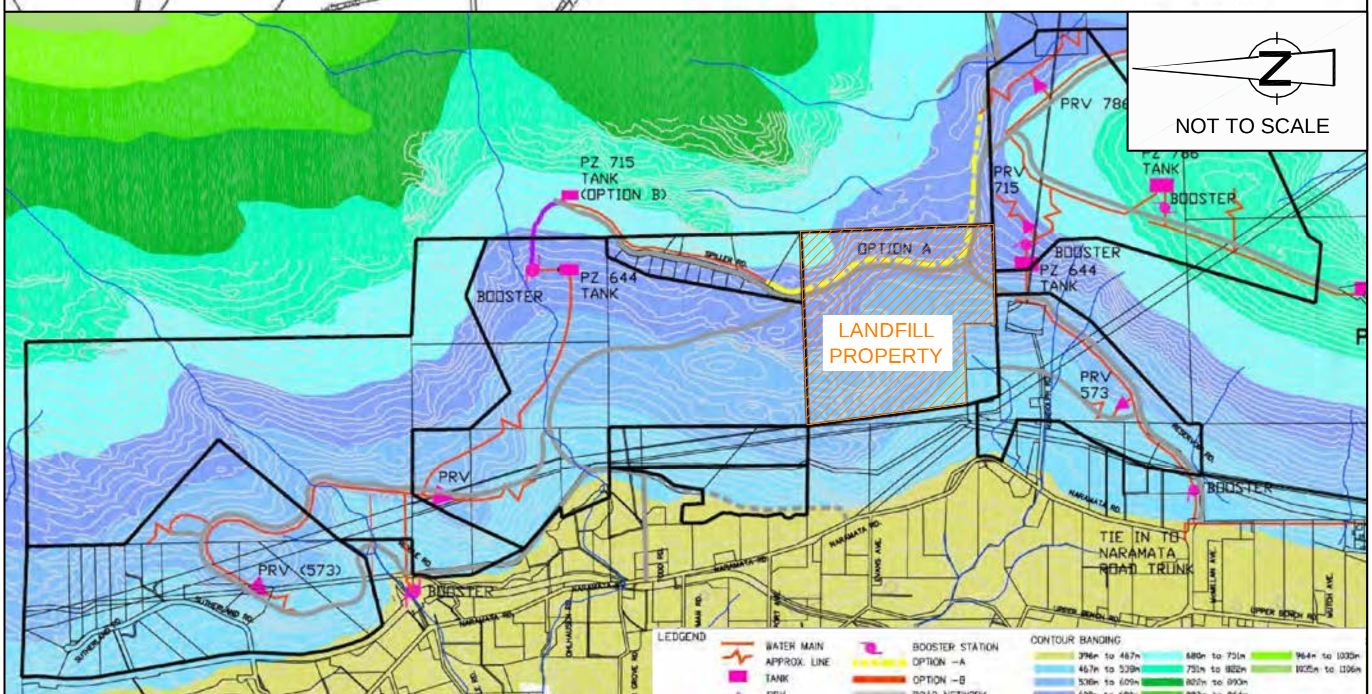
Legend

- Existing Roads
- Hillside Collector Roads
- Hillside Local Roads
- NCP Boundary
- Potential Development Cells
- Open Space

figure 6.2

SPILLER BLOCK PRELIMINARY ROAD NETWORK
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUNTAIN LANDFILL
Regional District of Okanagan-Similkameen





SOURCE: NORTH EAST SECTOR PLAN (URBAN SYSTEMS, JULY 2005)

figure 6.3

SPILLER BLOCK CONCEPTUAL UTILITY CORRIDOR LOCATIONS
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUNTAIN LANDFILL
Regional District of Okanagan-Similkameen

33765-21(016)GN-VA006 JUN 24/2008

LEGEND

PROPERTY BOUNDARY

EXISTING LIMIT OF REFUSE

APPROXIMATE EXTENT OF OBSERVED LANDFILL GAS IN SOIL GAS BASED ON SUMMER 2008 MONITORING

PROPOSED LANDFILL GAS SETBACK LIMIT

figure 8.1

PROPOSED NORTHERN LANDFILL GAS SETBACK
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUNTAIN LANDFILL
Regional District of Okanagan-Similkameen

33765-21(016)GN-VA008 SEP 01/2009

TABLES

TABLE 2.1

TYPICAL LFG COMPOSITION
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUTAIN LANDFILL
PENTICTON, BC

Compound	*Typical Concentration*
Primary	
Methane (CH_4)	30 to 60% (volume)
Carbon Dioxide (CO_2)	20 to 50% (volume)
Oxygen (O_2)	<2% (volume)
Nitrogen (N_2)	<10% (volume)
Moisture (H_2O)	Saturated
Hydrogen (H_2)	<5% (volume)
Trace Compounds (Total <	
Hydrogen Sulphide	<2% (volume)
Mercaptans (CHS)	0.1-1% (volume)
Vinyl Chloride	Trace
Hexane	Trace
Toluene	0.1-1% (volume)
Benzene	0.1-1% (volume)
Disulphates	0.1-2% (volume)
1,1,1-Trichloroethane	Trace
Chloromethane	Trace
Xylenes (m,p,o)	Trace
Dichloromethane	Trace
Trichlorofluoromethane	Trace
Cis-1,2 Dichloroethene	Trace
Benzyl Chloride	Trace
Chlorobenzene	Trace
1,2-Dibromoethane	Trace
Dichlorobenzene	Trace
1,2-Dichloroethane	Trace
1,1-Dichloromethane	Trace
Tetrachloroethylene	Trace
Tetrachloromethane	Trace
Toluene	Trace
Trichloroethylene	Trace
Trichoromethane	Trace
Vinyl Chloride	Trace
Supplemental Compounds	
Acetaldehyde	Trace
Acrylonitrile	Trace
Allyl Chloride	Trace
Bromomethane	Trace
Chlorinated Phenols	Trace
Chloroprene	Trace
Cresol	Trace
1,4-Dioxane	Trace
Epichlorohydrin	Trace
Ethylene Oxide	Trace
Formaldehyde	Trace
Hexachlorocyclopentadiene	Trace
Nitrobenzene	Trace
Phenol	Trace
Dibenzo-p-Dioxin	Trace
Polychlorinated Biphenols	Trace
Propylene Oxide	Trace
Thiophene	Trace

TABLE 2.2

TYPICAL NON-METHANOGENIC ORGANIC COMPOUNDS
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUTAIN LANDFILL
PENTICTON, BC

Acrylonitrile
Benzene
1,1-Dichloroethane
1,2-Dichloroethylene
Dichloromethane
Carbonyl sulfide
Ethylbenzene
Hexane
Methyl ethyl ketone
Tetrachloroethylene
Toluene
Trichloroethylene
Vinyl chloride
Xylene

Source: ATSDR, 2001

TABLE 3.1

MONITORING LOCATION INSTALLATION DETAIL SUMMARY
NORTHER LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUTAIN LANDFILL
PENTICTON, BC

Monitoring Location	Installation Date	Details	Stratigraphy Unit	Depth (m bgs)	Stick-up (m)	Perforated Interval (m BTOR)		Perforated Length (m)
Soil Gas Probes								
GP1-1(S)	2000	25 mm PVC	SP	2.5	0.25	1.23	2.75	1.52
GP1-2(M)	2000	25 mm PVC	SP	6	0.315	4.80	6.32	1.52
GP1-3(D)	2000	25 mm PVC	BD	10.1	0.35	8.93	10.45	1.52
GP2-1	2000	25 mm PVC	SP/BD	2.8	0.76	1.12	3.56	2.44
GP3-1	2000	25 mm PVC	SP/BD	2.5	1.00	2.28	3.50	1.22
GP14-1(S)	2008	25 mm PVC	SP	2.9	0.85	2.25	3.75	1.5
GP14-2(M)	2008	25 mm PVC	SW	5.8	0.82	5.11	6.61	1.5
GP14-3(D)	2008	25 mm PVC	BD	9.1	0.87	8.52	10.02	1.5
GP15-1	2008	25 mm PVC	SW/BD	2.7	0.86	2.10	3.60	1.5
GP16-1	2008	25 mm PVC	SW/BD	3.0	0.91	2.46	3.96	1.5
GP17-1(S)	2008	25 mm PVC	SP	2.44	0.83	2.07	3.27	1.2
GP17-2(D)	2008	25 mm PVC	BD	4.73	0.90	4.43	5.63	1.2
GP18-1(S)	2008	25 mm PVC	SW	2.44	0.97	2.21	3.41	1.2
GP18-2(D)	2008	25 mm PVC	BD	3.96	0.91	4.57	4.87	0.3
Gas Monitoring Wells								
GM98-1	1998	50 mm PVC/ 25 mm PVC	Refuse	27.40/ 16.75	1.21			1.5/ 1.5
GM98-2	1998	50 mm PVC/ 25 mm PVC	Refuse	23.77/ 8.5				1.5/ 1.5
GM98-3	1998	50 mm PVC/ 25 mm PVC	Refuse	15.85/ 6.7				1.5/ 1.5
GM98-4	1998	50 mm PVC/ 25 mm PVC	Refuse	9.00/ 4.5				1.5/ 1.5
GM98-5	1998	50 mm PVC/ 25 mm PVC	Refuse	15.4/ 7.6	1.17			1.5/ 1.5
GM98-6	1998	50 mm PVC/ 25 mm PVC	Refuse	20.4/ 10.1				1.5/ 1.5
GM98-7	1998	50 mm PVC/ 25 mm PVC	Refuse	19.2/ 9.75				1.5/ 1.5
GM98-8	1998	50 mm PVC	Refuse	8.50/ 8.5				1.5
Gas Extraction Well and Observation Probes								
Extraction Well	2000	100 mm PVC	Refuse	20.63				9.14
15-1a	2000	25 mm PVC	Refuse	4.90				3
15-1b	2000	25 mm PVC	Refuse	10.40				3
15-1c	2000	25 mm PVC	Refuse	15.90				3
15-1d	2000	25 mm PVC	Refuse	20.70				3

Notes:
m - metres
BGS - metres below ground surface
BTOR - metres below top of riser
SP - Sand, SW - Gravelly Sand, BD - Bedrock

TABLE 3.2

GRAIN SIZE ANALTYSIS RESULTS SUMMARY
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUTAIN LANDFILL
PENTICTON, BC

Upper Granualar Deposit

Location ID		TP10-08#1	TP8-08 #1
Sample ID		**SO-33765-050508-ZF-03**	**SO-33765-050508-ZF-04**
Sample Date		5-May-08	5-May-08
Sample Depth (m BGS)		1.5	1.3
	Units		
Physical Properties (1)			
Sieve - #4 (>4.75mm)	%	<0.2	<0.2
Sieve - #10 (>2.00mm)	%	2.8	4.7
Sieve - #40 (>0.425mm)	%	15.2	20.6
Sieve - #200 (>0.075mm)	%	29.2	28.1
Sieve - Pan	%	52.8	46.5

Lower Granualar Deposit

Location ID		TP7-08 #1	TP7-08 #1	TP16-08 #1	TP13-08 #1	TP10-08 #2	TP9-08 #1
Sample ID		**SO-33765-050508-ZF-01**	**SO-33765-050508-ZF-01**	**SO-33765-050508-ZF-02**	**SO-33765-050508-ZF-05**	**SO-33765-050508-ZF-06**	**SO-33765-050508-ZF-07**
Sample Date		5-May-08	5-May-08	5-May-08	5-May-08	5-May-08	5-May-08
Sample Depth (m BGS)		3.0	3.0	1.6	2.2	3.0	2.0
			Laboratory Duplicate				
	Units						
Physical Properties (1)							
Sieve - #4 (>4.75mm)	%	<0.2	<0.2	2.1	<0.2	<0.2	4.9
Sieve - #10 (>2.00mm)	%	11.9	13.4	26.4	8.2	9.1	8.3
Sieve - #40 (>0.425mm)	%	22.2	22.7	23.3	24.5	27.9	17.2
Sieve - #200 (>0.075mm)	%	29.1	28.4	43.9	33.1	37.9	22.7
Sieve - Pan	%	36.8	35.5	4.3	34.2	25.1	46.9

Notes:

(1) Results indicate % retained on the sieve. Larger grain sizes not included in the selection of the sample aliquot due to laboratory standard operating procedures.

m BGS - metres below ground surface

TABLE 4.1

WASTE CHARACTERIZATION
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUTAIN LANDFILL
PENTICTON, BC

	2003 [(1)] *(tonnes)*	*2004* [(2)] *(tonnes)*	*2005* [(3)] *(tonnes)*	*2006* [(3)] *(tonnes)*	*2007* [(4)] *(tonnes)*
REFUSE TYPE					
Asbestos	12.3	45.2	127.5	25.4	18.1
Asphalt-Source Seperated (Includes Roofing)			505.9	1,197.2	1,230.6
Bulky Waste - Area B, D, and G, City and Rural		57.2	77.3	108.8	171.2
Carcasses	5.8	15.1	7.6	7.2	5.4
Clean Earth Fill	154.4	517.9	271.3	429.2	942.3
Commercial Waste (includes Village of Keremeos, OK Falls)	17,024.7	18,412.9	20,123.9	20,036.7	17,531.1
Condemned Foods				19.4	0.4
Contaminated Soil	5,669.5	795.9	1,252.8	286.0	153.8
Controlled Waste	48.9	49.3	11.1	24.4	27.7
Demolition (includes insulation)	3,155.3	4,058.4	3,947.6	3,532.8	1,550.0
Electronic Waste					5.8
Food Process Waste	107.1	91.9	134.7	89.7	85.8
Foundry Dust	378.9	329.1	283.1	265.6	267.8
Highway Refuse			0.7	1.0	0.9
Illegal Dumping		0.3	0.4	0.7	6.3
Infested Vegetation and Noxious Weeds		4.6	13.5	11.2	16.8
Miscellaneous	2,725.7	2,966.6	3,185.7	3,474.7	4,551.8
Municipal Residential (includes Drop off)	5,080.4	5,265.6	5,185.7	5,103.9	5,454.5
Rural (Area B, D, G, Penticton, Residential, Similkameen)		1,641.9	2,324.8	2,373.6	2,349.8
Sewage Screen	10.7	8.5	20.3	16.8	10.9
Sod		111.7	111.8	153.5	327.4
Timber Waste				6.0	24.8
Vacuum Septic Sand	38.5	6.9		0.6	
Vinyl Siding (Source Seperated)				0.6	2.1
Village of Keremeos (includes Transfer Bin)		97.0	719.8	808.6	652.9
Total Landfilled	**34,412.2**	**34,476.0**	**38,305.5**	**37,973.6**	**35,388.2**
Septic Liquid		**3,709.5**	**3,676.8**	**3,206.3**	**4,534.7**
WASTE DIVERSION AND RECYCLING					
Agricultural Plastic			1.1	0.8	6.5
Agricultural Tree Stumps/Tree Stumps	205.3	82.8	123.3	186.1	430.1
Agricultural Organics/Processed Organics				125.9	535.3
Batteries	15.1	12.0	150.1	1.0	0.4
Compost (Wood/Branches, Bulk, bag, yard/garden, commercial etc.)			2,746.7	2,880.1	13,481.6
Concrete (source separated)			92.5	404.9	1,267.1
Freon Units	429.0	801.0	939.0	1,021.0	
Gyproc	840.5	944.5	1,020.8	1,254.9	1,593.8
Hazardous Waste (Household)					15.4
Masonry				0.8	7.6
Mattress Recycling	482.0	0.0	634.0	-	
Metal	84.9	100.3	160.0	204.7	283.4
Propane Tanks			300 units	300 units	
Tires	15.6	30.8	3,147.0	4,570.0	0.7
White Goods	61.4	91.0	47.9	22.1	0.4
Wood (includes preserved, recycled, and agricultural)	3,606.8	3,280.5			140.3
Yard and Garden Waste (includes rural, city, christmas trees, Village of Keremeos)	68.8	840.0	2,215.8	3,381.5	1,328.1
Sub-Total	5,809.4	6,182.9	11,278.2	14,053.8	19,090.7
Blue Bag Containers					53.1
Cardboard	80.5	97.5	100.9	141.0	199.2
Mixed Paper	18.1	18.4	2.4	16.9	21.3
Newsprint	13.9	17.5	46.0	42.5	13.0
Tin Cans	0.7	1.2	0.1	1.4	1.2
Plastic Milk Jug	4.4	0.8	0.3	1.9	1.7
Glass	117.6	0.8	0.9	11.7	49.7
Sub-Total	235.1	136.0	150.6	215.4	339.2
Total Waste Diversion and Recycling	**6,044.5**	**6,318.9**	**11,428.8**	**14,269.2**	**19,430.0**

Notes:

(1) Conestoga-Rovers and Associates, February 2005. 2003 Annual Operations and Monitoring Report

(2) Conestoga-Rovers and Associates, February 9, 2006. 2004 Annual Operations and Monitoring Report

(3) XCG Consultants Ltd, June 10, 2008. 2005/2006 Annual Operation and Monitoring Report

(4) RDCK correspondence email dated 6/24/2008.

TABLE 4.2

2003-2007 OPERATIONAL STATISTICS
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUTAIN LANDFILL
PENTICTON, BC

	Units	2003	2004	2005	2006	2007
Total Landfilled	*tonnes*	34,412	34,476	38,306	37,974	35,388
Total Waste Diversion/Recycled	*tonnes*	6,045	6,319	11,429	14,269	19,430
Total Generated ***(Total Landfilled plus Total Recycled/Diverted)***	*tonnes*	40,457	40,795	49,734	52,243	54,818
Recycling/Diversion Rate ***(Total Recycled/Diverted divided by Total Generated)***	%	15	15	23	27	35
Total Population Served by Landfill (1)	*persons*	41,152	41,399	41,648	41,843	42,261
Average Yearly Waste Landfilled Per Person ***(Total Waste Landfilled/population)***	*tonnes/person*	0.84	0.83	0.92	0.91	0.84

Notes:

(1) Population based on information provided in Table 4.4.

TABLE 4.3

SERVICE AREA POPULATION STATISTICS
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUNTAIN LANDFILL
PENTICTON, BC

Location	2006 Population	2001 Pop Using 2006 Boundary	Percent Growth 2001-2006	Average Percent Growth per Year
Penticton	31,909	30,985	3.0%	0.6%
Okanagan-Similkameen D	5,913	5,703	3.7%	0.7%
Okanagan-Similkameen E	2,010	1,996	0.7%	0.1%
Okanagan-Similkameen F	2,011	1,979	1.6%	0.3%
Total Population	**41,843**	**40,663**	**2.9%**	**0.6%**

Notes:

Reference: Statistics Canada, 2001 and 2006 Census

Electoral Area D - Kaleden and half of Lakeshore Highlands

Electoral Area E - Naramata

Electoral Area F - West Beach, Sage Mesa, and Husula Highlands

TABLE 4.4

REVISED WASTE PROJECTION AND LIFESPAN ANALYSIS
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUTAIN LANDFILL
PENTICTION, BC

Year	*Service Area Estimated/Projected Annual Growth Rate* *(%)*	*City Population*	*Service Population*	*Waste Landfilled Rate (tonnes/ person/year)*	*Yearly Waste Landfilled* *(tonnes)*	*Cumulative Waste Landfilled* *(tonnes)*	*Yearly Waste Landfilled Volume Consumed* *(m^3)*	*Cumulative Waste Landfilled Volume Consumed* *(m^3)*	*Yearly Cover Volume req @ 6:1* *(m^3)*	*Cumulative Airspace Volume Consumed* *(m^3)*	*Cumulative Air Space Volume Consumed After Settlement* *(m^3)*	*Cumulative Air Space Volume Consumed After Settlement Golder Plan (Golder, 2002) Starting 2002* *(m^3)*
1971		18,146	20,963	1.2	25,156	25,156	41,926	41,926	6,289	48,215	40,983	
1972		18,825	21,747	1.2	26,096	51,252	43,494	85,420	6,524	91,944	78,152	
1973		19,529	22,561	1.2	27,073	78,325	45,122	130,542	6,768	137,310	116,714	
1974		20,259	23,404	1.2	28,085	106,410	46,808	177,350	7,021	184,371	156,716	
1975		21,017	24,280	1.2	29,136	135,546	48,560	225,910	7,284	233,194	198,215	
1976		21,837	25,227	1.2	30,272	165,818	50,454	276,364	7,568	283,932	241,342	
1977		21,900	25,300	1.2	30,360	196,178	50,600	326,964	7,590	334,554	284,371	
1978		21,759	25,137	1.2	30,164	226,343	50,274	377,238	7,541	384,779	327,062	
1979		22,061	25,486	1.2	30,583	256,926	50,972	428,210	7,646	435,856	370,477	
1980		22,586	26,093	1.2	31,312	288,238	52,186	480,396	7,828	488,224	414,990	
1981		23,728	27,412	1.2	32,894	321,132	54,824	535,220	8,224	543,444	461,927	
1982		24,124	27,869	1.2	33,443	354,575	55,738	590,958	8,361	599,319	509,421	
1983		24,373	28,157	1.2	33,788	388,363	56,314	647,272	8,447	655,719	557,361	
1984		24,697	28,531	1.2	34,237	422,600	57,062	704,334	8,559	712,893	605,959	
1985		24,215	27,975	1.2	33,570	456,170	55,950	760,284	8,393	768,677	653,375	
1986		24,379	28,164	1.2	33,797	489,967	56,328	816,612	8,449	825,061	701,302	
1987		25,142	29,046	1.2	34,855	524,822	58,092	874,704	8,714	883,418	750,905	
1988		25,546	29,512	1.2	35,414	560,237	59,024	933,728	8,854	942,582	801,194	
1989		26,201	30,269	1.2	36,323	596,560	60,538	994,266	9,081	1,003,347	852,845	
1990		26,976	31,164	1.2	37,397	633,956	62,328	1,056,594	9,349	1,065,943	906,052	
1991		27,923	32,258	1.19	38,387	672,343	63,978	1,120,572	9,597	1,130,169	960,644	
1992		29,092	33,609	1.09	36,634	708,977	61,056	1,181,629	9,158	1,190,787	1,012,169	
1993		30,470	35,201	1.08	38,017	746,994	63,362	1,244,991	9,504	1,254,495	1,066,321	
1994		31,760	36,691	1.08	39,626	786,621	66,044	1,311,034	9,907	1,320,941	1,122,800	
1995		32,046	37,021	0.94	34,800	821,420	58,000	1,369,034	8,700	1,377,734	1,171,074	
1996		32,161	37,154	0.91	33,810	855,230	56,350	1,425,384	8,453	1,433,837	1,218,761	
1997		32,544	37,597	0.88	33,085	888,316	55,142	1,480,526	8,271	1,488,798	1,265,478	
1998		32,526	37,576	0.88	33,067	921,383	55,111	1,535,638	8,267	1,543,905	1,312,319	
1999		32,627	37,693	0.88	33,170	954,553	55,283	1,590,921	8,292	1,599,213	1,359,331	
2000		32,704	37,782	0.88	33,248	987,801	55,414	1,646,335	8,312	1,654,647	1,406,450	
2001(1)		30,985	40,663	0.88	35,783	1,023,584	59,639	1,705,974	8,946	1,714,919	1,457,682	
2002	0.6	31,171	40,907	0.88	35,998	1,059,582	59,997	1,765,970	9,000	1,774,970	1,508,725	51,043
2003(2)	0.6	31,358	41,152	0.87	35,697	1,095,279	59,494	1,825,465	8,924	1,834,389	1,559,230	101,549
2004(3)	0.6	31,546	41,399	0.83	34,559	1,129,838	57,598	1,883,063	8,640	1,891,703	1,607,947	150,266
2005	0.60	31,735	41,648	0.83	42,104	1,171,941	70,173	1,953,235	10,526	1,963,761	1,669,197	211,516
2006(4)	0.47	31,909	41,843	0.83	39,982	1,211,924	66,637	2,019,873	9,996	2,029,868	1,725,388	267,707
2007	1	32,228	42,261	0.83	35,388	1,247,312	58,980	2,078,853	8,847	2,087,700	1,774,545	316,864
2008	1	32,550	42,684	0.83	35,428	1,282,740	59,046	2,137,899	8,857	2,146,756	1,824,743	367,061
2009	1	32,876	43,111	0.83	35,782	1,318,522	59,637	2,197,536	8,946	2,206,482	1,875,509	417,828
2010	1	33,205	43,542	0.83	36,140	1,354,662	60,233	2,257,769	9,035	2,266,804	1,926,784	469,102

TABLE 4.4

REVISED WASTE PROJECTION AND LIFESPAN ANALYSIS
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUTAIN LANDFILL
PENTICTION, BC

Year	*Service Area Estimated/Projected Annual Growth Rate* (%)	*City Population*	*Service Population*	*Waste Landfilled Rate (tonnes/person/year)*	*Yearly Waste Landfilled* (tonnes)	*Cumulative Waste Landfilled* (tonnes)	*Yearly Waste Landfilled Volume Consumed* (m^3)	*Cumulative Waste Landfilled Volume Consumed* (m^3)	*Yearly Cover Volume req @ 6:1* (m^3)	*Cumulative Airspace Volume Consumed* (m^3)	*Cumulative Air Space Volume Consumed After Settlement* (m^3)	*Cumulative Air Space Volume Consumed After Settlement Golder Plan (Golder, 2002) Starting 2002* (m^3)
2011	1	33,537	43,977	0.83	36,501	1,391,163	60,835	2,318,605	9,125	2,327,730	1,978,570	520,889
2012	1	33,872	44,417	0.83	36,866	1,428,029	61,444	2,380,048	9,217	2,389,265	2,030,875	573,194
2013	1	34,211	44,861	0.83	37,235	1,465,264	62,058	2,442,107	9,309	2,451,415	2,083,703	626,022
2014	1	34,553	45,310	0.83	37,607	1,502,871	62,679	2,504,785	9,402	2,514,187	2,137,059	679,378
2015	1	34,898	45,763	0.83	37,983	1,540,855	63,306	2,568,091	9,496	2,577,587	2,190,949	733,267
2016	1	35,247	46,221	0.83	38,363	1,579,218	63,939	2,632,030	9,591	2,641,620	2,245,377	787,696
2017	1	35,600	46,683	0.83	38,747	1,617,965	64,578	2,696,608	9,687	2,706,294	2,300,350	842,669
2018	1	35,956	47,150	0.83	39,134	1,657,099	65,224	2,761,831	9,784	2,771,615	2,355,873	898,191
2019	1	36,315	47,621	0.83	39,526	1,696,625	65,876	2,827,708	9,881	2,837,589	2,411,951	954,269
2020	1	36,679	48,097	0.83	39,921	1,736,545	66,535	2,894,242	9,980	2,904,223	2,468,589	1,010,908
2021	1	37,045	48,578	0.83	40,320	1,776,865	67,200	2,961,442	10,080	2,971,523	2,525,794	1,068,113
2022	1	37,416	49,064	0.83	40,723	1,817,589	67,872	3,029,315	10,181	3,039,495	2,583,571	1,125,890
2023	1	37,790	49,555	0.83	41,131	1,858,719	68,551	3,097,866	10,283	3,108,148	2,641,926	1,184,244
2024	1	38,168	50,050	0.83	41,542	1,900,261	69,236	3,167,102	10,385	3,177,487	2,700,864	1,243,183
2025	1	38,550	50,551	0.83	41,957	1,942,218	69,929	3,237,031	10,489	3,247,520	2,760,392	1,302,710
2026	1	38,935	51,056	0.83	42,377	1,984,595	70,628	3,307,659	10,594	3,318,253	2,820,515	1,362,833
2027	1	39,324	51,567	0.83	42,801	2,027,396	71,334	3,378,993	10,700	3,389,693	2,881,239	1,423,558
2028	1	39,718	52,083	0.83	43,229	2,070,624	72,048	3,451,041	10,807	3,461,848	2,942,571	1,484,889
2029	1	40,115	52,603	0.83	43,661	2,114,285	72,768	3,523,809	10,915	3,534,724	3,004,515	1,546,834
2030	1	40,516	53,130	0.83	44,097	2,158,383	73,496	3,597,305	11,024	3,608,329	3,067,080	1,609,398
2031	1	40,921	53,661	0.83	44,538	2,202,921	74,231	3,671,535	11,135	3,682,670	3,130,270	1,672,588
2032	1	41,330	54,197	0.83	44,984	2,247,905	74,973	3,746,508	11,246	3,757,754	3,194,091	1,736,410
2033	1	41,744	54,739	0.83	45,434	2,293,339	75,723	3,822,231	11,358	3,833,590	3,258,551	1,800,870
2034	1	42,161	55,287	0.83	45,888	2,339,227	76,480	3,898,711	11,472	3,910,183	3,323,656	1,865,974
2035	1	42,583	55,840	0.83	46,347	2,385,574	77,245	3,975,956	11,587	3,987,543	3,389,411	1,931,730
2036	1	43,009	56,398	0.83	46,810	2,432,384	78,017	4,053,973	11,703	4,065,676	3,455,825	1,998,143
2037	1	43,439	56,962	0.83	47,278	2,479,663	78,797	4,132,771	11,820	4,144,591	3,522,902	2,065,220
2038	1	43,873	57,532	0.83	47,751	2,527,414	79,585	4,212,356	11,938	4,224,294	3,590,650	2,132,969

Assumed Apparent Waste Density 600 kg/m^3

Notes:

(1) Statistics Canada, 2001 Census

(2) Total Waste Landfilled tonnage from 2003 Annual Operations and Monitoring Report (CRA, February 2005)

(3) Total Waste Landfilled tonnage from 2004 Annual Operations and Monitoring Report (CRA, January 2006)

(4) Statistics Canada, 2006 Census

Reference: Landfill Gas Assessment (SHA, July 25, 2001)

Estimated Landfill Closure Year based on 962,000 m^3 for Phase 1 and an additional 715,300 m^3 for Phase 2 (Golder, 2006).

TABLE 4.5

LANDFILL GAS MONITORING RESULTS SUMMARY
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUTAIN LANDFILL
PENTICTON, BC

	1998		2008		
Monitoring ID	*Methane*	*Carbon Dioxide*	*Methane*	*Carbon Dioxide*	*Pressure*
	(% v/v)	*(% v/v)*	*(% v/v)*	*(% v/v)*	*(inches of water column)*
GMW98-1	48.0 to 75.2	37.5 to 49.9	51.2 to 64.2	34.7 to 39.2	0 to 0.47
GMW98-2	25.7 to 48.8	26.8 to 40.1	47.0 to 60.2	36.6 to 41.4	0 to 0.20
GMW98-3	34.0 to 63.1	31.1 to 41.0	35.5 to 59.1	33.9 to 40.9	0 to 0.16
GMW98-4	50.9 to 65.1	37.7 to 47.5	32.0 to 61.2	31.4 to 40.3	0 to 0.13
GMW98-5	58.0 to 65.7	42.0 to 48.6	34.7 to 59.5	34.4 to 44.6	-1.50 to 2.22
GMW98-6	49.1 to 65.4	36.1 to 49.1	52.5 to 65.3	38.4 to 44.1	0 to 0.31
GMW98-7	35.0 to 54.5	30.7 to 43.3	29.9 to 53.2	32 to 38.5	0 to 0.17
GMW98-8	40.0 to 70.7	33.5 to 49.8	n/m	n/m	n/m

TABLE 5.1

NORTHERN GROUNDWATER DATA SUMMARY
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUTAIN LANDFILL
PENTICTON, BC

Monitoring ID	*Year*	*Location*	*Aquifer Unit*	*Ground Surface Elevation (1) (m AMSL)*	*Water Level (m BTOR)*															
Northerly and Centrally Located Groundwater Monitoring Wells																				
					Jan-06	Apr-06	Aug-06	Dec-06	Feb-07	May-07	Sep-07	Dec-07	Mar-08	Jun-08	Sep-08	Dec-08	Apr-09	***Max.***	***Min.***	***Diff.***
BH 104	1994	North Ravine, northeast quadrant	BD	587	11.565	11.623	11.590	11.610	11.578	11.570	11.615	11.625	11.600	11.595	11.632	--	11.615	***11.632***	***11.565***	***0.067***
BH 105	1994	east of LF, central on eastern half of property	BD	614	5.460	5.395	5.430	5.865	5.865	5.235	5.925	5.985	5.858	6.060	6.408	6.830	6.334	***6.830***	***5.235***	***1.595***
BH2000-3	2000	west of LF, central	SP/BD	593	13.180	12.935	13.940	13.270	13.402	13.142	13.496	13.579	13.659	13.495	13.880	13.982	13.543	***13.982***	***12.935***	***1.047***
BH2000-4	2000	west of LF, central	SP/BD	598	n/a	--	18.279	18.835	18.940	18.540	18.779	--	19.189	19.165	19.334	19.595	19.750	***19.750***	***18.279***	***1.471***
Gas Probe																				
					May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08	Jan-09	Feb-09	Mar-09	Apr-09		***Max.***	***Min.***	***Diff.***
GP1-3	2000	east of ravine, northeast quadrant	SP/BD	635	8.974	8.900	8.828	9.143	9.161	9.290	9.470	9.400	9.150	8.625	8.420	8.400		***9.470***	***8.400***	***1.070***

Notes:
(1) Approximated ground surface elevation using 2007 contours.
AMSL - above mean sea level
BD - Bedrock
bgs - below ground surface
BTOR - below top of riser
LF - Liquid Waste Facility
m - metre
SP - Sand

TABLE 5.2

GAS PROBE MONITORING RESULTS SUMMARY
NORTHERN LANDFILL GAS SETBACK ASSESSMENT
CAMPBELL MOUTAIN LANDFILL
PENTICTON, BC

Monitoring ID	*Stratigraphy Unit*	*Methane (% v/v)*	*Carbon Dioxide (% v/v)*	*Pressure (inches of water column)*
GP1-1(S)	SP	0 to 0.1	0.1 to 0.5	0 to 0.05
GP1-2(M)	SP	0 to 0.1	0.1 to 1.2	0 to 0.024
GP1-3(D)	BD	0 to 0.1	0 to 0.1	0 to 0.05
GP2-1	SP/BD	0 to 0.1	0.4 to 0.9	0 to 0.01
GP3-1	SP/BD	0 to 0.1	0.5 to 0.9	0 to 0.01
GP14-1(S)	SP	0	3.6 to 6.8	0
GP14-2(M)	SW	0 to 0.1	1 to 14.8	0 to 0.03
GP14-3(D)	BD	0 to 0.4	0.3 to 15.7	0.015 to 0.03
GP15-1	SW/BD	0 to 0.1	0 to 0.5	0
GP16-1	SW/BD	0 to 0.2	0 to 17.7	0 to 0.02
GP17-1(S)	SP	18.9 to 50.9	43.5 to 66.5	0 to 0.014
GP17-2(D)	BD	20 to 48.5	41.9 to 59.8	0 to 0.02
GP18-1(S)	SW	0 to 0.1	0.4 to 1.6	0 to 0.016
GP18-2(D)	BD	0 to 0.1	0.4 to 1.4	-0.06 to 0.02

Notes:

SP - Sand, SW - Gravelly Sand, BD - Bedrock

Exceeds Trigger Level of 25% LEL (1.25% v/v)

APPENDICES

APPENDIX A

PERMIT No. PR 1597 AND DRAFT OPERATIONAL CERTIFICATE PR 15274

Province of British Columbia
Ministry of Environment, Lands and Parks

BC Environment

Suite 201
3547 Skaha Lake Road
Penticton
British Columbia
V2A 7K2
Telephone: (604) 493-8261

CMSL

JUN 1 1992
File: PR-1597

REGISTERED MAIL

Regional District of Okanagan-Similkameen
101 Martin Street
Penticton, British Columbia
V2A 5J9

Dear Sir/Madam:

LETTER OF TRANSMITTAL

Enclosed is a copy of the amended Permit No. PR-1597 issued under the provisions of the Waste Management Act in the name of Regional District of Okanagan-Similkameen. Your attention is respectfully directed to the terms and conditions outlined in the Permit.

The administration of this Permit will be carried out by staff from our Regional Office located at Suite 201 - 3547 Skaha Lake Road, Penticton, British Columbia, V2A 7K2, telephone 490-8200, facsimile 492-1314. Plans, data and reports pertinent to the Permit are to be submitted to the Regional Waste Manager at this address.

You will note that values have been expressed in the International System of Units (SI). These units are to be used in submitting monitoring results and any other information in connection with this Permit.

This Permit does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority shall rest with the Permittee.

Yours truly,

R.A. Nickel
Regional Waste Manager
Environmental Protection Program
Okanagan Sub-Region

Enclosures

MINISTRY OF ENVIRONMENT,
LANDS AND PARKS

PERMIT

Under the Provisions of the Waste Management Act

REGIONAL DISTRICT OF OKANAGAN-SIMILKAMEEN

101 MARTIN STREET

PENTICTON, BRITISH COLUMBIA

V2A 5J9

is authorized to discharge refuse to the land from sources located at Penticton and surrounding areas, British Columbia, subject to the conditions listed below. Contravention of any of these conditions is a violation of the Waste Management Act and may result in prosecution.

1 Specific Authorized Discharges and Related Requirements

1.1 Location of Discharge

The landfill operation shall be restricted to a portion of lot 368, Similkameen Division of Yale District, located approximately as shown on Appendix A of the Permit.

Date Issued: July 4, 1972

Amendment Date: JUN 1 1992

R.A. Nickel
Regional Waste Manager

Permit No. PR-1597

1.2 Maximum Monthly Discharge

The maximum quantity of refuse which may be discharged is 5,000 tonnes in any calender month.

1.3 Maximum Yearly Discharge

The maximum quantity of refuse which may be discharged is 50,000 tonnes in any calender year.

1.4 Permissible Discharges

The types of refuse which may be discharged are residential, industrial, commercial and institutional.

1.5 Non-permissible Discharges

The following types of wastes are not to be discharged unless specifically approved by the Regional Waste Manager:

- special wastes as defined in the Special Waste Regulation under the Waste Management Act

- bulk liquids or semi-solid wastes which contain free liquids including septage, raw sewage, and sewage treatment sludge

- anatomical, pathological, and untreated biomedical wastes

- slaughter house wastes

1.6 Water

The disposal of refuse into water is unacceptable. Surface water diversion to restrict storm water run-off from contacting the wastes is required.

1.7 Landfill Classification

The works authorized are a "Sanitary Landfill" operation as specified in Section 2 and regulated burning as specified in Section 3.

R.A. Nickel
Regional Waste Manager

Date Issued: July 4, 1972

Amendment Date: JUN 1 1992

Permit No. PR-1597

2 Sanitary Landfill Operation

2.1 Designated Recycling Areas

Once markets have been established, the Regional District is encouraged to provide areas on site for the separation, handling, and storage of recyclable materials such as automobile hulks, white goods, source separated glass, scrap tires, metals, plastic, newspaper, concrete, cardboard and drywall.

2.2 Storage of Recyclable Special Wastes

Storage of recyclable special wastes is subject to the approval of the Regional Waste Manager and is to be stored in accordance with the Special Waste Regulation.

2.3 Signs

A sign is to be posted at the front gate with the following information:

- site name
- owner and operator
- contact phone number and address for owner and operator
- phone number in case of emergency (such as fire)
- hours of operation
- tipping fees

Additional signs are required to clearly indicate the directions to the main tipping face, public disposal area, and the recycling/waste separation areas.

2.4 Supervision

Fulltime, trained, and competent operators are to be on site during operating hours.

2.5 Restricted Access

The gates are to be locked to prevent unauthorized access during non-operating hours.

Date Issued: July 4, 1972

Amendment Date: JUN 1 1992

R.A. Nickel
Regional Waste Manager

2.6 Reduction of Refuse Entering the Landfill

The Regional District is encouraged to reduce the amount of refuse entering the landfills by supporting reduce, reuse, recycle, and recover strategies.

2.7 Measurement of Refuse and Recyclables

All refuse and recyclables entering the landfill site are to be measured with a weigh scale. The unit of measurement to be used is the tonne. The weigh scale is to be calibrated, inspected, and certified in accordance with the federal government Weights and Measures Act and Regulations administered by Consumer and Corporate Affairs as required. The most current copy of the calibration certificate is to be posted in the weigh scale building. A monthly and yearly weight record is to be kept of the following components:

- residential waste from city contracted collection services
- commercial waste from city contracted collection services
- industrial and institutional waste from non-contracted collection services
- wood waste to landfill
- wood waste to burn piles including quantity and date of each burn
- carcasses
- recyclables diverted from landfilling including metals, compostables, newspapers, tires, glass, etc.

2.8 Scavenging

Uncontrolled scavenging of waste is to be prevented. The organized salvaging of wastes by the landfill operator should be encouraged by providing areas or facilities for separation of recyclable or reusable materials.

Date Issued: July 4, 1972

Amendment Date: JUN 1 1992

R.A. Nickel
Regional Waste Manager

Permit No. PR-1597

2.9 Dust Control

Dust is to be controlled using methods acceptable to the Regional Waste Manager.

2.10 Waste Layer Height and Compaction

Wastes are to be spread in thin layers (0.6m or less) on the working face and compacted.

2.11 Daily Cover

Suitable soil cover material is to be applied to a compacted depth of 0.15m on all exposed solid waste at the end of each day of operation.

2.12 Intermediate Cover

Suitable intermediate soil cover material is to be applied to a compacted depth of 0.30m on areas of the landfill where disposal will not occur for a period exceeding 30 days.

2.13 Minimize Working Face

The working face area shall not exceed a horizontal width of 25m, a vertical height of 3m, and shall be maintained at a slope of between 25 to 30 degrees.

2.14 Final Cover

Final Cover is to consist of a minimum of 1 m of low permeability (less than 1×10^{-5} cm/sec) compacted soil including a minimum of 0.15m of topsoil, of which a portion of such topsoil may be compost, with vegetation established on top. Soils of higher permeability may be approved based on leachate generation potential from this landfill site. Final cover is to be constructed with slopes between 4% and 33% with appropriate run-on/run-off drainage controls, erosion controls, and gas venting controls. Final cover is to be installed within 90 days on completed areas of the landfill subject to good weather conditions. Completed portions of the landfill are to progressively receive final cover during the active life of the landfill.

Date Issued: July 4, 1972

Amendment Date: JUN 1 1992

R.A. Nickel
Regional Waste Manager

Permit No. PR-1597

2.15 Extreme Weather Conditions

During periods of extreme weather conditions, such as those that cause the ground to freeze, an exemption to the daily cover requirement may be approved by the Regional Waste Manager upon written request.

2.16 Carcasses

Discharge of carcasses is to be limited to those of a domestic nature only. Carcasses are to be covered immediately with a minimum of 1m of suitable soil cover. Cremation of smaller carcasses at the local pet crematorium is encouraged.

2.17 Litter Control

Litter is to be controlled by compacting the waste, minimizing the work face area, applying cover and providing litter control fences and instituting a regular litter pick up and general good housekeeping program. Areas such as outside the front gate or along roads adjacent to the dump are to be kept free of litter. A tipping fee of twice the normal rate shall be applied to vehicles transporting uncovered and/or unsecured loads of refuse to the site in order to control litter.

2.18 Vector Control

Vectors (carriers capable of transmitting a pathogen from one organism to another including, but not limited to, flies and other insects, rodents, and birds) are to be controlled by the application of cover material.

2.19 Wildlife

This landfill is to be operated so as to minimize the attraction of wildlife such as bears and birds by applying cover at required frequencies and instituting a good housekeeping program.

2.20 Site Preparation and Restoration

Provision of fencing, site access, vehicle safety barriers, surface water diversionary works, and site restoration as required, shall be carried out to the satisfaction of the Regional Waste Manager.

3 Operational Requirements for Regulated Open Burning

3.1 Quantity and Frequency

The maximum quantity of wood waste to be burned is 500 tonnes at each burn at a frequency not to exceed 6 times per year during the period from November to April inclusive.

3.2 Permissible Burn Material

Acceptable material to be burned is wood waste including dried stumps, brush, and untreated wood. Stumps shall be stockpiled for at least 1 year prior to burning to allow the stumps to dry out.

3.3 Non-permissible Burn Materials

Unacceptable materials to be burned include putrescible wastes, animal carcasses, mattresses, rubber, plastic, tar, insulation, or any nuisance causing combustibles.

3.4 Alternate Methods to Burning

The Regional District is encouraged to utilize reduce and/or recycle strategies such as chipping and composting as an alternative to burning.

3.5 Area

The operation is to be restricted to an area on the site which is satisfactory to the Regional Waste Manager. The burning area is to be located in an area on site that has not been previously landfilled.

3.6 Setback

The burning area is to be a minimum of 15 m away from the refuse fill area and firebreaks are to be provided.

R.A. Nickel
Regional Waste Manager

3.7 Scrap Tires

Scrap tires stockpiled on site shall be located as far away as possible from the burn area.

3.8 Continuous Burn with no Recharging

Each burn shall comprise one continuous period necessary to reduce the stockpiled waste to ashes. Materials shall be originally charged in a manner to promote best combustion and restrict the uplift of lighter constituents. No recharging of material is allowed while burning is in progress.

3.9 Residue of Combustion

As soon as the residue of combustion has cooled to ambient temperature, it shall be incorporated into the landfill. If there is a concern regarding hot ash, the residue shall be hosed down with water prior to incorporation into the landfill.

3.10 Timing

The duration of the burn shall not exceed 5 days, or as otherwise directed by the Ministry of Forests, Penticton District Office, at which time all burning and smoking areas are to be completely extinguished.

3.11 Attendant at Burn

Burning shall take place only when an attendant is on duty and when conditions promote rapid combustion and dispersion of combustion products. No burning shall take place during periods of fire hazard nor when burning is prohibited by other government agencies.

3.12 Burning Permit

A burning permit is to be obtained from the City of Penticton prior to burning. A copy of this burning permit is to be submitted to the Regional Waste Manager. In addition, burning shall only take place when approved by the Ministry of Forests, Penticton Forest District Office, who will determine whether it is safe to burn and may specify conditions under which burning may take place.

R.A. Nickel
Regional Waste Manager

3.13 Notification of Agencies

Notification of the burn shall be provided prior to the burn to the following agencies:

- Ministry of Forests (Penticton District Office)
- City of Penticton (fire department and admin.)
- Regional Waste Manager

3.14 Control of Fire

Adequate fire fighting equipment as specified in the burning permit is to be provided.

3.15 Minimum Measures for Control

As a minimum measure of fire control, adequate heavy equipment and stockpiled suitable soil material is required to be on site to smother or contain accidental fires. The Regional District is encouraged to have a permanent pressurized water supply system with sufficient flow for fire fighting purposes. If a permanent pressurized water supply is not feasible, this could be provided by a water tank truck including a pump and a fire hose.

4 Monitoring

4.1 Sampling of Surface Waters

Surface water sampling is to be done once per year in April by the Regional District. One sample is to be taken from Randolph Spring and one from Scott Spring at the south west property boundary.

R.A. Nickel
Regional Waste Manager

4.2 Analysis of Surface Waters

Water samples are to analyzed for the following in mg/L or MPN/100mL as applicable:

zinc, arsenic, cobalt, molybdenum, cadmium, mercury, nickel, lead, selenium, specific conductance, nitrate nitrogen, ammonia nitrogen, kjedahl nitrogen, total nitrogen, nitrite nitrogen, total phosphorous, ortho phosphorous, total dissolved phosphorous, chloride, COD, BOD, acidity at pH 8.3, microtox EC 50 @ 15 minutes, total coliforms, and fecal coliforms.

4.3 Additional Sampling and Analysis

A one time analysis will be required for one of the first samples collected for polycyclic aromatic hydrocarbons, petroleum distillates, a PCB scan, and a diagnostic pesticide scan. If the analysis indicates there is leachate occurring or any other danger to the receiving environment, additional samples or parameters to be analyzed may be requested by the Regional Waste Manager.

5 Record Keeping

5.1 Copy of Permit

A copy of the current Permit is to be kept on site in the weigh scale building.

5.2 Copy of Inspections

A copy of all Ministry inspections are to be kept on site in the weigh scale building.

5.3 Copy of Burning Permits

A copy of the burning permits are to be kept on site in the weigh scale building.

5.4 Copy of Contingency Plan and Notification Procedures

A copy of the contingency plan and notification procedures in the event of an emergency such as a fire, accident, etc. are to be kept on site in the weigh scale building.

R.A. Nickel
Regional Waste Manager

5.5 Copy of Monitoring Results for Randolph and Scott Spring

A copy of surface water monitoring results and their interpretation for Randolph and Scott Spring are to be kept on site in the weigh scale building.

5.6 Copy of Training Procedures and Annual Reports

A copy of training procedures and annual reports are to kept on site in the weigh scale building.

5.7 Annual Report

An annual Operation and Monitoring Report is to be submitted to the Regional Waste Manager each year for the previous calender year. This report is to contain the following information:

- Total waste discharged for the year
- Total waste diversion by reduce, reuse, recycle, and recover initiatives
- Weight Records as per Section 2.7
- Operation and maintenance expenditures
- Leachate, water quality, and landfill gas monitoring data and interpretation
- Amounts of leachate collected, treated and disposed
- Any changes from approved reports, plans, and specifications
- A contingency plan
- Amount of landfill gas collected and its use

This report for the previous calender year is to be submitted such that it is received in the Regional Office before March 1 of the following year.

R.A. Nickel
Regional Waste Manager

6 Closure and Post-Closure Requirements

6.1 Operational and Closure Plan

An operational and closure plan is to be submitted to the Regional Waste Manager on or before December 31, 1993. The terms of reference for the operational and closure plan is to based on the criteria listed in the "Landfill Criteria for Municipal Solid Waste" and is subject to review and approval by the Regional Waste Manager.

6.2 Hydrogeological Investigation

A hydrogeological investigation report is to be submitted to the Regional Waste Manager on or before December 31, 1995. The terms of reference for the hydrogeological investigation is to based on the criteria listed in the "Landfill Criteria for Municipal Solid Waste" and is subject to review and approval by the Regional Waste Manager. Some of this investigation will focus on the following:

- installation of ground water monitoring wells
- assessment of groundwater and surface water quality impairment
- assessment of landfill gas generation
- development of a monitoring program

6.3 Legal Survey

The boundaries of this landfill site shall be legally surveyed. The survey plus additional information on the total weight of wastes plus the waste types must be legally registered on the deed to the property at the time of closure of the site.

6.4 Buildings and Structures

The building of structures on this landfill is not recommended for a period of 25 year after closure due to concerns about excessive settlement and combustible gas and will only be authorized after an investigation and report by qualified persons. The report is to be approved by the Regional Waste Manager.

R.A. Nickel
Regional Waste Manager

Date Issued: July 4, 1972

Amendment Date: JUN 1 1992

6.5 Operation of Control Systems

Operation of environmental control systems for leachate, gas and run-off as well as monitoring of leachate, groundwater, surface water and landfill gas must be continued during the 25 year post-closure period unless the suspension of operations of monitoring is approved by the Regional Waste Manager.

Date Issued: July 4, 1972

Amendment Date: JUN 1 1992

R.A. Nickel
Regional Waste Manager

Permit No. PR-1597

30354

POLLUTION
PREVENTION

BRITISH
COLUMBIA

Suite 201
3547 Skaha Lake Road
Penticton
British Columbia V2A 7K2
Telephone: (250) 490-8200
Fax: (250) 492-1314

MINISTRY OF ENVIRONMENT,
LANDS AND PARKS

OPERATIONAL CERTIFICATE
PR 15274

Under the provisions of the Waste Management Act and in accordance with the Approved Regional District of Okanagan-Similkameen Solid Waste Management Plan,

Regional District of Okanagan-Similkameen

101 Martin Street

Penticton, British Columbia

V2A 5J9

is authorized to manage recyclable materials and discharge refuse to the ground, at the Penticton Campbell Mountain landfill facility located approximately 5 km northeast of Penticton, British Columbia, subject to the conditions listed below. Contravention of any of these conditions is a violation of the ***Waste Management Act*** and may result in prosecution.

1. AUTHORIZED DISCHARGES

1.1. The discharge of refuse to which this Sub-Section is applicable is shown on the attached Site Plan A. The Environmental Monitoring System (EMS) reference number for this discharge is E212375.

1.1.1. The maximum rate at which refuse may be discharged to the landfill is 50,000 tonnes per year.

1.1.2. The type of refuse which may be discharged is municipal solid waste and other wastes as authorized by the Regional Waste Manager.

1.1.3. The works authorized are a sanitary landfill and related appurtenances.

1.1.4. The location from which the discharge originates is generally Penticton and area.

DRAFT

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

Date Issued:
Amendment Date:
(most recent)

1.1.5. The location of the approximate area of discharge is a portion of Lot 368, Similkameen Division of Yale District, as shown on Site Plan A.

2. GENERAL REQUIREMENTS

2.1. Maintenance of Works and Emergency Procedures

The holder of the Operational Certificate shall inspect the landfill, any related pollution control works and designated areas for managing recyclable or reusable materials regularly and maintain them in good working order. In the event of an emergency or condition beyond the control of the holder of the Operational Certificate which prevents continuing operation of the authorized method of pollution control, the holder of the Operational Certificate shall immediately notify the Regional Waste Manager and take appropriate remedial action.

2.2. Process Modifications

The holder of the Operational Certificate shall notify the Regional Waste Manager prior to implementing changes to any process that may affect the quality and/or quantity of the discharge.

2.3. Plans - New Works

Plans and specifications of any new works related to this facility shall be submitted to the Regional Waste Manager and his consent obtained before construction commences. The works shall be constructed in accordance with such plans. Review of the submitted plans and specifications is for the purpose of administration of the Operational Certificate and only implies that the works specified therein meet the appropriate guidelines, criteria or standards.

2.4. Operational and Closure Plan

2.4.1. An *Operational and Closure Plan*, prepared by a suitably qualified professional, was submitted for authorization by the Regional Waste Manager on January 7, 1997. The Regional Waste Manager will provide comments and/or authorization upon completion of the review.

2.4.2. The *Operational and Closure Plan* shall include the following:

- Anticipated total waste volumes and tonnage, and life of the landfill (ie: closure date);
- A topographic plan showing the final elevation contours of the landfill and surface water diversion and drainage controls;
- Design of the final cover including the thickness and permeability of barrier layers and drainage layers, and information on topsoil, vegetative cover and erosion prevention controls;

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- Procedures for notifying the public about the closure and about alternative waste disposal facilities;
- Rodent and nuisance wildlife control procedures;
- Proposed end use of the property after closure;
- A plan and implementation schedule for monitoring groundwater, surface water and landfill gas, erosion and settlement for a minimum post-closure period of 25 years;
- A plan and accompanying design and implementation schedule for the collection, storage and treatment/use of landfill gas for a minimum of 25 years;
- A plan and implementation schedule for operation of any required pollution abatement engineering works such as leachate collection and treatment systems, for a minimum post-closure period of 25 years;
- A schedule of reserve funds or security to be collected each year until closure; to cover estimated costs of closure, post-closure and a contingency for remediation;
- A screening plan, ie: vegetative or berm;
- A perimeter fencing design;
- Litter and odour control measures;
- Contingency Plan & notification procedures in the event of an emergency;
- Training procedures for operators; and
- Any other site specific concerns as identified by the Regional Waste Manager.

2.4.3. Terms of reference for the ***Operational and Closure Plan*** are subject to authorization by the Regional Waste Manager.

2.4.4. The Regional Waste Manager may request revisions to the ***Operational and Closure Plan***. Terms of reference for the revisions to the ***Operational and Closure Plan*** are subject to authorization by the Regional Waste Manager.

2.4.5. Operation of this landfill is to be in substantial accordance with the authorized ***Operational and Closure Plan***.

2.4.6. If there should be an inconsistency between this Operational Certificate and the authorized ***Operational and Closure Plan***, the Operational Certificate shall take precedence.

2.5. Ground and Surface Water Quality Impairment

2.5.1. Landfills must be operated in a manner such that ground or surface water quality does not decrease beyond that allowed by the ***Approved and Working Criteria for Water Quality*** dated 1995 prepared by the Water Quality Branch of the Ministry of Environment, Lands and Parks at or

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beyond the landfill property boundary. A suitably qualified professional, shall review uses of the ground and surface water resources, and shall submit to the Regional Waste Manager on or before July 31, 1998 the recommended appropriate water quality criteria to be used for analytical purposes.

2.5.2. If excursions result to the specified water quality criteria, the Regional Waste Manager may require that leachate management control measures or works be undertaken. Terms of reference for any leachate management study and/or design work is subject to the authorization of the Regional Waste Manager.

2.6. Landfill Gas Management

An assessment of the emissions of non-methane organic compounds (NMOCs) is required for landfills exceeding a total capacity of 100,000 tonnes. Based on the 1996 gas generation analyses, the NMOCs have been determined, and exceed the 150 tonnes/year limit, as specified in the Landfill Criteria, therefore, landfill gas recovery and management systems are required, and are to be designed, installed and operational within 3 years.

2.7. Property Boundary

The buffer zone between any municipal solid waste discharged and the property boundary is to be at least 50 metres of which the 15 metres closest to the property boundary must be reserved for natural or landscaped screening (berms or vegetative screens). Depending on adjacent land use and environmental factors, buffer zones of less than 50 metres but not less than 15 metres may be authorized by the Regional Waste Manager.

2.8. Setbacks

The distance between the discharged municipal solid waste and the nearest residence, water supply intake, hotel, restaurant, food processing facility, school, church or public park is to be a *minimum* of *300* metres. The distance between the discharged municipal solid waste and the nearest surface water is to be a minimum of 100m Greater or lesser separation distances may be authorized by the Regional Waste Manager where justified. For those landfills designed to collect and recover methane gas generated, the issue of potential on-site or off-site users of the energy should be addressed in siting the landfill, consistent with the preceding regarding public places. An exemption is granted to discharge municipal solid waste closer than 300 m to the existing residences.

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T.R. Forty, P.Eng.
Assistant Regional Waste Manager

2.9. Natural Control Landfill

2.9.1. The bottommost solid waste cell is to be at least 1.2 metres above the seasonal high water table. Greater or lesser separation depths may be authorized based on soil permeability and the leachate renovation capability of the soil.

2.9.2. There is to be at least a 2 metres thick layer of low permeability soil with a hydraulic conductivity of 1 x 10-6 cm/s or less (i.e. silt or clay), below each of the bottommost waste cells. Lesser thicknesses or no layer of low permeability soil may be authorized based on the potential for leachate generation and the unsaturated depth, permeability and leachate renovation capability of the existing soil.

2.10. Water

The disposal of municipal solid waste into water is unacceptable. Surface water diversion to restrict storm water runoff from contacting the wastes is required.

2.11. Final Cover

Final cover for landfill sites is to consist of a minimum of 1 metre of low permeability (<1 x 10-5 cm/s) compacted soil plus a minimum of 0.15 metre of topsoil with authorized vegetation established. The depth of the topsoil layer should be related to the type of vegetation proposed (ie rooting depth). Soils of higher permeability may be authorized based on leachate generation potential at the landfill site. Final cover is to be constructed with slopes between 4% and 33% with appropriate run-on/run-off drainage controls and erosion controls. An assessment of the need for gas collection and recovery systems shall be made so that, in the event such systems are required, cover can be appropriately designed and constructed. Final cover is to be installed within 90 days of landfill closure or on any areas of the landfill which will not receive any more refuse within the next 12 months. Completed portions of the landfill are to progressively receive final cover during the active life of the landfill.

Additional layers of natural materials including earth and aggregate and/or synthetic materials may be necessary for inclusion in the final cover design due to site specific conditions and the presence of management systems for leachate and landfill gas.

2.12. Access Road

An appropriately constructed and maintained access road to, and a road system within the landfill site capable of supporting all vehicles hauling waste, are required during the operating life of the landfill.

2.13. Fencing and Access

2.13.1. Fencing is required to be installed around the perimeter of the landfill on or before April 1, 1999. The type and extent of fencing will depend on the existing natural vegetation and topographic features and is to be authorized by the Regional Waste Manager. All access points are to have locking gates.

2.13.2. Bears shall be prevented from accessing any and all putrescible refuse from April to November inclusive through the use of electric fencing. Electric fencing is to be installed on or before April 1, 1999, and maintained thereafter.

2.13.3. The holder of the Operational Certificate is to conduct a public relations campaign 3 months prior to the installation of electric fencing. The purpose of the campaign is to inform the public of the impacts of installing electric fencing around the landfill. The Conservation Officer Service is to be consulted in the development of the public relations campaign.

2.13.4. Signage is to be attached to the electric fence at regular intervals with an appropriate safety warning indicating the fence is electrified.

2.14. Design by Qualified Persons

All landfills are to be designed by persons qualified in landfill site selection, design and operation. All plans, specifications, and reports are to be sealed by a professional engineer or geoscientist licensed to practice in the Province of British Columbia.

2.15. Prohibited Wastes

The co-disposal of the following wastes with the rest of the municipal solid waste is prohibited unless specifically authorized by the Regional Waste Manager:

- Special Wastes other than those specifically authorized in the ***Special Waste Regulation***
- Bulk liquids and semisolid sludges which contain free liquid;
- Liquid or semisolid wastes including septage, black water, sewage treatment sludge, etc.;
- Automobiles, white goods, other large metallic objects and tires;
- Biomedical waste as defined in the document ***Guidelines for the Management of Biomedical Waste in Canada*** (CCME, February 1992); and
- Dead animals and slaughter house, fish hatchery and farming wastes or cannery wastes and byproducts.

Burial of these wastes in dedicated locations (i.e. avoiding co-disposal) at a landfill site may be authorized by the Regional Waste Manager only if there is no other viable alternative such as treatment/disposal, recycling, reprocessing or composting. The viability of alternatives is to be determined by the Regional Waste Manager based on submission of cost data by the holder of the Operational Certificate. For those cases in which the dedicated disposal of otherwise prohibited wastes is authorized, the specific on-site location of the disposal shall be recorded to allow ready access to the waste should corrective or further action pertaining to the management of these wastes be required by the Ministry at some time in the future.

2.16. Hydrocarbon Contaminated Soils

The deposit of hydrocarbon contaminated soils below the ***Special Waste Regulation*** criteria is authorized at this landfill subject to the following conditions:

- Soil contaminated with hydrocarbons shall be deposited in layers less than 0.3 meters; and
- Soil contaminated with hydrocarbons shall be deposited a minimum of 1.2 meters above the seasonal high groundwater level and a minimum of 2.0 meters below the final grade of the landfill to prevent the impact on groundwater and any future vegetation on the site.

2.17. Designated Areas

Maintain areas for the separation, handling and storage of recyclable or reusable materials where applicable.

When a separated recyclable material is a special waste it is to be stored and managed in accordance with the ***Special Waste Regulation***.

2.18. Signs

A sign is to be posted at each entrance of the landfill with the following current information:

- Site name
- Owner and operator
- Contact phone number and address for owner and operator
- Phone number in case of emergency (such as fire)
- Hours of operation (if applicable)
- Materials/wastes accepted for landfill and recycling
- Materials/wastes banned
- Tipping fees (if applicable)

Additional signs which clearly indicate the directions to the active tipping face, public disposal area, recycling and waste separation areas, etc. should also be displayed.

2.19. Supervision

Fulltime, trained operators on-site are required at this landfill during operating hours. The gates are to be locked to prevent unauthorized access during non-operating hours. Properly designed and maintained public waste disposal and/or recyclable material bins situated outside the main gate may be provided for after hours use. The operator is required to be familiar with the Operational Certificate, inspection records, the authorized ***Operations and Closure Plan*** and all annual reports.

2.20. Scavenging

Scavenging of waste is to be prevented. The salvaging of wastes should be encouraged by providing areas and facilities for separation of recyclable or reusable materials.

2.21. Dust Control

Dust created within the landfill property is to be controlled, using methods and materials acceptable to the Regional Waste Manager, such that it does not cause a public nuisance.

2.22. Waste Compaction and Covering

2.22.1. Wastes are to be spread in thin layers (0.6 m or less) on the working face and compacted. The working face area should be minimized as much as possible. A compacted layer of cover material of at least 0.15 metre of soil or functionally equivalent depth of other cover material, as authorized by the Regional Waste Manager, is to be placed on all exposed solid waste at the end of each day of operation. If the landfill should operate continuously 24 hours per day, 0.15 m of cover material is to be applied at a frequency authorized by the Regional Waste Manager. Under specific circumstances, such as during bear season, the Regional Waste Manager may specify more stringent cover requirements. During periods of extreme weather conditions, such as those that cause the ground to freeze, an exemption to the normal cover requirements may be authorized at a frequency authorized by the Regional Waste Manager.

2.22.2. An intermediate cover consisting of a compacted layer of at least 0.30 metre of soil or functionally equivalent depth of other cover material is to be placed where no additional solid waste has been deposited or will be deposited within a period of 30 days.

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T.R. Forty, P.Eng.
Assistant Regional Waste Manager

2.23. Litter Control

Litter is to be controlled by compacting the waste, minimizing the working face area, applying cover, providing litter control fences and instituting a regular litter pickup and general good housekeeping program or any other measures required by the Regional Waste Manager.

2.24. Vectors

Vectors are to be controlled by the application of cover material at a specified frequency or by other control measures as required and authorized by the Regional Waste Manager.

2.25. Wildlife

The landfill is to be operated so as to minimize the attraction of wildlife such as bears and birds by applying cover at required frequencies and instituting a good housekeeping program. Further control measures, such as bear control fences, and bird control devices, may be specified by the Regional Waste Manager.

2.26. Fire Protection

Adequate fire fighting equipment is to be available to extinguish surface or underground fires. Recyclables and reusable materials are to be stored in such a manner to not constitute a fire hazard.

2.27. Open Burning

Open burning is not authorized at this facility.

3. MONITORING AND REPORTING REQUIREMENTS

3.1. Municipal Solid Waste Measurement

3.1.1. Provide and maintain a weigh scale and record the weight of refuse discharged to the landfill over a 24-hour period.

3.1.2. Record the weight of recyclable and reusable materials not being discharged and that are being separated, stored or processed at the landfill over a 24-hour period.

3.1.3. Density tests are to be performed utilizing a known scaled volume of representative compacted refuse at a frequency of at least once per year and reported in kg per m3.

3.2. Water Levels

Measure the water level and determine the elevation, on a quarterly basis, in monitoring wells BH 101 (EMS# E229418) BH 102 (EMS# E229419), BH 103 (EMS# E229420), BH 104 (EMS# E229421), BH 105 (EMS# E229422) and BH 106 (EMS# E229423) as shown on Site Plan B. Measure the water level and determine the elevation, on an annual basis, in water supply well (EMS# 229582) on District Lot A, Plan 34160 as shown on Site Plan B.

Sold + not used (Don Hamilton)

3.3. Water Quality

3.3.1. Obtain a grab sample of water, on a quarterly basis, in monitoring wells BH 102, BH 103, BH 104, Randolph Spring (EMS# E229579), sedimentation pond (EMS# 229580), and on an annual basis, the water supply well on District Lot A, Plan 34160; as shown on Site Plan B.

3.3.2. Obtain analyses of the samples in section 3.3.1 for the following:

conductivity, pH, chloride, total kjeldahl nitrogen, ammonia nitrogen, nitrate nitrogen, nitrite nitrogen, total organic nitrogen, total nitrogen, BOD, total organic carbon, total coliforms, fecal coliforms and dissolved metals of aluminum, arsenic, barium, boron, cadmium, chromium, cobalt, iron, lead, manganese, mercury, molybdenum, nickel, potassium, silver, sodium, selenium and zinc.

3.3.3. Obtain grab samples annually of the water in monitoring wells BH 102, BH 103, BH 104, Randolph Spring and the sedimentation pond as shown on Site Plan B.

3.3.4. Obtain analyses of the samples in section 3.3.3 for microtoxicity.

3.4. Vegetation Monitoring

Inspect vegetation during the growing season in the vicinity of the landfill at least once per year to determine if any environmental impacts are occurring.

3.5. Sampling and Analytical Requirements

3.5.1. The sampling and monitoring requirements specified above shall be carried out in accordance with the appropriate procedures listed in the table below. Alternative test methods may be used provided that the alternative test methods are authorized by the Regional Waste Manager prior to performing the actual source testing. Test methods for parameters not listed below require the consent of the Regional Waste Manager.

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Assistant Regional Waste Manager

DISCHARGES TO AIR, AMBIENT AIR:		
Parameter	**Source Testing Procedure**	**Analytical Procedure**
Particulate Matter Rate of Discharge (flow rate) Gaseous emissions	Stationary Emission Testing Code - contained in British Columbia Field Sampling Manual for Continuous Monitoring plus the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples, 1996 Permittee Edition	A Laboratory Manual for the Chemical Analysis of Ambient Air, Emissions, Precipitation, Soil and Vegetation, 3rd edition, April, 1983, 253 pp.
LIQUID EFFLUENTS, SURFACE WATER, GROUND WATER, SOILS, SEDIMENTS, VEGETATIVE MATTER:		
Parameter	**Source Testing Procedure**	**Analytical Procedure**
Metals Nutrients Organics Toxicity	British Columbia Field Sampling Manual for Continuous Monitoring plus the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples, 1996 Permittee Edition	British Columbia Environmental Laboratory Manual for the Analysis of Water, Wastewater, Sediment and Biological Materials, March, 1994, Permittee Edition

The above manuals are available from Queen's Printer Publications Centre, P.O. Box 9452, Stn. Prov. Govt, Victoria, BC, V8W 9V7 (1-800-663-6105 or (250) 387-4609). The above manuals are also available for inspection at all Pollution Prevention offices.

3.5.2. Proper care should be taken in sampling, storing and transporting the samples to adequately control temperature and avoid contamination and breakage.

3.5.3. Maintain the groundwater monitoring wells including provisions to ensure protection from damage due to vehicles or vandalism.

3.5.4. Groundwater monitoring wells are to be covered with lockable caps, fitted with locks all keyed alike, and a key is to be provided to the Regional Waste Manager.

3.5.5. Three well bore volumes are to be pumped from each monitoring well prior to sample collection.

3.6. Changes to Sampling and Monitoring Program

On the basis of findings during routine inspections and any other information related to the effect of the discharge on the receiving environment, the Regional Waste Manager may allow reductions or require additional sampling and monitoring of the discharge and receiving environment.

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Assistant Regional Waste Manager

3.7. Annual Report

An annual operations and monitoring report is to be submitted to the Regional Waste Manager within 60 days of the end of the calendar year. The first annual report is due on March 1, 1998. These reports are to contain at least the following information:

- Total volume and/or weight of waste discharged into the landfill for the year;
- Service population and waste discharge rate for the year (in tonnes per capita per year) and a trend analysis with a comparison to the 1991 baseline waste discharge rate of 1.2 tonnes per capita per year ;
- Authorized design volume;
- Remaining site life and capacity;
- Operational plan for next 12 months;
- Operation and maintenance expenditures;
- Monitoring data compilation, interpretation and trend analysis prepared by a suitably qualified professional regarding landfill gas, vegetation and leachate/water quality including a review of groundwater elevations and flow direction and a comparison made to the appropriate parameters found in the *Approved and Working Criteria for Water Quality* dated April 1995;
- Amounts of leachate collected, treated and disposed;
- Any changes from authorized reports, plans and specifications;
- any changes to the contingency plan;
- Amount of landfill gas collected and its disposition;
- Review of the closure plan and associated estimated costs, including an update of the schedule of reserve funds or security to be collected each year until closure; to cover estimated costs of closure, the 25 year post-closure period and a contingency for remediation; and
- Any other data relevant to this Operational Certificate

3.8. Format of Submission

Monitoring and/or reporting information shall be submitted in an electronic and/or printed format which is suitable for review by the public and/or other government agencies and is satisfactory to the Regional Waste Manager.

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Assistant Regional Waste Manager

3.9. Financial Security

Provide a future financial security for the operations at and beyond closure by establishing a Closure Fund in a form acceptable to the Regional Waste Manager, such as upfront security or a fund financed on a charge per tonne of waste disposed basis. Such a fund would be analogous to the provincial Waste Management Trust Fund which the Minister may establish under Section 53 of the ***Waste Management Act***. The ultimate amount of the financial security shall meet or exceed the currently estimated closure and post-closure costs as outlined in the closure plan plus a reasonable contingency for any remediation which may be required. For municipally owned landfills, the financial security can be built up over time according to a schedule authorized by the Regional Waste Manager.

3.10. Declaration of Landfill

Landfills sited on titled land must register a covenant that the property was used for the purpose of waste disposal as a charge against the title to the property as provided for under Section 215.1 of the ***Land Title Act***. Landfills located on crown land are to have a "notation on file" registered that the property was used for the purpose of waste disposal.

3.11. Buildings and Structures

The construction of buildings and other structures on landfills containing putrescible wastes is not recommended for a minimum period of 25 years after closure due to concerns about combustible gas and excessive settlement. Such activity will only be considered and /or authorized after an investigation and report by qualified persons. The report is to be submitted for authorization to the Regional Waste Manager prior to initiating construction activities.

3.12. Operation of Gas Recovery and Management System

Where landfill gas recovery and management is required, operation of the system should be considered an integral part of overall landfill management. The system should be planned for from the early design stage of the landfill and arrangements made for its operation for a minimum 25 year life after closure.

3.13. Operation of Other Control Systems

Operation of other environmental control systems for leachate and run-off as well as monitoring of leachate, groundwater and surface water must be continued during the entire post-closure period unless the early suspension of such operations or monitoring is authorized by the Regional Waste Manager.

PROVINCE OF
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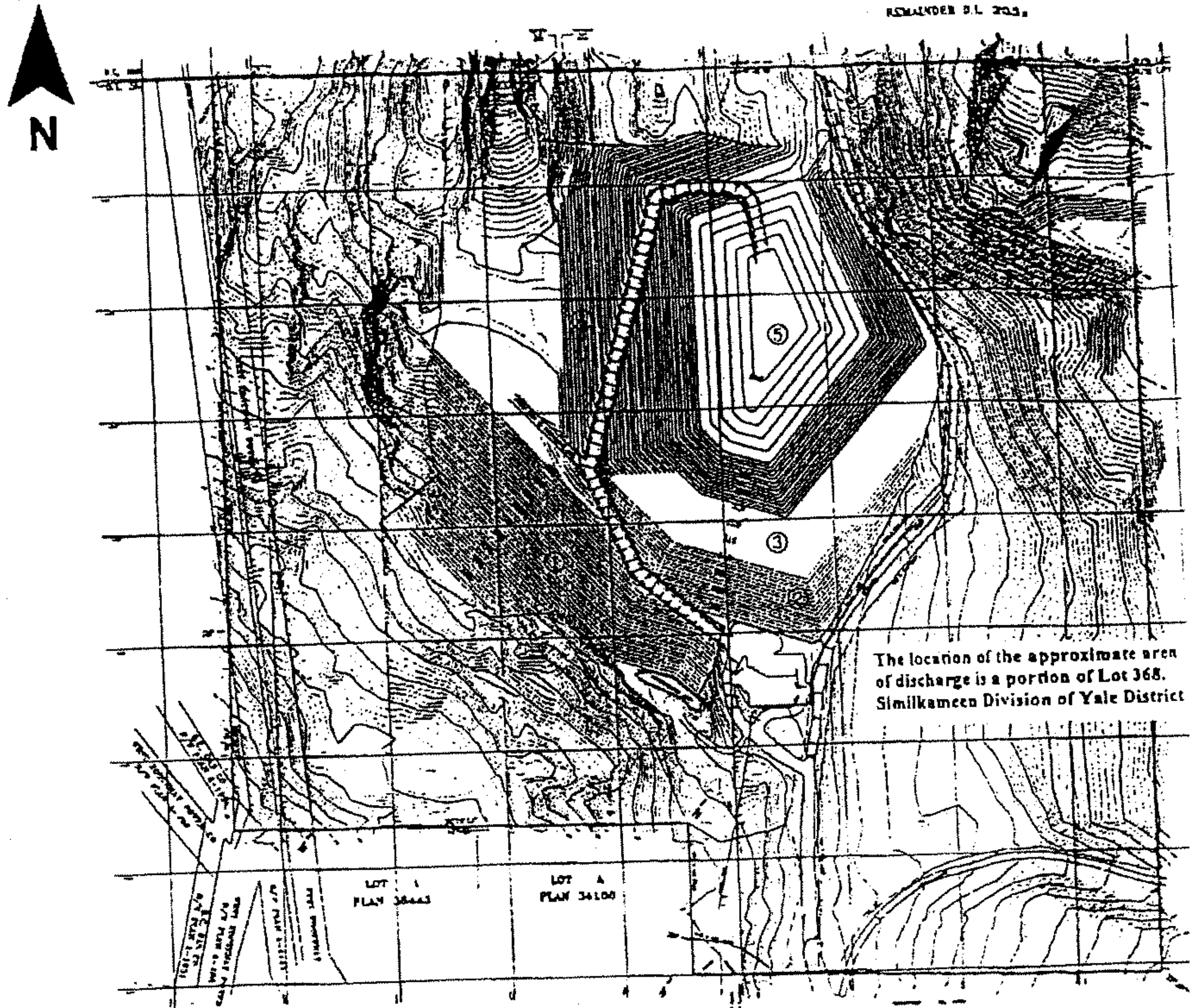
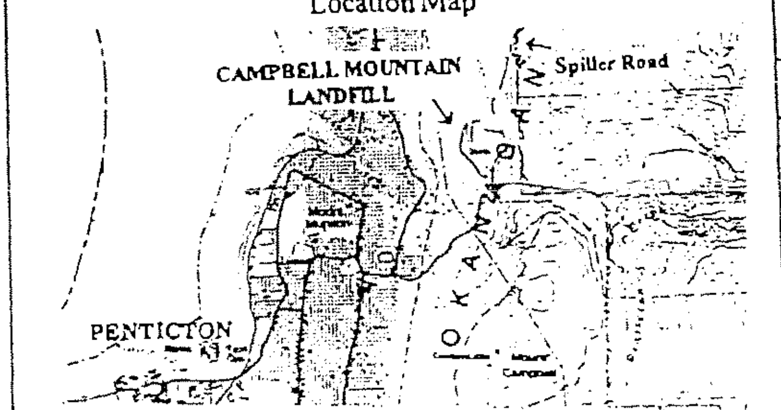
Pollution Prevention

SITE PLAN A



Scale: NTS



Permit No.: PR-15274

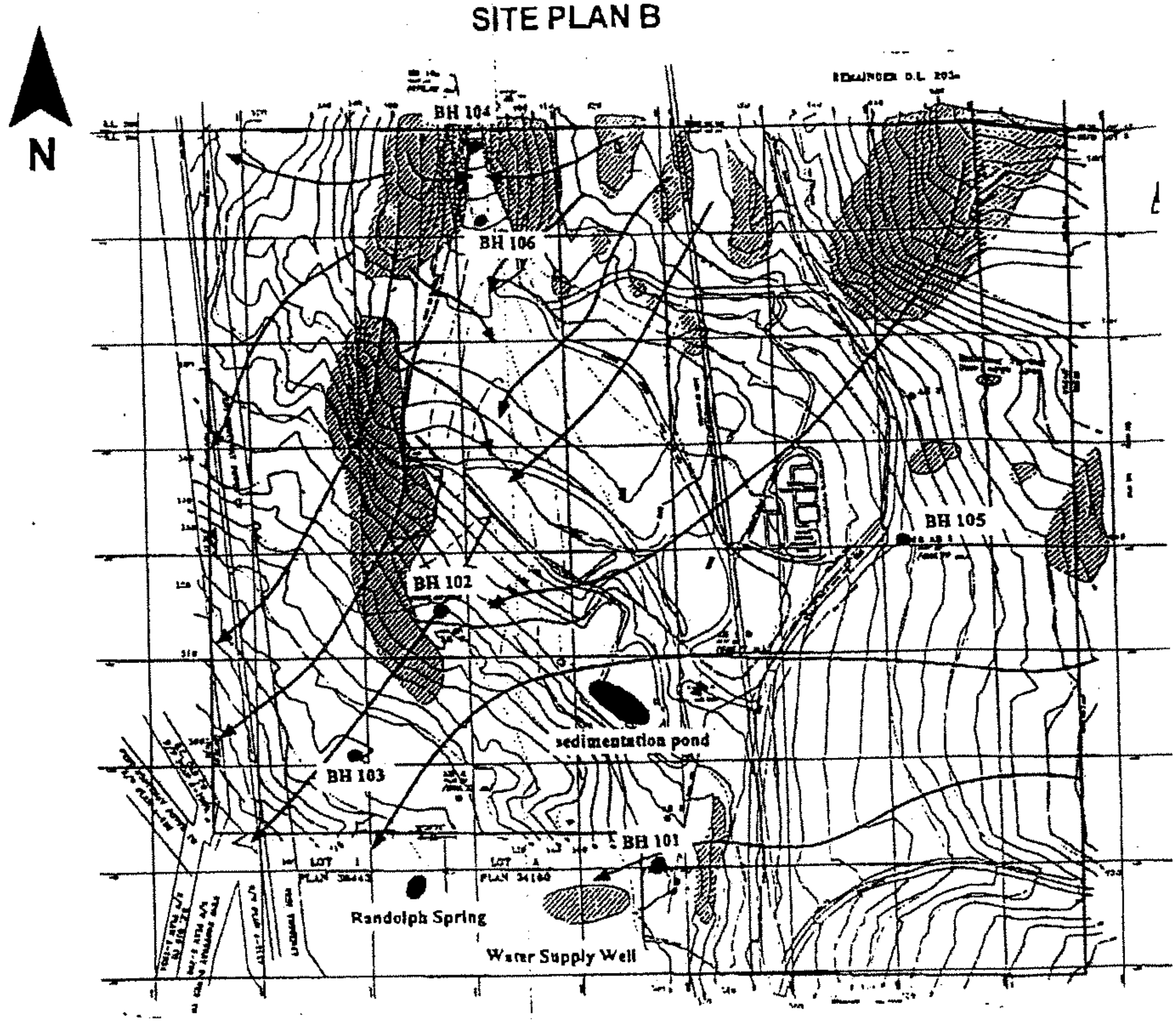
Date:

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

PROVINCE OF
BRITISH COLUMBIA

Pollution Prevention

SITE PLAN B



Scale: NTS

Permit No.: PR-15274

Date:

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

December 3, 1997

Notice of Intent to Issue an Operational Certificate to the Regional District of Okanagan-Similkameen under Sections 18(5) of the Waste Management Act

Please take notice that pursuant to Section 18(5) of the Waste Management Act, and Sections 4(6) and 7 of the Public Notification Regulation (B.C. Reg. 202/94), that the Assistant Regional Waste Manager intends to issue an **Operational Certificate No. PR-15274** in the name of the Regional District of Okanagan-Similkameen, 14 days from the date of this publication.

This Operational Certificate is in accord with the Regional District of Okanagan-Similkameen's Solid Waste Management Plan approved by the Minister of Environment, Lands and Parks, and contains the operational requirements for the Penticton Campbell Mountain Landfill.

Any person who considers that they may be adversely affected by the issuance of the aforementioned Operational Certificate may inspect the proposed Operational Certificate **at the Ministry of Environment, Lands and Parks office at 201-3547 Skaha Lake Road, Penticton BC or the Regional District of Okanagan-Similkameen office at 101 Martin Street, Penticton BC** and provide comments to the Assistant Regional Manager Waste Manager respecting the requirements of this Operational Certificate.

For the Assistant Regional Waste Manager to give consideration to submitted comments, they must be received by the Assistant Regional Waste Manager within 14 days of the date of the publication of this notice.

T.R. Forty, P.Eng.
Assistant Regional Waste Manager
Pollution Prevention
Southern Interior Region

APPENDIX B

2008 TEST PIT STRATIGRAPHY LOGS

TEST PIT STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: Northern Buffer Area Assessment
PROJECT NUMBER: 33765-21
CLIENT: RDOS
LOCATION: Campbell Mountain Landfill

HOLE DESIGNATION: TP05-08
DATE COMPLETED: May 5, 2008
TEST PIT METHOD: Excavator
FIELD PERSONNEL: Z.Ferreira

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (m)	SAMPLE 'N' VALUE
0.0–0.75	SM- Silty SAND with trace gravel, fine grained, poorly graded, light brown, dry, rooty					
0.75–3.30	SWG - Gravelly, Silty SAND, well graded, sub-rounded gravel, light brown, dry	0.75				
	END OF BOREHOLE @ 3.30m BGS Easting 0315668 Northing 5489136 (GPS Handheld Unit) CH4 and CO2 was not detected	3.30	1			

Depth scale (m BGS): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

TEST PIT STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: Northern Buffer Area Assessment
PROJECT NUMBER: 33765-21
CLIENT: RDOS
LOCATION: Campbell Mountain Landfill

HOLE DESIGNATION: TP06-08
DATE COMPLETED: May 5, 2008
TEST PIT METHOD: Excavator
FIELD PERSONNEL: Z.Ferreira

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (m)	SAMPLE 'N' VALUE
	SM- Silty SAND with gravel and trace cobbles, fine grained sand, poorly graded sand, light brown, dry					
0.5						
1.0						
1.5			1			
2.0						
2.5						
3.0						
	- Refusal at 3.40m BGS	3.40	2			
3.5	END OF BOREHOLE @ 3.40m BGS Easting 0315726 Northing 5489121 (GPS Handheld Unit) CH4 and CO2 was not detected					
4.0						
4.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

TEST PIT STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: Northern Buffer Area Assessment
HOLE DESIGNATION: TP07-08
PROJECT NUMBER: 33765-21
DATE COMPLETED: May 5, 2008
CLIENT: RDOS
TEST PIT METHOD: Excavator
LOCATION: Campbell Mountain Landfill
FIELD PERSONNEL: Z.Ferreira

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (m)	SAMPLE 'N' VALUE
0.0–1.0	SM- Silty SAND, fine grained, poorly graded, light brown, dry, rooty	1.00				
1.0–3.0	GWS- Silty GRAVEL and SAND, well graded, sub-rounded/rounded gravel, light brown, dry	3.00	1			
3.0	END OF BOREHOLE @ 3.00m BGS Easting 0315668 Northing 5489088 (GPS Handheld Unit) CH4 and CO2 was not detected					

Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS

TEST PIT STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: Northern Buffer Area Assessment
PROJECT NUMBER: 33765-21
CLIENT: RDOS
LOCATION: Campbell Mountain Landfill

HOLE DESIGNATION: TP08-08
DATE COMPLETED: May 5, 2008
TEST PIT METHOD: Excavator
FIELD PERSONNEL: Z.Ferreira

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (m)	SAMPLE 'N' VALUE
	SM - Silty SAND with trace gravel, fine grained, poorly graded, light brown, dry, rooty					
	SWG - Gravelly, Silty SAND, well graded, light brown, dry	1.30	1			
	END OF BOREHOLE @ 2.70m BGS Easting 0315730 Northing 5489086 (GPS Handheld Unit) CH4 and CO2 was not detected	2.70	2			

Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS

TEST PIT STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: Northern Buffer Area Assessment
HOLE DESIGNATION: TP09-08
PROJECT NUMBER: 33765-21
DATE COMPLETED: May 5, 2008
CLIENT: RDOS
TEST PIT METHOD: Excavator
LOCATION: Campbell Mountain Landfill
FIELD PERSONNEL: Z.Ferreira

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (m)	SAMPLE 'N' VALUE
	SWG - Gravelly, Silty SAND, well graded, brown, dry					
0.5						
1.0						
1.5						
2.0			1			
2.5						
3.0						
3.5						
4.0						
	END OF BOREHOLE @ 4.25m BGS	4.25	2			
4.5	Easting 0315590 Northing 5489056 (GPS Handheld Unit)					
	CH4 and CO2 was not detected					

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ☐

TEST PIT STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: Northern Buffer Area Assessment
PROJECT NUMBER: 33765-21
CLIENT: RDOS
LOCATION: Campbell Mountain Landfill

HOLE DESIGNATION: TP10-08
DATE COMPLETED: May 5, 2008
TEST PIT METHOD: Excavator
FIELD PERSONNEL: Z.Ferreira

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (m)	SAMPLE 'N' VALUE
	Refuse					
0.5	SM - Silty SAND with trace silt, fine grained, poorly graded, greyish brown, moist	0.50				
1.0						
1.5	SWG - Gravelly, Silty SAND with cobbles, well graded, brown, dry	1.50	1			
2.0						
2.5						
3.0	- Refusal at 3.00m BGS END OF BOREHOLE @ 3.00m BGS Easting 0315640 Northing 5489038 (GPS Handheld Unit) CH4 and CO2 was not detected	3.00	2			
3.5						
4.0						
4.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS

TEST PIT STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: Northern Buffer Area Assessment
HOLE DESIGNATION: TP11-08
PROJECT NUMBER: 33765-21
DATE COMPLETED: May 5, 2008
CLIENT: RDOS
TEST PIT METHOD: Excavator
LOCATION: Campbell Mountain Landfill
FIELD PERSONNEL: Z.Ferreira

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (m)	SAMPLE 'N' VALUE
	Refuse					
1.0	SM - Silty SAND with gravel, poorly graded, brown, dry	1.00				
1.5	- Refusal at 1.50m BGS	1.50	1			
	END OF BOREHOLE @ 1.50m BGS Easting 0315450 Northing 5488982 (GPS Handheld Unit) CH4 and CO2 was not detected					

Depth scale (m BGS): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

TEST PIT STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: Northern Buffer Area Assessment
HOLE DESIGNATION: TP13-08
PROJECT NUMBER: 33765-21
DATE COMPLETED: May 5, 2008
CLIENT: RDOS
TEST PIT METHOD: Excavator
LOCATION: Campbell Mountain Landfill
FIELD PERSONNEL: Z.Ferreira

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	SAMPLE NUMBER	INTERVAL	REC (m)	'N' VALUE
	SWG - Gravelly, Silty SAND with cobbles, well graded, brown, dry					
	- Refusal at 2.20m BGS	2.20	1			
	END OF BOREHOLE @ 2.20m BGS Easting 0315702 Northing 5489031 (GPS Handheld Unit) CH4 and CO2 was not detected					

Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS

TEST PIT STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: Northern Buffer Area Assessment
PROJECT NUMBER: 33765-21
CLIENT: RDOS
LOCATION: Campbell Mountain Landfill

HOLE DESIGNATION: TP16-08
DATE COMPLETED: May 5, 2008
TEST PIT METHOD: Excavator
FIELD PERSONNEL: Z.Ferreira

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (m)	SAMPLE 'N' VALUE
	SWG - Gravelly, Silty SAND with cobbles, well graded, brown, dry					
1.5	- Refusal at 1.50m BGS					
	END OF BOREHOLE @ 1.60m BGS Easting 0315765 Northing 5488926 (GPS Handheld Unit) CH4 and CO2 was not detected	1.60	1			

Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ☐

TEST PIT STRATIGRAPHIC LOG
(OVERBURDEN)

PROJECT NAME: Northern Buffer Area Assessment	HOLE DESIGNATION: TP18-08
PROJECT NUMBER: 33765-21	DATE COMPLETED: May 5, 2008
CLIENT: RDOS	TEST PIT METHOD: Excavator
LOCATION: Campbell Mountain Landfill	FIELD PERSONNEL: Z.Ferreira

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (m)	SAMPLE 'N' VALUE
0.0–2.5	Refuse					
2.5	END OF BOREHOLE @ 2.50m BGS Easting 0315662 Northing 5488848 (GPS Handheld Unit) CH4 and CO2 was not detected	2.50				

Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

TEST PIT STRATIGRAPHIC LOG (OVERBURDEN)

PROJECT NAME: Northern Buffer Area Assessment
PROJECT NUMBER: 33765-21
CLIENT: RDOS
LOCATION: Campbell Mountain Landfill

HOLE DESIGNATION: TP19-08
DATE COMPLETED: May 5, 2008
TEST PIT METHOD: Excavator
FIELD PERSONNEL: Z.Ferreira

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (m)	SAMPLE 'N' VALUE
	SWG - Gravelly, Silty SAND, well graded, brown, dry					
0.5						
1.0	END OF BOREHOLE @ 1.00m BGS Easting 0315731 Northing 5488895 (GPS Handheld Unit) CH4 and CO2 was not detected	1.00				
1.5						
2.0						
2.5						
3.0						
3.5						
4.0						
4.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

APPENDIX C

STRATIGRAPHY AND INSTRUMENTATION LOGS

Northern Soil Gas Probes

BOREHOLE LOG

SPERLING HANSEN ASSOCIATES

Borehole: **GP1-1, GP1-2, GP1-3**
Client: Regional District of Okanagan-Similkameen
Project: Landfill Gas Assessment
Site: Campbell Mountain Landfill

Project Num: PRJ00005
Date: 06-May-00
Logged By: Cliff Syroid

Graphic Log

Depth	From (m)	To (m)	Description
	0.0	9.1	Silty SAND few pebbles
5 m			
	9.14	10.06	Bedrock
10 m			

Completion Details

From (m)	To (m)	Material
0.0	0.6	Concrete
1.0	1.8	Bentonite Seal
2.4	2.9	Bentonite Seal
2.9	6.0	Sand Pack
6.0	8.41	Bentonite Seal
8.4	10.1	Sand Pack

From (m)	To (m)
	Screen 1.52m Length
	Screen 1.52m Length
	Screen 1.52m Length

END OF BOREHOLE @ 10.06 m

Borehole Location: East side of property access from Spiller Road down a short access road outside of bear fence.

Notes: All depth are from ground surface.
Stickup of 25mm PVC : GP1-1=? M GP1-2=?m, GP1-3=?m .

BOREHOLE LOG

SPERLING HANSEN ASSOCIATES

Borehole: **GP-2-1**
Client: Regional District of Okanagan-Similkameen
Project: Landfill Gas Assessment
Site: Campbell Mountain Landfill

Project Num: PRJ00005
Date: 07-May-00
Logged By: Cliff Syroid

Graphic Log

Depth	From (m)	To (m)	Description
	0.0	2.4	Silty SAND few pebbles
	2.4	2.8	Bedrock
5 m			

Completion Details

From (m)	To (m)		From (m)	To (m)
0.0	0.5	Concrete		Screen 2.44m length
0.5	1.0	Bentonite Seal		
1.0	2.8	Sand Pack		

END OF BOREHOLE @ 2.82 m

Borehole Location: East side of property access from Spiller Road down a short access road outside of bear fence.

Notes: All depth are from ground surface.
Stickup of 25mm PVC = 0.89 m.

BOREHOLE LOG

SPERLING HANSEN ASSOCIATES

Borehole: **GP-3-1**
Client: Regional District of Okanagan-Similkameen
Project: Landfill Gas Assessment
Site: Campbell Mountain Landfill

Project Num: PRJ00005
Date: 08-May-00
Logged By: Cliff Syroid

Graphic Log

Depth	From (m)	To (m)	Description
	0.0	2.4	Silty SAND few pebbles
	2.4	2.5	Bedrock
5 m			

Completion Details

From (m)	To (m)		From (m)	To (m)
0.0	0.5	Concrete		Screen 1.22m length
0.5	1.0	Bentonite Seal		
1.0	2.5	Backfill with Native Material		

END OF BOREHOLE @ 2.53 m

Borehole Location: East side of property access from Spiller Road down a short access road outside of bear fence.

Notes: All depth are from ground surface.
Stickup of 25mm PVC = 1.12 m.
Drilled first then backfilled, then relocated with backhoe and installed.

BOREHOLE LOG

SPERLING HANSEN ASSOCIATES

Borehole: GP9-1
Client: Regional District of Okanagan-Similkameen
Project: Landfill Gas Assessment
Site: Campbell Mountain Landfill

Project Num: PRJ00005
Date: 08-May-00
Logged By: Cliff Syroid

Graphic Log

From (m)	To (m)	Description
0.0	0.8	Silty SAND few pebbles
0.76	2.44	Bedrock

Completion Details

From (m)	To (m)	Material
0.0	0.5	Concrete
0.5	1.0	Bentonite Seal
1.0	2.4	

From (m)	To (m)
	Screen 1.52m length

Depth: 5 m

END OF BOREHOLE @ 2.44 m

Borehole Location: Along the Hydro easement at the bottom of access road hill on west side of landfill property.

Notes:
All depth are from ground surface.
Stickup of 51mm PVC = 0.73 m.

BOREHOLE LOG

SPERLING HANSEN ASSOCIATES

Borehole: GP10-1
Client: Regional District of Okanagan-Similkameen
Project: Landfill Gas Assessment
Site: Campbell Mountain Landfill

Project Num: PRJ00005
Date: 08-May-00
Logged By: Cliff Syroid

Graphic Log

From (m)	To (m)	Description
0.0	4.6	Silty SAND few pebbles
4.6		Bedrock Bottom

Completion Details

From (m)	To (m)	Material
0.0	0.5	Concrete
0.5	1.0	Bentonite Seal
1.0	4.6	Backfill with Native Material

From (m)	To (m)
	Screen 3.05m length

Depth: 5 m

END OF BOREHOLE @ 4.57 m

Borehole Location: Bottom of the North Gully inside of the bear fence.

Notes:
All depth are from ground surface.
Stickup of 25mm PVC = 1.07 m.
Installed with a backhoe.

BOREHOLE LOG

SPERLING HANSEN ASSOCIATES

Borehole:	GP11-1
Client:	Regional District of Okanagan-Similkameen
Project:	Landfill Gas Assessment
Site:	Campbell Mountain Landfill
Project Num:	PRJ00005
Date:	08-May-00
Logged By:	Cliff Syroid

Graphic Log

Depth	From (m)	To (m)	Description
	0.0	3.3	ROCK FILL silty Sand
	3.30		Bedrock Bottom
5 m			

Completion Details

From (m)	To (m)		From (m)	To (m)
0.0	0.5	Concrete		Screen 1.83m length
0.5	1.0	Bentonite Seal		
1.0	3.3	Backfill with Native Material		

END OF BOREHOLE @ 3.3 m

Borehole Location: East of the North Gully half way up the hill inside the bear fence.

Notes:
All depth are from ground surface.
Stickup of 51mm PVC = 1.14 m.
Installed with a backhoe.

BOREHOLE LOG

SPERLING HANSEN ASSOCIATES

Borehole:	GP12-1
Client:	Regional District of Okanagan-Similkameen
Project:	Landfill Gas Assessment
Site:	Campbell Mountain Landfill
Project Num:	PRJ00005
Date:	08-May-00
Logged By:	Cliff Syroid

Graphic Log

Depth	From (m)	To (m)	Description
	0.0	4.5	Silty SAND few pebbles
	4.5		Bedrock Bottom
5 m			

Completion Details

From (m)	To (m)		From (m)	To (m)
0.0	0.5	Concrete		Screen 3.05m length
0.5	1.0	Bentonite Seal		
1.0	4.6	Backfill with Native Material		

END OF BOREHOLE @ 4.45 m

Borehole Location: East of the North Gully top up the hill inside the bear fence.

Notes:
All depth are from ground surface.
Stickup of 25mm PVC = 1.04 m.
Installed with a backhoe.

SPERLING HANSEN ASSOCIATES

SYMBOLS & ABBREVIATIONS ON LOGS

Graphic Log / Description

- CONCRETE / ASPHALT
- CLAY
- SILT
- SAND Fine to Medium
- SAND Medium to Coarse
- GRAVEL
- FILL
- HUMIC HORIZON / PEAT

Grain Size Proportions

	%
trace, eg. "trace sand"	1 to 10
some, eg. "some sand"	10 to 20
adjective, eg. "sandy"	20 to 35
and, eg. "and sand"	35 to 50
noun, eg. "sand"	> 50

Note: approximate measure, based on field observations rather than a soil test.

Proportions > 75 mm

- isolated, eg "isolated cobbles"
- occasional, eg. "occasional cobbles"
- frequent, eg. "frequent cobbles"
- numerous, eg. "numerous cobbles"
- noun, eg. "cobbles"

Moisture Condition

Dry -	absence of moisture, dry to the touch
Damp	damp but no visible water
Moist -	moist but no visible water
Wet -	soil is damp, contains noticeable water
Saturated -	soil is completely wetted to excess
Free water -	excess water, soil is dripping

Soil Classification System

Type		Grain Size (mm)		
	Boulders		>	300
	Cobbles	75	-	300
Gravel:				
	Coarse	75	-	19
	Fine	19	-	4.8
Sand:				
	Coarse	4.8	-	2.0
	Medium	2.0	-	0.43
	Fine	0.43	-	0.08
Fines:				
	Silts	0.08	-	0.002
	Clays		<	0.002

Note: based on the Unified Soil Classification System (USCS)

Soil Descriptions

Cohesionless Soils

Relative Density	S.P.T. Value		
Very Loose	0	to	4
Loose	4	to	10
Compact	10	to	30
Dense	30	to	50
Very Dense		>	50

Cohesive Soils

Consistency	S.P.T. Value			C_u (kPa)		
Very Soft	0	to	2	0	to	12
Soft	2	to	4	12	to	25
Firm	4	to	8	25	to	50
Stiff	8	to	15	50	to	100
Very Stiff	15	to	30	100	to	200
Hard		>	30		>	200

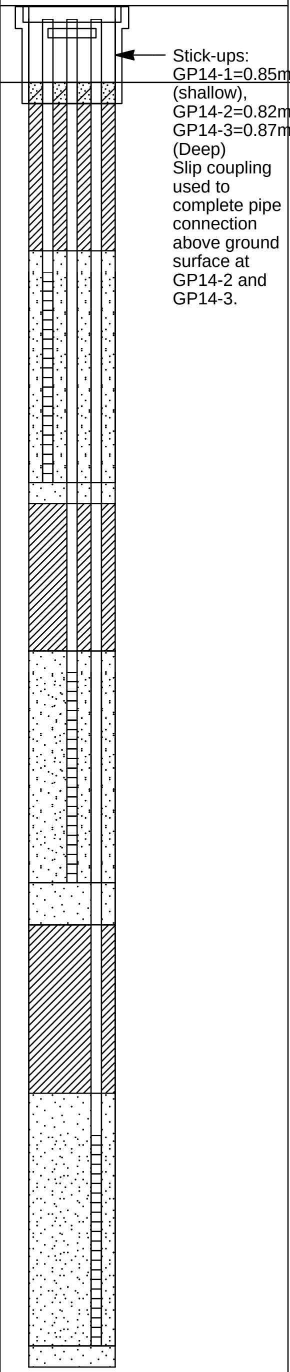
Note: C_u is the undrained shear strength

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Northern Buffer Area Assessment
PROJECT NUMBER: 33765-21
CLIENT: RDOS
LOCATION: Campbell Mountain Landfill

HOLE DESIGNATION: GP14
DATE COMPLETED: May 8, 2008
DRILLING METHOD: AUGER/ODEX
FIELD PERSONNEL: Z. FERREIRA

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	Gas Probe	SAMPLE NUMBER	INTERVAL	REC (m)	'N' VALUE
0.0	SP-SAND FILL with gravel, poorly graded, f. sand, coarse gravel, light greyish brown, dry			1	G		
				2	G		
				3	G		
4.57	SWG -Gravelly, Silty SAND with cobbles, well graded, sub-angular gravel, greyish-brown, moist, root fibres	4.57		4	G		
				5	G		
7.92	Fractured BEDROCK	7.92		6	G		
9.30	END OF BOREHOLE @ 9.30m BGS	9.30					



WELL DETAILS
Screened interval:
1.37 to 2.90m BGS

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Northern Buffer Area Assessment
PROJECT NUMBER: 33765-21
CLIENT: RDOS
LOCATION: Campbell Mountain Landfill

HOLE DESIGNATION: GP14
DATE COMPLETED: May 8, 2008
DRILLING METHOD: AUGER/ODEX
FIELD PERSONNEL: Z. FERREIRA

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	Gas Probe	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (m)	SAMPLE 'N' VALUE
10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5 19.0 19.5			Length: 1.52m Diameter: 25mm Slot Size: 1/4" Material: PVC Seal: 0.15 to 1.22m BGS Material: Hydrated Bentonite Chips Sand Pack: 1.22 to 3.05m BGS Material: Gravel ---------- Screened interval: 4.27 to 5.79m BGS Length: 1.52m Diameter: 25mm Slot Size: 1/4" Material: PVC Seal: 3.05 to 4.11m BGS Material: Hydrated Bentonite Chips Sand Pack: 4.11 to 6.10m BGS Material: Gravel ---------- Screened interval: 7.62 to 9.14m BGS Length: 1.52m Diameter: 25mm Slot Size: 1/4" Material: PVC Seal: 6.10 to 7.32m BGS Material: Hydrated Bentonite Chips Sand Pack: 7.32 to 9.30m BGS Material: Gravel				

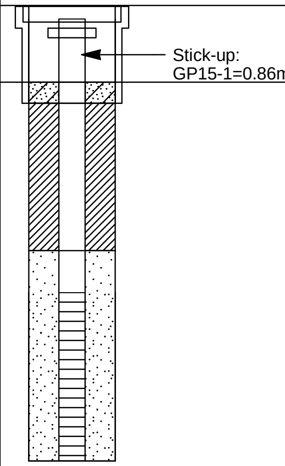
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Northern Buffer Area Assessment
PROJECT NUMBER: 33765-21
CLIENT: RDOS
LOCATION: Campbell Mountain Landfill

HOLE DESIGNATION: GP15
DATE COMPLETED: May 8, 2008
DRILLING METHOD: ODEX
FIELD PERSONNEL: Z. FERREIRA

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS	Gas Probe	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (m)	SAMPLE 'N' VALUE
0.0–1.83	SM - Silty SAND with gravel, poorly graded, loose, brown	1.83					
1.83–2.44	SWG -Gravelly, Silty SAND, well graded, brown	2.44					
2.44–2.74	BEDROCK	2.74					
	END OF BOREHOLE @ 2.74m BGS						



END OF BOREHOLE @ 2.74m BGS

Easting 0315592
Northing 5489092
(GPS Handheld Unit)

CH4 and CO2 was not detected

WELL DETAILS
Screened interval:
1.52 to 2.74m BGS
Length: 1.22m
Diameter: 25mm
Slot Size: 1/4"
Material: PVC
Seal:
0.15 to 1.22m BGS
Material: Hydrated Bentonite Chips
Sand Pack:
1.22 to 2.74m BGS
Material: Gravel

Depth scale (m BGS): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Northern Buffer Area Assessment

PROJECT NUMBER: 33765-21

CLIENT: RDOS

LOCATION: Campbell Mountain Landfill

HOLE DESIGNATION: GP16

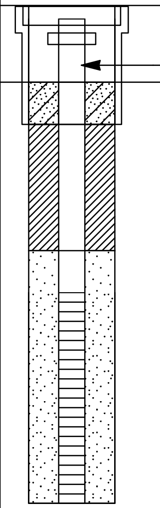
DATE COMPLETED: May 8, 2008

DRILLING METHOD: ODEX

FIELD PERSONNEL: Z. FERREIRA

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS
0.0	WOOD CHIPS	
0.61	SWG -Gravelly, Silty SAND with cobbles, well graded, brown, dry	0.61
2.44	Fractured BEDROCK	2.44
3.05	END OF BOREHOLE @ 3.05m BGS Easting 0315596 Northing 5489057 (GPS Handheld Unit) CH4 and CO2 was not detected	3.05

Gas Probe



WELL DETAILS
Screened interval:
1.52 to 3.05m BGS
Length: 1.52m
Diameter: 25mm
Slot Size: 1/4"
Material: PVC
Seal:
0.30 to 1.22m BGS
Material: Hydrated Bentonite Chips
Sand Pack:
1.22 to 3.05m BGS
Material: Gravel

SAMPLE			
NUMBER	INTERVAL	REC (m)	'N' VALUE

Depth scale (m BGS): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Northern Buffer Area Assessment

PROJECT NUMBER: 33765-21

CLIENT: RDOS

LOCATION: Campbell Mountain Landfill

HOLE DESIGNATION: GP17

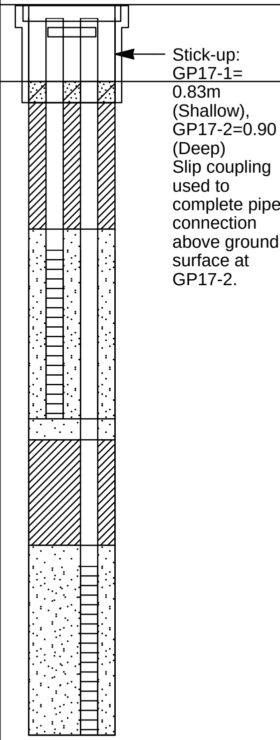
DATE COMPLETED: May 8, 2008

DRILLING METHOD: ODEX

FIELD PERSONNEL: Z. FERREIRA

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS
	WOOD CHIPS	
	SM - Silty SAND, poorly graded	0.30
	SWG - Gravelly, Silty SAND, with cobbles	1.22
2.5	- Sand lense at 2.44m BGS	
	Fractured BEDROCK	3.05
	- Competent BEDROCK at 4.72m BGS	4.72
	END OF BOREHOLE @ 4.72m BGS	
	Easting 0315659 Northing 5489038 (GPS Handheld Unit)	
	CH4 and CO2 was not detected	

Gas Probe



SAMPLE: NUMBER | INTERVAL | REC (m) | 'N' VALUE

WELL DETAILS

Screened interval:
1.22 to 2.44m BGS
Length: 1.22m
Diameter: 25mm
Slot Size: 1/4"
Material: PVC
Seal:
0.15 to 1.07m BGS
Material: Hydrated Bentonite Chips
Sand Pack:
1.07 to 2.59m BGS
Material: Gravel

Screened interval:
3.51 to 4.72m BGS
Length: 1.22m
Diameter: 25mm
Slot Size: 1/4"
Material: PVC
Seal:
2.59 to 3.35m BGS
Material: Hydrated Bentonite Chips
Sand Pack:
3.35 to 4.72m BGS
Material: Gravel

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

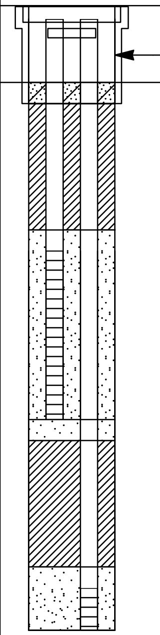
PROJECT NAME: Northern Buffer Area Assessment
PROJECT NUMBER: 33765-21
CLIENT: RDOS
LOCATION: Campbell Mountain Landfill

HOLE DESIGNATION: GP18
DATE COMPLETED: May 9, 2008
DRILLING METHOD: AIR ROTARY
FIELD PERSONNEL: Z. FERREIRA

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	DEPTH m BGS
	SM-Silty SAND, fine-medium grained, poorly graded, loose, brown	
0.91	SWG -Gravelly, Silty SAND with cobbles	0.91
3.51	Fractured BEDROCK	3.51
3.96	- Competent BEDROCK at 3.96m BGS	3.96
	END OF BOREHOLE @ 3.96m BGS	
	Easting 0315666 Northing 5489089 (GPS Handheld Unit)	
	CH4 and CO2 was not detected	

Depth scale (m BGS): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5

Gas Probe



Stick-up: GP18-1= 0.97m (Shallow), GP18-2= 0.91m (Deep) Slip coupling used to complete pipe connection above ground surface at GP18-2.

SAMPLE: NUMBER | INTERVAL | REC (m) | 'N' VALUE

WELL DETAILS
Screened interval:
1.22 to 2.44m BGS
Length: 1.22m
Diameter: 25mm
Slot Size: 1/4"
Material: PVC
Seal:
0.15 to 1.07m BGS
Material: Hydrated Bentonite Chips
Sand Pack:
1.07 to 2.59m BGS
Material: Gravel

Screened interval:
3.66 to 3.96m BGS
Length: 0.3m
Diameter: 25mm
Slot Size: 1/4"
Material: PVC
Seal:
2.59 to 3.35m BGS
Material: Hydrated Bentonite Chips
Sand Pack:
3.51 to 3.96m BGS
Material: Gravel

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

OVERBURDEN LOG 33765-21 GP LOGS (7-MAY-2008).GPJ CRA_CORP.GDT 7/13/09

Gas Monitoring Wells

BOREHOLE LOG

SPERLING HANSEN ASSOCIATES

Borehole:	GMW98-1	Project Num:	Prj97043
Client:	Regional District of Okanagan-Similkameen	Date:	24-Mar-98
Project:	Campbell Mountain Landfill Fire Suppression	Logged By:	Lee Ringham
Site:	Campbell Mountain Landfill		

Graphic Log

From (m)	To (m)	Description
0.00	1.00	Intermediate cover - wood debris, sand, silt and gravel
1.00	28.00	Well compacted waste, plastic, woody debris, metal fragments loose near surface, drilling time approximately 15 min per 10 ft dense to very dense with depth, approximately 1 hr per 10 ft. black and grey, dry to damp, odorous.
		@6 m - smoke/condensate was observed originating from borehole.
		Gas measurements: GMW98-1A (38 mm Well) LEL - 8% CO - 15 ppm O_2 - 20% H_2S - 0%

Completion Details

From (m)	To (m)	Material
0.00	1.23	Clay Seal
1.23	23.5	Slough and Pea Gravel Backfill
23.50	24.40	Clay Seal
24.4	25.3	Filter Sand
25.3	28	Pea Gravel

From (m)	To (m)	Well
0.00	25.9	38 mm Steel blanks
0.00	15.24	25 mm Steel blanks
15.24	16.75	Screen
25.9	27.40	Screen

Depth: 5 m, 10 m, 15 m, 20 m, 25 m, 30 m

END OF BOREHOLE @ 28 m

Borehole Location: Middle of Crest, South end of North Ravine.

Notes: Waste very well compacted. As depth increased drilling time per 3 m run also increased from 15 min to 1 hr. Smoke/condensate released from borehole, starting at 6 m depth, continuing to bottom of hole.

BOREHOLE LOG

SPERLING HANSEN ASSOCIATES

Borehole:	GMW98-2	Project Num:	Prj97043
Client:	Regional District of Okanagan-Similkameen	Date:	25-Mar-98
Project:	Campbell Mountain Landfill Fire Suppression	Logged By:	Lee Ringham
Site:	Campbell Mountain Landfill		

Graphic Log

From (m)	To (m)	Description
0.00	1.50	Road subgrade and intermediate cover - wood debris, sand, silt and gravel
1.50	24.40	Well compacted waste, plastic, woody debris, metal fragments loose near surface, drilling time approximately 15 min per 10 ft dense to very dense with depth, approximately 1 hr per 10 ft. black and grey, dry to damp, odorous. @ 3 m Small amount of smoke/condensate originating from borehole. Gas measurements: 25 mm Well LEL - 100+% CO - 380 ppm O_2 - 18.5% H_2S - 0% @ 12.2 m - large increase in volume of smoke/condensate visible. @ 12.2 - 13.7 m CO - 75 ppm Smoke/condensate visible until the end of hole.

Depth markers: 5 m, 10 m, 15 m, 20 m, 25 m

Completion Details

From (m)	To (m)	Backfill
0.00	1.23	Clay Seal
1.23	8.5	Slough and Pea Gravel Backfill
8.50	9.1	Slough
9.10	19.2	Pea Gravel
19.20	20.10	Clay Seal
20.10	21.40	Filter Sand
21.40	23.75	Pea Gravel
23.75	24.40	Slough

From (m)	To (m)	Well
0.00	22.25	38 mm Steel blanks
0.00	7.00	25 mm Steel blanks
7.00	8.50	Screen
22.25	23.77	Screen

END OF BOREHOLE @ 24.4 m

Borehole Location: Middle of the uppermost road, South end of North Ravine.

Notes: Very high concentrations of LEL and CO measured during drilling.
Drilling was faster than in the initial borehole (GMW98-1).

BOREHOLE LOG

SPERLING HANSEN ASSOCIATES

Borehole:	**GMW98-3**	Project Num:	Prj97043
Client:	Regional District of Okanagan-Similkameen	Date:	26-Mar-98
Project:	Campbell Mountain Landfill Fire Suppression	Logged By:	Lee Ringham
Site:	Campbell Maountain Landfill		

Depth	Graphic Log From (m)	To (m)	Description	Completion From (m)	To (m)	Well From (m)	To (m)
	0.00	1.50	Road subgrade and intermediate cover - wood debris, sand, silt and gravel	0.00 Clay Seal	1.23	0.00 38 mm Steel blanks	14.3
5 m	1.50	17.40	Well compacted waste, plactic, woody debris, metal fragments loose near surface, density increases with depth. black and grey, dry to damp, odorous. 0 - 9 m very quick drilling - approx 30 minutes 9 - 12 m approx 30 minutes 12 - 15.25 m -approximately 30 minutes drilling 15 - 16.75 m - slower drilling, 45 minuites.	Pea Gravel 3.00 Filter Sand 4.25 Pea Gravel	 4.25 15.75	0.00 25 mm Steel blanks	5.20
10 m			Augers hot when pulled from borehole. Gas measurements: GMW98-3A: LEL - 100+%; CO - 380 ppm; O_2 - 1.7%; H_2S - 7% 25 mm Well: LEL - 35%; CO - 390 ppm; O_2 - 16.9%; H_2S - 4%			5.2 Screen	6.7
15 m						14.3 Screen	15.85
				15.75 Slough (native sand and gravel) and pea gravel.	19.80		
	17.40	19.25	Gravelly SAND, dense, damp. No sample available, logged from rig response and fragments on the bit.				
20 m	19.25	19.80	Weathered BEDROCK, dense. No sample available.				

END OF BOREHOLE @ 19.8 m

Borehole Location: Middle road, North Ravine.

Notes: Waste was well compacted, drilling was quicker than the first two wells.

BOREHOLE LOG

SPERLING HANSEN ASSOCIATES

Borehole: GMW98-4
Client: Regional District of Okanagan-Similkameen
Project: Campbell Mountain Landfill Fire Suppression
Site: Campbell Maountain Landfill

Project Num: Prj97043
Date: 26-Mar-98
Logged By: Lee Ringham

Graphic Log

Depth	From (m)	To (m)	Description
	0.00	1.00	Road subgrade and intermediate cover - wood debris, sand, silt and gravel
	1.50	17.40	Well compacted waste, plactic, woody debris, metal fragments loose near surface, density increases with depth. black, dry, odorous. Some waste looked crystalline, similar to charcol. Drilling was easy throughout. Augers hot when pulled from borehole.
5 m			
10 m			

Completion Details

From (m)	To (m)	Material
0.00	1.23	Clay Seal
		Pea Gravel
5.20	6.1	Clay Seal
6.10	7.00	Filter Sand
7.00	9.00	Pea Gravel
9.00	10.00	Slough

From (m)	To (m)	Item
0.00	14.3	38 mm Steel blanks
0.00	3.00	25 mm Steel blanks
3.00	4.50	Screen
7.6	9.00	Screen

END OF BOREHOLE @ 10.0 m

Borehole Location: North end of the North Ravie, approximately 40 m south of bentonite pond.

Notes: Very quick and easy drilling. Waste loose to compact.

BOREHOLE LOG

SPERLING HANSEN ASSOCIATES

Borehole:	**GMW98-5**	Project Num:	Prj97043
Client:	Regional District of Okanagan-Similkameen	Date:	27-Mar-98
Project:	Campbell Mountain Landfill Fire Suppression	Logged By:	Lee Ringham
Site:	Campbell Maountain Landfill		

Graphic Log

From (m)	To (m)	Description
0.00	1.50	Intermediate cover - wood debris, sand, silt and gravel
1.50	16.20	Well compacted waste, plactic, woody debris, metal fragments loose near surface, density increases with depth. black and grey, dry to damp, odorous. Very slow drilling throughout. @ 6 m - Smoke/condenstate visible from top of augers and in the completed standpipe. @ 16.2 m Rig refusal on large metal object. Melted the bit. Standpipes installed at 16 m.

Completion Details

From (m)	To (m)	Material	From (m)	To (m)	Material
0.00	1.23	Clay Seal	0.00	13.9	38 mm Steel blanks
		Pea Gravel	0.00	6.10	25 mm Steel blanks
			6.1	7.6	Screen
10.60	11.60	Clay Seal	13.9	15.4	Screen
11.60	12.80	Filter Sand			
12.80	15.40	Pea Gravel			
15.40	16.20	Slough			

END OF BOREHOLE @ 16.2 m

Borehole Location: Borehole set back approximately 60 m from crest of North Ravine, near composting stockpiles.

Notes: Refusal at 16.2 m . Drilled into large mass of metal, destroyed the bnit. Rather than re-drill the borehole the well was installed to 16 m.

BOREHOLE LOG

SPERLING HANSEN ASSOCIATES

Borehole:	**GMW98-6**	Project Num:	Prj97043
Client:	Regional District of Okanagan-Similkameen	Date:	27-Mar-98
Project:	Campbell Mountain Landfill Fire Suppression	Logged By:	Jim Wong
Site:	Campbell Maountain Landfill		

Graphic Log

From (m)	To (m)	Description
0.00	0.50	Intermediate cover - wood debris, sand, silt and gravel
1.50	17.40	Well compacted waste, plactic, woody debris, metal fragments loose near surface, density increases with depth.

Completion Details

From (m)	To (m)	Material
0.00	1.23	Clay Seal
		Pea Gravel
15.50	16.50	Clay Seal
16.50	17.70	Filter Sand
17.70	20.40	Pea Gravel

From (m)	To (m)	Material
0.00	18.9	38 mm Steel blanks
0.00	8.50	25 mm Steel blanks
8.50	10.1	Screen
18.9	20.4	Screen

Depth: 5 m, 10 m, 15 m, 20 m

END OF BOREHOLE @ 20.4 m

Borehole Location: Approximately 50 m east of GMW98-1, near crest of North Ravine.

Notes: Waste was well compacted. Drilling was difficult, similar to GMW 98-2 and GMW98-5.

BOREHOLE LOG

SPERLING HANSEN ASSOCIATES

Borehole:	**GMW98-7**	Project Num:	Prj97043
Client:	Regional District of Okanagan-Similkameen	Date:	30-Mar-98
Project:	Campbell Mountain Landfill Fire Suppression	Logged By:	Jim Wong
Site:	Campbell Maountain Landfill		

Graphic Log

From (m)	To (m)	Description
0.00	1.25	Intermediate cover - wood debris, sand, silt and gravel
1.25	20.20	Well compacted waste, plactic, woody debris, metal fragments loose near surface, density increases with depth.

Completion Details

From (m)	To (m)	Material
0.00	1.23	Clay Seal
		Pea Gravel
15.50	16.50	Clay Seal
16.50	17.70	Filter Sand
17.70	20.40	Pea Gravel

From (m)	To (m)	Item
0.00	18.9	38 mm Steel blanks
0.00	8.50	25 mm Steel blanks
8.25	9.75	Screen
17.7	19.2	Screen

Depth: 5 m, 10 m, 15 m, 20 m

END OF BOREHOLE @ 20.2 m

Borehole Location: On the uppermost road in the North Ravine, approximately 15 m west of GMW98-2

Notes: Drilling was difficult due to well compacted waste.

BOREHOLE LOG

SPERLING HANSEN ASSOCIATES

Borehole:	**GMW98-8**	Project Num:	Prj97043
Client:	Regional District of Okanagan-Similkameen	Date:	30-Mar-98
Project:	Campbell Mountain Landfill Fire Suppression	Logged By:	Jim Wong
Site:	Campbell Maountain Landfill		

Depth	Graphic Log From (m)	To (m)	Description	Completion Details From (m)	To (m)		From (m)	To (m)
	0.00	0.50	Intermediate cover - wood debris, sand, silt and gravel	0.00	1.23		0.00	14.3
	0.5	8.5	Loose to compact waste. Metal fragments, plastic and woody debris.	Clay Seal			38 mm Steel blanks	
				Pea Gravel			0.00	3.00
				4.00	5.2			
5 m				Clay Seal				
				5.20	6			
				Filter Sand				
				6.00	8.50			
				Pea Gravel				
							7.00	8.50
								Screen

END OF BOREHOLE @ 8.5 m

Borehole Location: Approximately 50 m west of GMW98-1, near western edge of crest of North Ravine.

Notes: Very quick drilling as the waste was not well compacted. Borehole bottomed at 8.5 m on bedrock.

SPERLING HANSEN ASSOCIATES

SYMBOLS & ABBREVIATIONS ON LOGS

Graphic Log / Description

Graphic Log	Description
	CONCRETE / ASPHALT
	CLAY
	SILT
	SAND Fine to Medium
	SAND Medium to Coarse
	GRAVEL
	FILL
	HUMIC HORIZON / PEAT

Soil Classification System

Type		Grain Size (mm)		
	Boulders		>	300
	Cobbles	75	-	300
Gravel:				
	Coarse	75	-	19
	Fine	19	-	4.8
Sand:				
	Coarse	4.8	-	2.0
	Medium	2.0	-	0.43
	Fine	0.43	-	0.08
Fines:				
	Silts	0.08	-	0.002
	Clays		<	0.002

Note: based on the Unified Soil Classification System (USCS)

Grain Size Proportions

	%	Proportions > 75 mm
trace, eg. "trace sand"	1 to 10	isolated, eg "isolated cobbles"
some, eg. "some sand"	10 to 20	occasional, eg. "occasional cobbles
adjective, eg. "sandy"	20 to 35	frequent, eg. "frequent cobbles"
and, eg. "and sand"	35 to 50	numerous, eg. "numerous cobbles"
noun, eg. "sand"	> 50	noun, eg. "cobbles"

Note: approximate measure, based on field observations rather than a soil test.

Soil Descriptions

Cohesionless Soils

Relative Density	S.P.T. Value		
Very Loose	0	to	4
Loose	4	to	10
Compact	10	to	30
Dense	30	to	50
Very Dense		>	50

Cohesive Soils

Consistency	S.P.T. Value			C_u (kPa)		
Very Soft	0	to	2	0	to	12
Soft	2	to	4	12	to	25
Firm	4	to	8	25	to	50
Stiff	8	to	15	50	to	100
Very Stiff	15	to	30	100	to	200
Hard		>	30		>	200

Note: C_u is the undrained shear strength

Moisture Condition

Dry -	absence of moisture, dry to the touch
Damp	damp but no visible water
Moist -	moist but no visible water
Wet -	soil is damp, contains noticeable water
Saturated -	soil is completely wetted to excess
Free water	excess water, soil is dripping

Extraction Well and Nested Observation Wells

BOREHOLE LOG

Sperling Hansen Associates

Borehole:	Extraction Well	Project Num:	PRJ00005
Client:	Regional District of Okanagan-Similkameen	Date:	May 5,2000
Project:	Landfill Gas Assessment	Logged By:	Cliff Syroid
Site:	Campbell Mountain Landfill		

Graphic Log

Depth	From (m)	To (m)	Description
0–20.6 m	0.0	20.6	Waste

Completion Details

From (m)	To (m)	Description
0.0	4.7	Bentonite Seal
4.7	20.6	Backfill with Native Material

From (m)	To (m)
	Blanks
	Screen 9.14m length

Depth scale: 5 m, 10 m, 15 m, 20 m

END OF BOREHOLE @ 20.63 m

Borehole Location: On top of existing landfill.

Notes: All depth are from ground surface.
Stickup of 101mm PVC = 0.5 m.

SPERLING HANSEN ASSOCIATES

SYMBOLS & ABBREVIATIONS ON LOGS

Graphic Log	Description
	CONCRETE / ASPHALT
	CLAY
	SILT
	SAND Fine to Medium
	SAND Medium to Coarse
	GRAVEL
	FILL
	HUMIC HORIZON / PEAT

Grain Size Proportions

	%
trace, eg. "trace sand"	1 to 10
some, eg. "some sand"	10 to 20
adjective, eg. "sandy"	20 to 35
and, eg. "and sand"	35 to 50
noun, eg. "sand"	> 50

Note: approximate measure, based on field observations rather than a soil test.

Proportions > 75 mm

isolated, eg "isolated cobbles"
occasional, eg. "occasional cobbles"
frequent, eg. "frequent cobbles"
numerous, eg. "numerous cobbles"
noun, eg. "cobbles"

Moisture Condition

Dry -	absence of moisture, dry to the touch
Damp	damp but no visible water
Moist -	moist but no visible water
Wet -	soil is damp, contains noticeable water
Saturated -	soil is completely wetted to excess
Free water -	excess water, soil is dripping

Soil Classification System

Type		Grain Size (mm)		
	Boulders		>	300
	Cobbles	75	-	300
Gravel:				
	Coarse	75	-	19
	Fine	19	-	4.8
Sand:				
	Coarse	4.8	-	2.0
	Medium	2.0	-	0.43
	Fine	0.43	-	0.08
Fines:				
	Silts	0.08	-	0.002
	Clays		<	0.002

Note: based on the Unified Soil Classification System (USCS)

Soil Descriptions

Cohesionless Soils

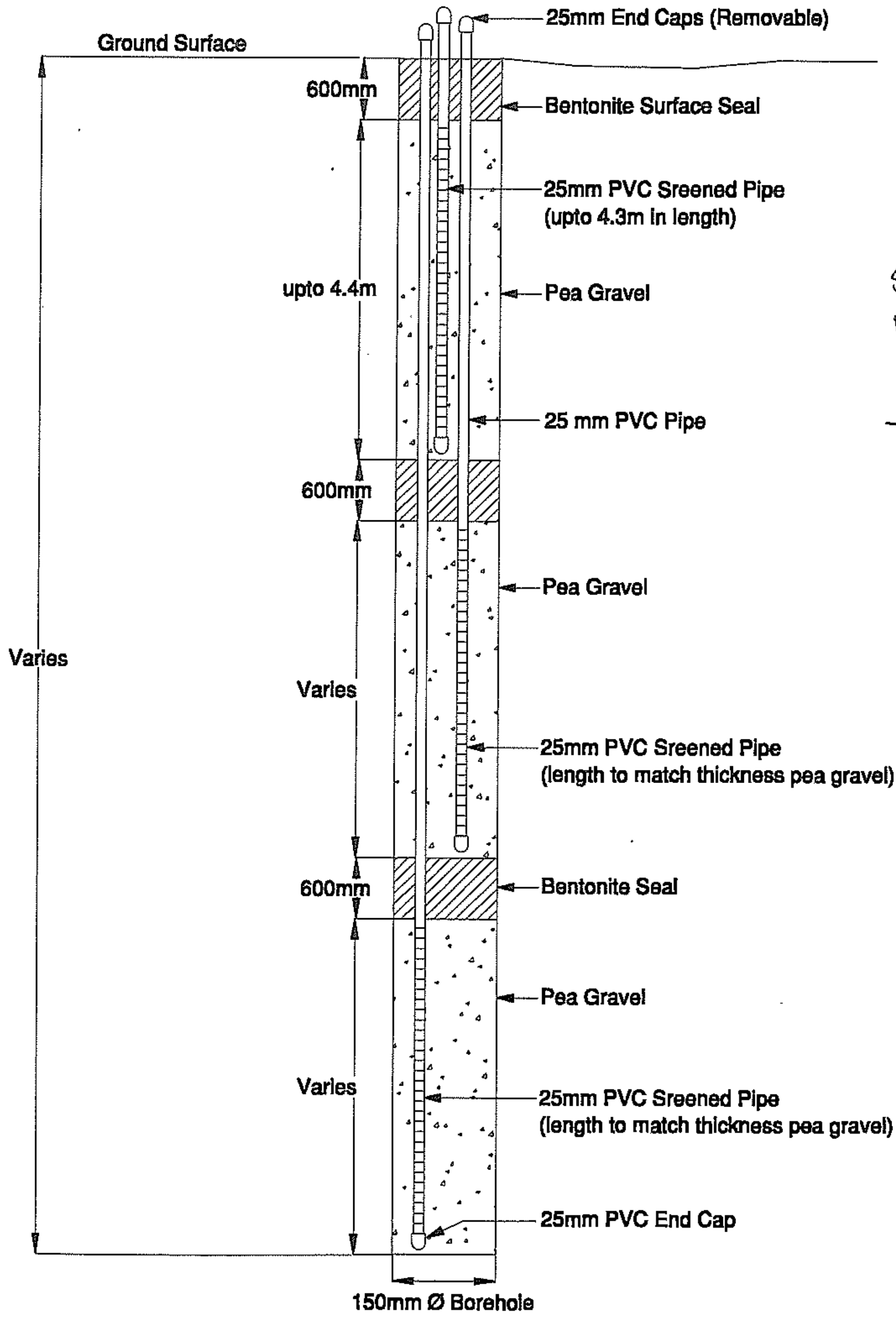
Relative Density	S.P.T. Value		
Very Loose	0	to	4
Loose	4	to	10
Compact	10	to	30
Dense	30	to	50
Very Dense		>	50

Cohesive Soils

Consistency	S.P.T. Value			C_u (kPa)		
Very Soft	0	to	2	0	to	12
Soft	2	to	4	12	to	25
Firm	4	to	8	25	to	50
Stiff	8	to	15	50	to	100
Very Stiff	15	to	30	100	to	200
Hard		>	30		>	200

Note: C_u is the undrained shear strength

Monitoring Probe Nests
45-3
30-2
15-1



SHA, 2001 pg. 5-2
Installation depths
-4.9m, 10.4m, 15.9m, and 20.7
-3m long Screen

Notes:

Respective screen lenghts to be field determined.

Upto 4 probes can be installed in a 150 mm diameter hole

Sperling Hansen Associates	Project No.: PRJ00005 Drawn: C.S. Reviewed: G.H. File Name: 00005-5-3 Date: June 26/2000	**TYPICAL MONITORING PROBE CONSTRUCTION** **CAMPBELL MOUNTAIN LANDFILL**	**Figure** **5-3**

APPENDIX D

LABORATORY SOIL ANALYTICAL REPORT

NORTHERN BUFFER ASSESSMENT -33765-21 FSK 05 MAY 2008

Location: Regional District of Okanagan-Similkameen
Project Code/Phase: 33765-21
Date: 5-May-08
Samplers: Zidra Ferreira

Sample Date	Sample Identification	Sample Location	Sample Depth (m bgs)	Sent to Lab Date Maxxam (Burnaby)	Matrix Code	Sample Type	Chain of Custody No.	Parameters Analyzed	Comments
SOIL									
5-May-08	SO-33765-050508-ZF-01	TP7-08 #1	3.0	7-Jul-08	SO	N	CRA 29012	GRAIN SIZE	
5-May-08	SO-33765-050508-ZF-02	TP16-08 #1	1.6	7-Jul-08	SO	N	CRA 29012	GRAIN SIZE	
5-May-08	SO-33765-050508-ZF-03	TP10-08#1	1.5	7-Jul-08	SO	N	CRA 29012	GRAIN SIZE	
5-May-08	SO-33765-050508-ZF-04	TP8-08 #1	1.3	7-Jul-08	SO	N	CRA 29012	GRAIN SIZE	
5-May-08	SO-33765-050508-ZF-05	TP13-08 #1	2.2	7-Jul-08	SO	N	CRA 29012	GRAIN SIZE	
5-May-08	SO-33765-050508-ZF-06	TP10-08 #2	3.0	7-Jul-08	SO	N	CRA 29012	GRAIN SIZE	
5-May-08	SO-33765-050508-ZF-07	TP9-08 #1	2.0	7-Jul-08	SO	N	CRA 29012	GRAIN SIZE	

Maxxam Analytics Inc

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Your P.O. #: 20-033765
Your Project #: 33765-21
Your C.O.C. #: 29012

Attention: JENNIFER BALKWILL
CONESTOGA-ROVERS & ASSOCIATES
651 COLBY DRIVE
WATERLOO, ON
CANADA N2V 1C2

Report Date: 2008/07/15

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: A833241
Received: 2008/07/07, 15:30

Sample Matrix: Soil
Samples Received: 7

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Particle Size by Sieve (Dry) (12)	7	N/A	2008/07/14	CAL SOP-00025	SSMA #47

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Maxxam Calgary
(2) Result indicates % of sample retained on the sieve.

Encryption Key

Sue Reynolds
15 Jul 2008 16:07:04 -07:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

SUE REYNOLDS, BBY Customer Service
Email: sue.reynolds@maxxamanalytics.com
Phone# (604) 444-4808 Ext:235

==

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. SCC and CAEAL have approved this reporting process and electronic report format.

For Service Group specific validation please refer to the Validation Signature Page

Total cover pages: 1

Maxxam Job #: A833241
Report Date: 2008/07/15

CONESTOGA-ROVERS & ASSOCIATES
Client Project #: 33765-21

Your P.O. #: 20-033765
Sampler Initials: ZF

RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID		K56021	K56021		
Sampling Date		2008/05/05	2008/05/05		
COC Number		29012	29012		
	Units	**SO-33765-050508-ZF-01**	**SO-33765-050508-ZF-01 Lab-Dup**	**RDL**	**QC Batch**
Physical Properties					
Sieve - #4 (>4.75mm)	%	<0.2	<0.2	0.2	2430475
Sieve - #10 (>2.00mm)	%	11.9	13.4	0.2	2430475
Sieve - #40 (>0.425mm)	%	22.2	22.7	0.2	2430475
Sieve - #200 (>0.075mm)	%	29.1	28.4	0.2	2430475
Sieve - Pan	%	36.8	35.5	0.2	2430475

RDL = Reportable Detection Limit

Maxxam ID		K56022	K56023		
Sampling Date		2008/05/05	2008/05/05		
COC Number		29012	29012		
	Units	**SO-33765-050508-ZF-02**	**SO-33765-050508-ZF-03**	**RDL**	**QC Batch**
Physical Properties					
Sieve - #4 (>4.75mm)	%	2.1	<0.2	0.2	2430475
Sieve - #10 (>2.00mm)	%	26.4	2.8	0.2	2430475
Sieve - #40 (>0.425mm)	%	23.3	15.2	0.2	2430475
Sieve - #200 (>0.075mm)	%	43.9	29.2	0.2	2430475
Sieve - Pan	%	4.3	52.8	0.2	2430475

RDL = Reportable Detection Limit

Maxxam ID		K56024	K56025		
Sampling Date		2008/05/05	2008/05/05		
COC Number		29012	29012		
	Units	**SO-33765-050508-ZF-04**	**SO-33765-050508-ZF-05**	**RDL**	**QC Batch**
Physical Properties					
Sieve - #4 (>4.75mm)	%	<0.2	<0.2	0.2	2430475
Sieve - #10 (>2.00mm)	%	4.7	8.2	0.2	2430475
Sieve - #40 (>0.425mm)	%	20.6	24.5	0.2	2430475
Sieve - #200 (>0.075mm)	%	28.1	33.1	0.2	2430475
Sieve - Pan	%	46.5	34.2	0.2	2430475

RDL = Reportable Detection Limit

CONESTOGA-ROVERS & ASSOCIATES
Maxxam Job #: A833241
Client Project #: 33765-21
Report Date: 2008/07/15

Your P.O. #: 20-033765
Sampler Initials: ZF

RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID		K56026	K56027		
Sampling Date		2008/05/05	2008/05/05		
COC Number		29012	29012		
	Units	**SO-33765-050508-ZF-06**	**SO-33765-050508-ZF-07**	**RDL**	**QC Batch**

Physical Properties					
Sieve - #4 (>4.75mm)	%	<0.2	4.9	0.2	2430475
Sieve - #10 (>2.00mm)	%	9.1	8.3	0.2	2430475
Sieve - #40 (>0.425mm)	%	27.9	17.2	0.2	2430475
Sieve - #200 (>0.075mm)	%	37.9	22.7	0.2	2430475
Sieve - Pan	%	25.1	46.9	0.2	2430475

RDL = Reportable Detection Limit

Maxxam Job #: A833241
Report Date: 2008/07/15

CONESTOGA-ROVERS & ASSOCIATES
Client Project #: 33765-21

Your P.O. #: 20-033765
Sampler Initials: ZF

General Comments

Results relate only to the items tested.

CONESTOGA-ROVERS & ASSOCIATES
Attention: JENNIFER BALKWILL
Client Project #: 33765-21
P.O. #: 20-033765
Site Reference:

Quality Assurance Report

Maxxam Job Number: VA833241

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
2430475 BM8	QC STANDARD	Sieve - #200 (>0.075mm)	2008/07/14		101	%	89 - 111
		Sieve - Pan	2008/07/14		99	%	95 - 105
	RPD [K56021-01]	Sieve - #4 (>4.75mm)	2008/07/14	NC		%	35
		Sieve - #10 (>2.00mm)	2008/07/14	12.2		%	35
		Sieve - #40 (>0.425mm)	2008/07/14	2.5		%	35
		Sieve - #200 (>0.075mm)	2008/07/14	2.5		%	35
		Sieve - Pan	2008/07/14	3.7		%	35

NC = Non-calculable
RPD = Relative Percent Difference

Validation Signature Page

Maxxam Job #: A833241

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

LILI ZHOU, Senior analyst, Inorganic department.

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A833241

CHAIN OF CUSTODY RECORD

CRA CONESTOGA-ROVERS & ASSOCIATES 651 Colby Drive Waterloo, Ont. N2V 1C2 (519)884-0510	SHIPPED TO (Laboratory Name): Maxxam (Burnaby)	REFERENCE NUMBER: 33765-21

SAMPLER'S SIGNATURE: [signature] PRINTED NAME: Z. Ferreira

SEQ. No.	DATE	TIME	SAMPLE No.	SAMPLE TYPE	No. OF CONTAINERS	PARAMETERS: Grain size									REMARKS
	05May08		SO-33765-050508-ZF-01	SO	1	✓									
	↓		" -02	SO	1	✓									
	↓		" -03	SO	1	✓									
	↓		" -04	↓	1	✓									
	↓		" -05	↓	1	✓									
	↓		" -06	↓	1	✓									
	↓		" -07	↓	1	✓									

TOTAL NUMBER OF CONTAINERS: 7 bags

HEALTH/CHEMICAL HAZARDS

RELINQUISHED BY:	DATE/TIME	RECEIVED BY:	DATE/TIME
① [signature]	DATE: July 7, 08 TIME: 4:30	② [signature]	DATE: [illegible] TIME: 0[illegible]
②	DATE: TIME:	③	DATE: TIME:
③	DATE: TIME:	④	DATE: TIME:

METHOD OF SHIPMENT:

WAY BILL No.

White -Fully Executed Copy Yellow -Receiving Laboratory Copy Pink -Shipper Copy Goldenrod -Sampler Copy	SAMPLE TEAM: Z. Ferreira	RECEIVED FOR LABORATORY BY: JT 21,21,21 DATE: JULY 7/08 TIME: 15:30	№ 29012

1001 (D) SEPT 28/93(W) REV.0 (F-42)

APPENDIX E

SOIL GAS MONITORING RESULTS

GP1-1(S)

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	14:10	0.05	20600	0.0	0.1	21.7	78.2	--	--	riser has slots resulting in unsealed space between riser and cap repairs could not be completed, dry
6-Jun-08	14:50	0	20600	0.0	0.1	20.3	79.6	2.920	--	cap greased
10-Jul-08	13:50	0	20600	0.0	0.2	22.0	77.8	2.920	2.930	threads resealed with teflon tape, cap greased
13-Aug-08	8:55	0	26200	0.0	0.5	20.3	79.2	2.907	NM	cap greased
8-Sep-08	10:25	0.009	26200	0.0	0.5	20.5	79.0	2.910	2.934	27.84"Hg, cap greased
3-Oct-08	11:00	0.01	26200	0.0	0.3	20.9	78.8	2.915	2.935	pressure not stable due to high winds
6-Nov-08	10:10	0	26200	0.1	0.2	20.9	78.8	2.920	2.930	cap greased
8-Dec-08	10:30	0	26200	0.1	0.2	20.8	78.9	2.920	2.935	27.93"Hg, cap greased
7-Jan-09	11:15	0	26200	0.0	0.2	21.2	78.6	--	2.950	27.47" Hg, minimal water in well but no reading from water level because sensor was 7cm from the tip
9-Feb-09	10:15	0	26200	0.0	0.2	21.0	78.8	2.900	2.935	27.61" Hg
9-Mar-09	12:30	0.02	26200	0.0	0.2	20.8	79.0	2.900	2.935	27.72"Hg
9-Apr-09	10:30	0	26200	0.0	0.1	20.6	79.3	2.900	2.935	27.52" Hg

GP1-2(M)

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	14:20	0.024	20600	0.0	0.6	21.2	78.2	-	4.738	riser has slots resulting in unsealed space between riser and cap repairs could not be completed, dry
6-Jun-08	14:55	0	20600	0.0	0.1	20.7	79.2	-	6.605	cap greased, dry
10-Jul-08	13:50	0-0.05	20600	0.0	0.1	22.1	77.8	-	6.620	pressure not stable due to high winds, cap greased, threads resealed with teflon tape, dry
13-Aug-08	8:54	0	26200	0.0	0.4	20.5	79.1	-	6.619	cap greased, dry
8-Sep-08	10:25	0.014	26200	0.0	0.2	20.9	78.9	-	6.624	dry
3-Oct-08	11:00	0.022	26200	0.0	0.4	20.7	78.9	-	6.620	dry
6-Nov-08	10:10	0.015	26200	0.1	0.4	21.0	78.5	-	6.620	cap greased, dry
8-Dec-08	10:30	0	26200	0.1	0.3	20.5	79.1	-	6.620	cap greased, dry
7-Jan-09	11:15	0.03	26200	0.0	0.3	21.0	78.7	-	6.620	27.47" Hg , dry
9-Feb-09	10:15	0	26200	0.0	0.2	21.0	78.8	-	6.620	27.61" Hg, dry
9-Mar-09	12:30	0	26200	0.0	0.2	21.1	78.7	-	6.620	27.72" Hg dry
9-Apr-09	10:30	0	26200	0.0	0.2	20.7	79.1	-	6.620	27.52" Hg, dry

GP1-3(D)

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	14:50	0	20600	0.0	0.0	0.0	21.2	8.974	10.450	riser has slots resulting in unsealed space between riser and cap repairs could not be completed, dry
6-Jun-08	14:40	0	20600	0.0	0.0	20.0	80.0	8.900	10.450	monitoring port was open prior to sampling, cap greased
10-Jul-08	13:50	0-0.05	20600	0.0	0.0	22.6	77.4	8.828	10.455	pressure not stable due to high winds, threads resealed, cap greased (27.66" Hg, high winds, light rain)
13-Aug-08	8:54	0	26200	0.0	0.0	20.9	79.1	9.143	10.456	cap greased
8-Sep-08	10:25	0	26200	0.0	0.1	21.0	78.9	9.161	10.453	27.66" Hg, high winds, light rain
3-Oct-08	11:00	0	26200	0.0	0.0	21.0	79.0	9.290	10.460	27.49" Hg
6-Nov-08	10:10	0	26200	0.1	0.1	21.1	78.7	9.470	10.460	28.08"Hg, cap greased
8-Dec-08	10:30	0	26200	0.1	0.0	20.7	79.2	9.400	10.455	27.93"Hg, cap greased
7-Jan-09	11:15	0.03	26200	0.0	0.1	20.9	79.0	9.150	10.410	27.47"Hg
9-Feb-09	10:15	0	26200	0.0	0.1	21.1	78.8	8.625	10.455	27.61" Hg, cap greased
9-Mar-09	12:30	0.03	26200	0.0	0.1	21.4	78.5	8.420	10.455	27.72" Hg, windy
9-Apr-09	10:30	0	26200	0.0	0.0	20.9	79.1	8.400	10.455	27.57" Hg

GP2-1

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08		0	40600	0.0	0.6	20.6	78.8	-	4.738	dry
6-Jun-08	15:40	0	40600	0.0	0.8	20.1	79.1	-	3.730	monitoring port was open prior to sampling, cap greased, dry
10-Jul-08	9:10	0.01	40600	0.0	0.6	20.0	79.4	-	3.735	dry
13-Aug-08	10:00	0	41200	0.0	0.6	20.5	78.9	-	3.740	27.92" Hg, cap greased, dry
8-Sep-08	11:30	0	41200	0.0	0.6	20.9	78.5	-	3.738	27.84" Hg, dry
3-Oct-08	12:15	0	41200	0.0	0.5	20.8	78.7	-	3.740	27.48" Hg, dry
6-Nov-08	11:35	0.011	41200	0.1	0.4	20.6	78.9	-	3.740	28.08'Hg, cap greased, dry
8-Dec-08	11:15	0	41200	0.1	0.4	20.7	78.8	-	3.740	27.93"Hg, cap greased, dry
7-Jan-09	12:15	0.01	41200	0.0	0.6	20.7	78.7	-	3.740	27.45" Hg, dry
9-Feb-09	11:00	0	41200	0.0	0.9	20.1	79.0	-	3.740	27.61" Hg, dry
9-Mar-09	13:15	0	41200	0.0	1.2	19.8	79.0	-	3.740	27.72" Hg, dry
9-Apr-09	11:45	0	41200	0.0	0.8	20.3	78.9	-	3.740	27.57" Hg, dry

GP3-1

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08		0	20600	0.0	0.5	20.3	79.2	-	2.406	dry
6-Jun-08	15;20	0	20600	0.0	0.9	20.4	78.7	-	2.410	cap greased, dry
10-Jul-08	8:45	0.01	20600	0.0	0.8	19.5	79.7	-	2.405	dry
13-Aug-08	9:35	0.01	41200	0.0	0.9	20.1	79.0	-	2.406	cap greased, threads resealed with teflon tape, dry
8-Sep-08	12:00	0	21200	0.0	0.7	21.0	78.3	-	2.410	cap greased, dry
3-Oct-08	13:00	0	21200	0.0	0.5	20.8	78.7	-	2.410	27.48" Hg, dry
6-Nov-08	11:20	0	21200	0.1	0.5	20.5	78.9	-	2.410	cap greased, dry
8-Dec-08	11:00	0	21200	0.1	0.5	20.6	78.8	-	2.405	27.93"Hg, cap greased, dry
7-Jan-09	12:00	0.01	21200	0.0	0.7	20.9	78.4	-	2.410	27.45" Hg dry
9-Feb-09	10:45	0	21200	0.0	0.9	20.1	79.0	-	2.410	27.61" Hg, dry
9-Mar-09	13:00	0	21200	0.0	0.9	20.2	78.9	-	2.410	27.72" Hg, dry
9-Apr-09	11:00	0	21200	0.0	0.5	20.5	79.0	-	2.410	27.57"Hg, dry

GP14-1(S)

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	9:50	0	20600	0.0	3.6	17.6	78.8	-	3.731	dry
6-Jun-08	17:10	0	20600	0.0	5.9	13.3	80.8	-	3.730	cap greased, dry
10-Jul-08	10:57	0	15300	0.0	6.7	12.6	80.7	-	3.730	cap threads resealed with teflon tape, dry
13-Aug-08	12:15	0	26200	0.0	6.2	13.8	80.0	-	3.725	cap greased, dry
8-Sep-08	12:53	0	26200	0.0	6.8	13.9	79.3	-	3.730	27.8" Hg, dry
3-Oct-08	14:25	0	26200	0.0	6.2	14.6	79.2	-	3.740	dry
6-Nov-08	13:30	0	26200	0.1	6.5	15.6	77.8	-	3.740	cap greased, dry
8-Dec-08	13:30	0	26200	0.1	5.2	15.6	79.1	-	3.740	27.95"Hg, cap greased, dry
7-Jan-09	14:30	0	26200	0.0	5.1	15.7	79.2	-	3.740	27.58: Hg, dry
9-Feb-09	13:30	0	26200	0.0	4.6	15.6	79.8	-	3.740	27.60" Hg, dry
9-Mar-09	14:45	0	26200	0.0	5.5	14.4	80.1	-	3.740	27.71" Hg, dry
9-Apr-09	14:00	0	26200	0.0	4.8	14.8	80.4	-	3.740	27.70" Hg, dry

GP14-2(M)

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	10:00	0.03	20600	0	1	19	80	-	6.725	dry
6-Jun-08	17:15	0	20600	0	8.1	5.8	86.1	-	6.73	cap greased, dry
10-Jul-08	10:56	-	15300	0	13.4	4.1	82.5	-	6.73	cap accidently removed before pressure reading taken, cap threads resealed with teflon tape, dry
13-Aug-08	12:15	0		0	10.3	15.6	74.1	-	6.729	dry
8-Sep-08	12:55	0	26200	0	14.8	6.1	79.1	-	6.726	dry
3-Oct-08	14:30	0	26200	0	13.1	7.5	79.4	-	6.73	27.55" Hg, dry
6-Nov-08	13:30	0	26200	0.1	11.3	10.1	78.5	-	6.73	cap greased, dry
8-Dec-08	13:30	0.013	26200	0.1	9.8	11	79.1	-	6.73	cap greased, dry
7-Jan-09	14:30	0	26200	0	8.9	11.8	79.3	-	6.73	27.58" Hg, dry
9-Feb-09	13:30	0	26200	0	8.5	11.3	80.2	-	6.73	27.60" Hg, dry
9-Mar-09	14:45	0.015	26200	0	9.5	10.6	79.9	-	6.72	27.71" Hg, windy, dry, repairs completed to seal coupling of riser by RDOS prior to event
9-Apr-09	14:00	0	26200	0	9.8	8.2	82	-	6.72	27.70" Hg, dry

GP14-3(D)

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	10:10	0.03	20600	0.0	0.3	20.4	79.1	-	10.043	dry
6-Jun-08	17:20	0	20600	0.0	3.0	6.0	91.0	-	10.040	cap greased, dry
10-Jul-08	10:55	0.015	15300	0.0	10.0	3.5	86.5	-	10.052	cap threads resealed with teflon tape, dry
13-Aug-08	12:15	0	26200	0.0	14.0	3.5	82.5	-	10.044	dry
8-Sep-08	12:57	0	26200	0.0	15.7	4.5	79.8	-	10.048	dry
3-Oct-08	14:30	0.015	26200	0.0	15.1	6.5	78.4	-	10.050	27.55" Hg, dry
6-Nov-08	13:30	0	26200	0.1	14.9	7.8	77.2	-	10.050	cap greased, dry
8-Dec-08	13:30	0.017	26200	0.1	12.5	10.0	77.4	-	10.050	27.95"Hg, cap greased, dry
7-Jan-09	14:30	0	26200	0.0	10.2	11.8	78.0	-	10.050	27.58"Hg, dry
9-Feb-09	13:30	0	26200	0.0	8.4	12.2	79.4	-	-	27.60" Hg, coupling of riser came apart in the casing after LFG measurements taken
9-Mar-09	14:45	0.018	26200	0.4	8.1	10.9	80.6	-	10.050	27.71" Hg, windy, dry, repairs completed by RDOS prior to event
9-Apr-09	14:00	0	26200	0.0	8.9	7.5	83.6	-	10.050	27.70" Hg, dry

GP15-1

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	13:20	0	20600	0.0	0.0	20.7	79.3	-	3.029	dry
6-Jun-08	16:40	0	20600	0.0	0.4	21.0	78.6	-	3.050	monitoring port was open prior to sampling, cap greased, dry
10-Jul-08	13:35	0	20600	0.0	0.2	21.1	78.7	-	3.051	threads resealed with teflon tape, cap greased (27.64" Hg, Windy, Dark Clouds), dry
13-Aug-08	11:25	0	26200	0.0	0.3	21.1	78.6	-	3.060	cap greased, dry
8-Sep-08	12:34	0	26200	0.0	0.3	21.2		-	3.073	27.6" Hg, dry, windy dark clouds
3-Oct-08	14:00	0	26200	0.0	0.2	21.0	78.8	-	3.075	dry
6-Nov-08	13:00	0	26200	0.1	0.3	20.7	78.9	-	3.075	28.06"Hg, cap greased, dry
8-Dec-08	13:00	0	26200	0.1	0.3	20.6	79.0	-	3.075	27.95"Hg, cap greased, dry
7-Jan-09	13:30	0	26200	0.0	0.3	20.9	78.8	-	3.075	27.45" Hg, dry,
9-Feb-09	12:35	0	26200	0.1	0.3	20.3	79.3	-	3.075	27.48" Hg, dry
9-Mar-09	14:15	0	26200	0.0	0.5	20.1	79.4	-	3.075	27.71" Hg, dry
9-Apr-09	13:30	0	26200	0.0	0.3	20.7	79.0	-	3.075	27.61" Hg, dry

GP16-1

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	13:00	0	20600	0.0	0.0	20.7	79.3	-	-	could not remove monitoring port
6-Jun-08	16:20	0	20600	0.5	12.2	6.3	81.0	-	3.380	cap greased, dry
10-Jul-08	10:30	0	25300	0.0	17.7	4.1	78.2	-	3.392	dry, cap threads resealed with teflon tape
13-Aug-08	11:11	0	26200	0.0	12.4	8.7	78.9	-	3.545	cap greased, dry
8-Sep-08	12:20	0	26200	0.0	9.5	12.7	77.8	-	3.838	dry
3-Oct-08	13:45	0.015	26200	0.0	7.3	14.7	78.0	-	3.840	27.44" Hg, dry
6-Nov-08	12:45	0	26200	0.2	6.7	15.1	78.0	-	3.840	28.06"Hg, cap greased, dry
8-Dec-08	12:45	0	26200	0.1	6.7	14.6	78.6	-	3.840	27.95"Hg, cap greased, dry
7-Jan-09	13:15	0	26200	0.0	7.6	14.5	77.9	-	3.840	27.45: Hg, dry
9-Feb-09	12:15	0	26200	0.1	10.7	10.2	79.0	-	3.840	27.48" Hg, dry
9-Mar-09	14:30	0.02	26200	0.0	14.3	6.9	78.8	-	3.840	27.71" Hg, windy, dry
9-Apr-09	13:00	0	26200	0.0	13.9	7.3	78.8	-	3.840	27.61" Hg, dry

GP17-1(S)

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	15:30	0.01	20600	18.9	43.5	0.0	37.5	-	2.076	dry
6-Jun-08	16:10	0	20600	32.6	56.7	0.0	10.7	-	-	could not remove monitoring port
10-Jul-08	10:15	0	20600	32.9	63.9	0.0	3.2	-	2.095	cap threads resealed with teflon tape, dry
13-Aug-08	10:45	0.014	21200	28.9	61.0	0.0	10.1	-	2.080	cap greased, dry
8-Sep-08	11:05	0	21200	32.5	66.5	0.0	1.0	-	2.089	dry
3-Oct-08	11:35	0	21200	33.0	64.2	0.8	2.0	-	2.090	dry
6-Nov-08	11:00	0	21200	32.3	56.0	0.0	11.7	-	2.090	cap greased, dry
8-Dec-08	11:50	0	21200	38.1	53.8	0.0	8.1	-	2.090	cap greased, dry
7-Jan-09	12:45	0	21200	41.1	50.2	0.0	8.7	-	2.090	27.45" Hg, dry
9-Feb-09	13:00	0	21200	50.9	51.9	0.0	-2.8	-	2.090	27.48" Hg, dry
9-Mar-09	13:45	0	21200	41.8	49.3	0.0	8.9	-	2.090	27.72" Hg dry
9-Apr-09	12:00	0	21200	48.4	48.5	0.0	3.1	-	2.090	27.57" Hg, dry

GP17-2(D)

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	15:10	0.016	20600	20.0	41.9	1.2	36.9	-	5.620	dry
6-Jun-08	16:00	0	20600	31.8	48.2	0.9	19.1	-	-	could not remove monitoring port
10-Jul-08	10:02	0.013	20600	30.2	54.8	1.8	13.2	-	5.620	dry, cap threads resealed with teflon tape
13-Aug-08	10:45	0	21200	29.2	57.6	0.3	12.9	-	5.630	cap greased, dry
8-Sep-08	11:15	0.015	21200	30.2	59.8	1.8	8.2	-	5.625	dry
3-Oct-08	11:35	0	21200	31.6	57.6	1.8	9.0	-	5.225	coupling of riser in casing came apart and bentonite/fill fell down well
6-Nov-08	11:00	0.013	21200	32.8	53.6	0.0	13.6	-	5.220	28.08"Hg, repairs completed by RDOS prior to event , cap greased, dry
8-Dec-08	11:50	0	21200	37.4	50.2	0.0	12.4	-	5.225	cap greased, dry
7-Jan-09	12:45	0	21200	40.1	46.7	0.0	13.2	-	5.230	27.45" Hg, dry
9-Feb-09	13:00	0	21200	48.5	46.7	0.0	4.8	-	5.220	27.48" Hg, dry
9-Mar-09	13:45	0.02	21200	39.5	44.2	0.0	16.3	-	5.220	27.72" Hg dry
9-Apr-09	12:00	0.015	21200	47.0	43.2	0.0	9.8	-	5.220	27.57" Hg, dry

GP18-1(S)

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	-	0	20600	0.0	0.4	20.6	79.0	-	3.275	dry
6-Jun-08	15:45	0	20600	0.0	1.6	19.4	79.0	-	3.270	cap greased, dry
10-Jul-08	9:41	0	20600	0.0	1.4	19.2	79.4	-	3.280	cap threads resealed with teflon tape, dry
13-Aug-08	10:19	0	21200	0.0	1.4	19.8	78.8	-	3.278	cap greased, dry
8-Sep-08	11:45	0	21200	0.0	1.3	20.4	78.3	-	3.278	cap greased, dry
3-Oct-08	12:30	0	21200	0.0	0.9	20.6	78.5	-	3.280	dry
6-Nov-08	12:00	0	21200	0.1	0.9	20.1	78.9	-	3.280	28.08"Hg, cap greased, dry
8-Dec-08	11:30	0	21200	0.1	0.8	20.5	78.6	-	3.280	27.93"Hg, cap greased, dry
7-Jan-09	12:30	0.016	21200	0.0	0.9	20.5	78.6	-	3.280	27.45" Hg, dry
9-Feb-09	11:15	0	21200	0.0	1.0	20.3	78.7	-	3.280	27.61" Hg, dry
9-Mar-09	13:30	0	21200	0.0	1.3	20.2	78.5	-	3.280	27.72" Hg, dry
9-Apr-09	11:15	0	21200	0.0	0.9	20.4	78.7	-	3.280	27.57" Hg, dry

GP18-2(D)

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	-	0	20600	0	0.4	20.6	79	4.975	5.04	
6-Jun-08	15:50	0	20600	0	0.5	20	79.5	-	5.02	cap greased, dry
10-Jul-08	9:30	0	20300	0	1.2	19.6	79.2	-	5.02	27.64" Hg, cap threads resealed with teflon tape, dry
13-Aug-08	10:20	0	6200	0	1.2	19.4	79.4	-	5.018	cap greased, dry
8-Sep-08	11:50	0	6200	0	1.4	20.2	78.4	-	5.019	dry
3-Oct-08	12:30	-0.06	6200	0	1.2	20.4	78.4	-	5.015	27.48" Hg, dry
6-Nov-08	12:00	0.015	6200	0.1	1.4	20	78.5	-	5.02	28.08"Hg, cap greased, dry
8-Dec-08	11:30	0	6200	0.1	1.2	20.3	78.4	-	5.02	27.93"Hg, cap greased, dry
7-Jan-09	12:30	0.02	6200	0	1.2	20.5	78.3	-	5.02	27.45" Hg, dry
9-Feb-09	11:15	0	6200	0	1	20.2	78.8	-	5.02	27.61" Hg, dry
9-Mar-09	13:30	0	6200	0	1	20.1	78.9	-	5.02	27.72" Hg, riser coupling visible above ground in casing, repair work required, dry
9-Apr-09	11:15	0	26200	0.7	0.9	20.3	78.1	-	4.875	27.57" Hg, glue odour while purging, repairs completed by RDOS prior to event, bentonite/fill fell down well from repair

GM98-1

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	10:35	0.2	600	56.0	38.5	0.2	5.3	22.812	23.259	
6-Jun-08	18:15	0	600	57.4	34.7	0.0	7.9	22.950	23.000	
10-Jul-08	12:30	0.175	5600	61.9	38.0	0.0	0.1	23.022	23.263	threads resealed with teflon tape, cap greased
13-Aug-08	13:20	0.465	600	56.2	34.7	0.3	8.8	23.045	23.260	water drawn up tubing during sampling stopped before reaching GEM
8-Sep-08	13:50	0.3	600	62.5	39.2	0.2	-1.9	23.067	23.262	
3-Oct-08	15:20	0.26	600	61.7	38.2	0.6	-0.5	23.080	23.260	27:51" Hg
6-Nov-08	14:30	0.26	600	64.1	38.6	0.0	-2.7	23.090	23.260	28.16"Hg, cap greased
8-Dec-08	14:30	0.14	600	63.3	36.5	0.0	0.2	23.100	23.260	27.95"Hg
7-Jan-09	15:45	0.21	600	62.3	36.7	0.0	1.0	23.160	23.260	27.50" Hg
9-Feb-09	15:00	0.08	600	64.2	37.8	0.0	-2.0	23.120	23.260	27.55" Hg
9-Mar-09	16:10	0.2	600	51.2	38.0	0.0	10.8	-	-	27.78"Hg, water level not taken due to time constraints
9-Apr-09	15:35	0.125	600	59.2	37.6	0.0	3.2	23.130	23.260	29.59" Hg

GM98-2

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	10:55	0.035	600	51.8	39.5	0.0	8.7	-	-	could not remove monitoring port
6-Jun-08	18:30	0	600	54.1	36.6	0.0	9.3	-	-	could not remove monitoring port
10-Jul-08	12:20	0.023	5600	59.8	40.2	0.0	0.0	-	-	could not remove monitoring port
13-Aug-08	13:08	0.09	600	53.1	37.9	0.4	8.6	-	-	could not remove monitoring port
8-Sep-08	13:45	0.193	600	59.6	40.7	0.1	-0.4	-	-	could not remove monitoring port
3-Oct-08	15:50	0.2	600	59.3	40.3	0.6	-0.2	-	-	27.51"Hg, could not remove monitoring port
6-Nov-08	14:25	0.144	600	56.0	39.0	0.0	5.0	-	-	28.16"Hg, could not remove monitoring port
8-Dec-08	14:15	0.08	600	55.8	38.6	0.0	5.6	-	-	27.95"Hg, could not remove monitoring port
7-Jan-09	15:10	0.067	600	53.7	38.7	0.0	7.6	-	-	27.54" Hg, could not remove monitoring port
9-Feb-09	14:30	0.06	600	60.2	40.0	0.0	-0.2	-	-	27.60" Hg, could not remove monitoring port
9-Mar-09	15:50	0.16	600	47.0	40.3	0.0	12.7	-	-	27.78" Hg, could not remove monitoring port
9-Apr-09	14:40	0.083	600	58.3	41.4	0.0	0.3	-	-	27.70" Hg, could not remove monitoring port

GM98-3

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	11:10	0.02	600	43.5	33.9	0.0	22.6	-	-	could not remove monitoring port
6-Jun-08	17:40	0	n/a	47.0	34.0	0.0	19.0	-	8.880	dry
10-Jul-08	11:45	0.02	5300	58.5	37.9	0.0	3.6	-	8.880	threads resealed with teflon tape, cap greased, dry
13-Aug-08	13:00	0.085	600	54.7	36.6	0.1	8.6	-	8.913	cap greased, moist
8-Sep-08	13:30	0.158	600	59.1	40.9	0.0	0.0	-	8.905	27.84" Hg, moist
3-Oct-08	15:55	0.158	600	56.8	40.5	0.6	2.1	-	8.900	moist
6-Nov-08	14:20	0.095	600	51.2	38.5	0.0	10.3	-	8.910	cap greased, moist
8-Dec-08	14:05	0.053	600	47.5	36.6	0.0	15.9	-	8.910	27.95"Hg, cap greased, moist
7-Jan-09	15:00	0.01	600	44.0	35.0	0.0	21.0	-	8.910	27.58" Hg, moist
9-Feb-09	14:20	0.025	600	44.7	37.4	0.0	17.9	-	8.910	27.60" Hg, moist
9-Mar-09	13:35	0.105	600	35.5	36.1	0.0	28.4	-	8.910	27.78" Hg, moist
9-Apr-09	14:35	0.067	600	45.5	37.0	0.0	17.5	-	8.910	27.70" Hg, moist

GM98-4

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	11:10	0.02	600	43.5	33.9	0.0	22.6	-	6.342	dry
6-Jun-08	17:25	0	600	50.3	31.4	0.0	18.3	-	6.330	dry
10-Jul-08	11:35	0.025	5600	60.8	36.7	0.0	2.5	-	6.353	pressure not stable due to high winds, resealed threads with teflon tape, dry
13-Aug-08	12:51	0.08	600	55.1	34.5	0.2	10.2	6.320	6.345	cap greased, threads resealed with teflon tape
8-Sep-08	13:27	0.125	600	61.2	40.3	0.3	-1.8	6.322	6.345	
3-Oct-08	16:05	0.12	600	60.3	38.4	0.5	0.8	6.320	6.340	27.51" Hg
6-Nov-08	14:10	0.132	600	56.7	37.9	0.0	5.4	6.320	6.345	28.16"Hg, cap greased
8-Dec-08	14:00	0.026	600	50.7	36.3	0.0	13.0	6.330	6.350	27.95"Hg, cap greased
7-Jan-09	14:45	0.068	600	43.6	34.9	0.0	21.5	-	6.350	27.58" Hg, minimal water in well but no reading from water level because sensor was 7cm from the tip
9-Feb-09	14:10	0	600	41.3	35.6	0.0	23.1	6.320	6.345	27.60" Hg
9-Mar-09	15:30	0.08	600	32.0	34.4	0.0	33.6	6.320	6.350	27.71"Hg
9-Apr-09	14:30	0.06	600	43.7	34.8	0.0	21.5	6.320	6.350	27.70" Hg

GM98-5

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	10:35	0	600	55.1	43.3	0.8	0.8	8.213	8.240	
6-Jun-08	18:10	n/a	50600	3.0	2.2	20.3	74.5	-	8.220	monitoring port was open prior to sampling, reading is an anomaly
10-Jul-08	13:00	0.6	5600	57.7	40.0	0.3	2.0	8.193	8.223	threads resealed with teflon tape, cap greased
13-Aug-08	13:43	-0.5	600	51.0	40.2	0.2	8.6	8.203	8.223	cap greased
8-Sep-08	14:00	2.218	600	51.5	41.7	0.0	6.8	8.188	8.224	
3-Oct-08	15:30	1.754	600	47.2	38.6	1.3	12.9	8.190	8.220	27.51" Hg
6-Nov-08	14:50	-1.5	600	47.8	39.0	0.0	13.2	8.200	8.220	28.16"Hg, cap greased
8-Dec-08	14:55	-1.013	600	44.5	37.0	0.0	18.5	8.200	8.220	27.99"Hg, cap greased
7-Jan-09	15:30	1.525	600	42.3	34.4	0.0	23.3	-	8.220	27.50" Hg, minimal water in well but no reading from water level because sensor was 7cm from the tip
9-Feb-09	14:35	0.644	600	45.2	37.2	0.0	17.6	8.200	8.220	27.60" Hg
9-Mar-09	15:55	-1.16	600	34.7	36.7	0.0	28.6	8.180	8.220	27.78"Hg
9-Apr-09	14:55	0	6200	59.5	44.6	0.0	-4.1	8.190	8.220	27.59" Hg, monitoring port replaced due to damage, lid no longer closes

GM98-6

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	10:45	0.12	600	59.3	44.1	0.0	-3.4	-	16.414	dry
6-Jun-08	18:00	0	n/a	58.7	38.4	0.0	2.9	-	15.870	dry
10-Jul-08	12:40	0.068	5600	59.0	40.0	0.0	1.0	-	16.405	threads resealed with teflon tape, cap greased, dry
13-Aug-08	13:35	0	600	56.5	38.3	0.3	4.9	-	16.405	cap greased, dry
8-Sep-08	13:55	0.312	600	62.0	43.9	0.1	-6.0	-	16.410	moisture in cap, dry
3-Oct-08	15:40	0.25	600	61.5	42.4	0.6	-4.5	-	16.400	27.51"Hg, dry
6-Nov-08	14:40	0.18	600	62.8	42.0	0.0	-4.8	-	16.410	28.16"Hg, cap greased, dry
8-Dec-08	14:40	0.136	600	61.2	41.2	0.0	-2.4	-	16.410	27.99"Hg, dry
7-Jan-09	15:15	0.11	600	59.4	39.1	0.0	1.5	-	16.410	27.54" Hg, dry
9-Feb-09	14:50	0.08	600	65.3	42.9	0.0	-8.2	-	16.410	27.60" Hg, dry
9-Mar-09	16:00	0.2	600	52.5	41.9	0.0	5.6	-	16.410	27.78"Hg dry
9-Apr-09	15:20	0.105	600	61.8	42.2	0.0	-4.0	-	16.410	27.59" Hg, dry

GM98-7

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	11:20	0.04	600	39.8	35.7	0.0	24.5	-	12.050	dry
6-Jun-08	17:50	0	n/a	41.5	32.0	0.0	26.5	-	12.060	dry
10-Jul-08	12:05	0.04	5600	50.0	35.3	0.0	14.7	-	12.055	resealed threads with teflon tape, cap greased , dry
13-Aug-08	13:12	0.097	600	46.6	33.9	0.1	19.4	-	12.050	cap greased, dry
8-Sep-08	14:10	0.168	600	51.2	38.5	0.2	10.1	-	12.060	dry
3-Oct-08	15:15	0.138	600	51.5	36.7	0.7	11.1	-	12.050	dry
6-Nov-08	15:00	0.15	600	53.2	37.3	0.0	9.5	-	12.050	cap greased, dry
8-Dec-08	14:20	0.07	600	49.1	35.4	0.0	15.5	-	12.050	dry
7-Jan-09	15:05	0.033	600	43.3	34.8	0.0	21.9	-	12.050	27.54" Hg, dry
9-Feb-09	14:40	0.018	600	40.4	36.0	0.0	23.6	-	12.050	27.60" Hg, dry
9-Mar-09	15:40	0.15	600	29.9	35.5	0.0	34.6	-	12.050	27.78" Hg, dry
9-Apr-09	14:45	0.067	600	37.8	34.3	0.0	27.9	-	12.050	27.70" Hg, dry

GAS EXTRACTION WELL

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
10-May-08	-	-	-	-	-	-	-	-	-	monitoring port to be installed
6-Jun-08	-	-	-	-	-	-	-	-	-	monitoring port to be installed
10-Jul-08	14:00	0.874	5300	56.2	43.3	0.3	0.2	-	-	lid sealed, small diameter water level required to measure depth to water and well depth
13-Aug-08	14:00	0.236	600	57.3	40.5	0.4	1.8	-	-	dry
8-Sep-08	14:19	0.362	600	62.7	45.4	0.2	-8.3	-	-	
3-Oct-08	16:25	0.317	600	62.2	43.8	0.6	-6.6	-	-	27.44" Hg
6-Nov-08	15:10	0.154	600	63.7	43.6	0.0	-7.3	-	-	28.16"Hg
8-Dec-08	15:10	0.086	600	63.1	42.3	0.0	-5.4	-	-	27.99"Hg
7-Jan-09	13:50	0.105	600	62.8	41.5	0.0	-4.3	-	-	27.50" Hg
9-Feb-09	15:15	0.026	600	67.5	43.4	0.0	-10.9	-	-	27.55" Hg
9-Mar-09	16:15	0.18	600	54.4	43.6	0.0	2.0	-	-	27.78" Hg
9-Apr-09	15:50	0.055	600	62.7	44.2	0.0	-6.9	-	-	27.59" Hg

OBSERVATION WELL SERIES 15

Date	Time	Pressure (in. of H20)	Purged Vol. (cm^3)	CH_4 (%v/v)	CO_2 (%v/v)	O_2 (%v/v)	BAL	Water Level (m TOR)	Depth to Bottom (m TOR)	Comments
15-5.87 m BTOR (depth to bottom)										
10-May-08	-	-	-	-	-	-	-	-	-	-monitoring port to be installed
6-Jun-08	-	-	-	-	-	-	-	-	-	-monitoring port to be installed
10-Jul-08	14:10	0.15	-	-	-	-	-	-	-	
13-Aug-08	14:15	0.101	-	50.2	37.0	2.5	10.3	-	-	
8-Sep-08	14:21	0.153	-	-	-	-	-	-	-	
3-Oct-08	16:30	0.154	-	-	-	-	-	-	-	
6-Nov-08	15:30	0.06	-	-	-	-	-	-	-	
8-Dec-08	15:15	0.044	-	-	-	-	-	-	-	
7-Jan-09	14:00	0.052	-	-	-	-	-	-	-	
9-Feb-09	15:15	0.05	-	-	-	-	-	-	-	
9-Mar-09	16:15	0.05	-	-	-	-	-	-	-	
9-Apr-09	15:50	0.046	-	-	-	-	-	-	-	
15-7.75 m BTOR (depth to bottom)										
10-May-08	-	-	-	-	-	-	-	-	-	-monitoring port to be installed
6-Jun-08	-	-	-	-	-	-	-	-	-	-monitoring port to be installed
10-Jul-08	14:11	0.964	-	-	-	-	-	-	-	
13-Aug-08	14:15	0.326	-	72.7	39.7	0.4	-12.8	-	-	
8-Sep-08	14:21	0.5	-	-	-	-	-	-	-	
3-Oct-08	16:30	0.44	-	-	-	-	-	-	-	
6-Nov-08	15:30	0.24	-	-	-	-	-	-	-	
8-Dec-08	15:15	0.151	-	-	-	-	-	-	-	
7-Jan-09	14:00	0.172	-	-	-	-	-	-	-	
9-Feb-09	15:15	0.113	-	-	-	-	-	-	-	
9-Mar-09	16:15	0.24	-	-	-	-	-	-	-	
9-Apr-09	15:50	0.15	-	-	-	-	-	-	-	
15-7.88 m BTOR (depth to bottom)										
10-May-08	-	-	-	-	-	-	-	-	-	-monitoring port to be installed
6-Jun-08	-	-	-	-	-	-	-	-	-	-monitoring port to be installed
10-Jul-08	14:12	0.233	-	-	-	-	-			
13-Aug-08	14:15	0.074	-	53.6	39.0	1.1	6.3	-	-	
8-Sep-08	14:21	0.108	-	-	-	-	-	-	-	
3-Oct-08	16:30	0.104	-	-	-	-	-	-	-	
6-Nov-08	15:30	0.034	-	-	-	-	-	-	-	
8-Dec-08	15:15	0.023	-	-	-	-	-	-	-	
7-Jan-09	14:00	0.027	-	-	-	-	-	-	-	
9-Feb-09	15:15	0.025	-	-	-	-	-	-	-	
9-Mar-09	16:15	0.042	-	-	-	-	-	-	-	
9-Apr-09	15:50	0.024	-	-	-	-	-	-	-	

APPENDIX F

GAS MONITORING WELL TEMPERTURE PROFILES

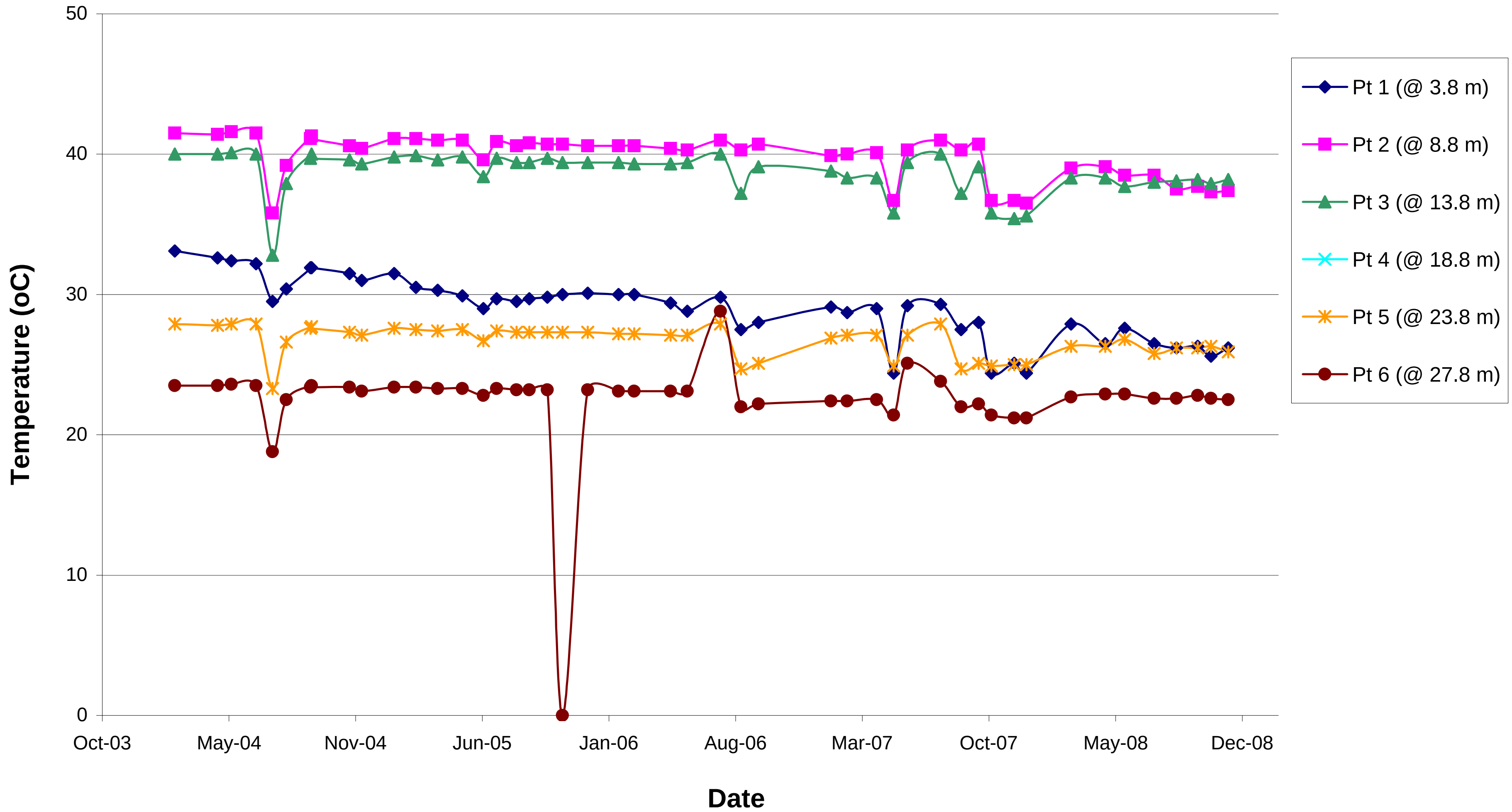


figure F1

GM98-1 TEMPERATURE PROFILE

NORTHERN LANDFILL GAS SETBACK ASSESSMENT

CAMPBELL MOUNTAIN LANDFILL

Regional District of Okanagan-Similkameen

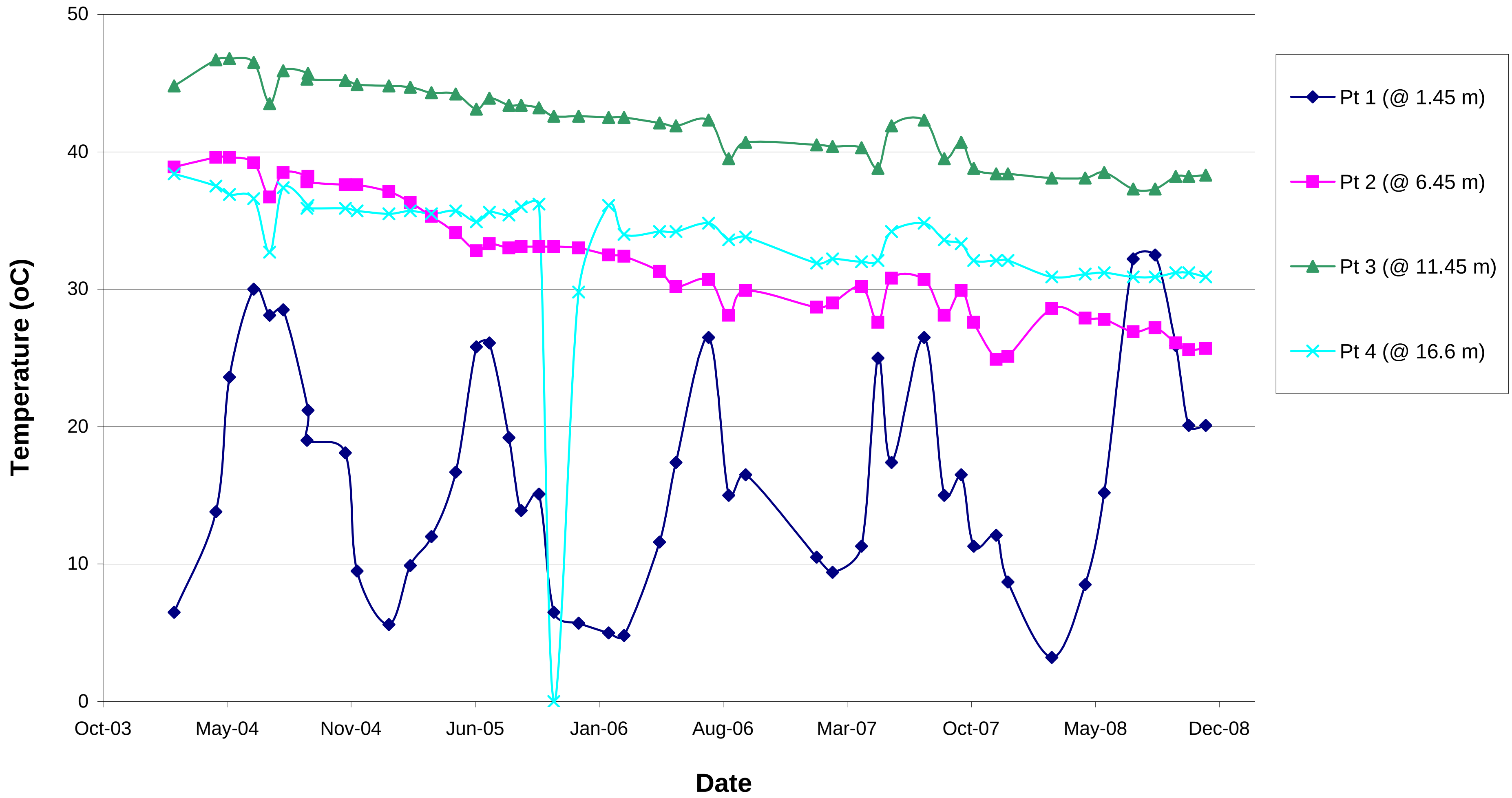


figure F2

GM98-2 TEMPERATURE PROFILE

NORTHERN LANDFILL GAS SETBACK ASSESSMENT

CAMPBELL MOUNTAIN LANDFILL

Regional District of Okanagan-Similkameen

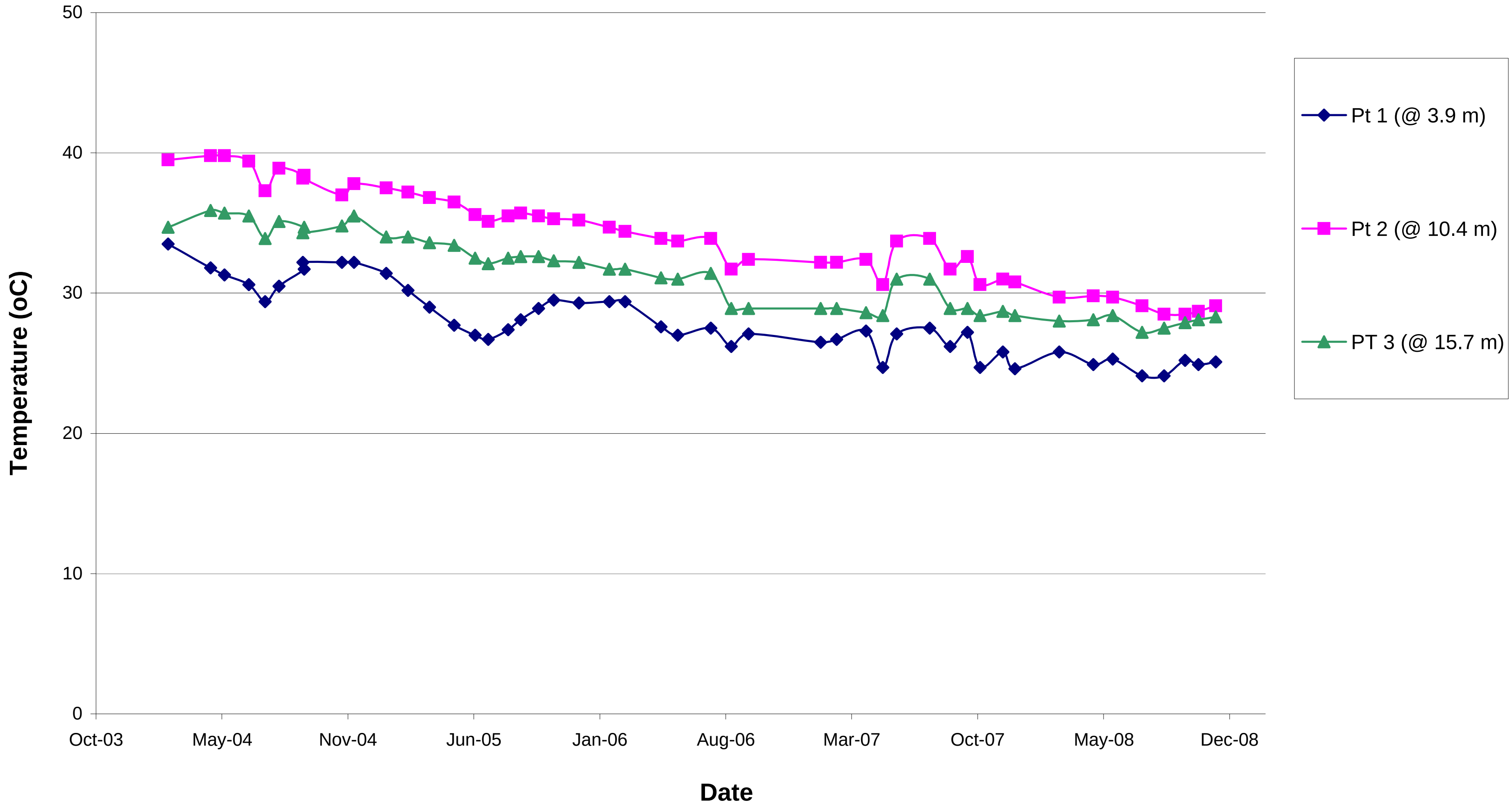


figure F3

GM98-3 TEMPERATURE PROFILE

NORTHERN LANDFILL GAS SETBACK ASSESSMENT

CAMPBELL MOUNTAIN LANDFILL

Regional District of Okanagan-Similkameen

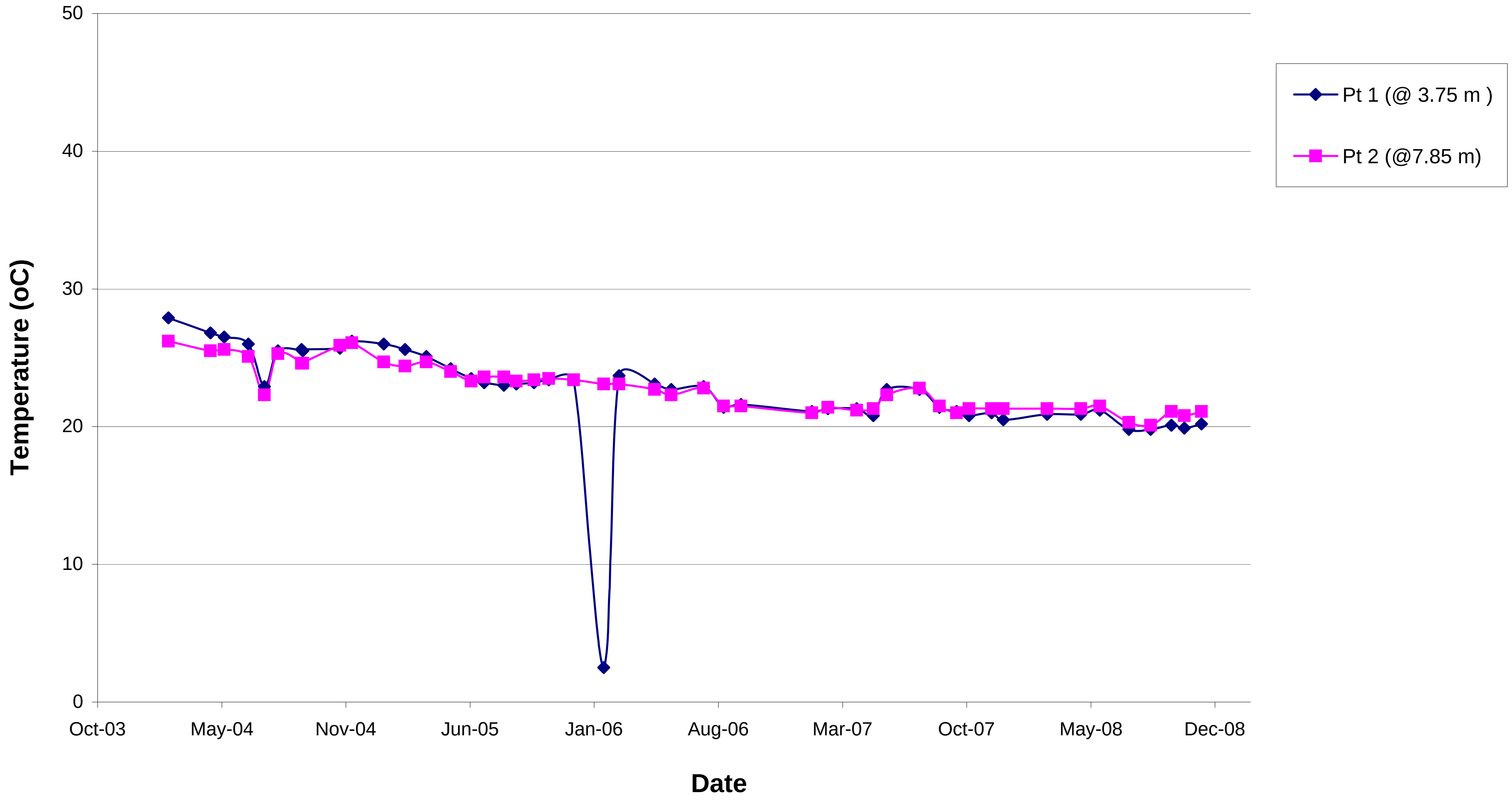


figure F4

GM98-4 TEMPERATURE PROFILE

NORTHERN LANDFILL GAS SETBACK ASSESSMENT

CAMPBELL MOUNTAIN LANDFILL

Regional District of Okanagan-Similkameen

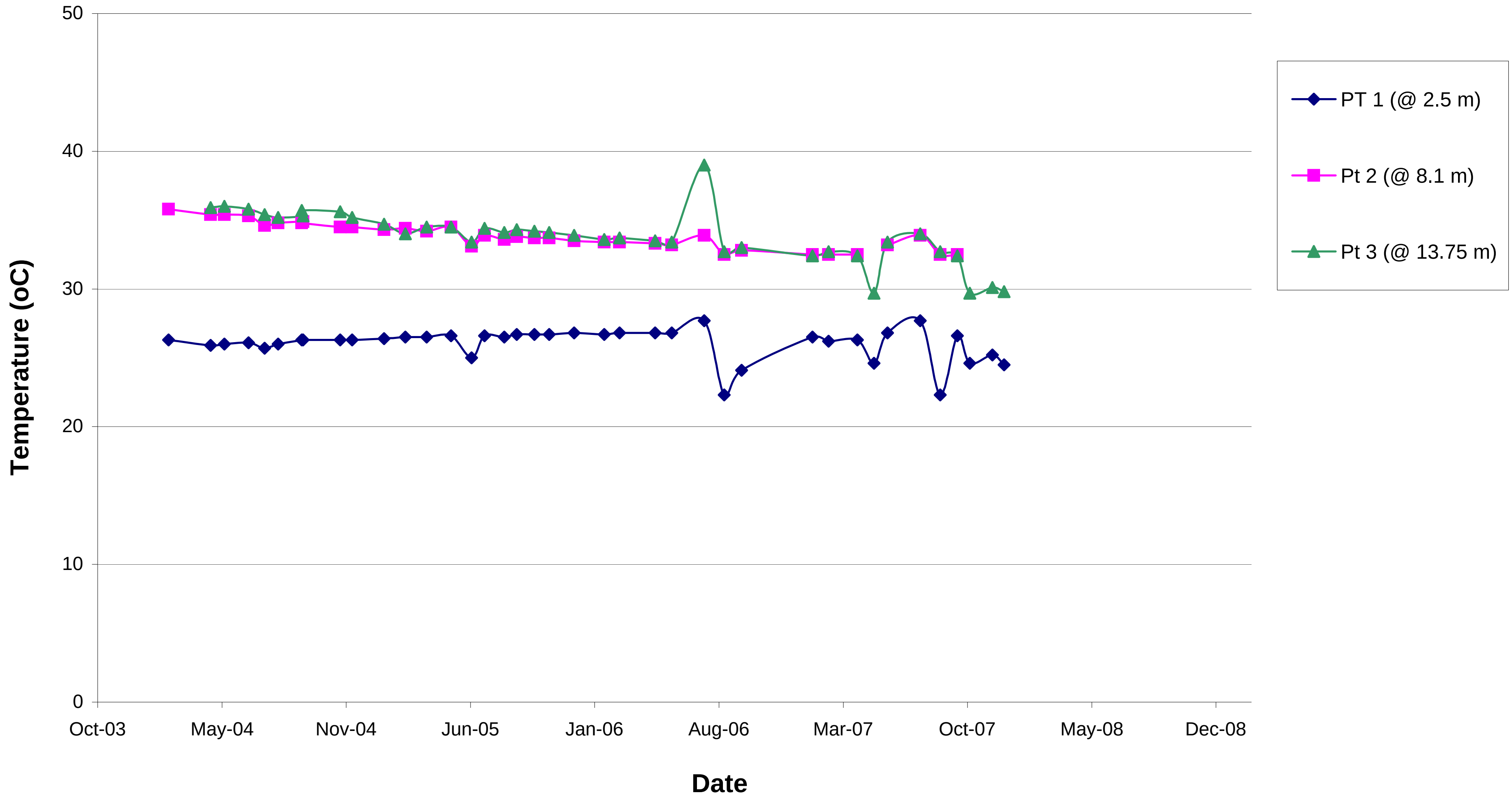


figure F5

GM98-5 TEMPERATURE PROFILE

NORTHERN LANDFILL GAS SETBACK ASSESSMENT

CAMPBELL MOUNTAIN LANDFILL

Regional District of Okanagan-Similkameen

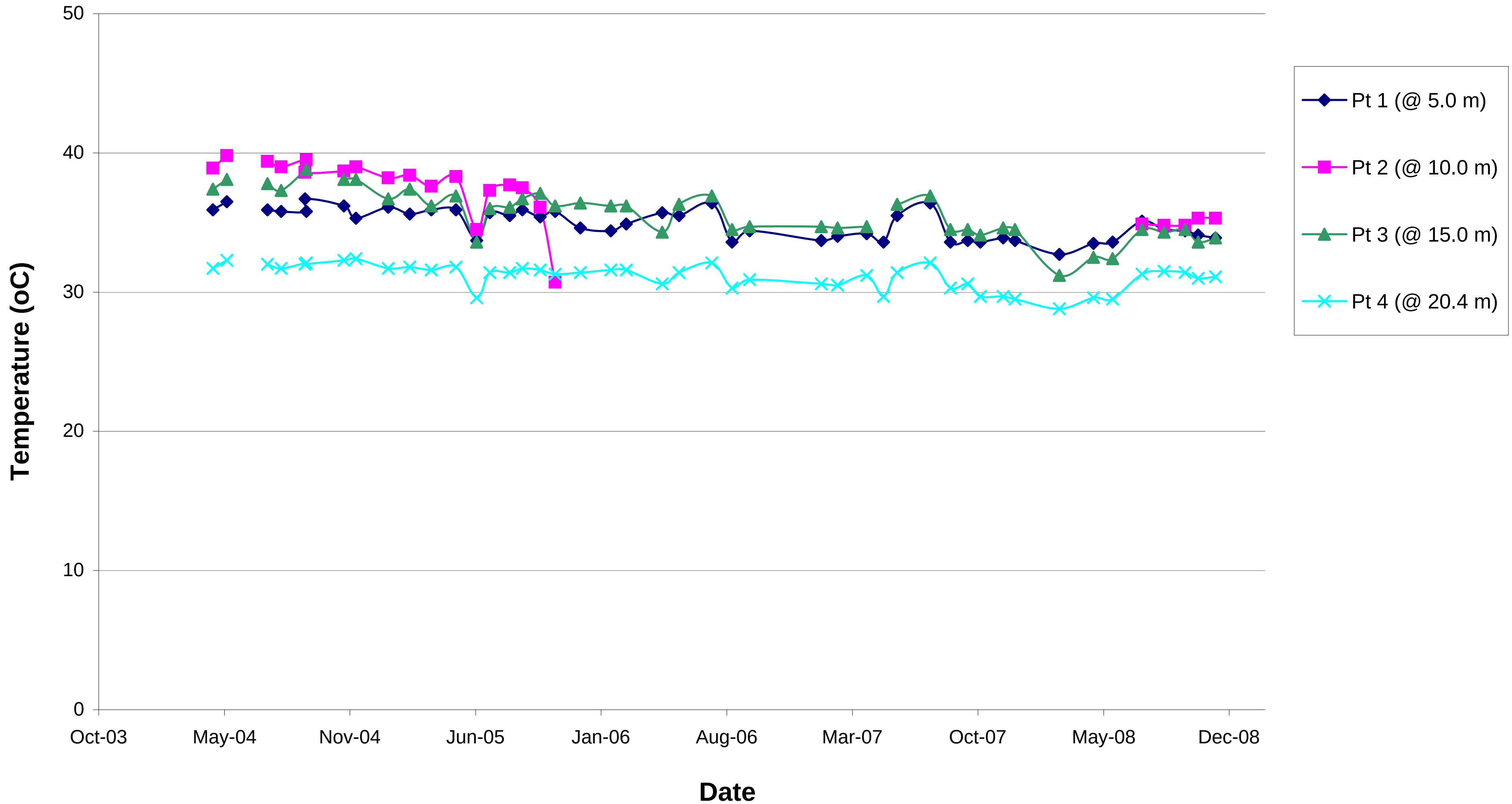


figure F6

GM98-6 TEMPERATURE PROFILE

NORTHERN LANDFILL GAS SETBACK ASSESSMENT

CAMPBELL MOUNTAIN LANDFILL

Regional District of Okanagan-Similkameen

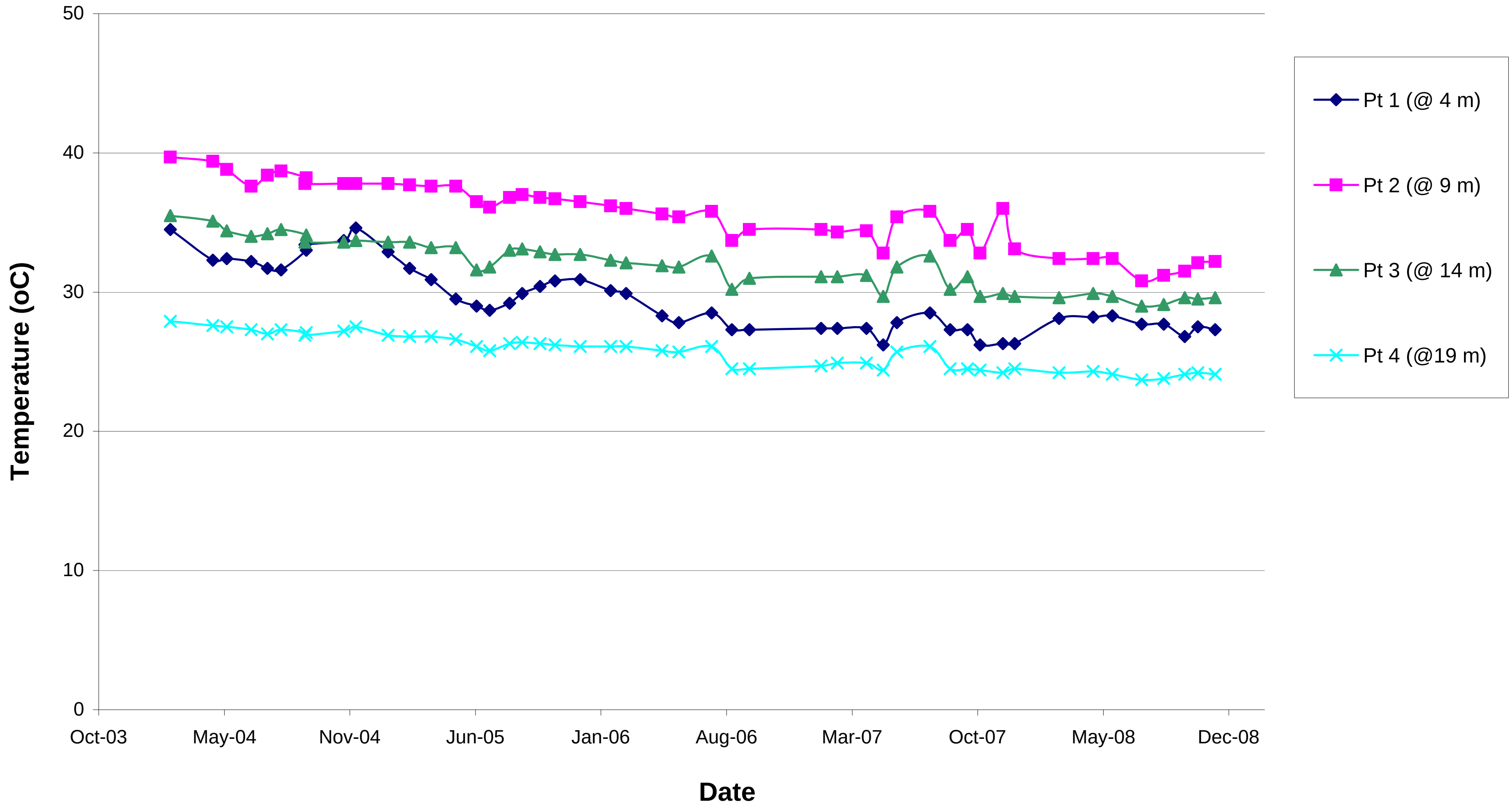


figure F7

GM98-7 TEMPERATURE PROFILE

NORTHERN LANDFILL GAS SETBACK ASSESSMENT

CAMPBELL MOUNTAIN LANDFILL

Regional District of Okanagan-Similkameen

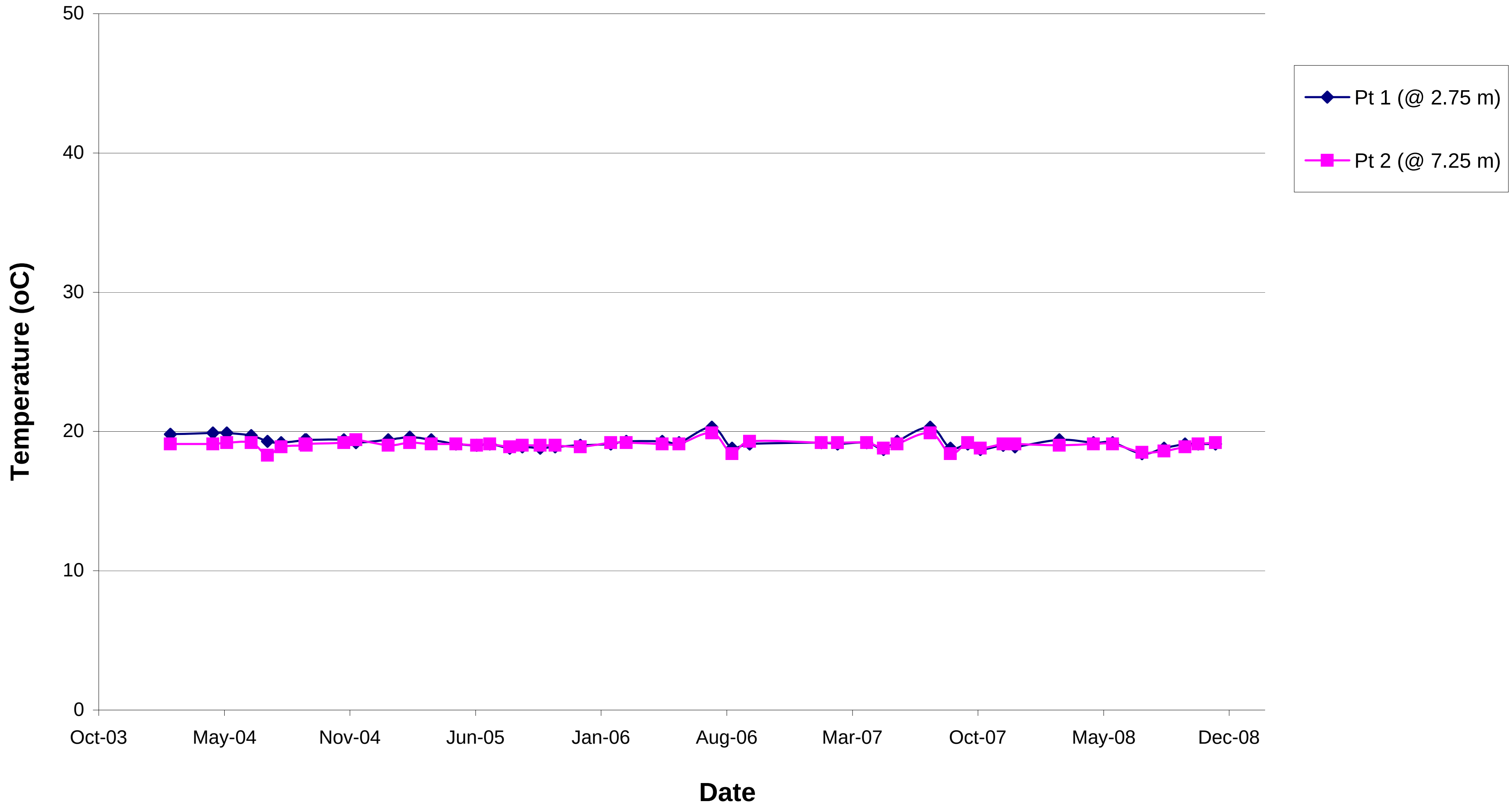


figure F8

GM98-8 TEMPERATURE PROFILE

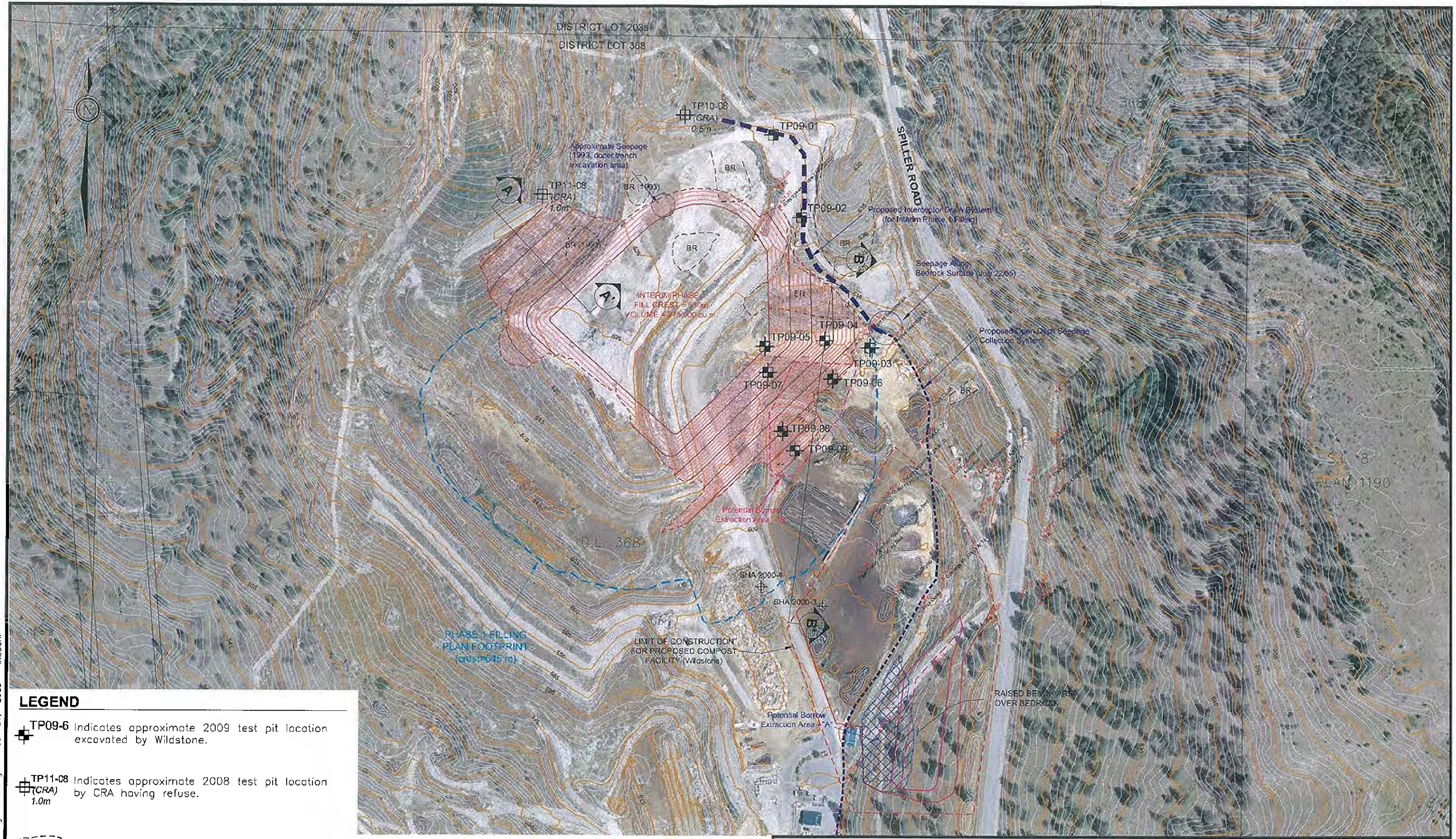
NORTHERN LANDFILL GAS SETBACK ASSESSMENT

CAMPBELL MOUNTAIN LANDFILL

Regional District of Okanagan-Similkameen

APPENDIX G

INTERIM PHASE I FILLING PLAN DETAILS



LEGEND

TP09-6 Indicates approximate 2009 test pit location excavated by Wildstone.

TP11-08 (CRA) 1.0m Indicates approximate 2008 test pit location by CRA having refuse.

BR Indicates approximate area of previously identified bedrock exposure.

2005 GPS survey point locations and elevations.

REFERENCE

Base plan and photo provided by RDOS (topo based on July 2008 aerial photograph).

NOTES: Calculated storage volume based on filling to elevation 630 m using 3H:1V (horizontal : vertical) side slopes, except along southeast temporary side slope having 2H:1V slope.

50 0 50
SCALE METRES

Golder Associates
Kelowna, British Columbia

FILE No.	Final 2008 Filling Plans.dwg		
PROJECT No.	03-1480-040 (9700)	REV.	1
SCALE	1:2500		
DATE	21Jan2009		
DESIGN	RT		
CADD	RT		
CHECK			
REVIEW			

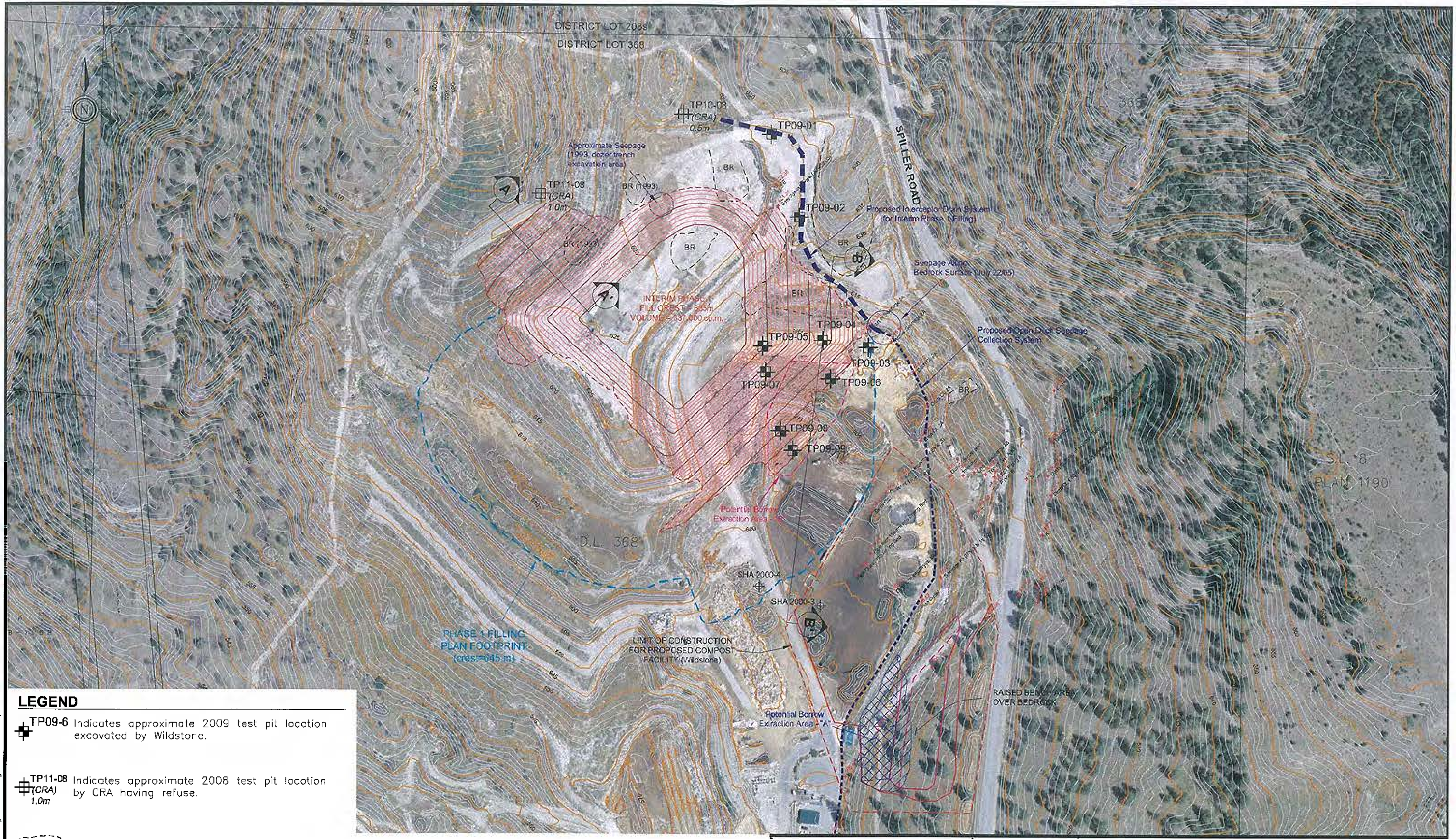
TITLE

EXPANDED INTERIM PHASE 1 FILLING PLAN CREST ELEVATION = 630m

RDOS - CAMPBELL MTN LANDFILL

FIGURE 3

Drawing file: final_2008 Filling Plans.dwg Jan 31, 2009 - 9:25am



LEGEND

TP09-6 Indicates approximate 2009 test pit location excavated by Wildstone.

TP11-08 (CRA) 1.0m Indicates approximate 2008 test pit location by CRA having refuse.

BR Indicates approximate area of previously identified bedrock exposure.

2005 GPS survey point locations and elevations.

REFERENCE

Base plan and photo provided by RDOS (topo based on July 2008 aerial photograph).

NOTES: Calculated storage volume based on filling to elevation 635 m using 3H:1V (horizontal : vertical) side slopes, except along southeast temporary side slope having 2H:1V slope.

50 0 50
SCALE METRES

Golder Associates
Kelowna, British Columbia

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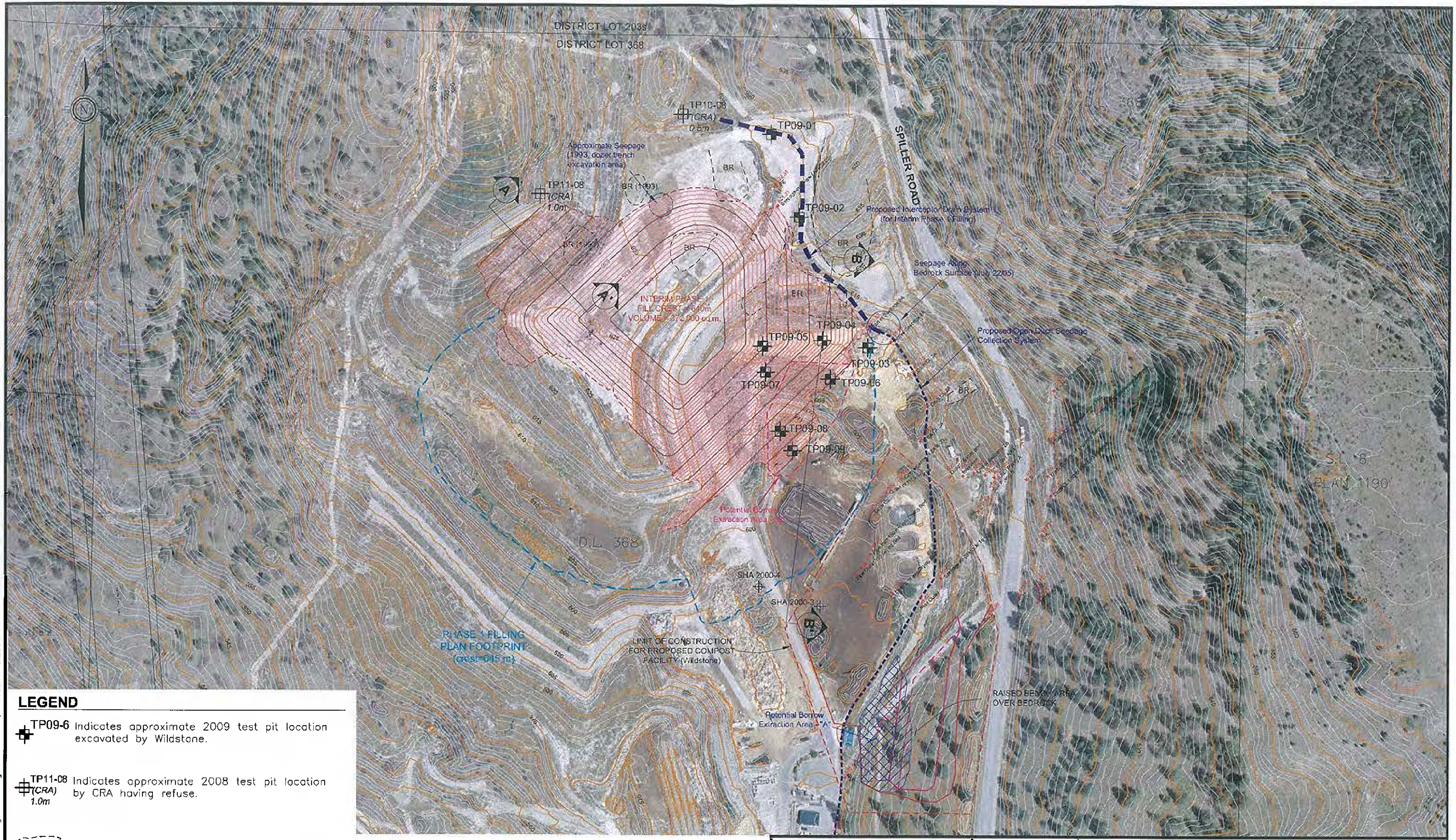
DATE	21Jan2009		
DESIGN	RT		
CADD	RT		
FILE No.	Final 2008 Filling Plans.dwg	CHECK	
PROJECT No. 03-1480-040 (9700)	REV. 1	REVIEW	RDOS - CAMPBELL MTN LANDFILL — FIGURE 3A

Drawing file: final_2008 Filling Plans.dwg Jan 31, 2009 - 9:26am



LEGEND

TP09-6 Indicates approximate 2009 test pit location excavated by Wildstone.

TP11-08 (CRA) 1.0m Indicates approximate 2008 test pit location by CRA having refuse.

BR Indicates approximate area of previously identified bedrock exposure.

2005 GPS survey point locations and elevations.

REFERENCE

Base plan and photo provided by RDOS (topo based on July 2008 aerial photograph).

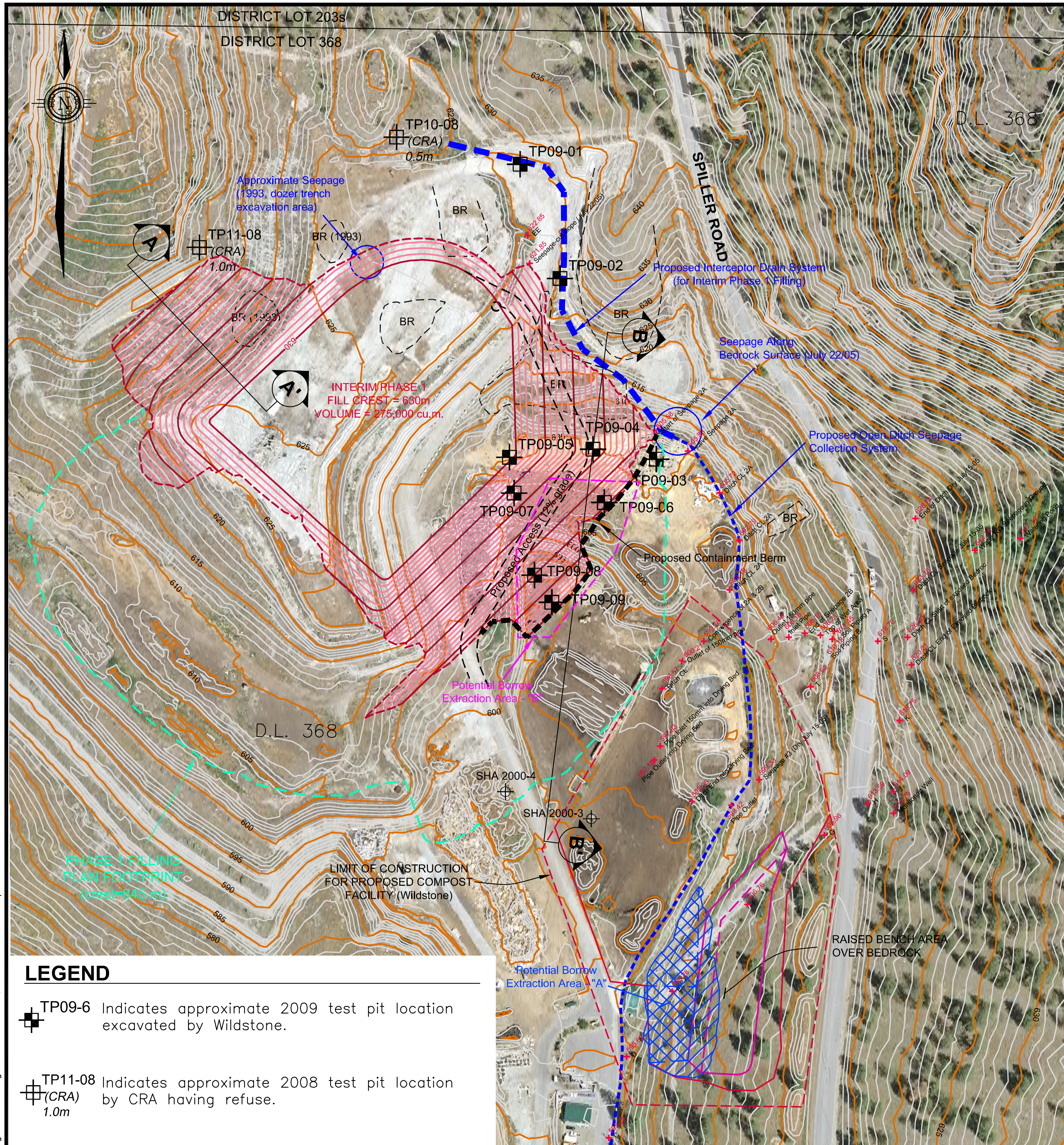
NOTES: Calculated storage volume based on filling to elevation 640 m using 3H:1V (horizontal : vertical) side slopes, except along southeast temporary side slope having 2H:1V slope face.

50 0 50
SCALE METRES

Golder Associates
Kelowna, British Columbia

SCALE	1:2500	TITLE	**EXPANDED INTERIM PHASE 1 FILLING PLAN CREST ELEVATION = 640m**
DATE	22Jan2009		
DESIGN	RT		
CADD	RT		
CHECK			
REVIEW			RDOS - CAMPBELL MTN LANDFILL
FILE No.	Final 2008 Filling Plans.dwg	FIGURE	3B
PROJECT No.	03-1480-040 (9700)	REV.	1

Drawing file: final_2008 Filling Plans.dwg Jan 31, 2009 - 9:26am



LEGEND

TP09-6 Indicates approximate 2009 test pit location excavated by Wildstone.

TP11-08 (CRA) 1.0m Indicates approximate 2008 test pit location by CRA having refuse.

BR Indicates approximate area of previously identified bedrock exposure.

2005 GPS survey point locations and elevations.

REFERENCE

Base plan and photo provided by RDOS (topo based on July 2008 aerial photograph).

NOTES: Calculated storage volume based on filling to elevation 630 m using 3H:1V (horizontal : vertical) side slopes, except along southeast temporary side slope having 2H:1V slope.

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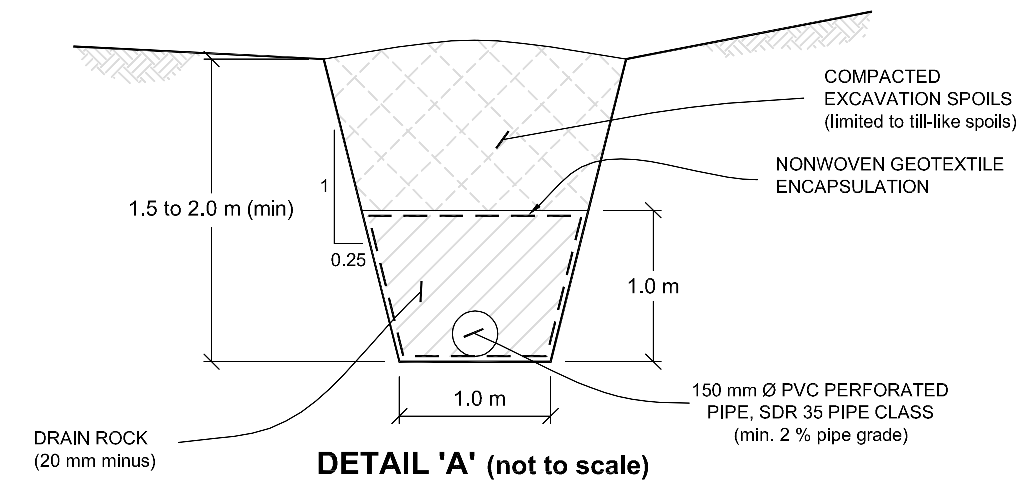
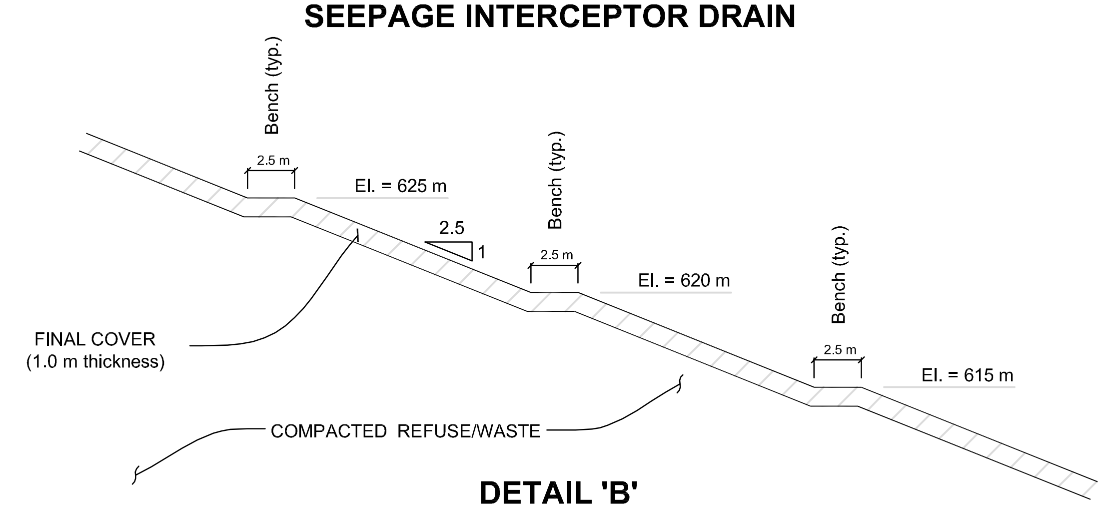
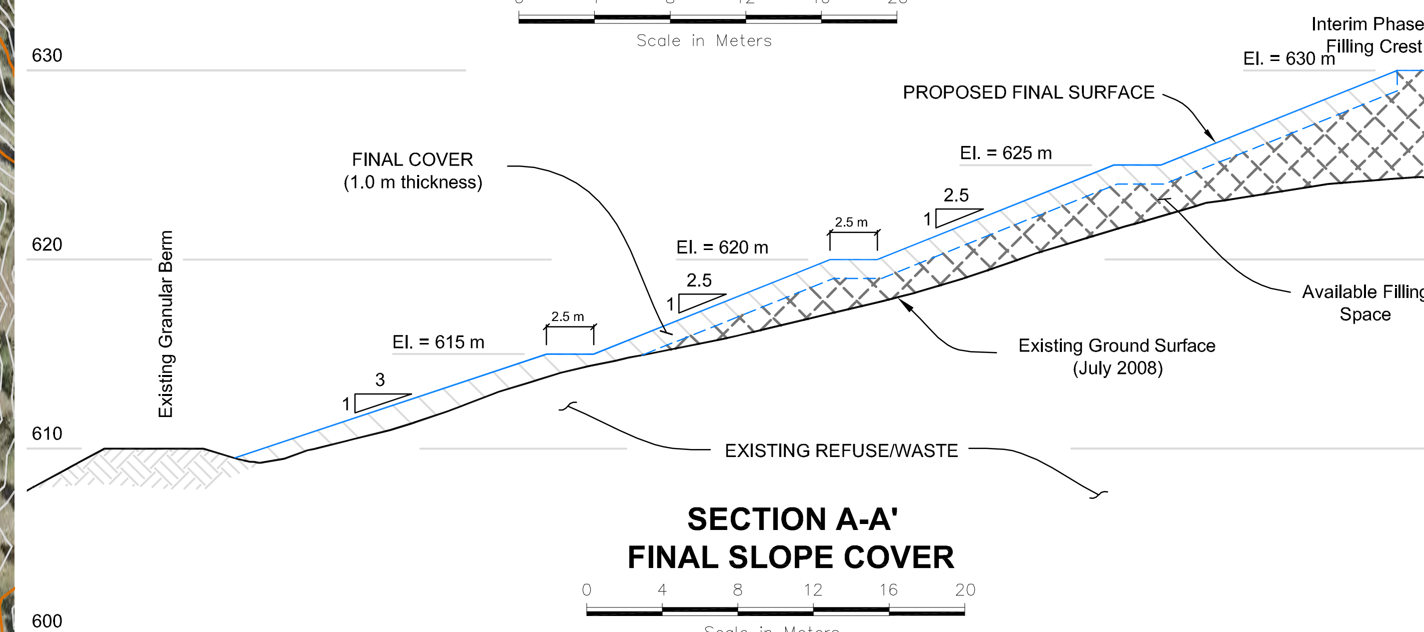


DETAIL 'A' (not to scale)
NATURAL GROUNDWATER SEEPAGE INTERCEPTOR DRAIN



DETAIL 'B'
FINAL SLOPE GRADING CONCEPT



SECTION A-A'
FINAL SLOPE COVER

Golder Associates, Kelowna, British Columbia	
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DESIGN	RT
CADD	RT
CHECK	
REVIEW	
FILE No.	Final 2008 Filling Plans.dwg
PROJECT No.	03-1480-040 (9700)
REV.	1

TITLE

PROPOSED INTERCEPTOR DRAIN, ACCESS ROAD AND FINAL SLOPE DETAILS

RDOS - CAMPBELL MTN LANDFILL

FIGURE 4

Drawing file: final_2008 Filling Plans.dwg Feb 10, 2009 - 4:59pm

APPENDIX E

Preliminary Water & Wastewater Servicing Strategy
(Urban Systems Ltd.)

Spiller Road / Reservoir Road Development

Preliminary Water & Wastewater Servicing Strategy

REPORT

URBANSYSTEMS.

January 23, 2013
2707.0008.01

TABLE OF CONTENTS

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1.0 INTRODUCTION

1.1 Background

This report has been prepared to support the completion of the Spiller Road / Reservoir Road Area Neighbourhood Concept Plan. As such, the reader is directed to the reference documents listed in Section 1.4 in order to obtain a more complete context for the information presented herein.

1.2 Subject Area

The subject area is located approximately 4 kilometers northeast of downtown Penticton, overlooking the southeast corner of Okanagan Lake, as shown in NCP Figure 1.1. It covers 297 hectares, 83 of which are proposed to be developed. The majority of the site sits on the foothills of Campbell Mountain, with the east boundary defined by the Campbell Mountain Sanitary Landfill and the City boundary, while the westerly portion extends to the Agricultural Land Reserve (ALR). The northern and southern borders are Riddle Road and Hillside Avenue, respectively. While the Naramata bench is primarily located within the Agricultural Land Reserve, the study area contains only non-ALR lands.

1.3 Study Objectives

The purpose of this document is to present preliminary water & wastewater servicing concepts (Appendix 1) for the study area, which will provide the basis for discussions with City Staff and ultimately, the context for the water and sewer pre-design reports.

Specific water system objectives are as follows:

- Confirm key design criteria and guiding principles
- Identify water system issues specific to the North-East sector
- Review North-East sector off-site servicing (water) options provided by the City
- Develop water system concept complete with phasing arrangement
- Determine maximum growth based upon phasing plan

Specific sanitary sewer system objectives are listed below:

- Define sewer catchment areas based upon existing topography
- Confirm key design criteria and guiding principles
- Establish peak design flow rates and verify minimum sewer pipe sizing per catchment
- Develop sewer main alignments and pump station locations
- Create a phasing plan for the required sewer projects

1.4 Reference Documents

This document is based on a significant amount of background information and several planning documents which were developed previously. While key data, concepts, conclusions, and recommendations have been summarized within this report, the reader is encouraged to review the following source information for a broader and more complete context.

- *City of Penticton Subdivision and Development Bylaw 2004-81*; City of Penticton, November 2004
- *2005 Sanitary Sewer Study*; EarthTech, 2005
- *2005 Water Study*; EarthTech, 2005
- *City of Penticton North East Sector Plan;* Urban Systems Ltd., July 2005
- *Naramata Road Water and Sewer System Pre-Design Report*; Urban Systems Ltd., Sept 2005
- *Geotechnical Overview of Site, North-East Sector Plan, Spiller Road / Reservoir Road Area, Penticton, BC;* Interior Testing Services Ltd., November 20, 2007
- *Spiller Road / Reservoir Road Area Neighbourhood Concept Plan Background Report;* Urban Systems, January 2008
- *Northeast Sector Optional Water Servicing Staging Plan*; AECOM, February 17, 2010

1.4.1 North East Sector Plan (2005)

The portions of this document dealing with off-site water delivery have now been superseded by the "Northeast Sector Optional Water Servicing Staging Plan" (Appendix 2), prepared by AECOM, which reflects an up-to-date view of the existing system infrastructure.

1.4.2 Northeast Sector Optional Water Servicing Staging Plan

This document provided 4 viable options to provide water service the Northeast sector area. Option #3 of the AECOM report serves as the basis for the design presented in this brief and the rationale behind the choice is outlined in section 4.3 of this report.

1.4.3 2005 Sanitary Sewer Study

The 2005 sanitary sewer study cites three (3) DCC projects (included in Appendix 3) that the Spiller Road/Reservoir Road NCP area would be required to contribute to or construct:

- Project 14: Wade Avenue/Johnson Road Trunk Replacement
- Project 15: Naramata/Upper Bench Road Servicing
- Project 16: Wastewater Treatment Plant Expansion

Much of DCC Project 14 has been constructed. By constructing the diversion at Penticton Creek (creek crossing), the NCP area will be assured of adequate downstream capacity for the initial stages of development. Confirmation from the City will be required to determine if the recent replacement of the Alberni Street lift station (South Okanagan Event Centre offsite works) in combination with the Wade Avenue/Johnson Road upgrade will allow full buildout of the NCP area and additional infill development upstream of Lakeshore Drive.

The offsite upgrades suggested by this design brief constitute the majority of DCC Project 15, with the exception of the collection system, forcemain and lift station servicing the North Block service area.

The wastewater treatment plant expansion project (Project #16) will not be constructed as part of the works outlined in this brief. Instead, the developments within the Spiller Road/Reservoir Road Neighbourhood Concept Plan area will contribute monies to the DCC program.

2.0 GOVERNING CONCEPTS

This section outlines the various criteria and guidelines which govern the water and wastewater system planning process presented in this report. These governing concepts are based on a variety of sources – provincial guidelines, City bylaws, and the reference documents cited in Section 1.4.

2.1 Criteria – Water System

The City of Penticton specifies certain criteria which govern water system analysis and design. Key criteria are summarized and discussed below.

2.1.1 Demands

The Subdivision and Development Bylaw (SD bylaw) provides per capita demand flow rates in Schedule G of the bylaw as follows:

Demand	Flow (L/capita/day)
Average Day Demand (ADD)	700
Maximum Day Demand (MDD)	1,750
Peak Hour Demand	2,625

2.1.2 Fire Flow Demand

The Subdivision and Development Bylaw (SD bylaw) lists the minimum fire flow rate for residential development (low density) as 60 Litres per second for the duration of 2 hours. The AECOM memo, "Northeast Sector Optional Water Servicing Staging Plan" was also developed with a fire flow rate of 60 Litres per second for the Neighbourhood area. Nevertheless, the City of Penticton has indicated that the required minimum fire flow rate is anticipated to increase from 60 Litres per second to 90 Litres per second.

Given the City's current bylaw requirements, the NCP water servicing strategy was developed using the requirement for a minimum fire flow rate of 60 Litres per second. It is not expected that a change to a 90 Litres per second requirement will result in any major adjustments to the off-site water systems sizing that is outlined in the Preliminary Water Servicing Strategy, presented below. However there will be impacts to both on-site reservoir sizing and distribution system piping sizing.

2.1.3 System Pressures

The Subdivision and Development Bylaw (SD bylaw) provides minimum and maximum system pressures in Schedule G of the bylaw as follows:

Pressure	kPa	Psi
Maximum Static Pressure	1034	150
Minimum System Pressure at ADD	275	40
Minimum System Pressure at PHD	250	36
Minimum System Pressure at MDD+Fireflow	140	20

2.1.4 Maximum Allowable Design Velocity

The Subdivision and Development Bylaw (SD bylaw) states that the maximum allowable design velocity shall not exceed the following:

- Pump Supply, Reservoir trunk mains 2.0 m/s
- Distribution lines, at PHD 2.0 m/s
- Fire Flow Conditions 4.0 m/s

2.2 Criteria – Sanitary Sewer System

The design of the sanitary sewer system has been based on providing service to new development only within the North East Sector. As such the demand generation has been based on an average of 400 litres/capita/day, as outlined in the bylaw. Peaking factors have been applied based on factors consistent with the City sanitary sewer modeling work that has been completed. These are approximately equal to 65% of Harmon's Peaking Factor. This is a deviation from the City draft bylaw which indicates 100% of Harmon's as a peaking factor. We have considered the impact of this peaking factor adjustment.

Inflow and infiltration rates have been designed at 0.06 litres/s/ha consistent with the criteria outlined in the Bylaw for land above the water table.

For sewage force mains the minimum velocity of 0.9 m/s has been maintained to ensure cleansing velocities.

There may be the capacity to service existing homes within the Naramata Road area however, the location of the gravity sewer has not been selected to maximize servicing the existing area by gravity and as such many of the homes would require pumping into the proposed sewer system.

3.0 POPULATION PROJECTIONS

The proposed water system improvements have been developed to provide service that meets the design criteria outlined in Section 2.0 to both the existing population within the Naramata Road area as well as to accommodate the development of the North East Sector. The proposed sewer system improvements have been limited to servicing the development within the North East Sector only.

Based on concept planning throughout the study area, it is anticipated that the NCP will achieve the following development yield:

Table 3.1: Potential Development Yield (NCP Area)

Land Use	Yield (Units)
Single Detached & Duplex (Neighbourhood Residential)	700-750
Residential Estate Lots (Hillside Estate/Hillside Holdings)	20-50
Multiple Unit Residential (Village/Neighbourhood Centre)	80-200
Total Residential Units	**800-1,000**

Based on a yield of 800 to 1,000 residential units and an average household size of 2.1 (according to the 2006 Census for the City of Penticton), it is projected that the NCP population will be in the range of 1,680 to 2,100 at full build-out.

For the entire North East Sector, population projections and demands have been based on the 2005 North East Sector Plan and the Spiller Road / Reservoir Road Area NCP currently under development. Below is a summary of the development unit projection and associated population based on a development density of 2.1 people per unit.

Table 3.2: North East Sector Development Summary

Development Area	Units	Population
NCP (Spiller Road/Reservoir Road)	800-1000	1,680-2,100
Campbell Mountain	1,400	2,940
North Block	600	1,260
Total	**2,800-3,000**	**5,880-6,300**

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4.0 WATER SYSTEM

4.1 Background

While watermains are not typically constrained by topography like sewer systems are, they do have limiting factors such as fluid velocities and pressures. Watermains must be of adequate size to convey the necessary volume of water (for consumption and for fire emergencies) to all points in the system, at a rate that is not excessive, all the while ensuring that pressures fall between minimum and maximum stated levels. As mentioned in *The Naramata Road Water and Sewer System Pre-Design* report, the geometry of the northeast sector creates two distinct challenges for water systems:

- The length of the service area means that there will be increased friction losses along the water mains; and,
- The elevation ranges throughout the area will require significant boosting (pumping) and storage (reservoirs).

4.2 Existing System

Treated water for the Naramata Road area is supplied from the City's Water Treatment Plant (WTP). Water from the WTP is pumped to the Ridgedale reservoir where it is stored and gravity-fed to the existing Northeast sector service area. The Ridgedale reservoir currently provides the only storage for the Northeast sector.

4.3 Ultimate System

The ultimate water system is shown in NCP Figure 5.1, included at the end of this report in Appendix 1, and it is based upon the same principles that were used by AECOM to prepare the concepts illustrated in the "Northeast Sector Optional Water Servicing Staging Plan" document. The two consistent features of servicing options 2 through 5 of the AECOM report were:

- A dedicated 350mm supply main from the WTP to the subject area; and,
- A new booster station at the WTP to push flows above pressure zone 502.

These two upgrades are necessary to provide flows during MDD and fire-flow conditions as well as to ensure pressures within the system remain within bylaw parameters.

Option #3 of the AECOM report was selected as the basis for the design (Figure 1) presented in this brief. The following items represent the key differences between the two strategies as reflected in the USL design:

- A reservoir is considered adjacent to the pump station near Evans Road as a potential phasing element (outlined in Option #4 of the AECOM report);
- The 643 (TWL) reservoir is relocated north, just below Spiller Road; and,
- The 715 (TWL) reservoir is relocated adjacent to the Northeast corner of the landfill, with a revised top of water elevation of 705 meters.

The rationale behind the design changes are listed in section 4.3.1 below.

4.3.1 Design Rationale

Since the preparation of the North East Sector Plan, the City has developed a water master plan that has changed the way that the NE Sector is to receive water. This has necessitated a change in the scope and phasing of the offsite works. We have reviewed the options presented by AECOM and selected Option #3 since it provides the greatest flexibility to construct the work in phases. The only material change that we have considered is the addition of a reservoir adjacent to the proposed booster pump station on Naramata Road.

The installation of a reservoir near the pump station at Evans Road provides immediate benefit to the NCP area as well as the pressure zone 502 area (balancing). The AECOM report indicated that both the booster station as well as the reservoir at Evans Road would be classified as temporary and would not form part of the DCC program. However, these facilities could be designed to be part of the ultimate water system and as such not be temporary.

The pump station at Evans Road could reduce the pumping requirements of the booster station that must eventually be constructed at the water treatment plant and also reduce the pressures in the supply main from the WTP pump station. Retention of the proposed reservoir near Evans Road would marginally reduce the amount of storage required at Ridgedale to service the existing users on Naramata Road. The decision on whether these facilities would serve as permanent or temporary facilities would ultimately be a decision of the City and would impact how the facilities would be constructed and whether or not they would be considered eligible to be included in the DCC program.

The relocation of the 643 (TWL) reservoir was a function of the suggested lot layout of the NCP area. The 715 (TWL) reservoir was relocated adjacent to the Northeast corner of the landfill to avoid property acquisition at an approximate elevation of 705 meters. The 705 (TWL) reservoir would be filled by a booster station adjacent to the 643 (TWL) reservoir. Development of the Campbell Mountain area would be contingent on the future installation of a booster station at the eastern end of Randolph Road. The 705 reservoir will have sufficient pressure to supply all homes below 675m elevation. This will be sufficient for all proposed new homes. Any existing homes (at most 4 lots) on the upper east side of Spiller Road that are above 675m elevation who desire to be connected to the City water system would need to install individual booster pump stations. The 705 (TWL) reservoir also allows for the greatest amount of looping within the proposed distribution system.

4.3.2 Phasing – Offsite Works

As shown on Figure 1, the ultimate water system can be split into 5 distinct projects. The 5 projects have been grouped into 3 phases, by which, the construction of each subsequent phase increases the amount of development growth possible in the Northeast sector.

Table 4.1: Project Phasing

Project	Phase	Description
1	1	Construct booster station near Evans Road
2	2	Construct reservoir near Evans Road
3	3	Construct 350mm twin main from Evans Road reservoir to intersection of Upper Bench and Johnson Roads
4	3	Construct 350mm twin main from Water Treatment Plant to intersection of Upper Bench and Johnson Roads
5	3	Construct booster station at Water Treatment Plant

The additional system capacity attributed with each phase is shown in the next section.

4.3.3 Capacity due to Offsite Upgrades

Based upon the phasing identified in section 4.3.2, it is possible to determine the amount of development that can occur before the next phase or project is triggered. The maximum development per phase is illustrated in Table 4.2 below:

Table 4.2: Maximum Development per Water System Phase

Phase	Description	Maximum Flow (PHD conditions)	Equivalent Population
1	Construct booster station at main entrance to Spiller Road block	5 L/s	240
2	Construct reservoir at main entrance to Spiller Road block	25 L/s ([1]) 37 L/s ([2])	1,230 ([1]) 1,825 ([2])
3	Construct twin 350mm main from site entrance	NE Sector Buildout	NE Sector

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	to WTP and new booster station at WTP		Buildout

[1] Construction of a 1,250m^3 reservoir to store local PHD (PZ 502)

[2] Construction of a 1,650m^3 reservoir to store local PHD (PZ 502)

It is recommended that a cost comparison be completed to determine the incremental cost for each of the phases. If sufficient funding exists it may be advantageous to immediately jump to Phase 3 bypassing the need for Phase 1 and 2.

4.3.4 Phasing – Onsite Works

The phasing of the water system will follow suit with the sanitary system, which is constrained by topography (gravity). Development in the lower half portion of the Spiller Road block will require the construction of the Evans Road booster station and balancing reservoir (PZ502). In order to service the upper part of the Spiller Block as well as any development in the Reservoir Road block, the reservoirs (PZ644) and (PZ705) must be constructed along with a booster station at the PZ644 reservoir.

5.0 SANITARY SEWER SYSTEM

5.1 Background

5.1.1 Existing System

The Naramata Road Water and Sewer System Pre-Design report, completed in September of 2005, stated that the limit of the existing gravity sewage collection system was located at the intersection of Wade Avenue and Braid Street. Since that time, the gravity collection trunk has been extended along Johnson Road to a point just east of Middle Bench Road. There is approximately 3.4km of distance between the terminus of the existing system and the main entrance to the Spiller Road development block.

5.1.2 Topography

The proposed main entrance to the Spiller Road development block represents the highest point along Naramata Road and as such, a gravity trunk could not extend further north beyond that point. As such, any parcels developed along Naramata Road north of the site entrance would require a separate gravity collection system that would ultimately pump back to the high point of the roadway.

The majority of the lands within the Spiller Road development block naturally drain from east to west, towards Okanagan Lake. A gravity collection system, beginning at the main site entrance could potentially collect approximately two-thirds of the proposed development units north of the landfill. The remaining units situated in the northwest corner of the development block would require a sewage pump station to transmit flows to the site entrance.

The Reservoir Road development block, for the most part, allows gravity flow down to Naramata Road. There may be isolated areas where an individual pumped service may be required to connect to the collection system. As mentioned in section 4.3.4, the Reservoir Road block cannot be serviced until the construction of the PZ644 reservoir (just below Spiller Road) is complete.

It is expected that the existing topography would serve as a natural division between development phases.

URBANSYSTEMS.

5.2 Peak Flows

From the design criteria presented in section 2 and the population projections listed in section 3, the peak flow generated by the Spiller Road/Reservoir Road Neighbourhood Concept Plan area is calculated to be 26.4 L/s. This peak flow rate will be used to determine sizing on on-site collection mains for the NCP area.

$$Q_{peak} = (\text{Peaking Factor x Population x Flow Rate}) + (\text{Catchment Area x I/I Rate})$$

$$Q_{peak} = (2.32 \text{ x } 2{,}100 \text{ x } 400 \text{ L/cap/day}) + (64 \text{ Ha x } 0.06 \text{ L/s/Ha}) = 26.4 \text{ L/s}$$

The 2005 Naramata Road Water and Sewer System Pre-design report suggested a 375mm diameter gravity collection main to gather flows from the entire Northeast sector. Applying bylaw requirements and best practices, a 375mm diameter main, flowing ¾ full at a minimum grade of 0.3% has a capacity of 103 L/s. The minimum grade of 0.3% ensures a minimum velocity of 1.0 meter/second.

Since the Spiller Road/Reservoir Road Neighbourhood Concept Plan area constitutes approximately 1/3 of the total population of the Northeast sector, and that the peaking factor will decrease as population increases, we can safely infer that the 375mm collection main will have adequate capacity under ultimate buildout conditions in the Northeast sector.

As a comparison, applying a peaking factor based on 100% of the Harmon equation results in an ultimate peak flow rate of 38.5 L/s and would still require the installation of a 375mm main.

The 2005 Sanitary Sewer Study, prepared by EarthTech for the City of Penticton, identified the Naramata Road gravity collection system as a DCC project, with a main size of 300mm. While the scope of this report did not cover the entire Northeast area and precluded a total peak flow calculation, the minor cost difference between 300mm and 375mm diameter sewage main does not outweigh the flexibility in design that the increase in pipe size brings.

5.3 Servicing Concept

5.3.1 Tie-in connection

The existing City of Penticton sanitary sewer system currently extends to the intersection of Johnson Road and Upper Bench Road. This point would serve as the connection point for the proposed 375mm sewer to the NCP area.

In order to ensure sufficient capacity, the proposed Penticton Creek diversion (creek crossing), as outlined in the 2005 Sanitary Sewer Study, must be completed prior to any development in the Northeast sector.

5.3.2 Routing

The proposed routing for the 375mm trunk sewer, as well as the onsite servicing concept, is shown on NCP Figures 5.2a and 5.2b, attached at the end of this report in Appendix 1. The proposed main would be aligned within the road right-of-way along Upper Bench Road, McMillan Avenue and Naramata Road until reaching the high point of the roadway, between Evans and Randolph Road.

Much of the onsite sewer concept will be dictated by existing topography and the proposed development grading/lot layout. As noted in section 5.1.2, most of the Spiller Road block will drain by gravity to McMillan Avenue whilst portions of the Spiller Road block will require a sewage lift station to convey flows back to the Naramata Road trunk main.

NCP Figure 5.2a illustrates a localized pumping concept in which sewage lift stations are strategically placed to service the lower regions of the Spiller block area and convey flows back to the 375mm gravity trunk main.

NCP Figure 5.2b reveals how a community lift station, situated near Todd Road, could service both the lower parts of the Spiller block as well as lands to the north of Todd Road.

5.3.3 Pump Stations

Sewage pump station locations will be dictated by topography. For any development along Naramata Road, north of Evans Road, collection via the 375mm gravity trunk will not be possible. A second gravity trunk (this one flowing northwards) would be required to collect flows from the residential properties along Naramata Road and would terminate at a new sewage pump station near either Evans Road or Todd Road (see NCP Figures 5.2a and 5.2b). The forcemain from this new station would connect to the 375mm Naramata Road gravity trunk sewer at the high point, further south along the roadway.

The north-west portion of the Spiller Road development block also sits in such a manner as to require a lift station. As shown in NCP Figure 5.2a, a localized pump station could be utilized to collect this lower portion of the Spiller block. Alternately, a community lift station could be constructed near Todd Road, as shown in Figure 5.2b, which would collect the lower portion of the Spiller block as well as other development parcels north of Todd Road.

The community lift station at Todd Road would negate the need for a localized pump station near Evans Road. Connecting the lower regions of the Spiller block development area by gravity to the community lift station may required some property acquisition along Todd Road itself.

5.3.4 Phasing

No development within the Spiller Road/Reservoir Road Neighbourhood Concept Plan area may occur without first constructing two projects:

1. The diversion at Penticton Creek (creek crossing) identified in the DCC program
2. The installation of the 375mm gravity trunk from Johnson Road to the high point along Naramata Road, between Randolph and Evans Roads.

When flows from the North East Sector reach approximately 25 Litres per second, the existing Wade Avenue/Johnson Road trunk sewer will reach capacity. This is a DCC upgrade project as indentified in the 2005 Sanitary Sewer Study.

The remaining onsite infrastructure will be driven by development phasing.

6.0 ADDITIONAL UPGRADES

Three phase power must be supplied to the booster stations in the northeast sector. Three phase power currently exists (overhead) along Naramata Road.

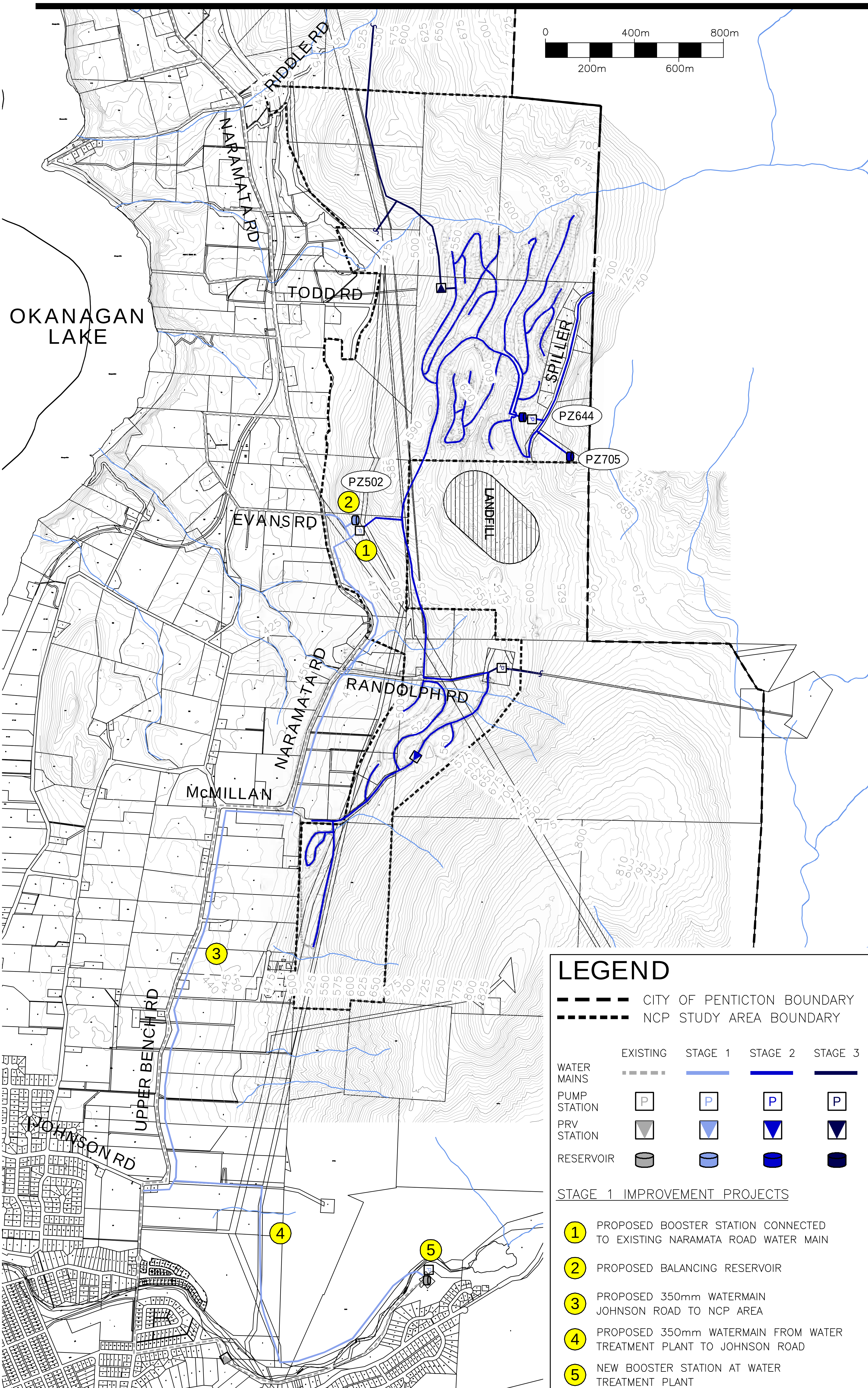
7.0 COMMUNITY BENEFIT

The completion of the off-site and on-site improvements proposed by the Spiller Road/Reservoir Road Neighbourhood Concept Plan area development will not only allow the development of the northeast sector to achieve 40%-50% of its' full build-out potential, but has the added benefit of increasing the level of service (sanitary and water) for some existing parcels in the area to meet City of Penticton standards.

APPENDIX 1

WATER AND SEWER SERVICING CONCEPTS (NCP FIGURES 5.1 AND 5.2)

SPILLER RD. / RESERVOIR RD. NEIGHBOURHOOD CONCEPT PLAN

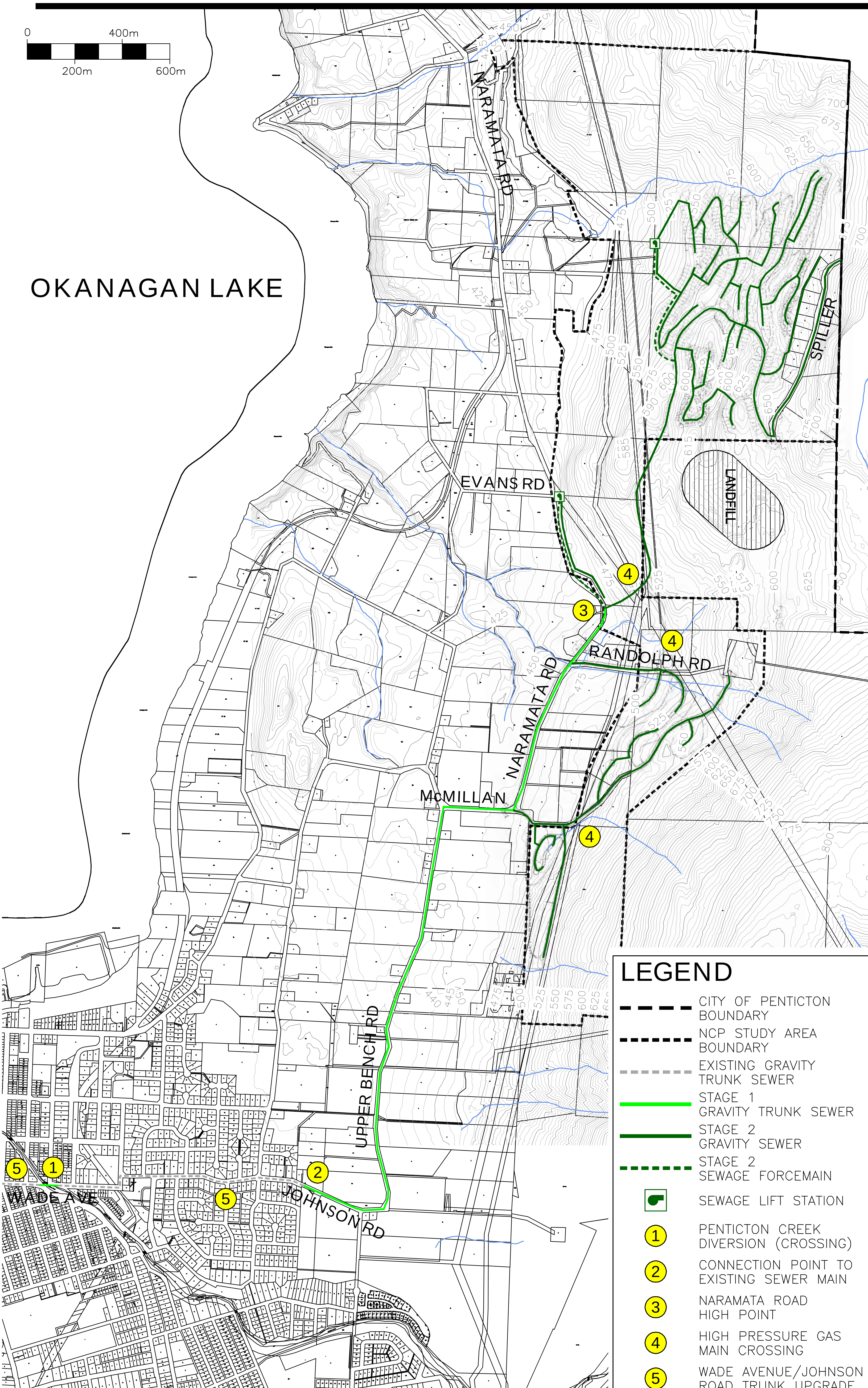


Water Servicing Concept

Figure 5.1

SPILLER RD. / RESERVOIR RD. NEIGHBOURHOOD CONCEPT PLAN

URBANSYSTEMS.



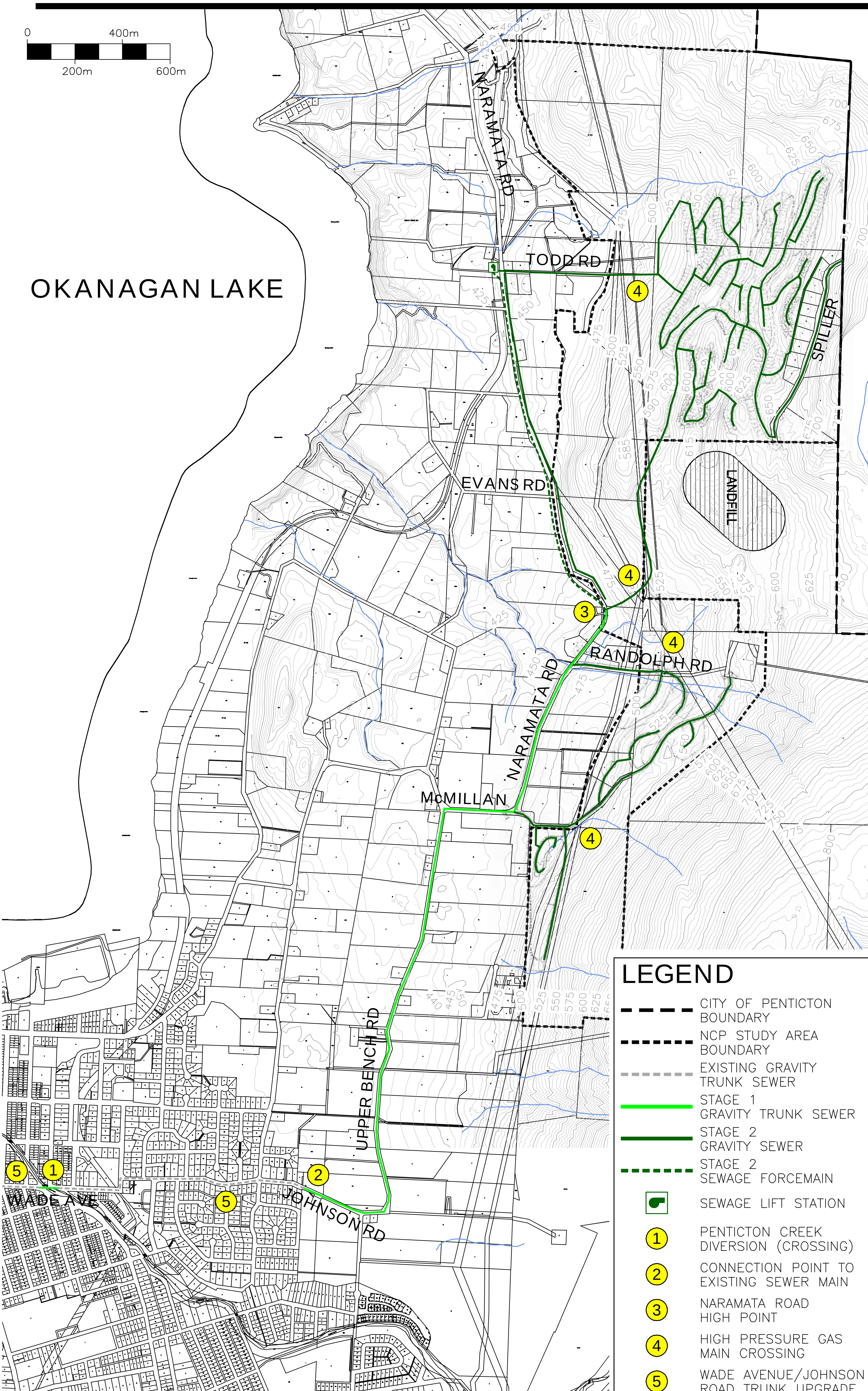
Sewer Servicing Concept #1

Figure

5.2a

URBANSYSTEMS.

SPILLER RD. / RESERVOIR RD. NEIGHBOURHOOD CONCEPT PLAN



Sewer Servicing Concept #2

Figure
5.2b

APPENDIX 2

NORTHEAST SECTOR OPTIONAL WATER SERVICING STAGING PLAN (AECOM)

URBANSYSTEMS.

AECOM

AECOM
201 – 3275 Lakeshore Road
Kelowna, BC, Canada V1W 3S9
www.aecom.com

250 762 3727 tel
250 762 7789 fax

February 17, 2010

Kristen Meersman, P.Eng.
Assistant City Engineer

City of Penticton
171 Main Street
Kelowna, BC V2A 5A9

Dear Ms. Kristen Meersman:

Project No: 60119399

Regarding: Northeast Sector Optional Water Servicing Staging Plan

INTRODUCTION

Further to our meeting with the City staff, Urban Systems, and AECOM we have completed additional analysis of the City water system related to the conveyance of water to the proposed developments in the Northeast Sector. The below letter is organized with the option being considered indicated first with the results of our water system analysis provided below.

All the water system analysis is based on the Subdivision Bylaw, with the one exception being fire flow in the location of agricultural properties. The structures on the agricultural land within the Naramata bench can be significant, but detailed review of the actual Fire Underwriters Survey fire flow requirements was not completed. Instead a minimum fire flow of 60 L/s was assumed for all the agricultural zoned land within the study area. Given the ability of the fire department to fight a fire in a rural setting this is a reasonable assumption and we recommend that the City Bylaw be amended to clarify that a 60 L/s fire flow will be provided by the City distribution network in locations of agricultural land.

NORTHEAST SECTOR OFFSITE SERVICING OPTIONS

Option 1 Use the abandoned Duncan Avenue booster station to "push water" out to Naramata Road through the distribution network.

There are two key issues associated with this option. The first issue being the high network pressures experienced during the operation of the Duncan Avenue Pump Station (PS). This is not currently a major problem but, as demand increases and the use of 2 or more of the Duncan Avenue PS pumps are required the system will experience pressures in excess of 1170 kPa (170 psi). This exceeds the City's Bylaw maximum allowable system pressure of 1034 kPa (150 psi). The second issue is the City will incur additional operating and capital costs due to unnecessary headloss and the eventual requirement to upgrade PRV 1.

An alternate approach could be to build a dedicated main from the Duncan Avenue PS to the North East Sector. The existing Duncan Avenue PS can convey the ultimate North East Sector flow and the dedicated main will address the high network pressure. However, this approach is not the recommended solution given that the additional long term operating costs are significant. Based on separate analysis completed as part of the Master Water Plan Update, the lowest life cycle cost solution is to establish a new booster station at the Water Treatment Plant (WTP) and dedicated transmission main from the WTP to the Northeast Sector.

Option 2 Use the capacity of the existing network to convey water by gravity allowing water to be pumped from Naramata Road to the North East Sector development.

This option requires construction of a temporary booster station located in the vicinity of Naramata Road to boost water to a reservoir with a top water level of 643 m. To remain compatible with the original plan this booster station will need to be abandoned and eventually replaced with a dedicated transmission main from the WTP to the Northeast Sector. Once the transmission main is built the booster station will be relocated to the space allocated at the WTP. This means any cost invested in the temporary booster station is completely a Developer cost and should not be used against the Development Cost Charges (DCC) associated with the ultimate solution.

The maximum allowable flow that could be pumped from the existing Naramata Road distribution network is as follows:

1. 5 L/s (240 people) during peak hour demand (PDH) without having more nodes fail due to low pressure;

A schematic of the infrastructure requirements for Option 2 is provided in **Figure 1-1.**

Option 3 Increase the capacity of the existing network:

This staging option consists of installing part of the ultimate dedicated transmission main. The section of transmission main suggested for the first phase of construction is shown on **Figure 1-2** (Option 3). It was assumed that this section of transmission main parallels the sanitary main required for servicing of the North East Sector. This main will initially function as a distribution main in PZ 503 and will ultimately be converted to a dedicated transmission main from the WTP to the PZ 643m reservoir.

The addition of the flow that can be conveyed by installing a portion of the ultimate transmission main is:

1. 15 L/s (740 people) during PDH without having more nodes fail due to low pressure;

Option 4 Provide a temporary reservoir in the vicinity of the North East Sector:

As indicated in the previous options the hydraulic system analysis indicates that the existing system fails during the conveyance of peak flow. To allow more water to be diverted to the North East Sector development a temporary storage tank could be added in the vicinity of the proposed development with a top water level of 503 m. In order to maintain adequate water storage levels in the proposed reservoir a small inline booster pump will be required. The key criteria for this option were the determination of the flow available if the peak hour and fire flow storage were to be provided locally. The addition of a reservoir to PZ 503 will result in the need for telemetric controls to ensure both reservoirs in this pressure zone function suitably.

The addition of a temporary reservoir will allow for the conveyance of the following flows to the North East Sector development:

1. 25 L/s (1230 people) with the construction of a 1250 m^3 reservoir to store the local PZ 503 PHD with no additional failures occurring within the existing distribution system.
2. By further increasing the capacity of the reservoir to 1650 m^3, 37 L/s (1825 people) is available with no additional failures occurring within the existing distribution system.

Initial capital investment of Option 3 and Option 4 should be similar, but the completion of Option 4 results in more future infrastructure once the capacity of the temporary system is reached.

A schematic of the infrastructure requirements for Option 4 is provided in **Figure 1-3.**

Option 5 Install the dedicate transmission main from the WTP to the PZ 643 Reservoir allowing for the water to be pump directly to the North East Sector:

This is the approach recommended in the Master Water Plan and allows for all the necessary water for the Northeast Sector to be conveyed at the lowest total cost without adversely impacting the existing distribution network.

A schematic of the infrastructure requirements for Option 5 is provided in **Figure 1-4**.

RECOMMENDATION

We recommend that the potential solutions identified in Option 1 not be pursued by the City. These options involve modifications to the existing network that will adversely impact the existing water system customers and result in higher operating costs for the City.

If the Developer wants to stage capital infrastructure investments associated with the water system then we recommend that Options 2, and 3 be completed since, with the exception of the local temporary booster station, they are directly compatible with the ultimate long term solution. If necessary, Option 4 can be explored but this option results in the construction of a significant temporary reservoir. We assume that the cost of the temporary reservoir will make this option undesirable.

In summary the recommended flow that could be diverted to the development with the completion of each option is:

1. Option 2 – The flow available is 5 L/s before PHD failures occur;
2. Option 3 – Construct a portion of the future transmission main resulting in the flow available being 15 L/s before PHD failures occur in PZ 503;
3. Option 4a – Add 1250 m^3 (peak hour storage) reservoir and inline booster station at PZ 503 on Naramata Road to provide an available flow of 25 L/s before MDD + fire flow failures occur; and
4. Option 4b - Add 1650 m^3 (peak hour + fire flow storage) reservoir and inline booster station at PZ 503 on Naramata Road to provide an available flow of 37 L/s before MDD + fire flow failures occurs.

Please review the above comments and let us know if you have any questions.

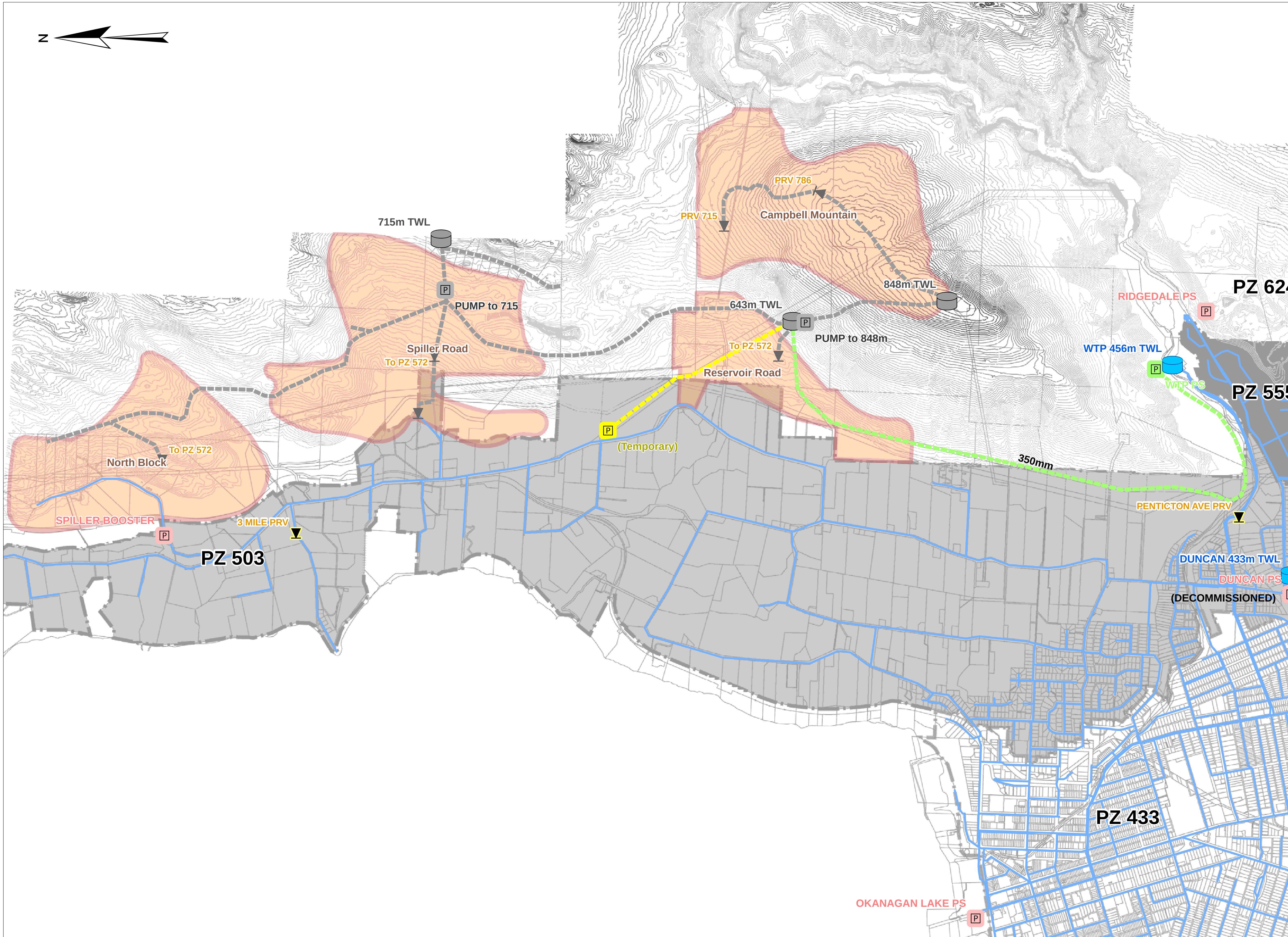
Sincerely,
AECOM Canada Ltd.

Stephen Horsman, EIT
Project Engineer

Sincerely,
AECOM Canada Ltd.

Brett deWynter, P.Eng.
Project Manager and Reviewer

Encl. Figure 1-1 Northeast Sector Optional Staging Plan - OPTION 2
Figure 1-2 Northeast Sector Optional Staging Plan - OPTION 3
Figure 1-3 Northeast Sector Optional Staging Plan - OPTION 4
Figure 1-4 Northeast Sector Optional Staging Plan - OPTION 5
cc: City of Penticton - Ian Chapman, P.Eng. City Engineering Manager



CITY OF PENTICTON

WATER SYSTEM

STAGING REQUIREMENTS

PUMP STATION

- Stage #1 (Temporary)
- Ultimate (2005 MWP Concept)

PIPE

- Stage #1 (Temporary)
- Ultimate (2005 MWP Concept)

WATER SYSTEM

PUMP STATION

- Existing Pump Station
- Future Development

RESERVOIR

- Existing
- Future Development

PRV

- Existing PRV
- Future PRV

PIPE

- Existing Pipe Network
- Future Development

AECOM

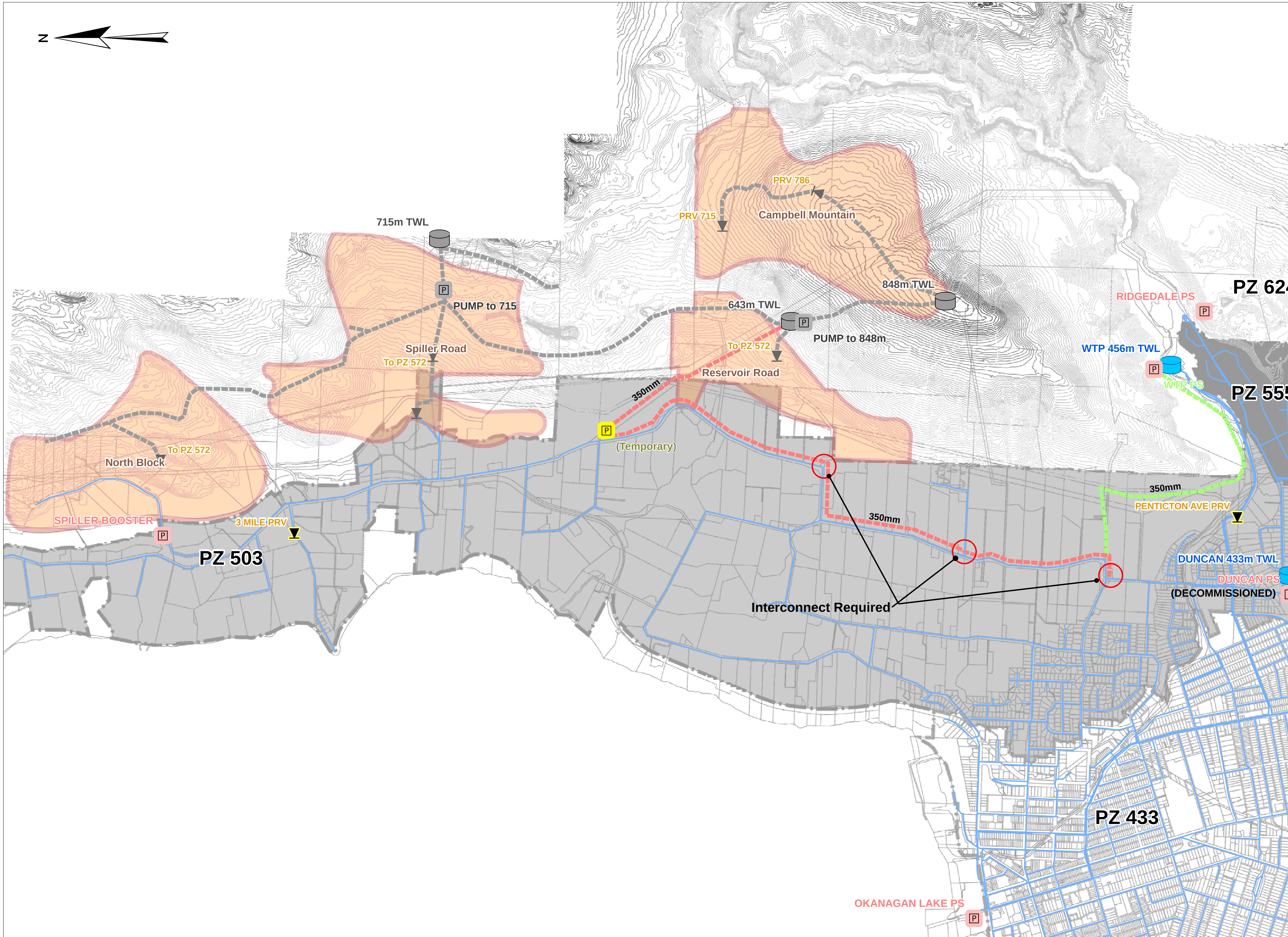
Suite 201- 3275 Lakeshore Road
Kelowna, BC V1W 3S9
T.250.762.3727 F.250.762.7789

250 125 0 250 500 Meters

Project No.	Date
60119399	2009-11-02

Northeast Sector
Optional Staging Plan
OPTION 2

FIGURE 1-1



CITY OF PENTICTON

WATER SYSTEM

STAGING REQUIREMENTS

PUMP STATION

- Stage #1 (Temporary)
- Ultimate (2005 MWP Concept)

PIPE

PIPE

- Stage #1
- Ultimate (2005 MWP Concept)

WATER SYSTEM

PUMP STATION

- Existing Pump Station
- Future Development

RESERVOIR

- Existing
- Future Development

PRV

- Existing PRV
- Future PRV

PIPE

- Existing Pipe Network
- Future Development

AECOM

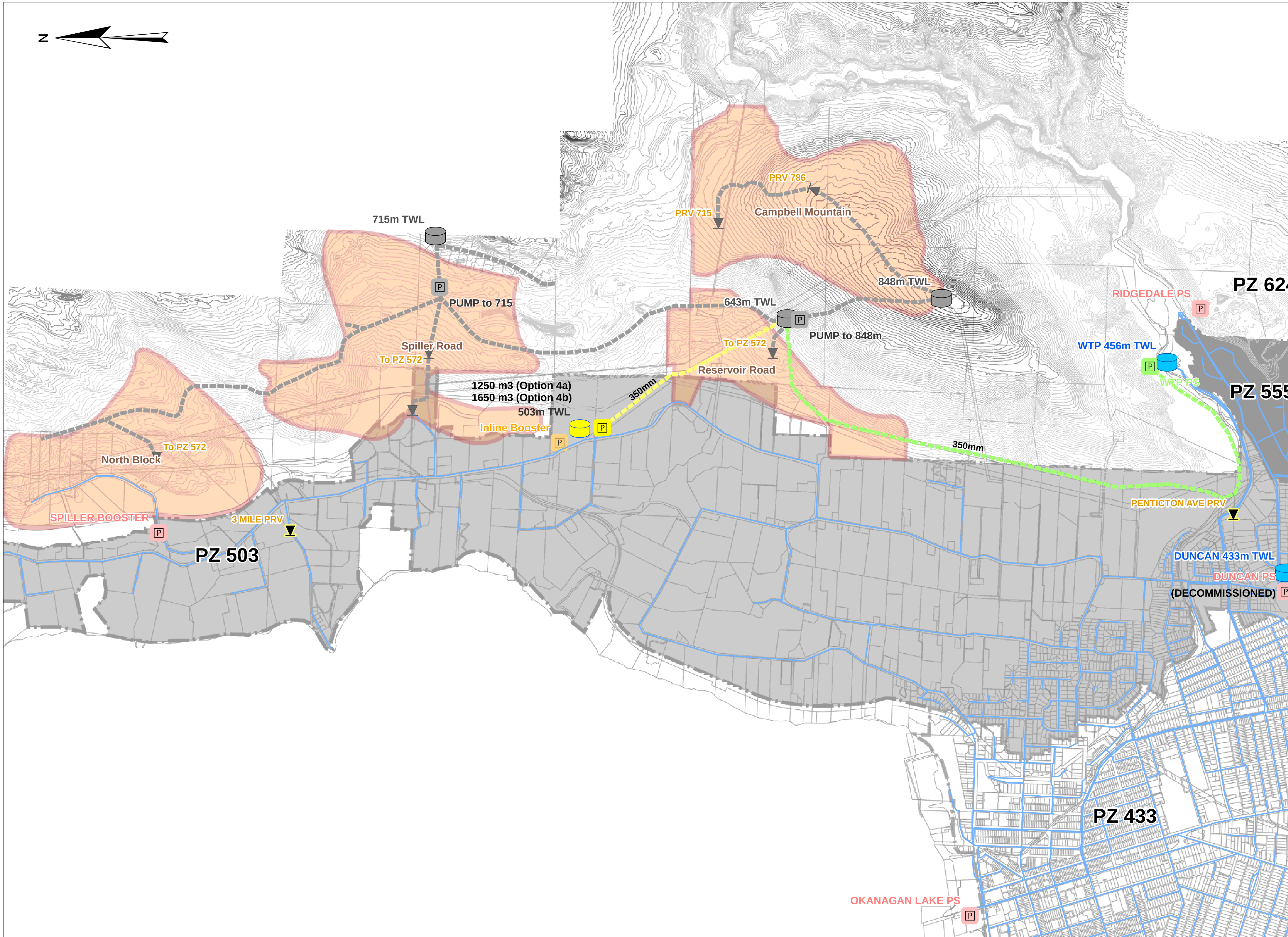
Suite 201- 3275 Lakeshore Road
Kelowna, BC V1W 3S9
T.250.762.3727 F.250.762.7789

250 125 0 250 500 Meters

Project No.	Date
60119399	2009-11-02

Northeast Sector
Optional Staging Plan
OPTION 3

FIGURE 1-2



CITY OF PENTICTON

WATER SYSTEM

STAGING REQUIREMENTS

PUMP STATION

- Stage #1 (Temporary)
- Stage #2 (Temporary)
- Ultimate (2005 MWP Concept)

RESERVOIR

- Stage #2 (Temporary)

PIPE

- Stage #1 (Temporary)
- Ultimate (2005 MWP Concept)

WATER SYSTEM

PUMP STATION

- 0
- Future Development

RESERVOIR

- Existing
- Future Development

PRV

- Existing PRV
- Future PRV

PIPE

- Existing Pipe Network
- Future Development

AECOM

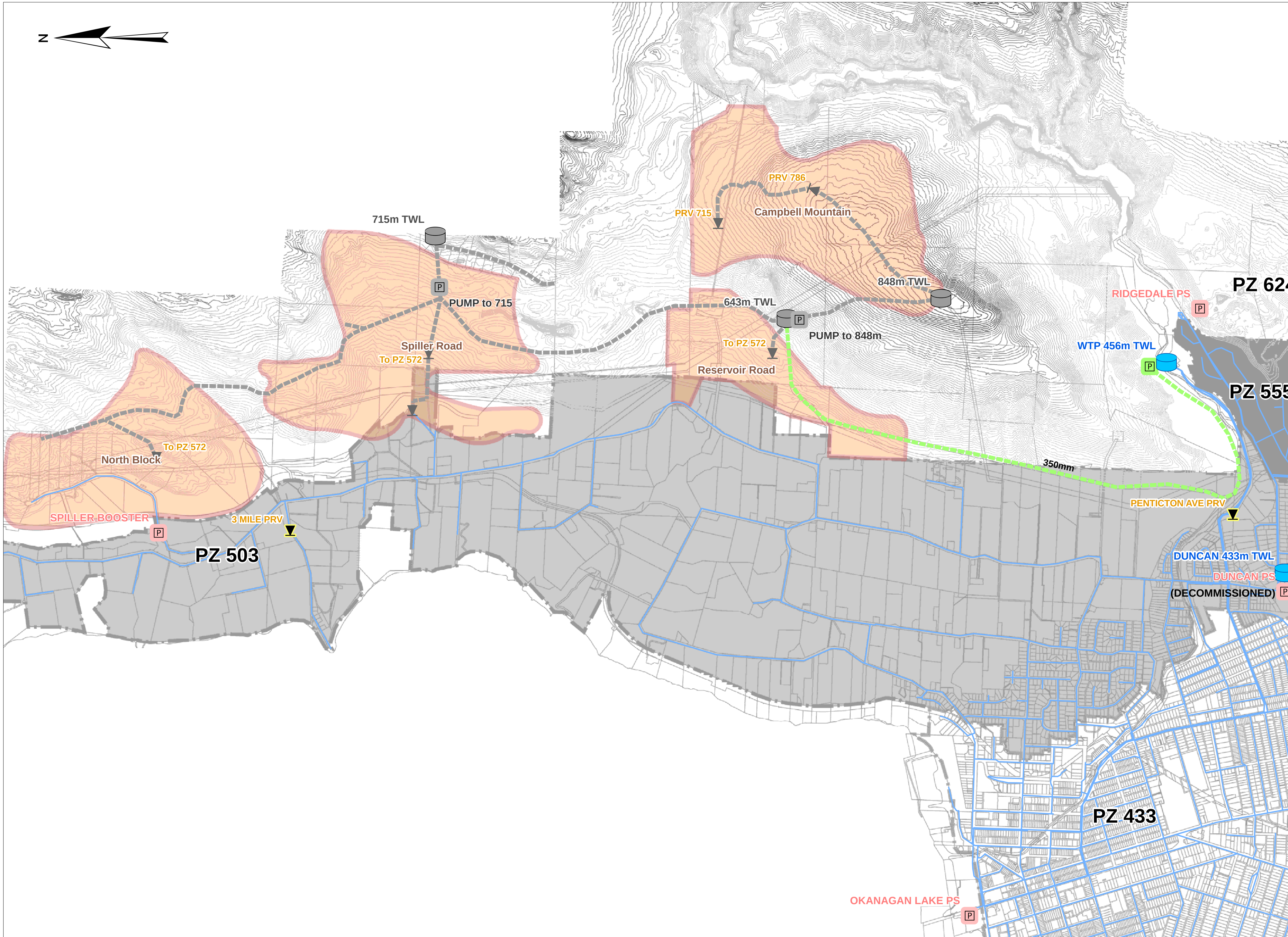
Suite 201- 3275 Lakeshore Road
Kelowna, BC V1W 3S9
T.250.762.3727 F.250.762.7789

250 125 0 250 500 Meters

Project No.	Date
60119399	2009-11-02

Northeast Sector
Optional Staging Plan
OPTION 4

FIGURE 1-3



CITY OF PENTICTON

WATER SYSTEM

STAGING REQUIREMENTS

PUMP STATION

2005 MWP Concept

PIPE

2005 MWP Concept

WATER SYSTEM

PUMP STATION

Existing

Future Development

RESERVOIR

Existing

Future Development

PRV

Existing PRV

Future PRV

PIPE

Existing Pipe Network

Future Development

AECOM

Suite 201- 3275 Lakeshore Road
Kelowna, BC V1W 3S9
T.250.762.3727 F.250.762.7789

250 125 0 250 500 Meters

Project No.	Date
60119399	2009-11-02

Northeast Sector
Optional Staging Plan
OPTION 5

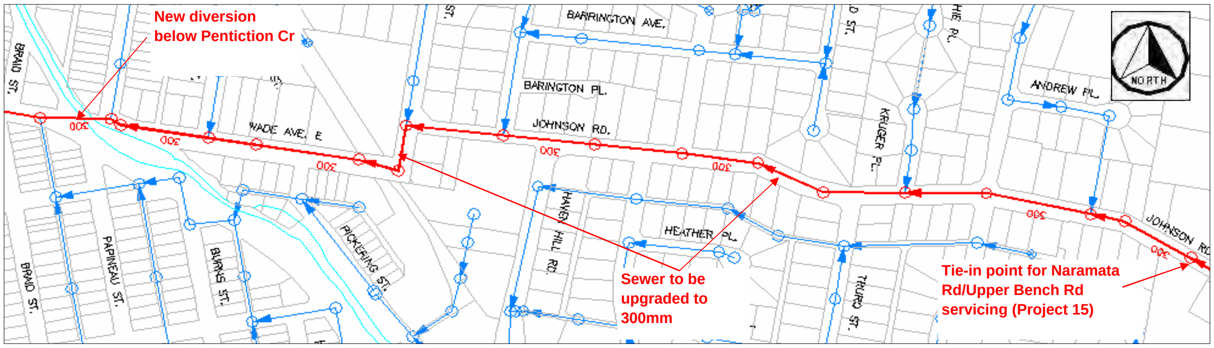
FIGURE 1-4

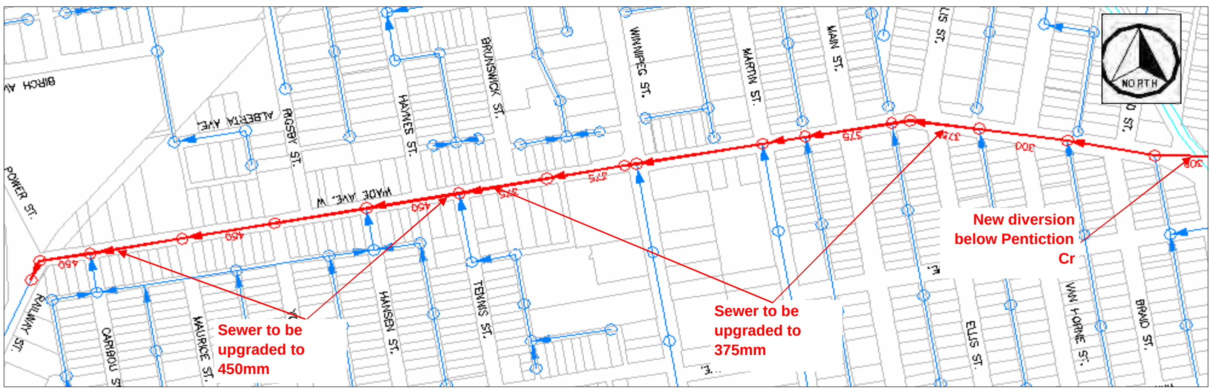
APPENDIX 3

SANITARY SEWER PROJECT SHEETS
(2005 CITY OF PENTICTON SANITARY SEWER STUDY)

PROJECT NO. 14

Wade Ave / Johnson Road Trunk Replacement





Project Description

- This project consists of replacing the existing trunk from Railway St. to the stub at the top of Johnson Rd where the future Naramata Rd trunk will tie-in. This project includes installation of a new creek crossing to provide a diversion down Wade Street. The new crossing eliminates the need to replace the sewer along Lakeshore Dr and provides a diversion around the Alberni liftstation. By reducing the flow into the Alberni lift station, future pump upgrades are avoided.
- Above figure shows the required upgrades to accomodate future peak flows. All "red" sewer sections highlighted in the above figure should be upsized, assuming the same slope as the existing sewers.
- Most of this cost is attibutable to the development in the North East sector, however, a portion should be allocated to infill because the diversion allows for additional capacity in the Lakeshore Dr trunk and reduces O&M costs for the Alberni liftstation.
- Proposed upgrades will provide adequate Qpeak/Qfull ratio of less than 80%

Growth Areas this Project is Required For

- Middle Bench
- Campbell Mountain
- Reservoir Road
- Spiller Road
- North Block

Project Priority: "MEDIUM"

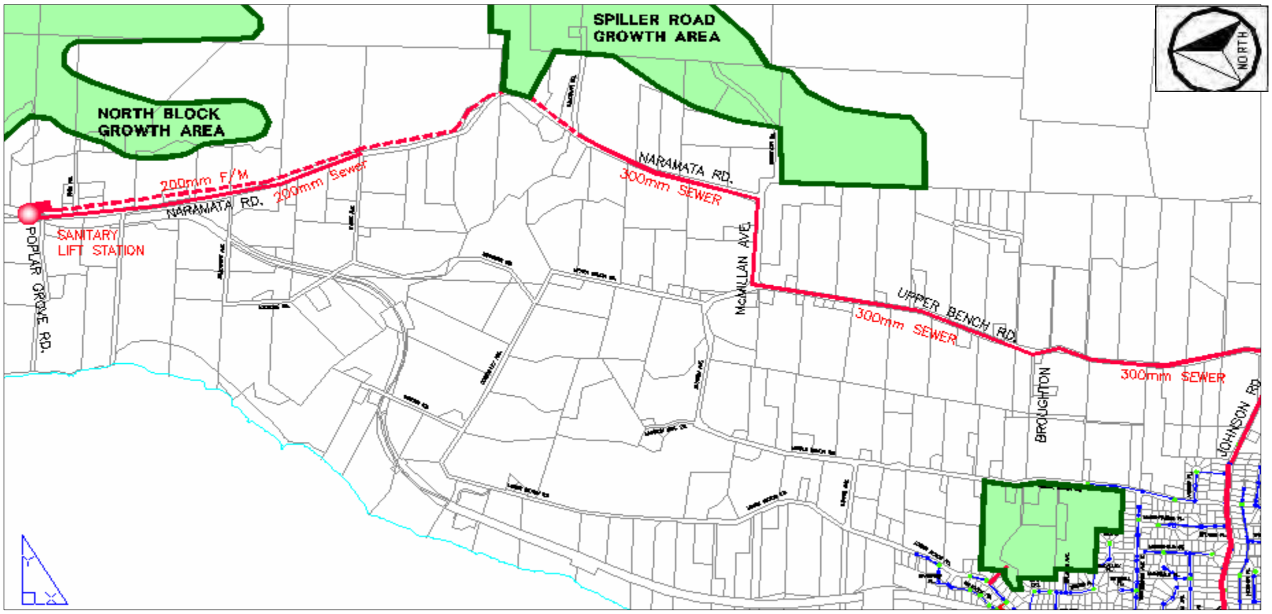
Capital Cost Estimate	**Total Length**	**Unit**		**Unit Price**		**Extension**
300mm gravity sanitary sewer	1400	m	$	430	$	602,000
375mm gravity sanitary sewer	600	m	$	500	$	300,000
450mm gravity sanitary sewer	450	m	$	600	$	270,000
1050mm manholes	35	ea	$	3,500	$	122,500
Sanitary sewer service connections	40	ea	$	3,000	$	120,000
Subtotal , Construction Cost Estimate					**$**	**1,414,500**
Engineering Allowance	10%				$	141,450
Base Capital Cost					$	1,555,950
Contingency Allowance	25%				$	388,988
TOTAL CAPITAL COST ESTIMATE (Estmiated in 2005 $)					**$**	**1,944,938**

Cost Benefit Assessment		**Current Users**		**DCC Project**		**New Devel.**
Percentage Apportionment		35%		65%		0%
Capital Value Apportionment	$	680,728	$	1,264,209	$	-

THE CITY OF Penticton

PROJECT NO. 15

Naramata / Upper Bench Road Servicing



Project Description

- A new trunk sewer system is required to provide sanitary servicing to the projected growth areas along Naramata Road and Upper Bench Road
- Along Naramata & Upper Bench Road Road (south of Popular Grove Road) and along Johnson Road, the trunk sewer improvements are only required to service future developments.
- The Figure above illustrates a potential servicing network, including a 300mm gravity sewer, new lift station and 200mm forcemain.

Growth Areas this Project is Required For

- Middle Bench
- Campbell Mountain
- Reservoir Road
- Spiller Road
- North Block

Project Priority: "MEDIUM"

Capital Cost Estimate	Total Length	Unit	Unit Price	Extension
200mm gravity sanitary sewer	1200	m	$ 350	$ 420,000
300mm gravity sanitary sewer	3800	m	$ 430	$ 1,634,000
200mm sanitary forcemain sewer	2000	m	$ 500	$ 1,000,000
1050mm manholes	50	ea	$ 3,500	$ 175,000
Package Sanitary Lift Station	1	ea	$ 500,000	$ 500,000
Subtotal , Construction Cost Estimate				**$ 3,729,000**
Engineering Allowance	10%			$ 372,900
Base Capital Cost				$ 4,101,900
Contingency Allowance	25%			$ 1,025,475
TOTAL CAPITAL COST ESTIMATE **(Estimated in 2005 $)**				**$ 5,127,375**

Cost Benefit Assessment	Current Users	DCC Project	New Devel.
Percentage Apportionment	0%	100%	0%
Capital Value Apportionment	$ -	$ 5,127,375	$ -

EarthTech
A Tyco International Ltd. Company

PROJECT NO. 16
Wastewater Treatment Plant Expansion

Project Description
- The City's WWTP currently has a treatment capacity of 18 ML/day, which is more than the 2005 average annual flow of 16ML/day
- A previous Optimization Study has indicated the treatment capacity of the existing plant can be increased to 26 ML/day
- The future projected average annual inflows to the City's WWTP (including contribution from the PIB) are estimated to be:
  - 2004: Population 32,904
  - 2010: Population 36,963 - Estimated Average Annual Flow is 18 ML/day
  - 2015: Population 45,972 - Estimated Average Annual Flow is 22 ML/day
  - 2025: Population 53,254 - Estimated Average Annual Flow is 26 ML/day
- It is estimated that by 2011 the WWTP's existing capacity will be reached, with respect to average annual flow
- The capacity of the WWTP should be increased to 26 ML/day (an increase of 8 ML/day) to service the projected 2025 population

Growth Areas this Project is Required For
- All future development, including Penticton Indian Band

Timing / Trigger
- The timing / trigger for this Project is a sewer serviced population of approxaimtely 37,000 (likely to be reached by 2010 / 2011)

Project Priority: "MEDIUM"

Capital Cost Estimate	Total	Unit	Unit Price	Extension
WWTP Expansion by 8 ML/day	1	LS	$ 16,000,000	$ 16,000,000
Subtotal , Construction Cost Estimate				**$ 16,000,000**
Engineering Allowance	10%			$ 1,600,000
Base Capital Cost				$ 17,600,000
Contingency Allowance	25%			$ 4,400,000
TOTAL CAPITAL COST ESTIMATE (Estimated in 2005 $)				**$ 22,000,000**

Cost Benefit Assessment	Current Users	DCC Project	New Devel.
Percentage Apportionment	0%	100%	0%
Capital Value Apportionment	$ -	$ 22,000,000	$ -

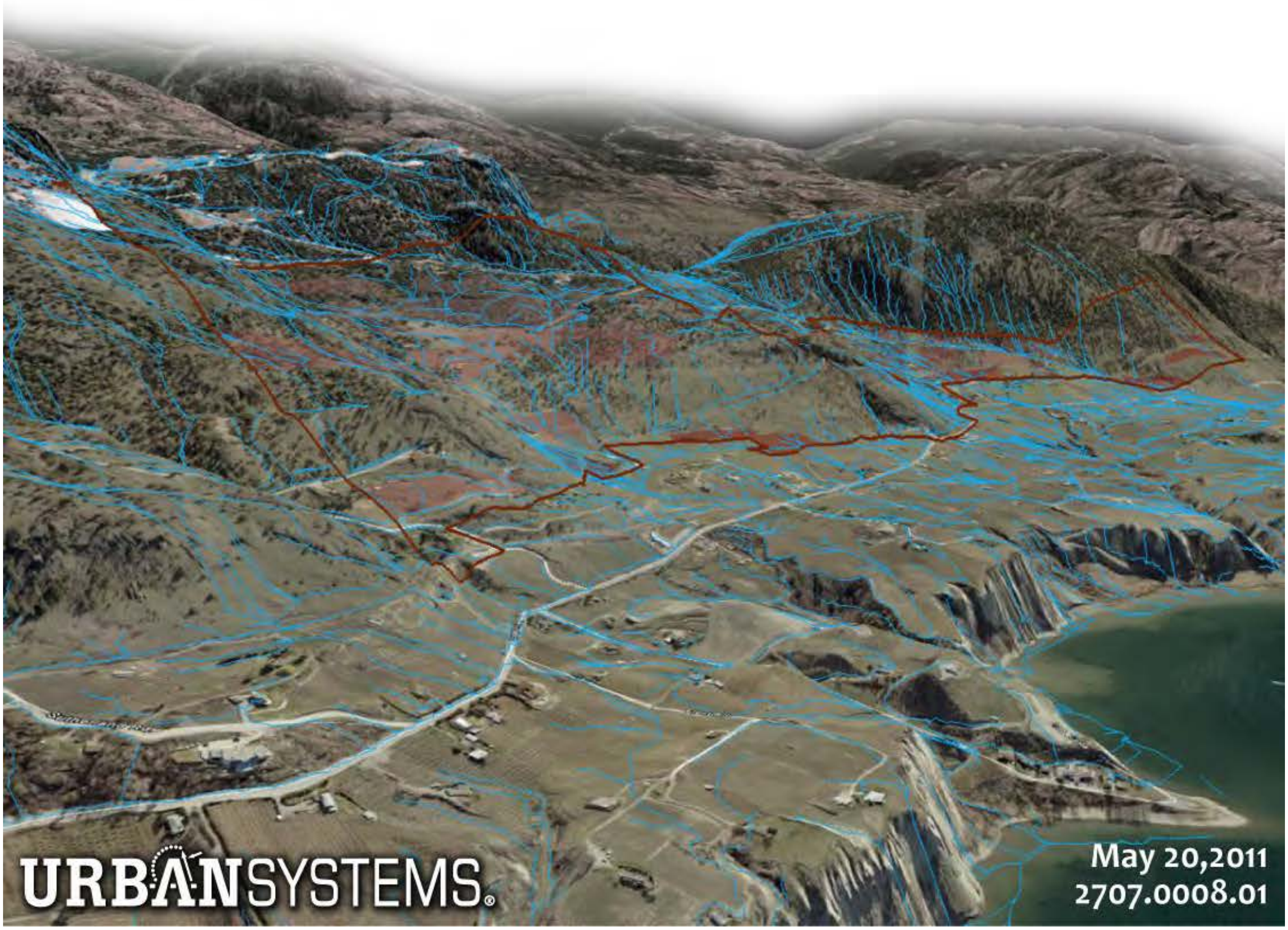
APPENDIX F

Preliminary Stormwater Management Plan
(Urban Systems Ltd.)

Spiller Road / Reservoir Road Development

Preliminary Stormwater Management Plan

REPORT



URBANSYSTEMS.

May 20,2011
2707.0008.01

TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION

1.1 Background

This report has been prepared to support the completion of the Spiller Road / Reservoir Road Area Neighbourhood Concept Plan. As such, the reader is directed to the reference documents listed in Section 1.4 in order to obtain a more complete context for the information presented herein.

1.2 Subject Area

The subject area is located approximately 4 kilometers northeast of downtown Penticton, overlooking the southeast corner of Okanagan Lake, as shown in Figure 1.1. It covers 297 hectares, 83 of which are proposed to be developed. The majority of the site sits on the foothills of Campbell Mountain, with the east boundary defined by the Campbell Mountain Sanitary Landfill and the City boundary, while the westerly portion extends to the Agricultural Land Reserve (ALR). The northern and southern borders are Riddle Road and Hillside Avenue, respectively. While the Naramata bench is primarily located within the Agricultural Land Reserve, the study area contains only non-ALR lands.

1.3 Study Objectives

The purpose of this document is to present a preliminary stormwater management plan for the study area, which will provide the basis for discussions with City Staff and ultimately, the context for a comprehensive stormwater management plan, including detailed design. Specific objectives are as follows:

- Identify existing drainage routes which pass through and downstream of the study area.
- Define on-site and upstream catchments based on major drainage routes
- Confirm key design criteria and guiding principles
- Establish key pre-development design flow rates
- Identify stormwater management issues that must be addressed
- Develop and propose strategies for addressing identified stormwater management issues

1.4 Reference Documents

This document is based on a significant amount of background information and several planning documents which were developed previously. While key data, concepts, conclusions, and recommendations have been summarized within this report, the reader is encouraged to review the following source information for a broader and more complete context.

- *Stormwater Infiltration Evaluation – Proposed Development on Spiller Rd, Penticton, BC;* Summit Environmental Consultants Ltd., June 13, 2007
- *Spiller Road / Reservoir Road Area Neighbourhood Concept Plan Background Report;* Urban Systems, January 2008
- *Geotechnical Overview of Site, North-East Sector Plan, Spiller Road / Reservoir Road Area, Penticton, BC;* Interior Testing Services Ltd., November 20, 2007
- *City of Penticton Master Drainage Plan;* Earth Tech, September 2007
- *City of Penticton Subdivision and Development Bylaw 2004*-81; City of Penticton, November 2004
- *City of Penticton North East Sector Plan;* Urban Systems Ltd., July 2005

1.4.1 Northeast Sector Plan

The Northeast Sector plan adopts the philosophy that storm runoff generated on new development be attenuated to pre-development runoff conditions. The City of Penticton *Master Drainage Plan* and design standards expand on this philosophy by recommending that stormwater management design be based on the Province's *Stormwater Planning Guidebook.*

In practice, limiting post development flows can be difficult to achieve – much is dependent upon topography and ground conditions. The strategy presented in this report for the subject development will be a combination of:

- retention/detention facilities to attenuate flows,
- infiltration facilities to disperse as much of the water to ground as possible,
- lot-level and on-site source controls, and
- some upgrading of existing flow paths to accommodate the surplus and to deal with major storm flows.

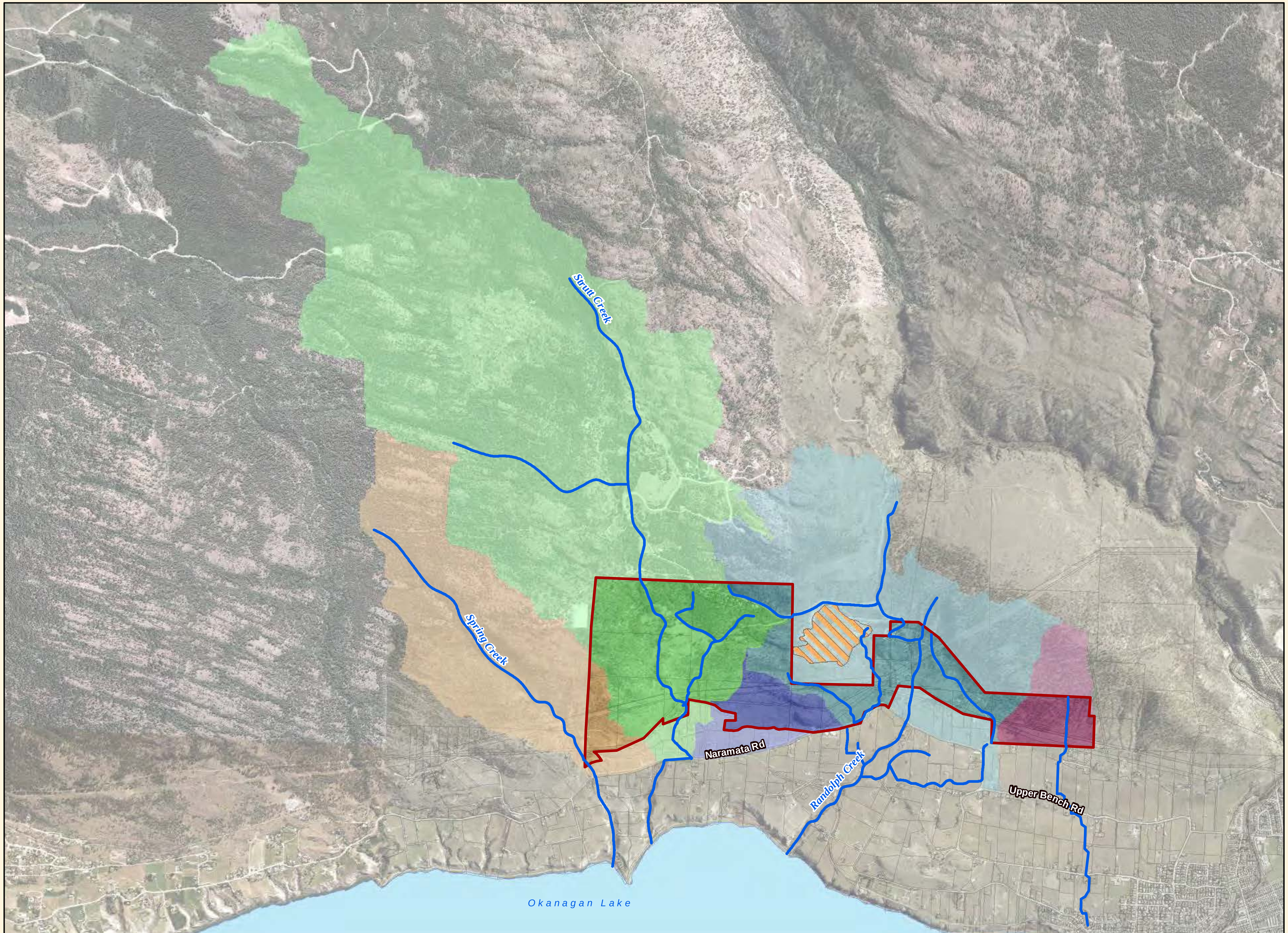
1.4.2 Master Drainage Plan

The City *Master Drainage Plan* also identifies a number of other storm improvements within and near the potential development.

- Projects EX-14 and 18 are associated with drainage from the Campbell Mountain area and the existing ditch through the landfill.

- Project EX-15 focuses on improving the natural drainage route from McMillan Avenue to Randolph Creek.
- Projects FT-P and FT-Q address drainage impacting Naramata Road, while
- Project FT-T outlines preliminary information for the northern part of the subject development area.

See **Appendix A** for relevant Master Drainage Plan excerpts.

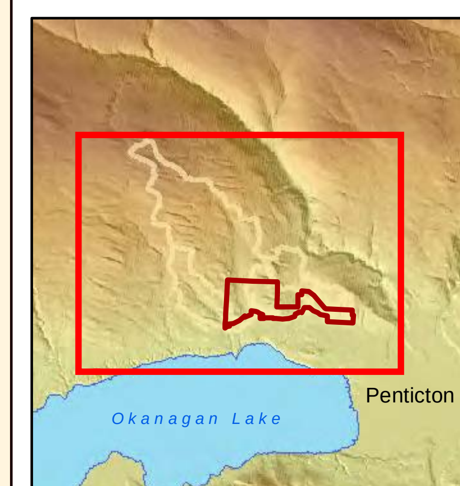


Legend

- Major Drainage Routes
- Proposed Development Boundary
- Sanitary Landfill

Subcatchments

- Lower Bench Road
- Randolph Creek
- Spring Creek
- Strutt Creek
- Naramata Road



Spiller Road Development
Stormwater Management

Study Area

0 500 1,000 2,000
Meters

Figure 1.1

URBANSYSTEMS.

2.0 GOVERNING CONCEPTS

This section outlines the various criteria and guidelines which govern the stormwater management planning process presented in this report. These governing concepts are based on a variety of sources – provincial guidelines, City bylaws, and the reference documents cited in Section 1.4.

2.1 Guiding Principles

Guiding principles establish context for the concepts and plans proposed in this report. While sometimes reinforced by standards and bylaws, their true purpose is to reflect the values held by the key stakeholders. With respect to stormwater management within the study area, the guiding principles are as follows:

- Minimize surface parking for commercial buildings and apartments, by locating underground or to side/rear of building.
- Store rainwater for landscape irrigation use.
- Reduce road asphalt widths where feasible.
- Use rural road section or flush curbs where feasible.
- Disperse collected runoff to encourage infiltration.

2.2 Criteria

The City of Penticton specifies certain criteria which govern stormwater management systems analysis and design. Key criteria are summarized and discussed below.

2.2.1 *Dual Drainage Systems*

The Subdivision and Development Bylaw (SD bylaw) requires that all developments covering an area larger than 5 hectares be serviced by both a minor and major drainage system. The minor system manages runoff from the more frequent events, while the major system manages flows when the minor system capacity is exceeded.

2.2.2 *Return Periods*

The SD bylaw specifies the following return periods for the analysis and design of the indicated systems:

- minor system – 5 year

- major system – 100 year
- 200 year return period where required by the Ministry of Environment, or for major structures such as bridges.

2.2.3 Development Runoff

Currently, the SD bylaw requires runoff from subdivisions or development to be limited to the 5 year return period under pre-developed runoff conditions. Since the return period is commonly assigned to the rainfall event, and not to the runoff peak flow rates, it is understood that for the design 5 year rainfall event, the post-development peak flow rates must not exceed the pre-development peak flow rates. The *Master Drainage Plan* suggests that to further reduce potential impacts from post-development runoff, post-development peak flows generated under the design 100 year rainfall event be attenuated to the pre-development peak flows generated under the design 5 year rainfall event.

Attenuating post-development 100 year peak runoff flows to 5 year pre-development rates is typically not a requirement for residential development. However, as discussed in Section 3, many of the off-site, downstream drainage routes have limited capacities. Therefore, the stormwater management strategy presented in this report adopts the 100 year post to 5 year pre criterion.

2.2.4 Mean Annual Rainfall

The *Master Drainage Plan* (MDP) defines the mean annual rainfall (MAR) for the City of Penticton to be 18 mm over a 24 hour period. It further indicates that the peak runoff from an undeveloped watershed under a MAR rain storm is estimated to be 0.25 L/s/ha. These values can be used to estimate the allowable release rates and associated detention volumes required by new development. The MAR, however, has a return period of approximately only 2 years. Currently, provincial guidelines suggest that 50% of the MAR volume for a development be infiltrated on-site. The MDP further suggests that:

- 0.25 L/s per hectare be used as the allowable discharge rate from developed sites, and that
- 100 m^3 of detention storage per hectare of impervious area be provided.

For the purposes of this preliminary SWM plan, we propose to:

- Provide 90 m^3 of retention storage per hectare (50% of 18mm) of development, from which collected runoff can infiltrate, evaporate, or be used for landscape irrigation. This would probably be a combination of lot-level storage (depressions, amended soils) and in-road or off-road systems.
- Provide sufficient detention storage to attenuate 100 year post-development peak flow rates to the rate corresponding to a 0.25 L/s per hectare release rate.

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2.2.5 Infiltration Systems

The SD bylaw indicates that:

- The use of French drains shall be permitted only where the topography and soil conditions are proven adequate to the acceptance of the City. A soils report will be required to support the design.
- Where lands have acceptable soils, alternative on site disposal system such as rock pit drywells will be encouraged.

2.3 Soils

From a stormwater perspective, key soil characteristics play an important role in how much surface runoff occurs during a rainfall or snowmelt event. In general terms, these key characteristics are:

- Porosity (fraction of the soil volume which is void – influences storage capacity for infiltrated water)
- Depth (one of the factors which determines potential storage capacity)
- Hydraulic conductivity (determines infiltration rates)
- Groundwater table depth (impacts infiltration potential)

Interior Testing Services Ltd. was retained to undertake a geotechnical overview of the Neighbourhood Concept Plan (NCP) area. The geotechnical overview highlights the following general observations:

- Bedrock is typically visible within steeper portions of the site, and it is frequently visible in moderately sloping areas.
- Flatter portions of the site are likely underlain by dense, till-like silts, or in some circumstances, local sand and gravel deposits. This is based on a limited number of site exposures, and in part on test holes dug on the Spiller Road (Westview) site.
- There are no major zones of rock hazard other than local, easily avoided, or easily remediated areas.

The geotechnical overview also identifies the following runoff impacts to potential development:

- Flatter areas within the site have greater depth to bedrock. This will facilitate on-site disposal of stormwater to ground.

- In steeper bedrock areas, the local bedrock is normally of volcanic origin. It is frequently fractured or weathered within the top 0.5 meters. This will provide some rainfall storage.
- Local drainage channels exist, and are best left as undisturbed / undeveloped areas except where crossings are required, or where engineering designs to manage the drainage are provided.

Summit Environmental Consultants were also commissioned to conduct site-specific field work to determine design values for discharging runoff to ground. Their conclusions and recommendations are as follows:

- Soils of suitable thickness and appropriate hydro-geological properties to infiltrate and manage stormwater are present at the site. They are generally limited to bedrock controlled depressions which often contour the hill slope.
- For much of the site, bedrock is present at or near the surface. Depth to bedrock will be a limiting factor in the storage capacity of individual recharge facilities.
- Much of the site has too little infiltration potential for large, dedicated recharge/infiltration facilities. However, lot specific stormwater management techniques can be applied in most areas and should include rooftop downspouts and drywells for individual residential lots.
- Use curb and gutter systems to convey stormwater away from areas with low infiltration potential. Stormwater can be discharged along the roads in depressions with thicker soil deposits, or routed to areas suitable for larger detention/infiltration facilities.
- A shallow water table does not appear to be present at the site.
- If BMPs are followed and stormwater is dispersed in suitable locations as identified in the report, groundwater mounding is not expected to result from short duration storm infiltration.
- Seepage and slope instability are not likely to result from the application of stormwater to the areas investigated.

2.4 Hydrology

Due to the dry climate and soil conditions, precipitation tends to infiltrate quickly into the surface layer, where much of it is lost to evapo-transpiration. A small amount eventually finds its way into the groundwater table or into the lake. Field reconnaissance indicates that except for the well-established streams draining large areas upstream of the subject site, little to no surface runoff occurs from the most frequent (5 year or less return period) storms. Of the existing identified streams, only Strutt and Randolph creeks exhibit any indication of flow activity. These are discussed in more detail in Section 3.

While field observations provide some indication of a catchment's hydrology, they do not adequately represent conditions associated with less frequent runoff events. As outlined in Section 2.2, we are proposing to attenuate post-development flows from events with return periods of up to 100 years to 5 year pre-development rates. Unfortunately, there is no long-term set of recorded flows within either Strutt or Randolph creeks from which to conduct statistical analyses in order to determine appropriate pre-development peak flows. It is possible to calculate these pre-development flow rates using a variety of tools (computer models, Rational Method, curve numbers, etc…), however, little data are available to verify results. Common practice is to use design criteria specified in the governing subdivision and development services bylaw. These values, however, tend to generate pre-development flow rates which are significantly higher than what would actually be observed in the field. While this can work in the Developer's favour (less on-site detention storage is required), it can also cause off-site problems downstream when adequate drainage routes and infrastructure do not exist.

The Master Drainage Plan suggests that 0.25 L/s per ha be used as a unit pre-development discharge rate. For the purposes of this preliminary SWM plan, we will use this value.

2.5 Water Quality

For rainfall events which occur relatively frequently (5 year return period), it appears that little to no surface runoff reaches Okanagan Lake. Rainfall, and therefore any pollutants it carries, is infiltrated into the ground before it reaches the lake. Therefore, if and when groundwater does reach the lake, as is probably the case with Randolph Creek, some treatment has already occurred.

Runoff from the landfill currently carries the most potential for generating contaminated water. Currently, all runoff and leachate from the landfill is directed to a buffer zone where it infiltrates before crossing over onto neighbouring lands. Fortunately, as shown in Figure 3.2a, no development is planned immediately downstream of the natural flow paths extending from the landfill.

2.6 Stormwater Management Classifications

Typically, stormwater management can occur at either the source of runoff (roof leaders, driveways, parking lots, road surfaces), or at the outlet of a conventional drainage system. For discussion purposes, the potential development areas have been divided into one of three classifications:

- Conventional (Source Control is Optional) – the development site could or should be serviced with conventional drainage systems. This might be due to limited opportunities to use source controls, or because there is an opportunity to use a larger, downstream facility to treat, attenuate, and/or dispose of collected runoff.
- Combination (Some Source Control is Recommended) – there are opportunities to implement source controls to limit the amount of runoff which must be managed downstream. In this classification, conventional drainage systems might be used in only select locations, and perhaps coupled with a modified source control at the system outlet.
- Source Controls (Significant Source Control is Recommended) – conditions are suitable for extensive use of source controls. Therefore, conventional drainage systems would be avoided if possible.

3.0 PRELIMINARY CATCHMENT PLANS

This section outlines the existing conditions, issues, and proposed stormwater management strategies within each of the primary catchments impacting the subject area. Each sub-section addresses:

- existing land use
- soils
- existing hydrology and drainage
- potential future development areas
- potential impacts
- key issues
- proposed strategies

While the following sub-sections provide greater detail about these issues for each of the identified primary catchments, Table 3.1 summarizes the areas within the subject site by existing land use.

Table 3.1: Development Site Existing Land Use Summary

Land Use	Area (ha)	Description
Agriculture	17.9	*Irrigated vineyards, orchards, and hay/pasture*
Dry Grassland	90.8	*Open areas vegetated with native tuft grasses – may contain a few trees*
Pine Forest	172.3	*Moderate to dense Ponderosa pine forest with shrubs and tuft grass*
Rural Residential	16.5	*Large home sites with grassed/cleared areas*
Total	**297.5**	

In general, the primary stormwater-related impacts of new development are:

- Increased surface runoff from the impervious (hard surface) areas
- Increased magnitude, duration, and frequency of flows within natural and constructed drainage routes
- Erosion and sediment deposition within natural and constructed drainage routes
- Increased pollutant loads (suspended solids, grease & oil, heavy metals, chemical and biological nutrients, and general litter)

Since the potential development consists primarily of residential units, and since the development sites are situated to preserve a substantial amount of “green space”, the magnitudes of these impacts are expected to be relatively low, and where they do occur, they are expected to be manageable.

3.1 Spring Creek

3.1.1 Existing Conditions

Although named as a creek, this channel does not contain perennial flow. Nor is there much evidence of annual or intermittent flows. If there are culverts across the KVR bed and across Naramata Road, they are not evident. The channel passes through the extreme northwest corner of the subject area. Two rural home sites exist within the subject area in this catchment. However, outside of this boundary, homes and agricultural land are located within the channel where it parallels Riddle Road. Downstream of Naramata Road, the channel generally follows Three Mile Road to Okanagan Lake.

Of the catchment's 241 ha (upstream of Naramata Road), only 16.5 are actually contained within the study area. Approximately only 8.4 ha of this catchment flows into the subject area and through potential development sites. Table 3.2 summarizes the areas by existing land use within the catchment.

Table 3.2: Existing Land Use - Spring Creek Catchment

Land Use	Area (ha)			Description
	Site	Upstream	Total	
Agriculture				*Irrigated vineyards, orchards, and hay/pasture*
Dry Grassland	3.9	14.7	18.6	*Open areas with native tuft grasses – may contain a few trees*
Pine Forest	7.5	226.3	233.8	*Moderate to dense Ponderosa pine forest with shrubs and tuft grass*
Rural Residential	5.1		5.1	*Large home sites with grassed/cleared areas*
Total	**16.5**	**241.0**	**257.5**	

3.1.2 Proposed Conditions

Referring to Figure 3.2a, only one potential development cell is identified within this catchment. Since the natural channel downstream of this site has been encroached upon by agricultural development, it is essential that potential discharges to the stream be significantly controlled. The City *Master Drainage Plan* (MDP) recognizes that the Spring Creek channel along Three Mile Road is poorly defined, and recommends upgrades in Project FT-P.

3.1.3 Proposed Strategies

Development cell 11 has been classified as suitable for using both source controls and conventional drainage systems. Referring to Figure 3.2a, the strategy for this cell is outlined as follows.

Cell 11

Natural drainage from this cell leads directly to Riddle Road. Source controls on each lot would be used to store 50% of the MAR volume while a detention facility (most likely an oversized storm sewer) would be used to attenuate runoff from the roads to the allowable discharge rate. Drainage along Riddle Road would be used for the downstream route.

3.2 Strutt Creek

3.2.1 Existing Conditions

Strutt Creek forms the largest of the natural catchments which impact the subject site. The channel is well defined upstream of the study boundary, but is impacted significantly by rural development within and downstream of the site. Figure 3.1 shows, for example, a corrugated flume through a vineyard. At Naramata Road, the channel enters a 450mm culvert. Downstream of the road, a wide, rip-rapped channel has been constructed through a second vineyard. However, this channel appears to end in a constructed pond perched near the top bank of the ravine which terminates at Okanagan Lake.

Since the Strutt Creek catchment extends for almost 4 km up the mountain, it is primarily subject to snowmelt-generated runoff. Field reconnaissance conducted on April 8, 2009 revealed a small amount of flow (10-15 L/s estimated) in the creek channel. This flow was evident within the channel until it neared the reaches through the developed agricultural lands. No flow was observed within the flume where it meets Naramata Road. It is assumed that the flow infiltrated through the channel bed before reaching the flume.

For the most part, the catchment is undeveloped. There are, however, several locations where rural homes and access roads have been constructed. The largest such area is located along Spiller Road just north of the land fill. Approximately ten houses have been constructed along a 0.5 km stretch of this paved rural road. A gravel lane also extends north-west from Spiller Road to two rural home sites just south of Strutt Creek. There are also pockets of agricultural development – primarily vineyards. The rest of the land use, from an hydrological perspective, consists of either open grasslands, or pine forest.

The entire Strutt Creek catchment (draining to Naramata Road) covers approximately 1,046 ha. Of that, 764 ha enters the main channel upstream of the subject site. Another 99 ha drains to the subject site on the north side of Strutt Creek, while a final 46 ha drains to the site on the south side of the stream. Table 3.3 summarizes the areas by existing land use within the catchment.

Table 3.3: Existing Land Use - Strutt Creek Catchment

Land Use	Area (ha)			Description
	Site	Upstream	Total	
Agriculture	5.1		5.1	*Irrigated vineyards, orchards, and hay/pasture*
Dry Grassland	29.1	184.7	213.8	*Open areas with native tuft grasses – may contain a few trees*
Pine Forest	95.5	711.8	807.3	*Moderate to dense Ponderosa pine forest with shrubs and tuft grass*
Rural Residential	7.0	13.1	20.1	*Large home sites with grassed/cleared areas*
Total	**136.7**	**909.6**	**1,046.3**	

3.2.2 *Proposed Conditions*

Referring to Figure 3.2a, we see that a significant amount of development is situated along Strutt Creek. Topography dictates that drainage from these development cells will ultimately flow into the creek, but this poses a number of challenges:

- Erosion potential. Uncontrolled discharges to this stream will cause erosion within the stream channel. It is evident that the channel is stable under current flow regime conditions, which is governed by snow melt. The objective is to limit discharges from the potential development to levels no greater than currently observed.
- Routes through private property. While runoff from some of the potential development cells can drain directly to the stream within the site boundaries, topography dictates that some routes must pass through private property before reaching the stream. These locations are shown on Figure 3.2a.

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- Existing infrastructure capacity limits. There are two sets of infrastructure within this catchment that are downstream of the subject site:
  - a corrugated flume located on private property, and
  - a culvert crossing Naramata Road.

  The estimated capacity of both of these items is approximately 0.16 to 0.17 m^3/s. Rather than upgrading these works, the objective is to reduce the post-development peak flow rates to be less that this capacity limit.
- Naramata Road. The City *Master Drainage Plan* (MDP) indicates that ultimately, Naramata Road might be upgraded to an urban cross section. MDP Project FT-P proposes that drainage from this road be directed to several locations via a storm sewer system. It appears that the section of the road passing through the Strutt Creek catchment is to be directed to Spring Creek along Three Mile Road. The issue is how soon the City wants to implement this plan, and what impacts it would have on the Strutt Creek drainage.
- The City *Master Drainage Plan* (MDP) recognizes that development may occur within the Strutt Creek catchment, and estimates the need for approximately 10,000 m^3 of detention storage volume in Project FT-T. It is highly likely that the final storage volumes required to meet the design objectives will be less than this since:
  - some areas will be able to use infiltration, and
  - the intent is to minimize the amount of impervious area created.

3.2.3 Proposed Strategies

Of the approximately 51 ha of potential development within this catchment,

- 20 ha is classified as suitable for conventional SWM
- 29 ha is classified as requiring some source controls, and
- 2 ha is classified as requiring all source controls.

Referring to Figure 3.2a, strategies for the potential development cells are presented below.

Cell 3 – Conventional SWM

Runoff generated on the roads within this development cell can ultimately be directed to the primary access road which is proposed to originate near the intersection of Naramata Road and Evans Avenue. There are opportunities along these roads to construct linear storage facilities in order to attenuate the flows to pre-development levels. The alternative is to simple convey the collected runoff to a larger detention site along Naramata Road. In either case, the runoff would ultimately be conveyed to the Randolph Creek wetland proposed in MDP project EX-14. (See more on this in Section 3.3.2.)

Note that approximately a hectare of Cell 3 drains into a ravine within the Randolph Creek catchment. It is proposed to direct all design runoff in excess of the 50% MAR to this ravine, which terminates at the landfill. Since there is no surface drainage route out of this ravine, it is anticipated that the runoff would infiltrate and evaporate.

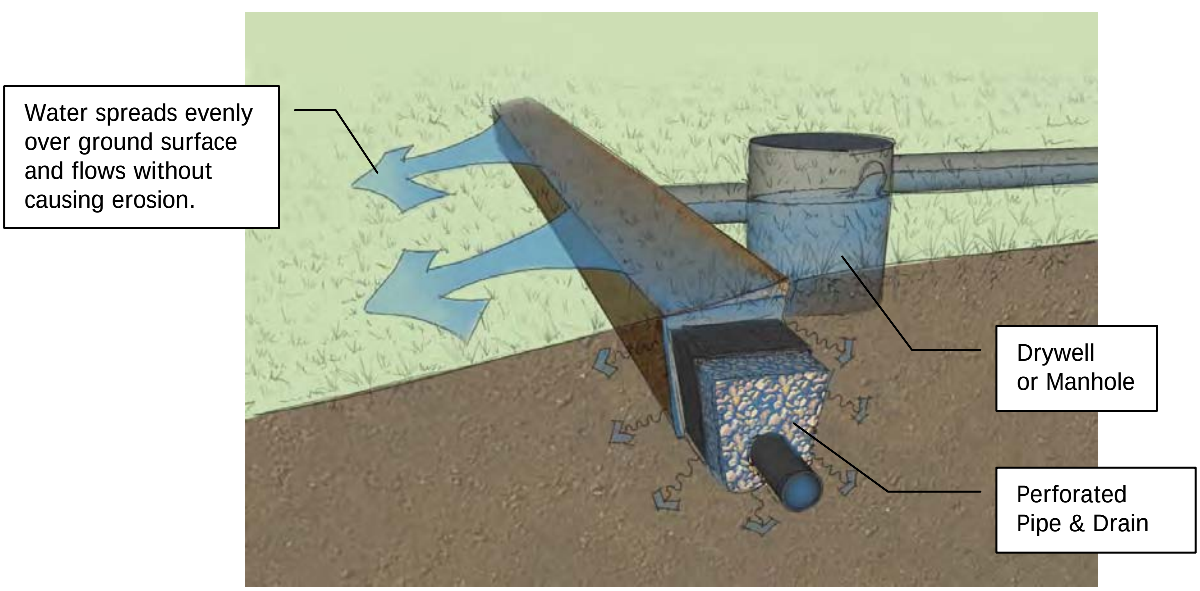
Cells 6-7, 27-29, and 34 – Combination SWM

These cells all drain directly to Strutt Creek. In addition to ensuring that works are incorporated to infiltrate 50% of the MAR, road runoff would be collected and directed to a facility which would:

- Attenuate peak flows through storage,
- Infiltrate a portion of the stored volume, and
- Distribute the runoff which cannot be infiltrated over a designated area so that it flows into the stream in a more natural, un-concentrated manner.

This facility is envisioned to function as a French drain, constructed with a flat grade on the hillside. For rainfall events yielding less than 9mm (50% of the MAR), the collected runoff would be infiltrated. Runoff from larger evens would overflow at the surface – distributed along the length of the drain to prevent erosion. This system is illustrated in Figure 3.3. Note that implementation of this proposed system will require review and design guidance from a geotechnical professional to identify and address potential slope instabilities due to water saturation.

Figure 3.3 – Distributed Discharge System



Cell 8 – Onsite SWM

Stormwater management within this cell would consist of infiltration systems for all of the design runoff. Surface routes would, however, be incorporated into the design to ensure runoff can reach Strutt Creek under extreme conditions. It is likely that infiltration trenches and/or oversized storm sewers would be required to temporarily store the road runoff until it is infiltrated.

3.3 Randolph Creek

3.3.1 Existing Conditions

Although the Randolph Creek catchment is smaller in area than the Strutt Creek catchment, it impacts a wider swath of the subject area because it contains several drainage routes. These routes, which ultimately drain to a single ravine which terminates at Okanagan Lake, cross Naramata Road at approximately 200 m south of Evans Avenue and at the Randolph Road intersection. A third significant drainage route also extends from McMillan Avenue.

For the most part, the catchment is undeveloped. South of the landfill there are, however, several rural homes and associated access roads exist. There are also pockets of agricultural development – primarily orchards and pasture. The rest of the land use, from an hydrological perspective, consists of either open grasslands, or pine forest. While erosion rivulets are evident on fill slopes within the landfill, there is no evidence of surface flows within the natural, downstream drainage routes.
The only location where existing drainage infrastructure was noted is at the intersection of Randolph and Naramata Roads. A 300mm diameter culvert exists on the west side of Naramata Road into a recently excavated ditch. A small, steady flow (less than 10 L/s) was observed. However, the inlet to this system was not found. It is therefore assumed that the observed flow is intercepted groundwater.

The catchment covers approximately 326 ha. Of this, approximately 265 has is located upstream of the subject site. Spiller Road intercepts drainage from approximately 154 ha (including 10 ha within the site boundaries), directing it to Reservoir Road. An additional 22.6 ha upstream of the site is ultimately intercepted by Reservoir Road before topography directs it across the road and through the potential development sites south of the landfill. Approximately 55.4 ha drains through the development sites identified along the southeast side of Reservoir Road before being intercepted and directed to the low point on McMillan Avenue. All of the 42.6 ha landfill site ultimately drains into the subject site. Approximately 3.2 ha drains into a deep gulley along the northern landfill boundary, while the rest follows several shallow surface routes. Table 3.4 summarizes the catchment areas by existing land use.

Table 3.4: Existing Land Use – Randolph Creek Catchment

Land Use	Area (ha)			Description
	Site	Upstream	Total	
Agriculture	8.8		8.8	*Irrigated vineyards, orchards, and hay/pasture*
Dry Grassland	19.9	36.9	56.8	*Open areas with native tuft grasses – may contain a few trees*
Pine Forest	52.3	203.0	255.3	*Moderate to dense Ponderosa pine forest with shrubs and tuft grass*
Bare Soil	3.6	1.2	4.8	*Area stripped of organic topsoil*
Rural Residential		24.0		*Large home sites with grassed/cleared areas*
Total	**84.6**	**265.1**	**325.7**	

3.3.2 Proposed Conditions

Development within the Randolph Creek catchment is divided into two general locations – north and south of the landfill. There is also a cell located on a knoll directly west of the landfill. Referring to Figure 3.2a, the proposed primary access road from Naramata Road to the northern part of the subject site would pass through this catchment, and would form the major drainage route for the northern and western development areas. This major drainage route would terminate near the intersection of Naramata Road and Evans Avenue. In general, drainage from the southern development could be directed to two locations – Randolph Road and Reservoir Road. Specific issues within this catchment are as follows.

- Landfill drainage. A small portion of the sanitary landfill drains north into a deep ravine. At one time, this ravine flowed south, but is now blocked by the landfill. The City *Master Drainage Plan* (MDP) identifies this issue in its Project EX-18 (see Appendix A), where it recommends intercepting all runoff from the landfill and directing it to the landfill leachate collection/treatment system. The MDP notes, however, that the presence of a leachate collection/treatment system had not been confirmed. Further investigation into this revealed that a formal leachate collection and treatment system does not currently exist. Surface runoff typically flows onto a buffer strip, where it infiltrates before leaving the landfill property. To date, no leachate has been observed reaching the ground surface downstream of the landfill. However, since the subject ravine makes an ideal location for retaining potential runoff from some of the development sites, the leachate / landfill runoff issue must be addressed in a timely manner by the City.

- Access road drainage. The proposed access road which terminates near the intersection of Naramata Road and Evans Avenue will direct and produce significant amount of runoff. The challenge will be to attenuate and transport this runoff to Randolph Creek, where it can be discharged to the existing wetland.
- Reservoir Road drainage. The City *Master Drainage Plan* (MDP) identifies an existing issue which will have an impact on the portion of Reservoir Road which is located within the potential development area. As outlined in MDP Project EX-14, ditching along Spiller and Reservoir Roads is to be improved to ensure that upstream runoff is diverted around the landfill. The MDP also recommends that this runoff be routed through the development site to Randolph Road. While this must be considered in the site design, it is also an existing deficiency which will require City participation, contribution, and direction.
- McMillan Avenue drainage. Project EX-15 of the City Master Drainage Plan (MDP) identifies the need for a drainage route from the low point on McMillan Avenue to Randolph Creek. This impacts the potential development since this is the downstream route for the southern part of the Randolph Creek catchment. Since it is considered by the MDP to be an existing deficiency, the City should take the lead to obtain the required easements/ROWs and to improve the required channel.

3.3.3 Proposed Strategies

Referring to Figures 3.2a and 3.2b, strategies for each of the potential development cells are outlined as follows.

Cell 1 – Combination SWM

This cell is located on a knoll which naturally drains in all directions. However, it is anticipated that the design runoff in excess of the 50% MAR can be directed to detention pond site near the primary access road. There is some potential for infiltration at this location, however, it is proposed that the attenuated runoff be directed along the access road to Naramata Road. Ultimately, the runoff must be conveyed to the Randolph Creek wetland proposed in MDP project EX-14.

The most obvious route from Naramata Road to the proposed wetland site would be along Evans Avenue and Lochore Road. It is anticipated that a short piped section from the proposed access road to Evans Avenue would be required. However, once on Evans Avenue, the proposed route would consist of an open drainage swale within the road ROW.

Cells 12, 19, and 32 – Combination SWM

Development cells 12 and 19 are located upstream of a proposed road which would drain to a natural ravine identified in the MDP as a major drainage route to Naramata Road. All of the design runoff in excess of the 50% MAR could be conveyed to this ravine. Erosion control measures would be required within the ravine, but the runoff would then flow into a detention pond upstream of Naramata Road. Runoff in excess of the 50% MAR from Cell 32 would also be directed to this proposed pond, as would runoff from the primary access road to the development area north of the landfill. Three options exist for directing discharge from this pond to Randolph Creek:

- an open channel along Naramata road to the system proposed on Evans Avenue (see discussion for Cell 1 above),
- a culvert across Naramata Road and subsequent open channel (through private property), and
- a storm sewer south on Naramata Road to the Randolph Road intersection.

Cells 25 and 35 – Onsite SWM

Since these development cells border private property, it is essential that the design runoff be entirely managed onsite. This will consist of required storage (mostly over-sized pipes) and infiltration systems. Surface drainage routes, however, will be incorporated for runoff from extreme events. Most of these emergency drainage routes can be directed to either the natural ravine just north of Cell 25, to Randolph Road, or to the proposed pond near Reservoir Road.

Cell 17 – Combination SWM

Design runoff in excess of the 50% MAR would be directed to the road which terminates at Reservoir Road. It would be conveyed by storm sewer to a proposed detention pond just south of the road intersection. Discharge from the pond would be directed to the conveyance system on Reservoir Road, and ultimately to the major drainage route from McMillan Avenue to Randolph Creek. There are some opportunities to construct linear storage areas along the collector road.

Cell 31 – Combination SWM

This development cell fronts Reservoir Road. Design runoff exceeding the 50% MAR would be attenuated using storage (most likely oversized storm sewers) prior to discharge to the ditch along Reservoir Road. Ultimately this runoff would flow to the major drainage route from McMillan Avenue to Randolph Creek.

Cell 33 – Combination SWM

Design runoff in excess of the 50% MAR would be directed to an open channel along the east side of Naramata Road, where it would ultimately be attenuated by the proposed pond servicing the primary access road. See more discussion regarding flow from the pond in Section 3.3.2.

Cell 34 – Combination SWM

This development cell fronts Spiller Road. Design runoff exceeding the 50% MAR would be attenuated using storage (most likely oversized storm sewers) prior to discharge to the ditch along Spiller Road.

Ultimately this runoff would flow to the drainage along Reservoir Road, eventually reaching a proposed detention pond along Naramata Road.

3.4 Lower Bench Road

3.4.1 Existing Conditions

The most southern portion of the subject site is located within an area that contains no well-defined downstream drainage route. For the purposes of this preliminary stormwater management plan, it has been named the “Lower Bench Road” catchment since that is where potential runoff would eventually arrive. Topographically, surface runoff would flow southwest from the site to a low point on Upper Bench Road approximately 140 m north of the Hillside Avenue intersection. From there, the route winds through orchards and crosses Middle Bench Road approximately 420 m north of the Westminster Avenue East intersection. The route continues through private property, eventually entering a wide, well-defined ravine which suddenly terminates at a swimming pool in the back yard of a house off Uplands Court. At this point, the route becomes poorly defined. However, it appears that runoff would eventually reach Lower Bench Road and then flow down it to the traffic circle at Front St.

There does not appear to be any existing drainage infrastructure along this route, except for curb & gutter, and presumably storm sewer, on Lower Bench Road. The catchment which drains through and on the subject site covers an area of 52.5 ha, 24.5 of which is upstream of the site boundary. Table 3.5 summarizes the areas by existing land use within the catchment.

Table 3.5: Existing Land Use – Lower Bench Road Catchment

Land Use	Area (ha)			Description
	Site	Upstream	Total	
Agriculture				*Irrigated vineyards, orchards, and hay/pasture*
Dry Grassland	13.5		13.5	*Open areas with native tuft grasses – may contain a few trees*
Pine Forest	14.5	24.5	39.0	*Moderate to dense Ponderosa pine forest with shrubs and tuft grass*
Rural Residential				*Large home sites with grassed/cleared areas*
Total	**28.0**	**24.5**	**52.5**	

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3.4.2 Proposed Conditions

The single access road into the development area south of Reservoir Road will likely drain north and south. The portion which drains north will contribute to the McMillan Avenue drainage. The portion draining south, however, will probably have to be serviced by the natural ravine which terminates at the north end of Hillside Avenue. Referring to Figure 3.2b, the issues pertinent to this area are as follows:

- While the objective is to replicate pre-development conditions, prudent design recognizes the need for a major drainage route. Two homes are located at the north end of Hillside Avenue at the base of the natural ravine. While it appears that the natural channel veers to the north, around these homes, it is essential that this be confirmed. It may be necessary to obtain an easement or ROW for the major drainage route.

- Once past the above-referenced homes, the topography flattens-out considerably. It is highly probable that any rainfall-generated runoff which might reach this area from the potential development would disperse and infiltrate before reaching Upper Bench Road. This is an important assumption since there is currently no formal drainage system to Okanagan Lake from this location.

3.4.3 Proposed Strategies

Referring to Figure 3.2b, strategies for each of the development cells are outlined as follows.

Cell 20 – Combination SWM

The City *Master Drainage Plan* recommends construction of a detention pond in its project FT-Q, located at the southeast corner of the Reservoir Road and Naramata Road intersection as shown in Figure 3.2b. Design runoff exceeding the 50% MAR would be attenuated using this proposed detention pond. Ultimately runoff from the pond would flow along McMillan Avenue to the major drainage route from McMillan Avenue to Randolph Creek. The internal roads would form the major drainage routes to the pond for most of the area, however, it may be necessary to construct a swale along the western boundary of Cell 20 to protect the downstream properties.

Cell 21 – Onsite SWM

This potential development cell is located on the downhill side of the proposed road. Lot-level controls will be implemented to ensure that roof and driveway runoff is disposed on-site where possible. It may be necessary, however, to also install a system along the western lot lines to distribute any excess runoff so that it can flow over the downstream green space as sheet flow.

Cell 21 (south side) – Onsite SWM

Approximately 150 m of the propose road would have to drain to the existing ravine that cuts through the southern portion of cell 21. It will be necessary to install detention storage, most likely an underground tank or oversized storm sewers. The discharge would be via a French drain system that would infiltrate the anticipated small volume into the ravine. It may be necessary to obtain a drainage easement, and improve the channel, around the two homes at the north end of Hillside Avenue for major drainage purposes.

3.5 Naramata Road

3.5.1 Existing Conditions

There are a group of small sub-catchments bounded by Naramata Road and the Strutt Creek and Randolph Creek catchments. For the purpose of this report, they are referred to collectively as the Naramata Road Catchment. Totaling 51 ha, 31.7 ha of this is located within the subject site. Based on existing topography, it appears that potential runoff from this area would initially flow through orchards and vineyards until it is intercepted by Naramata Road. It also appears that because there is not a well-defined ditch along the east side of Naramata Road, runoff could cross the road at several locations along the stretch between Evans Avenue and Poplar Grove Road. These poorly-defined drainage routes tend to flow toward only a couple of locations along Okanagan Lake:

- at the end of a ravine just west of Chapman Road, and
- over a silt bluff west of Davenport Avenue.

No existing drainage infrastructure was noted along these routes.

While there is some agricultural and rural residential development within this catchment extending eastward from Naramata Road, only a portion of it is within the potential development area. Table 3.6 summarizes the areas by existing land use within the catchment.

Table 3.6: Existing Land Use –Naramata Road Catchment

Land Use	Area (ha)			Description
	Site	Upstream	Total	
Agriculture	4.0		4.0	*Irrigated vineyards, orchards, and hay/pasture*
Dry Grassland	24.3		24.3	*Open areas with native tuft grasses – may contain a few trees*

Pine Forest	2.5		2.5	*Moderate to dense Ponderosa pine forest with shrubs and tuft grass*
Rural Residential	0.9		0.9	*Large home sites with grassed/cleared areas*
Total	**31.7**		**31.7**	

3.5.2 Proposed Conditions

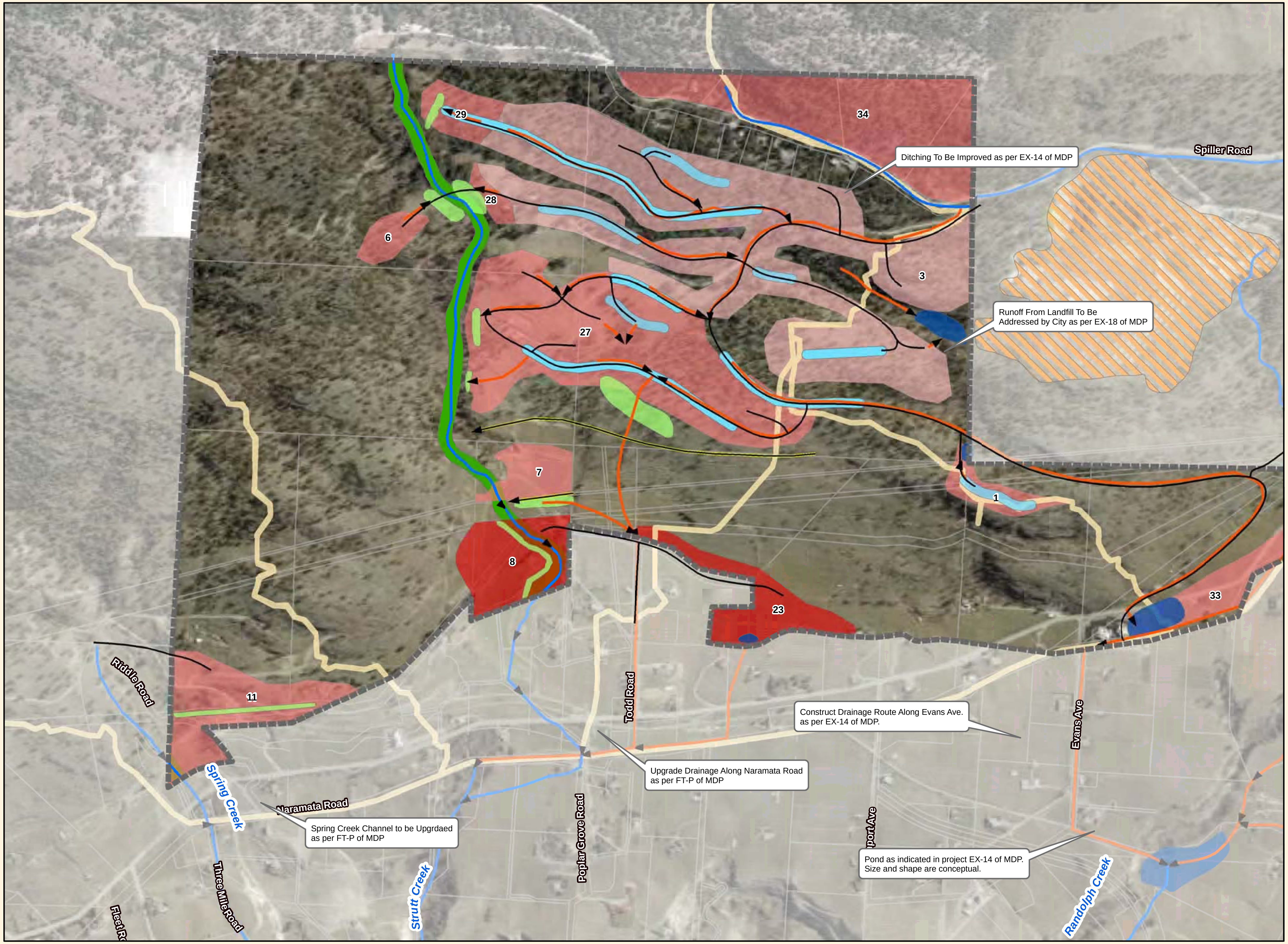
As shown in Figure 3.2a, approximately 2.8 ha of this collection catchments is identified as having development potential for residential purposes. The existing drainage routes which naturally service the potential development cell all drain through private property before reaching Naramata Road. The key issue, therefore, will be to establish a major drainage route from this development area to Naramata Road.

3.5.3 Proposed Strategies

Cell 23 – Onsite SWM

In addition to the controls to manage the 50% MAR on each lot, the road drainage must be directed to detention storage – possibly a surface pond or an underground system. Since vineyards and orchards border the western boundary of the potential development, discharge from the detention pond would be distributed using a French drain system. Negotiations will be required to obtain a drainage easement for emergency flow conditions. On-site grading will be required to ensure flows from extreme conditions are directed to this route.

Spiller Rd/Reservoir Rd. Neighbourhood Concept Plan



Legend

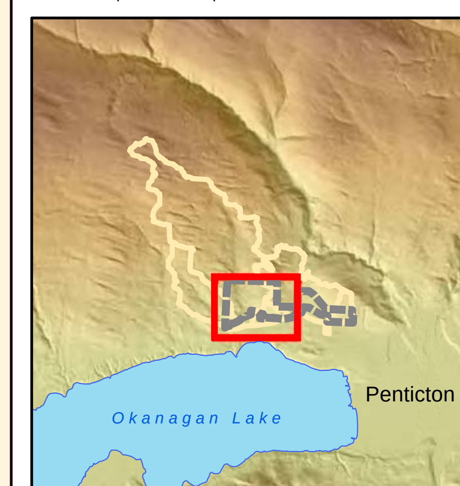
- Proposed Road Network
- Existing Major Drainage Routes
- Optional Major Drainage Route
- Proposed Major Drainage Routes
- Subject Site Boundary
- Sanitary LandfillLandfill
- Potential Distributed Discharge Site*
- Potential Linear Storage Area*
- Potential Pond Site*
- Riparian Zone
- Primary Catchment Boundaries

Development Cells

Stormwater Management Strategy

- Source Control is Optional
- Limited Source Control Recommended
- Significant Source Control Recommended
- 99 Development Cell ID

* Size & Shape are Conceptual



Spiller Road Development Stormwater Management

Proposed SWM Strategy - North

Figure 3.2a

URBANSYSTEMS.

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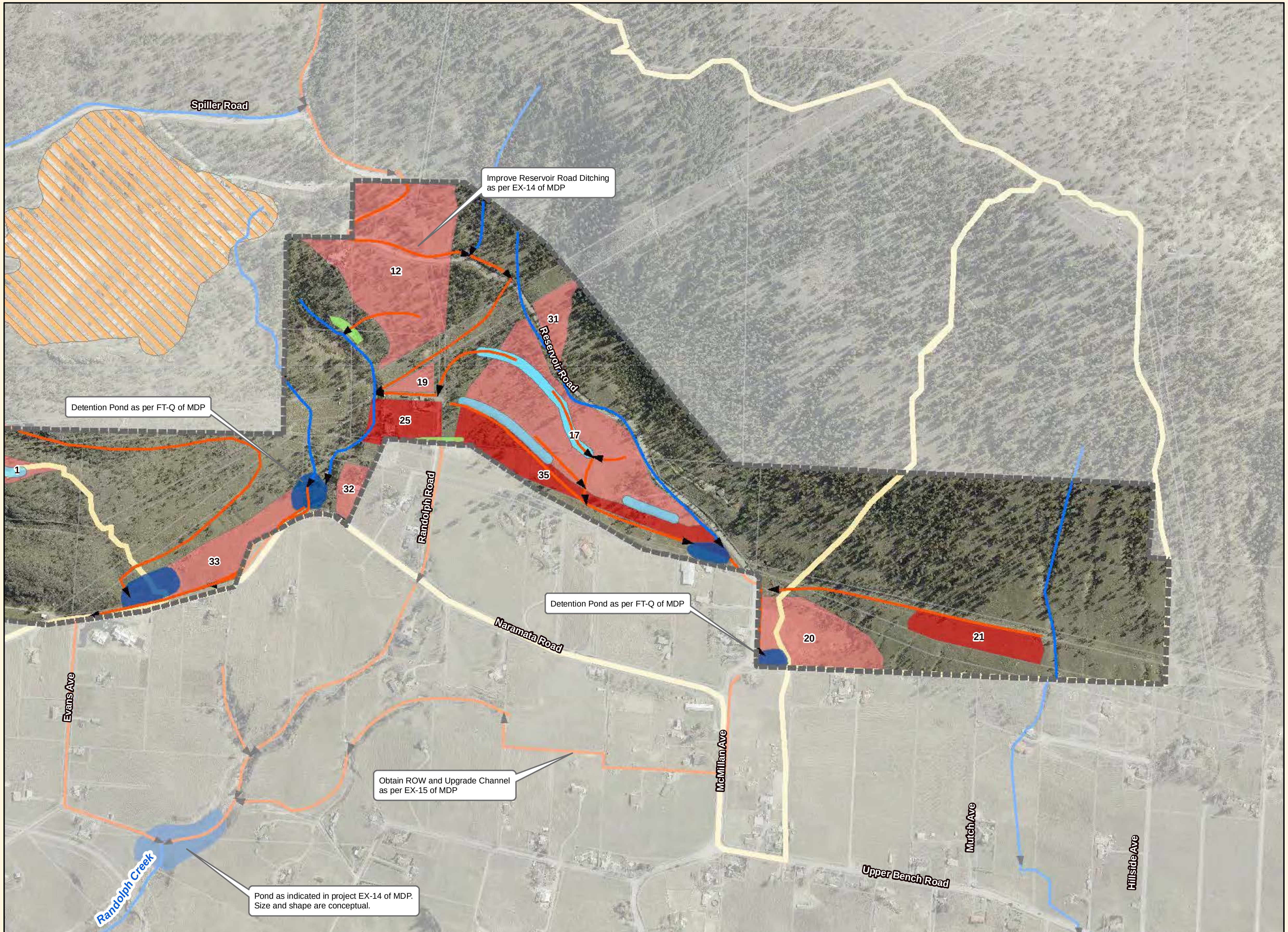


Spiller Rd/Reservoir Rd Neighbourhood Concept Plan

Legend

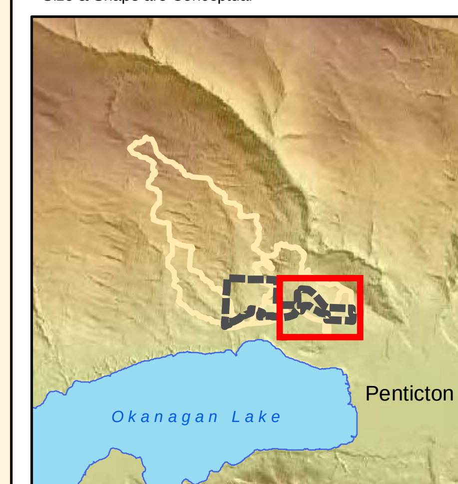
- Proposed Road Network
- Existing Major Drainage Routes
- Proposed Major Drainage Routes
- Potential Distributed Discharge Site*
- Potential Linear Storage Area*
- Potential Pond Site*
- Subject Site Boundary
- Landfill
- Catchment Boundaries

Development Cells

Stormwater Management Strategy

- Source Control is Optional (Conventional)
- Some Source Control Required
- Significant Source Control Required
- 99 Development Cell ID

* Size & Shape are Conceptual



Spiller Road Development Stormwater Management

Proposed SWM Strategy - South

0 125 250 500
Meters

Figure 3.2b

appendix a

EXCERPTS FROM
CITY OF PENTICTON
MASTER DRAINAGE PLAN

Spiller Road/ Reservoir Road Development

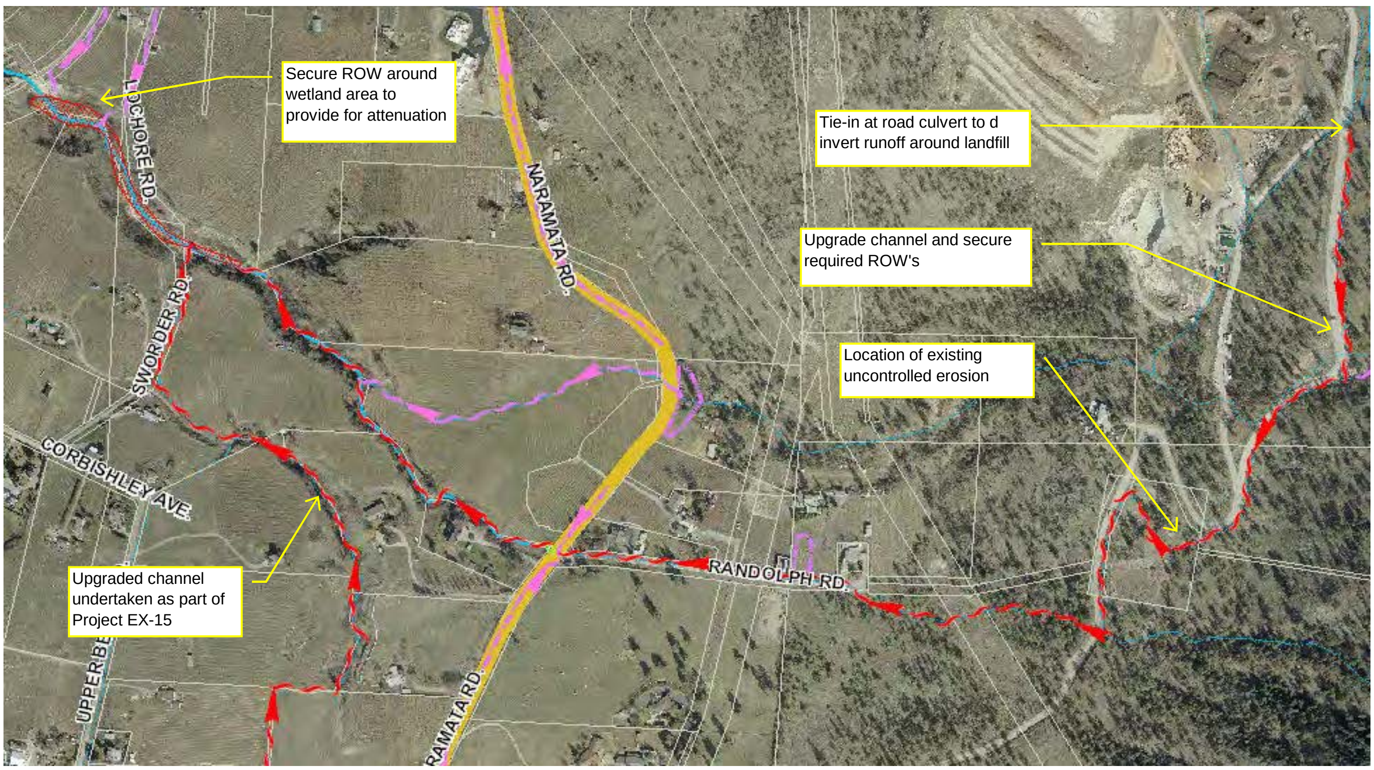
Preliminary Stormwater Management Plan

PROJECT No. EX-14: CAMPBELL MTN LANDFILL DRAINAGE UPGRADES

PROJECT DESCRIPTION:

Runoff from the slopes above the Campbell Mountain landfill are currently routed through the landfill site. Recently, increased runoff has resulted in severe erosion in the ditches and channels. Some ad hoc work appears to have been carried out to re-divert or contain the flow. However, in order to prevent further deterioration of the drainage channels and possible flooding, upgrades are required.

Design and reconstruction of the channels from the landfill to the KVR right-of-way is proposed. The proposed upgraded alignment would divert all upland runoff away from the landfill site to prevent potential contamination. Furthermore, the upgraded channel will serve as a major drainage route for any development that occurs within the Campbell Mountain area, indicated by the current CDP.



CAPITAL COST ESTIMATE

					Cost Allocation					
					DCC		Existing User		Developer Cost	
Item	**Quantity**	**Unit**	**Unit Price**	**Cost Estimates**	%	Cost	%	Cost	%	Cost
Channel restoration (c/w erosion control)	2200	m	$90	$198,000	90%	$178,200	10%	$19,800		
Road culverts	4	LS	$1,500	$6,000	90%	$5,400	10%	$600		
Driveway culverts	5	LS	$500	$2,500	90%	$2,250	10%	$250		
Capital Cost (Subtotal)				***$206,500***		$185,850		$20,650		
Engineering Allowance (10%)				$20,650		$18,585		$2,065		
Contingency Allowance (15%)				$30,975		$27,878		$3,098		
Capital Cost (Total $2006)				**$258,125**	***90%***	***$232,313***	***10%***	***$25,813***		

PRIORITY: High

CONSIDERATIONS:

1.) Provision for a 30m riparian ROW should be considered for the channel downstream of Naramata Rd
2.) Drainage ROW should be acquired to protect corridor from the landfill to Okanagan Lake

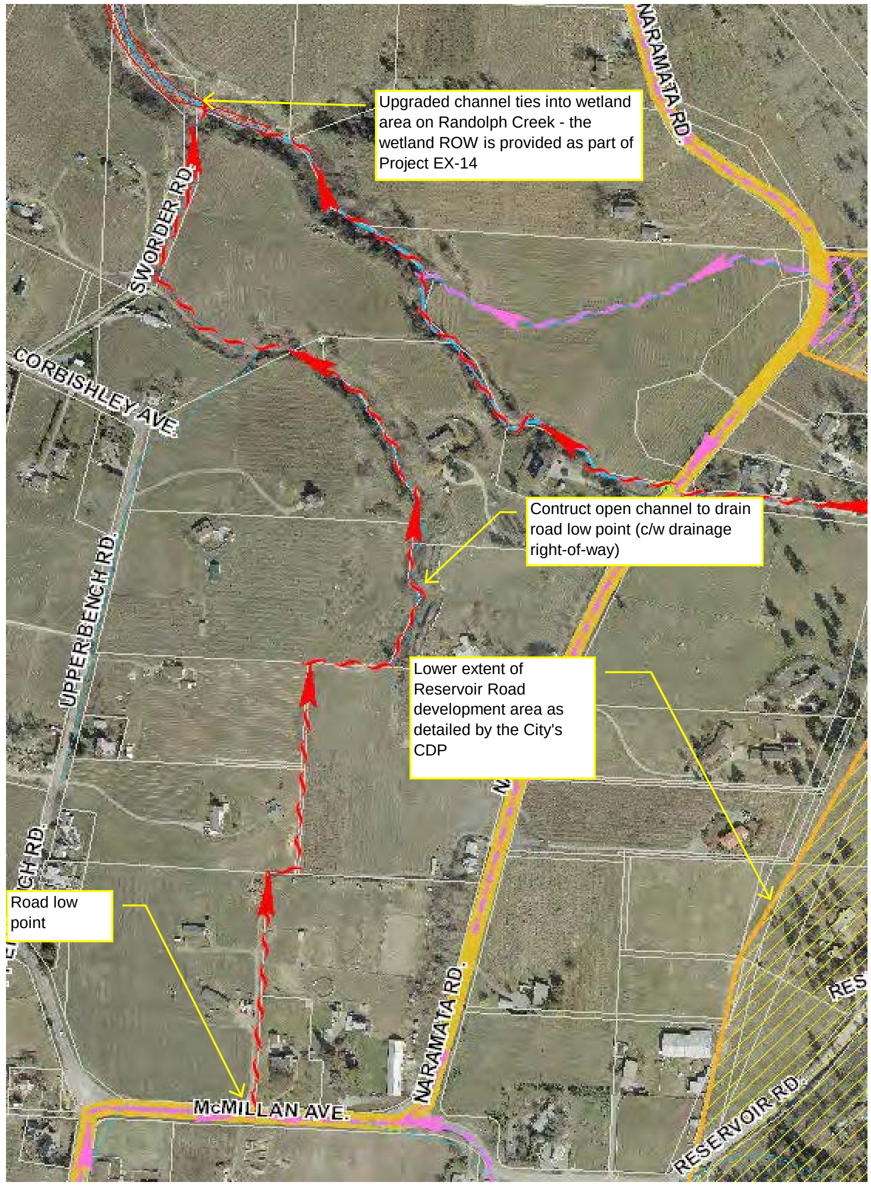
PROJECT No. EX-15: McMILLAN AVE DRAINAGE UPGRADES

PROJECT DESCRIPTION:

A road low-point on McMillan Avenue near Naramata Road has no positive drainage route and is a source of maintenance. Construction of a channel and acquisition of a drainage right-of-way from the low-point on McMillan Ave to Randolph Creek is recommended.

The channel upgrades are recommended to address an existing deficiency but are also required for the future Naramata Road upgades.

These drainage upgrades should be carried out after implementation of Project EX-14.



CAPITAL COST ESTIMATE

					Cost Allocation					
					DCC		Existing User		Developer Cost	
Item	**Quantity**	**Unit**	**Unit Price**	**Cost Estimates**	%	Cost	%	Cost	%	Cost
Channel upgrades	1200	m	$55	$66,000			100%	$66,000		
			Capital Cost (Subtotal)	***$66,000***				$66,000		
			Engineering Allowance (10%)	$6,600				$6,600		
			Contingency Allowance (15%)	$9,900				$9,900		
			Capital Cost (Total $2006)	**$82,500**			***100%***	***$82,500***		

PRIORITY: Low

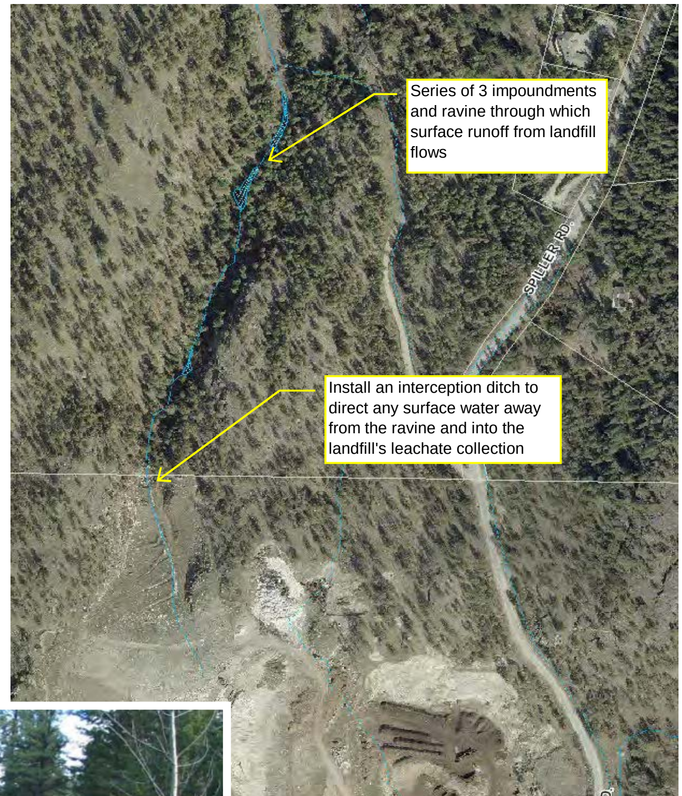
CONSIDERATIONS: 1.) Requires acquisition of drainage ROW from McMillan Ave to Randolph Cr

PROJECT No. EX-18: CAMPBELL MOUNTAIN LANDFILL INTERCEPTION DITCH

PROJECT DESCRIPTION:

Runoff from a portion of Campbell Mountain landfill appears to flow south into a narrow ravine. The runoff flows through three ponds before entering the Strutt Creek drainage basin.

In order to prevent and surface runoff from the landfill from reaching the ravine, construction of an interception ditch is recommended. The ditch should be designed to direct runoff to the landfill's leachate collection/treatment system.



CAPITAL COST ESTIMATE

Item	Quantity	Unit	Unit Price	Cost Estimates	Cost Allocation: DCC %	DCC Cost	Existing User %	Existing User Cost	Developer Cost %	Developer Cost Cost
Extend leachate collection system	1	LS	$45,000	$45,000			100%	$45,000		
			Capital Cost (Subtotal)	***$45,000***				$45,000		
			Engineering Allowance (10%)	$4,500				$4,500		
			Contingency Allowance (15%)	$6,750				$6,750		
			Capital Cost (Total $2006)	**$56,250**			***100%***	***$56,250***		

PRIORITY: Medium

CONSIDERATIONS:

1.) This cost estimate assumes an leachate collection system is in-place - this should be confirmed
2.) Since the RDOS manages the landfill, the cost of this upgrade should be assumed by the RDOS

THE CITY OF Penticton

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A Tyco International Ltd. Company

PROJECT No. FT-P: NARAMATA ROAD DRAINAGE UPGRADES

PROJECT DESCRIPTION:

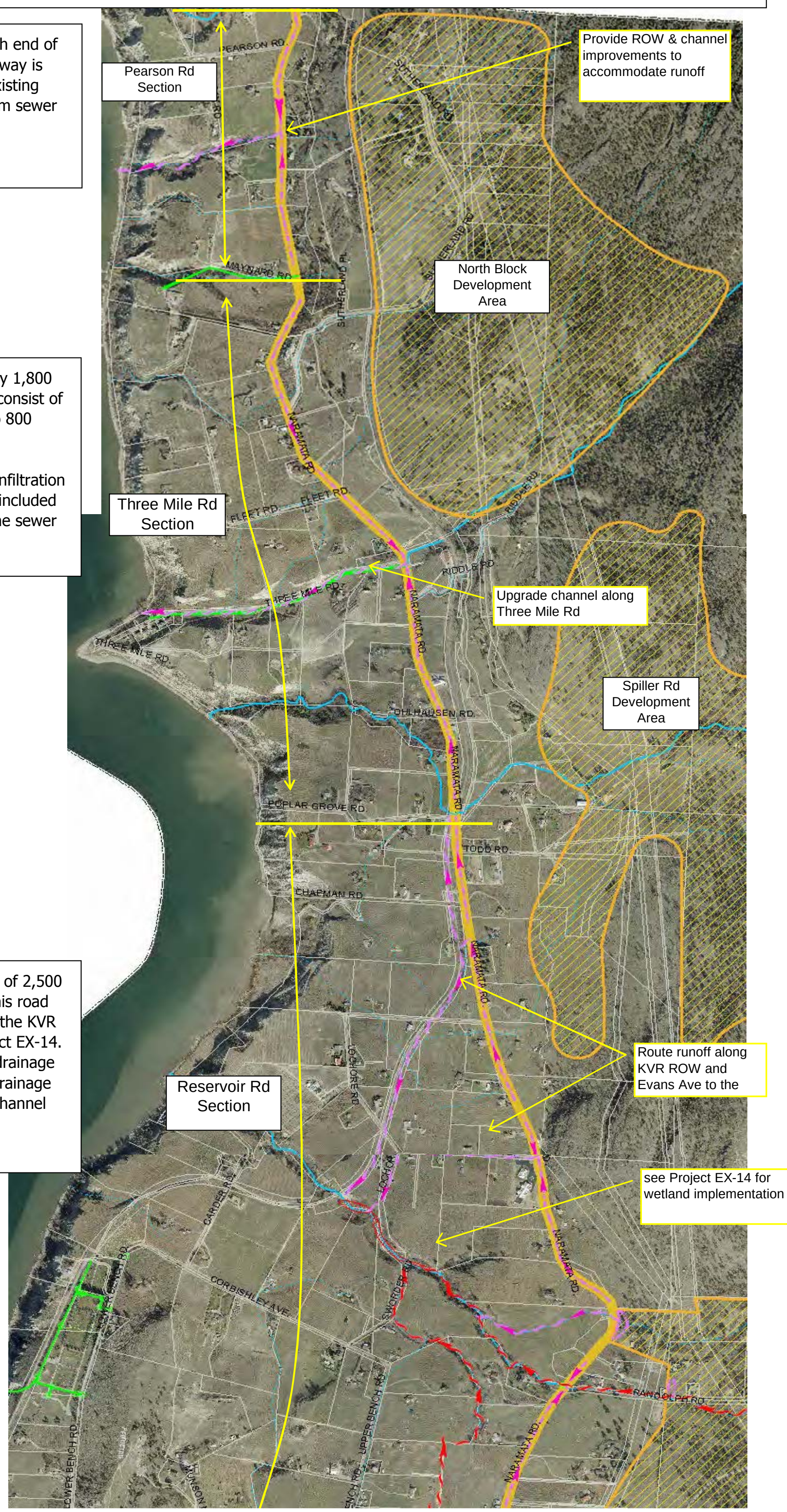
The CDP identifies Naramata Road from Middle Bench Road to the City boundary as requiring upgrading to service development in the North-East sector. Under a long-term scenario, the road way would upgraded to a 4 lane facility. However, development identified by the CDP could be marginally accommodated by a 2 lane urban residential collector. Under either scenario, consideration for installation of a piped system and management of runoff from the new roadway is required. Based on the existing road alignment, 5 distinct catchments have been identified - these are shown in the adjacent figure. Proposed design criteria and routing for each section is described below.

Pearson Rd Section - This road section occurs at the north end of Naramata Road within the City limits. Runoff from the roadway is proposed to be collected and conveyed to the lake via an existing draw. This would require installation of 420 metres of storm sewer pipe and 480 metres of channel improvements.

Three Mile Rd Section - This road section is approximately 1,800 metres in length and drains to Three Mile Road. Upgrades consist of installation of 1,700 metres of storm sewer and upgrades to 800 metres of ditching on Three Mile Rd.

There does not appear to be any opportunity for providing infiltration or detention for the runoff. As a result, provision should be included for providing an oil/water separator at the transition from the sewer to the ditch section at Three Mile Rd.

Reservoir Rd Section - The Reservoir Rd section consists of 2,500 metres of roadway and six sub catchments. Runoff from this road section is conveyed to an engineered wetland located near the KVR ROW. Development of wetland is provided as part of Project EX-14. In addition to installation of 2,200 metres of storm sewer, drainage for the Reservoir Rd section requires developing overland drainage corridors. This will require approximated 2,000 metres of channel upgrades and acquisition of ROW's where necessary.



THE CITY OF Penticton

EarthTech
A Tyco International Ltd. Company

PROJECT No. FT-P: NARAMATA ROAD DRAINAGE UPGRADES

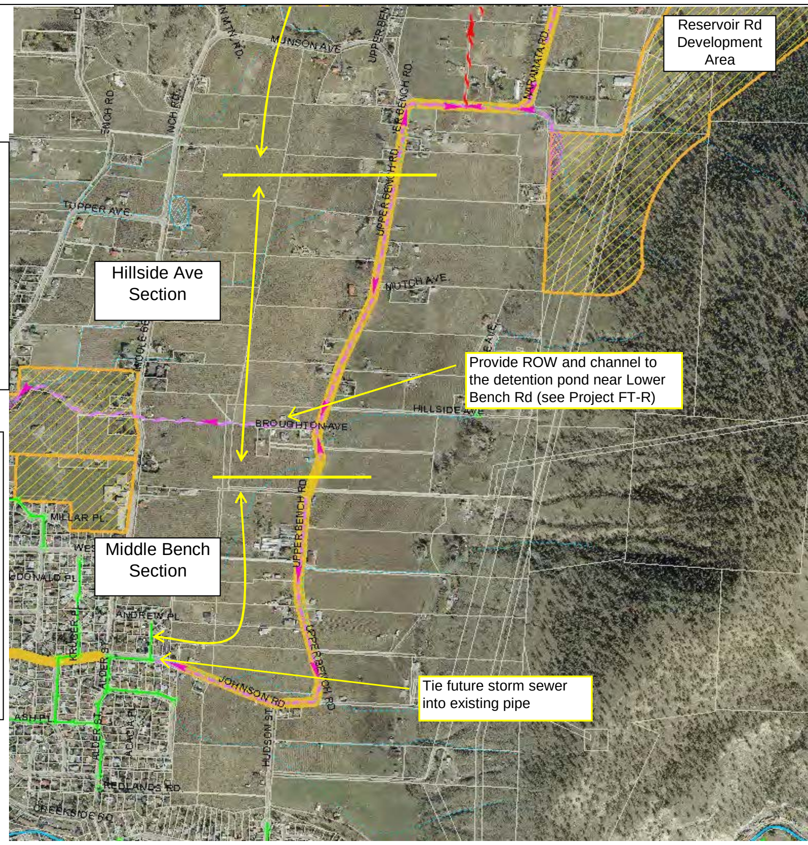
PROJECT DESCRIPTION:

The CDP identifies Naramata Road from Middle Bench Road to the City boundary as requiring upgrading to service development in the North-East sector. Under a long-term scenario, the road way would upgraded to a 4 lane facility. However, development identified by the CDP could be marginally accommodated by a 2 lane urban residential collector. Under either scenario, consideration for installation of a piped system and management of runoff from the new roadway is required. Based on the existing road alignment, 5 distinct catchments have been identified - these are shown in the adjacent figure. Proposed design criteria and routing for each section is described below.

Hillside Ave Section - This road section drains to a low point located near Hillside Rd. Runoff from the road will be conveyed to the low point by a storm sewer. From here, the water is conveyed to a future detention pond located near Lower Bench Rd. (see Project FT-R). The drainage upgrades for this section requires installation of approximately 850 metres of storm sewer and 800 metres of channel upgrades.

Middle Bench Section - drainage upgrades for the Middle Bench Section will consist of installation of 1,100 metres of storm sewer. The sewer will tie in to the existing storm system. The stormwater will discharge to Penticton Creek at an existing outfall near Eckhardt Avenue.

There does not appear to be any opportunity for providing infiltration or detention for the runoff. As a result, provision should be included for providing an oil/water separator at or near the existing outfall at Penticton Creek.



CAPITAL COST ESTIMATE

Item	Quantity	Unit	Unit Price	Cost Estimates	Cost Allocation: DCC %	DCC Cost	Existing User %	Existing User Cost	Developer Cost %	Developer Cost Cost
300mm storm pipe	4550	m	$380	$1,729,000	46%	$790,153	54%	$938,847		
375mm storm pipe	1800	m	$410	$738,000	46%	$337,266	54%	$400,734		
450mm storm pipe	750	m	$460	$345,000	46%	$157,665	54%	$187,335		
Channel upgrades	3625	m	$60	$217,500	46%	$99,398	54%	$118,103		
Capital Cost (Subtotal)				***$3,029,500***		***$1,384,482***		***$1,645,019***		
Engineering Allowance (10%)				$302,950		$138,448		$164,502		
Contingency Allowance (15%)				$454,425		$207,672		$246,753		
Capital Cost (Total $2006)				**$3,786,875**	46%	$1,730,602	54%	$2,056,273		

TRIGGER: Reconstruction of Naramata Rd

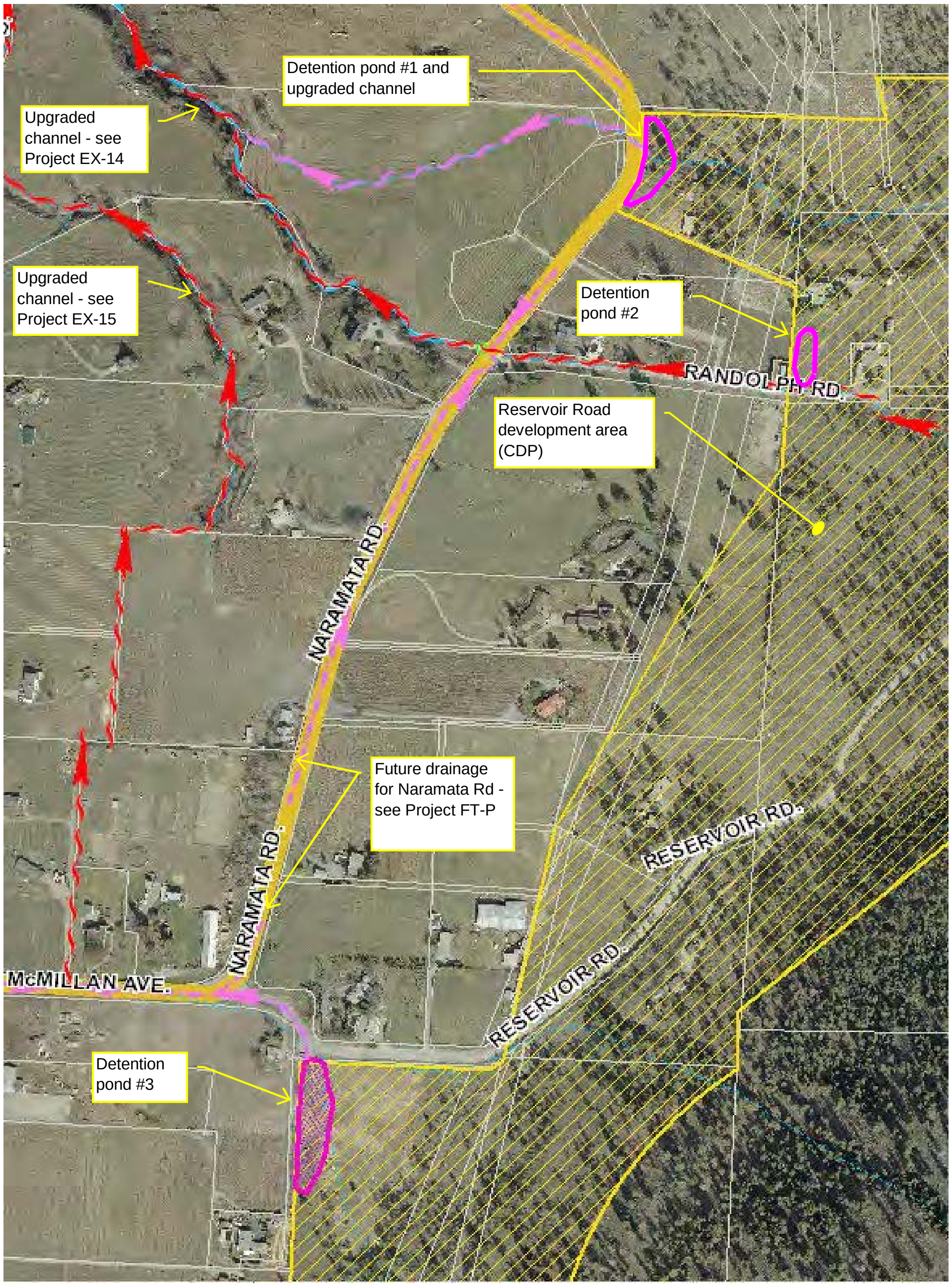
CONSIDERATIONS:

PROJECT No. FT-Q: RESERVOIR ROAD AREA FUTURE UPGRADES

PROJECT DESCRIPTION:

The CDP identifies potential residential development just above Naramata Road (Reservoir Road area). Although the area encompasses multiple parcels and the ultimate layout unknown, the Provincial Stormwater Planning Guidebook should be used as a basis for design to mitigate the impacts of runoff on the natural channels - this will likely require detention storage since infiltration is not recommended.

Three detention storage areas have been identified. The precise location will need to be determined at the design phase. However, it is expected, depending on the development density, that the combined storage volume will be approximately 4,600 m^3.



CAPITAL COST ESTIMATE

Item	Quantity	Unit	Unit Price	Cost Estimates	Cost Allocation DCC %	DCC Cost	Existing User %	Existing User Cost	Developer Cost %	Developer Cost Cost
Stormwater treatment pond	3	LS	$60,000	$180,000					100%	$180,000
Channel upgrades	380	m	$60	$22,800					100%	$22,800
			Capital Cost (Subtotal)	***$202,800***						
			Engineering Allowance (10%)	$20,280	\					
			Contingency Allowance (15%)	$30,420						
			Capital Cost (Total $2006)	**$253,500**					100%	$253,500

TRIGGER: Development of the Reservoir Rd CDP area

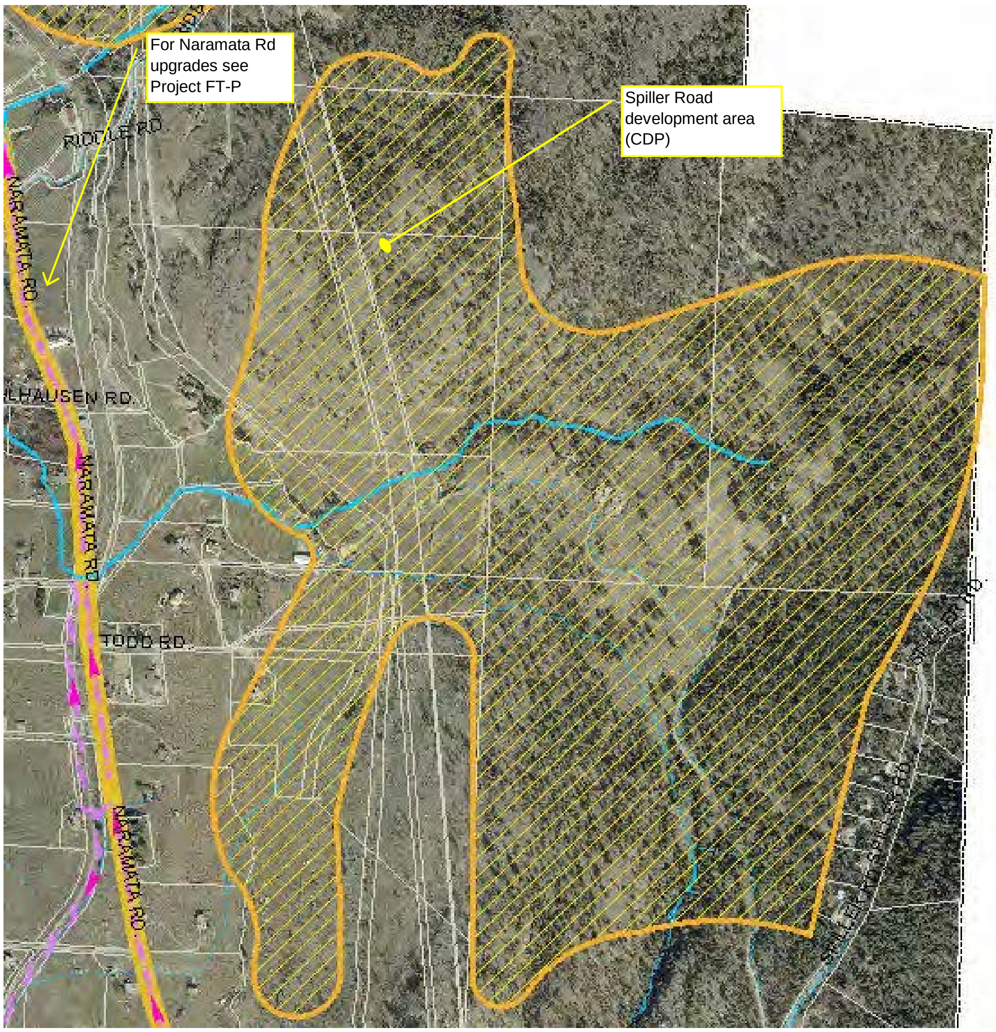
CONSIDERATIONS:

PROJECT No. FT-T: SPILLER ROAD DEVELOPMENT AREA UPGRADES

PROJECT DESCRIPTION:

The CDP identifies a potential residential development area between Spiller Road and Naramata Road (Spiller Road area). Although the area encompasses multiple parcels and the ultimate layout unknown, the Provincial Stormwater Planning Guidebook should be used as a basis for design to minimize impacts on the natural channels - this will likely require detention storage since infiltration is not recommended for this area.

The location of detention storage or other BMP's required to satisfy the requirements of the Guidebook will need to be determined as part of pre-design phase - a detailed storm drainage plan will be useful in this regard. However, it is expected, depending on the density, that the development should provide for a combined storage volume of approximately 10,000 m^3.



CAPITAL COST ESTIMATE

					Cost Allocation					
					DCC		Existing User		Developer Cost	
Item	**Quantity**	**Unit**	**Unit Price**	**Cost Estimates**	%	Cost	%	Cost	%	Cost
Stormwater treatment/detention pond	1	LS		N/A					100%	N/A
Capital Cost (Subtotal)				***N/A***						
Engineering Allowance (10%)				N/A						
Contingency Allowance (15%)				N/A						
Capital Cost (Total $2006)				**N/A**					100%	N/A

TRIGGER: Development of the Spiller Road area

CONSIDERATIONS:

APPENDIX G

Transportation Impact Study
(Urban Systems Ltd.)

#500 - 1708 Dolphin Avenue, Kelowna, BC V1Y 9S4
Telephone: 250-762-2517 Fax: 250-763-5266

URBANSYSTEMS®

MEMORANDUM

date:	May 19, 2009
to:	City of Penticton c/o Kristin Meersman, P.Eng, Deputy City Engineer
cc:	Canadian Horizons Land Investment Corp. c/o Bentley Harris, P.Eng, Development Manager
from:	James Donnelly, P.Eng., PTOE
file #:	2707.0008.01
subject:	**SPILLER/RESERVOIR NEIGHBOURHOOD – OFF-SITE TRAFFIC IMPACT STUDY**

This memorandum represents a traffic impact study that was undertaken on behalf of Canadian Horizons Land Investment Corp. for the Spiller Road/Reservoir Road Development Area in the NE Sector of the City of Penticton. In particular, the analysis includes a review of off-site intersection and roadway needs resulting from the proposed development concept, including:

- A description of methodology and assumptions used in the analysis, and,
- A summary of recommended off-site roadway improvements in order to accommodate the growth potential in the area, including the full build-out of the proposed development concept.

1.0 EXISTING AND FUTURE ROAD NETWORK

The proposed Development Area is anticipated to access the exiting road network on Naramata Road, Reservoir Road and Spiller Road. Primary access to and from the development will be along Naramata Road and into Penticton City Centre via Upper Bench Road to Eckhardt Avenue or Munson/Tupper/Lower Bench Roads to Front Street. These roads are predominantly two lane rural, with a speed limit of 50 km/hr. The adjacent photograph illustrates a typical cross-section of the roads in this area.

Northbound Upper Bench Road

The following are key intersections along the two routes between the Development Area and Penticton that were included in the analysis for this traffic review:

1. Naramata Road & Todd Road (stop control on Todd Road)
2. Naramata Road & Evans Road (stop control on Evans Road)
3. Naramata Road & Randolph Road (stop control on Randolph Road)
4. Naramata Road/McMillan Road & Reservoir Road (stop control on Reservoir Road)
5. McMillan Road & Upper Bench Road (stop control on Upper Bench Road)
6. Vancouver Avenue/Front Street & Ellis Street (single lane roundabout)

7. Front Street/Westminster Avenue & Main Street (signal control, one way Main Street northbound)
8. Eckhardt Avenue & Government Street (signal control)
9. Eckhardt Avenue & Main Street (signal control, one way Main Street northbound)

The remaining intersections along the two routes are minor road intersections with low traffic volumes leading mainly to lower density rural residential areas. It was assumed for this review that these roads lead to areas of negligible future growth and were therefore not included in the overall analysis for this study.

The existing traffic volumes at the key intersections were acquired from the City of Penticton's *2004 Transportation Study (Phase 1 – Data Collection)*. Where volumes were not available, traffic counts were undertaken in early March 2008 to supplement the available data. The existing traffic volumes and intersection controls are provided in **Figure 2**.

For this study, a forecast horizon of +20 years was assumed. Recognizing that the Development Area represents the majority of the anticipated growth within this area of the City of Penticton, a background annual traffic growth rate of 0.5% was assumed and utilized in the analysis.

2.0 DEVELOPMENT GENERATED TRAFFIC

The Spiller Road/Reservoir Road Development Area is located in the NE Sector of Penticton, to the east of Naramata Road. Once fully built-out, it is anticipated to accommodate in the order of 800 residential units. As specific details of the development land uses are yet to be confirmed, it was estimated that approximately 10% of the development units will be multi-family, and the remaining 90% will be single family dwellings. The development area is expected to be built out over 10-15 years at a rate of 50 to 100 units per year, with construction beginning in 2010.

There are six potential access points from the existing road network to the Development Area, as follows and illustrated in **Figure 1**:

- Randolph Road (at Naramata Road)
- Todd Road (at Naramata Road)
- New Development Access to South (at Reservoir Road)
- New Development Access to North (at Reservoir Road)
- New Development Access to West (at Naramata Road)

Full build-out development generated traffic volumes were calculated for the AM and PM peak hours using standard industry accepted ITE trip rates for multi-family (Residential Condominium) and single family (Single Family Detached). A summary of the trip generation is provided in **Table 1**.

Table 1: Development Generated Traffic Volume Summary

Land Use	Size	Trip Rate	Trips Inbound	Trips Outbound	Total Trips
AM Peak					
Multi-Family	80 units	0.44 veh/hr 18% inbound	5	30	35
Single-Family	720 units	0.77 veh/hr 26% inbound	145	410	555
Total			**150**	**440**	**590**
PM Peak					
Multi-Family	80 units	0.52 veh/hr 64% inbound	25	15	40
Single-Family	720 units	1.02 veh/hr 64% inbound	470	265	735
Total			**495**	**280**	**775**

The development traffic was assigned to the six proposed Development Area access points and existing roadway network assuming three major origin/destination routes to and from the development:

1. To and from Naramata (i.e. Naramata Road north of the Development Area)
   5% of total trips

2. To and from Downtown Penticton via McMillan Road, Munson Avenue, Tupper Avenue, Lower Bench Road, Vancouver Avenue and Front Street
   60% of total trips

3. To and from Penticton via McMillan Road, Upper Bench Road, Johnson Road, Haven Hill Road and Eckhardt Avenue.
   35% of total trips

Both the second and third routes also provide access to Highway 97. The development trips were distributed along the latter two routes up to and including their connections with Main Street, which is a major collector and distributor for the City of Penticton. Beyond this route, it was assumed that the traffic would be absorbed and distributed throughout the remaining road network.

The trip distribution pattern (5%/60%/35%) was assumed and is based on professional judgement. Although the existing traffic split at the McMillan Ave/Upper Bench Rd intersection showed a higher percentage of trips following Lower Bench Road into town, as traffic volumes increase along this route, and in particular at the signalized intersections along Front Street and Westminster Avenue, it is anticipated that more users will choose the Upper Bench Road route into town. A sensitivity analysis of this assumption was undertaken to confirm its reliability, and it was found that the intersection performance results are not significantly dependent on the accuracy of the trip distribution pattern. With the proposed intersection improvements, there is adequate room for fluctuations in route preference.

The development trip distribution and traffic volumes at each of the study intersections and access points are summarized in **Figure 3**. **Figure 4** shows the total forecast (+ 20 year) plus development traffic volumes.

3.0 ROAD AND INTERSECTION ANALYSIS

The forecast peak hour volumes along the principal corridors (post full build out) are estimated as follows:

Table 2: Forecast Traffic Volumes with Development Traffic on Key Corridors

Key Corridor	AM (veh/hr)	PM (veh/hr)
Naramata Road	500	660
McMillan Road	730	970
Vancouver Ave	700	900
Upper Bench Road	210	300
Eckhardt Avenue (east of Government St)	1190	1200

While the projected volumes are beginning to escalate toward more intensive usage levels, they do not specifically trigger the need for capacity related improvements (ie. 2 lane to 4 lane widening) along any corridor.

Each of the key intersections and access points were analyzed to determine any potential traffic performance issues for the +20 year forecast horizon (full build out of the Spiller Road/Reservoir Road Development Area). The results of the analyses are provided in **Table 3**. All intersections will operate at an overall LOS D or better, and are generally within the reasonable performance expectations of the City of Penticton. Of note, the roundabout at Vancouver Ave/Front St & Ellis Avenue will operate at LOS B or better for all movements, with a maximum queue of 28m in the AM peak (Vancouver Ave approach) and 30m in the PM peak (Front St approach).

Some of the traffic volume data along Naramata Road were acquired through a traffic counts that were undertaken in March of 2008. It is recognized that the volumes along this route may swell during the summer months. A sensitivity analysis of the results was undertaken to confirm the analysis results, which assumed a 100% increase in traffic along Naramata Road. This sensitivity analysis did not result in any significant changes to the conclusions, and as such, it is anticipated that the recommendations are resilient to potential fluctuations in traffic throughout the year. At intersections near to downtown Penticton, such as Eckhart Ave/Government St and Eckhart Ave/Main St some increased delays and degraded levels of service were found during the sensitivity analysis. This would be expected during Penticton's peak summer conditions.

Table 3: AM/PM Peak Hour Traffic Analysis Results for +20 Year Forecast Horizon
(with development traffic)

Intersection / Access	AM Peak		PM Peak	
	LOS	delay (s)	LOS	delay (s)
Vancouver Ave/Front St & Ellis St	B	-	A	-
Upper Bench Rd & McMillan Rd	A	2.7	A	3.6
Westminster Ave/Front St & Main St	A	8.0	A	9.1
Eckhardt Ave & Main St	A	8.2	B	10.1
Eckhardt Ave & Government St	C	21.8	B	13.3
Naramata Rd/McMillan Rd & Reservoir Rd	A	4.7	A	3.2
Naramata Rd & Randolph Rd	A	1.4	A	0.9
Naramata Rd & Evans Ave	A	5.2	A	3.2
Naramata Rd & Todd Rd	A	2.4	A	1.5
Reservoir Rd & Access to South	A	0.8	A	0.4
Reservoir Rd & Access to North	A	-	A	-
Spiller Rd & Access to West	A	7.0	A	6.9

4.0 DISCUSSION

In general terms, the results of the technical analysis would suggest that there is capacity in the roadway network in the Northeast Sector of the City of Penticton to accommodate growth, and particularly growth of a nature and scale as is being proposed within the context of this study. Despite visual images of congestion during extreme peaking conditions related to tourism during the summer months, background traffic volumes are generally low and rural in nature when considered on a 24 hour and 365 day basis. As a result, and not surprisingly, layering the proposed traffic generated by the development concept over the existing background traffic conditions does not trigger the need for capacity upgrades along the Naramata Road corridor; or in other words, 4 laning is not required as a direct result of this project. The peak hour volumes along the key corridors serving the site (Naramata Road, McMillan Road and Upper Bench Road) are not beyond what could typically be accommodated by a two lane rural cross-section (upwards of 1800 vehicles per hour).

Naramata Road, McMillan Avenue, and Upper Bench Road to Eckhardt Avenue are classified as Major Collector Roadways in the *2005 City of Penticton Transportation Plan*. It is not anticipated that Naramata Road, McMillan Avenue or Upper Bench Road should ever need to be upgraded to an urban standard (ie. curb and gutter), but they should be an minimum upgraded to conform to the 'Rural Collector Road' standard as detailed in the City of Penticton's Subdivision and Development Bylaw (2004) as opportunities present themselves.

The current road configurations are not ideal for vulnerable road users, in particular cyclists and pedestrians. However, the Rural Collector cross-section provides wide (1.5m) paved shoulders that will function as designated bicycle lanes, and also provide space on the paved surface for pedestrians. The

1.5m paved shoulders should ultimately extend along Naramata Road between the City limits and into the City Centre to tie in where there are existing facilities. This will improve the safety for vulnerable road users along these routes, given that the traffic volumes are anticipated to increase with the proposed developments in the sector. Appropriate signage should be included along these routes to note the presence of vulnerable road users on the road (i.e. bicycle route signage).

Intersections typically represent the key points of congestion along any arterial roadway corridor; as they represent the 'choke' points of lowest capacity. On a rural corridor of the nature of Upper Bench/McMillan/Naramata Roads, intersections are typically configured in favour of through traffic along the main corridor, as is the case here. Therefore, degradation of intersection performance as a result of increasing traffic volumes typically manifests itself as increasing levels of delay on the side street (STOP controlled) intersection approaches. Ultimately, conversion to a multi-way stop configuration, a roundabout, a traffic control signal or even a grade-separated interchange is the typical application. The technical analysis undertaken in this study does not indicate the presence of any capacity related issues at any of the key intersections along the length of the approach corridors.

There is currently no transit service to the proposed development, but it is assumed with the addition of 800 new units that at some point in the future transit may be considered. The recommended Rural Collector Road standard will be able to accommodate buses.

There are several curves with awkward alignments on the existing road network in the vicinity of the proposed development. One lies on Naramata Road between Randolph Road and Evans Road. This curve is well signed and highly visible on both approaches. However, due to the embankment on the east side, visibility around the curve is limited. While traffic volumes do not warrant any further upgrades, this curve should be monitored as development progresses to ensure that safety is not further compromised as the traffic volumes increase at this location. There is a second curve located on Upper Bench Road where the road becomes Johnson Road. Again, this curve should be monitored as traffic volumes continue to increase along this route.

Also along both main routes into town are series of 90 degree corners associated with minor road intersections. For example, at the intersections of Munson Ave/Middle Bench Road N, Middle Bench Rd N/Tupper Ave and Johnson Rd/Haven Hill Rd. As these roads are upgraded to accommodate the Rural Collector cross-section, minor tweaking of signage and/or road markings should be considered at these intersections as appropriate to improve visibility, to minimize confusion and to ensure the safety of vulnerable road users.

5.0 RECOMMENDATIONS

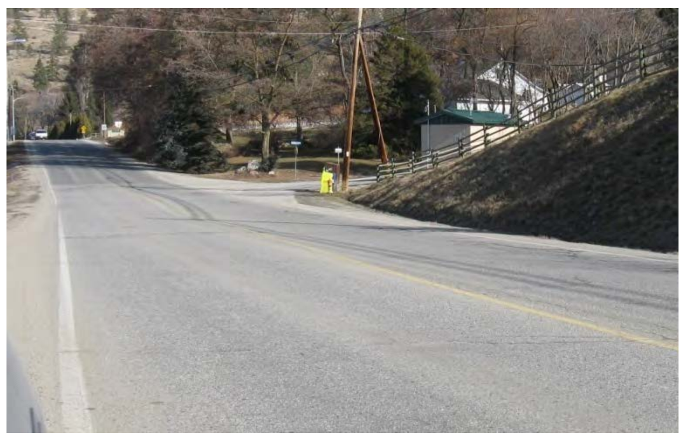
The recommended off-site roadway network improvements are summarized, to support the proposed land use in **Table 4**, and more generally development growth in the sector **Table 5**. Although not all intersections noted in this table had discernable performance issues (i.e. poor LOS, large delays, long queues), some improvements have been recommended on a basis of improved operations and safety, and professional judgement.

Delivery mechanism and timing / triggers for the upgrades are still under review and discussion with the City of Penticton, however, it is proposed that those improvements itemized in **Table 4** will be linked to this application and borne by the applicant, while those improvements itemized in **Table 5** will be accommodated as a function of the broader growth of the City of Penticton and accommodated accordingly.

Table 4: Recommended Improvements to Support Development Application

INTERSECTION UPGRADE ***Naramata Rd/McMillan Rd/Reservoir Rd*** ▪ Delineate/narrow Reservoir Road approach with designated right turn lane (minimum 20m) ▪ Add new eastbound right turn lane on McMillan Road for access to Reservoir Road (minimum 20m) **OR** ▪ Consider a future roundabout at this location – ideally situated to act as a 'gateway' to Naramata	 **Looking West from Reservoir Road**
INTERSECTION UPGRADE ***McMillan Rd/Upper Bench Rd*** ▪ Intersection is wide and undefined – all approaches need to be further delineated ▪ Add new westbound left turn lane on McMillan Road (20m) ▪ Separate right and left turn movements on northbound Upper Bench Road approach with left turn storage lane (20m)	 **Looking West on McMillan Road**
INTERSECTION UPGRADE ***Naramata Rd/Site Access*** ▪ Develop new, safe intersection as primary access ▪ Include northbound right turn taper ▪ Improve Naramata Rd alignment to accommodate intersection	

Table 5: Recommended Improvements to Support Growth in the NE Sector

INTERSECTION UPGRADE ***Naramata Road/Evans Road*** ▪ Delineate westbound approach with designated left turn lane (20m) and shared through/right turn lane ▪ New northbound right turn lane on Naramata Road (minimum 20m)	 **Looking North on Naramata Road**
INTERSECTION UPGRADE ***Naramata Road/Randolph Road*** ▪ Delineate westbound Randolph Road approach with designated left turn storage lane (20m) ▪ Improve intersection visibility and turning sight lines by cutting back vegetation on north side of intersection and providing warning signs on Naramata Road from both approaches. Consider illumination of the intersection.	 **Looking North on Naramata Road**
INTERSECTION UPGRADE ***Naramata Road/Todd Road*** ▪ Delineate westbound Todd Road approach with designated left turn storage lane (20m)	 **Looking North on Naramata Road**

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INTERSECTION UPGRADE
Eckhardt Ave/Government St

Improvements as per 2005 Transportation Study (Phase 2):

- Add second eastbound through lane on Eckhardt Avenue
- Add northbound right turn lane
- Extend westbound and southbound left turn bays

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Looking West on Eckhardt Avenue

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CROSS-SECTION UPGRADE

- Upgrade Lower Bench Rd, Tupper Ave, Middle Bench Rd, Munson Ave, McMillan Rd, Naramata Rd to rural collector configuration
- Enhance provisions for vulnerable roadway users (bicycle lanes)
- Implement as opportunities present themselves

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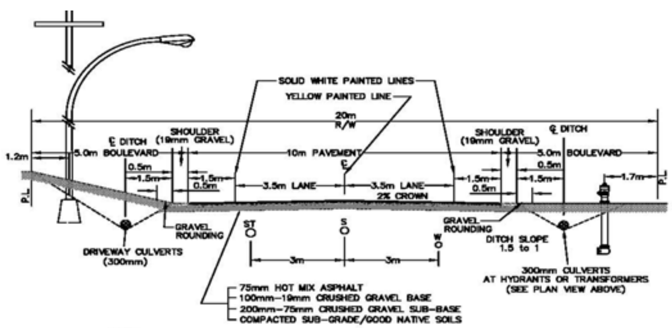

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The recommended road network improvements are summarized in **Figure 5**.

URBAN SYSTEMS LTD.

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Figure 1: Proposed Development Area and Road Network

Figure 2: Existing AM/PM Peak Hour Volumes (veh/hr)

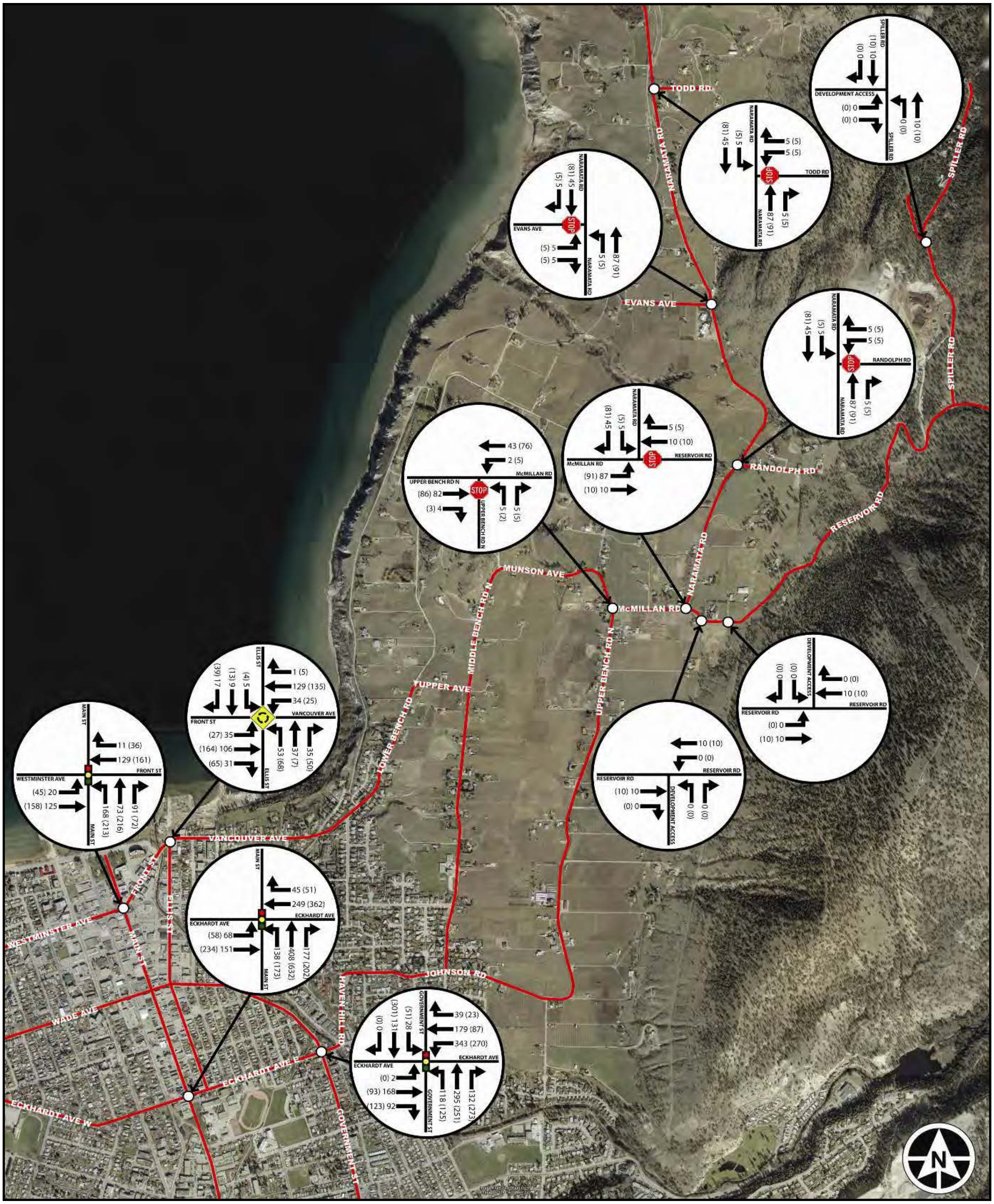

Figure 3: Development Generated AM/PM Peak Hour Traffic Volumes (veh/hr)

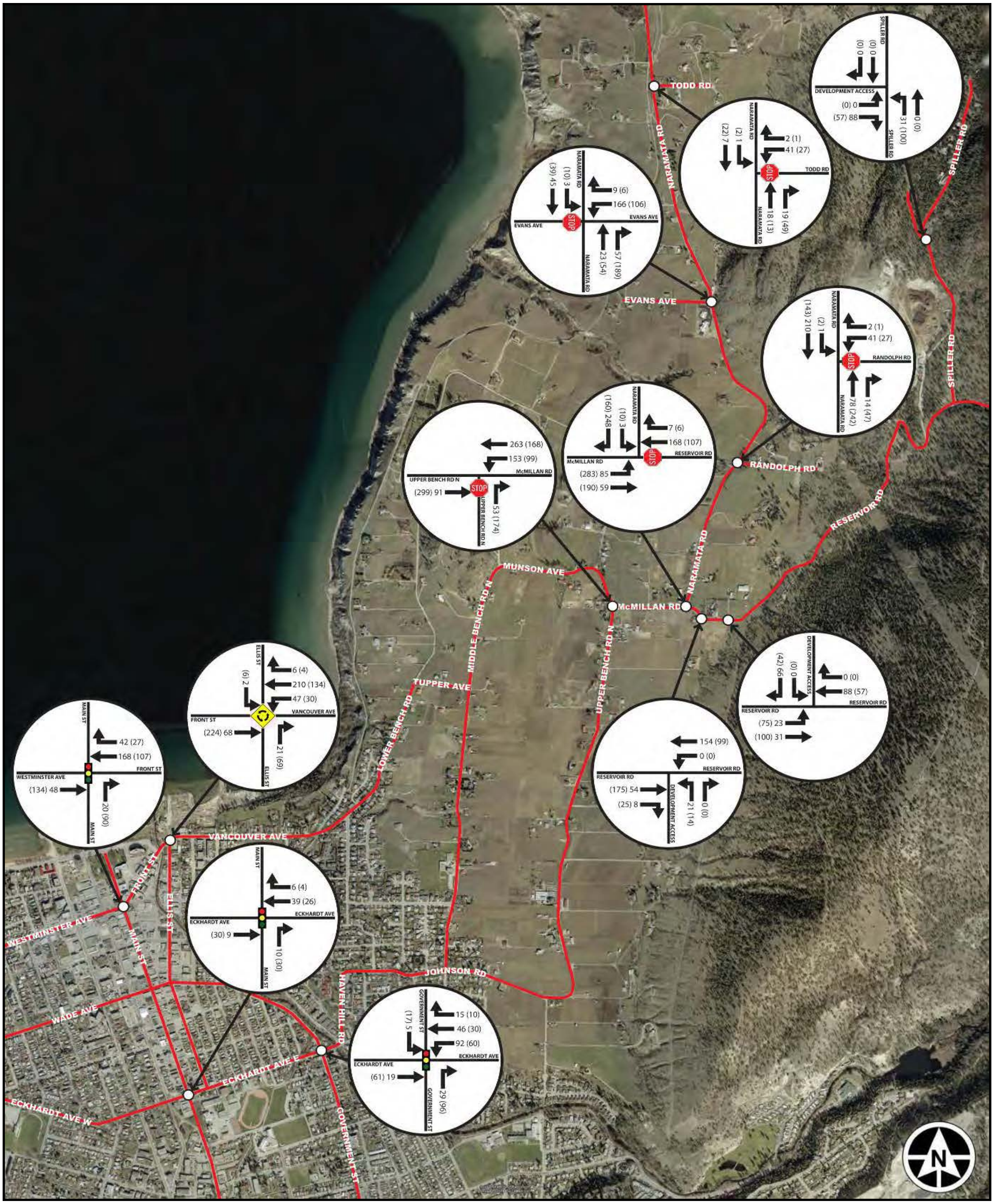

Figure 4: 20-Year Forecast plus Development Generated AM/PM Peak Hour Traffic Volumes (veh/hr)

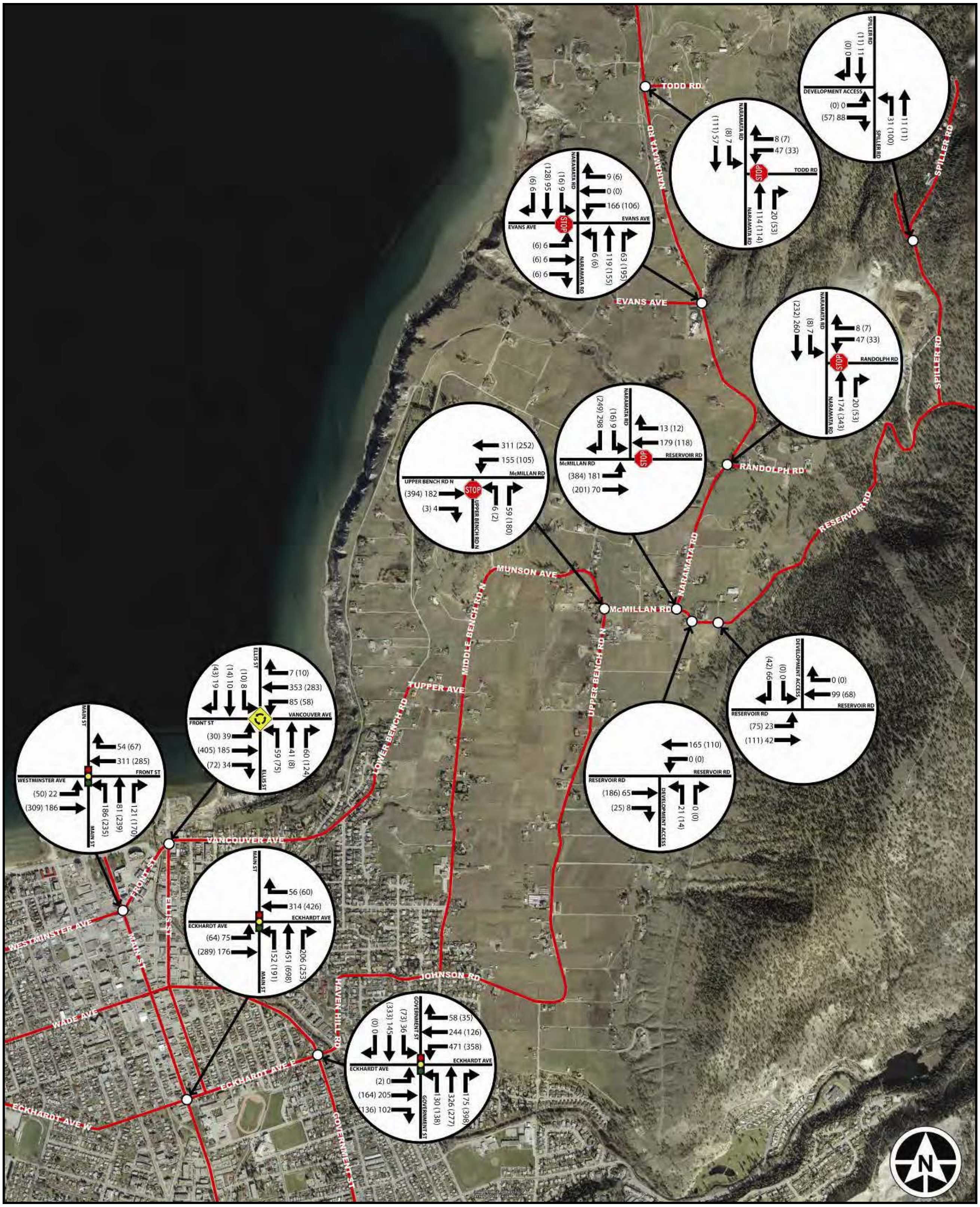

Figure 5: Recommended Road Network Improvements