South Fraser Perimeter Road
Approaches to Creating Land-use Compatibility

Submission to Transportation Association of Canada

Transport Canada and the Ministry of Transportation and Infrastructure

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INTRODUCTION

The South Fraser Perimeter Road (SFPR) is a four-lane, 40 kilometre route travelling along the south side of the Fraser River extending from Deltaport Way (Corporation of Delta) to 176th Street and 104th Avenue (City of Surrey). Advanced by the BC Ministry of Transportation and Infrastructure (MOTI) with approximately $365 million of federal (Transport Canada) support, the SFPR was constructed in response to growing regional congestion in the Lower Mainland and to improve the movement of people, goods. Environmental assessment of the Project was completed in 2008 with full operation of the road commencing in December, 2013.

Given existing levels of development in Greater Vancouver, the development of the highway required that the alignment be located directly adjacent to Burns Bog - a 3,000 ha peat bog located within the community of Delta. Burns Bog is one of Canada's largest undeveloped land masses within an urban area and supports distinctive bog vegetation communities and recognized rare and endangered plant and wildlife species (**Figure 1**).

Due to its ecological importance, large areas of Burns Bog are protected within a land conservancy and the area is valued by a large and diverse group of community interests. Given land constraints in the highway corridor, the ecological importance of the Bog and the high level of community interest in the area, development of the SFPR required significant effort in order to reconcile the potentially competing interests of highway construction/operation and conservation of a valued and highly sensitive ecosystem.

Reconciling these interests was supported by collaboration between highway design and engineering specialists and experts in bog ecological and conservation. While the process for reconciling operation of a highway and conservation of a protected area took time, the outcomes include new information for understanding the complex ecology of the Bog and improved tools for active management of hydrology to achieve restoration outcomes. These tools, which facilitated environmentally sensitive development adjacent to Burns Bog, also represent an important investment in the effort to protect Burns Bog over the long term and restore areas impacted by past development.

ECOLOGY OF BURNS BOG

Burns Bog was established as a unique, raised bog feature as a result of environmental conditions on the former Fraser River delta over a period of 8,000 to 10,000 years. In more recent history, Burns Bog was subject to considerable land development pressures around its periphery, resulting in as much as half of the original wetland being reclaimed for development (i.e., agricultural, settlement, commercial and industrial land development, landfilling, and peat extraction). This resulted in a general decline in the ecological viability and significant long-term erosion of the critical hydrological function of the Bog.

While it has the typical characteristics of a raised bog ecosystem such as a peat mound above the regional water table, an internal water mound, and widespread peatland communities

dominated by Sphagnum and heather, Burns Bog is globally unique due to its form and size. The Bog relies entirely on inputs of water from precipitation making the ecological viability of the Bog directly dependent upon the extent and continued integrity of its water mound and the peat that encloses it. Because input waters are low in nutrients and have not had contact with mineral soil materials, the ecosystems supported within the Bog tend are nutrient poor, and sensitive to the effects of development.

Water chemistry is one of the key determinants of the ecological condition within Burns Bog with low pH (i.e., acidic) water supporting specific plant communities that are supported by such conditions. As such, the introduction of "non-bog" water (i.e., high pH and higher in nutrients) results in changes to hydrochemistry and to the representative plant communities. The long term introduction of "non-bog" water ultimately can lead to the establishment of terrestrial plant communities, the exclusion of bog vegetation and the loss of the unique ecology associated with a bog.

BURNS BOG ECOLOGICAL CONSERVANCY AREA

Recognizing the high ecological and conservation values of Burns Bog, in 2004, Environment Canada, the Province of British Columbia, Metro Vancouver, and the Corporation of Delta purchased approximately 2,000 ha of Burns Bog for $73 million in order to protect and maintain the ecological integrity of Burns Bog. These three levels of government committed, in a *Conservation Covenant*, to manage the lands as a bog ecosystem, collectively referred to as the Burns Bog Ecological Conservancy Area (BBECA), and co-managed by the Corporation of Delta and Metro Vancouver.

In 2007, Metro Vancouver and signatories to the Conservation Covenant developed the Burns Bog Ecological Conservancy Area Management Plan to facilitate the long term management and restoration of the Bog. In the context of planning for the South Fraser Perimeter Road, the BBECA Management Plan provided a critical tool to guide dialogue between design and engineering teams planning the SFPR and ecologists working to advance the long term protection and restoration of the area.

PROJECT CHALLENGES

Constructing a highway in the narrow zone between Burns Bog, adjacent agricultural land, and industrial developments, while protecting the ecological integrity of the adjacent Burns Bog, presented several risks to the long term ecological integrity of Burns Bog and design challenges to MOTI. These included:

- **Protecting water chemistry -** Ensuring that "non-bog" waters including highway run-off and water from adjacent upland areas did not flow towards Burns Bog which could result in changes to water chemistry within the BBECA;

- **Maintaining water levels** – Given the unique hydrology regime of the Bog, construction and operation of the highway could not result in increased drainage of areas within the BBECA or lowering of water tables;
- **Avoiding introduction of invasive plants –** Ensuring that construction and operation of the proposed road did not result in the introduction of non-bog plant species;
- **Minimizing road related dust/particulate** – Need to avoid the introduction of particulate matter, associated with pre-load/construction activities as well as operation, that could impact water chemistry;
- **Limited data** – Obtaining sufficient information to support a robust understanding of existing conditions particularly with respect to the movement of surface and ground water associated with the area. The absence of such information represented a challenge for both environmental assessment and mitigation design; and
- **Managing existing site contamination** – Construction of the Project required decommissioning of existing landfills directly adjacent to Burns Bog. While closure of these facilities made best use of land in a constrained corridor, and addressed an existing and ongoing environmental risk to the Bog, it also presented engineering and schedule challenges.

APPROACH

While the development of the SFPR adjacent to the BBECA was considered of some stakeholders as incompatible with the protection and long term restoration the area, a review of the BBECA Management Plan by the highway design team, and dialogue with the ecologists responsible for the development of the Plan, identified a number of opportunities for aligning work that was required to plan and construct the highway and work that was required to advance conservation objectives. Early examples of such alignment include information that was identified as necessary by both the highway design team and ecologists leading the implementation of the Management Plan such as: long term data on water levels and water chemistry (i.e., baseline data to support environmental impact assessment and restoration plans) and data on hydrological dynamics within and adjacent to Burns Bog (i.e., data to support design of drainage systems and to guide management of water levels within Burns Bog).

Recognizing the opportunity for alignment between highway development activities and implementation of the management plan for the BBECA, at the onset of the environmental impact assessment studies and project planning stages, the MOTI working with government agencies responsible for managing the BBECA, established a working group to discuss planning of the proposed highway. Working group dialogue focused on:

- Sharing of information to facilitate common understanding of existing ecological conditions;
- Identifying potential effects of highway development on the BBECA;

- Collaborative development of measures to mitigate potential effects of the project on the BBECA; and
- Identification of infrastructure that could be developed that would support both highway operation requirements and bog restoration objectives.

Key participants in the working group included, Metro Vancouver, the Ministry of Environment, the Ministry of Forests, Lands, and Natural Resource Operations, Corporation of Delta, Environment Canada, the Burns Bog Management Planning Committee, and a Scientific Advisory Panel that provided independent advice to government agencies charged with the long-term management of the BBECA.

The initial outputs of the working group included: input into the development of an extensive baseline data collection program to collect information on water levels, water chemistry and development of a water balance model to better understand hydrological dynamics within the larger watershed within and adjacent to Burns Bog and the proposed highway.

The water balance model provided an important tool for facilitating collaboration between technical staff working on highway design and bog restoration and increased the common understanding of ecological processes associated with the Bog. Knowledge gained from the development and use of the model guided the development of highway drainage that avoided impacts to Burns Bog and also guided the development of conceptual plans for bog restoration activities. Following highway construction, the water balance model remains an important tool that can be applied to monitoring and assessing changes in bog hydrology related to management activities within the BBECA.

The working group also provided critical input into the development of the Burns Bog Hydrology Workplan that describes the mitigation proposed to address potential effects associated with highway development and operation. Development of the workplan provided a critical deliverable that facilitated project approval under federal and provincial environmental assessment processes. The workplan, which identifies specific infrastructure to be built and operated to avoid potential project-related effects, is based on objectives developed in consultation with the working group which include:

- **Site-specific solutions** – The design, construction and operation of hydrology mitigation would be based on, and take into account, site-specific conditions;
- **Compatibility between highway water management and bog water management** – Providing for active water level controls in the Bog that are independent of SFPR-related water management;
- **Prevention of mineral migration into the Bog** – Providing a low permeability barrier between the SFPR and bog by using material that prevents the introduction of mineral material, and maintains hydraulic gradients;
- **Resilience** – Providing a design that is sufficiently robust to maintain and actively manage water levels under average and extreme conditions and if Bog conditions change;

- **Not precluding future restoration of Burns Bog** – Providing flexibility of design that allows for future water control structures that allow for raising of water levels as part of future bog restoration; and
- **Holistic design** – Hydrology mitigation concepts designed in ways that are compatible with and help achieve multiple mitigation requirements.

Key infrastructure that was developed as a result of the Burns Bog Hydrology Workplan included design and installation of water control structures, one-way culverts and mitigation berms to ensure clear separation of Bog related waters from drainage waters associated with the SFPR (**Figure 2; Photos 1 and 2**). In addition, berms, using materials and construction techniques to avoid impacts to the Bog, were constructed along the boundary of the Bog (**Figures 3 and 4; Photos 3 and 4)** in order to:

- Divert runoff from developed areas within mineral soils away from the Bog;
- Lower water levels north of SFPR;
- Provide a physical barrier/separation between the SFPR and the Bog;
- Screen airborne particulates;
- Provide hydrological and surface water separation; and
- Act as a barrier to adventives / invasive plant species.

One immediate outcome associated with the development of infrastructure identified in the workplan has been an 89% reduction in the area which previously drained “non-bog” waters from historic development areas towards Burns Bog. Removal of this source of mineralized water removes an ongoing threat to Burns Bog and may facilitate the restoration of areas impacted by past development.

In addition to implementation of mitigation measures to avoid potential project related effects on the BBECA, project development also led to the remediation of several existing landfills along the north side of Burns Bog. The closure of these facilities included designs that exclude landfill leachate from entering the Burns Bog. While the remediation work did pose a cost and schedule risk to the project, it also resulted in additional developable land and reduced the need for greenfield development.

In financial terms, environmental enhancements that provide a benefit with respect to the long term protection and restoration of the BBECA, that were made as a result of the SFPR project, total $25 million. These investments include landfill closure ($19 million) as well as investments in information collection, development of decision making tools, long term monitoring programs, and infrastructure development noted above. Many of these investments might not have been possible in the absence of the project.

FOLLOW UP AND MONITORING

The implementation of the Burns Bog Hydrology Workplan has been complemented by a long term monitoring program which monitors the effectiveness of mitigation measures and changes in ecological conditions at the interface of the highway right-of-way and the BBECA.

In confirming the effectiveness of the mitigation measures identified during the EA process, the monitoring program also helps to confirm prediction regarding the extent and nature of project related effects that were reached during the EA and meet requirements under the *Canadian Environmental Assessment Act* for a formal monitoring and follow up program.

The monitoring program collects and assesses trends in information such as: dust fall, water quality, water levels, and vegetation. Most monitoring programs have been in place for 5 years since the start of construction. Key findings to date indicate:

- No increase in aerial deposition of particulate matter to Burns Bog (compared to pre-construction and ambient conditions);
- Seasonal and climate-related changes in water levels remained consistent with historical/baseline data;
- Water quality has remained consistent with historical trends and in accordance with historical seasonal patterns and cycles;
- No adverse changes to plant communities in monitoring plots; and
- Increased growth of sphagnum in some locations.

Such monitoring programs provide an important source of data that can also be used to guide, and assess the effectiveness, of measures undertaken through the BBCEA Management Plan to protect and restore Burns Bog.

CONCLUSION

The development of the SFPR project represents a success story in that the project has been advanced in a way that helps to protect and conserve a sensitive ecosystem within a developing urban area (**Photos 5 and 6**). By considering conservation objectives for the BBECA alongside highway planning objectives during project planning, the Project has been able to provide:

- Better information for understanding the ecological function of Burns Bog;
- Tools for making decisions regarding the development and monitoring of infrastructure to support highway operation and bog conservation; and
- Infrastructure for actively managing water adjacent to and within the BBECA to achieve conservation objectives for the Bog including restoring impacts associated with historical development.

While the works undertaken to facilitate the protection and conservation of the BBECA could have been undertaken in isolation from the Project, the Project expedited the process of implementing the Management Plan for the BBECA and identifying financial resources to support the implementation of the Plan.

In addition to new tools for advancing the protection and long term restoration of Burns Bog, MOTI has developed monitoring programs to ensure that enhancement work undertaken to avoid impacts to Burns Bog are functioning as intended. Over the long term, these monitoring

programs will be of value in assessing the effectiveness of actions undertaken to conserve and restore areas within the BBECA.

The construction of the SFPR, in a way that has reconciled the requirements of highway development and operation with the conservation objectives associated with the Burns Bog Ecological Conservancy Area, includes some important lessons learned that can be applied to future projects.

The success that was achieved in reconciling the potentially competing interests of highway development and bog restoration was possible due to the willingness of all interests to work together. The SFPR project team, in order to obtain project approval and meet project schedule, recognized the need to find ways to mitigate potential project effects that were supported by key stakeholders. Organizations responsible for the long term protection and restoration of the BBECA recognized that some of the infrastructure investments required to support highway development, if planned and delivered in an appropriate manner, could support bog conservation activities.

The key to this successful collaboration was early and ongoing dialogue that supported the development of strong working relationships. The SFPR project team engaged key stakeholders with an interest in the BBECA at the early stages of project design before decisions regarding final alignment and design were complete. In addition to initiating dialogue early in the project planning process, all parties committed significant amounts of time to allow for highly technical discussions – on both highway design and bog ecology – that allowed for the development of a shared understanding of the technical challenges and potential solutions. This investment of time resulted in the establishment of trust and respect between participants and allowed the working group to effectively work through challenging issues and find solutions that met the needs of all interests.

FIGURES

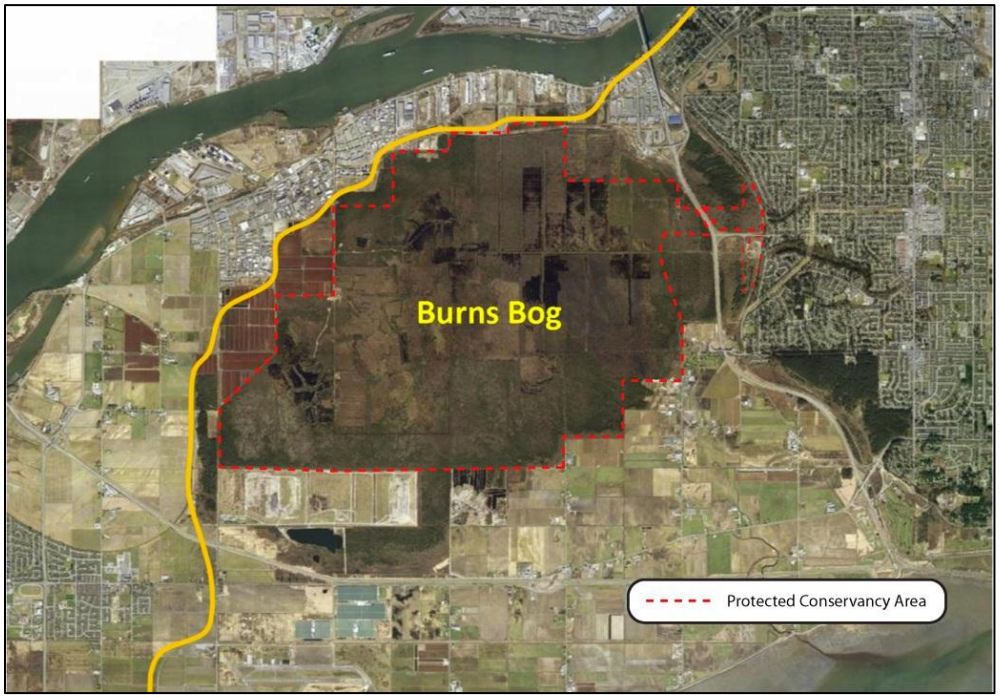

Figure 1. Burns Bog Ecological Conservancy Area (red) in proximity to South Fraser Perimeter Road (yellow)

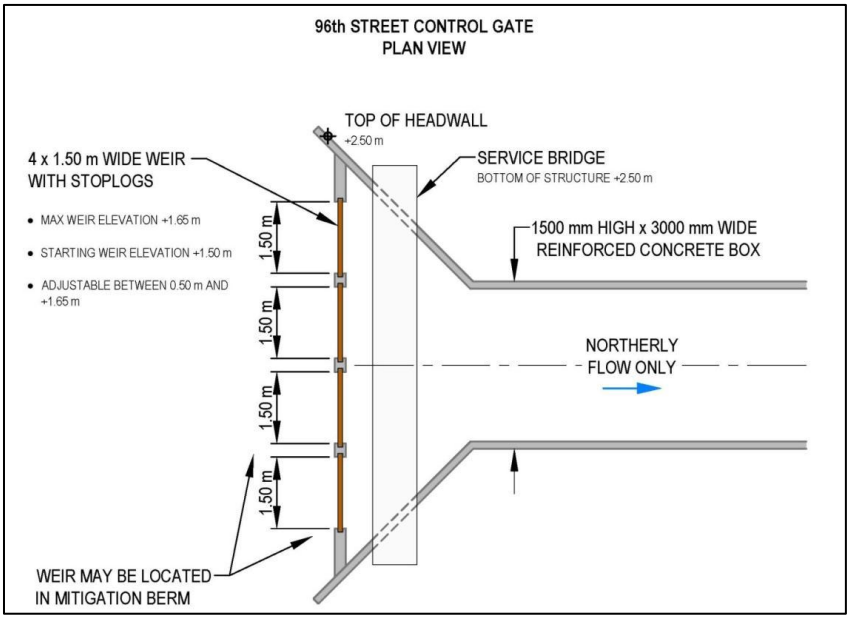

Figure 2. Water Control Structure designed to separate mineralized water/runoff from entering the Bog.

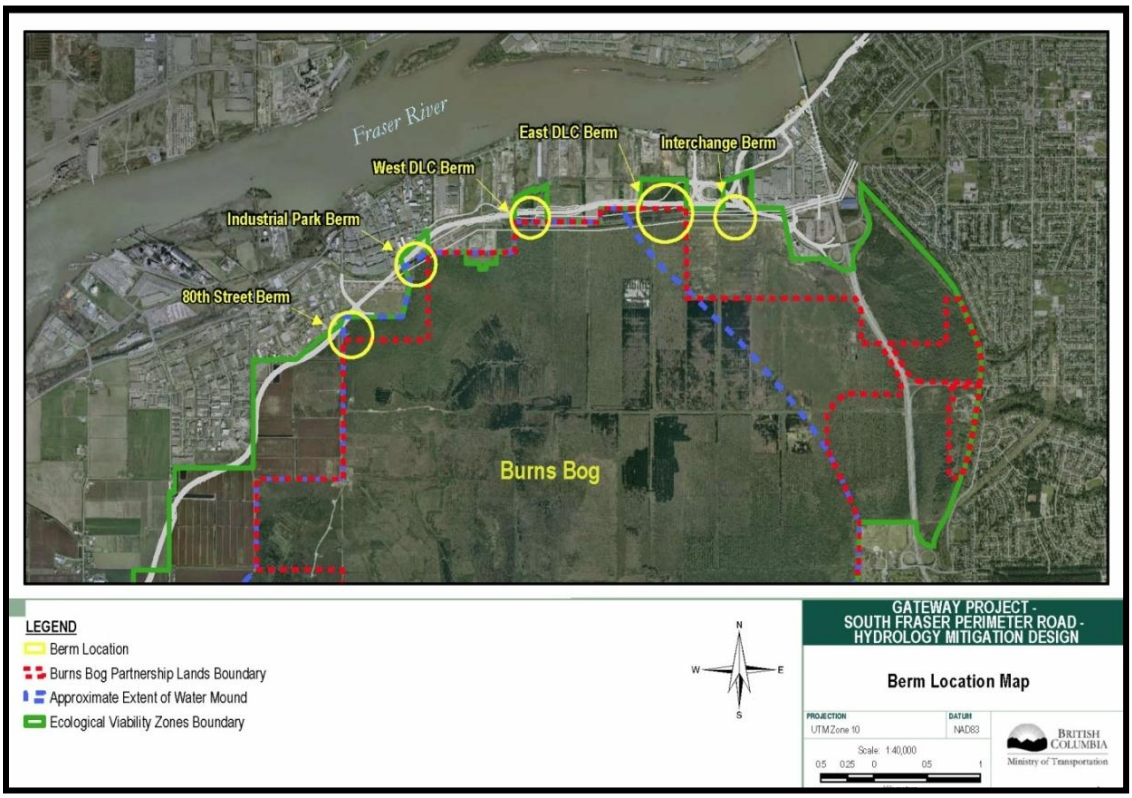

Figure 3. Separation berms construction along the northern boundary of Burns Bog.

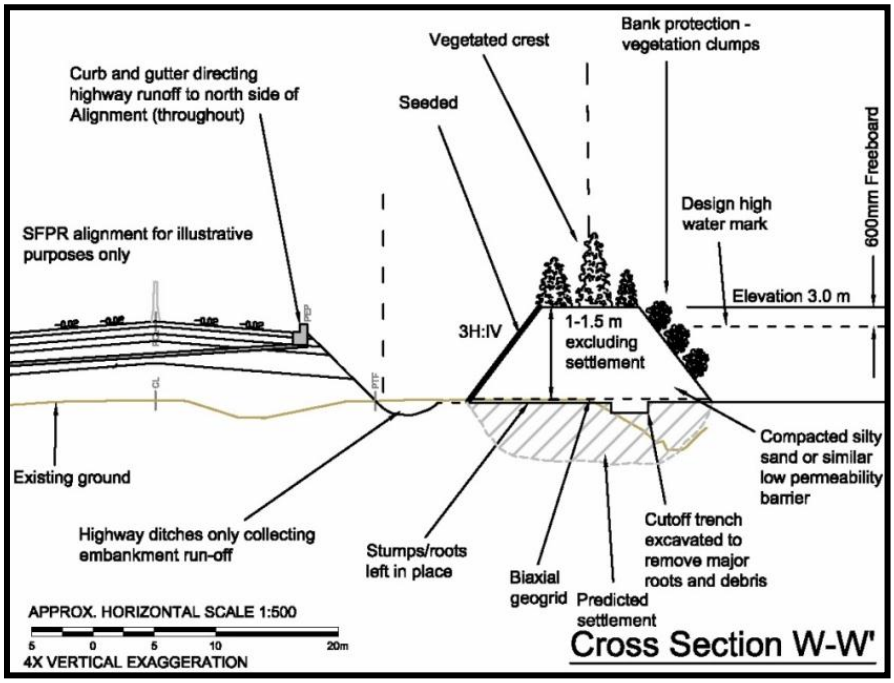

Figure 4. Plan view of separation berm design.

PHOTOS

Photo 1. Water control structure installed facing south.

Photo 2. Water control structure installed, facing southeast.

Photo 3. Separation berm along northern periphery of Burns Bog, under construction.

Photo 4. Separation berm along northern periphery of Burns Bog, completed and planted.

Photo 5. South Fraser Perimter Road, north of Burns Bog, south of highly developed area.

Photo 6. Burns Bog Ecological Conservancy Area, south of the South Fraser Perimeter Road.