



TSAWWASSEN FIRST NATION
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Tsawwassen First Nation Integrated Rainwater Management Plan

FINAL REPORT



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INTEGRATED RAINWATER MANAGEMENT PLAN



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Executive Summary

An Integrated Rainwater Management Plan (IRMP) is a comprehensive plan that examines the interrelationships between drainage servicing, land use planning, and environmental protection. Its purpose is to outline an approach to support and promote the growth of a community in a way that maintains, or ideally enhances, the overall health of a watershed. By applying an integrated approach, an IRMP can be used to link watershed and stream health to land use and policy decisions. Further, as a policy level document, an IRMP can be a powerful tool that supports a community's path towards achieving its vision for the future.

Tsawwassen First Nation (TFN) is poised to experience considerable growth and development over the next few decades. This growth will directly result in the need to provide improved drainage services and protect environmental assets, all while allowing development to proceed. The IRMP provides the opportunity for TFN to outline its rainwater management goals and objectives, in a proactive manner, to guide future development. It also satisfies TFN's commitments under the existing services agreements between TFN and the Corporation of Delta (Delta), and has been prepared in accordance with Metro Vancouver's Integrated Liquid Waste and Resource Management Plan requirements.

TFN lands are situated next to the Strait of Georgia (Salish Sea) and are bordered by Delta on the north, east and south sides. TFN lands are bisected near the north and south limits by the Port Metro Vancouver Roberts Bank Causeway (Deltaport Way) and the BC Ferries Causeway (Highway 17A), respectively. The total area of TFN lands (post-Treaty; as of September 2011) is 662 hectares (ha) (identified as the "Tsawwassen Lands" in the TFN Land Use Plan).

While the scope of the IRMP mainly focuses on TFN lands, it is important to understand how TFN lands interact with and are affected by the surrounding area. Therefore, the IRMP also considers external lands that are hydraulically connected to TFN; that is, rainwater runoff generated by these external lands is conveyed through TFN lands and discharged to the Strait of Georgia. The external lands are located within Delta and are roughly bounded by Deltaport Way to the north, Boundary Bay to the east, 14 Avenue to the south, and 52 Street to the west. TFN lands and external lands together comprise the Study Area for the IRMP (approximately 1,716 ha in total).

The IRMP has been organized into four stages; the purpose and outcomes of each stage is highlighted in Table E.1 below.

Table E.1: IRMP Stages

| STAGE | TITLE | PURPOSE AND OUTCOMES |
|---------|--|---|
| Stage 1 | What Does TFN Have? (Inventory of Existing Systems) | <ul style="list-style-type: none"> Summarize key features and properties of the Study Area Highlight opportunities and constraints Identify key issues for the IRMP to address |

| STAGE | TITLE | PURPOSE AND OUTCOMES |
|----------------|--|--|
| Stage 2 | What Does TFN Want? (Vision, Goals and Objectives) | <ul style="list-style-type: none"> Summarize anticipated future land uses in the Study Area Articulate a vision (supported by goals and objectives) for rainwater management that meets community needs and guides the IRMP process |
| Stage 3 | How Does TFN Put The IRMP Into Action? (Assessment, Analysis and Implementation) | <ul style="list-style-type: none"> Identify, assess and present the recommended servicing approach(es) for future development conditions Outline performance targets and design criteria Develop a clear framework for implementation Prepare cost estimates for recommended works |
| Stage 4 | How Does TFN Ensure That The IRMP Stays On Target? (Monitoring and Adaptive Management) | <ul style="list-style-type: none"> Identify performance indicators for key IRMP components Outline monitoring and assessment programs Describe an adaptive management process that TFN can use to modify the implementation strategy if, through monitoring and assessment program results, TFN determines that the IRMP vision, goals and objectives are not being met |

Stage 1 – What does TFN have?

The IRMP provides an inventory of existing systems, including drainage infrastructure (open ditches, culverts, sewers, pump stations and dikes), land use, regulatory framework (laws and regulations, service agreements), environmental features (aquatic and foreshore habitat, wildlife, vegetation), geotechnical (soil characteristics, slope stability), hydrogeology (groundwater and aquifer), and water and sediment quality.

The majority of TFN lands are currently undeveloped or used for agricultural purposes, with remaining lands consisting of housing, community facilities and limited commercial uses. The remainder of the Study Area primarily consists of agricultural lands, although residential, recreational (golf courses) and commercial uses are also present. There are several future developments planned on TFN lands, which will result in an increase in impervious (hard surface) area in the order of 260 hectares over existing conditions. Per Delta's Official Community Plan (OCP), Delta will only experience a 19 hectare increase in impervious area under future conditions.

The regulatory framework varies depending on whether lands are located within TFN or Delta. Regional, Provincial and Federal statutes and regulations may also be relevant. In general, TFN Regulations and Delta Bylaws cover many of the same topics; however, TFN's Regulations tend to be broader in scope and definition whereas Delta Bylaws tend to be more defined and prescriptive.

The drainage network within the lowland portions of the Study Area primarily consist of interconnected ditches, with culverts at road and driveway crossings. The network collects and conveys rainwater and irrigation runoff to pump stations, which in turn discharge flows to the Strait of Georgia. In the upland portions of the Study Area, the drainage network generally consists of an underground storm sewer system, with limited segments of roadside ditching.

TFN lands are currently protected from ocean inundation by a dike system that separates the community from the Strait of Georgia. The existing dike system generally meets current Provincial flood protection requirements; however, recently published Provincial documents on climate change adaptation suggest that flood protection infrastructure on TFN lands may need to be altered significantly over the next several decades to respond to climate change.

From an environmental perspective, the ditches in the Study Area are channelized and straight, have poor water quality characteristics, contain no characteristic features of salmonid-bearing stream habitat, and largely function as a conveyance network for the surrounding lands and road system. By contrast, the foreshore marine environment (to which the internal drainage network discharges to) contains high value habitat for birds, fish and other wildlife.

The majority of vegetated areas within TFN lands consist of cultivated agricultural or fallow lands, with stands of trees on the Tsawwassen Bluff escarpment and along larger drainage ditches. Watercourses and associated riparian habitat have been substantially modified since settlement and development of agriculture. Remaining riparian habitat is of important ecological value as it provides habitat for a variety of mammal and bird species, stabilizes ditch banks, and filters runoff from adjacent lands.

TFN lands provide habitat for a variety of wildlife species including those associated with marine, intertidal, grassland, riparian and forest habitat types. The Study Area supports amphibians (frogs, salamanders), garter snakes, a wide variety of birds, mammals (mice, beavers, coyotes, raccoons) and invertebrate species. TFN lands, adjacent farmland and foreshore have been identified as an Important Bird Area (IBA); approximately 264 bird species have been documented within the Boundary Bay – Roberts Bank – Sturgeon Bank IBA.

Within the lowland portions of the Study Area, the natural soil conditions likely consist of a thin layer of topsoil, overlying up to about 3 metres of silt to clayey silt, overlying about 50 metres of interlayered sand and silt layers. Some areas have been previously filled, and the quality and composition of such fill has not been characterized, although is likely highly variable. The water table is high and is likely near the surface of the natural soils during the wetter months or when irrigated. Groundwater flow directions are complex as they are dependent on the water levels in the ditches (which are controlled by the pump stations) and the water levels in the ocean relative to the water table elevation in the soil.

Within the upland portions of the Study Area, the steep slopes of the Tsawwassen Bluffs are subject to a slow process of sloughing and slope regression that is expected to continue. Groundwater seepage discharge is common on the slopes at and near the slope toe of the escarpment. This contact and seepage discharge forms the initiation zones of active shallow debris slides.

A limited water and sediment quality sampling program was conducted as part of the IRMP. Measured levels of dissolved oxygen and total suspended solids suggest that these parameters are limiting factors for fish in local ditches. There were exceedances for some chemical and bacteriological water quality samples, as well as exceedances for total organic carbon, metals, and hydrocarbon constituents in sediment samples.

Based on the inventory of existing systems in the Study Area, the key issues identified to consider in the IRMP are:

- Conveyance and Pumping
- Water Quality
- On-Lot Rainwater Retention
- Flood Protection

Stage 2 – What does TFN want?

TFN's location, the surrounding natural environment, and the community's connection to the land and the ocean all lend themselves to the opportunity to showcase sustainable and innovative approaches to rainwater management. Through discussions with TFN Staff, Council and Community Members, a Vision for Integrated Rainwater Management on TFN lands has been developed:

Tsawwassen First Nation's (TFN) approach to Rainwater Management supports and promotes the balanced growth of the community in a way that positively contributes to the overall health of the surrounding environment. Rainwater is viewed as a resource, and development capitalizes on the opportunities to implement innovative Rainwater Management techniques while providing effective drainage service that does not impede the use and enjoyment of adjacent lands by others.

The collective Rainwater Management system allows the surrounding environment to thrive, supporting wildlife, aquatic species, and vegetation by providing habitat, food and migration routes. TFN's historic connection to the land and the sea is reflected through the proliferation of naturalized drainage systems throughout the community. Aside from their intended functions, these systems also act to educate and inform community members of the importance of Rainwater to humans and the natural environment. TFN is proud of the example that the community has set towards Rainwater Management.

This vision is supported by several goals and objectives related to rainwater management, environment, geotechnical, planning and land use, and landscape.

Stage 3 – How does TFN put the IRMP into action?

The IRMP assessed the hydrological characteristics of TFN lands and the overall Study Area, along with the hydraulic performance of the drainage infrastructure that services those lands under existing and future land use conditions. Various scenarios have been assessed their ability to adequately service the TFN community and maintain a comparable level of drainage service (as compared to existing

development conditions) to the overall Study Area. Climate change (sea level rise, rainfall pattern distribution changes) and land subsidence has been considered as part of the future servicing analyses.

The recommended servicing approach (Figure ES.1) to support future growth and development on TFN lands and the overall Study Area consists of the following:

- Increase total capacity of Brandrith Drainage Pump Station from 2.8 m³/s to 5.2 m³/s (plus existing jockey) by retrofitting the existing station
- Construct a new drainage pump station for the TFN Industrial Lands with a pumping capacity of 2.5 m³/s
- Upgrade several culverts along the 48th Street and 52nd Street drainage channels to increase conveyance capacity
- Provide 300mm depth of amended topsoil in all pervious areas within new development (both private and public areas)
- Disconnect impervious areas to the greatest extent possible (e.g., discharge roof downspouts to splash pads for single family and multi-family residential development, grade sites to drain impervious areas to pervious areas)
- Maximize opportunities to decrease impervious surfaces (e.g., reduce road widths and parking areas, use porous paving materials for driveways, patios, parking pads, on-street parking areas, etc.)
- Review opportunities to retain rainwater runoff generated by impervious surfaces through the use of rainwater management features (RMFs) including rain gardens, vegetated bioswales, rainwater harvesting techniques, etc.

Cost estimates for recommended drainage infrastructure, summarized in Table E.2 below, are representative of Class D cost estimates and include 35% contingency and 12% engineering, but exclude GST.

Table E.2: Recommended Drainage Infrastructure – Construction Cost Estimates

| ITEM | TOTAL |
|---|--------------|
| Retrofit Brandrith Drainage Pump Station for 5.2m ³ /s capacity | \$ 1,259,000 |
| TFN Industrial Lands Drainage Pump Station (2.5 m ³ /s capacity) | \$ 2,498,000 |
| CI01: Provide drainage connection across Highway 17A (allowance) | \$500,000 |
| CU01: Upgrade existing 600mm to 900mm HDPE Culvert | \$ 56,000 |
| CU02: Upgrade existing 600mm to 900mm HDPE Culvert | \$ 47,000 |
| CU03: Upgrade existing 600mm to 900mm HDPE Culvert | \$ 47,000 |
| CU04: Upgrade existing 600mm to 900mm HDPE Culvert | \$ 50,000 |
| CU05: Upgrade existing 600mm to 1050mm HDPE Culvert | \$ 46,000 |



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Legend

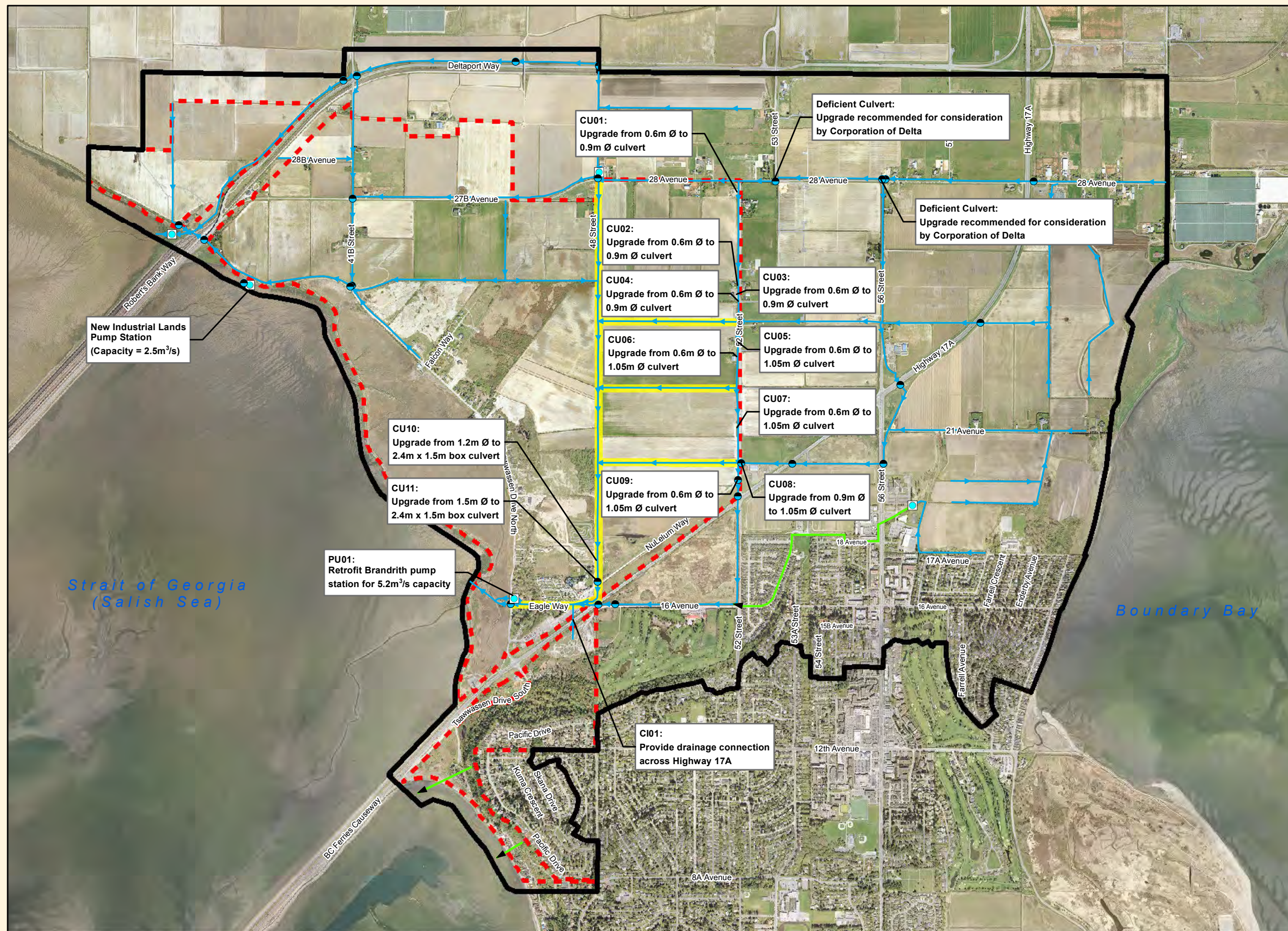
- Modeled Culverts
- Modeled Pump Stations
- Modeled Ditch Network
- Modeled Pipe Network
- Watercourses identified within the Drainage and Irrigation Services Agreement
- Tsawwassen First Nation (TFN) lands
- IRMP Study Area

Note: Orthophoto on west half of figure was taken on July 31, 2013.
Orthophoto on east half of figure was taken in 2008.

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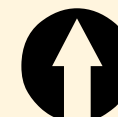
Integrated Rainwater Management Plan Recommended Drainage Infrastructure Improvements

Figure ES.1



THE ACCURACY & COMPLETENESS OF INFORMATION SHOWN ON THIS DRAWING IS NOT GUARANTEED. IT WILL BE THE RESPONSIBILITY OF THE USER OF THE INFORMATION SHOWN ON THIS DRAWING TO LOCATE & ESTABLISH THE PRECISE LOCATION OF ALL EXISTING INFORMATION WHETHER SHOWN OR NOT.

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Meters



| ITEM | TOTAL |
|--|---------------------|
| CU06: Upgrade existing 600mm to 1050mm HDPE Culvert | \$ 46,000 |
| CU07: Upgrade existing 600mm to 1050mm HDPE Culvert | \$ 50,000 |
| CU08: Upgrade existing 900mm to 1050mm HDPE Culvert | \$ 61,000 |
| CU09: Upgrade existing 600mm to 1050mm HDPE Culvert | \$ 102,000 |
| CU10: Upgrade existing 1200mm to 2.4m x 1.5m Box Culvert | \$ 132,000 |
| CU11: Upgrade existing 1500mm to 2.4m x 1.5m Box Culvert | \$ 147,000 |
| Subtotal | \$ 5,041,000 |
| 35% Contingency | \$ 1,764,000 |
| 12% Engineering | \$ 605,000 |
| TOTAL | \$ 7,410,000 |

Works could be funded through TFN's offsite levies (OSL) program, or through a future rainwater management utility, depending on the nature of the work, the benefitting area, and TFN's preference for cost recovery.

Three tiers of water quality treatment are recommended for future development:

- Basic Control – focuses on removal of total suspended solids (with associated pollutants that are attached to those sediments)
- Oil Control – focuses on removal of petroleum hydrocarbons
- Enhanced Control – focuses on removal of dissolved metals (e.g., copper and zinc)

The level of water quality treatment to be applied will depend on the proposed land use.

Future development at TFN also provides an opportunity to incorporate wildlife movement linkages into the landscape. Environmental enhancement efforts should focus on wildlife habitat improvements and linkages, which in turn should also improve habitat conditions for non-salmonid fish species that may be present in the ditch network. Developments should maintain aquatic habitat where feasible, with priority given to retention of Class A ditches. Compensation for habitat lost due to ditch infilling can best be achieved by designating specific areas for newly created habitat, and placing these within or adjacent to larger retained or managed habitat.

Opportunities to achieve multiple goals and objectives through shared spaces should be explored. In particular, applying a multi-functional corridor network approach to roadways (48th Street, local roads) and the proposed Great Blue Heron Way is encouraged. These spaces should strive to achieve drainage, environmental and landscape goals and objectives.

The IRMP also identifies a suite of regulatory amendments and additions to enhance TFN's support of integrated rainwater management. High priority regulatory amendments and additions are listed in Table E.3.

Table E.3: High Priority Regulatory Amendments and Additions

| RECOMMENDATIONS | |
|-----------------|---|
| 1. | Finalize the MMCD Design Guideline Manual and Construction Specifications – Supplementary Specifications document |
| 2. | Amend the Drainage and Sewer Regulation |
| 3. | Establish an Erosion and Sediment Control Regulation |
| 4. | Update the Capital Plan |
| 5. | Update the Offsite Levies Regulation |
| 6. | Amend the Landscape Guidelines |

With sea levels predicted to rise and land predicted to subside (sink) in the future, the current flood protection (dike) system will not be adequate to protect the TFN community in the long-term. Therefore, options to provide improved flood protection to the community should be explored. Building on the IRMP, TFN should undertake a flood protection study to review and assess the suitability of various alternatives for providing flood protection to the TFN community in the future. In-depth drainage studies for TFN's community lands and the Tsawwassen Bluffs area are also recommended to resolve specific drainage concerns with these areas.

Stage 4 – How does TFN ensure that the IRMP stays on target?

Performance indicators and targets are needed to evaluate proposed development schemes and to determine the level of success in achieving the IRMP goals and objectives. Primary performance indicators and targets are listed in Table E.4.

Table E.4: IRMP Performance Indicators and Targets

| PERFORMANCE INDICATOR | TARGET |
|----------------------------------|--|
| Frequency and Extent of Flooding | Not to exceed current levels |
| Water and Sediment Quality | Stabilize, or ideally improve, over current conditions |
| Open Channel Riparian Health | Minimum 80% survival rate of native (existing or planted) vegetation Minimize / remove invasive species within riparian zones |

The IRMP outlines a comprehensive monitoring program to assess the ability of future development to meet the IRMP vision, goals and objectives as works and programs are implemented. Precipitation, water levels, flow rates, water and sediment quality, riparian habitat, and intertidal and marine habitat condition monitoring are all recommended, along with annual assessments and reporting. Approximately \$150,000 is required to establish the monitoring programs and conduct an initial year's review. Approximately \$30,000 to \$40,000 per year is estimated to maintain the programs thereafter. This excludes TFN's internal costs associated with administration and records.

The IRMP also outlines an adaptive management framework to assist in identifying issues and outlining corrective actions should the monitoring program results indicate that IRMP goals and objectives are not being met.