WATER STREET ENGINEERING

Storm Sewer Master Plan

Village of Harrison Hot Springs

04 Dec 2025

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EXECUTIVE SUMMARY

Water Street Engineering Ltd. (Water Street) was retained by the Village of Harrison Hot Springs (the Village) to prepare a Storm Sewer Master Plan. The purpose of this plan is to assess the performance of the existing storm sewer system, identify current and future deficiencies, and establish a prioritized capital works program to support sustainable growth and stormwater management within the Village.

This plan builds on the 2016 Liquid Waste Management Plan (LWMP) and associated Autodesk Storm and Sanitary Analysis model. To update the storm sewer model, the previous model was imported into PCSWMM and updated to incorporate record drawings from recent developments, new survey data, and observed field conditions. The hydraulic network was expanded to include Miami Creek (more commonly known as Miami River) and key open-channel ditches to represent complete flow connectivity to Harrison Lake. Subcatchments were re-delineated using 2016 LiDAR data, and imperviousness was reassessed using 2023 aerial imagery and current zoning. Infiltration and other hydrologic parameters were assigned based on provincial soil classifications and established literature values.

Model calibration and validation were completed using flow monitoring data collected at three representative sites between February and June 2025. Calibration results demonstrated agreement between observed and modelled flows, confirming that the updated model provides a reliable basis for evaluating infrastructure capacity and informing design decisions.

Deficiency analysis was completed for existing and future (Year 2050) design storm scenarios. This analysis indicated many storm sewers do not meet the Village's current design criteria. However, the drainage system is still able to convey the design flows under surcharged conditions with minimal surface flooding. The most significant deficiencies noted were:

- The Miami River Dike Pump Station has observed inlet capacity concerns.
- The model indicates significant potential for surface flooding along Bear Ave.
- There is no drainage system on the east portion of Echo Ave, which is prone to flooding.
- McPherson Rd ditch is subject to backwater conditions from beaver activity west of Hot Springs Rd.
- There is limited water quality treatment within the Village, with approximately 29% of developed drainage areas discharging to Miami River or a tributary without any documented water quality treatment.

Based on the background review, input from Village staff, and the storm sewer model work, a capital works plan was developed. The Village is currently confirming access rights for storm sewers that were identified to be crossing private property.

There is one recommended "High" priority project; assessing the Miami River Dike Pump Station and outlet works to Harrison Lake based on observed capacity issues. The pump station function is critical to the performance of the storm sewer system. It is understood that this assessment is ongoing.

There are six recommended "Medium" priority projects:

1. Implementation of a surface flooding field verification program to confirm modelled capacity issues.
2. Implementation of a stormwater quality monitoring program to prioritize areas for treatment projects.
3. Completion of a storm sewer condition assessment to identify pipes that are at risk of failure.
4. Sewer upgrades to resolve capacity deficiencies along Bear Ave.
5. Installation of a new storm sewer on Echo Ave and restore outfall function for the Mount St system to address reported drainage issues.
6. Resolution of backwater conditions and inflow issues along McPherson Rd and McCombs Dr, including elimination of an inappropriate drainage connections from the East Sector Recreation Area.

There are two recommended "Low" priority projects:

1. Realignment of the storm sewer from Lillooet Ave that crosses private property at 565 Lillooet Ave.
2. Addition of a Hope Pl storm sewer to reduce local inflow and infiltration issues with the sanitary sewer.

In addition to the recommended projects, 18 conditional projects have been identified to resolve capacity deficiencies where the risk of damaging surface flooding is low based on model results. Six of the conditional projects have been identified for monitoring to verify any surface flooding during significant storm events. Potential triggers for the conditional projects include field verification of surface flooding issues, identification of water quality issues, and condition assessment data that indicates pipes are at risk of failure. An overview of the estimated costs for the identified projects is provided as follows:

Table 1: Projects Summary by Priority

Project Priority	Number of Projects	Total Capital Costs
High	1	$30,000
Medium	6	$1,146,000[1]
Low	2	$799,000
Conditional - Monitor	6	$4,792,000
Conditional - Assess	12	$5,654,000
Total		$12,421,000
Notes: [1]Excludes estimated cost of $50,000/yr for stormwater quality monitoring program.		

The identified capital projects are not triggered by growth. They are required to resolve existing system limitations and increased rainfall intensity associated with climate change. As such, they are not eligible for Development Cost Charge funding. The projects are recommended to reduce flood risk, improve stormwater quality, and enhance environmental protection or asset condition information and thus align with the objectives of provincial and federal grant programs that focus on disaster risk reduction, climate adaptation, and sustainable water infrastructure.

In addition to the identified capital projects, the following recommendations are made regarding urban drainage concerns:

1. Confirm access rights for storm pipes crossing 114 Cedar Ave, 830 Ramona Pl, 861 and 875 Myng Cr.
2. The Village's Subdivision and Development Servicing Bylaw should be updated to require consideration of climate change impacts.
3. An updated Emergency Response Plan should be developed that considers hazards from urban drainage and flooding. A project to provide a Drainage/Sewer Emergency Response Plan is identified in the Sanitary Sewer Master Plan (Water Street Engineering Ltd., 2025).

Overall, the updated modelling work, deficiency assessment, and capital works plan provides the Village with a clear framework for stormwater infrastructure investment and policy decisions. Implementation of the recommended improvements will reduce flooding risk, enhance water quality, and align the Village's infrastructure planning with its 2022 *Subdivision and Development Servicing Bylaw* and future climate-adaptation objectives.

1 INTRODUCTION

1.1 PURPOSE

Water Street Engineering Ltd. (Water Street) was retained by the Village of Harrison Hot Springs (the Village) to provide engineering services for the development of the Village's Storm Sewer Master Plan. The purpose of this Storm Sewer Master Plan is to create an updated plan for stormwater infrastructure improvements to meet future demands and resolve existing deficiencies. An overview of the storm sewer infrastructure is provided on Figure 1-1 attached.

1.2 SCOPE

The scope of the Storm Sewer Master Plan includes:

- Review of relevant background reports
- Updated assessment of stormwater infrastructure deficiencies based on updated modelling of existing condition with current rainfall data
- Updated assessment of future condition stormwater infrastructure requirements
- Recommendations for flow reduction and flow management
- Recommendations for infrastructure improvements to meet future demands
- Class D cost estimates for recommended improvements
- Prioritized recommendations for infrastructure improvements

1.3 PREVIOUS STUDIES

The storm system was previously assessed for the 2016 Liquid Waste Management Plan (LWMP) (CTQ Consultants Ltd., 2016). The 2016 LWMP built on a 2008 Storm Water Drainage Requirements Study completed by Civic Consultants (2008). The 2008 study included a Drainage Features Survey by Eaton Land Surveyors Ltd.

1.4 LIMITATIONS

This report is based on information received from the Village. It must be read with the Statement of Limitations at the beginning of this document.

The following data limitations affect the accuracy of the model and calculated results:

- **Assumption that Miami River and Harrison Lake water levels do not cause backwater conditions that could limit storm sewer performance. This assumption is further detailed in later sections of the report.**
- Potential inaccuracies and/or missing information from the GIS shapefiles and record drawings provided to update the model. This includes missing information on pipe materials and age of install for many sewers.
- Limited flow monitoring data was used for calibration. Flow monitoring at three strategic locations from Feb to Jun 2025 was used to calibrate the entire model as detailed in this report.
- Limitations on forecasting impacts of future development on stormwater runoff.
- Limitations on forecasting climate change impacts on rainfall.
- Limitations on available catch basin information such that inlet capacity was not modelled (full utilization of the sewer capacity was assumed).

Legend

Drainage Elements

- Creek System
- Ditch
- Storm Sewer
- Storages
- Outfalls
- Manholes, Storm Junctions

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

EGBC Permit to Practice #1000830

Storm Sewer Master Plan

PREPARED FOR

Village of Harrison Hot Springs

PROJECT NO. 456.2

DATE 04 DEC 2025

REVISION 0

Storm Infrastructure Overview

Figure 1-1

Document Path: D:\WSE Dropbox\001-Projects\456-Harrison Hot Springs Master Plans\430-GIS\data\MD_Storm Infrastructure\ArcMap Working Folder\Storm Infrastructure Overview.mxd

1.5 ACKNOWLEDGEMENTS

The project development, leadership, and review of interim deliverables was accomplished with the assistance of the following individuals.

- Village of Harrison Hot Springs
  - Director of Operations
  - Utilities Supervisor
  - Public Works Supervisor
- SFE Global (flow monitoring program)
  - Glenn Cumyn
  - Nicole Moen
  - Sam Cumyn
- Wedler Engineering
  - Jonathan Funk, PEng; Principal

In addition to the authors, the Water Street Engineering team included: Andrew Clow, PEng; Laura Christensen, PEng, Connor Dickson, EIT; and Jade Sangha, EIT.

We acknowledge ClimateData.ca for providing the climate information used. ClimateData.ca was created through a collaboration between the Pacific Climate Impacts Consortium (PCIC), Ouranos Inc., the Prairie Climate Centre (PCC), Environment and Climate Change Canada (ECCC), Centre de Recherche Informatique de Montréal (CRIM), and Habitat7.

2 EXISTING SYSTEM BACKGROUND

The existing storm sewer system primarily discharges to Miami Creek (more commonly known as Miami River) upstream of Harrison Lake. Drainage is conveyed to Miami River via a system of storm sewers, ditches, and culverts that has several discharge points distributed along the length of the creek.

2.1 EXISTING STORM SYSTEM MODEL

An Autodesk Storm and Sanitary Analysis storm system model was developed by CTQ Consultants Ltd. (CTQ) for the Village during the preparation of the 2016 LWMP. The existing model included a total catchment area of 105 ha. Areas where runoff flowed directly into Miami River, or a natural tributary, were not modelled. The model did not include leads from catch basins or stormwater management infrastructure in private developments. Downstream boundary conditions for pipe outlets were set to free flow conditions. Deficiencies that were identified during the 2016 review included pipes with reverse grades, undersized pipes, and lack of water quality treatment. This is further described in the following section.

2.2 EXISTING DEFICIENCIES (FROM 2016 LWMP)

The 2016 LWMP identified several deficiencies in the existing storm system. The 2016 deficiencies are summarized in Table 2-1.

Table 2-1: Existing Condition Deficiencies from 2016 LWMP

2016 ID	Location	Deficiency	Status
1, 8	Cedar Ave west of Hot Springs Rd	Negative slope, undersized pipe	No deficiency. Misidentified flow direction.
2	Maple St north of Lillooet Ave	No slope	Unresolved
3	Angus Estates	ROW registration on private properties	Location of new storm sewer. IFC Drawings indicate a ROW.
4	Various ditches	Ditch alterations by property owners	Unknown
5	Discharge locations	Treatment required	Select areas have treatment
6	Driftwood Ave	Clogged manhole	Unknown. Assumed to be resolved.
7	Pine Avenue	Vitrified clay pipe	Resolved. Upgraded in 2018.
9	Lillooet Ave west of Chehalis St	Undersized pipe	Modelled incorrectly. Resolved through record drawing.
10, 11	Lillooet Ave near Spruce St	Rock pits with no overflow	Resolved through new storm system for 470 Esplanade Ave
12	Echo Ave	Undersized pipe	Resolved. Updated survey confirmed adequate.
13	Hadway Dr	Undersized pipe	Unresolved
14, 15	Myng Cres	Undersized outfalls	Unresolved

2016 ID	Location	Deficiency	Status
16	Hot Springs Rd	Inadequate drainage system	The inadequate stormwater management system on Hot Springs Road (Highway 9), identified as deficiency 16 in the LWMP, is under the jurisdiction of the Ministry of Transportation and Transit (MOTT). Improvements to provide a proper drainage system are ongoing (autumn 2025) and will address drainage south of 750 Hot Springs Road.
17	McPherson Rd	Collapsed pipe section	Submerged due to backwater condition during site visit
18	McCombs Dr & McPherson Rd	Standing water / collapsed pipe	Unresolved. Negligible slope and backwater condition.
19	McCombs Dr	Collapsed pipe section	Resolved as part of 2019 Lift Station 3 upgrades

More generally, the LWMP noted there are significant areas that lack a storm sewer system and do not have adequate drainage. In some of these areas, storm services have been connected to the sanitary sewer system which impacts the conveyance and treatment capacity of the sanitary sewer system and the wastewater treatment plant (WWTP).

2.3 POTENTIAL DEFICIENCIES NOTED IN 2024 FIELD VISIT

Beyond deficiencies identified in the LWMP, the following additional deficiencies were identified during a Nov 2024 site visit by Water Street (David Marshall and Neal Whiteside) and through conversations with Village staff:

- There are conveyance capacity limitations with the box culvert that connects Miami River to the Harrison Lake pump intake (at the Miami River Dike Pump Station).
- There is no drainage system for the section of Echo Ave (east of Eagle St) leading to Mount St drainage system.
- Water ponds at Lillooet Ave near Eagle St. It is understood that regrading as part of ongoing paving work (autumn 2025) may resolve this issue.
- A catch basin on McCombs Dr (approximately 100 m north of McPherson Rd) is elevated and should be levelled or lowered to improve drainage capture.
- There is inflow to the McCombs Dr storm sewer from the East Sector Recreation Area. This area should be draining away from the Village's storm sewer system.
- There was a significant backwater condition in the McPherson Rd ditch extending upstream of the Hot Springs Rd culvert crossing.
- Considerable surface runoff from 872 Hot Springs Rd drains to 880 Hot Springs Rd. The homeowners at 880 Hot Springs Rd have built an onsite storm detention pond and pump the stormwater out to the highway. It is understood that a new storm connection has been added to this property as part of drainage upgrades along Hot Springs Rd.

2.4 RECENT DEVELOPMENTS

Subsequent to the development of the 2016 LWMP, the following developments have occurred:

- Harrison Lake View
- 470 Esplanade Ave (Oasis at Harrison Lake)
- Pine Ave Subdivision
- 750 Hot Springs Rd
- 775 Hot Springs Rd
- 798 Hot Springs Rd

The following infrastructure improvements have also occurred:

- Pine Ave, Emerald Ave, and Myng Cr Neighbourhood Upgrades
- Lift Station 3 drainage improvements

Additionally, the following infrastructure improvements are in the process of being constructed or have been constructed in 2025:

- Hot Springs Rd (Highway 9) drainage improvements (from north of Emerald Ave south to Miami River)
- McCombs Dr drainage improvements (from Hot Springs Rd south of Emerald Ave to the McCombs Dr ditch and Miami River)

3 EXISTING CONDITION MODEL UPDATES

3.1 SOFTWARE SELECTION

The existing storm system model from the 2016 LWMP was developed in Autodesk Storm and Sanitary Analysis. To update the 2016 model, the model was exported in EPA SWMM format for modelling in PCSWMM. PCSWMM was selected for its compatibility with the original model format, proven performance and regulatory acceptance in urban drainage modelling, dual drainage network capabilities, and its stand-alone GIS engine that enables efficient model updates and results analysis.

3.2 MODEL SETUP

EPA SWMM software allows for the selection of a range of simulation options to characterize flow and runoff. The following modelling methodologies have been selected for the updated PCSWMM model:

- Routing method: Dynamic Wave
    - This is the same methodology as used in the 2016 model and is typically used for urban storm networks. The dynamic wave method allows for more complex system hydraulics, such as backwater effects and surcharging, to be modelled.
- Infiltration method: Green-Ampt
    - Green-Ampt was selected over Horton (used in the 2016 model) because its physically based approach offers more accurate infiltration estimates for event-based urban runoff modelling than Horton's empirical method which requires more field data and responds less effectively to varying rainfall intensity.

3.3 HYDRAULIC NETWORK UPDATES

As a starting point for the model updates, the hydraulic network was verified and updated with infrastructure from recent developments. The existing model lacked documentation on data sources, which limited confidence in reliability. Therefore, data for the existing junctions and conduits in the model was cross-checked with available record or design drawings and available survey information. For each junction and conduit, information about the asset type, condition, dimensions, data sources, and assumptions were recorded. Through this process, several inaccuracies in the 2016 modelling were identified and corrected. Significant changes included addition of the Mount St drainage infrastructure and the Harrisburgh and Emerald Gate Estates development drainage infrastructure. For the recent developments listed in Section 2.3, the associated infrastructure was also added to the model.

To improve model connectivity and comprehensiveness, open channel ditches and Miami River were added to the hydraulic network. Miami River was modelled in PCSWMM as a series of conduits between the outlet nodes from the storm sewer network. The Miami River channel geometry was derived from a Digital Elevation Model (DEM) available from the Forests, Lands, and Natural Resource Operations and Rural Development, GeoBC project NDMP 2016 which included LiDAR data acquisition between June and September 2016. The data indicates that that water level at the downstream limit of Miami River was approximately 10.5 m when the LiDAR was collected. The Miami River channel inverts and slopes were assigned based on survey points collected at mid-channel from select bridge crossings.

After finalizing the base hydraulics for the model, a dual drainage system was added to the storm sewer conduits to convey major system flows that exceed the capacity of the storm sewer. The dual drainage system is a simplified representation of the roadway above the storm sewer. The model assumes that all surface runoff enters the storm sewer network and overflows into the dual drainage network if the pipe capacity is exceeded. This assumption does not account for potential inlet capacity restrictions that would limit the effectiveness of the storm sewers (assumes the collection system has higher capacity than the storm sewer).

Following the model updates, the total number of nodes was increased from 175 in the 2016 model to 261 in the updated model and the total number of conduits was increased from 161 to 256 (not including the overland drainage system above the pipes). By adding Miami River to the model, the number of outfalls

was decreased. The ultimate outfalls for the updated model are Harrison Lake, the undeveloped area west of the Village that connects to the Miami Slough, and the west end of the ditch on McPherson Rd.

3.4 HYDRAULIC NETWORK PARAMETERIZATION

Roughness coefficients are used to quantify the major energy losses due to friction along the drainage network. For the updated model, a Manning's roughness coefficient of 0.013 was assigned to all concrete and PVC pipes[1], 0.024 was assigned to corrugated metal pipes, 0.05 was assigned to roadway ditches and Miami River. The assigned Manning's roughness coefficients were selected based on typical published values and are similar to the Village's *Subdivision and Development Servicing Bylaw No. 1179* (Village of Harrison Hot Springs, 2022).

Loss coefficients are applied at manhole directional changes, culvert inlets, and culvert or storm sewer outlets to account for minor losses in the system. An entrance loss coefficient of 0.50 has been assigned to culvert inlets and an exit loss coefficient of 1.00 has been assigned to culvert or storm sewer outlets based on typical published values. Losses due to directional changes at manholes have been assigned based on design guidance in the Mile High Flood District's 2024 *Urban Storm Drainage Criteria Manual: Volume 1 – Management, Hydrology, and Hydraulics* as summarized in Table 3-1. It is generally assumed that manholes do not have benching (higher losses are assumed).

Table 3-1: Manhole Bend Loss Coefficients (Mile High Flood District, 2024)

Angle in Degree	Loss Coefficient (No Benching)	Loss Coefficient (With Benching)
0 - 5	0.05	0.05
5 - 22.5	0.13	0.10
22.5 - 30	0.20	0.15
30 - 45	0.38	0.28
45 - 60	0.63	0.48
60 - 70	0.85	0.63
70 - 80	1.08	0.82
80 +	1.32	1.01

3.5 SUBCATCHMENT DELINEATION

The subcatchments in the 2016 model were generally delineated based on property boundaries. Upon closer inspection of subcatchments and the private development stormwater management plans, various inaccuracies in the subcatchment delineation were identified. To take advantage of improved topographic data and to address issues in the 2016 model, an updated subcatchment delineation was completed using PCSWMM's delineation tool and the DEM from 2016 LiDAR data. Delineating catchments in urban areas is more difficult because of the surface features and underground infrastructure that impact overland flow directions. To limit inaccuracies from automated delineation, the following process was used.

1. PCSWMM's watershed delineation tool was used to define catchment boundaries for outlets to creeks or ditches based on the DEM from 2016 LiDAR.
2. Catchments that did not contribute to the Village's storm infrastructure were generally eliminated from the model.
3. The major catchment boundaries (delineated to outlets to creeks or ditches) were verified with reference to the previous delineation, topographic data, record drawings, and lot parcel data.

[1] 2016 LWMP used n=0.011, typical textbook values for materials, are PVC 0.009-0.010, AC 0.010-0.011, Concrete 0.011 - 0.013, CMP 0.022 - 0.030.

4. Major catchments were manually subdivided into minor subcatchments for each manhole or other drainage node based on the previous delineation, topographic data, record drawings, and lot parcel data.

With the updated delineation, the total modelled subcatchment area in the developed area was slightly increased from 105 ha to 111 ha. Based on refined modelling of the sewer and ditch systems in the northwest portion of the model (Mount St) and the southern portion of the model (McPherson Rd), 119 ha of external subcatchments were added to the model.

3.6 SUBCATCHMENT PARAMETERIZATION

In the 2016 LWMP model, the imperviousness for each subcatchment was characterized based on land use as presented in Table 3-2. In some cases, an area-weighted value was used where subcatchments had multiple land use types. The 2016 model assumed that all impervious area and all pervious area was routed directly to the catchment outlet with no subarea routing (i.e. no impervious area drains across any grassed area before connecting to the storm sewer).

Table 3-2: Land Use Impervious Coefficients (CTQ Consultants Ltd., 2016)

Land Use	% Impervious
Commercial / Industrial	80
Multi Family	60
Subdivision	40
Natural Environment	2

To improve the assigned imperviousness values, 2023 aerial imagery was used to determine more appropriate values for imperviousness and subarea routing. Similar to the methodology for the 2016 LWMP, the Zoning land use was used as a basis for assigning imperviousness values. The Zoning land use was converted into an imperviousness shapefile with the base impervious values summarized in Table 3-2. A percent routed field was added to the shapefile to represent the percentage of impervious area that is routed over pervious areas before contributing to the storm sewer system. Based on input from the Village, it was assumed that most roof drainage in older areas of the Village had a direct connection to the storm sewer. After assigning base imperviousness and percent routed values to the shapefile, it was overlaid on the 2023 aerial imagery to assess the appropriateness of the assigned values. Spot checks of areas with consistent land use were completed to calculate actual imperviousness values based on area measurements of the impervious and pervious areas within a sample area. Appropriate percent routed values were assigned based on engineering judgement of the aerial imagery. Recognizing that many buildings in the Village have roof leaders directly connected to the sewer system, the percentage of impervious area routed to pervious surfaces was generally assumed to be low. Detailed review showed that several residential areas were developed at a higher imperviousness than the base land use assumptions. After finalizing the imperviousness and percent routed shapefile, this shapefile was used to apply area-weighted imperviousness and percent routed parameters to each subcatchment.

For the pervious area, the infiltration characteristics were assigned based on soil information. A soils shapefile was sourced from the BC Soil Information Finder Tool (Provincial Soils Working Group, BC Ministry of Environment and Climate Change Strategy and Ministry of Agriculture, 2018). The information relevant to the study area is from the 1962 *Soil Map of Chilliwack Area* (Comar, 1962). The soils shapefile included several shapes that encompass the study area. Appropriate Suction Head, Hydraulic Conductivity, and Initial Deficit values were assigned according to the values summarized in Table 3-3. The soils shapefile was then used to apply area-weighted infiltration parameters to each subcatchment.

Table 3-3: Green-Ampt Infiltration Parameters (Rawls, 1982)

Soil Texture Class	Hydraulic Conductivity (mm/hr)	Suction Head (mm)	Initial Deficit
Sand	120.34	49.02	0.413
Loamy Sand	29.97	60.96	0.39
Sandy Loam	10.92	109.98	0.368
Loam	3.3	88.9	0.347
Silt Loam	6.6	169.93	0.366
Sandy Clay Loam	1.52	219.96	0.262
Clay Loam	1.02	210.06	0.277
Silty Clay Loam	1.02	270	0.261
Sandy Clay	0.51	240.03	0.209
Silty Clay	0.51	290.07	0.228
Clay	0.25	320.04	0.21

The flow length and slope for each subcatchment was assigned based on the DEM from 2016 LiDAR by drawing flow paths for each subcatchment. Other hydrologic parameters were assigned based on typical published values as summarized in Table 3-4.

Table 3-4: Miscellaneous Hydrologic Parameters

Parameter	Value
Manning's roughness coefficient - impervious	0.018
Manning's roughness coefficient - lawns	0.15
Manning's roughness coefficient - fields	0.20
Manning's roughness coefficient - brush	0.40
Depression storage - impervious	2 mm
Depression storage - pervious	5 mm
Impervious Area with no depression storage	25%

3.7 STORMWATER CONTROLS

Currently the Village does not have any regional stormwater controls. Based on the proximity of Miami River to the storm sewer system, the contributing drainage areas to the storm sewer upstream of Miami River are generally modest. There is limited information about lot level stormwater controls, and it is generally assumed that there are no runoff controls. Stormwater controls that were added to the model based on available information include:

- The underground storage tank for the Oasis at Harrison Lake condo development (470 Esplanade Ave) was modelled with a storage node and outlet orifices.
- The soak away trenches for the private developments at 750, 775, and 798 Hot Springs Road were modelled as infiltration trench LIDs based on information from the record drawings.
- Storage nodes representing rock pits (dry wells) were maintained from the 2016 LWMP model for the drainage areas along Hot Springs Road. The storage nodes for the dry wells on Lillooet Rd

near 470 Esplanade Ave were removed based on servicing drawings for the Oasis at Harrison Lake condo development.

3.8 BOUNDARY CONDITIONS

Most of the storm sewer network in the Village directs water to Miami River which flows north and discharges to Harrison Lake. Miami River typically outlets to Harrison Lake by gravity via two box culverts. During high lake levels, flood gates on the box culverts close and Miami River is pumped over the Harrison Lake Dike into the lake.

The Miami River Dike Pump Station Replacement project was completed in 2016 to replace the aging pump station and improve flood construction. The upgraded station has twin screw pumps that each have a design capacity of 3.0 m^3/s (with 3 m of head) to meet hydraulic objectives through a range of flow and lake level scenarios. The second pump provides redundancy and additional emergency capacity.

As outlined in the 2014 *Miami Creek Pump Station Hydrologic Assessment* (Northwest Hydraulic Consultants Ltd., 2014), a maximum water elevation of 12.0 m was targeted for the 200-year design event (joint probability of flow and lake level) based on the surveyed top of banks and key elevations for local infrastructure. A flood elevation of 12.0 m would result in some flooding of Harrison Hot Springs Resort. When the gates are closed and the box culverts are not functioning, the single pump capacity can keep the water elevation below 12.0 m for a 10-year summer flood event and two pumps can keep the water elevation below 12.0 m for a 20-year summer flood event. A pumping capacity exceeding 10 m^3/s is required to safely convey flows associated with larger Miami River flood events, such as the 100-year summer flow or the 10-year winter flow.

To assess the storm sewer system, minimal backwater impacts from Harrison Lake and Miami River are assumed. Based on information presented in the *Miami Creek Pump Station Hydrologic Assessment*, the lake level was set to a typical value for October through April (9.5 m) and Miami River was set to convey a modest peak flow representative of a 10-year summer storm or a modest winter storm (6.3 m^3/s). See Section 6.6 for discussion of performance with higher backwater levels.

It is noted that there is potential for boundary conditions to have a significant impact on the storm system. During the Nov 2024 site visit, the Miami River level was at 9.9 m and the pumps were set to turn on at 11.0 m and turn off at 10.8 m. It is reasonable to expect Miami River levels to be above 11.0 m at the lake with higher water levels expected further upstream. Recent monitoring at Harrison Lake (Environment Canada, Oct 2025) indicates maximum yearly values of:

- 2021: 12.27 m (2 Jul 2021)
- 2022: 12.09 m (5 Jul 2022)
- 2023: 12.00 m (22 May 2023)
- 2024: 11.13 m (2 Feb 2024)

While extreme maximum values typically occur during the freshet period (late May to early July), a peak winter value of 12.04 m was recently recorded on 16 Nov 2021.

The Miami River Dike Pump Station is essential for the storm system to function effectively when the Harrison Lake water level is high.

4 MODEL CALIBRATION AND VALIDATION

4.1 MONITORING

To improve confidence in the existing conditions model that will be used to assess the storm sewer infrastructure, a monitoring program was completed to allow for model calibration and validation. The Village's drainage system is composed of several small storm sewer networks that outlet to Miami River at different locations. This makes it challenging to select monitoring locations that encompass large areas of the Village. Several candidate sites were reviewed before selecting three representative locations for the monitoring program. A rain gauge was installed at one of the monitoring sites. The monitoring began in late February and continued through early June. The selected monitoring locations are summarized in Table 4-1. The base imperviousness represents the pre-calibrated values based on the methodology described in Section 3.6.

Table 4-1: Selected Monitoring Locations

Site	Model ID	Location	Drainage Area (ha)	Base Imperviousness (%)
1	J074	Manhole east of Lift Station 3 along McCombs Dr	20.78	35%
2	J021	Miami River outfall west of Hot Springs Rd	6.49	89%
3	J058	Miami River outfall east of Walnut Ave	7.55	45%

Storm Site 1 includes a significant undeveloped area east of McCombs Drive. This undeveloped area is 7.78 ha and is largely forested. The developed area is 13 ha with ~55% impervious area. The other sites have more uniform development characteristics.

As shown in Figure 4-1, during the monitoring period, the Harrison Lake levels (Environment Canada, Oct 2025) were within normal range (between 8.5 and 10.0 m), hence storm sewers were not backwatered.

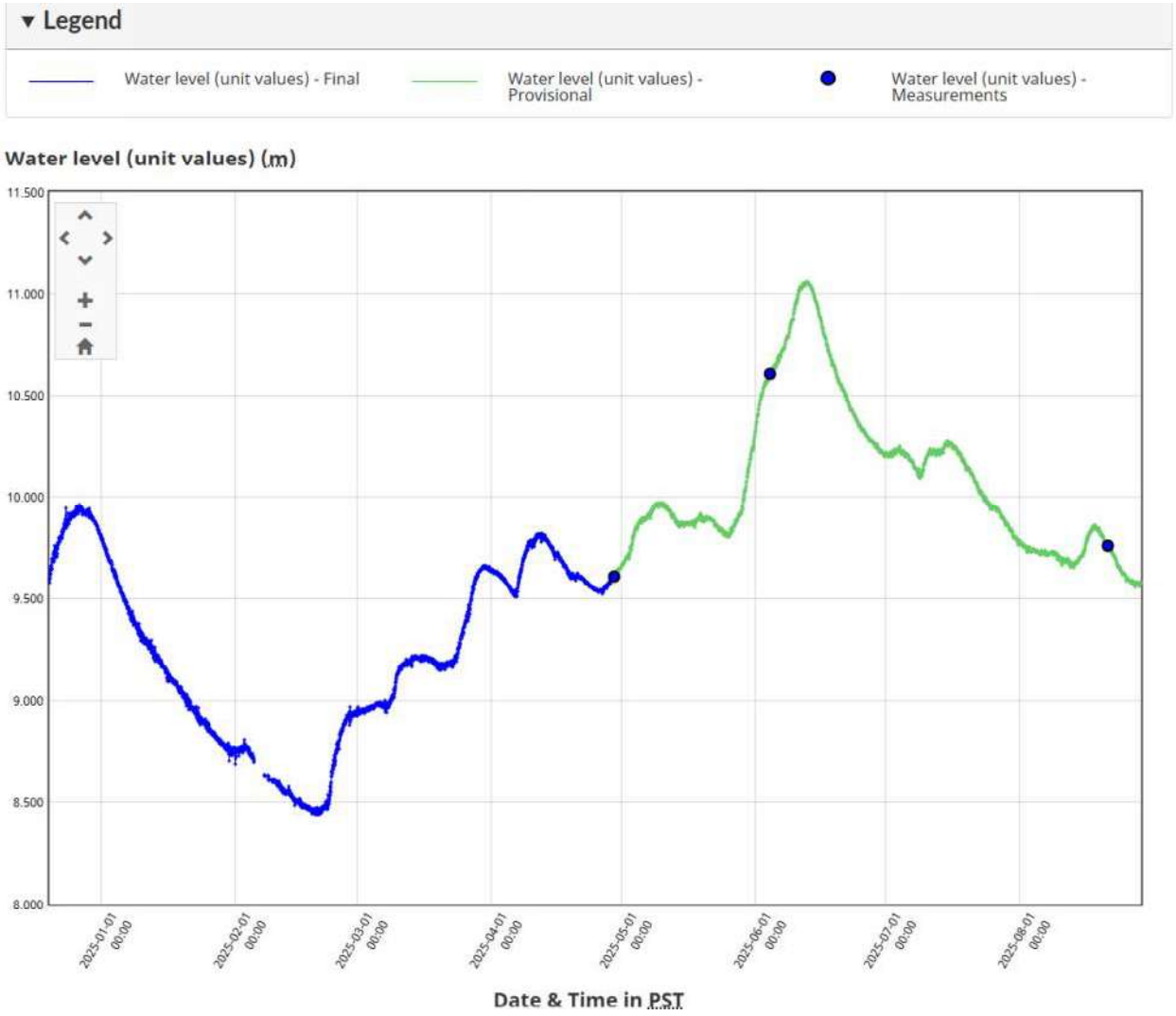


Figure 4-1: 2025 Real-Time Hydrometric Data Graph for Harrison Lake Near Harrison Hot Springs - 08MG012 (Environment Canada, Oct 2025)

4.2 CALIBRATION COMPARISON

The February 2025 model results for Harrison Hot Springs overpredicted storm sewer flows relative to observed data. Although temperatures remained near or above freezing and no snow accumulation was recorded, soil conditions were likely dry following a cold start to the month. These antecedent conditions likely reduced effective runoff. In contrast, model performance improved significantly in March when rainfall events were larger, more frequent, and coincided with saturated ground conditions, suggesting the model is well-calibrated for wet-season response but may overpredict runoff for dry or transitional periods.

Based on the discrepancy in results, March was used as the targeted calibration period, when higher runoff was observed. During the calibration period, five significant events were examined. As summarized in Table 4-2 below, no extreme rainfall events occurred during the calibration period, but each of the calibration events is substantial (typically 25% - 50% of 2-year return period volumes).

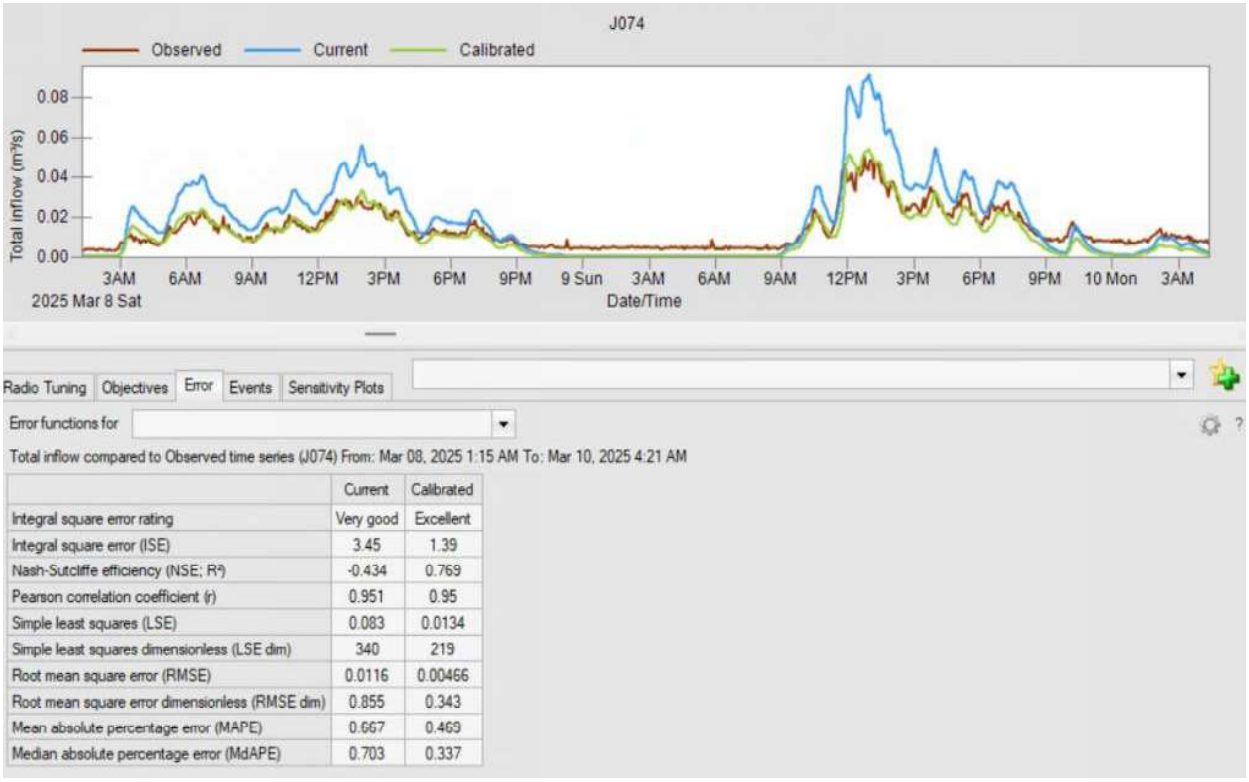
Table 4-2: Calibration Events

Event	Duration	Volume percentage of 2-year return period volume		
		Peak hour	Peak 6 hours	Peak 24 hours
1	March 8 at 03:00 - March 9 at 20:00	~40%	~50%	~40%
2	March 12 at 23:25 - March 13 at 20:00	~30%	~30%	~25%
3	March 19 at 23:15 - March 21 at 02:30	~30%	~25%	~30%
4	March 21 at 11:10 - March 21 at 23:00	~30%	~25%	~30%
5	March 23 at 00:30 - March 25 at 02:00	~50%	~60%	~85%

The calibration process used several PCSWMM tools, including the sensitivity analysis module, graphical hydrograph comparisons, and automated error statistics reporting. Sensitivity analysis results helped identify which input parameters had the greatest influence on peak inflows at each monitored node. Through this analysis, imperviousness, routing of impervious area to pervious surfaces, and subcatchment length were consistently ranked as the most impactful parameters across the sites.

After determining parameter sensitivity, PCSWMM's event-based calibration interface was used to isolate the calibration events and visualize the impact of parameter changes. Calibration performance was assessed using a range of statistical metrics available in PCSWMM, including Nash–Sutcliffe Efficiency (NSE), Integral Square Error (ISE), and Pearson correlation coefficient (r). Peak flow magnitude and timing were assessed manually. For the base condition, most events achieved "very good" to "excellent" agreement with observed data according to the calculated ISE value, with modelled peak timing and shape closely aligning with the monitored hydrograph. However, opportunities for improvements were identified.

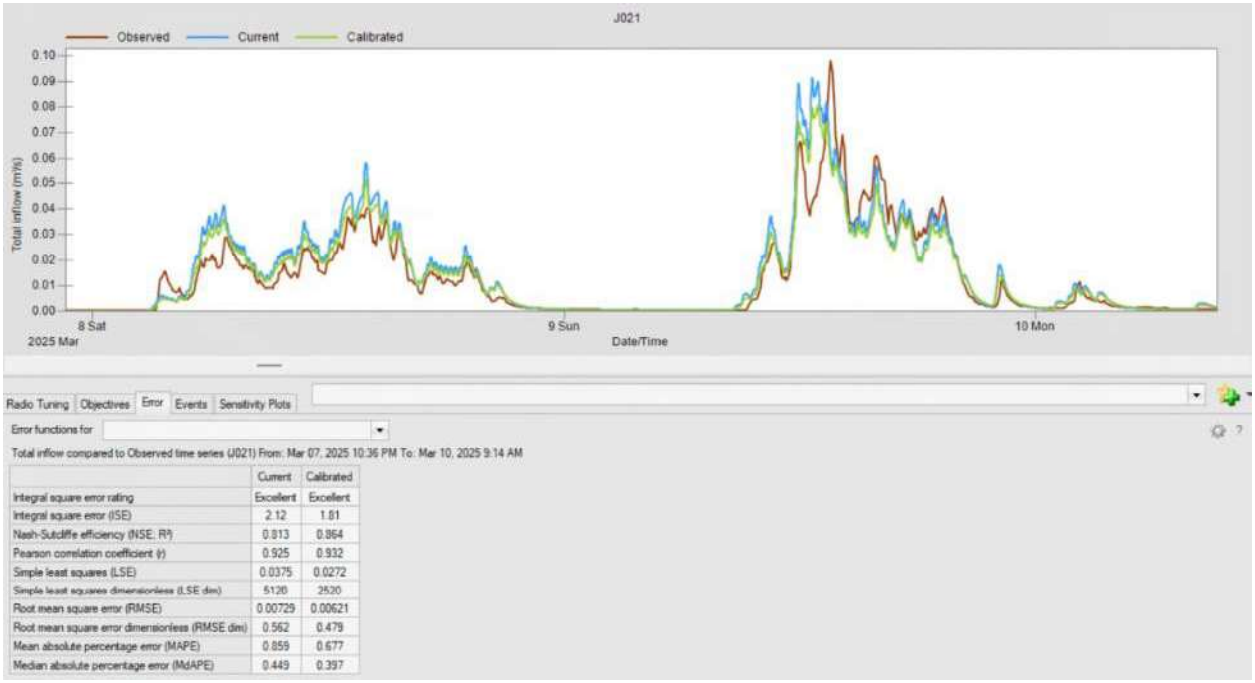
For Storm Site 1, which captures drainage from conventional single-family lots, higher density townhouse lots, and undeveloped area south of Miami River Drive, the monitoring results indicated that peak flows were over predicted. The calibration results for Event #1 are shown in Figure 4-2 below (note that the time series with the label "Current" is the uncalibrated flow hydrograph). To better match the monitored flow data, the impervious values were re-evaluated and reduced based on area-specific measurements from the 2023 aerial imagery. The routing of impervious area to pervious surfaces was also significantly increased. These changes notably improved the event-specific error metrics across the calibration events.



	Current	Calibrated
Integral square error rating	Very good	Excellent
Integral square error (ISE)	3.45	1.39
Nash-Sutcliffe efficiency (NSE; R^2)	-0.434	0.769
Pearson correlation coefficient (r)	0.951	0.95
Simple least squares (LSE)	0.083	0.0134
Simple least squares dimensionless (LSE dim)	340	219
Root mean square error (RMSE)	0.0116	0.00466
Root mean square error dimensionless (RMSE dim)	0.855	0.343
Mean absolute percentage error (MAPE)	0.667	0.469
Median absolute percentage error (MdAPE)	0.703	0.337

Figure 4-2: Storm Site 1 Calibration for Event #1

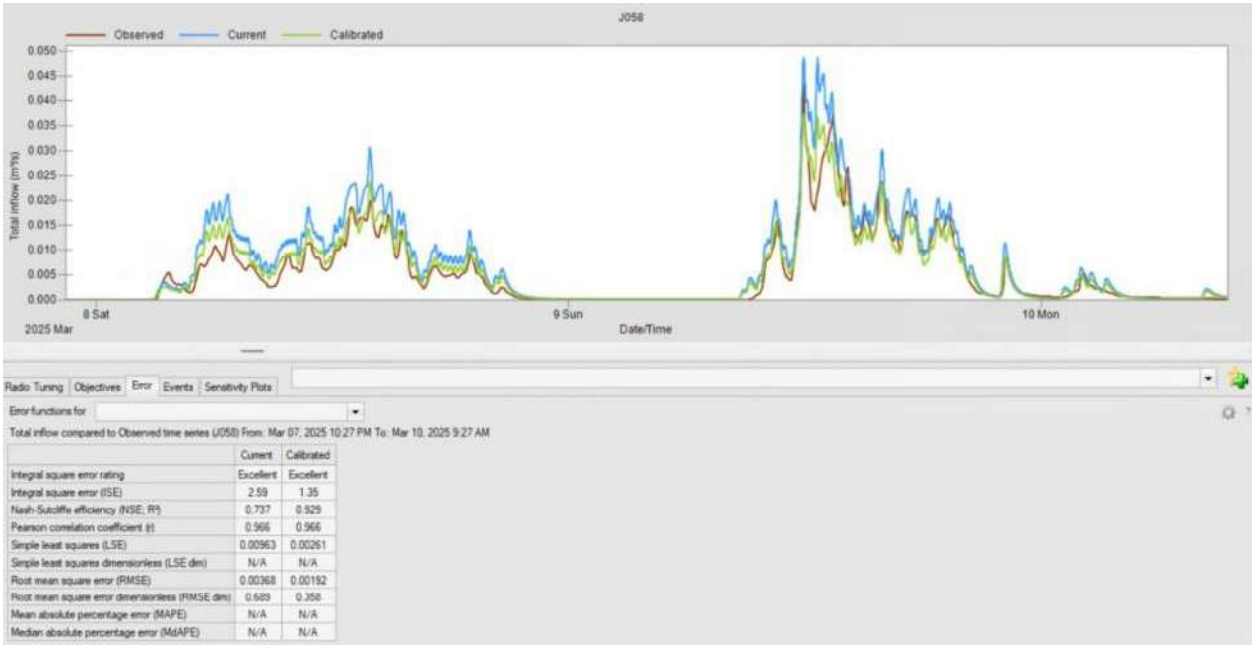
For Storm Site 2, which captures the highly impervious commercial drainage area in the northwest corner of the Village, the monitoring results indicated that peak flows were slightly over predicted. To better match the monitored flow data, the drainage area was modified to add 10% routing of impervious area to pervious surfaces (from an initial value of 0%). These changes yielded modest improvements to event-specific metrics, which were already good. The calibration results for Event #1 are shown in Figure 4-3 below.



	Current	Calibrated
Integral square error rating	Excellent	Excellent
Integral square error (ISE)	2.12	1.81
Nash-Sutcliffe efficiency (NSE, R^2)	0.913	0.864
Pearson correlation coefficient (r)	0.925	0.932
Simple least squares (LSE)	0.0375	0.0272
Simple least squares dimensionless (LSE dim)	5126	2520
Root mean square error (RMSE)	0.00729	0.00621
Root mean square error dimensionless (RMSE dim)	0.562	0.479
Mean absolute percentage error (MAPE)	0.859	0.677
Median absolute percentage error (MdAPE)	0.449	0.397

Figure 4-3: Storm Site 2 Calibration for Event #1

For Storm Site 3, which captures drainage from conventional single-family lots and Harrison Hot Springs Elementary School, the monitoring results indicated that peak flows were slightly over predicted. The calibration results for Event #1 are shown in Figure 4-4 below. To better match the monitored flow data, the impervious values were slightly reduced and routing of impervious area to pervious surfaces was modestly increased (from a typical value of 10% to 20%). Similar to Storm Site 2, these changes resulted in modest improvements to the event-specific error metrics.



	Current	Calibrated
Integral square error rating	Excellent	Excellent
Integral square error (ISE)	2.59	1.35
Nash-Sutcliffe efficiency (NSE, R^2)	0.737	0.929
Pearson correlation coefficient (r)	0.966	0.966
Simple least squares (LSE)	0.00963	0.00261
Simple least squares dimensionless (LSE dim)	N/A	N/A
Root mean square error (RMSE)	0.00368	0.00192
Root mean square error dimensionless (RMSE dim)	0.689	0.358
Mean absolute percentage error (MAPE)	N/A	N/A
Median absolute percentage error (MdAPE)	N/A	N/A

Figure 4-4: Storm Site 3 Calibration for Event #1

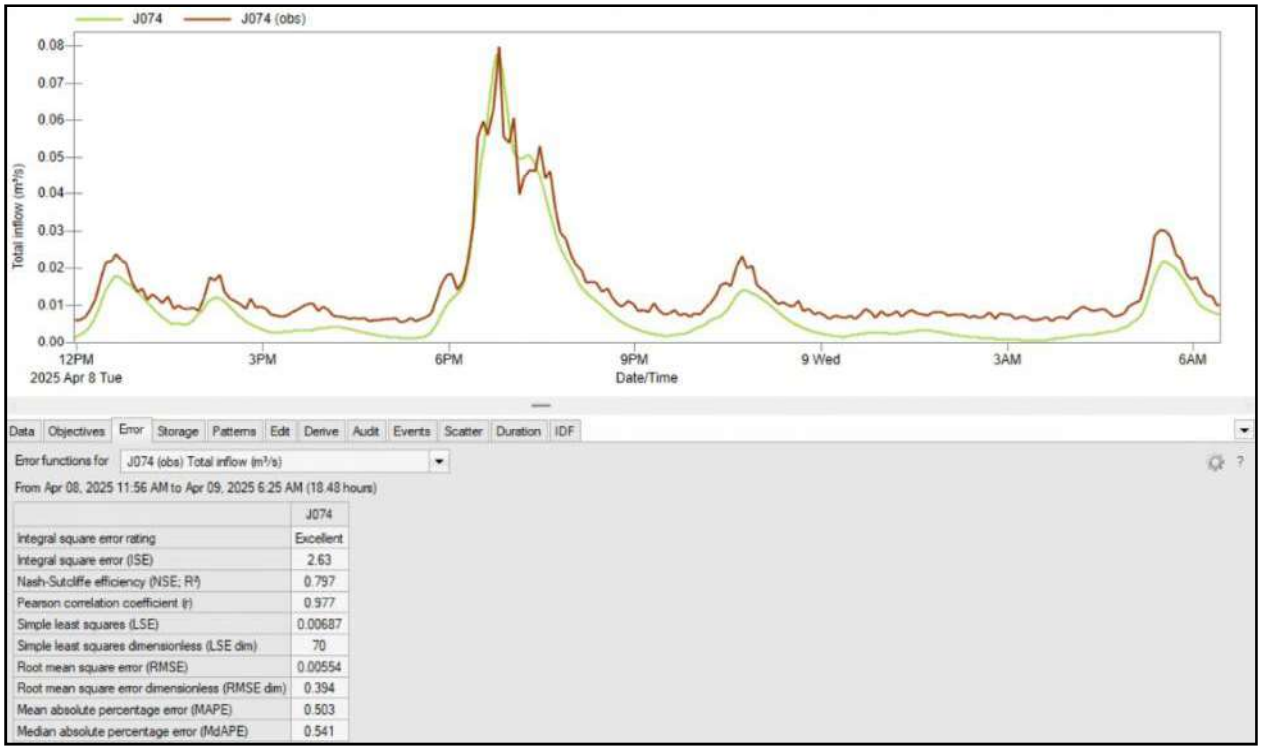
4.3 VALIDATION

After completing the calibration model adjustments, results of calibration were validated for significant rainfall events from April through June. During this period, five significant events were examined. Similar to the calibration events, the validation events were significant, but not extreme rainfall events. The validation events are summarized in Table 4-3.

Table 4-3: Validation Events

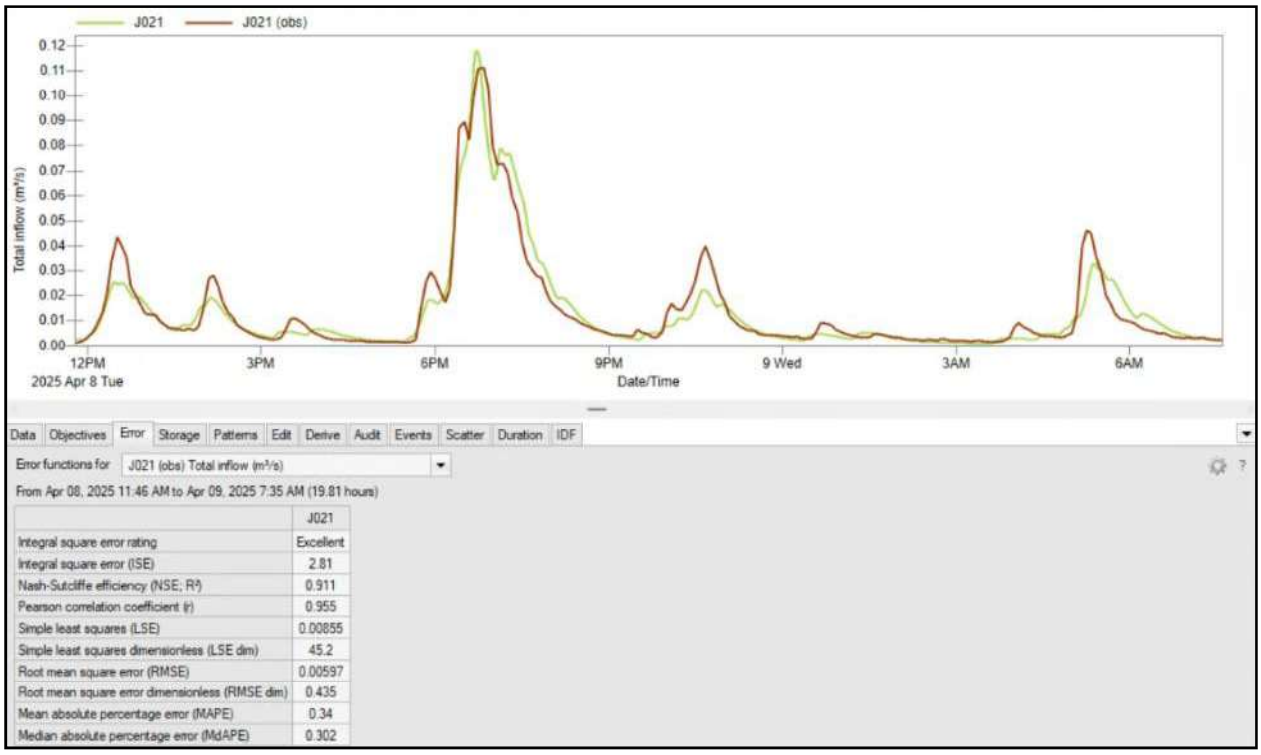
Event	Duration	Volume percentage of 2-year return period volume		
		Peak hour	Peak 6 hours	Peak 24 hours
1	April 6 at 13:50 - April 7 at 07:00	~30%	~30%	~20%
2	April 7 at 14:00 - April 7 at 18:40	~25%	~25%	~20%
3	April 8 at 11:30 -April 9 at 06:30	~50%	~30%	~20%
4	April 10 at 14:00 - April 11 at 01:30	~40%	~40%	~30%
5	May 17 at 11:10 - May 18 at 06:50	~30%	~30%	~40%

As with the calibration, performance was assessed using PCSWMM's statistical metrics. For the validation events the ISE values showed "very good" to "excellent" alignment between the modelled data and the observed data. The only outlier was Event #5. For this event, the monitored flow data exhibited sharper peaks relative to the distributed rainfall pattern. Because the sharper peaks are not reflected in the recorded rainfall data, this alignment issue does not reflect a need for further model calibration. Overall, based on the validation results, the parameter adjustments completed for the calibration were confirmed to be appropriate. The monitored versus observed flow data for Validation Event #3 for the monitoring sites are shown in the figures below.



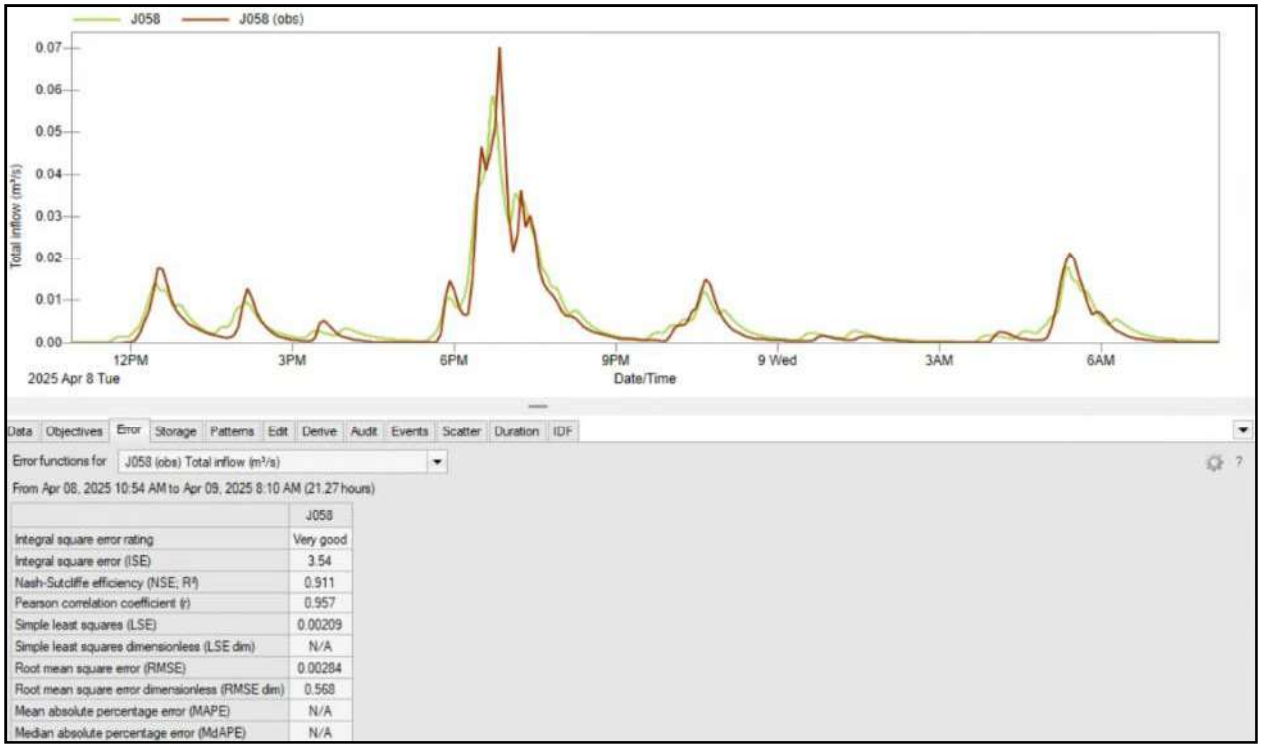
	J074
Integral square error rating	Excellent
Integral square error (ISE)	2.63
Nash-Sutcliffe efficiency (NSE; R^2)	0.797
Pearson correlation coefficient (r)	0.977
Simple least squares (LSE)	0.00687
Simple least squares dimensionless (LSE dim)	70
Root mean square error (RMSE)	0.00554
Root mean square error dimensionless (RMSE dim)	0.394
Mean absolute percentage error (MAPE)	0.503
Median absolute percentage error (MdAPE)	0.541

Figure 4-5: Storm Site 1 Validation for Event #3



	J021
Integral square error rating	Excellent
Integral square error (ISE)	2.81
Nash-Sutcliffe efficiency (NSE; R^2)	0.911
Pearson correlation coefficient (r)	0.955
Simple least squares (LSE)	0.00855
Simple least squares dimensionless (LSE dim)	45.2
Root mean square error (RMSE)	0.00597
Root mean square error dimensionless (RMSE dim)	0.435
Mean absolute percentage error (MAPE)	0.34
Median absolute percentage error (MdAPE)	0.302

Figure 4-6: Storm Site 2 Validation for Event #3



	J058
Integral square error rating	Very good
Integral square error (ISE)	3.54
Nash-Sutcliffe efficiency (NSE; R^2)	0.911
Pearson correlation coefficient (r)	0.957
Simple least squares (LSE)	0.00209
Simple least squares dimensionless (LSE dim)	N/A
Root mean square error (RMSE)	0.00284
Root mean square error dimensionless (RMSE dim)	0.568
Mean absolute percentage error (MAPE)	N/A
Median absolute percentage error (MdAPE)	N/A

Figure 4-7: Storm Site 3 Validation for Event #3

4.4 CALIBRATION ADJUSTMENTS

Following confirmation of calibration and validation results for the monitored catchments, the imperviousness and routing parameter shapefile was reviewed to determine whether adjustments were appropriate beyond the monitored catchments.

The calibration for Storm Site 1 and Storm Site 3 indicated that the imperviousness shapes for the associated residential areas were measured slightly large during initial parameterization. The calibration results across all sites indicated that the conservative assumptions for impervious areas routed to pervious surfaces (typically 10%) were overly conservative. These insights were used to inform a detailed review of the imperviousness and routing parameter shapefile. Based on the calibration results, increasing the impervious to pervious routing by 10% was considered reasonable for most areas and this increase was applied broadly.

Storm Site 1 indicated a larger increase could be appropriate, but this would be area specific and would require further monitoring to justify in other areas. Select refinements were also applied to impervious values where detailed visual review indicated this was appropriate. The changes to impervious percentages are area-specific and the adjustments for Storm Site 1 and Storm Site 3 are not necessarily indicative of changes that should be applied to all catchments. Therefore, refinements were only made where there was adequate evidence for an adjustment. After updating the imperviousness and routing parameter shapefile, the existing conditions model is considered calibrated and validated and is suitable for identifying system deficiencies to inform future infrastructure planning and design.

5 DESIGN CRITERIA

The following section summarizes relevant design criteria for assessment of the storm sewer system from the Village's *Subdivision and Development Servicing Bylaw No. 1179* (Village of Harrison Hot Springs, 2022).

5.1 SITE REQUIREMENTS

The Village requires on-site stormwater systems to include provisions for retention, conveyance, and flood risk management. Development proposals are to provide quantity control through capture and detention of runoff and quality control to treat runoff from impervious areas. Performance targets include:

- Capture and management of the first 30 mm of daily rainfall through infiltration, evapotranspiration, storage, or reuse
- Conveyance of the first 60 mm of rainfall per day (up to the 10-year event) through the drainage system, with detention as necessary to maintain pre-development release rates
- Safe conveyance of major rainfall events up to the 100-year return period

The extent to which these controls have been implemented in the Village is unknown. The performance targets are provided for reference, but it is generally assumed that most existing developments do not meet the on-site stormwater control performance targets.

5.2 WATER QUALITY

For stormwater quality treatment, all flow up to 50% of the 2-year (1-hour duration) post-development flow is to be routed through a water quality treatment facility to remove suspended solids and floatables. Facility options include green infrastructure such as biofiltration swales, detention facilities such as constructed wetlands, and mechanical devices such as oil and grit separators. Specific to the evaluation of existing condition deficiencies, storm sewer outlets with no documented water quality treatment will be identified.

5.3 MINOR SYSTEM

The minor system is the infrastructure associated with the collection, conveyance and treatment of minor (frequently occurring) rainfall events. The minor system is to be designed to prevent flooding and property damage and to limit public inconvenience caused by rainfall events with a return period equal to or more frequent than the 10-year event. Specific to evaluation of deficiencies in the minor system, the model will be used to evaluate:

- Areas with no minor system for drainage
- Surcharging of storm mains for the 10-year storm
- Storm mains that do not have a minimum diameter of 250 mm
- Storm mains that do not have a minimum velocity of 0.6 m/s flowing full and storm mains where the maximum velocity exceeds 3 m/s
- Storm mains that do not meet the Village's minimum grading specifications based on pipe diameter

Additional criteria are specified for ditch dimensions, erosion protection, inlet capacity, and urban roadway flooding limits. This is outside the scope of the model assessment as there is inadequate information on ditch dimensions and inlet capacities. Roadway flooding will be assessed as part of the major system.

5.4 MAJOR SYSTEM

The major system is the infrastructure associated with the collection, conveyance and treatment of major (infrequent) rainfall events. The major system is comprised of surface flood paths, swales, channels, watercourses, roadways, walkways, pathways, and flow control facilities. The major system is to be designed to protect the public and prevent significant property damage caused by rainfall events with a

return period equal to or more frequent than the 100-year event. Requirements for on-site control of the major system are specified, but most developed areas do not have on-site control because the development occurred prior to the Village's 2022 *Subdivision and Development Servicing Bylaw No. 1179*.

Specific to evaluation of deficiencies in the major system, the model will be used to evaluate:

- Performance of existing flow control facilities
- Flooding depths within the dual drainage system (urban roadway flooding)
    - Particular attention will be devoted to sags or low points to evaluate whether there is a safe overland outlet flow route.

An additional criterion is specified for the maximum hydraulic grade line to be kept below minimum building elevations. This is outside the scope of the current modelling as the dual drainage system only allows for a simplified understanding of major system flow depths.

Major system watercourse crossings in the Village include the Miami River bridge crossings and the Hot Springs Rd crossing for the ditch on the south side of McPherson Rd. The Miami River bridge crossings are outside the scope of this analysis. The Hot Springs Rd culvert crossing was also not modelled. During the site visit, it was noted that water levels in the McPherson Rd ditch were very high. It is understood this is related to backwater conditions from beaver activity. Based on site observations, there is potential that the Hot Springs Rd crossing would not have capacity to convey major storm event flows without overtopping due to the severe backwater condition.

5.5 DESIGN STORM SCENARIOS

Design storms were developed for the model using the latest Environment Canada intensity-duration-frequency (IDF) data for Agassiz, BC. Historic and climate adjusted rainfall data is available from ClimateData.ca. The historic data was used to develop existing condition design storms. Climate projected data is also provided for specific time horizons and emissions scenarios. The 2022 *Design Guidelines* from the Master Municipal Construction Documents (MMCD) Association generally recommends that new infrastructure is designed for Year 2050 projections with moderate emissions. The MMCD guidelines recommend that high-risk infrastructure is designed for Year 2100 projections.

An analysis of IDF data from the Agassiz climate station indicates that long duration storms are most similar to an SCS Type 1A distribution. This is consistent with guidance about the likely geographic distribution of storm types in BC (Millar, 2017). For short and medium duration storms, Water Street completed a comprehensive review of municipal guidelines of nearby municipalities to determine appropriate distributions. This review showed that the 30% AES BC Coast distribution storm is most appropriate for short-duration storms (0 – 2 hours) and the 50% AES BC Coast distribution is most appropriate for medium-duration storms (6 – 12 hours). For a comprehensive assessment of the Village's storm infrastructure, a 1-hour storm with a 30% AES BC Coast distribution, a 6-hour storm with a 50% AES BC Coast distribution, and a 24-hour storm with an SCS Type 1A distribution were selected for evaluation. The AES BC Coast distributions were sourced from the City of Mission's Engineering Department. The rainfall volumes were determined based on the historic IDF data and Year 2050 with moderate emissions data for the Agassiz climate station and are presented in Table 5-1.

Table 5-1: Selected Design Storms

Storm Duration (hr)	Historic IDF (mm)		Year 2050 Agassiz IDF (mm)	
	10-year event	100-year event	10-year event	100-year event
1	19.3	22.0	28.8	32.0
6	43.6	48.6	56.1	60.0
24	103.3	115.2	139.5	156

6 GENERAL DEFICIENCIES

6.1 MIAMI RIVER OUTFALL

During the site visit, the Miami River Dike Pump Station was reviewed. This station drains the Miami River to Harrison Lake during high lake levels. It was noted that there have been issues with the culvert inlet capacity to the pump station. The pump station is an important component of the drainage system that allows the creek to outlet to the lake even when there are high lake levels. NHC is currently doing an assessment of the pump station and associated infrastructure to confirm that the pump station is meeting the needs of the Village. The function of the pump station is critical to the performance of the storm sewer system as further discussed in Section 6.6.

In addition to potential issues at the pump station, the creek immediately upstream of the pump station is exposed to high ground from Mount Agassiz to the southwest. A rock fall or landslide in this area has potential to block the Miami River outlet to the lake and potentially leading to flooding. This hazard has not been assessed as part of this study.

6.2 NO DRAINAGE SYSTEM

In the northeast portion of the Village, Echo Ave and Naismith Ave have no documented drainage system to the Mount St storm sewer or the downstream ditch outlet to Miami River. The Village noted there have been drainage issues on Echo Ave due to inadequate drainage infrastructure and poor grading. A field review in Oct 2025 confirmed there is no drainage system on Echo Ave and that Naismith Ave has a ditch and culvert system. Where the ditch on Naismith Ave has been filled, some catch basins and drainage pipes were identified. The Naismith Ave system is not documented, and the level of service has not been modelled.

Similarly, Hot Springs Rd north of Alder Ave to Miami River does not have a documented drainage system. The Miami Slough is the primary outlet to Miami River for this area and runs parallel to Hot Springs Rd on the west side of the road. The east side of the road has intermittent dry wells. Based on input from the Village, it is understood that there are issues with stormwater inflows to the sanitary sewer along Hot Springs Rd. Resolving the inflow and infiltration (I&I) issues for the sanitary sewer system may require drainage improvements along Hot Springs Rd. This issue is further described in the Village's Sanitary Sewer Master Plan (Water Street Engineering Ltd., 2025).

6.3 MUNICIPAL INFRASTRUCTURE ON PRIVATE PROPERTY

During the Oct 2025 field investigation, it was confirmed that a municipal sewer from Lillooet Ave likely crosses under the 565 Lillooet Ave building to outlet to Harrison Lake in Rendall Park. As this sewer is on private property, it is desirable to re-route the drainage. Additional areas where municipal infrastructure crosses private property include:

- 114 Cedar Ave
- 830 Ramona Pl
- 861 and 875 Myng Cr

For these areas, property access rights should be confirmed.

6.4 PIPE GEOMETRY DEFICIENCIES

The review of pipe geometry revealed deficiencies throughout the entire network. These deficiencies are shown on Figure 6-1.

Legend

Drainage Elements

- Creek System
- Ditch
- No Drainage System
- Outfalls
- Storages
- Manholes
- Municipal Infrastruture On Private Property

Pipe Deficiency

- No Deficiency
- Min Slope Deficiency (varies based on dia.)
- Min Diameter Deficiency (<250 mm dia.)

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

EGBC Permit to Practice #1000830

Storm Sewer Master Plan	PROJECT NO. 456.2	**Storm Infrastructure General Deficiencies**
PREPARED FOR **Village of Harrison Hot Springs**	DATE 04 DEC 2025	
	REVISION 0	**Figure 6-1**

Document Path: D:\WSE Dropbox\001-Projects\456-Harrison Hot Springs Master Plans\430-GIS\data\MD_Storm Infrastructure\ArcMap Working Folder\Minor System Deficiencies\Storm General Minor System Deficiencies.mxd

MINIMUM GRADING

26 storm mains were identified with slopes less than the Village's minimum grading specifications. Areas with a concentration of storm mains with slopes less than design criteria include the lakefront area along Esplanade Ave; the central residential area along Pine Ave, Schooner Pl, and Alder Ave; along Eagle St and McCombs drive near Miami River; and the southern extents of the Village near McPherson Rd.

The topography throughout the Village is relatively flat and it is not uncommon for gravity drained storm mains to have flatter sections to achieve the required pipe length when little elevation relief is available. Capital upgrades for these pipes are only recommended if capacity deficiencies were also present.

MINIMUM DIAMETER LESS THAN 250 MM

23 storm pipes were identified to have an inner diameter less 250 mm. These pipes are primarily located in the Angus Estates areas, at the southern extent of the Village on McPherson Rd, and near the north end of the Village on Poplar St and Esplanade Ave. Upsizing for pipes that do not meet minimum diameter requirements should be based on capacity deficiencies.

FLOW VELOCITIES

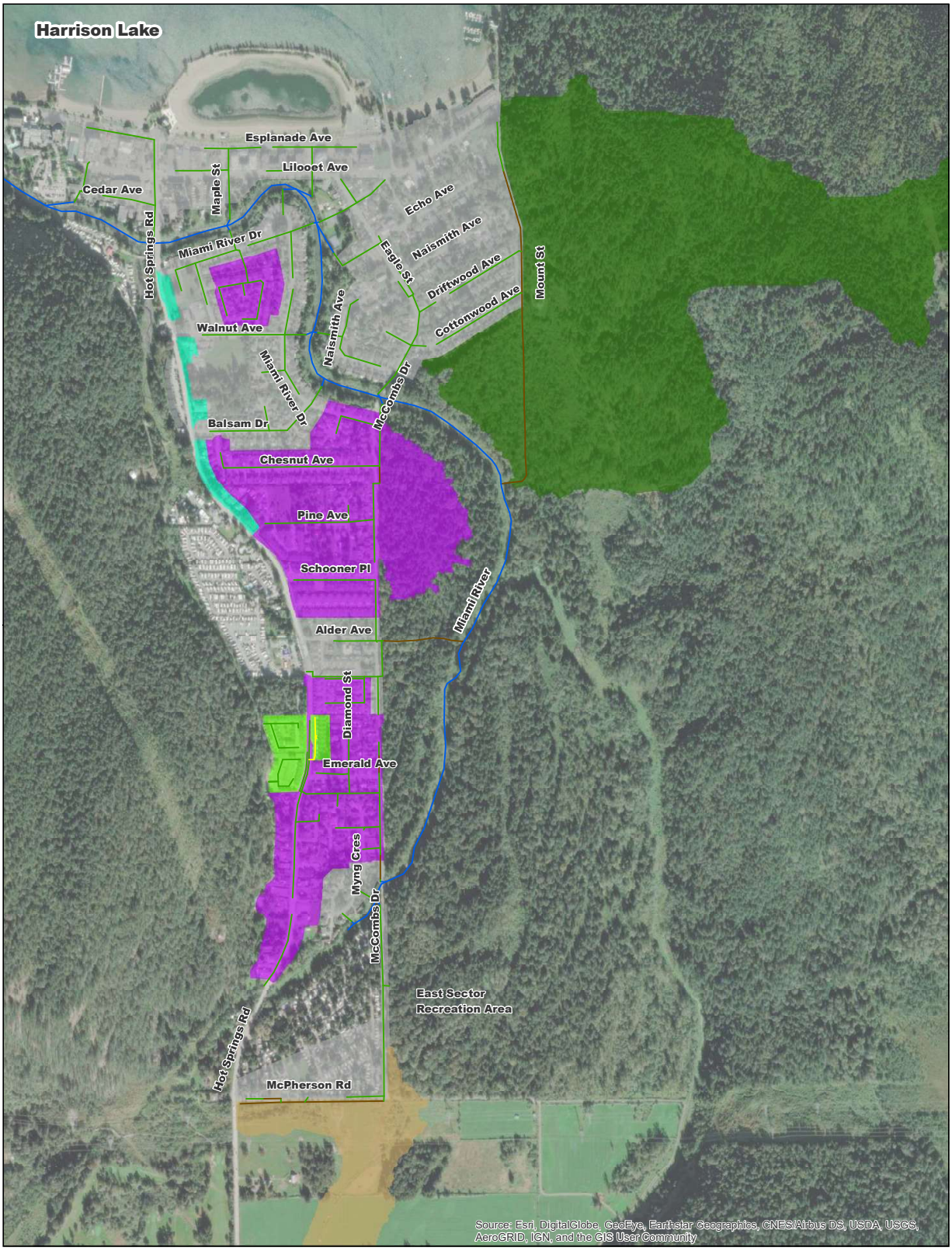
No velocities exceeding 3.0 m/s were identified during design storm runs. When velocities exceed 3.0 m/s and supercritical flow occurs, provisions for structural stability and durability are required. Storm mains that were identified with velocities lower than 0.6 m/s had low velocities due to backwater conditions and not the pipe gradient. All storm mains that meet the Village's minimum grading also meet the minimum velocity requirements when unimpeded and flowing full.

6.5 WATER QUALITY DEFICIENCIES

Through review of the available record drawings, five oil grit separator units were identified. Additionally, there are several dry wells throughout the Village and three recent developments have soak away trenches. To achieve a high-level understanding of quality concerns, drainage areas have been categorized based on the type of runoff that is expected from the drainage area and the type of quality control that is provided. The performance of the quality controls has not been assessed. The results of this analysis are summarized in Table 6-1 and are shown on Figure 6-2.

Table 6-1: Water Quality Treatment Overview

Treatment	Area (ha)	Percent of Total Area Assessed
Drains to OGS	41.66	18%
Drains to Soakaway Trench	2.52	1%
Drains to Dry Well	2.07	1%
Agricultural Area	37.07	16%
Undeveloped Forested Area	79.62	35%
Developed Area, No Known Treatment	66.82	29%



Legend

Subcatchments
- Undeveloped
- Drains to Soakaway Trench
- Drains to Dry Well
- Agricultural
- No Known Treatment
- Drains to OGS

Drainage Elements
- Storm Sewer
- Creek System
- Ditch
- Soakaway Trench Sewer

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

EGBC Permit to Practice #1000830

Storm Sewer Master Plan

PREPARED FOR

Village of Harrison Hot Springs

PROJECT NO. 456.2

DATE 04 DEC 2025

REVISION 0

Storm Water Quality Treatment

Figure 6-2

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6.6 BOUNDARY CONDITION DEFICIENCIES

In the 2014 *Miami Creek Pump Station Hydrologic Assessment* (Northwest Hydraulic Consultants Ltd., 2014), the maximum water level during the 200-year design event was recommended to be no greater than 12.0 m based on the surveyed top of banks and local infrastructure. This recommendation was not based on a detailed infrastructure assessment, and a significant amount of drainage infrastructure is below the 12.0 m target (connections to Miami River are as low as 9.57 m). Figure 6-3 shows manholes, outfalls, and conduits (storm sewers) that would be submerged at a water level of 12.0 m. This figure provides some context on areas of potential backwatering concern.

It is understood that NHC is currently completing a study of the pump station that considers joint probability of high lake levels and high creek flows. It is a potential concern that the pump station's operating level (when the pumps turn on) are set to an elevation of 11.0 m when many of the storm sewer outfalls to Miami River are below 10.5 m. In conjunction with NHC's ongoing pump station assessment, the potential to reduce the operating level should be assessed. This will increase the reliability of the storm sewer system during high lake levels. The simplified assessment of the storm sewer system assumes there is no backwater condition from the lake/creek.

For future storm system improvements that outlet to Miami River, a higher backwater level should be considered during detailed design. This should be informed by the updated assessment of the Miami River Dike Pump Station. It may be advisable to raise the storm sewer system where feasible to reduce sensitivity to high creek levels.

Legend

Drainage Elements	Outfall Rim Elevation	Manhole Crown Elevation	Conduit Crown Elevation

	Storm Sewer Master Plan		Storm Infrastructure Below 12.0 m Flood Level
WATER STREET ENGINEERING	Village of Harrison Hot Springs		Figure 6-3

7 EXISTING CONDITION ASSESSMENT

7.1 MINOR SYSTEM (STORM SEWER) DEFICIENCIES

A summary of deficiencies for insufficient flow capacity in the existing storm sewers during the current 10-year storm peak flows is provided in Table 7-1 and the deficiencies are shown on Figure 7-1.

Table 7-1: Existing Condition Minor System Deficiencies

Capacity Deficiency	Pipe IDs	Area	Surcharge Severity	Cause
1	C024, C025, C026	Esplanade Ave and Hot Springs Rd	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
2	C037, C038, C135	Esplanade Ave and Maple St	Significant, below ground level	Combination of insufficient slope and insufficient pipe size
3	C044, C138	Esplanade Ave and Chehalis St	Significant, below ground level	Combination of insufficient slope and insufficient pipe size
4	C055, C056	Bear Ave	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
5	C063	Naismith Ave outlet	Significant, below ground level	Insufficient pipe size
6	C084, C086, C087, C088, C163	Eagle St approaching Miami River	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
7	C028, C030	Miami River Dr outlet near Poplar St	Significant, below ground level	Combination of insufficient slope and insufficient pipe size
8	C060	Walnut Ave	Significant, below ground level	Insufficient pipe size
9	C069, C070	Balsam Ave	Significant, below ground level	Insufficient pipe size
10	C156, C157, C158	Chestnut Ave	Significant, below ground level	Insufficient pipe size
11	C074, C075, C079, C081, C082	Pine Ave and McCombs Dr approaching Miami River	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
12	C176, C177, C197, C198, C199, C200	Alder Ave, Schooner Pl and along McCombs Dr	Significant, below ground level	Combination of insufficient slope and insufficient pipe size
13	C191, C192	Diamond St	Significant, below ground level	Insufficient pipe size
14	C189	McCombs Dr near Emerald Ave	Minor, below ground level	Insufficient pipe size
15	C184, C205	Hadway Dr	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
16	C117, C122	Myng Cr	Significant, below ground level	Insufficient pipe size

17	C231, C232, C235, C237	South portion of McCombs Dr, McPherson Rd	Significant, approaching ground level	Combination of insufficient slope, insufficient pipe size, and backwater condition at McPherson Rd ditch.

In addition to the deficiencies described in the table above, the following deficiencies were identified for the private infrastructure that was modelled.

- C180, C181, C182, C202, and C204 are private pipes that are part of the Harrison Lake Estates development and have modest surcharging.
- C209 is a private pipe part of the 750 Hot Springs Rd development and has modest surcharging.
- C254 is a private pipe part of the 798 Hot Springs Rd development and has modest surcharging.

7.2 MAJOR SYSTEM PERFORMANCE

For the current 100-year storm peak flows, most storm sewers have capacity to convey the flow with surcharging that remains below the manhole rim elevations. Only 26 conduits show surcharging above ground level. For overland flow, a typical street cross-section was modelled to convey flow. Only 6 locations were simulated to have water depths greater than 0.10 m. Only Bear Ave has overland flow greater than 50 L/s.

Legend

Drainage Elements
- Creek System
- Ditch
- Outfalls
- Storages
- Deficiency Area

Manhole Surcharging
- Well Below Crown (>0.1 m below crown)
- Near Crown (within 0.1 m below crown)
- Minor Surcharge (<0.1 m above crown)
- Significant Surcharge (>0.1 m above crown)

Capacity
- Under Capacity (<85%)
- Near Capacity (85-100%)
- Minor Surcharge (100-115%)
- Siginificant Surcharge (>115%)

N

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1:10,000

WATER STREET ENGINEERING

EGBC Permit to Practice #1000830

Storm Sewer Master Plan

PREPARED FOR

Village of Harrison Hot Springs

PROJECT NO. 456.2

DATE 04 DEC 2025

REVISION 0

Current 10-Year Storm Minor System Deficiencies

Figure 7-1

Document Path: D:\WSE Dropbox\001-Projects\456-Harrison Hot Springs Master Plans\430-GIS\data\MD_Storm Infrastructure\ArcMap Working Folder\Minor System Deficiencies\Existing Storm Minor System Deficiencies_v2.mxd

8 FUTURE CONDITION ASSESSMENT

To account for future development and densification, the Village's *Official Community Plan Bylaw No. 1184* (Village of Harrison Hot Springs, 2022) land use was evaluated to determine where increases in impervious coverage should be considered. The MMCD's 2022 *Design Guidelines* were used as a reference for imperviousness associated with different land uses. In general, for areas that already had an imperviousness greater than the design numbers provided in the MMCD's design guidelines, the imperviousness was maintained. Areas with lower imperviousness were adjusted to match the design guideline values.

Based on input from the Village, it is understood that there is a potential development area just north of the East Sector Recreation Area. This area is east of the Miami River bridge connecting McCombs Dr and Eagle St. This area naturally drains to Miami River without contributing to Village infrastructure. Future development of this area should discharge directly to Miami River suitable quantity and quality controls to prevent deleterious impacts on the watercourse. Development of this area is considered unlikely and has not been assessed for this Storm Sewer Master Plan.

8.1 MINOR SYSTEM (STORM SEWER) DEFICIENCIES

A summary of deficiencies for insufficient flow capacity in the existing storm sewers during the year 2050 10-year storm peak flows under future conditions is provided in Table 8-1 and the deficiencies are shown on Figure 8-1.

Table 8-1: Future Condition Minor System Deficiencies

Capacity Deficiency	Pipe IDs	Area	Surcharge Severity	Cause
1	C023, C024, C025, C026	Esplanade Ave and Hot Springs Rd	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
2	C037, C038, C135	Esplanade Ave and Maple St	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
3	C044, C138	Esplanade Ave and Chehalis St	Significant, below ground level	Combination of insufficient slope and insufficient pipe size
4	C055, C056	Bear Ave	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
5	C063, C151	Naismith Ave outlet	Significant, surface flooding, insufficient overland flow route	Insufficient pipe size
6	C084, C085, C086, C087, C088, C163, C165, C166	Eagle St approaching Miami River	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
7	C028, C030	Miami River Dr outlet near Poplar St	Significant, below ground level	Combination of insufficient slope and insufficient pipe size
8	C060	Walnut Ave	Significant, below ground level	Insufficient pipe size
9	C069, C070	Balsam Ave	Significant, below ground level	Insufficient pipe size

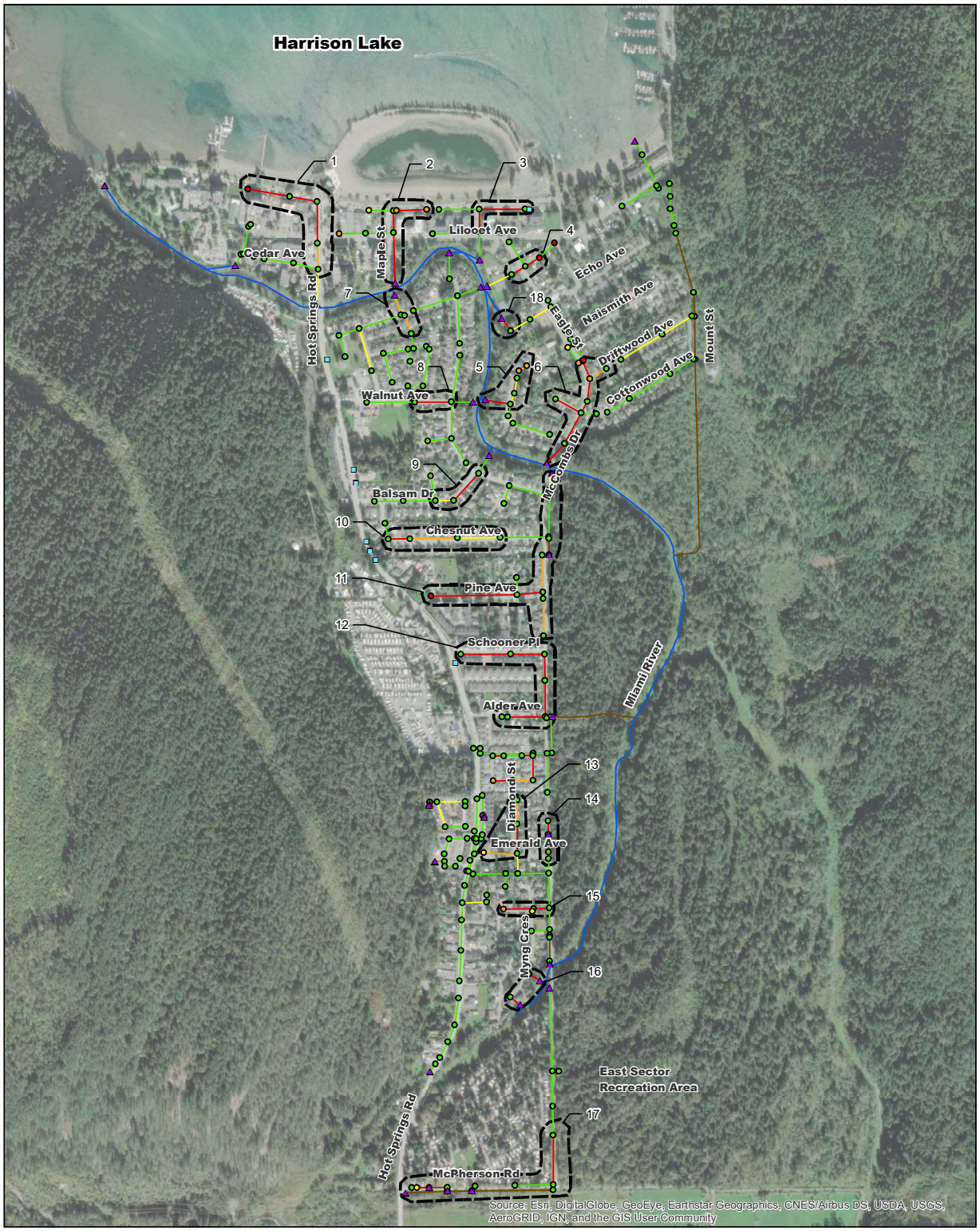
10	C156, C157, C158	Chestnut Ave	Significant, below ground level	Insufficient pipe size
11	C074, C075, C079, C080, C081, C082, C161	Pine Ave and McCombs Dr approaching Miami River	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
12	C175, C176, C177, C197, C198, C199, C200	Alder Ave, Schooner Pl and along McCombs Dr	Significant, below ground level	Combination of insufficient slope and insufficient pipe size
13	C191, C192, C206	Diamond St	Significant, approaching ground level	Insufficient pipe size
14	C187, C189	McCombs Dr near Emerald Ave	Significant, approaching ground level	Insufficient pipe size
15	C184, C205	Hadway Dr	Significant, surface flooding	Combination of insufficient slope and insufficient pipe size
16	C117, C122	Myng Cr	Significant, below ground level	Insufficient pipe size
17	C231, C232, C235, C237	South portion of McCombs Dr, McPherson Rd	Significant, approaching ground level	Combination of insufficient slope, insufficient pipe size, and backwater condition at McPherson Rd ditch.
18	C047, C048	Echo Ave outlet	Significant, below ground level	Insufficient pipe size

In addition to the deficiencies described in the table above, the following deficiencies were identified for the private infrastructure that was modelled.

- C180, C181, C182, C202, and C204 are private pipes that are part of the Harrison Lake Estates development and have modest surcharging.
- C209 is a private pipe part of the 750 Hot Springs Rd development and has modest surcharging.
- C254 is a private pipe part of the 798 Hot Springs Rd development and has modest surcharging.

8.2 MAJOR SYSTEM PERFORMANCE

For the 2050 100-year storm peak flows overland flow increases to 61 conduits that show surcharging above ground level. 15 locations show water depths greater than 0.10 m. 8 locations have flows greater than 50 L/s and are distributed along Bear Ave, Pine Ave, Hadway Dr, and Esplanade Ave approaching Hot Springs Rd.



Legend

Drainage Elements
- Creek System
- Ditch
- Outfalls
- Storages
- Deficiency Area

Manhole Surcharging
- Well Below Crown (>0.1m below crown)
- Near Crown (within 0.1m below crown)
- Minor Surcharge (<0.1m above crown)
- Significant Surcharge (>0.1 m above crown)

Pipe Surcharging
- Under Capacity (<85%)
- Near Capacity (85-100%)
- Minor Surcharge (100-115%)
- Significant Surcharge (>115%)

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WATER STREET ENGINEERING

EGBC Permit to Practice #1000830

Storm Sewer Master Plan

PREPARED FOR

Village of Harrison Hot Springs

PROJECT NO. 456.2

DATE 04 DEC 2025

REVISION 0

Future 10-Year Storm Minor System Deficiencies

Figure 8-1

Document Path: D:\WSE Dropbox\001-Projects\456-Harrison Hot Springs Master Plans\430-GIS\data\MD_Storm Infrastructure\ArcMap Working Folder\Minor System Deficiencies\Future Storm Minor System Deficiencies.mxd

9 PROJECT IDENTIFICATION AND PRIORITIZATION

Following deficiency identification, a complete project list was developed and analyzed to determine project priorities. Projects are rated as either High, Medium, Low or Conditional. These designations are defined as follows:

- High: Project addresses an existing significant deficiency or system need with broad impacts. Typical timeline is completion within 5 years.
- Medium: Project addresses an existing significant deficiency or system need with localized impact or addresses information gaps to identify deficiencies that could have localized impacts. Generic timeline is completion within 5 to 10 years but subject to project specifics.
- Low: Project addresses an existing minor deficiency or system need with localized impact. Generic timeline is completion within 10 to 20 years but subject to project specifics.
- Conditional: Projects may or may not be required subject to completion of additional work to verify need. No recommended timeline.

9.1 GENERAL CONSIDERATIONS

Regarding the drainage design criteria, the Village's 2022 update to the Subdivision and Development Servicing Bylaw is a significant improvement that will reduce the impact of future development. Notably, the design criteria now require stormwater quality treatment, which is absent or undocumented in many areas of the Village. Currently the Village's Subdivision and Development Servicing Bylaw does not provide criteria related to climate change, which is expected to increase the intensity of extreme storms. This could be resolved by referencing the MMCD's 2022 *Design Guidelines* for climate change impact considerations.

In reviewing the Village's storm sewer system, the capacity requirements to provide safe conveyance to Miami River are generally modest (provided Miami River levels are controlled to be below 9.5 m at Harrison Lake). Based on the well distributed outfalls along Miami River, drainage areas are small. Preliminary sizing for the year 2050 10-year storm peak flows and increased imperviousness with no on-site stormwater control indicates that the largest required sewer size is 900 mm dia. and only 967 m of the 11,641 m of storm sewer needs to be larger than 600 mm dia. For this type of system, centralized detention has limited benefit in reducing sewer size requirements. Further, the Village is close to the outlet for the Miami River watershed such that efficient drainage to Miami River is preferable for peak flow timing. Therefore, no centralized storage detention facilities are recommended. For flow reduction, the Village's existing requirements for on-site stormwater control are considered adequate. The requirements will generally improve conditions where there is re-development since much of the Village was developed before these criteria were implemented.

In reviewing major system flows, several areas within the Village do not have positive drainage to Miami River and significant flood depths could occur with overland flow. Therefore, reliable performance from the storm sewer is critical. In most of these areas, the model shows that the major flows can be conveyed via the storm sewer with only minimal surcharging on the road if the storm sewer capacity is fully utilized. However, the storm sewer conveyance is dependent on sufficient inlet capacity and a free-flowing outfall. Inlet capacity was not within the scope of this analysis and high backwater levels were not considered. Further review of inlet capacity and potential backwater conditions may be warranted where the storm sewer is providing conveyance for major system flows.

In reviewing hazards associated with urban drainage and flooding, it is noted that it is important for the Village to have an Updated Emergency Response plan. A non-comprehensive list of hazards that have been identified through the preparation of this Storm Sewer Master Plan is provided as follows:

1. Hazards associated with Harrison Lake include a landslide induced wave, elevated lake levels associated with local precipitation and Harrison River backwater, and dike failures.
2. Hazards associated with Miami River include high water levels from high creek flows, blockages from landslides or debris inflows, and insufficient outlet capacity to the lake at the pump station.
3. Hazards associated with storm sewer failures include significant surface ponding and flooding.

For areas where municipal infrastructure crosses private property and no alternative routing is proposed, an internal assessment project has been identified to confirm access rights for maintenance. This assessment is ongoing for 114 Cedar Ave, 830 Ramona Pl, and 861 and 875 Myng Cr and is considered a low concern.

9.2 PROJECT PRIORITIZATION

HIGH PRIORITY

The Miami River outfall to Harrison Lake was not part of the storm sewer analysis, however an adequate outlet is critical to the function of the storm sewer infrastructure. It is understood that debris clogging at the pump station is a primary concern. To confirm the reliability of this outlet, an assessment of the Miami River Dike Pump Station is currently being completed by NHC. This ongoing project is most critical to overall flooding concerns and has been assessed as "High" priority (Project #1). As part of the NHC assessment, the potential to lower the operating water level at the pump station should be reviewed as this will improve storm sewer system performance. After reviewing the potential to lower the operating water level at the pump station, further analysis of the storm sewer system is recommended to confirm flooding concerns associated with the storm sewer system during high backwater conditions.

MEDIUM PRIORITY

For all storm sewer projects with capacity deficiencies, model results indicate that the potential flood damage is low based on the modest surface flooding. To verify potential surface flooding concerns, a surface flooding field verification program is recommended as a "Medium" priority project to confirm capacity issues (Project #2). Priority areas for field verification have been identified based on model results.

Based on available information, there are several areas of the Village that do not have any known water quality treatment. To confirm water quality concerns and determine prioritization of future water quality improvement projects, a water quality monitoring program is recommended as a "Medium" priority project (Project #3). It is understood that the Miami River Streamkeepers currently monitor the Miami River at 3 locations on a quarterly basis. It is recommended to collaborate with the Miami River Streamkeepers to expand the quality monitoring. Results from the water quality monitoring could impact project prioritization.

To understand the risk of failure for the existing sewer system, a condition assessment of the storm sewer system is recommended as a "Medium" priority project (Project #4). The modelling assumes that the storm sewer system is functioning according to the as-built condition. Identifying condition issues that could lead to pipe failure could dramatically impact project prioritization.

Storm sewer projects have been ranked according to their impact on surface flooding. In general, surface flooding is modest with only one area (Bear Ave) where the model indicates flooding will be significantly greater than 0.3 m for the 2050 100-year event. The Bear Ave sewer improvement is the only project that has been given a priority of "Medium" based on the model results (Project #5).

Two projects have been given a priority of "Medium" based on information from the Village and site observations of existing issues. The first project (Project #6) is to add a storm sewer on Echo Ave to the Mount St sewer to eliminate the reported drainage issues in this area. During an Oct 2025 field visit to assess this area, it was observed that the outlet to the Mount St sewer was almost entirely buried. Based on this observation, a ditch cleanout and outfall improvements at the Mount St sewer outlet are also recommended as part of this project. The second project (Project #7) is to eliminate the backwater impact from beaver damming downstream of McPherson Rd that compromises the performance of upstream drainage infrastructure and has potential to result in flooding of Hot Springs Rd. As it is presumed that the damming is on District of Kent property, a portion of this work may need to be a collaborative project with the District of Kent. Contributing to this backwater area is drainage from the East Sector Recreation Area that drains south on McCombs Dr and west to the McPherson Rd ditch and Miami River. Topographically, this drainage area should be draining northeast to Miami River rather than contributing

to the existing issues along the McPherson Rd ditch. Eliminating the East Sector Recreation Area drainage contribution to McCombs Dr is a second component of this "Medium" priority project.

LOW PRIORITY

The final recommended projects are based on input from Village staff and field investigation work. One project is to eliminate a municipal storm sewer on private property that crosses under 565 Lillooet Ave (Marina Beach). The Oct 2025 field investigation confirmed that this sewer likely crosses under the 565 Lillooet Ave building to outlet to Harrison Lake in Rendall Park. As this sewer is on private property, it is desirable to re-route the drainage to the Mount St sewer, which is on municipal land. No drainage issues have been identified for this area, so this project is recommended as "Low" priority subject to confirmation of any condition issues. The other recommended project is to improve drainage conditions at the Angus Estates development to reduce I&I issues with the sanitary sewer. This project will be informed by the I&I reduction program recommended for the Sanitary Sewer Master Plan (Water Street Engineering Ltd., 2025). The initial recommendation is to provide a storm sewer on Hope Pl and redirect stormwater from the dry well on Myng Cr that is likely to contribute to local I&I issues. This project is recommended as "Low" priority and could be refined or expanded based on investigations completed for the I&I reduction program.

CONDITIONAL PRIORITY

In addition to the recommended projects, conditional projects were defined for areas that have identified deficiencies associated with low flooding risks.

Where sewer capacities are deficient and some surface flooding is expected during the 10-year event, the projects were given a priority of "Conditional – Monitor." These projects are not currently monitored but should be included in the surface flooding field verification program and could be assigned as "Low" priority or higher if field observations confirm surface flooding occurs during significant rain events. The risk of surface flooding informs the ranking of the "Conditional – Monitor" projects. The priority of these projects could also be increased if the condition assessment indicates the sewers are damaged and need to be replaced.

Where sewer capacities are deficient and no surface flooding is expected during the 10-year event, the projects have been given a priority of "Conditional – Assess". The priority of these projects could be increased if the condition assessment indicates the sewers are damaged and need to be replaced. The risk of surface flooding informs the ranking of the "Conditional – Assess" projects. Higher ranked "Conditional – Assess" projects could be included in the surface flooding field verification program.

All conditional projects should be considered where there are cost efficiencies of implementing with other projects in the Village.

Of note, there are sewers in the Village that are below minimum slope and below minimum diameter but have not been identified for replacement as the capacity impact is marginal.

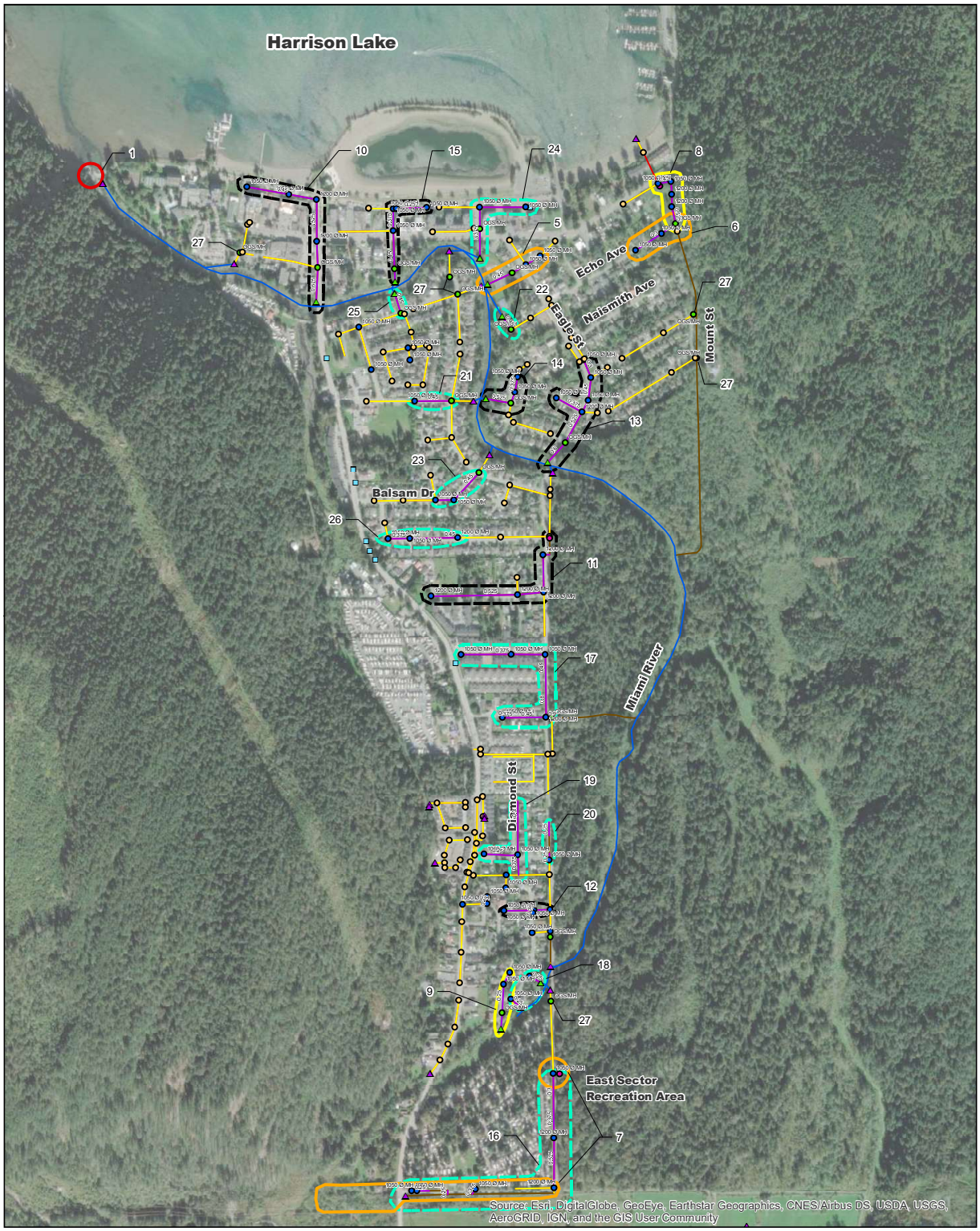
SUMMARY

All recommended and conditional projects are summarized in Table 9-1. An overview of the projects is provided on Figure 9-1 and additional details for each project are included in Appendix 1. For the current ranking, the potential to provide water quality treatment to areas that do not have any documented treatment has been used as a differentiator between projects that have equivalent or similar impacts on surface flooding.

Table 9-1: Capital Project List

Project Number	Description	Deficiency	Surface Flooding (10-Year)	Surface Flooding (100-Year)	Water Quality Impact	Additional Notes	Priority
1	Assess Miami River Dike Pump Station	Confirm resilience to blockages at culvert inlet, adequate inlet capacity to the pumps, adequate pump capacity for storm system function	Extensive	Extensive	N/A	Risk of widespread flooding issues if Miami River cannot be pumped to Harrison Lake during high water levels.	High
2	Surface flooding field verification program	Potential surface flooding	To be confirmed	To be confirmed	N/A	Recommended field verification of areas with identified capacity constraints.	Medium
3	Stormwater quality monitoring program	Untreated stormwater flows	N/A	N/A	High	Recommended water quality monitoring during rainfall events to confirm areas to prioritize for stormwater treatment.	Medium
4	Storm sewer condition assessment	Unknown	Not quantified	Not quantified	N/A	Recommended to assess condition of sewers older than 20 years (or undocumented age) to identify risks.	Medium
5	Bear Ave sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	2 manholes (existing and future), >0.3 m depth	5 manholes (2 existing +3 future)	3.74 ha Area	Confirm recent paving eliminated ponding issue at Lillooet Ave and Eagle St intersection. Maximum surface flooding for future 100-year storm simulated at >0.5 m depth and 0.240 m^3/s flow.	Medium
6	New sewer for Echo Ave approaching Mount St, outfall improvements	No drainage system connecting to Mount St and buried outlet. Drainage issues noted by Village.	Not quantified	Not quantified	2.00 ha Area	The severity of this issue is not quantified. Maximum surface flooding for future 100-year storm is 0.105 m^3/s.	Medium
7	General improvements for south McCombs Dr, McPherson Rd	Backwater condition from beaver dam on McPherson Rd ditch, unnecessary drainage connection to McCombs Dr	Not quantified	Not quantified	N/A	East Sector Recreation Area should not be flowing to McCombs Dr. Significant backwater on McPherson Rd due to beaver damming downstream of Hot Springs Rd culvert crossing needs to be resolved.	Medium
8	Eliminate private property sewer (565 Lillooet Ave)	Sewer crosses under a building on private property	None	None	3.59 ha Area	Private sewer to be eliminated by connecting Lillooet Ave sewer to Mount St and upgrading capacity.	Low
9	Angus Estates drainage improvements	Excessive I&I in sanitary sewer	Not quantified	Not quantified	0.89 ha Area	Improvements to be informed by I&I reduction program. Add storm sewer on Hope Pl with outlet to Miami River.	Low
10	Esplanade Ave and Hot Springs Rd sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	1 manhole (existing and future)	2 manholes (1 existing +1 future)	6.49 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.28 m depth and 0.098 m^3/s flow	Conditional - Monitor
11	Pine Ave and McCombs Dr sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	1 manhole (existing and future)	5 manholes (1 existing +4 future)	Already treated	Maximum surface flooding for future 100-year storm simulated at 0.31 m depth and 0.133 m^3/s flow	Conditional - Monitor
12	Hadway Dr sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	1 manhole (existing and future)	3 manholes (existing and future)	Already treated	Maximum surface flooding for future 100-year storm simulated at 0.17 m depth and 0.063 m^3/s flow	Conditional - Monitor
13	Eagle St sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	4 manholes (future only)	7 manholes (2 existing +5 future)	3.96 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.26 m depth and 0.028 m^3/s flow	Conditional - Monitor
14	Naismith Ave outlet sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	1 manhole (future only)	2 manholes (existing and future)	3.02 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.13 m depth and 0.019 m^3/s flow	Conditional - Monitor
15	Esplanade Ave and Maple St sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	3 manholes (future only)	5 manholes (4 existing +1 future)	2.50 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.19 m depth and 0.042 m^3/s flow	Conditional - Monitor
16	South portion of McCombs Dr, McPherson Rd sewer improvements	Significant, 10-year event approaching ground level	None	5 manholes (2 existing +3 future)	6.09 ha Area	CB on McCombs Dr should be lowered to improve drainage capture. Collapsed pipes noted in 2016 LWMP (to be confirmed). Maximum surface flooding for future 100-year storm simulated at 0.06 m depth and 0.007 m^3/s flow.	Conditional - Assess
17	Alder Ave, Schooner Pl and along McCombs Dr sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	None	2 manholes (existing and future)	3.52 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.09 m depth and 0.012 m^3/s flow	Conditional - Assess

18	Myng Cr sewer improvements	Significant, 10-year event below ground level	None	2 manholes (existing and future)	1.57 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.03 m depth and 0.022 m^3/s flow	Conditional - Assess
19	Diamond St sewer improvements	Significant, 10-year event approaching ground level	None	3 manholes (2 existing +1 future)	Already treated	Maximum surface flooding for future 100-year storm simulated at 0.17 m depth and 0.021 m^3/s flow	Conditional - Assess
20	McCombs Dr near Emerald Av sewer improvements	Significant, 10-year event approaching ground level	None	1 manhole (existing and future)	Already treated	Maximum surface flooding for future 100-year storm simulated at 0.05 m depth and 0.011 m^3/s flow	Conditional - Assess
21	Walnut Ave sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	None	2 manholes (future only)	7.55 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.04 m depth and 0.014 m^3/s flow	Conditional - Assess
22	Echo Ave outlet sewer improvements	Significant, 10-year event below ground level	None	4 manholes (future only)	4.06 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.07 m depth and 0.007 m^3/s flow	Conditional - Assess
23	Balsam Ave sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	None	2 manholes (future only)	3.41 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.07 m depth, no flow	Conditional - Assess
24	Esplanade Ave and Chehalis St sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	None	None	2.67 ha Area	No surface flooding, just sewer surcharging below ground level	Conditional - Assess
25	Miami River Dr outlet near Poplar St sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	None	5 manholes (future only)	1.96 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.05 m depth and 0.007 m^3/s flow	Conditional - Assess
26	Chestnut Ave sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	None	2 manholes (future only)	Already treated	Maximum surface flooding for future 100-year storm simulated at 0.11 m depth, no flow	Conditional - Assess
27	Various water quality improvements	Untreated areas where not addressed through other projects	None	None	6 outlets 8.49 ha Area	Largely residential areas with exception of Alice St outlet	Conditional - Assess



Legend

Drainage Elements
- Creek System
- Ditch
- Proposed Outfall Upgrade
- Outfalls
- Storages

Capital work project area
- High
- Medium
- Low
- Conditional - Monitor
- Conditional - Assess

Manholes
- Existing Manhole
- Proposed MH/OGS Upgade
- Proposed Manhole Upgrade
- Inlets

Storm Sewer
- Existing Storm Sewer
- Proposed Storm Sewer Upgrade
- To Be Abandoned

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WATER STREET ENGINEERING

EGBC Permit to Practice #1000830

Storm Sewer Master Plan

PREPARED FOR

Village of Harrison Hot Springs

PROJECT NO. 456.2

DATE 04 DEC 2025

REVISION 0

Capital Works Projects

Figure 9-1

Document Path: D:\WSE Dropbox\001-Projects\456-Harrison Hot Springs Master Plans\430-GIS\data\MD_Storm Infrastructure\ArcMap Working Folder\Capital Works Projects_v2.mxd

10 CAPITAL WORKS PLAN

Based on the identified deficiencies and ranking outlined above, a capital works plan has been developed. All proposed projects are based on capacity improvements to meet future development conditions with climate change (2050). The sizing difference between existing development conditions with current storms is marginal. No allowance for additional on-site storage has been made. The unit pricing for sewer replacement is inclusive of removals and restoration.

None of the recommended drainage upgrades are driven by growth. Therefore, they are not eligible for Development Cost Charges (DCCs) because they are not specifically required to service new development. The upgrades are required to resolve deficiencies that are attributed to existing system limitations and increased rainfall intensity associated with climate change. Climate change has a larger influence on future peak flows than incremental increases in imperviousness. As the recommended drainage upgrades are recommended to reduce flood risk, improve stormwater quality, and enhance environmental protection or asset condition information, they align with the objectives of provincial and federal grant programs that focus on disaster risk reduction, climate adaptation, and sustainable water infrastructure. Therefore, these projects are expected to be good candidates for external grants.

The capital costs for construction projects include an allowance of 20% for design and contract administration and 30% for construction contingency. Projects without construction scopes include a 20% contingency. The cost opinions presented are EGBC/ACEC-BC Class C estimates, based on unit rates from similar projects. They are intended for initial capital project budgeting. The expected accuracy range is between a low of -25% and a high of +40% for the given scope. Costs are to yr-2025 and no escalation is included for future completion of the projects.

The capital works plan is divided into recommended projects and conditional projects in Table 10-1 and Table 10-2 below. The total cost of the recommended projects is estimated at $1,975,000 excluding an annual cost for a stormwater quality monitoring program (estimated at $50,000/year). The total cost of the conditional projects is estimated at $10,446,000.

Project numbers 1, 2, 3, and 4 are projects related to further assessment of the drainage system to confirm deficiencies. The pump station assessment has the broadest impact on system performance and has been given a “High” priority. The pump station assessment is ongoing and may require some refinement to address recommendations within this report. The “Medium” priority assessment projects are not associated with known deficiencies and have been ranked in order of implementation cost (lower cost assessment projects are higher priority). Though the sewer condition assessment (Project #4) is the lowest ranked assessment project, it could notably impact project priorities if significant condition deficiencies are identified. Therefore, this project should occur at the earliest feasibility dependent on available funding.

Table 10-1: Recommended Capital Projects with Cost Opinions

Project Number	Description	Deficiency	Priority	Capital Cost
1	Assess Miami River Dike Pump Station	Confirm resilience to blockages at culvert inlet, adequate inlet capacity to the pumps, adequate pump capacity for storm system function	High	$30,000
2	Surface flooding field verification program	Potential surface flooding	Medium	n/a (operating cost)
3	Stormwater quality monitoring program	Untreated stormwater flows	Medium	n/a (operating cost)[1]
4	Storm sewer condition assessment	Unknown	Medium	$90,000

5	Bear Ave sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	Medium	$450,000
6	New sewer for Echo Ave approaching Mount St	No drainage system connecting to Mount St and buried outlet to ditch. Drainage issues noted by Village.	Medium	$381,000
7	General improvements for south McCombs Dr, McPherson Rd	Backwater condition from beaver dam on McPherson Rd ditch, unnecessary drainage connection to McCombs Dr.	Medium	$225,000
8	Eliminate private property sewer (565 Lillooet Ave)	Sewer crosses under a building on private property	Low	$419,000
9	Angus Estates drainage improvements (Hope Pl sewer)	Excessive I&I in sanitary sewer	Low	$380,000
Total				$1,975,000
Notes: [1]Project #3 is estimated at $50,000 per year for a stormwater quality monitoring program based on 4 samples per year and 5 - 10 sampling locations. This cost is excluded from the total cost as the duration will be determined based on results.				

Table 10-2: Conditional Capital Projects

Project Number	Description	Deficiency	Priority	Capital Cost
10	Esplanade Ave and Hot Springs Rd sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	Conditional - Monitor	$1,242,000
11	Pine Ave and McCombs Dr sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	Conditional - Monitor	$1,115,000
12	Hadway Dr sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	Conditional - Monitor	$306,000
13	Eagle St sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	Conditional - Monitor	$1,017,000
14	Naismith Ave outlet sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	Conditional - Monitor	$421,000
15	Esplanade Ave and Maple St sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	Conditional - Monitor	$691,000
16	South portion of McCombs Dr, McPherson Rd sewer improvements	Significant, 10-year event approaching ground level	Conditional - Assess	$931,000
17	Alder Ave, Schooner Pl and along McCombs Dr sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	Conditional - Assess	$1,342,000

18	Myng Cr sewer improvements	Significant, 10-year event below ground level	Conditional - Assess	$164,000
19	Diamond St sewer improvements	Significant, 10-year event approaching ground level	Conditional - Assess	$593,000
20	McCombs Dr near Emerald Av sewer improvements	Significant, 10-year event approaching ground level	Conditional - Assess	$122,000
21	Walnut Ave sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	Conditional - Assess	$289,000
22	Echo Ave outlet sewer improvements	Significant, 10-year event below ground level	Conditional - Assess	$172,000
23	Balsam Ave sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	Conditional - Assess	$417,000
24	Esplanade Ave and Chehalis St sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	Conditional - Assess	$591,000
25	Miami River Dr outlet near Poplar St sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	Conditional - Assess	$199,000
26	Chestnut Ave sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	Conditional - Assess	$429,000
27	Various water quality improvements	Untreated areas where not addressed through other projects	Conditional - Assess	$405,000
Total				$10,446,000

11 CONCLUSIONS AND RECOMMENDATIONS

11.1 SUMMARY

The background review and storm sewer system modelling revealed that there are extensive storm sewer deficiencies based on the Village's existing design criteria. However, most deficient sewers have adequate capacity for the design flows with surcharging that remains below ground level. A high-level summary of the deficiencies is provided as follows:

- Potential access issues for storm sewer crossing private property
- Potential capacity and/or function issues at the Miami River Dike Pump Station could result in backwater conditions that limit storm sewer performance due to elevated water levels in Miami River
- Widespread areas with capacity issues, where surface flooding should be confirmed
- Widespread areas with no documented water quality treatment and inadequate information on the extent of water quality issues
- Inadequate information about the condition of the existing storm sewers
- Significant capacity issues along Bear Ave with high probability of surface flooding
- No drainage system on Echo Ave and documented drainage issues
- Backwater conditions along McPherson Rd due to beaver activity and an inappropriate drainage connection from the East Sector Recreation Area
- Municipal sewer crossing underneath building at 565 Lillooet Ave (private property)
- Inadequate drainage system on Hope Pl that is presumed to contribute to local I&I issues
- 18 additional areas with sewer systems that do not meet the Village's design criteria for pipe geometry, capacity, or water quality treatment where model results indicate the potential damage is low

11.2 RECOMMENDATIONS

Twenty-seven capital projects were identified based on the background review and storm sewer modelling. Nine of the projects are recommended. The 18 remaining projects have been identified as conditional because there is low risk of damage due to surface flooding. Where some surface flooding is expected for the 10-year storm, the project is classified as "Conditional – Monitor." Otherwise, the project is classified as "Conditional – Assess."

Assessment of the Miami River Dike Pump Station is the only project that has been identified as "High" priority based on the significant impact of the pump station on backwater conditions for the storm sewer system.

Three monitoring and/or assessment projects have been recommended as "Medium" priority. These projects will provide a better understanding of surface flooding risk, water quality issues, and condition issues that could result in pipe failures.

Three storm infrastructure improvement projects are recommended as "Medium" priority based on the existing surface flooding risk.

Two storm infrastructure improvement projects are recommended as "Low" priority based on private property access issues and potential contributions to sanitary sewer deficiencies.

A summary of total capital costs is provided in Table 11-1. It is recommended to initiate the monitoring and assessment projects in the near term. To improve understanding of risks that could result in flood damage, the surface flooding field verification program should be initiated immediately. Completion of a CCTV assessment to understand condition concerns and refine the capital works project prioritization is recommended to occur at the earliest feasibility based on available funding.

Table 11-1: Projects Summary by Priority

Project Priority	Number of Projects	Total Capital Costs
High	1	$30,000
Medium	6	$1,146,000[1]
Low	2	$799,000
Conditional - Monitor	6	$4,792,000
Conditional - Assess	12	$5,654,000
Total		$12,421,000
Notes: [1]Excludes estimated cost of $50,000/yr for stormwater quality monitoring program.		

In addition to the identified capital projects, the following recommendations are made regarding urban drainage concerns:

1. Confirm access rights for storm pipes crossing 114 Cedar Ave, 830 Ramona Pl, 861 and 875 Myng Cr.
2. The Village's Subdivision and Development Servicing Bylaw should be updated to require consideration of climate change impacts.
3. An updated Emergency Response Plan should be developed that considers hazards from urban drainage and flooding. A project to provide a Drainage/Sewer Emergency Response Plan is identified in the Sanitary Sewer Master Plan (Water Street Engineering Ltd., 2025).

12 CLOSURE

We trust this report meets your present requirements. Please contact the undersigned with any questions or comments.

WATER STREET ENGINEERING LTD.

David Marshall, PEng
Senior Water Resources Engineer

EGBC permit number 1000830

Neal Whiteside, MASC, PEng
Principal, Senior Municipal Engineer

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ABBREVIATIONS

CTQ – CTQ Consultants Ltd.

DCC – Development Cost Charge

DEM – digital elevation model

I&I – inflow and infiltration

IDF – intensity-duration-frequency

ISE – integral square error

LWMP – Liquid Water Management Plan

MH – maintenance hole

MMCD – Master Municipal Construction Documents

MOTT – Ministry of Transportation and Transit

NSE – Nash–Sutcliffe efficiency

NHC – Northwest Hydraulic Consultants Ltd.

OGS – Oil and Grit Separator

VHHS – Village of Harrison Hot Springs

Village – Village of Harrison Hot Springs

WWTP – wastewater treatment plant

DEFINITIONS

Minor System – The minor system is the infrastructure associated with the collection, conveyance and treatment of minor (frequently occurring) rainfall events. The minor system is to be designed to prevent flooding and property damage and to limit public inconvenience caused by rainfall events with a return period equal to or more frequent than the 10-year event.

Major System – The major system is the infrastructure associated with the collection, conveyance and treatment of major (infrequent) rainfall events. The major system is comprised of surface flood paths, swales, channels, watercourses, roadways, walkways, pathways, and flow control facilities. The major system is to be designed to protect the public and prevent significant property damage caused by rainfall events with a return period equal to or more frequent than the 100-year event.

APPENDIX 1: PROJECT DEFINITION SHEETS

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 1
Assess Pump Station
Priority: High

Project Description: Assess Miami River inlet to Harrison Lake pumps to confirm resilience to blockages at culvert inlet, adequate capacity of the pumps, and potential to lower operating water level at the pumps to improve storm sewer performace. Update analysis of storm sewer performance considering potential backwater condition within Miami River.

Deficiency: Resilience to culvert blockages, adequate inlet capacity to the pumps, storm sewer performance during backwater condition.

Additional Notes: Risk of widespread flooding issues if Miami River cannot be pumped to Harrison Lake during high water levels.

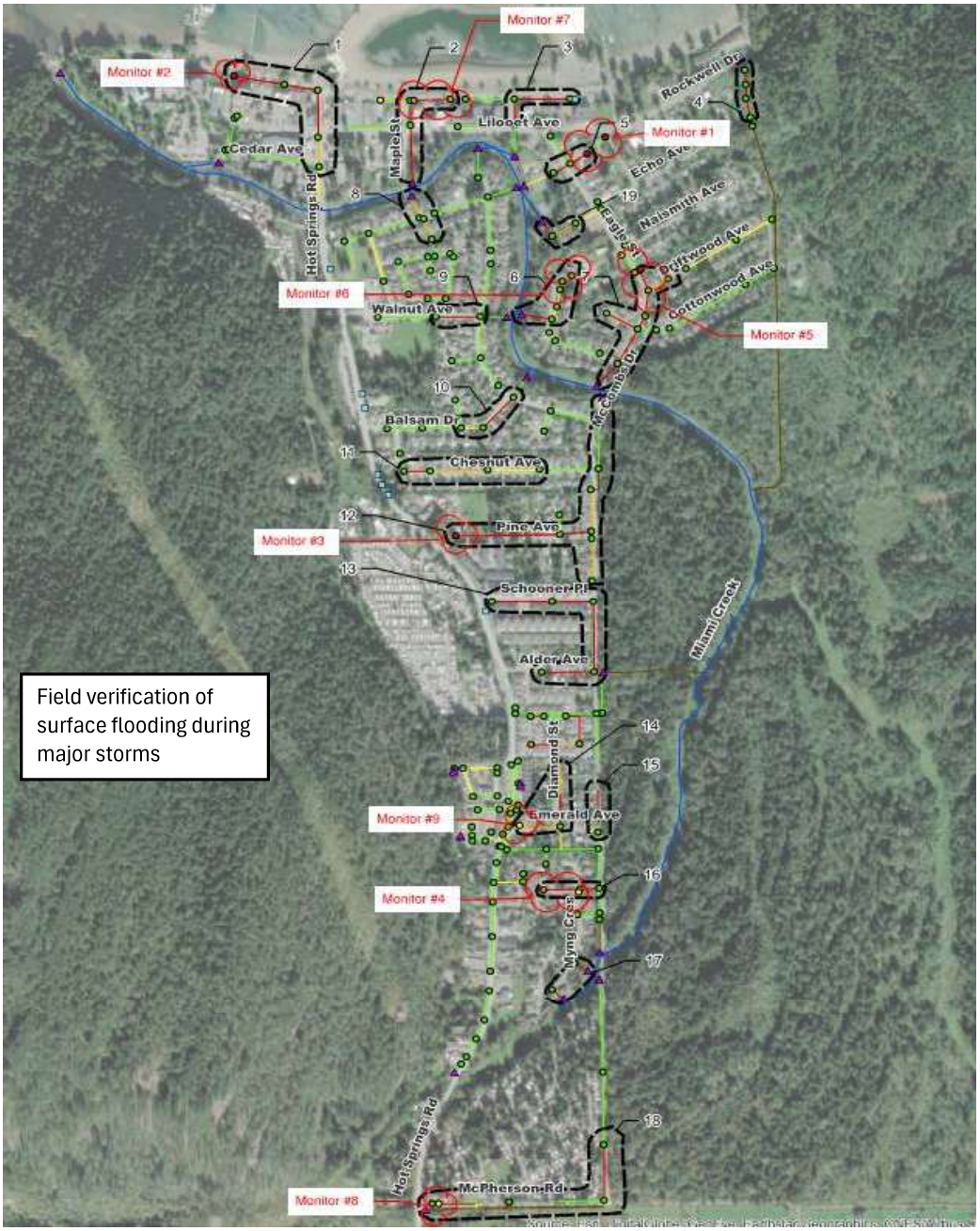
Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Assessment	LS	1	$ 25,000.00	$ 25,000
			Subtotal:		**$ 25,000**
			Administration Contingency (%)	**20%**	**$ 5,000**
			Total Estimated Cost:		**$ 30,000**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 2
Surface Flooding Field Verification Program
Priority: Medium

Project Description: Field verification program to verify surface flooding in vulnerable locations during major storms.

Deficiency: Potential surface flooding.

Additional Notes: Recommended field verification of surface flooding in areas with identified capacity constraints.



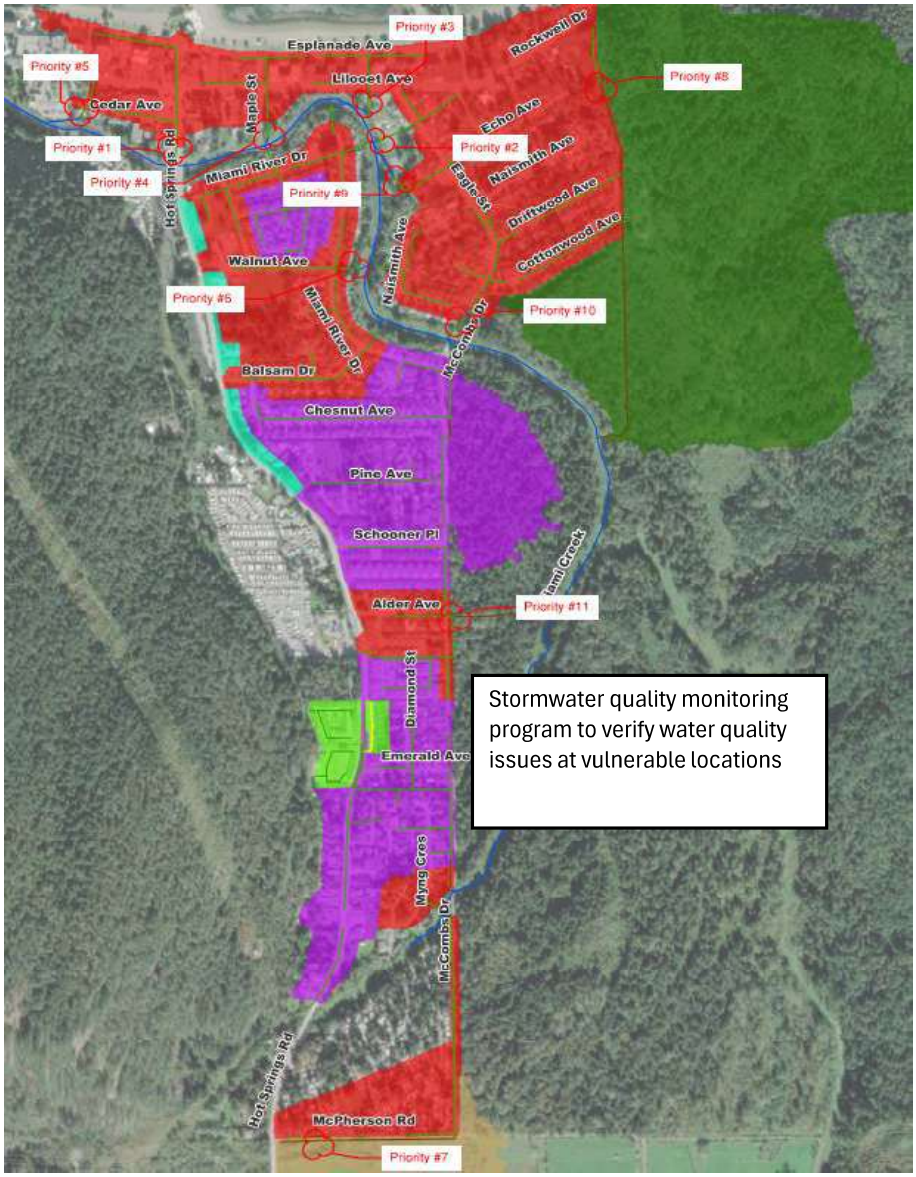
Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Field reviews	LS	1	$ -	$ -
			Total Estimated Cost:		**$ -**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 3
Stormwater Quality Monitoring Program
Priority: Medium

Project Description: Monitoring program to verify water quality issues in vulnerable locations during discharges. Assume 2 samples during dry seasons and 2 samples during wet season. Assume 5 - 10 sampling locations.

Deficiency: Untreated stormwater flows with potential for negative environmental impact.

Additional Notes: Recommended water quality monitoring during rainfall events to confirm areas to prioritize for stormwater treatment.



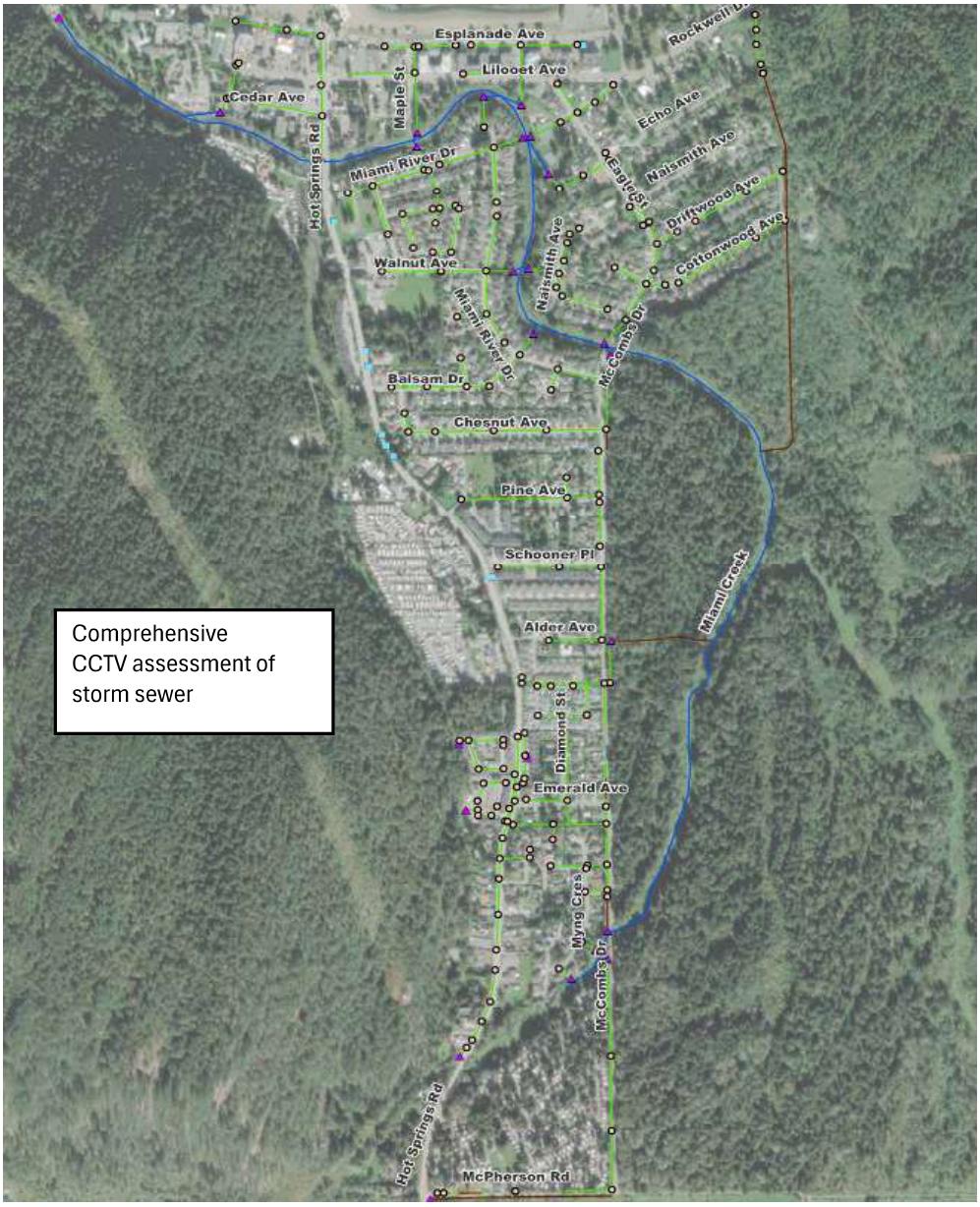
Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Monitoring program	per annum	1	$ 41,667.00	$ 41,667
			Subtotal:		**$ 41,667**
			Administration Contingency (%)	**20%**	**$ 8,333**
			Total Estimated Cost:		**$ 50,000**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 4
Storm Sewer Condition Assessment
Priority: Medium

Project Description: Comprehensive CCTV assessment of storm sewer system to identify condition issues.

Deficiency: Potentially unknown condition deficiencies.

Additional Notes: Recommended to assess condition of sewers older than 20 years (or undocumented age) to identify risks.



Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	CCTV Assessment	LS	1	$ 70,000.00	$ 70,000
2	Updated capital works plan	LS	1	$ 5,000.00	$ 5,000
			Subtotal:		**$ 75,000**
			Administration Contingency (%)	**20%**	**$ 15,000**
			Total Estimated Cost:		**$ 90,000**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 5
Bear Ave Sewer Improvements
Priority: Medium

Project Description: Upgrade 153m of existing storm main along Bear Ave to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement, outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year event surface flooding, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm is simulated at >0.5 m depth and 0.240 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	450mm Dia. Storm Sewer	m	70	$ 1,330.00	$ 93,221
2	450mm Dia. Storm Sewer	m	41	$ 1,330.00	$ 54,301
3	450mm Dia. Storm Sewer	m	42	$ 1,330.00	$ 56,016
4	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
5	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
6	Catchbasins	ea.	4	$ 4,600.00	$ 18,400
7	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 299,938**
	Design / Construction Management / Contingency (%)			**50%**	**$ 149,969**
			Total Estimated Cost:		**$ 449,907**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 6
New Sewer for Echo Ave Approaching Mount St and Outfall Improvements
Priority: Medium

Project Description: Add 122m of new storm main along Echo Ave to resolve lack of drainage system and clean out ditch outlet from Mount St sewer, which is currently buried. Provide capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement.

Deficiency: No drainage system connecting to Mount St and buried outlet. Drainage issues noted by Village.

Additional Notes: The severity of this issue is not quantified. Maximum surface flooding for future 100-year storm is 0.105 m^3/s.

Assumptions: Assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	300mm Dia. Storm Sewer	m	78	$ 1,140.00	$ 89,007
2	300mm Dia. Storm Sewer	m	44	$ 1,140.00	$ 50,137
3	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
4	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
5	Catchbasins	ea.	4	$ 4,600.00	$ 18,400
6	Ditch Maintenance	LS	1	$ 25,000.00	$ 25,000
			Subtotal:		**$ 253,544**
	Design / Construction Management / Contingency (%)			**50%**	**$ 126,772**
			Total Estimated Cost:		**$ 380,316**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 7
General Improvements for South McCombs Dr, McPherson Rd
Priority: Medium

Project Description: Resolve backwater condition on McPherson Rd from beaver dam, ditch upgrades and water quality upgrades along McPherson Rd ditch, eliminate drainage connection from East Sector Recreation Area to McCombs Dr.

Deficiency: Backwater condition from beaver dam on McPherson Rd ditch, unnecessary drainage connection to McCombs Dr.

Additional Notes: East Sector Recreation Area should not be flowing to McCombs Dr. Significant backwater on McPherson Rd due to beaver damming downstream of Hot Springs Rd culvert crossing needs to be resolved.

Assumptions: Balance of maintenance work and modest measures to discourage downstream beaver activity. Modest ditch improvements to reduce pollutant conveyance. Modest improvements to provide outflow to East Sector Recreation Area.

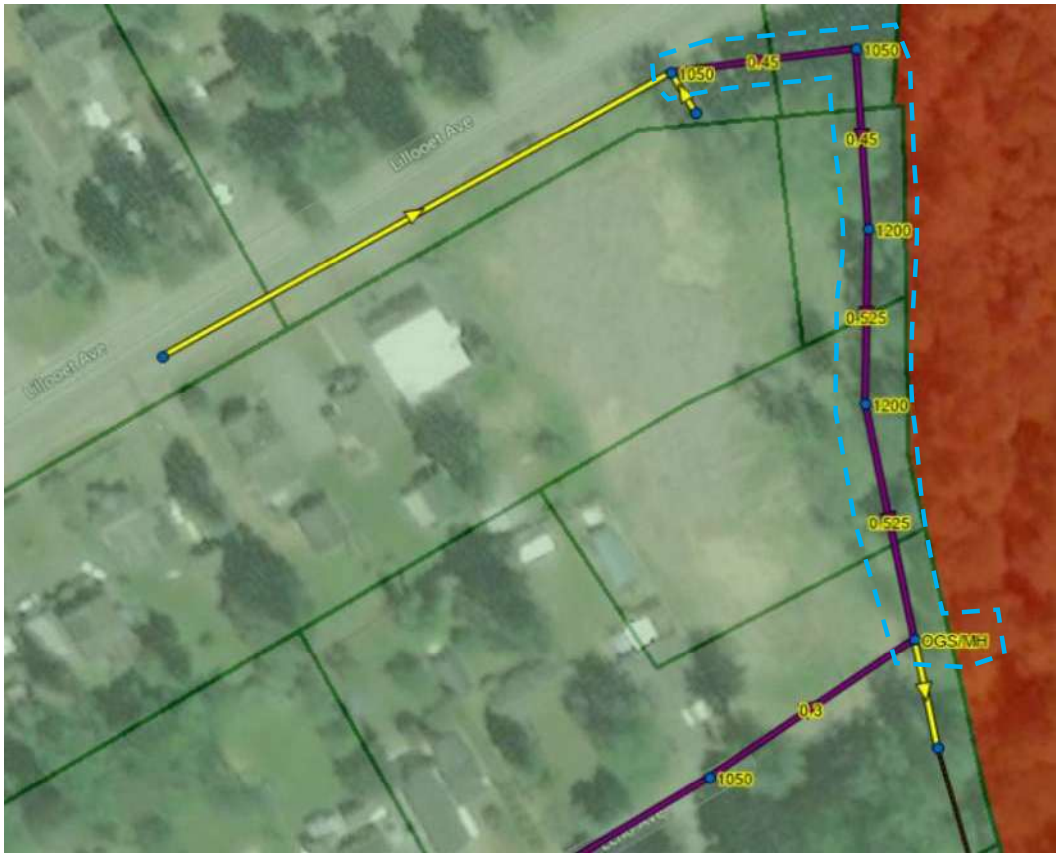
Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Resolve Beaver Dam Backwater Condition	LS	1	$ 50,000.00	$ 50,000
2	Water Quality Upgrades, Ditch Maintenance	LS	1	$ 80,000.00	$ 80,000
3	Eliminate Drainage Connection	LS	1	$ 20,000.00	$ 20,000
			Subtotal:		**$ 150,000**
			Design / Construction Management / Contingency (%)	**50%**	**$ 75,000**
			Total Estimated Cost:		**$ 225,000**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 8
Eliminate Private Property Sewer (565 Lillooet Ave)
Priority: Low

Project Description: Add 33m of new storm main from Lillooet Ave to eliminate crossing through 565 Lillooet Ave. Upgrade 108m of existing storm main along Mount St to accommodate and provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Water quality improvements and downstream improvements part of Project 6.

Deficiency: Sewer crosses under a building on private property

Additional Notes: Private sewer to be eliminated by connecting Lillooet Ave sewer to Mount St and upgrading capacity.



Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

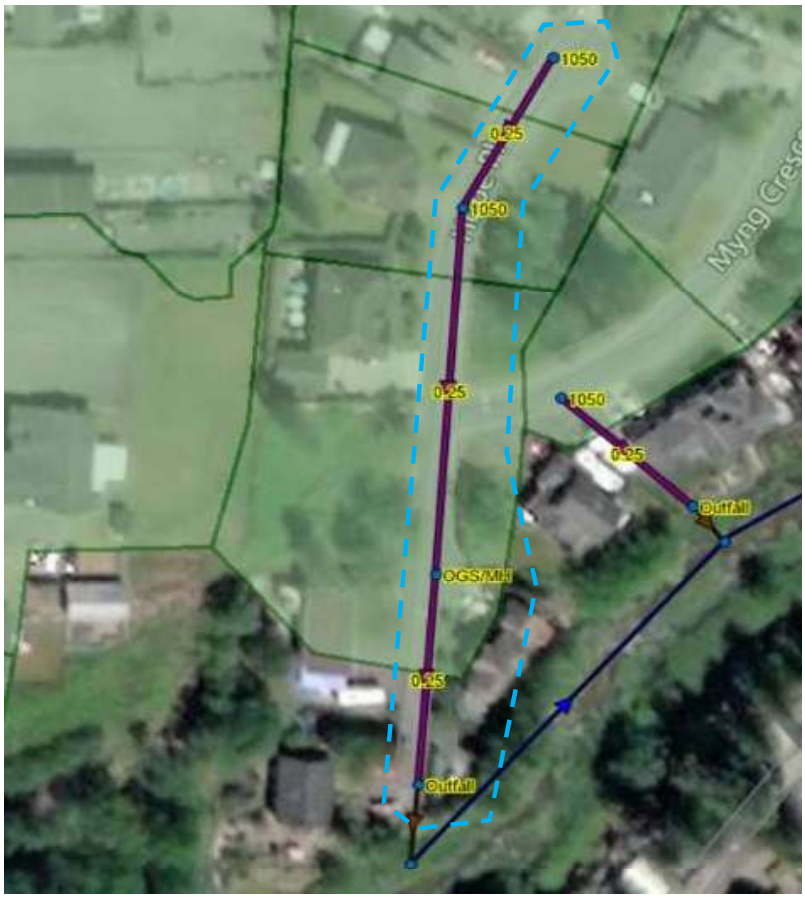
Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	450mm Dia. Storm Sewer	m	33	$ 1,330.00	$ 43,765
2	450mm Dia. Storm Sewer	m	33	$ 1,330.00	$ 43,692
3	525mm Dia. Storm Sewer	m	32	$ 1,575.00	$ 50,375
4	525mm Dia. Storm Sewer	m	44	$ 1,575.00	$ 68,769
5	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
6	1200mm Dia. Manhole	ea.	2	$ 14,000.00	$ 28,000
7	Catchbasins	ea.	4	$ 4,600.00	$ 18,400
			Subtotal:		**$ 279,001**
	Design / Construction Management / Contingency (%)			**50%**	**$ 139,500**
			Total Estimated Cost:		**$ 418,501**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 9
Angus Estates Drainage Improvements
Priority: Low

Project Description: Add 149m of new storm main along Hope Pl to resolve lack of drainage system and reduce local I&I. Provide capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement.

Deficiency: Excessive I&I in sanitary sewer.

Additional Notes: Improvements to be informed by I&I reduction program. Add storm sewer on Hope Pl with outlet to Miami Creek.



Assumptions: Assume approximately 2 catch basins per 100 m of sewer.

Item No.	Ref No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	250	250mm Dia. Storm Sewer	m	34	$ 1,050.00	$ 35,681
2	250	250mm Dia. Storm Sewer	m	73	$ 1,050.00	$ 76,759
3	250	250mm Dia. Storm Sewer	m	42	$ 1,050.00	$ 43,880
4	1050	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
5	2400	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
6	1000	Catchbasins	ea.	4	$ 4,600.00	$ 18,400
7	3000	Outfall	ea.	1	$ 7,000.00	$ 7,000
				Subtotal:		**$ 252,720**
				Design / Construction Management / Contingency (%)	**50%**	**$ 126,360**
				Total Estimated Cost:		**$ 379,080**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 10
Esplanade Ave and Hot Springs Rd Sewer Improvements
Priority: Conditional - Monitor

Project Description: Upgrade 442m of existing storm main along Esplanade Ave and Hot Springs Rd to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement, outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year event surface flooding, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.28 m depth and 0.098 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	450mm Dia. Storm Sewer	m	109	$ 1,330.00	$ 144,570
2	450mm Dia. Storm Sewer	m	72	$ 1,330.00	$ 95,152
3	525mm Dia. Storm Sewer	m	107	$ 1,575.00	$ 167,819
4	675mm Dia. Storm Sewer	m	67	$ 1,760.00	$ 117,374
5	675mm Dia. Storm Sewer	m	88	$ 1,760.00	$ 155,596
6	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
7	1200mm Dia. Manhole	ea.	2	$ 14,000.00	$ 28,000
8	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
9	Catchbasins	ea.	9	$ 4,600.00	$ 41,400
10	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 827,912**
	Design / Construction Management / Contingency (%)			**50%**	**$ 413,956**
			Total Estimated Cost:		**$ 1,241,868**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 11
Pine Ave and McCombs Dr Sewer Improvements
Priority: Conditional - Monitor

Project Description: Upgrade 400m of existing storm main along Pine Ave and McCombs Dr to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year event surface flooding, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.31 m depth and 0.133 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	525mm Dia. Storm Sewer	m	110	$ 1,575.00	$ 173,223
2	525mm Dia. Storm Sewer	m	110	$ 1,575.00	$ 173,223
3	525mm Dia. Storm Sewer	m	67	$ 1,575.00	$ 105,746
4	525mm Dia. Storm Sewer	m	95	$ 1,575.00	$ 149,790
5	525mm Dia. Storm Sewer	m	17	$ 1,575.00	$ 27,542
6	1200mm Dia. Manhole	ea.	5	$ 14,000.00	$ 70,000
7	Catchbasins	ea.	8	$ 4,600.00	$ 36,800
8	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 743,324**
	Design / Construction Management / Contingency (%)			**50%**	**$ 371,662**
			Total Estimated Cost:		**$ 1,114,987**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 12
Hadway Dr Sewer Improvements
Priority: Conditional - Monitor

Project Description: Upgrade 125m of existing storm main along Hadway Dr to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness.

Deficiency: Significantly below design criteria capacity, 10-year event surface flooding, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.17 m depth and 0.063 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	250mm Dia. Storm Sewer	m	7	$ 1,050.00	$ 7,749
2	300mm Dia. Storm Sewer	m	77	$ 1,140.00	$ 87,649
3	300mm Dia. Storm Sewer	m	40	$ 1,140.00	$ 46,112
4	1050mm Dia. Manhole	ea.	3	$ 13,000.00	$ 39,000
5	Storm Sewer Tie-In	ea.	1	$ 5,000.00	$ 5,000
6	Catchbasins	ea.	4	$ 4,600.00	$ 18,400
			Subtotal:		**$ 203,910**
	Design / Construction Management / Contingency (%)			**50%**	**$ 101,955**
			Total Estimated Cost:		**$ 305,865**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 13
Eagle St Sewer Improvements
Priority: Conditional - Monitor

Project Description: Upgrade 373m of existing storm main along Eagle St approaching Miami Creek to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement, outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year climate change event surface flooding, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.26 m depth and 0.028 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	300mm Dia. Storm Sewer	m	49	$ 1,140.00	$ 55,804
2	375mm Dia. Storm Sewer	m	75	$ 1,180.00	$ 88,137
3	450mm Dia. Storm Sewer	m	33	$ 1,330.00	$ 44,164
4	450mm Dia. Storm Sewer	m	59	$ 1,330.00	$ 77,910
5	525mm Dia. Storm Sewer	m	90	$ 1,575.00	$ 141,199
6	600mm Dia. Storm Sewer	m	67	$ 1,720.00	$ 115,986
7	1050mm Dia. Manhole	ea.	4	$ 13,000.00	$ 52,000
8	1200mm Dia. Manhole	ea.	1	$ 14,000.00	$ 14,000
9	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
10	Catchbasins	ea.	8	$ 4,600.00	$ 36,800
11	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 678,000**
	Design / Construction Management / Contingency (%)			**50%**	**$ 339,000**
			Total Estimated Cost:		**$ 1,017,000**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 14
Naismith Ave Outlet Sewer Improvements
Priority: Conditional - Monitor

Project Description: Upgrade 134m of existing storm main along Naismith Ave to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement, outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year climate change event surface flooding, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.13 m depth and 0.019 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

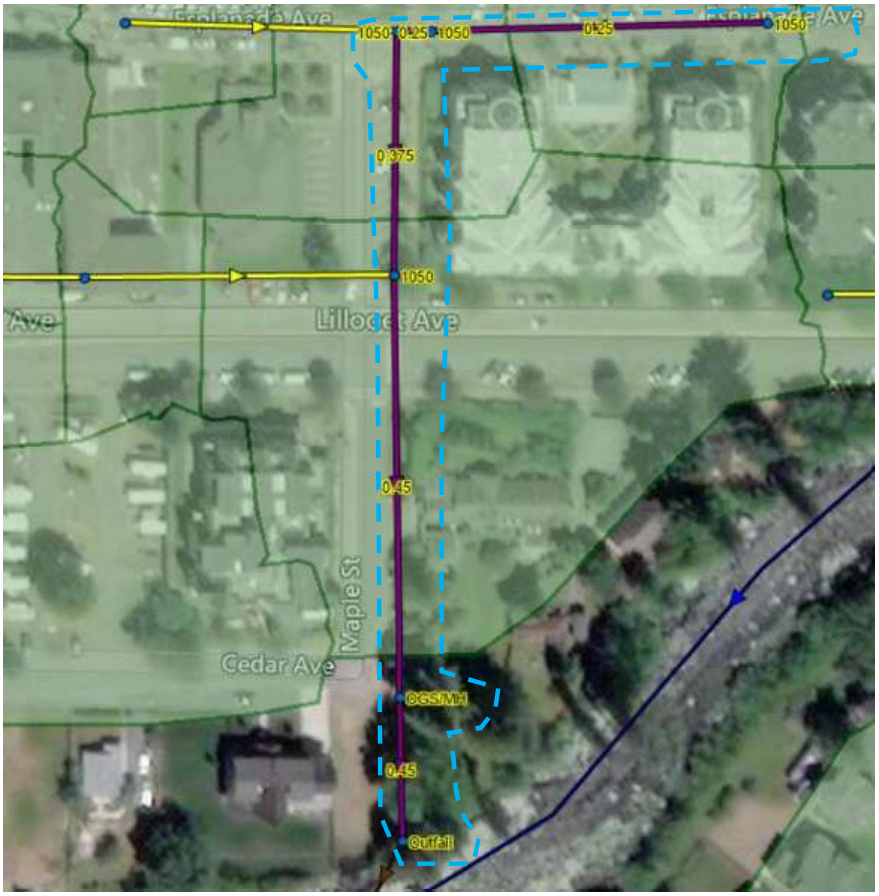
Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	375mm Dia. Storm Sewer	m	39	$ 1,180.00	$ 46,231
2	375mm Dia. Storm Sewer	m	30	$ 1,180.00	$ 35,087
3	525mm Dia. Storm Sewer	m	65	$ 1,575.00	$ 102,608
4	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
5	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
6	Catchbasins	ea.	4	$ 4,600.00	$ 18,400
7	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 280,327**
	Design / Construction Management / Contingency (%)			**50%**	**$ 140,163**
			Total Estimated Cost:		**$ 420,490**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 15
Esplanade Ave and Maple St Sewer Improvements
Priority: Conditional - Monitor

Project Description: Upgrade 271m of existing storm main along Esplanade Ave and Maple St to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement, outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year climate change event surface flooding, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.19 m depth and 0.042 m^3/s flow.



Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	250mm Dia. Storm Sewer	m	78	$ 1,050.00	$ 81,378
2	250mm Dia. Storm Sewer	m	8	$ 1,050.00	$ 8,378
3	375mm Dia. Storm Sewer	m	56	$ 1,180.00	$ 65,787
4	450mm Dia. Storm Sewer	m	130	$ 1,330.00	$ 173,142
5	1050mm Dia. Manhole	ea.	4	$ 13,000.00	$ 52,000
6	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
7	Catchbasins	ea.	6	$ 4,600.00	$ 27,600
8	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 460,286**
			Design / Construction Management / Contingency (%)	**50%**	**$ 230,143**
			Total Estimated Cost:		**$ 690,428**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 16
South Portion of McCombs Dr, McPherson Rd Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 361m of existing storm main along McPherson Rd and McCombs Dr to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add outfall protection. Water quality improvements and ditch improvements part of Project 7.

Deficiency: Significantly below design criteria capacity, 10-year event approaching ground level.

Additional Notes: CB on McCombs Dr should be lowered to improve drainage capture. Collapsed pipes noted in 2016 LWMP (to be confirmed). Maximum surface flooding for future 100-year storm simulated at 0.06 m depth and 0.007 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	250mm Dia. Storm Sewer	m	14	$ 1,050.00	$ 14,654
2	250mm Dia. Storm Sewer	m	30	$ 1,050.00	$ 31,530
3	2500mm Dia. Culvert	m	12	$ 860.00	$ 10,096
4	300mm Dia. Storm Sewer	m	89	$ 1,140.00	$ 101,002
5	375mm Dia. Storm Sewer	m	75	$ 1,180.00	$ 88,115
6	375mm Dia. Storm Sewer	m	15	$ 1,180.00	$ 17,378
7	525mm Dia. Storm Sewer	m	127	$ 1,575.00	$ 199,959
8	1050mm Dia. Manhole	ea.	5	$ 13,000.00	$ 65,000
9	1200mm Dia. Manhole	ea.	2	$ 14,000.00	$ 28,000
10	Catchbasins	ea.	8	$ 4,600.00	$ 36,800
11	Intake	ea.	1	$ 7,000.00	$ 7,000
12	Outfall	ea.	3	$ 7,000.00	$ 21,000
			Subtotal:		**$ 620,534**
	Design / Construction Management / Contingency (%)			**50%**	**$ 310,267**
			Total Estimated Cost:		**$ 930,802**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 17
Alder Ave, Schooner Pl and Along McCombs Dr Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 512m of existing storm main along Alder Ave, Schooner Pl, and McCombs Dr to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement, outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year event below ground level, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.09 m depth and 0.012 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	375mm Dia. Storm Sewer	m	15	$ 1,180.00	$ 17,819
2	375mm Dia. Storm Sewer	m	6	$ 1,180.00	$ 6,554
3	375mm Dia. Storm Sewer	m	128	$ 1,180.00	$ 151,044
4	450mm Dia. Storm Sewer	m	96	$ 1,330.00	$ 127,639
5	450mm Dia. Storm Sewer	m	69	$ 1,330.00	$ 91,198
6	450mm Dia. Storm Sewer	m	87	$ 1,330.00	$ 115,307
7	600mm Dia. Storm Sewer	m	93	$ 1,720.00	$ 159,380
8	600mm Dia. Storm Sewer	m	15	$ 1,720.00	$ 26,326
9	900mm Dia. Storm Sewer	m	4	$ 2,100.00	$ 7,797
10	1050mm Dia. Manhole	ea.	5	$ 13,000.00	$ 65,000
11	1200mm Dia. Manhole	ea.	2	$ 14,000.00	$ 28,000
12	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
13	Catchbasins	ea.	10	$ 4,600.00	$ 46,000
14	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 894,064**
			Design / Construction Management / Contingency (%)	**50%**	**$ 447,032**
			Total Estimated Cost:		**$ 1,341,096**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 18
Myng Cr Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 63m of existing storm main along Myng Cr to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year event below ground level.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.03 m depth and 0.022 m^3/s flow.

Assumptions: All manholes require replacement.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	250mm Dia. Storm Sewer	m	31	$ 1,050.00	$ 32,563
2	300mm Dia. Storm Sewer	m	32	$ 1,140.00	$ 36,316
3	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
4	Outfall	ea.	2	$ 7,000.00	$ 14,000
			Subtotal:		**$ 108,878**
			Design / Construction Management / Contingency (%)	**50%**	**$ 54,439**
			Total Estimated Cost:		**$ 163,318**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 19
Diamond St Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 274m of existing storm main along Diamond St and Emerald Ave to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness.

Deficiency: Significantly below design criteria capacity, 10-year event approaching ground level.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.17 m depth and 0.021 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	250mm Dia. Storm Sewer	m	86	$ 1,050.00	$ 90,186
2	300mm Dia. Storm Sewer	m	62	$ 1,140.00	$ 70,338
3	375mm Dia. Storm Sewer	m	51	$ 1,180.00	$ 60,614
4	375mm Dia. Storm Sewer	m	76	$ 1,180.00	$ 89,090
5	1050mm Dia. Manhole	ea.	4	$ 13,000.00	$ 52,000
6	Storm Sewer Tie-In	ea.	1	$ 5,000.00	$ 5,000
7	Catchbasins	ea.	6	$ 4,600.00	$ 27,600
			Subtotal:		**$ 394,828**
			Design / Construction Management / Contingency (%)	**50%**	**$ 197,414**
			Total Estimated Cost:		**$ 592,242**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 20
McCombs Dr Near Emerald Ave Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 51m of existing storm main or culvert along McCombs Dr to provide flow capacity for year 2050 10-year storm event.

Deficiency: Significantly below design criteria capacity, 10-year event approaching ground level.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.05 m depth and 0.011 m^3/s flow.

Assumptions: All manholes require replacement.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	250mm Dia. Culvert	m	34	$ 860.00	$ 29,537
2	250mm Dia. Sewer	m	17	$ 1,050.00	$ 17,538
3	1050mm Dia. Manhole	ea.	1	$ 13,000.00	$ 13,000
4	Intake	ea.	2	$ 7,000.00	$ 14,000
5	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 81,075**
	Design / Construction Management / Contingency (%)			**50%**	**$ 40,537**
			Total Estimated Cost:		**$ 121,612**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 21
Walnut Ave Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 94m of existing storm main along Walnut Ave to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality treatment.

Deficiency: Significantly below design criteria capacity, 10-year event below ground level, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.04 m depth and 0.014 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

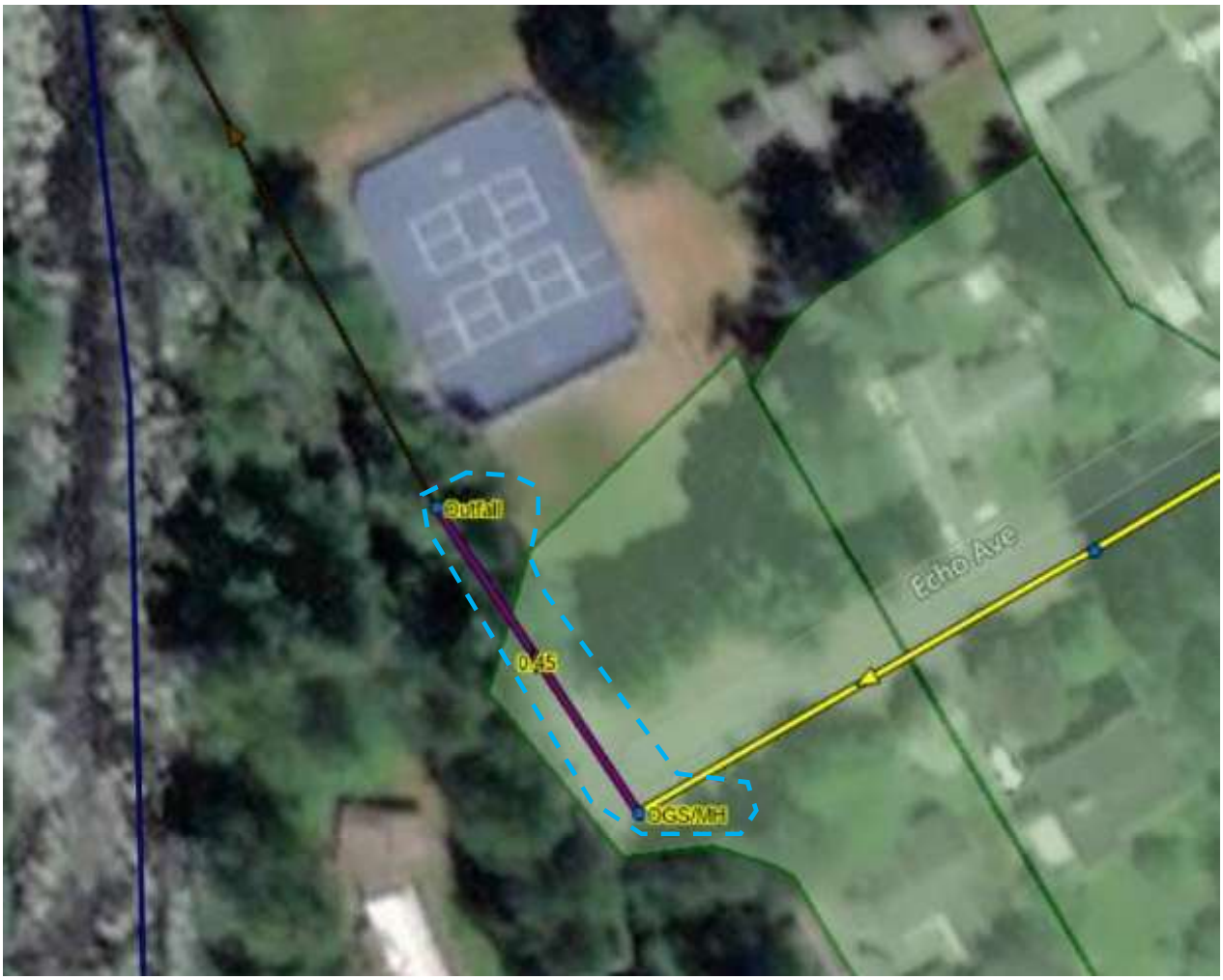
Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	450mm Dia. Storm Sewer	m	94	$ 1,330.00	$ 124,992
2	1050mm Dia. Manhole	ea.	1	$ 13,000.00	$ 13,000
3	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
4	Catchbasins	ea.	2	$ 4,600.00	$ 9,200
			Subtotal:		**$ 192,192**
	Design / Construction Management / Contingency (%)			**50%**	**$ 96,096**
			Total Estimated Cost:		**$ 288,288**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 22
Echo Ave Outlet Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 40m of existing storm main along Echo Ave to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement, outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year event below ground level.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.07 m depth and 0.007 m^3/s flow.



Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	450mm Dia. Storm Sewer	m	40	$ 1,330.00	$ 53,010
2	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
3	Catchbasins	ea.	2	$ 4,600.00	$ 9,200
4	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 114,210**
	Design / Construction Management / Contingency (%)			**50%**	**$ 57,105**
			Total Estimated Cost:		**$ 171,315**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 23
Balsam Ave Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 141m of existing storm main along Balsam Ave to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality treatment.

Deficiency: Significantly below design criteria capacity, 10-year event below ground level, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.07 m depth and no flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	450mm Dia. Storm Sewer	m	95	$ 1,330.00	$ 125,991
2	450mm Dia. Storm Sewer	m	47	$ 1,330.00	$ 62,068
3	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
4	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
5	Catchbasins	ea.	4	$ 4,600.00	$ 18,400
			Subtotal:		**$ 277,459**
	Design / Construction Management / Contingency (%)			**50%**	**$ 138,730**
			Total Estimated Cost:		**$ 416,189**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 24
Esplanade Ave and Chehalis St Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 248m of existing storm main along Esplanade Ave and Chehalis St to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement, outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year event below ground level, insufficient overland flow route.

Additional Notes: No surface flooding, just sewer surcharging below ground level.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	375mm Dia. Storm Sewer	m	118	$ 1,180.00	$ 138,967
2	375mm Dia. Storm Sewer	m	55	$ 1,180.00	$ 65,119
3	375mm Dia. Storm Sewer	m	75	$ 1,180.00	$ 88,282
4	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
5	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
6	Catchbasins	ea.	5	$ 4,600.00	$ 23,000
7	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 393,369**
	Design / Construction Management / Contingency (%)			**50%**	**$ 196,684**
			Total Estimated Cost:		**$ 590,053**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 25
Miami River Dr Outlet Near Poplar St Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 53m of existing storm main from Miami Creek Dr to Miami Creek near Poplar St to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement, outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year event below ground level, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.05 m depth and 0.007 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	450mm Dia. Storm Sewer	m	53	$ 1,330.00	$ 71,039
2	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
3	Catchbasins	ea.	2	$ 4,600.00	$ 9,200
4	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 132,239**
	Design / Construction Management / Contingency (%)			**50%**	**$ 66,120**
			Total Estimated Cost:		**$ 198,359**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 26
Chestnut Ave Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 177m of existing storm main along Chestnut Ave to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness.

Deficiency: Significantly below design criteria capacity, 10-year event below ground level, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.28 m depth and 0.098 m^3/s flow

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

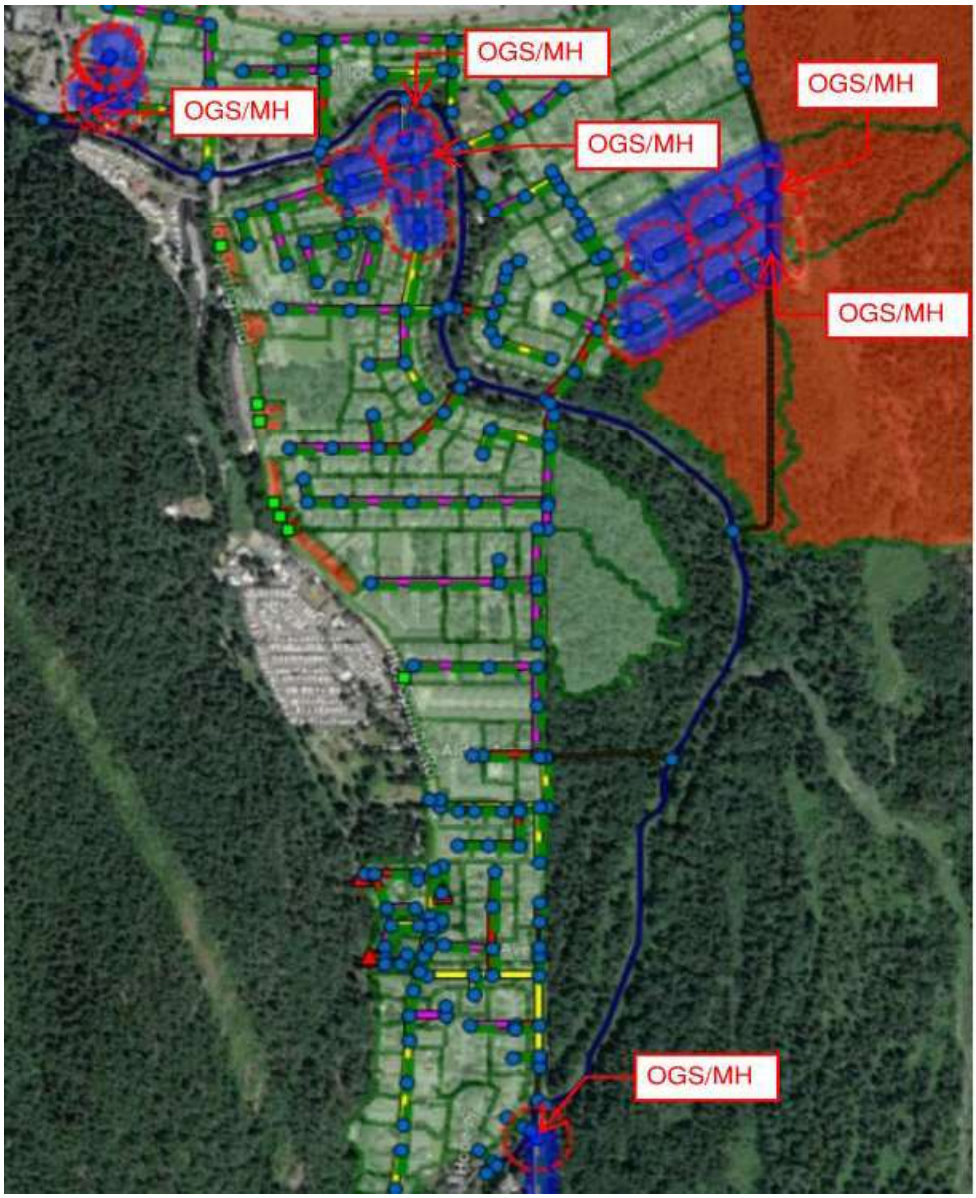
Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	375mm Dia. Storm Sewer	m	55	$ 1,180.00	$ 65,084
2	450mm Dia. Storm Sewer	m	122	$ 1,330.00	$ 162,297
3	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
4	1200mm Dia. Manhole	ea.	1	$ 14,000.00	$ 14,000
5	Catchbasins	ea.	4	$ 4,600.00	$ 18,400
			Subtotal:		**$ 285,781**
			Design / Construction Management / Contingency (%)	**50%**	**$ 142,891**
			Total Estimated Cost:		**$ 428,672**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 27
Various Water Quality Improvements
Priority: Conditional - Assess

Project Description: Upgrade various outlets to provide water quality improvements.

Deficiency: Untreated areas where not addressed through other projects.

Additional Notes: Largely residential areas with low priority based on expected pollutant load. Exception is Alice St area.



Assumptions: OGS / Manhole provided at each outlet without water quality treatment.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	OGS / Manhole	ea.	6	$ 45,000.00	$ 270,000
			Subtotal:		**$ 270,000**
			Design / Construction Management / Contingency (%)	**50%**	**$ 135,000**
			Total Estimated Cost:		**$ 405,000**