4.13 Priority Site #11: Exposed Sanitary Sewer Crossing Upstream of Blessed Trinity Parish

Priority Site #11 is located in Reach N3 of Newtonbrook Creek, approximately 210 metres downstream of the Maxome Culvert Crossing, and 50 metres upstream of a Pedestrian Bridge. Scouring along the creek bed has partially exposed a 250 mm diameter PVC sanitary sewer (**Figure 4-61**) that crosses the creek before feeding into the 675 mm sanitary trunk sewer that runs through the lower reaches of Newtonbrook Creek. The exposed portion of the sewer is not encased in concrete and is therefore directly vulnerable to damage from exposure to hydrodynamic forces.

Evidence of channel widening and lateral bank erosion is evident at this location, in addition to the aforementioned scouring, with a loose piece of geotextile fabric visible in an unprotected eroded bank (**Figure 4-62**). The opposite bank is protected by a gabion basket retaining wall found to be in fair condition, with a few baskets starting to fail due to undermining and failure of the wire mesh. Immediately downstream of the crossing, a 675 mm diameter storm sewer outfall discharges to Newtonbrook Creek. The storm sewer outfall is setback a few meters from the main channel, with an engineered outfall channel that is integrated into a gabion retaining wall (**Figure 4-63**). Unique to this priority site is the fact that the site is situated within a hydro corridor and that three (3) oil & gas pipelines owned by Sun Canadian, Trans-Northern and Imperial Oil cross the creek within a 20-metre buffer of the sanitary sewer crossing. Field investigations indicate that none of the three pipelines are exposed, however the depth of cover over each pipeline remains uncertain. Upstream and downstream channel conditions indicate that the vertical and lateral erosion observed at this priority site is not localized, but is occurring consistently at a reach scale (**Figure 4-64**).

Figure 4-61: Exposed Sewer in Channel Bed Without Visible Encasement

Figure 4-62; Bank Subject to Erosion with Degraded Geotextile Fabric

Figure 4-63: Gabion Basket Bank with Storm Outfall Circled in Red

Figure 4-64: Channel Conditions in Close Proximity to Exposed Sewer

Sanitary Sewer parameters relevant to this priority site are summarized below in **Table 4-14** with a drawing illustrating the existing conditions of the project site presented in **Figure 4-65**.

Table 4-14: Summary of Priority Site #11 Sanitary Sewer Parameters

Parameter	Sanitary Trunk Sewer
Toronto Water Asset ID	SL4032523
Year of Construction	1987
Diameter	250 mm
Depth of Cover	Exposed
Estimated Time to Contact	0 years
Erodibility of Adjacent Substrate	Moderate

4.13.1Priority Site #11 – Description of Restoration Alternatives

Alternative 1: Do Nothing – The risk to the sanitary sewer crossing will continue to increase as the channel continues to erode further exposing the PVC pipe to damage. Continued unmitigated erosion may also eventually lead to the exposure of the three (3) oil pipelines crossing Newtonbrook Creek at this location. Emergency works may need to be undertaken in the future if the sanitary sewer or any of the oil pipelines rupture or fail.

Alternative 2: Local Works – Apply natural channel design works for approximately 120 metres of channel length including riffle-pool morphology and bioengineered bank treatments (vegetated buttresses). The proposed works will tie-into existing conditions upstream where Newtonbrook Creek confluences with a major storm sewer outfall channel. The downstream tie-in point will be situated immediately upstream of the downstream pedestrian bridge crossing. Adjustments to the longitudinal profile, planimetric alignment and typical channel dimensions will look to stabilize the creek from a geomorphic perspective. The proposed solution will establish 1.0 metres depth of cover over the sanitary sewer crossing, and will have the added benefit of also increasing the depth of the cover over sanitary sewer crossing #12, located downstream of this priority site, from an estimated 1.19 metres to 1.50 metres. Depth of cover over each of three (3) oil and gas pipelines will also be increased by a minimum of 1.0 m. Vegetated buttresses will be placed along the outside of each meander bend for erosion protection, with any erosion scars filled in using approved materials. The slopes behind the channel works will be regraded to tie-into existing conditions and will be stabilized through the application of coir matting and restoration plantings. A new armourstone retaining wall will be constructed along both channel banks to mitigate lateral erosion risks to sanitary sewer infrastructure and the three (3) oil pipelines. The existing storm sewer will be also retained and integrated into the Armourstone retaining wall, with an engineered scour pool.

Alternative 3: Sub-Reach-Based Works – Apply natural channel design works for approximately 435 metres of channel length. Accumulated debris, including failed erosion control works, will be removed with riffle-pool morphology established through the placement of engineered substrate. Adjustments to the longitudinal profile, planimetric alignment and typical channel dimensions will look to stabilize the creek from a geomorphic perspective. The slopes behind the channel works will be regraded to tie-into existing conditions and stabilized.

The proposed solution will increase the depth of cover over the exposed sanitary sewer crossing by 1.0 m, and will also increase the depth of cover overtop of a major watermain crossing downstream (Priority Site #10) to a minimum of 1.42 metres (current estimated depth of cover is 0.42 m). As an added benefit the depth of cover overtop of two buried sanitary sewer crossings (Priority Sites #39 and #43) will be increased to a minimum of 1.50 m. The proposed channel restoration works will also help to establish an additional meter of cover overtop of four (4) oil and gas pipelines owned by Sun-Canadian, Imperial Oil, Trans-Northern and Enbridge Gas (The Enbridge Pipeline crossing is located downstream of the local works extents). Two (2) storm sewer outfalls (Priority Sites #64 and #69) will also be rehabilitated as part of the proposed sub-reach-based works solution.

Preliminary concept drawings illustrating Alternative 2 and Alternative 3 are provided in **Figure 4-66**.

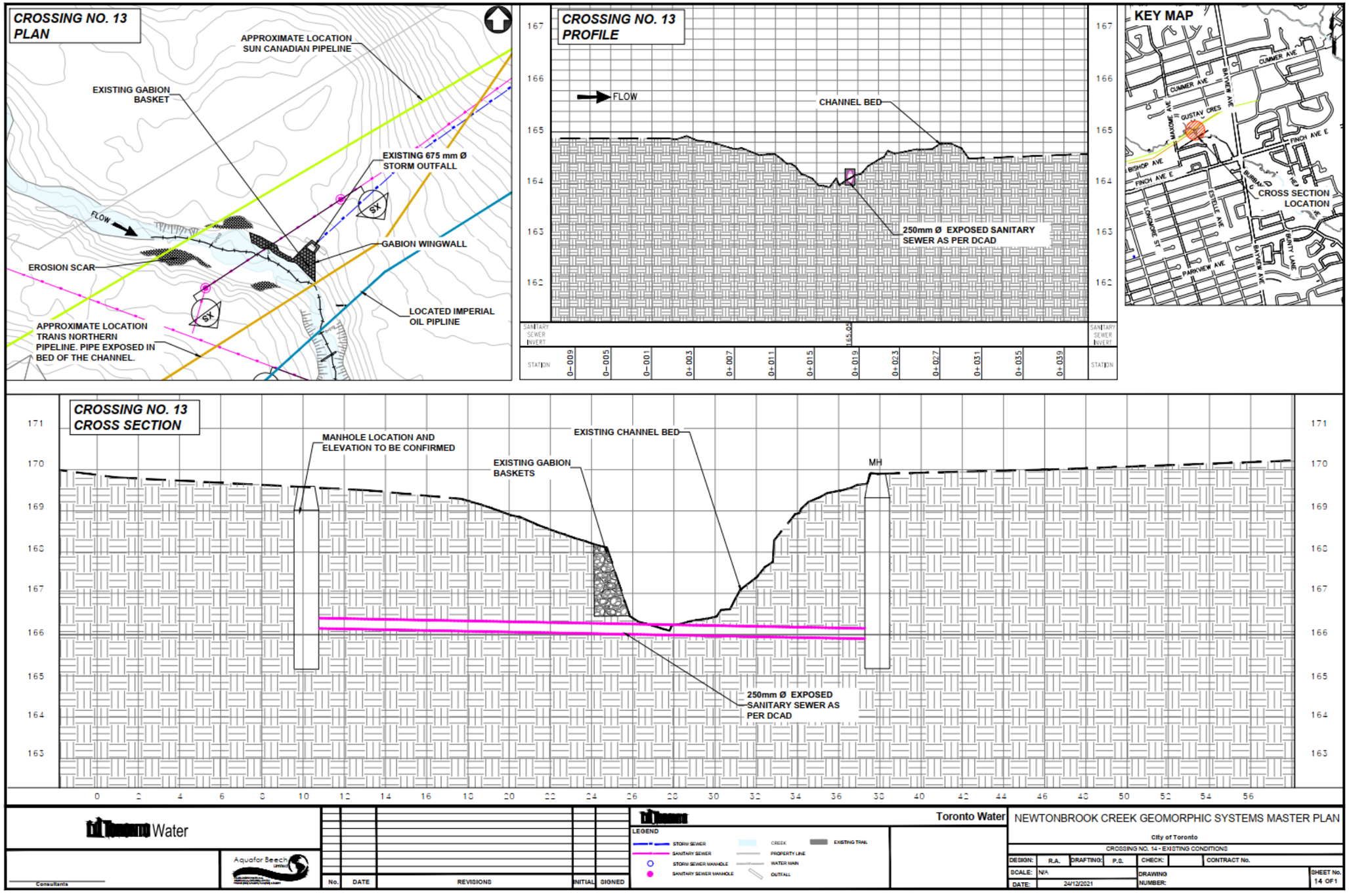

Figure 4-65: Existing Conditions - Priority Site #11

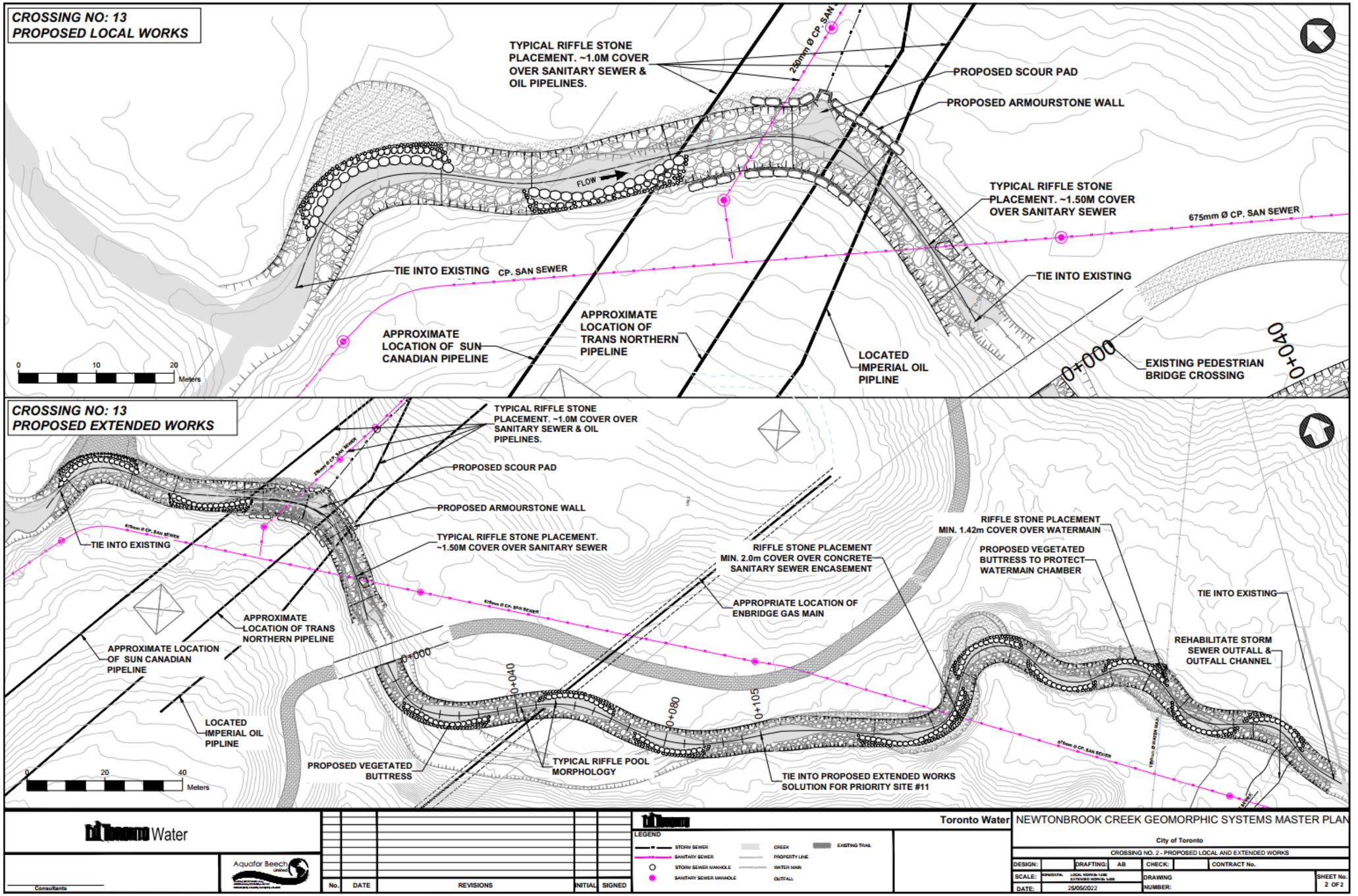

Figure 4-66: Preliminary Design Concepts Alternative 2 & 3 – Priority Site #11

4.13.2Priority Site #11 – Evaluation of Restoration Alternatives

Restoration Alternatives for Priority Site #11 were evaluated using the methodology outlined in **Section 4.2.** Based on this evaluation process, Alternative 2 - Local Works was selected as the preferred alternative.

4.13.3Priority Site #11 – Selection of the Preferred Alternative

As per the evaluation table, the Local Works option was selected as the preferred alternative for Priority Site #11 with a total score of 81.33/100. The Sub-Reach-Based Works solution was the second preferred alternative with a total score of 77.40/100 while the Do Nothing alternative was the least preferred alternative with a total score of 37.33/100.

Key elements of the Local Works alternative include:

- Removal of channel debris and failed erosion control structures (i.e., gabion baskets).
- Apply approximately 120 metres of channel restoration work using natural channel design principles to establish riffle-pool morphology.
- Where feasible, lower and regrade channel banks to restore floodplain connectivity.
- Provide a minimum of 1.0 metres of cover overtop of the exposed sanitary sewer crossing.
- Mitigate lateral erosion risks to storm sewer and sanitary sewer infrastructure through the construction of armourstone retaining wall and vegetated buttress bank treatments.
- Increase the depth of cover overtop of the three oil pipelines (Trans-Northern, Sun-Canadian and Imperial Oil) by a minimum of 1.0 m.
- Increase the depth of cover overtop of the downstream sanitary trunk sewer crossing (identified as Priority Site #39 - SL4034029) from 1.19 metres to a minimum of 1.50 m.
- Rehabilitate the existing storm sewer outfall as required (Priority Site #64 - OF4950913010) and integrate the outfall into the proposed armourstone retaining wall.
- Establish a geomorphically stable transition into existing channel conditions at the upstream and downstream tie-in points.
- Apply restoration plantings to compensate for construction-related vegetation removals and to help stabilize regraded slopes.
- Coordination with Enbridge to establish a smooth transition between the proposed channel restoration works and Enbridge's planned future channel works project to protect their gas main crossing located downstream.
- Coordination with Pipeline companies to confirm design standards for depth of cover and construction requirements with respect to utility stabilization and protection.

4.14 Priority Site #12: Failed Storm Sewer Outfall at Hi Mount Drive

Priority Site #12 is located in Reach BR1 of Blue Ridge Creek, roughly 80-100 metres upstream of the Creek's confluence with the East Don River. A municipal storm sewer, collecting stormwater inflows from Hi Mount Drive and the upstream sewer shed, flows down into the Blue Ridge Valley corridor between the houses at 59 & 55 Hi Mount Drive. The storm sewer is a 600 mm diameter corrugated metal pipe (CMP), that outlets to the creek via a concrete headwall located at the toe of the valley slope (**Figure 4-67)**. The headwall structure is setback approximately 35 metres from the main channel, conveying flows to the creek through a steeply graded outfall channel lined with Gabion Baskets and Armourstone blocks (**Figure 4-68)**.

A combination of degrading pipe infrastructure, overland flow erosion, and unstable slope conditions have contributed to the complete failure of this drainage system. A number of gullies/sinkholes have formed along the length of the storm sewer pipe, with the CMP having become visibly detached at a number of locations (**Figure 4-69)**. The concrete headwall itself is in poor condition and is showing signs of starting to shift/slump downslope (**Figure 4-70)**. In its current state, the drainage system is unable to effectively convey flows from Hi Mount Drive downslope. Continued expansion of the existing erosion gullies and sinkholes is expected if this site is not effectively remediated, creating significant erosion risks to private property. A 300 mm diameter sanitary sewer is also offset around 2.0 metres to the east of the storm sewer, conveying sanitary flows from Hi Mount Drive to the Trunk sewer that runs through the Blue Ridge Creek valley corridor. While currently unexposed, this sewer is also at risk of failure/damage if the erosion gullies along the length of the storm sewer continue to expand and migrate upslope.

Figure 4-67: Storm Outfall Failure in the Slope of the Valley

Figure 4-68: Degraded Outfall Channel

Figure 4-69: Two Failed Pipes Upslope of Headwall

Figure 4-70: Sinkhole Observed Upstream of Headwall Structure

Storm Sewer parameters relevant to this priority site are summarized in **Table 4-15** with a drawing illustrating the existing conditions of the project site presented in **Figure 4-71**.

Table 4-15: Summary of Priority Site #12 Outfall Parameters

Parameter	Outfall
Toronto Water Asset ID	OF4830215159
Year of Construction	1977
Diameter	Medium (250 – 1200 mm)
Shape	Circular
Material	CMP
Headwall	Concrete headwall
Outfall Condition	Failed
Erodibility of Adjacent Substrate	High

4.14.1Priority Site #12 – Description of Restoration Alternatives

Alternative 1: Do Nothing – If left unaddressed the erosion gullies and sinkholes observed upslope of the outfall will continue to erode due to a combination of uncontrolled overland flow, and storm flows discharging partway up the unprotected slope where the CMP has become detached or damaged. Overtime additional pipe segments may become exposed and dislodged and continued erosion along the valley slope may create significant erosion related risks to private properties on Hi Mount Drive as well as the adjacent sanitary sewer. The concrete headwall and engineered outfall channel will also continue to degrade overtime and may eventually fail.

Alternative 2: Local Works – Repair/Replace two (2) segments of failed/damaged storm sewer pipe (total length of approximately 74.10 m), as per the City's recommendation, maintaining the same pipe alignment in planform. Care must be taken to construct the pipes with appropriate bedding and backfill materials, as per City standards, to prevent future failure. All sewer repair/replacement works must also be coordinated with other City departments / basement flooding projects. Erosion sinkholes and gullies along the slope should be infilled with engineered fill and appropriately compacted. The degraded concrete headwall and failing gabion basket protection should be replaced with a new headwall structure discharging to an armourstone lined scour pool. The outfall channel should be re-graded and lined with engineered substrate, tying into the main channel through vegetated buttress lined banks. An easement / permission to enter agreement with 59 Hi Mount Drive will be required to undertake these works.

Alternative 3: Sub-Reach-Based Works – Complete the same local works solution proposed above (Alternative 2), as part of a larger project, intended to apply natural channel works along the lower portion of reach BR1. This will include approximately 275 metres of channel restoration work intended to build the creek back up and stabilize this segment of Blue Ridge creek from a geomorphic perspective. The proposed works will extend from the Creek's confluence with the East Don River, upstream to the confluence with Reach BR2, and will include a combination of riffle-pool morphology coupled with a mixture of engineered bank treatments (vegetated buttresses and armourstone retaining walls).

Adjustments to the longitudinal profile, planimetric alignment and typical channel dimensions will look to stabilize the creek and provide increased lateral cover to the sanitary trunk sewer that runs through the Blue Ridge Creek Valley Corridor. These works will have the added benefit of not only restoring the failed storm sewer outfall, but will also address lateral erosion risk sites #17 & #18, which have been defined as priority sites #23 & #40 respectively. These works are intended to tie-into a second sub-reach-based works alternative, intended to address priority sites #13, #14, #15, #21, #29, and #36 by restoring the remaining upstream portion of Reach BR1.

Preliminary concept drawings illustrating Alternative 2 and Alternative 3 are provided in **Figure 4-72**.

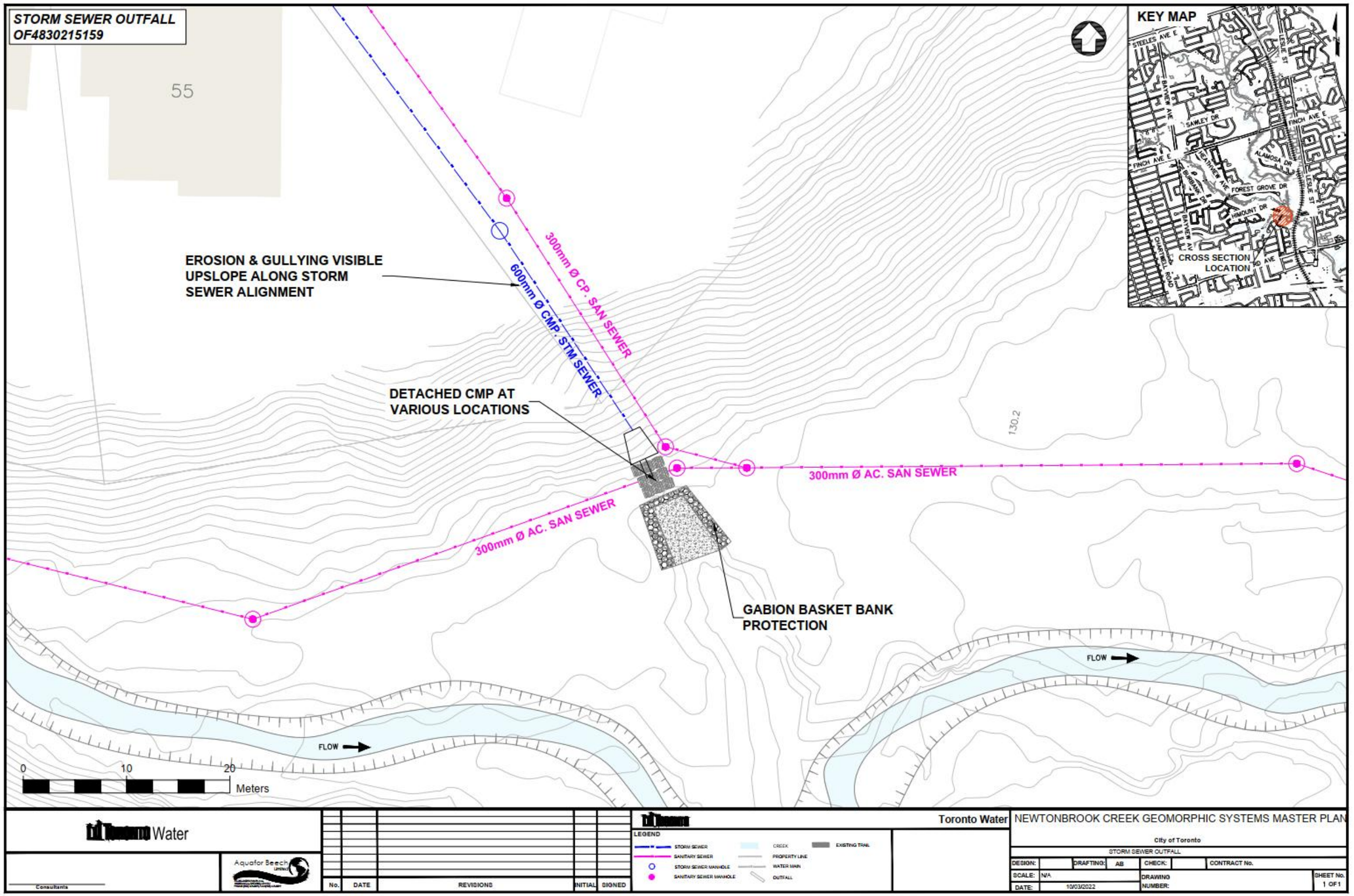

Figure 4-71: Existing Conditions - Priority Site #12

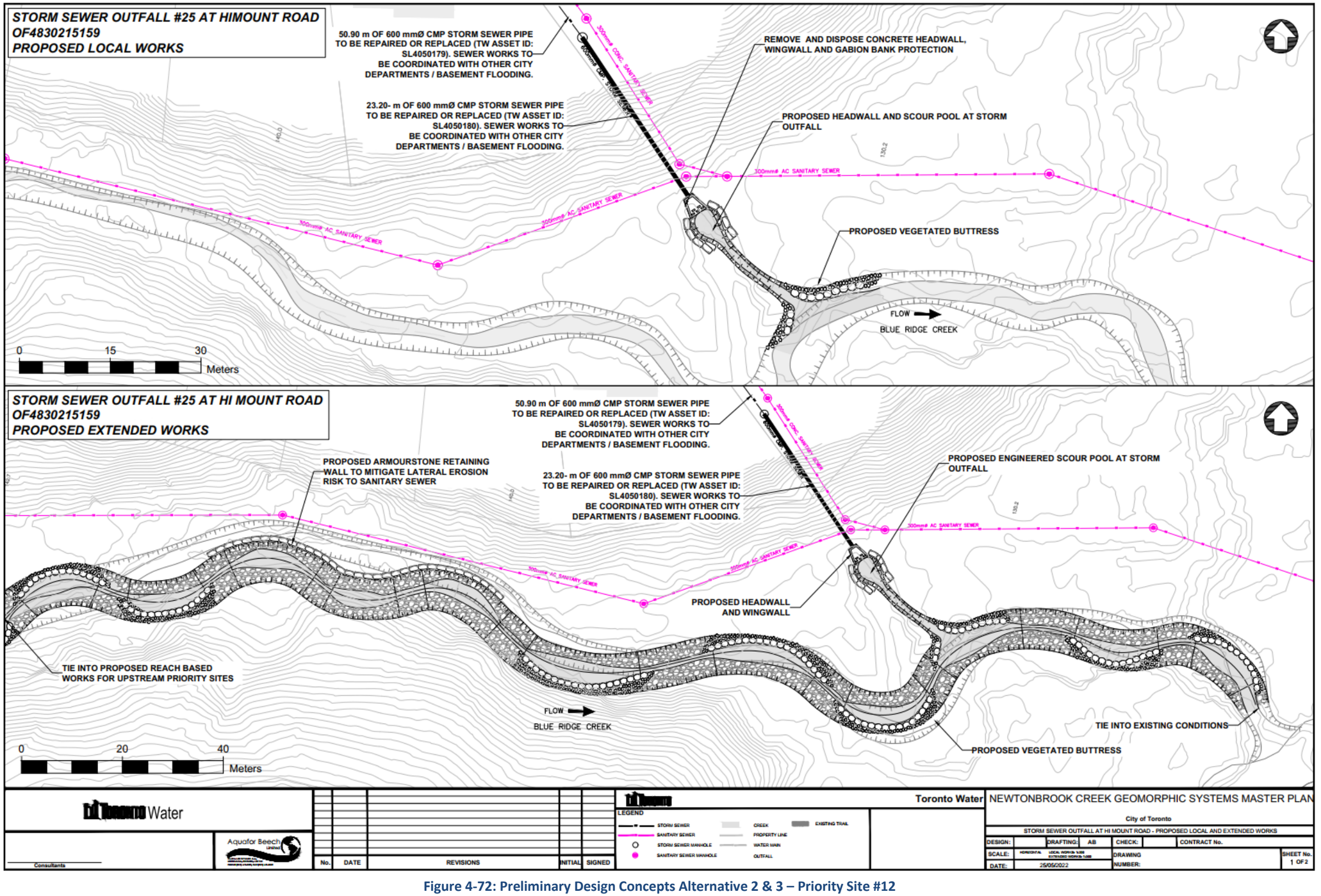

Figure 4-72: Preliminary Design Concepts Alternative 2 & 3 – Priority Site #12

4.14.2Priority Site #12 – Evaluation of Restoration Alternatives

Restoration Alternatives for Priority Site #12 were evaluated using the methodology outlined in **Section 4.2.** Based on this evaluation process, Alternative 3 - Sub-Reach-Based Works was selected as the preferred alternative.

4.14.3Priority Site #12 – Selection of the Preferred Alternative

As per the evaluation table, the Sub-Reach-Based Works option was selected as the preferred alternative for Priority Site #12 with a total score of 80.53/100. The local works solution was the second preferred alternative with a total score of 64.33/100 while the Do Nothing alternative was the least preferred alternative with a total score of 36.93/100.

Key elements of the Sub-Reach-Based Works alternative include:

- Removal of channel debris, failed erosion control structures (i.e., gabion baskets), and failed Toronto Water Infrastructure (i.e., failed outfall and storm sewer pipe segments).
- Repair/Replace approximately 74 metres of failed corrugated metal storm sewer pipe, maintaining the same general pipe alignment in planform. All sewer repair/replacement works must be coordinated with other City departments / basement flooding projects.
- Replace the failed outfall structure.
- Construct an engineered scour pool with an armourstone lined outfall channel that transitions into the main branch of Newtonbrook Creek. Give consideration to routing the outfall channel to transition into Newtonbrook Creek at an oblique angle to help mitigate scouring and erosion at the confluence.
- Restore the failed slope through regrading and infilling of observed sinkholes and gullies with appropriately compacted fill materials. Apply additional slope stabilization measures (i.e., soil anchors, coir logs, etc.) as defined at the detailed design phase.
- Undertake construction along a steep valley slope, including working between private properties on Hi Mount Drive.
- Apply approximately 275 metres of channel restoration work using natural channel design principles to establish riffle-pool morphology.
- Where feasible, lower and regrade channel banks to restore floodplain connectivity.
- Mitigate lateral erosion risks to sanitary sewer infrastructure (Priority Site #23 - SL4053177 and Priority Site #40 - SL4051741), through minor channel realignment and the construction of engineered bank treatments (i.e., armourstone walls and vegetated buttresses).
- Provide benefit to private properties by providing toe erosion protection at select locations.
- Transition into a second sub-reach-based works project upstream intended to address priority sites Priority Site #15 - SL4030293, Priority Site #21 - SL4030487, Priority Site #29 - MH4825114957, SL4030369, and Priority Site #36 - SL4030294.
- Coordinate permission to enter agreements and/or land/easement acquisitions as required to facilitate construction. Private property impacts to be confirmed at detailed design.

4.15 Priority Site #13: Failed Storm Sewer Outfall at Citation Drive

Priority Site #13 is located in Reach BR1 of Blue Ridge Creek, just upstream of the confluence between Reaches BR1 and BR2 (**Figure 4-73**, **Figure 4-74**). There is a sanitary sewer crossing of Reach BR2, immediately upstream of the aforementioned confluence. The estimated depth of cover above this crossing is 1.40 m, with a corresponding estimated time to contact of 122 years. The sewer crossing itself is therefore considered a lower priority risk site, ranked as priority site #37 for the purposes of this risk assessment report. However, while the sewer crossing itself is sufficiently protected, the upstream maintenance hole structure is in very poor condition and needs repair. The concrete casing around the maintenance hole has degraded, exposing brick underneath, and creating a fall risk to pedestrians. As the maintenance hole is not functioning safely, a temporary pipe conduit has been installed and a blue tarp covers the maintenance hole **(Figure 4-75)**.

The degraded maintenance hole has two (2) inletting sanitary sewers: a 300 mm diameter sewer that runs through the Blue Ridge Creek Valley corridor and a second 300 mm diameter sewer conveying sanitary flows collected from Citation Drive. This second sanitary sewer runs down a steep valley slope between two private properties at the end of Citation Drive. Running parallel to the sanitary sewer line is a 600 mm diameter Corrugated Metal Pipe storm sewer that was designed to outlet to the creek at the toe of the valley. The downstream segments of the storm sewer pipe and the outfall structure itself have failed, leading to the formation of large erosion gullies along the valley slope. Segments of detached corrugated metal pipes are also visible upslope (**Figure 4-76**).

Figure 4-73: Channel Conditions Upstream of Confluence with Tributary BR-2

Figure 4-74: Channel Conditions Downstream of Confluence with Tributary BR-2

Figure 4-75: Highly Degraded Maintenance Hole Covered By Tarp

Figure 4-76: Detached Pipe Upstream of Storm Outfall, Located Adjacent to Degraded Maintenance Hole

Sanitary Sewer & Storm Sewer parameters relevant to this priority site are summarized in **Table 4-16** with a drawing illustrating the existing conditions of the project site presented in **Figure 4-77**.

Table 4-16: Summary of Priority Site #13 Sanitary Sewer Parameters

Parameter	Outfall
Toronto Water Asset ID	OF4824214956
Year of Construction	1977
Diameter	Medium (250 – 1200 mm)
Shape	Circular
Material	CMP
Headwall	Concrete
Outfall Condition	Failed
Erodibility of Adjacent Substrate	High

Parameter	Sanitary Trunk Sewer	Exposed Maintenance Hole
Toronto Water Asset ID	SL4030369	MH4824014951
Year of Construction	1955	1977
Diameter	300	N/A
Depth of Cover	1.5 m	None
Estimated Time to Contact	122 years	N/A
Erodibility of Adjacent Substrate	high	high

4.15.1Priority Site #13 – Description of Restoration Alternatives

Alternative 1: Do Nothing – If left unaddressed the erosion gullies and sinkholes observed upslope of the outfall will continue to erode. Overtime additional pipe segments may become exposed and dislodged, and continued erosion along the valley slope may create significant erosion related risks to private properties on Citation Drive as well as the adjacent sanitary sewer. The degraded maintenance hole structure may also continue to fail, creating risks to the inletting and out-letting sewer pipes.

Alternative 2: Local Works – Remove three (3) segments of failed/damaged storm sewer pipe (total length of approximately 97.30 m), and two (2) segments of sanitary sewer pipe (total length of approximately 94.7 m) as per the City's recommendation, and replace with a new set of concrete pipes maintaining the same pipe alignment in planform. Care must be taken to construct the pipes with appropriate bedding and backfill materials to prevent future failure. Erosion sinkholes and gullies along the slope should be infilled with engineered fill and appropriately compacted. A new concrete headwall structure is to be constructed and integrated into a vegetated buttress designed to mitigate lateral erosion risks to Toronto Water infrastructure. The degraded maintenance hole structure will be repaired, with the eroded slope around the maintenance hole regraded and filled in using approved materials. An easement / permission to enter agreement with 141 & 142 Citation Drive may be required to undertake these works.

Alternative 3: Sub-Reach-Based Works – Complete the same local works solution proposed above (Alternative 2), as part of a larger project, intended to apply natural channel works along the upper portion of reach BR1. This will include approximately 300 metres of channel restoration work intended to build the creek back up and stabilize this segment of Blue Ridge creek from a geomorphic perspective. The proposed works will extend from the confluence of Reaches BR1 and BR2 to just upstream of the confluence between Reaches BR3 and BR1. The restoration works will include a combination of riffle-pool morphology coupled with a mixture of engineered bank treatments. These works will have the added benefit of addressing priority sites #14, #15, #21, #29, and #36, and are intended to tie-into a second sub-reach-based works alternative designed to address priority sites #12, #23 & #40 by restoring the remaining downstream portion of Reach BR-1. Preliminary concept drawings illustrating Alternative 2 and Alternative 3 are provided in **Figure 4-78**.

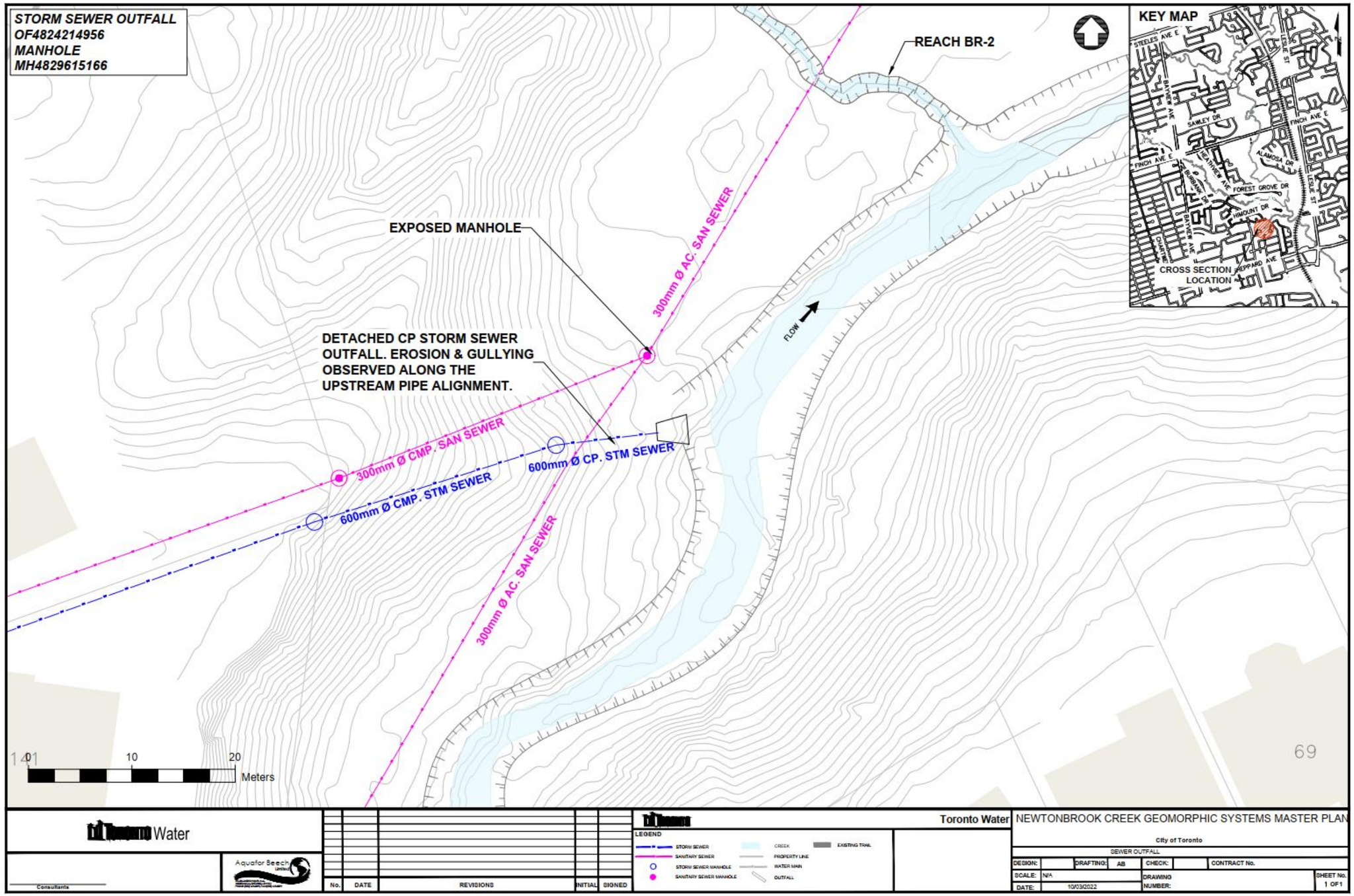

Figure 4-77: Existing Conditions - Priority Site #13

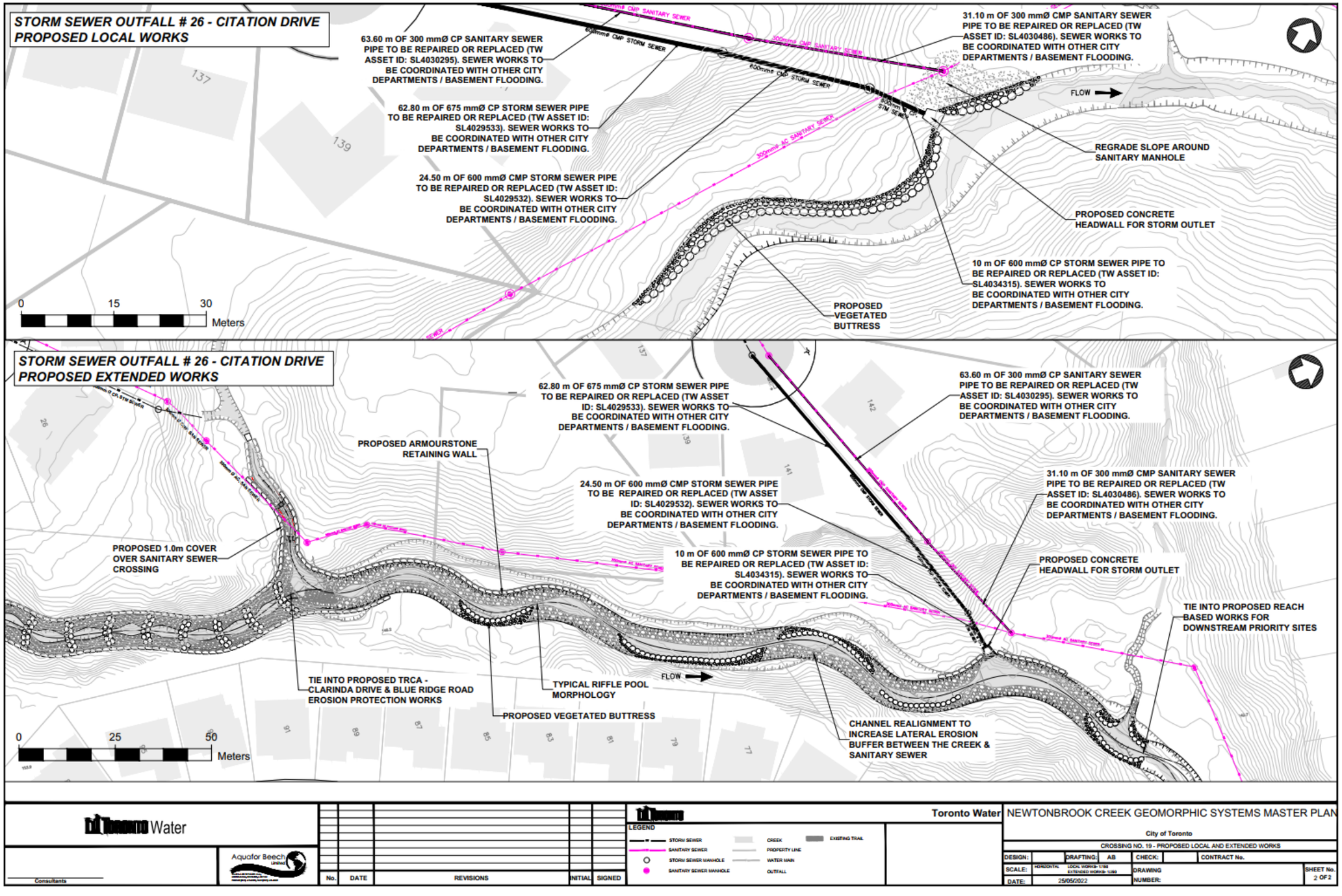

Figure 4-78: Existing Conditions - Priority Site #13

4.15.2Priority Site #13 – Evaluation of Restoration Alternatives

Restoration Alternatives for Priority Site #13 were evaluated using the methodology outlined in **Section 4.2.** Based on this evaluation process, Alternative 3 - Sub-Reach-Based Works was selected as the preferred alternative.

4.15.3Priority Site #13 – Selection of the Preferred Alternative

As per the evaluation table, the Sub-Reach-Based Works option was selected as the preferred alternative for Priority Site #13 with a total score of 80.53/100. The local works solution was the second preferred alternative with a total score of 64.33/100 while the Do Nothing alternative was the least preferred alternative with a total score of 36.93/100.

Key elements of the Sub-Reach-Based Works alternative include:

- Removal of channel debris, failed erosion control structures (i.e., gabion baskets, armourstone walls, etc.), and failed Toronto Water Infrastructure (i.e., failed outfall and sewer pipe segments).
- Repair/Replace approximately 97.30 metres of failed corrugated metal storm sewer pipe, maintaining the same general pipe alignment in planform. All sewer repair/replacement works must be coordinated with other City departments / basement flooding projects.
- Repair/Replace approximately 94.7 metres of sanitary sewer pipe, maintaining the same general pipe alignment in planform. All sewer repair/replacement works must be coordinated with other City departments / basement flooding projects.
- Retrofit/Repair the degraded maintenance hole structure and Replace the failed storm sewer outfall.
- Construct an engineered scour pool with an armourstone lined outfall channel that transitions into the main branch of Blue Ridge Creek. Consider routing the outfall channel to transition into Blue Ridge Creek at an oblique angle to help mitigate scouring and erosion at the confluence.
- Restore the failed slope through regrading and infilling of observed sinkholes and gullies with appropriately compacted fill materials. Apply additional slope stabilization measures (i.e., soil anchors, coir logs, etc.) as defined at the detailed design phase.
- Undertake construction along a steep valley slope, including working between private properties on Citation Drive.
- Apply approximately 300 metres of channel restoration work using natural channel design principles to establish riffle-pool morphology.
- Provide 1.0 metres of cover overtop of an exposed sanitary sewer crossing upstream (Priority Site #14 - SL4029711).
- Mitigate four lateral erosion risk sites to sanitary sewer infrastructure (Priority Site #15 - SL4030293, Priority Site #21 - SL4030487, Priority Site #29 - MH4825114957, SL4030369, and Priority Site #36 - SL4030294), through minor channel realignment and the construction of engineered bank treatments (i.e., armourstone walls and vegetated buttresses).
- Establish a geomorphically stable transition into existing channel conditions and a TRCA proposed channel restoration project to benefit private properties on Clarinda Drive at the upstream tie-in points.