

Stormwater Evaluation

Crosstown Canal

Village of Potsdam

Prepared for:

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1.0 EXECUTIVE SUMMARY

The Village of Potsdam supports a number of infrastructure services to provide an above-average quality of life to its residents. These services include water supply, wastewater collection and treatment, hydroelectric power generation, and stormwater collection and conveyance.

On September 30, 2010, the Village experienced a significant rainfall event following a period where 22 out of the previous 30 days had measurable rainfall. This event resulted in its stormwater collection and conveyance system (Crosstown Canal) being overwhelmed with a volume of runoff that the existing system could not handle. Drainage swale and collection points overflowed within the Village, which resulted in the residents being directly affected.

As a result, the Village conducted a preliminary investigation to understand the impact of the September 30th event to the existing stormwater systems, as well as understand the Village's goal in performing a study on the existing systems. The preliminary investigation included review of closed circuit televising video (CCTV) obtained by the Village, utilizing of a HydroCAD software to model differing storm events and their impact on the Crosstown Canal, and recommended improvements. One of the improvements recommended was to eliminate three utility obstructions within the canal to prevent accumulation of sediment and debris. The Village completed this project in the summer/fall 2017. Following completion of this project, a portion of the canal roof collapsed within Canal Street which impacted residences in this area. Based on this evaluation, the following is recommended:

- Install stormwater storage areas for sub-watershed Nos. 5 and 6
- Replace the roof of the Crosstown Canal and rehabilitate the walls and floor

The Village retained Environmental Design and Research, Landscape Architecture, Engineering & Environmental Services, D.P.C. (EDR) to perform an evaluation of the Crosstown Canal which includes:

- Meet with Village staff to update information and background knowledge.
- Perform a visual inspection of the interior of the canal utilizing CCTV video provided by the Village and visual inspection from the road (no entry).
- Perform a structural review of the Crosstown Canal and provide recommended improvements.
- Perform a hydraulic analysis of the Crosstown Canal and provide recommended improvements.

2.0 PROJECT BACKGROUND AND HISTORY

2.1 Site Information

The Village of Potsdam's Crosstown Canal was built in the early 1900's and serves a drainage area of approximately 800 acres which is divided into six sub-watersheds. The Crosstown Canal is located below grade within the Village limits and begins south of Potsdam High School and continues along Broad Street, Waverly Avenue, Pleasant Street, Market Street, and Canal Street and ultimately discharges to the Raquette River. An outline of the Crosstown Canal System is shown on Figure 1.

Land uses within the drainage area are medium density residential, university, business, and farm land. Within the Village, stormwater is collected from rooftops and impervious surfaces through catch basins and roof leaders. Stormwater collected outside of the Village is conveyed to the canal via sheet and open channel flow and accounts for approximately 550 acres of the total drainage area contributing to the Crosstown Canal. Stormwater runoff from the Town of Potsdam runs directly into the Village's Crosstown Canal System at the following locations:

- Sub-watershed No. 5 located north of Potsdam High School
- Sub-watershed No. 6 located south of Potsdam High School

Soils within the Village of Potsdam consist predominantly of clay and sandy loam (Hydrologic Soil Group C) and fill material. Topography within the Village is generally flat and the depth to groundwater is approximately 8-feet.

The Village of Potsdam is located adjacent to the Raquette River. The river water elevation is controlled through dams located upstream, within and downstream of the Village with varying elevation throughout the year. Flood insurance rate maps indicate the presence of special hazard areas inundated by the 100-year flood (Zone A) present along the open channel north of Potsdam High School prior to entering the Crosstown Canal. Additionally, the base flood elevation at the discharge to the Raquette River is shown to be at elevation 400.

2.2 Ownership and Service Area

The Crosstown Canal is owned and maintained by the Village of Potsdam with a total contributing drainage area of 800 acres, with approximately 250 acres within Village limits and 550 acres outside Village limits. The Crosstown Canal is located within easements on private property in several locations throughout the Village. Currently, the Village maintains the Crosstown Canal System. The cost of maintenance is funded by the Village budget.

Based on U.S. census data from 2010 and 2016, the population within the Village grew from 9,422 to 9,708 (3%). However, industrial and commercial growth within the Village has remained consistent for the past decade and a significant variation in population is not anticipated in the near future. Based on the U.S Census bureau, the median household income in the Village of Potsdam in 2016 was \$36,300.

2.3 Existing Facilities and Present Condition

2.3.1 Crosstown Canal Description

The Crosstown Canal System drainage area is approximately 800 acres with approximately 550 acres draining into the Village's stormwater collection system from the Town of Potsdam. Two stormwater entrance headwalls are located at the north and south ends of Potsdam High School. The influent headwall located to the north feeds a 4-foot tall by 4-foot wide canal section, which ties into the main line at the intersection of Market



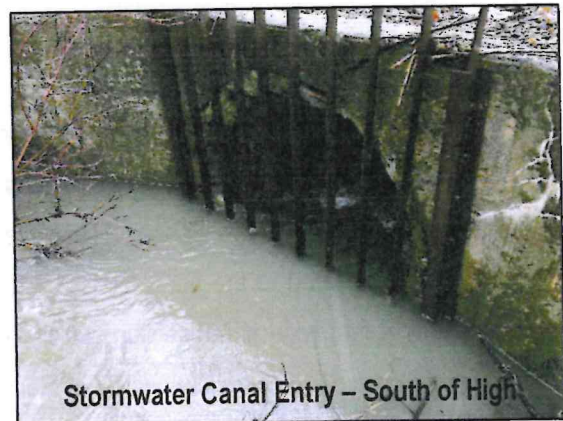
Street and Canal Street. To the south, the headwall feeds a 40-inch reinforced concrete pipe (RCP) and is the beginning of the Crosstown Canal System, which continues to the intersection of LeRoy Street and Clinton Street. At the intersection of LeRoy and Clinton Streets, the canal widens to 16-feet wide and 4-feet tall. At this location, stormwater runoff from the 40-inch RCP is combined with runoff collected from LeRoy Street to the south and Clinton Street to the east, which are identified as sub-watershed Nos. 3 and 4 and are shown on Figure 2. Stormwater is conveyed approximately 135-feet, at which point the channel transitions to dual 40-inch RCP for the next 360-feet until it reaches Broad Street. The dual 40-inch RCP discharges to an 8-foot

wide by 3-foot tall sandstone channel 1,500 feet in length. This channel continues west along Broad Street, north on Waverly Avenue, and west along Pleasant Street and through private properties until it reaches Market Street. Runoff from sub-watershed Nos. 1 and 2 is collected in this section of the channel. The sandstone channel expands along Pleasant Street to a 12-foot wide by 4-foot tall section and continues 650-feet where it is intersected by another channel. At this intersection, the channel expands once again to a 16-foot wide by 4-foot tall section, which extends 675-feet to the discharge point at a channel invert elevation of 395.7 near the Raquette River. An open stone and earth channel then extends to the Raquette River.

Free discharge into the Raquette River occurs when the river is at its mean water surface elevation; therefore, no backwater effect is experienced. However, based on Federal Emergency Management Agency (FEMA) mapping, the 100-year flood elevation of the Raquette River is 400-feet, which is higher than the discharge elevation (395.7'). Therefore, when the river is at the 100-year flood elevation, the system outfall becomes submerged, creating a backwater condition. Backwater conditions can impact the capacity of the system and could potentially lead to flooding of residences.

The Village of Potsdam conducted CCTV of the Crosstown Canal system during the week of February 7, 2011. The video was reviewed and the information was compiled regarding the system, including sizes and conditions of televised channels.

The existing Crosstown Canal stormwater conveyance system that begins northeast of LeRoy Street and continues down Broad Street, along Waverly Street, and ultimately through Canal Street to the discharge point at the Raquette River, is characterized by shallow depths (up to 4-feet) and slopes. In some locations, the canal is visible at the surface and, in most sections, the road surfacing serves as the cover. Based on the limited available information, slopes on the upstream end of the channel located at LeRoy Street were estimated at approximately 2%. Downstream slopes from Broad Street to the discharge point were estimated at approximately 0.3%. The condition of the canal was estimated by viewing CCTV video provided by the Village.



Based on a review of the CCTV, the canal appears to be constructed of sandstone walls, cast-in-place concrete, and some railroad ties for the floor.

An outline of canal segments, lengths televised, channel dimensions, and overall opinion on condition are shown in Table 1 below. Images are also included depicting what is considered to be a medium quantity of debris in the system as seen on the video.

Table 1. Summary of CCTV Inspections

Upstream Manhole	Downstream Manhole	Length (ft)	Structural Degradation		Dimensions		
			Yes	No	Width (ft)	Height (ft)	Diameter (in)
Canal Street	Outfall	675	✓		16	4	-
Canal/Market	Canal Street	650		✓	16	4	-
Robar Barn	Canal/Market	206		✓	16	4	-
Pleasant Street	Robar Barn	293		✓	12/16	4	-
Pleasant/Waverly ⁽¹⁾	Pleasant Street	186		✓	8/12	3	-
Waverly/Beal	Pleasant/Waverly	347	✓		8	3	-

Upstream Manhole	Downstream Manhole	Length (ft)	Structural Degradation		Dimensions		
			Yes	No	Width (ft)	Height (ft)	Diameter (in)
Broad Street ⁽¹⁾	Waverly/Beal	503	✓		8	3	-
Broad Street (Pipe Change)	Broad Street	65		✓	6	4	-
LeRoy Street ⁽¹⁾	Broad Street	134		✓	8	4	-
LeRoy Street	Broad Street	363		✓	-	-	40
Inlet (High School)	LeRoy Street	460		✓	-	-	40
Clinton Street	LeRoy Street	160		✓	8	4	-
Elm Street	Broad Street	1,000	✓		-	-	24

⁽¹⁾ Video indicates what appears to be concentrations of significant debris located within channel section.

Sediment accumulation, structural degradation, and other obstructions will contribute to reduced capacity within the stormwater system. There are sediment deposits within sections of the channel that could decrease the overall capacity of the stormwater system in the immediate area. In addition to sediment, there is debris which has been deposited in the canal which range from pieces of wood to plastic bottles and other inert materials.

In addition to sediment accumulation, CCTV video shows structural degradation within the system. Structural degradation may be attributed to the age of the system, which was constructed in the early 1900's and has deteriorated over time. The majority of the canal roof has exposed and missing rebar sections which provide the structural support to poured concrete. Additionally, numerous locations of the roof show signs of cracking and spalled concrete. These include areas along Broad Street, Pleasant Street, and along Canal Street to the outlet. Structural degradation also allows infiltration into the canal further reducing the available carrying capacity of the channel as well as increases the potential for catastrophic failure (collapse) since the majority of the canal is located in public roads with minimal cover. In March 2018, a portion of the canal roof along Market Street collapsed. During this event, a vehicle fell into the canal. While similar events have not occurred since, the structural integrity of the canal is at risk.

2.3.2 Significant Rainfall Events

On September 30, 2010, the Village experienced a significant rainfall event following a period where 22 out of the previous 30 days had measurable rainfall. This event resulted in its stormwater collection and conveyance system being overwhelmed with a volume of runoff that the existing systems could not handle. Drainage swale and collection points overflowed within the Village, which resulted in the residents being directly affected. While events of this magnitude infrequently occur, rainfall data is trending toward more intense and frequent rainfall events lasting in shorter durations.

2.3.3 Previous Capital Improvement Projects

In the summer/fall of 2017, the Village completed the Crosstown Canal Improvements Project which removed three utility obstructions within the canal. The utility pipes (water and sewer) intersected the canal, causing accumulation of debris and sediment which ultimately reduced the capacity of the canal at these locations. One obstruction was located at the intersection of LeRoy Street and Clinton Street (18-inch sanitary sewer line) and two were located along Pleasant Street (18-inch sanitary sewer and water). The project involved installation of a dual siphon at each location to reroute utilities under the canal in order to remove the obstructions.

2.3.4 Stormwater Modeling

Existing USGS and Village mapping was utilized to identify the drainage area of the Crosstown Canal watershed. Watershed delineations were performed to determine their size and drainage patterns. Watershed delineations were conducted according to Natural Resources Conservation Service (NRCS) Method for Comparative Evaluation of Nontidal Wetlands. The Crosstown Canal watershed, shown in Figure 2, was broken into six sub-watersheds that contribute flow to the canal system at various locations. Watershed drainage area, cover type, and inlet location are shown in Table 2 below:

Table 2. Crosstown Canal System Watershed

Sub-Watershed	Drainage Area (Acres)	Cover Type	Inlet Location
1	150	Medium Density Residential	Various Streets
2	15	Medium Density Residential	Beal Street/Waverly Street
3	40	Medium Density Residential	LeRoy Street
4	45	Medium Density Residential	LeRoy Street
5	300	Open Field	South of High School
6	250	Open Field	North of High School
Total	800	Varied	---

HydroCad hydraulic modeling software was used to develop a system model for the Crosstown Canal watershed. The model was used to estimate capacity and determine constraints on the system.

HydroCad utilizes various physical characteristics to determine system capacity. These characteristics include pipe sizes, slopes, materials of construction, cover type, and rainfall intensity. The CCTV video and background data provided by the Village was also used. Modeling was completed to simulate the effects of the 1-, 5-, 10-, 50-, and 100-year storm events and assumed a new system. Storm events and their corresponding rainfall intensities, shown in Table 3 below, were then modeled:

Table 3. Rainfall Intensity

Rainfall Event (24-hour storm)	Precipitation (inches)
1-Year	1.88
5-Year	2.69
10-Year	3.14
50-Year	4.52
100-Year	5.28

HydroCad reports are attached for the existing and proposed conditions as Appendix A and B respectively and a discussion of modeling results for each storm event is included below.

The system was assessed utilizing the extreme precipitation data in New York and New England developed by Cornell University in conjunction with the Northeast Regional Climate Center (NRCC) and Natural Resources Conservation Service (NRCS). The model was developed with non-submerged (free discharge) and submerged (backwater) conditions at the discharge point. Backwater conditions were generated using the 100-year flood elevation of the Raquette River at elevation 400. Model results for the 1-, 5-, 10-, 50- and 100-year storms are as follows.

- 1) 1-Year Storm - The model indicates that with a free discharge to the Raquette River, the system can convey the 1-year storm event. There have been no indications that field conditions differ from the model and no flooding has been reported during rainfall events of this intensity. When backwater conditions were introduced, the model shows system backup in the 16-foot wide by 4-foot tall section leading to the discharge point. Even with this backup, this section is capable of passing the 1-year storm. The other sections of the canal are able to pass the 1-year event.
- 2) 5-Year Storm - Modeling results for the 5-year storm event with free discharge to the Raquette River indicate the system is capable of passing the 5-year rainfall event. Previous reports from 2011 indicate the canal was not capable of passing the 5-year storm. A combination of new rainfall data and recent capital improvements project to remove utility obstructions within Pleasant Street identified in the report allow the canal to pass the 5-year storm without backup of the system. Backwater conditions in the model show system backup in the 16-foot wide by 4-foot tall section leading to the discharge point. Even with this backup, this section remains able to pass the 5-year storm.

- 3) 10-Year Storm - Modeling results for the 10-year storm event with free discharge to the Raquette River indicate the system is not capable of passing the 10-year event. Previous reports from 2011 also indicate the canal was not capable of passing the 10-year storm. A combination of new rainfall data and recent capital improvements project to remove utility obstructions within LeRoy and Pleasant Streets demonstrate a reduction in potential flood areas along Pleasant Street and the corner of LeRoy and Clinton Street which have previously been reported. The model indicates backups along Broad Street where the canal segments are 8-feet wide. In downstream areas where the channel is 12 to 16-feet wide the stormwater canal is capable of passing the 10-year storm.
- 4) 50-Year/100-Year Storm - HydroCad model results for these storm events indicates that the system is undersized for these storms and is not capable of passing either event. The discharge of the system is completely submerged under these conditions and flooding is anticipated to occur as a result. During the 100-year event, according to FEMA maps, the discharge point is fully submerged by the Raquette River creating a backwater effect which further overloads the canal.

2.4 Definition of the Problem

Due to the age, structural degradation, dimensional limitations, and increased storm intensity, the Crosstown Canal can no longer reliably convey stormwater through the Village of Potsdam as originally designed. As a result of rain events with greater frequency and intensity, areas of the Village are prone to increased flood risk and threat to human health, sanitation, and safety. A recent catastrophic failure of a section of the canal roof has intensified the need to perform a project to upgrade and improve the Village's stormwater system. The purpose of this engineering report is to provide recommendations for improvements to the Village's stormwater collection system and structural rehabilitation of the Crosstown Canal.

2.5 Financial Status

Capital project and operation and maintenance costs for the stormwater system are funded by the general fund. The Village of Potsdam currently does not have any outstanding debt for the stormwater system.

3.0 ALTERNATIVES ANALYSIS

3.1 Stormwater Improvements

3.1.1 Description of Alternatives

Based on the results of the HydroCAD model, the Crosstown Canal is not adequately sized to convey stormwater from storm events equal to or greater than the 10-year storm. In order to address storm events of increased intensity and frequency, and dimensional constraints within the Crosstown Canal, a comparison of alternatives was made between: 1) installation of two stormwater storage areas located on the north and south ends of the high school; 2) demolition and rebuilding of the Crosstown Canal; and 3) no action.

- 1) Stormwater Storage Areas – Installation of two stormwater storage areas at the north and south ends of the Potsdam High School property will serve to mitigate the peak rate of runoff entering the stormwater canal during a rain event. Controlled outlet structures will be installed to reduce the inflow to the Crosstown Canal from these areas for an anticipated period of 6-hours allowing the rainfall from the remaining four sub-watersheds to be discharged by the Crosstown Canal.

Topographical maps, background data, and the model results were evaluated to determine potential areas for stormwater detention. Runoff detention is an option to help minimize or reduce flooding potential. Watershed size and current land uses were also taken into consideration while evaluating potential detention areas.

As referenced in Table 2 and Figure 2, the Crosstown Canal System watershed was delineated into six sub-watersheds based on drainage patterns and topography. Watersheds 1, 2, 3, and 4 are smaller and located within the Village. These watersheds have higher spatial constraints and lower contribution of runoff into the stormwater canal. Watersheds 5 and 6 are the highest contributing areas of stormwater runoff (approximately 550 acres) and are located at the upstream end of the overall watershed. Much of this area is open or wooded and better suited for detention. Two areas located in sub-watersheds 5 and 6 were identified for capture of stormwater runoff. These areas are shown on Figures 3, 4, and 5.

Detention will act as a holding area for runoff from sub-watershed Nos. 5 and 6, while allowing runoff from sub-watershed Nos. 1 through 4 to flow through the system. Preliminary calculations confirm the canal system is capable of passing the 25-year storm from sub-watersheds 1 through 4. Proper sizing and release rate control of stormwater from sub-watersheds 5 or 6 will reduce downstream flood potential by reducing the initial runoff load to the canal system.

A potential detention area identified in sub-watershed No. 5 is located south of Potsdam High School adjacent to the existing open channel, which leads to the canal inlet as shown in Figure 3. This point is located on the discharge end of the watershed outside the Village and allows for a high quantity of stormwater to be captured and released at a controlled rate. Preliminary calculations indicate 20 acre-feet (approximately 875,000 cubic feet) of storage is needed to reduce the peak rate of runoff sufficiently for the stormwater system to pass the 50- and 100- year storms in conjunction with stormwater detention in sub-watershed No. 6.

Two locations were identified for possible detention areas in sub-watershed No. 6. One is located to the north of the Potsdam High School athletic field, across from Castle Drive on land already owned by the Village of Potsdam as shown in Figure 4; the other is located east of the Potsdam High School athletic field as shown in Figure 5. While installation of the storage area on the land already owned by the Village is a viable option, the area is predominantly wetland and the opportunity for storage is reduced by existing groundwater levels in the area, and constructability of working within the wetland area with heavy machinery poses unique challenges. Additionally, the area is densely wooded and would require clearing prior to excavation. The alternate location is within the grassed area to the east of the athletic field at Potsdam High School. This location would require a land acquisition but would not pose the same constructability issues and is anticipated to be lower capital cost. Additionally, the storage area can be installed off-line from normal stormwater flow and be placed into service upon completion of construction.

Therefore, it is proposed to install the storage area to the east of the athletic fields at Potsdam High School. This would require a land acquisition from the school district and diversion of the existing flow channel. Preliminary calculations show a required 30 acre-feet (approximately 1,300,000 cubic feet) of storage is needed to reduce the peak rate of runoff sufficiently for the stormwater system to pass the 50- and 100- year storms in conjunction with stormwater detention in sub-watershed No. 5. Each of the storage areas is anticipated to be equipped with an outlet control structure including concrete headwall, pipe penetrations and emergency overflow in order to reduce the peak rate of discharge to the stormwater collection system.

Modelling results demonstrate a reduction in the peak runoff rate of the 50-year storm from 551 cfs to 231 cfs and the 100-year storm from 694 cfs to 284 cfs. The peak runoff reduction demonstrated by the model allows the stormwater system to pass runoff from sub-watershed Nos. 1 through 4 while releasing runoff from areas 5 and 6 at a controlled rate to mitigate flood potential during intense rainfall events.

- 2) **Crosstown Canal Replacement** - The second alternative is to reconstruct the canal at a size suitable for current rainfall intensity and frequency to reduce flood potential within the Village. This would require excavation and demolition of the existing canal from the entry point at the south end of Potsdam High School to the discharge location at the Raquette River. As noted above, the Crosstown Canal was constructed under Village roads, homes, and public utilities which is anticipated to increase capital cost. Additionally, based on preliminary sizing, the new canal is anticipated to be 16-feet wide in order to maintain the same elevation and existing hydraulic conditions (slope). It is anticipated that precast concrete sections will be installed in lieu of a hand laid masonry channel for the reconstruction. Precast concrete allows for a less labor-intensive installation and the sections can be water tested prior to arrival onsite.
- 3) **No Action** - The third alternative is to take no action. This is determined not to be a viable alternative, as the Village residents have historically experienced flooding during rain events which poses a threat to public health and safety.

3.1.2 Cost Estimates

Estimates capital costs of each stormwater alternative discussed in Section 3 are shown in Table 4 below.

Table 4. Stormwater – Opinion of Probable Construction Costs

Option	Estimated Capital Cost
Stormwater Storage Areas	\$5,500,000
Crosstown Canal Replacement	\$17,750,000
No Action ⁽¹⁾	\$7,650,000

⁽¹⁾ No action alternative costs projected based on an annual maintenance and emergency action cost of \$50,000/year over a 50-year design life at 3% interest.

⁽²⁾ Cost estimate does not include land acquisition or easement.

Estimates of 20-year present worth includes the initial capital cost and annual operation and maintenance costs. These are projected over a 20-year period to determine their "present worth". Refer to Table 5 below for a present worth estimate for the two stormwater alternatives.

Table 5. Stormwater – 20-Year Present Worth

Option	Estimated Capital Cost	Annual O&M Cost	20-Year Present Worth
Stormwater Storage Area	\$5,500,000	\$10,000	\$12,350,000
Crosstown Canal Rebuild	\$20,500,000	\$10,000	\$45,250,000
No Action ⁽¹⁾	---	\$50,000	\$1,200,000

⁽¹⁾ Based on the upper range of O&M cost estimates and an inflation rate of 3%.

3.1.3 Non-Monetary Factors

Non-monetary factors considered in the selection of the alternative for the Crosstown Canal stormwater improvements include aesthetics, improved habitat, resiliency, and impacts to existing natural resources (i.e., wetlands). The bioretention basins provide an option to improve aesthetics while increasing habitat for local wildlife and providing an educational opportunity for local students.

3.2 Structural Improvements

3.2.1 Description of Alternatives

Based on discussions with Village staff, review of CCTV video, observed degradation, and age of the Crosstown Canal, it is proposed to perform structural improvements within the canal to reduce the potential for catastrophic failure (collapse). A comparison of structural rehabilitation options was conducted which includes: 1) replace the existing roof of the canal and reinforce the walls (in conjunction with stormwater detention discussed in previous sections); 2) replace the existing canal in its entirety; and 3) No action.

- 1) Roof Replacement and Reinforcing – The first alternative is to replace the existing concrete roof of the Crosstown Canal. Visual inspection of the roof via CCTV inspection video reveal exposed rebar, cracking and spalling of the surface. The majority of the Crosstown Canal is installed over local roadways with pedestrian and truck traffic increasing the chance of catastrophic failure. In order to address the age, condition and structural integrity of the Crosstown Canal installation of a new roof was evaluated in

addition to enhancing the structural soundness of the walls and base. While the roof displayed signs of deterioration, the sidewalls and base appeared to be in acceptable condition. However, in order to enhance the structural integrity of the walls and floor it is proposed to install a layer of shot-crete.

- 2) Crosstown Canal Replacement - The second alternative is to reconstruct the canal at a size suitable for current rainfall intensity and frequency to reduce flood potential within the Village. This would require excavation and demolition of the existing canal from the entry point at the south end of Potsdam High School to the discharge location at the Raquette River. As noted above, the Crosstown Canal was constructed under Village roads, homes, and public utilities which is anticipated to increase capital cost. Additionally, based on preliminary sizing, the new canal is anticipated to be 16-feet wide in order to maintain the same elevation and existing hydraulic conditions (slope). It is anticipated that precast concrete sections will be installed in lieu of a hand laid masonry channel for the reconstruction. Precast concrete allows for a less labor-intensive installation and the sections can be water tested prior to arrival onsite.
- 3) No Action - The third alternative is to take no action. This is determined not to be a viable alternative due to the observed condition of the Crosstown Canal and potential for catastrophic failure and threat to public health and safety.

3.2.2 Cost Estimates

Estimated capital costs of each structural alternative are shown in Table 6 below.

Table 6. Structural – Opinion of Probable Construction Costs

Option	Estimated Capital Cost
Roof Replacement and Reinforcing	\$6,500,000
Crosstown Canal Rebuild	\$20,500,000
No Action ⁽¹⁾	\$7,650,000

⁽¹⁾ No action alternative costs projected based on an annual maintenance and emergency action cost of \$50,000/year over a 50-year design life and an inflation rate of 3%.

Estimates of 20-year present worth includes the initial capital cost and operation and maintenance costs projected over a 20-year period as shown in Table 7 below.

Table 7. Structural – 20-Year Present Worth

Option	Estimated Capital Cost	Annual O&M Cost	20-Year Present Worth
Roof Replacement and Reinforcing	\$6,500,000	\$10,000	\$14,550,000
Crosstown Canal Rebuild	\$20,500,000	\$10,000	\$45,250,000
No Action ⁽¹⁾	---	\$50,000	\$1,200,000

⁽¹⁾ Based on the upper range of O&M cost estimates and an inflation rate of 3%.

3.2.3 Non-Monetary Factors

Non-monetary factors considered for the Crosstown Canal structural improvements include resiliency and community impact. While replacement of the canal is a more resilient solution, the impact to subsurface utilities, homes, and community spaces located above the canal pose significant restrictions. Therefore, it is determined replacement of the roof to provide a structurally reliable road surface in conjunction with installation of bioretention basins to reduce the impact during intense rainfall events is optimal.

4.0 SUMMARY AND COMPARISON OF ALTERNATIVES

4.1 Stormwater Improvements

As discussed in Section 3, the existing Crosstown Canal is inadequately sized to convey stormwater from intense rainfall events. Table 8 represents the advantages and disadvantages of each option considered:

Table 8. Comparison of Stormwater Improvements

Option	Advantages	Disadvantages
Stormwater Storage Area	• Lower capital cost • Higher aesthetic value • Higher educational value • Increased animal habitat • Increased water quality • No relocation of existing infrastructure • Lower risk of catastrophic failure • Various grant/funding opportunities	• Higher maintenance burden • Land acquisition required
Crosstown Canal Rebuild	• Lower maintenance burden • Lower area of installation • Lower risk of catastrophic failure	• Higher capital cost • No aesthetic value • No educational value • No increase in animal habitat • No stormwater treatment • Utility relocation required
No Action	• No capital cost	• High risk to public health and safety • Higher risk of catastrophic failure

4.1.1 Stormwater Storage Area Advantages

As shown in Table 5, constructing stormwater storage areas has a lower estimated capital cost than rebuilding the canal. The storage areas will be located in an exposed area within the Village and will be designed with the aesthetic value to blend in with the surrounding area. Both storage areas will be designed to include landscaping features such as trees and plants, as well as riprap, to allow for some water uptake and to reduce the velocity and energy of the stormwater as it enters the storage area. This design approach will create a new habitat in these areas which may allow for other animals to utilize them. The storage areas will be designed to retain the stormwater from Watershed Areas 5 and 6 which will mitigate the potential for the canal's capacity to be exceeded during significant wet weather events. This more fiscally responsible approach will eliminate the need to rebuild the canal and will reduce the risk of a catastrophic failure of it. Water quality will also increase as the heavier material will be allowed to settle before the stormwater is conveyed into the canal and ultimately discharged to the river.

With several universities in the area, as well as Potsdam's school district, this project presents a unique educational opportunity to the many students in the area. These academic institutions could utilize the stormwater system as an opportunity to teach students about stormwater.

4.1.2 Crosstown Canal Rebuild Advantages

Rebuilding the canal would reduce the amount of maintenance required by the existing canal. The existing canal requires repairs because of its deteriorating structural components which would be eliminated in the rebuild. The canal would also be rebuilt larger to increase its capacity and, therefore, reducing the risk of catastrophic failure. If the canal were to be rebuilt, it would likely be in the same area as it is today, and with an increase of its size, it would eliminate the need for a storage area.

4.2 Structural Improvements

As discussed in Section 3, the existing Crosstown Canal shows signs of deterioration and degradation. Table 9 represents the advantages and disadvantages of each option considered:

Table 9. Comparison of Structural Improvements

Option	Advantages	Disadvantages
Replace Roof	• Lower capital cost • Lower community impact • No utility relocations required	• Higher maintenance burden
Crosstown Canal Rebuild	• Lower maintenance burden • Lower risk of catastrophic failure	• Higher capital cost • Utility relocation required
No Action	• No capital cost	• High risk to public health and safety • Higher risk of catastrophic failure

5.0 RECOMMENDED ALTERNATIVE

5.1 Qualitative Analysis

An evaluation was conducted to determine feasible alternatives for upgrade to the Crosstown Canal stormwater conveyance system and structural improvements within the Village of Potsdam. The alternatives were considered as outlined in Chapters 3 and 4. When comparing each alternative, factors considered

included capital cost, O&M requirements, constructability, the ability to convey high intensity rainfall events, environmental impacts and human health and safety.

Based on the current condition assessment for the Crosstown Canal, alternatives including rehabilitation of the existing system versus replacement of the entire canal were considered along with the no action alternative. Rehabilitation of the existing canal would utilize existing infrastructure with minimal impact to existing subsurface utilities. Replacement of the entire canal would require and higher capital cost but would increase the structural integrity of the canal.

Tables 8 and 9 above present the advantages and disadvantages for mitigating stormwater impacts from high intensity rainfall events and structural improvements to the Crosstown Canal while Tables 4, 5, 6, and 7 represent the projected costs.

5.2 Basis of Selection

Based on capital cost and those non-monetary factors discussed in previous sections of this report, it is recommended that the Village install a stormwater storage area for sub-watershed No. 5, install a stormwater storage area on the east side of the Village Potsdam Athletic Fields for sub-watershed No. 6, and replace the roof of the existing stormwater canal with new precast concrete planks. Of the alternatives considered, the combination of stormwater detention while increasing the structural integrity of the canal is most cost-effective, enhances water quality within the Village, and can be constructed with the least interruption to Village residents during construction. Additionally, as a result of installation of the stormwater storage area, the Crosstown Canal is anticipated to be able to convey the 50- and 100-year storms with a reduced risk of flooding to Village residents.

5.2.1 Cost Estimate

Table 10 represents the opinion of probable project costs based on a projected construction start date of August 2019.

Table 10. Opinion of Probable Project Costs

Option	Estimated Capital Cost
Stormwater Storage Areas	\$5,500,000
Crosstown Canal Roof Replacement and Reinforcing	\$6,500,000
Construction Cost Subtotal	\$12,000,000
Contingency	\$1,800,000
Total Estimated Construction Cost	\$13,800,000
Engineering (design, bidding, construction administration)	\$1,400,000
Fiscal, Legal, Administrative	\$200,000
Total Estimated Project Cost	\$15,400,000

5.2.2 Proposed Schedule

The following is a proposed schedule to advance the design and construction phases of the proposed projects:

- Funding Application Submission: July 2018
- Funding Award: December 2018
- Start Design: January 2019
- Complete Design: July 2019
- Permitting: August 2019
- Bidding/Construction: September 2019
- Complete Construction: September 2020

5.2.3 Next Steps

Upon completion of the Engineering Report, it will be submitted to various funding agencies in order to apply for grants and loans to finance the project. Upon securing project financing and funding agency approval of the Engineering Report, the final design phase can commence. Recent experience has shown that projects which are "construction ready" are more likely to be funded than those not progressed beyond the preliminary phase. However, this is typically a function of the availability of agency funds, which vary with the state and federal fiscal cycle.

If the project is funded in an amount less than the amount estimated to perform the improvements identified in the Preliminary Engineering Report, project phasing should be considered. This approach allows the improvements recommended in the Engineering Report to be designed. Separate project bid items will be included for each phase, allowing the Village to take advantage of the current competitive bidding market. By separating out various project components, the Village is allowed to choose which parts of the project are to be built based on the available funding and priorities.

5.2.4 Project Funding

New York State and the Federal government have available funding opportunities for projects of the type as recommended by this study. Funding can be provided in the form of a loan or grant, from one or multiple sources. Each funding program is governed by eligibility requirements and the need. Listed within this section are various funding programs which the Village should consider pursuing for this project. It is recommended that for each program, if allowed by their program funding eligibility requirements, the entire project cost be applied for.

- a. New York State Environmental Facilities Corporation (NYSEFC) Clean Water State Revolving Fund. This project is currently listed on EFC's Intended Use Plan (Project number C6-6066-04-00) on their multi-year project priority list in Category B (i.e. a municipal population between 3501 through 2,000,000). By completing this engineering study, this will allow the project to be listed on the Annual List. The projects included on the Annual List are a subset of the multi-year list and are those which EFC may provide financial assistance to. The current project score is 44, which would be below the 2018 IUP Category B Annual List subsidy line score of 57. Given that the Village has performed some work to the canal via the utility relocation completed in 2017, there may be an opportunity to increase the project score. Projects which score above the subsidy line qualify for a reduced interest loan. In order to determine the project financing that EFC could provide, the Village would need to complete a State Environmental Quality Review (SEQR) and prepare and submit a CWSRF finance application for their review. It is recommended the Village pursue submitting a finance application after receiving EFC's approval of this engineering report. The CWSRF loan program could fund the entire project. In parallel, the Village should also complete the SEQR process.

- b. Green Innovation Grant Program (GIGP). Through the Regional Economic Development Councils Consolidated Funding Application (CFA) process, the Green Innovation Grant Program (GIGP) supports projects across New York State that utilize unique stormwater infrastructure. GIGP provides grants on a competitive basis to projects that improve water quality and demonstrate green stormwater infrastructure in New York. GIGP is administered by the New York State Environmental Facilities Corporation (EFC) and the grant provides funding of a minimum of 40% up to a maximum of 90% of the total eligible project costs as provided in the application. A minimum of 10% up to 60% match from state or local sources is required. Applications for the GIGP program are due on July 27, 2018 and it's recommended the Village Board consider passing a resolution to prepare and apply for this program. Based on the GIGP program eligible activities, the portion of the recommended project which may qualify for funding would be the storage components, whereas the canal structural rehabilitation is an ineligible activity. Based on the project cost estimate, the grant potential is estimated to be in the range of \$2.8M to \$6.4M. A minimum of 10% matching funds is required if the Village is awarded a grant through the GIGP.
- c. Community Development Block Program (CDBG). This program is a federally funded program authorized and administered by the Office of Community Renewal. This program provides funds to small NYS communities and counties for projects that focus on community development needs such as creating or expanding job opportunities, providing safe affordable housing, and improving local public infrastructure. Improvements to the Village of Potsdam Crosstown Canal system is eligible as it falls within one of their two eligible funding activities.. Eligible projects include the repair or replacement of existing systems, construction of new systems, or the expansion of existing systems. Specifically, improvements to stormwater drainage is included as an eligible funding activity.

The first step in pursuing CDBG funding is to submit an application through the CFA process. The Office of Community Renewal will review the initial submission; if accepted, the applicant will receive an invitation to complete a full application within the CFA portal. A maximum of \$750,000 is available for individual counties, towns, cities, and villages to fund public infrastructure projects. Applicants can only apply for funds that can be utilized and the types of activities that can be completed within the specified project completion period of 24 months. Priority will be given to projects that clearly demonstrate a defined need, address specific community and economic development priorities, and meet program objectives. Applications for the CDBG program are due on July 27, 2018 and it is recommended the Village Board consider completing the required steps to prepare and apply for this program.

- d. USDA – Rural Development. Based on the Village's 2010 U.S. census, population (9,428) being less than the USDA-RD's 10,000 persons threshold, the Village could consider submitting a funding application to RD through their water and waste program. Based on initial discussion with the local RD office, stormwater projects such as the Crosstown Canal qualify for loan only. Therefore, it is recommended the Village consider RD as a potential funding source and continue to prioritize pursuing grant funds for this project. Grant funding will reduce the loan amount, thereby reducing the financial impact. Based on the amount of grant funding secured, an analysis should be performed to determine if applying for and securing RD loan funding is a fiscally responsible approach for the Village.

Table 11. Funding Options

Funding Program	Type	Potential Funding Amount
NYSEFC-CWSRF	Loan	\$15.4M
GIGP	Grant	\$2.8M -6.4M
CDBG	Grant	\$750k
USDA-RD	Loan	\$15.4M

- e. District Formation. The Village could consider forming a stormwater or drainage district with the Town since the watershed is within both municipalities. This approach may open up other state funding source opportunities through a shared services approach. A primary advantage of this approach includes the sharing of capital and operation and maintenance costs over a larger base, thereby reducing the cost per user when compared to Village only. If there is a joint Village-Town interest in forming a district, the Village and Town will need to complete several, legally required activities. Each municipality's legal council should be consulted prior to any formal action by either municipality.
- f. Project Phasing. If funding is not able to be secured to complete the recommended improvements as a single project, the Village could consider a phased approach. With this approach, the project would be segmented into portions which align with the funding available and prioritization of improvements. It is recommended the most critical priority will be to perform the roof replacement and rehabilitation of the canal, followed by the stormwater storage portions of the project.

FIGURES

LEGEND:

 CATCH BASIN
 CROSTOWN CANAL



PROJECT TITLE: CROSTOWN CANAL

DRAWING TITLE: CROSTOWN CANAL SYSTEM

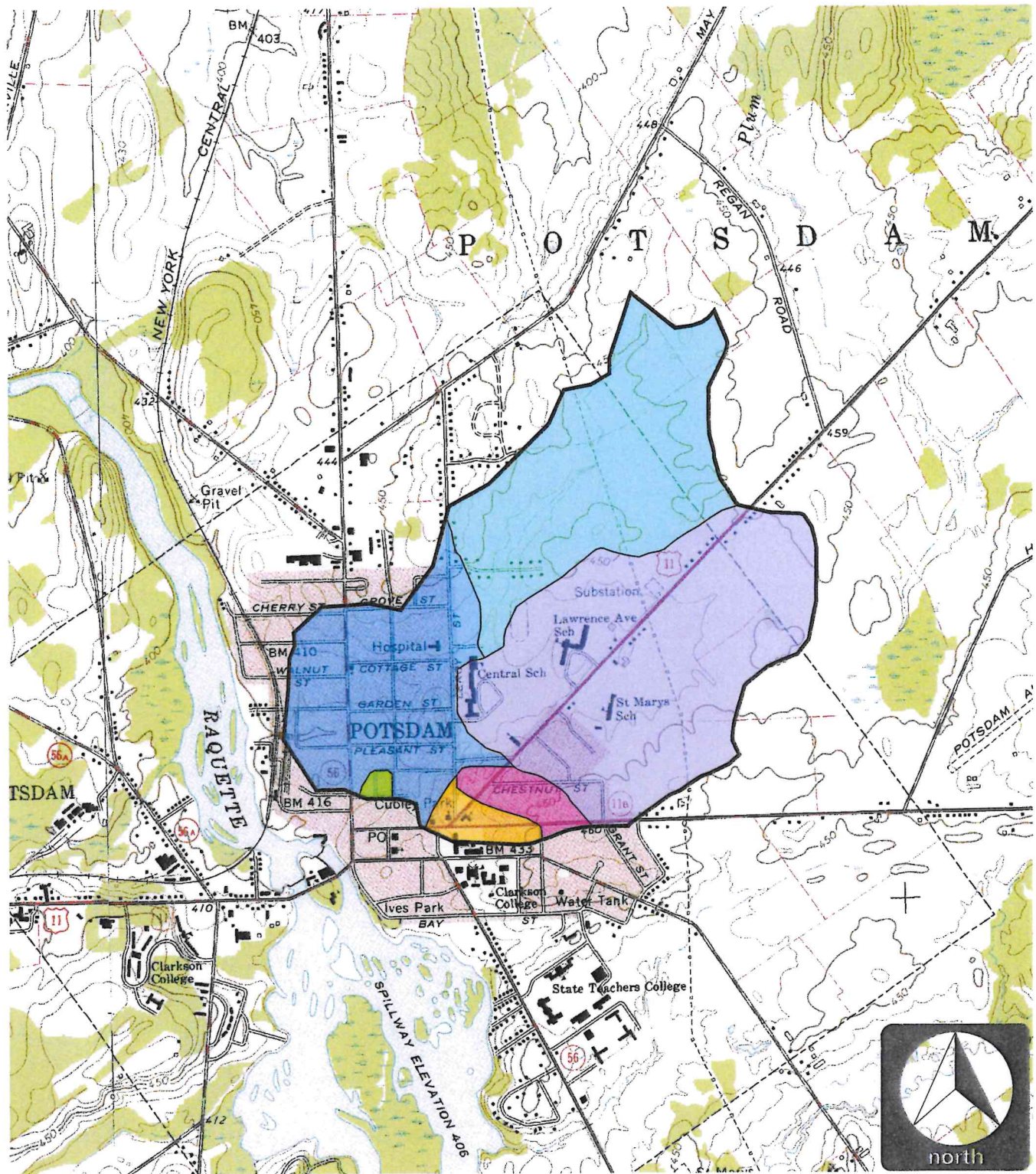
DRAWN BY: ASD

CHECKED BY: CPP

EDR JOB NUMBER: 18042

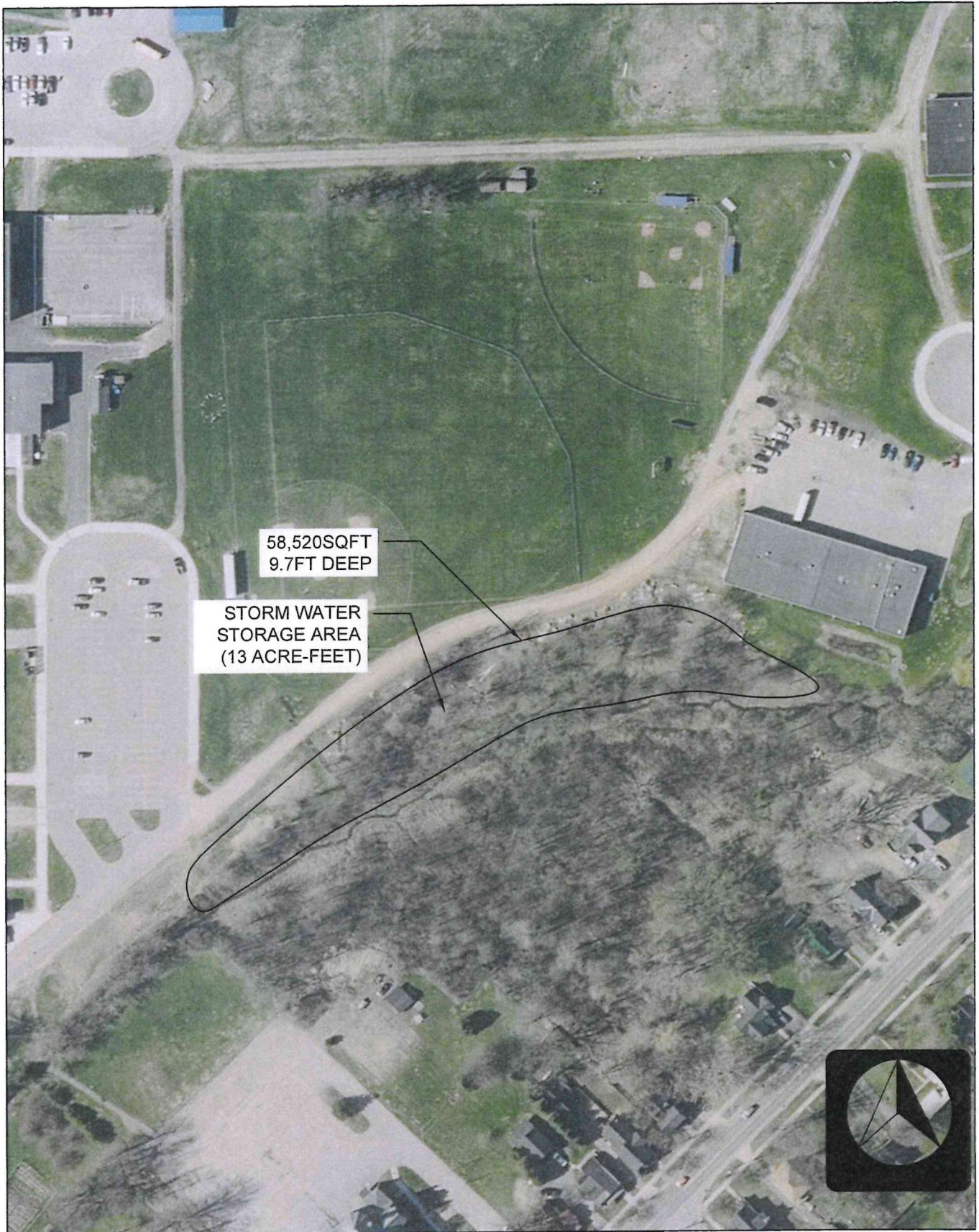
DRAWING NUMBER: FIGURE 1

SCALE: 1" = 500' DATE: 4/30/2018



LEGEND:

- | | | | |
|------------------|-----------------|-----------------|-----------------|
| VILLAGE WATERSED | SUB-WATERSHED 2 | SUB-WATERSHED 4 | SUB-WATERSHED 6 |
| SUB-WATERSHED 1 | SUB-WATERSHED 3 | SUB-WATERSHED 5 | |





STORM WATER
STORAGE AREA
181,464 SQFT
2.4FT DEEP
(10 ACRE-FEET)

CASTLE DRIVE



**Environmental
Design & Research,**
Landscape Architecture, Engineering
& Environmental Services, D.P.C.
217 Montgomery Street, Suite 1000
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P. 315.471.0688

PROJECT TITLE: **CROSTOWN CANAL**

DRAWING TITLE: **STORM WATER STORAGE - NORTH NO.1**

DRAWN BY: **ASD**

CHECKED BY: **CPP**

EDR JOB NUMBER: **18042**

DRAWING NUMBER: **FIGURE 4**

SCALE: **1" = 250'**

DATE: **4/30/2018**

