CITY OF ROCKLAND, MAINE

Report

MAY 2023

Stormwater Master Plan

WRIGHT-PIERCE
Engineering a Better Environment

Stormwater Master Plan
CITY OF ROCKLAND, MAINE

MAY 2023

Prepared By:

Wright-Pierce
11 Bowdoin Mill Island, Suite 140
Topsham, ME 04086
207.725.8721 | wright-pierce.com

Table of Contents

Executive Summary 1

Section 1 Study Overview 1-1
1.1 General 1-1
1.2 Phase 2 Stormwater Master Plan Tasks 1-4
1.2.1 Field Investigations 1-4
1.2.2 Hydraulic Analysis 1-4
1.2.3 Grant/Funding Opportunities 1-5
1.2.4 Reprioritization of Improvements 1-5
1.2.5 Update Stormwater Master Plan 1-5

Section 2 Analysis Methodology 2-1
2.1 Existing System Assessment 2-1
2.2 Review of Projects in Current CIP 2-2
2.3 Field Inspection 2-3
2.4 Hydrologic & Hydraulic Modeling 2-4
2.4.1 HydroCAD 2-4
2.4.2 Storm and Sanitary Analysis (SSA) 2-4
2.4.3 Hydrology 2-5
2.4.4 HydroCAD Calibration 2-8
2.5 Analyze Potential for Green Infrastructure 2-9

Section 3 Evaluation of Alternatives 3-1
3.1 Introduction 3-1
3.2 Storm and Sanitary Analysis Alternatives Analysis (Outfall Analysis) 3-1
3.2.1 Crescent Street Outfall 3-2
3.2.2 Front Street Outfall 3-2
3.2.3 Park Drive Outfall 3-2
3.2.4 Winter Street Outfall 3-3
3.2.5 Maverick / Washington Street Drainage Re-Route Project 3-4
3.3 HydroCAD Results (Lindsey Brook Analysis) 3-4
3.3.1 Existing Conditions 3-4
3.3.2 Alternatives Analysis – Culvert Projects 3-7
3.3.3 Alternatives Analysis – Flood Control Projects 3-11
3.4 Green Infrastructure Projects 3-14
3.4.1 Harbor Park 3-15
3.4.2 Snow Marine Park 3-15
3.4.3 Samoset Road / Marie Reed Park 3-15
3.4.4 Oak/Orient Parking Lot 3-15
3.4.5 Johnson Memorial Park 3-16
3.4.6 Ralph Ulmer Square 3-16
3.4.7 General Green Infrastructure Recommendations 3-16
3.5 Sea Level Rise (SLR) Analysis in Proposed Projects 3-16
3.5.1 Impacts to Lindsey Brook System 3-17

3.5.2 Impacts to Front Street Separation Project 3-17
3.5.3 Impacts to Winter Street Outfall Relocation Project 3-17
3.5.4 Impacts to Crescent Street Outfall Separation Project 3-17

Section 4 Recommended Stormwater Projects 4-1
4.1 General 4-1
4.2 Budgetary Opinions of Probable Project Costs 4-1
4.2.1 Crescent Street Outfall Separation Project 4-1
4.2.2 Front Street Outfall Separation Project 4-1
4.2.3 Winter Street Outfall Separation Project 4-1
4.2.4 Harbor Park Green Infrastructure Project 4-1
4.2.5 Snow Marine Park Green Infrastructure Project 4-1
4.2.6 Samoset Road / Marie Reed Park Green Infrastructure Project 4-2
4.2.7 Oak/Orient Parking Lot Green Infrastructure Project 4-2
4.2.8 Johnson Memorial Park Green Infrastructure Project 4-2
4.2.9 Ralph Ulmer Square Green Infrastructure Project 4-2
4.2.10 Talbot Avenue to Rankin Street Flood Control Structure 4-2
4.2.11 Gay Street to Broadway Flood Control Structure 4-2
4.2.12 Winter Street Outfall Redirection Project 4-2
4.2.13 Center Street Separation Project 4-2
4.2.14 School Street Separation Project 4-3
4.2.15 Maverick/Washington Street Storm Drain Re-Route Project 4-3
4.2.16 Lawn Avenue East Culvert Replacement Project 4-3
4.2.17 Broadway Culvert Replacement Project 4-3
4.2.18 Willow Street Culvert Replacement Project 4-3
4.2.19 Granite-Grove Street Culvert Replacement Project 4-3
4.2.20 Talbot Avenue West Culvert Replacement Project 4-4
4.2.21 Summer-Maple Street Culvert Replacement Project 4-4
4.2.22 Knox Center Culvert Replacement Project 4-4
4.2.23 Grace Street Culvert Replacement Project 4-4
4.3 Prioritization of Improvements 4-5
4.4 Stormwater Project Recommendations 4-8
4.5 Project Funding 4-10
4.5.1 Grant and Loan Programs 4-10
4.5.2 Congressional Earmarks 4-16
4.5.3 Stormwater Utility 4-17

List of Appendices

Appendix A Project Summary
Appendix B Halloween Storm 2021 Map
Appendix C Field Survey Photos and Narrative
Appendix D H&H Model Hydrology
Appendix E Green Infrastructure & Flood Control Projects
Appendix F Cost Estimating
Appendix G Project Ranking Matrix
Appendix H Grant Funding Table

List of Tables

Table ES-1	City of Rockland Stormwater Master Plan Project List	ES-7
Table 1-1	Known Properties Impacted by Halloween 2021 Event	1-2
Table 2-1	City of Rockland Stormwater Plans	2-1
Table 2-2	City of Rockland Anticipated 2023-2024 Paving Projects	2-2
Table 2-3	City of Rockland Anticipated 2023-2024 Collection System Improvement Projects	2-3
Table 2-4	Curve Number and Time of Concentration – Lindsey Brook Hydrocad Model	2-6
Table 3-1	Lindsey Brook Culvert Crossing Existing Conditions HydroCAD Model Results	3-5
Table 3-2	Pre- vs Post- HydroCAD Model Results	3-10
Table 3-3	Gay Street to Broadway Flood Control Structure Model Results (Peak Flood Elevation)	3-12
Table 3-4	Talbot Avenue to Rankin Street Flood Control Structure Model Results (Peak Flood Elevation)	3-12
Table 4-1	Stormwater Project Rankings	4-7
Table 4-2	City of Rockland Stormwater Master Plan Project List	4-9

Executive Summary

The purpose of this Stormwater Master Plan is to provide the City with the framework to make educated and informed decisions about future stormwater improvement projects while considering project benefits, costing, and the impact of other planned infrastructure projects that may result in costs savings if completed in conjunction with stormwater improvements.

Many of the decisions and recommendations made in this report were informed by the results of survey data collected in the field, hydrologic and hydraulic (H&H) models that were developed using this data, and input provided by City staff. Wright-Pierce sent field crew representatives throughout the City's drainage system to perform a field survey of potential locations of existing drainage networks that were not captured in the City's GIS database. This work included a focused survey of the storm drainage infrastructure associated with Lindsey Brook, including culverts and open channel reaches, amongst other system elements. Additionally, the field work targeted several drainage systems with existing storm water outfalls that may be potential discharge locations for sewer separation projects. Coordinates of locations and inverts were collected and added to the GIS.

Following the data collection and GIS system updates, H&H analysis models of various portions of the Rockland drainage system were developed. One model, developed using HydroCAD, was primarily focused on the Lindsey Brook watershed. The second set of H&H models were developed in Storm and Sanitary Analysis (SSA). SSA was utilized for modeling the closed storm drainage systems at the Crescent Street, Front Street, and Park Street outfalls.

Based upon input from City staff, review of available record drawings, the results of the H&H models, and consideration of a variety of other factors impacting project cost and feasibility, a list of recommended projects and associated budgetary opinions of probable project costs was developed as presented in **Table ES-1**. The locations of these projects are shown on **Figure 1 and Figure 2** in **Appendix A** and a description of each project is included below (in no particular order):

Potential Green Infrastructure Sites

The following locations were identified as potential sites for green infrastructure improvements. These improvements involve a variety of green infrastructure design approaches, such as vegetated bio-retention facilities, tree boxes, or other stormwater treatment devices.

- Harbor Park
- Snow Marine Park
- Samoset Road/Marie Reed Park
- Oak/Orient Parking Lot
- Johnson Memorial Park

Crescent Street Outfall Separation Project

The Crescent Street outfall serves as the outlet location for the storm drainage network collecting flows from portions of Lawrence Street, Crescent Street, Pacific Street, Scott Street, Linden Street, and McLoud Street. Eight catch basins at Linden Street and Suffolk Street, Linden Street and Pacific Street, and McLoud Street and Pacific Street currently deliver flows to the combined sewer system. Separating these catch basins would result in a reduction of approximately 7.5 acres of stormwater subcatchment area from the combined sewer. The model results indicated that the existing 30-inch outfall pipe had the capacity to convey the additional flow from the proposed sewer separation area for a 25-year, 24-hour event.

Front Street Outfall Sewer Separation Project

The Front Street outfall conveys flows collected from portions of Front Street, Camden Street, and Cedar Street. The combined sewer line on Cedar Street would be the primary source of separated flows being added to the Front Street Outfall. Redirection of Cedar Street stormwater flows to the Front Street outfall would result in a reduction of approximately 60 acres from the combined sewer. Modeling results indicated that the existing storm drain was already undersized and that upsizing the Front Street outfall to a 60-inch pipe would be required to handle the flows for a 25-year design storm event.

Winter Street Outfall Sewer Separation Project

Winter Street outfall serves as the outlet location for the drainage structures on Winter Street as well as approximately 25 catch basins in the vicinity of Winter Street and Park Drive. Rockland's PCF effluent flows are discharged to a manhole structure on Park Drive shortly upstream of this outfall. The proposed improvements at the Winter Street Outfall involve the separation of combined sewer catch basins in the vicinity of Oak Street, Orient Street, School Street, and Museum Street. Separating the approximately 25 combined sewer catch basins in this area for discharge to the Winter Street Outfall results in a removal of approximately 7.0 acres of subcatchment area to the combined sewer system. The results of the model run indicated that the existing Winter Street outfall had the capacity to convey the additional flow from the proposed sewer separation project for a 25-year, 24-hour event.

Winter Street Outfall Redirection Project

Due to the existing Winter Street outfall's use of the PCF effluent outfall pipe, an analysis was conducted to determine the required size of a new outfall, separate from the PCF effluent line. The new outfall would intercept the existing Winter Street storm drain near Park Drive and be redirected to the south down Park Drive. It would also intercept flows from the undersized Park Drive outfall and ultimately discharge via a new outfall through Buoy Park. The results of the model run indicated that a new 24-inch storm drain outfall would be required to convey a 25-year, 24-hour event.

Center Street Outfall Separation Project

This project involves the separation of combined catch basins at the intersection of Center Street and Traverse Street into a new, dedicated storm drain that discharges to Lindsey Brook at the end of Center Street. This project was originally part of the City's CIP project list, but is now included in the Stormwater Master Plan.

School Street Outfall Separation Project

This project involves the separation of combined catch basins on School Street, to be routed to a dedicated storm drain that coneys stormwater flows north, to a proposed outfall into Lindsey Brook. This project was originally part of the City's CIP project list but is now included in the Stormwater Master Plan.

Talbot Avenue to Rankin Street Flood Control Structure

A portion of Lindsey Brook between Talbot Avenue and Rankin Street has the potential for conversion into a stormwater/flood storage area. This storage area would likely be created by the construction of a berm or wall upstream of the Talbot Avenue crossing and would take advantage of the large low lying area between the two crossings. An outlet pipe for the new impoundment would be placed at stream level to maintain normal stream flows and levels, but would be sized to provide peak flow attenuation and allow storage of storm-related flows, reducing downstream impacts. The results of the flood control model run indicate that peak flows could be reduced from approximately 125 cfs to 90 cfs for the 10-year, 24-hour event (28% reduction), and 180 cfs to 148 cfs for the 25-year, 24-hour event (18% reduction).

Gay Street to Broadway Flood Control Structure

Similar to the Talbot to Rankin Street area, the Gay Street to Broadway segment of Lindsey Brook has the potential for conversion into a stormwater/flood storage area. Based upon an analysis of the available LiDAR topographic data for the area, the flood control structure could provide up to approximately 175,000 cubic feet of storage prior to overtopping. The results of the flood control model run indicate that peak flows could be reduced from approximately 56 cfs to 42 cfs for the 10-year, 24-hour event (25% reduction), and 74 cfs to 69 cfs for the 25-year, 24-hour event (6% reduction).

Lawn Avenue East Culvert Replacement Project

The Lawn Avenue East Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The existing Lawn Avenue East culvert appears to be in acceptable condition but has minimal cover, which causes the roadway and adjacent areas to flood easily when the culvert is beyond capacity. The culvert has an irregular stone block construction with an opening size of approximately 2 feet by 4 feet and is approximately 50' long. The proposed project would replace the existing culvert with a 48" circular pipe, improving capacity by approximately 50% and reducing upstream flooding. The existing channel would likely be lowered by approximately 2 feet to accommodate the larger pipe and provide adequate cover. Further improvements including vegetation trimming in the existing downstream channel would also provide additional benefits at minimal additional cost. The improvement of this culvert is expected to reduce upstream flooding in the immediate vicinity of the culvert by up to 100% under 10-year, 24-hour conditions.

Broadway Culvert Replacement Project

The Broadway Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The existing Broadway Culvert inlet consists of an approximately 2.5' x 4' stone block channel that transitions to a 52" metal pipe culvert approximately 100'

before the outlet. The cover above this transition has eroded and is now visible from the surface. The culvert is approximately 275' long in total. The proposed project would replace the existing culvert with a 48" Circular pipe. The improvement of this culvert is expected to reduce upstream flooding in the immediate vicinity of the culvert by up to 100% under 10-year, 24-hour conditions.

Willow Street Culvert Replacement Project

The Willow Street East Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The Willow Street Culvert is a concrete box culvert that conveys Lindsey Brook from North to South under Willow Street. It is approximately 30' long, 4.5' wide and 3' tall. The culvert has a large crack that appears to have progressed through the full height and length of the culvert. This may undermine the roadway as the culvert deterioration progresses. The Willow Street Culvert Replacement Project would replace the existing culvert with a 54" circular pipe. The improvement of this culvert is expected to reduce upstream flooding in the immediate vicinity of the culvert by up to 100% under 10-year, 24-hour conditions.

Granite - Grove Street Culvert Replacement Project

The Granite-Grove Street Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The channel is approximately 900 feet long, beginning as a stone block channel, transitioning to concrete walls, and transitioning again to an approximately 45" corrugated metal pipe at the outlet between Grove Street and Beech Street. The Granite Street to Grove Street Culvert Replacement Project would replace the existing culvert with a 54" circular pipe. The improvement of this culvert is expected to reduce upstream flooding in the immediate vicinity of the culvert by up to 100% under 10-year, 24-hour conditions.

Talbot Avenue West Culvert Replacement Project

The Talbot Avenue West Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. This location was heavily impacted during the Halloween 2021 storm event, causing significant flooding in the roadway and at nearby properties. The Talbot Avenue West Culvert is an approximately 200' box culvert conveying Lindsey Brook from the North-West to South-East beneath Talbot Avenue and Broadway. The culvert begins as a stone block channel and transitions to concrete before the outlet. The box culvert opening is approximately 3' deep and 5' wide at the downstream end. The inlet of the culvert and immediate upstream area appeared to be partially silted or filled with debris, causing the inlet to be restricted compared to the rest of the downstream culvert. There is an existing make-shift grate covering the inlet to the culvert which further restricts flow. The Talbot Avenue West Culvert Replacement Project would replace the existing culvert with a 48" circular pipe. Replacement of this culvert would improve capacity, reduce maintenance, and reduce the likelihood of blockages. The improvement of this culvert is expected to reduce upstream flooding in the immediate vicinity of the culvert by up to 100% under 10-year, 24-hour conditions.

Summer-Maple Street Culvert Replacement Project

The Summer-Maple Street Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The Summer Street West Culvert is the longest closed conduit channel of the Lindsey Brook system, conveying Lindsey Brook from the North-West to the South-East over 1,000' from the inlet on Summer Street to the outlet south of Maple Street. Over the length of the culvert, the channel collects roadway drainage through structures on Summer Street, Beech Street, and Maple Street. The inlet to the channel is a 66" corrugated plastic pipe surrounded by a stone block channel of slightly wider and taller dimensions than the pipe. The outlet is a 56" wide by 38" tall oval corrugated metal pipe, discharging to a loose stone and silt channel approximately 9' wide and 4' deep. It is unclear whether additional material transitions occur during the length of the culvert or where these transitions occur. Upgrade of this culvert would address existing maintenance and capacity issues, and ensure that greater capacity was available for the increased flow resulting from the proposed Talbot Avenue West Culvert Replacement project. The improvement of this culvert is expected to reduce upstream flooding in the immediate vicinity of the culvert by up to 100% under 10-year, 24-hour conditions, and reduce flooding along the length of the culvert by reducing surcharging and flooding to grade at drainage structures.

Knox Center Culvert Replacement Project

The Knox Center Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The Knox Center Culvert is an approximately 750' long culvert conveying Lindsey Brook from the West to East. The culvert combines with the Limerock Street Culvert underground, which is the confluence point of the Northeast, Northwest, and South branches of Lindsey Brook. The confluence is located approximately 8-10 feet below grade on the grassed lawn in front of the South side of St. Peter's Episcopal Church. This material transition is believed to be the source of the capacity and maintenance issues observed at the Knox Facility Culvert. The culvert inlet at the Knox Center for Long Term Living is a 60" reinforced concrete pipe, continuing for approximately 200' (est.) before meeting the confluence point. Upstream of the inlet is an approximately 3-5' deep and 5' wide stone block open channel. The outlet is constructed of stone blocks and continues as an open stone block channel downstream, approximately 6' deep and 3-4' wide.

The Knox Center Culvert Replacement project would leave the existing 60" reinforced concrete pipe culvert at the Knox Facility undisturbed, with proposed improvements beginning at the confluence location of the Northeast, Northwest, and South branches of Lindsey Brook. From this location, an 80" culvert pipe would convey storm flows along the same path as the existing culvert, continuing to the existing outlet location near Main Street. This project would improve flow capacity, reduce risk to the public and private assets in the immediate area, and reduce the likelihood of future blockages in the culvert.

Grace Street Culvert Replacement Project

The Grace Street Culvert Replacement project will address existing capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The existing Grace Street culvert consists of a 36" corrugated pipe, spanning approximately 40' from end to end underneath Grace Street. Though the culvert did not show maintenance concerns when surveyed, the culvert has minimal cover and may be susceptible to future

flooding. The Grace Street Culvert Replacement project would replace the existing culvert with a larger 36" x 48" concrete box culvert, improving capacity and reducing the likelihood of blockages from upstream debris.

Maverick/Washington Street Storm Drain Re-Route Project

The Maverick/Washington Street Storm Drain Re-Route Project will provide greater level of service and reduce flooding in the storm drain system tributary to eastern Maverick Street and Washington Street. This will be achieved by upsizing the existing storm drainage mains on Maverick Street and Camden Street near the intersection and installing a re-routed storm main down lower Maverick Street. The proposed re-routed storm main would terminate at the existing outfall structure at Harbor Front Road.

Table ES-1 summarizes the prioritized list of proposed projects and their associated budgetary opinion of probable project cost. In order to generate a list of prioritized projects, the proposed projects were scored independently considering:

- parcels benefited vs cost,
- grant funding probability,
- environmental impacts,
- property short- and long-term impacts,
- flow increase to Lindsey Brook,
- risk to public infrastructure,
- reduction in flows to the PCF,
- hydraulic performance,
- parcels benefited,
- overlapping CIP projects,
- permitting,
- O&M requirements, and
- constructability.

The proposed projects were then ranked based on their scores, and a final prioritized list was developed after considering project sequencing and contingent projects. This final step was completed in order to prevent potential issues with increasing the capacity of upstream culverts without first addressing downstream issues. It should be noted that the project prioritization list was developed with stormwater control and flood mitigation as primary goals. Should the City decide they would like to prioritize one type of project over another (i.e. complete sewer separation before culvert replacement), the City can simply select the highest prioritized separation project to complete.

ES-1 City of Rockland Stormwater Master Plan Project List

Priority	Project Name	Type	Cost
1	*Knox Center Culvert Replacement Project	Culvert Replacement	$2,413,000
2	Crescent Street Outfall Separation Project	Sewer Separation	$1,483,000
3	*Summer-Maple Street Culvert Replacement Project	Culvert Replacement	$2,916,000
4	*Talbot Avenue West Culvert Replacement Project	Culvert Replacement	$715,000
5	*Granite-Grove Street Culvert Replacement Project	Culvert Replacement	$2,579,000
6	Winter Street Outfall Redirection Project	Sewer Separation	$1,019,000
7	*Willow Street Culvert Replacement Project	Culvert Replacement	$340,000
8	*Broadway Culvert Replacement Project	Culvert Replacement	$680,000
9	*Lawn Avenue East Culvert Replacement Project	Culvert Replacement	$303,000
10	*Center Street Separation Project	Sewer Separation	$220,000
11	Front Street Outfall Separation Project	Sewer Separation	$7,052,000
12	Winter Street Outfall Separation Project	Sewer Separation	$1,913,000
13	Maverick/Washington Street Storm Drain Re-Route Project	Sewer Separation	$1,669,000
14	Samoset Road/Marie Reed Park Green Infrastructure Project	Green Infrastructure	$133,000
15	School Street Separation Project	Sewer Separation	$1,300,000
16	*Grace Street Culvert Replacement Project	Culvert Replacement	$384,000
17	Snow Marine Park Green Infrastructure	Green Infrastructure	$240,000
18	Oak / Orient Parking Lot Green Infrastructure Project	Green Infrastructure	$926,000
19	Ralph Ulmer Square Green Infrastructure Project	Green Infrastructure	$155,000
20	Johnson Memorial Park Green Infrastructure	Green Infrastructure	$245,000
21	Harbor Park Green Infrastructure Project	Green Infrastructure	$143,000
22	*Talbot to Rankin Flood Control Structure	In-stream Flood Control	$1,540,000
23	*Gay Street to Broadway Flood Control Structure	In-stream Flood Control	$1,392,000
	TOTAL PROJECT COSTS		**$29,760,000**

*located in the Lindsey Brook watershed

Project Funding

Implementing stormwater management practices that support master plans and other stormwater controls can be costly and are generally underfunded in many communities. This document describes various grant and low-interest loan programs that should be considered to help fund the projects described above. The recent Bipartisan Infrastructure Law (Infrastructure Investment and Jobs Act) has created numerous funding sources for infrastructure projects, including stormwater projects. Grant programs are facilitated through both State and Federal agencies including the U.S. Environmental Protection Agency (EPA), U.S. Department of Agriculture (USDA), U.S. Department of Transportation (DOT), U.S. Federal Emergency Management Agency (FEMA), and many others.

In addition to grant/loan programs, this document also discusses the development of a stormwater utility. While most municipalities have dedicated funding sources for sewer and water services via user fees, stormwater infrastructure has historically been funded through a portion of sewer and water user fees or general capital improvement project funds. Stormwater utilities offer a way for communities to directly fund stormwater maintenance and improvement projects through a dedicated funding source directly tied to users of the stormwater infrastructure.

City Input

Wright-Pierce presented the SMP to City Council on June 29, 2022 and March 27, 2023. During those meetings, input was received from City staff, City Council, and member of the public. Additional correspondence was received from residents impacted by Lindsey Brook flooding. Input received was subsequently reviewed with City staff and addressed in the final SMP.

WRIGHT-PIERCE
Engineering a Better Environment

Section 1 Study Overview

1.1 General

In October of 2021 a Preliminary Stormwater Master Plan (SMP) was completed by Wright-Pierce for the City of Rockland. The Preliminary SMP was completed with the following goals in mind:

- Reduce flooding and risk to private and public infrastructure in the Lindsey Brook culvert system
  - Reduce peak flood stages during rainfall events
  - Address existing maintenance issues at various culverts in the City
  - Improve resilience and reduce risk to roadways
  - Lower the likelihood of blockages and other maintenance problems at culverts
- Reduce peak flows at the PCF
  - Reduce the duration of sustained wet weather flows
  - Reduce the costs of future upgrades at the PCF from these reduced wet weather flows
  - Minimize PCF Combined Sewer Overflows (CSOs) to Rockland Harbor
- Reduce Rockland Harbor pollution from stormwater
  - Collect and treat the "first flush" of dirty stormwater runoff
- Reduce flows in the wastewater collection system
  - Reduce inflow and infiltration (I/I) in existing system
  - Reduce operation and maintenance costs
- Plan for cost savings opportunities
  - Realize cost savings if done with planned street reconstruction
  - Realize cost savings if done with planned utility projects
  - Realize costs are lower and schedule is more flexible if done ahead of future DEP regulations

The study tasks for the Preliminary SMP included:

- An existing system assessment to review and evaluate existing stormwater information available and identify areas that are lacking detail or completeness.
- A review of projects in current Capital Improvement Plan (CIP)
- Field inspections, including a focused survey of the storm drainage infrastructure associated with Lindsey Brook, including culverts and open channel reaches, amongst other system elements. Field crew representatives also performed a survey of potential locations of existing drainage networks not captured in the GIS database.
- Hydraulic modeling including the development of hydrologic and hydraulic (H&H) analysis models of various portions of the Rockland drainage system. A HydroCAD model primarily focused on the capacity and storage properties of conveyance piping within the Lindsey Brook watershed was developed, and a second set of H&H models were developed in Storm and Sanitary Analysis (SSA) for modeling the closed conduit systems tributary to the Crescent Street, Front Street, and Park Street outfalls.
- Assessment for the potential for green infrastructure. Focusing on City-owned parcels, which hold the best potential for GI improvements, Wright-Pierce staff visited each site to photograph and develop concept-level ideas about how to best implement various GI installations in these locations.
- Development of a prioritized list of storm water improvement projects to address stormwater conveyance and flooding issues identified within the City.

- The prioritization focused on installation of new or replacement storm drainage or other stormwater infrastructure within areas where other CIP or private utility projects were already planned. Planning level cost estimates were created for each project to assist in prioritization, on a per project basis.
- Submission of the Preliminary Stormwater Master Plan document to the City.

While an analysis of Lindsey Brook was performed as part of the Preliminary SMP it was not the focus of the prioritized project list. At the time of the original analysis, the limited flooding information was available relating specifically to Lindsey Brook. The understanding was the Pleasant Street diversion project in 2005 and the Summer Street diversion project in 2011 were intended to improve functionality of Lindsey Brook. Therefore, the Preliminary SMP carried just two flood control projects within Lindsey Brook, with the remaining projects primarily focused on sewer separation and green infrastructure in other portions of the City.

The Preliminary SMP was submitted to the City on October 15, 2021 and the report was presented to the City Council at a meeting on November 8, 2021. In the period of time between the submission of the Preliminary Master Plan and the Council meeting, the City experienced an extreme precipitation event, causing widespread flooding along the branches of Lindsey Brook and other places throughout the City. Residents that were impacted by the 2021 Halloween flooding event spoke at the November 8, 2021 Council meeting to express their desire to have the City address and prevent future flooding.

The Halloween 2021 storm occurred overnight and into the early morning hours of Halloween day in late October of 2021, resulting in total rainfall depths more than five inches in under 24 hours. This storm caused widespread flooding in the City, impacting private property and public infrastructure in numerous locations. Table 1-1 below lists the known locations impacted by flooding during this storm. While many of the properties listed below were impacted due to flooding in the Lindsey Brook system, flooding that was not influenced by Lindsey Brook that occurred at other parcels in the City is given as well. This list was developed using a combination of insurance claims and photos received from residents and the City. A map of the properties and roadways that were directly impacted by Lindsey Brook flooding can be found on **Figure 1** in **Appendix B**.

Table 1-1 Known Properties Impacted by Halloween 2021 Event

Street Number	Street Name	Lindsey Brook Branch (if applicable)
19	BEECH STREET	NW
276	BROADWAY	NW
10	CRESCENT STREET	-
5	FOGG STREET	NE
38	GAY STREET	NE
41	GRANITE STREET	NE
38	HIGH STREET	S
186	LAKE VIEW DRIVE	-
87	LIMEROCK STREET	NW
101	LIMEROCK STREET	NW

Street Number	Street Name	Lindsey Brook Branch (if applicable)
61	LIMEROCK STREET	NW
155	LIMEROCK STREET	-
9	LINCOLN STREET	NW
18	MAPLE STREET	NW
7	MARKS LANE	-
75	MECHANIC STREET	-
82	NEW COUNTY ROAD	-
98	NEW COUNTY ROAD	-
44	RANKIN STREET	NE
88	SUMMER STREET	NW
38	TALBOT AVENUE	NE
109	TALBOT AVENUE	NW
41	TALBOT AVENUE	NE
14	THOMASTON STREET	S
4	WHITE STREET	NW/S
11	WHITE STREET	NW/S
47	WILLOW STREET	NE

The effects of the Halloween 2021 storm prompted the City to expand the scope of the Stormwater Master Plan to include projects aimed at improving the capacity of the Lindsey Brook system, addressing existing maintenance defects, thereby mitigating risk for both private and public assets in the City. This led to Phase 2 of the Stormwater Master Plan and the subsequent tasks listed below.

While several stormwater projects are underway in the City, the City is focused on continuing to be proactive about planning efforts related to stormwater system improvements and the phasing of future stormwater projects. The purpose of this Phase 2 Stormwater Master Plan is to provide the City with the framework to make educated and informed decisions about future stormwater improvement projects while considering project benefits, costing, and the impact of other planned infrastructure projects that may result in costs savings if completed in conjunction with stormwater improvements. Additionally, in anticipation of the projects contained within the updated SMP, the City was able to place a stormwater bond on the November 2022 ballot for members of the community to vote on. The bond, which provides up to $15,000,000 to finance the cost of stormwater management through the City, was passed, giving the City critical funds to complete projects through matching state and federal grand funds, or by self-funding projects when required.

1.2 Phase 2 Stormwater Master Plan Tasks

The major tasks conducted as part of the Phase 2 SMP included:

- Performing additional field inspections
- Performing additional hydraulic analysis,
- Researching and recommending grant or other funding opportunities,
- Addition of and reprioritization of improvement projects,
- Researching the possibility of a stormwater utility, and
- Preparation of an updated Stormwater Master Plan.

Descriptions of these tasks are outlined in more detail in the following sections.

1.2.1 Field Investigations

Based on the recent flooding issues that occurred in the City in the Fall of 2021, Wright-Pierce will visited select sites to collect additional geometry information and field survey of critical infrastructure in the vicinity of Lindsey Brook and other areas impacted by flooding. The additional inspections were conducted to support analysis and hydraulic modeling in the following areas:

- Summer Street crossing near Broadway and potential for redirection of Lindsey Brook down Summer Street
- Maverick and Washington Street Drainage
- Underground portions of Lindsey Brook between Summer Street and Maple Street
- Underground portions of Lindsey Brook between Granite Street and Grove Street
- Drainage around and downstream of the Knox Center
- Review and document condition and approximate dimensions of stream channels entering and exiting underground portions of Lindsey Brook
- Rankin Street property for potential to support a stormwater detention facility
- Old County Road watershed for use in developing list of potential stormwater projects located in newly formed TIF in this area.

1.2.2 Hydraulic Analysis

After completion of the additional field inspections, the hydrologic and hydraulic analyses performed in Phase 1 of the Master Planning effort was updated. The updated modeling focused on determining potential alternatives for reducing and/or mitigating the flooding in the areas referenced above.

The model updates to the Lindsey Brook HydroCAD model included:

- Adjusting current representations of existing stream channel cross-sections to better match obtained field measurements.
- Modifying the underground portions of Lindsey Brook to better estimate existing flooding using updated field data.
- Adding Lawn Avenue detention basin.
- Adding tidal aspects to the existing conditions model, and
- Further model calibration using rainfall data from the 2021 Halloween storm, anecdotal information received, and tidal data.

Additional modeling tasks completed outside of the Lindsey Brook watershed included:

- Development of an H&H model of the Maverick and Washington Street closed drainage system using Autodesk Storm and Sanitary Analysis modeling software (SSA).

In addition to the model updates, the following proposed projects model runs were conducted:

- Determined the extent of culvert replacement/upgrades required to convey a 10-year and 25-year design storm event through Lindsey Brook without overtopping roadways.
- Determined whether re-channelization of Lindsey Brook would be effective for flood mitigation.
- Determined the benefit of construction of an additional connection to the Summer Street bypass.
- Determined the upgrades necessary to prevent flooding along the Maverick Street and Washington Street drainage outfall.
- Running of the flood mitigation structures proposed in the Preliminary Master Plan and summarized the benefits of the structures at downstream locations.

1.2.3 Grant/Funding Opportunities

A review of potential funding sources was conducted including but not limited to Clean Water State Revolving Fund (CWSRF), the American Rescue Plan (ARPA), Coronavirus State and Local Fiscal Recovery Funds, EPA Planning Assistance, EPA Water Infrastructure Finance and Innovation Act (WIFIA), and FEMA Building Resilient Infrastructure and Communities (BRIC), FEMA Preparedness Grants, FEMA Public Assistance Grants, and local TIF districts. The review was conducted to assist the City in outlining the various funding and grant opportunities that may benefit the City's implementation of the SMP. Wright-Pierce also summarizes the benefits of a stormwater utility.

1.2.4 Reprioritization of Improvements

Significant coordination was conducted with the City to develop an updated project prioritization matrix for inclusion in the updated SMP. The project scoring was expanded from a list of four categories to a list of 14 different metrics, further explained in Section 4. Planning level cost estimates were created for each new improvement project, and existing project cost estimates created under the Preliminary SMP were updated to reflect new analysis results.

1.2.5 Update Stormwater Master Plan

After updating and finalizing the prioritized list of projects, the study efforts conducted as part of this project were summarized and documented into an updated Stormwater Master Plan for the City's review. The Stormwater Master Plan will summarize the major factors of each improvement and how these factors relate to the overall implementation plan. A series of maps were prepared that depicts these proposed improvement projects.

2

WRIGHT-PIERCE
Engineering a Better Environment

Section 2 Analysis Methodology

2.1 Existing System Assessment

The existing system assessment task was completed as part of the Phase 1 Preliminary SMP in 2020 and 2021. Wright-Pierce was provided with several plan sets, consisting of scanned PDF documents and hard copies of plans which were scanned and reviewed. The provided plans are summarized in **Table 2-1**.

Once the list of project plans was developed, Wright-Pierce staff went through each of the plan sets and compared each plan view containing stormwater infrastructure to what was in the existing GIS. If drainage structures were shown both on the plans and on the GIS (in relatively the same location), no changes were made to the GIS. Pipes in the GIS were also compared to pipes shown on the plans, and attribute information, such as flow direction, pipe size, and pipe material were added to the GIS, where available. Proposed or existing stormwater infrastructure shown on the plans, but not in the GIS, were added to the GIS along with other available information. Rim elevations were not available for all structures; however, for the structures that were edited, the rims on the plans, if available, were compared to the LiDAR Height listed in the GIS. If the Lidar Height was within 0.5 foot of those shown on the plans, no changes were made. If the LiDAR Height was not included in GIS, but available on the plans, it was added. It is important to note that some of the plan sheets appeared to use an assumed or local datum; therefore, rims and inverts for any structures edited on these sheets were not adjusted or added.

A summary table of changes made to the GIS was developed, which included the street, item needing updating, reference to the plan set and sheet, and the Wright-Pierce project number, if applicable.

Table 2-1 City of Rockland Stormwater Plans

Title	Type	Design Engineer	Date
Wastewater System Improvements	Record Drawings	Wright-Pierce	May 2011
South Main Street Sewer Separation	Record Drawings	Wright-Pierce	Nov 2018
Elm & Museum Street Drainage[1]	Stamped	Gartley & Dorsky	Jul 2015
Park & Main Streets Stormwater/Sewer Separation	Stamped	Landmark Corporation	Mar 2019
Pen Bay Acres	Advance Copy	Gartley & Dorsky	Aug 2013
South End CSO Abatement Contract I	Hand Marked Up As-Builts	Wright-Pierce	Apr 2005
Summer Street Drainage Interceptor	Hand Marked Up As-Builts from Contractor	Wright-Pierce	Aug 2011
Summer Street Sewer Replacement[1]	Preliminary	Wright-Pierce	--
Winter Street	Stamped	Gartley & Dorsky	Feb 2015
Public Library[1]	Stamped	Gartley & Dorsky	Mar 2011
Lindsey Brook Detention Basin Nightingale Subdivision	Contract Drawing (Stamped)	Wright-Pierce	Jan 2003
Thompson Meadow Road Stream Crossing Improvements[1]	Contract Drawing (Stamped)	Wright-Pierce	Jul 2011
Thomaston Street Stream Crossing Improvements[1]	Contract Drawing (Stamped)	Wright-Pierce	Jul 2011

[1] Data from these plans not applicable and not added to GIS.

The changes to the City's GIS were made using copies of the most-recent data available from the City's ArcGIS Online profile. At the time of the assessment the City's GIS Database was dated August 2020. Relevant pages were georeferenced into ArcMap using a combination of parcel lines, existing sewer and water features, and aerial imagery before being used to add and adjust features. Once the GIS edits were made, they were back-checked and further revisions were made for completeness.

A figure was created to summarize the drainage features that were edited or created versus any other existing drainage layer available. Additionally, the figure overlaid the combined catch basin layer from previous studies completed by Wright-Pierce to help identify the areas that may be directed into a nearby combined sewer versus those missing important connectivity data. The figure was then used to conduct a gap analysis and ultimately guided the field effort by allowing field staff to focus on areas where gaps were observed.

2.2 Review of Projects in Current CIP

The CIP project review was completed as part of the Preliminary SMP, and the CIP at the time contained a number of improvement projects around the City, including projects involving repaving and/or collection system upgrades or repairs. As of February 2023, a number of projects in the CIP have been completed, but many are pending completion. Coordination and phasing of the projects proposed in the Stormwater Master Plan to align with other proposed projects in the City will result in overall reduction in construction costs and better access to funding sources. The projects listed in the following sections have been spatially mapped in the City's GIS database, to facilitate project combination planning efforts. A summary of the projects in the CIP is given below:

Table 2-2 and **Table 2-3** below detail the anticipated paving and stormwater/sewer separation projects that are planned to take place in the 2023 and 2024 fiscal year.

Table 2-2 City of Rockland Anticipated 2023-2024 Paving Projects

Location	Project Begin	Project End	Length (LF)
Lisle Street	Park Street	Pleasant Street	715
Broad Street	Park Street	Limerock Street	1,170
Lake View Terrace	Old City Road	48 Lake View Terrace	750

Table 2-3 City of Rockland Anticipated 2023-2024 Collection System Improvement Projects

Project/Location	Project Begin	Project End	Length (LF)
Center St. (West side of Traverse intersection.)	Traverse Street	Lindsey Brook	525
School St./Limerock/Custom House Parking	Union Street	Lindsey Brook	725
Cottage Street Lateral Sewer Extension	N Main Street	Main Street (Route 1)	400
Luce Avenue Lateral Sewer Extension	Railroad Avenue	Pleasant Street	535
McCloud Street Lateral Sewer Extension	Suffolk Street	Pacific Street	470
Linden Street Lateral Sewer Extension	Suffolk Street	Pacific Street	500
Beacon Street Lateral Sewer Extension	Traverse Street	End of Roadway	130

Typically, Maine Water works in conjunction with the City during applicable projects. Maine Water currently does not have any projects planned in Rockland for the next few years, so coordination to combine Maine Water work into the projects in this section will likely be unnecessary.

2.3 Field Inspection

Wright-Pierce dispatched field crews to Rockland on more than a dozen occasions between December 12th, 2020, and April 11th, 2022.

The objective of these field visits was to fill in data gaps by inspecting the stormwater system and Lindsey Brook drainage system to gather enough information to properly model the necessary components of the system and update the City's GIS database. The first field crew visit conducted by Wright Pierce in December 2020 collected survey information with GPS equipment for various points along the north and south reaches of Lindsey Brook. Further verification was conducted by field crews at later dates until a satisfactory network mapping of Lindsey Brook was created.

Subsequent field visits in early January through March 2021 were focused on system inspection to verify various properties of the system that may have been incomplete or insufficient in the existing GIS database, such as pipe material and size, pipe depth, structure connectivity, and structure/outfall location. Using tablet devices equipped with Esri's Collector app, Wright-Pierce staff were able to verify and then immediately upload updated system attributes and photos to the cloud-based data storage provided through ArcGIS Online. Wright-Pierce crews used this inspection workflow to assess portions of the City's stormwater system (where known system components were accessible and able to be located).

Following the Halloween Storm in October 2021, Wright-Pierce and/or City staff re-visited crossings with known flooding after the storm event and documented additional dry-weather conditions at these locations. The dry weather conditions were later compared to the documented flooding conditions in the same locations. In general, the sites shown on **Figure 1** in **Appendix B** were visited. This information was then used to support calibration of the Lindsey Brook hydrologic and hydraulic model, as described in **Section 2.4**.

Ahead of the April 2022 field crew visit, the data collected on the Lindsey Brook culvert system was reviewed and checked for completeness. Field crews collected any remaining necessary information on culverts and channels in the Lindsey Brook system, for inclusion in the hydrologic and hydraulic model of Lindsey Brook. Once the remaining information for the Lindsey Brook system was collected during this field visits, the information was reviewed by Wright-Pierce and a summary document of the properties and condition of each culvert crossing was developed. A narrative summary and photograph for each culvert location in each reach of Lindsey Brook is provided in **Appendix C.** Additional information regarding other aspects of the City's stormwater system was collected by field crews during the April 2022 visit, including survey of the drainage structures on Washington Street and Harbor Front Road, and further investigations of the drainage system on Summer Street.

2.4 Hydrologic & Hydraulic Modeling

2.4.1 HydroCAD

HydroCAD was one of two H&H modeling programs selected by Wright-Pierce for the drainage study. The HydroCAD model requires several input parameters including, but not limited to, average watershed slope, longest flow path, land cover type, soil type, localized rainfall data, geometry of the impoundment and geometry of the spillway.

The variability in hydrologic properties across the Town is accounted for by dividing the study area up into a collection of smaller subcatchment areas, each containing individual hydrologic parameters. Time-varying rainfall is inserted into the model as a time series. This feature greatly increases the versatility of HydroCAD because it gives the software the ability to simulate rain events of varying intensities, volumes, and durations.

The HydroCAD model calculates the amount of rainfall that becomes runoff on each subcatchment and then routes the runoff through the hydraulic drainage network. The user can then view program results reports to determine runoff quantities, hydraulic grade lines throughout the system, flow through individual culverts and reaches, and determine the causes of flooding in focus areas.

The HydroCAD model used in this analysis was built upon an existing model developed by Wright-Pierce in 2007. The model was reviewed and overhauled based on updated hydraulic data and new or updated information on the hydrology of the area.

2.4.2 Storm and Sanitary Analysis (SSA)

Autodesk SSA was selected to model the closed-pipe drainage networks tributary to the stormwater outfalls at Crescent Street, Front Street, Park Street, and the drainage system on lower Maverick Street to Washington Avenue. SSA was selected for this application due to the more reliable computation of closed-pipe network hydraulics versus HydroCAD. SSA is a link-node based dynamic rainfall-runoff simulation model program. It allows the user to create, edit, modify, run, analyze, and design stormwater management device and stream network. SSA utilizes a variety of computational methods of calculating hydrologic and hydraulic outcomes, and as such, is capable of accounting for various stormwater hydrologic and hydraulic processes such as:

- Time-varying rainfall;
- Routing direct runoff and external inflows
- Using a wide variety of standard closed and open conduit shapes, model flow dividers, weirs, and orifices;
- Applying external flows from surface runoff and Rainfall Dependent Inflow and Infiltration (RDII) and;
- Modeling backwater, reverse flow, surcharging, and surface ponding in the system

2.4.3 Hydrology

In order for the models to accurately model hydrologic processes, the user must obtain data unique to the area modeled, process it into a form that the program can recognize, and input the data into the model. The hydrologic data used to develop the Rockland stormwater models includes:

- Subcatchment boundary delineation;
- Acreage of each subcatchment;
- Land cover statistics;
- Longest flow paths;
- Soil infiltration parameters (Curve Number Method – requires CN, conductivity, and drying time), and;
- Slope of each subcatchment.

The City's soil survey data was obtained from Web Soil Survey, a soil database source developed from Natural Resources Conservation Service (NRCS) soil survey data.

For the development of the Lindsey Brook HydroCAD model, Wright-Pierce started with the subcatchment delineations completed in a study completed by Wright-Pierce in 2007. These subcatchments were reviewed and updated in ArcGIS, informed by current topographical data, aerial imagery, and new system knowledge gained from field data collection. Additional subcatchments were added where flows were believed to be entering the drainage system at locations that were not included in the 2007 study. In addition to the subcatchment updates completed to support the Lindsey Brook HydroCAD model, new subcatchment delineations were completed for runoff calculation as part of the Front Street, Crescent Street, and Pleasant Street SSA models as well.

2.4.3.1 Subcatchment Acreage

Subcatchment boundaries were derived from the previous models completed by Wright-Pierce and updated or expanded as needed. The area boundaries were updated in ArcGIS based on a review of available storm system maps, field visits by Wright-Pierce staff, and LiDAR generated topography. Based on the updated delineations, the total drainage area tributary to the study area of the Lindsey Brook is 1,071 acres**. Figure 1** in **Appendix D** provides a visual representation of the updated watershed delineations.

2.4.3.2 Curve Number

The curve number, or CN, is determined according to the soil group and land cover. CN values from the 2007 HydroCAD model were kept where appropriate and calculated for new subcatchments. The SSA models had CN calculated for each subcatchment. A high CN indicates low infiltration and high runoff typically associated with highly impervious areas (pavement, roofs, concrete, etc.) and areas with poor soils, and low CN indicates high infiltration capacity and low runoff such as undisturbed vegetated or wooded areas. The CN is also included in calculations to produce runoff, including time of concentration (Tc), as part of the Lag/CN method. Decreasing the CN value increases the Tc of the subcatchment, which increases the amount of time available for a drop of water to infiltrate, reducing total runoff volume, and peak flow rates. Decreasing the CN value also increases the proportion of fallen rain that becomes runoff. For information on how CN values in the HydroCAD model were modified from the initially calculated values, see **Section 2.4.4**.

2.4.3.3 Land Cover

Land cover types were taken from the previously developed Wright-Pierce HydroCAD model and adjusted as needed based upon current and higher quality aerial orthophotography. Land cover for the SSA model was derived from analysis of aerial orthophotography. From here, ArcGIS was used to determine the area of each land cover type within each subcatchment each land cover type. Each land cover type was assigned a runoff CN depending on hydrologic soil group. A weighted CN was then calculated for each subcatchment.

2.4.3.4 Time of Concentration

An important element in calculating runoff for any application is the time of concentration (Tc). Tc is the time required for runoff to travel from the most hydrologically remote point of the watershed to the collection point. The Lag/CN method was used to conduct this calculation, which takes into account the longest flow path and the subcatchment slope.

The subcatchment slope represents the average slope of each subcatchment. Average slope was calculated using functions in ArcGIS that determine average slope for each individual subcatchment using a Digital Elevation Model (DEM) and a statistical analysis tool. The longest flow path within each subcatchment was determined using manual measurement within ArcGIS. These two calculated values in conjunction with the calculated watershed Curve Numbers were used to calculate the time of concentration of each watershed. The weighted curve number and resulting Tc for each subcatchment is presented in **Table 2-4**.

Table 2-4 Curve Number and Time of Concentration – Lindsey Brook Hydrocad Model

Subcatchment ID	Weighted Curve Number*	Flow Length (ft)	Average Slope	Time Of Concentration (min)
1S	79	2,458	0.92	70.16
11S	66	4,041	4.79	65.85
12S	80	4,926	1.15	106.11
13S	82	4,194	1.23	84.63
14S	83	1,497	1.13	37.47
15S	79	2,566	1.04	68.30
16S	58	3,534	0.98	160.49
17S	81 (66)	1,367	1.06	38.40
18S	88 (76)	1,256	0.8	32.39
19S	88 (81)	504	0.95	14.32
20S	81 (62)	2,573	0.86	70.71
21S	82 (72)	989	1.09	28.30

Subcatchment ID	Weighted Curve Number*	Flow Length (ft)	Average Slope	Time Of Concentration (min)
22S	80 (73)	1,069	1.04	32.87
23S	78	929	0.83	34.96
24S	81	1,595	1.02	44.29
25S	83	1,336	0.80	40.66
26S	84	1,206	0.72	38.18
27S	84	1,252	0.75	38.55
28S	84	1,970	0.72	56.54
2S	79(67)	1,053	0.57	45.24
30S	88	3,277	0.88	66.51
32S	87	1,159	0.85	30.60
34S	87	1,122	0.77	31.32
35S	91	328	0.93	9.09
36S	95	897	1.00	16.29
37S	87 (80)	1,184	0.79	32.28
38S	95 (80)	211	3.80	6.00
39S	87(79)	2,038	1.88	32.31
3S	83	598	0.66	23.53
4S	82(79)	2,848	0.85	74.70
5S	79	2,404	0.79	74.38
6S	84	2,192	0.88	55.70

*Curve number values in parentheses are post-calibration curve numbers. Values not in parentheses were used for Time of Concentration calculation.

2.4.3.5 Rainfall

The design storm unit hydrographs used in the model simulations for both the HydroCAD and SSA models were obtained from the Northeast Regional Climate Center (NRCC) and Natural Resources Conservation Service (NRCS) joint website precip.eas.cornell.edu, which provides extreme precipitation data for New York and New England.

The rainfall depth values for each design storm were obtained from Maine DEP's Chapter 500: Stormwater Management Appendix H table "24-hour duration rainfalls for various return periods". This table is included in **Appendix D**. The storm hydrograph for the Halloween Event was recorded by a private rain-gage and data was accessed via Weather Underground, an online source of crowdsourced rainfall data, local & long-range weather forecasts, weather reports, maps & weather conditions for locations worldwide.

2.4.3.6 Hydraulics

The hydraulic portion of the model was developed using a combination of open channel/pipe schematics provided by the Town of Rockland, field surveys by Wright-Pierce staff, LiDAR topographic data, and open channel geometry taken from hydraulic models.

Conduit diameter, slope, and depth were determined from existing information and modeling, where complete, and supported and/or verified by field investigations and survey measurements conducted during the field work task. Impoundment volume/storage and roadway flooding heights for each culvert or roadway crossing were determined using a combination of contour analysis and field survey data.

The SSA closed conduit drainage network model was developed primarily from the City of Rockland GIS data. Where the data was found or suspected to be insufficient, field verification was conducted to gather the necessary information.

2.4.4 HydroCAD Calibration

During the Preliminary SMP analysis, after updating the model subcatchments and reviewing existing conditions results, the model reported roadway flooding at a number of locations in the city. These were, at the time, believed to be overly conservative results based upon observation by City staff at that time. During the last 5-10 years, there was no known roadway flooding associated with the Lindsey Brook drainage network reported in the City. Due to this, Wright Pierce felt it was suitable to calibrate the model runoff rates so they would generate results consistent with observations by City staff, while still maintaining a certain level of conservatism. Performing this model adjustment involved identifying which stream crossings were flooding to roadway grade and incrementally reducing the curve number of the subcatchments contributing to those locations until the model output was consistent with City observations but still somewhat conservative.

In 2022, as part of the updated SMP, a more detailed model calibration was able to be completed following the Halloween 2021 event, where information about peak flood stage elevation and location was available. Because local rain gauges in the City were able to measure the intensity and total depth of the Halloween Event as the storm progressed, a hydrograph time series of the Halloween Event was imported into the model and a re-creation of the storm was simulated. Peak water surface elevation model results were collected at each major culvert crossing in the Lindsey Brook system and compared against peak stages estimated from available flooding photos in Rockland during the Halloween Storm. Calibration involved the review and adjustment of parameters that control the quantity and peak flow rate of stormwater runoff that enters the Lindsey Brook system. By comparing the location and extents of documented flooding at various locations to the results that the model predicted, the model was calibrated accordingly, making it a more accurate predictive tool.

2.5 Analyze Potential for Green Infrastructure

Shortly after a September 29th, 2020 meeting between Wright-Pierce and the City, six locations throughout the City were identified as potential locations for GI improvements. This was later revised down to the five areas described below and in subsequent sections of this report. The locations are listed as follows:

- Harbor Park
- Snow Marine Park
- Samoset Road / Marie Reed Park
- Oak/Orient Parking Lot
- Johnson Memorial Park
- Ralph Ulmer Square

Preliminary GI plan figures were developed for the City in March of 2021 and updated in July 2021. These figures are provided in **Appendix E**. More detailed descriptions of proposed GI improvements are provided in **Section 3**.

WRIGHT-PIERCE
Engineering a Better Environment

Section 3 Evaluation of Alternatives

3.1 Introduction

The City of Rockland seeks to plan and execute projects that will reduce or mitigate flooding within the Lindsey Brook watershed, reduce the demand on the City's Pollution Control Facility, which has existing capacity issues due to an excess of flow from the combined portions of the City's sewer system, and to seek opportunities to provide stormwater treatment through Green Infrastructure recommendations. Mitigation of flooding along Lindsey Brook can be achieved using various methods including the addition of watershed storage, increasing the conveyance capacity of culverts and conveyance channels, or through source control. The most effective means of reducing demand on the PCF is to separate combined sewer catch basins and other sources of combined sewer inflow into dedicated stormwater drainage lines.

A number of watershed storage and culvert upgrade options were modeled using HydroCAD with the goal of mitigating flooding within Lindsey Brook to the extent feasible. Additionally, a number of outfalls in the City of Rockland were modeled in SSA with the goal of determining the most cost effective and impactful sewer separation projects. Assessing the costs of executing these projects requires considering the schedule of other planned projects in the City's CIP. Executing stormwater projects alongside CIP projects could result in substantial savings in construction cost and reduce interruption of service. After the impact of each project is assessed and eligibility for CIP combination is determined, these stormwater projects could then be prioritized ahead of other projects that may not provide such benefit for the cost.

Four existing stormwater outfalls downstream of three potential sewer separation projects were studied and subsequently modeled in SSA to gage what effects the addition of stormwater flows previously conveyed by the combined sewer system would have on the existing outfall systems. Focus was placed on what changes, improvements, or relocations would be necessary for the stormwater outfalls associated with each of the closed conduit networks studied. Usage of existing stormwater outfalls without the need for improvement avoids a large amount of project cost in separation. Once the closed conduit systems at the three locations below were added to the model, 10-year and 25-year, 24-hour design storm rainfalls were applied to the system. The results of sewer separation simulation for the four locations are described in Section 3.2. The subcatchment extents of these sewer separation projects are shown on **Figure 1** in **Appendix D**.

3.2 Storm and Sanitary Analysis Alternatives Analysis (Outfall Analysis)

The four locations described in the following sections were modeled using SSA. The level of service each system was capable of achieving was assessed during the modeling effort. Initially, existing conditions were modeled and the existing level of service was determined. Each location was considered to have achieved an adequate level of service if the system could pass the 25-year, 24-hour design storm event without flooding to grade in the existing condition. If a proposed separation project resulted in minor flooding to grade on an existing line that previously provided a 25-year level of service, this was considered acceptable. The reduction in level of service between existing and proposed conditions is only deemed acceptable if the proposed separation project would be achievable without upsizing or improving the existing outfall. If an existing outfall would need upsizing or improvement in order to meet a minimum level of service, a 25-year level of service would be pursued.

3.2.1 Crescent Street Outfall

3.2.1.1 Existing Conditions

The Crescent Street outfall serves as the outlet location for the storm drainage network collecting flows from portions of Lawrence Street, Crescent Street, Pacific Street, Scott Street, Linden Street, and McLoud Street. Subcatchments labeled as "SSA-CS" on the watershed map included as **Figure 1** in **Appendix D** are tributary to this outfall. Based on model results, the Crescent Street outfall has adequate capacity under existing conditions for the 25-year design storm event, making it a potential candidate for receiving additional flows from proposed sewer separation projects in the area.

3.2.1.2 Sewer Separation

Eight catch basins at Linden Street and Suffolk Street, Linden Street and Pacific Street, and McLoud Street and Pacific Street currently deliver flows to the combined sewer system. Separating these catch basins would result in a reduction of approximately 7.5 acres of stormwater subcatchment area from the combined sewer. Model results indicate that the additional stormwater flows from proposed sewer separation directed to the existing drainage network would result in a reduction in level of service from the 25-year to the 10-year event. This reduced level of service would only impact the existing storm drain between Scott Street and its connection point to the major outfall off the end of Crescent Street. The existing 30-inch outfall has sufficient capacity to pass these additional flows without need for upgrade or improvement. The proposed Crescent Street Outfall Separation project is shown in **Figure 1**, in **Appendix A**.

3.2.2 Front Street Outfall

3.2.2.1 Existing Conditions

The Front Street outfall conveys flows collected from portions of Front Street, Camden Street, and Cedar Street. Subcatchments labeled "SSA-FS" on the watershed map included as **Figure 1** in **Appendix D** are tributary to this outfall. Modeling results show the Front Street outfall only meets a 1-year level of service under existing conditions and therefore is not a suitable candidate for addition of separation flows without significant outfall improvements. The Front Street outfall passes under facilities at the North End Shipyard, making access for maintenance or construction difficult. While a relief line could be constructed to increase the level of service at this location, due to the lack of access for maintenance at the existing drain, the system would be vulnerable to any additional loss of service in the existing outfall. Abandoning the existing outfall and constructing a new outfall in a new nearby location is the most practical solution for increasing capacity. This new outfall would be sized to provide the full 25-year level of service.

3.2.2.2 Sewer Separation

The combined sewer line on Cedar Street would be the primary source of separated flows being added to the Front Street Outfall. Redirection of Cedar Street stormwater flows to the Front Street outfall would result in a reduction of approximately 60 acres from the combined sewer. Modeling results suggest that upsizing the Front Street outfall to a 60-inch pipe would be required to handle the flows for a 25-year design storm event. The proposed Front Street Outfall Separation project is shown in **Figure 1**, in **Appendix A**.

3.2.3 Park Drive Outfall

3.2.3.1 Existing Conditions

The Park Drive outfall conveys flows collected from ten catch basins located along the intersection of Park Street and Main Street, continuing east to Park Drive and Police Plaza. The subcatchment labeled "SSA-PS1" on the watershed map included as **Figure 1** in **Appendix D** are tributary to this outfall. Based on conversations with the

City and evidence collected from field inspections, the 15-inch Park Drive outfall is believed to be crushed or collapsed. While there is repair and maintenance that likely needs to be completed to replace the 15-inch pipe and/or associated structures at the Park Drive outfall, the outfall was modeled as normally functioning to assess its hydraulic capacity and the upstream drain line. Based on the results, the line is nearly at capacity under existing conditions during the 10-year storm event.

3.2.3.2 Sewer Separation

The Park Drive drain line was nearly at capacity passing flows during the 10-year event. Based on the results of the existing conditions model for the Park Drive outfall, it does not appear to have sufficient capacity to pass additional flows resulting from a sewer separation project without significant improvement. For this reason, a more feasible solution for separating stormwater flows would involve directing the additional stormwater to the nearby Winter Street outfall, which has a more adequate level of service in existing conditions. Many of the catch basins eligible for separation in the vicinity of the Park Drive outfall, such as those at the East and West ends of Orient Street and Oak Street, could be routed to Winter Street.

3.2.4 Winter Street Outfall

3.2.4.1 Existing Conditions

Winter Street outfall serves as the outlet location for the drainage structures on Winter Street as well as approximately 25 catch basins in the vicinity of Winter Street and Park Drive. Subcatchments labeled "SSA-PS2" and "SSA-PS3" on the watershed map included as **Figure 1** in **Appendix D** are tributary to this outfall. Rockland's PCF effluent flows are discharged to a manhole structure on Park Drive shortly upstream of this outfall. Existing conditions model runs for the Winter Street outfall do not indicate any issues with capacity for the 25-year event. This outfall has the capacity to pass greater flows making it a suitable location to route separated stormwater flows to.

3.2.4.2 Sewer Separation

The proposed improvements at the Winter Street Outfall involve the separation of combined sewer catch basins in the vicinity of Oak Street, Orient Street, School Street, and Museum Street. Separating the approximately 25 combined sewer catch basins in this area for discharge to the Winter Street Outfall results in a removal of approximately 7.0 acres of subcatchment area to the combined sewer system. Rainfall simulation of the 25-year, 24-hour design storm event results in near-negligible flooding to grade at a single manhole with no upsizing of the existing system. This is considered an adequate level of service and makes this location a feasible candidate for sewer separation. The proposed Winter Street sewer separation project is shown in **Figure 1**, in **Appendix A**.

3.2.4.3 Outfall Redirection Project

Due to the existing Winter Street outfall's use of the PCF effluent outfall pipe, an analysis was conducted to determine the required size of a new outfall, separate from the PCF effluent line. The new outfall would intercept the existing Winter Street storm drain near Park Drive and be redirected to the south down Park Drive. It would also intercept flows from the undersized Park Drive outfall and ultimately discharge via a new outfall through Buoy Park. The results of the model run showed that a new 24-inch storm drain and outfall would have the capacity to discharge flows from a 25-year, 24-hour event. The proposed Winter Street Outfall Redirection project is shown in **Figure 1**, in **Appendix A**.

3.2.5 Maverick / Washington Street Drainage Re-Route Project

An analysis was conducted to determine a new downstream routing and sizing for the storm drain system tributary to eastern Maverick Street and Washington street. In the existing condition, the drainage system is undersized and is routed through private property between Washington Street and Maverick Street. The existing conditions model simulations predict flooding to grade for the 1-year, 24-hour event. The Maverick/Washington Street Storm Drain Re-Route Project will provide greater level of service and re-route the storm main into the public right-of-way on lower Maverick Street and Camden Street, while re-connecting to the existing outfall structure near Harbor Front Road. The proposed conditions model simulations predict a level of service increase to the 10-year, 24-hour event.

3.3 HydroCAD Results (Lindsey Brook Analysis)

3.3.1 Existing Conditions

Table 3-1 presents the results of the existing conditions post-calibration water surface elevations for various design storms at each culvert and road crossing of Lindsey Brook in the City of Rockland.

The results of the existing conditions model run indicates that a total of five crossings along the three branches of Lindsey Brook experience roadway flooding for a 10-year, 24-hour event. That number increases to 9 crossings for a 25-year, 24-hour event. Overall, the depth of flooding or overtopping appears to be limited to 8-inches or less except for one crossing located at the Broadway end of Summer Street. This location is the upstream end of an approximately 1,000-foot-long underground portion of the brook. The brook leading into the crossing features nearly vertical granite block walls that do not provide for very much attenuation in the model. Additionally, because the brook continues downstream across private property, the field crews were unable to verify pipe sizes and inverts along its length, making verification of the model difficult.

It is important to note that the previously described narrow granite block channels appear to occur in several locations across the more built-up portions of the brook. These sections of the brook are known to be on private property and not currently under the City's jurisdiction. In order to maintain, and potentially widen these channel sections would require a significant easement acquiring effort prior to beginning any channel modifications.

As discussed in **Section 2**, the Lindsey Brook HydroCAD model was developed and calibrated with a combination of existing City GIS data, publicly available topographic, soils, and aerial data, field survey information collected in the field, and observational evidence from City staff in the recent past.

Members of the community have raised concerns about some impacts Lindsey Brook has on the community, including flooding of private property and erosion. Future development in the City of Rockland in the Lindsey Brook watershed and further encroachment on the brook will only serve to increase the peak flows and volume of runoff into Lindsey Brook if peak flow attenuation isn't provided. For these reasons, any proposed separation or development projects that may direct additional flow to Lindsey Brook would need to be executed such that sufficient peak flow attenuation could be achieved, to ensure existing issues and concerns do not become more severe.

Table 3-1 on the following page presents the peak water surface elevation that occurred at each culvert crossing location in the existing conditions model.

Table 3-1 Lindsey Brook Culvert Crossing Existing Conditions HydroCAD Model Results

			Existing Conditions - Peak WSE (ft)				
Model Location	Branch	Model Flood Elevation[1]	1YR	5YR	10YR	25YR	Halloween 2021
Golf Course	Northeast	-	156.95	157.35	157.57	157.93	157.76
Maverick Street Culvert	Northeast	124.0	117.73	118.25	118.57	119.11	118.82
38S Pond	Northeast	-	106.12	106.24	106.30	106.39	106.37
Cedar Street Culvert W	Northeast	99.0	93.68	94.43	94.90	96.25	94.99
Cedar Street Culvert E	Northeast	86.0	81.04	81.50	81.74	82.16	81.42
School Drive Culvert W	Northeast	76.0	69.30	70.29	70.86	71.68	70.89
School Drive Culvert S	Northeast	77.3	65.84	66.76	67.27	68.06	67.14
Lawn Ave East Culvert	Northeast	59.1	57.78	**59.11 (.01)**	**59.34 (0.24)**	**59.57 (0.47)**	**59.25 (0.15)**
Broadway Culvert	Northeast	59.2	50.13	51.80	54.34	58.80	52.52
Gay Street	Northeast	41.3	36.15	37.49	38.33	39.34	37.49
Rankin Culvert	Northeast	34.4	30.47	32.11	33.14	**34.49 (.09)**	31.91
Willow Street Culvert	Northeast	30.3	27.63	29.62	**30.36 (0.06)**	**30.93 (0.63)**	29.25
Granite-Grove Culvert	Northeast	30.0	24.90	27.18	28.92	**30.41 (0.41)**	26.65
Summer St Diversion	Northeast	25.0	18.33	20.05	20.69	21.55	19.35
Union Street Culvert	Northeast	21.0	13.92	15.17	15.50	16.27	14.84
Main Street Culvert	Northeast	25.0	12.60	14.11	14.50	15.69	13.87
Lawn Ave Culvert West	Northwest	81.0	76.86	78.56	79.60	**81.23 (0.23)**	78.40
Rankin West Culvert	Northwest	52.0	43.77	44.86	45.47	46.48	44.51
Talbot West Culvert	Northwest	38.0	34.10	**38.27**	**38.96**	**39.67**	**38.22**

			Existing Conditions - Peak WSE (ft)				
Model Location	Branch	Model Flood Elevation[1]	1YR	5YR	10YR	25YR	Halloween 2021
				(0.27)	**(0.96)**	**(1.67)**	**(0.22)**
Summer-Maple Culvert	Northwest	32.0	28.05	29.17	**33.78 (1.78)**	**36.49 (4.49)**	29.03
Knox Center Culvert	Northwest	24.0	19.08	21.92	**24.16 (0.16)**	**26.51 (2.51)**	21.63
Confluence	Northwest	-	18.45	20.73	22.23	22.66	20.47
Maine Central RR Culvert	South	38.2	37.73	**38.96 (0.76)**	**39.28 (1.08)**	**39.69 (1.49)**	**38.97 (0.77)**
Holmes Street Culvert	South	41.0	35.34	37.35	38.23	39.26	38.97
Franklin Street Culvert	South	31.2	30.00	**31.66 (0.42)**	**32.09 (0.89)**	**32.60 (1.40)**	**31.41 (0.21)**
Pleasant Diversion	South	30.5	27.94	28.11	28.15	28.24	28.10
Rail Yard Culvert	South	34.7	25.37	26.63	27.25	28.00	26.00
Park Street Culvert	South	27.0	24.07	26.06	26.78	**27.46 (0.46)**	25.36
Grace Street Culvert	South	24.5	23.56	**25.21 (0.71)**	**25.73 (1.23)**	**26.90 (2.4)**	**24.72 (0.22)**
Masonic/Claremont Culvert	South	30.0	22.52	24.90	25.59	26.86	23.74
Limerock Culvert	South	24.0	19.71	21.77	22.83	23.37	21.43

[1]Model Flood Elevation is defined as the elevation that impacts to public or private infrastructure was anticipated to begin or be at high risk of beginning. Includes roadway centerline elevations, and the elevation of private parcels, particularly near buildings or residences.

3.3.2 Alternatives Analysis – Culvert Projects

Following the development of the calibrated existing conditions HydroCAD model, a proposed conditions HydroCAD model was developed that simulated the necessary improvements to various culverts in the Lindsey Brook system with the goal of eliminating flooding at each culvert location that flooded in the existing conditions model under 10-year, 24-hour conditions. At each culvert location, the flooding elevation was defined as the estimated flood stage elevation that would begin to impact private property or public infrastructure. This elevation is given in **Table 3-1** as the "Model Flood Elevation". Any culvert location with a peak stage exceeding this defined flood elevation was a target for a proposed replacement culvert with greater capacity, resulting in reduced upstream flooding. While numerous storm events were modeled in these analyses, the 10-year, 24-hour event and the simulated Halloween Storm event were the guiding events for sizing the proposed culverts. As an expected result of increasing the size of culverts to reduce upstream flooding, more flow would pass through the culverts under peak conditions, increasing impacts at downstream culverts. For this reason, most or all of the culverts downstream of proposed improved culverts would need upsizing as well, to avoid the risk of worsening flooding downstream. Completion of upstream culvert improvement projects, and the resultant increase in flow, was factored into the sizing of all downstream culvert projects. For this reason, it is recommended that the completion of upstream culvert improvement projects be contingent on the completion of the culverts downstream of it that have shown to be under capacity for the events described above. More information on project phasing and prioritization is given in **Section 4**. Photos and description of each existing culvert location surveyed in the Lindsey Brook system can be found in **Appendix C**, and the locations of all proposed culvert projects described below is shown in **Figure 2** of **Appendix A**.

3.3.2.1 Lawn Avenue East Culvert Replacement Project

The Lawn Avenue East Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The existing Lawn Avenue East culvert appears to be in acceptable condition but has minimal cover, which causes the roadway and adjacent areas to flood easily when the culvert is beyond capacity. The culvert has an irregular stone block construction with an opening size of approximately 2 feet by 4 feet and is approximately 50' long. The proposed project would replace the existing culvert with a 48" circular pipe, improving capacity by approximately 50% and reducing upstream flooding. The existing channel would likely be lowered by approximately 2 feet to accommodate the larger pipe and provide adequate cover. Further improvements including vegetation trimming in the existing downstream channel would also provide additional benefits at minimal additional cost. The improvement of this culvert is expected to reduce upstream flooding in the immediate vicinity of the culvert by up to 100% under 10-year, 24-hour conditions.

3.3.2.2 Broadway Culvert Replacement Project

The Broadway Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The existing Broadway Culvert inlet consists of an approximately 2.5' x 4' stone block channel that transitions to a 52" metal pipe culvert approximately 100' before the outlet. The cover above this transition has eroded and is now visible from the surface. The culvert is approximately 275' long in total. The proposed project would replace the existing culvert with a 48" Circular pipe. The improvement of this culvert is expected to reduce upstream flooding in the immediate vicinity of the culvert by up to 100% under 10-year, 24-hour conditions.

3.3.2.3 Willow Street Culvert Replacement Project

The Willow Street East Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The Willow Street Culvert is a concrete box culvert that conveys Lindsey Brook from North to South under Willow Street. It is approximately 30' long, 4.5' wide and 3' tall. The culvert has a large crack that appears to have progressed through the full height and length of the culvert. This may undermine the roadway as the culvert deterioration progresses. The Willow Street Culvert Replacement Project would replace the existing culvert with a 54" circular pipe. The improvement of this culvert is expected to reduce upstream flooding in the immediate vicinity of the culvert by up to 100% under 10-year, 24-hour conditions.

3.3.2.4 Granite-Grove Street Culvert Replacement Project

The Granite-Grove Street Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The channel is approximately 900 feet long, beginning as a stone block channel, transitioning to concrete walls, and transitioning again to an approximately 45" corrugated metal pipe at the outlet between Grove Street and Beech Street. The Granite Street to Grove Street Culvert Replacement Project would replace the existing culvert with a 54" circular pipe. The improvement of this culvert is expected to reduce upstream flooding in the immediate vicinity of the culvert by up to 100% under 10-year, 24-hour conditions.

3.3.2.5 Talbot Avenue West Culvert Replacement Project

The Talbot Avenue West Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. This location was heavily impacted during the Halloween 2021 storm event, causing significant flooding in the roadway and at nearby properties. The Talbot Avenue West Culvert is an approximately 200' box culvert conveying Lindsey Brook from the North-West to South-East beneath Talbot Avenue and Broadway. The culvert begins as a stone block channel and transitions to concrete before the outlet. The box culvert opening is approximately 3' deep and 5' wide at the downstream end. The inlet of the culvert and immediate upstream area appeared to be partially silted or filled with debris, causing the inlet to be restricted compared to the rest of the downstream culvert. There is an existing make-shift grate covering the inlet to the culvert which further restricts flow. The Talbot Avenue West Culvert Replacement Project would replace the existing culvert with a 48" circular pipe. Replacement of this culvert would improve capacity, reduce maintenance, and reduce the likelihood of blockages. The improvement of this culvert is expected to reduce upstream flooding in the immediate vicinity of the culvert by up to 100% under 10-year, 24-hour conditions.

3.3.2.6 Summer-Maple Street Culvert Replacement Project

The Summer-Maple Street Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The Summer Street West Culvert is the longest closed conduit channel of the Lindsey Brook system, conveying Lindsey Brook from the North-West to the South-East over 1,000' from the inlet on Summer Street to the outlet south of Maple Street. Over the length of the culvert, the channel collects roadway drainage through structures on Summer Street, Beech Street, and Maple Street. The inlet to the channel is a 66" corrugated plastic pipe surrounded by a stone block channel of slightly wider and taller dimensions than the pipe. The outlet is a 56" wide by 38" tall oval corrugated metal pipe, discharging to a loose stone and silt channel approximately 9' wide and 4' deep. It is unclear whether additional material transitions occur during the length of the culvert or where these transitions occur. Upgrade of this culvert would address existing maintenance and capacity issues and ensure that greater capacity was available for the

increased flow resulting from the proposed Talbot Avenue West Culvert Replacement project. The improvement of this culvert is expected to reduce upstream flooding in the immediate vicinity of the culvert by up to 100% under 10-year, 24-hour conditions, and reduce flooding along the length of the culvert by reducing surcharging and flooding to grade at drainage structures.

3.3.2.7 Knox Center Culvert Replacement Project

The Knox Center Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The Knox Center Culvert is an approximately 750' long culvert conveying Lindsey Brook from the West to East. The culvert combines with the Limerock Street Culvert underground, which is the confluence point of the Northeast, Northwest, and South branches of Lindsey Brook. The confluence is located approximately 8-10 feet below grade on the grassed lawn in front of the South side of St. Peter's Episcopal Church. This material transition is believed to be the source of the capacity and maintenance issues observed at the Knox Center Culvert. The culvert inlet at the Knox Center for Long Term Living is a 60" reinforced concrete pipe, continuing for approximately 200' (est.) before meeting the confluence point. Upstream of the inlet is an approximately 3-5' deep and 5' wide stone block open channel. The outlet is constructed of stone blocks and continues as an open stone block channel downstream, approximately 6' deep and 3-4' wide.

The Knox Center Culvert Replacement project would leave the existing 60" reinforced concrete pipe culvert at the Knox Facility undisturbed, with proposed improvements beginning at the confluence location of the Northeast, Northwest, and South branches of Lindsey Brook. From this location, an 80" culvert pipe would convey storm flows along the same path as the existing culvert, continuing to the existing outlet location near Main Street. This project would improve flow capacity, reduce risk to the public and private assets in the immediate area, and reduce the likelihood of future blockages in the culvert.

3.3.2.8 Grace Street Culvert Replacement Project

The Grace Street Culvert Replacement project will address existing capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The existing Grace Street culvert consists of a 36" corrugated pipe, spanning approximately 40' from end to end underneath Grace Street. Though the culvert did not show maintenance concerns when surveyed, the culvert has minimal cover and may be susceptible to future flooding. The Grace Street Culvert Replacement project would replace the existing culvert with a larger 36" x 48" concrete box culvert, improving capacity and reducing the likelihood of blockages from upstream debris.

The following table presents the expected change in peak water surface elevation at each culvert location as a result of completion of all of the culvert projects described above.

Table 3-2 Pre- vs Post- HydroCAD Model Results

Location	Branch	PRE	POST	Change	PRE	POST	Change	PRE	POST	Change	PRE	POST	Change	PRE	POST	Change
		1YR			5YR			10YR			25YR			Halloween 2021		
Golf Course	NE	157.0	157.0	0.0	157.4	157.4	0.0	157.6	157.6	0.0	157.9	157.9	0.0	157.8	157.8	0.0
Maverick Street Culvert	NE	117.7	117.7	0.0	118.3	118.3	0.0	118.6	118.6	0.0	119.1	119.1	0.0	118.8	118.8	0.0
38S Pond	NE	106.1	106.1	0.0	106.2	106.2	0.0	106.3	106.3	0.0	106.4	106.4	0.0	106.4	106.4	0.0
Cedar Street Culvert W	NE	93.7	93.7	0.0	94.4	94.4	0.0	94.9	94.9	0.0	96.3	96.3	0.0	95.0	95.0	0.0
Cedar Street Culvert E	NE	81.0	81.0	0.0	81.5	81.5	0.0	81.7	81.7	0.0	82.2	82.2	0.0	81.4	81.4	0.0
School Drive Culvert W	NE	69.3	69.3	0.0	70.3	70.3	0.0	70.9	70.9	0.0	71.7	71.7	0.0	70.9	70.9	0.0
School Drive Culvert S	NE	65.8	65.8	0.0	66.8	66.8	0.0	67.3	67.3	0.0	68.1	68.1	0.0	67.1	67.1	0.0
Lawn Ave East Culvert	NE	57.8	56.0	-1.8	59.1	56.8	-2.3	59.3	57.4	-2.0	59.6	58.3	-1.3	59.3	57.0	-2.3
Broadway Culvert	NE	50.1	50.0	-0.2	51.8	51.1	-0.7	54.3	51.7	-2.6	58.8	53.0	-5.8	52.5	51.1	-1.4
Gay Street	NE	36.2	36.3	0.1	37.5	37.7	0.2	38.3	38.5	0.2	39.3	40.0	0.6	37.5	37.4	-0.1
Rankin Culvert	NE	30.5	30.5	0.1	32.1	32.2	0.1	33.1	33.2	0.1	34.5	34.6	0.1	31.9	31.7	-0.2
Willow Street Culvert	NE	27.6	27.9	0.3	29.6	29.7	0.1	30.4	30.3	0.0	30.9	30.7	-0.3	29.3	29.0	-0.2
Granite-Grove Culvert	NE	24.9	24.7	-0.3	27.2	26.3	-0.9	28.9	26.9	-2.0	30.4	28.4	-2.0	26.7	25.6	-1.1
Summer St Diversion	NE	18.3	18.6	0.2	20.1	20.8	0.8	20.7	21.7	1.0	21.6	22.7	1.1	19.4	19.6	0.2
Union Street Culvert	NE	13.9	14.0	0.1	15.2	15.9	0.7	15.5	16.6	1.1	16.3	17.4	1.2	14.8	15.2	0.3
Main Street Culvert	NE	12.6	12.9	0.3	14.1	15.1	1.0	14.5	15.9	1.4	15.7	16.7	1.0	13.9	14.5	0.6
Lawn Ave Culvert West	NW	76.9	76.9	0.0	78.6	78.6	0.0	79.6	79.6	0.0	81.2	81.2	0.0	78.4	78.4	0.0
Rankin West Culvert	NW	43.8	43.8	0.0	44.9	44.9	0.0	45.5	45.5	0.0	46.5	46.5	0.0	44.5	44.5	0.0
Talbot West Culvert	NW	34.1	32.7	-1.4	38.3	36.0	-2.3	39.0	37.6	-1.4	39.7	39.0	-0.7	38.2	34.5	-3.7
Summer-Maple Culvert	NW	28.1	28.2	0.1	29.2	29.8	0.6	33.8	30.4	-3.4	36.5	33.6	-2.9	29.0	29.2	0.2
Knox Center Culvert	NW	19.1	18.2	-0.9	21.9	21.3	-0.6	24.2	22.9	-1.3	26.5	25.5	-1.0	21.6	20.0	-1.6
Confluence	NW	18.5	16.8	-1.6	20.7	18.7	-2.0	22.2	19.5	-2.8	22.7	20.4	-2.3	20.5	18.1	-2.4
Maine Central RR Culvert	S	37.7	37.7	0.0	39.0	39.0	0.0	39.3	39.3	0.0	39.7	39.7	0.0	39.0	39.0	0.0
Holmes Street Culvert	S	35.3	35.0	-0.3	37.4	37.1	-0.2	38.2	38.1	-0.1	39.3	39.1	-0.1	39.0	38.9	-0.1
Franklin Street Culvert	S	30.0	29.8	-0.2	31.7	31.4	-0.3	32.1	31.8	-0.3	32.6	32.4	-0.2	31.4	31.1	-0.3
Pleasant Diversion	S	27.9	28.0	0.0	28.1	28.2	0.1	28.2	28.3	0.2	28.2	28.3	0.1	28.1	28.2	0.1
Rail Yard Culvert	S	25.4	25.4	0.0	26.6	26.3	-0.4	27.3	26.9	-0.3	28.0	27.7	-0.3	26.0	25.8	-0.2
Park Street Culvert	S	24.1	23.6	-0.5	26.1	25.3	-0.8	26.8	26.1	-0.7	27.5	27.0	-0.5	25.4	24.4	-1.0
Grace Street Culvert	S	23.6	22.9	-0.6	25.2	24.9	-0.4	25.7	25.5	-0.2	26.9	26.3	-0.6	24.7	23.8	-0.9
Masonic/Claremont Culvert	S	22.5	22.3	-0.3	24.9	24.3	-0.6	25.6	25.3	-0.3	26.9	26.2	-0.7	23.7	23.2	-0.6
Limerock Culvert	S	19.7	18.8	-0.9	21.8	20.1	-1.6	22.8	20.8	-2.1	23.4	21.6	-1.8	21.4	19.6	-1.8

3.3.3 Alternatives Analysis – Flood Control Projects

The HydroCAD model was also run to evaluate several different storage/flood control alternatives including a flood control structure between Talbot and Rankin Street along the northeast branch of Lindsey Brook, and flood control structures between Rankin Street and Gay Street, and Gay Street and Broadway along the northwest branch of Lindsey Brook. The goal of these structures would be to help improve the overall level of service downstream of each proposed flood control structure. It is important to consider that property acquisition and easements would likely be required to construct flood control structures. Short term impacts to adjacent properties would likely occur during construction and portions of adjacent properties near the flood control device may be inundated during and after heavy rainfall events.

3.3.3.1 Talbot Avenue to Rankin Street Flood Control Structure

A portion of Lindsey Brook between Talbot Avenue and Rankin Street has the potential for conversion into a stormwater/flood storage area. This storage area would likely be created by the construction of a berm or wall upstream of the Talbot Avenue crossing and would take advantage of the large low lying area between the two crossings. An outlet pipe for the new impoundment would be placed at stream level to maintain normal stream flows and levels, but would be sized to provide peak flow attenuation and allow storage of storm-related flows, reducing downstream impacts. Based upon an analysis of the available LiDAR topographic data for the area, the flood control structure could provide up to approximately 250,000 cubic feet of storage prior to overtopping. It is estimated that a 5- to 6-foot tall berm could be constructed with a 36-inch diameter pipe outlet. The berm would need to be designed to withstand overtopping during periods of high flow. The proposed flood control structure is shown on **Figure E-7** in **Appendix E**.

The results of the flood control model run indicate that peak flows could be reduced from approximately 125 cfs to 90 cfs for the 10-year, 24-hour event (28% reduction), and 180 cfs to 148 cfs for the 25-year, 24-hour event (18% reduction).

3.3.3.2 Gay Street to Broadway Flood Control Structure

Similar to the Talbot to Rankin Street area, the Gay Street to Broadway segment of Lindsey Brook has the potential for conversion into a stormwater/flood storage area. Based upon an analysis of the available LiDAR topographic data for the area, the flood control structure could provide up to approximately 175,000 cubic feet of storage prior to overtopping. It is estimated that a 5- to 6-foot tall berm could be constructed with a 30-inch diameter pipe outlet. The berm would need to be designed to withstand overtopping during periods of high flow.

The results of the flood control model run indicate that peak flows could be reduced from approximately 56 cfs to 42 cfs for the 10-year, 24-hour event (25% reduction), and 74 cfs to 69 cfs for the 25-year, 24-hour event (6% reduction). The proposed flood control structure is shown on **Figure E-7** in **Appendix E**.

3.3.3.3 Rankin Street to Gay Street Flood Control Structure

Based upon the analysis of available LiDAR topographic data for the area, and the HydroCAD model results at the Rankin Street culvert crossing, the reach of Lindsey Brook between Gay Street and Rankin Street is not a suitable location for a flood control structure. The Rankin Street culvert already acts as a flow restriction in this location and appears to back flows up and use the same storage area that would be targeted by this flood control structure. Installation of additional flood control devices at this location would not be recommended.

Table 3-3 and **Table 3-4** below present the expected downstream reduction in peak water surface elevation that could be expected if the Talbot Avenue to Rankin Street Flood Control Structure and Gay Street to Broadway Flood Control Structure projects are completed.

Table 3-3 Gay Street to Broadway Flood Control Structure Model Results (Peak Flood Elevation)

		10YR			25YR			Halloween 2021		
Culvert/Storage Name	Flood Elevation (ft)	Exist. (ft)	Prop. (ft)	Change (ft)	Exist. (ft)	Prop. (ft)	Change (ft)	Exist. (ft)	Prop. (ft)	Change (ft)
Golf Course	-	157.6	157.6	0	157.9	157.9	0	157.8	157.8	0
Maverick Street Culvert	124.0	118.6	118.6	0	119.1	119.1	0	118.8	118.8	0
38S Pond	-	106.3	106.3	0	106.4	106.4	0	106.4	106.4	0
Cedar Street Culvert W	99.0	94.9	94.9	0	96.3	96.3	0	95.0	95.0	0
Cedar Street Culvert E	86.0	81.7	81.7	0	82.2	82.2	0	81.4	81.4	0
School Drive Culvert W	76.0	70.9	70.9	0	71.7	71.7	0	70.9	70.9	0
School Drive Culvert S	77.3	67.3	67.3	0	68.1	68.1	0	67.1	67.1	0
Lawn Ave East Culvert	59.1	59.3	59.3	0	59.6	59.6	0	59.3	59.3	0
Broadway Culvert	59.2	54.3	54.3	0	58.8	58.8	0	52.5	52.5	0
Gay-Broadway Storage	42.5	-	40.2	-	-	41.8	-	-	39.8	-
Gay Street	41.3	38.3	37.5	-0.8	39.3	38.2	-1.2	37.5	37.1	-0.4
Rankin Culvert	34.4	33.1	32.2	-1.0	34.5	33.2	-1.3	31.9	31.5	-0.4
Willow Street Culvert	30.3	30.4	29.7	-0.6	30.9	30.6	-0.4	29.3	28.8	-0.4
Granite-Grove Culvert	30.0	28.9	27.4	-1.5	30.4	29.7	-0.7	26.7	26.2	-0.4
Summer St Diversion (primary)	25.0	20.7	20.4	-0.3	21.6	21.0	-0.5	19.4	19.1	-0.3
Union Street Culvert	21.0	15.5	15.4	-0.1	16.3	15.8	-0.5	14.8	14.7	-0.2
Main Street Culvert	25.0	14.5	14.5	-0.1	15.7	15.2	-0.4	13.9	13.8	-0.1

Table 3-4 Talbot Avenue to Rankin Street Flood Control Structure Model Results (Peak Flood Elevation)

		10YR			25YR			Halloween 2021		
Culvert/Storage Name	Flood Elevation	Exist.	Prop.	Change	Exist.	Prop.	Change	Exist.	Prop.	Change
Lawn Ave Culvert West	81.0	79.6	79.6	0	81.2	81.2	0	78.4	78.4	0
Rankin West Culvert	52.0	45.5	45.5	0	46.5	46.5	0	44.5	44.5	0
Rankin-Talbot Storage	38.0	-	38.9	-	-	39.6	-	-	38.5	-
Talbot West Culvert	38.0	39.0	38.4	-0.6	39.7	39.3	-0.4	38.2	37.4	-0.8
Summer/Maple Culvert	32.0	33.8	30.9	-2.9	36.5	35.0	-1.5	29.0	28.6	-0.4
Knox Center Culvert	24.0	24.2	22.8	-1.4	26.5	25.5	-1.1	21.6	21.3	-0.3
Confluence	-	22.2	21.7	-0.6	22.7	22.5	-0.1	20.5	20.3	-0.2

Table 3-5 and **Table 3-6** below present the expected downstream reduction in peak water surface elevation that could be expected if both the Talbot Avenue to Rankin Street Flood Control Structure and Gay Street to Broadway Flood Control Structure projects are completed **and** the proposed culvert improvement projects are completed. This scope of improvements would provide the greatest level of overall flood reduction for the Lindsey Brook system.

Table 3-5 Proposed Culvert Replacement Projects and Gay Street to Broadway Flood Control Structure Model Results (Peak Flood Elevation)

		10YR			25YR			Halloween 2021		
Culvert/Storage Name	Flood Elevation	Exist.	Prop.	Change	Exist.	Prop.	Change	Exist.	Prop.	Change
Golf Course	-	157.6	157.6	0	157.9	157.9	0	157.8	157.8	0
Maverick Street Culvert	124.0	118.6	118.6	0	119.1	119.1	0	118.8	118.8	0
38S Pond	-	106.3	106.3	0	106.4	106.4	0	106.4	106.4	0
Cedar Street Culvert W	99.0	94.9	94.9	0	96.3	96.3	0	95.0	95.0	0
Cedar Street Culvert E	86.0	81.7	81.7	0	82.2	82.2	0	81.4	81.4	0
School Drive Culvert W	76.0	70.9	70.9	0	71.7	71.7	0	70.9	70.9	0
School Drive Culvert S	77.3	67.3	67.3	0	68.1	68.1	0	67.1	67.1	0
Lawn Ave East Culvert	59.1	59.3	57.4	-2.0	59.6	58.3	-1.3	59.3	57.0	-2.3
Broadway Culvert	59.2	54.3	51.7	-2.6	58.8	53.0	-5.8	52.5	51.1	-1.4
Gay-Broadway Storage	42.5	-	40.4	-	-	41.9	-	-	39.9	-
Gay Street	41.3	38.3	37.7	-0.7	39.3	38.6	-0.7	37.5	37.1	-0.4
Rankin Culvert	34.4	33.1	32.2	-0.9	34.5	33.4	-1.1	31.9	31.3	-0.6
Willow Street Culvert	30.3	30.4	29.7	-0.6	30.9	30.4	-0.5	29.3	28.7	-0.6
Granite-Grove Culvert	30.0	28.9	26.4	-2.5	30.4	27.3	-3.1	26.7	25.3	-1.4
Summer St Diversion (primary)	25.0	20.7	21.2	0.5	21.6	22.3	0.8	19.4	19.2	-0.1
Union Street Culvert	21.0	15.5	16.3	0.8	16.3	17.2	0.9	14.8	14.9	0.1
Main Street Culvert	25.0	14.5	15.6	1.1	15.7	16.4	0.7	13.9	14.3	0.4

Table 3-6 Proposed Culvert Replacement Projects and Talbot Avenue to Rankin Street Flood Control Structure Model Results (Peak Flood Elevation)

		10YR			25YR			Halloween 2021		
Culvert/Storage Name	Flood Elevation	Exist.	Prop.	Change	Exist.	Prop.	Change	Exist.	Prop.	Change
Lawn Ave Culvert West	81.0	79.6	79.6	0	81.2	81.2	0	78.4	78.4	0
Rankin West Culvert	52.0	45.5	45.5	0	46.5	46.5	0	44.5	44.5	0
Rankin-Talbot Storage	38.0	-	38.7	-	-	39.3	-	-	37.4	-
Talbot West Culvert	38.0	39.0	36.1	-2.9	39.7	38.4	-1.3	38.2	34.0	-4.2
Summer-Maple Culvert	32.0	33.8	29.8	-4.0	36.5	31.7	-4.8	29.0	29.0	-0.1
Knox Center Culvert	24.0	24.2	22.0	-2.1	26.5	24.2	-2.3	21.6	19.7	-2.0
Confluence	-	22.2	19.2	-3.1	22.7	20.0	-2.6	20.5	17.9	-2.6

3.4 Green Infrastructure Projects

GI design strives to improve water quality and reduce flows to sewer systems or surface waters while delivering environmental, social, and economic benefits. There are a variety of commonly used approaches to GI design, such as rain gardens, permeable pavement, bioswales, or tree boxes, amongst others. The City of Rockland has a number of sites that are suitable locations for GI improvements. Following a meeting with the City of Rockland in September 2020, six sites were highlighted as suitable locations:

- Harbor Park
- Snow Marine Park
- Samoset Road / Marie Reed Park
- Oak/Orient Parking Lot
- Johnson Memorial Park
- Ralph Ulmer Square

When visiting each site, consideration was given to the use of several different GI options including the following:

A – Vegetated bio-retention area
B – Swirl concentrator/Stormceptor
C – Porous pavement
D – Bio-swale
E – Tree box filter

More detailed information for each GI option is provided in **Appendix E**. The proposed GI option and location for each project has been shown alongside existing system elements over aerial photos in **Figures E-1** through **E-6** in **Appendix E**. The GI treatment designations follow the lettering system outlined above. The proposed GI improvements for each location are summarized below.

3.4.1 Harbor Park

Harbor Park serves as a public attraction for a variety of reasons. The park offers a wide view of the ocean, is spacious and open with both grassed and paves areas for accommodating visitors and is the site of Rockland's Fisherman Memorial monument. The park is within walking distance of many of the businesses on Main Street and hosts the Rockland Farmer's Market. The aesthetics and natural appeal of the park is a primary motivator for visiting. Any GI improvements proposed would be most effective if they provided further aesthetic and natural appeal to the park's green space, or if they were able to be concealed beneath the existing surfaces.

Harbor Park serves as a hosting location for various communal events, such as the Rockland Farmer's Market. Maintaining the open green space in the park is important for accommodating such events. For this reason, Harbor Park is not a priority location for above-ground GI improvements. Despite this, the stormwater outfall that is located beneath the park is eligible for improvements to stormwater quality. A swirl concentrator device could be installed beneath the grassed surface of the park to aid in pollutant and debris removal from stormwater flows prior to discharge to the ocean. This improvement would allow the open grassed space of Harbor Park to be maintained, to continue accommodating community events. **Figure E-1** in **Appendix E** shows the proposed location for a swirl concentrator device.

3.4.2 Snow Marine Park

Snow Marine Park, located south of Mechanic Street, is a wide-open grassed field that meets the ocean, with an additional boat launch and associated parking facility with a grassed internal island on the east side of the park. Due to the low elevation of the grassed surface of much of western side of the park, frequent saltwater inundation occurs. Field observation conducted by Wright-Pierce staff concluded that the low-lying grassed areas of Snow Marine Park are not suitable locations for GI improvements for this reason. The grassed island in the center of the parking area is at a higher elevation and therefore is able to remain unimpacted by the nearby saltwater inundation. This makes is a more suitable location for GI improvements. A vegetated bioretention facility could provide additional stormwater treatment and storage with additional aesthetic benefits. **Figure E-2** in **Appendix E**: GI shows the proposed location for the proposed vegetated bio-retention facility.

3.4.3 Samoset Road / Marie Reed Park

Marie Reed Park lies at the end of Samoset Road. There is currently no stormwater infrastructure on Samoset Road (the entrance to Marie Reed Park). In the present condition, stormwater runoff flows down Samoset Road towards the entrance of Marie Reed Park, carrying pollutants and contributing to erosion. Placement of a bioretention area in the vicinity of the park entrance at the end of Samoset Road would provide stormwater quality and peak flow attenuation, mitigating erosion. Space is limited at the entrance to the park and achieving the proper grading for such a device may be difficult. For this reason, GI improvements at the entrance to Marie Reed Park are considered low priority. **Figure E-3** in **Appendix E** shows the suggested location of the proposed bio-retention facility.

3.4.4 Oak/Orient Parking Lot

The parking lot bounded by Oak Street, Orient Street, Main Street, and Union Street lacks drainage infrastructure and adequate means to treat stormwater runoff. Due to the high number of vehicles and traffic associated with these lots, pollutant loading in the area is likely high. The Oak/Orient parking lot is a suitable candidate for porous pavement, which provides a rigid, durable surface similar to conventional asphalt, but allows for rapid transmission of water. Flows collected from the porous pavement surface are then conveyed via an underdrain to a stormwater collection network. The collection system in the vicinity of the Oak/Orient Parking Lot is currently a combined system. Any GI improvements that occur in the lot would need to be executed alongside or following a sewer

separation project in the area, to ensure a dedicated stormwater outlet for the GI devices. Additionally, this site appears to be suitable for the installation several of tree box filters which would be consistent with the existing streetscape of Rockland's downtown area. **Figure E-4** in **Appendix E** shows the most feasible GI improvements that could be made to the Oak/Orient Parking Lot.

3.4.5 Johnson Memorial Park

Johnson Memorial Park is a small freshwater beach and park on Chickawaukie Lake, located on Route 17 in Rockland. The park has an existing gravel lot and entrance facility. An existing grassed area on the western side of the lot between the entrance and exits to the gravel is suitable for conversion into a bio-swale, a vegetated channel designed to collect and convey stormwater while providing treatment and groundwater recharge. Similar to a vegetated bio-retention area, the key difference with a bio-swale is the ability for the swale to collect water from smaller rain events for treatment but easily convey larger flows downstream for larger rain events.

In addition to the proposed bio-swale, the grassed space on the eastern side of the gravel lot could have further GI improvements, including a vegetated bio-retention area. **Figure E-5** in **Appendix E** shows the most feasible GI improvements that could be made to Johnson Memorial Park.

3.4.6 Ralph Ulmer Square

Ralph Ulmer Square is a small, triangular park located at the intersection of North Main Street and Main Street. While the park itself is only about 4,000 square feet in size, approximately 1,000 square feet of space is feasibly usable for conversion into a vegetated bio-retention facility. The proposed facility would be designed such as to not disturb the existing military monuments and to minimize impact to the existing utilities at the Square. In addition to providing aesthetic value to the park, stormwater flows conveyed by the gutter on North Main Street and/or Main Street could be routed into the bio-retention facility via curb cuts. Such improvements would allow for stormwater treatment prior to discharge into the bay. **Figure E-6** in **Appendix E** shows the most feasible GI improvements that could be made to Ralph Ulmer Square.

3.4.7 General Green Infrastructure Recommendations

Outside of the more specific recommendations for GI improvements at the sites mentioned above, there are more general approaches to GI that can be incorporated at various sites throughout the City, either as retrofitted improvements or as design considerations on future construction projects. Tree box filters are an aesthetic and effective means of stormwater pretreatment and filtration. They can be installed with minimal footprint requirements and serve as an aesthetic improvement to streets or public spaces, adding social and economic benefits.

It is important to note that all forms of GI come with a potentially significant operation and maintenance commitment to keep them functioning properly. Annual or sometimes monthly inspections and maintenance can be an added burden on Public Works or other City staff and should be taken into consideration. Sometimes specialized equipment is required for conducting the maintenance.

3.5 Sea Level Rise (SLR) Analysis in Proposed Projects

The Maine Climate Council has recommended that the State of Maine manage for +4.0 feet of sea level rise by the year 2100. Projects proposed in this Master Plan that discharge directly to the Rockland Harbor and/or contain conveyance structures at or near sea-level may be at risk of reduced performance or flooding due to future sea

level rise. In terms of hydraulic performance, the typical worst-case scenario for proposed projects discharging to the bay is a combination of regular high tide elevations in combination with the effects of sea level rise.

To gauge the impacts of sea level rise on projects that may be impacted, the sea-level of the Rockland Harbor in the hydraulic models for affected projects was modified to assume a combination of Mean Higher-High Water (MHHW) tidal elevation as well as the Year 2100 sea level rise projection of +4.0 feet. The nearest NOAA tidal gage with an NAVD88 datum available was used, which is the Portland, Maine gage, #8418150. This gage gives a Mean Higher-High Water elevation of 4.65. Adding the sea level rise projection of +4.0 feet to this, the sea level elevation assumption for use in gaging model impacts was 8.65' NAVD88.

3.5.1 Impacts to Lindsey Brook System

Based upon the known invert elevations of the most-downstream culverts in the Lindsey Brook system, and supported by the HydroCAD model results, the hydraulics of the proposed improvement projects will not be affected under the sea level rise assumptions given above. Only the Main Street Culvert and Union Street Culverts were impacted, and the impact was minimal. These locations showed about 0.1-0.2 feet of increase in peak water surface elevation for the 10-year, 24-hour event given the MHHW+4.0' sea level assumption. Upstream of these locations, there were no further impacts to system performance. For this reason, the given sea level rise assumption is not a cause for concern regarding impacts to the hydraulic performance of the Lindsey Brook system.

3.5.2 Impacts to Front Street Separation Project

The proposed sewer separation project on Front Street would route newly-separated catch basins into the existing stormwater drainage line and outfall in the Front Street drainage basin. The existing outfall has an invert of approximately 2.0 feet NAVD88. The existing system departs Front Street and steeply drops approximately 18 feet in elevation over about 100 horizontal feet before traveling underneath an existing manufacturing facility, continuing beneath the paved surfaces of the North End Shipyard, and discharging to the Rockland Harbor. This elevation drop at Front Street prevents the structures on Front Street from flooding under the sea level rise condition. All drainage structures and pipes located underneath the commercial facility and the North End Shipyard, however, will be surcharged and/or submerged under the MHHW+4.0' sea level assumption modeled. This may cause flooding to grade at structures nearby the shipyard and the manufacturing facility.

3.5.3 Impacts to Winter Street Outfall Relocation Project

While the outfall pipes proposed in the Winter Street Outfall Relocation Project are very deep and will become surcharged under the MHHW+4.0' sea level assumption, the drainage systems tributary to this outfall on Park Drive and Winter Street are significantly higher than the sea level rise elevation, and are not expected to be impacted.

3.5.4 Impacts to Crescent Street Outfall Separation Project

The Crescent Street Outfall Separation Project has an existing outfall elevation of approximately 8.0 feet, so significant hydraulic impacts are not expected under the sea level rise assumption described above.

WRIGHT-PIERCE
Engineering a Better Environment

4

Section 4 Recommended Stormwater Projects

4.1 General

The Stormwater Master Plan is the product of the data collection, modeling, and prioritization efforts described in the preceding sections of this report. The intent of the Master Plan is to best provide the City of Rockland with a comprehensive plan and list of actions dedicated to improving the function and service of the City's stormwater system while managing cost as efficiently as possible. The sections below detail the recommended projects to be completed in the City, as well as budgetary opinions of probable construction costs associated with executing each project. Tabular breakdowns of the cost estimates can also be found in **Appendix F**.

4.2 Budgetary Opinions of Probable Project Costs

The budgetary opinions of probable project costs were developed using an average of unit prices obtained from various projects that were bid within the past year (2021). The estimates carry an assumed cost for Engineering, Construction Administration (C/A), and Inspection. The estimates are tied to an ENR 20-City average Construction Cost Index for April 2023 of 13230. The estimates also carry a 40% contingency.

4.2.1 Crescent Street Outfall Separation Project

The Crescent Street Outfall Separation Project provides separation of catch basins in the Scott Street drainage basin, tributary to the Crescent Street outfall. The project would separate approximately 35 catch-basins and approximately 7.5 acres of stormwater drainage area from the combined sewer system. The estimated budgetary opinion of probable project cost is $1,483,000.

4.2.2 Front Street Outfall Separation Project

The Front Street Outfall separation project provides separation of catch basins in the Front Street drainage basin. The project would separate approximately 60 acres of stormwater drainage area from the combined sewer system. The estimated budgetary opinion of probable project cost is $7,052,000. This estimate includes the upgrade or replacement of the entire Front Street Outfall, as the existing outfall was determined to be undersized.

4.2.3 Winter Street Outfall Separation Project

The Winter Street Outfall Separation Project provides separation of catch basins in the Oak/Orient Street and Museum Street area. The separation project would direct flows to the Winter Street storm drain and outfall into the WWTF ocean outfall. The project would separate approximately 7.0 acres of stormwater drainage area from the combined sewer system. The estimated budgetary opinion of probable project cost is $1,913,000.

4.2.4 Harbor Park Green Infrastructure Project

The Harbor Park Green Infrastructure Project provides stormwater quality improvements via a proposed stormwater treatment device. It is to be installed underneath the existing grassed surface in the vicinity of the parking lot, to maintain open grassed space for community events. The estimated budgetary opinion of probable project is $143,000.

4.2.5 Snow Marine Park Green Infrastructure Project

The Snow Marine Park Green Infrastructure Project provides stormwater quality improvements and stormwater detention via a vegetated bio-retention facility, to be installed in the grassed island area in the parking lot. The estimated budgetary opinion of probable project cost is $240,000.

4.2.6 Samoset Road / Marie Reed Park Green Infrastructure Project

The Samoset Road / Marie Reed Park Green Infrastructure Project provides stormwater quality improvements and stormwater detention via a vegetated bio-retention facility, to be installed at the end of Samoset Road at the entrance to Marie Reed Park. The estimated budgetary opinion of probable project cost is $133,000.

4.2.7 Oak/Orient Parking Lot Green Infrastructure Project

The Oak/Orient Parking Lot Green Infrastructure Project will provide stormwater quality improvements and peak flow reduction via the introduction of porous pavement, as a substitute for the portions of the existing bituminous asphalt surface of the lot. Further improvements such as tree boxes will be introduced where appropriate. The estimated budgetary opinion of probable project cost is $926,000. It is anticipated that this would be constructed at the same time as the Winter Street Outfall Separation Project in the same area.

4.2.8 Johnson Memorial Park Green Infrastructure Project

The Johnson Memorial Park Green Infrastructure Project will provide stormwater quality improvements, peak flow reduction, and stormwater detention via a vegetated bio-retention facility and a vegetated bio-swale. The estimated budgetary opinion of probable project cost is $245,000.

4.2.9 Ralph Ulmer Square Green Infrastructure Project

The Ralph Ulmer Square Green Infrastructure Project will provide stormwater quality improvements, peak flow reduction, and stormwater detention via a vegetated bio-retention facility. The estimated budgetary opinion of probable project cost is $155,000.

4.2.10 Talbot Avenue to Rankin Street Flood Control Structure

The Talbot Avenue to Rankin Street Flood Control Structure Project will provide storage and peak flow attenuation during heavy rainfall events, lessening downstream impacts. The estimated budgetary opinion of probable project is $1,540,000. It is important to note that this project could require significant land acquisition costs, which has been included in the estimate but is generally an unknown and can vary significantly.

4.2.11 Gay Street to Broadway Flood Control Structure

Project will provide storage and peak flow attenuation during heavy rainfall events, lessening downstream impacts. The estimated budgetary opinion of probable project cost is $1,392,000. It is important to note that this project could require significant land acquisition costs, which has been included in the estimate but is generally an unknown and can vary significantly.

4.2.12 Winter Street Outfall Redirection Project

The Winter Street Outfall Redirection Project will redirect flows from the existing Winter Street storm drain and remove from the PCF outfall pipe, ultimately constructing its own dedicated storm drain outfall approximately 725-feet away near Buoy Park. The estimated budgetary opinion of probable project cost is $1,019,000.

4.2.13 Center Street Separation Project

The Center Street Separation Project provides drainage and stormwater quality improvements by re-routing existing combined catch basins on Center Street into a new, separated storm drain system. The estimated budgetary opinion of probable project cost is $220,000. This cost opinion was created by others. This project was originally part of the City's CIP project list but is now included as part of the Stormwater Master Plan.

4.2.14 School Street Separation Project

The School Street Separation Project provides drainage and stormwater quality improvements by re-routing existing combined catch basins on School Street into a new, separated storm drain system. The estimated budgetary opinion of probable project cost is $1,300,000. This cost opinion was calculated on a cost per linear foot basis and is a placeholder until a more detailed cost is prepared by others or until a preliminary design is available to develop a cost estimate. This project was originally part of the City's CIP project list but is now included as part of the Stormwater Master Plan.

4.2.15 Maverick/Washington Street Storm Drain Re-Route Project

The Maverick/Washington Street Storm Drain Re-Route Project will provide greater level of service and reduce flooding in the storm drain system tributary to eastern Maverick Street and Washington Street. This will be achieved by upsizing the existing storm drainage mains on Maverick Street and Camden Street near the intersection and installing a re-routed storm main down lower Maverick Street. The proposed re-routed storm main would terminate at the existing outfall structure at Harbor Front Road. The estimated budgetary opinion of probably cost is $1,669,000.

4.2.16 Lawn Avenue East Culvert Replacement Project

The Lawn Avenue East Culvert Replacement project will address existing maintenance and capacity issues in the Lindsey Brook system, lessening the frequency and severity of flooding along Lindsey Brook. The proposed project would replace the existing 50-foot long 28" by 48" rectangular culvert on Lawn Avenue with a proposed 48" circular culvert of similar length. The existing catch basins providing roadway drainage on Lawn Avenue adjacent to the culvert would also be replaced. The stream bed on the upstream end of the culvert would be lowered by approximately 2 feet. The estimated budgetary opinion of probably cost is $303,000.

4.2.17 Broadway Culvert Replacement Project

The Broadway Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The existing culvert underneath Broadway transitions from a restrictive stone block inlet to a 52" round steel pipe approximately 100 feet upstream of the outlet. The proposed project would replace the full 260-foot length of the culvert with a 48" circular pipe. The estimated budgetary opinion of probably cost is $680,000.

4.2.18 Willow Street Culvert Replacement Project

The Willow Street East Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The existing Willow Street Culvert is an approximately 40' long, 42" x 54" reinforced concrete box culvert with shallow cover. The proposed project would replace the culvert with a 54" circular pipe culvert of similar length. The project would also replace adjacent roadway catch basins on Willow Street and raise the roadway in the vicinity of the culvert by approximately 1 foot to provide adequate cover for the proposed culvert. The estimated budgetary opinion of probably cost is $340,000.

4.2.19 Granite-Grove Street Culvert Replacement Project

The Granite-Grove Street Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The existing culvert begins near Granite Street and travels underground beneath Talbot Avenue and Summer Street to the discharge location near Grove Street, at a length of approximately 900'. The culvert has changes in cross sectional area and material

through the length of the culvert in the existing condition but is generally undersized and restrictive. The proposed project would replace the full length of the culvert with a 54" circular pipe and replace existing roadway drainage structures adjacent to the culvert. The estimated budgetary opinion of probably cost is $2,579,000.

4.2.20 Talbot Avenue West Culvert Replacement Project

The Talbot Avenue West Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The existing Talbot West culvert is an approximately 200' long 24" x 48" rough stone block channel that is in poor condition and has an undersized and restrictive inlet. The upstream end of the culvert and nearby area is a known location of flooding during and after heavy rain events.

The proposed project would replace the existing culvert with a 48" circular pipe culvert of similar length, as well as replace any adjacent roadway drainage basins that discharge to the existing culvert. The estimated budgetary opinion of probably cost is $715,000.

4.2.21 Summer-Maple Street Culvert Replacement Project

The Summer-Maple Street Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The existing culvert, at approximately 1100 feet long, begins near Summer Street and Broadway as a 66" corrugated plastic pipe and travels beneath multiple roadways before discharging to an oblong 24" x 48" pipe outlet south of Maple Street. There are likely additional material changes and cross-sectional area variations that occur along the length of the culvert that are not currently known. The proposed project would replace most or all of the culvert with a 54" circular pipe culvert, which is sized for the expected greater flow rates resulting from upstream culvert improvement projects. The project scope presented in this report assumes full replacement of the culvert, but future investigations may reveal that some portion of the culvert, likely beginning on the upstream side at Summer Street, is adequate in size and condition to remain as existing. The estimated budgetary opinion of probably cost is $2,916,000.

4.2.22 Knox Center Culvert Replacement Project

The Knox Center Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook, and lessening the risk of flooding to upstream structures such as the Knox Facility. The proposed project would begin near the existing underground confluence of the North-West and South branches of Lindsey Brook and end at the outlet near Main Street, a length of approximately 500 feet. This proposed project extent would leave the existing 60" reinforced concrete pipe under the Knox Facility undisturbed, while addressing the existing stone block channel in the downstream portion of the culvert, which is believed to be the source of existing capacity and maintenance issues.

Additionally, the connection at the junction of the southern branch of Lindsey Brook should be evaluated for hydraulic performance and reconfigured if required. It is possible that the Limerock Road crossing may also need to be replaced as part of this project, as the condition of this line is generally unknown. Much of the culvert is not accessible from finished grade. The estimated budgetary opinion of probably cost is $2,413,000.

4.2.23 Grace Street Culvert Replacement Project

The Grace Street Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook. The existing culvert is approximately

30' long and consists of a 36" corrugated plastic pipe, with approximately 1' of cover. The proposed project would replace the pipe with a 36" x 48" concrete box culvert and raise the roadway by 1-2 feet to provide adequate cover to the culvert structure. The estimated budgetary opinion of probably cost is $384,000.

It is important to note that the scope of each of the culvert replacement projects should include improvements to or restoration of stream channels entering and exiting each culvert. Additionally, any infrastructure that is part of or adjacent to these projects should be evaluated for rehabilitation or replacement along with the culvert or storm drain project.

4.3 Prioritization of Improvements

The timing associated with initiating construction on the prioritized stormwater projects could have significant impact on the cost associated with each project. Combining stormwater projects with other scheduled CIP projects will allow an overall construction cost reduction due to reduced mobilization and traffic control costs. Newly paved roads may have construction moratoriums in place preventing additional projects for a number of years. In addition, funding from many of the available grant sources has timing requirements for full advantage to be taken of the available funding.

In order to generate a list of prioritized projects for this Stormwater Master Plan, the proposed projects were scored independently considering 14 different categories. Additionally, through various meetings with City staff, each of the 14 categories were weighted in order of importance to the City's overall goals. These category weights were then multiplied by the individual category score it received, and the weighted scores were added up to obtain an overall project score. The scoring categories and their weights include:

- Parcels benefited vs cost – a calculated ratio of project costs against the sum of parcels directly benefitted by a particular project. The lower the project costs combined with a higher number of properties benefitting from the project will score the highest. A project that was costly to complete and directly benefitted a small number of parcels would score low in this category. This category was given a score weight of 4/5.
- Grant funding probability – considers total project cost, grant win probability based on grant scoring criteria, timing, and municipal funding match requirements. Projects with a high probability of receiving grant funding would score the highest. If a project only qualified for low interest loans or grants with a high funding match requirement, it received a lower score. This category was given a score weight of 5, which is the maximum weight.
- Environmental impacts – projects that may adversely impact natural resources through permanent excavation or filling in or around natural resources would score lower than projects that create a net positive impact. An example of a project likely to score low on Environmental Impact would be a flood control structure, which requires extensive re-grading and permanent filling of existing streambeds. An example of a project with a high Environmental Impact score would be a green infrastructure project, which improves the quality of stormwater discharged to waterways and minimally impacts the surrounding environment. This category was given a score weight of 3.
- Property short-term impacts – considers impacts from construction. Projects requiring significant work on private property via temporary easements would score lower than work contained to the right-of-way. This category was given a score weight of 1, which is the minimum weight.
- Property long-term impacts – considers impacts that will remain after construction is completed. Long-term impacts could include permanent easements, periodic inundation/flooding of undeveloped property, road

alterations to improve traffic, etc. A lower score in this category assumes long-term impacts would be more severe than a higher scoring project. This category was given a score weight of 4.

- Flow increase to Lindsey Brook – considers the impact of various proposed projects on Lindsey Brook. A project resulting in flow increases to Lindsey Brook would score lower than projects reducing flow to the brook. An example of this could be a combined sewer separation project that discharges new separated storm drainage directly to Lindsey Brook. This category was given a score weight of 4.
- Risk to public infrastructure – considers infrastructure that is susceptible to damage or failure if a particular project is not implemented. For example, a culvert that is in disrepair and in danger of collapse that could damage a major roadway would score higher than projects that have low consequences of failure if left unimproved. This category was given a score weight of 4.
- PCF flow reduction – considers a projects potential impact to the PCF. Projects that have the potential to reduce flows from combined storm drains currently being conveyed to the PCF would score higher than projects that increase flow or have no impacts. A combined sewer separation project that removes stormwater flow from the sewer system, for example, would score high in this category. This category was given a score weight of 3.
- Hydraulic performance – considers the overall impact a project has on improving stormwater conveyance. Projects like culvert replacements directly improve the hydraulic performance of a stream or drainage way. Projects that do not improve the hydraulics of stormwater conveyance, like green infrastructure projects, would score lower. This category was given a score weight of 4.
- Parcels benefited – Quantified number of parcels directly benefited by a particular project. This category was given a score weight of 5.
- City CIP overlap – considers a project overlap with previously planned capital improvement projects such as paving projects and sidewalk rehab/construction projects. Overlap in projects will likely result in lower construction costs. This category was given a score weight of 4.
- Permitting – considers the level of effort and costs that a project might encounter to obtain required environmental permitting to complete the project. An example of a project with a high level of effort and cost to permit would be a flood control structure project. A project scoring high in the Permitting category would be comparatively easy to permit, such as a sewer separation project. This category was given a score weight of 1.
- O&M requirements – considers the operation and maintenance requirements that a given project might carry. O&M requirements can add significant long-term costs, and without proper O&M, some infrastructure will become less effective over time until replacement is required. Most green infrastructure projects, such as pervious pavement projects require more maintenance than other stormwater BMPs, would likely score low in this category. Culvert replacements would likely score higher as they typically do not require significant effort to maintain. This category was given a score weight of 3.
- Constructability – considers how easily constructable a particular project is. Projects that have costly or high risks constraints are sometimes considered infeasible and/or less desirable. This category was given a score weight of 4.

The scoring matrix has been included in **Appendix G** for reference, and the scoring totals and rankings are shown in **Table 4-1**.

Table 4-1 Stormwater Project Rankings

Project Name	Total Project Score	Contingent Projects
Knox Center Culvert Replacement Project	191	-
Crescent Street Outfall Separation Project	189	-
Talbot Avenue West Culvert Replacement Project	188	Summer-Maple St. Culvert Replacement Project Knox Center Culvert Replacement Project
Granite-Grove Street Culvert Replacement Project	187	-
Winter Street Outfall Redirection Project	184	-
Willow Street Culvert Replacement Project	183	Granite-Grove Culvert Replacement Project
Lawn Avenue East Culvert Replacement Project	180	Broadway Culvert Replacement Project Willow Street Culvert Replacement Project Granite-Grove Culvert Replacement Project
Center Street Separation Project	178	-
Front Street Outfall Separation Project	176	-
Winter Street Outfall Separation Project	176	-
Maverick/Washington Street Storm Drain Re-Route Project	176	-
Summer-Maple Street Culvert Replacement Project	175	Knox Center Culvert Replacement Project
Broadway Culvert Replacement Project	167	Willow Street Culvert Replacement Project Granite-Grove Culvert Replacement Project
Samoset Road/Marie Reed Park Green Infrastructure Project	165	-
School Street Separation Project	164	-
Grace Street Culvert Replacement Project	163	-
Snow Marine Park Green Infrastructure	160	-
Oak / Orient Parking Lot Green Infrastructure Project	159	-
Ralph Ulmer Square Green Infrastructure Project	148	-
Johnson Memorial Park Green Infrastructure	143	-
Harbor Park Green Infrastructure Project	140	-
Talbot to Rankin Flood Control Structure	125	-
Gay Street to Broadway Flood Control Structure	112	-

In addition to the scoring matrix, contingent projects were also considered to help the City prioritize projects that should only be constructed after other projects are completed, and which projects can be completed independently of other projects. The contingent projects are summarized in **Table 4-1**. Based on the results of the project scoring and analysis of contingent projects, a prioritized project table has been provided in **Table 4-2** in **Section 4.4**.

The following section presents a list of Stormwater Projects recommended to be undertaken by the City, given in order of priority based on the analyses in this report.

4.4 Stormwater Project Recommendations

Based on the assessment and inventory of the current condition of the City of Rockland's stormwater infrastructure, the estimated costs associated with various improvement projects proposed in this report, and the relative benefit each project offers, the following table presents the projects recommended for execution by the City of Rockland in order of priority. **Table 4-2** below also provides anticipated project duration (in years) for each project to further help the City plan the implementation of these projects. The project duration includes engineering, bidding, and construction phases. Depending on required right-of-way negotiation efforts such as property and easement acquisitions, the project duration could lengthen substantially. In-stream work is limited to July 15 – September 30 which can also impact project duration. It should be noted that multiple projects can either be completed simultaneously or may have overlapping timelines, meaning that multiple projects may be in various stages of design or construction. The anticipated project duration is only provided as a planning tool.

Based on the anticipated duration and schedule of the proposed projects, it is clear that these projects are long-term solutions to ongoing flooding issues throughout the City, however, they do not provide short-term relief to property owners and residents that are impacted by frequent inundation and/or erosion of property. Therefore, it is recommended that the City explore options to provide short-term flood protection, channel/embankment armoring, or channel restoration solutions before the larger culvert projects are implemented. The steps required to design and implement these solutions might include collection of detailed survey data (topography), development of concepts including graphic renderings of these concepts, stakeholder coordination and selection of concept, final design and construction of short-term solution.

Based on input received at the City Council meetings, a major concern is implementing projects that increase stormwater flow to Lindsey Brook. Therefore, projects located in the Lindsey Brook watershed are denoted with an asterisk (*) in **Table 4-2** below.

Table 4-2 City of Rockland Stormwater Master Plan Project List

Priority	Project Name	Type	Duration (years)	Cost
1	*Knox Center Culvert Replacement Project	Culvert Replacement	2.5	$2,413,000.00
2	Crescent Street Outfall Separation Project	Sewer Separation	2.0	$1,483,000.00
3	*Summer-Maple Street Culvert Replacement Project	Culvert Replacement	3.0	$2,916,000.00
4	*Talbot Avenue West Culvert Replacement Project	Culvert Replacement	1.5	$715,000.00
5	*Granite-Grove Street Culvert Replacement Project	Culvert Replacement	3.0	$2,579,000.00
6	Winter Street Outfall Redirection Project	Sewer Separation	2.0	$1,019,000.00
7	*Willow Street Culvert Replacement Project	Culvert Replacement	1.5	$340,000.00
8	*Broadway Culvert Replacement Project	Culvert Replacement	2.5	$680,000.00
9	*Lawn Avenue East Culvert Replacement Project	Culvert Replacement	1.5	$303,000.00
10	*Center Street Separation Project	Sewer Separation	1.5	$220,000.00
11	Front Street Outfall Separation Project	Sewer Separation	3.0	$7,052,000.00
12	Winter Street Outfall Separation Project	Sewer Separation	2.5	$1,913,000.00
13	Maverick/Washington Street Storm Drain Re-Route Project	Sewer Separation	2.5	$1,669,000.00
14	Samoset Road/Marie Reed Park Green Infrastructure Project	Green Infrastructure	1.5	$133,000.00
15	School Street Separation Project	Sewer Separation	2.0	$1,300,000.00
16	*Grace Street Culvert Replacement Project	Culvert Replacement	1.5	$384,000.00
17	Snow Marine Park Green Infrastructure	Green Infrastructure	1.5	$240,000.00
18	Oak/Orient Parking Lot Green Infrastructure Project	Green Infrastructure	1.5	$926,000.00
19	Ralph Ulmer Square Green Infrastructure Project	Green Infrastructure	1.5	$155,000.00
20	Johnson Memorial Park Green Infrastructure	Green Infrastructure	1.5	$245,000.00
21	Harbor Park Green Infrastructure Project	Green Infrastructure	1.5	$143,000.00
22	*Talbot to Rankin Flood Control Structure	In-stream Flood Control	2.0	$1,540,000.00
23	*Gay Street to Broadway Flood Control Structure	In-stream Flood Control	2.0	$1,392,000.00
TOTAL PROJECT COSTS				**$29,760,000**

*located in the Lindsey Brook watershed

4.5 Project Funding

While it is understood the City recently passed a significant bond to fund stormwater projects, the purpose of this section is to identify potential additional funding sources for projects listed in Table 4-2. Projects listed include outfall separation projects (which also includes outfall redirection projects), flood control structures, green infrastructure projects, and Lindsey Brook culvert replacement projects. A table summarizing the information in this section has been included in **Appendix H**.

4.5.1 Grant and Loan Programs

Below is a list of applicable grant and low-interest loan programs facilitated through both State and Federal agencies. It should be noted that many of the funding sources identified below are in various states of the application process.

Applicants are encouraged to seek multiple grant/funding sources as they can increase an application's score. However, federal funds can not be used as a "match" on other federal programs. For example, if Rockland received a FEMA grant (75% grant/25% match), the City cannot use ARPA funds as part of the 25% match. CWSRF loans are not considered a federal match.

4.5.1.1 Municipal Stream Crossing Upgrade Grant Program

The Municipal Stream Crossing Upgrade Grant Program matches local funding for the upgrade of municipal culverts at stream crossings. The program supports cost-effective projects that improve fish and wildlife habitats, as well as reduce flooding and improve community safety. The program is administered through the Maine Department of Environmental Protection (DEP), which solicits grant applications on an annual basis. The 2022 maximum award is $150,000 per project and two (2) awards per municipality. Grant monies can cover both engineering and construction costs. Although there is no minimum municipal match requirement, the grants cannot fund 100% of any project.

Projects that score well and are considered good candidates include:

- Crossings that identify as 'barriers' or 'potential barriers'
- Crossings within critical fish habitat systems
- Historical flooding records
- Ongoing maintenance issues
- Dead-end and/or limited emergency access roads

Eligible projects include:

- Lawn Avenue culvert(s)
- Broadway culvert(s)
- Gay Street culvert
- Rankin Street culvert(s)
- Willow Street culvert
- Granite – Grove Street culvert
- Talbot Avenue (west) culvert
- Summer – Maple Street culvert
- Knox Center culvert
- Franklin Street culvert
- Grace Street culvert

The most recent request for application (RFA) closed on November 10, 2022. We understand the City submitted a grant application for the Bog Road culvert in the most recent RFA round. The grant applications are still under review. A future RFA is likely, however it is subject to available funding. Updates can be found on the MaineDEP website (https://www.maine.gov/dep/land/grants/stream-crossing-upgrade.html). **Applications are typically due in the fall.**

4.5.1.2 Clean Water State Revolving Fund Loan (CWSRF)

The CWSRF program provides low-interest rate financing to municipalities to construct water quality protection projects such as sewers and wastewater treatment facilities. A variety of publicly owned water quality improvement projects are eligible for financing. As part of the Bipartisan Infrastructure Law (BIL), Maine expects to receive $13.78 million for the CWSRF Supplemental Grant. The Supplemental CWSRF Grant requires that Maine provide at least $6.75 million, 49% of its total grant amount, as loan forgiveness to eligible projects based on the affordability tier system. **Loan applications are open enrollment with no specific deadline. Applications for loans with additional subsidy are expected to be due in Spring 2023.**

Eligible projects include:

- CSO mitigation
  - Crescent Street Outfall Separation
  - Front Street Outfall Separation
  - Winter Street Outfall Separation
  - Winter Street Outfall Redirection
- Green Infrastructure/nonpoint source pollution abatement projects:
  - Harbor Park Green Infrastructure
  - Snow Marine Park Green Infrastructure
  - Samoset Road/Marie Reed Park Green Infrastructure
  - Oak/Orient Parking Lot Green Infrastructure
  - Johnson Memorial Park Green Infrastructure
  - Ralph Ulmer Square Green Infrastructure

4.5.1.3 Water & Waste Disposal Loan and Grant Program

The U.S. Department of Agriculture (USDA) Rural Development (RD) administers the Water & Waste Disposal Loan & Grant Program to provide funding for clean and reliable drinking water systems, sanitary sewerage disposal, sanitary solid waste disposal, and stormwater drainage to households and businesses in eligible rural areas. Eligible applicants are state and local governmental entities, federally recognized tribe, and private non-profits in rural areas and towns with populations of 10,000 or less, and tribal lands in rural areas.

Long-term, low-interest loans are available up to a 40-year payback period, based on the useful life of the facilities financed. Interest rates are fixed, and based on the need for the project, and the median household income of the area to be served. Interest rates for the 4th Quarter of FY 2022, effective July 1, 2022, to September 30, 2022 range from 2.0% to 3.25%. **Applications are accepted on an ongoing basis.**

Eligible projects are the acquisition, construction, or improvement of:

- Drinking water sourcing, treatment, storage and distribution;

- Sewer collection, transmission, treatment and disposal;
- Solid waste collection, disposal and closure; and
- Storm water collection, transmission, and disposal.

Eligible projects include:

- Sewer collection, transmission, treatment, and disposal
  - Crescent Street Outfall Separation
  - Front Street Outfall Separation
  - Winter Street Outfall Separation
  - Winter Street Outfall Redirection
- Storm water collection, transmission, and disposal
  - Talbot to Rankin Flood Control Structure
  - Rankin Street to Gay Street Flood Control Structure
  - Various Lindsey Brook Culvert Projects
  - Various Linsey Brook Restoration Projects

4.5.1.4 Maine Infrastructure Adaption Fund (MIAF) Grant

The MIAF grant program is administered through the Maine Department of Transportation (DOT) and provides grants to municipalities to improve stormwater, drinking water, and wastewater infrastructure against extreme weather, flooding, sea-level rise, and other climate change events. The grants help protect public infrastructure most at risk from impacts of climate change and benefit public safety. The most recent round of Request for Applications (RFA) closed on May 31, 2022 with $20M in allocations. Based on recent discussions with DOT, a future RFA is likely, however it is subject to available funding. Updates can be found on the DOT's grant opportunities web page (https://www.maine.gov/mdot/grants/). Applications are typically due in the spring.

We understand the City was recently awarded $75,000 through MIAF for the engineering of the Crescent Street Outfall Separation project.

Eligible projects include:

- Sewer collection, transmission, treatment, and disposal
  - *Crescent Street Outfall Separation
  - Front Street Outfall Separation
  - Winter Street Outfall Separation
  - Winter Street Outfall Redirection
- Storm water collection, transmission, and disposal
  - Talbot to Rankin Flood Control Structure
  - Rankin Street to Gay Street Flood Control Structure
  - Various Lindsey Brook Culvert Projects
  - Various Linsey Brook Restoration Projects

4.5.1.5 National Culvert Removal, Replacement, and Restoration Grants

The U.S. Department of Transportation Federal Highway Administration (FHWA) has established the National Culvert Removal, Replacement, and Restoration Grant program through the Bipartisian Infrastructure Law. The grant program provides funding for projects that improve or restore anadromous fish passage through streams and rivers. Atlantic Salmon are an example of anadromous fish that migrate from marine to freshwater.

FHWA has allocated $200M to this year's program. A 20% (minimum) match is required, and grant funds can only be applied to construction. Applications are due on February 6, 2023.

Based on the Maine Stream Habitat Viewer, Lindsey Brook is not located in an Atlantic Salmon critical habitat. In fact, the only watershed located in an Atlantic Salmon critical habitat is Meadow Brook.

4.5.1.6 Hazard Mitigation Grant Program (HMGP)

The Maine Emergency Management Agency (MEMA) administers the federal Hazard Mitigation Grant Program (HMGP). Funds may be available statewide following a Presidential Major Disaster Declaration as requested by the Governor, with priority given to projects in the area of the state affected by the disaster. These funds assist communities to enact mitigation measures that reduce the risk of loss of life and property from future disasters. Eligible applicants include local governments who are part of a FEMA-approved multi-jurisdictional county hazard mitigation plan (or plan that is in the process of being updated), Native American tribes, and private non-profit organizations (sponsored by local government).

The Knox County Hazard Mitigation Plan (HMP) 2019 identifies "Reduce loss of life, injury, and property damage in Knox County caused by flooding" as a goal of the County HMP.

The Maine Emergency Management Agency must submit sub-applications to FEMA within 12 months of the Presidential Major Disaster Declaration; therefore, application deadlines vary. A minimum 25% local match is required.

Eligible project types include:

- Storm-water upgrades
- Drainage and culvert improvements
- Property acquisition
- Slope stabilization
- Infrastructure protection
- Seismic and wind retrofits, and
- Structure elevations

Eligible projects include:

- Talbot to Rankin Flood Control Structure
- Rankin Street to Gay Street Flood Control Structure
- Various Lindsey Brook Culvert Projects
- Various Linsey Brook Restoration Projects

4.5.1.7 Flood Mitigation Assistance (FMA)

The United States Federal Emergency Management Agency (FEMA) administers the Flood Mitigation Assistance (FMA) grant program to support states, local communities, tribes, and territories, that experience repetitive flood damage to buildings insured by the National Flood Insurance Program. FEMA will select up to $60 million of Capability and Capacity Building (C&CB) activities to enhance knowledge, skills, and expertise of the current workforce to expand or improve flood mitigation projects. Applications are due on January 27, 2023. The grant program has the following maximum allocations for individual applicants:

1. $25,000 for local-multi hazard mitigation planning
2. $50,000 for technical assistance
3. $900,000 for project scoping
4. $300,000 for C&CB

Eligible project types include:

- Structure elevations
- Property acquisition
- Floodproofing
- Detention/retention systems
- Drainage/culvert improvements
- Flood control systems

Eligible projects include:

- Talbot to Rankin Flood Control Structure
- Rankin Street to Gay Street Flood Control Structure
- Various Lindsey Brook Culvert Projects
- Various Linsey Brook Restoration Projects

4.5.1.8 Building Resilient Infrastructure and Communities (BRIC)

FEMA also administers the Building Resilient Infrastructure and Communities (BRIC) to support states, local communities, tribes, and territories, with pre-disaster mitigation activities. Approximately $1 billion was available for FY 2021 of which $56 million was allocated to State/ Territories, $25 million was allocated to Tribes, and $919 million was available for national competition. Local governments, including cities, townships, counties, special district governments, and Native American tribal organizations are considered Sub-applicants and must submit sub-applications for mitigation planning and projects to their State/Territory applicant agency. Eligible projects include:

1. Mitigation Projects: cost-effective projects designed to increase resilience and public safety; reduce injuries and loss of life; and reduce damage and destruction to property, critical services, facilities, and infrastructure.

The maximum grant award for nationally competitive Sub-applications was $50 million. The maximum award to States/Territories and Tribes was $1 million per applicant for all Sub-applications. Funding is available for up to 75% of the eligible activity costs, with a 25% non-federal match required. FEMA may contribute up to 90% of the eligible activity costs with a 10% match for small and impoverished communities of less than 3,000 in population with residents having an average per capita annual income not exceeding 80% of the national per capita income. Applications will be accepted between September 30, 2022, and January 27, 2023.

Eligible project types include:

- Storm-water upgrades
- Drainage and culvert improvements
- Property acquisition
- Slope stabilization
- Infrastructure protection
- Seismic and wind retrofits, and
- Structure elevations

Eligible projects include:

- Talbot to Rankin Flood Control Structure
- Rankin Street to Gay Street Flood Control Structure
- Various Lindsey Brook Culvert Projects
- Various Linsey Brook Restoration Projects

4.5.1.9 Northern Borders Regional Commission

The Northern Border Regional Commission (NBRC) administers the Economic & Infrastructure Development Investment Program to provide funding that will encourage economic development and job creation across the Northern Forest region. Eligible applicants are public bodies, non-profit organizations, Native American Tribes, and the four NBRC state governments with projects located within the NBRC service area counties in Maine:

Androscoggin, Aroostook, Franklin, Hancock, Kennebec, Knox, Oxford, Penobscot, Piscataquis, Somerset, Waldo, and Washington counties.

Eligible projects include:

Basic Public Infrastructure. Services that are generally necessary to conduct business and operate (e.g., waste, water, and energy). Specifically, the collection and distribution systems, treatment plants, and other infrastructure that collects, treats, and delivers drinking water and waste water-related services; electric power generation and transmission; solid waste to include, recycling, composting, disposal, and waste-to-energy via incineration; systems for heat distribution through sources such as co-generation, biomass, geothermal heating, heat pumps, and central solar heating.

Maximum grant awards are $1 million for infrastructure projects and $350,000 for all others. For FY2022, Androscoggin, Aroostook, Franklin, Kennebec, Oxford, Penobscot, Piscataquis, Somerset, and Washington were designated as Distressed and require a 20% non-federal match, and Hancock, Knox, and Waldo were designated as Transitional and require a 50% non-federal match. Letters of Notification to Apply were due April 22, 2022. Full applications were due June 2, 2022. Upcoming deadlines have not been published as of the date of issuance of this memo, however, it can be expected that Letters of Notification to Apply will be due in Spring 2023.

Eligible projects include:

- Sewer collection, transmission, treatment, and disposal
  - *Crescent Street Outfall Separation
  - Front Street Outfall Separation

- Winter Street Outfall Separation
- Winter Street Outfall Redirection

4.5.2 Congressional Earmarks

Congressional earmarks are congressional funding for a specific local project. The various Lindsey Brook improvements and culverts may be a good fit for Congressional earmarks. Without the Lindsey Brook projects being completed, there may not be sufficient capacity in the Brook for the flows related to the combined sewer separation projects.

4.5.2.1 US House of Representatives – Community Project Funding Requests

In 2021, the US House of Representatives reinstated the use of earmarks (member-directed spending requests) and it is expected that these "Community Project Funding Requests" will be accepted again next year for FY2024. Within the US House Committee on Appropriations, there are subcommittees for different agencies and accounts. If Rockland is interested in applying for water or wastewater-related assistance, IUP listing is required for earmark projects under the Interior Subcommittee USEPA STAG program as well as a 20% local match.

1 Interior Subcommittee – eligible projects include:
- Crescent Street Outfall Separation
- Front Street Outfall Separation
- Winter Street Outfall Separation
- Winter Street Outfall Redirection

- Homeland Security Subcommittee – eligible projects include:
  - Talbot to Rankin Flood Control Structure
  - Rankin Street to Gay Street Flood Control Structure
  - Various Lindsey Brook Culvert Projects
  - Various Linsey Brook Restoration Projects

The application would be made through Representative Chellie Pingree's office in **early 2023**. Community Project Funding | U.S. Representative Chellie Pingree (house.gov)

4.5.2.2 US Senate – Congressionally Directed Spending Requests

The US Senate also reinstated the earmark process and is expected to do so again for FY24. The same requirements as for water and wastewater infrastructure Community Project Funding Requests would apply. Within the US Senate Committee on Appropriations, there are subcommittees for different agencies and accounts.

- Interior Subcommittee – eligible projects include:
  - Crescent Street Outfall Separation
  - Front Street Outfall Separation
  - Winter Street Outfall Separation
  - Winter Street Outfall Redirection
- Homeland Security Subcommittee – eligible projects include:
  - Talbot to Rankin Flood Control Structure
  - Rankin Street to Gay Street Flood Control Structure
  - Various Lindsey Brook Culvert Projects
  - Various Linsey Brook Restoration Projects

Applications would be made through both Senator Angus King's office Congressionally Directed Spending Requests - FY2023 (senate.gov) and Senator Susan Collin's office Appropriations Request | U.S. Senator Susan Collins (senate.gov) in early 2023.

4.5.3 Stormwater Utility

A public utility is an organization that supplies a community with a particular service or product. In the case of a stormwater utility, the product being supplied is a functioning stormwater network. Most communities have sewer, water, gas, electricity, and cable/internet public utilities. Stormwater is a newer type of public utility that communities are implementing. A stormwater utility charges an equitable fee to users based on how much the utility is used, i.e., how much stormwater runoff is generated from individual property owners. There are typically different fees for residential and commercial users. Some municipalities offer mitigation credits that users can qualify for by making physical changes to their property that improve the quality or reduce the quantity of stormwater runoff. Other communities have offered exemptions that waive the stormwater fee to undeveloped properties or certain land uses such as government owned properties.

A stormwater utility provides a stable revenue for stormwater infrastructure improvements and maintenance. It allows the municipality to provide adequate revenue for stormwater while staying affordable for community members. As the utility is developed, it can be shaped in a way that fits the exact needs and goals of a community while setting rates at a level that its users can afford. The utility can provide funding in a more equitable way than the alternative of raising taxes or user fees within other established utilities serving the public. Increasing taxes to provide funding for stormwater infrastructure maintenance and improvements does not require tax exempt organizations with large stormwater usage to contribute, and contributions are based on property assessment rather than stormwater impacts. To summarize, the benefits of a stormwater utility include:

- Stable Revenue – provides stable revenue to support operations & maintenance costs, as well as a capital improvement plan. A stormwater utility would supplement or replace the City's current stormwater funding sources and would improve budgetary planning.

- Address Existing Stormwater Issues – allows the City to address the flooding issues in Lindsey Brook and elsewhere, and to replace deteriorated systems that may be susceptible to washouts and other natural disasters.

- Improve Water Quality – allows the City to implement stormwater treatment "green infrastructure" systems that remove pollutants from stormwater runoff before discharging to natural waterbodies like Lindsey Brook and Rockland Harbor. Pollutants include heavy metals, bacteria, and trash. Additionally, stormwater utility credits encourage private property owners to implement their own green infrastructure systems.

- Reduce Secondary Treatment at PCF – provides opportunity to implement new stormwater systems via sewer separation projects that reduce flows to sewer systems and ultimately the City's Pollution Control Facility (PCF). Reducing flow to the PCF improves wastewater treatment efficiency, reduces costs, and benefits water quality.

There is precedent in Maine and across the United States for forming stormwater utilities. It is an effective way to fund and manage a municipal stormwater system.

Appendix A
Project Summary

Legend

Green Infrastructure Locations

Master Plan Projects

Project Type

- Flood Control
- Stormwater/Sewer Separation

CIP Projects

Project Type

- Bridge/Culvert Replacement
- Paving
- Planned Sewer
- Sidewalk Project
- Stormwater/Sewer Separation

Lindsey Brook

- Lindsey Brook

Johnson Memorial Park

Front Street Outfall Separation Project

Maverick/Washington Street Storm Drain Re-Route Project

Marie Reed Park

Gay St. to Broadway Flood Control Structure

Center Street Separation Project

Ralph Ulmer Square

Winter Street Outfall Separation Project

Talbot Ave. to Rankin St. Flood Control Structure

Winter Street Outfall Separation Project

School Street Separation Project

Harbor Park

Crescent Street Outfall Separation Project

Oak/Orient Lot

Snow Marine Park

N

0 500 1,000 2,000 Feet

Proposed Project Map
Rockland, Maine

PROJ NO:	DATE:	FIGURE:
20279	4/27/2023	1

WRIGHT-PIERCE
Engineering a Better Environment

Lawn Avenue
Culvert Replacement Project

Broadway
Culvert Replacement Project

Willow Street
Culvert Replacement Project

Talbot Avenue
Culvert Replacement Project

Granite Street to Grove Street
Culvert Replacement Project

Summer Street to Maple Street
Culvert Replacement Project

Knox Culvert
Replacement Project

Grace Street
Replacement Project

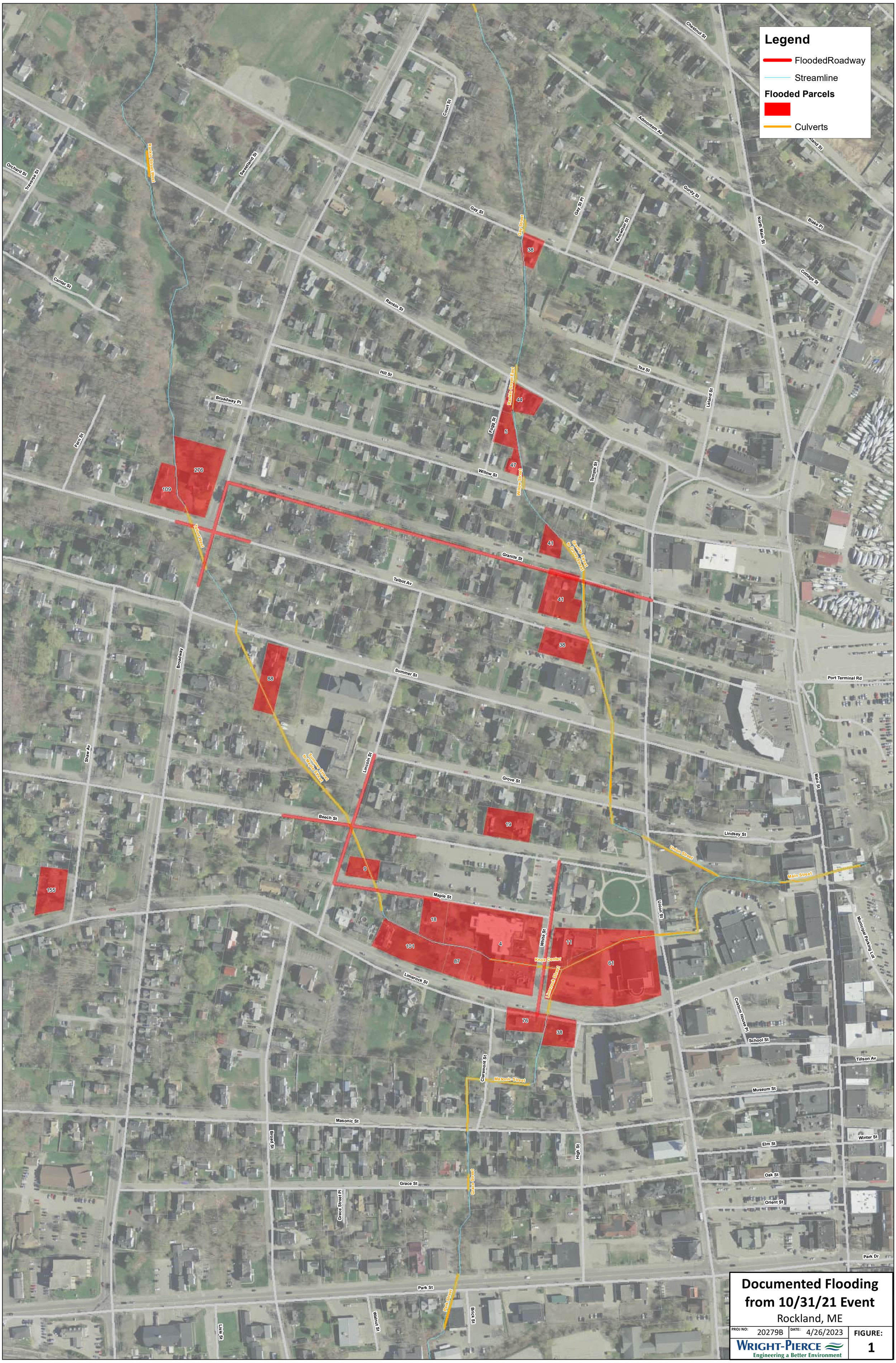
Proposed Culvert Projects Map

Rockland, Maine

PROJ NO:	DATE:	FIGURE:
20279	1/6/2023	2

WRIGHT-PIERCE
Engineering a Better Environment

Appendix B
Halloween Storm 2021 Map



Documented Flooding from 10/31/21 Event

Rockland, ME

PROJ NO:	DATE:	FIGURE:
20279B	4/26/2023	1

WRIGHT-PIERCE
Engineering a Better Environment

Appendix C
Field Survey Photos and Narrative

Lindsey Brook – North East Branch

Field Data Collection Summary – Culverts and Channels

Maverick Street Culvert

Cedar St Culvert (inlet)

School Drive– Service Road Culvert (West) (outlet)

FACING NORTH-WEST, APRIL 2022

FACING SOUTH, APRIL 2022

Photo 1, looking North-West, shows the downstream end of the 12" Corrugated plastic culvert that passes beneath the high school service road that runs perpendicular to School Drive, with Oceanside High School visible in the background. The channel immediately downstream and around the pipe show signs of significant erosion – stabilization is recommended to prevent further erosion that may undermine the pipe.

School Drive – South Culvert (inlet)

FACING NORTH, APRIL 2022

FACING NORTH-EAST, DECEMBER 2020

School Drive – South Culvert (outlet)

FACING WEST, DECEMBER 2020

FACING SOUTH-WEST, DECEMBER 2020

The School Drive – South culvert is an approximately 100' long 48" corrugated metal pipe that crosses underneath School Drive, conveying Lindsey Brook from the North to South. The culvert is generally in good condition on the upstream and downstream ends, but capacity at the upstream end may be influenced by vegetation overgrowth, particularly in the spring and summer.

FACING SOUTH, DECEMBER 2020

Lawn Ave – East Culvert (inlet)

FACING NORTH, DECEMBER 2020

Lawn Ave – East Culvert (outlet)

FACING SOUTH, DECEMBER 2020

FACING NORTH, DECEMBER 2020

The Lawn Ave East culvert is an approximately 2’ by 4’ stone block channel traveling underneath Lawn Ave. The culvert is generally in good condition, with only minor debris spotted in the downstream channel at the time of survey. In the spring and summer, dense vegetation may reduce the capacity of the channel.

Lawn – Broadway Channel

FACING SOUTH, APRIL 2022

FACING NORTH, APRIL 2022

The Lawn Ave to Broadway Channel is an approximately 2.5'x4' irregular stone block channel conveying Lindsey Brook from North to South between Lawn Avenue and Broadway. The roughly 175' long channel is generally in good condition and free of debris at the time of survey.

Broadway North Culvert – Inlet

FACING SOUTH, APRIL 2022

FACING SOUTH, DECEMBER 2020

Broadway North Culvert –- Outlet

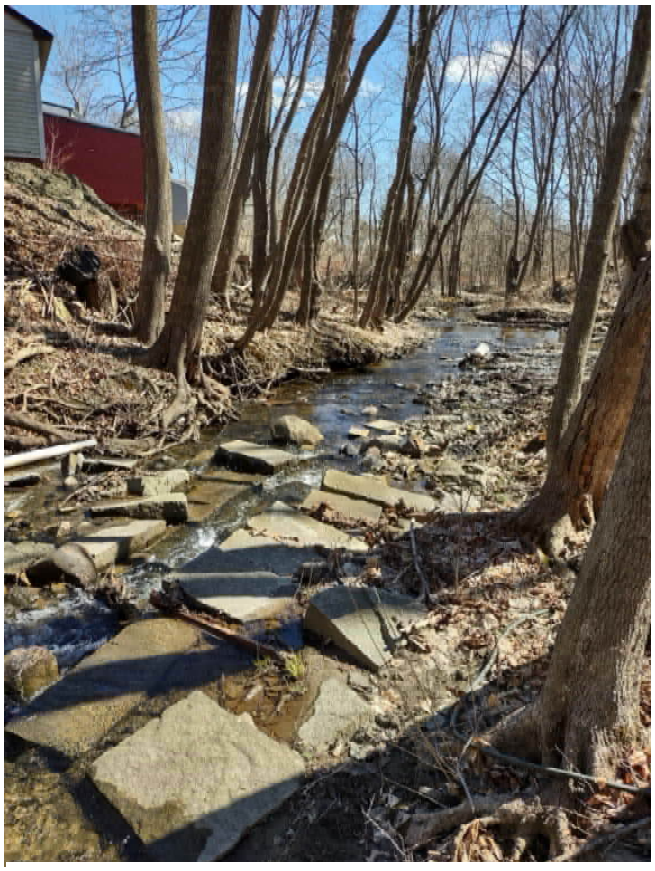
FACING SOUTH, DECEMBER 2020

FACING NORTH-WEST, APRIL 2022

The Broadway North culvert is an approximately 2.5’ x 4’ stone block channel (on the inlet side) that transitions to a 52” metal pipe culvert approximately 100’ before the outlet. As seen in the photo above, the cover above this transition has eroded and is now visible from the surface. The culvert is approximately 275’ long.

Broadway to Gay Street Channel

FACING SOUTH, DECEMBER 2020



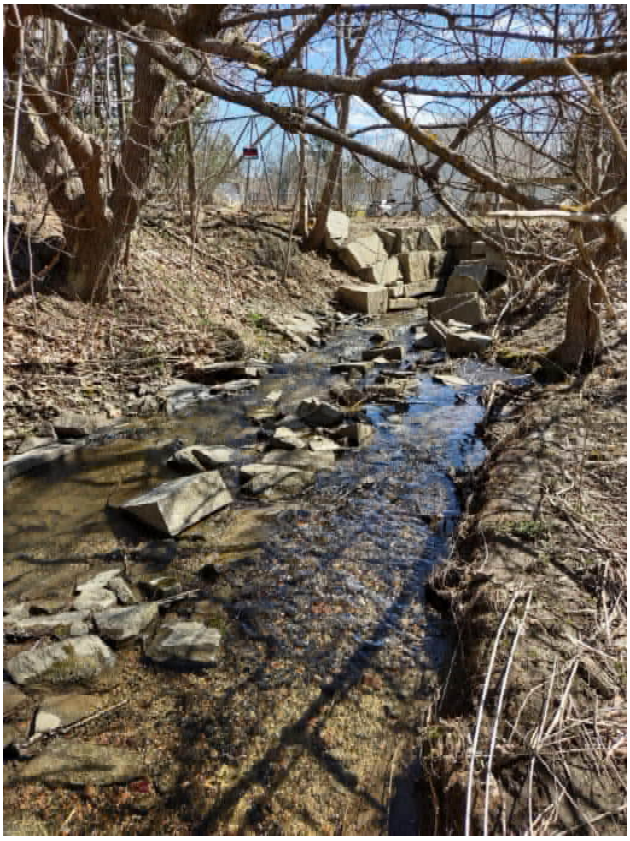
FACING SOUTH, APRIL 12 2022

FACING NORTH-WEST (NEAR GAY ST), DECEMBER 2020

The Broadway to Gay St Channel is an approximately 12’ wide, shallow stone rubble channel that conveys Lindsey Brook between Broadway and Gay Street at a length of approximately 700’.

Gay St. Culvert (inlet)

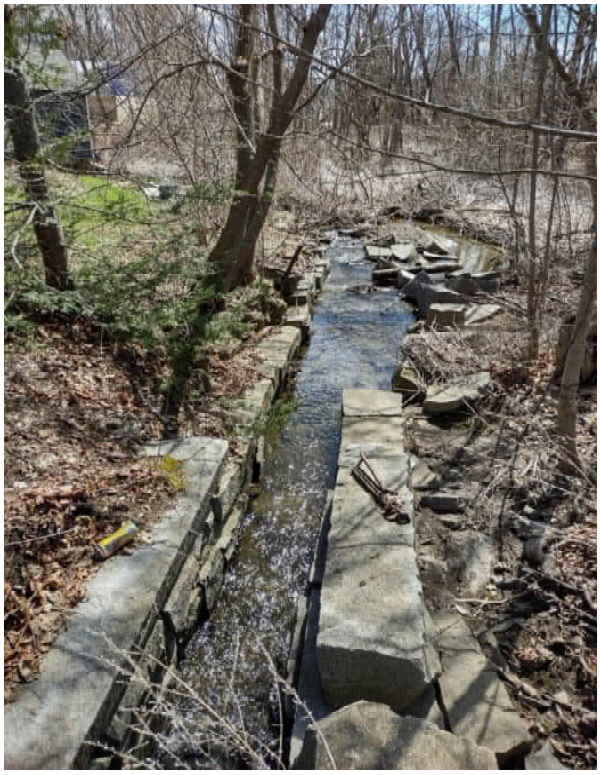
FACING SOUTH, DECEMBER 2020



FACING SOUTH-EAST, APRIL 2022

Gay St. Culvert (outlet)

FACING NORTH-WEST, DECEMBER 2020



FACING SOUTH, APRIL 2022

The Gay Street Culvert is a stone block culvert containing a 42" corrugated plastic pipe that conveys Lindsey Brook from North to South underneath Gay Street. The stone block channel narrows from the upstream to downstream end, although capacity is controlled by the 42" plastic pipe. Downstream out the outlet, the approximate 3.5' x 5' stone block channel continues for approximately 50' before transitioning to a more loose stone and granite block channel.

Gay Street to Rankin Street Channel

FACING NORTH, APRIL 2022

FACING SOUTH, APRIL 2022

The Gay Street to Rankin Street Channel is an approximately 400' long stone block and loose stone channel conveying Lindsey Brook from North to South between Gay Street and Rankin Street. At the time of survey, the channel had blockages of leaves and sticks at multiple locations, which could impact capacity. It is recommended that this channel be cleared of debris to ensure proper function.

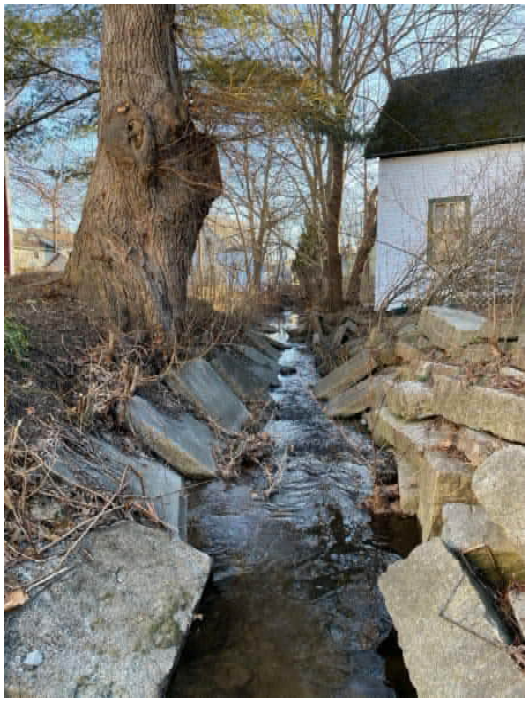
Rankin Street Culvert East (inlet)

FACING SOUTH-WEST, DECEMBER 2020

FACING NORTH, APRIL 2022

Rankin Street Culvert East (outlet)

FACING NORTH, APRIL 2022

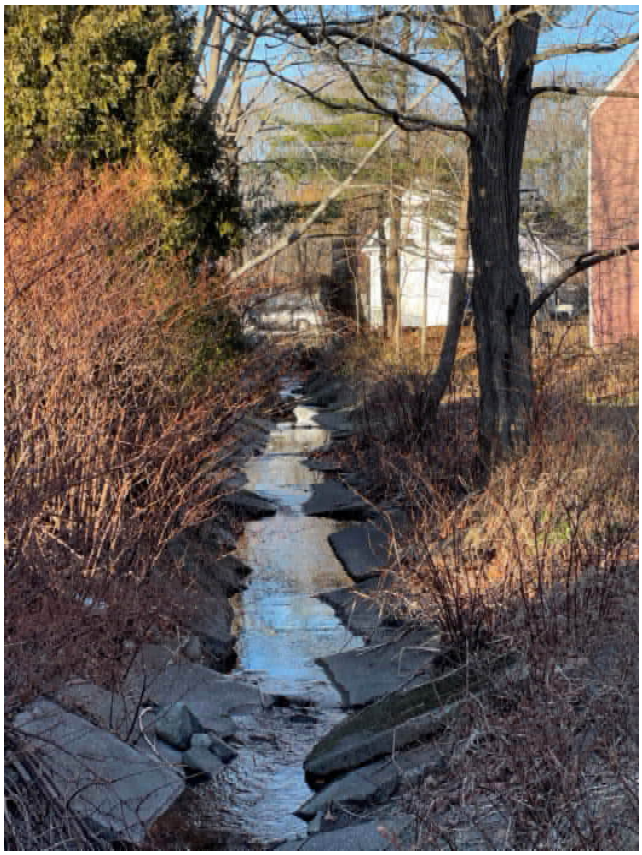


FACING SOUTH, APRIL 2022

The Rankin Street Culvert is an approximately 150’ long corrugated metal pipe that conveys Lindsey Brook from the North to South under Rankin Street and abutting properties. The pipe begins as a 42” on the upstream end and transitions to a 48” diameter underground. (Doubt this? Transitions according to CAD notes)

Rankin Street to Willow Street Channel

FACING NORTH-WEST, APRIL 2022



FACING NORTH, DECEMBER 2020

The Rankin Street to Willow Street channel is an approximately 225’ open channel consisting of stone blocks and overlapping concrete slab pieces. The channel varies in width between approximately 8-10’ and is generally clean and free of large debris at the time of survey. While wide, the channel is somewhat shallow and residential Structures on Rankin Street and Fogg Street are very close to the channel, so abutting properties may be vulnerable in the event of flooding at this location.

Willow Street Culvert (inlet)

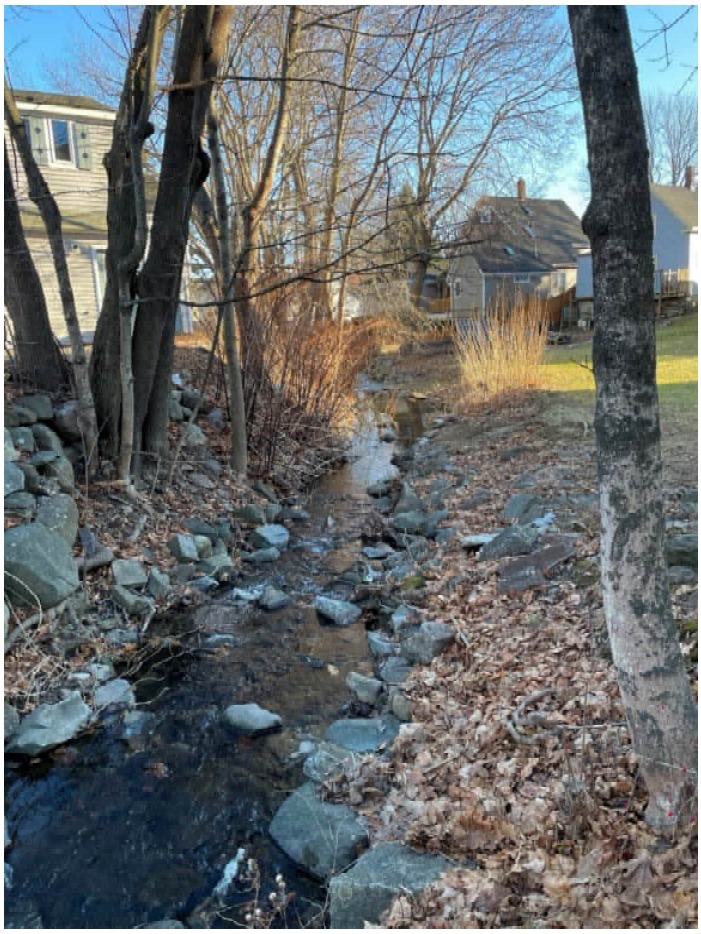
FACING SOUTH, DECEMBER 2020

Willow Street Culvert (outlet)

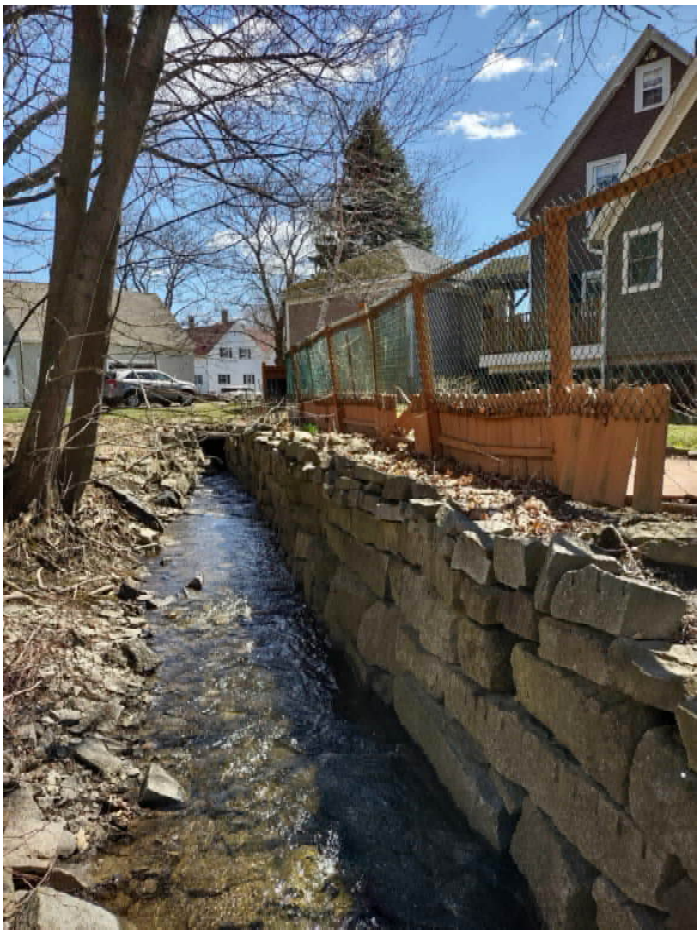
FACING NORTH-EAST, APRIL 2022

The Willow Street Culvert is a concrete box culvert that conveys Lindsey Brook from North to South underneath Willow Street. It is approximately 30' long, 4.5' wide and 3' tall. The culvert has a large crack that appears to have progressed through the full height and length of the culvert. This may undermine the roadway deterioration progresses. Repair or replacement of the culvert is recommended.

Willow Street to Granite Street Channel



FACING SOUTH-EAST, APRIL 2022

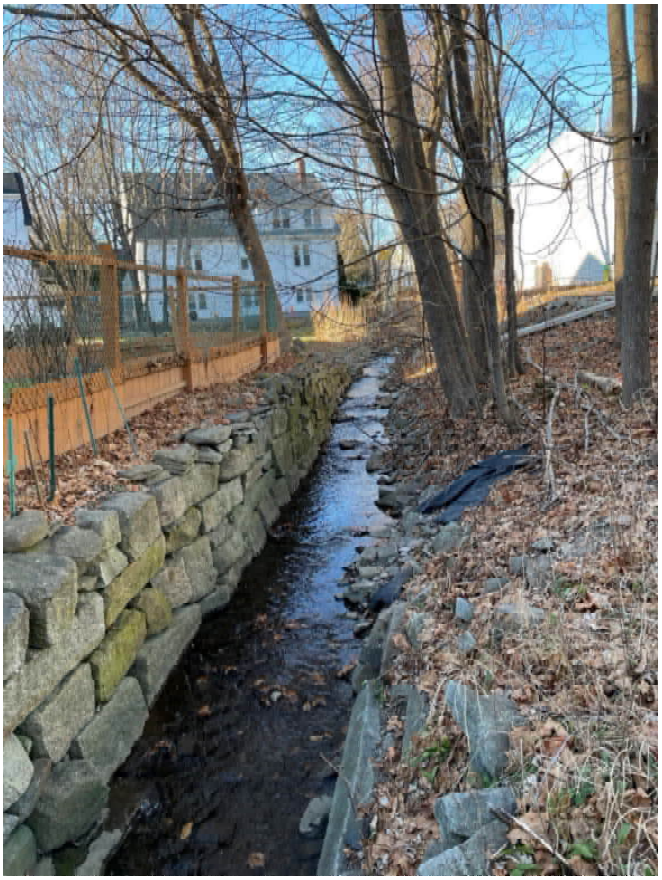


FACING SOUTH-EAST, APRIL 2022

The Willow Street to Granite Street Channel is an approximately 200’ long stone and silt bottom channel conveying Lindsey Brook between Willow Street and Granite Street. The channel narrows from approximately 7’ wide near Willow Street to approximately 4’ wide near the inlet to the Granite Street Culvert. As the channel approaches Granite Street, the bed material transitions to a granite slab and riprap bottom. The channel runs alongside an approximately 4’ tall stone block wall near Granite Street, offering erosion and flooding protection to abutting properties to the South-West.

Granite Street to Grove Street Culvert (inlet)

FACING SOUTH-EAST, DECEMBER 2020



FACING NORTH-WEST, DECEMBER 2020

Granite Street to Grove Street Culvert (outlet)

FACING NORTH-WEST, DECEMBER 2020

FACING SOUTH-EAST, DECEMBER 2020

The Granite Street to Grove Street culvert is a long underground closed channel for conveying Lindsey Brook from the inlet between Willow Street and Granite Street, to the outlet between Grove Street and Beech Street. The channel is approximately 900 feet long, beginning as a stone block channel, transitioning to concrete walls, and transitioning again to an approximately 45" corrugated metal pipe at the outlet between Grove Street and Beech Street. Access to the channel is possible via drainage structures on Granite Street and Talbot Avenue, or via a square-grate access hatch on Summer Street.

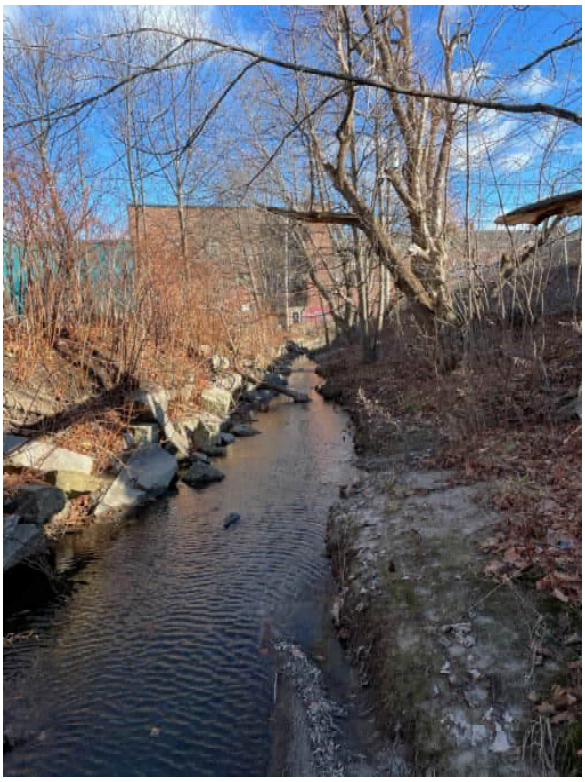
Union Street Culvert (Inlet)

FACING SOUTH-EAST - DECEMBER 2020

FACING NORTH-WEST - DECEMBER 2020

Union Street Culvert (Outlet)

FACING WEST - DECEMBER 2020



FACING EAST - DECEMBER 2020

The Union Street Culvert is an approximately 250’ long concrete box culvert conveying Lindsey Brook from West to East underneath Union Street (Route 1). This culvert is the most downstream culvert of the North-Eastern branch of Lindsey Brook before it reaches confluence with the South and Northwest branches between Union Street and Main Street.

Main Street Culvert (inlet)

The Main Street Culvert is an approximately 275' long concrete box culvert and is the most downstream culvert of the Lindsey Brook system, conveying flows West to East under Main Street (Route 1) before discharging to the Penobscot Bay.

Main Street Culvert (outlet)

Lindsey Brook – North West Branch

Field Data Collection Summary – Culverts and Channels

Lawn Ave West Culvert (inlet)

FACING SOUTH-EAST, DECEMBER 2020

FACING NORTH, DECEMBER 2020

Lawn Ave West Culvert (outlet)

FACING NORTH-WEST, DECEMBER 2020

FACING SOUTH, DECEMBER 2020

The Lawn Ave West Culvert is an approximately 50’ long, 40” diameter corrugated metal pipe culvert surrounded by stone blocks and rubble. The culvert is the most upstream public roadway crossing of the North-West branch of Lindsey Brook. The culvert and channel are generally in good condition, minor debris was observed at the time of survey at the downstream end of the culvert, but was likely only a temporary obstruction.

Rankin Street West Culvert (inlet)

FACING SOUTH, DECEMBER 2020

FACING NORTH-WEST, DECEMBER 2020

Rankin Street West Culvert (outlet)

FACING NORTH, DECEMBER 2020

FACING SOUTH, DECEMBER 2020

The Rankin Street West Culvert is an approximately 80' long culvert constructed out of corrugated metal pipes and stone blocks. The culvert contains two 48" pipes conveying Lindsey Brook from North to South, with an additional 24" pipe conveying runoff from abutting private property and the roadway from the West. At the time of survey, there was debris spotted accumulating at the inlet of the culvert, and loose stone block debris on the downstream end. Clean-up of the channel shortly upstream and downstream of the culvert is recommended to ensure proper function and capacity.

Talbot Avenue West Culvert (inlet)

FACING SOUTH, DECEMBER 2020

FACING NORTH-WEST, DECEMBER 2020

Talbot Avenue West Culvert (outlet)

FACING NORTH-WEST, DECEMBER 2020

FACING SOUTH, DECEMBER 2020

The Talbot Avenue West Culvert is an approximately 200’ box culvert conveying Lindsey Brook from the North-West to South-East beneath Talbot Avenue and Broadway. The culvert begins as a stone block channel and transitions to concrete before the outlet. The box culvert opening is approximately 3’ deep and 5’ wide at the downstream end. The inlet of the culvert and immediate upstream area appeared to be partially silted or filled with debris, causing the inlet to be restricted compared to the rest of the downstream culvert. In addition, strips of U-channel signpost have been added to the entrance to the culvert, presumably as a means of blocking large debris. These signpost strips were accumulating debris and further restricting flow at the time of survey. It is recommended that the inlet of the culvert be cleared of the signposts and any accumulated debris, and that the inlet invert be cleared of silt or stones to a depth that more matches the rest of the culvert.

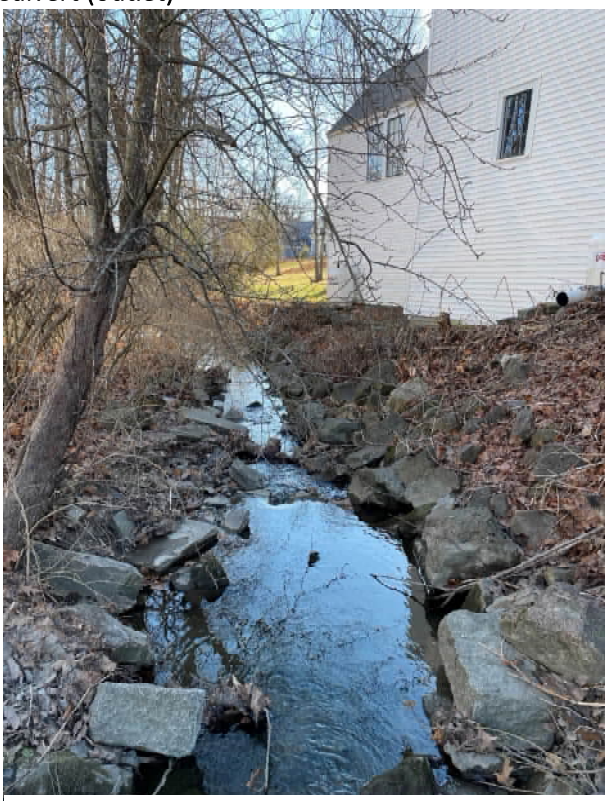
Summer Street West Culvert (inlet)

FACING SOUTH-EAST, APRIL 2022

FACING NORTH, APRIL 2022

Summer Street West Culvert (outlet)

FACING NORTH, DECEMBER 2020



FACING SOUTH, DECEMBER 2020

The Summer Street West Culvert is the longest closed conduit channel of the Lindsey Brook system, conveying Lindsey Brook from the North-West to the South-East over 1000' from the inlet on Summer Street to the outlet south of Maple Street. Over the length of the culvert, the channel collects roadway drainage through structures on Summer Street, Beech Street, and Maple Street. The inlet to the channel is a 66" corrugated plastic pipe surrounded by a stone block channel of slightly wider and taller dimensions than the pipe. The outlet is a 56" wide by 38" tall oval corrugated metal pipe, discharging to a loose stone and silt channel approximately 9' wide and 4' deep. It is unclear whether additional material transitions occur during the length of the culvert or where these transitions occur. In general, the upstream and downstream ends of the Summer Street West culvert are in good condition and do not appear to contain blockages. Further investigation of the culvert along some of the connected drainage structures may provide more information about underground defects.

Knox Center to Broadway Culvert (Inlet)

FACING EAST, JANUARY 2021

FACING NORTH-EAST, JUNE 2022

Knox Center to Broadway/NW&S Branch Confluence Culvert (Outlet)

FACING NORTH-EAST, DECEMBER 2020

FACING NORTH, DECEMBER 2020

The Knox Center to Broadway Culvert is an approximately 750’ long culvert conveying Lindsey Brook from the West to East. The culvert combines with the Limerock Street Culvert underground, which is the confluence point of the North-West and South branches of Lindsey Brook. The location of the confluence is believed to be somewhere underneath the lawn to the South of St. Peter’s Episcopal Church.

The culvert inlet at the Knox Center for Long Term Living is a 60” reinforced concrete pipe, continuing for approximately 200’ (est.) before meeting the confluence point. Upstream of the inlet is an approximately 3-5’ deep and 5’ wide stone block open channel. The outlet is constructed of stone block and continues as an open stone block channel downstream, approximately 6’ deep and 3-4’ wide.

The Knox Facility inlet is a known location of flooding during and after heavy rainfall events. Although no obvious defects that could impact capacity have been observed during field surveys, it is possible that blockages or maintenance issues exist in the underground portions of the culvert. The material of the culvert is known to transition from pipe to stone block before the outlet, this could be a potential location for blockage or capacity reduction to occur. In addition, the stone block box culvert outlet east of Union Street may be undersized for handling the flow of both the North-West and South branches of the Brook.

Lindsey Brook – South Branch

Field Data Collection Summary – Culverts and Channels

Salt River Railroad Culvert (inlet)

FACING NORTH-WEST, DECEMBER 2020

Salt River Railroad Culvert (outlet)

FACING SOUTH-EAST, DECEMBER 2020

The Salt River Railroad Culvert is the most upstream culvert surveyed in the South Branch of Lindsey Brook. It consists of two 24" CMP pipes buried in roadway ballast, with concrete slab wingwalls. The culverts are located within a saltwater wetland system that is divided by the railroad track. The outlets of the two pipes were partially buried in ballast at the time of survey, likely resulting in a significant reduction in capacity. It is recommended that these culverts be cleared of ballast to restore capacity and ensure proper hydraulic connectivity of the wetlands on either side of the railroad.

Halls Lane Culvert (inlet)

FACING SOUTH, DECEMBER 2020

Halls Lane Culvert (outlet)

FACING SOUTH, DECEMBER 2020

FACING NORTH, DECEMBER 2020

The Halls Lane Culvert is an approximately 40’ long 36” corrugated metal pipe culvert conveying Lindsey Brook from the South to North under Halls Lane. The channel upstream of the culvert, coming from the wetlands, is wide and slow-moving. The downstream of the culvert is narrow and shallow, and was lined mostly with leaves, small debris, and stones at the time of survey. While the flow in this reach of Lindsey Brook is lower than other locations in the Lindsey Brook System, a noteworthy amount of trash and debris was spotted in the upstream channel and outlet of the culvert at the time of survey. In addition, the cover above the crown of the pipe is shallow, making the roadway more susceptible to flooding if a blockage did occur. It is recommended that the channel and culvert be checked and/or cleared of debris periodically to ensure proper function.

Holmes Street & Franklin Street Culvert (inlet)

FACING NORTH, DECEMBER 2020

FACING SOUTH, DECEMBER 2020

Holmes Street & Franklin Street Culvert (outlet)

FACING SOUTH-WEST, DECEMBER 2020

FACING NORTH, DECEMBER 2020

The Holmes Street & Franklin Street Culvert is an approximately 250’ long concrete and stone block culvert conveying Lindsey Brook from the South to North under the intersection of Holmes Street & Franklin Street and nearby properties on Holmes Street and Franklin Street. The culvert inlet is constructed of concrete with an approximate opening of 3.5’ height by 5.25’ width, receiving flow from a narrow loosely constructed stone channel. At an unknown location within the culvert, the material transitions to stone block. The outlet is considerably smaller than the inlet, measured at approximately 14” tall and 16” wide, and is in poor condition. This opening contraction from the upstream to downstream ends of the culvert increases the likelihood of blockages and restricts capacity. It is recommended that the outlet be cleared of debris and inspected for further maintenance issues. Repair and/or enlargement of the opening to match the inlet dimensions more closely should be considered, however because Lindsey Brook crosses underneath residential structures downstream of this location at the Franklin Street North Culvert, increasing potential flow at this culvert should be done with caution.

Franklin Street North Culvert (inlet)

FACING NORTH, DECEMBER 2020

FACING SOUTH, DECEMBER 2020

FACING NORTH, DECEMBER 2020

FACING WEST, DECEMBER 2020

The Franklin Street North Culvert is an approximately 32” high by 40” wide stone block culvert that passes underneath residential structures on private property between Franklin Street and Purchase Street. The culvert receives flow from an open stone block channel on private property, and is closed by flat stone slabs once emerging from underneath the residential structure. The channel turns to the west and connects to the closed drainage system on Franklin Street, which continues North, crossing Pleasant Street and flowing towards the Maine Coast Railroad.

Maine Coast Railroad Culvert (inlet)

NO PHOTOS, INACCESSIBLE

Maine Coast Railroad Culvert (outlet)

FACING SOUTH, DECEMBER 2020

The Maine Coast Railroad Culvert is a stone block and mortar culvert that conveys Lindsey Brook from South to North underneath the Maine Coast Railroad. Dimensions are unknown, as the culvert is on private property.

Park Street Culvert (inlet)

FACING WEST, DECEMBER 2020

FACING SOUTH-WEST, DECEMBER 2020

Park Street Culvert (outlet)

FACING SOUTH-WEST, DECEMBER 2020

FACING NORTH, DECEMBER 2020

The Park Street Culvert is an approximately 180’ long stone block culvert conveying Lindsey Brook from South to North beneath an industrial/commercial property and Park Street (Route 1). The culvert is approximately 3.5’ wide and 2’ deep on the inlet side. The outlet dimensions were unable to be verified at the time of survey, but the culvert appears to be in poor condition and may be operating under reduced capacity. It is recommended that the culvert be inspected further and that debris is removed.

Grace Street Culvert

FACING NORTH, DECEMBER 2020

FACING NORTH, DECEMBER 2020

The Grace Street Culvert is an approximately 40’ culvert consisting of a single 36” corrugated plastic pipe.

Masonic Street Culvert (inlet)

FACING NORTH, DECEMBER 2020

FACING SOUTH, DECEMBER 2020

Masonic Street Culvert (outlet) – Unavailable

Appendix D
H&H Model Hydrology

APPENDIX H. 24-hour duration rainfalls for various return periods

COUNTY	Storm Type	1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR	500-YR
ANDROSCOGGIN	III	2.5	3.0	3.7	4.3	5.4	6.4	7.6	11.1
AROOSTOOK C (Presque Isle Area)	II	1.9	2.3	2.8	3.2	3.9	4.6	5.3	7.6
AROOSTOOK N (Fort Kent Area)	II	1.9	2.2	2.7	3.1	3.7	4.3	5.0	7.0
AROOSTOOK S (Houlton Area)	II	2.1	2.5	3.0	3.4	4.1	4.7	5.4	7.5
CUMBERLAND NW (Bridgton Area)	III	2.5	3.0	3.7	4.3	5.4	6.3	7.5	10.9
CUMBERLAND SE (N Windham Area)	III	2.6	3.1	3.9	4.6	5.8	6.9	8.1	12.1
FRANKLIN	II	2.0	2.4	2.9	3.4	4.2	4.9	5.7	8.2
HANCOCK	III	2.5	2.9	3.6	4.2	5.2	6.1	7.2	10.5
KENNEBEC	III	2.4	2.8	3.5	4.2	5.2	6.1	7.2	10.6
KNOX	III	2.6	3.2	3.9	4.6	5.7	6.7	7.9	11.5
LINCOLN	III	2.5	3.1	3.8	4.5	5.5	6.5	7.6	11.1
OXFORD E (Rumford Area)	II[1]	2.3	2.7	3.3	3.9	4.8	5.7	6.7	9.7
OXFORD W (Gilead Area)	II	2.2	2.7	3.4	4.0	4.9	5.8	6.9	10.1
PENOBSCOT N (Millinocket Area)	II	2.2	2.6	3.2	3.8	4.7	5.6	6.5	9.5
PENOBSCOT S (Hudson Area)	II	2.3	2.7	3.4	3.9	4.9	5.7	6.7	9.7
PISCATAQUIS N (Chesuncook Area)	II	2.0	2.4	2.9	3.4	4.2	5.0	5.8	8.5
PISCATAQUIS S (Monson Area)	II	2.2	2.7	3.3	3.9	4.8	5.7	6.8	10.0
SAGADAHOC	III	2.6	3.2	3.9	4.6	5.7	6.7	7.8	11.4
SOMERSET N (Pittston Farm Area)	II	2.0	2.3	2.8	3.3	4.0	4.7	5.4	7.8
SOMERSET S (Solon Area)	II	2.3	2.7	3.4	3.9	4.9	5.7	6.7	9.8
WALDO	III	2.4	2.9	3.6	4.2	5.2	6.1	7.2	10.5
WASHINGTON	III	2.5	2.8	3.4	3.9	4.8	5.5	6.4	9.0
YORK	III	2.6	3.3	4.1	4.9	6.2	7.3	8.7	13.2

1 Use Type III rainfall for the towns of Brownfield, Buckfield, Denmark, Hartford, Hebron, Hiram, Oxford, and Porter.

Source: Data extracted by the Maine Department of Environmental Protection from the Northeast Regional Climate Center website (http://precip.eas.cornell.edu), Extreme Precipitation Tables. Data from this website was obtained from the National Oceanic and Atmospheric Administration's Regional Climate Center Program.
June 2014

Legend

- Lindsey Brook
- Subcatchment
- Subcatchment (Proposed Separation)

39S
16S
20S
38S
17S
11S
18S
37S
21S
19S
12S
22S
23S
SSA-FS1
24S
13S
25S
26S
27S
14S
28S
15S
36S
34S
35S
SSA-PS3
SSA-PS2
32S
SSA-PS1
30S
6S
5S
4S
3S
SSA-CS3
2S
SSA-CS2
SSA-CS1
1S

N

0 250 500 1,000 Feet

Watershed Map

Rockland, Maine

PROJ NO:	DATE:	FIGURE:
20279	10/15/2021	1

WRIGHT-PIERCE
Engineering a Better Environment

Appendix E
Green Infrastructure & Flood Control Projects

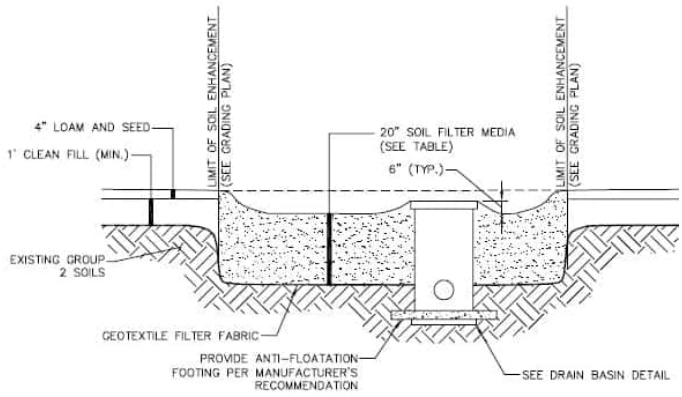
A – VEGETATED BIORETENTION AREA - RAINGARDEN

Benefits:

- Reduce runoff by absorbing and retaining stormwater
- Filters sediment and pollutants
- Mitigates heat island effects
- Adds aesthetic value
- Evapotranspiration benefits
- Low maintenance
- Can be designed to any shape and size

Plants must withstand the extremes of moisture and nutrients, particularly nitrogen and phosphorus.

SOIL FILTER MEDIA		
Filter Media	Filter By Volume	Specification
Sand	45%–50%	MEDOT Specification #703.01 fine aggregate for concrete
Topsoil	25%–35%	Loamy Sand topsoil with minimal clay content and between 15 to 25% fines passing the #200 sieve
Mulch	20%–30%	Moderately fine, shredded bark or wood fiber mulch with less than 5% passing the #200 sieve



RAIN GARDEN SOIL ENHANCEMENT
N.T.S.

Photo source: Wright-Pierce

B – SWIRL CONCENTRATOR/STORMCEPTOR

Stormceptor® STC

Stormceptor STC is the recognized leader in stormwater treatment, offering a range of versatile treatment systems that effectively remove pollutants from stormwater and snowmelt runoff. Stormceptor is flexibly designed to protect waterways from hazardous material spills and stormwater pollution, including suspended sediment, free oils, and other pollutants that attach to particles, no matter how fierce the storm.

Stormceptor's scour prevention technology ensures pollutants are captured and contained during all rainfall events.

Learn More:
www.ContechES.com/stormceptor

Ideal uses

- Sediment (TSS) removal
- Spill control
- Debris and small floatables capture
- Pretreatment for filtration, detention/retention systems, ponds, wetlands, Low Impact Development (LID), green infrastructure, and water-sensitive urban design

Proven performance

With more than 20 years of industry experience, Stormceptor has been performance tested and verified by some of the most stringent technology evaluation programs in North America.

- NJCAT
- Washington ECOLOGY
- EN858 Class 2

FEATURE	BENEFIT
Patented scour prevention technology	Superior pollutant removal and retention
Can take the place of a conventional junction or inlet structure	Eliminates the need for additional structures
Minimal drop between inlet and outlet	Site flexibility
Multiple inlets can connect to a single unit	Design flexibility
3rd party tested and verified performance (Sediment & Oil)	Eliminates the need for a separate bypass structure

Source: Contech Engineer Solutions

C - POROUS PAVEMENT

Benefits:

- Reduce runoff
- Promotes groundwater recharge
- Filters pollutants
- Ideal for parking areas where sand and salt use can be minimized

May require annual vacuum expense.

Photo source: Wright-Pierce

D - BIO-SWALE

Benefits:

- Reduce runoff
- Maximizes time of concentration
- Promotes groundwater recharge
- Filters sediments and pollutants

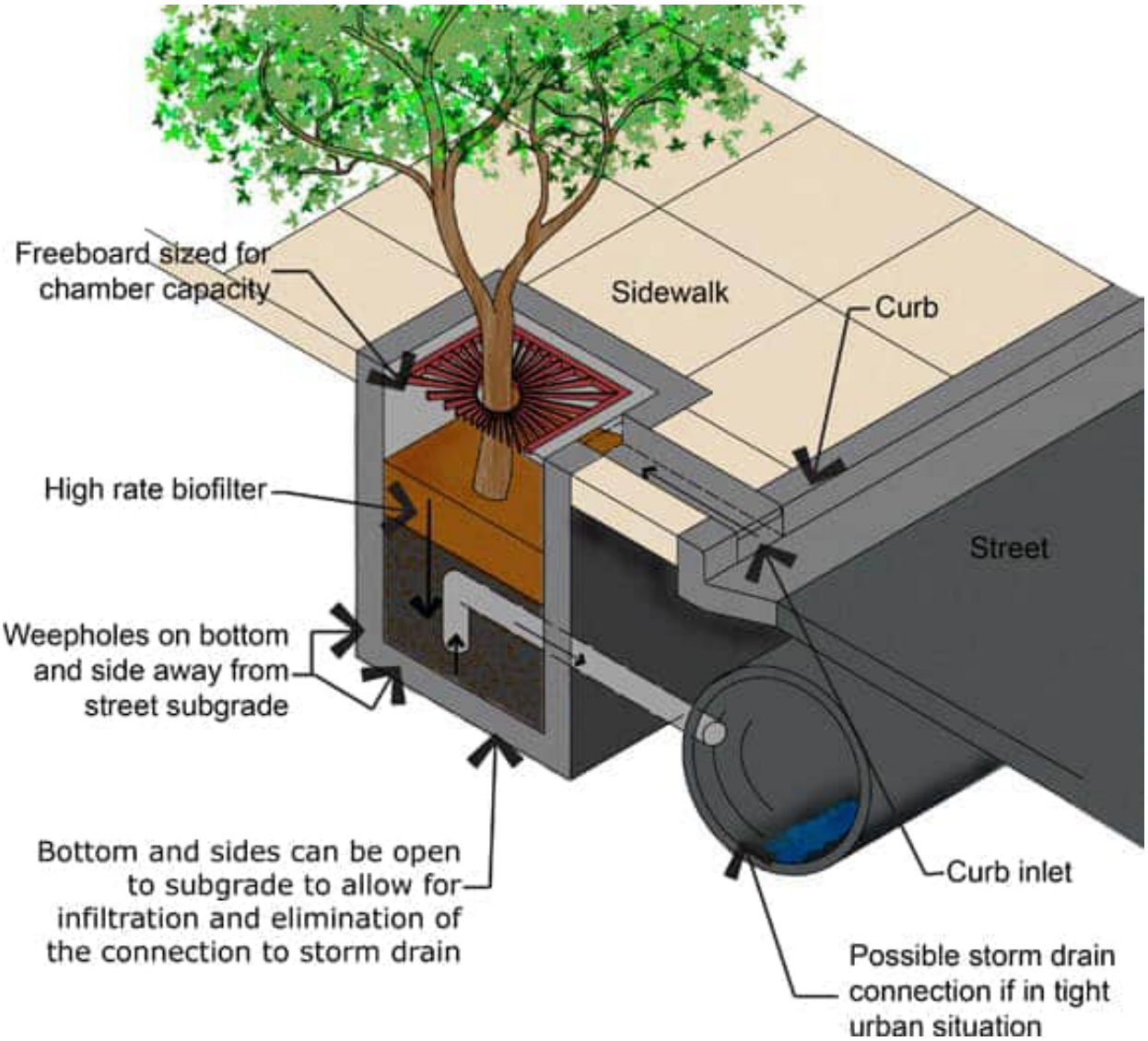
Long, continuous bio-swales maximize the time water spends in the swale and trench. This reduces stormwater quantity in the piped system and aids in the trapping of pollutants.

Photo source: New England Water Environment Association

E - TREE BOX FILTER

Benefits:

- Filters sediment and pollutants
- Mitigates heat island effects
- Adds aesthetic value
- Evapotranspiration benefits
- Low maintenance



Legend

Green Infrastructure Area

Catch Basin

Catch Basin

Drain Manhole

Drain Manhole

Contours - 2ft

Culvert

Storm Drain

Sewer Manhole

Sanitary Main

A Vegetated Bio-Retention Area

B Swirl Concentrator/Stormceptor

C Porous Pavement

D Bio-Swale

E Tree Box Filter

Park Dr

Myrtle St

Main St

Pleasant St

Robinson St

Water St

B

N

0 25 50 100 150 Feet

Harbor Park

Rockland, Maine

PROJ NO:	DATE:
20279	10/15/2021

WRIGHT-PIERCE
Engineering a Better Environment

FIGURE: E-1

ABL C:\Users\alexander.liptak\Desktop\Files\Rockland\FigureMXDs\GreenInfrastructureFigures082321.mxd

Legend

Green Infrastructure Area

Catch Basin

- Catch Basin

Drain Manhole

- Drain Manhole
- Contours - 2ft
- Culvert
- Storm Drain
- Sewer Manhole
- Sanitary Main
- A Vegetated Bio-Retention Area
- B Swirl Concentrator/Stormceptor
- C Porous Pavement
- D Bio-Swale
- E Tree Box Filter

Mechanic St

Snow St

Snow St

Gamage Ln

A

N

0 25 50 100 150 Feet

Snow Marine Park

Rockland, Maine

PROJ NO:	DATE:
20279	10/15/2021

WRIGHT-PIERCE
Engineering a Better Environment

FIGURE: E-2

ABL C:\Users\alexander.liptak\Desktop\Files\Rockland\FigureMXDs\GreenInfrastructureFigures082321.mxd

Legend

Green Infrastructure Area

Catch Basin

- Catch Basin

Drain Manhole

- Drain Manhole
- Contours - 2ft
- Culvert
- Storm Drain
- Sewer Manhole
- Sanitary Main
- A Vegetated Bio-Retention Area
- B Swirl Concentrator/Stormceptor
- C Porous Pavement
- D Bio-Swale
- E Tree Box Filter

Samoset Rd

Jameson Point Rd

A

N

0 25 50 100 150 Feet

Marie Reed Park

Rockland, Maine

PROJ NO:	DATE:
20279	10/15/2021

WRIGHT-PIERCE
Engineering a Better Environment

FIGURE: E-3

ABL C:\Users\alexander.liptak\Desktop\Files\Rockland\FigureMXDs\GreenInfrastructureFigures082321.mxd

Legend

Green Infrastructure Area

Catch Basin

- Catch Basin

Drain Manhole

- Drain Manhole
- Contours - 2ft
- Culvert
- Storm Drain
- Sewer Manhole
- Sanitary Main
- A — Vegetated Bio-Retention Area
- B — Swirl Concentrator/Stormceptor
- C — Porous Pavement
- D — Bio-Swale
- E — Tree Box Filter

Elm St
Oak St
Orient St
Union St
Main St
Park St
Park Dr

N

0 25 50 Feet

Oak/Orient Lot
Rockland, Maine

PROJ NO:	DATE:
20279	10/15/2021

WRIGHT-PIERCE
Engineering a Better Environment

FIGURE: E-4

ABL C:\Users\alexander.liptak\Desktop\Files\Rockland\FigureMXDs\GreenInfrastructureFigures082321.mxd

Johnson Memorial Park
Rockland, Maine

PROJ NO:	DATE:
20279	10/15/2021

WRIGHT-PIERCE
Engineering a Better Environment

FIGURE: E-5

ABL C:\Users\alexander.liptak\Desktop\Files\Rockland\FigureMXDs\GreenInfrastructureFigures082321.mxd

Legend

Green Infrastructure Area

Catch Basin

- Catch Basin

Drain Manhole

- Drain Manhole
- Contours - 2ft
- Culvert
- Storm Drain
- Sewer Manhole
- Sanitary Main
- A Vegetated Bio-Retention Area
- B Swirl Concentrator/Stormceptor
- C Porous Pavement
- D Bio-Swale
- E Tree Box Filter

North Main St

Main St

A

N

0 25 50 Feet

Ralph Ulmer Square

Rockland, Maine

PROJ NO:	DATE:
20279	10/15/2021

WRIGHT-PIERCE
Engineering a Better Environment

FIGURE: E-6

ABL C:\Users\alexander.liptak\Desktop\Files\Rockland\FigureMXDs\GreenInfrastructureFigures082321.mxd

Legend

- Catch Basin
- Drain Access Cover
- Culvert
- Storm Drain
- Sewer Manhole
- Sanitary Main
- Flood Control Boundary
- Roads
- Contours - 2ft
- Contours - 10ft
- Lindsey Brook

Orchard St
Center St
Beacon St
Traverse St
Fern St
Talbot Av
Sweetland St
Broadway
Court St
Gay St
Chestnut St
James St
Rockland St
Admontem Av
Gurdy St
North Main St
Blake Pl
Gay St Pl
Knowlton St
Gay St. to Broadway Flood Control Structure
Cottage St
Rankin St
Hill St
Broadway Pl
Willow St
Fogg St
Temple St
Leland St
Tea St
Union St
Main St
Talbot Ave. to Rankin St. Flood Control Structure
Granite St

N

0 100 200 Feet

Proposed Flood Control Projects
Rockland, Maine

PROJ NO:	DATE:	FIGURE:
20279	1/6/2023	E-7

WRIGHT-PIERCE
Engineering a Better Environment

Crescent Street Outfall Separation Project
Rockland, Maine

PROJ NO:	DATE:	FIGURE:
20279	10/15/2021	E-8

WRIGHT-PIERCE
Engineering a Better Environment

Legend

- Proposed Catch Basins
- Proposed Separated Pipes
- Proposed Separated Manholes
- Catch Basin
- Drain Access Cover
- Culvert
- Storm Drain
- Sewer Manhole
- Sanitary Main
- Lindsey Brook

Birch Street
Birch
Frederick
Knott
Spruce
Pine
Cedar
Rockland Plaza
Maverick
Camden St
Fales
Washington
Camden
Broadway
Stanley
Amesbury
Main
Lawn
Chestnut
Bunker
Brewster
Jefferson
Griffin
Trinity
Perry
Front
Achorn
Warren
John
Knox
James
Admontem
Rockland
Gurdy
Blake
Gay
Court
Main

N

0 215 430 Feet

Front Street Outfall Separation Project
Rockland, Maine

PROJ NO:	DATE:	FIGURE:
20279	10/15/2021	E-9

WRIGHT-PIERCE
Engineering a Better Environment

Legend

- Proposed Catch Basins
- Proposed Separated Pipes
- Proposed Separated Manholes
- Catch Basin
- Drain Access Cover
- Culvert
- Storm Drain
- Sewer Manhole
- Sanitary Main
- Lindsey Brook

Custom House
School
Museum
Masonic
Elm
Union
Grace
Oak
Orient
Myrtle
Main
Park
Winter
Tillson
Commercial
Weeks
Police Plz

Winter Street Outfall Redirection Project

N

0 100 200 Feet

Winter Street Outfall Projects
Rockland, Maine

PROJ NO:	DATE:	FIGURE:
20279	10/15/2021	E-10

WRIGHT-PIERCE
Engineering a Better Environment

Legend

- Proposed Pipe
- Proposed Manhole
- Catch Basin
- Drain Manhole
- Storm Drain

Rocky Hill
Bayview
Camden St
Fales
Rockland Plaza
Birch
Birch Street
Frederick
Maverick
Knott
Spruce
Pine
Brewster
Cedar
Jefferson
Griffin
Camden
Washington
Front
Trinity
Perry
Text

Connect to Existing Outfall Structure (unmapped)

N

0 125 250 500 Feet

XY C:\Users\alexander.liptak\Desktop\Files\Rockland\MXDs\11x17-Landscape_Existing071822.mxd

Maverick/Washington Storm Drain Re-Route Project

Rockland, Maine

PROJ NO:	DATE:
20279B	7/18/2022

WRIGHT-PIERCE
Engineering a Better Environment

FIGURE: E-11

Appendix F
Cost Estimating

Project: Maverick/Washington Street Storm Drain Re-Route Project

Date: 05/05/23

April 2023 ENR CCI: 13230

By: ABL/SLG

	Item	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	LS	$ 40,600.00	$ 40,600.00
2	Utility Relocation	LS	$ 25,000.00	$ 25,000.00
3	Re-investigation	LS	$ 5,400.00	$ 5,400.00
4	Traffic Regulation and Control	LS	$ 21,300.00	$ 21,300.00
5	Furnish and Install 18" Storm Drain Culvert	LF	$ 190.00	$ 50,350.00
6	Furnish and Install 24" Storm Drain Culvert	LF	$ 220.00	$ 77,000.00
7	Furnish and Install 30" Storm Drain Culvert	LF	$ 240.00	$ 252,000.00
8	Furnish and Install Catch Basins	EA	$ 6,400.00	$ 64,000.00
9	Furnish and Install Storm Drain Manholes	EA	$ 6,400.00	$ 83,200.00
10	Roadway Base Gravel (3" Type B)	CY	$ 80.00	$ 58,880.00
11	Rip-rap	CY	$ 80.00	$ 3,200.00
12	Roadway Pavement (2" Grading C and 3" Grading B)	TONS	$ 300.00	$ 120,000.00
13	Sidewalk Construction (Bituminous)	SY	$ 50.00	$ 25,000.00
14	Erosion and Sediment Control	LS	$ 15,800.00	$ 15,800.00
15	Permitting	LS	$ 10,000.00	$ 10,000.00
Construction Subtotal			**$**	**851,730.00**
Contingency (40%)			**$**	**340,692.00**
Subtotal of Construction Costs			**$**	**1,192,422.00**
Engineering Design, Construction Administration and Inspection (40%)			**$**	**476,968.80**
Estimated Total Project Cost			**$**	**1,669,000.00**

Project: Lawn Ave East Culvert Date: 05/05/23

April 2023 ENR CCI: 13230 By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 7,400.00	$ 7,400.00
2	Utility Relocation	1	LS	$ 25,000.00	$ 25,000.00
3	Re-investigation	1	LS	$ 5,400.00	$ 5,400.00
4	Traffic Regulation and Control	1	LS	$ 21,300.00	$ 21,300.00
5	Furnish and Install 48" Storm Drain Culvert	50	LF	$ 850.00	$ 42,500.00
6	Furnish and Install Catch Basins	2	EA	$ 6,400.00	$ 12,800.00
7	Furnish and Install Storm Drain Manholes	1	EA	$ 6,400.00	$ 6,400.00
8	Roadway Base Gravel (3" Type B)	67	CY	$ 80.00	$ 5,360.00
9	Rip-rap	40	CY	$ 80.00	$ 3,200.00
10	Roadway Pavement (2" Grading C and 3" Grading B)	37	TONS	$ 300.00	$ 11,100.00
11	Sidewalk Construction (Bituminous)	28	SY	$ 50.00	$ 1,388.75
12	Erosion and Sediment Control	1	LS	$ 2,700.00	$ 2,700.00
13	Permitting	1	LS	$ 10,000.00	$ 10,000.00
Construction Subtotal				**$**	**154,548.75**
Contingency (40%)				**$**	**61,819.50**
Subtotal of Construction Costs				**$**	**216,368.25**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**86,547.30**
Estimated Total Project Cost				**$**	**303,000.00**

Project: Broadway Culvert
April 2023 ENR CCI: 13230

Date: 05/05/23
By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 16,600.00	$ 16,600.00
2	Utility Relocation	1	LS	$ 25,000.00	$ 25,000.00
3	Re-investigation	1	LS	$ 5,400.00	$ 5,400.00
4	Traffic Regulation and Control	1	LS	$ 21,300.00	$ 21,300.00
5	Furnish and Install 48" Storm Drain Culvert	260	LF	$ 850.00	$ 221,000.00
6	Furnish and Install Catch Basins	2	EA	$ 6,400.00	$ 12,800.00
7	Furnish and Install Storm Drain Manholes	1	EA	$ 6,400.00	$ 6,400.00
8	Roadway Base Gravel (3" Type B)	67	CY	$ 80.00	$ 5,360.00
9	Rip-rap	40	CY	$ 80.00	$ 3,200.00
10	Roadway Pavement (2" Grading C and 3" Grading B)	37	TONS	$ 300.00	$ 11,100.00
11	Sidewalk Construction (Bituminous)	28	SY	$ 50.00	$ 1,388.75
12	Erosion and Sediment Control	1	LS	$ 6,700.00	$ 6,700.00
13	Permitting	1	LS	$ 10,600.00	$ 10,600.00
Construction Subtotal				**$**	**346,848.75**
Contingency (40%)				**$**	**138,739.50**
Subtotal of Construction Costs				**$**	**485,588.25**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**194,235.30**
Estimated Total Project Cost				**$**	**680,000.00**

Project: Willow Culvert
April 2023 ENR CCI: 13230

Date: 05/05/23
By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 8,300.00	$ 8,300.00
2	Utility Relocation	1	LS	$ 25,000.00	$ 25,000.00
3	Re-investigation	1	LS	$ 5,400.00	$ 5,400.00
4	Traffic Regulation and Control	1	LS	$ 21,300.00	$ 21,300.00
5	Furnish and Install 54" Storm Drain Culvert	40	LF	$ 1,070.00	$ 42,800.00
6	Furnish and Install Catch Basins	2	EA	$ 6,400.00	$ 12,800.00
7	Furnish and Install Storm Drain Manholes	1	EA	$ 6,400.00	$ 6,400.00
8	Roadway Base Gravel (3" Type B)	134	CY	$ 80.00	$ 10,720.00
9	Rip-rap	40	CY	$ 80.00	$ 3,200.00
10	Roadway Pavement (2" Grading C and 3" Grading B)	73	TONS	$ 300.00	$ 21,900.00
11	Sidewalk Construction (Bituminous)	56	SY	$ 50.00	$ 2,777.50
12	Erosion and Sediment Control	1	LS	$ 3,100.00	$ 3,100.00
13	Permitting	1	LS	$ 10,000.00	$ 10,000.00
Construction Subtotal				**$**	**173,697.50**
Contingency (40%)				**$**	**69,479.00**
Subtotal of Construction Costs				**$**	**243,176.50**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**97,270.60**
Estimated Total Project Cost				**$**	**340,000.00**

Project: Granite-Grove Culvert
April 2023 ENR CCI: 13230

Date: 05/05/23
By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 62,700.00	$ 62,700.00
2	Utility Relocation	1	LS	$ 25,000.00	$ 25,000.00
3	Re-investigation	1	LS	$ 5,400.00	$ 5,400.00
4	Traffic Regulation and Control	1	LS	$ 21,300.00	$ 21,300.00
5	Furnish and Install 54" Storm Drain Culvert	950	LF	$ 1,070.00	$ 1,016,500.00
6	Furnish and Install Catch Basins	8	EA	$ 6,400.00	$ 51,200.00
7	Furnish and Install Storm Drain Manholes	4	EA	$ 6,400.00	$ 25,600.00
8	Roadway Base Gravel (3" Type B)	267	CY	$ 80.00	$ 21,360.00
9	Rip-rap	40	CY	$ 80.00	$ 3,200.00
10	Roadway Pavement (2" Grading C and 3" Grading B)	145	TONS	$ 300.00	$ 43,500.00
11	Sidewalk Construction (Bituminous)	111	SY	$ 50.00	$ 5,555.00
12	Erosion and Sediment Control	1	LS	$ 24,400.00	$ 24,400.00
13	Permitting	1	LS	$ 10,000.00	$ 10,000.00
Construction Subtotal				**$**	**1,315,715.00**
Contingency (40%)				**$**	**526,286.00**
Subtotal of Construction Costs				**$**	**1,842,001.00**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**736,800.40**
Estimated Total Project Cost				**$**	**2,579,000.00**

Project: Talbot West Culvert Date: 05/05/23

April 2023 ENR CCI: 13230 By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 17,400.00	$ 17,400.00
2	Utility Relocation	1	LS	$ 25,000.00	$ 25,000.00
3	Re-investigation	1	LS	$ 5,400.00	$ 5,400.00
4	Traffic Regulation and Control	1	LS	$ 53,100.00	$ 53,100.00
5	Furnish and Install 48" Storm Drain Culvert	200	LF	$ 850.00	$ 170,000.00
6	Furnish and Install Catch Basins	4	EA	$ 6,400.00	$ 25,600.00
7	Furnish and Install Storm Drain Manholes	2	EA	$ 6,400.00	$ 12,800.00
8	Roadway Base Gravel (3" Type B)	134	CY	$ 80.00	$ 10,720.00
9	Rip-rap	40	CY	$ 80.00	$ 3,200.00
10	Roadway Pavement (2" Grading C and 3" Grading B)	73	TONS	$ 300.00	$ 21,900.00
11	Sidewalk Construction (Bituminous)	56	SY	$ 50.00	$ 2,777.50
12	Erosion and Sediment Control	1	LS	$ 6,700.00	$ 6,700.00
13	Permitting	1	LS	$ 10,000.00	$ 10,000.00
Construction Subtotal				**$**	**364,597.50**
Contingency (40%)				**$**	**145,839.00**
Subtotal of Construction Costs				**$**	**510,436.50**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**204,174.60**
Estimated Total Project Cost				**$**	**715,000.00**

Project: Summer&Maple Culvert Date: 05/05/23

April 2023 ENR CCI: 13230 By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 70,900.00	$ 70,900.00
2	Utility Relocation	1	LS	$ 25,000.00	$ 25,000.00
3	Re-investigation	1	LS	$ 5,400.00	$ 5,400.00
4	Traffic Regulation and Control	1	LS	$ 21,300.00	$ 21,300.00
5	Furnish and Install 54" Storm Drain Culvert	1,100	LF	$ 1,070.00	$ 1,177,000.00
6	Furnish and Install Catch Basins	8	EA	$ 6,400.00	$ 51,200.00
7	Furnish and Install Storm Drain Manholes	4	EA	$ 6,400.00	$ 25,600.00
8	Roadway Base Gravel (3" Type B)	267	CY	$ 80.00	$ 21,360.00
9	Rip-rap	40	CY	$ 80.00	$ 3,200.00
10	Roadway Pavement (2" Grading C and 3" Grading B)	145	TONS	$ 300.00	$ 43,500.00
11	Sidewalk Construction (Bituminous)	111	SY	$ 50.00	$ 5,555.00
12	Erosion and Sediment Control	1	LS	$ 27,600.00	$ 27,600.00
13	Permitting	1	LS	$ 10,000.00	$ 10,000.00
Construction Subtotal				**$**	**1,487,615.00**
Contingency (40%)				**$**	**595,046.00**
Subtotal of Construction Costs				**$**	**2,082,661.00**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**833,064.40**
Estimated Total Project Cost				**$**	**2,916,000.00**

Project: Knox Culvert
April 2023 ENR CCI: 13230

Date: 05/05/23
By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 58,700.00	$ 58,700.00
2	Utility Relocation	1	LS	$ 25,000.00	$ 25,000.00
3	Re-investigation	1	LS	$ 5,400.00	$ 5,400.00
4	Traffic Regulation and Control	1	LS	$ 53,100.00	$ 53,100.00
5	Furnish and Install 72" Storm Drain Culvert	600	LF	$ 1,600.00	$ 960,000.00
6	Furnish and Install Catch Basins	6	EA	$ 6,400.00	$ 38,400.00
7	Furnish and Install Storm Drain Manholes	3	EA	$ 6,400.00	$ 19,200.00
8	Roadway Base Gravel (3" Type B)	134	CY	$ 80.00	$ 10,720.00
9	Rip-rap	40	CY	$ 80.00	$ 3,200.00
10	Roadway Pavement (2" Grading C and 3" Grading B)	73	TONS	$ 300.00	$ 21,900.00
11	Sidewalk Construction (Bituminous)	56	SY	$ 50.00	$ 2,777.50
12	Erosion and Sediment Control	1	LS	$ 22,800.00	$ 22,800.00
13	Permitting	1	LS	$ 10,000.00	$ 10,000.00
Construction Subtotal				**$**	**1,231,197.50**
Contingency (40%)				**$**	**492,479.00**
Subtotal of Construction Costs				**$**	**1,723,676.50**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**689,470.60**
Estimated Total Project Cost				**$**	**2,413,000.00**

Project: Grace Street Culvert Date: 05/05/23

April 2023 ENR CCI: 13230 By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 9,400.00	$ 9,400.00
2	Utility Relocation	1	LS	$ 25,000.00	$ 25,000.00
3	Re-investigation	1	LS	$ 5,400.00	$ 5,400.00
4	Traffic Regulation and Control	1	LS	$ 53,100.00	$ 53,100.00
5	Furnish and Install Box Culvert 32" x 40"	50	LF	$ 1,070.00	$ 53,500.00
6	Furnish and Install Catch Basins	2	EA	$ 6,400.00	$ 12,800.00
7	Furnish and Install Storm Drain Manholes	1	EA	$ 6,400.00	$ 6,400.00
8	Roadway Base Gravel (3" Type B)	12	CY	$ 80.00	$ 960.00
9	Rip-rap	40	CY	$ 80.00	$ 3,200.00
10	Roadway Pavement (2" Grading C and 3" Grading B)	37	TONS	$ 300.00	$ 11,100.00
11	Sidewalk Construction (Bituminous)	28	SY	$ 50.00	$ 1,388.75
12	Erosion and Sediment Control	1	LS	$ 3,500.00	$ 3,500.00
13	Permitting	1	LS	$ 10,000.00	$ 10,000.00
Construction Subtotal				**$**	**195,748.75**
Contingency (40%)				**$**	**78,299.50**
Subtotal of Construction Costs				**$**	**274,048.25**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**109,619.30**
Estimated Total Project Cost				**$**	**384,000.00**

Project: Crescent Street Outfall Separation Project
Combined Area 7.5 Acres
April 2023 ENR CCI: 13230

Date: 05/04/23
By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 36,100.00	$ 36,100.00
2	Utility Relocation	1	LS	$ 50,000.00	$ 50,000.00
3	Re-investigation	1	LS	$ 5,400.00	$ 5,400.00
4	Traffic Regulation and Control	1	LS	$ 21,300.00	$ 21,300.00
5	Furnish and Install Storm Drain Pipe	1,275	LF	$ 320.00	$ 408,000.00
6	Furnish and Install Catch Basins	8	EA	$ 6,400.00	$ 51,200.00
7	Furnish and Install Storm Drain Manholes	4	EA	$ 6,400.00	$ 25,600.00
8	Roadway Base Gravel (3" Type B)	440	CY	$ 80.00	$ 35,200.00
9	Roadway Pavement (2" Grading C and 3" Grading B)	200	TONS	$ 300.00	$ 60,000.00
10	Sidewalk Construction (Bituminous)	800	SY	$ 50.00	$ 40,000.00
11	Erosion and Sediment Control	1	LS	$ 14,000.00	$ 14,000.00
12	Permitting	1	LS	$ 10,000.00	$ 10,000.00
Construction Subtotal				**$**	**756,800.00**
Contingency (40%)				**$**	**302,720.00**
Subtotal of Construction Costs				**$**	**1,059,520.00**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**423,808.00**
Estimated Total Project Cost				**$**	**1,483,000.00**

Project: Front Street Outfall Separation Project
Combined Area 60.0 Acres
April 2023 ENR CCI: 13230

Date: 05/04/23
By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 172,000.00	$ 172,000.00
2	Utility Relocation	1	LS	$ 50,000.00	$ 50,000.00
3	Re-investigation	1	LS	$ 5,400.00	$ 5,400.00
4	Traffic Regulation and Control	1	LS	$ 21,300.00	$ 21,300.00
5	Furnish and Install Storm Drain Pipe - Lateral	300	LF	$ 200.00	$ 60,000.00
6	Furnish and Install Storm Drain Pipe	5,900	LF	$ 380.00	$ 2,242,000.00
7	Furnish and Install Catch Basins	51	EA	$ 6,400.00	$ 326,400.00
8	Furnish and Install Storm Drain Manholes	21	EA	$ 7,900.00	$ 165,900.00
9	Roadway Base Gravel (3" Type B)	2,060	CY	$ 80.00	$ 164,800.00
10	Roadway Pavement (2" Grading C and 3" Grading B)	910	TONS	$ 300.00	$ 273,000.00
11	Sidewalk Construction (Bituminous)	800	SY	$ 50.00	$ 40,000.00
12	Erosion and Sediment Control	1	LS	$ 67,000.00	$ 67,000.00
13	Permitting	1	LS	$ 10,000.00	$ 10,000.00
Construction Subtotal				**$**	**3,597,800.00**
Contingency (40%)				**$**	**1,439,120.00**
Subtotal of Construction Costs				**$**	**5,036,920.00**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**2,014,768.00**
Estimated Total Project Cost				**$**	**7,052,000.00**

Project: Winter Street Outfall Separation Project
Combined Area 7.0 Acres
April 2023 ENR CCI: 13230

Date: 05/04/23
By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 46,500.00	$ 46,500.00
2	Utility Relocation	1	LS	$ 50,000.00	$ 50,000.00
3	Re-investigation	1	LS	$ 8,500.00	$ 8,500.00
4	Traffic Regulation and Control	1	LS	$ 42,500.00	$ 42,500.00
5	Furnish and Install Storm Drain Pipe	1,500	LF	$ 340.00	$ 510,000.00
6	Furnish and Install Catch Basins	17	EA	$ 6,400.00	$ 108,800.00
7	Furnish and Install Storm Drain Manholes	5	EA	$ 6,400.00	$ 32,000.00
8	Roadway Base Gravel (3" Type B)	510	CY	$ 80.00	$ 40,800.00
9	Roadway Pavement (2" Grading C and 3" Grading B)	230	TONS	$ 300.00	$ 69,000.00
10	Sidewalk Construction (Bituminous)	800	SY	$ 50.00	$ 40,000.00
11	Erosion and Sediment Control	1	LS	$ 18,100.00	$ 18,100.00
12	Permitting	1	LS	$ 10,000.00	$ 10,000.00
Construction Subtotal				**$**	**976,200.00**
Contingency (40%)				**$**	**390,480.00**
Subtotal of Construction Costs				**$**	**1,366,680.00**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**546,672.00**
Estimated Total Project Cost				**$**	**1,913,000.00**

Project: Winter Street Outfall Redirection
Combined Area 7.0 Acres
April 2023 ENR CCI: 13230

Date: 05/04/23
By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 24,800.00	$ 24,800.00
2	Utility Relocation	1	LS	$ 20,000.00	$ 20,000.00
3	Traffic Regulation and Control	1	LS	$ 20,000.00	$ 20,000.00
4	Furnish and Install Storm Drain Pipe	730	LF	$ 340.00	$ 248,200.00
5	Furnish and Install Catch Basins	10	EA	$ 6,400.00	$ 64,000.00
6	Furnish and Install Storm Drain Manholes	5	EA	$ 6,400.00	$ 32,000.00
7	Roadway Base Gravel (3" Type B)	175	CY	$ 80.00	$ 14,000.00
8	Roadway Pavement (2" Grading C and 3" Grading B)	200	TONS	$ 300.00	$ 60,000.00
9	Sidewalk Construction (Bituminous)	235	SY	$ 50.00	$ 11,750.00
10	Erosion and Sediment Control	1	LS	$ 15,000.00	$ 15,000.00
11	Permitting	1	LS	$ 10,000.00	$ 10,000.00
Construction Subtotal				**$**	**519,750.00**
Contingency (40%)				**$**	**207,900.00**
Subtotal of Construction Costs				**$**	**727,650.00**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**291,060.00**
Estimated Total Project Cost				**$**	**1,019,000.00**

Project: Talbot Avenue to Rankin Street Flood Control
Combined Area N/A Acres
April 2023 ENR CCI: 13230

Date: 05/04/23
By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 50,000.00	$ 50,000.00
2	Traffic Regulation and Control	1	LS	$ 10,000.00	$ 10,000.00
3	Flood Control Structure	1	LS	$ 500,000.00	$ 500,000.00
4	Erosion and Sediment Control	1	LS	$ 25,000.00	$ 25,000.00
5	Permitting, Legal, Property Acqusition	1	LS	$ 200,000.00	$ 200,000.00
Construction Subtotal				**$**	**785,000.00**
Contingency (40%)				**$**	**314,000.00**
Subtotal of Construction Costs				**$**	**1,099,000.00**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**439,600.00**
Estimated Total Project Cost				**$**	**1,540,000.00**

Project: Gay Street to Broadway Flood Control Structure
Combined Area N/A Acres
April 2023 ENR CCI: 13230

Date: 05/04/23
By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 50,000.00	$ 50,000.00
2	Traffic Regulation and Control	1	LS	$ 10,000.00	$ 10,000.00
3	Flood Control Structure	1	LS	$ 450,000.00	$ 450,000.00
4	Erosion and Sediment Control	1	LS	$ 25,000.00	$ 25,000.00
5	Permitting, Legal, Property Acqusition	1	LS	$ 175,000.00	$ 175,000.00
Construction Subtotal				**$**	**710,000.00**
Contingency (40%)				**$**	**284,000.00**
Subtotal of Construction Costs				**$**	**994,000.00**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**397,600.00**
Estimated Total Project Cost				**$**	**1,392,000.00**

Project: Harbor Park Green Infrastructure Project
Combined Area N/A Acres
April 2023 ENR CCI: 13230

Date: 05/04/23
By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 10,000.00	$ 10,000.00
2	Utility Relocation	1	LS	$ 5,000.00	$ 5,000.00
3	Traffic Regulation and Control	1	LS	$ 5,000.00	$ 5,000.00
4	Roadway Base Gravel (3" Type B)	40	CY	$ 80.00	$ 3,200.00
5	Roadway Pavement (2" Grading C and 3" Grading B)	25	TONS	$ 300.00	$ 7,500.00
6	Swirl Concentrator	1	EA	$ 31,850.00	$ 31,850.00
7	Erosion and Sediment Control	1	LS	$ 5,310.00	$ 5,310.00
8	Permitting	1	LS	$ 5,310.00	$ 5,310.00
Construction Subtotal				**$**	**73,170.00**
Contingency (40%)				**$**	**29,268.00**
Subtotal of Construction Costs				**$**	**102,438.00**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**40,975.20**
Estimated Total Project Cost				**$**	**143,000.00**

Project: Snow Marine Park Green Infrastructure Project
Combined Area N/A Acres
April 2023 ENR CCI: 13230

Date: 05/04/23
By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 10,000.00	$ 10,000.00
2	Utility Relocation	1	LS	$ 5,000.00	$ 5,000.00
3	Traffic Regulation and Control	1	LS	$ 2,500.00	$ 2,500.00
4	Vegetated Bio-Retention Area	2,500	SF	$ 38.00	$ 95,000.00
5	Erosion and Sediment Control	1	LS	$ 5,000.00	$ 5,000.00
6	Permitting	1	LS	$ 5,000.00	$ 5,000.00
Construction Subtotal				**$**	**122,500.00**
Contingency (40%)				**$**	**49,000.00**
Subtotal of Construction Costs				**$**	**171,500.00**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**68,600.00**
Estimated Total Project Cost				**$**	**240,000.00**

Project: Samoset Road/Marie Reed Park Green
Combined Area N/A Acres
April 2023 ENR CCI: 13230

Date: 05/04/23
By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 10,000.00	$ 10,000.00
2	Utility Relocation	1	LS	$ 5,000.00	$ 5,000.00
3	Traffic Regulation and Control	1	LS	$ 5,000.00	$ 5,000.00
4	Vegetated Bio-Retention Area	1,000	SF	$ 38.00	$ 38,000.00
5	Erosion and Sediment Control	1	LS	$ 5,000.00	$ 5,000.00
6	Permitting	1	LS	$ 5,000.00	$ 5,000.00
Construction Subtotal				**$**	**68,000.00**
Contingency (40%)				**$**	**27,200.00**
Subtotal of Construction Costs				**$**	**95,200.00**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**38,080.00**
Estimated Total Project Cost				**$**	**133,000.00**

Project: Oak Street / Orient Street Parking Lot Green Infrastructure Project
Combined Area N/A Acres
April 2023 ENR CCI: 13230

Date: 05/04/23
By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 22,500.00	$ 22,500.00
2	Utility Relocation	1	LS	$ 5,000.00	$ 5,000.00
3	Traffic Regulation and Control	1	LS	$ 10,700.00	$ 10,700.00
4	Roadway Base Gravel (3" Type B)	40	CY	$ 80.00	$ 3,200.00
5	Roadway Pavement (2" Grading C and 3" Grading B)	25	TONS	$ 300.00	$ 7,500.00
6	Sidewalk Construction (Bituminous)	200	SY	$ 50.00	$ 10,000.00
7	Tree Box Filter	10	EA	$ 21,300.00	$ 213,000.00
8	Pervious Asphalt	6,200	SF	$ 30.00	$ 186,000.00
9	Erosion and Sediment Control	1	LS	$ 9,300.00	$ 9,300.00
10	Permitting	1	LS	$ 5,000.00	$ 5,000.00
Construction Subtotal				**$**	**472,200.00**
Contingency (40%)				**$**	**188,880.00**
Subtotal of Construction Costs				**$**	**661,080.00**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**264,432.00**
Estimated Total Project Cost				**$**	**926,000.00**

Project: Johnson Memorial Park Green Infrastructure Project
Combined Area N/A Acres
April 2023 ENR CCI: 13230

Date: 05/04/23
By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 10,000.00	$ 10,000.00
2	Utility Relocation	1	LS	$ 5,000.00	$ 5,000.00
3	Traffic Regulation and Control	1	LS	$ 5,000.00	$ 5,000.00
4	Roadway Base Gravel (3" Type B)	40	CY	$ 80.00	$ 3,200.00
5	Roadway Pavement (2" Grading C and 3" Grading B)	25	TONS	$ 300.00	$ 7,500.00
6	Vegetated Bio-Retention Area	1,900	SF	$ 40.00	$ 76,000.00
7	Bio-Swale	170	LF	$ 50.00	$ 8,500.00
8	Erosion and Sediment Control	1	LS	$ 5,000.00	$ 5,000.00
9	Permitting	1	LS	$ 5,000.00	$ 5,000.00
Construction Subtotal				**$**	**125,200.00**
Contingency (40%)				**$**	**50,080.00**
Subtotal of Construction Costs				**$**	**175,280.00**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**70,112.00**
Estimated Total Project Cost				**$**	**245,000.00**

Project: Ralph Ulmer Square Green Infrastructure Project
Combined Area N/A Acres
April 2023 ENR CCI: 13230

Date: 05/04/23
By: ABL/SLG

	Item	Qty.	UNIT	2023 UNIT AMT	AMOUNT
1	Mobilization and Demobilization	1	LS	$ 3,800.00	$ 3,800.00
2	Utility Relocation	1	LS	$ 10,000.00	$ 10,000.00
3	Traffic Regulation and Control	1	LS	$ 1,700.00	$ 1,700.00
4	Roadway Base Gravel (3" Type B)	40	CY	$ 80.00	$ 3,200.00
5	Roadway Pavement (2" Grading C and 3" Grading B)	25	TONS	$ 300.00	$ 7,500.00
6	Sidewalk Construction (Bituminous)	60	SY	$ 50.00	$ 3,000.00
7	Vegetated Bio-Retention Area	1,000	SF	$ 40.00	$ 40,000.00
8	Erosion and Sediment Control	1	LS	$ 5,000.00	$ 5,000.00
9	Permitting	1	LS	$ 5,000.00	$ 5,000.00
Construction Subtotal				**$**	**79,200.00**
Contingency (40%)				**$**	**31,680.00**
Subtotal of Construction Costs				**$**	**110,880.00**
Engineering Design, Construction Administration and Inspection (40%)				**$**	**44,352.00**
Estimated Total Project Cost				**$**	**155,000.00**

Appendix G
Project Ranking Matrix

Project Number		1	2	3	4	5	6	7	8	9	10	11
Project Name		**Crescent Street Outfall Separation Project**	**Front Street Outfall Separation Project**	**Winter Street Outfall Separation Project**	**Oak Street / Orient Street Parking Lot Green Infrastructure Project**	**Ralph Ulmer Square Green Infrastructure Project**	**Harbor Park Green Infrastructure Project**	**Winter Street Outfall Redirection Project**	**Talbot to Rankin Flood Control Structure**	**Johnson Memorial Park Green Infrastructure**	**Gay Street to Broadway Flood Control Structure**	**Snow Marine Park Green Infrastructure**
Project Description		The Crescent Street Outfall Separation Project provides separation of catch basins in the Scott Street drainage basin, tributary to the Crescent Street outfall. The project would separate approximately 7.5 acres of stormwater drainage area from the combined sewer system.	The Front Street Outfall separation project provides separation of catch basins in the Front Street drainage basin. The project would separate approximately 60 acres of stormwater drainage area from the combined sewer system. This includes the upgrade or replacement of the entire Front Street Outfall, as the existing outfall was determined to be undersized.	The Winter Street Outfall Separation Project provides separation of catch basins in the Oak/Orient Street and Museum Street area. The separation project would direct flows to the Winter Street storm drain and outfall into the WWTF ocean outfall. The project would separate approximately 7.0 acres of stormwater drainage area from the combined sewer system.	The Oak/Orient Parking Lot Green Infrastructure Project will provide stormwater quality improvements and peak flow reduction via the introduction of porous pavement, as a substitute for the portions of the existing bituminous asphalt surface of the lot. Further improvements such as tree boxes will be introduced where appropriate.	The Ralph Ulmer Square Green Infrastructure Project will provide stormwater quality improvements, peak flow reduction, and stormwater detention via a vegetated bio-retention facility.	The Harbor Park Green Infrastructure Project provides stormwater quality improvements via a proposed stormwater treatment device. It is to be installed underneath the existing grassed surface in the vicinity of the parking lot, to maintain open grassed space for community events.	The Winter Street Outfall Redirection Project will redirect flows from the existing Winter Street storm drain and remove from the PCF outfall pipe, ultimately constructing its own dedicated storm drain outfall approximately 725-feet away near Buoy Park.	The Talbot Avenue to Rankin Street Flood Control Structure Project will provide storage and peak flow attenuation during heavy rainfall events, lessening downstream impacts by up to 35% for a 10-year, 24-hour event and 17% for a 25-year, 24-hour event. It is important to note that this project could require significant land acquisition costs, which has been included in the estimate but is generally an unknown and can vary significantly.	The Johnson Memorial Park Green Infrastructure Project will provide stormwater quality improvements, peak flow reduction, and stormwater detention via a vegetated bio-retention facility and a vegetated bio-swale.	The Rankin Street to Gay Street Flood Control Structure Project will provide storage and peak flow attenuation during heavy rainfall events, lessening downstream impacts by up to 23% for a 10-year, 24-hour event and 7% for a 25-year, 24-hour event. It is important to note that this project could require significant land acquisition costs, which has been included in the estimate but is generally an unknown and can vary significantly.	The Snow Marine Park Green Infrastructure Project provides stormwater quality improvements and stormwater detention via a vegetated bio-retention facility, to be installed in the grassed island area in the parking lot.
Project Type		Sewer Separation	Sewer Separation	Sewer Separation	Green Infrastructure	Green Infrastructure	Green Infrastructure	Sewer Separation	In-Stream Flood Control	Green Infrastructure	In-Stream Flood Control	Green Infrastructure
# Parcels Benefited		30	82	32	15	2	1	32	8	1	9	1
Amount of Benefit per Parcel		Low	Low	Low	Low	Medium	High	Medium	High	High	High	High
Amount of Benefit per Parcel Adjuster		0.5	0.5	0.5	0.5	0.75	1	0.75	1	1	1	1
Adjusted # Parcels Benefited		15	41	16	7.5	1.5	1	24	8	1	9	1
Project Cost		$ 1,483,000.00	$ 7,052,000.00	$ 1,913,000.00	$ 926,000.00	$ 155,000.00	$ 143,000.00	$ 1,019,000.00	$ 1,540,000.00	$ 245,000.00	$ 1,392,000.00	$ 240,000.00
Category	Category Weight[2]											
Parcels Benefited / Cost Score	4	4	2	3	3	4	3	5	2	2	2	2
Grant Funding Probability	5	4	4	4	2	2	2	4	1	2	1	2
Environmental Impacts	3	4	5	4	4	3	3	3	2	4	2	4
Property Short-Term Impacts	1	3	2	2	3	4	4	3	2	4	2	4
Property Long-Term Impacts	3	5	5	5	5	5	5	5	2	5	2	5
Flow Increase to Lindsey Brook	4	5	5	5	5	5	5	5	4	5	4	5
Risk to Public Infrastructure	4	3	3	3	3	2	2	3	2	2	2	3
PCF Flow Reduction	3	5	5	5	4	3	3	5	5	3	5	5
Hydraulic Performance	4	3	3	3	3	2	2	4	2	3	2	3
Parcels Benefited	5	3	4	3	3	2	2	3	4	2	3	2
City CIP Project Overlap	4	5	2	4	3	4	2	3	4	2	2	3
Permitting	1	5	5	5	5	5	5	3	1	5	1	5
O&M Requirements	3	4	4	4	1	2	2	4	2	2	2	3
Constructability	4	3	3	2	4	3	4	3	2	4	2	4
Alternative Score		60	67	60	57	52	56	50	51	63	46	67
Weighted Alternative Score		189	176	176	159	148	140	184	125	143	112	160
Ranking Results												

1. Project scoring system as follows: 1 = Very Poor; 2 = Poor; 3 = Neutral; 4 = Good; 5 = Excellent.
2. Category weight based on feedback from City staff as follows: 1 = Very Insignificant; 2 = Insignificant; 3 = Neutral; 4 = Important; 5 = Very Important.

12	13	14	15	16	17	18	19	20	21	22	23
Samoset Road/Marie Reed Park Green Infrastructure Project	**School Street Separation Project**	**Center Street Separation Project**	**Maverick/Washington Street Storm Drain Re-Route Project**	**Lawn Avenue East Culvert Replacement Project**	**Broadway Culvert Replacement Project**	**Willow Street Culvert Replacement Project**	**Granite-Grove Street Culvert Replacement Project**	**Talbot Avenue West Culvert Replacement Project**	**Summer-Maple Street Culvert Replacement Project**	**Knox Culvert Replacement Project**	**Grace Street Culvert Replacement Project**
The Samoset Road / Marie Reed Park Green Infrastructure Project provides stormwater quality improvements and stormwater detention via a vegetated bio-retention facility, to be installed at the end of Samoset Road at the entrance to Marie Reed Park.	The School Street Separation Project provides drainage and stormwater quality improvements by re-routing existing combined catch basins on School Street into a new, separated storm drain system.	The Center Street Separation Project provides drainage and stormwater quality improvements by re-routing existing combined catch basins on Center Street into a new, separated storm drain system.	The Maverick/Washington Street Storm Drain Re-Route Project will provide greater level of service and reduce flooding in the storm drain system tributary to eastern Maverick Street and Washington Street via a proposed storm drain system on lower Maverick Street.	The Lawn Avenue East Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook, by as much as 100% flooding reduction for a 10-year, 24-hour event.	The Broadway Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook.	The Willow Street East Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook.	The Granite-Grove Street Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook.	The Talbot Avenue West Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook.	The Summer/Beech Street Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook.	The Knox Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook.	The Grace Street Culvert Replacement project will address existing maintenance and capacity issues in Lindsey Brook, lessening the frequency and severity of flooding along Lindsey Brook.
Green Infrastructure	Sewer Separation	Sewer Separation	Sewer Separation	Culvert Replacement	Culvert Replacement	Culvert Replacement	Culvert Replacement	Culvert Replacement	Culvert Replacement	Culvert Replacement	Culvert Replacement
1	10	12	24	7	2	5	26	8	10	38	4
High	Low	Medium	Medium	Medium	Medium	High	High	High	High	Medium	Medium
1	0.5	0.75	0.75	0.75	0.75	1	1	1	1	0.75	0.75
1	5	9	18	5.25	1.5	5	26	8	10	28.5	3
$ 133,000.00	$ 1,300,000.00	$ 220,000.00	$ 1,669,000.00	$ 303,000.00	$ 680,000.00	$ 340,000.00	$ 2,579,000.00	$ 715,000.00	$ 2,916,000.00	$ 2,413,000.00	$ 384,000.00
Alternative Score (1 - 5)[1]											
3	1	5	4	5	1	5	4	4	1	5	3
3	4	4	4	3	3	3	3	3	3	3	3
4	4	4	3	3	3	3	3	3	3	3	3
4	2	2	2	4	4	3	1	2	2	1	3
5	5	5	4	5	5	5	5	5	5	5	5
5	3	1	5	2	2	2	2	2	2	2	2
4	3	3	3	3	4	5	5	5	5	5	2
5	5	5	2	5	5	5	5	5	5	5	5
3	5	5	5	5	5	5	5	5	5	5	5
2	3	3	4	3	2	3	5	5	4	5	3
1	2	3	1	3	4	2	2	2	3	2	2
5	5	3	4	4	4	4	4	4	4	4	4
3	4	4	5	5	5	5	5	5	5	5	5
4	3	4	4	4	4	4	4	4	4	4	4
62	69	47	53	52	73	53	58	56	72	54	59
165	164	178	176	180	167	183	187	188	175	191	163

Appendix H
Grant Funding Table

Grant	Due Date	Maximum Award	Match Requirement	Allowable Expenditures	Facilitated By	Applicable Projects
Municipal Stream Crossing Upgrade Grant Program	*Fall 2023	$150,000	No minimum match; grants cannot fund 100% of any project	• Design • Construction	Maine Department of Environmental Protection (DEP)	• School Drive culvert(s) • Lawn Avenue culvert(s) • Broadway culvert(s) • Gay Street culvert • Rankin Street culvert(s) • Willow Street culvert • Granite – Grove Street culvert • Talbot Avenue (west) culvert • Summer – Beech Street culvert • Knox Center culvert • Franklin Street culvert • Grace Street culvert

Clean Water State Revolving Fund Loan (CWSRF)	Loan applications are open enrollment with no specific deadline. Applications for loans with additional subsidy are expected to be due in Spring 2023.	No maximum	No match	• Design
				• Construction
					U.S. Environmental Protection Agency (EPA)	• CSO mitigation
						  ○ Crescent Street Outfall Separation
						  ○ Front Street Outfall Separation
						  ○ Winter Street Outfall Separation
						  ○ Winter Street Outfall Redirection
						• Green Infrastructure/nonpoint source pollution abatement projects:
						  ○ Harbor Park Green Infrastructure
						  ○ Snow Marine Park Green Infrastructure
						  ○ Samoset Road/Marie Reed Park Green Infrastructure
						  ○ Oak Street/Orient Street Parking Lot Green Infrastructure
						  ○ Johnson Memorial Park Green Infrastructure
						  ○ Ralph Ulmer Square Green Infrastructure

Water & Waste Disposal Loan and Grant Program	Open enrollment	No maximum	No match for loans	• Design • Construction	U.S. Department of Agriculture (USDA) Rural Development (RD)	• Sewer collection, transmission, treatment, and disposal ○ Crescent Street Outfall Separation

Grant	Due Date	Maximum Award	Match Requirement	Allowable Expenditures	Facilitated By	Applicable Projects
						○ Front Street Outfall Separation ○ Winter Street Outfall Separation ○ Winter Street Outfall Redirection • Storm water collection, transmission, and disposal ○ Talbot to Rankin Flood Control Structure ○ Rankin Street to Gay Street Flood Control Structure ○ Various Lindsey Brook Culvert Projects ○ Various Linsey Brook Restoration Projects
Maine Infrastructure Adaptation Fund (MIAF) Grant	Spring 2023	$10,000 for project scoping $75,000 for project design $4M for project implementation	5%	• Project scoping • Design • Construction	Maine Department of Transportation (DOT)	• Sewer collection, transmission, treatment, and disposal ○ *Crescent Street Outfall Separation ○ Front Street Outfall Separation ○ Winter Street Outfall Separation ○ Winter Street Outfall Redirection • Storm water collection, transmission, and disposal ○ Talbot to Rankin Flood Control Structure ○ Rankin Street to Gay Street Flood Control Structure ○ Various Lindsey Brook Culvert Projects ○ Various Linsey Brook Restoration Projects
National Culvert Removal, Replacement, and Restoration Grants	February 6, 2023	$2,000,000	20%	• Construction	U.S. Department of Transportation (DOT) Federal Highway Administration	• Meadow Brook watershed

Grant	Due Date	Maximum Award	Match Requirement	Allowable Expenditures	Facilitated By	Applicable Projects
Hazard Mitigation Grant Program (HMGP)	Application deadlines vary; must submit within 12-months of a presidential Major Disaster Declaration	No maximum	25%	• Construction	Maine Emergency Management Agency (MEMA)	• Talbot to Rankin Flood Control Structure • Rankin Street to Gay Street Flood Control Structure • Various Lindsey Brook Culvert Projects • Various Lindsey Brook Restoration Projects
Flood Mitigation Assistance (FMA)	January 27, 2023	• $25,000 for local multi-hazard mitigation planning • $50,000 for Technical Assistance to states • $900,000 for Project Scoping • $300,000 for Additional C&CB Activities	25% for community flood mitigation projects	• Project scoping • Community Flood Mitigation Projects • Flood Hazard Mitigation Planning • Individual Flood Mitigation Projects	U.S. Federal Emergency Management Agency (FEMA)	• Talbot to Rankin Flood Control Structure • Rankin Street to Gay Street Flood Control Structure • Various Lindsey Brook Culvert Projects • Various Lindsey Brook Restoration Projects
Building Resilient Infrastructure and Communities (BRIC)	January 27, 2023	$1M	25%	• Project scoping • Construction	U.S. Federal Emergency Management Agency (FEMA)	• Talbot to Rankin Flood Control Structure • Rankin Street to Gay Street Flood Control Structure • Various Lindsey Brook Culvert Projects • Various Linsey Brook Restoration Projects

Grant	Due Date	Maximum Award	Match Requirement	Allowable Expenditures	Facilitated By	Applicable Projects

Economic & Infrastructure Development Investment Program	Letters of Notification to Apply due Spring 2023
	
	Full Applications due Summer 2023
		$350,000 or $1M depending on the project	20%	• Construction	Northern Border Regional Commission (NBRC)	• Sewer collection, transmission, treatment, and disposal
						  ○ *Crescent Street Outfall Separation
						  ○ Front Street Outfall Separation
						  ○ Winter Street Outfall Separation
						  ○ Winter Street Outfall Redirection

House Congressional Earmarks	Early 2023	No maximum	20%	• Design
				• Construction
					Varies (EPA, FEMA, etc.)	• Interior Subcommittee – eligible projects include:
						  ○ Crescent Street Outfall Separation
						  ○ Front Street Outfall Separation
						  ○ Winter Street Outfall Separation
						  ○ Winter Street Outfall Redirection
						• Homeland Security Subcommittee – eligible projects include:
						  ○ Talbot to Rankin Flood Control Structure
						  ○ Rankin Street to Gay Street Flood Control Structure
						  ○ Various Lindsey Brook Culvert Projects
						  ○ Various Linsey Brook Restoration Projects

Senate Congressional Earmarks	Early 2023	No maximum	20%	• Design
				• Construction
					Varies (EPA, FEMA, etc.)	• Interior Subcommittee – eligible projects include:
						  ○ Crescent Street Outfall Separation
						  ○ Front Street Outfall Separation
						  ○ Winter Street Outfall Separation
						  ○ Winter Street Outfall Redirection

Grant	Due Date	Maximum Award	Match Requirement	Allowable Expenditures	Facilitated By	Applicable Projects
						• Homeland Security Subcommittee – eligible projects include: o Talbot to Rankin Flood Control Structure o Rankin Street to Gay Street Flood Control Structure o Various Lindsey Brook Culvert Projects o Various Linsey Brook Restoration Projects

WRIGHT-PIERCE
Engineering a Better Environment

11 Bowdoin Mill Island, Suite 140
Topsham, ME 04086
207.725.8721 | wright-pierce.com