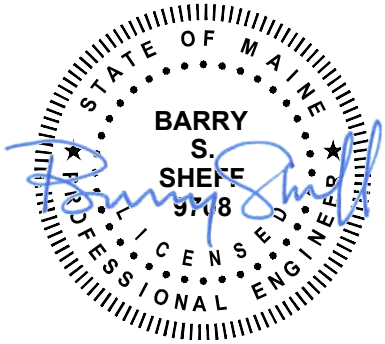
Curtis Road Pump Station Upgrade Alternatives

Business Case Study



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EXECUTIVE SUMMARY

The City of Portland Department of Public Works (DPW) owns and operates the Curtis Road Pump Station, a suction lift pump station which serves approximately 164 homes in the western portion of the City. The pump station is nearing the end of its useful service life. Woodard & Curran was retained to complete a business case study (hereinafter also referred to as BCS) to evaluate the financial, environmental, and social impacts associated with three upgrade options presented in the November 2013 Sewer CMOM Report, as well as the "do nothing" option.

A summarization of the BCS conclusions is provided below:

Table ES-1: Summary of Business Case Study Evaluation Results

Option Description	30-year Net Present Value[1]	Non-Cost Factors Evaluation[2]
Option 1 - Comprehensive Curtis Road PS Upgrades	$1,285,000	3 Advantageous 5 Neutral 0 Not Advantageous
Option 2 - Prioritized Curtis Road PS Upgrades	$1,209,000	2 Advantageous 6 Neutral 0 Not Advantageous
Option 3 - Eliminate Curtis Road PS & Upgrade Hope Avenue PS	$1,623,000	3 Advantageous 2 Neutral 3 Not Advantageous
Option 4 - Do Nothing / Defer Action	$1,297,000	0 Advantageous 3 Neutral 5 Not Advantageous

1 – Net Present Value calculates the overall cost of a project over a given timeframe and estimates the total value in present-year dollars. This includes an estimate of all capital, operating and any other costs.
2 – The non-cost factors are evaluated to account for project's environmental and social impacts which are not quantifiable in terms of financial impacts. These are described in additional detail in Sections 2 and 4.

Based on the results of this BCS, we recommend the City of Portland perform a comprehensive upgrade at the existing Curtis Road Pump Station. The opinion of capital cost estimate to complete the work in 2016 US Dollars is $638,000. The project should include the replacement of suction lift pumps with increased capacity to capture future high flow events and eliminate the existing overflow. The upgrade should also include the following:

- Discharge piping and valves supplied;
- An insulated fiberglass pump enclosure;
- A standby generator system housed in an integral enclosure;
- Abandon in-place the existing sanitary overflow structure; and
- Upgrades to the process controls & alarms

1. INTRODUCTION

1.1 PROJECT BACKGROUND

The City of Portland Department of Public Works (DPW) owns and operates the Curtis Road Pump Station (PS), a suction lift pump station which serves approximately 164 homes in the western portion of the City. The pump station is nearing the end of its useful service life. In 2013, Woodard & Curran (W&C) prepared a Capacity, Management, Operations & Maintenance (CMOM) report for the City which evaluated the condition of the majority of the City's wastewater collection system assets. The CMOM report identified the Curtis Road PS as a candidate for upgrades, due to the age and condition of critical equipment such as the pumps and standby generator.

The CMOM report evaluated three options for upgrades to the station: a comprehensive upgrade at the existing PS location; a targeted upgrade of specific high-risk components; and elimination of the pump station by re-routing flow to the site of the Hope Avenue Pump Station, where a larger station would be constructed. The CMOM report recommended elimination of the Curtis Road Pump Station based on an analysis that compared the overall project cost to the amount of risk reduction using the CMOM methodology for risk assessment, with consideration also given to staff desire to eliminate wastewater pump stations within the City's system where appropriate.

Due to the significant capital cost of the proposed project, the City sought to review the various options available for upgrades by performing a Business Case Study evaluation. This evaluation will review the project direct costs (capital and operations) as well as other risks and benefits associated with the options.

The alternatives evaluated in this business case study were identified by the City in its RFP dated May 16, 2016, and include:

1. Comprehensive Curtis Road PS Upgrades
2. High-Risk Curtis Road PS Asset Upgrades
3. Elimination of Curtis Road PS / Connection to a new, larger Hope Avenue Pump Station
4. Do Nothing / Defer Action

The business case study methodology attempts to define the categories of both financial and non-financial impacts of the different options for addressing the City's needs. This report is specific to the Curtis Road PS, however the methodology and categories that have been analyzed can be applied to the vast array of projects the City plans to undertake.

1.2 PROJECT DRIVERS

The driver for the overall project is to determine the best option to provide reliable wastewater collection service for the homes tributary to the Curtis Road and Hope Avenue pump stations. This report is a part of an overall process which began with the CMOM report and will continue through construction of the preferred alternative.

The Business Case Study evaluation will help the City define the most desirable option to continue to provide these services for the 30-year planning period. This evaluation will account for both direct costs as well as other considerations to recommend the option for implementation.

1.3 PROJECT OBJECTIVES

This report will review the options for upgrades to the Curtis Road pump station and evaluate the impacts over the 30-year planning period for the project. This report will present the benefits, costs and risks associated with each of the options and evaluate each option. Put simply, the goal of this evaluation is to define and describe the best alternative for upgrades at the Curtis Road Pump Station.

2. PROJECT EVALUATION METHODOLOGY

The City of Portland DPW's overall goal for this project is to aid the City's staff in the decision making process for potential upgrades at the Curtis Road Pump Station. In addition to a technical review of the various options, the DPW wishes to perform a Business Case Study evaluation of the various options for upgrades. We have identified the criteria which will be used in the BCS, broken down into Direct Costs, Environmental and Social Impacts, and Benefits. These criteria were developed using industry reference materials and were customized to the goals of the DPW based on discussions between W&C and the DPW. Independent of the Curtis Road project, these criteria can be used in the future to evaluate other DPW projects to provide consistency in the evaluation process. The descriptions below are more general in nature to allow their use on other project BCS evaluations. Discussion of these criteria specific to Curtis Road are included in Section 3 of this report.

2.1 DIRECT COSTS

The most straightforward and quantifiable cost associated with a project are the direct costs. Direct costs are specific expenses associated with a given option. Direct costs can be further broken down into capital costs and operation and maintenance (O&M) costs.

Capital costs are the total expense of a capital investment, and include the cost of labor, equipment, and materials. If the capital costs of a given option include a publicly bid construction project, then Contractor overhead & profit, bonds, and engineering services will also be included in the capital cost. Depending on the level of detail associated with a particular option, the capital cost will typically also include a contingency to account for unknown items. Capital costs for a given item will typically occur only once during a planning period, but for some items with shorter expected lives (e.g. PLC panels) they may occur more than once.

O&M costs are the annual expense of regular operation and maintenance of the option. This includes labor (typically DPW staff or contractor), utilities, and wearing parts (e.g. belts, lights, etc.). O&M costs will typically increase as an asset ages, as certain types of equipment will need to be replaced or undergo significant overhauls during the approximately 30-year life of a project. An example of this type of expense is the replacement of an impeller on a pump or the replacement of instruments, which are not expected to have a 30-year life.

Both capital costs and O&M costs should be quantified using standard cost estimating practices. Capital costs are typically estimated based on comparisons to other recent, similar projects. O&M costs can be estimated based on historical equipment and utility usage (if available), and labor costs based on estimates from DPW staff or projections.

The overall impact of capital and O&M costs can be summarized in a life cycle cost estimate for each option. A life cycle cost normalizes future capital and O&M costs to current day dollars based on estimated inflation and interest rates. Typically the option with the lowest life cycle cost would be most advantageous from a direct cost standpoint, however if one-time sources of funding are available (e.g. ARRA grant money), an option with a higher capital but lower O&M cost may be more desirable.

2.2 ENVIRONMENTAL AND SOCIAL IMPACTS

In addition to the direct costs, the different options will vary in how they impact the environment and society. BCS evaluations must consider the ways that the various options will impact the community at large, not just the direct costs. Some examples of these types of costs include:

- Impacts during construction on abutters, commuters, and/or businesses.
- Pollution/emissions caused by the project (air, noise, visual, etc.)

- Risk of spills/environmental impacts, and subsequent enforcement actions
- Public relations and impacts on the City's profile with residents and the general public

For instances where an environmental or social cost can be quantified (e.g. a specific fine for delayed action included in an existing consent order; quantifiable impacts on businesses impacted by a proposed option), these costs can be included in the life cycle cost of the option. More often, these costs are not quantifiable – it is difficult to estimate a direct cost associated with a resident expressing concerns about construction on their street. In these instances, based on discussion with the DPW, the various options can be rated as "advantageous", "not advantageous", or "neutral". This will allow these costs to be considered with the direct costs to allow an informed judgement of the total costs associated with a given option.

2.3 BENEFITS

Just as there can be intangible environmental and social costs associated with the various options, there can also be benefits from a project which are difficult to quantify. These can be evaluated and rated in a similar manner as the costs. Some examples of benefits which can be realized for various projects are:

- Impact on buildout/economic development: If a project will either trigger additional private development, or avoid a moratorium on connections this provides a benefit to the City. If specific developments can be identified, it is possible to include these in the life cycle cost analysis.
- Standardization: Typically there is an efficiency with standardizing similar assets such as pump stations to a single approach.

The BCS evaluation criteria listed above are intended to serve as a general guide. Specific projects may have costs or benefits which are unique to that particular project. For each individual project the BCS should attempt to identify any unique criteria and include these in the BCS evaluation process.

3. DESCRIPTION OF ALTERNATIVES

3.1 EXISTING CONDITIONS

The following is a brief description of the existing sanitary sewer system in the project area. This information was derived from a combination of City-provided record drawings, discussions with City staff, and evaluations contained in the 2013 CMOM report.

- Approximately 164 user services are connected in the Curtis Road wastewater collection area
    - Approximately 134 users are served solely by the Curtis Road Pump Station
        - 60 services exist between the Curtis Road Pump Station and the intersection of Alice Street and Hope Avenue. These services would be effected by a sewer replacement that reverses flow in the Alice Street Sewer (Option 3). This is discussed further below.
        - 45 services exist on the upstream side of the Alice Street and Hope Avenue intersection. These services would not be effected by a sewer replacement that reverses the flow in Alice Street sewer; and
        - 29 services flow to the Curtis Road Pump Station from the Southerly direction and the gravity sewer size would not be affected by reverse flow of the Alice Street sewer.
    - Approximately 33 users are served by the Hope Avenue Pump Station
- The Curtis Road Pump Station was built in the late 1970s and is approaching the end of its service life, and will be in need of an upgrade in the coming years. The Hope Avenue Pump Station is a newer station and has pumps, a generator and appurtenances which are generally in good condition.
- Hope Avenue Pump Station discharges to the gravity sewer in Alice Street at an elevation of approximately 91.4' and is then conveyed by gravity to the Curtis Road Pump Station. The force main is 4-inch ductile iron pipe and is approximately 570 linear feet.
- The Hope Avenue Pump Station wetwell influent sewer invert elevation is 69.7' and the bottom of wetwell elevation is 64.2'. The pump flowrates, determined from SCADA history drawdown calculations, are as follows:
    - Pump 1 =90 gpm;
    - Pump 2 = 80 gpm; and
    - Combined Pump 1 and Pump 2 = 148 gpm.
- The Alice Street sewer, between the intersection with Hope Lane and the Curtis Road Pump Station site is approximately 1,450 LF of 10-inch asbestos concrete laid at a slope of 0.005 feet / LF. The 80% capacity of this section of sewer is estimated to be 800 gpm, assuming Manning's roughness equal to 0.011. Based on information provided by the City staff, this sewer is generally in good condition. A NASSCO rating for this pipe was not available.
- The sewer pipe segment on Clapboard Road is approximately 200 LF of 8-inch asbestos concrete laid at a slope of 0.026 feet / LF. The existing invert at MH located at STA 0+27.5 is 90.7', which is immediately upstream of the Curtis Road Pump Station wetwell. Based on information provided by the City staff, this sewer is generally in good condition. A NASSCO rating for this pipe was not available.

- The Curtis Road Pump Station discharges to the Virginia Carpenter Interceptor near the Abby Lane intersection at elevation 126.6'. The force main exits the pump station as 6-inch ductile iron and increases to 8-inch ductile iron once outside the pump station footing. The force main is estimated to be approximately 940 linear feet. Based on discussions with City Staff, there is no history of force main breaks or other problems. No other conditions assessments have been performed on this force main.

- The Curtis Road Pump Station wetwell influent sewer invert elevation is 85.5' and the bottom of wetwell elevation is 76.0'. The pump flowrates, determined from SCADA history drawdown calculations, are as follows:

    - Pump 1 = 188 gpm;

    - Pump 2 = 165 gpm; and

    - Combined Pump 1 and Pump 2 = 315 gpm.

- The Virginia Carpenter Interceptor pipe size increases from 12-inch diameter to 18-inch diameter at the intersection of Abby Lane, at the sewer manhole where the Curtis Road Pump Station discharges. Assuming a Manning roughness of 0.011 for the asbestos concrete gravity pipes and slopes indicated on record drawings, then a 12-inch gravity pipe at slope of 0.003 feet / LF is estimated to have an 80% capacity of approximately 1,010 gpm and an 18-inch gravity pipe at slope of 0.002 feet / LF is estimated to have an 80% capacity of approximately 2,450 gpm. Based on information provided by the City staff, this sewer is generally in good condition. A NASSCO rating for this pipe was not available.

3.2 OPTION 1 - COMPREHENSIVE CURTIS ROAD PS UPGRADES

This alternative is the complete replacement of the equipment at the existing Curtis Road Pump Station. The pump station wetwell will remain as the only original equipment pump station asset.

This option will increase the pump flow rate capacity to an estimated maximum of 420 gpm to eliminate the existing sanitary sewer overflow from within the wetwell. The upgrades will include the disconnection of the overflow pipe and plugging and capping within the wetwell. The overflow structure will be demolished to a minimum of 18-inches below grade and sealed with flowable fill.

The replacement of the Alice Street sewer is not necessary in this option. However, the asset is aging (estimated install date of 1978) and the condition will likely need to be addressed during the 30-year analysis to maintain sewer service in the area. It is assumed the gravity sewer will require major investment when the asset age is 60 years. This occurs in 2038, which is Year 22 of this analysis. Based on information provided to us by the City, we understand that this section of gravity sewer is in generally good condition. Therefore we have assumed that the rehabilitation will be via CIPP lining rather than "dig and replace".

3.3 OPTION 2 - PRIORITIZED CURTIS ROAD PS UPGRADES

This alternative includes the prioritized replacement of assets that have been identified as the highest risk and failure could result in a sanitary sewer overflow. These high risk assets include both pumps, suction piping and valves, the emergency generator, and the equipment enclosure. The discharge piping and valves, local controls, alarms, and telemetry are not considered to be the highest risk, and thus would not be upgraded with this alternative. However they would likely require replacement during the 30-year study period.

This option will increase the pump flow rate capacity to eliminate the existing sanitary sewer overflow from within the wetwell. The upgrades will include the disconnection of the overflow pipe and plugging and capping within the wetwell. The overflow structure will be demolished to a minimum of 18-inches below grade and filled with flowable fill.

The replacement of the Alice Street sewer is not necessary in this option. However, the asset is aging (estimated install date of 1978) and the condition will likely need to be addressed during the 30-year analysis to maintain sewer service in the area. It is assumed the gravity sewer will require major investment when the asset age is 60 years. This occurs in 2038, which is Year 22 of this analysis. Based on information provided to us by the City, we understand that this section of gravity sewer is in generally good condition. Therefore we have assumed that the rehabilitation will be via CIPP lining rather than "dig and replace".

3.4 OPTION 3 - ELIMINATE CURTIS ROAD PS AND UPGRADE HOPE AVENUE PS

Option 3 includes the elimination of the Curtis Road Pump Station, which would be replaced by a new, larger Hope Avenue Pump Station. This requires modifications to the gravity sewer along Alice Street. The elimination of the Curtis Road Pump Station will include demolition and removal of the existing structures to , site restoration and preparation for a potential sale as a residential house lot.

The connection will require the construction of approximately 2,220 linear feet of gravity sewer to convey flows from the Curtis Road PS to the Hope Avenue PS site, at depths of up to 15-feet deep along Alice Street. Approximately 1,882 linear feet of 8-inch ductile iron force main will be installed in the gravity sewer trench at a higher elevation with minimal horizontal offset. The gravity and force main connections are further detailed in sections 3.4.1 and 3.4.2, respectively.

This option requires increasing the capacity of the Hope Avenue Pump Station to an estimated maximum flow of 420 gpm in order to accommodate the additional flow from the Curtis Road Pump Station. Upgrades at the Hope Avenue pump station will include the upgrade to a 3-phase electrical service entrance and sound attenuated and enclosed diesel standby power generator with 5 days of fuel storage. This option includes the installation of a new 10-foot diameter wetwell to accommodate the larger flows. The pump station is envisioned to be a duplex submersible pump station with an external valve pit with a portable pump connection and pigging station. The pump station controls and power panel will be of integral design, rated for outdoor conditions, and pad mounted. The power and control panel will meet NEC 70E requirements for safety and separation.

3.4.1 Gravity Sewer Upgrade

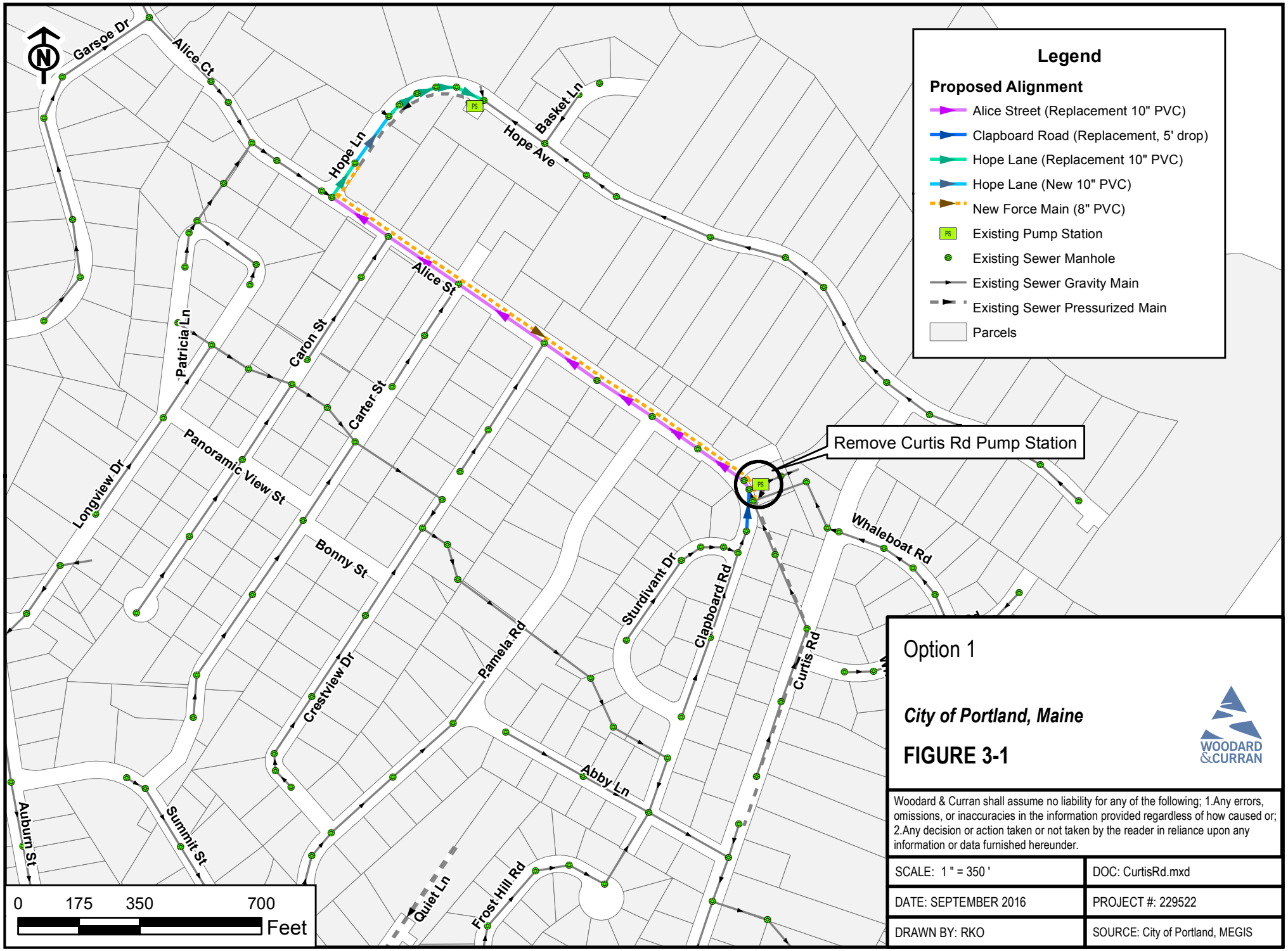
As described above, a gravity sewer extension is required to convey wastewater from the Curtis Road PS to Hope Ave. A summary of the proposed route of the new gravity sewer is included below. However, if this option is selected, additional alternatives could be evaluated during preliminary design of the project.

a. Replace approximately 1,450 LF of gravity sewer in Alice Street from the existing manhole near the Curtis Road PS to the intersection of Alice Street and Hope Lane. Assume 10-inch PVC gravity sewer is installed at minimum slope equal to 0.0026 feet /LF. Estimated 80% capacity equal to approximately 800 gpm

b. Replace approximately 200 LF of gravity sewer pipe on Clapboard Road with 8-inch PVC installed such that invert in at MH located at STA 0+27.5 is 93.00' (5 feet below existing grade). This effectively raises the Alice Street sanitary sewer invert at MH located at STA 0+27.5 by approximately 2.25' feet. The purpose of this is to reduce the depth of cut in Alice Street and to get the new sewer above the elevation of identified ledge

c. Assume 0.1 feet drop across manholes assumed to be spaced at a maximum of 300 feet separation;

Table 3-1 provides a summary of the gravity sewer replacement project. The proposed re-alignment of the gravity sewer and force main to accommodate this alternative is shown in Figure 3-1.



Option 1

City of Portland, Maine

FIGURE 3-1

WOODARD &CURRAN

Woodard & Curran shall assume no liability for any of the following; 1.Any errors, omissions, or inaccuracies in the information provided regardless of how caused or; 2.Any decision or action taken or not taken by the reader in reliance upon any information or data furnished hereunder.

SCALE: 1 " = 350 '	DOC: CurtisRd.mxd
DATE: SEPTEMBER 2016	PROJECT #: 229522
DRAWN BY: RKO	SOURCE: City of Portland, MEGIS

Table 3-1: Summary of Alice Street Sewer Modifications

Location ID	LF Above Existing Sewer	LF Below Existing Sewer	Avg Depth
Hope Ave (Existing Replacement)	300	0	11.5
Hope Ave (New Gravity Sewer)	0	150	11.5
Hope Ave at Alice Street (Existing Replacement)	0	120	11.5
Alice Street (CR PS to Hope Ave)	413	875	15
Alice Street (CR PS to Hope Ave)	160	0	10
Clapboard Road	202	0	7.5
Total	**2,220 LF**		--

3.4.2 Force Main Upgrade Alternatives

Diverting the area flow to the Hope Avenue Pump Station requires a new force main alignment, to convey flows from the Hope/Curtis area to the Virginia Carter Interceptor to be conveyed for treatment. We evaluated two options for this force main including a short route via Caron Street and a longer route which connects to the existing Curtis Road Pump Station force main. Only the option which connects to the existing force main was determined to be viable given the information available at the time we completed this BCS. For the benefit of this report and to memorialize our work, we describe each option here.

a. The shortest potential force main route from the upgraded Hope Ave pump station would be to connect to the Virginia Carpenter Interceptor at a point on Caron Street. The 80% capacity of the interceptor in this location is estimated to be 1,010 gpm. The pumped flow rate from the upgraded station is 420 gpm, approximately 40% of the available capacity. Due to the fact that flow monitoring has not been conducted on the interceptor in this location, we cannot ascertain if sufficient capacity exists to allow the new discharge in this location. Upgrading the size of the Interceptor in this location would present several challenges due to the alignment in right-of-ways through residential property. Due to these issues, most importantly the unknown available capacity, this option is not recommended. If flow monitoring is conducted in the future showing the availability of sufficient capacity in this area, this alternative could be revisited.

b. The alternative to the "short route" involves the installation of an 8-inch force main from the Hope Ave Pump Station to a point where it connects to the existing 8-inch force main which the existing Curtis Road Pump Station discharges to. The connection location does not require any changes to the Virginia Carpenter Interceptor, and discharges into the interceptor at a point where the Virginia Carpenter Interceptor has a higher capacity, due to increases in diameter and slope of the pipe relative to the location near Caron Street. The alignment is estimated to be 1,882 linear feet. The existing force main could be tested prior to or during construction to assess the condition of the pipe and it's approximate remaining service life.

3.5 OPTION 4 - DO NOTHING / DEFER ACTION

This alternative is to perform the minimum work to keep the collection system and pump station operational. This option provides the scenario for analysis whereby the City can run all of the assets to failure and does not proactively upgrade aging equipment and/or piping. No investments above or beyond routine maintenance and emergency repairs is conducted at the Curtis Road or Hope Avenue Pump Station in this option. No improvements to the collection system are conducted under this option.

4. BUSINESS CASE STUDY EVALUATION

As previously described in this BCS, three options for upgrades at the Curtis Road pump station have been identified, and are detailed in Section 3 of this report. Each of the three options will be evaluated based on the following criteria, as well as a fourth "do-nothing" option. It is important to note that the "do-nothing" option does not mean that the DPW can ignore all costs and responsibilities related to the pump station – the DPW must continue to operate the station and provide wastewater services to the residents. The "do-nothing" option may be better described as a "run to failure" option, where all equipment replacement costs are deferred until the point where the DPW has no choice but to replace the existing equipment in order to continue operation of the pump station.

The direct costs (financial), environmental, and social impacts, and benefits associated with the upgrade of the Curtis Road Pump Station are discussed in depth below for each option. A summary of the evaluation is provided in the following section and additional documentation for each alternative can be found in Appendixes:

- Appendix A: Opinion of Probable Cost Estimates
- Appendix B: Equipment Replacement Schedules
- Appendix C: Operation and Maintenance Cost Estimates
- Appendix D: 30-Year – Net Present Value Figures

4.1 DIRECT COSTS

For the purpose of this report, direct costs are broken down into Capital Expenses, Operating Expenses, Equipment Service/Replacements, and Revenue Opportunities. Each is further described herein, however each includes a number of assumptions for calculating net present value. The net present value calculation of the options annualizes the cash flow from year 0, considered calendar year 2016, through year 30, considered calendar year 2046.

The global assumptions that apply to all projects include the following:

- Net present value discount rate equal to 4.0%;
- Capital Expense annual escalation equal to 1.25%;
- Operating Expense annual escalation equal to 2.5%; and
- Revenue annual escalation equal to 1.0%.

A spreadsheet has been developed to separately identify the associated costs at the Curtis Road PS, Hope Avenue PS, and wastewater conveyance system. Each module has a financial analysis including four categories to quantify expenses and revenue categories as follows:

- Capital expense with project specific inputs including:
- Operating labor expenses
- Equipment replacement expenses;
- Revenue opportunity inputs, which include the land transfer revenue (sale price) of any parcels transferred to private ownership, and annual tax revenue in future years.

4.1.1 Capital Expenses

Project cost estimates include equipment, labor, and materials. Contractor overhead & profit, engineering services, and contingencies are added as percentages of the project cost, based on industry standard estimates. The cost estimates are largely based upon the estimates included in the 2013 CMOM report, and have been adjusted to 2016 dollars using the Engineering News Record (ENR) 20-city average construction cost index.

The cost of gravity sewer replacement in the project area is considered a planning level cost estimate suitable for the comparison of alternative solutions. Actual replacement costs require a design engineering effort to define actual bid tabulation and extent the project impacts infrastructure in the right of way and along the sewer alignment. The upgrade assumes the following is included in the project:

- Pipe alignment is assumed to be unchanged; removal of old pipe is incidental to the cost;
- 10 foot wide trench at road surface;
- Sewer services replaced with gravity sewer from trunk sewer to property line;
- It is assumed the asbestos concrete pipe will be abandoned in place at no additional cost to the project, per typical practice in the City of Portland;
- Sewer at a depth of 11.5' below grade with an invert above the existing sewer is estimated to cost $163/LF to replace, this is considered the base unit cost of sewer replacement;
    - Cost of sewer replacement adjusts based on the average depth factor referenced to 11.5' below grade. As an example, a sewer of 15 feet in average depth has a depth adjustment factor of 15.0 / 11.5 = 1.3. Therefore the cost of sewer replacement per linear foot is equal to $163 / LF * 1.3 = $211 / LF. The cost inclues the following:
        - Pavement Demolition
        - Pipe Bedding
        - Granular Borrow
        - Test Pit Excavation
        - Crushed Stone (Overdepth)
        - Earth Excavation (Overdepth)
        - 10-foot Trench Paving
        - Bituminous Curb replacement
        - Insert-A-Tee Pipe
        - White or Yellow Striping
        - Dust Control
        - Density Test
        - Traffic Flaggers
        - Erosion Control
    - Cost of sewer replacement below the existing sewer invert includes an additional $8.15 / LF (5 percent over the base cost) to account for unknown conditions and potential ledge in the project area.
- Sewer manholes are demolished and replaced at an average cost of $7,000 each; and
    - Manhole count is based on existing conditions and alternative project requirements;
    - New manholes are located in nearly the same location as existing; demo is incidental to the cost.
    - Manholes are 4-ft. in diameter;
    - No structural rock removal is anticipated; and

- The cost includes all appurtenances (barrel, cone, brick riser, frame and cover, etc.);

- Installation of force main where gravity sewer is being installed is assumed to be located in the same open trench at a cost of $20 / LF.

Woodard & Curran developed these unit costs based on actual installed project costs in Portland at the probable cost expressed in the 2013 CMOM Report. Contractor insurance, overhead and profit are included in these prices. A contingency of 20 percent, and an engineering cost of 25 percent were added to the project cost. The engineering cost includes permitting, design, bidding, and construction administration and oversight.

4.1.2 Operating Expenses

The operating expenses included in the financial analysis include the following:

- Pre and Post Project Annual O&M
    - Fully burdened labor rates, hourly based estimates
        - Labor for weekly check in
        - Labor for land maintenance (lawn mowing & snow removal)
        - Labor estimate to address alarm response
    - Annual lump sum based operating cost estimates:
        - Electricity expense;
        - Backup power fuel costs;
- Annual incidental Expenses covering:
    - Miscellaneous parts repair expenses; and
    - Consumable expenses.

4.1.3 Equipment Service/Replacement

Certain pieces of equipment require replacement or significant overhauls between larger overall upgrades at a pump station. We have estimated these costs by listing the major components of a pump station and identifying those which will likely require an investment or overhaul during the useful life of the item. Some examples of these types of expenses include replacing the impeller on a pump, overhauling a generator engine, replacement of process instruments and alarms, and re-paving of driveways.

4.1.4 Revenue Opportunities

The revenue opportunities for the Curtis Road / Hope Avenue Pump Stations area are seen as the following associated with the parcel. Pump Station revenue opportunities include:

- Land transfer revenue;
- Tax revenue; and
- Equipment salvage.

The area being residential in nature has minimum economic development potential beyond the possible addition of a single housing lot. It is assumed that, due to the area sewer existing, that all alternatives can support the housing development, therefore, the revenue opportunity from collection system modifications are equal to the existing system. Additional user fee revenue would be generated if the lot were developed, however the amount of revenue is not significant compared to the other project costs.

4.2 ENVIRONMENTAL AND SOCIAL IMPACTS

As discussed in Section 2, the options for upgrading the Curtis Road Pump Station will also be evaluated using non-cost factors. Given that there is a margin of error in cost estimating, especially over a 30-year study period, these non-cost factors can aid the City in the decision making process by giving the City another criterion to evaluate the upgrade options. For non-cost factors, each upgrade option will be ranked as either "Advantageous", "Neutral", or "Not Advantageous".

We have identified the following eight environmental and social impacts which will be used to evaluate the options presented for the Curtis Road Pump Station upgrades:

- **Regulatory Compliance:** Projects will be evaluated based on their impacts to the City's compliance with state and federal laws and regulatory agencies. This may include the Clean Water Act, specific NPDES permits issued to the City, any current or potential Administrative Consent Orders, and other factors.

- **Hazardous Materials Liability:** This category will be used to differentiate options based on their potential to encounter hazardous materials such as lead paint, asbestos (including asbestos concrete pipe), PCBs, contaminated soils, and other regulated materials.

- **Project Risk:** Certain types of projects carry more risk than others. Generally, projects with a limited footprint will be less risky than those impacting a larger area. Similarly, projects which include excavation have more risk than projects which do not, due to the potential for unforeseen subsurface conditions.

- **Economic Development:** For this category, options which will spur growth and encourage additional tax revenue to be generated will be ranked higher than those that have no effect or discourage economic development.

- **Traffic Impacts:** Projects will be evaluated based on their impacts on traffic patterns due to detours and/or road closures during construction and after the project completion.

- **Socioeconomics / Impact to Abutters:** This category will be used to evaluate the projects based on the level of impact to abutters of the project area, as well as the number of abutters impacted.

- **Nuisance Odors & Alarms:** Projects will be evaluated based on their potential to generate nuisance odors and alarms, which impacts not only abutters but also City staff who must be "on call" to address these issues.

- **Public Safety:** Projects which have a beneficial effect on overall public safety will be ranked higher than those which do not improve safety conditions.

Each option for upgrades will be ranked in the categories listed above, and the number of total "Advantageous", "Neutral", and "Not Advantageous" will be tallied. These scores will be used along with the project cost evaluation to determine the most beneficial option for implementation.

4.3 COMPARISON – CAPITAL EXPENSES

The opinion of project construction cost for each option was originally presented in the 2013 CMOM report. For this Business Case Study evaluation, we have reviewed the 2013 cost estimates and made minor adjustments where warranted. The 2013 cost estimates have also been inflated to August 2016 dollars using the Engineering News Record (ENR) 20-City construction cost index.

Capital expense information is presented in Table 4-1 below. Additional information on the opinion of probable cost is included in Appendix A. For Option #4 (Do Nothing/Defer Action), no capital expense is included, due to the fact that all maintenance is assumed to be performed on an "as needed" basis in this option. The capital expenses are separated into three categories: Work at Curtis Road PS, Work at Hope Avenue PS, and collection system work.

Table 4-1: Capital Expense Comparison

Category	Option 1 – Comprehensive Curtis Upgrade	Option 2 – Prioritized Curtis Upgrade	Option 3 – Curtis PS Elimination	Option 4 – Do Nothing/Deferred Action
Curtis Road PS	$638,000	$419,000	$0[1]	N/A
Hope Avenue PS	$0	$0	$853,000	N/A
Collection System	$89,000	$89,000	$564,000	N/A

1 – Cost to abandon Curtis Road PS is included in the Hope Ave PS capital expense for Option 3

The capital expense estimate for Option 3 is the highest for any of the pump stations due to the fact that this includes construction of a new pump station on a new site, rather than an upgrade to an existing station. As noted in Section 3, the existing Hope Avenue PS wetwell is neither deep enough nor does it have enough volume to accommodate the new, larger station. Due to the increase in capacity, Option 3 essentially abandons not only the existing Curtis Road PS but also the existing Hope Avenue PS and replaces it with a completely new, larger Hope Avenue PS.

As discussed above, the Net Present Value (NPV) analysis assumes that the collection system upgrades associated with Options #1 and 2 occur in Year 22 of our analysis. All other capital expenses are assumed to occur in Year 0.

4.4 COMPARISON – OPERATING EXPENSES

Our estimates of the operating expenses for the four options is presented below in Table 4-2. We have separated the operating expenses into labor and utilities, with a separate estimate for equipment overhaul and replacement during the 30-year study period. Costs in Table 4-2 are shown as Net Present Value costs over the 30-year lifecycle.

Table 4-2: Operating Cost Comparison

Category	Option 1 – Comprehensive Curtis Upgrade	Option 2 – Prioritized Curtis Upgrade	Option 3 – Curtis PS Elimination	Option 4 – Do Nothing/Deferred Action
Labor/Utility – Curtis Road PS	$133,000	$151,000	$0	$491,000
Equipment – Curtis Road PS	$162,000	$286,000	$0	$340,000
Labor/Utility – Hope Avenue PS	$79,000	$79,000	$136,000	$231,000
Equipment – Hope Avenue PS	$169,000	$169,000	$159,000	$169,000

The operating expenses for Options #1 and 2 show the impact of performing a selective upgrade at Curtis Road PS as compared to a comprehensive upgrade. The equipment cost for Option #2 is higher than Option #1 to reflect the fact that certain items which were deferred from the capital project in Option #2 will need to be addressed at a future date

in the study period. The costs at Hope Avenue PS are identical for Options #1 and 2 because operations at Hope Avenue are identical under either option.

Option 3 has the lowest operating expenses of any of the options. This reflects the fact that two existing stations would be eliminated and replaced with a single, brand new station.

A detailed breakdown of the estimated annual labor and equipment cost is included in Appendix C. The labor estimates for Options #1, 2 and 3 are based on an assumption that each station would require a weekly check in of 1 hour each week. This applies to the existing Hope Avenue PS and the upgraded Curtis PS, or the new replacement Hope Avenue PS. We have included additional labor hours for snow removal and lawn maintenance, as well as time for alarm response. We assume 5 alarm response events per year for the upgraded stations.

For Option #4 we have developed an estimated labor cost for a station which is not receiving proactive upgrades and maintenance. Under this scenario, we assume that the pump station will need to be checked in on 3 times per week. We assume up to 15 alarm events per year under this scenario. We have also included 4 hours/week of administrative time to address the impacts and issues associated with a station in this state of repair, as well as two days of septic hauler rental per year. For the Net Present Value analysis, it is assumed that the Curtis Road PS would reach this level of service after 5 years of deferred maintenance, and Hope Avenue PS would reach this level after 20 years of deferred maintenance. During these time periods we have also increased the cost of maintenance by 25% to account for the inefficiency of addressing maintenance issues reactively and due to the increased potential of experiencing equipment failures on nights/weekends due to deferred maintenance.

4.5 REVENUE OPPORTUNITIES

Options #1, 2 and 4 have no impacts on revenue to the City. For Option #3, we have assumed that after the abandonment of the Curtis Road PS, the City will sell the 0.24 acre (10,700 square feet) lot, as the lot meets zoning requirement for a single-family house (minimum lot size of 10,000 SF, Zone R-2). We have assumed a sale price of $100,000 in Year 1 of the NPV analysis (after the upgrades are completed), and $5,805 annual tax revenue each year beginning in Year 2, using City's FY17 mil rate of 21.11 and an assessed (taxable) value for the home and land of $275,000 based on a brief review of City's Tax Roll for homes on Curtis Road.

4.6 COMPARISON – ENVIRONMENTAL AND SOCIAL IMPACTS

Our evaluation of the options based on the environmental and social impacts, or non-cost factors identified is included below in Table 4-3.

Table 4-3: Non-Cost Factor Evaluation

Category	Option 1 – Comprehensive Curtis Upgrade	Option 2 – Prioritized Curtis Upgrade	Option 3 – Curtis PS Elimination	Option 4 – Do Nothing/Deferred Action
Regulatory Compliance	Advantageous	Advantageous	Advantageous	Not Advantageous
Hazardous Materials Liability	Neutral	Neutral	Not Advantageous	Neutral
Project Risks	Advantageous	Neutral	Not Advantageous	Not Advantageous
Economic Development	Neutral	Neutral	Neutral	Neutral
Traffic Impacts	Neutral	Neutral	Not Advantageous	Neutral
Socioeconomics / Impact to Abutters	Neutral	Neutral	Not Advantageous	Not Advantageous
Nuisance Alarms/Odors	Advantageous	Advantageous	Advantageous	Not Advantageous
Public Safety	Advantageous	Advantageous	Advantageous	Not Advantageous

A brief discussion of each evaluative criteria follows:

- **Regulatory Compliance:** Options 1 through 3 will eliminate the overflow at Curtis Road PS. Option #4 increases the risk of sanitary sewer overflows and the potential of enforcement action.

- **Hazardous Materials Liability:** None of the options have significant risk in this category, however Option #3 includes excavation, including some work near existing asbestos concrete (AC) piping. The new sewer to convey flow to the new, larger Hope Avenue PS would require the removal or abandonment in place of the existing AC pipe.

- **Project Risk:** In our opinion, Option 1 contains the least amount of risk. A comprehensive upgrade to the station on the existing site has very few unknowns, and provides upgrades to the entire pump station. Option #2 entails more risk because it requires the City to continue using antiquated controls and telemetry with new pumps for a period of time. Option #3 carries additional risk as compared to Option #1 due to the increase in the scope of work – this project will require significantly more excavation which increases the risk of encountering unforeseen underground conditions. Option #3 will require the largest permitting effort as well. Option #4 carries significant risk because it requires the City to be dependent on antiquated infrastructure for the entirety of the study period.

- **Economic Development:** None of the options have significant impacts on economic development, as the area tributary to the pump stations is largely built out already. The economic benefits of Option #3 have been included in the NPV analysis and therefore are not included in the non-cost factors as well.

- **Traffic Impacts:** Options #1, 2 and 4 have very little impact on traffic. Option #3 is a significant roadway utility project which will have impacts on neighborhood traffic patterns for several months.

- **Socioeconomics / Impact to Abutters:** Options #1 and 2 will have some impacts to abutters during construction, however they should be minimized due to the fact that minimal excavation will be required for each project. Option #3 impacts the greatest number of abutters due to the increased project area. Option #4 will have a long term impact on abutters as the number and frequency of alarms and other pump station issues increases in the future as maintenance is deferred.

- **Nuisance Odors & Alarms:** Options #1, 2 and 3 include upgrades to the pump station infrastructure and should reduce long term alarms and odors. Option #4 will increase the frequency of these events.

- **Public Safety:** Pubic safety will be improved by Options #1, 2 and 3 due to the elimination of the overflow at Curtis Road PS. Option #4 does not address this overflow and the deferred maintenance would make other SSO events more likely.

A summary of the total number of non-cost factors rated “Advantageous”, “Neutral”, and “Not Advantageous” is included in Table 4-4.

Table 4-4: Non-Cost Factor Evaluation

Category	Option 1 – Comprehensive Curtis Upgrade	Option 2 – Prioritized Curtis Upgrade	Option 3 – Curtis PS Elimination	Option 4 – Do Nothing/Deferred Action
"Advantageous"	3	2	3	0
"Neutral"	5	6	1	3
"Not Advantageous"	0	0	4	5

4.7 NET PRESENT VALUE

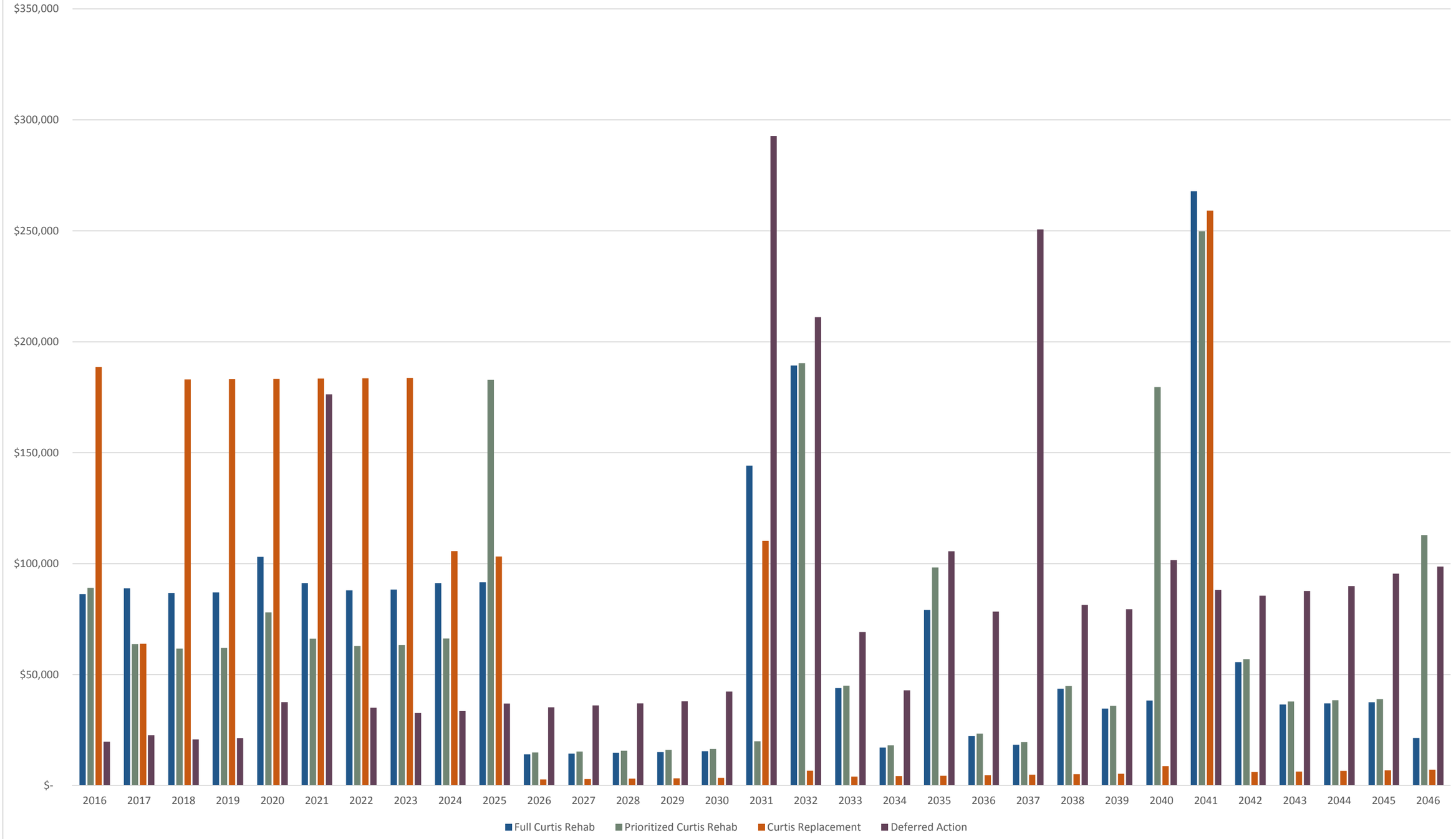
Using the capital costs, operating costs, and discount rates discussed at the beginning of this section, we have calculated the estimate Net Present Value (NPV) cost of each of the options. The costs are presented in Table 4-5, and annual costs for each of the options are shown in Figure 4-1.

Table 4-5: Net Present Value Analysis

Category	Option 1 – Comprehensive Curtis Upgrade	Option 2 – Prioritized Curtis Upgrade	Option 3 – Curtis PS Elimination	Option 4 – Do Nothing/Deferred Action
Total Capital Costs, Pump Stations	$635,000	$417,000	$849,000	N/A
Total Operating Costs, Pump Stations	$543,000	$685,000	$295,000	$1,231,000
Total Costs, Collection System	$107,000	$107,000	$610,000	$66,000
Total Revenue	$0	$0	($228,000)	$0
Total Net Present Value	**$1,285,000**	**$1,208,000**	**$1,526,000**	**$1,297,000**

As shown in the table, Options #1, 2 and 4 are similar, and Option #3 is slightly higher. Options #1 and 2 are similar in total cost, however Option #2 defers some of the items included in the capital project of Option #1 to later years, resulting in a lower NPV. Option #3 has the lowest operating cost due to the fact that the Curtis Road PS is eliminated, however the costs associated with constructing the new sewer between the Curtis Road PS site and the Hope Avenue PS site more than offset the annual cost savings. Option #4 has similar NPV costs to Options #1 and 2, however this option scores significantly worse than the other three options in the non-cost evaluation in Table 4-4.

Figure 4-1: Annual Cost



5. RECOMMENDATION

5.1 RECOMMENDATION

Based on the results of the Net Present Value analysis and the evaluation of the options on the environmental and social impacts identified, we recommend the City implement Option #1, the comprehensive rehabilitation of Curtis Road Pump Station.

Options #1, 2 and 4 all have similar NPV costs over the 30-year life cycle of the project. Option #4 (Do Nothing/Deferred Action) is not considered viable due to the poor evaluation of the environmental and social impact (non-cost factors). Option #2 (Prioritized Upgrade of Curtis Road PS) was calculated to have a slightly lower NPV cost as compared to Option #1, however this option also scored slightly lower in the non-cost evaluation. Option #2 offers a lower capital cost during the initial upgrade, which may make this option more affordable and more viable to implement than Option #1. However, given that the overall capital cost of either Option #1 or #2 is less than $1M, we recommend the comprehensive upgrade of Option #1 rather than the "piecemeal" approach of Option #2.

Option #3 (Elimination of Curtis Road PS), offers some significant benefits due to the elimination of one pump station. Option #3 has the lowest operating costs once the capital project completes the new pump station and sewer re-alignment. This option also scored highly in the environmental and social impact analysis, with as many "Advantageous" scores as the recommended Option #1. However, the gravity sewer re-alignment which would be required as part of Option #3 both increases the cost of the project, and increases the impacts/risk of the project, which results in a greater number of "Not Advantageous" scores as compared to Options #1 or 2. The CMOM report concluded that the elimination of Curtis Road PS would reduce the risk of pump station failures as compared to Option #1, however the CMOM analysis did not account for the increased risks and impacts of the elimination option as compared to upgrading Curtis Road PS in its existing location, which carries very little risk.

Another factor which worked against Option #3 is the good condition of the existing Hope Avenue PS. If Hope Avenue PS were in similar condition to Curtis Road PS, and in need of an upgrade, the analysis may have favored Option #3 more. Similarly, if this area were unsewered and this evaluation were to evaluate options for a "green" site, the outcome of the NPV analysis and non-cost analysis would likely favor Option #3 as well. However, given that the elimination of the Curtis Road PS would also require the abandonment and replacement of the gravity sewer on Alice Road, and the existing Hope Avenue PS, which are both in good condition, the overall analysis favors maintaining the existing sewer configuration and pump station locations.

APPENDIX A: OPINION OF CAPITAL COST ESTIMATES

The following tables are based on the opinions of probable cost for the various alternatives presented in the CMOM report from November 2013. These have been updated as appropriate to reflect any changes in the projects. The cost estimates have also been adjusted using the Engineering News Record (ENR) 20-City Construction Cost Index (CCI) to account for inflation between November 2013 and August 2016 (the most recent month for which ENR 20-City CCI data is available).

Table A-1 provides a detailed breakdown and opinion of probable cost the comprehensive upgrade of the Curtis Road Pump Station.

Table A-1: Comprehensive Curtis Road PS Upgrades – Opinion of Probable Cost

Item		Unit Cost Estimate	Installation Cost Estimate
General Conditions		$42,000	
Demolition		$25,000	
Discharge Piping and Valves		$8,000	$2,400
Enclosure		$30,000	$6,000
Local Controls		$7,500	$2,250
PLC		$15,000	$4,500
Process Alarm		$1,500	$300
Process Instruments		$3,000	$900
Pump 1		$6,000	$1,800
Pump 2		$6,000	$1,800
Pump Suction		$4,000	$1,200
Standby Power System		$55,000	$27,500
Telemetry/Communication		$25,000	$10,000
Motor Starters		$10,000	$2,000
Bypass Pumping		$15,000	
Misc. Unaccounted for Items	5%	$16,000	
Overhead, Profit, & Insurance	20%	$66,000	
Subtotal Contractor Costs		$396,000	
Contingency	20%	$79,000	
Engineering	25%	$119,000	
Project Cost Estimate (November 2013)		**$594,000**	
Project Cost Estimate (August 2016)		**$638,000**	

Notes:

1) Onsite construction estimated at 6 weeks. General conditions estimated at $7,000 per week.

The second option for a comprehensive upgrade of the Curtis Road Pump Station involves upgrading specific high risk assets, such as the generator with integral enclosure, pump station enclosure, wastewater pumps, and pump suction piping.

Table A-2 provides a detailed breakdown and opinion of probable cost for this option.

Table A-2: Phased Curtis Road PS Upgrades – Opinion of Probable Cost

Item		Unit Cost Estimate	Installation Cost Estimate
General Conditions[1]		$28,000	
Demolition		$25,000	
Pump Enclosure		$30,000	$6,000
Pump 1		$6,000	$1,800
Pump 2		$6,000	$1,800
Pump Suction		$4,000	$1,200
Standby Power System		$55,000	$27,500
Bypass Pumping		$15,000	
Misc. Unaccounted for Items	5%	$10,000	
Overhead, Profit, & Insurance	20%	$43,000	
Subtotal Contractor Cost		$260,000	
Contingency	20%	$52,000	
Engineering	25%	$78,000	
Project Cost Estimate (November 2013)		**$390,000**	
Project Cost Estimate (August 2016)		**$419,000**	

Notes:

1) Onsite construction estimated to be 4 weeks. General conditions estimated at $7,000 per week.

Table A-3 provides a detailed breakdown and opinion of probable cost for the option of eliminating the Curtis Road PS**.**

Table A-3: Eliminate Curtis Road PS & Upgrade Hope Avenue PS – Opinion of Probable Cost

Item		Unit Cost Estimate	Installation Cost Estimate
General Conditions[1]		$70,000	
Curtis Demolition		$25,000	
Hope Demolition		$25,000	
Abandon Wet well - Flowable Fill		$12,000	
Cable & Enclosure		$6,000	$3,000
Concrete Foundation Pad		$5,000	$1,000

Item		Unit Cost Estimate	Installation Cost Estimate
Discharge Piping and Valves		$8,000	$2,400
Enclosure		$30,000	$6,000
Land		$25,000	
Local Controls		$7,500	$2,250
Pavement		$1,500	
PLC		$15,000	$4,500
Process Alarm		$1,500	$300
Process Instruments		$3,000	$900
Pump 1		$6,000	$1,800
Pump 2		$6,000	$1,800
Pump Suction		$4,000	$1,200
Standby Power System		$55,000	$27,500
Telemetry/Communication		$25,000	$10,000
Variable Frequency Drive		$10,000	$2,000
By-Pass Pumping		$15,000	
Misc. Unaccounted for Items	5%	$21,000	
Overhead, Profit, & Insurance	20%	$88,000	
Subtotal Pump Station Contractors Cost		$529,000	
Contingency	20%	$106,000	
Pump Station Engineering	25%	$159,000	
Project Cost Estimate (November 2013)		**$794,000**	
Project Cost Estimate (August 2013)		**$853,000**	

Notes:

1) Onsite construction estimated to be 10 weeks. General conditions estimated at $7,000 per week

2) Assumes 2,000 linear feet (LF) of gravity sewer and force main installed in Alice Street ROW.

3) Estimate includes 20% contingency

Manhole Unit Cost $ 7,050
Base Unit Cost Per Linear Foot $ 163
Base Depth = 11.5 Feet
Below Existing Sewer adjust cost up by 5%

Op3 - Sewer Modification

Location ID	LF	Avg Depth	Standard SMH	Drop SMH	Laterals	LF Above Existing Sewer	LF Below Existing Sewer	Depth Adj	Below Adj	Pipe $	SMH $	
Hope Avenue (Existing Replacement)	300	11.5	5	1		300	0	1	1.05	$ 48,900	$ 42,300	
Hope Avenue (New Gravity Sewer)	150	11.5	1	0		0	150	1	1.05	$ 25,673	$ 7,050	
Hope Avenue at Alice Street (Existing Replacement)	120	11.5	0	1		0	120	1	1.05	$ 20,538	$ 7,050	
Alice Street (CRPS to Hope Avenue)	1288	15	1	3		573	875	1.30434783	1.05	$280,971	$ 28,200	
Alice Street (CRPS to Hope Avenue)	160	10	0	2				0.86956522	1.05	$ 22,678	$ 14,100	$ 189.29 Pipe cost / LF
Clapboard Road	202	7.5	0	1		202	0	0.65217391	1.05	$ 21,473	$ 7,050	$ 47.64 SMH cost / LF
									Subtotal	**$**	**525,983**	$ 236.93 All in Construction Cos

	LF	Cost / LF		
Force main alligned in Trench	1882.5	20	**Subtotal**	**$ 37,650**

Construction Subtotal	**$ 563,633**
Engineering included in base estimate	**$ -**
TotalEstimate	**$ 563,633**

Op1 and Op2 - Sewer Rehabilitation

Location ID	LF	Avg Depth	Standard SMH	Drop SMH	Laterals	LF Above Existing Sewer	LF Below Existing Sewer	Depth Adj	Below Adj	Pipe $	SMH $	
Hope Avenue at Alice Street (Existing Replacement)	120	11.5	0	1		0	120	1	1.05	$ 20,538	$ 7,050	
Alice Street (CRPS to Hope Avenue)	1288	15	1	3		573	875	1.30434783	1.05	$280,971	$ 28,200	
Alice Street (CRPS to Hope Avenue)	160	10	0	2				0.86956522	1.05	$ 22,678	$ 14,100	$ 195.29 Pipe cost / LF
Clapboard Road	202	7.5	0	1		202	0	0.65217391	1.05	$ 21,473	$ 7,050	$ 31.86 SMH cost / LF
									Subtotal	**$**	**402,061**	$ 227.15 All in Construction Cos

Engineering included in base estimate	**$ -**
	$ 402,061

Op1, Op2, Op3 Existing force main replacement

	LF	Cost / LF		
Force main alligned in Trench	937	115	**Subtotal**	**$ 107,755**
			Engineering (6%)	**$ -**
				$ 107,755

TotalEstimate	**$ 509,816**

Op1, Op2 Op4 - Sewer Relining	LF	Unit Cost	Estimated Cost
CIPP	1770	50	$ 88,500

APPENDIX B: RESERVE REPLACEMENT SCHEDULES

Option 1 - Reserve Replacement Years & 2016 Estimated Asset Value
Curtis Road Pump Station Business Case Study
City of Portland, ME

Pump Station	Asset	Installed Date	EST 2016 Asset Value	EST Replacement Year	2nd Replacement Year	3rd Replacement Year	4th Replacement Year	5th Replacement Year
Hope Avenue Pump Station	Land	2005	$ 20,000					
Hope Avenue Pump Station	Pavement	2005	$ 1,500	2017	2025	2033	2041	
Hope Avenue Pump Station	Cable & Enclosure	2005	$ 6,000	2042				
Hope Avenue Pump Station	Standby Power System	2005	$ 53,000	2032				
Hope Avenue Pump Station	Process Alarm	2005	$ 2,000	2021	2036			
Hope Avenue Pump Station	Process Instruments	2005	$ 3,000	2020	2035			
Hope Avenue Pump Station	PLC	2005	$ 5,000	2020	2035			
Hope Avenue Pump Station	Local Controls	2005	$ 7,500	2032				
Hope Avenue Pump Station	Pump 1	2005	$ 5,000	2033				
Hope Avenue Pump Station	Pump 2	2005	$ 5,000	2033				
Hope Avenue Pump Station	Pump Suction	2005	$ 5,000					
Hope Avenue Pump Station	Discharge Piping and Valves	2005	$ 7,500					
Hope Avenue Pump Station	Enclosure	2005	$ 20,000	2035				
Hope Avenue Pump Station	Concrete Foundation Pad	2005	$ 4,000	2038				
Hope Avenue Pump Station	Wet Well	2005	$ 15,000					
Curtis Road Pump Station	Land	1980	$ 25,000					
Curtis Road Pump Station	Pavement	2016	$ 1,500	2024	2032	2040		
Curtis Road Pump Station	Cable & Enclosure	2016	$ 6,000					
Curtis Road Pump Station	Standby Power System	2016	$ 55,000	2041				
Curtis Road Pump Station	Variable Frequency Drive	2016	$ 10,000	2031				
Curtis Road Pump Station	Telemetry/Communication	2016	$ 25,000	2031				
Curtis Road Pump Station	Process Alarm	2016	$ 1,500	2031				
Curtis Road Pump Station	Process Instruments	2016	$ 3,000	2031				
Curtis Road Pump Station	PLC	2016	$ 15,000	2031				
Curtis Road Pump Station	Local Controls	2016	$ 7,500	2041				
Curtis Road Pump Station	Pump 1	2016	$ 6,000	2041				
Curtis Road Pump Station	Pump 2	2016	$ 6,000	2041				
Curtis Road Pump Station	Pump Suction	2016	$ 4,000					
Curtis Road Pump Station	Discharge Piping and Valves	2016	$ 8,000					
Curtis Road Pump Station	Enclosure	2016	$ 30,000					
Curtis Road Pump Station	Concrete Foundation Pad	2016	$ 5,000					
Curtis Road Pump Station	Wet Well	1980	$ 20,000					

Option 2 - Reserve Replacement Years & 2016 Estimated Asset Value
Curtis Road Pump Station Business Case Study
City of Portland, ME

Pump Station	Asset	Installed Date	EST 2016 Asset Value	EST Replacement Year	2nd Replacement Year	3rd Replacement Year	4th Replacement Year	5th Replacement Year
Hope Avenue Pump Station	Land	2005	$ 20,000					
Hope Avenue Pump Station	Pavement	2005	$ 1,500	2017	2025	2033	2041	
Hope Avenue Pump Station	Cable & Enclosure	2005	$ 6,000	2042				
Hope Avenue Pump Station	Standby Power System	2005	$ 53,000	2032				
Hope Avenue Pump Station	Process Alarm	2005	$ 2,000	2021	2036			
Hope Avenue Pump Station	Process Instruments	2005	$ 3,000	2020	2035			
Hope Avenue Pump Station	PLC	2005	$ 5,000	2020	2035			
Hope Avenue Pump Station	Local Controls	2005	$ 7,500	2032				
Hope Avenue Pump Station	Pump 1	2005	$ 5,000	2033				
Hope Avenue Pump Station	Pump 2	2005	$ 5,000	2033				
Hope Avenue Pump Station	Pump Suction	2005	$ 5,000					
Hope Avenue Pump Station	Discharge Piping and Valves	2005	$ 7,500					
Hope Avenue Pump Station	Enclosure	2005	$ 20,000	2035				
Hope Avenue Pump Station	Concrete Foundation Pad	2005	$ 4,000	2038				
Hope Avenue Pump Station	Wet Well	2005	$ 15,000					
Curtis Road Pump Station	Land	1980	$ 25,000					
Curtis Road Pump Station	Pavement	1980	$ 1,500	2016	2024	2032	2040	
Curtis Road Pump Station	Cable & Enclosure	1980	$ 6,000	2016				
Curtis Road Pump Station	Standby Power System	2016	$ 55,000	2041				
Curtis Road Pump Station	Variable Frequency Drive	2010	$ 10,000	2025	2040			
Curtis Road Pump Station	Telemetry/Communication	2010	$ 25,000	2025	2040			
Curtis Road Pump Station	Process Alarm	1980	$ 1,500	2016	2031	2046		
Curtis Road Pump Station	Process Instruments	2010	$ 3,000	2025	2040			
Curtis Road Pump Station	PLC	2010	$ 15,000	2025	2040			
Curtis Road Pump Station	Local Controls	2010	$ 7,500	2035				
Curtis Road Pump Station	Pump 1	2016	$ 6,000	2041				
Curtis Road Pump Station	Pump 2	2016	$ 6,000	2041				
Curtis Road Pump Station	Pump Suction	2016	$ 4,000					
Curtis Road Pump Station	Discharge Piping and Valves	2016	$ 8,000					
Curtis Road Pump Station	Enclosure	2016	$ 30,000	2046				
Curtis Road Pump Station	Concrete Foundation Pad	1980	$ 5,000	2016	2046			
Curtis Road Pump Station	Wet Well	1980	$ 20,000					

Option 3 - Reserve Replacement Years & 2016 Estimated Asset Value
Curtis Road Pump Station Business Case Study
City of Portland, ME

Pump Station	Asset	Installed Date	EST 2016 Asset Value	EST Replacement Year	2nd Replacement Year	3rd Replacement Year	4th Replacement Year	5th Replacement Year
Hope Avenue Pump Station	Land	2016	$ 20,000					
Hope Avenue Pump Station	Pavement	2016	$ 1,500	2024	2032	2040		
Hope Avenue Pump Station	Security Perimeter	2016	$ 4,000	2036				
Hope Avenue Pump Station	Cable & Enclosure	2016	$ 6,000	2051				
Hope Avenue Pump Station	Standby Power System	2016	$ 60,000	2041				
Hope Avenue Pump Station	Variable Frequency Drive	2016	$ 10,000	2031				
Hope Avenue Pump Station	Telemetry/Communication	2016	$ 25,000	2031				
Hope Avenue Pump Station	Process Alarm	2016	$ 2,000	2031				
Hope Avenue Pump Station	Process Instruments	2016	$ 3,000	2031				
Hope Avenue Pump Station	PLC	2016	$ 5,000	2031				
Hope Avenue Pump Station	Local Controls	2016	$ 7,500	2041				
Hope Avenue Pump Station	Pump 1	2016	$ 7,500	2041				
Hope Avenue Pump Station	Pump 2	2016	$ 7,500	2041				
Hope Avenue Pump Station	Discharge Piping and Valves	2016	$ 7,500					
Hope Avenue Pump Station	Wet Well	2016	$ 15,000					

APPENDIX C: OPERATION AND MAINTENANCE COST ESTIMATES

Curtis Road Pump Station Operation & Maintenance Estimate
Curtis Road Pump Station Business Case Study
City of Portland, ME

Pre Project Annual O&M

Activity	Unit	Events / Year	Hrs / Event	Manhours	Labor Rate	Overhead (23%)	Burdened Rate	EST Expense
Labor								
Check in Rounds	Each	104	3	312	$ 20.00	$ 4.60	$ 24.60	$ 7,675
Lawn Maintenance	Each	16	2	32	$ 20.00	$ 4.60	$ 24.60	$ 787
Snow Removal	Each	10	3	30	$ 20.00	$ 4.60	$ 24.60	$ 738
Alarm Response	Each	15	4	60	$ 30.00	$ 6.90	$ 36.90	$ 2,214
Non-Labor								
Electrical Expense	Lump Sum							$ 1,700
Backup Power Fuel	Lump Sum							$ 150
Maintenance Agreements	Lump Sum							$ -
WPC Equipment Cost	Lump Sum							$ -
							Total	$ 13,264

Post Project Annual O&M

Activity	Unit	Events / Year	Hrs / Event	Manhours	Labor Rate	Overhead (23%)	Burdened Rate	EST Expense
Labor								
Check in Rounds	Each	52	1	52	$ 20.00	$ 4.60	$ 24.60	$ 1,279
Lawn Maintenance	Each	16	2	32	$ 20.00	$ 4.60	$ 24.60	$ 787
Snow Removal	Each	10	3	30	$ 20.00	$ 4.60	$ 24.60	$ 738
Alarm Response	Each	5	4	20	$ 30.00	$ 6.90	$ 36.90	$ 738
Non-Labor								
Electrical Expense	Lump Sum							$ 1,700
Backup Power Fuel	Lump Sum							$ 150
Maintenance Agreements	Lump Sum							$ -
WPC Equipment Cost	Lump Sum							$ -
							Total	$ 5,392

Run to Failure Annual O&M

Activity	Unit	Events / Year	Hrs / Event	Manhours	Labor Rate	Overhead (23%)	Burdened Rate	EST Expense
Labor								
Check in Rounds	Each	156	1	156	$ 20.00	$ 4.60	$ 24.60	$ 3,838
Lawn Maintenance	Each	16	2	32	$ 20.00	$ 4.60	$ 24.60	$ 787
Snow Removal	Each	10	1	10	$ 20.00	$ 4.60	$ 24.60	$ 246
Alarm Response	Each	15	4	60	$ 30.00	$ 6.90	$ 36.90	$ 2,214
Additional Administration	Each	52	4	208	$ 30.00	$ 6.90	$ 36.90	$ 7,675
Non-Labor								
Electrical Expense	Lump Sum							$ 1,700
Backup Power Fuel	Lump Sum							$ 150
Vactor Truck Rental		2 Events / Year	@		$2,000 each			$ 4,000
Maintenance Agreements	Lump Sum							$ -
WPC Equipment Cost	Lump Sum							$ -
							Total	$ 20,610

Hope Avenue Pump Station Operation & Maintenance Estimate
Curtis Road Pump Station Business Case Study
City of Portland, ME

Pre Project Annual O&M

Activity	Unit	Events / Year	Hrs / Event	Manhours	Labor Rate	Overhead (23%)	Burdened Rate	EST Expense
Labor								
Check in Rounds	Each	104	1	104	$ 20.00	$ 4.60	$ 24.60	$ 2,558
Lawn Maintenance	Each	16	1	16	$ 20.00	$ 4.60	$ 24.60	$ 394
Snow Removal	Each	10	1	10	$ 20.00	$ 4.60	$ 24.60	$ 246
Alarm Response	Each	3	4	12	$ 30.00	$ 6.90	$ 36.90	$ 443
Non-Labor								
Electrical Expense	Lump Sum							$ 230
Backup Power Fuel	Lump Sum							$ 150
Maintenance Agreements	Lump Sum							$ -
WPC Equipment Cost	Lump Sum							$ -
							Total	$ 4,021

Post Project Annual O&M

Activity	Unit	Events / Year	Hrs / Event	Manhours	Labor Rate	Overhead (23%)	Burdened Rate	EST Expense
Labor								
Check in Rounds	Each	52	1	52	$ 20.00	$ 4.60	$ 24.60	$ 1,279
Lawn Maintenance	Each	16	1	16	$ 20.00	$ 4.60	$ 24.60	$ 394
Snow Removal	Each	10	1	10	$ 20.00	$ 4.60	$ 24.60	$ 246
Alarm Response	Each	3	4	12	$ 30.00	$ 6.90	$ 36.90	$ 443
Non-Labor								
Electrical Expense	Lump Sum							$ 230
Backup Power Fuel	Lump Sum							$ 150
Maintenance Agreements	Lump Sum							$ -
WPC Equipment Cost	Lump Sum							$ -
							Total	$ 2,742

Post Project Annual O&M - Larger Hope PS

Activity	Unit	Events / Year	Hrs / Event	Manhours	Labor Rate	Overhead (23%)	Burdened Rate	EST Expense
Labor								
Check in Rounds	Each	52	1	52	$ 20.00	$ 4.60	$ 24.60	$ 1,279
Lawn Maintenance	Each	16	1	16	$ 20.00	$ 4.60	$ 24.60	$ 394
Snow Removal	Each	10	1	10	$ 20.00	$ 4.60	$ 24.60	$ 246
Alarm Response	Each	3	4	12	$ 30.00	$ 6.90	$ 36.90	$ 443
Non-Labor								
Electrical Expense	Lump Sum							$ 2,500
Backup Power Fuel	Lump Sum							$ 150
Maintenance Agreements	Lump Sum							$ -
WPC Equipment Cost	Lump Sum							$ -
							Total	$ 5,012

APPENDIX D: 30 YEAR NET PRESENT VALUE SUMMARY

Business Case Study
Curtis Road / Hope Avenue Wastewater Collection Area

		Option NPV	**$ 1,285,000**	**$ 1,208,000**	**$ 1,525,000**	**$ 1,297,000**
		Option ID	Op1	Op2	Op3	Op4
		Option Description	Comprehensive Curtis Road PS Upgrades	Phased Curtis Road PS Upgrades	Eliminate Curtis Road PS & Upgrade Hope Avenue PS	Do Nothing / Defer Action
	Capital Expense	CapEX NPV 30	$ 635,000	$ 417,000	$ -	$ -
	Operating Expense	OpEX NPV 30	$ 133,000	$ 151,000	$ -	$ 491,000
	Replacement Reserve	RR NPV 30	$ 162,000	$ 286,000	$ -	$ 340,000
	Revenue Opportunity	OpREV NPV 30	$ -	$ -	$ (211,000)	$ -
Curtis Road Pump Station	**Curtis Road PS NPV 30**		$ 930,000	$ 853,000	$ (211,000)	$ 831,000
	Capital Expense	CapEX NPV 30	$ -	$ -	$ 849,000	$ -
	Operating Expense	OpEX NPV 30	$ 79,000	$ 79,000	$ 136,000	$ 231,000
	Replacement Reserve	RR NPV 30	$ 169,000	$ 169,000	$ 159,000	$ 169,000
	Revenue Opportunity	OpREV NPV 30	$ -	$ -	$ (17,000)	$ -
Hope Avenue Pump Station	**Hope Avenue PS NPV 30**		$ 248,000	$ 248,000	$ 1,126,000	$ 400,000
	Capital Expense	CapEX NPV 30	$ 49,000	$ 49,000	$ 566,000	$ -
	Operating Expense	OpEX NPV 30	$ 58,000	$ 58,000	$ 44,000	$ 66,000
	Replacement Reserve	RR NPV 30	$ -	$ -	$ -	$ -
	Revenue Opportunity	OpREV NPV 30	$ -	$ -	$ -	$ -
Conveyance System	**Conveyance System NPV 30**		$ 107,000	$ 107,000	$ 610,000	$ 66,000
TOTAL			$ 1,285,000	$ 1,208,000	$ 1,525,000	$ 1,297,000
	Total PUMP STATION CAPITAL		$ 635,000	$ 417,000	$ 849,000	$ -
	Total PUMP STATION OPERATING		$ 543,000	$ 685,000	$ 295,000	$ 1,231,000
	Total COLLECTION SYSTEM		$ 107,000	$ 107,000	$ 610,000	$ 66,000
	Total REVENUE		$ -	$ -	$ (228,000)	$ -
	Total		$ 1,285,000	$ 1,209,000	$ 1,526,000	$ 1,297,000

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COMMITMENT & INTEGRITY DRIVE RESULTS