

14.0 CONCLUSIONS AND RECOMMENDATIONS

14.1 CONCLUSIONS

The Phase 1 Part 2 CSO Control Plan for the Wellington Avenue CSO Facility included the following:

- Sewer System Evaluation Survey (SSES) in Priority Catchments 1, 3, 4, and 7 consisting of the following:
 - 68,000 linear feet of flow isolation and 23,300 linear feet of follow up closed circuit television inspection;
 - 6,200 linear feet of closed circuit television inspection of the Thames Street Interceptor;
 - 388 manhole inspections;
 - 1,309 house to house inspections;
 - 80,400 linear feet of smoke testing; and
 - 409 dye tests.

- Flow metering, rainfall gauging, and tide gauging to measure and evaluate dry weather and wet weather flows in Catchment Area 6 and development of the scope of work for SSES field activities to identify sources of infiltration and inflow;

- Development of recommendations for the removal of inflow sources, consisting of roof drains, area drains, and sump pumps, identified on private property in Priority Catchment Areas 1, 3, and 4 by the SSES field activities;

- Update of the City's Geographic Information System (GIS) database based on the results of a review of existing field markups, performance of approximately 400 additional manhole inspections, and field observations during the windshield surveys.

- Evaluation of the EPASWMM, XP-SWMM, INFOWORKS and DHI MOUSE/MIKEURBAN hydraulic/hydrologic models and recommendations for the appropriate model for the City to utilize to evaluate the sanitary sewer system and combined sewer overflow treatment facilities under existing conditions and the effectiveness of proposed CSO control alternatives;
- Development of conceptual sewer separation recommendations for the public inflow sources, consisting of catch basins and cross connections, that were identified by review of existing information, SSES field activities, and windshield surveys;
- Update of the evaluation of CSO activations at the Wellington Avenue CSO Facility CSO and the control alternatives that were developed in the Phase 1 Part 1 Report; and,

The following are the conclusions of Phase 1 Part 2 and the recommendations for the Phase 2 CSO Control Plan for the Wellington Avenue CSO Treatment Facility study area.

1. Table 14.1 summarizes the results of the SSES field activities.

TABLE 14.1
SUMMARY OF SEWER SYSTEM EVALUATION SURVEY RESULTS
AND RECOMMENDATIONS PRIORITY CATCHMENTS 1, 3, 4, AND 7

| SSES Activity | Findings | Structural Defects | Estimated Potential Infiltration/ Inflow Removal (gpd) See Note 1 |
|-----------------------------------|--|-----------------------|---|
| Flow Isolation/CCTV | Identified defects such as pipe cracks, holes, misalignments, breaks, sags | Yes | 107,000 gpd |
| Thames Street Interceptor CCTV | Identified defects such as perforated covers, loose/leaking/missing bricks, mineral/sediment deposits, running services, crossing pipes | Yes | See Note 2. |
| Manhole Inspections | Identified defects such as wall, corbel and invert cracks/leaks, loose/missing bricks, damaged frames/covers | Yes | 6,000 gpd |
| House to House Surveys | Identified 192 sump pumps connected to the sanitary sewer | No | 276, 500 - 1,400,000 gpd See Note 3 |
| Smoke Testing – Private | Identified 65 connections to the sanitary sewer | No | 500,000 gpd |
| Smoke Testing - Public | Identified 28 locations with cross connections and catch basins connected to sanitary sewer | No | 2,000,000 gpd |
| Dye Testing | Identified 139 connections to the sanitary sewer | No | 1,700,000 gpd |
| Catchment Area 6 Flow Metering | Review of flow metering indicates high inflow | Probable | To Be Determined in Phase 1 Part 3 |
| Total | | | 4.6 to 5.7 MGD |

1. Quantities of I/I have been rounded from those presented in Chapter 9.
2. Inflow from perforated manhole covers is nominal. Infiltration from running services to be determined in Phase 1 Part 3 Catchment Area 6 SSES.
3. Sump pump flows were estimated based on an assumed pumping rate of 1 to 5 gpm.

2. Chapters 2 through 7 presented the results of the SSES activities including the recommendations, prioritization, and cost estimates for sanitary sewer system rehabilitation. As noted in Chapter 3, the results of the flow isolation and follow-up closed circuit television inspections performed in Priority Catchments 1, 3, and 4 indicate that the system has multiple defects that would be expected due to the age of the system and type of materials (i.e., vitrified clay pipe). It is recommended that the City address the recommended high priority rehabilitation in Phase 2 that was identified in the Flow Isolation/CCTV Technical Memorandum.

3. As presented in Chapters 5, 6, and 7, sources of private inflow consisting of roof drains, area drains and sump pumps were identified in Priority Catchments 1, 3, and 4 during the SSES. Based on these results, the City prepared and sent notifications to those residents where these sources were identified requesting that the source(s) be disconnected from the sanitary sewer by the property owner.

The results of the notification process as of January 2007 are summarized below.

Roof and Yard Drain Disconnections

- 56 letters were sent on November 15, 2006. Twenty-one owners responded to this initial letter and agreed to disconnect;
- A second letter was sent on December 11, 2006 to the non-responders to the initial letters. Twenty-two owners have responded to the second letter indicating a willingness to disconnect;
- In total, 75% of the owners have agreed to disconnect;
- Inspections performed between January 2 and January 11, 2007 confirmed that nineteen of these disconnections have been accomplished. To date, a total of 34% of the structures have been disconnected.
- Additional letters including Enforcement Action to the non-responders will be sent.

Sump Pump Disconnections

- 183 letters were sent on December 14, 2006 requesting owners to disconnect their sump pumps from the sanitary sewer system;
- As of January, 2007, 34 owners have responded to the letter (19% of total);
- Inspections have not begun to confirm how many disconnections have been accomplished; and
- A second letter to non-responders was sent in January, 2007.

A similar process is recommended to be performed by the City based on the results of the dye testing.

4. As discussed in Chapter 8, flow metering was performed for Catchment Area 6 to determine its infiltration and inflow contribution to the sewer system. The results of the analysis of the flow metering performed in this phase indicated that inflow was significant and that development of a SSES consisting of smoke testing, house to house inspections and dye testing was recommended. Infiltration flows were determined to be low, however, sources of infiltration that were identified in the CCTV inspection of the Thames Street Interceptor, consisting of running flows in some side street connections, are recommended to be investigated by flow isolation and follow-up CCTV. The scope of services, schedule, and budget, appended to this Chapter, were prepared by the City and reviewed and approved by RIDEM with field work scheduled to begin in January, 2007. The cost estimate for the SSES in Catchment Area 6 is \$175,000.
5. As presented in Chapter 12, 18 catch basins and cross connections were identified in the SSES field investigations. Earth Tech received a contract amendment from the City in December 2006 as part of Phase 1 Part 3 to prepare plans to separate the 18 catch basins and cross connections observed in the SSES, in addition to the 10 catch basins that were identified in the review of information performed in Phase 1 Part 1. The separation design will be prepared in the spring of 2007 with construction plans and specifications ready for bidding in the summer of 2007. In order to maximize the cost effectiveness of sanitary system rehabilitation recommendations, rehabilitation of the defects identified in 290 manholes and the replacement of perforated

manhole covers is included with this Phase 1 Part 3 design package. The cost estimate to prepare this design package is \$174,000.

6. EPA, in its CSO Control Policy, has stated that a collection system hydraulic model developed for system characterization is an appropriate tool for predicting CSO flow rates and volumes. The system model can be used to establish the system's existing hydrologic and hydraulic conditions and be calibrated and verified such that it can be used to predict CSO frequency, duration and volume and to evaluate the impacts of CSO control alternatives as proposed in the Long Term CSO Control Plan.

The development of a hydraulic model of the entire Newport sewer system, including its pump stations and CSO facilities, is recommended to be included in Phase 2 to accurately predict the effectiveness of either sewer separation or storage with regard to reduction/elimination of CSOs. The model will provide an analysis tool to better understand how the system functions under varying conditions; to estimate possible CSO reductions for different alternatives, either as stand-alone or in combination; and to evaluate the cost of various alternatives. Development of a hydraulic model of Newport's sewer system will consist of the following tasks:

- Evaluation and selection of the most appropriate model has been completed in this phase of work. As presented in Chapter 10, the DHI MOUSE/MIKEURBAN model is recommended to be utilized;
- Flow metering and rainfall monitoring to provide model calibration and verification data;
- Field data collection to fill in gaps in missing GIS or record plan attribute data and to verify the configuration of diversion structures or other hydraulic structures;
- Input of sewer system attribute information into the GIS;
- System-wide model development;

- Model calibration and verification to confirm accuracy of simulation of existing hydrologic and hydraulic conditions;
- Development of CSO control alternatives such as storage, conveyance and sewer separation; and,
- Model simulations of continuous rainfall events (i.e., several years of rainfall data) or design storm events (such as the 1-year 6 hour storm as required by RIDEM CSO Control Policy) to evaluate the effectiveness of CSO control alternatives on the reduction or elimination of CSOs at the Wellington Avenue and Washington Street CSO Facilities and Long Wharf Pumping Station.

The estimated cost to prepare a hydraulic model for the City's sewer system is \$418,000 broken down as follows:

- Model purchase: \$18,000
- Flow metering and rainfall monitoring to be used for model calibration and verification: \$50,000.
- Review available plans, perform field inspections and measurements of manholes, regulators and other hydraulic structures to collect and verify data, collect and review pump station data, and input sewer system attribute information into the GIS for use with the hydraulic model: \$50,000
- Model development, calibration, analysis of alternatives and inclusion of the modeling in the Phase 2 Report: \$300,000.

Technical Memoranda will be prepared and submitted to document the modeling progress and will include the following:

- Data Collection and Review and Model Setup and Development;
- Flow Metering Plan;

- Model Calibration, Verification and Assessment of Existing Conditions;
- Development of CSO Control Alternatives; and
- Evaluation of Proposed Conditions/Alternatives Analysis.

It has been assumed that the development of CSO controls as part of the Phase 2 Control Plan will be based on meeting the requirements of EPA's Presumptive Approach. Based on this approach, it is assumed that receiving water quality modeling is not required and has not been included in this phase of work.

7. Based on the updated evaluation of the CSO data and the assessment of CSO control alternatives presented in Chapter 13, removal of 4,000,000 gallons of flow from the tributary catchments to the Wellington Avenue CSO Facility will potentially reduce CSO frequency at this facility by over 90%. This target removal volume includes the catchments in Newport as well as the flow contribution from Middletown via Wave Avenue Pump Station, either by enhanced sewer separation, storage, and conveyance and treatment at the WPCP, either separately or in combination. Based on the results presented in Chapter 9, the infiltration and inflow sources that were identified in this phase of work contribute approximately 6 million gallons of flow to the sanitary sewer system. Removing a significant portion of this flow from the system will reduce the overall volume of flow that the sanitary sewer system conveys during wet weather which is expected to reduce CSO frequency and volume measurably.
8. As part of any program to manage flows in Newport, and similar to the recommendation that was included in the Phase 1 Part 1 Report, the Town of Middletown should be required to reduce its flows in general and to control its wet weather discharges to Newport. The City is currently negotiating a renewal of the inter-municipal agreement with Middletown. It is recommended for the City to impose dry and wet weather flow limits on Middletown to provide an incentive to reduce their flows to Newport.

14.2 RECOMMENDATIONS

14.2.1 PHASE 1 PART 3 CSO CONTROL PLAN SCOPE OF SERVICES, COST, AND IMPLEMENTATION SCHEDULE

As noted above, in order to immediately address some of the findings in Phase 1 Part 2, the City amended Earth Tech's contract in December, 2006 to initiate Phase 1 Part 3 work activities consisting of the following:

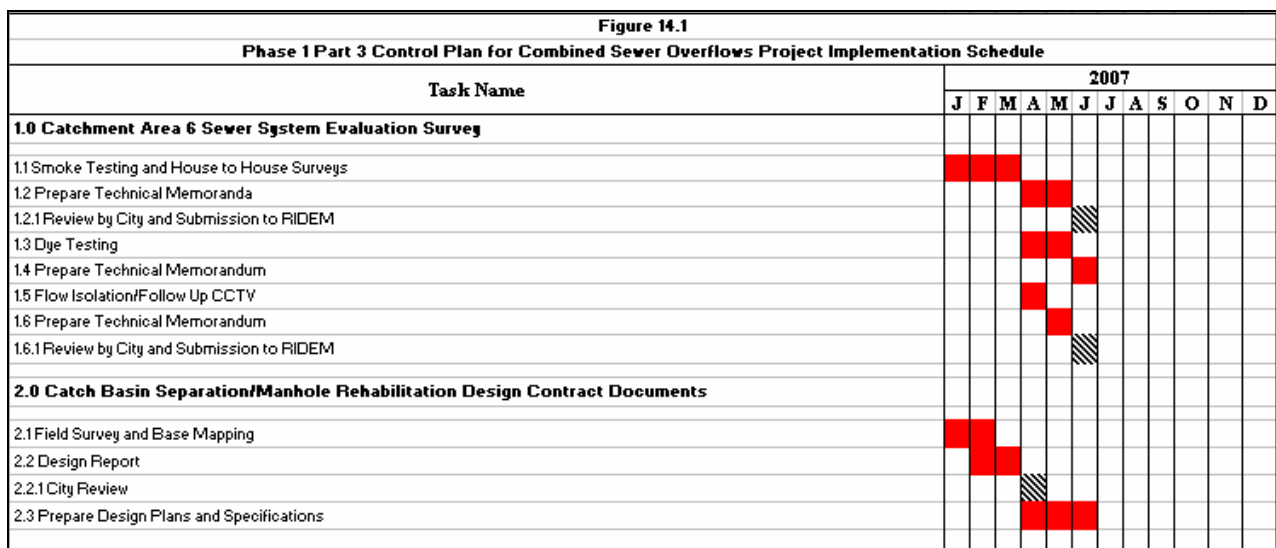
- Performance of smoke testing, house to house surveys, dye testing, and limited flow isolation/closed circuit television inspection in Catchment Area 6 to identify sources of inflow and infiltration;
- Development of design plans and specifications to separate 28 catch basins and cross connections identified in the smoke testing, review of information, and windshield surveys. The completion date of this work is planned for June, 2007 to allow for bidding and initiation of construction in July , 2007; and,
- Development of rehabilitation design plans and specifications of 290 manholes identified with defects during the manhole inspections including the replacement of the perforated manhole covers identified during the closed circuit television inspection of the Thames Street Interceptor.

The costs for these services are presented in Table 14.2.

TABLE 14.2
PHASE 1 PART 3 CSO CONTROL PLAN COST

| Phase 1 Part 3 Activity | Cost |
|--|------------------|
| Catchment Area 6 Sewer System Evaluation Survey | \$175,000 |
| Preparation of Catch Basin Separation and Manhole Rehabilitation Design Contract Documents | \$174,000 |
| Total Cost | \$349,000 |

Figure 14.1 presents the implementation schedule for Phase 1 Part 3 which is currently underway.



Development of Recommendations and Plans for Catchment Area 6

At the conclusion of the Phase 1 Part 3 SSES field activities in Catchment Area 6, sources of inflow and infiltration will be identified on both public and private property. The Phase 1 Part 2 Report will be amended to include the results and recommendations from this Catchment Area 6 SSES, and submitted to RIDEM by May 31, 2007.

With regard to private sources, such as roof leaders, yard drains, and sump pumps identified on private property, the City will continue with its ongoing Notification and Disconnection Program. Similarly, as

part of a separate contract (Phase 1 Part 4), design plans and specifications will be developed to separate the sources identified on public property, such as catch basins and cross connections. The cost and schedule to prepare the designs to separate the public sources of inflow will be developed based on the review of the results of the SSES at the conclusion of the Catchment Area 6 SSES. The subsequent construction of the separation of public sources will be performed under Phase 2.

14.2.2 PHASE 2 CSO CONTROL PLAN SCOPE OF WORK, COST, AND IMPLEMENTATION SCHEDULE

The following are the recommended tasks for the Phase 2 CSO Control Plan for the Wellington Avenue CSO Facility.

1. Development of a Hydraulic Model of the City's Sanitary Sewer System

The development of a hydraulic model of the entire Newport sewer system, including its pump stations and CSO treatment facilities, is recommended to be included in Phase 2 to accurately predict the effectiveness of sewer separation, storage, or conveyance and treatment at the Newport Water Pollution Control Plant, either individually or in combination, to accomplish reduction and/or elimination of CSOs. The model will provide an analysis tool to better understand how the system functions under existing and proposed conditions to estimate possible CSO reductions for different alternatives, either as stand-alone or in combination; and to use the results of the modeling investigations to determine the cost and affordability of various alternatives.

2. Development of Design Plans and Specifications for High Priority Defects Identified in Flow Isolation/CCTV Investigations

The results of the flow isolation and follow-up closed circuit television inspections performed in Priority Catchments 1, 3, and 4 indicate that the system has multiple defects that would be expected due to the age of the system and type of materials (i.e., vitrified clay pipe). It is recommended that the City address in Phase 2 the recommended high priority rehabilitation that was identified in the Flow Isolation/CCTV Technical Memorandum including broken pipes, sagging pipes, pipes with holes, and pipes exhibiting other signs of imminent failure.

3. Preparation of Phase 2 CSO Control Plan Report

The results, recommendations, and costs based on the hydraulic modeling analysis of the system will be presented in the Phase 2 CSO Control Plan Report. The report will include the following:

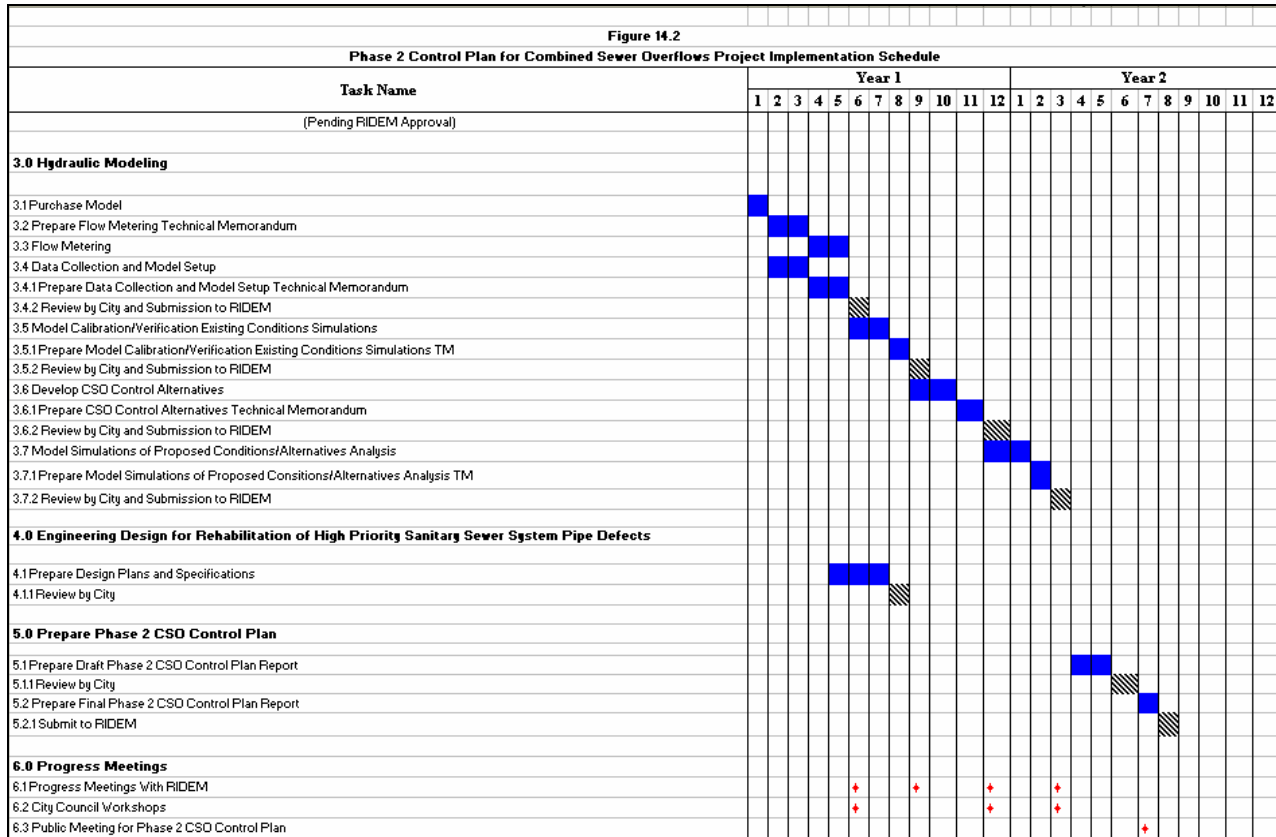
- Results of existing and proposed conditions hydraulic analysis;
- Recommended CSO Control Plan for the Wellington Avenue CSO Treatment Facility based on the evaluation of CSO control alternatives such as sewer separation, storage, conveyance and treatment at the WPCP, and relocation/elimination of the CSO outfall based on the requirements of EPA and RIDEM CSO Control Policies;
- Impacts of the recommendations for the Wellington Avenue CSO Treatment Facility on operation and performance of the Washington Street CSO Treatment Facility, Long Wharf Pump Station, Water Pollution Control Plant, and other key facilities;
- Evaluation of impacts of flows received from the Wave Avenue Pump Station in Middletown on the existing and proposed sanitary sewer system;
- Estimated costs for the recommended CSO Control Plan and economic achievability analysis to determine cost impacts to ratepayers;
- The proposed schedule for the Phase 3 Design and Phase 4 Construction of the elements recommended in the CSO Control Plan;
- The results of post-monitoring of the removal of inflow and infiltration sources as identified in Phase 1 Part 2 and Phase 1 Part 3 as well as the recommended post-monitoring plan for the recommended Phase 3 design elements.

The estimated costs for the recommended planning and design elements of the Phase 2 CSO Control Plan are summarized in Table 14.3.

TABLE 14.3
PHASE 2 CSO CONTROL PLAN COST ESTIMATE

| Phase 2 Planning/Design Projects | |
|---|------------------|
| Engineering Design for Rehabilitation of High Priority Sanitary Sewer System Pipe Defects Identified in Flow Isolation/CCTV | \$83,000 |
| Hydraulic Modeling | \$418,000 |
| <ul style="list-style-type: none"> • Model Purchase • Model Setup • Flow Metering • Calibration/Verification/Existing Conditions Simulations • Development and Simulation of CSO Control Alternatives • Technical Memoranda Documentation | |
| Preparation of the Phase 2 CSO Control Plan Report | \$50,000 |
| Project meetings with the City of Newport and RIDEM | \$15,000 |
| Public Meetings and Workshops to Present Results of Hydraulic Modeling Analysis and Phase 2 CSO Control Plan Recommendations to City Council and Public | \$20,000 |
| Total | \$586,000 |

The implementation schedule for the Phase 2 Program is presented in Figure 14.2.



14.3 OVERALL CSO CONTROL PLAN SCHEDULE AND COSTS

In order to present the proposed scope and timeline for the Long Term Control Plan for the Wellington Avenue CSO Facility, Figure 14.3 has been prepared to chart the following:

- a. The work that has been completed, is underway, or is scheduled for future parts of Phase 1,
- b. The work that is proposed in Phase 2, and
- c. The work that is anticipated for subsequent Phases 3 and 4 which will involve design of CSO controls, construction, and post construction monitoring.

Table 14.4 presents a summary of the costs for the planning, design, and estimated construction of the improvements for the overall CSO Control Program based on the work completed in Phase 1 Part 1 and Phase 1 Part 2; the Phase 1 Part 3 work that is currently underway; and, the recommendations for Phase 2. The construction cost estimates that are shown in the table are planning level costs and will be refined based on the completion of the designs.

FIGURE 14.3
OVERALL CSO CONTROL PLAN SCHEDULE

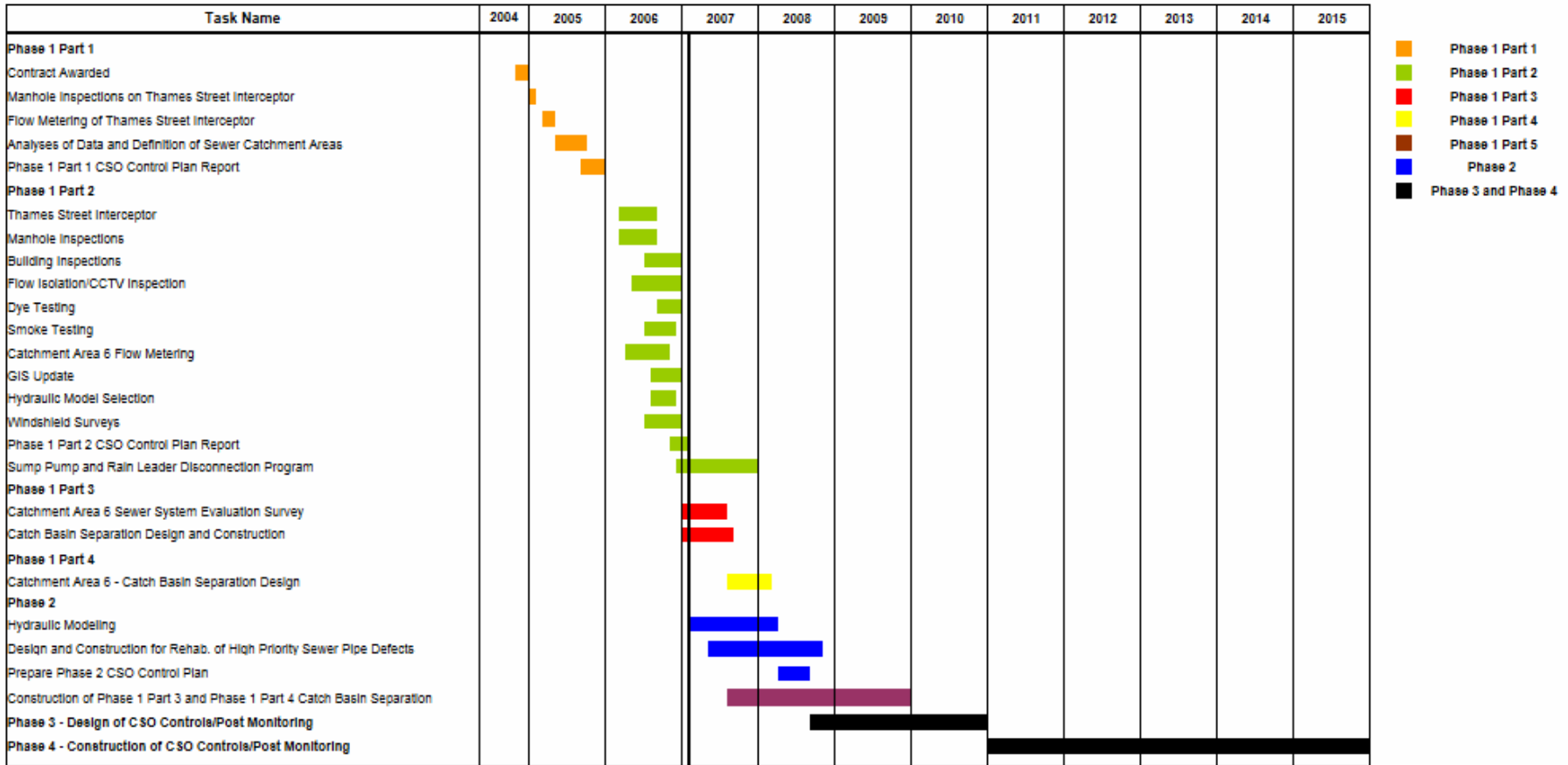


TABLE 14.4
OVERALL CSO PROGRAM COSTS FOR RECOMMENDED IMPROVEMENTS

| | Short Term Operation and Maintenance | Phase 1 Part 3 Planning/Design | Phase 1 Part 4 Design Catchment Area 6 | Phase 2 Planning/Design | Phase 2 Construction of System Improvements | Long Term Operation and Maintenance | Phase 3 CSO Controls Design | Phase 4 CSO Controls Const. and Post - Const. Monitoring |
|--|--|-----------------------------------|--|----------------------------|---|--|-----------------------------------|--|
| Thames Street Interceptor (TSI) CCTV | | | | | | | | |
| Identify Type and Status of Crossing Pipes | Ongoing | | | | | | | |
| Remove/Relocate Crossing Pipes | | | | | | \$5,000,000 (See Note 4.) | | |
| Engineering/Const. to Repair Minor Defects and Rehabilitate (Lining) TSI | | | | | | \$4,500,000 (See Note 4.) | | |
| Flow Isolation/CCTV | | | | | | | | |
| Engineering Design for Rehabilitation of High Priority Defects | | | | \$83,000 | | | | |
| Pipeline Rehabilitation Construction for High Priority Defects, Replacement of Perforated Manhole Covers | | | | | \$697,000 (See Note 4.) | | | |
| System wide Rehabilitation Design | | | | | | Cost TBD | | |
| System wide Rehabilitation Construction | | | | | | Cost TBD | | |
| Manhole Inspections | | | | | | | | |
| Manhole Rehabilitation Engineering Design | | See Note 1. | | | | | | |
| Manhole Rehabilitation Construction | | | | | \$286,000 (See Note 4.) | | | |
| House to House Surveys | | | | | | | | |
| Private Sources - Disconnection of Sump Pumps | Owners Notified by City | | | | | | | |
| Smoke Testing | | | | | | | | |
| Private Sources - Disconnection of Roof Drains/ Area Drains | Owners Notified by City | | | | | | | |
| Public Sources - Separation of Catch Basins and Cross Connections | | \$174,000 | | | Cost TBD | | | |
| Dye Testing | | | | | | | | |
| Private Sources - Disconnection of Roof Drains/ Area Drains | Owners Notified by City | | | | | | | |
| Catchment Area 6 Flow Metering | | | | | | | | |
| Sewer System Evaluation Survey | | \$175,000 | | | | | | |
| Notifications to Owners with Identified Private Sources | | | | Notifications TBD | | | | |
| Separation Design of Public Sources | | | Cost TBD | Cost TBD | Cost TBD | | | |
| Separation Construction of Public Sources | | | | | Cost TBD | | | |
| Hydraulic Modeling | | | | | | | | |
| Hydraulic Modeling | | | | \$418,000 | | | | |
| Phase 2 CSO Control Plan | | | | | | | | |
| Prepare Phase 2 Long Term Control Plan | | | | \$50,000 | | | | |
| Progress Meetings, Workshops and Public Meetings | | | | \$35,000 | | | | |
| Post Construction Monitoring of Enhanced Separation Improvements | | | | | Ongoing | | Ongoing | |
| Design of Phase 2 CSO Controls | | | | | | | Cost TBD | |
| Construction of Phase 2 CSO Controls | | | | | | | | Cost TBD |
| Post Construction Monitoring of Phase 2 CSO Controls | | | | | | | | Ongoing |
| Cost Totals | \$0 | \$349,000 | TBD | TBD | TBD | TBD | TBD | TBD |

- Notes
1. The engineering design cost for manhole rehabilitation and replacement of perforated manhole covers is included in the Phase 1 Part 3 Catch Basin Separation Design.
 2. Estimated construction costs are indexed to December 2006 ENR = 7,887.
 3. TBD = To be determined.
 4. Construction costs shown are planning level estimates and will be refined after completion of designs.

**PHASE 1 PART 3 SCOPE OF SERVICES FOR CATCH BASIN SEPARATION DESIGN,
MANHOLE REHABILITATION DESIGN, AND SEWER SYSTEM EVALUATION SURVEY
ENGINEERING SERVICES
WELLINGTON AVENUE CSO FACILITY
NEWPORT, RHODE ISLAND**

Introduction

As part of the Phase 1 Part 2 CSO Control Plan for the Wellington Avenue CSO Treatment Facility project that was awarded to Earth Tech, Inc. (ENGINEER) in 2006, a Sewer System Evaluation Survey (SSES) was performed in Priority Catchments 1, 3 and 4 to identify wet weather inflow sources presently connected to the City’s sanitary sewer system. The SSES investigative activities, including smoke testing and dye testing, identified inflow sources on public property and private property. This included identification of catch basins, cross connections, abandoned drain lines, and services on public property that are presently connected to the sanitary sewer system. Based on the results of the SSES field investigations to date in Priority Catchments 1, 3 and 4, the following catch basins, cross connections, drain manholes/lines, and “unknown” (i.e., smoke observed rising from the ground within the street right of way and are possible cracked pipes or abandoned service connections) sources on public property were identified as connected to the sanitary sewer:

| Catchment Area | Type | Address/Location |
|-----------------------|----------------------|--|
| 1 | Catch Basin | 27/29 Chapel Street |
| 1 | Catch Basin | Edgar Ct/Memorial Blvd |
| 1 | Catch Basin | Bellevue Avenue/Memorial Blvd |
| 1 | Catch Basin | Parker Avenue |
| 1 | Catch Basin | Middleton Avenue/Parker Avenue |
| 1 | Catch Basin | Memorial Blvd/Red Cross Avenue |
| 1 | Catch Basin | Clay Street/Ward Avenue |
| 4 | Catch Basin | Henry Carey Elementary School |
| 4 | Catch Basin | Houston Avenue/Wellington Avenue |
| 4 | Catch Basin | Marchant Street/Atlantic Street |
| 1 | Cross Connection | Middleton Avenue/Parker Avenue |
| 1 | Drain Manhole | 35 Annandale Road |
| 3 | Cross Connection | Narragansett Avenue/Ochre Point Avenue |
| 3 | Unknown | 19 McCormick Road |
| 3 | Abandoned Drain Line | Ruggles Avenue/Wellington Avenue |
| 4 | Unknown | Columbus Avenue/Wellington Avenue |
| 4 | Unknown | Between Harborview Drive and Columbus Avenue/Wellington Avenue |
| 4 | Unknown | Between Harborview Drive and Columbus Avenue/Wellington Avenue |

In addition, review of existing City plans and reports and previous field investigations performed in Phase 1 Part 1 identified catch basins that are connected to the sanitary sewer at the following locations:

- Cherry Street (dead end, tributary to Washington Street CSO Treatment Facility)
- Willow Street (dead end, tributary to Washington Street CSO Treatment Facility)
- Gladding Court (dead end, tributary to Washington Street CSO Treatment Facility)
- Broadway at Friendship Street (tributary to Washington Street CSO Treatment Facility)
- Harrison Lane (dead end, tributary to Washington Street CSO Treatment Facility)
- Newport Hospital – main entrance and parking lot on Powell Avenue (tributary to Washington Street CSO Treatment Facility)
- Findley Place (dead end, tributary to Washington Street CSO Treatment Facility)
- Long Wharf (tributary to Long Wharf Pump Station)
- Morton Park (tributary to Wellington Avenue CSO Treatment Facility)
- Gidley Street

In addition, the SSES included the following:

- Performance of manhole inspections in Phase 1 Part 2 for Priority Catchments 1, 3, 4 and 7. The results of the manhole inspections indicated that 290 manholes require rehabilitation of one or more defects (i.e., replacement of manhole covers, cracks, loose/missing bricks, leaks, etc.).
- Performance of flow metering in Catchment Area 6 and Closed Circuit Inspection of the Thames Street Interceptor. Based on the results of the CCTV of the Thames Street Interceptor and flow metering, it was recommended that the City perform an SSES program, consisting of flow isolation and follow up CCTV to identify sources of infiltration and house to house inspections, smoke testing and dye testing, to identify inflow sources.

For this Scope of Services, the ENGINEER shall provide professional design services associated with the separation of the catch basins on public property that have been identified as connected to the sanitary sewer system, manhole rehabilitation design for 290 manholes, and performance of a Sewer System Evaluation Survey in Priority Catchment Area 6.

The following Scope of Services represents the work to be performed by the ENGINEER.

Task 1 – Project Administration and Management

- 1.1 ENGINEER shall administer, manage and coordinate design services. ENGINEER shall ensure conformance with the project schedule and budget and overall compliance with project objectives and requirements. In addition, all work performed by subconsultants on the project shall be coordinated, administered and reviewed by the ENGINEER.
- 1.2 ENGINEER shall prepare and submit a monthly progress report and invoice to present project progress and track costs incurred for each Task.
- 1.3 ENGINEER shall prepare for and attend a kickoff meeting and progress meeting (six meetings assumed). ENGINEER shall prepare for and attend up to six additional meetings with federal, state and local agencies, utility companies, and interested groups. ENGINEER shall conduct up to two community meetings to inform the City and public of project progress and issues and to obtain public comment.

Task 2 – Sewer System Evaluation Survey

- 2.1 ENGINEER will perform a Sewer System Evaluation Survey (SSES) of Catchment Area 6. The cost budget for the SSES field work will be based on the quantities, unit rates, and costs as presented in the Catchment Area 6 Flow Metering Technical Memorandum and Thames Street Interceptor CCTV Technical Memorandum. In addition, ENGINEER shall perform dye flooding tests on suspected catch basin sources as identified below in Section 2.7. The work shall consist of the following activities:
 - 2.2 Flow Isolation
 - 2.2.1 In order to isolate extraneous flow within segments of sewer, up to 6,800 linear feet of flow isolation will be performed during high groundwater conditions.
 - 2.2.2 Flow isolation will be performed during the hours of midnight and 6:00 a.m. on a manhole segment by manhole segment basis. The procedure will consist of installing a plug in the inlet of upstream manholes and measuring flow in downstream manholes. The flow measured during these times will be assumed to be extraneous unless use of the system is known to be occurring.
 - 2.3 Cleaning and Television Inspection
 - 2.3.1 In sewer line segments where extraneous flow has been isolated, up to 3,400 linear feet of cleaning and television inspection will be performed to pinpoint sources of infiltration and inflow within the segment. In addition, up to 1,000 linear feet of cleaning and television inspection will be performed to identify locations of sources identified as “unknown” during the smoke testing. The results of television inspection will be summarized on a log. The log will include size of pipe televised, length, manhole identifiers, materials of construction and joint spacing. Where leaking sources are found, the log will include estimates of leakage rate. Television inspection will be the closed circuit, pan and tilt type. The camera used will either be self propelled or pulled through the pipe segment using a winch and pulley system. To facilitate the inspection process, each segment of sewer will be light cleaned using a high pressure hydraulic cleaning nozzle. The scope for television inspection allows for one to two cleaning passes. If more passes are necessary to adequately clean the pipe prior to television

inspection, either Earth Tech's Contract Operations Group will be asked to perform the work or a unit price will be negotiated with the OWNER on a case by case basis. The OWNER will be responsible for providing a disposal site for accumulated debris and pay for any laboratory testing required.

2.4 Smoke Testing

- 2.4.1. Up to 58,000 linear feet of smoke testing will be performed within the priority catchment areas to locate possible interconnections between the drain and sewer piping and possible sources of inflow on private property. This work will be performed during low groundwater conditions.
- 2.4.2 The smoke testing procedure will consist of placing a smoke blower on open sewer manholes, lighting a smoke generating candle and forcing smoke through the sanitary sewer system and out through potential sources of Infiltration/Inflow.
- 2.4.3 Approximately 24 hours (weekends excluded) beforehand, a notice will be circulated in the area to be smoke tested to advise residents of imminent testing.
- 2.4.4 Prior to smoke testing, ENGINEER shall coordinate with fire department, police department and other interested parties and City personnel to review the purpose and nature of smoke testing.

2.5. Building Inspections

- 2.5.1 Up to 1,354 homes or businesses will be inspected for evidence of a sump, sump pump, open cleanout or similar inflow sources. The inspection will also include observation of the foundation area immediately surrounding each home or business for evidence of down spouts, roof leaders or other drains that may be connected to the sewer.
- 2.5.2 Up to three attempts will be made to gain access to the home or business. The first test will be at random. The second attempt will be timed to coincide with a time that the occupant is likely to be home. If after 2 attempts the ENGINEER cannot gain entry to a house, this address will be given to the OWNER so the OWNER can follow-up at a later date.
- 2.5.3 Each person conducting the inspections will carry picture identification badges and wear clothing indicating the company they work for. In addition, the inspector will carry a letter written on Department of Public Works stationary advising occupants that the inspector is carrying out work endorsed by the OWNER. A female will be part of the inspection team, whenever possible.

2.6. Dye Testing

- 2.6.1 Within the catchment, in suspect areas identified through the smoke testing and building inspections, up to 100 suspect sources will be dye tested to confirm whether they are connected to the sewer or not. This work will be performed during low groundwater conditions.

2.7 The following catch basins were identified through the smoke testing as suspected to be connected to the sanitary sewer system.

| Catchment Area | Address/Location |
|----------------|-----------------------------------|
| 1 | Annandale Road/Dresser Street |
| 4 | Marchant Street/Connection Street |
| 4 | 5 Harrison Avenue |
| 4 | 23 Halidon Avenue |
| 4 | Halidon House |
| 4 | Halidon Avenue/Wellington Avenue |
| 4 | Rose Hill Cottages |
| 4 | Henry Carey Elementary School |

ENGINEER shall perform dye flooding tests at each catch basin location to confirm whether each catch basin noted above is connected to the sanitary sewer or not. For costing purposes, it is assumed all of the catch basins noted above will be confirmed as connected to the sanitary sewer, and each will be included in the Catch Basin Separation Contract Documents.

2.8 ENGINEER shall prepare and submit a technical memorandum documenting the results of each of the activities in the SSES.

Task 3 – Geotechnical Investigations

3.1 ENGINEER shall develop and implement a program of geotechnical investigation and evaluation, for use in the design, permitting, and construction of the catch basin separation project. Geotechnical program will consist of review of any existing geotechnical information in the project areas, establishment of locations for geotechnical testing, performance of utility clearance/marketing coordination with the City and DIG-SAFE, coordination of necessary approvals and notifications to gain field access to each testing location, performance of geotechnical investigations using solid stem probes, and preparation of a Geotechnical Investigations Technical Memorandum.

Task 4 – Field Survey and Mapping

4.1 ENGINEER shall coordinate and provide topographic survey, underground and overhead utilities survey (by research and on-site investigation), cadastral survey, AutoCAD photogrammetric plotting services , and deed research necessary to produce plans reflecting existing conditions which are to be used as the base plans for the Contract Drawings and record drawings for the project. The field survey and mapping will be performed as part of the Amendment No. 1 budget.

Task 5 - Design Report

5.1 ENGINEER shall prepare a Design Report to establish design criteria, define the design approach at each catch basin separation location, and resolve outstanding issues to develop contract documents that conform to the City’s applicable standards. Design criteria shall include hydraulic design, manhole rehabilitation requirements for the 290 manholes identified in the Phase 1 Part 2 SSES, rehabilitation recommendations based on the results of the Task 2 SSES activities, construction impacts, construction materials, proposed alignments, construction limits, utility

requirements, methods of construction, construction cost, and construction sequencing and schedule requirements.

- 5.2 ENGINEER shall perform preliminary calculations to determine if the existing storm drainage system has adequate capacity to include flows from the drainage areas presently served by the catch basins to be separated. If capacity does not appear available in the existing storm drain system, ENGINEER shall propose alternatives, such as overland flow, construction of new storm drain systems, or use of flow throttling devices to regulate discharge of additional stormwater from the separated catch basins to the existing storm drain system. It is assumed that locations that require significant reconstruction of existing storm drain systems will require additional geotechnical, field survey and preliminary design activities, and will require a further amendment to this Scope of Services in order to be included in the Contract Documents for this project.
- 5.3 ENGINEER shall identify local, state and federal permits, licenses and other approvals which will be required prior to advertising for construction.
- 5.4 After submission of the Draft Design Report, ENGINEER shall coordinate and conduct a workshop with City staff to provide an overview of the Design Report to provide a technical discussion and exchange of information between the ENGINEER and the City. Upon completion of the workshop, and receipt of City review comments on the Draft Design Report, ENGINEER shall incorporate comments and submit a Final Design Report.

Task 6 – Final Design

- 6.1 ENGINEER shall prepare contract plans, specifications and cost estimates for bidding and construction of one construction contract. Draft plans and specifications shall be prepared and reviewed to ensure consistency with the Design Report. For costing purposes, it is assumed that 28 locations will require catch basin separation plans.
- 6.2 Contract drawings shall be prepared using AutoCAD System, version 2004 for drafting on this project. Base plans shall identify details of existing conditions and structures in the vicinity of work, including existing overhead and underground utilities in plan and profile of the proposed alignments of catch basin separation piping.
- 6.3 ENGINEER shall prepare specifications in accordance with the requirements of the City. ENGINEER shall utilize Construction Specifications Institute (CSI) format for numerical designation of specification sections. ENGINEER shall incorporate the City's standard sections for bidding requirements, contract forms, conditions of the contract, and additional federal and/or state requirements.
- 6.4 ENGINEER shall prepare detailed construction cost estimates covering all project elements including detailed quantity takeoff estimate reflecting the eventual bid item list.
- 6.5 ENGINEER shall prepare and submit 75% complete design submission of plans, specifications and cost estimate and submit to the City for review and comment. For costing purposes, it is assumed that six copies of plans, specifications and cost estimate will be submitted to the City for review.
- 6.6 ENGINEER shall prepare and submit 100% complete design submission of plans, specifications and cost estimate that incorporates City review comments. For costing purposes, it is assumed that six copies of plans, specifications and cost estimate will be submitted to the City for review.

- 6.7 ENGINEER shall prepare and submit bid plans, specifications and cost estimate revised to address comments received on the 100% submission. For costing purposes, it is assumed that ENGINEER shall submit one set of reproducible plans, AutoCAD electronic files, and six copies of plans, specifications and cost estimate.

Task 7 Obtain Permits for Construction

- 7.1 ENGINEER shall apply for and monitor the progress of all necessary permits, licenses and other approvals required for construction. ENGINEER shall prepare draft and final permit applications and provide supplemental information as required by the permitting agency; initiate the application process; attend any pre-submission meetings, including site visits required to establish applicability, jurisdiction and permitting requirements. For costing purposes, it is assumed that up to four permits will be required for construction.