City of Tacoma

NPDES Annual Report
4th Year Report

September 3, 1999

Prepared by:

Public Works Department
Utility Services Engineering Division

TABLE OF CONTENTS

Introduction 1

1. Assessment of Individual Program Elements 1

S7B1 Stormwater Management Program Planning Process 1
S7B2 Water Quality Problems, Needs and Priorities 2
S7B3 Legal Authority 3
S7B4 Monitoring 5
S7B5 Fiscal Analysis 5
S7B6 Data Management 6
S7B7 Intergovernmental Coordination 7
S7B8a Runoff from New Development and Redevelopment 8
S7B8b Existing Residential and Commercial Development Runoff 9
S7B8c Municipal Storm Sewer Operation and Maintenance 10
S7B8d City Road Operation and Maintenance 11
S7B8e Water Quality Consideration in Flood Management Projects 12
S7B8f Runoff from Pesticide and Fertilizer Application 13
S7B8g Illicit Storm Sewer Discharge Elimination 14
S7B8h Industrial Stormwater Monitoring and Control 15
S7B8i Stormwater Education 16
S12 Thea Foss Waterway Basin Program 17

2. Overall Success of the Program 19

3. Monitoring Analysis 20

Thea Foss Waterway Source Control Program 20
Additional Monitoring in the Foss Waterway – Twin 96'ers Bacteria Monitoring 22
Gulch and Stream Assessment Program 23
Commencement Bay Environmental Hotline 25
Monthly Commencement Bay Shoreline Patrol 25
Stream Team Creek Monitoring 26
Monitoring of Surface/Stormwater along Marine View Drive 26
Wetland Monitoring Reports 26

4. Appendix – Monitoring Data 28

Thea Foss Waterway 28
Gulch and Stream Assessment Program 28
Monitoring of Surface/Stormwater along Marine View Drive 29

CITY OF TACOMA
NPDES ANNUAL REPORT
4TH YEAR REPORT

SEPTEMBER 3, 1999

INTRODUCTION

This report is the fourth year report, submitted in accordance with the City of Tacoma's municipal National Pollutant Discharge Elimination System (NPDES) permit that was issued to the City on July 5, 1995 by the Washington State Department of Ecology (Ecology). This report is for the period from July 5, 1995 to the present and it only relates to the overall assessment of the stormwater program. An annual report was submitted in March 1999 for the 1998 program year. Detailed descriptions of program activities were included in that report.

The program descriptions in this report are very brief. Additional information about each program element is available in the City's Stormwater Management Program (SWMP) that was approved by the Department of Ecology in July 1999.

The SWMP was written and approved by Ecology prior to the Endangered Species Act (ESA) coming into play with respect to salmon. The City has been participating in the Tri-County ESA effort. This effort has involved Pierce, King and Snohomish counties and many of the larger cities in these counties. The City, as part of its ESA effort, has been and will continue to review all of its programs with respect to their potential effects on salmon. Programs will be added or modified as needed. The stormwater programs described in the SWMP are being reviewed and will be modified accordingly. It is expected that the next SWMP developed in 2000 for the next five year NPDES permit cycle will contain programs different from the current ones because of the needed focus on salmon preservation. This report is an evaluation of the City's stormwater program activities from July 1995 to the present time and doesn't attempt to evaluate these programs with respect to the ESA.

1. Assessment of Individual Program Elements

S7B1 STORMWATER MANAGEMENT PROGRAM PLANNING PROCESS

- Description of the program.

  Participation by elected officials and the public took place in 1995 and in the first half of 1996. A City Council Study Session on the Stormwater Management Program (SWMP) was held in April of 1999. The Department of Ecology held a public hearing and a public workshop on the City's SWMP in April of 1999. Comments received from the public were incorporated into the SWMP and it was approved by Ecology in July, 1999.

Coordination with elected officials, the public and representatives from other agencies and from the Puyallup Tribe will continue during the term of this permit.

- How is the activity meant to control impacts from stormwater pollution to beneficial uses?

  The planning process involves the public officials, managers, the Puyallup Tribe, other agencies and citizens in the development and operation of the SWMP. The support of these various entities is very important to the funding and operation of the entire stormwater program.

- Should the activity be effective if fully implemented?

  Yes.

- To what extent is the activity implemented currently relative to the Program and to the full potential?

  The activities described are being implemented relative to the Program.

- How is effectiveness being measured?

  Effectiveness is not currently being measured as we are not aware of a way to accurately measure this program element.

- Based on the measurements, is the activity effective?

  Not applicable.

- What would improve effectiveness?

  Evaluating the roles of the various Public Works divisions during the term of this permit will ensure that all of the necessary stormwater related activities such as erosion and sediment control plan review and inspections are accomplished. Hiring the necessary staff during the term of this permit will allow the stormwater program to be effectively implemented. Having adequate staff, trained to do what they're supposed to do, will go a long way towards controlling the effects of stormwater on the beneficial uses of our surface waters.

S7B2 Water Quality Problems, Needs and Priorities

- Description of the program.

  The approved stormwater program, particularly with respect to the identification of unmet needs, provides structure and guidance to the City in its implementation of the program.

Background information on all of the watersheds was gathered. Current activities were described. Watersheds were prioritized and a priority approach for the City-wide source control program was included. Unmet program needs were identified and were prioritized.

- How is the activity meant to control impacts from stormwater pollution to beneficial uses?

  The prioritization of the unmet needs is one of the major provisions of the SWMP. The identification and prioritization of these needs provides a focus for the allocation of resources over the remaining term of the permit. This focus will help to ensure that the most important unmet needs are addressed first.

- Should the activity be effective if fully implemented?

  This is hard to quantify. Problems have been identified and unmet needs have been addressed. Full implementation of this program element is not a realistic goal at this time.

- To what extent is the activity implemented currently relative to the Program and to the full potential?

  Several of the unmet needs have already been accomplished based on the time schedule that was established. The equivalency document has been submitted, the gulch/stream assessment has been started, the sampling and analysis plan for Snake Lake has been submitted, the Stormwater BMP manual was resubmitted and approved. Progress is also being made on accomplishing the unmet needs identified for the Foss Waterway Basin Program.

- How is effectiveness being measured?

  Right now, the effectiveness is being measured by completion of the unmet needs.

- Based on the measurements, is the activity effective?

  This type of measurement does not truly measure the effectiveness of meeting the unmet needs, only that they have been met.

- What would improve effectiveness?

  Each of the program elements needs to be evaluated for effectiveness separately. Each program element consists of more than the unmet needs.

S7B3 LEGAL AUTHORITY

- Description of the program.

The City's drainage ordinance, Chapter 12.08 of the City Code is currently in effect and it will be modified with a tentative adoption date of March 2000. The modifications include the following: inclusion of the minimum requirements; plan review, inspections, permits and enforcement provisions for the minimum requirements; requirements for the maintenance of private storm drainage systems and other small housekeeping type changes.

- How is the activity meant to control impacts from stormwater pollution to beneficial uses?

  Inclusion and enforcement of the specific minimum requirements will provide up to date storm drainage control for the City which will have a direct effect on water quality. The requirement for maintenance of private storm drainage facilities may also have a direct effect on water quality. If private systems are found to be poorly maintained and therefore haven't provided the water quality protection for which they were designed, they will be repaired.

- Should the activity be effective if fully implemented?

  Once the ordinance is modified, it will provide a strong legal basis for the rest of the program. The ordinance supports the other program elements to ensure that they can be carried out when other measures, such as education, don't work.

- To what extent is the activity implemented currently relative to the Program and to the full potential?

  The existing ordinance is useful and is currently used successfully for resolving water quality problems. It contains provisions for notices of violation, administrative orders, fines and criminal penalties. It has been used during industrial inspections to gain compliance. The revisions will broaden the ordinance with respect to the inclusion of all of the stormwater minimum requirements and will require maintenance of private drainage systems which will improve water quality.

- How is effectiveness being measured?

  The ordinance is being used, and problems are being effectively resolved. It would be very difficult to assess the actual effectiveness of the current ordinance other than saying that it works and that the identified problems are being resolved.

- Based on the measurements, is the activity effective?

  Effectiveness is not currently being measured, but problems are being resolved.

- What would improve effectiveness?

  When the ordinance is revised, it will be more comprehensive and therefore should be more effective.

S7B4 MONITORING

- Description of the program.

  The City has a variety of stormwater monitoring programs that are described later in Section 3, Monitoring Analysis.

- How is the activity meant to control impacts from stormwater pollution to beneficial uses?

  The City's monitoring efforts are not designed to control impacts from stormwater pollution. They are designed to measure pollution levels in different types of water bodies. These measurements then help the City prioritize and implement other programs such as the elimination of illicit discharges, industrial and business inspections and education.

- Should the activity be effective if fully implemented?

  The monitoring activities should be effective when they are fully implemented.

- To what extent is the activity implemented currently relative to the Program and to the full potential?

  The activities are being implemented relative to the Program.

- How is effectiveness being measured?

  The monitoring programs will be evaluated as they are completed.

- Based on the measurements, is the activity effective?

  Please refer to Section 3. Data Analysis for additional information on the City's monitoring programs.

- What would improve effectiveness?

  As more monitoring is done and the monitoring is evaluated, the efforts that are less effective will be discontinued and the more effective ones will be continued or enhanced.

S7B5 FISCAL ANALYSIS

- Description of the program.

  The operation and maintenance of the Storm Drainage Utility is funded from service charges. No revenue is derived ~~form~~ taxes or from the City's general fund. Major capital

improvements are funded from revenue bonds and pay-as-you-go financing. The service charges are reviewed annually to insure that they are adequate to pay for operation and maintenance costs, debt service, capital improvements and taxes. All changes to the rates must be approved by the City Council. The annual revenues are about $14 million.

- How is the activity meant to control impacts from stormwater pollution to beneficial uses?

  The service charges fund all of the stormwater activities.

- Should the activity be effective if fully implemented?

  Not applicable.

- To what extent is the activity implemented currently relative to the Program and to the full potential?

  The revenues received are as described in the Program.

- How is effectiveness being measured?

  Not applicable.

- Based on the measurements, is the activity effective?

  Not applicable.

- What would improve effectiveness?

  Not applicable.

S7B6 DATA MANAGEMENT

- Description of the program.

  The City makes extensive use of various data bases and mapping systems. There are precipitation, customer and industry databases. There are section maps, a geographic information system (GIS), basin and sub-basin maps and other land use maps.

- How is the activity meant to control impacts from stormwater pollution to beneficial uses?

  Effective data management allows the other program elements to be carried out effectively.

- Should the activity be effective if fully implemented?

Yes.

- To what extent is the activity implemented currently relative to the Program and to the full potential?

  The activities are currently being implemented relative to the Program.

- How is effectiveness being measured?

  Not applicable.

- Based on the measurements, is the activity effective?

  Not applicable.

- What would improve effectiveness?

  The GIS system is continually being updated.

S7B7 INTERGOVERNMENTAL COORDINATION

- Description of the program.

  The City cooperates with other governmental agencies on its NPDES permit, stormwater management manual, educational activities, watershed planning, transportation projects and other areas.

- How is the activity meant to control impacts from stormwater pollution to beneficial uses?

  Watersheds don't reflect political boundaries and its important to work cooperatively with the other affected agencies. These cooperative efforts allow a more holistic approach to a body of water and its water quality problems.

- Should the activity be effective if fully implemented?

  Yes.

- To what extent is the activity implemented currently relative to the Program and to the full potential?

  The activities are being implemented relative to the program.

- How is effectiveness being measured?

  Not applicable.

- Based on the measurements, is the activity effective?

  Not applicable.

- What would improve effectiveness?

  The City will improve effectiveness in this area by continuing to work with the Port of Tacoma, the Puyallup Tribe and the Environmental Protection Agency regarding outfalls. The City will also be working cooperatively with the Port of Tacoma on a project to improve water quality in the Sitcum Waterway. The City will also work with Drainage District #23 and with the Washington State Department of Transportation on drainage related issues.

S7B8A RUNOFF FROM NEW DEVELOPMENT AND REDEVELOPMENT

- Description of the program.

  The City has a draft Stormwater Management Manual (Manual) that has been submitted to Ecology for review along with an associated Equivalency Document. All residential, commercial and industrial stormwater plans are reviewed for compliance with the provisions of the Manual. Stormwater facilities designed by staff and by consultants are done in accordance with the Manual. Erosion and sediment control plans are reviewed for compliance with the City's Excavation and Grading Ordinance. Inspections are made of all facilities.

- How is the activity meant to control impacts from stormwater pollution to beneficial uses?

  Design, plan review and inspection are very important to the control of stormwater impacts from new development. Uncontrolled development can lead to sediment and erosion control problems, other water quality problems and flooding concerns.

- Should the activity be effective if fully implemented?

  Yes.

- To what extent is the activity implemented currently relative to the Program and to the full potential?

  The activities are being implemented relative to the Program.

- How is effectiveness being measured?

The City has implemented erosion and sediment control inspection forms that are used by inspection personnel to evaluate site conditions and the effectiveness of the BMPs. The inspection reports are compiled into a database and the information is used to identify the on-site performance of the program.

- Based on the measurements, is the activity effective?

Yes, the field inspection reports are helping us identify areas in the program that are having a positive impact on reducing erosion and sediment control issues. In areas where improvement is needed, the data identifies the problem and monitors the effectiveness of the solution implemented.

- What would improve effectiveness?

A grading and erosion quality control team has been identified and staff is currently working on ways to improve the plan review process relating to temporary and permanent erosion control plans. The team is developing ways to educate the public on the needs of implementing adequate erosion and sediment control measures. The team is also researching new technologies and encouraging contractors to try these new technologies. As the education of the public increases, the City will continue to increase its efforts in enforcing the requirements stipulated in the Manual. New inspection and enforcement techniques will be developed in the next year.

Several other things will be completed this permit term that will improve effectiveness. Finalizing the Stormwater Management Manual will be done by January 2000 contingent upon Ecology time frames. Training on the Manual will be developed and provided. Staff will continue to develop written procedures for use in the plan review process.

S7B8B EXISTING RESIDENTIAL AND COMMERCIAL DEVELOPMENT RUNOFF

- Description of the program.

The City's current program includes business inspections, drainage complaints, interagency coordination, stormwater education, a major source control effort in the Foss Waterway drainage basin and enhanced activities in the Snake Lake drainage basin.

- How is the activity meant to control impacts from stormwater pollution to beneficial uses?

Runoff from existing residential and commercial development can have a significant effect on water quality. This program reviews what can be done and then implements activities to reduce pollutants from existing sites.

- Should the activity be effective if fully implemented?

Effectiveness is too hard to quantify. Treating runoff from all existing sites would be prohibitively expensive. Business inspections are effective in that they allow for one-on-one contact with business owners to provide information on best management practices. Also, inappropriate discharges to the storm drainage system can be identified and eliminated.

- To what extent is the activity implemented currently relative to the Program and to the full potential?

  Part of the program is being implemented as described above. The program will be more fully implemented in 2000.

- How is effectiveness being measured?

  Data collected during the monitoring activities in the Foss Waterway will be added to the data base for analysis of trends in stormwater quality. New data will be plotted with existing data for comparative purposes and new averages will be computed to evaluate any trends in the results.

- Based on the measurements, is the activity effective?

  Yes. In municipal outfalls that drain to the Foss Waterway, stormwater loads for specific chemicals of concern (COCs) have undergone 80-85 percent reduction over the last ten years.

- What would improve effectiveness?

  The City has agreed to develop a strategy to address water quality concerns from existing residential and commercial development runoff. This strategy will be completed during this permit term. It will include the above mentioned programs, will incorporate the results of monitoring and will include a plan for evaluating the need for and implementation of structural and non-structural treatment and source control measures.

S7B8C MUNICIPAL STORM SEWER OPERATION AND MAINTENANCE

- Description of the program.

  The Sewer Utility Maintenance Division is developing a comprehensive maintenance program that will extend the life of facilities and systems, and improve system reliability and performance. The program will be completed and implemented by the middle of year 2000. This program includes maintenance improvement and modification, monitoring and evaluation of system performance, and the development of specific performance standard for each maintenance activity. Some of the critical maintenance activities included the maintenance program are, TV inspections, Catch basins inspection and cleaning, ditch inspection and maintenance and the cleaning of scuppers and sumps.

- How is the activity meant to control impacts from stormwater pollution to beneficial uses?

  This program will improve~~ment of~~ storm water quality, by removing contaminants from the storm drainage system before discharge into the receiving waters. Defective facilities and system will be repaired and maintained, and maintenance modification will be made to facility and system to improve performance and reliability.

- Should the activity be effective if fully implemented?

  Yes, should be effective.

- To what extent is the activity implemented currently relative to the Program and to the full potential?

  Parts of the program outlined above are presently in place and working, but full implementation will take place in year 2000.

- How is effectiveness being measured?

  Effective tools are now being put in place. Annual work program describing the kind and amount of work needed to successfully maintain the system is being developed, performance standards are being put in place, and data is now being gathered to determine the kind and amount of contaminants removed from the system.

- Based on the measurements, is the activity effective?

  From inspecting, cleaning and maintaining the system catch basins, ditches, scuppers and sumps we are removing contaminants from the system before they get into the receiving waters. However the gathering of data and implementation of measurements will allow us to evaluate the effectiveness of the program by year 2000.

- What would improve effectiveness?

  Evaluate the maintenance program and practices implemented to determine what is working, and what needs to be done differently.

S7B8D CITY ROAD OPERATION AND MAINTENANCE

- Description of the program.

  The Streets and Grounds Division of the Public Works Department is responsible for road operation and maintenance. This division sweeps the streets, does manual cleaning of

stormwater features such as culverts and catch basin grates, has a fall leaf pick-up program, has a de-icing and snow removal program and responds to spills.

The Streets and Grounds Division has made some recent changes in procedures that will have a positive effect on water quality. They've evaluated their herbicide spraying program and have reduced the use of herbicides. They've also started using a new product on the beds of asphalt trucks to replace diesel. All of the vehicles in the Division are now equipped with spill pads and the staff is trained to use the equipment.

- How is the activity meant to control impacts from stormwater pollution to beneficial uses?

  These programs have an ongoing positive effect on stormwater quality because they all help to keep pollutants off of the streets and out of the storm drainage system.

- Should the activity be effective if fully implemented?

  Yes.

- To what extent is the activity implemented currently relative to the Program and to the full potential?

  Most of the activities are implemented relative to the program. The street sweepers are in the shop frequently and are not in use as often as they have been in the past.

- How is effectiveness being measured?

  Street sweeping is measured by cubic yards of material removed and by miles of street swept. The effectiveness of the other programs are not currently being measured.

- Based on the measurements, is the activity effective?

  The street sweeping is effective. If the material were not removed from the streets, a lot of it would end up in the City's surface waters. The effectiveness of the other programs is not currently being measured.

- What would improve effectiveness?

  The City will be reviewing all existing road maintenance practices with regards to water quality during the next permit term, 2000-2005.

S7B8E WATER QUALITY CONSIDERATION IN FLOOD MANAGEMENT PROJECTS

- Description of the program.

Flood management projects include the City's regional detention facilities, stream bank projects and structures. During the design stage, each project is reviewed for water quality considerations.

- How is the activity meant to control impacts from stormwater pollution to beneficial uses?

  Water quality considerations may be incorporated into the traditional flood management projects during the design stage. Some of the flood control projects can be large and offer a good opportunity to incorporate water quality measures into large projects. This can result in enhanced water quality on a large scale.

- Should the activity be effective if fully implemented?

  The incorporation of water quality into traditional flood management projects doesn't directly deal with effectiveness. The installed water quality BMPs would have to be monitored for effectiveness.

- To what extent is the activity implemented currently relative to the Program and to the full potential?

  The City is now reviewing all of its flood management projects to determine if water quality provisions can be added. The wet pond added to the new detention system at the North Shore Golf Course is an example of the addition of water quality to a flood control project.

- How is effectiveness being measured?

  Effectiveness is not currently being measured.

- Based on the measurements, is the activity effective?

  Effectiveness is not currently being measured.

- What would improve effectiveness?

  The City will continue to improve its review of flood control systems and will try to incorporate innovative water quality measures in future projects.

S7B8F RUNOFF FROM PESTICIDE AND FERTILIZER APPLICATION

- Description of the program.

  The City's Public Works Department and Public Utilities, Metro Parks and the Tacoma-Pierce County Health Department all have their own pesticide, fertilizer and herbicide

programs The City also educates the public about the proper use of these chemicals through its public education program.

- How is the activity meant to control impacts from stormwater pollution to beneficial uses?

  These programs are designed to ensure proper use of the chemicals thereby minimizing the opportunity for the chemicals to get into surface water bodies or ground water through runoff or over spray.

- Should the activity be effective if fully implemented?

  The program should be effective if fully implemented, but the effectiveness will be very difficult to quantify.

- To what extent is the activity implemented currently relative to the Program and to the full potential?

  The agencies mentioned above all have programs to manage the use of these chemicals. The City is educating the public about pesticide, fertilizer and herbicide use. The SWMP indicates that these programs will be reviewed during the next permit term.

- How is effectiveness being measured?

  Effectiveness is not currently being measured.

- Based on the measurements, is the activity effective?

  Effectiveness is not currently being measured.

- What would improve effectiveness?

  The programs will be reviewed for effectiveness during the next permit term.

S7B8G ILLICIT STORM SEWER DISCHARGE ELIMINATION

- Description of the program.

  Elimination of illicit discharges is the City's top stormwater priority. All complaints are investigated. The two people assigned to stormwater source control look for illicit discharges during their business inspections. They also observe or assist emergency response agencies with spill response activities, including the Fire Department's Hazardous Response Unit.

- How is the activity meant to control impacts from stormwater pollution to beneficial uses?

This program directly affects water quality. When illicit discharges are eliminated, pollution sources are eliminated so stormwater quality is immediately improved.

- Should the activity be effective if fully implemented?

  Yes.

- To what extent is the activity implemented currently relative to the Program and to the full potential?

  The program is currently being fully implemented.

- How is effectiveness being measured?

  The elimination of each illicit discharge has a positive effect on stormwater quality. The City recently identified and corrected some illicit discharges that were going into Puget Creek. The elimination of these sources had a positive effect on water quality, although the effect wasn't measured.

- Based on the measurements, is the activity effective?

  Effectiveness is not being implemented, but the activities are effective. The elimination of each illicit discharge, such as the ones impacting Puget Creek mentioned above, has a direct and positive effect on water quality.

- What would improve effectiveness?

  The program is being fully implemented and is very effective.

S7B8H INDUSTRIAL STORMWATER MONITORING AND CONTROL

- Description of the program.

  The City reviews all commercial stormwater plans for adequacy of the private storm sewer systems. There are two stormwater source control staff that inspect industrial facilities. The City's industrial pretreatment staff also look for stormwater problems during their industrial inspections. These inspections are coordinated with Ecology staff.

- How is the activity meant to control impacts from stormwater pollution to beneficial uses?

  This program is designed to ensure that stormwater runoff from new industrial sites receives water quality treatment and that adequate BMPs are in place on existing sites so runoff does not pollute surface waters.

- Should the activity be effective if fully implemented?

  Yes.

- To what extent is the activity implemented currently relative to the Program and to the full potential?

  Activities are currently being implemented as described in the Program. Volume II of the City's stormwater Management Manual - Stormwater Pollution Prevention Manual, A Guide to Best Management Practices for Industries, Businesses and Homeowners was submitted to Ecology for review and was approved in August 1999. Business inspections in areas besides the Foss will be done in accordance with Table 3-1 of the SWMP. City facilities will be inspected and the implementation of BMPs will be done during the term of this permit.

- How is effectiveness being measured?

  Effectiveness is not currently being measured.

- Based on the measurements, is the activity effective?

  Effectiveness is not currently being measured.

- What would improve effectiveness?

  The program will continue to be operated.

S7B8I STORMWATER EDUCATION

- Description of the program.

  The City has a strong educational program as described in the City's SWMP. Some of the highlights of this program are the Stream Team, the charity car washing kits and the educational partnerships that the City has developed with the Tacoma School District, with Metro Parks and with other municipalities.

- How is the activity meant to control impacts from stormwater pollution to beneficial uses?

  The educational program is the means used by the City to reach citizens of all ages. The citizens are provided with educational messages about things that they can do to protect water quality. The main messages that they City conveys are the need for proper automobile maintenance, proper use of fertilizers and pesticides, proper car washing and the need to clean up pet waste. As the citizens become educated, their behaviors will change and water quality will improve.

- Should the activity be effective if fully implemented?

  This is very hard to quantify. Education is a very important component of the program, but it's hard to quantify the effectiveness of each activity.

- To what extent is the activity implemented currently relative to the Program and to the full potential?

  The City's educational program is being almost fully implemented.

- How is effectiveness being measured?

  Effectiveness is not being measured directly. The City has not tried to quantify the effectiveness of the educational program through surveys or other types of program evaluation. We are reaching kids through the school program and adults through other programs.

- Based on the measurements, is the activity effective?

  The program is not currently being measured.

- What would improve effectiveness?

  More and different types of education could be offered.

S12 Thea Foss Waterway Basin Program

- Description of the program.

  The City of Tacoma has entered into an Administrative Order on Consent (AOC) with the Environmental Protection Agency (EPA) for Pre-Remedial Design and Remedial Design for the Thea Foss and Wheeler-Osgood Waterways. The objective of the City and EPA under the AOC is to design a remedial action for these waterways which is consistent with the requirements of the Record of Decision (ROD) for the Commencement Bay Nearshore/Tideflats Superfund Site issued by EPA. In order to facilitate the design effort, additional information about the waterways is being gathered by the City. Much of this effort is focused around a multi-faceted effort that includes an extensive research and screening effort, source control activities, education, business inspections, stormwater monitoring and other activities.

  The Thea Foss Waterway Basin Program was submitted to Ecology in February 1996 and was approved in April 1996. The approved program is included in Chapter 18 of the City's SWMP. The Thea Foss and Wheeler-Osgood Waterways Source Control Report (October 1997, Final update September 1999) and the Stormwater Monitoring Sampling and Analysis

Plan (March 1999) provides an update of the Foss source control program and a monitoring strategy.

- How is the activity meant to control impacts from stormwater pollution to beneficial uses?

  This ongoing program is designed to control impacts from a variety of stormwater sources. Business inspections were completed and follow-up inspections are continuing. Staff investigates spills and complaints relating to other drainage problems; other activities such as street sweeping and catch basin cleaning are continuing, the public and business community are being educated about stormwater concerns. Sampling and analysis of the storm drains entering the Thea Foss and Wheeler-Osgood Waterways has been done. Sediment traps were sampled, and other monitoring efforts were completed. Both whole water sampling and sediment trap sampling will continue as outlined in the Stormwater Monitoring Sampling and Analysis Plan and will assist in evaluating progress and focussing future efforts. Investigations of point sources as identified by the City are coordinated with Ecology. All of these efforts are designed to improve water quality.

- Should the activity be effective if fully implemented?

  The activities are being fully implemented. The effectiveness of a source control program in reducing the levels of specific contaminants is difficult to accurately estimate. In the past ten years, the water quality in municipal stormwater discharges has improved indicating that the SWMP is effective.

- To what extent is the activity implemented currently relative to the Program and to the full potential?

  The activities are being fully implemented relative to the Program.

- How is effectiveness being measured?

  Data collected during the monitoring activities will be added to the data base for analysis of trends in stormwater quality. New data will be plotted with existing data for comparative purposes and new averages will be computed to evaluate any trends in the results.

- Based on the measurements, is the activity effective?

  Yes. In municipal outfalls, stormwater loads for specific chemicals of concern (COCs) have undergone 80-85 percent reduction over the last ten years.

- What would improve effectiveness?

  The SWMP will continue to be operated including monitoring to further identify land use or activities where COCs are prevalent and additional source controls are needed.

The City is preparing a Stormwater Source Control Feasibility Study. The study will be submitted to Ecology in September 1999. The study includes an evaluation of source control effectiveness for the SWMP as a measure of City dollars spent on source control in the Thea Foss subwatershed per mass load reduction.

2. Overall Success of the Program

The City has had many successes related to its stormwater management program over the years. The Utility itself was formed in 1979 and at the time was one of the first stormwater utilities in the state. On another historical note, the City's storm drain and sanitary sewer lines were separated thirty years ago while other major municipalities only recently started separating stormwater from sanitary sewers. More recently, the City's Municipal NPDES permit was issued in July of 1995 and the Stormwater Management Program (SWMP) was approved by Ecology in July 1999. The City's Stormwater Pollution Prevention Manual, A Guide to Best Management Practices for Industries, Businesses and Homeowners was approved by Ecology in August 1999. Progress has already been made towards meeting many of the unmet needs outlined in the SWMP.

Several of the components of the City's SWMP have historically been very strong and remain so today. The educational program is extensive and operates with several effective partnerships. The source control program has not only been effective in the Foss Watershed, but in other areas of the City as well. Illicit discharges are corrected as soon as they are identified.

The educational program has had a positive, but unquantified, effect upon the public's knowledge of water quality. The stormwater program is where the recycling program was about 5-10 years ago. Few people were recycling, because they didn't have information about the program. After a lot of educational efforts, over 60 % of the residents of the City now utilize curbside recycling, and in some neighborhoods this number exceeds 80%. Most people will do the right thing when they have the background to make decisions. People are starting to change their behaviors that have an effect on water quality. When City staff answer the phone, meet the public in the field during the course of regular work or at special community events, they have noticed that more people are aware of water quality issues and concerns. Again, this can't be quantified, but the City feels that its strong educational program has been making an impact on the public and that behaviors are changing.

The source control program has also been a very effective one. The City assigned two staff people to the source control program several years ago. These two people first focused their efforts on source control in the Foss Waterway drainage basin and are now working in other areas as well. Through these inspections, some industrial sources of contaminants to the storm drainage system have been identified and the City is working with these businesses, as well as Ecology, to eliminate these sources. More typically, they have provided technical advice to many businesses about how to keep pollutants out of stormwater.

In addition, source control investigations have been performed by the inspectors to follow up on concerns identified through monitoring. Through these investigations, several sources of infiltration into the system have been identified and the City is now working with Ecology to eliminate these sources.

While effectiveness of these specific efforts are difficult to quantify, existing monitoring data indicates a trend of decreasing loads for several constituents, including contaminants of concern to the waterway. Qualitative assessment indicates that these source control efforts have been successful in increasing the level of awareness of the impacts of business practices on stormwater quality. In addition, through inspection and source control investigations, discreet sources of contaminants have been identified and these sources have been or will be eliminated.

The illicit discharge elimination program has been very effective. As discharges are identified, they are taken care of immediately. The priority placed on the elimination of these discharges has helped improve water quality since the removal of these discharges has a direct impact on water quality.

The City's stormwater priorities were identified in the recently approved Stormwater Management Program (SWMP). Unmet needs were identified and were prioritized as high, medium and low. The identified unmet needs are still appropriate and the City has made exemplary progress in meeting these needs. The equivalency document for the Stormwater Management Manual, Volume I, Design has been submitted to Ecology, the gulch/stream assessment is well underway, the sampling and analysis plan for Snake Lake has been submitted to Ecology, and the Stormwater BMP manual was resubmitted to Ecology and approved. Progress is also being made on accomplishing the unmet needs identified for the Foss Waterway Basin Program.

At this early stage of the development of the stormwater program, it's extremely difficult to determine the amount of water quality improvement on a City wide basis. Many of the activities, such as the illicit discharge elimination program, have had a direct improvement on water quality in Puget Creek and other areas. Staff response to and resolution of problems at Snake Lake and at the Coal Tar Site on the Foss Waterway, as outlined in the last annual report, also had a direct improvement on water quality. The City is currently making a major effort to improve its erosion and sediment control program for sites undergoing development. These efforts are described earlier in this report under S7B8a Runoff from New Development and Redevelopment. These program changes should result in direct improvements to water quality by keeping sediments out of the water bodies. The monitoring program is in its early stages. As more monitoring is done now and over the next permit cycle, we will have more information that can be used to assess the impact of stormwater discharges on beneficial uses of our waters.

3. Monitoring Analyses

THEA FOSS WATERWAY SOURCE CONTROL PROGRAM

With respect to the Thea Foss Waterway Source Control Program, the City has performed a significant amount of sampling and analysis in compliance with:

- the Administrative Order on Consent (EPA);
- Section S12 of the NPDES Stormwater Permit ; and
- the Centennial Clean Water Fund Grant No. G9700021.

These sampling activities, which are summarized in the City's Stormwater Management Program (SWMP) July 1999, include catch basin sediment sampling (both public and private catch basins), whole water sampling, and in-line sediment trap sampling. To date, sampling efforts have been successful in: 1) confirming the identification of contaminants of concern, 2) identifying problem areas within drainage basins, 3) identifying potential specific industrial sources, 4) confirming sources and/or contaminants during spill investigations, and 5) identifying the types and concentrations of pollutants in stormwater sediments relative to specific drainage basins.

Whole water and catch basin sediment sampling are key elements for identifying potential point sources during business inspections and source investigations. In-line sediment traps provide important data relating to pollutants in stormwater particulates. In-line sediment traps can be installed near outfalls or upstream in major trunk lines and laterals to isolate problems identified in specific drainage basins.

Specific projects within the Thea Foss Waterway basin involving sampling activities as discussed above are summarized in Section 19 of the SWMP, July 1999. Detailed descriptions of these projects and activities, including sampling analysis results, are contained in the Round 3 Data Evaluation and Pre-Design Evaluation Report, Appendix Q.

Most of the sampling related to source control activities is conducted "as needed" when problems are identified through inspections, complaints, spills, and pollutant source investigations. As such, no QA/QC Plan exists for these sampling activities. Rather, the City relies on the Source Control Flow Chart as a guide for addressing problems identified "in the field." (See Flow Chart in the SWMP, 7/99, Figure 3-3.)

Detailed information relating to the following projects will be included in the final submittal of Appendix Q, which is due September 30, 1999.

In 1996, the City collected whole water samples at key manholes within Basins #237A, #237B, and #230. The objective was to obtain additional data with respect to upland concentrations of bis(2-ethylhexyl) phthalate (BEP) in an attempt to identify problem areas and/or specific sources of BEP. After obtaining one round of both wet and dry weather samples, a Quality Assurance Project Plan (QAPP) was later prepared and submitted to Ecology for funding approval under a Centennial Clean Water Fund Grant. But, because BEP exhibits a strong tendency to adsorb to sediments, the project was discontinued in favor of in-line sediment trap monitoring. Attached is the City's Draft QAPP, Ecology comments to the QAPP, and a Final Project Report. This

information was previously submitted to Ecology in the Centennial Grant Quarterly Report dated January 21, 1997. This can be found as #1 in the Appendix - Monitoring Data.

In November 1996, Ecology prepared a QAPP for Stormwater Sediment Trap Monitoring of Discharges to Thea Foss Waterway. The objective of the project was to refine source loading terms for the Water Quality Analysis Simulation Program (WASP) modeling and more accurately evaluate the potential for recontamination of bottom sediments in the waterway. In-line sediment traps were successfully deployed between September 1996 and January 1997 in the three major discharges to Thea Foss Waterway. Attached is the QAPP and Project Summary. This can be found as #2 in the Appendix - Monitoring Data.

In November 1997, Ecology prepared a QAPP for the 2nd round of Sediment Trap Monitoring of Stormwater Discharges to Thea Foss Waterway. All sites sampled the previous year were re-occupied. The primary objective was to verify contaminant levels associated with particulates found the previous year. New sites were also chosen in an attempt to isolate suspected contaminant sources identified during inspections. Attached is the QAPP and Project Summary. This can be found as #3 in the Appendix - Monitoring Data.

In February 1999, in-line sediments deployed in October 1998 were retrieved and analyzed by the City. Four locations were chosen to isolate suspected contaminant sources and to obtain a sample at a location which was lost the previous year. Attached is the sample analysis report dated May 3, 1999. This can be found as #4 in the Appendix - Monitoring Data.

In 1999, the City manufactured 20 in-line sediment traps which were installed in late summer 1999. Two additional traps will also be manufactured and installed. A total of 22 traps will be collecting sample during the fall of 1999. The purpose of this project is to meet NPDES monitoring requirements and isolate problem areas upstream in Basins #235, #237A, and #230. Attached is a list of these sample locations. This can be found as #5 in the Appendix - Monitoring Data.

The City has recently completed a source control investigation in the lower portion of Basin #235 which was conducted to identify the source of persistent petroleum odors in the storm drainage system. The investigation concluded that groundwater contaminated with gasoline is infiltrating at various locations within the system. A report on the findings, which is currently being finalized, will be included in Appendix Q.

In March 1999, the City submitted to Ecology a Sampling and Analysis Plan for stormwater monitoring of specific outfalls draining to Thea Foss and Wheeler-Osgood Waterways. The plan proposes sediment trap monitoring as well as whole water sampling during both wet and dry weather conditions. As stated above, sediment traps have been installed. The City will begin implementation of whole water sampling in September 1999.

ADDITIONAL MONITORING IN THE FOSS WATERWAY - TWIN 96'ERS BACTERIA MONITORING

Monitoring for fecal coliform and fecal strep began after a report came out showing elevated levels of bacteria at the mouth of Thea Foss Waterway in February of 1998. Initially several samples were taken throughout the Waterway. Ongoing monitoring has continued at three locations. Initially samples were taken two times per week. In 1999 sampling and analysis was reduced to once per week. Samples are taken at the mouth of each of the 96" storm lines located at the head of Thea Foss Waterway and in the middle of the Waterway at the 509 bridge. The information collected at each location is fecal coliform, fecal strep, and flow. Observations are also made of weather conditions and rainfall. No sampling and analysis plan (SAP), quality control/quality assurance plan was developed for this sampling. Standard Laboratory Quality Control/Quality Assurance guidelines are followed in the performance of this work. This sampling and analysis is being performed for the City's own information. The data that has been collected so far is included in the Appendix, Thea Foss Waterway, #6 Fecal Coliform and Fecal Strep.

The data has been analyzed in a variety of ways to try and determine the possible source of the bacteria contamination. The data is highly variable and no pattern of contamination has been discovered that might lead to potential sources.

The conclusion is that bacteria contamination is still present at times in the twin 96'ers, at time exceeding water quality criteria. The recommendation is to continue to monitor and look for possible sources of contamination entering the storm lines. If possible sources of contamination are identified, the plan is to eliminate the sources and see if monitoring indicates any improvement in the water quality.

The goal is to improve water quality coming out of the twin 96'ers. Results of some analysis indicate that contamination is still present at times exceeding water quality criteria.

Follow up will entail continued monitoring as well as up line monitoring and observations to try and identify and eliminate possible sources of contamination.

GULCH AND STREAM ASSESSMENT PROGRAM

The City of Tacoma wants to adequately assess the condition of and the impacts to its gulches and the streams within them. After gaining this data, the City will possess the background needed to support the development of water quality priorities and programs for the City, as well as influence decisions concerning the Endangered Species Act. The City of Tacoma has identified three areas to assess: Western Slopes, North Tacoma, and Northeast Tacoma (refer to map in the Appendix, Gulch and Stream Assessment, #1). Physical habitat assessments are conducted to identify habitat degradation, the causes of the degradation, and restoration potential. Taking measurements of the stream's physical and chemical characteristics is the method chosen by the City to accomplish this task. The goals of this task are:

- Identify and map all the creeks/gulches within Tacoma's city limits.

- To identify each creek's unique characteristics, such as: bank and bed problems (e.g., existing erosion), poor or exotic vegetative cover, extreme litter, presence of odors, illicit discharges, and improper uses of creek waters.

Of these three basins, Western Slopes is the first to be assessed and is almost complete. Our GIS ArcView program generated maps of the Western Slopes area. Topographic lines, stormwater pipes and their discharge/collection points, roads, and aerial pictures were included on the maps and analyzed in order to determine potential gulches and sources of water. The identified areas were then accessed and appropriately evaluated using the techniques and attributes presented in the Project Plan.

Data collection has been modified. Forms #1-4, previously submitted, are working well. Form 1 now includes records of salinity and turbidity. It was also decided that flow and other noticeable characteristics be recorded (see attached new forms). Other than the additional forms and added stream attributes, the proposal direction and actual project direction remain the same.

Water quality is being measured by using an Horiba U-10 Water Checker (Form 1). Calibration is performed every day to ensure accuracy. Stream assessments are made approximately every 200 feet measured by paces or eyesight estimation. Many times the streams are heavily vegetated; the 200-ft distance is modified and recorded accordingly. Instream physical measurements (Form 2) are taken. Riparian vegetation estimates (Form 3) are made using visual approximations. In channel characteristics are assessed using the given codes and visual cues (Form 4). One of the additional forms, titled Noticeable Characteristics of Streams, provides space to record extreme litter, sediment characteristics, erosion, illegal creek usage, and poor vegetative cover. The second additional form, Data Sheet 5 – Flow Method II (taken from Streamkeeper's Field Guide), will provide an estimation of the flow. This measurement will be taken as close to the mouth of the stream as possible.

The objectives presented in the Project Plan are being met. Identification of the area's gulches and streams has been thorough and will be mapped using landmarks and pacing techniques. Unique characteristics (bank erosion, litter, poor vegetation, etc.) of all creeks thus far have been documented and photographed.

The project is not yet completed; therefore conclusions are not appropriate. Recommendations thus far would be for projects (e.g. erosion control, litter removal, public awareness, culvert relocation) in identified problem areas.

The project hasn't achieved its goals yet because it hasn't been completed yet.

The following follow-up projects would be useful: investigation into the causes of gulch/stream erosion, enhancement projects resulting in restored areas and/or increased habitat for salmon or other species, in-depth research projects to further analyze impacts to and potential of studied areas.

COMMENCEMENT BAY ENVIRONMENTAL HOTLINE

Pursuant to a federal consent decree settling presumed natural resource damages liability, a hotline was established to act as a clearing house for reports about environmental threats to Commencement Bay, whether from storm water outfalls or other sources. Staffed by City of Tacoma Stormwater Quality Representatives, the hotline receives citizen concerns about environmental problems and refers them on to the appropriate agency: Coast Guard, Ecology, a Department within the City itself, etc. The establishment of this hotline included an extensive effort to promote it. The promotion included the production of posters to hang in local businesses and Public Service Announcements for broadcast on City Cable TV (Channel 12). Only one call was received during the first 6 months of operation and was strictly a marine incident with no stormwater association.

Calls relating to stormwater issues will be tracked in the City's Stormwater Trouble Call database. Analysis of trends relating to stormwater issues will be covered in that program element.

It is premature, given the brief period of operation, to draw conclusions or make recommendations based on this project. It is also premature to evaluate this project due to its limited period of operation. Follow-up projects may be identified after a longer period of operation.

MONTHLY COMMENCEMENT BAY SHORELINE PATROL

Pursuant to a federal consent decree settling presumed natural resource damages liability, the City has instituted monthly shoreline patrols to search for environmental violations and other problems in the Commencement Bay shoreline area. Staffed by City of Tacoma Stormwater Quality Representatives and Buildings and Land Use personnel, the patrol examines the shoreline of Commencement Bay and its waterways looking for illicit discharges or spills, building code violations and other environmental problems. The issues are referred on to the appropriate agency: Coast Guard, Ecology, a Department within the City itself, etc.

In the first 8 months of patrols, 15 incidents have been recorded. One incident involved a turbid discharge from stormwater outfall #230. Further investigation by City stormwater staff found the turbidity to be related to a break in a water supply pipe, which was fixed immediately.

Calls relating to stormwater issues will be tracked in the City's Stormwater Trouble Call database. Analysis of trends relating to stormwater issues will be covered in that program element.

It is premature, given the brief period of operation, to draw conclusions or make recommendations based on this project. It is also premature to evaluate this project due to its limited period of operation. Follow-up projects may be identified after a longer period of operation.

STREAM TEAM CREEK MONITORING

Volunteer Stream Team members have been monitoring many creeks in the City and also in locations outside of the City, but in creeks that Tacoma shares with other municipalities. The monitoring has included physical and chemical parameters. Macroinvertebrate sampling has also been done. The creeks include Puget, Hylebos, Swan, Chambers, Flett, Leach and Wapato Creeks. This data is available, but has not been analyzed. Therefore, the data is not included in this report.

MONITORING OF SURFACE/STORMWATER ALONG MARINE VIEW DRIVE

This project is monitoring surface/storm water running off the cliffs above Marine View Drive in the vicinity of Natural Resource Damages Assessment (NRDA) trustee proposed restoration sites. The purpose is to determine if the water is of acceptable quality to be used in restoration projects. The trustees have two proposed restoration sites. The first site is referred to as the Puyallup Intertidal Plant Nursery site and the second site is referred to as the Meeker site. Monitoring is conducted twice per quarter at three locations. Parameters tested for are organic, inorganic and conventional parameters. Monitoring began in early 1999 and will continue for 4 quarters. A sampling and analysis plan (SAP) was prepared and approved by the trustees before monitoring began. The data that has been collected so far is included in the Appendix, Monitoring of Surface/Stormwater along Marine View Drive.

Data will be analyzed upon completion of the 4 quarters of monitoring to determine if the water is of acceptable quality to meet the needs of the restoration projects.

There are no conclusions or recommendations at this time while data is still being collected.

The goal is to monitor two times per quarter during both dry and wet weather conditions. To date the sampling and analysis goals of this one year project are being met.

At this time it is not known whether there will be any follow up after the 4 quarters of data are collected. That will likely be dependent on the results of the monitoring data.

WETLAND MONITORING REPORTS

Wetland Mitigation Plans are required for mitigation in the event that creation, enhancement, or restoration as a form of compensation is chosen for mitigation. Monitoring of the area is required for at least 3 years, and can be extended to five years if deemed appropriate by the Land Use Administrator. Monitoring reports are received annually for projects that require them. If the monitoring indicates that the performance standards are being met, or will be met with enacted contingency plans, the report is filed with the original permit. If the monitoring report indicates some performance standard is not being met, the corrective action will be requested through a letter identifying the problem and corrective measure. If the problem is not addressed in a timely manner, the matter is handled as a violation and enforcement commences.

The Critical Areas Preservation Ordinance includes the following requirements for mitigation plans. The plan shall provide information on land acquisition, construction, maintenance and monitoring of the created, enhanced or restored wetland or stream that recreates as nearly as possible the original wetland or stream in terms of function, geographic location and setting. All mitigation plans shall be prepared by a wetlands specialist, submitted by the applicant, and contain the following information:

1. Data collected and synthesized for the newly created, enhanced or restored site;

2. Specific goals and objectives describing site function, target species and selection criteria;

3. Performance standards which shall include criteria for assessing goals and objectives;

4. Contingency plans which clearly define course of action or corrective measures needed if performance standards are not met;

5. A legal description and a survey prepared by a licensed surveyor of the proposed development site and location of the wetland or stream on the site;

6. A scaled plot plan indicating the proposed construction location, zoning setback requirements, and sequence of construction phases. The plan also shall include cross-sectional details, topographic survey data (including percent slope and existing and finished grade elevations) and other technical information, as required, in sufficient detail to explain, illustrate and provide for:

a. Soil and substrate conditions, topographic elevations, scope of grading proposal, and erosion and sediment treatment and source controls needed for wetland or stream construction and maintenance;

b. Planting plans specifying plant species, types, quantities, locations, sizes, and spacing; the planting season or timing; watering schedule; nutrient requirements for planting and, where appropriate, measures to protect plants from destruction;

c. Water-quality parameters; turbidity class and criteria for water quality as set forth in RCW 173-201, Water Quality Standards for Surface Waters of the State of Washington, during construction and after completion; water source; water depths; water control measures and water level maintenance practices needed to achieve the necessary ambient water conditions; and hydrocycle or hydroperiod characteristics;

d. Contingency or mid-course corrections plan; and

e. A monitoring plan, for a period of not less than three years, which establishes responsibility for removal of exotic and nuisance vegetation and for permanent

establishment of the wetland or stream and all its component parts;

7. A clearly defined approach to assess progress of mitigation project;

8. The plan must indicate ownership, size, type, and complete ecological assessment, including flora, fauna, hydrology, functions, etc., of the stream or wetland being created, enhanced or restored; and

9. Information on the natural suitability of the proposed site for establishing the replaced wetland or stream (i.e., water source and drainage patterns, topographic position, wildlife habitat opportunities, value of the existing area to be converted, etc.).

The monitoring reports are important to provide information necessary to show wetland permitting has been carried out effectively without loss to the resource. Specific monitoring reports and the data collected will not be included in this report. However, they are available at the Building and Land Use Services Division of Public Works.

4. Appendix - Monitoring Data

THEA FOSS WATERWAY

1. Draft QAPP: Survey of Phthalate Concentrations in Priority Drainage Basins within Foss Waterway Subwatershed, 1996.

- Ecology Comments, Letter 12/3/96
- Final Project Report

2. Stormwater Sediment Trap Monitoring of Discharges to Thea Foss Waterway, Commencement Bay, Washington. Quality Assurance Project Plan, November 1996.

3. Sediment Trap Monitoring of Discharges to Thea Foss Waterway, Commencement Bay, Washington. Draft Quality Assurance Project Plan, November 1997.

4. Sample Analysis Report for Sediment Samples collected on February 19, 1999.

5. List of Sediment Trap Sample Locations.

6. Fecal Coliform and Fecal Strep sampling results.

GULCH AND STREAM ASSESSMENT PROGRAM

1. Map - City of Tacoma, Watershed and Subwatersheds.
2. Data Sheet 5 Flow - Method II
3. Form - Noticeable Characteristics of Streams

MONITORING OF SURFACE/STORMWATER ALONG MARINE VIEW DRIVE

1. Cover letter from City to National Oceanographic and Atmospheric Administration (NOAA), August 1999. The laboratory field reports are included.