COMPREHENSIVE SURFACE WATER MANAGEMENT PLAN

FINAL PLAN

City of Mount Vernon

CITY OF MOUNT VERNON

NOVEMBER 1995

R·W·BECK

November 20, 1995

R·W·BECK

Mr. John Wiseman
City Engineer
City of Mount Vernon
P. O. Box 800
Mount Vernon, Washington 98273

Dear Mr. Wiseman:

Subject: **City of Mount Vernon**
Final Comprehensive Surface Water Management Plan

We are pleased to submit this final Comprehensive Surface Water Management Plan for the City of Mount Vernon. The plan contains recommendations for a combination of policies, ordinances, regulations, public education, increased maintenance activities, and capital improvements to solve current and future flooding, water quality, and environmental resource protection problems.

The plan also contains a maintenance and operations and a financial plan to guide the City's long-term implementation of this plan.

We have enjoyed working with the City of Mount Vernon on the preparation of this plan, and appreciate the valuable assistance that the staff members have given to us.Sincerely,

R. W. BECK

Steve Swenson
Project Manager

SS:ec

Attachments

File: 12-00029-10101-0109
X1279120.987

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COMPREHENSIVE SURFACE WATER MANAGEMENT PLAN

CITY OF MOUNT VERNON

Project funded with assistance from:

Washington State Department of Ecology
Centennial Clean Water Fund

Prepared for

City of Mount Vernon
Engineering Department

R·W·BECK

November 1995

ACKNOWLEDGEMENTS

R. W. BECK

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CITY OF MOUNT VERNON

COMPREHENSIVE SURFACE WATER MANAGEMENT PLAN

The technical material and data contained in this report were prepared under the supervision and direction of the undersigned, whose seal as registered professional engineer licensed to practice as such in the State of Washington is affixed below.

Steven J. Swenson
Project Manager
R. W. Beck

MOUNT VERNON SURFACE WATER MANAGEMENT PLAN

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SECTION I
EXECUTIVE SUMMARY

RW BECK

SECTION I

EXECUTIVE SUMMARY

The City of Mount Vernon Surface Water Management Plan was developed with funding from the City of Mount Vernon and the Washington State Department of Ecology under the Centennial Clean Water Fund (CCWF). This plan consists of a comprehensive examination of the existing surface water management system with primary focus on water quantity and quality control as well as the preservation and enhancement of valuable environmental resources such as wetlands, riparian corridors, and fish habitat.

Through the use of field observations, results of past studies, hydrologic/hydraulic computer modeling, public input, and City input, the plan identifies existing problems and potential future problems that may result from continued development within the study area. A combination of policies, ordinances, regulations, public education, increased maintenance activities and capital improvements are recommended to solve these problems. The major plan elements include the following:

- Establishment of a Citizen Advisory Committee (CAC) and a series of several meetings in which public input was collected.
- Development of an environmental resources inventory.
- Continuous hydrologic and hydraulic computer modeling analysis of the major streams within Mount Vernon to simulate existing flows, project future flows and evaluate system requirements.
- Development of public education programs to increase the understanding and awareness of citizens and business owners about flood control and how their actions can affect water quality and environmental resources.
- Development of a Capital Improvement Program.
- Development of a Maintenance and Operations Plan.
- Development of a financial strategy and funding mechanism to support the recommended surface water management program.
- Review of local, state and federal policies, regulations, and programs relevant to surface water management and development of recommended changes to City regulations to be consistent with current and pending state and federal programs.

The City of Mount Vernon is an area that typifies the problems associated with protecting natural resources while accommodating development. Much of the study area has developed to urban and suburban densities and displays many of the unintended surface water problems

associated with rapid growth. These problems include flooding, erosion, sedimentation, destruction of fish habitat, and degraded water quality.

The plan recommends a comprehensive surface water management program that relies on a combination of education, regulations, operation and maintenance, and capital projects to protect surface water resources. The recommendations, if implemented, will aid in preventing future flooding, improving the existing water quality, and protecting and enhancing valuable environmental resources.

The purpose of a Maintenance and Operations Program is to ensure system reliability, achieve the lowest life-cycle cost for facility replacement, and to use maintenance methods and standards that promote water quality. The recommended stormwater maintenance and operations program will require an annual budget of approximately $195,300 in 1995 dollars, which includes the equivalent of approximately three full-time staff persons. This represents an increase of the current budget and the addition of two maintenance workers. Specific maintenance and operation recommendations include increasing the frequency of catch basin cleaning an average of once every eight months, more maintenance of pipes and small culverts, and modified maintenance of roadside ditches.

The implementation of the 10-year capital improvement program was estimated to cost $7,129,500 in 1995 dollars. A summary of these costs is provided on Table X-1. The estimated total annual costs, minus maintenance, for ongoing programs is $278,200. The City has established a utility service charge to finance the program shown on Table I-1. The rate is set at $3.95 per month for each single family residence or duplex and each commercial Equivalent Service Unit (ESU).

TABLE I-1

Recommended Plan Summary

Brief Description	Annual Cost	Estimated Project Cost
Annual Maintenance Program	$195,300	
Surface Water Manager-Engineering and Regulatory Support	$ 88,200	
Operations	$ 41,000	
Public Education	$ 16,000	
Finance/Billing/Accounting/Payroll	$ 21,000	
Utility Taxes	$ 72,000	
Engineering[1]	$40,000	
Capital Improvements Program		
Years 1–10		$7,129,500
Years 11–20		$2,582,000
	$473,500	$9,711,500

[1] Costs to be incurred through the year 2000.

SECTION II
INTRODUCTION

SECTION II

INTRODUCTION

A. Purpose

A large percentage of the City of Mount Vernon has been developed into residential, commercial, and industrial land uses. As the City continues to grow and development continues, this conversion of natural pervious land areas to impervious areas will result in increased volumes of runoff entering the surface water drainage system. With existing development, the City experiences localized flooding, ponding, channel erosion, water quality, and sensitive resource problems. The flooding, water quality, and sensitive resource problems are the result of uncontrolled runoff from developed areas, inadequate capacity in existing storm drainage systems, and the loss of the natural flood-reducing capacity of wetlands, closed depressions and stream channel corridors. With future development, these problems will become worse unless proper surface water management strategies are implemented.

The purposes of this study are to:

- Analyze the existing drainage system with respect to flooding, water quality, and sensitive resources;
- Predict future flooding and storm water runoff patterns;
- Recommend revisions to existing policies and regulations to reduce future flooding, reduce water quality problems, and protect environmental resources;
- Recommend improvements to the existing surface water system to reduce future flooding and water quality problems, and to protect and enhance existing sensitive resources;
- Recommend a long-term maintenance and operation program that ensures system reliability and incorporates maintenance methods and standards that promote water quality and sensitive resource preservation; and
- Recommend a financing plan capable of funding recommended capital improvements, long-term education and monitoring programs, and maintenance and operations program.

B. Authority and Cooperation

Preparation of this Surface Water Management Plan was authorized by the City of Mount Vernon by an engineering agreement with R. W. Beck and Associates dated September 23, 1991.

The study area includes the entire Urban Service Area, as currently proposed and discussed in Section III. The study area is shown on Figure III-1.

The Washington State Department of Ecology (Ecology) provided funding assistance on this project through the Centennial Clean Water Fund (CCWF). Ecology will also provide a detailed review of this draft document prior to final approval of this plan.

C. Scope of Work

The scope of work was developed through discussions between City staff, Ecology staff, and R. W. Beck and Associates. Ecology staff and the City initially negotiated a scope of work for the project as part of the CCWF grant agreement. The City then negotiated a scope of work with R. W. Beck and Associates as part of the consultant contract that includes the scope of work items contained in the CCWF grant agreement. In accordance with the grant requirements, the plan will create a coordinated long-term management approach to issues affecting flood hazards, water quality, and protection of natural resources.

D. Public Involvement

To date, the public involvement program has included a series of eight Citizen Advisory Committee (CAC) meetings, one public meeting and two presentations to City Council. It is anticipated that several more CAC meetings and City Council presentations will be required before final completion of the final plan.

Public participation is an important part of the preparation of this plan. The public's opinions and concerns were expressed during meetings held throughout the duration of the project. Issues covered at the CAC and public meetings held to date were as follows:

1. Citizen's Advisory Committee

CAC Meeting 1 ..... October 20, 1992

- Surface water needs and problems
- Planning process
- Role of CAC
- Goals and objectives of CAC

CAC Meeting 2 ..... November 17, 1992

- Goals and objectives of the Surface Water Management Plan
- New City ordinance specifying surface water system standards for new development

CAC Meeting 3 ..... December 15, 1992

- Goals and objectives of the Surface Water Management Plan
- New City ordinance specifying surface water system standards for new development

- Wetlands and Ecology regulations
- Financing the Surface Water Management Plan Recommendations

CAC Meeting 4 ..... January 19, 1993

- Financing the Surface Water Management Plan Recommendations
- New City ordinance specifying surface water system standards for new development

CAC Meeting 5 ..... February 16, 1993

- Funding direction
- Utility financial policies
- Preliminary budget for plan recommendations
- Sample rates and revenue projections
- Surface water utility ordinance framework
- New City ordinance specifying surface water system standards for new development

CAC Meeting 6 ..... March 16, 1993

- Surface water utility service charge
- New City ordinance specifying surface water system standards for new development

CAC Meeting 7 ..... May 18, 1993

- Results of April public meeting
- Surface water utility charge
- Surface water management plan status
- New City ordinance specifying surface water system standards for new development

CAC Meeting 8 ..... September 21, 1993

- Management Plan Capital Improvements Program
- Preliminary Service Charge Rate Calculation

CAC Meeting 9 ..... October 19, 1993

- Surface Water Management Plan Draft Document
- Utility Service Charge Revised Rate Analysis
- Utility Rate Ordinance
- Draft Drainage Ordinance

CAC Meeting 10 ..... **November 20, 1993**

- Draft Drainage Ordinance

CAC Meeting 11 ..... **January 18, 1994**

- Draft Drainage Ordinance

CAC Meeting 12 ..... **February 8, 1994**

- Draft Drainage Ordinance

CAC Meeting 13 ..... **March 8, 1994**

- Draft Drainage Ordinance

2. Public Meetings

Public Meeting 1 ..... **April 27, 1993**

- Project introduction
- Problem identification
- Storm water management planning process
- Financing alternatives
- Questions and answers

These public meetings resulted in considerable discussions and input from local residents.

3. Council Presentation

Council Presentation 1 ..... **March 24, 1993**

- Surface water issues
- What the Surface Water Management plan will provide
- Recommendations
- Surface water requirements
- Funding
- Next steps

Council Presentation 2 ..... **July 14, 1993**

- Utility Formation Ordinance Public Hearing

Council Presentation 3 ..... **November 3, 1993**

- Surface Water Management Plan - Draft Document
- Citizen's Committee
- Surface Water Program Financing
- Surface Water Utility Rate Ordinance

Council Presentation 4 ..... **November 10, 1993**

- Surface Water Utility Rate Ordinance Public Hearing

Council Presentation 5 ..... **July 12, 1995**

- Drainage Ordinance Public Hearing

Council Presentation 6 ..... **November 29, 1995**

- Surface Water Management Plan—Final Document

Appendix D contains additional information about the public involvement process. Information includes:

1. Meeting agenda for each meeting.

2. Meeting graphics, which provided a partial summary of what was discussed at each meeting.

3. Meeting minutes for each meeting.

E. Goals and Objectives

Goals and objectives for the City of Mount Vernon's surface water management program were developed through input from City staff and the CAC. These goals, and the objectives to be met so as to accomplish each goal, are as follows.

Goal #1 - Prevent property damage from flooding

a. **OBJECTIVE:** Require adequate peak flow controls for new development.

The plan recommends and the City has adopted a new drainage ordinance consistent with the minimum requirements contained in Ecology's Stormwater Management Manual for the Puget Sound Basin. This ordinance includes requirements for peak flow controls. The adopted ordinance is contained in Appendix H.

b. **OBJECTIVE:** Perform the necessary analysis and recommend solutions for existing flooding problems.

As discussed in Section VII, the existing drainage system was analyzed to determine existing conveyance problems, and problems that might occur under future development conditions as well. Solutions to these problems are presented in the recommended plan under both the regional and local system solutions.

c. **OBJECTIVE:** Employ management strategies in flood prone areas to ensure that new development is not exposed to significant flood risk.

The recommended plan includes a number of management strategies to minimize flood risk. These include a recommendation for a new drainage ordinance with strict detention standards and requirements for an offsite analysis to determine any adverse impacts downstream. The plan also includes management strategies for streamside corridors and wetlands that will also minimize flood risk for new development.

Goal #2 - Maintain good water quality

a. **OBJECTIVE:** Attempt to meet state Class A Water Quality Standards in area streams.

A number of recommendations for are proposed for improving water quality such as a public education program, source controls, erosion control, maintenance, spill response, prevention of illicit dumping, wetland protection, new ordinances, and residential, commercial, and agricultural water quality BMPs. A sampling program has also been recommended to monitor water quality parameters and progress towards achieving water quality goals.

b. **OBJECTIVE:** Require adequate erosion and sedimentation controls from new construction sites.

The plan recommends that the City enforce its new drainage ordinance consistent with the minimum requirements contained in Ecology's Stormwater Management Manual for the Puget Sound Basin. This ordinance includes requirements for erosion and sediment controls. The ordinance is contained in Appendix I.

c. **OBJECTIVE:** Require adequate water quality controls for new development.

The plan recommends that the City enforce its new drainage ordinance consistent with the minimum requirements contained in Ecology's Stormwater Management Manual for the Puget Sound Basin. This ordinance includes requirements for water quality BMPs. The ordinance is contained in Appendix I.

d. **OBJECTIVE:** Implement public education programs to reduce the source of pollutants entering surface waters.

The plan recommends that a public education program be implemented to improve stormwater quality. This education program includes components to inform citizens about surface water quality source controls, erosion control, spill response, prevention of illicit dumping, maintenance of private drainage systems, and residential, commercial, and agricultural water quality BMPs.

Goal #3 - Preserve sensitive resources and maintain varied use

a. **OBJECTIVE:** Preserve fish and wildlife habitat.

The plan includes a number of preservation and enhancement projects for fish habitat. The plan includes an inventory of City streams by category, and the City's Critical Areas Ordinance provides adequate protection for stream corridors by specifying minimum setback requirements according to the stream category.

b. **OBJECTIVE:** Preserve wetlands and implement a wetlands management strategy.

The plan includes a recommendation that the City review the wetlands management section of the City's Critical Areas Ordinance to determine the need for a wetland classification system and associated buffers. The report also suggests several alternative wetlands management strategies with the recommendation that these be reviewed and that a policy decision be made as to which alternative should be implemented.

c. **OBJECTIVE:** Provide public access and recreation opportunities.

The plan does not include specific recommendations on public access and recreation opportunities. A number of opportunities exist within areas along the City's streams for trails and passive recreation. If these recreational opportunities are pursued, additional buffer requirements may be necessary so that human recreation does not interfere with fish and wildlife habitat needs.

d. **OBJECTIVE:** Preserve open space.

The plan does not include specific recommendations on preserving open space, but recommendations on preservation of wetlands and fish habitat will preserve open space associated with surface water resources.

e. **OBJECTIVE:** Review the City's Sensitive Areas Ordinance to ensure consistency with the surface water management program goals.

As mentioned previously, the plan includes a recommendation to that the City review the wetlands management section of the City's Critical Areas Ordinance to determine the need for a wetland classification system and associated buffers.

Goal #4 - Develop a continuous and comprehensive program for managing surface water.

a. **OBJECTIVE:** Ensure a dedicated funding source for program implementation.

The plan recommends and the City has implemented primary and secondary funding sources. The City implemented a surface water utility as the primary funding source for implementing the plan.

b. **OBJECTIVE:** Coordinate the City program with the Skagit County program.

Several recommendation have been included to coordinate the City of Mount Vernon's program with programs in Skagit County and adjacent drainage districts. These include coordination with Drainage District 17 and Skagit County on future preparation of a watershed plan for Madox Creek. The plan also lists the recommendations as they relate to Mount Vernon, from the Nookachamps Creek Watershed Plan prepared by Skagit County.

F. Agency Coordination

In the preparation and review of this plan, various agencies and jurisdictions were contacted to obtain input:

- Puget Sound Water Quality Authority: Regarding regulations for storm water management plans. Presenting information to the public and City Council.
- Department of Ecology: CCWF grant administration, attendance at CAC meetings, and information on wetlands management.
- Department of Fisheries: Participation of regional habitat manager on CAC and habitat inventory field trip.
- Department of Wildlife: Telephone contract, deferred to Department of Fisheries.

G. Previous Studies

The primary investigations previously conducted in the study area that were consulted in preparation of this report are as follows:

1. Storm Drainage Study (Riverside Drive/ Freeway Drive Basins)

The Storm Drain Study (Bell-Walker Engineers, Inc., 1987) analyzed the area within the City of Mount Vernon that presently drains to the Kulshan Creek Pump Station and Skagit River outfall system located west of Freeway Drive and south of Riverbend Road. The purpose of the study was to determine the probable runoff from the study area, and to establish a recommended network of storm drainage trunk lines, open conveyance systems, and detention facilities needed to transport and dispose of the stormwater runoff.

2. Comprehensive Sewer and Combined Sewer Overflow Reduction Plans for the City of Mount Vernon.

The Comprehensive Sewer and Combined Sewer Overflow Reduction Plans (R. W. Beck and Associates, 1991) addresses alternatives for reducing combined sewer overflows (CSOs) in order to help protect the health and safety of the public, the environment, and property while maintaining the economic capability of the City.

3. Wetlands Mitigation Banking

The guidance document Wetlands Mitigation Banking (Castelle et al, 1992), recently published by Ecology, discusses many mitigation banking issues from agency, developer, and environmental view point. The report addresses planning considerations and general guidelines for potential mitigation bank implementation.

4. Nookachamps Watershed Nonpoint Action Plan

The Nookachamps Watershed Nonpoint Action Plan (Skagit County, May 1995) evaluated a number of source control strategies such as programs to repair or eliminate failing septic systems, improve forest and agriculture Best Management Practices, control stormwater runoff, and implement a public education program.

SECTION III
CHARACTERISTICS OF THE STUDY AREA

R·W·BECK

SECTION III

CHARACTERISTICS OF THE STUDY AREA

A. Study Area

The study area is shown on Figure III-1. When this project began in 1991, this study area was designated as the proposed GMA Urban Growth Boundary (UGB). Between 1991 and 1995, the Urban Growth Boundary, as shown in the City's 1995 Comprehensive Plan, changed. The 1995 UGB is slightly larger than the 1991 UGB. It was decided that the 1991 UGB would still be adequate in this plan for addressing the majority of surface water issues for the City. The major differences between the study area for this plan and the UGB in the 1995 Comprehensive Plan is the addition of a small area to the north along the Skagit River and over to Nookachamps Creek, the addition of an area on the east that is east of Sections 15, 22, 27, and 34, and a reduction of the area along Hickox Road to the south. The study area includes all the existing city incorporated area, plus some portions of Skagit County. Although the UGB changed, portions of Skagit County were included in the study area as a result of the growth management planning process which in 1991 identified areas that the City will likely annex in the future. These areas were included so that the Plan would represent the ultimate system the City may have to manage. There are seven drainage basins that make up the study area. The basins in the study area are as follows: Kulshan Creek, Madox Creek, Carpenter Creek, the area tributary to Nookachamps Creek, Trumpeter Creek, Britt Slough, and West Mount Vernon.

B. Climate

The average annual precipitation and temperature are approximately 30 inches and 50 degrees Fahrenheit, respectively. Precipitation data from the NOAA station in Burlington, Washington as well as data collected at the City's waste water treatment plant and the Washington State University Research Station were used in this study. How the different precipitation data sets were used is discussed in Section IV.

C. Topography and Soils

The study area slopes in all directions with all the surface water eventually draining into the Skagit River or Nookachamps Creek. The study area is situated above the surrounding area so all surface water runoff exits the area, and no runoff is contributed from outside areas. The highest elevation is approximately 910 feet above mean sea level. Slopes range from zero in the lower areas to 96 percent around Little Mountain. The upper reaches of Madox Creek, Flower Creek, and Carpenter Creek are situated in Ravines with sideslopes of 35 to 45 percent.

Information on area soils was obtained from the "Soil Survey of Skagit County Area, Washington," Soil Conservation Service, U. S. Department of Agriculture, 1979. Approximately 35 different soil types exit within the study area. For the purposes of this study these soil types were combined into four basic categories based on their hydrologic properties. The four categories are glacial till, glacial outwash, flood plain, and wetland soils.

The flood plain soils, which are found in the lower areas within the flood plain of the Skagit River, cover approximately 30 percent of the study area. Till soils cover approximately 65 percent. The wetland and outwash soils cover the remaining area. The areas covered by the different soil categories are shown in Figure III-2.

D. Vegetation

The Puget Sound region is part of the Coastal Coniferous Fir Zone, the largest vegetation zone in Western Washington. The zone, also known as the Cedar-Hemlock zone, reaches from British Columbia to Oregon. Two dominant types of vegetation characterize the region: Fir-Cedar-Hemlock and Alder-Maple-Cottonwood.

Coniferous trees of the Fir-Cedar-Hemlock association include Western Red Cedar, White and Douglas Fir, Sitka Spruce, and Western Hemlock.

Deciduous or native broadleaf species of the Alder-Maple-Cottonwood association include Black Cottonwood, Pacific Madrona, Oregon Ash, Red Alder, Broadleaf Maple, Vine Maple, Sitka Willow, Coast Willow, Brown Dogwood, Pacific Dogwood, and Bunchberry Dogwood.

Salal, Oregon Grape, Bracken and Sword Fern, Red Elderberry, Salmonberry, Creambush and Grand Oceanspray, Shinyleaf Spirea and various currants are the most common varieties of understory vegetation.

Typical urban area vegetation is found throughout the study area, including lawns, ornamental plants, and landscaped areas. While most of the natural vegetation that remains is concentrated on steep slopes, in riparian areas, and on the undeveloped parcels, there are a few developed areas in which mature natural vegetation remains.

E. Land Use

The land use in the study area are single family residential, multi-family residential, commercial, schools and churches, parks and open spaces and agricultural. Figures III-3 and III-4 show the areas of the various land use for existing conditions and future buildout conditions respectively. Aerial photos taken in 1987 and 1991 along with field observations were used to evaluate the existing land use conditions. Future land uses were evaluated based on information presented in the City's Comprehensive Plan assuming full buildout. For the purposes of the hydrologic analysis, the land uses were categorized in a slightly different manner as described in Section IV.

F. Existing Surface Water System

1. Major Streams and Associated Drainage Basins

The study area is comprised of seven separate drainage basins: Kulshan Creek, Madox Creek, Carpenter Creek, Nookachamps Creek, Trumpeter (College Way) Creek, Britt Slough, and West Mount Vernon. Each of these drainage basins were further divided into several smaller subbasins. The surface water conveyance system in the study area consists of open channels, ditches, and pipes. Figure III-5 shows the drainage basins and subbasins

within the study area. The existing surface water system is shown on Figure B-1 through B-14 in both Appendix B and Appendix C.

The Kulshan Creek drainage basin is 1,404 acres and is made up of subbasins 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14. It is located in the northwest corner of the study area. The creek begins just east of LaVenture and flows west between College Way and Fir Street to the Kulshan Creek Pump Station. When Skagit River water levels are low, the flow from Kulshan Creek flows by gravity into the Skagit River. At high Skagit River water levels, the pump station can pump up to 20 cfs of the flow in Kulshan Creek into the river.

The Madox Creek drainage basin is 1,984 acres and is made up of subbasins 22, 19, 34, 37, and 51. It is located in the south central portion of the study area. Madox Creek originates in the Eaglemont Golf Course Residential Development and flows southwest into Drainage District 17. After it exits the study area, Madox Creek flows south for several miles before discharging through tide gates into Skagit Bay south of Conway. Flowers Creek is a tributary to Madox Creek that begins at Blackburn Road near South 16th Street. Flowers Creek flows southwest and crosses Blodgett Road and eventually joins Madox Creek east of the freeway near Anderson Road.

The Carpenter Creek drainage basin within the Urban Service Area is 3,753 acres and is comprised of subbasins 35, 36 and 38. It is located in the southeast corner of the study area. Carpenter Creek flows out of the study area as it crosses Hickox Road, and then continues to flow southwest along the base of the hill until it joins the Skagit River south of Conway.

The three basins that drain directly to the Nookachamps Creek, subbasins 2, 38 and 39 are 254, 303 and 90 acres respectively. They are located on either side of Trumpeter Creek in the northeast portion of the study area. Neither basin has a well established conveyance system.

The Trumpeter (College Way) Creek drainage basin is 2,013 acres and is made up of subbasins 4, 15, 16, 17, and 18. It is located in the in the east central portion of the study area. The main stem of Trumpeter Creek originates just north of Fir Street. Two tributaries (southwest fork and southeast fork) east of the main stem join together at College Way and then join the main stem about 900 feet north east of College Way. Trumpeter Creek flows east from its confluence and eventually joins Nookachamps Creek.

The Britt Slough drainage basin is 73 acres and is represented by subbasin 30. It is located in the southwest portion of the study area. The slough flow southwest and enters the Skagit River just upstream of where the Skagit splits around Fir Island.

The West Mount Vernon drainage basin is 450 acres and is comprised of subbasins 24, 25, and 26. It is a portion of the study area located west of the Skagit River. The main drainage system in the basin flows east along Memorial Highway (SR 536) and then heads south along Wall Street. After Wall Street ends, the storm drain crosses undeveloped property south to a small pump station. The pump station pumps the stormwater runoff from the basin through the dike into the Skagit River.

The major streams were analyzed to determine if they have the capacity to carry the 100-year storm flow. This analysis and a discussion of stream segments, pipes, or culverts that do not have the capacity to pass the 100-year peak flow is contained in Section VI.

Subbasin 23 is 462 acres and is a combined sewered area. All of the surface runoff in that area flows to the sanitary sewer and is treated at the waste water treatment plant. Previous work on the combined sewer system concluded that it was not cost effective to separate the storm and sanitary flows. Therefore, it is not likely that the City will ever have to manage a separate storm drain system in this area.

2. Major Storm Drainage Pipe and Ditch Systems

The major storm drain systems that feed the major streams include the pipe system along Riverside Drive, the pipe system along Stanford Drive between Division and Fir Streets, the pipe system under I-5 south of Blackburn Road, the culverts along the southwest fork of Trumpeter Creek near Fir Street, the culvert and ditch system between Britt Slough and Blackburn Road near Walter Street, the pipe system along Memorial Highway and Wall Street, and the pipe system along Fox Hill Street. Pertinent information about theses systems was gathered from surveys or as-builts, and the information was entered into the computer program Flow Master (Haestad, 1991) to determine the capacity of each system. The major storm drain systems were analyzed to determine if they have capacity to handle the 10-year storm flow. A discussion of the systems that did not have the capacity to pass the peak flow from the 10-year storm event is contained in Section VI.

G. Existing Resources

1. Fish Habitat

The existing fish habitat was assessed based on field observations and agency consultations. A complete discussion and maps describing the fish habitat assessment are presented in Appendix B. According to the Washington Department of Fisheries, all five streams (Kulshan Creek, Madox Creek, Trumpeter Creek, Carpenter Creek, and Flowers Creek) in the study area are used to some extent by salmonids for rearing and spawning. Species include coho, chum and chinook salmon, and steelhead and cutthroat trout. The field survey indicated that all the streams had available fish habitat and met the criteria of Mount Vernon's Critical Areas Ordinance Category II streams (streams that are used by a substantial number of anadromous or resident game fish for spawning, rearing, or migrating) in at least some portion of the study area. The field survey also indicated that each of the drainages displayed varying effects from past and present development. Portions of some drainages have been channelized or ditched and riparian vegetation has been removed. This has resulted in a loss of pools and riffles, a loss of cover for fish, increased erosion, and loss of shade which results in increased summertime stream temperatures. Culverts have been installed for road crossings of streams which often result in fish migration barriers during certain stream flow conditions.

2. Wildlife

A reconnaissance level evaluation of wildlife habitat was conducted to determine the general availability of wildlife habitat within the study area. A complete discussion and maps describing the wildlife habitat assessment are presented in Appendix B.

Riparian corridors, forested areas, and wetlands existing within the study area provide habitat for a variety of wildlife. Mammals that are likely to occur in these habitats include raccoons, coyotes, opossums, various rodents, cottontail rabbit, and blacktailed deer. In addition, a variety of songbirds, waterfowl, reptiles, and amphibians are expected to use these habitats.

Three important sensitive species have been identified by the Washington State Department of Wildlife (DOW) as inhabiting the study area. The bald eagle is on the DOW's priority species list and is federally designated as a threatened species. The osprey is listed as a state monitor species on the DOW's priority species list. The DOW manages monitor species, as needed, to prevent them from becoming endangered, threatened, or "sensitive". Trumpeter swans are protected under the Migratory Bird Treaty Act and the Skagit County lowlands provide important winter feeding habitat for the birds.

In addition, other priority wildlife species not specifically identified in the study area by DOW, but whose distribution range and habitat characteristics suggest that they may be within the study area, are blue grouse, Columbian black-tailed deer, great blue heron, pileated woodpecker, and several species of waterfowl.

3. Wetlands

As part of the Surface Water Management Plan, a wetland reconnaissance level inventory was conducted. The inventory included the following three tasks:

1) a wetlands paper inventory with limited on-site and roadside surveys,
2) a discussion of wetlands resources problem areas, and
3) a discussion of wetlands resources protection measures.

The inventory study area included the city's Urban Service Area, but concentrated on the area located within the city's Urban Growth Boundary. The characterization of wetlands according to the U.S. Fish and Wildlife Service classification system (Cowardin et al., 1979) and further classification of these wetlands based upon their qualitative functional values. The location and type of each wetland is indicated in Appendix A. A complete wetland inventory report is also contained in Appendix A. No formal wetland delineations were conducted as part of this project.

The inventory was limited to a reconnaissance-level survey. Performing a detailed survey would require extensive fieldwork and was beyond the scope of this planning effort.

a. Wetland Definition and Regulations.

Wetlands are formally defined as "... those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." (Federal Register, 1980, 1982).

Numerous federal, state, and local regulations govern development and other activities in or near wetlands; at each level, there are typically several agencies charged with such powers (Appendix A). Mount Vernon has adopted a Critical Areas Ordinance (CAO) (Ordinance No. 2482) in compliance with the Washington State Growth Management Act. A summary of some of the regulatory implications of the city's ordinance is also included in Appendix A.

b. Methods.

Two levels of investigation were conducted for the analysis of wetlands located within the study area: a review of existing information and an on-site reconnaissance survey.

A review of existing literature, maps, and other materials was conducted to identify wetlands or site characteristics indicative of wetlands in the study area. Note that these sources can only indicate the likelihood of the presence of wetlands; actual wetland determinations must be based upon data obtained from field investigations.

Several documents were available for this review:

- U.S. Geological Survey 7.5-Minute Topographic Map, Mount Vernon Quadrangle (1981)
- Soil Survey of Skagit County Area, Washington (Klungland and McArthur, 1989)
- *National Wetland Inventory*, Mount Vernon Quadrangle (1989)
- *Hydric Soils of the State of Washington* (SCS, 1985)
- Aerial photograph, 1"=800'
- Mount Vernon wetlands paper inventory (Jones and Stokes, 1991)
- Previous wetland delineation reports

Given that there were no rights-of-entry granted for this survey, in most instances site reconnaissance was limited to roadside surveys. However, several landowners and tenants encountered during the survey invited somewhat closer observations of a few parcels. Wetland hydrology (such as standing water) and

dominant vegetation types were the features most readily identified from the roadways. In some instances, soil saturation at the surface could be observed in places where water was not ponded. Binoculars were used to facilitate these assessments. Additional soils information was limited to published documents and readily apparent features; no soil cores were taken.

c. Wetland Characteristics.

Wetland Functions and Values. Wetlands play important roles that provide valuable benefits to the environment and society. Detailed scientific knowledge of wetland functions is limited, so that evaluations of the functions of individual wetlands are often necessarily qualitative and dependent upon professional judgement.

Several wetland functional evaluation methods have been developed. The most common methods applicable in the Pacific Northwest were developed by the Army Corps of Engineers (Reppert et al., 1979; Adamus, 1983; Adamus et al., 1987). These methods were modified for use for wetland evaluations of the following wetland functions: (1) water quality improvement; (2) storm and flood flow attenuation and storage; (3) hydrologic support; and (4) natural biological support.

Water quality improvements functions of wetlands include the ability of wetlands to remove sediments from surface waters passing through the wetlands. This helps prevent the siltation of fish spawning gravels, particularly for economically-important salmonid species. Because many pollutants are associated with particulates, sediment removal results in better water chemistry in receiving waters. Further, many wetland plants and microbial communities associated with plants have the ability to directly remove pollutants or to transform them into less harmful chemical compounds.

Storm and flood flow attenuation and storage results in smoother (less "flashy") hydrographs for streams and other surface waters. The helps prevent flooding conditions on private and public lands, reduces streambank erosion, and maintains the hydrology necessary to support wetland plants.

Because stormwater is detained in wetlands, water is released to surface and occasionally to groundwater receiving waters at a slower rate. Such hydrologic support helps maintain proper flow rates in streams and may help recharge aquifers. The hydrologic support function of some wetlands may also assist in providing readily available irrigation water for agricultural uses.

Natural biological support functions of wetlands includes providing the necessary hydrologic regime for aquatic organisms and providing the habitat resources (for example, food, cover, and nesting materials) for wildlife. Wetlands may be particularly important for biological support because many organisms are partially or completely dependent on wetlands for their survival. In Washington for example, the number of sensitive, threatened, and endangered species which are

associated with wetlands is disproportionately high relative to the extent of wetlands in the landscape.

d. Findings.

The National Wetlands Inventory (Mount Vernon quadrangle, 1989) was used as a rough indicator of wetland presence; this inventory identified only four wetlands within the study boundary. A preliminary wetlands inventory limited to the Urban Growth Boundary area was prepared in 1991 (Jones and Stokes and Associates, 1991). That document identified 31 wetlands and proved to be a valuable resource. However, many wetlands identified in the earlier inventory were found to differ in size from this current inventory due to both development activity and because this inventory included field studies. For example, one of the wetlands identified in the earlier work was determined to be completely upland, and one new wetland was identified. Several other areas identified as discrete wetlands in the earlier inventory were determined to be contiguous wetlands through site reconnaissance. As a result, the locations of 28 wetlands were verified within this portion of the study area. Note that a few wetland sites inventoried in the fall of 1991 were under development only a few months later.

Differences in wetland classification using the 1987 Corps Manual versus the 1989 Federal Manual are largely due to vegetation ratings. Many of the pastures in Mount Vernon were dominated in part by facultative species such as colonial bentgrass (Agrostis tenuis) with additional dominant species having facultative upland or upland ratings. As a result, many of these pastures failed to meet the hydrophytic vegetative criteria under the 1987 Manual. A discussion of these manuals is included in Appendix A.

The most common type of wetlands within the study site are fresh water, non-tidal ("palustrine"), emergent wetlands. The majority of these are used as grazing areas for livestock, but others are fallow fields and open pastures. Large tracts of relatively undisturbed forested wetlands are also somewhat common. Scrub/shrub wetlands are primarily restricted to small streamside corridors and successional areas. Open water areas are limited to a few small farm ponds and the seasonal flooding of Barney Lake. Note that while it is likely that additional wetlands would be identified with more intensive field surveys (for example, those resulting in formal wetlands delineations), it appears unlikely that additional wetland types would be identified. The following summaries describe the types of wetlands located within the study area.

- Palustrine Open Water (POW) Wetlands. Few open water wetlands are found within the study site boundary. These are essentially farm ponds likely used to water livestock, and with the exception of Barney Lake, are typically inclusions in emergent wetland areas. Characteristic vegetation includes common cattail (Typha latifolia), reed canarygrass (Phalaris arundinaceae), and soft rush (Juncus effusus). Due to their small size - typically less than one acre - and low vegetative diversity, they do not merit

a high rating for habitat. However, Barney Lake provides relatively high wetland functions.

- Palustrine Emergent (PEM) Wetlands. The typical fresh water emergent wetland in the study area ranges from five to 30 acres in size, with saturated soils and fewer than 10 plant species. Often these sites are active pastures or have other agricultural use. Common vegetation includes soft rush, creeping buttercup (Ranunculus repens), hardhack (Spiraea douglasii), and reed canarygrass. Depending on size, overall diversity, and adjacent land uses, these wetlands have low to moderate wetland functional value.

- Palustrine Scrub/ Shrub (PSS) Wetlands. Scrub/shrub wetlands are commonly found along stream corridors and at the edge of emergent sites. These areas often have low plant species diversity; those observed include hardhack, red alder, reed canarygrass, red osier dogwood (Cornus stolonifera), and black-berries (Rubus spp.). Their role in providing streamside habitat and water quality protection generally gives them a moderate functional rating.

- Palustrine Forested (PFO) Wetlands. Forested sites are the second most common wetland in the study area. These wetlands are included as portions of other wetland areas, or in strictly forested tracts of up to 100 acres. Western red cedar and red alder are the typical dominant species. Forested wetlands are considered a more unusual wetland type in western Washington, and therefore merit higher functional value ratings.

e. Summary.

The following is a summary of the functional levels of the wetland types found in the study area.

Generally, larger, more diverse wetlands provide the highest wetland functions and small, less diverse, and disturbed wetlands provide the lowest degree of wetland function. Water quality improvements are best realized in larger wetlands, simply because they can "treat" relatively large volumes of water, and by wetlands located either near pollutant sources or near receiving waters. In Mount Vernon, these wetlands include the larger of the emergent wetlands, Barney Lake, much of the forested wetland, and most of the riparian scrub/shrub wetlands located near the creeks and the skagit River. The small, isolated emergent wetlands, particularly those located in active pastures, function at a low level for water quality improvements.

Storm and flood flow attenuation and storage are best realized in the same types of wetlands which provide the most water quality improvement. This is because the longer water is held in a wetland (that is, the greater the storage capacity), the more water quality improvement is possible. In this regard, Barney Lake appears to be the most valuable wetland in the study area with respect to water storage functions.

Hydrologic support, particularly of surface waters, is best provided by wetlands located near streams and other surface water bodies. These wetlands, even if moderately-sized, release water over time to help maintain important base flows in the city's streams. In this regard, Barney Lake may be viewed both as receiving water for many of the wetlands and small tributaries of the Nookachamps Creek system, and as a wetland which itself helps hydrologically support the Skagit River. The smaller, isolated wetlands provide low hydrologic support.

Biological support is primarily a function of size and habitat diversity. Accordingly, the larger, undisturbed wetlands, particularly Barney Lake and the city's forested wetlands, provide high biological support. Additionally, the scrub/shrub wetlands located in riparian areas provide food and cover for fish and other aquatic organisms. This is particularly important since salmonids are known to utilize many reaches of the streams located in the city. Further, suitable habitat for salmonids is known to exist through the study; however, downstream obstructions are preventing the full utilization of these streams by salmonids. Maintenance of the riparian wetlands are an important element of maintaining viable habitat so that as the obstructions are removed, salmonids may reclaim greater portions of the creeks. The small, isolated emergent wetlands provide habitat for some songbirds, and during the dry season may help support small mammals. While their individual contributions to wildlife support are quite low, in conjunction with surrounding upland areas they provide food resources for larger wildlife such as raptors and coyotes.

H. Existing Water Quality

A water quality assessment was prepared as part of the surface water management plan. Its purpose was to characterize the quality of the surface waters and to identify potential sources of pollution in the Mount Vernon study area. A complete discussion of the water quality assessment is presented in Appendix G. Pollutant loading for existing and future land uses is presented in Appendix H. Historical information (Skagit River basin study, Entranco 1991; Nookachamps management plan, Cook 1980; A catalog of Washington streams and salmon utilization, WDF 1975; Baseline monitoring at proposed Sea-Van Development Site, Sea-Van fisheries resources, W&H Pacific 1992; Predicted water quality impacts from the proposed Sea-Van golf course and residential site, Harding Lawson Associates), was used to characterize the Skagit River, Nookachamps Creek and streams in the study area. A water quality monitoring program and a stormwater pollutant loading study were used to characterize the streams in the study area. The monitoring program was used to identify specific pollutant problems in the study area, while the pollutant loading study, which estimates loadings based on land use activity, was used to indicate the relative pollutant problem in each of the study area major drainage basins and also the relative increase in pollutants in each basin due to future urbanization.

1. Monitoring Program

The monitoring program was implemented to identify the water and sediment quality of the streams in the study area. The monitoring program was conducted according to the

water quality monitoring and quality assurance plan prepared for the surface water management plan. Five monitoring stations were used and they are located as listed below:

- Station 1 is located at the mouth of Kulshan Creek, which flows west into the Skagit River
- Station 2 is located on main stem of Trumpeter (College Way) Creek at Waugh Road, which flows east into Nookachamps Creek
- Station 3 is located on Madox Creek near Anderson Road, which flows southwest into the Skagit River
- Station 4 is located on Carpenter Creek at Hickox Road, which also flows southwest into the Skagit River
- Station 5 is located on a tributary to Madox Creek along freeway north of Anderson Road that flows south into Madox Creek below Station 3.

Water samples were collected as grab samples three times at each station between January and July 1992. Sampling occurred twice during storm flow conditions and once during base flow conditions. At each station, five sediment subsamples were collected to a depth of 2 cm in sediment deposition areas, then combined into a single sample for each station. All of the deposition areas were located less than 60 feet downstream of the water sampling stations, except for Station 1 on Kulshan Creek where the nearest deposition area is located 2,400 feet upstream of the mouth, upstream of a long piped section of the stream.

The results of the monitoring program and the review of historical information indicates that all four study area streams have pollutant parameter concentrations greater than those in the Skagit River upstream of Mount Vernon. Kulshan Creek is the most urbanized and has the highest pollutant parameter concentrations of the four streams, while Carpenter Creek is the least urbanized and has the lowest pollutant parameter concentrations.

From this preliminary assessment of the water quality in the study area, moderate contamination by metals and petroleum hydrocarbons was observed in streams located in developed basins. Kulshan Creek had the highest levels of these pollutants, as a result of runoff from paved areas and perhaps from commercial activity. Contamination by fecal coliform bacteria and nutrients was observed in each stream, probably from a combination of poor agricultural (livestock) practices, failing septic systems, and improper sewer line connections. These pollutants were most elevated in the Kulshan Creek basin, probably as a result of sewage contamination. Further discussion of water quality problems is contained in Section VI.

2. Stormwater Pollutant Loading Study

A stormwater pollutant loading study was performed to estimate the relative stormwater pollutant loading for each basin based on land use activities. Basins that had the highest relative estimates, and thus contribute the greatest amount of pollution, were

identified and targeted as having the greatest need for water quality protection. This information is contained in Appendix H.

The national urban runoff model, developed by the U.S. Environmental Protection Agency (USEPA,1983), was used to determine annual pollutant loadings from five major basins draining from the Mount Vernon Urban Service Area. Each of the drainage basins were divided into one of four land use categories based on current land use and future zoning. The four land use categories are: commercial, residential, forest, and pasture. Five target pollutants were selected due to their association with stormwater. The pollutants are total suspended solids, nitrate + nitrite nitrogen, total phosphorus, lead, and fecal coliform bacteria. The concentration of stormwater pollutants used to estimate loadings for each land use type were obtained from the City of Portland's Clean Rivers Program (Wooward-Clyde 1993).

The results of the pollutant loading study indicates that the Kulshan Creek drainage basin is the most significant contributor of stormwater-related pollution from the urban service area for the existing conditions, followed by Trumpeter Creek, then the Madox Creek drainage basins. Despite its large area, Carpenter Creek contributes relatively lower loadings of pollutants. Existing pollutant washoff estimates for the area draining to Nookachamps Creek were the lowest of all basins due to the high percentage of rural area within this basin. This pollutant loading analysis was used primarily to describe problems associated with relative increases in pollutant loads with future development. These problem descriptions are discussed in Section VI.

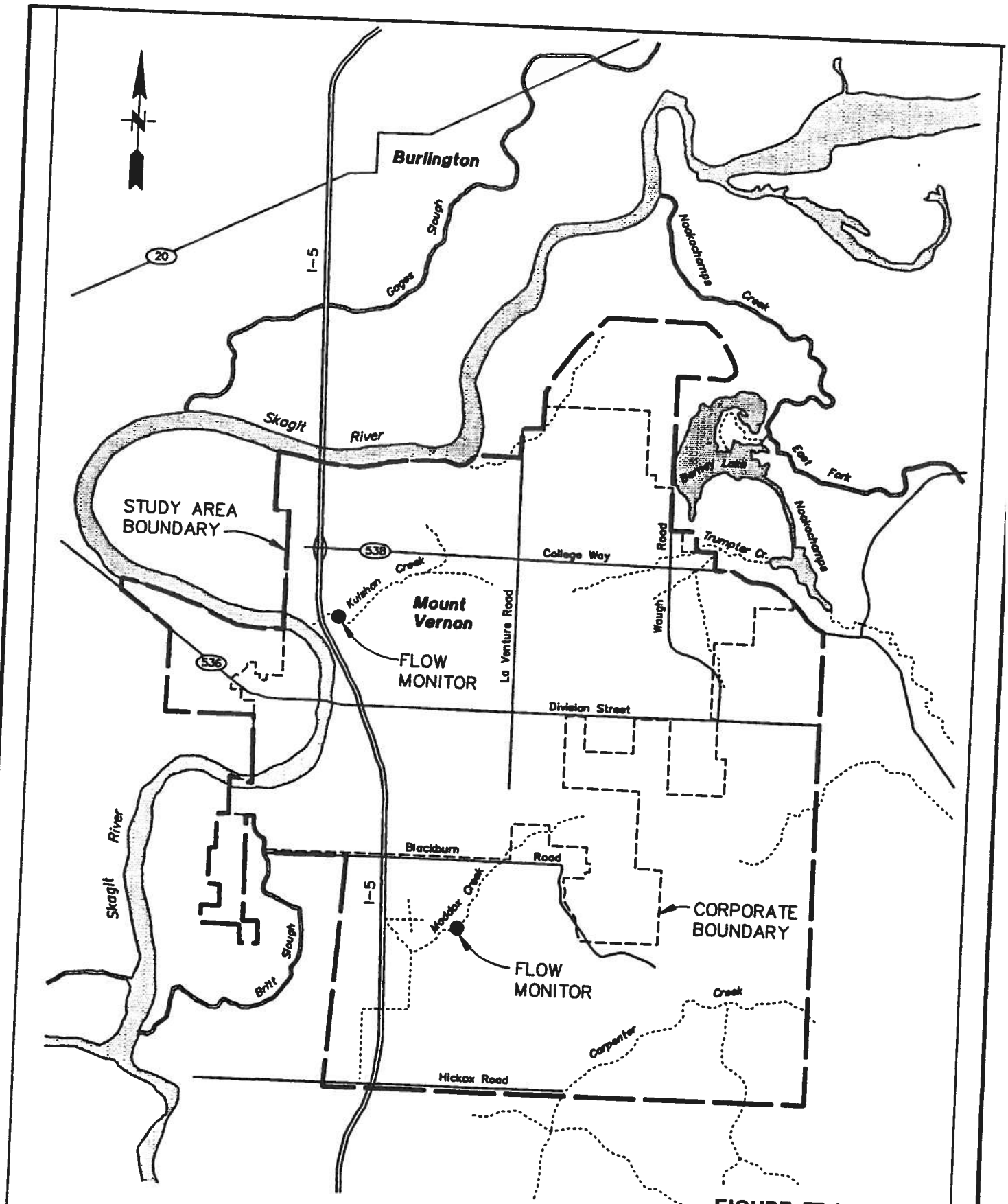


FIGURE III-1
CITY OF MOUNT VERNON
WASHINGTON
SURFACE WATER MANAGEMENT PLAN
STUDY AREA

R·W·RECK

T.M.G. K:\MAA04\MAA04-033 8-13-83 ● 15:48

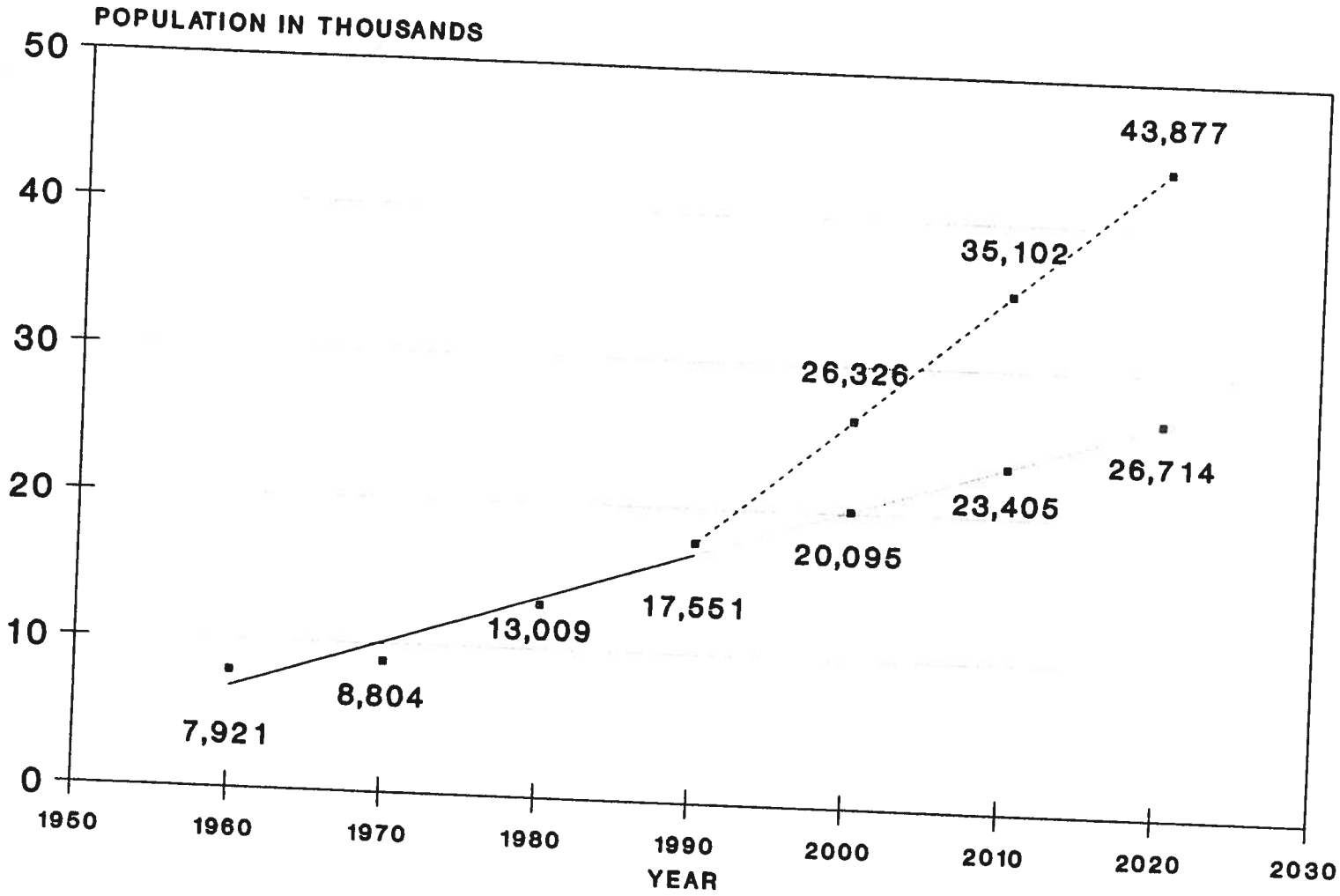
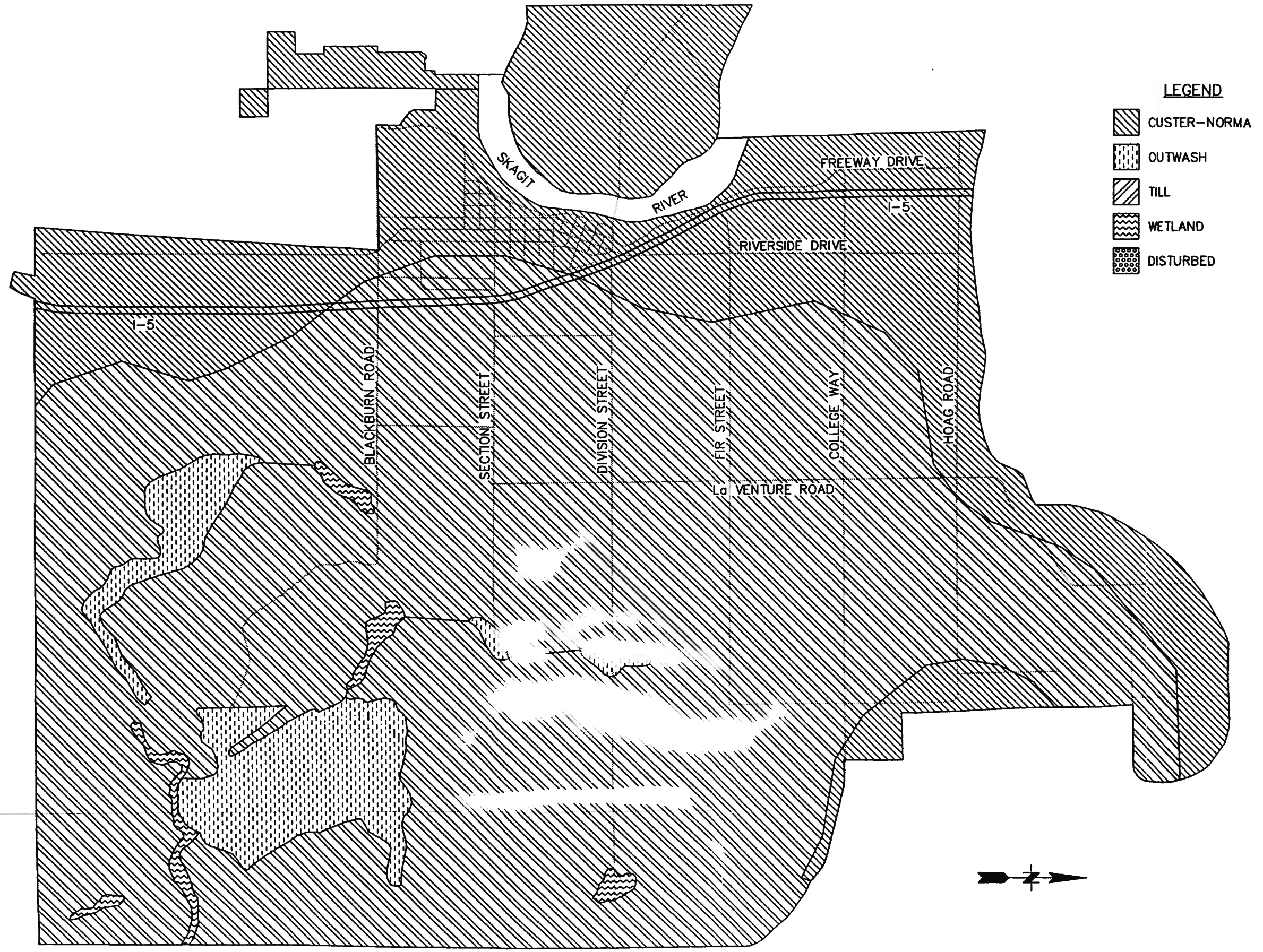


FIGURE II-2
HISTORICAL POPULATION AND
PROJECTED POPULATION GROWTH

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE
SEWER AND COMBINED
SEWER OVERFLOW
REDUCTION PLANS

PAUL DECK



LEGEND

- CUSTER–NORMA
- OUTWASH
- TILL
- WETLAND
- DISTURBED

FIGURE III-2

CITY OF MOUNT VERNON
SURFACE WATER
MANGEMENT PLAN

SOIL TYPES

R·W·BECK

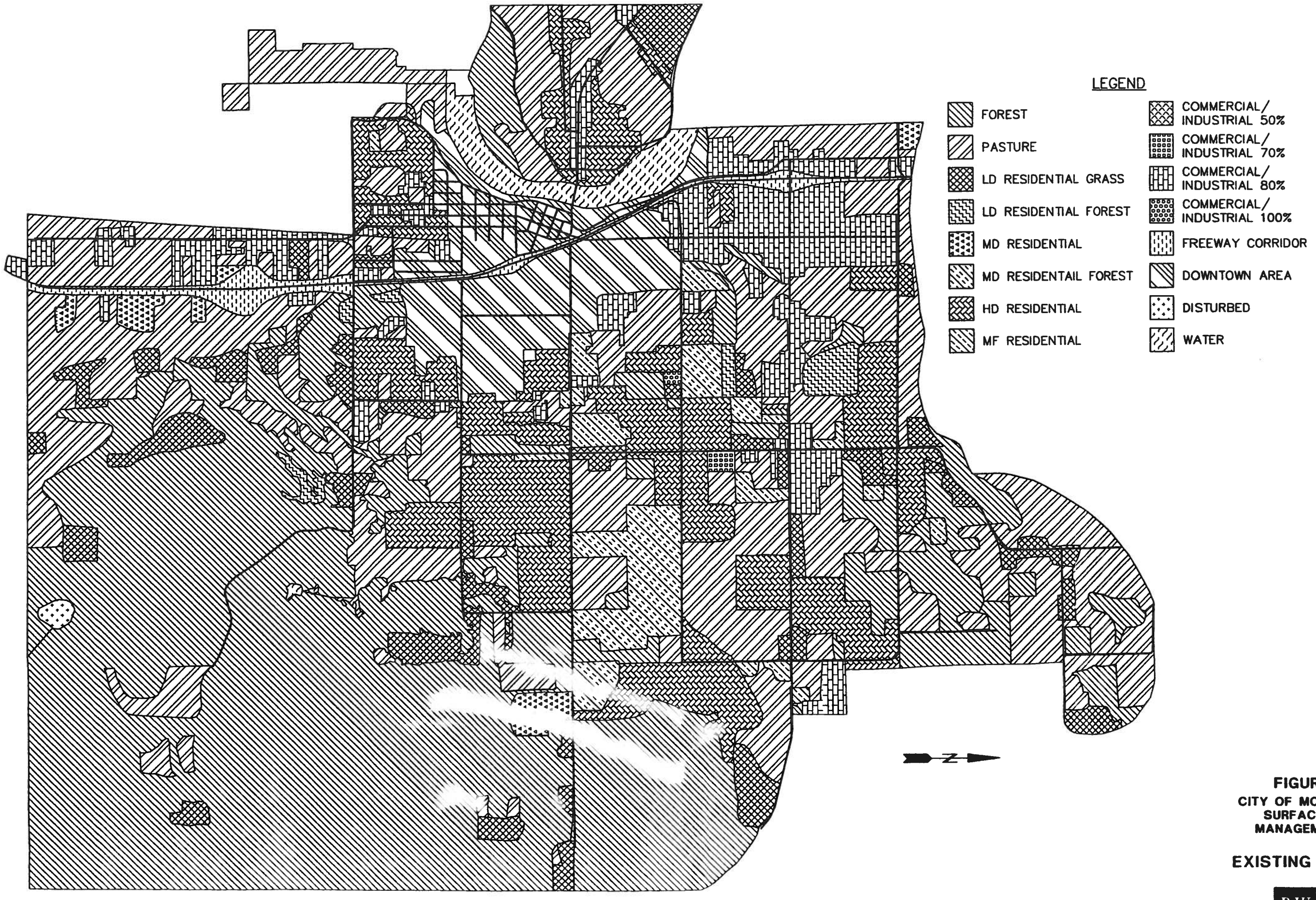


FIGURE III-3
CITY OF MOUNT VERNON SURFACE WATER MANAGEMENT PLAN

EXISTING LAND USE

R·W·BECK

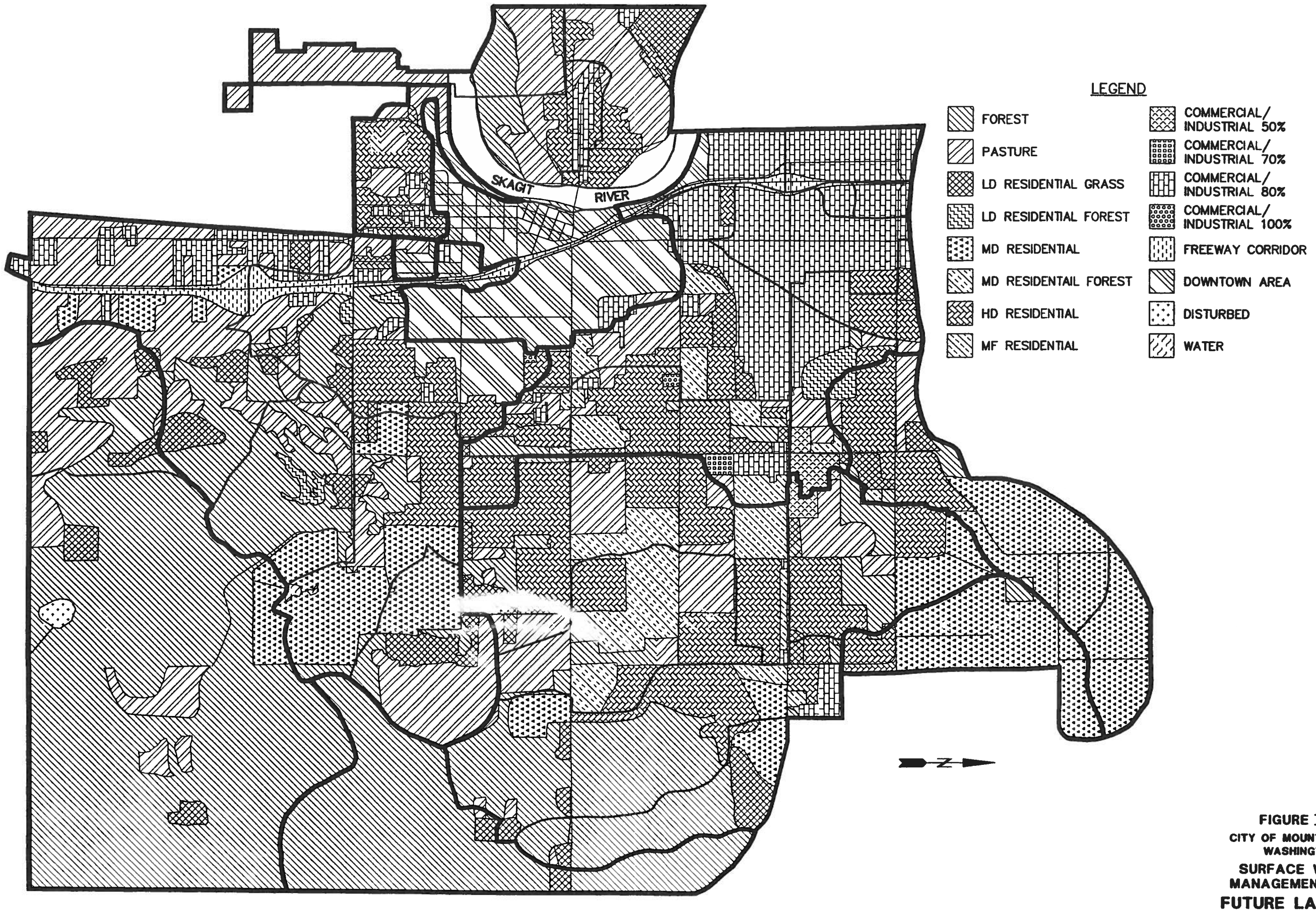


FIGURE III-4

CITY OF MOUNT VERNON
WASHINGTON

SURFACE WATER MANAGEMENT PLAN

FUTURE LAND USE

RW BECK

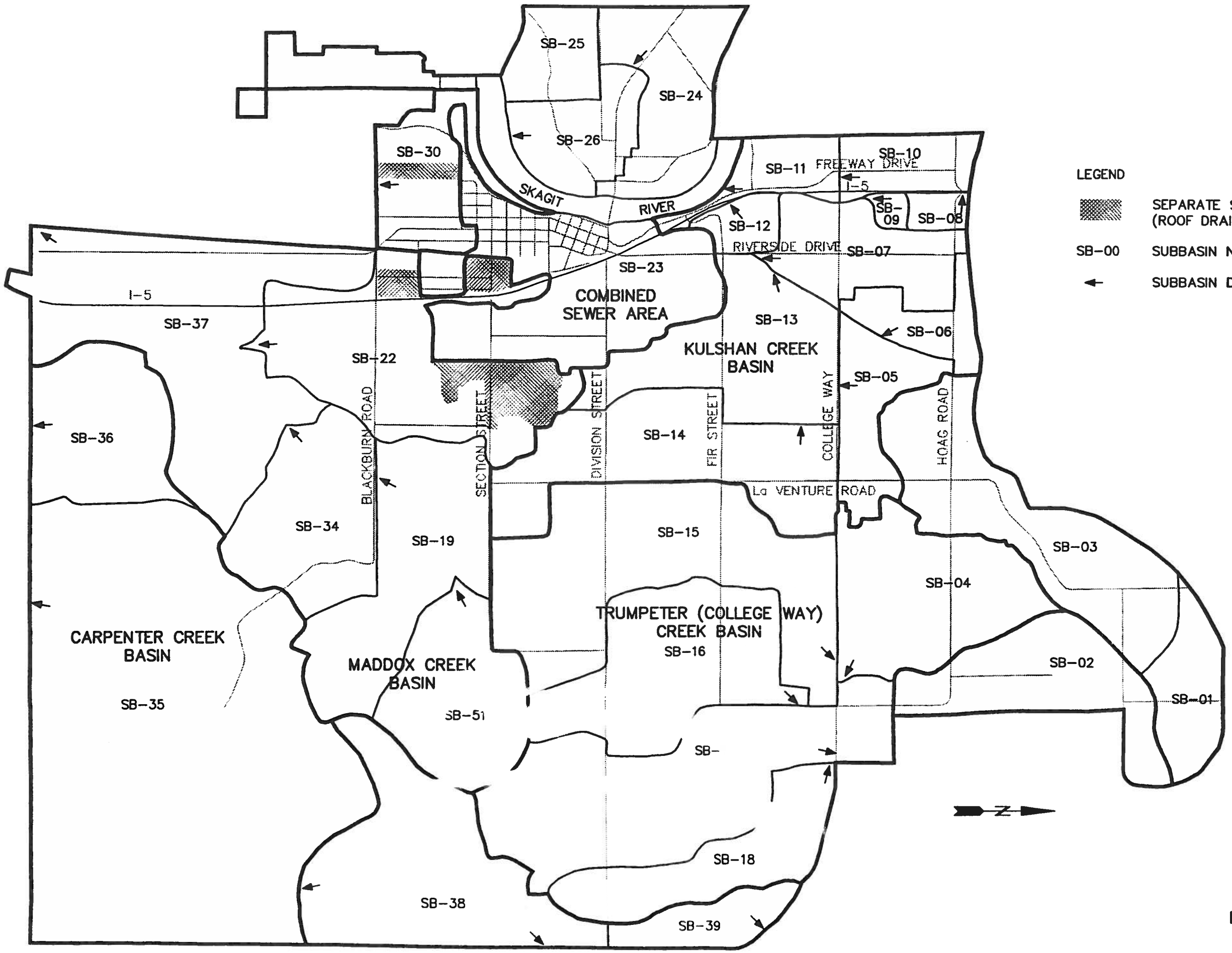


FIGURE III-5
CITY OF MOUNT VERNON
WASHINGTON
SURFACE WATER
MANAGEMENT PLAN
DRAINAGE SUB BASINS

R·W BECK

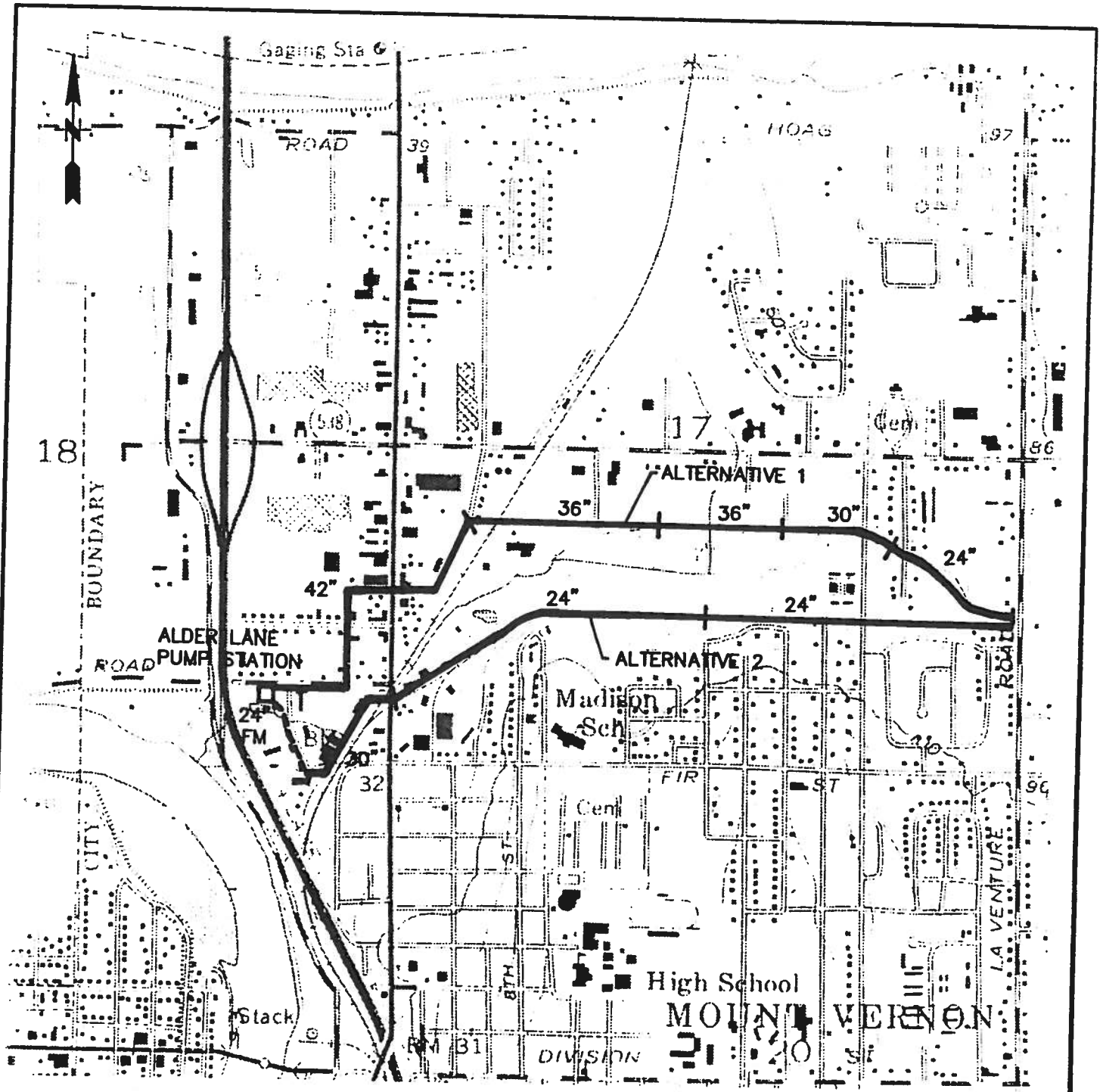


FIGURE III-3
CITY OF MOUNT VERNON
WASHINGTON
COMPREHENSIVE SEWER PLAN
KULSHAN INTERCEPTOR
ALTERNATIVES

RW BECK

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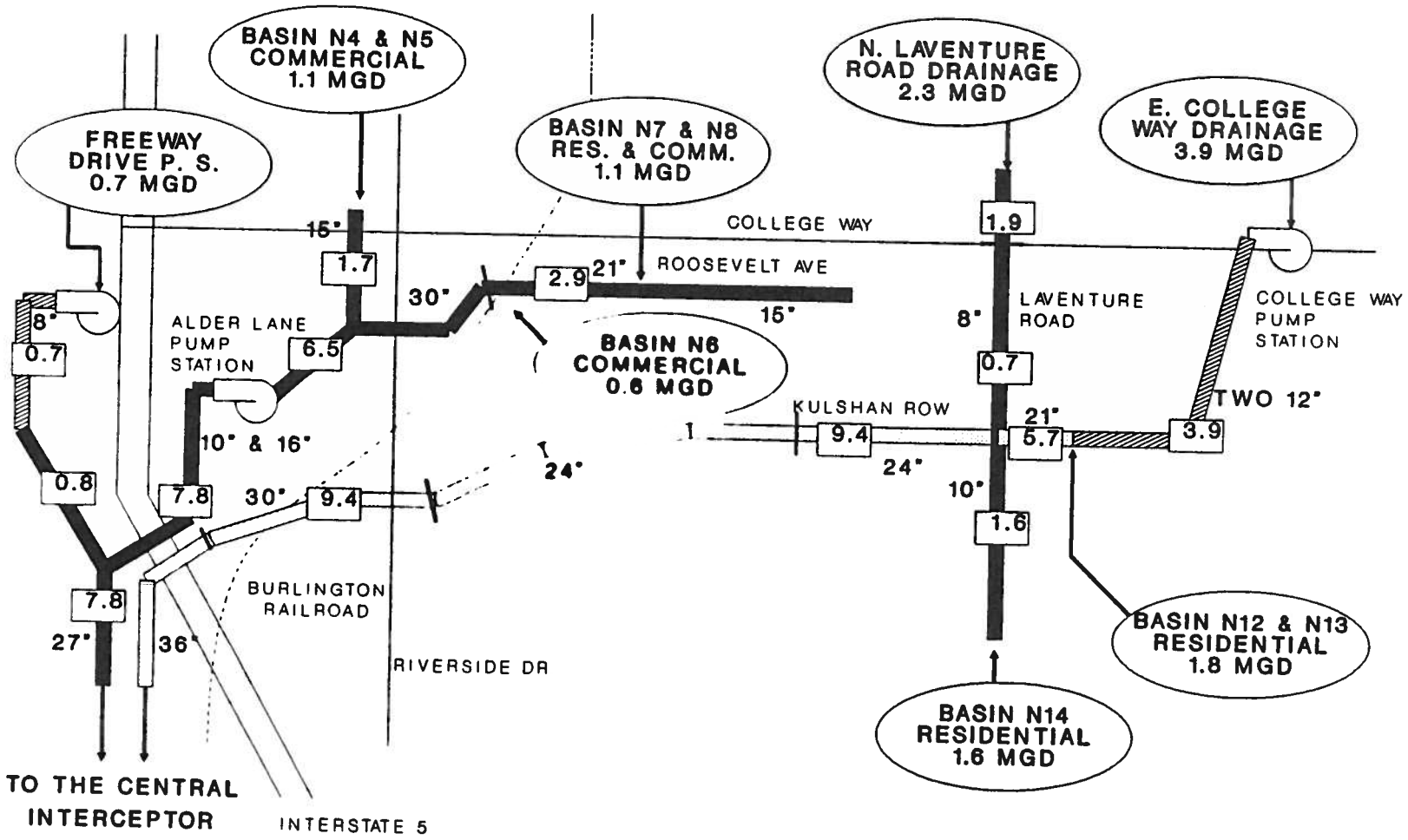

LEGEND

- NEW FORCE MAIN
- NEW KULSHAN INTERCEPTOR
- EXISTING INTERCEPTOR
- RAILROAD TRACKS
- 3.9 — INTERCEPTOR OR FORCE MAIN CAPACITY, MGD

FIGURE III-4
NORTH SERVICE AREA SCHEMATIC

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE
SEWER AND COMBINED
SEWER OVERFLOW
REDUCTION PLANS

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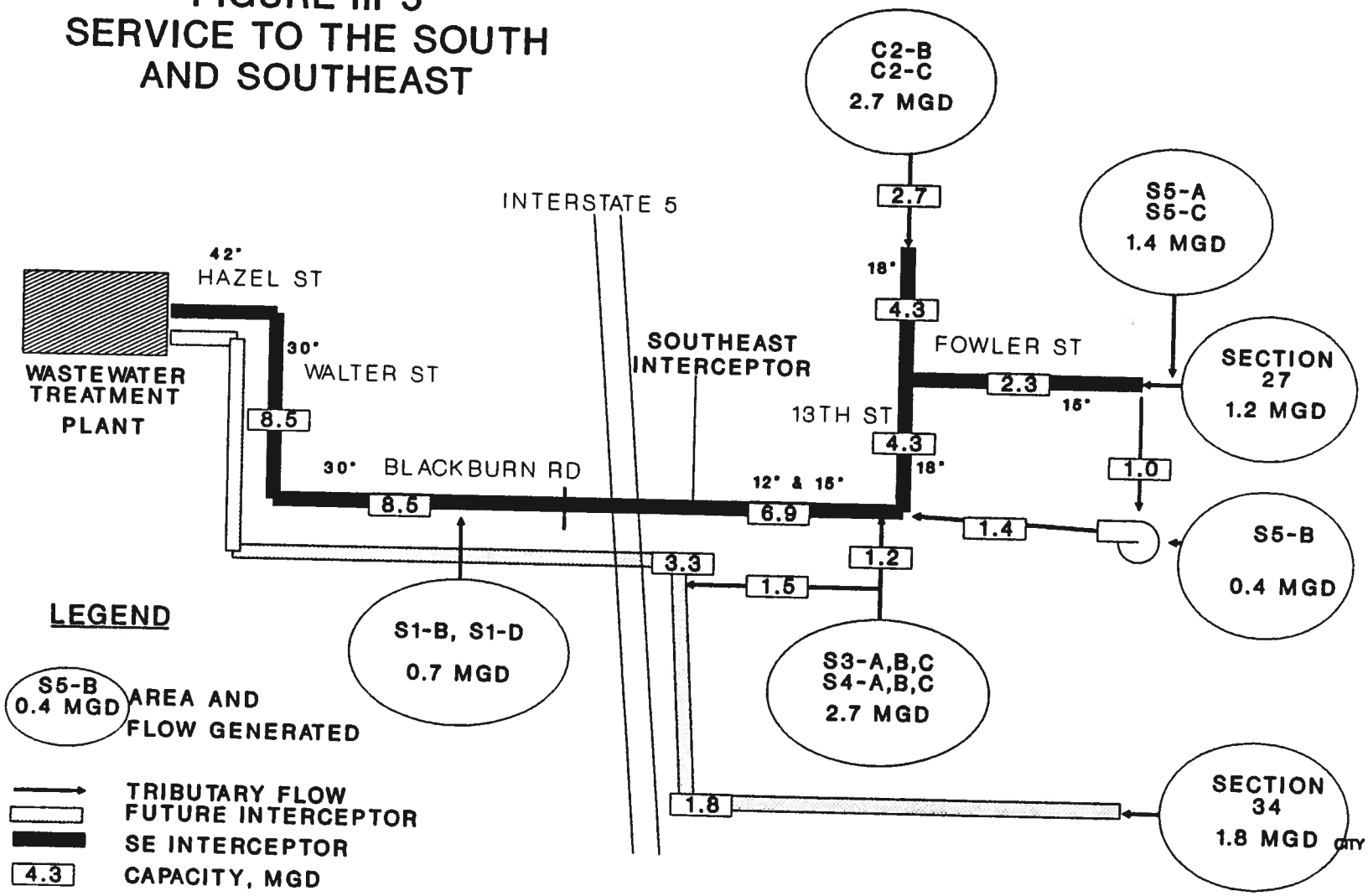
FIGURE III-5
SERVICE TO THE SOUTH AND SOUTHEAST



CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE
SEWER AND COMBINE
SEWER OVERFLOW
REDUCTION PLANS

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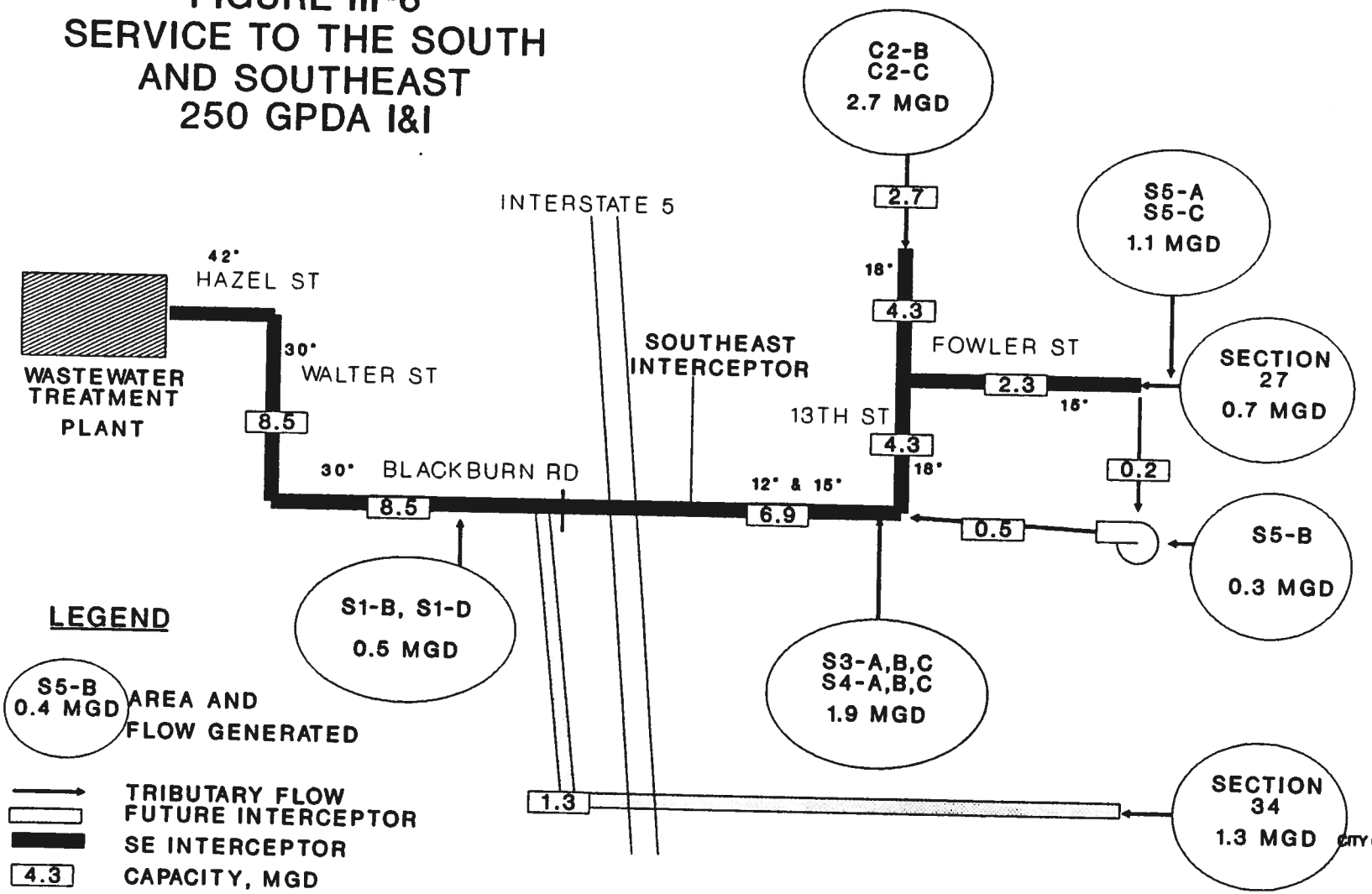
FIGURE III-6
SERVICE TO THE SOUTH AND SOUTHEAST 250 GPDA I&I



CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE SEWER AND COMBINED SEWER OVERFLOW REDUCTION PLANS

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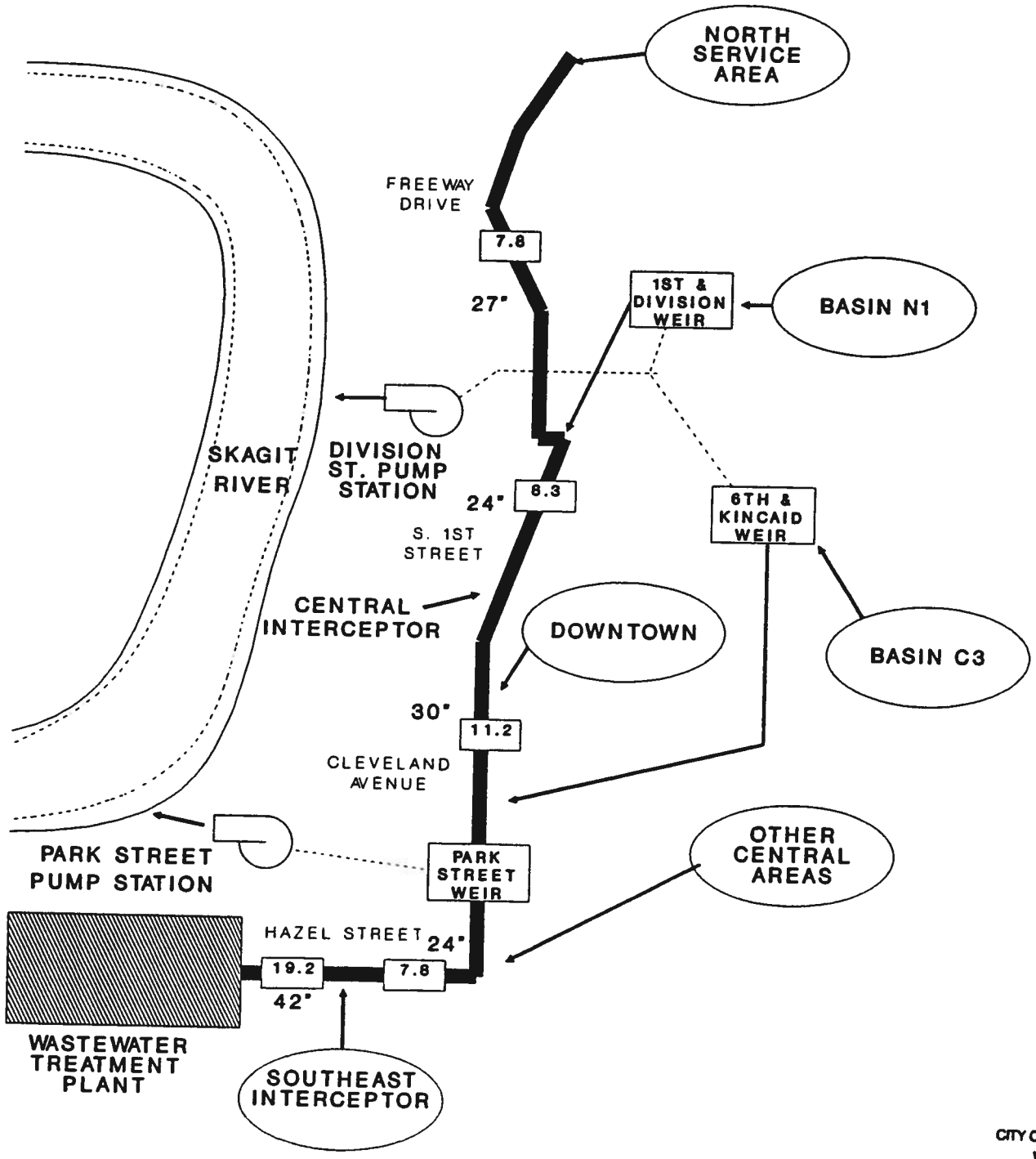
FIGURE III-7
EXISTING CENTRAL AREA DRAINAGE



CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE SEWER AND COMBINED SEWER OVERFLOW REDUCTION PLANS

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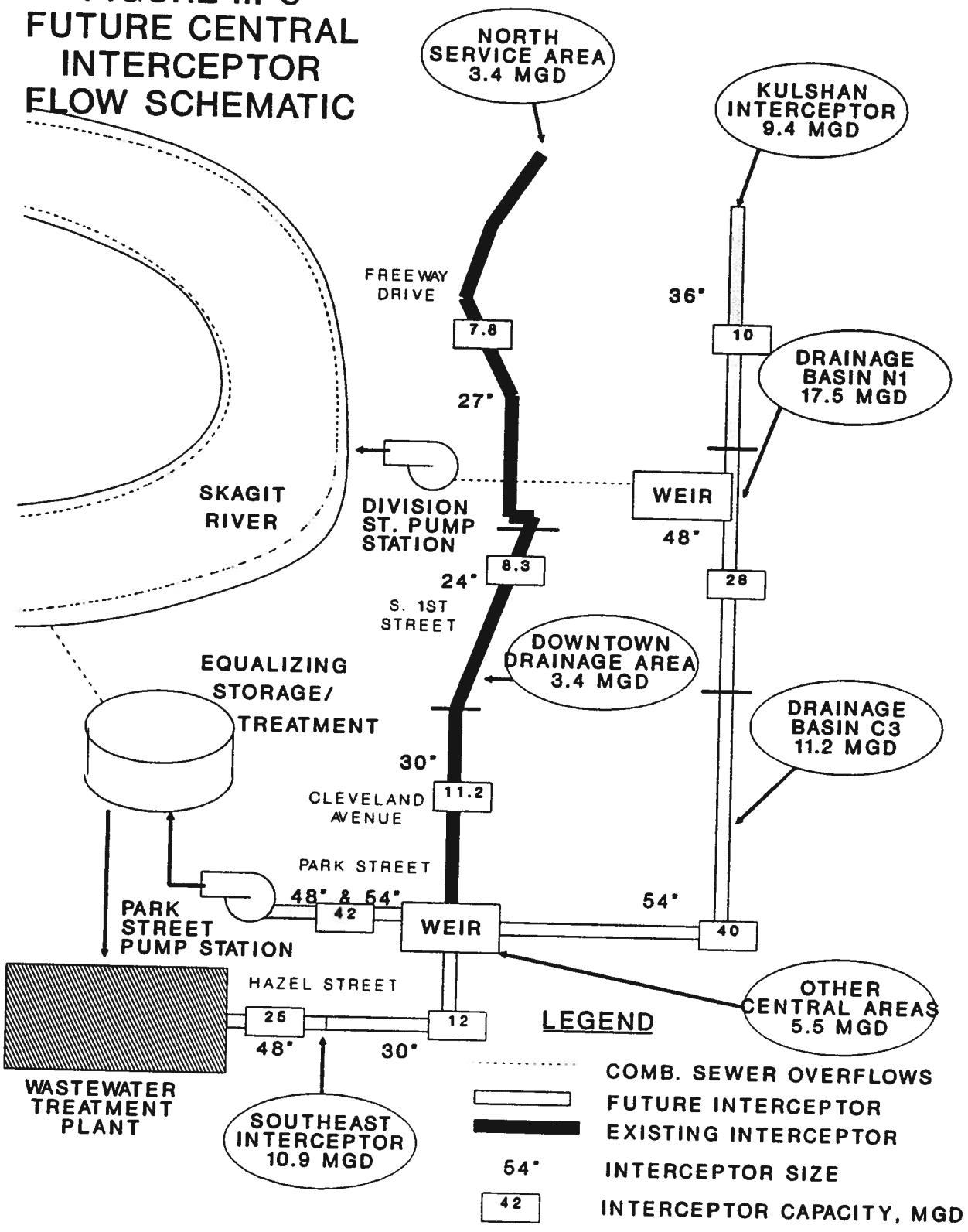
FIGURE III-8
FUTURE CENTRAL INTERCEPTOR FLOW SCHEMATIC



CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE SEWER AND COMBINED SEWER OVERFLOW REDUCTION PLANS

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SECTION IV
HSPF HYDROLOGIC COMPUTER ANALYSIS

SECTION IV

HSPF HYDROLOGIC COMPUTER ANALYSIS

A. General

A sophisticated hydrologic analysis was performed for each of the major drainage basins within the study area. This analysis was used to predict runoff volumes and peak flows for storm events with a specified return frequency. This information is necessary to establish design criteria for conveyance, water quality controls, and fish habitat preservation.

B. Hydrologic Modeling

Hydrologic modeling was performed using EPA's HSPF model. HSPF is a sophisticated computer modeling program that simulates land surface and instream hydrologic processes on a continuous basis. The model is used to transform a long time-series of observed rainfall and evaporation data into a time-series of runoff using continuous accounting of soil moisture levels.

The HSPF model provides a distinct advantage over more traditional event-based models. Event-based models simulate streamflow for individual synthetic storms, and their accuracy depends on the user's ability to accurately portray watershed conditions (primarily soil moisture levels) existing before the storm being modeled.

Hydrologic modeling involved four basic steps:

- definition of drainage basin and subbasin characteristics;
- calibration with recorded flow data;
- simulation of runoff for current and future land use conditions; and
- frequency analysis of simulated runoff data to provide design inflow hydrographs to the storm drainage system.

To provide the necessary hydrologic design data for this project, HSPF was used to simulate an extended period of runoff data that was then subject to a frequency analysis.

As noted earlier, HSPF operates by transforming a long sequence of rainfall data into a sequence of runoff data. The exact nature of this transformation is controlled by a number of model parameters. Application of HSPF involves appropriate configuration of the model by characterizing each of the study area basins, selection of model parameters to represent the rainfall/runoff transformation by calibrating the model to continuous flow monitoring devices, performing long-term simulations by applying a time-series of rainfall data representative of local meteorological conditions, and frequency analysis to estimate 2-, 10-, and 100-year runoff values.

1. Basin Characterization

The study area is comprised of seven separate drainage basins: Kulshan Creek, Madox Creek, Carpenter Creek, Nookachamps Creek, Trumpeter Creek, Britt Slough, and West Mount Vernon. Each of those subbasins were further divided into several smaller subbasins. The land use for each subbasin were divided into seven different land use categories: forest, grassland, low-density residential, medium-density residential, high-density residential, multi-family residential, and commercial/industrial. Presented in Tables IV-1 and IV-2 are the existing and future land uses for the study area by basin. Figure III-5 shows the drainage basins and subbasins within the study area. The Flowers Creek basin (subbasin 22) was further divided to perform a hydrologic analysis and evaluate the surface water impacts of the proposed Blackburn Ridge development on the south side of Blackburn Road. The results of that analysis are presented in Appendix M.

HSPF differentiates between impervious and pervious surfaces. The effective impervious area is that portion of the impervious area contributing runoff directly to the drainage system. In low-density residential, medium-density residential, high-density residential, multi-family residential, and commercial/industrial, this was estimated to be 4, 10, 18, 50, and 85 percent, respectively, of the total area in each land use. The commercial/ industrial areas were further divided into 50 percent impervious, 70 percent impervious, and 100 percent impervious. Non-effective impervious areas in residential and commercial districts were assumed to have the same hydrologic characteristics as grass or as open pasture overlying the appropriate soil type.

The areas identified in Figure III-5 with shading are unique in terms of the surface runoff they generate. Because these are formerly combined sewered areas, the homes in the areas have roof drains that are connected to the City's sanitary sewer. Therefore, it is assumed that only the runoff generated from the streets and driveways enters the storm drainage system. Subbasin 23 is a combined sewered area and was excluded from the hydrologic and hydraulic analysis. All of the surface runoff in that area flows to the sanitary sewer and is treated at the waste water treatment plant.

The pervious areas within each of the subbasins were further divided into 11 categories based on soil type. Each pervious area category was assumed to have homogeneous hydrologic characteristics. The nine categories of pervious area used were:

(1) Forested outwash soils
(2) Pastured outwash soils
(3) Grassed outwash soils
(4) Forested till soils
(5) Pastured till soils
(6) Grassed till soils
(7) Forested flood plain soils
(8) Grassed flood plain soils
(9) Wetland soils

2. Model Calibration

The hydrologic response of the various pervious and impervious areas is controlled in HSPF by a number of model parameters. The parameter values were adjusted to reflect actual streamflow measurements so that the model will accurately simulate the hydrologic response of a drainage basin. This process of parameter values adjustment is known as model calibration. Model calibration was performed for both the Madox Creek and Kulshan Creek drainage basins where flow monitoring equipment was installed at the beginning of this planning effort. The two drainage basins are very different in terms of existing land use conditions.

Madox Creek is mostly undeveloped with only a small amount of effective impervious surface in that basin. A continuous flow recording device was installed in a 200-foot-long 84-inch-diameter corrugated metal pipe approximately 1200 feet upstream from Anderson Road. The device was used to monitor depth of flow in the pipe. The recorded depths were then converted to flow in CFS using Manning's equation, which was verified by comparison with selected flows measured by a flume at this same location. The total basin area tributary to the monitoring location is approximately 900 acres.

The Kulshan Creek Basin is mostly developed and has a high percentage of effective impervious area. A continuous flow recorder was installed in the 48-inch concrete pipe section of the creek where it parallels the Burlington Northern railroad track on the east side of and approximately 200 feet downstream of Riverside Drive. The total basin area tributary to the monitoring location is approximately 1125 acres.

Calibrating both of the drainage basins using recorded flow data verified that the selected parameter values produced reasonable results for both Madox Creek and Kulshan Creek. Once the parameter values were adjusted for the Madox and Kulshan Creek basins, these same values were used to produce predicted flowrates for the other five drainage basins within the study area.

The period used to calibrate the model was from December 1991 through February 1993. Flow data were collected on both Kulshan Creek and Madox Creek during that period at the locations identified in Figure III-5 and previously described. Precipitation data were collected at the Mount Vernon Waste Water Treatment Plant during the same period. Both the flow and precipitation data were collected with equipment that provided this information on a fifteen minute time increment.

The calibration process involved adjustment of certain model parameter values to produce simulated flow volumes for the calibration period which were similar to the recorded flow volumes. Once the volumes were accurately simulated, other parameter values were modified to produce simulated hydrographs for individual precipitation events which were similar to the recorded hydrographs.

The calibration period was extended from the original plan to monitor only the 91-92 wet weather season because of the lack of data for a large storm. By including the 92-93 wet season, there was a greater chance that data from a large storm could be collected.

which would improve the accuracy of the model simulation for larger storm events. In spite of this extended calibration period, the largest precipitation event that occurred during the calibration period was in January of 1992. The flow and precipitation data from that storm event were used to fine tune the calibration of the HSPF model. Based on the frequency analysis performed for the long term simulation as described in the subsequent subsection the return period for the January 1992 event is approximately a three-year event.

The calibration process produced a set of parameter values that could be used to represent both Kulshan Creek and Madox Creek drainage basins. One parameter was assigned different values for the Madox Creek and Kulshan Creek calibration. The value for "DEEPFR" used for the Kulshan Creek calibration was 0.85. This means that 85 percent of the portion of the rainfall that enters the groundwater system never reenters the creek and continues down gradient until it reaches the Skagit River. This assumption is based on the fact the topography is flat. Also, the creek in the lower portion of the basin is contained in a 48-inch concrete conduit, which precludes subsurface groundwater flows from entering the system. Because of the length of time it takes for groundwater flows to reach surface waters downgradient, the peak flows in the area streams are not affected by the groundwater flows in the system. However, because some portion of the groundwater flows do eventually reach surface waters, the volumes of surface water runoff are affected by the groundwater contribution. For that reason, in areas where the HSPF model was used to simulate alternative solutions involving detention storage, careful consideration was given to the amount of groundwater that could reasonably be expected to enter the surface water system. The value of the "DEEPFR" parameter was set to 0.0 for the other basins.

There are some indications that the peak flow estimates generated by the HSPF model may be too high and could lead to overly conservative designs. One indication is the flow period used to calibrate the model. Although the flow monitoring was extended to include the 92-93 wet season in addition to the 91-92 wet season, unfortunately this period coincided with two of the driest winters in recent years. As noted above, only one moderately large storm event occurred during this period (January 1992) and it was only approximately a three-year event. The calibration is therefore based on minimal amount of high flow data.

Further uncertainty about the peak flows estimates arises when comparing flows predicted by HSPF with reported occurrences of flooding on Kulshan Creek. The HSPF model for current land use conditions predicts peak flows on Kulshan Creek below Riverside Drive of 110 cfs with a return period of about 2.5 years. Hydraulic analysis of the current pipeline capacity below Riverside Drive indicates that flows of this magnitude with free outflow to the Skagit River would produce water levels at about elevation 27 feet. Since serious flooding would occur if the water level in the area exceeded elevation 26, this would indicate that serious flooding should occur about once in every two years on average. Although serious flooding occurred in November 1990 as a result of inadequate pump station capacity, there is no evidence to suggest that flooding occurs as frequently as once every two years as the result of limitations in the pipeline capacity under gravity flow conditions. This observation therefore suggests that the current estimates of peak flows under current and future land use conditions are too high. It follows that design based on these peak flows might be overly conservative.

The graphs in Figures IV-1 and IV-2 show the results of the calibration for the January 1992 event for Madox Creek and Kulshan Creek respectively. Each graph shows two lines. One line represents actual flow measurements, and the other line represents the HSPF computer simulation of flow at the same location.

3. Long Term Runoff Simulation

The calibrated HSPF model was then used by inputting 36 years of hourly rainfall data from the NOAA Weather Station in Burlington, Washington to simulate 36 years of runoff for each subbasin for each pervious land use category and for impervious areas. For pervious areas, HSPF splits runoff into a surface, interflow and groundwater component. For each subbasin, careful consideration was given as to which of these three components of runoff could reasonably be assumed to enter the pipe or channel system. In general, it was assumed that the surface runoff component generated within a subbasin would leave the subbasin as a surface water discharge at its defined outlet point in either a stream channel or a major storm drain. Interflow (shallow groundwater flow) generated within a subbasin was assumed to either leave the subbasin by reaching a surface water system at its defined outlet point or the interflow would continue to accumulate as subsurface flow moving downslope in a dispersed manner to the next downslope subbasin. Interflow was assumed to enter the surface water system only if shallow subsurface movement of water could reasonably be expected to be intercepted by roadside ditches. Otherwise, the model assumed it continues to flow downhill until intercepted by a perennial stream channel. The groundwater component of runoff was generally assumed not to enter pipe systems in the basin. Remaining groundwater was assumed to flow downslope until it reached a defined stream channel.

HSPF was used to combine runoff data from the effective impervious and pervious areas for the surface, interflow, and groundwater runoff components. This process gave a 36-year time-series of outflows at selected points for each subbasin.

Runoff was simulated for both the existing land use and the future buildout condition.

4. Frequency Analysis

Peak annual discharges were determined for each of the 36 years of simulated flows and subjected to frequency analysis. Frequency analyses were used to estimate the peak 2-, 10-, and 100-year runoff values at selected locations for both existing and future land use conditions. The results of the frequency analyses are presented in Tables IV-3 and IV-4 for future and existing land use conditions, respectively. The future runoff condition assumes that no onsite or regional controls are effective in reducing peak flows. As part of the work performed for Section VII, frequency analyses were also used to evaluate the effectiveness of alternative structural solutions. The HSPF model was modified as part of that work to simulate the effects of alternatives involving detention. As discussed in Section VII, comparisons of peak runoff were made for the alternatives to evaluate their effectiveness.

C. Use of Hydrology for Evaluating New Development Projects

The hydrologic data contained in Table IV-4 can be used to determine peak flows from smaller areas within individual subbasins. This may be useful for establishing design criteria for new conveyance improvements. This table shows the total acreage, and return period flows for each subbasin in the study area under future land use conditions. The return period flows listed are for the 2, 10, and 100 year return frequencies.

To provide flow information for design, the drainage area tributary to any proposed conveyance improvements should be calculated. This smaller tributary area should be divided by the total subbasin area in which it is contained to determine the fraction of the subbasin area tributary to the proposed conveyance improvements. This fraction is multiplied by the flows for the subbasin presented in Table IV-4 to determine the appropriate flow for the smaller tributary area for the various return periods.

Some care should be taken when applying this methodology. This methodology assumes that the future land use within the entire larger subbasin is somewhat uniform. If a significant portion of the future land use within a subbasin is undeveloped, the undeveloped area should be subtracted from the total subbasin area before the subbasin area is used in any of the calculations described above. To assist in determining whether the future land use within any individual subbasin is uniform, the subbasin boundaries are shown together with the future land use on Figure III-4.

Table IV-1
City of Mount Vernon

Existing Land Use in Acres

LAND USE	Drainage Subbasin				
	Kulshan Cr.	Trumpeter Cr. (College Way Cr.)	Madox Cr.	Carpenter Cr.	Area to Nookachamps
Commercial					
100% Impermeable	3.10	0.00	1.50	0.00	0.00
80% Impermeable	388.80	22.60	212.60	0.00	0.00
50% Impermeable	31.00	15.40	0.00	0.00	0.00
Total Commercial	422.90	38.00	214.10	0.00	0.00
Residential					
Multifamily	89.00	25.70	0.00	0.00	0.00
High Density	242.10	442.60	156.80	0.00	30.40
Medium Density	50.50	208.60	35.80	0.00	0.00
Low Density (forested)	36.50	6.00	20.80	35.70	0.00
Low Density (grassland)	40.50	106.10	146.40	18.80	16.30
Separate Sewer Area	0.00	0.00	103.00	0.00	0.00
Total Residential	458.60	789.00	462.80	54.50	46.70
Forest	87.70	700.60	730.20	3,319.60	340.30
	435.10	485.20	577.00	378.60	100.50
Total Land Use Area	1,404.00	2,013.00	1,984.00	3,753.00	488.00

Table IV-2
City of Mount Vernon

Future Land Use in Acres

LAND USE	Drainage Subbasin				
	Kulshan Cr.	Trumpeter Cr. (College Way Cr.)	Madox Cr.	Carpenter Cr.	Area to Nookachamps
Commercial					
100% Impermeable	3.10	0.00	1.50	0.00	0.00
80% Impermeable	682.02	27.10	212.60	0.00	0.00
50% Impermeable	30.99	15.36	0.00	0.00	0.00
Total Commercial	716.11	42.46	214.10	0.00	0.00
Residential					
Multifamily	97.12	70.55	0.00	0.00	0.00
High Density	319.47	619.40	200.73	0.00	30.40
Medium Density	31.97	328.39	320.00	118.01	448.90
Low Density (forested)	26.18	6.00	20.77	0.00	0.00
Low Density (grassland)	58.58	127.42	142.71	54.41	0.00
Separate Sewer Area	0.00	0.00	103.00	0.00	0.00
Total Residential	533.32	1,151.76	787.21	172.42	479.30
Forest	37.13	560.10	431.03	3,129.77	8.17
Pasture	117.30	258.71	551.24	450.18	0.00
Total Land Use Area	1,404.00	2,013.00	1,984.00	3,753.00	488.00

Table IV-3
City of Mount Vernon

Existing Land Use and Existing Drainage System
Peak Flows (cfs)

Drainage Basin	Drainage Subbasin	Return Period (years)		
		2	10	100
Skagit River Tributary	SB-01	4.6	7.4	10.8
	SB-03	19.7	32.4	51.8
Riverbend Road	SB-08	2.0	3.1	5.0
	SB-09	1.2	1.8	2.8
	SB-10	8.3	12.7	20.2
	SB-11	10.3	15.6	23.9
West Mount Vernon	SB-24	10.8	17.2	27.9
	SB-25	3.9	6.0	8.2
	SB-26	10.2	15.2	23.1
Kulshan Creek	SB-05	13.1	20.1	30.8
	SB-14	37.2	58.2	91.5
	SB-13	57.3	74.0	90.9
	SB-06	11.7	18.0	27.1
	SB-07	25.2	38.5	57.9
Entire Kulshan Creek Basin at Pump Station	SB-05, 14, 13, 06, 07, 12	96.9	132.0	173.0
Trumpeter Creek	SB-04	18.3	31.9	54.7
	SB-15	42.2	74.5	134.0
	SB-04, 15	59.3	103.0	183.0
	SB-16	21.9	40.4	82.0
	SB-17	30.9	53.5	100.0
	SB-16, 17	51.8	91.2	160.0
	SB-18	8.7	15.0	22.5
Nookachamps Creek	SB-02	11.6	19.5	30.6
Madox Creek	SB-51	12.0	20.0	32.0
	SB-51, 19	17.0	25.0	40.0
	SB-51, 19, 34	28.0	45.0	70.0
	SB-22	40.1	64.6	107.0
	SB-37	40.3	61.6	93.6
Entire Madox Creek Basin	SB-51, 19, 34, 22, 37	95.0	170.0	280.0
Carpenter Creek	SB-35	99.2	174.0	267.0
	SB-36	10.9	19.1	29.8
Britt Slough	SB-30	14.6	22.4	35.7

Table IV-4
City of Mount Vernon

Future Land Use and Existing Drainage System
Peak Flows (cfs)

Drainage Basin	Drainage Subbasin	Area (Acres)	Return Period (years)		
			2	10	100
Skagit River Tributary	SB-01	125	4.8	8.32	13.2
	SB-03	395	25.1	41.9	73.4
Riverbend Road	SB-08	27	5.9	8.9	71.4
	SB-09	15	3.4	5.1	7.4
	SB-10	99	21.6	32.5	47.1
	SB-11	91	19.9	29.9	43.4
West Mount Vernon	SB-24	208	10.8	17.2	27.9
	SB-25	101	3.9	6.0	8.2
	SB-26	140	10.2	15.2	23.1
Kulshan Creek	SB-05	146	15.8	24.2	37.0
	SB-14	384	41.4	64.3	99.7
	SB-13 (includes SB-05 and 14)	843	66.6	84.7	106.0
	SB-06	89	16.1	24.4	36.0
	SB-07	190	34.5	52.3	77.0
Entire Kulshan Creek Basin at Pump Station	SB-05, 14, 13, 06, 07, 12	1172	121.0	163.0	210.0
Trumpeter Creek	SB-04	327	23.3	41.5	77.2
	SB-15	561	52.1	88.1	154.0
	SB-04, 15	888	74.1	127.0	226.0
	SB-16	365	26.8	30.0	100.0
	SB-17	543	33.3	57.1	105.0
	SB-16, 17	908	58.6	103.0	190.0
	SB-18	216	9.4	16.0	24.2
Nookachamps Creek	SB-02	253	19.1	34.9	65.2
Madox Creek	SB-51	283	18.0	31.0	70.0
	SB-51, 19	615	35.0	70.0	120.0
	SB-51, 19, 34	901	50.0	90.0	170.0
	SB-22	469	40.7	65.9	109.0
	SB-37	616	40.3	61.6	93.6
Entire Madox Creek Basin	SB-51, 19, 34, 22, 37	1989	110.0	205.0	350.0
Carpenter Creek	SB-35	2622	100.0	177.0	230.0
	SB-36	261	11.3	19.7	31.2
Britt Slough	SB-30	169	14.5	22.4	35.6

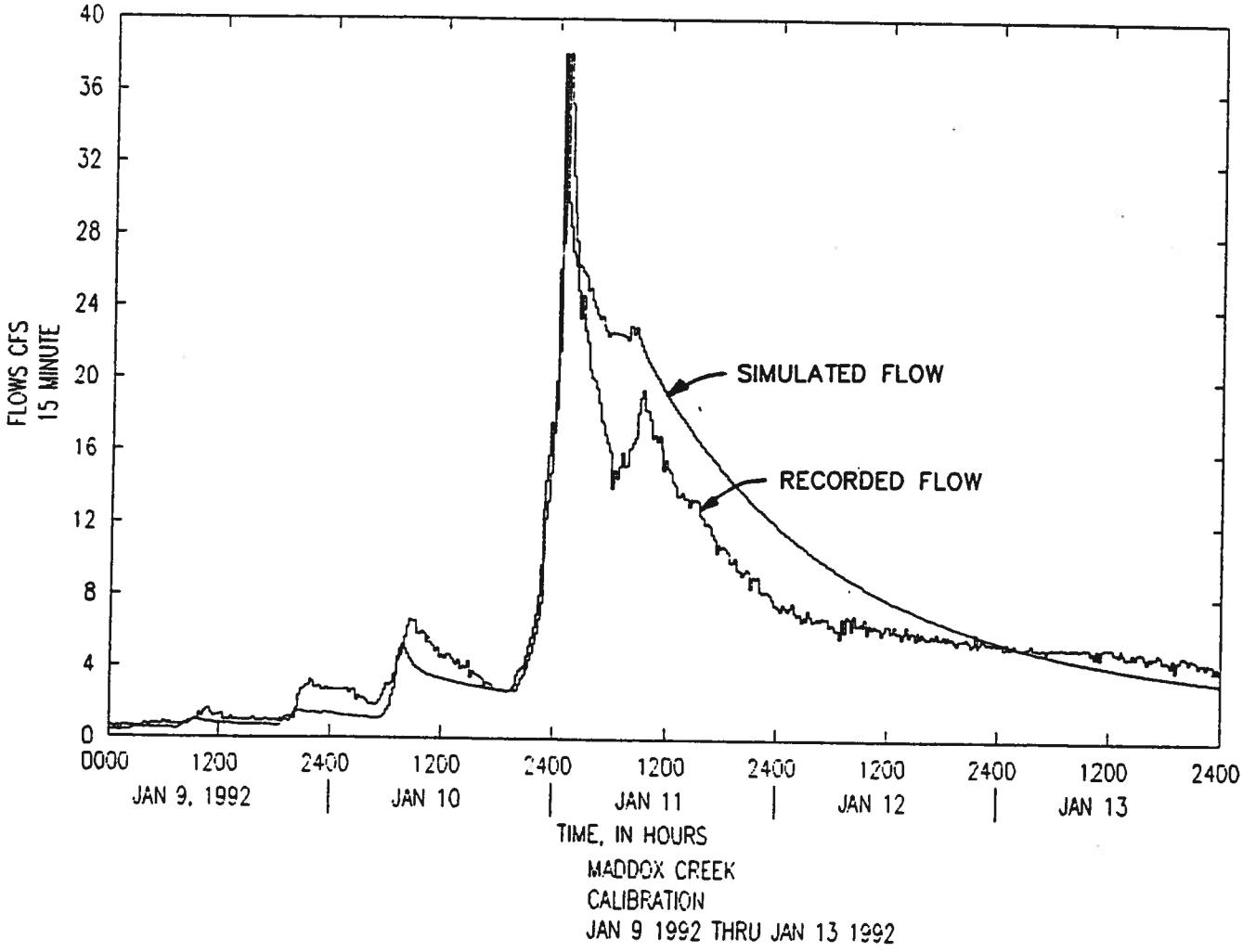

FIGURE IV-1
CITY OF MOUNT VERNON
SURFACE WATER MANAGEMENT PLAN
HSPF RESULTS FOR JANUARY 1992 EVENT ON MADDOX CREEK

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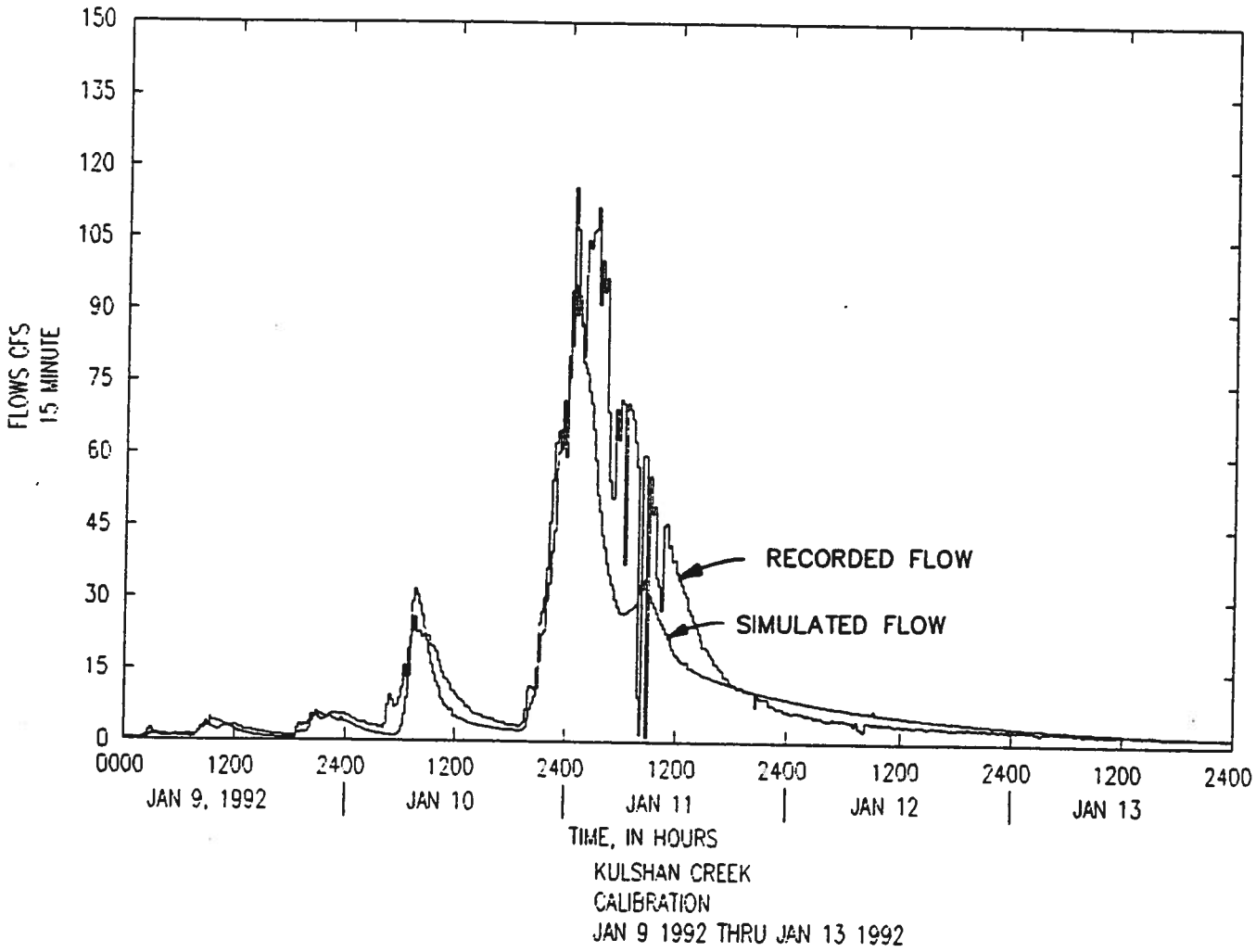

FIGURE IV-2
CITY OF MOUNT VERNON
SURFACE WATER MANAGEMENT PLAN
HSPF RESULTS FOR JANUARY 1992 EVENT ON KULSHAN CREEK

R·W·BECK

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SECTION V
EXISTING POLICIES, ORDINANCES AND REGULATIONS

SECTION V

EXISTING POLICIES, ORDINANCES AND REGULATIONS

A. Introduction

This section includes a review of the existing City, state, and federal policies, regulations, and ordinances relevant to surface water management.

B. Relevant City Policies, Ordinances and Regulations

This section provides an overview of the City's relevant policies, ordinances, and regulations to surface water management.

1. City of Mount Vernon Municipal Code

   a. Chapter 2673 Drainage Ordinance. The City has recently adopted a new drainage ordinance that fulfills the minimum requirements for development standards as required by the *Puget Sound Water Quality Management Plan.* These minimum requirements for stormwater facilities and Best Management Practices (BMPs) are described in Ecology's *Stormwater Management Manual for the Puget Sound Basin.*

   b. Chapter 16.32 Short Plats and Sub-Divisions. This chapter includes requirements for specific design standards for short plats and subdivisions served by private roads.

      These include requirements that storm drainage runoff from the easement road be directed away from other properties and preferably into the public storm-sewer or drainage system and that all sewer, drainage and roadway improvements be designed by a professional civil engineer registered in the state of Washington.

   c. Chapter 15.36 Floodplain Management Standards. This chapter outlines regulations and conditions for floodplain development. City development regulations are identical to State of Washington floodplain development regulations. State regulations are, in turn, consistent with National Flood Insurance Program regulations promulgated by FEMA, with the single exception of residential development within a designated floodway.

      City regulations require the submittal of a development permit application for properties within an "area of special flood hazard" so that the City Building Official may review flood hazard area status and proposed flood control/floodproofing measures in consideration of the permit.

Significant features of City floodplain management standards include the following:

(1) City-designated "areas of special flood hazard" are identified by FEMA in its Flood Insurance Study and associated Flood Insurance Rate Maps (FIRM) prepared in 1985. These include the extent of the 100-year base flood, based on topography and the base (100-year) flood elevation profile.

(2) Residential and nonresidential development within the areas of special flood hazard is permitted under specific fixed floor elevation and floodproofing conditions for new construction or substantial improvements of existing structures. New residential construction or substantial improvements are required to elevate lowest floors one foot above the base flood elevation. Nonresidential construction or substantial improvements are required either to elevate lowest floor one foot above the base flood elevation or provide watertight floodproofing to one foot above the base flood elevation.

(3) Construction of residential structures in the floodway (designated as Zone AI on the FIRM maps) is prohibited except for repairs to an existing structure that do not exceed 50 percent of its market value.

(4) New construction within the AO zones must be elevated one foot above the elevation specified on the FIRM.

(5) Regulations specify conditions for structure anchoring and pressure equilibration, floodproofing materials, piling, and development utility provisions.

(6) Provisions for noncompliance penalties, appeals, and variances are provided. Variances involving floodway development will not be considered if an increase in base flood elevation will result.

2. Critical Areas Ordinance #2482

This ordinance was adopted February 26, 1992 to comply with the requirements of the Growth Management Act (GMA) which was passed by the Washington State Legislature in 1990. A brief summary is also provided here.

The GMA requires the fastest growing counties (including Skagit County and the Cities within Skagit County) to comply with the act. The act requires these cities and counties to develop local comprehensive land use plans and development regulations. It also requires that cities and counties classify, designate and develop regulations to protect certain critical areas prior to the completion of comprehensive land use plans. The critical areas include:

- Wetlands;
- Streams;

- Fish and wildlife habitat conservation area;
- Areas of potential geologic instability or hazard; and
- Hillside developments.

The first three critical areas have a direct impact on surface water and are discussed in detail later in this section.

The intent of the critical area designation is to require cities and counties to provide regulatory protection of these critical areas prior to the development and adoption of comprehensive land use plans. Mount Vernon's critical areas ordinance requires that permits be obtained from the City for any activity which alters or disturbs an environmentally sensitive area as defined by the Critical Areas Inventory Maps or by separate studies. Further, no development permits shall be granted for any lot which contains or is adjacent to an environmentally sensitive area until approvals as required by this ordinance have been granted by the City.

The following paragraphs provide a summary of the recommendations pertaining to critical area designations and interim policies for each critical area.

a. Wetlands. Wetlands and associated buffers may be altered provided that:

   - The city approves a mitigation plan, construction techniques and appropriate permits before any site work occurs.

   - The plans and proposals comply with all applicable state and federal laws and regulations.

   A wetland buffer zone is defined as the area up to 25 feet from a wetland edge as marked in the field. Regulating activity in the 25-foot buffer is presumed to provide necessary and sufficient protection to the wetland, but may be increased pursuant to the following paragraph.

   The City may require increased buffer widths as necessary to protect wetland functions and values, based on local conditions. The areas where an increased buffer may be required include areas where adjacent land is susceptible to severe erosion, areas where a larger buffer is necessary to maintain viable populations of existing species or to prevent degradation or alteration of existing hydro-regime.

   Building setback of ten feet is required from the edge of any wetland buffer. Minor structural intrusions into the area may be allowed if the City determines that such intrusions will not negatively impact the wetland.

b. Streams. The standard buffer width for streams depends upon the stream's classification according to WAC 222-16-030, Forest Practice Regulations.

- Category I. Category I streams are those streams inventoried as "Shoreline of the State" under Chapter 90.58 RCW. Within the City of Mount Vernon, those portions of the Skagit River which lie within the City's jurisdiction are classified as Category I. The buffer required for this category shall be determined by the City's Shoreline Management Plan.

- Category II. Category II streams are those streams that are classified as Type 2 and Type 3 waters by WAC 222-16-030. The characteristic Category II stream is, in part, one used by a substantial number of anadromous or resident game fish for spawning, rearing, or migration. According to this ordinance, the buffer for this category shall be 100 feet total width centered on the stream.

- Category III. Category III streams concern, in part, protection of the downstream water quality and includes streams that are naturally intermittent or ephemeral during years of normal rainfall and are not used by anadromous or resident game fish. According to this ordinance, the buffer for this category shall be 50 feet total width centered on the stream.

The City may require increased buffer widths to protect streams when they are particularly sensitive to disturbance or the development poses unusual impacts. Such circumstances may include:

- Stream reaches affected by the development proposal serves a critical fish habitat for spawning or rearing.

- The stream or adjacent riparian corridor is used by endangered, threatened, rare, sensitive, or monitored species, or provides critical or outstanding actual habitat for such species.

- The riparian corridor is underlain by highly infiltrative soils that provide ground water which nourishes the stream or by till soils that produce high runoff if cleared of vegetation.

- The riparian corridor provides a significant source of water, provides shading of stream waters, or contributes organic material important to stream habitat areas.

- A drainage improvement or water quality feature such as a grass lined swale is proposed within the buffer.

A building setback of ten feet from the edge of all stream buffers is required to prevent any encroachment into the buffer area during and after construction.

c. Fish and Wildlife Habitat. If a development is proposed within or adjacent to a priority habitat area, a wildlife assessment shall be prepared by a qualified

professional. The assessment shall include recommendations for protection of the habitat and species of concern.

3. Shoreline Master Program

The Skagit County Shoreline Master Program was originally developed in 1976 in accordance with the State Shorelines Management Act, and was adopted by the City of Mount Vernon. The program provides for orderly management and regulation of uses along significant stream, lake, and marine shorelines of the City. The program seeks to accommodate water-dependent uses in a balanced manner that will achieve shoreline planning objectives of public access, economic development, historical/cultural amenities, circulation, recreation, and conservation.

The program authorizes the Planning Department to administer a shorelines permit program for development within or adjacent to regulated shorelines. The process includes submittal of a permit application to the City Planning Department for consideration, public notification of development intent, and a public hearing if warranted. The process culminates in a recommendation from the Shoreline Planning Commission to grant or deny the permit, and transmittal of its decision to Ecology and the State Attorney General's Office for review. Provisions are outlined for conditional use, variance, and appeals procedures.

Within the study area, only the Skagit River is considered to be waters of the state and thereby under the program. Because all of the streams within the study area have a mean annual flow of less than 20 cubic feet per second, they are not regulated under this program. The scope of this plan includes only surface waters that are tributary to receiving waters such as the Skagit River and none of these streams are regulated by this program. Therefore, this program does not include any areas regulated by this program.

4. City of Mount Vernon Comprehensive Plan

To comply with the Washington State Growth Management Act, the City adopted its Comprehensive Plan in January 1995. This plan contains policies and recommendations to direct public and private decisions affecting future growth and development. It contains elements relating to land use, housing, transportation, utilities, public facilities and services, and parks and open space. The Comprehensive Plan includes a brief summary of the City of Mount Vernon Draft Surface Water Management Plan, October 1993. This summary describes the surface water plan goals and objectives, the study area and drainage area subbasins, problem and solution identification, and the plan capital improvements program.

C. Relevant State and Federal Regulations and Programs

1. Stormwater Management Standards/Guidelines

There are a number of recently promulgated programs relevant to stormwater management planning in the study area. These are discussed below.

a. Puget Sound Water Quality Management Plan. The Puget Sound Water Quality Management Plan (PSWQMP) establishes a comprehensive plan to protect and improve water quality and aquatic resources in Puget Sound. The Puget Sound Water Quality Authority (PSWQA) was directed to identify water quality problems and corresponding pollution sources affecting marine life and human health, and to develop effective pollution control and management programs that could be implemented in a comprehensive multijurisdictional manner throughout the Puget Sound basin.

The 1994 plan incorporates and builds on the Authority's 1991, 1989, and 1987 management plans. The 1994 plan is also the draft Puget Sound Comprehensive Conservation and Management Plan (CCMP) under the Puget Sound Estuary Program, as authorized by the federal Clean Water Act.

A continuing planning process was established through 1994, with a revised management plan to be produced every two years. The revised plans evaluated progress toward Plan goals and addressed new concerns. Plan revisions were produced in 1987, 1989, and 1991.

In addition to plan development, the Authority carries out responsibilities in the areas of planning, coordination, analysis, education, contract and grant administration, studies and research relating to Puget Sound water quality, and the implementation of programs to implement Chapter 90.70 RCW.

A number of programs regarding stormwater management have been included in the 1994 plan. State authority to require jurisdictions to implement the provisions contained within the PSWQMP is inherent with the 1994 plan adoption. These programs are as follows:

(1) Development Standards and Operations and Maintenance Programs for All Cities and Counties.

The provisions within the 1994 PSWQMP for achieving the program's goal of controlling pollution from stormwater is to implement best management practices (BMPs), assess their effectiveness, and, as necessary, require further water quality controls that may include treatment. This includes a requirement for jurisdictions to adopt minimum standards for new development and redevelopment.

These ordinances shall address, at a minimum: (1) the control of off-site water quality and quantity impacts; (2) the use of source control best management practices and treatment best management practices; (3) the effective treatment, using best management practices, of the 6-month design storm for proposed development; (4) the use of infiltration, with appropriate precautions, as the first consideration in stormwater management; (5) the protection of stream channels and wetlands; (6) erosion and sedimentation

control for new construction and redevelopment projects; (7) local enforcement of these stormwater controls.

In addition, each county and city shall also develop and enforce operation and maintenance programs and ordinances for new and existing public and private stormwater systems. Each county and city shall maintain records of new public and private storm drainage systems and appurtenances.

The 1994 plan also requires that in conjunction with the runoff control ordinances for new development and redevelopment, each jurisdiction shall adopt a stormwater management manual containing state-approved BMPs. A local government may adopt the manual prepared by WSDOE or prepare its own manual as long as it has equivalent technical standards to those prepared by WSDOE. The City staff is currently working with the study's Citizen Advisory Committee on developing this manual.

Education programs to inform citizens about stormwater and its effects on water quality, flooding, and fish-wildlife habitat, and to discourage dumping of waste material or pollutants into storm drains, are also included in the Education and Public Involvement Program and the Household Hazardous Waste Program sections of the 1994 plan.

Each city or county that adopts a comprehensive land use plan and development regulations under the provisions of Chapter 36-70A RCW (the Growth Management Act), shall incorporate the goals of the local stormwater program into the goals of the comprehensive plan and shall incorporate the ordinances required by this element into the development regulations.

Consistent with the Growth Management Act, each local jurisdiction in the Puget Sound Basin is expected to cooperate with neighboring jurisdictions in growth management stormwater planning and stormwater basin planning.

WSDOE will monitor compliance with these requirements, reviewing the status of city and county operation and maintenance and runoff control programs every two years to ensure consistent and adequate implementation and report to the Authority. WSDOE's oversight role shall pertain only to compliance with the objectives of the plan's stormwater program and appropriate rules and statutes and technical suggestions to improvement implementation. This should ensure maximum flexibility and creativity for local governments to resolve site-specific stormwater problems in accordance with their land use and other local policies.

(2) Comprehensive Urban Stormwater Programs: Stormwater Management Programs for Urbanized Areas. Starting with the five larger jurisdictions in the Puget Sound basin named in the EPA stormwater NPDES regulation and eventually expanding to cover all urbanized areas, each city must develop

and implement a stormwater management program consistent with the requirements in appropriate subsections of the stormwater NPDES regulations.

- The purposes of the comprehensive urban stormwater management program will be:
    - To control erosion and manage the quantity and the quality of stormwater runoff from public and private activities
    - To protect and enhance water quality, and achieve water quality and sediment quality standards
    - To reduce the discharge of pollutants to the maximum extent practicable within the constraints of federal and state laws
    - To protect beneficial uses, as described in Chapter 173-201 WAC
    - To achieve the four items above in a manner that makes efficient use of limited resources to address the most critical problems first

    Each urban stormwater program shall seek to control the quality and quantity of runoff from public facilities and industrial, commercial, and residential areas, including streets and roads. Each program shall cover both new and existing development. Early action by urbanized areas that are prepared to implement stormwater control programs shall be allowed. Emphasis shall be placed on controlling stormwater through source controls and BMPs. Where local programs are not effectively solving stormwater problems, Ecology shall ensure compliance through its oversight role or through issuance and enforcement of individual or watershed-based NPDES permits. Each city or urban area shall have the flexibility to design its own program, but the content, priorities, and deadlines for compliance shall be subject to review by Ecology for consistency with the Puget Sound Plan and NPDES regulations.

    In some cases, significant stormwater problems may be originating in urbanized areas outside of a local jurisdiction. In those situations, the sequencing of areas for urban stormwater programs may be modified to address problems in shared watersheds. The neighboring jurisdictions will develop local coordination mechanisms to cooperatively resolve the identified problems. Where joint programs are not developed, WSDOE shall ensure consistency in programs through its oversight role.

At a minimum, each urban stormwater program shall include:

- Identification and ranking of significant pollutant sources and their relationship to the drainage system and water bodies through an ongoing assessment program.

- Investigations and corrective actions of problem storm drains, including sampling.

- Programs for operation and maintenance of storm drains, detention systems, ditches, and culverts.

- A water quality response program, to investigate sources of pollutants, and respond to citizen complaints or emergencies such as spills, fish kills, illegal hookups, dumping, and other water quality problems. These investigations should be used to support compliance/ enforcement efforts.

- Assurance of adequate local funding for the storm water program through surface water utilities, sewer charges, fees, or other revenue-generating sources.

- Local coordination arrangements such as interlocal agreements, joint programs, consistent standards, or regional boards or committees.

- Ordinances requiring implementation of stormwater controls for new development and redevelopment.

- A stormwater public education program aimed at residents, businesses, and industries in the urban area.

- Inspection, compliance, and enforcement measures.

- An implementation schedule.

- If, after implementation of the control measures listed in the points above, there are still discharges that cause significant environmental problems, retrofitting of existing development and/or treatment of discharges from new and existing development may be required.

Stormwater quality in public stormwater systems in commercial and industrial areas shall have a high priority in the city programs. WSDOE shall determine, in compliance with EPA regulations, and in consultation with local governments, the appropriate approach to controlling stormwater discharges from industrial and commercial

facilities that are not currently required to have stormwater NPDES or point source discharge permits. Stormwater controls are included in NPDES permits for discharges of stormwater from commercial and industrial point source facilities, which are addressed in the Municipal and Industrial Discharges Program.

WSDOE shall have oversight responsibilities for the urban stormwater programs. WSDOE shall review each urban stormwater program every two years to ensure consistent and adequate implementation and report to the Authority.

This Surface Water Management Plan fulfills many of these requirements.

(3) Technical Manuals and Assistance on Stormwater and Erosion Controls.

Technical Manuals. WSDOE has produced a technical manual for use by local jurisdictions in stormwater planning. The technical manual provides technical guidance for implementing local programs.

Vactor Waste. In the 1994 plan, Ecology has committed to develop a program for a vactor waste disposal program.

Monitoring Guidance. In the 1994 plan, Ecology has also committed to develop guidance on how to monitor stormwater runoff compliance and the effectiveness of BMPs.

(4) Local Government Stormwater Assistance Service.

The intent of the 1994 PSWQMP is to provide technical assistance to local governments through people who have hands-on experience with (1) the design and implementation of stormwater programs at the local level, (2) current Best Management Practices for stormwater, and (3) local basin characteristics. WSDOE shall work with the City with current stormwater expertise to establish a technical assistance service.

This service will support the exchange of technical information and assistance on stormwater among local governments, will train WSDOE and local government staff in current practices and real world application and problems in stormwater technology, and will operate as an integral part of the state technical assistance program. The service will have the goal of acting as an in-the-field branch of WSDOE's technical assistance program.This service will support the exchange of technical information and assistance on stormwater among local governments, will train WSDOE and local government staff in current practices and real world application and problems in stormwater technology, and will operate as an integral part of the state technical assistance program. The service will have the goal of acting as an in-the-field branch of WSDOE's technical assistance program.

NPDES Coordination. In the 1994 plan, Ecology has been designated to provide technical assistance to local governments that are required to obtain NPDES permits.

(5) Guidance and Model Ordinances.

WSDOE will prepare and update guidance and model ordinances for stormwater programs for all cities and for comprehensive urban stormwater programs. All cities will adopt stormwater programs that include minimum requirements for new development and redevelopment set by the plan and in guidance developed by WSDOE.

The guidance shall include:

- Procedures for development local programs, including procedures for review and approval of programs.
- Minimum requirements for runoff controls and system maintenance required in local ordinances.
- Minimum requirements for control of private sector maintenance of private drainage systems.
- Minimum requirements for the operation and maintenance programs, including recordkeeping requirements for new drainage systems and facilities.
- Methods for assuring practical and appropriate disposal procedures for decant water, solid, and other substances from drainage system clean out and maintenance. Methods shall address catch basins, oil/water separators, pipelines, swales, detention/retention basins, and other appropriate drainage elements.

Additionally, the guidance for the comprehensive urban stormwater programs will include:

- Procedures for identification and ranking of significant pollutant sources and their relationship to the drainage system and water bodies
- Procedures for source tracing investigations, including sampling of problem storm drains
- Procedures for investigations, implementation of spill control measures, enforcement, and remedial actions
- Methods for assuring adequate local funding for the urban stormwater program

- Provisions for agreements with neighboring jurisdictions when stormwater and watersheds do not follow jurisdictional boundaries
- Requirements for public education programs
- Requirements for retrofitting and/or treatment measures, if necessary
- Procedures for inspection, compliance, and enforcement measures
- Requirements for implementation schedules
- Methods to coordinate stormwater management with other watershed habitat protection and growth management activities

The guidance will lay out acceptable approaches to control stormwater from new development and redevelopment, such as water quality policies for use in SEPA, NPDES, and other permit decisions; density controls to limit development in sensitive areas; development standards to limit the amount of impervious surfaces; regional detention ponds; oil separators or other treatment facilities; grading and drainage ordinances; erosion control programs; buffers next to waterways; preservation of wetlands; and other appropriate elements.

a. Federal Requirements - National Pollutant Discharge Elimination System. The Environmental Protection Agency (EPA) has determined that stormwater discharges will be regulated under the National Pollutant Discharge Elimination System (NPDES) process. As a result, some stormwater dischargers will be required to submit permit applications.

On October 31, 1990, the EPA administrator signed into law final regulations requiring NPDES permits for three categories of stormwater discharges: (1) medium cities with population between 100,000 and 250,000; (2) large cities with population greater than 250,000; and (3) discharges associated with industrial activity.

The non-point source permits will differ from standard NPDES permits in that the industrial discharge permits can be issued to a class or group of dischargers, and the municipal stormwater permit can be issued on a jurisdiction-wide basis. EPA stated that the ideal permit basis would be the watershed. In other words, individual permits for each outfall would not be required.

The municipal stormwater permit programs will include a combination of required ordinances, mapping, discharge characterization, source identification, and public education. Stormwater associated with industrial activities would also be regulated. Some industrial activities within the City may be regulated depending on their Standard Industrial Code (SIC). The City of Mount Vernon may also

conduct certain activities that would require NPDES permits for stormwater. This includes operation of the City's waste water treatment plant.

The City of Mount Vernon is not required by federal law to apply for a municipal permit because it's population is less than 100,000. The State of Washington has been given the authority to administer the federal NPDES program.

2. Growth Management Act

A general discussion of the Growth Management Act is provided in this section because it contains land use planning requirements for designating and protecting critical environmental areas such as wetlands and fish habitat areas.

a. Purpose. The Growth Management Act became effective July 1, 1990. The Act's goal is to manage growth in Washington State's fastest growing counties through the adoption of local comprehensive land use plans and development regulations. The City of Mount Vernon adopted its Comprehensive Plan in conformance with the Growth Management Act in January 1995.

b. Who Must Develop Comprehensive Plans. The Act requires the following jurisdictions to adopt comprehensive land use plans:

- Counties with population of 50,000 or greater and an increase in population of more than 10 percent in the last 10 years and any cities in such a county.
- Counties that have a population increase of more than 20 percent in the last 10 years and any cities in such a county.
- Counties that elect to conform with the Act.

Eleven counties in Washington, including Skagit County must adopt comprehensive plans under the Act. Mount Vernon, as a city in Skagit County, must comply with this Act. Those required to adopt comprehensive land use plans must do so on or before July 1, 1994.

c. Comprehensive Plans - Advisory Goals. The standard for all plans are thirteen advisory goals aimed solely at guiding the development of local comprehensive plans. These advisory goals include encouraging urban growth where reasonable, reducing urban sprawl, encouraging efficient transportation systems based on regional priorities, encouraging the availability and variety of affordable housing, encouraging the retention of open space and recreational opportunities, and protecting the environment.

d. Comprehensive Plans - Requirements

(1) Comprehensive plans must contain design elements for the following:

- land use
- housing
- capital facilities
- utilities
- rural areas (counties only)
- transportation

(2) Where applicable, the land use element must:

- provide for protection of the quality and quantity of groundwater used for public water supplies;
- shall review drainage, flooding, and stormwater runoff in the area and nearby jurisdictions; and
- provide guidance for corrective actions to mitigate or cleanse those discharges that pollute waters of the state, including Puget Sound, or waters entering Puget Sound.

(3) Comprehensive plans must be consistent with plans of neighboring jurisdictions.

e. Development Regulations - Natural Resource Lands and Critical Areas. Cities and counties subject to the act must:

(1) Inventory and designate natural resource lands and critical areas on or before September 1, 1991. This has been completed by the City with the adoption of Ordinance #2482.

(2) Adopt development regulations on or before September 1, 1991 to ensure the conservation of agricultural, forest, and mineral resource lands. This has been completed by the City with the adoption of Ordinance #2482.

(3) Adopt development regulations on or before September 1, 1991, precluding land uses or development that is incompatible with designated "critical areas," which include the following areas and ecosystems:

- Wetlands
- Areas with a critical recharging effect on aquifers used for potable water
- Fish and wildlife habitat conservation
- Frequently flooded areas
- Geologically hazardous areas

This has been completed by the City with the adoption of Ordinance #2482.

f. Implementation. Within one year of the adoption of its comprehensive plan, counties and cities must enact development regulations, such as zoning ordinances, official controls, and planned unit development ordinances, that are consistent with and implement the comprehensive plan.

Each county and city that adopts a comprehensive plan under the Act is required to report to the Department of Community Development annually for a period of five years, beginning on January 1, 1991, and each five years thereafter, on the progress made by that county or city in implementing the requirements of the Growth Management Act.

3. Wetlands - Relevant Federal and State Regulations

Wetlands are identified and delineated within the City of Mount Vernon using the *Corps of Engineers Wetlands Delineation Manual* (1987 Manual) (Environmental Laboratory, 1987). The 1987 Manual is required for review of wetlands within the City as well as required by the U.S. Army Corps of Engineers for federal review of wetland impact. As of September 1995, the State of Washington also follows the 1987 Manual in determining the presence and extent of jurisdictional wetlands. The methodology outlined in this manual is based upon three characteristics of wetlands: 1) hydrophytic vegetation, 2) hydric soils, and 3) wetland hydrology. All three of these characteristics must be present in order to make a positive wetland determination using the 1987 Manual (unless disturbed areas are encountered).

a. Federal Regulations. The primary federal laws that regulate activities in or near wetlands are Sections 401 and 404 of the Clean Water Act (CWA), Section 10 of the River and Harbor Act of 1899, and the "Swampbuster" provision of the Food Security Act (FSA) of 1985. All federal actions are also subject to the 1969 National Environmental Policy Act (NEPA) and many to the Coastal Zone Management Act of 1972.

Section 401 of the CWA mandates that federally permitted activities in wetlands comply with the CWA and state water quality standards. Under Section 404 of the CWA, the U.S. Army Corps of Engineers (Corps) has been given the responsibility and authority to regulate the discharge of dredged or fill materials into waters and adjacent wetlands of the United States (Federal Register, 1986). Under the River and Harbor Act, the Corps also issues permits for construction in or along navigable waters, including any wetlands within those waters. The "Swampbuster" provision of the FSA denies eligibility for all U.S. Department of Agriculture farm programs to farmers who convert wetlands to croplands.

Of the above regulations, Section 404 permitting is the most commonly applicable to freshwater wetlands. Two kinds of permits are issued by the Corps: General and Individual. General Permits (also known as Nationwide Permits, or NWPs) cover proposals that would have minimal adverse impacts on the environment. The most commonly used NWP for wetland alterations is NWP 26; this NWP specifically addresses wetlands which are (1) above the headwaters of

a river or stream (that point in the watercourse at which the mean annual discharge is less than five cubic feet per second) or (2) hydrologically isolated. Such permits apply to fills and other impacts of less than one acre, although impacts of up to two acres may be covered by a General Permit. However, proposed impacts from one to two acres require a Water Quality Certification under Section 401 of the CWA from the Department of Ecology (as discussed under Washington State regulations, below). Other NWPs allow impacts to wetlands for specific purposes. For example, a NWP 12 is used for wetland impacts due to utility installation and maintenance. Unless they may be covered by one of the NWPs, projects with wetlands impacts of more than two acres require Individual Permits. The Corps evaluates Individual Permits based upon the probable impacts of a project on environmental quality and on a determination of whether or not the project is in the public interest. Actions seeking Individual Permits must comply with the Section 404(b)(1) guidelines which require that an applicant prove that there are no other practicable alternatives to the proposed project and that the project has avoided and/or minimized impacts to wetlands to the maximum extent practicable.

b. Washington State Regulations. The principal Washington State regulations that govern activities in or near wetlands are the Shoreline Management Act (SMA) of 1971 (Chapter 90.58 RCW), the 1949 State Hydraulic Code (RCW 75.20.100-140), State 401 (Water Quality) Certification, Coastal Zone Management (CZM) determinations, and the Floodplain Management Program. All actions are also subject to the State Environmental Policy Act (SEPA) of 1971 (with new implementation rules adopted in 1984, Chapter 197-11 WAC) and, in Western Washington, to the Puget Sound Water Quality Act (Chapter 90.70 RCW). Some actions may also be subject to the Forest Practices Act (Chapter 76.09 RCW). The Shoreline Master Program, Hydraulic Project Approval, and the Floodplain Management Program were discussed previously.

4. Wetlands Standards/Guidelines

The preservation/enhancement of wetlands has recently become a prominent issue in the Pacific Northwest, spurred in large part by the Growth Management Act. Two relevant wetland protection programs which provide guidelines and standards for wetlands protection are the Washington Department of Ecology's (Ecology) Model Wetlands Protection Ordinance (September 1990) and element W-2 of the Puget Sound Water Quality Management Plan (May 1994).

a. Model Wetlands Protection Ordinance, Department of Ecology. The purpose of Ecology's model wetlands ordinance is to provide guidance to cities and counties in developing standards and regulations governing wetlands. It is written as a template which cities and counties may adopt and modify according to their needs and provides minimum guidelines for wetlands protection. The model ordinance establishes a definition of wetlands, recognizes their value and the negative impacts which may result from construction, and provides guidelines for the following:

(1) Lands to which the ordinance applies. This section provides standards for regulated activities which are subject to approval if they are conducted in wetlands or their buffers; standards for wetland delineation; and suggestions for adopting either the Washington State rating system or the Puget Sound Region wetlands rating system in order to categorize wetlands. The newly adopted Washington State Wetlands Rating System for Eastern and Western Washington (October 1991) provides guidelines for categorizing wetlands. The wetlands rating system is a process that differentiates wetlands according to specific characteristics or functional attributes. The rating system includes four categories of wetland that are used to determine the size of buffer zones and the ratio for replacing wetlands. A Category I wetland has exceptional resource value and contains rare plant or animal species; a category IV wetland has ordinary resource value, with generally one type of vegetation, and is isolated from other aquatic systems. Categories II and III are intermediate in terms of species diversity and resource value. The Model Ordinance requires a 200- to 300-foot buffer (depending upon surrounding land use) for a category I wetland, a 100- to 200-foot buffer for Category II, a 50- to 100-foot buffer for Category III, and a 25- to 50-foot buffer for a Category IV wetland. Permit decisions can then be considered in light of the wetland rating and the potential development impact. The Puget Sound Region wetlands rating system provides slightly more specific criteria for classification of wetlands than the Washington State system.

(2) Regulated and allowed activities. This section lists the types of activities which will be regulated and allowed in wetlands under the ordinance. Examples of regulated activities include the removal, excavation, grading, or dredging of soil, sand, gravel, minerals, organic matter, or material of any kind; and the destruction or alteration of wetlands vegetation through clearing, harvesting, shading, intentional burning, or planting of vegetation that would alter the character of the wetland. Examples of allowable activities include conservation of soil, water, vegetation, fish, shellfish, and other wildlife; and existing or ongoing agricultural activities.

(3) Procedures for wetland permits. This section provides guidelines on information required and procedures for obtaining, complying with, and processing wetlands permits.

(4) Standards for wetland permit decisions. This section establishes standards and conditions for wetlands permits, including: establishing wetland buffers according to classification category; permitted uses within buffers; procedures for minimizing and/or avoiding impacts to wetlands; density transfers; special use conditions for sensitive areas; and compensatory mitigation requirements for wetlands impacts.

b. 1994 Puget Sound Water Quality Management Plan - Section W-2 Puget Sound Local Government Wetland Protection Programs. The Puget Sound Water Quality Authority (PSWQA) has adopted minimum standard guidelines for local governments to use in protecting wetlands in the Puget Sound area under the Growth Management Act. Local governments are encouraged to use these guidelines for reviewing actions that impact wetlands.

The goal of the standards is to protect wetlands by achieving no net loss of wetlands in the short-term and a long-term wetlands gain. The proposed standards call for all local governments in the Puget Sound planning area to develop and carry out a wetlands protection program. The PSWQA standards present a framework for wetlands protection, allowing local governments to decide specifics in implementing the program, such as permitting requirements, penalties, etc.

Under the standards, local governments would use permits or other mechanisms to avoid impacts on wetlands or to minimize and compensate for unavoidable and necessary impacts. Permits would be required for dredging, dumping, draining, construction or clearing in wetlands.

The PSWQA standards include a minimum definition of regulated wetlands and compensatory mitigation for wetlands impacts. The standards also specify regulated activities, methods to avoid wetland impacts, and general permits to allow some activities.

The PSWQA standards require that damage or destruction of a wetland is allowable only if there is no reasonable alternative. If the destruction is unavoidable and necessary, compensation is required to replace it by creating or restoring wetlands at an increased ratio. The proposed replacement ratio for category IV is 1.25 to one, e.g., for every one acre of wetland destroyed, it must be replaced with 1.25 acre of wetland.

5. Floodplain Regulations

a. State Floodplain Regulations. Chapter 86.16 RCW establishes statewide authority through regulations promulgated by WSDOE for coordinating the floodplain management regulation elements of the National Flood Insurance Program. Under Chapter 173-158 WAC, WSDOE requires local governments to adopt and administer regulatory programs compliant with the minimum standards of the NFIP. WSDOE provides technical assistance to local governments for both identifying the location of the 100-year (base) floodplain and in administering their floodplain management ordinances.

WSDOE also establishes land management criteria in the base floodplain area by adopting the federal standards and definitions contained in 44 CFR, Parts 59 and 60, as minimum state standards. In addition to adopting the federal standards, the state regulations provide for additional regulation of residential development in

the floodplain. Federal regulations allow residential and nonresidential development in the floodplain if the proponent can demonstrate there is no resultant increase in base flood elevations within the floodway. State regulations allow only for repair or reconstruction of existing residential structures within the floodway that do not increase the building footprint and that cost less than 50 percent of the value of the existing structure.

b. Federal Floodplain Regulations. The Federal Emergency Management Agency, (FEMA), implements provisions of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This legislation and companion administrative regulations support the availability of flood insurance for development in flood-prone areas and ensures that the availability of insurance is conditional on the development of a floodplain management plan that will limit flood damages.

A detailed outline of the National Flood Insurance Program (NFIP) and its companion regulations is presented in 44 CFR. Selected elements of FEMA regulations with special significance to Mount Vernon are as follows:

(1) The technical basis for the NFIP is the development of a flood boundary map and the corresponding Flood Insurance Rate Map (FIRM). The flood boundary map is the product of a hydrologic/hydraulic analysis that designates base flood elevations and corresponding lateral boundaries of flood hazard. This map serves as the technical basis for an approved floodplain management plan. The FIRM identifies appropriate insurance premium rates for zones of varying risk within the floodplain.

Flood Insurance Studies were performed in the City in 1979 and 1980. The studies included the preparation of Flood Insurance Rate Maps, which show the 100-year flood boundary and were adopted by the City. The flood zones are shown in Figure V-1.

The flood hazard zones each have a specific flood potential or hazard as is indicated by one of the following flood insurance zone designations:

Zone A: Special flood hazard areas inundated by the 100-year flood, determined by approximate methods.

Zone AO: Special flood hazard areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown on the FEMA maps.

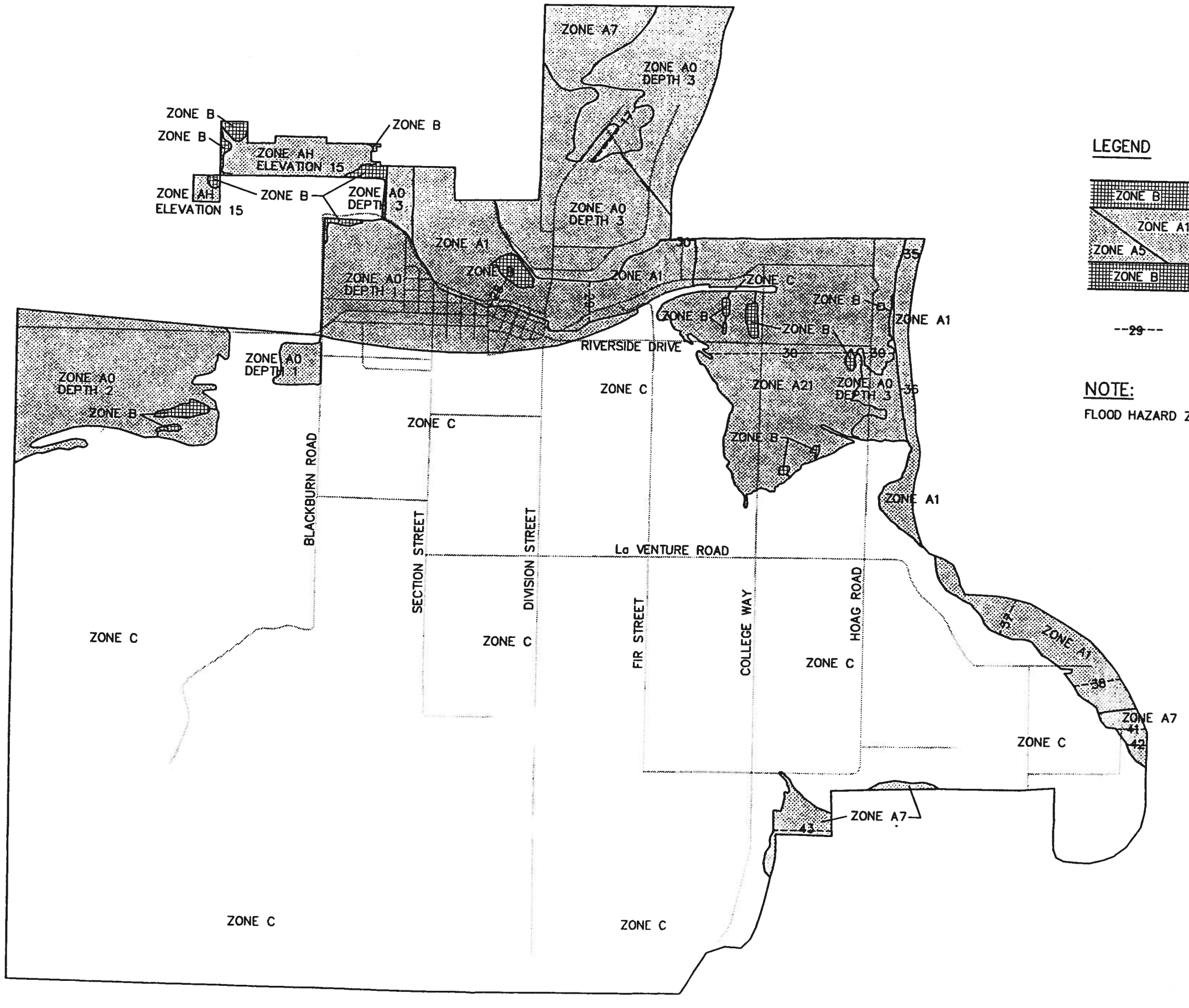
Zone AH: Special flood hazard areas inundated by types of 100-year shallow flooding where the depths are between 1.0 and 3.0 feet; base flood elevations are shown on the FEMA maps.

Zones A1, A7 and A21: Special flood hazard areas inundated by the 100-year flood, determined by detailed methods; base flood elevations and zones subdivided according to flood hazard factors are shown on the FEMA maps.

Zone B: Areas between the special flood hazard areas and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also areas subject to certain types of 100-year shallow flooding where the depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile.

Zone C: Areas of minimal flooding.

(2) Specific floodplain management criteria for development are presented in 44 CFR Section 60.3. These measures, and more restrictive measures, have been adopted by the State of Washington and the City of Mount Vernon under Chapter 15.36 of the Mount Vernon Municipal Code.



LEGEND

ZONE B — 500 YEAR FLOOD BOUNDARY

ZONE A1 / ZONE A5 — 100 YEAR FLOOD BOUNDARY

ZONE B — 500 YEAR FLOOD BOUNDARY

--29-- BASE FLOOD LEVEL ELEVATION LINE WITH ELEVATION IN FEET (NATIONAL GEODETIC VERTICAL DATUM OF 1929)

NOTE:

FLOOD HAZARD ZONE DESIGNATION ARE DEFINED IN THE TEXT.

FIGURE V-1
CITY OF MOUNT VERNON
SURFACE WATER
MANAGEMENT PLAN

FLOOD ZONES

PAUDEGY

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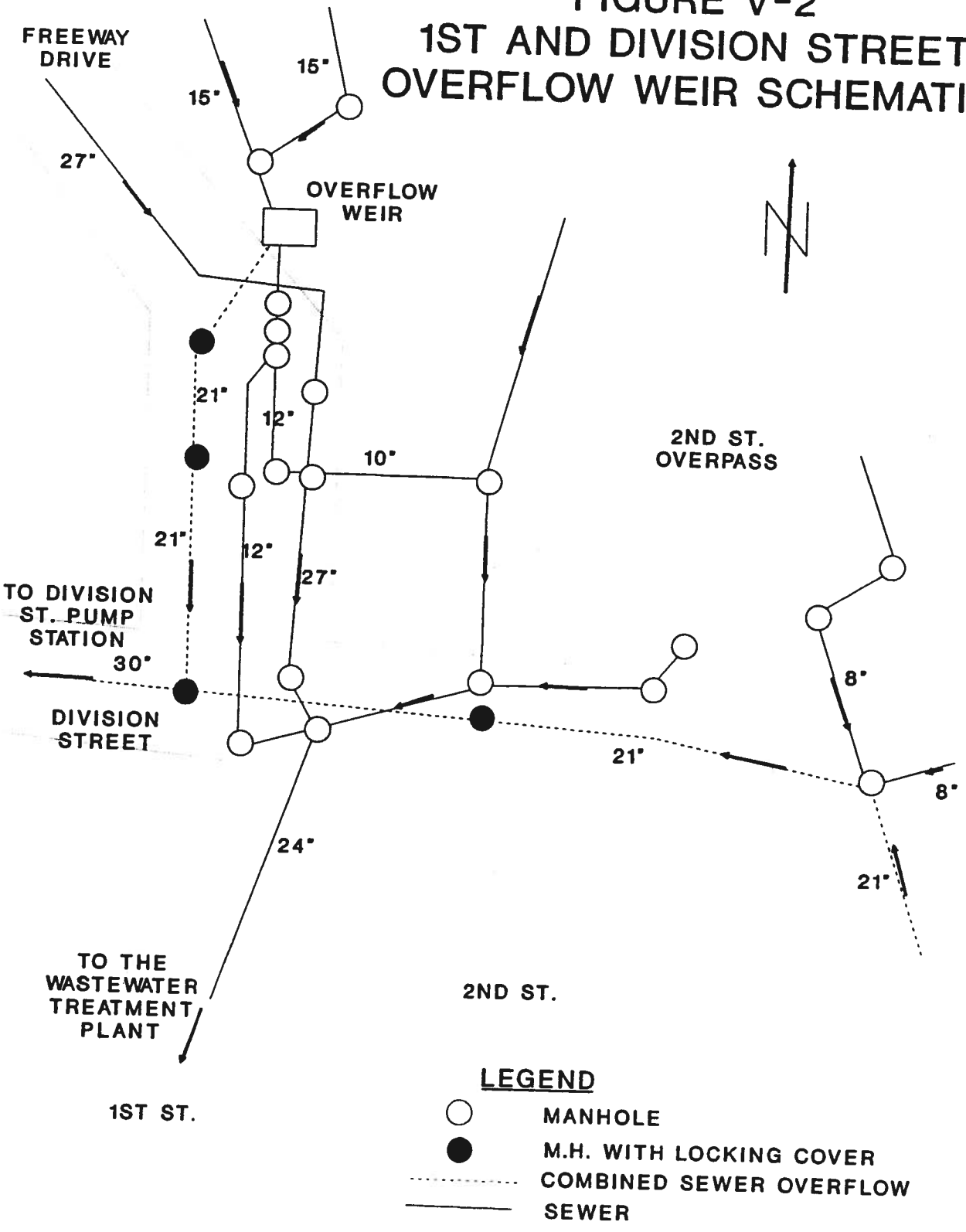
FIGURE V-2
1ST AND DIVISION STREET
OVERFLOW WEIR SCHEMATIC

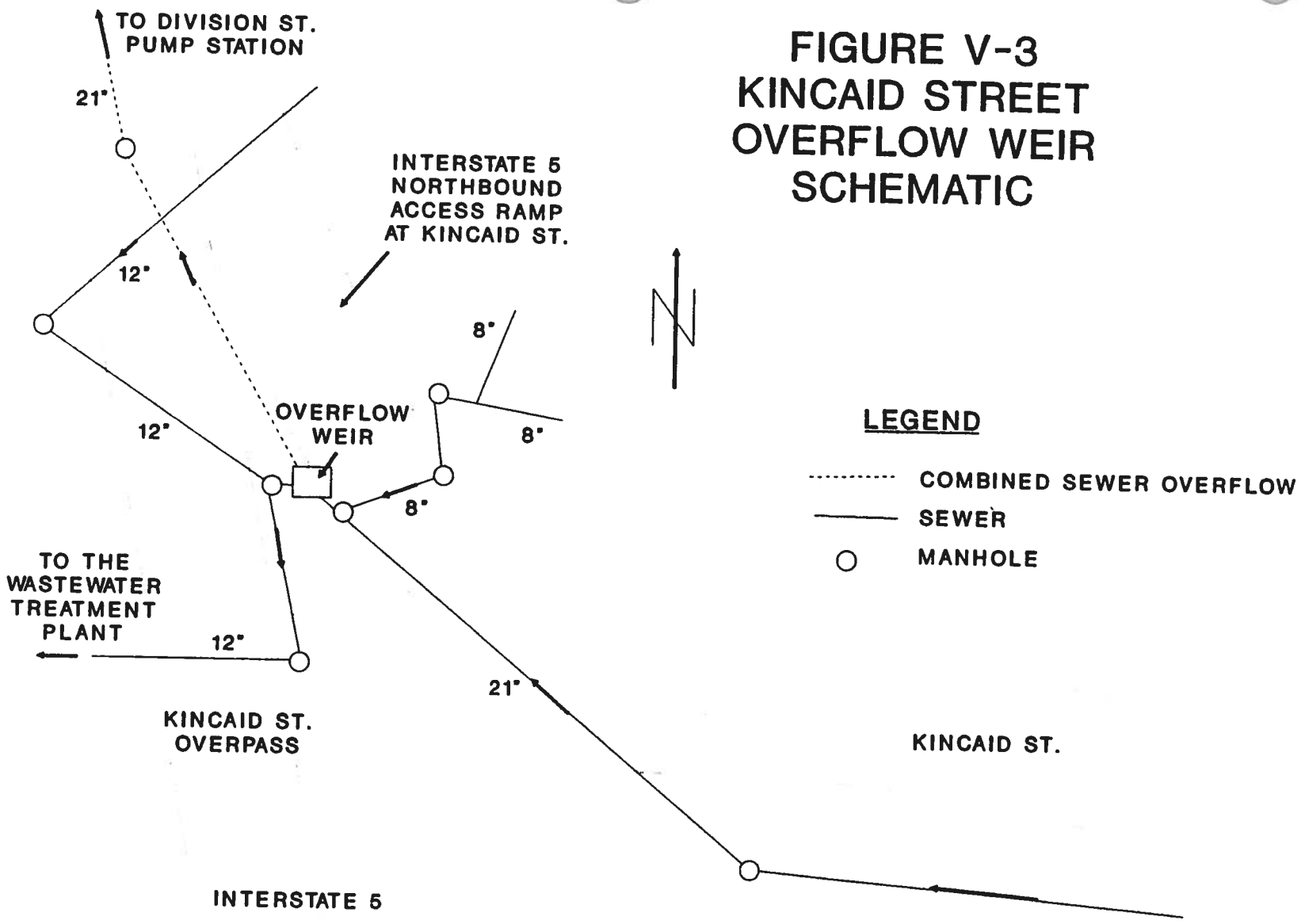


CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE SEWER AND COMBINED SEWER OVERFLOW

RWBECK

FIGURE V-3
KINCAID STREET
OVERFLOW WEIR
SCHEMATIC

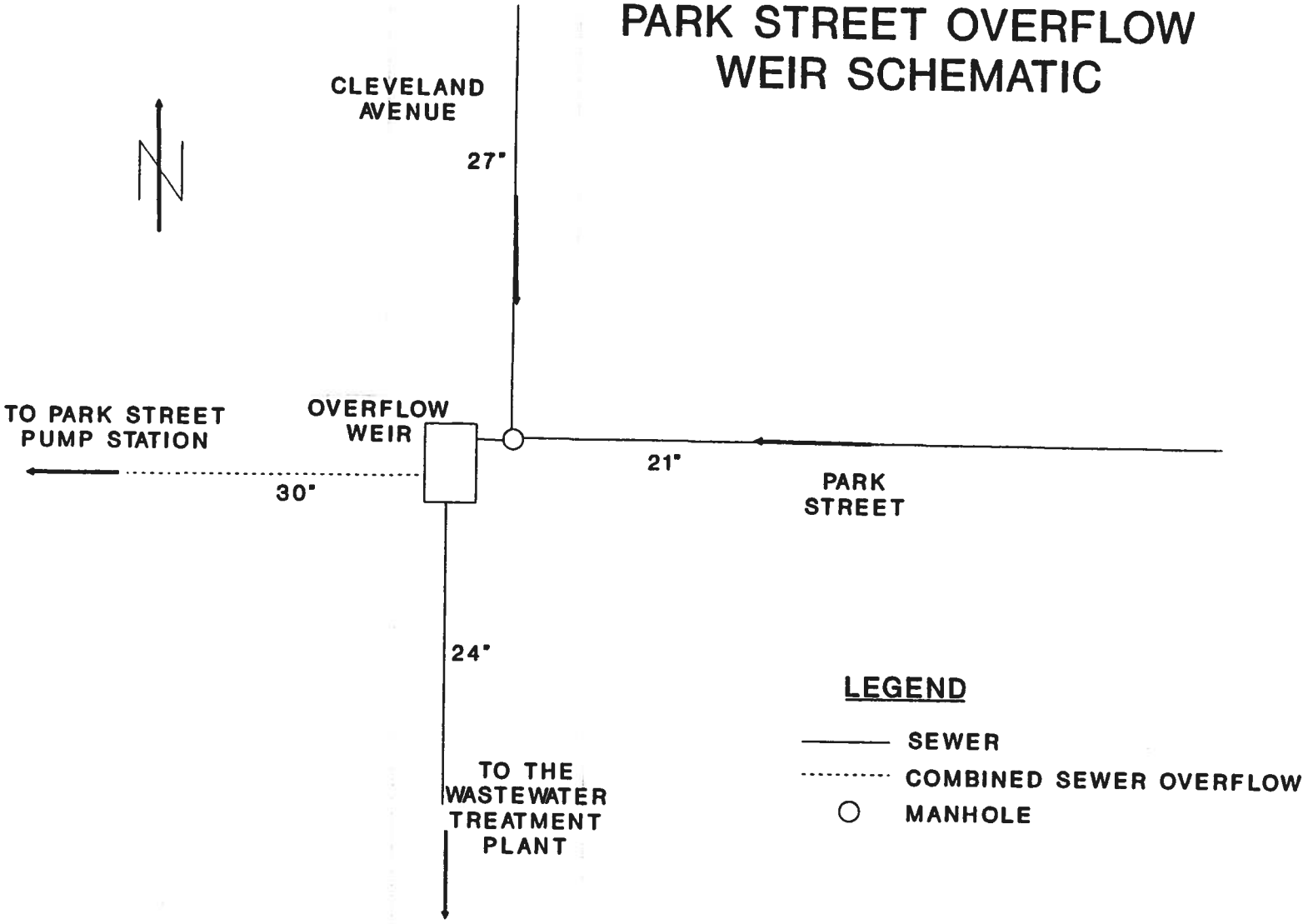


CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE
SEWER AND COMBINED
SEWER OVERFLOW
REDUCTION PLANS

RW BECK

FIGURE V-4
PARK STREET OVERFLOW WEIR SCHEMATIC

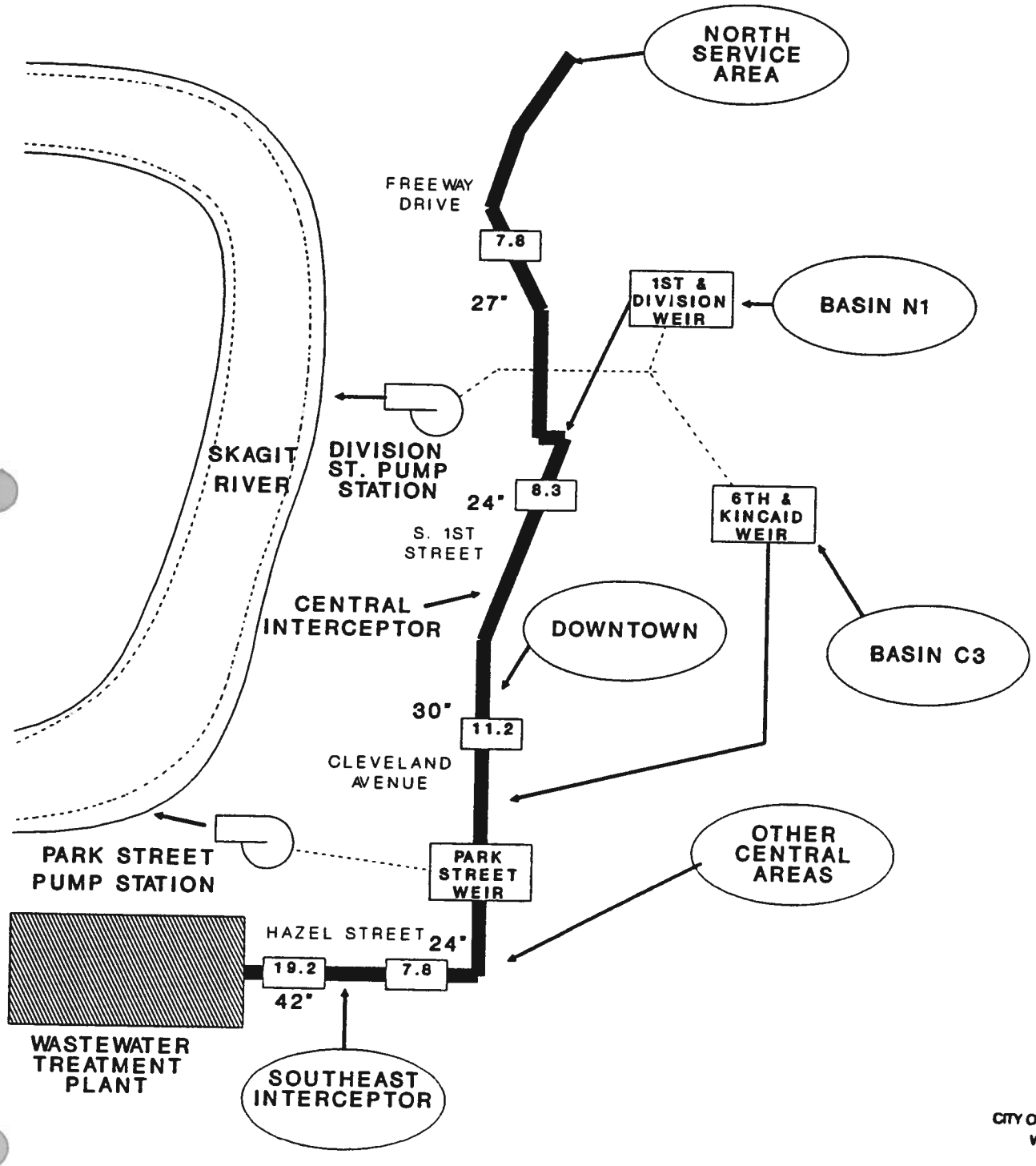


CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE SEWER AND COMBINE SEWER OVERFLOW REDUCTION PLANS

R·W·BECK

FIGURE V-5
EXISTING CENTRAL AREA DRAINAGE



CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE SEWER AND COMBINED SEWER OVERFLOW REDUCTION PLANS

R·W·BECK

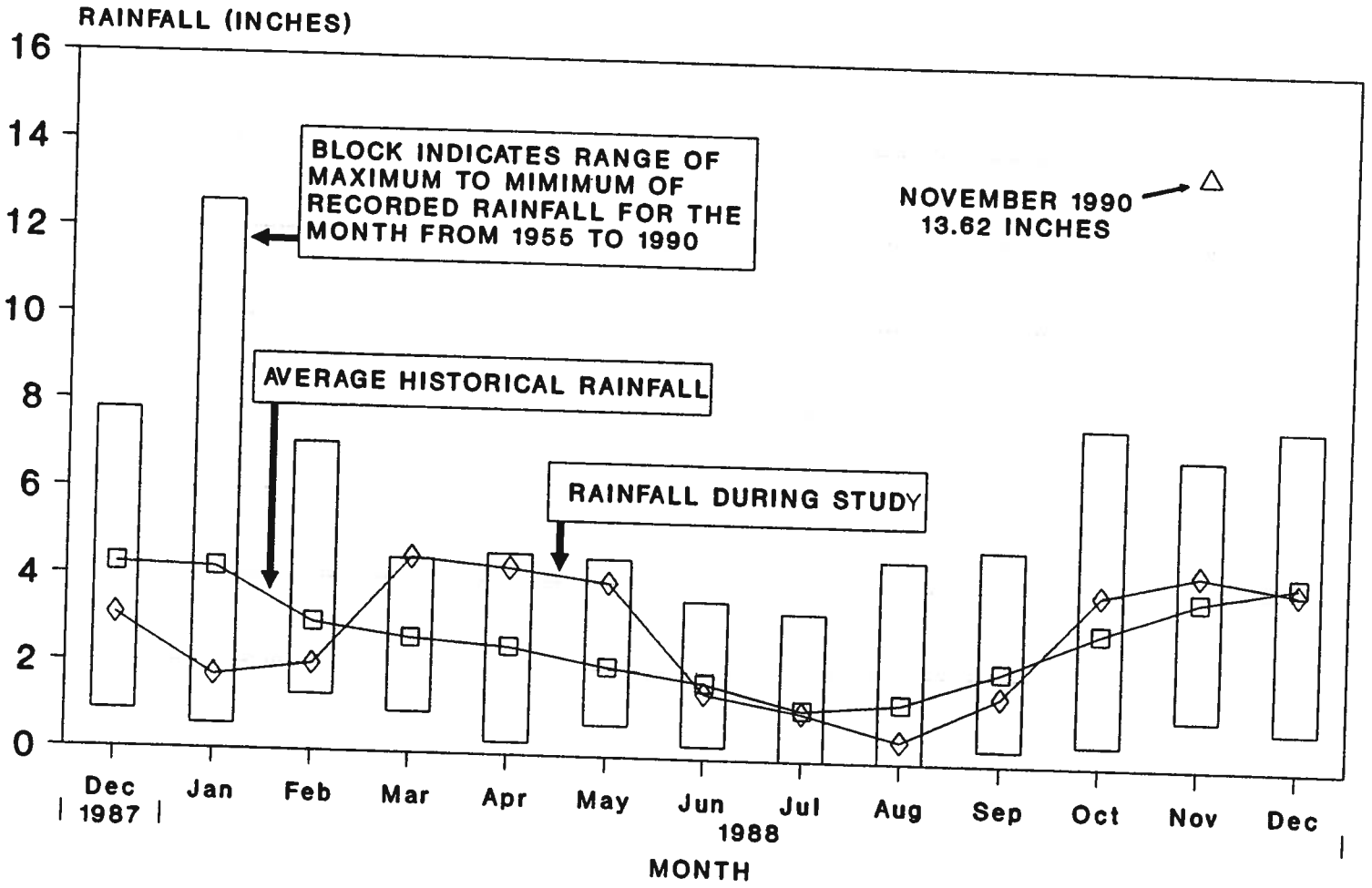


FIGURE V-6
RAINFALL DURING THE STUDY AND HISTORICAL RAINFALL PATTERNS FOR WSU RESEARCH STA.

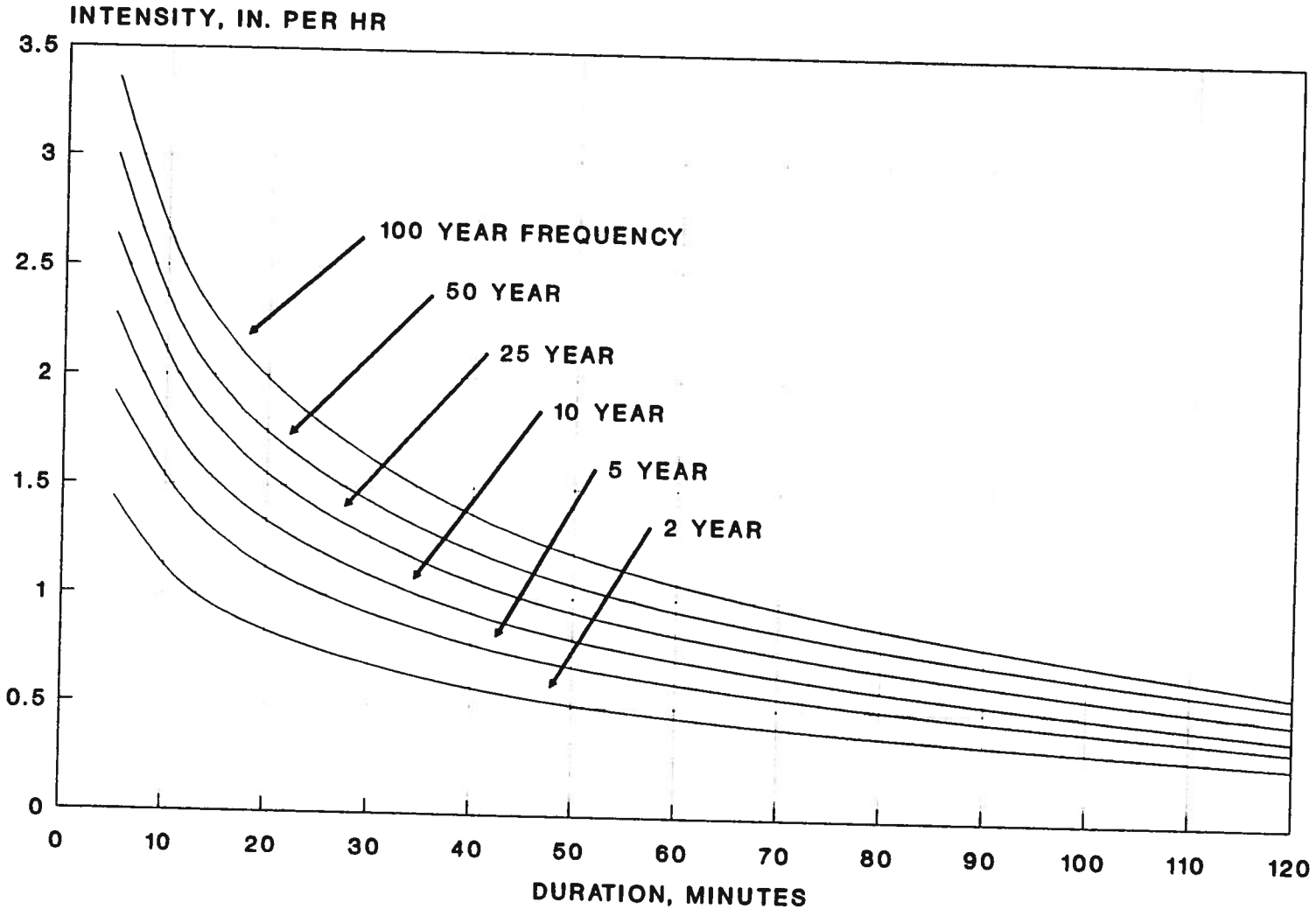


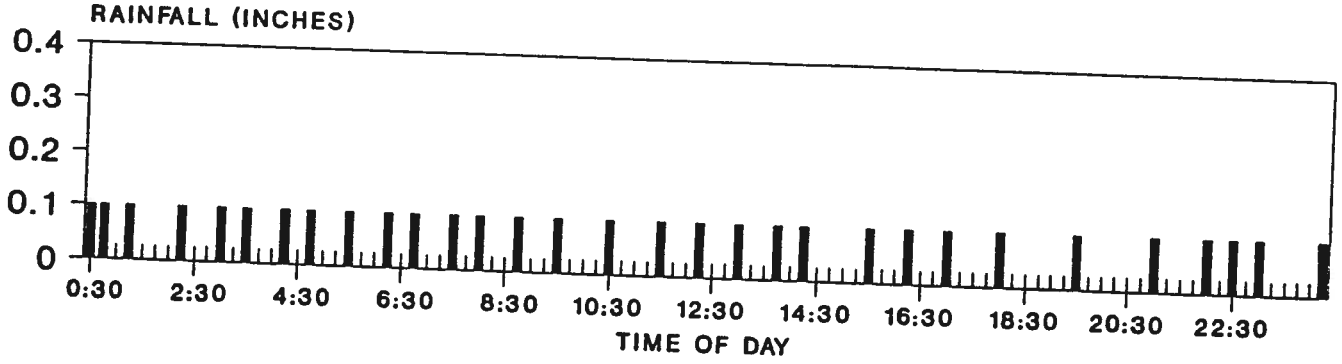
FIGURE V-7
RAINFALL - INTENSITY - DURATION

CITY OF MOUNT VERNON
WASHINGTON

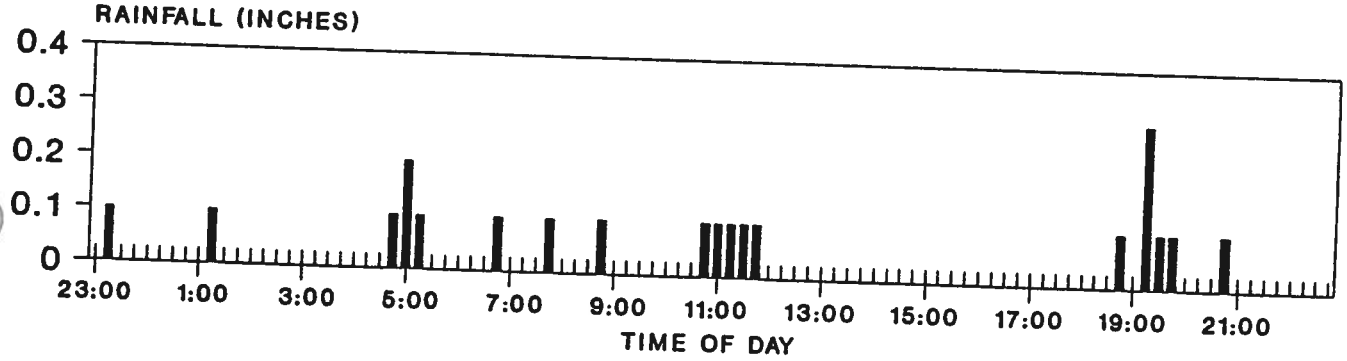
COMPREHENSIVE
SEWER AND COMBINE
SEWER OVERFLOW
REDUCTION PLANS

RW RECK

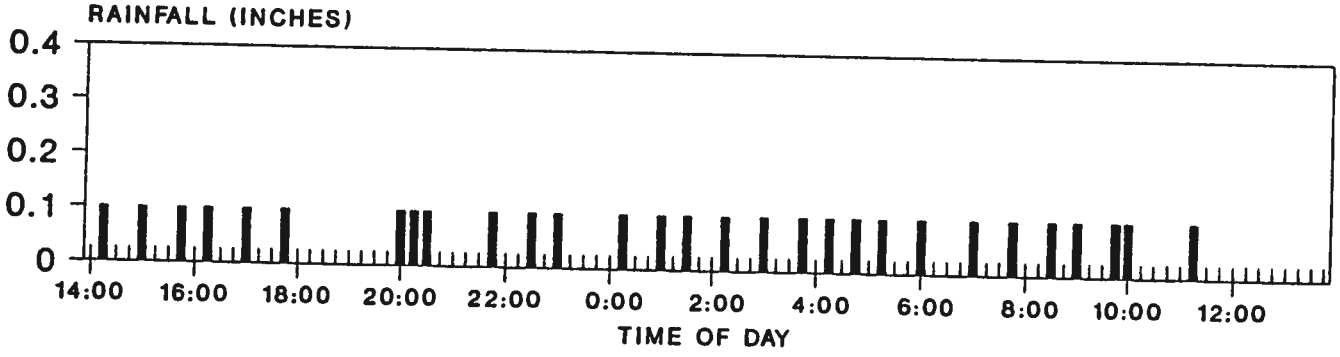
FIGURE V-8
STORMS OF NOVEMBER 1990



NOVEMBER 9, 1990
3.1 INCHES OF RAINFALL IN 24 HOURS
25 YEAR -24 HOUR STORM



NOVEMBER 12 - 13, 1990
2.1 INCHES OF RAINFALL IN 24 HOURS
2 TO 5 YEAR - 24 HOUR STORM



NOVEMBER 23 - 24, 1990
3.0 INCHES OF RAINFALL IN 24 HOURS
ALMOST A 25 YEAR - 24 HOUR STORM

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE
SEWER AND COMBINED
SEWER OVERFLOW
REDUCTION PLANS

R·W·BECK

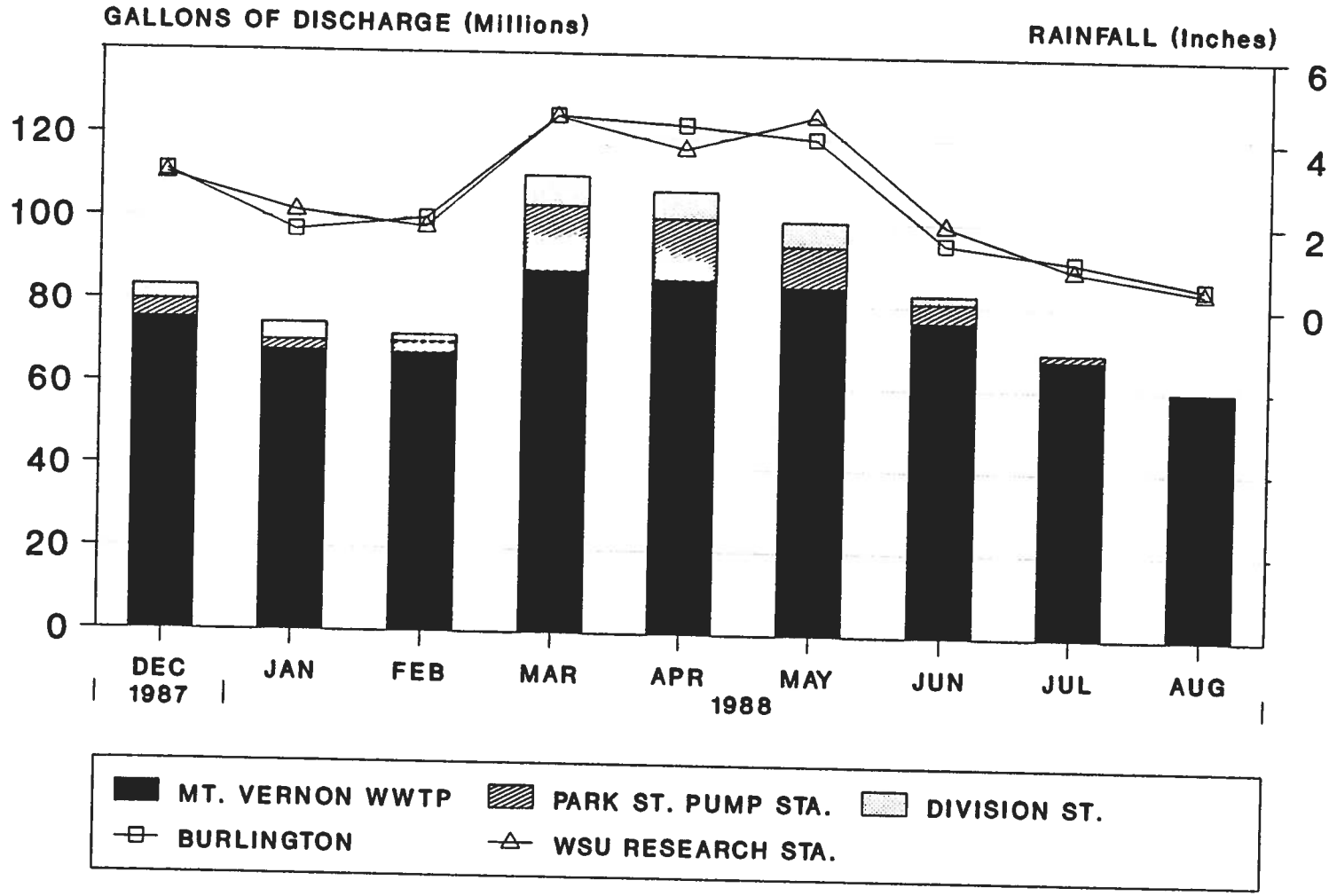


FIGURE V-9
MONTHLY RAINFALL AND DISCHARGES TO THE SKAGIT RIVER DURING THE STUDY

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE SEWER AND COMBINED SEWER OVERFLOW REDUCTION PLANS

R·W·BECK

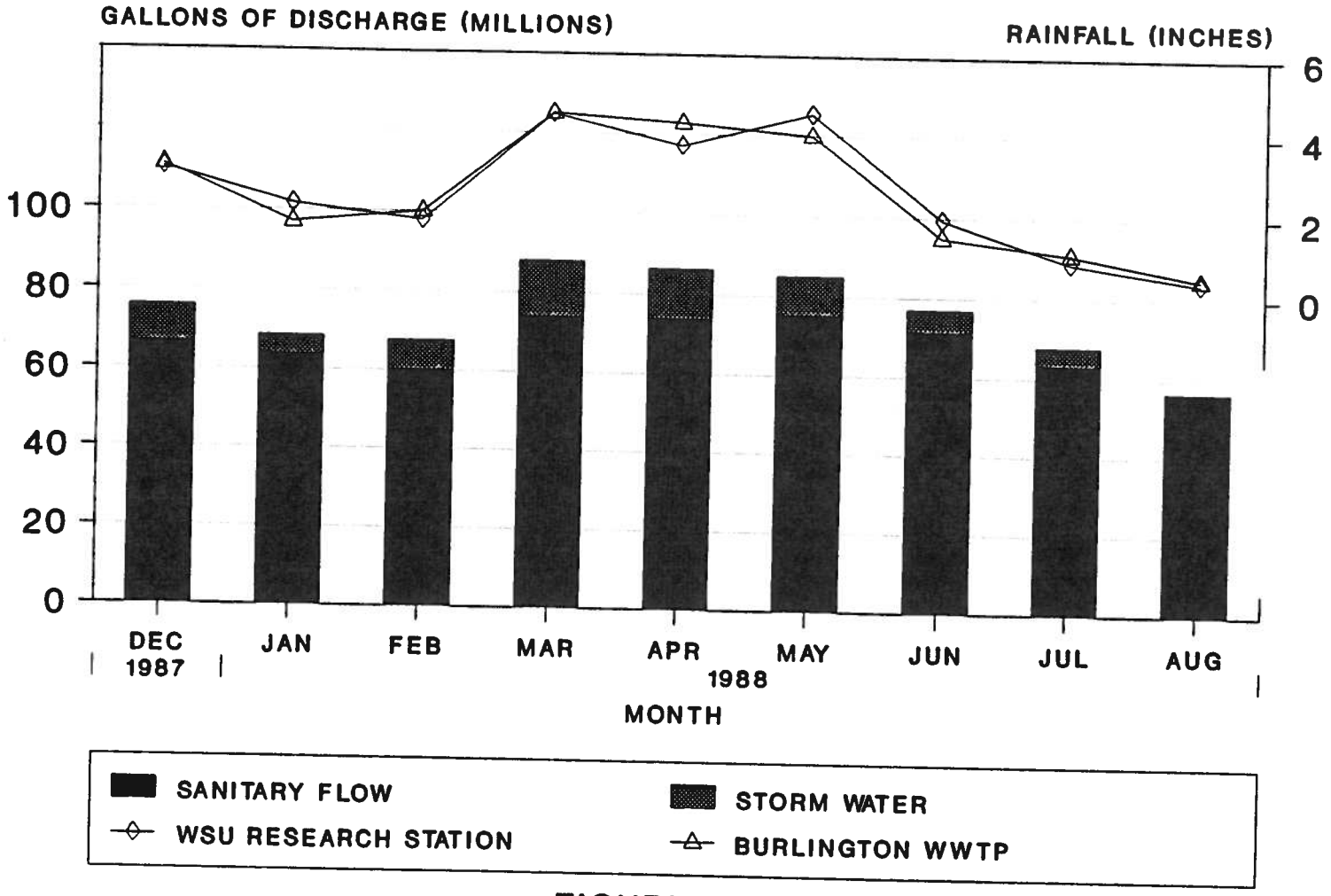


FIGURE V-10
TOTAL FLOWS TREATED AT THE MT. VERNON WWTP - SANITARY FLOW AND STORM WATER

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE SEWER AND COMBINED SEWER OVERFLOW REDUCTION PLANS

R·W·BECK

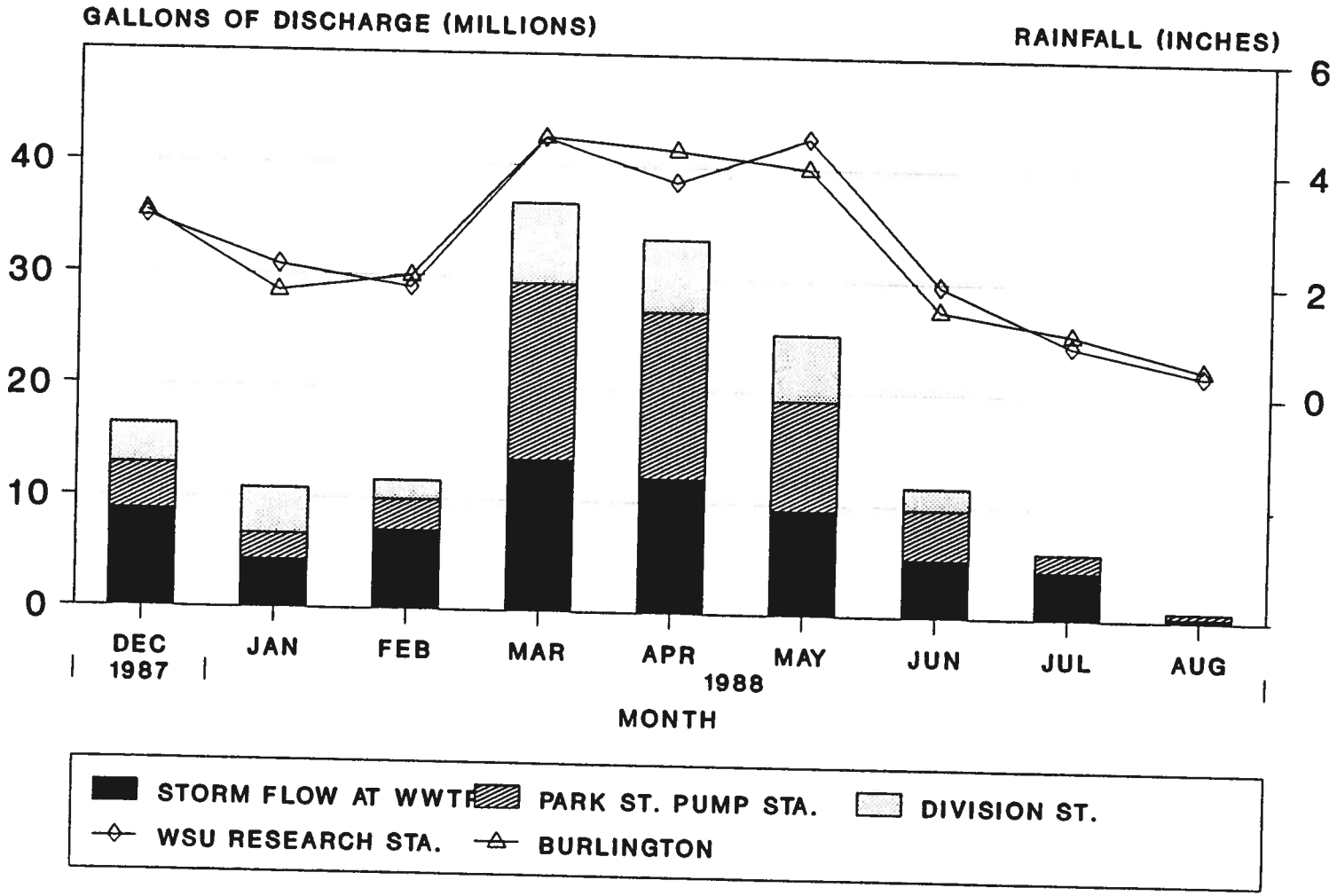


FIGURE V-11
MONTHLY STORMWATER FLOW AND
RAINFALL DURNING THE STUDY

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE
SEWER AND COMBINED
SEWER OVERFLOW
REDUCTION PLANS

R·W·BECK

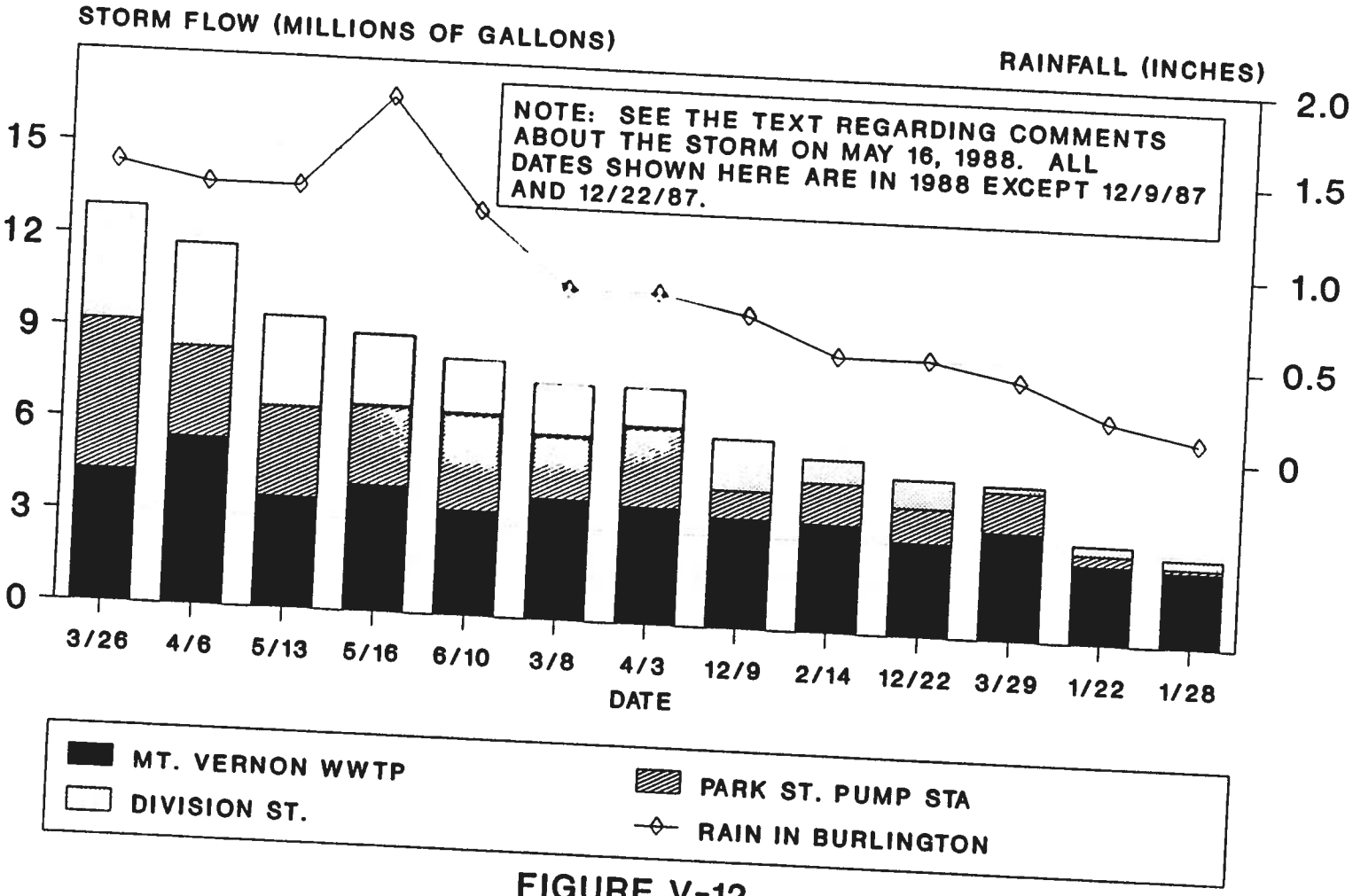


FIGURE V-12
DISCHARGES TO THE SKAGIT RIVER AND
RAINFALL FOR SIGNIFICANT STORM EVENTS

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE
SEWER AND COMBINED
SEWER OVERFLOW
REDUCTION PLANS

R·W·BECK

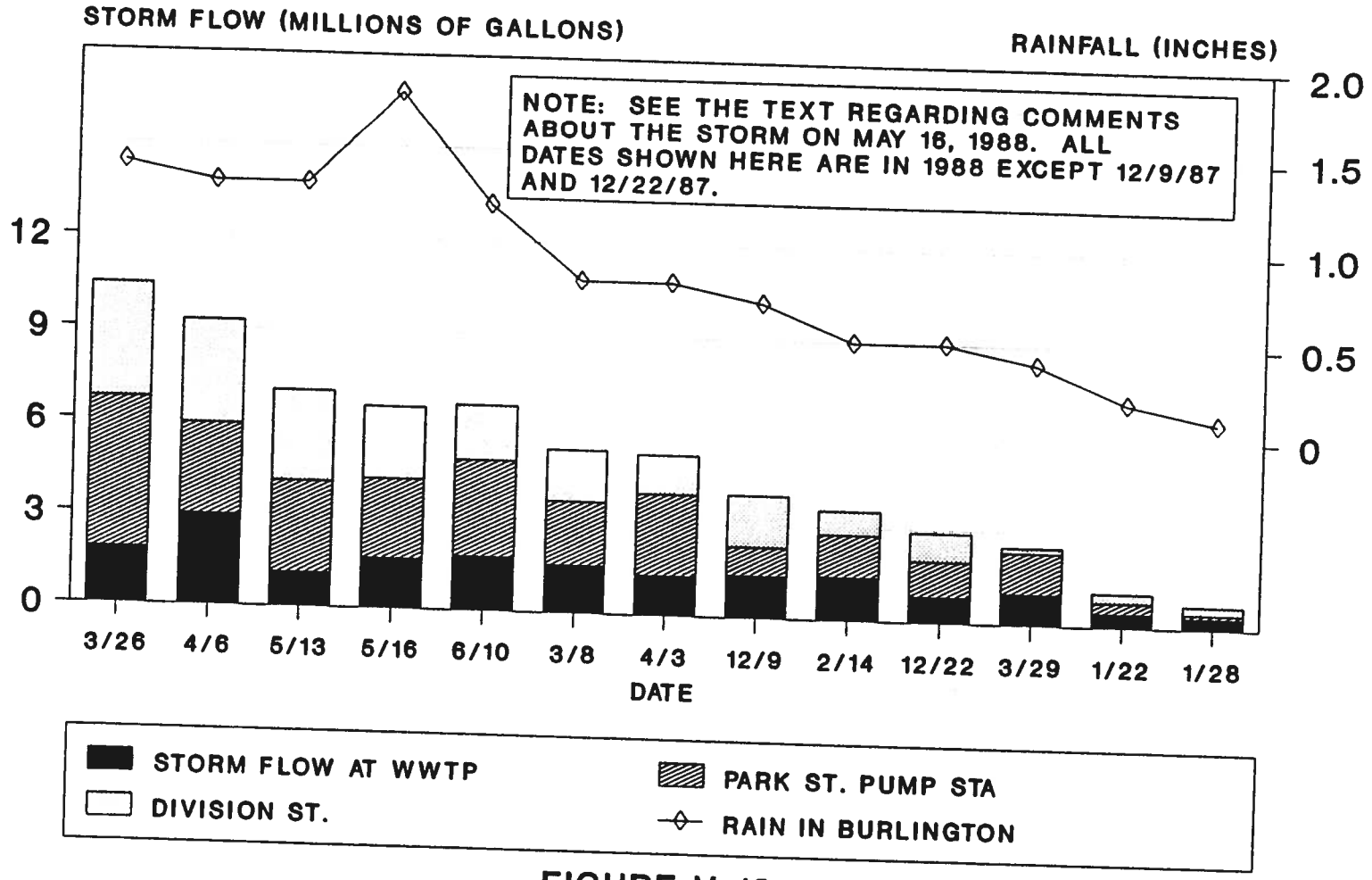


FIGURE V-13
STORM FLOW AND RAINFALL FOR
SIGNIFICANT STORM EVENTS

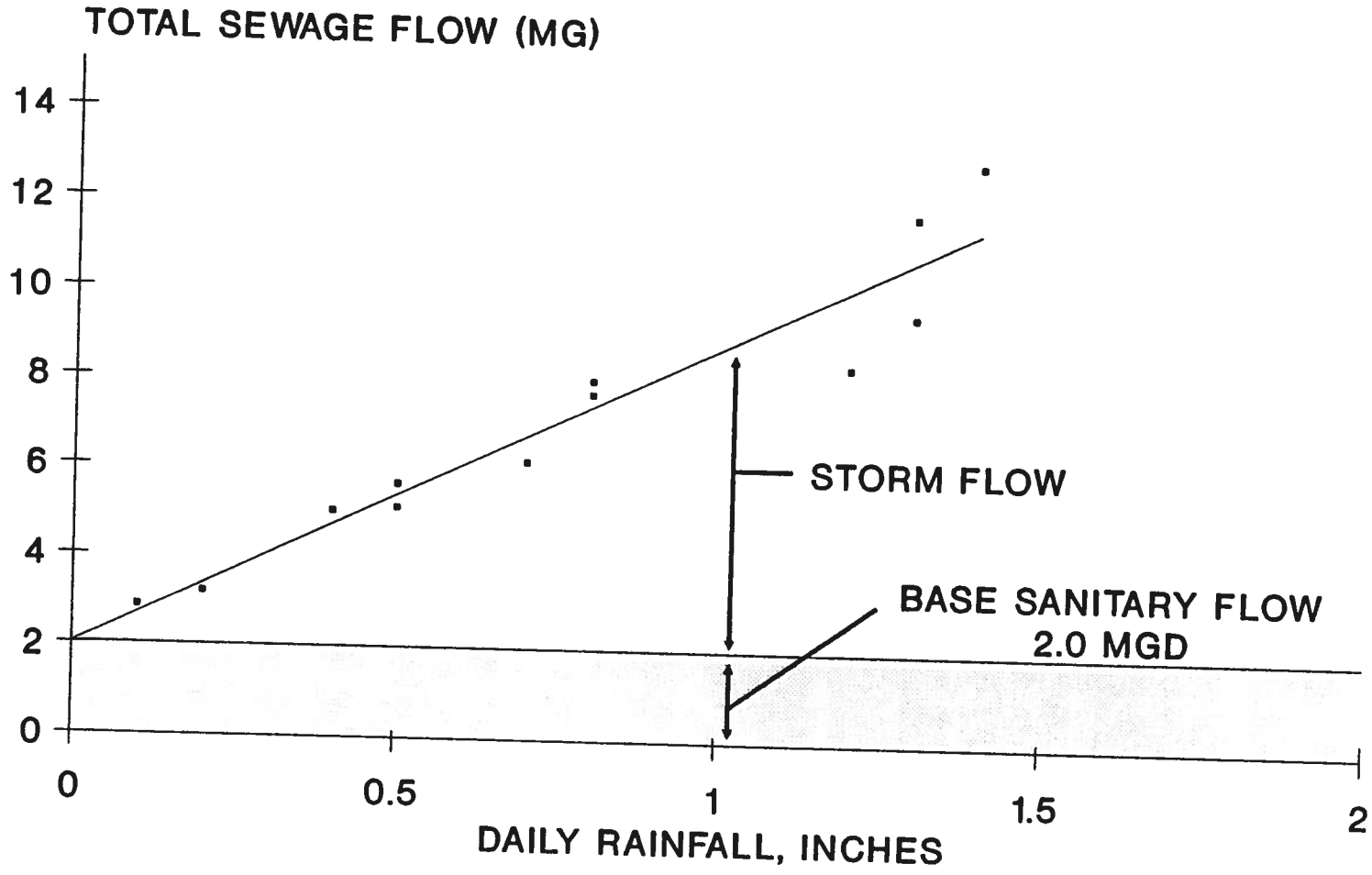


FIGURE V-14
TOTAL SEWAGE FLOW FROM STORM EVENTS VS. RAINFALL

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE SEWER AND COMBINED SEWER OVERFLOW REDUCTION PLANS

R·W·BECK

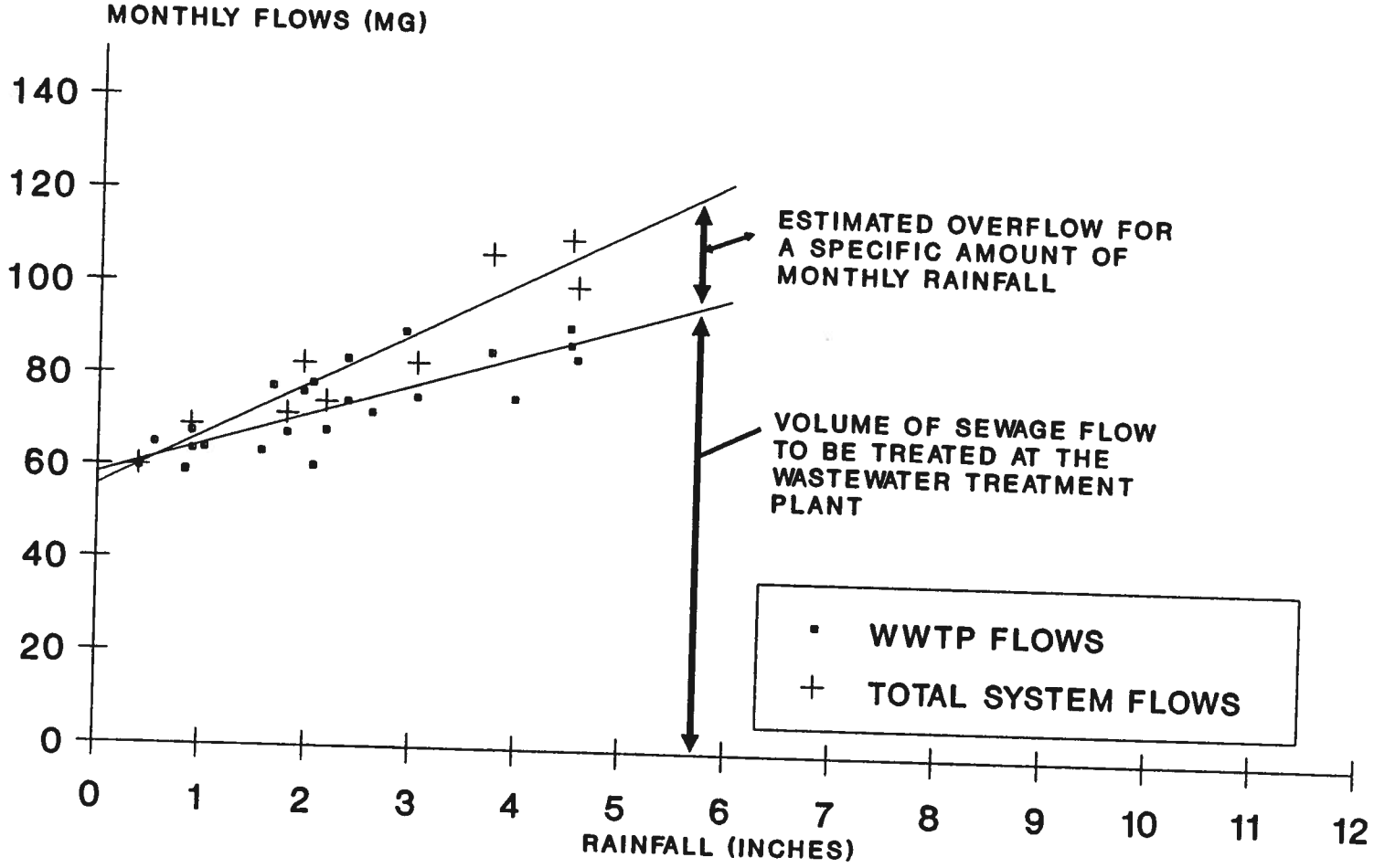


FIGURE V-15
MONTHLY WWTP FLOWS AND TOTAL SEWER SYSTEM FLOWS VS. RAINFALL

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE SEWER AND COMBINED SEWER OVERFLOW REDUCTION PLANS

RW BECK

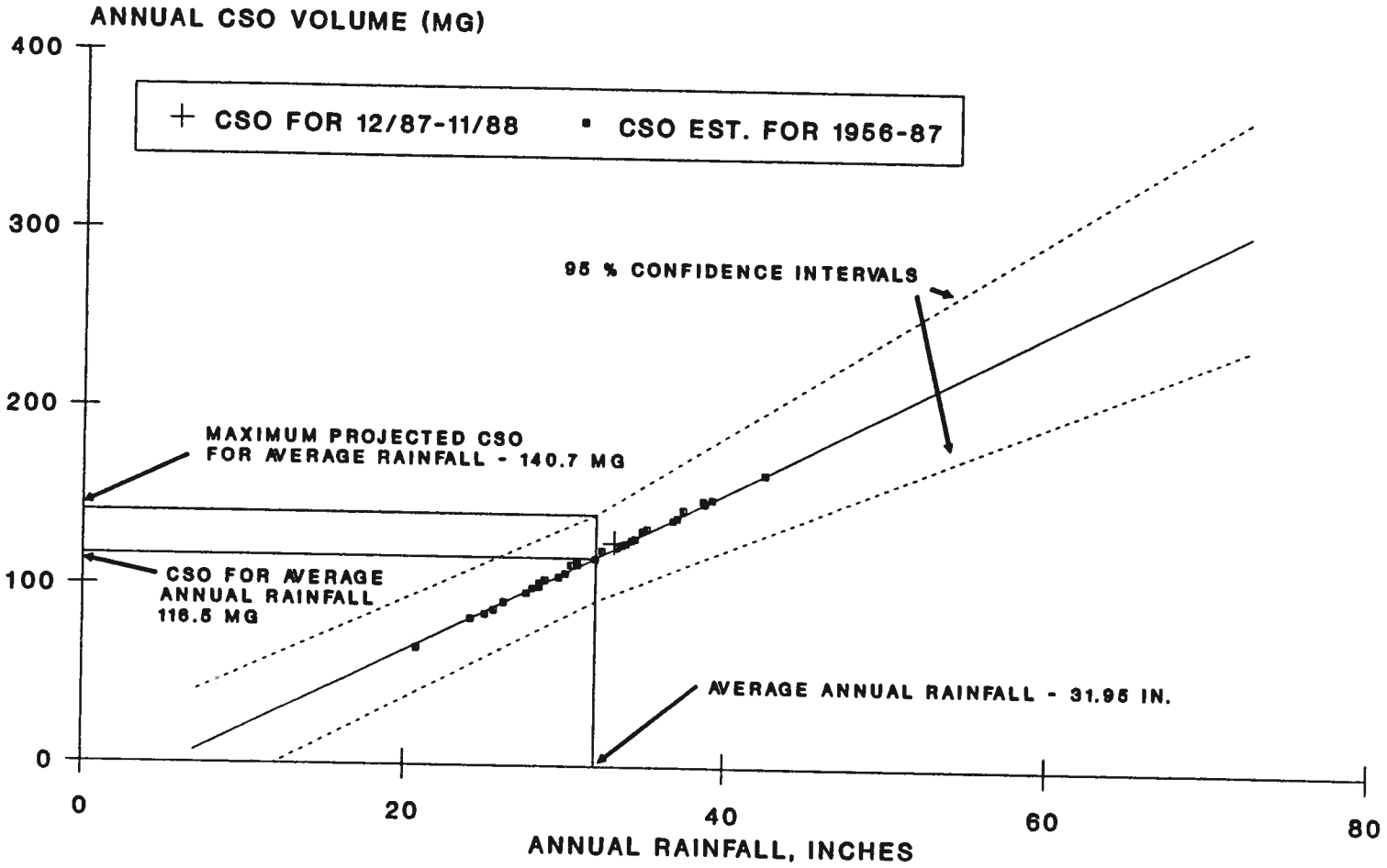


FIGURE V-16
CSO BASELINE FOR THE MOUNT VERNON SEWER SYSTEM: ESTIMATED CSO VS ANNUAL RAINFALL

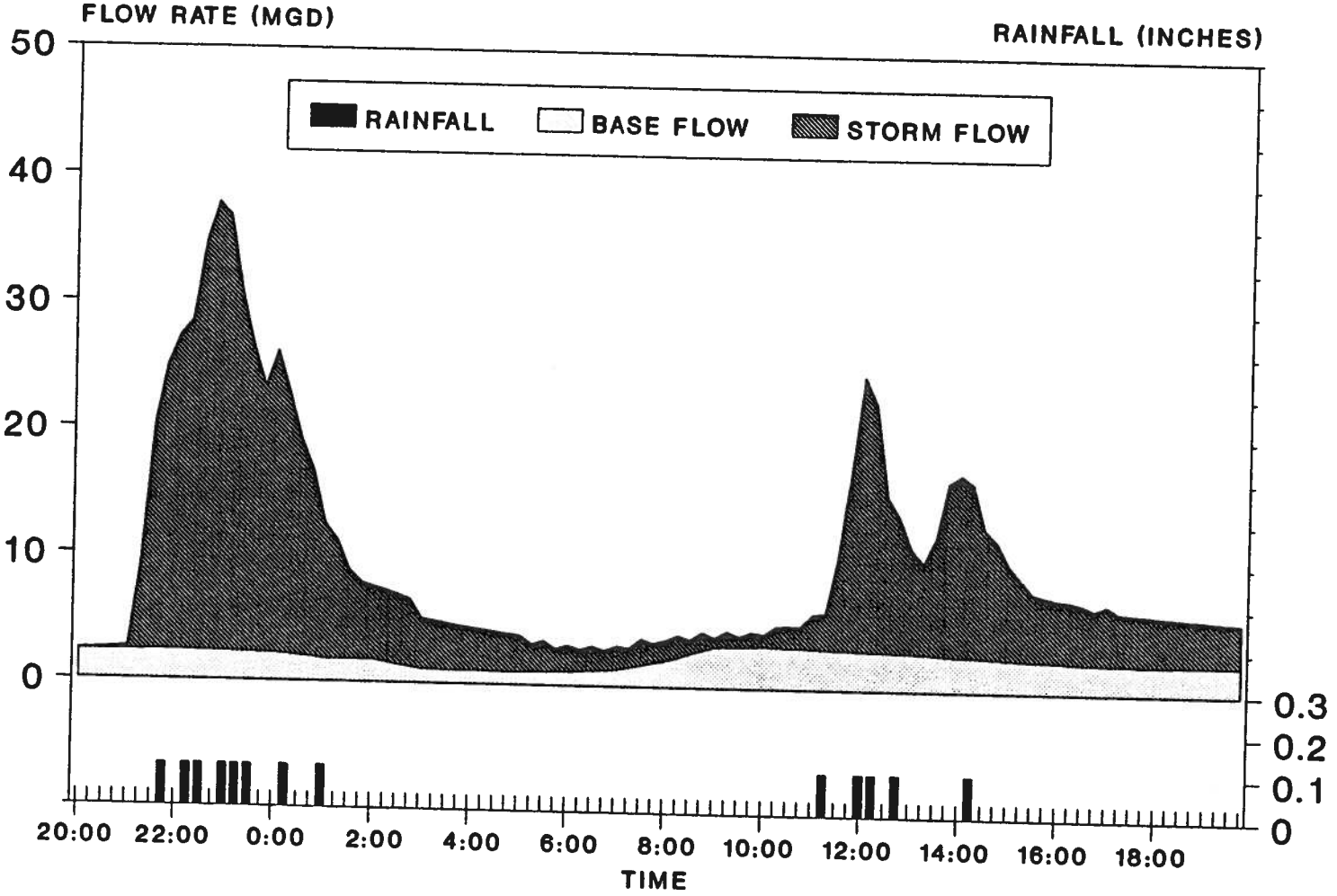


FIGURE V-17
SANITARY AND STORMWATER FLOWS
MAY 12 - 13, 1988

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE
SEWER AND COMBINED
SEWER OVERFLOW
REDUCTION PLANS

R·W·BECK

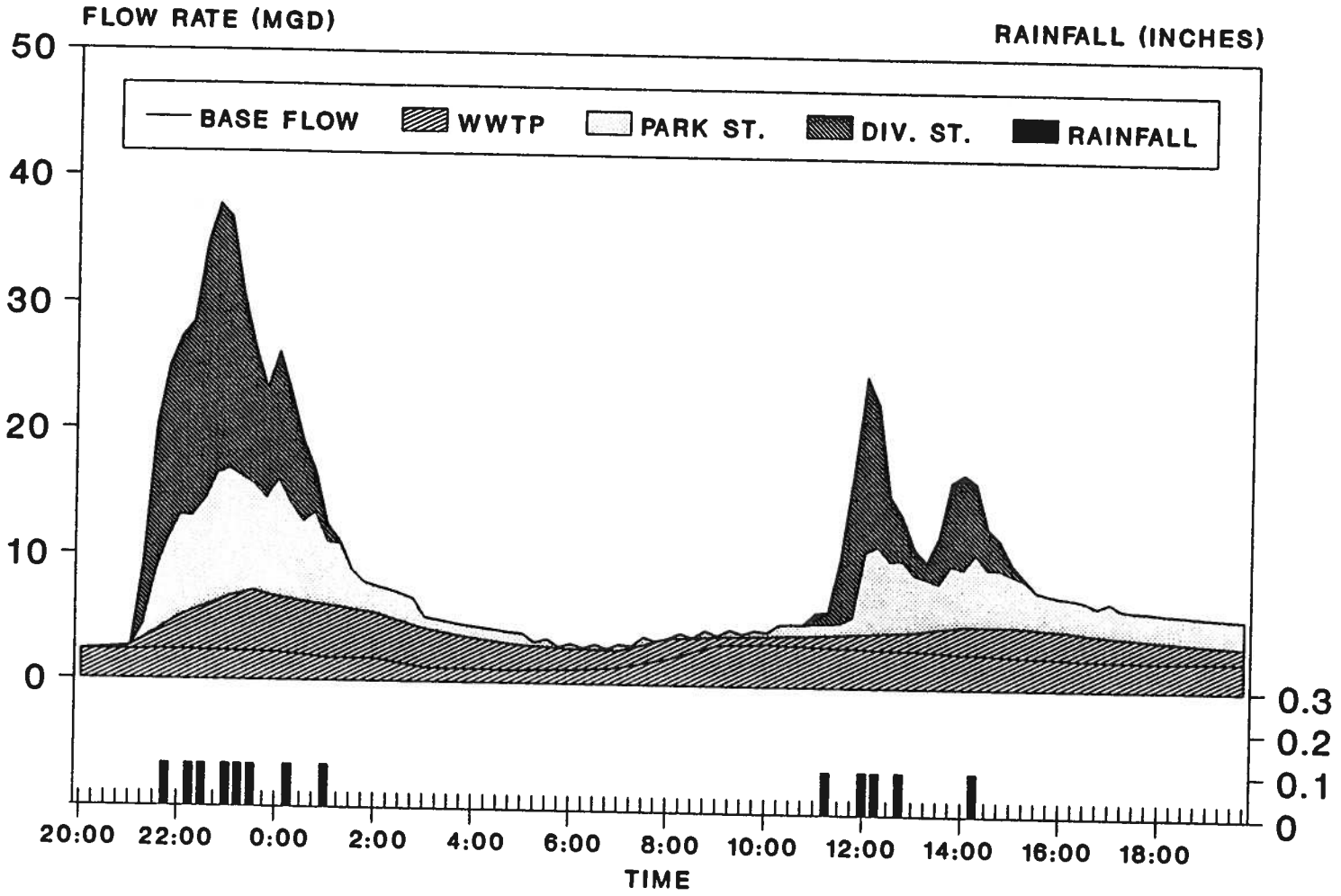


FIGURE V-18
COMBINED SEWER FLOWS
MAY 12 - 13, 1988

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE
SEWER AND COMBINED
SEWER OVERFLOW
REDUCTION PLANS

RW BECK

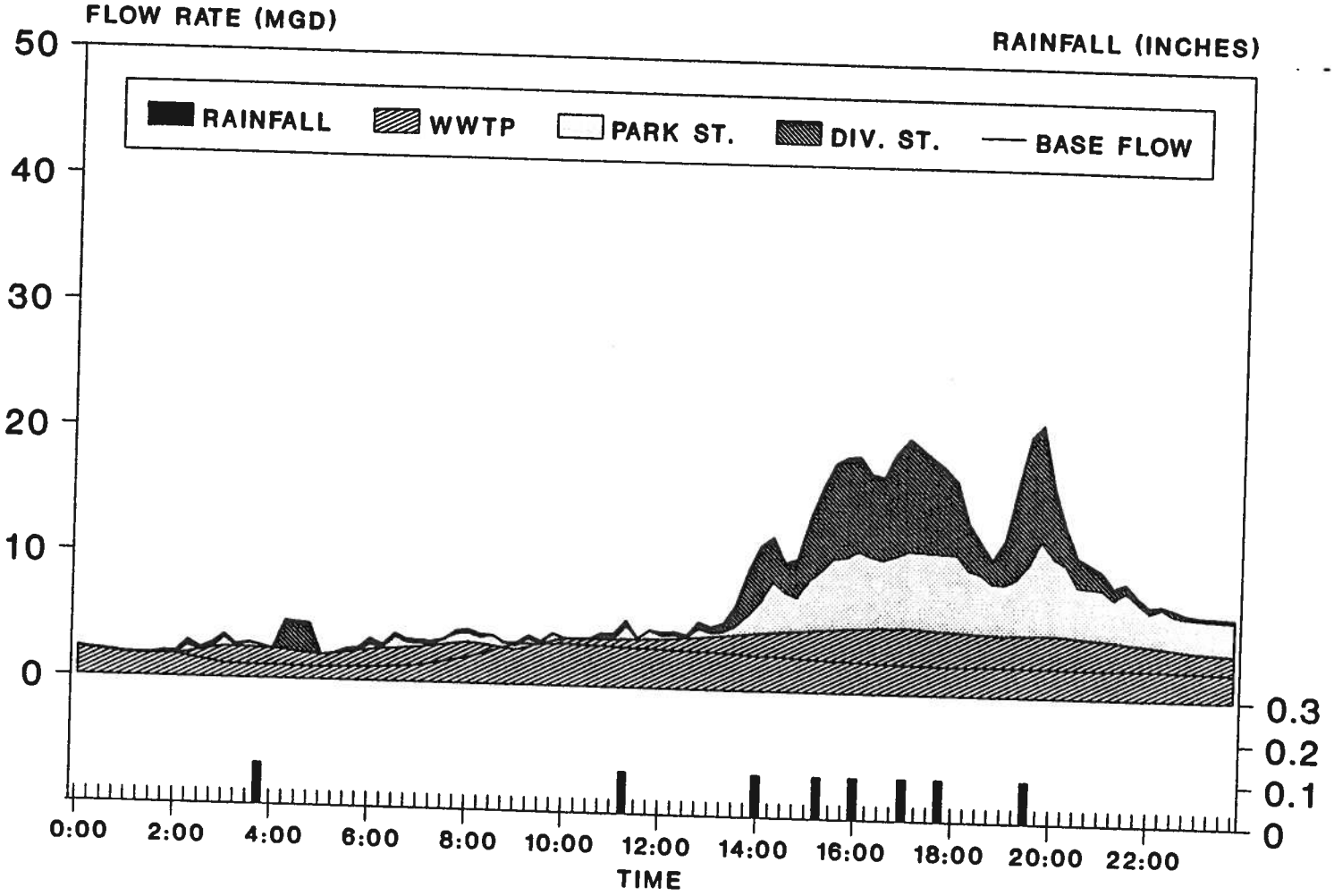


FIGURE V-19
COMBINED SEWER FLOWS
MARCH 8, 1988

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE
SEWER AND COMBINED
SEWER OVERFLOW
REDUCTION PLANS

R·W·BECK

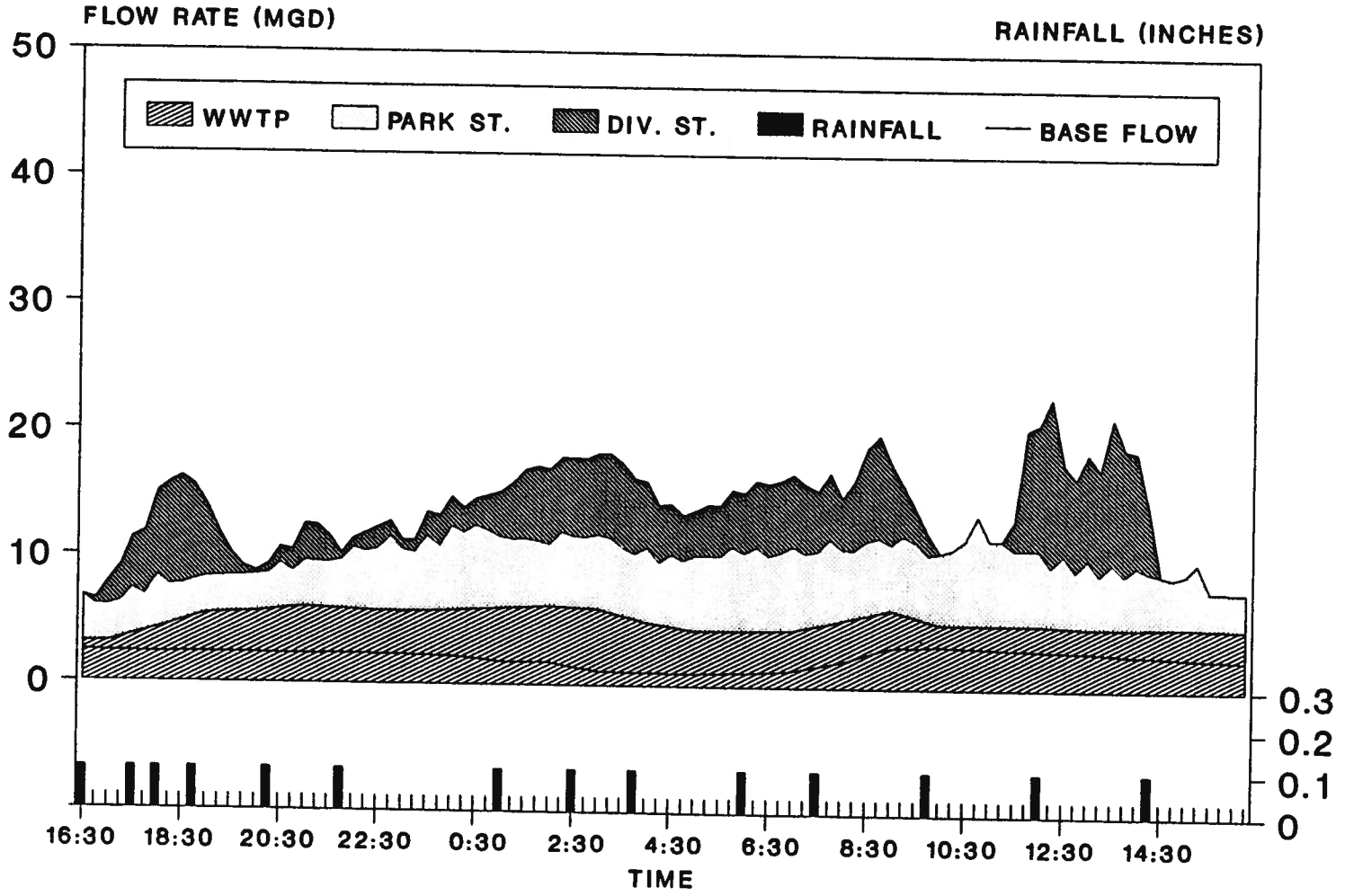


FIGURE V-20
COMBINED SEWER FLOWS
MARCH 25-26, 1988

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE
SEWER AND COMBINED
SEWER OVERFLOW
REDUCTION PLANS

RW BECK

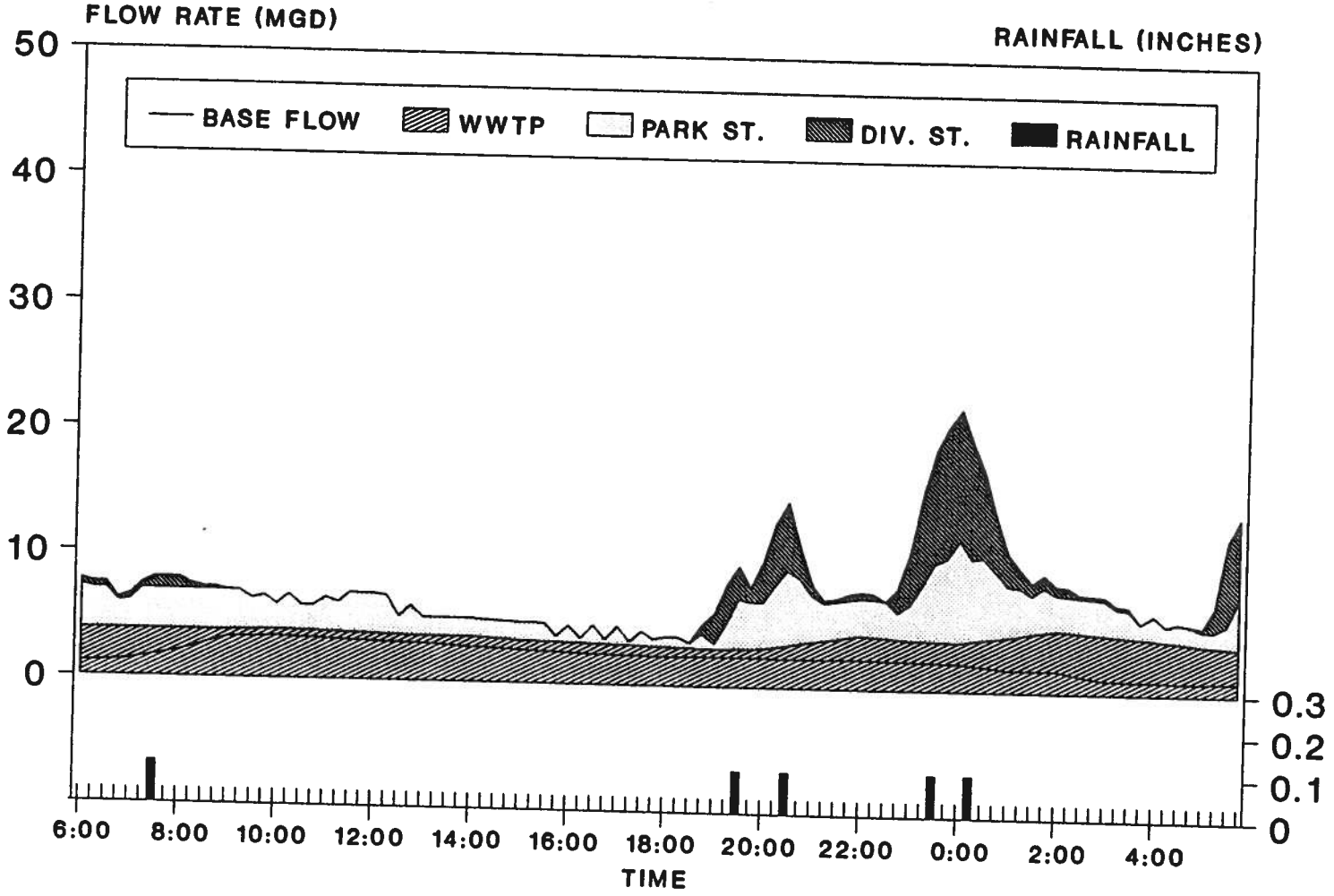


FIGURE V-21
COMBINED SEWER FLOWS
APRIL 3 - 4, 1988

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE
SEWER AND COMBINED
SEWER OVERFLOW
REDUCTION PLANS

R·W·BECK

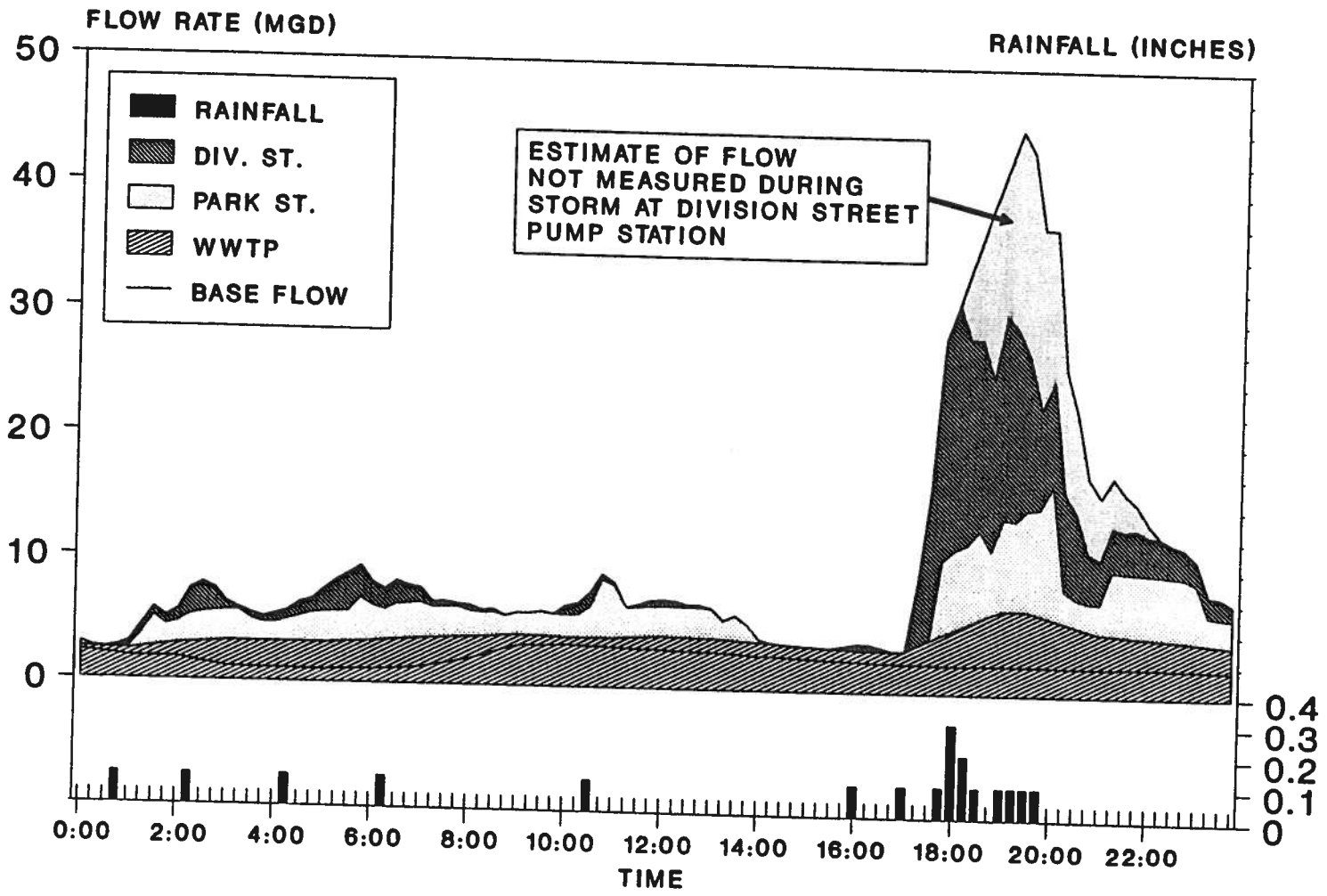


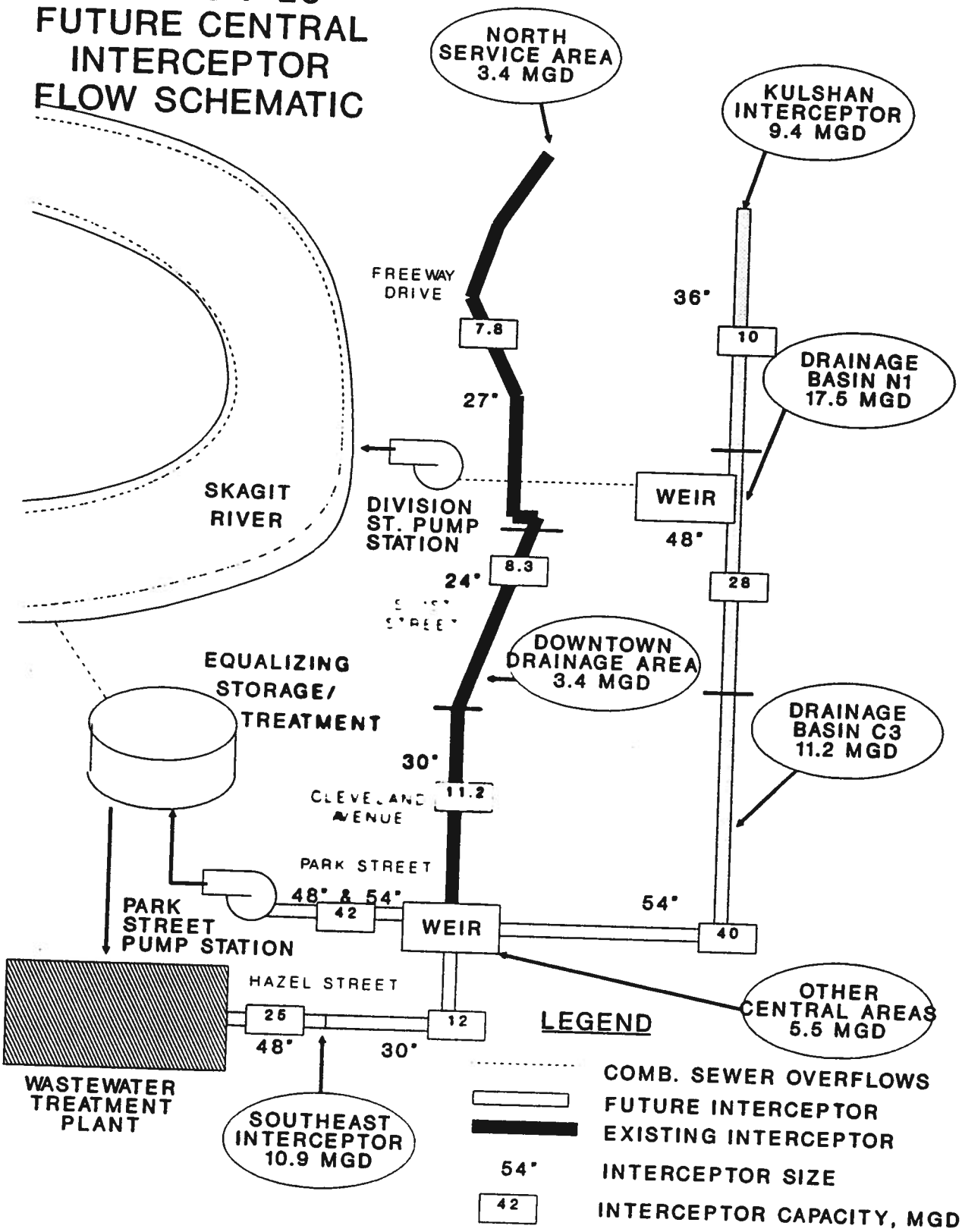
FIGURE V-22
COMBINED SEWER FLOWS
MAY 16, 1988

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE
SEWER AND COMBINED
SEWER OVERFLOW
REDUCTION PLANS

R·W·BECK

FIGURE V-23
FUTURE CENTRAL INTERCEPTOR FLOW SCHEMATIC



CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE SEWER AND COMBINED SEWER OVERFLOW REDUCTION PLANS

R·W·BECK

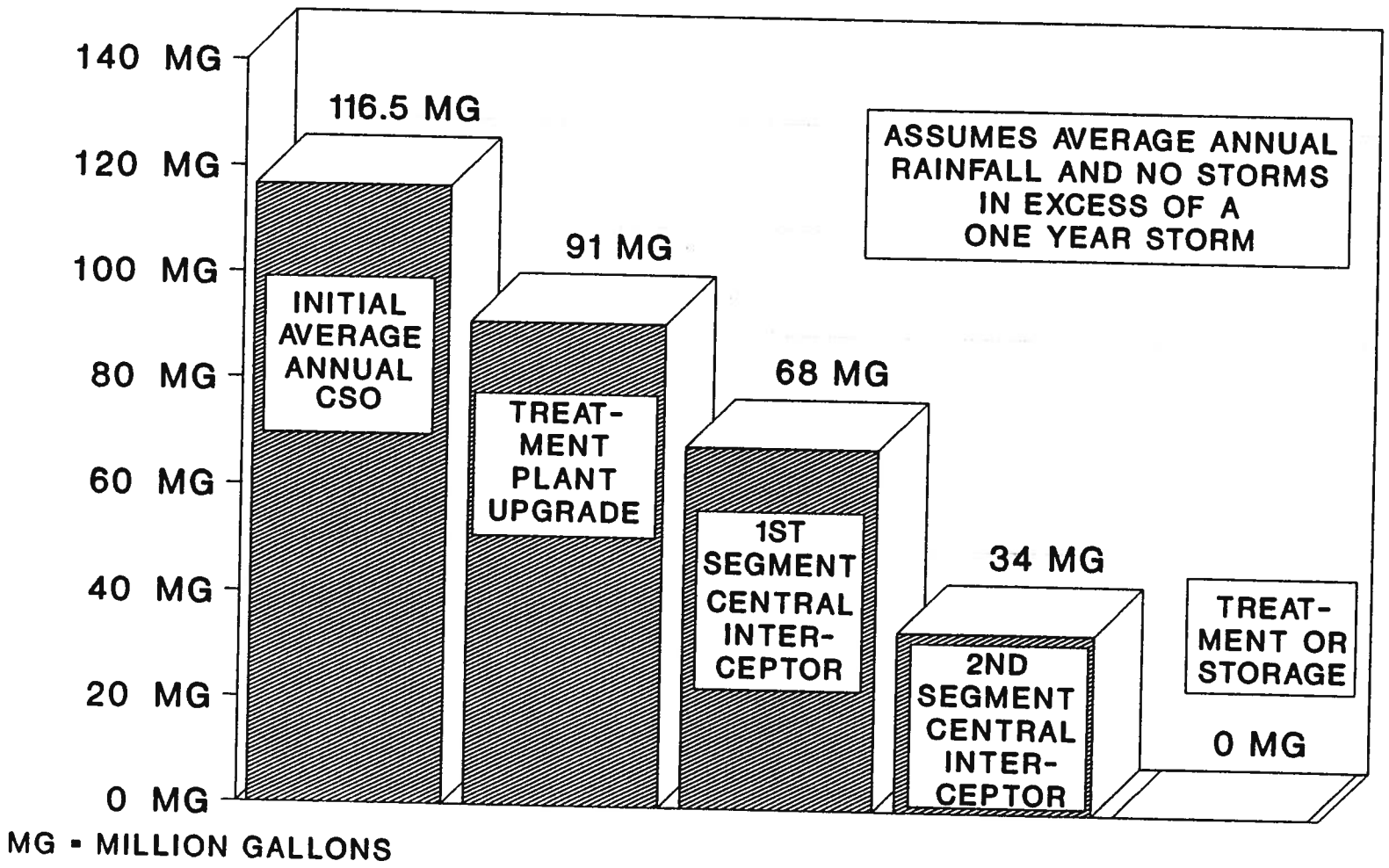


FIGURE V-24
ESTIMATED ANNUAL OVERLFOWS
WITH CSO REDUCTION FACILITIES

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE SEWER AND COMBINED SEWER OVERFLOW REDUCTION PLANS

R·W·BECK

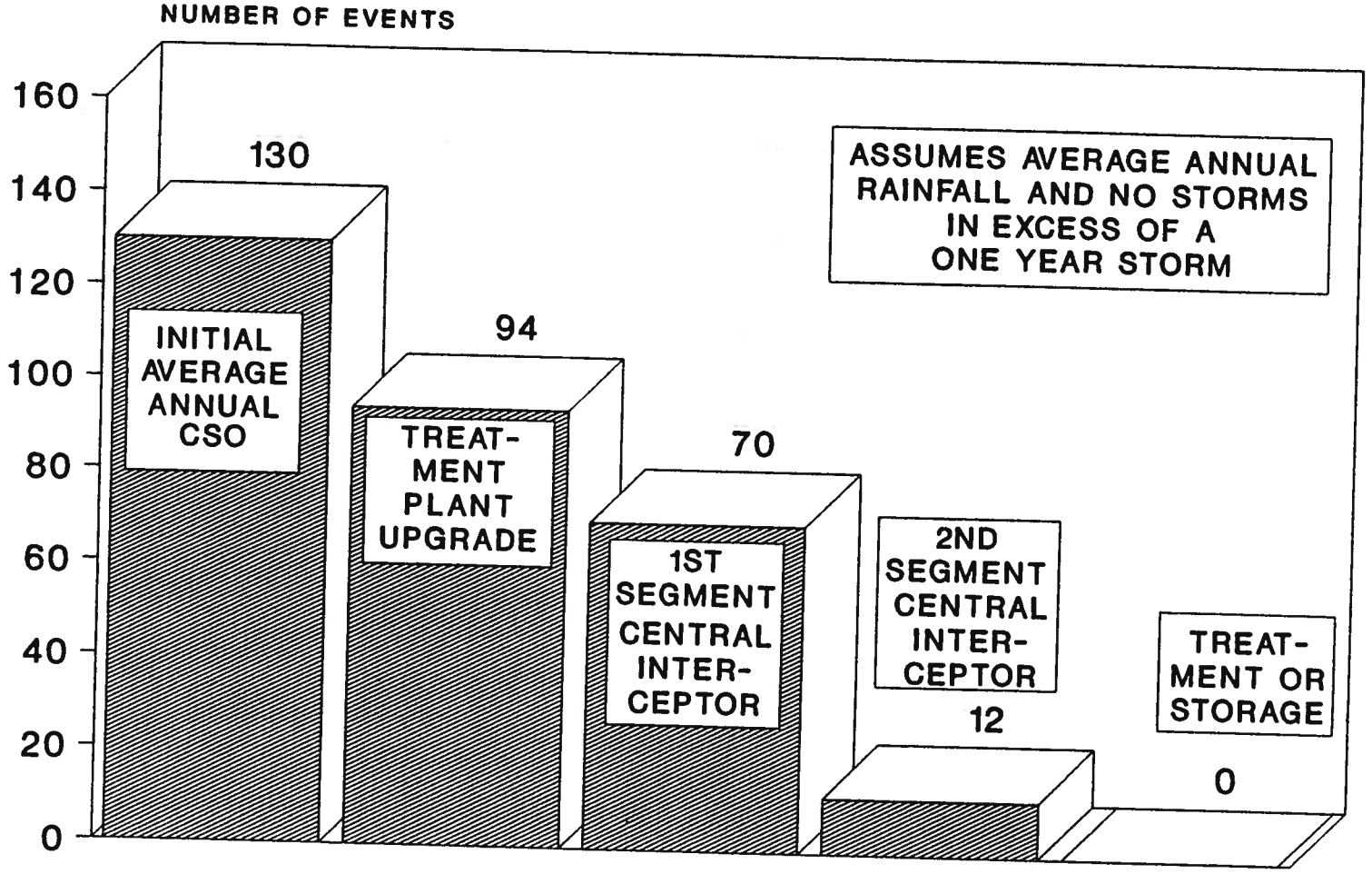


FIGURE V-25
ESTIMATED FREQUENCY OF OVERFLOWS
PER YEAR WITH CSO REDUCTION FACILITIES

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE SEWER AND COMBINED SEWER OVERFLOW REDUCTION PLANS

RW BECK

SECTION VI
PROBLEM IDENTIFICATION

R·W·BECK

SECTION VI

PROBLEM IDENTIFICATION

A. General

This section describes surface water problems in the study area and the methodology used to identify them. Problems are categorized into one of the following type:

- System problems, such as flooding, channel erosion, and damaged or old-substandard storm drainage systems
- Water quality problems
- Environmental resource problems, such as fish habitat and wetlands preservation problems

The development of solutions to address these problems is discussed in Section VII.

B. Problem Identification Methodology

Developing a comprehensive summary of stormwater problems in the study area involved a combination of conducting interviews, field observations, and performing specific technical investigations. Detailed descriptions of the information sources used and technical investigations performed are described in the following paragraphs.

1. Public Input

Input from the public regarding drainage problems was solicited through a notice that was sent out in a citywide mailing. The notice described the comprehensive surface water management plan and requested individuals to attend a public meeting to help identify existing drainage problems.

2. City Staff

Both the City engineering staff and the maintenance personnel provided input on problems. Several of the staff have personal knowledge of historical flooding problems.

3. Interviews with Agencies/Jurisdictions

Agencies and jurisdictions were contacted, informed about the planning effort, and solicited for information regarding problems occurring in the study area. Agencies and jurisdictions contacted as a part of this planning effort were listed in Section II.

4. Citizen's Advisory Committee

A Citizen's Advisory Committee (CAC) was formed by the City to assist in formulating the history of problems and facilities in the drainage basins, make recommendations to the final goals and objectives, and assist in developing the surface water management plan.

5. Hydrologic/Hydraulic Computer Analysis

Hydrologic and hydraulic computer models were developed to simulate the response of the drainage basins to storm events. The computer models were used to help assess the magnitude and frequency of flooding problems in the basins, and also to identify flooding problems not already identified by City staff or the public.

a. Hydrology. Hydrologic modelling of the study area was performed using EPA's HSPF computer model. The hydrologic computer model was developed to simulate the runoff hydrographs from the study area during storm events. The hydrologic computer analysis was described in Section IV.

b. Hydraulics.

(1) Regional System Problems, as defined in Part C. of this section, were analyzed using the future and existing flows at various points in the study area based on the results from the HSPF hydrologic computer simulation. HEC-2, Water Surface Profiles computer program (US Army Corps of Engineers, 1990) was used to assess the impacts of these flows in Kulshan Creek upstream of Riverside Drive. The computer program HY8, Culvert Analysis (Federal Highway Administration, 1987) was used to estimate the performance of culverts on channels other than Kulshan Creek.

(2) Local System Problems

Local system problems, as defined in Part C. of this section, were analyzed by comparing the peak flows from the runoff hydrographs generated by the HSPF computer model, with the capacity of existing drainage systems determined using Flowmaster computer program (Haestad, 1991). The capacity of these systems were compared with the peak flows for the 10-year 24-hour storm event to estimate the magnitude and frequency of flooding problems. The results are tabulated in Table VII-1.

6. Water Quality Investigations

A water quality assessment was prepared as part of the surface water management plan. Its purpose was to characterize the quality of the surface waters and to identify potential sources of pollution in the Mount Vernon study area. A complete discussion of the water quality assessment is presented in Appendix G. Historical information (Skagit River basin study, Entranco 1991; Nookachamps management plan, Cook 1980; A catalog of Washington streams and salmon utilization, WDF 1975; Baseline monitoring at proposed Sea-Van

Development Site, Sea-Van fisheries resources, W&H Pacific 1992; Predicted water quality impacts from the proposed Sea-Van golf course and residential site, Harding Lawson Associates), was used to characterize the Skagit River, Nookachamps Creek and streams in the study area. A water quality monitoring program and a stormwater pollutant loading study was used to characterize the streams in the study area. The monitoring program was used to identify specific pollutant problems in the study area, while the pollutant loading study, which estimates loadings based on land use activity, was used to indicate the relative pollutant problem in each of the study area major drainage basins and also the relative increase in pollutants in each basin due to future urbanization.

7. Fish Habitat Inventory and Investigation

A field inventory of the fish habitat and riparian corridors was conducted for Kulshan Creek, Trumpeter (College Way) Creek, Maddox Creek, Flowers Creek, and Carpenter Creek. The inventory describes fish habitat and associated riparian areas of importance to both fish and wildlife. As part of this inventory, fish habitat problems were identified and are discussed in Section VII.

C. System Problems

System problems such as flooding and channel erosion are a result of uncontrolled runoff from developed areas, inadequate capacities or material failures in existing storm drainage systems, and the loss of flood reducing storage capacity in natural depressions and riparian areas. Some of the problems are considered local system problems if they are located in areas tributary to major streams or drainage systems. Other problems are considered regional system problems if they are associated with a major stream or drainage system. The following problems have been identified by City staff, modelling efforts based on existing and future land use, and the public. The locations of these problems are shown in Figure VI-1.

1. Regional System (RS) Problems

a. Problem RS1 The drainage system along Freeway Drive north of College Way, including the detention pond constructed with the Eagle Hardware development and the existing 2.67 cfs pump station, does not have enough capacity to adequately convey flows with proposed future development in the area. There is also no drainage system along Freeway Drive south of College Way.

b. Problem RS2 The two 36-inch-diameter culverts under Parker Way along Kulshan Creek have insufficient capacity to prevent overtopping of the road.

c. Problem RS3 The existing culvert for a tributary to Kulshan Creek across College Way east of Continental Place has insufficient capacity to pass the 10-year storm event. This problem may be aggravated by routing flows from areas west of the Burlington Northern Railroad tracks into this system.

d. Problem RS4 Kulshan Creek is conveyed to the Skagit River via a pipe system from Riverside Drive to an existing pump station west of Freeway Drive. When the

water levels in the Skagit River are normal and low enough for gravity flow, the existing pipe conveyance system to the Kulshan Creek Pump Station has a capacity of 100 cfs with an upstream water surface elevation of about 25 feet at Riverside Drive. When the water level on the Skagit River is high, the water from Kulshan Creek must be pumped into the Skagit River. The combined capacity of the existing two pumps at the pump station is about 20 cfs at 20 feet total dynamic head. Therefore, if the flow from Kulshan Creek is more than 20 cfs when the Skagit water level is high or if the flow from Kulshan Creek is more than 100 cfs during normal Skagit River levels, extensive flooding is possible along Kulshan Creek upstream of the pump station. This is one of the most severe flooding problems in the City, which resulted in extensive property damage during flood events in November 1990.

e. Problem RS5 According to the hydrologic analysis, future development in the Trumpeter Creek basin could cause peak flows to increase by up to 30 percent in some areas over existing conditions if no additional detention were provided. This would cause an increase in local flooding and erosion problems, as well as water quality and fish habitat problems.

f. Problem RS6 Large amounts of undeveloped property remain in the Madox Creek basin and, without adequate controls, development to current zoning would result in significant increases in peak flows at all points along the main stem of Madox Creek. Some of the areas of the basin could experience an increase in peak flows that would be triple the peak flow under existing conditions. Such a significant increase in peak flows would undoubtedly create local flooding problems and aggravate the existing erosion problems along Madox Creek.

g. Problem RS7 Erosion problems on the main stem of Madox create have been noted just below Blackburn Road. At this point, Madox Creek enters a well defined steep-sided ravine with a bed slope of approximately 0.05 foot/foot. Erosion of the channel bed and banks has resulted in downcutting of the channel bed up to three feet in places and a number of side slope failures over a distance of several hundred yards downstream from Blackburn Road. The channel bed has been eroded down to an underlying layer of relatively hard glacial till, which will likely impede further down cutting. Similar erosion problems on a tributary to Madox Creek, Flowers Creek, have also occurred downstream from Blackburn Road. Continued erosion of the stream banks and further side slope failures are likely in the future and the problems will likely become more severe in the absence of adequate stormwater controls. In addition, the material eroded from Madox Creek and Flowers Creek will be carried downstream and deposited in the low gradient reaches downstream of Blodgett Road. Deposition of eroded material will reduce the capacity of the downstream reaches of Madox Creek and may result in increased incidence of flooding.

h. Problem RS8 Madox Creek exits the City of Mount Vernon into Drainage District 17 south of the City. Concerns have been raised by the district as to the overall responsibility of the City to contribute to maintenance and operations of the Madox

Creek system within the district. The primary concern is related to costs associated with maintaining and operating a stormwater pump station near Conway, and removal of sediment near Blodgett Road. This problem relates to determining how much the City contributes to problems in the district. and to what degree the City should be responsible for maintaining and operating the pump station at Conway.

2. Local System (LS) Problems

a. Problem LS1 During periods of high water levels in the Skagit River, flooding occurs in the area west of LaVenture Road and north of Hoag Road. One house on the corner of Hoag Road and Horizons Street has sustained flood damage.

b. Problem LS2 Flooding occurs northwest of the intersection of Hoag Road and the Burlington Northern Railroad. There is no drainage system in this area so once runoff collects in this area it has no means of escape.

c. Problem LS3 Flooding has occurred at the residence located west of where La Venture Road turns east several blocks north of Hoag Road. It was reported that drainage from La Venture Road was running off into the property. It appears that the problem may have already been resolved. During a field visit, it was noted that a concrete berm had been placed along the outside of the curve to prevent runoff from entering the property.

d. Problem LS4 Ponding occurs on a commercial site northeast of the College Way - Urban Avenue intersection. The loading bays were graded much lower than the rest of the site and therefore collect site runoff.

e. Problem LS5 Runoff from the south side of Fir Street flows north across the roadway just west of North 14th Street because of an inadequate drainage system in that area. This problem was recently solved with system improvements that were installed as part of the Fir Street reconstruction.

f. Problem LS6 Erosion is occurring in a small stream channel tributary to Kulshan Creek north of Cedar Lane. The channel has incised down to a glacial till soil layer.

g. Problem LS7 Erosion is occurring in an open channel tributary to Kulshan Creek north of Viewmont Drive and downstream from an 18-inch pipe outlet. The erosion problem originated where the channel descends a steep grade immediately south of Kulshan Creek. Over time, the channel erosion has progressed south towards the 18-inch pipe outfall.

h. Problem LS8 There is an undersized culvert along the west side of North 16th Street just south of the railroad grade which is causing flooding in the area.

i. Problem LS9 There are two problems in trailer parks adjacent to Trumpeter Creek. One flooding problem occurs in a trailer park east of North 30th Street and 1,300 feet south of College Way as runoff overtops a ditch and flows overland to

Trumpeter Creek. There are several areas where flows overtop the ditch which is adjacent to the south property line of the trailer park. Another problem occurs in the Park Village trailer court north of First Street and east of LaVenture Road. This problem occurs on the main stem of Trumpeter Creek along the east property line of the development. It is our understanding that this flooding problem is limited to landscaped areas and has not caused property damage to adjacent structures.

j. Problem LS10 There are stream channel erosion and deposition problems along the southeast fork of Trumpeter Creek where it crosses Kiowa Drive west of Seneca Drive and east of Waugh Road.

k. Problem LS11 A storm drain runs through an easement along the east property line of the second house east of Nez Perce Drive on the south side of Kiowa Drive. Sediment and debris plug a pipe inlet behind the house which is flooded as a result.

l. Problem LS12 There is localized flooding along Memorial Highway (SR 536) in West Mount Vernon due to insufficient capacity of the storm drain system. The storm drain system which collects drainage for most of West Mount Vernon is only 12 inches in diameter.

m. Problem LS13 Flooding occurs near the intersection of Garfield Street and Wall Street in West Mount Vernon. When the Skagit River is high, the groundwater table rises above the ground surface in the low spots in this area causing flooding of several residences.

n. Problem LS14 Ponding occurs at the intersection of Cosgrove Street and Wall Street in West Mount Vernon.

o. Problem LS15 Flooding occurs at the intersection of Division Street and South 20th Street as a result of an undersized conveyance system north of Division Street. Several homes are affected.

p. Problem LS16 Erosion is occurring along a portion of the southwest fork of Trumpeter Creek between Mohawk Drive and Apache Drive east of Comanche Drive.

q. Problem LS17 Uncontrolled runoff from an undeveloped parcel south of Commanche Drive flows north into a ditch on the south side of Commanche Drive. The ditch capacity is insufficient and high flows spill out of the ditch, causing flooding of two homes on the north side of Commanche Drive just east of 30th Street.

r. Problem LS18 There is a 12-inch-diameter culvert under Shoshone Drive just east of Sioux Drive that is overtopped during high flows.

s. Problem LS19 The two detention ponds north of Division Street and west of Waugh Road do not have emergency overflow spillways. Lack of well armored

spillways for emergency use may lead to failure of the pond in an extreme flood event. Also, residents have encroached with landscaping into the easements around these ponds which may inhibit access for maintenance.

t. Problem LS20 Several homes are flooded on the west side of South 6th Street north of Blackburn Road. There is no drainage system in the area.

u. Problem LS21 Flooding occurs on the west side of Riverside Drive in the vicinity of Willow Lane and Alder Lane.

v. Problem LS22 Flooding occurs northwest of the Riverside Drive - Fir Street intersection in the area south east of the Burlington Northern Railroad. There is no drainage system to convey runoff from the area. Three businesses in the area are affected by the flooding.

w. Problem LS23 Flooding occurs along the east side of Interstate 5 where Fir Street curves into Cameron Way. Several businesses are affected by the flooding. There is no drainage system to convey runoff from this area.

x. Problem LS24 Flooding occurs in a large commercial area on the west side of Interstate 5 south of College Way. Because of the flat topography and lack of any conveyance system, the runoff that is generated remains on site.

y. Problem LS25 It was determined from the hydraulic analysis that portions of the pipe and ditch system between Blackburn Road and Britt Slough appear to be under capacity and may cause water to back up in the system and cause flooding during a 10-year storm event.

z. Problem LS26 It was determined from the hydraulic analysis that portions of the storm drain system containing the North Fork of Trumpeter Creek along Fox Hill Street have insufficient capacity to pass the 10-year storm event. This may cause flow to back up and flood the streets and homes in the area. In addition, safety problems associated with a deep ditch west of 32nd need to be resolved.

aa. Problem LS27 It was determined from the hydraulic analysis that the culvert under Interstate 5 on the system tributary to Madox Creek between Blackburn Road and Anderson Road appears to have insufficient capacity. In fact, the pipe section on the east side of Interstate 5 is set at a reverse grade. Therefore, in order for flow to pass through this pipe, water must pond upstream of the pipe and create enough pressure to force the flow through.

D. Water Quality Problems

1. Introduction

For purposes of discussion, water quality problems in the study area are separated into water quality problems attributable to urban development and water quality problems

attributable to rural development. Stormwater runoff from these distinct land uses typically contains different types of pollutants and are discussed below. In addition to these two types of general water quality problems, several specific water quality problems identified in the water quality monitoring program are also discussed. Problems associated with pollutant loading increases from future development are also discussed based on the pollutant loading analysis.

2. Water Quality Problems Resulting From Urban Development

The problem of contaminated urban runoff is not unique to the Mount Vernon urban service area. This pollution problem is prevalent everywhere urban development occurs, and nationwide efforts to clean up surface waters reflect the increasing concern with this form of water pollution. Urban development results in increased contamination of runoff as a variety of commercial and residential activities introduce chemicals, petroleum products, solid wastes, and other pollutants onto the land surface, and stormwater runoff subsequently carries those pollutants into receiving waters. Urban development also causes an increase in the volume and peak rate of stormwater runoff. As more buildings, paved areas, and other impervious surfaces are constructed in an area, a greater proportion of the precipitation over the area becomes surface runoff rather than infiltrating into the ground. Greater areas of impervious surfaces also lead to increased peak runoff rates because roof drains, streets, gutters, storm sewers, and other stormwater drainage facilities quickly convey runoff to receiving waters. With the increased volume and peak rate of surface runoff, there is greater potential for pollutants to be washed off the land surface and carried into surface waters.

The general causes of water quality problems related to urban development in the study area can be classified into several broad categories, including illicit wastewater discharges to the storm drainage system; erosion, transport, and deposition of sediments; contamination of runoff by diffuse sources of pollutants on the land; spills of solid and liquid materials; and illegal dumping of materials into the storm drainage system. These general urban water quality problems within the study area are discussed individually below. Specific water quality problem sources within the study area are discussed in a later section of this report.

a. Problem WQ-1—Illicit Connections of Wastewater Discharges to the Storm Drainage System. A common problem that occurs in urbanized areas is illicit wastewater discharges into a designated storm drainage system. Examples are plumbing connections for sanitary sewer pipes, process wastewater discharges, sump overflows, and internal shop floor drains that enable wastewater to enter storm sewers and drainage ditches, and ultimately to receiving waters. These discharges should be directed to sanitary sewers, combined sewers, septic systems, onsite process water treatment systems, or isolated sumps so that the wastewater is treated (or collected for treatment) before entering the surface water environment.

   In many instances these connections are unknown to the business or home owner, and may not even show up on building drawings. The pollution problems these discharges cause can be severe, and they may persist because detection of the illicit wastewater discharge locations may never occur. Cross-connections of sanitary sewer pipes to the storm drainage system were discovered at the Heritage

Apartments on 19th Street, and have since been rerouted to the sanitary sewer system (Enquist 1993 personal communication). It is likely that other illicit wastewater discharges exist in the study area.

b. Problem WQ-2—Erosion, Transport, and Deposition of Sediments. Erosion within the study area results in increased sediment loading to surface waters. Sedimentation degrades receiving water quality and impacts aquatic habitat. Sediment can be the result of several phenomena. The major causes of sediment deposition include:

- Erosion of stream channels and ditches
- Erosion of cleared or disturbed land
- Particulates, such as wintertime traction sand, which settle on surfaces such as roadways, are washed off and carried to the drainage system.

Pollutants often found in stormwater, including metals, nutrients, bacteria, and petroleum products, can accumulate in sediments deposited near the outfalls from storm drainage systems. Significant sediment deposition was observed in the lower reaches of Madox Creek and Flowers Creek.

Urbanization within the study area has resulted in increased soil erosion from developed land, subsequent deposition of sediments in receiving waters, and scouring of sediments in streams receiving elevated rates of stormwater runoff. Construction sites typically create conditions where soils are vulnerable to erosion by wind or rain. Soils that are stripped bare during site preparation can easily erode. Heavy equipment operating on a construction site can track sediments off the site onto adjacent roads, where the sediments are picked up by wind or stormwater runoff and carried into receiving waters. The steeper the ground slope, the greater the potential for construction-related erosion problems. Erosion can also occur in residential and commercial areas where lawns, landscaped planters, and gardens typically have reduced amounts of ground cover compared to predevelopment conditions.

Sediments that are picked up by wind or stormwater runoff can be carried into receiving waters, where they eventually settle to the bottom. Sediments that are suspended in water can cause problems for the normal functioning of fish and other aquatic organisms. When sediments deposit in the bottom of lakes, wetlands, and streams, they can destroy the habitat for fish and a variety of aquatic organisms.

Erosion and sedimentation problems are aggravated by existing maintenance practices for grass-lined ditches which, in some instances, resulted in removing all the vegetation in the ditch. This practice results in exposing ditch soils to increased erosion, and eliminates the biofiltration capacity of the grass-lined ditch. It also increases runoff velocity through the ditch, which in turn results in increased erosion.

c. Problem WQ-3—Contamination of Runoff by Diffuse Sources of Pollutants on the Land. Urbanization leads to a variety of diffuse sources of pollution. These pollution sources are called nonpoint sources because they cannot be traced to a single location. Rather, they occur in a widespread and uneven manner over the developed land surface. Examples of nonpoint pollution sources in the study area, and urban areas in general, are oil and grease that drip from the undercarriages of automobiles in parking lots, roadways, and driveways; pesticide and fertilizer residues that wash off lawns and other landscaped areas; animal wastes that wash off residential yards; and automobile emissions and other airborne particulates that fall from the air. The collective adverse impact of these nonpoint sources of pollution on the quality of receiving waters can be great. This unseen and previously ignored type of pollution is increasingly being targeted nationwide as a major cause of environmental degradation. Nonpoint pollution sources within the Mount Vernon study area are a major threat to the continuing health of surface and ground water resources.

Results of water quality monitoring conducted as part of this study indicate the existence of several water quality problems that are caused by nonpoint pollution of urban runoff. The general trend of the monitoring results shows that streams in the more urbanized drainage basins have lower dissolved oxygen levels; higher turbidities; higher nutrient concentrations; higher metals concentrations; higher fecal coliform bacteria concentrations; and higher concentrations of oil, grease, and metals in the sediments (Herrera 1993).

Based on the stormwater pollutant loading study, urban runoff water quality problems will become exacerbated with new growth. Concentrated growth will occur in the Mount Vernon area, and existing stormwater regulations to protect water quality from new development may not be adequate.

Nonpoint sources such as sediment and associated pollutants that are carried into storm drain systems can be trapped in catch basins and then removed and disposed of. A potential cause of water quality problems in the study area is infrequent cleaning of catch basins or other urban storm drainage facilities. Nearly all of the urbanized portions of the study area drain into a constructed conveyance system. The stormwater conveyance system includes numerous catch basins. These devices are located where two or more drainpipes join together as well as beneath many surface drains. Catch basins usually have sumps in the bottom that provide storage spaces to collect floating materials, street grit, and other particulates in runoff. If the materials that collect in catch basin sumps are frequently removed and properly disposed of, the sumps do not contribute to pipe clogging problems and can continue to effectively prevent many pollutants from traveling downstream into receiving waters. However, if catch basin sumps are not frequently cleaned out, the collected materials can build up to a point where turbulent inflows easily dislodge the mucky contents, including pollutants, and move them downstream. When this happens, the catch basins may actually contribute to downstream pollution problems because concentrated amounts of polluted material are conveyed into receiving waters within a short period of time.

d. Problem WQ-4—Spills of Solid and Liquid Materials. An obvious source of pollution in urban areas is spills of solid and liquid materials. Countless types of chemicals, petroleum products, manufactured parts, packaging materials, and other synthetic materials are handled every day within the study area. Many of these materials are toxic in the receiving water environment, even in minimal concentrations or quantities. Spills, drips, and inadvertent littering of many of these materials occur frequently in urbanized areas. If spills go unreported and uncontrolled, they can reach a storm drain or surface water directly. Spilled, dripped, and littered materials that are not cleaned up can be carried into the receiving water environment with stormwater runoff and can cause subsequent water quality problems.

The potential for transportation-related and storage-related spills of hazardous materials is a concern for protection of groundwater and surface water resources. If a hazardous materials spill is not adequately cleaned up, residual contamination will contaminate the soil and groundwater and acts as a long-term pollutant source.

The major highways are generally of greatest concern from transportation-related spills because they have high traffic volumes and tend to have a high number of traffic accidents. Traffic accidents associated with automobiles can lead to spillage of crankcase oil, transmission fluid, and gasoline. Accidents associated with truck traffic can lead to more intense spills of oil and gas and spills of hazardous materials such as chemicals being transported. Water quality impacts from transportation related spills can occur either through infiltration of contaminants into groundwater, or by discharge directly into surface waters.

The City of Mount Vernon has no formal spill prevention regulations or written requirements for storage or handling of hazardous materials applicable to businesses. The city fire department relies on the Skagit County Department of Emergency Management for hazardous material spill response and cleanup resources. Thus, individual businesses that handle solid and liquid materials are not required by the city to develop spill control, response, or cleanup plans to prevent pollution problems from occurring (Lindall 1993 personal communication).

e. Problem WQ-5—Illegal Dumping into the Storm Drainage System. Another source of surface water pollution is illegal dumping of solid and liquid materials into street drains, roadside ditches, and other features of the storm drainage system. This often includes litter, lawn clippings, construction waste, landscaping refuse, used crankcase oil, and household hazardous wastes. It is common in many urbanized areas for a variety of materials to be dumped illegally (often by people who do not know it is illegal), including such substances as used motor oil, excess paints and solvents, and assorted refuse. Illegal dumping can introduce high concentrations of contaminants into the storm drainage system, causing severe water quality problems downstream.

3. Water Quality Problems Resulting From Rural Development

Rural development within the study area has led to water quality problems stemming from failure of septic systems, erosion of pasture land, and loading of animal wastes into surface waters. Each of these problems is discussed individually below.

a. Problem WQ-6—Failure of Septic Systems. Although the portion of the study area within the City of Mount Vernon is serviced by sanitary sewers, there are still active septic systems outside the City, but within the Urban Service Area. Septic system failures are a known problem within parts of this area (Herrera 1993). Malfunctioning septic systems have the potential to allow untreated sewage to reach receiving waters. Septic system failures have various causes: If a septic tank is ruptured or otherwise leaking, untreated sewage can seep into the surrounding soil and migrate toward ground water. If sandy and gravelly soils are present in a septic drain field, wastewater will quickly pass through the soil, potentially surfacing downslope or migrating toward ground water. If a drain field is underlain by a hard layer of clay or other impermeable material, percolating wastewater can travel laterally along the hard layer and move quickly away from the drain field without being fully treated. Infrequent maintenance of septic systems may also lead to drainfield failures. Finally, tree roots and other obstructions may cause drainpipes to rupture or collapse, resulting in partial failure of the system.

b. Problem WQ-7—Erosion of Pasture Land. Land that is converted into pasture can be a source of surface water pollutants if it is not managed properly. Overgrazing can strip the ground bare, leaving the soil vulnerable to erosion. If animals are allowed to graze near unprotected stream banks, they may trample the banks and eliminate streamside vegetation. This trampling and loss of vegetation can lead to sloughing of large amounts of soil and sediment into streams and can also cause longer-term erosion problems as gullies develop in the stream banks.

c. Problem WQ-8—Loading of Animal Wastes in Runoff and Directly to Surface Waters. Heavy grazing in certain spots can lead to concentrated areas of animal wastes. Rain that falls on these areas can carry high concentrations of fecal coliform bacteria and nutrients with runoff, degrading downstream surface waters. Similarly, if livestock are allowed to roam in streams or wetlands, they may introduce these pollutants directly to those waters in even greater concentrations than would occur in overland runoff.

4. Specific Water Quality Problems in the Study Area

Based on a review of previous studies, interviews with city staff members, analysis of records of registered businesses in the study area, and field reconnaissance, limited information on specific water quality problems has been identified within the study area. The few specific problems that were discovered are discussed below.

a. Problem WQ-9—Sewage Overflows in the Kulshan Creek Basin. Recent water quality monitoring in Kulshan Creek indicates numerous water quality problems.

One of the primary water quality problems in this 1,404-acre drainage basin is caused by discharges of untreated sewage into the creek (Herrera 1993). A sanitary sewer line adjacent to Kulshan Creek overflows during storm events, causing untreated sewage to spill into Kulshan Creek. This problem has been studied recently, and a bypass sewer line will be constructed next year to eliminate this raw sewage discharge (Bergstrom 1993 personal communication).

b. Problem WQ-10—Contaminated Sediments in Kulshan Creek. Water quality monitoring conducted for this plan indicates that sediments in Kulshan Creek have total petroleum hydrocarbon (TPH) contamination as high as 3,200 milligrams per kilogram (mg/kg) dry weight, a level that far exceeds the state Model Toxics Control Act cleanup level for soil of 200 mg/kg dry weight. This high sediment TPH contamination may be due to concentrations of TPH in runoff from streets and parking lots in the drainage basin, but it appears to be indicative of other sources in addition to urban runoff.

The sediment monitoring station was located approximately 2,400 feet upstream of the mouth of Kulshan Creek near the inlet to the pipe system. Field reconnaissance in the basin did not indicate any obvious sources of TPH contamination in the vicinity of the monitoring station. A former fuel oil storage and distribution business located on the south side of College Way to the west of the railroad crossing is under consideration as a state toxic waste site (Buckenmeyer 1993 personal communication). This site may be a significant contributor to TPH contamination in Kulshan Creek via contamination of stormwater runoff. Another source of TPH may be untreated stormwater runoff from numerous parking lots in the basin that discharges into Kulshan Creek. Several large parking lots are located near the sediment sampling station.

The city now requires new developments and redevelopments to comply with the Washington Department of Ecology (Ecology) stormwater management regulations, which require oil/water separators in some instances. However, existing developments are not required to be retrofitted to provide stormwater treatment (Buckenmeyer 1993 personal communication). Thus, most of the parking lots in the Kulshan Creek basin do not treat runoff using oil/water separators or other stormwater treatment devices. Other sources of oil in runoff, such as unprotected waste oil drums, may also be contributing to the problem.

5. Future Water Quality Problems in the Study Area

a. Problem WQ-11—Future Water Quality Problems. Increasing development within the study area will lead to a greater potential for contamination of stormwater runoff, which in turn will lead to increased surface water quality problems. Table 2 in Appendix H shows projected future land uses within the study area. Pollutant loading changes associated with the land use changes in the study area are shown in Table 4 of Appendix H. As Table 2 shows, most of the projected development is for residential uses, with a lower level of commercial development expected. While the new development will be required to incorporate stormwater treatment

measures to satisfy Ecology standards, there remains a likelihood of degraded water quality in study area streams because stormwater treatment methods are not capable of removing all of the runoff pollutants that result from development.

Of particular concern is the impact that construction activities may have on water quality. Erosion and sedimentation controls on construction sites are often ineffective, even when they are designed and implemented according to established pollution control standards. Thus, increased sediment loading in study area streams is anticipated. In addition, the expansion of residential development in many parts of the study area will present a variety of potential stormwater quality problems. Pesticides, animal wastes, yard wastes, and automobile-related pollutants are typical sources of water quality problems that are difficult to control in residential areas.

Future water quality problems will also persist due to existing developments unless they are targeted for retrofitting of stormwater treatment facilities. This may be an even greater concern than stormwater contamination caused by new developments.

E. Environmental Resource Problems

1. Wetlands

This subsection identifies and describes wetlands management problems facing the City of Mount Vernon. Wetlands management problems have been divided into two groups: (1) "at-risk" wetlands, and (2) balancing wetlands protection with economic growth.

The City of Mount Vernon recognizes the presence and importance of wetlands within the city, and realizes that many of the wetlands are threatened by the encroachment of urbanization, agriculture, and other land uses. Several types of wetlands are particularly subject to degradation for a variety of reasons. This subsection first identifies and describes these threatened wetland areas, summarizing the nature of the problem affecting the wetland, and identifying the potential or known causes of the degradation. The second portion of this subsection describes potential difficulties the city may encounter in balancing wetlands protection while encouraging sound economic growth.

a. "At-Risk" Wetlands. Due to rapid growth in the City of Mount Vernon, wetland areas, particularly those located within the most urbanizing portions of the City, are threatened by the encroachment of development. These threatened wetland areas fall into five broad categories:

- Disturbed Areas
- Prior Converted Cropland and Farmed Wetlands
- High Value Wetlands Adjacent to Potentially Damaging Land Uses
- Unbuffered Wetlands
- Wetlands Historically Subjected to Filling

The following sections describe each of these categories.

Problem WT1—Disturbed Areas. Wetlands which have been disturbed are often difficult for the layperson to recognize as wetland. Many such wetlands lack one or more of the three wetland criteria (hydrophytic vegetation, hydric soils, and wetland hydrology). For example, areas without vegetation or those planted in tree plantations are considered disturbed areas. These areas are often disturbed by human activity such as ditching, diking, clearing, and filling. A disturbance may also be due to natural events such as landslides, beaver dams, or flooding. Should these man-made or natural disturbances occur in a wetland, the land would still be considered, and therefore regulated, as wetland, although the area may not be readily recognized as wetland. Further, although wetlands are still present after the disturbance, their ability to provide valuable wetland functions is often diminished by the disturbance.

The 1987 Manual describes most disturbed areas under the heading of "atypical situations." These are defined as those situations where one or more indicator is missing due to unauthorized activity (filling or dredging) or natural events. The 1987 Manual definition of atypical situations also includes wetlands dominated by facultative plant species (those plants equally likely to be found in wetlands and in uplands). A red cedar swamp is an example of an area described by this definition of an atypical situation.

Problem WT2—Prior Converted Cropland and Farmed Wetlands. Land that was historically wetland presently under agricultural use may fall under two different designations: prior converted cropland and farmed wetland. The following defines prior converted cropland; a summary of farmed wetlands follows.

The Soil Conservation Service has defined "Prior Converted Cropland" in the August 1988 National Food Security Act Manual as:

> Wetlands which were both manipulated (drained or otherwise physically altered to remove excess water from the land) and cropped before 23 December 1985, to the extent that they no longer exhibit wetland values. Specifically, prior converted cropland is inundated for no more than 14 consecutive days during the growing season.

This designation includes many areas that have been ditched or filled for use as pasture or cropland. The Soil Conservation Service is the only agency empowered to determine if agricultural land is indeed prior converted cropland. There are potentially many examples of prior converted cropland in Mount Vernon, as this area has been extensively used for agriculture.

These areas are exempt from regulation by the federal government. However, Washington State does not exempt prior converted cropland associated with Waters

of the State from the Washington State Shorelines Management Act, and state and local agencies may consider prior converted croplands to be wetlands subject to regulation.

Another type of agricultural wetlands is known as "farmed wetlands." According to the 1988 National Food Security Act Manual, the Soil Conservation Service has defined "farmed wetland" as farmland where the soil and hydrology remain unchanged, and therefore still exhibit wetland characteristics. Ditched or filled farmland that is inundated for 15 or more days during the growing season is considered farmed wetland. In other words, hydric soil and wetland hydrology exist on the farmed land, and hydrophytic vegetation would return with the cessation of farming practices. There are many examples of farmed wetland within the city; most of these farmed wetlands are being used primarily for pasture. Farmed wetlands are still subject to wetlands regulation at all levels of government. However, no permitting is necessary to continue to use farmed wetlands for agricultural purposes.

The difference between prior converted cropland and farmed wetlands is important for several reasons. As mentioned above, prior converted croplands are exempt from federal regulation while farmed wetlands are regulated at all levels. Unfortunately, it is often difficult to distinguish one type of agricultural wetland from another. This makes it difficult for individual property owners and public planners alike to anticipate the regulatory constraints which may confront a given project without a detailed investigation. Additionally, often neither type of agricultural area appears to be wetlands to those lacking substantial training and expertise.

Problem WT3—High Value Wetlands Adjacent to Potentially Damaging Land Uses. High quality wetlands are those which perform valuable functions in the natural ecosystem and in the human environment. In general, wetlands are considered to be of high value if they (1) are large, (2) contain thick or diverse vegetative cover, (3) are close to a perennial stream or river, (4) are able to detain runoff and retain sediments and other pollutants, and (5) are located directly upstream from urban and developable areas. A number of wetlands located within the study area fulfill these criteria, and provide valuable storm and flood water control, water quality improvement, and biological support.

Residential development and small commercial development is the primary land use within the study area. These uses increase the stormwater runoff in the watersheds and degrade water quality by the non-point introduction of metals and excess nutrients.

Agricultural use can pose a threat to water quality in wetlands. One large dairy is located in close proximity to, and upslope from a valuable wetland in the northeast portion of the study area. The excess nutrients generated by the dairy are potentially damaging to the large wetland below.

Commercial operations such as the large nursery located off East College Way east of Waugh Road, may be a source of non-point pollutants such as fertilizers and herbicides. This operation is adjacent to a perennial stream and associated wetlands.

Problem WT4—Unbuffered Wetlands. Buffers are strips of land utilized to protect one type of land use from the effects of another. Buffers have been found to be effective at mitigating the effects of surrounding development on wetlands (Castelle et al. 1992a).

Buffers protect wetlands by providing the following functions:

- Stabilizing Soil and Preventing Erosion
- Filtering Suspended Solids, Nutrients, and Harmful or Toxic Substances
- Moderating Impacts of Stormwater Runoff
- Moderating System Microclimate
- Protecting Wetland Habitat from Adverse Impacts
- Maintaining and Enhancing Habitat Diversity and Integrity
- Supporting and Protecting Wetland Species and Providing Wildlife Corridors for Wetland and Upland Species
- Discouraging Adverse Human Impacts to Wetlands

Scientific studies have demonstrated that buffer effectiveness varies with buffer size. Buffer widths of between 25 and 600 feet are necessary to protect wetlands, depending upon site-specific conditions.

Numerous wetlands in the study area are surrounded by little or no upland buffer. They are bordered by roads, agricultural areas, and residential and commercial development.

Problem WT5—Wetlands Historically Subjected to Filling. Wetlands in urban and rural areas are often vulnerable to dumping of yard waste, construction debris, and refuse. The debris impacts wetland functions such as water quality, wildlife habitat, and aesthetic values.

Evidence of dumping of small amounts of yard waste, soil, and household refuse was observed during the field survey but was not widespread.

b. Wetlands Protection and Economic Growth.

Problem WT6: One of the main problems facing wetlands protection is the public's lack of recognition of (1) what wetlands are, and (2) what values wetlands may contribute to society. This lack of recognition of what many wetlands are and what benefits they may provide has resulted in the innocent loss of a significant amount of wetlands.

While most people would recognize an open water pond, ringed with cattails and full of turtles and waterfowl, as a wetland, this type of wetland is uncommon in Mount Vernon (see Chapter One). For example, one of the most common types of wetlands in the city, particularly within the Urban Growth Boundary, is wet meadows. Few individuals may realize that an area which has been used for pasturing livestock for generations could be considered a valuable natural resource. As a result, they are not likely to realize that the conversion of wet meadows to developed land uses results in a loss of wetlands.

Even those who may realize that a pasture may be a wetland may not appreciate the functional values provided by the wet meadows. For example, it has been a common mitigative practice to "compensate" for the loss of wet meadows by constructing open water wetlands. Most feel that since ponds have a more wetland-like appearance, then a meadow-for-pond trade-off actually results in a net gain for the environment. While this may be true in some instances, many ponds cannot provide the water quality improvement functions provided by wetland pasture grasses. Further, water fowl which utilize ponds may contribute significant excess nutrient and bacterial loading to streams and other natural water bodies. Additionally, many wildlife species which utilize wet meadows cannot survive in an open water setting. For example, most small mammals, which are important prey for sustaining raptors such as eagles and hawks, cannot survive if the soil is permanently inundated.

Problem WT7: Another problem may be contained within the city's CAO. This ordinance does not distinguish between higher- and lower-valued wetlands. As a result, no greater measure of protection is afforded the city's most valuable wetlands than is given to the least valuable wetlands. Because all wetlands are treated equally, there is no mechanism to plan for long-term protection of the most important wetlands. In some instances, for example, a developer may have a choice of impacting either a low-value or high-value wetland. Without a means of distinguishing one from the other, or without a regulatory disincentive to avoid the high-value wetland, the developer might spare the low-value wetland while destroying the high-value wetland. Note that both state and federal agencies (for example, the Washington Department of Ecology and the U.S. Army Corps of Engineers) do recognize that not all wetlands are of equal value. Differences between wetland functions and values are often reflected in permitting and mitigation requirements established by these agencies. However, projects which impact less than one acre of many wetlands are often not subject to state regulation, and may not receive the scrutiny from federal agencies which projects with larger impacts would. As a result, some higher-value wetlands may be impacted even though they appear to be protected by state and federal regulation.

Even the most restrictive wetlands management ordinances allow for the opportunity to impact some wetlands provided some form of compensatory mitigation is performed. The Mount Vernon CAO is an exception: there are no specific provisions for compensatory mitigation. As a result, each project proponent is left to develop a wetlands mitigation plan independently of any other wetlands

management programs or projects. Without a means of coordinating wetlands protection and mitigation measures, the diversity and distribution of wetlands may be significantly altered. As in the example given above, it is common for open water wetlands to be created as compensation for the loss of wet meadows; open water wetland creation has also been used to compensate for the loss of scrub/shrub, forested, and other wetland types. If this were to occur in Mount Vernon, the city could see an increase in the number of small ponds, but a decrease in all other types of wetlands. Such a decrease in wetlands diversity may result in the degradation of the water quality of the city's streams, a reduction of the number of wildlife species, flood water storage capacity, and the diminution of other important wetland functions.

Problem WT8: Another problem regarding wetlands protection is that there are currently few incentives to protect wetlands, nor are there any mechanisms to fund or otherwise complete wetlands restoration and enhancement projects unless they are the result of some compensatory mitigation. In the absence of incentives, many people who own wetlands may view them as nothing but an economic liability; that is, as areas which have no or low recognizable intrinsic value to the land owners, but which cannot be fully developed. Further, despite development constraints placed on wetlands, many times the land is assessed as though it were non-wetland and may be fully developed.

Problem WT9: There are wetlands located within the study area of this report which have been degraded through past land use practices. Other wetlands have been eliminated or significantly reduced in size in locations where they may be particularly important. Currently, there are no programs which are aimed at enhancing or restoring these wetlands to a highly functioning condition. Further, as an ever-increasing amount of the city becomes developed, the opportunities for pro-active wetlands protection and enhancement are diminished.

2. Fish Habitat

Fish habitat problems identified within the study area generally fall into one of two categories: fish passage barriers and habitat limitations. Passage problems inhibit or prevent fish migration upstream or downstream. Fish habitat limitations generally include spawning and rearing habitat variables that limit the natural production of fish. Spawning habitat limitations deal with the quantity or quality of spawning gravels. Rearing habitat limitations include instream cover, food supply, temperature, and other water quality parameters.

a. Problem E1 A pump station on the piped section of Kulshan Creek at the outlet to the Skagit River presents a nearly total barrier to fish passage. Passage is only obtainable when conditions are such that the flap gate on the pipe outlet is propped open from flow and the Skagit River is high enough to create a take-off pool below the flap gate but not high enough to force the gate shut.

b. Problem E2 An existing manhole section in Kulshan Creek located east of the railroad collects debris and creates a partial fish passage barrier.

c. Problem E3 A culvert for Cedar Lane in an unnamed tributary to Kulshan Creek creates a partial fish passage barrier due to a 1-foot drop at the outlet.

d. Problem E4 The portion of Kulshan Creek upstream of Riverside Drive to about North 18th Street lacks riparian vegetation as well as pools and riffles that provide good instream habitat.

e. Problem E5 There is a lack of riparian vegetation as well as pools and riffles to provide good stream habitat along Trumpeter Creek from the confluence with Nookachamps Creek to 2,700 feet upstream and in portions of the mainstem from College Way to Fir Street.

f. Problem E6 The culvert along the Southeast Fork of Trumpeter Creek at Seneca Drive plugs with debris which causes fish passage problems.

g. Problem E7 The culvert along the Southeast Fork of Trumpeter Creek at Kiowa Drive presents a partial barrier to fish migration due to a 1-foot drop at the culvert outlet.

h. Problem E8 The culvert along the Southeast Fork of Trumpeter Creek at Lupine Street is blocked with debris and presents a barrier to fish passage.

i. Problem E9 A 42-inch-diameter culvert at Fir Street on the east side of Bakerview Park presents a partial fish passage barrier on the Southwest Fork of Trumpeter Creek due to a 1-foot drop at the culvert outlet.

j. Problem E10 A 210-foot-long 60-inch-diameter culvert on Maddox Creek 1,200 feet upstream from Anderson Road creates a fish barrier. The culvert is too long for fish to be able to maintain the energy to swim against the current in the culvert, and the fish would not be able to enter the culvert due to the 2-foot drop at the culvert's outlet.

k. Problem E11 The culvert on Maddox Creek at Blackburn Road is nearly a total fish passage barrier due to a 2-foot drop at the culvert's outlet.

l. Problem E12 The outfall pipe at the lower detention pond on Maddox Creek south of Section Street and east of Little Mountain Estates is plugged and creates a total fish passage barrier.

m. Problem E13 The section of Flowers Creek between its confluence with Maddox Creek and Blodgett Road lacks riparian vegetation.

n. Problem E14 The culvert for Flowers Creek at Blodgett Road presents a partial barrier for fish at low flows due to a 1-foot drop in elevation between the culvert outlet and the streambed.

o. Problem E15 The lower portion of Carpenter Creek along Bacon Road lacks pools and riffles as well as riparian vegetation that provide instream habitat.

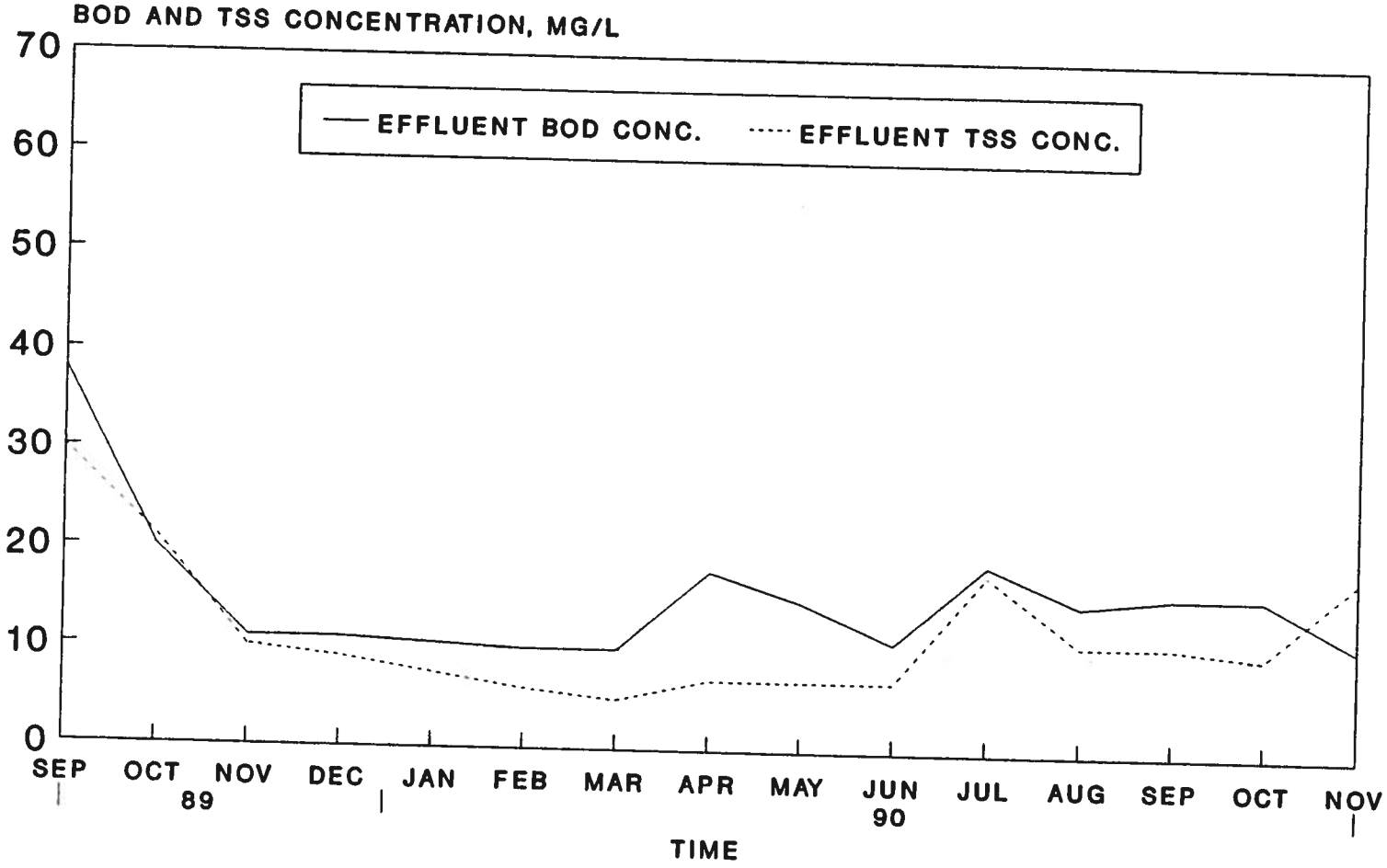


FIGURE VI-1
AVERAGE MONTHLY EFFLUENT BOD AND TSS CONCENTRATION SINCE PLANT STARTUP

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE SEWER AND COMBINED SEWER OVERFLOW REDUCTION PLANS

R·W·BECK

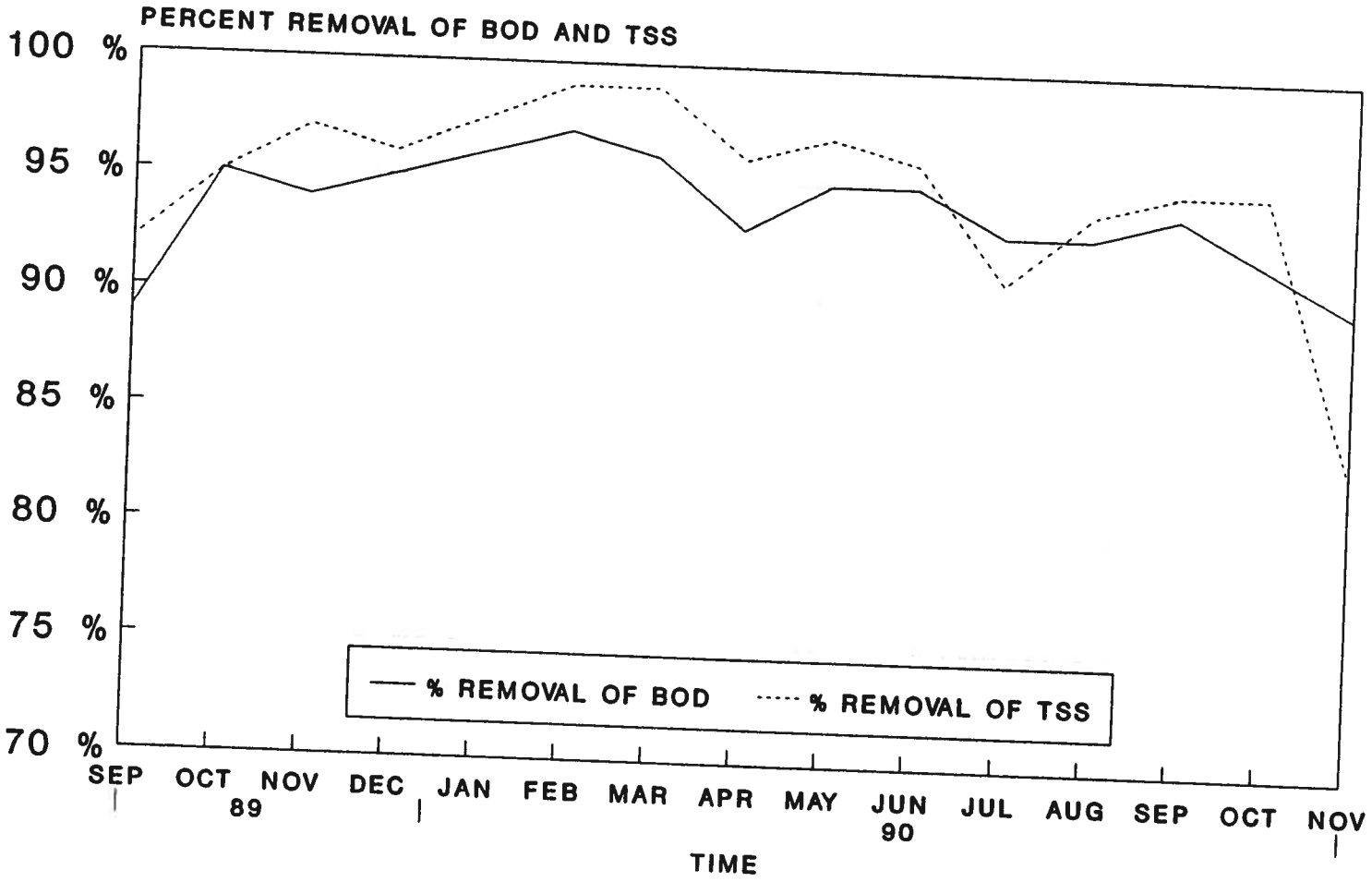


FIGURE VI-2
MONTHLY PERCENT REMOVAL OF BOD
AND TSS SINCE PLANT STARTUP

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE
SEWER AND COMBINED
SEWER OVERFLOW
REDUCTION PLANS

R·W·BECK

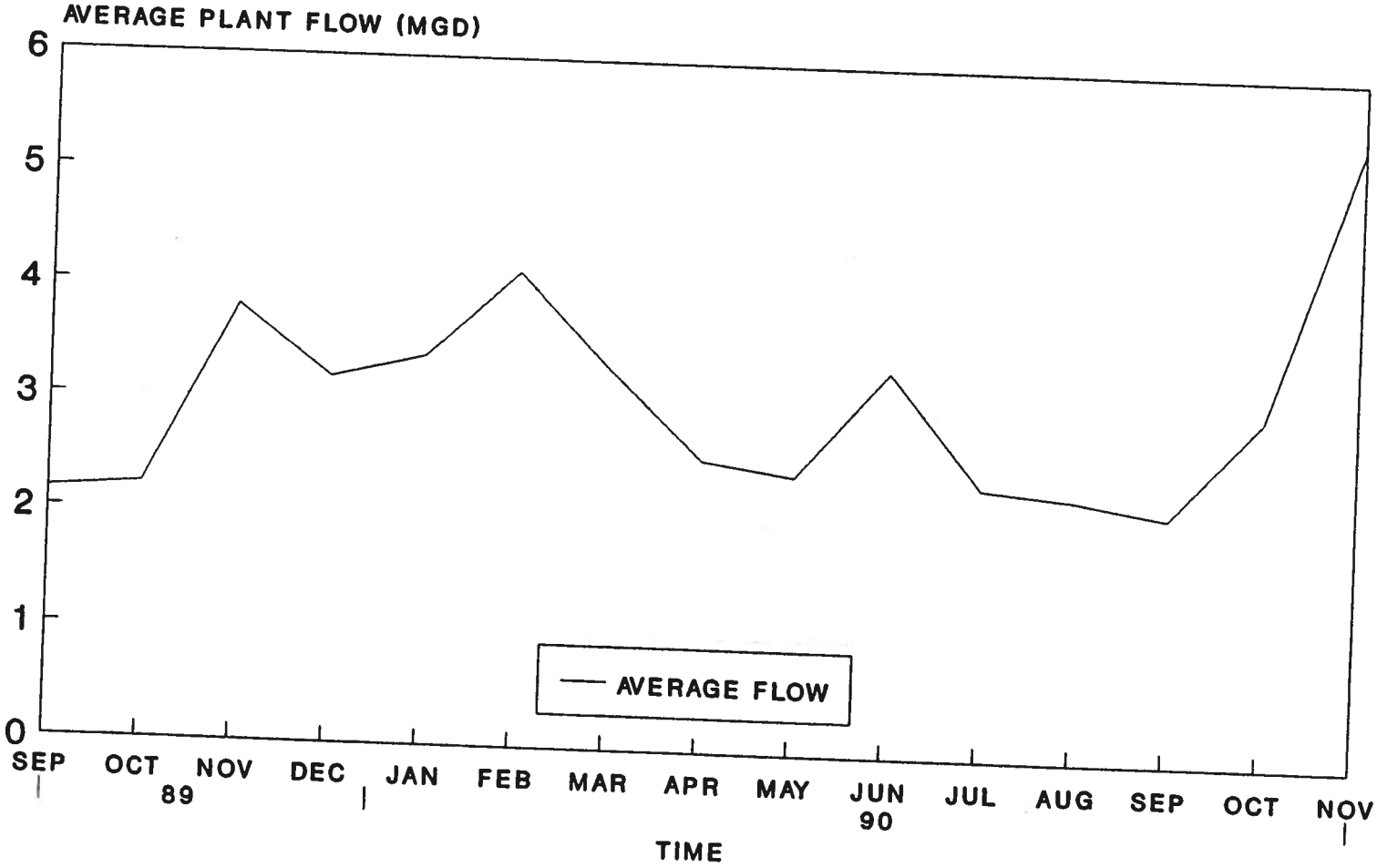


FIGURE VI-3
AVERAGE DAILY PLANT FLOWS
SINCE PLANT STARTUP

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE
SEWER AND COMBINED
SEWER OVERFLOW
REDUCTION PLANS

RW BECK

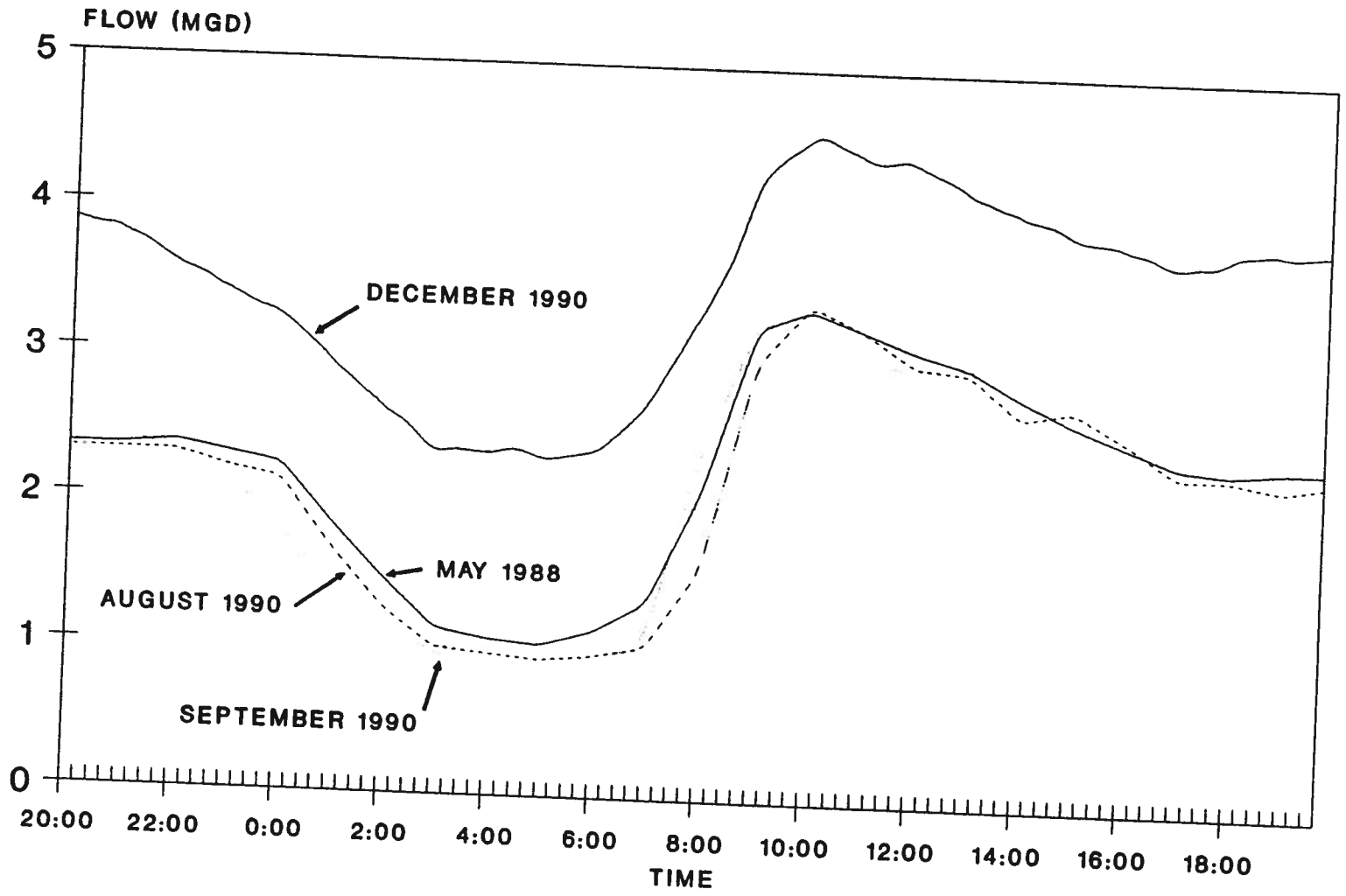
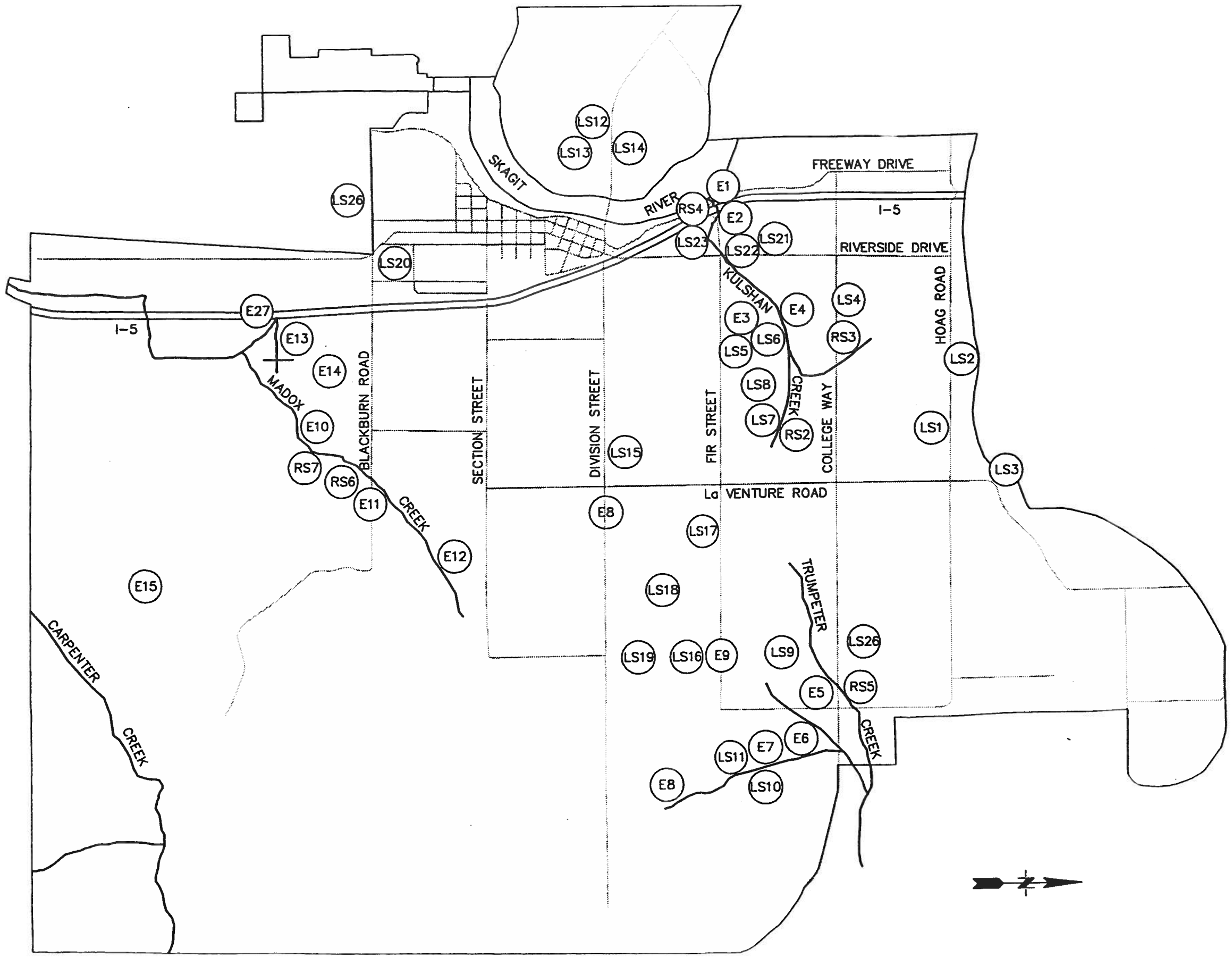


FIGURE VI-4
DIURNAL CURVE FOR FLOWS ENTERING
THE WASTEWATER TREATMENT PLANT

CITY OF MOUNT VERNON
WASHINGTON

COMPREHENSIVE
SEWER AND COMBINED
SEWER OVERFLOW
REDUCTION PLANS

R·W·BECK



LEGEND

RS4 REGIONAL SYSTEM PROBLEMS

LS9 LOCAL SYSTEM PROBLEMS

E6 FISH HABITAT PROBLEMS

FIGURE VI-1
CITY OF MOUNT VERNON
SURFACE WATER
MANGEMENT PLAN

PROBLEM LOCATION MAP

R:W·RECK

SECTION VII
EVALUATION OF PROBLEM SOLUTIONS AND RECOMMENDATIONS

R·W·BECK

SECTION VII

EVALUATION OF PROBLEM SOLUTIONS AND RECOMMENDATIONS

A. General

The following paragraphs describe the alternative solutions to the problems identified in the preceding section. For each problem, appropriate structural measures and/or non-structural measures are evaluated and recommendations are presented. Tables VII-1 and VII-2 show typical structural and nonstructural solutions to stormwater problems. Structural measures are capital improvements such as pipe replacement, a pump station, channel widening, or construction of detention facilities. Non-structural solutions include policies, ordinances, regulations, public education, and increased maintenance activities. The alternative solutions were evaluated and a recommendation is given to solve the problem. The alternative analysis for each problem is based upon criteria such as effectiveness; cost; environmental impacts; consistency with the long and short term goals; consistency with existing or proposed local, State, or Federal requirements for managing storm water; and public acceptance. Sketches of selected alternative solutions are also shown.

Two basic types of structural solutions to flooding and erosion problems are recommended due to the regional or local nature of the water quantity problems. Construction or modification of regional facilities may be required to solve problems that provide benefits throughout the stream system. Local improvements to the conveyance system may be all that is required to solve local water quantity problems.

For the regional system problems, flooding and erosion can be solved by sizing detention facilities to reduce peak outflows so that they can be accommodated by the existing conveyance system. The advantage of this type of structural solution is that it results in a reduction in downstream peak flow rates. The disadvantage is that in order to get the required peak flow reductions to prevent flooding, substantial storage volumes may be required, and the detention facilities needed may require large areas of land. Where land is not available, or where appropriate, increasing the capacity of the conveyance system is also used to solve regional problems.

For the large regional problems, alternative solutions are described. As part of this plan, the recommended alternatives were subject to environmental review, including a planning level SEPA checklist.

Local flooding or erosion problems can be solved at any specific location usually by increasing the capacity of the conveyance system. The advantage of this type of structural solution is that it does not require large areas of land. In some instances, undersized drainage system components result in flooding, but also create a significant amount of water storage. A disadvantage to increasing the system capacity is that in cases where eliminating flooding also eliminates significant storage volumes, downstream peak flow rates are increased, which can impact aquatic resources and

increase flooding further downstream. The conveyance system improvements recommended here generally do not involve loss of flood storage of any significance and do not result in appreciable increases in downstream peak flows.

Cost estimates for several problems have been updated as part of several design projects and review of developer proposals. These estimates are shown in Appendix E. Estimates for the remaining problems have been taken from the 1993 draft plan and escalated at 4.5 percent per year for two years. The 1993 estimates for the remaining problems prior to escalation to 1995 costs are also shown in Appendix E. The 1993 estimates include an allowance of 10 percent for mobilization; 30 percent for construction contingency; 8 percent for sales tax; 2 percent for administration; and 30 percent for surveying, permitting, and engineering. Pipe replacement costs are based on using corrugated HDPE for pipes 24-inches in diameter or less, and concrete for pipes with diameters greater than 24 inches.

B. System Solutions

1. Regional System Problems

As described in Section VI - Problem Identification, regional system problems are those associated with flooding or erosion of major streams or drainage systems. These problems generally affect a larger geographic area and represent the most serious surface water problems within the City. Much of the work performed to identify the regional problems was performed as part of a separate task report contained in Appendix F. The problem solutions contained in that task report, with a few exceptions, are summarized under the following Regional System Problem solutions. It should be noted that the design criteria for solving regional system problems is to provide flood protection for a 100-year event. All the proposed solutions also assume runoff under future build-out land use conditions.

a. Problem RS1 — Riverbend Road (Freeway Drive) Drainage Problem.

RS1 Problem Description: The drainage system along Freeway Drive does not have enough capacity to convey flows from future development, nor does it provide service to the area south of College Way.

RS1 Structural Solutions: Two alternative structural solutions involving increased pumping capacity are proposed to provide drainage for the drainage basin around Freeway Drive. The first alternative solution would increase the capacity of the existing pump station. This solution would provide additional pumping and conveyance system capacity to service full development of the basin area around Freeway Drive north of College Way without construction of additional detention storage. It was found through model simulations that the pump capacity would need to be increased from 2.67 cfs to about 10 cfs to keep the frequency of pond overtopping to about once in 50 to 100 years. The 10-cfs pump station would be accompanied by 2,600 feet of 24-inch force main to carry the increased flow. This system would not provide drainage along Freeway Drive south of College Way.

Construction Cost = $983,000
Approximate Annual Energy Cost = $600–$1,200

The second alternative structural solution would provide gravity flow and pumping capacity to service all of the Freeway Drive drainage basin, both north and south of College Way, without construction of additional detention storage. This would require the construction of 2,600 feet of 48-inch gravity main and a 50-cfs pump station. The 48-inch gravity flow pipe would begin at the Eagle Hardware detention pond and run south along the western city boundary to a new pump station located near the Skagit River along Riverbend Road. The pump station would only operate under high water conditions in the Skagit River. This solution would limit the Eagle Hardware detention pond overtopping to about once in 100 years.

Construction Cost = $1,750,000
Design Cost = $242,000
Approximate Annual Energy Cost = $50–$100

RS1 Nonstructural Solutions: Because all of the existing commercial development along Freeway Drive is served by an existing pump station that is greatly undersized, serving this area under full build-out conditions, will require additional conveyance. Construction of additional on-site detention systems would not preclude the need for construction of additional conveyance capacity. Detention times in the existing Eagle Hardware pond are already becoming excessive, and this extra time that the pond is full causes a risk of additional flooding in back-to-back storms. For this reason, this problem is better solved by structural solutions.

RS1 Recommendations: To provide adequate flood protection for the full development of the basin, both north and south of College Way, the second alternative solution is recommended. The first alternative has a higher annual energy cost because all the flow is pumped. The second alternative has a lower annual energy cost because flow will only need to be pumped when the river levels are high.

b. Problem RS2 — Kulshan Creek Culverts.

RS2 Problem Description: The two 36-inch-diameter culverts under Parker Way have insufficient capacity to prevent overtopping of the road.

RS2 Structural Solutions: To prevent Kulshan Creek from overtopping Parker Way and possible local flooding upstream, two additional 36-inch diameter culverts are needed to supplement the capacity of the existing two 36-inch-diameter culverts.

Construction Cost = $13,100

RS2 Nonstructural Solutions: Since most of this basin is already developed, this problem is best solved by structural solutions. Nonstructural solutions such as new development standards will not solve this problem.

c. Problem RS3 — College Way Culvert.

RS3 Problem Description: The culverts for a tributary to Kulshan Creek across College Way and Continental Place have insufficient capacity to pass the 100-year storm event.

RS3 Structural Solution: To prevent local flooding upstream of the pipe system across College Way and Continental Place along a tributary to Kulshan Creek, both culverts should be replaced in accordance with the NHC report included in Appendix N. This report recommends installing a parallel 54-inch concrete or 6.42 x 4.33 CMP pipe arch at College Way, and adding a second 36-inch CMP culvert at Continental Place. It also recommends keeping this channel clear. In discussions with City Staff, an additional 24-inch pipe crossing of College Way is located a short distance to the east of the existing culvert for the Kulshan Creek Tributary. This crossing will provide some additional capacity, but will not preclude the need for constructing a new crossing for the Kulshan Creek Tributary.

Cost = $109,000

RS3 Nonstructural Solutions: The existing system is undersized for meeting design criteria for a major creek culvert crossing so that the solution to this problem is better accomplished by structural methods.

d. Problem RS4 — Kulshan Creek Pump Station.

RS4 Problem Description: The existing gravity pipe system and pump station discharge for Kulshan Creek is undersized and results in severe flooding of this area.

RS4 Structural Solutions: Several alternative structural solutions involving conveyance and pump station improvements were investigated to improve the drainage along Kulshan Creek. The alternatives describe several conveyance options, but they involve the same basic pump station design to provide capacity to serve a 100-year flow of 210 cfs. The basic design includes four vertical shaft centrifugal pumps in a concrete sump. Other alternatives to reduce the pump station capacity requirements through the use of upstream flood storage are described later in this problem solution section. The pump motors, controls and other associated equipment would be located in a frame structure above the sump. A below-grade reinforced concrete horizontal and vertical expansion structure would provide the room for a hydraulic transition between the supply pipe(s) and pump sump. The exact configuration of the expansion structure and sump will need to be determined during final design so that an economical structure can be devised that will not result in vortexes and pump cavitation. It may be cost effective to test the operation of a minimally sized expansion structure during design with the aid of a physical scale model. The alternatives discussed here primarily involve the location of the pump station and conveyance system.

The first alternative solution would be with a pump station sited at the same location as the existing pump station (see Appendix F, Figure 3.2). This location would require removing the existing pump station, and installing 1,600 feet of 60-inch-diameter supply pipe to supplement the existing 48-inch supply pipe. About 150 feet of the new 60-inch-diameter supply pipe would need to be installed under Interstate 5 either by jacking or some other trenchless method that would not require highway closure. The existing 10-inch-diameter force main from the Freeway Drive area basin would discharge directly into the sump. A concrete outlet structure would be adjacent to the downstream wall of the pump sump and would include a flap-gate to prevent back flooding from the Skagit River. Both the gravity drain and the pumps would discharge into the outlet structure then through the existing water course to the river. The outlet structure would be integral with the pump station structure.

The second alternative solution would be with a pump station sited on a portion of City of Mount Vernon property presently used for equipment storage and maintenance located on the east side of Interstate 5, opposite the existing pump station (see Appendix F, Figure 3.3). This alternative would allow gravity flow from the Kulshan Creek basin. The proposed location for this alternative would require supplementing 1,400 feet of existing 48-inch-diameter supply pipe with an additional 72-inch-diameter supply pipe, and will ultimately require the use of two force main pipelines under Interstate 5. Installation of a 72-inch pipe will allow for future service at the design flow with the existing 48-inch supply pipe out of service. One of the two force mains could be created by slip-lining the existing 48-inch-diameter gravity flow pipe; the second force main would require that an additional 48-inch pipe be installed either by jacking or some other trenchless method that will not require highway closure. Installing higher head pumps can defer construction of the second 48-inch force main under the freeway to beyond the 20-year planning period.

The third alternative solution would be sited with a pump station immediately southwest of existing manhole K-3 (see Appendix F, Figure 3.4). The existing pump station and outlet structure would remain in place and accommodate flow from the existing 10-inch-diameter force main from the Freeway Drive area basin as well as gravity flow from the Kulshan Creek basin. The existing 48-inch-diameter supply pipe between manholes K-5 and K-3, about 500 feet, would be supplemented by a new 60-inch-diameter pipe. Manhole K-3 would be modified to permit up to 20 cfs to flow to the existing pump station gravity outlet. Discharges in excess of 20 cfs and the entire discharge when gravity drainage is not possible, would flow into the new pump station sump and then be pumped through a new 1,200-foot-long 60-inch-diameter force main located along the railroad right-of-way. The force main would go under the Interstate 5 overpass to a new outlet structure that would be located on the left bank of the Skagit River at the north end of Riverside Park.

The fourth alternative solution is similar to the third alternative except that the pump station would be located on a portion of the City of Mount Vernon equipment maintenance and storage property (see Appendix F, Figure 3.5). This location will require 500 feet of new 72-inch-diameter supply line from the pump station to Manhole K-3, and supplementing about 500 feet of the existing 48-inch-diameter pipe between Manholes K-3 and K-5 with a new 60-inch-diameter pipe. Manhole K-3 would be modified the same as described for the third alternative solution. The force main from the pumps to the Skagit River would be the same as the third alternative solution, except the main would follow Cameron Way to the interstate highway overpass and then on the same route to the river as the third alternative solution.

Each of the pump station alternatives and modifications to the existing conveyance system would provide the required pumping capacity to prevent flooding in Kulshan Creek Basin; however, each alternative presents its own construction and operation considerations. The following presents a discussion of some of the more significant of these considerations.

- **Phased Construction.** To minimize initial construction costs, but still provide an appreciable reduction in flood risk for the initial investment, the overall layout of the pump station, related structures and piping should allow for phased construction. Items to be considered would include deferring construction of additional pipelines and using the existing 48-inch-diameter pipe to supply to a new pump station which would have the mechanical and electrical equipment to match the capacity of the existing pipe. The first and second alternative solutions allow phased construction that incorporates these items. The other alternatives do not.

- **Pumping Costs.** Pumping costs should be considered in the selection of the preferred alternative. Long force mains will require pumps with a larger total dynamic head, consequently larger horsepower motors and larger operating costs. Both the third and fourth alternative solutions will have the greatest operating costs due to the long force mains associated with these alternatives. The second alternative solution will also have some increase in operating costs when compared to the first alternative solution, which does not have any force mains.

- **Sited on City-owned Property.** Siting of the pump station on the identified city-owned property will reduce costs of acquiring real estate, will provide an added measure of security and reduced liability, could reduce problems in obtaining construction permits, and allow for construction out of the designated floodway. The second and fourth alternative solutions are sited on the city-owned property.

- **Construction Under Interstate Highway 5.** In order to convey Kulshan Creek floodwater to the Skagit River, a pipe must be passed under the interstate highway without interrupting the flow of traffic during

construction. This means that the pipe must be tunneled or jacked under the roadway, or it must utilize an existing interstate overpass. The third and fourth alternative solutions utilize the overpass via long force mains. The first and second alternative solutions will ultimately require tunneling or jacking of at least one pipe under the interstate road bed. The existing 48-inch-diameter line under Interstate 5 could be slip-lined to provide a force main with an approximate 90 cfs capacity which would eventually be supplemented with another new 48-inch force main for the second alternative solution.

- **Access During Construction and for Operation.** Ease of access and ample room for construction will result in lower construction costs. Ease of access for operation and maintenance, especially during flood conditions, will result in lower operation costs and greater pumping reliability. Alternatives 2, 3, and 4 appear to allow reasonably good access. Alternative 1 has inadequate room for construction and would be the least accessible during flood conditions.

Considering the above factors, the preferred alternative appears to be Alternative 2 sited at the City of Mt. Vernon storage and maintenance yard on the east side of I-5 opposite the existing pump station. It is on city-owned property on the outside of the Skagit River floodway, there is ample room for construction and maintenance, construction can be phased to use the existing supply pipe, and future pump operating costs will be lower than other alternatives (3 and 4) with longer force mains.

In addition to evaluating alternatives for locating the pump station and conveyance system, opportunities for regional detention facilities were considered as a means to reduce peak flows and downsize the necessary pumping and conveyance system requirements. This would save on construction costs.

Preliminary costing for pump station improvements showed that using detention storage to reduce the required pump capacity is cost effective if it results in reducing peak flows from about 210 cfs to 100 cfs, which is the gravity-flow capacity of the existing system. If the required system capacity is reduced to the capacity of the existing system, then construction of new pipelines will not be required, resulting in significant cost savings. If peak flows exceed 100 cfs, major pipe system improvements would be required between Riverside Drive and the Skagit River. Pipe system improvements are a major part of the estimated $1.6 million cost difference for a 210 cfs versus 100 cfs capacity system for Kulshan Creek, assuming the recommended Alternative 2 pump station configuration.

Because of the previously mentioned cost difference and flow capacities, regional detention facilities would be cost-effective relative to downstream conveyance improvements only if 100-year peak flows at the downstream end of the Kulshan Creek basin could be limited by detention facilities to 100 cfs for a

cost less than roughly $1.60 million dollars. 100-year peak flows at the downstream end of the Kulshan Creek basin under full development with on-site storage are estimated to be about 210 cfs. Of this amount, about 100 cfs originates east of the BNR railway tracks (sub-basins 5, 13, and 14). Another 90 cfs originates north and west of the railway tracks (sub-basins 6 and 7), and the remaining flow originates in the area west of Riverside Drive and south of Willow Lane (sub-basin 12). For regional detention to limit 100-year peak flows to 100 cfs, facilities would be required both east and west of the railway tracks or else sufficient hydraulic conveyance would need to be constructed under the tracks to equalize storage in both areas.

Two alternatives were evaluated to estimate the required storage volume to reduce the 100-year peak flow to 100 cfs. Under the first alternative, a hypothetical detention facility was modeled at the location which makes the most efficient use of the available storage. This ideal location is immediately downstream of the Kulshan Creek railway track crossing. It was found that about 30 acre-feet of storage between elevations 21.0 feet and 24.5 feet would keep 100-year peak flows to under 100 cfs. Unfortunately, 30 acre-feet of storage is not available at this location and land acquisition costs alone for this hypothetical facility, assuming 8 acres at $130,000 per acre, would exceed $1.0 million dollars. This alternative would not be acceptable relative to the larger pump station alternative because land acquisition is not possible given that this area is already developed. Given that this storage cannot realistically be provided at this preferred downstream location where the full basin flow could be intercepted, more than 30 acre-feet of storage would be required for alternative detention sites further upstream in the basin.

The locations of potential detention pond sites where land is available are shown on Figure 3.1. The site immediately west of the railroad marked as "vacant land" on Figure 3.1 in Appendix F is presently undeveloped, except for about five large power poles for a 55,000 Volt 3-phase transmission line (Puget Sound Power & Light Co. Easement No. 176764), and a sewer line (Easement No. 567033) as some of its easements. The property is about 1.5 acres in size.

The other potential detention site is on about 10 acres of land already owned by the City adjacent to Kulshan Creek as shown by Figure 3.1 in Appendix F. However, the land at this site has been tentatively classified as wetlands, which would make it very difficult to obtain the necessary permits to develop this area as a detention facility. The cost of a wetland development permit application would be in the order of $125,000. If approved, and there is no assurance of approval, there would likely be additional wetland mitigation costs of more than $0.50 per square foot of impacted wetland. Wetland mitigation costs for 10 acres would likely exceed $200,000. In addition to the wetland permitting and mitigation costs, additional costs would be required to provide fish passage since this would be an in-stream facility.

The maximum amount of detention storage which could realistically be developed at the two identified sites is about 7 acre-feet at the vacant land site west of the railway, and about 50 acre-feet at the city-owned site east of the railway along Kulshan Creek. Initial HSPF simulations found that if these sites were both fully developed for detention storage, and the drainage system in sub-basin 13 (see Figure III-5) were modified to directed all flows from this sub-basin to or above the 50 acre-foot pond, the frequency of downstream flood peaks exceeding 100 cfs would be reduced to about once every 50 to 100 years.

RS4 Nonstructural Solutions: The Kulshan Creek Basin is nearly built out so that implementation of nonstructural solutions such as strict onsite peak flow controls will not solve the existing flooding problems. The existing pump station is grossly undersized and the conveyance system must also be increased if this system is to provide 100-year protection. For these reasons, structural solutions will be necessary to solve this problem.

RS4 Recommendations

Nonstructural Recommendations: Developers should be required to provide on-site detention following accepted standards and guidelines to minimize further increases in flows in this basin.

Structural Recommendations: As discussed in the following paragraphs, the City should construct a 210-cfs pump station in the City-maintenance yard east of Interstate 5. Increase conveyance with the addition of a 72-inch-diameter gravity flow pipe from Riverside Drive to the new pump station, and a second 48-inch-diameter force main from the pump station to the outlet structure west of I-5. This work can be accomplished in two phases as discussed previously, and the City has obtained $724,500 in grant funds to offset the cost of constructing phase 1. Phase 2 would include the second 48-inch force main under I-5 and one 50-cfs pump. Phase 2 can be deferred beyond the 20-year planning period.

Phase 1 Cost	City Funds	=	$3,339,000
	Hazard Mitigation Grant	=	$ 724,500
	Total Phase I Design and Construction Cost	=	$4,063,500
Total Phase 2 Construction Cost (deferred past 20 years)		=	$ 672,000

The cost of constructing a 7-acre-foot detention facility west of the railway would be approximately $220,000. Land acquisition would be as much as $200,000 for a total cost of about $420,000. Construction costs are however uncertain because of lack of information on requirements to accommodate the existing utilities crossing the site.

The cost of constructing a 50-acre-foot detention facility in the city-owned property east of the railway would be in the order of $1,400,000, for a total cost

including $325,000 for permitting and wetland mitigation of about $1,725,000. Fisheries mitigation costs could increase the cost of this facility.

The total cost of providing regional detention facilities to limit peak flows in Kulshan Creek at Riverside Drive to 100 cfs for return periods of 50- to 100-years would therefore be at least $2.145 million, which is greater than the cost of increasing pump station system capacity from 100 to 210 cfs. Also, provision of regional detention is subject to considerably greater risk because of uncertainty about the ability to obtain necessary wetland permits.

e. Problem RS5 — Problems in Trumpeter Creek Basin from Increased Flows.

RS5 Problem Description: Increases in peak flows in the Trumpeter Creek basin due to future development will occur and will result in aggravating existing flooding, water quality, and fish habitat problems downstream.

RS5 Structural Solutions: Structural solutions for this problem consist of two opportunities for improved or new regional detention facilities in the Trumpeter Creek basin as described below.

(1) The existing detention pond in the northeast corner of Bakerview Park was assessed to maximize the performance of this facility. The existing pond has a capacity of about 2.4 acre feet. Water backs up into the pond via a 24-inch plastic pipe from a ditch which runs along the north side of the pond. Discharge from the pond is by the same 24-inch pipe. Backup of water into the pond is caused by an 18-inch berm in the bed of the ditch downstream from the 24-inch pipe through which passes a 12-inch plastic pipe with its invert at the ditch invert. Apparently there was no detailed design for the pond or its control structure. It is unlikely that the current design makes effective use of the available storage since much of the storage is filled at relatively low flows. Improved performance could be achieved by eliminating the pond intake from the ditch on the north side of the pond and replacing it with an intake from the channel flowing along the pond's east edge. This inlet would consist of a side channel weir to divert high flows into the pond. The outlet structure should be modified as well. This project was constructed as a part of the Park Meadows project.

Cost = $0

(2) Preliminary analyses were done for a new detention pond south of the new school on Martin Road along the north fork of Trumpeter Creek to determine the storage requirements to keep future flows to current levels at the confluence of the north fork and mainstem of Trumpeter Creek. There is potential for considerable new development in the area draining to the north fork of Trumpeter Creek. This system at present consists of a number of small drainage ditches which enter a 30-inch-diameter pipe system near North 32nd and Fox Hill St. The pipe system has a current capacity of

between 6 and 21 cfs with the lowest capacity corresponding to the most upstream section of line which has the flattest grade. A new 7.5-acre-foot detention pond would control peak flows, reducing the 100-year peak to 15 cfs. This solution would require that the most upstream section pipe in the drainage system be replaced so that the entire system has a capacity of 15 cfs or greater. The City currently owns a parcel of property along the north fork of Trumpeter Creek that was intended to be developed as a regional detention pond. Because this parcel was determined to be a wetland, the City was not able to receive the necessary permits to construct a detention pond. Developing a pond on the north fork would require that the City purchase additional property.

Cost = $500,000

RS5 Nonstructural Solution: Because of the high cost of property along the north fork of Trumpeter Creek, it would be better for the City to enforce the new detention standards as described in Appendix I.

RS5 Recommended Solutions: The Bakerview Pond improvements were constructed.

Enforce new development peak flow control detention standards in accordance with the ordinance contained in Appendix I. As discussed previously, these standards should be applied in the Kulshan Creek Basin as well.

f. Problem RS6 — Problems in Madox Creek Basin from Increased Flows.

RS6 Problem Description: A large portion of the Madox Creek Basin remains undeveloped. Based on the HSPF hydrologic modeling, 100-year peak flows in Madox Creek at Blackburn Road are expected to triple with future buildout in the basin and assuming no peak flow control facilities. In addition, Madox Creek downstream from Blackburn Road has experienced severe erosion problems that would be aggravated by any increase in peak flows from new development.

RS6 Structural Solutions: In order to control the increase in peak flows due to future development in the Madox Creek basin, peak flow controls must be constructed. A structural solution would be to increase regional detention. One of the largest (11.1 acre-feet) existing detention facilities was built as part of the Little Mountain Estates subdivision. Analysis of this detention facility shows that a relatively large amount of available storage is not being used effectively due to improperly sized inlet and outlet structures. Analysis shows that the current inlet structure is too small to divert more that a small percentage of the peak stream flows into the diversion structure. Similarly, the orifices in the outlet structure are too large to maximize use of the available storage. Considerable improvements in the effectiveness of this pond could be gained by reconstructing the intake structure and adjusting the orifice sizes in the outlet structure. Design details on modifications to this regional detention facility are given in

Appendix F. The effectiveness of these modifications on peak flows is shown on Table 5.1 in Appendix F. These improvements are scheduled to be constructed by a developer as a condition for our upstream project.

Cost = $0

RS6 Nonstructural Solutions: Given the relatively steep topography in the Madox Creek basin, it is difficult to site regional detention facilities which alone could prevent future peak flow increases to the eroding reach of Madox Creek below Blackburn Drive. If peak flows are to be controlled, an alternative would be to impose stringent on-site detention standards for new developments in those areas of the basin which discharge to Madox Creek below the Little Mountain Estates pond.

For the Madox Creek basin, we suggest that on-site detention be designed either using an HSPF approach or by the SCS-based hydrograph procedures as required by the draft drainage ordinance in Appendix I, and as described in the King County Surface Water Design Manual (revised November 1992). If the SCS procedures are used, the following particular requirements are suggested for the design of on-site detention facilities in the Madox Basin:

- Time of concentration calculations for existing land use conditions must include travel time for the longest realistic distance of sheet flow, computed by the formula presented on page 3.5.2-6 of the KCSWDM as Manning's kinematic solution.

- All Madox Creek basin soils in SCS group "D" should be treated as SCS group "C" soils for purposes of selecting SCS runoff curve numbers.

- The SCS runoff curve number (CN) for current conditions land use should be the lowest number which could reasonably be selected for the existing land use (see table on page 3.5.2-3 of the KCSWDM).

- On-site pond volumes and orifices should be initially sized to meet the detention standards stated in the draft drainage ordinance in Appendix H, and then pond volumes at each depth should be increased by 30 percent for a factor of safety. This factor of safety is necessary because calibrated continuous hydrologic modeling has shown that SCS procedures used to size detention facilities to the standards in Appendix H do not reduce post-developed peak flows to predeveloped flows.

RS6 Recommended Solutions: Construct modifications to Little Mountain Estates Pond. Also, strict onsite stormwater control detention standards should be implemented for the Madox Creek Basin as described previously.

g. Problem RS7 — Erosion of Madox Creek Downstream of Blackburn Road.

RS7 Problem Description: The erosion on Madox Creek and Flowers Creek below Blackburn Road will likely continue in the future causing bank failures and increased sediment accumulation downstream reducing the channel capacity.

Madox Creek

RS7 Structural Solutions: Further erosion of the steep section of Madox Creek could be minimized by construction of a pipeline to divert peak flows around the steep reach of the channel (see Appendix F, Figure 5.1). Approximately 4,500 feet of pipe would be required to transport water from an intake constructed just above Blackburn Road to an outlet returning flow to the main channel below Blodgett Road. Assuming that improvements are made as recommended to the Little Mountain Estates pond, the diversion system should be sized for a 100-year flow of about 56 cfs, this being the difference between the current 100-year peak flow at Blackburn Road and the projected 100-year peak flow after future development. The first 1,400 feet of pipe would be at a flat grade and would need to be about 60-inch-diameter (CMP) to minimize head losses. The remaining pipe would mostly be on a steep grade with a slope of 0.019 or more and would need to be about 42-inch-diameter (CMP) to avoid pressure buildups by keeping the pipe friction slope less than the ground slope. However, the high-flow bypass pipeline will serve only to limit erosion through the steep reach of Madox Creek; the effect of increased peak flows below Blodgett Road have not been assessed. The cost estimate of this alternative, includes inlet and outlet structures and five road crossings.

Cost = $688,000

Another structural alternative to solving the erosion problem in Madox Creek is to construct bio-engineered stream channel protection that will prevent further erosion. Bio-engineered channel protection uses a combination of vegetation, log structures, and rock to reinforce the existing banks and stream but still provide opportunities for fish habitat. Prior to constructing any channel protection, a detailed examination of the erosion potential and further geotechnical and geomorphic investigations should be performed to determine the likelihood and risk of continued erosion, and to recommend what type of remedial actions should be taken. The estimated cost of any instream channel protection depends on the results of additional investigations. For budget purposes, it is anticipated that a moderate combination of bed control weirs and bank protection will be required for approximately 400 feet of channel.

Cost = $44,000 for additional geotechnical and geomorphic investigations
Cost = $349,000 for construction of channel restoration improvements

Flowers Creek

A structural solution to the erosion problem along Flowers Creek can be solved by installing a high flow bypass. How this can be constructed in conjunction with a nearby development project is described in Appendix M.

Cost = $0, to be constructed by the developer

RS7 Nonstructural Solutions: Nonstructural solutions to help solve erosion problems in Madox Creek are the same nonstructural solutions proposed for Problem RS6. These are strict onsite detention for new development.

RS7 Recommended Solutions: Because of the higher cost of constructing a bypass pipeline for Madox Creek, additional geotechnical and geomorphic investigations should be performed and recommended channel stabilization projects should be constructed. For Flowers Creek, a bypass pipeline could be constructed as part of an adjacent development project. Also, enforce strict onsite detention requirements for new development that are described under Problem RS6.

h. Problem RS8 — Madox Creek and Drainage District 17 Maintenance Responsibility.

RS8 Problem Description: It is uncertain as to what portion of the sediment removal work at Blodgett Road and the maintenance and operation of the Conway Pump Station is the responsibility of the City of Mount Vernon. This work and this facility is located in Drainage District 17, but Mount Vernon contributes flow to this system.

RS8 Recommended Solution: The Madox Creek system within Drainage District 17 is very complex. It extends south of Conway for several miles prior to discharging to Skagit Bay via tide gates. Backwater from the tide gates could affect water surface elevations in the wide channel all the way upstream to the pump station at Conway. Runoff from the entire basin could cause water levels to rise and thus trigger operation of the Conway Pump Station. Determining how much of the pump station maintenance and operation is necessary because of the area in Mount Vernon contributing to the system is not readily apparent. Additional hydraulic analysis of the Madox Creek system is necessary to answer this question. Mount Vernon's share in the cost of this analysis has been included in the surface water program budget.

The cost to remove sediment at Blodgett Road is not significant, and the City and the District have agreed to share this cost.

Cost of Mount Vernon's Share in Analysis Work = $44,000

2. Local System Problems

Local system problems are those flooding and erosion problems that are tributary to major streams or drainage systems. These problems generally affect only a small, localized area and represent mostly citizen complaints or staff-identified problems. These types of existing problems cannot be solved by nonstructural solutions such as new development standards or other regulations. For this reason, only structural solutions are presented for these more localized problems.

a. Problem LS1 One alternative to prevent the floodwater from the Skagit River from backing up over Hoag Road west of La Venture Road would be to build approximately 700 feet of berm along the north side of Hoag Road to an elevation of 385 feet.

Cost = $224,000

A less expensive alternative is recommended. This would involve warning potentially affected residences during a flood, and sandbagging their homes.

b. Problem LS2 This area northwest of the intersection of Hoag Road and the Burlington Northern Railroad is lower than the surrounding areas that have been filled for the road to the south, the railroad to the east and the Skagit River levee to the north. Any new development in the area would likely be built at least as high as the roadway and therefore it would be difficult for any new drainage system to include a connection to drain this area. The property owner could install a small pump station to discharge into the storm drain system being constructed for the new development on the south side of Hoag Road at this location. This should be the individual property owners' responsibility.

c. Problem LS3 Flooding has occurred at the residence located west of La Venture Road where it turns east several blocks north of Hoag Road. This problem appears to have been solved. A concrete curb has been placed on the west side of La Venture Road above the affected property.

d. Problem LS4 Ponding occurs on a commercial site northeast of the College Way - Urban Avenue intersection. The loading bays on this site have been graded much lower than the surrounding grounds and they collect water. The surrounding undeveloped area is heavily grassed and appears to be slightly lower in elevation than the commercial site, and therefore could not contribute any appreciable runoff to the site. Any water collected on the site would be from runoff generated on the site itself. Therefore, any water collected is the result of site grading and drainage problems that are the responsibility of the private property owner.

e. Problem LS5 This problem was resolved as part of a City project that improved portions of Fir Street.

f. Problem LS6 The Kulshan Creek tributary north of Cedar Lane has eroded the stream channel down to a firm till layer. Since the till layer is hard and resistant to erosion, the stream bed is not expected to erode any further. However, the channel banks are steep and not yet completely stabilized. The steep banks will most likely slough to the angle of repose where they will then be stable. Since this is a short section of stream, only 100- to 150-feet-long, it is recommended that the banks be allowed to come to the angle of repose naturally. This will be less disruptive to the environment than manually regrading the bank slopes. It is also recommended that a small log structure be placed across the creek downstream from the culvert outlet. The weir structure would help to stabilize the stream bed at the pipe outlet and prevent undermining of the culvert and therefore, would protect the stability of the roadway embankment. The weir would also provide better fish access to the culvert.

Cost = $11,000

g. Problem LS7 Flow from an 18-inch pipe north of Viewmont Drive is causing erosion where it descends a fairly steep grade down to Kulshan Creek. It is recommended that the pipe be extended to Kulshan Creek. A manhole drop structure near Kulshan Creek should be installed to dissipate energy and to allow the pipe to enter Kulshan Creek at the same elevation as the stream bottom.

Cost = $48,000

h. Problem LS8 The flooding problem along the west side and north end of North 16th Street north of Florence Street is caused by an undersized culvert. The culvert should be replaced with approximately 200 feet of 24-inch-diameter pipe.

Cost = $29,000

i. Problem LS9 Flooding occurs in a trailer park east of North 30th Street and south of College Way as runoff overtops a ditch 1300 feet south of College Way and flows overland to Trumpeter Creek. The ditch was analyzed based on current survey information and appears to have adequate capacity to carry the 10-year storm event. However, the ditch is not large enough to provide any freeboard for the 10-year peak flow. It is recommended that when the sewer interceptor is constructed along the north side of the ditch that an additional 6 to 12 inches be added to the top of the berm to provide additional room for freeboard.

Flooding also occurs at the Park Village Trailer Park north of First Street. To solve this flooding problem, a two-stage low flow and high flow channel is recommended. The low flow channel would handle flows up to the two-year peak and the high flow channel would be excavated to the east to accommodate the 100-year flow event. To obtain a Hydraulic Project Approval from the Department of Fish and Wildlife, fish habitat improvements would be required such as in stream elements like boulders and logs and out-of-stream elements such as trees for shade.

Cost = $53,000

j. Problem LS10 The southeast fork of Trumpeter Creek east of Waugh Road and south of College Way has problems with erosion and deposition. Channel erosion and mass wasting upstream of the culverts crossing Seneca Drive and Kiowa Drive has caused large amounts of material to move downstream and plug the culverts. Downstream of the culverts the stream bed is being eroded. This has created a large drop between the culvert outlets and the stream bottom causing fish passage problems.

One alternative solution would be a combination of stream bed control weirs and an enhanced maintenance program. A series of stream bed control log weir structures downstream of the culverts would accomplish two objectives. First, the weirs would dissipate some of the energy in the stream and would eliminate any channel incision downstream of the culverts. Second, they would create a series of pools that would facilitate fish access to the culverts. Regular mining of sediment deposited upstream of the culverts by maintenance staff during periods when fish are not migrating could prevent the culverts from filling up with sediment.

Cost = $22,000

Another alternative solution is to replace the existing culverts under Seneca and Kiowa drives with large concrete box culverts. The culverts would be large enough so that there is enough open area to pass both the 10-year peak flow and also allow most of the material moving downstream to pass through rather than plugging the culverts. This would also minimize the scour that is occurring downstream from the culverts.

Cost = $131,000

Because of the lower construction cost, the construction of bed control weirs is recommended.

k. Problem LS11 A trashrack should be installed behind the house that is east of Nez Perce on the south side of Kiowa Drive. Upstream from the inlet behind this house there is a driveway culvert. A trashrack should be installed upstream from the driveway culvert to prevent sediment and debris from plugging the downstream inlet. The driveway culvert with the trashrack and the inlet behind the house to the north should be included in a maintenance program and checked and cleaned regularly.

Cost = $500

l. Problem LS12 The solution to localized flooding problems in West Mount Vernon could be resolved by replacing the 12-inch-diameter storm drain system along Memorial Highway with a 30-inch-diameter system. The current 12-inch-diameter system is the main storm drainage for West Mount Vernon and is

greatly undersized. This will increase the system's capacity and allow more flow to reach the pump station south of Wall Street and be pumped out into the Skagit River.

Cost = $557,000

m. Problem LS13 During periods of high water levels in the Skagit River, the ground water table in this portion of Mount Vernon is also high and reaches the ground surface in a low spot near the intersection of Wall Street and Garfield Street. Several homes are flooded as a result. To ensure that the water can drain once the Skagit recedes, catch basins should be placed in the low spots. Also, a notification system should be implemented. The residents in the areas should be notified when the Skagit River rises so they can move their belongings to higher levels. The only other alternative solution would be to demolish the affected houses and regrade the site to a higher elevation.

Cost = $14,000

n. Problem LS14 The flooding of the intersection of Cosgrove Street and Wall Street in West Mount Vernon is due to a lack of a drainage system at a low spot. The solution to this problem is to install a new inlet at the low spot and connect it to the storm drain on Wall Street north of Memorial Highway with a 12-inch-diameter pipeline.

Cost = $40,000

o. Problem LS15 Portions of the storm drain system north of Division Street along Stanford Drive, Streeter Place, North 21st Street and Fir Street west of LaVenture should be replaced due to insufficient capacity to carry a 10-year storm flow. Refer to Figure VII-1 and Table VII-3 for details of this solution.

Cost = $371,000

p. Problem LS16 There are two alternative solutions to control the channel incision between Mohawk Drive and Apache Drive east of Comanche Drive.

The first alternative is to install a rock lining in the stream between Mohawk Drive and Apache drive to protect the channel bed from further erosion.

Cost = $9,000

The second alternative solution is to install log structures across the channel to act as bed control weirs downstream of the culvert under Mohawk Drive. This would not only reduce the erosion in the stream bed, but would also facilitate upstream fish migration by creating a "ladder" with resting pools and access to the culvert under Mohawk Drive.

Cost = $11,000

It is recommended that the second alternative solution, the log weir structures, be implemented. Since the alternative solutions are fairly close in price, the second solution was chosen because constructing the log weir structures would provide better fish passage and habitat than lining the channel with rock.

q. Problem LS17 The flooding of the two homes on the north side of Comanche Drive east of 30th Street could be prevented by the implementation of one of two following alternative solutions.

The first alternative solution would be to construct a ditch on the north side of Comanche Drive (see Figure VII-2) and construct a 24-inch-diameter culvert across Comanche Drive from the ditch on the south side to the new ditch on the north side of the road. The upstream invert of the new culvert would be placed higher than the elevation of the bottom of the south ditch. This would allow the low flows to travel down the south ditch, as it currently does. But, during higher flows, some of the flow would spill into the new 24-inch pipe and then travel down the north ditch. The additional capacity provided by the north ditch would help contain high flows and transport them to the ditch system that is parallel to and 200 feet east of North 30th Street.

Cost = $14,000

The second alternative solution would be to install a 24-inch-diameter storm drain on the south side of Comanche Drive (see Figure VII-2 for details). The storm drain would begin upstream of the curve in Comanche Drive east of North 30th Street. The storm drain would follow Comanche Drive and then connect to the existing storm drain on North 30th Street. Sections of the storm drain on North 30th Street will also need to be upgraded to accommodate the additional flow from Comanche Drive.

Cost = $153,000

The first alternative solution is the recommended solution to this problem. Since either solution would solve the flooding problem adequately, the least cost solution is recommended.

r. Problem LS18 The 12-inch-diameter culvert under Shoshone Drive east of Sioux Drive should be replaced with 100 feet of 36-inch-diameter culvert.

Cost = $24,000

s. Problem LS19 Armored emergency overflow spillways should be constructed for the two detention ponds west of Waugh Road and north of Division Street. The armored spillways help ensure the stability of the embankment in case the control structure plugs or during an extreme event. The armoring may consist of gabions, heavy riprap or concrete lining. The spillways would channelize

overflow and allow it to reach the downstream system without jeopardizing the embankment. Also, encroachments into the detention pond easements by the local residents should not be allowed so that proper maintenance of the ponds is ensured.

Cost = $59,000

t. Problem LS20 There is a low area behind several homes on the west side of South 6th Street north of Blackburn Road that collects water. During certain storm events, runoff drains to this low spot and can accumulate to where it floods several homes. It is recommended that two catch basins be placed in the low spot and a new storm drain system be constructed north on Railroad Avenue to Lind Street and east to the fork of Madox Creek that runs along the west side of Interstate 5. This would allow the area to drain and help prevent any further flooding in the area.

Cost = $155,000

u. Problem LS21 The flooding on the west side of Riverside Drive in the vicinity of Willow Lane and Alder Lane should be somewhat alleviated by the storm drain that was recently installed along the east side of Interstate 5 in this area. Also, the Kulshan Creek pump station as described in the solution to Problem RS 4 should significantly reduce the chance of flooding in this area from Kulshan Creek.

v. Problem LS22 The flooding in the low-lying area northwest of the Riverside Drive-Fir Street intersection is due to the lack of a drainage system to convey runoff. A catch basin should be installed in the low spot and it should be connected to the storm drain system west of the railroad tracks from this intersection. The cost for installing this system is high because it involves tunneling or jacking a new pipe under the railroad track.

Cost = $100,000

w. Problem LS23 Flooding occurs along the east side of I-5 where Fir Street curves into Cameron Way. Several businesses are affected by the flooding. This flooding problem could be solved by installing a storm drain system along the east side of I-5 that connects a new system along Cameron Way to the existing storm drain system to the north that contains Kulshan Creek.

Cost = $73,000

x. Problem LS24 With construction of the recommended solution to regional system problem RS1, drainage will be provided to the area south of College Way west of Interstate 5.

y. Problem LS25 From the hydraulic analysis, portions of the pipe and ditch system between Blackburn Road and Britt Slough are under capacity and may cause

water to back up in the system and cause flooding during a 10-year storm event. The possibility of flooding could be reduced by replacing three of the pipes as indicated in Table VII-3 and Figure VII-3 with 30- to 36-inch-diameter concrete pipe.

Cost = $284,000

z. Problem LS26 From the hydraulic analysis, it was determined that portions of the storm drain system containing the North Fork of Trumpeter Creek along Fox Hill Street have insufficient capacity to pass the 10-year storm event. This may cause flow to back up flooding the streets and homes in the area. Since the recommended solution to regional solution RS5 was not to construct a regional detention facility, one of the two following alternatives for conveyance improvements can solve this problem.

The first alternative solution would be to replace the inadequate portions of the existing storm drain system. This would require that five sections of the storm drain system be replaced. See Figure VII-4 and Table VII-3 for the details of this solution.

Cost = $235,000

To solve the safety problem associated with the deep ditch west of 32nd will require placement of approximately 400 feet of 36-inch storm drain.

Cost = $66,000

The second alternative solution is to reroute flows from the portion of the subbasin north of Hoag Road. These flows would be directed into a new stormdrain system built as part of the extension of 30th Street from Hoag Road to College Way. The rerouted flows would travel south along the future 30th Street system to the existing system on College Way. The existing system on College Way flows east to where it discharges into Trumpeter Creek approximately 500 feet west of Waugh Road. By directing a portion or all of these flows away from the Fox Hill Street system, replacement of the portions of the system described under the first alternative might not be necessary. A hydraulic analysis was performed on the existing College Way system to determine if there is sufficient capacity to carry the additional flows rerouted down a future 30th Street stormdrain. The existing system on College Way is a 30-inch concrete stormdrain from west of 30th Street to east of 33rd Street. From this point east of 33rd Street, the College Way system is a 36-inch concrete stormdrain to where it discharges into Trumpeter Creek approximately 500 feet west of Waugh Road. Our hydraulic analysis indicates that the 30-inch portion of the College Way system has a capacity of approximately 40 cfs. The 36-inch portion has a capacity of 46 cfs. The 100-year return flow from the part of Subbasin 4 south of Hoag Road and west of 30th Street is 28 cfs. This means that 12 cfs can be directed to the College Way system from the area of the

subbasin north of Hoag Road and still not exceed the 40 cfs capacity of the College Way System.

The existing system on Fox Hill Street and the existing system on College Way can provide a 10-year level of protection if 12 cfs is diverted from the area north of Hoag Road into the new system on 30th Street. The 10-year return flow for the area north of Hoag Road is 14 cfs. The 10-year flow for the area south of Hoag Road, but east of 30th Street, is 13 cfs. This means that during a 10-year event, 27 cfs will be routed through the Fox Hill Street system. The capacity of all but one segment of the Fox Hill system is 16 cfs. If 12 cfs out of the 27 cfs is diverted into the new 30th Street system, the Fox Hill Street system can carry the remaining 15 cfs in a 10-year event. With the 12-cfs diversion, the College Way system can still provide a 100-year level of protection. If the City wishes to provide a 100-year level of protection for the Fox Hill Street system, we recommend that, in addition to diverting 12 cfs of flow from north of Hoag Road through the new system on 30th Street, the pipe replacements described in Figure VII-4 and Table VII-3 should also be constructed. It is assumed that since pipe Number 7 shown on Figure VII-4 only has a capacity of 6 cfs, this segment will need to be replaced to provide even a 10-year level of protection.

aa. Problem LS27 From the hydraulic analysis, part of the storm drain system that crosses under Interstate 5 at Anderson Road is determined to have insufficient capacity to pass a 100-year flow. Two pipe sections of this storm drain system were determined to have insufficient capacity. These include the pipe section on the east side of Interstate 5 parallel to the frontage road that is set at a reverse grade and the pipe section that crosses the frontage road. In order to correct this problem, the two inadequate sections of this system must be replaced and set at a positive grade. Details of this solution are presented in Figure VII-5 and Table VII-3.

Cost = $50,000

C. Water Quality Solutions

1. Introduction

The combination of the effects of urban and rural development on the quality of stormwater runoff and receiving waters results in a complex stormwater pollution prevention problem. For new development, water quality control facilities should be required because it is difficult to control the quality, volume, and rate of runoff once the areas are developed. Once pollutants are entrained in runoff, it is difficult to remove them before they reach receiving water bodies. Thus, the most effective approach to controlling water pollution attributable to existing developments is to implement source control best management practices (BMPs) for prevention of stormwater contamination. Source control BMPs are a variety of managerial, behavioral, and physical measures designed to prevent the release of pollutants and their entrainment into stormwater runoff. The following discussion of water

quality problem solutions relies heavily on source control BMPs, although some water quality problems necessarily require more elaborate structural solutions.

2. Urban Water Quality Problems

a. Problem WQ1 — Illicit Connections of Wastewater Discharges to the Storm Drainage System.

WQ1 Problem Description: There may be cross-connections between the sewer and storm drain systems. Such cross-connections are usually caused by direct pipe connections between the sanitary sewer and the publicly maintained storm drain.

WQ1 Structural Solutions: Generally, the solution to this problem is more appropriately addressed by nonstructural solutions to identify cross-connections. However, when cross-connections are located, structural measures to eliminate the illicit connection would be required.

WQ1 Nonstructural Solutions: The first step in controlling pollution problems due to illicit connections is identifying locations where illicit connections to the storm drainage system exist (for example, where shop floors, appliances, or wastewater flows discharge to the storm drainage system rather than the sanitary sewer system). These plumbing connections are often unknown to the property owner. The list of registered businesses attached to the task report in Appendix G should be used to develop an initial prioritized list of the businesses that could adversely impact receiving water quality if they have illicit connections to the storm drainage system.

A program of water quality monitoring, smoke testing, dye testing, and pipe video inspections of storm sewers should be used to identify potential entry points for cross-connections as well as other water quality problems. The City's pipe video system will be very helpful in this effort. The video system can be used to identify pipe connections, leaks, damaged pipe, and the source of inflows during dry conditions.

The recommended approach for this water quality and illicit connection program is as follows:

Step (1) Water Quality Monitoring: A monitoring program should be initiated to confirm cross-connections or any other water quality problems.

Water quality monitoring should be conducted at strategic locations in the storm drainage system to assist in determining subareas of the city that have abnormally high pollutant concentrations in runoff. The monitoring program should include three wet weather and three dry weather sampling events. Samples collected during each event should be tested for several pollutant parameters, including fecal coliform

bacteria and surfactants. The surfactants test is recommended because it will confirm that the source of contamination is a sanitary sewer cross-connection rather than some other fecal coliform contamination source (e.g., pet waste). Soaps and detergents, which are associated with sanitary sewage, will be indicated by a positive surfactants test.

Step (2) Smoke Testing, Die Testing and Pipe Video Inspections: After obtaining water quality data for specific systems that might indicate a problem, these tests are used to pinpoint cross-connection locations.

Step (3) Correct Cross-Connections: Cross-connections found that are part of the City maintained storm drainage system (in the right-of-way) can be corrected by City maintenance crews. Cross-connections that are part of private facilities are the responsibility of the private property owner, and the City will need to enforce corrective action.

Step (4) Additional Monitoring: Once it is believed that all cross-connections have been corrected for each of the systems determined to have a problem in Step 1, the City should conduct a follow-up monitoring program (similar to Step 1) for each system. This information can be used to evaluate whether all cross-connections have been corrected.

In addition, while the City is conducting this monitoring program, additional testing of outfall samples for other pollutant parameters is recommended.

WQ1 Recommendations: The City should conduct a monitoring and investigative program such as that described above (steps 1–4) for water quality parameters. The same protocol of six sampling events should be used. All major stream systems and outfalls should be sampled during each sampling effort. These pollutants include:

- Total petroleum hydrocarbons
- Suspended solids
- Nitrate plus Nitrite Nitrogen
- Total phosphorus
- pH
- Ammonia Nitrogen
- Temperature
- Lead
- Copper
- Zinc
- Dissolved oxygen
- Hardness

Sampling for these pollutants would provide additional information about the quality of water entering receiving waters and could be evaluated to determine the existence of other water quality problems in the City. This data could also be used as baseline information to evaluate the effectiveness of source control programs. It is recommended that the City conduct the monitoring program initially as a high priority and then a second time, a few years later, to determine

the effectiveness of source control programs. In addition, this sampling program should include some sediment sampling in the Kulshan Creek Basin as discussed under problem WQ9.

Cost Estimate:	$19,500 baseline monitoring (staff time and sample costs)
	$19,500 follow-up monitoring
TOTAL	$39,000

b. Problem WQ2 — Erosion, Transport, and Deposition of Sediments.

WQ2 Problem Description: Erosion within the study area results in increased sediment loading to surface waters. Sedimentation of these systems degrade receiving water quality and impact aquatic habitat. Two types of erosion commonly occur: stream channel erosion and erosion associated with land disturbance activities.

Structural solutions are appropriate for solving existing stream channel erosion problems, whereas nonstructural solutions such as regulations requiring BMPs for erosion and sedimentation control are appropriate for erosion associated with existing and future land clearing. Nonstructural solutions are also effective in areas where measures to prevent future flooding and stream channel erosion are appropriate.

WQ2 Structural Solutions: Structural solutions for stream channel erosion problems consist of channel armoring or controlling peak runoff rates and reducing velocities through the use of detention facilities, diversions, check dams, and infiltration. Properly sized sedimentation facilities, either alone or combined with a detention facility, can effectively remove sediment load from surface waters.

WQ2 Nonstructural Solutions: Nonstructural solutions for erosion due to land clearing include ordinances and regulations that require new development to provide onsite erosion control devices. The City has adopted erosion and sedimentation control standards that meet the minimum requirements in Ecology's *Stormwater Management Manual for the Puget Sound Basin.*

Prompt revegetation requirements for cleared areas are required by the new standards and will reduce sediment loads to the stream system. BMPs, including minimizing the amount of clearing conducted, avoiding exposing denuded areas to runoff by stabilizing these areas, and prompt revegetation or replacement with sod, plastic covering, or mulch would help reduce land related erosion.

Retaining or promoting development of vegetated buffers between developed areas and surface water systems is an important mechanism in preventing sediment laden water from reaching the stream. Sheet flow runoff that must travel through a vegetated area is filtered and sediments are removed.

Catch basin cleaning at regular intervals has been shown to be an effective sediment removal technique. By increasing the frequency of cleaning private catch basin systems, sediment loads to surface water are significantly decreased. Increased maintenance is discussed further under problem WQ3.

WQ2 Recommendations: Recommendations for structural solutions for specific erosion problems are presented under specific system problems and environmental resource problems. Recommendations for nonstructural solutions for erosion problems include:

(1) The City has adopted a new ordinance that meets the PSWQA minimum requirements contained in Ecology's *Stormwater Management Manual.* The City must accompany the new standards with a public education and enforcement program to achieve the objectives of the erosion control ordinance. The City should develop a program to inform and educate area contractors about the new erosion control requirements. It is suggested that the City develop this program jointly with Skagit County. A joint City and County effort would likely be more successful in attracting area contractors.

This education program can be one component of an overall public education program. The recommended overall education program is discussed later in this section.

(2) Increase the stream buffer requirements from the City's current standard described in Section 5. This is described in greater detail under the environmental resource problem solutions.

(3) Increase the frequency of catch basin cleaning from once a year to once every eight months. Increasing the frequency of catch basin cleaning is part of the recommended maintenance and operation plan, discussed in Section VIII. In addition, identify areas of potential high pollutant loading, such as streets that receive runoff from shopping center parking lots. Develop more frequent cleaning schedules for these areas, such as once every three months during the rainy season, or at least once every six months. The cost associated with catch basin cleaning is included in the annual maintenance and operation program costs.

c. Problem WQ3 — Contamination of Runoff by Diffuse Sources of Pollutants on the Land.

WQ3 Problem Description: Urban runoff from the City of Mount Vernon and surrounding area contributes to nonpoint source pollution in area streams and the Skagit River.

Existing problems associated with urban runoff will be addressed with both structural and nonstructural solutions as appropriate. Solutions for future urban

runoff problems caused by anticipated future development will be addressed by nonstructural solutions.

WQ3 Structural Solutions: Structural solutions used for improving runoff water quality from existing development often requires the use of subsurface structures such as oil/water separators and oversized catch basins. Site constraints can cause difficulty in locating above ground facilities in existing development areas. Catch basins in the existing storm drainage system should be outfitted with inverted elbow outflow restrictors that enable trapping of floatable materials and some oil/water separation. These devices can significantly reduce the suspended solids loading to receiving waters and can trap larger-sized oil droplets in runoff. Currently, few of the city's catch basins have the capability to trap floating material (Haehn 1993 personal communication). Key locations such as large parking lots, maintenance facilities, and gas stations should be targeted for installation of inverted elbow outflow restrictors in catch basins. Maintenance personnel generally agree that oil/water separators are effective if frequently maintained. Depending upon the rate of accumulation (which is greatest during the rainy season), oil/water separators may require cleaning as frequently as every three months.

Installing oversized catch basins will provide greater sediment trapping than a standard catch basin, thereby reducing pollutant loading to the receiving water.

In some areas with existing development, it might be possible to install above ground stormwater quality control facilities. These types of facilities include biofiltration swales, extended detention ponds, and wet ponds. These facilities are described further under the nonstructural solutions required for new development.

WQ3 Nonstructural Solutions: Nonstructural solutions can help solve urban runoff water quality problems for both existing and future development. The nonstructural solutions for water quality improvement include methods for source control, regulatory strategies, and maintenance practices.

(1) Source Controls

(a) Reduce and Properly Dispose of Household Hazardous Waste

Conscientious use of household cleaning products, water disposal, and do-it-yourself automobile change practices by residents, will reduce the risk of stormwater contamination. Vehicles and other equipment should be washed either under covered areas where the drain is connected to the sanitary sewer, on a lawn where wash water can infiltrate, or at a commercial washing establishment. Liquid chemicals, waste oils, solvents, paints, and other household hazardous materials should be stored indoors and disposed of as hazardous waste. If these types of materials must be stored outside, a lean-to roof or other

protective cover should be provided to keep them out of the rain. Care should be taken when changing automotive oil, and used oil should be brought to a gas station or proper disposal area. Skagit County Department of Public Works has begun a new program for collection of household hazardous waste materials. The County has opened a new Moderate Risk Waste Collection Center at the County's Resource Recovery Facility at 1200 Ovenell Road, Mount Vernon, Washington 98273. Information can be obtained by calling the facility at 424-7807.

(b) Eliminate Illegal Dumping of Waste

Residents should emphasize proper disposal of oil and liquid waste products as well as yard waste. Also, dumping of pet waste into roadside ditches should be avoided. Pet waste can contribute to bacteriological contamination of water resources.

(c) Minimize Exposure of Pollutants to Stormwater

Prevention measures undertaken by business owners that reduce the amount of waste materials that can come in contact with stormwater are the most effective ways of reducing stormwater pollution. It is much easier to keep pollutants out of stormwater than it is to remove them from contaminated stormwater ("an ounce of prevention is worth a pound of cure"). Measures include the proper storage of waste materials or other potential pollutants as an effective method of reducing stormwater pollution. Replacing aging, leaking, and otherwise ineffective outdoor waste containers (such as dumpsters and garbage cans) and ensuring that all containers have tight-fitting lids is also an effective method of controlling source pollution.

Reduction of impervious surfaces within the study area that are exposed to pollutants will reduce pollutant loading and improve stormwater quality. Viable impervious area limitation measures have been identified as: (1) development clustering; (2) porous pavement applications; (3) development conditions limiting impervious area; (4) subsurface parking or covered parking areas; and (5) downzoning to lower development density or intensity.

(d) Safely Use Pesticides and Herbicides

When businesses, groundskeepers, and residents emphasize conservative and correct use of herbicides and pesticides on gardens and lawns within urban areas, the potential for stormwater contamination by these products is reduced. Taking steps to limit over-application (and application preceding storm events) of fertilizers and/or pesticides used in landscaping activities can also reduce risks

associated with these products and improve water quality. Information on the use of integrated pest management (IPM) should be made available to these groups to reduce dependence on chemical fertilizers and pesticides.

(e) Implement Public Education Programs

Several different types of public education programs regarding stormwater pollution prevention have been undertaken by other jurisdictions to educate targeted groups such as businesses, the public, contractors, and special industries. Table VII-4 provides examples of public education programs initiated in the Puget Sound area. Information can be communicated to the public in the form of workshops, flyers, pamphlets, and public meetings. A wealth of information on implementing stormwater management public education programs is contained in Ecology's *Stormwater Program Guidance Manual for the Puget Sound Basin.*

Implementation of a public education program for specific groups such as business owners, residents, and contractors regarding the need to help control stormwater pollution is an important first step in stormwater pollution source control. Public assistance with simple pollution control measures can be implemented to help improve stormwater quality. Educate contractors regarding the importance of stormwater source control related to erosion and sedimentation control procedures. Prepare a plastic coated pocket sized pamphlet that presents information on erosion control measures and distribute it to the contractors. Public works maintenance and inspection staff should also be educated in these areas. Many of these types of educational materials have already been developed by other local governments or state and federal agencies. These materials could be obtained from them and used in Mount Vernon as well.

Abatement of this large-scale water quality problem depends upon many applicable BMPs that collectively can reduce the pollution of receiving waters. A public education program should be developed to inform businesses and residences about various BMPs they should implement. Educational efforts should distinguish between residential activities of concern and commercial/industrial activities of concern. The list of registered businesses at the end of the task report in Appendix G can be of assistance in tailoring the educational program for businesses to focus on prevalent business types and related activities.

Many BMPs, including stormwater treatment measures that can be used if source controls are not feasible, are potentially applicable to businesses and residences. King County has developed a

comprehensive BMP manual that outlines many of these additional measures. Additionally, Ecology's *Stormwater Management Manual for the Puget Sound Basin* contains BMP requirements for businesses in specific standard industrial codes (SIC). These manuals can serve as reference documents for further steps that can be taken to clean up nonpoint source discharges to streams in the study area.

Development of an outreach and education program on the importance of catch basin cleaning of private systems on a regular basis, and specific methods for cleaning the systems, would improve the success of implementing maintenance practices for private systems. These efforts should target commercial and industrial uses. Information could be distributed in the form of flyers, town meetings, newspaper articles, and workshops. Providing businesses with information and guidance on the importance of maintaining private catch basins would improve sedimentation problems within these systems. The City should also implement a new ordinance requiring maintenance of private systems. A model ordinance prepared by Ecology for this purpose is included in Appendix I.

The City could issue window stickers designating businesses as "environmentally friendly" (or something similar) if they actively implement and maintain pollution prevention BMPs. Other incentives to accomplish voluntary pollution prevention should be explored.

(2) Regulations and Ordinances

(a) Enforce New Development Standards Meeting PSWQA Minimum Requirements

In accordance with the *PSWQMP*, the City has adopted minimum requirements for water quality controls for new development. These standards will include erosion and sediment control requirements and runoff treatment BMPs.

(b) Adopt Regulations for Maintenance of Privately Owned Stormwater Control Facilities

As mentioned previously, maintenance of stormwater control facilities is important for improving water quality. Maintenance of privately owned facilities should be performed and encouraged by the City through public education. If education efforts fail, the City should have an ordinance that requires maintenance to be performed. A model ordinance developed by Ecology for this purpose is included in Appendix I.

(3) Maintenance

(a) Increase Frequency of Catch Basin Cleaning

Increased frequency of catch basin cleaning is needed along with the establishment of a list of priority catch basins. Catch basins should be prioritized for cleaning according to both the rate at which sediment accumulates in the trap and the degree to which land use in the upstream drainage area may contribute pollutants. The high priority catch basins to be cleaned most frequently should be those that accumulate the greatest sediment load and those that show signs of poor water quality. These catch basins may be located adjacent to areas used for automotive work, roadways following winter application of traction grit, and areas subject to new land clearing and development. Regular maintenance of catch basins is an effective means of reducing stormwater pollution because it reduces the amount of contaminants flushed into the storm drainage system. In areas known to generate high quantities of pollutants, catch basins may require increased maintenance especially during the rainy season.

A catch basin cleaning program should be developed that includes a schedule giving cleaning priority to those catch basins that are most frequently clogged with sediment and areas with the highest levels of stormwater pollutants. The schedule should provide for cleaning of the high priority sites as frequently as is necessary and the cleaning of the remaining catch basins a minimum of once every eight months.

(b) Improve Ditch Cleaning and Biofiltration Swale Maintenance Practices

The method and frequency of ditch maintenance should be conducted to improve water quality. Increased erosion and reduced filtration efficiency in drainage ditches due to maintenance practices can lead to increased stormwater pollution. Ditch maintenance should preserve vegetation lining to prevent erosion and to capture pollutants. Vegetation should only be disturbed when it is necessary to remove sediments in order to regain hydraulic capacity. When this type of ditch maintenance is required, it is best done so that some vegetative material remains to regenerate the vegetation lining. Reseeding or sodding of ditches should be performed as required to help prevent erosion.

(c) Maintain Detention Pond Vaults

Regular maintenance of detention ponds and vaults such as removal of sediment build-up will improve water quality and maintain the quantity control functions of the facility.

WQ3 Recommendations

Structural Recommendations

Two alternative structural measures were described above. They include the installation of oil/water separators at appropriate locations to reduce oils from entering area streams or the Skagit River, and the installation of enlarged catch basins/manholes where necessary to increase the volume of sediment and associated pollutants removed from the system. As part of the decision-making process over where it would be beneficial to install such facilities, it is recommended that the City perform monitoring investigations which would identify the severity of pollution from oil associated pollutants in these systems. A water quality monitoring program is recommended as a part of the solution to water quality problem WQ1 (sewer cross-connections). It is recommended that the City include tests for total petroleum hydrocarbons (to determine extent of contamination from oils) at each of the City major streams and outfalls when conducting the monitoring program as outlined under WQ1. If it is determined that a particular drainage area has a problem, the City should consider further investigations similar to the steps described under WQ1 solutions. These investigations may determine that installation of oil/water separators is appropriate at certain locations. For the purpose of cost estimates, it is assumed that 5 oil/water separators will be installed each year. Cost for the monitoring for this problem is included in WQ1.

Construction Cost = $16,350 per year

Installation of enlarged catch basins costs approximately $6,000 for a 72-inch manhole and $9,000 for a 96-inch manhole. Because of these high construction costs and because the increased frequency of catch basin cleaning can also reduce sediment entering the system at a lower cost, it is recommended that installation of enlarged catch basins be considered only if the increased frequency of catch basin cleaning does not adequately solve the problem. Under the catch basin cleaning program described above, the City will identify priority catch basins that need to be cleaned out more frequently than the standard eight months (e.g. every two months during the winter). If the more frequent cleaning does not solve the problem, source control measures should be pursued in the areas tributary to these catch basins. If these specific catch basins continue to be filled with sediment, it is recommended that these specific catch basins be replaced with oversized catch basins. In addition, water quality monitoring for suspended solids could be included in the monitoring program discussed under the solution for WQ1. This information would help identify sediment loads throughout the system and the associated need for source control measures, increased maintenance, and possibly enlarged catch basins. For the purpose of estimating costs, it is assumed that the increased frequency of catch basin cleaning and source control measures will solve the problem and that oversized catch basins will not be required. The cost associated with monitoring for suspended solids is included under water quality problem WQ1.

Nonstructural Recommendations

(1) Source Controls: Develop a public education program that encourages source control of stormwater pollution and includes the following objectives:

(a) Residents should reduce the use of household products that are harmful to the environment. When these products are used, they should be disposed of as hazardous waste at the County's new Moderate Risk Waste Collection Center.

(b) Eliminate illegal dumping of oils, liquid waste products, lawn clippings, pet waste and other pollution sources by the public and area businesses.

(c) Reduce stormwater exposure whenever and wherever possible through the use of recommended BMPs.

(d) Use pesticides and herbicides wisely and always follow application instructions. Also, whenever possible implement an Integrated Pest Management Plan (IPMP) rather than use chemical treatment.

(e) Implement public education programs such as those indicated in Table VII-4 and in Ecology's *Stormwater Program Guidance Manual for the Puget Sound Basin*, Volume 2. Develop an educational program that educates commercial and industrial business owners of proper catch basin cleaning. Information could be distributed in the form of flyers, town meetings, newspaper articles and workshops. This education program can be a component of an overall public education program. The recommended overall commitment to an effective education program will require at least 25 percent to 30 percent of the City's new stormwater manager's time.

(2) Regulations and Ordinances:

(a) Enforce new development standards meeting PSWQA minimum requirements.

(b) Adopt a new ordinance requiring maintenance of privately owned stormwater control facilities.

(3) Maintenance:

(a) Develop a catch basin cleaning program that (1) includes cleaning catch basins at a minimum frequency of once every eight months, and (2) develops a list of priority catch basins for more frequent cleaning.

(b) Educate City maintenance crews as to how to maintain ditches to leave a vegetative lining. It is recommended that the staff person responsible for this activity conduct interviews with other jurisdictions which have successfully implemented such practices. The Cities of Bellevue and Mountlake Terrace have historically focused on water quality and could provide valuable information.

(c) The recommended changes to current maintenance practices and associated costs are discussed in Section VIII — Maintenance and Operations.

d. Problem WQ4 — Spills of Solid and Liquid Materials.

WQ4 Problem Description: The potential for transportation-related and storage-related spills of hazardous materials causes concern for protection of groundwater and surface water resources. In addition, in cases where spilled material is not adequately cleaned up, pollution can act as long-term environmental contamination.

WQ4 Structural Solutions: Nonstructural and structural solutions are appropriate for addressing transportation-related spills whereas nonstructural solutions are more appropriate for storage-related spills. State highways and roadways are of greatest concern for transportation-related spills. Because of the risk of direct surface water contamination from spills of hazardous or toxic materials, implementation of roadway spill containment facilities at key intersections and other roadway areas of concern should be used to protect water resources. Generally, spill containment facilities consist of detention basins, oil/water separators, oil holding tanks, and high flow diversion systems. Other options for spill containment include oversized catch basins with overflow provisions designed for containing spills and an overflow device capable of separating floating material. All spill containment facilities should be constructed according to design standards adopted by the Federal Highway Administration (FHWA).

The City should perform a preliminary study to determine the need for spill containment facilities. The study should identify the areas of greatest concern, whether there is a problem, and whether corrective action is needed. The study should include the following:

(1) Traffic counts and historical accident counts on State Highways. The Department of Transportation will provide this information for a small fee.

(2) A summary of historical spills from City records, fire department records, Department of Transportation records, and Department of Ecology may also have records. Locations of these spills and proximity to resources should be noted.

(3) The ability of the Fire department to respond to a spill.

(4) An assessment as to the environmental damage that could result from a potential spill.

(5) The City should coordinate the study with the Department of Transportation.

WQ4 Nonstructural Solutions: Nonstructural solutions for handling transportation-related and storage-related spills include District Fire Department training and public education programs.

Spills of solid and liquid materials at businesses can be prevented or controlled in several ways. For certain types of businesses the state already has spill control requirements, for others an education program should be used to encourage spill control planning. Presently only businesses that work with chemicals listed as "extremely hazardous" by the EPA are required to prepare an emergency response plan (Bumgarner 1993 personal communication). There are many other chemicals and petroleum products of concern that are not on the EPA list.

State regulations require generators of "dangerous wastes" to obtain a Department of Ecology identification number if they generate more than 220 pounds of dangerous waste per month, or if they generate more than 2.2 pounds per month of wastes classified as "extremely hazardous." Ecology has several requirements related to waste storage, spill containment, and spill response for businesses that generate this much dangerous or extremely hazardous waste. Based on the list of registered businesses in the study area provided at the end of the task report in Appendix G, there should not be many businesses in Mount Vernon that fit the above category of dangerous waste generators. Ecology should already be communicating with these businesses.

Businesses that always generate less than 220 pounds of dangerous wastes or 2.2 pounds of extremely hazardous wastes per month, and that always dispose of the waste before it accumulates to these levels, are considered "small quantity generators" by state regulations. Small quantity generators (SQGs) are prevalent in all urbanized areas, and many of them are unaware of the state's regulations. Based on the types of registered businesses listed at the end of the task report in Appendix G and the limited ability of Ecology to identify and regulate SQGs, it is likely that several SQGs in the Mount Vernon urban service area are not following the state requirements. These requirements include characterizing wastes to determine if they are hazardous, properly packaging and labeling dangerous wastes, and disposing or recycling of dangerous wastes appropriately. As part of an overall education program for the Surface Water Management Plan, the city should inform potential businesses that might be SQGs of the state's dangerous waste regulations and work with Ecology to distribute appropriate educational materials that Ecology should already have available. Skagit County Department of Public Works has recently begun operation of a Moderate Risk Waste Collection Center. This collection center is currently collecting household hazardous waste as well as hazardous waste from SQGs.

It is likely that businesses that properly label, store, and dispose of dangerous wastes will be better prepared to prevent and control spills. Educational efforts for businesses of all types should encourage business owners and managers to implement spill control plans; educate employees about spill prevention, control, and reporting; and stock spill cleanup materials. Businesses in the automotive, printing, and manufacturing industries should especially be targeted for educational material on spill prevention and control because they have a greater likelihood of working with hazardous materials.

Similar educational efforts should be made for non-waste materials of concern, such as pesticides, paints, petroleum products, and a variety of solid and liquid chemicals. The Uniform Fire Code contains provisions for storing and working with reactive, ignitable, and flammable materials; the Mount Vernon Fire Department can enforce these provisions. As part of an overall pollution prevention education program for businesses, the City of Mount Vernon Engineering Department along with the Mount Vernon Fire Department, and the Skagit County Department of Emergency Management should work together to develop and distribute information on appropriate (and required) material handling storage, and spill control practices.

Fire Department Staff should be trained to address a hazardous or toxic spill within the City in a way that protects both human health and the environment. Clean up should include the use of methods that completely remove the material from the area, including contaminated soil. In addition, the fire department staff should be trained about the drainage system layout, including major storm drain system locations and discharges into the various creeks and the Skagit River. A copy of the drainage system maps should be available at the Fire Department. The Fire Department should also have emergency procedures for contacting affected agencies including the Department of Ecology, Department of Fisheries, and Department of Transportation.

A public education program that provides residents and business owners with information regarding who to contact in the event of a spill is an effective method of improving clean up time and protecting human health and the environment.

Nonstructural solutions for storage-related spills include a spill response program, training of the district Fire Department, and an inventory of industrial activities within the study area.

The development of a spill response program for large, but particularly for small, industrial and commercial business is a good first start in storage-related spill containment and control. Businesses to be targeted include gas stations, laundromats, Car washes, and automotive shops. The response program should provide information to the business owner or operator regarding who to contact in the event of spill and other important first steps to take immediately following

the spill. All spill containment systems put into place will require effective response in the event of a spill.

The fire department should be trained to handle storage-related spills of hazardous or toxic materials. Training should include knowledge of the location and operation of spill containment facilities and other clean up procedures depending on the type of spill.

An inventory of all industrial activities within the study area has been conducted, and is included at the end of the task report in Appendix G. These facilities have been classified according to their standard industrial classification (SIC) code. Those facilities with SIC codes of concern that are in close proximity to water resources should be made a priority for spill prevention and containment facilities and programs. In addition, information on these sites should be available to the fire department and routine monitoring and inspection of these facilities should be performed.

WQ4 Recommendations:

(1) The City should conduct a study to identify the need for spill containment facilities to prevent spills from entering area streams and the Skagit River. The contents of the study were described above under structural solutions. This work should be accomplished by the new City stormwater manager who will be hired to administer the City's stormwater program.

(2) A City staff person should be assigned to develop information on how to handle transportation and storage related spills. It is suggest that this staff person interview the City of Renton Maintenance Department regarding the program Renton has developed for emergency spill response. The City of Renton has one of the most extensive emergency spill response programs in Washington. This staff person should then educate the fire department on appropriate methods and procedures. The staff person should also provide the fire department with all the necessary information on the City's storm drain system layout and the major outfalls to area streams and the Skagit River. This work should be accomplished by the new City stormwater manager who will be hired to administer the City's stormwater program.

(3) Develop a public education program to inform individuals of what to do in the event of a spill such as to report spills immediately using the 911 telephone number. This could be one component of the City's overall public education program that is budgeted for under a separate task.

(4) The City should develop a comprehensive information network to facilitate communication between the public, city staff, agencies and fire department spill clean up personnel in the event of a spill. Also, the City should develop a spill response program for the study area. The City should interview cities with successful programs such as the City of Renton to

develop the contents of the plan. This work will be accomplished by the City's new stormwater manager as well.

(5) Conduct an inventory of industrial facilities that store hazardous materials and keep their drainage system maps on file at the City and Fire Department. Those facilities with SIC codes of concern that are in close proximity to water resource should be made a priority for spill prevention and containment facilities and programs. In addition, information on these sites should be available to the fire department and routine monitoring and inspection of these facilities should be performed. Again, these types of nonstructural solutions will be coordinated by the City's stormwater manager.

e. Problem WQ5 — Illegal Dumping into the Storm Drainage System.

WQ5 Problem Description: Illegal dumping of material such as oil, antifreeze, vegetation and pet waste into the storm drain system has resulted in increased pollution of stormwater within the study area. Such dumping is often done due to ignorance of the harmful effects to water quality and the environment.

WQ5 Structural Solutions: This problem is best addressed by non-structural measures (e.g. public education).

WQ5 Nonstructural Solutions: An education program on the impacts of improper disposal of waste material on storm and surface water quality would provide guidance to the public regarding practices to improve water quality. Information could be provided in the form of public notices, outreach to targeted business by City staff, public events, flyers, and newspaper articles. Also, development of an area where individuals can safely, easily, and legally dispose of waste material such as motor oil, yard waste, and household chemicals would reduce the probability of these materials being dumped illegally. Information on Skagit County's household hazardous waste program was described under the solutions for Problem WQ3. Increased enforcement and the establishment of fines is also an effective deterrent for illicit dumping. A section of the new drainage ordinance in Appendix I defines illicit discharges to the storm drain system and establishes this as an illegal activity and describes penalties. Local citizens should be encouraged to report any illicit dumping actions. Increased patrolling of areas typically used for dumping will also help to reduce these actions.

Storm drains should have warning signs stenciled or posted near them with wording such as "dump no waste; drains to stream." Some storm drains in the city currently are stenciled in this manner, but many more are not. This simple measure can prevent much of the illegal dumping that occurs due to ignorance of the downstream effects. Other municipalities have had success stenciling warning signs near a large number of storm drains by means of educational or volunteer projects involving school students, Boy Scouts, church groups, etc. Mount Vernon should impose fines on individuals who illegally dispose of

materials in drainage ditches, street drains, and other drainage system features. Citizens should be educated about the problems illegal dumping can cause and the associated penalties.

WQ5 Recommendations:

(1) Educational programs should be developed to inform the public of the impact to stormwater quality associated with illicit dumping of waste. This public education component and associated cost shall an element of the recommended overall public education program.

(2) The City should adopt the drainage ordinance and strictly enforce it to deter illegal dumping. Along with a public education element, this will reduce the potential for stormwater contamination associated with illegal waste disposal. Local citizens should be encouraged to report any illicit dumping to further help prevent these actions.

3. Rural Water Quality Problems

a. Problem WQ6 — Failure of Septic Systems. Since nearly all the existing septic systems in the study area are between the existing City corporate boundary and the urban growth boundary, the City should establish a policy of requiring sewer construction for new areas to be annexed to the City.

b. Problem WQ7 — Erosion of Pasture Land, and WQ8 — Loading Animal Wastes Directly to Surface Waters.

WQ7 and WQ8 Problem Description: Livestock farms are contributing to fecal coliform bacteria contamination and erosion and sedimentation within the study area. Another common problem associated with agricultural activities includes overgrazing by livestock which leads to land erosion within the study area.

WQ7 and WQ8 Structural Solutions: These problems are best addressed by nonstructural measures such as regulations and public education.

WQ7 and WQ8 Nonstructural Solutions:

Maintaining vegetation, and ground cover on grazed lands, croplands, and stream banks in the watershed will further protect the stream bank and preserve water quality. Vegetation helps to stabilize soil thereby decreasing soil erosion potential.

Maintaining vegetation on stream banks plays an important role in filtering pollutants from farm runoff. Maintenance of vegetated ground cover slows the velocity of runoff enabling more biofiltration to occur which reduces the potential for contamination by runoff that reaches the Creek. Vegetation filters out

pollutants in runoff and reduces the amount of soil particles that become suspended in runoff thus diminishing the erosion process.

Several steps can be taken to limit erosion of farm lands used for livestock grazing, including limiting livestock density in grazing areas, rotating grazing pastures with the help of temporary fencing to maintain grass cover, and fencing off steep slopes to prevent livestock access to these erosion-prone areas.

The city should work with the Skagit Conservation District, the Washington State University/Skagit County Cooperative Extension, and the U.S. Department of Agriculture Cooperative Extension to develop an educational program and a set of BMPs for pastures within the study area. Commercial farms are likely to be getting information on pasture management BMPs from the above agencies. Therefore, educational efforts should target hobby farms. Examples of erosion control BMPs for pastures include the following:

- Preventing animal grazing access to steep slopes
- Reducing the density of animals on a given pasture size
- Rotating grazing areas with temporary fencing or other means to prevent overgrazing in any one area of the pasture
- Maintaining vegetated buffers between pastures and drainage paths
- Preventing animal access to stream banks and drainage ditches to prevent trampling of the banks.

Providing education to farmers regarding BMPs for farming practices may help to reduce fecal coliform bacteria contamination and bank erosion throughout the study area. BMPs should focus on those discussed below.

Restricting animal access to area creeks will reduce stream contamination and bank erosion. Installing sturdy fences along the banks of area creeks where livestock are kept will restrict direct access to the creek. In addition, fencing off drainage ditches and other significant tributary drainage paths that feed into the Creek is another effective measure for controlling source pollution. Fences can help in two ways; 1) animals are not able to defecate in the stream, thereby reducing the potential for fecal coliform bacteria contamination, and 2) trampling of the stream banks can be avoided thereby reducing the potential for bank erosion. Provision of a watering trough or pond away from the creek can also help to keep a particular farm's livestock out of the creek and off of its banks.

Other important BMPs limit contamination of farm runoff by manure and fertilizers. These include covering manure piles to protect them from precipitation, spreading manure in grazing pastures to avoid concentrated pollution source areas, applying fertilizers after a period of light rain (such that

the soil is not saturated) and dry weather is expected, avoiding over-application of fertilizers and ensuring that fertilizers are worked into the soil when applied rather than simply dumped on the soil surface.

Erosion and runoff pollution can be further prevented by implementing source controls that limit contact between potential pollutants and stormwater. This will reduce the quantity of contaminated water that drains off of farms in the watershed. If possible, gutters and downspouts should be provided for all buildings and the runoff from these buildings should be routed away from animal confinement areas and/or manure piles.

The city should work with the Skagit Conservation District, the Washington State University/Skagit County Cooperative Extension, and the U.S. Department of Agriculture Cooperative Extension to develop an educational program and a set of BMPs aimed at limiting the amount of livestock waste that reaches receiving waters. Again, larger farms are probably getting this information already. Therefore, smaller commercial farms and hobby farms should be targeted for the educational outreach.

The simplest preventive measure is to fence off stream banks and drainage ditches so that livestock do not have direct access to them. Other BMPs that can reduce the problem of high fecal coliform concentrations in runoff include rotating grazing areas so that accumulations of manure do not develop, and maintaining vegetated buffers between grazing areas and drainage paths.

WQ7 and WQ8 Recommendations:

(1) The City should improve water quality by requiring the use of fences to keep farm animals out of area streams. The effort to install fences within the City should include a public education program for farm owners, development of an ordinance requiring the use of fences, and the possible development of assistance programs such as low interest loans for farmers to lessen the cost of fence installation. Methods of waste and pasture management should be established to reduce erosion and fecal coliform bacteria contamination from farms within the study area. Again, these efforts will be coordinated by the City's surface water manager.

2) The City should coordinate with area farmers to maintain riparian vegetation that will improve filtration of pollutants and reduce erosion thereby improving water quality. The City should prepare a public education program to inform farmers of the importance of riparian vegetation for water quality protection. As before, these efforts will be coordinated by the City's surface water manager.

4. Specific Water Quality Problems

a. Problem WQ9 — Sewage Overflows in Kulshan Creek Basin. A new sewer interceptor will be constructed in the spring and summer of 1996, which will eliminate future sanitary sewer overflows within the Kulshan Creek basin.

b. Problem WQ10 — Contaminated Sediments in Kulshan Creek. The problem of total petroleum hydrocarbon (TPH) contaminated sediments in Kulshan Creek may result from one or more specific sources that have yet to be identified, or from urban development in the basin in general. The city should collect additional sediment samples as part of the sampling program discussed under Problem WQ1 at various points in Kulshan Creek to determine if the TPH contamination problem can be traced to a localized area. More information should also be collected on the extent of soil contamination at the former fuel oil storage and distribution site on College Way near the railroad crossing. Leaching of contaminants from the soils on this site may be a major cause of the sediment contamination problem in Kulshan Creek. If the primary problem appears to be urban development in general, then educational efforts should be stepped up to convince businesses and residences within the drainage basin to implement many of the BMPs described in this report. In addition, if general urban runoff is found to be the problem, coalescing plate oil/water separators should be considered for installation in the larger parking lots of the basin as discussed under the solutions to Problem WQ3.

5. Future Water Quality Problems

a. Problem WQ11 — Future Water Quality Problems.

The first step the City should take to implement stormwater pollution control measures is to enforce the new drainage ordinance that meets the minimum requirements set forth in Ecology's *Stormwater Management Manual for the Puget Sound Basin*. The City should also educate residents and businesses in the study area about simple source control BMPs that can be used to reduce or prevent stormwater contamination. The City should encourage local schools to incorporate stormwater pollution prevention issues into environmental education programs.

Streams in the study area should also be monitored periodically, as discussed under Problem WQ1, to determine whether water quality improvements are being made. Where persistent problems are found, educational and enforcement efforts can be targeted at the sources.

D. Environmental Resource Solutions

1. Wetlands

a. Problems WT1, WT2, WT3, WT4, and WT5 — At-risk Wetlands.

To preserve "at risk" wetland areas described in Section VI that are threatened by encroachment of development, the following solutions have been developed. Since preservation of wetland areas is primarily a regulatory issue, these solutions are nonstructural by nature.

Public Information. As part of the City's overall public information/education program, land owners, and others may be assisted in understanding which types of land may be wetlands, and in recognizing the important functions and values which the wetlands provide to society and the environment.

A public information/education program should be combined with other public education program elements for water quality. For example, information regarding wetlands recognition, value, and regulation may be disseminated via mailing brochures, at demonstrations and question-and-answer sessions at public meetings, on posters displayed at public buildings, and through educational programs incorporated into primary, secondary, and post-secondary curricula.

Numerous pamphlets and brochures, many written for the non-scientific public, which describe wetlands and discuss their unique value, are available from public agencies such as the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, and the Washington Department of Ecology. Some organizations have prepared videos which present such information. Of course, the wetlands inventory maps compiled in support of the City of Mount Vernon Surface Water Management Plan should be included in the list of available information. Wetlands experts, such as those from public agencies, private consulting firms, and conservation organizations, are often available to speak at public information meetings. Further, several organizations have or are developing wetlands educational materials which may be incorporated into formal education at nearly any level.

Critical Areas Ordinance Revision. Other solutions may be accomplished by revising the CAO. For example, a revised CAO might contain a wetlands rating system based on wetland functional value. There are several wetlands ratings paradigms, but the most common models used in Washington are either a three- or four-tiered rating system. The three-tiered system was perhaps pioneered by King County and was adopted by many of the local governments which drafted wetlands management ordinances prior to being forced to do so by the state Growth Management Act (GMA). The primary criteria for establishing a wetlands' rating under this system are wetland size, the number of wetland habitats available within the wetland, and the presence or absence of sensitive or rare plant or animal species. Assigning a rating to a wetland under this system

is a relatively easy task since few criteria must be quantified. Since the GMA, many jurisdictions have adopted wetlands ordinances which are based on the Model Wetlands Protection Ordinance prepared by the Washington Department of Ecology. These ordinances rely on a four-tiered system. Instead of relying on a few easily quantified criteria, this model uses a four-page rating form which requires that numerous questions be answered. Points are awarded for a wetlands' having certain physical attributes. In many cases, wetlands ratings are then determined by the number of points assigned to a wetland as a result of completing the data form.

Under both systems, wetlands protection varies as a function of wetland rating. For example, higher value wetlands are often protected by larger buffers. Further, the compensatory mitigation requirements for higher value wetlands are typically greater than for lower value wetlands. This in turn provides some disincentive for developers to impact high-value wetlands. For example, if a developer has a choice of impacting a low-and high-value wetland, and he knows that mitigation for impacts to the higher value wetland will cost more money, will require additional permit review time, or will necessitate setting aside a larger amount of land for compensatory purposes, then in most instances the developer will choose to avoid impacts to these wetlands.

b. Problems WT6, WT7, WT8, and WT9 — Wetlands Protection and Economic Growth.

All of the above solutions address case-by-case wetlands protection problems. This subsection presents two programmatic solutions which address a coordinated approach towards achieving both wetlands protection and economic growth goals. The first of these programs is known as "wetlands mitigation banking," and the second is known as a "Special Areas Management Plan," or "SAMP."

Wetlands Mitigation Banking. Wetlands mitigation banks involve the off-site creation, restoration, and/or enhancement of wetlands to compensate for unavoidable adverse impacts associated with development activities. The concept of mitigation banking was developed in the early 1980's as a mechanism to compensate for unavoidable habitat losses primarily associated with the federal Section 10 (Rivers and Harbors Act) and Section 404 (Clean Water Act) permit programs for wetland development projects (Short, 1988). The Washington Department of Ecology recently published a guidance document, Wetlands Mitigation Banking (Castelle et al., 1992b) which discusses many mitigation banking issues from agency, developer, and environmental viewpoints. A copy of this document is included in the task report in Appendix A.

Mitigation banking differs from most compensatory mitigation projects in that mitigation banking is a program created by agencies or other organizations to provide a relatively large compensatory mitigation site (or sites) to be used to collectively compensate for many, usually unrelated, development projects. This

contrasts with more traditional compensatory mitigation measures which typically involve individual projects implemented by developers (Castelle et al., 1992b). In addition, most wetlands mitigation banking programs are established so that the compensation is accomplished prior to the wetlands impacts. This is one means of assuring that the compensatory measures will be successful and that there will be no net loss of wetlands.

An advantage of mitigation banking is that this type of program may reduce the cost of mitigation, thus allowing large, otherwise cost-prohibitive, mitigation projects to be completed (Borsch, 1987). Another advantage may be that large mitigation projects like those typical of mitigation banks are more useful than several small project in various locations. Arguably, larger mitigation projects provide more habitat, are easier to create, and prevent cumulative impacts (for example, habitat fragmentation) associated with many small, scattered mitigation projects (Castelle et al., 1992b).

However, mitigation banking programs also have several potential disadvantages. For example, there are relatively large up-front costs for establishing a mitigation bank. While these costs are sometimes borne by private groups, on other occasions public agencies must provide the "up-front" money. Further, these costs may never be recovered if the bank does not become fully utilized or utilized in a timely fashion. There are also ecological concerns about mitigation banking. For example, the same problems which have contributed to low success rates for individual compensation projects in many locations will also exist for mitigation bank sites. Lastly, widespread use of mitigation banks may be perceived, especially by conservation groups, to be a "wetlands give-away," wherein the normal mitigation process of first attempting to avoid and minimize wetlands impacts will be by-passed.

In Mount Vernon, mitigation bank sites might be established in one or several of the many large meadows which cover a significant portion of the city within the Urban Growth Boundary. In particular, meadows which fail to meet the mandatory criteria for wetlands identification only because they lack wetland plants may be useful. In these fields, wetland hydrology and wetland soil conditions are often present or can be established at low cost and with a high probability of success. Unfortunately, many of the areas which are best suited for banking sites are also well suited for development. However, with proper coordination, the city could achieve no net loss of wetlands while providing both large, high-value wetlands and sustained economic growth potential.

Lastly, consideration of a mitigation banking program for the city should include regulatory implications. For example, although the city may choose to promote, and perhaps to fund, the use of mitigation banking, all other pertinent wetlands permits must be obtained by each project proponent on a case-by-case basis. Despite the availability of using mitigation banks, any of the other agencies which may have permitting authority of wetlands impacts may decide against the use of the mitigation banking program. Unfortunately, project

proponents may not be able to determine if their projects may be included in the banking program until after substantial resources are expended.

A recent strategy developed to help avoid the permitting uncertainties of a typical mitigation banking program is a SAMP; the following section summarizes this potential programmatic solution.

Special Areas Management Plans. Special Areas Management Plans, or SAMPs, like mitigation banking, represent a more global approach to managing wetlands resources and balancing natural resources protection with economic growth than a case-by-case approach. Unlike wetlands mitigation banking, however, SAMPs are designed to provide wetlands permitting on a "one-stop shopping" basis.

This is accomplished by generating an agreement, signed by all affected regulatory and resource agencies, as well as affected tribes and, in some instances, conservation groups. As a result of a SAMP, a local public agency, in this instance the Mount Vernon city government, would receive a "regional" permit. This permit transfers all permitting responsibilities from agencies such as the U.S. Army Corps of Engineers and the Washington Department of Ecology to the local agency. From that point forward, project proponents need only to secure a permit from the city, instead of having to approach each agency in turn.

The potential ecological advantages and disadvantages of SAMPs are essentially identical to those for mitigation banking. While larger, better planned wetlands may be created or restored, many conservation groups are concerned that the full mitigation process may be short-circuited.

Another advantage of a SAMP is the significant time savings for project proponents. Further, most SAMPs identify both the wetlands which may be impacted as part of the program and appropriate mitigation sites. The SAMP might also identify certain wetlands which are not included in the plan; those wetlands, typically the most highly valued wetlands, would still be subject to the standard permitting process. Therefore, a significant amount of both ecologically and economically sound planning is completed prior to the first wetland impact. Some SAMPs have incorporated a mitigation banking strategy.

Another disadvantage of SAMPs, however, is the relatively long time required for all agencies and other affected parties to reach an agreement. For example, a SAMP is being developed in the Auburn-Kent area of King County. Like Mount Vernon, these cities have large areas marked by low- to moderate-value wetlands, primarily wet meadows. The SAMP development process in that area has already taken in excess of four years, and only now the process seems as if an agreement may be reached. Until the Auburn-Kent SAMP is completed, it may be difficult to estimate the resources necessary to complete a SAMP in Mount Vernon.

c. Wetlands Recommendations.

Public information programs concerning the value of wetlands should be incorporated into the overall public education program and any costs will be incurred by that program.

The City could review its Critical Areas Ordinance in the future and evaluate its effectiveness, and consider the need to develop a rating system accompanied by associated buffer sizes.

Whether the City should sponsor a programmatic solution such as mitigation banking or a SAMP for managing wetlands, is a policy decision that should be made by City staff and elected officials.

2. Fish Habitat

A number of fish habitat problems were identified in Section VI that involve either fish passage problems or fish habitat problems. These problem solutions require physical changes to the existing environment and, therefore, are best handled through the use of structural solutions. Implementing nonstructural solutions such as new development standards will help preserve fish habitat in areas to be developed in the future. Nonstructural solutions to regulate new development were described in the water quality solutions section.

a. Problem E1 A pump station on Kulshan Creek above the outlet to the Skagit River presents a nearly total barrier to fish passage. Passage is only obtainable when flow from Kulshan Creek is sufficient to open a flap gate, and the Skagit River is high enough to create a take-off pool below the gate, but not high enough to force the gate shut. The problem with the flap gate can be solved by construction of the new pump station described under the solution to regional system problem RS4 which would eliminate the flap gate and replace it with a mechanically operated gate that will only close during high river levels. Allowing for fish access to the system will be solved by installing a vertical fishway. The cost of the fishway is included under RS4.

Cost= $0, included under solution for RS4

b. Problem E2 An existing manhole in the section of Kulshan Creek located east of the railroad collects debris and creates a partial fish passage barrier. There are two solutions to this problem. The first alternative is to increase the frequency of maintenance at the manhole. The second alternative is to remove the manhole. Removal of the manhole is recommended since there is no purpose for the structure in the middle of Kulshan Creek.

Cost = $2,000

c. Problem E3 A culvert in an unnamed tributary to Kulshan Creek north of Cedar Lane creates a partial fish passage barrier due to a one-foot drop at the outlet. One alternative solution to this problem is to replace the existing 24-inch-diameter culvert with a 36-inch diameter culvert.

Cost = $17,000

Another alternative solution is to install a series of two log weir structures at the outlet of the culvert that would create take-off pools downstream that would facilitate fish passage into the culvert.

Cost = $11,000

Installation of the log weir structure is the recommended solution because it is less expensive.

d. Problem E4 Approximately 2,200 feet of Kulshan Creek upstream of Riverside Drive to about North 18th Street lacks riparian vegetation as well as pools and riffles that would provide good stream habitat. Instream logs, root wads or other strategically placed devices should be added to this section of Kulshan Creek to create pools and riffles within the channel. Also, native riparian vegetation should be planted such as willow, red osier dogwood, and salmonberry. Utilizing volunteers and/or local schools will reduce costs. Constructing these habitat restoration projects can be phased, with only certain sections of the creek being restored in any given year.

Total Cost = $104,000 or $10,400 every other year over a 20-year period

e. Problem E5 There is a lack of riparian vegetation as well as pools and riffles to provide good stream habitat along Trumpeter Creek from its confluence with the Nookachamps Creek to 2,700 feet upstream, and in portions of the mainstem from College Way to Fir Street. All of this amounts to approximately 7,000 feet of stream channel. The solution to this problem would be the same as in Problem E4. Instream logs, root wads or other strategically placed devices should be added to these sections of stream to create pools and riffles within the channel. Also, native riparian vegetation should be planted such as willow, red osier dogwood, and salmonberry. Utilizing volunteers and/or local schools will reduce costs. Constructing these habitat restoration projects can be phased, with only certain sections of the creek being restored in any given year.

Total Cost = $327,000 or $32,700 every other year for 20 years

f. Problem E6 The culvert along the South Fork of Trumpeter Creek at Seneca Drive plugs up with debris which causes fish passage problems. Downstream there is a large drop between the culvert outlet and the stream channel. To correct the debris problem, the frequency of normal maintenance of this culvert should be increased. Maintenance costs are included in the cost of the stormwater maintenance program discussed in Section VIII. To correct the fish

passage problem the log weirs proposed under the solution to local system problem LS10 provide the solution.

g. Problem E7 The culvert along the Southeast Fork of Trumpeter Creek at Kiowa Drive presents a partial barrier to fish migration due to the one-foot drop at the culvert outlet. This problem would also be solved by implementing the recommended solution to Problem LS10.

h. Problem E8 The culvert along the Southeast Fork of Trumpeter Creek at Lupine Street is blocked and presents a barrier to fish passage. This problem could be resolved by increasing the frequency of maintenance at the culvert.

i. Problem E9 A culvert at Fir Street on the east side of Bakerview Park presents a partial fish passage barrier on the Southwest Fork of Trumpeter Creek due to a one-foot drop at the culvert outlet. No action is recommended for this problem. Providing fish passage at this location would be unproductive because the creek immediately upstream of this pipe is completely enclosed in a pipe system and would not be suitable fish habitat.

j. Problem E10 The 210-foot-long culvert on Madox Creek 1,200 feet above Anderson Road is too long to allow fish passage. This culvert should be removed and the stream channel restored.

Cost = $40,000

k. Problem E11 The culvert on Madox Creek at Blackburn Road is a nearly total fish passage barrier due to a two-foot drop at the culvert outlet. Two alternative solutions could solve this problem. The first solution is to replace the culvert.

Cost = $33,000

The second solution is to install a series of log weir structures to create a series of pools downstream of the culvert that would raise the water surface level at the culvert outlet minimizing the distance fish would have to jump to enter the culvert.

Cost = $11,000

Installation of the log weir structures is the recommended solution because it would be less expensive.

l. Problem E12 The outfall pipe at the lower detention pond on Madox Creek south of Section Street and east of Little Mountain Estates is plugged and creates a total fish passage barrier. Two alternative solutions could solve this problem. The first solution is to replace the plugged culvert.

Cost = $19,000

The second solution is to clean out and maintain the existing culvert. This maintenance is included in the normal maintenance program. The second alternative solution is recommended.

m. Problem E13 The section of Flowers Creek between its confluence with Maddox Creek and Blodgett Road lacks riparian vegetation. Plant streamside vegetation of native species such as willow, red osier dogwood, and salmonberry. Cost is based on planting 1,500 feet of stream.

Cost = $38,000

n. Problem E14 The culvert along Flowers Creek at Blodgett Road presents a partial fish barrier at low flows due to a one-foot drop in elevation between the culvert outlet and the streambed. Again, two alternative solutions could solve this problem. The first solution would be to replace the culvert.

Cost = $19,000

The second solution is to install a series of log weir structures to create a series of pools downstream of the culvert that would raise the water surface level at the culvert outlet minimizing the distance fish would have to jump to enter the culvert.

Cost = $11,000

Installation of the log weir structures is the recommended solution because it would be less expensive.

o. Problem E15 The lower portion of Carpenter Creek along Bacon Road lacks pools and riffles that provide instream habitat as well as riparian vegetation on one bank. Instream logs, root wads or other strategically placed devices should be added to this section of stream to create pools and riffles within the channel. Also, native riparian vegetation should be planted such as willow, red osier dogwood, and salmonberry. Utilizing volunteers and/or local schools will reduce costs.

Cost = $21,000

TABLE VII-1

STRUCTURAL STORMWATER CONTROL SOLUTIONS

Typical Structural Solutions	Reduce Flooding	Reduce Channel Erosion	Improve Water Quality
Detention Facilities			
Ponds with Vegetation	✓	✓	✓
Closed Systems	✓	✓	
Detention/Sedimentation	✓	✓	✓
Infiltration	✓	✓	✓
Pipe Systems/Structures	✓		
Grass Swales		✓	✓
Stormwater Diversions	✓	✓	
Oil/Water Separators			✓
Check Dams		✓	✓
Channel Stabilization		✓	

TABLE VII-2

NONSTRUCTURAL STORMWATER SOLUTIONS

Typical Structural Solutions	Reduce Flooding	Reduce Channel Erosion	Improve Water Quality
Public Education	✓		✓
Improved Drainage Facility Maintenance	✓	✓	✓
Maintain Stream Vegetation and Natural Wetlands	✓	✓	
Regulation Enforcement		✓	✓
Ordinances (Clearing, Grading, Site Drainage Plan Requirements, and Maintenance)	✓	✓	✓
Revegetation		✓	✓
Coordination with Adjacent Jurisdictions	✓	✓	✓

TABLE VII-3

RESULTS OF HYDRAULIC ANALYSIS FOR VARIOUS PIPE SYSTEMS CITY OF MOUNT VERNON

Pipe System along Stanford between Division and Fir Streets LS15				
Pipe No.	**Capacity (cfs)**	**10-Year Flow (cfs)**	**Existing Diameter**	**Required Diameter**
1	2.13	32.15	18 CMP	36 CP
2	2.79	32.15	18 CMP	36 CP
3	6.92	32.15	18 CMP	36 CP
4	9.99	32.15	18 CMP	24 HDPE
5	5.57	32.15	15 CMP	24 HDPE
6	5.00	32.15	15 CMP	24 HDPE
7	5.93	32.15	15 CMP	24 HDPE
8	5.76	32.15	15 CMP	24 HDPE
9	5.80	32.15	15 CMP	24 HDPE
10	5.58	32.15	15 CMP	24 HDPE
11	22.66	42.90	24 CMP	24 HDPE[1]
12	19.37	42.90	24 CMP	24 HDPE[1]
13	12.38	42.90	24 CMP	30 HDPE
14	32.41	42.90	24 CMP/CP	24 HDPE[1]
15	45.72	42.90	24 CP	OK
16	20.35	42.90	21 CP	30 CP
17	16.72	42.90	18 CP	30 CP
Culvert and Ditch System between Britt Slough and Blackburn Road near Walter Street LS25				
Pipe No.	**Capacity (cfs)**	**10-Year Flow (cfs)**	**Existing Diameter**	**Required Diameter**
1	16.16	22.40	36 CMP	36 CP
2	5.71	22.40	21 CP	36 CP
3	129.75	22.40	Ditch	OK
4	19.79	22.40	36 CMP	30 CP
5	20.44	22.40	36 CMP	30 CP
Pipe System along Fox Hill Street LS26				
Pipe No.	**Capacity (cfs)**	**10-Year Flow (cfs)**	**Existing Diameter**	**Required Diameter**
1	59.2	41.50	42 CMP	OK
2	111.13	41.50	48 CMP	OK
3	16.63	41.50	30 CMP	36 CP
4	15.39	41.50	30 CMP	36 CP
5	16.63	41.50	30 CMP	36 CP
6	21.08	41.50	30 CMP	36 CP
7	6.07	41.50	30 CMP	36 CP
Pipe System under I-5 South of Blackburn LS27				
Pipe No.	**Capacity (cfs)**	**10-Year Flow (cfs)**	**Existing Diameter**	**Required Diameter**
1	11.11	11.00	30 CMP	OK
2	0.00[2]	13.18	30 CMP	24 HDPE[1]
3	7.37	13.18	30 CMP	30 CP[1]

NOTES: CP — Concrete Pipe
CMP — Corrugated Metal Pipe
HDPE — Smooth-lined Corrugated HDPE Pipe

[1] Smoother pipe material will accommodate additional flow.

[2] Existing pipe set at reverse grade.

PUBLIC EDUCATION PROGRAMS

General

Clean Water Community (Steilacoom)
- Purpose: Educate community in water quality issues
- Methods:
  1) Development of a "Puget Sound Promoter" theme with various activities to encourage participation
  2) Water quality presentations in schools
  3) Student monitoring of local waters
  4) County declaration of Puget Sound Promoter Week
  5) Distribution and collection of pledge cards endorsing water quality

Clean Water Action Committee (North Mason Community)
- Purpose: Build community support for the addition of the water quality element to the Mason County Comprehensive Plan
- Methods:
  1) Brochures to increase awareness
  2) Developing water quality element of comprehensive plan based upon community recommendations
  3) Increase general awareness about water quality using information gathering technique called "sondeo"

Water in Whatcom County
- Purpose: Broaden community involvement in watershed issues
- Methods:
  1) Developing educational materials
  2) Establishing network for disseminating information
  3) Promoting watershed related events

Opportunities for Public Involvement
- Purpose: Increase public awareness of importance of watershed in involving citizens in developing watershed plans
- Methods:
  1) Public awareness meetings
  2) Training for citizen advisory committees
  3) Involvement of boy scouts in cleaning up stormwater detention ponds
  4) Establishment of an Adopt-a-Wetlands program

Puget Sound Project
- Purpose: Give educators a program focusing on the science an social issues that will determine the future of Puget Sound and to use that program as a basis for public outreach
- Methods:
  1) Developing curricula on Puget Sound for elementary, middle, junior, and senior high students

Public Service Announcements for Radio
- Purpose: Increase public awareness of water quality issues and positive steps listeners may follow to improve water quality
- Methods:
  1) Development of 18 - 30 second public service announcements

Rainy Days Festival: The Problem of Stormwater Runoff (Federal Way)
- Purpose: Inform residents of the damaging effect of stormwater runoff on Puget Sound and about remedies to correct the problem
- Method:
  1) Junior high school science students developing a video tape and fact sheet

School Stormwater Education Project (Roosevelt)
- Purpose: Increase household and small business awareness about how their activities affect stormwater runoff and what they can do to reduce pollution
- Method:
  1) A year long curriculum for students including classroom, field, and community activities

Household Hazardous Waste

Household Hazardous Waste Collection
- Purpose: To give households a safe way to dispose of hazardous waste
- Method:
  1) Collection events (e.g., 3 per year)
  2) Public notice (advertising) events, flyers, newspaper, etc.

C.A.R. (change and Recycle) Oil Committee
- Purpose: Encourage proper disposal of oil for the do-it-yourself oil changer
- Methods:
  1) Establishment of Committee consisting of representatives of auto supply stores and related businesses
  2) Video to help train staff at these stores to encourage oil recycling when they sell oil
  3) Brochure explaining consequences of improper disposal and identifying locations for proper disposal

Hazard Free Community
- Purpose: Decrease household use of hazardous materials and increase knowledge of alternative materials
- Methods:
  1) Get households and businesses to sign Hazard Free Community Pledges
  2) Recruit and train 50 community volunteers to be actively involved in the project
  3) Distribute information to all students in area

Oil Recycling Project
- Purpose: Increase proper disposal of oil by do-it-yourself auto oil changers
- Methods:
  1) Bring together high school students enrolled in science, vocational marketing, and graphics to market a product (the Gott Drain Tainer) which makes it easy for car owners to properly dispose of oil

Wetlands

Wetlands Awareness (for Mercer Slough)
- Purpose: Involve community in protecting wetlands (Mercer Slough)
- Methods:
  1) Development of interpretive trail and canoe tour
  2) Wetland clean-up day
  3) Stream and wildlife enhancement projects
  4) Training of park naturalist in water quality issues
  5) Environmental studies by Bellevue Community College students

Wetlands Public Education Program (San Juan Islands)
- Purpose: To demonstrate the value of wetlands
- Methods:
  1) Coordination with planning department
  2) Contacting wetland owners to inform them of protective measures
  3) Booth at fair emphasizing value of wetlands

Water Resources Poster
- Purpose: Increase a community's awareness of its largest wetland and other resources
- Method:
  1) Inventory of Wetland and Creeks
  2) Design of poster (map, text, and photos)
  3) Evaluation survey
  4) Distribution of survey and poster

Small Businesses

Waste Information Network

Purpose: To reduce amount of hazardous waste produced and/or improperly disposed of by small businesses

Method:
1) Gain support/assistance from trade associations
2) Staging a waste information network trade fair
3) Informational brochures on waste disposal

Waste Management for Auto Shops

Purpose: To show people in auto shops what to do with hazardous waste

Method:
1) Workshops/trade fair on waste disposal
2) Hazardous waste turn-in day at local treatment facility
3) Poster campaign aimed a auto shop employees

Team Consultations for Small Businesses

Purpose: Increase pollution prevention from small businesses

Methods:
1) Formation and training of industry/agency consultation teams to address pollution control faced by small businesses
2) Team Consultations conducted for small business requesting consultation
3) Development of a resource guide containing compliance expectations, pollution prevention suggestions, and listing resource contacts.

Hazardous Waste Management Assistance

Purpose: Inform area dry cleaners of proper pollution control

Methods:
1) One on one consultations with dry cleaner operators informing them of costs associated with improper disposal and of the benefits of proper disposal

Painting Contractor Education

Purpose: Inform paint contractors of proper disposal and waste reduction

Methods:
1) Brochure, posture, and live telephone information shall be used to communicate information
2) Information shall be disseminated through local paint suppliers

Water Quality Monitoring

Water Quality Monitoring Project

Purpose: Train students to perform scientific investigation of water quality in Green River that will be used by regulatory bodies

Methods:
1) Selecting teachers to devote class time to technical training
2) Using college science students to teach testing techniques

Volunteer Monitoring Program (Stilliguamish River)

Purpose: Involve diverse groups of citizens in collecting baseline data on water quality

Methods:
1) Designating 13 sites for sampling over 7 month period
2) Recruiting, training, and coordinating students, trout fisherman, tribal members, and environmentalist in water quality monitoring techniques and related issues

Construction/Erosion Practices

Water Quality and Construction Practices

Purpose: Encourage contractors to understand construction related impacts to water quality

Method:
1) Bring together contractors and discuss problems/solutions (seminars)
2) Distributing information to contractors
3) Compile regulations which apply to contractors

Streams

Stream Enhancement Newsletter

Purpose: To communicate the details of successful stream enhancement projects

Methods:
1) Publication of a quarterly newsletter

Stream Team Program (City of Bellevue)

Purpose: Involve people in caring for their neighborhood stream and to provide data on those streams to regulatory agencies

Methods:
1) Creating stream teams for specific areas
2) Workshops training volunteers to observe, gather data, and enhance streams
3) Public information campaign, city mailings, local media, and presentations to community groups

Blackjack Creek Brochure

Purpose: Increase awareness of the value of Blackjack Creek which was one of the few remaining salmon spawning stream in the City of Port Orchard

Methods:
1) Development/distribution of information brochure
2) Boy scouts stencilling storm drains to discourage dumping of oil

Miscellaneous

Horse Waste and Land Management Education

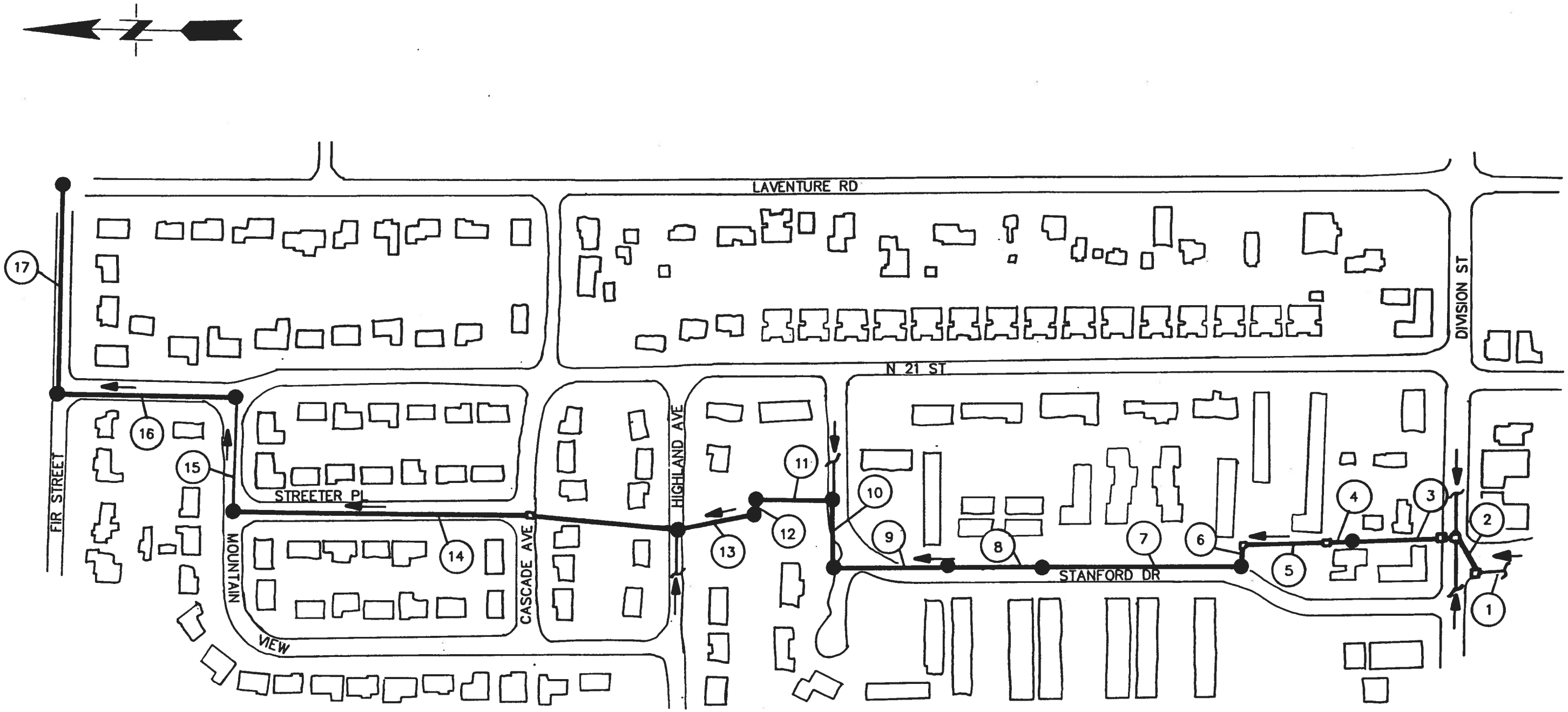
Purpose: Teach horse owners methods of waste and pasture management

Method:
1) Producing/distributing information about environmentally responsible methods for keeping horses

SOUND Gardening, SOUND Farming

Purpose: Educate gardeners and small farmers about the effects of their activities on water quality

Methods:
1) Developing instructional materials to be used in the ongoing Master Gardener and Seattle Food Gardener programs
2) Training and sending volunteers to educate proper gardening practices
3) Conference on better farming practices
4) Newsletter on water quality tips for farmers



KEY

- PIPE TO BE REPLACED
- EXISTING PIPE TO REMAIN
- DITCH / STREAM
- MANHOLES
- CATCH BASINS
- (3) PIPE REPLACEMENT REFERENCE NUMBER, SEE TABLE VII-1

FIGURE VII-1
CITY OF MOUNT VERNON
SURFACE WATER MANAGEMENT PLAN
PROBLEM LS15 SOLUTION

RW BECK

JM. H:\MAA07\MAA07001 9-27-93 @ 08:52

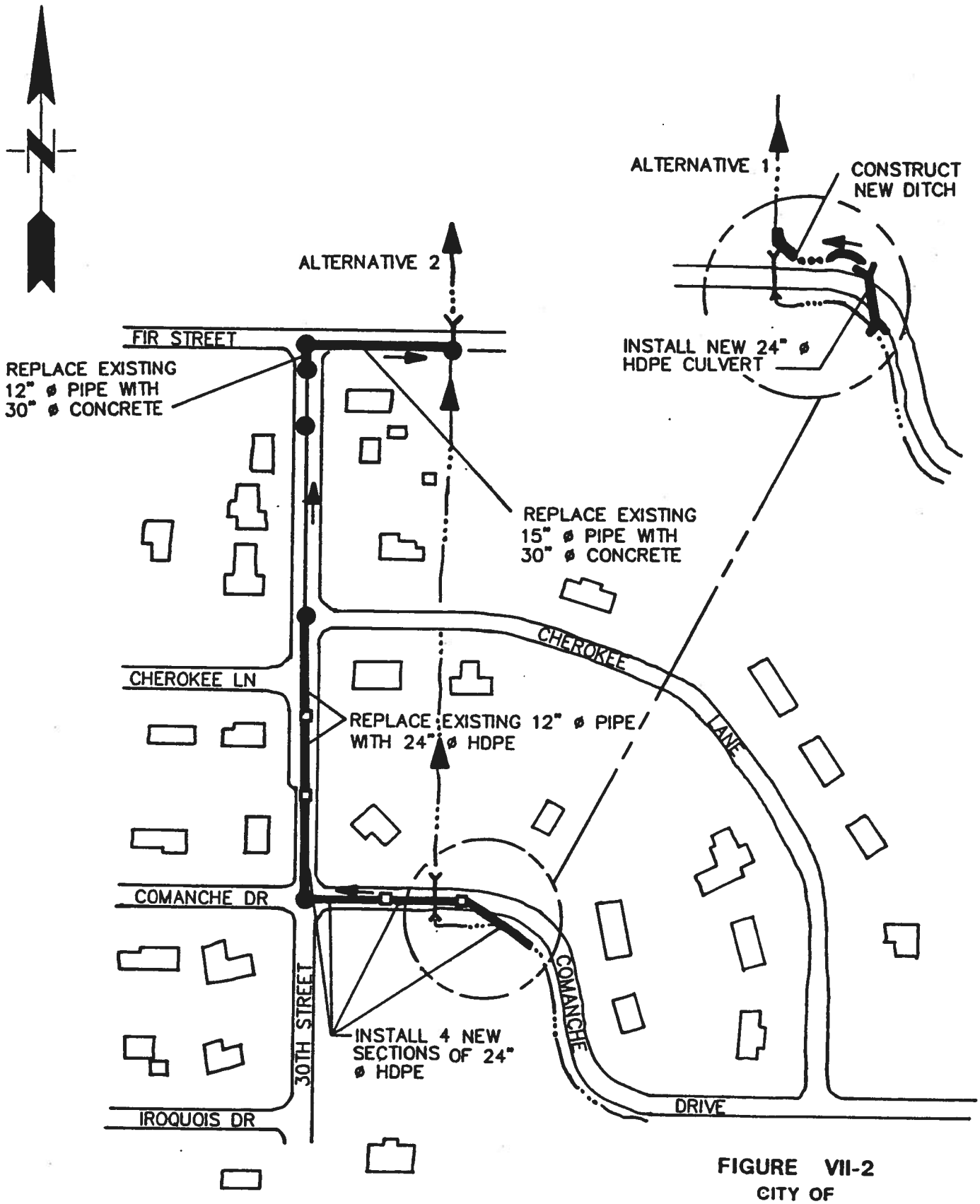


FIGURE VII-2

CITY OF MOUNT VERNON

SURFACE WATER MANAGEMENT PLAN

PROBLEM LS17 SOLUTION

RW BECK

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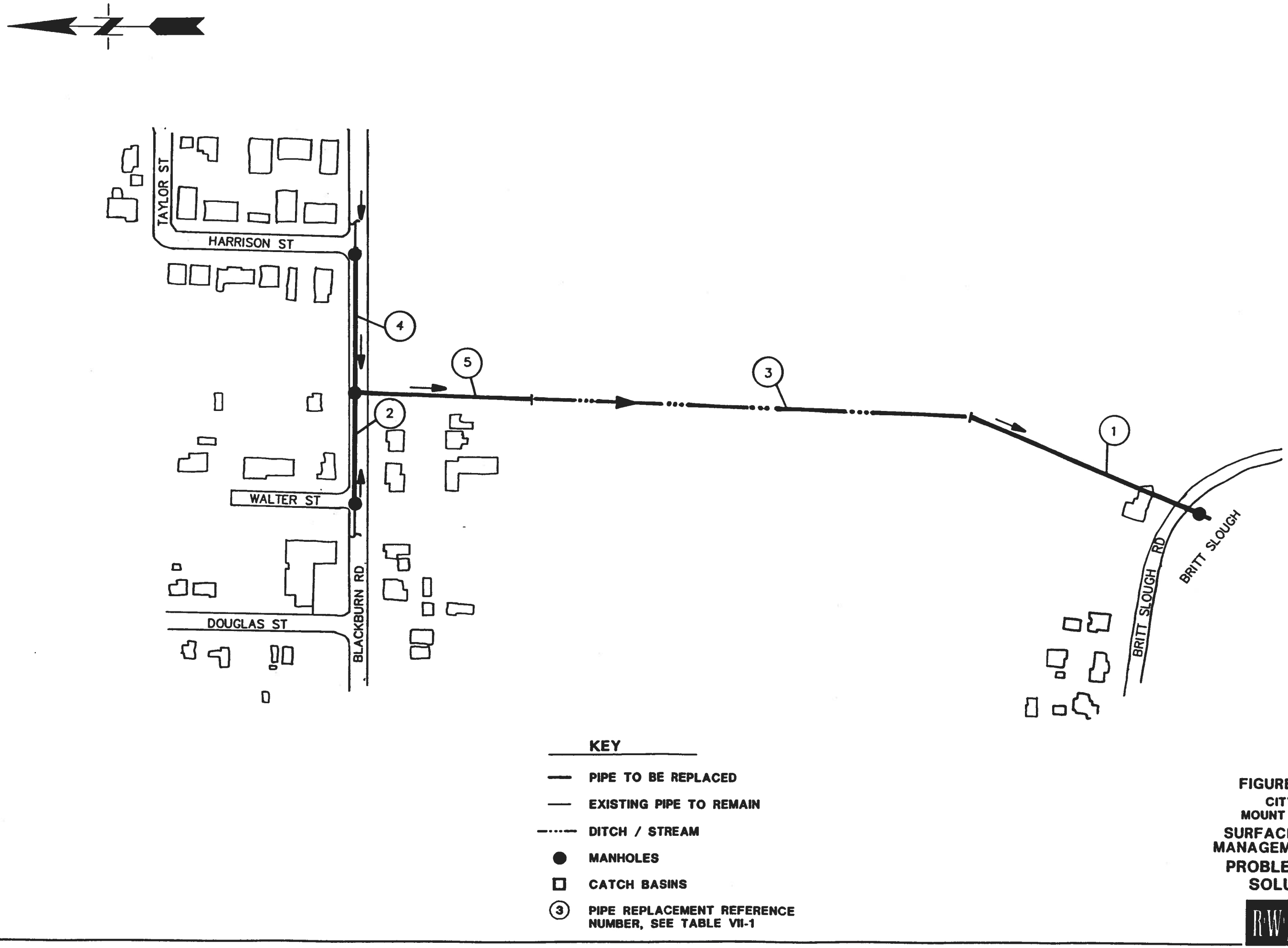

KEY

- PIPE TO BE REPLACED
- EXISTING PIPE TO REMAIN
- DITCH / STREAM
- MANHOLES
- CATCH BASINS
- (3) PIPE REPLACEMENT REFERENCE NUMBER, SEE TABLE VII-1

FIGURE VII-3
CITY OF MOUNT VERNON
SURFACE WATER MANAGEMENT PLAN
PROBLEM LS25 SOLUTION

R·W BECK

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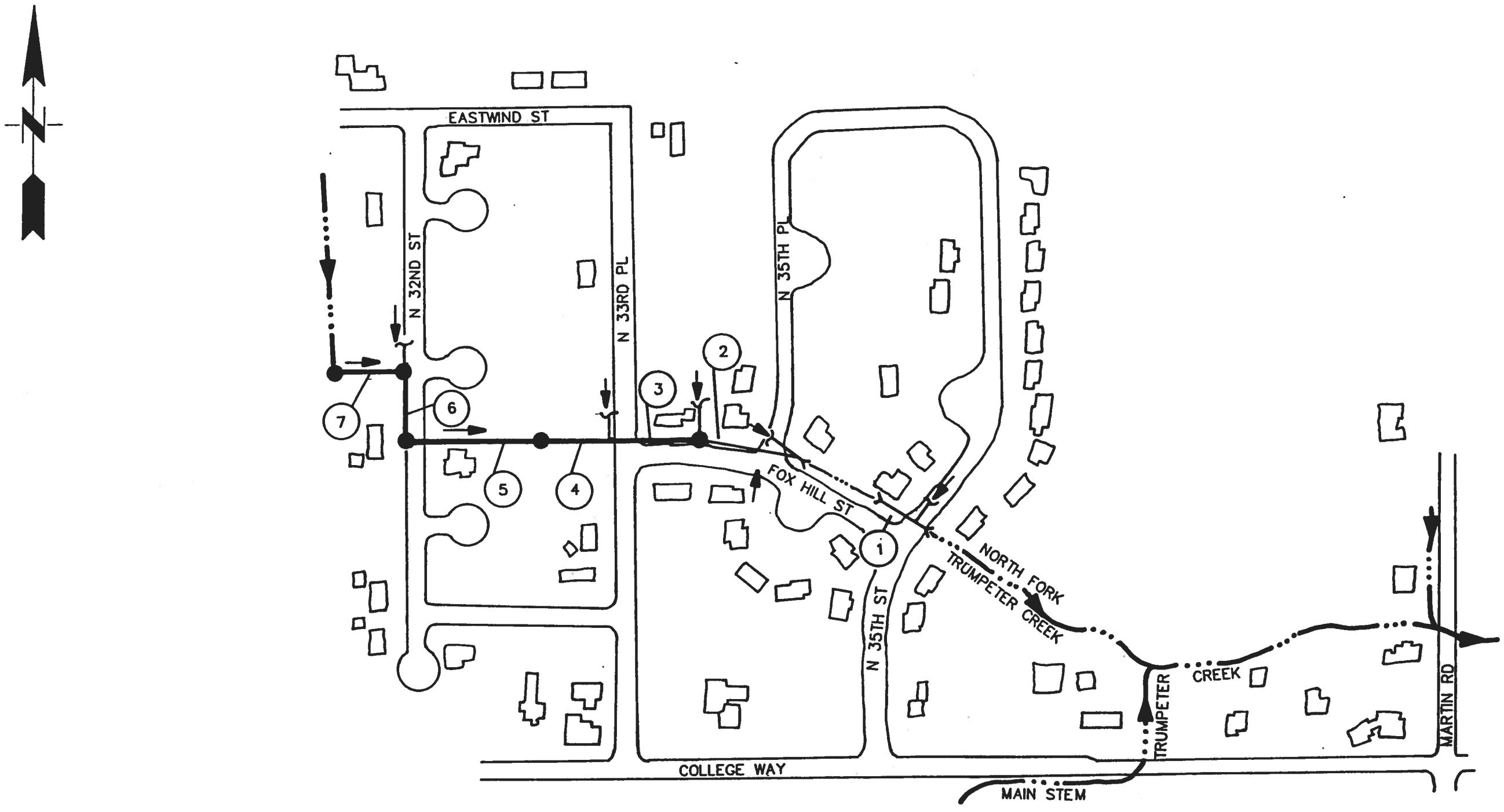


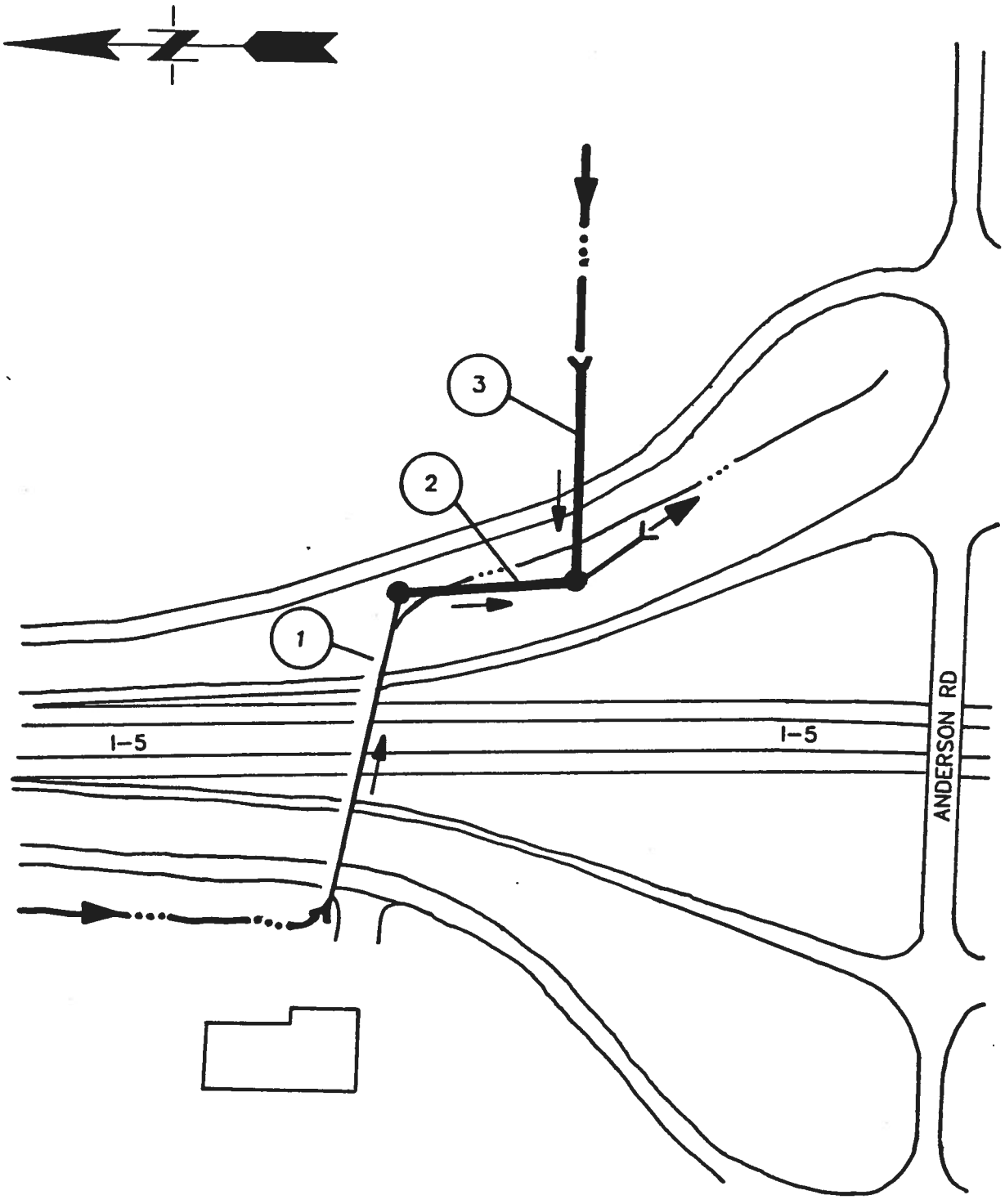
KEY

- PIPE TO BE REPLACED
- EXISTING PIPE TO REMAIN
- DITCH / STREAM
- MANHOLES
- CATCH BASINS
- (3) PIPE REPLACEMENT REFERENCE NUMBER, SEE TABLE VII-1

FIGURE VII-4
CITY OF MOUNT VERNON
SURFACE WATER MANAGEMENT PLAN
PROBLEM LS26 SOLUTION

RW BECK

C.A.M. K:\MAA07\MAA07005 9-27-93 @ 08:38



KEY

- PIPE TO BE REPLACED
- EXISTING PIPE TO REMAIN
- DITCH / STREAM
- MANHOLES
- CATCH BASINS
- (3) PIPE REPLACEMENT REFERENCE NUMBER, SEE TABLE VII-1

FIGURE VII-5
CITY OF MOUNT VERNON
SURFACE WATER MANAGEMENT PLAN
PROBLEM LS27 SOLUTION

R·W·BECK

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SECTION VIII
MAINTENANCE AND OPERATIONS

R·W·BECK

SECTION VIII

Maintenance and Operations

A. General

The objective of a surface water maintenance and operations program is to assure the reliability and dependability of the surface water infrastructure including, but not limited to, catch basins, pipe networks, detention basins, and open ditches. Such a program is designed to minimize life-cycle costs, protect the lives and property of the residents living in the affected watershed, and enhance water quality.

Too often, a "fix it when it's broken" philosophy prevails. In the long term, this approach will cost far more than ongoing maintenance. Maintenance management programs include analysis of the frequencies and levels of maintenance required to ensure reliability and achieve the lowest life-cycle cost.

Findings are presented in Part B of this section and recommendations are provided in Part C. A typical maintenance management program is described in Part D. Recommended elements of a surface water maintenance management program for the City of Mount Vernon are identified in Part E. This subsection includes an inventory of facilities, maintenance frequencies, optimal crew configurations, equipment requirements, and performance standards. Staffing and equipment budget estimates are presented in Part F. Section G contains a brief discussion regarding maintenance management software.

The surface water program described in this section of the report uses generally accepted maintenance practices and planning standards. All data are based on best available estimates.

B. Findings

The City of Mount Vernon is making commendable efforts to maintain its surface water infrastructure, especially given that the City does not have a dedicated surface water maintenance crew. For instance, the City has implemented a comprehensive street cleaning program. All downtown streets and most arterials are cleaned daily, curb residential streets are cleaned every three weeks, and non-curb residential streets are cleaned every two months. Another example is the City's curb inlet cleaning program. Twice a year three two-person crews clean all curb inlets over a three day period.

However, the City has experienced water quality and quantity problems, which are especially apparent during heavy rain storms. A comprehensive maintenance program will help to alleviate some of the problems.

C. Recommendations

Four primary changes to the current surface water maintenance program are recommended. First, increase the maintenance frequencies for cleaning catch basins and manholes from once a year to once every eight months. This is an effective way to improve both water quality and water quantity carrying capacity. By cleaning these surface water collection facilities more frequently, sediments and accompanying contaminants will be removed from the surface water system. This will reduce both the level of contaminants in the water and the amount of sediments inhibiting the flow of water.

Second, decrease the maintenance frequency of downtown streets and arterials from once every day to once every week. Although it is commendable that the City is cleaning all downtown streets and arterials every day, once a week is more consistent with what is performed by other jurisdictions and will result in more efficient use of human resources.

Third, in accordance with recommendations in other sections of this plan to convert dirt ditches to grass swales, focus maintenance activities for these facilities on vegetation control and trash removal and away from sediment removal, especially removal that involves a backhoe. Backhoe operation can be extremely intrusive to a swale. Operation of a backhoe in a swale should be limited to removing pockets of sedimentation, such as those that form near culvert openings. Extensive reshaping of swales should be performed with a ditchmaster.

Fourth, incorporate inspections into maintenance activities. For example, prior to sending out a vactor crew to clean catch basins in an area of the City, conduct an inspection of the catch basins in the area to determine which need cleaning and which do not. This will ultimately save time since catch basin cleaning can be much more efficiently accomplished if catch basins that require cleaning have been identified in advance. This approach can be applied to the maintenance of all surface water facilities. It will also facilitate development of a condition and maintenance history of the facilities if the inspections are used to indicate condition and date of maintenance activity.

As part of an inspection program, utilize indicators to determine when maintenance is necessary. The following conditions indicate the need for maintenance:

- Pipes — accumulated sediment exceeds 20 percent of the pipe diameter.
- Catch basins — accumulated sediment exceeds 35 percent of basin capacity.
- Detention basins — accumulated sediment exceeds 10 percent of the design forebay/basin depth and unmowed grass/ground cover exceeds 18 inches.
- Detention pipes — accumulated sediment exceeds 10 percent of pipe diameter for 1/2 length of the pipe or exceeds 15 percent of pipe diameter at any point.
- Biofiltration swale — accumulated sediment inhibits healthy grass cover.

In order for the City's surface water system to function properly, the Recommended Surface Water Maintenance Program presented in Part E of this section, which reflects the above recommendations, should be followed. Implementation of this program, along with the recommended capital improvements will improve the performance of the surface water infrastructure. The maintenance program described in Table VIII-6 will require an estimated annual budget of $195,300 and approximately three full-time persons, along with a one-time purchase of additional equipment needed to support new maintenance activities at a cost of approximately $20,000. Table VIII-1, Annual Maintenance Costs, illustrates the distribution of maintenance costs for the major components of the surface water system, based on the recommended program described in Part E.

Current surface water maintenance activities are performed by street maintenance crews. Approximately one full-time equivalent of surface water maintenance service is realized by the combined efforts of several street crews. Achieving the workload required by the recommended surface water maintenance program will necessitate two additional surface water maintenance workers, which will bring surface water maintenance resources to three full-time equivalents.

The recommended surface water maintenance program places significant additional demands on the City's vactor, which is shared by the Sewer and Street departments. This piece of equipment is currently used primarily by the Sewer Department. The Sewer and Street departments will need to continue to work closely to coordinate the shared use of the vactor, given the increased demands on this vital piece of equipment. Over the next two years, when additional surface water maintenance personnel have been acquired and increased levels of service begin, the City should conduct an overall Sewer and Street department utilization assessment to determine if additional equipment is necessary. If the vactor cannot be shared to the extent that it is needed, a reduced level of service over what is proposed may be necessary until an additional vactor is obtained.

Table VIII-1
Annual Maintenance Costs

Structure	Maintenance Cost	Percent of Total Cost
Pipes	$ 37,500	19%
Catch Basins	$ 37,400	19%
Streets	$ 46,400	24%
Roadside Ditches	$ 22,100	11%
Manholes	$ 15,600	8%
Detention Basins	$ 19,700	10%
Pump Stations	$ 9,400	5%
Curb Inlets	$ 7,200	4%
Total	$195,300	100%

D. Typical Maintenance Management Program

A maintenance management program is a set of policies, procedures, and management tools for planning, organizing, directing, and controlling maintenance activities. Maintenance management is not a "speed up the work," highly controlled, punitive approach to work, but rather a system of "working smarter."

A typical maintenance management program, shown in schematic form in Figure VIII-1, Maintenance Management Program Development Process, consists of six basic modules: (1) inventory of facilities, (2) needs assessment, (3) optimal crew configurations, (4) planning factors, (5) schedule and resource allocation, and (6) reporting and control. These modules are described in more detail below.

1. Inventory of Facilities

An inventory is a complete record of all physical facilities that are maintained. This inventory should document the number, condition, and locations of each facility. A procedure for keeping the inventory current is critical.

2. Needs Assessment

Assessing needs (i.e., determining which facilities need how much maintenance, of what type, and why) is the initial step in a comprehensive maintenance management program. This module consists of several components, each of which assist in answering those questions. These components include:

a. Condition Assessment. Closely connected to the facilities inventory is the condition assessment. Some form of rating scale must be established for describing the condition of each type of facility that is maintained. A procedure is needed to describe the methods for evaluating and recording the condition of each facility. Like the inventory, the condition needs to be updated regularly.

b. Level of Service. Level of service goals or standards identify the conditions that necessitate maintenance (e.g., sedimentation exceeding 20 percent of pipe diameter or 35–50 percent of catch basin capacity as measured by depth).

c. Frequencies. Frequencies identify how often maintenance activities must be performed if the program is to achieve the desired level of service.

3. Optimal Crew Configurations

Optimal crew configurations are based on the accepted fact that for every activity, there is a combination of resources that results in the most efficient performance of work. Thus, optimal crew configurations are the compilation of the number and skills of people, the types of equipment, and the kinds and amounts of materials required to perform a task most efficiently.

4. Planning Factors

Inventorying needs, converting those needs to long- and short-term work plans, scheduling, and assigning individual work projects are all ingredients of the single most important aspect of effective maintenance management, which is planning. To engage in these planning activities, to "work smarter", it is necessary to establish planning tools.

Planning factors are those identifiers, measurement units, and standards that are necessary for planning and budgeting maintenance activities and reporting actual versus planned costs and performance. Planning factors include a list of all tasks and activities performed by the municipality and charts of accounts, output measures, and performance standards for each task or activity.

a. Chart of Accounts. A chart of accounts is a list by task code of all tasks or activities for which the municipality needs to plan and collect costs. As a general rule, a separate task code should be established for each activity.

b. Output Measures. Output measures are the appropriate units of measure for documenting production for each of the work tasks or activities contained within the chart of accounts. Examples of output measures include lineal feet, number of catch basins, and lane-miles.

c. Planning/Performance Standards. These standards are used to determine resource requirements as measures of efficiency. They are expressed in number of output units (e.g., numbers of catch basins cleaned) per unit of time (e.g., days).

5. Scheduling and Resource Allocation

In order to perform needed work activities at the appropriate time, a program for prioritizing work needs to be established. Given established priorities, a long-term work plan and budget can be developed to make the most efficient use of available resources. Once a long-term plan is completed, short-term scheduling facilitates the actual performance of maintenance activities.

a. Priorities. Priorities represent the relative importance of maintaining each type of facility and, therefore, conducting each type of maintenance activity. Priorities are used in preparing both long- and short-term work plans and schedules.

b. Annual Work Plans and Budgets. Annual work plans and budgets identify the types and locations of maintenance work to be performed during the coming year. The work plan is derived by scheduling work to be performed during the year over quarterly, monthly, or seasonal periods, in order of priority. Attention is given to 1) spreading the workload throughout the time period (i.e., resource leveling), and 2) preparing the work program in light of resource constraints (e.g., budget limitations).

The work that needs to be performed is determined by applying the desired level of service or frequencies to the inventory of physical facilities. In developing the work plan, consideration must also be given to emerging or unexpected needs, complaint response, non-project loss factors such as vacations, holidays, and sick leave, as well as requirements for replacements and improvements.

Cost estimates for work included in the proposed annual work plan are computed by applying optimal crew configurations and planning standards to the quantity of work to be performed to determine the crew-hours, various skill types, and equipment required. The cost of the necessary resources can then be computed by applying wage rates and equipment rental rates. Material costs for budgeting purposes also need to be determined, using estimated or historical data.

c. Short-term Work Plans and Schedules. Short-term work plans and schedules are the means by which the work activities identified in the annual program are translated into actual work assignments in the field. The process of work planning and scheduling determines who will do the work, where it will be done, when it will be done, and how much will be done.

6. Reporting and Control

a. Reports. Work reporting is the critical feedback mechanism that enables the comparison of actual versus planned costs, production, and efficiency. Work reporting is necessary to provide deserved recognition for a job well done, develop a database that can be used for improved planning and maintenance management in future years, and monitor group performance in order to take corrective action as needed to bring actual and planned performance into conformance.

Work reporting should provide a timely and accurate flow of information with a minimum of paperwork. Variables include time, equipment hours, materials used, and units of production. Reporting encompasses a hierarchy of reports that provide the appropriate level of detail to each level of management.

b. Control. Control includes establishing clear accountability for specific results and for the resolution of problems or variances from plans. Consequently, it is necessary to establish thresholds which, when exceeded, will trigger corrective action on the part of the appropriate manager. Thresholds will vary in sensitivity depending on the level of detail contained in the report and level of management that is receiving the report. Exception reporting is useful for highlighting only those instances where thresholds have been exceeded.

Finally, control includes determining the cause of the variance, assigning the appropriate resources to take corrective action, and describing the nature of the corrective action. Corrective actions may include changing work practices or amending the original work plan.

E. Proposed Maintenance Management Program

1. Inventory of Facilities

With the assistance of the municipal staff, the consultant team identified the number of each type of facility included within the City of Mount Vernon's present surface water system that requires maintenance. This information is summarized in Table VIII-2, Existing Inventory Summary.

Table VIII-2
Existing Inventory Summary

Maintenance Item	Quantity	Measurement Unit
Catch Basins	1,500	Each
Manholes	250	Each
Curb Inlets	800	Each
Roadside Ditches	105,600	Feet
Pipes	264,000	Feet
Regional Detention Basins	5	Each
Streets	80	Miles
Detention Pipes	25	Each
On-site Detention Basins	30	Each

2. Needs Assessment

a. Condition assessment. If the maintenance frequencies recommended in this report are adhered to, it will not be necessary to conduct separate periodic condition assessments of the surface water facilities. The condition of facilities, such as catch basins, manholes, and pipes, should be recorded at the time maintenance is performed. A condition assessment scheme, or a common rating system, is recommended below. Four levels of criticality are suggested to prioritize maintenance needs for each type of surface water facility.

(1) Maintenance Needed Immediately — Failure to perform maintenance will threaten public health or safety or will result in imminent damage to other publicly-owned facilities or private property.

(2) Maintenance Needed Sooner Than Scheduled — Maintenance can be scheduled on a short-term basis but will be required before the following year's annual work plan is developed or before the regularly scheduled preventive maintenance for a particular facility or piece of equipment.

(3) Regularly Scheduled Maintenance Program — The regularly scheduled preventive maintenance activities will be sufficient.

(4) Maintenance Done Only When Unused Resources Are Available — Maintenance should be performed only after the above three categories of maintenance requirements have been accomplished.

b. Level of Service. Desired levels of service have been established with staff and are expressed in terms of maintenance frequencies.

c. Frequencies. As stated above, the levels of service for surface water facilities have been established in terms of maintenance frequencies. These frequencies are the time intervals for performing recurring maintenance in order to realize the desired level of service. Average annual frequencies appear in Table VIII-3, Maintenance Frequencies.

Table VIII-3
Maintenance Frequencies

	Activity	Recommended Frequency
1	Clean Catch Basins	1.50 times/year
2	Clean Manholes	1.50 times/year
3	Clean Curb Inlets	2.00 times/year
4	Roadside Ditches (Remove sediments)	0.20 times/year
5	Roadside Ditches (Vegetation control)	2.00 times/year
6	Clean Pipes	0.33 times/year
7	Detention Basins (Vegetation Control)	1.00 times/year
8	Detention Basins (Remove Sediments)	0.33 times/year
9	Clean Streets	See Table VIII-6
10	Clean Detention Pipes	1.00 times/year
11	Pump Station Maintenance	See Table VIII-6

3. Optimal Crew Configurations

As a part of the maintenance management program development effort, optimal crew configurations were established for the City of Mount Vernon. These optimal configurations, assumed to be the most efficient complement of labor and equipment to perform each of the tasks, appear in Table VIII-4, Optimal Crew Configurations.

Table VIII-4
Optimal Crew Configurations

	Activity	Recommended Crew Configurations
1	Clean Catch Basins	2 Maintenance Workers 1 Vactor
2	Clean Manholes	2 Maintenance Workers 1 Vactor
3	Clean Inlets	6 Maintenance Workers 3 1 Ton Trucks
4	Roadside Ditches (Clean, reshape, remove sediments)	3 Maintenance Workers 1 Backhoe, 2 Dumptrucks
5	Roadside Ditches (Vegetation control)	1 Maintenance Worker 1 Mower
6	Detention Basins (Vegetation Control)	1 Maintenance Worker 1 Mower
7	Detention Basins (Remove Sediments)	2 Maintenance Workers 1 Backhoe, 1 Dumptruck
8	Clean Streets	1 Maintenance Worker 1 Street Sweeper
9	Clean Detention Pipes	2 Maintenance Workers 1 Vactor
10	Pump Station Maintenance	Work to continue to be performed by Sewer Department

4. Planning Factors

a. Chart of accounts. The surface water maintenance program should include the 10 surface water activities identified in Table VIII-4.

b. Output Measures. As a part of the development of this surface water maintenance program, measurement units were identified for each of the activities. These output measures, which appear in Table VIII-2, are used to document the amount of activity or production. They also allow for the identification of unit costs, which are the costs of labor, equipment, and materials associated with one unit of production. This information is used for planning, budgeting, scheduling, and reporting actual accomplishment.

c. Planning/Performance Standards. Planning/performance standards are expressed in terms of an average or reasonable amount of daily crew accomplishment. Standards recommended for the City of Mount Vernon are provided in Table VIII-5, Planning/Performance Standards.

Table VIII-5
Planning/Performance Standards

	Activity	Recommended Standard
1	Clean Catch Basins	30 per day
2	Clean Manholes	12 per day
3	Clean Inlets	266 per day
4	Roadside Ditches (Remove sediments)	750 lf/day
5	Roadside Ditches (Vegetation Control)	2500 lf/day
6	Clean Pipes	See Table VIII-6
7	Regional Detention Basins (Veg. Control)	1 per day
8	Regional Detention Basins (Remove Sed.)	1 per day
9	Clean Streets	See Table VIII-6
10	Clean Detention Pipes	2 per day
11	On-site Detention Basins (Veg. Control)	2 per day
12	On-site Detention Basins (Remove Sed.)	2 per day

The above performance standards are consistent with those standards used by other comparable municipalities. In the consultant's opinion, these represent a reasonable starting point. These standards should be reviewed at least annually, and refined as historical daily production data become available.

5. Scheduling and Resource Allocation

a. Priorities. While a maintenance management program is designed to ensure that all facilities will receive the appropriate level of maintenance, the reality is that this may not always be possible, due to emergencies, weather, inadequate resources, etc. Consequently, there is a need to establish relative priorities for various types of facilities and associated deficiencies. Under Needs Assessment, a general prioritization scheme was suggested. This scheme should be used to prioritize the need for certain types of maintenance activities on specific facilities.

b. Annual Work Plans and Budget. An annual work plan displays the amount and type of work, when it should be performed, and anticipated costs. It is used to compare actual versus planned performance of the maintenance program. The annual work program is also used to develop short-term schedules.

To develop annual resource requirements and budget estimates for a surface water maintenance program, recommended annual maintenance requirements and the associated resources were documented. The proposed program appears in Table VIII-6, Recommended Surface Water Maintenance Program.

c. Short-term Work Plans and Schedules. Short-term (e.g., weekly or bi-weekly) schedules should be prepared by the maintenance supervisor. Schedules should be based on planned preventive maintenance activities, improvements or small works projects, and outstanding work orders generated from complaints, system failures, and emergency needs. Schedules should be approved by the appropriate supervisor and posted for the crew's information.

Weekly scheduling permits the flexibility to respond to:

- Unscheduled breakdowns and failures
- Weather
- Reduced resource availability due to vacation and sick leave
- Construction projects planned by private utilities and other City crews

Most importantly, the weekly schedule permits the supervisor to coordinate and plan in detail the resources, labor, and equipment needed to accomplish the proposed monthly work plan.

6. Reporting and Control

a. Reports. A cost and performance report by activity should be produced monthly, which provides both monthly and year-to-date data. By tracking labor hours, equipment hours, and production data, comparisons can be made of planned versus actual costs and performance. This will enable supervisors and management to identify and reconcile performance problems in a timely manner. The records of actual production and cost will also be valuable for developing an historical database that can be used to refine planning, scheduling, and budgeting.

b. Control. Management control is based on the establishment of clear accountability for specific results. Reporting provides the critical feedback mechanism that enables supervisors and managers to track accomplishment or results as compared with the approved plan. Through this exercise, performance problems and deviations from the plan can be identified early on. This allows supervisors and managers to complete the control cycle by identifying causes for unacceptable production and taking action to either solve the problem or revise the plan.

Table VIII-6

City of Mount Vernon
Recommended Surface Water Maintenance Program

Item No.	Maintenance Activity	Units to be Maint.	Prod. Unit	Freq. (times/ year)	Daily Prod.	Crew Size	Equipment	Annual Crew Days	Full-time Equip. Equiv.	Annual Person Days	Full-time Labor Equiv.	Annual Labor Cost	Annual Equipment Cost	Total Cost	Percent of Program
1	Clean Catch Basins	1,500	EA	1.50	30.00	2	1 Vactor	75.00	0.34	150.00	0.68	$28,462.91	$8,947.88	$37,410.78	19.15
2	Clean Manholes	250	EA	1.50	12.00	2	1 Vactor	31.25	0.14	62.50	0.28	$11,859.55	$3,728.28	$15,587.83	7.98
3	Clean Curb Inlets	800	EA	2.00	266.00	6	3 Trucks	6.02	0.03	36.09	0.16	$6,848.22	$321.92	$7,170.14	3.67
4	Roadside Ditches Remove Sediments	70,400	LF	0.20	750.00	3	1 Backhoe 2 Dumptrucks	18.77	0.09	56.32	0.26	$10,686.87	$4,538.12	$15,224.99	7.79
5	Roadside Ditches Vegetation Control	35,200	LF	2.00	2,500.00	1	1 Mower	28.16	0.13	28.16	0.13	$5,343.44	$1,664.12	$7,007.55	3.59
6	Clean Pipes (18" dia. or less)	132,000	LF	0.33	1,500.00	2	1 Vactor 1 Truck	29.04	0.13	58.08	0.26	$11,020.84	$3,982.69	$15,003.53	7.68
7	Clean Pipes (over 18" dia.)	132,000	LF	0.33	1,000.00	2	1 Vactor 1 Truck	43.56	0.20	87.12	0.40	$16,531.26	$5,974.04	$22,505.29	11.52
8	Regional Detention Basins Veg. Control	5	EA	2.00	1.00	1	1 Mower	10.00	0.05	10.00	0.05	$1,897.53	$590.95	$2,488.48	1.27
9	Regional Detention Basins Remove Sed.	5	EA	0.33	1.00	2	1 Backhoe 1 Dumptruck	1.65	0.01	3.30	0.02	$626.18	$243.58	$869.77	0.45
10	Clean Streets Downtown/Arterials	16	MI	50.00	12.00	1	1 Street Sweeper	66.67	0.30	66.67	0.30	$12,650.18	$16,130.33	$28,780.52	14.73
11	Clean Streets Curb Residential	24	MI	15.00	14.00	1	1 Street Sweeper	25.71	0.12	25.71	0.12	$4,879.36	$6,221.70	$11,101.06	5.68
12	Clean Streets Non-Curb Residential	40	MI	6.00	16.00	1	1 Street Sweeper	15.00	0.07	15.00	0.07	$2,846.29	$3,629.33	$6,475.62	3.32
13	Clean Detention Pipes	25	RT	1.00	2.00	2	1 Vactor	12.50	0.06	25.00	0.11	$4,743.82	$1,491.31	$6,235.13	3.19
14	On-site Detention Basin Veg. Control	30	EA	2.00	2.00	1	1 Mower	30.00	0.14	30.00	0.14	$5,692.58	$1,772.85	$7,465.43	3.82
15	On-site Detention Basins Remove Sed.	30	EA	0.33	2.00	2	1 Backhoe 1 Dumptruck	4.95	0.02	9.90	0.05	$1,878.55	$730.75	$2,609.30	1.34
16	Pump Station Maintenance	5	EA	*	*	*	*	*	*	*	*	*	*	$9,400.00	4.81
17	Catch Basins Repair/Replace	1,500	EA	0.02	1.00	3	1 Dumptruck 1 Backhoe	0.00	0.00	0.00	0.00	$0.00	$0.00	$0.00	**

City of Mount Vernon
Recommended Surface Water Maintenance Program

Item No.	Maintenance Activity	Units to be Maint.	Prod. Unit	Freq. (times/ year)	Daily Prod.	Crew Size	Equipment	Annual Crew Days	Full-time Equip. Equiv.	Annual Person Days	Full-time Labor Equiv.	Annual Labor Cost	Annual Equipment Cost	Total Cost	Percent of Program
18	Manholes Repair/Replace	250	EA	0.02	3.00	3	1 Dumptruck 1 Backhoe	0.00	0.00	0.00	0.00	$0.00	$0.00	$0.00	**
19	Curb Inlets Repair/Replace	800	EA	0.02	3.00	3	1 Dumptruck 1 Backhoe	0.00	0.00	0.00	0.00	$0.00	$0.00	$0.00	**
20	Pipes Repair/Replace	264,000	LF	0.02	50.00	3	1 Dumptruck 1 Backhoe	0.00	0.00	0.00	0.00	$0.00	$0.00	$0.00	**
								398.28	1.81	663.85	3.02	$125,967.57	$59,967.84	$195,335.41	100.00

Assumptions

Labor Costs (Maintenance Worker)		Equipment Costs	
Average cost per hour	$20.07	Vactor	$119.31/day
Regular Workday (hrs.)	8 hours	10 Yard Dump	$94.11/day
		Mower	$59.10/day
		Street Sweeper	$241.96/day
		1 Ton Truck	$17.84/day
		Backhoe	$53.52/day

* Pump stations are maintained by the Sewer Department.

** These costs are typically covered in street replacement programs.

F. Budget, Staffing, and Equipment Requirements

Proper maintenance of the surface water facilities requires adequate budget, staff, and equipment to support the desired level of service. Annual resource requirements and direct costs necessary to accomplish the recommended maintenance program for the City of Mount Vernon appear in Table VIII-7, Annual Budget, Staffing, and Equipment Requirements.

Table VIII-7
Annual Budget, Staffing and Equipment Requirements

	Person Days	Crew Days	Budget Estimate
Direct Labor	663.85		$126,000
Pump Station Maintenance			$ 9,400
Equipment			
Vactor		191.35	$ 22,800
10 Yard Dumptruck		44.14	$ 4,100
1 Ton Truck		90.66	$ 1,600
Backhoe		25.37	$ 1,400
Mower		68.16	$ 4,000
Street Sweeper		107.38	$ 26,000
Equipment Subtotal			$ 69,300
TOTAL			$195,300

If actual time is assumed to be 220 days per year or about 85 percent of available time, then 3.03 full-time equivalents are required to perform surface water maintenance activities. This is determined by dividing 663.85 person-days by 220 annual work days.

In order to facilitate the performance of some new maintenance activities such as cleaning manholes and mowing detention basins, the City will need additional equipment. Equipment acquisitions should include safety equipment for cleaning manholes and a mower and trailer for vegetation control of regional detention basins. Approximately $20,000 should be budgted for purchase of this equipment.

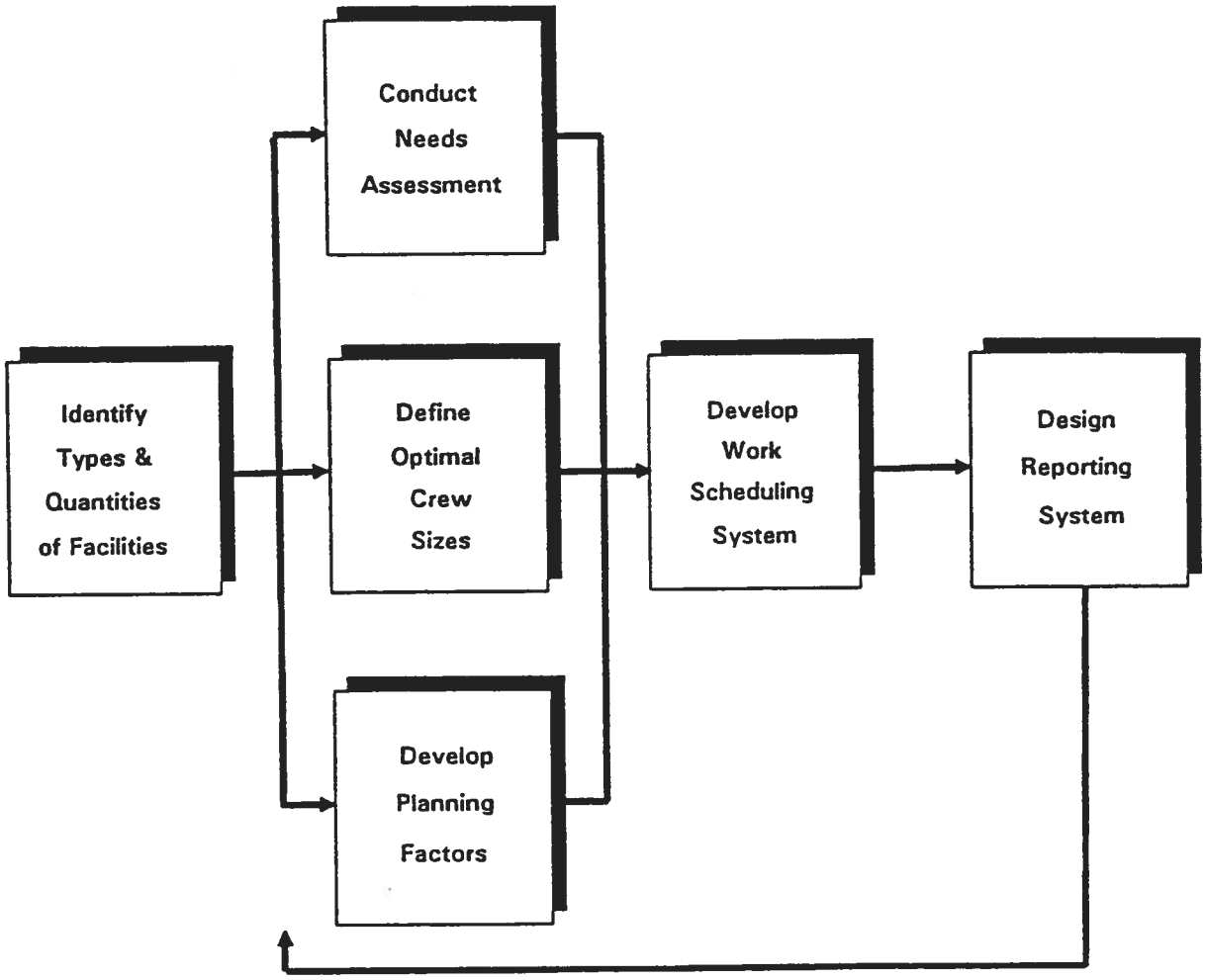
G. Maintenance Management Software

The ideal next step in establishing a Surface Water Maintenance Management Program is to automate the program. An automated program will support scheduling, tracking, reporting, and accomplishment of maintenance activities. Ideally, an automated maintenance program should be linked with other databases, such as a Geographic Information System. The reporting component of the program should be integrated with cost-accounting and financial reporting systems, so that performance and associated cost data is easily available in a useful format. Once maintenance standards are adopted, and planning, scheduling, and reporting procedures are in place, software can either be acquired or developed to meet data management requirements.

Software can be developed in-house or purchased through a vendor. Developing programs in-house using common database management software (e.g., DBASE, RBASE, and Paradox) is not recommended based upon the amount of time, effort, and knowledge necessary to develop an effective maintenance management program.

Vendor-supplied software can be acquired in two ways. First, software can be acquired by issuing a Request for Proposals (RFP) to develop a "custom" program. Second, software can be obtained by acquiring "off-the-shelf" packages. Custom developed programs can be time consuming and costly. Commercially available maintenance management software packages represent the most cost effective product.

Figure VIII-1
Maintenance Management Program Development Process



SECTION IX
FUNDING

RW BECK

SECTION IX

FUNDING

A. Background

1. Authority and Council Mandates

The financial portion of Mount Vernon's Surface Water Master Plan was considered critical in moving the engineering recommendations, water quality requirements and fish habitat recommendation from concept to reality. The City established a Citizen's Advisory Committee (CAC) to provide recommendations on the development of the Surface Water Management Plan, with specific emphasis on the funding program necessary to support implementation of the Plan. The stated goal for the Committee was to "ensure that the Surface Water Management Program, including financing alternatives, reflects the needs, priorities, and concerns of Mount Vernon's citizens and impacted organizations." The CAC members, meeting agendas, and meeting minutes are contained in Appendix D.

2. Process

Development of this financial program required the commitment of personnel from the City's Engineering Department, Street Department, Finance, and Building Inspection. Beyond these project team members were the persons who dedicated their time to participation on the Surface Water Citizen's Advisory Committee. These persons reviewed the analyses prepared by the Project Team and made recommendations to the Council. However, it was the Citizen's Committee who provided ongoing guidance to the Project Team in the design and implementation of the surface water financial program and ultimately the utility approach.

B. Surface Water Needs

Like many jurisdictions in the Northwest and throughout the country, surface water management in Mount Vernon has historically been considered a funding priority only after a major storm event. The 1990 floods and the management planning conducted as part of this project reemphasized the fact that surface water required an elevation of status supported by a dedicated and predictable funding source. This recognition is critical as Mount Vernon addresses not only surface water flooding issues and fish habitat, but also the water quality regulations from the Puget Sound Water Quality Authority and possible future federal requirements under the National Pollutant Discharge Elimination System (NPDES).

When evaluating Mount Vernon's management approach toward surface water, three functional areas have been addressed through this Plan. These focus on the technical, institutional and financial areas. A major milestone was passed when the City passed its Surface Water Utility Formation Ordinance in August in 1993 and the Surface Water Utility Rate Ordinance in November 1993. These ordinances will provide the financing to allow the City to

undertake the institutional and technical issues necessary to implement a comprehensive surface water management program.

In order to implement the program, an assessment was made of Mount Vernon's current ability to support compliance with water quality nonpoint source regulations; maintain, repair and improve the City's overall surface water management system; and preserve, and possibly enhance, sensitive environmental resources. The Citizen's Committee reviewed the funding options available and concluded that the service charge represented a reasonable and equitable approach. Most surface water activities in Mount Vernon have been funded through piecemeal allocations from the City's General Fund, Street Fund or Sewer Fund. The Citizen's Committee agreed that given the magnitude of surface water flooding, water quality, and sensitive resource issues facing Mount Vernon, a dedicated funding source to surface water management needed to be given strong consideration. The idea of a utility approach toward funding surface water was considered to be the best option as the primary revenue source. Many if not most of the cities and counties in the Puget Sound area have implemented or are in the process of implementing a similar funding approach. The legal framework underlying development of this funding mechanism has long been established through Revised Code of Washington (RCW) 35.67 and has been upheld by the Washington Courts in Teter v. Clark County/City of Vancouver.

1. Management Plan Priorities

Comprehensive basin planning is the fundamental building block for long term surface water management in Mount Vernon. The water quality, flooding, and sensitive environmental resource needs identified through the planning effort provide the basis for prioritizing the capital needs and operations requirements. These needs are then translated to costs and construction schedules. Many of these needs are, or will be, mandated by new state and federal requirements. This includes the state's Puget Sound Water Quality Authority, which has issued its own rules pertaining to the quality and quantity of surface water discharges to the Sound. As discussed in the regulatory section of this Plan, legal mandates require specific actions of the City in terms of design standards, enforcement and maintenance. While the state does make some funds available for loans and grants, the on-going commitment required to meet these regulations mandates a financial approach far exceeding available grant funding.

C. Utility Design and Implementation

1. Introduction

The stated objective for financing the City's surface water program has been development of a consistent and dedicated surface water funding mechanism. This issue is also listed in the state PSWQA surface water requirements for Comprehensive Urban Stormwater Programs. Although Mount Vernon is not included in the urbanized areas that are required to implement the Comprehensive Urban Stormwater Program elements of the Puget Sound Plan, recent and future growth may soon trigger these requirements.

Specifically, the kind of commitment required by the Comprehensive Urban Stormwater Program is an assurance that there be adequate local funding for the stormwater program. This requires that a financial analysis be performed that includes:

- What funding options are available
- How these options compare in terms of accessibility and process for implementation
- What the cost estimates are for the principal nonpoint source controls being proposed
- What level of revenue can be anticipated and whether it meets the program's needs

The process of constructing Mount Vernon's funding program addressed each of these funding elements and identified a reasonable and implementable strategy for financing the program's surface water management program.

2. Funding Approaches—Citizen's Committee Evaluation Process

The Citizen's Committee reviewed the full spectrum of surface water funding options over the nine month evaluation process. The criteria used to evaluate funding options included:

- **Timing/Ease of Implementation**—How long will it take to implement the option(s) and is it flexible enough for use in the City's operating and political environment?
- **Responsiveness**—Will the option(s) be responsive/accountable to customers within the service area?
- **Start-up Costs**—Can the funding option be merged into existing data bases and accounting systems or will it require a separate process?
- **Equity**—Does the option produce an equitable allocation of surface water service costs?
- **Legal Framework**—Is the funding option consistent with local and state laws?
- **Revenue Capacity**—Can the option(s) produce the revenue necessary to meet the program needs/priorities identified in the Master Plan?

As a further guide toward developing a financial strategy for surface water management, the Citizen's Committee was focused on establishing a funding mechanism that equitably allocates program costs and ensures that the cost of program elements is commensurate with their benefits. Within this evaluation framework, the Citizens

Committee received staff reports and recommendations on each of the funding mechanisms being considered. It was also emphasized that no single source of funding would satisfy the overall surface water quality and quantity program requirements. Although the funding options discussed were presented individually, none of them were considered to be mutually exclusive. The Committee emphasized the need to recognize the difference between getting the existing surface water system working properly versus those future system requirements resulting from new development. Given this direction, the following options for funding the surface water program were reviewed by the Committee.

3. Funding Mechanisms—Surface Water Management

The Citizen's Committee review of the following options was geared toward the immediate objective of developing the funding required to meet the needs identified in the Surface Water Management Plan. However, these funding mechanisms were also evaluated in light of their flexibility to adjust as more data was developed regarding specific application of water quality charges to individual system users. A short discussion of funding options follows:

a. State/Federal Grants and Loans. Historically, local governments have experienced significant infrastructure funding support from state and federal government agencies in the form of block grants, direct grants in aid, interagency loans, and general revenue sharing. Federal deficit reduction pressures and virtual elimination of federal revenue sharing dollars are clear indicators that cities such as Mount Vernon will be left to their own devices regarding infrastructure finance in general and surface water funding in particular. Presently, the primary sources of assistance in the areas of surface water are the federally funded grants provided by the Housing and Urban Development's Community Development Block Grant (CDBG) Program. However, access to this funding mechanism becomes much more difficult in relation to surface water facilities. Numerous applicants compete for a very limited resource pool making this a questionable funding source and one that cannot be credibly relied upon as a consistent element of this program's on-going revenue base. Experience indicates that even when jurisdictions secure grants for their programs, the revenue rarely provides for a fully funded capital improvement program. The typical scenario is to apply these grant monies to a master planning process which often does not address the long term funding issues necessary to sustain the program.

   State funding, primarily through the Department of Ecology, presents opportunities for support of specific surface water related projects. These include the Centennial Clean Water Fund, DOE's Water Quality Financial Assistance Program; State Revolving Fund, Public Works Trust Fund, and the Flood Control Account Assistance Program (FCAAP). It is expected that the City will continue to aggressively pursue these sources of funds.

b. Debt Financing. General Obligation Bonds - Washington statute enables municipal issuance of bonds for the purposes of paying the cost of acquisition or construction of service facilities. General Obligation (G.O.) Bonds are debt

instruments backed by the full faith and credit of the issuing jurisdiction. The bonds are secured by an unconditional pledge of the City to levy the necessary assessments, charges or ad valorem taxes necessary to retire the bonds. G.O. bonds are the lowest-cost form of debt financing available to local governments and can be combined with other revenue sources such as specific fees, grants/loans, or special assessment charges to form a dual security through the City's revenue generating authority. These bonds are supported by the City as a whole, so the amount of debt issued for stormwater management purposes will be a function of Mount Vernon's overall debt capacity. G.O. bond financing requires voter approval.

c. Revenue Bonds. This form of debt financing would also be available to Mount Vernon if and when a surface water utility revenue stream was established. Unlike G.O. bonds, revenue bonds are not backed by the City as a whole, but constitute a lien against the operating revenues of the City's surface water utility. Revenue bonds present a greater risk to the investor than do G.O. bonds, since repayment of debt depends on an adequate revenue structure and sound fiscal management by the issuing jurisdiction. Due to this increased risk, revenue bonds generally command a higher interest rate than G.O. bonds. This type of debt also has very specific coverage requirements in the form of a reserve fund specifying an amount, usually expressed in terms of average or maximum debt service due in any future year. This debt service is required to be held as a cash reserve for annual debt service payment to the benefit of bondholders. Typically, voter approval is not required when issuing revenue bonds.

d. System Development Charges. Mount Vernon does not presently employ impact or connection fees for surface water. However, some members of the Citizen's Committee did express an interest in keeping this option open as the surface water program gets further into its capital improvement programming. These charges are designed to provide a mechanism by which owners of properties to be developed in the future will share in the current cost of constructing surface water improvements. Surface water and flood control improvements are characteristically designed to last twenty years or more into the future. This charge offsets the inequity which results when owners of developed properties bear the entire cost of the surface water improvements while owners of property developing in the future enjoy the benefits of these improvements at no incremental cost.

The use of system development charges will provide important flexibility in terms of equitably allocating the cost of new development on the surface water quality or quantity infrastructure. Questions regarding who should pay for required upsizing of the surface water system due to new development, or how historical payers into the system can recover their costs in oversizing facilities that enable future growth, are exactly the types of equity issues that system development charges can be designed to accommodate. This method is also being considered for nonpoint source water quality controls by providing incentives for new

development in order to maximize the mitigation of surface water quality impacts at the development site.

e. Fee-in-lieu-of Onsite Detention. In-lieu-of fees can either be a regulatory requirement or a development option that enables the City to offer developers the opportunity to construct on-site detention facilities in accordance with the established design criteria, or pay a fee into a fund dedicated to the construction of an off-site (regional) detention facility serving multiple properties.

This approach can be effective within the context of promoting the siting and construction of more regional versus on-site detention/retention facilities. This objective is consistent with the intent of fee-in-lieu-of ordinances which have proven practical as a vehicle to guide development patterns within a watershed and as a tool to encourage comprehensive surface water planning.

The shortcomings associated with fee-in-lieu-of construction revolve around cash flow and construction timing. The customary fee for a single property or development is rarely large enough to fund the construction of a regional facility. Therefore, either multiple developments must occur simultaneously in a given area to generate enough revenue to fund the construction of a regional facility, or more realistically, the project must be initially funded from Mount Vernon's utility rate reserves. Many surface water programs are finding it necessary to provide seed monies in order to successfully establish fee-in-lieu-of structures. It is also important to note that monies collected for fee-in-lieu-of purposes be "earmarked" for use in constructing the specific facility identified. Courts have generally held that commingling these funds and allocating them to unrelated surface water projects is illegal.

f. Improvement Districts and Special Assessments. The use of special drainage districts for funding surface water programs has decreased significantly due, in part, to the difficulty in quantifying the benefit to individual properties. In water, street, or sewer special assessments the benefit is normally determined as a function of the total area benefitted. The situation in surface water differs in that upstream or hillside properties that are major runoff contributors may not be specific recipients of project/maintenance benefits. Because the level of benefit could not be quantified, these properties would not be required to participate in the assessment base. In addition, the concept of local improvement or special assessment districts creating facilities or systems to mitigate surface water problems within narrowly defined areas can be counter-productive to a comprehensive approach to surface water management.

g. Plan Review and Inspection Fees. These fees are intended to recoup the expense of examining development plans to ensure consistency with comprehensive or master plans, and to insure that construction standards and regulations are met in the field. These fees are not designed to be primary revenue generating sources. Specific tasks are usually limited to engineering review and field inspection/certifications. In theory, a detailed cost accounting system can

determine the actual costs of providing these services to developers. However, in practice most surface water authorities monitor the accumulated cost of providing this service so that the resulting fee is based on an average of the total cost.

One of the major concerns regarding current surface water development review operations is the lack of regulatory enforcement in the field. Plan review and inspection fees are designed to allocate direct costs back to those receiving service. These services are typified by the code enforcement work done by field inspection personnel. By implementing a plan review/inspection charge based on the true cost of providing an adequate level of service, the surface water program could enhance the development/construction review process (timeliness and predictability) and avoid passing the costs of these direct services back to the general rate or tax payers.

h. General, Street, Sewer Fund Support. These funding sources have historically been accessed by local governments to pay for minor drainage improvements and complaint/emergency response. Mount Vernon has allocated a portion of its general operating revenues to road related drainage maintenance in order to protect the integrity of the roadway network and for surface water emergency response activities. Overall, this characterizes the traditional approach toward funding surface water emergency response or protection of the transportation system. In most cases, the number of public services becoming reliant on general fund support is increasing. Therefore, services with potential customer bases, such as surface water, are being required to become self sufficient to the greatest extent possible. This self sufficiency is particularly true in terms of nonpoint source compliance.

i. Surface Water Service Charges. As conventional funding sources for surface water management become more difficult to access and as the costs of meeting surface water quality requirements are gaining focus, the utility or service charge approach toward surface water funding is becoming broadly applied and generally accepted by local government. There are numerous combinations and variations for surface water service charges. The generally accepted characteristics of a surface water service charge or rate are described below:

- **Amount of Impervious Surface**—Rates under this approach are set in direct proportion to the measured, estimated, or assumed extent of impervious area for each parcel of land. Impervious surface is that land occupied by building footprints, pavement or other non-permeable surfaces.

- **Density of Development**—Under this approach rates are determined by a runoff coefficient which is deemed to be appropriate for the type of land and the nature of the improvements on each parcel.

- **Flat Fee**—This mechanism utilizes a constant or uniform fee for each property within pre-existing classes or can be applied on a community-wide basis.

A service charge for surface water management reflects a rationale that those who contribute runoff to the surface water system should pay in relation to the amount of runoff conveyed by the systems and facilities operated by the surface water management entity. This approach is consistent with current rate structures for wastewater in Mount Vernon. As in the other rate structure, surface water service charges are based on an equivalent service/residential unit. Typically, the equivalent residential unit represents the average amount of impervious surface on a single family residential lot. Courts have consistently held that this type of approach toward a surface water service charge is reasonable and logical. The key test is whether the rate methodology relates the service charge with a measurable factor causing runoff. Impervious surface or other density of development factors are typically used as the basis for the rate structure. Jurisdictions including Anacortes, Everett, Snohomish County, Lynnwood, Mountlake Terrace, Seattle, King County, Tacoma, Auburn, Puyallup, Sumner, Steilacoom, Olympia, Thurston County, etc. have operating utilities. Nationally, it is estimated that 250 larger municipalities have implemented a surface water service charge.

j. Property Taxes. The property tax approach, while administratively straightforward, is flawed in relation to surface water because use or contribution of runoff to the system is not closely correlated with the value of the property. It is the increased emphasis on equity in allocating surface water costs to those contributors of runoff to the system that is the basis for moving away from taxes as the primary revenue source. A property tax approach toward funding surface water management in Mount Vernon would exempt the numerous developed properties owned by churches, schools and other owners enjoying tax exempt status. A key observation made by the Citizen's Committee in comparing the taxation versus service charge approach was that program costs are not affected by tax exempt status and if properties drop out of the revenue base due to tax status, program costs are shifted to the remaining properties. The bottom line is that all developed properties in Mount Vernon would be served by the utility, but only taxable properties would pay for these surface water services. This was considered inequitable by the Citizen's Committee.

4. Utility Approach and Financial Flexibility

While it is important that Mount Vernon's program develop a funding mix to support operations, it is also true that the elements of this mix will be designed and implemented over time. While financing techniques such as developer charges, plan review fees and grants/loans can serve to offset new facility or direct service costs, they cannot provide the revenue stream necessary to support a full-time, comprehensive surface water management program.

The following information summarizes the specific advantages correlated with the service charge approach in terms of Mount Vernon's specific situation:

a. Flexibility and Ability to Generate Required Revenue. As the surface water program develops, the need to adjust the funding plan to meet identified needs will be critical. The service charge can be adjusted to meet these requirements and the rate structure altered to most equitably allocate cost. As an example, some programs have involved surface water rate structures that consider the unique maintenance and capital requirements for each basin.

b. Process to Implement Database. Given the fact that Mount Vernon has a billing system in place for solid waste and sewer, economies of scale can be gained if a surface water service charge were to be added. However, there will be a one time cost in preparing the data base for surface water customer accounts.

c. Equity. The optimal approach for funding any infrastructure program is to allocate the cost of service/facilities based on levels of use. The stronger the correlation between use of the system and individual level of payment, the greater the equity of the cost allocation methodology. Jurisdictions employing surface water service charges (based on a measure of impervious surface for an individual property) have done so because, as a public utility, there must be a relationship between surface water rates and use of the surface water system.

Given the chief criteria of equity, flexibility and overall revenue capacity, the surface water service charge was endorsed by the Citizen's Committee as the optimal primary revenue source. The Committee also determined that secondary funding sources should be evaluated to further refine the equity of the revenue base.

5. Funding Recommendation and Citizen's Committee Evaluation

The Citizen's Committee's evaluation of the primary revenue sources available to support the overall surface water program resulted in the following direction to staff:

> A (surface water utility) service charge should be implemented based on a property's contribution of runoff to the surface water system with single family residences treated as one residential/dwelling service unit and other properties charged based on their estimated total runoff as primarily determined by the amount of impervious surface.

Based on the financial directions established through the Committee, the dedicated, predictable and consistent element for nonpoint management is the surface water service charge. At the same time, the flexibility to implement essential secondary funding options is preserved as the overall funding mix for addressing surface water quality and quantity needs is determined.

6. Program Directions and Costs

The services to be provided through the surface water management program emphasize activities that will enable the program to meet water quality requirements and, from an overall surface water management perspective, "not let current problems get worse." The program responds to the need for Mount Vernon to begin thinking of surface water quality and quantity management as an on-going and critical component of the public infrastructure. In order to begin this process, the initial program establishes a capital improvement schedule and a commitment to maintenance; implements a nonpoint source management plan; promotes regulatory and design criteria consistency; and actively involves the public with surface water management issues.

Revenue requirements for the surface water program have been prepared for the following budget categories (FY 95-96):

- Maintenance
- Engineering, Regulation, Erosion Control
- Operations
- Public Education
- Administration/Billing
- Utility Taxes
- Sewer Fund Repayment
- Capital Improvement

The functional service areas for the initial surface water program are summarized below.

a. Maintenance. There will be an increased emphasis on field maintenance operations throughout the City. Preservation of natural conditions while maintaining the hydrologic characteristics of these drainages is a delicate balance which often results in more labor intensive procedures for maintenance of these systems. This emphasis, in addition to the increased frequencies and enhanced maintenance procedures necessary to realize water quality nonpoint source reductions, will require a commensurate commitment of resources to this program element.

1995 Budget $195,300

b. Engineering, Regulation, and Erosion Control.

(1) Water Quality Management—Implementation of a water quality nonpoint source pollution control program will require additional expenditures for monitoring, enforcement and problem mitigation. Therefore, compliance monitoring will be an on-going and expanding cost to the City.

It should be emphasized that activities related to compliance with state, and possible federal, surface water regulations are contained in virtually all the

budget categories. The costs contained in water quality management are specific to a response to the regulatory requirements issued by the PSWQA and EPA.

(2) Engineering Services—This function involves implementation of the projects identified in the management plan in a manner that is consistent with water quality flood control, and sensitive resource preservation policies and programs. With the management plan, overall guidance can be provided for directing the program toward more than meeting nonpoint source load allocations, but developing a full range of surface water services to the City. This document also provides the necessary data for estimating program costs and establishing legally defensible system development charges.

This program element will also be the lead in water quality nonpoint source management and will work with all program areas in assuring that: (a) a nonpoint source identification/monitoring program is implemented (b) control strategies are implemented, and (c) pollutant load reductions are achieved and measured. This process will include the necessary monitoring to measure the impacts of various nonpoint source mitigation measures in the field. This program area will also play a key role in water quality related regulations and conduct special analyses as required to evaluate the effectiveness of nonpoint source technologies.

The Engineering element will provide lead technical support for all surface water program areas and be a direct service provider in the area of plan review, design, field inspection and enforcement, including erosion and sedimentation control. While project management will be an increasingly important function, emphasis will also be placed on non-structural program planning. Initial program priorities will include preparing consistent design criteria and standards, developing an accurate surface water system inventory and implementing a hazard mitigation program. An overall physical feature (structures, floodplain, streams, problem areas, hazard locations) and problems assessment of the surface water system within the service area has not been prepared but will be an important element within this program heading.

The non-structural regulatory functions include enforcement and overseeing of surface water policies within the service area. It is through enforcement of the regulatory provisions that the overall surface water management program will be applied on a consistent basis and maximize nonpoint load reductions from all tributaries in the service area. Also, this mechanism provides the means to monitor the consistent application of standards and criteria to provide a uniform level of water quality, flood, and sensitive resource protection to the public.

1995 Budget $88,200

c. Operations. This function involves costs related to operational factors such as supplies, energy and equipment services.

1995 Budget $41,000

d. Public Education. Includes expenditures for public awareness brochures/flyers regarding surface water program needs, costs and rates. Billing stuffers and newsletters will also be developed as part of the short term utility implementation information effort and longer term program of public involvement regarding site quantity/quality controls.

1995 Budget $16,000

e. Finance/Billing/Accounting/Payroll. Are the utility support functions related to surface water data processing, invoicing, remittance handling and accounting? The surface water program's *pro rata* share of revenue generated in relation to the City's other utility programs is estimated based on projected staffing impacts and allocations based on the total number of additional accounts generated as a result of the program.

1995 Budget $21,000

f. Utility Taxes. For the upcoming year, includes state utility taxes and other costs which are allocated to Mount Vernon's surface water utility for city manager, city attorney and human resources time. This category also includes the utilities allocation for general government support.

1995 Budget $72,000

g. Sewer Fund Repayment. A loan from the Sewer Fund to support development of the Surface Water Master Plan is being paid back in equal installments through the year 2000.

1995 Budget $40,000

h. Capital Improvement Program. The Master Plan has identified numerous important projects to be scheduled over a 20-year planning period. A key element of the financial analysis is determining whether these projects will be funded on a "pay as you go" basis versus the debt service options discussed previously. In reviewing the financing strategies within the context of the projects, the Committee expressed its desire to minimize debt service costs while implementing a ramping of rates. As these options are further evaluated with the Committee, annual capital costs will be determined. Additional analysis on the funding of capital projects has been performed and is included in Appendix L, *Engineering Report Debt-Funded Stormwater Capital Projects*, April 1995, and

this analysis was updated as described below. The Capital Improvements Program is listed on Table X-1 in the following section.

7. Historical and Forecasted Cash Flows

Historical and Forecasted Cash Flows for the Mount Vernon Surface Water Utility are shown in Section 4 of the *Engineering Report Debt-Funded Stormwater Capital Projects* contained in Appendix L. This cash flow analysis has been updated to:

- Reflect escalation of 1993 cost estimates to 1995 prices
- Update design costs for the Riverbend Road Pump Station
- Solve the flooding problem at the Park Village Trailer Court
- Update costs to provide adequate conveyance capacity in a tributary to Kulshan Creek across Continental Place and College Way.

This updated cash flow analysis is shown on Table IX-1.

D. Billing/Service Charge Implementation

The Citizen's Committee reviewed and voted on staff recommendations contained in a series of "issue papers." These papers, designed as decision tools for development of the surface water utility rate structure, became the building blocks of the rate structure.

This recommendation and the supporting issue papers were presented to Council with the following recommendations:

1. Three specific policies should be reflected in the surface water service charge:
   - Undeveloped properties, defined as those properties left in a natural state, would not be included in the service charge.
   - All publicly owned property should be included in the surface water service charge, except publicly owned streets which operate as part of the City's storm water conveyance system.
   - No exemptions be allowed from the rate based on property use (other than undeveloped) or tax exempt status.
2. The surface water service charge should be set at a level that recovers total surface water program costs while recognizing the cumulative impact of rates for water, sewer and solid waste.

3. Implementation of the surface water rate be accomplished in a manner that allows adequate time to inform the public about the program, regulatory mandates, costs and rate approach.

Based on these rate provisions, project staff and the City Attorney were directed to prepare a utility formation ordinance and a second ordinance establishing a system and structure for rates. These ordinances are contained in Appendix K.

The Project Team began the process of developing a customer inventory and surface water service charge system for all properties within Mount Vernon. This process involved not only Project Team members but also included utility billing personnel from the City's Finance Department and EDEN Systems (the City's Utility Billing software/programming consultant) in constructing an accurate data base on impervious area and downloading this data into a utility billing system.

City of Mount Vernon
Surface Water Program
Cash Flow Analysis

Table IX-1
CASH FLOW ANALYSIS

Term (yrs.) of Interfund Loan:	6
Kulshan Creek Alternative:	5
RS1 Year of Construction:	1996
Year Staff Added:	1995

Assumed Monthly Rate:	$3.95	$3.95	$5.35	$5.35	$6.05	$6.05	$6.05	$6.05	$6.05
Assumed Growth:	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Assumed # of ESUs:	15,190	15,494	15,804	16,120	16,442	16,771	17,106	17,448	17,797
Assumed Bond Issue: (1)	$0	$2,084,875	$0	$0	$0	$0	$0	$0	$0
Assumed PWTF Loan (2)	$0	$3,100,000	$0	$0	$0	$0	$0	$0	$0

Estimated Cash Flow									
	1995	1996	1997	1998	1999	2000	2001	2002	2003
Beginning Balance	$477,962	$584,960	$293,268	$67,062	$57,798	$178,734	$320,442	$228,608	$354,042
Revenues									
Rate Revenue	$720,000	$734,400	$1,014,588	$1,034,879	$1,193,690	$1,217,564	$1,241,915	$1,266,753	$1,292,088
Fund Earnings	$22,703	$27,786	$13,930	$3,185	$2,745	$8,490	$15,221	$10,859	$16,817
Rev. Bond Proceeds	$0	$1,825,531	$0	$0	$0	$0	$0	$0	$0
PWTF Loan Proceeds	$0	$3,100,000	$0	$0	$0	$0	$0	$0	$0
Total Available Funds	$1,220,666	$6,272,676	$1,321,786	$1,105,126	$1,254,233	$1,404,787	$1,577,578	$1,506,220	$1,662,947
Expenditures									
Operating Expenses	$473,500	$455,175	$477,934	$501,830	$526,922	$553,268	$580,931	$609,978	$640,477
Capital Spending	$123,184	$5,325,320	$284,813	$58,415	$66,390	$53,784	$334,661	$113,719	$117,995
Interfund Loan Repayment	$39,022	$39,022	$39,022	$39,022	$39,022	$39,022	$0	$0	$0
Rev. Bond Debt Service	$0	$145,941	$196,797	$196,797	$196,797	$196,797	$196,797	$196,797	$196,797
PWTF Debt Service	$0	$13,950	$256,158	$251,263	$246,368	$241,474	$236,579	$231,684	$226,789
Total Expenditures	$635,706	$5,979,408	$1,254,724	$1,047,328	$1,075,500	$1,084,345	$1,348,969	$1,152,179	$1,182,058
Ending Balance	$584,960	$293,268	$67,062	$57,798	$178,734	$320,442	$228,608	$354,042	$480,888
Coverage Attained	0.00	2.10	2.80	2.72	3.40	3.42	3.44	3.39	3.40
Target Balance (3)	$38,918	$37,412	$39,282	$41,246	$43,309	$45,474	$47,748	$50,135	$52,642

NOTES
1 Assumes bond reserve funded with proceeds.
2 Assumed match: 10% ; Interest rate: 3.00% ; 1st yr draw: 15% .
3 Target balance = 30 days of cash operating expenses.

Shaun Pigott Associates / FCS Group
Last Edited: 03-Nov-95

SECTION X
RECOMMENDED PLAN

R·W·BECK

SECTION X

RECOMMENDED PLAN

A. General

The recommended plan consists of five major components and includes non-structural (regulatory) recommendations, structural solutions (capital improvements), operations and maintenance program, financing plan, and interjurisdictional coordination. Collectively, these components will help solve current and future water quality and flooding problems, preserve and enhance valuable environmental resources, and establish a comprehensive and long-term approach to surface water management.

In general, non-structural solutions were emphasized to solve these problems because they do not require major capital expenditures. Non-structural solutions include public education, policies, ordinances and regulations, maintenance, monitoring and investigative studies. Where non-structural solutions could not, by themselves, solve these problems, structural solutions were recommended to supplement non-structural solutions. Recommended non-structural and structural solutions were developed in Section VII. The recommended operations and maintenance program was developed in Section VIII. The recommended financing plan was developed in Section IX.

This section also lists the goals and objectives that were developed in Section II and provides an explanation of how these goals and objectives can be achieved by implementing the recommended solutions.

Table X-1 lists the capital improvements plan. All costs are in 1995 dollars. This table also identifies relative priorities for implementation. These priorities were generally arrived at by considering, in order of importance, safety and human health, potential for property damage, correcting environmental problems, and enhancing environmental resources. The 1995 costs were escalated at 4.5 percent per year to show the future project cost in the year it is scheduled for implementation.

B. Cost Estimates

Cost estimates were developed for the recommended structural solutions. Cost estimates for several problems have been updated as part of several design projects and review of developer proposals. These estimates are shown in Appendix E. Estimates for the remaining problems have been taken from the 1993 draft plan and escalated at 4.5 percent per year for two years. The 1993 estimates for the problem solutions prior to escalation to 1995 costs are also shown in Appendix E. The 1993 cost estimates include an allowance for mobilization of 10 percent; construction contingency of 30 percent; state sales tax of 8 percent; administration of 2 percent; and surveying, permitting and engineering of 30 percent. All cost estimates are based on 1993 costs with an ENR construction cost index of 5,600.

C. Recommended Plan

1. Recommended Non-Structural Solutions

a. Public Education. The benefits of a strong public education program have been demonstrated by other communities and is recommended as a high priority for the City of Mount Vernon. The public education program should include elements to protect and improve water quality, protect against flooding, and preserve environmental resources. The purpose of public education is to increase the understanding of citizens and business owners about flood control and how their actions can affect water quality and environmental resources. The program should foster public ownership of and responsibility for stormwater quality and quantity.

Public education was identified as a solution, or as one component of a solution for several drainage system, water quality and environmental resource problems described in Section VII. A summary of the recommended public education elements is provided below; more specific detail about each of the program elements is contained in Section VII.

(1) Maintenance of Private Systems: Develop an educational program that educates commercial and industrial business owners of the benefits of proper catch basin cleaning and maintenance of detention systems. Information could be distributed in the form of flyers, town meetings, newspaper articles, outreach by City staff, and workshops. In addition, the City should adopt an ordinance requiring maintenance of private facilities similar to the model ordinance in Appendix J.

(2) Proper Erosion Control: Develop a program to inform and educate area contractors about the new erosion control requirements that the City has implemented as part of the new drainage ordinance that complies with the Puget Sound Water Quality Management Plan. It is suggested that the City develop this program jointly with Skagit County. A coordinated joint program would likely be more effective in attracting area contractors.

(3) Source Controls: Develop a public education program that encourages source control of stormwater pollution and includes the following objectives:

(a) Residents should reduce the use of household products that are harmful to the environment. When these products are used, they should be disposed of as hazardous waste at the County's new Moderate Risk Waste Collection Center.

(b) Eliminate illegal dumping of oils, liquid waste products, lawn clippings, pet waste and other pollution sources by the public and area businesses.

(c) Reduce stormwater exposure whenever and wherever possible through the use of recommended BMPs.

(d) Use pesticides and herbicides wisely and always follow application instructions. Also, whenever possible implement an Integrated Pest Management Plan (IPMP) rather than use chemical treatment.

(e) Implement public education programs such as those indicated in Table VII-4 and in Ecology's *Stormwater Program Guidance Manual for the Puget Sound Basin*, Volume 2. Develop an educational program that educates commercial and industrial business owners of proper catch basin cleaning. Information could be distributed in the form of flyers, town meetings, newspaper articles and workshops. This education program can be a component of an overall public education program. The recommended overall commitment to an effective education program will require at least 25% to 30% of the City's new stormwater manager's time.

(4) Spill Response: Develop a public education program to inform individuals of what to do in the event of a spill such as to report spills immediately using the 911 telephone number.

(5) Illicit Dumping: Develop a public educational program to inform the public of the impact to stormwater quality associated with illicit dumping of waste.

(6) Riparian Corridors: Develop an education program to increase community awareness of stream resources. The City could establish a volunteer program with school children or interested citizens, to assist in a planting program. The planting program would include planting additional native plant species to improve the quality of stream corridors by increasing cover, shade, visual buffer and filtration functions. The City should coordinate this effort with the Department of Fisheries to define the corridors most needing improvement. Several capital projects to help restore and enhance fish habitat could use volunteer labor for some portions of the work.

(7) Wetlands: Public information programs concerning the value of wetlands should be incorporated into the public education program.

(8) Agriculture BMPs: The City should coordinate with area farmers to maintain riparian vegetation that will improve filtration of pollutants and reduce erosion thereby improving water quality. The City should prepare a public education program to inform farmers of the importance of riparian vegetation for water quality protection. Example BMPs include:

- use fences to keep farm animals out of the area creeks.

- cover manure piles with plastic or spreading manure piles to avoid a concentrated pollution source, and

- maintain riparian vegetation along streams to improve filtration of pollutants and reduce erosion thereby improving water quality

To be effective, the above public education programs should be ongoing. It is therefore recommended that the City's new surface water manager be responsible for implementing and maintaining these education programs. It is estimated that these programs would require approximately a one-quarter to one-third full time staff equivalent.

b. Recommended Changes to Policies, Ordinance, and Regulations.

(1) Enforce the new drainage ordinance consistent with the minimum requirements of Ecology's *Stormwater Management Manual for the Puget Sound Basin.* The ordinance is contained in Appendix I.

The City should implement the new standards with a public education program designed to inform and educate affected parties about the new regulations. These public education programs were described earlier in this section. The City should attempt to use education as the primary mechanism to successfully implement the new regulations, and then enforcement as a last resort for those who fail to comply.

(2) Adopt a new ordinance requiring maintenance of privately owned stormwater control facilities. A draft model ordinance is contained in Appendix J.

(3) Enforce the new drainage ordinance provisions to deter illegal dumping. The drainage ordinance in Appendix I includes provisions to deter illegal dumping of material into or near the drainage system. Increased enforcement and prosecution of illicit dumpers will help to reduce the problem. Local citizens should be encouraged to report any illicit dumping to further help prevent these actions.

(4) Review existing wetland protection standards and wetlands management strategy. The City should review its Critical Areas Ordinance and evaluate the need to develop a rating system accompanied by associated buffer size. Whether the City should sponsor a programmatic solution such as mitigation banking or a SAMP for managing wetlands, is a policy decision that should be made by City staff and elected officials.

(5) Require fences to keep animals out of area streams. The City should improve water quality by adopting an ordinance requiring the use of fences

to keep farm animals out of area streams. The effort to install fences within the City should include a public education program for farm owners, development of an ordinance requiring the use of fences, and the possible development of assistance programs such as low interest loans for farmers to lessen the cost of fence installation.

(6) Require sewer construction for new construction. The City should establish a policy of requiring sewer construction for new construction in areas to be annexed to the City.

c. Monitoring/Investigative Studies.

(1) Investigating/Monitoring Program. The City should conduct a monitoring and investigative program for water quality parameters. Six sampling events should be used. All major stream systems and outfalls should be sampled during each sampling effort. These pollutants include:

- Total petroleum hydrocarbons
- Suspended solids
- Nitrate plus Nitrite Nitrogen
- Total phosphorus
- pH
- Ammonia Nitrogen
- Temperature
- Lead
- Copper
- Zinc
- Dissolved oxygen
- Hardness

Sampling for these pollutants would provide additional information about the quality of water entering receiving waters and could be evaluated to determine the existence of other water quality problems in the City. This data could also be used as baseline information to evaluate the effectiveness of source control programs. It is recommended that the City conduct the monitoring program initially as a high priority and then a second time, a few years later, to determine the effectiveness of source control programs. In addition, this sampling program should include some sediment sampling in the Kulshan Creek Basin.

(2) Spill Containment Needs Assessment. The City should conduct a study to identify the need for spill containment facilities to prevent transportation related spills from entering area streams and the Skagit River. This work would be accomplished by the City's new stormwater manager.

(3) Emergency Spill Response Program. The City should implement a emergency spill response program. A City staff person should be assigned to develop information on how to handle transportation and storage related spills. This staff person should then educate the fire department on appropriate methods and procedures. The staff person should also provide the fire department with all the necessary information on the City's storm drain system layout and the major outfalls to area streams and the Skagit River. The City should develop a comprehensive information network to

facilitate communication between the public, city staff, agencies and fire department spill clean up personnel in the event of a spill. The City should conduct an inventory of industrial facilities that store hazardous materials and keep their drainage system maps on file at the City and Fire Department. Those facilities with SIC codes of concern that are in close proximity to water resource should be made a priority for spill prevention and containment facilities and programs. In addition, information on these sites should be available to the fire department and routine monitoring and inspection of these facilities should be performed. This work should be coordinated by the City's stormwater manager.

d. Maintenance.

(1) Increase the Frequency of Catch Basin Cleaning. The City should increase the frequency of catch basin cleaning from once a year to once every eight months. Increasing the frequency of catch basin cleaning is part of the recommended maintenance and operation plan, discussed in Section VII. In addition, the City should identify areas of potential high pollutant loading, such as streets that receive runoff from shopping center parking lots and develop more frequent cleaning schedules for these areas, such as once every three months during the rainy season, or at least once every six months.

(2) Maintain Ditches to Preserve Vegetative Lining. Ditch maintenance should preserve vegetation lining to prevent erosion and to capture pollutants. Vegetation should only be disturbed when it is necessary to remove sediments in order to regain hydraulic capacity. When this type of ditch maintenance is required, it is best done so that some vegetative material remains to regenerate the vegetation lining. Reseeding or sodding of ditches should be performed as required to help prevent erosion.

2. Recommended Structural Solutions

a. General. Table X-1 lists the recommended structural solutions that were developed in Section VII. Structural solutions were developed to solve both regional and local system problems, water quality problems, and sensitive environmental resource problems.

b. Regional System Structural Recommendations.

- To provide adequate flood protection for the full development of the Freeway Drive basin, a 2,600-foot, 48-inch gravity main and a 25-cfs pump station should be constructed. The 48-inch gravity flow pipe would begin at the Eagle Hardware detention pond and run south along the western city boundary to a new pump station located near the Skagit River along Riverbend Road. The pump station would only operate under high water

conditions in the Skagit River. This solution would limit the Eagle Hardware detention pond overtopping to about once in 100 years.

- To prevent Kulshan Creek from overtopping Parker Way and possible local flooding upstream, two additional 36-inch diameter culverts are needed to supplement the capacity of the existing two 36-inch-diameter culverts.

- To prevent local flooding upstream of the pipe systems across College Way and Continental Place along a tributary to Kulshan Creek, a parallel 54-inch concrete or 6.42 x 4.33 CMP pipe arch should be constructed. An additional 36-inch CMP culvert should also be constructed across Continental Place.

- As discussed in Section VII, the City should construct a 210-cfs pump station for Kulshan Creek in the City-maintenance yard east of Interstate 5. Increase conveyance with the addition of a 72-inch-diameter gravity flow pipe from Riverside Drive to the new pump station, and a second 48-inch-diameter force main from the pump station to the outlet structure west of I-5. This project can be phased as discussed previously.

- Construct modifications along Madox Creek to the Little Mountain Estates Pond.

- Construct bio-engineered stream channel protection that will prevent further erosion along Madox Creek. Prior to constructing any channel protection, a detailed examination of the erosion potential and further geotechnical and geomorphic investigations should be performed to determine the likelihood and risk of continued erosion, and to recommend what type of remedial actions should be taken.

- Work with the developer to construct a high flow bypass on Flowers Creek.

c. Local System Structural Recommendations. Local system structural recommendations are shown on Table X-1 and described in Section VII.

d. Water Quality Structural Recommendations. As shown on Table X-1 and described in Section VII, water quality structural recommendations consist of a water quality sampling program, and a program to install oil/water separators where sampling results indicate problems with oil and grease.

e. Sensitive Environmental Resource Structural Recommendations. Sensitive environmental resource structural recommendations are shown on Table X-1 and described in Section VII.

3. Recommended Maintenance and Operations Plan

The purpose of a Maintenance and Operations Program is to ensure system reliability, achieve the lowest life-cycle cost for facility replacement, and to use maintenance methods and standards that promote water quality. The recommended stormwater maintenance and operations program will require an annual budget of approximately $195,300, including the equivalent of approximately three full-time staff persons. This represents a slight increase of the current budget and the addition of two maintenance workers. Specific maintenance and operation recommendations include increasing the frequency of catch basin cleaning an average of once every eight months; more maintenance of pipes and small culverts; maintenance of stormwater pump stations; modified maintenance of roadside ditches; purchasing equipment; and, purchasing and implementing a maintenance management software package to support the reporting, scheduling, and completion of maintenance activities.

4. Recommended Financial Plan

The purpose of the financial plan is to develop a financial strategy that will support the recommended surface water management program on a long-term basis. Now that the surface water utility is in place, the overall financial plan is described in more detail in the document *Engineering Report Debt-Funded Stormwater Capital Projects*, April 1995, in Appendix L, as well as updated cash flow projections in Section IX.

Available state and federal grant programs should also be utilized whenever possible, particularly to implement the recommended capital improvement program. Grant funds, as well as other secondary funding sources, can serve to reduce the need for anticipated rate increases.

5. Interjurisdictional Coordination

Many of the recommendations included in this plan will require interjurisdictional coordination. Opportunities may also exist for joint funding of projects. Some of the major coordination efforts are listed in the following paragraphs.

a. Coordination with the Washington State Department of Transportation regarding recommended drainage improvements along state highways.

b. Coordination with Skagit County regarding possible joint public education efforts, and a consistent approach to stormwater management regulations.

c. Coordination with Drainage District 17 and Skagit County on future preparation of a watershed plan for Madox Creek.

d. Coordination of the City's plan with the watershed plan recently completed by Skagit County for Nookachamps Creek. The Nookachamps Creek Plan did not evaluate specific non-point problems related to stormwater runoff, because it suggested these issues are already being addressed by Mount Vernon and Skagit

County in their respective plans. The Nookachamps Plan does recommend that Mount Vernon adopt clearing and grading ordinances that meet the intent of Ecology's minimum requirements (this ordinance was adopted by the City in July 1995). The Nookachamps Plan also recommends that a memorandum of agreement be developed between Mount Vernon and Skagit County to define a process for project review when a development proposal in either jurisdiction can have an impact on surface water resources in the other jurisdiction. The Nookachamps Plan also recommends that the City of Mount Vernon fund pollution control equipment on drainage systems that are part of the Nookachamps basin. The Nookachamps Plan also recommends that the City of Mount Vernon allocate a specific percentage of time for an inspector to inspect drainage projects in the City that are also in the Nookachamps Watershed. The Nookachamps Plan also recommends that the City of Mount Vernon should implement a storm drain stenciling program. The Nookachamps Plan also recommends cross training Skagit County and Mount Vernon staff involved in permitting and inspection to identify code violations that might impact water quality. The Nookachamps Plan also recommends education forums for Skagit County Commissioners and the Mount Vernon City Council on stream protection and recycling programs.

e. Coordination with the Washington State Department of Fisheries regarding habitat management and improvements to the area streams.

D. Plan Goals

Implementation of the recommended solutions will enable the City to achieve the goals and objectives that were defined in Section II. The following paragraphs provide an explanation of how these goals and objectives can be achieved by implementing the recommended solutions.

Goal #1 - Prevent property damage from flooding

a. **OBJECTIVE:** Require adequate peak flow controls for new development.

This objective has been accomplished because the City has adopted a new drainage ordinance consistent with the minimum requirements contained in Ecology's *Stormwater Management Manual for the Puget Sound Basin*. This ordinance includes requirements for peak flow controls. The ordinance is contained in Appendix I.

b. **OBJECTIVE:** Perform the necessary analysis and recommend solutions for existing flooding problems.

As discussed in Section VII, the existing drainage system was analyzed to determine existing conveyance problems, and problems that might occur under future development conditions as well. Solutions to these problems are presented in the recommended plan under both the regional and local system solutions.

c. **OBJECTIVE:** Employ management strategies in flood prone areas to ensure that new development is not exposed to significant flood risk.

The recommended plan includes a number of management strategies to minimize flood risk. These include enforcement of the new drainage ordinance with strict detention standards, and requirements for an offsite analysis to determine any adverse impacts downstream. The plan also includes management strategies for streamside corridors and wetlands that will also minimize flood risk for new development.

Goal #2 - Maintain good water quality

a. **OBJECTIVE:** Attempt to meet state Class A Water Quality Standards in area streams.

A number of recommendations for are proposed for improving water quality such as a public education program, source controls, erosion control, maintenance, spill response, prevention of illicit dumping, wetland protection, new ordinances, and residential, commercial, and agricultural water quality BMPs. A sampling program has also been recommended to monitor water quality parameters and progress towards achieving water quality goals.

b. **OBJECTIVE:** Require adequate erosion and sedimentation controls from new construction sites.

This objective has been accomplished because the City adopted a new drainage ordinance consistent with the minimum requirements contained in Ecology's *Stormwater Management Manual for the Puget Sound Basin.* This ordinance includes requirements for erosion and sediment controls. The ordinance is contained in Appendix I.

c. **OBJECTIVE:** Require adequate water quality controls for new development.

This objective has been accomplished because the City adopted a new drainage ordinance consistent with the minimum requirements contained in Ecology's *Stormwater Management Manual for the Puget Sound Basin.* This ordinance includes requirements for water quality BMPs. The ordinance is contained in Appendix I.

d. **OBJECTIVE:** Implement public education programs to reduce the source of pollutants entering surface waters.

The plan recommends that a public education program be implemented to improve stormwater quality. This education program includes components to inform citizens about surface water quality source controls, erosion control, spill response, prevention of illicit dumping, maintenance of private drainage systems, and residential, commercial, and agricultural water quality BMPs.

Goal #3 - Preserve sensitive resources and maintain varied use

a. **OBJECTIVE:** Preserve fish and wildlife habitat.

The plan includes a number of preservation and enhancement projects for fish habitat. The plan includes an inventory of City streams by category, and the City's Critical Areas Ordinance provides adequate protection for stream corridors by specifying minimum setback requirements according to the stream category.

b. **OBJECTIVE:** Preserve wetlands and implement a wetlands management strategy.

The plan includes a recommendation that the City review the wetlands management section of the City's Critical Areas Ordinance to determine the need for a wetland classification system and associated buffers. The report also suggests several alternative wetlands management strategies with the recommendation that these be reviewed and that a policy decision be made as to which alternative should be implemented.

c. **OBJECTIVE:** Provide public access and recreation opportunities.

The plan does not include specific recommendations on public access and recreation opportunities. A number of opportunities exist within areas along the City's streams for trails and passive recreation. If these recreational opportunities are pursued, additional buffer requirements may be necessary so that human recreation does not interfere with fish and wildlife habitat needs.

d. **OBJECTIVE:** Preserve open space.

The plan does not include specific recommendations on preserving open space, but recommendations on preservation of wetlands and fish habitat will preserve open space associated with surface water resources.

e. **OBJECTIVE:** Review the City's Sensitive Areas Ordinance to ensure consistency with the surface water management program goals.

As mentioned previously, the plan includes a recommendation to that the City review the wetlands management section of the City's Critical Areas Ordinance to determine the need for a wetland classification system and associated buffers.

Goal #4 - Develop a continuous and comprehensive program for managing surface water.

a. **OBJECTIVE:** Ensure a dedicated funding source for program implementation.

The City has implemented a surface water utility as the primary funding source for implementing the plan.

b. **OBJECTIVE:** Coordinate the City program with the Skagit County program.

Several recommendation have been included to coordinate the City of Mount Vernon's program with programs in Skagit County and adjacent drainage districts. These include coordination with Drainage District 17 and Skagit County on future preparation of a watershed plan for Madox Creek. The plan also lists the recommendations as they relate to Mount Vernon from the Nookachamps Creek Watershed Plan prepared by Skagit County.

11/15/95

Table X-1
CITY OF MOUNT VERNON CAPITAL IMPROVEMENT PLAN

REGIONAL SYSTEM PROBLEMS

Problem No	Location	1995 Costs	Escalated Costs																		
			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
RS1	Construct new Riverbend Road (Freeway Drive) System	1750000		1750																	
RS1	Design new Riverbend Road (Freeway Drive) System	242000	121	121																	
RS2	Install two additional 36" culverts at Parker Way	13000									19										
RS3	Culvert replacement at College Way update price	109000							142												
RS4a	Kulshan Creek Pump Station Phase I (1)	3339000		3489																	
RS4b	Kulshan Creek Pump Station Phase II - Beyond 20 Years	672000																			
RS6	Little Mountain Estates Detention Pond modifications	Developer Build																			
RS7	Erosion control on Madox Creek	393000										584									
RS8	Madox Creek-Drainage District 17 Study	44000			48																

LOCAL SYSTEM PROBLEMS

Problem No	Location	Cost	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
LS6	Install log bed control weir to control erosion north of Cedar Lane	11000			12																
LS7	MH drop structure and pipe extension on Kulshan tributary near Viewmount	48000			52																
LS8	Culvert replacement along N 16th north of Florence	29000											46								
LS9	Park Village Mobile Home Park	53000							69												
LS10	Culvert Replacement at Kiowa and Seneca	22000			24																
LS11	Install trashrack at storm drain inlet near Kiowa and Nez Perce	500			1																
LS12	Replace storm drain system in W. Mount Vernon along Memorial Highway	557000														987					
LS13	Install additional catchbasins at Wall Street and Garfield Street	14000			16																
LS14	Install a new catchbasin and storm drain connection at Wall Street north of Memorial Hwy	40000								55											
LS15	Replace 16 of the storm drains between Division and Fir just west of LaVenture	371000																		785	
LS16	Install log bed control weir in stream between Mohawk and Apache.	11000								15											
LS17	Install culvert and ditch at Comanche Drive	14000									20										
LS18	Culvert replacement at Shoshone east of Sioux	24000							31												
LS19	Install armoured spillway in two detention ponds near Waugh and Division	59000											92								
LS20	Install storm drain west of S 6th upto Lind and connect to Madox tributary	155000										230									
LS22	Install catchbasin and storm drain connection for the NW corner of Riverside and Fir	100000													170						
LS23	Install storm drain connection along I-5 between Cameron and Kulshan Pump Station	73000															135				
LS25	Replace 3 pipes between Britt Slough and Blackburn Road	284000																	574		
LS26a	Upgrade drainage system on Fox Hill Street - Replace Pipes in Street	235000										349									
LS26b	Upgrade drainage system on Fox Hill Street - Install Pipe in Deep Ditch	66000			72																
LS27	Replace 2 pipes along I-5 between Blackburn and Anderson Road	50000															93				

WATER QUALITY PROBLEMS

Problem No	Location	Cost	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
WQ1	Water Quality Monitoring Program	39000			21							29									
WQ3	Oil/water separators	328000			21	22	23	24	25	26	27	29	30	31	33	34	36	37	39	41	43

ENVIRONMENTAL RESOURCE PROBLEMS

Problem No	Location	Cost	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
E1	Kulshan Creek Pump Station - Fish ladder	Included in RS4																			
E2	Manhole barrier in Kulshan east of Railroad	2000	2																		
E3	Log weir fish structure - Kulshan Creek north of Cedar Lane	11000						14													
E4	Restore channel on Kulshan from Riverside to N 18th (2,200 feet)	104000				15		16		18		19		21		23		25		27	
E5	Restore channel on mainstem of Trumpeter (7,000 feet)	328000			40		43		47		52		57		62		67		74		80
E10	Remove Culvert and restore stream channel on Madox near Anderson	40000																		85	
E11	Log weir fish passage structure d/s of culvert on Madox Creek at Blackburn Road	11000																			24
E13	Add riparian vegetation on Flowers Creek between Madox and Blodgett (1,500 feet)	38000				44															
E14	Log weir fish passage structure on Flowers Creek at Blodgett Road	11000																			24
E15	Restore channel on Carpenter Creek along Bacon Road (1,600 feet - one side)	21000																			46

Total	$9,711,500	123	5360	306	80	66	54	315	114	118	1241	224	52	265	1044	332	62	687	938	217
Total 1995-2004	$7,129,500																			
Total -After 2005	$2,582,000																			

(1) Project cost adjusted to reflect $724,500 grant.

SECTION XI
BIBLIOGRAPHY

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