CITY OF ALGONA

KING COUNTY WASHINGTON

COMPREHENSIVE FLOOD HAZARD MANAGEMENT PLAN

1/27/97

EXPIRES: 12-14-1998

G & O No. 95743

JANUARY 1997

Gray & Osborne, Inc.
CONSULTING ENGINEERS
701 DEXTER AVENUE NORTH SUITE 200
SEATTLE, WASHINGTON 98109 • (206) 284-0860

Table of Contents

List of Figures

List of Tables

1. EXECUTIVE SUMMARY

1.1 INTRODUCTION

The City of Algona in King County, Washington contracted with Gray & Osborne, Inc. to prepare this Comprehensive Flood Hazard Management Plan under a grant from the Flood Control Assistance Account Program (FCAAP) within the Department of Ecology. The planning area is within the jurisdictional limits of the City of Algona. However, storm drainage from Algona depends, to a large extent upon the efficiency of stormwater conveyance to the north in the City of Auburn and to the south in the City of Pacific. Thus the study area in this report includes portions of those jurisdictions.

The goal of this plan is to minimize loss of or damage to property due to flooding from storm events. Specific objectives of the plan include addressing the following issues:

- Capacity of the stormwater drainage system within the City of Algona,
- Impediments to drainage to the north through the City of Auburn,
- Impediments to drainage to the south through the City of Pacific,
- Flat gradients and high water table causing poor drainage.

This plan addresses these issues within the context of the reoccurring flooding in the Green River valley and specifically the Mill Creek (Auburn) tributary to the Green River. Currently the Cities of Kent and Auburn and King County Surface Water Management are studying flooding in the Mill Creek valley. This work, to the extent that it is applicable, shall be incorporated into this plan.

1.2 PROJECT METHODOLOGY AND PUBLIC PARTICIPATION

Drainage problems were evaluated both qualitatively and quantitatively. The qualitative assessment included:

- A synthesis of the reports issued by Northwest Hydraulics Consultants, Inc. for King County, Auburn and Kent addressing flooding in Mill Creek,
- Discussions with representatives from these jurisdictions regarding flood control planning efforts,

- Discussions with Algona city staff regarding the stormwater system and recommendations as to how it or maintenance on it might be improved,
- Input from the citizens at a public meeting regarding flooding issues and particularly impacts from the February 8 & 9, 1996 storm,
- Assessment of non-structural alternatives to mitigate flooding in Algona.

The quantitative analysis was performed to:

- Estimate runoff to the stormwater conveyance system from various storms and with different land uses,
- Estimate flow within the stormwater conveyance system,
- Determine stormwater pipe capacity and replacement pipe size if necessary.

The combination of qualitative and quantitative techniques resulted in a series of recommendations. These recommendations, if implemented, should reduce flooding on new and existing structures.

1.3 RECOMMENDATIONS

Recommendations regarding future flood control management, both structural and non-structural, were developed from the results of the quantitative and qualitative analyses (Table 1-1). Prioritization of the recommended management solutions were developed in cooperation with the City. The proposed schedule represents the most likely rate of implementation of this Plan based upon projected funding (Section 7.2).

Stormwater Utility - The City should consider the formation of a stormwater utility to finance capital improvements to the stormwater system. Estimated rates are approximately $4.25 per month per equivalent residential unit. This rate will finance capital upgrades to the system and ongoing maintenance (Section 7.4).

Flood Insurance - The City should encourage citizens to purchase flood insurance. Portions of the City lie below elevation 69 feet which the Federal Emergency Management Agency (FEMA) has established as the 100-year flood elevation immediately north of Algona in Auburn. Those areas within Algona below 69 feet could be included within the 100-year floodplain by submitting a detailed topographic map showing the 69 foot elevation contour to FEMA.

Minimum Floor Elevations - The City should adopt an ordinance which sets minimum floor elevations for all new construction at 71 feet or one foot above road level, which ever is greater. Elevation 71 feet is two feet above the projected 100-year flood elevations established by the FEMA.

Maintenance - A written scheduled maintenance plan should be developed. This plan should include a check on all major drainage outlets and features on a regularly scheduled basis. In addition, if weather forecasts predict a rainfall event of over one inch in the next 24 hours, the outlets should be checked.

Pipe Replacement - Some of the stormwater pipes have been identified as being undersized. To mitigate future flooding these pipes should be replaced as finances become available

Increased Cooperation with Neighboring Jurisdictions (Interlocal Agreements) - The City should negotiate with neighboring jurisdictions to ensure that downstream conveyances are kept open. Particularly the City should attempt to ensure that sedimentation transport from Peasley Canyon to the culvert under SR 18 is reduced and that sediment does not create a block to water flow. Keeping the conveyance through the SR 18 culvert free of sediment is probably the single most important factor influencing flooding in northern Algona, aside from rainfall.

Table 1-1

Summary of Problems and Recommendations

Purpose	Recommendation	Rank	Cost Estimate 1996 Dollars
Provide funding dedicated to capital improvements to, and maintenance of, the stormwater system	Create Stormwater Utility	1	N.A.
Minimize flood damage to future buildings	Set Minimum Floor Elevations at 71 feet	2	N.A.
Flood damage coverage	Encourage Citizens in flood prone areas to buy flood insurance	3	N.A.
Increase pipe conveyance capacity	Replace pipes as recommended in Chapter 7	4	$433,000
Maintain full capacity in existing system	Develop and implement regularly scheduled maintenance plan	5	$20,000/yr
Increase cooperation with neighboring jurisdictions	Form interlocal agreements which target maintaining open conveyances in Pacific and Auburn	6	N.A.

2. INTRODUCTION

2.1 AUTHORITY AND SCOPE

2.1.1 Legal Authority under 86.26 RCW

The preparation of this plan is authorized under Chapter 86.26 RCW, and in particular Section 86.26.040, which describes those projects to which the State may allocate flood control assistance account funds. Section 86.26.050 precludes State participation with a county or other municipal corporation for flood control projects until a comprehensive flood control management plan has been completed and adopted by the appropriate local authority, in this case, the City of Algona.

2.1.2 Agreements and Sponsorship of Local Government

The City of Algona in King County, Washington contracted with Gray & Osborne, Inc. on August 15, 1995 to prepare a Comprehensive Flood Hazard Management Plan for the City of Algona. The Plan was prepared under the direction of the Algona Public Works department with input from the Cities of Auburn and Pacific and King County Surface Water Management.

Algona received a grant (No. G96000, August 15, 1995) from the Washington Department of Ecology Flood Control Assistance Account Program (FCAAP) to prepare a Comprehensive Flood Hazard Management Plan which proposes mechanisms to minimize flooding.

2.1.3 Plan Scope

The scope of this plan is as described in the 1991 DOE planning manual *Comprehensive Planning for Flood Hazard Management*. Flood hazards and management alternatives are evaluated for the 10-year, 25-year and 100-year storm event. This plan evaluates methods and estimates costs to reduce flooding due to inadequate capacity in, or poor location of, the existing stormwater conveyance system. Backwater effects from areas outside of the City of Algona are also considered. Poor drainage from private lots to the stormwater system is not evaluated.

2.2 BACKGROUND

2.2.1 Need for plan

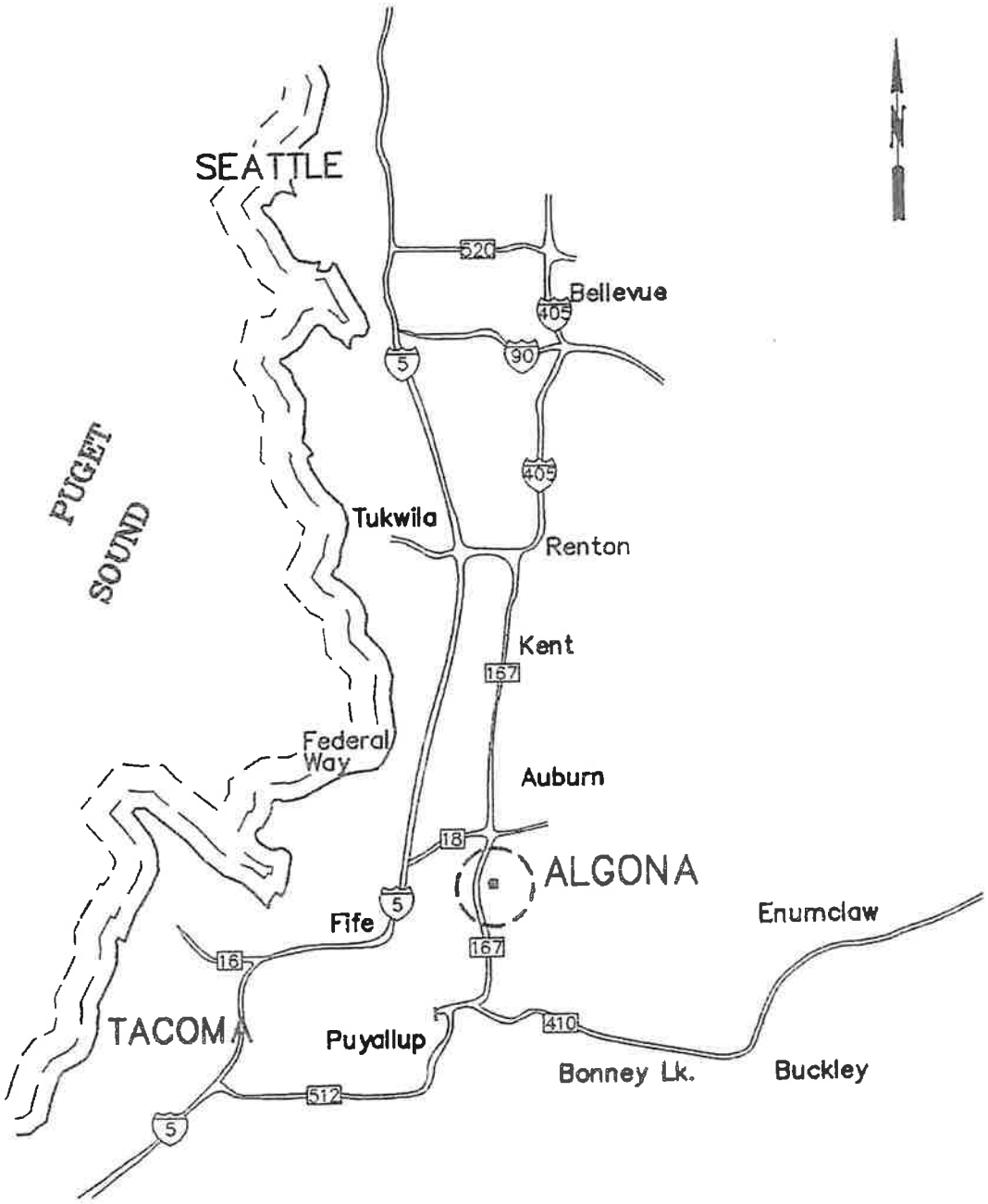
The City of Algona is located in southern King County in the lower Green River and White River valleys (Figure 2-1). The City has a history of recurrent flooding problems. Most recently properties were flooded during the November 1990 and February 1996 floods. The flooding results from a combination of insufficient capacity within the Algona system, backwater effects from areas offsite and poor drainage from low spots on private property. This plan was developed to help the City prioritize flood control management techniques.

2.2.2 Plan Adoption / Implementation

The City of Algona may adopt this plan and its recommendation for capital improvements. If the plan is adopted, capital projects would be approved for design and construction in the annual budgeting process. Non-structural elements of the adopted plan would be implemented through passage of resolutions and ordinances (as in the case of minimum floor elevations) or through the annual budgeting process (as in the case of increased maintenance).

2.2.3 Description of Flood Control Assistance Account Program (FCAAP)

The FCAAP in the Department of Ecology was established by the Washington State Legislature in 1984 to help local jurisdictions reduce flood hazards and flood damages. Grants are available for up to 75% of the cost of funding Comprehensive Flood Hazard Management Plans and up to 50% for projects that preserve or restore natural conditions, or restore or enhance facilities or structures.



CITY OF ALGONA

PROJECT LOCATION

FIGURE 2-1

Gray & Osborne, Inc.

CONSULTING ENGINEERS

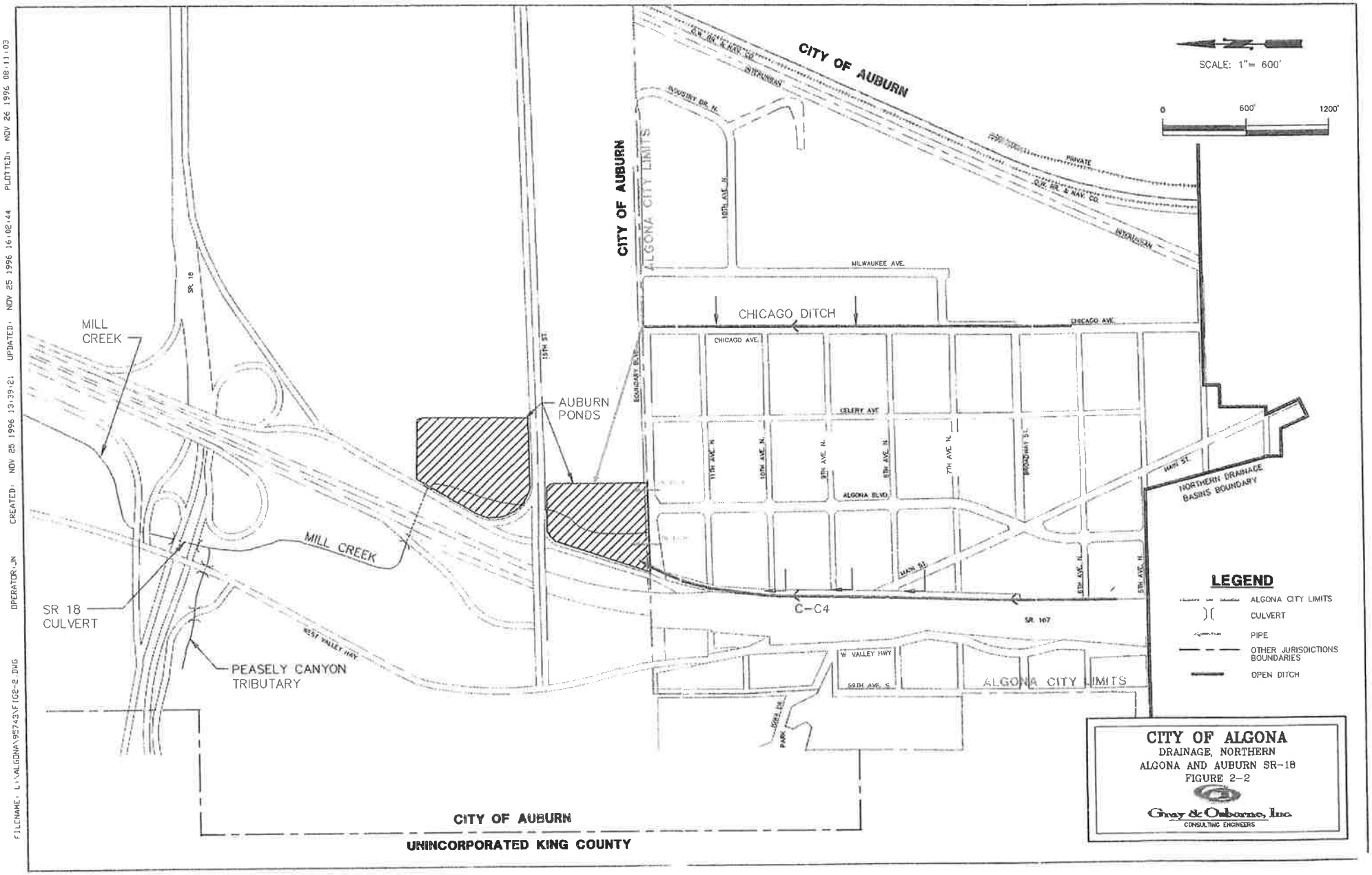
2.2.4 Historical Background

The City of Algona's flooding problems have been occurring since development in the area began. The area originally was swampy with a high water table, creating soggy soil for much of the year, as evidenced by the widespread presence of the Seattle Muck soil type. This soil type forms in upland depressions and in river valleys (USDA, 1973) with a seasonal water table at or near the ground surface. Original flood control efforts included the digging of agricultural drainage ditches in order to lower the high water table.

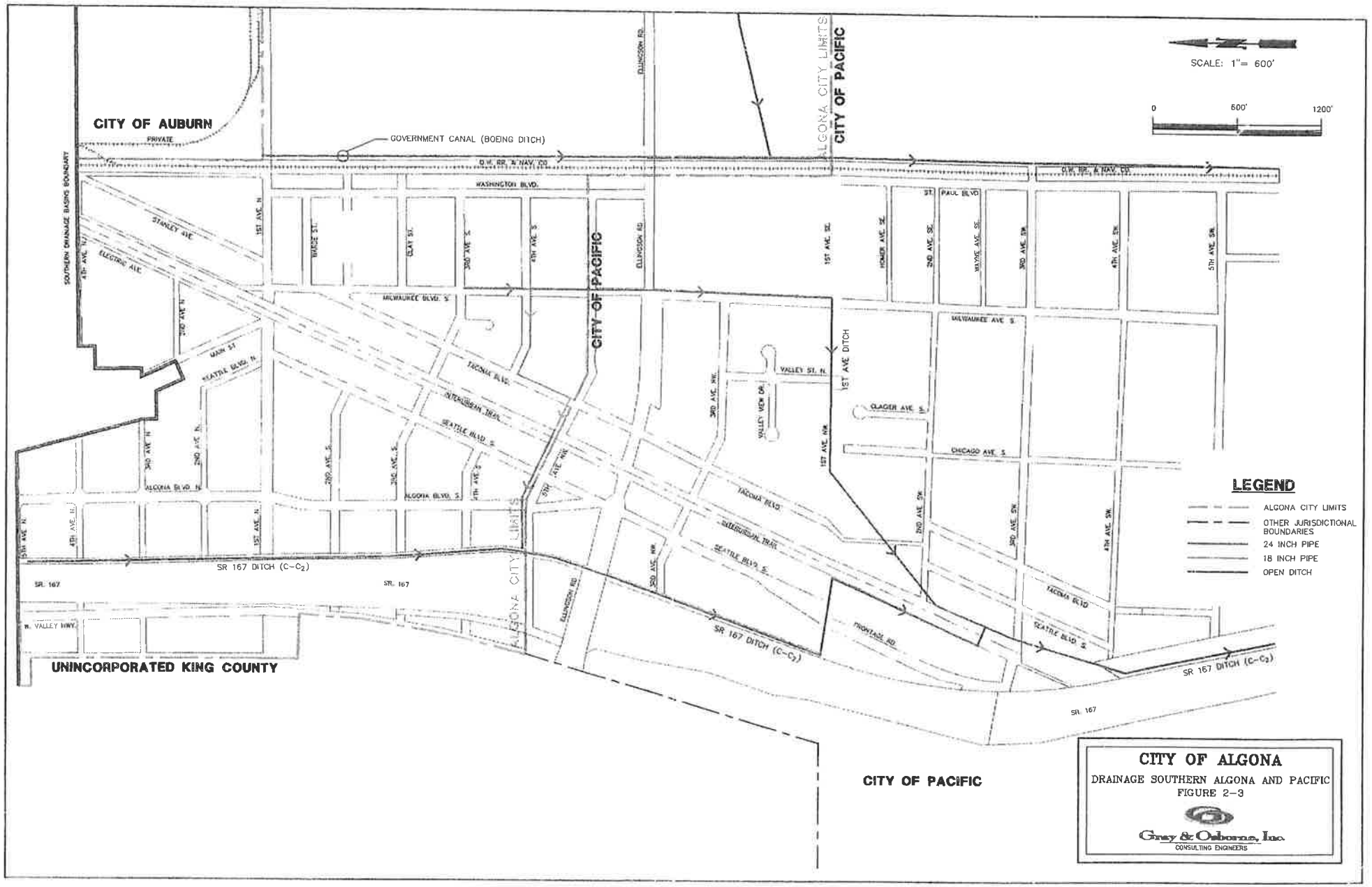
Since incorporation of the City a stormwater drainage system has been installed to improve runoff and reduce flooding. State Route 167, constructed in the early 1970s, increased the volume of stormwater runoff to the receiving waters and altered the drainage patterns in Algona. To control runoff and reduce flood volumes entering Mill Creek the Auburn 400 ponds were constructed in 1983 adjacent to the northern boundary of Algona (Figure 2-2). All stormwater from the northern portion of Algona discharges into these ponds. The ponds were designed to provide flood control and wetland habitat. However, maintenance has been largely deferred and sediment deposition and vegetation growth in the ponds has reduced their volume.

As part of the construction of SR 167 the Washington Department of Transportation (DOT) constructed a large drainage ditch paralleling the east side of the freeway. However, in the City of Pacific south of Algona, from 1st Ave NW to 4th Ave SW, the DOT routed stormwater through existing ditches in Pacific instead of along the freeway. This area has experienced flooding due to the large amount of runoff and partial blockage of the ditch due to deferred maintenance. All stormwater from the southern portion of Algona discharges to Pacific (Figure 2-3).

Subsequent to the construction of SR 167 and the Auburn 400 Ponds the City of Algona undertook a major capital improvement program of its stormwater conveyance system. The City enlarged, redirected and replaced the storm drainage ditches on 8th, 10th and 11th Avenues North with pipes. This was done to improve conveyance and reduce maintenance costs.



FILENAME: L:\ALGONA\95743\FIG2-2.DWG OPERATOR: JN CREATED: NOV 25 1996 13:39:21 UPDATED: NOV 25 1996 16:02:44 PLOTTED: NOV 26 1996 08:11:03



CITY OF ALGONA

DRAINAGE SOUTHERN ALGONA AND PACIFIC

FIGURE 2-3

Gray & Osborne, Inc.
CONSULTING ENGINEERS

FILENAME: L:\ALGONA\95743\FIG2-3.DWG OPERATOR:GERST CREATED: AUG 07 1996 19:53:19 UPDATED: SEP 16 1996 20:19:10 PLOTTED: SEP 16 1996 21:16:40

In 1988 PAC-TECH completed the *City of Algona, Comprehensive Storm Drainage Study* (PAC-TECH, 1988). This report provided a detailed description of the stormwater conveyance system in existence at that time. In addition the report contained recommendations to upgrade the conveyance system. The recommendations called for a combination of ditch replacement with pipes and increasing the size of existing pipes. No justification or sizing criteria was given in the PAC-TECH report, except that sizes were based upon a 25-year storm.

FEMA issued a series of maps in 1989 delineating the 100 year floodplain in the lower Green River and Mill Creek basins. Those maps indicate that the Mill Creek 100-year floodplain, in the southern portion of Auburn, is at elevation 69 feet. The study area stopped at the Auburn-Algona boundary and did not extend into Algona. However, the 69 foot elevation in the northern portion of Algona was drawn by interpolation between elevation contours on the topographic maps presented as part of the PAC-TECH (1988) study. The resulting 69-foot elevation contour in northern Algona indicates the probable 100-year flood limit (Figure 2-4).

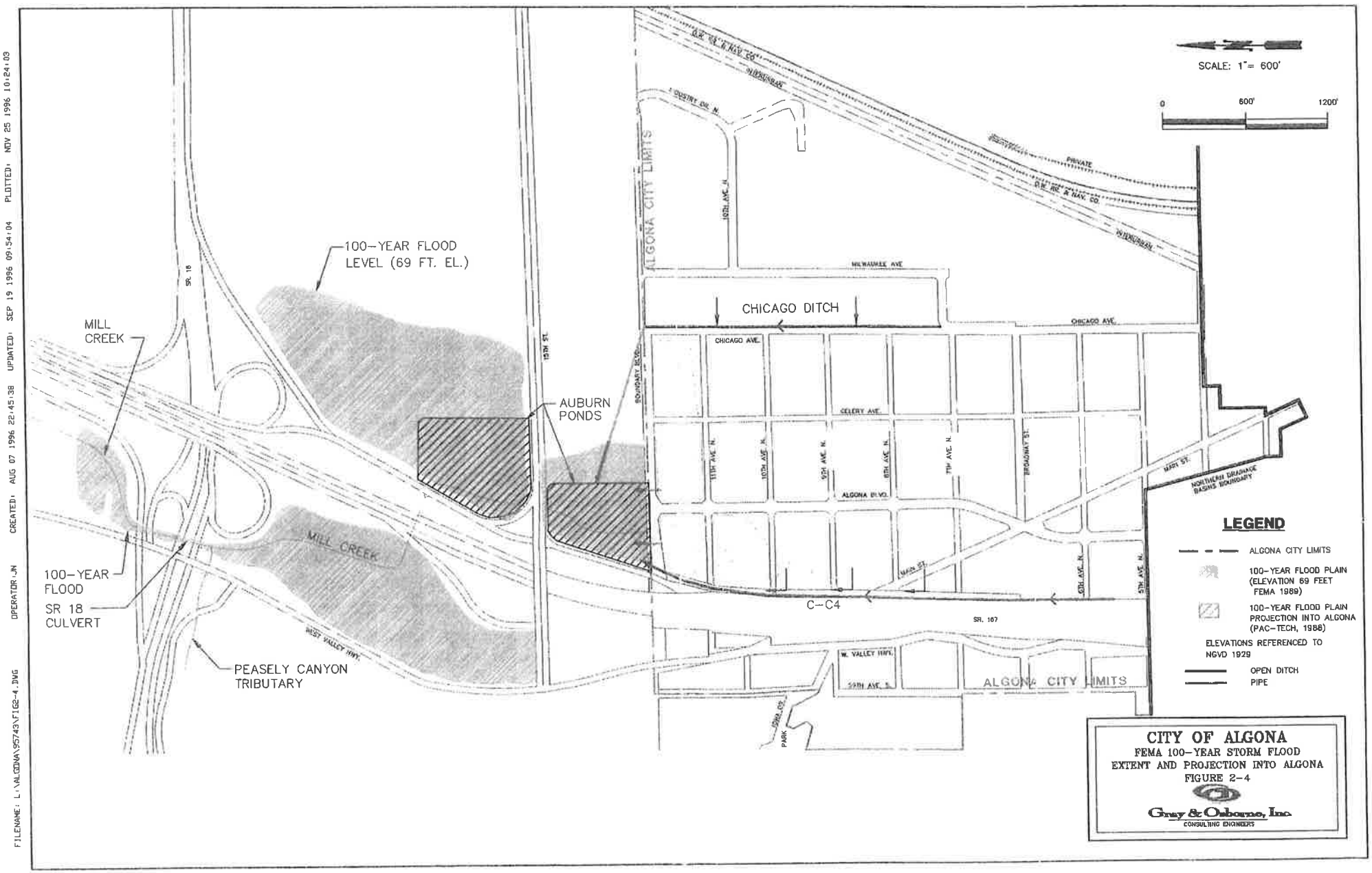
In 1994 the Auburn Super Mall constructed detention facilities north of the northern Auburn 400 Ponds to mitigate increased stormwater runoff from the mall. The large detention pond was designed to mitigate flooding impacts to Mill Creek due to increased runoff. Hydraulic modeling has indicated that runoff from the Mall will increase water levels in the Auburn 400 Ponds, north of Algona by about 0.25 feet for a 100-year storm (Northwest Hydraulics, 1993a).

The Chicago Ditch drains that portion of the Auburn 400 Corporate Park located in Algona. This ditch drains northward, discharging to the Auburn 400 ponds. The Government Canal (Boeing Ditch) drains the Boeing Auburn facility east of the Burlington Northern railroad tracks. This drainage ditch was constructed in the early 1940s and drains into the White River.

On a regional scale comprehensive flood control planning in the Green River and White (Stuck) River valleys began when the Corps, constructed the Mud Mountain Dam on the White River to reduce flooding in the White River valley between 1939 and 1948. The Howard Hansen Dam on the Green River was constructed between 1959 and 1961. This effort was complemented by the construction of levies along the lower Green River. The

levies were constructed by various organizations and entities but most are now maintained by King County. The levies are constructed to prevent flooding up to a discharge level of 12,000 CFS in the Green River at the Auburn gaging station.

Since the 1960s significant population growth has occurred in the Green and White River valleys. This growth has caused significant land use change and probably has increased the volume and rate of stormwater runoff to both these rivers and to Mill Creek which drains to the Green River. The flooding in Algona is at least in part caused by insufficient flood water transport in the upper reaches of Mill Creek. Thus if flooding in the upper portions of Mill Creek, in Auburn and unincorporated King County, were controlled Algona would benefit.



FILENAME: L:\ALGONA\95743\FIG2-4.DWG OPERATOR: JN CREATED: AUG 07 1996 22:45:38 UPDATED: SEP 19 1996 09:54:04 PLOTTED: NOV 25 1996 10:24:03

2.2.5 Maintenance and Easement Agreements on Major Storm Water Conveyances

Government Canal

Our understanding is that Boeing is responsible for maintenance of the Government Canal. Boeing bought the Government Services Administration facility in Auburn in the 1960s. As part of that purchase Boeing also agreed to maintain the Government Canal. An east-west ditch across the southeastern portion of Algona, which is tributary to the Government Canal, is under the same agreement. The east west ditch drains the southeastern portion of the Boeing facility and an apartment complex (N. Konwent, 1996, personal communication).

SR 167 Ditches

As a part of the agreement between the WDOT and Algona for the construction of SR 167 the WDOT widened and repaved Algona Boulevard. In exchange for this Algona agreed to take over the maintenance of the SR 167 ditches, ($C\text{-}C_4$ and $C\text{-}C_2$), within the City limits. Pacific also assumed maintenance for the $C\text{-}C_2$ ditch within its jurisdiction. The Cities cleaned these ditches once in 1987 in a cooperative program. Since that time no work has been performed on the ditches.

Chicago Ditch

An agreement between Algona and the Quadrant Corporation calls for the businesses in the commercial area bordering the Chicago Ditch to maintain it. As part of the agreement the business park is supposed to build and the City is supposed to maintain a sedimentation pond at the south end of the ditch (Appendix D). To date this sedimentation pond has not been built. However, each commercial facility in this development has built its own stormwater detention facility on-site.

City ditches

The stormwater ditches and pipes within the City traverse private property. Examples of easements which the City has, in order to maintain its stormwater system are presented in Appendix D.

2.2.6 Interlocal Agreements between Algona and Neighboring Jurisdictions

Pacific

As the flooding in Algona is influenced by the facilities and maintenance practices of neighboring jurisdictions, Algona should pursue agreements and memorandums of understanding with neighboring jurisdictions regarding stormwater management. Algona has worked cooperatively in the past with both Auburn and Pacific on project specific tasks. For example, Algona joined with Pacific to clean the 1st Ave ditch in Pacific in 1989 and the southward flowing SR 167 ditch in 1986.

Auburn and King County

King County, Auburn and Kent have entered into a local agreement to address flooding issues in the Mill Creek basin. That study will present a recommended alternative to reduce the chronic flooding problems within the Mill Creek basin. If this alternative is adopted and successful the flooding in Mill Creek and the northern end of Algona will be reduced. Implementation of the plan is estimated to occur over the next 20 years.

2.3 METHODS AND PLANNING PROCESS

Figure 2-5 outlines the process for preparing the Comprehensive Flood Hazard Management Plan.

2.3.1 Role of the Project Committee

The Project Committee consisted of representatives from the Cities of Algona, Auburn, Pacific and King County Surface Water Management. The project committee provided coordination with ongoing efforts in these jurisdictions.

2.3.2 Public Participation Process

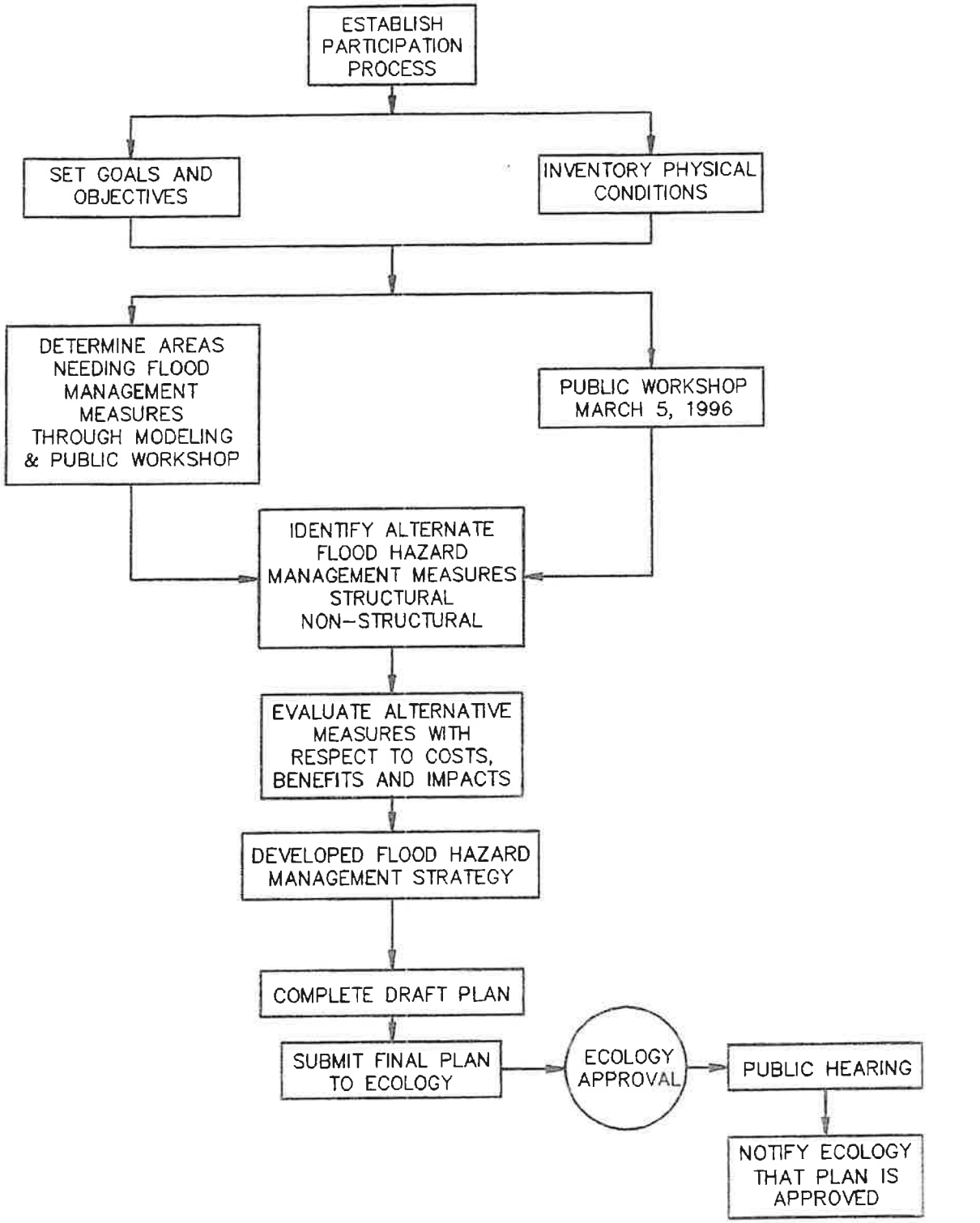
A goal setting meeting and problem identification meeting was conducted on March 5, 1996 with the citizens of Algona. The purpose of this meeting was to receive input from citizens regarding the flooding issues in Algona. The flooding which occurred on

February 8 and February 9, 1996 was a topic of discussion. The meeting was advertised in the local paper the "Valley Press", and invitations were sent out to citizens identified as owning property in flood prone areas. Representatives from the Cities of Auburn and Pacific, King County Surface Water Management, the Washington Department of Transportation, the Washington Department of Fish and Wildlife and the Washington Department of Ecology all were informed of the meeting in advance. Representatives from the Washington Department of Transportation attended.

The citizens at the meeting voiced numerous concerns regarding the flooding problems in Algona. The major concerns focused on:

- Flooding due to backwater effects and undersized or poorly located pipes
- Maintenance
- Future development
- Poor drainage from private lots
- Land subsidence

This plan discusses strategies to mitigate the first three concerns. Many private lots with access to a public drainage system have poor drainage and or low spots disconnected from the City's storm drain system. This type of problem is a site specific issue which must be dealt with on a case by case basis by the property owner. Yard drainage issues are outside the scope of this report and are not addressed. Layers of peat may be present under portions of Algona. Due to land development the peat may have compressed at selected locations causing land subsidence. However, quantification of the increase in flooding due to this settlement is not possible and is beyond the scope of this project.



CITY OF ALGONA

COMPREHENSIVE FLOOD HAZARD MANAGEMENT PLAN PROCESS

FIGURE 2-5

Gray & Osborne, Inc.
CONSULTING ENGINEERS

2.3.3 Overview of Technical Planning Methods

A planning horizon of 20 years was established for this plan. The study and planning areas were established using information from a combination of sources as well as public input. The technical references included the 1988 *Comprehensive Storm and Drainage Study* (PAC-TECH, 1988), Federal Emergency Management Agency 1989 Flood Insurance Rate Maps, *City of Algona - Comprehensive Plan and Final Impact Statement*, (PAC-TECH, 1995), *City of Auburn - Comprehensive Drainage Plan* (CH2M Hill, 1990), *Auburn Supermall Analysis* (Northwest Hydraulics, 1993a), *Mill Creek (Auburn) Modeling* (Northwest Hydraulics, 1993b), *Mill Creek (Auburn) Hydrologic Modeling and Analysis* (Northwest Hydraulics, 1993c), *Mill Creek (Auburn) HSPF Model Calibration* (Northwest Hydraulics, 1993d), *Downstream Analysis of Proposed Auburn Thoroughbred Racetrack* (Northwest Hydraulics, 1995), *Washington Department of Ecology, Stormwater Design Manual* (1992), *Mill Creek Water Quality Management Plan* (King County Surface Water Management, 1993) and aerial photographs (Walker and Associates). Projected land use for the planning horizon was derived from current zoning within the City of Algona. Wetlands were identified based upon the Comprehensive Plan (PAC-TECH, 1995) and previous development projects.

HYDRA hydrologic/hydraulic software was used to estimate the capacity of the stormwater conveyance system using the Soil Conservation Service Curve Number method as modified by the Santa Barbara algorithms. The purpose of this analysis was to evaluate the adequacy of the conveyance system. Backwater flooding effects were evaluated through review and evaluation of the Mill Creek flood mitigation reports.

3. GOALS AND OBJECTIVES

3.1 INTRODUCTION

The goals of flood hazard management include:

- protection of life and property from flooding,
- protection of natural drainage systems from excessive flows and erosion,
- maintenance of water quality in receiving waters. Stormwater runoff should be managed in a manner so that habitat for fish and wildlife, or other beneficial uses, are not adversely impacted,
- Minimization of capital, and operational and maintenance costs.

3.2 DEVELOPMENT OF GOALS AND OBJECTIVES

This plan includes recommendations for specific improvements derived from the goals and objectives outlined in Table 3-1. The goals presented in Table 3-1 include prevention and loss of life and property, preservation of water quality, and minimization of cost. The objectives presented in Table 3-1 are intended to meet these goals. The goals and objectives were developed during discussions with the Project Committee and other public participants. They are not ranked or prioritized. The goals and objectives were finalized in a public meeting held on March 5, 1996.

Table 3-1

Goals and Objectives

Goals - Long Term	Objectives - Short Term
• Prevent the loss of life and property due to flooding while preserving the character and function of the land within Algona.	• Upgrade drainage systems, to reduce flooding due to insufficient conveyance system capacity. • Develop programs in coordination with Auburn, Pacific and King County to mitigate flooding due to backwater effects. • Develop a funding mechanism to ensure long term maintenance of the stormwater conveyance system. • Codify non-structural methods to flood protection.
• Preserve water quality	• Reduce the impact of untreated stormwater runoff by instituting treatment systems where possible.
• Minimize present and future public and private costs for flood control systems	• Prioritize improvements including interjurisdictional agreements so as to maximize benefit while minimizing expense. • Develop long term planning to anticipate the need for purchase of right-of ways, easements and properties. • Develop a regular maintenance program for flood control facilities. • Provide regular public involvement and education regarding flood safety, with particular emphasis on those residences exposed to the greatest risks.

4. PLANNING AREA CHARACTERISTICS AND FUTURE CONDITIONS

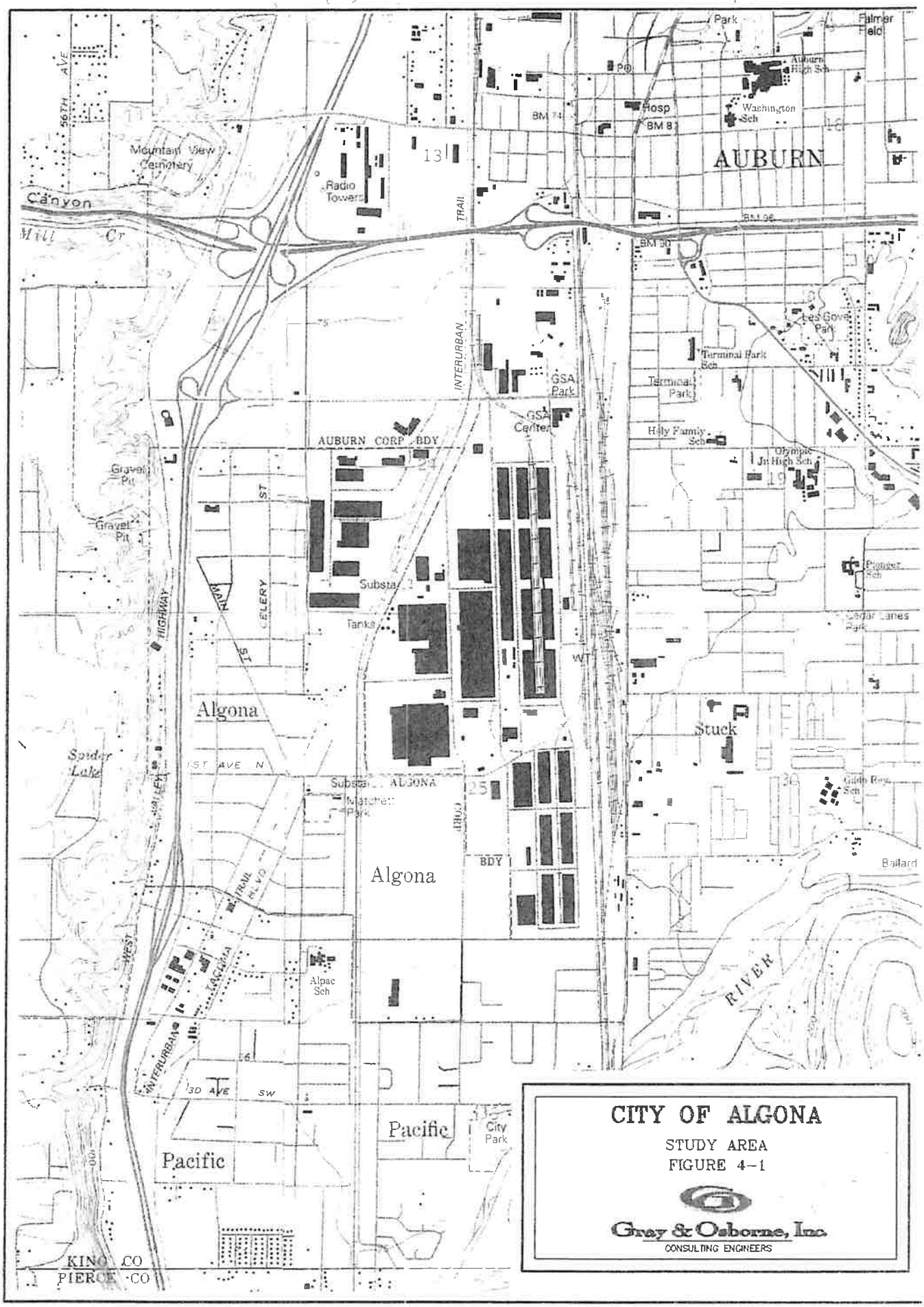
4.1 PLANNING AREA DEFINED

The study area incorporates all of the planning area as well as areas to the north and south (Figure 4-1). The major drainages are Mill Creek to the north, which flows north into the Green River, the Chicago Ditch which drains the Auburn 400 industrial area north to the Auburn 400 ponds, the Channel Change (C-C) ditches which drain SR 167 and the western portions of Algona both north to Mill Creek and south to the White River, and the Government Canal (Boeing Ditch) which drains the area east of the railroad tracks south to the White River.

Within the study area is the "model" area. Within this area stormwater modeling was performed on the drainage network as part of this study. The limits of the area are east of SR 167, west of the Burlington Northern railroad tracks, south of Boundary Boulevard and north of 5th Ave South (Figure 4-2). The southeast portion of the city, east of the railroad tracks, has been designated as wetland areas (PAC-TECH, 1995). Development in this area, other than that which exists already is not anticipated. In addition this area is drained by the Government Canal and is hydraulically separated from the major portion of Algona. Altogether, the model area is about 1.5 miles long in a north south direction and about 0.6 of a mile wide in an east west direction.

4.2 CLIMATE

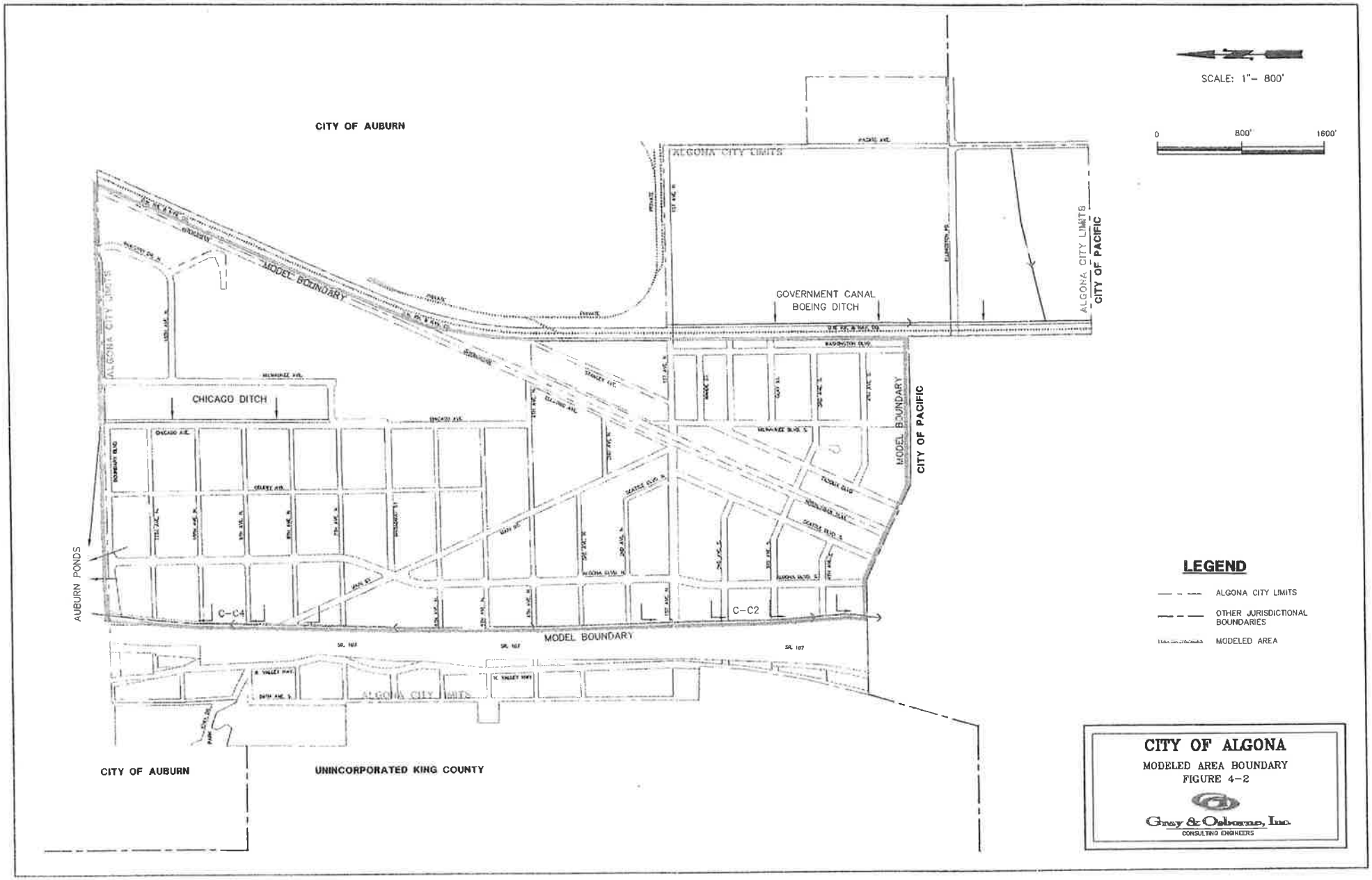
The climate of the Algona area is temperate and typical of that encountered elsewhere on the Puget Sound lowland area. The summers are warm and comparatively dry, and the winters are cool, wet, and cloudy. The Pacific Ocean moderates seasonal temperature and provides the moisture for storms which periodically sweep inland, most frequently during the winter months. Seasonal offshore pressure centers control the prevailing wind direction, which shifts between northwesterly in the summer and southwesterly in the winter. A seasonal reversal in the offshore ocean current, bringing cool water down from the north in summer and warm water up from the south in winter, maintains the temperature between about 40 °F in the winter and about 65 °F in the summer.



CITY OF ALGONA

STUDY AREA
FIGURE 4-1

Gray & Osborne, Inc.
CONSULTING ENGINEERS



FILENAME: L:\ALGONA\95743\TIG-2.DWG OPERATOR: KCEST CREATED: AUG 06 1996 21:26:38 UPDATED: SEP 16 1996 22 44:58 PLOTTED: SEP 16 1996 21:21:40

The majority of weather events with the potential to cause flooding occur during the late fall and winter months. In fall and winter, a low pressure center near the Aleutian islands intensifies and spreads southward, causing the prevailing winds to shift to southwest. Weather disturbances crossing the North Pacific increase and so the number and intensity of storms striking the Washington coast and traveling inland. The intense winter storms are typically accompanied by large quantities of precipitation. Precipitation and other climatological records have been kept at National Weather Service stations at SeaTac airport since 1950.

Average monthly precipitation for the period of record (1950 - 1993) is shown in Figure 4-3. The average annual precipitation over this period was 39 inches. In an average year, the vast majority of the rainfall (75%) occurs in the months of October-March. The period from November 1, 1995 through February 29, 1996 had the largest amount of rainfall of any four month period on record, 32.5 inches. Approximately 2.5 inches of rain occurred during the heaviest 24-hour period in the week February 4, 1996.

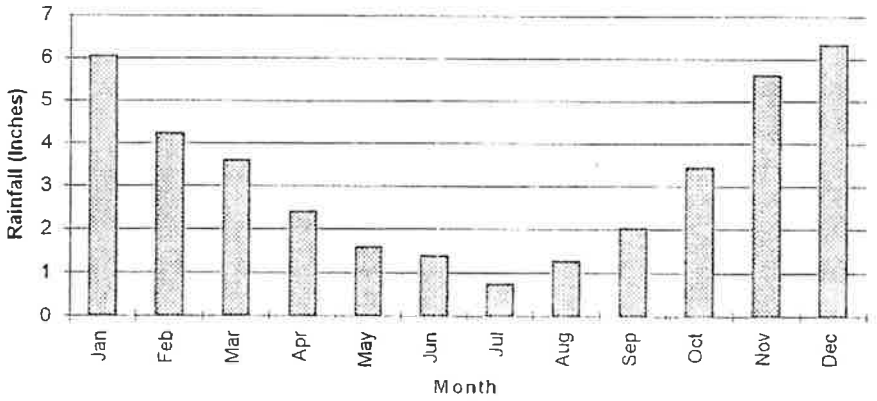


Figure 4-3 Average Rainfall at Seattle Tacoma International Airport

The design of flood control and drainage works is generally predicated upon the use of rainfall data associated with a given frequency of occurrence. King County Surface Water Management (KCSWM) has published precipitation data for the western portions of King County (KCSWM Surface Water Design Manual, 1990) that relates 24-hour rainfall depths to return frequencies. The 24-hour design storm precipitation data used in the preparation of this Plan, is from the 1990 Manual (Table 4-1).

Table 4-1

24- Hour Design Storm Precipitation

Recurrence Interval (Years)	Volume (Inches)
2	2.0
5	2.4
10	2.9
25	3.4
50	3.6
100	3.9

Source: King County Surface Water Design Manual Figures 3.5.1C-3.5.1H

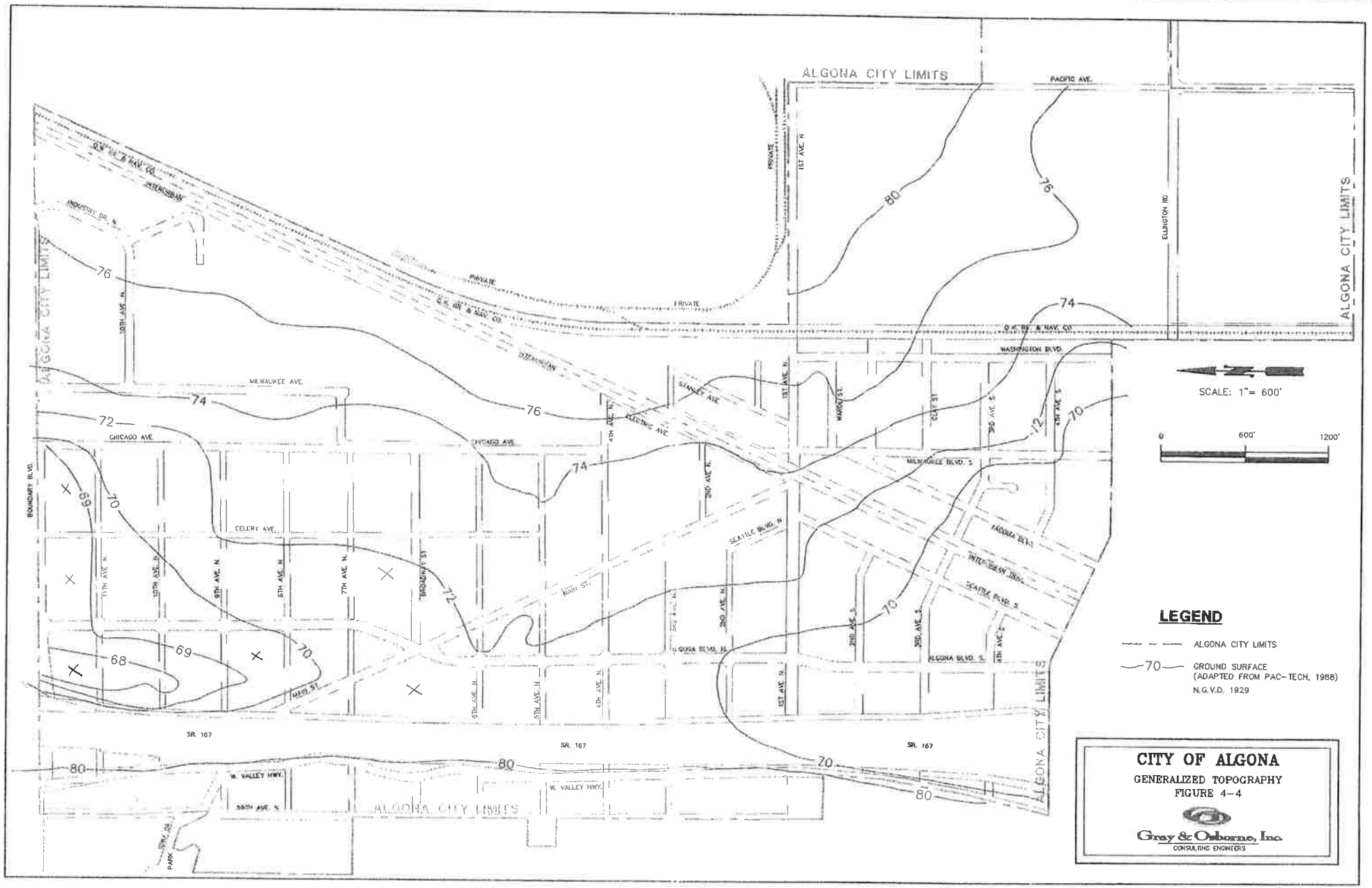
4.3 GEOLOGY, TOPOGRAPHY, SOILS, MINERAL RESOURCES

4.3.1 Geology

The geology of the Algona area has been described by the U.S. Department of Interior, Geologic Survey (USGS) in the Auburn (1965) and Poverty Bay (1961) geologic quadrangle maps. Algona is situated in the floodplain of the Green and White Rivers. The central portion of Algona is located on a surface water divide between the Green and White Rivers. The overall slope to the west reflects the depositional processes which were occurring as sediment was carried by the White and Green Rivers down from the Cascades and deposited when the river entered the valley lowlands. Modeling performed by Northwest Hydraulic Consultants (1993c) indicates that there may be a net movement of ground water to the north from the White River basin into the Green River basin. Thus the surface water and ground water divides may not be coincident.

4.3.2 Topography

The topography in Algona, east of SR 167, is relatively flat. The elevation ranges from approximately 67 feet in the northwestern portion of the City, east of SR 167, to 82 feet in the northeast corner. The highest elevation between SR 167 and Chicago Avenue is about 75 feet not including raised foundation pads (Figure 4-4).



FILENAME: L:\ALGONA\95743\FIG4-4.DWG OPERATOR: JN CREATED: AUG 07 1996 19:11:55 UPDATED: NOV 25 1996 11:01:11 PLOTTED: NOV 25 1996 11:02:12

The topography of the Algona area in general reflects the processes that formed the land surface. Unconsolidated sediments, primarily fine sand and silt with some clayey lenses, were deposited by the Green and White Rivers onto the valley floor by periodic floods. The deposits formed a relatively flat alluvial floodplain with a slight slope to the west. In addition there is a slight rise in the center portion of Algona representing the deposition of alluvial fan sediments from the White River.

4.3.3 Soils

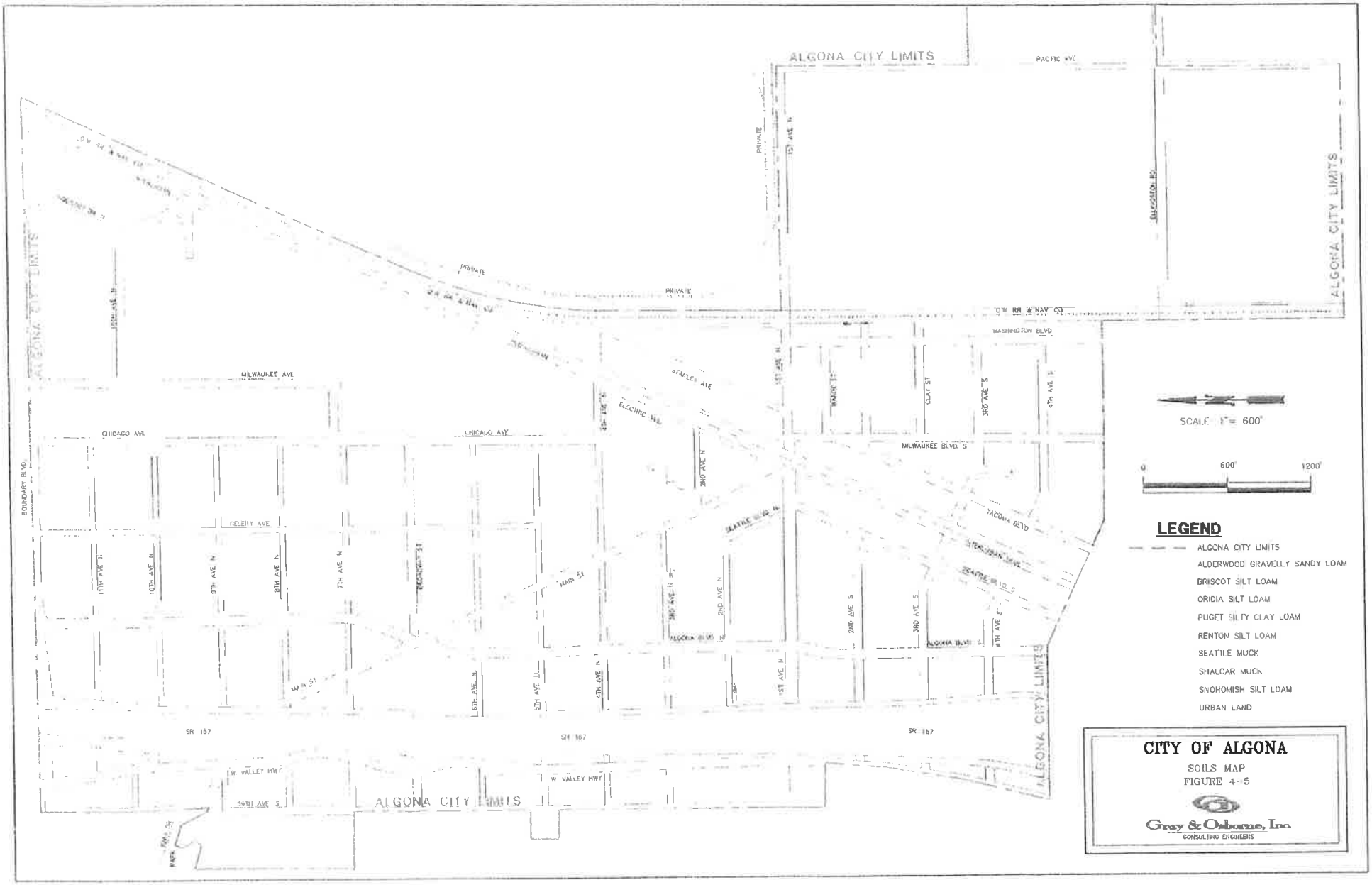
Algona area soils are characterized in the "*Soil Survey of King County Area, Washington*" (USDA, 1973). Soil deposits in the planning area are typically poorly drained with a seasonal high water table at or near the ground surface. The combination of shallow ground water and low topographic (and hydraulic) gradients lead to standing water in depressions during the wet portions of the year. In the uplands and hill slopes in the western portion of the study area the infiltration into the shallow soils may be greater than on the valley floor, especially when the valley floor soils are saturated. However, much of the hill slopes and upland area are underlain by till at depths of approximately six inches. The till is relatively impermeable and causes much shallow subsurface flow (interflow) to occur. The shallow soils can become saturated quickly under wet conditions leading to relatively rapid runoff response time.

Soils found within the study area are described in Table 4-2, and are shown on a soils map (Figure 4-5). The majority of the soils have been identified as Seattle Muck. Map codes refer to the soils types defined by the U.S. Department of Agriculture, Soil Conservation Service (1973).

Table 4-2
Soils in Algona

Soil Group	Hydrologic Group	Map Code	Summary Description
Alderwood and Kitsap	B	AkF	Gravelly sandy loam to silt loam. Slopes 25 to 75 percent. Rapid runoff and severe erosion hazard
Alderwood gravelly sandy loam	B	AgB, AgC	Gravelly sandy loam, runoff slow to medium erosion hazard slight to moderate (AgB 0-6 percent slope; AgC 6-15 percent slope)
Briscot Series	D	Br	Somewhat poorly drained, approximately 9-inches of dark grayish brown silt loam overlying grayish brown to dark brown silt loam. Slopes less than 2 percent. Seasonal water table at 1 - 2 feet below ground.
Seattle Muck	D	Sk	Poorly drained organic black muck. Slopes generally 1 to 2 percent; seasonal water table at or near the ground surface.
Shalcar Muck	C	Sm	Poorly to moderately drained gray brown muck and mucky peat. Slopes generally less than 1 percent. Seasonal water table at or near the ground surface.
Snohomish silt loam	C	So	Poorly to moderately drained dark grayish brown silt loam. Slopes nearly level. Seasonal water table at or near the ground surface.
Urban Land	B	Ur	Disturbed soil with additions of fill.

Source: Soil Conservation Service, King County Area, 1973


ALGONA CITY LIMITS
PACIFIC AVE
PRIVATE
D W RR & NAV CO
WASHINGTON BLVD
MILWAUKEE AVE
CHICAGO AVE
STAPLES AVE
ELECTRIC AVE
MILWAUKEE BLVD S
DELEHY AVE
SEATTLE BLVD N
TACOMA BLVD
MAIN ST
ALGONA BLVD
W VALLEY HWY
SR 167
BOUNDARY BLVD
17TH AVE N
10TH AVE N
8TH AVE N
7TH AVE N
2ND AVE N
3RD AVE S
2ND AVE S
4TH AVE N
1ST AVE N
4TH AVE S
SCALE 1" = 600'
0
600'
1200'
LEGEND
ALGONA CITY LIMITS
ALDERWOOD GRAVELLY SANDY LOAM
BRISCOT SILT LOAM
ORIDIA SILT LOAM
PUGET SILTY CLAY LOAM
RENTON SILT LOAM
SEATTLE MUCK
SHALCAR MUCK
SNOHOMISH SILT LOAM
URBAN LAND
CITY OF ALGONA
SOILS MAP
FIGURE 4-5
Gray & Osborne, Inc.
CONSULTING ENGINEERS

4.3.4 Mineral Resources

There are no actively mined mineral resources within the city limits of Algona. The sand and gravel pit on the western slopes is temporarily closed.

4.4 HYDROLOGY

4.4.1 Surface Drainage Patterns, and Geohydrology

There are no natural streams within the city limits. Drainage patterns within Algona are determined by the stormwater drainage system associated with the roads. PAC-TECH (1988) identified 28 drainage sub-basins within the City limits. In this plan 14 sub-basins are shown (Figure 4-6). The current sub-basin delineation is a revision of that presented by PAC-TECH (1988).

The planning area for this report is smaller than the area covered in that report. Unlike the previous study this report does not consider development east of the railroad tracks. This area has been identified as wetlands except for a portion which is already developed and drains to the Government Canal (PACTECH, 1995) (Figure 4-6). Additionally, the entire area east of the railroad tracks drains to the Government Canal and thus is hydraulically separated from the City's drainage system. The 14 sub-basins can be grouped into two major categories, those which drain north to the Green River by way of Mill Creek and those which drain south through Pacific to the White River.

Northern Sub-basins, Flow through Auburn Ponds, to Mill Creek and Green River

All drainage from the northerly sub-basins flows into the Auburn 400 Ponds, immediately to the north of Algona (Figure 2-4). Sub-basins A, C and D drain directly into the ponds by separate outfalls (Figure 4-6). Sub-basins B, E and F drain to the Ponds by way of the Channel Change 4 ($C\text{-}C_4$) ditch which is adjacent to the east side of SR 167.

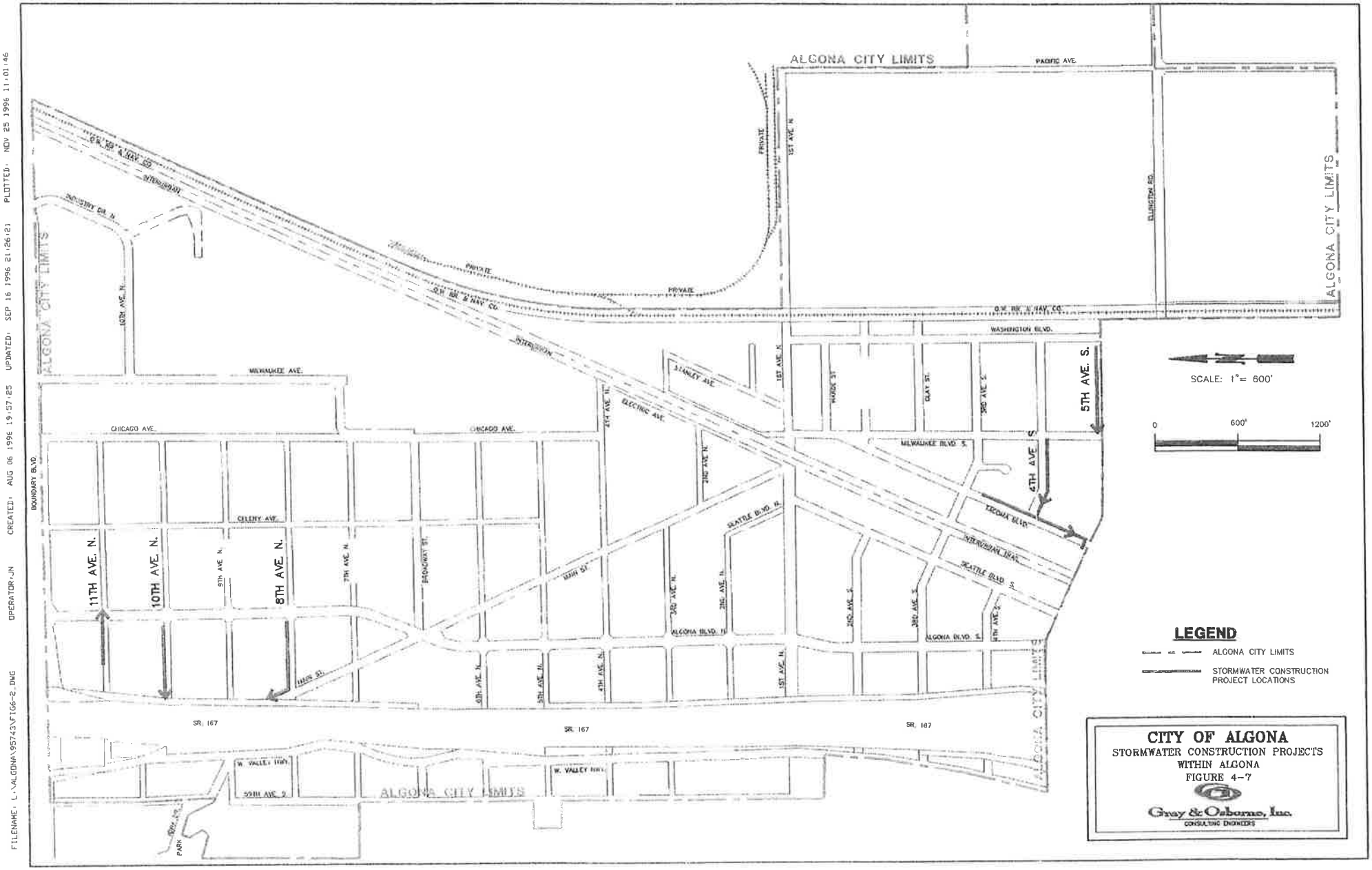
The Chicago Ditch in the north central portion of the City drains the commercial and industrial area in the northeast portion of the City (Sub-basin A). Water in the Chicago Ditch moves north into a 30-inch pipe under Boundary Boulevard. The water in this pipe combines with runoff from the southern portion of Auburn and flows through a 36-inch pipe into the Auburn Ponds (Figure 4-6).


ALGONA CITY LIMITS
PACIFIC AVE
AREA NOT MODELED
BOEING DITCH
CITY OF AUBURN
ALGONA CITY LIMITS
CITY OF PACIFIC
MILWAUKEE AVE
CHICAGO DITCH
CHICAGO AVE
WASHINGTON BLVD
MILWAUKEE BLVD S
TACOMA BLVD
ALGONA BLVD
A
B
C
D
E
F
G
H
J
K
L
M
R
W
X
SCALE: 1" = 600'
0
600'
1200'
LEGEND
ALGONA CITY LIMITS
SUB-BASIN BOUNDARIES
DITCH
12 - INCH
18 - INCH
24 - INCH
30 - INCH
36 - INCH
TO WHITE RIVER
TO AUBURN PONDS AND MILL CREEK
SR 167
W VALLEY HWY
58TH AVE S
ALGONA CITY LIMITS
UNINCORPORATED KING COUNTY
CITY OF ALGONA
SUB-BASINS AND DRAINAGE NETWORK
FIGURE 4-6
Gray & Osborne, Inc.
CONSULTING ENGINEERS

Sub-basins C and D in the northern portion of the City drain residential areas directly into the Auburn Ponds. Each of these sub-basins drain through separate outfalls. The remaining sub-basins in the northern portion of the City (B, E and F) drain largely residential areas to the northerly-flowing portion of the SR 167 ditch, C-C_4, and then to the Auburn Ponds.

The discharge from the Auburn Ponds travels north for approximately 0.3 miles then joins Mill Creek at the base of Peasley Canyon (Figure 2-2). Immediately downstream of this confluence the water passes through an eight foot diameter 300 foot long culvert under SR 18. Northwest Hydraulics (1993a) has identified this culvert as having insufficient capacity to convey stormwater runoff from large events. The culvert was submerged by about 6-inches in the February 1996 flood (see Mill Creek Backwater Impacts, later this section). The water levels in the culvert during that flood dropped from 67.4 feet at the upstream end to 66.0 feet at the downstream end. The water level also dropped between the northern end of Algona and the SR 18 culvert by approximately 1.3 feet. The highest water level at 11th Avenue North was 68.7 feet (NGVD) during the February 1996 storm.

In the mid 1980s the City replaced ditches on 11th Ave North, 10th Ave North and 8th Ave North with stormwater pipes (Figure 4-7). The objectives of these grant funded projects were to increase stormwater conveyance and to reduce the number of open ditches. The pipe replacement on 11th Avenue North was unsuccessful in reducing flooding . Thus the City subsequently punched a hole in the manhole at the west end of the 11th Ave North pipeline allowing water to drain to the north towards Boundary Boulevard in an old stormwater ditch.



FILENAME: L:\ALGONA\95743\FIG6-2.DWG OPERATOR: JN CREATED: AUG 06 1996 19:57:25 UPDATED: SEP 16 1996 21:26:21 PLOTTED: NOV 25 1996 11:01:46

Southern Sub-Basins

The southern sub-basins drain to the southerly flowing SR 167 ditch ($C\text{-}C_2$) and then to the White River (Figures 2-3 and 4-6). The smaller sub-basins in the southwestern portion of the City drain directly to $C\text{-}C_2$ along the eastern side of SR 167. The remaining southern portion of Algona is within Sub-basin J. The relatively large size of sub-basin J is due to the interconnection of pipes at two locations. The interconnections are essentially diversion structures which route peak flows to minimize flooding. The two locations are:

- 1st Ave North and Milwaukee Boulevard and
- 4th Ave South and Milwaukee Boulevard (Figure 4-6).

Discharge from basin J occurs at Milwaukee Boulevard in Pacific and at $C\text{-}C_2$ in the southwest corner of the City.

The 4th Ave South storm drain pipeline was constructed by Algona in 1993 to reduce stormwater flow along Milwaukee Boulevard in the City of Pacific as that drainage was overloaded. Reportedly, flooding frequently occurred in Pacific between 5th Avenue South and Ellingson Boulevard (Dorsey, J., personal communication). The project alleviated this flooding by diverting some of the stormwater away from the area, west along 4th Ave South to Tacoma Boulevard (Figure 4-7). The diversion also included sealing off the discharge along Tacoma Boulevard into Pacific. Stormwater discharging to Pacific on Milwaukee Boulevard travels south then west in the ditch on 1st Ave in Pacific to $C\text{-}C_2$. The stormwater along Tacoma Boulevard flows south to 5th Ave South then west to $C\text{-}C_2$. Water in $C\text{-}C_2$ flows south to the White River.

4.4.2 Stormwater Modeling

Figure 4-6 shows the storm drainage network simulated in a computer model called HYDRA. The model was developed to assess the capacity and demands of the existing system. HYDRA uses input data of: land use, basin size, precipitation intensity and magnitude, pipe or ditch sizes and slopes, pipe or ditch roughness factor, the time for runoff to reach the stormwater system, the percent of land cover which is impervious and the infiltration capacity of the area not covered with impervious surfaces. With this input data HYDRA routes the stormwater through the storm-drainage system assuming gravity flow conditions and accounts for the travel time within the pipes. The input data is fully presented in the Technical Appendix and summarized in Table 4-3. Land use, both present and future, is discussed in Section 4-7.

The HYDRA program uses the Santa Barbara Urban Hydrograph method to estimate flow in the stormwater conveyance. The curve numbers, utilized to estimate runoff, were derived from the soil type, largely Seattle Muck (Figure 4-5). The King County Surface Water Design Manual (1990)(Table 3.5.2B) assigns a value ranging from 86 to 90 to this soil type depending upon vegetation. Vegetation was estimated by field observation and from a 1995 aerial photograph (Walker & Associates). Impervious areas were assigned a curve number of 98. The percentage of impervious area was estimated based upon the housing density within each sub-basin.

In addition to the curve numbers, the time of travel for each sub-basin was input to HYDRA. The time of travel is the length of time it takes for runoff to reach the outlet from the most distant point in the sub-basin. This time was calculated using the methodology discussed in the King County Surface Water Design Manual (1990) and required distance, slope and land surface roughness parameters. This is the same methodology as the one used in the Department of Ecology's 1992 Stormwater Management Manual.

The pipe sizes and slopes and general ditch elevations were obtained from the PAC-TECH (1988) survey data. If different elevations were given at the junction of pipes, for example at opposing sides of a manhole, one of the elevations, which provided for a consistent pipe slope, was chosen. The ditch bottom elevations were assumed to be approximately two to three feet below the surrounding ground elevation within the constraint that the slope of the ditch was consistent to the general topographic slope parallel to, and in the vicinity of, the ditch. All pipes were assigned a Manning's "n" coefficient value of 0.015.

A major assumption in the modeling effort was that the stormwater conveyance system will have a free and clear discharge to the Auburn Ponds and to the SR 167 drainage ditch. For this assumption to be true the Cities of Auburn and Pacific, as well as King County and the Washington Department of Transportation, must maintain their drainages so that Algona is not impacted by downstream flooding.

Table 4-3

HYDRA Input Parameters

Sub-basin	Ditch Length (ft)	Pipe Length (ft)	Area (acre)	Drains to
A	2760	2915	135.2	Auburn Ponds
B	1730	1285	50.7	C-C_4 (167) to Auburn Ponds and then Mill Creek
C	380	55	7.6	Auburn Ponds/Mill Creek
D	1080	520	27.1	Auburn Ponds/Mill Creek
E	380	1230	22.1	C-C_4 to Auburn Ponds/Mill Creek
F	1860	3719	67.6	C-C_4 to Auburn Ponds
G	805	0	10.9	C-C_4 to Auburn Ponds
H	450	710	9.9	C-C_2 (167) to Pacific and then White River
J	855	12908	142.7	C-C_2 and Milwaukee Blvd to Pacific/White River
K	600	1555	16.3	C-C_2 to Pacific/White River
L	1300	1195	23.8	C-C_2 to Pacific/White River
M	550	50	4.6	C-C_2 to Pacific/White River
R	300	50	6.4	C-C_2 to Pacific/White River
W	200	0	3.7	C-C_2 to Pacific/White River
Total	**13,250**	**26,192**	**529**	

Stormwater modeling performed for this project indicates that future development may increase flooding in Algona. Thus some increased demands will be placed on the storm water system due to development. Table 4-4 shows those pipes and ditches which were identified as being under capacity, or as experiencing surcharge condition. Twenty-four hour design storms with recurrence intervals of both 10 and 25 years and existing and future land use conditions were utilized to evaluate the stormwater system. At storm volumes and intensities greater than a 25 year storm regional flooding occurs and water levels downstream of Algona cause backwater flooding in Algona.

In addition to the pipes, two ditches have been identified:

- The ditch adjacent to the north side of Broadway Ave floods due to poor placement of the outlet. The invert elevation of western outlet is higher than the bottom of the eastern end of the ditch. The western outlet needs to be lowered to better drain the ditch.

- The North - South ditch west of Algona Boulevard between 9th and 10th Avenues North discharges into a storm drain under the proposed location for "Spud's Produce." Flooding could be minimized at this location by either increasing ditch size and maintenance or by replacement of the ditch with pipe.

Recommendations to mitigate the increased demands on the stormwater system are discussed in Chapter 7.

Table 4- 4

Pipes Identified as Having Insufficient Stormwater Conveyance Capacity or Experiencing Surcharge

Pipe Number	Location	Pipe Diam (in)	Pipe Length	Pipe Size Required for Future Land Use		Comments
				10-yr Storm	25- yr Storm	
A10830	Under Boundary Blvd at Chicago Ave	30	55	**36**	**54**	May need to be an arch culvert
A10536	From boundary and Chicago to Auburn Ponds	36	1140	**42**	**60**	May need to be a lined ditch
B17418	Under Algona at 9th Ave North	**15**	70	**18**	**18**	
B167A24	West of Algona between 9th and 10th	24	220	**30**	**30**	
B113824	N side 10th Ave, Comm prop to SR 167	24	385	**30**	**30**	
D112218	Intersection Boundary and Algona	18	70	**36**	**36**	Pipe surcharged by 6-inches
E19812	Algona, south of 8th Ave North	12	70	12	**18**	
E11018	East side Algona Blvd south of 8th Ave N	12	600	18	**24**	
F3BRDWD	Under Algona at Broadway [1]	24	70	**24**	**24**	
F39524	Main St, Algona to 7th Ave N	24	510	**30**	**30**	
F34124	West SIde Main St 1st and 2nd Ave North	24	485	**30**	**30**	
J58418	East Side Main, 1st N - 2nd N (North seg)	18	305	**24**	**30**	
J58518	East Side Main, 1st N - 2nd N (South seg)	18	205	**24**	**24**	
J59912	Cross under Stanley at	12	25	**24**	**24**	
J59812	West side of Stanley North of 1st N	12	165	**24**	**24**	
J59112	North Side of 1st, West of Stanley	12	160	**24**	**24**	
J72424	West side of Seattle,between 4th and 5th	24	468	**30**	**30**	
J710124	East side of Milwaukee, Clay to 3rd St	24	395	**30**	**30**	
J712724	East Side of Milwk 3rd Ave S - 4th Ave S	24	460	**30**	**30**	
J712524	East Side of Milwk 4th Ave S - 5th Ave S	24	430	**30**	**30**	
JMLWEX24	East side of Milwk 5th to Ellingson	24	400	**30**	**30**	
J74SDIV18	S Side 4th S, Milwaukee to Tacoma	18	620	**24**	**24**	
J76018	Crossing under Tacoma at 4th South	18	50	**24**	**24**	
J715718	West Side Tacoma, 4th Ave S - 5th Ave S	18	470	**30**	**30**	
J714818	5th Ave South, Tacoma - Interurban	18	250	**24**	**30**	
J714624	5th Ave S, Interurban - Seattle	24	290	**30**	**36**	May need reinforced pipe at road crossing
J714524	Crossing under Seattle at 5th Ave S	24	40	**30**	**36**	May need reinforced ripe
J714424	Seattle to SR 167 at 5th Ave S	24	550	**36**	**36**	May need reinforced pipe at road crossing
K516618	2nd Ave N, Algona Ave to SR 167	18	400	**24**	**24**	
L510812	North side 1st, between Seattle & Algona	12	385	**18**	**18**	
L512512	Crossing under Algona at 2nd Ave South	12	65	**18**	**18**	
L512318	N side of 2nd South Algona Ave to SR 167	**18**	300	**24**	**24**	

Note 1 - recommend lowering culvert under Algona Blvd

Number in Bold Face indicates insufficient capacity or surcharged pipe

Mill Creek Backwater Impacts

The SR 18 culvert on the Mill Creek basin has been identified as a restriction to flow (Northwest Hydraulics, 1993a). Backwater from this culvert impacts flooding in the northern portions of Algona. Results from that study indicate that a build-up of 4 feet of sediment in the SR 18 culvert may raise water elevation behind the culvert during the 10-year and 100-year storms to approximately 70 and 71 feet respectively; two feet higher than if the culvert was completely open (Northwest Hydraulics, 1993a). Water levels behind the culvert above 70 feet will flood the northbound off-ramp of SR 167 to eastbound SR-18. Additionally, since the ground surface elevation in northwestern Algona is generally less than 70 feet (Figure 4-4) that portion of Algona will also be impacted. Thus keeping the SR 18 culvert free of sediment is critical to preventing flooding in northern Algona.

In order to minimize the flooding upstream of the culvert DOT removed sediment from it in the summer of 1995 and constructed a small sediment pond at the upper end of the culvert. However, representatives from King County Surface Water Management walked through the culvert in July 1996 and found three feet of sediment in it. This sediment was most likely the result of the landslide which occurred in Peasley Canyon during the February 1996 storm.

The Northwest Hydraulics study has also indicated that another 0.5 feet of water level drop may occur in the Auburn Ponds (Leytham, personal communication). The channel through these ponds has largely overgrown and thus some resistance to surface water flow occurs.

The City of Auburn had planned to clean these ponds in the summer of 1996. A survey conducted by INCA Engineers in the fall of 1995 estimated the amount of sediment in the ponds. That survey indicated that there had been less sediment build-up in the ponds than anticipated. However the survey was performed from a canoe and areas of dense vegetation were specifically avoided (Custer, B. 1996. personal communication). The maintenance scheduled for the summer of 1996 was deferred.

Options to reduce flooding in the northern portion of Algona include maintaining a clean culvert for Mill Creek under SR 18 by the construction of a large sediment basin at the

base of Peasley Canyon and the construction of an open channel through the Auburn Ponds.

Stormwater Hydraulics of the City of Pacific

Flooding in the northern portion of Pacific has diminished since the 4th Avenue South Diversion project in Algona (Dorsey, J. 1996. personal communication). However, flooding still remains a problem in the southern portions of Pacific where the SR 167 runoff is routed through ditches adjacent to City streets. Generally the conveyance capacity of the ditches, although initially sufficient, has been reduced due to deferred maintenance by the City of Pacific. At the junction of the City of Pacific ditches and the SR 167 drainages, at 4th Ave south, the ditches are partially blocked due to tree and brush growth within the ditch. Cleaning of the ditch would likely require a Hydraulic Project Approval permit from the Washington Department of Fish and Wildlife.

4.4.3 Geohydrology

Ground water is shallow, generally within a foot, of the ground surface for much of the year. This shallow ground water creates standing water in ditches and isolated depressions for much of the year. In addition, due to the fine-grained, low permeability nature of the soils there is little drainage from the soils into the storm drainage pipes. An investigation into the contribution of ground water to the stormwater system was conducted, while the soil was still wet, on February 14, 1996, after the storm of February 7 and 8. Flow depths in the 18-inch and 24-inch pipes were generally less than 2-inches, indicating that the ground water contribution to the overall flow in the stormwater pipes is minimal.

4.5 BIOLOGICAL RESOURCES

4.5.1 Fisheries

Two major ditches may provide fish habitat within the City limits (Nauer, D. 1995. personal communication). These are the Government Canal, which drains the area east of the railroad tracks, and the SR 167 drainage (C-C_4) which drains north into the Auburn Ponds. The C-C_2 ditch which parallels SR 167 in the southern portion of town likely has insufficient water during the summer months to maintain fish habitat. The City has approached the Washington Department of Fish and Wildlife (WDFW) to ascertain whether permits would be necessary and the likelihood of obtaining the permits to clean

$C\text{-}C_4$. The WDFW has indicated that a hydraulic permit will probably be required and that they may grant a permit to clean the ditches if the City plants shade trees alongside the ditches to control weed growth in the ditch and to reduce water temperature (Pullar, R. 1996. personal communication).

4.5.2 Endangered Species

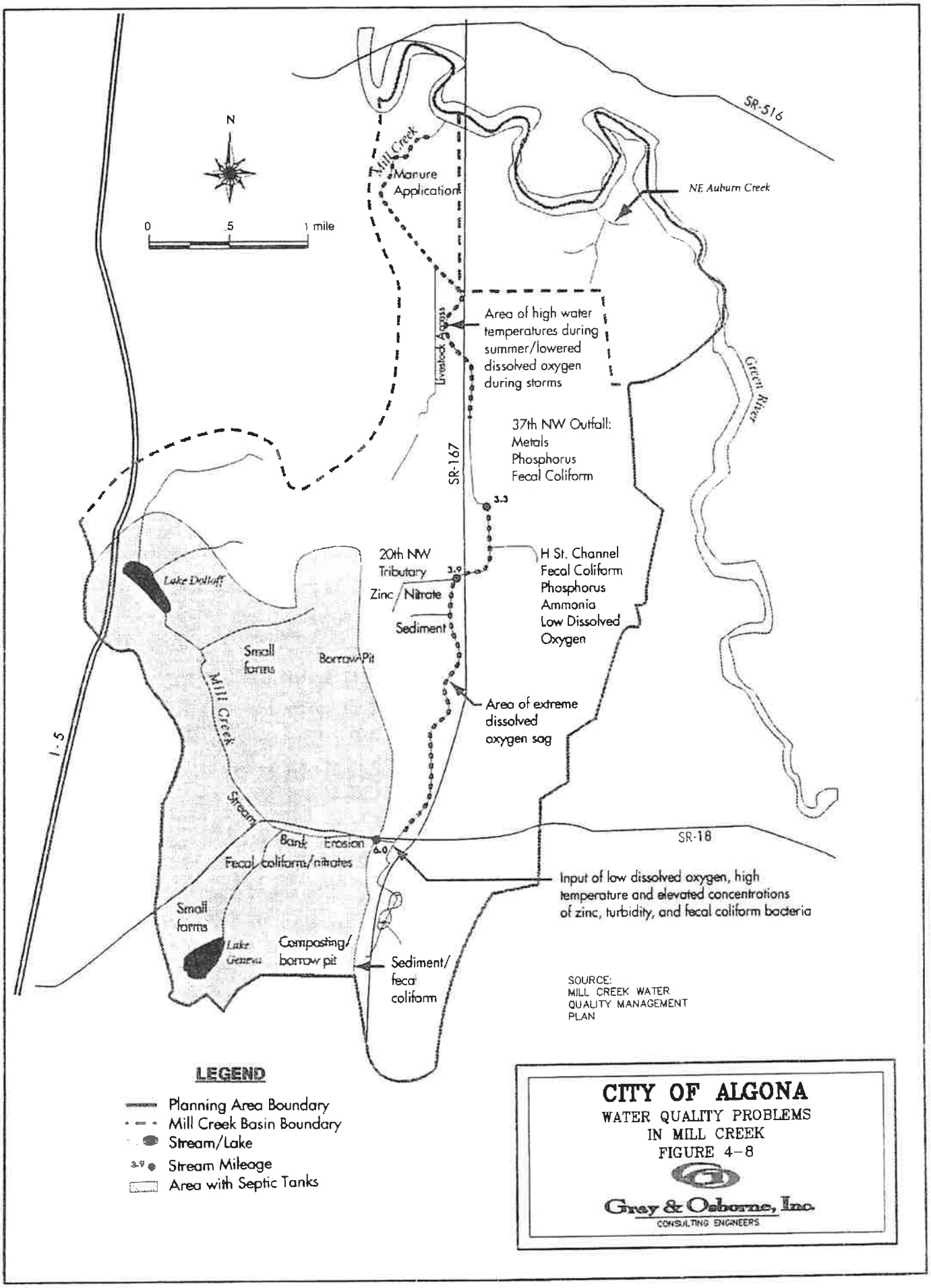
There are no known endangered species within Algona (Appendix C).

4.6 WATER QUALITY

The *Mill Creek Water Quality Management Plan* (KCSWM. 1993) discusses the water quality in Mill Creek. The major water quality problems are low dissolved oxygen , high water temperature in the summer and high turbidity (Figure 4-8). The low dissolved oxygen is a result of oxygen demand from benthic organisms and from the organic bottom sediments which are enriched with much canary grass (KCSWM. 1993). The high water temperature results from a lack of canopy cover (shade trees). The turbidity, at the time the Mill Creek report was written, was from stormwater runoff in Peasley Canyon and from construction in the area between the Auburn 400 Ponds and SR 18.

There are no known studies of surface water quality in the ditches within Algona. However, water quality in the $C\text{-}C_2$, $C\text{-}C_4$, and Chicago ditches and the 1st Avenue ditch in Pacific most likely also suffers from high temperature and low dissolved oxygen. The ditches are exposed to direct sunlight and significant weed growth has enriched the bottom sediments with organic material.

The water quality in the Government Canal may be somewhat better than the other ditches due to the recent weed removal from the bottom. Additionally when this ditch was cleaned the banks were lined with young trees. When these trees mature they should provide shade and reduce the water temperature.


N
0
.5
1 mile
SR-516
Mill Creek
Manure Application
NE Auburn Creek
Livestock Access
Area of high water temperatures during summer/lowered dissolved oxygen during storms
Green River
37th NW Outfall:
Metals
Phosphorus
Fecal Coliform
SR-167
3.3
20th NW Tributary
3.0
Zinc
Nitrate
Sediment
H St. Channel
Fecal Coliform
Phosphorus
Ammonia
Low Dissolved Oxygen
Lake Dolloff
Small farms
Borrow Pit
Mill Creek
I-5
Area of extreme dissolved oxygen sag
Stream
Bank Erosion
6.0
Fecal coliform/nitrates
SR-18
Input of low dissolved oxygen, high temperature and elevated concentrations of zinc, turbidity, and fecal coliform bacteria
Small farms
Lake Geneva
Composting/ borrow pit
Sediment/ fecal coliform
SOURCE:
MILL CREEK WATER QUALITY MANAGEMENT PLAN
LEGEND
Planning Area Boundary
Mill Creek Basin Boundary
Stream/Lake
3.9 Stream Mileage
Area with Septic Tanks
CITY OF ALGONA
WATER QUALITY PROBLEMS
IN MILL CREEK
FIGURE 4-8
Gray & Osborne, Inc.
CONSULTING ENGINEERS

4.7 LAND USE

Land development impacts stormwater runoff by creating impervious surfaces. Impervious surfaces direct stormwater to drainages relatively quickly as compared to natural systems. Onsite detention slows down the runoff rate and mitigates flooding to the receiving waterbodies. Current City ordinances require onsite detention of stormwater from all new construction which creates greater than 5,000 ft^2 of impervious area as discussed in Chapter 5.

4.7.1 Land Use Categories

The land use categories in Algona are listed and described in Table 4-5. Land use in Algona is largely residential except for the area in the northeast portion of the City, east of the Chicago Ditch (Figure 4-9). Future land use is based upon current zoning and sensitive area designations (Figure 4-10). If Algona realizes land development, as predicted for the next 20 years, the amount of residential and commercial development will be significantly increased. The current and projected land use shown on Figures 4-9 and 4-10 is tabulated in Table 4-6.

Table 4-5

Algona Land Use Categories

Designation	Description	Density
Low Density Residential	Single family residential	5.45 dwelling units/acre
Medium Density Residential	Mixture of single and multi-family residential	10 dwelling units/acre
Wetlands and Sensitive Areas	Designated as wetlands or as steep slopes and sensitive soils	No development currently anticipated
Commercial and Light Industrial	General commercial use	95% impervious


ALGONA CITY LIMITS
PACIFIC AVE
O.W. RR. & NAV. CO.
U.S. RR. & NAV. CO.
PRIVATE
ELLINGTON RD.
WASHINGTON BLVD
MILWAUKEE AVE.
CHICAGO AVE
MILWAUKEE BLVD. S.
SEATTLE BLVD. S.
ALGONA BLVD.
MAIN ST.
CELERY AVE.
BOULEVARD BLVD.
SR 167
S. VALLEY HWY.
PARK
SCALE: 1"= 600'
0
600'
1200'
LEGEND
ALGONA CITY LIMITS
INDUSTRIAL
HEAVY COMMERCIAL
COMMUNITY COMMERCIAL
PUBLIC
MULTI-FAMILY
VACANT
PARK
SINGLE FAMILY
CITY OF ALGONA
EXISTING LAND USE MAP
FIGURE 4-9
Gray & Osborne, Inc.
CONSULTING ENGINEERS
SOURCE: PACTECH, 1995

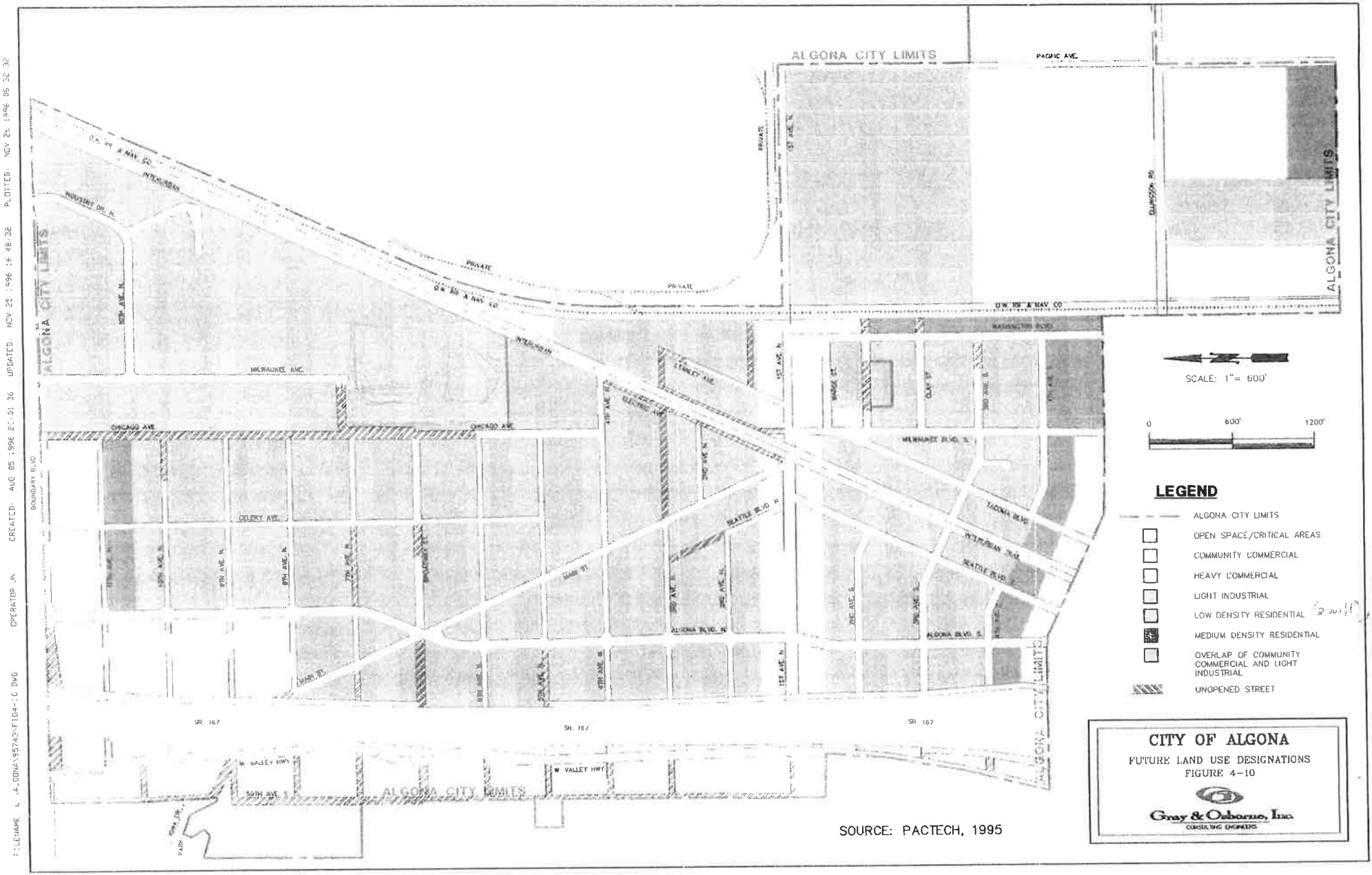


Table 4-6

Current and Projected Land Use for Planning Area Sub-Basins

Sub-basin	Total Area (ac)	Existing Land Use		Future Build-out Land Use	
		Residential Units	Comm/Indust Acres	Residential Units	Comm/Indust Acres
Sub-basin A	143.6	18	93	0	130
Sub-basin B	48.9	98	1.4	172	2.8
Sub-basin C	8.2	14	0	0	7.6
Sub-basin D	23.2	29	0	60	11.2
Sub-basin E	21.0	28	1	78	1
Sub-basin F	60.6	116	0	237	0
Sub-basin G	11.9	21	0	38	0
Sub-basin H	11.0	39	0	35	0
Sub-basin J	142.7	262	0.5	458	13
Sub-basin K	16.9	54	0	60	0
Sub-basin L	24.1	79	0	46	0
Sub-basin M	5.5	11	0	15	0
Sub-basin R	8.5	8	0	23	0
Sub-basin W	5.6	9	0	12	0

4.7.2 Population and Development Densities

The planning area within the City of Algona is suburban in character. At the end of 1994 there were approximately 784 residential units in the City (Table 4-6) and a population of approximately 1940. The King County Growth Management Planning Council has estimated that Algona, by the year 2015, should receive between 386 and 514 new dwellings (PAC-TECH, 1995). The city has targeted 450 as the number it would like to see constructed. Based upon this goal housing densities are projected to be about 3.5 dwelling units per acre at the end of the 20-year planning horizon. Ultimate zoning build-out is a density of 5.4 units per acre.

For the purposes of flood hazard management and prediction of stormwater flows, land use in terms of dwelling units per acre was estimated for current conditions and at build-out, for each of the sub-basins.

At the present time, residential development has taken place in most portions of the planning area. However, a significant amount is still undeveloped or underdeveloped. These areas are generally open and covered with Canary grass. The majority of the commercially zoned areas in the northeast portion of the City, east of Chicago Ave., have been developed or are in the process of development with plans submitted for approval.

Table 4-6 was developed in order to assess the impact land use changes will have on the stormwater system. The data in Table 4-6 reflects the anticipated increase in impervious land area, and thus the increase in the anticipated volume and timing of stormwater runoff.

4.7.3 Wetland Issues and Land Use

Land development and future land use within the City of Algona will almost certainly be impacted by wetlands. Proposed development which impacts existing wetlands must provide for wetland mitigation (See Section 5.1). Wetland mitigation is the preservation, enhancement, restoration or creation of wetlands. Traditionally wetland mitigation has occurred within, or immediately adjacent to the area targeted for development. Recently however there has been a national trend towards wetland banking. Wetland banking is essentially the regional coordination of wetland mitigation. Under wetland banking individual projects which independently impact local wetlands coordinate their efforts to mitigate large tracts of wetlands which may or may not be adjacent to any one of the developments. The intent of wetland banking is twofold. First, it allows for the creation of large wetland areas which may support a greater biodiversity than small individual parcels of wetlands as fragmentation of the wetlands is avoided. Second, the development community has greater flexibility than if onsite wetland mitigation were required.

Locally the Corps, US. Environmental Protection Agency (EPA), WDFW, Washington Department of Ecology (WDOE), King County, Auburn, Kent, the U.S. Soil Conservation Services and the Muckleshoot Indian Tribe have joined together to create a Special Area Management Plan (SAMP) for the Mill Creek basin which includes northern Algona. The intent of this plan is to prioritize wetlands and development corridors within the Mill Creek basin. A result of this plan may be that wetland banking becomes common in this area. The northern three city blocks of Algona have been identified as wetlands in the SAMP. Wetland banking will add flexibility to the development of the that area of Algona.

4.8 SCENIC, AESTHETIC, AND HISTORIC/CULTURAL RESOURCES

The principal scenic/aesthetic resource is the Heron Rookery located adjacent to the northwest portion of the City, outside of the planning area. The historic/cultural resources within the City are not unique or significant.

5. RELEVANT REGULATORY AND CAPITAL IMPROVEMENT PROGRAMS

Regulations affecting the Algona area have been developed at the Federal, State, regional and local levels. These regulations are discussed below.

5.1 FEDERAL ORDINANCES AND REGULATIONS

The major Federal regulation impacting storm water are Sections 401 and 404 of the Clean Water Act (Appendix A). The Corps administers Section 404 permitting, whereas Section 401 certification is administered by WDOE as discussed in Section 5.2.

5.1.1 Clean Water Act Section 404

Section 404 requires a U.S. Army Corp. of Engineers (Corps) permit for any project which alters or degrades waters of the United States. This includes wetlands and tributaries to navigable waterways. The specific requirements of a Section 404 permit are discussed in Appendix A. The Corps will determine which areas within a site are considered wetlands on a case by case basis after receipt of a development application. Currently the Corps requires that wetland enhancement, preservation or construction occur if the proposal includes loss of existing wetland. The amount of wetlands to be enhanced, created or preserved depends upon the mixture of mitigation approaches and the location of the wetlands, both lost and gained. Generally the Corps will require that a minimum of 2 acres of wetlands must be enhanced for each acre destroyed. If the mitigation involves the purchase of wetlands then the ratio may as high as 5 acres bought and preserved for each acre lost.

Locally, the Corps is developing a SAMP, as discussed in Section 4.7.3, to identify and manage the wetlands in the Mill Creek basin on a watershed wide basis. This document will prioritize wetlands within the basin. Development will not be allowed within wetlands receiving a high priority. The permitting process within wetlands of a low priority will be facilitated, however the mitigation of the wetlands will not be reduced. The SAMP is currently in draft form. Release of a draft for public review of the SAMP is expected in 1997.

5.2 STATE ORDINANCES AND REGULATIONS

5.2.1 Clean Water Act Section 401

The WDOE has jurisdiction over the certification of Section 401. Section 401 is closely tied with Section 404. WDOE must certify, by way of a Section 401 certificate, that any activity applied for under Section 404 will comply with discharge limits, water quality standards and any other applicable state laws. This certification can apply to long term discharges to the receiving water bodies or to transitory construction discharges.

5.2.2 Hydraulic Project Approval

The Department of Fish and Wildlife maintains control over all waterways in which natural resources, such as fish habitat must be protected. Their authority is authorized in the Washington State Hydraulic Code, RCW 75.20.100-103. The Department of Fish and Wildlife will probably require permits for the cleaning of major ditches such as the SR 167 ditches as they believe these ditches provide fish habitat (Nauer, 1995, personal communication). Boeing received this permit for the 1995 cleaning of the Government Canal.

5.2.3 Shoreline Management Act

The Washington Shoreline Management Act requires permits for any substantial development within the 200 foot shoreline jurisdiction. The Shoreline Master Program requires that local jurisdictions develop a Shoreline Master Plan for any streams with an annual average flow of greater than 20 CFS. Although there are no stream gauging data, modeling results of this study and from Northwest Hydraulics (1993a) indicate that none of the ditches which the City maintains has an annual average flow above 20 CFS.

5.2.4 Growth Management Act

The Growth Management Act requires that all projected growth be planned. One specific goal of the GMA is to "ensure that those public facilities and services necessary to support development shall be adequate to serve development at the time the development is available for occupancy and use without decreasing current service levels below locally established minimum standards".

5.3 LOCAL ORDINANCES AND REGULATIONS

The City of Algona has adopted resolutions and ordinances to control the runoff of stormwater and to reduce flooding within the City limits. Those ordinances from the City of Algona Municipal Code which apply to stormwater are discussed below.

Chapter 13.46 Stormwater Management, General Requirements

The Washington Department of Ecology, Stormwater Design Manual (Ecology, 1990) is adopted in Section 060 of this chapter. The Ecology manual restricts the runoff rate from new construction. New facilities should be designed to release stormwater at rate not greater than 50% of the pre-development intensity for a 2-year, 24-hour storm and 100% of the pre-development intensity for 10-year and 100-year storms. The manual also requires treatment of runoff before discharge.

Chapter 22.80 Environmentally Sensitive Areas

Sections 690 through 760 of this chapter regulates the setback of new construction from wetlands. The preservation of wetlands helps to mitigate flooding. Thus preventing the encroachment of new development into wetlands will reduce the impact of new development on flooding.

Chapter 15.22 Grading and Filling of Land

Section 210 of this chapter requires "All drainage facilities, improvements, drainage design and maintenance of drainage facilities shall be in accordance with Chapter 13.46." There are no ordinances regarding floor elevations for new development. However the City "strongly recommends" that all new development be constructed with floor elevations at or above street level.

Section 240 of this chapter requires that "Grading, filling or clearing in an area of special flood hazard shall be done in accordance with the latest version of the Algona floodplain management ordinance or this chapter, whichever has the more stringent development regulations." At the current time Algona has not delineated any floodplains within the city limits and thus they have no floodplain management ordinance (FEMA, 1989) .

6. FLOOD DAMAGE HISTORY, PATTERNS AND PROJECTED PROBLEMS

6.1 FLOODING HISTORY

The City of Algona has kept no written record of flooding within its boundaries. However through conversations with city staff and citizens a "picture" of the recent history of flooding can be formed. The storms of November 1990 and February 1996 are the two storms that have created the most recent flooding in Algona.

The construction of SR 167 in the early 1970s significantly altered the drainage patterns in Algona and may have increased the frequency of flooding in the area. However, record keeping is insufficient to be certain if or how much the flood frequency was increased as a result of this road. Flooding problems are summarized in Table 6.1.

Table 6-1
Flood Areas Within Algona

Problem Area	Specific Location	Problem	Comment
Northern Algona	10th Ave N to Boundary Blvd.	Stormwater flooding, backwater from Mill Creek	Current problem
	Broadway Ave N, Celery Ave to Algona Blvd	Standing water - high maintenance	Current problem
	8th and 10th Aves N	Open ditches - high maintenance	Fixed in 1980s with installation of pipes
	9th Avenue N	Open ditches, high maintenance	Current problem
Southern Algona Northern Pacific	between 5th Ave S and Ellingson	poor drainage, insufficient pipe and ditch capacity	Fixed in 1993 with installation of bypass
Southern Algona	5th Ave South and Tacoma Blvd.	Stormwater flooding, insufficient pipe capacity	Current problem
Washington Blvd.	2nd Ave S to 4th Ave S	poor drainage across Washington Blvd	New lower culvert installed 5/96

6.1.1 Recent Storms

The total precipitation from the February 1996 storm was 2.3 inches over a 24-hour period on February 7 and 8 at the Lake Doloff gaging station located about 2 and 1/2 miles northwest of Algona and about 2.5 inches at Sea-Tac airport. This storm had a repeat interval of approximately 5 years for a 24-hour storm and about a 25 years for a 72-hour period. Additionally the winter from November 1, 1995 through February 29, 1996 was the wettest on record. The weather station at SeaTac airport recorded 32.5 inches of rain during that period compared to an average of approximately 22 inches. Thus the ground was well saturated prior to the storm and may have exacerbated the flooding.

6.1.2 Flooding in Northern Algona

The northern portion of Algona was flooded in both the November 1990 and February 1996 storms (Figure 6-1). The water level reached a high of 68.8 ft (National Geodetic Vertical Datum, NGVD) at a surveyed mark inside a garage on 11th Ave N west of Algona Boulevard as a result of the November 1990 storm. The flood water elevation in February 1996 was slightly lower at 68.7 feet (NGVD) as previously mentioned. The ground elevation in the vicinity of the flooding is approximately 67 feet. Thus flood waters were slightly less than 2 feet deep at the maximum flood. Flood waters were observed crossing 11th Avenue North northwest of Algona Blvd. during peak flood conditions but did not disrupt traffic.

In the north central portion of the City the Chicago ditch discharges into 30-inch culvert under Boundary Boulevard. The trash rack at the entrance to this culvert was partially plugged with grass and sticks during the storm on February 8, 1996. Water was observed to be cascading over the top of the trash rack, some backing up of water behind the culvert entrance occurred.

The ditch which parallels Broadway Ave North on the north side is frequently full to near capacity and has standing water in it for much of the year. The outlet from this ditch at a culvert under Algona Boulevard is set approximately 1 foot higher than the inlet pipe under Chicago Ave. No flooding has been reported in this area, however, the City has indicated a desire to eliminate the standing water in the ditch by lowering the outlet culvert.

6.1.3 Flooding in Southern Algona

Flooding occurred in February 1996 in the vicinity of the 4th Ave South diversion. Flood water elevations were not surveyed in the south end of Algona but were at approximately 68 ft based upon a topographic map and information gained from citizens in the area. The flood water rose rapidly and was observed to be bubbling up through the stormwater grating during the afternoon of the 8th. However by the evening on February 8 the floodwaters had subsided.

Drainage along Washington Boulevard has been chronically poor for a number years (Figure 6-1). Several homes were built using loans from the Federal Department of Housing and Urban Development (HUD) in the late 1980s and early 1990s. The floor elevations and the yards of these homes are higher than the surrounding areas. Runoff from the HUD homes reportedly lead to a worsening of the chronic flooding problems surrounding the preexisting homes. The City recently lowered the culvert crossing under Washington Boulevard at Clay St. by approximately 1 foot. This retrofit helped to reduce the water levels east of Washington Blvd.

6.1.4 Timing of Peak Flood Waters

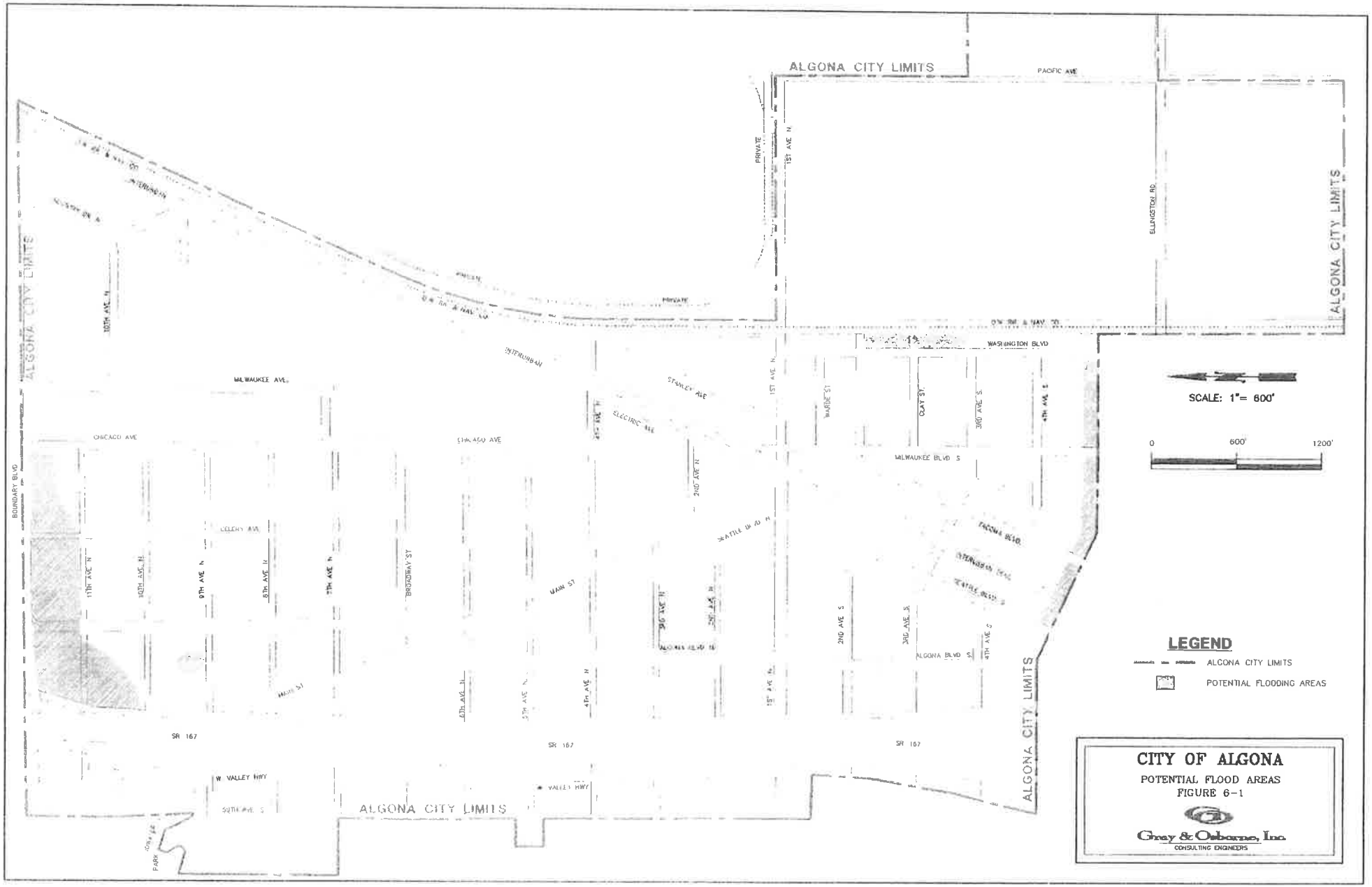
The flooding in northern Algona occurred during the night of February 8 -9 with the flood waters subsiding during the morning of February 9. The peak rainfall occurred in the mid afternoon, thus there was approximately a 12 hour lag time between peak rain and peak flood. In southern Algona the peak flood occurred in the late afternoon and by 8:00 PM the flood waters had subsided. The difference in the timing of peak flood between northern and southern Algona indicates that the mechanisms causing the flooding are not the same.

The relatively slow response time of the flood waters to rainfall in the northern part of the City indicates this flooding is part of a larger regional problem related to Mill Creek. The relatively fast response time of the floodwaters to rainfall in the southern end of the City indicates that flooding is caused largely by insufficient pipe capacity. Solutions to flooding are thus different for each end of the City.

6.2 DAMAGE ESTIMATES

Any damage resulting specifically from the 1996 flooding that Algona residents may have suffered was not reported (Pullar, R. 1996. personal communication). However, there was disruption, inconvenience and much flooding of private property which resulted from the storm.

The 1990 storm did do some property damage in the northern portion of Algona. The damage was restricted to outbuildings in which electrical appliances were submerged by the floodwaters causing them to short circuit. There are no cost estimates of damage in Algona from either the 1990 or 1996 storm.


ALGONA CITY LIMITS
PACIFIC AVE
PRIVATE
1ST AVE N
EDGEWATER RD
ALGONA CITY LIMITS
WASHINGTON BLVD
MILWAUKEE AVE
INTERURBAN
STANLEY AVE
ELECTRIC AVE
CHICAGO AVE
MILWAUKEE BLVD S
WARDE ST
CLAY ST
3RD AVE S
4TH AVE S
BOUNDARY BLVD
ALGONA CITY LIMITS
10TH AVE N
11TH AVE N
9TH AVE N
8TH AVE N
7TH AVE N
BROADWAY ST
MAIN ST
2ND AVE N
SEATTLE BLVD N
TACOMA BLVD
2ND AVE S
3RD AVE S
ALGONA BLVD S
4TH AVE S
SR 167
W VALLEY HWY
S 15TH AVE
PARK AVE
ALGONA CITY LIMITS
ALGONA CITY LIMITS
SCALE: 1"= 600'
0
600'
1200'
LEGEND
ALGONA CITY LIMITS
POTENTIAL FLOODING AREAS
CITY OF ALGONA
POTENTIAL FLOOD AREAS
FIGURE 6-1
Gray & Osborne, Inc.
CONSULTING ENGINEERS

6.3 PRIOR FLOOD CONTROL INVESTIGATIONS

PACTECH (1988) performed the only previous study on flood control in Algona. This study provided detailed data regarding pipe locations and size. In addition the study made specific recommendations regarding the replacement of existing pipes or the replacement of ditches with pipes. No action was taken as a result of this study.

Other studies in the Algona area have been performed or are in progress. Completed studies include the FEMA (1989) Flood Insurance Rate study and the City of Auburn 1990 Comprehensive Drainage Plan (CH2M Hill, 1990). As mentioned in Section 2.2 FEMA produced a series of maps for the lower Green River basin. The extent of this study was the Auburn-Algona boundary. The Auburn drainage plan extended as far south as SR 18. This plan did not cover the Auburn 400 Ponds or the SR 18 culvert.

Northwest Hydraulics is currently under contract to King County Surface Water Management to produce a Flood Mitigation Plan for the Mill Creek basin. As mentioned in Section 2.2 and 4.4 this study has identified the SR 18 culvert as being a critical item impacting flooding in northern Algona. The Corps is currently writing as Special Area Management Plan for Mill Creek which will prioritize wetlands and potential development within the basin (See Section 4.7).

6.4 PRIOR FLOOD MITIGATION PROJECTS

The City completed several grant funded projects in the mid-1980s to replace ditches with stormwater pipes. These projects provided for increased conveyance capacity, and reduced maintenance (Table 6-2).

The 4th Ave South diversion discussed in Section 4.4 occurred subsequent to the PACTECH (1988) study but was unrelated to that study. The City of Algona completed this diversion and reconfiguration of the storm water system in 1993. Prior to the diversion the area south of Algona between 5th Ave South and Ellingson Boulevard flooded frequently partly due to runoff from Algona. The diversion alleviated this flooding by diverting much of the stormwater away from the area west along 4th Ave South to Tacoma Boulevard (Figure 4-7). The storm water along Tacoma Boulevard flows south to 5th Ave South then west to C-C_2.

In the mid 1980s the City replaced ditches on 11th Ave North, 10th Ave North and 8th Ave North with storm water pipes (Figure 4-7). The objectives of these grant funded projects were to increase stormwater conveyance and to reduce the number of open ditches. The pipe replacement on 11th Avenue North was unsuccessful in reducing flooding. Thus the City subsequently punched a hole in the manhole at the west end of the 11th Ave N pipeline allowing water to drain to the north to Boundary Boulevard and the Auburn ponds in an old stormwater ditch, its preconstruction route.

Algona in cooperation with the City of Pacific applied for a grant and received money to clean the SR-167 ditches. This work was performed in 1987. This work improved the conveyance capacity of ditches in an effort to reduce flooding.

Table 6-2

Past Projects

Project	Year Completed	Cost ($)	Objective
11th Ave North	1985	(1)	Remove ditches and improve conveyance
5th Ave South	1988	(1)	Remove ditches and improve conveyance
4th Ave S. Diversion Milwaukee to Tacoma	1993	97,000	Reduce flooding on Milwaukee between 5th Ave S and Ellingson.
Milwaukee Blvd.	1989	(1)	Remove ditches and improve conveyance. Completed as part of Milwaukee Blvd. reconstruction.
Clean 1st Ave ditch in Pacific	1987	(1)	Improve conveyance in 1st Ave ditch within the City of Pacific
Clean SR-167 ditches	1987	60,000	Improve conveyance in SR 167 ditches

(1) Cost unknown at present time

6.5 HISTORICAL MAINTENANCE ISSUES

Maintenance of the storm water drainage system in Algona is largely done on an "as needed" basis. Some routine maintenance is performed on smaller ditches within the City's boundaries.

Minor City ditches

Vegetation in the ditches requires regular maintenance, mowing, to keep the conveyances open. This is particularly true in the summer and early fall when the grass grows at a rapid rate and can quickly lead to reduced conveyance capacity when the rains begin in the fall. Removal of vegetation from the ditches with a backhoe occurs when the vegetative mat is sufficiently thick that mowing no longer keeps the ditches open, every three to five years.

Culverts

Entrances to the culverts from the ditches can become plugged with grass and debris if trash racks are present. Conversely, if trash racks are not present the culverts themselves can become plugged. After the February 8, 1996 storm a basketball was discovered plugging a storm drainage pipe along Milwaukee Boulevard.

Stormwater Pipes

Generally the stormwater pipe network in the City needs little maintenance. Storm drain catch basins were vactored in 1991. They have not been vactored since then.

Chicago Ditch

Maintenance of the Chicago Ditch has been sporadic. As discussed is Section 2.2 the industries along the Chicago Ditch are responsible for maintenance of it. Regular maintenance generally has been restricted to the City's work on the outlet structure at Boundary Boulevard where the ditch enters a 30-inch pipe. This maintenance has been the removal of grass, sticks, and other debris from the structure.

SR 167 Ditches

The C-C ditches on SR 167 both need to be cleaned in order to increase the conveyance capacity. The ditches have become overgrown since 1987, the last time they were cleaned. However, as discussed in Section 4.5, permits from WDFW will probably be required in order to clean the ditch. The WDFW has indicated they would issue the permits contingent upon trees being planted along the sides of the ditch to keep future vegetative growth down and to provide shade to keep the water cool. Currently fish (especially in Mill Creek) suffer from high water temperatures in the summer due to lack of shade trees on the banks. If the cleaning of the ditch and the planting of the trees occurs maintenance of the ditch, until the trees provide sufficient shade, may need to occur by hand as Boeing is doing on the Government Canal.

Government Canal

In the winter of 1994 some residents of Pacific experienced flooding due to clogging of the Government Canal by weed growth (Canary grass) (Konwent, N. 1996, personal communication). Boeing applied for, and in the summer of 1995 received, a Hydraulic Project Approval permit from WDFW and a Section 401 certification to remove the Canary grass from the ditch (Section 5.2 and Appendix A). The maintenance work was accomplished in the fall of 1995. Boeing agreed, in exchange for receiving the permits, to plant Pacific Willow trees along the banks at 20 foot spacing. This work is still underway with approximately 40% of the canal now lined with trees. Until the trees are sufficiently tall to provide shade to the ditch and control Canary grass growth, Boeing is controlling weed growth by selective application of herbicides and with a hand held weed wacker (Konwent, N. 1996, personal communication).

6.6 FUTURE POTENTIAL PROBLEMS

The flooding problems in the northern portion of Algona are expected to continue unless the Mill Creek flood mitigation project is effective and selected stormwater pipes are replaced. The pipes identified by the stormwater modeling as being undercapacity were identified in Section 4.4.2.

Hydraulic modeling performed by Northwest Hydraulics indicates that the SR 18 culvert has insufficient capacity to convey flood waters (Leytham, M. 1996. personal communication). In addition the capacity of the culvert may be reduced due to sediment build up from landslides in Peasley Canyon. To limit sediment build-up in the culvert the Washington D.O.T. constructed a small sedimentation basin at the upstream end of the culvert. This basin captured some of the sediment from landslides in Peasley Canyon during the February 1996 storm. However, three feet of sediment was deposited in this culvert despite the small sedimentation basin.

Maintenance of the SR 18 culvert by removal of sediment and the stabilization of slopes in Peasley Canyon must be a critical component of flood mitigation in northern Algona.

7. ALTERNATIVE FLOOD HAZARD MANAGEMENT

Management methods to reduce flooding require evaluation of both non-structural and structural alternatives. Non-structural alternatives include zoning, interlocal agreements, building ordinances and property acquisition. Structural alternatives include increasing stormwater conveyance by the installation or replacement of stormwater pipes, increasing detention through the construction of facilities or diking to prevent floodwaters from entering an area.

In the evaluation of alternatives several criteria must be considered. These criteria include:

- the impact on the environment,
- permit considerations,
- cost,
- reliability,
- feasibility.

7.1 "NO-ACTION ALTERNATIVE"

The no-action alternative is used for comparative purposes to evaluate alternatives. If no action is taken to reduce future flooding then the flood waters are expected to inundate the problem areas on a periodic basis. As discussed in Section 6.1 the February 1996 storm had a 24-hour repeat interval of approximately 5 years. However due to the wet weather and saturated conditions which preceded the storm the runoff and impacts may have been more representative of a storm with a greater repeat interval. Floodwaters innundated the northern portion of the City (Figure 6-1). The southern portion of the City also experienced localized flooding.

Future flooding in northern Algona will be impacted by the frequency of maintenance performed on the SR 18 culvert and efforts made to reduce sediment delivered to it. If Algona does not advocate for keeping the SR 18 culvert free of sediment, flooding may increase as this culvert becomes increasingly plugged.

7.2 STRUCTURAL ALTERNATIVES

Structural alternatives include projects such as: building levies which complemented by the road network could be utilized to hold back flood waters, construction of regional detention facilities, and pipe replacement. The effects of these alternatives on flooding both locally and regionally are discussed below.

7.2.1 Diking and Pumping

Diking and pumping would be performed to reduce the amount of backwater flooding in Algona. Diking could be accomplished by construction of a levy along the C-C_4 ditch and the Chicago Ditch to an elevation of approximately 71 feet. These levies would be augmented by the installation of one way flow valves on the pipes under Boundary Boulevard and Chicago Avenue. Ponded water in the northern portion of Algona which could not flow into Auburn due to flood waters in Mill Creek would be pumped to the Auburn 400 Ponds.

Any diking and pumping structure in Algona will increase downstream flooding in Mill Creek. Permits to construct such a facility most likely will be difficult to obtain. Anticipated permits include a Section 404 permit, a Section 401 certification and a Hydraulic Project Approval permit. Wetland mitigation will be required as this type of project would impact wetlands both through the placement of the levy and the pumping of floodwaters. In addition to the permitting issue Algona would incur some significant costs associated with diking and storm water pumps. The capital costs for a pumping and diking project in northern Algona are anticipated to be approximately $500,000 (Appendix E).

Principle Advantages

- Reduction in the height of flood waters in the northern portion of the City

Principle Disadvantages

- Difficult to obtain permits to perform this work,
- Wetlands mitigation would most likely be required as wetlands would be impacted,
- Probable objections from Auburn,
- High capital cost,

- Long term maintenance on the pumps and dikes,
- Increased flooding downstream of Algona, violating a major tenant of the WDOE Stormwater Management Manual, which the City has adopted.

Recommendations

Based upon the likely regulatory issues that would be involved with diking and pumping this alternative is not recommended.

7.2.2 Regional Detention

The purpose of increased detention would be two fold. In the northern portion of the City the detention would reduce the stress in the Mill Creek drainage system by holding back the stormwater. In the southern portion of the City detention would be designed to reduce the rate of storm water runoff entering the storm water system by temporarily storing storm water. A combination of existing roads and constructed berms could be used as berms to retain the water. Due the high water table in Algona, near ground surface, storage would have to occur above the current ground surface. Due the low topographic relief in the City above ground storage of stormwater could only occur if stormwater is pumped to the detention facility. Additionally for detention the City will have to purchase property to provide storage area. Costs will in part be dependent upon the price of the property chosen for regional detention. Because pumping will be required, costs are anticipated be at least as much as the diking and pumping option.

Principle Advantages

- Reduction in the rate of storm water runoff,
- Reduced flooding downstream.

Principle Disadvantages

- High capital cost.
- Long term operation and maintenance costs for storm water pumps.

Recommendations

Regional Detention is not a viable alternative due to the high water table and the high capital cost.

7.2.3 Pipe Replacement

The selection of pipes to be replaced should be dependent upon the cost, the expected benefit in reducing flood water elevations upstream of the pipe and the ability of the downstream conveyance system to carry the increased flow. The number of pipes which can be replaced is a function of the money available for capital improvements.

Principle Advantages

- The replacement of storm drain pipes is relatively straight forward.

Principle Disadvantages

- Cost, which is dependent upon the pipe size and length, is presented below.

Recommendations

The City should replace undersized pipes in the City's system. Seven of the pipes from the list presented in Table 4-4 have been selected for upgrading in the first six years of a twenty year plan in three separate phases (Figure 7-1). An implementation schedule of pipe replacement capital projects is presented in Table 7-1 below.

The pipes selected for replacement were scheduled as the revenue becomes available (Table 7-1). Revenue generation is discussed in Section 7.4. The criteria used to prioritize pipe replacement was:

1. The estimated cost and projected improvement in conveyance capacity,
2. The position of the pipe in the conveyance system, i.e. replace downstream pipes before upstream pipes, and
3. The impact, or ability of the receiving jurisdiction's stormwater system to absorb the additional flow.

A complete breakdown of cost is presented in Appendix E. Revenue requirements are discussed in Section 7.4.

The pipe under Algona Boulevard at 9th Avenue North is scheduled to be replaced with new development on 9th Avenue which has been permitted. Thus replacement costs and scheduling for this pipe (B17415) have not been included.

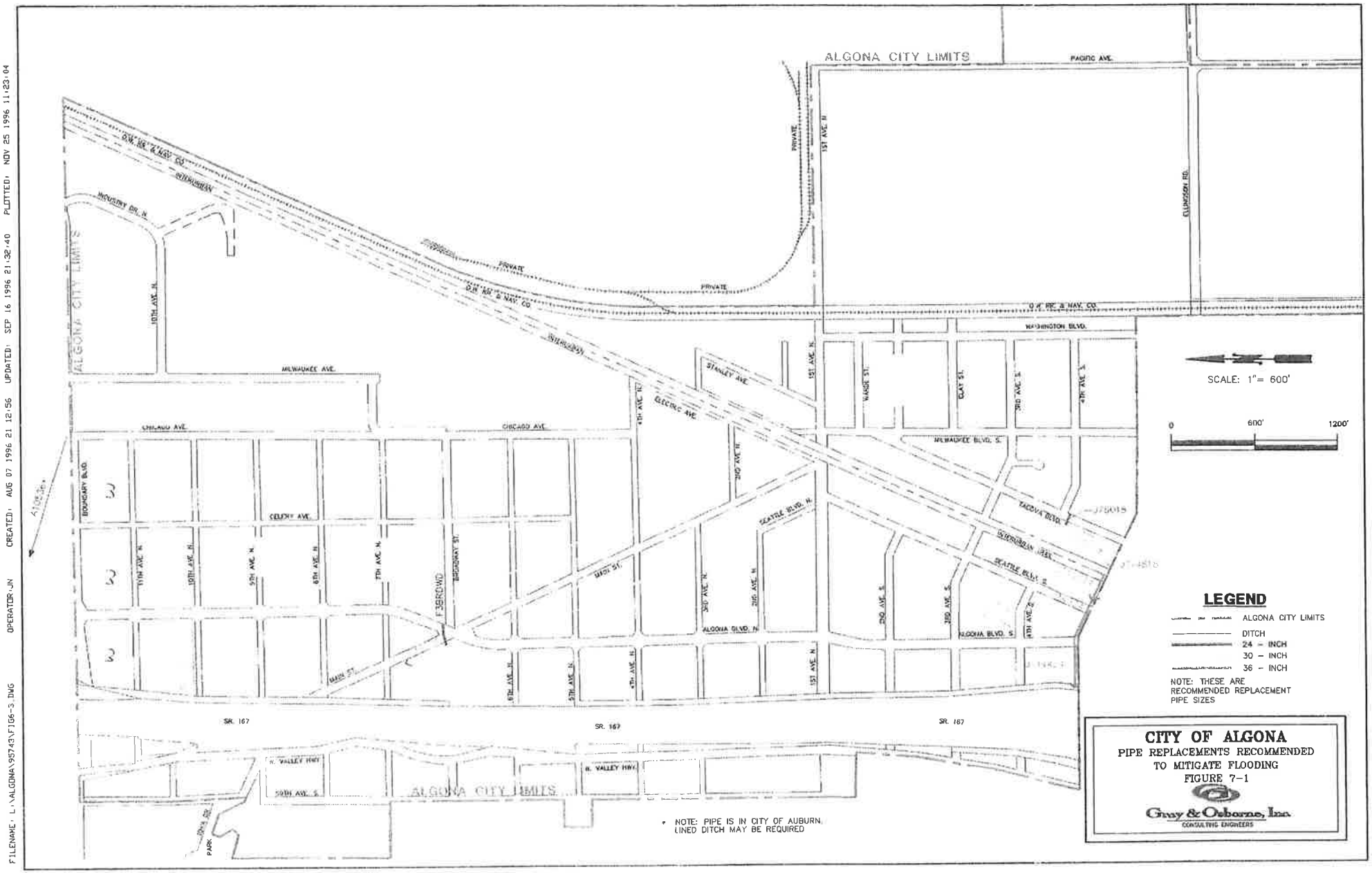
Table 7-1

Recommended Pipe Improvements - Estimated Cost [1]

Pipe Number	1997	1998	1999	2000	2001	2002	2003
J714424			129,400				
J714524			12,400				
J714624					79,100		
B113824					88,800		
F3BRDWD[2]					25,500		
F34124							123,700
J714818							67,100
Maintenance	23,400	24,300	25,300	26,300	27,300	28,400	29,600
J715718	After the Year 2002						
J76018							
A10536							

(1) - Inflation rate assumed at 4%

(2) - Represents cost for installing new pipe under Algona Boulevard and which lowers the invert and thus better drains the ditch.



FILENAME: L:\ALGONA\95743\FIG6-3.DWG OPERATOR: JN CREATED: AUG 07 1996 21:12:56 UPDATED: SEP 16 1996 21:32:40 PLOTTED: NOV 25 1996 11:23:04

7.3 NON-STRUCTURAL ALTERNATIVES

7.3.1 Flood Insurance

The City is currently a participating jurisdiction in FEMA's flood mitigation program. Areas below the 100-year flood elevation in Algona could be designated as either a flood hazard area or a non-special flood hazard area. A flood hazard area is anywhere within the 100 year flood elevation delineated on FEMA flood maps (Figure 2-4). Residents within flood hazard areas are required to buy flood insurance from insurance companies as a condition of real estate financing. Residents within the non-special flood hazard area are eligible, but not required, to buy flood insurance. The City is currently characterized as a non-special flood hazard area.

Insurance companies offer several rates for residential flood insurance based upon the residence (Appendix B):

1) predating the City's participation in the flood program (PreFirm),
2) location relative to the flood hazard area,
3) floor elevation relative to base flood elevation (100 year flood plain).

The determination of the least expensive flood insurance will depend upon the floor elevations of the homes. The recent flooding reached an elevation of 68.8 feet but caused no damage in the houses. Floor elevations are then likely to be between 69 and 70 feet which is a few inches to 1 foot above the Base Flood Elevation. Flood insurance is less expensive in the hazard area than outside the hazard area if floor elevations are one foot or more above the base flood elevations (Appendix B).

Currently the entire City is considered to be outside the hazard area. If the City wishes to have the northern portion of the City, below elevation 69, inside the 100 year flood elevation they would need to provide FEMA a detailed topographic map showing elevation 69 as this is the base flood elevation identified by FEMA. The process to get the floodplain shown on the FEMA maps takes about one year.

Principle Advantages

- Flood insurance provides current homeowners protection against financial loss if a flood, serious enough to damage residences, does occur.

Principle Disadvantages

- Purchasing of flood insurance does not "fix the problem" it simply removes the financial liability.
- Asking residents to purchase flood insurance is essentially asking them to absorb the cost of flood management.

Recommendation

The City should encourage citizens in flood prone areas, particularly those in the north end, to purchase flood insurance. Any solutions to flooding in the north end will require cooperation with Auburn and King County to minimize flooding in the Mill Creek corridor. Capital projects to rectify the flooding in Mill Creek may be many years down the road. In the short term flood insurance may be the best way to lower the financial exposure to current residents from flood damage.

7.3.2 Minimum Floor Elevations

City building ordinances may be created which establish minimum floor elevations for new construction. The City already "strongly encourages" new construction to be built to at least street level (Pullar, R. 1990. personal communication). A FEMA (1989) floodplain map, Figure 2-3, shows the 100-year flood elevation at 69 feet. The flood elevation reached 68.9 and 68.8 feet in the 1989 and 1996 storms respectively. If minimum floor elevations are to be established they should be at least at 71 feet (NGVD). This elevation should be sufficiently high to eliminate flooding on new properties for storms with a repeat frequency of less than 100 years.

Provision for minimum floor elevations may negatively impact neighboring properties because the fill required may raise water surface elevations on neighboring unfilled property. To partially mitigate the impacts of future development runoff from it should not be allowed to drain to neighboring low lying properties. The City has adopted the Washington Department of Ecology's *Stormwater Management Manual for the Puget Sound Basin* (1992). This manual requires that all stormwater from new construction of greater than 5,000 ft^2 of impervious area be controlled so as to not impact neighboring properties. For example perimeter drains could be installed, with the collected runoff going to the City's conveyance system.

Principle Advantages

- Reduce flooding for new construction
- Minimal maintenance
- Easy to enforce

Principal Disadvantages

- Potential increased flood elevation which exacerbate flooding at existing homes due to displaced floodwaters

Recommendation

The City should codify a policy of minimum floor elevations which is now strongly encouraged. Additionally the City may wish to require runoff from any new construction, regardless of size, be controlled in such a manner as to prevent impacts to neighbors. Recommended floor elevations are 71 feet or 1 foot above the nearest road, whichever is higher.

7.3.3 Zoning

Currently the northern three blocks of the City, blocks 71, 72, and 73 are zoned for commercial development. The City may wish to evaluate zoning in light of the wetlands issues as these blocks have been identified as wetlands in the Special Area Management Plan. If zoning is used in combination with building ordinances which establish minimum floor elevations then new development and redevelopment less prone to flooding, may eventually replace existing development.

Principle Advantages

- Opportunity to encourage new development which would be built to minimum floor elevations specified in Section 7.4,
- Increased revenue base for the City,

Principle Disadvantages

- Probable dislocation of existing residences,
- Lack of significant open space for commercial development,
- Potential intermingling of residences and commercial development.

Recommendation

The City should examine its zoning in light of potential wetlands issues and attempt to develop a zoning plan which optimizes potential tax revenues and at the same time avoids lengthy wetlands mitigation projects.

7.3.4 Agreements or Memorandums with Downstream Jurisdictions

Agreements with neighboring jurisdictions and the Washington Department of Transportation may provide the opportunity for Algona to ensure maintenance of downstream conveyances. The agreements might address issues such as: 1) a common understanding of the issues and impacts on Algona, 2) development of maintenance schedules and 3) assessment of the need for new facilities.

A maintenance agreement with the City of Pacific would reduce flooding in that City and would allow the City of Algona to upgrade that portion of its storm water system which drains south. As mentioned the flow capacity in the drainages in Pacific have been compromised due to a lack of maintenance over the years.

Principle Advantages

- Opportunity to participate in flood control management in other jurisdictions
- Increased control over decisions and actions impacting flooding in Algona

Principle Disadvantages

- Cost sharing arrangements with other Cities may be expensive
- Significant expenditure of time may occur for relatively little action from other jurisdictions

Recommendations

The City should enter into a Memorandum of Understanding with Pacific to maintain the existing system, both in Algona and Pacific. The agreement should consider coordinated maintenance activities on the SR 167 ditch and the 1st Avenue ditch to maximize the benefit of such maintenance.

The City should become involved in the Mill Creek flood mitigation project and the Special Area Management Plan. As stated in Section 4.4 maintaining an open culvert

under SR 18 is critical to flooding in the northern part of Algona. The culvert should be inspected and if necessary cleaned. The City should communicate regularly with King County and DOT to ensure that SAMP recommendations to reduce sediment from Peasely Canyon are implemented. King County and DOT should be aware that neglect of erosion control in Peasely Canyon and of cleaning of SR 18 culvert may have severe and costly implications for flooding in Algona.

Enforcement of Covenants / Chicago Ditch and Government Canal

The City could reach agreements with property owners responsible for keeping the Chicago ditch and the Government Canal clean and free flowing. The agreement could be a Memorandum of Understanding regarding criteria and schedule for maintaining these conveyance facilities. The memorandums could also cite covenants assigning owners with maintenance responsibility and describe flooding in Algona as a result of neglect of maintenance.

Principle Advantages

- Awareness on all side of responsibilities and consequences of neglect.

Principle Disadvantages

- None

Recommendations

The City should initiate such Memorandums of Understanding. The City should regularly inspect these ditches and remind owners of maintenance needs as necessary.

7.3.5 Property Acquisition

The City could acquire properties which are chronically flooded. The City would purchase the residences and then resell the property for other purposes or hold the land as open space thereby preventing future development on the property. The new owner, if there is one, would be subject to set minimum floor elevations for any new construction.

Principle Advantages

- Removal of flood prone buildings,
- Gain open space which the City could develop into park land.
- Reduction of City's liability for flood damage

Principle Disadvantages

- Potential high capital cost if City does not resell property,
- Loss of tax revenue if property is not resold.

Recommendations

The City should review its need for parks and coordinate its needs with flood control objectives where feasible. In the absence of such a need the City should encourage existing landowners to insure their property and require developer's to meet standards recommended under Minimum Floor Elevations.

7.3.6 Increased and Scheduled Maintenance

Currently maintenance on the stormwater conveyance system is performed as necessary to repair broken or plugged pipes and to clean the ditches for which the City has an easement. There is no regularly scheduled maintenance for pipes or ditches. Increased maintenance would provide for cleaner ditches and earlier identification of broken pipes.

The City currently has four field personnel in the Public Works Department. They perform maintenance and repairs on the water, sewer roadways, and stormwater systems. Thus scheduling of stormwater maintenance projects is difficult due to competing demands.

Cleaning of the $C\text{-}C_2$ and $C\text{-}C_4$ ditches along SR 167 is particularly important. As mentioned in Section 6.4 the ditches were last cleaned in 1987. Since that time there has been much vegetation growth and thus a reduction in the conveyance capacity. To clean these ditches, a permit from the WDFW will probably be necessary. The WDFW has indicated they would be inclined issue the permits contingent upon trees being planted along the sides of the ditch to keep future vegetative growth down and to provide shade to keep the water cool. Currently fish in streams in the area (especially Mill Creek) suffer from high water temperatures in the summer due to lack of shade trees on the banks. However, tree growth along the side of the ditch may require specialized equipment for future ditch cleaning.

The Chicago Ditch should also receive regular maintenance. The current agreement between the businesses and the City calls for the businesses in the Auburn 400 Park, the northeast portion of Algona, to maintain the ditch (see Appendix D). Vegetation growth

in this ditch is rapid. In the February 1996 storm this ditch flooded partly due to a clogging of the trash rack at the north end with grass and sticks.

Principle Advantages

- Increased maintenance is effective in reducing local blockages to stormwater flow,
- High public recognition that funds are spent wisely.

Principle Disadvantages

- Currently unfunded

Recommendations

The City should schedule cleaning of the SR 167 ditches every two years or as necessary. This cleaning should be coordinated with the Cities of Pacific and Auburn. The program should include replanting of trees to control future plant growth and reduce stream temperatures. The two year time frame will allow for the removal of vegetation by hand. Permits from fisheries if applied for regularly may be easier to obtain in future.

The City should begin a regular program of stormwater facility maintenance and enforcement of maintenance agreements with others.

7.4 IMPLEMENTATION OF PLAN

To implement this plan the City needs to increase the money available for stormwater capital projects. A common way to increase revenue is to create a surface water utility.

7.4.1 SURFACE WATER UTILITY

The City of Algona currently funds its stormwater-related operations, maintenance and construction out of the general and street funds. These funds are subject to many competing demands and priorities. As such, they cannot be relied upon to provide the dedicated ongoing funding required to support an adequate stormwater management program.

A surface water utility is a stand-alone entity, usually set up as an enterprise fund within the governmental structure. It is defined as being financially and organizationally self-sufficient, and can be designed to furnish a comprehensive set of services related to surface water quantity and quality management. A "city" utility

operates under the purview of the city legislative authority. A utility may use rates to support debt obligations, including revenue bonds or general obligation bonds used to finance utility improvements.

The *Stormwater Program Guidance Manual for the Puget Sound Basin* provides the following summary of the utility concept:

> "A stormwater utility provides a reliable, dedicated source of revenue and an organizational structure that is dedicated to stormwater concerns. As a utility, a stormwater management program can be carried out as a "stand alone" operation, with its own budget, implementation plan, and employees dedicated solely to stormwater system operation, maintenance, administration, and education. Also, creating a utility is often more acceptable politically, as many communities tend to resist the creation of new programs using special districts. Creating a utility has the added benefit of freeing up tax dollars from the local government's general fund that would normally be used for stormwater concerns, and this "extra" money can be applied toward other needs."

In order to estimate the revenue needed to fund a Surface Water Utility cost estimates were developed by City staff and the project engineer. The revenue would provide a dedicated source of revenue for stormwater facilities maintenance and construction. Typically, a surface water utility will maintain two funds, an operating fund and a capital improvement fund. The operating fund will cover ongoing costs such as maintenance, while the capital fund will provide revenue for capital improvements to the system.

7.4.2 OPERATING COSTS

In order to estimate annual maintenance costs in 1997 and beyond, two sources were used: (1) the City's estimates of existing maintenance performed and (2) the project engineer's estimates of additional maintenance needed. The City provided the following detail of hours spent, and the resulting cost, for the following maintenance activities in 1995 (Table 7-2).

TABLE 7-2

1995 Maintenance Cost Estimates

Activity	Annual Hours	Hourly Rate	Resulting Cost
Wages and Benefits	160	$46.88	$7,500
Dump Truck	100	$45.00	$4,500
Backhoe	100	$60.00	$6,000
Total	360		$18,000

This cost is expected to increase with inflation.

In the utility's initial year of operation, rates should be sufficient to fund an operating reserve. Funds in this reserve would be available to meet unexpected revenue shortfalls, or higher than anticipated operating expenses. Typically 45 days (12.5%) of annual cash operating expenses is maintained as a minimum balance. An operating fund surplus, such as cash over 60 days (16.67%) of annual cash operating expenses could be transferred to the capital fund.

7.4.3 CAPITAL COSTS

A number of stormwater capital projects were identified in Section 7.3. The total uninflated cost of these projects is $430,000.

7.4.4 RATE BASIS

The rate basis is the method by which the rate revenue requirement is recovered from utility customers. The most common rate basis for stormwater utilities is contribution of runoff, reflecting the belief that those who cause the problem are most served by the services provided. Contribution of runoff is often measured by the amount of "impervious" surface area on a property. Impervious surface area is defined as hard surface which retards or prevents the absorption of water into the ground. Examples of impervious surface area include rooftops, paved parking lots, sidewalks, and patios.

The stormwater rates developed in this analysis are based on the concept of the equivalent service unit (ESU). Single family residences would be charged a single flat rate per residence, in the rate structure proposed. Commercial and industrial areas would be charged the same rate as residential units for each 2,000 square feet of impervious area.

Under this rate approach, single family residential customers would be charged for one ESU per residence. All other customers would be charged based on the actual or estimated amount of impervious surface area on the parcel, expressed as a number of ESUs.

The number of residential units were based upon 1996 residential water connections, 857, plus a 1996 commercial area of approximately 1.6 million square feet. Residential connections are anticipated to increase by 22 units per year. Commercial property is anticipated to increase in 1997 and in 2000 with increased development in the Auburn 400 Corporate Park.

7.4.5 RATES

Projected annual rates are calculated by dividing the annual revenue requirement, capital costs plus maintenance, by the appropriate number of equivalent service units. Resulting annual rates, per ESU are $51.00 per year or $4.25 per month, with an increase to $4.75 per month in the year 2000. As a comparison, King County currently charges $7.09 per month, Renton charges $5.23 per month, and Bothell charges $3.25 per month.

These estimated rates reflect a number of important assumptions:

- Annual growth is assumed to occur at a rate of 22 residential units per year plus increased commercial development;
- Fund balances are assumed to earn annual interest at 4%;
- Annual costs are assumed to escalate at 4%;
- Annual utility administrative and engineering costs are assumed to total 20% of operating costs.

7.4.6 IMPLEMENTATION

Water and sewer utility billing is currently tied to the number of water meters for all services. Each water meter is considered a separate account. For single family residences, this does not present a problem. Single family residential stormwater customers are to be charged for one equivalent service unit each. A typical single family residence has one water meter, and so in a stormwater utility would be billed for one ESU per SFR account.

However, in order to bill non-SFR customers, the City will need to ensure that the number of "units" billed is not based on the number of meters, but is instead based on the number of equivalent residential units. For example, commercial properties may be charged reflecting the square footage where and 2,000 square feet is equivalent to one ESU.

Multi-family homes, however, may be charged at a rate less than one ESU for each unit. Additionally, some developed properties in the southern portion of the City along Ellingson Boulevard are currently supplied water by the City of Pacific. The City may wish to include these properties in the stormwater utility.

REFERENCES

CH2M Hill. 1990. City of Auburn, Comprehensive Drainage Plan.

Custer, Bob. 1996. INCA Consulting Engineers. Personal Communication with Warren Perkins.

Dorsey, Jim. 1996. Public Works Director, City of Pacific. Personal Communication with Warren Perkins.

Federal Emergency Management Agency. 1989. Flood Insurance Rate Map Panel 461 of 650.

Frederick, D. 1996. U.S. Department of Interior, Fish and Wildlife Service. Letter to Warren Perkins regarding Endangered Species in Algona area.

King County Surface Water Management. 1993. Mill Creek Water Quality Management Plan

King County Surface Water Management. 1990. Surface Water Design Manual.

Konwent, Nick, Boeing Facilities Permits Administrator. 1996. Personal Communication with Warren Perkins.

Leytham, Malcolm. Northwest Hydraulics, Inc. 1996, Personal Communication with Warren Perkins.

Nauer, Don, Washington Department of Fish and Wildlife. 1996. Personal Communication with Warren Perkins.

Northwest Hydraulics. 1993a. Auburn Supermall Downstream Analysis.

Northwest Hydraulics. 1993b. Mill Creek (Auburn) Hydraulic Modeling.

Northwest Hydraulics. 1993c. Mill Creek (Auburn) Hydrologic Modeling and Analysis.

Northwest Hydraulics. 1993d. Mill Creek (Auburn) HSPF Model Calibration.

Northwest Hydraulics. 1995. Downstream Analysis of Proposed Auburn Thoroughbred Racetrack Washington

PAC-TECH. 1988. City of Algona, Comprehensive Storm and Drainage Study.

PAC-TECH. 1995. City of Algona, Comprehensive Plan and Final Impact Statement.

Pullar, Ray. 1996. Algona Public Works Director. Personal communication with Warren Perkins.

U. S. Geological Survey. 1961. Geology of the Poverty Bay Quadrangle, Washington, GQ-158

United States Department of Agriculture, Soil Conservation Service. 1973. Soil Survey King County Area, Washington.

United States Geological Survey. 1962. Geology of the Des Moines Quadrangle, Washington, GQ-159

Walker & Associates. 1995. Aerial photographs.

Washington Department of Ecology. 1992. Stormwater Management Manual for the Puget Sound Basin

Washington Department of Ecology. 1992. Stormwater Program Guidance Manual for the Puget Sound Basin

Washington Department of Ecology. 1991. Comprehensive Planning for Flood Hazard Management Pub. #91-44.

APPENDIX A

Regulatory Programs

Appendix A: Regulatory Programs

Introduction

Federal, state and local regulatory programs directly affect flood hazard management. For the purpose of sorting out the numerous jurisdictions that have a role in flood hazard management, this appendix has grouped the many regulations into four major types listed below.

1. Land Use Management
2. Resource Management
3. Environmental Protection
4. Flood Hazard Management

There will be a brief discussion concerning their individual rationale, the regulatory mechanisms that drive them, and how the jurisdictions are responsible. Each regulation will be discussed in greater detail, exploring the individual tools available and how they relate to a Comprehensive Flood Hazard Management Plan (CFHMP).

Land Use Management

The purpose of land use management is to provide guidance for growth and development and the associated physical improvements that coincide with it. Both the State of Washington and federal agencies require counties to adopt specific regulations concerning land use issues and as such, many of the county regulations are very similar. Within most cities/counties, development regulations will include a comprehensive plan, zoning ordinance, building code, subdivision ordinance, shoreline master program and possibly a flood plain management ordinance. Those land use management regulations that effect flood hazard management plans are discussed briefly below.

Comprehensive Plan

The purpose of a city/county comprehensive plan is to give long range direction and guidance for systematic growth and development. The plan should emphasize immediate local concerns that can range from land use, transportation, utilities, water resources, open space, environmentally sensitive areas, drainage and others. Typically, these plans are non-regulatory, lacking the enforcement mechanisms to ensure compliance. Their purpose is to provide goals, objectives, and policy statements that are met through various ordinances set by the jurisdiction.

Within the past year, the State of Washington passed the Growth Management Act (GMA). The intention of the GMA is to manage growth in the state's fastest growing counties through the adoption of local comprehensive land use plans and development regulations. Although comprehensive planning is a common tool used by many local governments, the legislature found that too often growth occurred in an uncoordinated and unplanned manner, lacking common goals that expressed the public's interest in conservation and wise use of lands. The citizenry of the state saw the effects of undirected growth as a threat to their quality of life. Growth without direction was seen as posing a threat to not only the environment, but to the sustainability of economic development across the state. The GMA attempts to bring consistency and coordination to long range planning by reforming the decision-making processes that have been often unpredictable and disjointed.

The planning goals of the GMA range from economic land use issues such as urban growth, transportation, housing, economic development, and others to resource/environmental issues dealing with open space, conservation, and cultural resources. The resource/environmental planning goals specifically address critical areas (which include the following areas and ecosystems: wetlands, critical recharge areas affecting aquifers used for potable water, fish and wildlife habitat, frequently flooded areas, and geologically hazardous areas), requiring effected counties to adopt development regulations that preclude land uses or development deemed incompatible with those critical areas. The protection given these critical areas is intended to cross over jurisdictional boundaries in a coordinated manner.

It is at the comprehensive plan level, whether defined by the GMA or through a local effort, that communities are able to set a direction for regulations. For example, some comprehensive plans identify special flood hazard areas and include a set of guidelines to direct growth within those areas. These areas are typically designated by the United States Department of Housing and Urban Development using maps developed by the Federal Emergency Management Agency (FEMA). Using the FEMA maps to designate special flood hazard areas in a comprehensive plan is one of several steps needed to be taken.

Zoning Ordinance

The purpose of a zoning ordinance is to implement the growth management policies of the Comprehensive Plan. Typically, the zoning code assigns use and density requirements that guide land use in either a city or county. The major tools are a zoning map that identifies specific land use zones accompanied by a zoning code book that defines each zone and provides specific regulations. Zoning codes have the ability to grant variance and conditional uses as well as enforce the code if they are not complied with.

Land use zones are determined by environmental constraints and infrastructure. The availability of water, sewer, fire protection and transportation sets limits to densities. Environmental constraints include: geology, soils, slopes, drainage, earthquake potential, avalanche danger, flooding, as well as wildlife protection for fisheries and endangered species.

Employing zoning regulations is a useful tool in flood hazard management. Zoning sets the density and standards of development and has the ability to direct growth in such a way as to minimize the impact on flood plains. Development diminishes the ability of soils to absorb precipitation and recharge groundwater. This removal of pervious soil increases the loads on drainage systems and elevates the frequency and extent of flooding. Similarly, development constructed on fill intended to withstand a 100-year storm reduces the flood plain's capacity to carry the increased flow by displacing volume. Setting zoning regulations that address the impacts of development assist in the management of flood plains.

Building Code

Building codes are meant to regulate the safety and quality of a structure. The Uniform Building Code (UBC) is often used to set those standards. The building code is intended to be used in conjunction with other regulations such as the zoning ordinance.

When used in consort with flood hazard management planning, the building code ensures proper flood proofing of new construction in flood hazard areas.

Subdivision Ordinance

A Subdivision Ordinance prescribes procedures and conditions for dividing land into smaller parcels. The definition of a subdivision may vary among jurisdictions but is usually determined by some specified amount of parcels, usually five or more. Typically, subdivisions must conform to zoning regulations in effect at the time of the proposed subdivision.

Subdivisions influence flood hazard management planning by their intrinsic nature of increasing density. Because they are tied to zoning, subdivisions are often limited by environmental constraints including flood hazards.

Washington State Shoreline Management Act

The purpose of the Washington State Shoreline Management Act (SMA) is to protect the public's interests in preserving natural resources such as water, fish and wildlife and their habitat by regulating public and private development in shoreline areas. Through an innovative administrative framework that involves joint, state and

local jurisdiction, management of shoreline resources, the SMA provides an effective tool for protecting, utilizing and enhancing shorelines within SMA jurisdiction. The Department of Ecology (Ecology) is the agency mandated to oversee the development of local Shoreline Master Programs and their subsequent implementation.

The legal basis for SMA regulatory documents is through the Washington Administrative Code (Chapter 173-14, 16, 17, 18, 19, 20 and 22). The WAC defines several shoreline designations including shorelines of state-wide significance; provides guidance to both Ecology and local jurisdictions for developing procedures and rules for shoreline uses, activities, and modifications; establishes time lines for the development of local shoreline master programs; and identifies uses and activities generally exempt from certain shoreline permits.

The SMA requires permits for any "substantial development" within the two hundred foot (200') shoreline jurisdiction. A substantial development is defined as any development where the total cost of fair market value is equal to or exceeds two thousand five hundred dollars ($2,500), or any development which materially interferes with the normal public use of the water or shorelines of the state; except as specifically exempted pursuant to RCW 90.58.030(3)(e) and WAC 173-14-040. Permits can be issued on a "conditional use" or on a "variance" basis. Permits are issued through the local Shoreline Master Programs and are reviewed by Ecology.

The Shoreline Management Act and local shoreline master programs are extremely useful in flood hazard management planning. The SMA requires local governments to define their shoreline jurisdictions along rivers in one of two ways:

1. The area 200' from the ordinary high water mark (OHWM) or floodway, whichever is greater, plus all wetlands in the 100-year flood plain associated with them; or

2. All or any portion of the 100-year flood plain as long as it includes all of those areas falling within the area describe in option 1 above.

There are advantages to using the entire 100-year flood plain to define the shoreline jurisdiction. One advantage is that it accommodates the complete meandering river ecosystem so that changes in the river bed itself will not effect jurisdictional boundaries, it also automatically places shoreline management protection on lands surrounding wetlands in the flood plain eliminating an extensive inventory, and finally allows more comprehensive shoreline management planning of the entire flood plain. This is a strong tool for flood hazard management planning, as well as shoreline management because it carries the legal and administrative status associated with a state regulation.

Using the second option for defining the shoreline jurisdiction (200' of floodway plus associated marshes, bogs and swamps in the 100-year flood plain) demands that wetlands in the flood plain be inventoried and recorded. Once the shoreline jurisdiction has been established,

permit applications can then be evaluated quickly as to whether or not a wetland will be affected by the proposed development. The major advantage of this option is that proposed developments that do not include wetland areas and which are not within 200' of the floodway do not require a shoreline permit. These developments, however, may still be required to attain local flood permits and go through a State Environmental Policy Act (SEPA) review process.

Sometimes a diked floodway is used as the boundary from which the 200' shoreline jurisdiction is measured. In order to qualify under FEMA requirements, the dike must extend at least as high as the 100-year flood elevation plus three feet.

Another important element of the SMA and local Shoreline Master Programs is shorelines of state-wide significance. Designated by the SMA, Chapter 173-16 WAC, these shorelines have a set of prioritized policies that first and foremost "recognize and protect the state-wide interest over local interest" and secondly, "preserve the natural character of the shoreline." The consequences of these policies is a strong shoreline management policy that provides another layer of protection to particularly unique shorelines within our state.

The SMA recognizes our states' shorelines as an important public natural resource which should be protected from degradation. The SMA authorizes local jurisdictions to develop local Shoreline Master Programs that reflect a community's goals and values in keeping with the SMA. The local regulations are used as an overlay to zoning and as such can guide future development within the flood plain and its watersheds.

Shoreline Master Program

The Shoreline Master Program (SMP), developed at the local, city or county level, is mandated by the state's SMA for the purpose of protecting the public's shoreline resources. Local governments develop SMP's, guided by the Department of Ecology, the SMA and the WAC's pertaining to it as briefly discussed above.

As a regulatory tool, the SMP provides local government a strong means by which to manage the effects of development on shorelines, including flood plains. All streams with a mean annual flow of 20 cubic feet per second (cfs) or more, and associated wetlands, are included within the shoreline management jurisdiction. Development can be regulated around these streams, reducing urban runoff effects by creating buffers, ensuring property containment of runoff and reducing densities. Wetlands can be retained to perform one of their major functions, absorbing excess water thereby reducing storm surge effects down stream. If the more inclusive method of defining a floodway is chosen by a jurisdiction, development can sensibly proceed, reducing potential damage, loss of life and property, and increasing the capacity of the flood plain to absorb water volumes during periods of flooding. Upstream in watersheds, baseflow can be increased by increasing vegetation in both forested wetlands and wet meadows. These habitats

have a great capacity to absorb and retain water, reducing storm surges, and releasing water slowly during low flow periods. Often times such systems fall under the jurisdiction of the SMA, providing the opportunity to manage the resource.

The SMP is an excellent tool to be used in consort with a flood hazard management plan because it directs land use and activities along shorelines, sets design criteria to ensure best management practices, and provides the enforcement mechanism that will be backed by Ecology.

Resource Management

The purpose of resource management is to preserve and protect our nation's natural resources from degradation. Resource management emphasizes sustainability of natural resources, and the industries based on their exploitation, as the timber, agricultural and fisheries industries. To this end, resource conservation and best management practices of productive forest and agricultural lands, and habitats associated with fisheries is the direction resource management regulations has taken. Various state and federal agencies are involved in resource management. All cities/counties must comply with these state and federal regulations depending on the type of project. Resource management regulations affecting flood hazard management include the Washington State Hydraulic Code (Hydraulic Code), Sections 404 and 401 of the Federal Clean Water Act, Section 10 of the Rivers and Harbor Act, and other local ordinances developed to reflect the needs of the particular community.

Hydraulic Code

The purpose of the Washington State Hydraulic Code, RCW 75.20.100-103, is to preserve fish and wildlife habitat by regulating activities within the state's salt and fresh waters. Any construction that will use, divert, obstruct, or change the natural flow or bedding of any of our state's waters within high water areas, including many wetlands, will require a Hydraulic Project Approval (HPA) permit. Such activities include, but are not limited to, streambank protection, dredging, culvert installation, pile driving, construction of bridges, piers and docks, pond construction, log jam or debris removal, mineral prospecting and extraction, and alteration or realignment. Within the code, specific technical provision for hydraulic projects are provided by the administrating agencies; the Department of Fisheries (WDF) and the Department of Wildlife (WDW).

The administration of the Hydraulic Code is split between the two agencies along fish use lines. WDF has jurisdiction over food fish (salmon, sturgeon, marine fish, etc.) while WDW has jurisdiction over "game fish" (trout, bass, perch, etc.). The Department of Fisheries takes the lead in all marine and estuarine waters of the state, and whenever salmon are present in either salt or fresh waters. In fresh

waters where salmon are not present, the Department of Wildlife takes the lead. Some jurisdictions within the state will be dealing with both agencies depending on where the project is located. An application may be denied when the administrating agency determines that the project will be directly or indirectly harmful to fish life and acceptable mitigation cannot be assured.

The Hydraulic Code provides city/county jurisdictions a tool to ensure that no harm to fish and wildlife habitat will occur during the construction of any structural or bioengineering modifications of shorelines. The provision given to assist in the design and construction of shoreline modification structures can also be useful to evaluate proposed projects.

Section 404 - Clean Water Act

Section 404 of the Clean Water Act is one of three federal laws that expanded the regulatory authority of the Army Corps of Engineers (COE) during the 1970's from regulating navigable waters of the United States to maintaining the biological integrity of the nation's waters. Section 401 is the most relevant to structural flood control measures, although Section 401 of the Clean Water Act ensures that federally permitted activities comply with the federal Clean Water Act, state water quality laws, and any other appropriate state laws.

Section 404 requires a COE permit for any project that alters or degrades the waters of the United States, ranging from the openwater disposal of dredge or fill material to the filling of nearshore areas. This includes adjacent wetland and tributaries to navigable waters, and any degradation or destruction of which could affect interstate or foreign commerce. Guidelines for permit approval have been developed by the Environmental Protection Agency (EPA). There are two types of permits issued: an individual permit and a general, or nationwide, permit. The following details each.

1. Individual Permit - This permit is generally issued for a single proposed activity, unless it falls under a blanket authorization for a general permit or if the project involves an especially valuable ecological area such as a wetland. The determination is based on whether the benefits of the project outweigh the predicted environmental impacts. Known as public interest review, the evaluation process entails:

    - o Pre-application meeting with the COE and other resource agencies (optional).
    - o Submittal of a permit application to the COE.
    - o Public notice for a 30-day review period by federal, state, and local permitting agencies, tribes, interest groups and the general public.
    - o Consideration of all comments received from public review process.
    - o Additional information from the applicant may be required.

- o COE decides on whether to prepare an Environmental Assessment and Finding of No Significance, or to prepare a National Environmental Policy Act (NEPA) Environmental Impact Statement (EIS).
- o Public hearing is held, if needed.
- o COE prepares the appropriate decision documentation
- o The District Engineer approves or rejects the permit application.
- o The applicant's permit is advised of the decision.

2. General Permit - The General Permit, also called the Nationwide Permit 26, provides blanket authorization on a nationwide, state, or regional level for actions which have minimal adverse impacts on the environment. Such actions would include, but are not limited to, bank stabilization projects, navigation markers, utility line structures, minor road crossings and bridges, boat docks, minor dredge and fills involving less than 10 cubic yards, or fills involving one to ten acres of isolated wetland or adjacent wetlands located above the headwaters of a stream with an average annual flow of less than 5 cfs. The process involves the following:

   - o Notify the COE, EPA, and other permitting agencies for a review of the potential environmental impacts.
   - o Based on feedback from other agencies, COE accepts or denies permit.
   - o If denied, the applicant may appeal the decision by applying for an Individual Permit.

Section 401 - Clean Water Act

Section 401 is closely tied to Section 404 with the difference being that it is a certification process issued through the Washington Department of Ecology. Whenever there is an activity requiring a federal permit, the applicant must obtain certification as a prerequisite. The state essentially certifies the materials discharged into a water body, ensuring compliance with discharge limitations, water quality standards and any other applicable conditions of state law (Chapter 173-201 WAC). This certification also applies to the eventual operation of the facility. If Ecology denies the certification, then the federal permit must be denied. If the state imposes any conditions on a certification, those conditions become part of the federal permit.

The certification process begins with notification of Ecology at the time a Section 404 permit is filed with COE. Ecology becomes the clearinghouse for all state agency responses to Section 404 with the Environmental Review Section (ERS) reviewing all documents. The ERS prepares a state comment letter based on the responses from various state agencies along with the 401 certification or denial. Ecology has the authority to override any state agency recommendation, unless a violation of state law would result. All state 401 certifications are exempt from the State Environmental Policy Act (SEPA) requirements.

As Section 401 applies to flood hazard management measures, the application often requires what is called a "modification." Typical structural flood control measures such as stream bank protection and instream gravel removal have the potential of temporarily creating excess instream turbidity during the construction phase. This will require a Temporary Modification of Water Quality Criteria from Ecology before a water quality certification will be issued. This is an additional step projects will need to take if water quality is deemed in jeopardy.

Structural shoreline modification or bioengineering techniques have the potential to affect water quality due to the proximity of construction to the shoreline. Section 401 certifications are an important part of the permitting process required through Section 404 of the Clean Water Act and in fact takes precedence over it.

Section 10 - Rivers and Harbors Act

Enacted in 1989 to preserve the navigability of the nation's waterways, Section 10 prohibits the unauthorized obstruction or alteration of those navigable waters without a permit from the COE. The provisions apply to all structures or activities associated with a structure located "in, over, or affecting" navigable waters below the mean high water mark of tidal waters or ordinary high water mark of fresh waters.

This law pertains to navigable waters that are presently, historically, or have a reasonable potential to be navigable and all waters subject to the ebb and flow of the tide up to mean higher high tide or ordinary high water mark. The permit process includes consideration of navigational waters, flood control, fish and wildlife management, and environmental impacts. Section 10 review often occurs simultaneously with the Section 404 permitting process and includes compliance with NEPA.

Special Districts

A special district is a quasi-governmental body that is formed by an agreement of the effected property owners and maintained by special assessment on those property owners to provide particular services. The services vary depending on the districts (i.e. diking and drainage, water, sewer, public utilities districts, and flood control zone districts). Each district has an elected governing body that is empowered to ensure that the needs of the district are met. Any of these districts have the authority to engage in flood control activities.

For illustration purposes, the structure of a flood control district will be used to represent what is typical for a special district. The flood control district is designed to protect life and property, to preserve public health, and to conserve and develop the natural resources of the state. They are authorized to acquire, purchase, sell, lease and manage real and personal property either inside or outside the district's boundary. They also have the right to maintain and operate flood

control works, including their scoping, planning, construction, improvement, replacement, repair and or acquisition of flood control works. These flood control works can include, but are not limited to dams, dikes, levees, ditches, channels, canals, banks, revetments, and other techniques convenient and necessary to reduce floods and lessen their danger. It also has the right to enter into contracts, the right to sue and be sued, the right to eminent domain, and the right to do any and all lawful acts necessary to achieve their purposes.

Environmental Management

Environmental management concerns the natural resources of our state, including fish and wildlife, their habitats, along with recreational resources. Landmark legislation at the federal and state levels have provided a strong foundation for management of our environment. These laws are not strictly preservation or conservation oriented, but rather attempt to link our natural resources (i.e. air, water, public access, and wildlife) to provide rigorous examination of proposed projects to minimize adverse environmental impacts.

These regulations consist of the National Environmental Policy Act, State Environmental Policy Act, Shoreline Management Act and its Shoreline Master Programs, and other local ordinances developed to reflect the needs of the particular community.

National Environmental Policy Act

With the passing of the National Environmental Policy Act (NEPA) (42 U.S.C. 4321 et. seq.) a process was initiated requiring federal agencies to consider the environmental impacts of both development projects sponsored by the agency and those privately sponsored projects that require agency permits and approval. Concerned with project impacts, the NEPA process stresses full disclosure of environmental impacts along with technical and economic considerations of a development project, prior to an agency decision.

The Council on Environmental Quality (CEQ) provides the guidance to implement NEPA, however, most federal agencies have adopted their own regulations for implementation. The CEQ Regulation (40 CFR 1500-1508) emphasizes the consideration of alternatives, including ways to mitigate harmful environmental effects through reducing or avoiding those effects. The NEPA process generally occurs concurrently with Section 404.

Any major federal action that would have significant adverse environmental impacts is required by NEPA to prepare an environmental impact statement (EIS). The EIS must thoroughly evaluate any negative environmental impacts caused from the proposed action and its alternatives. Privately sponsored projects may also be required to perform an EIS if any federal monies are a part of the project or if anyone recommends to the permitting federal agency that

an EIS be performed. Such a recommendation should be based on evidence that indicates a proposed action would result in significant adverse environmental impacts.

To determine whether a proposal would produce significant adverse environmental impacts an environmental assessment (EA) must be performed. Typically the permit applicant provides much of the information and analysis used to prepare the EA. If it is determined that an EIS is not required, a Finding of No Significant Impact (FONSI) document is prepared, explaining why an EIS is not needed.

Generally, all structural and bioengineering flood control projects are federally funded and as such must comply with NEPA requirements. Even when grants are appropriate for operations and maintenance, those funds trigger the NEPA process and must comply with the rules. Private projects are also subject to preparing an EIS when, during review by state or federal agencies, the project is seen as potentially detrimental to the environment.

Washington State Environmental Policy Act

The Washington State Environmental Policy Act (SEPA) was passed by the legislature in 1969 for the purpose of providing a process to analyze the environmental impacts of development. SEPA is not a permit but rather a process of information gathering for the purpose of helping agency decision-makers and the general public understand how a project would affect the environment. SEPA requires a full disclosure of likely significant adverse environmental impacts of a proposed action and a mitigation plan for identified impacts to either the natural or built environment. Proposed actions with possible significant adverse environmental impacts are required to prepare an EIS. Many agency decisions can only be made after the SEPA process has been completed which may include: Hydraulic Project Approval, Shoreline Substantial Development permit and many other local permits (clearing and grading, utility, street use etc.).

There are a variety of actions that are "categorically exempt" from the SEPA process. For example, size is used as the criteria to differentiate between an exempt or nonexempt action. Exempted projects include most single-family homes, commercial buildings under 4,000 square feet, parking lots for 20 cars or less, and any landfill or excavation of 100 cubic yards or less. SEPA rules allow cities and counties to set their own size criteria based on a specific range for five categories of exemptions. The criteria cannot be more restrictive than those of SEPA unless the action affects an environmentally sensitive area.

One of the first steps in the SEPA process is the analysis of alternatives. Funds are available through FCAAP to assist in the EIS process and can actually be extended up to the time of implementation.

Flood Hazard Management

This section is concerned with policies and programs relating directly to issues surrounding flood hazard management and the protection of life and property. A primary regulatory tool is the National Flood Insurance Program (NFIP) which provides low cost insurance to communities that have adopted approved flood plain management regulations.

National Flood Insurance Program

The U.S. Congress initiated the National Flood Insurance Program (NFIP) in 1968 for the purpose of relieving the national Treasury and local jurisdictions from the burden of disaster relief. This program is administered by the Federal Insurance Administration (FIA) which is part of the Federal Emergency Management Agency (FEMA). The thrust of the program is to make affordable flood insurance available to communities. To qualify, the community must adopt approved flood plain management regulations. In 1973 Congress expanded the NFIP to require that funding for structures related to government programs within the 100-year flood plain be permitted only if the structure is covered under a flood insurance policy and the community participates in the NFIP.

The NFIP administers two separate programs, the emergency program and the regular program. Each has their own process within FIA and each provides for the community differently.

- Emergency Program - The process begins with the identification by FIA of flood prone communities. Notification comes in the form of a Flood Hazard Boundary Map (FHBM) which is a preliminary delineation of flood hazard areas. Along with the FHBM, the community receives an application from the FIA for the purpose of attaining limited amounts of flood insurance. Based on the FHBM, the community is required to adopt minimum flood plain management regulations. They are also encouraged to use any additional information available to establish flood elevations.

- Regular Program - The regular program provides communities full flood insurance once that community adopts a local flood plain management ordinance approved by FEMA. The ordinance is based on a detailed technical flood insurance study involving hydrologic and hydraulic analyses culminating in the Flood Insurance Rate Map (FIRM), and a report. Data on floodway width, cross sectional area and flood water velocity are provided at various points along the water-course. The purpose is to determine the flood risk and thereby the insurance rates for areas adjacent to the river. The floodway map defines the areas along the river channel where encroachment is disallowed.

The flood plain management ordinance is a local ordinance which is intended to satisfy the FEMA requirement for participating in the NFIP. Washington State requirements for flood plain management ordinances are contained in Chapter 86.16 RCW. Typically flood plain management ordinances contain the floodway designation, special flood hazard areas identified by the FIMA and establish specific development regulations for the purpose of minimizing losses due to flooding. Specific regulations concern building codes for on-site disposal systems, the use of flood resistant materials, flood proof design of on-site disposal systems, special designs for RV parks; and land use regulations limiting subdivision for residential or commercial use, permitting agricultural, recreational and business uses in the flood plain and or other uses which may impact the flood plain. Variances and conditional use permits are often allowed for hardship situations which demonstrate need, or actions which will not increase flood levels or *result in the habitable portion of a structure being below the base flood elevation*. Variances should have to maintain the minimum requirements of FEMA to continue participation in the NFIP.

State Flood Plain Management

Chapter 86.16 RCW - Flood Plain Management forms the core of the state's regulatory program. WAC 173-158 are the rules developed by Ecology to administer the provisions of Chapter 86.16 RCW. The state's regulatory program has aodpted the NFIP minimum standards as the state minimum standards for flood plain management. Washington exceeds the minimum federal standards in one area - Chapter 86.16 RCW- which has a provision prohibiting new or substantially improved residential development in any designated floodway. Other provisions of the state's program include the provision of technical assistance to localities in determining flood plain boundaries and the ability to assist localities in the development of additional standards that exceed the minimum federal requirements.

APPENDIX B

FEMA Insurance Rates

FEMA Insurance Rates

Pre Firm Construction $100,000 policy

	First $50,000	Over $50,000	Expense	Annual Premium
Single Family	$0.68	$0.20	$75	$515

Post Firm Construction $100,000 policy

1st Floor Elev (relative to BFE)	First $50,000	Over $50,000	Expense	Annual Premium
3ft above	$0.16	$0.07	$75	$180
2ft above	$0.17	$0.07	$75	$195
1ft above	$0.24	$0.07	$75	$230
0ft above	$0.40	$0.07	$75	$310
1ft below	$1.05	$0.55	$75	$875
2ft below	$1.15	$0.75	$75	$1,025
3ft below	$1.55	$1.00	$75	$1,350

Mobile Homes $60,000 policy

1st Floor Elev (relative to BFE)	First $50,000	Over $50,000	Expense	Annual Premium
1ft above	$0.29	$0.07	$75	$227
0ft above	$0.73	$0.07	$75	$582
1ft below	$1.05	$0.55	$75	$655
2ft below	$1.15	$0.75	$75	$725
3ft below	$1.55	$1.00	$75	$950

Structures Not in Flood Hazard Area $100,000 policy

	First $50,000	Over $50,000	Expense	Annual Premium
Single Family	$0.28	$0.08	$75	$255

Pre-Firm homes - existing prior to the area being included in the Flood Hazard area.

Post-Firm homes - built subsequent to the identification of an area as a Flood Hazard area.

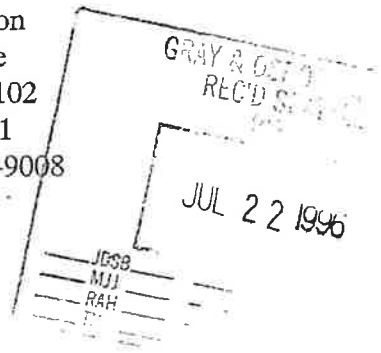
BFE - Base Flood Elevation or 100 year flood elevation.

APPENDIX C

Endangered Species

United States Department of the Interior

FISH AND WILDLIFE SERVICE
North Pacific Coast Ecoregion
Western Washington Office
3704 Griffin Lane SE, Suite 102
Olympia, Washington 98501
(360)753-9440 Fax: (360)753-9008



July 18, 1996

Warren W. Perkins
Gray and Osborne, Inc.
701 Dexter Avenue North, Suite 200
Seattle, Washington 98109

FWS Reference: 1-3-96-TA-395

Dear Mr. Perkins:

This is in response to your letter dated June 3, 1996, and received in this office on June 17. Enclosed is a list of proposed endangered and threatened species, candidate species and species of concern (Attachment A) that may be present within the area of the proposed Flood Hazard Management Plan for the City of Lagoon/Algona in King County, Washington. The list reflects changes to the candidate species list published February 28, 1996, in the Federal Register (Vol. 61 No. 40, 7596) and the addition of "species of concern" prepared by the U.S. Fish and Wildlife Service's (Service) Western Washington Office.

We are providing this information to assist you in determining possible impacts to species of Federal concern. Should there be future Federal agency involvement in your project area (through funding, permitting, licensing, or other authorization), then the involved Federal agency will be required to assure that its responsibilities under Section 7(a)(2) of the Endangered Species Act of 1973, as amended (Act), are met. We are also enclosing an outline of those responsibilities for your information (Attachment B).

To the best of our present knowledge, there are no listed species within the area of the subject project. However, candidate species and species of concern may occur in the vicinity of the project.

Candidate species are those species for which the Service has sufficient information to propose for listing as threatened or endangered under the Act. Species of concern (many were formerly known as Category 1 and Category 2 candidates) are those species whose conservation standing is of concern to the Service, but for which further status information is still needed. Conservation measures for species of concern are voluntary but recommended. Protection provided to these species now may preclude possible listing in the future.

In addition, please be advised that Federal and State regulations may require permits in areas where wetlands are identified. You should contact the Seattle District of the U.S. Army Corps of Engineers for Federal permit requirements and the Washington State Department of Ecology for State permit requirements. There may be other Federally listed species that may occur in the vicinity of your project which are under the jurisdiction of the National Marine Fisheries Service (NMFS). Please contact NMFS at (503) 230-5400 to request a species list.

Your interest in endangered species is appreciated. If you have additional questions regarding your responsibilities under the Act, please contact Chandra Madrona at (360) 753-7762 or John Grettenberger at (360) 763-6044 of this office.

Sincerely,

John Englring

for David C. Frederick
Supervisor

cm/jkp
Enclosures
SE/1-3-96-TA-395/King
c: WDFW, Region 4
WNHP, Olympia

ATTACHMENT A

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES, CANDIDATE SPECIES AND SPECIES OF CONCERN WHICH MAY OCCUR WITHIN THE VICINITY OF THE PROPOSED FLOOD HAZARD MANAGEMENT PLAN FOR THE CITY OF LAGOON/ALGONA IN KING COUNTY, WASHINGTON (T21N R04E S13,14,23-26,35,36)

FWS REF: 1-3-96-SP-395

LISTED

None

PROPOSED

None

CANDIDATE

The following candidate species may occur in the vicinity of the project:

Bull trout *(Salvelinus confluentus)*
Spotted frog *(Rana pretiosa)*

SPECIES OF CONCERN

Long-eared myotis (*Myotis evotis*)
Long-legged myotis (*Myotis volans*)
Northwestern pond turtle *(Clemmys marmorata marmorata)*
Olive-sided flycatcher (*Contopus borealis*)
Pacific western big-eared bat *(Corynorhinus (=Plecotus) townsendii townsendii)*
River lamprey *(Lampetra ayresi)*

ATTACHMENT B

FEDERAL AGENCIES' RESPONSIBILITIES UNDER SECTIONS 7(a) AND 7(C) OF THE ENDANGERED SPECIES ACT OF 1973, AS AMENDED

SECTION 7(a) - Consultation/Conference

Requires: 1. Federal agencies to utilize their authorities to carry out programs to conserve endangered and threatened species;

2. Consultation with FWS when a federal action may affect a listed endangered or threatened species to ensure that any action authorized, funded, or carried out by a federal agency is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. The process is initiated by the federal agency after it has determined if its action may affect (adversely or beneficially) a listed species; and

3. Conference with FWS when a federal action is likely to jeopardize the continued existence of a proposed species or result in destruction or an adverse modification of proposed critical habitat.

SECTION 7(c) - Biological Assessment for Construction Projects *

Requires federal agencies or their designees to prepare a Biological Assessment (BA) for construction projects only. The purpose of the BA is to identify any proposed and/or listed species which is/are likely to be affected by a construction project. The process is initiated by a federal agency in requesting a list of proposed and listed threatened and endangered species (list attached). The BA should be completed within 180 days after its initiation (or within such a time period as is mutually agreeable). If the BA is not initiated within 90 days of receipt of the species list, please verify the accuracy of the list with our Service. No irreversible commitment of resources is to be made during the BA process which would result in violation of the requirements under Section 7(a) of the Act. Planning, design, and administrative actions may be taken; however, no construction may begin.

To complete the BA, your agency or its designee should: (1) conduct an onsite inspection of the area to be affected by the proposal, which may include a detailed survey of the area to determine if the species is present and whether suitable habitat exists for either expanding the existing population or potential reintroduction of the species; (2) review literature and scientific data to determine species distribution, habitat needs, and other biological requirements; (3) interview experts including those within the FWS, National Marine Fisheries Service, state conservation department, universities, and others who may have data not yet published in scientific literature; (4) review and analyze the effects of the proposal on the species in terms of individuals and populations, including consideration of cumulative effects of the proposal on the species and its habitat; (5) analyze alternative actions that may provide conservation measures; and (6) prepare a report documenting the results, including a discussion of study methods used, any problems encountered, and other relevant information. Upon completion, the report should be forwarded to our Endangered Species Division, 3704 Griffin Lane SE, Suite 102, Olympia, WA 98501-2192.

---

* "Construction project" means any major federal action which significantly affects the quality of the human environment (requiring an EIS), designed primarily to result in the building or erection of human-made structures such as dams, buildings, roads, pipelines, channels, and the like. This includes federal action such as permits, grants, licenses, or other forms of federal authorization or approval which may result in construction.

APPENDIX D

Easements

#5769

The Quadrant Corporation
A Weyerhaeuser Company

Weyerhaeuser

January 18, 1983

Post-it™ brand fax transmittal memo 7671	# of pages ▸ 2
To WARREN	From KAY
Co.	Co. Algona
Dept.	Phone # 833-2741
Fax # 283-32106	Fax # 939-3366

* AS REQUESTED *

Members of the City Council
City of Algona
402 Warde Street
Algona, WA 98002

Gentlemen:

Subject: Auburn 400 Corporate Park

In response to questions and concerns with regard to ditch maintenance along the west boundary of the subject project located in Algona, please be advised that The Quadrant Corporation agrees to the following:

1. Ditch maintenance will be the responsibility of those owners in the park whose property abuts the ditch so long as the siltation basin constructed by Auburn 400 Corporate Park at the southerly most point of the ditch on the Park property is maintained by the City of Algona.

2. The Quadrant Corporation, its heirs, successors and assigns will agree not to protest formation of an LID to pipe the entire length of the ditch if all affected owners are included in such future LID.

Item 1 will be a part of the Protective Covenants recorded at the time of final plat recording.

Item 2 will either be a part of the Protective Covenants or a separate agreement between The Quadrant Corporation and The City of Algona.

West Campus
530 South 336th Street
Federal Way, Washington 98003
Seattle (206) 838-1693
Tacoma (206) 924-2165

These 2 items are being reviewed by our attorney but have not yet been finalized. A draft will be forwarded for your review when it is available.

If you have any questions, please don't hesitate to contact me.

Sincerely,

THE QUADRANT CORPORATION

Nancy Scharf

Nancy Scharf
Project Manager

NS:dl

cc: Jamie Skowronski, Pac-Tec
Jim Wiley, SEA

END

EASEMENT

Don Hellickson and _____, do hereby grant and convey to the City of Algona, a municipal corporation, an easement over and across, upon and underneath, the following described land for ingress and egress and for the purpose of laying, maintaining, and installing a storm drainage ditch, said land being described as:

The westerly five foot strip of Lot 8 and south eight feet (8') of Lot 7, Block 96, C. D. Hillman's Pacific City Addition to the City of Seattle, Division Number 6 measured at right angles to and abutting Algona Boulevard (presently known as "the Frontage Road").

DATED this 30th day of March, 1976.

Donald E Hellickson

Elsie M. Hellickson

STATE OF WASHINGTON)
) ss
COUNTY OF KING)

I, the undersigned, a notary public in and for the State of Washington, duly commissioned and sworn, hereby certify that on this day personally appeared before me Donald E. & Elsie M. Hellickson to me known to be the individuals described in and who executed the foregoing instrument, and acknowledged that they signed and sealed the same as their free and voluntary act and deed for the uses and purposes therein mentioned.

GIVEN under my hand and seal this 30th day of March, 1976

Margaret J. Grace
Notary Public in and for the State of Washington
residing at Enumclaw, Wn.

EASEMENT

A. T. Boswell and _____, do hereby grant and convey to the City of Algona, a municipal corporation, an easement over and across, upon and underneath, the following described land for ingress and egress and for the purpose of laying, maintaining, and installing a storm Drainage ditch, said land being described as:

The westerly five foot (5') strip of Lots 4, 5, 6 and lot 7, (except the southern 8' for lot 7), Block 96, C. D. Hillman's Pacific City Addition to the City of Seattle, Division No. 6.

DATED this 26th day of March, 1976.

Abraham T. Boswell

Lula M. Boswell

STATE OF WASHINGTON)
) ss
COUNTY OF KING)

I, the undersigned, a notary public in and for the State of Washington, duly commissioned and sworn, hereby certify that on this day personally appeared before me Abraham T. & Lula M Boswell, to me known to be the individuals described in and who executed the foregoing instrument, and acknowledged that they signed and sealed the same as their free and voluntary act and deed for the uses and purposes therein mentioned.

GIVEN under my hand and seal this 26th day of March, 1976

Margaret J. Fraser
Notary Public in and for the State of Washington
residing at Pacific, Wash.

EASEMENT

Joseph C. and Louise C. Stevens, do hereby grant and convey to the City of Algona, a municipal corporation, an easement over and across, upon and underneath, the following described land for ingress and egress and for the purpose of laying, maintaining, and installing a Storm Drainage Ditch, said land being described as:

A five foot (5') strip of Lot 16, Block 88, C. D. Hillman's Pacific City Addition to the City of Seattle, Division No. 6, measured at right angels to and abutting the east right-of-way of Algona Boulevard (presently known as "the Frontage Road"). The pear tree located 4½' east of Frontage Road will not be damaged in any way.

DATED this 12th day of May, 1976.

Joseph C. Stevens

Louise C. Stevens

STATE OF WASHINGTON)
COUNTY OF KING)ss

I, the undersigned, a notary public in and for the State of Washington, duly commissioned and sworn, hereby certify that on this day personally appeared before me _____, to me known to be the individuals described in and who executed the foregoing instrument, and acknowledged that they signed and sealed the same as their free and voluntary act and deed for the uses and purposes therein mentioned.

GIVEN under my hand and seal this _____ day of _____, 19___.

_____
Notary Public in and for the State of Washington
residing at _____.

5-19-76
signatures witnessed by Stephanie J. Morton, Court Clerk

E A S E M E N T

Ralph Donat, do hereby grant and convey to the City of Algona, a municipal corporation, an easement over and across, upon and underneath, the following described land for ingress and egress and for the purpose of laying, maintaining, and installing a storm drainage ditch, said land being described as:

The westerly five foot (5') strip running 175' in length, abutting and paralleling the east right-of-way of Algona Boulevard (presently known as "the Frontage Road") of Lot 54, Block 97, C. D. Hillman's Pacific City Addition to the City of Seattle, Division No. 6

DATED this 19th day of April, 1976.

Ralph Donat

STATE OF WASHINGTON)
) ss
COUNTY OF KING)

I, the undersigned, a notary public in and for the State of Washington, duly commissioned and sworn, hereby certify that on this day personally appeared before me Ralph Donat, to me known to be the individuals described in and who executed the foregoing instrument, and acknowledged that they signed and sealed the same as their free and voluntary act and deed for the uses and purposes therein mentioned.

GIVEN under my hand and seal this 19th day of April, 1976

Margaret J. Hansen
Notary Public in and for the State of Washington
residing at Enumclaw.

APPENDIX E

Preliminary Cost Estimates

Summary

Pipe Number	Location	Present Pipe Diameter	Pipe/Ditch Length	New Pipe Diameter, Replacement Pipe (1)	New Pipe Diameter, Parallel Pipe (1)	Estimated Replacement Pipe Cost	Estimated Parrallel Pipe Cost
A10536	North of Boundary Chicago to 400 Ponds	36	1140	40	30	$367,000	$336,000
A10830	Across Boundary at Chicago	30	55	40	21	$32,000	$38,000
B167A24	West of Algona between 9th & 10th	24	220	Note 2	12	$56,000	N.A
B113824	10th Ave, discharge to SR 167 ditch	24	386	30	21	$73,000	$64,000
B1117D	Ditch W of Algona between 9th & 10th	Ditch	260	Note 3	30	$48,000	N.A.
D112218	Intersection Boundary and Algona Ave	18	70	36	30	$19,000	$24,000
E15012	Algona, south of 8th Ave N	12	70	18	18	$12,000	$12,000
F3BRDWD	Broadway Ave Ditch between Celery & Algona	Ditch	600	Note 4	24	$21,000	N.A.
F39524	Main St between 6th Ave N and Algona	24	510	30	12	$98,000	$50,000
F34124	West side Main St, Algona to 7th Ave	24	485	30	24	$94,000	$81,000
J58418	East side Main St 1st and 2nd Ave N	18	275	30 - 2 @	24	$39,000	$37,000
J58518	East side Main St 1st and 2nd Ave N	18	205	24	18	$33,000	$33,000
J59912	Cross under Stanley Ave	12	25	24	24	$5,000	$5,000
J59812	West side of Stanley Ave, north of 1st	12	165	24	24	$26,000	$26,000
J59112	North of 1st, West of Stanley	12	160	24	24	$27,000	$27,000
J72424	West side Seattle between 4th and 5th	24	468	24	18	$89,000	$63,000
J710124	East side of Milwaukee, Clay to 3rd S	24	395	30	18	$77,000	$56,000
J712724	East side Milwaukee, 3rd to 4th Ave S	24	460	30	18	$70,000	$96,000
J712524	East side Milwaukee, 4th to 5th Ave S	24	430	30	24	$84,000	$74,000
J7MLWEX24	East side Milwaukee, 5th to Ellingson	24	400	30	18	$79,000	$58,000
J74SDIV18	S Side 4th S, Milwaukee to Tacoma	18	620	24	18	$93,000	$81,000
J76018	Cross Tacoma at 4th Ave S	18	50	18	24	$10,000	$16,000
J715718	West side Tacoma, 4th to 5th Ave S	18	470	30	30	$92,000	$92,000
J714818	5th Ave S, Tacoma to Interurban	18	250	30	24	$51,000	$65,000
J714624	5th Ave S, Interurban - Seattle	24	290	36	30	$65,000	$56,000
J714524	Cross Seattle at 5th Ave S	24	40	30	24	$11,000	$15,000
J714424	Seattle to Milwaukee Canal on 5th S	24	550	36	30	$115,000	$109,000
L510812	N Side of 1st, Seattle to Allgona	12	385	18	12	$44,000	$38,000
L512512	Across Algona at 2nd South	12	65	18	12	$18,000	$16,000
L512318	North Side 2nd Algona to CC	18	200	24	18	$28,000	$29,000

Note 1 - All pipe sizes are rounded up to the nearest standard size.

Note 2 - This pipe is to be routed around the building thus a parrallel pipe is not recommended.

Note 3 - Flooding in this area could be improved by replacement of the ditch with 24-inch stormwater pipe.

Note 4 - Drainge in these ditches could be improved by lowering the culverts under Algona Boulevard allowing the ditches to drain more freely Thus the pipe lengths represented in the cost estimate are the length of the pipe across Algona Boulevard.

F3BRDWD Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	676	$676
5	24 -inch Stormwater Pipe	70 LF	65	$4,550
7	54-inch manhole	1 EA	3900	$3,900
11	Road Restoration	70 SY	50	$3,500
	Subtotal Construction Items			$12,626
	Sales Tax (8.2%)			$1,035
	Subtotal			$13,661
	Contingency (25%)			$3,415
	TOTAL ESTIMATED CONSTRUCTION COST			$17,077
	Engineering, Inspection, Legal & Administration (25%)			$4,269
	ESTIMATED PROJECT COST			**$21,000**

Note: The cost estimate presented here is for the replacement of the pipe under Agona Boulevard at Broadway Avenue at the west end of the Broadway Avenue Ditch.

Cost estimate assumptions

	UNIT PRICE
Mobilization at 8% of sum of construction items	
Unit Costs as follows:	
12-inch stormwater pipe per foot	30
18-inch stormwater pipe per foot	48
24-inch stormwater pipe per foot	65
30-inch stormwater pipe per foot	87
36-inch stormwater pipe per foot	100
42-inch stormwater pipe per foot	120
48-inch stormwater pipe per foot	140
54-inch stormwater pipe per foot	155
60-inch stormwater pipe per foot	170
Type 1 Catch basin	800
54-inch manhole	3900
72-inch manhole	7400
Surface restoration per Square Yard (1)	5
Road Restoration per Square Yard (2)	50

1) - Assumes surface restoration of 0.75 square yard per lineal foot of pipe

2) - Assumes road restoration of 1 square yard per lineal foot of pipe

Manhole sizes based upon pipe size. For pipe sizes 36 inches or less use a 54-inch manhole. For pipe sizes 36-inches or greater use 72-inch manhole.

Algona ordinance 13.42 calls for catch basins "every 50 to 80 feet as fas as is deemed practicable". A spacing of 80 feet was used to estimate the number of catch basins which will be necessary. No catch basins are called for if the pipe is less than 100 feet.

Road crossings are assumed to be 50 feet in length except Boundary Blvd and Algona Blvd which are assumed to be 60 feet

Sub-basin A

A10830 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	608	$608
2	54-inch Stormwater Pipe	70 LF	155	$10,850
3	72-inch manhole	1 EA	7400	$7,400
4	Road Restoration	70 SY	50	$3,500
	Subtotal Construction Items			$18,858
	Sales Tax (8.2%)			$1,546
	Subtotal			$20,405
	Contingency (25%)			$5,101
	TOTAL ESTIMATED CONSTRUCTION COST			$25,506
	Engineering, Inspection, Legal & Administration (25%)			$6,376
	ESTIMATED PROJECT COST			**$32,000**

A10830 Parallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	1656	$1,656
2	48 -inch Stormwater Pipe	70 LF	140	$9,800
3	72-inch manhole	1 EA	7400	$7,400
4	Road Restoration	70 SY	50	$3,500
	Subtotal Construction Items			$22,356
	Sales Tax (8.2%)			$1,833
	Subtotal			$24,189
	Contingency (25%)			$6,047
	TOTAL ESTIMATED CONSTRUCTION COST			$30,236
	Engineering, Inspection, Legal & Administration (25%)			$7,559
	ESTIMATED PROJECT COST			**$38,000**

A10536 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	16096	$16,096
2	60-inch Stormwater Pipe	1140 LF	170	$193,800
3	72-inch manhole	1 EA	7400	$7,400
4	Surface Restoration	855 SY	5	$4,275
	Subtotal Construction Items			$217,296
	Sales Tax (8.2%)			$17,818
	Subtotal			$235,114
	Contingency (25%)			$58,779
	TOTAL ESTIMATED CONSTRUCTION COST			$293,893
	Engineering, Inspection, Legal & Administration (25%)			$73,473
	ESTIMATED PROJECT COST			**$367,000**

A10536 Parallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	14728	$14,728
2	54 -inch Stormwater Pipe	1140 LF	155	$176,700
3	72-inch manhole	1 EA	7400	$7,400
4	Surface Restoration	855 SY	5	$4,275
	Subtotal Construction Items			$198,828
	Sales Tax (8.2%)			$16,304
	Subtotal			$215,132
	Contingency (25%)			$53,783
	TOTAL ESTIMATED CONSTRUCTION COST			$268,915
	Engineering, Inspection, Legal & Administration (25%)			$67,229
	ESTIMATED PROJECT COST			**$336,000**

B167A24 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	2464	$2,464
2	24 -inch Stormwater Pipe	220 LF	65	$14,300
3	30 -inch Stormwater Pipe	0 LF	87	$0
4	54-inch manhole	1 EA	3900	$3,900
5	Type 1 Catch basin	2 EA	800	$1,600
6	Road Restoration	220 SY	50	$11,000

Subtotal Construction Items	$33,264
Sales Tax (8.2%)	$2,728
Subtotal	$35,992
Contingency (25%)	$8,998
TOTAL ESTIMATED CONSTRUCTION COST	$44,990
Engineering, Inspection, Legal & Administration (25%)	$11,247
ESTIMATED PROJECT COST	**$56,000**

Note: This pipe is under the proposed location fro Spud's produce, thus the length will take the pipe west and then north around the building.

B1117D Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	2100	$2,100
2	30 -inch Stormwater Pipe	260 LF	87	$22,620
3	Type 1 Catch basin	4 EA	800	$3,200
4	Surface Restoration	87 SY	5	$433

Subtotal Construction Items	$28,354
Sales Tax (8.2%)	$2,325
Subtotal	$30,679
Contingency (25%)	$7,670
TOTAL ESTIMATED CONSTRUCTION COST	$38,348
Engineering, Inspection, Legal & Administration (25%)	$9,587
ESTIMATED PROJECT COST	**$48,000**

B113824 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	3186	$3,186
2	30 -inch Stormwater Pipe	386 LF	87	$33,582
3	Type 1 Catch basin	6 EA	800	$4,800
4	Surface Restoration	290 SY	5	$1,448
	Subtotal Construction Items			$43,016
	Sales Tax (8.2%)			$3,527
	Subtotal			$46,543
	Contingency (25%)			$11,636
	TOTAL ESTIMATED CONSTRUCTION COST			$58,179
	Engineering, Inspection, Legal & Administration (25%)			$14,545
	ESTIMATED PROJECT COST			**$73,000**

B113824 Parallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	2819	$2,819
2	24 -inch Stormwater Pipe	386 LF	65	$25,090
3	Type 1 Catch basin	6 EA	800	$4,800
4	54-inch manhole	1 EA	3900	$3,900
5	Surface Restoration	290 SY	5	$1,448
	Subtotal Construction Items			$38,057
	Sales Tax (8.2%)			$3,121
	Subtotal			$41,177
	Contingency (25%)			$10,294
	TOTAL ESTIMATED CONSTRUCTION COST			$51,471
	Engineering, Inspection, Legal & Administration (25%)			$12,868
	ESTIMATED PROJECT COST			**$64,000**

D112218 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	560	$560
2	36 -inch Stormwater Pipe	70 LF	100	$7,000
3	Road Restoration	70 SY	50	$3,500
	Subtotal Construction Items			$11,060
	Sales Tax (8.2%)			$907
	Subtotal			$11,967
	Contingency (25%)			$2,992
	TOTAL ESTIMATED CONSTRUCTION COST			$14,959
	Engineering, Inspection, Legal & Administration (25%)			$3,740
	ESTIMATED PROJECT COST			**$19,000**

D112218 Parrallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	487	$487
2	30 -inch Stormwater Pipe	70 LF	87	$6,090
3	54-inch manhole	1 EA	3900	$3,900
4	Road Restoration	70 SY	50	$3,500
	Subtotal Construction Items			$13,977
	Sales Tax (8.2%)			$1,146
	Subtotal			$15,123
	Contingency (25%)			$3,781
	TOTAL ESTIMATED CONSTRUCTION COST			$18,904
	Engineering, Inspection, Legal & Administration (25%)			$4,726
	ESTIMATED PROJECT COST			**$24,000**

E19812 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	269	$269
2	18 -inch Stormwater Pipe	70 LF	48	$3,360
3	Road Restoration	70 SY	50	$3,500
	Subtotal Construction Items			$7,129
	Sales Tax (8.2%)			$585
	Subtotal			$7,713
	Contingency (25%)			$1,928
	TOTAL ESTIMATED CONSTRUCTION COST			$9,642
	Engineering, Inspection, Legal & Administration (25%)			$2,410
	ESTIMATED PROJECT COST			**$12,000**

F39524 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	4114	$4,114
5	30 -inch Stormwater Pipe	510 LF	87	$44,370
7	Type 1 Catch basin	7 EA	800	$5,333
10	Surface Restoration	345 SY	5	$1,725
11	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$58,043
	Sales Tax (8.2%)			$4,759
	Subtotal			$62,802
	Contingency (25%)			$15,701
	TOTAL ESTIMATED CONSTRUCTION COST			$78,503
	Engineering, Inspection, Legal & Administration (25%)			$19,626
	ESTIMATED PROJECT COST			**$98,000**

F39524 Parrallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	877	$877
2	12-inch Stormwater Pipe	510 LF	30	$15,300
3	Type 1 Catch basin	7 EA	800	$5,333
4	54-inch manhole	1 EA	3900	$3,900
5	Surface Restoration	345 SY	5	$1,725
6	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$29,635
	Sales Tax (8.2%)			$2,430
	Subtotal			$32,065
	Contingency (25%)			$8,016
	TOTAL ESTIMATED CONSTRUCTION COST			$40,081
	Engineering, Inspection, Legal & Administration (25%)			$10,020
	ESTIMATED PROJECT COST			**$50,000**

F34124 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	3887	$3,887
2	30 -inch Stormwater Pipe	485 LF	87	$42,195
3	Type 1 Catch basin	6 EA	800	$4,800
4	Surface Restoration	319 SY	5	$1,594
5	Road Restoration	60 SY	50	$3,000
	Subtotal Construction Items			$55,476
	Sales Tax (8.2%)			$4,549
	Subtotal			$60,025
	Contingency (25%)			$15,006
	TOTAL ESTIMATED CONSTRUCTION COST			$75,031
	Engineering, Inspection, Legal & Administration (25%)			$18,758
	ESTIMATED PROJECT COST			**$94,000**

F34124 Parrallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	3346	$3,346
2	24 -inch Stormwater Pipe	485 LF	65	$31,525
3	Type 1 Catch basin	6 EA	800	$4,800
4	54-inch manhole	1 EA	3900	$3,900
5	Surface Restoration	319 SY	5	$1,594
6	Road Restoration	60 SY	50	$3,000
	Subtotal Construction Items			$48,164
	Sales Tax (8.2%)			$3,949
	Subtotal			$52,114
	Contingency (25%)			$13,028
	TOTAL ESTIMATED CONSTRUCTION COST			$65,142
	Engineering, Inspection, Legal & Administration (25%)			$16,286
	ESTIMATED PROJECT COST			**$81,000**

J58418 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	1705	$1,705
2	24 -inch Stormwater Pipe	275 LF	65	$17,875
3	Type 1 Catch basin	3 EA	800	$2,400
4	Surface Restoration	206 SY	5	$1,031
	Subtotal Construction Items			$23,011
	Sales Tax (8.2%)			$1,887
	Subtotal			$24,898
	Contingency (25%)			$6,224
	TOTAL ESTIMATED CONSTRUCTION COST			$31,122
	Engineering, Inspection, Legal & Administration (25%)			$7,781
	ESTIMATED PROJECT COST			**$39,000**

J58418 Parallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	1643	$1,643
2	18 -inch Stormwater Pipe	275 LF	48	$13,200
3	Type 1 Catch basin	3 EA	800	$2,400
4	54-inch manhole	1 EA	3900	$3,900
5	Surface Restoration	206 SY	5	$1,031
	Subtotal Construction Items			$22,174
	Sales Tax (8.2%)			$1,818
	Subtotal			$23,992
	Contingency (25%)			$5,998
	TOTAL ESTIMATED CONSTRUCTION COST			$29,990
	Engineering, Inspection, Legal & Administration (25%)			$7,497
	ESTIMATED PROJECT COST			**$37,000**

J58518 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	1241	$1,241
2	24 -inch Stormwater Pipe	205 LF	65	$13,325
3	Type 1 Catch basin	2 EA	800	$1,600
4	Surface Restoration	116 SY	5	$581
5	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$19,247
	Sales Tax (8.2%)			$1,578
	Subtotal			$20,825
	Contingency (25%)			$5,206
	TOTAL ESTIMATED CONSTRUCTION COST			$26,031
	Engineering, Inspection, Legal & Administration (25%)			$6,508
	ESTIMATED PROJECT COST			**$33,000**

J58518 Parallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	1274	$1,274
2	18 -inch Stormwater Pipe	205 LF	48	$9,840
3	Type 1 Catch basin	2 EA	800	$1,600
4	54-inch manhole	1 EA	3900	$3,900
5	Surface Restoration	116 SY	5	$581
6	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$19,695
	Sales Tax (8.2%)			$1,615
	Subtotal			$21,310
	Contingency (25%)			$5,327
	TOTAL ESTIMATED CONSTRUCTION COST			$26,637
	Engineering, Inspection, Legal & Administration (25%)			$6,659
	ESTIMATED PROJECT COST			**$33,000**

J59912 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	130	$130
2	24 -inch Stormwater Pipe	25 LF	65	$1,625
3	Road Restoration	25 SY	50	$1,250
	Subtotal Construction Items			$3,005
	Sales Tax (8.2%)			$246
	Subtotal			$3,251
	Contingency (25%)			$813
	TOTAL ESTIMATED CONSTRUCTION COST			$4,064
	Engineering, Inspection, Legal & Administration (25%)			$1,016
	ESTIMATED PROJECT COST			**$5,000**

Parallel Pipe is the same size.

J59812 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	957	$957
2	24 -inch Stormwater Pipe	165 LF	65	$10,725
3	Type 1 Catch basin	1 EA	800	$800
4	Surface Restoration	86 SY	5	$431
5	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$15,413
	Sales Tax (8.2%)			$1,264
	Subtotal			$16,677
	Contingency (25%)			$4,169
	TOTAL ESTIMATED CONSTRUCTION COST			$20,846
	Engineering, Inspection, Legal & Administration (25%)			$5,211
	ESTIMATED PROJECT COST			**$26,000**

Parallel Pipe is the same size.

J59112 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	993	$993
2	24 -inch Stormwater Pipe	160 LF	65	$10,400
3	Type 1 Catch basin	2 EA	800	$1,600
4	Surface Restoration	83 SY	5	$413
5	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$15,906
	Sales Tax (8.2%)			$1,304
	Subtotal			$17,210
	Contingency (25%)			$4,302
	TOTAL ESTIMATED CONSTRUCTION COST			$21,512
	Engineering, Inspection, Legal & Administration (25%)			$5,378
	ESTIMATED PROJECT COST			**$27,000**

Parallel Pipe is the same size.

J72424 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	3717	$3,717
2	30 -inch Stormwater Pipe	470 LF	87	$40,890
3	Type 1 Catch basin	5 EA	800	$4,000
4	Surface Restoration	315 SY	5	$1,575
5	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$52,682
	Sales Tax (8.2%)			$4,320
	Subtotal			$57,002
	Contingency (25%)			$14,251
	TOTAL ESTIMATED CONSTRUCTION COST			$71,253
	Engineering, Inspection, Legal & Administration (25%)			$17,813
	ESTIMATED PROJECT COST			**$89,000**

J72424 Parallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	2563	$2,563
2	18 -inch Stormwater Pipe	470 LF	48	$22,560
3	Type 1 Catch basin	5 EA	800	$4,000
4	54-inch manhole	1 EA	3900	$3,900
5	Surface Restoration	315 SY	5	$1,575
6	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$37,098
	Sales Tax (8.2%)			$3,042
	Subtotal			$40,140
	Contingency (25%)			$10,035
	TOTAL ESTIMATED CONSTRUCTION COST			$50,175
	Engineering, Inspection, Legal & Administration (25%)			$12,544
	ESTIMATED PROJECT COST			**$63,000**

J710124 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	3209	$3,209
2	30 -inch Stormwater Pipe	400 LF	87	$34,800
3	Type 1 Catch basin	5 EA	800	$4,000
4	Surface Restoration	263 SY	5	$1,313
5	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$45,822
	Sales Tax (8.2%)			$3,757
	Subtotal			$49,579
	Contingency (25%)			$12,395
	TOTAL ESTIMATED CONSTRUCTION COST			$61,974
	Engineering, Inspection, Legal & Administration (25%)			$15,493
	ESTIMATED PROJECT COST			**$77,000**

J710124 Parallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	2273	$2,273
2	18 -inch Stormwater Pipe	400 LF	48	$19,200
3	Type 1 Catch basin	5 EA	800	$4,000
4	54-inch manhole	1 EA	3900	$3,900
5	Surface Restoration	263 SY	5	$1,313
6	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$33,186
	Sales Tax (8.2%)			$2,721
	Subtotal			$35,907
	Contingency (25%)			$8,977
	TOTAL ESTIMATED CONSTRUCTION COST			$44,883
	Engineering, Inspection, Legal & Administration (25%)			$11,221
	ESTIMATED PROJECT COST			**$56,000**

J712724 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	2899	$2,899
2	24 -inch Stormwater Pipe	460 LF	65	$29,900
3	Type 1 Catch basin	6 EA	800	$4,800
4	Surface Restoration	308 SY	5	$1,538
5	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$41,637
	Sales Tax (8.2%)			$3,414
	Subtotal			$45,051
	Contingency (25%)			$11,263
	TOTAL ESTIMATED CONSTRUCTION COST			$56,313
	Engineering, Inspection, Legal & Administration (25%)			$14,078
	ESTIMATED PROJECT COST			**$70,000**

J712724 Parallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	4021	$4,021
2	30 -inch Stormwater Pipe	460 LF	87	$40,020
3	Type 1 Catch basin	6 EA	800	$4,800
4	54-inch manhole	1 EA	3900	$3,900
5	Surface Restoration	308 SY	5	$1,538
6	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$56,778
	Sales Tax (8.2%)			$4,656
	Subtotal			$61,434
	Contingency (25%)			$15,358
	TOTAL ESTIMATED CONSTRUCTION COST			$76,792
	Engineering, Inspection, Legal & Administration (25%)			$19,198
	ESTIMATED PROJECT COST			**$96,000**

J712524 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	3491	$3,491
2	30 -inch Stormwater Pipe	430 LF	87	$37,410
3	Type 1 Catch basin	6 EA	800	$4,800
4	Surface Restoration	285 SY	5	$1,425
5	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$49,626
	Sales Tax (8.2%)			$4,069
	Subtotal			$53,695
	Contingency (25%)			$13,424
	TOTAL ESTIMATED CONSTRUCTION COST			$67,119
	Engineering, Inspection, Legal & Administration (25%)			$16,780
	ESTIMATED PROJECT COST			**$84,000**

J712524 Parallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	3046	$3,046
2	24 -inch Stormwater Pipe	430 LF	65	$27,950
3	Type 1 Catch basin	6 EA	800	$4,800
4	54-inch manhole	1 EA	3900	$3,900
5	Surface Restoration	285 SY	5	$1,425
6	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$43,621
	Sales Tax (8.2%)			$3,577
	Subtotal			$47,198
	Contingency (25%)			$11,799
	TOTAL ESTIMATED CONSTRUCTION COST			$58,997
	Engineering, Inspection, Legal & Administration (25%)			$14,749
	ESTIMATED PROJECT COST			**$74,000**

J7MLWEX24 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	3291	$3,291
2	30 -inch Stormwater Pipe	400 LF	87	$34,800
3	Type 1 Catch basin	6 EA	800	$4,800
4	Surface Restoration	308 SY	5	$1,538
5	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$46,929
	Sales Tax (8.2%)			$3,848
	Subtotal			$50,777
	Contingency (25%)			$12,694
	TOTAL ESTIMATED CONSTRUCTION COST			$63,471
	Engineering, Inspection, Legal & Administration (25%)			$15,868
	ESTIMATED PROJECT COST			**$79,000**

J7MLWEX24 Parallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	2355	$2,355
2	18 -inch Stormwater Pipe	400 LF	48	$19,200
3	Type 1 Catch basin	6 EA	800	$4,800
4	54-inch manhole	1 EA	3900	$3,900
5	Surface Restoration	308 SY	5	$1,538
6	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$34,293
	Sales Tax (8.2%)			$2,812
	Subtotal			$37,104
	Contingency (25%)			$9,276
	TOTAL ESTIMATED CONSTRUCTION COST			$46,381
	Engineering, Inspection, Legal & Administration (25%)			$11,595
	ESTIMATED PROJECT COST			**$58,000**

J74SDIV18 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	3907	$3,907
2	24 -inch Stormwater Pipe	620 LF	65	$40,300
3	Type 1 Catch basin	8 EA	800	$6,400
4	Surface Restoration	428 SY	5	$2,138
5	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$55,245
	Sales Tax (8.2%)			$4,530
	Subtotal			$59,775
	Contingency (25%)			$14,944
	TOTAL ESTIMATED CONSTRUCTION COST			$74,718
	Engineering, Inspection, Legal & Administration (25%)			$18,680
	ESTIMATED PROJECT COST			**$93,000**

J74SDIV18 Parallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	3376	$3,376
2	18 -inch Stormwater Pipe	620 LF	48	$29,760
3	Type 1 Catch basin	8 EA	800	$6,400
4	54-inch manhole	1 EA	3900	$3,900
5	Surface Restoration	428 SY	5	$2,138
6	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$48,073
	Sales Tax (8.2%)			$3,942
	Subtotal			$52,015
	Contingency (25%)			$13,004
	TOTAL ESTIMATED CONSTRUCTION COST			$65,019
	Engineering, Inspection, Legal & Administration (25%)			$16,255
	ESTIMATED PROJECT COST			**$81,000**

J76018 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	260	$260
2	24 -inch Stormwater Pipe	50 LF	65	$3,250
3	Road Restoration	50 SY	50	$2,500
4				
	Subtotal Construction Items			$6,010
	Sales Tax (8.2%)			$493
	Subtotal			$6,503
	Contingency (25%)			$1,626
	TOTAL ESTIMATED CONSTRUCTION COST			$8,129
	Engineering, Inspection, Legal & Administration (25%)			$2,032
	ESTIMATED PROJECT COST			**$10,000**

J76018 Parallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	504	$504
2	18 -inch Stormwater Pipe	50 LF	48	$2,400
3	54-inch manhole	1 EA	3900	$3,900
4	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$9,304
	Sales Tax (8.2%)			$763
	Subtotal			$10,067
	Contingency (25%)			$2,517
	TOTAL ESTIMATED CONSTRUCTION COST			$12,584
	Engineering, Inspection, Legal & Administration (25%)			$3,146
	ESTIMATED PROJECT COST			**$16,000**

J715718 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	3845	$3,845
2	30 -inch Stormwater Pipe	470 LF	87	$40,890
3	Type 1 Catch basin	7 EA	800	$5,600
4	Surface Restoration	315 SY	5	$1,575
5	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$54,410
	Sales Tax (8.2%)			$4,462
	Subtotal			$58,872
	Contingency (25%)			$14,718
	TOTAL ESTIMATED CONSTRUCTION COST			$73,590
	Engineering, Inspection, Legal & Administration (25%)			$18,397
	ESTIMATED PROJECT COST			**$92,000**

J714818 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	2056	$2,056
2	30 -inch Stormwater Pipe	250 LF	87	$21,750
3	Type 1 Catch basin	4 EA	800	$3,200
4	Surface Restoration	150 SY	5	$750
5	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$30,256
	Sales Tax (8.2%)			$2,481
	Subtotal			$32,737
	Contingency (25%)			$8,184
	TOTAL ESTIMATED CONSTRUCTION COST			$40,921
	Engineering, Inspection, Legal & Administration (25%)			$10,230
	ESTIMATED PROJECT COST			**$51,000**

J714818 Parallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	2648	$2,648
2	30 -inch Stormwater Pipe	250 LF	87	$21,750
3	Type 1 Catch basin	4 EA	800	$3,200
4	54-inch manhole	1 EA	7400	$7,400
5	Surface Restoration	150 SY	5	$750
6	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$38,248
	Sales Tax (8.2%)			$3,136
	Subtotal			$41,384
	Contingency (25%)			$10,346
	TOTAL ESTIMATED CONSTRUCTION COST			$51,730
	Engineering, Inspection, Legal & Administration (25%)			$12,933
	ESTIMATED PROJECT COST			**$65,000**

J714624 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	2648	$2,648
2	36 -inch Stormwater Pipe	290 LF	100	$29,000
3	Type 1 Catch basin	4 EA	800	$3,200
4	Surface Restoration	180 SY	5	$900
5	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$38,248
	Sales Tax (8.2%)			$3,136
	Subtotal			$41,384
	Contingency (25%)			$10,346
	TOTAL ESTIMATED CONSTRUCTION COST			$51,730
	Engineering, Inspection, Legal & Administration (25%)			$12,933
	ESTIMATED PROJECT COST			**$65,000**

J714624 Parallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	2346	$2,346
2	30 -inch Stormwater Pipe	290 LF	87	$25,230
3	Type 1 Catch basin	4 EA	800	$3,200
4	Surface Restoration	180 SY	5	$900
5	Road Restoration	23 SY	50	$1,167
	Subtotal Construction Items			$32,843
	Sales Tax (8.2%)			$2,693
	Subtotal			$35,536
	Contingency (25%)			$8,884
	TOTAL ESTIMATED CONSTRUCTION COST			$44,420
	Engineering, Inspection, Legal & Administration (25%)			$11,105
	ESTIMATED PROJECT COST			**$56,000**

J714524 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	320	$320
2	36 -inch Stormwater Pipe	40 LF	100	$4,000
3	Road Restoration	40 SY	50	$2,000
	Subtotal Construction Items			$6,320
	Sales Tax (8.2%)			$518
	Subtotal			$6,838
	Contingency (25%)			$1,710
	TOTAL ESTIMATED CONSTRUCTION COST			$8,548
	Engineering, Inspection, Legal & Administration (25%)			$2,137
	ESTIMATED PROJECT COST			**$11,000**

J714524 Parallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	520	$520
2	24 -inch Stormwater Pipe	40 LF	65	$2,600
3	54-inch manhole	1 EA	3900	$3,900
4	Road Restoration	40 SY	50	$2,000
	Subtotal Construction Items			$9,020
	Sales Tax (8.2%)			$740
	Subtotal			$9,760
	Contingency (25%)			$2,440
	TOTAL ESTIMATED CONSTRUCTION COST			$12,200
	Engineering, Inspection, Legal & Administration (25%)			$3,050
	ESTIMATED PROJECT COST			**$15,000**

J714424 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	4870	$4,870
2	36 -inch Stormwater Pipe	550 EA	100	$55,000
3	Type 1 Catch basin	5 EA	800	$4,000
4	Surface Restoration	375 SY	5	$1,875
5	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$68,245
	Sales Tax (8.2%)			$5,596
	Subtotal			$73,841
	Contingency (25%)			$18,460
	TOTAL ESTIMATED CONSTRUCTION COST			$92,301
	Engineering, Inspection, Legal & Administration (25%)			$23,075
	ESTIMATED PROJECT COST			**$115,000**

J714424 Parallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	4610	$4,610
2	30 -inch Stormwater Pipe	550 LF	87	$47,850
3	Type 1 Catch basin	5 EA	800	$4,000
4	54-inch manhole	1 EA	3900	$3,900
5	Surface Restoration	375 SY	5	$1,875
6	Road Restoration	50 SY	50	$2,500
	Subtotal Construction Items			$64,735
	Sales Tax (8.2%)			$5,308
	Subtotal			$70,043
	Contingency (25%)			$17,511
	TOTAL ESTIMATED CONSTRUCTION COST			$87,554
	Engineering, Inspection, Legal & Administration (25%)			$21,889
	ESTIMATED PROJECT COST			**$109,000**

L510812 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	1914	$1,914
2	18 -inch Stormwater Pipe	385 LF	48	$18,480
3	Type 1 Catch basin	5 EA	800	$4,000
4	Surface Restoration	289 SY	5	$1,444
	Subtotal Construction Items			$25,838
	Sales Tax (8.2%)			$2,119
	Subtotal			$27,956
	Contingency (25%)			$6,989
	TOTAL ESTIMATED CONSTRUCTION COST			$34,945
	Engineering, Inspection, Legal & Administration (25%)			$8,736
	ESTIMATED PROJECT COST			**$44,000**

L510812 Parallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	1672	$1,672
3	12 -inch Stormwater Pipe	385 LF	30	$11,550
4	54-inch manhole	1 EA	3900	$3,900
5	Type 1 Catch basin	5 EA	800	$4,000
6	Surface Restoration	289 SY	5	$1,444
	Subtotal Construction Items			$22,565
	Sales Tax (8.2%)			$1,850
	Subtotal			$24,416
	Contingency (25%)			$6,104
	TOTAL ESTIMATED CONSTRUCTION COST			$30,520
	Engineering, Inspection, Legal & Administration (25%)			$7,630
	ESTIMATED PROJECT COST			**$38,000**

L512512 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	562	$562
2	18 -inch Stormwater Pipe	65 LF	48	$3,120
3	54-inch manhole	1 EA	3900	$3,900
4	Road Restoration	65 SY	50	$3,250
	Subtotal Construction Items			$10,832
	Sales Tax (8.2%)			$888
	Subtotal			$11,720
	Contingency (25%)			$2,930
	TOTAL ESTIMATED CONSTRUCTION COST			$14,650
	Engineering, Inspection, Legal & Administration (25%)			$3,662
	ESTIMATED PROJECT COST			**$18,000**

L512512 Parallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	468	$468
2	12 -inch Stormwater Pipe	65 LF	30	$1,950
3	54-inch manhole	1 EA	3900	$3,900
4	Road Restoration	65 SY	50	$3,250
	Subtotal Construction Items			$9,568
	Sales Tax (8.2%)			$785
	Subtotal			$10,353
	Contingency (25%)			$2,588
	TOTAL ESTIMATED CONSTRUCTION COST			$12,941
	Engineering, Inspection, Legal & Administration (25%)			$3,235
	ESTIMATED PROJECT COST			**$16,000**

L512318 Replacement Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	1228	$1,228
2	24 -inch Stormwater Pipe	200 LF	65	$13,000
3	Type 1 Catch basin	2 EA	800	$1,600
4	Surface Restoration	150 SY	5	$750
	Subtotal Construction Items			$16,578
	Sales Tax (8.2%)			$1,359
	Subtotal			$17,937
	Contingency (25%)			$4,484
	TOTAL ESTIMATED CONSTRUCTION COST			$22,422
	Engineering, Inspection, Legal & Administration (25%)			$5,605
	ESTIMATED PROJECT COST			**$28,000**

L512318 Parallel Pipe

NO.	ITEM	QUANTITY	UNIT PRICE	AMOUNT
1	Mobilization & Demobilization	1 LS	1268	$1,268
2	18 -inch Stormwater Pipe	200 LF	48	$9,600
3	Type 1 Catch basin	2 EA	800	$1,600
4	54-inch manhole	1 EA	3900	$3,900
5	Surface Restoration	150 SY	5	$750
	Subtotal Construction Items			$17,118
	Sales Tax (8.2%)			$1,404
	Subtotal			$18,522
	Contingency (25%)			$4,630
	TOTAL ESTIMATED CONSTRUCTION COST			$23,152
	Engineering, Inspection, Legal & Administration (25%)			$5,788
	ESTIMATED PROJECT COST			**$29,000**

Horizontal Split Case Centrifugal Pump Station (Typical)
Above Grade
1500 GPM (Example)

ITEM	QUANTITY	UNIT PRICE	AMOUNT
Mobilization & Demobilization	1 LS	$22,400	$22,400
Site Prep, Drainage & Fencing	1 LS	$30,000	$30,000
Pump Station Building	200 Sq Ft	$200	$40,000
Pump Station Electrical	1 LS	$40,000	$40,000
Telemetry and Control	1 LS	$15,000	$15,000
Yard Piping Valves, Fittings	1 LS	$25,000	$25,000
Retrofit existig pipes	4 EA	$2,000	$8,000
Split Case Centrifugal Pumps	2 EA	$8,000	$16,000
Levy Construction	5000 CY	$10	$50,000
Subtotal Construction Items			$246,400
Sales Tax (8.2%)			$20,205
Subtotal			$266,605
Contingency (25%)			$66,651
Emergency Generator (optional with owner)			$35,000
TOTAL ESTIMATED CONSTRUCTION COST			$368,256
Engineering, Inspection, Permitting & Administration (35%)			$128,890
ESTIMATED PROJECT COST [1]			**$497,000**

1 - Cost will vary depending upon site conditions, permitting factors, power requirements, existing utility constraints among others.