CITY OF SOAP LAKE

GRANT COUNTY **WASHINGTON**

STORMWATER MANAGEMENT PLAN

G&O #17037
JUNE 2019

Gray & Osborne, Inc.
CONSULTING ENGINEERS

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47600 • Olympia, WA 98504-7600 • 360-407-6000
711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341

July 10, 2019

Via Electronic Delivery

Raymond Gravelle
City of Soap Lake
PO Box 1270
Soap Lake, WA 98851

Re: FY2017 Stormwater Financial Assistance Program
Agreement No. WQC-2017-SoaLak-00086

Dear Mayor Gravelle:

Ecology has reviewed the Stormwater Plan for the City of Soap Lake agreement WQC-2017-SoaLak-00086. I am pleased to inform you that Ecology accepts the Stormwater Capital Improvement Plan deliverable as complete.

Please move forward with closeout deliverables for the project.

If you have any questions, you can reach me at sarah.zehner@ecy.wa.gov or (360) 407-7196.

Sincerely,

Stormwater Grant Project Manager
Water Quality Program

CITY OF SOAP LAKE

GRANT COUNTY **WASHINGTON**

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Acknowledgements

We would like to thank the following groups and individuals for their contributions to and support of this Plan:

- City of Soap Lake Council
- Soap Lake Conservancy
- Lake Liason Committee
- Department of Ecology
- Raymond Gravelle
- Darrin Fronsman
- Darryl Piercy

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EXECUTIVE SUMMARY

The City of Soap Lake owns, operates, and maintains a stormwater collection and conveyance system within its city boundary. This Stormwater Comprehensive Management Plan (Plan) provides City staff and policy makers with the necessary information to implement the City's stormwater management program in a manner that is effective and compliant with current regulations and best management practices. The Plan was developed with a view toward protecting the City's namesake waterbody, Soap Lake, from pollution or dilution that could be caused by stormwater runoff. The Plan is organized to provide scope and background information in the beginning chapters and detailed information on the City's drainage system, operation and maintenance, and recommendations in the latter chapters.

PLAN SUMMARY

Chapter 1 of the Plan provides an overall outline of the tasks undertaken to develop the Plan, as well as an outline of the structure of the Plan. General topographic, geologic, and land use characteristics of the City are described in Chapter 2.

Regulatory considerations are provided in Chapter 3. In addition to the federal, state, and county regulations, the City's specific codes regarding stormwater runoff are included in Soap Lake Municipal Code, Title 15.24. Elements of the City's Comprehensive Plan that relate to stormwater management are cited.

A base map of the stormwater conveyance system was created from as-built maps of developments, local survey, and field reconnaissance. Aerial imagery and topographic data were used to develop landcover and flow path estimates for each basin. This information was used in the XP-Storm computer model for analysis of several different storm events. Chapter 4 provides background and findings of the analysis.

As determined by field survey, the City maintains approximately 4 miles of stormwater conveyance systems, nearly 200 catch basins and other structures, and six outfalls to Soap Lake. Drainage basins are determined by topography and runoff collection/conveyance facilities. Detailed information on delineation of the basins is provided in Chapter 4.

Chapters 5 and 6 outline nonpoint source pollution generation and control, respectively. Maintenance activities and costs are outlined in Chapter 7 and include facility inspection, routine maintenance standards, staff training, public education and outreach, and use of best management practices.

Chapter 8 identifies the capital improvement projects and lays out an order of project completion according to priority and budgetary limitations. Chapter 8 also includes a discussion of the potential to integrate stormwater management more effectively within the City's road improvement projects.

Chapter 9 includes a discussion of available funding opportunities for stormwater projects including state-funded grants and loans. An overview of the process to implement a formal stormwater utility is also provided. A utility could be used to fund stormwater improvements and maintenance through the collection of a monthly service fee. A simple cash flow budget/rate analysis showing potential storm drainage utility revenues and expenditures for implementation of the Capital Improvement Plan and recommended maintenance schedule is provided in Chapter 9. The analysis includes various loan funding scenarios and a recommendation of the monthly service charge required to fund the improvements and pay off any loans.

CAPITAL IMPROVEMENT PLAN

The Capital Improvement Plan (CIP) identified two major infrastructure projects to install treatment and infiltration capacity at the downstream end of two parts of the City's conveyance system, in the East Basin and the West Basin. An alternative to the end-of-pipe East Basin infiltration project is also provided. The CIP construction cost estimate for the two recommended projects is approximately $1.1 million (January 2019 dollars). The Plan recommends the use of bioretention swales, permeable pavement, or infiltration trenches and estimates a cost for these techniques of $10 to $15 per square foot (January 2019 dollars).

TABLE E-1

Capital Improvement Projects

Capital Improvement Projects	Total Project Cost Alternative A (2019 dollars) (1)	Total Project Cost Alternative B (2019 dollars)
CIP 1A – Eastern Outfall Bioswale and Infiltration Facility	$609,000	N/A
CIP 1B – 6th Avenue SE to 1st Avenue NE Bioretention Ditches and East Basin Infiltration Facility	N/A	$747,000
CIP 2 – Central Outfall Bioswale and Infiltration Facility	$360,000	$360,000
Total	**$969,000**	**$1,107,000**

CHAPTER 1

INTRODUCTION

The City of Soap Lake Stormwater Management Plan (Plan) is a planning document that provides guidance to minimize adverse effects of stormwater runoff on ground and surface water. The Plan identifies water quality and quantity problems associated with stormwater runoff that may affect the environment and community and provides recommendations for improvements and programs including a cost analysis and an implementation schedule.

Historically, stormwater management consisted primarily of conveying runoff away from developed areas. Drainage improvement projects addressed local flooding with little thought for downstream impacts. However, more recently, the cumulative effects of smaller storms and upstream development have been recognized as a major contributor to water quality degradation.

Stormwater runoff carries sediment from exposed land and pollutants from residential, commercial, agricultural, and industrial areas. Pollutants in stormwater runoff include metals such as lead, cadmium, and copper; oil and grease; pesticides and fertilizers; and harmful bacteria. In addition, new development increases the quantity of impervious surfaces such as rooftops, streets, and parking areas. Increases in impervious surface area directly relate to increased runoff volumes and peak flow rates. The pollutant loads and increased volumes of stormwater runoff can negatively impact downstream properties and water bodies and can reduce infiltration to groundwater.

The Plan identifies specific solutions to water quality problems within the City, including replacement of damaged pipes and culverts and installation of water quality and infiltration facilities. Nonstructural solutions include stormwater management facility inspection and maintenance, public education and outreach, water quality monitoring, and encouraging infiltration and low impact development.

The Plan meets the technical standards of the 2004 Washington State Department of Ecology *Stormwater Management Manual for Eastern Washington* (2004 Ecology Manual).

WATER QUALITY AND QUANTITY GOALS

The primary goal of the Soap Lake Stormwater Management Plan is to preserve and protect water quality and the hydraulic regime within the receiving water of Soap Lake through management of runoff within City limits. Areas outside of the City that are part of the lake's watershed are not considered in this Plan and are outside of the City's jurisdiction.

To this end, the City intends to manage stormwater to minimize contact with contaminants, mitigate the impacts of increased runoff due to development within the City's drainage areas, provide management of runoff from construction sites, and to preserve the unique hydrological characteristics of Soap Lake. The City's implementation of the Plan will meet the goals to protect the health, safety, and welfare of the local citizenry and to preserve surface water resources within the City.

SCOPE OF WORK

Development of the Stormwater Management Plan included the following tasks.

TASK 1 – PROJECT MANAGEMENT

Throughout development of the Plan, in-house quality control reviews are conducted to identify and address relevant issues affecting the development of the Plan.

TASK 2 – SURVEY AND MAP EXISTING FACILITIES

As the City does not currently have a stormwater base map, Gray & Osborne creates a base map including all known publicly owned storm drainage facilities. As-built plans are used to identify locations and elevations of the existing facilities where available. Field survey reconnaissance is conducted to verify locations and invert elevations of storm facilities.

TASK 3 – DRAINAGE AREA CHARACTERIZATION

Drainage basins are delineated in the City and any tributary basins located outside of the City are identified and delineated. Land use is defined in the drainage basins. This information is included on the stormwater base map for use in analysis of the system.

TASK 4 – EXISTING DRAINAGE SYSTEM

The drainage basins are modeled for short duration and regional design storms based on the modified SCS Type IA storm events using XPStorm, a single event model in order to size proposed detention and water quality systems.

TASK 5 – IDENTIFICATION OF WATER QUALITY PROBLEMS

Field survey is performed and county information is reviewed to identify activities and locations that are possible sources of stormwater pollution, such as erosion control practices during construction, heavily travelled thoroughfares, and various commercial activities. Water quality problems in runoff and receiving waters are identified.

TASK 6 – IDENTIFY POTENTIAL CONVEYANCE AND WATER QUALITY RELATED SOLUTIONS

Information generated by the hydraulic model, field surveys, county information, and staff interviews are used to identify portions of the existing drainage network that are not capable of conveying the design storm. The potential of water quality related problems such as erosion, sedimentation, and pollutant transport due to conveyance system deficiencies is also evaluated, with a particular focus on maintaining the quality of Soap Lake.

Long-range and interim facility improvements for conveyance and water quality problems are proposed. Estimated construction costs are included.

TASK 7 – OPERATION AND MAINTENANCE PROGRAM

Gray & Osborne gathers information on the level of maintenance currently being provided. Facilities or activities that require additional maintenance are identified. The desired level of maintenance is discussed with City staff. A maintenance schedule is developed along with maintenance procedures and costs for performing facility maintenance.

TASK 8 – CAPITAL IMPROVEMENT PLAN

Based on the improvements recommended in Task 6, a prioritized schedule of capital improvements for the next 10 years is proposed.

TASK 9 – STORMWATER FINANCIAL ANALYSIS

An outline of a stormwater utility is provided including possible stormwater rates and system development charges (SDCs). The aim of the financial analysis is to provide the City with a framework for establishing a stormwater utility in the near future in order to provide adequate funds for implementing the proposed capital improvements and maintenance schedule. The analysis includes several potential funding scenarios for 10-year, 20-year, and 30-year CIP implementation schedules. A sample ordinance to establish a stormwater utility and a sample ordinance to establish a stormwater rate structure and SDC are provided.

TASK 10 – DRAFT STORMWATER MANAGEMENT PLAN

A draft version of the Plan is prepared and presented to City staff for review.

TASK 11 – FINAL STORMWATER MANAGEMENT PLAN

Gray & Osborne attends two staff and two council workshops regarding the stormwater utility and Plan. Gray & Osborne assists the City with conducting a public meeting.

A final version of the Plan is prepared based on comments received and direction of the City, public, and other interested parties.

TASK 12 – GRANT AND LOAN MANAGEMENT

Gray & Osborne assists the City throughout the preparation of the Plan in complying with the requirements of funding agencies and in tracking project costs.

CHAPTER 2

DRAINAGE AREA CHARACTERISTICS

LOCATION

The City of Soap Lake (City) is located in Grant County and was incorporated in 1919. The City's current corporate limits include 1.25 square miles of land, shown on Figure 2-1. The City is bordered by the area of Lakeview to the southwest, Soap Lake to the north, and is otherwise surrounded by undeveloped or agricultural land within unincorporated Grant County. State Route 17 passes through the City.

All runoff within the City flows into Soap Lake at the north boundary of the City or infiltrates into the ground. Much of the City area at the south end of the lake is developed, including the main residential and commercial areas of the City. The portions of the City that border the east and west sides of the lake are largely undeveloped. Per the census conducted in 2010, the population within the City is 1,514, representing approximately 1.7 percent of the total population of Grant County.

TOPOGRAPHY

Topography ranges from approximately 1,080 feet above sea level at the lake shores to 1,330 feet above sea level in the northwestern corner of the City, as shown on Figure 2-2. Topography in the City generally slopes to the north to Soap Lake, which has no natural outlet.

DRAINAGE BASINS

The City of Soap Lake is located within the Grand Coulee Watershed, known as Water Resource Inventory Area (WRIA) 42. All surface runoff from the City discharges to Soap Lake, a meromictic lake (i.e., no mixing occurs between layers of the lake) with no natural inlet or outlet waterways. Soap Lake is located within the greater Columbia Basin.

There are several drainage subbasins within the City. The major basins tributary to the City and the lake are shown on Figure 2-3. The City's 1.25-square-mile area comprises approximately 4.6 percent of the lake's 27-square-mile watershed.

WATERWAYS AND WATER BODIES

The only significant water body in the City is Soap Lake, as shown on Figure 2-3. The lake has a recorded water elevation of 1,078 feet. No natural waterways flow within the City and Soap Lake has no defined inlets or outlets. Manmade irrigation ditches associated with the Columbia Basin Project and managed by the United States Bureau of Reclamation exist just outside of the city limits to the east and west. These ditches are described further in a later part of this Chapter.

SOILS

The most prevalent soil type in the city limits of Soap Lake is Kennewick fine, sandy loam, with slopes of 5 percent or less. This soil is deep and well-drained with a moderate infiltration rate. The second-most prevalent is Kennewick silt-loam, with slopes of 5 to 10 percent. This soil is also deep and well-drained and has a moderately low infiltration rate. Other soil groups include Umapine silt-loam, a deep, well-drained soil made up of glacial till and typically containing discontinuous lime and silica lenses less than 1/8-inch thick. Permeability through Umapine silt-loam is moderate through the soil and moderately slow through the lenses. Also present is the Schawana complex on 0 to 15 percent slopes, which is composed of loamy fine sand, and cobbly loamy fine sand.

Quincy loamy fine sand, a deep, somewhat excessively drained soil located on dunes and terraces is also found within the City. Permeability is rapid, available water capacity is low, and runoff is slow. The hazard of soil erosion is slight; however, the hazard of soil blowing is high. The final large group of soil within the City is Warden silt-loam, which is a very deep, well-drained soil with a moderate permeability and a high water capacity (Source: Soil Survey of Grant County, Washington).

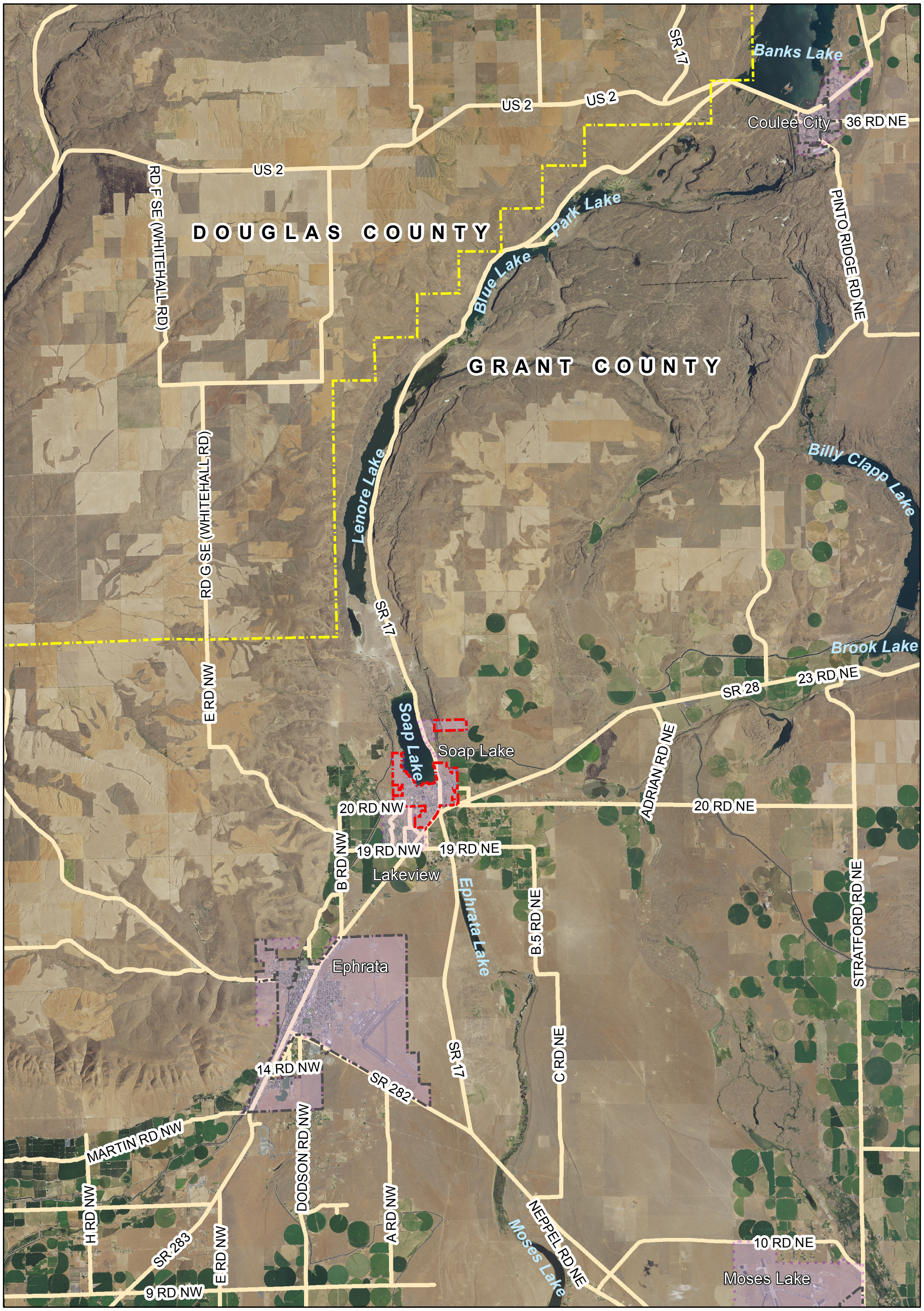
CLIMATE

The climate in the Soap Lake area is influenced to a great extent by the Cascade Range and the Rocky Mountains. The Rocky Mountains shield the county from the more severe winter storms moving southward across Canada, while the Cascade Range forms a barrier to the eastward movement of moist air from over the ocean; however, some of the air from each of these sources reaches Soap Lake.

In Soap Lake summers are hot, and the ground is frequently covered with snow in the winters. The average annual precipitation is about 7 inches, falling mainly as showers in the summer, with occasional thunderstorms. Chinook winds, which blow downslope and are warm and dry, often melt and evaporate the snow

The average annual temperature is about 50 degrees F and the average frost-free season is about 165 days.

Table 2-1 summarizes the historical average climate and rainfall data for the Soap Lake area.



LEGEND

- County Boundary
- Major Roads
- Soap Lake City Limits
- Other Cities
- Urban Growth Area

N

0 1 2 4 Miles

CITY OF SOAP LAKE

Stormwater Management Plan

Figure 2-1
Vicinity Map

Gray & Osborne, Inc.

SOURCE: GRANT COUNTY

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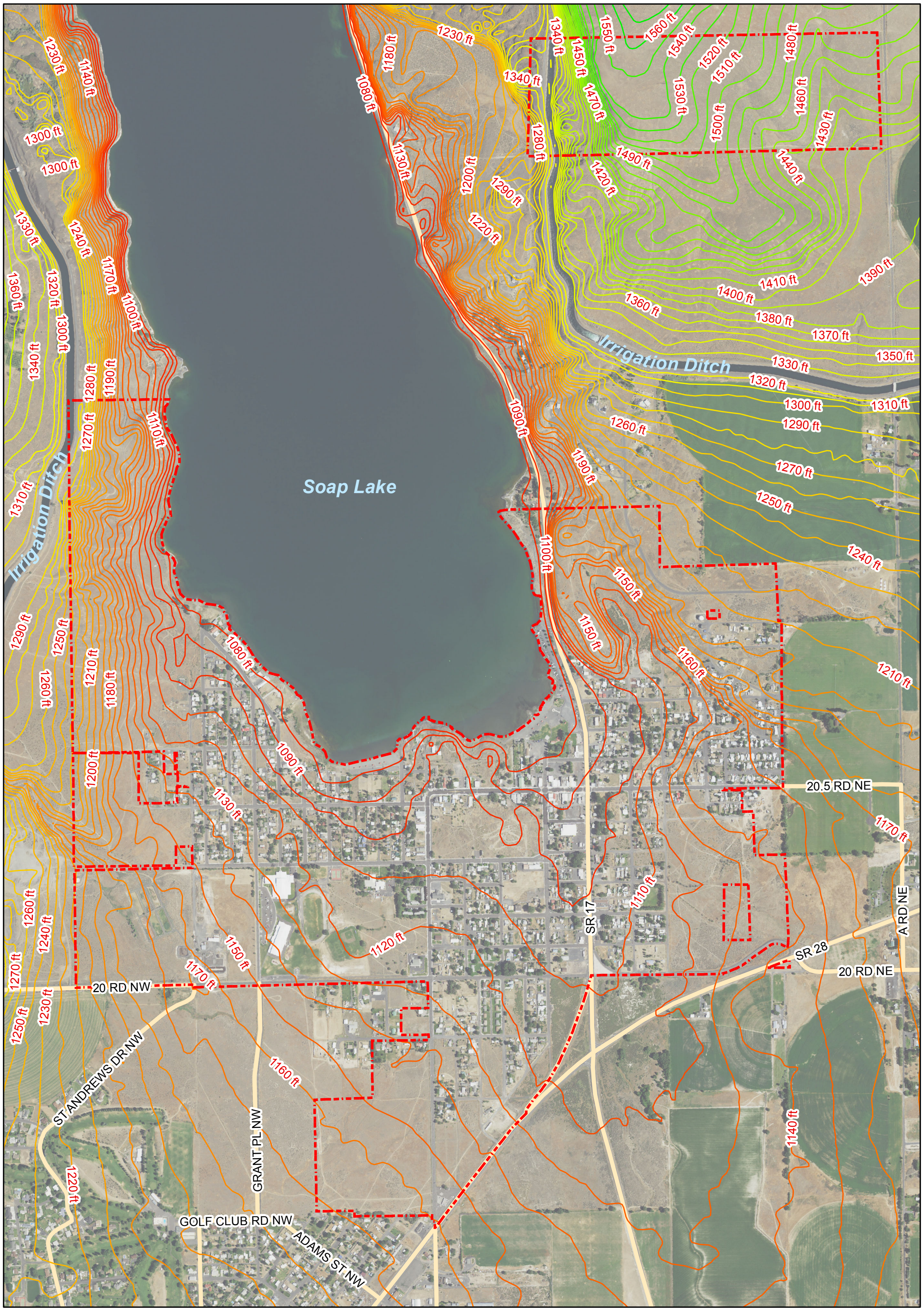

LEGEND

ELEVATION

- 1050 - 1075
- 1076 - 1100
- 1101 - 1125
- 1126 - 1150
- 1151 - 1175
- 1176 - 1200
- 1201 - 1225
- 1226 - 1250
- 1251 - 1275
- 1276 - 1300
- 1301 - 1325
- 1326 - 1350
- 1351 - 1375
- 1376 - 1400
- 1401 - 1425
- 1426 - 1450
- 1451 - 1475
- 1476 - 1500
- 1501 - 1525
- 1526 - 1550
- 1551 - 1575
- Major Roads
- Soap Lake City Limits

SOURCE: GRANT COUNTY

N

0 500 1,000 2,000 Feet

CITY OF SOAP LAKE
Stormwater Management Plan
Figure 2-2
Soap Lake Topography

Gray & Osborne, Inc.

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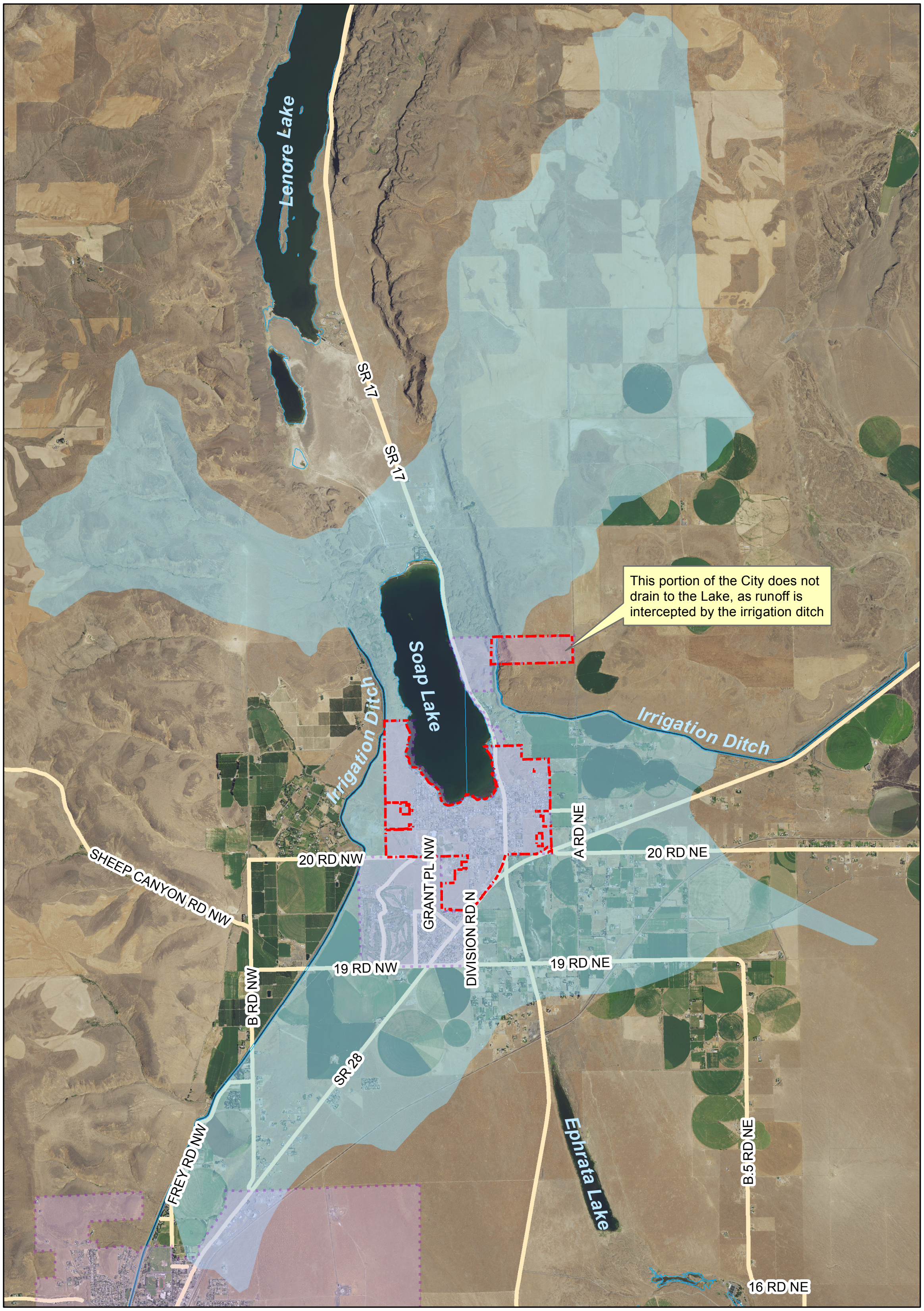


LEGEND

- Major Roads
- Soap Lake City Limits
- Urban Growth Area
- Soap Lake Drainage Basins

N

0 0.5 1 2 Miles

SOURCE: GRANT COUNTY

CITY OF SOAP LAKE
Stormwater Management Plan
Figure 2-3
Soap Lake Drainage Basin

Gray & Osborne, Inc.

Document Path: M:\Soap Lake\17037 - Stormwater Plan\GIS\Fig 2-3 Drainage Basins.mxd

TABLE 2-1

Average Monthly Climate Data

Month	High Temperature	Low Temperature	Precipitation (inches)
January	34°F	22°F	0.83
February	42°F	27°F	0.78
March	54°F	33°F	0.75
April	64°F	40°F	0.43
May	73°F	48°F	0.64
June	81°F	55°F	0.51
July	88°F	61°F	0.44
August	88°F	60°F	0.25
September	78°F	51°F	0.37
October	63°F	40°F	0.47
November	45°F	30°F	1.03
December	34°F	23°F	1.19
Total			**7.69**

SENSITIVE AREAS

The types of sensitive areas found within the City are discussed below. Sensitive areas include water supply, floodplains, wetlands, and habitat areas. The locations of sensitive areas impact where stormwater facilities can be located.

WATER SUPPLY

The City's drinking water is currently drawn from two wells. The City's water system consists of these wells located within city limits, approximately 15.5 miles of water distribution lines, one booster pumping station, and two 500,000-gallon steel reservoirs. The City's water service area is mostly contained within city limits and the City does not supply water to any other municipalities.

Wellhead Protection Zones for Wells No. 1 and 3 are located in the developed portion of the City. Well No. 1 is 466 feet deep and Well No. 3 is 901 feet deep.

In addition, the City operates a non-potable water supply system which pumps mineral water from Soap Lake to residences and businesses in the City Center. The system is currently reduced to the portion of the City between approximately Division Street N and Fern Street North, from approximately 4th Avenue SE to 4th Avenue NE. The remainder of the system west of Division Street North is abandoned due to deteriorated pipes. The City is currently developing a Mineral Water System Plan.

FLOODPLAINS

The Federal Emergency Management Agency (FEMA) documents areas that are subject to 100- and 500-year floods nationwide. The 100-year flood has been adopted as the base flood for purposes of floodplain management. A 100-year flood area is defined as those lands which are subject to a 1 percent or greater chance of flooding in any 1 year. The 500-year flood indicates additional areas of flood risk in the community and has a 0.2 percent chance of flooding in any given year.

Information on flood hazard areas can be found on the Grant County, Washington and Incorporated Areas Flood Insurance Rate Maps (FIRM). The maps applicable to the City of Soap Lake are Community-Panels 53025C0800C, 53025C0550C, and 53025C0525C, all effective February 18, 2009, developed by FEMA. These flood maps are shown as Figures 2-4a and 2-4b. No portion of the City is subject to 100- or 500-year flooding.

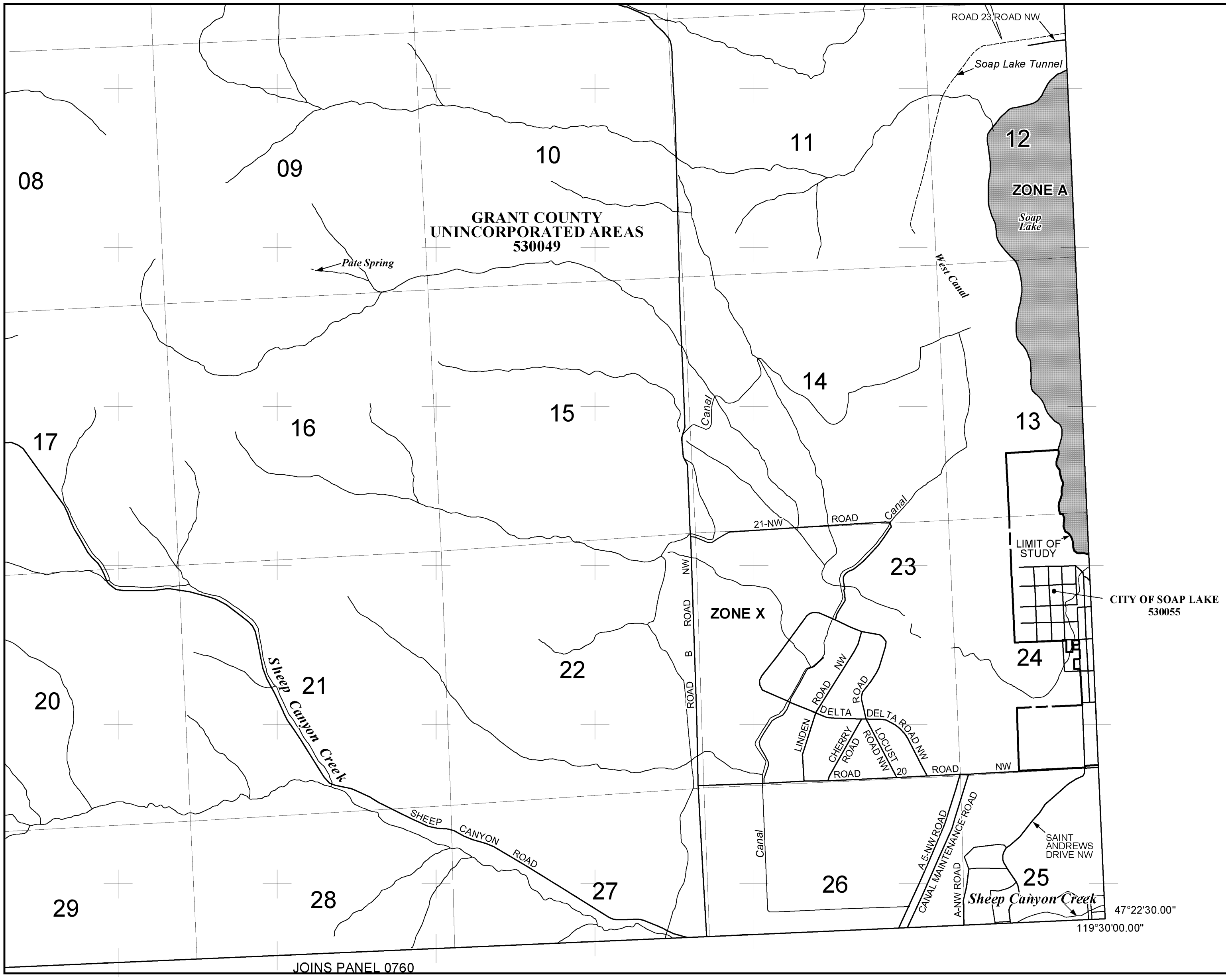
GEOLOGICAL CHARACTERISTICS AND HISTORY

Soap Lake was formed approximately 13,000-18,000 years ago during the Missoula Floods, at the end of the Ice Age. The lake has a high mineral content, as there is no natural inlet or outlet, and the surrounding soils are rich in carbonate salts and lacking in the magnesium or calcium that would ordinarily precipitate the carbonate ions. Water enters the lake through surface runoff or groundwater and exits the lake through evaporation. The stratified lake is unique in its composition, and no mixing occurs between the upper mixolimnion layer and the lower monimolimnion layer. The layers are distinguished by their different levels of salinity, dissolved oxygen, and temperature.

The unique qualities of the lake's water may be at risk due to increased irrigation runoff, which could dilute the mineral content. Additionally, runoff may carry pollutants from urban or agricultural land use such as oils, metals, sediment, or nutrients, further degrading the quality of the lake.

Historically, the lake's salinity has been impacted by human activity. In the 1940s, the Columbia Basin Irrigation Project was established in the greater Columbia River basin with the construction of the Grand Coulee Dam. This irrigation project, the largest of its kind in the United States, was developed to aid agricultural production in the area, diverting fresh water from the Columbia River at the dam. The lake experienced a marked decrease in salinity due to the additional freshwater runoff from irrigation in the area and from several years of particularly wet weather and high rainfall during the early 1950s.

As a remedy, the Bureau of Reclamation initiated the Soap Lake Protective Works project, temporarily pumping directly from the lake during the winters to remove some of the excess volume in the upper layer and, as a long-term solution, installing a number of interception wells around the lake to remove groundwater. The principal components of the Protective Works are the FMX wellfield and the INY wellfield. These wellfields



MAP SCALE 1" = 2000'

1000 0 2000 4000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0525C

FIRM

FLOOD INSURANCE RATE MAP

GRANT COUNTY, WASHINGTON

AND INCORPORATED AREAS

PANEL 525 OF 1950

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

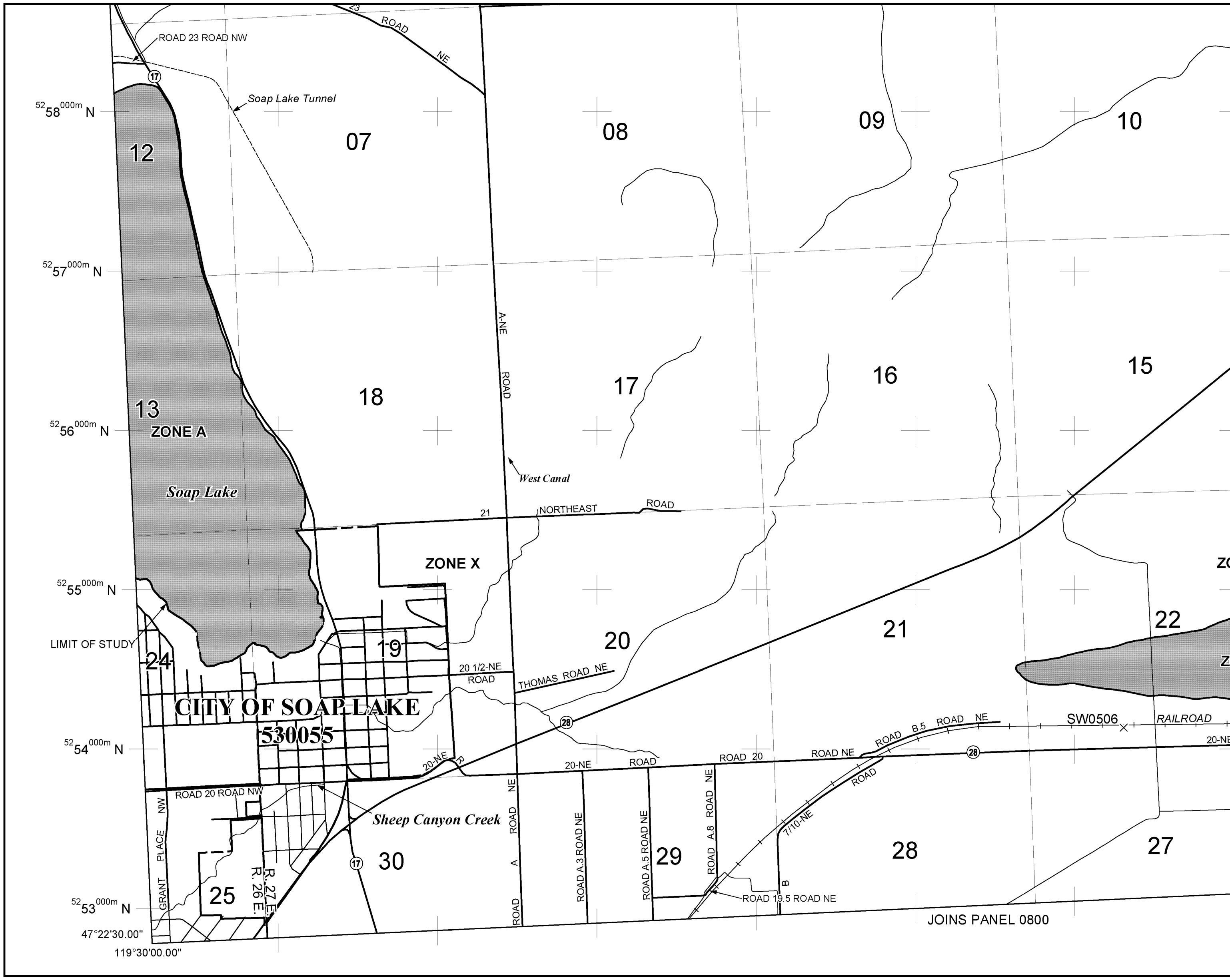
COMMUNITY	NUMBER	PANEL	SUFFIX
GRANT COUNTY	530049	0525	C
SOAP LAKE, CITY OF	530055	0525	C

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
53025C0525C

EFFECTIVE DATE
FEBRUARY 18, 2009

Federal Emergency Management Agency



MAP SCALE 1" = 2000'

1000 0 2000 4000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0550C

FIRM

FLOOD INSURANCE RATE MAP

GRANT COUNTY, WASHINGTON

AND INCORPORATED AREAS

PANEL 550 OF 1950

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GRANT COUNTY	530049	0550	C
SOAP LAKE, CITY OF	530055	0550	C

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 53025C0550C

EFFECTIVE DATE FEBRUARY 18, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov each consist of three pumping wells in a manifold to a discharge header which discharges to the Bureau of Reclamation West Canal to supplement the irrigation water supply for the Columbia Basin Project. Several years after the pumps were installed, they were estimated to discharge an average of 10,000 to 24,000 acre-feet per year (per *Environmental Impact Statement for the Columbia Basin Project*, U.S. Department of the Interior, 1975, pp. I-63; *Isotope Techniques in the Hydrologic Cycle*, Glenn E. Stout, American Geophysical Union, 1967, pp. 78). The purpose of the Protective Works is to maintain the level of Soap Lake and to prevent groundwater from diluting or otherwise modifying the unique water chemistry of Soap Lake. The water level is maintained at an elevation of 1,078 feet.

The interception wells are pumped year-round, prohibiting groundwater from reaching the lake. As a result of this, the City notes relatively low levels of infiltration and inflow (I/I) within its sanitary sewer system. The interception wells remove the groundwater, which is low in salinity and would dilute the lake, prior to it reaching the lake, and they pump the water to the west canal where it flows downslope to the Columbia River Wasteway. The irrigation canals along the east and west sides of the lake also intercept much of the surface runoff from areas upslope before it can enter the lake.

It seems that a new normal of salinity was established in the 1950s, with the lake more diluted than previously noted, but the interception wells appear to have succeeded in maintaining the pre-irrigation water balance in the lake and the lake salinity levels of the 1950s. It is unclear whether the lake could be restored fully to its pre-irrigation condition.

WETLANDS

The U.S. Fish and Wildlife Service's National Wetlands Inventory shows that no wetlands are present within the vicinity of Soap Lake; the only body of water present is Soap Lake.

HABITAT

No fish and wildlife habitat critical areas are noted in the vicinity of Soap Lake. Because of human activity and limited biological diversity, the habitat value within the City is low relative to natural communities.

Wildlife species are found within the City. The Washington State Department of Fish and Wildlife PHS database notes the presence of shorebirds and waterfowl including red-necked phalaropes, ruddy ducks, and grebes as well as mammals including Washington ground squirrels and American badgers. Common wildlife species in the area include raccoons, common crows, eastern gray squirrels, and other small mammals and passerine birds. Many of these species, especially those that adapt to urban areas, can be observed in Soap Lake's residential neighborhoods.

Soap Lake itself serves as an isolated habitat for a number of unique bacteria that have adapted to the lake's high alkalinity.

ZONING AND LAND USE

The City of Soap Lake has identified seven land use codes within its corporate limits and UGA as shown in Table 2-2. The land use designations are each intended to allow flexibility in the development of each area, and to recognize that the City contains several distinct neighborhoods, each with a different character. Figure 2-5 includes a zoning map.

TABLE 2-2

Zoning/Land Use

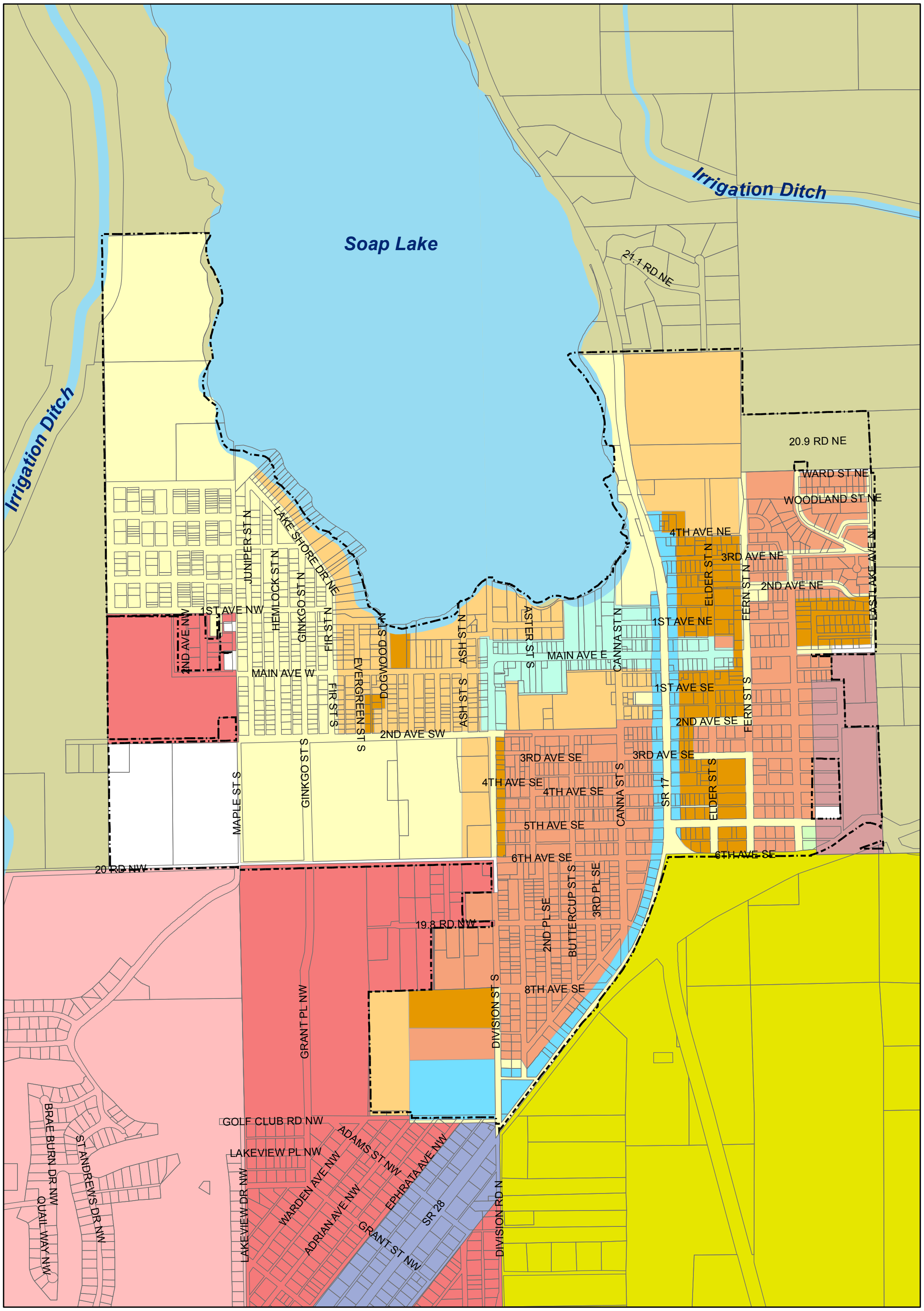
Land Use Designation	Area (square miles)	Percent of Total Area
R-1 Residential	0.34	27%
R-2 Multiple Dwelling	0.27	21%
R-3 Permanent Mobile	0.15	12%
R-4 Trailer Courts and Camps	0.02	1%
C-1 1st Class Commercial	0.05	4%
C-2 2nd Class Commercial	0.05	4%
M-1 Industrial	0.09	7%
City Right-of-Way	0.3	24%
Totals	**1.27**	**100%**

The City's 2009 Comprehensive Plan indicates that approximately 39 percent of City land (excluding rights-of-way) is undeveloped.

POPULATION TRENDS

Residential population within the City is estimated to be 1,535 (2016 Office of Financial Management), approximately 1.6 percent of the population of Grant County. The current population is approximately 1.1 percent lower than the 2000 population of 1,733 (2000 U.S. Census).

Table 2-3 summarizes the historic population for the years 1990, 2000, 2010, and 2016 based on the federal census and OFM estimates.



LEGEND

Soap Lake City Limits

Grant County Zoning

- Rural Residential 1
- Rural Residential 3
- Urban Commercial 1
- Urban Residential 2
- Urban Residential 3
- Urban Residential 4

Soap Lake Zoning

- R-1 Residential
- R-2 Multiple Dwellling
- R-3 Permanent Mobile
- R-4 Trailer Courts and Camps
- C-1 1st Class Commercial
- C-2 2nd Class Commercial
- M-1 Industrial

SOURCE: GRANT COUNTY

N

0 500 1,000 2,000 Feet

CITY OF SOAP LAKE

Stormwater Management Plan

Figure 2-5

Zoning

Gray & Osborne, Inc.

TABLE 2-3

Population Trends

Year	Population
1990	1,149
2000	1,733
2010	1,514
2018	1,575

Per the 2009 Comprehensive Plan, the projected population within the City is expected to reach 2,514 by 2025.

UTILITY SERVICES

The City of Soap Lake currently has City-owned facilities for its sewer, drinking water, mineral water, and storm drainage utilities. There are no known septic tanks within the City limits, and the City is not aware of any cross-connection problems between the sanitary sewer and storm sewer systems. Telephone land line service is provided by Verizon and cellular service is provided by the national carriers. Electric power is provided by Grant County Public Utility District. Refuse service is supplied by Consolidated Disposal under contract.

LOCAL INTEREST

A number of local groups are invested in the long-term quality of Soap Lake. The City's tourism industry is heavily reliant on the lake, as it attracts people from around the world looking to take advantage of potential healing properties.

The Soap Lake Conservancy is an organization run by citizens of the City dedicated to maintaining the lake's quality and improving the surrounding environment in order to protect the lake and bolster the City's economy. The group operates using membership fees and donations. The Conservancy worked with scientists at the University of Washington in 2004 to study the levels and characteristics of the minerals in the lake. The group is partnered with the City and shares its information, research, and planning ideas with the City.

The City council recently founded a Lake Committee, which aims to address concerns about the water quality within the lake and potential pollution issues.

The City has operated its own separated mineral water system in the past to supply residences and businesses with lake water on their properties. The City is currently developing a Mineral Water System Plan.

CHAPTER 3

REGULATORY CONSIDERATIONS

INTRODUCTION

Stormwater drainage planning and construction have historically been provided for the purposes of keeping stormwater away from structures and property so that the property can be drained and protected from damage. Local and state governments have installed the majority of existing stormwater facilities to drain roadways. Private property owners have installed facilities to drain their properties, which then discharge into public drainage systems that in turn connect with the roadway drainage system. Historically, few water quality facilities have been constructed in Soap Lake. However, over the past 30 years, new regulations have required protection of the natural environment from the increasing pollution loads and flow volumes resulting from urban stormwater runoff. Chapter 5 describes many of the water quality and quantity problems associated with today's urban stormwater runoff.

Through the Clean Water Act and other legislation, the federal government has delegated to Washington State the authority to implement rules and regulations within the state that meet the goals of the act. Subsequently, the state has delegated some of this authority to local agencies: cities, counties, and drainage districts. Permits may be issued by all three levels of government, depending on the type of project and the impacts it may have on the natural drainage systems, including streams (intermittent or year-round flows), wetlands, lakes, ponds, rivers, estuaries, marine waters, and groundwater.

The role of federal, state, and local stormwater regulations is to provide minimum standards for the drainage and discharge of stormwater runoff. Specifically, the goal of these regulations is to reduce the damaging effects of increased runoff volumes on the natural environment, to prevent pollutants from getting into runoff, and to remove the pollutants that become entrained in the runoff.

Because of changing administrations, conditions, and technology, all of these policies, rules, and regulations are subject to significant change over time.

FEDERAL REGULATIONS

The federal government regulates stormwater through several different programs. Responsibility for implementing the policies of the programs is often delegated to the state and local agencies through various rules, regulations, and permitting policies. The federal government does, however, maintain some of the responsibilities for those activities that are of national interest.

FEDERAL WATER POLLUTION CONTROL ACT (CLEAN WATER ACT)

The Clean Water Act (CWA) is a 1977 amendment to the Federal Water Pollution Control Act of 1972, which set the basic structure for regulating discharges of pollutants to waters of the United States. The CWA gave the Environmental Protection Agency (EPA) the authority to set effluent standards based on the performance of treatment and control technologies, and extended the requirements of the original act to set water quality standards for all contaminants in surface waters. The CWA makes it unlawful for any person to discharge any pollutant from a point source into waters of the United States unless a National Pollutant Discharge Elimination System (NPDES) permit is obtained.

The CWA provides for the delegation by EPA of many permitting, administrative, and enforcement aspects of the law to state governments. In states with the authority to implement CWA programs, EPA still retains oversight responsibilities.

Provisions of the CWA directly apply to the purpose and creation of the non-point source management program. Non-point pollution is pollution from many diffuse sources caused by runoff from rainfall and snowmelt transporting the pollutants from their sources. Under the CWA, stormwater control was established as part of the NPDES Permit Program (Section 402 of the CWA).

Section 303(d) of the CWA mandates that states develop a list of waters that do not meet federal and state water quality standards and then develop Total Maximum Daily Load (TMDL) Cleanup Plans to restore waters to support beneficial uses. In Washington State, the Department of Ecology is charged with administering these requirements.

Soap Lake is not listed on the State's assessment of deficient water bodies.

National Pollutant Discharge Elimination System Stormwater Permits

Polluted stormwater runoff is commonly transported through Municipal Separate Storm Sewer Systems (MS4s), from which it is often discharged untreated into local water bodies. To prevent harmful pollutants from being washed or dumped into an MS4, operators within urbanized areas must obtain an NPDES permit and develop a Stormwater Management Program.

The Department of Ecology is the permitting agency in Washington. Each regulated MS4 is required to develop and implement a Stormwater Management Program (SWMP) to reduce the contamination of stormwater runoff and prohibit illicit discharges. Ecology included explicit requirements or best management practices (BMPs) as part of the municipal stormwater permit. The permit requires that NPDES permittees in Eastern Washington adopt either Ecology's 2004 *Stormwater Management Manual for Eastern Washington* or an equivalent manual. The City of Soap Lake has adopted Ecology's Manual but is not subject to the NPDES requirements at this time.

ENDANGERED SPECIES ACT

The Endangered Species Act (ESA) was passed in 1973 and provides a program for protection of endangered and threatened species by conserving the ecosystems which such species depend on. The ESA prohibits the "take" of all listed species, which is defined as harming, harassing, pursuing, hunting, shooting, wounding, killing, trapping, or collecting a listed species. The U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration (NOAA) maintain ESA listings for threatened or endangered species.

The ESA applies when activities either directly or indirectly modify habitat or injure listed species, such as the following activities related to stormwater management:

- Constructing barriers that eliminate or impede a listed species' access to habitat.
- Removing, poisoning, or contaminating plants, fish, or wildlife required by the listed species for survival.
- Discharging pollutants into a listed species' habitat.
- Removing or altering rocks, soil, gravel, vegetation, or other physical structures that are essential to the integrity and function of a listed species' habitat.
- Removing water or otherwise altering streamflow in a manner that significantly impairs spawning, migration, feeding, or other essential behavioral patterns.

U.S. Fish and Wildlife Service

The listed endangered species in Soap Lake include the Columbia basin pygmy rabbit, gray wolf, grizzly bear, marbled murrelet, and northern spotted owl (USFWS, Central Washington Field Office). These species would not be impacted by construction or maintenance of the City's stormwater system.

WASHINGTON STATE STORMWATER REGULATIONS

The principal state programs related to stormwater management include the 2004 *Stormwater Management Manual for Eastern Washington*, Hydraulic Project Approval, the Growth Management Act, State Water Quality Standards, and the Shorelines Management Act.

STORMWATER MANAGEMENT MANUAL FOR EASTERN WASHINGTON

The City of Soap Lake has adopted Ecology's 2004 *Stormwater Management Manual for Eastern Washington* (2004 Ecology Manual) in SLMC Chapter 15.24. The 2004 Ecology Manual is intended for guidance of new development and redevelopment, with overall goals of protecting and restoring aquatic species and habitat, water quality, and natural hydrology and processes, including achieving no net detrimental change in natural infiltration and surface runoff. The 2004 Ecology Manual establishes the minimum requirements for stormwater control and site development requirements for all new development and redevelopment. These manuals outline water quality design criteria, water quality controls, erosion and sediment control practices, and site development.

The intent and purpose of the 2004 Ecology Manual is to provide for the following elements:

- Establish criteria for review and analysis of all development,
- Manage stormwater to minimize contact with contaminants,
- Mitigate the impacts of increased runoff due to urbanization,
- Manage runoff from developed property and that being developed, and
- Protect the health, safety, and welfare of the public.

The 2004 Ecology Manual does not have any independent regulatory authority. The minimum requirements and technical guidance in the 2004 Ecology Manual only become required through:

- Ordinance and rules established by local governments; and
- Permits and other authorizations issued by local, state, and federal authorities.

In the absence of a permit or other regulatory requirement, local jurisdictions may adopt and apply all or a portion of the minimum requirements, thresholds, definitions, BMP selection processes, and BMP design criteria of the 2004 Ecology Manual through local ordinances. The City adopted the 2004 Ecology Manual in 2014 (SLMC 15.24.080). The City's design storm for conveyance and detention is the 50-year storm event for general conveyance or the 100-year storm event for culvert crossings (SLMC 15.24.080).

In 2019, Ecology released an updated version of the Manual, the 2019 *Stormwater Management Manual for Eastern Washington*. It is recommended that the City adopt the newer version of the Manual in order to ensure that stormwater design is in accordance with the latest research and best practices.

HYDRAULIC PROJECT APPROVAL

The Washington State Department of Fish and Wildlife (WDFW) requires Hydraulic Project Approval (HPA) for construction activities that will use, divert, obstruct, or change the bed or flow of state waters. The law came from the recognition that virtually any construction that affects the bed or flow of the waters of the state has the potential to cause habitat damage. The law's purpose is to ensure that needed construction is done in a manner to prevent damage to the state's fish, shellfish, and their habitat. Any construction activities, such as channel widening or culvert improvements that occur within the ordinary high-water mark of any stream, must comply with HPA requirements. However, WDFW generally does not exert jurisdiction over stormwater system repairs outside of the stream channel.

GROWTH MANAGEMENT ACT

The Growth Management Act (GMA) was written in response to the realization that uncoordinated and unplanned growth posed a threat to the environment, sustainable economic development, and the quality of life in Washington. It was adopted by the Washington State Legislature in 1990 and has been amended several times since. The GMA requires that local governments manage growth by identifying and protecting critical areas and natural resource lands, designating Urban Growth Areas (UGAs), and preparing and implementing comprehensive plans. Grant County opted to plan under the GMA and the City adopted an updated Comprehensive Plan in 2006 in accordance with GMA requirements.

STATE WATER QUALITY STANDARDS

The CWA requires that states establish water quality standards that identify the maximum level of pollutants allowed in state waters in order to protect uses within those waters. It also requires that the state protect those waters of quality that exceed the standards requirement, including an antidegradation policy. The Washington State water quality standards can be found in the Washington Administration Code (WAC) Chapter 173-201A. The standards set limits on pollution in lakes, rivers, and marine waters to protect beneficial uses such as aquatic life, swimming, and fishing.

There are currently no waters within the City listed on the States 303(d) list of deficient waterbodies.

STATE OF WASHINGTON SHORELINE MANAGEMENT ACT

The Shoreline Management Act (SMA) is outlined in WAC Chapters 173-18 through 173-26 and requires municipalities to develop Shoreline Master Programs (SMPs) that include consideration of water quality as well as critical areas and wildlife habitat areas. A draft Shoreline Master Program was prepared by Anchor QEA, LLC for the City of

Soap Lake in 2014. The document focuses on methods and measurements to preserve the unique mineral composition of Soap Lake.

Soap Lake's shoreline is categorized as a shoreline of the state but not a shoreline of Statewide Significance, as the lake is less than 1,000 acres in area. The shoreline elevation is maintained at 1,078 feet.

CITY OF SOAP LAKE STORMWATER REGULATIONS

Local jurisdictions are typically responsible for implementing and enforcing regulations passed down from the state and federal governments and for enacting additional policies, procedures, and regulations based on local conditions and desires of the citizens.

SOAP LAKE COMPREHENSIVE PLAN

Soap Lake adopted its updated Comprehensive Plan in November 2009. The updated Comprehensive Plan addresses the GMA issues of housing, land use, transportation, utilities, and capital facilities and meets the 13 goals that address community issues. The following policies included in the updated Comprehensive Plan are related to stormwater management:

- Policy LU 2.1: The community will continue its primary role in the conservation of housing by publicly investing in the infrastructure servicing the area, such as storm drainage, street paving, and recreation, and will provide zoning to help prevent incompatible land uses and depreciation of property values.

- Policy LU 2.3: Encourage residential growth to occur in areas where public utilities exist or may be provided at reasonable costs.

- Policy LU 3.7: Commercial land will be developed in a manner which is complementary and compatible with adjacent land uses and the surrounding environment.

- Policy LU 3.10: Promote development in the Central Business District that is compatible with the existing characteristics. This may include common-wall construction, zero-lot lines, and off-street parking located behind structures.

- Policy LU 3.12: Recognize pedestrian needs in commercial areas by promoting a more pleasant and comfortable environment through drought-tolerant landscaping, buffering vehicular traffic, and pedestrian amenities.

- Policy LU 4.3: Encourage clean industrial and light industrial development which is compatible with the quality of the City and natural environment (air, water, noise, visual).

- Policy LU 4.5: Encourage industrial and light industrial development to locate in industrial/business park areas adjacent to major street arterials, preferably on lands not well suited for residential uses.

- Policy LU 4.7: Encourage variety and innovative design in industrial site development and encourage an attractive and high-quality environment for industrial activities through good landscaping, parking, and building design where land uses of distinct character or intensity adjoin.

- Policy LU 5.5: Ensure adequate drainage facilities to protect property and environment from flooding and declines in water quality.

- Policy CA 1.1: Protect environmentally sensitive natural areas and the functions they perform by the careful and considerate regulation of development.

- Policy CA 1.2: Coordinate conservation strategies and efforts with appropriate state and federal agencies and private organizations to take advantage of both technical and financial assistance and to avoid duplication of efforts.

- Policy CA 1.3: Encourage the development of an education program that promotes conservation areas and private stewardship of these lands.

- Policy CA 1.5: Use best available science when determining critical areas location and qualified specialists for site-specific development.

- Policy CA 1.6: Promote fertilizer and pesticide best management practices of schools, parks, and other non-residential facilities that maintain large landscaped areas to protect against groundwater contamination, as recommended by the Cooperative Extension Service or a licensed chemical applicator.

- Policy CA 1.7: Adopt a Critical Areas Ordinance which provides for appropriate regulation of:

    a. Frequently flooded areas,
    b. Areas with critical recharging effect on aquifers used for potable water;
    c. Geologically hazardous areas,

d. Fish and wildlife habitat conservation areas, and
e. Wetlands.

- Policy U 1.2: Encourage development of vacant properties adjacent to established utility systems, where feasible, according to the appropriate zoning classification and/or land use designation.

- Policy CF 1.11: Improvement standards for new development proposed within the Urban Growth Area should be jointly developed by the County and the City of Soap Lake. Standards should address such improvements as street alignment and grade, public road access, right-of-way widths, street improvements, sanitary sewer, stormwater improvements, and park and recreation facilities.

- Policy ED 3.4: The City will develop ordinances to define maintenance standards for streets, water, sewer, and sidewalks.

Shoreline goals and policies:

- Goal SH 1: Ensure that public access to the lake is maintained and encouraged.

- Policy SH 1.1: The City should maintain existing ownership and seek opportunities to place additional shoreline areas into public ownership.

- Policy SH 1.2: The City should adopt into the City Code adequate regulations to ensure that all citizens have equal opportunity to enjoy the benefits of Soap Lake.

- Policy SH 1.3: The City should encourage joint-use docks and common access points when the shoreline of Soap Lake is privately owned and developed.

- Policy SH 1.4: The City should encourage community events and public gatherings to utilize the facilities within city parks adjacent to Soap Lake.

- Goal SH 2: The unique mineral content of Soap Lake should be preserved to the greatest extent possible.

- Policy SH 2.1: The City of Soap Lake should encourage study and programs that demonstrate methods to preserve the mineral content of Soap Lake.

- Policy SH 2.2: The City of Soap Lake should adopt "Best Available Science" as defined under the Growth Management Act 36.70A when developing shoreline regulations.

- Policy SH 2.3: The City of Soap Lake should maintain and enforce those regulations which are intended to preserve the mineral content of Soap Lake.

- Goal SH 3: Update the City of Soap Lake's Shoreline Management Master Program (SMMP) to reflect current needs and requirements including Best Available Science.

- Policy SH 3.1: Update the SMMP at least as often as mandated by state law, but more often if needs or science changes.

- Policy SH 3.2: Seek guidance from the Washington State Department of Ecology, Department of Fish and Wildlife, scientists, and others with technical skills and knowledge when updating the SMMP.

- Policy SH 3.2: Seek input from local citizens, user groups, and other interest groups specific to Soap Lake.

LAND USE ELEMENT

While the Comprehensive Plan Land Use Element is not a stormwater management regulation, it guides how land is developed, specifically the locations of commercial development, residential densities, and open-space requirements. These policies in turn have a direct impact on the quantity and quality of runoff from a particular area. An effective way to control stormwater is to preserve the natural environment and the natural hydrologic functions of land as much as possible.

CHAPTER 4

EXISTING STORM DRAINAGE SYSTEM

EXISTING CONVEYANCE SYSTEM

The City of Soap Lake's existing stormwater conveyance system consists of a combination of ditches, pipes, catch basins, and culverts. The extent of the storm drainage system is fairly limited and collects flow primarily from the City's downtown business district. A base map showing piped drainage facilities within the City is shown on Figure 4-1 with a large-format map included in Appendix A.

The City has multiple drainage outfalls that discharge to the lake. Part of the storm system conveys runoff from the southeast area of the City via a swale to the west of Daisy Street, then through a drainage pipe that discharges to East Beach. A second channel collects water from Division Street and South Street near the center of town, as well as the City Hall parcel, which flows to a drainage pipe that deposits in the center of the lake's south shore. A third channel collects stormwater from the area southwest of the lake and outfalls at West Beach. Careful attention should be paid to the pollution that is allowed to enter these stormwater runoff channels – particularly the southeast channel, which appears to collect runoff from agricultural uses just outside city limits. The drainage pipe outlets from the channels are also a visual concern on both East Beach and West Beach.

The City's stormwater system consists primarily of catch basins and pipes. The City has a number of siphon catch basins along Main Avenue West that are connected in pairs by a single pipe. These structures serve to hold runoff temporarily before the water evaporates, as a means of removing water quickly from City roads during short, intense rainfall. They also prevent runoff from crossing the centerline of the road. Storm sewer facility information was collected from a number of as-built drawings for various road improvement projects within the City, field survey, and City sketches. An inventory of the identified pipes within the City's system is provided in Table 4-1.

TABLE 4-1

Storm Sewer Facilities

Pipe Diameter (inch)	Approximate Length (ft)
4	48
6	445
8	7,364
10	843
12	8,167
16	946
24	1,182
30	564
36	430
Ditch	1,930
Unknown	1,168

CONDITION

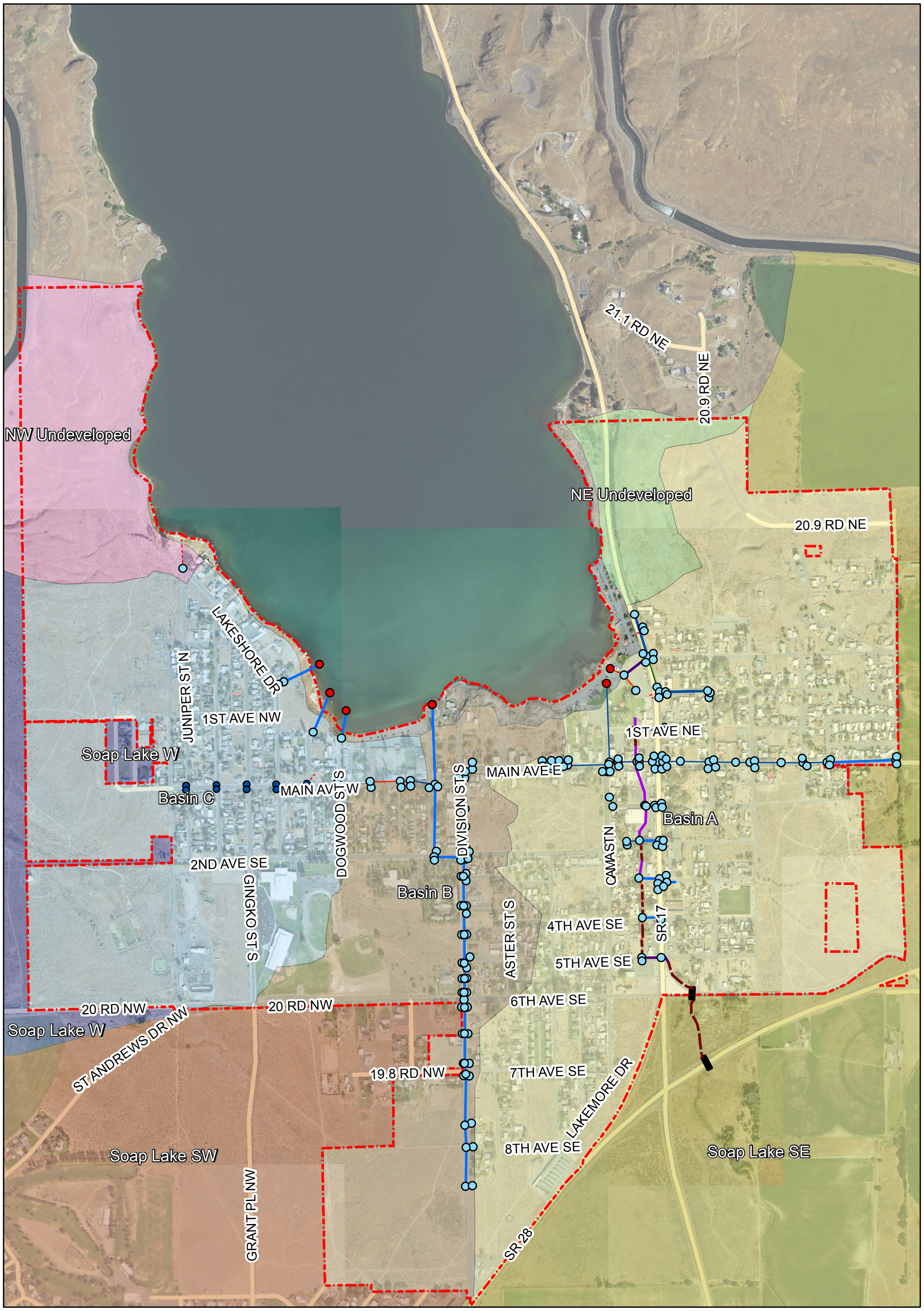
The City's conveyance system largely includes concrete or clay pipes installed before or around the middle of the 20th century. The existing system was constructed at the same time as the neighborhoods within the City were developed. Assuming a standard service lifetime of approximately 75 years for concrete pipe, much of the City's system is approaching the anticipated end of its useful life. The City does not report any areas of significant concern at this time.

Several sections of the City's conveyance system are much newer. Division Street North and Division Street South, Main Avenue East, and portions of Canna Street North and 1st Avenue SE have been reconstructed since 2000, and a stormwater system in these locations was installed. These parts of the conveyance system consist of PVC pipe and have at least 30 to 50 years, assuming a useful lifetime of 50 to 75 years.

It is recommended that the City conduct video inspections in the future in order to determine if there are significant structural problems with any parts of the conveyance system. Inspections will allow the City to more accurately identify which sections of the conveyance system are in greater need of repair or replacement.

OWNERSHIP

Much of the City's existing storm conveyance system is located within City right-of-way; however, some of the existing pipes and ditches cross through private property not owned by the City. In many of these locations, it is unclear if the City has utility easements for the conveyance alignments. It is recommended that the City investigate the easement status of any stormwater infrastructure that appears to be located on private property. If



SOURCE: GRANT COUNTY

LEGEND

- Soap Lake City Limits
- Major Roads
- Catch Basin/Manhole
- Outfall
- Siphon Catch Basin

Diameter

- Unknown Direction
- Unknown Diameter
- 4-inch Diameter
- 6-inch Diameter
- 8-inch Diameter
- 10-inch Diameter
- 12-inch Diameter
- 16-inch Diameter
- 24-inch Diameter
- 30-inch Diameter
- 36-inch Diameter
- Ditch, Open Trench

Drainage Basin

- Basin A
- Basin B
- Basin C
- NW Undeveloped
- NE Undeveloped
- Soap Lake W
- Soap Lake SW
- Soap Lake SE

N

0 250 500 1,000 1,500 Feet

CITY OF SOAP LAKE

Stormwater Management Plan

Figure 4-1
City Storm System

Gray & Osborne, Inc.

Document Path: M:\Soap Lake\17037 - Stormwater Plan\GIS\Fig 4-1 City Storm System.mxd easements are not found, the City should acquire them to facilitate maintenance, repair, and replacement of the conveyance system.

MODELING

Hydrologic and hydraulic analysis of the City's stormwater basins was performed using the XP-Storm software program that utilizes the EPA's SWMM (Surface Water Management Model) computer model. The hydrologic/hydraulic model for the City was developed to provide a basis for the design of system improvements.

The basic steps in the development of the hydrologic or runoff model include:

- Development of rainfall intensity over time;
- Delineation of the drainage basins and subbasins;
- Identification of land use and estimation of the amount of pervious and impervious areas;
- Identification of soil types and estimation of the infiltration parameters; and
- Identification of topographic characteristics and estimation of flow parameters including average slope, roughness coefficients, and depression storage.

Based on this information, the model estimates the resulting runoff from each subbasin. Hydraulic analysis is then used to determine the flow rates during the design storm, including the peak flow rate for the event.

DRAINAGE BASINS

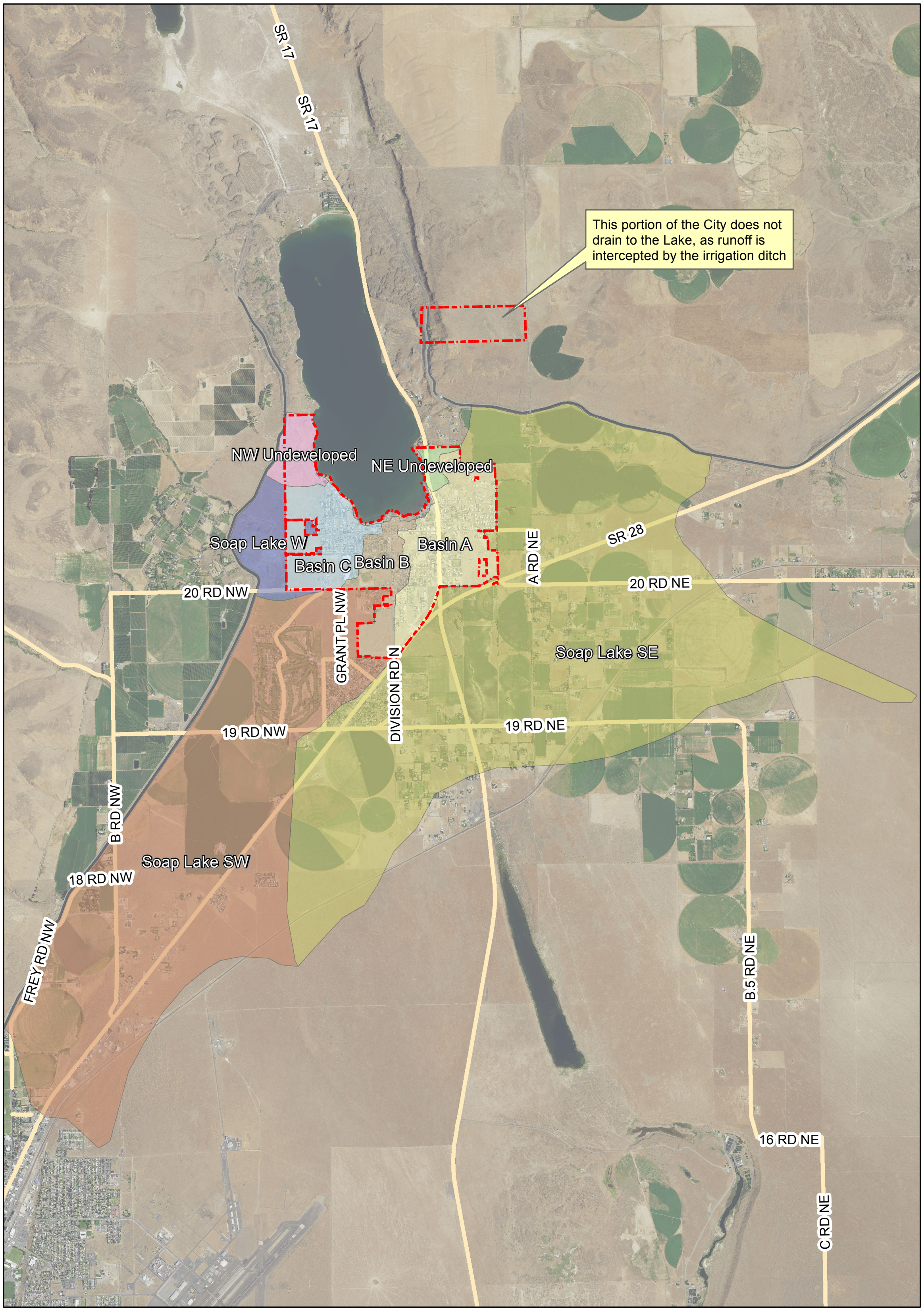
The City was divided into separate drainage basins using a 10-foot contour map and GIS information. Though all runoff in the City eventually flows to Soap Lake, the basins distinguish drainage areas to each of the City's outfalls for the purpose of sizing future stormwater management facilities and characterizing the type of runoff and potential pollutants based on land use.

Figure 2-3 shows the drainage basins that contribute stormwater to Soap Lake. Figure 4-2 shows the drainage basins that flow through the City and are likely tributary to the City's collection system. The collection system is shown on Figure 4-1. Subbasin boundaries were established using topographic maps, field investigation of topography, and existing City utility mapping. The topography indicates that the drainage basins extend far outside of the city limits. In order to develop conservative flow projections, these greater drainage basins outside of the city limits have been considered in the modeling of runoff tributary to the City's system and the lake. In reality, it is likely that runoff from undeveloped areas outside of the City is able to infiltrate prior to reaching the City's drainage infrastructure. The Federal Bureau of Reclamation's irrigation ditches located to the east and west of the City intercept some of the runoff from the nearby hills, and convey it to the south.

The lake's surface runoff drainage basin was determined using aerial photos and topographic GIS data. The total area draining to the lake by surface flow is approximately 11.9 square miles. In the northernmost portions of the City, approximately 0.2 square mile drains directly to Soap Lake without encountering the City's conveyance system. Much of the surface drainage basin is cut off from the lake by the large irrigation canals that follow along either side of the lake.

The groundwater basin for the Lake is likely much larger than the surface water drainage basin, and is estimated to be 400 square miles. Groundwater is typically not considered in stormwater management, as it is impacted by many other factors aside from rainfall. This Plan considers infiltration of surface runoff, which would contribute rainfall to the groundwater basin instead of directing surface runoff to the Lake. Runoff infiltrated to the subsurface will likely have a longer travel time if it does eventually reach the lake, as compared to surface runoff. The infiltrated water may accumulate dissolved minerals that contribute positively to the Lake's chemistry, which would not occur if surface runoff is discharged directly to the Lake. Beyond the consideration of infiltration to manage stormwater flows, further groundwater analyses were not conducted as part of this Plan. A future hydrogeology study would be needed to address the quality of and potential impacts of groundwater on the Lake. Given the large area that contributes to the groundwater basin, any remedial efforts would likely need to be coordinated with many other municipalities, state, and federal entities.

The land cover for each subbasin was estimated based on the designated land use and aerial imagery. Table 4-2 shows the total area and the estimated amount of impervious area assumed for each subbasin. Impervious area estimates were based on aerial imagery of existing development.



SOURCE: GRANT COUNTY

LEGEND

Drainage Basin

- Basin A
- Basin B
- Basin C
- NW Undeveloped
- NE Undeveloped
- Soap Lake W
- Soap Lake SW
- Soap Lake SE

- Major Roads
- Soap Lake City Limits

N

0 0.25 0.5 1 Miles

CITY OF SOAP LAKE

Stormwater Management Plan

Figure 4-2
City Drainage Basins

Gray & Osborne, Inc.

Document Path: M:\Soap Lake\17037 - Stormwater Plan\GIS\Fig 4-2 City Drainage Basins.mxd

TABLE 4-2

Drainage Basin Characteristics

Basin	Total Area (acres)	Impervious Area (acres)	Percent Impervious
A	347.9	131.5	37.8%
B	180.1	38.5	21.3%
C	235.7	47.6	20.2%
Northwest Undeveloped	89.9	0	0%
Northeast Undeveloped	32.0	1.6	5%
West Undeveloped	167.0	0	0%
Southwest Undeveloped	2,693.6	134.7	5%
Southeast Undeveloped	3,983.4	199.1	5%

Basins A and B appear to be suitable for the installation of regional, end-of-pipe stormwater improvements. These basins have fairly robust conveyance networks that discharge to the lake shore. Basin C, on the other hand, has fragmented conveyance elements that generally do not converge or discharge to a common location.

MODELING PARAMETERS

In order to set up the XP-Storm model, a number of parameters must be developed. The first is landcover and land characteristics. These parameters include the flowpath of the basin, which is the longest path runoff would travel through the basin measured from the furthest upstream point of the basin to the discharge location. The slope of the basin along this flowpath is determined using LIDAR data.

The overall curve number is developed using a weighted average of the impervious and pervious surfaces within each basin. A curve number of 98 is assigned to impervious areas. A curve number of 70 is assigned to pervious areas within the City, which consist of lawn, dirt, and sagebrush cover. A curve number of 60 is assigned to pervious areas outside of the City, which consist of sagebrush, grazing land, and crop cover.

The time of concentration (Tc) in the smaller basins is developed using Friend's Equation, which determines Tc based on the basin's overall slope, longest flowpath, and average roughness. For the larger basins outside of the City limits, the Bransby-Williams equation is used, which better estimates Tc for large areas where channelized flow regimes may be more predominant than sheet flow. These parameters are presented in Table 4-3.

TABLE 4-3

Modeling Input Parameters

Basin	Flowpath Length (ft)	Slope (ft/ft)	Roughness (n)	Impervious Coverage	Overall Curve Number(1)	Time of Concentration (min)
A	4,000	0.04	0.035	37.8%	80.6	35.5
B	5,800	0.02	0.035	21.3%	76.0	39.4
C	5,400	0.03	0.035	20%	75.6	30.3
Northwest Undeveloped	2,000	0.11	0.06	0%	60.0	33.7
Northeast Undeveloped	1,500	0.09	0.045	5%	61.9	23.9
West Undeveloped	5,000	0.05	0.055	0%	60.0	39.6
Southwest Undeveloped	27,000	0.01	0.055	5%	61.9	235.0
Southeast Undeveloped	20,000	0.01	0.055	5%	61.9	167.5

(1) A curve number of 98 is assigned to impervious areas. A curve number of 70 is assigned to pervious areas within the City, which consist of lawn, dirt, and sagebrush cover. A curve number of 60 is assigned to pervious areas outside of the City, which consist of sagebrush, grazing land, and crop cover.

DESIGN STORM

All storm event models, such as XP-Storm, require the input of data describing rainfall intensity over time. Design storms are defined in terms of:

- Return frequency – the statistically estimated length of time between which storms with a given total amount of rainfall will occur;
- Total rainfall – depth, typically in inches; and
- Storm duration and rainfall distribution over time

Design storms are hypothetical storms based upon a statistical analysis of historical storm events. For Eastern Washington, design storm rainfall, both intensity at a given time and the total volume, is described in the Washington State Department of Ecology 2004 *Stormwater Management Manual for Eastern Washington* Chapter 4, Hydrologic Analysis and Design. The 2004 Ecology Manual has designated four Eastern Washington climatic regions which reflect the differences in storm characteristics and the seasonality of storms. Soap Lake is located in Region 2, Central Basin. The rainfall distribution used for modeling rainfall events in Region 2 areas is either an SCS Type 1A rainfall distribution, or a synthetic regional storm distribution with lower rainfall intensities but a longer duration. Per Table 4.2.10 of the 2004 Ecology Manual, the multiplication factor for converting from 24-hour to regional storm precipitation depth in Region 2 is 1.00.

The 2-year, 24-hour and 10-year, 24-hour design storms total precipitation are 0.8 and 1.2 inches, respectively, over a 24-hour period (NOAA Atlas 2, Volume IX, 1973). The 2-year storm is used to determine a 6-month storm runoff depth using a scaling factor of 0.66 for the Central Basin region (per Table 4.2.9 of the 2004 Ecology Manual).

Rain-on-snow events often cause stormwater runoff events that exceed the predicted amount of runoff for the storm event. Section 4.2.7, Rain-on-Snow and Snowmelt Design, in the 2004 Ecology Manual provides guidance for sizing stormwater facilities. The average annual snowfall in the Ephrata/Soap Lake area is approximately 18.3 inches according to Table 4.2.12. The average snow depth during the winter months is 1 inch in December, 3 inches in January, and 1 inch in February. In order to analyze the worst-case scenario for stormwater runoff, the water equivalent of the average daily snow depth from December to February was determined to be 1.7 inches. Assuming 20 percent moisture content and a precipitation adjustment factor of 0.84 (2004 Ecology Manual, page 4-25) the 24-hour additional runoff contribution from snowmelt during a rain-on-snow event is 0.29 inch. Table 4-4 summarizes the design storm parameters used to model the City of Soap Lake stormwater conveyance system.

TABLE 4-4

Design Storm Parameters

Storm Event	Precipitation Depth 24-Hour Storm (inches)
6-month	0.53
6-month + rain-on-snow	0.82
2-year	0.8
2-year + rain-on-snow	1.09
10-year	1.2
10-year + rain-on-snow	1.49
25-year	1.5
25-year + rain-on-snow	1.79

Flow rates were determined for each basin for the different design storms. The lower-intensity storms do not produce notable runoff in some of the undeveloped basins, as the permeability of the soil is likely high enough to infiltrate all runoff. The larger storms cause greater amounts of runoff with higher peak flow rates.

TABLE 4-5

Modeled Basin Flow Rates(1)

	6-Month Flow (cfs)	2-Year Flow (cfs)	10-Year Flow (cfs)	25-Year Flow (cfs)
A	1.095	2.551	6.957	16.954
B	0.160	0.560	1.701	2.767
C	0.219	0.816	2.517	4.138
Northwest Undeveloped	0	0	0.032	0.274
Northeast Undeveloped	0	0	0.039	0.139
West Undeveloped	0	0	0.058	0.506
Southwest Undeveloped	0	0	2.243	10.622
Southeast Undeveloped	0	0	3.804	16.032

(1) All with rain on snow assumed.

CITY-IDENTIFIED STORMWATER CONVEYANCE PROBLEMS

The City's stormwater conveyance system includes older drainage networks as well as more recently installed facilities. Stormwater conveyance throughout the City was not hydraulically modeled. It is assumed that the short lengths of conveyance pipe are adequate for tributary flows, as the City notes few drainage complaints from residents or businesses. Several intersections in the City do experience ponding during larger rainfall events, likely due to a lack of conveyance and curb and gutter in these locations. The City notes that these issues are unlikely to be caused by the stormwater collection system itself and that future road improvements in these areas will provide better drainage.

Much of the City's drainage and conveyance system is at least partially filled with Mount St. Helens ash. Over time, this has solidified into a clay-like or concrete-like substance within the drainage structures, reducing capacity within the drainage system and likely inhibiting the infiltrative ability of dry wells. The City has been unable to effectively remove the ash from the drainage system, and complete replacement of portions of the drainage system may be necessary to restore capacity.

The City generally does not note flooding or ponding issues. This indicates that the conveyance system is likely robust enough to manage the majority of runoff produced even during large storm events. It is possible that runoff infiltrates over pervious surfaces, removing some of the rainfall before it can turn into runoff.

CITY-IDENTIFIED WATER QUALITY PROBLEMS

The City is concerned with the quality of its runoff and the impact of urban runoff on the water quality of Soap Lake. Currently, all of the City's conveyed stormwater flows to Soap Lake through outfalls without treatment for sediment or pollutants. The City is interested in exploring general methods of stormwater treatment to prevent polluted runoff from discharging directly to the Lake.

Additionally, due to the unique nature of the Lake, the City is concerned that increased freshwater runoff, such as treated stormwater, that could flow to the Lake may dilute the salinity and mineral concentrations within the Lake. The City is interested in implementing runoff management methods, such as infiltration, to prevent freshwater from flowing directly to the Lake. Cleaned runoff that is infiltrated to the groundwater will likely indirectly feed the Lake, but will have a higher chance of accumulating minerals from the soil as compared with surface runoff, helping to maintain the chemical balance of the Lake.

The City is concerned about increased freshwater volumes due to irrigation on the farms upslope of the City to the southeast. The City notes flowing water in the ditches in the southeast portion of the City during the summer, even following periods without any precipitation, and therefore believes the runoff is from farm irrigation. Because the increased irrigation occurs during the summer, and therefore does not coincide with rainfall events, it is assumed that the irrigation flow rates are small enough to be conveyed by the City's system, and the City does not note drainage problems due to this flow. However, the City is concerned with the possibility that irrigation water could contaminate Soap Lake through dilution. It should be noted that irrigation discharges are an issue separate from stormwater runoff. The City will need to coordinate with the individual land owners of the farms that are producing excessive irrigation discharges. This may also require coordination with the Bureau and/or state agencies. This issue is discussed further in Chapter 5.

CHAPTER 5

NON-POINT SOURCE POLLUTION ANALYSIS

INTRODUCTION

The City of Soap Lake's surface water plays a part in its natural beauty and rich heritage. Surface water quality is of particular importance to the City due to the prominence of its centerpiece natural resource, Soap Lake. The lake's unique composition attracts numerous tourists wishing to benefit from its fabled medicinal properties. Without proper stormwater management, urban runoff may degrade or alter the quality of the lake.

Stormwater is defined as the runoff from residential, commercial, and other urban areas. As rain falls and runs off of urban surfaces, pollutants associated with the urban environment are removed and transported to surface waters where they may damage aquatic organisms and reduce the aesthetic value of the water body.

The March 2005 Downtown Master Plan determined that solutions to manage stormwater runoff into the Lake must be identified and implemented to preserve the integrity and quality of the mineral water. In particular, excess irrigation drainage from surrounding farm land as well as polluted runoff from highway corridors and increasingly developed urban areas pose a threat to the composition of the lake. Dilution of the lake by fresh irrigation water could change the salinity and pH balance of the lake, which could jeopardize the unique environment that supports a number of distinct bacterial organisms that live in the lake.

IMPACTS TO WATER QUALITY

Pollutants discharged in stormwater are largely uncontrolled. Research in Washington has shown that the concentrations of many pollutants found in stormwater from residential, commercial, and industrial areas exceed established state and federal water quality criteria.

The EPA's Nationwide Urban Runoff Program has extensive field monitoring throughout the United States to characterize urban runoff flows and pollutant concentrations and states the following:

> *Urbanization increases the variety and amount of pollutants carried into our nation's waters. In urban and suburban areas, much of the land surface is covered by buildings, pavement and compacted landscapes with impaired drainage. These surfaces do not allow rain and snow melt to soak into the ground which greatly increases the volume and velocity of stormwater runoff. In addition to these habitat-destroying impacts, pollutants from urban runoff include:*

> - *Sediment*
> - *Oil, grease and toxic chemicals from motor vehicles*
> - *Pesticides and nutrients from lawns and gardens*
> - *Viruses, bacteria and nutrients from pet waste and failing septic systems*
> - *Road salts*
> - *Heavy metals from roof shingles, motor vehicles and other sources*
> - *Thermal pollution from dark impervious surfaces such as streets and rooftops*
>
> *These pollutants can harm fish and wildlife populations, kill native vegetation, foul drinking water, and make recreational areas unsafe and unpleasant.*

The conclusions reached by the Nationwide Urban Runoff Program study indicate that sedimentation, erosion, and bacterial pollution are the pollutants of most concern in stormwater runoff, but that habitat changes associated with streambed scour and sedimentation produced by urbanization were more significant than pollutant concentrations.

WATER QUALITY STANDARDS

The following discussion focuses on the criteria used to evaluate water quality contaminants and sources most common in runoff. Potential water quality problems in the Soap Lake area and proposed solutions are identified later in this chapter.

Non-point source pollution is primarily transported by stormwater from developed areas to nearby water bodies or infiltrated into shallow groundwater. In developed areas, certain pollutants are more prevalent than in undeveloped areas. Pollutants accumulate in surficial soils and on paved surfaces from vehicular emissions, atmospheric deposition, spills, leaks, improper waste storage/disposal practices, and fertilizer/pesticide application. Although these types of non-point source pollution can be attributed to an individual source, their intermittent nature makes them difficult to identify and control. For the purposes of this plan, these discharges have been considered non-point source pollutants.

PARAMETERS OF CONCERN

There are numerous classes of water quality parameters that are affected by stormwater runoff including sediment, nutrients, and metals; oxygen-demanding and inert material; particulate and dissolved substances; chemical, biological, and physical; toxic and nontoxic; and organic and inorganic. In Soap Lake, an additional concern is dilution of the natural salinity through increased freshwater runoff or from fresh groundwater entering the lake. The following section provides a brief description of contaminants, likely sources, and potential environmental effects.

Dissolved Oxygen

Dissolved oxygen is consumed in the oxidation of organic matter by biological activities and is therefore necessary in maintaining aquatic life. Concentrations vary naturally but low levels occur in summer months when low streamflow and high temperatures increase the rate of oxygen-demanding processes.

The City's only surface water body, Soap Lake, is not home to fish or aquatic animals, but does support a unique bacterial population. Studies conducted on these bacteria have shown that bacteria near the bottom of the lake where oxygen is not accessible due to the lake's stratification are suited to this anaerobic environment. Other organisms in the upper layer of the lake do require oxygen to survive. Dissolved oxygen concentration measured in May 2001 was determined to be 9 mg/L in the upper layer of the lake (Peyton and Yonge, 2002).

pH

pH moderates the degree of dissociation of weak acids and bases, which affect the toxicity, reactivity, and solubility of many compounds. The value varies based on natural processes and water sources.

Soap Lake's pH was determined to be approximately 9.5 to 9.9 as measured in May 2001, revealing the alkali nature of the water (Peyton and Yonge, 2002).

Temperature

Temperature affects rate of natural processes and stream chemistry, specifically the solubility of oxygen, carbon dioxide, and metals, and varies diurnally and seasonally.

A study of the lake conducted in 1975 determined a temperature range in the upper level of the lake of 8 degrees Celsius in the winter to 20 degrees Celsius in the summer. The lower level of the lake exhibits a much smaller seasonal temperature variation, ranging from 6 degrees Celsius in the winter to 8 degrees Celsius in the summer (Peyton and Yonge, 2002).

Turbidity

Turbidity is a measure of the clarity of water. Turbidity responds to physical factors such as runoff, proximity to exposed erodible soils, and streamflow.

Nutrients

Nutrients are generally required for growth of aquatic organisms. The primary nutrients of concern are nitrogen and phosphorous. Typical sources include detergents, fertilizers, septic system effluent, and manure. High nutrient levels will increase algal activity. Algal decomposition results in lower dissolved oxygen levels, surface algal scums, water discoloration, and odors.

Pathogens/Bacteria

Fecal coliform bacteria concentrations are used as indicators of waterborne pathogenic bacteria or viruses. High levels are caused by failing septic systems, poor livestock management practices, poorly operated wastewater treatment systems, poorly maintained municipal storm and sanitary sewers, and other point or non-point sources.

High Oil and Grease

Hydrocarbon compounds can be toxic to aquatic life at low concentrations. High concentrations are associated with runoff events from urban and industrial areas.

Total Suspended Solids

Sediments wash off paved surfaces and are transported by runoff and discharged to receiving waters. Sediments can act as a substrate for adhesion of other pollutants.

Metals

Lead, zinc, copper, chromium, arsenic, cadmium, and nickel are found in runoff from driving surfaces. Most metals are adsorbed onto suspended solids present in the runoff and are probably not toxic to aquatic life.

Toxic Organic Compounds

Pesticides, petroleum hydrocarbons, and volatile organic compounds (VOCs) are found in urban and agricultural runoff, hazardous substance spills, improper disposal of waste products, and industrial discharges. The availability of toxic organic compounds is difficult to determine because of their adsorption to particulate matter.

Organic Material

Organic content of soil is primarily produced by microorganisms during the degradation of dead plant and animal material. The microbial degradation of organic matter in aerobic systems results in the consumption of oxygen.

CRITERIA

Water quality standards for surface water in Washington State are established in WAC Chapter 173-201A. Standard criteria allow for comparison of the data of interest to a safe or desired concentration or level. Management practices that violate established standards are subject to further investigation and ultimately, appropriate corrective measures.

The Department of Ecology has responsibility for managing the State's water resources which are classified into four classes for surface water:

- Type S – Large waters of the State;
- Type F – Non-Type S waters that support salmon and other fish;
- Type Np – Perennial non-fish habitat stream; and
- Type Ns – Seasonal non-fish habitat stream.

State water quality standards assign specific use categories to surface waters of the State, such as aquatic life uses, recreational uses, water supply uses, and miscellaneous uses. Water quality standards have been assigned to each specific use category for parameters such as fecal coliform, dissolved oxygen, temperature, pH, turbidity, and toxic, radioactive, and deleterious substances.

The City of Soap Lake is located in the Grand Coulee Water Resource Inventory Area (WRIA 42). Table 602 (WAC Chapter 173-201A-602) assigns use designations for fresh waters by WRIA; however, since Soap Lake is not a freshwater lake, these criteria do not apply.

Because of its unique nature and lack of fish, not all criteria listed in WAC Chapter 173-201A are applicable to Soap Lake.

The water quality parameters listed in Table 5-1 are applicable to freshwater bodies that support aquatic life, and are typical for most freshwater bodies throughout the state. Additionally, concentrations of toxic substances, such as organic compounds and metals, must not exceed standards specified in WAC Chapter 173-201A-240. These standards are based on the EPA Quality Criteria for Water (1986), which are derived from federal water quality criteria based on aquatic toxicology. As Soap Lake has a unique habitat and composition that does not support aquatic life, these parameters should not be relied upon to dictate the quality of the water within the Lake. Rather, they are supplied as a reference for an appropriate level of treatment of surface runoff from the City prior to discharge to the Lake.

The WAC defines both acute and chronic criteria for toxic substances. Acute toxicity criteria are based on death percentages of test organisms within 24 hours. Chronic toxicity criteria are defined as the concentration that causes long-term adverse effects on an organism's functions.

Water quality criteria for nutrients are not defined in federal or state regulations for surface water. However, because of their influence on algal growth in surface water, nitrogen and phosphorus are the nutrients of greatest interest in stormwater runoff. Phosphorous is often the limiting nutrient for growth of plants in freshwater systems. Phosphorous enrichment can, therefore, result in the excessive algal blooms and associated nuisance conditions in streams and lakes. The general threshold for eutrophic conditions in lakes is 20 micrograms per liter (μg/L) of total phosphorous. Criteria for defining eutrophic thresholds in streams do not exist. However, soluble phosphorous in the range of 15 to 25 μg/L promotes nuisance conditions in streams.

TABLE 5-1

Fresh Water – Water Quality Criteria (WAC Chapter 173-201A-200)

Parameter	Criteria
Temperature: Core Summer Salmonid Habitat	The 7-day average of daily maximum temperatures (7-DADMax) shall not exceed 16 degrees C.
Dissolved Oxygen: Core Summer Salmonid Habitat	Dissolved oxygen shall exceed 9.5 mg/L (lowest 1-day minimum).
Turbidity: Core Summer Salmonid Habitat	Turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.
Total Dissolved Gas: Core Summer Habitat	Total dissolved gas shall not exceed 110 percent of saturation at any point of sample collection.
pH: Core Summer Habitat	pH shall be within the range of 6.5 to 8.5 with a human-caused variation within a range of less than 0.2 unit.
Bacteria: Extraordinary Primary Contact	Fecal coliform organisms shall not exceed a geometric mean value of 50 colonies/100 mL, with not more than 10 percent of samples exceeding 100 colonies/100 mL.
Toxic, Radioactive, or Deleterious Materials	Toxic, radioactive, or deleterious material concentrations must be below those which have the potential, either singularly or cumulatively, to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health (see WAC Chapter 173-201A-240, Toxic Substances, and WAC Chapter 173-201A-250, Radioactive Substances).
Aesthetic Values	Aesthetic values shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.

The general impacts of non-point sources on beneficial uses that are likely to be of concern to water bodies in or adjacent to the City are indicated in Table 5-2.

TABLE 5-2

General Impact of Non-Point Sources Likely to Be of Concern to the City of Soap Lake

Body	Key Pollutants	Effect on Water	Affected Uses
Lake	Sediment/ Suspended Solids	Turbidity deposition in stream pools and wetlands	Loss of flood control capacity, degraded fish habitat, loss of wetland cleaning ability, visual pollution
	Turbidity/ Hydraulic, Erosion	Streambank loss, sediment deposit downstream	Damage of private and public property and fish habitat
	Toxic Organics	Contaminate resident organisms	Health problems in fish and humans
	Temperature	Some fish cannot survive in higher temperatures	Decline in fish population, potential effect on unique bacteria
Groundwater	Nitrates	Loss of use as a drinking water supply	Loss of drinking water supply
	Toxic Organics	Cancer, related diseases	Decline in drinking water quality
	Bacteria/ Viruses	Contamination	Decline in drinking water quality

Beyond those regulations set by the State of Washington, the City desires to maintain the unique composition of the lake. Because of the lake's high salinity and high pH, the goal for certain water quality parameters is not to meet the State's normal standards for surface waters, as some of the normal parameters for Soap Lake are out of the ordinary.

POINT SOURCES

The City operates a wastewater treatment plant that is permitted to discharge a maximum monthly flow of 0.30 million gallons per day (mgd) and a maximum daily flow of 0.42 mgd. The plant discharges to one of six rapid infiltration basins located just south of 2nd Avenue SW and west of Maple Street. Operators rotate through each of the six basins to ensure that flows have sufficient time to infiltrate. The plant also has a sludge drying bed to dispose of treated solids. The dried sludge is transported to Mansfield, Washington for land application as Class B biosolids. The plant is located approximately 2,500 feet to the southwest of the shoreline of Soap Lake.

A gas station is located near the center of the City at the corner of Daisy Street South and Main Avenue East. The underground fuel storage tanks are a potential source of pollution. The gas station is located approximately 800 feet from the shoreline of the lake, to the southeast. Inspections of the facility will ensure that best management practices to reduce the potential for contaminated runoff are being implemented. The Lake is also used recreationally for powerboating throughout the summer. Leaks from powerboats may contribute pollutants including oil or fuel to the Lake.

SOURCES OF NON-POINT POLLUTANTS

The major types of non-point pollution sources in the Soap Lake area are related to urban development, construction-related activities, industrial activities, agricultural activities, and transportation-related activities. Other important sources of non-point pollution may include illicit connections to the storm drain system, on-site sewage systems, and improper waste storage and disposal practices.

URBAN DEVELOPMENT

Potential sources of pollution from urban development include oil and grease, suspended solids and metals from the parking lots, bacterial loads and garbage from improper waste storage and disposal practices at the grocery stores and restaurants, oil and grease and petroleum hydrocarbons from boat yards and fertilizers, and pesticides and herbicides from landscaping activities. Runoff from commercial development and from roadways throughout the City most likely contributes metals, such as cadmium (a catalyst used in tire manufacture) and lead, to stormwater runoff. These contaminants are produced by dryfall from vehicle emissions, vehicle wear and tear, and chemical products. Other contaminants that may be associated with the commercial establishments in the City include toxic organic compounds. VOCs, such as solvents, may also be present in urban runoff and are typically associated with spills and improper waste storage and disposal activities.

SR 17 is the most heavily traveled road within the City and likely contributes a notable amount of pollutants. Currently, WSDOT does not operate its own stormwater collection, conveyance, or treatment infrastructure along this route, relying on the City's system for management of runoff from the portion of SR 17 that is within the City limits. The City maintains this infrastructure.

CONSTRUCTION-RELATED ACTIVITIES

Any construction-related activities of land clearing and site preparation are potential sources of stormwater pollution. Areas that have been cleared of vegetation are more prone to erosion and can significantly increase sediment loading to nearby water bodies. Sediments can be deposited in natural and constructed channels, thereby reducing the hydraulic capacity. The efficiency and capacity of associated stormwater control structures such as culverts, pipes, and detention facilities will also be affected by the deposition of sediment.

HIGHWAYS

Stormwater runoff from SR 17 and City streets can contain elevated concentrations of metals, suspended solids, and organic compounds such as petroleum hydrocarbons. Studies have shown that pollutant loading is directly related to the amount of vehicle traffic during the storm. Sanding in the winter further contributes sediment to the drainage system. Major thoroughfares in the City include SR 17 (Daisy Street), Main Avenue East, and Division Street South.

AGRICULTURAL ACTIVITIES

Based on national studies, non-point source pollution from agricultural uses consists primarily of small hobby farms and small ranches. Agricultural activities are limited within the City of Soap Lake, but may still contribute to stormwater pollution. The greater drainage basin for the lake does include some larger farms where fertilizer, pesticides, and livestock may affect the quality of runoff. Animal-keeping activities are most likely the most significant source of non-point source pollution from agricultural activities. Pasturing and boarding of animals generally contribute to non-point pollution sources through waste management and poor grazing practices. Runoff from barnyard and pastureland may contaminate water supplies, destroy aquatic life in streams, and generally degrade water quality. Nitrate, ammonia, organic carbon, and fecal coliform are commonly elevated in runoff from land used by livestock. When livestock are allowed direct access to open water bodies, they severely damage the banks causing erosion and bank sloughing. The direct access of animals to streams, ponds, and wetlands also promotes the direct disposal of feces and urine wastes. The associated sediments, nutrients, organic loads, and pathogens are then introduced to the surface water system.

An additional concern associated with agricultural activities is excess irrigation runoff. City staff notes that the irrigation ditches within the City often flow during the summer when larger farms upslope are regularly watering crops. The City is concerned that this runoff, which is comprised of freshwater and may carry pollutants from the farmland it travels over, would degrade the quality of the Lake or dilute the Lake's concentration of minerals. The responsibility to manage irrigation runoff lies with the farmer and with the Bureau of Reclamation, and the City plans to discuss this issue with all stakeholders in order to limit or eliminate the intrusion of excess irrigation runoff into the City's drainage system.

DOMESTIC ACTIVITIES

Non-point pollution from domestic activities in the City consists primarily of pet waste and runoff from residential gardens and landscaping. Pet wastes are likely the most significant source of non-point pollution from residential activities. Runoff laden with animal wastes, fertilizers, pesticides, or herbicides can contribute to non-point pollution.

The Soap Lake dog park located at the corner of 2nd Avenue South and Ginkgo Street South has potential to create runoff contaminated with pet waste. Educating the public on how to properly dispose of pet waste and providing bags to do so can reduce the potential for contamination.

Though there are no septic tanks within the City limits and all sewage is collected and treated at the City's wastewater treatment plant, areas outside of the City may be served by septic systems. In particular, the Smokiam RV Resort at the north end of the lake includes several dozen RV hookup sites, campsites, cabins and tipis, and is served by a septic system.

Just outside of the City limits to the northeast, several resorts along SR 17 are served by septic systems. These resorts have expressed interest in connecting to the City's wastewater collection and treatment system at some point in the future. The City has no regulatory or inspection power over the septic systems that exist outside of City limits.

ADDITIONAL POLLUTANT SOURCES

In addition to the pollutant sources discussed above, the following activities may contribute to stormwater pollution:

- Lack of preventive maintenance of stormwater facilities;
- Bacterial loading from garbage storage at restaurants;
- Pollutant wash-off from car and truck parking areas;
- Dumping of used motor oil into the City's storm drainage system or on the ground;
- Nutrient loading due to excessive fertilizer usage; and

- Bacterial contamination from pet wastes that are not "scooped."

RECOMMENDATIONS

The unique composition of the Lake prevents comparison with more typical water bodies. In order to accurately characterize the physical parameters of the lake, a thorough monitoring effort is recommended. The past studies referenced in this plan (Andersen, 1958; Peyton and Yonge, 2002) were able to identify salinity levels, temperatures, dissolved oxygen content, and pH in the upper and lower layers of the lake, and they determined the depth of both layers. These studies indicate that a change in some of the lake's parameters has occurred over time. In order to determine whether stormwater improvements are effective in maintaining the salinity of the lake, ongoing monitoring is necessary. Long-term, regular monitoring can indicate which parameters are changing and at what rate, which can help to guide intervention efforts to preserve the water quality.

Because the lake is not a priority water body from a habitat standpoint, funding for monitoring may be difficult to obtain. Generally, the State's efforts in water quality testing and monitoring have focused on freshwater bodies that are prime habitat for fish and other species.