Unalaska Lake Watershed

Stormwater Management Program Plan

Prepared for:

City of Unalaska

Prepared by:

PND Engineers, Inc.

April 2015

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Table of Contents

List of Figures

List of Photos

List of Tables

Appendices

Executive Summary

PND Engineers, Inc. was selected to prepare a Stormwater Management Program Plan for the City of Unalaska pertaining to sedimentation in the Unalaska Lake watershed under funding from the Coastal Impact Assistance Program. This program plan is written to present options for remediation and for further actions per grant language and with the grant funding. Stormwater management options include public education and outreach, public involvement, discharge detection and elimination, construction and maintenance stormwater runoff controls (such as applicable best management practices), and municipal operations and maintenance.

Multiple sites were identified as major sediment sources, and several were chosen as priority areas: Overland Drive, Steward Road Bridge area, and the area around the former "Duck Pond Lot". These priority areas were then assessed to determine appropriate remediation measures, such as routing water into natural drainage paths, remediating and/or enhancing existing sedimentation structures, road treatment, installation of oil and grit separators, and others.

This plan's information is then to be used by the City of Unalaska to determine which measures should be implemented at which sites in 2015.

List of Acronyms and Abbreviations

ADEC: Alaska Department of Environmental Conservation
AK-CESCL: Alaska Certified Erosion & Sediment Control Lead
APDES: Alaska Pollutant Discharge Elimination System
AWCRSA: Aleutians West Coastal Resource Service Area
CGP: Construction General Permit
CIAP: Coastal Impact Assessment Program
COU: City of Unalaska
CWA: Clean Water Act
DPW: Department of Public Works
EPA: Environmental Protection Agency
IBC: International Building Code
NPDES National Pollutant Discharge Elimination System
PND: PND Engineers, Inc.
MS4: Municipal Separate Storm Sewer System
NTU: Nephelometric Turbidity Units
RAP: Recycled Asphalt Pavement
ROM: Rough Order of Magnitude
SMPP: Stormwater Management Program Plan
SWPPP: Stormwater Pollution Prevention Plan
TDS: Total Dissolved Solids
USACE United States Army Corps of Engineers

1.0 Introduction

1.1 Background

PND Engineers, Inc. (PND) was selected to prepare a Stormwater Management Program Plan (SMPP) for the City of Unalaska (City) and the Unalaska Lake watershed. Currently, the Unalaska Lake watershed is the most impacted in the entire Aleutians West Coastal Resource Service Area (AWCRSA) due to human development. The ability of the Unalaska Lake system to produce fish, particularly sockeye salmon, has been substantially degraded. The most significant development in the watershed affecting water quality and fish habitat is road design, construction, and maintenance. Since the 1940s, when the first roads were constructed associated with World War II, and to the current stage of development, portions of the lake have been filled, sections have been cut off by fill, inlet stream channels have been diverted, and much of the lakeshore sockeye salmon spawning habitat may be covered with silt deposits. Additional contributors of sediment are in-fill developments within the valley and from natural causes, such as landslides, during large storm events.

Public observations and historical aerial photography has provided evidence suggesting that the lake has started to fill in over time with sediment starting at the upper portion of the lake where the Iliuliuk River enters from the southeast. The public has expressed concern regarding the key spawning habitat and that this area used to be covered in aquatic grasses that have been essentially choked out by the sediment.

In November 2007 a large storm event resulted in a significant amount of sedimentation into Unalaska Lake. This storm resulted in upper basin erosion of natural slopes and associated transport by surface runoff and through the river until it finally deposited into the headwaters of the lake. See Photo 1-1 and Photo 1-2 where sedimentation at the headwaters of Unalaska Lake is notable. Other large storm events have had a similar effect per conversations with the public.

Photo 1-1. Suspended Sediment in Lake 12/6/07 (photo courtesy of Abi Woodbridge)

Photo 1-2. Unalaska Lake Sedimentation 8/6/08 (photo courtesy of Abi Woodbridge)

Suspended silt in the lake and river's water column reduces sunlight penetration and thereby decreases survival of salmon fry by limiting plankton production and the ability of rearing salmon fry to feed in the lake. Additionally, the suspended silt can injure the juvenile salmon's gills and increase incidence of disease.

Another key factor in the siltation of Unalaska Lake is that the steep topography, geology and soils, sparse large vegetation, and high rainfall are conducive to rapid runoff and erosion. Under these conditions, silt and pollutants from natural slopes, residential and industrial development and associated transportation infrastructure adversely impact water quality and fish habitat. Reducing silt flow and other pollutants into the lake and its tributaries is vital to the wellbeing of the lake's biological resources.

The City of Unalaska has been making progress in reducing sedimentation of the lake through the paving of Broadway Avenue and other roads, installation of curbs and gutters, installation of catchment basins on storm drains, installation of sediment separators, grass hydro seeding, placement of recycled asphalt pavement (RAP) on Overland Drive and Dutton Road, and ditching to control runoff.

1.2 Unalaska Lake Watershed Characteristics

The Unalaska Lake watershed is comprised of approximately 72,000 acres of land that collects rainfall and runoff within the Iliuliuk River (also known as Unalaska Creek or Town Creek) and within Unalaska Lake. The Iliuliuk River drains Unalaska Lake and discharges into Iliuliuk Harbor. The Dutch Harbor weather station provides information on precipitation and average temperatures with a record dating back to 1951 (Western Regional Climate Center 2012). The annual average temperatures range from 35.9° F as a minimum, and 45.8° F as a maximum, and average annual precipitation is approximately 61 inches. On average, the month with the highest amount of

precipitation is typically December or January; however, storms occur throughout other periods of the year bringing higher than average precipitation quantities.

1.3 Clean Water Act Legislation

The Clean Water Act (CWA) was passed by the U.S. Congress, enacted in 1948 as the Federal Water Pollution Control Act, expanded and amended in 1972, to develop regulations for discharge of pollutants into waters of the United States. Under the CWA, the Environmental Protection Agency (EPA) implemented pollution control programs such as the National Pollutant Discharge Elimination System (NPDES). In 2012, the State of Alaska Department of Environmental Conservation (ADEC) received primacy to regulate and permit point source discharges into waters of the U.S. under the Alaska Pollutant Discharge Elimination System (APDES). ADEC requires permits for industrial, municipal, and other facilities discharging directly into surface waters.

The pollutants of concern for this SMPP are primarily total dissolved solids (TDS), sediment, and turbidity. ADEC defines a pollutant as: "any kind of industrial, municipal, or agricultural waste discharged into water. Pollutants include sewage, solid waste, chemical wastes, biological materials, seafood processing wastes, dredged soil, mining wastes, rock, sand, dirt, munitions, heat, garbage, discarded equipment, and runoff from construction or agricultural sites". The State of Alaska Water Quality Standards (ADEC 2012) states the following in relation to the pollutants of concern within this SMPP:

- Dissolved Inorganic Substances, for Fresh Water Uses - Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife
    - "TDS may not exceed 1,000 mg/l. A concentration of TDS may not be present in water if that concentration causes or reasonably could be expected to cause an adverse effect to aquatic life."
- Sediment, for Fresh Water Uses – Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife
    - "The percent accumulation of fine sediment in the range of 0.1 mm to 4.0 mm in the gravel bed of waters used by anadromous or resident fish for spawning may not be increased more than 5% by weight above natural conditions. In no case may the 0.1 mm to 4.0 mm fine sediment range in those gravel bed exceed a maximum of 30% by weight. In all other surface waters no sediment loads (suspended or deposited) than can cause adverse effects on aquatic animal or plant life, their reproduction or habitat may be present)"
- Turbidity, for Fresh Water Uses – Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife
    - "May not exceed 25 NTU above natural conditions. For all lake waters, may not exceed 5 NTU above natural conditions."

1.4 Water Quality Results

Water quality of the Unalaska Lake watershed was tested by the City during 2014. In-situ testing was completed using a handheld YSI multi-parameter probe, calibrated per manufacturer recommendations, and bottle samples were collected by the City and sent to a water quality laboratory for testing. Sampling points were chosen by the City and are displayed in Figure 1-1 along with one set of turbidity results. Test results of various parameters sampled by the City are displayed in Table 1-1.

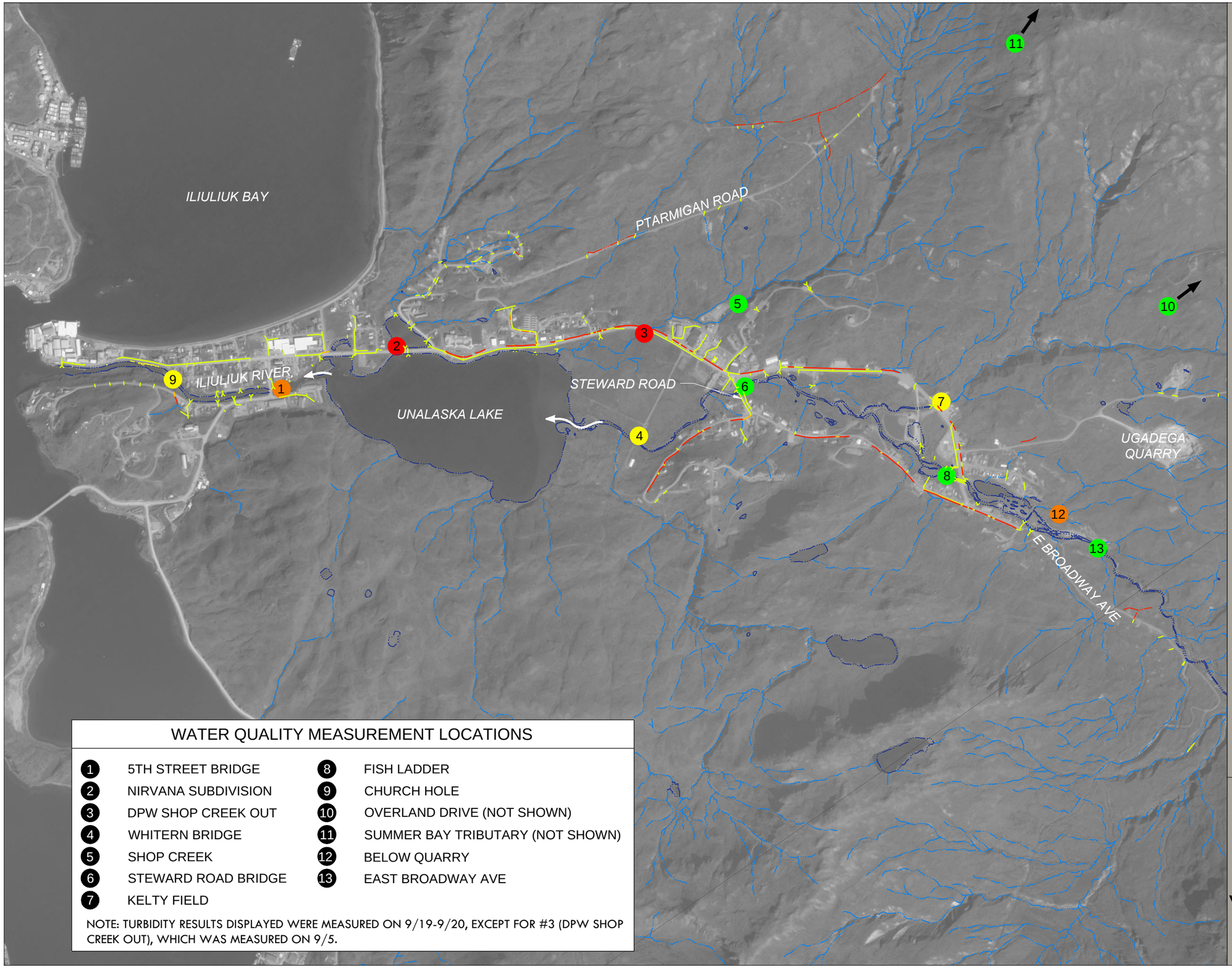
It should be noted that these results are just snapshots in time as certain parameters can vary depending on weather and time of year. The City first took samples and tested during a dry period with no rain. The second sampling period was following a small rainfall event.

1.5 Purpose of Plan

The purpose of this SMPP for the Unalaska Lake watershed is to reduce the discharge of excessive sediment to the maximum extent practicable, protect water quality, and satisfy the appropriate water quality requirements of the CWA. This SMPP will be a guide for action by the City, land owners, and developers, and should be used in planning, decision making, and permit review activities.

1.6 Funding

Funding for the SMPP and initial implementation of the restoration activities discussed in the plan is part of the Coastal Impact Assistance Program (CIAP) originally granted to the former AWCRSA, and is now under the City of Unalaska. The funding provides a total of $626,657 over a course of two years. Year 1 provides $100,000 to gather necessary data and to write the SMPP. Year 2 provides $526,657 and involves the development and implementation measures to reduce sediment entering the lake; and design, permitting, and installation of sediment traps, separators, or other stormwater treatment as seen necessary.



WATER QUALITY MEASUREMENT LOCATIONS

1	5TH STREET BRIDGE	8	FISH LADDER
2	NIRVANA SUBDIVISION	9	CHURCH HOLE
3	DPW SHOP CREEK OUT	10	OVERLAND DRIVE (NOT SHOWN)
4	WHITERN BRIDGE	11	SUMMER BAY TRIBUTARY (NOT SHOWN)
5	SHOP CREEK	12	BELOW QUARRY
6	STEWARD ROAD BRIDGE	13	EAST BROADWAY AVE
7	KELTY FIELD		

NOTE: TURBIDITY RESULTS DISPLAYED WERE MEASURED ON 9/19-9/20, EXCEPT FOR #3 (DPW SHOP CREEK OUT), WHICH WAS MEASURED ON 9/5.

N

600 0 600 1200 1800 FT

LEGEND

TURBIDITY (NTU)

- 0 - 0.2
- 0.2 - 0.6
- 0.6 - 0.8
- 0.8 - 2.0

STORMWATER

- STORM DRAIN PIPE
- DITCH
- CULVERT
- OUTFALL

WATERBODIES

- CREEK/DRAINAGE
- RIVER/LAKE

P N D
ENGINEERS, INC.

STORMWATER MANAGEMENT PROGRAM PLAN

WATER QUALITY TESTING
FIG 1-1

Table 1-1
Water Quality Results

Site	Description	Latitude	Longitude	Temp °F		Turbidity NTU		D.O. %		Total Dissolved Solids mg/L		Total Solids mg/L	Total Suspended Solids mg/L	pH -	
				#1	#2	#1	#2	#1	#2	#1	#2	#1	#1	#1	#2
1	5th St. Bridge	53°52'19"N	166°31'55.39"W	58	52	1.56	0.69	105	103	294	270	330	2.25	7.9	8.35
2	Nirvana Subdivision	53°52'13.07"N	166°31'32.41"W	59	48.7	1	2.03	106	97	70	78	89	not detected	7.96	8.19
3	DPW Shop Creek out	53°51'52.98"N	166°30'49.38"W	51	-	0.82	-	107	-	55	-	76	not detected	7.68	-
4	Whittern Bridge	53°51'43.88"N	166°31'6.98"W	55	48.6	0.4	0.26	122	103	41	37	50	1.5	8.33	7.97
5	Shop Creek	53°51'47.75"N	166°30'32.80"W	49	47	0.18	0.04	109	102	60	50	78	not detected	7.76	7.76
6	Steward Rd Bridge	53°51'39.63"N	166°30'43.47"W	55	48.3	0.48	0.15	113	103	40	37	53	1.5	8.08	7.54
7	Kelty Field	53°51'22.56"N	166°30'18.18"W	54	47.8	0.8	0.35	109	104	47	41	59	not detected	7.95	7.66
8	Fish Ladder	53°51'15.23"N	166°30'22.70"W	52	47.6	0.73	0.05	116	101	39	32	50	not detected	7.71	7.6
9	Church Hole	53°52'30.67"N	166°32'10.81"W	-	50.1	-	0.54	-	99	-	292	-	-	-	8.18
10	Overland Dr.	53°51'0.92"N	166°28'42.21"W	47	43	0.27	0.03	101	100	50	48	69	not detected	7.01	8.1
11	Summer Bay Trib	53°51'41.70"N	166°26'36.01"W	-	43.9	-	0.00	-	110	-	45	-	-	-	7.74
12	Below Quarry	53°51'1.26"N	166°30'11.32"W	56	47.7	1.1	0.66	106	105	56	41	72	1.5	8.03	7.75
13	East Broadway Ave	53°50'56.23"N	166°30'11.74"W	48	45.3	0.18	0.00	105	103	39	34	45	not detected	7.38	7.67

Notes:

1) Water quality testing was conducted on 9/4 and 9/5 after a period of little-to-no rain, and then again on 9/19 and 9/20 after a short and light rainfall event. These results are presented under #1 & #2, where #1 is during the period with little-to-no rain, and #2 was after the short, light rainfall event. Total solids and total suspended solids were tested by a water quality lab, and were not tested during the second period.

2.0 Program Organization

2.1 Legal Authority

A Stormwater Management Program Plan is typically a required document under a Municipal Separate Storm Sewer System (MS4). An MS4 is under the NPDES (or APDES in Alaska) stormwater program and allows a community, meeting population and other criteria, to assume authority over their stormwater system instead of governance by the state. An MS4 requires acquiring an NPDES (or APDES in Alaska) permit, and development of an SMPP to prevent harmful pollutants from being washed by stormwater runoff into the MS4, and then discharged from the MS4 into local water bodies. Only communities with a population over 100,000, or an "Urbanized Area" (as classified by the Bureau of Census) fall under the MS4 category. Additionally, some communities outside of an "Urbanized Area" can fall under an MS4 if designated by the NPDES. Currently, only Anchorage and Fairbanks fall under a small regulated MS4; however the Matanuska-Susitna Borough is pursuing an MS4 with the State of Alaska.

This SMPP is primarily for planning purposes in bettering the water quality (specifically sediment) in the Unalaska Lake watershed. There is no legal authority above the general CWA requirements governing this project, and there is no actual legal requirement to implement this SMPP. The SMPP is not a new law or regulation. It will not require any new permits or approvals by the City of Unalaska.

2.2 Enforcement Policy

Currently there is no means or authority for the City to enforce this policy, except as it applies to the City itself. All projects should post and/or have all permits and approvals, including permit conditions, readily available for review upon request. If certain permit stipulations are not followed, anyone can report the perpetrator to the appropriate agency (storm water discharge – ADEC, filling of wetlands or other waters of the U.S. – U.S. Army Corps of Engineers). For example, if someone observes a person routing a substantial amount of water from their construction site into a stormwater conveyance system (such as a ditch or into a catch basin) or into a body of water, that person can call ADEC and report the complaint. Also, if someone witnesses a person filling in wetlands or waters or the U.S., they can contact the U.S. Army Corps of Engineers (USACE) to confirm that a permit has been issued for the project. The contact information for reporting such violations are displayed in Table 2-1. Additionally, violation forms can be found in Appendix A.

Table 2-1. Reporting Violation Contact Information

Agency	Concern	Phone Number	Address	Email	Violation Form
ADEC	Stormwater	(907) 269-7567	555 Cordova St, Anchorage, AK 99501	michael.charland@alaska.gov	http://dec.alaska.gov/applications/das/ecu/
USACE	Wetlands	(907) 269-7567	44669 Sterling Hwy, Soldotna, AK 99669	Cepoa-rd-kenai@usace.army.mil	http://www.poa.usace.army.mil/Missions/Regulatory/ViolationsandEnforcement.aspx
Alaska Wildlife Troopers	Safeguarding habitat	1-800-478-3377/ (907) 581-1432			

3.0 Public Education and Outreach

3.1 Training Program

In order to ensure a successful stormwater program, it is important to inform the community of its purpose and benefits. Many community members have already expressed an interest and concern for the degradation of the Unalaska Lake watershed due to sedimentation. Training the community in the proper best management practices and providing educational data to them should be done either continuously or on an annual basis. This can be done through brochures or the City of Unalaska website (available year-round) or through public outreach. An example would be making an informative flyer available to the public for information on site development and required procedures.

Additionally, Alaska Certified Erosion & Sediment Control Lead (AK-CESCL) training could be made available in Unalaska to encourage members of the community to take the class and become certified. The training and certification program was developed to enhance the compliance with the ADEC Construction General Permit (CGP) and stormwater discharge. Anyone working in the road crew or with the storm drains system should take this course and become certified.

3.2 Public Outreach

Public outreach for the SMPP has already been initiated through holding stakeholder meetings and gathering public comment for the creation of this plan. Although some forms of public outreach are already in use, future outreach and community involvement will be needed through the implementation of this plan and can be conducted in multiple ways.

3.2.1 Media Outreach

Media outreach, such as advertisements posted around town, recorded on the local radio station, printed in the newspaper, and posted on the public website have already been utilized for informing

the public regarding future meetings and regarding the outcome or information discussed in the meeting.

These measures can also be used, such as public service announcements, and informative signage and flyers, to inform the community on the importance of water quality in the watershed. Additional options could include special storm drain covers that state that it is leading to a stream, or a salmon stream (see Figure 3-1).

Figure 3-1. Storm Drain Cover "Leads to Fish Habitat" (Think Salmon 2006)

As the SMPP and its measures are decided upon and throughout the implementation process, the use of the radio, newspaper, brochures, and the City website should be used to inform the community and to gather input.

3.2.2 Educational Outreach

The community should be kept involved and informed on the overall program and plan, and they should be educated on the specifics of its implementation. This can be done through the aforementioned media outreach, such as publication of documents and allowing access to brochures and the information on the City website. Informative meetings can also be held to allow an interactive environment for the public to learn and ask questions.

Informative kiosks could be used throughout the watershed, such as along the bike path, to help inform the community on the importance of the watershed, how a stormwater system works, information on different stormwater structures (swales, ponds, sediment traps, etc.), and others.

Additionally, the SMPP information and the overall protection of the Unalaska Lake watershed should be discussed and taught to the young people in the community. Education can be accomplished through special curriculum topics, school visitations by engineers or people working with the stormwater system, and encouraging school projects related to the SMPP such as in a science fair. It is important to educate everyone in the community on the overall purpose of this program plan and its necessity to the health of the watershed. A good example is the Unalaska High

School which currently has a fisheries class that frequently spends time sampling and observing the Iliuliuk River, Unalaska Lake, and the watershed.

3.2.3 Implementation

Upon initial implementation of the SMPP restoration measures, an annual survey to the public could assist the City in assessing the success of the program.

Additional action could be made to implement some of the suggestions made within this SMPP by the addition of ordinances into the City code. A chapter could be added into Title 10 to address code regarding the storm drain system, as it is one of the only City utilities not mentioned. More detail could be added in Title 8, Chapter 8, Section 90 on buffer zones. Finally, specifics on BMP requirements could be added into Title 15.

4.0 Public Involvement and Participation

4.1 Public Review of SMPP

As discussed previously, the public has been invited to comment and make suggestions throughout the preparation of the SMPP. Three meetings have been held, and the draft document has been made public to educate and discuss the content of the plan and incorporate public comment. The final document will be made public as well, and a summary of this document was presented to the City Council on January 27, 2015. If future review of this SMPP results in changes to the plan, these should be added to the document as amendments.

4.2 Other Public Involvement Activities

During the preparation of this plan, public comment has been accepted and encouraged. Future public involvement will be necessary for implementation of this program and could greatly offset the cost of construction and other implementation measures required to achieve goals within this SMPP. Examples of this could include:

- Revegetation of aquatic grasses in Unalaska Lake
- Revegetation of shoreline grasses in eroded areas
- Stream cleanup day

5.0 Illicit Discharge Detection and Elimination

It is important to locate and eliminate pollutants discharging into the watershed, though difficult to do entirely. The source of the pollutant must first be identified in order to be treated appropriately or eliminated. In order to assist with illicit discharge elimination, many municipalities implement permitting and specific requirements prior to landowners connecting into the city stormwater system. For commercial projects and subdivisions, the Department of Public Works may require ADEC approved storm drain plans. The Department of Public Works currently outlines building permit guidance on the City website under Department of Public Works and Permits. For drainage,

it states, "Show the path of storm water on the property and drainage structures such as ditches, swales, and culverts. International Building Code (IBC) projects which significantly alter existing drainage may require an ADEC approved storm system plan and separator(s) prior to discharge to a public storm system". The City could adopt Appendix J (Grading) of the IBC into COU Tile 17 to regulate excavation and grading outside of their right-of-way, requiring Corps permits or wetland delineation for new development.

5.1 Identification and Inspection of Illicit Discharges and Illegal Connections

The City currently possesses survey data and a database of the city stormwater system. In order to determine any illicit discharges and illegal connections, the City must assess existing survey data, or obtain more, to determine if each private connection into the system is approved and site discharge from that location is appropriate.

In order to assess any potentially illegal connections, investigations must take place throughout the city. Personnel should assess current connections and ensure proper best management practices are in place prior to site runoff discharging into the City stormwater system.

City outfalls should all either be discharging into a treatment system, or should be treated appropriately prior to discharging into a water body. Private entities must treat their own stormwater prior to discharge into a public system, and they should not discharge site runoff in the form of an outfall into any water body without appropriate approvals. Additionally, COU Title 15 states that, for drainage from a business, "it is unlawful for an owner or operator of a filling station or other place of business, or any agent or employee thereof, to cause or allow water, grease, or other fluid to flow or drain into, upon, over or across any sidewalk, parking, street, alley, or other public way" (COU §15.36.030).

5.2 Spill Prevention and Response

If proper best management practices are not in place, and if sediment is deposited from a landowner's site, the landowner should be made responsible for cleanup with enforcement being established through City ordinance. An ordinance should be added to the City code within Title 15 to elaborate on responsibility, similar to §15.36.050 (Spilled Loads): "The owner or operator of any vehicle which has spilled, dropped, dumped, or in any manner deposited any matter upon a public place shall cause the public place to be cleaned immediately unless specific permission for delay is authorized by the Director of Public Words. Failure to clean the public place upon demand of the Director of Public Works shall make the owner or operator or both subject to the penalties of Chapter 15.48 of this title."

6.0 Construction Site Runoff Control

New construction can cause a large production and discharge of sediment into waters of the U.S. Appropriate permits and use of best management practices is required in order to protect from illicit

discharge. State and federal regulations already exist, but it appears compliance by private developments is limited.

New construction should require careful consideration of site runoff, including obtaining the appropriate permits, following required municipal codes, using appropriate best management practices, and following up with any necessary maintenance or inspections. To determine the necessary requirements that need to be followed, the entity doing construction must acquire a building permit and follow any required instructions. Reference the City's Department of Public Works website for more direction.

Additionally, discharges and volumes of stormwater must be calculated in order to determine the proper conveyance totals and amount of treatment. ADEC requires the following design events be calculated for the required treatment and/or conveyance. Table 6-1 displays which design event at what duration in the geographical area should be utilized for the treatment and conveyance discharge quantity calculation. Note that time of concentration is a separate calculation that considers the amount of time it takes for the water to percolate into the underlying soil. Table 6-2 displays which year and duration should be used for calculating volumes for treatment, retention, and conveyance. A good guideline, which is used by the Municipality of Anchorage (one of the two MS4s in the state), from the Municipality of Anchorage Project Management and Engineering Design Criteria Manual, suggests the sediment storage volume be twice the anticipated one-year accumulation. The annual sediment yield for commercial and industrial areas is approximately 15 ft^3/acre and 23 ft^3/acre, respectively. Annual sediment yield for residential areas ranges from 1.3 to 3.2 ft^3/acre (MOA 2007).

Table 6-1. Discharge calculation for ADEC treatment and conveyance

	Design Event (Year)	Duration
ADEC Treatment	2	Time of concentration
Conveyance	10	Time of concentration

Table 6-2. Volume calculation for ADEC treatment, retention volume, and conveyance

	Design Event (Year)	Duration
ADEC Treatment	2	6 hour
Retention Volume	1	24 hour
Conveyance	10	24 hour

6.1 Required Permits

Any new construction may require a permit. Projects occurring in wetlands would require a USACE permit under Section 404 of the CWA. A "wetland" is defined by the USACE and the EPA as "Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation

typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (Environmental Laboratory U.S. Army Corps of Engineers 1987).

Any project causing over one acre of disturbance and discharging to waters of the U.S. would also need to attain coverage under the Construction General Permit (CGP) issued by ADEC under the APDES. This would involve the submittal of a Storm Water Pollution Prevention Plan (SWPPP) to the Alaska Department of Conservation (ADEC) detailing measures (such as use of best management practices) that would be taken to ensure that temporary and permanent stormwater runoff from the project would not negatively impact waters of the U.S. The general permit must be prominently displayed in the project site and included information on where to find the SWPPP.

A full checklist of permits required for specific projects mentioned in this SMPP can be found in Appendix B.

6.2 Appropriate Use of BMPs

Construction sites commonly include the use of heavy equipment and involve large areas of exposed soils which both contribute to the risk of pollutants reaching the surrounding environment, especially during rain events. Best management practices, or BMPs, have been developed to both reduce and contain contamination from flowing downstream. To be most effective, BMPs should be installed prior to disturbing the project site. As sediment, pollutants, and other debris are collected, maintenance is required to clean and prolong the effective lifespan of the BMP. Different types of BMPs used to control construction site runoff are described below.

For supplementary information, reference the 'Alaska Storm Water Guide', which is a comprehensive manual developed by ADEC to aide in effective management and treatment of stormwater. This document provides general guidance specific to Alaskan conditions and summarizes the implementation of stormwater BMPs. Some of these BMPs are discussed below.

Straw Wattles are used to reduce flow velocity while filtering out suspended sediments. Straw wattles utilize wheat straw as the filter material which is wrapped with jute netting to create a typical 12-inch diameter roll. Straw wattles are commonly staked into position along swales and side slopes where water runoff is anticipated. Wattles are placed perpendicular to the slope, and are often installed in series to act as check dams to reduce flow velocity which further decreases downstream erosion. Straw wattles are used as a temporary BMP, and may require maintenance or replacement depending on runoff and sediment loading. Straw wattles are displayed in use in Photo 6-1 along with other BMPs.

Photo 6-1. Silt Fence, Straw Wattles, and Seeded Slopes in Use at City Stockpile

Inlet Protection uses a permeable fabric barrier to physically retain debris and sediments while allowing clean water runoff to enter storm drain structures. There are many inlet protection products that are designed for specific applications and to be used with differing stormwater structures. Inlet protection, such as the Imbrium Jellyfish filter or witch's hats, can be very effective at removing eroded and suspended sediments from runoff waters, which will protect the downstream water quality. Inlet protection should be applied to storm drain structures in the project vicinity, including culverts, catch basins, and curb inlets. Inlet protection used during construction projects are usually temporary; although permanent inlet protection products may be specified. One example of inlet protection is a "witch's hat", shown in Figure 6-1. These are placed at an inlet drain and are constructed out of a permeable geotextile that allows water to pass through, but prevents silt and other sediments from entering into the system.

Figure 6-1. Witch's Hat Installation (Williams-Villano 2013)

Silt Fences also utilize a fabric, or geotextile, barrier to filter out sediments. Silt fences are commonly placed around the project perimeter to encapsulate the potentially contaminated runoff within the project area. Silt fences can also act to create ponding which allows the sediments to settle out before flowing downstream. Proper installation is very important in achieving an effective silt fence. Silt fence placement typically runs perpendicular to the slope, similar to straw wattle placement. Silt fences are temporary BMPs, and require frequent maintenance due to heavy stormwater and sediment loading. Photo 6-1 displays multiple BMPs in place, including silt fences, below the City's gravel stockpile.

Sediment Basins are temporary ponds ordinarily constructed at the downstream end of a construction site which collect and detain stormwater runoff for a long enough duration to allow settlement of suspended sediment (see Photo 6-2). The clean stormwater runoff will either infiltrate into the pond bottom or will continue to the basin outfall and continue as channelized flow. For smaller drainage areas, typically less than five acres, a sediment trap may be used which shares the same functionality as a basin, but for smaller flow rates and volumes. Sediment basins/traps are simple and effective measures to reduce sedimentation and turbidity particularly related to runoff from exposed soils and excavated areas. Sediment basins/traps are temporary BMPs, whereas detention and retention ponds are permanent stormwater structures which satisfy the same purpose and function.

Photo 6-2. Sediment Basin at Ugadega Quarry

6.3 Specifications, Provisions and Notes

All plans for new construction with over one acre of disturbance should include specifications, provisions, and notes regarding required sediment controls. Sediment controls may include required BMPs, a SWPPP, and any discussion on required inspections of the control structures.

6.4 Inspections

In order to enforce the regulations in place by the APDES and associated permits, inspections should take place to ensure proper BMPs are in use, and permit stipulations are followed. Since ADEC has little agency enforcement in Unalaska, public involvement plays an important role to identify and report any unlawful discharge to the appropriate agencies. Any observed violations to these permits, or the lack of acquiring a required permit, can be reported to the appropriate permitting agency: ADEC for stormwater, or USACE for wetlands and filling of water bodies. Contact information was provided in Section 2.2.

7.0 Post-Construction Stormwater Management in New Development and Redevelopment

In addition to new or ongoing construction, events occurring post-construction and certain maintenance procedures can present or create large amounts of exposed soil leading to erosion and discharge of sediment into water bodies. The City of Unalaska can take part in overseeing these smaller projects through use of the following:

- Development and implementation strategies for structural and nonstructural BMPs.
  - Requirements for specific BMPs for specific development
- Development of ordinances to address post-construction runoff.
  - Requirements for buffer zones around development
  - Requirements for leaving temporary BMPs installed for a certain period of time
  - Seeding requirements for bare slopes (or gravel for flat areas)
- Requirements for construction site owners and operators
  - Use of BMPs and maintenance
- Requirements for adequate long-term operations and maintenance of structural stormwater improvements.
  - Requirements for frequent maintenance of stormwater structures as removal of sediment and debris will improve the structures' performance and increase downstream water quality. For grit separators, suggest:
    - A minimum of two cleanouts per year, one following the snow melt season and one prior to winter
    - Annual inspection and corrective action as necessary for damage, including reduced capacity, corrosion, settling, and other factors that may compromise effectiveness
  - If the site and stormwater discharge location are on private land, the owner and/or operator must ensure proper treatment prior to discharge into City water systems or a water body.
- Conduct site inspections.
  - Site inspections at ongoing construction projects (and permanent installations) should be enforced to verify proper use, placement, and maintenance of BMPs and stormwater structures.
- Track all known permanent stormwater facilities that discharge into the City's system or water body.
  - By identifying upstream discharge sources, stormwater structures can be properly sized and maintained to improve effective treatment and conveyance of stormwater.

8.0 Municipal Operations and Maintenance

8.1 Training

The City of Unalaska's road maintenance crew should be kept informed on any adjustments to the current operations and maintenance procedures. If changes or adjustments are made, the road crew should be trained and educated accordingly. The result of this SMPP and its information should be communicated with anyone involved in the stormwater system and other affected facilities.

Additionally, it would be helpful for the Roads crew to go through AK-CESCL training that discusses erosion and sedimentation processes, regulatory requirements, SWPPPs, BMPs, inspections, record-keeping, and cold weather challenges.

8.2 Debris Control BMP Program

The City of Unalaska has already taken part in reducing excess sedimentation and controlling and treating stormwater runoff into Unalaska Lake. They have paved roadways around the watershed and installed numerous sediment traps to pull out excess sediment before discharging into the lake. In addition to the permanent construction practices, the City sweeps the paved roads for sediment and performs maintenance on the existing storm drain system.

8.2.1 Street Sweeping and Storm Drain Cleaning

8.2.1.1 Street Sweeping

Fairly recently, the City has begun paving many of their roads within town; however, many side roads are gravel. This gravel easily gets picked up in tires and deposited onto paved roadways. The City currently sweeps the paved roads and disposes of the gravel either at the landfill stockpile or the Department of Public Works' yard stockpile area.

During the winter, gravel is used on top of snow on the side roads for traction control. Like the rest of the year, the gravel falls down along (or into) the river and lake. During plowing, this snow filled with gravel is sometimes plowed into the river and/or lake. Care should be taken to ensure snow is not plowed or deposited along banks of the river or lake where, during breakup, the snow will melt and create a concentrated source of gravel and sediments that may end up in the stream or lake. Photo 8-1 displays City Roads crew cleaning up gravel at an old snow dump above the river with silt fences in place.

Photo 8-1. City Roads Crew Cleaning up Gravel from Snow Dump

Options for preventing unnecessary deposition of gravel could include training City maintenance crews to drive slower over bridges to ensure snow and associated gravel are not plowed into the stream, and requiring snow plowing operations near the water bodies to gather the snow and transport it to a snow dump area away from the water bodies. Additionally, the City could make an addition to City ordinance Title 15, Chapter 36. Currently under COU §15.36.090, snow placement in public ways is prohibited. The City could add language stating that it is also prohibited to place plowed snow within a specified buffer zone of a water body.

8.2.1.2 Storm Drain Cleaning

Maintenance of the storm drain system is necessary in order to ensure it functions properly. If grit separators are not cleaned out, sediment-laden runoff may enter the structure and bypass the separator, discharging the sediment into the water body. This can also occur if the separator is not sized appropriately for annual heavy rainfall events. This was observed during the site reconnaissance at the outlet of the stormwater system originating from the intersection of Overland Drive and E Broadway Avenue. The system crosses under E Broadway Avenue, enters (or bypasses) a separator and is discharged into a swale. This runoff then crosses under the bike path and discharges at a point adjacent to the Iliuliuk River. See Photo 8-2.

Photo 8-2. Sediment-Laden Stormwater Discharge

Additionally, sediment basins should be cleaned out and inspected to make sure they are functioning correctly on a bi-annual and an as-needed basis (such as after large storm events).

Currently the City Roads Division does not have a dedicated vacuum truck which is necessary to clean out the separators. The Roads Division shares the truck with the Public Utilities Sewer Division, so use has to be coordinated, and the truck isn't always available when needed. Photo 8-3 displays the City Roads crew cleaning the storm drain system near the 5th Street Bridge.

Photo 8-3. City Cleaning Storm Drain with a Vacuum Truck

8.3 Erosion Control BMP Program

Erosion is a key factor in the deposition of sediment into the lake. Sources of erosion must be identified in order to remediate the problem. Various options are available for mitigation and protection of downstream water bodies from sediment.

8.3.1 Erosion and Sediment Control BMPs

Swales are a vegetated channel that collects and channelizes stormwater runoff (see Photo 8-4). The vegetation acts as a filter to remove sediment and pollutants as well as to slow water velocities down as water flows through the channel. Some of the runoff will infiltrate into the ground, and if the swale is designed appropriately, the remainder of the water will be filtered prior to the downstream collection or discharge location. During winter, and prior to snow melt, swales are full of snow, and can oftentimes have ice on the bottom, blocking infiltration. Maintenance of swales is very difficult in Unalaska due to the winter conditions that typically consist of alternating snow and rain/thaw events, which leads to ice buildup.

Photo 8-4. Swale Adjacent to Bike Path

Vegetated slopes Exposed soil is a target for erosion. Adding vegetation to the soil face can protect the soil through binding it with a root system and creating a filtration system along the face of the slope. This is often done after a construction project, and can be done through hydro seeding. The City of Unalaska uses jute fabric to protect bare slopes, and uses a specialized seed mix for the region from Alaska Garden & Pet Supply, Inc. for much of their seeding projects. Additionally, a special mix is often used by the City in areas with high gravel content, or along the beach.

Jute Fabric is comprised of vegetable fibers that are spun into threads and woven to create a blanket. This biodegradable fabric is commonly used as a temporary erosion-control blanket that is placed on newly seeded areas. The open mesh style allows light and water to pass through to encourage the growth of vegetation underneath while stabilizing the earth to prevent erosion. Long-term and permanent erosion control blankets can also be considered where appropriate.

Outlet Protection is used at the outlet of a pipe or culvert to prevent soil scour by reducing high flow velocities to non-erosive levels. Depending on the design intent, outlet protection can be either a temporary or permanent BMP. Commonly used during construction projects, temporary outlet protection consists of a riprap apron placed at the downstream end of a culvert, channel, or bypass to reduce flow velocities and scour potential. Permanent outlet protection may use a similar apron constructed out of rock, concrete, or articulating concrete blocks. A riprap apron is shown just above the swale in Photo 8-4.

The City has also recommended an engineered outfall at storm drain system outlets. This would consist of the outfall discharging above another pipe or manhole allowing any remaining settleable solids to collect into this basin instead of the water body. The City has one of these currently in use at the 5th Street Bridge. See Photo 8-5. These could also be used to captures sediments released when jetting culverts during maintenance procedures.

Photo 8-5. Engineered Outfall at 5th Street Bridge

Settling basins collect and retain stormwater runoff from the outlet of a swale, and function similarly to swales as they help filter out sediment and pollutants as the runoff infiltrates into the ground.

Detention and retention ponds can also be used to decrease erosion by storing water for a period of time. Both types of basins are excavated and/or depressed areas, or constructed above ground with berms, near a water body and are designed to store water. These ponds also assist with controlling discharge into the nearby water body by storing water during peak flows and releasing at a slower rate into the stream. Some basins are designed to only hold water for a short period and are

considered "dry" (detention ponds), while others (retention ponds) are designed to retain water for an extended period of time as a manmade pond.

Oil and grit separators are a mechanical type of treatment. As stormwater flows through the device, the large sediment sinks to the bottom and any oil present floats to the top and is collected. Separators are typically located after the outlet of a stormwater basin and prior to delivery into a storm drain network. They require maintenance to remove any captured oil or grit from the structure to continue to function. As previously mentioned, if they are not maintained, or if the rain event exceeds the design structure size, stormwater will bypass the separator and pollutants will continue into the storm drain network or to an outfall. In the Unalaska Lake watershed, these devices are primarily used as grit separators and may also be referred to as sediment traps.

There are various types of configurations of separators that are used to achieve removal of site specific pollutants and sediment. These include large concrete vaults with chambers or baffles (API Type Separator), and circular systems that use centrifugal force to separate out oil and grit (coalescing media separators).

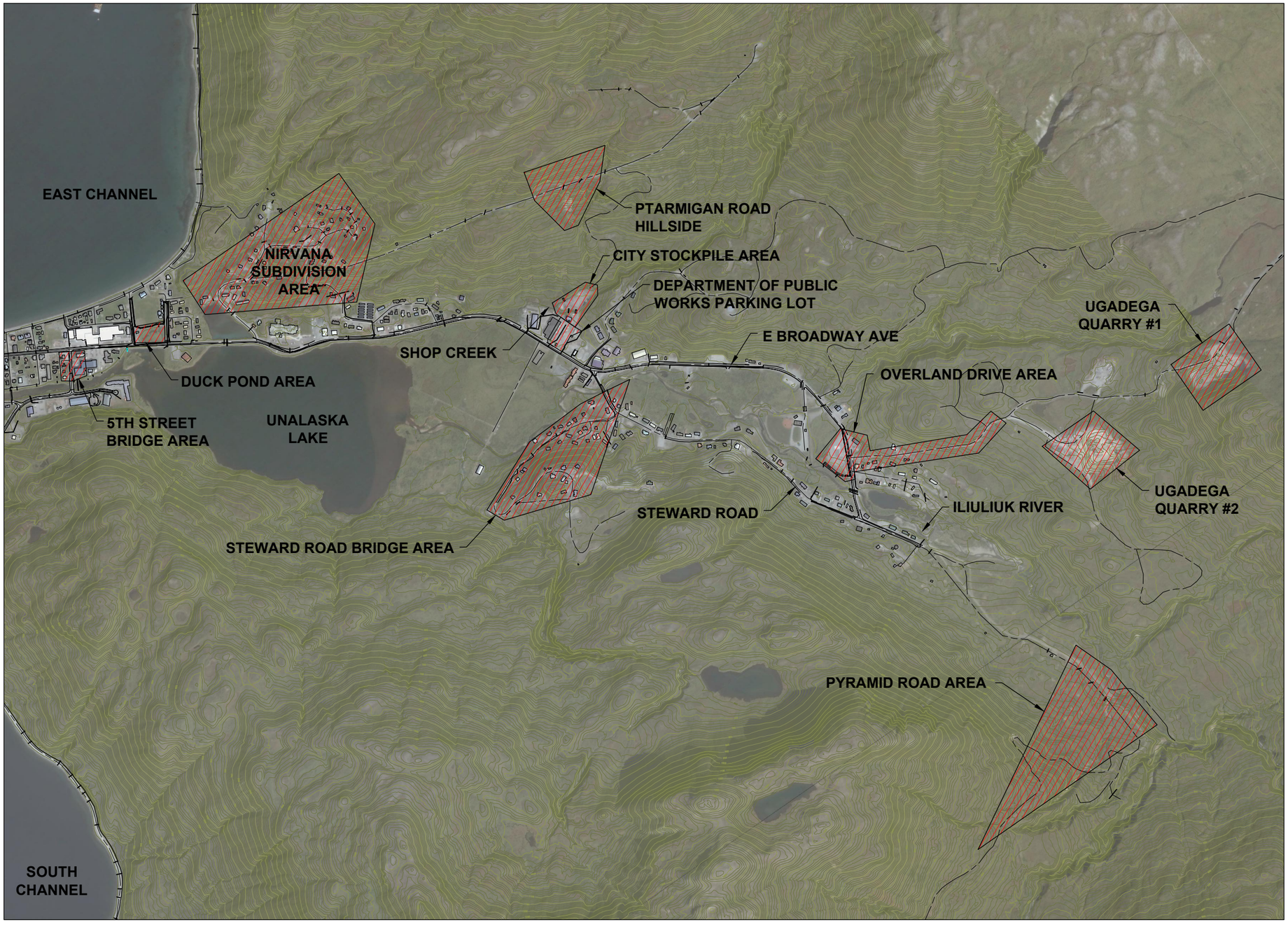
8.3.2 Identification of Erosional Areas

Based upon preliminary water quality testing and general site evaluations, the following locations have been identified as having a notable impact on the erosion and sedimentation issues within the Unalaska Lake watershed. These are shown in Figure 8-1, and it should be noted that this is not an all-inclusive list.

Ptarmigan Road Hillside appears to have soil erosion and slope stability concerns both above and below the roadway. The area of interest is situated approximately 0.8 miles up Ptarmigan road from the E Broadway Avenue intersection. The hillside ranges between a 30-40% slope, and continues another 900 feet towards the ridgeline of Mount Newhall. Eroded side slopes are visible along approximately 750 feet of roadway and contribute to approximately 1.5 acres of eroded and exposed native soils. Erosion and sedimentation associated with this site can be attributed to the eroded areas connecting with a drainage that flows into the west side of Unalaska Lake.

Nirvana Subdivision contains approximately 35 residences and is situated between Unalaska Lake to the west and Mount Newhall to the east. The subdivision rests on a slope ranging from 10-20%. The existing storm drain system consists of driveway culverts and roadside ditches that direct water towards multiple culvert crossings at Dutton Road before outfalling into the eastern portion of Unalaska Lake that is separated by E Broadway Avenue. Approximately 0.85 miles of gravel road surfacing is the primary source of sediment for this location.

Steward Bridge Area contains approximately 50 residences and is situated on the hillside south-southeast of Unalaska Lake. The subdivision rests on a slope ranging from 10-20%. The existing storm drain system consists of a few culverts, although the majority of runoff is conveyed by roadside ditches and swales that outlet into the Iliuliuk River which flows into the south side of



N

600 0 600 1200 1800 FT

LEGEND

- IDENTIFIED EROSION AREA
- EXISTING SWALE
- EXISTING DRAINAGE STRUCTURES

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STORMWATER MANAGEMENT PROGRAM PLAN
EROSION AREAS OVERVIEW

FIG 8-1

Unalaska Lake. Approximately 1.5 miles of gravel road surfacing serves as the primary source of sediment for this location.

Another source adjacent to this area is lower Steward Road. Along a 1,000 foot length of Steward Road that runs south from the Eagle Drive intersection, a swale directs stormwater runoff east towards Iliuliuk River. This swale is vegetated with native grasses and appears to be in satisfactory condition. The southernmost swale discharges into a settling pond which collects sediments prior to discharging into the nearby Iliuliuk River.

Overland Drive is a gravel road of over 10% grade that extends southeast from the intersection with E Broadway Avenue. The area of interest includes a 1.4 acre parcel on the northwest side of the intersection and continues for 0.3 miles along Overland Drive. A stormwater conveyance ditch runs along the northern slope of Overland Drive intercepting multiple natural drainages down to the intersection and is piped southwest, adjacent to E Broadway Avenue where it is deposited into the Iliuliuk River. The existing drainage ditch experiences high water volumes and flow velocities which contribute to accelerated erosion.

Ugadega Quarry #1 is the easternmost quarry, located approximately 0.85 miles southeast along Overland Drive. The site consists of approximately 6 acres of exposed native soils and is located on a steep slope ranging from 30-50%. The quarry slopes towards the adjacent drainage that runs down to Unalaska Lake. Due to the large area of exposed soil and close proximity to a stream, there is a high sedimentation potential associated with this area. Currently, BMPs such as silt fences, settling ponds, and straw wattles are implemented at the site to capture sediments and reduce erosion potential.

Ugadega Quarry #2 is located approximately 0.4 miles southeast along Overland Drive. The site consists of approximately 6.3 acres of exposed native soils and stockpiles and is located on a slope ranging from 10-20%. A small stream appears to develop at the downhill side of the quarry and continues until it joins the larger tributaries leading towards Unalaska Lake. This stream's water quality was sampled and was presented earlier. Due to the large area of exposed soil and close proximity to the stream, there is a high sedimentation potential associated with this area. Currently, BMPs such as silt fences, settling ponds, and straw wattles are implemented at the site to capture sediments and reduce erosion potential.

Steward Road in the Unalaska Valley connects the south end of E Broadway Avenue and Pyramid Creek Road by traversing the Pyramid Peak pass. Approximately 1,800 linear feet of channel length leading down to E Broadway Avenue experiences deep channel cutting and bank erosion during large storm events (see Photo 8-6). This channel merges with the Iliuliuk River after crossing E Broadway Avenue and continues to flow towards Unalaska Lake. The channel slope averages 20% along the area of interest. The steep slopes and loose soils are subject to considerable erosion due to high flow velocities developing during rainstorms. Following onsite inspection of the local erosion characteristics, it is assumed that this area is a significant (and perhaps the most

significant) contributor to sediment deposits in Unalaska Lake during large storm events, but otherwise appears to be stable during more typical storms.

Photo 8-6. Steward Road Unalaska Valley Area Channel Erosion (photo courtesy of Abi Woodbridge)

Stockpiles have also been associated with erosion and substantial sediment loading. One stockpile is located behind the Department of Public Works building and adjacent to Shop Creek which flows into the eastern side of Unalaska Lake. A stockpile is just an exposed mound of sediment and could potentially be eroded and gravel transported into down gradient water bodies; however, the City has applied multiple types of BMPs (as shown in Photo 6-1) to mitigate sedimentation into Shop Creek and eventually the lake. Another stockpile (not on City property) is located adjacent to E Broadway Avenue on the former "Duck Pond Lot", as shown in Photo 8-7.

Photo 8-7. Stockpile on Former "Duck Pond Lot"

City Department of Public Works Parking Lot The Department of Public Works' parking lot appears to be a significant source of sedimentation. High activity levels of large vehicles driving over the lot pulverizes the soft gravel and creates a find powder that is easily transported with surface runoff into the storm drain system.

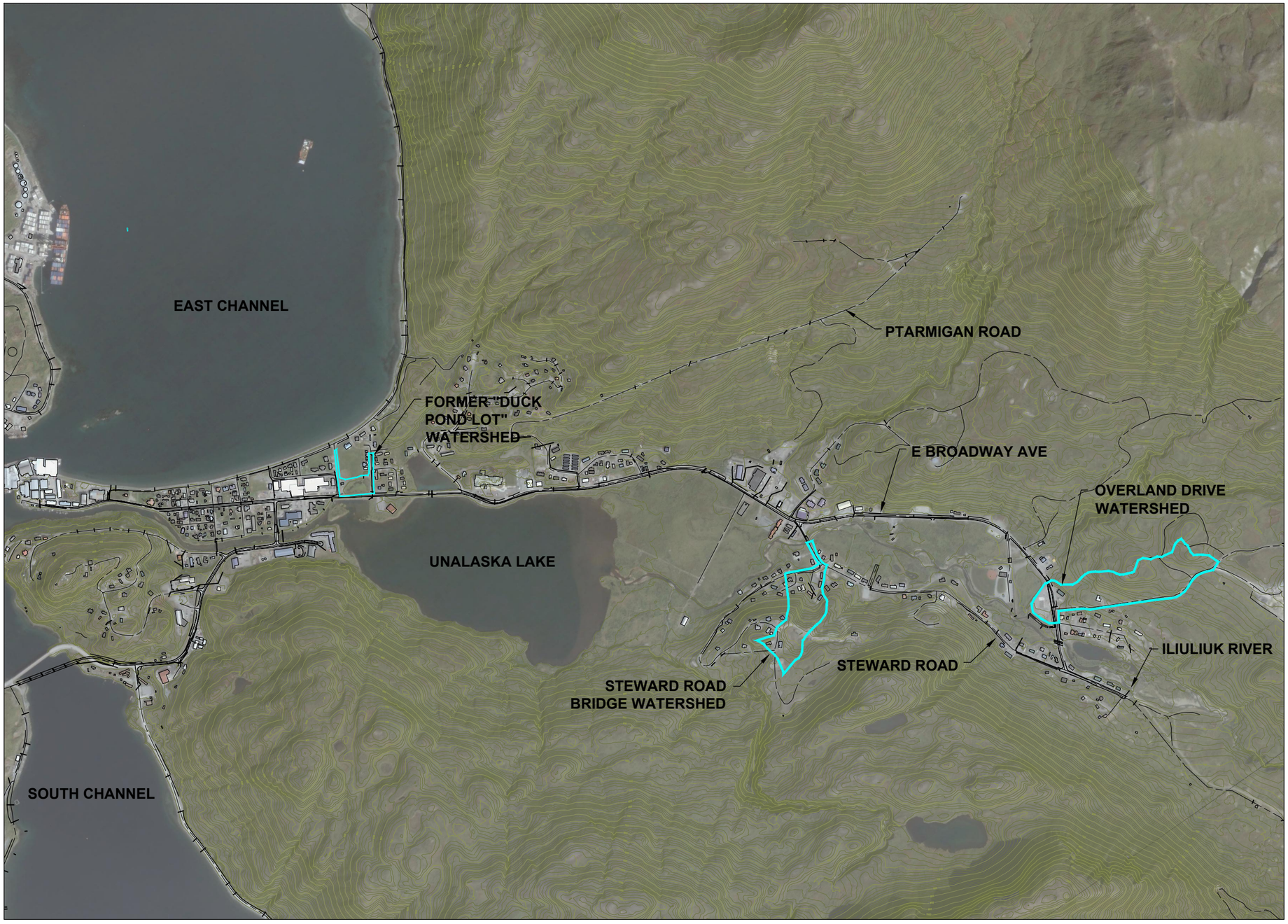
The Former "Duck Pond Lot" was once part of Unalaska Lake, but was cut off by the World War II era roadway. Recently, the separated pond area was filled in with gravel by private landowners and is now used as parking/storage area. This lot sees sediment-laden runoff from both King Street and Armstrong Court. Both gravel streets run on either side of the lot with little-to-no ditching along their edges.

8.3.2.1 High Priority Erosional Areas

A few areas were identified as being key sources of sediment, and prioritized for implementation using grant funding during 2015. These are shown in Figure 8-2 with their delineated watersheds.

1) **Overland Drive** has been identified as a high priority area due to sediment loading associated with pulverized gravel from commercial truck traffic from the quarry and its overloaded ditch and check dam system with associated sediment loads discharging into Iliuliuk River. The existing swale along on the north side of Overland Drive collects water from multiple streams and conveys it alongside the road to the intersection of E Broadway Avenue (shown in Photo 8-8). At the intersection, gravel gabion check dams were installed as erosion control devices to reduce water velocities and allow ponding for settlement. The runoff water is then collected into a culvert where it is piped underneath E Broadway Avenue to a sediment separator and bypass system which outfalls into a swale. This swale acts as final treatment of surface runoff before it reaches Iliuliuk River. This was displayed in Photo 8-4. The delineated watershed for this source is shown in Figure 8-3.

Photo 8-8. Overland Drive/East Broadway Avenue Intersection



N

600 0 600 1200 1800 FT

LEGEND

- WATERSHED DELINEATION BOUNDARY
- EXISTING SWALE
- EXISTING DRAINAGE STRUCTURES

P N D
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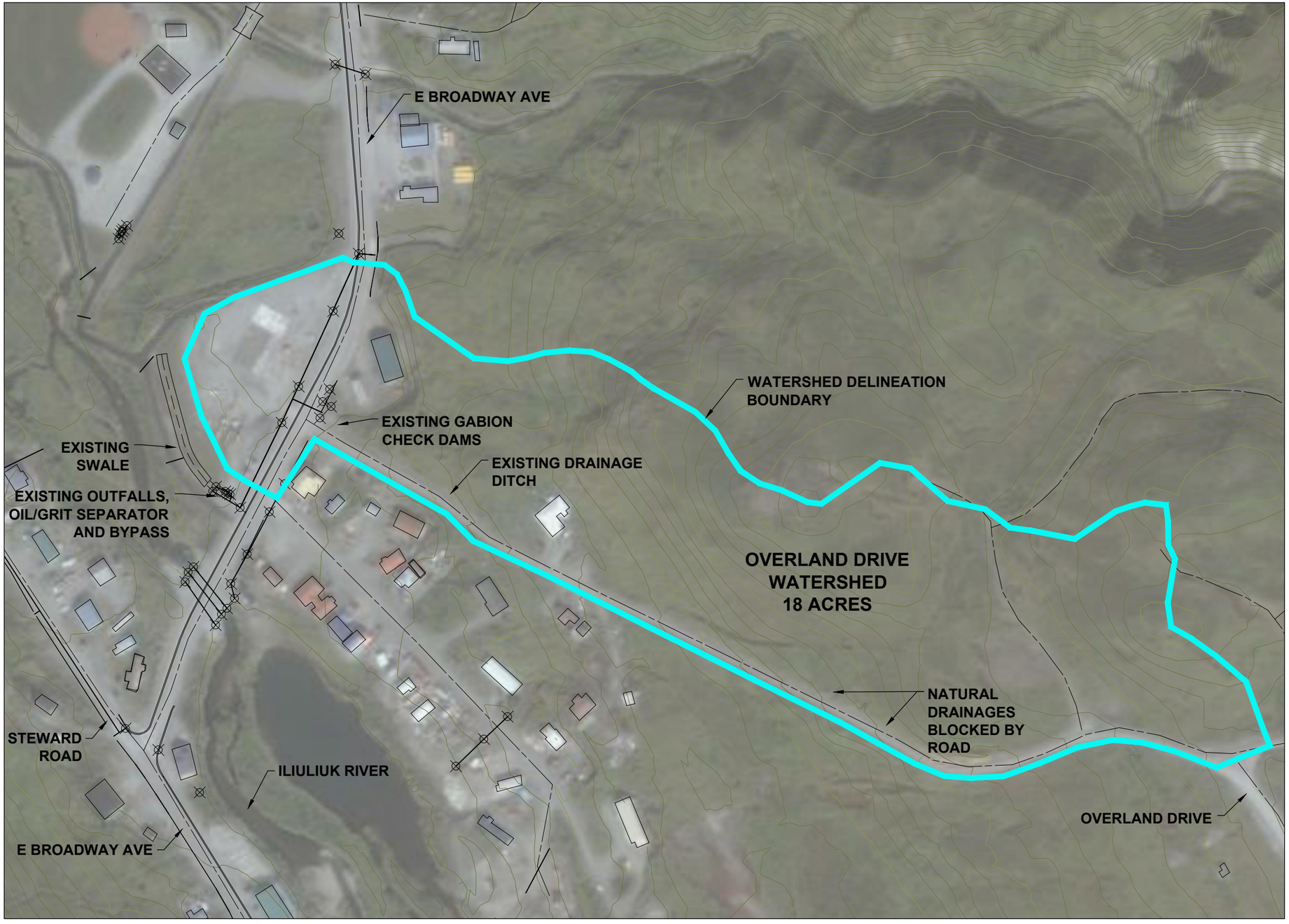
STORMWATER MANAGEMENT PROGRAM PLAN
PRIORITY EROSION AREAS OVERVIEW

FIG 8-2



N

100 0 100 200 300 FT

LEGEND

- WATERSHED DELINEATION BOUNDARY
- EXISTING SWALE
- EXISTING DRAINAGE STRUCTURES
- STORMWATER INLET/OUTFALL STRUCTURE

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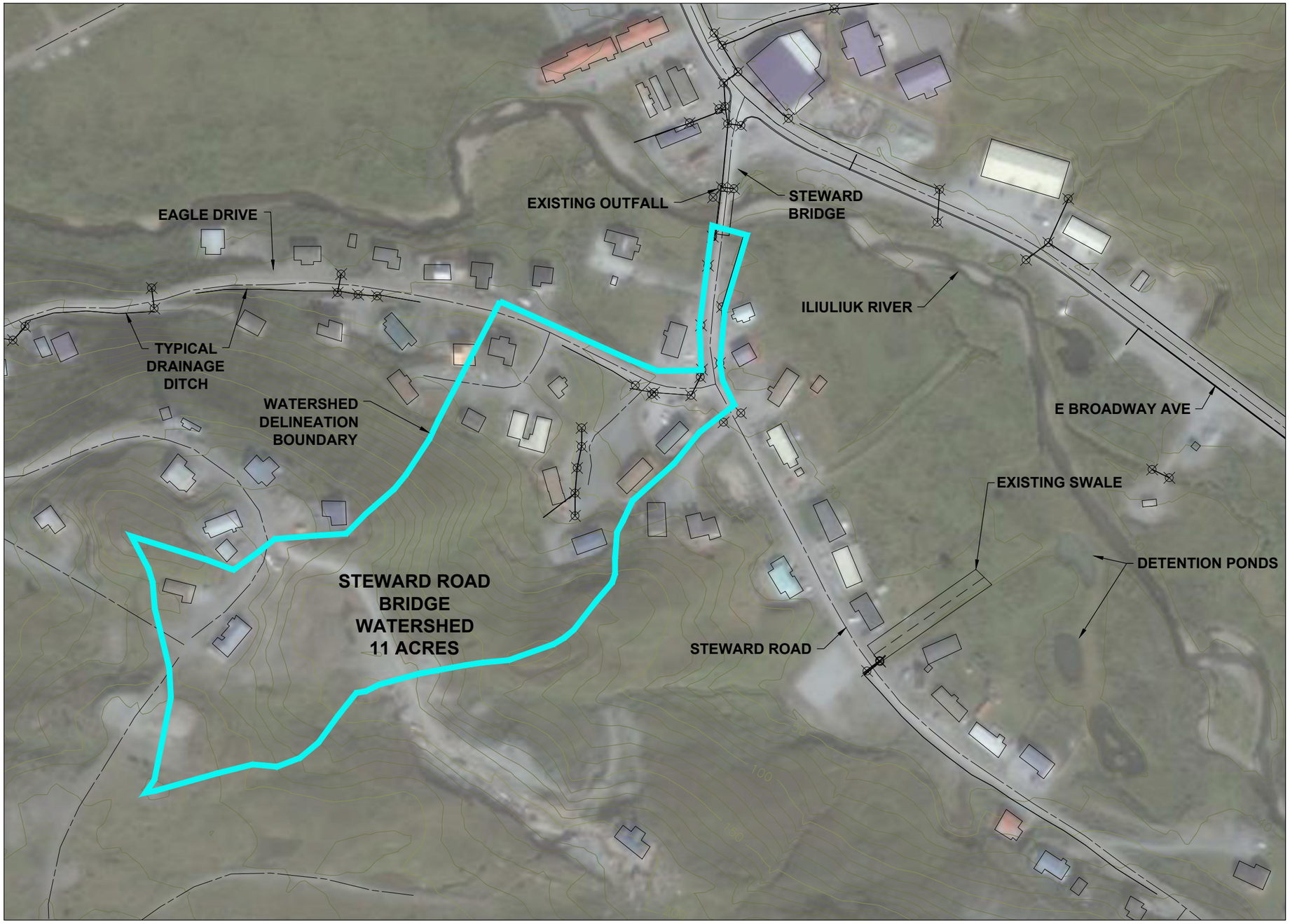
STORMWATER MANAGEMENT PROGRAM PLAN OVERLAND DRIVE WATERSHED

FIG 8-3

2) **Steward Road Bridge Site** has been identified as a high priority area due to the steep gravel roads being in close proximity to Iliuliuk River and Unalaska Lake. Sediments are washed away as stormwater flows down the hillside, across gravel roads, and other exposed soil areas. Aerie Drive lacks culverts and ditches to properly control stormwater runoff down to Eagle Drive and Steward Road. Both Eagle Drive and Steward Road have roadside ditches and culverts to convey stormwater towards Iliuliuk River. There are no existing separators associated with this site. See Figure 8-4 for the Steward Bridge site area.
3) **The Former "Duck Pond Lot"** is the area in between Armstrong Court and King Street along Broadway Avenue. This lot is privately owned, but surrounded by City property. The land used to be connected to Unalaska Lake, but was separated by roadway circa World War II. In early 2014, a USACE permit was acquired by the private landowner for this lot, and associated wetlands, was filled in. See Photo 8-9 and Photo 8-10 for photos of some issues along these roads, including turbid water running towards the City storm drain system along King Street, and noted erosion from surface runoff at the intersection of King Street and E Broadway Avenue bordering the Duck Pond lot. This area is shown in Figure 8-5.

Photo 8-9. Sediment-Laden Runoff in King Street Ditch (looking northeast from Duck Pond Lot)



N

100 0 100 200 300 FT

LEGEND

- WATERSHED DELINEATION BOUNDARY
- EXISTING SWALE
- EXISTING DRAINAGE STRUCTURES
- STORMWATER INLET/OUTFALL STRUCTURE

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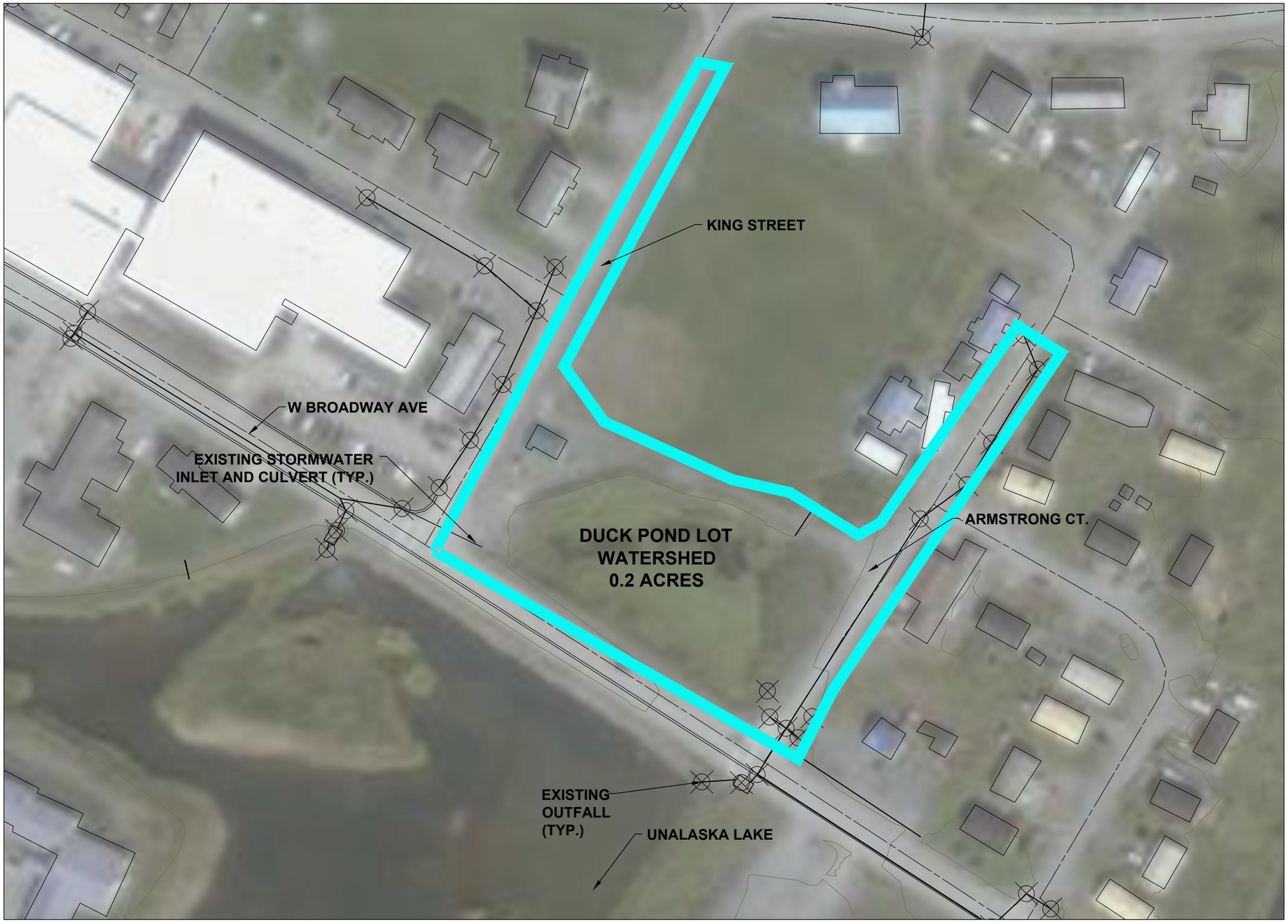
STORMWATER MANAGEMENT
PROGRAM PLAN
STEWARD ROAD BRIDGE WATERSHED

FIG 8-4



N

50 0 50 100 150 FT

LEGEND

- WATERSHED DELINEATION BOUNDARY
- EXISTING DRAINAGE STRUCTURES
- STORMWATER INLET/OUTFALL STRUCTURE

PND ENGINEERS, INC.

STORMWATER MANAGEMENT PROGRAM PLAN
DUCK POND WATERSHED

FIG 8-5

Photo 8-10. King Street/E. Broadway Intersection Culvert and Noted Erosion

8.3.3 Remediation Measures

Various remediation measures were identified for the three high priority erosion areas. These watersheds were delineated, as shown in the associated figures, and drainage calculations were completed. Drainage calculations, including design discharges and volumes, are displayed in Appendix C.

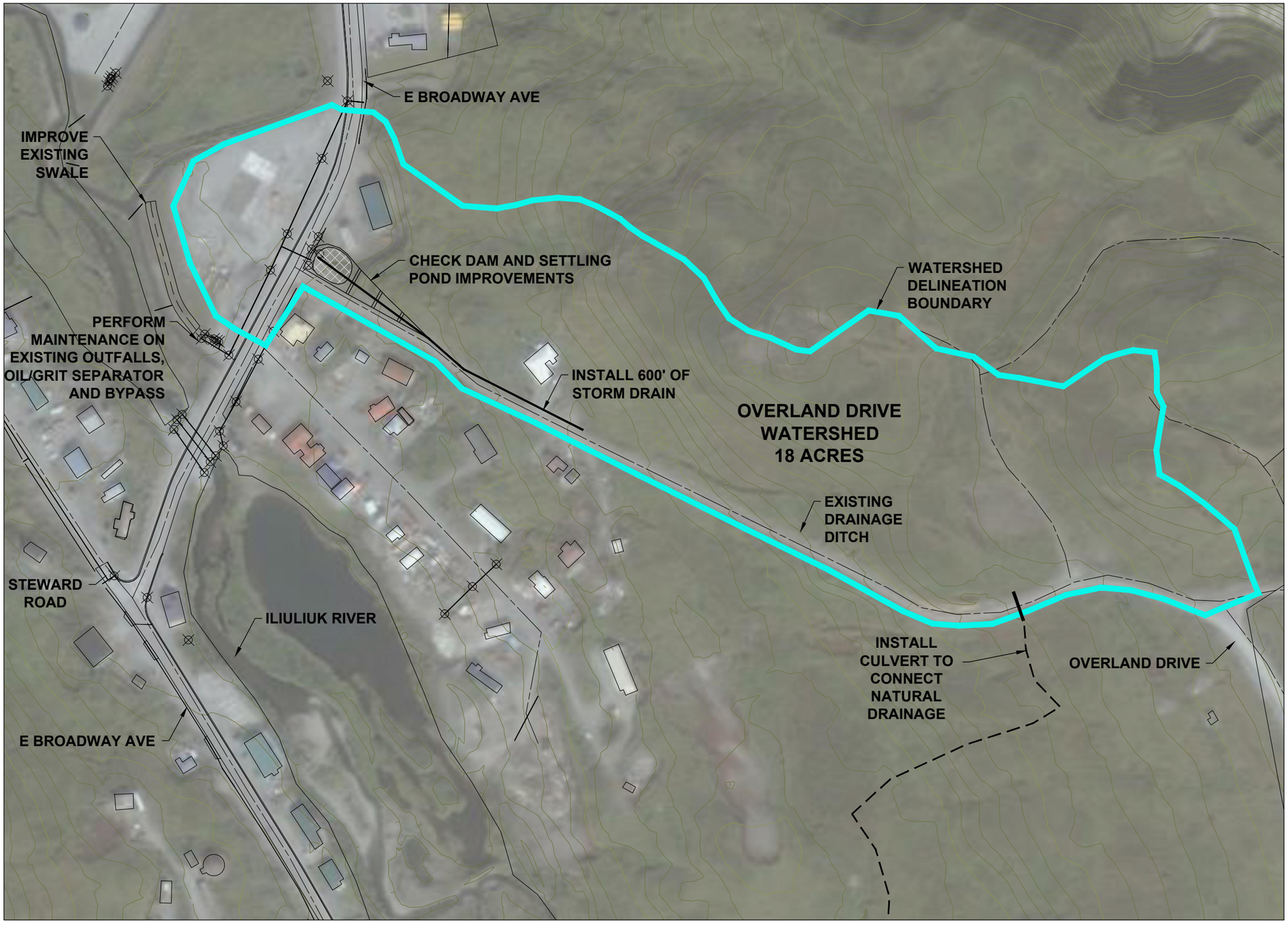
1) **Overland Drive** The efforts to reduce erosion and sedimentation include improvements to the first 1,600 feet of Overland Drive, the erosion control structures at the intersection with E Broadway Avenue, as well as the treatment and outfall structures. These are described below and displayed in Figure 8-6.
    a. Paving of Overland Drive would be one of the most effective measures to reduce sedimentation in the area below by eliminating a large source (gravel surfacing).
    b. A couple natural drainage paths have been identified along the project site that have been intercepted by the drainage ditch and could possibly be rerouted through their natural channels away from the Overland Drive and E Broadway Intersection. By providing culvert crossings for one of these drainages in particular, the natural stream hydrology will be restored while reducing runoff loading on the downstream stormwater structures. The culvert should be appropriately sized for the anticipated flows. Catchments and rock apron outlet protection may be used to dissipate flow energy and reduce erosion potential. This drainage should be connected to its

historical channel path, where existing vegetation will act as a natural filter for stormwater.

c. Improvement and routine maintenance of the existing check dam/baffle system at the intersection of Overland Drive and E Broadway Avenue will improve sediment collection and increase the performance of the erosion control structures. Depending on land owner status, appropriate space may be available for the design and installation of a settling basin or a manhole catch to further decrease sediment output to Unalaska Lake.
d. The existing separator and bypass system should be inspected and maintained to ensure proper treatment is achieved. The separator discharges into a swale which should also be inspected and maintained. Improvements should be addressed if any deficiencies exist, which may include revegetation and slope stabilization.
e. Improve the vegetated swale system below the separator to include more vegetation and a check dam system with gabion baskets and/or coir logs.
f. Another option is to install 600-feet of storm drain and catch basins at the bottom of Overland Drive beginning near the intersection and running uphill towards the quarry. A storm drain would assist in keeping roadside sediment out of the drainage system by conveying water through non-erodible pipes underground within this steep portion of the road where high flow velocities lead to greater erosion. Installing a storm drain, instead of modifying the existing ditch in that area would also save roadside space, as there may not be enough room to make the ditch larger.

2) **Steward Road Bridge** The Steward Road Bridge site discharges a majority of the basin's stormwater at existing outfalls near Steward Road Bridge. By improving this single discharge area, treatment of stormwater from nearly the entire watershed can be achieved. The remediation measures are described below and shown in Figure 8-7.
   a. Inspection and maintenance of the drainage ditches leading towards Steward Road Bridge will identify areas which can be improved by planting additional vegetation or adding outfall protection to increase filtration potential and reduce flow velocities.
   b. The preferred location of a detention pond has been identified within City-owned property just to the south of Steward Road Bridge. A detention pond will provide an attenuated release of stormwater to lessen peak flows to the Iliuliuk River as well as allow settlement of suspended sediments prior to discharge. This will require rerouting the storm drain system to outfall at this location.
   c. Road surface treatment is a viable option for reducing sedimentation associated with the gravel roads. Recycled asphalt pavement (RAP) can be used to cap the road surface to prevent sediment transport during runoff events.
   d. Another option is the potential installation of a sediment separator, such as a pre-cast gravel catch, at a location prior to the outfall into the infiltration area.

3) **Duck Pond Lot** The empty lot on the southeast side of the high school was historically part of Unalaska Lake before the construction of E Broadway Avenue. The northern perimeter of the lot is owned by the City of Unalaska, and the remaining portion is privately owned. Treatment of stormwater runoff from King Street and Armstrong Court could utilize this area. See Figure 8-8.
    a. The paving of all of King Street would greatly decrease sedimentation and deposition of sediment into the storm drain system near the Duck Pond lot.
    b. Paving the portion of Armstrong Court that contributes drainage towards the Duck Pond Lot would achieve the same as mentioned for King Street.
    c. Utilizing the City-owned property bordering the Duck Pond lot for construction of a vegetated and/or rocky swale and associated culverts near Armstrong Court to provide better treatment to runoff prior to its entrance into the storm drain system. A guardrail may also need to be constructed to assist with limiting traffic and parking in this area.



N

100 0 100 200 300 FT

LEGEND

- WATERSHED DELINEATION BOUNDARY
- EXISTING SWALE
- EXISTING DRAINAGE STRUCTURES
- STORMWATER INLET/OUTFALL STRUCTURE
- SETTLING POND
- PROPOSED CULVERT

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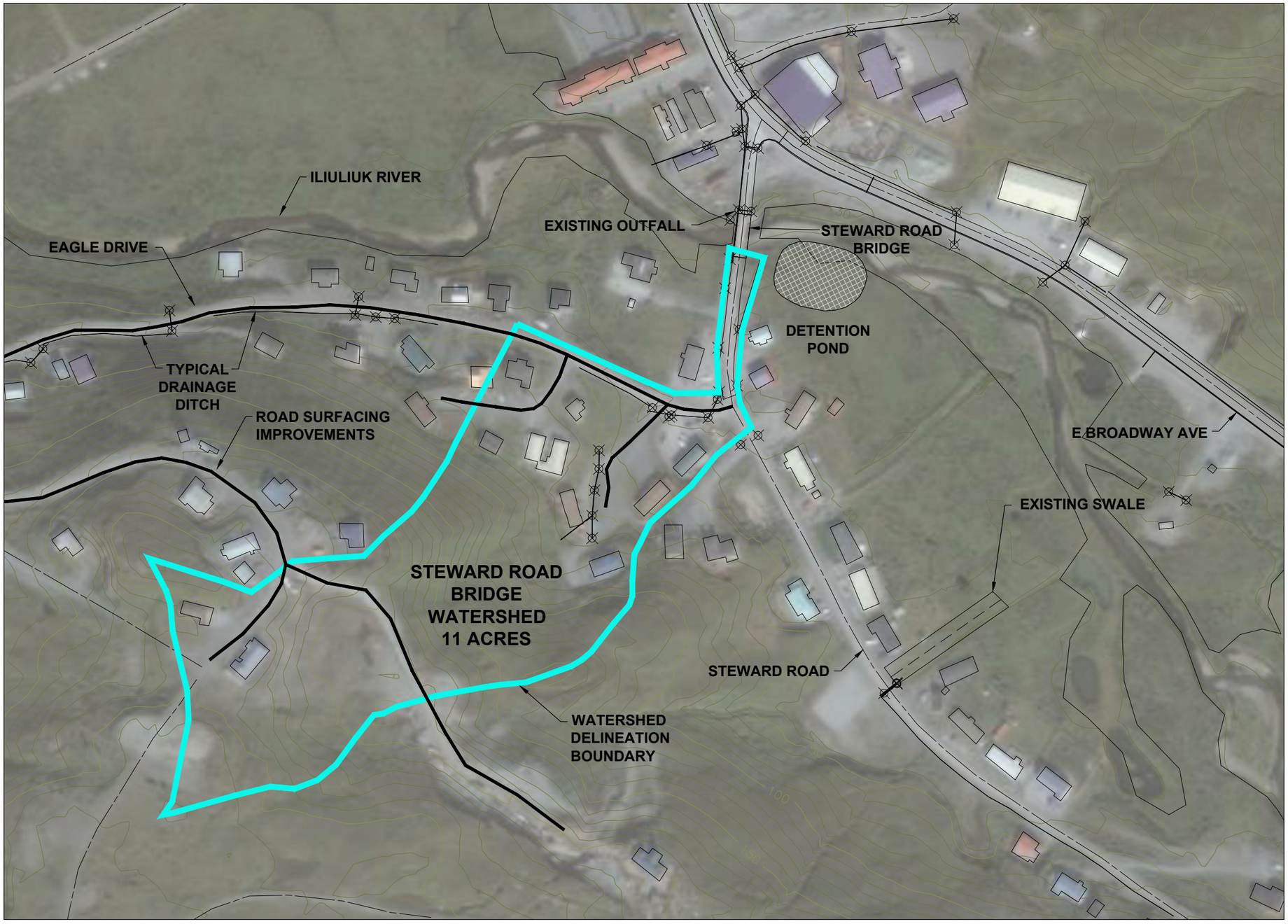
STORMWATER MANAGEMENT PROGRAM PLAN
OVERLAND DRIVE IMPROVEMENTS

FIG 8-6



N

100 0 100 200 300 FT

LEGEND

- WATERSHED DELINEATION BOUNDARY
- EXISTING SWALE
- EXISTING DRAINAGE STRUCTURES
- STORMWATER INLET/OUTFALL STRUCTURE
- DETENTION POND

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STORMWATER MANAGEMENT PROGRAM PLAN
STEWARD ROAD BRIDGE IMPROVEMENTS

FIG 8-7

N

40 0 40 80 120 FT

LEGEND

- EXISTING DRAINAGE STRUCTURES
- STORMWATER INLET/OUTFALL STRUCTURE
- APPROXIMATE CITY OF UNALASKA PROPERTY
- PROPOSED SWALE

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STORMWATER MANAGEMENT PROGRAM PLAN
DUCK POND LOT IMPROVEMENTS

FIG 8-8

8.3.3.1 ROM Cost Estimate

A ROM (rough order of magnitude) cost estimate has been prepared for the design, permitting, and construction of option 1-3, above. These were prepared in coordination with the City based on past project knowledge including mobilization costs and common weather delays. A summary of the project costs can be found in Table 8-1.

Table 8-1. ROM Cost Estimate

Item	Description	Cost
Overland Drive Diversion Culvert	Installation of culvert just below Ugadega Quarry	$100,800
Overland Drive Downhilll Diversion	Installation of 600' of storm drain	$339,000
Overland Drive-E. Broadway Ave Inlet	Improve inlet at bottom of Overland Dr. with catch basins and riprap	$90,000
Overland Drive Discharge Swale	Install gabion basket check dams and revegetate channel	$51,600
Steward Road Bridge	Reroute Stormwater to constructed pond	$267,000
Former "Duck Pond Lot" Armstrong Court	Installation of vegetated swale	$153,000
Former "Duck Pond Lot" King Street	Pave and install concrete gutter in parking areas on the southeast side of King street	$257,100
	TOTAL	**$1,258,500**

Year 2 funding falls short of the cost for the three priority remediation options for Overland Drive, Steward Road Bridge area, and the Former "Duck Pond Lot". The City should take the recommendations into account and determine which improvements discussed above to execute with the grant funding. Additional options discussed in this report should also be considered in the future.

8.3.4 Future Remediation Options

The funding from the CIAP grant will only cover some remediation options as discussed above. Other, future options that are at a higher priority are discussed below. If funding allows some of the following could also be accomplished:

- **Easements along Overland Drive** will likely need to be reallocated in order to accommodate the culverts and associated catch basins previously discussed in this plan. The current right-of-way is extremely narrow, bordering Ounalashka Corporation land.
- **Overland Drive Swale System Improvements** are a lower priority than other improvements along Overland Drive and therefore may not be funded by the existing grant.

Future funds could be allocated towards improvements on the existing swale system along the river. Improvements would include revegetation and installation of rock-filled gabion check dams.

- **The Former "Duck Pond Lot"** was discussed as a priority erosional area; however, less of a priority than Overland Drive and Steward Road Bridge area improvements. Future funds, if obtained, should be used for the aforementioned improvements at the former "Duck Pond Lot", including paving King Street (which the City plans to do during 2015), improvements at culvert inlets at the two bordering intersections, and installation of a vegetated settling basin and swale along Armstrong Court.
- **AK-CESCL Training** would benefit the City Roads Division, contractors, and the general public by informing them on stormwater controls and regulations. This training would require contracting an instructor to travel to Unalaska and give the training.
- **Resurfacing the Department of Public Works' Parking Lot** with RAP could greatly decrease the amount of sediment from pulverized gravel entering the storm drain system around this location.
- **Steward Road in the Unalaska Valley** should be considered in the future for implementation of erosion control measures. This area is noted as possibly contributing the largest amount of sediment into the head of Unalaska Lake during large storm events. Future studies should be conducted in this area, and erosion control considered to prevent future sloughing, erosion, and large loads of sediment transport in future significant storm events.
- **5th Street Bridge** area should be considered for future restoration measures as the site is one that was mentioned multiple times during the public involvement process. With further review, a separator may not fit in the confined space, but other measures, such as installation of a witch's hat, may help assist with sediment control at this discharge location.
- **Continued Upgrade from Gravel to Paved Roads** will continue to assist with sedimentation issues within the watershed. The gravel on roads in Unalaska appears to be one of the major sediment sources around the lake, as the rock is pulverized easily. Along with paving roads, appropriate stormwater controls, such as ditching and other forms of conveyance are necessary to truly remediate some of the sedimentation issues.
- **Revegetation of aquatic grasses** at the eastern end of Unalaska Lake is a potential remediation measure of interest expressed by the community. Initially, this would require determination of the species of aquatic grass that once grew in this area by gathering samples from Summer Bay as a reference. Then, research would need to be done to determine if revegetation is feasible as some aquatic grasses do not revegetate well.
- **Other measures as described in the Alaska Stormwater Guide that will reduce sediment**

8.3.4.1 ROM Cost Estimate

A ROM cost estimate has been prepared for some of the additional, prioritized, improvement measures to be conducted in the future. During the final review of this report, the City learned of

and is pursuing a potential opportunity to obtain additional funding through the granting agency to allow a more complete implementation of the recommendations in this report; however, the additional funds are not guaranteed. Additional funding is being requested for easements along Overland Drive, restoration measures at the former "Duck Pond Lot", improvements to the existing Overland Drive discharge swale, AK-CESCL training, and installation of RAP on the Department of Public Works' parking lot. The ROM cost estimate is displayed in Table 8-2. Note that some of these items were previously mentioned in Table 8-1, but since grant funding may not cover them, they are restated here for future considerations.

Table 8-2. ROM Cost Estimate for Future Options

Item	Description	Cost
Resurface DPW Parking Lot	Resurface DPW parking lot with RAP	$303,000
AK-CESCL Training	Training Roads maintenance workers in stormwater protection practices	$21,600
	TOTAL	**$324,600**

9.0 Monitoring Program Effectiveness Measures

In order to document the effectiveness of the plan and the monitoring of its success, PND suggests making public comments, water quality results, and inspection documents and results conducted under the SMPP, available to the public. This could be done by posting the aforementioned documents along with this SMPP on the City website or within the Public Works building.

9.1 Public Education and Outreach Program

Public education and outreach should be assessed annually. PND recommends the City holds a public meeting once a year educating the public on the SMPP purpose and plan, its effectiveness, and any amendments that may have been made. It would then be suggested that the community's comments and questions be answered and recorded to be taken into consideration for the future year and on determining the effectiveness of this plan.

9.2 Illicit Discharge Detection and Elimination Program

Program effectiveness should be monitored on an annual basis following the first year of implementation. PND recommends monitoring in such a way as to measure water quality pre- and post-implementation. The parameters should include total dissolved solids, total suspended solids, and turbidity. Monitoring should be done in locations downstream of the remediation measures and should be conducted at the same time of year during a period of several days of no rain or storm events.

9.3 Construction Site Runoff Control Program

Assessment of the construction site runoff control program could be through documenting inspections, BMPs in use, and any noticeable erosion or sedimentation within or around the construction site.

9.4 Post-Construction Stormwater Management for New Development and Significant Redevelopment

Monitoring the effectiveness of stormwater management for post-development would be similar to that during construction. Inspections should take place throughout a period of time post-construction to verify that any appropriate BMPs are still in place, and that they are removed when no longer needed (such as silt fences which oftentimes are left in place long after their use). Inspections should also document whether any required post-construction activities, such as revegetating slopes, has been initiated.

9.5 Municipal Operations and Maintenance

Assessing the aforementioned improvements in the municipal operations and maintenance measures could involve review of these measures each year and review of public comment. Inspection of separators and other storm drain system components should be completed at least twice a year to ensure they were properly maintained that year.

Public comment could include information from people, such as the high school fisheries class, that visit the river every week. Their observations could inform the City whether large amounts of gravel from the roadway are still being deposited into the stream.

Monitoring the effectiveness of most of the remediation measures could include water quality measurements below the sources of erosion to compare before and after values.

10.0 Conclusions and Recommendations

In conclusion, after review of grant documents, existing information from site visits, literature, historical data, and information and observations from the public, PND has prepared this SMPP for the City of Unalaska to review and determine uses of the grant funding for 2015 to effectively meet the purpose of this document.

PND recommends keeping the community involved in the progress and implementation of the SMPP by informing them via education and outreach efforts, and through allowing and encouraging volunteer participation whenever it can be used. The City should also assess their stormwater requirements within the city and for private landowners, including specific requirements for construction site runoff and for maintenance and use of BMPs after construction is complete. Additionally, City operations and maintenance measures should be assessed and potentially refined in order to ensure the storm drain system is properly maintained.

Within this SMPP, PND has also identified multiple priority sites that could use remediation. These sites include Overland Drive, Steward Road Bridge area, and the area surrounding the Former "Duck Pond Lot". If additional funds are available, resurfacing the Department of Public Works' parking lot, improvement to Overland Drive's discharge swale, conducting AK-CESCL training and otheroptions as discussed in section 8.3.4 could be pursued.

Additional recommendations include additions to City ordinances in Title 8 regarding buffer zones, Title 10 regarding the storm drain system, Title 15 regarding use of BMPs, snow placement, and spills, and finally, Title 17 regarding the addition of IBC Appendix J (Grading) in order to assist with regulation of excavation and grading outside of the right-of-way, and requiring Corps permits or wetland delineations for new development.

Finally, in order to assess the effectiveness of this plan and the implemented measures, PND highly recommends that the City of Unalaska develops and follows a monitoring program.

11.0 References

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Think Salmon. September 2006. What is the significance of the yellow fish beside the storm drains on our roads? Retrieved 12/12/14 from http://www.thinksalmon.com/professor/item/yellow_fish_beside_storm_drains_are_reminders/

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APPENDIX A

Violation Forms

US ARMY CORPS OF ENGINEERS
ALASKA DISTRICT

REPORT OF ALLEGED VIOLATION / PERMIT NON-COMPLIANCE

Do you wish to remain Anonymous? (Circle) Yes* or No *IF "Yes" **DO NOT** complete this information.

Your Name: _____ Organization: _____

Address: _____ Phone #: _____

Location and Directions to Site: _____

_____

Is the alleged violation within: water body ☐ wetlands ☐ or both water body and wetlands ☐

Alleged Violator

Name: _____ Phone #: _____

Address: _____

_____

Contractor Involvement

Is there a contractor involved? Yes or No.

Contractor's Name: _____ Phone #: _____

Address: _____

Activity Info

Description of Work: (Circle) *Filling* *Dredging* *Road Construction* *Stream Diversion* *Other:* (Describe)

_____

_____

Purpose of Work: (If Known) _____

Type of Equipment Involved: (Circle) *Dump Truck* *Front-End Loader* *Excavator* *Back Hoe* *Grader* *Dredge*

Other Equipment: _____

Type of Material Discharged: (Circle) *Gravel* *Rocks* *Trees/Brush* *Concrete* *Other*: _____

When did work begin? _____

Is work on-going? (Circle) Yes or No Is work Completed? (Circle) Yes or No

Additional Notes:

APPENDIX B

Permit Checklist

ADF&G Fish Habitat Permit

Because the Iliuliuk River is an anadromous stream, a Fish Habitat permit from the Alaska Department of Fish and Game (ADF&G) is required for any work that occurs within or across the waterbody. The jurisdiction of the ADF&G typically extends to the OHWM but can also include the banks of anadromous streams that occur above this mark.

ADF&G Fish Resource Permit

A Fish Resource Permit (FRP) is required for any activity to collect fish, shellfish, or aquatic plants that is not covered by current sport, personal use, aquatic farm, and commercial regulations. This requirement includes methods and means (i.e., gear), numbers of animals, locations, and seasons in which collection can occur. The permit may address whether or not any of the collected specimens, or the water in which they have been held, can be released back to the wild. The ADF&G only issues FRPs to organizations and individuals engaged in legitimate scientific, educational, propagative, or exhibition activities, and who meet other requirements stated in the department's guiding policy.

USACE Section 404/10

The US Army Corps of Engineers (USACE) is responsible for issuing permits for the placement of materials within waters of the US under Section 404 of the Clean Water Act. The USACE also issues permits under Section 10 of the Rivers and Harbors Act of 1899, which requires approval prior to the accomplishment of any work in, over or under navigable waters of the United States, or which affects the course, location, condition or capacity of such waters. Tidal waters are considered navigable waters.

ADEC Stormwater

Any stormwater project causing over an acre of disturbance and discharging to waters of the U.S. would also need to attain coverage under the Construction General Permit (CGP). This would involve the submittal of a Storm Water Pollution Prevention Plan (SWPPP) to the Alaska Department of Conservation (ADEC) detailing measures that would be taken to ensure that storm water runoff from the project would not negatively impact waters of the U.S.

Engineering plans for permanent stormwater projects with impacts of less than one acre would need to be submitted to the ADEC. A letter of non-objection is typically issued by the ADEC two weeks after these plans have been submitted. Plans would include signed and stamped drawings and calculations as well as a project narrative with a description of soil types and existing land cover.

SMPP					
Restoration Measure		ADF&G		USACE	ADEC
		Fish Habitat	Fish Resource	Section 404/10	Stormwater
Overland Drive new culverts (diverting water)					X
Overland Drive: Installation of gabion check dams and vegetation in existing swale					X
Duck Pond Lot: Settling basin installation				X	X
Steward Road (wetlands area)					
	• Add berms to create a settling basin			X	X
	• Reroute stormwater to this new basin prior to its discharge into the river			X	X

APPENDIX C

Runoff Calculations

Unalaska SMPP Stormwater Calculations

Watershed Characteristics

Description	Area *acres*	Area (A) *sf*	Soil Type	Slope *%*	Land Cover	C*	C*A *sf*
Overland Drive	18	784080	C	7	Gravel Street	0.6	470448
Steward Road Bridge	11	479160	B	15	Earthen Slope	0.6	287496
Nirvana Subdivision	340	14810400	B	15	Earthen Slope	0.6	8886240
5th St. Bridge	2.2	95832	D	4	Paved Street	0.86	82415.52
Duck Pond	0.21	9086	D	2	Gravel Street	0.5	4543

** C coefficients from Alaska Storm Water Guide December 2011 Table 3-2: http://dec.alaska.gov/water/wnpspc/stormwater/docs/AKSWGuide.pdf*

Rainfall Intensities & Volumes

Intensities	Year	Duration	I (in/hr)	Duration	I (in/hr)
DEC Treatment	2 year	5 min	1.79	15 min	0.94
Conveyance	10 year	5 min	3	15 min	1.57

Time of concentration is ~ 15 minutes for all watersheds except 5th St. Bridge

Volumes	Year	Duration	R (in)
DEC Treatment	2 year	6 hour	1.48
Retention Volume	1 year	24 hour	2.61
Conveyance	10 year	24 hour	4.63

Intensities and volumes taken from NOAA Atlas 14, Volume 7, Version 2 DUTCH HARBOR, Station ID: 50-2587

Design Flows & Volumes

Watershed	Discharge (cfs)		Volumes (ft^3)		
	DEC Treatment	Conveyance	DEC Treatment	Retention	Conveyance
Overland Drive	10	17	58022	102322	181515
Steward Road Bridge	6	10	35458	62530	110926
Nirvana Subdivision	193	323	1095970	1932757	3428608
5th St. Bridge	3	6	10165	17925	31799
Duck Pond	0.1	0.2	560	988	1753

Calculations were completed using the Rational Method: Q=CiA, V=CRA

Q	*discharge*
C	*rational coefficient*
i	*intensity*
R	*depth*
A	*area*

APPENDIX D

Relevant Specifications & Concept Drawings

Alaska Garden & Pet Supply Inc. dba **Alaska Mill & Feed Co.**

114 North Orca • P.O. Box 101246 • Anchorage, Alaska 99510 • Phone (907) 279-4519 • FAX (907) 276-7416

October 11, 2013

City Electric

Reference: Dutch Harbor Seeding
Seed Submittal

Gentlemen:

The seed mix you have requested consists of 40% Boreal Red Fescue, 40% Nortran Tufted Hairgrass, and 20% Glaucous Tundra Blue The seeds meet the germination and purity minimums as required. All seeds are in compliance with the USDA Federal Seed Act, the State of Alaska Seed Regulations, and contain no invasive species.

Certification will accompany actual product.

Sincerely,

Steve Rooke
Alaska Garden & Pet Supply, Inc.

To be used generally (such as for hydro seeding swale)

To be used on rocky terrain

RINGER II PERENNIAL RYEGRASS

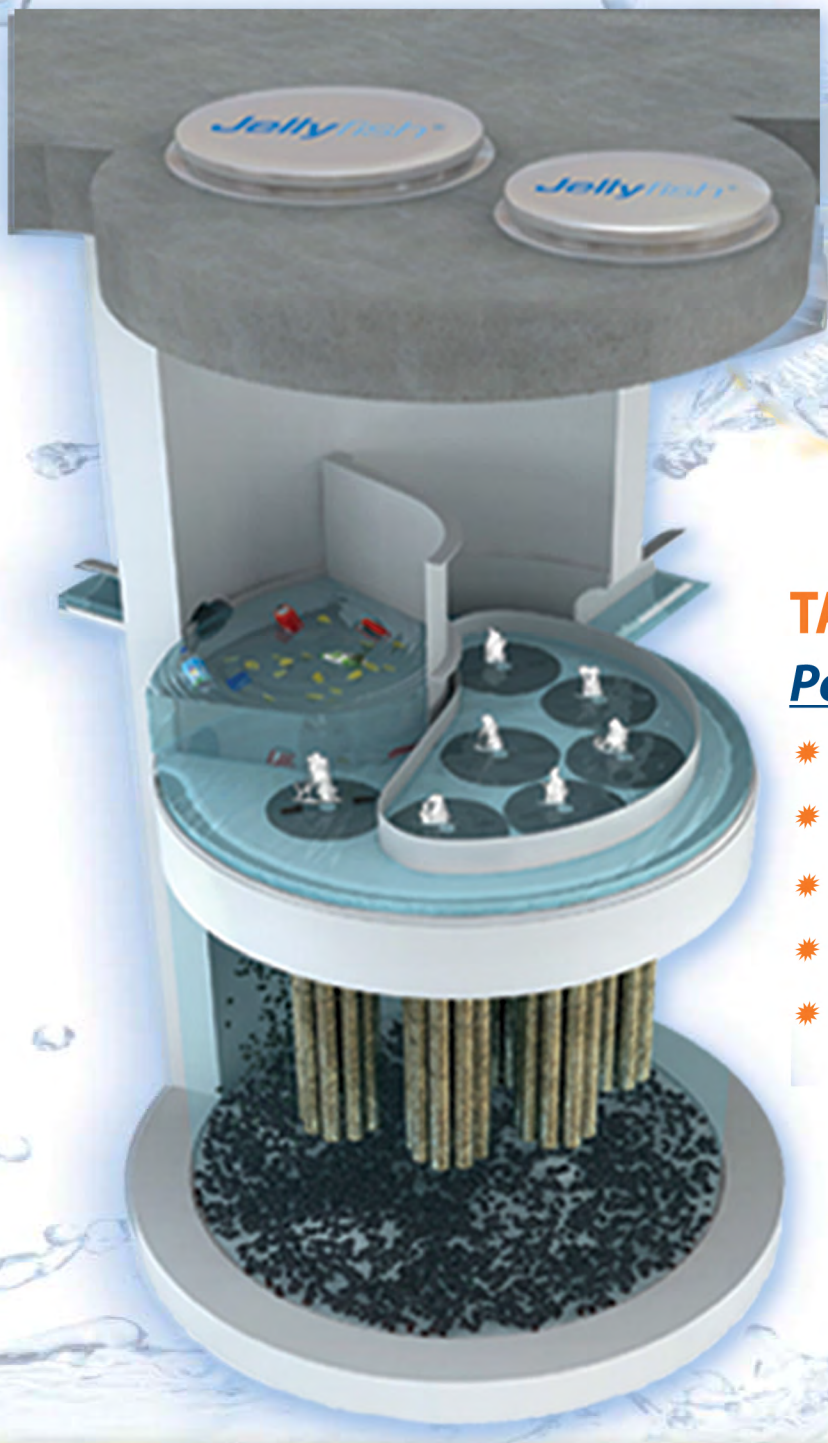
		GERM	ORIGIN
98.00 %	PURE SEED	90 %	OR
0.10 %	OTHER CROP	LOT #	Y38 – 12 – PR21
1.89 %	INERT MATTER	NET WT.	50 LBS
0.01 %	WEED SEED	TEST DATE:	4/13
			AMS 634

NOXIOUS WEED:
NONE FOUND

ALASKA GARDEN AND PET SUPPLY
PO BOX 101246
ANCHORAGE, AK 99510

Innovative Stormwater Treatment

Jellyfish® Filter



TARP Field Tested Performance

Pollutant Removal:

- *TSS 89%*
- *Total Phosphorus 60%*
- *Total Metals >50%*
- *Turbidity <15 NTU*
- *Trash 100%*

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Engineered Stormwater Treatment

www.imbriumsystems.com

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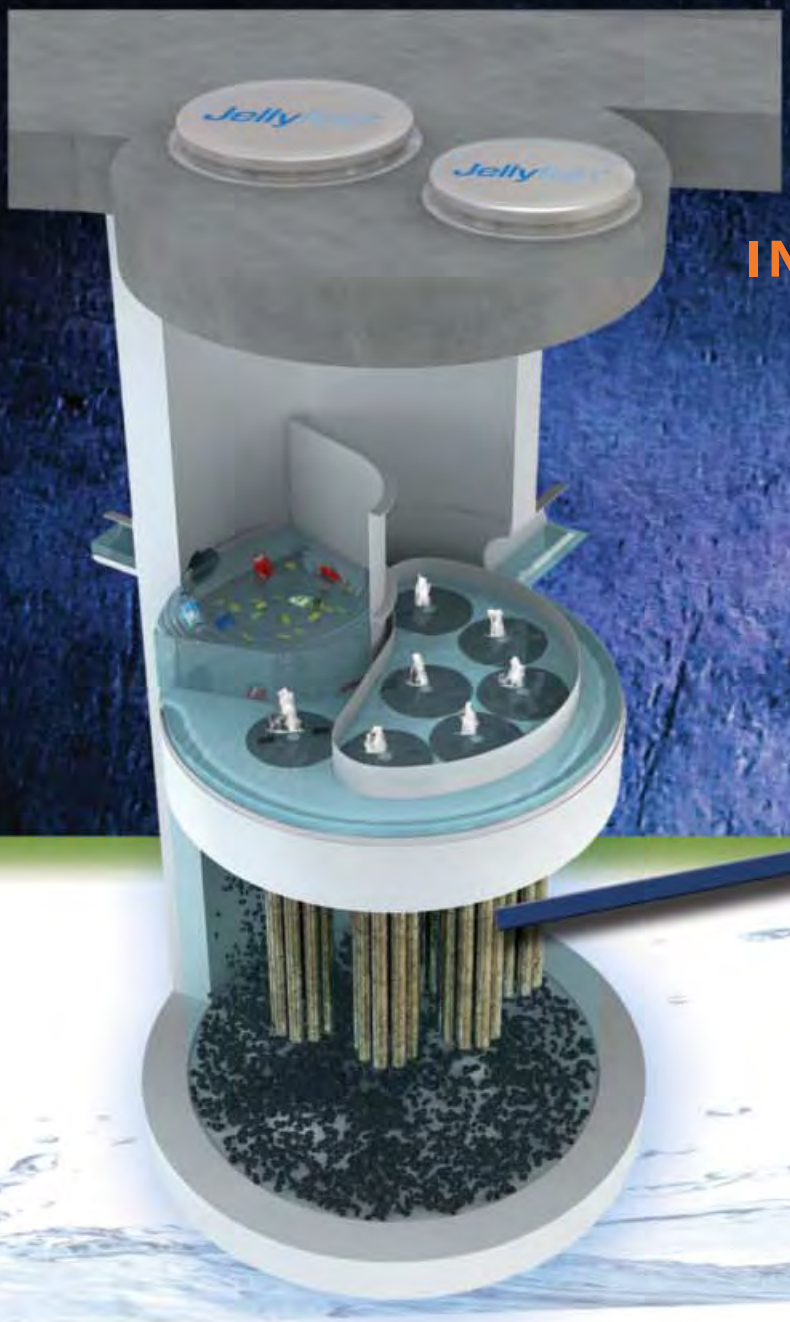
Jellyfish®

INNOVATIVE MEMBRANE

SMALL FOOTPRINT



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PRETREATMENT

- Traps oil, trash and debris outside the filtration zone.
- Coarse particles settle to the sump.
- Separator skirt protects the cartridges from floatables contamination.

FILTRATION

- Membrane filtration tentacles capture fine particles as small as 2 microns.
- Removes a high percentage of particulate-bound pollutants including nutrients, metals, hydrocarbons and bacteria.
- High surface area membranes ensure long-lasting treatment.

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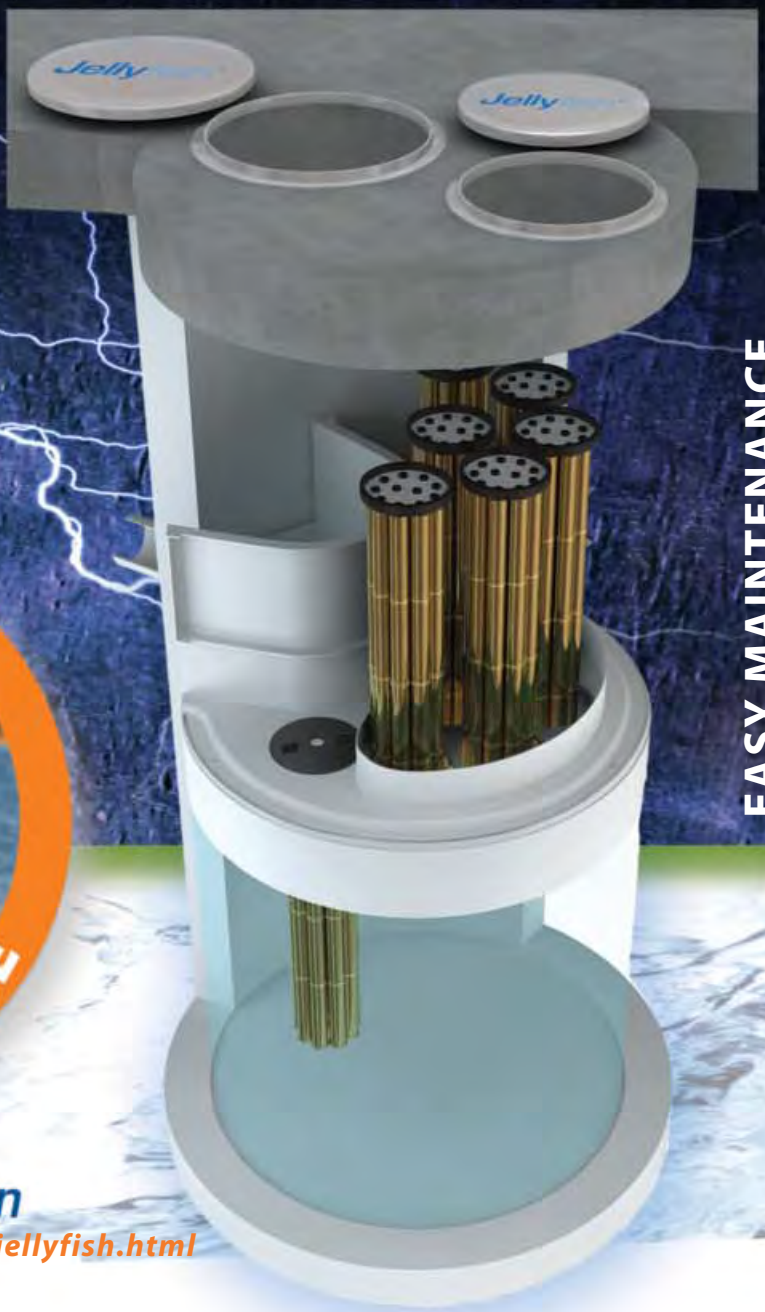
Filter

FILTRATION



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SELF-CLEANING

- During filtration, vibrational pulses dislodge sediment from the membrane surfaces.
- After every storm peak, filtered water back-washes membrane filtration tentacles.
- Sediment is continuously removed from the tentacles by gravity.

APPROVALS

Jellyfish Filter has key agency approvals

- ✓ New Jersey Corporation for Advanced Technology **(NJCAT)** - Verification
- ✓ New Jersey Department of Environmental Protection **(NJDEP - TARP) -** Certification
- ✓ Washington State Department of Ecology **(TAPE)**
- ✓ Maryland Department of the Environment **(MDE)**
- ✓ Ontario Ministry of Environment - New Environmental Technology Evaluation **(NETE) -** Certification

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Jellyfish® Filter

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Features:

1. High surface area, high flow rate membrane filtration
2. Highest design treatment flow rate per cartridge (up to 80 gpm (5 L/s))
3. Low head loss (typically 18 inches or less (457 mm))
4. Captures particles as small as 2 microns
5. Light weight self-cleaning cartridges
6. No granular media to dispose of
7. 3rd party verified performance & TARP tested

Benefits:

1. Long-lasting and effective stormwater treatment
2. Fewer cartridges required, lower cost and easier maintenance
3. Design is compatible with all piping systems
4. Superior pollutant capture
5. Easy maintenance and low life-cycle cost
6. More sustainable
7. Environmentally reliable

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