



CHESTER CREEK WATERSHED PLAN 2014

Prepared for: the Municipality of Anchorage
Prepared by: Anchorage Waterways Council

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Executive Summary

Chester Creek watershed is home to about 109,000 residents, several businesses, two universities, three major hospitals, elementary, middle, and secondary schools, and Merrill Field, a commercial service airport. Its area is almost 20,000 acres, which drains nearly 38 river miles. Settlement in the watershed was early in Anchorage's history, which has resulted in a fairly dense population of which much is literally along Chester Creek. Unfortunately many of the rules and regulations that apply to more recent development were not in place during much of the early construction, so that there are spots where Chester Creek is hemmed in tightly by homes and businesses. Regardless, the creek is a popular recreation area that has miles of multi-use trails, lakes and lagoons, and parks and greenbelts which attract a variety of recreational users.

Early on, Chester Creek ran unimpeded to Knik Arm, but in the late 1960s and early 1970s a dike and tidal gate were constructed at its mouth, which greatly altered the flow regime as well as the annual spawning migration of a once strong salmon population. This, coupled with development and channel alterations, resulted in major changes to the creek and its tributaries. In barely 100 years, Chester Creek has been transformed dramatically.

It remains a very popular waterway, but it has received considerable mistreatment. Besides an interruption in fish passage (which was reversed around 2008 by removal of the dam), there are several undersized culverts that freeze and clog and need replacement, straightened sections which enhance water velocity, sections that flood property, and stormwater runoff which has led to it being categorized as an impaired waterbody—primarily from fecal coliform.

This plan addresses the issues confronting Chester Creek Watershed as well as a variety of general and specific actions to improve the creek's water quality so it can remain one of Anchorage's urban assets.

The *Chester Creek Watershed Plan 2014* was adopted by the Anchorage Municipal Assembly during their May 14, 2014 meeting (original agenda date was May 12, 2014) after it went through the public process by way of Community Councils and written comments from a variety of stakeholders including a Resolution from the Municipal Commission on Watershed and Natural Resources and the Municipal Planning and Zoning Committee.

Acknowledgements

The *Chester Creek Watershed Plan* was developed through a collaborative effort with help by many individuals from the following groups and agencies:

- **Alaska Department of Environmental Conservation (ADEC)**
- **Alaska Department of Fish and Game (ADF&G)**
- **Alaska Department of Natural Resources (ADNR)**
- **Alaska Department of Transportation and Public Facilities (AKDOT&PF)**
- **Alaska Pacific University (APU)**
- **Alaska Railroad Corporation (AKRR)**
- **Anchorage Park Foundation (APF)**
- **Anchorage Watershed Task Force**
- **Anchorage Watershed Roundtable**
- **Anchorage Waterways Council (AWC)**
- **Bureau of Land Management, Anchorage Field Office (BLM)**
- **HDR Alaska, Inc. (HDR)**
- **Joint Base Elmendorf-Richardson (JBER)**
- **KPB Architects**
- **Municipality of Anchorage (MOA), Watershed Management Services (WMS), Department of Parks and Recreation, Planning Department**
- **National Oceanic and Atmospheric Administration (NOAA)**
- **U.S. Army Corps of Engineers (USACE)**
- **U.S. Environmental Protection Agency (USEPA)**
- **U.S. Fish and Wildlife Service (USFWS)**

1. Introduction

A watershed is an area whose topography collects and routes water that falls as rain, melts from snowpack, flows from springs, and collects by gravity into a drainage system. Chester Creek watershed is the nearly 19,540 acres (30.5 mi²)¹ that are drained by Chester Creek and its tributaries. The Chester Creek drainage system predominantly occupies northeast Anchorage and flows west through the Anchorage Bowl. Natural features that include flowing water, wetlands, fish, and wildlife, alongside a world-class trail and park system make the Chester Creek watershed an attraction and an asset to the Municipality of Anchorage (MOA). A unique urban Alaska amenity, this watershed is also home to many residents, businesses, two universities, three hospitals, a variety of schools, a large joint military base, and even an airport (Merrill Field).

This document, the *Chester Creek Watershed Plan*, is a tool for planners, scientists, community members, and others to make decisions that will slow further declines and enhance the positive characteristics of the watershed. This plan² describes the area's resources, addresses social and environmental concerns, and identifies development and activities that are most beneficial to the watershed as a whole. It recommends policies and objectives compatible with maintaining urban development and preserving a healthy watershed that is a centerpiece of the community.

Chester Creek watershed is composed of the land area and waterbodies that drain Chester Creek to Cook Inlet. This area is home to about 109,000 residents³ (or 37% of Anchorage's official population). The watershed supports a wide range of fish and wildlife species from salmon to bears. Approximately 10% of the land area (exclusive of trails) within the watershed is devoted to parks and open spaces⁴. Some of these areas support trails for walking, running, hiking, biking, skiing, skjoring, and horseback riding.

In addition to its many positive attributes Chester Creek also has a multitude of problems that harm the creek's biotic community, limit recreational and economic opportunities, and impair its aesthetic qualities. Degradation of water quality and important habitats along with loss of natural productivity and biodiversity are concerns for the entire watershed. And, in several areas of the watershed, development has encroached upon creek-side habitat, which increases the probability of flooded property.

¹ MOA Hydrography Geodatabase, 2012.

² Due to the variability between information and GIS datasets for certain parts of the plan, it is possible that some inconsistencies exist over boundaries between the MOA and JBER. Because JBER has its own 'Integrated Natural Resources Management Plan', it would take precedence on JBER lands. Most of the comments in this document refer to non-JBER lands.

³ U.S. Department of Commerce, Bureau of the Census, *United States Census, 2010*.

⁴ LANDUSE_MOA, 2004-2005. MOA planner, Thede Tobish, reports that this is the most recent GIS data on MOA land use. (personal communication, July 8, 2013).

Importance of Watershed Planning

Watershed planning is essential for many reasons. As local areas develop and grow (often quickly), the result can be a degradation of water resources. It has become more evident that protecting local water resources must be viewed from and happen at the watershed level. From this scale, it is possible to identify specific issues or problems that are the sources of and contribute to degradation and work towards solutions. Watershed planning also provides local governments with a framework to prioritize valuable and sometimes scarce resources, such as funding and internal staff time, and work cooperatively with other agencies and organizations. This helps ensure compliance with federal, state and local regulations. The following lists some of the benefits of watershed planning:

Local Government Benefits

- Enables analyses that are most meaningful at a watershed or subwatershed scale (e.g., nutrient and sediment loadings, impervious cover estimates, low impact development (LID) potential, etc.)
- Enables management at a scale necessary to ensure consistency with TMDLs (Total Maximum Daily Loads)
- Provides a framework for prioritizing resources (staff, funding, etc.)
- Provides educational opportunities for citizens to understand how natural resource management interacts with existing and future development
- Gives citizens an active voice in protecting and restoring natural resources that are important to the community

Administrative Benefits

- Provides a structure for communities to target geographic areas for land conservation and development to maximize the efficiency of community planning efforts including LID
- Enables more efficient management of permitting programs
- Focuses data collection and analysis for environmental assessments
- Provides benchmarks for measuring the success of management efforts

Environmental and Health Benefits

- Improves quality of water from a variety of aspects, i.e. non-point source pollution, thermal impacts, and sedimentation
- Enhances water supply and recreational contact safety
- Protects wildlife habitat and improves natural resources and ecologically sensitive areas, such as riparian corridors, headwaters, floodplains, and wetlands
- Controls flooding by retaining and/or restoring riparian and wetland areas

Financial Benefits

- Avoids development in sensitive areas and can help minimize compliance and mitigation costs
- Provides a framework and rationale to pursue various funding opportunities
- Prevention and planning is less costly than restoration

Regulations and Plans

There are a number of existing regulations and permit requirements that infer or specifically call for watershed planning in Anchorage. These include:

- Alaska Administrative Code Title 18, Chapter 70⁵ provides standards for water quality that must be maintained in Alaska.
- Anchorage Municipal Code, especially Title 21⁶, outlines regulations related to land use, including setback areas for stream protection, water quality protection, pollution, and construction requirements⁷.
- The National Pollutant Discharge Elimination System (NPDES) Permit No. AKS-052558 held jointly by the Municipality of Anchorage and the Alaska Department of Transportation and Public Facilities (AKDOT&PF) was transferred from the Environmental Protection Agency (USEPA) on February 1, 2010, to the Alaska Department of Environmental Conservation (ADEC). Known as the Alaska Pollutant Discharge Elimination System (APDES) permit, it calls for the development of two watershed plans during the first five years of the newly transferred permit's implementation (by 2015).

Additionally, planning documents for Anchorage contain recommendations for creating and adopting watershed plans.

- In February 2001, the Municipality of Anchorage adopted the *Anchorage 2020 Anchorage Bowl Comprehensive Plan*, which is a guide to address 21st century development. *Anchorage 2020* emphasizes the need for watershed management plans. Under "Policy" it states, "*Integrate water resource and land use planning through watershed planning and [d]evelop watershed plans for all Anchorage creeks*"⁸. It also calls for aquatic resources to be protected and restored where feasible⁹.

⁵ At <http://dec.alaska.gov/commish/regulations/pdfs/18%20AAC%2070.pdf>, April 8, 2012.

⁶ At <http://library.municode.com/index.aspx?clientId=12717>.

⁷ Note: Title 21 is being revised and reader should check the latest version, revisions, and adoptions on the Municipality of Anchorage's website at <http://www.muni.org>.

⁸ Municipality of Anchorage Planning and Development, *Anchorage 2020, Anchorage Bowl Comprehensive Plan*, March 2000, p. 85.

⁹ *Ibid*, p. 86.

- *Anchorage Bowl Park, Natural Resource, and Recreation Facility Plan*¹⁰. Park Strategy 7 refers to Stewardship of Natural Resources. Both short-term and long-term strategies contain elements for conserving existing natural resources (water being one) as well as adjacent habitat.

Finally, the USEPA listed Chester Creek, University Lake and Westchester Lagoon as Section 303 (d) impaired waters in 1990 due to fecal coliform which identified urban runoff as the pollutant source¹¹. A Total Daily Maximum Load (TMDL)¹² for urban runoff was completed in 2005 for these waters.

2. Creation of the Plan

History of the Plan and Participants

Early on, the Chester Creek watershed was selected as the logical choice for a comprehensive watershed plan because of long-standing issues with pollution. In 2003 the MOA, agencies, and the public came together to synthesize data into a draft plan¹³. Although a draft watershed plan was completed in 2005—it was not put through the formal adoption process by the Municipal Assembly.

The data in the 2005 report were nearly a decade old in 2011 when an advisory committee was created by a grant from the U.S. Fish and Wildlife Service (USFWS) to the Anchorage Waterways Council (AWC) to facilitate a review of the existing plan with a goal to bring the information up to date and prepare a document for adoption by the Municipal Assembly. The 2005 draft included years of collected data, literature reviews, and public and agency participation. A mission statement and vision statement had been drafted; forums for public and agency input were created; desired outcomes and results were defined and placed in categories; policy and objectives were reviewed which could be tied to the categories; and consensus building was used to bring the public and agency interests together for acceptance. A considerable amount of work had already been accomplished.

When the newly established group began to meet in January 2011, the funded project was titled, “Watershed Planning in the Municipality of Anchorage.” As part of the evaluation process, several meetings were held, 3 field trips were taken along Chester Creek by group members, and there was careful review of the earlier vision, mission statement, and goals set forth in the 2005 plan. Some projects had been completed so they could be removed from the list, other alterations had taken place, and new issues had developed. The 2005 *Chester Creek Watershed Plan’s* original vision and mission statement were retained. The goals were evaluated in conjunction with the *Little Campbell Creek Watershed Plan*

¹⁰ Municipality of Anchorage Planning Department & Parks and Recreation Department, *Anchorage Bowl Park, Natural Resource, and Recreation Facility Plan*, April 2006, pp. 50-51.

¹¹ *Total Daily Maximum Load for Fecal Coliform in Chester Creek, University Lake, and Westchester Lagoon, Anchorage, Alaska*, Alaska Department of Environmental Conservation, May 2005.

¹² A TMDL or Total Daily Maximum Load is defined by the EPA as “a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards”. See <http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/> for more information.

¹³ From Municipality of Anchorage Planning Department & Watershed Management Division. (Prepared by HDR Alaska, Inc.). *Chester Creek Watershed Plan Draft*. June 2005.

(December 2007), which was adopted by the Municipal Assembly in June 2008. The advisory group found the *Little Campbell Creek Watershed Plan* to be more streamlined with less detail—leaving more latitude on objectives and a good model. The *Little Campbell Creek Watershed Plan* goals were: water quality, water quantity, terrestrial habitat, aquatic habitat (in the Chester plan these two had been combined), recreational and economic opportunities, communication and coordination, and the addition of two new objectives: open space and data acquisition. The 2005 plan also provided a starting point for evaluation of issues, improvements, and actions, which resulted in prioritized lists that will be provided later in this plan.

Participants in the latest revision included: the MOA Watershed Management Services (WMS), the MOA Planning Department, the MOA Parks and Recreation Department, the Alaska Department of Environmental Conservation (ADEC), Joint Base Elmendorf-Richardson (JBER), the U.S. Fish and Wildlife Service (USFWS), the Alaska Railroad (AKRR), the Alaska Department of Fish and Game (ADF&G), Anchorage Waterways Council (AWC), HDR, Alaska Inc. (HDR), the U.S. Army Corps of Engineers (USACE), National Oceanic and Atmospheric Administration (NOAA), Anchorage Park Foundation (APF), Alaska Department of Transportation and Public Facilities (AKDOT&PF), the Environmental Protection Agency (USEPA), Alaska Department of Natural Resources (ADNR), Bureau of Land Management (BLM), Alaska Pacific University (APU), and KPB Architects.

Vision, Mission, and Goals for the Chester Creek Watershed Plan:

The **Vision** is, “*The Chester Creek Watershed is a system that promotes and enhances healthy neighborhoods, businesses, and habitats*”.

The **Mission Statement** is, “*The mission of the Chester Creek Watershed Plan is to guide community decisions within the Chester Creek Watershed in order to sustain and enhance environmental, social, and economic functions and values of the land and watercourse*”.

The **Goals** are:

	GOAL	OBJECTIVE
Water Quality	<i>Meet state standards for water quality in Chester Creek.</i>	<i>Reduce pollution from point and non-point sources.</i>
Water Quantity	<i>Return Chester Creek to a more natural hydrologic scheme.</i>	<i>Eliminate flood hazards, maintain flows for habitat, preserve and/or widen existing floodplains where necessary.</i>
Wildlife Habitat	<i>Provide habitat for diversity of wildlife along Chester Creek.</i>	<i>Maintain and enhance existing wildlife corridors, riparian habitat, greenbelts, and parks.</i>
Fish Habitat	<i>Provide for healthy fish and other aquatic organism populations in Chester Creek.</i>	<i>Provide habitat connectivity, quality, and diversity for all aquatic life stages.</i>
Social and Economic Opportunities	<i>Foster a high degree of social and economic opportunities.</i>	<i>Establish and build a connection between a healthier watershed and social and economic benefits to the community.</i>
Communication and Coordination	<i>Have a highly motivated and dedicated community and Municipality in maintaining the health of Chester Creek.</i>	<i>Promote community and municipal awareness and stewardship of Chester Creek.</i>
Data Acquisition	<i>Improve our understanding of the watershed.</i>	<i>Evaluate research needs, conduct studies, gather data, and share information.</i>

3. Watershed Characterization

Chester Creek, one of Anchorage’s three major urban creeks, bisects the Anchorage Bowl, with approximately one-third of the city north of the creek and two-thirds south. Before Anchorage was built in 1914, the local indigenous people were the *Dena’ina*, and this area was popular for fishing. The *Dena’ina* name for Chester Creek is *Chanshtnu*, or Grass Creek, which later was transliterated into “Chester”¹⁴. At that time, the watershed consisted of forest, peat bogs, glacial residue, and wetlands. In the 100 years since the birth of Anchorage, a growing population and expanded development have transformed the Chester Creek watershed into the most developed watershed in the Municipality with the highest human population (~37%) of Anchorage’s urban watersheds.

This characterization of the Chester Creek watershed includes summary information ranging from geographical and physical characteristics to land use and biotic quality. References for this information should be utilized to obtain more detailed information.

Location and Watershed Features

The Chester Creek watershed extends 21 miles from the Chugach Mountains to the creek’s mouth on Knik Arm at Westchester Lagoon. Its four subwatersheds and seven drainages (Table 3.1) consist of 37.8¹⁵ river miles. Each drainage has its own headwaters. The watershed consists of

¹⁴ Kari, J. and J.A. Fall, 2003, *Shem Pete’s Alaska*, Fairbanks: University of Alaska Press, p. 332.

¹⁵ MOA Hydrography Geodatabase, 2012.

approximately 19,532 acres (30.5 mi²)¹⁶. An estimated 12,583 acres are contained within the municipal boundaries and the remaining portion lies within Joint Base Elmendorf—Richardson (JBER) and Chugach State Park.

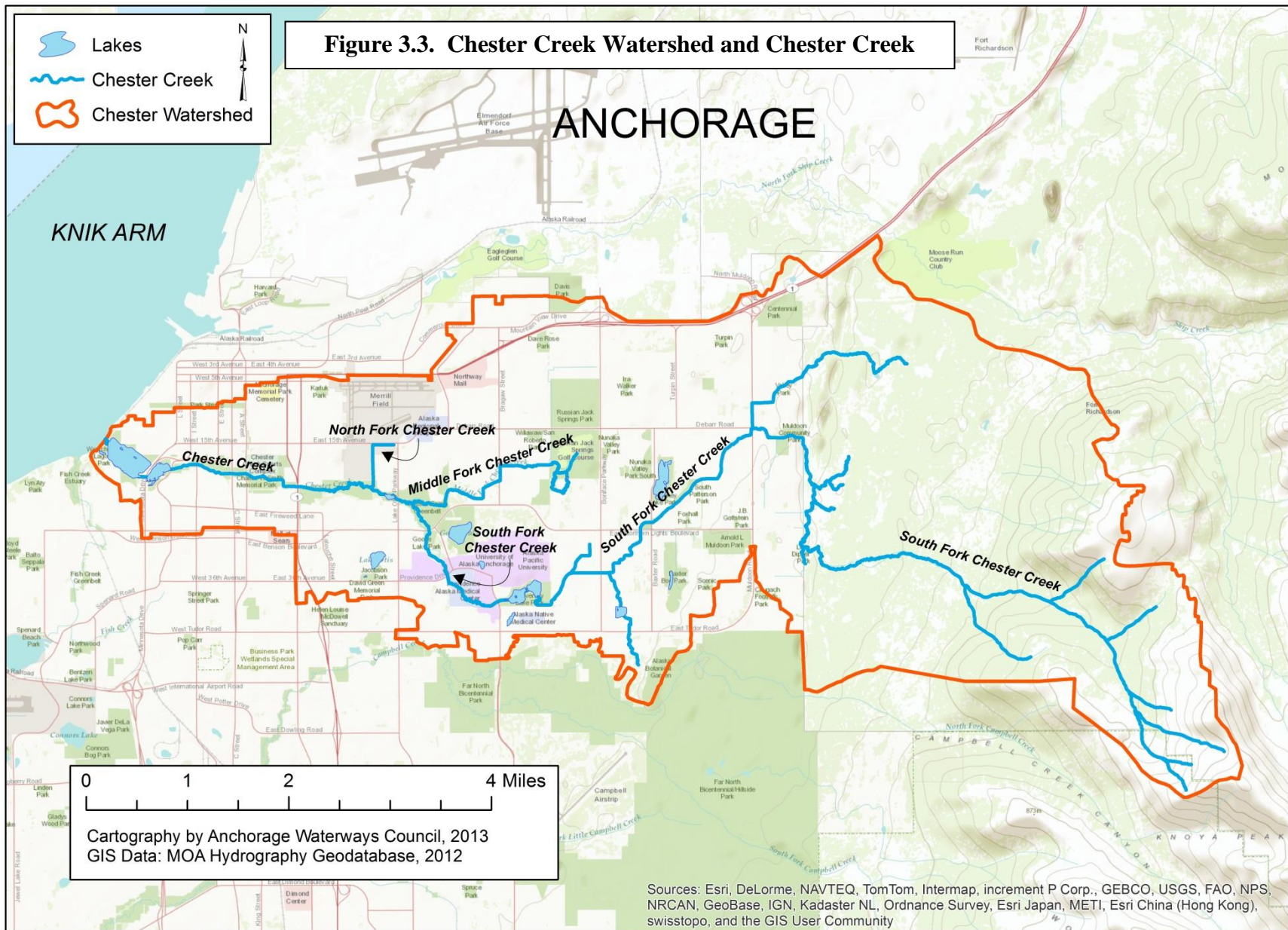


Figure 3.1. South Fork Chester Creek Leaving JBER (Military Lands) (2011)



Figure 3.2. Chester Creek Flowing out of Westchester Lagoon to Knik Arm (2013)

¹⁶ MOA Hydrography Geodatabase, 2012.



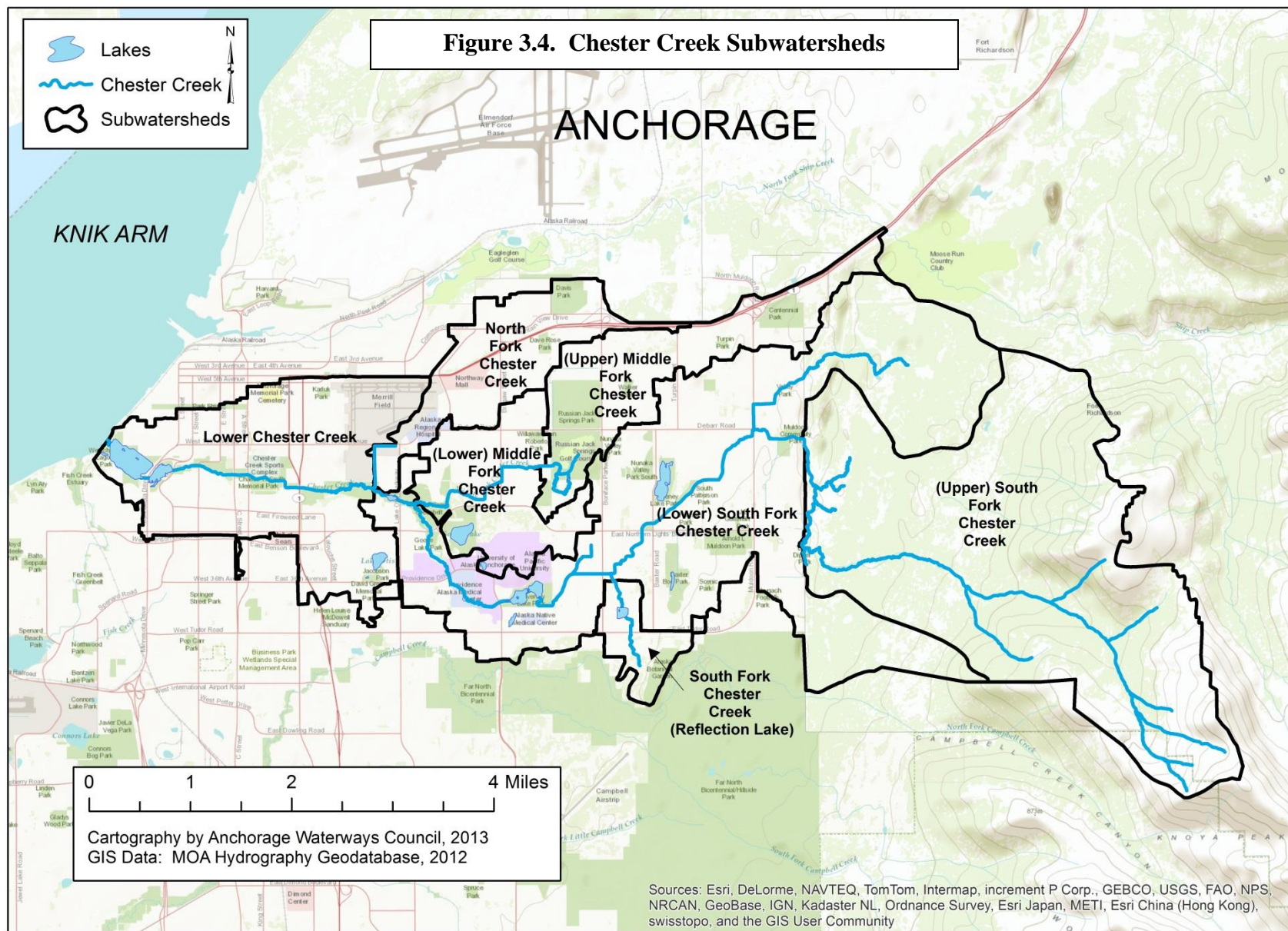
Subwatersheds and Creek Sections

- **Lower Chester Creek**, often called the “main stem”, begins where the North and South forks meet, and flows west through Anchorage. Lower Chester Creek creates an approximate division between the downtown and midtown areas of Anchorage. It flows to Westchester Lagoon and ultimately into Knik Arm, the northernmost branch of Cook Inlet.
- **North Fork** begins near Lake Otis Parkway, 15th Avenue, and Sitka Street by Merrill Field. The North Fork joins Chester Creek at the Chester Creek Greenbelt just west of Lake Otis Parkway and Hillstrand Pond, between Maplewood and E. 20th Avenue.
- **Middle Fork** emerges as a spring at Russian Jack Springs Park. It flows both south like a large “U”, then north where a reach of it flowing west joins it. It runs into the South Fork in an area just east of Lake Otis Parkway by the Davenport (ball) Fields.
- **South Fork** forms the main headwaters of Chester Creek. It originates in the Chugach Mountains on the Fort Richardson portion of JBER and drains a relatively undeveloped portion of the watershed in the Chugach foothills before reaching the Anchorage Bowl. The South Fork actually comprises two branches (north and south) that join near Muldoon Road and Debarr Road. From here, the South Fork flows southwest to University Lake, adjacent to Alaska Pacific University (APU). From the lake, the South Fork flows northwest through part of the University of Alaska Anchorage (UAA) campus until it joins the Middle Fork. Reflection Lake drainage is located near the southeast reach of the South Fork drainage. For management purposes, the Reflection Lake drainage has been combined with the South Fork in this plan. Reflection Lake itself is a small lake located just north of E. Tudor Road between Boniface Parkway and Baxter Rd. Reflection Lake does not appear on the 1962 U.S. Geological Survey Anchorage and Vicinity topographic map (1:24,000), and is a human-made lake.

Subwatershed	Drainage	Area in acres
Lower Chester Creek	Westchester	2,798.2
North Fork Chester Creek	North Fork	1,187.4
Middle Fork Chester Creek	Lower Middle Fork	1,203.0
Middle Fork Chester Creek	Upper Middle Fork	1,513.3
South Fork Chester Creek	Lower South Fork	6,265.3
South Fork Chester Creek	Upper South Fork	6,182.4
South Fork Chester Creek	Reflection Lake	382.11
Total		19,531.7

Table 3.1. Subwatersheds and Drainages of Chester Creek Watershed

Within Anchorage, all forks of Chester Creek are affected by development, channelization, and parts of certain forks are routed through the Municipal storm drain system. The South Fork has been straightened and diverted to a new channel through University Lake, which was created from a gravel pit. The Reflection Lake drainage appears to have been created after 1962.



Lakes

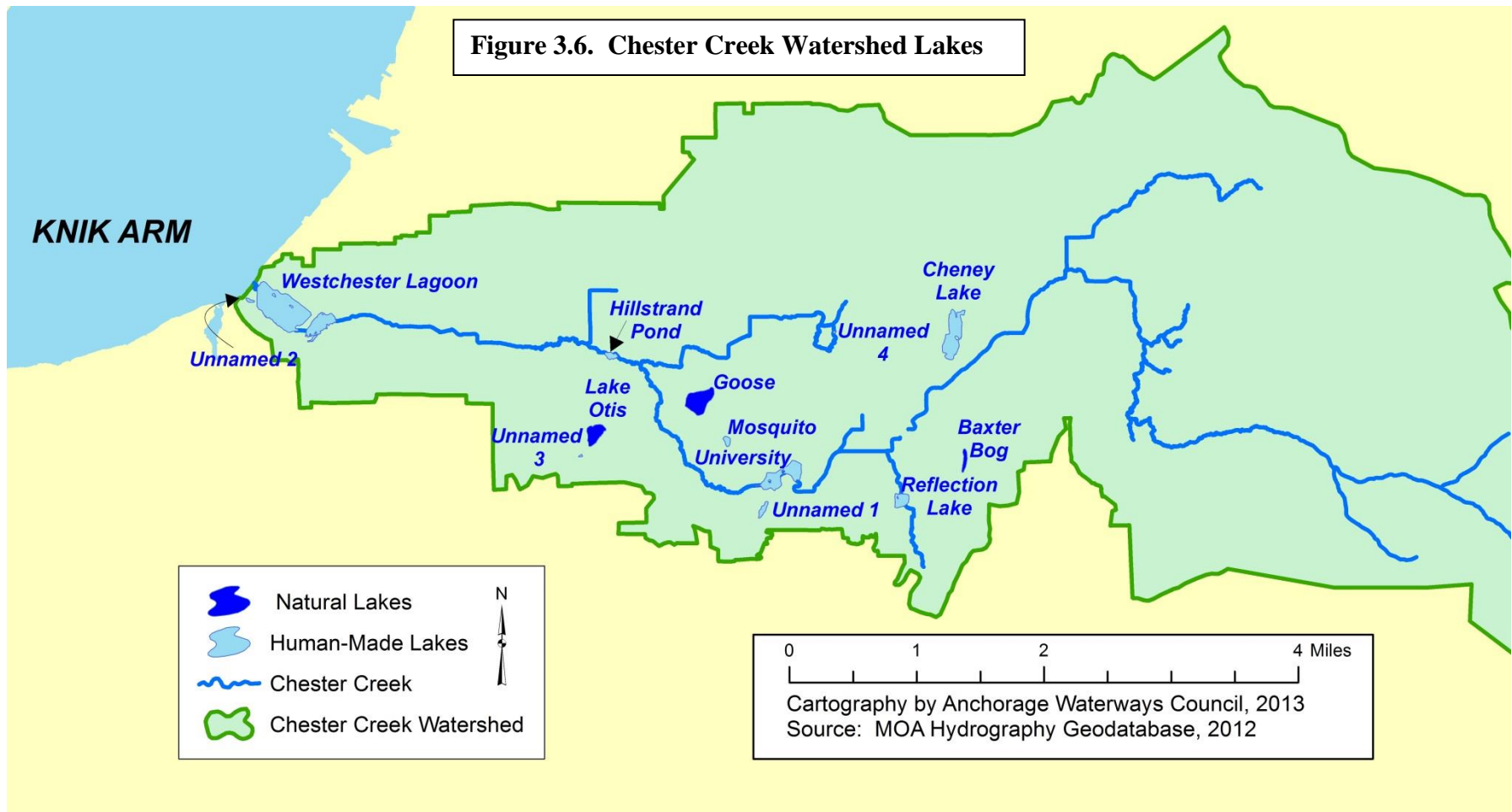
Lakes are another significant characteristic of the Chester Creek watershed. Nine named lakes are found within the watershed (Table 3.2). Four of the lakes are connected to Chester Creek: Westchester and East Westchester Lagoons, Hillstrand Pond, Reflection Lake, and University Lake (Figure 3.6), although several are human-made. In the 1980's Chester Creek was diverted to flow through a former gravel pit to create University Lake. Westchester Lagoon was created in the late 1960's and early 1970's by building a dike and then a tide gate at its mouth. In July 2008, the mouth of Chester Creek was redesigned with the tide gate removed, and a more natural outflow system that would enhance fish passage was installed.

Lake Name	Acreage	Origin
Westchester Lagoon/Eastchester Lagoon	75.4	Human-made (weir)
Cheney	24	Human-made (gravel extraction)
University (formerly Behm)	21.1	Human-made (gravel extraction)
Goose	19.0	Natural
Lake Otis	10.1	Natural
Reflection	6.6	Human-made (gravel extraction)
Baxter Bog	2.8	Natural
Unnamed 1	2.7	Human-made
Hillstrand Pond	2.5	Channel constriction (cause unknown)
Mosquito	2.0	Human-made ?
Unnamed 2	0.8	Human-made
Unnamed 3	0.2	Human-made
Unnamed 4	0.2	Human-made

Table 3.2. Chester Creek Watershed Lakes



Figure 3.5. Westchester Lagoon Looking East (2005)



Climate and Soils

The MOA has conducted analyses of climate for watershed planning and stormwater management, and the results have been incorporated within the MOA Design Criteria Manual¹⁷. Climate variation within the Chester Creek watershed is significant, as temperature and precipitation change dramatically with elevation gain. For example, municipal design criteria compensate for precipitation intensity variation by elevation using a multiplication factor up to 2.0 times the precipitation intensity that falls at the Anchorage airport compared to the upper reaches of Chester Creek¹⁸. Winter snowfall and lower temperatures can stay up to a month longer at elevations above 1,000 feet. Climate summaries are available from various sources such as the National Weather Service in Anchorage.

¹⁷ Municipality of Anchorage. Project Management and Engineering, 2007. *Design Criteria Manual*. The Municipality is currently seeking comment for updating the manual.

¹⁸ Dilley, L. and T. Dilley. *Guidebook to Geology of Anchorage, Alaska*. Anchorage: Publication Consultants, 2000.

From its headwaters, the creek flows through various landscape features of glacial origin before reaching its mouth at Knik Arm. Glaciation has been the major geological process in the watershed. Soils in the Chester Creek watershed are primarily the result of historic glacial processes. In the eastern section of the watershed where the creek flows down the foothills of the Chugach Range, thin layers of soil cover bedrock. The mid-portion of the watershed has soils that are primarily glacial in origin¹⁹. Parent materials are mostly sand, loess and other silts, and over-lying gravel, that have been deposited by eolian processes. In the flatter lowlands to the west, soils can be deeper than 30 feet and loamy in nature. The tidal plains at the mouth are clayey and silty sediments deposited by Chester Creek. Poorly drained bogs and fens occupy broad depressions throughout the watershed.

Natural Vegetation

Natural undeveloped areas of the Chester Creek watershed are important for moderating water flow, improving and protecting water quality, evapotranspiration, providing wildlife habitat, and enhancing quality of life. During rainfall and breakup, water runs into natural low lying areas before reaching creeks or lakes. Natural vegetation, especially in wetlands, holds water and releases it slowly over time into the creek and lakes. Thus, natural areas moderate stream flow by providing flood storage and energy dissipation during storm events. Because natural vegetation slowly releases water to streams and lakes, it provides base flow during periods when the creek is low. These areas also improve water quality by acting as a natural treatment system—trapping sediment, retaining or removing nutrients, and increasing the amount of dissolved oxygen in the water column.

Vegetation in the Chester Creek watershed varies with elevation, soil type, aspect, water table level, and drainage. Mixed coniferous (primarily white and black spruce) and deciduous (willows, birch, cottonwoods, and aspens) forests dominate the well-drained soils in the upper reaches of the eastern part of the watershed. Dwarf dogwood, moss, and grasses and sedges are found on the ground below. In other areas, cottonwood and birch trees grow above willow and alder shrubs. Fireweed, grasses, and sedges provide the primary ground covers in these areas. In many places, as native vegetation has been removed, invasive plant species, such as White Sweetclover (*Melilotus alba*), Bird Vetch (*Vicia cracca*), and Common Toadflax (*Linaria vulgaris*), have increased.

Wetlands were commonly found in the more poorly drained lowland areas to the west, but few remnant wetlands are still present, mainly along creeks. These wetlands have been inventoried and documented in the *Anchorage Wetlands Atlas, 2008*²⁰, as well as in Municipal GIS shapefiles.²¹ A variety of wetland types are found in the Chester Creek watershed, including the following:

- **Shrub bogs** with willows, alders, and other shrubs. The wetlands near the North Fork south of Merrill Field are a good example of this wetland type.
- **Spruce bogs** (or needleleaf forest wetlands) with black and white spruce. This type is evident near the University of Alaska Anchorage and Alaska Pacific University campuses.
- **Bog meadows** (or wet graminoid herbaceous wetlands) with grasses and sedges. Such wetlands are found near Westchester Lagoon.

¹⁹ U.S. Department of Agriculture. *Soil Survey of Anchorage Area, Alaska*. 2001.

²⁰ At <http://anchoragewatershed.com/datalibrary.html>. It has been updated to 2012, but that has not been approved by the MOA Assembly as of this writing.

²¹ *MOA Hydrography Geodatabase*, 2012.

As Anchorage has grown, wetlands have been filled or drained to provide land for development. In 1950, wetlands made up 42% of the Chester Creek watershed area. Steer estimated that of the wetlands extant in 1950, by 1999 they had been reduced by 74% or 2,831 acres²². Today, wetlands account for just 5% or about 1,065 acres of the entire Chester Creek watershed²³ (Figure 3.7).

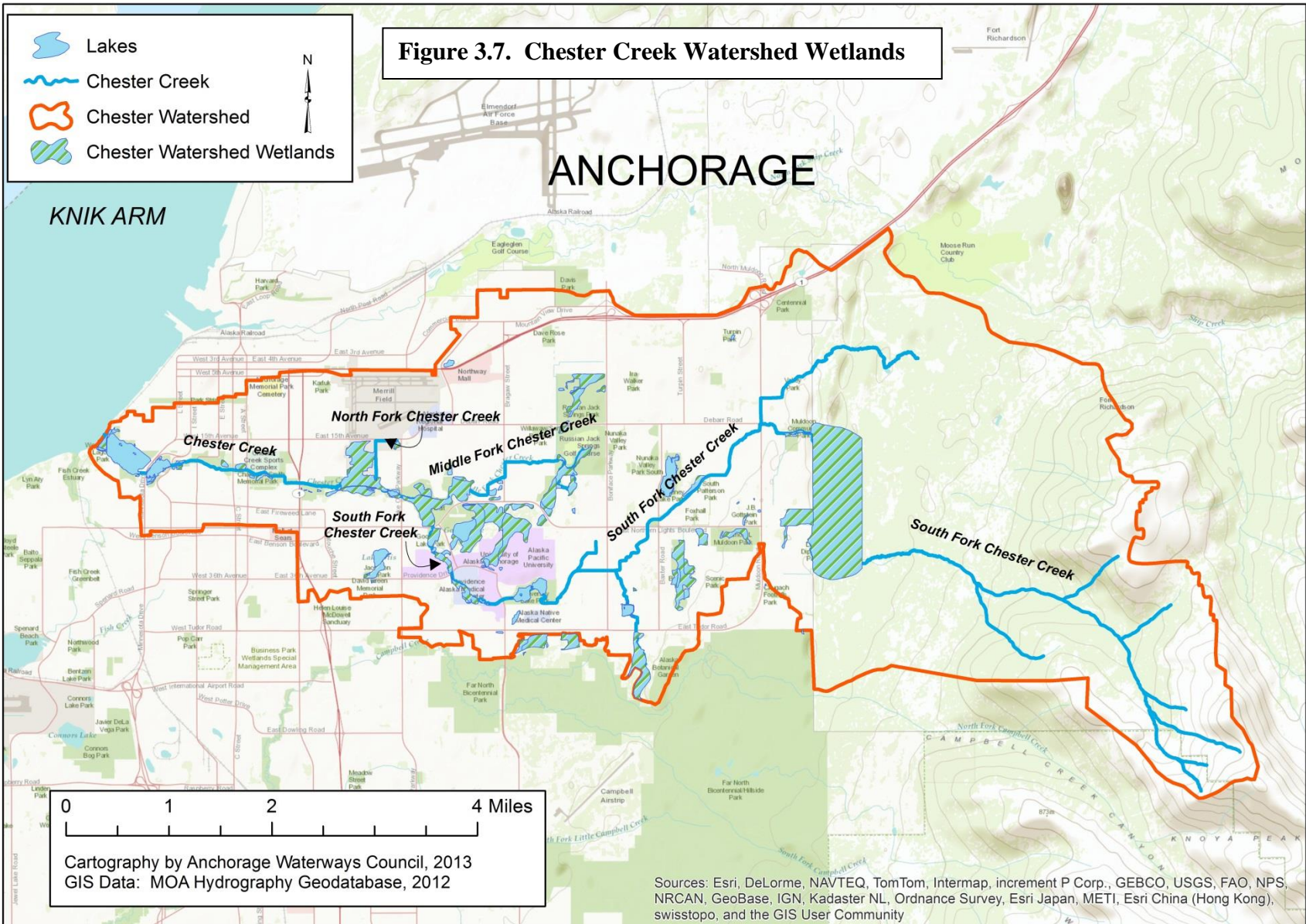
The riparian zone is the interface between land and a river, stream or lake, and it, along with wetlands, is essential to the survival of salmon and other fish. Riparian areas often correspond with the active floodplain, the lowland bordering a waterbody that is subject to flooding. Although the riparian zone makes up a relatively small percentage of a watershed, it is a crucial component of the ecosystem. The riparian zone provides important fish and wildlife habitat, areas of ground water recharge, flood control, and water quality protection. In undeveloped areas, riparian zones are wide enough to allow the channel to meander naturally. This riparian buffer area is typically seven to ten times the width of a stream or creek. It accommodates the winding of the stream as it travels toward its mouth.

Riparian quality varies drastically within the Chester Creek watershed. The creek is considered a medium-sized stream and is estimated to need a 125-foot wide riparian buffer zone on each side of the stream channel. The current Anchorage Municipal Code protects a 25-foot stream setback area, although there has been much citizen and scientist involvement trying to expand this in the Municipal Code's Title 21. In areas where a stream is directly associated with a wetland, this setback may be wider, up to 100 feet. Along many areas of Chester Creek, development extends right to the edge of the creek. However, in the Municipal greenbelt within the Chester Creek watershed, there are many areas that provide buffer zones and protect the riparian corridor.

Although highly modified, the Middle Fork drainage retains decent riparian quality. Functioning riparian zones are almost non-existent in the upper two-thirds of the South and North Forks of Chester Creek within the Municipal boundaries. The headwaters of the Reflection Lake tributary have a significant amount of undeveloped riparian area remaining. The riparian zone along the lower end of Chester Creek, where dense development predominates, contains only a few isolated, undeveloped riparian areas.

²² Steer, M. Anjanette, 1999, pp. iv.

²³ *MOA Hydrography Geodatabase*, 2012.



Fish and Wildlife

Anchorage residents enjoy the diversity and abundance of fish and wildlife that are present in the Chester Creek watershed. Wildlife makes living in Anchorage interesting and special. The Chester Creek watershed contains many of the mammals and birds typical of Anchorage. As these animals move through the watershed, they encounter roads and development where there are conflicts and vehicular collisions. Providing corridors for these animals is important to maintain population numbers and to reduce accidents. Some information on these corridors is provided in the Alaska Department of Fish and Game's (ADF&G) *Living with Wildlife in Anchorage: A Cooperative Planning Effort* (2000), and *Technical Report on Significant Open Space in the Anchorage Bowl: A Survey of Biologically Important Habitat and Areas Identified As Important to the Anchorage Community*²⁴.

A variety of fish, wildlife, and bird species inhabit the watershed. These include moose, coyote, red fox, lynx waterfowl, songbirds, and four native salmon species. Chester Creek wildlife not only adds to the quality of life for residents of Anchorage, it also boosts the economy. Many visitors come to Anchorage to experience the city's unique wildlife. Most Anchorage residents have had the experience of trying to find a moose to show visiting friends or relatives.

Westchester Lagoon provides some of Anchorage's first open water in the spring, attracting many migratory birds. Canada Geese (*Branta canadensis*), Great Scaup (*Aythya marila*), Barrow's Goldeneye (*Bucephala islandica*), Mew Gull (*Larus canus*), Green-winged Teal (*Anas carolinensis*), and American Wigeon (*Anas americana*) are just some of the birds that rest, nest or rear young on the lagoon. The lagoon is the most prolific site for Red-necked Grebes (*Podiceps grisegena*) and the second most productive site for Mallard Duck (*Anas platyrhynchos*) nesting in the Anchorage area. It provides a fall and early winter home for the large number of mallards that reside year-round in the Anchorage area. The diversity and concentration of birds around the lagoon draw birders from across the country.

Coho (*Oncorhynchus kisutch*), Pink (*Oncorhynchus gorbuscha*), Dolly Varden (*Salvelinus malma*) and Rainbow Trout (*Oncorhynchus mykiss*) have been documented in Chester Creek²⁵ and much of Chester Creek is classified by the ADF&G as anadromous fish habitat (Figure 3.12). Reports have been made of Chinook (*Oncorhynchus tshawytscha*), and Sockeye (*Oncorhynchus nerka*) salmon as well.

In the early 1970s when the weir and culverts were built at the mouth of Chester Creek, an ineffective fish ladder was also placed in the area, and the result was a great reduction in a once strong return of Coho Salmon and Dolly Varden²⁶. In the intervening years, pipelines owned by the Anchorage Water and Wastewater Utility (AWWU), Tesoro Alaska Petroleum Company, and the Anchorage Fueling and Service Company (AFSC), which is now known as Aircraft Services International Group (ASIG), were constructed in the fill over the culverts that connected the dam and weir. The result of all this construction and constriction at Chester Creek's mouth was "severely restricted fish passage between Cook Inlet and Chester Creek"²⁷. It had a cascading effect due to fill in the upstream channel which restricted salinity changes [needed by fish] that had occurred previously in

²⁴ Great Land Trust, December 1999, Anchorage, AK.

²⁵ Johnson, J. and M. Daigneault. 2013. *Catalogue of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes—Southcentral Region, Effective July 1, 2013*

²⁶ U.S. Army Corps of Engineers, 2004. *Section 206 Ecosystem Restoration Report and Environmental Assessment, Chester Creek, Anchorage, Alaska*, p. 1.

²⁷ *Ibid.*, p. 5.

the intertidal zone, leading to a loss in species diversity, increased colonization of salt-tolerant “weedy” plants, and the likelihood of decreased bird use and diversity²⁸. The primary issue for the previous large runs of Coho Salmon, Dolly Varden, and probably Pink Salmon, was their near extinction in Chester Creek from the dam and weir²⁹. Using Section 206 of the Water Resources Development Act of 1996, the degraded aquatic ecosystem was studied to see if this area could be returned to a more natural condition which would improve anadromous fish passage. The results were a set of alternatives, with the preferred alternative being the construction of an open channel from the lagoon under the trestle bridge to Cook Inlet³⁰. Several agencies coordinated the effort, and in 2009 the “Chester Creek Aquatic Restoration Project” was completed.

It is important to note that although Chester Creek has a multitude of problems within the Municipal boundaries that need to be fixed, it was decided that there was basically no point to focus on them until some sort of solution had taken place at the mouth since so few fish were able to get upstream, and this usually only occurred during extreme high tides. In 2008, Dr. Rusty Myers of Alaska Pacific University (APU) was funded to set up a video monitoring station at Westchester before construction began to establish a baseline of fish numbers escaping into Westchester Lagoon³¹. By 2009, estimates were that four times the number escaped into Westchester Lagoon during the first year alone³².

Table 3.3 Salmon Counts for Sampled Years³³

Year	Salmon Count
2008	481
2009	1704
2010	No count
2011	1743
2012	1752
2013	2481

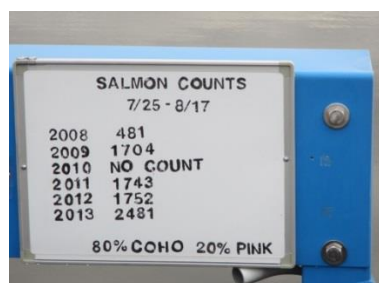


Figure 3.9. Salmon Counts by APU



Figure 3.8. Outflow of Westchester Lagoon Where Fish Escapements Were counted by APU

²⁸ Ibid.

²⁹ Ibid., p. 1.

³⁰ Ibid., p. 39.

³¹ Amman, E., NOAA. “Chester Creek Video Monitoring and Habitat Restoration”. 2008 http://alaskafisheries.noaa.gov/habitat/restoration/chestercreek_videoprj.pdf.

³² Myers, R., 2010. “Salmon Escapement into Chester Creek Before and After Habitat Restoration”, paper presented at the 2010 AWRA Alaska Section Conference.

³³ These figures are taken from the sign posted by Alaska Pacific University at the counting area (the outflow of Westchester), and were confirmed by Dr. Rusty Myers, (personal communication, January 21, 2014). See Figure 3.9.

Other fish found in the creek include stickleback, both Threespine Stickleback (*Gasterosteus aculeatus*) and Ninespine Stickleback (*Pungitius pungitius*)³⁴, Slimy Sculpin (*Cottus cognatus*), and Pacific Lamprey (*Lampetra tridentata*). Alaska Blackfish (*Dallia pectoralis*)³⁵, apparently have been introduced into the Chester Creek watershed, contrary to state law, and have been found in University Lake, Goose Lake, and Lake Otis. Because blackfish are found in University Lake, they have the potential of spreading through the whole Chester Creek system.³⁶ To date, Northern Pike (*Esox lucius*) have only been found in Cheney Lake, and an eradication program was conducted in 2008 although 4 pike were found in 2011. It is believed that they were illegally introduced and ADF&G still believes Cheney Lake to be pike-free³⁷. The ADF&G introduced Rainbow Trout into Chester Creek between 1971 and 1973 to establish a reproducing population, which was estimated at 7 fish per stream mile in 1974 and 368 per stream mile in 2001³⁸.



Figure 3.10. Coho Fry in Chester Creek



Figure 3.11. Spawning Coho in Chester Creek³⁹

³⁴ Dr. Frank von Hippel, (personal communication, December 24, 2013).

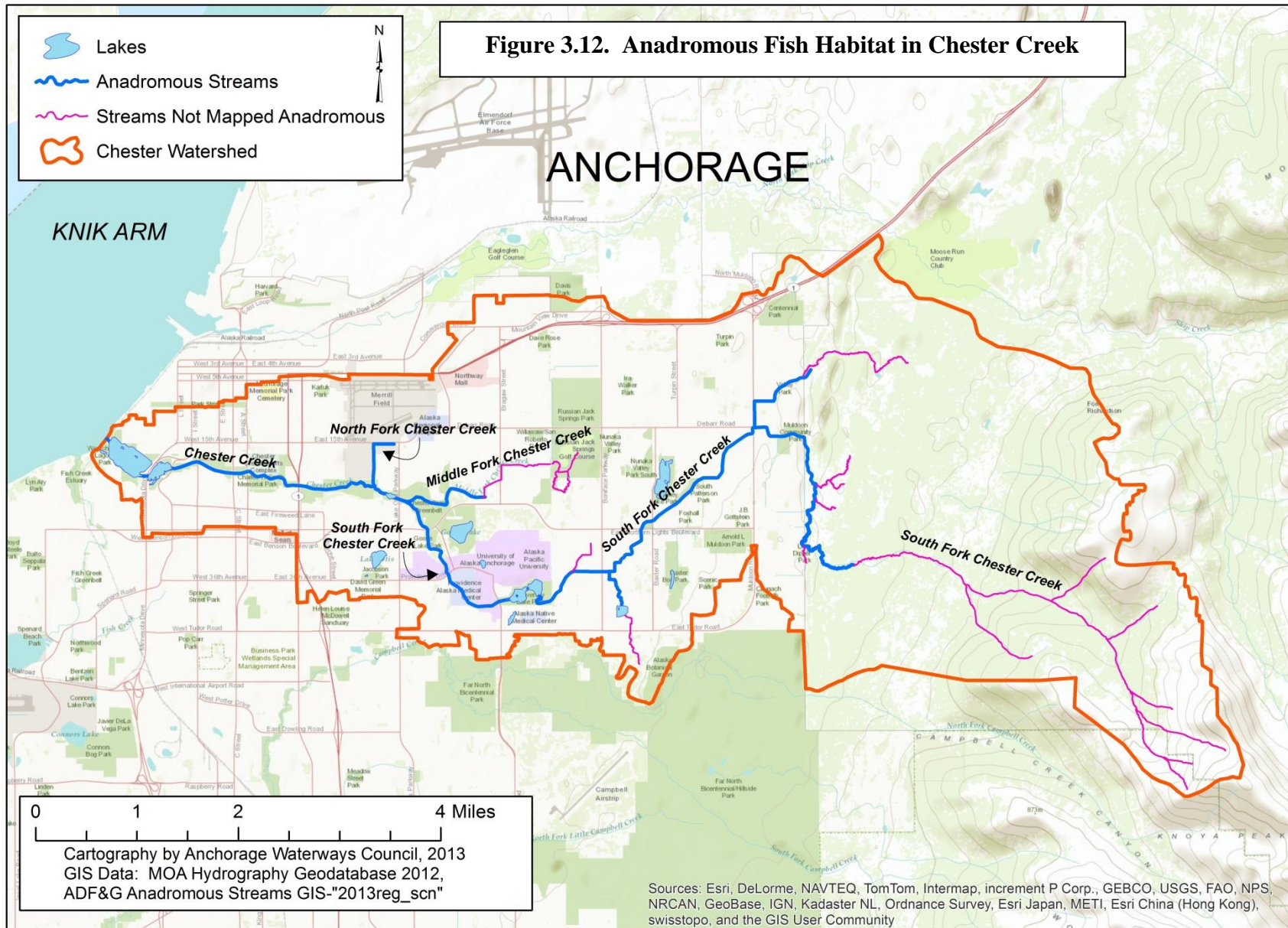
³⁵ Alaska Department of Fish and Game. 1994. *Alaska Blackfish*. http://www.adfg.alaska.gov/static/education/wns/alaska_blackfish.pdf.

³⁶ Chlupach, R.S. 1975. *Studies of introduced blackfish in waters of southcentral Alaska*. Annual Performance Report for Sport Fish Studies, volume 16, study G-II-K. Alaska Department of Fish and Game.

³⁷ Dunker, K. (ADF&G), (personal communication, November 8, 2013).

³⁸ Davis, J.C. and G. A. Muhlberg, *Chester Creek Stream Condition Evaluation*, Alaska Department of Fish and Game, Technical Report No. 01-7, July 2001, p. 29.

³⁹ Both photos courtesy of Shawna Nieraeth.



Aquatic Macroinvertebrates: Aquatic macroinvertebrates are good indicators of stream quality because they are affected by the physical, chemical, and biological conditions of the stream, are unable to escape pollution, and can show the effects of short- and long-term pollution events as well as cumulative impacts. The effects of habitat loss which might not be detected by traditional water quality assessments may be apparent. Macroinvertebrates are important because they are a critical part of the stream's food web, and some are very intolerant of pollution—thus will be absent or in low numbers when doing an assessment. Finally, they are relatively easy to sample and identify at a very reasonable expense⁴⁰. Available studies on Chester Creek macroinvertebrates conclude, as would be expected, that the less pollution-tolerant species are found further upstream, and the more pollution-tolerant reside downstream. Results from Ourso's and Frenzel's⁴¹ determinations were that there was a fairly even distribution of the five major macroinvertebrate groups near Tank Trail⁴², but the non-insect group (worms especially), were predominant downstream at their Arctic Blvd. test location. Davis and Muhlberg's report⁴³ states that there were no longitudinal trends in the metrics except for the percent of Ephemeroptera (mayflies) at their upstream monitoring stations compared to the lower stations around Arctic Blvd. Additionally, they found that there was a significant difference between the communities found at channelized sites vs. non-channelized sites. Oligochaeta (a class of worms that live in terrestrial and aquatic environments) were highly prevalent at channelized sites (40%-70%), but never more than 30% in non-channelized sites⁴⁴.

Hydrology, Water Quantity, and Flooding

Stream flow in Chester Creek varies on a seasonal basis. During winter, stream flow is sustained by groundwater that seeps into the creek. Several areas of the creeks are prone to frequent icing, and MOA maintenance staff document these areas for regular maintenance. Snowmelt in the mountains, beginning in May and continuing through summer, contributes considerably to flow. Flow declines throughout summer until rainfall in July and August increases flow. Base flow occurs during the frozen winter months and summer months. Figure 3.13 shows the mean monthly flow (cubic feet per second) for the years 1966 to 2012⁴⁵.

⁴⁰ For more information, see U.S. Environmental Protection Agency. <http://water.epa.gov/type/rsl/monitoring/vms40.cfm>

⁴¹ Results are reported in Glass, R.L. and R.T. Ourso, 2006, *Water Quality Conditions of Chester Creek, Anchorage, Alaska, 1998-2001*. U.S.G.S., Report 2006-5229, p. 25.

⁴² Tank Trail is considerably upstream on the S. Fork of Chester Creek about a mile east of Muldoon Rd.

⁴³ Davis, J.C. and G. A. Muhlberg, *Chester Creek Stream Condition Evaluation*, Alaska Department of Fish and Game, Technical Report No. 01-7, July 2001, pp. 17 & 23.

⁴⁴ *Ibid.*, 17

⁴⁵ U.S. Geological Survey. *USGS 15275100 CHESTER C AT ARCTIC BOULEVARD AT ANCHORAGE AK*. 2014. http://waterdata.usgs.gov/usa/nwis/uv?site_no=15275100.

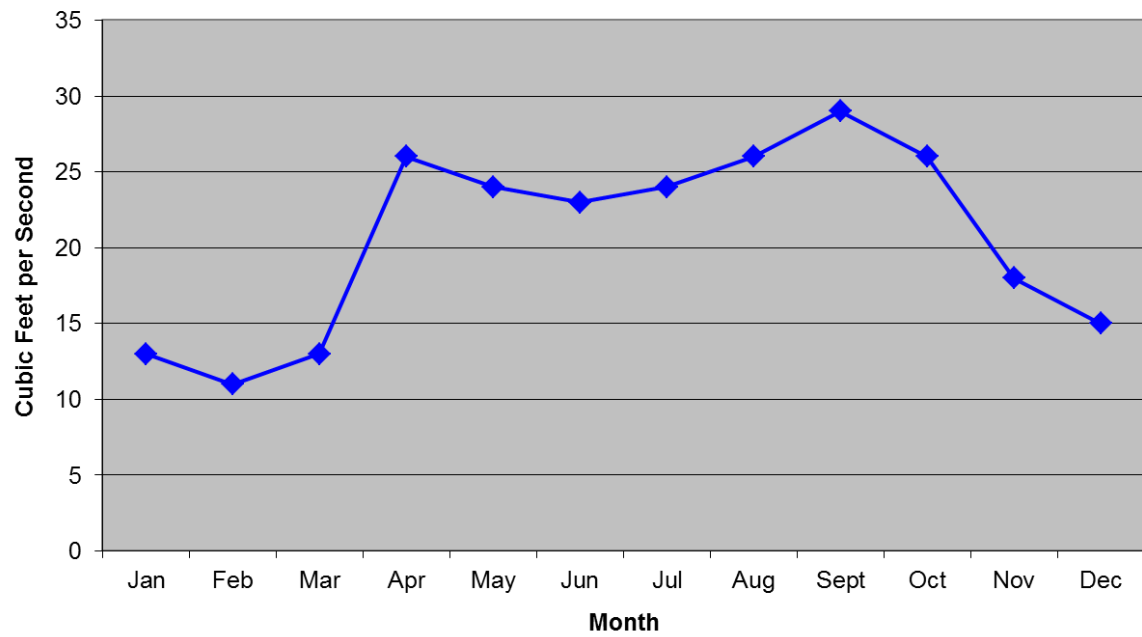


Figure 3.13. Mean Monthly Discharge of Chester Creek at the Arctic Blvd. Gage Station, (USGS15275100), 1966 to 2012

Figure 3.14 graphs the USGS annual flow data for Chester Creek by year from 1967 to 2011⁴⁶, which shows high water in 1989 and 1990⁴⁷

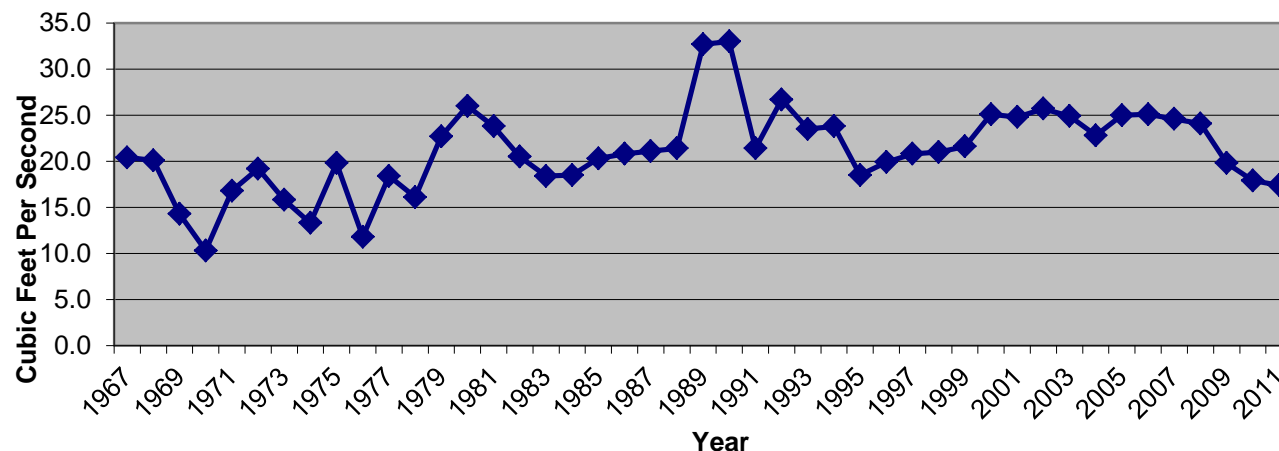


Figure 3.14. Mean Yearly Flow in Chester Creek at the Arctic Blvd. Gage Station, 1967 to 2011

Water quantity refers not just to the amount of water that flows down a stream, but also to the frequency, duration, timing, and rate of change of that flow. Such variations in water quantity are often referred to as the “flow regime”. Flow regimes are a defining factor in ecosystems and an integral part of stream health. Flows increase after a rain or during breakup into the creek especially because of increased impervious surfaces. In drier times, the creek relies on base flow from its headwaters, wetlands, and groundwater. Currently, there are no instream flow reservations for aquatic habitat⁴⁸, although water discharges, mostly from drilled wells, have been permitted within the Chester Creek watershed by ADN⁴⁹.

A reservation of water for in-stream use is a water right that protects specific in-stream water uses, such as fish spawning or recreation. It sets aside water volumes necessary for these specific activities and keeps subsequent users of creek water from appropriating water that may affect the in-stream activity. Water can be reserved for one or more permissible uses on a particular part of a stream or lake during a certain period of time. Under Alaska Statutes 46.15.145, permissible uses include:

- Protection of fish and wildlife habitat, migration, and propagation
- Recreation and parks
- Navigation and transportation
- Sanitation and water quality

⁴⁶ U.S. Geological Survey *USGS 15275100 CHESTER C AT ARCTIC BOULEVARD AT ANCHORAGE AK*. 2014. http://waterdata.usgs.gov/usa/nwis/uv?site_no=15275100 .

⁴⁷ Ibid.

⁴⁸ Thomas A. Cappiello, ADF&G, (personal communication May 11, 2011).

⁴⁹ For discussion on water rights and temporary use authorizations, see *Water Rights and Temporary Use Authorizations*. 2013. http://dnr.alaska.gov/mlw/mapguide/wr_intro.cfm.

According to documents provided by ADNR, well water is used for cooling several buildings (primarily institutional users, such as UAA, Providence Hospital, and the Alaska Native Medical Center, in the “U-MED” district⁵⁰). The discharged water goes either directly into the MOA’s storm drain system where it will “commingle with other storm water, with eventual outfall (via overland flow) to Chester Creek”⁵¹ as noted on the 2013 permit issued for UAA’s Allied Health Science Building or into Chester Creek or University Lake, which is a permitted outfall from the Alaska Native Medical Center that discharges directly at the south shore of University Lake. The new UAA Sports Arena, under construction at Elmore and Providence at the time of writing, applied for a Temporary Water Use Permit (TWUP)⁵² in 2013. Overall there are 11 permits that have been issued or are pending. ADNR has provided a map, Figure 3.15, that depicts wells and injection points as of Feb. 25, 2014.

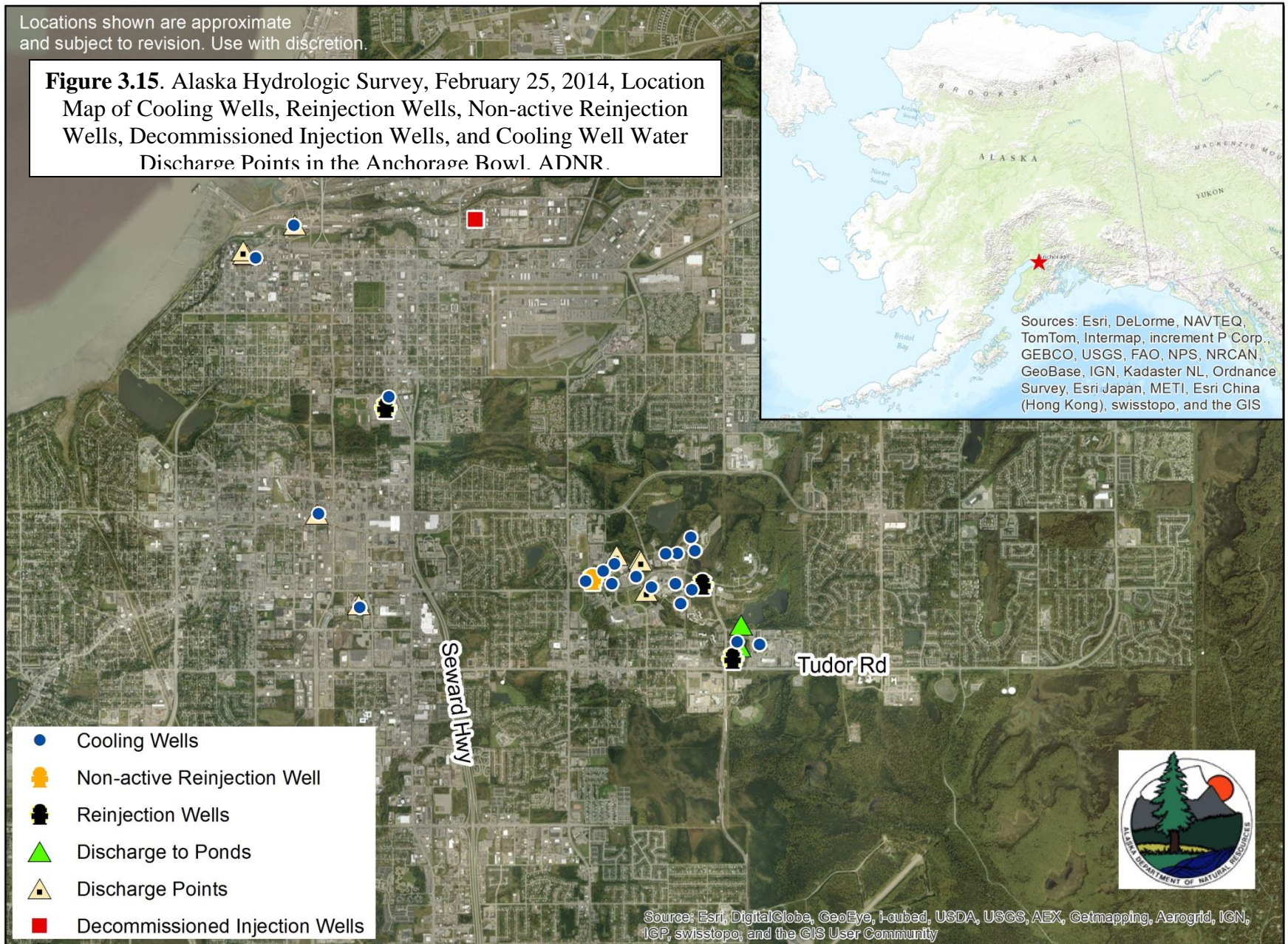
⁵⁰ The “U-Med” area is an 1,130 acre planning district composed of 2 universities and 2 hospitals. www.muni.org/Departments/OCPD/Planning/Documents/UMedExecSum.pdf

⁵¹ ADNR Case Abstract: TWUP, File A2013-38. This is for the UAA Allied Health Science Building. Search at: http://dnr.alaska.gov/mlw/mapguide/wr_intro.cfm.

⁵² ADNR Case Abstract: TWUP, File A2013-28. Search at: http://dnr.alaska.gov/mlw/mapguide/wr_intro.cfm.

Locations shown are approximate and subject to revision. Use with discretion.

Figure 3.15. Alaska Hydrologic Survey, February 25, 2014, Location Map of Cooling Wells, Reinjection Wells, Non-active Reinjection Wells, Decommissioned Injection Wells, and Cooling Well Water Discharge Points in the Anchorage Bowl. ADNR.



Map generated by Melissa Hill, 02/25/2014, Alaska Hydrologic Survey



0 0.75 1.5 3 Miles



Source: Esri, DigitalGlobe, GeoEye, I-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



**Fig 3.16 Discharged Water from the Alaska Native Medical Center
Outflow Bubbling into University Lake, (2010)⁵³**

As the Chester Creek watershed became urbanized, much of its natural vegetation and top soil was replaced by impervious surfaces such as roads, parking lots, and pavement, or has been compacted for lawns. These surfaces reduce the ability of the land to absorb and filter incoming rain and pollution, and allow water to flow quickly to the creek, altering the flow regime. Additionally, development has typically diverted the creek to the margin of properties. Some of these developments have changed the dimension, pattern and profile of certain creek reaches, and it has had to reach a new equilibrium with the speed and volume of water it experiences. The altered regime in urbanized areas consists of higher and more frequent peak flows that can cause higher rates of bank erosion and lower base flows. The urbanized hydrology also likely contributes to increases in bank erosion as easily erodible peat streambanks are common in the Chester Creek watershed. Preserving and protecting native soils and the prevention of topsoil stripping and soil compaction are important aspects for watershed planning.

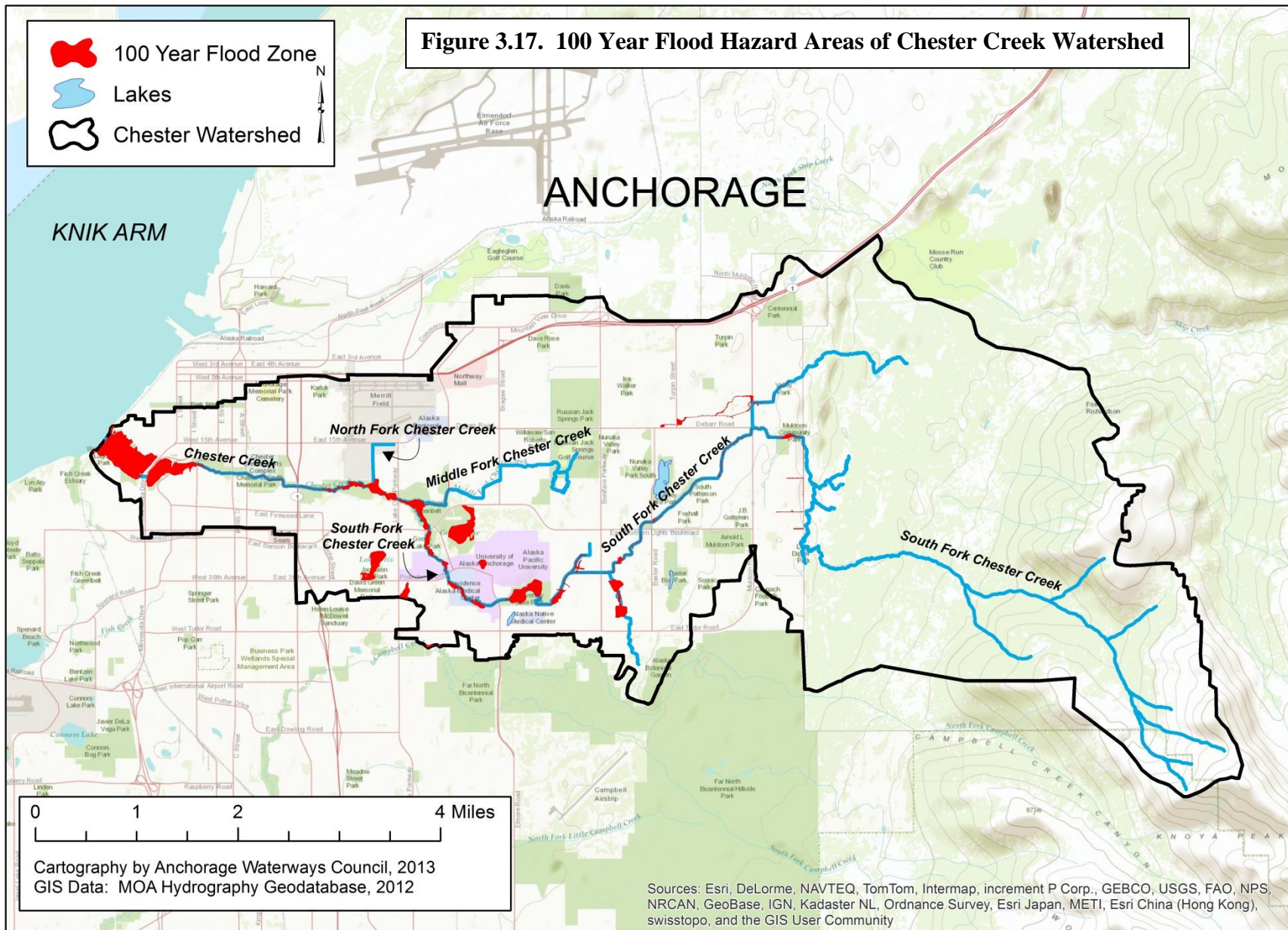
Residents and resource agency representatives are concerned about both high and low flow levels in Chester Creek. Flooding is a concern in some parts of the watershed because it can negatively affect fish, wildlife, habitat, property, access, and aesthetic quality. About 1.7%⁵⁴ of the watershed falls within the 100 year flood hazard area designated by FEMA⁵⁵ (Figure 3.17). Current flood hazard mapping is available for areas that have been mapped, but the user is cautioned to obtain the most recent information from the Municipal Flood Hazard Program⁵⁶.

⁵³ Dan Southard, MOA Street Maintenance Superintendent (personal communication, September, 21, 2010).

⁵⁴ Jeff Urbanus, MOA Watershed Management Services, (personal communication, January 24, 2014).

⁵⁵ Federal Emergency Management Agency

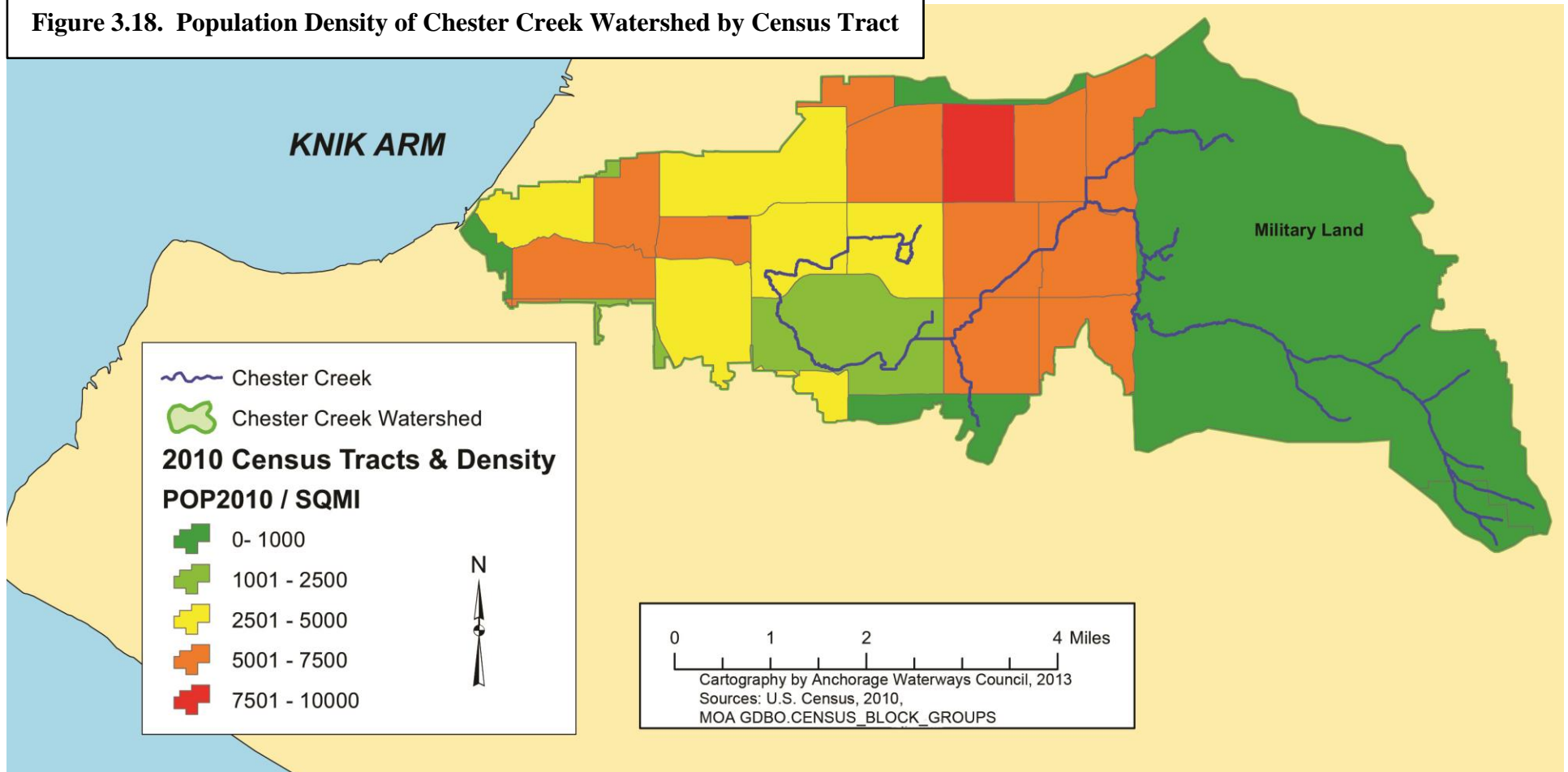
⁵⁶ See *Floodplains* at <http://www.anchoragewatershed.com/floodplains.html> .



Human Population

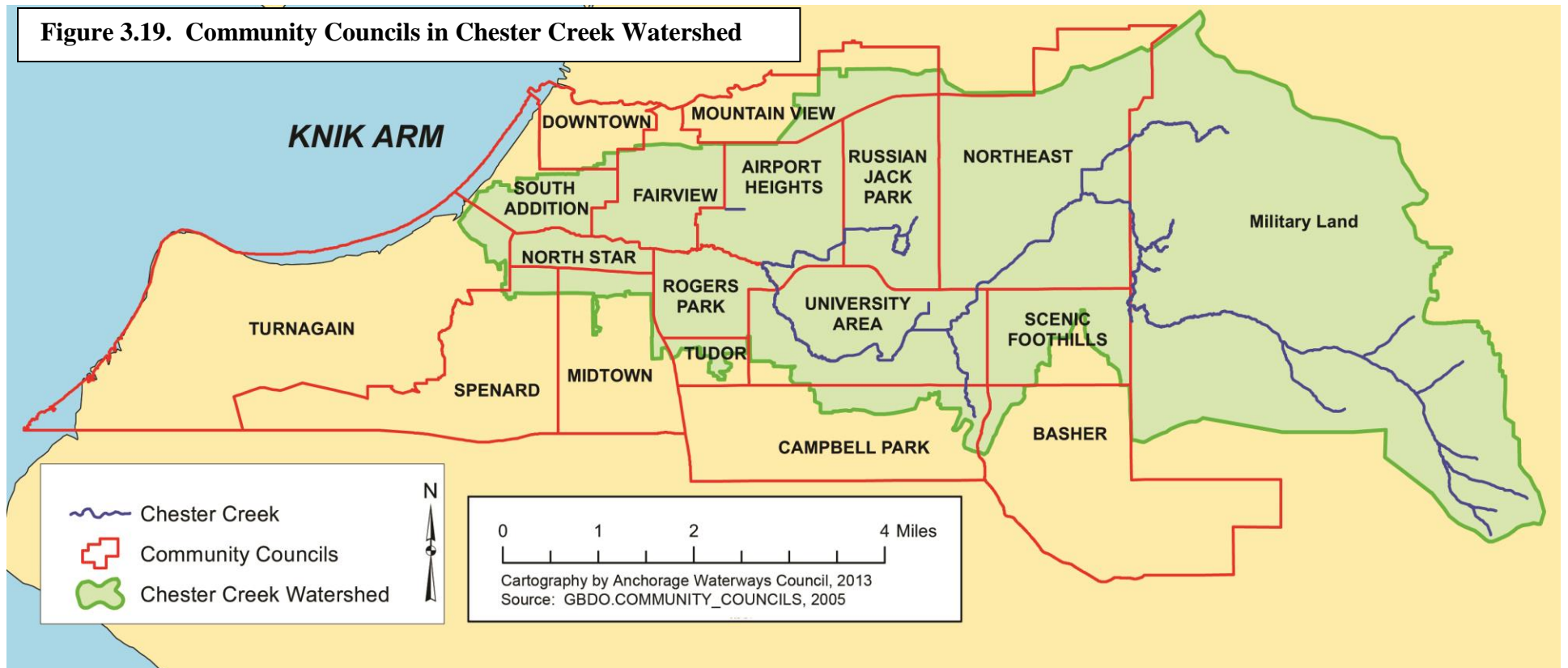
The 2010 U.S. Census⁵⁷ statistics show that approximately 108,985 people lived in the Chester Creek watershed or approximately 37.3% of Anchorage's population. This percentage is up about 25% as indicated by the 2000 U.S. Census. Figure 3.18 shows the estimated density by square mile by Census Tract.

Figure 3.18. Population Density of Chester Creek Watershed by Census Tract



⁵⁷ U.S. Department of Commerce, Bureau of the Census, *United States Census, 2010*.

The Chester Creek watershed is covered by 13 Community Councils (Figure 3.19).



Land Use

As shown in Table 3.4, the dominant land use in 2008 in the Municipal part of the watershed is Rights of Way (ROW) followed by residential. Residential, institutional, vacant and industrial densities tend to be evenly distributed throughout the watershed, while commercial density is highest in the Midtown area. Some military land use is in the northeast section and consists of JBER lands. Relatively little open space was identified in 2008 within the Chester Creek watershed with about 15.3 % of the total area undeveloped (Park and Vacant). Only 5.3% of the land in the watershed is considered vacant, and whether or not it is developable would be on a case by case basis.

Land Use Category	Acreage	% of Watershed Area
Residential	4,252	26
Commercial	813	5
Industrial	319	2
Institutional	1,922	11
Park	1,586	10
Transportation	260	2
Right-of-way	5,772	35
Military	718	4
Vacant	829	5
TOTAL	16,471	100%

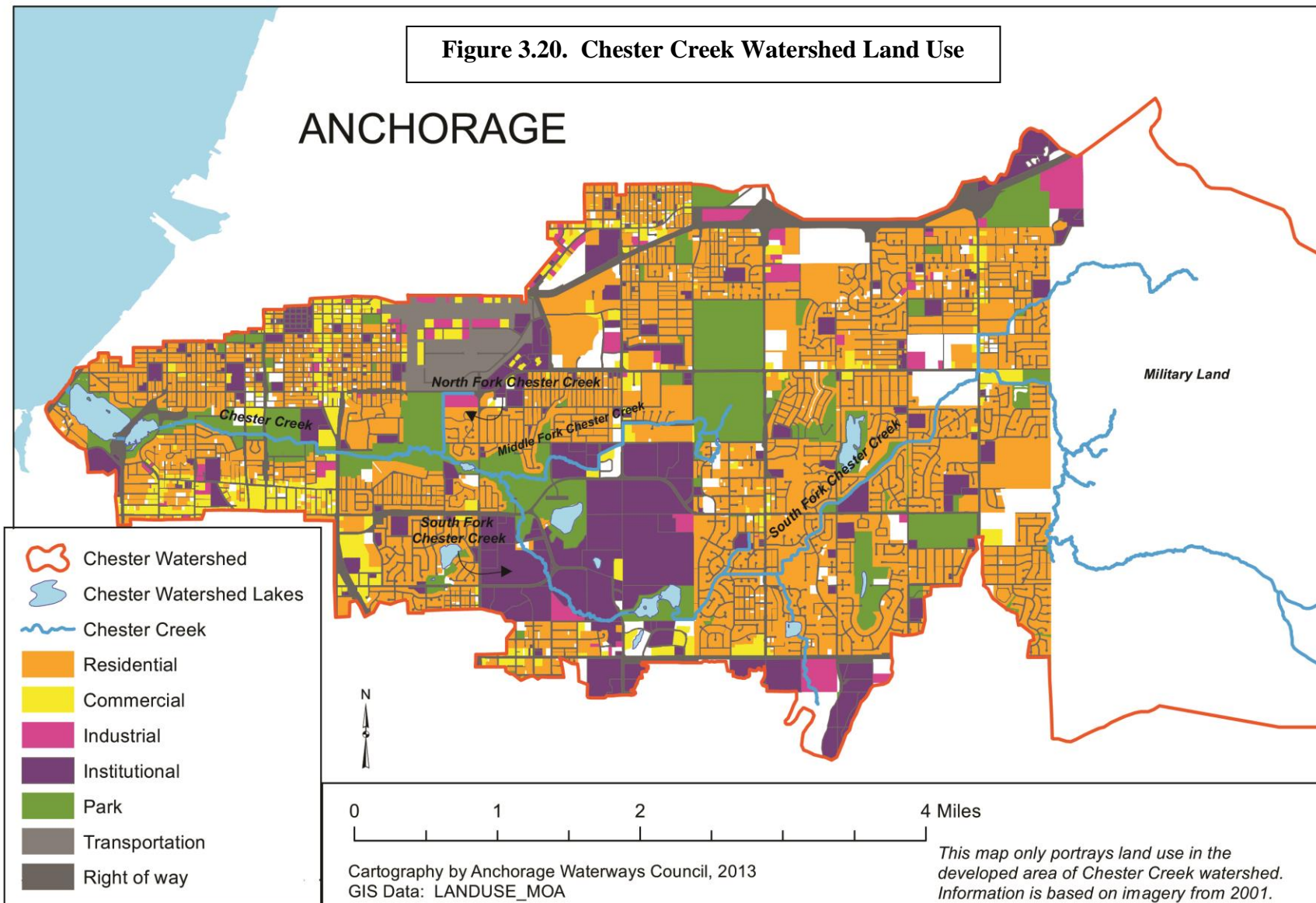
Table 3.4. Land Use in Chester Creek Watershed⁵⁸

Around 20,000 dwellings are found in the watershed and account for nearly 26% of the land use. Residential housing is primarily single-family, interspersed with two-family and multi-family dwellings such as apartments, condominiums, university housing, and trailer courts. Elementary, middle and secondary schools, and churches are found in association with residential development. Larger developments within the watershed include three major hospitals, medical buildings⁵⁹, two major universities, the Sullivan Arena, the new University of Alaska Anchorage arena, Mulcahy Stadium, Russian Jack Golf Course, and Merrill Field. Commercial and industrial properties located within the watershed consist of roughly 900 businesses including car dealerships, gas stations, large grocery stores, restaurants, and strip malls. The watershed boasts some of Anchorage's most popular social areas. It is heavily used for recreation and is well known for its greenbelt and multi-use trail system. Over 50 parks, including Westchester Lagoon, Valley of the Moon, Tikishla, Goose Lake, University Lake, and Russian Jack Springs, are found there.

⁵⁸ Municipality of Anchorage *LANDUSE_MOA*. 2008. Thede Tobish, MOA Planner reports that this is the most recent data on MOA land use, (personal communication, July 8, 2013).

⁵⁹ Considerable development in the "U-Med" (University-Medical) District, which is bounded by Northern Lights, Lake Otis Parkway, Tudor Road, and Bragaw, has been occurring over the past several years and is most likely not reflected in the Institutional land use category in the 2008 data.

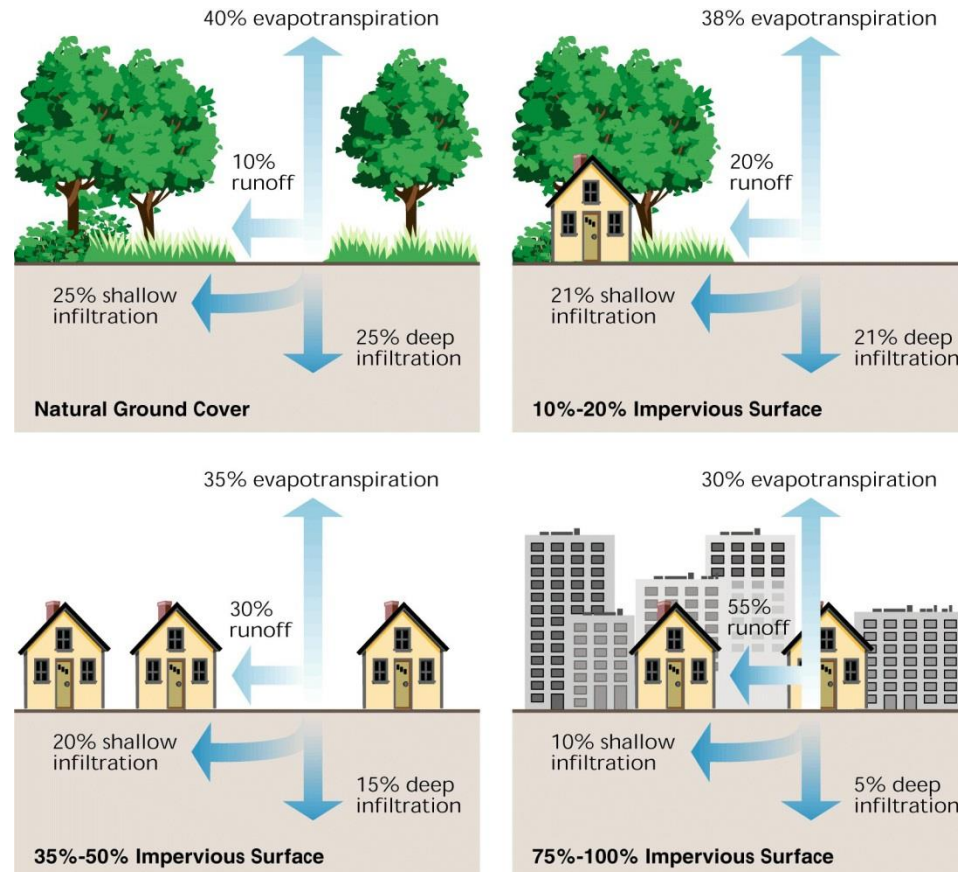
Figure 3.20. Chester Creek Watershed Land Use



Impervious Surfaces and Stormwater System

Impervious surfaces, such as paved areas, roofs, or compacted soil and lawns, reduce the natural infiltration of water back into the earth as part of the hydrologic cycle. As depicted in Figure 3.21, impervious surfaces increase the amount of surface runoff. In Anchorage, stormwater runoff (including snow melt) is commonly transported through a Municipal Separate Storm Sewer System (under an MS4 permit) that is often discharging directly untreated into local waterbodies.

Figure 3.21. Illustration of the Effect of Increased Urbanization on Impervious Surfaces and Surface Runoff⁶⁰



As cities grow and watersheds are urbanized, much of the vegetation is replaced by impervious surfaces, which reduces the area where infiltration to groundwater can happen. Thus, an increase in stormwater runoff occurs—runoff that must be collected by extensive drainage systems that

⁶⁰ From *Stream Corridor Restoration: Principles, Processes, and Practices*. Federal Interagency Working Group, October 1998, Fig. 3-21.

combine curbs, storm sewers, and ditches that carry it directly to streams. Simply put, in a developed watershed, more water arrives into a stream considerably faster, resulting in a greater likelihood of frequent and more severe flooding that can carry increased levels of pollutants. As cities grow and more development occurs, the natural landscape is replaced by roads, buildings, housing developments, and parking lots (Figures 3.22 and 3.23).

This was recognized nearly 50 years ago in a 1968 report by the U.S. Army Corps of Engineers, “[each] new subdivision and each new residence in the upper reaches of the drainage area increases the possibility of floods and flood damage in the lower areas of the drainage basin”⁶¹. The report also points out areas of flood concern: “in the upper reaches near the border of the military reservation due to the flatter terrain; housing and trailer parks downstream of Alaska Methodist University [now Alaska Pacific University] are not only subject to flooding but health hazards from cesspools and contaminated wells; the area between C St. and the Minnesota By-pass; and two areas east of C St.”⁶². Concern also exists at the easterly portion of Tudor Road and the military reservation⁶³.

Urban Anchorage has experienced dynamic growth over the last 50 years, and, along with it, large amounts of impervious surfaces have replaced the natural landscape. With a greater volume of water entering Chester Creek during a storm event, if it exceeds the collection rate of the stormwater system then flooding often occurs. Sediment flow into streams is also increased by an expansion of impervious surfaces as greater water volume and velocity cause sediment and other particulates that collect on surfaces to be washed away into creeks.

One means of reducing stormwater runoff is the Anchorage Rain Gardens program⁶⁴. The Municipality has offered grants to assist homeowners and businesses install them. As of early 2014, there were 40 rain gardens in the Chester Creek Watershed (see Figure 3.24).

In order to minimize the impact to streams, stream setbacks nationally can be up to at least 150 m for impervious areas along water bodies⁶⁵. The current 25’ stream setback requirement in Anchorage can create challenges for maintaining water body health in some of the reaches and watersheds in Anchorage. As Low impact Development (LID) becomes incorporated more into planning and development, some of the deleterious effects of runoff can be reduced. A 2012 report by HDR, Inc. titled “Chester Creek Watershed Subbasin Prioritization for LID Stormwater Projects” lists 13 LID projects that were underway in the Chester Creek watershed (at the time of the report) and also suggests 20 priority potential LID projects that should be considered in the watershed⁶⁶. These projects and 20 priorities are listed in the Appendix, Tables 6.2 and 6.3 along with a map.

⁶¹ U.S. Army Corps of Engineers, 1968. *Flood Plain Information, Chester Creek, Anchorage, Alaska*. p. 16

⁶² *Ibid.*, p. 17.

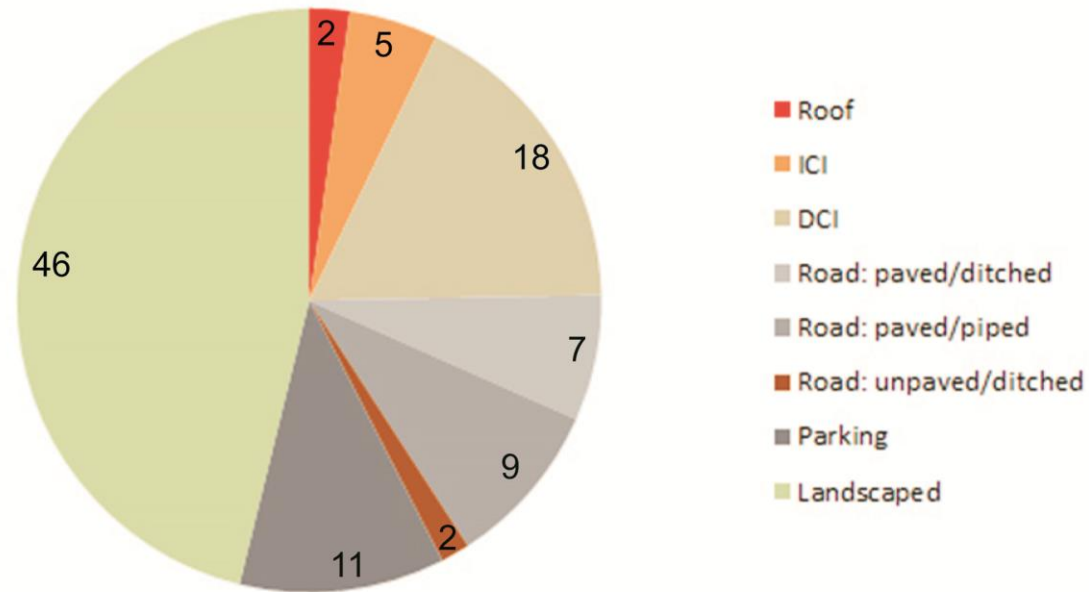
⁶³ *Ibid.*

⁶⁴ <http://www.anchorageraingardens.com/>

⁶⁵ Garfield, S.J. et al, 2003, “Public Health Effects of Inadequately Managed Stormwater Runoff” in *American Journal of Public Health*, pp. 1527-1533.

⁶⁶ These lists can be found in this report’s Appendix.

Figure 3.22. Percentage of Various Impervious Landcover Surfaces in Chester Creek Watershed⁶⁷



Surface Type	Acreage	% of Impervious Area ⁶⁸	Description
Roof	164.0	2	Roof drainage (DCI)
ICI	366.9	5	Other Indirectly connected impervious surface ⁶⁹
DCI	1,303.0	18	Other Directly connected impervious surface ⁷⁰
Road: paved/ditched	516.3	7	Paved road drained by ditching (ICI)
Road: paved/piped	684.2	9	Paved road drained by storm water pipes (ICI)
Road: unpaved/ditched	117.9	2	Dirt or gravel road drained by ditching (ICI)
Parking	845.9	11	Large paved surface, paved parking (DCI)
Landscaped	3,427.0	46	Deep water table, maintained vegetation (ICI)

Table 3.5. Impervious Landcover Surfaces in Chester Creek Watershed

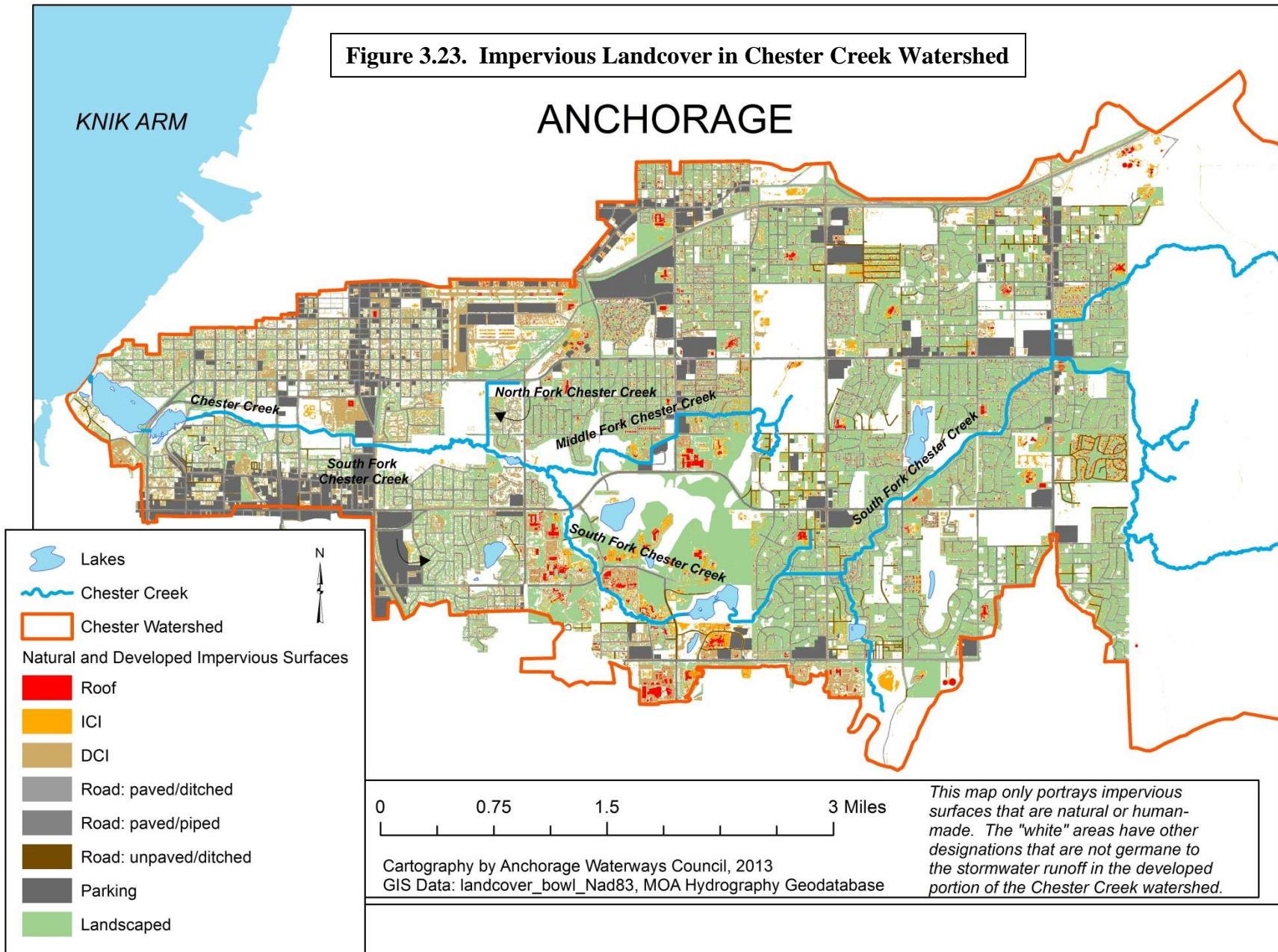
⁶⁷ Data were derived from Ikonos imagery dated 2000 according to the *landcover_bowl_Nad83* Data Dictionary.

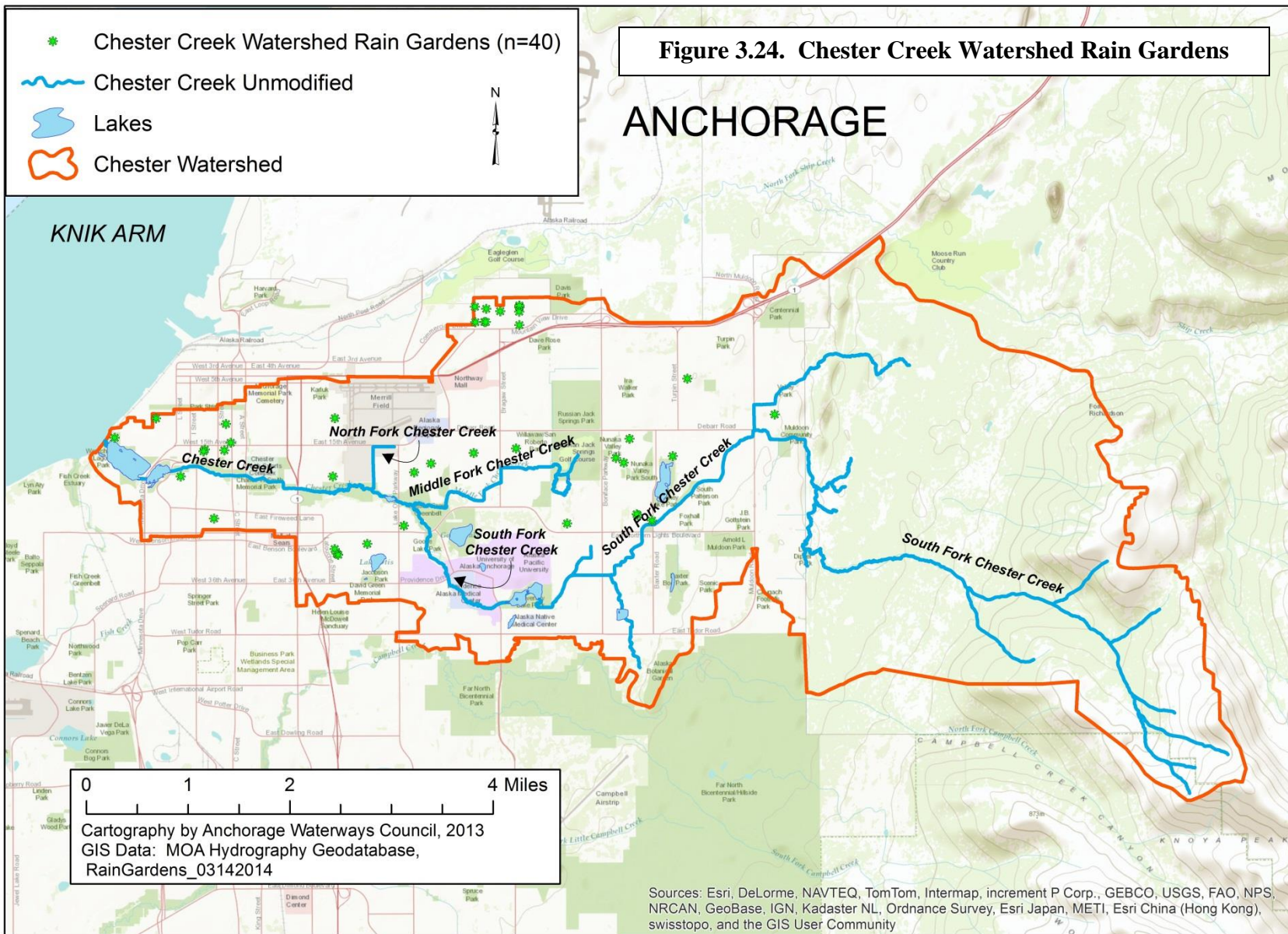
⁶⁸ Percentage of natural and human-made impervious surfaces in the Chester Creek watershed.

⁶⁹ ICI-Indirectly connected impervious surface is used to designate parcels where runoff is first detained or directed across permeable surfaces before entering piped drainage systems or natural waters (*landcover_bowl_Nad83* Data Dictionary, v. 1).

⁷⁰ DCI-Directly connected impervious surfaces means that runoff drains directly into pipes and receiving waters (*landcover_bowl_Nad83*, v. 1).

Figure 3.23. Impervious Landcover in Chester Creek Watershed





Channel Habitat



In an undeveloped state, stream channels are bordered by natural vegetation and can meander across their flood plain. Natural channels include diverse depths and configurations. In such systems normalization can occur because numerous wetland areas store precipitation and release it slowly into the creek. Often as development or urbanization occurs in a watershed, creek channels are straightened, deepened, realigned, put in culverts, or directed underground. Changes in flow regimes can cause biological impairment. Low flows can result in more “drought-tolerant” taxa, while high flows and increased peak flows may result in increased scouring and displacement of biota—again changing the taxa⁷¹. Sometimes, stream bank (or riparian) vegetation is removed or trampled. These activities can cause the loss of fish and wildlife habitat, stream bank erosion and land loss, and water quality problems from sedimentation. As Chester Creek was developed, such impacts have occurred.

Before development in the Chester Creek watershed, the creek channel was braided, undercut, and meandering. By straightening, deepening, and channelizing the creek, the groundwater table was lowered and more developable land was created. Today, approximately 41% of the Chester Creek channel has been human-modified in some form whether by straightening, ditching, diverting, or placing it in a culvert or pipe⁷². The reshaping is especially apparent between L Street and the New Seward Highway in midtown Anchorage (Figure 3.25). The instability of the channel is also apparent in natural sections between modified sections of the creek, where many meander bends have cutoffs in various stages of development. These cutoffs are a natural geomorphic response to changes in the hydrologic regime and modifications within the channel. A good example is found on Chester Creek from Hillstrand Pond west to the New Seward Highway—either by walking it or using Google Earth®.

The earlier creek modifications resulted from development, and an approximation of where this took place can be seen in Figures 3.26 and 3.27, which show current stream delineations (MOA GIS stream delineations) and historic stream channels as interpreted from USGS topographic maps from 1962 with 1965 revisions at 1:25,000 scale. Care must be used when determining changes between the years because of the differences in scales or resolution drawn. Some of the larger changes are very apparent, such as shrinkage of stream miles, straightening of the channel, and channel relocation. Note that some changes to the stream (straightening and relocation) had already occurred by 1962 when the USGS published this map.

⁷¹ See U.S. Environmental Protection Agency. *Caddis Volume 2: Sources, Stressors & Responses—Flow Alteration* at www.epa.gov/caddis/ssr_flow4d.html

⁷² Calculations from the MOA Stream Attributes and Values GIS Dataset per Scott Wheaton, (personal communication, February 14, 2014).

-  Channel Modification
-  Chester Creek Unmodified
-  Lakes
-  Chester Watershed


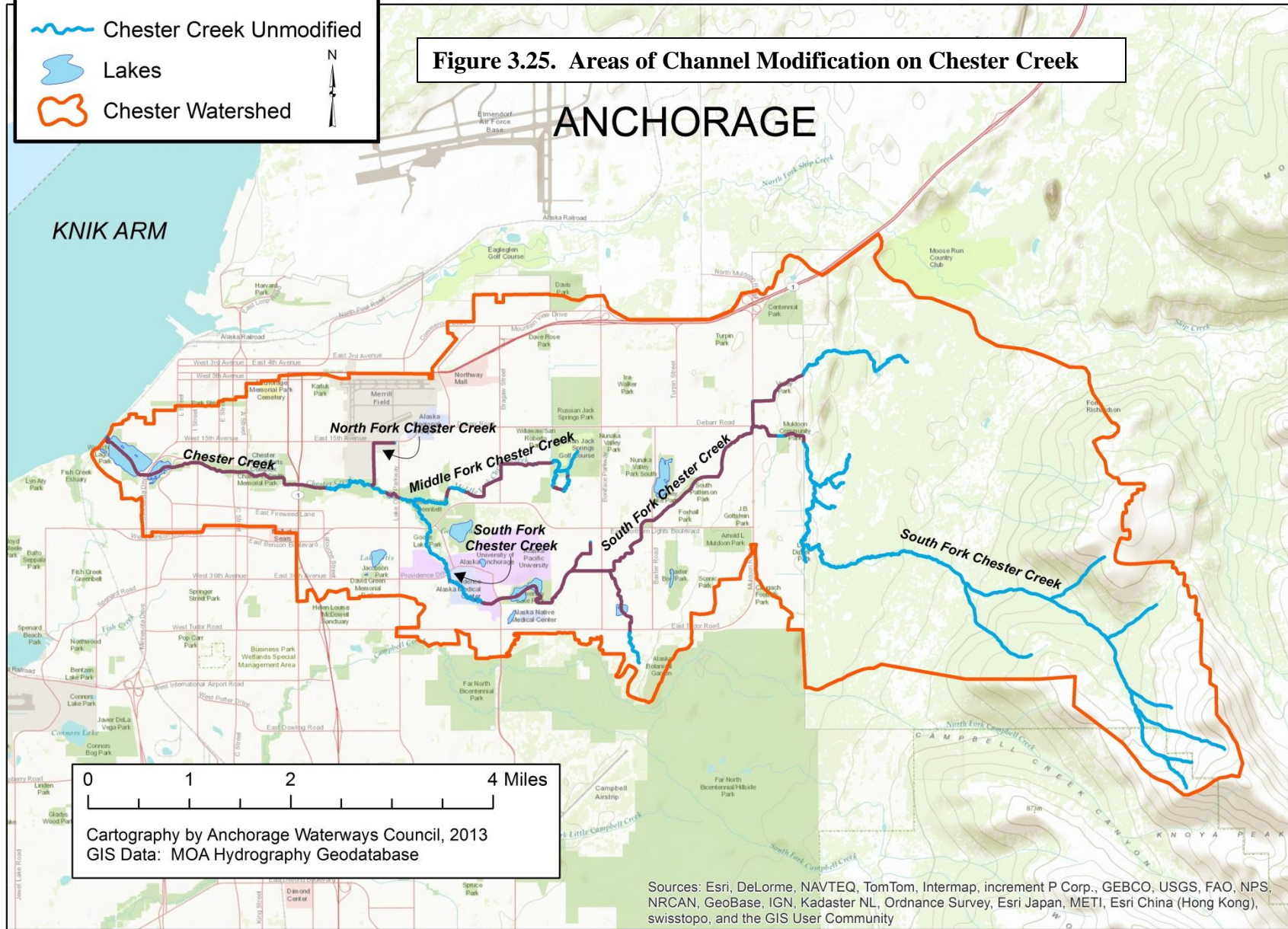
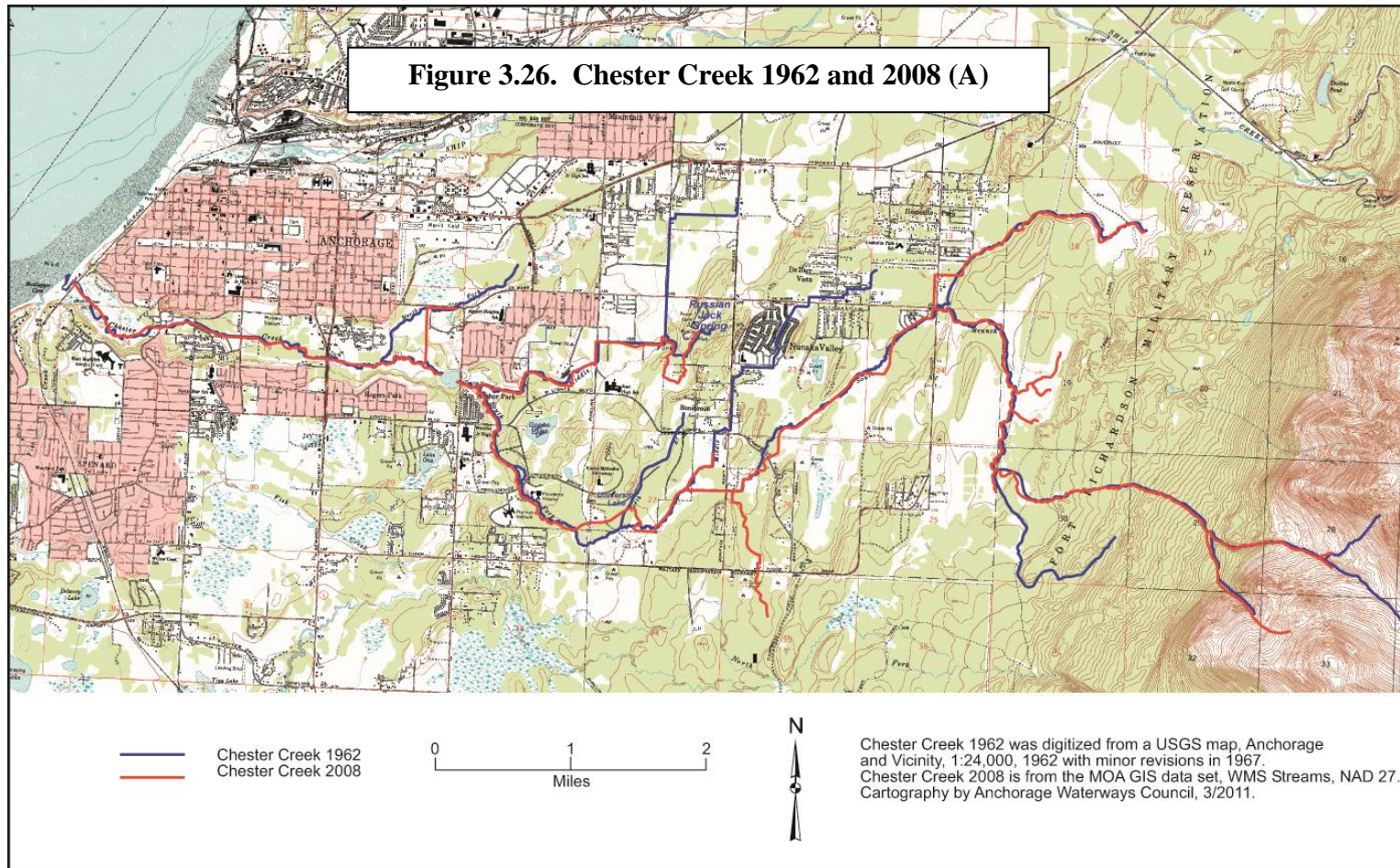


Figure 3.25. Areas of Channel Modification on Chester Creek

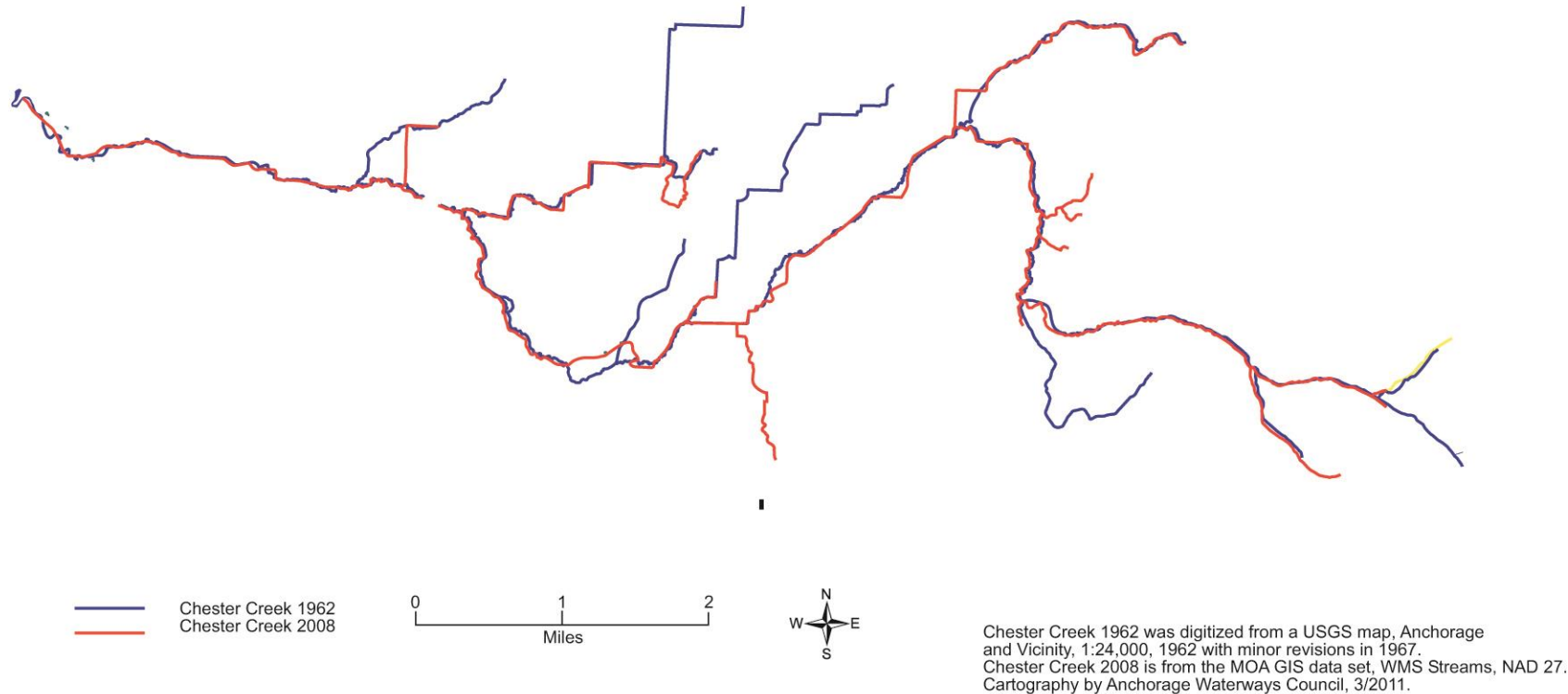


Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community



Originally, the creek had numerous small tributaries. To accommodate development, some of these tributaries were filled, and others were cut off and abandoned or combined into storm drain pipes. These changes confined Chester Creek to the three forks in which it flows today. In addition, wetland areas in and adjacent to the creek have been lost. As noted above, between 1950 and 1997, there was a net loss of over 2,800 acres of wetlands, and this has resulted in barely 1,000 acres remaining today. Besides loss, many of the wetlands in the watershed have also been modified.

Figure 3.27. Chester Creek 1962 and 2008 (B) (background removed)



Water Quality

Clean water is critical to the health and enjoyment of the Chester Creek watershed. Monitoring water quality is an important assessment tool (as well as a requirement for the Federal Clean Water Act [CWA]) that provides information on whether or not a waterbody's condition is sufficient to maintain multiple designated uses. Alaska Water Quality Standards (WQS) designate seven uses for fresh waters (drinking water; agriculture; aquaculture; industrial; contact recreation; non-contact recreation; and growth and propagation of fish, shellfish, other aquatic life, and wildlife)⁷³. Alaska's process for listing an individual waterbody for failure to meet WQS, as required in the CWA Section 303(d), begins with an internal review of existing and new information to determine (1) the presence of pollutants, (2) whether persistent exceedances of WQS are occurring, (3) whether impacts on the designated uses are occurring, and (4) the degree to which WQS and the other criteria are attained⁷⁴.

⁷³ See Alaska Department of Environmental Conservation. *Alaska's Final 2010 Integrated Water Quality Monitoring and Assessment Report July 15, 2010*. At http://dec.alaska.gov/wqsr/Docs/2010_Integrated_Report_Final_20100715_corrected_july_19.pdf, p. 90.

⁷⁴ *Ibid.*, 4.

Chemicals: Chemical pollutant runoff into the creek has been noted in several studies—mostly completed in 2001⁷⁵. Water quality parameters including alkalinity, conductivity, and pH, all tended to increase from upstream to downstream, with conductivity doubling between the JBER boundary near Early View Drive and Arctic Blvd., and pH increasing by roughly 0.4 units over the same area⁷⁶. Both these findings were similar to the USGS 1998-2001 NAQWA test results⁷⁷. Inorganic constituents including sodium and chloride showed increased levels in tests conducted. Sources for these are most likely road deicers used in the winter for street and private driveway maintenance. In addition, trace metals were studied in both the creek and sediment which showed varying effects—mostly downstream—the concern is that they could be impacting sensitive populations of invertebrates in the lower reaches of the creek⁷⁸.

Bacteria: Chester Creek was placed on the Section 303(d) list in 1990 for non-attainment of the fecal coliform (FC) bacteria standard. In April 1993, a water quality assessment was completed on the Chester Creek drainage. Although the assessment identified several parameters of concern for Chester Creek, it was concluded that the waterbody is water quality limited only for FC bacteria. A TMDL for FC bacteria was developed and approved by the EPA (dated May 2005). This listing covers 4.1 miles and the pollutant source is thought to be urban runoff and industrial pollution.

Additionally, Westchester Lagoon and University Lake were listed under Section 303(d) in 1990 for non-attainment of the FC bacteria standard. The 1993 Chester Creek Drainage Water Quality Assessment indicated both are impaired only for FC bacteria. A TMDL for FC bacteria was developed for each and was approved by the EPA (dated May 2005). The pollutant source is considered urban runoff.

FC bacteria are the most common microbiological contaminants of natural waters, typically living in the digestive tracks of warm-blooded animals, including humans, and excreted in the feces. Although most of these bacteria are not harmful and are part of the normal digestive system, some are pathogenic to humans. Those that are pathogenic can cause diseases, such as gastroenteritis, ear infections, typhoid, dysentery, hepatitis A, and cholera⁷⁹.

A FC test is used to determine whether water has been contaminated with fecal matter. The presence of FC indicates the possible presence of organisms that can cause illness. The EPA has set acceptable limits for FC in water based upon its use as has the State of Alaska (noted above).

How do fecal coliforms get into streams and lakes? In urban areas, FC contamination commonly originates from dog and waterfowl waste that is carried into storm drains, creeks, and lakes during storms, excessive yard watering, powerwashing impervious areas, or snowmelt. FC can also enter streams from illegal or leaky sanitary sewer connections and poorly functioning septic tanks.

⁷⁵ See Glass, R.L. and R.T. Ourso, 2006, *Water-Quality Conditions of Chester Creek, Anchorage, Alaska, 1998-2001*, U.S. Geological Survey, Scientific Investigations Report 2006-5229, and Davis, J.C. and G.A. Muhlberg, 2001. *Chester Creek Stream Condition Evaluation*, Alaska Department of Fish and Game Technical Report No. 01-7.

⁷⁶ Davis, J.C. and G.A. Muhlberg. 2001. p.6.

⁷⁷ Glass, R.L. and R.T. Ourso, 2006. p. 18.

⁷⁸ *Ibid.*, 12.

⁷⁹ Jolley, L W. and W.R. English, 2013. *What is Fecal Coliform? Why is it Important?* at www.clemson.edu/extension/natural_resources/water/publications/fecal_coliform.html.

The largest and most frequent exceedances of the water quality criteria for FC occur during summer months (July-September) due to increased rain events, the resulting stormwater runoff, and increased temperature and source activity (e.g. domestic animals and wildlife). Conversely, FC concentrations in the creek are lower during colder winter months because of less stormwater runoff. Concentrations steadily increase during spring months, with increased surface runoff during spring thaw and breakup. Because of the substantial seasonal variation in FC levels, the Chester Creek TMDL was developed on a seasonal basis to isolate times of similar weather, runoff, and in-stream conditions.

As noted, the water quality of Chester Creek and two of its lakes is considered impaired by federal standards for FC bacteria. It is likely that this listing is the result of pet, wildlife, waterfowl⁸⁰ and human feces⁸¹. Although estimates vary, it is thought that the minimum daily load of pet waste in Anchorage is at least 20 tons if not more⁸². Educating pet owners and convincing them to clean up after their pets can reduce a major portion of this problem. In response to this issue, the Municipality and ADEC are funding a variety of outreach programs to assist pet owners in understanding the impact of not cleaning up after their pets and also by providing more amenities, such as pet waste stations, to make it easier for pet owners. Wildlife can also contribute significantly to FC levels, although they are natural inhabitants of Anchorage. One issue that has arisen at Westchester and Eastchester Lagoon involves people feeding the waterfowl. In this area and others (e.g. Cuddy Park), the waterfowl are tending to overwinter and congregate in open water—thus creating increased waterfowl crowding and FC in smaller areas of streams and ponds. And, it has been noted that over the past decades as land use has changed to more urban development with inviting lawns and open water areas for waterfowl, the number of Canada geese has also steadily increased in the Anchorage area. Modification of human behavior in terms of not feeding wildlife, having areas of more natural vegetation and less landscaping, and fewer athletic fields could reduce waterfowl numbers, but these actions are not too likely to occur.

Failing septic systems also have the potential to contribute FC to receiving waters through surface breakouts and subsurface malfunctions. Regular maintenance (every 5 years is suggested) and water quality testing may reveal these potential problem areas.

Sedimentation and Turbidity: A report by Davis and Muhlberg in 2001 noted that sedimentation was one of the limiting factors of water quality in Chester Creek⁸³. Fine sediments impact spawning and rearing in Coho habitat. Their conclusions were that deposition of sediment in areas of reduced velocity implies there is a large transport of sediment in Chester Creek. Besides altering stream morphology to allow sediment to pass through, they call for a reduction of its introduction through increased Best Management Practices (BMPs). Improvement of riparian vegetation and wetland retention would also aid reduction of high sedimentation rates, although with Anchorage being a northern city the control of aggregate on roads, parking lots, and walkways for safety will always be an issue.

⁸⁰ Counts of Canada Geese (*Branta canadensis*) were ongoing until about 10 years ago. The original reason that spurred counts was the 1995 crash of an AWACS plane in Anchorage that apparently was caused by roosting geese that were sucked into the plane's engines. Twenty-four people were killed. This incident sparked better tracking of geese and numbers in Anchorage, however extensive research in 2013 showed that the most recent data is over 10 years old (personal communications from USFWS, ADF&G, and others—December 2013).

⁸¹ The source of human feces can be from homeless camps, broken sewer lines, or malfunctioning septic systems.

⁸² Municipality of Anchorage. Animal Care and Control. http://www.muni.org/Departments/health/Admin/animal_control/Pages/scoop.aspx.

⁸³ Davis, J and G.A. Muhlberg, 2001. p. 1.

Dissolved Oxygen (D.O.): Dissolved Oxygen is another critical component for the biological health of a stream. Fish and other aquatic organisms require a minimum level in order to survive. The ADEC standards for the amount of D.O. in Water Supply/Aquaculture and for the Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife must be greater than 7 mg/l in surface waters⁸⁴. Looking at AWC’s recent data for Chester Creek monitoring sites, there were no instances in 2011 or 2012 where the D.O. was below 7 mg/l.

Temperature: Temperature is another important indicator of stream health. ADEC WQS for Water Supply/Aquaculture and Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife are not to exceed 20° at any time, and the following maximum temperatures may not be exceeded, where applicable⁸⁵:

Spawning areas	13° C
Rearing areas	15° C
Migration routes	15° C
Egg & fry incubation	13° C

Table 3.6. Alaska Water Quality Maximum Temperatures for Specific Areas and Activities

The highest water temperature data in Chester Creek recorded during Davis and Mulhberg’s study was 15.2°C just south of Mulcahy Stadium in August 2000⁸⁶, which is quite a contrast from the highest water temperature of 12.5°C in the upper reaches during May 2001⁸⁷. Similar conclusions resulted from the Glass and Ourso study—temperatures are cooler at the upstream sites, and on two occasions water temperatures were as great as 17°C at the Arctic Blvd. site and 15°C at the Boniface Parkway site⁸⁸, which they feel could provide occasional stress to fish from the elevated stream temperatures. Water quality monitoring data from 2011 and 2012 by AWC show temperature exceedances ranging from 13.0°C to 17.0°C during the months of June, July and August at lower Chester Creek sites (see Table 3.7 and Fig 3.28)⁸⁹. Finally, the U-Med area, as suggested earlier, might be more carefully monitored to see if the cumulative effects of groundwater discharge from cooling systems into Chester Creek and University Lake could raise the temperature in various locations that would exceed state WQS.

⁸⁴ Alaska Department of Environmental Conservation. *Department of Environmental Conservation, 18 AAC70, Water Quality Standards, Amended April 8, 2012.*

<http://dec.alaska.gov/commish/regulations/pdfs/18%20AAC%2070.pdf> . p. 6

⁸⁵ Ibid., p. 11.

⁸⁶ Davis, J and G.A. Muhlberg, 2001. *Chester Stream Condition Evaluation*, p. 17.

⁸⁷ Ibid., p. 11

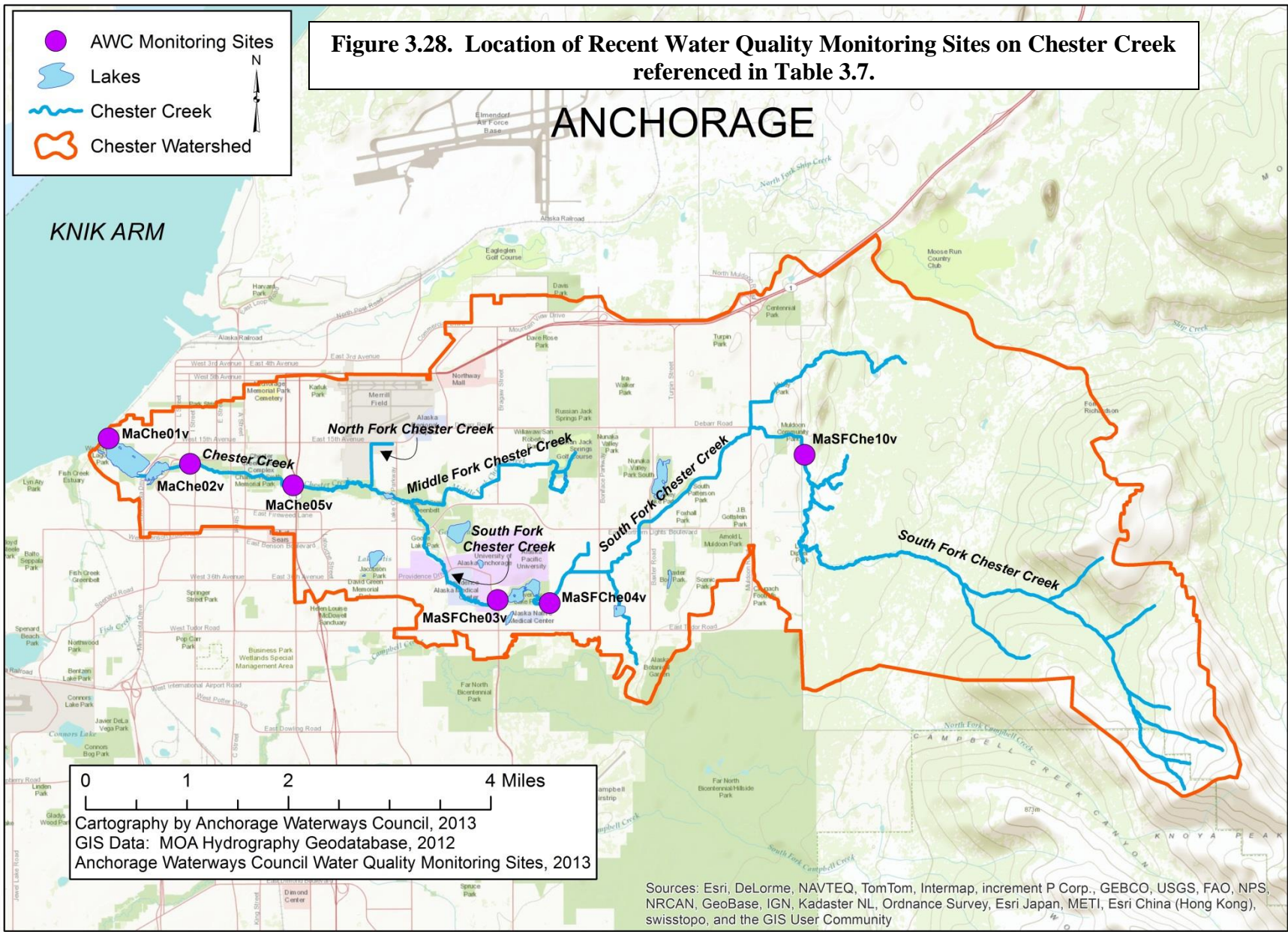
⁸⁸ Glass, R.L. and R.T. Ourso, 2006, *Water Quality Conditions of Chester Creek, Anchorage, Alaska, 1998-2001*, U.S.G.S., Report 2006-5229, p. 8

⁸⁹ Available data from AWC only alerts managers that there may be a problem, and an updated watershed temperature study would need to be conducted to assess the current temperature conditions.

Monitoring Date	Monitoring Site	Substrate	Flow	Temperature in Celsius
6/11/2011	MaChe01v	Cobble	Riffle	14.00
8/14/2011	MaChe01v	Cobble	Riffle	15.00
6/11/2012	MaChe01v	Gravel	Riffle	13.00
6/22/2012	MaChe01v	Cobble	Riffle	15.00
7/9/2012	MaChe01v	Gravel	Riffle	13.00
7/24/2012	MaChe01v	Cobble	Riffle	14.00
8/9/2012	MaChe01v	Cobble	Riffle	16.00
8/15/2012	MaChe01v	Gravel	Riffle	17.00
8/26/2012	MaChe01v	Cobble	Riffle	13.50
6/26/2011	MaChe02v	Gravel	Riffle	14.00
8/26/2012	MaChe02v	Sandy	Riffle	13.00
6/25/2011	MaChe05v	Cobble	Riffle	15.00
7/25/2011	MaChe05v	Cobble	Riffle	13.50
6/26/2011	MaSFChe03v	Gravel, Cobble	Pool	16.30
7/10/2011	MaSFChe03v	Gravel, Cobble	Pool	16.00
8/14/2011	MaSFChe03v	Gravel, Cobble	Pool	14.50
8/29/2011	MaSFChe03v	Gravel, Cobble	Pool	15.00
6/24/2012	MaSFChe03v	Cobble	Riffle	14.50
7/11/2012	MaSFChe03v	Cobble	Riffle	13.00
7/22/2012	MaSFChe03v	Cobble	Riffle	13.50
8/12/2012	MaSFChe03v	Cobble	Riffle	14.00
8/27/13	MaSFChe03v	Cobble	Riffle	13.00

Table 3.7. 2011-2013 Water Temperature Data for Selected Sites on Chester Creek that Meet or Exceed State Standards⁹⁰

⁹⁰ Data were collected by volunteers from Anchorage Waterways Council's Citizens Environmental Monitoring Program (CEMP).



4. Watershed Issues

To identify the important watershed issues concerning Chester creek, the planning group looked at scientific investigations and past studies, community and stakeholder input, and other planning efforts, and most issues within the watershed fell into the following categories:

- Water Quality
- Water Quantity
- Wildlife Habitat
- Fish Habitat
- Social and Economic Opportunities
- Communication and Coordination
- Data Acquisition

Water Quality:

Chester Creek provides habitat for fish and wildlife and recreational opportunities for residents and visitors year-round, however poor water quality may increase associated human health risks, make the creek unsafe for recreation, reduce the aesthetic benefits of the creek and watershed, and adversely affect fish and wildlife habitat. The factors that affect water quality include natural components, such as nutrients, bacteria, and the level of dissolved oxygen (DO); human-introduced pollutants including pesticides, herbicides, trace metals, vehicle fluids, de-icing chemicals, and pet waste; and some physical characteristics, such as geology, temperature, pH, sediment load, vegetation, and stream bed and channel configuration. As stated above, water quality monitoring of the Chester Creek watershed is important in order to conform to ADEC's WQS⁹¹ for compliance with federal water quality standards while supporting safe and beneficial uses of waterways for fish, wildlife, and humans. Because of Anchorage's MS4 designation, much of the water quality degradation can be attributed to untreated stormwater runoff from storm drains as well as from a high level of impervious surfaces.

Water Quantity:

As the Chester Creek watershed has become urbanized, much of the natural vegetation and soil has been replaced with impervious surfaces, such as roads, parking lots, pavement, compacted lawns, and building roofs. These surfaces reduce the ability of the land to absorb and filter incoming rain and snowmelt, thus allowing water and any pollutants picked up to flow quickly to the creek as sheet flows or through the storm drain system. This alters the flow regime as well as the creek's morphology and water quality. According to a 2007 Federal Emergency Management Agency (FEMA) report, "[w]hen rain falls in a natural setting, as much as ninety percent of it will infiltrate the ground; in an urbanized area, as much as ninety percent of it will run off"⁹². With expanded impervious surfaces, more water drains into Chester Creek which can cause high-water events such as flooding and bank erosion (which is also a natural phenomenon). As more culverts have been placed in the creek, the likelihood of

⁹¹ Alaska Department of Environmental Conservation. *Department of Environmental Conservation, 18 AAC70, Water Quality Standards, Amended April 8, 2012.* <http://dec.alaska.gov/commish/regulations/pdfs/18%20AAC%2070.pdf> .

⁹² Federal Emergency Management Agency, 2007, *National Flood Insurance Program, Floodplain Management Requirements, A Study Guide and Desk Reference for Local Officials, Federal Emergency Management Agency.* p. I-20.

them being constricted due to inadequate size or barriers that back them up, such as debris and ice, can change the flow regime dramatically. Water quantity in the exceedingly developed lower Chester Creek watershed is highly impacted from a variety of causes.

Natural phenomena can also exacerbate flooding situations as a combination of non-human factors and the presence of housing and infrastructure create the circumstances under which flooding becomes problematic. A major windstorm on September 5, 2012, hit Anchorage and the Chester Creek watershed particularly hard. It came early in the season when leaves were still on most trees, the ground was wet but not frozen, and many trees fell into and across Chester Creek (as well as other creeks in the MOA). Their presence caused flooding especially to the neighborhood east of University Lake where the creek is tightly bordered by homes. Another issue that has caused some flooding in several areas has to do with beaver dam construction—particularly in the east Anchorage neighborhood near Windsong Park. Two sediment settlement ponds were built before 1993 (when the area was acquired by MOA Parks and Recreation), and the combination of culverts and beavers has led to basement flooding in adjacent residences. It's a fairly natural area that borders JBER which provides a nice environment for beavers. Unfortunately, their presence and activities impacted some of the housing in the area, and many had to be removed.

Wildlife Habitat: A goal of the 2000 ADF&G report, *Living with Wildlife in Anchorage: a Cooperative Planning Effort* was to document wildlife, hazards, nuisances, impact on urban habitats, and the challenge to manage human population growth with expanded development. Terrestrial habitat in watersheds remains an important concern especially if it becomes fragmented and corridors for wildlife movement are disrupted by development.

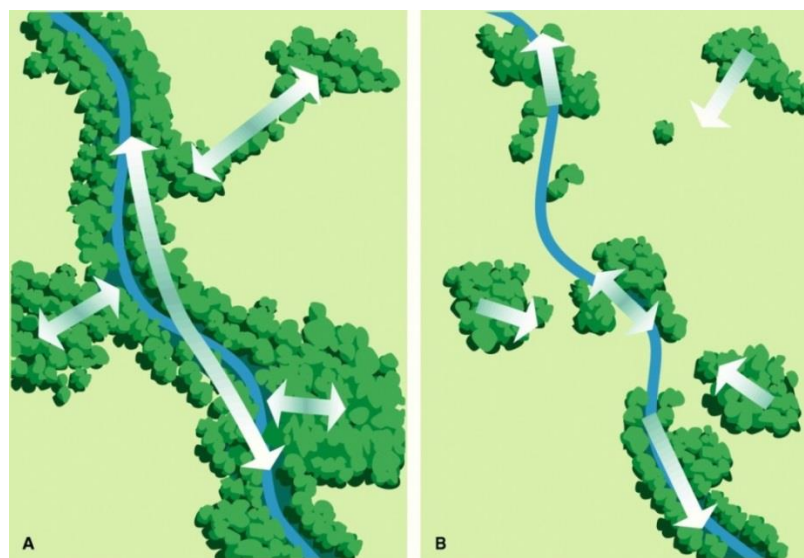


Figure 4.1. “A” shows a high degree of habitat connectivity and “B” is one of low connectivity which makes movement more perilous⁹³

⁹³ From *Stream Corridor Restoration: Principles, Processes, and Practices*. Federal Interagency Working Group, October 1998.

The destruction and filling in of wetlands can also greatly impact wildlife. Many of the iconic species that are part of Anchorage, such as beaver, moose, bears, grebes, loons, Sandhill cranes, geese, ducks, shorebirds, gulls, terns, and bald eagles, live or spend part of their lives in wetlands or along waterways. And yet wetlands, as noted above, have been reduced to a small percentage of what were originally in the Chester Creek watershed.

Lastly, the *Anchorage 2020 Plan*, also published in 2000, confirms that Anchorage residents desire a city that lives in harmony with its natural setting; natural spaces should remain as a “network” throughout the community to preserve and enhance fish, wildlife and plant habitats and their ecological functions and values; wetlands should be a system where their functions and values are preserved and enhanced, and a wide diversity of fish, wildlife and habitats throughout the Municipality are able to thrive and flourish in harmony with the community⁹⁴.

Fish Habitat:

Nieraeth⁹⁵ also addressed the various life stages of Coho salmon in terms of the physical characteristics of Chester Creek, although most water quality parameters (except D.O. and temperature) were excluded despite their importance in salmon habitat. Her conclusions were based on existing models which suggest that Chester Creek could have a high carrying capacity, however there are several limitations that affect these numbers. These include: culverts that impede fish passage, eroding banks and sediment deposition, presence/absence of woody debris, and presence of enough overwintering habitat. This is an interesting study in that it highlights the need to consider and work on a combination of habitat factors in order to increase the fish carrying capacity of Chester Creek. Many of these issues are part of this watershed plan as restoration projects.

Water quality is also impacted by the introduction of invasive plant species. These are defined as exotic plants that produce viable offspring in large numbers and have the potential to establish and spread in natural areas⁹⁶. Invasive plants impact both the terrestrial and aquatic environment. Efforts to control invasive species follow the Anchorage Invasive Species Management Plan within the MOA’s Parks and Recreation Department. The following examples are some that have been found in the Chester Creek watershed and are of concern:

- European Bird Cherry (*Prunus padus*) is a small deciduous tree that can grow to 30’ rather quickly. Frequently spread by birds that eat the fruit and excrete the seeds, it is successfully spreading along Anchorage streams and altering the riparian community composition⁹⁷. Over the years, efforts have been made to control their density along Valley of the Moon Park by removing younger trees.
- Purple Loosestrife (*Lythrum salicaria*) can be found in open bogs, along streambanks, riverbanks, lake shores, ditches and other disturbed wet soils. It is a prolific seed producer, and because it lacks natural enemies in Alaska, it can invade intact wetlands and deeper water, and often closes out open water species. Similar to Japanese knotweed, it can offset timing of nutrients into streams and impact salmon food sources⁹⁸.

⁹⁴ Municipality of Anchorage. Department of Community Planning and Development, 2000. *Anchorage 2020, Anchorage Bowl Comprehensive Plan*, p. 39.

⁹⁵ Nieraeth, S., 2010, *An Examination of the Carrying Capacity of Coho Salmon in the south fork Chester Creek, Anchorage, Alaska*.

⁹⁶ Alaska Exotic Plant Information Clearinghouse (AKEPIC), 2005. *Invasive Plants of Alaska*. Alaska Association of Conservation Districts Publication. Anchorage, Alaska, p. 230.

⁹⁷ *Ibid.*, 179.

⁹⁸ *Ibid.*, 128.

Purple Loosestrife has been found in Eastchester Lagoon just upstream of Spenard, and is being controlled and monitored as the only area of known presence.

- Reed Canarygrass (*Phalaris arundinacea*) forms dense, persistent stands in wetlands that displace other plants and may also slow stream flow and eliminate the scouring action needed to maintain the gravel river bottoms for salmon reproduction. Additionally it promotes silt deposition and can therefore constrict waterways. Stands of it have been discovered in the Debarr and Muldoon area near Grass Creek Village. Similar stands have been burned and tarped at Westchester Lagoon in the past few years. Recent removal of the tarps at Westchester Lagoon shows that this can be a cumbersome although partially effective manner of attacking Reed Canarygrass (RCG). Since using herbicides is problematic close to water, “mechanical methods”, such as burning and tarping or just double tarping, may be the only way to attempt eradication in areas adjacent to creeks⁹⁹. Education about RCG and other invasives is also important in controlling their introduction and spread.

Social and Economic Opportunities: Chester Creek watershed contains residential, business, educational, medical, tourism, military, and recreational areas. These enhance the local economy and quality of life for Anchorage. Maximizing these opportunities while not degrading the watershed presents some unique challenges. A major asset to the watershed is the Lanie Fleischer Chester Creek Trail that runs through the Chester Creek greenbelt approximately 4 miles from Westchester Lagoon (connecting to the Tony Knowles Coastal Trail) to Goose Lake. From the trail are majestic views of the Chugach Mountains, and it provides access to several parks. At the eastern end, smaller trail connections can be used to access various other locations in the watershed, such as Russian Jack Springs Park, University Lake Park, and Cheney Lake. In 2014 there are plans to begin resurfacing the trail during the summer¹⁰⁰.

Salmon fishing is not allowed in Westchester Lagoon or Chester Creek, however the ADF&G does stock Chester Creek, Cheney Lake, and University Lake with Rainbow Trout¹⁰¹, and fishing for them and Dolly Varden is allowed except during periods of closure (April 15-June 14)¹⁰².

Having this type of access can be a two-edged sword. It has been said that Anchorageites love their creeks to death. While it is fabulous to have Chester Creek running through a greenbelt where trail users are not impinged by homes and fences, the access points can receive an exceptional amount of foot traffic that results in bank trampling. This removes vegetation and speeds up erosion. One such area that has been particularly difficult to manage is adjacent to Valley of the Moon Park, where the main stem of Chester Creek is bounded on one side by the Lanie Fleischer trail and a large grassy area and playground that can attract hundreds of users on a single day. Dogs and children play along and in the creek for about a quarter mile starting at Arctic Blvd. and moving north. Exposed tree roots and vegetation that was worn away leaving bare soil resulted in the potential for trees to fall during windstorms and a scouring of soil during high water times and runoff¹⁰³.

⁹⁹ Tim Stallard, Invasive Plant Program Coordinator, Anchorage Park Foundation, (personal communication, October 9, 2013).

¹⁰⁰ Municipality of Anchorage. Parks and Recreation. Lanie Fleischer Chester Creek Trail Improvements. 2014.

<http://www.muni.org/Departments/parks/Pages/ChesterCreekTrailImprovements.aspx>.

¹⁰¹ Alaska Department of Fish and Game. *Stocked Lakes in the Cook Inlet/Kenai Peninsula Area*. 2013.

<http://www.adfg.alaska.gov/static/regulations/fishregulations/PDFs/southcentral/2013scstockedlakes.pdf>.

¹⁰² See Alaska Department of Fish and Game. *2013 Sport Fishing Regulations*. http://www.adfg.alaska.gov/index.cfm?adfg=fishregulations.sc_sportfish for current regulations.

¹⁰³ This reach has been of great concern for years. In 2012 ADF&G and AWC embarked on a plan for bank restoration. Other groups became involved, and in 2013 much of the area was “fenced” off and specific access points with rock stairs were put into place by the Anchorage Park Foundation’s “Youth Employed in Parks” (YEP) program. New

There are other locations along the multi-use trail that are inviting to the many walkers, runners, cyclists, and skaters that recreate along the creek. One area that contains a memorial bench alongside the trail attracts people to the creek and provides a nice resting place to view the natural surroundings. But it also has turned into a popular entry point where children can play in the creek while their parents sit on the bench. At the eastern end of Westchester Lagoon at Spenard is a parking area where adults and children feed the ducks. Besides not being healthy for the waterfowl, it tends to increase duck numbers and their desire to overwinter¹⁰⁴. As these areas freeze up, more ducks crowd into the open water and their fecal waste increases in that location.

During 2012 the task force working to update this plan and the Anchorage Waterways Council's Creek Report Card project noted that homeless camps are prevalent along the creek, which undoubtedly contributes to some of the trash found in the creek as well having the potential for FC from human waste. These are some of the conundrums that have to be dealt with in balancing the amenities and use of our creeks with their health. Creeks are a natural feature that people are drawn to, and development and maintenance along the creek should occur in ways that respect the natural features of the watercourse. Residents, businesses, and users alike will need education about their unique location and uses in order to protect and enhance the character of the community and Chester Creek.

Communication and Coordination: Numerous public and private entities have a special interest or control over certain activities occurring in the Chester Creek watershed as well as other watersheds. Central coordination and communication are essential to decrease redundancy and to enhance efficiency in data gathering and information sharing. Two past coordinated group efforts, the Watershed Task Force and the Watershed Round Table, are a good method for keeping the various stakeholders informed of issues and problems. Additionally, sharing plans by one agency or organization will often result in a beneficial synergy that might not be known by the other stakeholders.

Education is also an important aspect to help assist in watershed health. Thoughtful and appropriately placed signage can make citizens aware that what looks like a ditch could really be a creek, there are health benefits to creeks by picking up pet waste, and avoiding bank trampling reduces erosion and results in healthier fish habitat.

Data Acquisition: There are many agencies and organizations that collect data in the Chester Creek watershed. Some of these include water quality monitoring data; abundance and distribution of fish populations and invasive species (plant and animal); habitat assessments for rearing, spawning and wintering fish; loss of wetlands; obstructions to fish passage; wildlife, waterfowl and macroinvertebrate surveys; degraded bank areas; stream course changes; impacts on recreational areas and trails; and trash and debris problems. If all the existing data on the Chester Creek watershed were to be placed in a central clearinghouse and evaluated, it would allow agencies and organizations to focus on data gaps. This could be a useful means for compiling information, acquiring data that is missing, comparing it, looking for trends, cause and effect, and solving issues and conserving resources in a more efficient manner. As an example, if the MOA or AKDOT&PF were going to replace part of a road which has a culvert, coordination with ADF&G and their list of culverts that need replacing would make good economic sense. Hand in hand with data gathering and compilation is the need for funding.

vegetation was planted, and time will tell if the directed access to the creeks reduces bank erosion.

¹⁰⁴ Ducks do overwinter in Anchorage, but feeding them encourages more to stay in areas where the water can freeze up to fairly small openings.

Following are some examples of data that should be obtained or listed from one access point in a Chester Creek clearinghouse:

- One of the longest running set of data records on Chester Creek is being captured by the USGS at the Arctic Blvd. gage station (USGS 15275100). Information begins in 1966 until the present¹⁰⁵, and encompasses a variety of parameters.
- AWC has been collecting water quality data on several Chester Creek locations since 1999 (temperature, pH, D.O., turbidity, etc.)
- UAA's Alaska Natural Heritage Program has 50 records dating between 2000 and 2009 on benthic macroinvertebrates for Chester Creek¹⁰⁶
- There are publications from short studies by various researchers at USGS and from the Aquatic Restoration & Research Institute (ARRI)
- Theses and dissertations from APU and UAA students, i.e. Nierath, Steer, Moffat, Wilson, Whitman, Burich, et al.
- GIS data on Anchorage watersheds, drainageways, lakes, and biological information from the MOA WMS and ADF&G
- EPA and State of ADEC TMDL reports on Chester Creek, Westchester Lagoon, and University Lake¹⁰⁷

¹⁰⁵ U.S. Geological Survey., *USGS 15275100 CHESTER C AT ARCTIC BOULEVARD AT ANCHORAGE AK*. 2014. http://waterdata.usgs.gov/usa/nwis/uv?site_no=15275100 .

¹⁰⁶ University of Alaska Anchorage. Environmental and Natural Resources Institute. *Stream Team Online*. <http://astdatabase.uaa.alaska.edu/search/searchpage.asp>.

¹⁰⁷ Alaska Department of Environmental Conservation. *Total Daily Maximum Load for Fecal Coliform in Chester Creek, University Lake, and Westchester Lagoon, Anchorage, Alaska*?. May 2005. <http://www.epa.gov/waters/tmdl/docs/chestercrwatershedTMDLEPAFinal.pdf> .

5. Plan Implementation

The following general strategy has been created to address the highest priorities that accomplish the vision, mission, and goals of the *Chester Creek Watershed Plan*. These guidelines were developed through stakeholder and planning team input. This list is not exhaustive of all activities that could, or need to be, performed in the watershed, those listed by the planning team are projects that are considered top priorities.

The goals, objectives, and actions in the implementation plan are initially organized by issue category: Water Quality, Water Quantity, Wildlife Habitat, Fish Habitat, Social and Economic Opportunities, Communication and Coordination, and Data Acquisition. The strategy is rather generic and includes actions that can help accomplish the objectives and goals. Following in this report's appendix is a more specific listing of priorities based on overall and subwatershed delineations in the Chester Creek watershed as well as a prioritization of LID projects.

1.0 WATER QUALITY

Goal: Meet State standards for water quality in Chester Creek.

Objective: Reduce pollution from point and non-point sources.

Actions:

- 1.1 Evaluate and quantify streambank erosion.
- 1.2 Install strategic storm water infrastructure projects to maximize water quality improvement in storm water discharge.
- 1.3 Conduct feasibility assessments and install priority low impact development (LID) projects to reduce storm water discharge and improve water quality.
- 1.4 Conduct riparian improvements including restoration and rehabilitation of riparian wetlands to improve vegetated buffers along creeks.
- 1.5 Conduct water quality monitoring to validate improvements, note changes and trends in the creek.
- 1.6 Preserve and/or utilize wetlands for water quality improvement purposes.
- 1.7 Incorporate BMPs and apply Municipal design criteria to future drainage projects and retrofits.
- 1.8 Develop protocols and monitor Municipal BMP's for effectiveness in maintaining and improving water quality, and improve BMP's where necessary.
- 1.9 Reduce fecal coliform, turbidity sources and other pollutants from entering the creek.

2.0 WATER QUANTITY

Goal: Return Chester Creek to a more natural hydrologic regime.

Objective: Eliminate flood hazards, maintain flows for habitat, preserve and/or widen existing floodplains where applicable.

Actions:

- 2.1. Preserve existing floodplain and restore or re-create historic floodplain in selected locations.
- 2.2. Remove identified FEMA flood hazards that inundate existing neighborhoods.

- 2.3. Model storm water flow for a watershed-wide storm water drainage study.
- 2.4. Gage creek continuously at current USGS gage location and select upstream points for understanding tributary inputs.
- 2.5. Reduce and attenuate peak flows from stormwater discharge.
- 2.6. Reduce the amount of existing and proposed impervious surface within the watershed by way of LID; set thresholds/priorities.
- 2.7. Preserve and/or maintain wetlands within the floodplain for attenuation of peak flows.
- 2.8. Evaluate and analyze impacts of increasing groundwater withdrawals and subsequent thermal and flow discharge into the creek within the U-MED and UAA area.
- 2.9. Apply for a water reservation for fish habitat maintenance flows.

3.0 WILDLIFE HABITAT

Goal: Provide habitat for a diversity of wildlife along Chester Creek.

Objective: Maintain and enhance existing wildlife corridors, riparian habitat, greenbelts, and parks.

Actions:

- 3.1. Support GLT conservation easements of priority wildlife habitat.
- 3.2. Improve animal passage along creek corridors.
- 3.3. Support and create programs that offer assistance for restoration and protection of riparian habitats.
- 3.4. Manage existing invasive species and prevent new introductions.
- 3.5. Preserve and/or enhance wetlands for wildlife habitat values.

4.0 FISH HABITAT

Goal: Provide for healthy fish and other aquatic organism populations in Chester Creek.

Objective: Provide habitat connectivity, quality and diversity for all aquatic life stages.

Actions:

- 4.1. Upgrade culverts identified in ADF&G culvert survey that impede fish passage.
- 4.2. Maintain adequate fish passage and habitat.
- 4.3. Protect existing wetlands and open water habitats.
- 4.4. Increase riparian vegetation for thermal control, cover and food sources.
- 4.5. Improve instream diversity and quality of modified channels.
- 4.6. Manage existing invasive species and prevent new introductions.
- 4.7. Obtain a water reservation for minimum flows that support fish habitat.

- 4.8 Evaluate and maintain creek water temperatures for aquatic life.
- 4.9 Improve water quality within the creek, as per Goal 1.
- 4.10 Control excessive erosion and sediment inputs to the creek.

5.0 SOCIAL AND ECONOMIC OPPORTUNITIES

Goal: Foster a high degree of social and economic opportunities.

Objective: Establish and build a connection between a healthier watershed and social and economic benefits to the community.

Actions:

- 5.1. Conduct a cost/benefit analysis of a healthy Chester Creek watershed
- 5.2. Engage individuals, businesses and schools in efforts to protect and restore the watershed.
- 5.3. Incentivize wetland preservation for individuals and businesses.

6.0 COMMUNICATION AND COORDINATION

Goal: To have a highly involved and dedicated community and Municipality in maintaining the health of Chester Creek.

Objective: Promote community and municipal awareness and stewardship of Chester Creek.

Actions:

- 6.1. Promote implementation of the Chester Creek Watershed Plan within the community and Municipality.
- 6.2. Increase community understanding of the watershed problems and solutions.
- 6.3. Increase Chester Creek outreach and education program within the Municipality.
- 6.4 Identify major uses, community perceptions, and community values associated with Chester Creek.
- 6.5 Increase stewardship by the local community to care for the creek.
- 6.6 Build local stewardship for overseeing and maintain existing public access points in order to lessen the impact to the creek's banks.
- 6.7 Support green infrastructure and LID planning.
- 6.8 Promote coordination between departments within the Municipality and between relevant agencies outside of the Municipality, such as AKDOT&PF, ADF&G, USFWS, and JBER.

7.0 DATA ACQUISITION

Goal: Improve our understanding of the watershed.

Objective: Evaluate research needs, conduct studies, gather data, and share information.

Actions:

- 7.1. Plan and conduct a data gap analysis.
- 7.2. Conduct habitat and water quantity monitoring to fill data gaps.
- 7.3. Manage data and make accessible to the public.
- 7.4. Coordinate data acquisition and management across interested agencies.

6. Appendix

I. RESTORATION PRIORITIES FOR CHESTER CREEK WATERSHED¹⁰⁸

The following table (Table.6.1.) is divided into five drainage areas that begin at the mouth of Chester Creek and can be located on the accompanying map (Figure 6.1):

C = All Chester Watershed Drainages
CW = Westchester/Eastchester Drainage
CMF = Middle Fork Chester Drainage
CSF = South Fork Chester Drainage
CRL = Chester Reflection Lake Drainage
CNF = North Fork Chester Drainage

The 7 goals from the watershed plan are listed for each action item in the drainage. The actions are listed in geographic order for the most part.

Goal 1 – WATER QUALITY: Meet State standards for water quality in Chester Creek.

Goal 2 – WATER QUANTITY: Return Chester Creek to a more natural hydrologic regime.

Goal 3 – WILDLIFE HABITAT: Provide habitat for a diversity of wildlife along Chester Creek.

Goal 4 – FISH HABITAT: Provide for healthy fish and other aquatic organism populations in Chester Creek.

Goal 5 – SOCIAL and ECONOMIC OPPORTUNITIES: Foster a high degree of social and economic opportunities.

Goal 6 – COMMUNICATION and COORDINATION: To have a highly involved and dedicated community and Municipality in maintaining the health of Chester Creek.

Goal 7 – DATA ACQUISITION: Improve our understanding of the watershed.

“Lead” refers to the most likely agency or organization to work on the project.

ADF&G – Alaska Department of Fish and Game
AKDOT – Alaska Department of Transportation and Public Facilities
APF – Anchorage Park Foundation
APU – Alaska Pacific University
AWC – Anchorage Waterways Council
Coop Ext – UAF Cooperative Extension
DPW – MOA Department of Public Works

¹⁰⁸ This list was created from by recommendations from the “Watershed Planning in the Municipality of Anchorage” group, which met between 2010 and 2012.

GLT – Great Land Trust
HLB – MOA Heritage Land Bank
MOA – Municipality of Anchorage (Department of Public Works and/or Street Maintenance)
P&R – MOA Parks and Recreation
USFWS – U.S. Fish and Wildlife Service
WMS – MOA Watershed Management Services

“Cost” is an estimate range based on 2014 figures.

- 1 - \$0-\$10,000
- 2 - \$10,001-\$50,000
- 3 - \$50,001-\$100,000
- 4 - \$100,001-\$250,000
- 5 - \$250,001-\$500,000
- 6 - >\$500,000

“Priority” is a suggested value.

- 1 – Highest
- 2 – Medium
- 3– Lowest

“Mandate” is where the action’s need most likely originates.

ADEC WQS – Alaska Department of Environmental Conservation Water Quality Standards
ADF&G – Alaska Department of Fish and Game, Habitat Division
APDES – Alaska Pollutant Discharge Elimination System Permit
Comp Plan – Anchorage 2020 Comprehensive Plan
Title 21 – Anchorage’s Municipal Land Use Laws

Funding for projects will be sought from a variety of sources:
Municipal CIP (Capital Improvement Program) and Grants

Figure 6.1. Restoration Priority Locations for Chester Creek Watershed

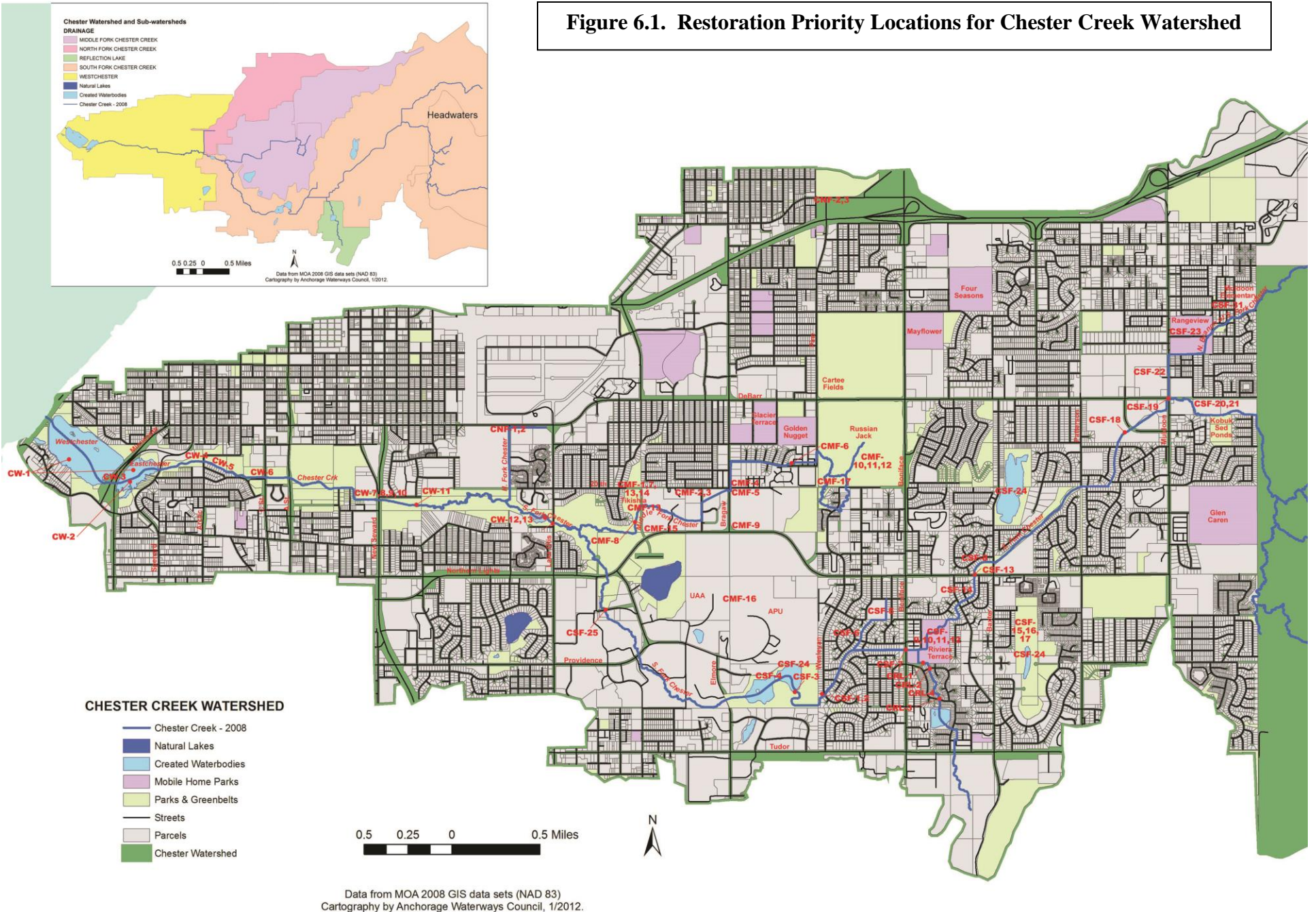


Table 6.1. Restoration Priorities Shown on Map

ALL CHESTER WATERSHED DRAINAGES (C)

Map ID	Goal(s)	Lat/Long	Approximate Location	Issue	Action Item	Lead	Cost	Priority	Mandate
C-1	2,3,4,6,7	N/A			Conduct update to flood mapping for watershed.	WMS	Varies	1	Title 21
C-2	1,2,3,4,5,6,7	N/A			Create and implement invasive removal and control strategy for Bird Cherry, Purple Loosestrife and Reed Canarygrass.	P&R, WMS, APF, Coop Ext	3	1	Title 21
C-3	1,3,4,5,6	N/A			Work with MOA Parks Dept and landowners to keep vegetation buffer between lawns and stream banks.	P&R	2	2	APDES, Title 21
C-4	1,2,3,4,5,6,7	N/A			Implement an LID/OGS strategy watershed-wide.	WMS	5	1	APDES
C-5	3,4,5,6,7	N/A			Conduct salmon monitoring on a yearly basis.	ADF&G, APU	1	2	ADF&G
C-6	1,3,4,5,6	N/A			Place signs at all creek crossings identifying creek.	WMS	2	2	APDES, Comp Plan
C-7	1,2,3,4,5	N/A			Protect privately-owned wetlands throughout drainage.	HLB, GLT	Varies	1	APDES, Comp Plan
C-8	1,3,4,5,6	N/A			Create interactive walking tours of greenbelt.	AWC	2	3	APDES
C-9	1,3,4,5,6	N/A			Conduct educational campaign on tossing household/greenhouse plants into the creek and riparian area.	AWC	1	1	Title 21
<u>C-10</u>	<u>2,4</u>	<u>N/A</u>			Identify low flow conditions for fish habitat.	WMS, APU, ADF&G	<u>2</u>	<u>1</u>	Comp Plan

WESTCHESTER/EASTCHESTER AREA (CW)

Map ID	Goal(s)	Lat/Long	Approximate Location	Issue	Action Item	Lead	Cost	Priority	Mandate
CW-1	1,2,3,4,5,6,7	N/A	Westchester & Eastchester		Control Reed Canarygrass, Purple Loosestrife and other invasives around Westchester and Eastchester Lagoons	P&R, WMS, APF, Coop Ext	2	1	Title 21
CW-2	1,2,3,4	N/A	Eastchester	Sediment has accumulated, filling in old channel as a natural process.	Active street sediment source removal in stormwater system to reduce rate of accumulation by reducing sediment input by streets upstream.	DPW, AKDOT	Varies	1	APDES, Title 21
CW-3	1,2,3,4,5,6	61.2, -149.89	Arctic Blvd.	Boulders backwater culvert and upstream creek, increasing sediment deposition and eroding banks. Culvert backwaters local area during 100-year flood event. ADF&G 20400056 culvert green.	Model culvert to review capacity, impact to homeowners for flooding concerns and fish passage. Replace Arctic Blvd. culvert top pass 100 year flood and minimize backwater effects to homeowners, remove or retrofit rocks to decrease sedimentation and backwater through area. Partially completed	MOA	6	1	Title 21
CW-4	1,3,4,5,6,7	N/A	Valley of the Moon Park along creek and bike trail	High use by public causing extensive streambank trampling and erosion.	Area was revegetated in 2013 and access stairs were placed to direct people and pets to creek in specific locations. Monitor progress.	P&R	1	2	Title 21
CW-5	1,3,4,5,6	N/A	Valley of the Moon Park along Chester Creek	Rock lined banks and lawn to water's edge of houses along south side of bike path and creek	Work with property owners to remove rocks and install more diverse habitat through bioengineering techniques and create a vegetated buffer of riparian vegetation between creek and lawn.	P&R, WMS	1	2	APDES, Title 21
CW-6	1,2,4,5,7	61.2, -149.88	C Street Bridge	Channel widened to accommodate construction, local slope may have been reduced, increasing sediment deposition rates.	Evaluate current condition and produce a feasibility study of potential options to consider the magnitude of the problem and to increase sediment transport and habitat features as well as riparian vegetation.	AKDOT	5	2	APDES, Comp Plan

Map ID	Goal(s)	Lat/Long	Approximate Location	Issue	Action Item	Lead	Cost	Priority	Mandate
CW-7	1,2,6,7	N/A	Seward Highway	Untreated stormwater from a 42-inch diameter storm drain southwest corner of crossing.	Evaluate AKDOT record drawings showing a petroleum separator in first manhole from outfall and if it is in service. Evaluate potential to connect part of storm network to other storm drains, reducing flows	AKDOT	1	1	APDES
CW-8	1,4	N/A	Seward Highway	Untreated stormwater from a 42-inch diameter storm drain southwest corner of crossing.	Construct stormwater treatment area at Chester Creek at Eagle Street and connect with 1300 feet of storm drain.	AKDOT	2	1	APDES
CW-9	2	N/A	Creek downstream of Seward Highway	High velocities from culvert during floods erode streambanks, banks are too steep, gabions eroding into creek, river left bank too steep for vegetation establishment, storm drain flow erodes creek/banks.	Remove/reinforce gabions - install root wads on both sides of creek revegetate, install boulder erosion protection to dissipate energy from storm water flows from storm drain outlet.	AKDOT	5	2	APDES
CW-10	2,3,4,5	61.2, -149.86	Seward Highway	ADF&G 20400033 fish passage issue. Culvert too small, constricted, debris and fish barrier, ice jacking compromised upstream 20-25 feet of culvert.	Replace Seward Highway culvert with bridge for fish, animal and pedestrian passage	AKDOT	6	2	Title 21
CW-11	1,3,4	N/A	Karluk Street Bike Trail Bridge	An exposed telephone cable is causing the creek to erode the channel banks.	Work with utility to bury utility line below streambed	Utility	1	1	ADF&G

Map ID	Goal(s)	Lat/Long	Approximate Location	Issue	Action Item	Lead	Cost	Priority	Mandate
CW-12	1,2,3,4	61.2, -149.84	Hillstrand Pond	ADF&G 20400035 fish passage issue. Perch and velocity issues at culvert outlets.	Replace Hillstrand Pond culverts with bridge, weir and rocky riffle	MOA	3	2	ADF&G
CW-13	1,3	N/A	Hillstrand Pond	Stormwater pipe from Cliffside Drive is not treated prior to discharge to creek near Hillstrand Pond	Install end-of-pipe controls at Cliffside Drive	DPW	2	1	APDES
CW-14	4	61.19, -149.83	Lake Otis Parkway	ADF&G 20400036 fish passage issue. Velocity and perch issues at culvert outlet	Replace culvert and wood fish ladder with bridge or large, embedded pipe.	MOA, AKDOT	3	2	ADF&G
CW-15	1	61.19, -149.83	Lake Otis Parkway	Runoff from road is not treated prior to discharge to creek.	Install pretreatment basin for Lake Otis runoff.	DPW	4	1	APDES

MIDDLE FORK CHESTER (CMF)

Map ID	Goal(s)	Lat/Long	Approximate Location	Issue	Action Item	Lead	Cost	Priority	Mandate
CMF-1	2,4	N/A	Middle Fork at Tikishla Park	Channel widening and habitat loss from utility work at ditch confluence	Reconstruct creek and ditch banks to increase depth and available habitat.	WMS	5	2	ADF&G
CMF-2	2,4	N/A	Middle Fork at Nichols Street	Middle Fork was culverted in this area during development for about 500 feet.	Construct an open channel. Channel would have one road and two driveway crossings with steep, deep sides.	ADF&G	6	2	ADF&G
CMF-3	2,4,7	61.2, -149.81	Middle Fork at Nichols Street	ADF&G 20400038 fish passage issue for slope.	Evaluate and replace culvert.	MOA	3	2	ADF&G
CMF-4	1,4	61.2, -149.8	Middle Fork at Bragaw Street	Untreated stormwater input	Construct a water treatment pond to improve water quality prior to discharge from approximately 1800 acres, including Russian Jack Springs which is located in an area bounded by Bragaw, Northern Lights and Nichols Street.	AKDOT	5	1	APDES
CMF-5	2,4	61.2, -149.8	Middle Fork at Bragaw Street	ADF&G 20400039 culvert fish passage issues at culvert, maintenance of culvert and stormwater piping of stream upstream.	Replace culvert for fish passage and hydraulic conductivity as a maintenance issue for flows.	MOA	3	2	ADF&G
CMF-6	2,4,6	61.2, -149.79	Middle Fork at Reka Street	ADF&G 20400043 fish passage issue and upstream driveway culverts small, banks mowed to edge, lack of habitat.	This area is cut off from rest of creek by 2400 feet of storm drain. Perform study of fish use, enlarge pipes, add riparian vegetation and instream logs and boulders for habitat diversity, replace fish passage issue at culvert.	MOA	5	2	ADF&G
CMF-7	1,2	N/A	Middle Fork at Tikishla Park	Floodplain disconnect and untreated stormwater flows.	Install pretreatment facilities and reconnect flows to adjacent lowlands in Tikishla Park.	DPW	5	1	APDES

Map ID	Goal(s)	Lat/Long	Approximate Location	Issue	Action Item	Lead	Cost	Priority	Mandate
CMF-8	1	N/A	Middle Fork at Alder Drive	Untreated stormwater flows.	Install end-of-pipe pretreatment at Alder Drive.	DPW	4	1	APDES
CMF-9	1,2,5	N/A	Middle Fork near East High School	Untreated stormwater flows.	Disconnect storm drains near East High School and Wesleyan to natural wetlands.	DPW	4	1	APDES, Comp Plan
CMF-10	1,2,5	N/A	Middle Fork near Russian Jack Park	Protection of wetlands for stormwater buffer	Protect uplands and wetlands north of Northern Lights and west of Wesleyan Drive.	HLB, GLT	5	2	Comp Plan
CMF-11	1,2,5	N/A	Middle Fork near Russian Jack Park	Protection of wetlands for stormwater buffer	Protect privately owned wetlands near Russian Jack Park.	HLB, GLT	4	2	Comp Plan
CMF-12	1	N/A	Middle Fork headwaters above Russian Jack Park	Untreated stormwater flows.	Construct LID at Glacier, Mayflower and Four Seasons mobile home parks.	WMS	5	1	APDES
CMF-13	1	N/A	Middle Fork at Tikishla Park	Middle Fork runs orange and highly turbid during rain events and springmelt.	Create a report that evaluates the history, conditions and feasibility of various options to decrease the amount of turbidity caused by groundwater input into the local stormwater system and creek. Implement suggestions.	WMS	1	1	APDES
CMF-14	4	N/A	Middle Fork/drainage tributary	Fish Passage is blocked under trail - no ADF&G name or location in database.	Lower culvert or replace with larger, embedded pipe.	ADF&G, P&R	3	2	ADF&G
CMF-15	4	61.19, -149.82	Northern Lights Blvd.	ADF&G Culvert 20400047 fish passage issue as constriction/velocity	Replace with a larger, embedded culvert.	MOA	3	2	ADF&G
CMF-16	1	N/A	Middle Fork at University Area	Untreated stormwater flows.	Install end-of-pipe pretreatments at UAA and APU.	DPW	2	1	APDES
CMF-17	1		Middle Fork at Pine Street	Untreated stormwater flows.	Disconnect Pine Street outfall that drains to Cartee Softball Fields.	DPW	2	1	APDES

SOUTH FORK CHESTER (CSF)

Map ID	Goal(s)	Lat/Long	Approximate Location	Issue	Action Item	Lead	Cost	Priority	Mandate
CSF-1	4	N/A	South Fork - University Lake and Wesleyan Drive	Creek is over-widened and straight with little habitat diversity as it is a rerouted section of creek to fill University Lake	Increase habitat diversity in stream between University Lake and Wesleyan Drive, potentially add bankfull banks to bring to a more representative cross-section area for riffles, add boulders for scour pools. This area has the potential to re-create meanders for the creek and a floodplain in undeveloped area to the north of creek.	USFWS	5	2	ADF&G
CSF-2	1,2,4	N/A	South Fork - University Lake and Wesleyan Drive	To keep the potential for remeandering creek in this area.	Protect uplands and wetlands north of Northern Lights and west of Wesleyan Drive	HLB, GLT	4	2	Comp Plan
CSF-3	1,3	N/A	South Fork at inlet to University Lake	Low flow issues over sediment delta at creek inlet to lake, potentially exacerbated when Chester was rerouted into the lake, causing significant erosion upstream.	Remove sediment from inlet, create sediment trap to capture estimated additional sediment from further bank erosion, narrow creek mouth downstream of bridge, consider habitat diversification in eroded section of channel.	P&R	5	2	APDES
CSF-4	1,3	N/A	South Fork at University Lake	Dog park introduction of fecal coliform into lake and trampling of lakeshore is high.	Create directed access to lake and maintain vegetated buffer outside of access areas, restore vegetated buffer in impacted locations.	P&R	3	1	APDES
CSF-5	1,2,3,4	N/A	South Fork at College Gate Elementary	Channel is overwidened with a gabion wall along the west bank. Slope grade causes severe icing and backwatering.	Replace gabion with bioengineering and replant riparian vegetation, potential to create wetland marsh while narrowing channel or regrade stream to eliminate backwater and create habitat diversity riffles and pools.	USFWS	5	1	Comp Plan

Map ID	Goal(s)	Lat/Long	Approximate Location	Issue	Action Item	Lead	Cost	Priority	Mandate
CSF-6	4	61.18, -149.78	South Fork at Emmanuel Street	ADF&G 20400056 fish passage issue - set at wrong grade creating a velocity chute at inlet of culvert.	Evaluate flows, at minimum remove mitered end of culvert and restore site unless flow calculations indicate complete replacement for hydraulic capacity.	AKDOT	3	1	ADF&G
CSF-7	4	61.18, -149.77	South Fork at Boniface	ADF&G 20400063 fish passage issue. Gradient grey, constriction ration grey, rock weir at inlet increase velocities.	Evaluate fish passage flows for crossing, take out rock weir (looks to be fallen rock from riprap sides) and replace. Evaluate large opening for large animal passage under Boniface.	AKDOT, ADF&G	3	1	ADF&G
CSF-8	1	N/A	South Fork between Boniface and Beaver	Untreated stormwater flows.	Install End of pipe controls in Nunaka Valley	DPW	2	1	APDES
CSF-9	4	61.18, -149.77	South Fork at Riviera Terrace Trailer Park - Lee Street	ADF&G 20400057 fish passage issue. Gradient and constriction issues for double pipe and velocity gradient, backwaters a large length of creek.	Evaluate for fish passage flows and replace pipe with one large pipe to comply with MOA Standard Design Criteria and ADF&G fish passage for embedded pipes, slope so no backwater of creek upstream.	Private	3	1	ADF&G
CSF-10	4	61.19, -149.77	South Fork at Riviera Terrace Trailer Court - Sylvia Drive	ADF&G 20400058 fish passage issues. Perch, velocity issues at this culvert. Triple culvert does not conform to MOA design criteria.	Replace with a larger, embedded culvert.	Private	3	1	ADF&G
CSF-11	4	61.19, -149.77	South Fork at Riviera Terrace Trailer Court - Sylvia Drive	ADF&G 20400060 fish passage issues. Velocity issues and triple culvert does not conform to MOA design criteria.	Replace with a larger, embedded culvert.	Private	3	1	ADF&G

Map ID	Goal(s)	Lat/Long	Approximate Location	Issue	Action Item	Lead	Cost	Priority	Mandate
CSF-6	4	61.18, -149.78	South Fork at Emmanuel Street	ADF&G 20400056 fish passage issue - set at wrong grade creating a velocity chute at inlet of culvert.	Evaluate flows, at minimum remove mitered end of culvert and restore site unless flow calculations indicate complete replacement for hydraulic capacity.	AKDOT	3	1	ADF&G
CSF-7	4	61.18, -149.77	South Fork at Boniface	ADF&G 20400063 fish passage issue. Gradient grey, constriction ration grey, rock weir at inlet increase velocities.	Evaluate fish passage flows for crossing, take out rock weir (looks to be fallen rock from riprap sides) and replace. Evaluate large opening for large animal passage under Boniface.	AKDOT, ADF&G	3	1	ADF&G
CSF-8	1	N/A	South Fork between Boniface and Beaver	Untreated stormwater flows.	Install End of pipe controls in Nunaka Valley	DPW	2	1	APDES
CSF-9	4	61.18, -149.77	South Fork at Riviera Terrace Trailer Park - Lee Street	ADF&G 20400057 fish passage issue. Gradient and constriction issues for double pipe and velocity gradient, backwaters a large length of creek.	Evaluate for fish passage flows and replace pipe with one large pipe to comply with MOA Standard Design Criteria and ADF&G fish passage for embedded pipes, slope so no backwater of creek upstream.	Private	3	1	ADF&G
CSF-10	4	61.19, -149.77	South Fork at Riviera Terrace Trailer Court - Sylvia Drive	ADF&G 20400058 fish passage issues. Perch, velocity issues at this culvert. Triple culvert does not conform to MOA design criteria.	Replace with a larger, embedded culvert.	Private	3	1	ADF&G
CSF-11	4	61.19, -149.77	South Fork at Riviera Terrace Trailer Court - Sylvia Drive	ADF&G 20400060 fish passage issues. Velocity issues and triple culvert does not conform to MOA design criteria.	Replace with a larger, embedded culvert.	Private	3	1	ADF&G

Map ID	Goal(s)	Lat/Long	Approximate Location	Issue	Action Item	Lead	Cost	Priority	Mandate
CSF-12	1,6	N/A	South Fork at Riviera Terrace Trailer Court	Debris in creek and riparian areas, general encroachment into buffer zone and backwater issues due to culverts or rock weirs at culverts.	Clean up area, education outreach needed, removal of rock weirs put there by locals, improve tossing of house plants into creek.	AWC	1	2	APDES
CSF-13	4	61.19, -149.76	South Fork at Northern Lights Blvd.	ADF&G 20400064 fish passage issue. Obstructions in pipe, barrier potential at outlet.	Clean obstructions and outlet barrier, evaluate for hydraulic and fish passage criteria, replace if necessary.	MOA	3	1	ADF&G
CSF-14	6,7	N/A	South Fork along Ambergate	General erosion along fences, lawns, issues with tree cutting.	Walk creek to evaluate extent of issues, form an approach to address erosion, educate local homeowners on value of riparian area.	AWC	1	2	Title 21
CSF-15	1	N/A	South Fork at Baxter Road	Untreated storm water runoff	Detention and treatment at discharge of basin Baxter Road and Northern Lights.	DPW	3	1	APDES
CSF-16	1	N/A	South Fork at Baxter Bog	Untreated storm water runoff	Sediment removal and hydraulic dampening all basins into Baxter Bog.	DPW, P&R	3	1	APDES
CSF-17	1,2,5	N/A	South Fork at Baxter Bog	Drying of Baxter Bog wetlands	Reconnect storm water flow to Baxter Bog.	DPW, P&R	3	1	APDES Comp Plan
CSF-18	4	N/A	South Fork at Begich Middle School	Invasives, rock weir formation by children to cross stream	Perform invasive removal and design/construct small bridges for children to cross creek.	AWC	1	3	Title21, ADF&G
CSF-19	4	61.2, -149.73	South Fork at Muldoon Road	ADF&G 20400249 fish passage issue. Gradient in culvert makes perch and velocity barrier, long-term maintenance issue for hydraulics, does not pass 100-year flood well, backwaters upstream businesses.	Replace culvert, evaluate current (2012) design to move creek to new location and crossing under Muldoon road. Underway	MOA, AKDOT	6	1	ADF&G

Map ID	Goal(s)	Lat/Long	Approximate Location	Issue	Action Item	Lead	Cost	Priority	Mandate
CSF-20	3,4	N/A	South Fork upstream of Muldoon Road	Creek is modified with low habitat diversity and at-risk of road and development.	Create more natural creek on South Fork east of Muldoon Road. Align to Hill with a 100 foot corridor.	DPW	5	2	ADF&G
CSF-21	1	N/A	South Fork upstream of Muldoon Road	Creek has significant debris in it up to halfway to military land	Take debris out of creek.	AWC	1	1	APDES
CSF-22	4	N/A	North Fork of the South Fork Muldoon Road	Creek is culverted under Muldoon Road for 1,500 feet	Remove North Branch of South Fork from Muldoon Road and put into open channel in a 100 foot ROW.	DPW	2	2	ADF&G
CSF-23	6	N/A	North Fork of the South Fork Rangeview Trailer Court	Encroachment and debris issues in the creek, dog use, trampling of banks.	Remove debris, install access points, revegetate other access points.	Private	1	3	APDES
CSF-24	6	N/A	South Fork at lakes and bogs	No education signage for public.	Install kiosks at University Lake, Baxter Bog, Cheney Lake.	AWC	1	3	APDES
CSF-25	4	61.19, -149.82	Mallard Drive	ADF&G Culvert 20400250 fish passage issue as a constriction to creek	Replace with a larger, embedded culvert.	MOA	3	2	ADF&G
CSF-26	1,4	61.19, -149.82	U-Med District	Evaluate cumulative effects of water temperature from building inputs	Monitor creek above, below and in selected areas where buildings are discharging HVAC water.	AWC	1	1	ADEC WQS

CHESTER REFLECTION LAKE (CRL)

Map ID	Goal(s)	Lat/Long	Approximate Location	Issue	Action Item	Lead	Cost	Priority	Mandate
CRL-1	4	61.18, -149.77	Reflection Lake at Sapien Ave.	ADF&G 20400212 fish passage issue. Perch and gradient issues.	Replace with a larger, embedded culvert. Completed (J. Urbanus 12/10/14)	MOA	3	2	ADF&G
CRL-2	4	61.18, -149.77	Reflection Lake at Image Drive	ADF&G 20400214 fish passage issue. Gradient, constriction and velocity issues.	Replace with a larger, embedded culvert. Completed (J. Urbanus 12/10/14)	MOA	3	2	ADF&G
CRL-3	4	61.18, -149.77	Reflection Lake at Reflection Drive	ADF&G 20400215 fish passage issue and flow capacity. Gradient, velocity.	Replace with a larger, embedded culvert and investigate outlet of Reflection Lake for open channel if necessary. Completed (J. Urbanus 12/10/14)	MOA	3	2	ADF&G
CRL-4	2,3,4	N/A	Reflection Lake between Image and Reflection Drive	Area could be made into a wetland marsh to enhance habitat.	Image Drive and Reflection Drive area turn greenbelt to marshy profile for creek.	MOA	4	3	Comp Plan

NORTH FORK CHESTER (CNF)

Map ID	Goal(s)	Lat/Long	Approximate Location	Issue	Action Item	Lead	Cost	Priority	Mandate
CNF-1	1,2,3,4,5,6	N/A	Sitka Street Park	The North Fork was diverted from this area in the 1960s. The original channel was dewatered but still exists through the park. Approximately 2,200 feet of prime Coho salmon rearing habitat exists in the dewatered channel and can be restored.	Construct a diversion at Sitka Street to route the North Fork base flow to the channel through Sitka Street Park while bypassing peak flood flows down the current ditched channel.	WMS	6	2	ADF&G
CNF-2	5,6	N/A	North Fork at Sitka and Davis Parks	No educational information available	Place kiosks at Sitka Street Park and Davis Park on LID, pesticide use, fertilizers and pets.	AWC	1	3	APDES
CNF-3	1,4	N/A	North Fork at Mountain View	Headwaters are highly developed curb and gutter, increasing runoff and pollutants into creek	Evaluate, prioritize and construct headwater street retrofits in Mountain View to improve stormwater.	WMS	4	1	APDES

II. RECENT LID PROJECTS IN CHESTER CREEK WATERSHED (as of 12/12)¹⁰⁹

According to the HDR report, LID has been implemented on a number of sites within Chester Creek watershed, which are listed on the following table.¹¹⁰

Table 6.2. LID Implementation in Chester Creek Watershed

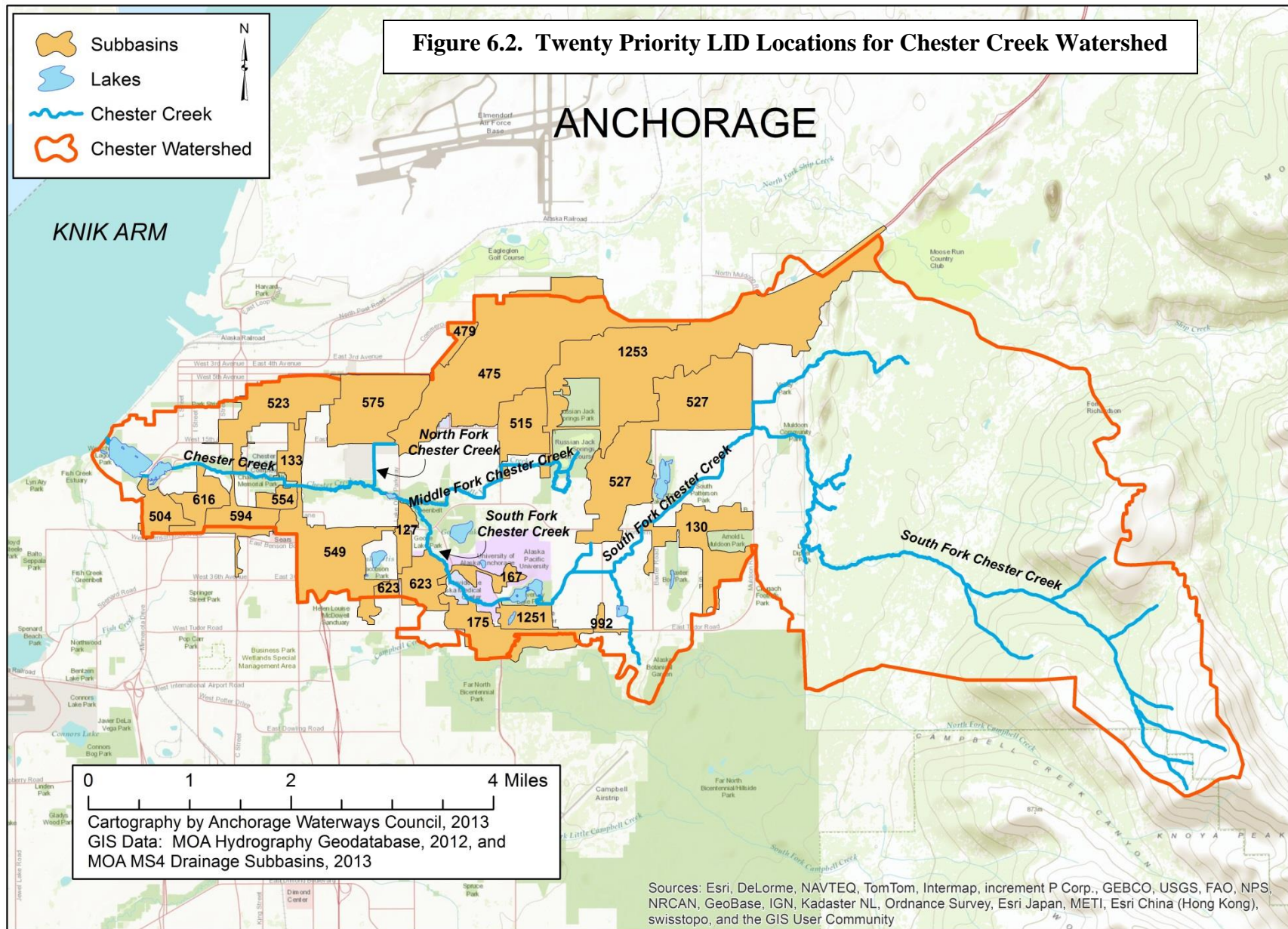
Subwatershed	Name of Project	Description
Middle Fork	New Providence Health Building	Detention pond for runoff. Still under construction (as of 12/12)
	Cartee Softball Fields	Porous pavement with underground detention and infiltration gallery. Accepts runoff from the parking lot. Pilot project to see how porous pavement works in Alaska conditions.
	Ace Hardware	Complete underground infiltration gallery. Connected to storm drain.
	New 4-plex at 20 th and Wesleyan	Development was graded so that runoff from parking lot drains to the adjacent wetland for treatment.
South Fork	UAA Sports Arena	When this development is completed, a large area of the roof and parking lot will be directed to a constructed depression.
	State Crime Lab	Low impact design features were incorporated into the new development.
	Providence Day Care	A constructed pond receives runoff.
	UAA Health Science Building	Runoff from the roof is directed to the west to a large infiltration building. Overflow goes to constructed pond. On south of the building, runoff from parking
	New Providence Extended Care, under construction (as of 12/12)	Runoff from building and parking will go to a constructed pond when completed.
	Medical Office Building – Alaska Heart Institute and Cancer Center Building	Runoff from parking lot goes to a constructed pond. Water discharges into the adjacent wetland. There is no direct connection to the creek.
	Creekside Drive Development	A constructed pond collects runoff from the roofs and parking lot. The pond drains to the west, towards the creek.
	MHLT-Mental Health Trust Fund	A constructed detention pond accepts runoff from this currently-vacant land.
	Alaska Native Tribal Health Consortium Building	A constructed pond to the east of the building receives runoff from the entire parking lot and roof. The area on the east side of the pond also drains to the pond.

¹⁰⁹ This table was part of a report to Watershed Management Services. (Prepared by HDR Alaska, Inc.). *Chester Creek Watershed Subbasin Prioritization for LID Stormwater Projects*. Dec. 17, 2012. <http://www.anchoragewatershed.com/Documents/AppA4ChesterCreekWatershedSubbasinPrioritizationforLIDStormwaterProjects.pdf> , p.3.

¹¹⁰ Some projects may still be under construction or completed.

Table 6.3. List of LID Opportunities in 20 Priority Subbasins (see Figure 6.2 for map of subbasins referenced)

Priority	Subbasin	Watershed	Potential LID Projects
1	575	North Fork	Investigate infiltration options that can be achieved without any risk of open water near Merrill Field.
2	475	North Fork	Investigate LID opportunity in Penland Park area drainage plan.
3	549	Lower	Look for LID integration into 36 th Ave. improvements.
4	523	Lower	In the Highway-to-Highway project, assess LID/storm drain improvements to various areas.
5	594	Lower	Divert flow from storm drain at C St. and 22 nd Ave. to nearby wetlands as well as other improvements along C St.
6	527	South Fork	Review several parcels and large parking areas for capturing runoff from 2 schools, several residences, large stores, and the Anchorage School District parking lot.
7	1253	Middle Fork	Investigate ways to disconnect this urban area (Wonder Park School, Carrs Shopping Center, and areas along Muldoon Rd.) from the storm drain system.
8	175	South Fork	Possibly disconnect catch basins at Municipal Tudor Road Complex (school bus barn), look at strip mall parking along Tudor, LID opportunities for the MOA building on Elmore, and evaluate State Crime Lab and Office of the State Veterinarian.
9	515	Middle Fork	Look at Costco parking lot and Williwaw Elementary School for a multi-use vegetated infiltration area.
10	616	Lower	Vegetated area near North Star School could be used for onsite stormwater management, and review areas along Arctic Blvd. and Northern Lights for parking lot pavement reduction.
11	133	Lower	Evaluate potential for disconnecting catch basins near First National Bank between Gambell and Ingra, and be involved when the Sullivan Arena area is redone.
12	623	South Fork	Look at the many disconnected impervious areas with vegetated buffers on the UAA and Providence Medical campuses.
13	504	Lower	Review Spenard Road planned improvements for LID, consider vegetated buffers at Romig Middle School parking lot, and look at areas along Northern Lights and Spenard for reducing paved lots.
14	1251	South Fork	Investigate parking requirements for the Alaska Native Medical Center, Anchorage Native Primary Care Center, and the Diplomacy Building to determine if pavement could be removed for infiltration.
15	992	South Fork	Have the Alaska Department of Public Safety building use a wetland buffer on its southeast side, and look at the Alaska Housing and Finance Corporation for retaining stormwater onsite.
16	130	South Fork	Implement LID at 3 schools and better manage stormwater runoff from the Carrs Center at Muldoon.
17	479	Middle Fork	Look for opportunities to disconnect and consider parking lot sizes for pavement reduction.
18	554	Lower	Investigate directing stormwater drainage to wetlands in the west and review CIRI's plans for LID in redevelopment
19	127	South Fork	Investigate LID opportunities for Wendler Middle School and Lake Otis Elementary.
20	167	South Fork	Investigate opportunities to divert runoff from Providence Hospital parking areas to adjacent wetlands.



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