



Alaska Department of Environmental Conservation

Anchorage Creeks and Lakes Pathogen Survey 2020-2021

Final Report

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DEC staff collecting water sample on an Anchorage area stream

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Contents

| | |
|--|----|
| Abstract..... | 3 |
| Introduction | 3 |
| Methods..... | 4 |
| Site Selection and Sampling..... | 4 |
| Data Analysis..... | 5 |
| Results..... | 8 |
| Ship Creek Watershed..... | 8 |
| Campbell Creek Watershed | 9 |
| Craig Creek | 9 |
| Campbell Lake..... | 10 |
| Campbell Creek..... | 11 |
| Little Campbell Creek..... | 11 |
| Eagle River Watershed..... | 12 |
| Chester Creek Watershed | 14 |
| Rabbit Creek Watershed | 16 |
| Fish Creek Watershed | 17 |
| Furrow Creek Watershed..... | 19 |
| Peters Creek Watershed | 21 |
| South Anchorage Watersheds (Rainbow, McHugh, and Potter Creeks) | 22 |
| Conclusion..... | 24 |
| References | 26 |
| Appendix A. Monitoring locations and coordinates | 27 |
| Appendix B. Impairment analysis for waterbodies sampled in 2020-2021 | 28 |
| Appendix C. Integrated Report Waterbody Categories..... | 29 |

Abstract

In 2020 and 2021, DEC Water Quality staff conducted pathogen (fecal coliform bacteria and *E. coli*) sampling on nineteen waterbodies within the Municipality of Anchorage, eleven of which were previously listed as impaired for fecal coliform bacteria and have Total Maximum Daily Loads (TMDLs) in place as a planning tool for waterbody recovery. The goals of this project were to determine whether water quality had improved on the impaired waters and whether the other waterbodies were still meeting water quality criteria for fecal coliform bacteria. Samples from each site were also analyzed using Microbial Source Tracking (MST) to help assess potential fecal bacteria host species. While samples from some waterbodies did not detect genetic markers or contained unquantifiable amounts, samples from other waterbodies, most commonly in urban Anchorage sites, contained quantifiable amounts of genetic markers for humans, birds, and dogs. Little Survival Creek and Campbell Lake, two waterbodies listed as impaired for pathogens, had results that did not exceed criteria in either year. Eagle River, not currently listed as impaired, had results exceeding pathogen criteria in both years. After further data analysis, DEC will be considering potential delisting of Little Survival Creek and Campbell Lake from the impaired waters list in the 2024 Integrated Water Quality Monitoring and Assessment Report. DEC will also propose additional pathogen monitoring on Eagle River.

Introduction

The Municipality of Anchorage (Municipality) is located between Cook Inlet and the Chugach Mountains. Chugach State Park encompasses the mountains east of Anchorage and encompasses 774 square miles. Anchorage is home to approximately 291,000 people (2019), roughly 40% of Alaska's population. Anchorage is the most populated and urbanized area in Alaska and as a result, stormwater runoff is prevalent in Anchorage waterbodies. In the late 1990's and early 2000's, several Anchorage waterbodies were found to be impaired for pathogens (fecal coliform bacteria).

Under section 303(d) of the Clean Water Act, states are required to develop a list of impaired waterbodies and establish waterbody recovery plans, like Total Maximum Daily Loads (TMDL), that when implemented will help the waterbody meet water quality standards (WQS). From 2004 to 2006 TMDLs were developed for eleven Anchorage waterbodies impaired for pathogens. The source of pathogen impairment was identified as bacteria from stormwater runoff. Since then, water quality sampling has been limited and it is unknown whether actions implemented in the watersheds to reduce pathogen pollution have been effective at reducing bacteria loads as described in the TMDLs.

The objectives of this project were to determine if water quality has improved on the eleven impaired waterbodies and to assess if other waterbodies within the Municipality are attaining criteria for pathogens. Pathogens sampled were fecal coliform and *Escherichia coli* (*E. coli*) bacteria. Fecal coliform bacteria are found in the intestinal tracts of warm-blooded animals, and *E. coli* is the dominant bacteria found in the waste of humans and animals. *E. coli* is a better predictor of swimming/water recreation associated illness than fecal coliform. These pathogens do not directly cause disease in humans however, they are indicator organisms of potentially more harmful pathogens present in the water. Environmental and anthropogenic factors can promote the growth of these bacteria in water. Contact with or consumption of such contaminated waters can result in a variety of gastrointestinal, respiratory, eye, ear, nose, throat, and skin diseases.

Methods

Site Selection and Sampling

Nineteen streams and lakes were selected within the Municipality for sampling during the early summer of 2020 and 2021 (Table 1), eleven of which are impaired for pathogens. One to three sample sites were selected on each waterbody for a total of 32 monitoring locations (Figure 1). For quality assurance, duplicate samples were collected during 10% of the sampling events. Monitoring locations were selected to be upstream and downstream of likely pathogen exposure areas and were sampled five times over a 30-day period in each year.

Impaired waterbodies with TMDLs were sampled only for fecal coliform; other waterbodies were sampled for both fecal coliform and *E. coli*. This approach was used as waterbodies that have a pathogen impairment were only listed as impaired for fecal coliform and this was the only pollutant addressed in the TMDLs. Both fecal coliform and *E. coli* were sampled for in waterbodies without a current pathogen impairment.

Samples were collected at a depth of one foot and analyzed for fecal coliform by Standard Method 9222D and *E. coli* by Standard Method 9223B. Water temperature was also recorded at each site along with any notable observations of potential pollution sources. An In-Situ Aqua TROLL 500, a water sampling device with multiparameter sensors, was used at each site to record temperature, pH, turbidity, conductivity, and dissolved oxygen during select sampling events. To help assess potential fecal bacteria host species, MST samples were collected once each summer at a sub-set of monitoring locations and analyzed for dog, bird, and human markers.

Table 1. Waterbody pathogen impairment status and category on the 2018 Integrated Water Quality Monitoring and Assessment Report (2018 IR)

| Watershed | Waterbody | Monitoring Sites | Pathogen Waterbody Status in 2018 IR | Pathogen Waterbody Category in 2018 IR* |
|----------------|-----------------------|------------------|--------------------------------------|---|
| Campbell Creek | Campbell Creek | 2 | Impaired | 4a |
| | Campbell Lake | 2 | | 4a |
| | Little Campbell Creek | 2 | | 4a |
| | Craig Creek | 1 | Not assessed | n/a |
| Chester Creek | Chester Creek | 3 | Impaired | 4a |
| | University Lake | 2 | | 4a |
| | Westchester Lagoon | 2 | | 4a |
| Eagle River | Eagle River | 1 | Not assessed | n/a |
| Ship Creek | Ship Creek | 2 | Impaired | 4a |
| Fish Creek | Fish Creek | 3 | Impaired | 4a |
| | Lake Hood | 1 | Delisted in 2010 | 2 |
| Furrow Creek | Furrow Creek | 2 | Impaired | 4a |
| McHugh Creek | McHugh Creek | 1 | Not assessed | n/a |
| Peters Creek | Peters Creek | 1 | Not assessed | n/a |
| Potter Creek | Potter Creek | 1 | Not assessed | n/a |
| Rabbit Creek | Little Rabbit Creek | 2 | Impaired | 4a |
| | Little Survival Creek | 2 | | 4a |
| | Rabbit Creek | 1 | Not assessed | n/a |
| Rainbow Creek | Rainbow Creek | 1 | Not assessed | n/a |

*See Appendix C for explanation of IR categories

Data Analysis

Results for fecal coliform and *E. coli* were compared to Alaska's Water Quality Standards (WQS) freshwater criteria for pathogens. The most stringent criteria were used (Table 2). Fecal coliform results are quantified as colony forming units (cfu)/100ml and *E. coli* results are quantified as most probable number (mpn)/100ml. Data were analyzed by watershed and the 30-day geomean was calculated to compare results with criteria. MST samples were quantified as copies per 100ml. Detected not quantified (DNQ) MST results suggest that the host's fecal contamination was present in the sample but below the limit of quantification. Non-Detect (ND) results mean that the fecal biomarker was not detected in either one, or both test replicates. Detected MST results mean that the host-associated fecal gene biomarker was detected, however, the presence of the biomarker does not signify the presence/absence of that form of fecal pollution conclusively. Geographic information systems were used to spatially assess results by using multiple layers to help identify potential pollutant sources.

Table 2. Alaska Water Quality Standards Freshwater Criteria for pathogens for designated uses most closely associated with this study.²

| Designated Use | Freshwater Most Stringent Criteria |
|---|---|
| (A) Water Supply (i) drinking, culinary, and food processing ² | In a 30-day period, the geometric mean may not exceed 20 fecal coliform colony forming units (cfu)/100 ml, and not more than 10% of the samples may exceed 40 fecal coliform cfu/100 ml. |
| (B) Water Recreation (i) contact recreation | In a 30-day period, the geometric mean of samples may not exceed 126 <i>Escherichia coli</i> (<i>E. coli</i>) cfu/ 100ml, and not more than 10% of the samples may exceed a statistical threshold value of 410 <i>E. coli</i> cfu/100 ml. |

²18 AAC 70

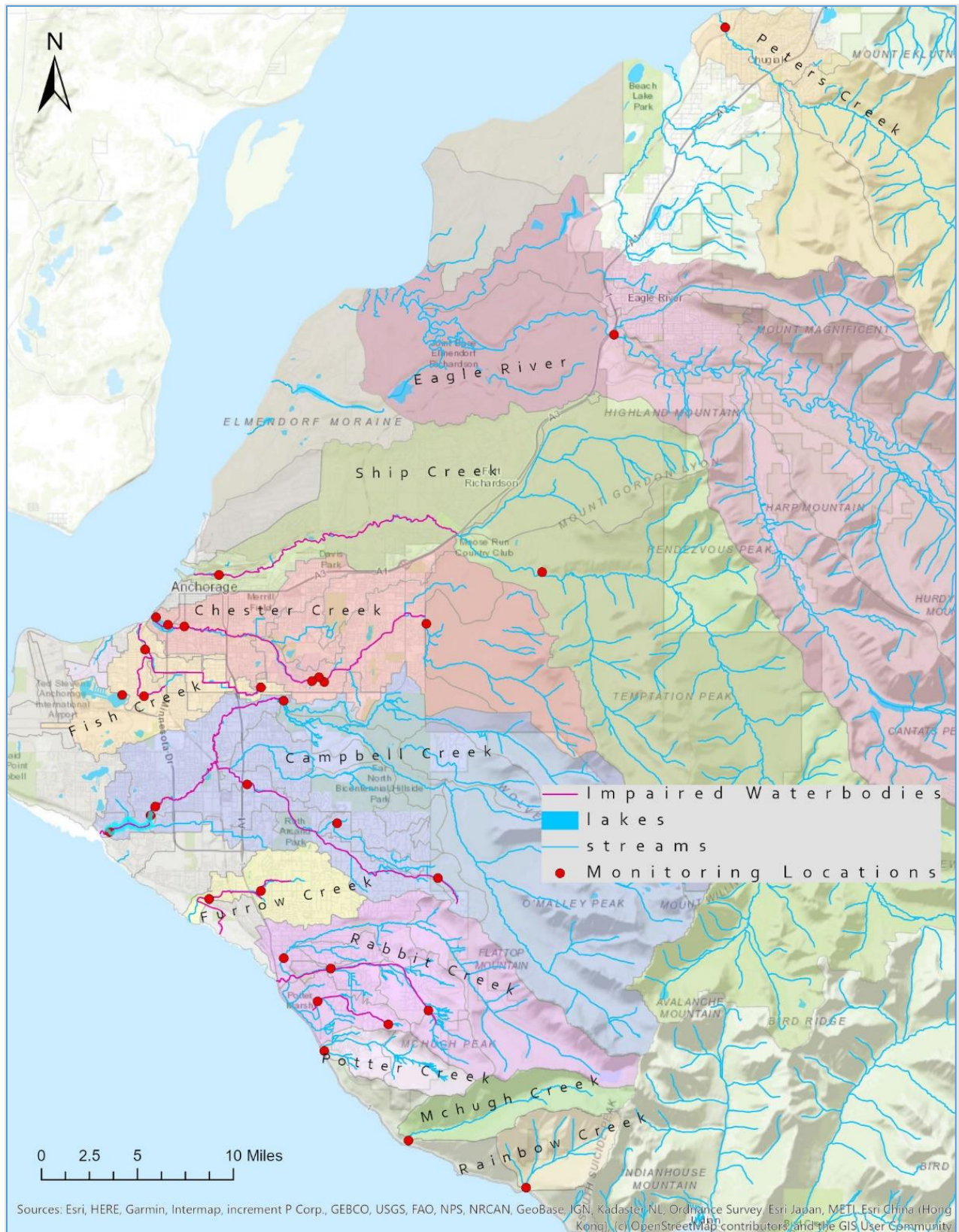


Figure 1. Map of monitoring locations, watersheds, and impaired waters in Anchorage; impaired waterbodies are shown in pink

Results

Ship Creek Watershed

The Ship Creek Watershed is located in northeast Anchorage, heads in the Chugach Mountains and drains an approximate area of 128 square miles before discharging into Cook Inlet (Figure 2). Much of the watershed is within Chugach State Park and Joint Base Elmendorf-Richardson (JBER), limiting access and leaving the landscape relatively undisturbed. A small extent of Ship Creek lies within the Municipality and flows through an industrialized area of downtown Anchorage. Lower Ship Creek from the Glenn Highway to the mouth was included on Alaska's 303(d) list of impaired waters for fecal coliform in 1998 (ADEC, 1998). A TMDL was finalized in 2004 for fecal coliform with urban runoff identified as the pollutant conveyance from watershed sources (ADEC 2004b)

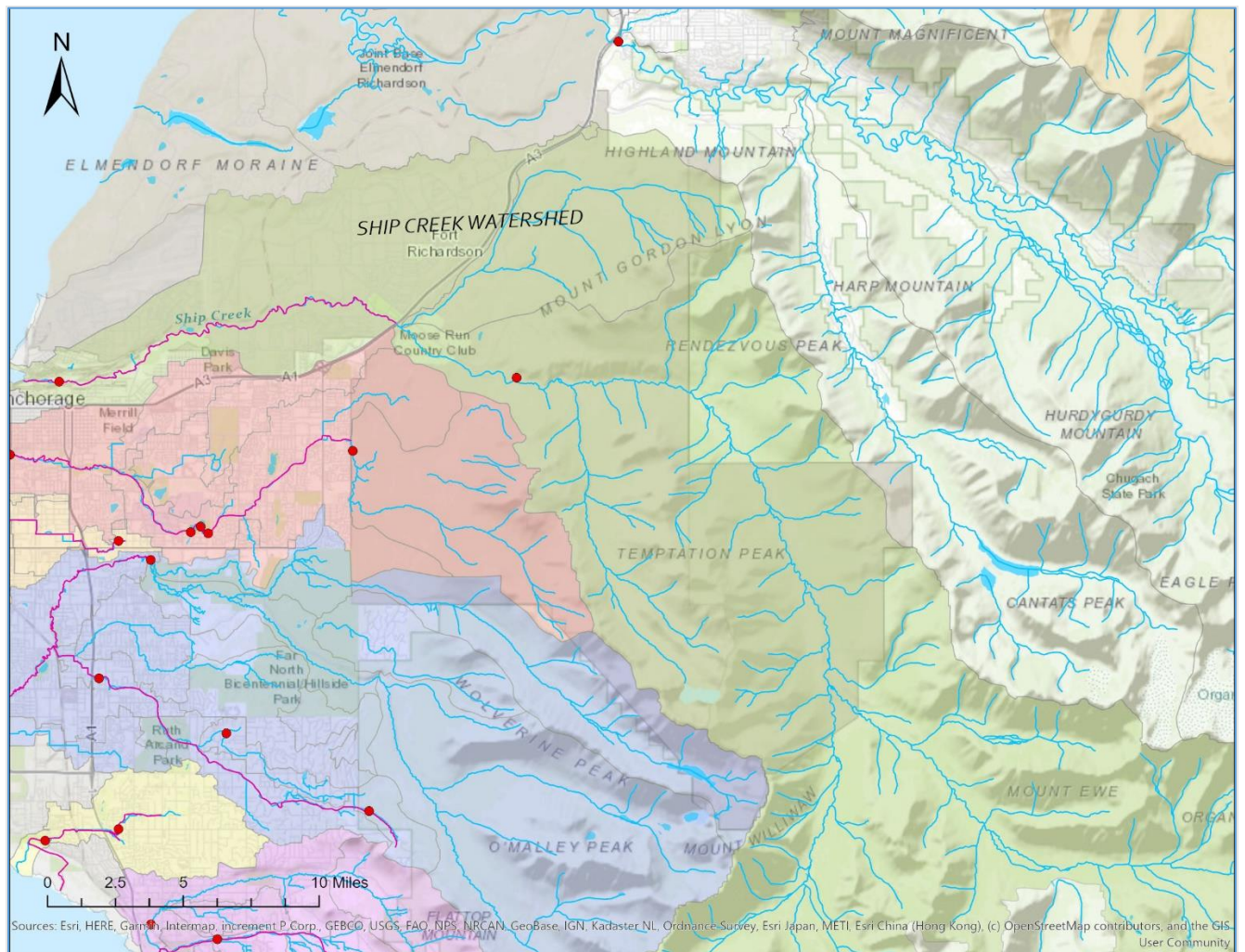


Figure 2. Map of the Ship Creek watershed and monitoring locations; impaired portions of streams are displayed in pink

Two monitoring locations were sampled on Ship Creek; fecal coliform and *E. coli* were sampled at the lower site, within the area of impairment, and only fecal coliform was sampled at the upper site, upstream of the impairment. There were no exceedances for fecal coliform at the upper site and no observed sources of pathogens. The lower site had exceedances for fecal coliform in both years and for *E. coli* in 2021 (Table 3). The 2004 TMDL for Ship Creek states that urban runoff is likely the main

conveyance transporting fecal coliform pollution into Ship Creek along with stormwater runoff and domestic and wild animals (ADEC, 2004). Based on the lower Ship Creek results, urban and stormwater runoff may be more prevalent and contributing to elevated results.

Table 3. Monitoring locations, criteria, and results in the Ship Creek watershed. Blank cells were not sampled for the described test.

| Criteria | Fecal Coliform | | <i>E. coli</i> | | MST | | |
|-------------------------|------------------------|----------------------------------|-------------------------|-----------------------------------|--------------------|------------------|-------------------|
| | Geomean > 20 cfu/100ml | >10% exceedance of 40 cfu/100 ml | Geomean >126 mpn/100 ml | >10% exceedance of 410 mpn/100 ml | Human Copies/100ml | Dog Copies/100ml | Bird Copies/100ml |
| Ship Creek - Upper 2020 | 4.92 | No | | | ND | DNQ | DNQ |
| Ship Creek - Upper 2021 | 2.11 | No | | | | | |
| Ship Creek - Lower 2020 | 17.01 | Yes | 27.97 | No | ND | ND | DNQ |
| Ship Creek - Lower 2021 | 63.28 | Yes | 102.71 | Yes | DNQ | ND | ND |

Campbell Creek Watershed

The Campbell Creek Watershed starts in the Chugach Mountains and drains an approximate area of 81 square miles before discharging into Turnagain Arm (Figure 3). The upper watershed is within Chugach State Park, the lower watershed is within urban Anchorage. Campbell Creek and other waterbodies within the watershed are important to the Anchorage area and provide outdoor recreation, aesthetic views, and habitat for many species. Little Campbell Creek was included on the 1998 303(d) list of impaired waters and a TMDL was established in 2004 (ADEC 2004a). Campbell Creek and Campbell Lake were included on the 2002/2003 303(d) list of impaired waters in the Integrated Water Quality Monitoring Assessment Report (ADEC, 2003) for fecal coliform and a TMDL was established for both waterbodies in 2006 (ADEC, 2006). Stormwater runoff was identified as the expected pollutant conveyance for all three of these waterbodies in the TMDLs (ADEC 2004a and ADEC 2006).

A total of seven sites were monitored in the Campbell Creek watershed. Sample results are shown in Table 4. Two sites were located on Campbell Lake, two on Campbell Creek, two on Little Campbell Creek, and one on Craig Creek. Lower Little Campbell Creek, lower Campbell Creek, and the west Campbell Lake site were also sampled for MST.

Craig Creek

Craig Creek is located within southcentral Anchorage and drains to Little Campbell Creek. Its headwaters begin near West Tree Drive, and it is approximately 5.5 miles long. It is not currently listed as impaired and was sampled for both fecal coliform and *E. coli*. Craig Creek had one exceedance of WQS in 2020 for fecal coliform. Potential sources of pollution include failing septic systems and pet waste.

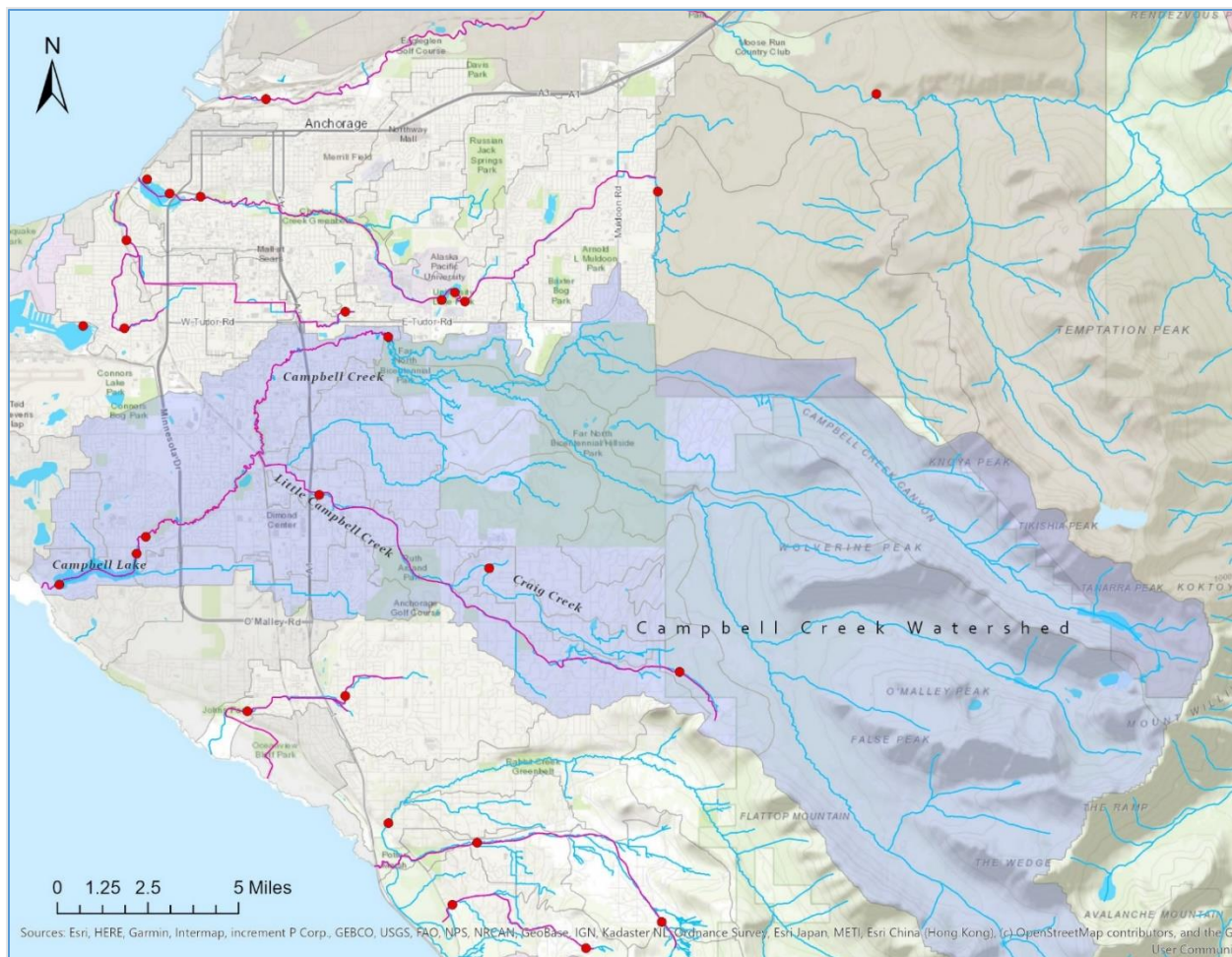


Figure 3. Map of the Campbell Creek watershed and monitoring locations; impaired portions of streams are displayed in pink

Campbell Lake

Two sites were sampled for fecal coliform on Campbell Lake, one on the east end near the inlet and one on the west end near the outlet. In 2021 the east end monitoring location was dropped due to lack of access. Samples exceeded criteria during only one sample event in 2020 at east end. Stormwater runoff was identified as the primary conveyance of fecal coliform pollution into Campbell Lake with domestic and wild animals listed as a contributing source (ADEC 2006). The downstream segment of Campbell Creek that flows into Campbell Lake still exceeds criteria for fecal coliform, likely elevating fecal coliform levels at the inlet end of the lake. This is reflected in elevated inlet site results compared to the outlet site throughout the 2020 sampling period. There are several stormwater outfalls that discharge to Campbell Creek and Campbell Lake which may be conveying pollutants to the lake from watershed sources. Campbell Lake is surrounded by residential development, which may contribute pollution from domestic pets, fertilizers, and other sources.

DEC will be considering a potential delisting of Campbell Lake from Category 4a to Category 2 in the 2024 Integrated Water Quality Monitoring and Assessment Report.

Campbell Creek

Two monitoring locations were sampled on Campbell Creek, one midway and one lower site. The midway site had results that do not exceed pathogen criteria in either monitoring year. The lower site exceeded criteria in both years, with higher results in 2021.

Stormwater runoff was identified as the primary conveyance of fecal coliform pollution into Campbell Creek with domestic and wild animals listed as contributing sources (ADEC 2006), several stormwater discharges drain to the Creek. The Campbell Creek greenbelt provides habitat for a variety of wildlife and is popular for walking dogs, which could be a potential source of fecal coliform. The lower Campbell Creek site was the only site that exceeded criteria, suggesting that Campbell Creek may become more polluted downstream. The midway site is located above most urban development and may not be exposed to the pollutant sources more common in urban Anchorage. The lower site was sampled for MST markers, both bird and human were ND and dog was DNQ.

Little Campbell Creek

Two monitoring locations were sampled on Little Campbell Creek. The lower monitoring location was sampled for both fecal coliform and *E. coli* and the upper monitoring location was sampled only for fecal coliform. The upper monitoring location results did not exceed criteria, the lower monitoring location had results for both fecal coliform and *E. coli* that exceed criteria in both years and had the highest results of any site sampled in this project. Samples taken at both monitoring locations were sampled for MST. Bird was DNQ for both the upper and lower sites and dog and human were ND at both sites.

As Little Campbell Creek enters urbanized areas, it may become more polluted by stormwater runoff conveying fecal coliform. Lower Little Campbell Creek may have increased fecal coliform pollution due to its location within an industrialized area and near stormwater retention ponds. There are also several encampments along the creek. Data from the Anchorage Water and Wastewater Utility show that the industrial area around Lower Little Campbell Creek utilizes septic systems, which could also be a source of fecal coliform pollution in the case of a septic failure (AWWU 2021). The creek flows through part of the Alaska Zoo and Ruth Arcand Park, both areas house and are used by wildlife and domestic animals. One section of the creek downstream



Figure 4a. Lower Little Campbell Creek in 2020



Figure 4b. Lower Little Campbell Creek in 2021

of the lower sampling location was affected by a blockage of accumulated debris, causing higher water levels and lower flow. After sampling was completed in 2021, the blockage was removed, lowering water levels and increasing flow.

Table 4. Monitoring locations, criteria, and results in the Campbell Creek watershed. Blank cells were not sampled for the described test, the Campbell Lake east site was not sampled in 2021

| Criteria | Fecal Coliform | | E. coli | | MST | | |
|------------------------------------|-----------------------|----------------------------------|-------------------------|-----------------------------------|---------------------|-------------------|--------------------|
| | Geomean >20 cfu/100ml | >10% exceedance of 40 cfu/100 ml | Geomean >126 mpn/100 ml | >10% exceedance of 410 mpn/100 ml | Human Copies/ 100ml | Dog Copies/ 100ml | Bird Copies/ 100ml |
| Campbell Creek - Mid 2020 | 16.71 | No | | | | | |
| Campbell Creek - Mid 2021 | 4.47 | No | | | | | |
| Campbell Lake Inlet - 2020 | 18.28 | Yes | | | | | |
| Campbell Lake - Outlet 2020 | 4.09 | Yes | | | DNQ | DNQ | ND |
| Campbell Lake - Outlet 2021 | 1.69 | No | | | | | |
| Campbell Creek - Lower 2020 | 48.51 | Yes | | | ND | ND | DNQ |
| Campbell Creek - Lower 2021 | 82.01 | Yes | 136.96 | No | DNQ | ND | ND |
| Craig Creek 2020 | 4.01 | Yes | 5.47 | No | | | |
| Craig Creek 2021 | 1.24 | No | 0.57 | No | | | |
| Little Campbell Creek - Upper 2020 | 5.17 | No | | | ND | ND | DNQ |
| Little Campbell Creek - Upper 2021 | 1.93 | No | | | | | |
| Little Campbell Creek - Lower 2020 | 641.32 | Yes | 557.72 | Yes | ND | ND | DNQ |
| Little Campbell Creek - Lower 2021 | 82.02 | Yes | 253.01 | Yes | ND | ND | ND |

Eagle River Watershed

The Eagle River watershed is located north and east of Anchorage and drains approximately 45 square miles before discharging into Knik Arm. The upper watershed is located within the Chugach Mountains and Chugach state Park and is largely undisturbed. Much of lower Eagle River is located within Joint Base Elmendorf-Richardson (JBER), limiting public access. Eagle River is not currently listed as impaired for fecal coliform. In 1995 a TMDL was completed for Eagle River for copper, lead, silver, ammonia, and chlorine impairments. In the 2018 Integrated Water Quality Monitoring and Assessment Report, Eagle River was determined to be attaining criteria for those parameters (EPA 2021).

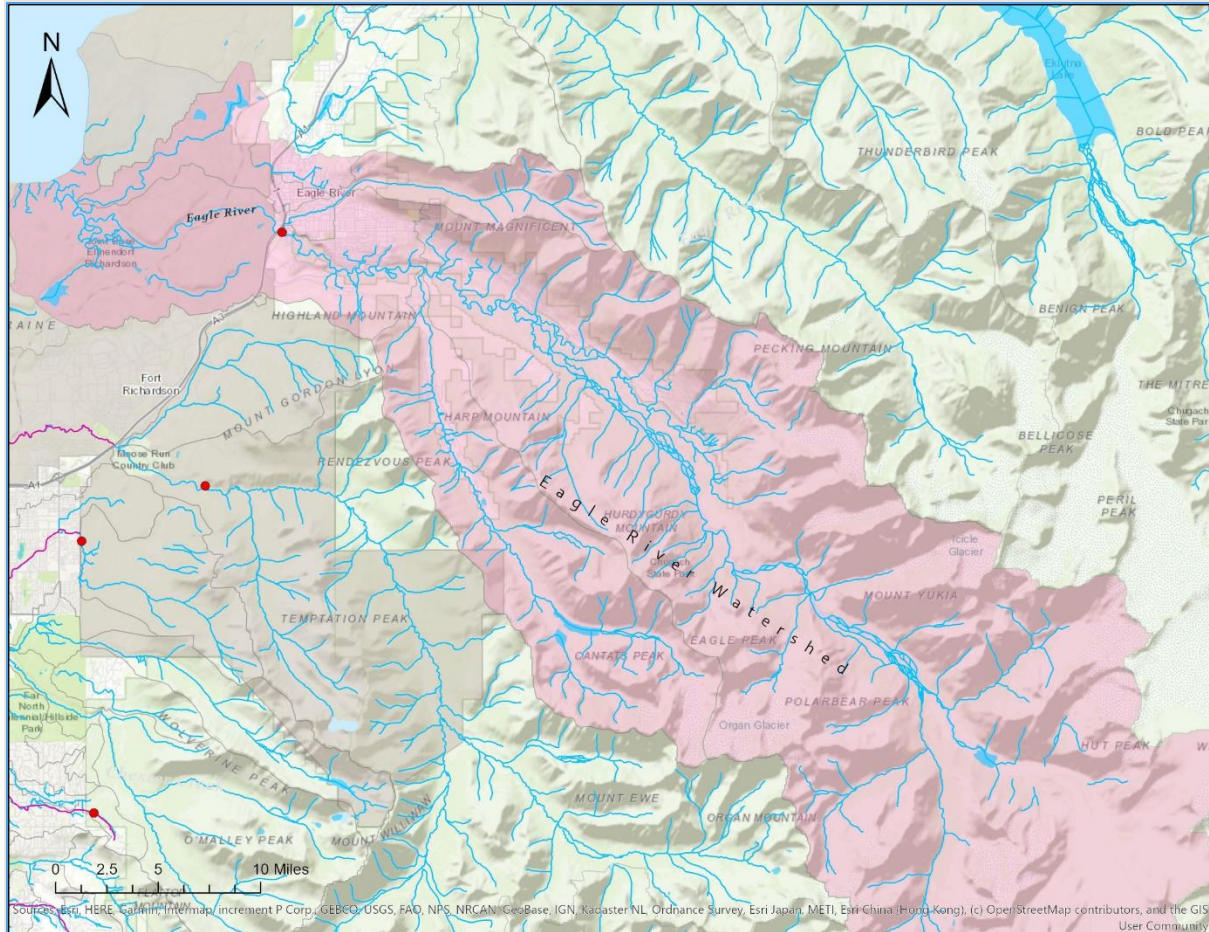


Figure 5. Map of the Eagle River watershed and monitoring location; impaired portions of streams are displayed in pink

One monitoring location was sampled on Eagle River (Figure 5). The monitoring location was sampled for both fecal coliform and *E. coli* and fecal coliform had results that exceed criteria in both years (Table 5). Preliminary analysis suggests urban and stormwater runoff could be contributing to elevated fecal coliform levels. The monitoring location is near a busy highway, residential neighborhoods, and the Eagle River campground. Eagle River also flows through urbanized areas upstream of the sample site. Failing septic systems from upstream neighborhoods are another potential pollutant source. MST sampling detected no markers for human, bird, or dog sources of pathogens.

DEC is proposing to collect additional pathogen data on Eagle River from multiple locations over the open water season (see 2023-2025 ACWA grant Request for Proposals).

Table 5. Monitoring locations, criteria, and results in the Eagle River watershed.

| Criteria | Fecal Coliform | | E. coli | | MST | | |
|--------------------|------------------------|----------------------------------|-------------------------|-----------------------------------|---------------------|-------------------|--------------------|
| | Geomean > 20 cfu/100ml | >10% exceedance of 40 cfu/100 ml | Geomean >126 mpn/100 ml | >10% exceedance of 410 mpn/100 ml | Human Copies/ 100ml | Dog Copies/ 100ml | Bird Copies/ 100ml |
| Eagle River - 2020 | 28.09 | Yes | 45.26 | No | ND | ND | ND |
| Eagle River - 2021 | 35.72 | Yes | 13.88 | No | 3.33E+03 | ND | ND |

Chester Creek Watershed

The Chester Creek watershed heads in the Chugach Mountains on JBER and drains an approximate area of 30 square miles before discharging into Cook Inlet (Figure 6). The upstream reaches of Chester Creek are located on minimally disturbed lands and are not listed as impaired. The watershed contains Chester Creek, University Lake, and Westchester Lagoon. These waterbodies were first included on the 303(d) impaired waters list in 1990 for fecal coliform bacteria pollution with urban runoff identified as the pollutant conveyance, a combined TMDL was approved in May 2005 (ADEC 2005).

Seven monitoring locations (Table 6) were sampled in the Chester Creek watershed. Three sites had exceedances in both years: lower Chester Creek, midway Chester Creek, and University Lake inlet. All sampled sites had at least one exceedance. Sources of fecal coliform in the Chester Creek watershed are urban runoff, stormwater discharge, and wildlife/domestic animal waste (ADEC 2005). University Lake is located within a dog park and pet waste is a likely source of pathogens. Westchester Lagoon, located downtown in a busy park, is heavily used by waterfowl and for recreation during the summer months. Although wildlife and domestic animals contribute to some fecal pollution into these waterbodies, the largest source of fecal coliform most likely comes from urban and stormwater runoff.

Table 6. Monitoring locations, criteria, and results in the Chester Creek watershed. Blank cells indicate that a particular waterbody was not sampled for the described analysis.

| Criteria | Fecal Coliform | | E. coli | | MST | | |
|----------------------------|------------------------|----------------------------------|-------------------------|-----------------------------------|---------------------|-------------------|--------------------|
| | Geomean > 20 cfu/100ml | >10% exceedance of 40 cfu/100 ml | Geomean >126 mpn/100 ml | >10% exceedance of 410 mpn/100 ml | Human Copies/ 100ml | Dog Copies/ 100ml | Bird Copies/ 100ml |
| Chester Creek - Lower 2020 | 121.26 | Yes | | | ND | DNQ | DNQ |
| Chester Creek - Lower 2021 | 116.23 | Yes | 305.04 | Yes | | | |
| Chester Creek - Mid 2020 | 132.70 | Yes | | | 2.77E+03 | DNQ | 3.16E+03 |
| Chester Creek - Mid 2021 | 50.74 | Yes | | | 7.20E+02 | ND | ND |
| Chester Creek - Upper 2020 | 63.84 | Yes | | | DNQ | DNQ | DNQ |
| Chester Creek - Upper 2021 | 4.59 | No | | | ND | ND | ND |

| | | | | | | | |
|----------------------------------|-------|-----|--|--|----------|----------|----------|
| University Lake - Inlet 2020 | 47.34 | Yes | | | 7.05E+02 | 5.45E+02 | 2.11E+03 |
| University Lake - Inlet 2021 | 10.71 | Yes | | | | | |
| University Lake - Outlet 2020 | 14.95 | Yes | | | | | |
| University Lake - Outlet 2021 | 3.05 | No | | | | | |
| Westchester Lagoon - Inlet 2020 | 21.52 | Yes | | | ND | 5.95E+03 | ND |
| Westchester Lagoon - Inlet 2021 | 2.22 | No | | | | | |
| Westchester Lagoon - Outlet 2020 | 2.41 | No | | | | | |
| Westchester Lagoon - Outlet 2021 | 4.25 | Yes | | | | | |

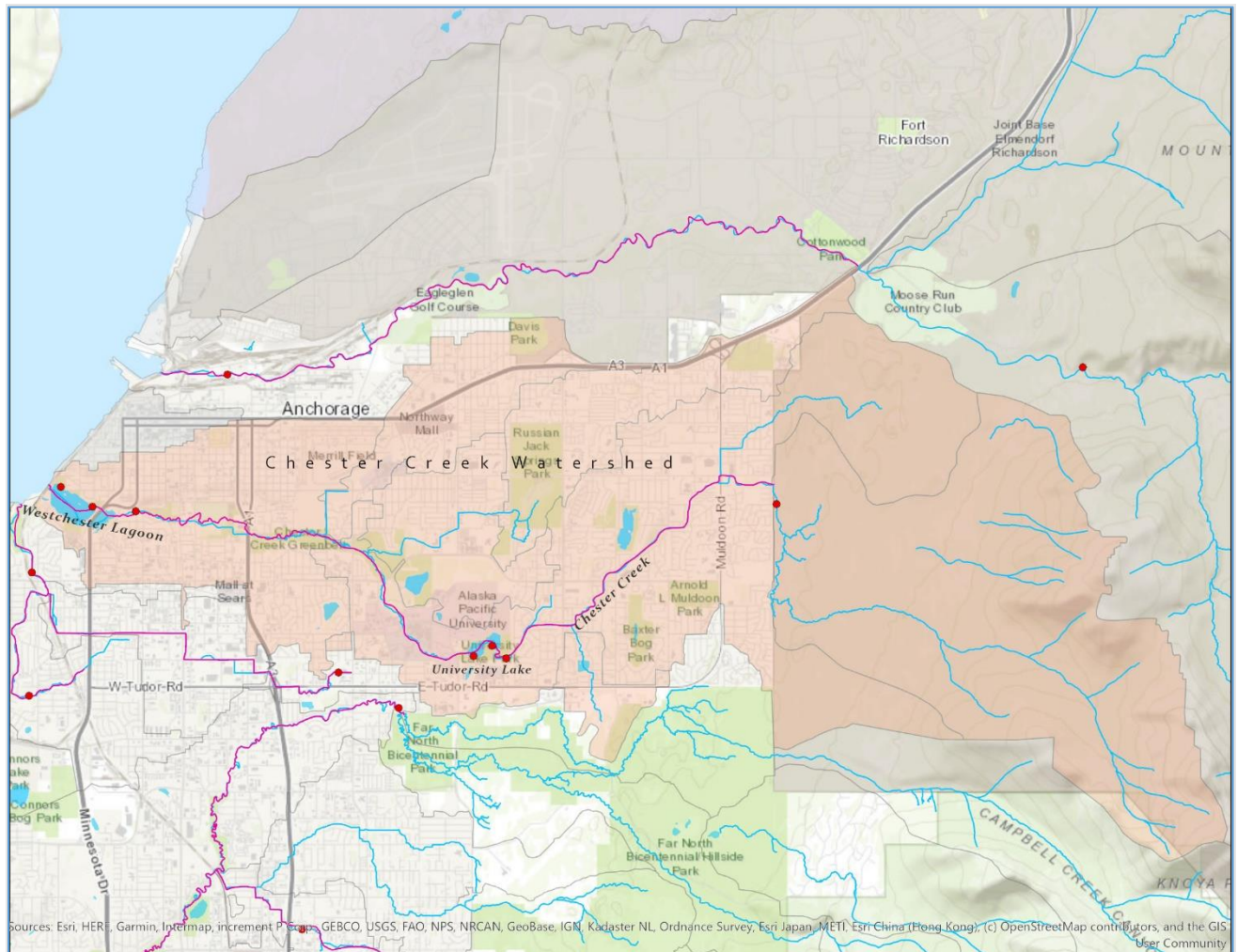


Figure 6. Map of the Chester Creek watershed and monitoring locations; impaired portions of streams are displayed in pink

Rabbit Creek Watershed

The Rabbit Creek watershed is located in south Anchorage, heads in the Chugach Mountains, and drains approximately 24 square miles before discharging into Cook Inlet (Figure 7). A small portion of the upper watershed is located within Chugach State Park, and much of the lower watershed is in residential areas. Little Rabbit Creek and Little Survival Creek were included on the 1998 303(d) list of impaired waterbodies for fecal coliform, and TMDLs were established for both waterbodies in 2004 with stormwater runoff identified as the pollutant conveyance (ADEC 2004c, ADEC 2004d).

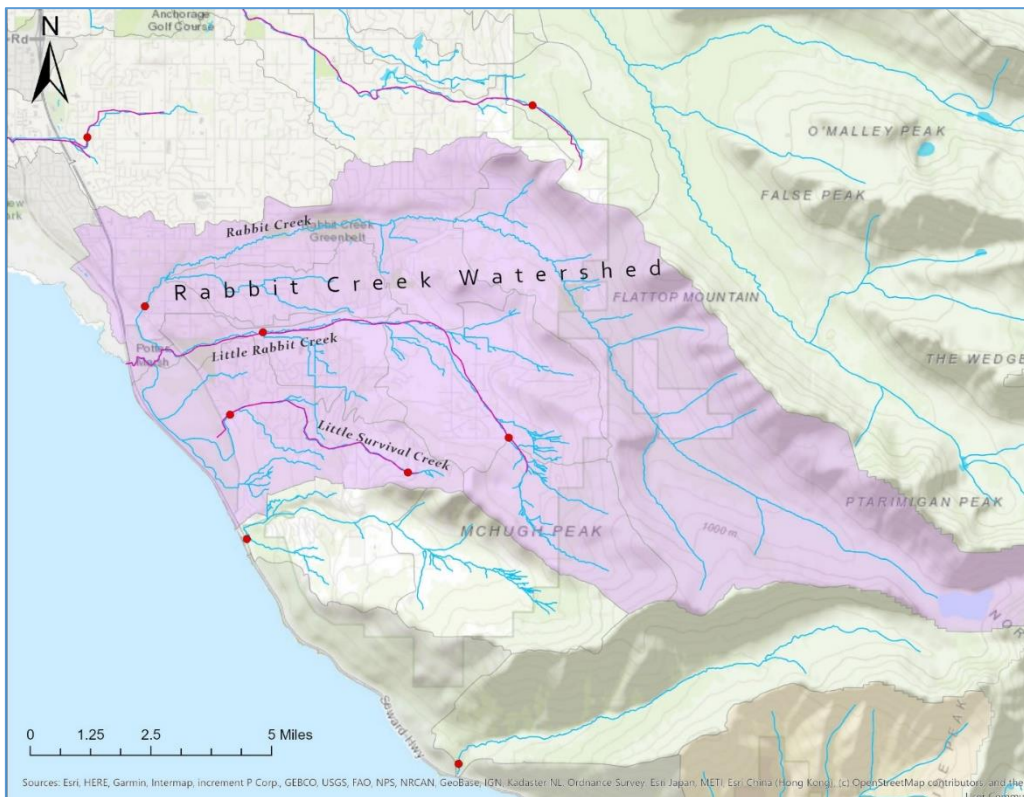


Figure 7. Rabbit Creek watershed and monitoring locations; impaired portions of streams are displayed in pink

Five monitoring locations were sampled in the Rabbit Creek watershed (Table 7). Rabbit Creek is not listed as impaired and was sampled for both fecal coliform and *E. coli*. Rabbit Creek had one exceedance in 2020. Little Survival Creek sites did not exceed criteria and pathogen levels are lower than documented in the TMDL (ADEC 2004d). Of the two Little Rabbit Creek sites, only lower Little Rabbit Creek exceeded criteria in both years.

Stormwater runoff is the primary conveyance of fecal coliform pollution in Little Survival and Little Rabbit Creek (ADEC 2004c and ADEC 2004d). Little Survival Creek had lower pathogen values when compared with the TMDL results; yearly summary statistics of geometric means from 1989-1990 show that May-June were some of the lowest of the year while August-October had the highest fecal coliform geomeans throughout the year (ADEC 2004d). This could be due to increased rain events during these months which may increase stormwater runoff into the creek. The lower Little Rabbit Creek site had higher pathogen values for 2020 than shown in 1989-90 data (ADEC 2004c). Potential sources of

pathogens may be several stormwater discharges upstream of the monitoring location; the lower site is located in a more urbanized area compared to the upper site.

DEC will be considering a potential delisting of Little Survival Creek from Category 4a to Category 2 in the 2024 Integrated Water Quality Monitoring and Assessment Report.

Table 7. Monitoring locations, criteria, and results in the Rabbit Creek watershed. Blank cells were not sampled for the described test.

| Criteria | Fecal Coliform | | E. coli | | MST | | |
|------------------------------------|------------------------|----------------------------------|-------------------------|-----------------------------------|---------------------|-------------------|--------------------|
| | Geomean > 20 cfu/100ml | >10% exceedance of 40 cfu/100 ml | Geomean >126 mpn/100 ml | >10% exceedance of 410 mpn/100 ml | Human Copies/ 100ml | Dog Copies/ 100ml | Bird Copies/ 100ml |
| Little Survival Creek - Lower 2020 | 9.37 | No | | | ND | ND | DNQ |
| Little Survival Creek - Lower 2021 | 3.79 | No | | | | | |
| Little Survival Creek - Upper 2020 | 1.78 | No | | | | | |
| Little Survival Creek - Upper 2021 | 0.76 | No | | | | | |
| Rabbit Creek - 2020 | 11.99 | Yes | 16.64 | No | DNQ | DNQ | ND |
| Rabbit Creek - 2021 | 4.05 | No | 5.09 | No | DNQ | ND | ND |
| Little Rabbit Creek - Lower 2020 | 105.43 | Yes | | | DNQ | ND | ND |
| Little Rabbit Creek - Lower 2021 | 22.84 | Yes | | | 3.61E+ 03 | ND | ND |
| Little Rabbit Creek - Upper 2020 | 7.53 | No | | | | | |
| Little Rabbit Creek - Upper 2021 | 7.61 | No | | | | | |

Fish Creek Watershed

The Fish Creek watershed encompasses approximately eight square miles located within the Municipality, the headwaters are near Lake Otis Parkway and Tudor Road, and it discharges to Cook Inlet (Figure 8). Development in the 1970s filled approximately three miles of the original stream. The upper reach of the creek was routed through an underground culvert called the Fish Creek Bypass, which runs from New Seward Highway to Arctic Boulevard. Fish Creek was included in Alaska’s 303(d) list of impaired waterbodies in 1998 for fecal coliform bacteria, and a TMDL was established in 2004 with stormwater runoff identified as the likely pollutant conveyance (ADEC 2004e). Lake Hood is located within the Fish Creek watershed and although it is not currently listed as impaired, it was placed on the 303(d) list in 1996 for dissolved gas and fecal coliform. To address this, Ted Stevens International Airport implemented a multi-step waterbody recovery plan which has since improved water quality in Lake Hood, it was removed from the 303(d) list in the 2014/2016 Integrated Water Quality Monitoring and Assessment Report (ADEC 2018).

Four monitoring locations were sampled in the Fish Creek Watershed. Trash was frequently observed at all sites. All sites had multiple exceedances of WQS in both 2020 and 2021 (Table 8). Sample results

show some reduction in pathogen levels compared with data collected in 1989-90 (ADEC 2004e), but exceedances are still occurring. Because most of the watershed lies within urban Anchorage and limited riparian areas exist, stormwater runoff is more likely to occur. Field observations near the sample sites and recent data from the Municipality (MOA 2021) show multiple encampments near Fish Creek.

Lake Hood is used as a seaplane base near the Ted Stevens International Airport and was sampled for both fecal coliform and *E. coli*. There was only one exceedance of fecal coliform criteria in 2021 and none in 2022.

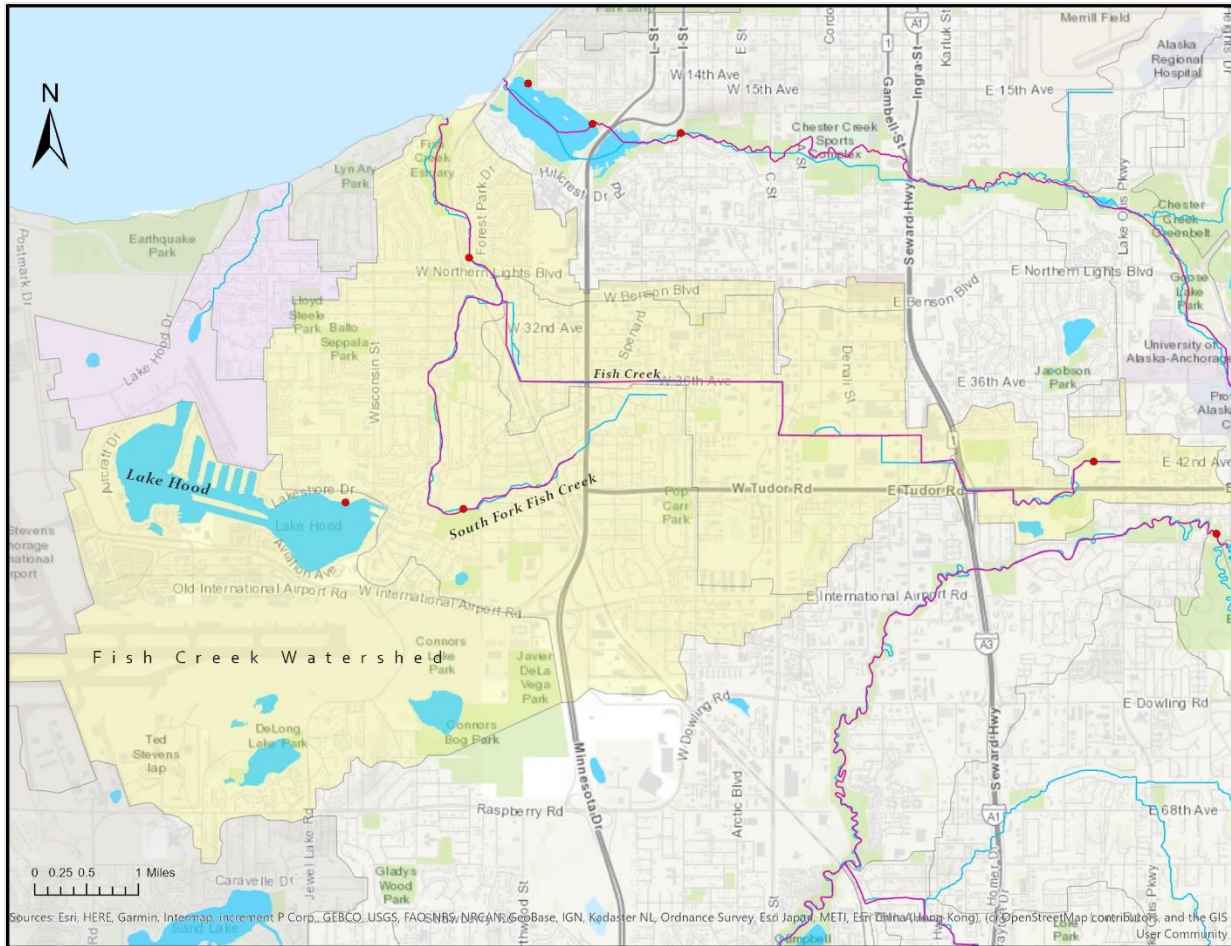


Figure 8. Map of the Fish Creek watershed and monitoring locations; impaired portions of streams are displayed in pink

Table 8. Monitoring locations, criteria, and results in the Fish Creek watershed. Blank cells were not sampled for the described test.

| Criteria | Fecal Coliform | | E. coli | | MST | | |
|--------------------------------|------------------------|----------------------------------|-------------------------|-----------------------------------|-----------------------|---------------------|----------------------|
| | Geomean > 20 cfu/100ml | >10% exceedance of 40 cfu/100 ml | Geomean >126 mpn/100 ml | >10% exceedance of 410 mpn/100 ml | Human (Copies/ 100ml) | Dog (Copies/ 100ml) | Bird (Copies/ 100ml) |
| Lake Hood - 2020 | 1.56 | No | 3.31 | No | | | |
| Lake Hood - 2021 | 4.67 | Yes | 1.15 | No | | | |
| Fish Creek - Lower 2020 | 42.78 | Yes | | | ND | 1.08E+03 | ND |
| Fish Creek - Lower 2021 | 38.92 | Yes | | | 5.14E+03 | DNQ | DNQ |
| Fish Creek - S Fork Upper 2020 | 11.66 | Yes | | | 6.45E+02 | 6.30E+02 | ND |
| Fish Creek - S Fork Upper 2021 | 106.78 | Yes | | | | | |
| Fish Creek - N Fork Upper 2020 | 23.18 | Yes | | | 2.44E+03 | DNQ | ND |
| Fish Creek - N Fork Upper 2021 | 1.60 | No | | | | | |

Furrow Creek Watershed

The Furrow Creek watershed is located within the Municipality with headwaters near Huffman and Elmore Roads and drains an approximate area of five square miles before discharging to Cook Inlet (Figure 9). Furrow Creek was included on Alaska’s 303(d) list of impaired waters in 1998 for fecal coliform and a TMDL was established in 2004 with stormwater runoff identified as the potential source.

Two monitoring locations were sampled for fecal coliform on Furrow Creek (Table 9). The upper location had more than one exceedance in both years. The lower site had exceedances during the 2020 sampling period and no exceedances in 2021. One sample result at the upper site in 2020 was reported as “too numerous to count”, which was confirmed in a duplicate sample taken on the same day. The most likely sources of fecal coliform in Furrow Creek are urban and stormwater runoff, and pet and wildlife waste. A potential source of fecal coliform is failing septic systems, though it is unlikely that they significantly impact instream water quality conditions in Furrow Creek. The TMDL for Furrow Creek states that most septic systems within Anchorage are located more than 100 feet from any stream.

Table 9. Monitoring location, criteria, and results for the Furrow Creek watershed. Blank cells were not sampled for the described test.

| Criteria | Fecal Coliform | | E. coli | | MST | | |
|---------------------------|------------------------|----------------------------------|-------------------------|-----------------------------------|---------------------|-------------------|--------------------|
| | Geomean > 20 cfu/100ml | >10% exceedance of 40 cfu/100 ml | Geomean >126 mpn/100 ml | >10% exceedance of 410 mpn/100 ml | Human Copies/ 100ml | Dog Copies/ 100ml | Bird Copies/ 100ml |
| Furrow Creek - Upper 2020 | 142.40 | Yes | | | 2.02E+03 | DNQ | ND |
| Furrow Creek - Upper 2021 | 2.11 | Yes | | not sampled | ND | DNQ | ND |
| Furrow Creek - Lower 2020 | 283.61 | Yes | | | | | |
| Furrow Creek - Lower 2021 | 2.61 | No | | not sampled | ND | 1.99E+03 | ND |



Figure 9. Map of the Furrow Creek watershed and monitoring locations; impaired portions of streams are displayed in pink

Peters Creek Watershed

The Peters Creek watershed is located north of Anchorage, heads in the Chugach Mountains and drains an approximate area of 89 square miles before discharging into Knik Arm (Figure 10). Most of the generally undeveloped upper watershed is within Chugach State Park. The most developed area is the lower watershed where the Glenn Highway and communities of Birchwood, Chugiak, and Peters Creek are located. Peters Creek is not currently listed as impaired and was tested for fecal coliform and *E. coli*. The results for fecal coliform and *E. coli* did not exceed criteria; however, stormwater runoff from roads, neighborhoods, and the nearby Birchwood Airport can be a conveyance for pollutants (Table 10).

Table 10. Monitoring locations, criteria, and results for Peters Creek. Blank cells were not sampled for the described test.

| Criteria | Fecal Coliform | | <i>E. coli</i> | | MST | | |
|---------------------|-------------------------|----------------------------------|-------------------------|-----------------------------------|-----------------------|---------------------|----------------------|
| | Geomean > 20 cfu/100 ml | >10% exceedance of 40 cfu/100 ml | Geomean >126 mpn/100 ml | >10% exceedance of 410 mpn/100 mL | Human Copies/100ml | Dog Copies/100ml | Bird Copies/100ml |
| Peters Creek - 2020 | 6.23 | No | 9.42 | No | ND | ND | ND |
| Peters Creek - 2021 | 2.63 | No | 2.23 | No | | | |



Figure 10. Map of the Peters Creek watershed and monitoring location

South Anchorage Watersheds (Rainbow, McHugh, and Potter Creeks)

The Potter, McHugh, and Rainbow Creek watersheds are located south of Anchorage, head in Chugach State Park, and collectively drain approximately fifteen square miles before discharging into Turnagain Arm (Figure 11). Most of these watersheds are undeveloped and none of the creeks are currently listed as impaired. These creeks were tested for both fecal coliform and *E. coli*.

The results for both fecal coliform and *E. coli* at Rainbow Creek did not exceed criteria in 2020 but did for fecal coliform in 2021 (Table 11). Significant amounts of pet feces were observed near the Rainbow Creek Trailhead in 2021, which may have contributed to this exceedance.

At McHugh Creek, fecal coliform and *E. coli* did not exceed criteria; however, the popular Turnagain Arm Trail crosses McHugh Creek just upstream of the sample site and stormwater runoff may convey pathogens from pet wastes into the creek. The site was tested for MST in 2020, both bird and dog were DNQ, while human was ND (Table 11).

Potter Creek was also sampled for MST in 2020. Both human and dog were ND, and bird was DNQ at Potter Creek. Both fecal coliform and *E. coli* did not exceed criteria (Table 11). Potential sources of pathogen pollution include failing septic systems and pet wastes from the surrounding residential neighborhood.

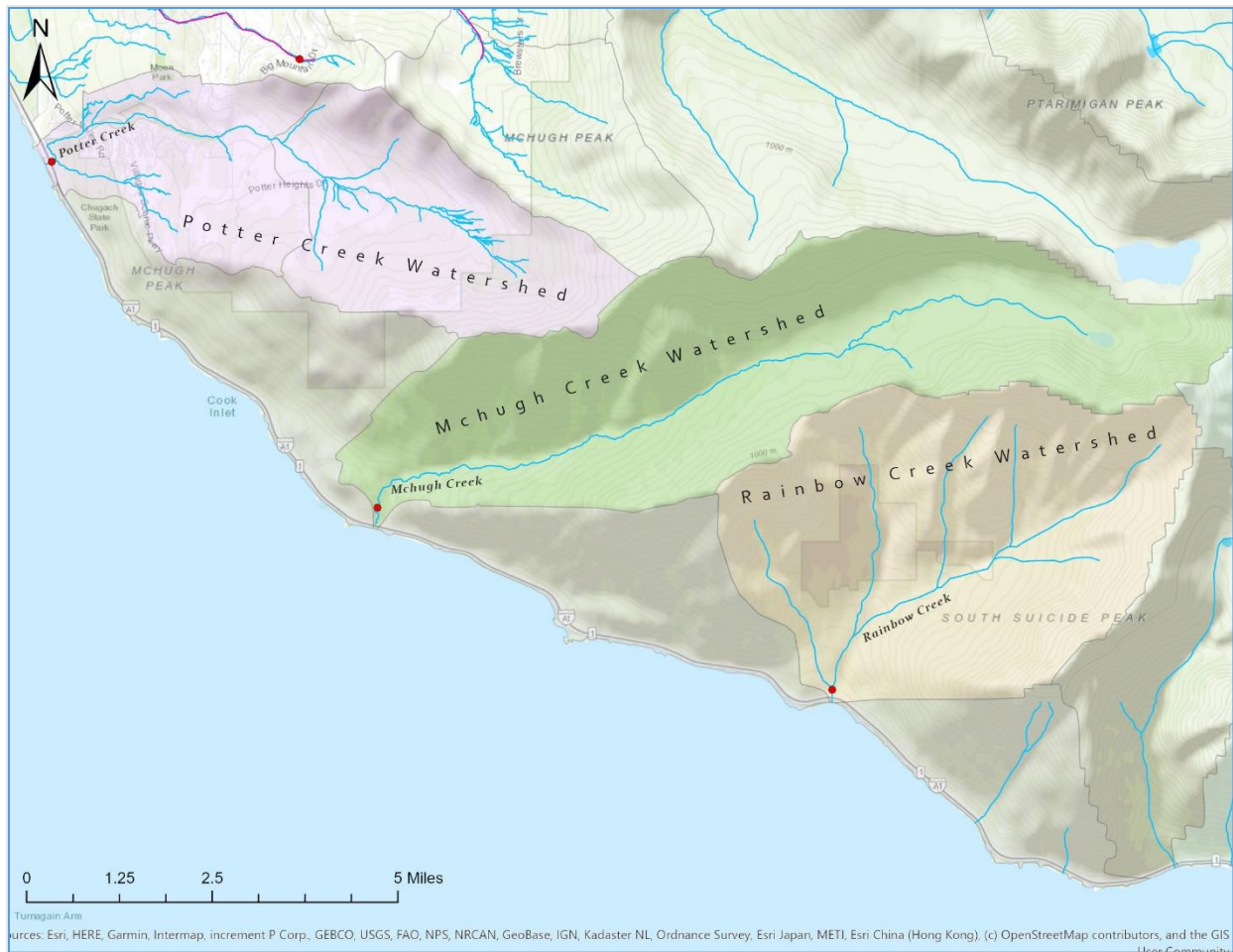


Figure 11. Map of monitoring locations in the Potter creek, McHugh Creek, and Rainbow Creek watersheds; impaired portions of streams are displayed in pink.

Table 10. Monitoring locations, criteria, and results for Rainbow, McHugh, and Potter Creeks. Blank cells were not sampled for the described test.

| Criteria | Fecal Coliform | | E. coli | | MST | | |
|-------------------------|------------------------------|---|----------------------------------|--|---------------------------|-------------------------|--------------------------|
| | Geomean > 20 cfu/100ml | >10% exceedance of 40 cfu/100 ml | Geomean >126 mpn/100 ml | >10% exceedance of 410 mpn/100 mL | Human Copies/ 100ml | Dog Copies/ 100ml | Bird Copies/ 100ml |
| Rainbow Creek - 2020 | 2.23 | No | 1.78 | No | | | |
| Rainbow Creek - 2021 | 7.97 | Yes | 9.57 | No | | | |
| McHugh Creek - 2020 | 1.23 | No | 2.85 | No | | | |
| McHugh Creek - 2021 | 0.87 | No | 1.00 | No | | | |
| Potter Creek - 2020 | 13.69 | No | 16.64 | No | ND | ND | DNQ |
| Potter Creek - 2021 | 1.99 | No | 3.15 | No | | | |

Conclusion

In total, 19 waterbodies were sampled for fecal coliform and *E. coli* in May and June of 2020-2021. Results were analyzed by using a combination of geographic information systems and by comparison to Alaska’s freshwater criteria for pathogens (Table 11). Results greater than the pathogen criteria were considered an exceedance. Most exceedances were observed at lower monitoring locations, and at locations within urban Anchorage areas. Results from MST analysis varied, and most results were either ND or DNQ with a few quantified results. Quantified MST results were most common in urban Anchorage waterbodies with human the most detected of the three sampled biomarkers, followed by bird and then dog.

Little Survival Creek and Campbell Lake are currently listed as impaired in Category 4a but had data that did not exceed criteria in either year. Based on these results, DEC will be considering potential delisting of Little Survival Creek and Campbell Lake moving them from Category 4a to Category 2 in the 2024 Integrated Report. Eagle River is currently not listed as impaired and exceeded criteria in both years; additional sampling on Eagle River is recommended at additional monitoring locations under various flow conditions (see 2023-2025 ACWA grant request for proposals).

Downstream monitoring locations typically had higher fecal coliform concentrations compared to upstream monitoring locations. Most downstream monitoring locations are in more urbanized areas, increasing potential fecal coliform exposure. In contrast, many of the upstream monitoring locations are in relatively undeveloped areas, reducing potential for fecal coliform exposure. A separate trend was observed in lakes. Campbell Lake, University Lake, and Westchester Lagoon had monitoring locations near inlet and outlet locations. Inlet monitoring locations had higher fecal coliform concentrations compared with outlet locations. This suggests that fecal coliform may be settling out or diluting as it moves through these waterbodies. Additionally, watersheds located further away from central Anchorage tended to have lower fecal coliform concentrations than those located within Anchorage. These watersheds are in less populated and developed areas, making them less susceptible to fecal coliform stormwater runoff.

Table 11. Waterbodies sampled in 2020-2021, pathogen status in the 2018 Integrated Water Quality Monitoring and Assessment Report (2018 IR), and proposed status for pathogens in the 2024 Integrated Water Quality Monitoring and Assessment Report

| Watershed | Waterbody | Number of Monitoring Sites | Waterbody Status in 2018 IR | Proposed Waterbody Status after 2020-2021 Sampling and Impairment Analyses |
|----------------|-----------------------|----------------------------|-----------------------------|--|
| Campbell Creek | Campbell Creek | 2 | Impaired | Remains Impaired |
| | Campbell Lake | 2 | | Attaining Water Quality Criteria |
| | Little Campbell Creek | 2 | | Remains Impaired |
| | Craig Creek | 1 | Not assessed | Attaining Water Quality Criteria |
| | Chester Creek | 3 | | Remains Impaired |

| | | | | |
|---------------|-----------------------|---|---------------------|----------------------------------|
| Chester Creek | University Lake | 2 | Impaired | Remains Impaired |
| | Westchester Lagoon | 2 | | Remains Impaired |
| Eagle River | Eagle River | 1 | Not assessed | Needs further assessment* |
| Ship Creek | Ship Creek | 2 | Impaired | Remains Impaired |
| Fish Creek | Fish Creek | 3 | Impaired | Remains Impaired |
| | Lake Hood | 1 | Delisted in 2010 IR | Attaining Water Quality Criteria |
| Furrow Creek | Furrow Creek | 2 | Impaired | Remains Impaired |
| McHugh Creek | McHugh Creek | 1 | Not assessed | Attaining Water Quality Criteria |
| Peters Creek | Peters Creek | 1 | Not assessed | Attaining Water Quality Criteria |
| Potter Creek | Potter Creek | 1 | Not assessed | Attaining Water Quality Criteria |
| Rabbit Creek | Little Rabbit Creek | 2 | Impaired | Remains Impaired |
| | Little Survival Creek | 2 | | Attaining Water Quality Criteria |
| | Rabbit Creek | 1 | Not assessed | Attaining Water Quality Criteria |
| Rainbow Creek | Rainbow Creek | 1 | Not assessed | Attaining Water Quality Criteria |

*Samples from Eagle River exceeded water quality criteria for pathogens in both years; DEC proposes additional monitoring prior to making an impairment decision.

References

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- ADEC (Alaska Department of Environmental Conservation). 2003. Alaska's final 2002/2003 integrated water quality monitoring and assessment report.
- ADEC (Alaska Department of Environmental Conservation). 2004a. Total maximum daily load (TMDL) for fecal coliform in the waters of Little Campbell Creek in Anchorage, Alaska. March 2004.
- ADEC (Alaska Department of Environmental Conservation). 2004b. Total maximum daily load (TMDL) for fecal coliform in the waters of Ship Creek in Anchorage, Alaska.
- ADEC (Alaska Department of Environmental Conservation). 2004c. Total maximum daily load (TMDL) for fecal coliform in the waters of Little Rabbit Creek in Anchorage, Alaska.
- ADEC (Alaska Department of Environmental Conservation). 2004d. Total maximum daily load (TMDL) for fecal coliform in the waters of Little Survival Creek in Anchorage, Alaska.
- ADEC (Alaska Department of Environmental Conservation). 2004e. Total maximum daily load (TMDL) for fecal coliform in the waters of Fish Creek in Anchorage, Alaska.
- ADEC (Alaska Department of Environmental Conservation). 2005. Total maximum daily load (TMDL) for fecal coliform in Chester Creek, University Lake, and Westchester Lagoon, Anchorage, Alaska.
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- MOA (Municipality of Anchorage). 2021. Addressing Homelessness. <https://addressing-homelessness-muniorg.hub.arcgis.com/pages/camp-abatement> (Accessed February 2021).

Appendix A. Monitoring locations and coordinates

| Monitoring Location Name | Latitude | Longitude |
|---------------------------------|-----------------|------------------|
| Furrow Creek - Upper | 61.10876 | -149.842 |
| Furrow Creek - Lower | 61.10581 | -149.881 |
| Rainbow Creek | 61.00065 | -149.643 |
| McHugh Creek | 61.01784 | -149.731 |
| Potter Creek | 61.05049 | -149.795 |
| Little Survival Creek - Lower | 61.06854 | -149.800 |
| Little Survival Creek - Upper | 61.06016 | -149.746 |
| Rabbit Creek | 61.08427 | -149.825 |
| Little Rabbit Creek - Lower | 61.08049 | -149.790 |
| Little Rabbit Creek - Upper | 61.06522 | -149.716 |
| Campbell Lake - West | 61.13019 | -149.956 |
| Campbell Lake - East | 61.13615 | -149.925 |
| Campbell Creek - Lower | 61.13939 | -149.922 |
| Campbell Creek - Mid | 61.17782 | -149.825 |
| Craig Creek | 61.13334 | -149.785 |
| Lake Hood | 61.17993 | -149.947 |
| Fish Creek - Lower | 61.19639 | -149.930 |
| Fish Creek - S Fork Upper | 61.17949 | -149.930 |
| Fish Creek - N Fork Upper | 61.18267 | -149.842 |
| Chester Creek - Lower | 61.20476 | -149.900 |
| Chester Creek - Upper | 61.20574 | -149.718 |
| Chester Creek - Mid | 61.18462 | -149.795 |
| University Lake - East | 61.18634 | -149.799 |
| University Lake - West | 61.18492 | -149.804 |
| Eagle River | 61.31035 | -149.576 |
| Peters Creek | 61.42081 | -149.486 |
| Westchester Lagoon - South | 61.20538 | -149.912 |
| Westchester Lagoon - North | 61.20809 | -149.921 |
| Little Campbell Creek - Upper | 61.11339 | -149.709 |
| Little Campbell Creek - Lower | 61.14746 | -149.853 |
| Ship Creek - Lower | 61.22348 | -149.874 |
| Ship Creek - Upper | 61.22446 | -149.630 |

Appendix B. Impairment analysis for waterbodies sampled in 2020-2021

| Waterbody Name | Current Category based on 2020 IR | Impaired based on current analysis? | Action | # Samples 2020 | # Samples 2021 | Water Supply (i) drinking/culinary/food processing | | | | Water Supply (ii) agriculture; (ii) aquaculture; (iv) industrial; (B)(i) contact recreation | | | | Water Recreation (i) contact recreation | | | |
|-----------------------|-----------------------------------|-------------------------------------|-----------------------------|----------------|----------------|--|------|----------------------|------|---|------|----------------------|------|---|------|-------------|------|
| | | | | | | Geomean > 20 FC CFU/100ml | | 10%> 40 FC CFU/100ml | | Geomean > 200 FC | | 10%>400 FC CFU/100ml | | Geomean >126 EC | | 10%> 410 EC | |
| | | | | | | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 |
| Furrow Creek | 4A | No | None, stay in 4A | 10 | 10 | 100% | 0% | 100% | 0% | 80% | 0% | 33% | 0% | N/A | N/A | N/A | N/A |
| Little Rabbit Creek | 4A | Yes | None, stay in 4A | 10 | 10 | 100% | 0% | 50% | 17% | 0% | 0% | 0% | 0% | N/A | N/A | N/A | N/A |
| Rabbit Creek | 3 | No | Move to Cat 2 | 5 | 5 | 0% | 0% | 20% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Little Survival Creek | 4A | No | Delist from Cat 4A to Cat 2 | 10 | 10 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | N/A | N/A | N/A | N/A |
| Potter Creek | 3 | No | Move to Cat 2 | 5 | 5 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| McHugh Creek | N/A | No | Move to Cat 2 | 5 | 5 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Rainbow Creek | N/A | No | Move to Cat 2 | 5 | 5 | 0% | 0% | 0% | 40% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Peters Creek | 3 | No | Move to Cat 2 | 5 | 5 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Eagle River* | 2 | Yes | Move from Cat 2 to 5 | 5 | 5 | 100% | 100% | 40% | 40% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Chester Creek | 4A | Yes | None, stay in 4A | 15 | 15 | 100% | 100% | 70% | 60% | 0% | 0% | 20% | 0% | N/A | N/A | N/A | N/A |
| Fish Creek | 4A | Yes | None, stay in 4A | 15 | 15 | 100% | 100% | 29% | 50% | 0% | 0% | 0% | 13% | N/A | N/A | N/A | N/A |
| University Lake | 4A | No | None, stay in 4A | 10 | 10 | 100% | 0% | 33% | 33% | 0% | 0% | 17% | 0% | N/A | N/A | N/A | N/A |
| Westchester Lagoon | 4A | No | None, stay in 4A | 10 | 10 | 0% | 0% | 20% | 20% | 0% | 0% | 0% | 0% | N/A | N/A | N/A | N/A |
| Lake Hood | 2 | No | No change | 5 | 5 | 0% | 0% | 0% | 20% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Campbell Creek | 4A | Yes | None, stay in 4A | 10 | 10 | 100% | 20% | 33% | 33% | 0% | 0% | 0% | 0% | N/A | N/A | N/A | N/A |
| Little Campbell Creek | 4A | Yes | None, stay in 4A | 10 | 10 | 100% | 20% | 100% | 33% | 100% | 0% | 60% | 0% | N/A | N/A | N/A | N/A |
| Campbell Lake | 4A | No | Delist from Cat 4A to Cat 2 | 10 | 5 | 0% | 0% | 40% | 0% | 0% | 0% | 0% | 0% | N/A | N/A | N/A | N/A |
| Craig Creek | N/A | No | Move to Cat 2 | 5 | 5 | 0% | 0% | 20% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Ship Creek Upper | N/A | No | Move to Cat 2 | 5 | 5 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | ? | 0% | ? |
| Ship Creek Lower | 4A | Yes | None, stay in 4A | 5 | 5 | 0% | 100% | 20% | 60% | 0% | 0% | 0% | 0% | 0% | 50% | 0% | 0% |

*DEC proposes additional monitoring on Eagle River prior to making an impairment determination.

Appendix C. Integrated Report Waterbody Categories

| | |
|--------------------|---|
| Categories 1 and 2 | Waters for which there is enough information to determine that water quality standards are attained for all or some of their designated uses. |
| Category 3 | Waters for which there is not enough information to determine their status. |
| Category 4 | Waters that are impaired but have one of several different types of waterbody recovery plans. |
| Category 5 | Waters that are impaired and do not yet have waterbody recovery plans. Also known as 303(d) list impaired waters. |