

Interim Report Year 1 - 2022

Bristol Bay Pathogen Testing

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A. Abstract

During the summer of 2022 Alaska Water Laboratories organized sample collection and analysis from three beach sites in Dillingham, Alaska to monitor the bacterial levels of Fecal Coliform and Enterococci during the summer recreational and fishing seasons. Fecal Coliform and Enterococci are considered indicator pathogens for potential exposure to high levels of bacterial pathogens at recreational sites. Site information regarding environmental parameters were also evaluated to determine correlations between temperature, nonpoint source pollution, and bacterial pathogen growth.

Values reported from all three sampling sites over seven sampling events (Prior to the opening of processing plants and water recreation season, five events over 30 days during processing and water recreation season, and a final sampling after closure of the processing plants and at the end of the water recreation season) were obtained and evaluated against the dates and temperatures of the environmental sites. Additionally microbial source tracking samples were taken to determine possible host organisms for these indicator pathogens.

A.1 Basic Water Body Information

All three sites are located around the city of Dillingham, Alaska, in the Bristol Bay region of Alaska. Dillingham hosts a local year-round population and hosts several processing plants for the seafood industry during the summer. The city is located on the Wood River and is perched just past the confluence of the Wood River and the Nushagak River at the head of Nushagak Bay. The Wood River flows south from Lake Aleknagik, passes Dillingham, and flows out into Bristol Bay.

Table 1. List of monitoring sites and their coordinates

Beach Name	Latitude	Longitude
Kanakanak (yellow icon below)	59.00345	-158.5346
Scandinavian (purple icon below)	59.03733	-158.47673
Snag Point (blue icon below)	59.037867	-158.462183

A.2 Monitoring Sites



*1. Google Earth, Google Maps – March 2022; Dec 2022. <https://www.google.com/maps/@58.9435433,-158.1643577,76629m/data=!3m1!1e3!5m1!1e4>

Figure 1. Google Earth maps of sampling sites and Dillingham location in confluence.



Figure 2. Kanakanak Beach photos 6/29/2022



Figure 3. Scandinavian Beach photos 6/29/2022



Figure 4. Snag Point Beach photos 6/29/2022

B. Project Background

The Dillingham Beaches selected, Kakanak Beach, Scandinavian Beach, and Snag Point Beach, are all located around the City of Dillingham and serve as recreational waterways in the summer. Scandinavian Beach and Snag Point beach are located near the Dillingham harbor area and a processing plant based near the harbor. Other processing plant locations can be found along the Wood River. Kakanak Beach is located further along the Wood River to the southwest of the City of Dillingham near Bradford Point and across from the Hospital. Processing plant by-products along with any other potential discharges into the Wood River are potential sources of pathogens at these monitoring locations.

Potential discharge products from fish processing plants, wastewater treatment facility discharges, and nonpoint source pollution are considered possible human-related drivers of bacterial growth. The west coast of Alaska is also used extensively by migrating bird populations, and most of the animals observed on beaches during the 2022 Sanitary Surveys were bird species.

Historic monitoring of the primary pathogen indicators was conducted at these locations in 2006 and 2009 to evaluate if the indicator pathogens were present, and the bacterial load at those locations. The most recent project is an effort to monitor those same sites. The pathogen indicators were present during the 2022 field season, with both bacteria monitored showing growth at all sites at some point during the 2022 sampling events.

A total of seven sampling events occurred between 5/25/2022 and 8/9/2022. Sampling events were conducted prior to, and after the opening of both the recreational seasons and the commercial fish processing seasons to evaluate bacterial loads with and without these activities. ADEC water quality criteria required a minimum of five sampling events in a 30-day period, which occurred between

6/21/2022 and 7/12/2022. A final sampling was conducted 8/9/2022, at the close of the recreational and processing seasons.

A marine sanitary survey was completed onsite during each sampling event. Measurements of Air and Water temperature, species observed, wind speed and direction, weather and water conditions, activity on beaches, and other beach and tidal observations were taken at each beach at each sampling event. Sampling occurred in roughly 3 feet of water, at approximately 12"-18" under the water, per U.S. Environmental Protection Agency recommended sampling of recreational beach sites. Air temperatures were taken of ambient air using a calibrated analytical lollipop thermometer. Estimates of Tide Height were based off NOAA tidal records for the Dillingham site and the time of sanitary survey and sampling recorded.

This report summarizes the findings of year one of a two-year monitoring project. Sampling will occur during the 2023 recreational season at the same three monitoring locations.

B.1.1 Project Objective(s)

The objectives for this project are to:

- Monitor selected beaches for fecal indicator organisms (i.e., fecal coliform and enterococci bacteria) during periods of high recreational use.
- Use microbial source tracking (MST) to identify host organisms of indicator pathogens.
- Notify the public when indicator organisms exceed Alaska Water Quality Standards (WQS).

Monitoring was achieved based off the sampling plans and allowed for evaluation of bacteria activity at beaches during periods of high recreation activity by the public¹.

MST samples were collected twice (June 28th and July 12th) during the summer at all locations and compiled into a separate report to identify possible sources.

No public notices were issued during the summer of 2022 for these sites as the Enterococci analytical results did not breach the public notification value of 130 MPN/100mL set by the QAPP. No Fecal Coliform Maximum Contaminant Limit (MCL) was established for this project in the QAPP prior. A one-page flyer with information on the project was shared with stakeholders prior to the start of sampling (see section F).

B.2 Methods

B.2.1 Sample Collection

Samples were collected by Northern Utility Services after environmental sampling training occurred with Alaska Water Laboratories (AWL). ADEC Quality Control staff evaluated sampling techniques at the first site visit to confirm protocols were acceptable for sample collection. AWL, an ADEC certified laboratory, received and analyzed all samples for presence of fecal coliforms by SM 9222 D and Enterococci by ASTM D6503 within 8 hours of sampling, meeting all method criteria.

¹ High use periods for this project are defined as ice-free months between May and September, with the highest use periods occurring in June and July.

Microbial Source Tracking samples were obtained during regular sampling events and preserved at AWL with the Filter and Freeze methods for shipping to LuminUltra mRNA laboratory.

Onsite environmental samplers also completed a Marine Sanitary Survey of each site, at each sampling event, and took extensive site photos recording potential nonpoint source pollution sources.

Table 2. Project Measurement Quality Objectives

Group	Analyte	Method	Method Detection Limit	Practical Quantitation Limit	Precision (RPD)	Accuracy
Pathogens	Fecal coliform	SM 9222 D, Membrane filtration (MF)	1 CFU/100 mL	1 CFU/100 mL	±60%	NA
	Enterococci	D6503-99, Enterococci by Enterolert	1 MPN/100 mL	1 MPN/100 mL	±60%	NA
Field	Temperature	EPA 170.1	N/A	0.1°C	±0.02°C	± 0.2 °C
	Turbidity	EPA 180.1	0 NTU	N/A	± 1% of reading or 0.01 NTU, whichever is greater	± 1 NTU

B.2.2 Results

*Fecal Coliform and Enterococci results reported as '0' in the charts below were recovered under the Method Detection Limit for those samples (<MDL).

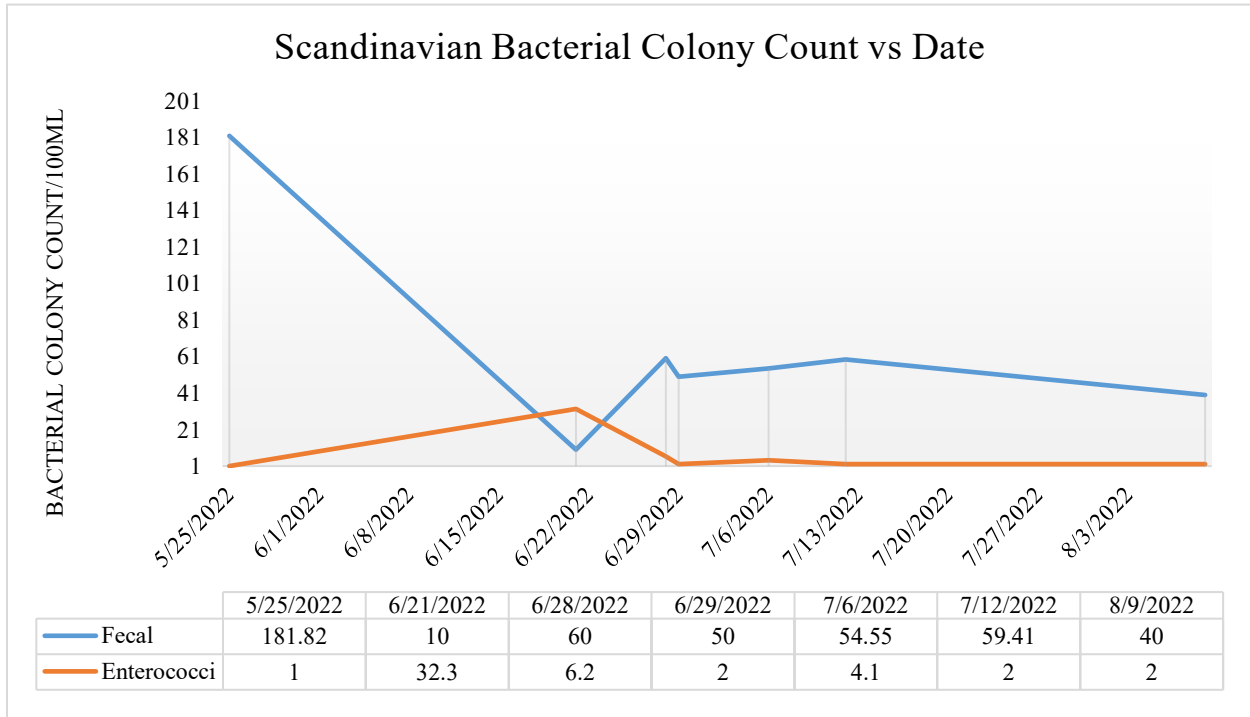


Figure 5. Scandinavian Beach Bacterial Counts

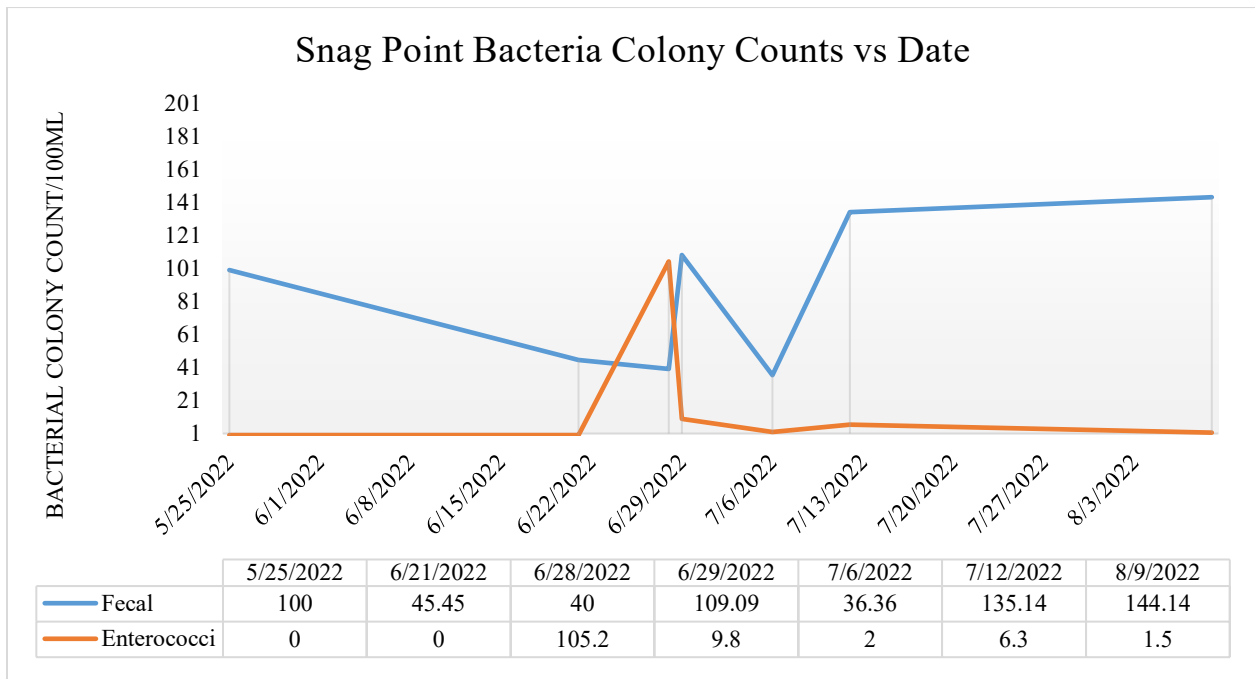


Figure 6. Snag Point Beach Bacterial Counts*

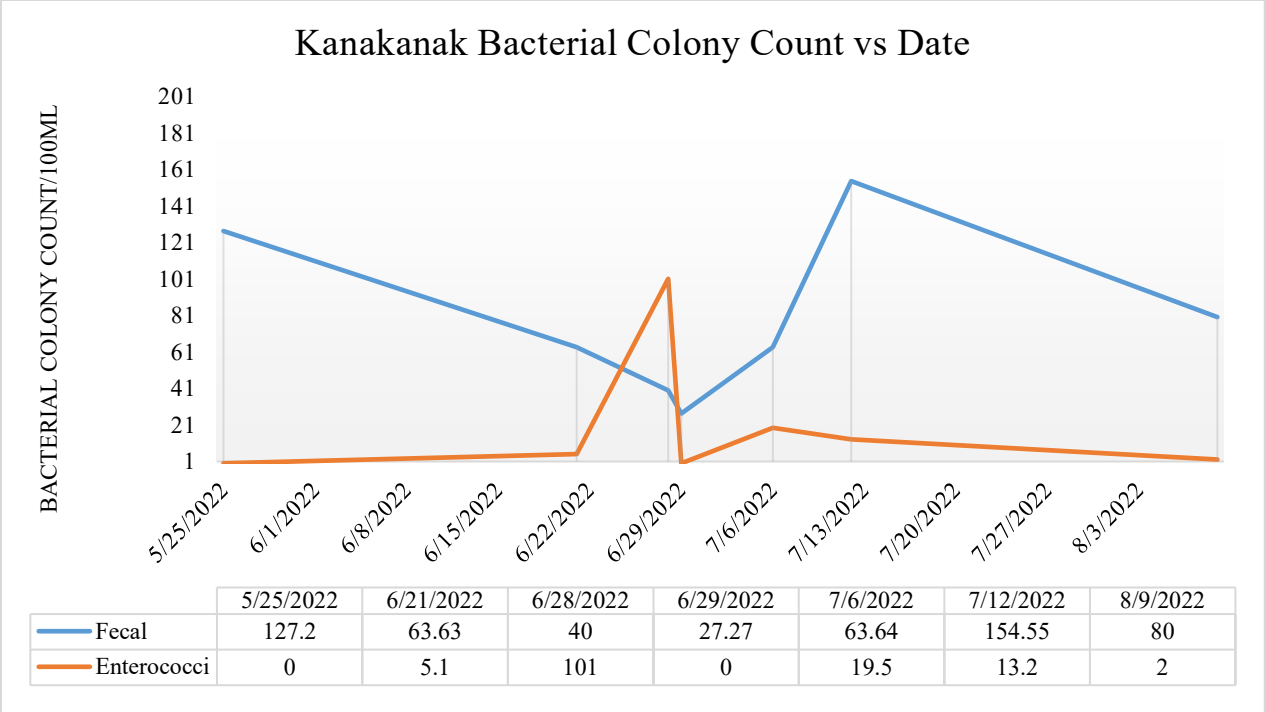


Figure 7. Kananak Beach Bacterial Counts*

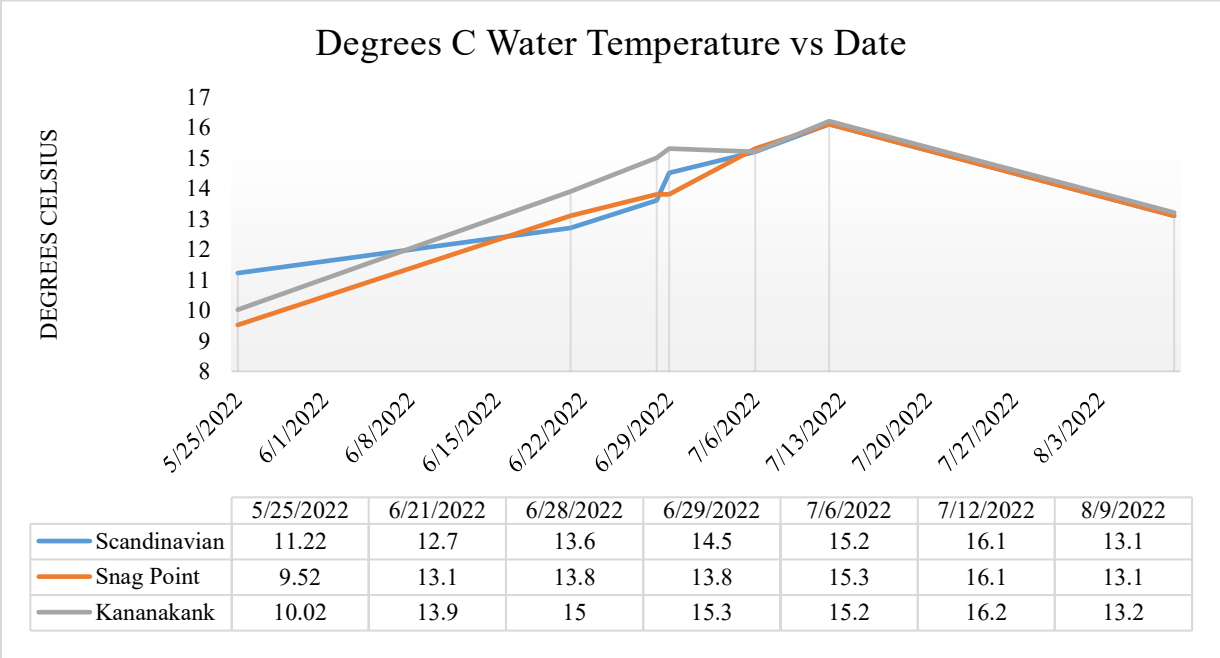


Figure 8. Water Temperature

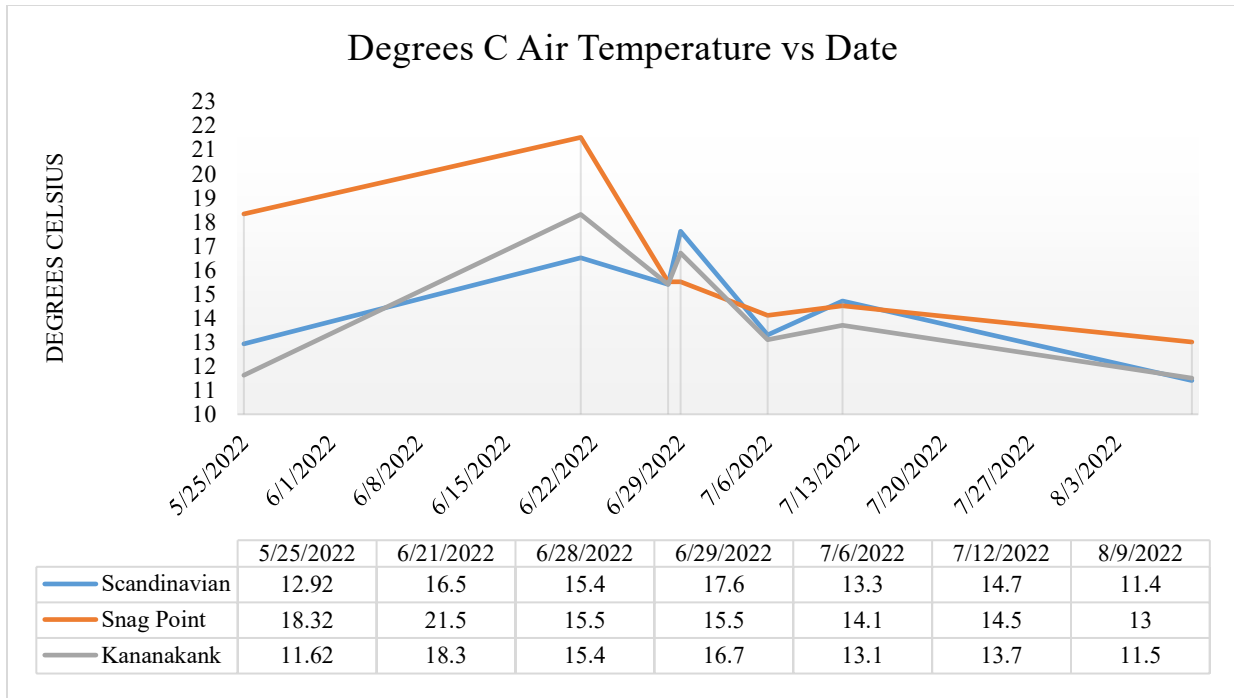


Figure 9. Ambient Air Temperature

Table 2. MST positive results for 2022 sampling events. Results are in units of Ct (Cycle threshold), RP (delta Rn value) – essentially a count is done after PCR replication, and then the count repeated to ensure values are consistent.

Laboratory ID	Sampling Location	Sampling Date	Sampling Time	mRNA	Ct, RP1	Ct, RP2
AWL-22-02075-001	Snag Point	6/28/2022	12:00 PM	Gull_Gull-4	33.81	33.79
AWL-22-02075-002	Scandinavian	6/28/2022	12:30 PM	Gull_Gull-4	32.78	33.07
AWL-22-02075-003	Kananakank	6/28/2022	1:00 PM	Gull_Gull-4	34.43	35.03
AWL-22-02228-001	Kananakank	7/12/2022	12:55 PM	Gull_Gull-4	34.3	34.62
AWL-22-02228-002	Scandinavian	7/12/2022	12:25 PM	Gull_Gull-4	33.93	33.69
AWL-22-02228-003	Snag Point	7/12/2022	12:05 PM	Gull_Gull-4	33.97	34.18
AWL-22-02075-001	Snag Point	6/28/2022	12:00 PM	Human_HF183	33.42	33.62
AWL-22-02075-002	Scandinavian	6/28/2022	12:30 PM	Human_HF183	35.96	ND
AWL-22-02228-003	Snag Point	7/12/2022	12:05 PM	Human_HF183	ND	35.49

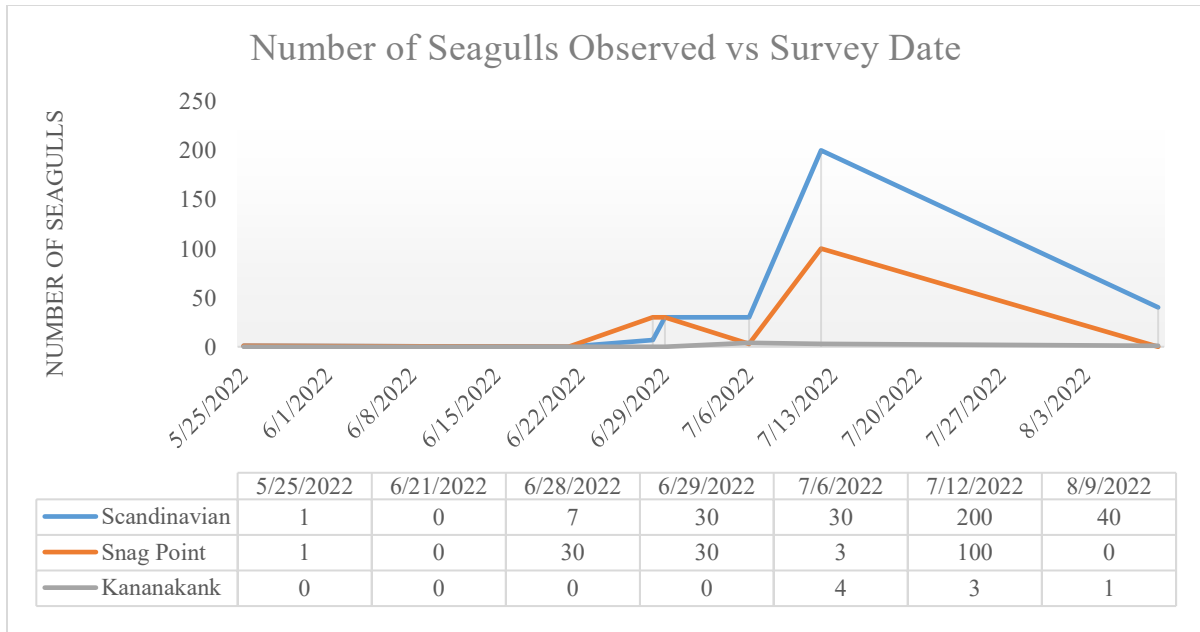


Figure 10. Number of Seagulls observed during Sanitary Surveys

C. Conclusions and 2023 Planned Events

C.1 Conclusions from 2022 Sampling Season

Results for both Fecal Coliform and Enterococci bacterial analysis can be found in Figures 5-7 above, plotted against each sampling date through the 2022 summer season. Scandinavian Beach Results can be found in Figure 5, Snag Point Beach results can be found in Figure 6, and Kananak Beach results can be found in Figure 7.

Initial Results taken 5/25/2022 (May) from all three sites show Fecal Coliform colonies are present at initial sampling. Enterococci analysis results show low or non-detectable presence of the Enterococci bacteria at that time. Results may indicate Fecal Coliform bacteria is hardier than Enterococci in the pre-summer environment and temperatures. The increase in Enterococci is not likely due to human sources since outside of the discharge season there was little Enterococci found at the beach sites. Potential causes of the increased Enterococci include increased bird activity, discharges related to fishing and processing, or wastewater treatment plant discharges (although wastewater treatment plants in Alaska are typically negative or have very low values for Enterococci).

Avian vectors may be included in possible Enterococci sources as migratory birds likely also increased their presence during this time, and the sanitary surveys record the highest rates of seagulls present at sampling sites during these periods. Both MST events showed seagull mRNA markers present at all sites.

The Kananak Beach site did have positive results for Enterococci recovered during the first sampling event, however the Enterococci result was low compared to the Fecal Coliform result from that site for the same event. The Kananak result does indicate there are natural hosts that exist for Enterococci prior to the summer or processing season, however the Enterococci recovery is still low.

A mid-season spike in Enterococci results can be seen between 6/21/2022 and 6/29/2022, at Kanakanak, Snag Point, and a small spike at Scandinavian Beaches. This follows the steady increase in water temperature at those times and is roughly when seafood processing factories begin fish processing for the summer season.

Fecal Coliform results showed higher results from the early sampling events, a dip in results during the 6/21/2022 – 6/29/2022 Enterococci spike, and another rise in results after 6/29/2022. Enterococci is considered more thermotolerant than Fecal Coliforms, and during the 6/21/22 – 6/29/22 period, Fecal Coliform results declined at all three sites. The competition between bacteria may also have contributed to the Fecal Coliform decline during this week as sample results indicate a significant source of Enterococci bacteria was introduced between the initial sample events and the week of 6/21 – 6/29/2022.

Later periods where Fecal Coliforms did well at higher water temperatures suggest there is another potential variable in the competition between Fecal Coliform and Enterococci between 6/21/2022 and 6/29/2022. Fecal Coliforms thrive in a 45C +/- 5C range, so any sudden temperature change during that week may have contributed to Fecal Coliforms being less able to compete against the Enterococci bacteria.

Introduction of seafood processing by-products and local fisherman beginning to use the local waterways may also have led to the Enterococci spike and Fecal Coliform dip seen in sample recoveries between 6/21/2022 and 6/29/2022. The Sanitary Surveys observed a variety of local fishing boats, a container boat, dead fish on the beach, set nets, and odors between 6/21/2022 and 6/29/2022. Snag Point was specifically noted with comments indicating fish chunks floating in the water from the process plant and a strong odor of fish from the processing plant on the 6/29/2022 Sanitary Survey. Due to the significantly higher impact of fish by-products from processing as opposed to smaller individual private fishing boats, local processing plant discharges combined with increased water temperature could relate to the observed increase in pathogens.

Seagull counts were highest between 7/6/2022 and 7/12/2022. Seagulls are known to have high counts of Fecal Coliforms, and often will defecate directly into water sources while hunting for food. While the introduction of recreation and fishing may have been a nonpoint source pollutant for Enterococci between 6/21/2022 and 6/29/2022, increasing Seagull numbers may have contributed to the rise in Fecal Coliform results again.

There is a significant difference between the numbers of seagulls observed at Kanakanak Beach vs. the numbers of seagulls observed at Snag Point and Scandinavian Beaches. Results for the seagull observations can be found in Table 8 above.

Mid to late season showed a significant dip in Enterococci results after 6/29/2022, with Fecal Coliform colony counts spiking again for the last three events. A continual increase in water temperatures can be seen in Table 5. Fecal Coliform colonies appear to establish an equilibrium at Snag Point Beach and Scandinavian Beach after 6/29/2022 through the end of the summer, and even the August sampling events showing similar Fecal Coliform recoveries at those two sites. Kanakanak Beach showed a significant spike in Fecal Coliform recoveries for the 7/12/2022 sampling, however the Fecal Coliform values began decreasing for the last sampling of the year at Kanakanak.

Another potential pollution source could be either of the waste treatment plants existing in Dillingham discharging into the river near one of the sampling sites. Fecal Coliforms are not only found in human waste, but the lagoon ponds for those sources are often hosts to migratory ducks, which are considered a significant host for Fecal Coliform bacteria. The City of Dillingham Waste treatment facility located in the city has several lagoons and a discharge point located approximately 0.5 miles upstream of the Snag Point monitoring location. See Figure 11 below. The City of Dillingham lagoon also accepts wastewater associated with housing for the processing facilities, along with other septage from local Dillingham homes. The Kakanak Hospital has its own small system of two ponds that are located near Scandinavian Beach. The proximity of these cannot be downplayed in relation to possible Fecal Coliform recoveries. See Figure 12 below.



Figure 11. Dillingham Water and Sewer Map, March 2020. Water Treatment Relocation Study.



Figure 12. Kakanak Hospital just past Kakanak Beach sampling point

Outfalls from waste treatment introducing Fecal Bacteria into the rivers may be linked to the Fecal Coliform bacteria recoveries at these sites, however the human mRNA from the MST sampling was only present at the Snag Point and Scandinavian beach samples. Discharges of human origin may be

contributing to indicator bacterial populations, but samples including mRNA of human origin were not found at all locations, or at all MST sampling events.

Additionally, photos and observations noted set-nets, vehicles parked along the beach, recreational users with pets, vegetation in or along the water line, and other potential nonpoint sources for pollution that were present during sampling events through summer. See figures 13-15.



Fig 13. Scandinavian Beach 5/25/22



Fig 14. Kananak Beach 7/8/22



Fig 15. Snag Point Beach 6/28/22

C.2 Field Parameters

Ambient air temperature and water temperature may affect the viability of Fecal Coliform and Enterococci colonies. Typically, both bacterial colony types survive best in high temperature environments, like animal gut and gastrointestinal systems. The Enterococci is considered more thermotolerant to higher temperatures.

The Ambient air temperature recoveries through the summer appeared scattered, usually based on weather conditions such as cloudiness or rain, and likely did not heavily affect the bacterial pathogen colony counts in the water.

Water temperatures steadily increased between May and July, and then predictably dropped for the August sampling as the summer temperatures waned.

Microbial Source Tracking or MST samples were taken and analyzed to determine possible animal vectors for bacterial pathogens. Three parameters, two human and one Seagull were selected for testing. Recoveries were positive at all sites for Gull, for both events sampled in 2022. Human markers were analyzed for, and only three sites were returned with positive mRNA, which can be seen in Table 2, Results section.







C.2.1 Future Project Events

In 2023, a second sampling season has been approved for the same sites, over roughly the same sampling periods, to determine a second set of bacterial results during the recreational and processing seasons.

A final report will be issued early 2024 with both the 2022 and 2023 sets of analytical data provided for analysis.

D. Site Photos

	Kanakanak	Snag Point	Scandinavian
5/25/22			
6/21/22			
6/28/22			
6/29/22			
7/6/22			

7/21/22			
8/9/22			

E. References

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