Alaska Department of Environmental Conservation 2022 Kenai River Beaches and Trend Analysis in Kenai, Alaska

Prepared by: S. Apsens[1]

Abstract

In 2022 the Alaska Department of Environmental Conservation successfully completed the tenth year of pathogen monitoring at two Kenai River beaches. 2022 was the final monitoring year for the Kenai River beaches program. Kenai North and Kenai South beaches are popular recreation areas year-round, but particularly during the personal use fishing season in July. Each beach was sampled four times between June and August 2022 for enterococci and fecal coliform bacteria. Water quality exceeded pathogen criteria for primary contact recreation once at Kenai South Beach on July 12th and once at Kenai North Beach on August 9th. No exceedances of the secondary contact recreation criteria were observed at either beach. Pathogen levels between 2010-2015 were compared with 2018-2022 pathogen levels to determine the impact of best management practices. Significant differences between time periods were observed for both enterococci and fecal coliform at Kenai North Beach and for fecal coliform at Kenai South Beach. The relative frequency of exceedances appeared to have decreased over time for South Kenai beach since 2018. Relative frequency decreased since 2018 for North Kenai Beach except for the one exceedance observed in 2022.

Virtual Beach modeling correctly predicted exceedances 75% of the time at both North and South Kenai beaches may be appropriate for predicting pathogens in future recreational seasons at Kenai River beaches.

Basic Waterbody Information

Table 1. Waterbody Information

Assessment Unit ID	AK_B_2030218_002	AK_B_2030218_003
Assessment Unit Name	Kenai River North Beach	Kenai River South Beach
Location description	Outlet of Kenai River into Cook Inlet	
Hydrologic unit code	Echo Lake-Frontal Cook Inlet HUC ID 190203021907	
Water Type	Marine-Estuarine	
Area sampled	Public access area used by personal use fishery	
Time of year sampled	June through August 2022	

[1] Nonpoint Source Pollution, Water Quality, Division of Water, Department of Environmental Conservation

Water Quality Evaluation

Background

Kenai River north and south beaches are located at the confluence of the Kenai River with Cook Inlet. Both beaches are popular for recreational activities including walking, wildlife watching, beachcombing, and even skiing in the winter months. Swimming is not a common activity due to cold water temperatures and strong currents. However, during the month of July each year fishermen will stand in waist deep water with a large net for long periods of time as part of the Personal Use (PU) fishery (Figure 1). The PU fishery brings hundreds of visitors from across Alaska to the Kenai Peninsula and is an important component of the region's summer tourism economy.

Figure 1. Personal Use fisherpersons using dipnets to fish for Pacific Salmon at North Kenai Beach in 2022.

Pathogen monitoring at the Kenai River beaches has occurred intermittently over the last decade under the Beaches Environmental Assessment and Coastal Health (BEACH) program. The BEACH Act was first signed into law in 2000 and prompted the Environmental Protection Agency (EPA) to establish criteria for monitoring and notifying recreational beach users of water quality issues at coastal beaches. The Kenai River beaches were nominated for this program by local community members over concerns about water quality in the summer months. Specifically, community members noted large numbers of gulls and other scavenging birds congregating on beaches to scavenge fish carcasses during the PU fishery. ADEC issued a BEACH program grant to the City of Kenai, who subcontracted with the Kenai Watershed Forum (KWF), and monitoring started in summer 2010. Exceedances of state water quality criteria for pathogens (18 AAC 70.020(14)) were periodically observed at both beaches in 2010 through 2014. The City of Kenai worked closely with ADEC to develop a set of best management practices (BMPs) to address the exceedances. The BMPs included raking the beaches at night to remove excess fish carcasses, establishing fines for littering, and installing additional restroom

facilities. These BMPs were implemented in the summer of 2015 and pathogen monitoring was paused. Monitoring resumed in 2018 and continued through 2022 to evaluate the impact of BMP implementation. Exceedances of the primary contact recreation criteria were still observed during this period. Microbial source tracking (MST) was used in 2018 and 2019 to identify pathogen host organisms. The results of the MST analysis indicated that gulls were the primary source of pathogens at both beaches (KWF 2019, KWF 2020).

In recent years outreach efforts focused on reducing attractants to scavenging birds and continuing BMP implementations. Public service announcements were developed for local radio stations with the aim of reaching recreational users driving to Kenai Peninsula beaches during summer weekends. Radio messages focused on raising awareness of the Alaska BEACH monitoring program and informing the public on how to protect their health while recreating. Various pamphlets, posters, and rack cards were developed (see Appendix C). The City of Kenai installed additional trash receptacles at beaches and posted signs prohibiting dumping of fish carcasses on beaches.

The 2022 monitoring effort marked the tenth season of pathogen monitoring on Kenai River beaches. Four sampling events were planned for 2022, occurring before, during, and after the period of highest recreational use (i.e., the PU fishery). Beach monitoring coincided with the development of the Virtual Beach Model for select beaches in Alaska. A full discussion and conclusion of that effort is available in ADEC 2022.b.

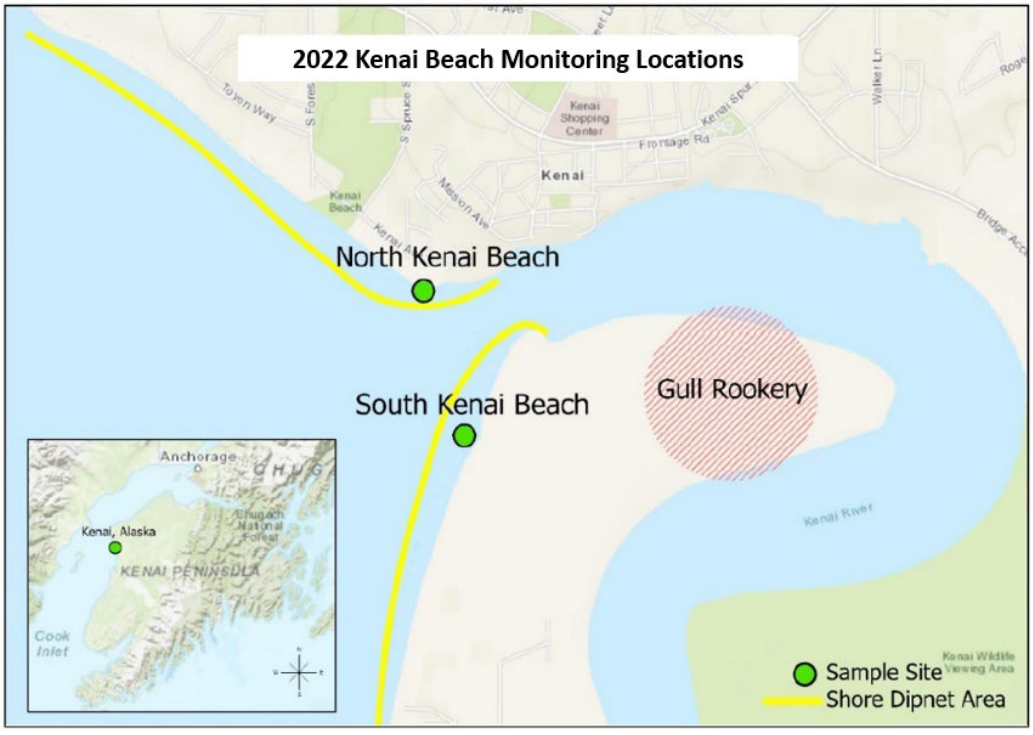

Figure 2. 2022 Kenai River Beach Monitoring Locations

Objective

The objectives for the 2022 monitoring season were to:

- Monitor pathogen levels at two recreational beaches and issue public advisories when levels exceeded state water quality criteria.
- Conduct outreach activities to inform recreational beach users of best practices for protecting their health and environment.
- Evaluate the fitness of the EPA Virtual Beach Model on Kenai River beaches.
- Evaluate all available data (2010-2022) for trends associated with pre and post BMP implementation.

Quality Assurance Review

All field staff followed the sample handling methods outlined in the Quality Assurance Project Plan (QAPP) for this project (ADEC 2022.a). Field notes were recorded on Rite-in-the-Rain® paper and later scanned back at the office. Any deviations from the original sample plan were noted on field sheets, in addition to observational data (e.g., weather, wind speed, wave height, number of birds, etc.). Deviations primarily occurred in 2022 due to tide height (e.g., too low to sample safely) or extreme weather conditions (e.g., the monitoring event planned for August 8th was moved to August 9th due to unsafe wave conditions).

All samples met the holding times required for pathogens[2]. All samples were placed in coolers with frozen gel ice shortly after collection. A chain of custody form was provided for each set of samples and sealed coolers were shipped to SGS North America Inc. (SGS) in Anchorage, AK. SGS performed the requested analysis for specified analytes and results of analysis were submitted to ADEC within 36 hours of sample collection.

Project goals were met or exceeded during the 2022 monitoring season. A completeness goal of 80% was set for the 2022 monitoring season (ADEC 2022). This goal was exceeded, as 100% of the planned sampling was completed. The precision goal for this project was set at 60%. Precision was measured by the relative percent difference (RPD) between a routine sample and its duplicate. This goal was met, except for the one pair of samples collected on August 9th. The RPD ranged from 4% to 105% for the 2022 season (Table 2).

[2] Holding time was 6 hours from time of collection to time of delivery to lab, and 2 additional hours for lab analysis, for a total of 8 hours.

Table 2. The relative percent difference (RPD) for the 2022 monitoring season.

Date	Beach	Characteristic	Routine	Duplicate	RPD (%)
6/30/2022	North	Enterococcus	25	34	31
6/30/2022	North	Fecal Coliform	18	15	18
7/12/2022	South	Enterococcus	435	687	45
7/12/2022	South	Fecal Coliform	350	450	25
7/27/2022	North	Fecal Coliform	23	20	14
7/27/2022	North	Enterococcus	22	23	4
8/9/2022	South	Enterococcus	117	378	105
8/9/2022	South	Fecal Coliform	Not Detected	Not Detected	-

See Appendix B for the Quality Assurance Data Checklist associated with this project.

Methods

A total of four sampling events were scheduled for the 2022 recreation season. Sampling events were planned for before, during, and after the highest period of recreational use. For both Kenai beaches the highest period of recreational use corresponded with the opening of the personal use fishery (July 10th through July 31st, 2022). Each sampling event included a set of routine samples for enterococci and fecal coliform at each beach site, along with a duplicate sample set that was assigned to an alternating site. Samples kits were provided by SGS. Samples were placed in coolers with gel ice and shipped as air cargo to SGS labs in Anchorage within 6-hours of collection. SGS performed pathogen analysis for fecal coliform (SM21 9222D) and total enterococci (ENTEROLERT).

A t-test was used to compare observed enterococci values before (2010-2015) and after (2018-2022) BMP implementation. This statistical analysis was conducted in the software package SigmaPlot. Relative frequency of exceedance for each year from 2010 to 2022 were plotted in Excel. Relative frequency was calculated by dividing the number of in-season contact recreation exceedances[3] by the total number of samples collected that year. Box plots were used to plot pathogen results from 2010 to 2022.

Outreach followed the Alaska Beach Program Outreach and Communication Plan for Kenai Beaches (ADEC 2020) and included radio, digital, and print media. Radio spots were selected to reach individuals from the Mat-Su, Anchorage, and Kenai Peninsula regions. Radio spots were aired Friday through Sunday to reach individuals driving to Kenai River beaches. Digital outreach included continuing the mailing listserv developed in 2020 and using DEC social media accounts, namely Facebook and Twitter. New print media for 2022 was developed using free online design tools.

The suitability of the EPA pathogen forecasting model Virtual Beach V. 3.0.7 was evaluated for both Kenai North and South beaches. The 2022 season pathogen data was combined with

[3] ≥130 MPN/100 ml enterococci. See Appendix C.

historic[4] pathogen data and set as the dependent variable in Virtual Beach. Corresponding environmental data was used for the independent variable(s) in the models. Environmental data was gathered from field sheets and multiple online publicly available data sources. Data from field sheets included: bird count, water temperature, and air temperature. Publicly sourced environmental data included historic local weather[5], Kenai River discharge data[6], and tide levels[7]. Three models were tested using the processed data in Virtual Beach: multiple linear regression (MLR), gradient boosting (GBM), and partial least squares (PLS). The resulting models were compared and evaluated by sensitivity and specificity, and accuracy.

In 2022 the resulting Virtual Beach models were used to forecast pathogen levels alongside traditional sample collection methods. Applicable independent variables were collected and ran through each model (MLR, GBM, and PLS) coinciding with each traditional water sample collection. The resulting forecasted pathogen levels were then compared with resulting lab results for each sample event.

Full description of methods for the 2022 VBeach pilot study are available in ADEC 2022.b.

Results

2022 Monitoring Results

A total of four sampling events occurred during the 2022 monitoring season (Table 3). Observed enterococci exceeded the in-season primary contact criteria (>130 MPN/100ml) twice in 2022, once at South Kenai Beach on July 12th and once at North Kenai Beach on August 9th. Fecal coliform exceeded the in-season criteria for the consumption of raw fish and shellfish (>31 CFU/100ml) three times at South Kenai Beach and once at North Kenai Beach. No in-season exceedance of the secondary contact criteria (Fecal coliform >400 CFU/100ml) at either beach was observed.

[4] North Kenai Beach data was sourced from 2011-2022, and in 2014-2022 for South Kenai Beach. All pathogen data was collected during the recreational season (May through September).
[5] Iowa Environmental Mesonet METAR data
[6] U.S. Geological Society National Water Information System
[7] National Oceanographic and Atmospheric Administration Currents and Tides Predictions

Table 3. 2022 Field Season Data Summary

	Kenai River North Beach		Kenai River South Beach	
Sample Collection Date	**Enterococci (MPN/100ml)**	**Fecal coliform (CFU/100ml)**	**Enterococci (MPN/100ml)**	**Fecal coliform (CFU/100ml)**
June 30	25	18	62	35
July 12	66	114	**435**	350
July 27	22	23	39	32
August 9	**248**	5	117	Not Detected

One-time exceedances of the primary contact recreation criteria (enterococci value greater than 130 MPN/100ml) are in bold text.

Pre and Post BMP Comparison

The t-test indicated that no statistically significant differences existed between pre and post BMP implementation for enterococci at South Beach but did for North Beach. Both datasets failed the Shapiro-Wilks test for normality ($P < 0.05$), so a Mann-Whitney Rank Sum Test was used. The difference in median values between pre and post BMP implementation was significant for both fecal coliform and enterococci for North Beach, and only fecal coliform for South Beach.

Table 4. Results of Mann-Whitney Rank Rum Test comparing pathogens pre and post BMP implementation.

Beach Name	Parameter	P-Value	Condition
North Beach	Enterococci	0.014	Significant
South Beach	Enterococci	0.305	Not Significant
North Beach	Fecal Coliform	0.040	Significant
South Beach	Fecal Coliform	0.009	Significant

Historic Trends

Frequency of exceedances of contact criteria at South Kenai Beach decreased since 2018 (trendline slope = -0.052), while frequency of exceedances remained steady, if not slightly positive, at North Kenai Beach (slope = 0.012) (Figure 3) between 2018 and 2022.

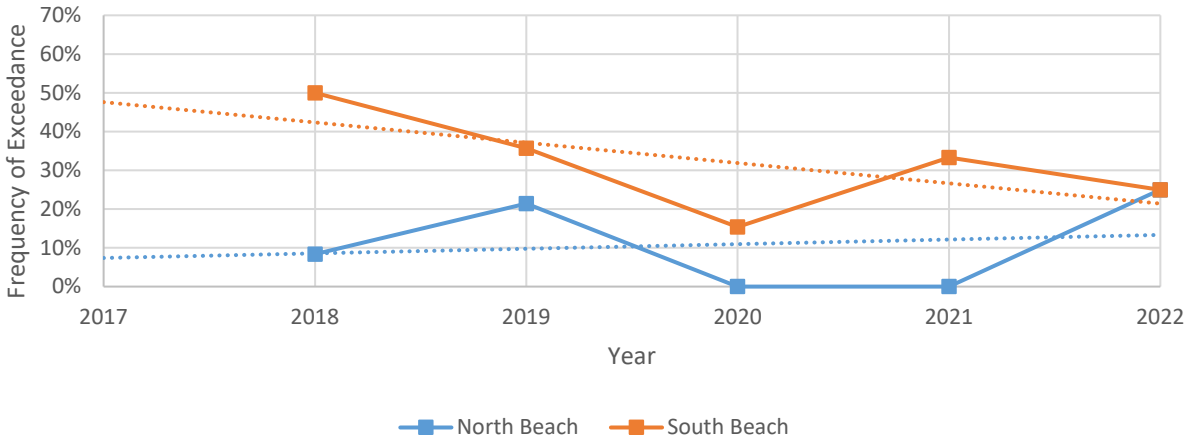

Figure 3. Relative frequency of exceedances of the in-season contact criteria (≥130 MPN/100ml enterococci) at North and South Kenai River beaches observed between 2018 and 2022.

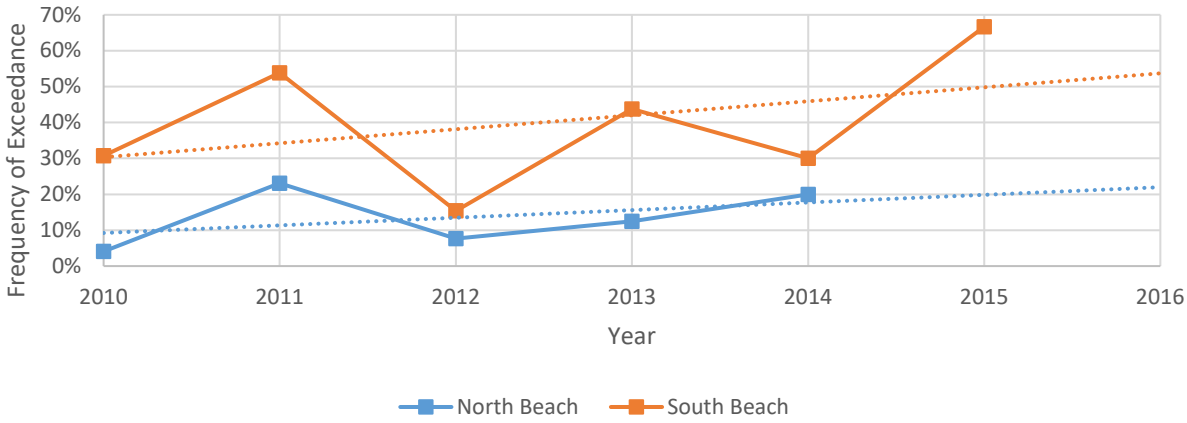

Figure 4. Frequency of exceedances of the in-season contact criteria (≥130 MPN/100ml enterococci) at North and South Kenai River beaches observed between 2010 and 2015. Note that only South Kenai Beach was sampled in 2015.

Frequency of exceedances of contact criteria prior to the BMP implementation (summer 2015) increased at both beaches (South Beach slope = 0.14, North Beach = 0.06, Figure 4). Note that only three samples were collected at South Kenai Beach in 2015 and zero samples were collected at North Kenai Beach that same year.

The magnitude of observed pathogens was generally lower at North Beach for enterococci and fecal coliform than at South Beach (Figures 5 through 9). Differences in magnitude of observed pathogen values between pre- and post BMP implementation were less clear. Observed fecal coliform values at South Kenai beach were the exception, as a clear decrease in magnitude of observed values can be seen after 2015 (Figure 9).

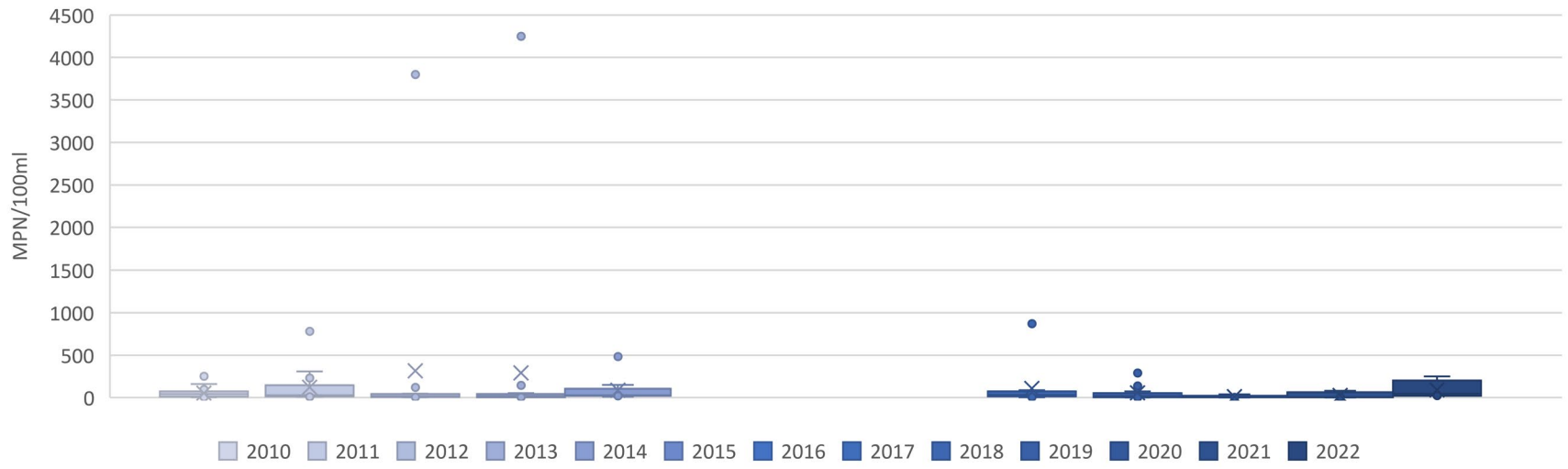

Figure 5. Box plots of enterococci at North Kenai River Beach between 2010 and 2022.

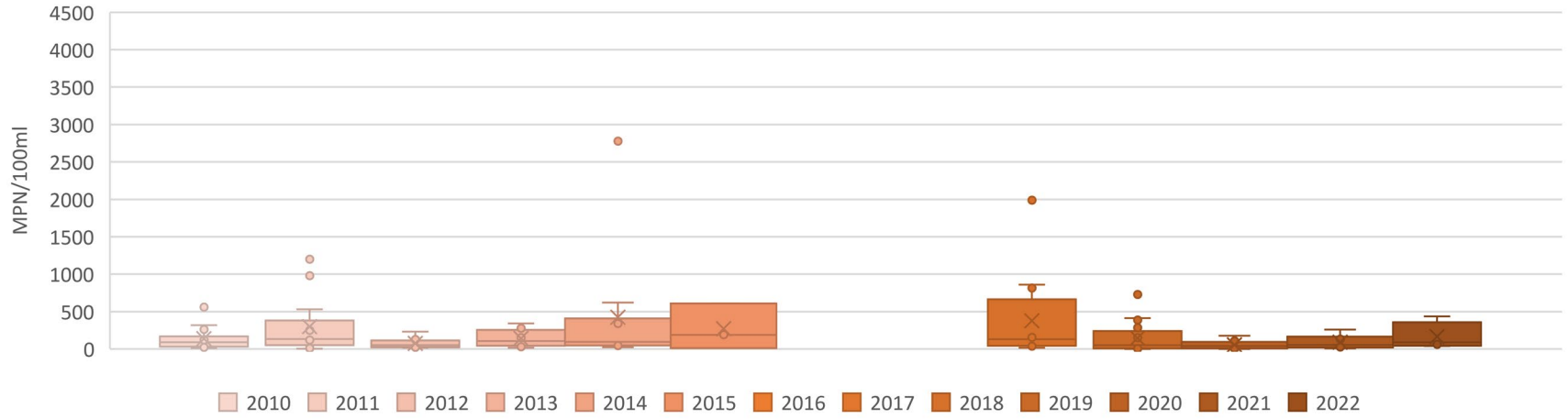

Figure 6. Box plots of enterococci at South Kenai River beach between 2010 and 2022.

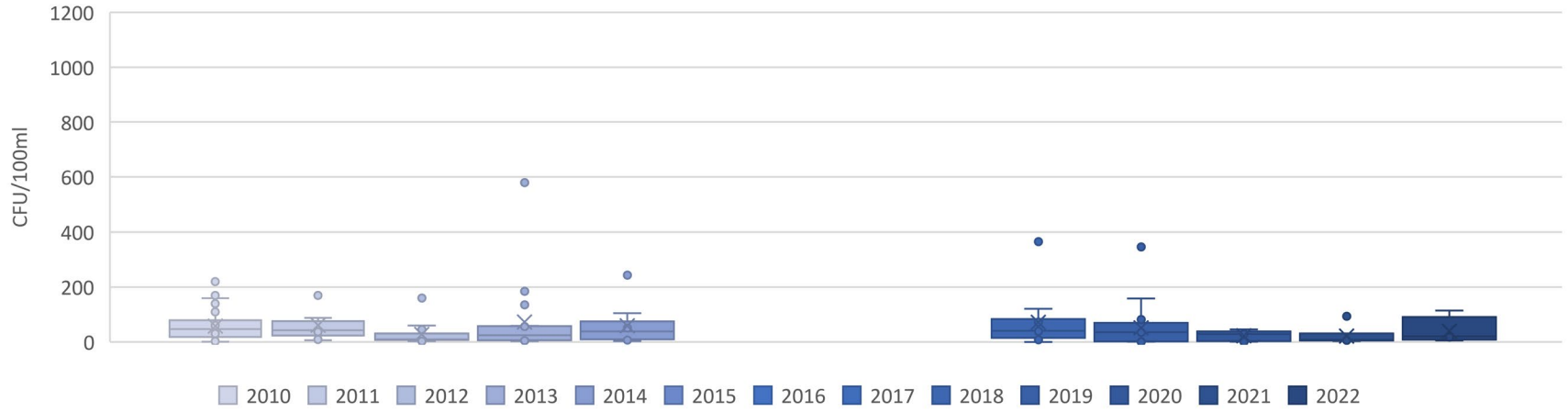

Figure 7. Box plots of fecal coliform observed at North Kenai River Beach between 2010 and 2022.

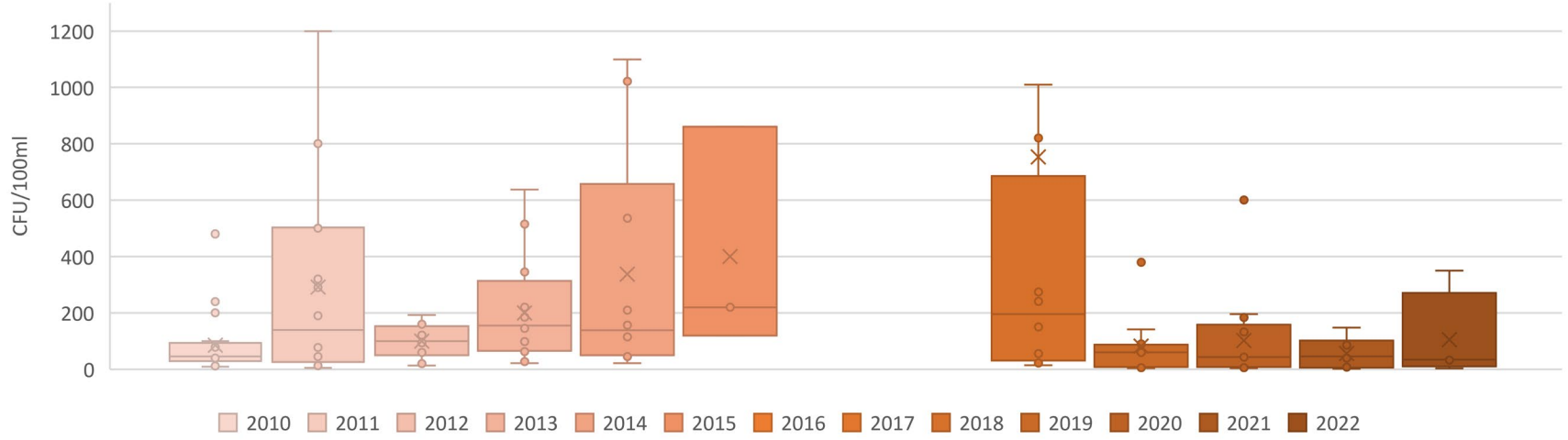

Figure 8. Box plots of fecal coliform observed at South Kenai River Beach between 2010 and 2022.

Outreach

Outreach activities during the 2022 monitoring season resembled 2020 and 2021 seasons. A pre-season public notice was issued for all beaches monitored in 2022 under the Alaska BEACH Program. A total of two Kenai specific public notices were issued and advertised on DEC social media accounts (i.e., Twitter and Facebook, see Appendix A) corresponding with the two primary contact exceedances. DEC Public Relations staff also issued nine social media post on the DEC Facebook page. Posters and flyers were distributed to seven private businesses in the cities of Kenai and Soldotna. Flyers were also distributed to the Kenai Public Health and City of Kenai Visitor centers. Informational flyers and posters were donated to the Dipnet Information Booth operated by the Kenai Watershed Forum. Radio was used to reach fishermen and fisherwomen in the Mat-Su, Anchorage, and Kenai Peninsula regions. The following radio script was played 144 times across three traditional stations and 11,250 times on iHeart Radio's digital streaming service:

"Help keep our beautiful Kenai beaches clean this summer by properly disposing of fish waste and packing out trash. Rinse your catch in tap water, cook to 145 degrees, and wash or sanitize your hands before eating. Check the latest bacteria levels and forecast at Beaches 'dot' Alaska 'dot' Gov. This message is provided by the Department of Environmental Conservation."

The above script was estimated to have potentially reached 40,050 listeners[8].

Virtual Beach

Virtual Beach performance varied between the two beaches (Table 5). Both the MLR and GBM models successfully predicted the exceedance observed on July 16th at South Kenai Beach. An exceedance was predicted on August 9th on South Kenai Beach that was not observed in the routine sample collected that day. However, it was reflective of the results of the duplicate sample collected on that day (378 MPN/100ml). Neither the GBM or the MLR successfully predicted the exceedance that was observed on August 8th at North Kenai Beach. The results of the VBeach pilot study are available in ADEC 2022.

[8] Estimate based on the estimated gross impressions (avg. GIs) number of listeners provided by iHeart Radio Alaska. KSRM Radio Group did not provide an avg. GIs number.

Table 5. Predicted and observed pathogen results for the 2022 monitoring season. Predicted enterococci (MPN/100ml) values for the gradient boosting model (GBM) and multiple linear regression (MLR) are presented alongside the observed routine enterococci (MPN/100ml). Table modified from DEC 2022.b.

Location	Date	GBM Prediction	MLR Prediction	Routine Sample Result	Outcome
South Kenai	6/30	39	26.4	62	Correct
	7/12	**183.5**	**140.6**	**435**	Correct
	7/27	34	116	39	Correct
	8/9	**499**	**157.6**	117	Incorrect
North Kenai	6/30	52	26.4	25	Correct
	7/12	**191**	24.6	66	Partially Correct
	7/27	2	16.2	22	Correct
	8/9	8	19.9	**248**	Incorrect

Conclusion

The frequency and magnitude of elevated pathogen levels observed during the 2022 monitoring season mirrored patterns observed in 2021. Exceedances in both 2022 and 2021 occurred later in the monitoring season (July and August) and both during and after the personal use fishery. One notable deviation from the previous year's pattern was the observed exceedance at North Kenai Beach on August 9th. No exceedances of the in-season recreational contact criteria had been observed at North Kenai Beach since 2019.

Multiple hypotheses have been proposed on what environmental factors influence pathogen levels at Kenai River beaches. Microbial source tracking (MST) analysis in previous years has indicated that birds are the major source of bacteria observed at Kenai River beaches (KWF 2019, KWF 2020). One of the leading hypotheses throughout the Kenai Beach Monitoring program was the relationship between pathogen levels and the number of scavenging birds present. Bird presence alone does not appear to correlate with elevated pathogen levels during the 2022 monitoring season. On July 12th, 327 birds[9] were observed at both North and South Kenai beaches. Later in the month on July 27th, approximately 1,060 birds were observed at the two beaches. If pathogen levels were directly correlated with bird counts, then an exceedance would be expected on July 27th as well as July 12th. However, that was not what was observed, as pathogen levels were relatively low on the 27th (22 MPN/100ml at North, and 39 MPN/100ml at South). In addition to birds, fewer people were present on July 12th (62 people) than on the 27th (175 people), and fewer fish were also counted in the river on the 12th than on the 27th (8,094 sockeye salmon on July 12th and 56,110 sockeye salmon on July 27th)[10]. The relationship

[9] Birds were primarily gulls with occasional eagles and other small seabirds

[10] Fish count data sourced from the Alaska Department of Fish and Game Kenai River (Late-Run Sockeye) Fish Count Data Search: https://www.adfg.alaska.gov/sf/FishCounts/index.cfm?ADFG=main.home

between scavenging birds and pathogen presence does not appear to be a 1:1 relationship as originally hypothesized. Instead, gull presence is just one factor contributing to pathogen levels in a dynamic system.

The observed exceedance at North Kenai Beach on August 9th provides additional evidence of the dynamic influence of the physical environment on observed pathogen levels. The final sampling event of the 2022 was delayed 24 hours due to extreme wave activity. The sampling team noted very turbid water and low tide conditions 24 hours later on August 9th (Figure 5). The observed high turbidity was a result of the high wave action over the previous 24 hours. Wave height, and the resulting turbidity, has been correlated with indicator pathogen levels in multiple previous studies (Enns et al. 2012, Laureano-Rosario et al. 2021). On August 9th only 10 people and 14 birds were observed at both beaches. The high turbidity observed on August 8th and 9th likely contributed to the pathogen exceedance. Why an exceedance was not observed at South Kenai beach is not known but could suggest additional environmental factors at work (e.g., advection, wave direction, local rainfall etc.) or was a result of natural error and high spatial-temporal variability observed in enterococci samples (Enns et al. 2012). Both models in Virtual Beach predicted an exceedance at South Kenai Beach on August 9th that did not materialize (ADEC 2022.b). However, even though the observed result (117 MPN/100ml) was below the in-season contact recreation criteria (130 MPN/100ml), the duplicate sample (378 MPN/100ml) was well above the criteria. The duplicate sample suggests that enterococci was elevated at South Kenai Beach on August 9th but was not observed in the routine sample due to natural error.

Figure 9. North Kenai Beach looking southeast. Photo collected on August 9th, 2022.

The 2022 public outreach campaign was designed to reach a broad range of stakeholders. Radio had the greatest potential impact based on the number of estimated listeners. However, radio messages are short in nature and require the listener to follow up by visiting a website. It is also difficult to determine how many of the potential 40,050 listeners were actively listening when the radio spot was played. Handouts and posters convey more detailed information and provide web addresses and QR codes to increase ease of access to additional materials. However, again it was difficult to assess how many individuals read the handouts and posters and these materials could only be posted on public bulletin boards and public information

kiosks. In 2022 DEC provided handouts and outreach materials to be used and distributed at the Beach Information Booth operated by Kenai Watershed Forum. The Information Booth is operated on weekends during the PU fishery at North Kenai Beach and is staffed by volunteers and forum staff. In-person conversations are easy to measure and can be tailored to everyone interests and needs. Statistics were not available for 2022, but 382 peer-to-peer conversations occurred at the Beach Information Booth in 2021. Effective outreach was accomplished by leveraging multiple different tools throughout the recreational season. A mixed outreach tool approach is recommended for future similar projects. Incorporating the Virtual Beach tool into future outreach activities has the potential to continue building awareness of the role of pathogens at Kenai River beaches in the absence of active monitoring.

The implementation of BMP's in 2015 did have a measurable positive impact on pathogens at Kenai River beaches. Large sporadic outliers in pathogen levels appear to have been more frequent prior to BMP implementation and became rare or nonexistent post BMP implementation. Likewise, the range of observed parameter values differed pre and post BMP implementation for all parameters and beaches, the exception being enterococci at South Kenai Beach. Although there was no statistically significant difference, the frequency of enterococci exceedances at South Kenai Beach generally has decreased since 2018. Continuation of BMPs and public education campaigns are recommended to keep pathogen levels low at both Kenai River beaches.

Recommended Next Steps

ADEC will not continue BEACH program monitoring at North or South Kenai River beaches beyond the 2022 monitoring season. After ten years of sampling, DEC believes the elevated bacterial levels observed at Kenai River beaches are the result of natural factors. Naturally elevated levels of pathogens are not considered an impairment of water quality standards (18 AAC 70.010; Appendix C). DEC will continue to work with, and advise stakeholders, on best management practices and aid in local outreach campaigns to continue to protect human health and the environment in the region. The Virtual Beach tool may be suitable for notifying the public of potential elevated pathogen conditions, particularly at North Kenai Beach (DEC 2022.b.). DEC will be offering Virtual Beach training for interested stakeholders and organizations in 2023.

Acknowledgements

Thank you to the City of Kenai and the Kenai Watershed Forum for managing the Kenai BEACH Monitoring program from 2010 through 2019, and the greater Kenai Peninsula community for helping us 'Keep our beautiful Kenai Peninsula beaches clean'.

References

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KWF (Kenai Watershed Forum). 2020. 2020 Kenai Beach Bacteria Monitoring Report. Prepared by Benjamin Meyer. Soldotna, AK. 54 pg.

Appendix A: 2022 Outreach

Outreach methods used for the 2022 monitoring season included radio, paper media, and social media. Below are examples of some of the materials used in 2022.

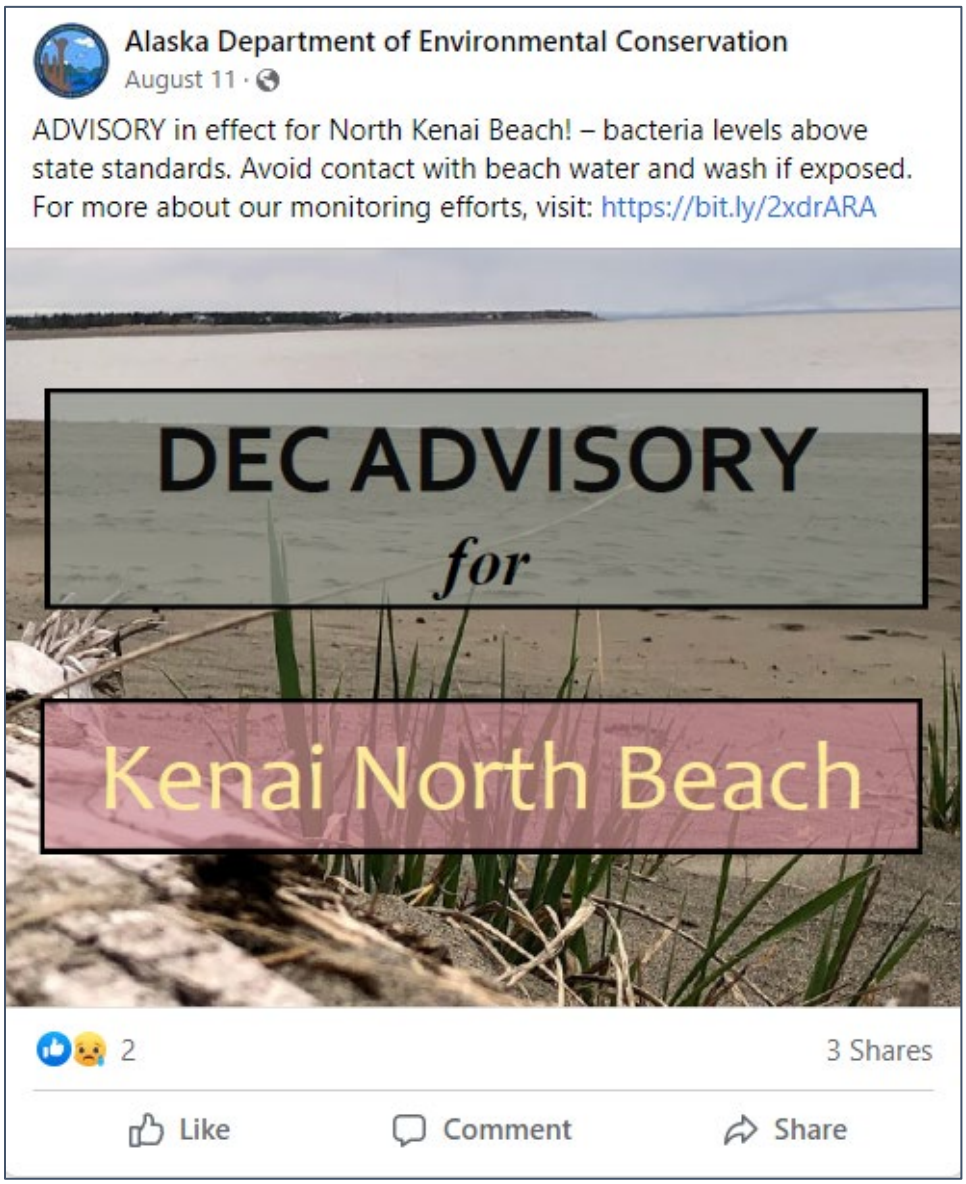

Figure A. 1. Example of a public advisory post made by DEC for the August exceedance at North Kenai Beach, 2022.

Figure A. 2. Example of a non-advisory social media post for the Kenai River BEACH Program. This post was issued on Facebook on July 23, 2022.

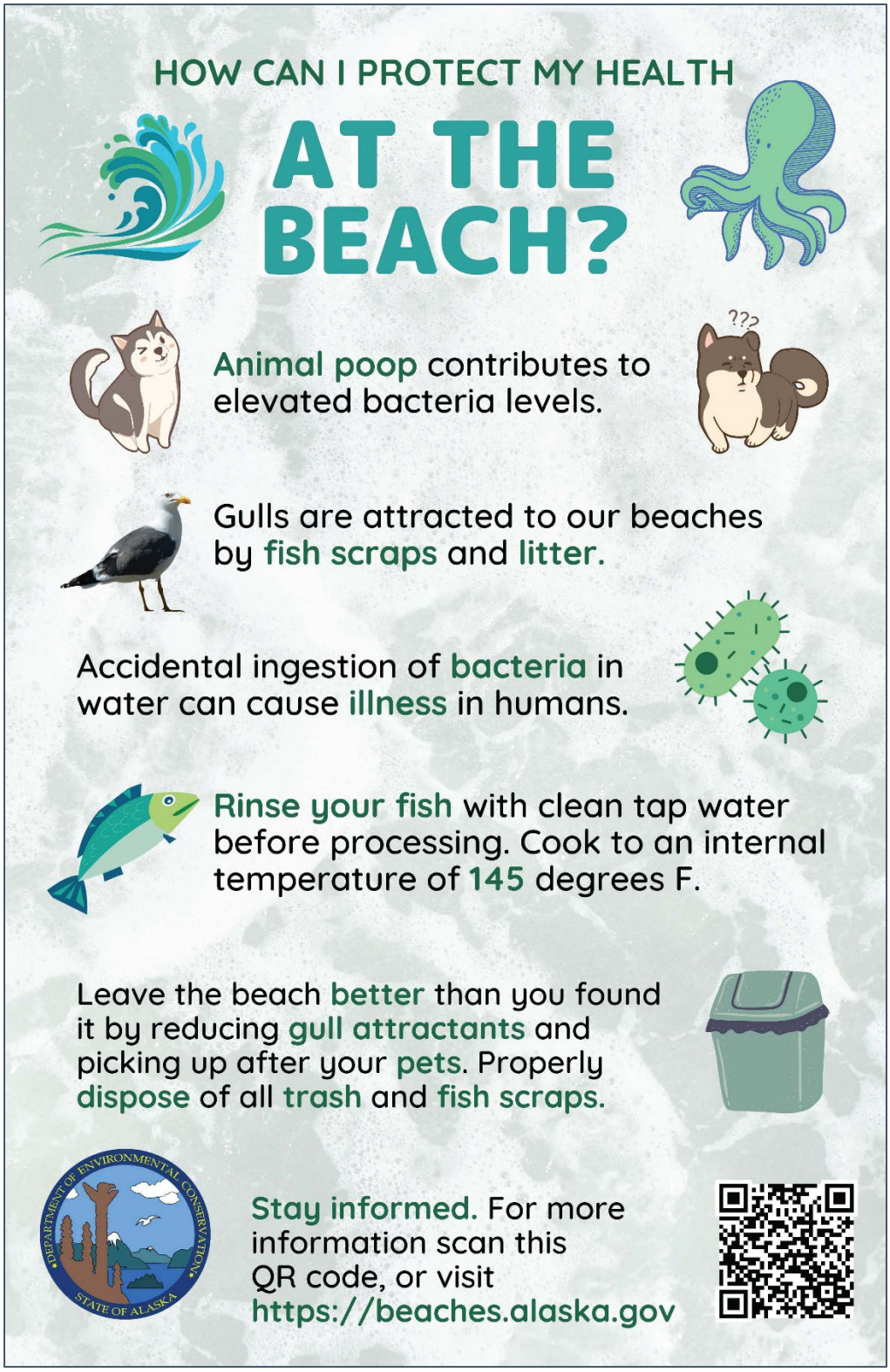

Figure A. 3. The 2022 season poster developed by J. Petitt for the Kenai River BEACH Program.

Appendix B: Quality Assurance Data Checklist

Project Information

Project Name:	Kenai BEACH Monitoring
Waterbody Name(s):	North Kenai Beach, South Kenai Beach
Assessment Unit ID(s):	AK_B_2030218_002, AK_B_2030218_003
DEC Project Manager:	Sarah Apsens
Data Conducting Organization:	Alaska Department of Environmental Conservation, Nonpoint Source Section, BEACH Program
Data Collection Dates:	6/30/2022 – 8/9/2022

Data Review Summary

Review Step		**Responsible person**	**Name**	**Date Completed**
Pre-Database	Raw data review during field season	Project Manager	Sarah Apsens	8/11/2022
	Complete project and raw data review post field season	Project Technician	Jenny Petitt	8/19/2022
Database Prep	Import configuration file review	Project Manager	Sarah Apsens	8/30/2022
Database Import	Provisional AWQMS and data export review	Project Technician	Jenny Petitt	8/31/2022
	Corrected AWQMS and data export review*	Secondary Reviewer	Gretchen Augat	8/31/2022
	QA Review Checklist	QA Officer	John Clark	10/21/2022
	Final review	Data Management Lead	Amber Bethe	11/8/2022

*repeat review process until neither the project manager nor secondary reviewer finds any errors, then submit for QA and DML final review and project status change to final.

Data Review Checklist

Pre-Database		
During the field season, review raw data files (EDDs, instrument records) as they are received. Document changes and corrections to methods as needed. Once all data is received, review for overall project success and conduct a detailed evaluation of field notes, in-situ field, and analytical results. Filter and sort raw data files to answer the following questions for all results. Include notes in this checklist as well as a supporting excel file with calculations and summary tables for all QA calculations. Document all data that fails QA and provide justification for any rejected results.		
Overall Project Success	**Yes or No**	**Notes**
Did the project follow the QAPP?	Yes	Notes: click or tap here to enter text.
Were there any deviations from the sampling plan?	Yes	Slight modifications to site locations/ sample dates for safety of samplers. Low tides caused muddy conditions on 7/27 and 8/9. All deviations from the planned locations were noted on field data sheets.
Are site names, dates, and times correct?	No	Electronic data deliverable from lab for 7/27 listed two samples as collected on 6/27. Lab result PDF says samples were collected on 7/27.
Is the dataset complete (did you receive the expected # of results?	Yes	Notes: click or tap here to enter text
Enter completeness goal (from QAPP) and project completeness. Provide calculations and a summary table in supporting excel file.		Goal: 80% Actual: 100% Notes: click or tap here to enter text.
Were field duplicates, blanks, and/or other QC samples collected as planned?	Yes	Field duplicates: 8 duplicates required (one for each pathogen type, enterococcus and fecal coliform, collected at alternating beaches. Field blanks: None required Other: Enter # required and # collected Notes: click or tap here to enter text.
Are the duplicate sample(s) RPD within range described in QAPP? Provide duplicate RPD calculations and a summary table in supporting excel file.	Yes or No	+/- 60% 1 Duplicate pair (enterococci at SKB) collected on 8/9 was 105.5% RPD- all others less than 60%.
In-situ Field Data and Instruments	**Yes or No**	**Notes**

Were there any issues with instrument calibration?	No	HANNA handheld was used to collect water temperature and air temperature data. No other in-situ measurements collected.
Was instrument calibration performed according to the QAPP and instrument recommendations?	Yes	Notes: click or tap here to enter text
Were calibration logs or records kept?	No	Only water temperature recorded
Was instrument verification during the field season performed according to the QAPP and instrument recommendations?	No	No verification required
Were verification logs or records kept?	No	NA
Did the instrument perform as expected?	Yes	Notes: click or tap here to enter text
Do the instrument data file site IDs, time stamps and file names match?	Yes	Notes: click or tap here to enter text
Do the range of results values make sense for the environmental conditions?	Yes	Notes: click or tap here to enter text
Is any field data rejected and why?	No	Notes: click or tap here to enter text
Any additional comments or concerns.		Notes: click or tap here to enter text
Analytical Laboratory Reports and Results	**Yes or No**	**Notes**
Do the laboratory reports provide results for all sites and analytes?	Yes	Notes: click or tap here to enter text
Were the appropriate analytical methods used?	Yes	Notes: click or tap here to enter text
Do the laboratory reports match the COC and requested methods?	Yes	Notes: click or tap here to enter text
Are the same methods used throughout the season?	Yes	Notes: click or tap here to enter text
Are the number of samples on the laboratory reports the same as on the COC?	Yes	Notes: click or tap here to enter text
Is a copy of the COC provided with the laboratory reports?	Yes	Notes: click or tap here to enter text

Were preservation, hold time and temperature requirements met?	No	"Fecal coliform sample received within hold time, but analyzed past hold due to laboratory error. Enterolert sample received within hold time, but analyzed past hold due to laboratory error." -lab report QC flag for NKB collected on 7/27
Was all supporting information provided in the laboratory report, such as reporting limits and definitions?	Yes	Notes: click or tap here to enter text
Were there any discrepancies, errors, data qualifiers or QC failures?	No	Notes: click or tap here to enter text
Do the range of results values make sense for the environmental conditions?	Yes	Notes: click or tap here to enter text
Is any laboratory data rejected and why?	No	Notes: click or tap here to enter text
Any additional comments or concerns.	No	Notes: click or tap here to enter text
Was the QA Officer consulted for any data concerns?	Yes	Notes: click or tap here to enter text

Database Prep

Add project to AWQMS database including QAPP and any supplemental data not part of import. Add monitoring locations to AWQMS database and associate monitoring locations with project. Develop import configuration file for Activities and Results. Copy raw data into import file and review for accuracy and completeness. Filter and sort import data file to review and correct any errors. Upload raw data in import file as "Provisional" status into AWQMS. Fix any import errors that arise. Repeat as necessary until all data is uploaded to AWQMS.

Complete	Yes	Notes: click or tap here to enter text.

Database

The fields identified for review below are suggestions based on typical projects. Your particular project may include more or fewer fields that need to be reviewed. Please include notes for any additional fields reviewed for your projects.

The following review should be conducted first by the project manager and then repeated by a secondary reviewer. Project manager corrects errors until project manager and secondary reviewer find no more errors. Once reviews are complete and no errors are found, submit to QA Officer for review.

AWQMS Project Detail Page	**Check box**	**Notes**
Is the project detail filled out?	☒	Notes: click or tap here to enter text.
Are the correct monitoring locations associated with the project?	☒	Notes: click or tap here to enter text.
Is the total number of results correct for the project?	☒	Notes: click or tap here to enter text.
Are the QAPP and other supporting documents attached?	☒	Notes: click or tap here to enter text.
AWQMS Monitoring Locations		
Create a map: Are the monitoring locations in the correct place?	☒	Notes: click or tap here to enter text.
Are the latitude and longitude filled in correctly in a consistent format?	☒	Monitoring location lat/long (the values entered in AWQMS monitoring location metadata) and Activity location lat/long (the values taken at actual sites where samples were collected) are both reported on the Standard Export. Sample sites changed slightly for safety reasons, new locations are noted with Activity lat/long.
Is metadata provided: monitoring location name, description, establishment date, state, county, HUC8, HUC12, alternate IDs		
Is all metadata correct?	☒	Notes: click or tap here to enter text.
Standard Export	Use sort and filter to review standard export of data for completeness and correctness.	
Is the organization ID correct?	☒	Notes: click or tap here to enter text.
Are the times zones consistent and correct? (AKDT in summer)	☒	Notes: click or tap here to enter text.
Are all media types included?	☒	Notes: click or tap here to enter text.
Are the Media types appropriate to the Characteristic?	☒	Notes: click or tap here to enter text.
Activities in the Standard Export		
Check Sample Collection, Preparation and Preservation Methods, Thermal Preservative, Equipment ID, Activity Media. Is supporting information included and correct?	☒	
Are expected Activity types present and are QC samples correctly identified?	☒	Notes: click or tap here to enter text.

Is metadata provided (as appropriate): sample collection and preparation methods, relative depth (water only), media subdivision, start date & time and project ID	☒	Notes: click or tap here to enter text.
Results in the Standard Export		
Is the number of results for each Characteristic correct?	☒	Notes: click or tap here to enter text.
Do the range of results values make sense for the environmental conditions?	☒	Notes: click or tap here to enter text.
Are units correct and consistent for each Characteristic?	☒	Notes: click or tap here to enter text.
Are detection limits, detection conditions and laboratory or other result qualifiers included for analytical results?	☒	Notes: click or tap here to enter text.
Is metadata provided (as appropriate): value type, method speciation and statistic N value	☒	Notes: click or tap here to enter text.
Other fields reviewed as applicable to your project.	☒	Notes: click or tap here to enter text.
Any additional comments or concerns.	No	Notes: click or tap here to enter text

Appendix C: State of Alaska Water Quality Standards for Bacteria for Marine Waters

Sourced from 18 AAC 7.020(14)

Pollutant & Water Use	Criteria
(14) Bacteria, for Marine Water Uses (see note 1)	
(A) Water Supply **(i) Aquaculture**	For products normally cooked, the geometric mean of samples taken in a 30-day period may not exceed 200 fecal coliform/100 ml, and not more than 10% of the samples may exceed 400 fecal coliform/100 ml. For products not normally cooked, the geometric mean of samples taken in a 30-day period may not exceed 20 fecal coliform/100 ml, and not more than 10% of the samples may exceed 40 fecal coliform/100 ml.
(A) Water Supply **(ii) Seafood Processing**	In a 30-day period, the geometric mean of samples may not exceed 20 fecal coliform/100 ml, and not more than 10% of the samples may exceed 40 fecal coliform/100 ml.
(A) Water Supply **(iii) Industrial**	Where worker contact is present, the geometric mean of samples taken in a 30-day period may not exceed 200 fecal coliform/100 ml, and not more than 10% of the samples may exceed 400 fecal coliform/100 ml.
(B) Water Recreation **(i) Contract Recreation**	In a 30-day period, the geometric mean of samples may not exceed 35 enterococci CFU/100 ml, and not more than 10% of the samples may exceed a statistical threshold value (STV) of 130 enterococci CFU/100 ml.
(B) Water Recreation **(ii) Secondary Recreation**	In a 30-day period, the geometric mean of samples may not exceed 200 fecal coliform/100ml, and not more than 10% of the samples may exceed 400 fecal coliform/100ml.
(C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife	Not applicable.

Pollutant & Water Use	Criteria
(D) Harvesting for Consumption of Raw Mollusks or Other Raw Aquatic Life	The geometric mean of samples may not exceed 14 fecal coliform/100 ml; and not more than 10% of the samples may exceed; • 43 MPN per 100 ml for a five-tube decimal dilution test; • 49 MPN per 100 ml for a three-tube decimal dilution test; • 28 MPN per 100 ml for a twelve-tube single dilution test; • 31 CFU per 100 ml for a membrane filtration test (see note 14).

Note 1. Wherever bacteria criteria are provided in this section, bacteria enumeration must be determined by the membrane filter technique or most probable number procedure according to any edition of Standard Methods for the Examination of Water and Wastewater, adopted by reference in (c)(1) of this section, and adopted by reference, or in accordance with other standards approved by the department and the United States Environmental Protection Agency (EPA). Bacteria results reported as “too numerous to count” (TNTC) is considered an exceedance for comparison to water quality standards. Analysis and reporting of the method recommended dilution of the sample is required.

Note 14. When fecal coliform is monitored in waters designated as state approved shellfish harvesting and growing waters, these waters are also subject to 18 AAC 34.010(19).