

# Alaska Department of Environmental Conservation

## Waterbody Field Report

### Kenai River North and South Beaches, Kenai Alaska



Prepared by: S. Apsens and J. Petitt<sup>1</sup>

## Abstract

Kenai North and Kenai South beaches are popular recreation areas located at the outlet of the Kenai River in Southcentral Alaska. Water quality has periodically exceeded the criteria for pathogens at both beaches since the Kenai Beach Monitoring program began in 2010. In 2021 the Alaska Department of Environmental Conservation conducted a ninth season of monitoring at these locations. Each beach was sampled six times between May and August 2021 for enterococci and fecal coliform bacteria. Water quality exceeded the criteria for primary contact recreation at South Kenai Beach twice, on June 28<sup>th</sup> and August 9<sup>th</sup>. No exceedances of the primary contact recreation criteria were observed at North Kenai Beach. No exceedances of the secondary contact recreation criteria were observed at either beach. Pathogen data and in situ environmental data collected in 2021 were used to build a predictive model (Virtual Beach) for use in future monitoring seasons. Recommended future outreach activities will continue to focus on educating beachgoers on hand washing, safe food handling, and beach stewardship.

## Basic Waterbody Information

*Table 1. Basic Waterbody Information*

<b>Assessment Unit ID</b>	AK_B_2030218_002 (North Kenai); AK_B_2030218_003 (South Kenai)
<b>Assessment Unit Name</b>	Kenai River North and South Beaches
<b>Location Description</b>	Outlet of Kenai River into Cook Inlet
<b>Water Type</b>	Marine
<b>Area Sampled</b>	North and South beaches, areas used by personal use fishery
<b>Time of Year Sampled</b>	May through August 2021

## Water Quality Evaluation

### Background

Kenai North and Kenai South beaches are located at the mouth of the Kenai River in Southcentral Alaska (Figure 1). Swimming is not common due to frigid water temperatures, but other activities such as dog walking, biking, beach combing, bird watching, and fishing are popular at both locations. Most notable is the personal use dipnet fishery (PUF) that attracts

<sup>1</sup> Nonpoint Source Pollution, Water Quality, Division of Water, Department of Environmental Conservation

thousands of fishermen to these beaches in July each year. The fishery results in increased fish carcasses on the beach, that in turn, attracts gulls from a nearby rookery.

The Kenai River Beach Monitoring Program was started in 2010 to address community concerns about bacteria levels at the two beaches. Exceedances of the Alaska Water Quality Standards (WQS) (18 AAC 70.020(14)<sup>2</sup>) were periodically observed at both beaches in the period 2010 to 2014. In 2014 the City of Kenai developed a set of best management practices (BMPs) to address the observed water quality exceedances. Monitoring was paused and the BMPs were implemented the summer of 2015. Monitoring resumed in 2018 and continues to present. In addition to pathogen monitoring, microbial source tracing (MST) was used in 2018 and 2019 to identify pathogen hosts. The MST results indicated that Gulls were the primary source of bacteria at Kenai River Beaches (KWF 2019, KWF 2020), followed by dogs, and rarely humans.

The 2021 monitoring effort marked the ninth year of monitoring on Kenai River beaches. The 2021 effort was led and executed by the Alaska Department of Environmental Conservation (DEC). Six sampling events were completed in 2021, occurring before, during, and after the PUF. The suitability of the Environmental Protection Agency's (EPA) Virtual Beach Predictive Model (VBeach) was tested simultaneously to the water quality monitoring effort.

The Kenai Beach Monitoring program is part of a nationwide program to decrease the incidence of water-borne illness at public beaches. Funding for this program is granted to the State of Alaska by the EPA under the federal Beaches Environmental Assessment and Coastal Health (BEACH) Act. The Kenai River beaches are two of sixteen<sup>3</sup> beaches monitored under the Alaska BEACH Monitoring Program during the 2021 recreation season.

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<sup>2</sup> See Appendix A

<sup>3</sup> During the 2021 monitoring season. Additional program beaches were in Ketchikan (12 beaches) and Hoonah (2 beaches).

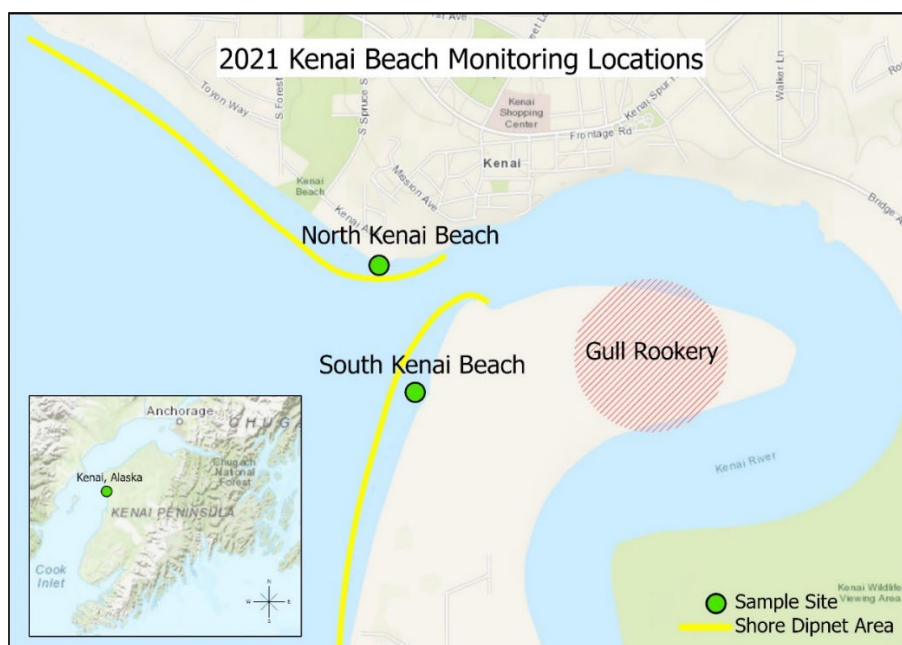


Figure 1. 2021 Kenai Beach Monitoring Locations.

## Objective

The objectives for the 2021 monitoring program 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 when pathogen levels were elevated.
- Evaluate the fitness of the EPA VBeach Model on Kenai River beaches.

## Quality Assurance Review

Field staff followed procedures for sample collection as outlined in the project's Quality Assurance Project Plan (QAPP) (DEC 2021). All samples met the requirements for handling and reporting outlined in the project QAPP, including the 6-hour field holding time. Samples were shipped to the lab with completed Chain of Custody forms and custody seals. All field equipment used to collect in situ measurements were calibrated prior to use in the field.

SGS North America Inc. (SGS) supplied the sample kits and performed the bacteria analysis for fecal coliform (SM21 9222D) and total enterococci (ENTEROLERT) bacteria. SGS analyzed all samples within the 8-hour holding time. Sample holding temperature ranges were met (minimum 3.4°C, maximum 5.8°C). The lab performed method blanks for each parameter per sample event, all of which were non-detects.

One duplicate for each parameter was collected per event at alternating beaches, totaling 12 for the 2021 monitoring season. No field blanks were collected for 2021 monitoring year.

The project achieved the data goals of providing sample results to the public and calibrating the Vbeach model to Kenai River beaches. The 2021 monitoring project exceeded the completeness goal of 80% (95% completeness achieved). The relative percent difference (RPD) exceeded the 60% difference limit set in the project QAPP for one enterococci sample and two fecal coliform samples. The DEC quality assurance officer evaluated paired samples that failed RPD and determined that the project goal to notify the public of exceedances of water quality standards was not impacted. The 2021 season monitoring data was successfully uploaded to the VBeach model for Kenai River beaches<sup>4</sup>.

## Methods

Sampling for pathogens occurred biweekly starting June 1<sup>st</sup>, 2021 and continued through August 9<sup>th</sup>, 2021 (6 total events for 2021). Samples were collected on Monday or Tuesday, so that the results could be made available to the public before the following weekend. Quality control duplicate samples were collected at alternating beaches every sampling event.

In situ measurements of key environmental parameters were conducted simultaneously as pathogen samples. A HANNA® Instruments handheld probe was used to measure water and air temperature. A HACH® 2100Q IS Portable Turbidimeter was used to measure turbidity. The sampling team also counted birds, dogs, and beachgoers at each site<sup>5</sup>. Weather data was acquired by on-site observation and from the Kenai Airport weather station (IEM 2021)<sup>6</sup>. Tide information was sourced from the National Oceanic and Atmospheric Administration Tides & Currents webpage<sup>7</sup> (NOAA 2021).

## Results

In 2021 there were two exceedances of the primary contact criteria for marine waters (enterococci > 130 MPN/100ml) (Table 3). Both exceedances occurred at South Kenai Beach, and no exceedances were observed for North Kenai Beach. Both exceedances of the primary contact criteria occurred outside the PUF fishery. No exceedance of the secondary contact criteria occurred at either beach during the 2021 season (fecal coliform > 400 col/100ml).

Exceedances of the criteria for harvest and consumption of raw fish and shellfish were observed at both beaches but were more frequent at South Kenai Beach (fecal coliform > 31 col/100ml for a membrane filtration test).

Observed pathogens were higher on average at South Kenai Beach than at North Kenai Beach. Average enterococci count observed at South Kenai Beach was 90 MPN/100ml ( $\pm$  96 Std. error). In contrast, the average enterococci count at North Kenai Beach was 26 MPN/100ml ( $\pm$  34 Std.

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<sup>4</sup> A completed Quality Assurance Checklist for the 2021 Kenai River Beach monitoring season is available from DEC upon request.

<sup>5</sup> Counts were conducted over a 5 minute period.

<sup>6</sup> Alaska Automated Surface Observing System (ASOS) Network, Kenai Municipal Airport (PAEN)

<sup>7</sup> Tidal station TWC1983, Kenai River Entrance

error). Average fecal coliform was greater at South Kenai Beach ( $56 \pm 55$  CFU/100ml) than North Kenai Beach ( $22 \pm 36$  CFU/100ml).

*Table 3. 2021 monitoring season data summary*

Sample Date	North Kenai Beach		South Kenai Beach	
	Enterococci (MPN/100 ml)	Fecal Coliform (col/100 ml)	Enterococci (MPN/100 ml)	Fecal Coliform (col/100 ml)
<b>June 1</b>	2	3	26	1 <sup>1</sup>
<b>June 14</b>	3	6	6	7
<b>June 28</b>	79	7	<b>260</b>	40
<b>July 12</b>	4	10	29	50
<b>July 26</b>	8	10	84	86
<b>August 9</b>	58	94	<b>132</b>	148

<sup>1</sup> Indicates the analyte was analyzed for, but not detected.

*One-time exceedances (enterococci value greater than 130 MPN/100ml or fecal coliform greater than 31 CFU/100 ml) are in **bold text**.*

Enterococci levels appeared to be slightly higher in 2021 than 2020 (Table 4). Statistical significance was tested using a single factor analysis of variance (ANOVA). Enterococci and fecal coliform bacteria were not found to be significantly different between the 2020 and 2021 monitoring seasons.

*Table 4. Comparison of enterococci and fecal coliform between 2020 and 2021 monitoring seasons*

Location	Parameter	Average $\pm$ Std. Dev.		P-Value
		2020	2021	
North Kenai	Enterococci	13 $\pm$ 11	26 $\pm$ 34	0.196859
	Fecal coliform	24 $\pm$ 17	22 $\pm$ 36	0.977075
South Kenai	Enterococci	24 $\pm$ 17	90 $\pm$ 96	0.362405
	Fecal coliform	110 $\pm$ 169	56 $\pm$ 55	0.512873

## Conclusion

Exceedances of water quality criteria for primary contact recreation mirrored those observed in 2020 (KWF 2021). In both 2020 and 2021, two exceedances of the primary contact recreation criteria occurred at South Kenai Beach. No exceedance of the criteria was observed at North Kenai Beach in 2020 or 2021. In addition, no exceedance of the secondary contact recreation criteria was observed at either beach in 2020 or 2021. The absence of exceedances for the secondary contact recreation criteria suggests improvement in pathogen levels in recent years. However, South Kenai beach continues to exceed the primary contact recreation criteria and may require an assessment of existing BMPs to address this issue.

Both exceedances during the 2021 monitoring season occurred outside the PUF. On August 9<sup>th</sup>, field samplers noted high gull counts at both North and South Kenai beaches (total 264 gulls), despite the lack of human activity on the beach due to the PUF having closed 9 days earlier on

July 31<sup>st</sup>. Gulls may have remained in the area to finish raising chicks or to feed off carcasses from fishing activities farther upstream. Although the gull count during the previous sampling event on July 28<sup>th</sup> was higher (total of 795, see Figure 2) than on August 9<sup>th</sup>, pathogen levels did not exceed the primary contact recreation criteria that day. This suggests that though birds are a known source of pathogens at Kenai River beaches, bird presence alone does not always result in elevated bacteria levels. Instead, observed pathogen levels are likely a result of bird presence comingled with specific environmental conditions. Tide height at time of sampling differed significantly between the July 26<sup>th</sup> (est. 15 ft) and August 9<sup>th</sup> (est. 0 ft). In addition, field samplers noted warm, turbid, and relatively slow-moving water on August 9<sup>th</sup> (see Figure 3). Likewise, the observed exceedance on June 28<sup>th</sup> occurred under relatively cold conditions and with significantly fewer bird sightings (18 gulls total). These results suggest a complex interaction of multiple environmental factors, not just gull counts, result in elevated bacteria levels.



*Figure 2. View of South Kenai Beach looking north on July 26th, 2021. No exceedance occurred this day despite the high gull presence.*

Exceedance of the criteria for consumption of raw fish and shellfish was observed at both beaches in 2021. To address this, public service announcements encouraged beachgoers to cook their fish to an internal temp of 145°F to kill off harmful bacteria. Outreach also focused on encouraging beachgoers to practice good hygiene by washing hands after fishing and before eating. Radio ads, posters, flyers, social media posts, and listserv notices were used to distribute outreach messages. Future outreach messages should also focus on reducing attractants to gulls and reducing other sources of pathogens by encouraging beachgoers to pick up their trash, pick up after pets, and use provided restroom facilities.

Working predictive models were developed for North and South Kenai beaches using the EPA VBeach model. Discussion of these models is available in a separate report<sup>6</sup>.





*Figure 3. North Kenai Beach, August 9<sup>th</sup>, 2021. Note low tide stage.*

## Recommended Next Steps

The 2021 Kenai bacteria data was used to develop a predictive model using EPA's VBeach<sup>8</sup> program. In-season reporting during the 2022 recreation season should incorporate pathogen conditions predicted by the appropriate model(s).

Limited sample collection will be necessary in future recreation seasons to ground truth the predictive model. A recommended sampling plan would include one sample event before, two during, and one after the personal use fishery. A minimum of four sampling events are proposed for the 2022 recreation season.

Public education will remain essential to reduce bacteria levels on Kenai beaches and to protect the public health. The use of radio public service announcements, posters, brochures, social media posts, and listservs should be continued in future years.

A comprehensive analysis of bacterial levels over time is recommended to assess the effectiveness of BMP implementation at both beaches.

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<sup>8</sup> For more information on this effort see: DEC. 2021. Application of EPA's Virtual Beach (VBeach) Modeling Tool for Kenai River Beaches, Kenai Alaska. Division of Water. Soldotna, AK.

## References

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## Appendix A

### State of Alaska Water Quality Standards for Bacteria for Marine Waters

Sourced from 18 AAC 7.020(14)

Pollutant & Water Use	Criteria
<b>(14) Bacteria, for Marine Water Uses (see note 1)</b>	
<b>(A) Water Supply</b>	
<b>(i) Aquaculture</b>	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.
<b>(ii) Seafood Processing</b>	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.
<b>(iii) Industrial</b>	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>(B) Water Recreation</b>	
<b>(i) Contract Recreation</b>	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>(ii) Secondary Recreation</b>	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.
<b>(C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife</b>	Not applicable.

Pollutant & Water Use	Criteria
<b>(D) Harvesting for Consumption of Raw Mollusks or Other Raw Aquatic Life</b>	<p>The geometric mean of samples may not exceed 14 fecal coliform/100 ml; and not more than 10% of the samples may exceed;</p> <ul style="list-style-type: none"> <li>• 43 MPN per 100 ml for a five-tube decimal dilution test;</li> <li>• 49 MPN per 100 ml for a three-tube decimal dilution test;</li> <li>• 28 MPN per 100 ml for a twelve-tube single dilution test;</li> <li>• 31 CFU per 100 ml for a membrane filtration test (see note 14).</li> </ul>

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).

## Appendix B

### Relative Percent Difference, Pathogen Data

Table C. 1. Relative Percent Difference (RPD) for 2021 Kenai River Beaches data. RPD analysis was performed for paired samples where pathogens were detected. Results that exceeded the project RPD of 60% are in bold red text.

	<i>Enterococcus (MPN/100ml)</i>				<i>Fecal Coliform (CFU/100ml)</i>		
	Sample	Duplicate	RPD		Sample	Duplicate	RPD
North Kenai Beach	1-Jun	2	3	40%	3.3	Not Detected	NA
	14-Jun	3	-		6	-	
	28-Jun	79	142	57%	6.7	13	<b>64%</b>
	12-Jul	4	-		10	-	
	26-Jul	8	6	29%	10	27	<b>92%</b>
	9-Aug	58	-		94	-	
South Kenai Beach	1-Jun	26	-				
	14-Jun	6	14	<b>80%</b>	7	7	0%
	28-Jun	260	-		40	-	
	12-Jul	29	24	19%	50	30	50%
	26-Jul	84	-		86	-	
	9-Aug	132	172	26%	148	90	49%