

City of Kenai, Kenai River Beach Sampling ACWA Grant-12-B4

Introduction

Elevated levels of enterococci and fecal coliform bacteria were measured in samples collected by the Alaska Department of Environmental Conservation (DEC) during the July 2010 dipnet salmon fishery at the mouth of the Kenai River. Exceedances of the fecal coliform and enterococci standards were found at the north and south beaches near the mouth of the Kenai River; however, acceptable levels of bacteria were found at the Warren Ames Bridge 5 miles upstream. A large number of birds, primarily *Laridae* (gulls), were observed on the beaches during the dipnet fishery. The birds are likely attracted by unnatural fish waste on the beach, produced by fisherman during the dipnet fishery, and are considered a likely bacteria source. Adequate sanitary facilities, including portable toilets and fish waste disposal containers, were available on both the north and south beaches for dipnet fishers to use.

The City of Kenai was awarded a grant to conduct a second year of monitoring at two beaches located at the mouth of the Kenai River. The City hired the Kenai Watershed Forum, as a contractor, to monitor and test for bacteria at two locations at the mouth of the Kenai River (one site on the north beach and one site on the south beach) and a third (reference) location near the Warren Ames Bridge (RM 5).

Methods

Three types of bacteria monitoring were used (Appendix 5). Enterococci and fecal coliform bacteria were monitored using membrane filtration and colony counts. The Fecal Coliform (FC) Most Probable Number (MPN) method for Marine Waters was used to determine if the Harvesting of Raw Seafood Standard was being met. Gulls were considered the most likely source of bacteria, but other potential sources were also considered, including generalized avian species, dogs, horse, and human.

A total of 16 monitoring events were conducted under this grant: eight events in July that included the entire personal use dipnet fishery period of July 10th-31st, five during the first half of August, once in October (presumably after most of the gulls had left the area), and twice on June 25th and 27th, 2012 (amended to grant in 2012), the latter occurring prior to the opening of the 2012 personal use dipnet fishery. During July and August 2011 samples were collected bi-weekly, once on a weekday and once on a weekend.

All samples were generally collected in the mornings, shipped via commercial air carrier to a DEC certified laboratory in Anchorage. The laboratory, Analytica Group (Analytica) provided results to KWF and DEC within 24-48 hours of receiving the samples and KWF notified the DEC immediately of any exceedances of Water Quality Standards with all data within 24 hours of receiving results.

Fecal Coliform MPN for Marine Waters samples were collected from one site on each sampling date. Samples were collected from the North Beach (NKB4) and the South Beach (SKB2) on alternating sample dates, but no samples were collected from the site near the Warren Ames Bridge (BRG1). The Fecal Coliform samples have a 6-hour holding time and were shipped to the DEC laboratory in Anchorage via commercial air carrier the same day they were collected.

A cursory sanitary survey was conducted on every sampling date to document conditions and any potential sources of bacteria present while the sampling team was on the beach. Specific conductance,

pH, water and air temperature, and turbidity were measured using a Hydrolab MS5 during each sampling event and at each sampling location.

Results

North Beach

At NKB4 fecal coliform bacteria colonies measured with analytical method ID SM9222-D Fecal Coliform by MF by Analytica ranged from 5.7 CFU (Colony Forming Unit) /100mL to 250 CFU/100mL. There was not an exceedance of the 30-day geometric mean and there were exceedances of the single sample standard at NKB4 (Appendix 1 and Appendix 4).

Enterococci measured with analytical method ID Enterococci by MPN – ASTM D-6503-99 by Analytica ranged from 10 MPN/100mL to 780 MPN/100mL. There was an exceedance of the 30-day geometric mean and there were exceedances of the single sample standard at NKB4 (Appendix 1 and Appendix 4).

Fecal Coliform MPN measured with analytical method 9221-E with A-1 Media ranged from 17 MPN/100mL to 220 MPN/100mL. There was an exceedance of the 30-day geometric mean and there was not an exceedance of the median MPN at NKB4 (Appendix 1 and Appendix 4).

Water temperature varied from 11 degrees Celsius to 14 degrees Celsius. The air temperature varied from 11 degrees Celsius to 21 degrees Celsius. The conductivity of the water ranged from 13 ms/cm to 20270 ms/cm. The water turbidity ranged from 47 NTU (Nephelometric Turbidity Units) to 411 NTU. The pH levels had a range of 7.57 to 8.3.

All results for NKB4 are summarized in Appendix 1 at the end of this document. A summary and geometric mean analysis for NKB4 can be found in Appendix 4.

South Beach

At SKB2 fecal coliform bacteria colonies measured with analytical method ID SM9222-D Fecal Coliform by MF by Analytica ranged from 11 CFU (Colony Forming Unit) /100mL to 1200 CFU/100mL. There was an exceedance of the 30-day geometric mean and there were exceedances of the single sample standard at SKB2 (Appendix 2 and Appendix 4).

Enterococci measured with analytical method ID Enterococci by MPN – ASTM D-6503-99 by Analytica ranged from 10 MPN/100mL to 780 MPN/100mL. There was an exceedance of the 30-day geometric mean and there were exceedances of the single sample standard at SKB2 (Appendix 2 and Appendix 4).

Fecal Coliform MPN measured with analytical method 9221-E with A-1 Media ranged from 8 MPN/100mL to 1600 MPN/100mL. There was an exceedance of the 30-day geometric mean and there was an exceedance of the median MPN at SKB2 (Appendix 2 and Appendix 4).

The water temperature varied from 9 degrees Celsius to 14 degrees Celsius. The air temperature varied from 7 degrees Celsius to 22 degrees Celsius. The conductivity of the water ranged from 23 ms/cm to 3938 ms/cm. The water turbidity ranged from 81 NTU (Nephelometric Turbidity Units) to 1764 NTU. The pH levels of the water at SKB2 varied between 7.0 and 9.0.

All results for SKB2 are summarized in Appendix 2 at the end of this document. A summary and geometric mean analysis for SKB2 can be found in Appendix 4.

Warren Ames Bridge

At BRG1 fecal coliform bacteria colonies measured with analytical method ID SM9222-D Fecal Coliform by MF by Analytica Laboratory in Anchorage (Analytica) ranged from 2.9 CFU (Colony Forming Unit) /100mL to 200 CFU/100mL. There was not an exceedance of the 30-day geometric mean and there were no exceedances of the single sample standard at BRG1 (Appendix 3 and Appendix 4).

Enterococci measured with analytical method ID Enterococci by MPN – ASTM-D-6503-99 by Analytica ranged from 10 MPN/100mL to 41 MPN/100mL. There was not an exceedance of the 30-day geometric mean and there were no exceedances of the single sample standard at BRG1 (Appendix 3 and Appendix 4).

The water temperature varied from 9 degrees Celsius to 14 degrees Celsius. The air temperature varied from 7 degrees Celsius to 20 degrees Celsius. The conductivity of the water ranged from 73 ms/cm to 38602 ms/cm. The water turbidity ranged from 36 NTU to 383 NTU. The pH levels of the water at BRG1 varied between seven and nine.

All results for BRG1 are summarized in Appendix 3 at the end of this document. A summary and geometric mean analysis for BRG1 can be found in Appendix 4.

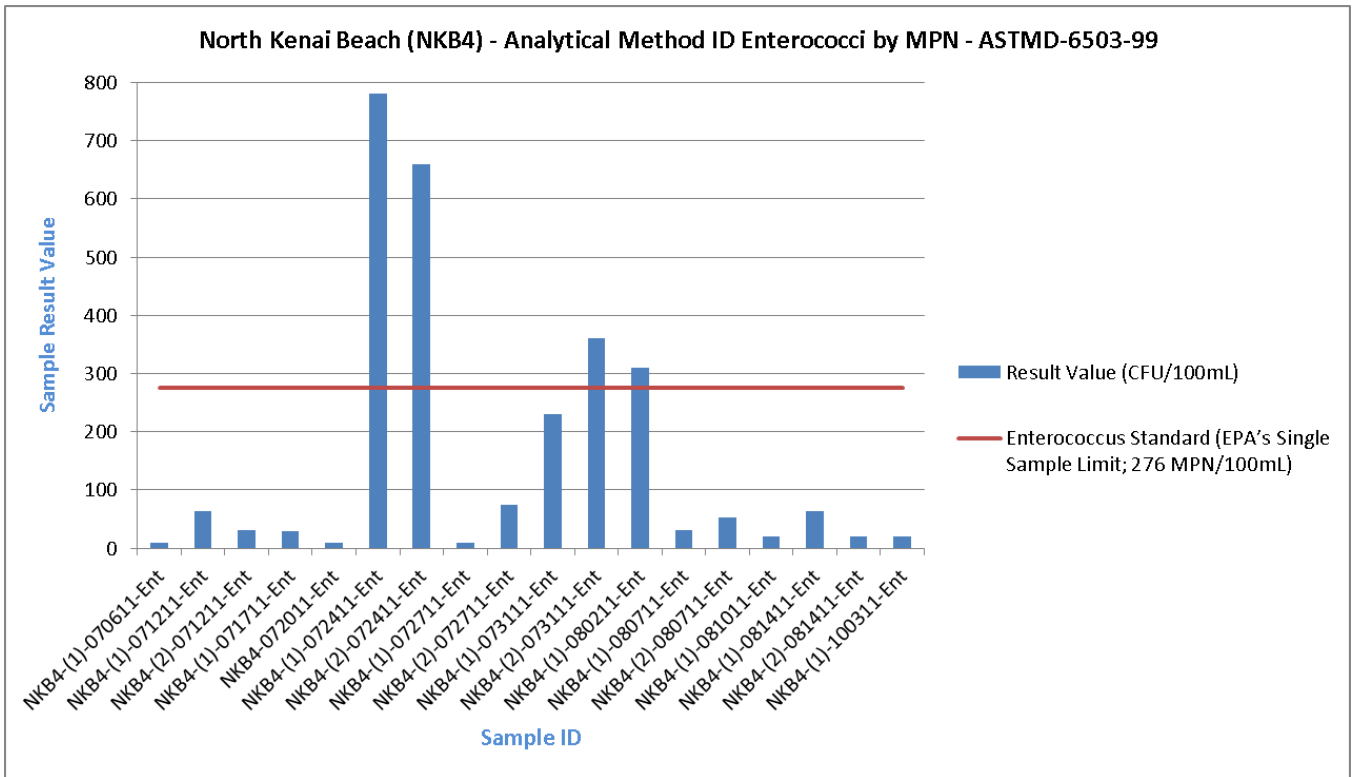
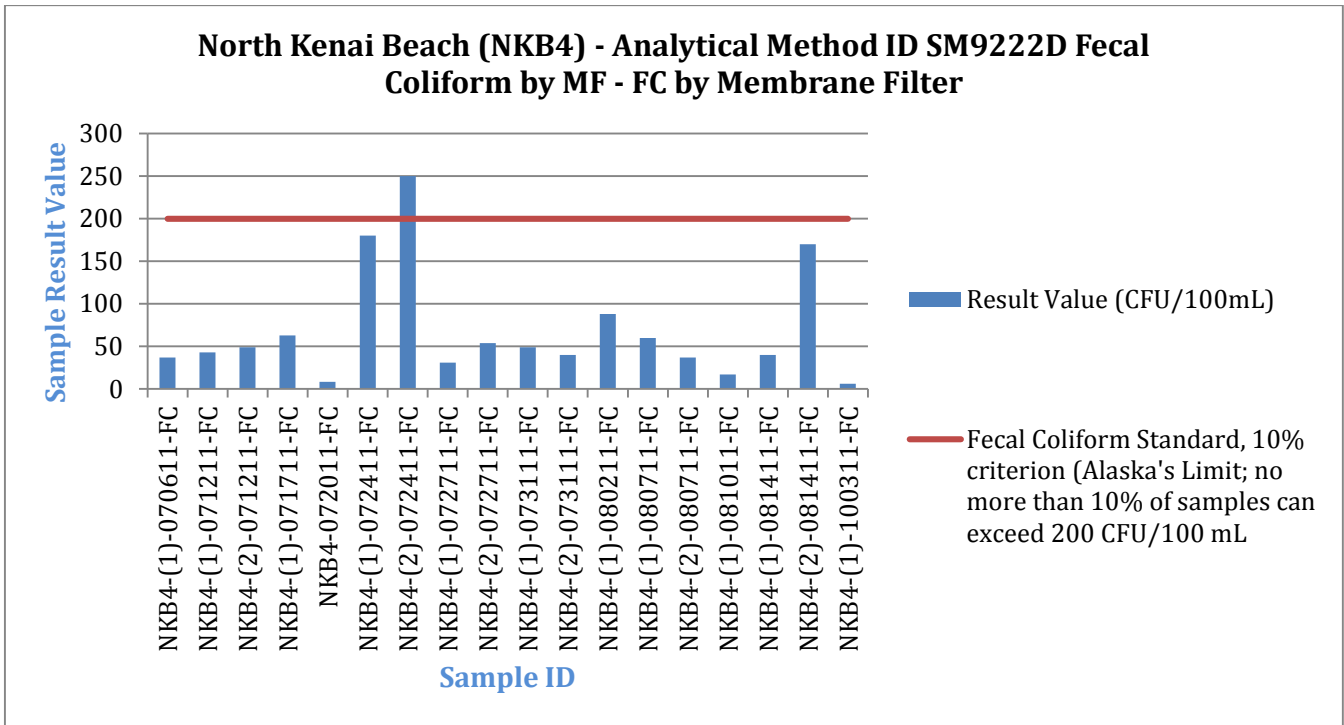
MST

Microbial Source Tracking (MST) samples were collected from one site on each of the sampling dates. Samples were collected from the North beach and the South Beach on alternating sampling dates and no samples were collected from the site near the Warren Ames Bridge. The MST samples were filtered, preserved, and frozen by KWF staff on the same day as collected and were sent to the Institute of Environmental Health Laboratory and Consulting Group in Lake Forest Park, WA for analysis.

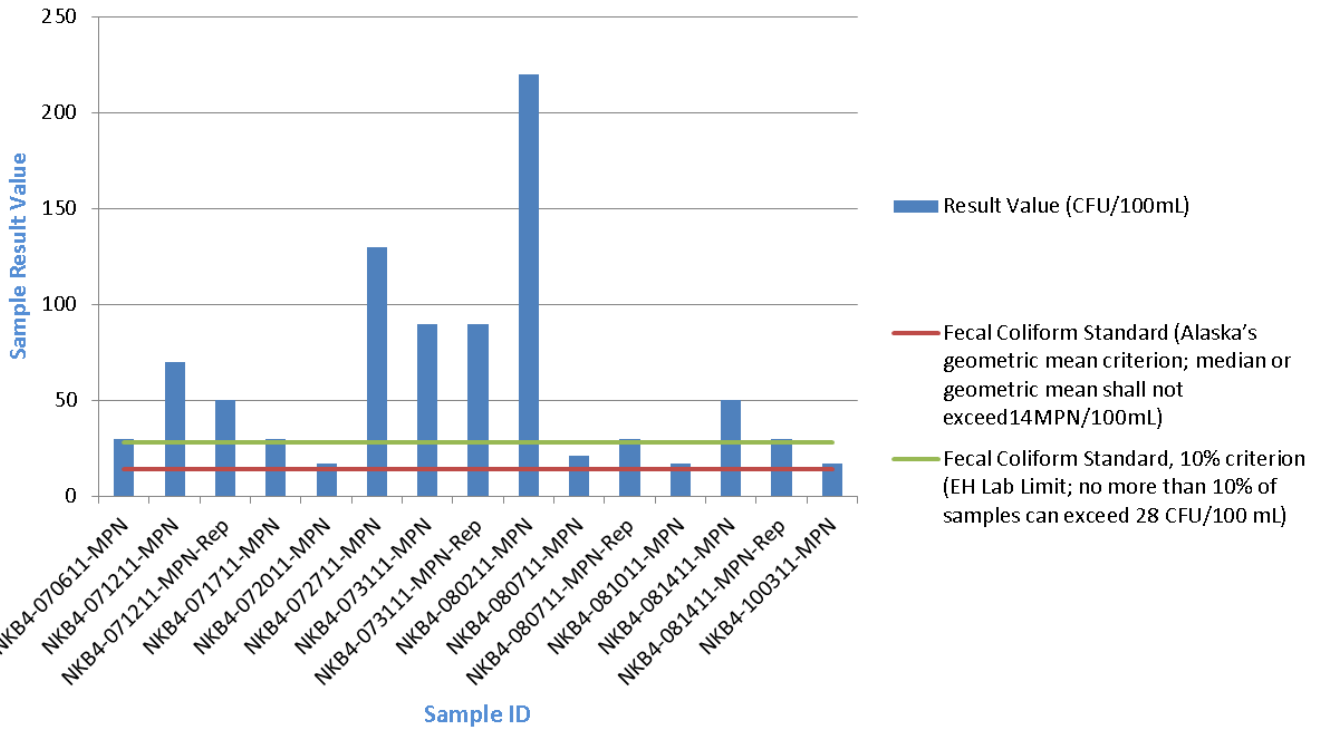
At NKB4 of the 30 MST samples tested, 28 showed general bacteroides, 20 showed avian bacteroides, two showed dog bacteroides, two showed human bacteroides, and none showed horse bacteroides. At SKB2 of the 30 MST samples tested, 28 showed general bacteroides, 27 showed avian bacteroides, two showed human bacteroides, and none showed dog or horse bacteroides.

Overall, the MST data analysis for both SKB2 and NKB4 shows a strong indication that the bacteria present in samples which exceeded state and federal standards were avian bacteria. The MST data and results are merely indicators of relative abundance and not to be interpreted as an assigned percentage of contribution from the various sources. An analysis of these samples that would have included the percentage of each sources' contribution was out of the range of this projects budget.

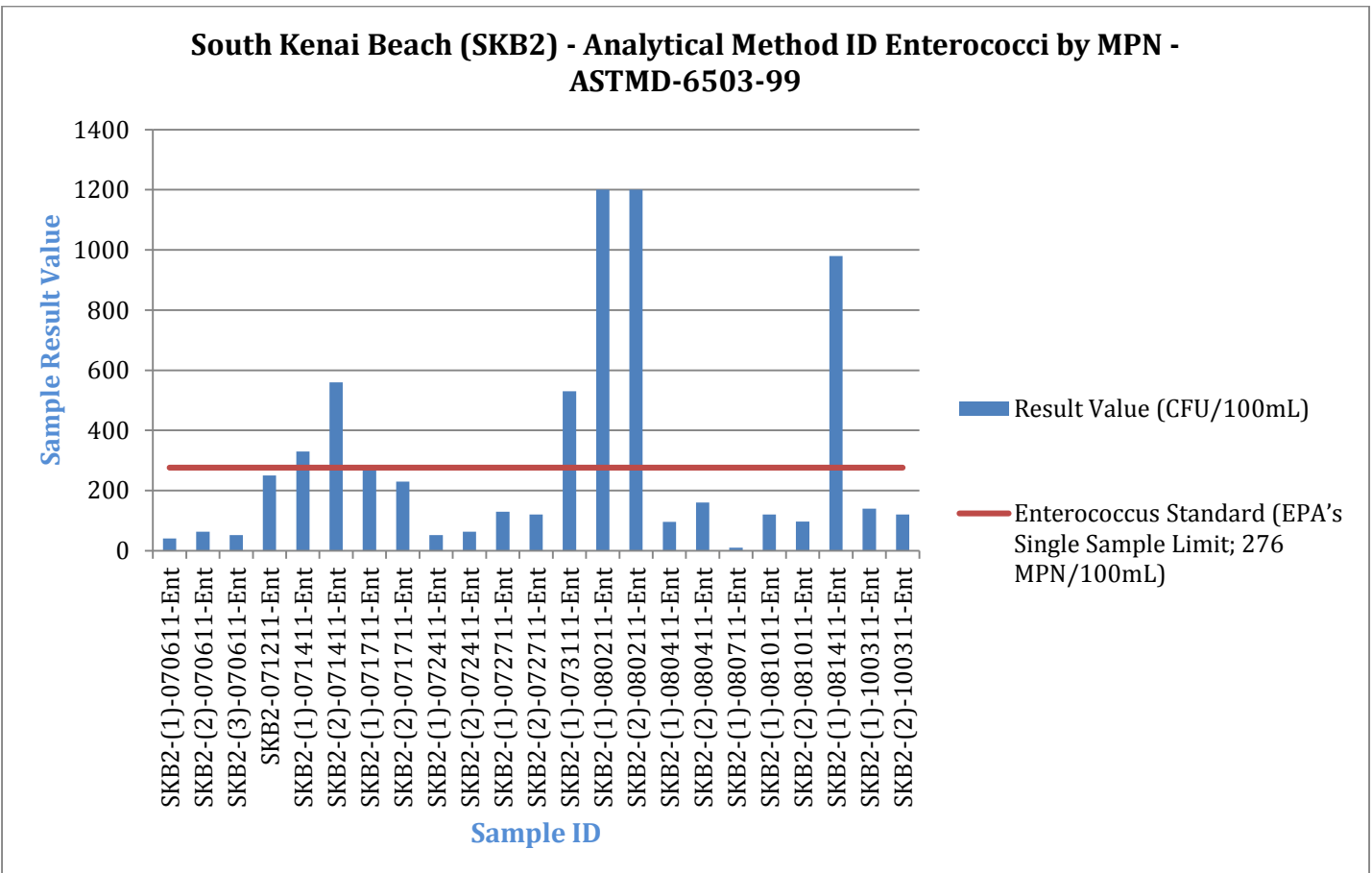
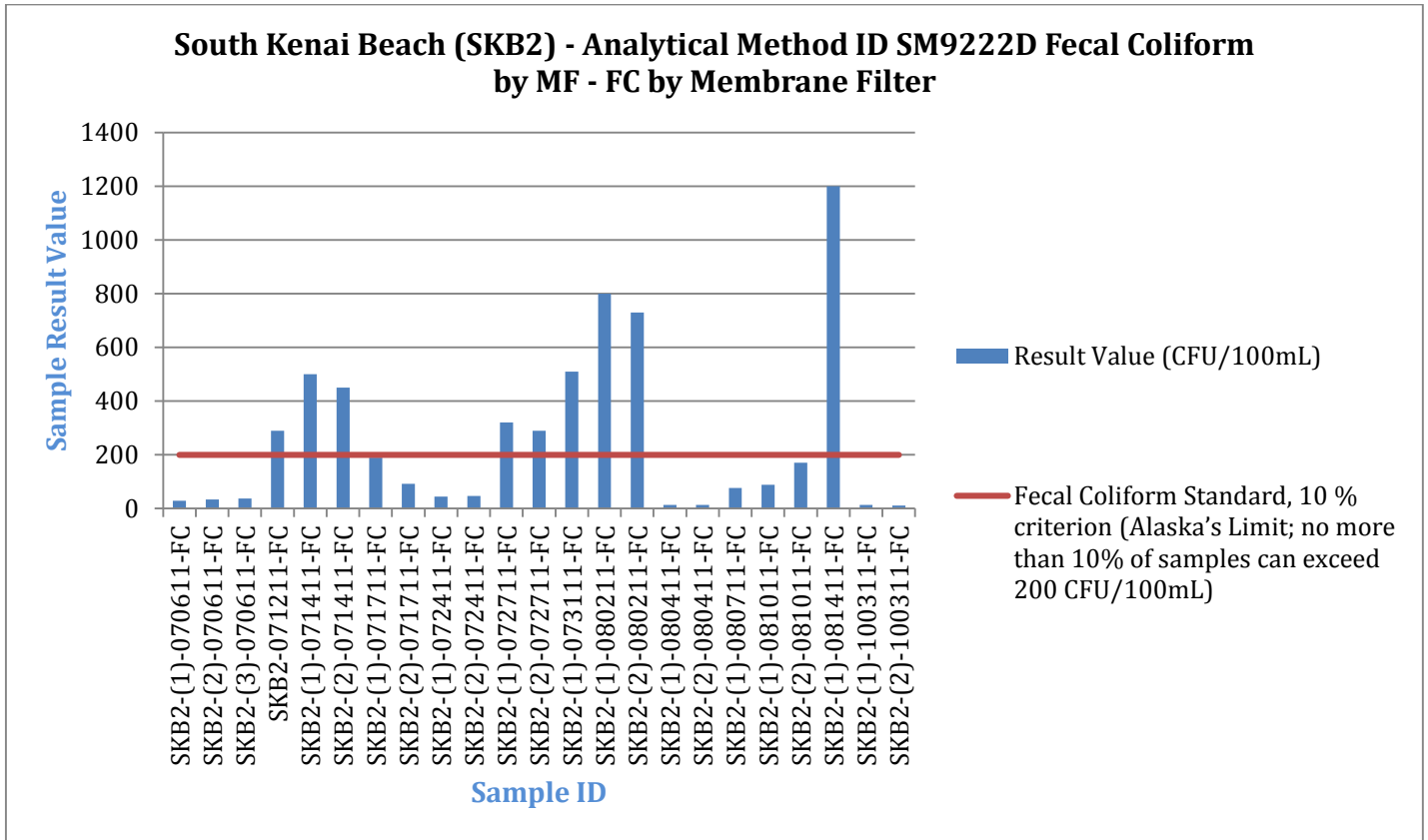
Appendix 1: North Kenai Beach 4 (NKB4) – Results



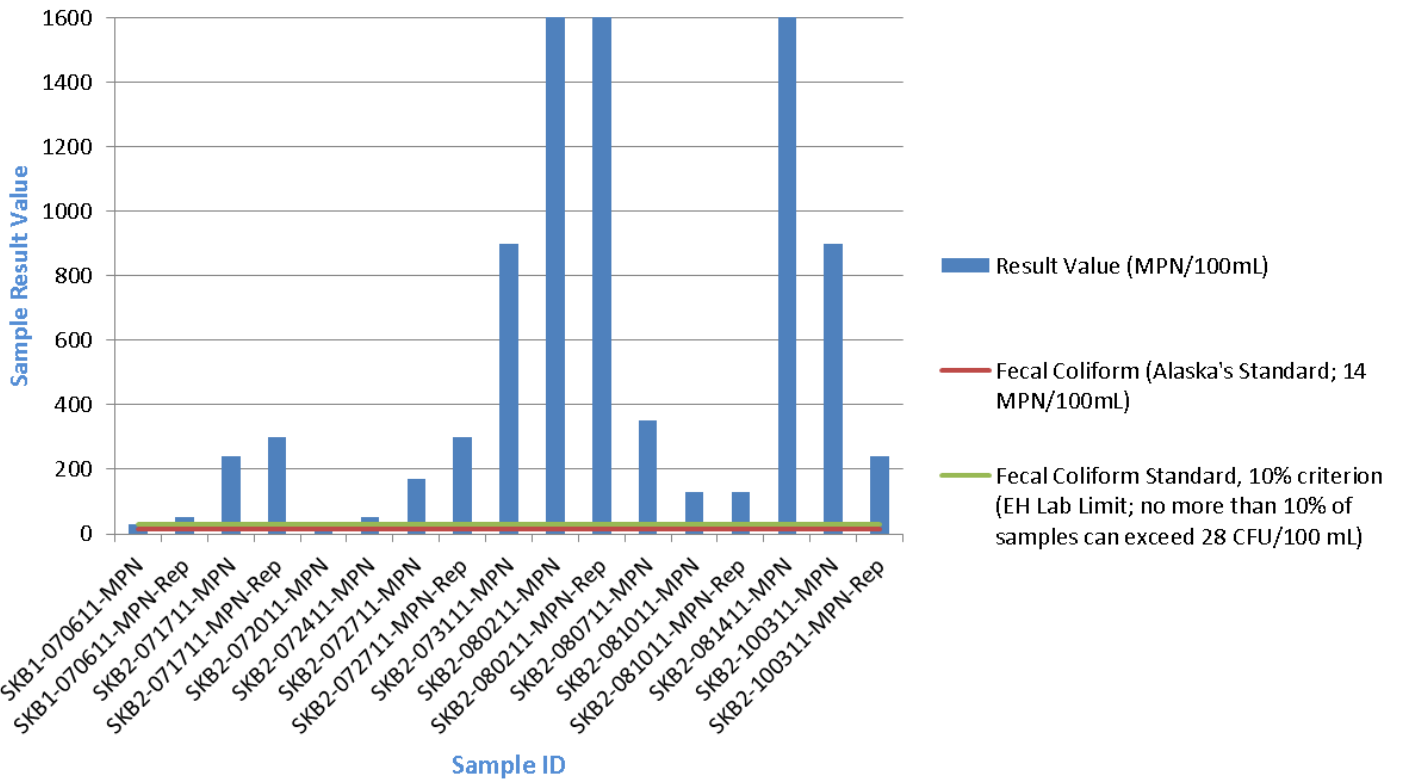
North Kenai Beach (NKB4) - Analytical Method ID Fecal Coliform by 9221-E with A-1 Media



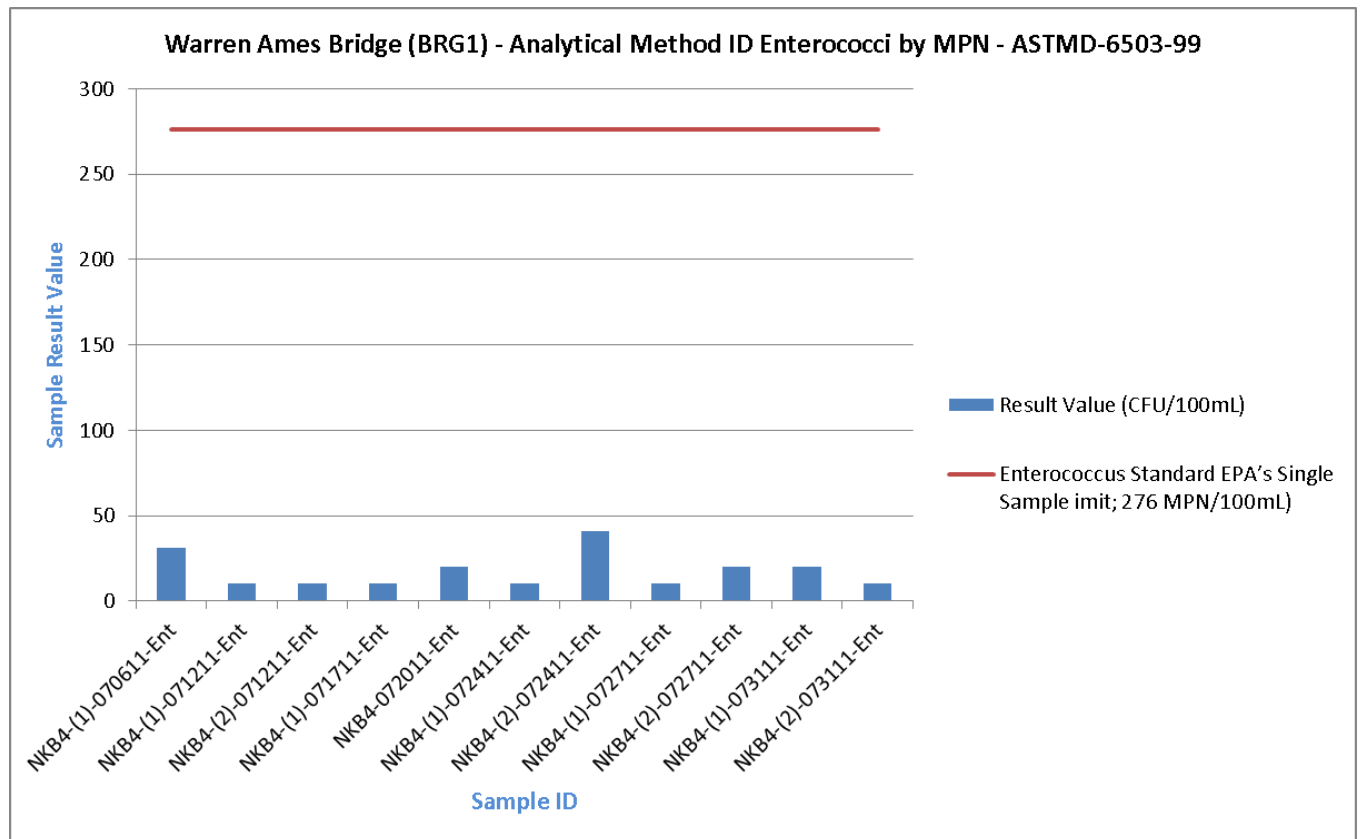
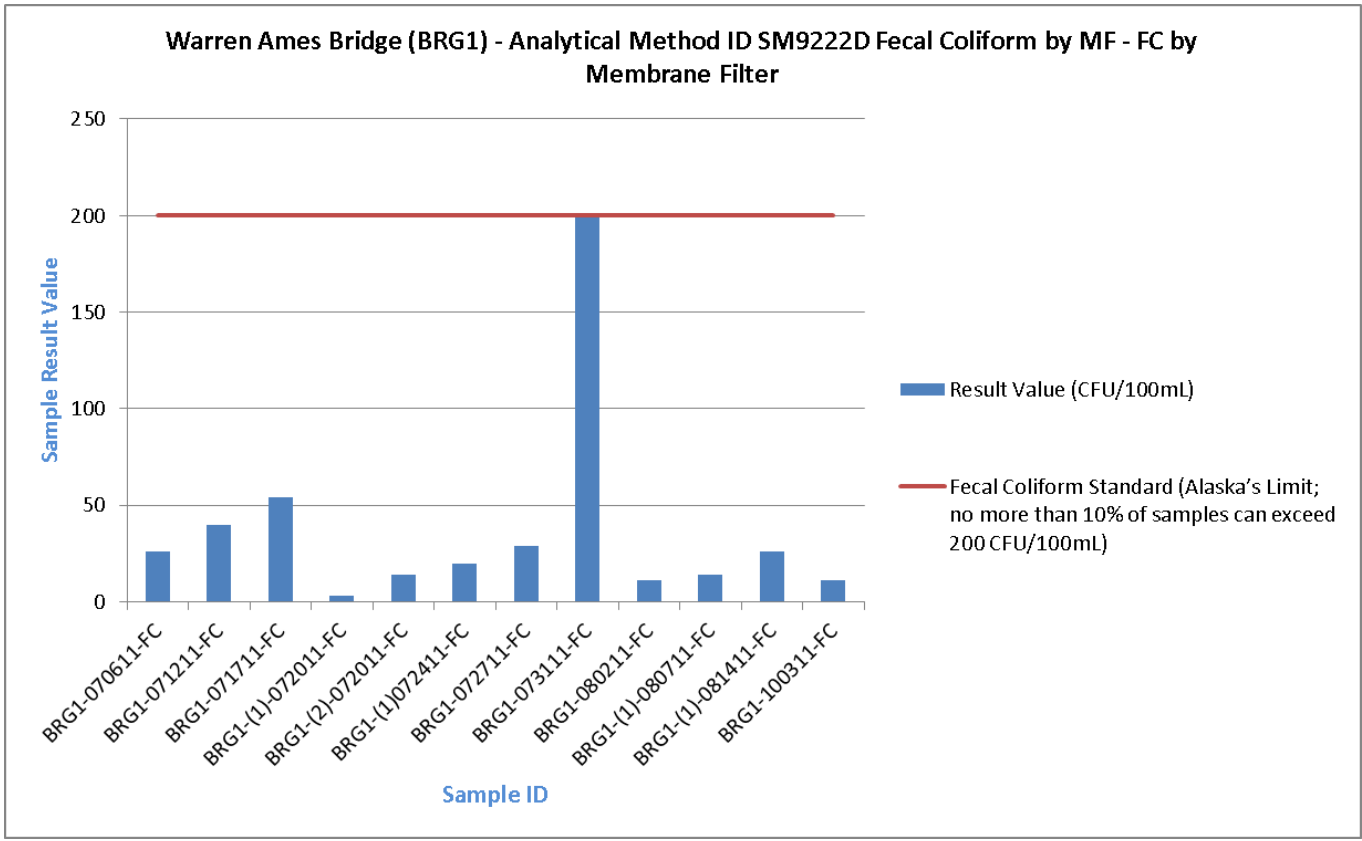
Appendix 2: South Kenai Beach 2 (SKB2) – Results



South Kenai Beach (SKB2) - Analytical Method ID Fecal Coliform by 9221-E with A-1 Media



Appendix 3: Warren Ames Bridge (BRG1) – Results



Appendix 4: Summary of Data and Geometric Mean

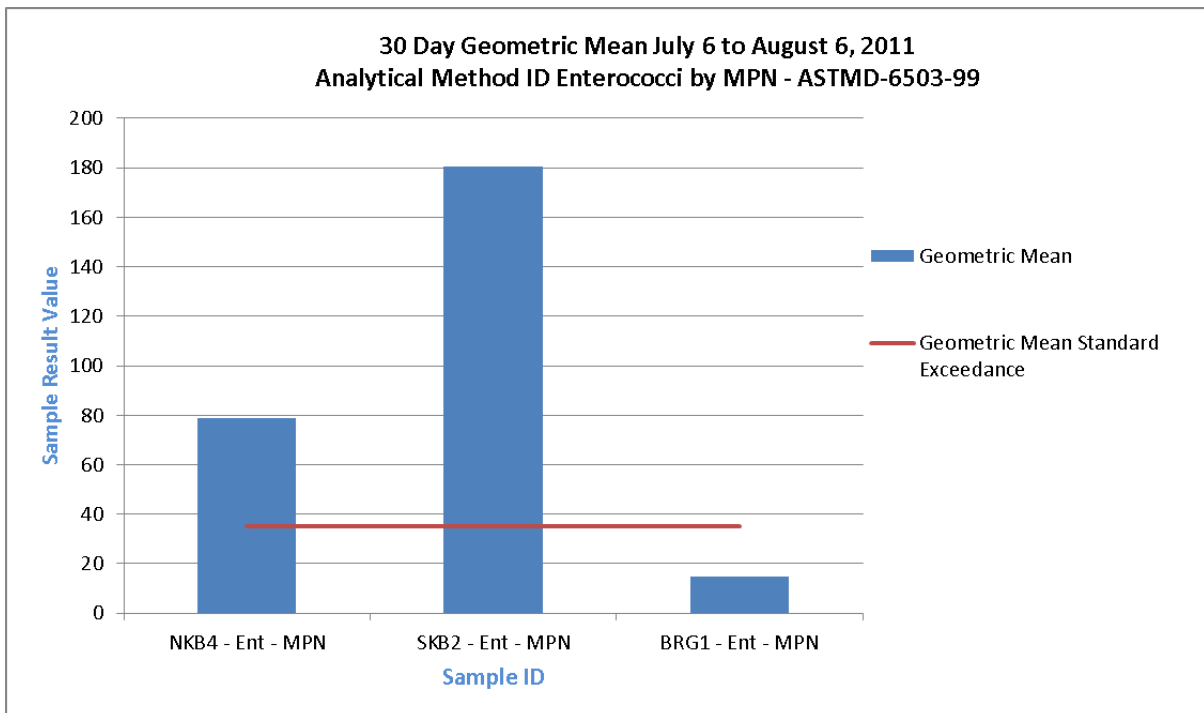
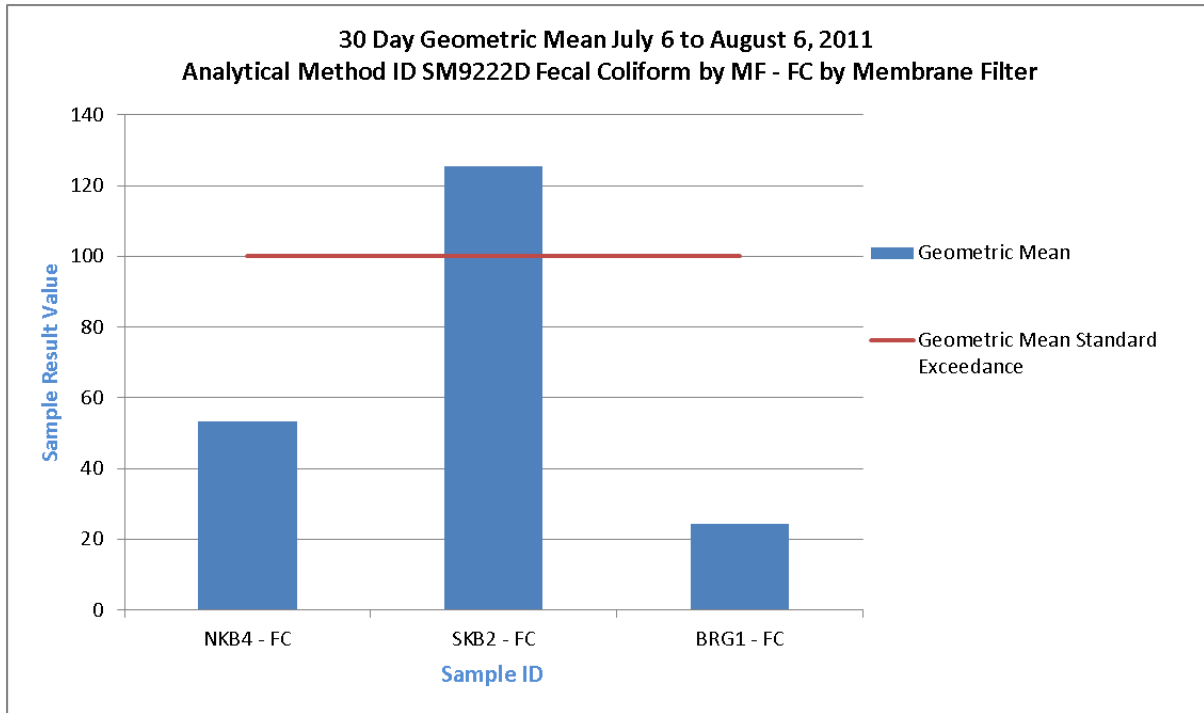
Summary of Data

Beach	Analytical Method ID	Units	Total Number of Samples	Geometric Mean 1 - 7/6/11 to 8/4/11	Fecal Coliform - Exceedance of 30-day Geometric Mean (100 FC/100 ml); Number of Samples Exceeding Single Sample Standard (200 FC/100 ml) (State Standard)	Enterococci - Exceedance of 30-day Geometric Mean (35 MPN/100 ml); Number of Samples Exceeding Single Sample Standard (276 MPN/100 ml) (Federal Standard)	Fecal Coliform - 10% rule Exceedance (43 FC/100 ml); Median MPN exceedance (14 FC/100 ml) (State Standard)
NKB4	Fecal Coliform - SM9222D	cfu/100mL	12	53.49	No; 1	N/A	N/A
	Enterococci - ASTMD-6503-99	MPN/100 mL	12	78.88	N/A	Yes; 4	N/A
	Fecal Coliform - 9221-E with A-1 Media	cfu/100mL	9	61.4	N/A	N/A	Yes; Yes
SKB2	Fecal Coliform - SM9222D	cfu/100mL	17	125.52	Yes; 9	N/A	N/A
	Enterococci - ASTMD-6503-99	MPN/100 mL	17	180.58	N/A	Yes; 5	N/A
	Fecal Coliform - 9221-E with A-1 Media	cfu/100mL	11	176.18	N/A	N/A	Yes; Yes
BRG1	Fecal Coliform - SM9222D	cfu/100mL	9	24.26	No; 0	N/A	N/A
	Enterococci - ASTMD-6503-99	MPN/100 mL	8	14.98	N/A	No; 0	N/A

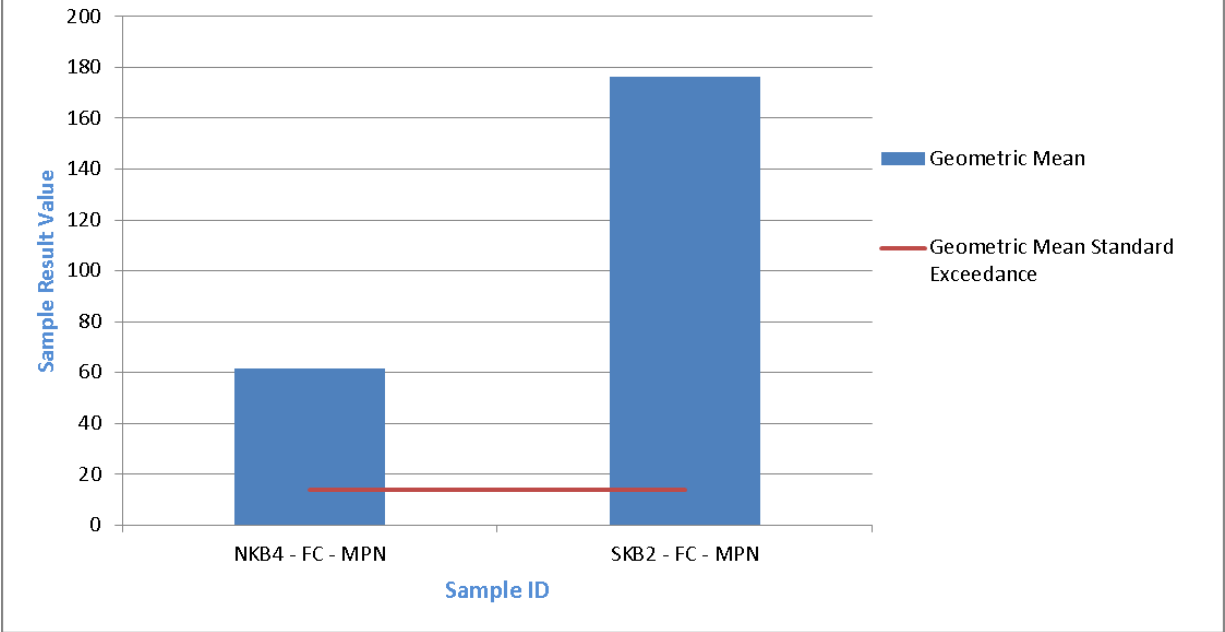
Beach	Analytical Method ID	Units	Total Number of Samples	Geometric Mean 2 - 7/12/11 to 8/10/11	Fecal Coliform - Exceedance of 30-day Geometric Mean (100 FC/100 ml); Number of Samples Exceeding Single Sample Standard (200 FC/100 ml) (State Standard)	Enterococci - Exceedance of 30-day Geometric Mean (35 MPN/100 ml); Number of Samples Exceeding Single Sample Standard (276 MPN/100 ml) (Federal Standard)	Fecal Coliform - 10% rule Exceedance (43 FC/100 ml); Median MPN exceedance (14 FC/100 ml) (State Standard)
NKB4	Fecal Coliform - SM9222D	cfu/100mL	14	49.69	No; 1	N/A	N/A
	Enterococci - ASTMD-6503-99	MPN/100 mL	14	75.27	N/A	Yes; 4	N/A
	Fecal Coliform - 9221-E with A-1 Media		11	49.56	N/A	N/A	Yes; Yes
SKB2	Fecal Coliform - SM9222D	cfu/100mL	17	153.79	Yes; 9	N/A	N/A
	Enterococci - ASTMD-6503-99	MPN/100 mL	17	179.07	N/A	Yes; 5	N/A
	Fecal Coliform - 9221-E with A-1 Media	cfu/100mL	12	228.27	N/A	N/A	Yes; Yes
BRG1	Fecal Coliform - SM9222D	cfu/100mL	9	22.65	No; 0	N/A	N/A
	Enterococci - ASTMD-6503-99	MPN/100 mL	8	14.19	N/A	No; 0	N/A

Beach	Analytical Method ID	Units	Total Number of Samples	Geometric Mean 3 - 7/14/11 to 8/14/11	Fecal Coliform - Number of Samples Exceeding 30-day Geometric Mean (100 FC/100 ml) or 10% Rule (200 FC/100 ml) (State Standard)	Enterococci - Number of Samples Exceeding 30-day Geometric Mean (35 MPN/100 ml) or Single Sample Standard (276 MPN/100 ml) (Federal Standard)	Fecal Coliform - Number of Samples Exceeding 10% rule (43 FC/100 ml) or median MPN exceedance (14 FC/100 ml) (State Standard)
NKB4	Fecal Coliform - SM9222D	cfu/100mL	14	54.03	No; 1	N/A	N/A
	Enterococci - ASTM-D-6503-99	MPN/100 mL	14	72.95	N/A	Yes; 4	N/A
	Fecal Coliform - 9221-E with A-1 Media	cfu/100mL	11	45.88	N/A	N/A	Yes; Yes
SKB2	Fecal Coliform - SM9222D	cfu/100mL	17	167.19	Yes; 9	N/A	N/A
	Enterococci - ASTM-D-6503-99	MPN/100 mL	17	194.05	N/A	Yes; 6	N/A
	Fecal Coliform - 9221-E with A-1 Media	cfu/100mL	13	265.16	N/A	N/A	Yes; Yes
BRG1	Fecal Coliform - SM9222D	cfu/100mL	9	21.59	No; 0	N/A	N/A
	Enterococci - ASTM-D-6503-99	MPN/100 mL	8	15.47	N/A	No; 0	N/A

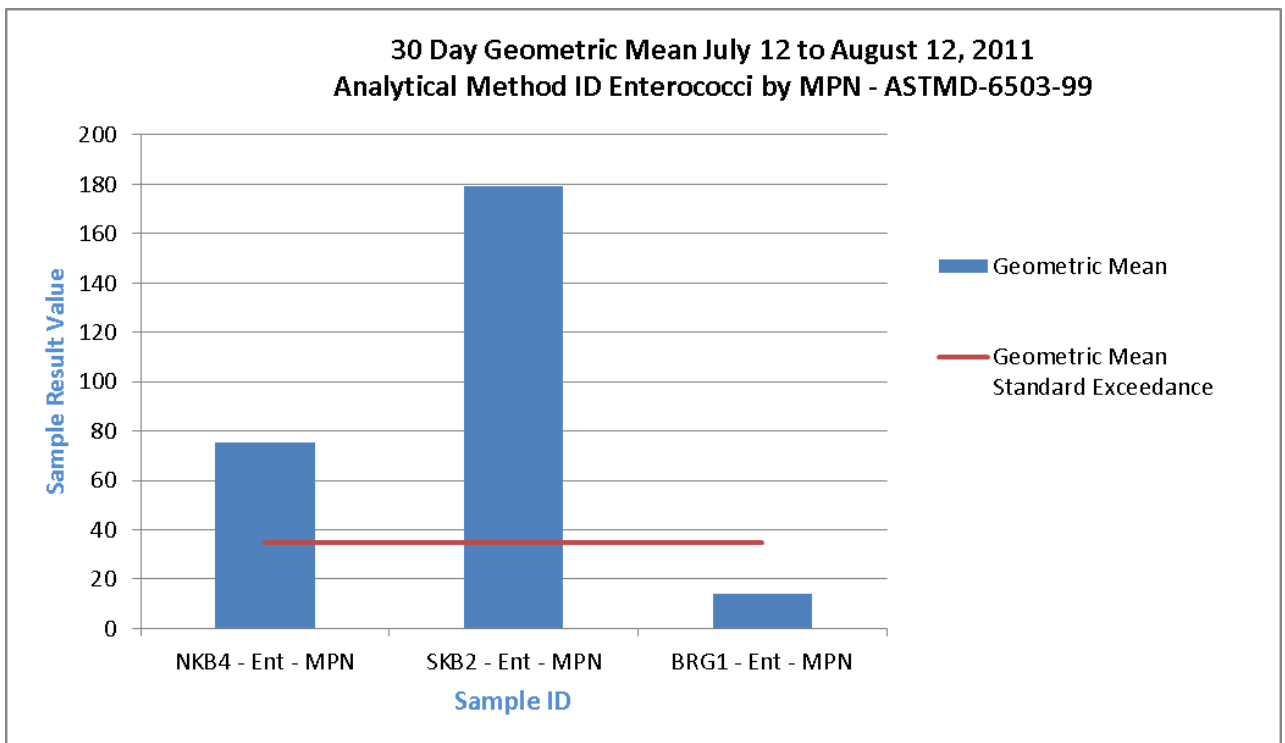
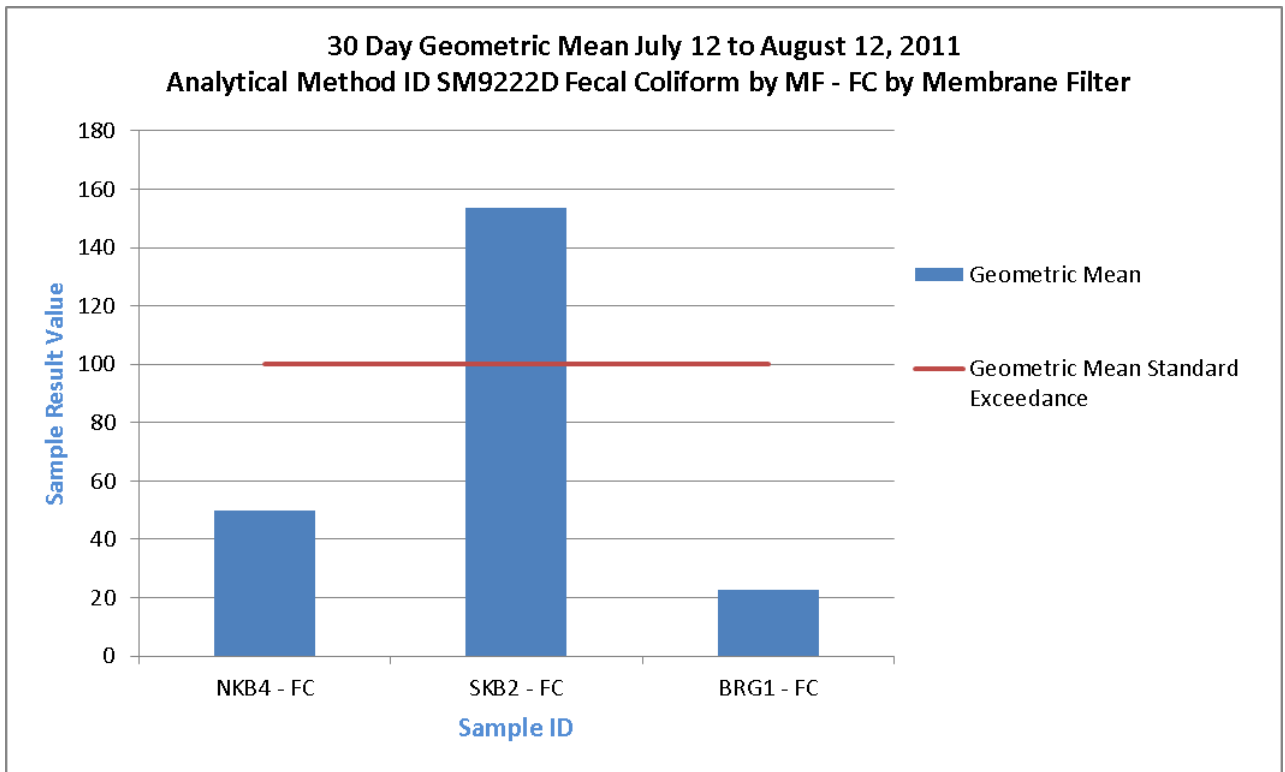
Geometric Mean 1 – 7/6/11 to 8/6/11- All Locations



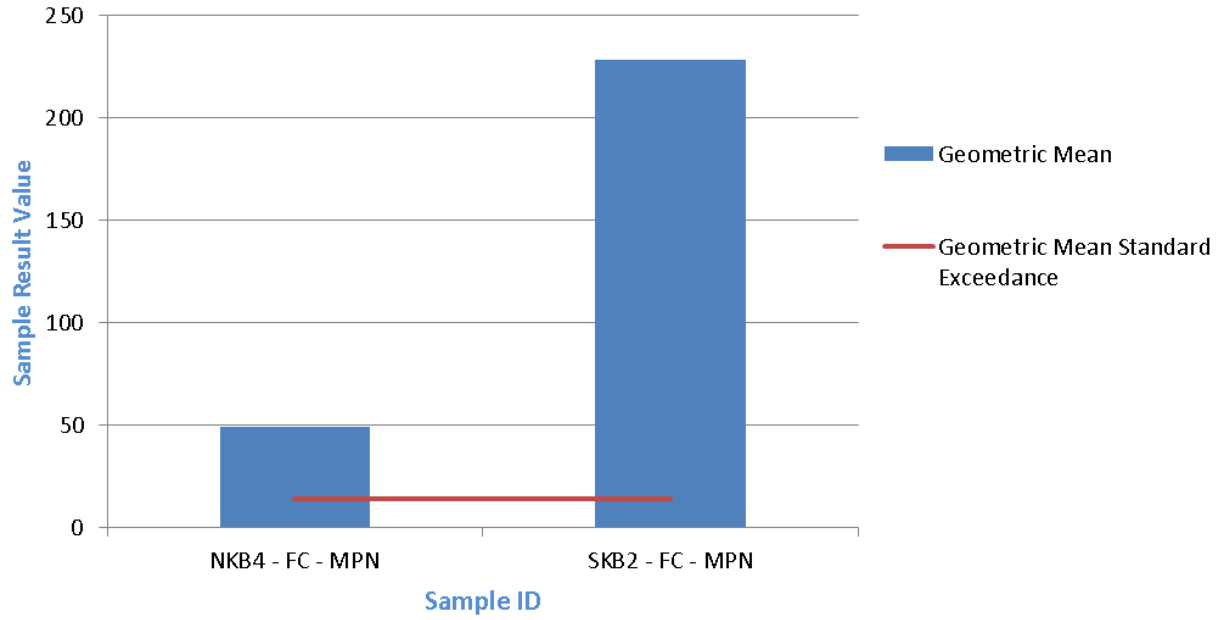
30 Day Geometric Mean July 6 to August 6, 2011
Analytical Method ID Fecal Coliform by 9221-E with A-1 Media



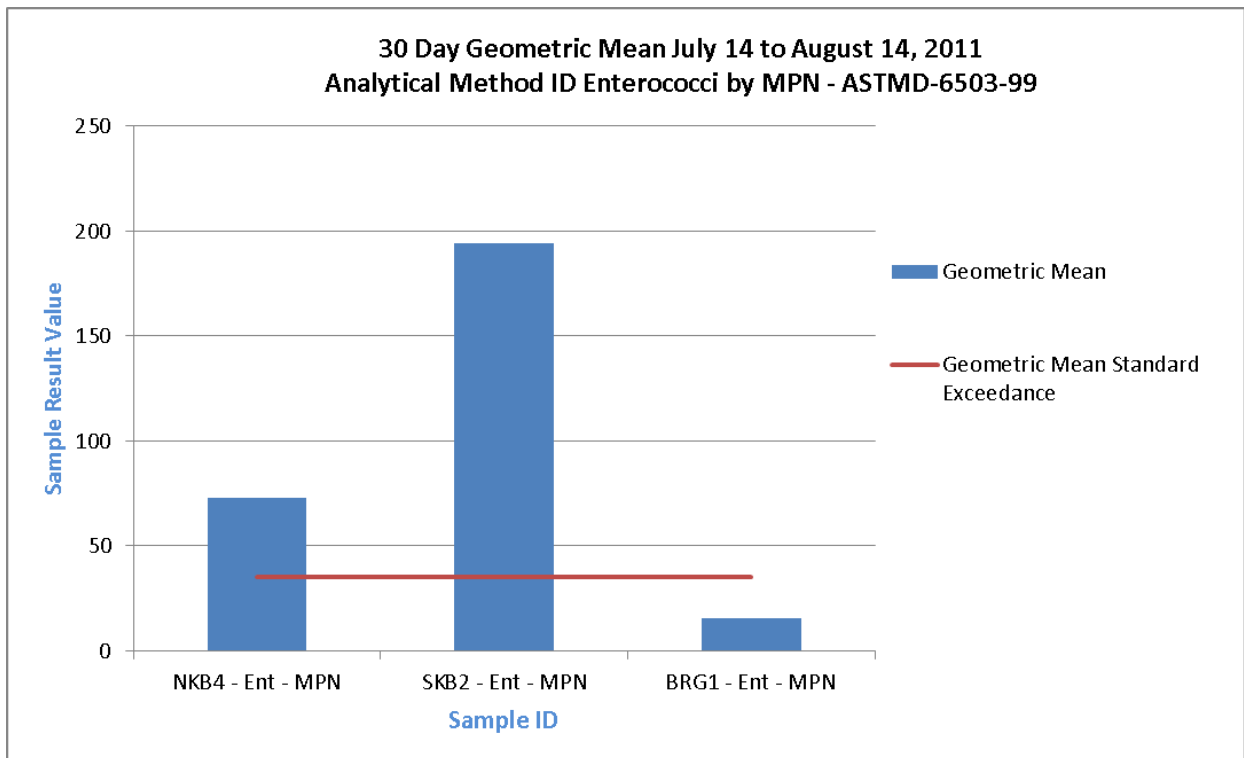
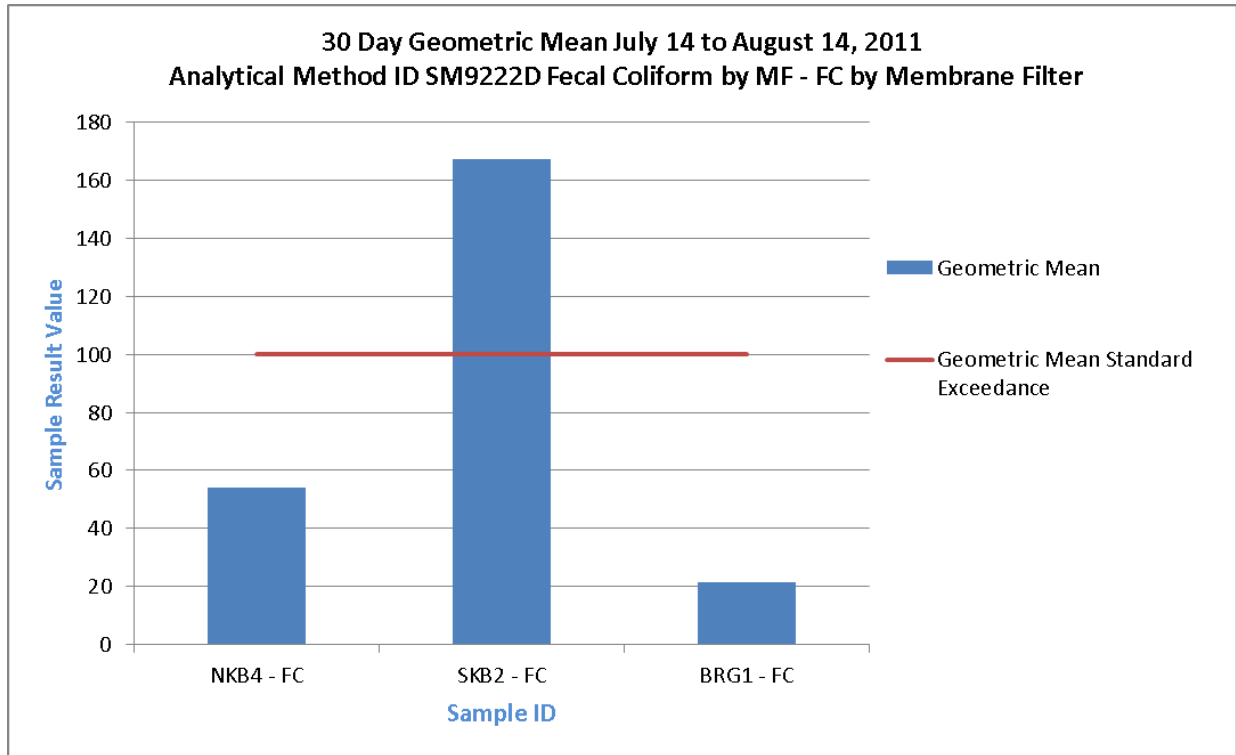
Geometric Mean 2 – 7/12/11 to 8/12/11- All Locations



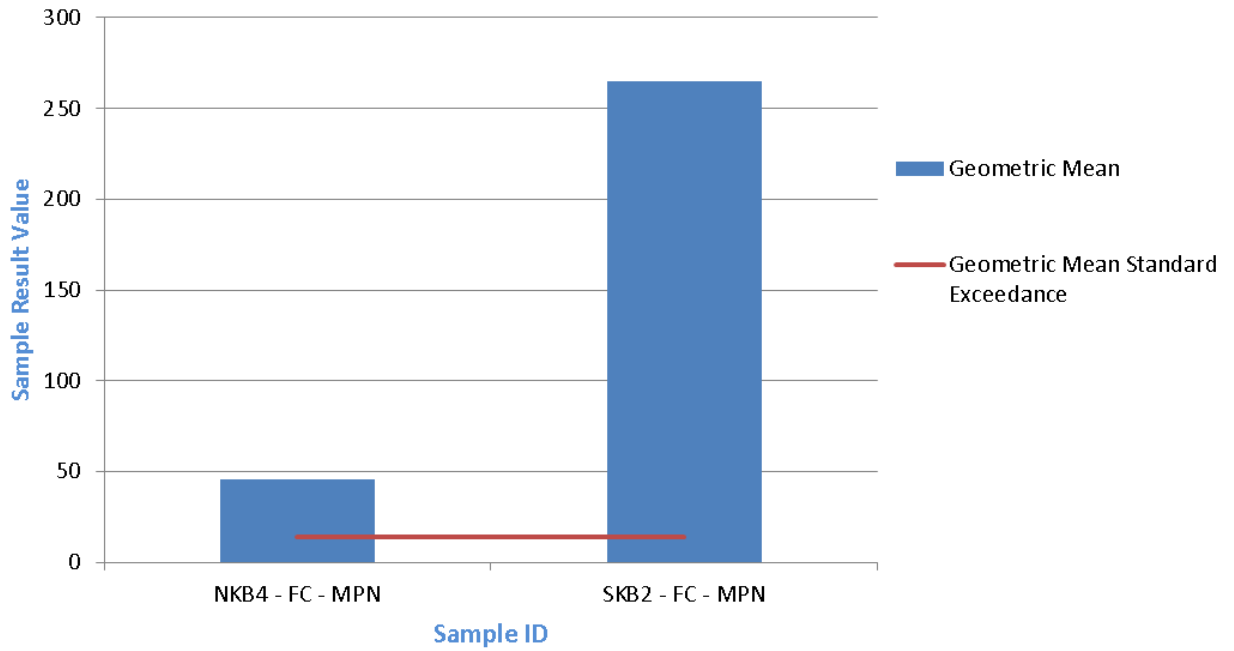
30 Day Geometric Mean July 12 to August 12, 2011
Analytical Method ID Fecal Coliform by 9221-E with A-1 Media



Geometric Mean 3 – 7/14/11 to 8/14/11- All Locations



30 Day Geometric Mean July 14 to August 14, 2011
Analytical Method ID Fecal Coliform by 9221-E with A-1 Media



Appendix 5: Analytical Methodology

	Analytical Method
Fecal Coliform - Water Recreation, Contact Recreation; State Water Quality Standards; Fecal Coliform Bacteria for Marine Waters	Analytical Method ID SM9222D Fecal Coliform by MF – FC by Membrane Filter
Enterococci; Federal Beach (Marine) Water Quality Standards; Enterococci	Analytical Method ID Enterococci by Most Probable Number – ASTM D-6503-99
Fecal Coliform - Harvesting for Consumption of Raw Mollusks or Other Raw Aquatic Life; State Water Quality Standards; Fecal Coliform Bacteria for Marine Waters	Analytical Method ID Fecal Coliform by 9221-E with A-1 Media

Appendix 6: State and Federal Water Quality Standards

State Water Quality Standards; Fecal Coliform Bacteria for Marine Waters	
Water Recreation, Contact Recreation	In a 30-day period, the geometric mean of samples may not exceed 100 FC/100 ml, and not more than one sample, or more than 10% of the samples if there are more than 10 samples, may exceed 200 FC/100 ml.
Harvesting for Consumption of Raw Mollusks or Other Raw Aquatic Life	Based on a 5-tube decimal dilution test, the fecal coliform median MPN may not exceed 14 FC/100 ml, and not more than 10% of the samples may exceed a fecal coliform median MPN of 43 FC/100 ml. * because the Environmental Health lab uses a 12-tube dilution analytical method the 10% criterion is reduced to 28 FC/100mL
Federal Beach (Marine) Water Quality Standards; Enterococci	
Single sample maximum allowable density	No single sample may exceed 276 MPN/100 mL
Steady state geometric mean indicator density	35 MPN/100 mL