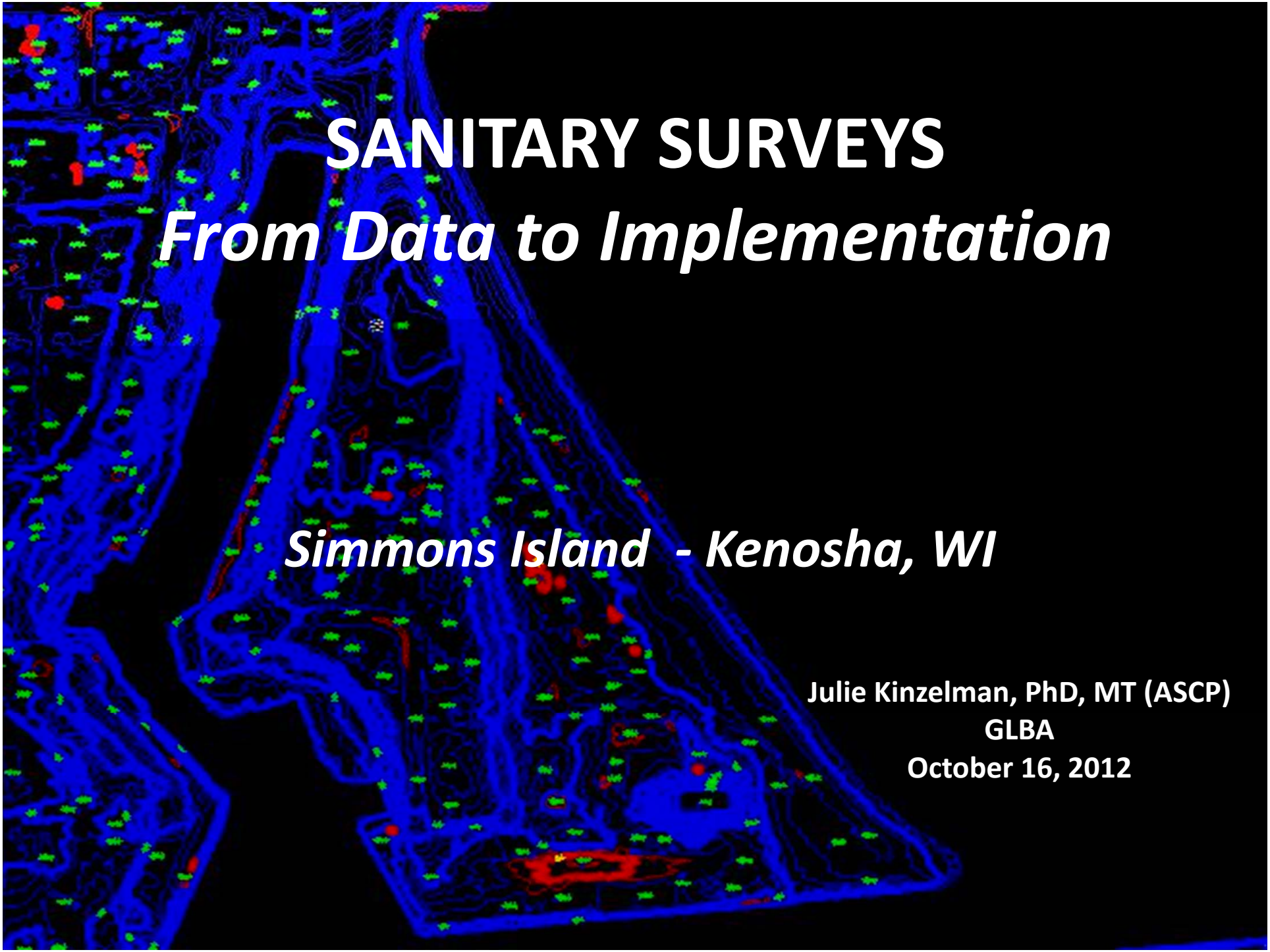


SANITARY SURVEYS
From Data to Implementation

Simmons Island - Kenosha, WI

Julie Kinzelman, PhD, MT (ASCP)
GLBA
October 16, 2012

GLRI – Southern WI Beaches

- **19 beaches in Milwaukee, Racine, and Kenosha Counties**
- 2010 – 2012, Conduct sanitary surveys at 303d listed *or* beaches with no/limited data which appear on EPA's beach list
- 2011 – 2013, Develop conceptual redesign and bid ready construction plans with the potential for some implementation
- 2012 – 2014, Provide implementation funding to select beaches based on:
  - sufficient BSS data lending itself to a successful outcome, feasibility, interest of the community

Kenosha, WI

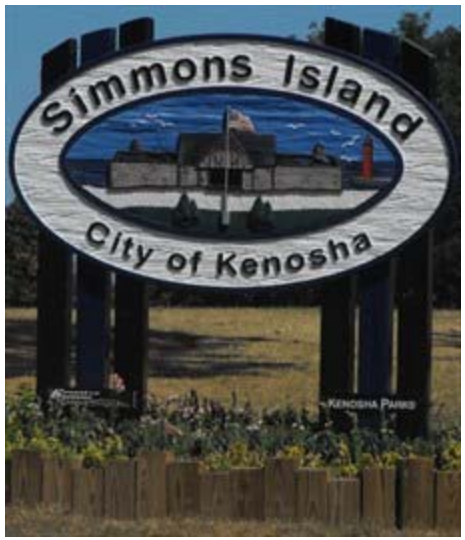
- All 5 of Kenosha's beaches were listed as impaired waters under the CWA (section 303d)
  - Excessive beach advisories/closures
- BEACH Act monitoring had been consistently conducted by the Kenosha County Health Department
- ***However***, little to no previous research had been conducted to determine sources of pollution

What Did the Citizens Think?

- A survey of residents in the Root-Pike watershed was conducted by UW-extension and Root Pike WIN
- ***72% believed poor water quality and closed beaches were a problem***
- **72% believed economic stability was tied to good water quality**
- **75% believed quality of life was dependent on good water quality**
- There was political will to move forward

Kenosha's Great Lakes Beaches

- Alford Park Beach
- Pennoyer Park Beach
- **Simmon's Island (Kenosha's "flagship" beach)**
  - **We'll be using this beach as an example today**
- Eichelmann Beach
- Southport Beach



Sanitary Survey - Step #1

Examine Historical Water Quality Monitoring or Other Data

Simmons Island-Historic Water Quality

Number of samples exceeding water quality standards per month

Year	May	June	July	Aug	Sept	Total Samples	Percent Exceedances
2003	0	0	2	6	1	45	20%
2004	0	1	1	5	0	36	19%
2005	1	1	11	3	1	48	35%
2006	0	1	3	1	0	31	16%
2007	1	1	8	14	0	50	48%
2008	0	2	1	2	0	30	17%
2009	0	2	1	1	0	33	12%
Total	2	8	27	32	2	273	26%

- 12 - 48% percent of samples exceeded water quality standards annually
- 37% of samples exceeding water quality standards occurred following precipitation events greater than 0.12 cm within the last 24 hrs
- 54% percent of samples exceeding water quality standards occurred within 48 hrs of rainfall events greater than 0.12 cm.

What Does the Historic Data Say?

- More advisories later in the summer
  - July and August
  - Possibly related to weather conditions or usage
- A portion of the advisories are preceded by precipitation events
  - 37% within 24 hrs = a close source
  - -54% within 48 hrs = source may be further away
- Not all of the advisories are preceded by precipitation
  - Dry weather advisories may be related to interactions between the aquatic and terrestrial environment

  Municipal infrastructure-related

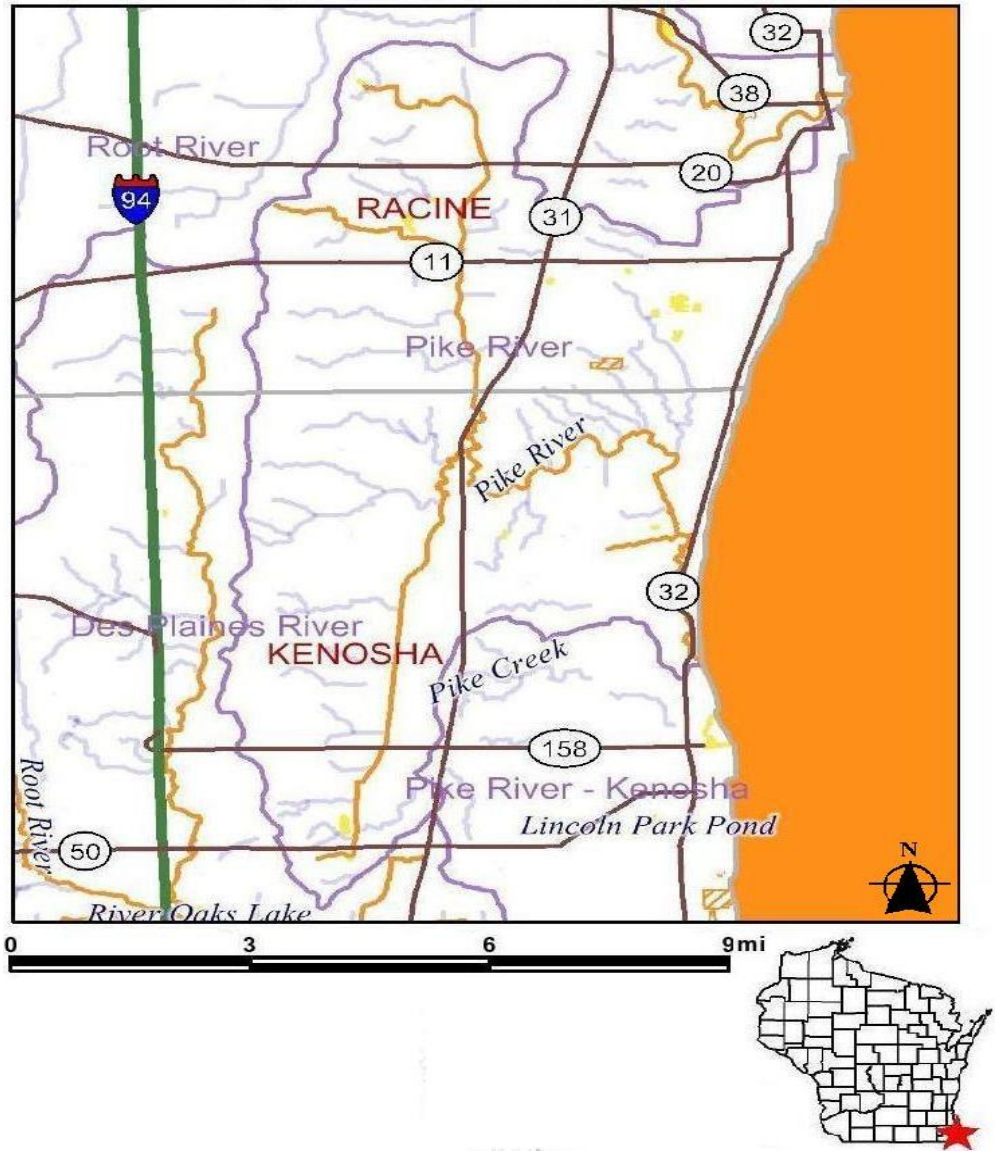
Sanitary Survey - Step #2

Perform an Initial Site Assessment

Initial Site Assessment

- The **Pike River** discharges to the north of the beach
- The **Kenosha Harbor** is south of Simmons Island beach
  - The harbor extends behind the beach area
  - **11 stormwater outfalls** empty into the harbor
- Simmons Island is bound on the north by shore armor
- 2 **storm water outfalls** discharge north of the beach
- The beach is bounded on the west by **parkland**
  - Primarily **turf grass** (low permeability)
- Multiple **paved surfaces** abut this site
  - Roads, parking lot, entry points
- There are engineered structures offshore
  - a **jetty** supporting the mouth of the harbor
  - a **groin** and sea armor along the north end of the park

Kenosha's Beaches are in the Pike River Watershed

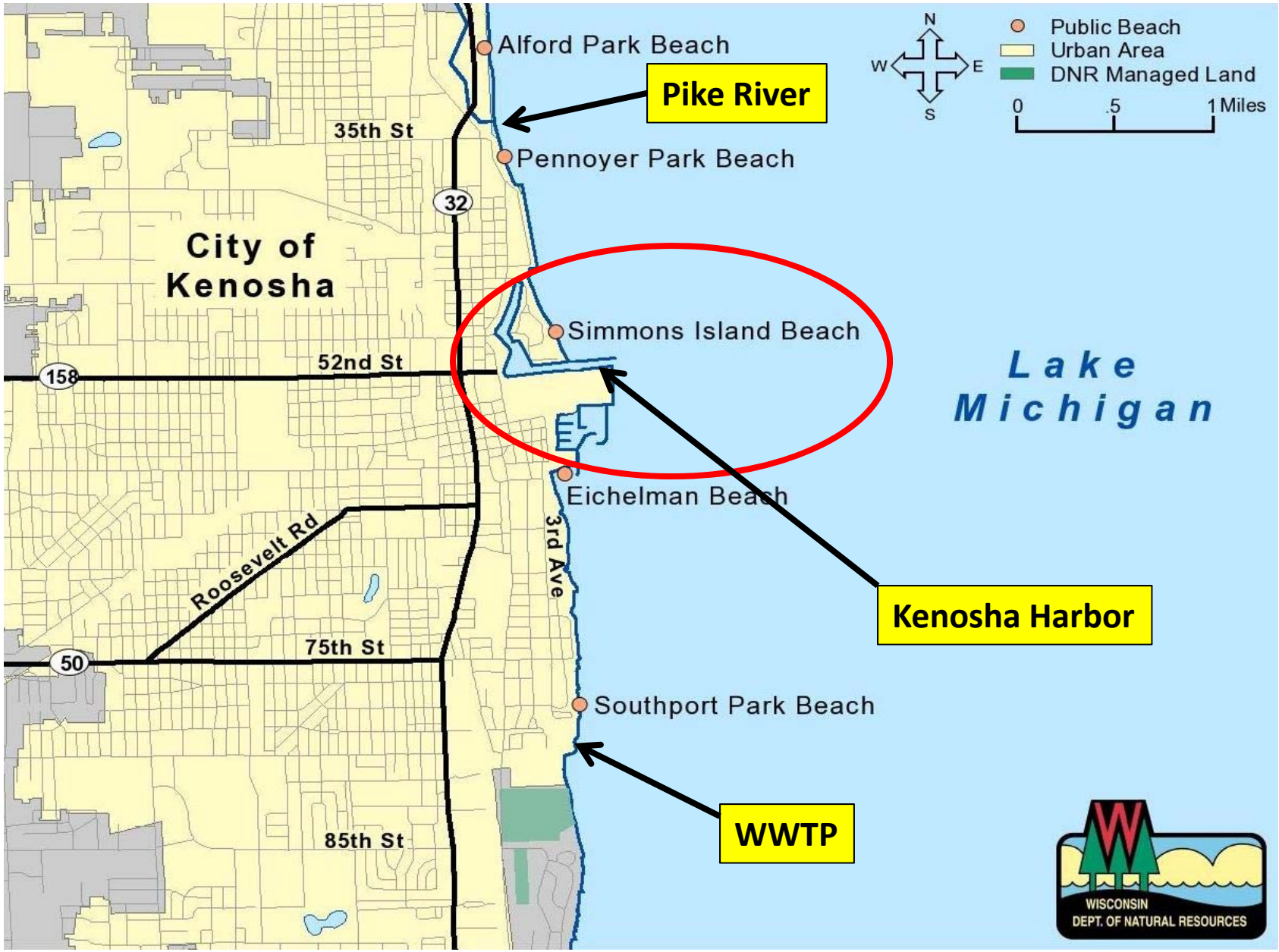


Land Use:

132 km^2 of the watershed drains to the Pike River

45% agricultural
30% urban
<1% wetlands

Potential Pollution Sources



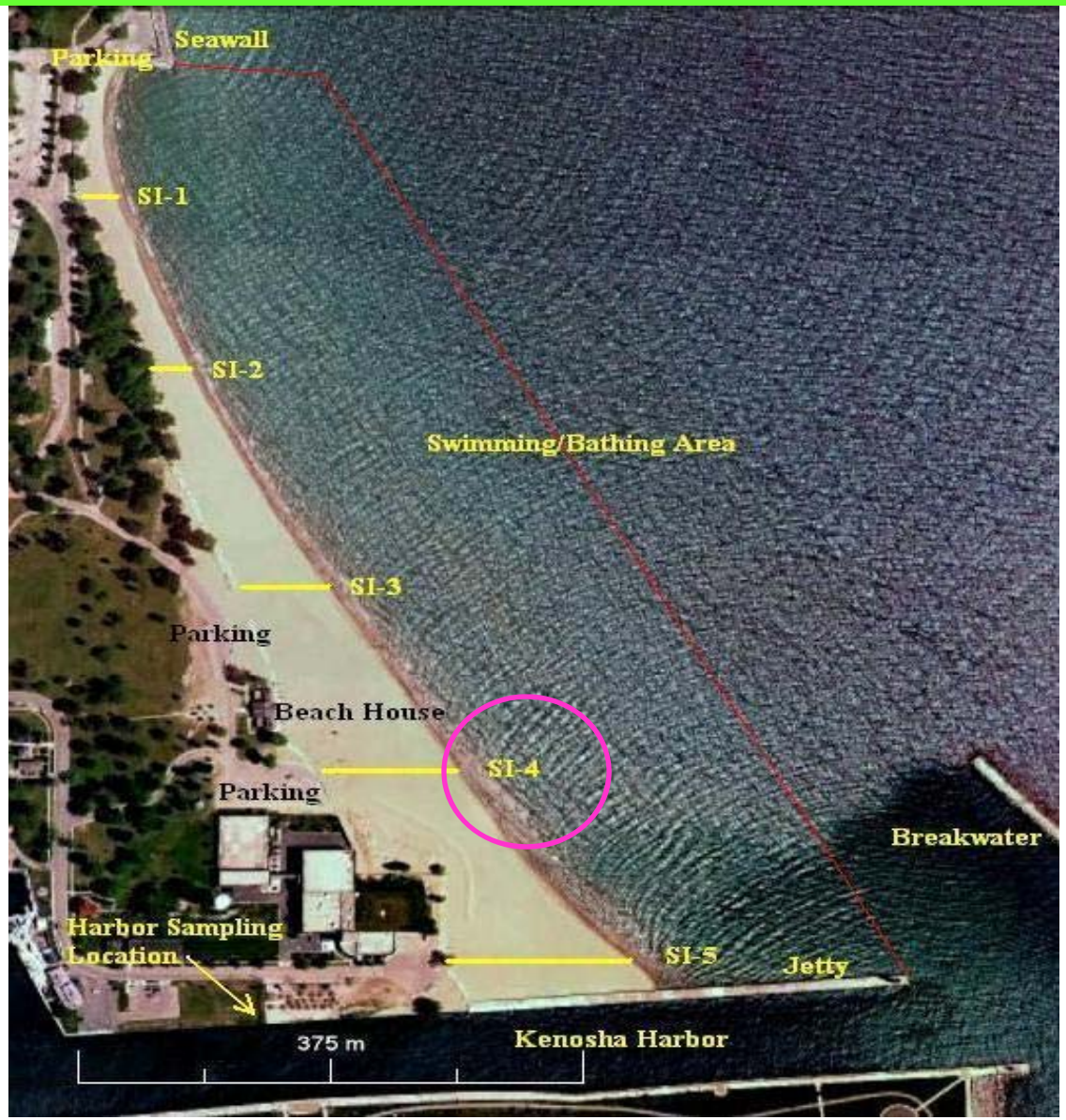
Physical Attributes

- Length
  - 930 meters in length
- Width
  - 34 m at transect SI-1 to 106 m at transect SI-5
- Slope
  - 5.3% gradient on the north end (at SI-1)
  - 1.9% gradient on the south end (at SI-5)
  - Beach gradients decreased along the beach moving from north to south
- Sediment Composition
  - Fine sand of uniform grain size
  - Few pebbles at berm crest

Sanitary Survey - Step #3

Develop a Sampling Plan, Collect Expanded Monitoring Data, then Analyze Results

Location of sampling transects



Sampling transects were evenly spaced when possible.

Sampling transect SI-4 corresponds to the location where historical data was collected.

Sanitary Survey - Sampling Plan

- Water samples were collected from 5 transects (43 days).
- Potential sources of fecal contamination were assessed at least weekly
  - Storm water outfalls, tributary discharge, surface runoff
- All water samples were enumerated for *E. coli*.
- Ambient environmental and beach conditions were qualified and quantified when possible on each date water samples were collected.
- 7 multi-depth sampling events at each transect to determine the geospatial distribution of *E. coli*.
  - 0.3 m, 0.9 m and 1.2 m
- Beach sediment samples were collected on seven dates to determine the effect of potential non-point sources of fecal contamination.
- Observed *E. coli* concentrations were compared to environmental conditions.

Ancillary Data Collected

- Pike River flow rate
- 24/48 hour precipitation
- Wind speed/direction
- Air/water temperature
- Conductivity
- Turbidity
- Wave height
- Long shore current
- Sediment assessments
  - E. coli
  - Grain size/uniformity
  - Moisture content
- Cloud cover
  - UV index
- Presence of algae
  - in water
  - washed ashore,
- Odors
- Presence of wildlife
- Amount of people using the beach and their activities
- Types/locations of litter
- Bird counts
- Other animal counts

Surface Water Quality - 2010

Water quality exceedances per transect (2010)*

Location	Advisories	Closures
SI-1	2	0
SI-2	3	0
SI-3	4	1
SI-4	8	2
SI-5	6	3

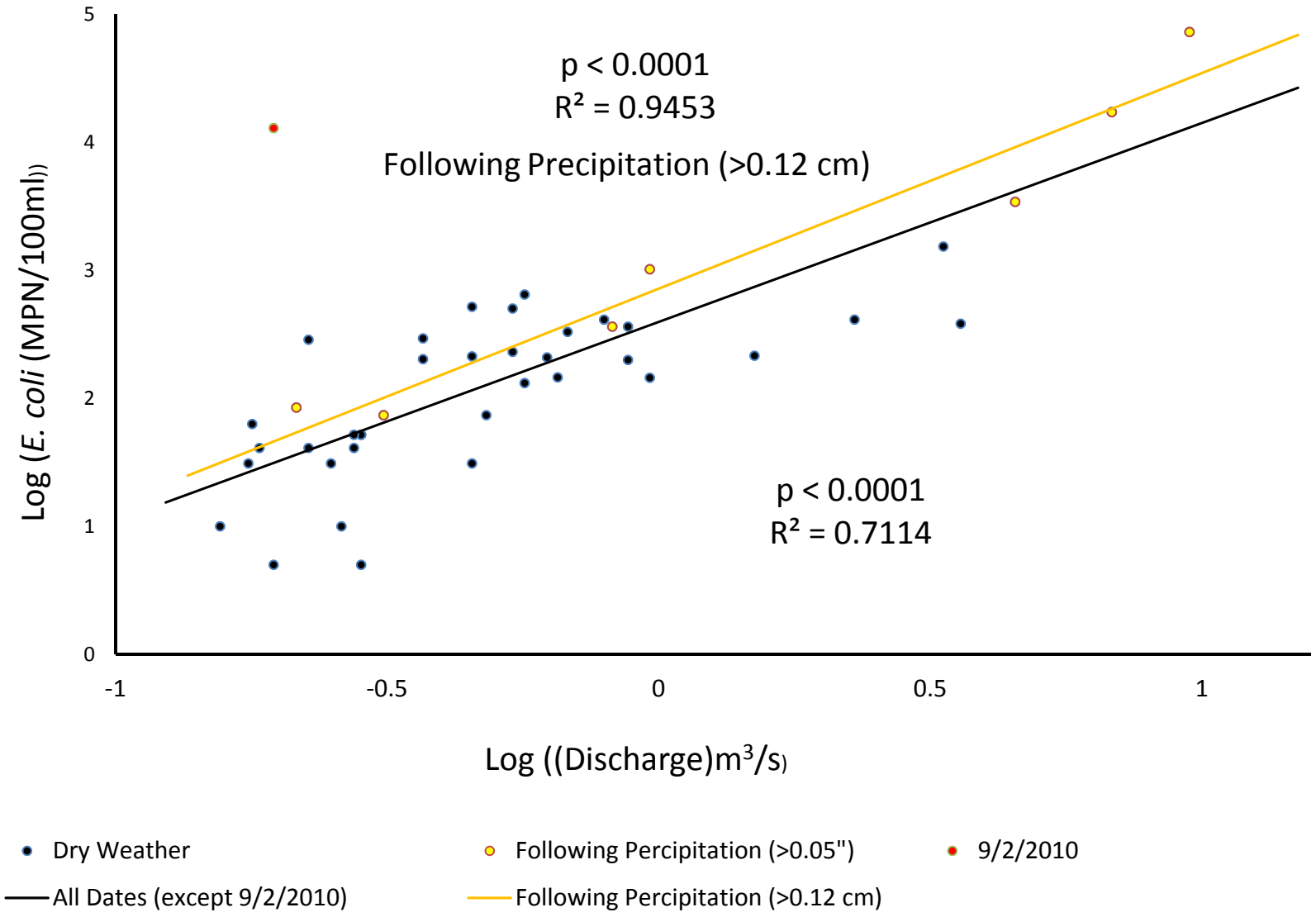
Poorer water quality was more prevalent at southern sampling transects (SI-3,SI-4 and SI-5) then northern sampling transects (SI-1 and SI-2).

***210 samples were collected from 6/29 to 9/21/10**

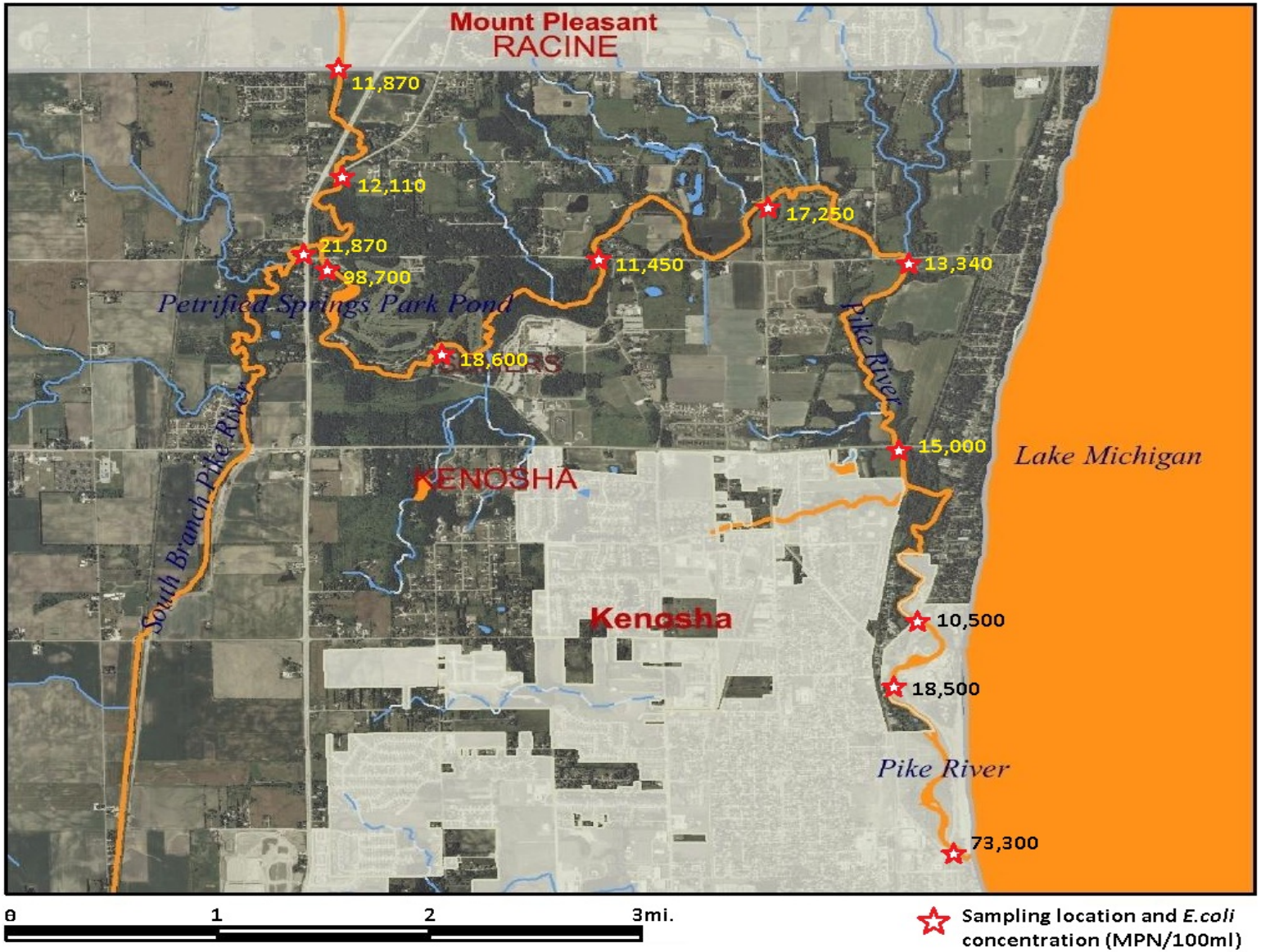
Year 1 - 2010

Wet Weather Sources

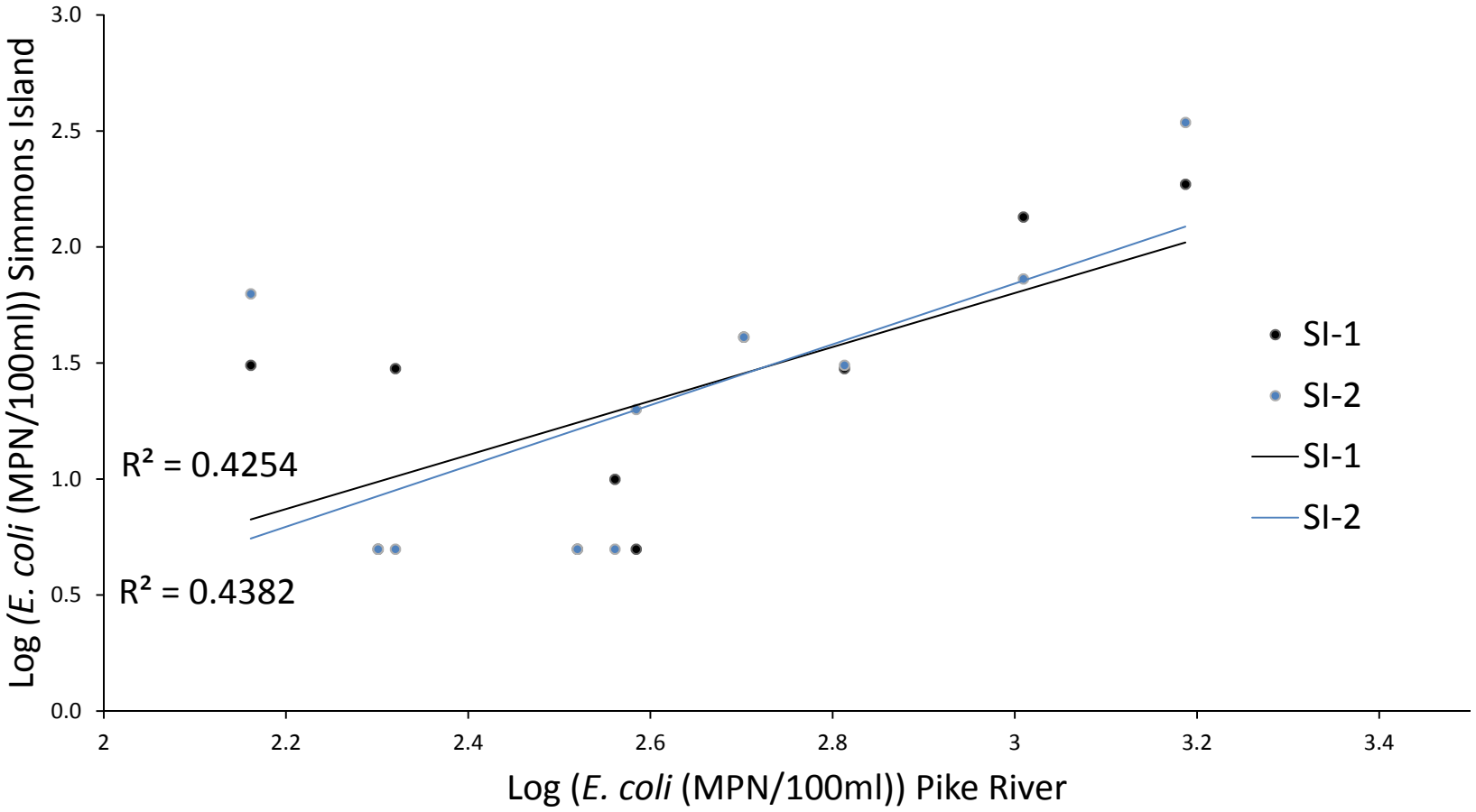
Influence of the Pike River



Upstream (Pike River) Monitoring



Tributary Loading (*E. coli*)



There is a positive correlation between *E. coli* concentrations in discharge from the Pike River when a southern long shore current exists.

Wet Weather Influences

- **Harbor had low *E. coli* except during storm events**; ESE winds may drive plume towards beach area
- **No evidence that the WWTP contributed**
- No significant relationship to wave height
- No significant relationship between *E. coli* and 24 or 48-hour precipitation alone
  - Use of an ***interactive variable*** including ***east winds & 48-hr rainfall*** made relationship significant
  - 44% of samples collected in the presence of easterly winds exceeded water quality standards compared to 10% when there were westerly winds

Wet Weather Influences (con.)

- **Pike River behaves as a transient source of *E. coli* following rain events**
- Increases in *E. coli* concentration when larger discharge volumes were present suggests that non-point sources were largely responsible for elevated bacteria concentrations inside the river's effluent
- Upstream sources of bacteria are present and contribute to poor water quality
- Conductivity may be a good surrogate for determining the influence of the river on near shore water quality

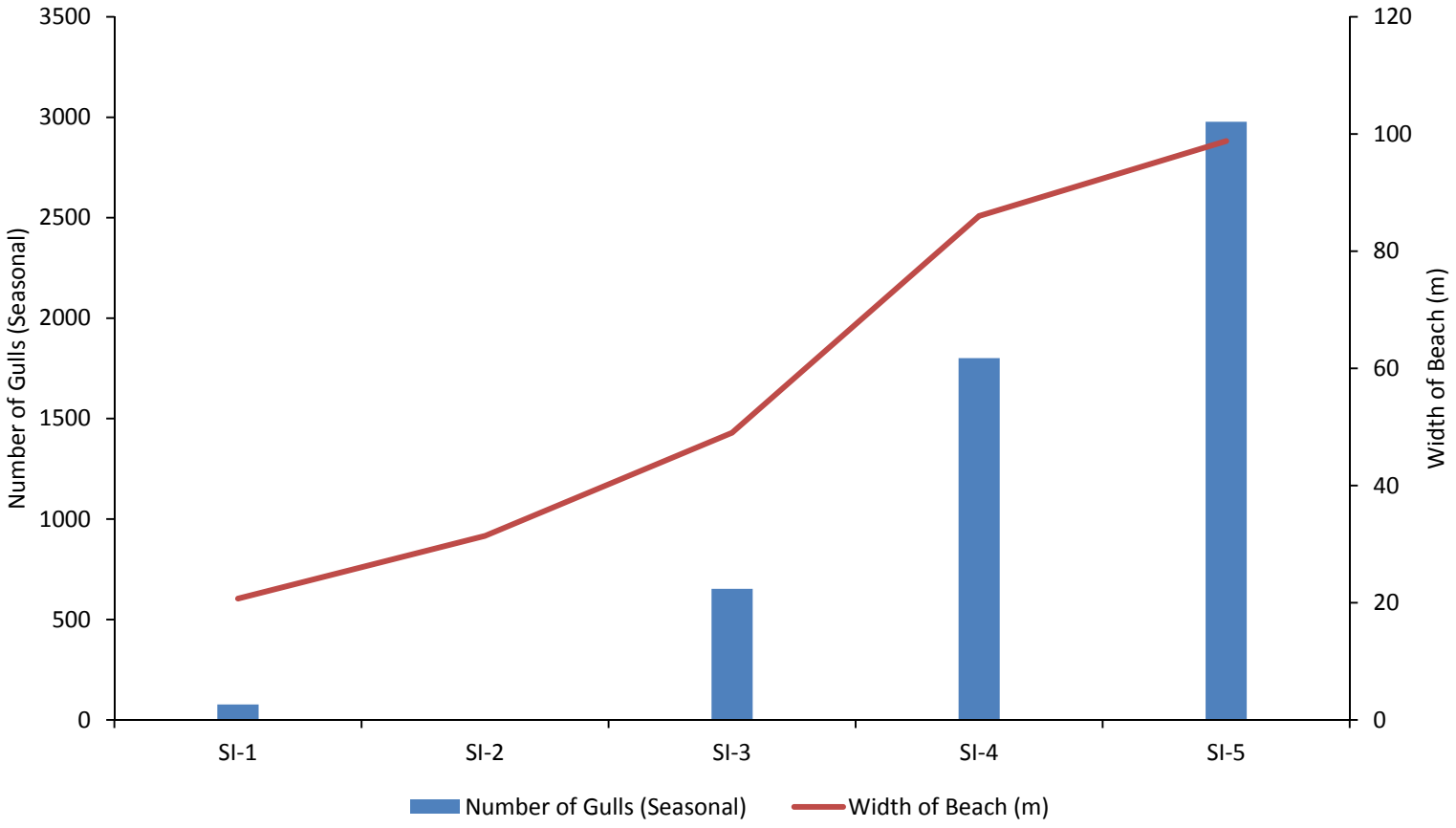
Year 1 - 2010

Dry Weather Sources

Seagulls

- Seagulls not evenly distributed
- Positive correlation between number of gulls and the width of the beach at each sampling transect (n=5, R^2= 0.940, p=0.006)
- Average number of seagulls observed:
  - 77 (SI-1) [northernmost]
  - 0 (SI – 2)
  - 653 (SI-3)
  - 1,801 (SI-4)
  - 2,978 (SI-5) [southernmost]

Gulls as a Function of Beach Width



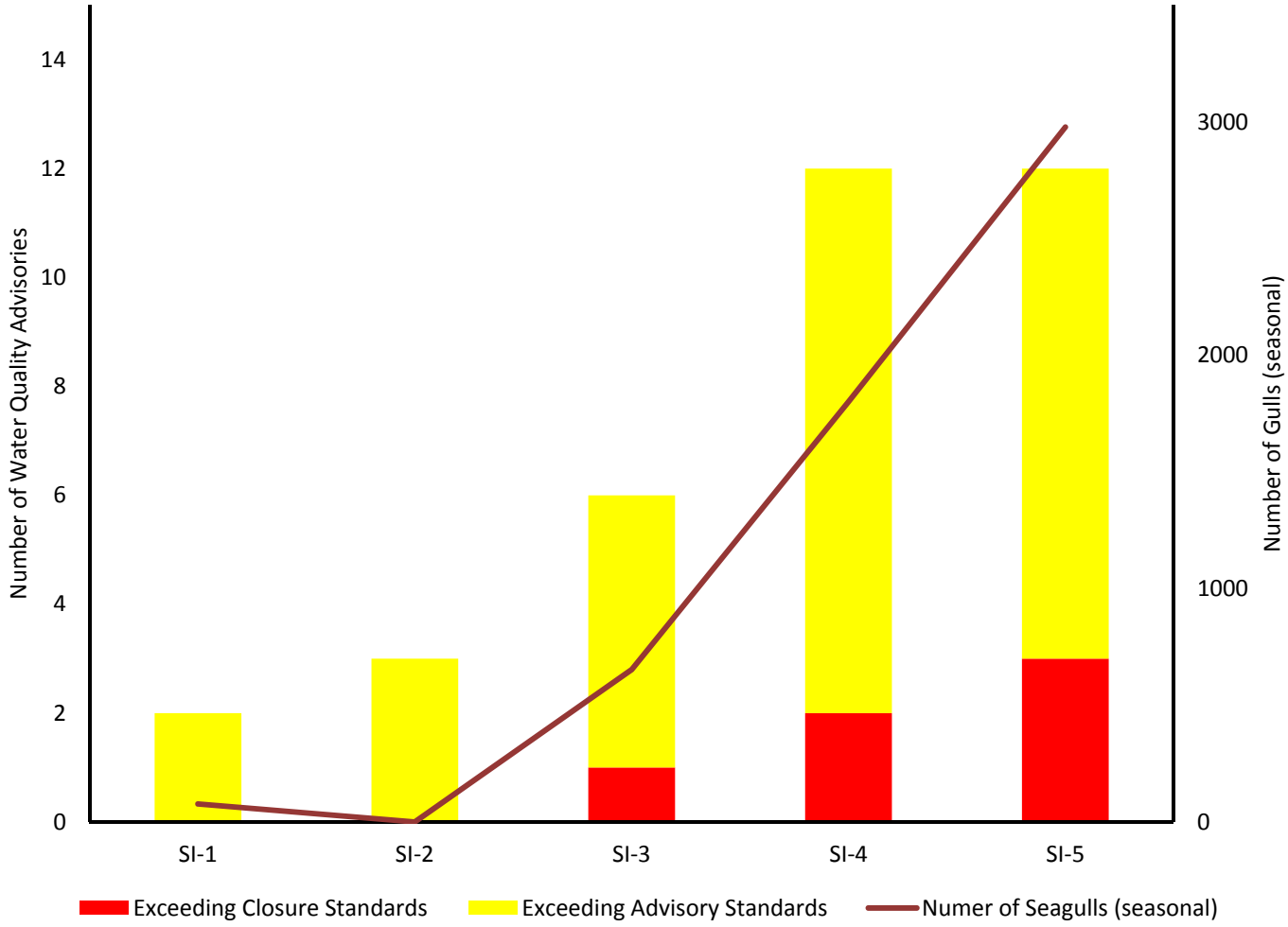
Relationship between beach width and the number of seagulls observed seasonally per transect. Seagulls appear to be attracted to the widest areas of the beach.

Seagull vs. *E. coli*

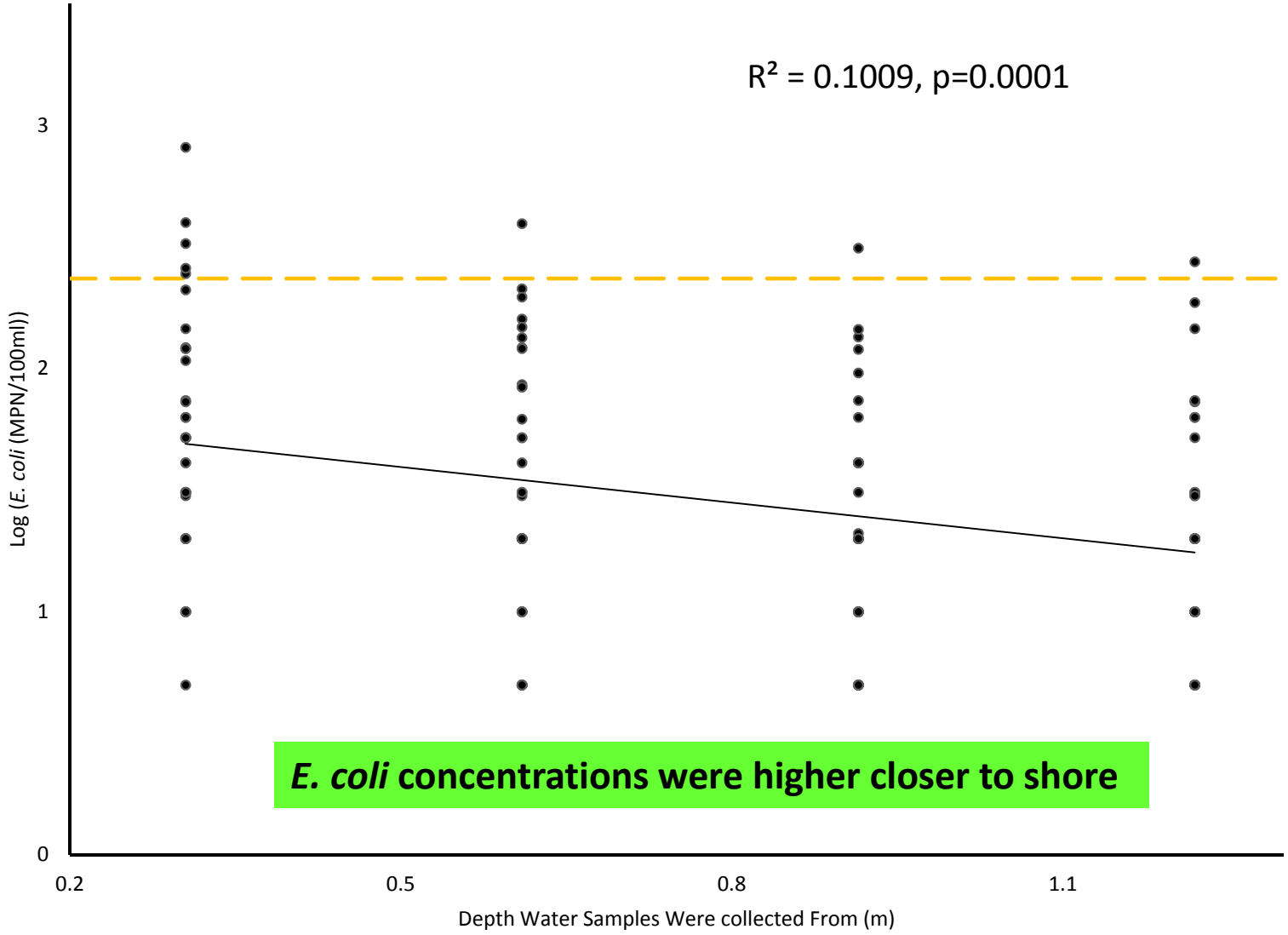
- No direct correlation between number of seagulls observed and DAILY bacteria concentrations in the water
- Field notes indicate that gulls have influence over water quality
  - Many days where poor water quality was noted at transects most frequented by gulls
- Poor water quality was more prevalent in areas frequented by gulls
- Correlation exists between number of SEASONAL advisories and presence of gulls (R^2=0.806, p=0.039)

GULLS, LOCATION & WATER QUALITY (2010 – 2012)					
Transect:	**SI-1**	**SI-2**	**SI-3**	**SI-4**	**SI-5**
2010					
Mean Gull Counts	77	0	653	1801	2978
Number of Days w/ Gulls	3	0	14	18	32
#Sampling Days/Season	42	42	42	42	42
Number of Exceedances	2	3	5	10	9
2011					
Mean Gull Counts	13	Unable to Collect	1668	3988	17516
Number of Days w/ Gulls	3		11	20	44
#Sampling Days/Season	51		51	51	51
Number of Exceedances	3		6	9	14
2012					
Mean Gulls Counts	32	155	2602	2668	4248
Number of Days w/ Gulls	7	7	32	32	43
#Sampling Days/Season	52	52	52	52	52
Number of Exceedances	8	8	11	13	11
Transect Width (m)	**24.99**	**35.05**	**51.21**	**76.81**	**92.66**

Mean Seasonal Gull Counts vs. WQF



E. coli vs. Depth

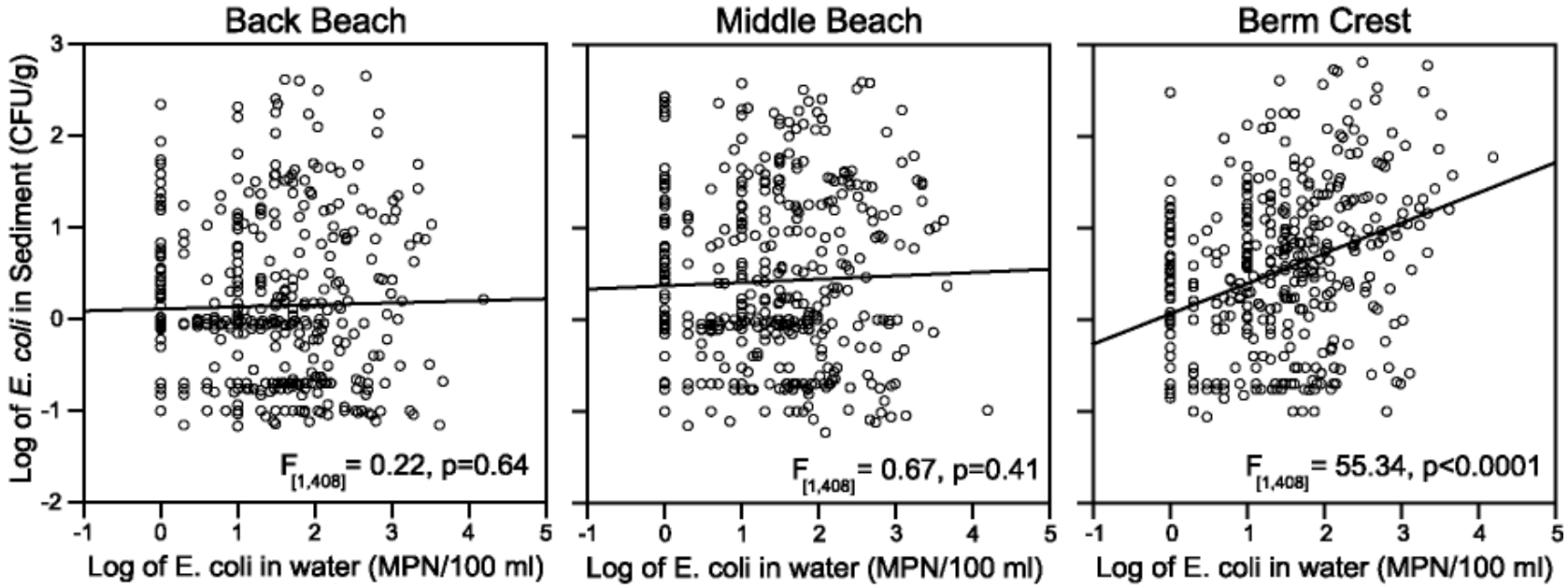


***E. coli* concentrations were higher closer to shore**

Sediments vs. *E. coli*

- Sediments were collected
  - berm crest
  - middle beach (10 m behind berm crest)
  - back beach (20 m behind the berm crest)
- All were well sorted fine grain sands
- Mean log normalized *E. coli* concentrations were higher at the berm crest
- Significant difference in mean *E. coli* concentrations in samples collected at S1 or S2 (northernmost) and S5 (southernmost)
  - S5 was where there were more gulls

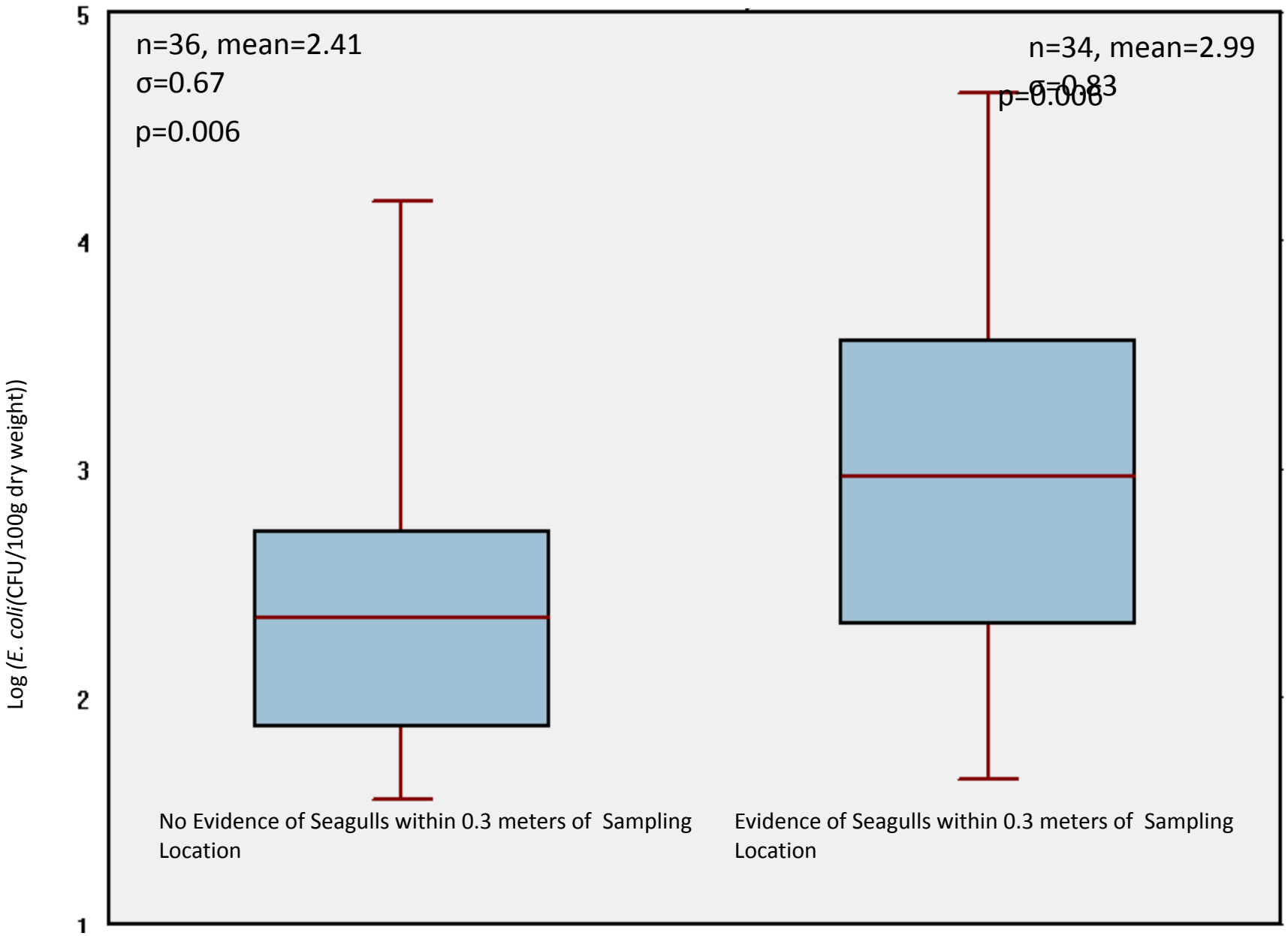
Relationship of *E. coli* to Grain Size



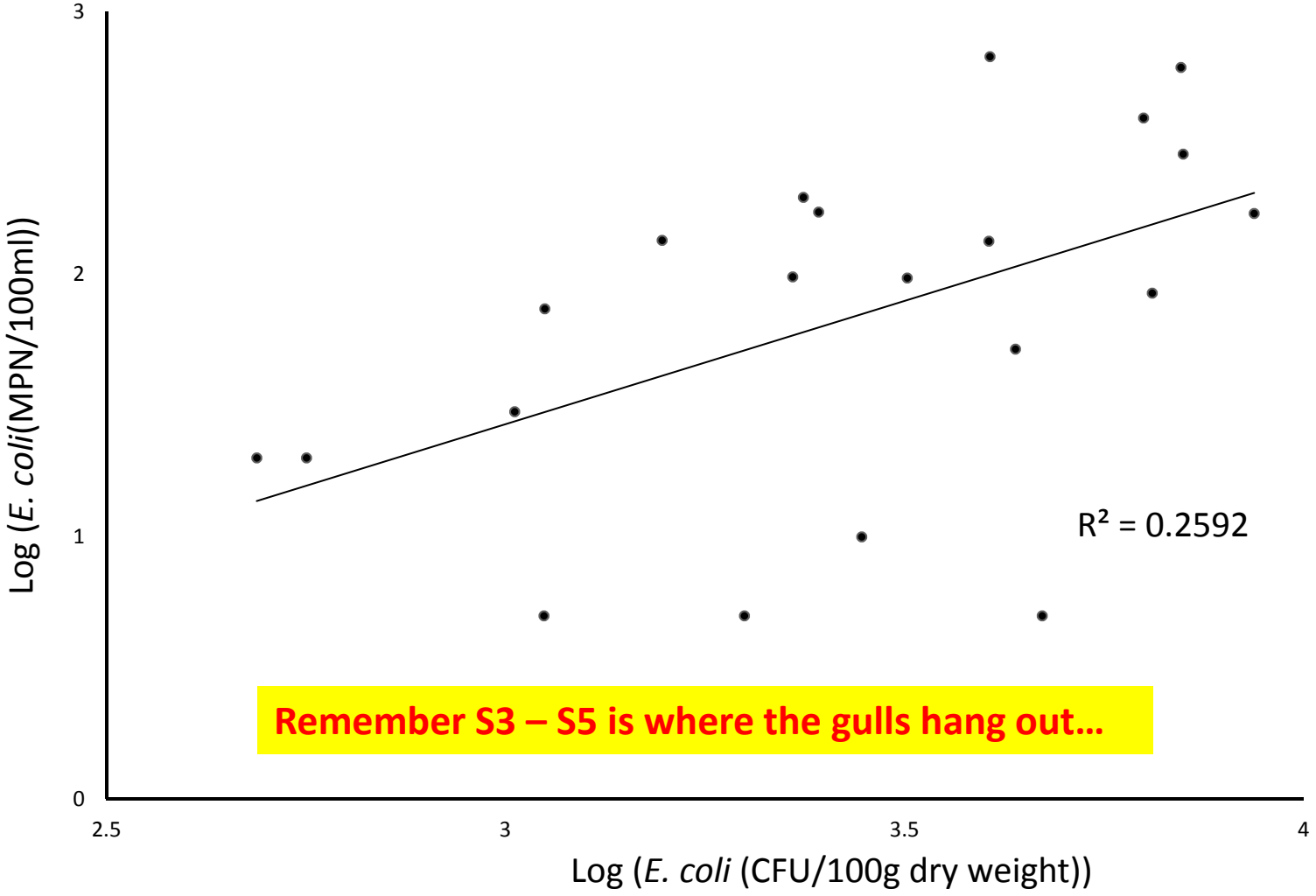
Mean grain size and uniformity accounted for variation in *E. coli* density with fine sand of uniform distribution having the highest content.

E. coli density in surface water was correlated to *E. coli* density in beach sand samples at the berm crest.

Sediment Sampling & Gulls



Significant relationship b/w *E. coli* at berm crest and *E. coli* in near shore water, S3 – S5 combined (n=21, R^2=0.259, p=0.0184)



Dry Weather Conclusions

- There was a positive correlation between the mean seasonal number of seagulls at a transect and the number of samples exceeding water quality standards
- *E. coli* in water was related to berm crest *E. coli* at areas most frequented by gulls
- Gulls tended to congregate at areas of the beach which were widest
- Widest areas were where most human activity was occurring
  - Observational and based on litter assessments

Sanitary Survey – Step #4

- *Determine if Further Monitoring is Needed*
- *Develop BMPs*
- *Develop Conceptual Redesign Plan Based on Sanitary Survey Data*

Recommendations for Future Monitoring

- Conduct expanded tributary assessments on Pike River
  - Include watershed assessments to determine source of fecal loading
- Determine utility of conductivity to be used as a source tracking marker
- Conduct dry and wet weather event monitoring on City of Kenosha stormwater infrastructure
  - Include human-specific marker testing

Pike River Studies

- 2011 – 2012, WI Coastal Management Program & City of Kenosha
  - Examine water quality at 20+ municipal storm water outfalls during wet and dry weather
- 2012 – 2014, Fund for Lake Michigan
  - Conduct physical, chemical, and microbiological assessments on the Pike River and its tributaries in support of watershed restoration planning
- **GLRI sanitary survey data has resulted in the ability to attract additional revenue to improve water quality**

Mitigation Recommendations

- Alter beach topography to improve slope
- Groom beach daily to reduce *E. coli* concentration at berm crest
- Increase number of garbage cans to reduce litter
- Naturalize beach area at widest portions to reduce loafing gulls (S3 – S5)
- Use gull intervention measures to reduce bird populations (see *ES &T*, Converse et al. 2012)

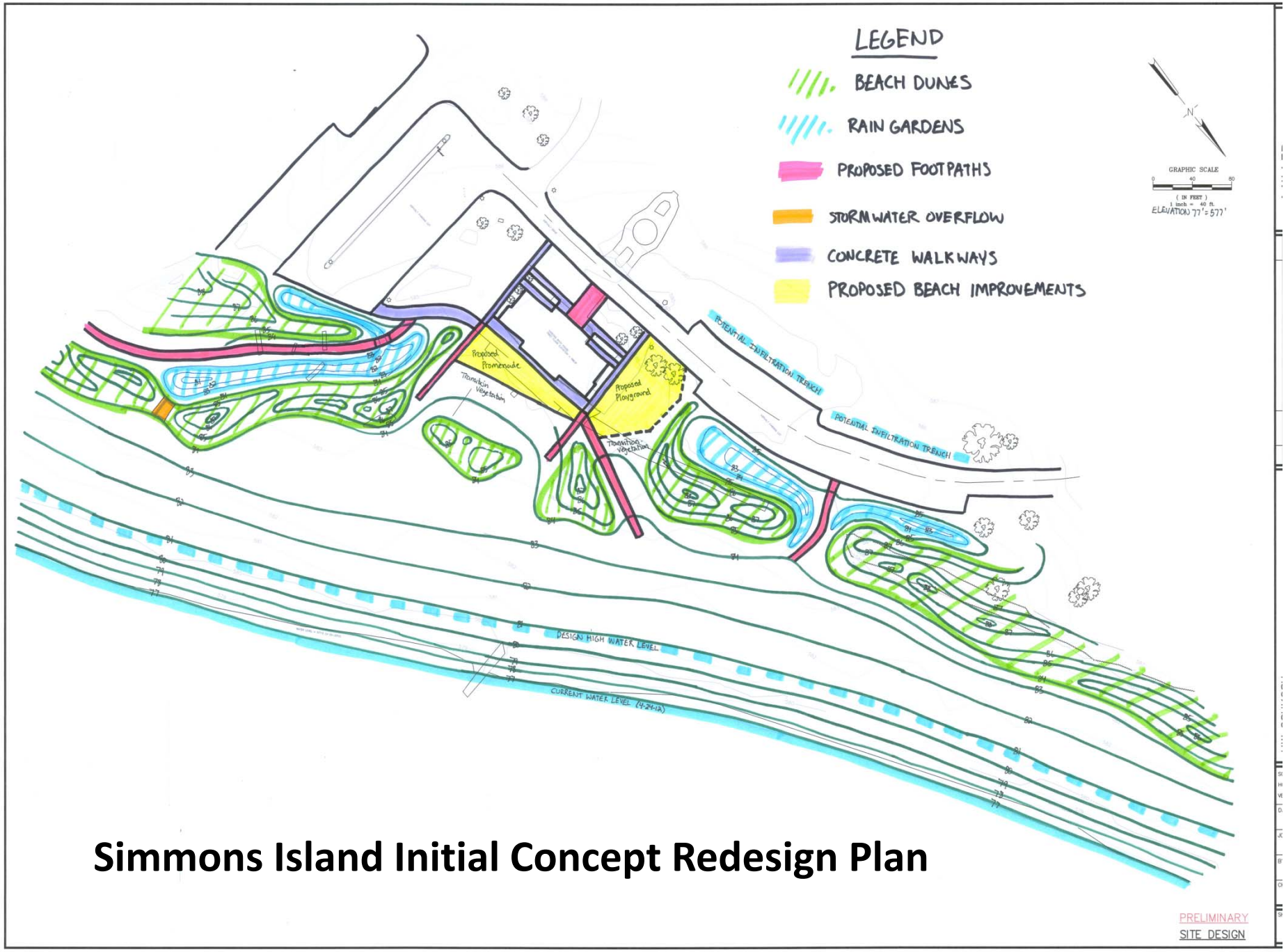
Beach Grooming for Fine Sandy Beaches: Deep and Not Compacted

Simmons Island Master Plan

- Great lawn, picnic area
- Renovate the existing beach house
  - Beach house plaza
  - Beach house promenade extending onto beach
- Themed playground
- *Manufactured dunes*
  - Berming & vegetation enhancements
  - Create barriers for sand migration
  - Act as buffers against non-compatible uses

Conceptual Redesign Plan

- Designed to mitigate pollution sources while still fitting into the City of Kenosha's master plan for this park
- Design elements reduce storm water runoff from impervious surfaces (paved and turf grass)
- Increase native vegetation as a deterrent to gull loafing,, i.e. dunes
- Changes elevation to reduce wave run up resulting in transfer of bacteria to near shore water



Simmons Island Initial Concept Redesign Plan

Utility of Beach Dunes

- Capture sheet flow from paved areas
- Restore habitat
- Deter loafing gulls
- Improve beach aesthetics
- Can be constructed by municipal staff and volunteers
- Naturalized engineering
- Lower cost alternative to hard engineered structures

Example of Dunes in Action

North Beach, Racine, WI

Improving Beach Slope/Gradient

TOO FLAT
Lots of Water on the Beach

HEALTHY
Minimal exchange

Returns on “Blue” Investments

Hard choices have to be made in a tough economic climate…

Returns on “Blue” Investments

- Investing capital in coastal and riparian improvements will generate revenue
  - Tourism, jobs attraction/retention, etc.
- Cost benefit analyses should be employed
  - **Mitigation measures should be based on sound science (*use the sanitary survey data*)**
  - Tiered implementation approach can distribute costs
- Once you have made improvements get the word out!
  - “If you build it they will come…”

Direct Economic Benefits

- Increased property values
- Attractive to external venues
- Small business opportunities
- Increased usage
- Tourism
- Population retention
- Attract new investments
- Improve the cityscape
- Avoided damages

Indirect (Passive) Returns

- ❑**Community identity**
- ❑**Community pride**
- ❑**Sense of place**

Providing Equity…

- Beaches are an asset
- Recognized as important across all community segments
  - Age
  - Race
  - Economic status

Acknowledgements

- Great Lakes Restoration Initiative
- UW-Oshkosh
- Adrian Koski, GLRI Project Coordinator
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- City of Racine
- Pete Pittner, Miller Engineers and Scientists

KENOSHA 1850 WISCONSIN

Great Lakes RESTORATION

RACINE ON THE LAKE
City of Racine, Wisconsin