

National Progress and Lessons Learned since EPA's 2012 Recreational Water Quality Criteria Update

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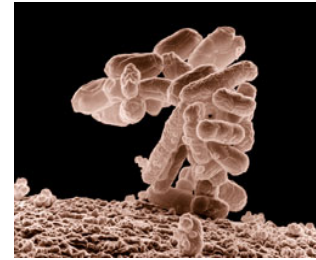
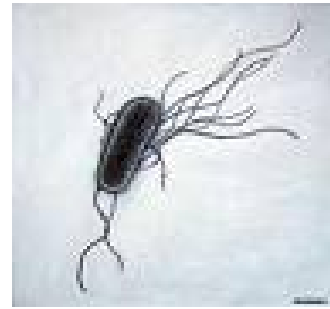
EPA's 2012 revised Recreational Water Quality Criteria (RWQC) are national recommendations for all waters in the U.S. designated for primary contact recreation.

What do RWQC do to protect public health?

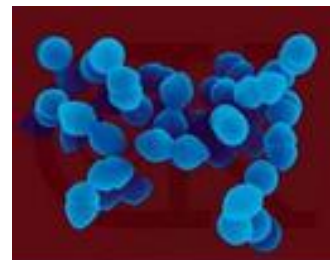
- Protect the public from exposure to pathogens.
- Help prevent illness through discharge permit limits.
- Include recommendations for identifying and restoring impaired waters.
- Identify water quality problems at beaches.

Indicators of Fecal Contamination

- ▶ Fecal pathogens are disease-causing microorganisms.
- ▶ RWQC are based on fecal indicator bacteria (FIB).
- ▶ RWQC are based on *E.coli* and Enterococci.
- ▶ FIB are measured to detect and estimate the level of fecal contamination in water.
- ▶ FIB are monitored because pathogens are difficult and expensive to detect.



Enterococcus spp.



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Waterborne Pathogens

Pathogen	Disease	Effects	
Bacteria	<i>Escherichia coli</i> (enteropathogenic)	Gastroenteritis	Vomiting, diarrhea, death in susceptible populations
	<i>Helicobacter pylori</i>	Gastritis	Diarrhea. Peptic ulcers are a long-term sequela.
	<i>Legionella pneumophila</i>	Legionellosis	Acute respiratory illness
	<i>Leptospira</i>	Leptospirosis	Jaundice, fever (Weil's disease)
	<i>Pseudomonas</i>	Infections in immunocompromised individuals	Urinary tract infections, respiratory system infections, dermatitis, soft tissue infections, bacteremia, and a variety of systemic infections
	<i>Salmonella typhi</i>	Typhoid fever	High fever, diarrhea, ulceration of the small intestine
	<i>Salmonella</i>	Salmonellosis	Diarrhea, dehydration
	<i>Shigella</i>	Shigellosis	Bacillary dysentery
	<i>Vibrio cholerae</i>	Cholera	Extremely heavy diarrhea, dehydration
	<i>Yersinia enterocolitica</i>	Yersinosis	Diarrhea
Protozoans	<i>Balantidium coli</i>	Balantidiasis	Diarrhea, dysentery
	<i>Cryptosporidium</i>	Cryptosporidiosis	Diarrhea
	<i>Entamoeba histolytica</i>	Ameobiasis (amoebic dysentery)	Prolonged diarrhea with bleeding, abscesses of the liver and small intestine
	<i>Giardia lamblia</i>	Giardiasis	Mild to severe diarrhea, nausea, indigestion

Swimming-associated outbreaks

Outbreak of *E. coli* O157:H7 at state park swimming beach in Rockford, Illinois affected 12 swimmers.



Outbreak of leptospirosis affected 98 triathletes in Springfield, Illinois.



History of Recreational Water Quality Criteria



- ▶ FIB used for many years to identify potential for illness.
- ▶ The first criteria recommendations were for total coliforms.
- ▶ In 1968, USPHS translated TC to FC and published first Federal bacteria criteria recommendations: 200 FC cfu/100 mL.
- ▶ In the late 1970s, EPA's epidemiological studies showed that *E. coli* and *enterococci* have a better correlation to gastroenteritis than FC.
- ▶ In 1986, EPA published *Ambient Water Quality Criteria for Bacteria*.
- ▶ In 2012, EPA published revised recommended water quality criteria.

Why Were Recreational Water Criteria Revised?

§ 304(a) of the CWA requires EPA to develop WQC based on the latest scientific information.

Beaches Environmental Assessment of Coastal Health (BEACH) Act requires EPA to study issues associated with pathogens and human health and publish new WQC based on studies.



National Epidemiological and Environmental Assessment of Recreational (NEEAR) Water Study

- EPA and CDC conducted epidemiological study 2003 - 2010.
- 54,250 study participants at 9 WWTP-impacted Great Lakes and marine beaches.

Study goals:

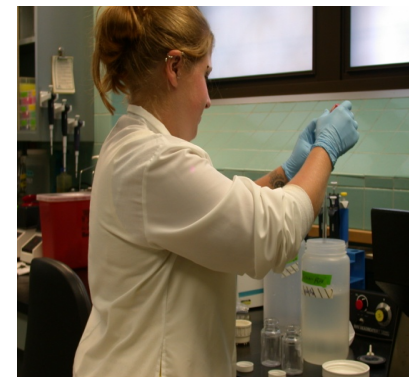
- Evaluate new rapid analytical methods.
- Collect health and water quality data.



NEEAR Epidemiological Studies

Based on the NEEAR study, EPA:

- ▶ Provided recommendations on culture methods and values for EN and EC.
- ▶ Provided a rapid method qPCR and values that correlate to the illness rates of the EN culture values.

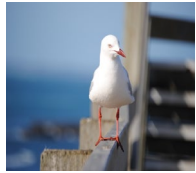


2012 Recreational Water Quality Criteria for Freshwater

Criteria Elements	<u>Estimated Illness Rates: 36/1,000</u> primary contact recreators		<u>Estimated Illness Rates:</u> 32/1,000 primary contact recreators	
Indicator	Geometric Mean (cfu/100 mL)	Statistical Threshold Value (cfu/100 mL)	Geometric Mean (cfu/100 mL)	Statistical Threshold Value (cfu/100 mL)
<i>E. coli</i>	126	410	100	320
Enterococci	35	130	30	110

- 2012 RWQC recommend both a GM and a STV.
- 2012 RWQC contains two sets of criteria that correspond to different illness rates.
- 2012 RWQC illness rates differ from the 1986 criteria but are not less protective.

Tools for Evaluating Recreational Waters and Alternative Criteria



States can adopt site-specific alternative criteria to reflect local conditions.

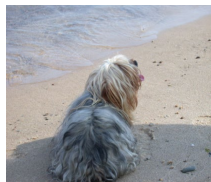
Criteria must be scientifically defensible and protect the designated use.



Criteria should reflect the conditions of the watershed.



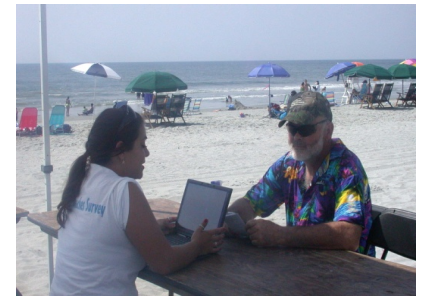
States may develop alternative criteria using new methods for FIB detection or enumeration that EPA has not validated.



A Guide to the Site-Specific Alternative Recreational Criteria Technical Support Materials (EPA-820-R-14-011).

<https://www.epa.gov/sites/production/files/2015-11/documents/sitespecific-alternative-recreational-indicators-methods.pdf>

Tools for Evaluating Recreational Waters and Alternative Criteria - Epidemiological Studies



- Epidemiological studies describe the risks associated with exposure to fecal contamination.
- Epidemiological studies are resource intensive and logistically difficult.
- Results can provide data for a scientifically defensible basis for WQS adoption.
- Technical support materials in progress.

Tools for Evaluating Recreational Waters and Alternative Criteria - Quantitative Microbial Risk Assessment (QMRA)



QMRA is a formal process of estimating health risks due to exposures to pathogens.

QMRA can be used to:

- Assess the potential for health risks associated with exposure to a known pathogen.
- Determine critical points for control, such as watershed protection measures.

QMRA studies should be well documented and rely on scientifically defensible data.

Research indicates that some nonhuman fecal sources (e.g., raccoons and cattle) may pose risks comparable to risks from human sources.



Future Directions - Coliphage

EPA is developing recreational criteria for coliphage, a viral indicator.

Risk assessments indicate that viruses cause most illnesses associated with recreational waters that are impacted by human sources.

Coliphage advantages:

- ▶ Highly concentrated in sewage
- ▶ Non-pathogenic
- ▶ More similar to human pathogenic viruses than traditional FIB
- ▶ Cost effective



Cyanobacteria - EPA published draft RWQC for cyanotoxins which can form harmful algal blooms (HABs).

Great Lakes Restoration Initiative (GLRI)

\$475M to address the most significant problems in the Great Lakes

Nearshore Health and Nonpoint Source Pollution



- Improving Beach Monitoring for Bacteria
- Communicating Beach Monitoring to the Public
- Developing Beach Forecasting Models
- **Conducting Beach Sanitary Surveys**
 - Grants issued to 43 entities to identify pollution sources at 400 GL beaches.
- **Making Beaches Safer**
 - Grants issued to mitigate bacteria pollution sources at 65 GL beaches based on findings of sanitary surveys

Great Lakes Beaches



Egg Harbor Beach and Parking Lot Restoration Project, Door County, Wisconsin



Hancock Beach BMPs Project, Houghton County, Michigan



Curb cuts to Bioretention Basins created to capture and infiltrate stormwater.



Phase I: Passive Treatment Wetland to Improve Nearshore Health & Reduce Non-point Source Pollution, Oregon, Ohio



The project reduced NPS pollution, improved public health protection, and created riparian habitat.

Phase II: Reduction of Sediment and Bacteria Loadings to Public Beaches at Maumee Bay State Park



During high flow events, water velocity reduced from 2.2 ft/s to 0.7 ft/s. Weekly sampling showed 94% reduction in EC, and >50% reduction in TSS and TP.

North Beach, Racine, Wisconsin



Photo taken after 2" of rain in previous 48 hours; no runoff on beach.



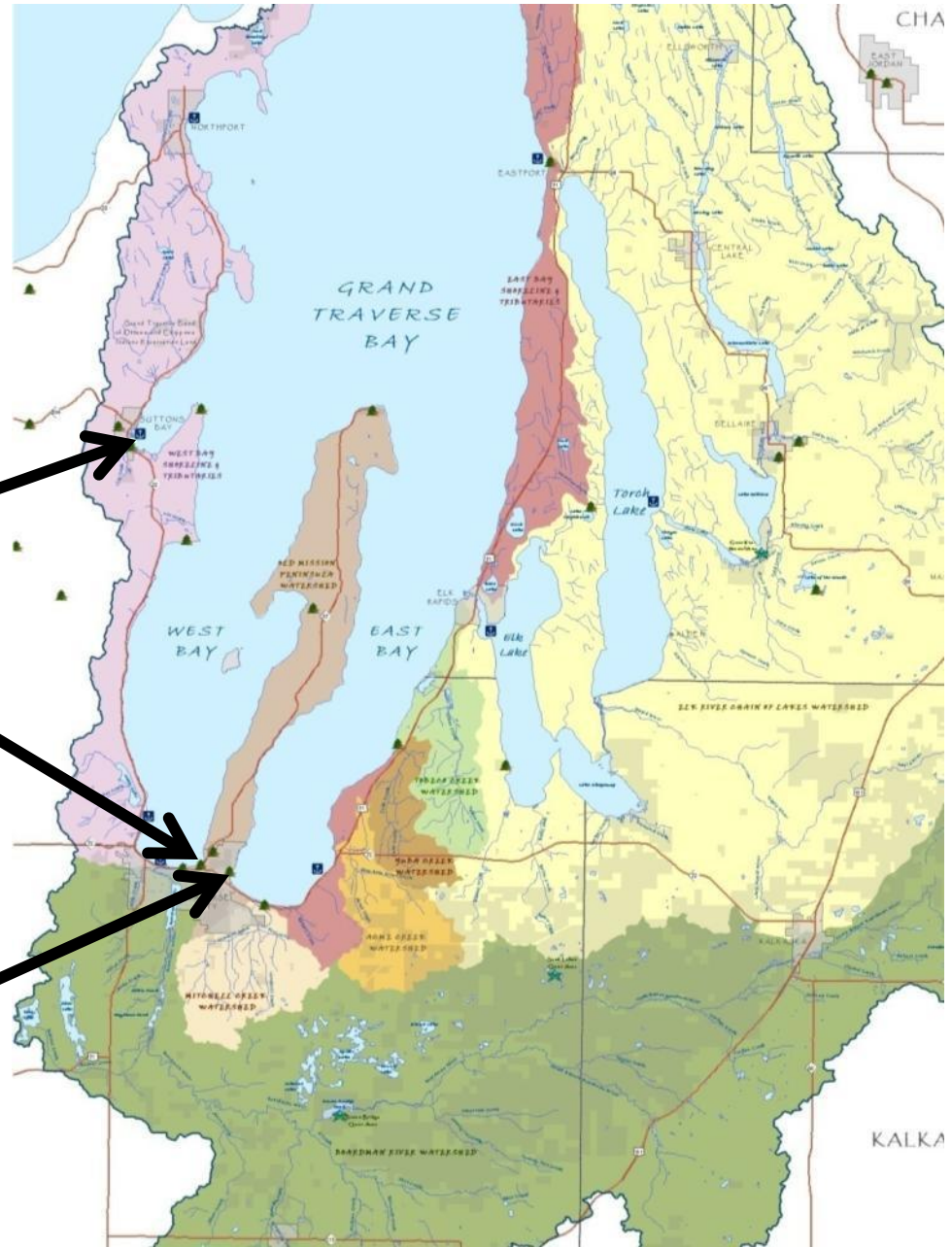
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Beach closures reduced to <5.



GLRI Beach Projects in Grand Traverse Bay Watershed, Traverse City, Michigan:

- 2011: Suttons Bay - \$987,102
- 2010: Bryant Park - \$267,755
Partnership with MDEQ
- 2011: East Bay Park - \$767,648



CHA

KALKA

Bryant Park Beach, Traverse City, Michigan



Bryant Park Beach, Traverse City, Michigan



Bryant Park Beach, Traverse City, Michigan



East Bay Park Beach, Traverse City, Michigan

3 storm drains discharged at East Bay Park Beach

Swimming Area

On State Impaired Waters List (303(d) List) for Bacterial Contamination.

Outfall downward of the beach.

Storm Drain Outlets

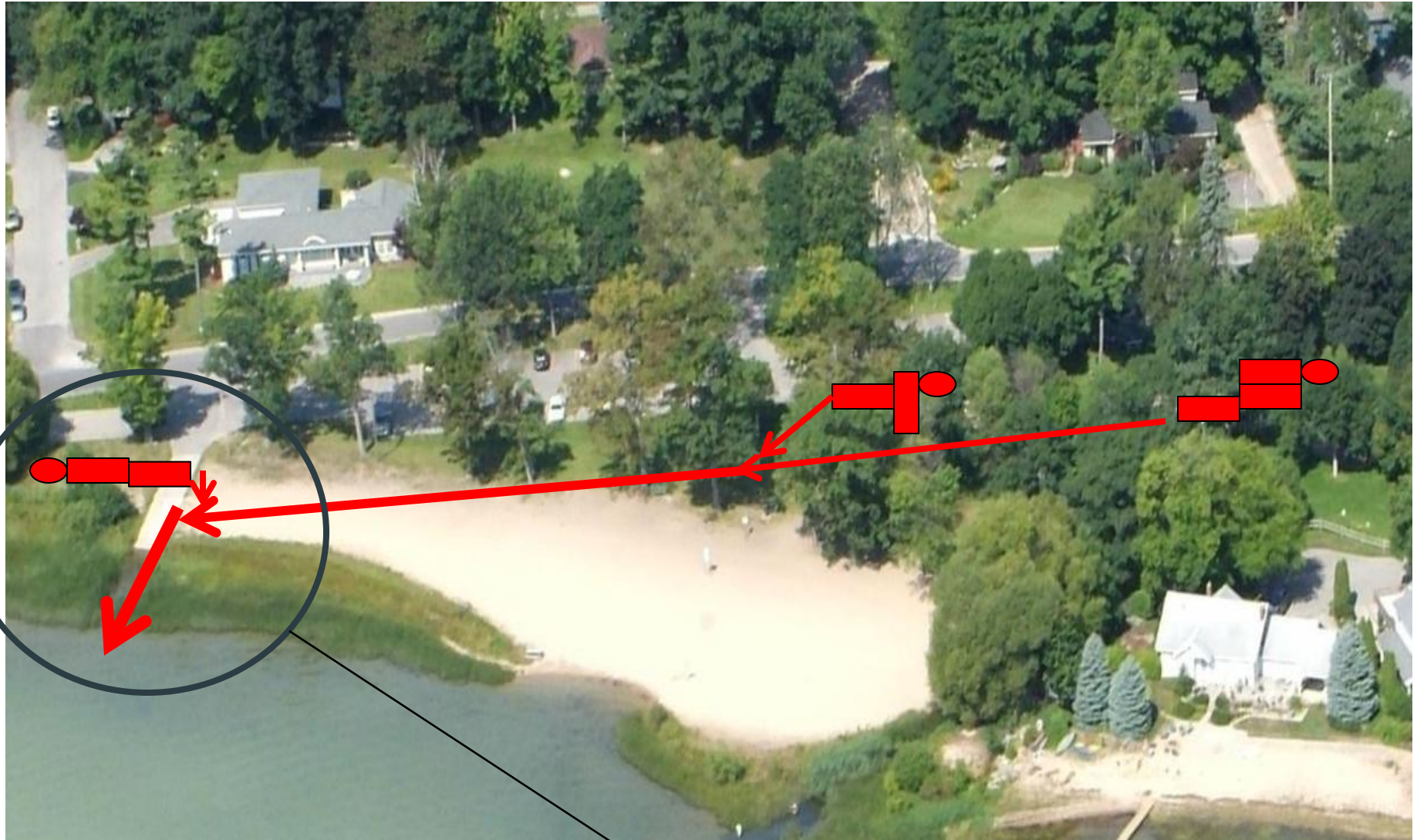


East Bay Park Beach, Traverse City, Michigan

Previous stormdrain system at East Bay Park:

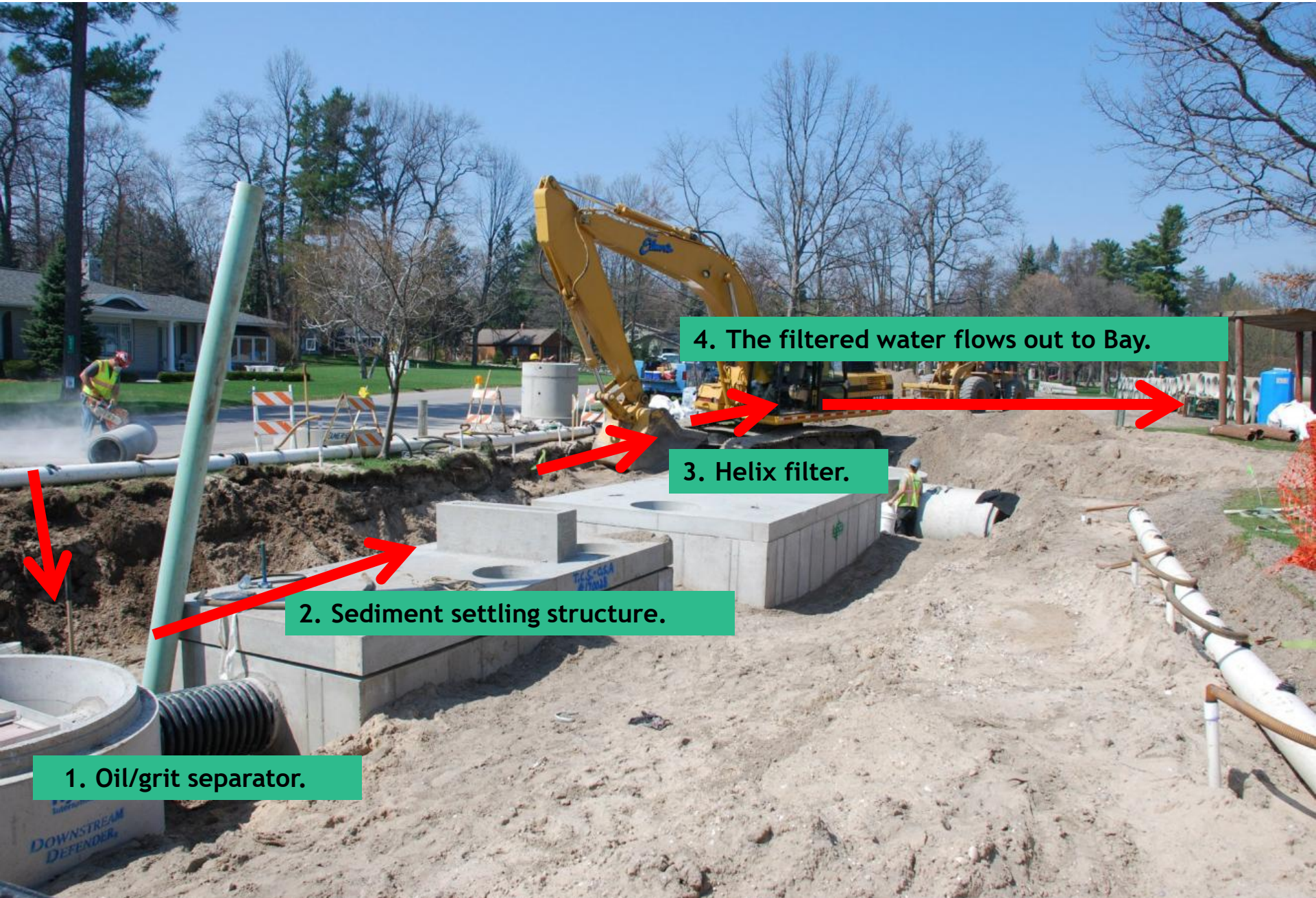


East Bay Park Beach, Traverse City, Michigan



This system is shown on next slide

East Bay Park Beach, Traverse City, Michigan



1. Oil/grit separator.

2. Sediment settling structure.

3. Helix filter.

4. The filtered water flows out to Bay.

Suttons Bay Beach, Traverse City, Michigan



Green infrastructure measures used to reduce runoff before end-of-pipe.

Suttons Bay Beach, Traverse City, Michigan BMP System: Raingardens



**15 installed in residential
areas in Village to reduce
runoff**

Installation Steps:

1. Cut out pavement
2. Excavate depression for rain garden
3. Plant garden, replace sidewalk if necessary

Suttons Bay Beach, Traverse City, Michigan BMP System: Raingardens



Southwest corner of Madison and
St. Joseph Ave (M-22)



Southwest corner of St. Mary's Ave and
Broadway Ave

Suttons Bay Beach, Traverse City, Michigan BMP System: Installation of Raingardens (before and after)



**Northwest corner St. Mary's and
Broadway Ave**

Suttons Bay Beach, Traverse City, Michigan BMP System: Installation of Raingardens (before and after)



Southwest corner Madison Ave and M-22

Suttons Bay Beach, Traverse City, Michigan BMP System: Installation of Raingardens (before and after)



**Broadway Ave, east of Elm
Street**

Suttons Bay Beach, Traverse City, Michigan BMP System: Infiltration Trenches



Where:

- Alleys: Broadway-Madison Ave, Madison-Jefferson Ave
- Front Street: Broadway-Jefferson, Grove-Adams Street

Suttons Bay Beach, Traverse City, Michigan BMP System: Installation of Infiltration Trenches



Suttons Bay Beach, Traverse City, Michigan BMP System: Installation of Infiltration Trenches

Trench installation



Oil/grit separator



Suttons Bay Beach, Traverse City, Michigan: Maintenance, Things to Consider, and General Observations

- Rain Gardens

- ✓ Watch closely the first few weeks, note where water is coming in and look for erosion
- ✓ Rocks will be helpful around inlets to rain garden and storm drains
- ✓ Mulch will float until a mat forms, some will be transported into pipe
- ✓ Clean storm inlets regularly
- ✓ Look for erosion around where current will be strongest
- ✓ Leaves will run into rain garden and clog inlets to storm drains

- Infiltration Trenches

- ✓ Oil grit separators must be cleaned periodically
- ✓ Trenches must be power washed and vacuumed out at least yearly

- Helix Filters

- ✓ Test effectiveness
- ✓ Filter cartridges need replacing eventually



Above: Note floating mulch, gullies in newly planted gardens

Left: Mulch and leaves blocking overflow inlet to drain system

Stomping out *E. coli*!



<https://www.youtube.com/watch?v=GoCEsXTgKxI>.

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*Healthier Beaches -
Using Sanitary Surveys
to Mitigate Pollution*