BENTHIC MACROINVERTEBRATE ASSESSMENT

For Waukegan Harbor Citizens Advisory Group

By Huff and Huff, Inc.

OUTLINE

- Purpose and Need

- Site Location

- Macroinvertebrates

- Goals
  - Assess Bowen Park Glen Flora Tributary
  - Assess Dunal Area

- Information Obtained
  - Baseline physical and biological data
  - MIBI and MBI Scores

PURPOSE

- Macroinvertebrates are used to assess water quality

- WHCAG wanted to have a baseline inventory of macroinvertebrate data
    - Assess Glen Flora tributary and Dune/Swale complex
    - Provide recommendations based on data

WHAT ARE MACROINVERTEBRATES?

– Animals without backbones living in streams, rivers, lakes, and ponds

– Visible to the naked eye

– Includes aquatic insects, crustaceans, snails/clams, and worms

– Macroinvertebrates are commonly used to assess water quality due to their 1-2 year life cycles, presence in most waterbodies, diversity and abundance

– Varying degrees of sensitivity or tolerance

TOLERANCE

- "Tolerant" vs "Intolerant"

- Tolerant
  - Tolerant organisms can live in a large range of conditions
  - Are tolerant of degraded or disturbed habitats
  - Found in most streams

- Intolerant
  - Live in a limited range of conditions
  - Require higher quality streams, lakes or rivers
  - Generally prefer
    - High oxygen levels
    - Moving water
    - Large/Coarse substrates or mix of large/small
    - Less pollution
    - Less urban development

- Sensitive

INTOLERANT ORGANISMS- EPT

- Mayflies, Stoneflies, Caddisflies (Ephemeroptera, Plecoptera, Trichoptera) are the most sensitive orders of insects.

- High numbers of EPTs can be indicative of good water quality
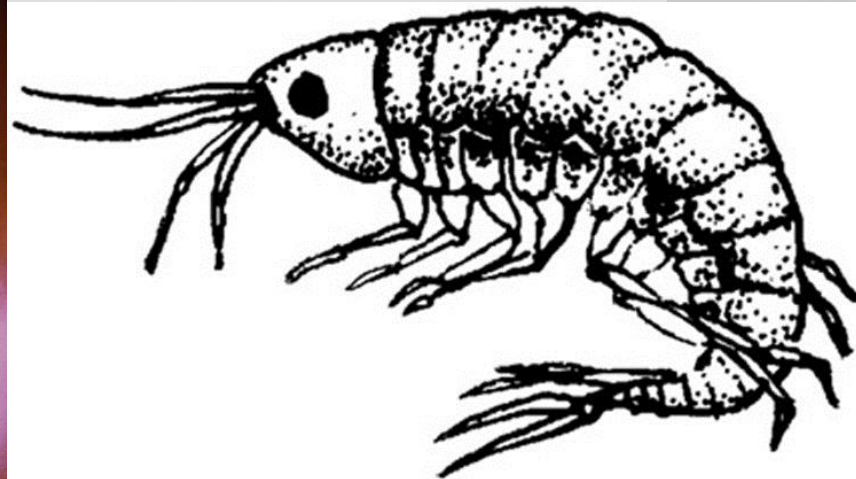   - Some EPTs are more sensitive than others
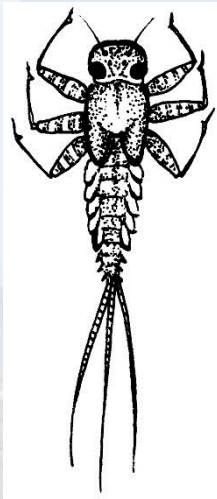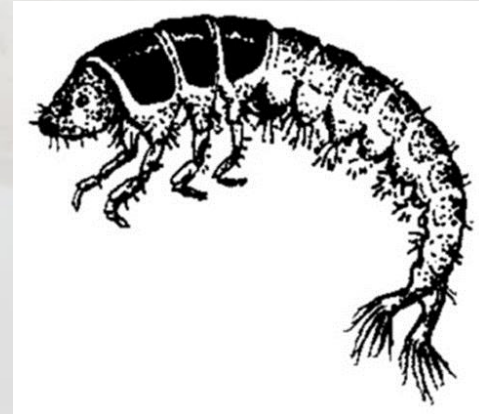
TOLERANT ORGANISMS

- Generally, aquatic beetles, midges, true bugs, some dragon/damselflies

- There are sensitive taxa from each group listed above but on average, these are the less sensitive groups

- Many tolerant organisms have alternate ways to get oxygen such as going the surface to collect an air bubble or having hemoglobin

- Many are also semi-aquatic and do not count towards the IEPA calculations for sensitivity
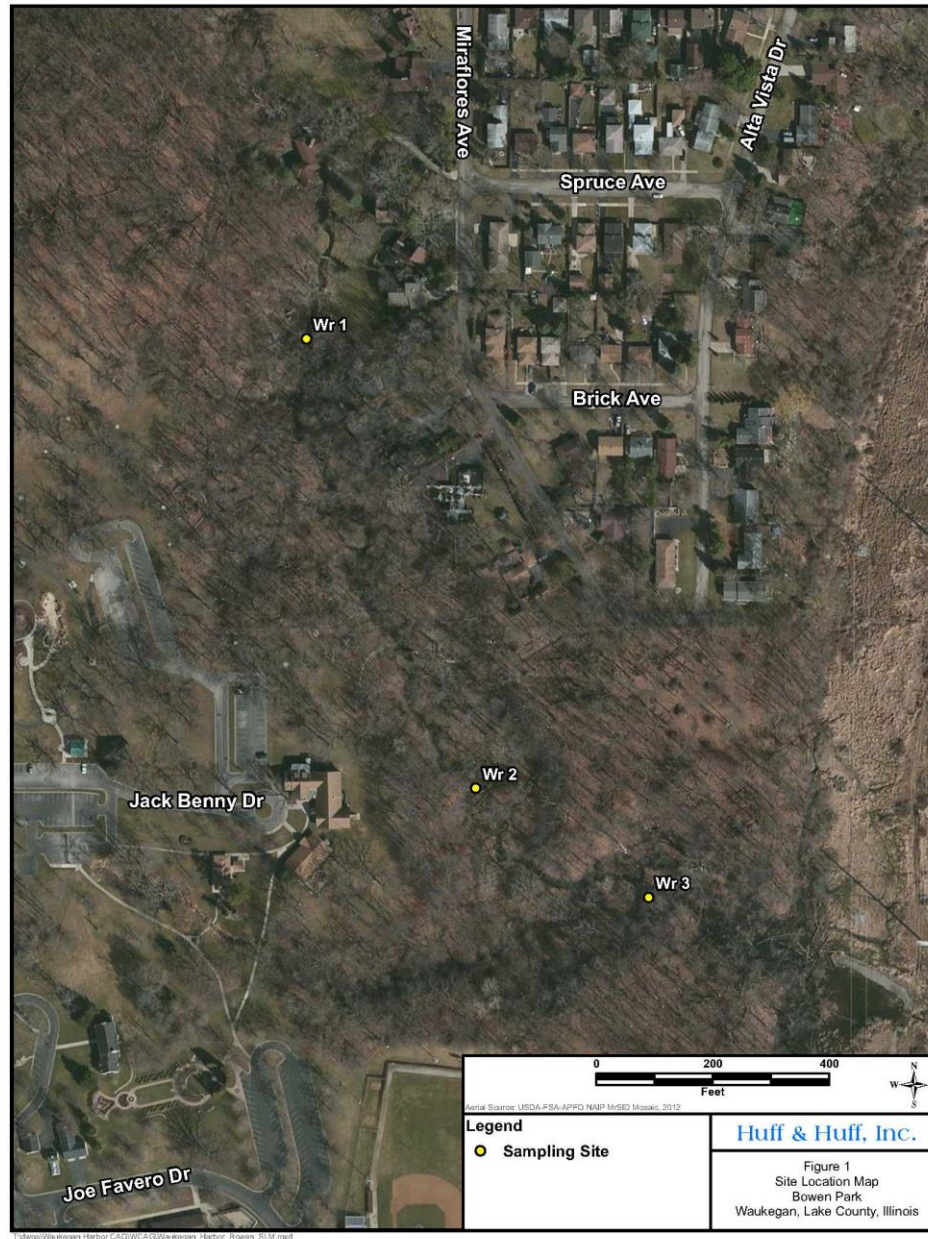

http://www.flycraftangling.com/

INTOLERANT ORGANISMS-
GAMMARUS

- Two major, non-invasive scuds
  - Gammarus found at all sites
  - IEPA tolerance value of 3
  - Most sensitive taxa found

SITE LOCATION MAP- BOWEN PARK

Figure 1
Site Location Map
Bowen Park
Waukegan, Lake County, Illinois

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WR-1
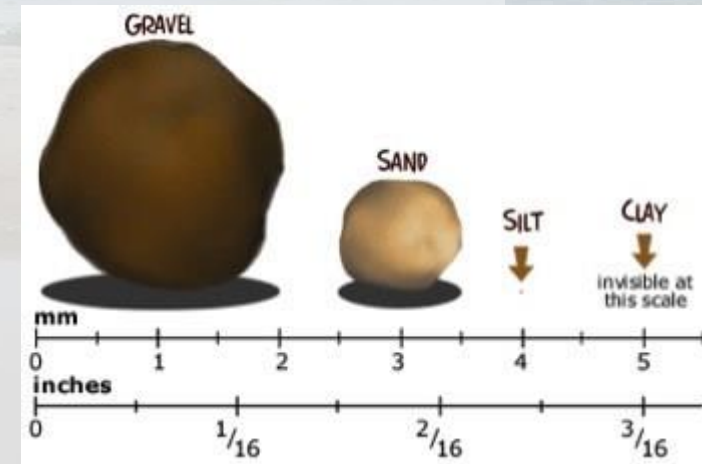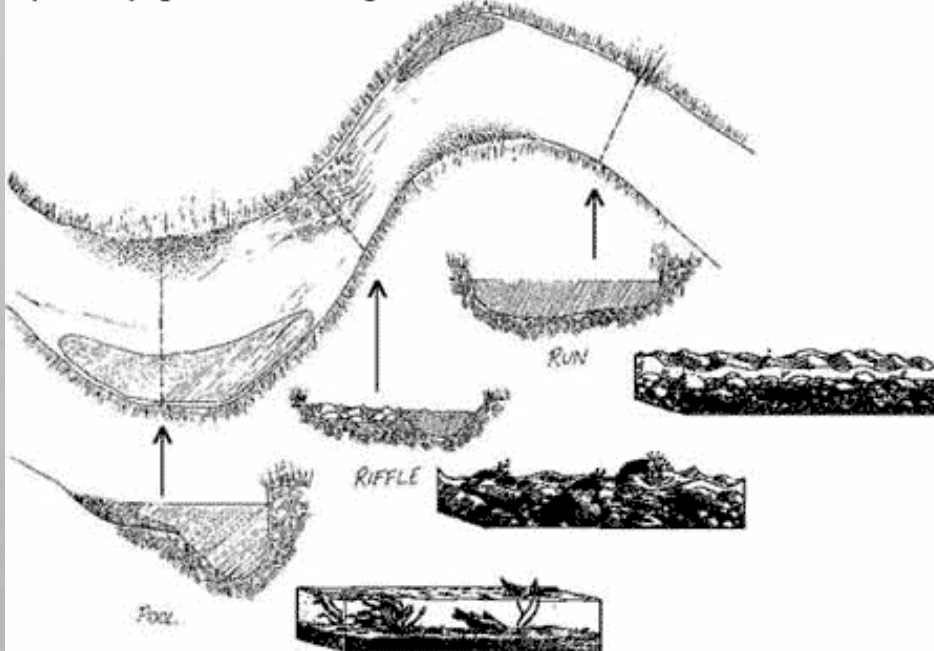

Characteristics
- Cobble, gravel, sand substrate
- Riffles

Substrate and importance of in-stream habitat

- Riffles generally have
  - Faster flowing water
  - Turbulence
  - More oxygen is mixed into the stream
  - Coarser substrate
  - Therefore, more sensitive/intolerant macroinvertebrates

http://img.geocaching.com/cache/large/6107ed1e-f5d7-4e74-9e2b-08dda01d72af.jpg

http://www.epa.gov/owow/monitoring/volunteer/stream/vms41.html

- Pools generally have
  - Slower flowing water
  - Less dissolved oxygen
  - They are important for fish
  - Less likely to dry out so important summer refuge

WR-2

Characteristics
- Gravel ,sand substrate
- Riffles
- Pool
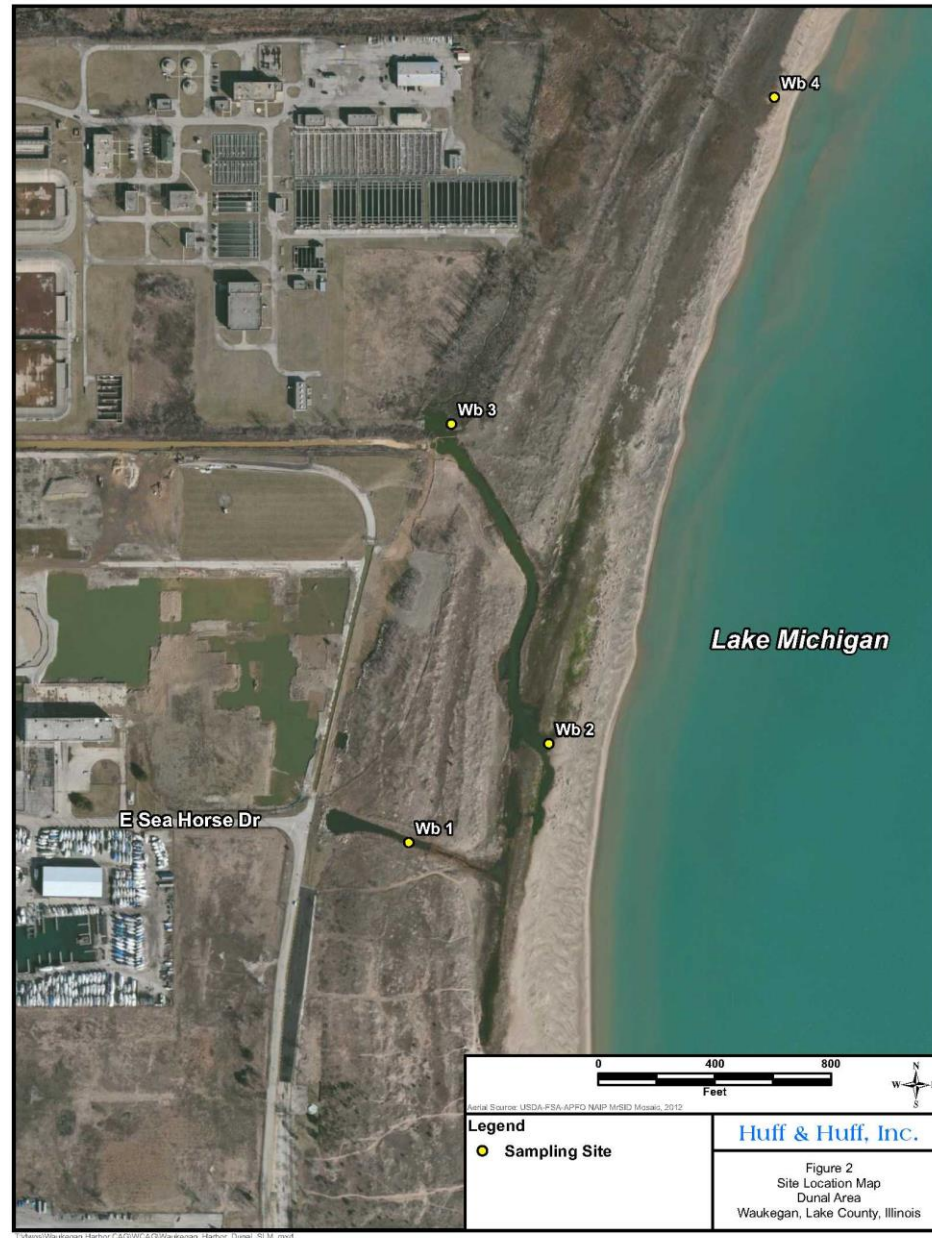- Woody debris
- Bank erosion

WR-3

Characteristics

- Silt substrate
- No riffles
- Non-flowing water
- Unstable banks

SITE LOCATION MAP- DUNAL AREA

Lake Michigan

E Sea Horse Dr

Wb 4
Wb 3
Wb 2
Wb 1

| 0 | 400 | 800 |
Feet

Aerial Source: USDA-FSA-APFO NAIP MrSID Mosaic, 2012

Legend
○ Sampling Site

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Figure 2
Site Location Map
Dunal Area
Waukegan, Lake County, Illinois

T:\dwgs\Waukegan Harbor CAD\WCAG\Waukegan_Harbor_Dunal_SLM.mxd

WB-1

Characteristics
- Sandy-silty substrate
- Slow, stagnant water
- Good vegetative habitat

WB-2

Characteristics
- Sandy substrate
- Slow, stagnant water
- Very little in-stream habitat

WB-3

Characteristics

- Sandy substrate
- Slow, stagnant water
- Extremely high vegetative habitat, not very diverse
- Good woody debris habitat

WB-4

Characteristics
- Sandy substrate
- Slow, stagnant water
- Debris cover
- Connection to well oxygenated Lake Michigan water in spring

Qualitative Habitat Index (QHEI)

- QHEI scores calculated using the Ohio EPA methodology.

- The swale sites do not have riffles, one of the major metrics used to calculate the QHEI and have lower scores as a result.

Site	QHEI Score	Narrative Rating
WB-1	31	Poor
WB-2	34	Poor
WB-3	41	Poor
WB-4	40	Poor
WR-1	73.5	Excellent
WR-2	71	Excellent
WR-3	43	Fair

Narrative Rating	QHEI Range	
	Headwaters	Larger Streams
Excellent	≥70	≥75
Good	55 to 69	60 to 74
Fair	43 to 54	45 to 59
Poor	30 to 42	30 to 44
Very Poor	<30	<30

METHODOLOGY

- IEPA Methodology
  - Used to assess streams and rivers (riffle/run sequence)
  - We used to assess swales as well
    - No current state specific pond/swale methodology

- Dnet
  - 20 jabs
  - Take jabs in different habitat types
  - Effort allocated based on percentages of habitat type

- Samples identified in the laboratory

MBI

- Macroinvertebrate Biotic Index

- Calculated using numerical rating of each taxa

- Used throughout U.S. for stream health evaluations

- Each taxa has a value from 0 to 11 with 0 being most sensitive and 11 being least

- A lower MBI score is better
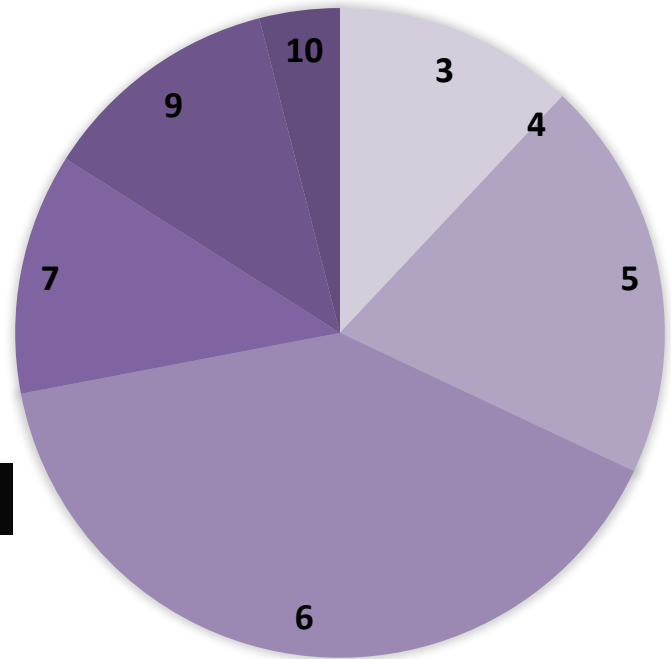
MBI Results

FIGURE 3.2
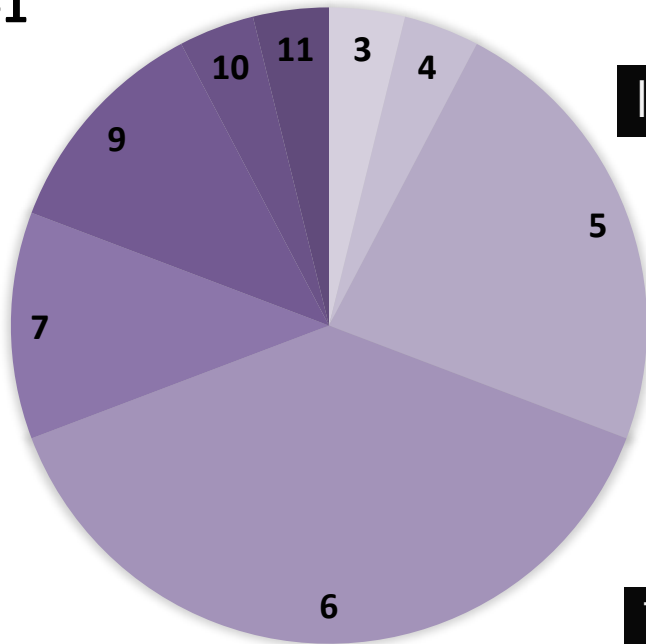MBI SCORE BY SITE AND DATE

BEACH SITES-IEPA VALUES

- IEPA Values range from 0 to 11
  - 0 to 3 are considered intolerant
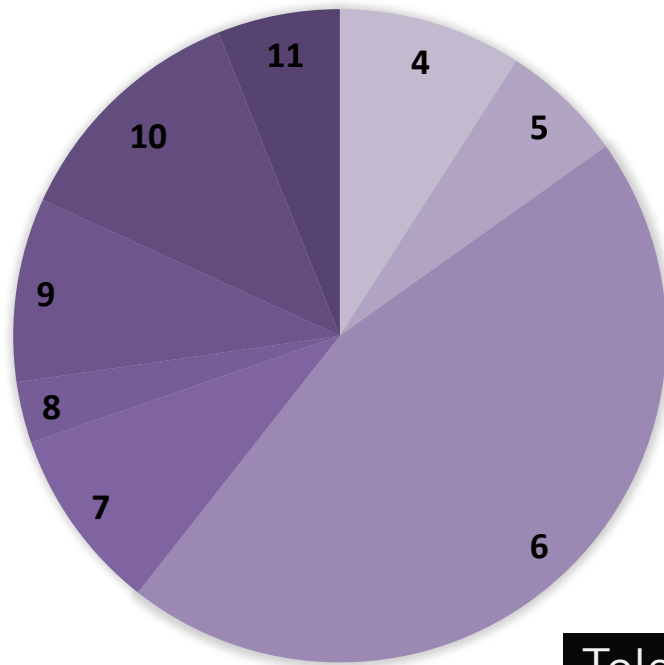
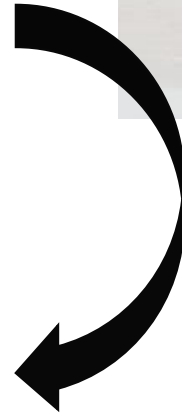**WB-2**

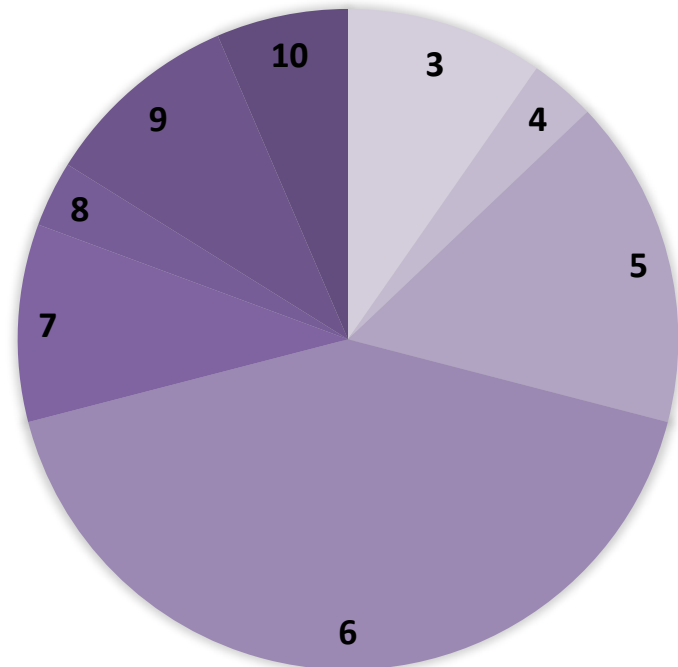**WB-1**

Intolerant

Tolerant

BEACH SITES-IEPA VALUES

BOWEN PARK SITES-IEPA VALUES
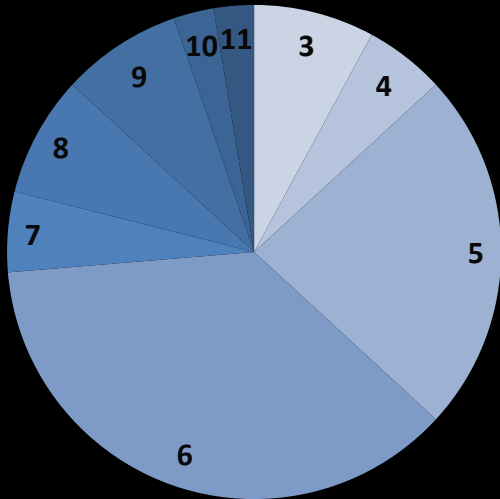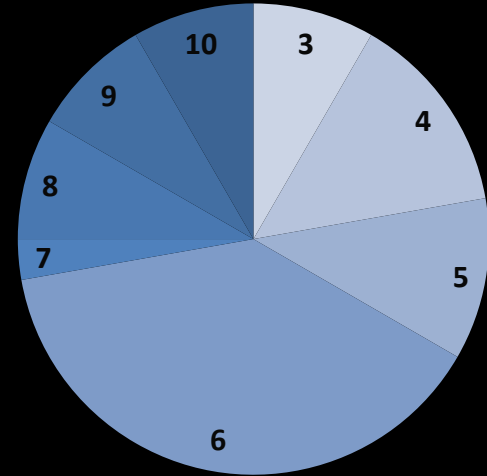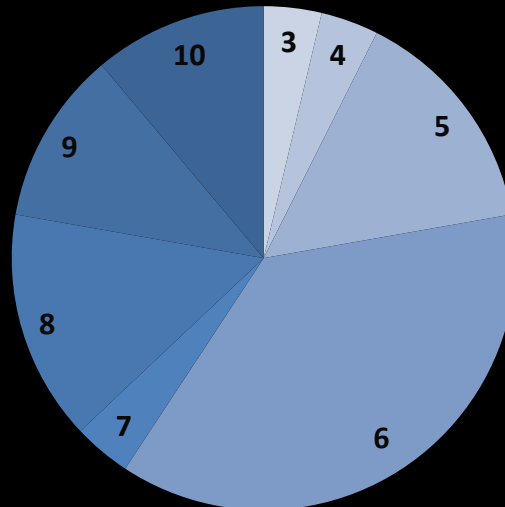
MIBI

- Macroinvertebrate Index of Biotic Integrity
- Illinois Environmental Protection Agency (IEPA)
- Multi-metric evaluation
- Preferred in Illinois due to resolution of detail
- A higher MIBI score is better

Lower Boundary Score	Upper Boundary Score	Comparison to Reference Conditions	Narrative description
73	100	> 75th Percentile	Exceptional
41.8	72.9	> 10th Percentile	Good
20.9	41.7	Bisects 10th percentile (Upper)	Fair
0	20.8	Bisects 10th Percentile (lower)	Poor

MIBI

- Total Number of Taxa

- Number of Coleoptera (Beetle) Taxa

- Number of Ephemeroptera (Mayfly) Taxa

- Number of Intolerant (as designated from IEPA list) Taxa

- Macroinvertebrate Biotic Index

- Percent individuals as Scrapers (as designated from IEPA list)

- Percent individuals as Ephemeroptera, Plecoptera (stonefly) or Trichoptera (caddisfly)

TABLE 2.1 BEST METRIC VALUES FOR MIBI	
Metric	Response to Disturbance
Coleoptera Taxa	Decrease
Ephemeroptera Taxa	Decrease
Total taxa	Decrease
Intolerant Taxa	Decrease
MBI	Increase
Percent Scrapers	Decrease
Percent EPT Taxa	Decrease

MIBI Results

FIGURE 3.1
MIBI SCORE BY SITE AND DATE
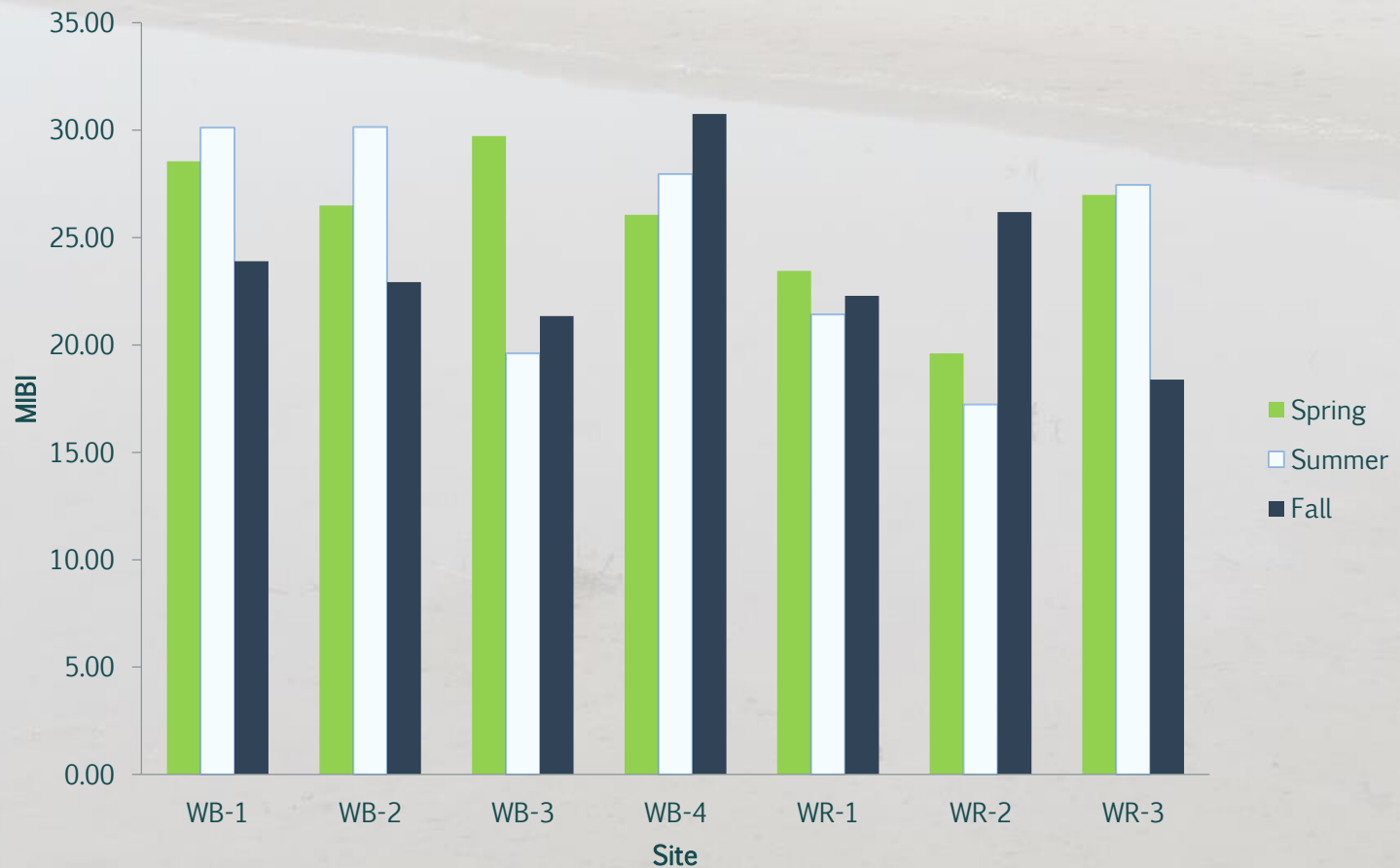
MIBI

MIBI						
Site	Spring	Summer	Fall	Average	Total	MIBI Narrative Description
WB-1	28.55	30.12	23.89	27.52	32.41	Fair
WB-2	26.49	30.15	22.93	26.52	31.43	Fair
WB-3	29.72	**19.61**	21.35	23.56	31.00	Fair
WB-4	26.06	27.96	30.76	28.26	32.83	Fair
WR-1	23.44	21.42	22.29	22.38	27.06	Fair
WR-2	**19.60**	**17.23**	26.19	21.01	29.87	Fair
WR-3	26.99	27.45	**18.39**	24.28	27.97	Fair

Bold denotes poor MIBI narrative description

| Lower Boundary Score	Upper Boundary Score	Comparison to Reference Conditions	Narrative description
73	100	> 75th Percentile	Exceptional
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OTHER METRICS

Site	Number of Unique Taxa	Number of individuals	Number of Coleoptera	Number of Ephemeroptera	Number of intolerant taxa	Percent lentic*	Percent lotic*	Lotic and Lentic*
WB-1	13	262	0	1	1	6.5	0.0	44.7
WB-2	13	179	0	1	1	5.5	0.0	59.5
WB-3	17	291	0	2	0	4.5	0.0	72.1
WB-4	18	286	1	0	1	6.1	0.0	34.1
WR-1	20	407	2	0	1	2.6	12.1	16.9
WR-2	20	754	2	1	2	0.8	3.0	26.0
WR-3	15	611	0	0	1	0.8	0.0	65.3

*Lentic and lotic percentages do not add up to 100% because all taxa have not been categorized

CONCLUSIONS

- Sites had similar MBI and MIBI scores.

- Lentic (still waters) and lotic (flowing waters) taxa indicate flow regime
  - Only one site is likely to be flowing year round (WR-1 was the only site with significant lotic taxa)
  - Rest of sites are mostly taxa without strong flow preferences

- The river sites and WB-4 had the greatest richness (number of unique taxa)

- The river sites had the greatest abundance (number of individuals)

- None of the sites had more than 1-2 intolerant taxa (IEPA value of less than 3)
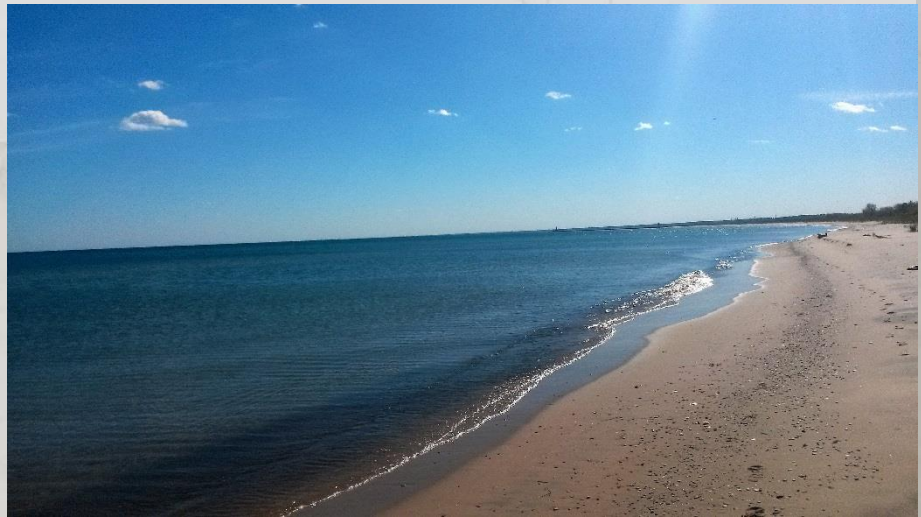
RECOMENDATIONS

- Swales
  - High spring MIBI scores
    - Two potential reasons
      - Lake Michigan water
      - Lack of predation
    - Large scud community
    - WB-4 had 100 scuds in the spring sample
  - Low fall scores
  - Low overall macroinvertebrate density
    - Almost all predatory insects in summer/fall
    - Need to increase food base to increase overall abundances
  - Very dense filamentous algae community

- Vegetation
  - Native plugs
  - Already burning invasive plants
  - **Need** to remove dead *Phragmite*s from swales

- Nutrients

- Habitat
  - Driftwood common in great lakes
  - Redistribute or add rootwads (more complex habitat)
  - Understand seiches, wave action might move or remove it

RECOMENDATIONS

- Glen Flora tributary
  - Good riffles and substrate at 2/3 sites
  - Scuds (every sites) and intolerant dragonfly (only 1 at WR-2 fall sample)
  - Water levels decrease drastically in late summer

- Bank Stabilization
  - High sediment loads from steep, unvegetated banks
  - Might be natural part of ravine system

- Flow
  - Maybe the flow regime is similar to historical flow regime
  - Hydrological study (gauges) would confirm
  - Less flow in late summer/fall, less riffles

- Deeper Pools
  - Provide refuge during summer
  - Natural pools probably getting buried by sediment

- Woody Debris
  - Some sites with good amounts of woody debris already
  - Don't want dams, strategically place

http://www.marylandinsects.com/images/Plathemis_lydia_nymph_Farm_Pond_West_Friendship_Park_26-Apr-14.jpg

QUESTIONS?