FACT SHEET

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Grand Traverse Bay
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# WATER QUALITY SUMMARY
## Grand Traverse Bay

Overall, the prevailing opinion among experts is that the water quality in the Grand Traverse Bay is excellent, but there are several potential threats to that quality. Excessive nutrients and toxic contaminants from runoff are just two examples of potential threats to the bay. For the most part, the Grand Traverse Bay is typical of other oligotrophic embayments in the Great Lakes; deep, clear, cold, with an overall low productivity.

The following tables highlight some of the most recent findings on various aspects of water quality in the Grand Traverse Bay. The information was summarized from the following publications:

- State of the Bay 2000
  - A collection and summary of publications and ongoing research studies and information about the Grand Traverse Bay and its watershed; please see publication for specific details and references (State of the Bay 2000).
- Integrated Habitat and Water Quality Inventory for the Grand Traverse Bay – 2000
  - Research Great Lakes Environmental Center (GLEC) completed for The Watershed Center
    *Included historical information from the following reports:*
    - The Limnology of Grand Traverse Bay, Lake Michigan (Auer et al., 1975)
    - Some Aspects of the physical Limnology of Grand Traverse Bay (Lauff, 1957)
    - Final Report for the Grand Traverse Bay Watershed Initiative: Part II, Water Quality of the Bay and Tributaries (Shuey et al., 1992) (Note: The Grand Traverse Bay Watershed Initiative has changed names to The Watershed Center Grand Traverse Bay)
    - The Acme Creek Ecological Project: Natural Features Inventory and Land Management Plan (GLEC 1994)
    - Peshawbestown and Omena Bay Baseline Water and Sediment Quality Study (GLEC 1998)
- Stormwater Source Identification, Sampling and Analysis at Select Storm Drains and Tributaries to Grand Traverse Bay (Lake Michigan) – 2001
  - A stormwater and stormdrain study GLEC completed for The Watershed Center
- Information obtained from other sources is noted where necessary.

Results from these and other research projects in the Grand Traverse Bay are also found in The Watershed Center's online interactive water quality database at www.gtbay.org/wqquery.asp. This database was designed to provide a

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comprehensive storehouse of available water quality data, collected by The Watershed Center, volunteer monitoring projects, researchers from universities, and other organizations, for the entire Grand Traverse Bay watershed. Users can search for specific results by parameter (nitrogen, phosphorus, etc.), report, or location.

**Water Clarity (Dissolved Oxygen – DO, Temperature, Secchi Disk)**

- DO and temperature indicate little stratification
- DO at or near saturation most of year
- Secchi Disk, Transparency –

The Secchi disk is a measure of water transparency, which is directly linked to inorganic suspended solids and plankton abundance. Transparency and secchi disk readings vary throughout year, with generally greater readings in Spring.

  - Transparency exceeds 7-8m
  - Average water clarity increased 20% from 1990-2000 in West Arm of Bay
  - 1957-10.5m (34ft); 1975-7.0m (23ft); 1992-5.7m (19ft); 1999-8.5m (28ft); Spring 2000 (Inland Seas Education Association): 9.8m (32ft) lower West Bay, 11.6m (38ft) Suttons Bay; Summer 2002 (GT Bay Power Squadron): 12.2-14.3m (40-47ft)
  - Increase in water clarity attributed to decrease in plankton community and introduction and proliferation of zebra mussels in the bay

**Sediment**

- Quality is good, typically coarse sand with numerous areas of cobble and gravel; at 100+ft depth the bottom is silt and clay
- Increases in silt and organic detritus along nearshore bottom
- Isolated areas that are relatively rich in inorganic matter (i.e., Omena Bay)
- Sediment does not contribute significant concentrations of nutrients to water column; most of the phosphorus in the sediment is organically bound
- There are few rooted macrophyte beds (possibly due to lack of suitable substrate)
- Seiche events (which are large scale periodic movements of water) can re-suspend sediments in deeper portions of the bay. If carried into the water column, they can release contaminants deposited decades ago.

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**Nutrients**

- Nutrients are relatively low (have continually declined since the 1970's), overall productivity low
- Urban tributaries and stormwater drains are a significant source of nutrients to the bay
- *Total Phosphorus(TP):* Growth limiting nutrient for the bay
  - TP higher at nearshore than offshore: nearshore average = 4.6ug/L, offshore average = 2.8ug/L
  - Continued decline since early 1970's: 1975 - 7.8ug/L, 1992 – 5.4ug/L, 1994 – 4.9ug/L, 1998 – 3.8ug/L, 1999 – 3.0ug/L
  - Significant differences between offshore surface and bottom samples in Omena Bay (due to sediment quality and incomplete mixing of Omena Bay with GT Bay): Spring 1999- 2ug/L at surface; 64ug/L at 80ft
  - Significantly higher levels of TP at mouth of Boardman River and Acme Creek
  - Highest concentration of TP are found at stormwater outfalls, *See Table 2 in State of the Bay 2000*

**Nutrients Cont'd**

- *Nitrate:* Not a growth limiting nutrient for the bay, sufficient quantities for growth
  - Generally higher in offshore near bottom than surface samples (except in Omena Bay)
  - 1998 – 0.2mg/L (0.25mg/L in W Bay), measurements similar to historical readings

**Weed and Macrophyte Beds**

- Weed bed numbers have nearly doubled from 64 growth areas (in 1991) to 124 areas (in 1998). These numbers are still low overall compared to the size of the bay, however, there should be some concern that numbers have doubled in the span of 8 years.
- Growth is most concentrated at South end of West Bay (an area with higher amount of phosphorus entering the bay) which is influenced by rapid development; nutrient inputs and the amount of water flushing an area were most important determinants for locations of beds

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## *Escherichia coli*

*Note: EPA recommends measuring recreational water quality by the abundance of Escherichia coli (E.coli): Water is unsafe for swimming if measurements are either 1) 130+colonies/100mL in 5 samples over 30-day period or 2) 300+colonies/100mL in any 1 sample*

- *E. coli is common intestinal organism so its presence indicates that fecal pollution has occurred. However, the kinds of E. coli measured in water don't generally cause disease. Organisms from fecal pollution that do cause disease are called **pathogens** and include a variety of other bacteria, viruses, protozoa, and small worms.*
- *EPA studies indicate that when E. coli exceeds set standards, there is an increased risk of gastroenteritis from pathogens carried in fecal pollution.*

- Sources of *E. coli* and fecal pollution include: urban runoff, inadequately treated wastewater, agricultural runoff, illegal sewage discharge from boats, and animal waste (house pets, waterfowl, etc.)
- Significant potential for fecal contamination following storm events; extremely high concentrations of *E. coli* and *Enterococci* were noted during some wet weather samples (For example: November 2000 *E. coli* = 15,300 colonies/100mL in Bryant Park; 80,000 colonies/100mL in East Bay Park) *See Table 2 in State of the Bay 2000*
- Summer storm events have potential for significant public health risk at local beaches because of stormwater outfalls and urban tributaries: At risk= West End, Clinch Park, and Bryant Park Beaches; East Bay Park; Elk Rapids City Park; Northport Beach; Southshore Park Beach (Suttons Bay); and waterfront homes near urban areas such as Traverse City

## Climate

- Significant changes in dates of freeze-up and break-up of Grand Traverse Bay between 1851-1993
  - Average freeze-up date is 12 days later
  - Average break-up date is 19 days earlier
  - 2002 was the 6$^{th}$ consecutive year of the bay not freezing over in the past hundred years of record; the bay froze over in 2003

## Endangered and Exotic Species

- Five federally listed endangered or threatened species in the watershed (+1 candidate): Bald Eagle, Kirtland's Warbler, Piping Plover, Pitcher's Thistle, Michigan Monkey Flower, Eastern Massasauga Rattlesnake
- Two new exotic species found in Bay since 1999: Fishhook Water Flea and Rusty Crayfish (since 2000, the Spiney Water Flea has been discovered)
- Other current exotic species in the bay include: sea lamprey, zebra mussels, Eurasian Ruffe, alewife

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**Minerals**

- Levels of Calcium, Magnesium, Sulfates, and Chlorides are typical of high quality freshwater lakes, no suggestion of water quality degradation
- Concentrations are all consistent among sampled sites and years

**Heavy Metals**

- Cadmium, Chromium, Lead, Zinc, Nickel: all relatively low, consistent with other lakes
- Copper decreased by 60% => 1ug/L (1975), 0.4ug/L (1998)
- Mercury levels low => 0.26ng/L, slightly higher at South end of West Arm and North end of East Arm; because of loadings from Boardman and Elk River

**Silica**

- Found in colloidal and suspended matter or in biomass (diatoms)
- Declined dramatically in past 40yrs: 1957 - 3.6mg/L, 1976 - 0.423mg/L, 1992 - 0.410mg/L, 1998/9 - 1.06mg/L

*Silica occurs naturally in the water; it is an essential element used by diatoms (planktonic organisms) for cell structure.*

**Chlorophyll a**

- Pigment found in plants that is necessary for photosynthesis. Measurements of chlorophyll a indicate the amount of suspended algae
- Relatively low readings, varies with seasons
- No significant change since 1975
- Overall Bay chlorophyll a average = 1.04ug/L
- Even though slight increases have been shown for chlorophyll a, the bay is still oligotrophic with overall low productivity

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**Phytoplankton, Zooplankton, and Fish**

- Phytoplankton
  - Greatest abundance in Spring, 21 total species observed in study; dominant ones typical of oligotrophic systems
  - Historically: Auer 1957 stated West Arm transitioning towards eutrophication
  - Current: West Arm has more organisms/liter than East Arm in late summer, this *suggests* more nutrients available in West Arm and a higher level of eutrophication
  - Overall samples taken have been typical of oligotrophic systems and there is no suggestion of eutrophication
- Zooplankton
  - Assemblages are similar to those typically found in Lake Michigan and Great Lakes
  - Diporeia: As in the rest of Lake Michigan, there are declining levels in Grand Traverse Bay (correspondence with Inland Seas Education Association), however, they have not been studied extensively here.
    - Diporeia is a quarter-inch long shrimp-like creature that lives in the sediment at the bottom of most of the Great Lakes. They are considered one of the basic building blocks of the Great Lakes food chain. Researchers used to find 10,000 diporeia in a square yard of sediment. Today researchers are finding only hundreds in a square yard and sometimes finding none at all. Severe declines in diporeia populations will have an effect on Lake Michigan food webs and fish populations (like whitefish or lake trout), either starving some of them or resulting in lower fish weights and size.
- Fish
  - Approximately 39 species of native and non-native fish live in Bay; diverse assortment of other insects and invertebrates