SECTION 1
PURPOSE AND ORGANIZATION

Weston Solutions, Inc. (WESTON) has developed this Conceptual Field Monitoring and Sampling Work Plan (Work Plan) to conduct an assessment of Bay Harbor Lake in Bay Harbor, Emmett County, Michigan. This Work Plan was prepared under the Superfund Technical Assessment and Response Team (START) Program, Contract 68-W-00-119, Technical Direction Document (TDD) S05-0409-006. This Work Plan was developed in cooperation with personnel from the United States Environmental Protection Agency (U.S. EPA), the United States Fish and Wildlife Service (U.S. FWS), the Michigan Department of Environmental Quality (MDEQ), the Little Traverse Bay Bands of Odawa Indians, the Northwest Michigan Community Health Agency, the Michigan Department of Community Health, the Tip of the Mitt Watershed Council, CMS Energy (CMS), the Bay Harbor Company, and private stakeholders (AssessmentTeam).

This Work Plan details a phased approach for the Bay Harbor Lake assessment, consistent with the consensus of the parties named above. Phase I of the Work Plan consists of shoreline monitoring activities, a dive team visual survey of lake conditions, and an evaluation of an unknown white substance previously observed within Bay Harbor Lake. Based on the results of the Phase I activities, additional phases of assessment activities (Phase II and Phase III) may be implemented, including the potential collection of surface water samples.

1.1 SITE BACKGROUND

1.1.1 Site Description

Bay Harbor Lake is an approximately 90-acre (3,920,000 square feet) fresh water lake located within the Bay Harbor residential/commercial development in Resort Township, Emmet County, Michigan (Township 34N, Range 6W, Sections 3 and 10).

From east to west, Bay Harbor Lake is approximately 3,600-ft long at its longest point. From north to south, Bay Harbor Lake is approximately 1,200-ft wide and the maximum depth of the lake is approximately 80 ft. Bay Harbor Lake is connected to Lake Michigan through an approximately 120-ft wide man-made channel along the north-central portion of the lake. This entry channel is protected by a rip-rap breakwater wall.

The area surrounding Bay Harbor Lake consists of single-lot residential properties, a mixed residential/commercial zone (including a swimming beach), private yacht club property (including docks extending approximately 365-ft into Bay Harbor Lake), approximately 120 private docks, a boat launch ramp, and a recreational golf course development. An unnamed creek (referred to as East-Unnamed Creek #2) is located approximately 180-ft west of Bay Harbor Lake. The golf course development to the west of Bay Harbor Lake was built over top of a large cement kiln dust (CKD) pile, known as the Seep 1 CKD Pile. At its closest point, the Seep 1 CKD Pile is located within 200-ft of Bay Harbor Lake.

1.1.2 Site History

Bay Harbor Lake is located in an area that was previously utilized for mining and cement manufacturing operations. Bay Harbor Lake itself was formerly referred to as the Central Limestone Quarry. Bay Harbor Lake was created in 1995, as a part of the property's redevelopment as the Bay Harbor Resort. The rock wall that formerly separated the quarry area from Lake Michigan was demolished, allowing water from the Little Traverse Bay of Lake Michigan to fill the former quarry and form Bay Harbor Lake.

1.1.3 Previous Investigations

Routine water quality monitoring and sampling has been conducted by various parties over the past several years. Since May 13, 2004, five separate field monitoring/sampling events have been conducted. Field activities have varied from surface water pH monitoring to sampling and analysis for pH, chloride, nitrate, total nitrogen, phosphorous, specific conductivity, ammonia, coli form, E. coli, and gasoline constituents. The results of these monitoring activities were compiled by the Bay Harbor Company and are presented within Attachment A.

Water quality monitoring/sampling activities from previous investigations have not identified any elevated parameters associated with CKD leachate (such as elevated pH or specific conductivity). However, the scope of the previous monitoring and sampling activities has been limited and the consensus of the Assessment Team is that a more comprehensive phased assessment is appropriate to determine if potential CKD leachate has impacted Bay Harbor Lake. Therefore, the phased monitoring/sampling activities detailed in this Conceptual Work Plan will be implemented.

1.2 WORK PLAN OBJECTIVES

The overall objective of the Work Plan is develop a phased approach for assessment activities that will provide public health officials and members of the public with the data appropriate to determine whether CKD material and/or CKD leachate are present within Bay Harbor Lake.

This Work Plan presents a phased approach for the implementation of assessment activities. The aspects of the various phases of the assessment are discussed below:

- **Phase I Assessment – Shoreline Water Quality Survey and Diver Visual Survey**
    - Conduct water quality monitoring along the entire shoreline of Bay Harbor Lake

    - Conduct visual survey of lake bottom with a certified dive team
    - Conduct evaluation of unknown white substance previously observed within Bay Harbor Lake

- **Phase II Assessment – Targeted monitoring of locations of interest identified during Phase I**
    - Diver-assisted water quality monitoring

- **Phase III Assessment – Potential Tasks Include Water Column Monitoring, Analytical Sampling, and Diver-assisted Taxonomic Characterization.**
    - Vertical water column monitoring
    - Targeted sampling of lake water
    - Diver assisted taxonomic characterization

1.3 WORK PLAN ORGANIZATION

This Work Plan is divided into three sections including:

Section 1- The Purpose and Organization Section presents an overview of the purpose of the assessment and site background and history.

Section 2- The Scope of Work Section presents a detailed discussion of the phased assessment activities and provides the field monitoring/sample collection procedures that will be utilized through the implementation of the Work Plan. This section also defines the conditions under which subsequent phases of assessment work will be implemented.

Section 3- The Schedule Section provides a schedule for assessment activities.

SECTION 2
SCOPE OF WORK

2.1 BAY HARBOR LAKE ASSESSMENT PLANNING

The Bay Harbor Lake assessment planning will include the following efforts:

Meetings/conference calls for Work Plan Approval
Meetings/conference calls for Assessment Activities Coordination
Meetings/conference calls for Assessment Phase Progression

In general if all parties are not available for meetings, conference calls may be utilized for planning purposes.

2.1.1 Meetings/Conference Calls – Work Plan Approval

It is anticipated that the Assessment Team will meet at least one additional time final Work Plan prior to its implementation. Following this meeting/conference call, the Work Plan will be updated and distributed to the parties. Additional meetings may be scheduled on an as needed basis. Representatives from the following parties will be invited to the meetings: U.S. EPA (and consultants); U.S. FWS, CMS (and consultants); Bay Harbor Company (and consultants); MDEQ; Little Traverse Bay Bands of Odawa Indians; Northwest Michigan Community Health Agency; Michigan Department of Community Health, Tip of the Mitt Watershed Council; and other private stakeholders.

2.1.2 Meetings/Conference Calls – Assessment Activities Coordination

At least one week prior to the planned start date of Phase I assessment activities, the Assessment Team will meet to discuss the coordination of resources and equipment. Prior to this meeting, the parties will provide a list of equipment, personnel, and services that each is capable of committing to the assessment. The resources will be evaluated and any additional resources required will be procured.

2.1.3 Meetings/Conference Calls – Assessment Phase Progression

Following the completion of Phase I activities, it is anticipated that the Assessment Team will meet to discuss the results of the Phase I assessment activities and the need to implement Phase II and/or Phase III assessment activities.

For logistical reasons, some activities will be conducted concurrently or within the same field mobilization, based upon the trigger conditions discussed within each phase of the assessment. Efforts will be made to keep all of the parties aware of any progression in the event that a Phase II or Phase III activity is completed during the Phase I assessment.

2.2 HEALTH AND SAFETY

It is anticipated that Bay Harbor Lake assessment activities can be completed under the existing Health and Safety Plans (HASPs) that were prepared by CMS and U.S. EPA consultants for the Little Traverse Bay CKD Release Site. HASP amendments will be prepared for assessment activities that are not already addressed within the existing HASPs (such as diving). All personnel participating in the assessment will be working under their own agency or organization's HASP.

2.3 COMMUNITY RELATIONS

The Assessment Team members have agreed and requested that the U.S. EPA shall be the spokesperson to address all inquiries from the Bay Harbor residents, the general public, and/or the media regarding the details of the assessment activities. All inquiries from the above parties shall be referred to OSC Ralph Dollhopf (231-301-0559). The Assessment Team field personnel will refer all inquiries on the Bay Harbor Lake Assessment activities to OSC Dollhopf.

2.4 BAY HARBOR LAKE ASSESSMENT

2.4.1 Phase I Activities

Phase I activities of the Bay Harbor Lake Assessment include the shoreline survey, diver visual survey, and unknown white substance evaluation tasks. These tasks will be completed in the following manner.

Shoreline Survey

The visual survey of the shoreline will be conducted by personnel walking or piloting a boat around the perimeter of the shoreline and collecting water quality measurements of the near-shore water. Water quality measurements will be collected every 25 feet around the perimeter of the lake as well as at any location where seeps, pools, or discolored lake water is observed at locations between the 25 foot measuring points. Water quality measurements will be collected using a YSI MPS 556 meter (or equivalent) and geographic coordinate data will be collected using a Trimble Pro XRS global positioning system (GPS) unit (or equivalent, capable of completing real-time differential correction of data). The shoreline survey will be conducted in the following manner:

- Prior to initiating the survey, the YSI Model 556 MPS Water Quality Monitoring System (or equivalent) will be field calibrated for pH and specific conductance. The pH calibration will be a 2-point calibration, with calibration points of pH 7 standard units (s.u.) and pH 10 s.u. The specific conductance calibration will be a single point calibration, calibrated to a standard of 1,412 microsiemens per centimeter. (µs/cm). Following the completion of each day's monitoring activities, a postmonitoring calibration check of the unit will be made using the same calibration standards. If multiple YSI units are utilized, all units will be calibrated using the same standards.

- The shoreline visual survey and any water quality monitoring will be completed under quiescent lake conditions. For the purpose of this Work Plan, quiescent lake conditions are defined as wave heights less than 2-inches. Based on the protected nature of Bay Harbor Lake, it is not anticipated that the quiescent lake condition requirement will restrict the execution of the Bay Harbor Lake assessment.

- Where access is possible, survey personnel will walk the perimeter of the Bay Harbor Lake shoreline, noting any areas where discolored lake water, pool, or seeps are present and will collect photo documentation and GPS coordinates for each area.

- At any area where discolored lake water, pools, or seeps are identified, water quality parameters will be monitored and recorded. In addition, water quality parameters will be monitored and recorded at 25-ft spaced monitoring intervals along the shoreline. The distance between monitoring points will be measured using a tape measure or equivalent measuring device.

- At each water quality monitoring location, the geographic coordinates will be recorded using the GPS unit. Specific conductance, pH, and temperature of the water at the monitoring point will be measured using a YSI Model 556 MPS Water Quality Monitoring System (or equivalent). The near-shore surface water monitoring point will be selected, to the extent possible, in water that is approximately 2 inches deep. If the 2-inch depth requirement cannot be met, the measurement point will be selected as close to shore as possible along the bottom and the approximate depth of the monitoring point will be recorded. The vertical profile of the water column at that location will be characterized in 5-foot intervals from the bottom.

- If elevated pH (i.e., pH >9.0) is measured at any location, additional measurements will be collected moving out into the lake approximately perpendicular to the shore at horizontal intervals of 5-feet. Measurements will continue to be made at 5-foot intervals out into the lake until pH <9.0 is measured.

- The following data will be recorded within a pre-numbered, site logbook using black or blue ink: the serial number of YSI monitoring system; lot number of calibration standards used; results of initial calibration; names and association of field monitoring personnel; the unique identifier of each monitoring location; the observed water quality parameters for each unique monitoring location; and the results of the post-survey calibration check.

Diver Visual Survey

An underwater visual survey will be conducted by a certified dive team to be provided by the U.S. EPA. Divers will conduct a visual inspection of the near shore and offshore areas of Bay Harbor Lake to identify locations of potential CKD leachate discharge. Suspect visual features (such as lake water/lake bottom discoloration, bedrock fracturing/dissolution cavities, visible groundwater upwelling, and the absence of aquatic vegetation, etc.) will be noted by dive team during the survey of the sidewalls and bottom of the former quarry.

The diver visual survey will be conducted in the following manner:

- A total of six transects from north to south will be visually surveyed by the dive team. The exact locations of the transects will be selected based on existing data and data collected during the shoreline survey portion of the Phase I assessment and a review of bathymetric data. Transect locations will be selected to optimize the likelihood of encountering CKD leachate seep areas. One of the north to south transects will be targeted along the western end of Bay Harbor Lake (the area closest to the Seep 1 CKD Pile). The number of transects may be adjusted based upon the variability of topography, variability in lake bottom material, and upon time allowances.

- A total of three transects from east to west will be visually surveyed by the dive team. Transect locations will be selected in the manner described above.

- Divers will visually survey the sidewalls and bottom of the former quarry and look for suspect features such as lake water/lake bottom discoloration, bedrock fracturing/dissolution cavities, visible groundwater upwelling, and the absence of aquatic vegetation, etc. The presence of suspect features will be communicated to the support boat via the diver communication system and the observations and GPS coordinates will be recorded in a logbook.

- The divers will conduct the visual survey using dry suits, full-face masks, and surface-supplied air. The air supply and hard-wired communication lines will be conveyed through an umbilical. This will enable the diver to describe observations to the surface support staff regarding bottom conditions, as well as streamline logistics regarding bottom time, etc. Moreover, the selected equipment will be safer as the divers using dry suits and full-face masks will be protected from potentially adverse environmental conditions. The diver will be carrying a pH electrode as part of the observational ensemble. The electrode will be coupled to a 100 foot line, which will be affixed to the umbilical, and a meter located onboard the diver boat.

In the event that any suspect features indicating the possible discharge of groundwater or CKD leachate are observed, the dive team will conduct the diver-assisted water quality monitoring portion of the Phase II assessment activities. For practical purposes (to eliminate the need for the diver to return to the surface), the diver will carry equipment necessary to complete Phase II activities during the execution of Phase I activities.

<u>Confirmation of White Substance Analysis and Characteristics</u>

Analysis of the white substance has been completed on behalf of Bay Harbor Company by Conestoga-Rovers and Associates (CRA) (Attachment B). A sample of the material will be collected to enable confirmation of the identification and characteristics of the white substance. This material will be observed under a microscope either on the dive boat or on-shore. Features such as cell walls, the presence of chlorophyll or chloroplasts, and other biological features will be recorded. If archived sample material is available from CRA's analysis of the material, the archived material will be compared to the material and data collected through the completion of this work plan.

2.4.2 Phase II Activities

Phase II activities of the Bay Harbor Lake Assessment include the diver-assisted water quality monitoring task. This task will be completed in the following manner.

<u>Diver-Assisted Water Quality Monitoring</u>

Through the completion of the Phase I tasks of the Bay Harbor Lake assessment, both the near-shore surface water and off-shore underwater visual conditions will be known. Based upon the results of the Phase I tasks, diver-assisted water quality monitoring may be completed. Due to the practical limitations of divers conducting the Phase II water quality monitoring as a separate event, it is recognized that a diver may implement water quality monitoring immediately based upon conditions observed during Phase I. Diver-assisted water quality monitoring will be conducted under the following conditions.

- Any suspect features noted by the dive team during the Phase I diver visual survey task will be further surveyed using a YSI MPS Water Quality System. The diver will place the water quality probe within the suspect area and describe the conditions through the hard-wired communication system. Water quality measurement values will be recorded by personnel on the dive support boat within a site logbook.

- At each monitoring location, the dive team will float a buoy to mark the location. Personnel on the dive support boat will collect geographic coordinate data using the GPS unit.

In the event that any locations identified and surveyed during the Phase II activities exhibit a field pH reading above 9.0 s.u., then Phase III assessment activities will be completed. Visual suspect features that are identified but do not show pH values above 9.0 s.u. during Phase II activities will be discussed in a meeting with the Assessment Team members to evaluate the need for the possible completion of Phase III assessment activities.

2.4.3 Phase III Activities

Phase III activities of the Bay Harbor Lake Assessment may include vertical water column monitoring, water sampling, and diver-assisted taxonomic characterization. The specific standard operating procedures (SOPs) and field methodologies incorporated for these tasks will be defined and detailed in a specific Phase III Assessment Work Plan to be developed prior to initiation of Phase III field activities. However, conceptually, it is anticipated that the Phase III Assessment will include the following tasks.

Vertical Water Column Monitoring

Vertical water column monitoring will be conducted using a field monitoring team equipped with a boat. The boat will navigate to the selected monitoring location (based on the geographic coordinates collected during Phase I and/or Phase II monitoring). The boat will then be anchored to avoid drifting during monitoring. The following survey will then be completed:

- The total depth at each location will be measured.
- Water quality parameters will be collected at 5-ft intervals down the vertical water column from the surface to the bottom.
- GPS coordinates and any other field data will be collected, prior to collection of water samples.

Water Sampling

Based on the results of the vertical water column monitoring, water sampling may be conducted. A water sample will be collected from the depth interval that exhibited the highest pH value during water column monitoring.

Water samples will generally be collected in the following manner:

- Water samples will be collected from discrete intervals using a method to be determined in the Phase III Assessment Work Plan. Water samples may also be collected using diver-assisted water sampling methods.

- Water samples will be analyzed for total metals, pH, and specific conductance.

- One field blank sample will be collected and analyzed for quality assurance (QA) purposes. A high performance liquid chromatography (HPLC) equipment blank will be collected at a 10% frequency.

- Duplicate (split) surface water samples will be collected on a 10% frequency. The duplicate samples will be collected in the same manner as the other surface water samples.

- Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples will be collected at a frequency of 1 sample per 20 investigative samples. Triple the normal sample volume will be collected and submitted to the laboratory. MS/MSD samples will be collected only for total metal analysis.

Diver-Assisted Taxonomic Characterization

A diver-assisted taxonomic characterization task may be completed to assess the relative condition of the ecosystem. Specific methods for conducting the characterization will be detailed in the Phase III Assessment Work Plan.

2.4.4 Location Identification

A numbering system has been developed to identify each monitoring location and sampling location. This numbering system will provide a tracking procedure to allow retrieval of information concerning a particular location or sample. The numbering system will be universally applied during each phase of the project.

Each monitoring or sample location will be identified using a combination of letters, numbers, and dashes in the following format: **AABBBB.CC.DD**. The components of the identifiers are described as follows:

- **Location Type Identifier (AA)**: A two character alphanumeric designation will be used to identify the location type. Typical location types to be used are as follows:

  LS – Lakeshore Survey
  DS – Diver Survey
  VS – Vertical Survey (Vertical Water Column)

- **Interval Identifier (BBBB)**: A four-digit numeral will be used to the interval sequence, where applicable. The number designation will represent distance in feet from the starting point of the lakeshore survey. For example, the first monitoring location will have an interval identifier of 0000. The next interval, 25-feet from the initial interval, will have an interval identifier of 0025. For diver survey locations, the sequence will progress from one interval to the next. For example, the first diver survey monitoring location will have an interval identifier of 0000. The next interval will have an interval identifier of 0001.

- **Perpendicular Interval Identifier (CC)**: A two-digit numeral will be used to identify the interval from shore where perpendicular measurements are collected (in cases with pH > 9.0). The number designation will represent distance in feet from the shoreline. For example, the first monitoring location will have an interval identifier of 00. The next interval, 5-feet from the initial interval, will have an interval identifier of 05.

- **Depth Identifier (DD)**: A two-digit numeral will be used to identify sample depth. The number designation will represent the depth in feet from the lake bottom. Depth numbers will be rounded to the nearest whole number. For example, a discrete water column sampling location collected from an interval of 5 feet above the lake bottom will have a sample depth identifier of 005, indicating the depth of the top of the sample interval. Sampling or monitoring depths collected from a depth less than six inches (surface water samples) will use XX as the depth identifier.

Some examples of a full sample identification number are as follows:

- **LS1025.05.XX**: Indicates a location that is part of the lakeshore survey and is located 1,025-ft from the initial monitoring location. The location is 5-ft perpendicular from shore and the location is a surface water monitoring location.

- **VS0004.XX.15**: Indicates an investigative sample collected during vertical water column monitoring. The location is the fourth location monitored and the sample was collected from an interval 15 feet from the bottom.

Provisions will be made as necessary where circumstances require a slight modification to the identifier system for a specific situation or sample, except that the sample identifier will not exceed 20 characters. Modifications will be noted as such in the field logbook.

Data entries in field logbooks covering sample collection activities, including those for field measurements taken during sample collection, will be referenced to the collection location and sample using the code described above.

2.4.5 Report Preparation

Upon completion of the phased Bay Harbor Lake assessment activities, all data will be validated and compiled by the U.S. EPA, CMS, and their respective consultants. The Assessment Team will then evaluate this data and prepare a report summarizing all the visual observations, monitoring data, and sample results compiled throughout the Phase I activities and the Phase II and III activities, if necessary. The data will be interpreted to evaluate if CKD material and/or CKD leachate may be impacting Bay Harbor Lake. Included in the report will be conclusions based on the evaluation of the data and recommendations for the scope and frequency of additional temporal monitoring and sampling events currently scheduled for August 2006 and December/January, 2006/2007. The draft report will be distributed to the Assessment Team for review and comment, prior to finalization and release to the public.

After completion of the shoreline survey portion of the Phase I work, the Assessment Team may develop a Fact Sheet summarizing the activities conducted during the shoreline survey, the data collected, and plans for completion of the additional phases of the Bay Harbor Lake survey. After review and concurrence from the Assessment Team, the Fact Sheet will be released to the public.

SECTION 3
SCHEDULE

This section presents the proposed meetings, monitoring activities, and reporting throughout the duration of the project (Figure – 3-1). The monitoring activities will be repeated in the months of August 2006 and December/January, 2006/2007. A schedule will be developed for these monitoring events following the completion of the spring 2006 monitoring event.

Figure 3-1
Project Schedule

Schedule - Bay Harbor Lake Study

Task	April					May																								June						
	24	25	26	27	28	1	2	3	4	5	8	9	10	11	12	13	14	15	16	17	18	19	22	23	24	25	26	29	30	31	1	2	5	6	7	8	9
Meeting: Discuss Work Plan	■									■					■							■					■										
Revision of Work Plan		■	■	■	■	■	■	■	■		■	■	■	■		■	■	■	■	■	■		■	■	■	■											
Meeting: Coordinate Resources										■																				■		■					
Field Monitoring: Shoreline Survey												▨	▨	▨																							
Field Monitoring: Diver Underwater Survey																																	▨	▨	▨	▨	▨
Meeting: Presentation and Discussion of Phase III Results (window to be determined)																																					

Key:
■ :Activity/Meeting
▨ : Field Activity

ATTACHMENT A

HISTORICAL MONITORING AND SAMPLE DATA

Bay Harbor Lake
Water Quality Sampling Chronology

- 1 Sample Collected by Voice Environmental on May 13, 2004
  Analyzed for pH, chloride, nitrate, total nitrogen, phosphorus, specific conductivity, ammonia, coliform, E. Coli, and gasoline constituents

- 3 Samples Collected by Tip of the Mitt Watershed Council on May 19, 2004
  Analyzed for pH, chloride, nitrate, total nitrogen, phosphorus, and specific conductivity

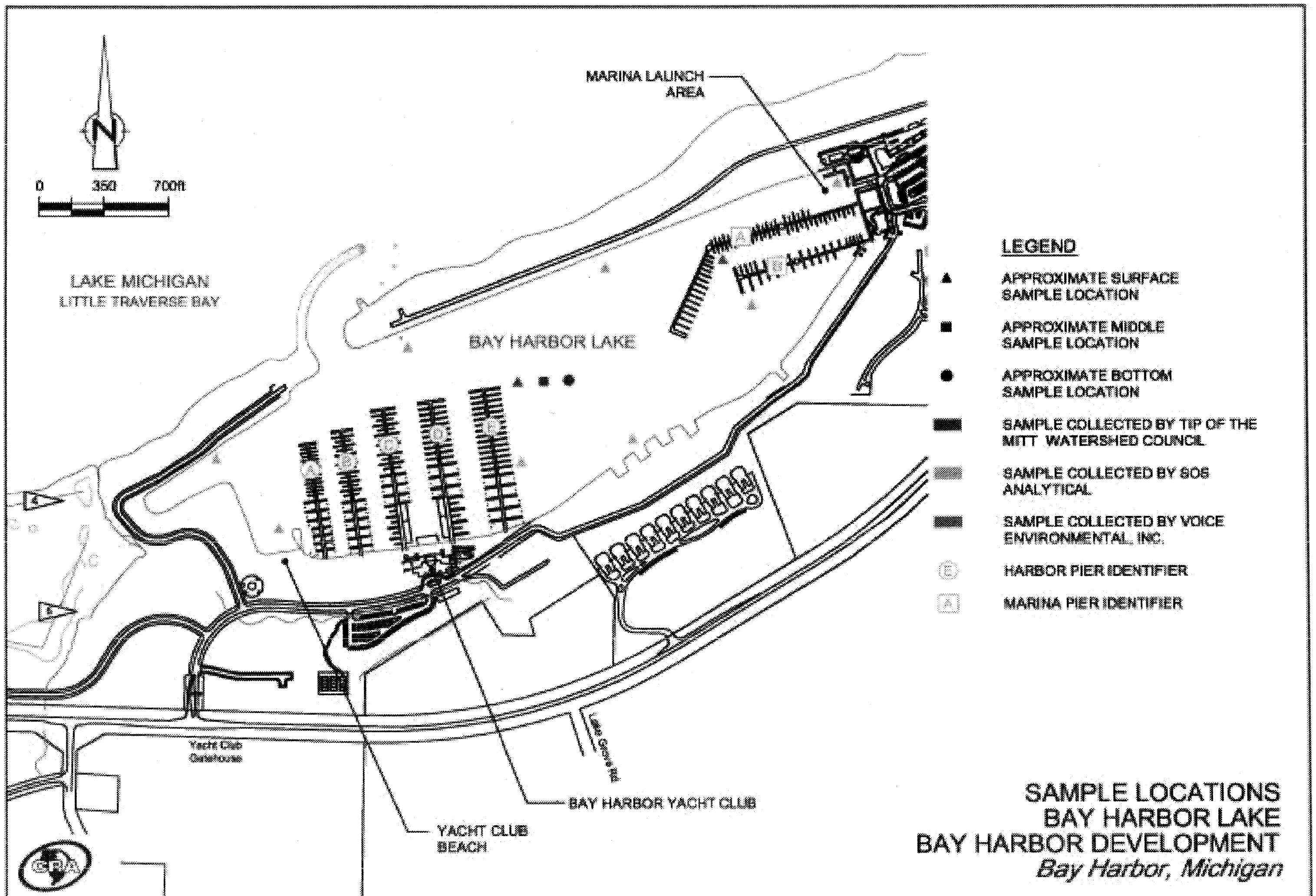
- 8 Samples Collected by SOS Analytical on July 9, 2004, August 9, 2004, and September 15, 2004
  Analyzed for nitrate, total nitrogen, phosphorus, ammonia, and E. Coli

- 8 pH Readings Taken by Conestoga-Rovers & Associates on October 11, 2004 and October 12, 2004

- 11 Samples Collected by SOS Analytical on April 21, 2005 and July 14, 2005
  Analyzed for pH, chloride, nitrate, nitrite, phosphorus, specific conductivity, ammonia, and E. Coli

All Results: None exceed the Michigan Water Quality Standards for drinking water or total body contact.

Bay Harbor Lake
Water Quality Sample Location Map



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Bay Harbor Lake
Biological Data Summary/Evaluation

- One Sample Analyzed for Total Coliform Bacteria

  Result of 5 CFU / 100 mL (Very Low Result)

- 19 Samples Analyzed for E. Coli

  Results Ranged from 0 to 102 CFU / 100 mL

  No Criteria (130/300 CFU/100mL – 30 Day Geometric Mean/Beach Closure Limit) Exceeded

Biological Data is indicative of excellent water quality.

Bay Harbor Lake
Water Quality Data Summary

• pH	(7.4 to 8.20 Standard pH Units)
• Chloride	(11.9 to 16.1 mg/L)
• Nitrate	(0.22 to 2.35 mg/L)
• Nitrite	(Non-detect)
• Nitrogen	(0.009 to 2.46 mg/L)
• Phosphorus	(0.0027 to 0.09 mg/L)
• Specific Conductivity	(149 to 341 uS/cm)
• Ammonia	(Non-detect to 0.08 mg/L)
• Gasoline	(Non-detect)

All Results: None exceed the Michigan Water Quality Standards for drinking water or total body contact.

Bay Harbor Lake
Water Quality Data Evaluation

- pH Levels Consistent with Background (i.e., No CKD Seeps)
- No Indication of CKD Located in Bay Harbor Lake

Analytical Results: None exceed the Michigan Water Quality Standards for drinking water or total body contact.

Water Quality Data is indicative of excellent water quality.

Water Quality Analysis
Bay Harbor Lake
2004

Site	Date	Sampler	Depth	Temp	DO	pH	SpCond uhmo/cm2	Nitrate mg/l	Total Nitrogen mg/l	Chloride mg/l	Total Phosphorus ug/l	Coliform Bacteria	E. coli	Fuel mg/l	Ammonia mg/l
Marina Pier A	5.13.04	SOS	surface			7.4	179	2.35	2.46	12	90	5	ND	ND	0.06
Launch	7.9.04	SOS	surface					0.36	0.009		ND		2		ND
	8.9.04	SOS	surface					0.31	0.37		ND		102		0.06
	9.15.04	SOS	surface					0.26	0.26		ND		7		ND
Yacht Club	7.9.04	SOS	surface					0.31	ND		ND		6		ND
	8.9.04	SOS	surface					0.33	0.39		ND		70		0.06
	9.15.04	SOS	surface					0.31	0.37		ND		29		0.06
Beach 2	8.9.04	SOS	surface					0.33	0.4		ND		42		0.07
	9.15.04	SOS	surface					0.3	0.03		ND		20		ND
Bay Harbor Lake	5.19.04	TMWC	surface	10.54	10.98	8.17	279	0.264	0.33	12.3	2.8				
Little Traverse Bay	9.15.04	TMWC	surface	8.69	11.46	8.23	260	0.238	0.32	10.4	3.1				
Grand Traverse Bay	5.7.04	TMWC	surface	2.94	13.34	8.26	273	0.253	0.335	10.8	2.6				
Round Lake	4.15.04	TMWC	surface	2.94	12.14	8.39	320	0.077	0.7	22.8	9.3				

SOS = SOS Analytical
TMWC = Tip of The Mitt Watershed Council
ND = Non Detect

Tip of The Mitt Watershed Council - Water Test Analysis Spring 2004

comparison of	Bay Harbor Lake	Little Traverse Bay	Grand Traverse Bay	Round Lake
Sample	Surface	Surface	Surface	Surface
sample ID	5920041	2820041	2720041	3620041
Date	5/19/04	5/19/04	5/7/04	4/15/04
Depth	0.1	0.2	0	0.2
Temperature	10.54	8.69	2.94	8.36
Dissolved Oxygen	10.98	11.46	13.34	12.14
pH	8.17	8.23	8.26	8.39
Specific Conductivity	279.4	260	273.5	319.9
Nitrate	264	238	253	77
Nitrogen	330	319	355	700
Chloride	12.3	10.4	10.8	22.8
Phosphorus	2.8	3.1	2.6	9.3
Sample	Middle	Middle	Middle	
sample ID	5920042	2820042	2720042	
Date	5/19/04	5/19/04	5/7/04	
Depth	11.1	27.1	42.2	
Temperature	7.04	4.06	2.86	
Dissolved Oxygen	11.87	12.51	13.15	
pH	8.16	8.22	8.28	
Specific Conductivity	278.4	255.3	273.9	
Nitrate	251	250	255	
Nitrogen	336	336	352	
Chloride	11.9	10.6	10.5	
Phosphorus	3.9	2.3	2.3	
Sample	Bottom	Bottom	Bottom	Bottom
sample ID	5920043	2820043	2720043	3620042
Date	5/19/04	5/19/04	5/7/04	4/15/04
Depth	21.4	53.1	105.5	3.9
Temperature	6.29	3.92	2.91	8.31
Dissolved Oxygen	11.62	12.19	13.33	12.25
pH	8.15	8.41	8.28	8.42
Specific Conductivity	286.3	255.1	274.1	319.8
Nitrate	269	241	245	74
Nitrogen	391	312	356	659
Chloride	12.6	10.7	10.5	24.3
Phosphorus	2.7	2.5	2.3	6.3

Water quality sample data from Lake Michigan for 2004.

WaterBody	Date	Depth	Sample	Temp	DO	pH	SpCond	Nitrate	Nitrogen	Chloride	Phosphorus
Michigan, Little Traverse Bay	5/19/2004	0.2	Surface	8.69	11.46	8.23	260.0	0.238	0.319	10.4	3.1
Michigan, Little Traverse Bay	5/19/2004	27.1	Middle	4.06	12.51	8.22	255.3	0.250	0.336	10.6	2.3
Michigan, Little Traverse Bay	5/19/2004	53.1	Bottom	3.92	12.19	8.41	255.1	0.241	0.312	10.7	2.5
Michigan, Grand Traverse Bay	5/7/2004	0.0	Surface	2.94	13.34	8.26	273.5	0.253	0.355	10.8	2.6
Michigan, Grand Traverse Bay	5/7/2004	42.2	Middle	2.86	13.15	8.28	273.9	0.255	0.352	10.5	2.3
Michigan, Grand Traverse Bay	5/7/2004	105.5	Bottom	2.91	13.33	8.28	274.1	0.245	0.356	10.5	2.3
Michigan, Bay Harbor	5/19/2004	0.1	Surface	10.54	10.98	8.17	279.4	0.264	0.330	12.3	2.8
Michigan, Bay Harbor	5/19/2004	11.1	Middle	7.04	11.87	8.16	278.4	0.251	0.336	11.9	3.9
Michigan, Bay Harbor	5/19/2004	21.4	Bottom	6.29	11.62	8.15	286.3	0.269	0.391	12.6	2.7

T-tests. If calculated value is greater than tabulated, then the difference of the means is significant.

DO	Others	Bay Harbor	Chloride	Others	Bay Harbor	Conductivity	Others	Bay Harbor
sum	76.0	34.5		63.5	36.8		1591.9	844.1
n	6.0	3.0		6.0	3.0		6.0	3.0
mean	12.7	11.5		10.6	12.3		265.3	281.4
sumx^2	964.9948	396.482		671.5161	451.154		422808.3	237538.610
(sumx)^2	5772.9604	1188.1809		4028.4409	1352.7684		2534145	712504.8100
((sumx)^2)/n	962.16006	396.0603		671.40681	450.9228		422357.6	237501.6033
sumd^2	2.8347	0.4214		0.1093	0.2312		450.7683	37.0067
variance = sigma^2	0.5669	0.2107		0.0219	0.1156		90.1537	18.5033
sigmad^2	0.1647244			0.042176			21.19338	
sigmad	0.4058625			0.2053682			4.603627	
Calculated t	2.8909619			8.1885432			3.486380	
degr. freedom	7.0			7.0			7.0	
tabulated t	2.37			2.37			2.37	

Nitrogen	Others	Bay Harbor	Nitrate	Others	Bay Harbor	Phosph	Others	Bay Harbor
sum	2.0	1.1		1.5	0.8		15.1	9.4
n	6.0	3.0		6.0	3.0		6.0	3.0
mean	0.3	0.4		0.2	0.3		2.5	3.1
sumx^2	0.6887	0.375		0.3663	0.205		38.4900	30.340
(sumx)^2	4.1209	1.1172		2.1963	0.6147		228.0100	88.3600
((sumx)^2)/n	0.686817	0.37242		0.366054	0.2048853		38.0017	29.4533
sumd^2	0.0018	0.0023		0.0002	0.0002		0.4883	0.8867
variance = sigma^2	0.0004	0.0011		0.0000	0.0001		0.0977	0.4433
sigmad^2	0.000438			3.644E-05			0.16406	
sigmad	0.020939			0.0060369			0.40504	
Calculated t	0.668624			2.3742778			1.52249	
degr. freedom	7.0			7.0			7.0	
tabulated t	2.37			2.37			2.37	

VOICE Environmental Inc.
Science / Expertise / Creativity / Solutions

Ecological Consulting
Wetland Determinations
& Permitting
Site & Project Planning

September 1, 2004

Dennis Brya
Construction Manager, Bay Harbor LLC
4000 Main Street
Bay Harbor, MI 49770

Re: Marina water quality samples

Mr. Brya:

Per you request, I sampled and tested the harbor/marina at Bay Harbor, on May 13, 2004. This letter outlines the results of this and other water samples.

Table 1. Results from samples taken May 13 and July 9, 2004. Also included are the results of two samples taken by the Tip of the Mitt Watershed Council (TMWC) within the Harbor and in Little Traverse Bay of Lake Michigan.

	Coliform Bacteria	E. coli	Gasoline mg/l	pH	Conductivity uhmo/cm^2	Chloride mg/l	Ammonia mg/l	Nitrate mg/l	Total Nitrogen mg/l	Total Phosphorus µg/l
May 13	5	ND	ND	7.4	179	12	0.06	2.35	2.46	90
July 9 Yacht		2					ND	.36	0.37	ND
Aug 9 Launch		102					.06	0.31	0.37	ND <50
Aug 9 Yacht		70					.06	.33	.39	ND <50
Aug 9 Beach 2		42					.07	.33	.4	ND <50
May 19 (TMWC)				8.17	279	12.3		0.264	0.33	2.8
L.T. Bay May 19 (TMWC)				8.23	260	10.4		0.238	0.32	3.1

ND – Not-Detected, ie. below detection limit

231.582.3498 PH / 231.582.2300 FX / www.voiceenv.com / 116 Water Street / Suite B / Boyne City / Michigan 49712

2004 pH Water Quality Data
As Reported on the Tip of the Mitt Watershed Council Web Site

Water Body	Test Date	pH Range
Bay Harbor Lake	05.19.04	8.15 - 8.17
Little Traverse Bay	05.19.04	8.22 - 8.41
Lake Charlevoix	05.11.04	8.29 - 8.36
Grand Traverse Bay	05.07.04	8.26 - 8.28
Walloon Lake	05.15.04	8.31 - 8.34
Torch Lake	05.06.04	8.29 - 8.31
Elk Lake	05.07.04	8.23 - 8.26
Lake Skegemog	05.07.04	8.37 - 8.38
Mullett Lake	05.05.04	8.23 - 8.26
Lake Bellaire	05.12.04	8.17 - 8.27
Douglas Lake	05.19.04	7.89 - 8.61

2005 pH Water Quality Data
Tests by SOS Analytical

Water Body	Test Date	pH Range
Bay Harbor Lake Data - 2005	4.21.05	8.0 - 8.1
Bay Harbor Yacht Club Beach	7.14.05	7.6 - 7.9
Little Traverse Bay Data - 2005	4.21.05	8.2 - 8.3
Village Harbor Lake Data - 2005	5.10.05	7.5 - 8.2

See attached map for test locations.

pH Drinking Water Limits 6.5 - 8.5

pH Surface Water Limits 6.5 - 9.0

G:\01-BHC\BHLake\pH 2005

Water Quality Analysis
Bay Harbor Lake and Village Harbor
2005

Site	Site #	Date	Sampler	Depth	Temp	DO	pH	SpCond uhmo/cm2	Nitrate mg/l	Total Nitrite mg/l	Chloride mg/l	Total Phosphorus ug/l	Coliform Bacteria	E. coli	Fuel mg/l	Ammonia mg/l
Bay Harbor Lake					f											
launch	1	4.21.05	SOS	surface	44.9		8	223	0.32	ND	15.2	0.09		0		ND
Marina pier b	2	4.21.05	SOS	surface	47.2		8.1	208	0.36	ND	16.1	ND		0		ND
mid Peninsula	3	4.21.05	SOS	surface	45.6		8.1	234	0.32	ND	15.3	ND		0		ND
end Peninsula	4	4.21.05	SOS	surface	44.8		8.1	149	0.33	ND	15.6	0.06		0		ND
mid Shores	5	4.21.05	SOS	surface	44.6		8.1	235	0.33	ND	15.4	ND		0		ND
YC beach	6a	4.21.05	SOS	surface	45.3		8.1	160	0.33	ND	15.5	ND		0		ND
	6a	7.14.05	SOS	surface			7.6	306	0.29	ND	12	ND		2		
	6b	4.21.05	SOS	surface	45.8		8.1	212	0.33	ND	15.5	ND		1		ND
	6b	7.14.05	SOS	surface			7.6	317	0.22	ND	12	ND		5		
	6c	7.14.05	SOS	surface			7.9	341	0.29	ND	12	ND		3		
YC pier E	7	4.21.05	SOS	surface	47.4		8.1	213	0.34	ND	16	ND		0		ND
Harborside	8	4.21.05	SOS	surface	47.1		8.1	207	0.33	ND	14.9	ND		0		ND
Village Harbor																
north docks	1	5.10.05	SOS	surface	45.2		7.5	446	0.37	ND	22	ND		ND		0.16
south docks	2	5.10.05	SOS	surface	44.5		7.9	435	0.39	ND	21	0.05		ND		0.21
mid entry	3	5.10.05	SOS	surface	45.8		8.1	432	0.39	ND	18	ND		ND		0.14
entry channel	4	5.10.05	SOS	surface	45.5		8.2	415	0.38	ND	18	0.06		ND		0.14
Little Traverse Bay																
mid Shores	9	4.21.05	SOS	surface	46.2		8.2	191	0.25	ND	12.1	ND		25		ND
entry channel	10	4.21.05	SOS	surface	43.1		8.2	192	0.26	ND	11.8	ND		0		ND
mid Peninsula	11	4.21.05	SOS	surface	42.4		8.3	176	0.26	ND	12.3	ND		1		0.06
2004 Results by Tip of The Mitt					c											
Bay Harbor Lake		5.19.04	TMWC	surface	10.54	10.98	8.17	279	0.264	0.33	12.3	2.8				
Little Traverse Bay		9.15.04	TMWC	surface	8.69	11.46	8.23	260	0.238	0.32	10.4	3.1				
Grand Traverse Bay		5.7.04	TMWC	surface	2.94	13.34	8.26	273	0.253	0.335	10.8	2.6				
Round Lake		4.15.04	TMWC	surface	2.94	12.14	8.39	320	0.077	0.7	22.8	9.3				
Lake Charlevoix		5.11.04	TMWC	surface	9.97	10.93	8.36	314.8	0.33	0.506	9.2	1.2				
Walloon Lake		5.15.04	TMWC	surface	12.32	10.42	8.33	268	0.116	0.461	8.9	5,1				

Chloride drinking water limit 250
E. coli beach closure limit 300
Nitrate drinking water limit 10
Nitrite drinking water limit 1
pH drinking water limit 6.5 - 8.5
pH surface water limit .9
ND = Non Detect
SOS = SOS Analytical
TMWC = Tip of The Mitt Watershed Council

ATTACHMENT B

RESULTS OF ‘WHITE SUBSTANCE’ ANALYSIS CONDUCTED BY CRA

CONESTOGA-ROVERS
& ASSOCIATES

14496 Sheldon Road, Suite #200, Plymouth, MI 48170
Telephone: 734-453-5123 Facsimile: 734-453-5201
www.CRAworld.com

May 2, 2006

Reference No. 037526

Mr. Dennis Brya
Construction Manager
Bay Harbor Company
4000 Main Street
Bay Harbor, MI 49770

Dear Mr. Brya:

Re: "White Organic Matter" Biological Assessment
GAP EnviroMicrobial Services
Bay Harbor Lake

Consistent with your earlier request, we have had GAP EnviroMicrobial Services (GAP) conduct a biological assessment of a sample of the "white organic material" collected from the rocks at the bottom of Bay Harbor Lake.

The "white organic material" is a naturally occurring "plant like" organic growth found commonly in pristine water throughout the Great Lakes. It is indicative of the excellent water quality which exists in Bay Harbor Lake.

A copy of GAP's letter report, which presents a detailed assessment of the nature of the "white organic matter", is presented in Attachment A.

Should you have any questions regarding this attached letter report, please do not hesitate to contact me at (519) 884-0510.

Yours truly,

CONESTOGA-ROVERS & ASSOCIATES

Glenn Turchan, P. Eng.
Executive Vice President

GTT/cnb/1
Encl.

ATTACHMENT A

GAP LETTER REPORT

MAY 1, 2006

GAP EnviroMicrobial Services
a division of Conestoga-Rovers & Associates Ltd.

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CRA# 037526/GAP Project # 017500-A5450

May 1, 2006

Glenn Turchan, P. Eng.
Conestoga-Rovers & Associates
14496 Sheldon Rd. Suite 200
Plymouth, MI 48170

PROJECT NAME: ANALYSIS OF BAY HARBOR LAKE BIOLOGICAL SAMPLE

GAP EnviroMicrobial Services (GAP), a division of Conestoga-Rovers & Associates, received a biological sample from Bay Harbor Lake on March 31, 2006 for microscopic examination (GAP sample #2594). The sample matrix consisted of a gelatinous and slimy material that was partially a greenish-brown color with some portions being white or colorless. The sample material was aseptically removed from the sample bottle and placed into a sterile petri plate for macroscopic examination.

Figures 1 and 2 identify the appearance of the greenish-brown slimy material in the base of the petri dish. In comparison, Figure 3 presents an image of the same material recovered from bottom debris at Bay Harbor Lake immediately following sample collection. As an environmental microbiologist, it is my opinion that the sample received at the laboratory is very similar in color and structure to that shown on Figure 3. Digital images of the sample taken at the laboratory were obtained with a Nikon Coolpix 4500 camera.

Figure 1. Macroscopic image of gelatinous, slimy material in petri plate (Bay Harbor Lake sample, March 2006).

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Figure 2. Macroscopic image of gelatinous, slimy material, close up (Bay Harbor Lake sample, March 2006).

Figure 3. Macroscopic image of gelatinous, slimy material as observed immediately following sampling (Bay Harbor Lake sample, March 2006).

Following initial observation of the sample in the petri plate, the digital camera was fitted to a Nikon SMZ-1B stereomicroscope for examination at 8 to 35 × magnifications. Figure 4 shows the gelatinous, slimy material as it separates from the algal growth. Figure 5 shows that the gelatinous, slimy material is composed of a water mold. The large opaque spherical object to the right of the image is the sexual form of the mold. *Allomyces* can produce gametangia (sex cells) that appear very similar to what is observed in the sample.

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Figure. 4. Image of sample as observed with the stereomicroscope and black background at 8 × magnification (Bay Harbor Lake sample, March 2006)

Figure 5. Image of sample as observed with the stereomicroscope and black background at 35 × magnification (Bay Harbor Lake sample, March 2006).

The next phase of the examination involved aseptically placing several pieces (1 cm^2) of the slimy material onto a clean glass microscope slide and teasing the material apart using sterile examination needles in order to reveal each component of the material for identification purposes. Thirty µL aliquots of water from the sample bottle were dispensed onto each of the fragments of sample material on the microscope slide. Glass cover slips were then placed over the watery fragments for microscopic examination.

A Nikon Eclipse E600 microscope, providing phase contrast microscopy and Kohler illumination, was used for the examination. At 200 × magnification, each piece of sample material was examined. It was immediately evident that the slimy greenish-brown material

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consisted of decomposing chlorophyll from filaments of the green algae (*Ulothrix)* and from the many diatoms of *Navicula* spp. and *Fragilaria* spp. The diatom pigments appeared brownish which is consistent with the appearance of diatoms in fresh water. The filamentous green algae and diatoms however were only one component of the slimy, gelatinous material in which they were bound. The hyphae (colorless filaments) of *Alternaria* sp. make up the majority of the gelatinous slimy matrix.

Figures 6, 7, and 8 show the hyphae of the water mold with the green algae filaments and the diatoms amongst the gelatinous material at a magnification of 400 ×. Further examination at 1000 × magnification shows the water mold hyphae.

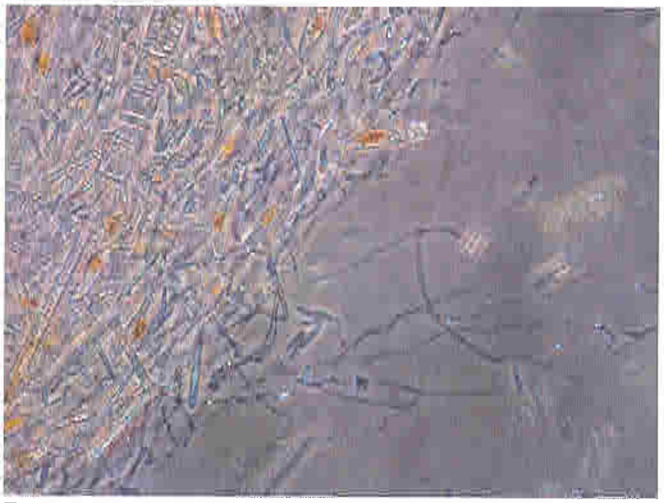

Figure 6. Microscopic image using phase contrast microscopy at 400 × magnification (Bay Harbor Lake sample, March 2006).

Figure 7. Microscopic image of diatoms using phase contrast microscopy at 400 × magnification (Bay Harbor Lake sample, March 2006).

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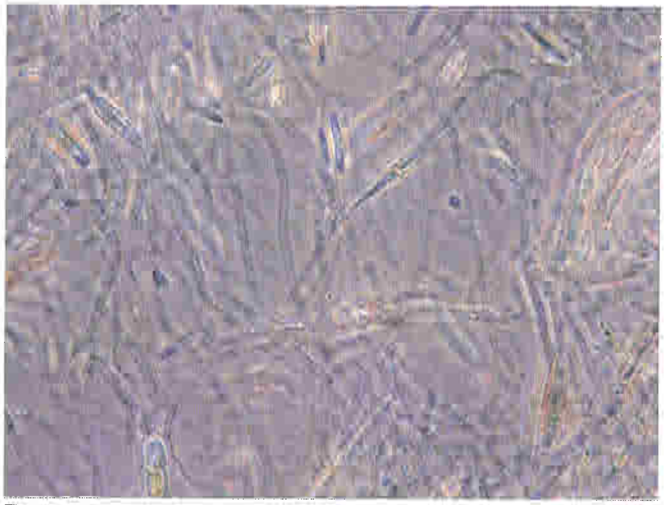

Figure 8. Microscopic image of water mold filaments (hyphae), diatoms and algae as observed at 400 × magnification (Bay Harbor Lake sample, March 2006).

Figure 9 shows the predominant diatoms in the sample at 1000 × magnification. Figure 10 again shows the gelatinous, slimy mass of hyphae of the water mold observed growing on the stones, pebbles, etc. on the bottom of Bay Harbor Lake.

Figure 9. Microscopic image of diatoms as observed at 1000 × magnification (Bay Harbor Lake sample, March 2006).

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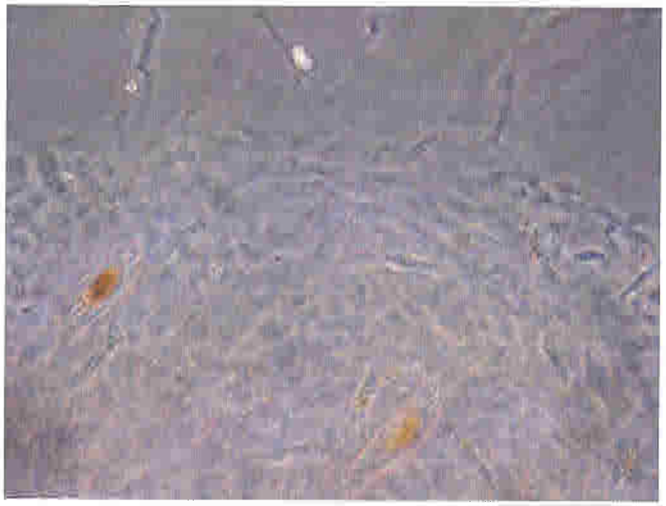

Figure 10. Microscopic image of the water mold hyphae as observed at 1000 × magnification (Bay Harbor Lake sample, March 2006).

Culturing and identification of the water mold was conducted in the laboratory using sterilized lake water (from Lake Huron) and pond water to mimic the natural growth environment. The organism was identified as *Alternaria* sp. and has been thoroughly examined using phase contrast microscopy and staining with lacto-aniline blue stain.

Figure 11 shows a microscopic image of the hyphae, which are long filaments of a mold that grows over the surface to which the mold is attached. Figure 12 shows the conidia under phase contrast microscopy at 400 × magnification. Conidia are asexual nucleate spores that are produced at the ends of the hyphae and are released into the environment.

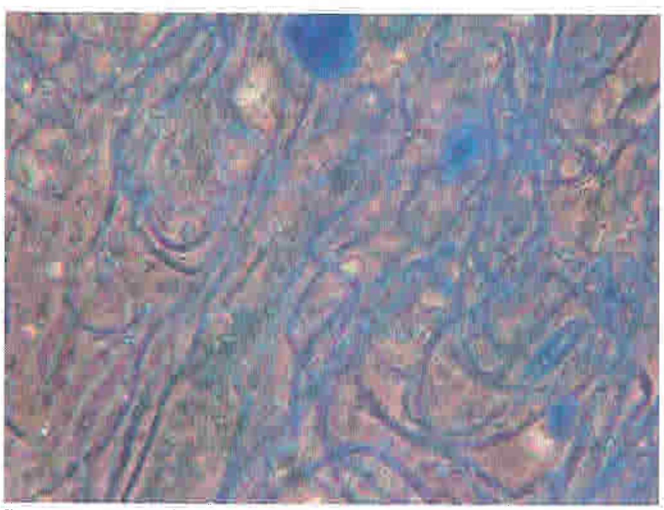

Figure 11. Hyphae of *Alternaria* sp. as observed at 400 × magnification (recovered from Bay Harbor Lake sample, March 2006 and grown in sterilized Lake Huron water).

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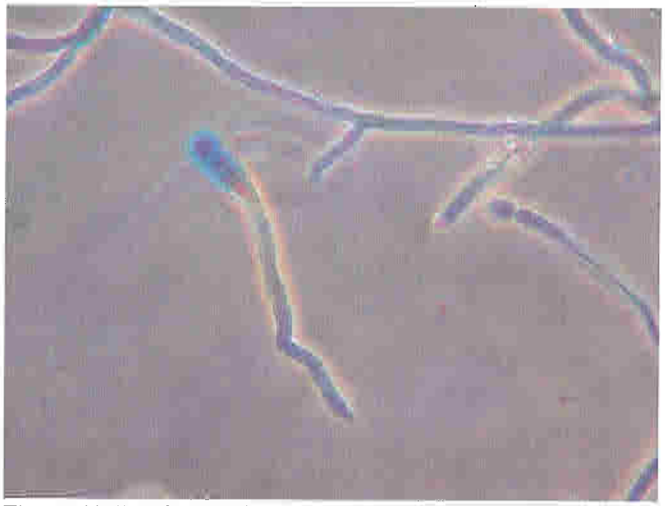

Figure 12. Hyphae and conidia of *Alternaria* sp. as observed at 400 × magnification (recovered from Bay Harbor Lake sample, March 2006 and grown in sterilized Lake Huron water).

This type of mold is known to grow in fresh water lakes including the Great Lakes. The reasons for the proliferation of molds of this nature include:

1) They are naturally found in fresh waters and soil;
2) Water temperatures that are less than 10 - 15°C allow them to compete with bacteria for nutrients such as carbon, nitrogen, and phosphorous. Higher temperatures in excess of 20°C are preferable for bacteria to out-compete mold for nutrients; and
3) Water molds grow where algae may be in a "die-off" phase due to a lack of nutrients or light. The green algae observed in the sample were in fact in a state of decomposition. Chemical parameters such as ammonia and phosphorus would not support the proliferation of green algae. The water molds can then compete for low levels of nutrients as saprophytes, which includes feeding on the decaying algae, as observed in the sample.

In summary, the proliferation of water molds in the Great Lakes, from Lake Superior through to Lake Ontario, has been observed over the years. This type of growth is unrelated to polluted waters, as compared to the growth of blue-green algae, or cyanobacteria, that grow up in littoral waters and is reported in the press from time to time. The growth of blue-green algae often occurs when surface run-off, which contains high levels of agricultural waste or waste from urban sources, enters a watercourse.

The water mold growth observed in the sample from Bay Harbor Lake is also related to littoral currents of the Great Lakes as well as other seasonal impacts. However, it is not the result of significant nutrient-rich point source or non-point source contamination into Bay Harbor Lake. The water mold observed is a natural phenomenon that occurs in fresh water lakes and rivers worldwide.

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Lisa Warcop

for Garry Palmateer, M.Sc.
Director of Technical Services, GAP

cc: Lisa Warcop (CRA)

mlr