Sources of drinking water contamination for the M'Chigeeng First Nation in West Bay, Manitoulin Island

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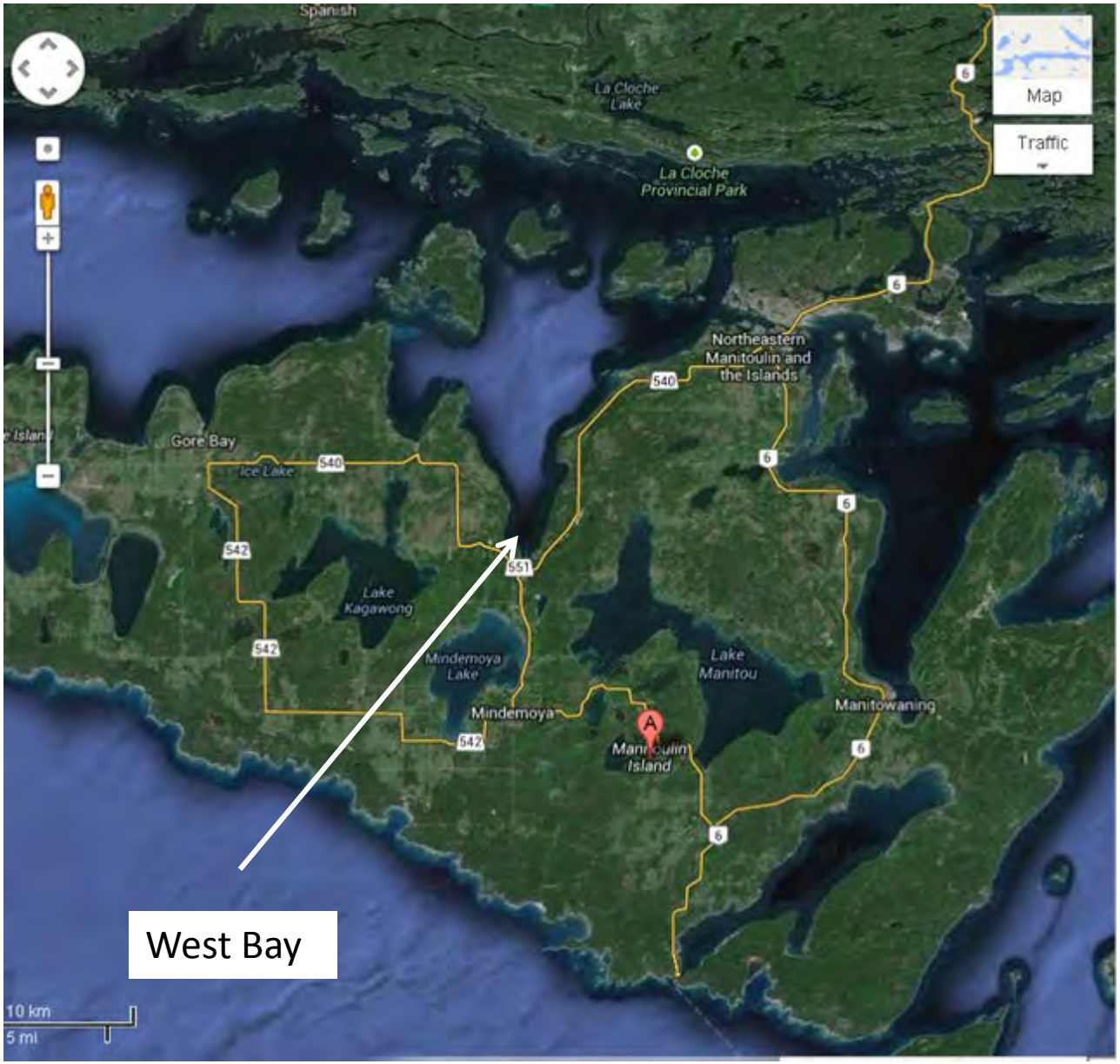
Supported by the H2O Create Program:
Drinking Water and Wastewater Management for First Nations

Manitoulin Island

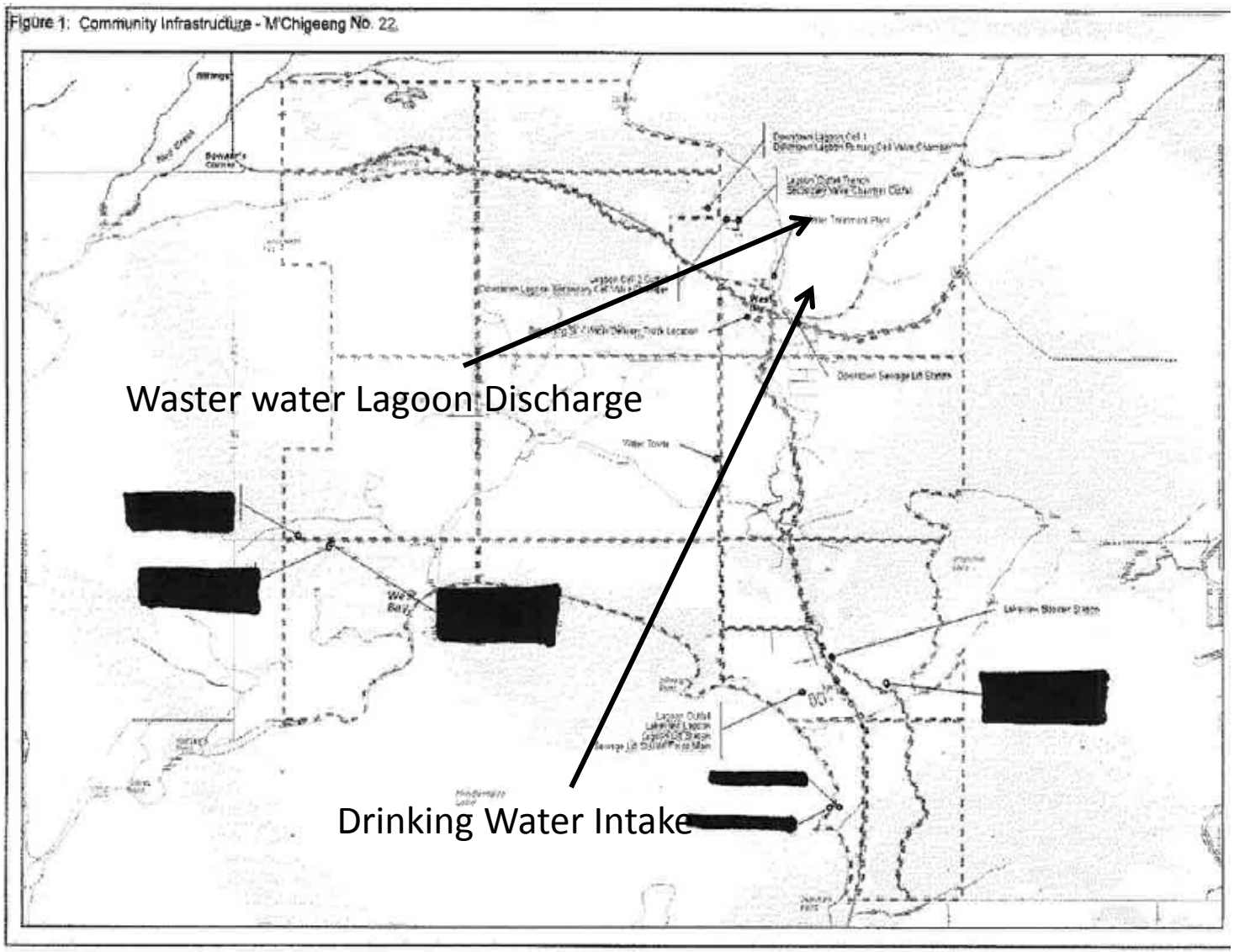


Official Map

2.3 Aerial Photo / Map of Community

The communal water and wastewater systems, water sources and discharge points are presented on the following map of M'Chigeeng community.

Figure 1: Community Infrastructure - M'Chigeeng No. 22



2010/11/24

M'Chigeeng

Introduction

- The Great Lakes is home to over 40 million people with nearly 2/3rds relying on its water as their primary source of drinking water
- Increased urban activities of land use impact our drinking water with contaminants
- Near shore zones where drinking water intakes are located are particularly affected

Significance

- Safe tap water is one of the most important services a government can provide to its citizens.
- Without it, sustaining good public health, a strong economy and overall productivity is incredibly difficult.

First Nations Impacts

- water advisories affect 20% of Canada's First Nations communities -- virtually all of which are located near abundant water supplies.
- One in five First Nations communities are living under a drinking water advisory.
- First Nations' homes are also 90 times more likely to be without any running water (1)

Importance even locally

- Not just remote communities are affected
- Six Nations of the Grand River: four out of five homes in this community are not connected to water lines
- Water is universally contaminated by run-off from nearby farms, industry and human waste.
- More than 300 homes have no access to water of any kind.

H2O Mandate

H2O CREATE trainees and graduates will assist First Nations, manufacturers of water and wastewater treatment systems, engineering and environmental firms and government policy analysts in decisionmaking and cost control at a crucial time when First Nations drinking water regulations are coming into effect.

The federal Safe Drinking Water for First Nations Act (introduced in the Senate on February 29, 2012, as Bill S-8) will, for the first time, provide a legislative framework for drinking water and wastewater security in First Nations communities.

It is expected to pass through Parliament soon and will require all First Nations reserves in Canada to meet drinking water quality standards.

Bill S-8 was passed April, 2012.

Introduction

- The impact of land based activities on local drinking water intakes needs to be thoroughly investigated---virtually no research exists
- potential Source Water Protection (SWP) threats require identification and quantification to help guide municipal decisions in infrastructure investment and regulatory changes to implement mitigations to protect drinking water security

Research Hypotheses

Contamination of raw water for the M'Chigeeng drinking water intake in West Bay, Manitoulin Island in Lake Huron:

- Hypothesis 1: Is not correlated with periodic discharges from the wastewater lagoon
- Hypothesis 2: Is not correlated with meteorological events (e.g. precipitation, snow melt) that drive land-based runoff and/or groundwater flow
- Hypothesis 3: Is not affected by wind direction and water currents

Data Requirements

- Lagoon discharge data
- Meteorological data
- Raw Water Quality data (West Bay)
- Land use activities:
  - Wildlife populations (MNR records)
  - Septic system installations (Municipal records)
  - Manure fertilization or livestock raising (OMAF)
  - Impermeable surface areas (roads and parking lots) (GIS)

Approach

- Analyze the temporal data on changes in waterborne pathogens from the M'Chigeeng drinking water intake in West Bay, Manitoulin Island in Lake Huron
- Test for statistically significant regression correlations between waterborne pathogens and the drivers listed:
  - Lagoon discharges
  - MET data
  - Land use
  - Currents
- Evaluate whether wastewater (lagoon, septic) is the source of contamination in the drinking water by monitoring for tracers of wastewater contamination (i.e. artificial sweeteners) using passive samplers deployed in West Bay

Passive Sampling Techniques for Monitoring Artificial Sweeteners in Surface Water

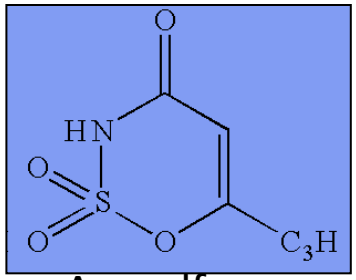
Passive sampling

- Determines time-weighted average concentrations over the period of deployment (2-4 weeks)
- Analytes are concentrated and stable when retained by the collection medium

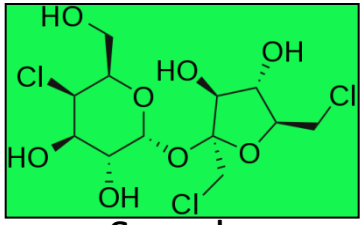
"Polar Organic Chemical Integrative Sampler" (POCIS)

Artificial sweeteners:

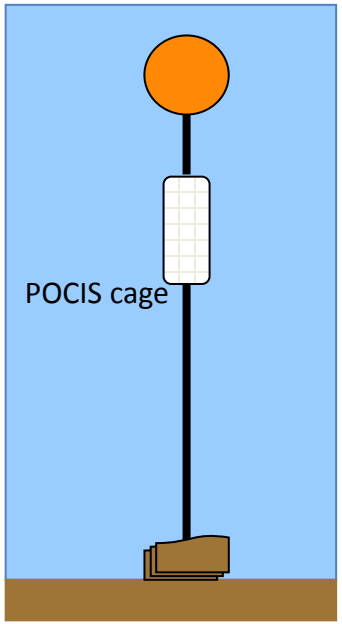
- Ubiquitous in wastewater
- High concentrations
- Persistent
- Tracer of wastewater contamination (300 km (1))



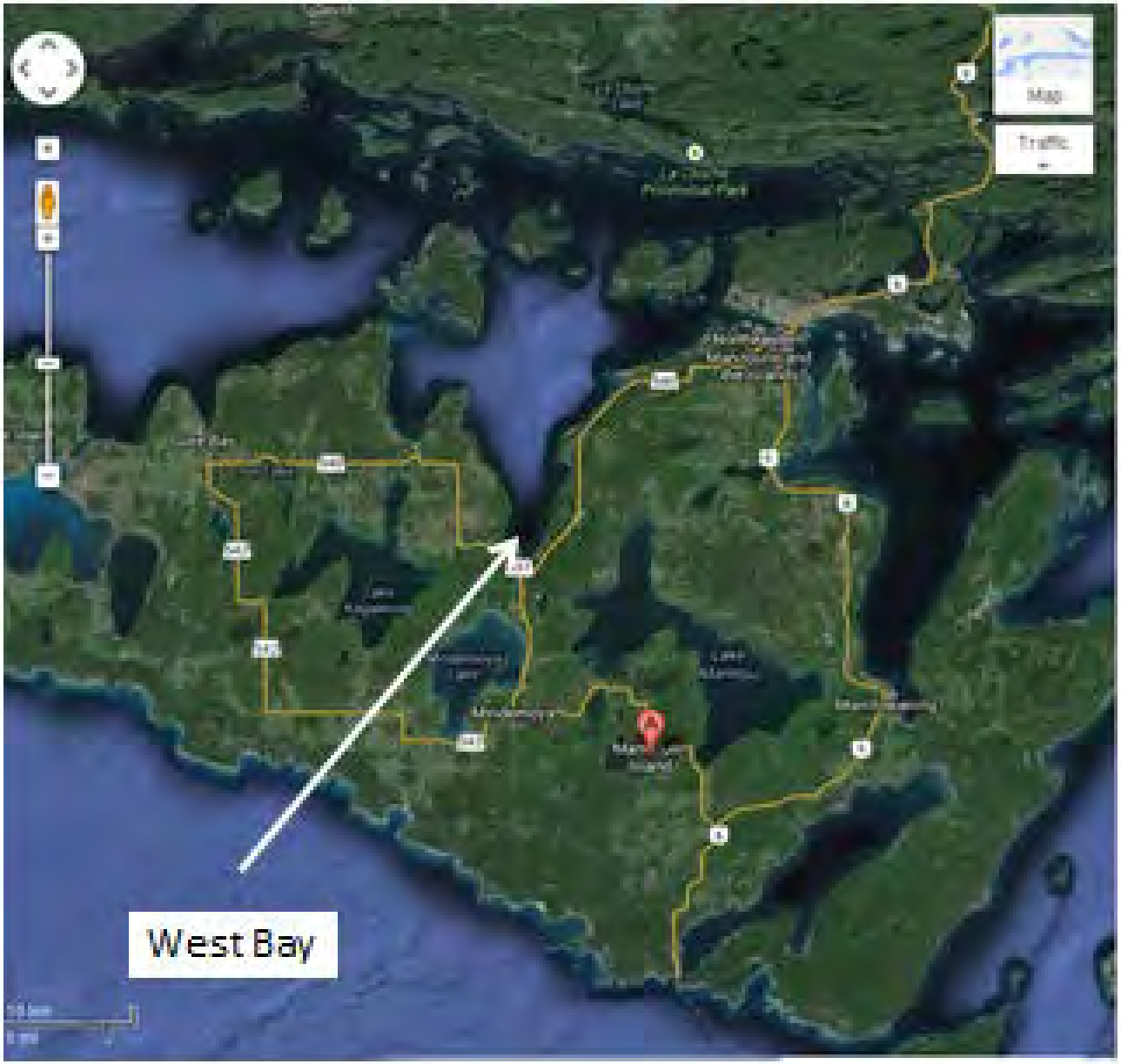
Acesulfame



Sucralose



Manitoulin Island



Approach

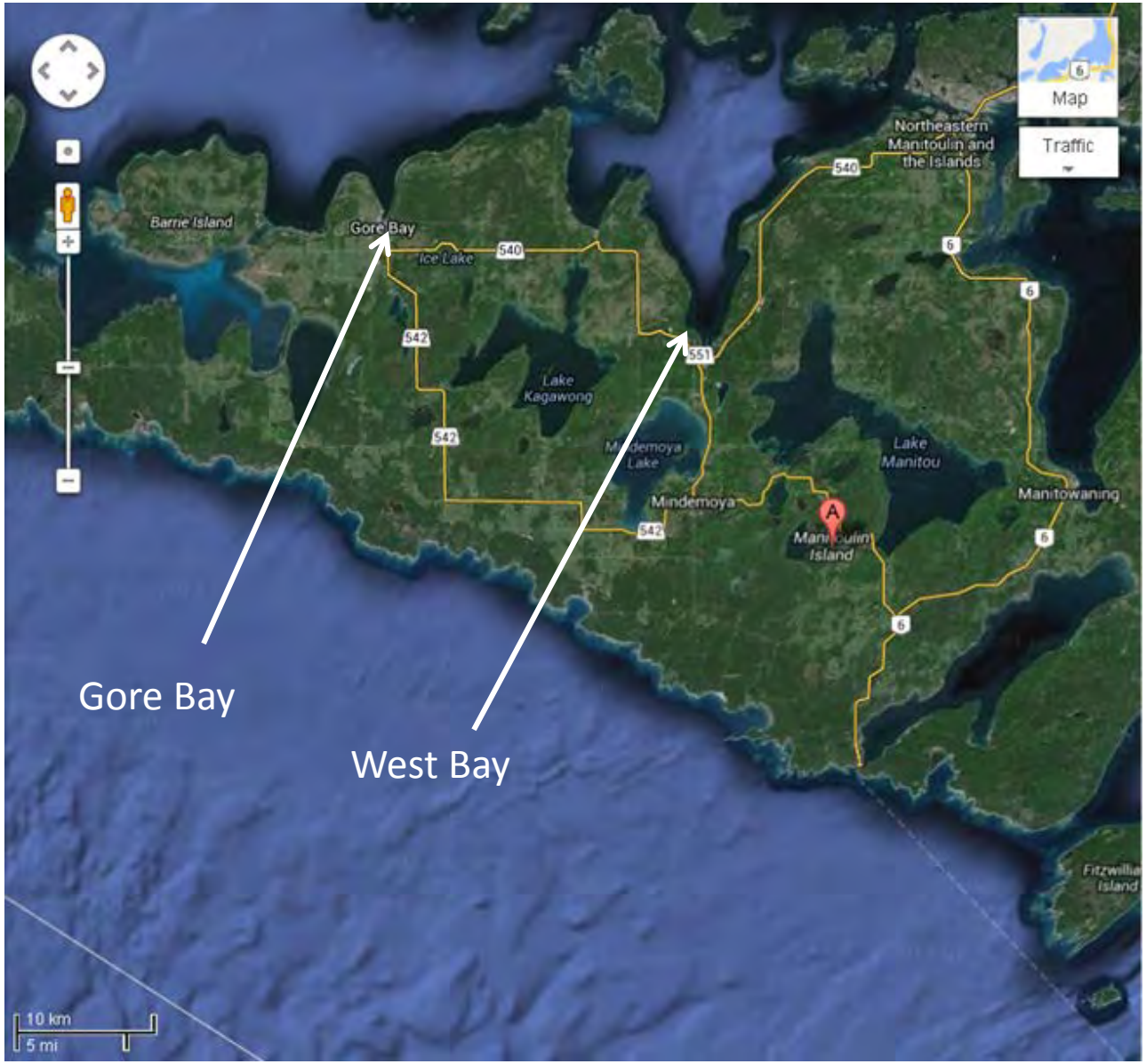
Advantages:

- Identifies specific drivers of contamination as potential security threats to drinking water
- Validates/quantifies impacts of differing land use trends
- Provides documented evidence required to make decisions on infrastructure investment and/or initiate regulatory changes
- Much of the data are already collected and available from the community DWTP and by government agencies
- Passive sampling is lo-tech and involves the community in the monitoring activity
- **Disadvantages:** Not monitored full year

Assumptions

- Assume temporal conditions of drivers match raw water quality data with little time lag
- Assume no contaminants are coming at a distance via Lake Huron (10 km offshore reference sampler)
- Gore Bay MET data (adjacent) and wind patterns are comparable to West Bay (which has no Met Data)
- Assume our results from our 4 to 6 week summer window is representative of general dynamics (better would be one year observing all seasons)
- Assume equal diffusion of sweetener in West Bay (passive sample at different depths to observe
- thermocline effects, 10 m L. Ontario (3))

Assumptions



Assumptions

Wind & weather statistics Gore Bay/Manitoulin Isle

Spot profile

Sunrise: 07:21
Sunset: 19:50

Local time: 11:06 (UTC -4)
Elevation: 193 m
Homepage weather

Current weather

-3° C

Wind statistics | Report | Forecast | Super Forecast | Maps

Statistics based on observations taken between 11/2009 - 02/2014 daily from 7am to 7pm local time. You can order the raw wind and weather data in Excel format from our historical weather data request page.

Month of year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	01	02	03	04	05	06	07	08	09	10	11	12	1-12
Dominant Wind dir.													
Wind probability >= 4 Beaufort (%)	46	48	41	55	41	29	26	34	40	48	48	45	41
Average Wind speed (kts)	11	11	11	12	11	9	9	10	10	12	11	11	10
Average air temp. (°C)	-6	-5	2	9	14	18	23	21	16	10	4	-3	6

Wind direction distribution in (%)

Year

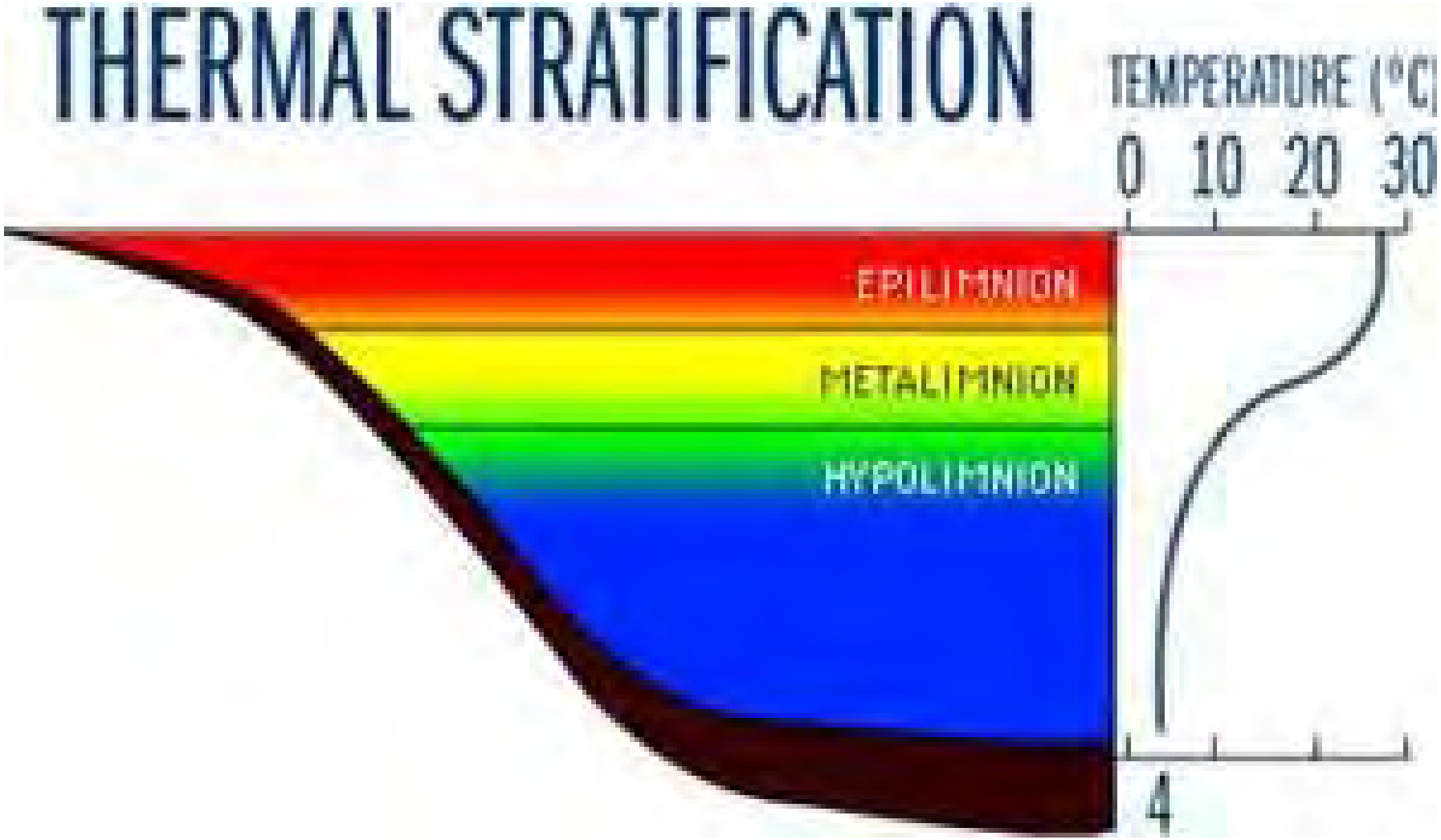
Expectations

- Expect Wastewater lagoon discharges present: enterococci, enteric viruses, Clostridia, Campylobacter, Cryptosporidium, Giardia and sweetener present on passive samplers
- Don’t expect septic system discharge
- Don’t expect E. coli (poor indicator) and anticipate little agricultural manuring effects
- Rain events cause increased Cryptosporidium and Giardia from wildlife run-off

Relevance/Significance

Why is this work important?

- Data analysis through statistical correlations and passive sampling will identify the source(s) of contamination affecting the M'Chigeeng drinking water intake
- First research characterizing Lake Huron (only L. Ontario so far) establishing a comparison. Are they different?
- The data will be useful for developing a source water protection plan for the First Nation community
- First time POCIS used for drinking water intake analysis
- Passive sampling can continue to be developed as an important technique for drinking water intake risk assessment using sweetener as wastewater tracer
- Exploiting the thermocline with Climate Change


THERMAL STRATIFICATION
TEMPERATURE (°C)
0 10 20 30
EPILIMNION
METALIMNION
HYPOLIMNION
4

Timeline for Source Water Protection Plan

Partners: Ontario First Nations Technical Services Corporation
Institute for Watershed Science, Trent University

M'Chigeeng Source Water Protection Pilot Project

Draft Workplan

( ) = who's responsible, PM=Project Manager, Stephanie Allen, OFNTSC

Timeframe	Technical/PM	Working Group	Community
Month 1-3 **March – May 2014**	Background Material Sourced (PM) Preliminary Maps prepared (Trent) Source Delineation Intake Protection Zones (Trent) Identification of Significant Recharge Areas (Trent) Identification of Highly Vulnerable Aquifers (Trent)	Working Group Established (PM/Band Manager) Workplan Finalized (PM/Band Manager/Working Group) Terms of Reference agreement (PM/Band Manager)	

Timeline

Month 4-6 **June – August 2014** *First Nations Day for Community Event?? *Booth at Elder's Picnic *Booth at Pow-wow *Treaty Day or other event?	1. Risk Assessment Prep (PM) 2.a Risk Assessment Write-Up (PM) 2.b Hazards and Risk results mapped (Trent) 2.c Mitigation Prep (PM)	1.a Review preliminary maps, source delineation, IPZs (PM w Trent) 1.b Water tour of community (PM) 2.a Review community issues & important waters (PM) 2.b Complete risk assessment – after community input (PM w Trent)	Community Event(s) Youth: issues & important waters (photo-voice) (PM) Children: water festival & pledge & posters (PM) Elders: issues & important waters (PM) Fishermen: info session on West Bay? (PM) General community: issues & important waters (PM) Presentation on maps and source water (Trent) Presentation on water and wastewater treatment (CRTP/Operators) Presentation on how water travels/spills (Trent) Presentation on Recreational water sampling (EHO/Health)

Timeline

Month 7-9 **Sept – Nov 2014** *tie community event with Great Canadian Shoreline Clean-Up??	1.a Mitigation Write-Up (PM) 1.b Implementation schedule write-up (PM) 1.c Draft Source Protection Plan (PM) 2. Finalize Source Protection Plan (PM)	1.a Mitigation exercise (PM) 1.b Implementation schedule (PM) 2. Review draft Source Protection Plan (PM)	Community Event(s) 1.a Present results of community input from previous event (PM) 1.b Comments on mitigation and implementation (PM) 1.c Possible community water tour for interested residents – Elders, Youth, Lands, Water Plant Operators to lead? (PM) 1.d Great Canadian Shoreline Clean-Up – challenge with prizes? (PM) 2. Opportunity to review and comment on draft SPPlan (PM)
Month 10-12 **Dec – Feb 2014** *March 2014 World Water Day possible date for Community Celebration	Final Source Protection Plan (PM) Develop General FNs Toolkit (PM) Develop General FNs Training (PM) Publicize Completion of M'Chigeeng's SPPlan (PM/Band Manager) Plan Implementation begins (PM working w FN)	1. Review and accept final Source Protection Plan (PM) 2. Chief & Council review and resolution to adopt Source Protection Plan (PM/Band Manager) 3. Plan Implementation begins (PM working w FN)	Community celebration/feast/activity to showcase Final Source Protection Plan and thank everyone for involvement (PM)

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Questions?