Independent Risk Analysis for the Straits Pipelines

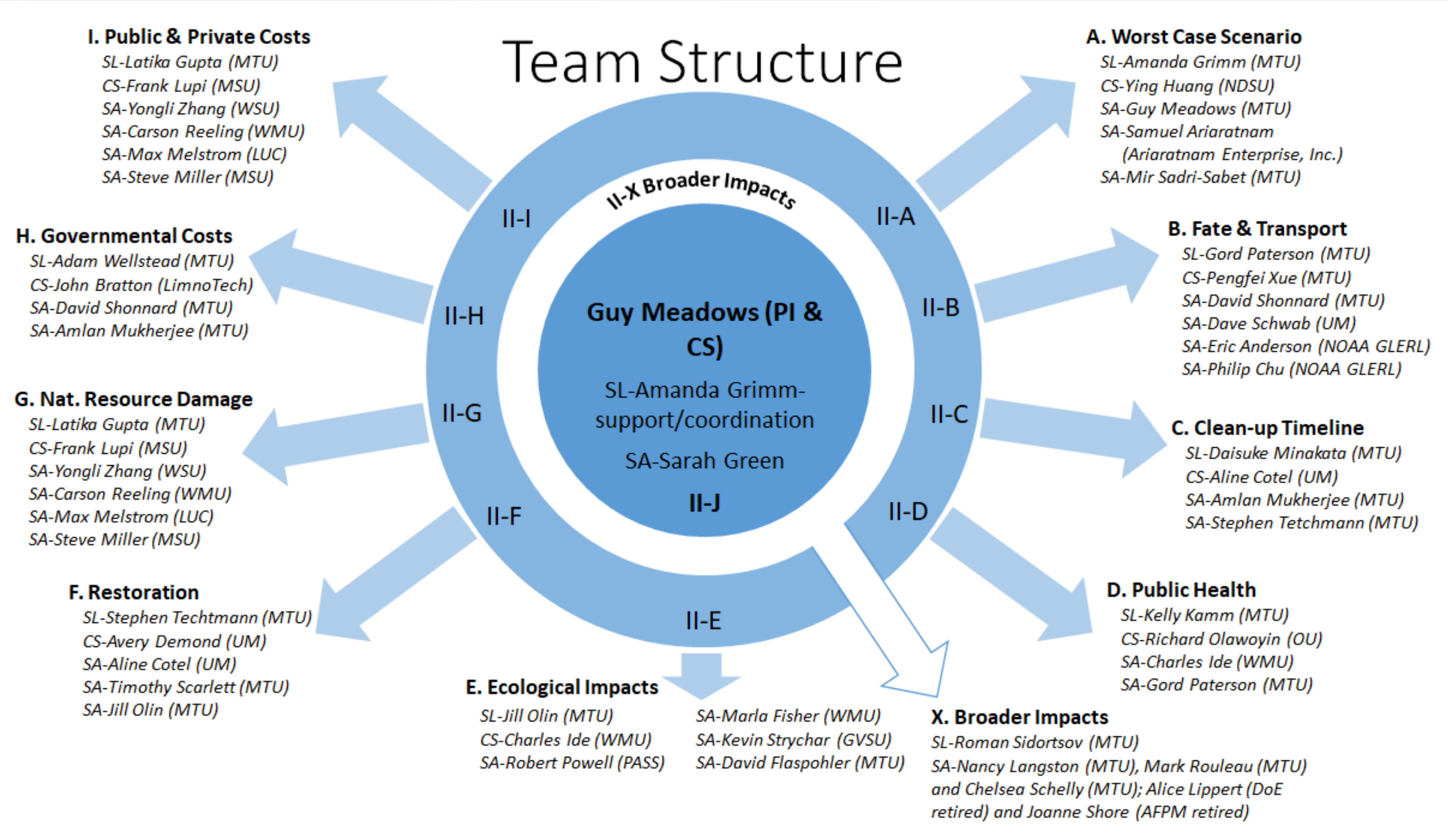
Public Information Meeting

Harbor Springs, MI August 13, 2018

Introduction

- Introduction of Presenters
  - Tasks A-C: Dr. Guy Meadows, MTU
  - Tasks D-F: Dr. Marla Fisher, WMU
  - Tasks G-I: Dr. Frank Lupi, MSU
  - Task X: Dr. Roman Sidortsov, MTU
  - Project support/coordination: Amanda Grimm, MTU
  - 12 additional university researchers from project team present today
- Completion timeline
  - **Feb 1**- Project start
  - **July 15** - Delivery of Draft Risk Analysis
  - **July/Aug** - Public presentation of Draft Report
  - **July/Aug** - Public comment period 30 days
  - **Aug** - Respond to public and State input
  - **Sept 15** - Delivery of Final Report

Project Organization



Task A: Identifying and analyzing the duration and magnitude of a “worst-case” spill or release

- US 40 CFR 194.5 defines a worst-case discharge volume as “the largest foreseeable discharge of oil, including a discharge from fire or explosion, in adverse weather conditions”, consider the maximum plausible potential release.

- We found several “worst-case” scenarios for an oil spill.
  - Most shoreline oiled in each lake
  - Most surface covered with floating oil
  - Fastest spread of oil to shorelines

Section Team:
Chief Scientist: Ying Huang (NDSU)
Section Authors: Guy Meadows (MTU), Mir Sadri-Sabet (MTU), Samuel Ariaratnam
Section Lead: Amanda Grimm (MTU)

Task A: Worst case spill or release

Threats	Mode	Pipes Affected
Corrosion	Pinhole leak	One
Cracking (defects)	Larger area hole	One
Spanning-related stress	Guillotine rupture	One
3rd Party damage	Any hole size	One or Both
Incorrect Operation (over pressure/hammer shock)	Guillotine rupture	One or Both

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Task A: Worst case discharge for different tiers of failure

3” pinhole leak, one pipe

Tier 1: Shutdown in 3.5 minutes: Spill **4,400 barrels.**

Tier 2: Shutdown in 13.5 minutes: Spill **8,600 barrels.**

3” pinhole leak, both pipes

Tier 3: Both pipes. **8,300 barrels** (3.5 min shutdown) or **16,800 barrels** (13.5 min shutdown).

Full rupture, one pipe

Tier 4: Manual shutdown in (1) to 2 hours. Spill: **(16,200) 29,000 barrels.**

Full rupture, both pipes

Tier 5: Manual shutdown in (1) to 2 hours. Spill: **(32,400) 58,000 barrels - carried through remaining tasks.**

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Task B: Fate & Transport

Predicting where spilled oil would go

- Model used weather conditions such as wind speed, currents, temperatures, and ice cover as well as oil weathering/evaporation to simulate how spilled oil would move.
- It used the conditions from Jan through Dec in 2016.
- The simulations show oil dispersal on the water and in the air, and when and where it would reach the shore.
- 4,380 simulations were run.

Section Team:
Chief Scientist: Pengfei Xue (MTU)
Section Authors: David Shonnard (MTU), David Schwab (UM), Philip Chu (NOAA), Eric Anderson (NOAA)
Section Lead: Gordon Paterson (MTU)

Task B: Fate & Transport

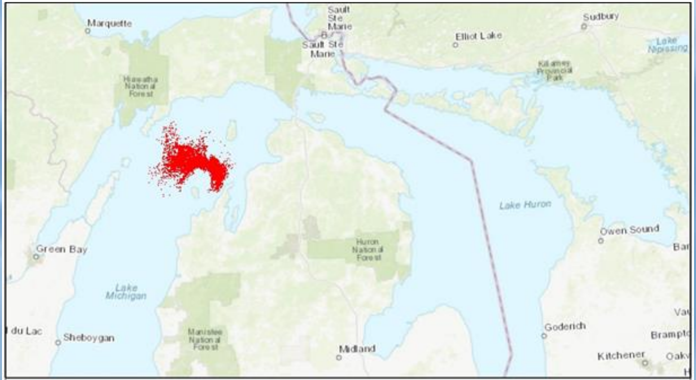
Sample model results

- Maximum shoreline oiled in one spill: 2,006 km, spread across 514 of the model's 1 km^2 grid cells, mainly in Lake Huron
- Largest area of open water covered: 1,745 km^2

- Lake Huron shoreline was oiled in more scenarios than Lake Michigan.

- Many scenarios showed oil reaching both lakes.

Scenario 07/20/2016 - 2006 km



Scenario 04/24/2016 - 1745 km^2

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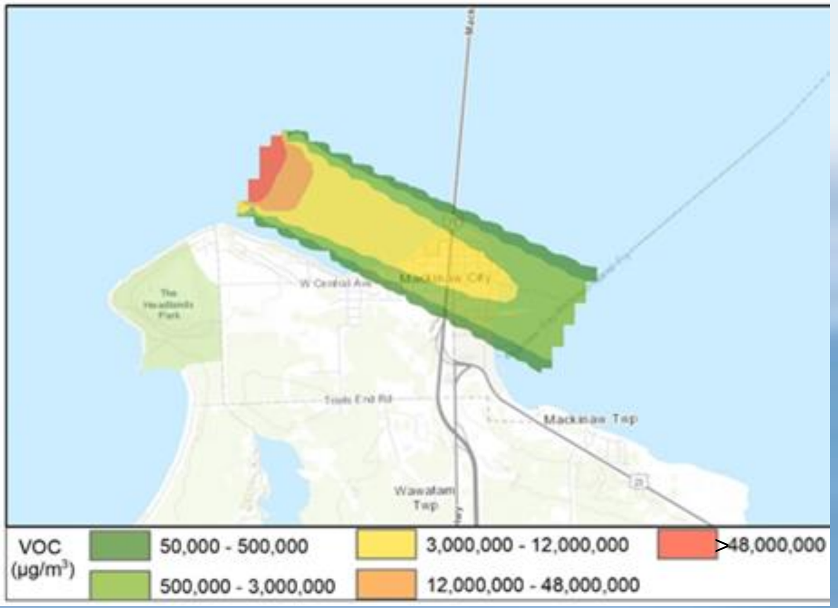
Task B: Fate & Transport

<u>Air Quality Modeling</u>

- A very small amount of vapor from evaporating oil would reach Mackinaw City.
- Most of the plume would be over water.
- The plume would dissipate before reaching population centers.



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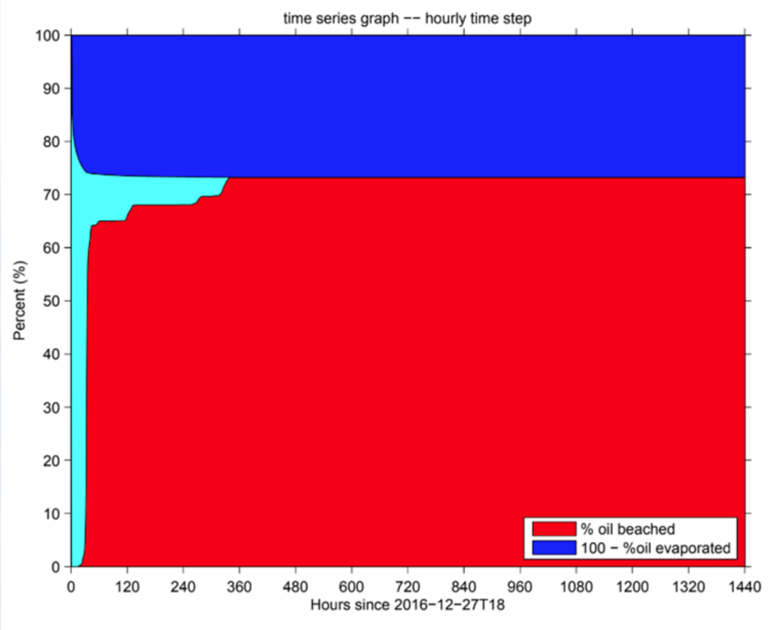
Task B: Fate & Transport



Example: Dec. 27 scenario identified as worst case for Task C

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Task B: Fate & Transport

Summary:

- Movement of spilled oil depends on the weather in the hours and days after a spill.
- Oil could move into one or both lakes.
- Maximum shorelines impacted:
  - 1,021 km in Lake Michigan
  - 2,006 km in Lake Huron
- VOCs would mostly dissipate over water, limited effects on population centers

Task C: Time to contain and clean up released oil

Case study: longest stretch of shoreline impacted in the shortest time

- Estimate the time to contain and recover oil from water
- Estimate clean-up time for beached oil

Consider:

- Emergency response process
- Resources available
- Weather conditions

Photo By: Lance Cpl. Jonah Lovy
https://www.beaufort.marines.mil/Photos/igphoto/2001315464/

Chief Scientist: Aline Cotel(UM)
Section Authors:Stephen Techtmann (MTU), Amlan Mukherjee (MTU)
Section Lead: Daisuke Minakata (MTU)

Task C: Overview of Spill Response

<u>Initial response</u>

- Emergency shutdown
- Initiate Incident Command System (ICS).

<u>Next phase</u>

- Oil containment
  - Priorities: capture the oil on water before it reaches shore
  - Tools: current busters, booms, skimmers, and possible in situ burning

<u>Long term</u>

- Shoreline Cleanup Assessment Technique (SCAT)
  - Monitor shoreline clean-up

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Amlan Mukherjee (MTU)
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Task C: Estimation of time to contain and recover oil on water

- Response Options Calculator (ROC) - Model for oil spill planning.
  → simulates oil spreading and recovery by advanced skimming systems.

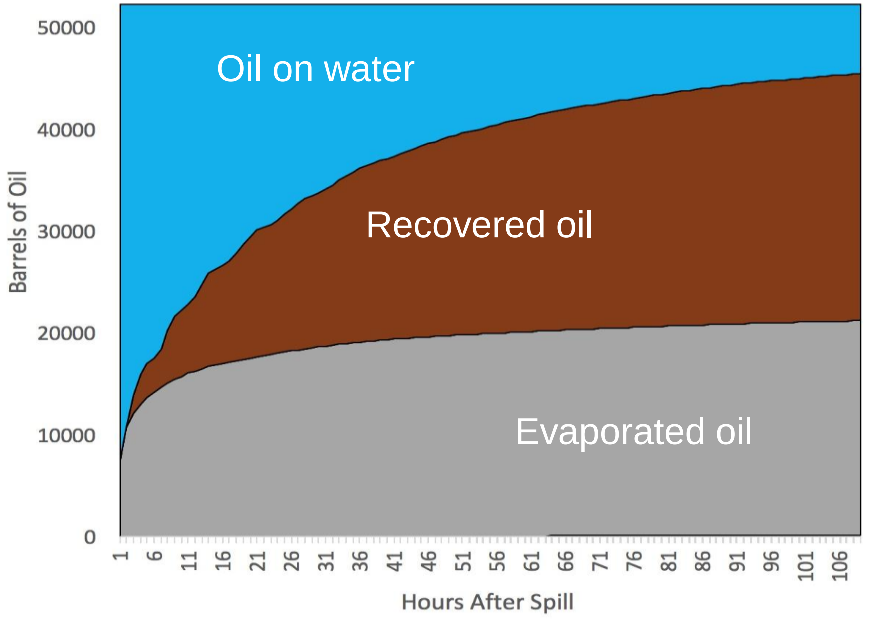
- Predicts effectiveness for different wind and wave conditions.

Equipment used in simulations:

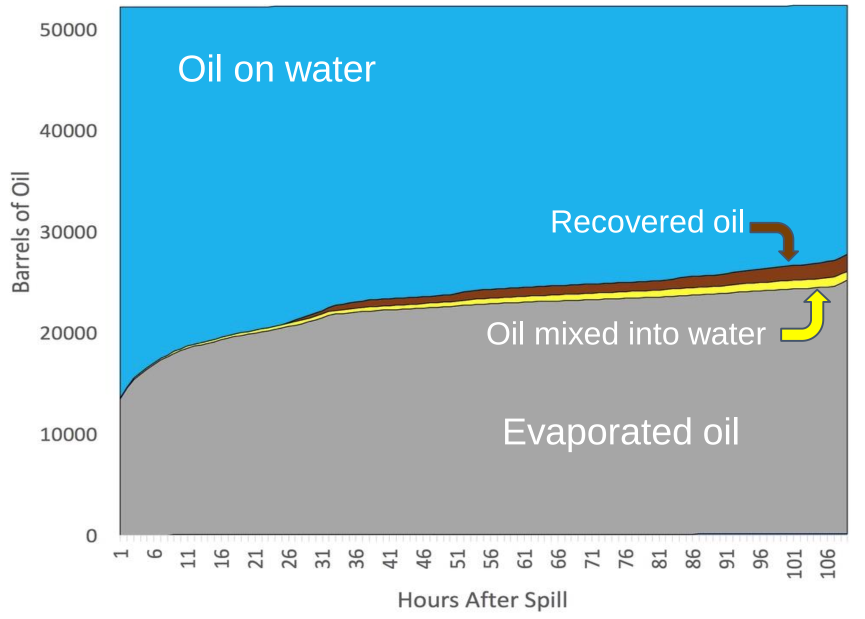
Equipment	Number	Location and owner
Current Buster IV	4	Straits (1), Cheboygan (2), Escanaba (1); Enbridge
Current Buster II	4	Straits (4); Enbridge
Foilex TDS 150	4	Straits (4); Enbridge
Lamor Bucket recovery system	2	Cheboygan (1), Escanaba (1); Enbridge
Medium Drum Skimmer	2	Straits (2); MPC
Medium Brush Skimmer	1	Straits; MPC
Medium Weir Skimmer	1	Straits; T&T

Task C: Results from ROC

Calm weather
(24 hour operations)



Actual conditions for Dec. 27 - 31st 2016
(Representative difficult cleanup conditions)



Task C: Estimated time to clean shoreline oil

Comparison shoreline spills

	Deep Water Horizon	Marshall, MI	Refugio, CA
Spill volume (Barrels)	4.9 Million	20,082	2500
Oiled shoreline (miles)	1100	70	24
Recovery Times			
Responsible Party engagement period	48 months	51 months	22 months
Beach closure duration	14 months	23 months	2 months
Fishing closure duration	5 months	24 months	41 days

Estimate for Straits: 12-24 months of active beach clean-up.

Task D: Public health & safety impacts

<u>Public health and safety potential threats</u>

- Contact with oil on water or on shore.
- Inhalation of contaminants in the air.
- Contamination of drinking water.
- Fire or explosion hazards.
- Mental Stress.

Photo courtesy of Mightymac.org

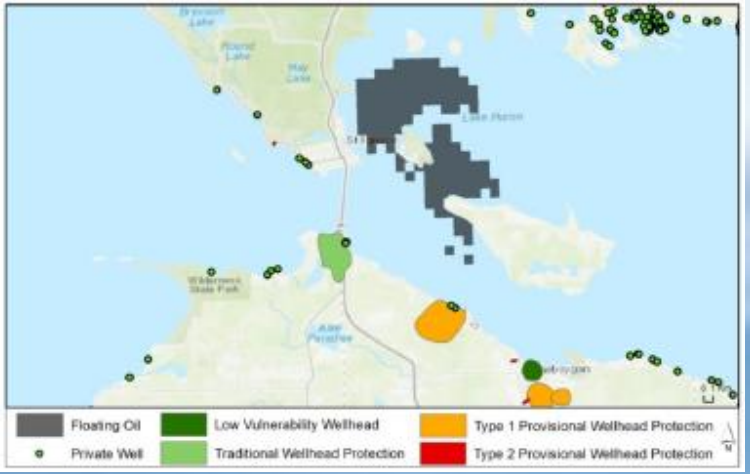
Section Team:
Chief Scientist: Richard Olawoyin (OU)
Section Authors: Charles Ide (WMU), Gord Paterson (MTU)
Section Lead: Kelly Kamm (MTU)

Task D: Public health & safety impacts

<u>Worst-case spill for public health</u>

1. Highest concentration of toxins in air
   - Large area of oil on water surface
   - Warm temperatures → more evaporation → greater inhalation risk

2. Largest number of people exposed
   - Population changes in Straits area: → tourism, seasonal residents/workers
   - High participation in water recreation



Simulation date: July 25, 2016, 6:00 AM
Dispersal time: 12 hours
Surface area oiled: 137 km^2

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Task D: Public health & safety impacts

Populations at risk from airborne, skin, ingestion exposures

Non-carcinogenic health impact (VOCs and PAHs)

- Permanent residents
- Clean-up workers
- Seasonal resident
- Tourists

Minimal risk

Carcinogenic health impact (PAHs)

- Permanent residents
  - 1 resident per 10,000 may develop cancer if exposure is prolonged
- Clean-up workers
- Seasonal resident
- Tourists

Minimal risk

Minimal health risk means less than 1 in 10,000.

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Task D: Public health & safety impacts

Drinking water contamination	Fire and explosion / Mental stress

• Municipal intakes → 12 could be contaminated
  • Alternative water sources may be needed
• Private wells: → low risk
  • Water testing advised
	Fire and explosion
	• Heat/fire from release occurs over water
	• Minimal risk to public
	Mental stress
	• Communities with ties to lakes may experience psychological stresses

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Task E: Ecological impacts

<u>Short-term effects</u>

- Animals and plants can die from oil exposure if they cannot move away.
- At risk:
  - Birds, swimming mammals, amphibians, and reptiles
  - Organisms in the water and lake bottom: plankton, invertebrates
  - Plants and submerged vegetation, fish eggs and larvae at the shoreline
- They die from being coated with oil and/or toxins.

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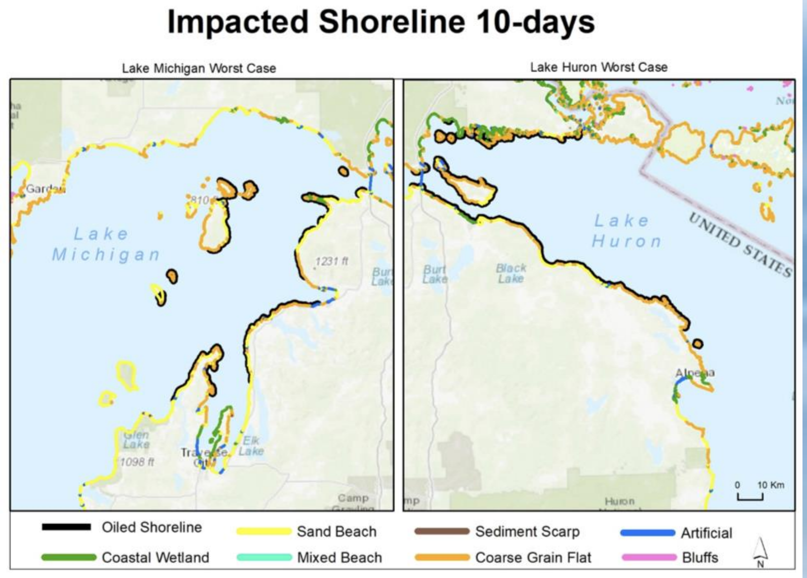
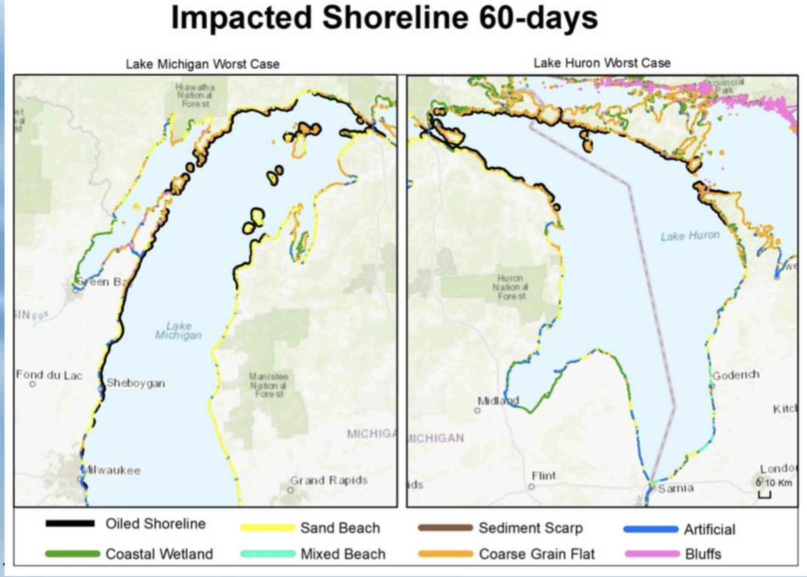
Task E: Ecological impacts

Estimate the impacts of a spill on natural resources: several scenarios

Short Term



Long-term



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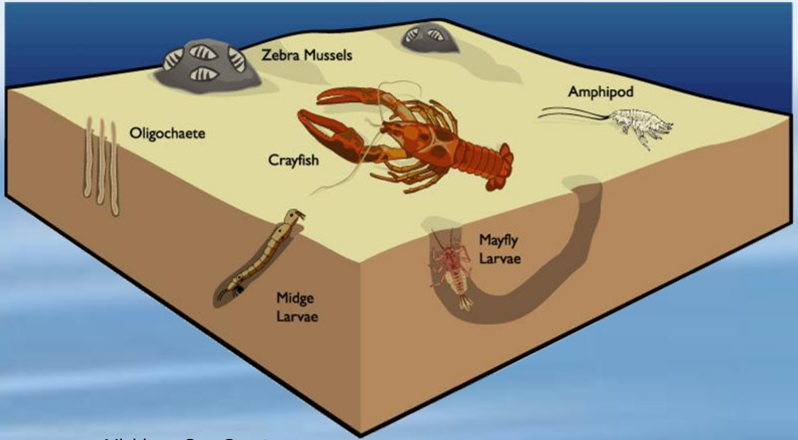
Task E: Ecological impacts

<u>Long-term effects</u>

- Oil on the shore can persist for years

- Oil contains toxic PAHs
  - PAHs disrupt endocrine and metabolic systems.
  - Cause cancer, compromised immunity, poor growth and reproduction.

- Juvenile and adult fish, birds, other animals that feed or live in contaminated sediments are at risk



Michigan Sea Grant
http://www.miseagrant.umich.edu/lessons/lessons/by-broad-concept/earth-science/water-quality/

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Task E: Ecological impacts

Habitats and Species at Risk

- Habitats:
  - **Fish spawning grounds**
  - ≈60,000 acres of rare and unique habitats: open dunes, wooded dune and swale, and marsh
- Key species:
  - 47 Threatened or endangered species
  - Shoreline mammals: raccoon, muskrat, river otter, beaver, mink, northern long-eared bat
  - Migrating birds, nesting shorebirds such as piping plover and terns

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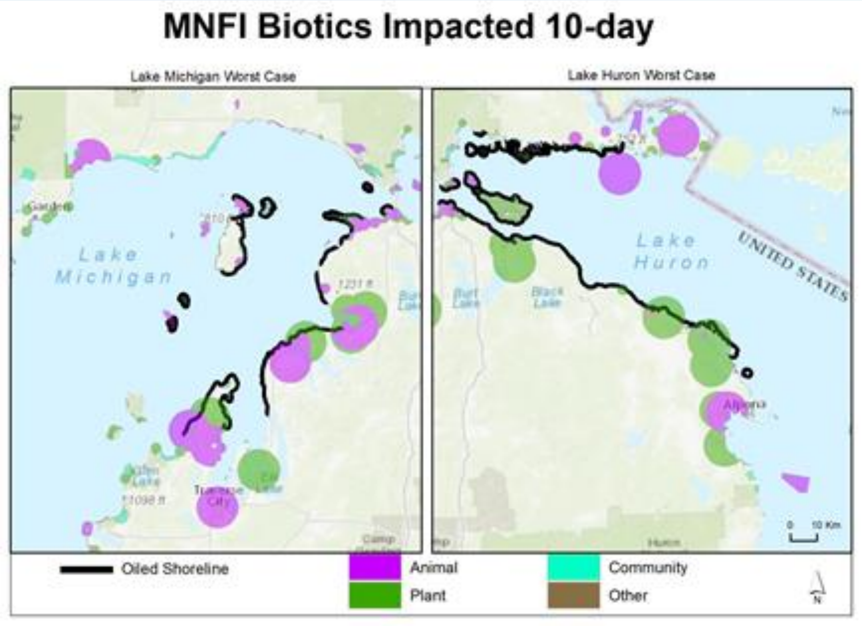

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Task F: Potential Restoration & Mitigation Measures

<u>Goals</u>

- Methods to restore damaged natural and cultural resources.
- Costs and effectiveness of restoration methods.

- Guided by:
  - Natural Resource Damage Assessment (NRDA)
  - Damage Assessment and Restoration Plan (DARP)
  - → defined in the Oil Pollution Act (OPA).
- Restoration types
  - Primary - return injured resources and services to baseline
  - Compensatory - reimburse the public for losses

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- Restoration types
  - **Primary** - return injured resources and services to baseline
  - Compensatory - reimburse the public for losses ← **Not included**

Only Primary restoration costs were assessed.

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Task F: Ecological Resources (Habitats)

<u>Habitats:</u>

Wetlands, Shorelines and Uplands, Open Water, Critical/Sensitive Habitat

<u>Approaches for Restoration</u>

- Removal of contaminated substrate
- Plantings to restore vegetation
- Bioremediation – using natural microbes for oil breakdown

<u>Monitoring</u>

- Monitor habitat structure, the progress of vegetation, and use by animals
- Restoration approaches must not further harm the environment
- Bioremediation can be slow

→ We don’t know much about oil biodegradation in the Great Lakes.

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Task F: Ecological Resources (Organisms)

Organisms:

Vegetation, Macrobenthos, Mussels, Clams, Snails, Reptiles, Amphibians, Fish, Birds, Terrestrial Mammals

Approaches for Restoration

- Habitat restoration and creation of new habitat
- Limit human interactions through signage, closures of fisheries, beach closures.

Monitoring

- Existing monitoring programs: Great Lakes Aquatic Habitat Framework, and Michigan DNR.
- Sampling of organisms to monitor populations and species in restored habitats.

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Task F: Cultural Resources

Some cultural resources **cannot** be "restored"

→ archaeological sites, shipwrecks

- Avoid damage during clean-up and restoration.
- Recover scientific and historical information before Damage occurs.
- ***Costs are included*** in clean-up and *primary restoration* projects

Shipwreck at Thunder Bay National Marine Sanctuary
Photo Courtesy of NOAA

Other resources ***can*** be physically restored

→ historic buildings, lighthouses, monuments, significant landscapes

- ***Costs are not included*** *in this study*. Would be calculated as part of *compensatory restoration.*

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Task F: Cultural Resources

Some resources *cannot* be restored

→ cemeteries, sacred sites

→ cultural resources like harvesting food, social traditions or religious rituals.

→ Intergenerational transmission of tradition or religious practice is disrupted.

Costs are compensatory only and would be determined by the courts.

Costs of litigation and liability are not included in this study.

- Costs would likely be high (see Task X report).

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Task F: Cost of Restoration

- No comparable spills have occurred in the Great Lakes.
- Estimates were based on Line 6B (Kalamazoo River) and *Deepwater Horizon* oil spills.
- Costs were estimated per km of shoreline oiled.
- Restoration costs would be **between $165M and $1.3B**. For the spring worst-case scenario, restoration costs are approx. **$500M**.
  - Overlap with Task H-estimated gov costs
- Costs will be higher with the addition of cultural resources restoration, compensatory restoration, and litigation costs.

Tasks G/I: Estimating public & private economic damages

Economic damages = lost economic values from worst-case release

Recreation and tourism

- Lost value to recreational users (beaches, fishing, boating, and parks)
- Lost incomes for tourism and recreation-related businesses

Other private costs and losses

- Water supplies
- Energy supplies
- Property values
- Commercial shipping & fishing

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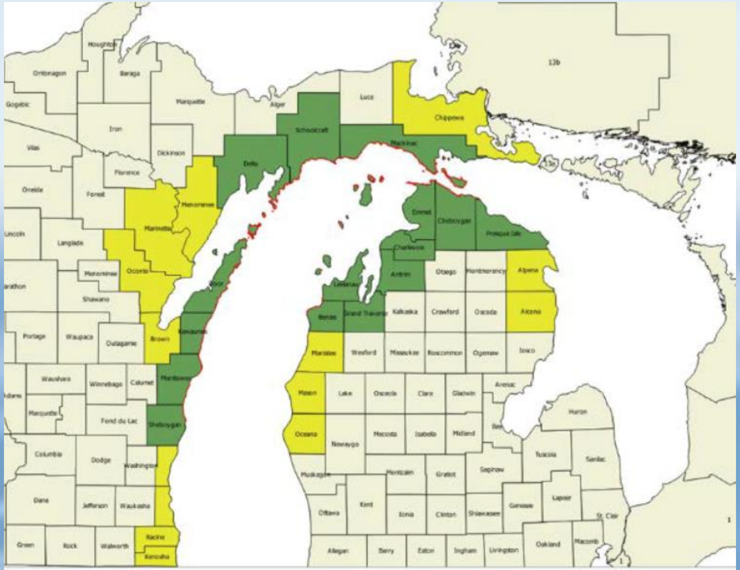
Tasks G/I: Economic damages

Recreation and tourism

Scenarios were derived from Deepwater Horizon spill and depend on activity

Higher impacts where oil washes ashore and lower impacts in surrounding areas

Some activities in core affected in year 2



High (green) and low (yellow) tourism impact areas: Economic worst case spill

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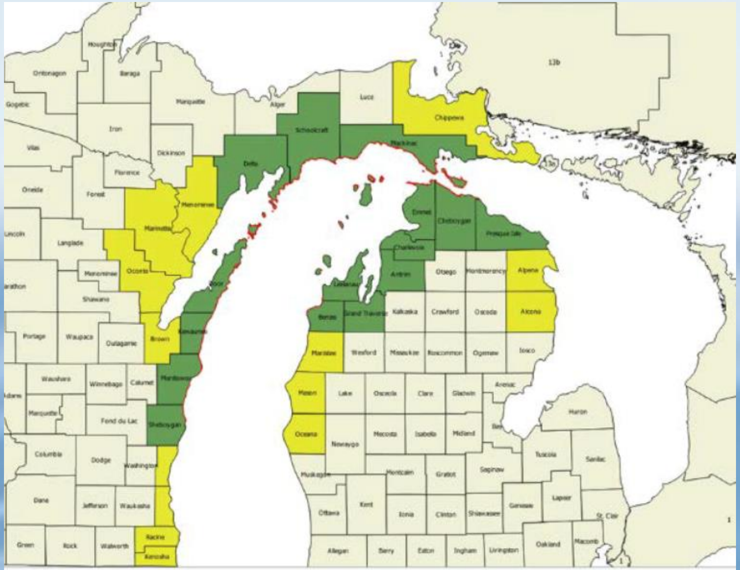
Tasks G/I: Economic damages

Losses to recreation users

Lost recreation days multiplied by values from MI studies and other literature

Beaches	398.6
Boating	32.5
Fishing	6.2
Parks	22.5
Total	$459.8 million



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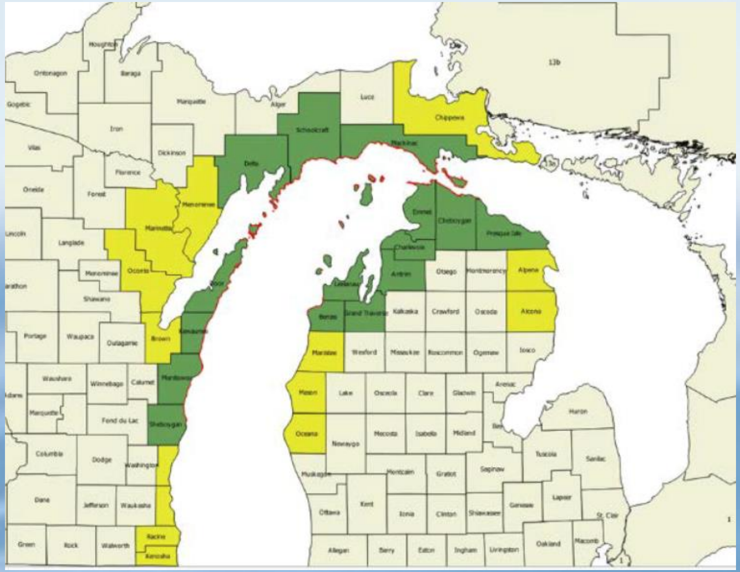
Tasks G/I: Economic damages

Tourism income losses

Impact scenarios run through regional economic models for MI & WI to estimate losses to wages and business incomes

$679.7 Million



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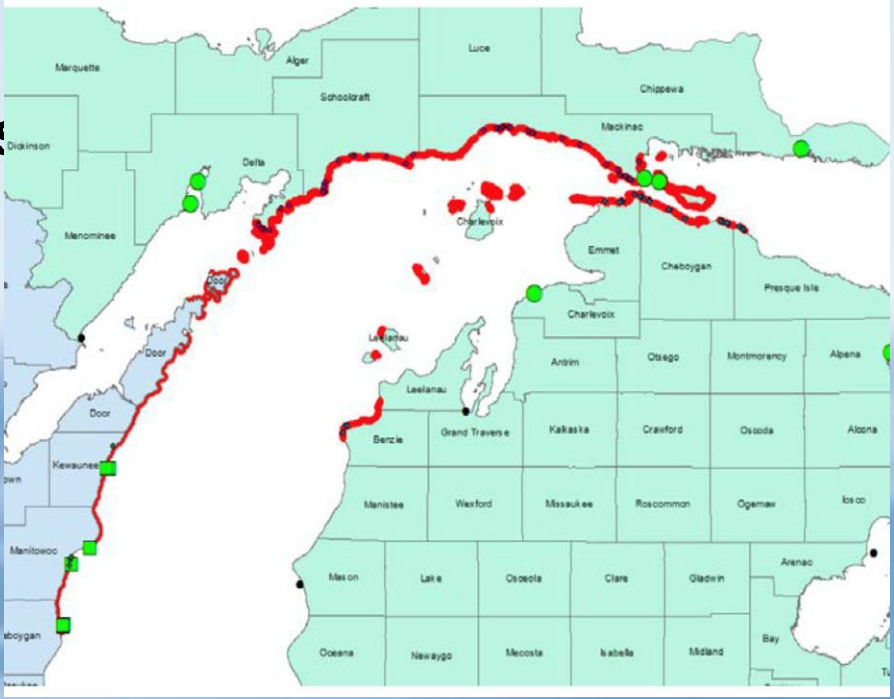
Tasks G/I: Economic damages

Water supplies

Costs for municipal water intakes for time alternative supplies are needed

Costs for testing for private wells within 200 feet of oiled shorelines

$3.6 Million



Water intakes (green) and private wells (black dots) within 200 ft of oiled shore (red line): Economic worst case spill

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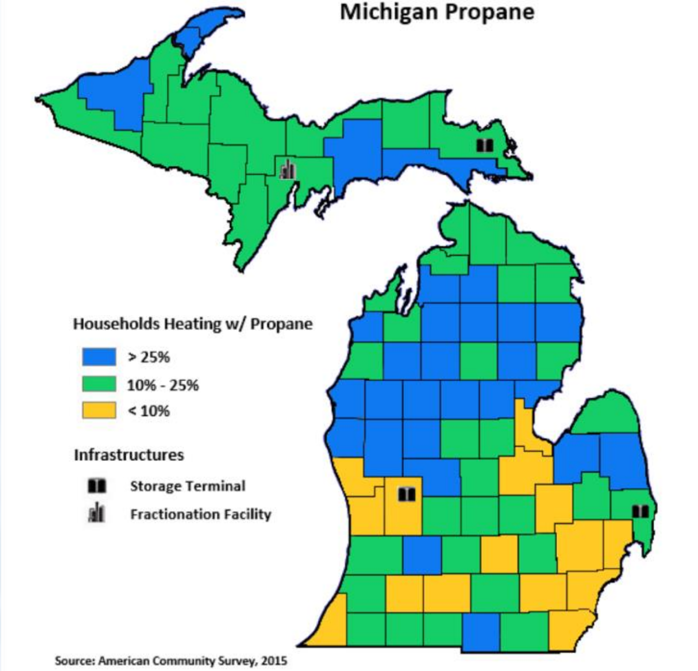
Tasks G/I: Economic damages

Energy supplies

Pipeline closure affects energy supplies (crude production) and increases prices for propane and gasoline.

$181 Million



Location of propane heating households

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Tasks G/I: Economic damages

Property values

Diminished value of property along coasts.

Commercial fishing

Lost tribal and state-licensed harvests during potential closures

Commercial shipping

Costs for waiting and holding until shipping lanes are passable

$45.9 Million

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Tasks G/I: Economic damages: total public and private

Lost value to recreation users	$ 459.8
Lost tourism incomes	$ 679.7
Other losses	$ 230.5
	=======
Total	**$1,370 Million**

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Task H: Estimating governmental costs of a worst-case release

- Estimate the costs to federal, state, local, and tribal governments of: --responding to the spill emergency,
  --conducting damage assessments,
  --monitoring cleanup activities,
  --overseeing restoration efforts,
  --negotiating a settlement with responsible parties,
  --lost tax revenue

  ...in the event of a worst-case spill.

Section Team:
Chief Scientist: John F. Bratton (LimnoTech)
Section Authors: Amlan Mukherjee (MTU), David Shonnard
Section Lead: Adam Wellstead (MTU)

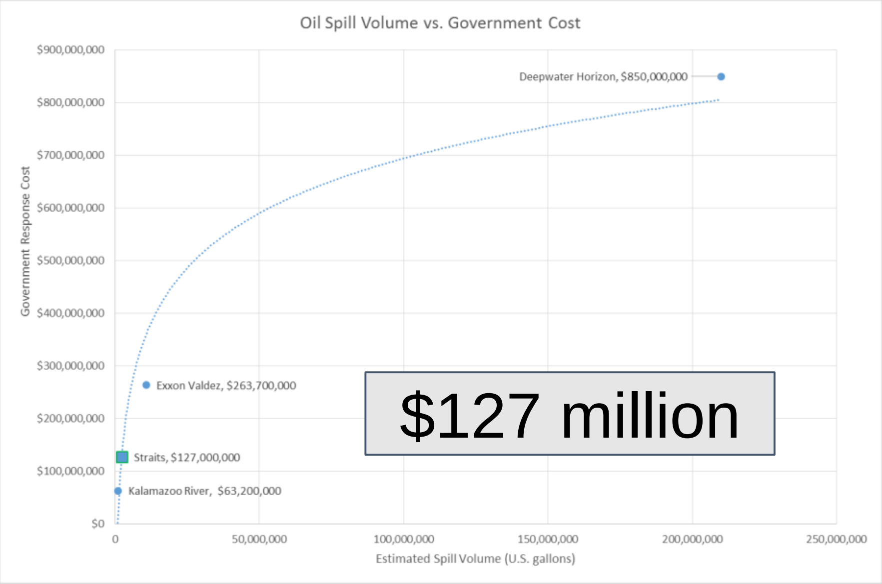
Task H: Estimating governmental costs of a worst-case release - approach

- Local, State and Federal Tax Revenues
  --Losses from tourism decline, up to $75M from beach visitor taxes alone
  --Gains from spill response worker income, up to $131M in income tax
- Analysis of Costs and Benefits
- Governmental Costs for Cleanup Oversight (USCG, EPA, NOAA, tribes, DNR, DEQ, etc.)- $123M - $535M
  --Floating Oil, shorter duration (days to weeks)
  --Shoreline Oiling, longer duration (months to years)
- Health Costs - not calculated
- Natural Resources Damage Assessment Costs - not calculated
- Loss from Responsible Party Cleanup Cost Deduction - $262.5M

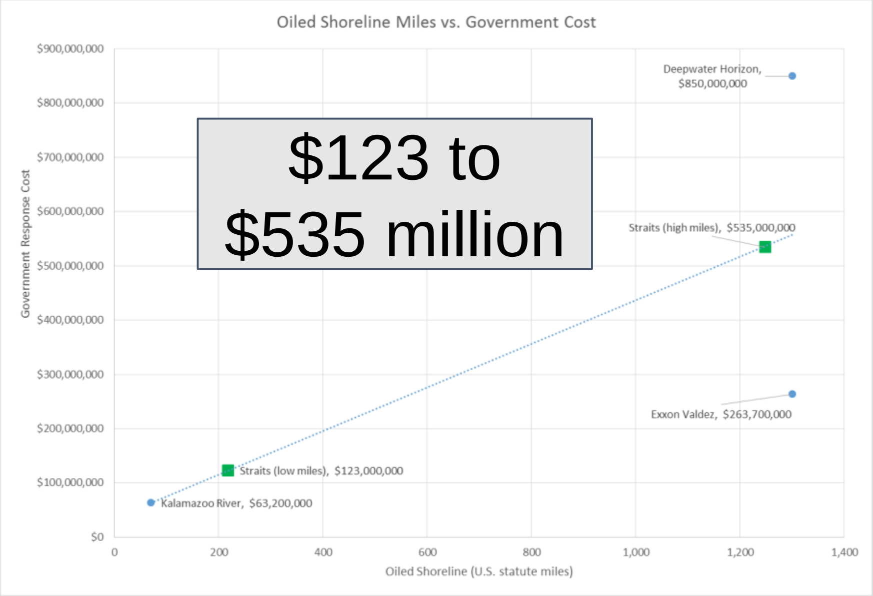
Section Team:
Chief Scientist: John F. Bratton (LimnoTech)
Section Authors: Amlan Mukherjee (MTU), David Shonnard
Section Lead: Adam Wellstead (MTU)

Task H: Estimating governmental costs of a worst-case release -- comparison with other spills (Valdez, DWH, Marshall)

Spill Volume vs. Gov't Cost



Oiled Shoreline Miles vs. Gov't Cost



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Task H: Estimating governmental costs of a worst-case release - approach

- Partial estimate of total losses:
  Beach tourism tax ($75M) + cleanup oversight ($123M-$535M) + loss deduction ($263M) = $461-$873 million

- Partial gains: cleanup worker income tax up to $131M

- Net government cost: **$330-$742 million**
  (does not include excluded costs mentioned previously)

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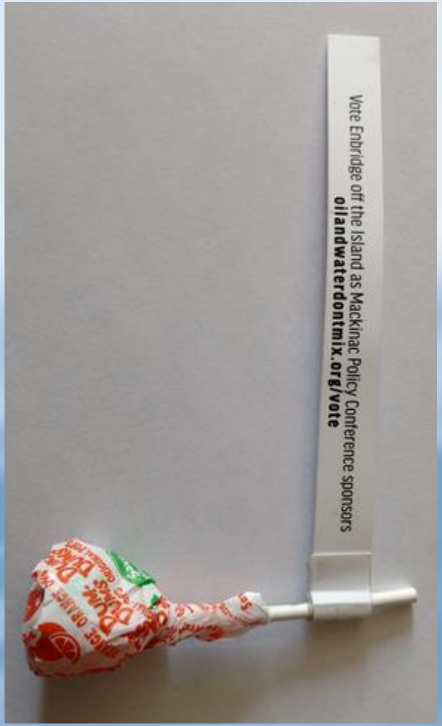
Section X - Broader Impacts

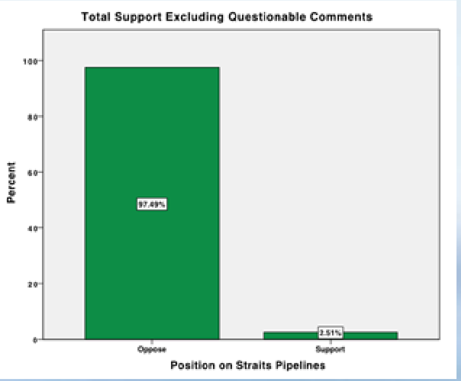
- Overall approach: if risk cannot be quantified, it does not mean that it does not exist.
  → perceived risk
- Data sources: 44,966 comments in response to the DR analysis, semi-structured interviews, tribal consultation
- Main concept: Social License to Operate (SLO)

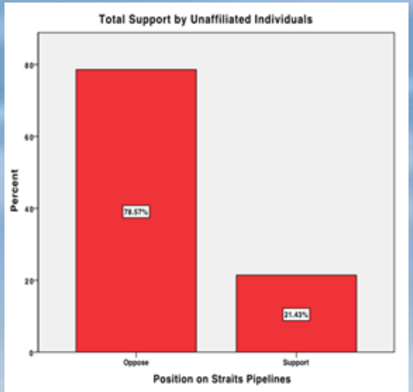


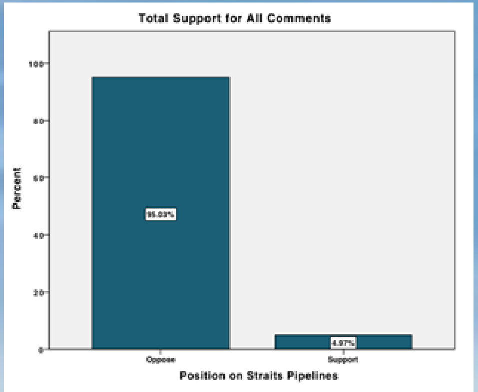
Section Team:
Section Scientists and Authors: Alice Lippert (DoE retired), Joanne Shore (DoE former), Mark Rouleau (MTU), Chelsea Schelly (MTU), John Baetan (MTU), Roman Sidortsov (MTU)
Section Lead: Roman Sidortsov (MTU)

Section X - Quantitative analysis

- Respondents = stakeholders
- Institutional respondents tend to comment on the DR reports, individual respondents tend to focus on risks posed by the Straits Pipelines
- Questionable comments
  - 4 subsets totaling 1,136 comments
  - 884 CEAM comments
- Overwhelming sentiment against the Straits Pipelines
- High organizational influence regarding SLO







Section X – Qualitative analysis

Two main themes: risk identification and risk tolerance/acceptance

- Risk identification:
  - No worst case scenario for supporters, severity of a worst case is very high for opponents
  - Additional risks: sudden service interruption, climate change, lack of trust in the industry and government, not just the Straits, future generations, Michigan’s image and reputation (Pure Michigan, tourism)
- Tolerance/acceptance
  - Split on the ability to manage risk - preparedness, safety record
  - Proponents focus on the benefits, very little risk v. benefit analysis
  - Opponents focus on low benefits compared to the risks and emphasize risk v. benefit analysis: Michigan v. Canada, industry v. people
  - Water is of utmost importance, acceptance of additional costs
- Institutional support by those who directly benefit

Section X – Tribal concerns

- Strong opposition from Michigan's 12 federally recognized Tribal Nations
- Legal rights, economic dependence, cultural & religious identity, thus, *highly* vulnerable
- Traditionally used flora and fauna for subsistence and cultural purposes, burial and other sacred sites = intergenerational relationship
- Strong basis for litigation, litigation against Enbridge and potentially against the state is near certain

Section X - Summary

- Overwhelming opposition, direct interest generally leads to support
- Opposition's concerns are generally well-reasoned and well- supported
- Not just the Straits
- Recreancy effect - SLO all but does not exist according to the stakeholders that grant it
- Unanimous and strong opposition by the Tribal Nations and near certain litigation in the case of a petroleum release
- Calculated impacts can only get worse, likely much worse

Summary

- A worst-case spill would release 58,000 barrels of oil into the Straits
- Water and shoreline in either or both lakes would be impacted
- Up to 40% of oil could be recovered from the water surface
- Shoreline clean-up would take 12-24 months
- Sensitive and threatened habitats and species would be harmed
- For the spring scenario expected to result in the highest total damages, liability is estimated as **$1.3B** in economic losses and **$500M** in restoration
- In addition to total liability, approx. $200M in net tax revenues would be lost.
- Intangible costs would also be very high

Thank You

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