

Agency for Toxic Substances and Disease Registry: RRT



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April 22, 2015

Centers for Disease Control and Prevention
Agency for Toxic Substances and Disease Registry



Agenda

1. Overview of ATSDR—Cory Kokko
2. Oil Responses: Characteristics and Health Effects—Mark Johnson
3. Public Health Involvement in Oil Responses—Michelle Watters

“The findings and conclusions in this presentation have not been formally disseminated by the Agency for Toxic Substances and Disease Registry and should not be construed to represent any agency determination or policy.”

Overview

- Who is ATSDR?
- ATSDR roles in Emergency Response
- Toxicology of Oil Constituents
- ATSDR Case Studies of Oil Response



Who is ATSDR?

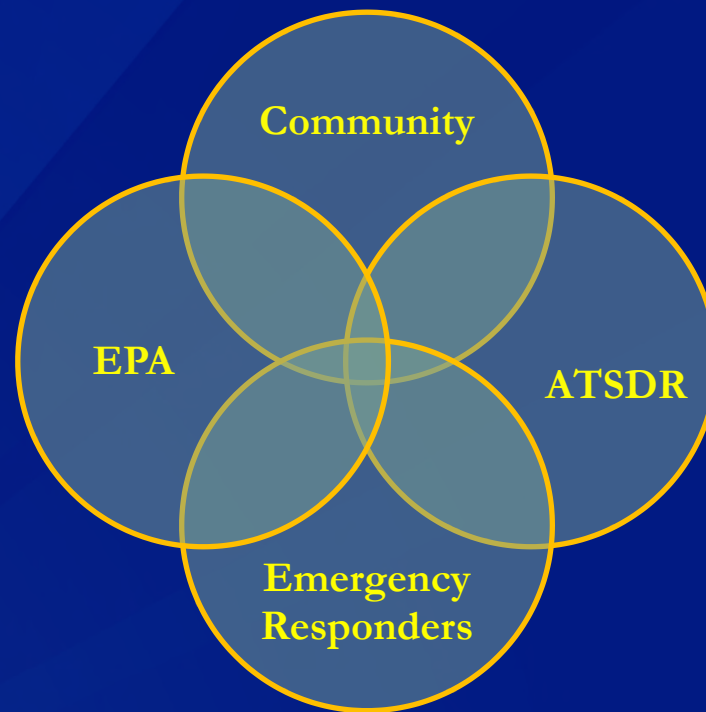
- Federal public health agency
 - Part of Department of Health and Human Services
 - Prevent harmful exposures and disease related to toxic substances
- Protect Public Health
 - Environmental data assessment
 - Health data assessment
 - Gather information on Communities health-related concerns
- Public Health Education
 - Explain health-related issues at sites.



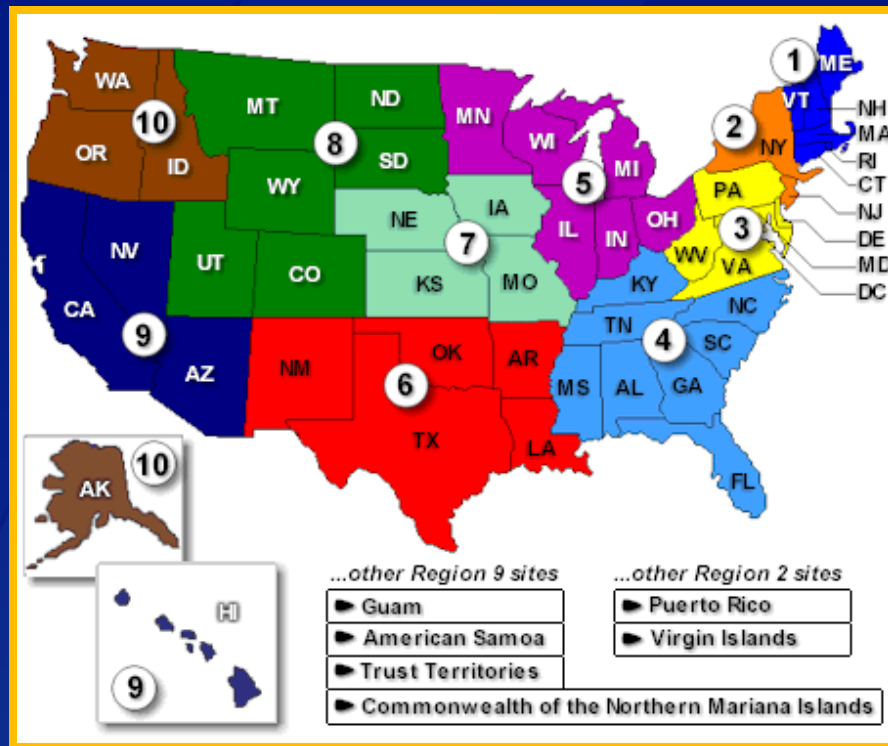
Protecting Communities



Partnerships



ATSDR Coverage



- Atlanta Headquarters
- 10 Regional Offices
- EPA Headquarters Office
- Field offices in Alaska, Idaho, and Montana

Protecting Communities



Extensive Staff Expertise:

- Toxicology
- Environmental Science
- Environmental Medicine
- Health Education and Community Engagement
- Public Health
- Physical Science and Engineering
(radiation, hydrology, modeling, etc.)
- Epidemiology

ATSDR Emergency Response Assistance

- 24–Hour Service
- Multidisciplinary Consult Team
- On-Site Response

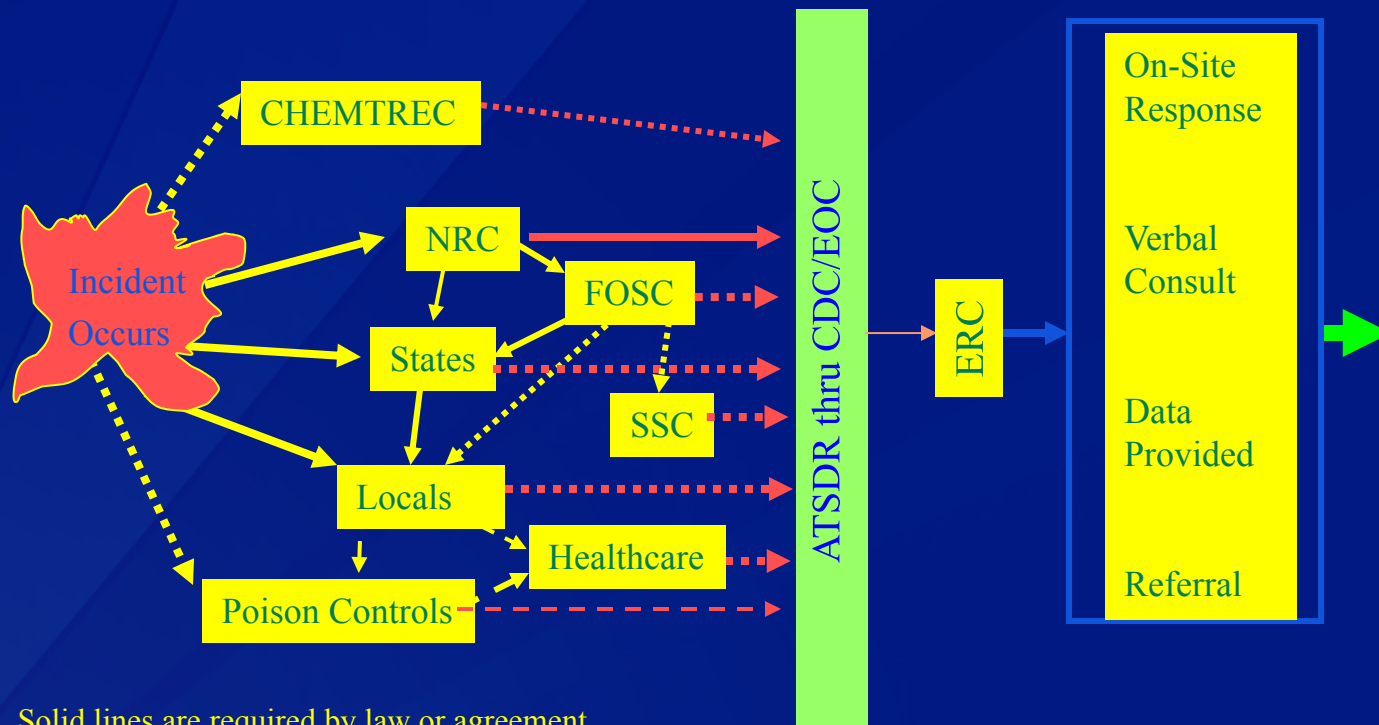


ATSDR's Role in Response

- Provide public health information to people
- Environmental data review
- Review screening levels proposed by EPA and States
- Answer health-related questions



Incident Information Flow



Solid lines are required by law or agreement.
Dashed lines are not.

Timeline is hours or days

Emergency Response Consultations

- Chemical/Toxicological Properties
- Data Review and Interpretation
- Assessment of Potential Exposures
- Medical Management
- Secondary Exposure Prevention
- Worker Safety and Health Issues
- Public Health Impact Assessment
- Simple Air Dispersion Modeling
- Combustion/Reaction By-Products
- Sampling/Monitoring Plan Development Assistance

Public Health Information for the General Public

- ToxFAQs (Frequently Asked Questions)
- Public Health Statements
- Medical Management Guide Patient Information Sheet
- CDC's Public Health Emergency Preparedness and Response Website at emergency.cdc.gov

Coffeyville Flood and Oil Spill



- 6/26 – 6/30
 - Verdigris River floods
 - Coffeyville Resources Refinery oil spill occurs
- 7/1
 - EPA responds to oil spill
- 7/2
 - EPA opens Emergency Operations Center (EOC)
 - EPA opened Mobile Command Posts
 - Presidential disaster declaration

ATSDR Role at EPA

Emergency Operations Center (EOC)

- Provide public health information to people in flooded areas
- Environmental data review
- Review clean-up standards proposed by EPA
- Answer health-related questions



Photo courtesy of Oklahoma Senator John W. Ford



ATSDR and EPA partnered to provide public health information

- Media
 - Press releases
 - Oil contamination
 - Environmental data
 - Fecal coliform
 - Personal protective equipment (PPE)
 - Public Service Announcements
 - CDC
 - EPA
- Flyers

Environmental News

FOR IMMEDIATE RELEASE

(Kansas City, Kan., July 2, 2007) – The U.S. Environmental Protection Agency mobilized two On-Scene Coordinators to Coffeyville, Kan. in the early morning of July 1, 2007, to respond to an oil spill caused by major flooding in the area. The OSCs have collected air and water samples.

Public Health Service Announcements

ATSDR and KDHE partnership

- “Stay Safe” poster
- Distribution of health education materials
- Partner in public health meetings

STAY SAFE!
xYES ✓NO

Water 	Drink only bottled or boiled water.	Don't use tap water for drinking, bathing or cleaning until local authorities say it is safe.
Food 	Eat only freshly bought and canned food.	Don't eat anything else.
Hygiene 	Wash hands often or use hand sanitizer, especially before eating.	Avoid contact with floodwater and wear gloves when removing debris.
Heat 	Wear light clothing, drink bottled water and stay in the shade.	Don't overwork yourself. Take frequent breaks. Watch for heavy sweating, dizziness and dry mouth.
Generators 	Use outside only, at least 20 feet from your house.	Don't use inside your house, on your deck or near air conditioner and vents.
Animals & Insects 	Use insect repellent, clean bites well, seek care and report animal bites.	Don't approach domestic or wild animals that may bite if scared or injured.

Environmental Data Review



- Data review
 - Partnered with EPA to establish health screening criteria
 - Do contaminants pose a health hazard?
 - Report with conclusions and recommendations

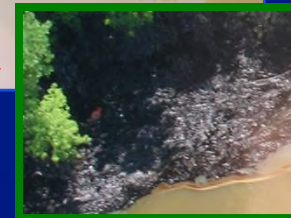


Photo courtesy of the O'Briens Group taken on 7/5/07

- Clean up criteria
 - Review proposed standards
 - Concurrence

On-Site Response



- 7/6
 - EPA requested ATSDR on-site support
- 7/7
 - Emergency Response Coordinator deployed from Atlanta
- 7/8
 - Environmental Health Officer deployed from Kansas City
- 7/10
 - Coffeyville Public Health Meeting
- 7/12
 - Independence Public Health Meeting
- 7/14
 - Demobilization

Oil Responses: Characteristics and Health Effects

Mark Johnson, PhD, DABT

Toxicologist/Regional Director, ATSDR-R5

Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations



Statute Authority under the National Contingency Plan [40 CFR 300.175(b8)]

- “the primary response to a hazardous materials emergency comes from Agency for Toxic Substances and Disease Registry (ATSDR) and the Centers for Disease Control (CDC)...
 - CDC takes the lead during petroleum releases regulated under the CWA and OPA
 - ATSDR takes the lead during chemical releases under CERCLA

Exposure to Crude Oil

- Releases from Drilling Operations
- Transportation incidents
 - Railcars
 - Pipelines
- Releases from Oil Storage facilities
- Burning of crude oil

Evaluation of Exposures to Oil Releases

- Environmental Media
 - Air, Surface Water, Groundwater
- Chemicals released
 - Oil-associated chemicals
 - Naturally-occurring constituents
 - Chemicals in Fracking materials
- Exposed Populations
- Exposure Pathways- Ingestion, Inhalation, Dermal

Petroleum-related Compounds

Aliphatics

Methane	Pentane
Ethane	Hexane
Propane	Nonane
Butane	Decane
Isobutane	

Aromatics

- Benzene
- Methylbenzenes
- Toluene
- Ethylbenzene
- Xylenes

Polycyclic Aromatic HCs

- Napthalenes
- Phenanthrene
- Pyrenes

Sulfur Compounds

- Hydrogen Sulfide
- Mercaptans/Thiols

Shale Oil

- Oil present in Sedimentary Rock
- Kerogen
- 60-90% mineral matter
- VOCs
- Heavy metals
- May have elevated sulfur content
 - (0.7%, up to 10%)



Bakken Crude Oil Properties

- Benzene: 0.1-1%
- Hydrogen sulfide: (0.14% sulfur)
- Specific Gravity: 0.7 - 0.8
- Vapor Density: 2.5 - 5.0
- Vapor Pressure: 280 - 360 mmHg
- Explosive Range: 0.8-8%
- Flash Point: -35°C

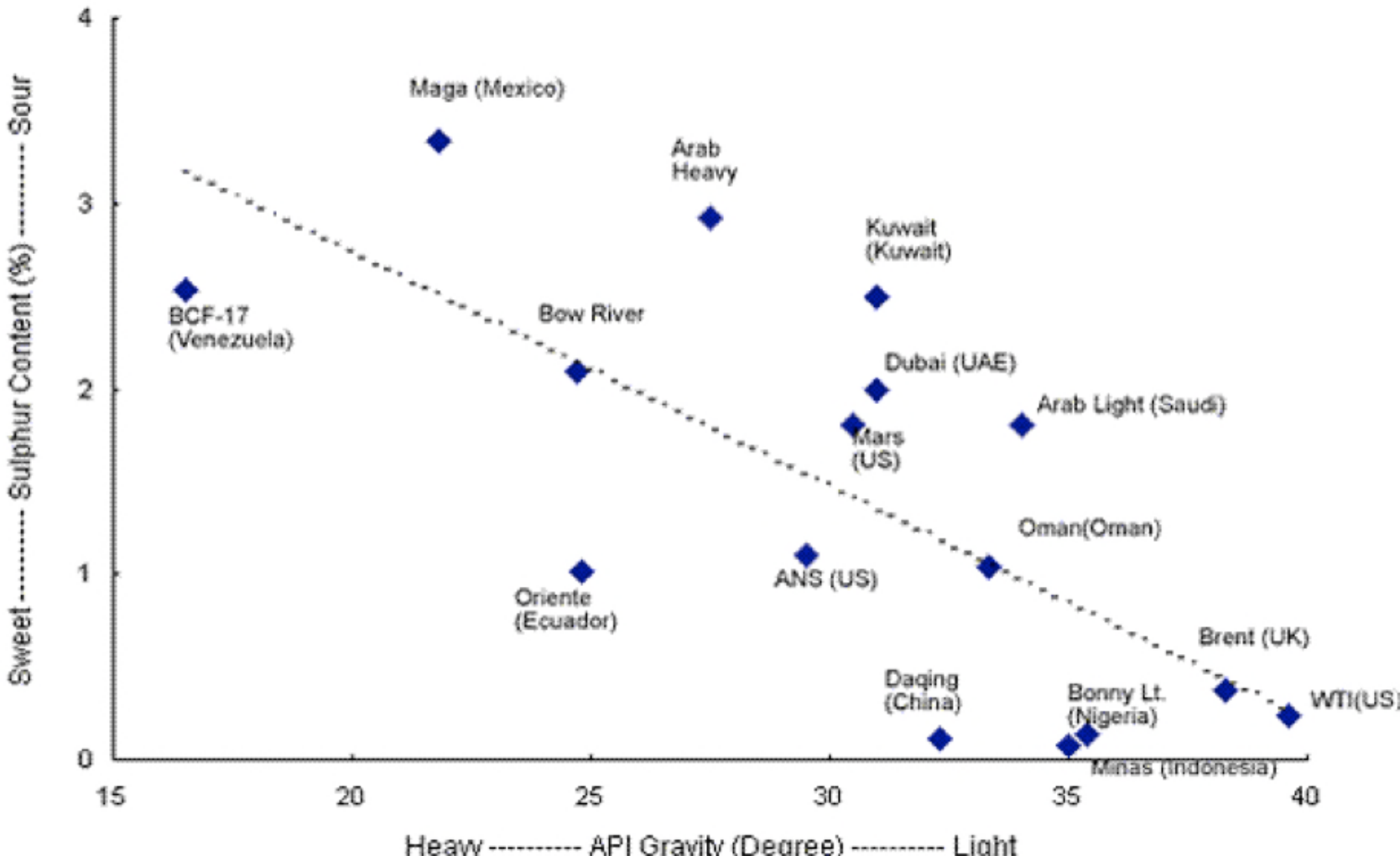
Tar Sands Oil

Heavy Crude (50-70%) and Diluent (30-50%)

- Benzene: 0.03-0.3%
- Hydrogen sulfide: <0.1%
- Specific Gravity: 0.91-0.94
- Vapor Density: 2.5 – 5.0
- Vapor Pressure: 570 mmHg
- VOC content : 15-30%
- Explosive range: 0.8-8%
- Flash Point: < -35°C

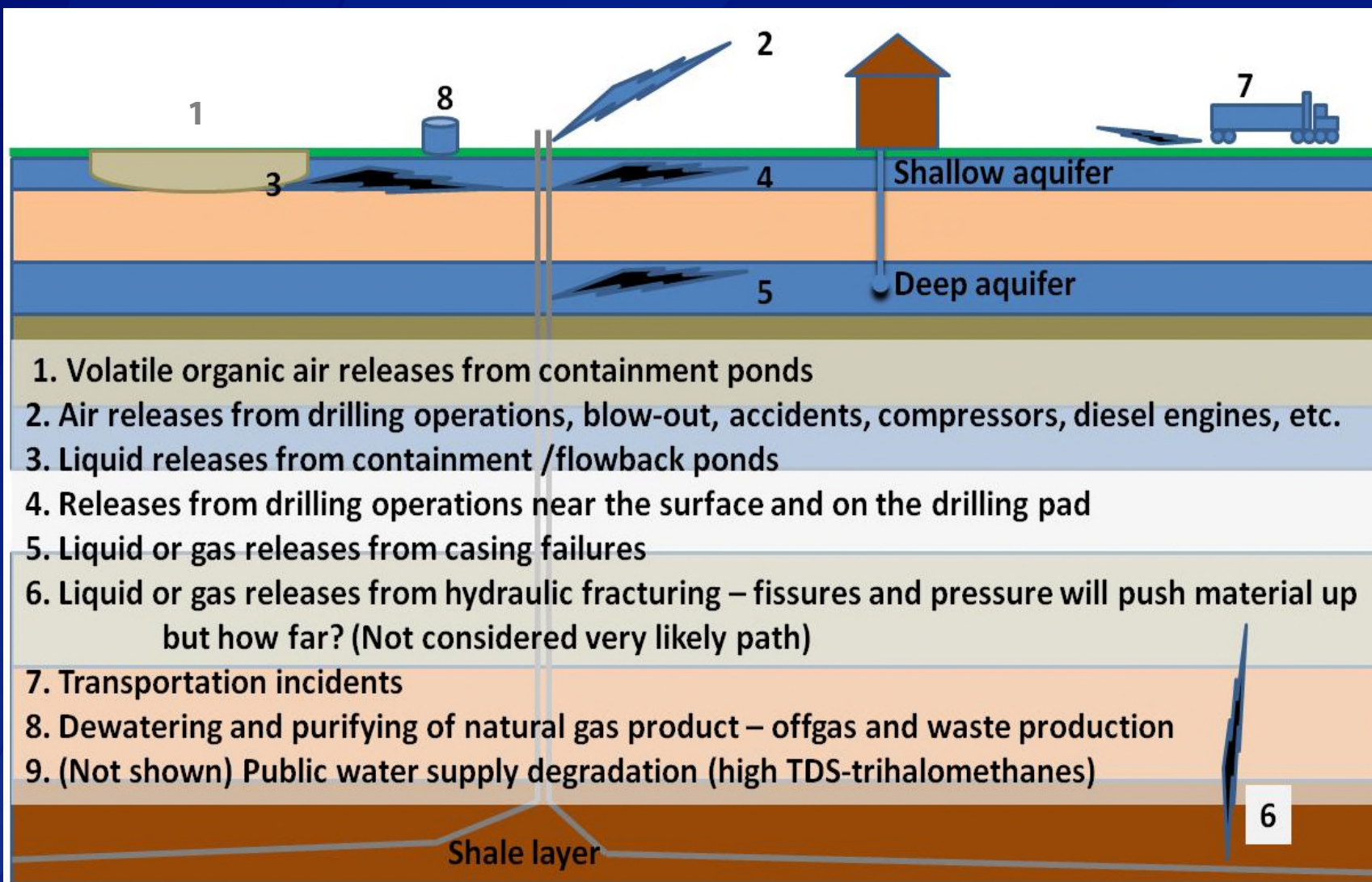


Grades of Crude Oil

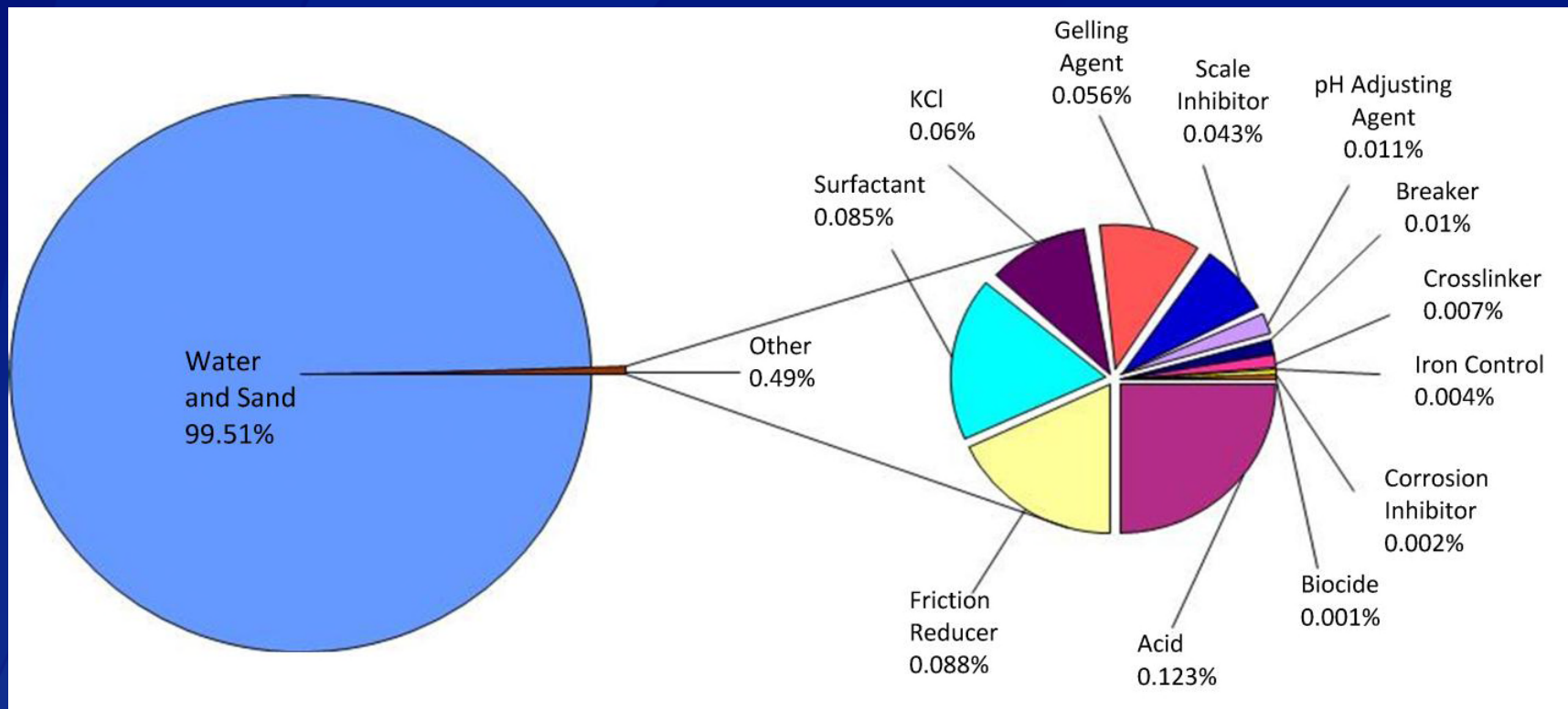


Source: The International Crude Oil Market Report

Potential Environmental Release Pathways



Components of Hydraulic Fracturing Fluids



Modern Shale Gas Development in the U.S.: A Primer, (2009) U.S. Dept of Energy

Potential Air Releases from Wastewater Impoundments



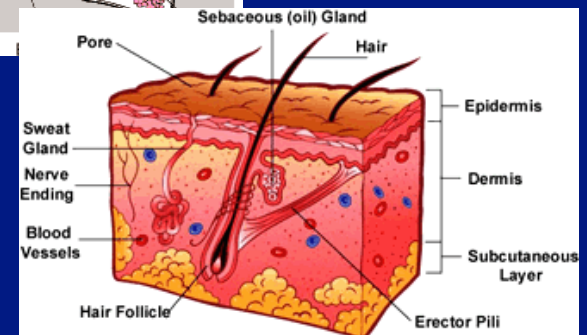
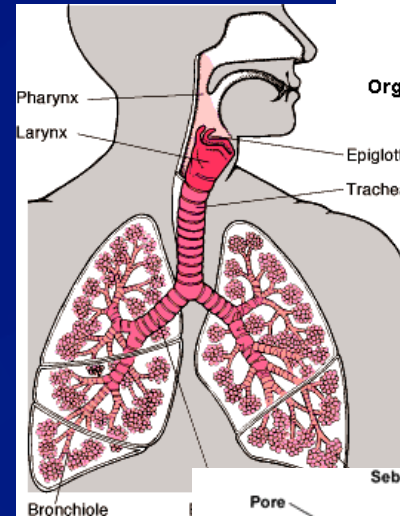
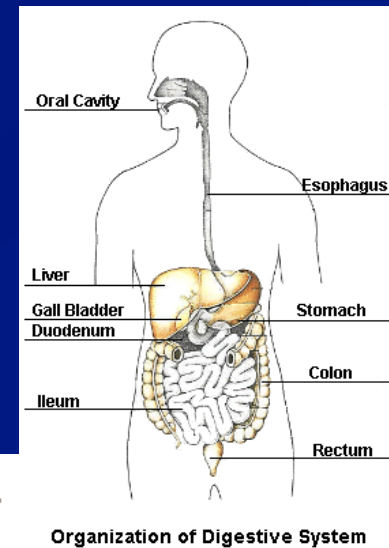
Statoil Eisenbarth Well Response Clarington, OH

- June, 2014- Fire consumed well pad
- Hydraulic fluid release onto hot equipment initiated fire
- 25,000 gallons of fracking reagents on-site
- 70,000 fish kill in downstream creek; may be attributed to the biocide, tributyl tetradecyl phosphonium chloride (TTPC)



Exposure Dose

- Dose is determined by the:
 - Chemical concentration
 - Route of exposure
 - Frequency of exposure
 - Duration of exposure
 - Body weight
 - Other individual factors



Health Guidance Values (HGVs)

- Emergency Response Planning Guidelines (ERPGs): 1 hr
- California EPA AIC: 1 hr
- Acute Exposure Guideline Levels (AEGs): 10 min – 8 hrs
- ATSDR MRLs
 - Acute: hrs - 14 days
 - Intermediate: 14 days – 1 year
 - Chronic: >1 year
- EPA RfDs/RfCs: lifetime

Chemicals of Concern- Acute Effects

- Explosive Conditions: Methane, Ethane, Propane
- Asphyxiant Conditions: Displacement of Oxygen
- Chemical Toxicity
 - Benzene
 - Ethylbenzene
 - Toluene
 - Xylenes
 - Hydrogen sulfide
 - Naphthalene

Benzene Health Effects

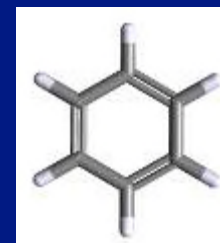
- Short-Term Effects

- CNS Depression

- Headache
- Dizziness
- Nausea
- Throat, eye and nose irritation
- Coughing, wheezing
- Immune Suppression

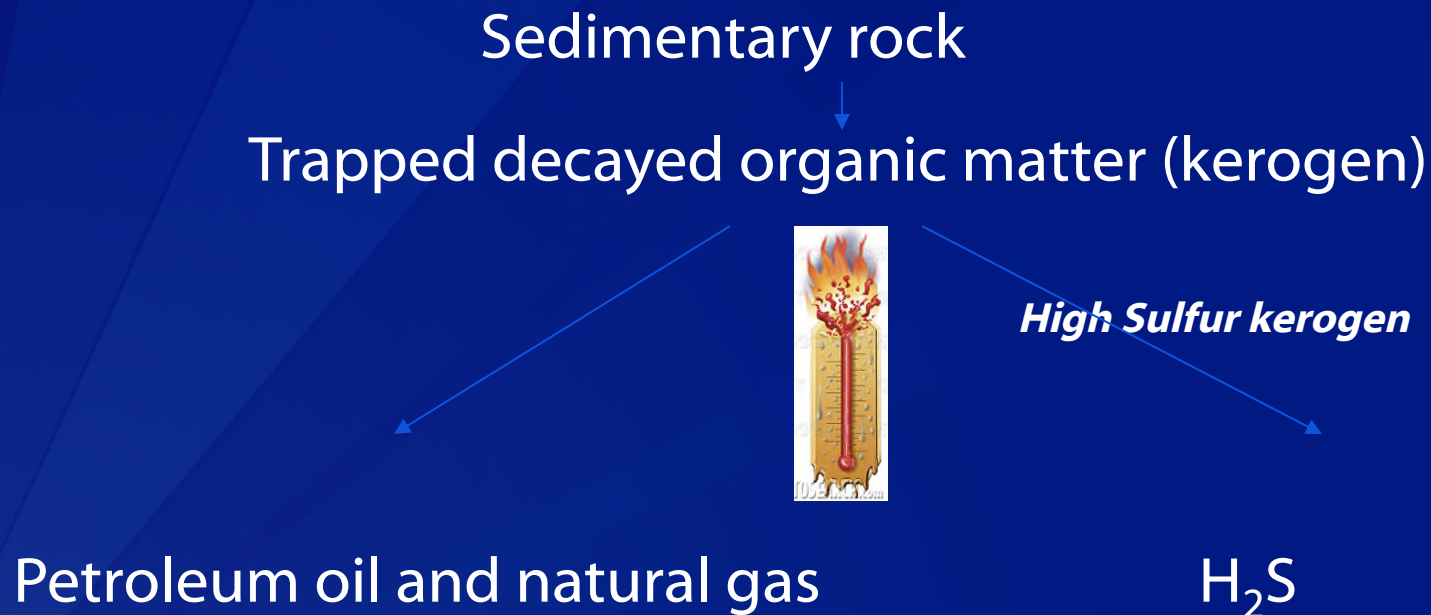
- Long-Term Effects

- Cancer: Leukemia
- Hemopoietic damage
- Immune System Damage



Hydrogen sulfide

- H_2S is a naturally occurring component of crude oil and natural gas



Hydrogen sulfide

- H_2S is the predominant impurity in natural gas.
- About 15 – 25% of natural gas in the US may contain H_2S
- Colorless, flammable gas, heavier than air (1.19)
- “rotten egg” odor; odor threshold: <10 ppb
- *Sour* Natural Gas: H_2S is present at > 4 ppm
- *Sour* Crude Oil: >0.5% sulfur

Acute Effects of Hydrogen Sulfide

Concentration	Effect
0.01–0.3 ppm	Odor threshold
>2 ppm	Respiratory effects (airway restriction) Neurologic effects (headaches, nausea)
>20 ppm	Eye irritation
>80 ppm	Cardiac effects Olfactory necrosis- loss of smell
>110 ppm	IDLH
>500 ppm	Death- pulmonary and cerebral edema, coma, cyanosis

Petroleum Combustion By-Products

- VOCs
- Carbon Monoxide
- Particulates
 - PM 10 (particles < 10 micron diameter)
 - PM 2.5 (particles < 2.5 micron diameter)
- Nitrogen dioxide
- Sulfur dioxide

Chemicals detected in Validated Environmental Dataset

Is chemical associated with oil spill?

Yes

No

Does concentration exceed background?

No

Yes

Compare to appropriate duration-specific screening level

Yes

No

Are screening levels exceeded?

Yes

Evaluation
- temporal and spatial trends to determine extent
- consider if more intensive sampling is needed

No Further Action

Take Appropriate Action

Summary

- Understanding the composition of crude oil material is critical to anticipating potential exposure hazards
- Bakken oil is more flammable and more volatile than other crude oils because of dissolved gases
- High sulfur oil may result in release of hydrogen sulfide
- Use of diluents with oil material (e.g. tar sands) increases the exposure hazard

Public Health Involvement in Oil Responses

Michelle Watters, MD, PhD, MPH

Division Medical Officer,
Division of Community Health Investigations, ATSDR

Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations



Public Health Involvement

- Local, State, Federal Public Health Agencies
- Public Health Advisory Group
- Unified Command
- Planning Section
 - Public Health Unit
 - Toxicology and Analysis Sub-group
 - Fish Consumption Advisory Workgroup
 - Environmental/Public Health Task Force
- Multi-Agency Coordination Group
- Responsibilities
- Jurisdiction

Public Health Involvement

- Needs assessment
- Surveillance and Epidemiology
 - Drinking water sources
 - Health Effects
- Organize delivery of health care services and supplies
- Health risk communication/health education
 - Proper sanitation and hygiene
 - Health effects of chemicals
- Environmental data review
- Review of sampling plans

Public Health Involvement

- Recommend actions that need to be taken to safeguard people's health
 - Personal Protective Equipment
 - Monitoring
 - Evacuation
 - Re-occupancy
 - Drinking water
 - Recreational Use
 - Fish advisories
- Site-specific action levels

Exposure concerns

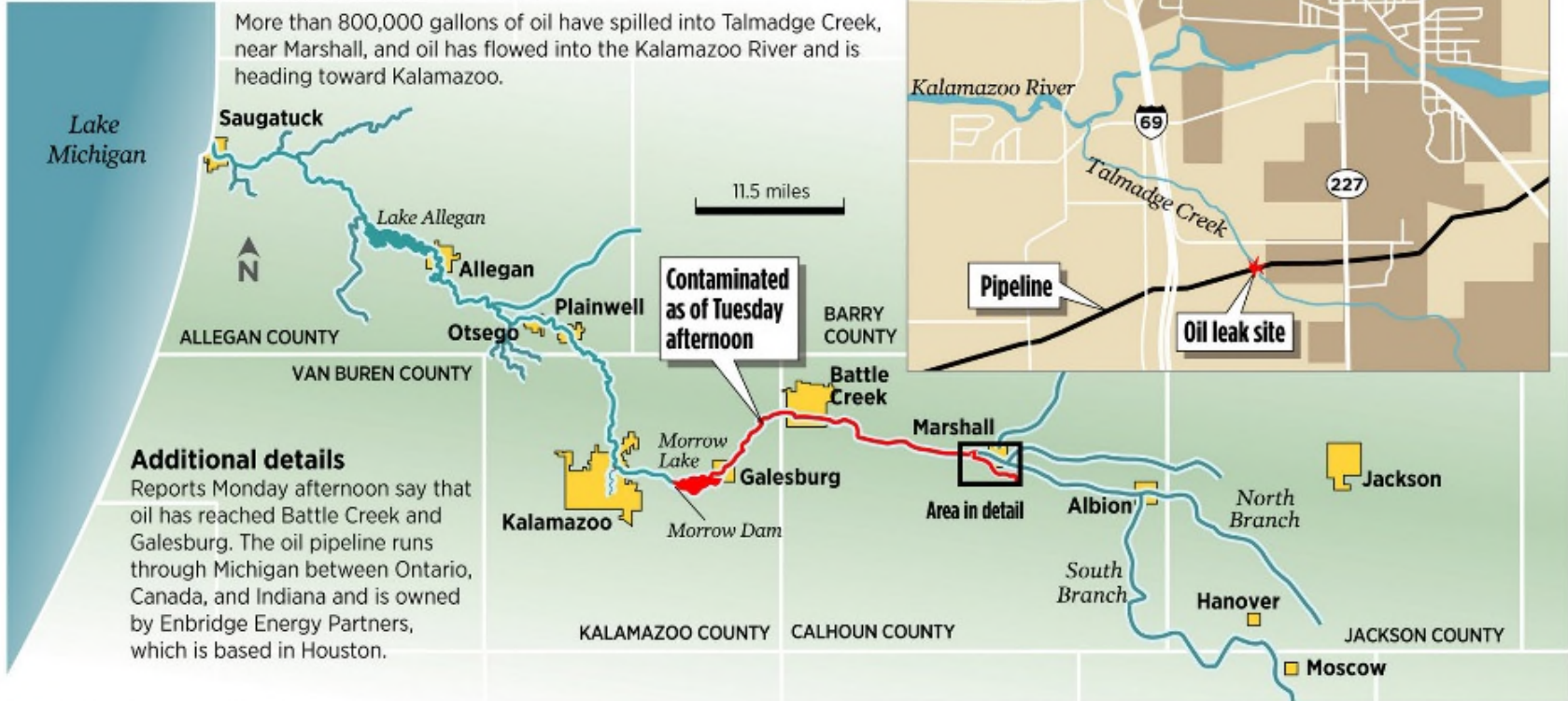
- Health implications
 - Immediate hazards
 - Acute health effects
 - Chronic health effects
 - Increased cancer risk
- Past, present, future exposures
- Residential, occupational exposures

Enbridge Oil Spill – July 2010



Oil flows into Kalamazoo River

More than 800,000 gallons of oil have spilled into Talmadge Creek, near Marshall, and oil has flowed into the Kalamazoo River and is heading toward Kalamazoo.



Additional details

Reports Monday afternoon say that oil has reached Battle Creek and Galesburg. The oil pipeline runs through Michigan between Ontario, Canada, and Indiana and is owned by Enbridge Energy Partners, which is based in Houston.

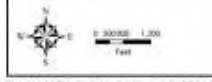
Source: Michigan Department of Natural Resources and Environment

GAZETTE GRAPHIC/KRIS KINKADE

Evacuation

- 50 to 9,750 ppb benzene
 - Monitoring data in residential areas in the vicinity of work areas (July 28, 2010)
 - Up to ~6,000 ppb (August 4, 2010)
- **Voluntary** evacuation notice to 60 homes Calhoun CO HD (July 29, 2010)
 - Door to door notification





LEGEND
 EVACUATION AREA

**FOR OFFICIAL
 USE ONLY**

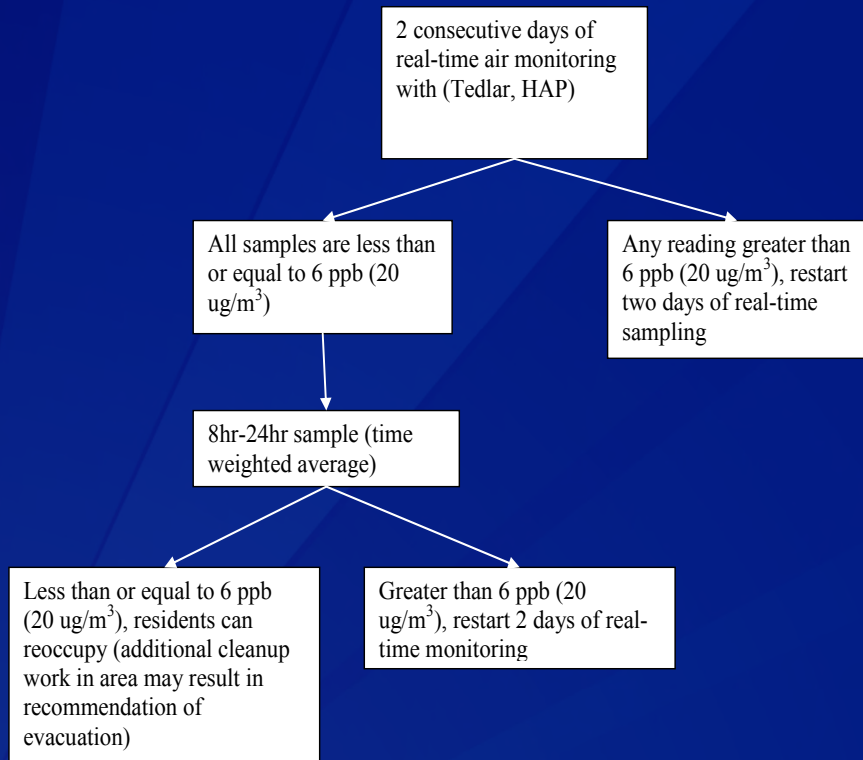
Prepared for:
 U.S. EPA REGION V
 Contract No.: EP-35-08-04
 TDD: 505-0005-1007-030
 DCN: 1154-4D-AHWS

Prepared by:
 WESTON SOLUTIONS, INC.
 2501 Jolly Road, Suite 100
 Okemos, MI

EVACUATION OVERVIEW
 MARSHALL OIL ER
 MARSHALL, KALAMAZOO AND CALHOUN COUNTIES, MICHIGAN
 CREATED: AUGUST 2, 2010

HA_170_11_EPA_2009_005_Geotoolkit_04_14_09_MXD_20100731_AK_NIGHTWORKING_NGUA_TO_SUMMARY_2010731_Agri.mxd: 21-Jul-10 08:51:16 EDT

Reoccupancy Decision Tree



□ ATSDR Intermediate MRL

- 6 ppb
- Instrumentation specified

□ Voluntary Evacuation Notice lifted August 18

Potable Water Well

CCPHD issues **Bottled Water Advisory**

- Notified residents door-to-door
- Wells within 200 feet of the high water mark
- Wells were eligible for potable water well sampling program
 - Oil constituents
 - Biweekly, monthly, quarterly basis
 - Advisory lifted November 2010



Water Requirements

- ▶ Normal active person: 2 quarts of water per day
 - Increased need with pregnancy, nursing, illness or in a hot environment
- ▶ Emergency supply recommendation: 1 gallon per person per day
- ▶ Sanitation
- ▶ Safety



www.keysan.com

Poplar Pipeline Response– January 2015



Municipal Drinking Water

- Water intake to Glendive Water Treatment Plant
 - Odor complaints
 - Detections of VOCs (benzene)
- Dawson County – DO NOT Drink order
 - Bottled water available at distribution centers
 - Need to decontaminate municipal water supply
 - Flushing of system
 - Instructions to residents and businesses
 - January 23, 2015 – bottled water distribution discontinued—MDEQ: water is safe to drink.



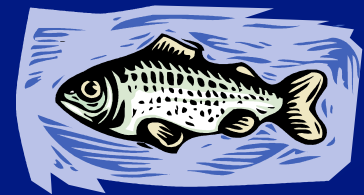
Recreational Use

- CCPHD issues **Recreation Ban (August 3, 2010)**
 - “[CCPHD] has also issued a ban on surface water activities on the Kalamazoo River as part of the county’s state of emergency, including swimming, wading, fishing, boating, canoeing and kayaking.”
 - Public access to 39 miles of the river system
 - June 2012—34 miles, plus entire 2 miles of Morrow Lake reopened



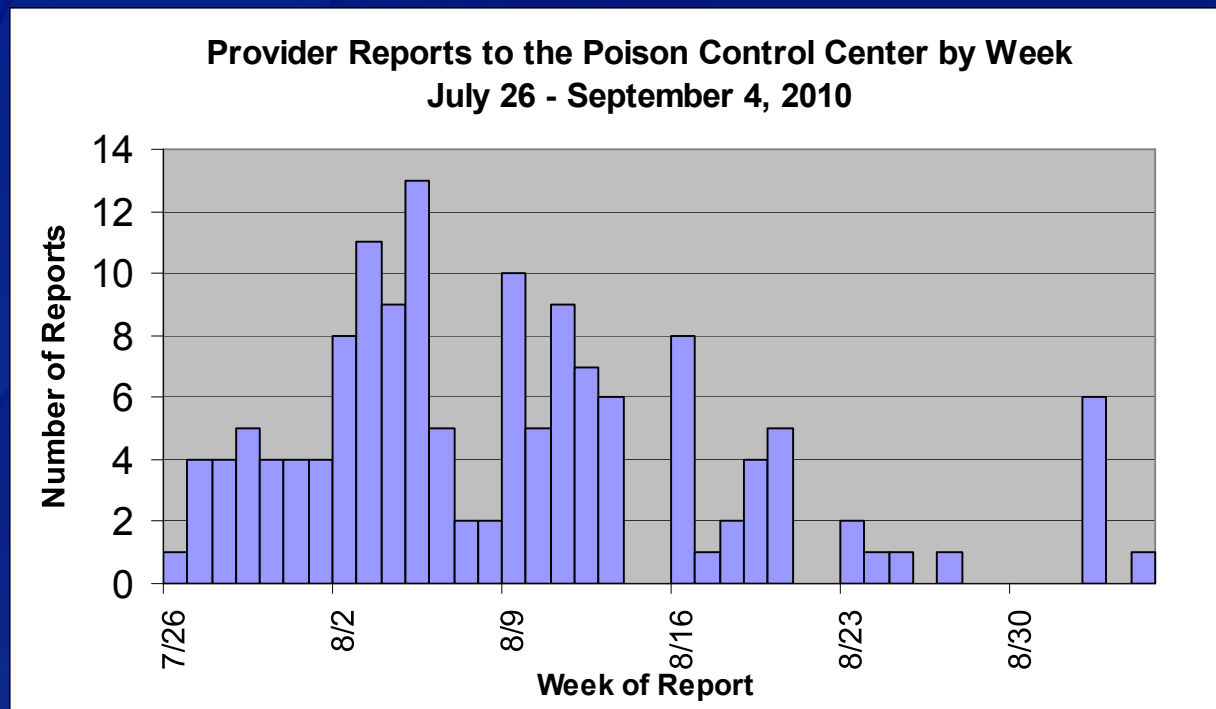
Fish Advisory

- “The Michigan Department of Community Health (MDCH) is advising that people not eat fish from Talmadge Creek or the Kalamazoo River following an oil spill that occurred on Monday, July 26, 2010.” (July 27, 2010)
- Downstream (west) of I-69 on the Kalamazoo River to the west end of Morrow Lake.
- June 28, 2012 – MDCH lifts “Do Not Eat” Fish Consumption Advisory on the affected stretch of the Kalamazoo River



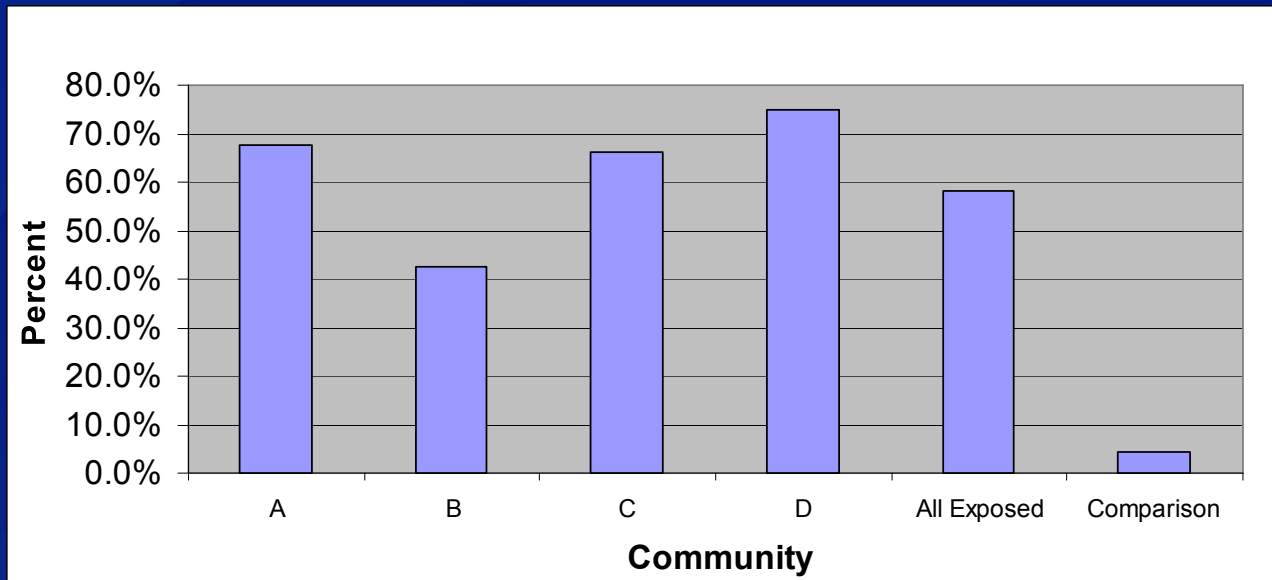
Public Health Surveillance

- Hospital counts and medical abstractions.
- Calhoun and Kalamazoo counties' medical care provider reports.
- MI Poison Control Center compiled reports.



Door-to-door Health Surveys

- Survey of 4 communities: one adult in each household
- Oil spill related health symptoms
- Odor intensity and duration
- Upstream community used as comparison.
- Headache, nausea, and respiratory symptoms were predominantly reported



Percent of Residents with Any Symptom by Community

Acknowledgement

With thanks to

Dr. Linda Dykema, Michigan Department of Community Health



Agency for Toxic Substances and Disease Registry

Division of Community Health Investigations

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CDC/ATSDR Emergency Contacts

- ❑ CDC Emergency Operations Center at 770 – 488 - 7100 (24/7)
 - For Chemical Emergencies: ask for ATSDR Duty Officer
 - For Petroleum Emergencies: ask for NCEH Duty Officer

- ❑ ATSDR Regional Offices
 - Region 5: 312-886-0840
 - Region 7: 312-551-1312