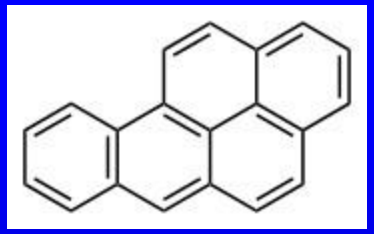
Crude Oil & Response Considerations



EPA Region 10
Emergency Management Program
2014 Oregon HAZMAT Response Teams Conference

Course Objectives

To discuss:

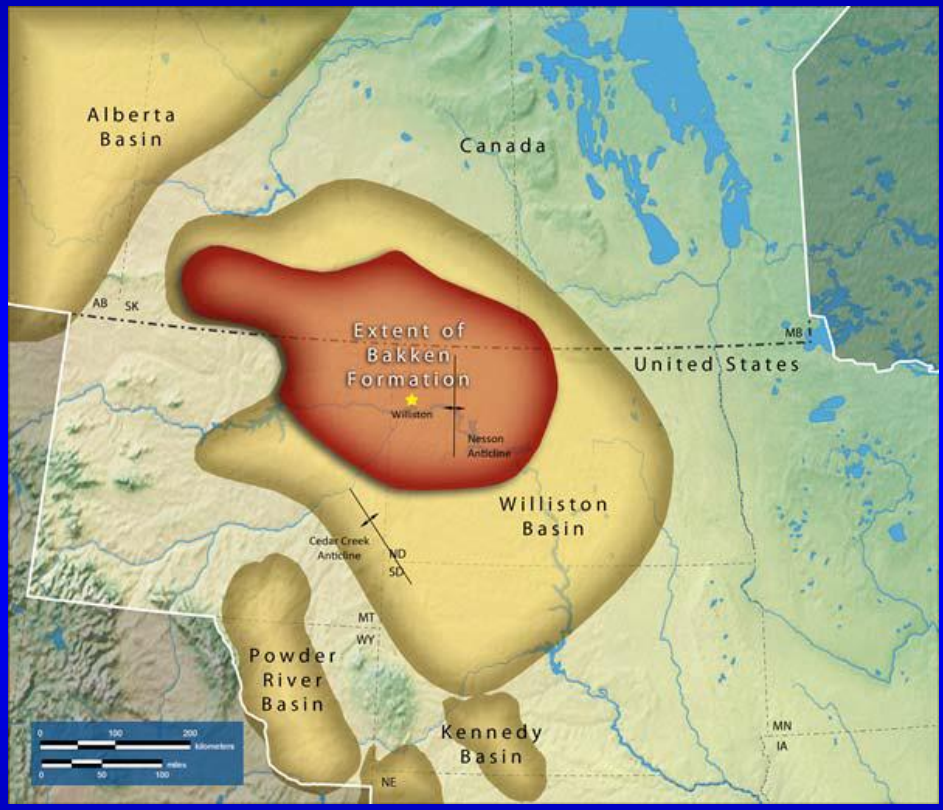
- Background of Emerging Oil Risks in the NW
- Basics of Crude Oil
  - Terminology
  - Characteristics, fate & transport of crude
- Bakken crude oil characteristics
- Spill response considerations
- Expectations for a large response

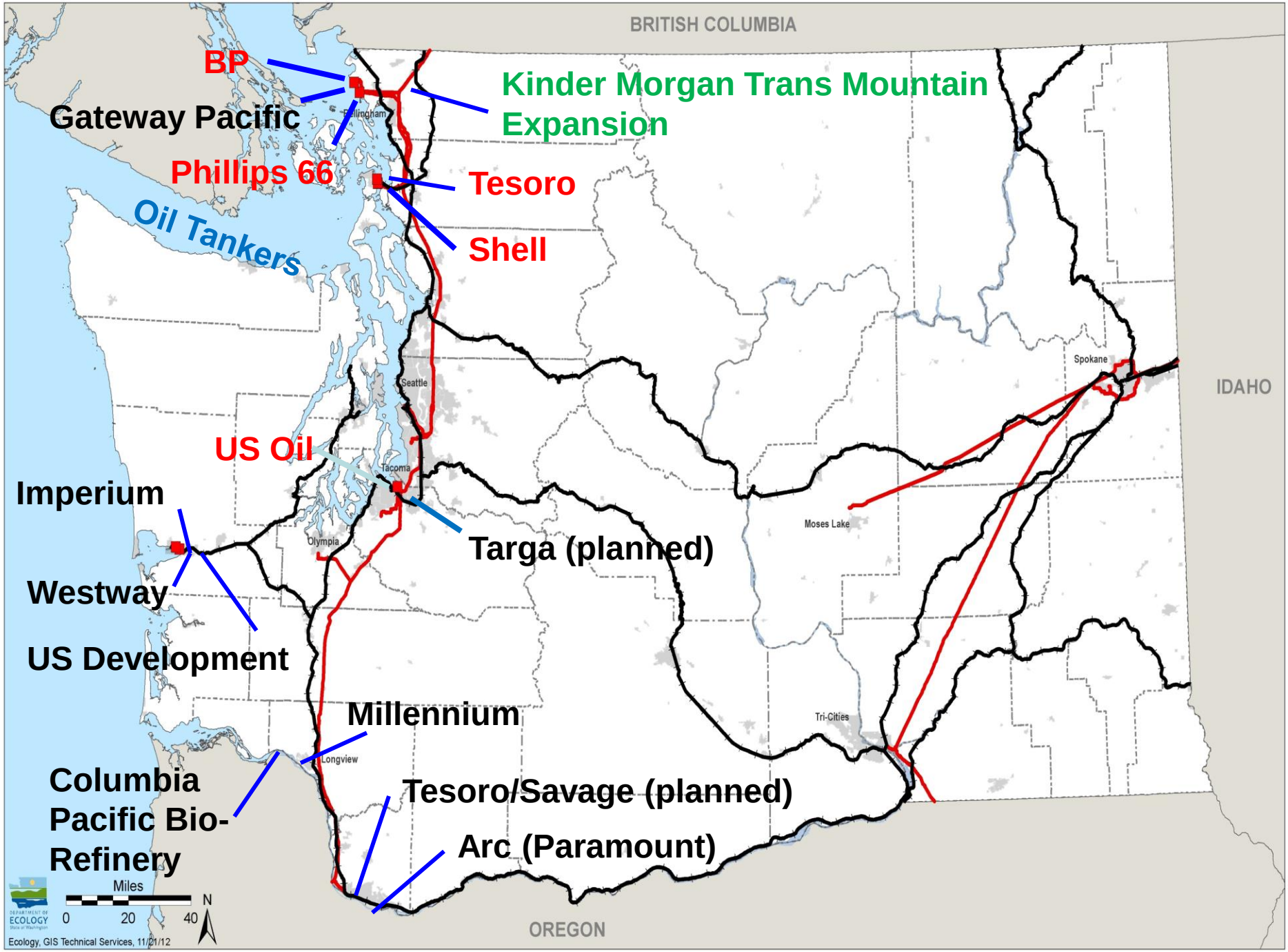
Emerging Oil Risks in NW

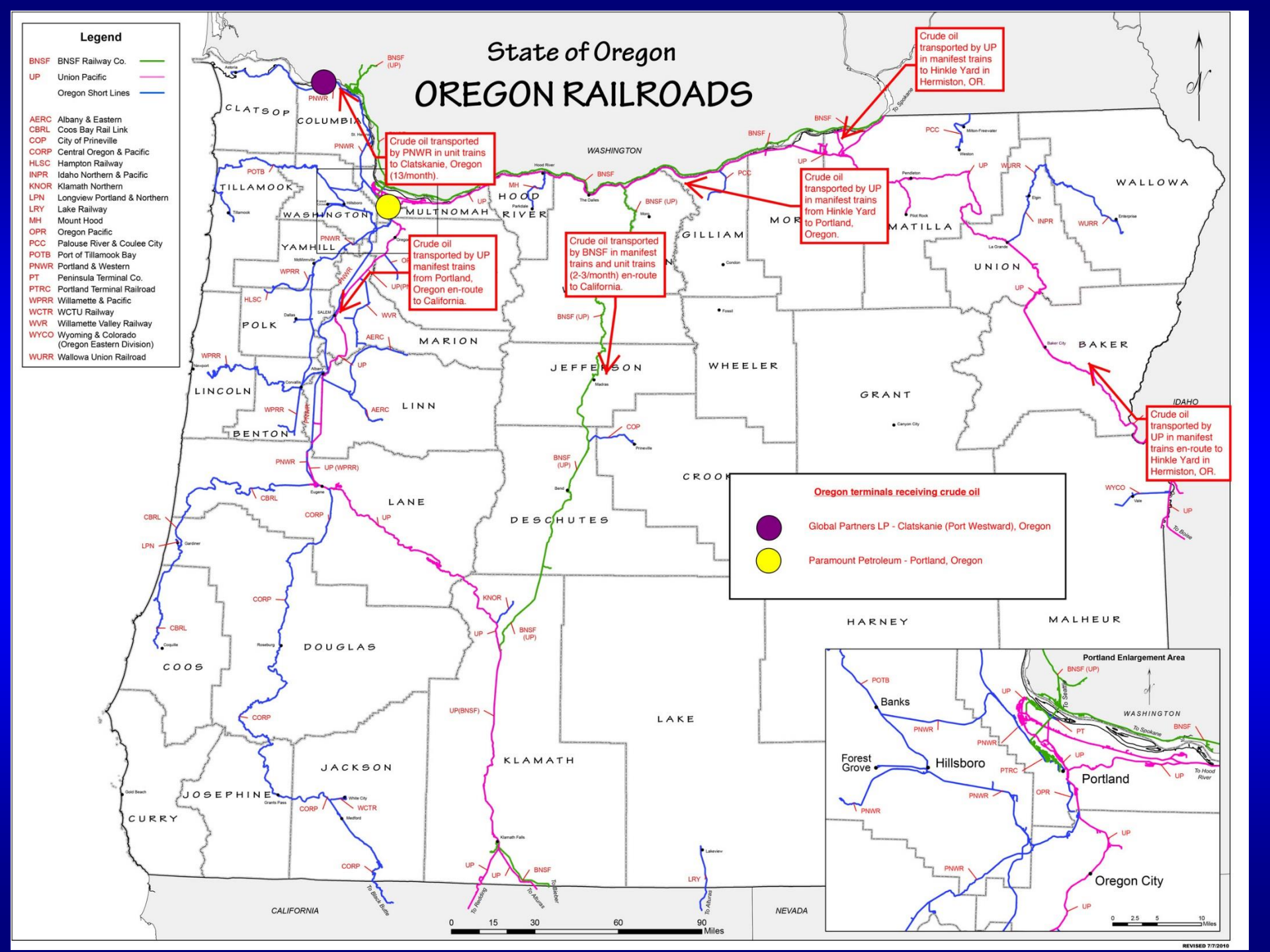
- Crude oil by rail – new for the NW and across the US
  - Bakken and Canadian Tar Sands
  - Routes thru Oregon and Washington
  - Manifest Trains vs Unit Trains
- Significant increase in crude by rail traffic
- Crude oil spill response new here (exc. refineries)
- New oil terminals planned, existing terminals adding tankage
- Media & politics heightened recent incidents and issues
  - Public safety
  - Rail and pipeline safety
  - Characteristics of the crude
- New DOT Emergency Orders and FRA Regulations

Bakken Crude Oil

- Bakken Formation underlies over 200,000 square miles in Williston Basin of MT, ND, Saskatchewan
- Recoverable reserves up to 24 Billion bbl




BRITISH COLUMBIA
BP
Gateway Pacific
Phillips 66
Oil Tankers
Kinder Morgan Trans Mountain Expansion
Tesoro
Shell
Bellingham
Seattle
Tacoma
Spokane
IDAHO
US Oil
Imperium
Targa (planned)
Olympia
Moses Lake
Westway
US Development
Millennium
Tri-Cities
Longview
Columbia Pacific Bio-Refinery
Tesoro/Savage (planned)
Arc (Paramount)
Miles
0
20
40
N
Ecology, GIS Technical Services, 11/21/12
OREGON


State of Oregon
OREGON RAILROADS
Legend
BNSF BNSF Railway Co.
UP Union Pacific
Oregon Short Lines
AERC Albany & Eastern
CBRL Coos Bay Rail Link
COP City of Prineville
CORP Central Oregon & Pacific
HLSC Hampton Railway
INPR Idaho Northern & Pacific
KNOR Klamath Northern
LPN Longview Portland & Northern
LRY Lake Railway
MH Mount Hood
OPR Oregon Pacific
PCC Palouse River & Coulee City
POTB Port of Tillamook Bay
PNWR Portland & Western
PT Peninsula Terminal Co.
PTRC Portland Terminal Railroad
WPRR Willamette & Pacific
WCTR WCTU Railway
WVR Willamette Valley Railway
WYCO Wyoming & Colorado (Oregon Eastern Division)
WURR Wallowa Union Railroad
Crude oil transported by PNWR in unit trains to Clatskanie, Oregon (13/month).
Crude oil transported by UP manifest trains from Portland, Oregon en-route to California.
Crude oil transported by BNSF in manifest trains and unit trains (2-3/month) en-route to California.
Crude oil transported by UP in manifest trains from Hinkle Yard to Portland, Oregon.
Crude oil transported by UP in manifest trains to Hinkle Yard in Hermiston, OR.
Crude oil transported by UP in manifest trains en-route to Hinkle Yard in Hermiston, OR.
Oregon terminals receiving crude oil
Global Partners LP - Clatskanie (Port Westward), Oregon
Paramount Petroleum - Portland, Oregon
Portland Enlargement Area
WASHINGTON
IDAHO
CALIFORNIA
NEVADA
0 15 30 60 90 Miles
REVISED 7/7/2010

Basics of Crude Oil

- Crude Oil…naturally occurring
- Very complex mixture of thousands of chemical compounds
- Crudes and their chemical composition can vary tremendously
  - From different producing regions
  - Possible even within a particular formation
- DOT UN1267, CASRN 8002-05-9

Basics of Crude Oil
Chemistry

- Hydrocarbons are most abundant compounds in crude oil
- Average crude oil contains
  - 84% Carbon
  - 14% Hydrogen
  - 1 – 3% Sulfur
  - 1% Nitrogen,
  - 1% Oxygen
  - Trace Metals and salts
    - V, Ni, Fe, Al, Na, Ca, Cu, U

Basics of Crude Oil

Chemistry - Non-hydrocarbon Constituents

- Sulfur Compounds
  - Very important non-hydrocarbon compounds
  - Hydrogen sulfide, mercaptans, sulfonic acids
- Nitrogen Compounds
  - Present in all crude oils
  - Pyridines, quinolines, pyrroles, etc.
- Oxygen compounds (found in distillation fractions)
  - Organic acids, alcohols, ketones, esters, phenols

Basics of Crude Oil
Terminology

- Light Crudes – lower densities, lower viscosities, have more “light ends”, such as gasoline, naptha, and kerosine fractions

- Heavy Crudes – higher densities, more viscous, have more heavy ends such as asphaltenes, usually rich in aromatics

- Sweet, Sour Crudes: refer to amount of sulfur present
  - Sweet < 0.5% sulfur
  - Sour > 0.5 % sulfur, Safety Issues (H_2S)

A Few Basics of Crude Oil

Terminology

- The industry speaks in terms of barrels (bbl)
  - Barrel vs Gallons: 1 bbl = 42 gal
- API Gravity – a specific scale for measuring the relative density of petroleum liquids, expressed in degrees.
  - API Gravity = (141.5/Sp. Gr at 60° F) – 131.5
- Rule of Thumb
  - Higher API Gravity = lighter the crude, less viscous, more light ends
  - Light Crudes > 33° API (alt > 31.3 °)
  - Medium Crudes 28° – 33° API (alt 22.3° – 31.3°)
  - Heavy Crudes < 28° API (alt < 22.3°)

Basics of Crude Oil

What does this mean for Oil Spill Response?

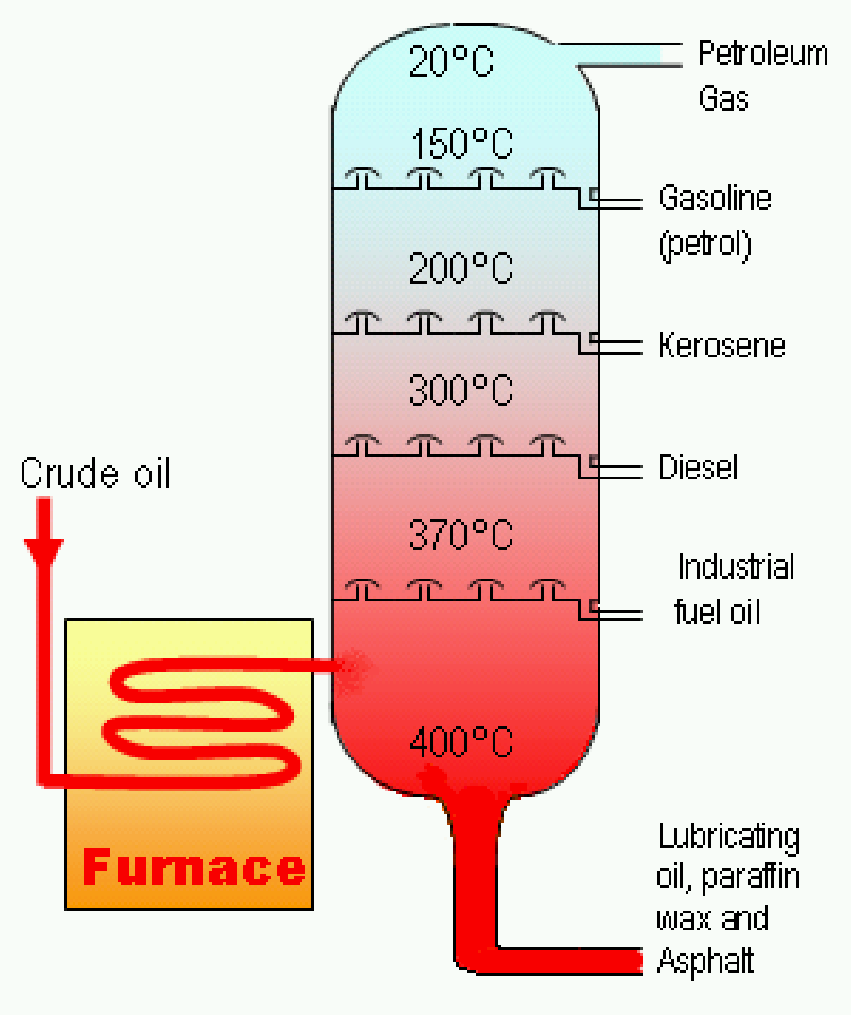
- Speaking with same knowledge of terminology
- Different types of crudes (and refined products) have differing fate and transport when spilled
  - Heavy vs light, API Gravity?
- Types of crudes important for Health & Safety, e.g. Sour oil will have H_2S present
  - Air monitoring at spill, what to look for at production site, etc.

Basics of Crude Oil

- Examples of 40 Different grades of Crude flowing thru the U.S.

Type	API	S%	Type	API	S%
Bakken	42.5	0.142	WTI	40	0.33
W.T. Sour	33.5	1.78	Bacquero	22.8	1.95
Dom. Sweet	40.0	0.420	Basra	33.5	2.10
ANS	31.4	0.96	Kirkuk	33.7	2.14
Bonny Light	35.2	.01750	Brent	38.0	0.3760
Maya	22.5	2.95	Mesa	30.3	0.980
Isthmus	32.5	1.320	Velma	26.4	
Rata	24.2	4.000	Cusian	29.4	0.2950
ABH	27.4	2.700	Olmeca	38.3	0.950

Refining the Crude



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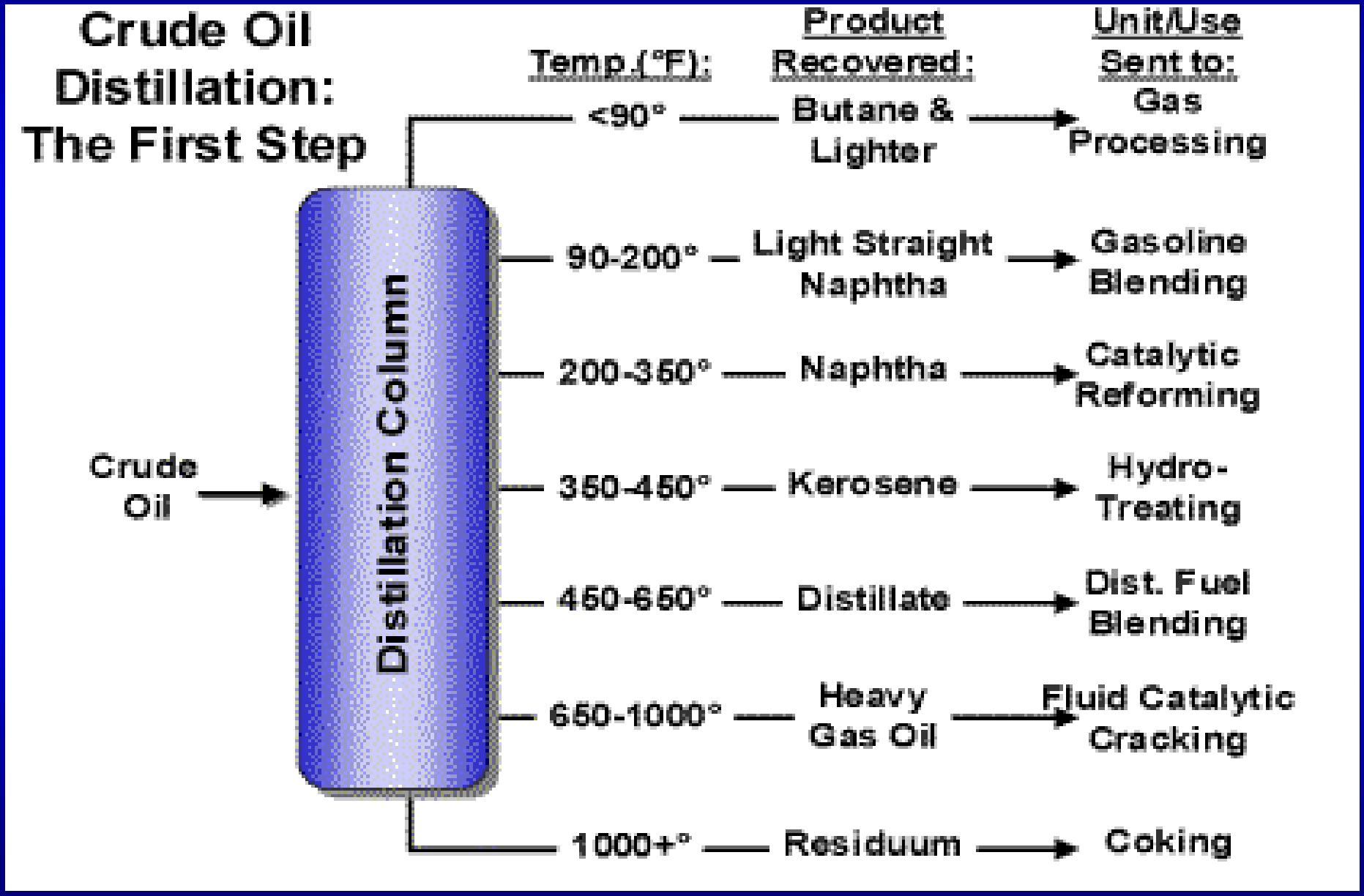
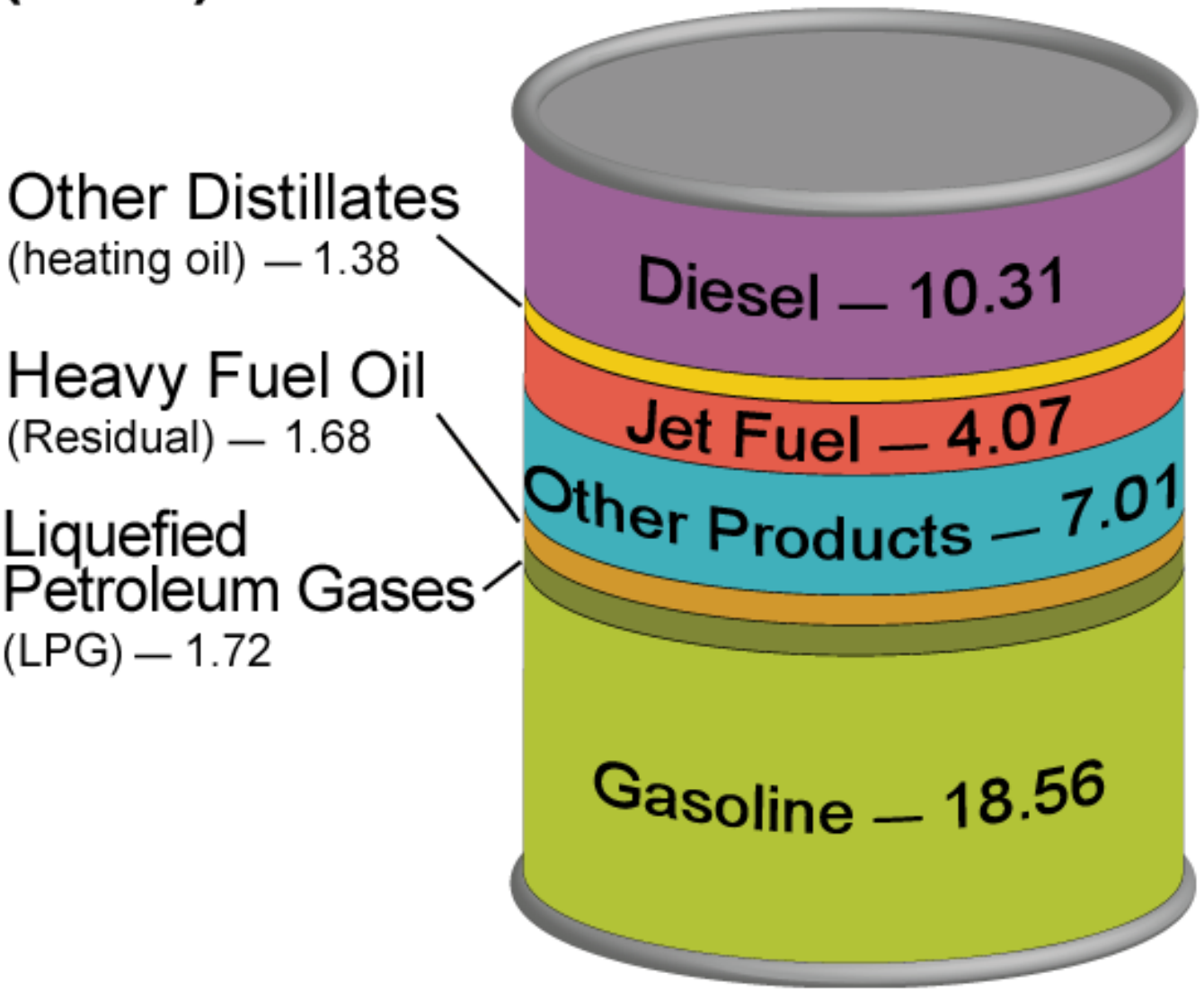


Products Made from a Barrel of Crude Oil (Gallons) (2008)



Oil Properties: Pour Point

(will it be a liquid, or not)

- Temperature above which an oil will flow
- If ambient temperature is above the pour point the oil will behave as a liquid
- If ambient temperature is below the pour point the oil will behave as a semi-solid

Nigerian Crude stranded in Mississippi River. semi-solid during cool nights, liquid in warmer temperatures during day

Oil Properties: Viscosity

- Measure of a fluid's resistance to flow and spread
- Temperature dependent
  - Decreases with increasing temperature
- Increases as oil weathers
- Affects oil behavior: spreading, dispersion, emulsification
- Affects response options

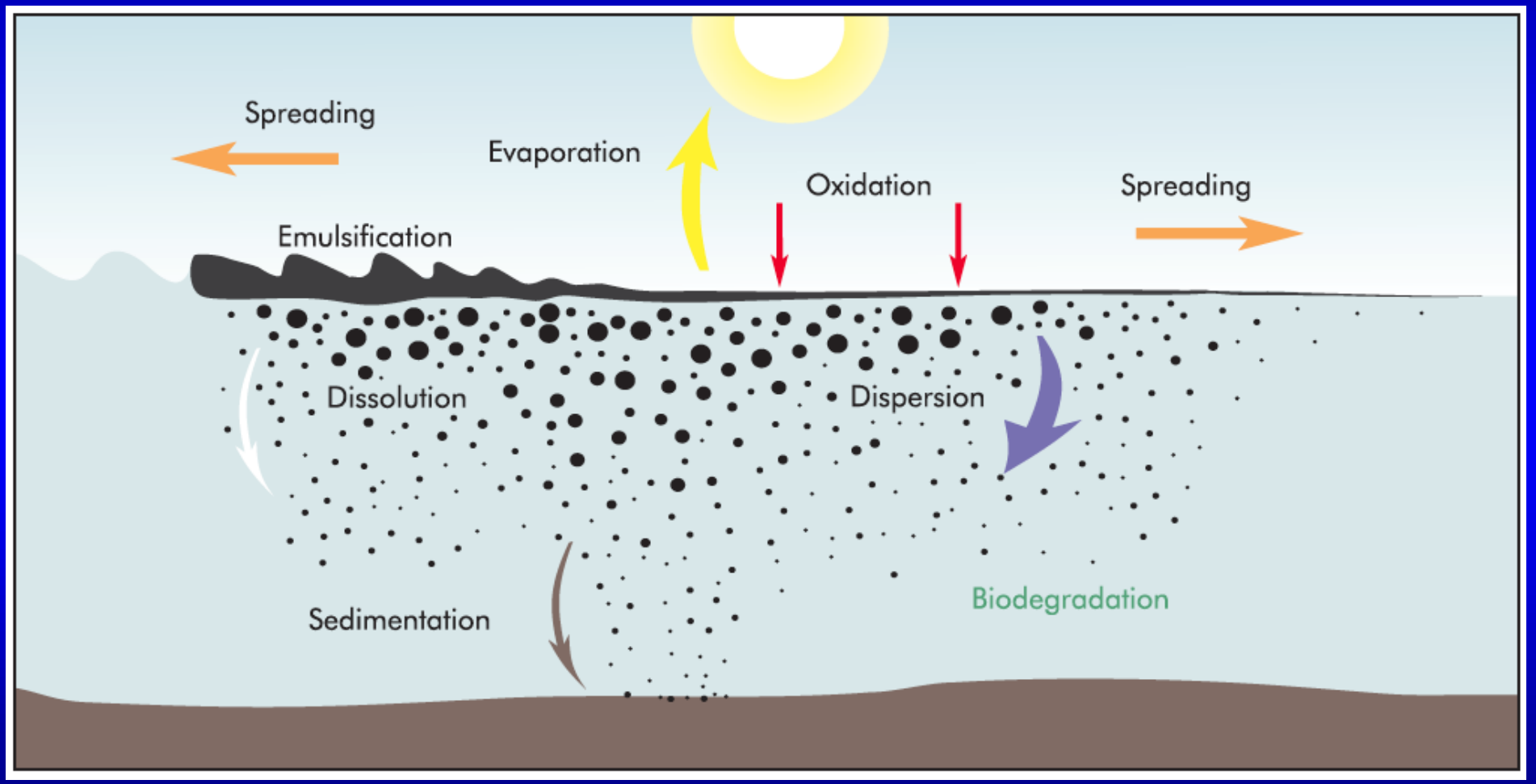
Viscosity

Liquid	Viscosity (cSt)
Water	1
Kerosene	10
SAE 10 motor oil	100
Glycerin or castor oil	1,000
Corn syrup	10,000
Molasses	100,000
Peanut butter	1,000,000

Athos I spill of heavy Venezuelan crude with viscosity = >50,000 cSt at ambient water temperature (cold honey)

Aliceville Alabama Derailment and Bakken Spill

Weathering (dynamics)

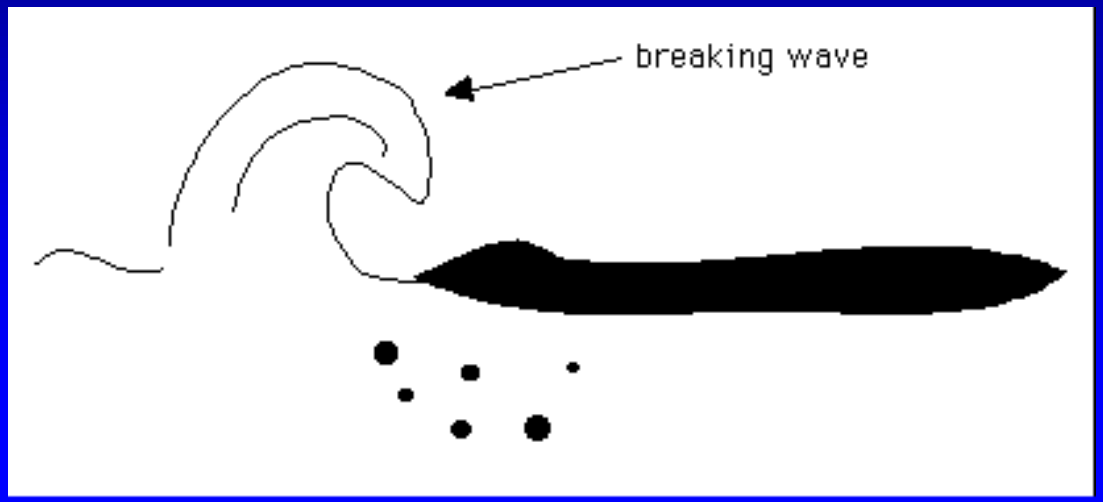


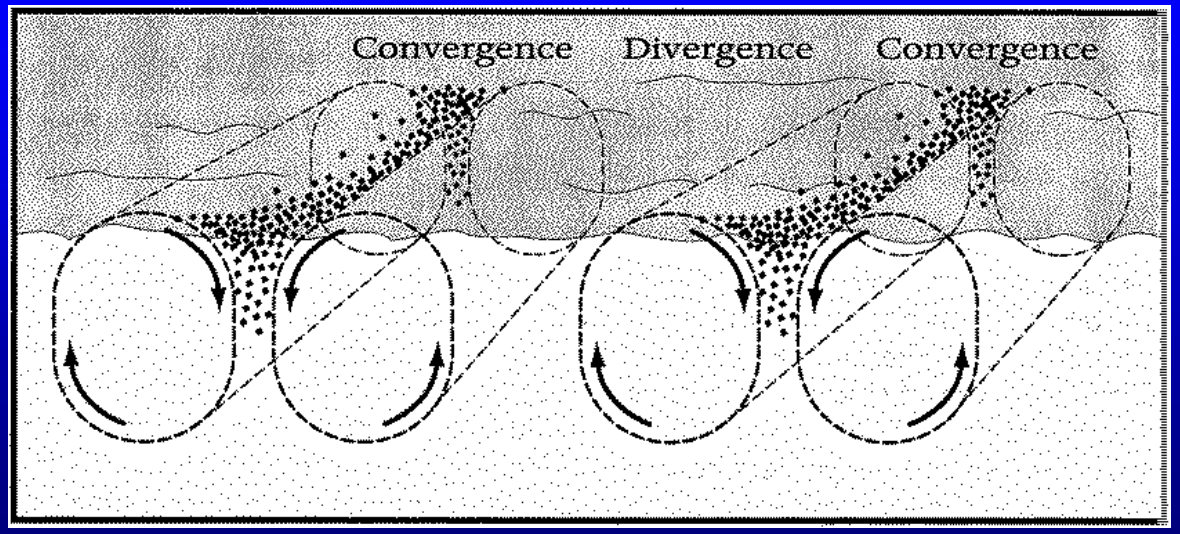
Evaporation

- Transfer from the liquid to the vapor phase
- Can be the most significant “loss” mechanism early in a spill
- Small impact on density
- Significant impact on viscosity
- Function of: oil type, environmental factors
  - Crude oil - up to 25% loss in 24 hours
  - Gasoline - up to 50% loss in 10 minutes
  - No. 6 fuel oil – up to 5-10% loss in 40 hours

Dispersion

- Other major removal mechanism
- Decreases as viscosity increases
- Droplets 50-70 microns in diameter are not likely to resurface due to turbulence



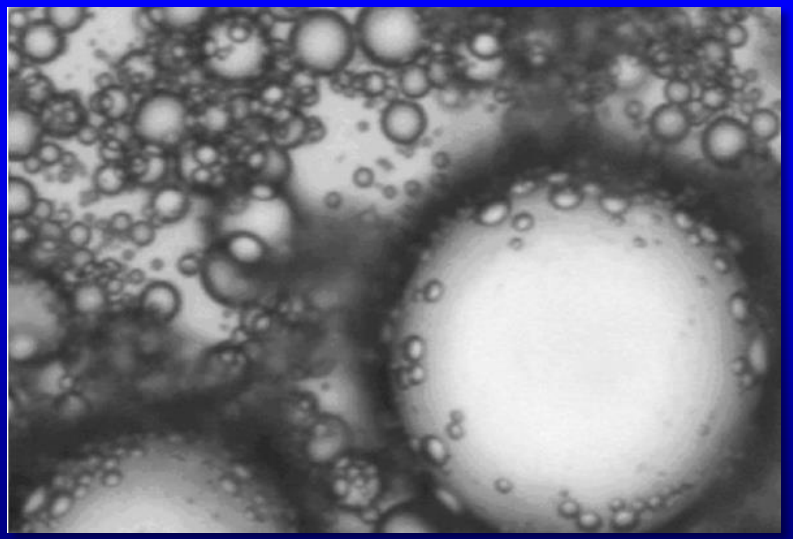


Dissolution

- Closely related to dispersion as dissolution occurs from the oil droplets
- Similar time scales as dispersion
- Less than 0.1% (very heavy oil) to 2% (gasoline) of the spilled oil volume actually dissolves into the water column

Emulsification

- NSOs play a role in forming “stable” emulsions (mousse)
- Oil sometimes must weather before forming a “stable” emulsion
- Emulsion can be 70-90% water
- Affects density and viscosity
- Even diesels form water-in-oil emulsions (not stable)



Sedimentation

- Adhesion of oil to solid particles in the water column
- Mostly occurs in muddy rivers
- Can occur when oil/sand mix in turbulent rivers

A) 10,000 g/m^3
B) 1000 g/m^3
C) 100 g/m^3
D) 10 g/m^3
E) 1 g/m^3

Biodegradation

- Ultimate fate of most oil spilled into the environment
- Controlled by:
  - Presence of HC degraders
  - Nutrients
  - Oxygen
  - Temperature
  - Oil composition
  - Bioavailability

Oil Types

Group 1	Gasoline Products
Group 2	Diesel-like Products/Light Crude Oils
Group 3	Medium Crude Oils/Intermediate Products
Group 4	Heavy Crude Oils/Residual Products
Group 5	Non-floating Oils

Group 2 Oils: Diesel-like Products and Light Crude Oils

- No. 2 fuel oil
- Diesel fuel
- Home heating oil
- Jet fuels
- Kerosene
- West Texas crude
- Bakken crude

Group 2 Oil: Diesel-like Products and Light Crude Oils

- Moderately volatile
- Refined products can evaporate – little to no residue
- Crude oils do have considerable remaining oil and residue after evaporation
- Low to moderate viscosity; spreads rapidly into thin slicks
- Specific gravity 0.80-0.85; API gravity 33-45°
  - Floats on water

Group 2 Oils: Diesel-like Products and Light Crude Oils

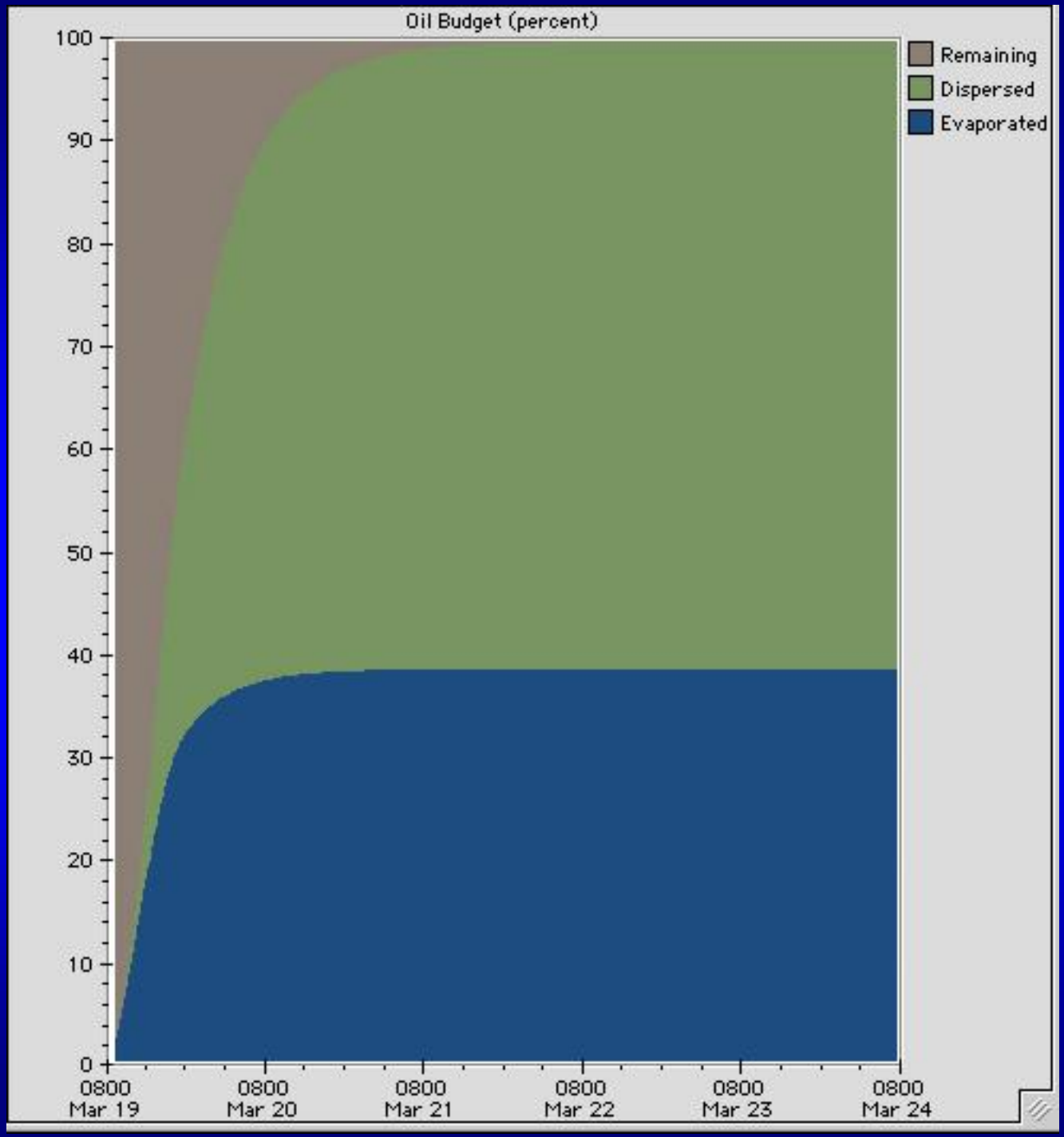
- Crude oils can form stable emulsions
  - Weathered/mousse
- Tend to penetrate substrates; fresh spills are adhesive
- Moderate to high acute toxicity to biota; product-specific toxicity is related to type and amount of aromatic hydrocarbons

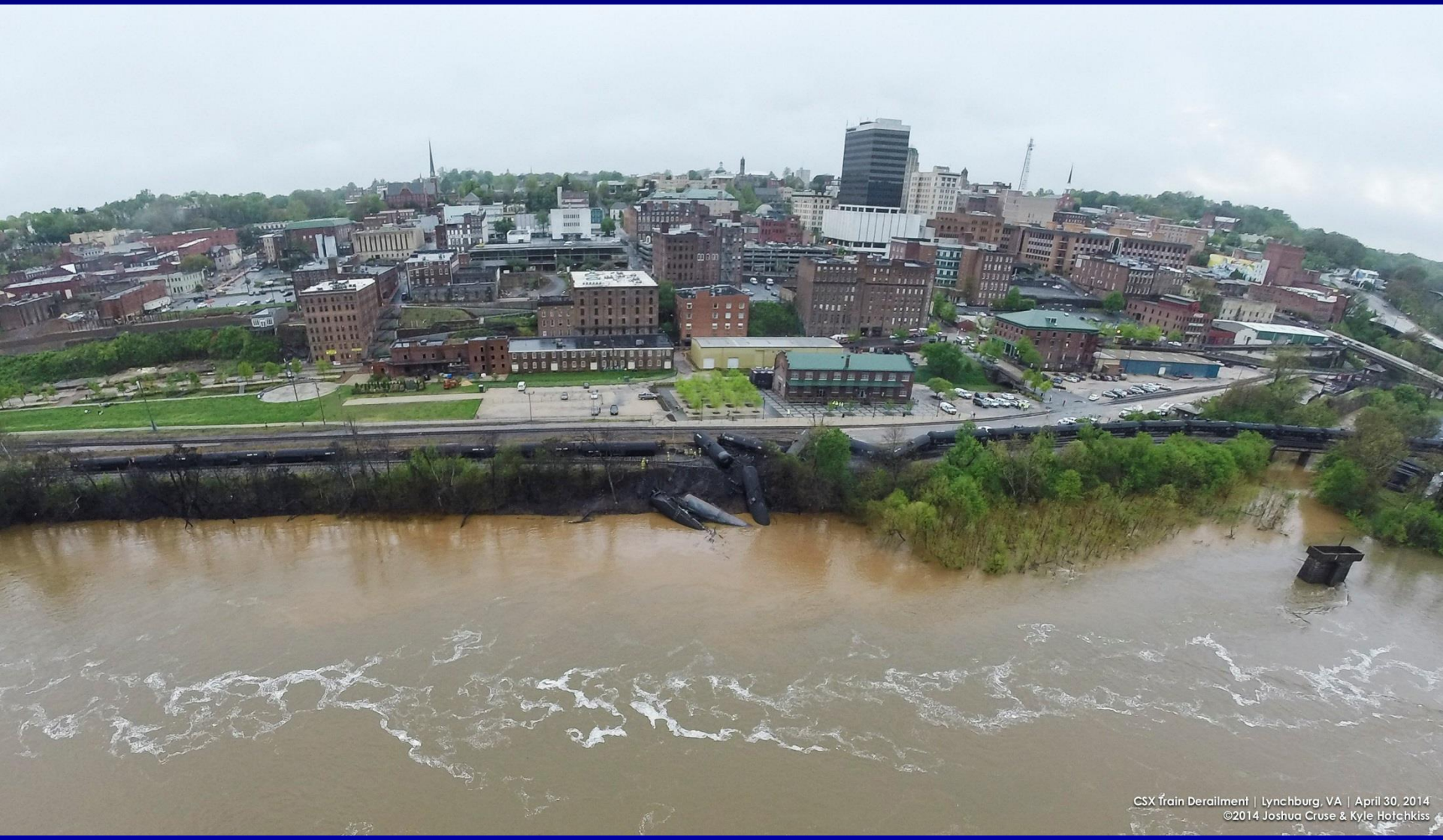
Diesel Spill from Sunken Barge: Monongahela River, 2008

Diesel Spill in a stream

Diesel

10 knots
70°F
500 bbls





Bakken Crude oil, Lynchburg River Derailment

Light crude in slow moving, flooded river (Farmland Verdigris River spill)

Group 3: Medium Crude Oils and Intermediate Products

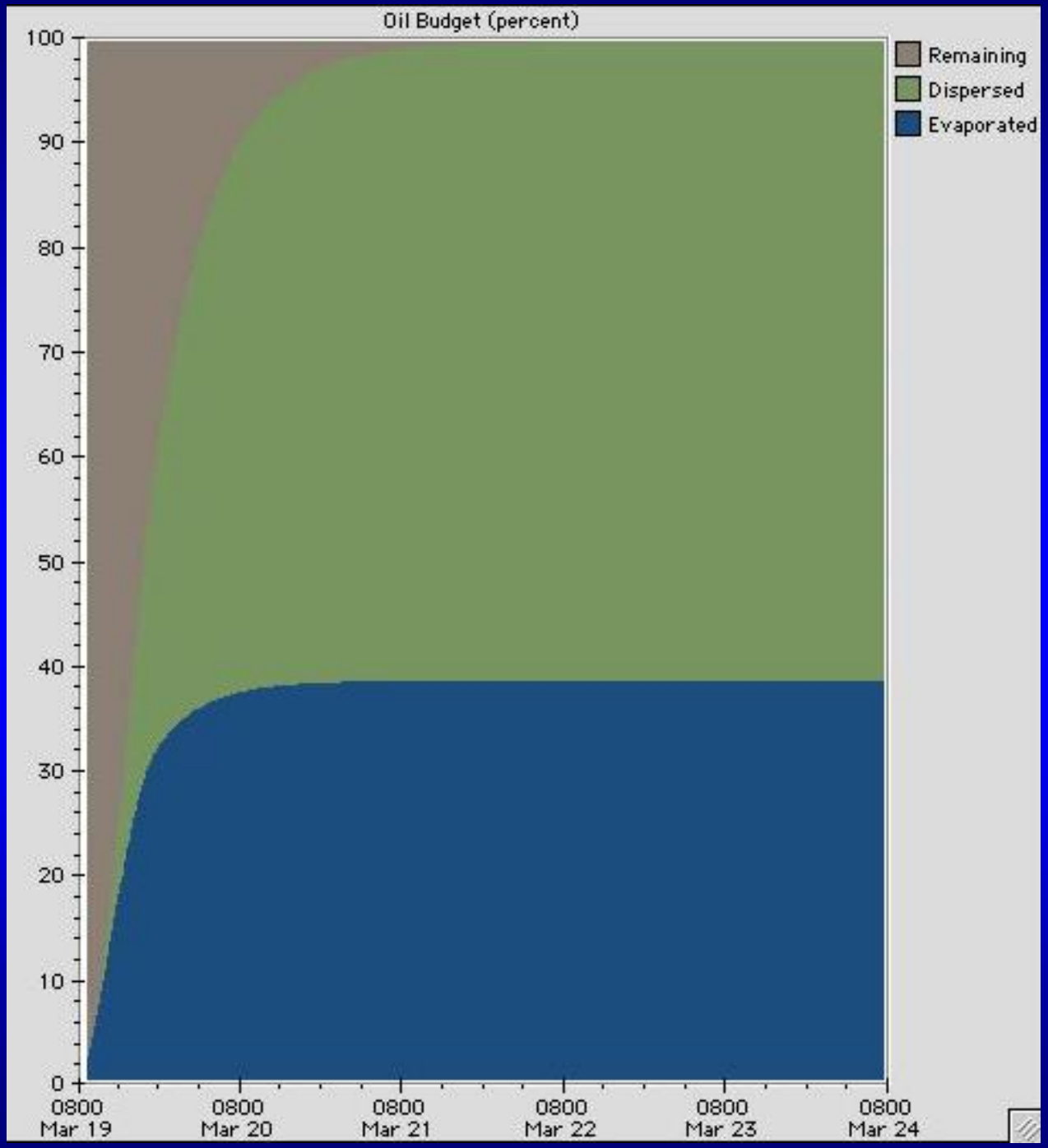
- Bonny Light crude
- Arabian Light crude
- Intermediate fuel oil (IFO) 180
- Lube oils

Group 3: Medium Crude Oils and Intermediate Products

- Moderately volatile
- For crude oils, up to one-third will evaporate in the first 24 hours
- Moderate to high viscosity
- Specific gravity of 0.85-0.95; API gravity 17.5-35
  - Floats on water

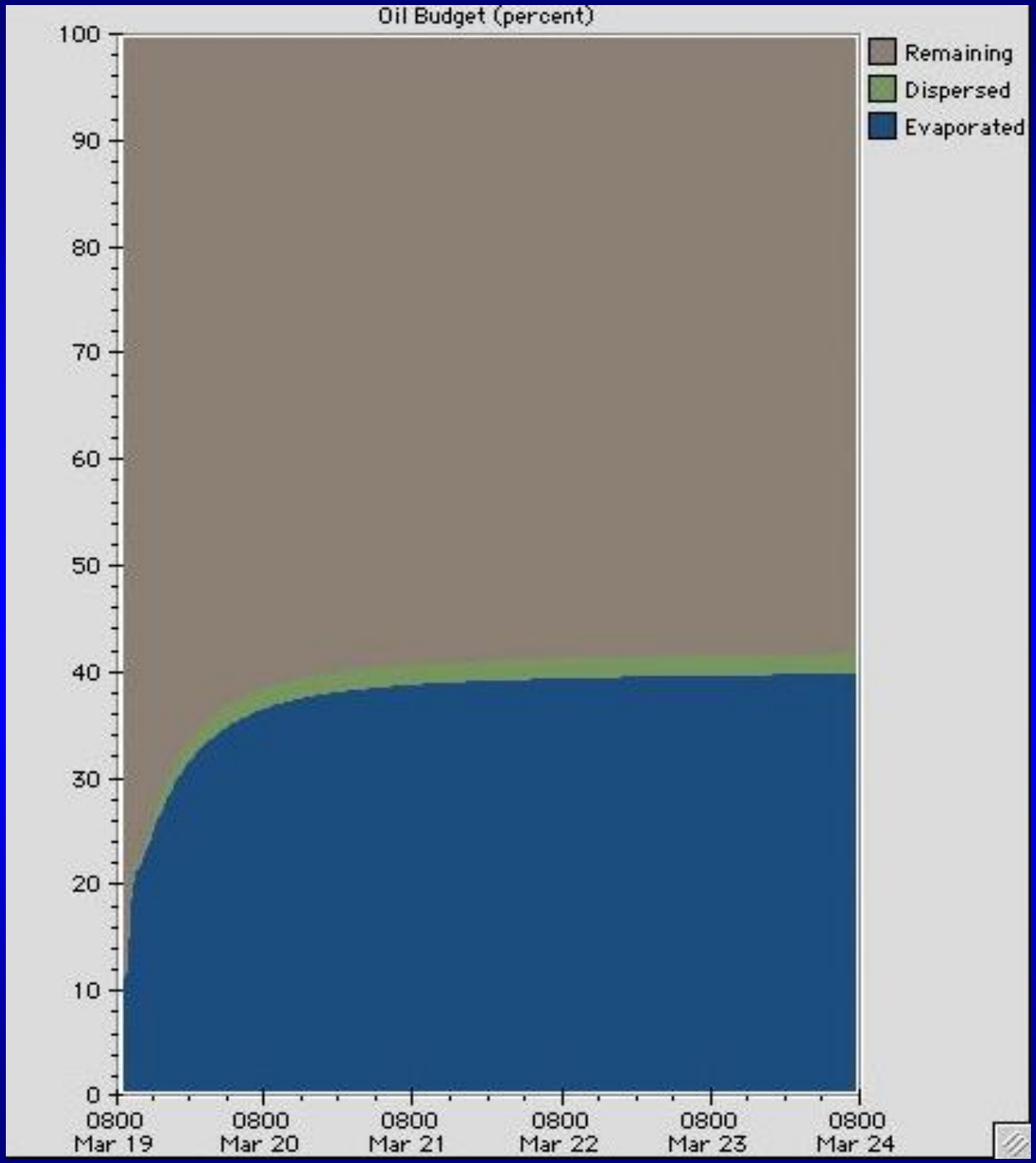
Arabian Light Crude

10 knots
70°F
500 bbls



Kuwait Crude

10 knots
70°F
500 bbls



Group 3: Medium Crude Oils and Intermediate Products

- Variable acute toxicity, depending on the amount of light fractions
- Can form stable emulsions
- Variable substrate penetration and adhesion; stickier when weathered
- Stranded oil tends to smother organisms

Arabian crude oil
San Jacinto River, 1994

Wyoming crude (API 23)
Yellowstone River, 2011

Nigeria Crude Oil (waxy) in Mississippi River

Arabian Crude Oil

Group 4: Heavy Crude Oils and Residual Products

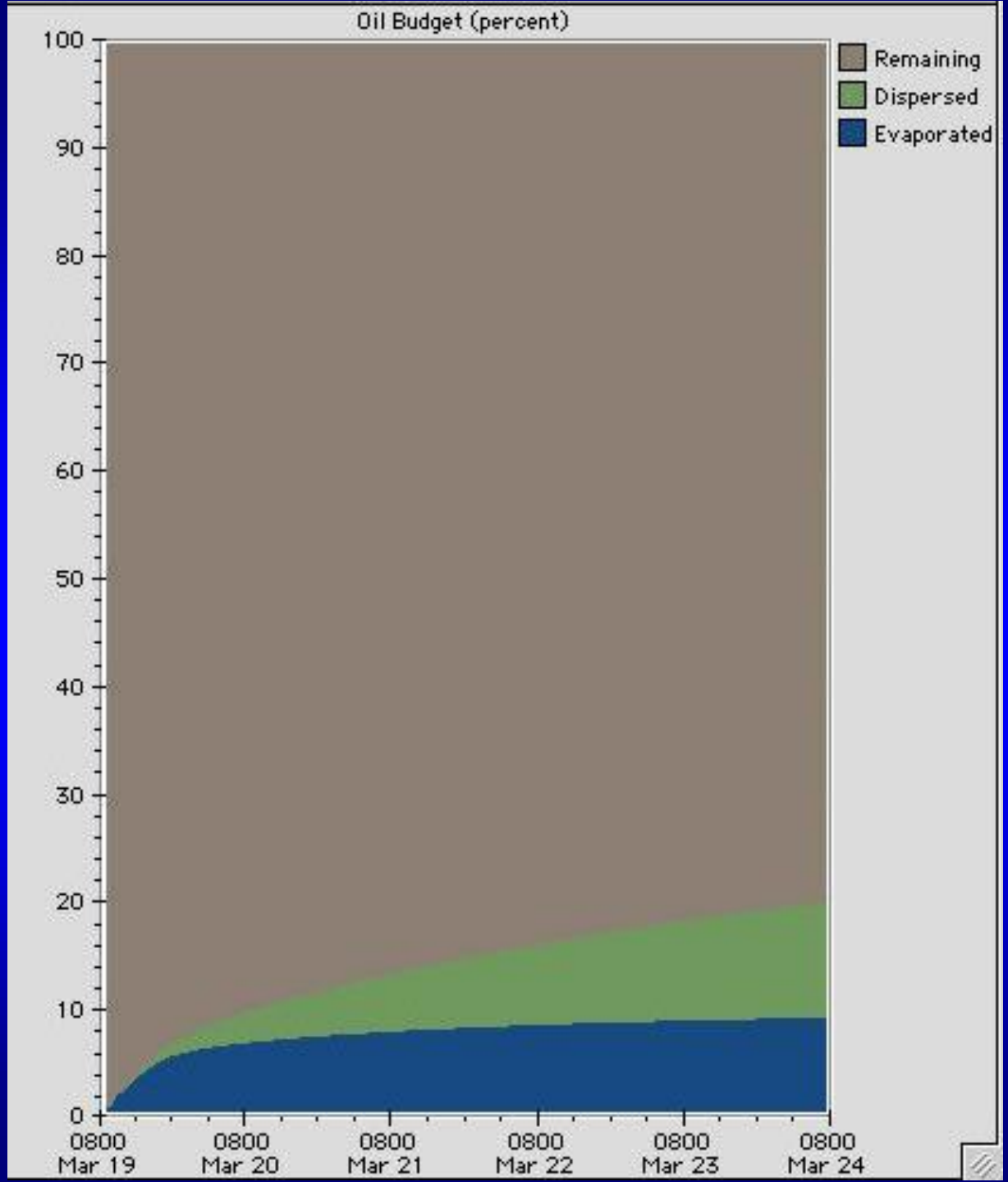
- California crudes
- Some Canadian crudes
- No. 6 fuel oil
- IFO 380
- Bunker oils

Group 4: Heavy Crude Oils and Residual Products

- Slightly volatile
- Very little product loss by evaporation
- Very viscous to semi-solid; may be heated during transport
- Specific gravity of 0.95-1.00; API gravity of 10-17.5
  - Can vary between floating or sinking

No. 6
Fuel Oil

10 knots
70°F
500 bbls



Group 4: Heavy Crude Oils and Residual Products

- Can form stable emulsions and become even more viscous
- Tend to break into tarballs quickly
- Low acute toxicity to water-column biota
- Little penetration of substrates but can be very sticky
- Stranded oil tends to smother organisms


Heavy Fuel Oil in the Mississippi River
UTC 2008:08:09 16:11:51

Heavy Crude Oils and Refined Products Stranding on Shorelines

Group 5: Non-floating Oil

- Tar sand oil/bitumen
- Slurry oils
- Very heavy fuel oils
- Asphalt products (special case because they cool and solidify)

Group 5: Non-floating Oils

- Crude oils are lightly volatile
- Blends vary in loss by evaporation, depending on the diluent or source oils
- Very viscous to semi-solid; usually heated during transport
- Specific gravity >1.00;
  API gravity of <10

Group 5: Non-floating Oils

- No clear break in behavior and fate at API >10
- Rather, there is a gradational trend, with some Group IV oils having similar properties
- API gravity is not critical in predicting the behavior of these oils, except whether or not they will initially float
- Composition and compatibility of the product are more important, but not available

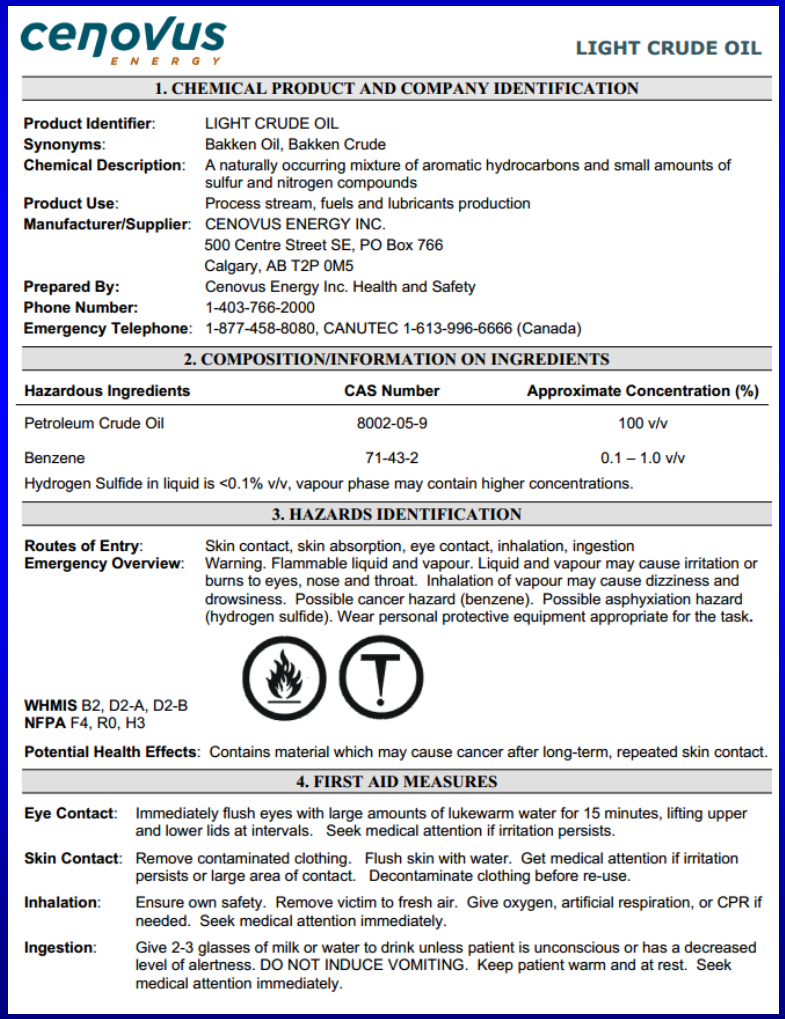
Group 5: Properties/Behavior

- Pour point is not always high (most are less than 45°F) because of low paraffin content
- Often remain liquid when spilled, unlike asphalt products, but often very viscous
- Oftentimes will initially float, then be more likely to submerge
- Location, containment, and recovery techniques are limited for oils that sink or become suspended in the water column

Bakken Formation Crude Oil

Properties & Response Considerations

- Properties
  - Recent sample taken, analyzed by EPA
- Spill Response



cenovus ENERGY

LIGHT CRUDE OIL

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Identifier: LIGHT CRUDE OIL
Synonyms: Bakken Oil, Bakken Crude
Chemical Description: A naturally occurring mixture of aromatic hydrocarbons and small amounts of sulfur and nitrogen compounds
Product Use: Process stream, fuels and lubricants production
Manufacturer/Supplier: CENOVUS ENERGY INC.
500 Centre Street SE, PO Box 766
Calgary, AB T2P 0M5
Prepared By: Cenovus Energy Inc. Health and Safety
Phone Number: 1-403-766-2000
Emergency Telephone: 1-877-458-8080, CANUTEC 1-613-996-6666 (Canada)

2. COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous Ingredients	CAS Number	Approximate Concentration (%)
Petroleum Crude Oil	8002-05-9	100 v/v
Benzene	71-43-2	0.1 – 1.0 v/v

Hydrogen Sulfide in liquid is <0.1% v/v, vapour phase may contain higher concentrations.

3. HAZARDS IDENTIFICATION

Routes of Entry: Skin contact, skin absorption, eye contact, inhalation, ingestion
Emergency Overview: Warning. Flammable liquid and vapour. Liquid and vapour may cause irritation or burns to eyes, nose and throat. Inhalation of vapour may cause dizziness and drowsiness. Possible cancer hazard (benzene). Possible asphyxiation hazard (hydrogen sulfide). Wear personal protective equipment appropriate for the task.

WHMIS B2, D2-A, D2-B
NFPA F4, R0, H3

Potential Health Effects: Contains material which may cause cancer after long-term, repeated skin contact.

4. FIRST AID MEASURES

Eye Contact: Immediately flush eyes with large amounts of lukewarm water for 15 minutes, lifting upper and lower lids at intervals. Seek medical attention if irritation persists.

Skin Contact: Remove contaminated clothing. Flush skin with water. Get medical attention if irritation persists or large area of contact. Decontaminate clothing before re-use.

Inhalation: Ensure own safety. Remove victim to fresh air. Give oxygen, artificial respiration, or CPR if needed. Seek medical attention immediately.

Ingestion: Give 2-3 glasses of milk or water to drink unless patient is unconscious or has a decreased level of alertness. DO NOT INDUCE VOMITING. Keep patient warm and at rest. Seek medical attention immediately.

Cenovus MSDS

Bakken Crude Oil Properties

- Very light crude – Class 2 Oil
  - same oil class as Diesel, #1 Fuel Oil
- API gravity 36°- 44°
  - Oregon sample = 42.5° API

- Benzene content in liquid < 0.5% by weight
  - Oregon sample = 0.14%
- Benzene air monitoring of Oregon sample
  - 0.25 ppm

Bakken Crude Oil Properties

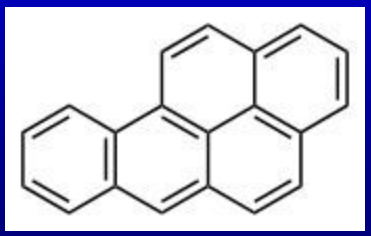
- Sulfur content generally ranges from 0.17- 0.20%
  - Bakken is a “Sweet” crude, very low sulfur
  - Recent sample very low = 0.142%
  - Reports of some sour recent shipments due to crude blending at source oilfield
- Hydrogen Sulfide (H_2S) content < 1.0 ppm
  - Recent sample < 1.0 ppm
- Pour Point
  - Recent sample = -32.8° F (in most all situations in Pacific NW – a liquid)

Bakken Crude Oil Properties

- Sp. gr. of Bakken is 0.7 – 0.8, Floats on water
  - Sp. gr. - weight of oil/ weight of "pure" water
  - 10 °API = 1.00 s.g. of pure water at 60°F
  - Recent sample = 0.8134

- Vapor Density 2.5 – 5.0, heavier than air
  - Vapors can hug ground and travel to an ignition source

- Vapor Pressure moderate, mmHg 280 – 360 @ 60° F
  - Water 12.5 mmHg @ 60° F
  - Gasoline 400 mmHg @ 60° F



Bakken Crude Oil Properties

Gases

AFPM Assay of Bakken Crudes		EPA Recent Sample	
Gas Conc	Liquid v/v%	Gas Conc	Liquid v/v%
Methane (C_1)	<0.01	Methane	<0.01
Ethane (C_2)	0.05	Ethane	0.14
Propane (C_3)	0.80	Propane	0.94
Iso-Butane (iC_4)	0.46	Iso-Butane	0.44
N- Butane (nC_4)	2.36	N- Butane	2.17
Total Gas	3.67	Total Gas	3.69

* EPA continuing to assess gas content

Properties & Response Considerations

- Properties
- Safety
- Spill Response

cenovus ENERGY

LIGHT CRUDE OIL

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Identifier: LIGHT CRUDE OIL
Synonyms: Bakken Oil, Bakken Crude
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Benzene	71-43-2	0.1 – 1.0 v/v

Hydrogen Sulfide in liquid is <0.1% v/v, vapour phase may contain higher concentrations.

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WHMIS B2, D2-A, D2-B
NFPA F4, R0, H3

Potential Health Effects: Contains material which may cause cancer after long-term, repeated skin contact.

4. FIRST AID MEASURES

Eye Contact: Immediately flush eyes with large amounts of lukewarm water for 15 minutes, lifting upper and lower lids at intervals. Seek medical attention if irritation persists.

Skin Contact: Remove contaminated clothing. Flush skin with water. Get medical attention if irritation persists or large area of contact. Decontaminate clothing before re-use.

Inhalation: Ensure own safety. Remove victim to fresh air. Give oxygen, artificial respiration, or CPR if needed. Seek medical attention immediately.

Ingestion: Give 2-3 glasses of milk or water to drink unless patient is unconscious or has a decreased level of alertness. DO NOT INDUCE VOMITING. Keep patient warm and at rest. Seek medical attention immediately.

Bakken Crude Oil Properties
Flammability

- NFPA Flammability = 3-4
  - Recent sample = 3
  - Sensitive to static discharge
- Explosive Limits variable:
  - LEL 0.4%
  - UEL 15.0%
  - Recent sample LEL 0.1%
  - Recent sample UEL 4.5%
- Flash point - 40° to 212° F
  - Recent sample < 74° F
- Auto-ignition Temp > 500° F

Spill Response Considerations
Safety

- PPE
  - Often Level D in spill to waterway, but be prepared for upgrade pending air monitoring
- Air monitoring - spill
  - O_2
  - Explosive Levels – LEL/UEL
  - H_2S
  - Benzene
  - Organic vapors (VOCs)

Spill Response Considerations
Safety

- Air monitoring - fire
  - O_2
  - CO
  - Explosive Levels – LEL/UEL
  - H_2S
  - Benzene
  - Organic vapors (VOCs)
  - Sulfur and Nitrogen Oxides
  - Particulates - smoke

Spill Response Considerations
Safety Equipment

For Spill

- 4 or 5 gas monitor with O_2, LEL, H_2S
- PID/FID for VOCs (FIDs may be more sensitive)
- Chemical-specific monitors for benzene
  - Colorimetric tubes
  - PID with benzene tube, e.g. ultrarae

- Additionally, for fire
  - Particulate monitors (e.g., Dataram) for Polynuclear Aromatic Hydrocarbons (PAHs), sampling
  - Monitors or sampling equipment for particulates (smoke)

Exposure Guidelines

Component	ACGIH	NIOSH	OSHA
Petroleum (8002-05-9)	Not established	CEIL: 1800 mg/m3 TWA: 350 mg/m3	Not established
Hydrogen sulfide (7783-06-4) [Oregon <1]	TWA: 1 ppm STEL: 5 ppm	CEIL: 10 ppm	CEIL: 20 ppm
Benzene (71-43-2) [Oregon 0.25 ppm]	TWA: 0.5 ppm STEL: 2.5 ppm	TWA: 0.1 ppm STEL: 1 ppm	TWA: 1 ppm STEL: 5 ppm
Ethylbenzene (100-41-4)	TWA: 20 ppm	TWA: 100 ppm STEL: 125 ppm	TWA: 100 ppm
Toluene (108-88-3)	TWA: 20 ppm	TWA: 100 ppm STEL: 150 ppm	TWA: 200 ppm CEIL: 500 ppm

Health & Safety – H_2S
Reminder

- Colorless, flammable, toxic gas, rotten egg odor, dangerous due to olfactory fatigue
- Heavier than air, soluble in water and oil
- Extremely corrosive to metal
- Explosive mixture with air between 4.3 and 45.5% by volume concentration. Auto ignition at 500°F
- Odor threshold 0.13 ppm
- Permissible Exposure Limit (PEL), Time-Weighted Average (TWA)/Threshold Limit Values (TLV) 10 ppm

Health & Safety – H_2S
(Continued)

- Olfactory fatigue or *adaptation* is the temporary, normal inability to distinguish a particular odor after a prolonged exposure to that airborne compound. After leaving the area of high odor, the sensitivity is restored with time
- 100 ppm, IDLH – Olfactory fatigue in 3-5 minutes; altered respiration, coughing, drowsiness
- 200 ppm – Olfactory fatigue shortly, sting eyes and throat, **death** after 1-2 hours exposure
- 500 ppm – Dizziness, sting eyes, throat, self rescue impossible, loss of muscle control
- 1000 ppm – Unconscious at once, death within minutes

Properties & Response Considerations

- Properties
- Safety
- Spill Response

cenovus ENERGY

LIGHT CRUDE OIL

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Identifier: LIGHT CRUDE OIL
Synonyms: Bakken Oil, Bakken Crude
Chemical Description: A naturally occurring mixture of aromatic hydrocarbons and small amounts of sulfur and nitrogen compounds
Product Use: Process stream, fuels and lubricants production
Manufacturer/Supplier: CENOVUS ENERGY INC.
500 Centre Street SE, PO Box 766
Calgary, AB T2P 0M5
Prepared By: Cenovus Energy Inc. Health and Safety
Phone Number: 1-403-766-2000
Emergency Telephone: 1-877-458-8080, CANUTEC 1-613-996-6666 (Canada)

2. COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous Ingredients	CAS Number	Approximate Concentration (%)
Petroleum Crude Oil	8002-05-9	100 v/v
Benzene	71-43-2	0.1 – 1.0 v/v

Hydrogen Sulfide in liquid is <0.1% v/v, vapour phase may contain higher concentrations.

3. HAZARDS IDENTIFICATION

Routes of Entry: Skin contact, skin absorption, eye contact, inhalation, ingestion
Emergency Overview: Warning. Flammable liquid and vapour. Liquid and vapour may cause irritation or burns to eyes, nose and throat. Inhalation of vapour may cause dizziness and drowsiness. Possible cancer hazard (benzene). Possible asphyxiation hazard (hydrogen sulfide). Wear personal protective equipment appropriate for the task.

WHMIS B2, D2-A, D2-B
NFPA F4, R0, H3

Potential Health Effects: Contains material which may cause cancer after long-term, repeated skin contact.

4. FIRST AID MEASURES

Eye Contact: Immediately flush eyes with large amounts of lukewarm water for 15 minutes, lifting upper and lower lids at intervals. Seek medical attention if irritation persists.

Skin Contact: Remove contaminated clothing. Flush skin with water. Get medical attention if irritation persists or large area of contact. Decontaminate clothing before re-use.

Inhalation: Ensure own safety. Remove victim to fresh air. Give oxygen, artificial respiration, or CPR if needed. Seek medical attention immediately.

Ingestion: Give 2-3 glasses of milk or water to drink unless patient is unconscious or has a decreased level of alertness. DO NOT INDUCE VOMITING. Keep patient warm and at rest. Seek medical attention immediately.

Oil Spill Response Techniques

- Physical Measures to be deployed –Stop it, Boom it, Suck it up if possible
  - Boom it (mechanical and sorbent boom)
  - Put in underflow and/or weir dams
  - Flushing, soil washing (water, leaf blowers)
  - Sorbent material (pads, pompoms, etc.)
  - Suck it up – Vacuum Trucks
  - Dispose of it correctly
  - Soil and vegetation excavation, bioremediation

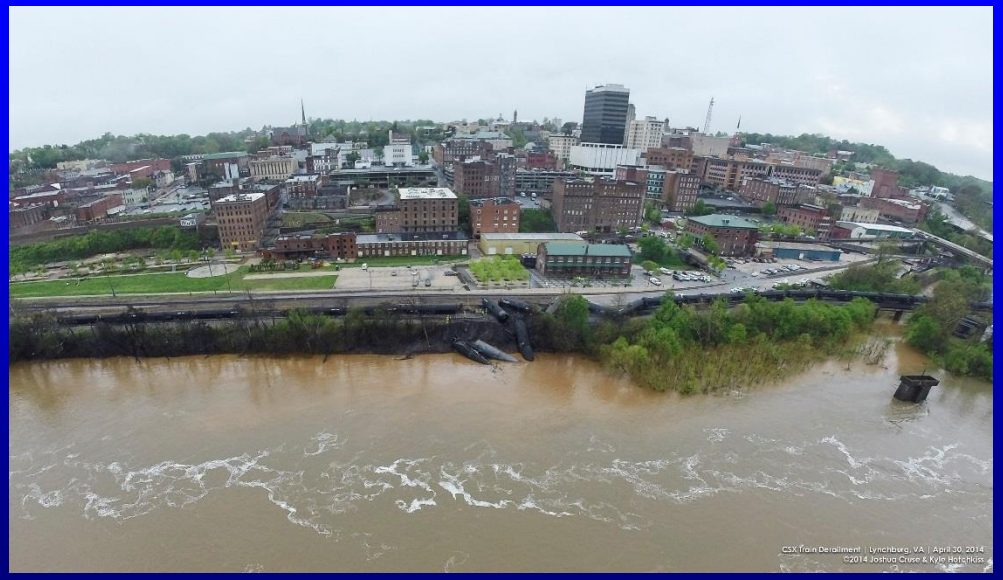
Spill Response Considerations

Light Crude Oil Spills,
Oklahoma and Texas

Crude Oil Response Considerations

Behavior in River

- Floats
- In faster water will flow in middle of fast river
- When slowing, will go to bank in curve
- Stranding on shorelines
- Entrainment
- Binding with sediment
- Dissolution
- Weathering, mousse development



Spill Response Considerations

Evaporation

- Key factor for light crudes, especially Bakken
- Can be the most significant “loss” mechanism early in a spill
- Small impact on density
- Significant impact on viscosity
- Function of: oil type, environmental factors
  - Crude oil - up to 25% loss in 24 hours
  - Gasoline - up to 50% loss in 10 minutes
  - No. 6 fuel oil – 5-10% loss in 40 hours

Aliceville Alabama Derailment and Bakken Spill

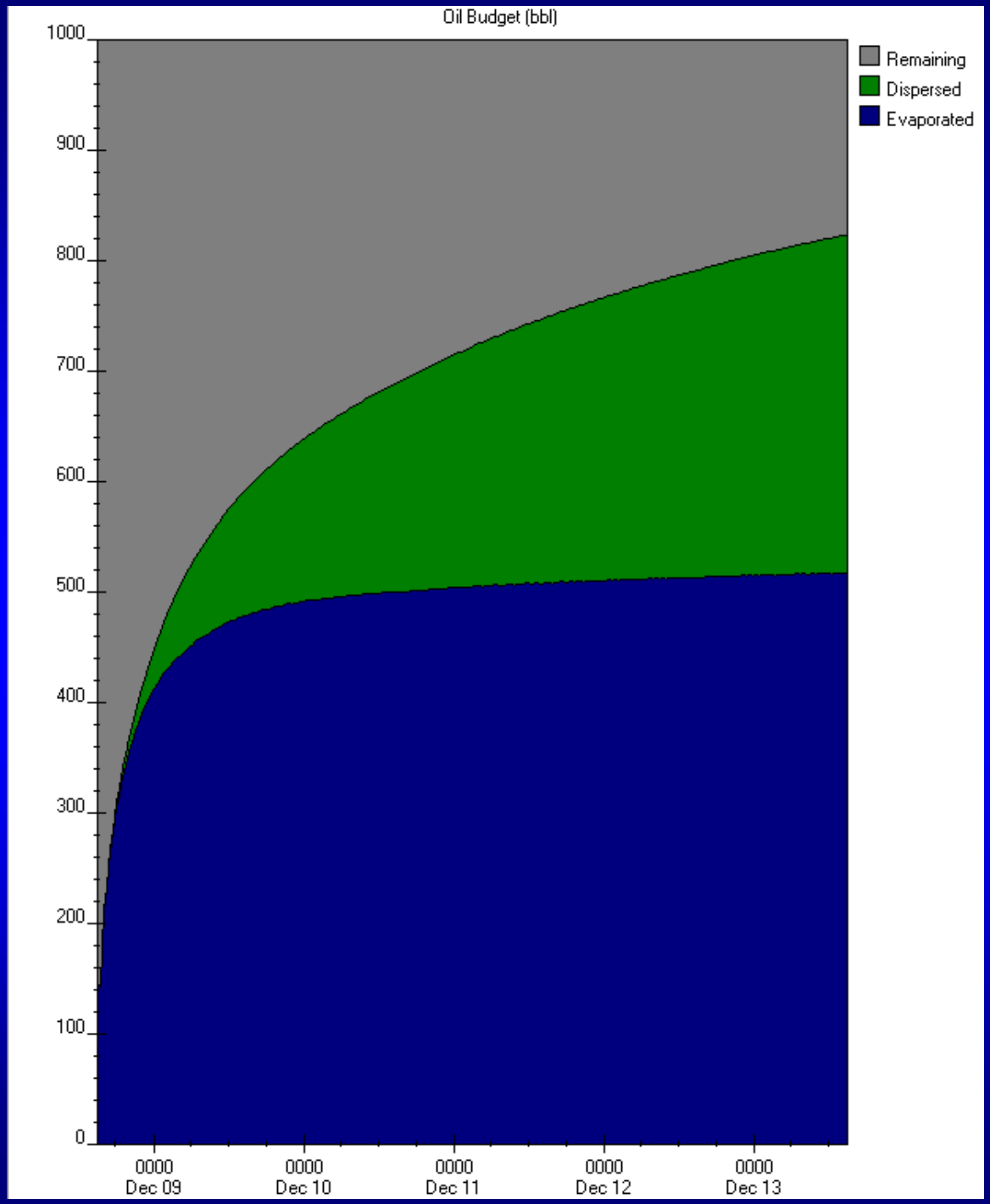
Spill Response Considerations

Bakken Spill in slow-moving water and marsh

Bakken Spill

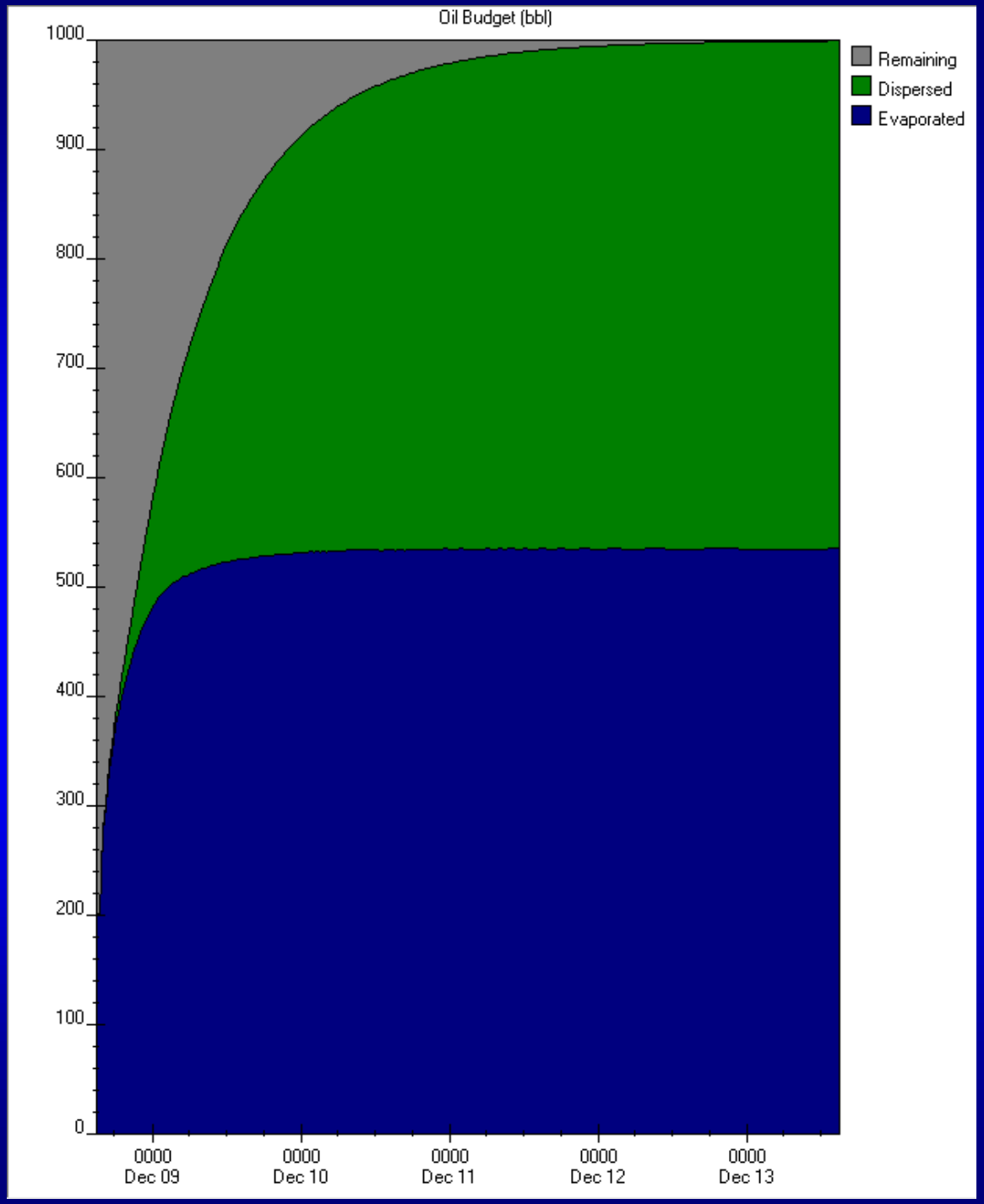
Bakken Crude Oil

Wind at 10 knots
37°F
1000 bbls



Bakken Crude Oil

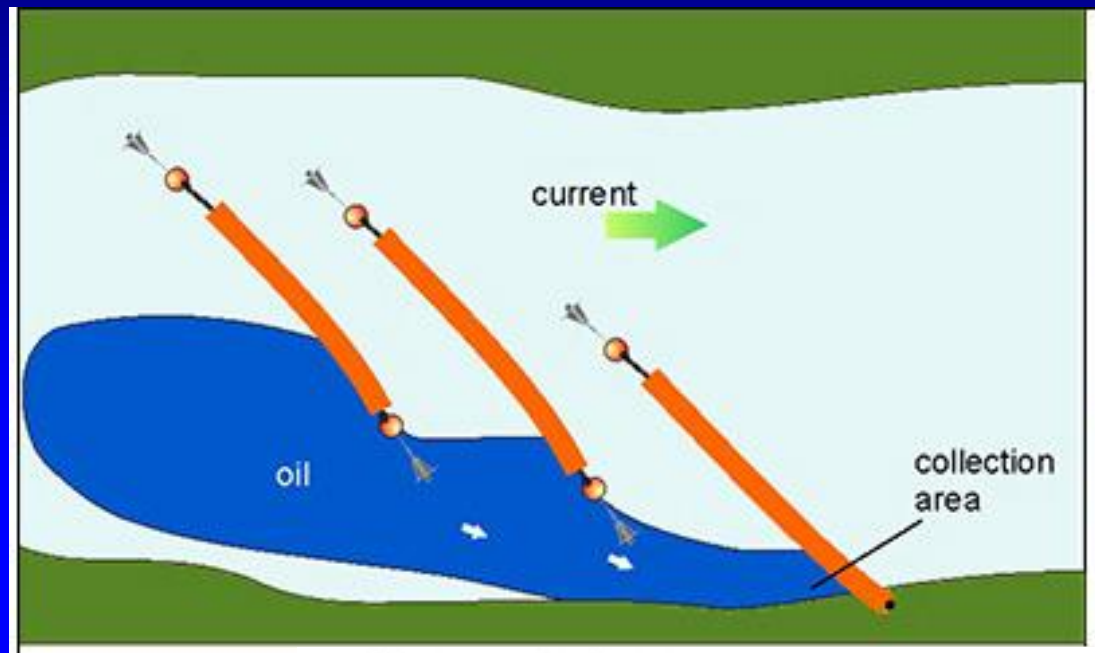
Wind at 10 knots
72°F
1000 bbls

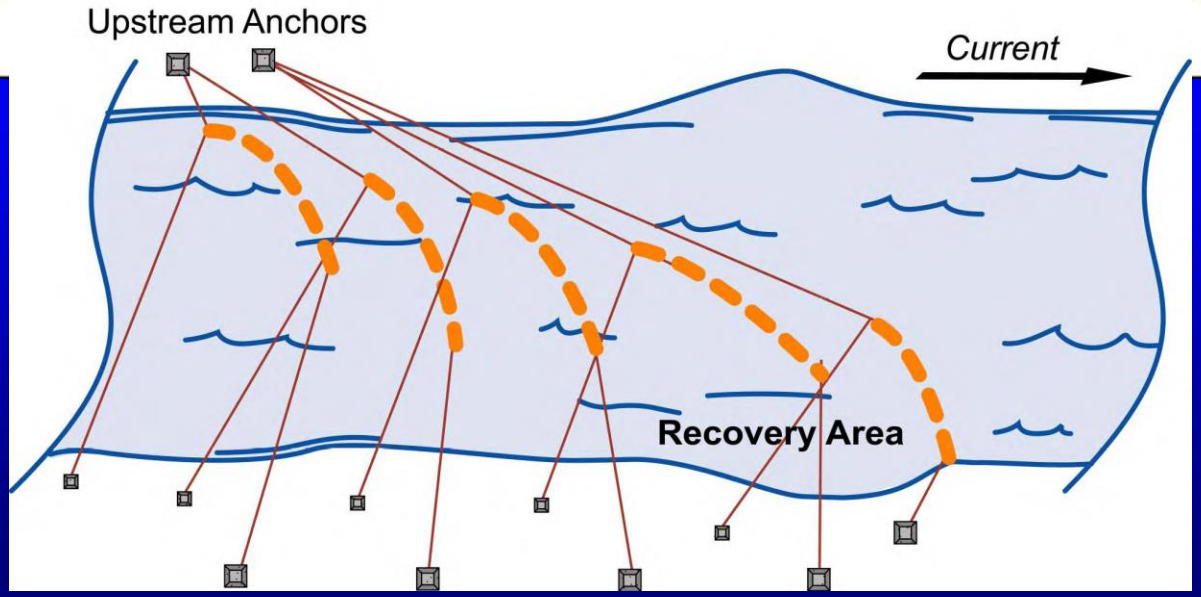


Oil Spill Response Techniques
Booming - Collection vs Deflection

- Fast Water booming
  - For many areas, streams in NW, will be necessitated
  - Specialized expertise needed
  - Big Safety concerns – if you do this wrong, you can get someone injured or drowned
  - If expertise and equipment not available, let the oil go and we'll catch it downstream

Spill Response Considerations – Fast Water





Spill Response Considerations

Fast Water Booming

Spill Response Considerations

Underflow Dam

Spill Response Considerations

Vegetation Removal

Spill Response Considerations

- May be best to remediate, in part, naturally
  - Cleanup trade offs with safety, environmental damage, destruction of the ecosystem
  - Determined by Unified Command
- Endpoints for cleanup
  - Will be determined by Unified Command
  - Don’t expect to get every molecule cleaned up

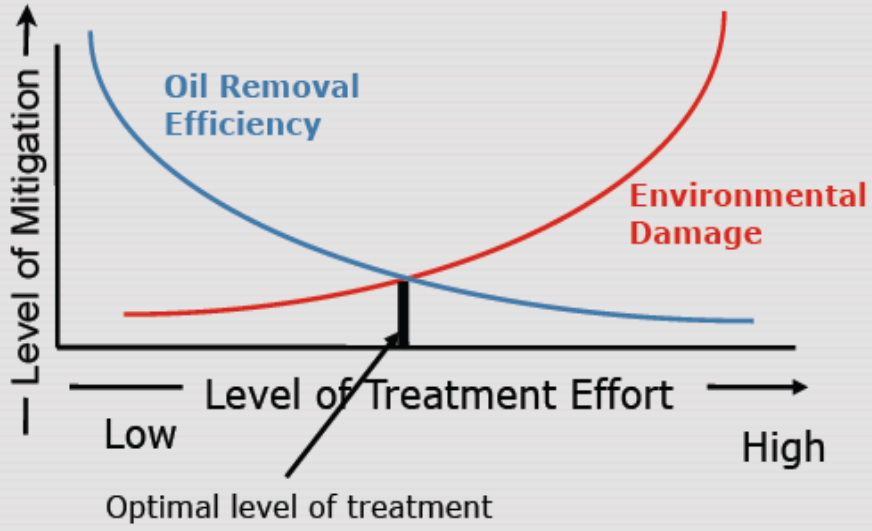
Spill Response Considerations

SCAT – *NEBA limits*

The NEBA process also involves knowing what to do **(response options)**, what not to do **(response constraints)**, defining when the job is done **(end points)**, and determining when the job is done **(sign-off)**.

The Recovery Rule

"The more effort to remove oil, the greater the degree of environmental intrusion"



Spill Response Basics

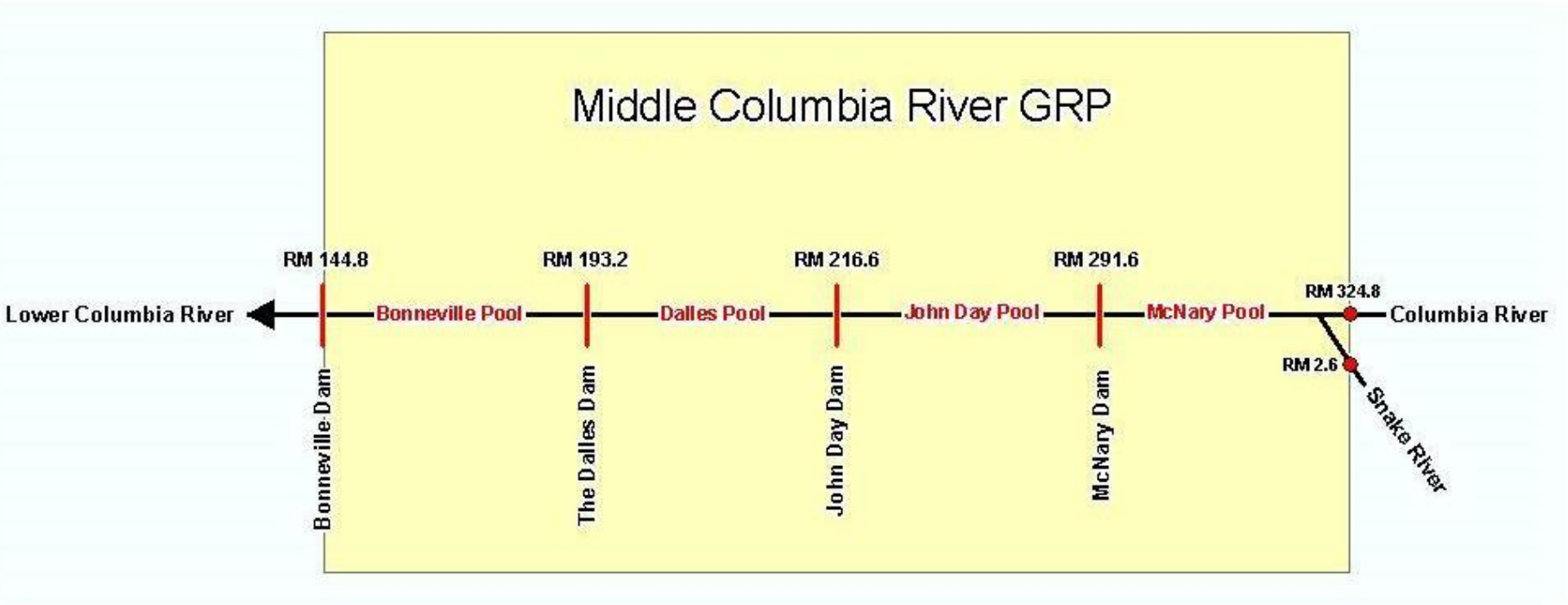
- When is it appropriate to use them, e.g. foam, dispersants?
  - To fight a fire, suppress explosive vapors, or other situation where there is threat to public health and safety
- When is it not appropriate to use them?
  - When cleaning up a spill
- Big question - Are you fighting a fire or spill??
  - Foam for fire……Yes
  - Foam for spill where no explosion/fire threat …..NO
  - Ditto for all other clean up agents (bugs, etc)

Emergency Response
Considerations & Expectations

- Large Response is complex & dynamic
- Many components
- A lot to know, consider
- Make a plan & implement it
  - Structured chaos
- Practice makes perfect – conduct drills
- Use Geographic Response Plans (GRPs) for Columbia River, Puget Sound, and other areas as available

http://www.rrt10nwac.com/GRP/Default.aspx

Emergency Response
Geographic Response Plans



Emergency Response
Geographic Response Plans

- Meant for First Responders
- Contain critical info on:
  - Important river access points
  - Specific booming strategies for specific areas
    - How many feet of boom required, etc.
  - Environmental, ecological, public resources at risk identified
  - Response resources and phone numbers

Components of a Good Response

- Quick Discovery
- Quick Notification
- Assessment
- Immediate Actions
- Health and Safety
- Evacuation plan
- Command System (NIMS ICS/UC)
- Alternate Command Post, office
- Media considerations
- Site security
- Environmental
- Offsite migration
  - Air monitoring, sampling of media
- Data sharing
- Disposal
- Long term clean up
- Drills/exercises

Actions Required

- Initiate efforts to stop the discharge
- Safety of Human Life top priority
- Minimize the impact to the public health and the Environment
- Stabilize situation
- Remove the discharged or spilled substances
- Manage the waste

Notification

- What's in place for timely notifications?
  - Call down lists of key telephone, fax numbers important
    - GRPs!
  - Agencies
    - County, local, 911
    - State – OERS, WA OEM
    - Federal – National Response Center
      - Courtesy call to USCG Sector or EPA appreciated
    - U.S Army Corps of Engineers or BLM dams
    - Tribes

Assessment

- SCAT implemented – formal process for shoreline assessment
- Source
- Cause
- Chain Reactions
- Material
- Amount
- Weather, direction
- Hazards imposed
- Offsite impact to public
  - What's downwind?
- Environmental impact
- Resources needed, deployed

Health and Human Safety

- On Site Workers- Company Responsibility- Health and Safety Plan
- Responders and Neighbors (Offsite) everyone's responsibility-Response Heath and Safety Plan
  - Shelter in place
  - Evacuations (alternate routes thought of?)
  - Sampling and Air Monitoring

Incident Command

- Need for command system to control response effectively and without losing span of control
- Full expectation of State OSC and Federal OSC to implement NIMS - ICS/UC
- Immediate access and integration of SOSC, FOSC with RP upon arriving on-scene
  - Includes gov contractors
- Immediate briefing of accurate information
- Good handoff for outgoing responders needed
  - Don’t just leave without briefing incoming teams

Site Control & Access

- Need to secure control access to site
- For everyone's health & safety
- Establish work zones
- For media control
- Traffic plan important

Third Coast Packaging Fire

Logistics

- Plan for, establish alternate command post, consideration of offsite location important
- Include:
  - Meeting rooms
  - needed utilities, phone lines
  - computer, internet access
  - Break room
  - parking

Offsite Impact & Sampling

- Fire Water Run off – keep an eye to offsite flow
- Water Bodies- ditches, canals, streams, lakes, bayous, rivers, and bays
- Surface wipe samples-metal surfaces
- Soil samples-exposed soil, gardens
- Drinking water supplies
- All this data should be shared in Unified Command

Air Monitoring and Data

- It is very important that all air monitoring data be freely exchanged between all the responding groups including:
- EIH date collected onsite- establish Hot Zones
- Fence line data collected by EIH, Company Contractors, Agencies, Agency Contractors
- Offsite data - Neighborhood and downwind data collected by all of the above

Media

- In the beginning of these large events media sends out request through all avenues, and it is difficult to respond with the same information from all the sources being questioned.

- The quicker we get Unified Command set up the more consistent and accurate the message can be.

Media

- Incident Command needs Media Officer / PIO as soon as possible
- Speak with one voice to media
  - Keeps from confusing public, creating problems
- Stay on message
- Frees up IC or others allows them to focus on their own duties

The Environment

- Contain, Control, and Stop the Release
- Identifying Routes and quantify risks of Offsite Impact.
- Make a plan to minimize the Impacts.
- Make a plan to remediate the Impacts.
- INCIDENT ACTION PLAN

Questions?