February 18, 2015

Ms. Lori Gifford , SERC/LEPC Coordinator
Washington Military Department
Mitigation and Recovery Section
Building 20, MS: TA-20
Camp Murray, WA 98430

Via Certified Mail

Dear Ms. Gifford,

The Portland and Western Railroad (PNWR) is providing you with the following information in accordance with Department of Transportation Docket Number DOT-OST-2014-0067.

General Information

- The PNWR operates crude oil trains through Washington, traversing the following counties:
    - *Clark*
- Based on current traffic volumes and projected traffic levels we anticipate the number of trains that will travel through these counties each week to be as follows:
    - *Clark 0-3 trains per week*
- The anticipated route of these trains is:
    - *Vancouver into the State of Oregon*
- The origin of these crude oil trains is:
    - *Berthold, Dore, Eland, and Epping ND.*
- The crude oil has a UN Code of:
    - *1267. Sample shipping papers and a material safety data sheet are attached.*

PNWR Emergency Response Plan

The following outlines relevant portions of the PNWR emergency response plan, including initial procedures, fire plan and crude oil plan. The risk of fire or explosion of this commodity has been deemed to be high.

- **Initial Actions**

Initial Actions – All Hazards

The primary concern of the initial person arriving at the site of an incident must be safety. The FIRST priority is always the protection of life, and the prevention of injuries. Railroad employees must always cooperate and work closely with local, State and Federal emergency response groups to achieve this goal.

Railroad Emergency Coordinator and Train Dispatch Initial Actions

The Railroad Emergency Coordinator will make an early evaluation of the emergency with information supplied by the Train Dispatcher and will verify what response personnel are needed. The Train Dispatcher should have already started the process of calling emergency services (if necessary) as soon as first reports of incident are received.

The Chief / Train Dispatcher Actions

- Ensure that all personnel are accounted for and isolated from danger
- Arrange for emergency services for any injured personnel
- Notify the required PNWR "Go Team"
- Notify all railroad response personnel - *This process can be given to a railroad manager to complete.*
- Notify CHEMTREC when necessary
- Notify Federal and State Agencies
- Notify Heavy Equipment and Emergency Response contractors when called for by the Railroad Emergency Coordinator

Railroad Emergency Coordinator Actions

- Go to the scene to conduct an initial detailed survey
- Ensure the safety of employees and the public
- Determine the identity, hazards and status of the cars and materials involved in the emergency
- Assess the possible hazards to human health or the environment
- Consider both direct and indirect effects of any release
- Cooperate with local responder groups to take measures to ensure that fire, explosions or releases do not occur or spread to other hazardous material cars

- Determine Response Management Team requirement
- Ensure that contractors and on-site response groups will monitor for leaks, pressure buildups, gas generation, or cracks developing in tank cars
- Monitor cleanup efforts, and ensure that the recovered material or contaminated material is properly treated, stored, or disposed of in accordance with Corporate Environmental Policies & Guidelines.
- Ensure that cleanup procedures are completed.
- Conduct a follow-up detailed survey.

First On-Scene Personnel (Train crew, fire, police, etc.)

In the event of an incident, the following actions should be taken by those first on the scene, ***BUT ONLY IF SAFE TO DO SO:***

HAZARD IDENTIFICATION:

Before attempting any response actions, it is important to identify the materials involved and their associated hazards. This vital action is the first and most important aspect of conducting an initial survey of the scene.

The three primary means by which hazardous materials can be identified are:

- Shipping papers including waybills.
- Placards and/or labels.
- Name of commodity stenciled on the car.

Shipping papers provide the best and most reliable source of identification of the materials involved. These are legal documents, which are in the custody of the Train Conductor, and are required to accompany all rail shipments. Those first on the scene of an incident should locate the Train Conductor and examine the shipping papers prior to attempting to mitigate the incident. If unable to locate the Train Conductor or the Train Conductor is incapacitated, contact the ***Train Dispatcher*** to obtain the "train list". This document contains a list of all cars in the train and the location of cars containing Hazardous Materials relative to the lead car.

Placards may also be used to identify the presence of hazardous materials; however, it is extremely important to recognize the limitations of the placarding system. The required placard represents only the most severe hazard established by the Department of Transportation. It does not, however, indicate if the material has multiple hazards. For example, a chemical classified as a flammable liquid by its primary hazard is placarded flammable; however, that same chemical may also be extremely toxic by inhalation or skin absorption.

Placards alone should never be used to identify hazardous materials. Always refer to the Emergency Response Guidebook provided to the train crews, the AAR's Emergency Handling of Hazardous Materials in Surface Transportation book, or CHEMTREC.

In addition, placards are frequently torn off or destroyed in incidents, and therefore may not be available as a source of identification. NEVER attempt to read a placard when fire is impinging on a car or a vapor cloud or odor is detected.

RESCUE THE INJURED:

Rescue the injured if possible, remove them to a safe area, and administer first aid. If there is evidence of smoke, fire, vapor clouds, or leakage of hazardous materials, protective clothing and appropriate respiratory protection must be worn as well as all other necessary personal protective equipment.

All rescue operations should be conducted as quickly as possible from the upwind side. Always plan an escape route prior to entering the immediate area. Personnel should never be unnecessarily exposed to smoke or fumes, and lives should NEVER be risked to save property or the environment.

EVACUATE THREATENED PERSONNEL:

If a large vapor cloud is observed, or there is fire involving a tank car, or car contains hazardous materials, it may be necessary to evacuate personnel to a safe area, one-half mile or more, with consideration given to wind speed and direction.

SECURE THE PERIMETER TO PREVENT UNAUTHORIZED ACCESS:

Set up roadblocks on the perimeter to prevent sightseers, evacuees, the news media, and all other non-essential personnel from entering a potentially dangerous environment. Personnel not directly involved with emergency response or rescue operations must be kept away from the hazard area.

PERSONAL PROTECTIVE EQUIPMENT:

Levels of Protection (A-D), from OSHA regulation (29 CFR 1910.120, Appendix B) are summarized in Table 4-1. Response personnel involved in oil spill cleanup operations will comply with all Federal, State and Company safety regulations and policies. All response personnel will use an acceptable level of PPE for their working environment based on the chemical or physical properties of the hazards present.

Table 4-1 Personal Protective Equipment / Levels of Protection: A-D

PERSONAL PROTECTION EQUIPMENT / LEVELS OF PROTECTION: A-D ---FROM OSHA REGULATIONS: 29 CFR 1910.120, APPENDIX B---	
CONDITIONS FOR USE	**EQUIPMENT (PPE)**
LEVEL A: Greatest level of protection for skin, respiratory, and eyes. SHOULD BE USED WHEN: 1. Hazardous substances identified for highest level of protection. * High concentration of atmospheric vapors, gases or particles. * Work functions potential for splash, immersion, or exposure. 2. Substances with a high degree of hazard to skin. 3. Operations being conducted in confined, poorly ventilated area, and not yet determined to de-escalate from Level A.	a. Positive-pressure, full face-piece SCBA. b. Totally encapsulating chemical protective suit. c. Gloves: inner and outer chemical resistant. d. Boots: chemical resistant with steel toe, and shank. * OPTIONAL, as applicable: Coveralls, long underwear, hard hat under suit.
LEVEL B: Highest level of respiratory protection but lesser level for skin protection SHOULD BE USED WHEN: 1. Type and atmospheric concentration identified. 2. Atmosphere contains less than 19.5% oxygen. 3. Presence of incompletely identified substance is indicated by organic vapor detection instrument, but are not suspected of containing high levels of chemicals harmful to skin or easily absorbed.	a. Positive-pressure, full face-piece SCBA. b. Hooded chemical resistant clothing. c. Gloves: inner and outer chemical resistant. d. Boots: chemical resistant, with steel toe and shank. * OPTIONAL, as applicable: Coveralls, boot covers, hard hat, face shield.
LEVEL C: SHOULD BE USED WHEN: 1. Atmospheric contaminants, liquid splashes, or other direct contact will adversely affect or be absorbed through skin. 2. Types of contaminants have been identified, concentrations measured, and an air purifying respirator can remove contaminant. 3. All criteria for use of air purifying respirators are met.	a. Full-face or half-mask air-purifying respirator. b. Hooded chemical resistant clothing. c. Gloves: inner and outer chemical resistant. * OPTIONAL, as applicable: Coveralls, boots (outer), boot covers, hard hat, escape mask, face shield.
LEVEL D: SHOULD BE USED WHEN:	a. Work uniform; used for nuisance contamination.

1. Atmosphere contains no known hazard, AND 2. Work functions preclude splashes, immersion, or potential for unexpected inhalation or contact with hazardous levels of any chemicals.	FRC Coveralls. b. Boots/shoes: chemical resistant, steel toe and shank. c. Safety glasses. * OPTIONAL, as applicable: Gloves, boots (outer), hard hat, escape mask, face shield.

CONDUCT AN INITIAL SURVEY OF THE SCENE:

The purpose of the survey is to assess the conditions and hazards of the incident so that evacuation, personnel safety procedures, mitigation activities, and cleanup can be planned. Facts concerning the incident can be accurately and timely disseminated to appropriate supervisory personnel.

Initial surveys, however, should NEVER risk human life. In some cases, the incident represents such an extreme hazard to life that the only safe course is to evacuate the area and protect the perimeter. When such conditions exist, initial surveys should be performed at safe distances, with binoculars or by aerial observation.

In situations where fire directly impinges on a tank car and there is a threat of the car rupturing violently, the initial survey should be performed from a distance of at least one-half mile and from the upwind side if possible. If highly radioactive materials or extremely toxic gases such as hydrocyanic acid are involved, only highly trained experts with proper protective equipment should survey the immediate area. An initial survey should determine the following information:

- Number and position of engines and/or cars derailed
- Identity and properties of the materials involved
- Potential hazards
- Presence of fire, smoke or fumes
- Disposition and overall condition of each container. Note structural damages, condition of valves, outer jacket torn, dents or gouges in inner tank etc.
- Evidence of leakage (wetness on sides of cars, vapor clouds, odors, etc.)
- Amount and rate of any leakage
- Look for material pooling, seeping into ground or entering any waterways
- Location of threatened waterways (streams, rivers, lakes, drainage ditches, culverts, sewers, etc.)
- Prevailing weather conditions (wind direction and speed, rain, humidity, temperature, etc.)
- Topography of and accessibility to the area
- Public exposure potential (nearest population, etc.)
- Nature and extent of any injuries

- Needed remedial action (dams or dikes, absorbents needed, etc.)
- Information obtained should be immediately provided to appropriate supervisory personnel, and the Chief/ Train Dispatcher

Work with Local Responders to Handle the Incident

Establish on-site procedure to coordinate the incident, and provide consistent information to local authorities. Train crews must not turn over the train manifest until authorized to do so by a Railroad Official.

Stabilize the Situation Until Expert Technical Assistance Arrives

The first and foremost goal is to protect lives and prevent injuries to the public. Once personnel are rescued and evacuated, and a perimeter has been secured, there is no need to rush into a scene and risk lives unnecessarily. In many cases, it is prudent to wait until expert assistance arrives before attempting to mitigate the situation.

If fire threatens a tank car, all personnel should be withdrawn until expert assistance arrives to assess whether or not it is safe to fight the fire.

Some materials react violently with water, while others can cause extensive environmental damage if diluting it with water spreads the contaminant. This frequently complicates and delays cleanup efforts.

REMEMBER: It is of critical importance to thoroughly understand the chemical and its properties before taking corrective action.

PNWR Emergency Response Plan – Fire Specific Information

The following is to be made available to fire fighters and first responders who are called to the scene in the event of a fire. This information is to ensure that the fire fighters are informed and is for their consideration in aiding PNWR in the case of an emergency.

Introduction to Rail Car Fires

Water is the most common and generally most available fire extinguishing agent. Exercise caution in selecting a fire extinguishing method since there are many factors to be considered in an incident. Water may be ineffective in fighting fires involving some materials; its effectiveness depends greatly on the method of application. Fires involving a spill of flammable liquids are generally controlled by applying a fire fighting foam to the surface of the burning material. Fighting flammable liquid fires requires foam concentrate which is chemically compatible with the burning material, correct mixing of the foam concentrate with water and air, and careful application and maintenance of the foam blanket. There are two general types of fire-fighting foam: regular and alcohol-resistant.

Examples of regular foam are protein-base, fluoroprotein, and aqueous film forming foam (AFFF). Some flammable liquids, including many petroleum products, can be controlled by applying regular foam. Other flammable liquids, including polar solvents (flammable liquids which are water soluble) such as alcohols and ketones, have different chemical properties.

A fire involving these materials cannot be easily controlled with regular foam and requires application of alcohol-resistant foam. Polar-solvent fires may be difficult to control and require a higher foam application rate than other flammable liquid fires (see NFPA/ANSI Standards 11 and 11A for further information). Refer to the appropriate guide to determine which type of foam is recommended. Although it is impossible to make specific recommendations for flammable liquids which have subsidiary corrosive or toxic hazards, alcohol-resistant foam may be effective for many of these materials. The emergency response telephone number on the shipping document, or the appropriate emergency response agency, should be contacted as soon as possible for guidance on the proper fire extinguishing agent to use. The final selection of the agent and method depends on many factors such as incident location, exposure hazards, size of the fire, environmental concerns, as well as the availability of extinguishing agents and equipment at the scene.

The following locations have been identified as foam sources:

Pasco, WA
BNSF Railway Fire Trailer
550 gallons AR/AFFF Foam
2-Fire Fighting Pumps
2-10,000 gallon Bladders for Water Storage
Various Hoses, Fittings and Nozzles
This Fire Trailer is capable of delivering 16,500 gallons of finished AR/AFFF Foam at 3% Concentration

Tacoma, WA
BNSF Railway Fire Trailer
275 gallons AR/AFFF Foam
1-Fire Fighting Pumps
1-10,000 gallon Bladders for Water Storage
Various Hoses, Fittings and Nozzles
This Fire Trailer is capable of delivering 8,600 gallons of finished AR/AFFF Foam at 3% concentration

Portland, OR
Maritime Fire and Safety Association Fire Fighting Trailer
600 Gallons of AFFF Foam
1-Fire Fighting Pump

Kalama, WA
Maritime Fire and Safety Association Fire Fighting Trailer
600 Gallons of AFFF Foam
1-Fire Fighting Pump

Specific tactics are involved when combating chemical fires. These tactics should only be attempted by qualified industrial firefighting personnel. Surgical application of foam and water is paramount in resolving the incident safely and quickly. Before any attempts are made at combatting the fire, all resources including water supplies and foam supplies, should be gathered at the site and used appropriately. An evaluation of each individual fire must be accomplished to decide if the incident should be allowed to continue to burn or needs to be extinguished. Each fire is evaluated on its own, and the decision to extinguish it or letting it continue to burn will depend on hazards, risk / benefit analysis, and environmental impact. These evaluations must only be performed by trained hazardous materials and firefighting personnel.

Flammable Liquid Properties – Flash Point / Boiling Point

- Flash Point Definition: the minimum temperature at which a liquid produces enough vapor to form an ignitable mixture in air.
    - USDOT:
        - Flammable Liquid = Liquids that have a flashpoint below 140 ^{o}F
        - Combustible Liquid = Liquids that have a flashpoint of 140 ^{o}F to 200 ^{o}F
    - NFPA:
        - Flammable Liquid = Liquids that have a flashpoint below 100 ^{o}F
        - Combustible Liquid = Liquids that have a flashpoint above 100 ^{o}F

- Boiling Point Definition: *the temperature at which the vapor pressure at the surface of the liquid is equal to or slightly greater than the atmospheric pressure. It's the point of maximum vapor production.*

Packing Groups

Packing Groups represent the degree of danger the material poses during transportation.

Table 4-5 - Class 3 Packing Groups

Class 3 (Flammable) Packing Groups		
Packing Group	**Flash Point**	**Initial Boiling Point**
I		**<= 35°C (95°F)**
II	**<23°C (73°F)**	**>35°C (95°F)**
III	**>23°C, <=60°C (140°F)**	**>35°C (95°F)**

Figure 4-6 - PG Key Physical Properties

Packing Group (PG) and Key Physical Properties of Common Flammable Materials							
	PG I Crude Oil*	PG II Crude Oil*	PG III Crude Oil*	Ethanol (PG II)	Gasoline (PGI or II)	Acetone (PG II)	LPG (Propane)
Boiling Point	*<95 °F*	*>95 °F*	*>95 °F*	*174 °F*	*90 - 410 °F*	*132 °F*	*- 43 °F*
Flashpoint	*<73 °F*	*<73 °F*	*>73 to <140 °F*	*55 °F*	*-36 to -50 °F*	*- 4 °F*	*- 156 °F*

*No two shipments (even from same well head or mine) will have the exact same chemical and physical composition, flashpoints/boiling points and Packing Groups will vary.

Vapor Density/Vapor Pressure

- Vapor Density Definition: Weight of a unit volume of gas or vapor compared to the weight of an equal volume of air (air is assumed to have a value of 1).
    - All Flammable Liquids have a Vapor Density Greater than 1 (air), meaning they will tend to accumulate in low areas
    - As such vapors can accumulate in low/depressed areas
    - Vapor accumulation will be affected by wind and topography

- Vapor Pressure Definition: the pressure exerted by a vapor in thermodynamic equilibrium with its condensed phases (solid or liquid) at a given temperature in a closed system.
    - A liquid with a high vapor pressure is considered to be volatile
    - Vapor pressure is directly related to temperature; Increasing temperature = Increasing vapor pressure
    - Light crude has a higher % of C1-C5 gases (i.e. methane, butane, ethane, propane, pentane) when compared to intermediate or heavy crudes which causes vapor pressures to be 10-12 psi range

Rail Specific Actions during an Incident Involving a Fire

- **Fire Fighting Considerations**
    - **Size up – from a distance and collect information**
        - What is burning?
        - What kind of railcars are burning (other than crude)?
        - What color is the smoke?
        - How long have the fires been burning?
        - Are there pool fires?
        - Pressure fires coming out of tank cars?
        - Intermittent fires from pressure relief devices or continuous fire?
        - What will be gained by an offensive approach?
        - Risk vs Reward
    - **BLEVE VS Heat Induced Tear**
        - *Boiling Liquid Expanding Vapor Explosion (BLEVE)*

BLEVEs can be caused by an external fire near the storage vessel causing heating of the contents and pressure build-up. While tanks are often designed to withstand great pressure, constant heating can cause the metal to weaken and eventually fail. If the tank is being heated in an area where there is no liquid, it may rupture faster without the liquid to absorb the heat. Gas containers are usually equipped with relief valves that vent off excess pressure, but the tank can still fail if the pressure is not released quickly enough. Relief valves are sized to release pressure fast enough to prevent the pressure from increasing beyond the strength of the vessel, but not so fast as to be the cause of an explosion. An appropriately sized relief valve will allow the liquid inside to boil slowly, maintaining a constant pressure in the vessel until all the liquid has boiled and the vessel empties.

If the substance involved is flammable, it is likely that the resulting cloud of the substance will ignite after the BLEVE has occurred, forming a fireball and possibly a fuel-air explosion, also termed a vapor cloud explosion (VCE). If the materials are toxic, a large area will be contaminated.

- *Heat Induced Tear* – low pressure container, lower energy, limited overpressure

    - Cause – Highly stressed metal (from heat/pressure) forms a "blister" then "pops"

    - Heat induced tears will occur in the vapor space (top of the car) so the pressurized liquid will be directed up.

    - Heat induced tears are the most common found instances where a general service tank car has been involved in a pool fire such as derailments involving crude oil or ethanol.

Note: Extreme caution should be used when a pressure tank car is involved in an incident involving a fire.

- **Fire protection and prevention**

Whenever hydrocarbons or flammable chemicals are present in closed containers such as tank cars and terminals the potential exists for release of liquids and vapors. These vapors could mix with air in the flammable range and, if subjected to a source of ignition, cause an explosion or fire. Spills and releases should be stopped from entering sewers and drainage systems. Small spills should be covered with dry earth and or absorbent materials , and larger spills with foam, to prevent vapors from escaping and mixing with air. Sources of ignition in areas when hydrocarbon vapors may be present should be eliminated or controlled. Portable fire

extinguishers should be carried on service vehicles and located at accessible and strategic positions throughout the incident.

Telephone numbers of responsible persons and agencies to be notified in case of an emergency should be posted at the facility and a means of communication provided. Local fire departments, emergency response, public safety and mutual aid organizations should also be aware of the procedures and familiar with the area and its hazards.

Hydrocarbon fires or chemical fires are controlled by one or a combination of methods, as follows:

- *Removing fuel.* One of the best and easiest methods of controlling and extinguishing a hydrocarbon fire is to shut off the source of fuel by closing a valve, diverting product flow or, if a small amount of product is involved, controlling exposures while allowing the product to burn away. Foam may also be used to cover hydrocarbon spills to prevent vapours from being emitted and mixing with the air.

- *Removing oxygen.* Another method is to shut off the supply of air or oxygen by smothering fires with foam or water fog, or by using carbon dioxide or nitrogen to displace air in enclosed spaces.

- *Cooling.* Water fog, mist or spray and carbon dioxide may be used to extinguish certain petroleum product fires by cooling the temperature of the fire below the product's ignition temperature and by stopping vapours from forming and mixing with air.

- *Interrupting combustion.* Chemicals such as dry powders and halon extinguish fires by interrupting the chemical reaction of the fire.

PNWR Emergency Response Plan – Oil Specific Plan

The following is to be made available to first responders and vendors who are called to the scene in the event of an oil spill. This information is to ensure that the vendors and responders are informed and is for their consideration in aiding PNWR in the case of an emergency.

Synopsis

Each incident and oil spill is different, therefore, phases of the spill will also vary depending on the type of oil, weather conditions, geographical location, environmental areas to be protected, logistics, etc.

However, there are many hardware systems and techniques, which remain similar, spill after spill. These will be described in this section for use as a training aid and ready reference.
Rapid deployment of containment and recovery equipment by on-site personnel increases the chance of a successful cleanup. This can significantly reduce the environmental impact and any subsequent cleanup and restoration costs. DO NOT BOOM GASOLINE OR ANY OTHER HIGHLY FLAMMABLE PRODUCT.

The Emergency Coordinator or Incident Commander should utilize the response decision diagram in Figure 4-1 to aid in decision making for the phases listed below.

- Detection
- Assessment
- Containment
- Recovery
- Shoreside Cleanup
- Restoration
- Decontamination
- Disposal

Priorities

The following priorities are general guidelines for response to an oil spill that may occur on any track operated by PNWR. They are based on the premise that the safety of life is of paramount importance in any pollution incident. The protection of the environment and property, although important, are secondary.

Nothing in this part is meant to indicate that higher priority items must be completed before performing a lower priority task. They may be carried out simultaneously or in the most logical sequence for each individual incident.

- Priority # 1 Safety of Life

  For all incidents which may occur, the safety of personnel must be given absolute priority. The term personnel include all individuals involved, including members of the response team. No personnel are to be sent into an affected area without first determining the hazards involved and subsequently, taking adequate precautions.

- Priority # 2 Protection of the Environment—By:

  - SECURE-STOP-THE SOURCE OF THE SPILL

    Every effort must be made to secure -- stop -- the source of the spill to prevent further damage. This is critical. All efforts made to ensure the safety and salvage of the train and track should be undertaken with the consideration to minimize further harm to the environment.

    - ON-WATER CONTAINMENT AND RECOVERY

      Rapid deployment of containment and recovery equipment will increase the likelihood of success during an oil spill.

- DIVERSION/EXCLUSION BOOMING TECHNIQUES / DAMMING

In the event that the location of the spill or the weather conditions does not permit open water recovery, protection of the shoreline becomes paramount. Environmentally sensitive areas must be given added consideration. It may not be possible to protect all areas entirely or even in part. It may be necessary to sacrifice some areas in order to achieve the best overall protection of the environment.

- DISPERSANT / BIOREMEDIATION / IN-SITU BURNING

It is highly unlikely that alternative response technologies will be a viable option in the rail operating areas.

- SHORESIDE CLEANUP/ REMEDIATION

Shoreside / land-based cleanup will be conducted when such removal can be accomplished with less environmental damage than allowing the oil to weather and biodegrade. Methods used will vary dependent on the area to be protected.

There are pros and cons to the bulk removal of oil and contaminated rock and sand. This process may remove oil and oily debris from a contaminated area but this may cause excessive erosion. In addition, the mechanical washing of rocks to remove oil could have damaging effects to the indigenous biological species.

<u>Assessment</u>

An important part of handling any oil spill response action is assessing the volume and direction of movement of the spill. An estimate of the oil spill volume allows response teams to determine both the type and quantity of equipment, and labor, necessary to recover the spilled oil. Plotting the spill movement allows response teams the time to plan their recovery strategies as well as protect environmentally sensitive areas.

Oil Spill Behavior

The rate at which oil spreads, evaporates and breaks down into the environment are all influenced by the processes of oxidation, dissolution, dispersion, emulsification and biodegradation. These processes over a period of days and/or weeks will alter the characteristics of spilled oil; thus, sometimes requiring a change in oil recovery equipment. However, in most cases, these processes aid in the cleanup operation by reducing the volume spilled. Weathering processes also reduce the toxicity of spilled oil, reducing its impact on the environment.

- Physical and Chemical Properties

- The term "oil" is applied to a wide variety of petroleum products ranging from crude oils to different grades of refined products.

- Crude oil is not a uniform substance and its properties vary widely from one location of origin to another.

- Oil spill behavior is a function of the oil's physical and chemical properties which include:

    - Density
    - Viscosity
    - Pour point
    - Flash point
    - Solubility in water

- By convention, physical and chemical properties of oil are measured at a standard or constant temperature and atmospheric pressure.

- However, the physical properties of oil will vary depending on local environmental conditions and may deviate considerably from values reported for "standard" conditions.

- The methods for dealing with spilled oil should be based on field observations.

<u>Response Options/Actions</u>

- Recovery
- Booming – Containment/Collection/Exclusion/Deflection/Diversion
- Blocking/Damming
- Decontamination
- Remediation/Shoreside Cleanup

Recovery

The recovery of oil is perhaps the most complex aspect of any oil spill control system. The types and volumes of oil, degrees of weathering and emulsification, sea state, presence of debris and/or ice, etc., all place constraints upon the size, ruggedness, complexity and capacity of a particular recovery device.

In brief, recovery devices (oil skimmers) can be categorized into systems that utilize adhesive surfaces, e.g. disc, belt, rope, and drum-type skimmers, and those that take advantage of gravitational effects, e.g. weirs, vortex skimmers, etc.

- Adhesive Surface (Oleophilic) systems require that a surface such as a disc, rope, or belt be drawn through an oil/water interface and out to where the oil can be scraped off or squeezed out of the adhesive material into a storage reservoir. The greatest advantage of the oleophilic skimmer is efficiency – (collects less water during recovery operations)- which can reduce the amount of temporary storage required. This can be a very important factor especially in remote locations.

- Gravitational/Weir systems involve such devices as centrifuges that increase the effects of gravity and thicken an oil slick for convenient removal, as well as weir devices that hold back water while allowing floating oil to pass over a slightly submerged barrier. Weir systems often have high recovery rates, but the temporary storage requirements will be much higher due to the amount of water that will be collected with the oil.

- Oil Sorbent Materials (pads/sweep/snare) are specialized materials which do not wet in water, but will absorb oil and most oil derivatives such as lube oil. The quantity of sorbents required and the application method depends on the size and location of a spill.

Booming Operations

The containment of oil at or near its source of discharge is desirable to limit its spread and to maximize the oil spill thickness, for more efficient recovery. Oil containment boom is a mechanical barrier that stops the flow of oil and surface water while allowing subsurface water to pass underneath. It is important for operations personnel to have a good working understanding of the various forces at work around an oil boom if successful boom performance is to occur at the spill site.

- Boom Forces
    - **WATER** current has the greatest effect on booms and must be seriously considered prior to boom deployment, or the boom can be badly damaged.
    - **WIND** currents are created and can be estimated as 3% of the wind's velocity.
    - **WAVE** action can cause oil to slop over or under a boom if the boom is not flexible enough to follow wave contours. It is an important factor in determining what boom to use in a spill cleanup.

- Boom Failure

- **EXCESSIVE LOADING & SUBMERGENCE** is the result of increased current velocities having shifted the boom to nearly a right angle. As the current increases, the loading increases on the boom, ultimately to a point above its design buoyancy. At that point, the boom will begin to sink, tear apart, or both.

- **ENTRAINMENT** occurs when the surface current hits the boom at a speed of 1.7 knots or greater, creating a hydraulic plane upstream of the boom. As oil thickens at the headwave of the oil slick, droplets of oil are torn away from the headwave by the current and forced down the hydraulic plane and under the boom, surfacing down current behind the boom.

- Proper Use of Boom

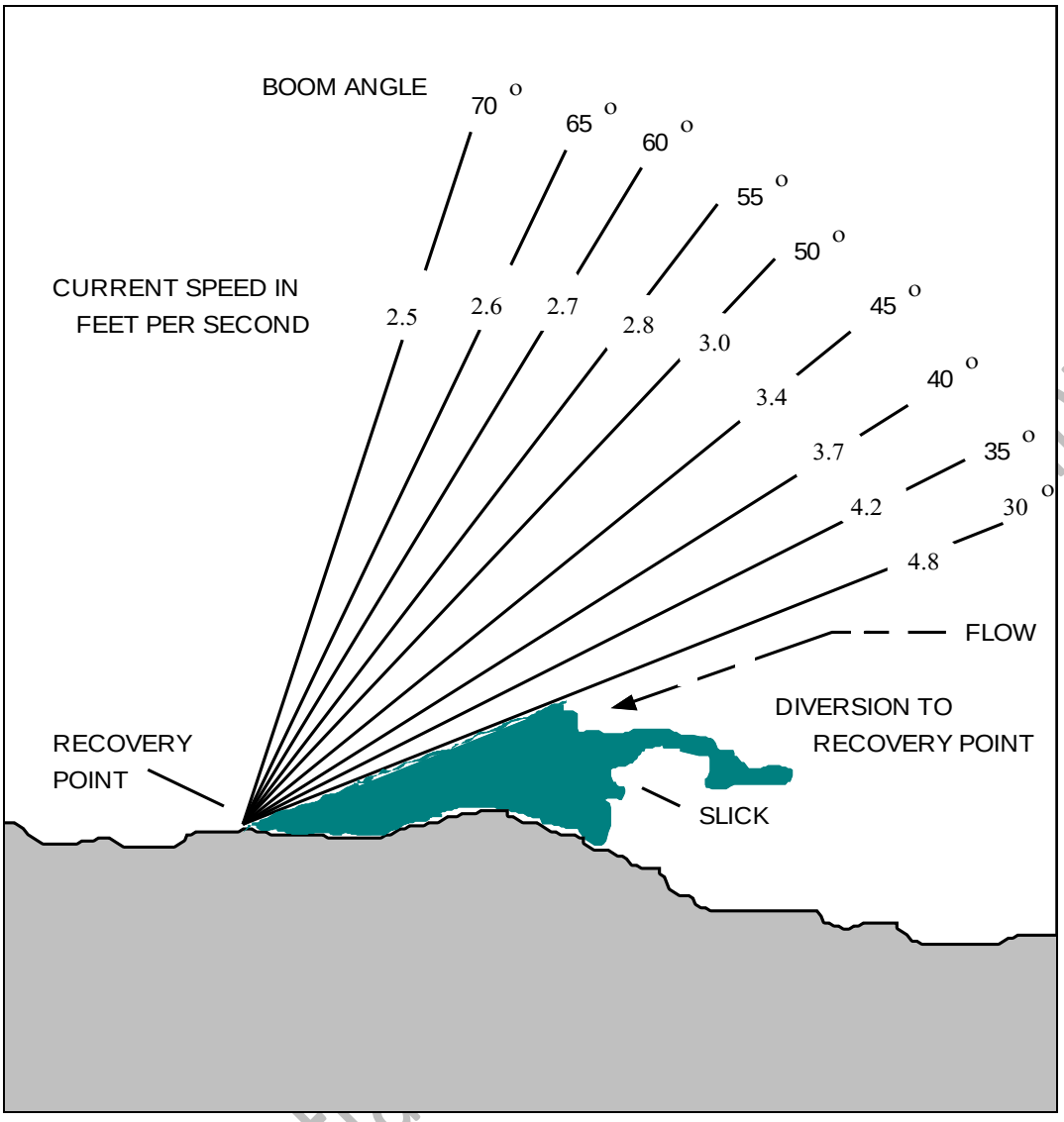
  - **DEFLECTION/DIVERSION -** In order to eliminate excessive boom loading and entrainment caused by high water currents (in excess of 1.7 knots), the boom is deployed at an angle to deflect and/or divert the oil. This type of deployment method slows the relative speed of the current to lessen entrainment and keeps oil off the shoreline or diverts the oil to a collection point. See Figure 4-2 Boom Deployment Angles.

  - **EXCLUSION –** Exclusion booming involves anchoring boom between two or more stationary points to exclude oil from entering water intakes, marinas, lagoons and other sensitive areas. Exclusion booms should also be deployed at an angle to the shoreline when possible to guide oil to an area where it can be recovered. In many cases, the deployment of a secondary boom behind the primary boom is needed to contain oil that may flow under the primary boom.

  - **COLLECTION/CONTAINMENT–** Containment at the source of the spill is accomplished by deploying boom around the area/source of the spill. This is the best way to prevent contamination of additional areas, but may not always be possible. Open water collection operations often involve "U", "V", "J", or "W" shaped configurations, that are used in conjunction with mechanical recovery or passive recovery devices.

  - **ANCHORING** – Anchor systems are usually deployed 3:1 (20ft water = 60ft of anchor line). The smaller scope usually works best if the chain attached to the anchor is a minimum of 6-8 ft. This helps with the angle and limits the upward pull on the anchor.

Figure 4-2 Boom Deployment Angles



- Fast Water / Swift Water Operations

Spill response operations on rivers can be accomplished with much of the same equipment, but some additional specialized equipment and techniques will make deployment operations safer and more effective. Boom with a shorter skirt (6-12") and 50-100' lengths will limit the amount of force placed on the boom. Line, hardware, and anchor points all need to have sufficient force and/or weight ratings. Personnel safety must always be considered first, since operations can involve steep slopes, slippery surfaces, and biological hazards. Pre-planning and staging rescue teams and first aid resources is recommended.

Blocking/Damming

If water is flowing into small estuarine entrances, damming may prevent oil from entering wetland areas. If the flow velocity is low, successful damming may be possible. Temporary

closures of these areas by damming should not cause environmental harm and impounded water should percolate through the sand. Damming can be accomplished using one of the following techniques:

- Flowing Water Dams

Dam locations should have high banks on the upstream side with the dam well-keyed into the banks. Construct dams with on / near site earthen materials, such as sandbags, plywood sheets, etc. Use heavy equipment or manual labor to excavate materials from the upstream side to increase dam storage capacity. Make the upstream side impermeable with plastic sheeting, if required. Underflow dams utilize inclined or valved pipes that have a flow capacity greater than the stream flow rate. Place the valved pipe(s) on the streambed and build a dam on top. Adjust the valve opening(s) until constant water / oil level is achieved behind the dam. Inclined pipes are placed in the dam at the lower end of the upstream side. The height of the raised end will determine the water level behind the dam.

For overflow dams, water flows over the top of the dam and boom positioned behind the dam contain the floating oil. Construct the dam as described above and cover it with plastic sheeting to prevent erosion. Anchor the boom several feet behind the dam. Pumps or siphons can also be used to pass water over the dam. To be effective, the pumping rate should be greater than the stream flow rate.

- Blocking Dam

Blocking dams are constructed across streambeds, ditches, or any other dry drainage courses to block and contain any flowing oil and to prevent oil mitigation during a rising tide. Dam locations should have high banks on the upstream side with the dam well-keyed into the banks.

Construct the dam using on-site earthen materials, such as sandbags, plywood sheets, or any other material that blocks the flow of oil. Excavate earthen materials from the upstream side to increase storage capacity. Oil is recovered from behind the dam by pumping or using vacuum trucks. Plastic sheeting should be placed over the dam to prevent oil penetration and erosion.

- Storm Drain Blocking

Sandbags, boards and specially constructed mats can be used to prevent spilled oil from entering urban storm drains. For curb inlets, position a board over the curb inlet and hold it in place with a sandbag. Street inlets can be blocked similarly with a board or plastic sheeting.

- Culvert Blocking

Boards, sandbags, inflatable plugs or earthen materials are used to block culverts as a means of containing oil flowing into ditches, creeks or other drainage courses that feed into culverts.

Culvert blocking may also be used to prevent oil from entering tidal channels that are connected to the ocean through culverts. Block the culverts by piling the dirt, sand or similar material over the upstream end of the culvert thereby creating a containment dam. Sandbags or plywood sheets are also effective - inflatable plugs work best if available at the site. Recover oil by skimming, vacuuming or pumping.

Remediation

An oil slick that is not contained will be carried by winds and currents into the open sea or onto a sensitive shoreline. Oil carried ashore should be removed quickly and thoroughly to minimize damage to property and sensitive ecosystems.

However, this is a complex ecological, technological and political issue. No decision making process should be undertaken without first consulting with experts in the field, including those representing various federal and state agencies.

The following factors will be considered in making decisions about whether to proceed with shoreline cleanup, and if so, to what extent.

- Will cleanup activities do more damage to sensitive shorelines than leaving the oil to biodegrade naturally?
- Some shoreline areas are not readily accessible to appropriate recovery equipment.
- Before cleanup of any shoreline takes place, the company legal/claims coordinator must procure authorization from the appropriate land management agency, or private land owner.
- Certain land classifications such as national and state parks, tribal lands, game refuges and private land may preclude cleanup operations, even when those activities are in the best interest of the particular shoreline.
- Biological and physical characteristics of a contaminated shoreline need to be evaluated.
- Sheltered shorelines not exposed to wave/flushing action should be given the highest priority for protection and cleanup

Decontamination

Keeping the oil and oily debris limited to a controlled area, as well as minimizing the contact of uncontaminated personnel and equipment with already contaminated personnel and equipment,

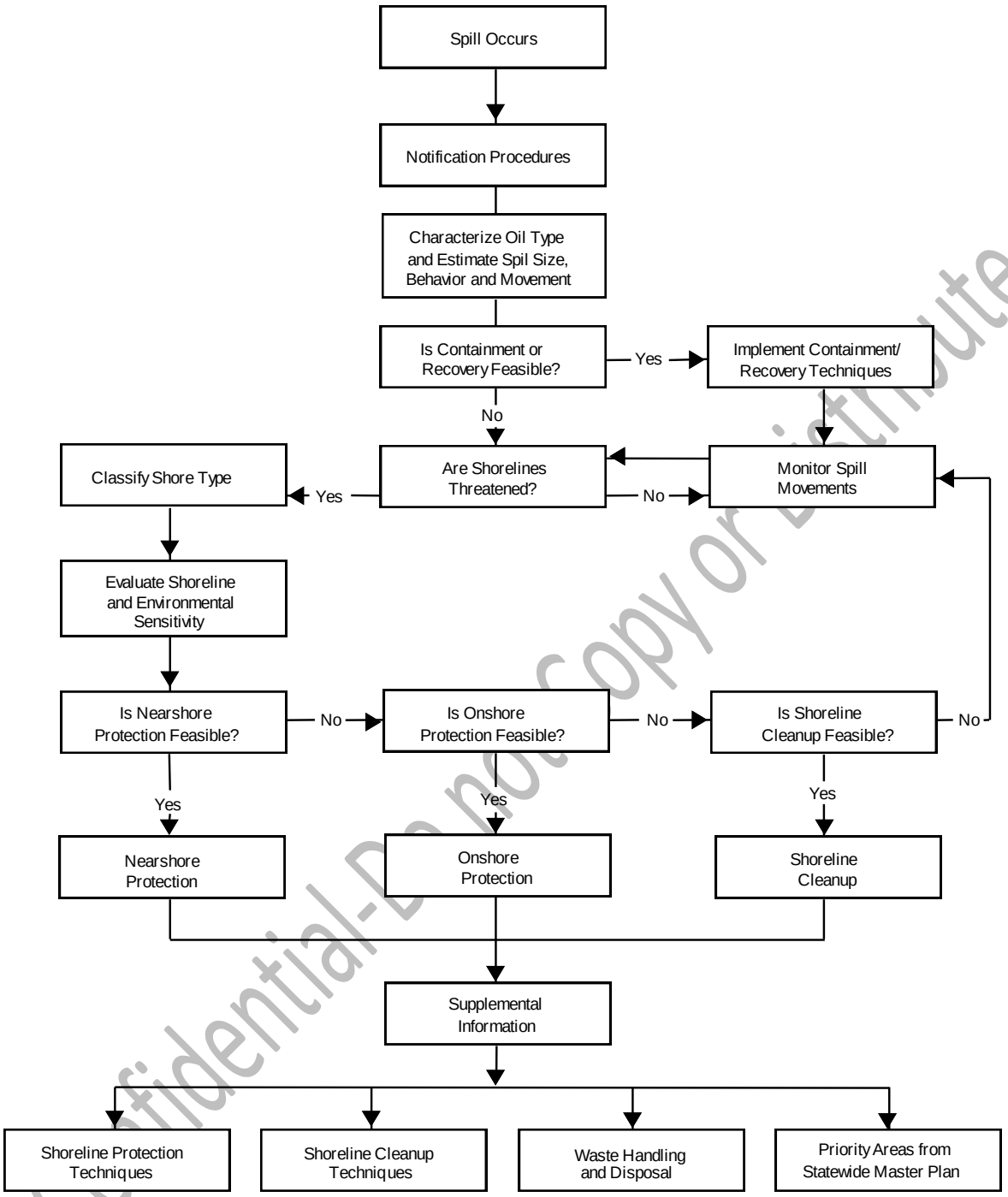
requires established procedures, and discipline. These procedures are to be developed, communicated, and implemented prior to entry of a contaminated (spill) area so that each person entering an area wearing protection equipment will understand the importance of keeping all contaminants inside the designated area.

Decontamination procedures should be tailored to a specific hazard. For an oil spill, this could mean making sure that protection equipment worn and the equipment used for cleanup are not taken away to a different area to be washed off with a hose and deposited down the storm drain. Precautions must be taken to insure that ALL oil or oily debris is properly contained and disposed of; that cleanup workers are decontaminated in such a way as to limit their exposure to any contamination; and, to limit any further (secondary) spreading of the contamination.

Decontamination procedures will vary from site to site, and according to available facilities and task categories. Specific procedures will be prescribed and supervised by the appropriate oil spill response contractor through their safety manager or field supervisor.

The essence of decontamination procedures is to remove all contamination from work clothing to prevent direct skin contact and secondary contamination of other garments and clean areas.

The PNWR Emergency Response Plan has notated initial methods for handling spills or leaks in the absence of fire **Figure 4-1 – Response Decision Diagram**



Preliminary First-Aid Measures

The preliminary first-aid measures to be taken due to exposure are as follows: Move victim to fresh air call emergency medical care. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact with material, immediately flush skin or eyes with running water for at least 20 minutes.

Points of Contact

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