Section 9301

Oil Spill Best Management Practices

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9301.1 Open Water Habitats

9301.1.1 Booming

Booms are flexible floating barriers that are placed on the surface of the water to control the spread of spilled oil and to protect ecologically sensitive areas. Oil spill containment booms generally have five operating components—flotation chamber, freeboard, skirt, tension member and ballast. The overall height of the boom is divided between the freeboard, the portion above the surface of the water, and the skirt, the portion below the water surface. Boom heights range from approximately 6 inches to over 90 inches, to address different types of water bodies and environmental conditions. Flotation attached to the freeboard and ballast (e.g., chain, weights) attached to the skirt enable the boom to float upright in the water. In other words, the plane created by the boom is perpendicular to that of the surface of the water. Boom is typically made up of 50-foot sections; the sections, and the connectors between sections, provide flexibility both in boom length and shape. Depending on the specific booming strategy employed, boom is towed through the water, anchored in place (typically in water less than 100 ft deep), or attached to the shoreline or to a vessel.

There are four basic booming strategies contained in the NWACP: (1) containment, where boom is used to contain and concentrate the oil until it can be removed; (2) deflection, where boom is used re-direct floating oil away from sensitive areas; (3) diversion, where boom is used to re-direct floating oil toward recovery sites that have slower flow, better access for equipment and personnel, and a way to remove the oil; and (4) exclusion, where boom is used to keep oil out of a sensitive area. In addition, booming strategies can be used in combination with each other. Boom may also be used to enhance recovery of oil by skimmers (de-scribed in greater detail below) or to collect and concentrate a sufficient thickness of oil on the water surface to allow in-situ burning (described in greater detail below). During a response, boom is typically in place for days to a week, depending on the spill. During that time, boom may be moved and repositioned to maximize its effectiveness at containing, excluding, diverting or deflecting oil.

Boom can potentially be used in all open water habitats, depending on environmental conditions, but boom placement may be constrained by water depth and boat accessibility (except in the cases of very small bodies of water, where boom may be deployed by hand). Boom may come in contact with the substrate in shallow water or along shore-lines. However, this is undesirable in most cases, as typical floating boom that comes into contact with the substrate is likely to lie flat and lose its ability to contain oil. Boom designed for this specific purpose (i.e., to maintain containment after coming in contact with the substrate), known as intertidal or tidal seal boom, may be used for oil containment along shorelines. Like other boom, intertidal boom floats up and down over tidal cycles. However, the skirt is replaced by one or two continuous tubes filled with water, which forms a seal with the substrate. As a result, a vertical plane is maintained by the boom and it continues containing oil as the tide recedes. Traditional boom attached to the shoreline typically comes in contact with substrate along shorelines for only a short distance, usually less than 10 ft, depending on the slope of the shoreline. In addition to shallow water depths, the effectiveness of booming strategies can be significantly reduced by wind, currents, waves and the presence of large quantities of floating debris. For maximum boom effectiveness, the depth of the water should be at least 5 times the draft of the boom. Once deployed, boom is routinely checked and repositioned by response personnel using small boats to maximize its effectiveness in changing environmental conditions.

9301.1.2 Removal of Floating Oil – Sorbents

The objective of this response is to remove floating oil by allowing it to adhere to pads or rolls made of oleophilic material. The dimensions of sorbent pads are typically 2 feet by 2 feet. Sorbent rolls are approximately the same width as pads and may be 100 ft long. The use of sorbents to remove floating oil is different from the use of skimmers in two ways: (1) the use of sorbents is a passive oil collection technique that requires no mechanized equipment, whereas skimmers may be attached to active vessels for oil collection and (2) sorbents are left temporarily in the affected environment to adsorb oil in a specific locale, whereas skimmers may transit in order to collect oil in a broader area.

Sorbents are most likely to be used to remove floating oil in nearshore environments that contain shallow water. They are often used as a secondary method of oil removal following gross oil removal, such as skimming. Sorbents may be used for all types of oil; lighter oils absorb into the material and heavier oils adsorb onto the surface of sorbent material, requiring sorbents with greater surface area. Retrieval of sorbent material is mandatory, as well as at least daily monitoring to check that sorbents are not adversely affecting wildlife or breaking apart after lengthy deployments. However, sorbent materials generally do not remain in the environment for longer than one day.

9301.1.3 Removal of Floating Oil – Skimmers

The objective of this response action is to recover floating oil from the water surface using mechanized equipment known as skimmers. There are numerous types or categories of skimming devices, including weir, centrifugal, submersion plane, and oleophilic. (1) Weir skimmers use gravity to drain oil from the water surface into a submerged holding tank. Once in the holding tank, oil may be pumped away to larger storage facilities. (2) Centrifugal (also vortex) skimmers create a water/oil whirlpool in which the heavier water forces oil to the center of the vortex. Once in the center, oil may be pumped away from the chamber within the skimmer. (3) Submersion plane skimmers (Figure A-7) use a belt or inclined plane to push the oil beneath the water surface and toward a collection well in the hull of the vessel. Oil is scraped from the surface or removed by gravity and then flows upward into a collection well where it is subsequently removed with a pump. (4) Oleophilic (i.e., having an affinity for oil) skimmers (Figure A-8) may take on several forms (e.g., disc, drum, belt, rope, brush), but the general principle of oil collection remains the same; oil on the surface of the water adheres to a rotating oleophilic surface. Once oil has adhered to the surface it may be scraped off into containers or pumped directly into large storage tanks.

Skimmers are placed at the oil/water interface to recover, or skim, oil from the water surface. Skimmers may be operated independently from shore, be mounted on vessels, or be completely self-propelled. To minimize the amount of water collected incidental to skimming oil, booming may be used in conjunction with skimming to concentrate the floating oil in a wedge at the back of the boom, which provides a thick layer of oil to the skimmer head.

In shallow water, hoses attached to vacuum pumps may be used instead of other skimming devices described earlier in this section. Oil may be removed from the water surface using circular hose heads (4 to 6 inches in diameter); however, this is likely to result in the intake of a large water-to-oil ratio and inefficient oil removal. Inefficient oil removal of this kind may also result in adverse effects to organisms in the surrounding water. In-stead, flat head nozzles, sometimes known as “duckbills” are often attached to the suction end of the hose in order to maximize the contact between the oil and vacuum, minimizing the amount of water that is removed from the environment. Duckbills (very much like an attachment to a vacuum cleaner) are typically 18 inches or less in width and less than 2 inches in height. In other words, duckbills are relatively small and designed for maximizing the amount of oil removed from the water surface relative to the volume of water re-moved. Vacuum hoses may also be attached to small, portable skimmer heads to recover oil they have collected. Adequate storage for recovered oil/water mixtures, as well as suitable transfer capability, must be available. Recovery systems that use skimmers are often placed where oil naturally accumulates: in pockets, pools or eddies.

Skimming can be used in all water environments (weather and visibility permitting) for most oils. The presence of large waves, strong currents, debris, seaweed, kelp, as well as viscous oils, will reduce skimmer efficiency.

Decanting

Efforts are made to minimize the amount of water collected during skimming (as discussed above). However, the collection of water, in addition to oil, may be a reality under some circumstances. Limited storage capacity for oil and water collected through skimming may constrain a response and the removal of floating oil. Decanting is a procedure that can help maximize the use of temporary storage capacity. When decanting is not used, storage limitations may necessitate that the removal of floating oil, either by skimming or vacuuming, is ceased until more storage is available. Decanting is the process of draining off recovered water from portable tanks, internal tanks, collection wells or other storage containers to increase the available storage capacity for recovered oil. The liquid in the tanks is allowed to sit for a sufficient period of time to permit oil to float to the top of the tanks. Water is then drained from the bottom of the tank (stopping in time to retain most of the oil). The water removed from the bottom of the tank is discharged back into the environment, usually in front of the skimmer or back into a boomed area. When decanting is conducted properly, minimal oil is discharged back into the environment. The decanting process is monitored visually to ensure prompt detection of oil discharges in decanted water and that water quality standards set forth in the Clean Water Act are not violated.

Decanting may be allowed because of storage limitations; however, it may not be permitted in all cases. In these cases, The NWACP Decanting Policy addresses "incidental discharges" associated with oil spill response activities. Incidental discharges include, but are not limited to, the decanting of oily water, oil and oily water returns associated with runoff from vessels and equipment operating in an oiled environment and the wash down of vessels, facilities and equipment used in the response. Incidental discharges, as addressed by this policy, do not require additional permits and do not constitute a prohibited discharge. See 33 CFR 153.301, 40 CFR 300, RCW 90.56.320(1), WAC 173-201A-110, ORS 468b.305 (2)(b). However, the NWACP advises the FOSC to consider and authorize the use of decanting on a case-by-case basis, after an evaluation of the environmental tradeoffs of allowing oil to remain in the environment (because of storage limitations) or discharging decanted water. The response contractor or responsible party will seek approval from the FOSC and/or State On-scene Coordinator (SOSC) prior to decanting by presenting the Unified Command with a brief description of the area in which decanting approval is sought, the decanting process proposed, the prevailing conditions (wind, weather, etc.) and protective measures proposed to be implemented. The FOSC and/or SOSC will review such requests promptly and render a decision as quickly as possible. FOSC authorization is required in all cases and, in addition, SOSC authorization is required for decanting activities in state waters.

9301.1.4 In-Situ Burning

The objective of in-situ burning is to remove oil from the water surface or habitat by burning it in place, or in situ. Oil floating on the water surface is collected into slicks a minimum of 2-3 mm thick and ignited. The oil is typically collected in fire-resistant boom that is towed through the spill zone by watercraft, or collected by natural barriers such as the shore. Although in-situ burning may be used in any open water environment, the environment dictates the specific procedure employed in a given burn. For example, in offshore and nearshore marine environments, bays and estuaries, large lakes and large rivers a boom may be towed at 1 knot or less during the burning process in order to maintain the proper oil concentration or thickness. In rivers and small streams, oil carried by currents may be collected and concentrated in stationary boom attached to the shoreline or other permanent structures (e.g., pilings). In small lakes and ponds the body of water may be too small or shallow to tow a boom and there may not be any consistent current. Wind or mechanically generated currents (known as herding) may be used to collect and concentrate oil along the shoreline or in a stationary boom attached to the shoreline.

Once an oil slick is sufficiently thick, an external igniter is used to heat the oil, generating enough vapors above the surface of the oil to sustain a burn. It is these vapors, rather than the liquid oil on the water surface, that actually burn. When enough oil burns, to the point that the remaining oil layer is less that 1-2 mm thick, the fire goes out. The fire is extinguished at this oil thickness because the oil slick is no longer sufficiently thick to provide insulation from the cool water. This insulation is necessary to sustain the heat that produces the vapors, which are subsequently burned. The small quantity of burn residue remaining in the boom is then manually recovered for disposal.

Please note, current air quality standards are based on PM 2.5 rather than PM 10. This section is slated for update in the future.
In-situ burning generates a thick black smoke that contains primarily particulates, soot, and various gases (carbon dioxide, carbon monoxides, water vapor, nitrous oxides and PAHs). The components of the smoke are similar to those of car exhaust. Of these smoke constituents, small particulates less than 10 microns in diameter, known as PM-10, (which can be inhaled deeply into the lungs) are considered to pose the greatest risk to humans and nearby wildlife. For this reason, the In-situ Burn Policy does not allow for pre-approval of in-situ burning within 3 miles of a population, defined as >100 people per square mile (NWACP, Chapter 4000). All other areas are considered on a case-by-case basis. Decisions to burn or not to burn oil in areas considered case-by-case are made on the basis of the potential for humans to be exposed to the smoke plume, and pollutants associated with it. PM-10 exposure is generally limited to 150 micrograms per cubic meter; however, a cap on exposure to PM-10 has been set in the NWACP at 150 micrograms per cubic meter averaged over a 24-hour period (NWACP, Chapter 4641). Smoke plume modeling is done to predict which areas might be adversely affected. In addition, in-situ burning responses require downwind air monitoring for PM-10. Aerial surveys are also conducted prior to initiating a burn to minimize the chance that concentrations of marine mammals, turtles and birds are in the operational area and affected by the response. SMART (Special Monitoring for Advanced Response Technologies) protocols are used. They recommend that sampling is conducted for particulates at sensitive downwind sites prior to the burn (to gather background data) and after the burn has been initiated. Data on particulate levels are recorded and the Scientific Support Team

forwards the data and recommendations to the Unified Command. Readers interested in learning more about SMART protocols can visit the following site: http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/resources/smart.html .

It is possible for as much as 95% of the oil contained in a boom to be burned, depending on the thickness of the initial layer of oil and whether it is possible to ignite the oil. Burning drastically reduces the requirement for waste storage and disposal. Weathered and emulsified oils that contain more than 50% water are extremely difficult to ignite. Therefore, it is important to make the decision to burn within 24-48 hours of the spill. The NWACP requires that trade-offs between the effects of the emissions produced from in-situ burning, such as PAHs, and the contamination that may result from floating oil or oil that washes ashore, are carefully weighed in making the decision to conduct an in-situ burn.

9301.1.5 Chemical Dispersion of Floating Oil

The objective of chemical dispersion is to reduce the impact to sensitive shoreline habitats and animals that use the water surface by chemically dispersing oil into the water column. Dispersants are chemicals that reduce the oil – water interfacial tension, thereby decreasing the energy needed for the slick to break into small droplets and mix into the water column. Specially formulated products containing surface-active agents (surfactants) are sprayed (generally at concentrations of 2-5% by volume of the oil) from aircraft or boats onto the slick. Agitation from wind and waves is required to achieve dispersion. Depending on the level of energy, very small droplets of oil (10 – 100 microns in diameter) are mixed in the upper meter of the water column creating a sub-surface plume. This plume of dispersed oil droplets rapidly (within hours) mixes and expands in three dimensions (horizontal spreading and vertical mixing) down to as much as 10 meters below the surface (Lewis et al. 1998, Lunel 1995, Lunel and Davies 1996, NRC 1989). As a result of this mixing, oil concentrations decrease rapidly from the initial peak concentrations, for example from 10 or 100 ppm down to 1 ppm or less, within hours to a day. Dispersion of oil and actual measurements of dispersed oil concentrations have been conducted and studied in several field studies (Cormack and Nichols 1977, McAuliffe *et al.* 1980, McAuliffe *et al.* 1981, Lichtenthaler and Daling 1985, Brandvick *et al.* 1995, Walker and Lunel 1995, Coelho *et al.* 1995). Dispersed oil concentrations were generally between 1 ppm and 4 ppm within 1 hour after application of the dispersant in all of these studies.

Dispersing oil changes the trajectory of the oil plume from onshore to along-shore, as dispersed oil is no longer transported by the wind. Therefore, oil dispersion may help protect sensitive shoreline environments, as wind usually is the dominant environmental factor that carries floating oil ashore to strand. Dispersants and dispersant applications are rarely 100% effective, however, so some oil will likely remain floating on the water surface.

Due to the relatively short window of opportunity in which oil may be dispersed effectively, the decision to use and deployment of this response technique are time–critical. In order to be used on a spill, a dispersant must be listed on the National Contingency Plan Product Schedule maintained by the U.S. Environmental Protection Agency. Section 4610 outlines the Northwest Area Dispersant Use Policy.

9301.1.6 Barriers/Berms and Inderflow Dams

The objective of the use of barriers/berms and underflow dams is to prevent entry of oil into a sensitive area or to divert oil to a collection area. A physical barrier is placed across an area to prevent moving oil from passing. Oil may be removed using sorbent material (placed in the water where oil is trapped by the barrier), skimmers or vacuums. Barriers can consist of earthen berms, filter fences, boards or other solid barriers. Because of the time and labor required to construct berms, they are likely to be in place for 1 to 5 weeks, depending on the specific event, if the decision is made to implement this response. This response is more likely to be implemented in shallow and small water bodies than deep ones. Earthen berms are fortified with sandbags or geotextile fabric (fabric or synthetic material that enhances water movement and retards soil movement), to minimize the amount of siltation that may be caused as a result of the structure. Silt fences and settling ponds (or a series of them) are used to contain any suspended sediments that may be mobilized in the water while the berm is being constructed in place or being removed. In-stream barriers may be removed using manual or mechanical means, or both, depending on the accessibility of the site, the size of the structure and stream and the sensitivity of the area to the use of heavy machinery.

If it is necessary for water to pass the barrier because of water flow volume or down-stream water needs, underflow dams (for low flow rates) can be used. Underflow dams contain oil with a solid barrier (e.g., boards, earthen berms) at the water level, while a submerged pipe (e.g., PVC or opening along the bottom of the barrier) allows some water to flow beneath and past the barrier (Figure A-9). This response is used in small rivers, streams and drainage ditches or at the entrances to shallow sloughs when the flow of oil threatens sensitive habitats. The importance of maintaining water quality and sufficient flow downstream of barriers is recognized (this response is often used to protect sensitive habitats that are located downstream of the barrier), so these features of affected habitats are monitored. This type of response activity may require permitting and will require coordination with the appropriate trustee agency. Contact the Environmental Unit to determine if any permits are required.

9301.1.7 Vegetation Cutting

The objective of vegetation cutting is the removal of oil trapped in the canopy of kelp beds, to prevent the oiling of wildlife or remobilization of trapped oil. Thick layers of oil may adhere to kelp fronds or collect under the kelp canopy. This response is used in nearshore marine areas along the coasts and in northern Puget Sound. The upper 1 to 2 feet of the kelp canopy is cut away by hand (bull kelp) or with a mechanical kelp harvester (*Macrocystis*). The oiled kelp cuttings are removed for disposal. Trapped tar balls in the kelp are freed and can be manually collected or flushed to a collection site. Vegetation cutting is used when a large quantity of oil is trapped in the kelp canopy and the oil poses a risk to sensitive wildlife using the kelp habitat or when the remobilization of oil to other adjacent sensitive environments is likely to occur. *Macrocystis* kelp plants grow very rapidly and continue to provide protective habitat to marine fishes and invertebrates. Other types of kelp (such as *Nereocystis* or bull kelp) may be more sensitive to cutting and removal. Bull kelp fronds comprise one layer, so cutting may result in loss of protective habitat for associated fishes and invertebrates. If the reproductive cycle is not taken into account, the kelp forest may not return the following spring. Resource experts are routinely consulted relative to these concerns prior to vegetation cutting activities.

9301.2 Shoreline Habitats

The action being analyzed in this biological assessment is comprised of a variety of methods, each of which may be further subdivided into two or more variations. While the effects of each response, and each variation thereof, may be discussed separately, they have been consolidated in a similar process to that followed in the consolidation of shoreline types. For the purposes of this analysis, it makes sense, both in terms on continuity and succinctness, to consolidate response methods that are similar in terms of (1) the habitats in which they are used (e.g., sand beaches, rocky shorelines), (2) the types of effects that may potentially result from them (e.g., increases in water temperature, siltation) and (3) the overall activities associated with each (e.g., boat activity, use of machinery). Each response is described below. Variations of each response are included. While variations of a given response are not typically expected to result in different effects from those described for the response, the inclusion of their descriptions is expected to increase the clarity of this document. Exceptions, in which a variation of a response is expected to result in different or magnified effects to listed species, are noted and discussed in the *Effects Analysis* section of this document.

9301.2.1 Removal of Surface Oil

The objective of this response method is to remove stranded oil on the shoreline while removing minimum amount of sediment. Collected oil is placed in bags or containers and removed from the shoreline. No mechanized machinery is used, with the possible exception of All Terrain Vehicles (ATVs) that may be used to transport containers of collected oil to a staging area for retrieval. ATVs are generally used on sand beaches, and restricted to transiting outside of the oiled areas along the upper part of the beach. The techniques used in the removal of surface oil can be used on most shoreline types, but they are most effective on sand or gravel beaches. Generally, removal of surface oil is not recommended on soft mud substrates where mixing oil deeper into the sediment might occur, unless this activity can take place from a boat when the substrate is under-water. It is most appropriate for light to moderate oiling by medium to heavy oils. Light oils such as gasoline and diesel rapidly evaporate and spread out to very thin layers and are not easily picked up. Removal of surface oil is not recommended for mud flats, be-cause of the potential for mixing the oil down into the soft sediments. For similar reasons, removal of surface oil is typically only used along the edges of sheltered vegetated low riverbanks and marshes, and must be closely monitored.

Best Management Practices for the Removal of Surface Oil

- Removal of surface oil may be used on all shoreline types with the exception of tidal flats; not recommended for these shorelines because of the likelihood of mixing oil deeper into the sediments.
- Cleanup should commence after the majority of oil has come ashore, unless significant burial (on sand beaches) or remobilization is expected; minimize burial and/or remobilization by conducting cleanup between tidal cycles.
- Minimize the amount of sediment removed with the oil.
- Minimize foot traffic through oiled areas on non-solid substrates (sand, gravel, dirt, etc) to reduce the likelihood that oil will be worked into the sediment.
- Restrict foot traffic over sensitive areas* (shellfish beds, salmon redds, algal mats, bird nesting areas, dunes, etc.) to reduce the potential for mechanical damage.
- Shoreline access to specific areas* may be restricted for periods of time to minimize the impact of human presence/excessive noise on nearby sensitive biological populations* (bird nesting, marine mammal pupping, breeding, fish spawning, etc.).
- Separate and segregate any contaminated wastes generated to optimize waste disposal stream and minimize what has to be sent to hazardous waste site.
- Establish temporary upland collection sites for oiled waste materials for large spill events; collection sites should be lined with asphalt pad and surrounded by berms to prevent secondary contamination from run-off.
- Ensure safety of responders by maintaining proper span of control under experienced crew bosses.

*Operations Section will be advised by Planning Section (Environmental Unit).

Three variations of this response exist: (1) manual removal of oil, (2) passive collection of oil (sorbents) and (3) vacuum removal of oil. A brief description of each variation follows.

9301.2.1.1 Manual Removal of Oil

The objective of this variation of the removal of surface oil is to remove oil by using tools such as hands, rakes, shovels, and other manual means. Collected oil is placed in bags or containers and removed from the shoreline. This variation of the response can be used on most shoreline types except for tidal flats where the threat of mixing oil deeper into sediments as a result of foot traffic is typically greater than the benefits gained through use of this variation. Manual removal of oil is recommended for use on (1) sheltered rocky shorelines and man-made structures and (2) sheltered rubble slopes. It is conditionally recommended on (1) exposed rocky shorelines, (2) sand beaches, (3) gravel beaches, (4) sheltered vegetated low banks and (5) marshes.

9301.2.1.2 Passive Collection of Oil (Sorbents)

This variation of the removal of surface oil allows for oil adsorption onto oleophilic ma-terial placed in the intertidal zone or along the riverbank. Sorbent material is placed on the surface of the shoreline substrate, allowing it to adsorb oil as it is released by tidal or wave action. The sorbents most typically used for medium to heavy oils are snares (like cheerleader pompoms) made of oleophilic material; snares are attached at 18-inch inter-vals along a rope that can be tied, anchored or staked along the intertidal shoreline. As the snares are moved about by tidal or wave action, they also help remobilize oil by rubbing across rock surfaces. Snare lines are monitored on a regular basis for their effectiveness at picking up oil, and to collect and replace oiled sorbents with new material. This method is often used as a secondary treatment method after gross oil removal, and along sensitive shorelines where access is restricted. Passive collection with sorbents can also be used in conjunction with other techniques (e.g., flushing, booming) to collect floating oil for recovery. Passive collection of oil using sorbents is recommended for (1) sand beaches, (2) gravel beaches, (3) sheltered rocky shores and man-made structures, (4) sheltered rubble slopes, (5) sheltered vegetated low banks and (6) marshes. It is conditionally recommended on (1) exposed rocky shores and (2) tidal flats.

Best Management Practices for Passive Collection of Oil

- Passive collection of oil using sorbent material may be used on all shoreline types, but is most useful with light to moderate oiling.
- Continually monitor and collect passive sorbent material deployed in the intertidal zone to prevent it from entering the environment as non-degradable, oily debris.
- Monitor passive absorbents placed in the mid- or lower intertidal zone for potential entrapment of small crustaceans; coordinate with Environmental Unit for corrective actions if entrapment is observed.

9301.2.1.3 Vacuum Removal of Oil

The objective of this variation of the removal of surface oil is to remove free oil that has pooled on the substrate. It entails the use of a vacuum unit with a suction head to recover free oil. Equipment can range in size from small portable units that fill individual 55-gallon drums to large “supersuckers” that are truck-mounted and have the capacity to lift large rocks. Supersuckers are primarily used when circumstances (e.g., the length or number of hoses used) necessitate that the suction capacity is great. In other words, suction is reduced with increasing hose length and with a number of the hoses used. In these situations, additional suction capacity may be necessary to make up for these losses. This system can also be used with water spray systems to flush the oil towards the suction head. This response variation is used when free, liquid oil is stranded on the shoreline (usually along the high-tide line) or is trapped in vegetation that is readily accessible. Vacuum removal of oil is not recommended on any shoreline habitat. It is conditionally recommended on (1) exposed rocky shores, (2) sand beaches, (3) gravel beaches, (4) sheltered rocky shores and man-made structures, (5) sheltered rubble slopes, (6) sheltered vegetated low banks and (7) marshes.

Best Management Practices for Vacuum Removal of Oil

- Vacuum removal of oil may be used on any shoreline type where liquid oil has pooled with the exception of tidal flats; not recommended for these shorelines because of poor access and potential for mixing oil deeper into the sediments.
- Closely monitor vacuum operations in wetlands; site specific restrictions* may be required to minimize impact to marsh plant root system which could lead to erosion.

*Operations Section will be advised by Planning Section (Environmental Unit).

9301.2.2 Oiled Debris Removal

The objective of this response is the removal of oiled debris (organic and man-made) from the shoreline. Debris (e.g., seaweed, trash and logs) is removed when it becomes heavily contaminated and when it is either a potential source of chronic oil release, an aesthetic problem or a source of contamination for organisms on the shoreline. If time and resources permit, unoiled, man-made debris (e.g., trash, mooring lines, etc.) may be removed or placed above the high tide line prior to oil reaching a shoreline (based on oil spill trajectory) in order to minimize the amount of oiled debris generated by the spill. Oiled debris removal is recommended for (1) sand beaches, (2) gravel beaches, (3) sheltered rocky shores and man-made structures and (4) sheltered rubble slopes. It is conditionally recommended on (1) exposed rocky shores, (2) tidal flats, (3) sheltered vegetated low banks and (4) marshes.

Best Management Practices for Oiled Debris Removal

- Removal of oily debris may be used on all shoreline types; removal of oily debris from shorelines with soft mud substrates (mudflats, marshes) is usually restricted to debris stranded at the high tide line where debris can be recovered without grinding oil into the substrate.
- Minimize foot traffic through oiled areas on non-solid substrates (sand, gravel, dirt, etc.) to reduce the likelihood that oil will be worked into the sediment.

- Minimize quantity of oiled vegetative debris removed by concentrating on debris that is moderately to heavily oiled; leave lightly oiled and clean stranded seaweed and wood debris in place to provide habitat for small invertebrates and to help stabilize shoreline.
- Restrict foot traffic over sensitive areas* (shellfish beds, salmon redds, algal mats, bird nesting areas, dunes, etc.) to reduce the potential for mechanical damage.
- Shoreline access to specific areas* may be restricted for periods of time to minimize impact of human presence/excessive noise on nearby sensitive biological populations* (bird nesting, marine mammal pupping, breeding, fish spawning, etc.).
- Separate and segregate any contaminated wastes generated to optimize waste disposal stream and minimize what has to be sent to hazardous waste site.
- Establish temporary upland collection sites for oiled waste materials for large spill events; collection sites should be lined with asphalt pad and surrounded by berms to prevent secondary contamination from run-off.
- Ensure safety of responders by maintaining proper span of control under experienced crew bosses.

*Operations Section will be advised by Planning Section (Environmental Unit).

9301.2.3 Trenching/Recovery Wells

The objective of trenching or the use of recovery wells is to remove subsurface oil from permeable substrates. Trenches or wells are dug down to the depth of the oil (or water table) to intercept oil migrating through the substrate. The oil collected in the trench or well is then recovered by vacuum pump or skimmer, and disposed of off site. The oil must be liquid enough to flow at ambient temperatures. Water flooding or flushing the substrate can be used to speed up oil migration into the trench or well. If the trench or well is not deep enough to reach the water table, the bottom must be lined with plastic to prevent oil penetration deeper into the sediment. Trenches are not dug in the lower portions of the beach where attached plants and organisms may be abundant.

Trenching and recovery wells are conditionally recommended for (1) sand beaches, (2) gravel beaches (pebble- to cobble-size substrate) and (3) sheltered vegetated low banks.

Best Management Practices for Trenching and the Use of Recovery Wells

- Trenching and recovery wells may be used on sand and gravel shorelines with grain sizes ranging from fine sand to pebble-size gravel.

- Line the bottom of trenches that do not reach the water table (dry) with plastic to prevent the collected oil from penetrating deeper into the substrate.
- Restrict trenches from the lower intertidal zone where attached algae and organ-isms are abundant.
- Collapse or fill in trenches/well when response action is completed; ensure sides and bottom of trenches are clean before collapsing.
- Minimize foot traffic through oiled areas on non-solid substrates (sand, gravel, dirt, etc.) to reduce the likelihood that oil will be worked into the sediment.
- Restrict foot traffic over sensitive areas* (shellfish beds, salmon redds, algal mats, bird nesting areas, dunes, etc.) to reduce the potential for mechanical damage.
- Shoreline access to specific areas* may be restricted for periods of time to minimize impact of human presence/excessive noise on nearby sensitive biological populations* (bird nesting, marine mammal pupping, breeding, fish spawning, etc.).
- Separate and segregate any contaminated wastes generated to optimize waste disposal stream and minimize what has to be sent to hazardous waste site.
- Establish temporary upland collection sites for oiled waste materials for large spill events; collection sites should be lined with asphalt pad and surrounded by berms to prevent secondary contamination from run-off.
- Ensure safety of responders by maintaining proper span of control under experienced crew bosses.

*Operations Section will be advised by Planning Section (Environmental Unit).

9301.2.4 Removal of Oiled Sediment

The objective of this response is to remove oiled surface sediments. Oiled sediment is removed by either use of hand tools or by use of various kinds of motorized equipment. Oiled sediment removal is restricted to the supratidal and upper intertidal areas to minimize disturbance of biological communities in the lower intertidal and subtidal. After removal, oiled sediments are transported and disposed of off site. New sediments are not typically transported to replace those that were removed; however, a variation of this response that includes sediment replacement (described below) is used for beaches with low natural replenishment rates or high rates of erosion. This method of cleanup is most effective when there is a limited amount of oiled sediment that must be removed. Close monitoring is required so that the quantity of sediment removed, siltation and the likelihood of erosion may be minimized in all cases. Such operations are generally restricted in fish spawning areas. Sensitive areas that are adjacent, and may be potentially affected by released oil sheens, must also be protected.

It should be noted that oiled sediment removal (and removal of adjacent sediment) may be used along riverbanks or other upland areas to prevent oil from leaching into the adjacent aquatic environment. For example, this may be necessary when a tanker truck or rail car overturns and spills oil in an upland area adjacent to a stream. As a primary response, the source of the oil in the environment, including the sediment and/or adjacent soil into which it was spilled, is removed before it has a chance to remobilize into nearby water. The tools used to remove source sediment and/or adjacent soil varies with the scale of the spill and the accessibility of the site; however, both manual and mechanized removal tools are used regularly. In areas that are prone to erosion, contaminated sediment and/or soil that is removed is typically replaced with clean sediment.

Best Management Practices for Removal of Oiled Sediment

- Oiled sediment removal (without replacement) is used primarily on sand beaches not subject to high rates of erosion; small quantities of oiled sediment removal may be permitted on gravel beaches (pebble- to cobble-size gravel or riprap) and sheltered vegetated stream banks.
- Cleanup should commence after the majority of oil has come ashore, unless significant burial (sand beaches) or remobilization is expected; minimize burial and/or remobilization by conducting cleanup between tidal cycles.
- Restrict sediment removal to supra and upper intertidal zones (or above waterline on stream banks) to minimize disturbance of biological communities in lower intertidal and subtidal zones.
- Take appropriate actions to protect nearby sensitive environments* (salmon spawning streams, shellfish bed, nursery areas) from the effects of increased oil runoff/sheening or siltation by the proper deployment of booms, siltation curtains, sorbents, etc.; monitor for effectiveness of protection measures.
- Minimize the amount of oiled sediment removed by closely monitoring mechanical equipment operations.
- Coordinate the locations of any temporary oiled sediment staging or storage sites near the shoreline with the Environmental Unit.
- Minimize vehicle traffic through oiled areas to reduce the likelihood that oil will be worked into the sediment and contamination carried off site by cleanup equipment.
- Restrict foot or vehicular traffic over sensitive areas* (shellfish beds, salmon redds, algal mats, bird nesting areas, dunes, etc.) to reduce the potential for mechanical damage.
- Shoreline access to specific areas* may be restricted for periods of time to minimize impact of human presence/excessive noise on nearby sensitive biological populations* (bird nesting, marine mammal pupping, breeding, fish spawning, etc.).

- Separate and segregate any contaminated wastes generated to optimize waste disposal stream and minimize what has to be sent to hazardous waste site.
- Establish temporary upland collection sites for oiled waste materials for large spill events; collection sites should be lined with asphalt pad and surrounded by berms to prevent secondary contamination from run-off.
- Ensure safety of responders by maintaining proper span of control under experienced crew bosses.

*Operations Section will be advised by Planning Section (Environmental Unit).

Typically, oiled sediment removal is conditionally recommended for (1) sand beaches, (2) gravel beaches, (3) sheltered rubble slopes and (4) sheltered vegetated low banks.

9301.2.4.1 Oiled Sediment Reworking

The objective of this variation of oiled sediment removal is to re-work oiled sediments to break up oil deposits, increase surface area and mix oxygen into deep subsurface oil layers; this activity exposes the oil to natural removal processes and enhances the rate of oil degradation. Oiled sediment is not removed from the beach. Instead, beach sediments are rototilled or otherwise mechanically mixed with the use of heavy equipment. The oiled sediments in the upper beach area may also be relocated to the mid-tidal portion of the beach. Relocation enhances natural cleanup during reworking by wave activity. This procedure is also known as surf washing, or berm relocation. Generally, sediment reworking is used on sand or gravel beaches where high erosion rates or low natural sediment replenishment rates are issues. Sediment reworking may also be used where remoteness or other logistical limitations make sediment removal unfeasible. Sediment reworking is not used on beaches near shellfish harvest or fish spawning areas because of the potential for release of oil or oiled sediments into these sensitive habitats. Sediment reworking is conditionally recommended for (1) sand beach and (2) gravel beach habitats.

Best Management Practices for Oiled Sediment Reworking

- Oiled sediment reworking (rototilling) breaks up oil crusts or aerates light surface oiling is used primarily on sand or mixed sand and gravel beaches, especially those prone to erosion.
- Berm relocation or surf washing may be used on sand, mixed sand and gravel, or gravel (pebble- to cobble-size) beaches exposed to at least moderate wave energy.
- Restrict rototilling to mid- and upper-intertidal zones to minimize disturbance of biological communities in lower intertidal and subtidal zones.

- Restrict berm relocation/surf washing in vicinity of sensitive environments* (salmon spawning streams, shellfish bed, nursery areas, etc.) to prevent adverse effects from increased oil runoff/sheening or siltation.

*Operations Section will be advised by Planning Section (Environmental Unit).

9301.2.4.2 Oiled Sediment Removal with Replacement

The objective of this response variation is to remove oiled sediment and replace it with cleaned or new material. Oiled sediments are excavated using heavy equipment on the beach at low tide. After removal of the oiled sediment, new clean sediment of similar composition is brought in for replacement. The oiled sediment may also be cleaned and then replaced on the beach. The sediments are loaded into a container for washing. Cleansing methods include a hot water wash or physical agitation with a cleaning solution. After the cleansing process, the rinsed materials are returned to the original area. Cleaning equipment must be placed close to beaches in order to reduce transportation problems. This variation is conditionally recommended on (1) sand beaches, (2) gravel beaches and (3) sheltered rubble slopes, although the beaches must be exposed to wave activity so the replaced sediments can be re-worked into a natural distribution.

Best Management Practices for Oiled Sediment Removal and Replacement

- Oiled sediment removal (with replacement) is used primarily on sand, mixed sand and gravel, gravel, and vegetated stream bank shorelines subjected to high rates of erosion.
- Restrict sediment removal and replacement to supra and upper intertidal zones (or above waterline on stream banks) to minimize disturbance of biological communities in lower intertidal and subtidal zones
- Take appropriate actions to protect nearby sensitive environments* (salmon spawning streams, shellfish bed, nursery areas) from the effects of increased oil runoff/sheening or siltation by the proper deployment of booms, siltation curtains, sorbents, etc.; monitor for effectiveness of protection measures.
- Coordinate the locations of any temporary oiled sediment staging or storage sites near the shoreline with the Environmental Unit.

*Operations Section will be advised by Planning Section (Environmental Unit).

9301.2.5 Flushing with Ambient (temperature, salinity) Water

The objective of ambient water flushing is to remobilize oil stranded on surface substrate, as well as oil from crevices and rock interstices, to water’s edge for collection. Water is pumped from hoses onto an oiled beach, beginning above the highest level where the oil is stranded and slowly working down to the water level. The flow of water remobilizes oil stranded on the surface sediments and flushes it down to water's edge. The remobilized oil is contained by boom and recovered for disposal. Increased water pressure may be needed to assist in the remobilization as the oil weathers and begins to harden on the substrate. Because of the potential for higher pressures to cause siltation and physical disruption of the softer substrates, flushing with higher pressures is restricted to rock or hard man-made substrates.

Intake and outflow hoses may range from 2 – 4 inches in diameter and, depending on the pump used, pump between 200 and 400 gallons of water per minute. Intake hoses are fitted with screens to minimize the extraction of debris, flora and fauna. Screen holes generally range from 0.25 inch to 1 inch in diameter, depending on the environment from which the water is being pumped. Intake hoses are propped off bottom using rebar in about 3 feet of water to further minimize the amount of sediment and debris, and the number of organisms, taken into the hose and pump.

Best Management Practices for Ambient Water Flushing

- Cleanup should commence after the majority of oil has come ashore, unless significant burial (sand beaches) or remobilization is expected; minimize burial and/or remobilization by conducting cleanup between tidal cycles.
- Protect sensitive nearby environments* (salmon spawning streams, shellfish bed, submerged aquatic vegetation, nursery areas, etc.) from the effects of increased oil runoff by the proper deployment of booms, sorbents, etc.; monitor for effective-ness of protection measures.
- Restrict foot or vehicular traffic over sensitive areas* (shellfish beds, salmon redds, algal mats, bird nesting areas, dunes, etc.) to reduce the potential for mechanical damage.
- Shoreline access to specific areas* may be restricted for periods of time to minimize impact of human presence/excessive noise on nearby sensitive biological populations* (bird nesting, marine mammal pupping, breeding, fish spawning, etc.).
- Ensure safety of responders by maintaining proper span of control under experienced crew bosses.

*Operations Section will be advised by Planning Section (Environmental Unit).

9301.2.5.1 Flooding (Deluge)

The objective of this variation of ambient water flushing is to mobilize stranded oil from rock crevices and interstices. Ambient water is pumped through a header pipe at low pressure above and inshore from the fouled area of shoreline. The pipe is meant to create a sheet of water that simulates tidal washing over the affected area. Removing stranded oil may be particularly important when a more sensitive habitat is nearby and in danger of becoming fouled with oil after the intertidal zone is washed over the next tidal cycle, remobilizing oil. The effects of flooding may also be desired when a spring tide has de-posited oil above the normal high water mark or when the wave energy of the adjacent water is not great enough to sufficiently wash the affected area over the following tidal cycle. After oil has been loosened from the substrate it is collected and removed using a variety of mechanical, manual and passive methods. Ambient water flooding is recommended for use on gravel beaches. Ambient water flooding is conditionally recommended for the following habitats: (1) sand beaches, (2) sheltered rocky shorelines and man-made structures, (3) sheltered rubble slopes, (4) sheltered vegetated low banks and (5) marshes.

Best Management Practices for Ambient Water Flooding

- Ambient water flooding (deluge) could be used on all shoreline types with the exception of fine- to coarse-grained sand beaches. Use in this habitat could mobilize contaminated sediment into the environmentally sensitive subtidal zone or cause excessive siltation.
- Closely monitor flooding of shorelines with fine sediments (mixed sand and gravel, sheltered rubble, sheltered vegetative banks, marshes) to minimize excessive siltation or mobilization of contaminated sediments into the subtidal zone.
- Ambient water flooding is not generally useful on exposed rocky shorelines or submerged tidal flats because these areas are naturally well flooded.

9301.2.5.2 Ambient Water, Low-Pressure Flushing

The objective of this variation of ambient water flushing is to mobilize liquid oil that has adhered to the substrate or man-made structures, pooled on the surface, or become trapped in vegetation to the water’s edge for collection. Low-pressure washing (<50 psi) with ambient seawater sprayed through hoses is used to flush oil to the water’s edge for pickup. Oil is trapped by booms and picked up with skimmers or sorbents. This variation may also be used in concert with ambient water flooding, which helps move the oil without the potential effects associated with higher water pressures. Low-pressure flushing is conditionally recommended for (1) exposed rocky shores, (2) sand beaches with coarser sediments (mixed sand and gravel), (3) gravel beaches, (4) sheltered rocky shore-lines and man-made structures, (5) sheltered rubble slopes, (6) sheltered vegetated low banks and (7) marshes.

Best Management Practices for Ambient Water, Low-pressure Flushing

- Ambient water, low-pressure flushing could be used on all shoreline types with the exception of sand beaches (fine- to coarse-grained) and mud flats (exposed or sheltered).
- Flushing on exposed rocky shorelines may be hazardous to response personnel; ensure presence of adequate safeguards and monitoring to ensure personnel safety.

- Prevent pushing or mixing oil deeper into the sediment by not directing the stream of water directly into the oil; direct hoses to place stream of water above or be-hind the surface oil to create a sheet of water to re-mobilize and carry oil down the beach to a containment area for recovery.
- Closely monitor flushing of shorelines with fine sediments (mixed sand and gravel, sheltered rubble, sheltered vegetative banks, marshes) to minimize excessive siltation or contaminated sediments mobilization into the subtidal zone.
- Restrict flushing in marshes from boats or on shore above the high tide line during high tide to minimize mixing oil into the sediments or mechanically damaging the marsh plants.

9301.2.5.3 Ambient Water, High-Pressure Flushing

The objective of this variation of ambient water flushing is to mobilize oil that has adhered to hard substrates or man-made structures to the water's edge for collection. It is similar to low-pressure washing except the water pressure may reach 100+ psi, and it can be used to flush floating oil or loose oil out of tide pools and between crevices on riprap. Compared to the lower pressure spray, high-pressure spray will more effectively remove oil that has adhered to rocks. Because water volumes are typically low, this response method may require the placement of sorbents directly below the treatment area or the use of a deluge to carry oil to the water's edge for collection. High-pressure flushing is conditionally recommended for (1) exposed rocky shores, (2) gravel beaches, particularly those consisting of cobble- and boulder-size rocks, and riprap, (3) sheltered rocky shorelines and man-made structures and (4) sheltered rubble slopes.

Best Management Practices for Ambient Water, High-pressure Flushing

- Ambient water, high-pressure flushing may be used on rocky (exposed and sheltered) and riprap shorelines.
- Flushing on exposed rocky shorelines may be hazardous to response personnel; ensure presence of adequate safeguards and monitoring to ensure personnel safety.
- Prevent pushing or mixing oil deeper into the riprap by not directing the stream of water directly into the oil; direct hoses to place stream of water above or behind the surface oil to create a sheet of water to re-mobilize and carry oil down to a containment area for recovery.
- If small volumes of high-pressure water are used to remobilize weathered oil from rocky surface, include larger volume of low-pressure water to help carry remobilized oil into containment area for recovery.

9301.2.6 Warm Water, Moderate-Pressure Washing

The objective of warm water, moderate-pressure washing is to mobilize thick and weathered oil that has adhered to rock surfaces, prior to flushing it to the water's edge for collection. Seawater is heated (typically between the ambient temperature and 90°F) and applied at moderate pressure to mobilize weathered oil that has adhered to rocks. If the warm water is not sufficient to flush the oil down the beach, flooding or additional low- or high-pressure washing may be used to float the oil to the water's edge for pickup. Oil is then trapped by boom and may be picked up with skimmers or sorbents.

Warm water, moderate-pressure washing is conditionally recommended for (1) exposed rocky shores, (2) gravel beaches (including riprap) and (3) sheltered rocky shorelines and man-made structures. One variation of the response exists: hot water, moderate-pressure washing (described below).

Best Management Practices for Warm Water, Moderate-pressure Washing

- Warm water, moderate-pressure flushing may be used on heavily oiled gravel beaches, riprap and hard, vertical, manmade structures such as seawalls, bulk-heads and docks.
- Restrict use to certain tidal elevations so that the oil/water effluent does not drain across sensitive low-tide habitats (damage can result from exposure to oil, oiled sediments and hot water).
- Flushing on exposed rocky shorelines may be hazardous to response personnel; ensure presence of adequate safeguards and monitoring to ensure personnel safety.
- If small volumes of warm water are used to remobilize weathered oil from rocky surface, include larger volume of ambient water at low-pressure to help carry re-mobilized oil into containment area for recovery.
- Cleanup should commence after the majority of oil has come ashore.
- Protect nearby sensitive environments* (salmon spawning streams, shellfish bed, submerged aquatic vegetation, nursery areas, etc.) from the effects of increased oil runoff by the proper deployment of booms, sorbents, etc.; monitor for effective-ness of protection measures.
- Restrict foot traffic over sensitive areas* (shellfish beds, salmon redds, algal mats, bird nesting areas, dunes, etc.) to reduce the potential for mechanical damage.
- Shoreline access to specific areas* may be restricted for periods of time to minimize impact of human presence/excessive noise on nearby sensitive biological populations* (bird nesting, marine mammal pupping, breeding, fish spawning, etc.).
- Ensure safety of responders by maintaining proper span of control under experienced crew bosses.

*Operations Section will be advised by Planning Section (Environmental Unit).

9301.2.6.1 Hot Water Moderate-Pressure Washing

The objective of this variation of warm water, moderate-pressure washing is to dislodge and mobilize trapped and weathered oil from inaccessible locations and surfaces not amenable to mechanical removal, prior to flushing oil to water's edge for collection. Water heaters are mounted on offshore barges or on small land-based units. The water is heated to temperatures from 90°F to 170°F, which is usually sprayed in small volumes by hand using moderate-pressure wands. Used without water flooding, this procedure re-quires immediate use of vacuums (vacuum trucks or super suckers) to remove the oil/water runoff. With a deluge system, the oil is flushed to the water's edge for collection with skimmers or sorbents. This response is generally used when the oil has weathered to the point that even warm water at high pressure is ineffective for the removal of adhered oil, which must be removed due to the threat of continued release of oil or for aesthetic reasons. Hot water washing is conditionally recommended for (1) exposed rocky shores, (2) gravel beaches (specifically riprap) and (3) sheltered rocky shorelines and man-made structures

Best Management Practices for Hot Water, Moderate-pressure Washing

- Hot water, moderate-pressure flushing is used only on heavily oiled hard, man-made structures such as seawalls, bulkheads, docks and riprap, primarily for aesthetic purposes.
- Restrict use to certain tidal elevations so that the oil/water effluent does not drain across sensitive low-tide habitats (damage can result from exposure to oil, oiled sediments and hot water).
- If small volumes of hot water are used to remobilize weathered oil from rocky surface, remobilized oil must be recovered using sorbent material at the base of the structure; or a second stream with ambient water can be used to flush the remobilized oil to the water's edge for recovery.

9301.2.7 Vegetation Cutting

The objective of vegetation cutting is the removal of oiled vegetation attached to the shoreline to prevent the oiling of wildlife or remobilization of trapped oil. Thick layers of oil may adhere to plant leaves or pool on the substrate under a layer of overlapping plant leaves. The upper parts of the oiled plant are cut away using hand tools or "weed eater" type power tools. The oiled plant cuttings are raked up and removed for disposal. Any remaining oil pooled around the roots/stems can then be flushed out for recovery. These attached plants provide protective habitat to fish and invertebrate species, so cutting of this type will result in a temporary loss of habitat. Cut vegetation may or may not recover depending on the reproductive cycle of the plant and whether the plant roots are oiled or damaged in the cutting operation. Resource experts are routinely consulted prior to initiating vegetation cutting. This response method is generally used when large quantities of potentially mobile oil is trapped in the vegetation or when the risk of oiled vegetation contaminating wildlife is greater than the value of the vegetation that is to be cut, and there is no less destructive method to remove the oil. When conducted in marshes, boards are generally laid down for workers to walk; this distributes the worker's weight to prevent damage to plant root system and to avoid working oil deeper into the soft sediments. This response is conditionally recommended for (1) exposed rocky shore-lines, (2) gravel beaches, (3) sheltered rocky shorelines and man-made structures, (4) sheltered rubble slopes, (5) sheltered vegetated low banks and (6) marshes.

Best Management Practices for Vegetation Cutting

- Vegetation cutting may be used on marsh, rock, gravel (boulder/riprap) and vegetated riverbanks.
- Cleanup should commence after the majority of oil has come ashore.
- Minimize mechanical impacts on vegetation being cut by taking appropriate actions* to ensure continued health and survival of vegetative ecosystem.
- Minimize foot traffic through oiled areas on non-solid substrates (sand, gravel, dirt, etc.) to reduce the likelihood that oil will be worked into the sediment.
- Restrict foot traffic over sensitive areas* (shellfish beds, salmon redds, algal mats, bird nesting areas, dunes, etc.) to reduce the potential for mechanical damage.
- Shoreline access to specific areas* may be restricted for periods of time to minimize impact of human presence/excessive noise on nearby sensitive biological populations* (bird nesting, marine mammal pupping, breeding, fish spawning, etc.).
- Separate and segregate any contaminated wastes generated to optimize waste disposal stream and minimize what has to be sent to hazardous waste site.
- Establish temporary upland collection sites for oiled waste materials for large spill events; collection sites should be lined with asphalt pad and surrounded by berms to prevent secondary contamination from run-off.
- Ensure safety of responders by maintaining proper span of control under experienced crew bosses.

*Operations Section will be advised by Planning Section (Environmental Unit).

9301.2.8 Nutrient Enhancement

The objective of nutrient enhancement is to increase the rates of natural degradation of oil by adding nutrients (specifically nitrogen and phosphorus). Microbial biodegradation is the conversion by microorganisms of hydrocarbons into oxidized products via various enzymatic reactions. Some hydrocarbons are converted into carbon dioxide and cell material, while others are partially oxidized or left unaltered as a residue. Nutrients are applied to the shoreline using one of several methods: (1) soluble inorganic formulations are dissolved in water and applied as a spray at low tide, requiring frequent applications; (2) slow-release formulations are applied as a solid to the intertidal zone and designed to slowly dissolve; and (3) oleophilic formulations that adhere to the oil itself and are sprayed directly on the oiled areas. This response method is limited to shorelines and adjacent water bodies, which are well flushed, minimizing the potential for nutrient runoff that may cause significant eutrophication. Nutrient enhancement is conditionally recommended on (1) sand beaches, (2) gravel beaches, (3) sheltered rubble slopes and (4) marshes.

Nutrient enhancement requires RRT approval on a case-by-case basis, as well as the development of a detailed operations and monitoring plan.

9301.3 Motorized Transportation/Support of Response Actions

Several of the open water and shoreline responses described in sections 2.1.2 and 2.1.5, respectively, may require the use of machinery in support of the response, or for transport of personnel. The responses that may use equipment are noted in their descriptions; how-ever, the use of boats and other watercraft, planes, helicopters and ATVs warrants further discussion. The use of these machines is described in this section, while the potential effects of their use are discussed separately in *Effects Analysis* sections 5.1.1 and 5.1.2 of this biological assessment.

9301.3.1 Boats and Other Watercraft

Boats and other watercraft (e.g., hovercraft, wave runners, and barges) may be used in open water and shoreline responses. The use of these resources varies depending on the specific response. However, they may be used as a component of the response itself (e.g., skimmers, platforms for applying dispersants, deploying or collecting boom), or as a mode of transportation to and from remote locations for response personnel (e.g., removal of surface oil). As a result, boats and other watercraft may be used in shallow or deep water, nearshore or offshore, fresh water or marine environments, etc. The GRPs outline boat and watercraft use restrictions within 200 yards of offshore National Wildlife Refuge sites or other sensitive areas. As a standard practice, the response organization immediately requests a waiver from the Services (National Marine Fisheries Service [NMFS] and/or USFWS) regarding approaching or hazing marine mammals inadvertently during open water response operations.

9301.3.2 Airplanes

Planes may be used in open water and shoreline responses. The use of planes depends on the specific response. However, they may be used as a component of the response itself (e.g., platforms for applying dispersants, directing on-water recovery operations), or as a part of pre- or post-response monitoring (e.g., wildlife surveys). As a result, planes may be used over any aquatic or terrestrial environment. However, flight restriction zones have been designated by the GRPs as a precaution against disturbing wildlife species (e.g., marine mammal rookery, bird breeding colony). Year-round restrictions may be imposed in some locations; however, restrictions are more likely to be imposed only during times of year in which species have been identified as most sensitive.

Typically, the area within a 1,500 ft radius and below 1,000 ft in altitude is restricted to flying in areas that have been identified as sensitive. However, some areas have more restrictive zones, such as the Olympic Coast National Marine Sanctuary and Olympic National Park. In addition to restrictions associated with wildlife, Tribal authorities may also request notification when overflights are likely to affect culturally sensitive areas within reservations.

9301.3.3 Helicopters

Helicopters may be used in open water and shoreline responses. The use of helicopters depends on the specific response. However, they may be used as a component of the response itself (e.g., platforms for igniting floating oil, directing skimming operations, transporting workers), or as a part of pre- or post-response monitoring (e.g., wildlife surveys). As a result, helicopters may be used over any aquatic or terrestrial environment. However, flight restriction zones have been designated by the GRPs as a precaution against disturbing wildlife species (e.g., marine mammal rookery, bird breeding colony). Year-round restrictions may be imposed in some locations; however, restrictions are more likely to be imposed only during times of year in which species have been identified as most sensitive (e.g., during the breeding season).

Typically, the area within a 1,500 ft radius and below 1,000 ft in altitude is restricted to flying in areas that have been identified as sensitive. However, some areas have more restrictive zones, such as the Olympic Coast National Marine Sanctuary and Olympic National Park. In addition to restrictions associated with wildlife, Tribal authorities may also request notification when overflights are likely to affect culturally sensitive areas within reservations.

9301.3.4 All Terrain Vehicles

ATVs may be used in support of open water and shoreline responses. The use of ATVs is often dependent upon the accessibility of the site (e.g., proximity of roads) to this kind of equipment and the type of shoreline in which they are to be used. It is possible to use ATVs on any accessible shoreline type in which an ATV can safely be driven; however, some shoreline types (e.g., marshes, vegetated low banks) are more sensitive to the use of motorized equipment (as well as human foot traffic) than other shoreline types, both in the presence and absence of oil. For example, it is recognized that the use of ATVs may adversely affect particular unoiled shoreline habitats that are susceptible to erosion. Some oiled shoreline types, such as marshes, are particularly vulnerable to the introduction and mixing of oil into subsurface sediments. As a result of these concerns relating to shoreline damage, care is taken to weigh the tradeoffs of ATV use on a particular shore-line type, whether oiled or unoiled. Therefore, in a practical sense, ATV use may be limited to those situations in which it is judged that the benefits of using ATVs outweigh any potential adverse effects of their use.

Generally, ATVs are used on sand beaches, and restricted to transiting outside of the oiled areas along the upper part of the beach. The decision process for use of ATVs near sensitive aggregations of wildlife (e.g., sea lion rookery) is similar to that described for shoreline habitats discussed above. ATVs may be used for a variety of purposes, including the transportation of response personnel and for the collection and disposal of oil, oiled sediments or oiled debris in support of response activities in nearshore open water and on shorelines.