INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Sand and Gravel Beaches/Sand Bar

I. Habitat Description

Beaches: areas infrequently flooded with nonvegetated sand or gravel. It typically includes sand spoil banks, beaches, and other sandy areas that are upland. This general class may have small inclusions of grasses or forbs (<10%), trees (<10%), or shrubs (<25%).

Sand Bar: areas that are temporarily flooded and exposed with nonvegetated sand flats. They are typically found in or near the main channel and are often associated with wing dams, shorelines, and islands. Sand bars may become exposed due to low water levels. This general class may have small incursions of grasses or forbs (<10%) or shrubs (<25%), but usually does not support plant life.

Beach on Mississippi River. Image: Washington University, St. Louis

II. Sensitivity to Oil Spills

Due to lack of vegetation and low biodiversity, sand and gravel beaches and sand bars are moderately sensitive to oil spills. However, oil can stick to sand, and has the ability to flow downward in spaces between sand grains and gravel, accumulating in lower levels, making recovery more difficult and increasing the chance of groundwater contamination. Beaches and sandbars are also ideal nesting and foraging habitat for a variety of shorebirds, including the endangered interior population of Least Tern (*Sternula antillarum*) and the threatened Piping Plover (*Charadrius melodus*). These areas are also popular recreation sites and exposure to oil may have significant socioeconomic impacts.

Emergent sandbar habitat for Least Terns on the Missouri River. Image: USACE

Least Tern and nest. Image: USFWS

Piping Plover. Image: Cornell Lab

References/Additional Information:

General Classification Handbook for Floodplain Vegetation in Large River Systems (http://pubs.usgs.gov/tm/2005/tm2A1/)

Inland Oil Spills: Options for Minimizing Environmental Impacts for Freshwater Spill Response (http://www.michigan.gov/documents/deq/deq-wb-wws-FreshwaterResponse_NOAA102706_265069_7.pdf)

USACE Missouri River Recovery Program (http://moriverrecovery.usace.army.mil/mrrp/f?p=136:132:0::NO:::)

Understanding Oil Spills and Oil Spill Response Chapter 4: Shoreline Cleanup of Oil Spills (http://www.epa.gov/osweroe1/docs/oil/edu/oilspill_book/chap4.pdf)

Information compiled by UMRBA staff from NOAA, USFWS, and U.S. EPA sources, March 2016.

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Sand and Gravel Beaches/Sand Bar

Beach Type	Grain Size
Pebble-Cobble	2-256 mm (0.078-10.07 in.)
Mixed sediment/sand- gravel	0.1-64 mm (0.0039-2.52 in.) and cobbles up to 256 mm (10.07 in.)
Sand	0.1-2 mm (0.0039-0.078 in.)

III. Sensitivity to Response Methods

The following text describes potential adverse impacts to this habitat resulting from various oil spill response methods and provides recommendations to reduce impact when these methods are implemented. This is not intended to preclude the use of any particular methods, but rather to aid responders in balancing the need to remove oil with the possible adverse effects of removal. More detail about the response methods themselves can be found in the Inland Response Tactics Manual.

Least Adverse Habitat Impacts

Sorbents

- Physical removal rates of lighter oil will be fastest, so more oil will be mobilized for recovery by sorbents
- Forcing contact between pads and the oil drives the oil into the sand
- Overuse generates excessive waste
- Snare and pom-poms are used along shorelines or in light sheen situations
- Most effective on sand beaches

Low-Pressure, Ambient-Water Flushing

- If water pressures are too high, the substrate may be disturbed and oil may be pushed into lower levels of sediment
- Effectiveness increases with lighter oils because less residual oil is left in the environment
- Most effective on pebble-cobble or mixed sediment beaches

Hand Tool Oil Removal/Cleaning

- Used where persistent oil occurs in heavy amounts and where sensitive resources are likely to be oiled
- Raking may driver oil into lower levels of sediment.
- This includes removal of surface soil contamination not gross digging

Some Adverse Habitat Impact

Vacuum

- Most effective where access is good and substrate can support vehicles
- Only useful when oil is pooled
- Can be used in combination with flooding to pool oil

Light Equipment Oil Removal

- Mixing of oil and disturbance of sediments may be reduced by controlling access routes or using boards placed on surface
- Needed to remove heavy debris and dead trees

Most Adverse Habitat Impact

Heavy Equipment Oil Removal

- Mixing of oil and disturbance of sediments may be reduced by controlling access routes or using boards placed on surface
- Needed to remove heavy debris and dead trees

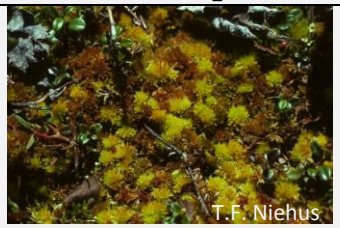
Sediment Removal

- Vacuum/dredge sediments and dewater using geotube/settling tank. Treat the water and dispose of sediment.
- Excavate the sediment. Dewater the area before excavation.
- The hydrology may change and it may be difficult to restore conditions that existed prior to the spill incident.
- Permits will be required for sediment removal and for water discharge.

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Bog

Indicator Species



Sphagnum Moss
Sphagnum spp.

Sundew
Drosera spp.

Bog Laurel
Kalmia spp.

Tussock Sedge
Carex spp.

I. Habitat Description

A bog is a distinctive type of freshwater wetland that accumulates peat derived from sphagnum moss. Due a lack of inflows and outflows, and the impermeability of the peat layer, most bogs receive nearly all of their water from surface rather than ground water. Wet conditions and low oxygen levels contribute to slow decay of organic material, resulting in layers of peat that can be meters deep. Punctuated by the occasional spruce (*Picea*) and tamarack (*Larix*), they are nutrient poor as a result of these acid forming peat deposits. Despite these limiting factors, bogs are composed of unique plant communities. These may include carnivorous plants such as the sundew (*Drosera*) and pitcher plant (*Sarracenia*), ericaceous shrubs, and sedges (*Carex*), making those important sites of biodiversity.

Shrubby blanket bog in northern Minnesota

Quaking bogs often form at the edges of acidic lakes

II. Sensitivity to Oil Spills

Bogs take millennia to form, and consequently are highly sensitive to damage resulting from oil spills. Poor drainage allows oil to accumulate and persist in layers of organic material. In drier hydrologic regimes, peat deposits are highly absorbent of hydrocarbons, making it difficult for clean-up without removing this valuable material which provides vital substrate for rare plant and animal communities. Light refined oils with high amounts of water-soluble fractions can cause acute mortality to animals and plants. Heavier oils tend to coat vegetation, which may survive if oil coats only the stems or if the roots are unaffected. It is difficult for thicker oils to penetrate densely vegetated areas.

References/Additional Information:

General Classification Handbook for Floodplain Vegetation in Large River Systems (http://pubs.usgs.gov/tm/2005/tm2A1/)
Inland Oil Spills: Options for Minimizing Environmental Impacts for Freshwater Spill Response (http://www.michigan.gov/documents/deq/deq-wb-wws-FreshwaterResponse_NOAA102706_265069_7.pdf)
NatureServe (natureserve.org)
Natural Wetland Inventory (http://www.fws.gov/wetlands/)
The U.S. National Vegetation Classification (http://usnvc.org/)
Wetland Plants and Plant Communities of MN & WI, 3rd Edition (http://www.bwsr.state.mn.us/wetlands/delineation/WPPC_MN_WI/index.html)

Information compiled by UMRBA staff from NOAA, USACE, USFWS, USGS, and U.S. EPA sources, March 2017.

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:
Bog

III. Sensitivity to Response Methods

The following describes potential adverse impacts to this habitat resulting from various oil spill response methods and provides recommendations to reduce impact when these methods are implemented. This is not intended to preclude the use of any particular methods, but rather to aid responders in balancing the need to remove oil with the possible adverse effects of removal. More detail about the response methods themselves can be found in the Inland Response Tactics Manual.

Least Adverse Habitat Impacts

Exclusion or Deflection Booming

- Boom can be used to exclude or deflect the spill away from sensitive resources.
- Effectiveness is increased by positioning boom at appropriate angles for the current speed.

Sorbents/Sorbent Boom

- In areas with vegetation at or above water, sorbents are most effective in water surrounding vegetation (as opposed to within/on top of vegetated areas).
- Care is necessary during placement and recovery to minimize disturbance of vegetation.
- Pom-pom type sorbents are best for heavy viscous oils that coat the strands; sorbent boom is best for light, low-viscosity oils that can penetrate into the sorbents.
- Sorbent boom must be changed frequently to prevent it from becoming a source of sheen.

Flooding

- This tactic is only applicable in areas where the water level can be controlled, such as near locks and dams or in a small pond/marsh. Contact the U.S. Army Corps of Engineers water control regarding lock and dam operation.
- Can be used selectively to remove localized heavy oiling This tactic is useful to remove oil trapped in vegetation, which can otherwise be difficult to herd toward recovery devices in open water. However, some oil may remain stranded in vegetation and will need to be removed through other means.

Low-Pressure, Ambient-Water Flushing

- Maintain low output pressures (less than 50 psi) to avoid disrupting the substrate and vegetation.
- Effectiveness increases with lighter oils because less residual oil is left in the environment.
- This tactic can be used with flooding to prevent re-deposition of oil.
- Use for spot removal of oil because of the limited area of effectiveness.

In-Situ Burning

- Presence of a water layer and peat can protect plant roots.
- "Heavy ends" of petroleum product remain unburned and must be recovered. This residue will sink once it is cool.
- The amount and placement of natural fuel in the surrounding area may present challenges to constraining the fire only to oiled areas.
- Authorization of in-situ burning is subject to RRT approval, consultation and concurrence from the state and the Department of the Interior.
- May be one of the least physically damaging means of moderate and heavy oil removal as it leaves plant roots intact.
- May be difficult to protect riparian vegetation.

Collection by Direct Suction

- Adverse impact can be mitigated by limiting vehicles, hoses, and equipment to staging areas with firm substrate and sparse vegetation. If equipment must access other areas, precautions should be taken to avoid driving oil into sediment or softer substrate, and trampling vegetation. For example: limit access routes through the area; walk, drive, and station equipment on mats or boards instead of directly on top of vegetation; use boats in flooded areas; and use a helicopter to bring in equipment to areas that are difficult to access.
- Only useful where oil is thickly pooled (not appropriate for sheens).

Debris/Vegetation Removal

- Most appropriate for oils that form a persistent, thick, sticky coating on the vegetation, such as medium and heavy oils.
- Removal will release trapped oil and speed natural flushing rates.
- Debris may be associated with nests or living areas (e.g., beaver and muskrat lodges), therefore impacts on resident animal habitat need to be considered.
- If oil is trapped in floating vegetation, removal may be the only way to recover the oil in the absence of water currents.
- May be appropriate to prevent secondary oiling of wildlife.
- Damage by cleanup crews may be reduced by avoiding excessive cutting/removal.
- Response crews entering the marsh can inadvertently trample vegetation during cleanup/removal. To reduce this impact: control and minimize access routes through the marsh; have personnel stand or kneel on boards while working; and conduct operations from boats when possible.

Some Adverse Habitat Impact

Natural Attenuation/Phytoremediation

- Because bogs contain many rare plant communities, leaving oiled plants could harm birds and other wildlife that come to the marsh to feed. If that is not an issue, this tactic has few adverse effects.
- Lesser impact for small to moderate spills and lighter oils; avoids damage often associated with cleanup activities.
- Cleanup should be used in addition to attenuation in areas where using only attenuation would put sizable wildlife populations as risk for becoming oiled or re-oiled.

Most Adverse Habitat Impact

Light Equipment Oil Removal

- Damage to vegetation and substrate may be reduced by controlling access routes, using pontoons or mats, or using a helicopter to bring in equipment.
- May be needed where oil has heavily contaminated bottom sediments.

Peat/Sediment Removal

- Vacuum/dredge sediments and dewater using geotube/settling tank. Or, where feasible, dewater area and excavate the sediment
- Significant sediment removal may result in a change in the area's hydrology as well as make it difficult to fully restore the plant community that existed prior to the spill incident.
- Removal of peat may lead to irrevocable damage to bog habitat.
- Permits will be required for sediment removal and for water discharge.

DRAFT INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:
DEEP MARSH ANNUALS (DMA)

I. Habitat Description

Deep Marsh Annuals (DMA) represents portions of lakes, ponds, marshes, or backwaters that are >10% vegetated with wild rice (*Zizania*). This general class is dominated by wild rice, but may have inclusions of submersed, nonrooted-floating aquatics, rooted-floating aquatics, or emergent vegetation. It is typically found growing between water depths of 0.25 and 2 m with a silty or mucky bottom. This general class is semipermanently flooded throughout the year.


Genus:*Zizania*

II. Sensitivity to Oil Spills

Deep marsh annual habitats are highly sensitive to oil spills. This habitat provides a home to many plants and animals, making the biological diversity in these habitats very significant. Some of the many animals that inhabit the emergent wetlands are amphibians, reptiles, fish, and a wide variety of invertebrates as well as a wide variety of migratory waterfowl. There are also a wide variety of plants.

Oil spills that occur in or near deep marsh annual habitats are of particular concern because they are home to many endangered species of plants and animals. Many animal species use the wetlands for reproductive and early life purposes. These animals are most susceptible to the effects oil during these life stages. Significant loss of this habitat would greatly affect the populations of these animals and consequently, the local ecology.

III. Sensitivity to Response Methods

Methods Causing Least Adverse Habitat Impacts

Exclusion or Deflection Booming

- Boom can be used to exclude or deflect the spill away from sensitive resources.
- Effectiveness is increased by positioning boom at appropriate angles for the current speed (Ops Manual).

Sorbents

- Use on edge vegetated area only or where water moves. Water movement is needed to bring oil to the sorbent.
- Care is necessary during placement and recovery to minimize disturbance of vegetation. Work in boats to avoid driving oil into the sediment.
- Snare and pom-poms are used along shorelines or in light sheen situations.

Flooding

- Where there is the ability to control water levels such as locks and dams, this technique can be used to remove trapped oil
- Though this technique can work well, some oil may still be stranded and will need to be removed through other means

Low-Pressure, Ambient Water Flushing

- Maintain low output pressures (less than 50 psi) to avoid disrupting the substrate and vegetation.
- Effectiveness increases with lighter oils because less residual oil is left in the environment.
- This tactic can be used with flooding to prevent re-deposition of oil.
- Use for spot removal of oil.

In-Situ Burning

- Presence of a water layer on marsh surface can protect roots.
- Heavy ends remain unburned and need to be recovered.
- Appropriate approval required (State air permit, RRT approval)

Debris/ Vegetation Removal

- Most appropriate for oils that form a thick, sticky coating on the vegetation, such as medium and heavy oils
- Damage by cleanup crews may be reduced by avoiding excessive cutting/removal, controlling access routes, or conducting operations from boats.

Methods Causing Probable Adverse Habitat Impact

Natural Attenuation

- This technique may have some adverse effects due to the fact that wild rice is an attractive food source and leaving oil could harm birds and other wildlife that come to feed. If that is not an issue, this technique has few effects.
- Lesser impact for small to moderate spills and lighter oils; avoids damage often associated with cleanup activities.
- Some cleanup may be warranted where large numbers of animals are likely to become oiled during wetland use.
- Seeding or planting may be used to assist oil degradation.

Methods Causing Most Adverse Habitat Impact

Light Equipment Oil Removal

- Use equipment such as swamp buggies or light equipment on pontoons.
- Damage to vegetation and substrate may be reduced by controlling access routes, using pontoons, or using a helicopter to bring in equipment.

Sediment Removal

- Vacuum and run through geotube to dewater. Treat the water and dispose sediment
- Excavate the sediment. Dewater the area before excavation
- The hydrology may change and vegetation may be difficult to restore
- Permits will be required for sediment removal and for water discharge

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Deep Marsh Perennial

Indicator Species

Arrowhead
Sagittaria spp.

Bur-Reed
Sparganium spp.

Pickerelweed
Pontederia spp.

I. Habitat Description

The deep marsh perennials habitat includes portions of lakes, ponds, marshes, or backwaters that are semi-permanently flooded and more than 10% vegetated with persistent emergent vegetation dominated by pickerelweed (*Pontederia*), arrowhead (*Sagittaria*), cattail (*Typha*), or bur-reed (*Sparganium*). Invasive species include hybrid cattail (*T. latifolia*), which is distinguished by its intermediate features between the parental common and narrow leaf cattails. This habitat may have incursions of submersed, nonrooted-floating aquatics, rooted-floating aquatics, or other emergent vegetation and is typically found growing in water up to 1 meter deep. During normal water conditions, there is little flow, though there can be wind-generated currents and stronger flows at inlets and outlets. During flood conditions, these habitats can be connected to rivers or streams, have strong currents, and the potential to carry large amounts of debris.

Deep marsh perennials. Image: Ben Kimball

Invasive hybrid cattail. Image: WI DNR

II. Sensitivity to Oil Spills

The deep marsh perennials habitat is high sensitive to oil spills. This habitat is valuable to a variety of birds, amphibian, reptile, and mammal species as well as micro and macro invertebrates, many of which are extremely sensitive to chemical exposure. During normal water levels, oil would be less likely to penetrate water-saturated soils; during floods, oil could be deposited in areas that dry out after the flood, and penetrate the loose, organic-rich surface soils. Light refined oils with high amounts of water-soluble fractions can cause acute mortality to animals and plants. Heavier oils tend to coat vegetation, which may survive if oil coats only the stems or if the roots are unaffected. It is difficult for more viscous oils to penetrate densely vegetated areas.

References/Additional Information:

General Classification Handbook for Floodplain Vegetation in Large River Systems (http://pubs.usgs.gov/tm/2005/tm2A1/)
Inland Oil Spills: Options for Minimizing Environmental Impacts for Freshwater Spill Response (http://www.michigan.gov/documents/deq/deq-wb-wws-FreshwaterResponse_NOAA102706_265069_7.pdf)
NatureServe (natureserve.org)
Natural Wetland Inventory (http://www.fws.gov/wetlands/)
The U.S. National Vegetation Classification (http://usnvc.org/)
Wetland Plants and Plant Communities of MN & WI, 3rd Edition (http://www.bwsr.state.mn.us/wetlands/delineation/WPPC_MN_WI/index.html)

Information compiled by UMRBA staff from NOAA, USFWS, and U.S. EPA sources, March 2016.

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Deep Marsh Perennial

III. Sensitivity to Response Methods

The following text describes potential adverse impacts to this habitat resulting from various oil spill response methods and provides recommendations to reduce impact when these methods are implemented. This is not intended to preclude the use of any particular methods, but rather to aid responders in balancing the need to remove oil with the possible adverse effects of removal. More detail about the response methods themselves can be found in the Inland Response Tactics Manual.

Least Adverse Habitat Impacts

Exclusion or Deflection Booming

- Boom can be used to exclude or deflect the spill away from sensitive resources.
- Effectiveness is increased by positioning boom at appropriate angles for the current speed.

Sorbents/Sorbent Boom

- In areas with vegetation at or above water, sorbents are most effective in water surrounding vegetation (as opposed to within/on top of vegetated areas).
- Care is necessary during placement and recovery to minimize disturbance of vegetation. Work in boats to avoid driving oil into the sediment.
- Pom-pom type sorbents are best for heavy viscous oils that coat the strands; sorbent boom is best for light, low-viscosity oils that can penetrate into the sorbents.
- Absorbent boom must be changed frequently to prevent it from becoming a source of sheen.

Flooding

- This tactic is only applicable in areas where the water level can be controlled, such as near locks and dams or in a small pond/marsh. Contact the U.S. Army Corps of Engineers water control regarding lock and dam operation.
- Can be used selectively to remove localized heavy oiling This tactic is useful to remove oil trapped in vegetation, which can otherwise be difficult to herd toward recovery devices in open water. However, some oil may remain stranded in vegetation and will need to be removed through other means.

Low-Pressure, Ambient-Water Flushing

- Maintain low output pressures (less than 50 psi) to avoid disrupting the substrate and vegetation.
- Effectiveness increases with lighter oils because less residual oil is left in the environment.
- This tactic can be used with flooding to prevent re-deposition of oil.
- Use for spot removal of oil because of the limited area of effectiveness.

In-Situ Burning

- Presence of a water layer on marsh surface can protect roots.
- "Heavy ends" of petroleum product remain unburned and must be recovered. This residue will sink once it is cool.
- The amount and placement of natural fuel in the surrounding area may present challenges to constraining the fire only to oiled areas.
- Authorization of in-situ burning is subject to RRT approval, consultation and concurrence from the state and the Department of the Interior.
- May be one of the least physically damaging means of moderate and heavy oil removal as it leaves plant roots intact.
- May be difficult to protect riparian vegetation.

Debris/Vegetation Removal

- Most appropriate for oils that form a persistent, thick, sticky coating on the vegetation, such as medium and heavy oils.
- Removal will release trapped oil and speed natural flushing rates.
- Debris may be associated with nests or living areas (e.g., beaver and muskrat lodges), therefore impacts on resident animal habitat need to be considered.
- If oil is trapped in floating vegetation, removal may be the only way to recover the oil in the absence of water currents.
- May be appropriate to prevent secondary oiling of wildlife.
- Damage by cleanup crews may be reduced by avoiding excessive cutting/removal.
- Response crews entering the marsh can inadvertently trample vegetation during cleanup/removal. To reduce this impact: control and minimize access routes through the marsh; have personnel stand or kneel on boards while working; and conduct operations from boats when possible.

Some Adverse Habitat Impact

Natural Attenuation/Phytoremediation

- Because perennials are an attractive food and habitat source, leaving oiled plants could harm birds and other wildlife that come to the marsh to feed and nest. If that is not an issue, this tactic has few adverse effects.
- Lesser impact for small to moderate spills and lighter oils; avoids damage often associated with cleanup activities.
- Cleanup should be used in addition to attenuation in areas where using only attenuation would put sizable wildlife populations as risk for becoming oiled or re-oiled.

Most Adverse Habitat Impact

Light Equipment Oil Removal

- Damage to vegetation and substrate may be reduced by controlling access routes, using pontoons or mats, or using a helicopter to bring in equipment.
- May be needed where oil has heavily contaminated bottom sediments.

Sediment Removal

- Vacuum/dredge sediments and dewater using geotube/settling tank. Or, where feasible, dewater area and excavate the sediment
- Significant sediment removal may result in a change in the area's hydrology as well as make it difficult to fully restore the plant community that existed prior to the spill incident.
- Permits will be required for sediment removal and for water discharge.

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Deep Marsh Shrub Habitat

I. Habitat

The Deep Marsh Shrub Habitat is found in or around lakes, ponds, backwaters, or shorelines that are >25% vegetated with semipermanently flooded shrubby vegetation. Common vegetation types include buttonbush (*Cephalanthus*), and swamp loosestrife (*Decodon*). This general class may have inclusions of submersed, nonrooted-floating aquatics, rooted-floating aquatics, or emergent vegetation. This habitat is more common in southern aquatic systems.

Deep Marsh Shrubs

Indicator Species

Buttonbush
Cephalanthus spp.

Swamp Loosestrife
Decodon spp.

II. Sensitivity to Oil Spills

The deep marsh shrub habitat is high sensitive to oil spills. This habitat is valuable to a variety of birds, amphibian, reptile, and mammal species as well as micro and macro invertebrates, many of which are extremely sensitive to chemical exposure. During normal water levels, oil would be less likely to penetrate water-saturated soils; during floods, oil could be deposited in areas that dry out after the flood, and penetrate the loose, organic-rich surface soils. Light refined oils with high amounts of water-soluble fractions can cause acute mortality to animals and plants. Heavier oils tend to coat vegetation, which may survive if oil coats only the stems or if the roots are unaffected. It is difficult for more viscous oils to penetrate densely vegetated areas.

References/Additional Information:

General Classification Handbook for Floodplain Vegetation in Large River Systems (http://pubs.usgs.gov/tm/2005/tm2A1/)

Inland Oil Spills: Options for Minimizing Environmental Impacts for Freshwater Spill Response (http://www.michigan.gov/documents/deq/deq-wb-wws-FreshwaterResponse_NOAA102706_265069_7.pdf)

NatureServe (natureserve.org)

Natural Wetland Inventory (http://www.fws.gov/wetlands/)

The U.S. National Vegetation Classification (http://usnvc.org/)

Wetland Plants and Plant Communities of MN & WI, 3rd Edition (http://www.bwsr.state.mn.us/wetlands/delineation/WPPC_MN_WI/index.html)

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INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Deep Marsh Shrub Habitat

III. Sensitivity to Response Methods

The following text describes potential adverse impacts to this habitat resulting from various oil spill response methods and provides recommendations to reduce impact when these methods are implemented. This is not intended to preclude the use of any particular methods, but rather to aid responders in balancing the need to remove oil with the possible adverse effects of removal. More detail about the response methods themselves can be found in the Inland Response Tactics Manual.

Least Adverse Habitat Impacts

Exclusion or Deflection Booming

- Boom can be used to exclude or deflect the spill away from sensitive resources.
- Effectiveness is increased by positioning boom at appropriate angles for the current speed.

Natural Attenuation

- Least impact for small to moderate spills and lighter oils; avoids damage often associated with cleanup activities.
- Some cleanup may be warranted where large numbers of wildlife are likely to become oiled during wetland use.
- Seeding or planting may be used to assist in oil degradation.

Sorbents

- Care is necessary during placement and recovery to minimize disturbance of substrate and vegetation
- Overuse generates excess waste.
- Forcing contact between pads and the oiled soil drives the oil deeper into the soil.
- Appropriate approval required for chemical additives to sorbents.

Flooding

- Erosion of substrate and vegetation may occur.
- Can be used selectively to remove localized heavy oiling.
- Local topography may limit the ability to control where the water and released oil flow and effectiveness of recovery.
- Boom or other methods of trapping and containment are used to collect the oil for removal.
- Effectiveness increases with lighter oils.

Low-Pressure, Ambient-Water Flushing

- If water pressures are too high, the substrate and vegetation may be disturbed.
- Effectiveness increases with lighter oils.

Solidifiers

- Use likely to increase adherence to vegetation and slow weathering/removal rates of residual oil.
- Most effective on lighter oils, which have low viscosity and allow the product to mix into the oil.
- Appropriate approval required.

Some Adverse Habitat Impact

In-Situ Burning

- May be one of the least physically damaging means of heavy oil removal.
- Presence of a water layer on marsh surface can protect roots.
- Time of year (vegetation growth stage) is important consideration.
- Heavy ends will remain unburned and will need to be recovered.
- Requires RRT approval and a state air permit.

Vacuum

- Can be effective in removal of pooled oil from the marsh surface.
- Trampling of vegetation and substrate can be limited by placing boards on the surface and limiting traffic.

Debris/Vegetation Removal

- The removal of heavily oiled and mobile debris may reduce the tracking of oil off-site and contamination of wildlife
- May be required in areas used by wildlife. Grass plants are damaged by oil at the root structure, removal of stained or oiled vegetation is to protect users of the habitat.
- Most appropriate for oils that form a thick, sticky coating on the vegetation, such as medium and heavy oils.
- Recovery of the vegetation due to both oil impact and physical destruction by cleanup crews may be reduced by avoiding excessive cutting/removal, controlling access routes, using boards placed on surface, or conducting operations from boats.

Hand Tool Oil Removal/Cleaning

- Used where persistent oil occurs in heavy amounts and where sensitive resources using the wetlands are likely to be oiled.
- Mixing of oil and trampling of vegetation may be reduced by controlling access routes, using boards placed on surface, or conducting operations from boats.
- This includes removal of surface soil contamination not gross digging.

Most Adverse Habitat Impact

Light Equipment Oil Removal

- Use equipment such as swamp buggies or light equipment on pontoons.
- Damage to vegetation and substrate may be reduced by controlling access routes, using pontoons or mats, or using a helicopter to bring in equipment.

Sediment Removal

- Vacuum/dredge sediments and dewater using geotube/settling tank. Treat the water and dispose of sediment.
- Excavate the sediment. Dewater the area before excavation.
- The hydrology may change and it may be difficult to restore the plant community that existed prior to the spill incident.
- Permits will be required for sediment removal and for water discharge.
- May be difficult to keep excavation dewatered.

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Calcareous Fen

Indicator Species

Brook Lobelia
Lobelia spp.

Lesser Fringed Gentian
Virgata spp.

Ohio Goldenrod
Solidago spp.

Sterile Sedge
Carex spp.

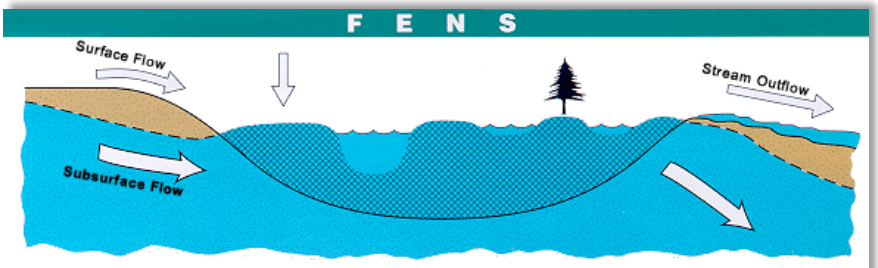
I. Habitat Description

Calcareous fens are one of the most rare habitat types in the United States. They typically form on or near slight slopes from upwelling groundwater trapped by a layer of peat. Like bogs, fens are characterized by a peat substrate, but are fed by a supply of cold, oxygen-deprived groundwater rich in calcium and magnesium bicarbonates. As they occur on sites of cold water seepage, active springs and trout streams are often associated with fens.

Calcareous fen in Wisconsin

II. Sensitivity to Oil Spills

Fens take millennia to form, and consequently are highly sensitive to oil spills. Poor drainage allows oil to accumulate and persist in layers of organic material. In drier hydrologic regimes, peat deposits are highly absorbent of hydrocarbons, making it difficult for clean-up without removing this valuable material, which provides vital substrate for rare plant and animal communities. Light refined oils with high amounts of water-soluble fractions can cause acute mortality to animals and plants. Heavier oils tend to coat vegetation, which may survive if oil coats only the stems or if the roots are unaffected. It is difficult for more viscous oils to penetrate densely vegetated areas.



Fens receive both surface and subsurface water and have both surface and subsurface outflows. As a result, fens tend to reflect the chemistry of the underlying geology and can be quite alkaline when fed from limestone sources.

DJ Welsch

References/Additional Information:

General Classification Handbook for Floodplain Vegetation in Large River Systems (http://pubs.usgs.gov/tm/2005/tm2A1/)

Inland Oil Spills: Options for Minimizing Environmental Impacts for Freshwater Spill Response (http://www.michigan.gov/documents/deq/deq-wb-wws-FreshwaterResponse_NOAA102706_265069_7.pdf)

NatureServe (natureserve.org)

Natural Wetland Inventory (http://www.fws.gov/wetlands/)

The U.S. National Vegetation Classification (http://usnvc.org/)

Wetland Plants and Plant Communities of MN & WI, 3rd Edition (http://www.bwsr.state.mn.us/wetlands/delineation/WPPC_MN_WI/index.html)

Information compiled by UMRBA staff from NOAA, USACE, USFWS, USGS, and U.S. EPA sources, March 2017.

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Calcareous Fen

III. Sensitivity to Response Methods

The following describes potential adverse impacts to this habitat resulting from various oil spill response methods and provides recommendations to reduce impact when these methods are implemented. This is not intended to preclude the use of any particular methods, but rather to aid responders in balancing the need to remove oil with the possible adverse effects of removal. More detail about the response methods themselves can be found in the Inland Response Tactics Manual.

Least Adverse Habitat Impacts

Exclusion or Deflection Booming

- Boom can be used to exclude or deflect the spill away from sensitive resources.
- Effectiveness is increased by positioning boom at appropriate angles for the current speed.

Sorbents/Sorbent Boom

- In areas with vegetation at or above water, sorbents are most effective in water surrounding vegetation (as opposed to within/on top of vegetated areas).
- Care is necessary during placement and recovery to minimize disturbance of vegetation.
- Pom-pom type sorbents are best for heavy viscous oils that coat the strands; sorbent boom is best for light, low-viscosity oils that can penetrate into the sorbents.
- Absorbent boom must be changed frequently to prevent it from becoming a source of sheen.

Flooding

- This tactic is only applicable in areas where the water level can be controlled, such as near locks and dams or in a small pond/marsh. Contact the U.S. Army Corps of Engineers water control regarding lock and dam operation.
- Can be used selectively to remove localized heavy oiling This tactic is useful to remove oil trapped in vegetation, which can otherwise be difficult to herd toward recovery devices in open water. However, some oil may remain stranded in vegetation and will need to be removed through other means.

Low-Pressure, Ambient-Water Flushing

- Maintain low output pressures (less than 50 psi) to avoid disrupting the substrate and vegetation.
- Effectiveness increases with lighter oils.
- This tactic can be used with flooding to prevent re-deposition of oil.
- Use for spot removal of oil because of the limited area of effectiveness.

In-Situ Burning

- Presence of a water layer can protect plant roots.
- "Heavy ends" of petroleum product will remain unburned and must be recovered. This residue will sink once it is cool.
- The amount and placement of natural fuel in the surrounding area may present challenges to constraining the fire only to oiled areas.
- Authorization of in-situ burning is subject to RRT approval, consultation and concurrence from the state and the Department of the Interior.
- May be one of the least physically damaging means of oil removal as it leaves plant roots intact.

Collection by Direct Suction

- Adverse impact can be mitigated by limiting vehicles, hoses, and equipment to staging areas with firm substrate and sparse vegetation. If equipment must access other areas, precautions should be taken to avoid driving oil into sediment or softer substrate, and trampling vegetation. For example: limit access routes through the area; walk, drive, and station equipment on mats or boards instead of directly on top of vegetation; use boats in flooded areas; and use a helicopter to bring in equipment to areas that are difficult to access.
- Only useful where oil is thickly pooled (not appropriate for sheens).

Debris/Vegetation Removal

- Most appropriate for oils that form a persistent, thick, sticky coating on the vegetation, such as medium and heavy oils.
- Removal will release trapped oil and speed natural flushing rates.
- Debris may be associated with nests or living areas (e.g., beaver and muskrat lodges), therefore impacts on resident animal habitat need to be considered.
- If oil is trapped in floating vegetation, removal may be the only way to recover the oil in the absence of water currents.
- Removal can prevent re-oiling of wildlife.
- Damage by cleanup crews may be reduced by avoiding excessive cutting/removal.
- Response crews entering the marsh can inadvertently trample vegetation during cleanup/removal. To reduce this impact: control and minimize access routes through the marsh; have personnel stand or kneel on boards while working; and conduct operations from boats when possible.

Some Adverse Habitat Impact

Natural Attenuation/Phytoremediation

- Leaving oil could have a negative impact on rare fen plant communities.
- Lesser impact for small to moderate spills and lighter oils; avoids damage often associated with cleanup activities.
- Cleanup should be used in addition to attenuation in areas where using only attenuation would put sizable wildlife populations as risk for becoming oiled or re-oiled.

Most Adverse Habitat Impact

Light Equipment Oil Removal

- Damage to vegetation and substrate may be reduced by controlling access routes, using pontoons or mats, or using a helicopter to bring in equipment.
- May be needed where oil has heavily contaminated bottom sediments.

Peat/Sediment Removal

- Vacuum/dredge sediments and dewater using geotube/settling tank. Or, where feasible, dewater area and excavate the sediment
- Significant sediment removal may result in a change in the area's hydrology as well as make it difficult to fully restore the plant community that existed prior to the spill incident.
- Permits will be required for sediment removal and for water discharge.

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Floodplain Forest

Indicator Species

Cottonwood
Populus spp.

Silver Maple
Acer spp.

Green Ash
Ulmus spp.

Noxious Species

Poison Ivy
Toxicodendron spp.

I. Habitat Description

Floodplain Forest (FF) represents areas on islands, near the shoreline, or around lakes, ponds, and backwaters that are >10% vegetated with seasonally flooded forests. These forests are predominantly silver maple (*Acer*), but also include elm (*Ulmus*), cottonwood (*Populus*), black willow (*Salix*), and river birch (*Betula*). Sedges (Carex), grasses (*Cinna*, *Elymus*, Leersia), and *Lianas* such as Virginia creeper, wild grape, and poison ivy are common understory plants. This general class is typically found growing at or near the water table where it becomes inundated from spring flooding and high-water events.

Inundated floodplain forest in Wisconsin. Image: Gary Shackleford

High water mark on a silver maple. Image: Larry Wade

II. Sensitivity to Oil Spills

Floodplain forest habitats are highly sensitive to oil spills. During spring and high water events oil could be deposited in areas that are typically dry for much of the year. This habitat is valuable to several songbird and colonial nesting water bird species, beaver, deer, and a variety of micro and macro invertebrates that constitute the base of the food supply. Significant loss of this habitat would greatly affect the populations of these animals and consequently, the local ecology.

References/Additional Information:

General Classification Handbook for Floodplain Vegetation in Large River Systems (http://pubs.usgs.gov/tm/2005/tm2A1/)
Inland Oil Spills: Options for Minimizing Environmental Impacts for Freshwater Spill Response (http://www.michigan.gov/documents/deq/deq-wb-wws-FreshwaterResponse_NOAA102706_265069_7.pdf)
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INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Floodplain Forest

III. Sensitivity to Response Methods

The following text describes potential adverse impacts to this habitat resulting from various oil spill response methods and provides recommendations to reduce impact when these methods are implemented. This is not intended to preclude the use of any particular methods, but rather to aid responders in balancing the need to remove oil with the possible adverse effects of removal. More detail about the response methods themselves can be found in the Inland Response Tactics Manual.

Least Adverse Habitat Impacts

Natural Attenuation

- Least impact for small to moderate spills and lighter oils that coat or stain vegetation; avoids damage often associated with cleanup activities
- Some cleanup may be warranted where large numbers of wildlife are likely to become oiled during wetland use
- Seeding or planting may be used to assist in oil degradation; work with trustees on a seed mixture
- Use loose materials as a barrier (e.g. local soils, baggase) to contain the spill

Sorbents/Solidifiers

- Useful for recovering sheens.
- Physical removal rates of lighter oil will be fastest, so more oil will be mobilized for recovery by sorbents
- Forcing contact between pads and the oil drives the oil into the soil
- Appropriate approval required for chemical additives
- Overuse generates excessive waste
- Snare and pom-poms are used along shorelines or in light sheen situations
- Application of loose particulates may impede removal of oil mixed with, and adhered to, vegetation, litter, and debris
- Most effective on lighter oils, which have low viscosity and allow the product to mix into the oil or penetrate netting or fabric encasing the loose particulates

Flooding

- Appropriate for gentle banks where persistent oil has pooled, assuming that the released oil can be directed towards recovery devices or sorbents
- Can be used selectively to remove localized heavy oiling
- Local topography may limit the ability to control where the water and released oil flow and effectiveness of recovery
- This tactic can be used with flooding to prevent re-deposition of oil
- Effectiveness increases with lighter oils because less residual oil is left in the environment

Low-Pressure, Ambient-Water Flushing

- If water pressures are too high, the substrate and vegetation may be disturbed
- Effectiveness increases with lighter oils because less residual oil is left in the environment

Some Adverse Habitat Impact

Vacuum

- Most effective where access is good and substrate can support vehicles
- Only useful when oil is pooled

Debris/Vegetation Removal

- Degree of oiling that warrants debris removal and disposal depends on use by humans and sensitive resources
- May be required in areas used by wildlife. Grass plants are damaged by oil at the root structure, removal of stained or oiled vegetation is to protect users of the habitat
- Most appropriate for oils that form a thick, sticky coating on the vegetation, such as medium and heavy oils
- Minimal concerns where substrate is firm

Hand Tool Oil Removal/Cleaning

- Used where persistent oil occurs in heavy amounts and where sensitive resources are likely to be oiled
- Mixing of oil and trampling of vegetation may be reduced by controlling access routes, using boards placed on surface, or conducting operations from boats
- This includes removal of surface soil contamination not gross digging

Most Adverse Habitat Impact

Light Equipment Oil Removal

- Mixing of oil and trampling of vegetation may be reduced by controlling access routes or using boards placed on surface
- Needed to remove heavy debris and dead trees

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Mudflat

I. Habitat Description

Most common in tidal environments, mudflats also occupy marginal areas of backwaters, estuaries, lakes, ponds, or shorelines that are prone to seasonal flooding and subsequently exposed to non-vegetated mud. Though typically barren, incursions of emergent vegetation, forbs, grasses, or sedges of less than 10% cover may be present. Water may be present depending on season or weather patterns.

Lakeshore mudflat

Dry mudflat

Estuary mudflat

II. Sensitivity to Oil Spills

Due to lack of vegetation and low biodiversity, mudflats are moderately sensitive to oil spills. On waterlogged flats, oil will remain on the surface if undisturbed by wind, rising water, rain, or human activity. Dried mudflats will crack, allowing for oil to seep under the surface. Many shorebirds, including the endangered interior population of Least Tern (*Sternula antillarum*) and the threatened Piping Plover (*Charadrius melodus*), utilize mudflats to forage for insects and small crustaceans and to access water. Shorebirds are most sensitive in the early morning hours during the spring and fall. Mudflats are typically thought to not have great socioeconomic value, though they do serve as an important erosion deterrent.

References/Additional Information:

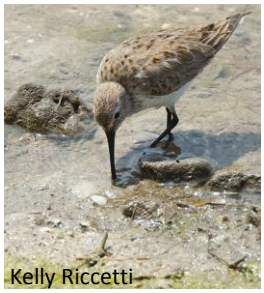
General Classification Handbook for Floodplain Vegetation in Large River Systems (http://pubs.usgs.gov/tm/2005/tm2A1/)

Inland Oil Spills: Options for Minimizing Environmental Impacts for Freshwater Spill Response (http://www.michigan.gov/documents/deq/deq-wb-wws-FreshwaterResponse_NOAA102706_265069_7.pdf)

USACE Missouri River Recovery Program (http://moriverrecovery.usace.army.mil/mrrp/f?p=136:132:0::NO:::)

Oil Spills Along the Shore http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/oil-spills-along-shore.html

Killdeer are common on mudflats



Mudflats are important stopovers for migrating birds like Dunlins.

Information compiled by UMRBA staff from NOAA, USACE, USFWS, USGS, and U.S. EPA sources, March 2017.

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:
Mudflat

III. Sensitivity to Response Methods

The following describes potential adverse impacts to this habitat resulting from various oil spill response methods and provides recommendations to reduce impact when these methods are implemented. This is not intended to preclude the use of any particular methods, but rather to aid responders in balancing the need to remove oil with the possible adverse effects of removal. More detail about the response methods themselves can be found in the Inland Response Tactics Manual.

Least Adverse Habitat Impacts

Sorbents

- Physical removal rates of lighter oil will be fastest and more oil will be mobilized for sorbent recovery.
- Overuse generates excessive waste.
- Snare and pom-poms are used along shorelines or for heavy oil situations.

Low-Pressure, Ambient-Water Flushing

- If water pressures are too high, the substrate may be disturbed and oil may be pushed into lower levels of sediment
- Effectiveness increases with lighter oils because less residual oil is left in the environment
- Most effective on impenetrable surfaces

Hand Tool Oil Removal/Cleaning

- Used where persistent oil occurs in heavy amounts and where sensitive resources are likely to be oiled
- Raking may drive oil into lower levels of sediment.
- This includes removal of surface soil contamination not gross digging

Some Adverse Habitat Impact

Vacuum

- Most effective where access is good and substrate can support vehicles
- Only useful when oil is pooled
- Can be used in combination with flooding to pool oil

Light Equipment Oil Removal

- Mixing of oil and disturbance of sediments may be reduced by controlling access routes or using boards placed on surface
- Needed to remove heavy debris and dead trees

Most Adverse Habitat Impact

Heavy Equipment Oil Removal

- Mixing of oil and disturbance of sediments may be reduced by controlling access routes or using boards placed on surface
- Needed to remove heavy debris and dead trees

Sediment Removal

- Vacuum/dredge sediments and dewater using geotube/settling tank. Treat the water and dispose of sediment.
- Excavate the sediment. Dewater the area before excavation.
- The hydrology may change and it may be difficult to restore conditions that existed prior to the spill incident.
- Permits will be required for sediment removal and for water discharge.

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Open Water

Indicator Species

Water Meal
Wolffia spp.

Duckweed
Lemna spp.

Duckweed
Spirodela spp.

I. Habitat Description

The open waters habitat includes main river channels and portions of lakes, ponds, and backwaters that remain permanently flooded all year and appear less than 10% vegetated. It also includes areas that are more than 10% vegetated with duckweed (*Lemna*, *Spirodela*, and *Wolffia*) and other nonrooted-floating aquatics. Because duckweed is free-floating, it can relocate day-to-day depending on current and wind direction. Therefore, any area of otherwise open water containing dense duckweed is be classified as Open Water (rather than being placed into any of the vegetation-specific habitat classes). These habitats are subject to varying currents and wave action.

Open Water can provide habitat for threatened plants such as these native phragmites in Pool 8 of the Mississippi River. Image: Matt Jacobson

Oil sheens on the Upper Mississippi River. Image: NOAA

II. Sensitivity to Oil Spills

The open waters habitat is highly sensitive to oil spills. Open waters provide critical habitat for many types of plants and animals, including a wide variety of fish, amphibians, reptiles, birds and mammals. Oil may inhibit the ability of vegetation to decompose, adversely affecting organisms within the detritus food web. Oil removal in this habitat is often driven by the threat of migratory waterfowl and/or wetland animals becoming oiled. Light oils with high water-soluble fractions can result in acute mortality of submersed vegetation, fish, and invertebrates. Heavier oils tend to smother aquatic animals and plants, and coat shorelines.

References/Additional Information:

General Classification Handbook for Floodplain Vegetation in Large River Systems (http://pubs.usgs.gov/tm/2005/tm2A1/)
Inland Oil Spills: Options for Minimizing Environmental Impacts for Freshwater Spill Response (http://www.michigan.gov/documents/deq/deq-wb-wws-FreshwaterResponse_NOAA102706_265069_7.pdf)
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III. Sensitivity to Response Methods

The following text describes potential adverse impacts to this habitat resulting from various oil spill response methods and provides recommendations to reduce impact when these methods are implemented. This is not intended to preclude the use of any particular methods, but rather to aid responders in balancing the need to remove oil with the possible adverse effects of removal. More detail about the response methods themselves can be found in the Inland Response Tactics Manual.

Least Adverse Habitat Impacts

Containment Booming

- Use containment boom to keep oil from spreading and to concentrate slicks from recovery.
- Recovery by skimmers or vacuum systems needs to accompany booming.
- Effectiveness is increased by positioning boom at appropriate angles for the current flow, areas where flow decreases and where debris naturally collects.

Sorbents/Sorbent Boom

- Deploy sorbent boom to recover sheens in low-current areas and along the shoreline.
- Overuse results in excess waste generation.
- Pom-pom type sorbents are best for heavy viscous oils that coat the strands; sorbent boom is best for light, low-viscosity oils that can penetrate into the sorbents.
- Absorbent boom must be changed frequently to prevent it from becoming a source of sheen.

Debris/Vegetation Removal

- Collect oiled free-floating vegetation. Minimize the cutting of rooted vegetation when possible.

Some Adverse Habitat Impact

In-Situ Burning

- Less likely to impact plants in areas of open water.
- "Heavy ends" of petroleum product remain unburned and must be recovered. This residue will sink once it is cool.
- The amount and placement of natural fuel in the surrounding area may present challenges to constraining the fire only to oiled areas.
- Authorization of in-situ burning is subject to RRT approval, consultation and concurrence from the state and the Department of the Interior.
- May be one of the least physically damaging means of moderate and heavy oil removal as it leaves plant roots intact.
- May be difficult to protect riparian vegetation.

Most Adverse Habitat Impact

Sediment Removal

- May make it difficult to restore the plant community that existed prior to the spill incident.
- Vacuum/dredge sediments and dewater using geotube/settling tank. Treat the water and dispose the sediment.
- Permits will be required for sediment removal and for water discharge.

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Rooted-Floating Aquatics

Indicator Species

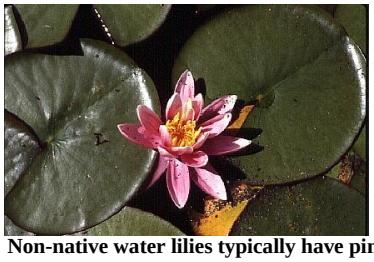
Spatterdock
Nuphar spp.

Water Lily
Nymphaea spp.

American Lotus
Nelumbo spp.

I. Habitat Description

Rooted-Floating Aquatics (RFA) represent portions of lakes, ponds, marshes, backwaters, or channel borders that are >10% vegetated with water lilies (*Nymphaea* and *Nuphar*) or American Lotus (*Nelumbo*). This general class is dominated by rooted-floating aquatics, but may have inclusions of submersed, nonrooted-floating aquatics, or emergent vegetation. It is typically found growing between water depths of 0.25 and 2 m. This general class remains permanently flooded all year.



Non-native water lilies typically have pink, purple, and red flowers.
Image: Dept. of Ecology, State of Washington

Colony of American lotus.

II. Sensitivity to Oil Spills

Due to proximity to shorelines and establishment in shallow water, the rooted floating aquatics habitat is highly sensitive to oil spills. Floating vegetation provides cover for several species of amphibians and fish. It is also important habitat for invertebrates. Many fish, invertebrates, and amphibious species deposit eggs on rooted floating vegetation. Light refined oils with high amounts of water-soluble fractions can cause acute mortality to animals and plants in these shallow habitats. Heavier oils tend to coat vegetation and animals, though the vegetation may survive because the roots are not affected. It is more difficult for more viscous oils to penetrate dense vegetation beds. However, these oils can smother water lily beds. Above all, oil reduces plant and animal tolerance to other environmental stress factors.

References/Additional Information:

General Classification Handbook for Floodplain Vegetation in Large River Systems (http://pubs.usgs.gov/tm/2005/tm2A1/)
Inland Oil Spills: Options for Minimizing Environmental Impacts for Freshwater Spill Response (http://www.michigan.gov/documents/deq/deq-wb-wws-FreshwaterResponse_NOAA102706_265069_7.pdf)
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INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Rooted-Floating Aquatics

III. Sensitivity to Response Methods

Relevant response tactics are ordered below by least-to-most adverse habitat impact. Bullet points list quick-reference information regarding the tactic; any potential adverse impacts of its use; and suggestions for mitigation of these impacts if available. This is not intended to preclude the use of any particular tactic, but rather to aid responders in choosing the tactic(s) best suited to a specific habitat. For more information on a tactic, click on it or go to the corresponding section in the Inland Response Tactics Manual.

Least Adverse Habitat Impacts

Containment Booming

- Use containment boom to keep oil from spreading and to concentrate slicks for recovery.
- Effectiveness is increased by positioning boom at appropriate angles for the current speed and where water slows down and debris naturally collects, such as the outside of a meander or below a point bar.
- Recovery by skimmers or vacuum systems needs to accompany booming.

Sorbents/Sorbent Booming

- Deploy sorbent boom to recover sheens in low-current areas and along the shoreline.
- Overuse results in excess waste generation.
- Pom-pom type sorbents are best for heavy viscous oils that coat the strands; sorbent boom is best for light, low-viscosity oils that can penetrate into the sorbents.
- Absorbent boom must be changed frequently to prevent it from becoming a source of sheen.

Debris/Vegetation Removal

- Collect oiled free-floating vegetation. Minimize the cutting of rooted vegetation when possible.

Natural Attenuation

- Least impact for small spills and lighter oils; avoids damage often associated with cleanup activities.
- Consider impact to aquatic life in the area. Consultation with a Trustee is recommended.

Some Adverse Habitat Impact

In-Situ Burning

- Burn only in calm water with no current where containment and maintenance of minimum slick thickness (1-3 millimeters) is possible.
- "Heavy ends" of petroleum product remain unburned. This residue will begin to sink as it cools and should therefore be recovered as quickly as possible after the burn is complete.
- Authorization of in-situ burning is subject to RRT approval, consultation and concurrence from the state and the Department of the Interior.

Herding Agents/Physical Herding and Visco-Elastic Agents/Solidifiers

- Should be coupled with recovery.
- Most effective on lighter oils, which allow the product to mix into the oil.
- Care should be taken not to drive oil into the water column or sediment, or damage rooted vegetation.
- Visco-elastic agents improve overall oil recovery from water surfaces, reducing the potential for secondary shoreline oiling.
- Best used in calm water without debris/vegetation.
- Prior approval must be obtained from the RRT before use of these agents and solidifiers.

Most Adverse Habitat Impact

Sediment Removal

- Vacuum/dredge heavily oiled sediments and dewater using geotube/settling tank. Or, where feasible, dewater area and excavate the sediment.
- Significant sediment removal may result in a change in the area's hydrology as well as make it difficult to fully restore the plant community that existed prior to the spill incident.
- Permits may be required for sediment removal and for water discharge.

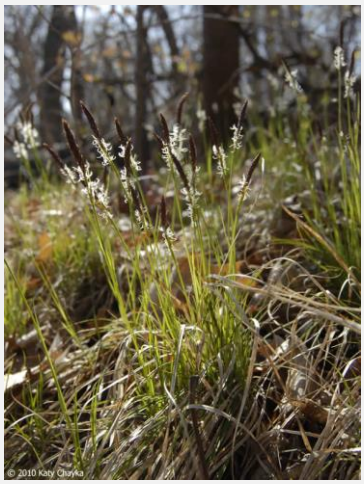
INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Sedge Meadow

Indicator Species

Lake Sedge
Carex spp.

Hummock Sedge
Carex spp.



Pennsylvania Sedge
Carex spp.

I. Habitat Description

The sedge meadows habitat includes lowland areas around lakes, ponds, backwaters, and along seasonally flooded shorelines. Similar to wet meadows, these habitats are close to 100% vegetated with perennial grasses and forbs. The distinction is over 20% of the vegetation consists of sedges (*Cyperaceae*). Most of the species present are from the genus *Carex*, true sedges characterized by three-ranked leaves and triangular stems, with grasses and rushes interspersed. Forbs are also present, but may grow poorly under competition with the sedges. Though the soils remain saturated most of the year, there is little standing water present (except after flooding or precipitation events).

Sedge meadow in Navarino Wildlife Area – Wisconsin Image: WI DNR

Tussock sedge meadow. Image: Steve Eggers, USACE

II. Sensitivity to Oil Spills

The sedge meadows habitat is highly sensitive to oil spills. This biologically diverse habitat provides a home to many types of plants and animals. Restoration of the plant community may require the purchase of plugs, as many of the area's plants have low germination rates. Many animal species such as the sandhill crane and common snipe use the sedge meadows for reproduction and feeding purposes. The abundance of small mammals makes these ideal feeding grounds for raptors, mink, and fox. Significant loss of this habitat would greatly affect the populations of these animals and, consequently, the local ecology. Light refined oils with high amounts of water-soluble fractions can cause acute mortality to animals and plants in this habitat. Heavier oils tend to coat vegetation and animals, though the vegetation may survive if oil coats only the stems or if the roots are not affected. Viscous oils will not penetrate into dense vegetation.

References/Additional Information:

General Classification Handbook for Floodplain Vegetation in Large River Systems (http://pubs.usgs.gov/tm/2005/tm2A1/)
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The U.S. National Vegetation Classification (http://usnvc.org/)
Wetland Plants and Plant Communities of MN & WI, 3rd Edition (http://www.bwsr.state.mn.us/wetlands/delineation/WPPC_MN_WI/index.html)
Oil Spills in Marshes: Planning and Response Considerations (http://response.restoration.noaa.gov/sites/default/files/Oil_Spills_in_Marshes.pdf)

Information compiled by UMRBA staff from NOAA, USFWS, and U.S. EPA sources, March 2016.

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:
Sedge Meadow

III. Sensitivity to Response Methods

The following text describes potential adverse impacts to this habitat resulting from various oil spill response methods and provides recommendations to reduce impact when these methods are implemented. This is not intended to preclude the use of any particular methods, but rather to aid responders in balancing the need to remove oil with the possible adverse effects of removal. More detail about the response methods themselves can be found in the Inland Response Tactics Manual.

Least Adverse Habitat Impacts

Flooding

- Appropriate for locations with gentle gradient where persistent oil has pooled.
- Should only be used if released oil can be reliably directed towards sorbents or recovery devices and prevented from impacting other areas.
- Effectiveness increases with lighter oils because they are less viscous and less residual oil is left in the environment.
- Some oil may still be left stranded after flooding and will need to be collected through other means.

Collection by Direct Suction

- Adverse impact can be mitigated by limiting vehicles, hoses, and equipment to staging areas with firm substrate and sparse vegetation. If equipment must access other areas, precautions should be taken to avoid driving oil into sediment or softer substrate, and trampling vegetation. For example: limit access routes through the area; walk, drive, and station equipment on mats or boards instead of directly on top of vegetation; use boats in flooded areas; and use a helicopter to bring in equipment to areas that are difficult to access.
- Only useful where oil is thickly pooled (not appropriate for sheens).

Low-Pressure, Ambient-Water Flushing

- Effective for washing oil stranded on banks into the water for recovery.
- Vegetation cover minimizes the potential for sediment erosion from flushing. However, thick vegetation also reduces area of influence of flushing operations.
- Effectiveness increases with lighter oils because they are less viscous and less residual oil is left in the environment.

In-Situ Burning

- May be one of the least physically damaging means of moderate and heavy oil removal.
- Fires are a naturally occurring part of this habitat's plant lifecycle, so vegetation should be able to recover quickly from a burn as long as the roots are not damaged.
- "Heavy ends" of petroleum product remain unburned and must be recovered. This residue will sink once it is cool.
- Least adverse impact when used in grassy areas versus areas covered with trees and shrubs. Fires are a naturally occurring part of this habitat's plant lifecycle, so vegetation should be able to recover quickly from a burn as long as the roots are not damaged.
- Authorization of in-situ burning is subject to RRT approval, consultation and concurrence from the state and the Department of the Interior.

Some Adverse Habitat Impact

Natural Attenuation/Phytoremediation

- Least impact for small to moderate spills and lighter oils; avoids damage often associated with cleanup activities.
- Cleanup should be used in addition to attenuation in areas where using only attenuation would put sizable wildlife populations as risk for becoming oiled or re-oiled.

Debris/Vegetation Removal

- Most appropriate for oils that form a thick, sticky coating on the vegetation, such as medium and heavy oils.
- Remove stained or oiled vegetation to protect wildlife users of the habitat. Additionally, grass roots can by damaged by oil and may need to be removed as well.
- Damage by cleanup crews may be reduced by avoiding excessive cutting/removal.
- Response crews entering the marsh can inadvertently trample vegetation during cleanup/removal. To reduce this impact: control and minimize access routes through the marsh; have personnel stand or kneel on boards while working; and conduct operations from boats when possible.

Most Adverse Habitat Impact

Light Equipment Oil Removal

- May be needed where oil has heavily contaminated bottom sediments.
- Avoid forcing oil into the substrate and trampling vegetation by limiting access routes through the area, traversing the area on boards/mats/pontoons, or using a helicopter to bring in equipment.

Nutrient Enrichment

- Applicable where nutrients are a limiting factor for oil degradation.
- More effective after gross oil removal is completed.
- Should be used in environments where preservation is not a priority.
- When used on bare soil, nutrients need to be mixed with oil and soil.

Sediment Removal

- For watered areas: vacuum/dredge sediments and dewater using geotube/settling tank; or, where feasible, dewater the area and excavate the sediment.
- Significant sediment removal may result in a change in the area's hydrology as well as make it difficult to fully restore the plant community that existed prior to the spill incident.
- Permits will be required for sediment removal and for water discharge.

Hand Tool Oil Removal/Cleaning

- Used where persistent oil occurs in heavy amounts and animals using the wetland are likely to be oiled.
- Avoid forcing oil into substrate and trampling vegetation by limiting access routes through the area and walking on boards or mats.

Sorbents

- Overuse generates excess waste.
- Forcing contact between pads and oiled substrate can drive oil into the soil, making it more difficult to recover.

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Shallow Marsh Annual

Indicator Species

Pinkweed
Polygonum spp.

Nodding-Bur Marigold
Bidens spp.

Barnard Grass (Invasive)
Echinochloa spp.

I. Habitat Description

The shallow marsh annuals habitat includes portions of lakes, ponds, backwaters, mudflats, or shorelines that are seasonally flooded and more than 10% vegetated with annual (non-persistent) emergent vegetation. Common vegetation types include barnyard grass (*Echinochloa*), smartweed/pinkweed (*Polygonum*), spike-rush (*Eleocharis*), nutsedge/red-root flatsedge (*Cyperus*), and beggarticks (*Bidens*). This habitat may have incursions of submersed, nonrooted-floating aquatics, or persistent emergent vegetation. It is typically found in areas which are seasonally flooded and have soils that are saturated or inundated by water up to 0.2 meters deep. During normal water conditions, there is little flow, though there can be wind-generated currents and stronger flows at inlets and outlets. During flood conditions, these habitats can be connected to rivers or streams, with strong currents and possibly large amounts of debris.

Shallow marsh dominated by barnyard grass. Image: USGS

Invasive cocklebur overtaking stand of Nodding-bur marigold. Image: USGS

II. Sensitivity to Oil Spills

The shallow marsh annuals habitat is highly sensitive to oil spills. This biologically diverse habitat is critical to many plants and animals. Many animal species, especially waterfowl, rely on annual plants as a food source. Significant loss of this habitat would greatly affect the populations of these animals and consequently, the local ecology. Light refined oils with high amounts of water-soluble fractions can cause acute mortality to animals and plants in these shallow habitats. Heavier oils tend to coat vegetation and animals, though the vegetation may survive if oil coats only the stem. Plant mortality is heightened during the growing season.

References/Additional Information:

General Classification Handbook for Floodplain Vegetation in Large River Systems (http://pubs.usgs.gov/tm/2005/tm2A1/)
Inland Oil Spills: Options for Minimizing Environmental Impacts for Freshwater Spill Response (http://www.michigan.gov/documents/deq/deq-wb-wws-FreshwaterResponse_NOAA102706_265069_7.pdf)
Natural Wetland Inventory (http://www.fws.gov/wetlands/)
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INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:
Shallow Marsh Annual

III. Sensitivity to Response Methods

The following text describes potential adverse impacts to this habitat resulting from various oil spill response methods and provides recommendations to reduce impact when these methods are implemented. This is not intended to preclude the use of any particular methods, but rather to aid responders in balancing the need to remove oil with the possible adverse effects of removal. More detail about the response methods themselves can be found in the Inland Response Tactics Manual.

Least Adverse Habitat Impacts

Exclusion or Deflection Booming

- Boom can be used to exclude or deflect the spill away from sensitive resources.
- Effectiveness is increased by positioning boom at appropriate angles for the current speed.

Sorbents/Sorbent Boom

- In areas with vegetation at or above water, sorbents are most effective in water surrounding vegetation (as opposed to within/on top of vegetated areas).
- Care is necessary during placement and recovery to minimize disturbance of vegetation. Work in boats to avoid driving oil into the sediment.
- Pom-pom type sorbents are best for heavy viscous oils that coat the strands; sorbent boom is best for light, low-viscosity oils that can penetrate into the sorbents.
- Absorbent boom must be changed frequently to prevent it from becoming a source of sheen.

Flooding

- This tactic is only applicable in areas where the water level can be controlled, such as near locks and dams or in a small pond/marsh. Contact the U.S. Army Corps of Engineers water control regarding lock and dam operation.
- Can be used selectively to remove localized heavy oiling This tactic is useful to remove oil trapped in vegetation, which can otherwise be difficult to herd toward recovery devices in open water. However, some oil may remain stranded in vegetation and will need to be removed through other means.

Low-Pressure, Ambient-Water Flushing

- Maintain low output pressures (less than 50 psi) to avoid disrupting the substrate and vegetation.
- Effectiveness increases with lighter oils because less residual oil is left in the environment.
- This tactic can be used with flooding to prevent re-deposition of oil.
- Use for spot removal of oil because of the limited area of effectiveness.

In-Situ Burning

- Presence of a water layer on marsh surface can protect roots.
- "Heavy ends" of petroleum product remain unburned and must be recovered. This residue will sink once it is cool.
- The amount and placement of natural fuel in the surrounding area may present challenges to constraining the fire only to oiled areas.
- Authorization of in-situ burning is subject to RRT approval, consultation and concurrence from the state and the Department of the Interior.
- May be one of the least physically damaging means of moderate and heavy oil removal as it leaves plant roots intact.
- May be difficult to protect riparian vegetation.

Debris/Vegetation Removal

- Most appropriate for oils that form a persistent, thick, sticky coating on the vegetation, such as medium and heavy oils.
- Removal will release trapped oil and speed natural flushing rates.
- Debris may be associated with nests or living areas (e.g., beaver and muskrat lodges), therefore impacts on resident animal habitat need to be considered.
- If oil is trapped in floating vegetation, removal may be the only way to recover the oil in the absence of water currents.
- May be appropriate to prevent secondary oiling of wildlife.
- Damage by cleanup crews may be reduced by avoiding excessive cutting/removal.
- Response crews entering the marsh can inadvertently trample vegetation during cleanup/removal. To reduce this impact: control and minimize access routes through the marsh; have personnel stand or kneel on boards while working; and conduct operations from boats when possible.

Some Adverse Habitat Impact

Natural Attenuation/Phytoremediation

- Because wild rice is an attractive food source, leaving oiled zizania plants could harm birds and other wildlife that come to the marsh to feed. If that is not an issue, this tactic has few adverse effects.
- Lesser impact for small to moderate spills and lighter oils; avoids damage often associated with cleanup activities.
- Cleanup should be used in addition to attenuation in areas where using only attenuation would put sizable wildlife populations as risk for becoming oiled or re-oiled.

Most Adverse Habitat Impact

Light Equipment Oil Removal

- Damage to vegetation and substrate may be reduced by controlling access routes, using pontoons or mats, or using a helicopter to bring in equipment.
- May be needed where oil has heavily contaminated bottom sediments.

Sediment Removal

- Vacuum/dredge sediments and dewater using geotube/settling tank. Or, where feasible, dewater area and excavate the sediment
- Significant sediment removal may result in a change in the area's hydrology as well as make it difficult to fully restore the plant community that existed prior to the spill incident.
- Permits will be required for sediment removal and for water discharge.

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Shallow Marsh Perennial

Indicator Species

Water Smartweed
Polygonum spp.

River Bulrush
Schoenoplectus spp.

Common Reed
Phragmites spp.

Invasive Species

Purple Loosestrife
Lythrum spp.

I. Habitat Description

The shallow marsh perennials habitat includes portions of lakes, ponds, backwaters, or shorelines that are seasonally flooded and more than 10% vegetated with persistent emergent vegetation. This habitat denotes the transition zone between deep marsh perennials and wet meadow. Common plant species are common cattail (*Typha*), perennial smartweeds (*Polygonum*), giant reed (*Phragmites*), and bulrush (*Schoenoplectus*). Invasives include purple loosestrife (*Lythrum*). This habitat may have inclusions of submersed, nonrooted-floating aquatics, or other emergent vegetation. It is typically found growing on soils that are saturated or inundated by water up to 0.2 meters deep. During normal water conditions, there is little flow, though there can be wind-generated currents and stronger flows at inlets and outlets. During flood conditions, these habitats can be connected to rivers or streams, with strong currents and possibly large amounts of debris.

Invasive common reed.

Stand of invasive purple loosestrife.
Image: Ned Hettinger

II. Sensitivity to Oil Spills

The shallow marsh perennials habitat is high sensitive to oil spills. This habitat is valuable to a variety of birds, amphibian, reptile, and mammal species as well as micro and macro invertebrates, many of which are extremely sensitive to chemical exposure. During normal water levels, oil would be less likely to penetrate water-saturated soils; during floods, oil could be deposited in areas that dry out after the flood, and penetrate the loose, organic-rich surface soils. Light refined oils with high amounts of water-soluble fractions can cause acute mortality to animals and plants. Heavier oils tend to coat vegetation, which may survive if oil coats only the stems or if the roots are unaffected. It is difficult for more viscous oils to penetrate densely vegetated areas.

References/Additional Information:

General Classification Handbook for Floodplain Vegetation in Large River Systems (http://pubs.usgs.gov/tm/2005/tm2A1/)
Inland Oil Spills: Options for Minimizing Environmental Impacts for Freshwater Spill Response (http://www.michigan.gov/documents/deq/deq-wb-wws-FreshwaterResponse_NOAA102706_265069_7.pdf)
NatureServe (natureserve.org)
Natural Wetland Inventory (http://www.fws.gov/wetlands/)
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INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Shallow Marsh Perennial

III. Sensitivity to Response Methods

The following text describes potential adverse impacts to this habitat resulting from various oil spill response methods and provides recommendations to reduce impact when these methods are implemented. This is not intended to preclude the use of any particular methods, but rather to aid responders in balancing the need to remove oil with the possible adverse effects of removal. More detail about the response methods themselves can be found in the Inland Response Tactics Manual.

Least Adverse Habitat Impacts

Exclusion or Deflection Booming

- Boom can be used to exclude or deflect the spill away from sensitive resources.
- Effectiveness is increased by positioning boom at appropriate angles for the current speed.

Sorbents/Sorbent Boom

- In areas with vegetation at or above water, sorbents are most effective in water surrounding vegetation (as opposed to within/on top of vegetated areas).
- Care is necessary during placement and recovery to minimize disturbance of vegetation. Work in boats to avoid driving oil into the sediment.
- Pom-pom type sorbents are best for heavy viscous oils that coat the strands; sorbent boom is best for light, low-viscosity oils that can penetrate into the sorbents.
- Absorbent boom must be changed frequently to prevent it from becoming a source of sheen.

Flooding

- This tactic is only applicable in areas where the water level can be controlled, such as near locks and dams or in a small pond/marsh. Contact the U.S. Army Corps of Engineers water control regarding lock and dam operation.
- Can be used selectively to remove localized heavy oiling This tactic is useful to remove oil trapped in vegetation, which can otherwise be difficult to herd toward recovery devices in open water. However, some oil may remain stranded in vegetation and will need to be removed through other means.

Low-Pressure, Ambient-Water Flushing

- Maintain low output pressures (less than 50 psi) to avoid disrupting the substrate and vegetation.
- Effectiveness increases with lighter oils because less residual oil is left in the environment.
- This tactic can be used with flooding to prevent re-deposition of oil.
- Use for spot removal of oil because of the limited area of effectiveness.

In-Situ Burning

- Presence of a water layer on marsh surface can protect roots.
- "Heavy ends" of petroleum product remain unburned and must be recovered. This residue will sink once it is cool.
- The amount and placement of natural fuel in the surrounding area may present challenges to constraining the fire only to oiled areas.
- Authorization of in-situ burning is subject to RRT approval, consultation and concurrence from the state and the Department of the Interior.
- May be one of the least physically damaging means of moderate and heavy oil removal as it leaves plant roots intact.
- May be difficult to protect riparian vegetation.

Debris/Vegetation Removal

- Most appropriate for oils that form a persistent, thick, sticky coating on the vegetation, such as medium and heavy oils.
- Removal will release trapped oil and speed natural flushing rates.
- Debris may be associated with nests or living areas (e.g., beaver and muskrat lodges), therefore impacts on resident animal habitat need to be considered.
- If oil is trapped in floating vegetation, removal may be the only way to recover the oil in the absence of water currents.
- May be appropriate to prevent secondary oiling of wildlife.
- Damage by cleanup crews may be reduced by avoiding excessive cutting/removal.
- Response crews entering the marsh can inadvertently trample vegetation during cleanup/removal. To reduce this impact: control and minimize access routes through the marsh; have personnel stand or kneel on boards while working; and conduct operations from boats when possible.

Some Adverse Habitat Impact

Natural Attenuation/Phytoremediation

- Because perennials are an attractive food and nesting source, leaving oiled plants could harm birds and other wildlife that come to the marsh to feed and nest. If that is not an issue, this tactic has few adverse effects.
- Lesser impact for small to moderate spills and lighter oils; avoids damage often associated with cleanup activities.
- Cleanup should be used in addition to attenuation in areas where using only attenuation would put sizable wildlife populations as risk for becoming oiled or re-oiled.

Most Adverse Habitat Impact

Light Equipment Oil Removal

- Damage to vegetation and substrate may be reduced by controlling access routes, using pontoons or mats, or using a helicopter to bring in equipment.
- May be needed where oil has heavily contaminated bottom sediments.

Sediment Removal

- Vacuum/dredge sediments and dewater using geotube/settling tank. Or, where feasible, dewater area and excavate the sediment
- Significant sediment removal may result in a change in the area's hydrology as well as make it difficult to fully restore the plant community that existed prior to the spill incident.
- Permits will be required for sediment removal and for water discharge.

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

SHALLOW MARSH SHRUB HABITAT

Indicator Species

Willow
Salix spp.

Red Osier Dogwood
Cornus spp.

Swamp Privet
Foresteria spp.

I. Habitat Description

Shrubs along marsh edge

The Shallow Marsh Shrub Habitat represents areas near the shoreline or around lakes, ponds, and backwaters that are >25% vegetated with seasonally flooded shrubby vegetation. It typically grows with mixed emergents, grasses, and forbs. This general class tends to be drier than deep marsh shrubs, but wetter than wet meadow shrubs. Willows (*Salix*) are the predominant shrub type. Other indicator species are Dogwood (*Cornus*), False Indigo (*Amorphia*), and Swamp Privet (*Foresteria*). Shallow marsh shrubs are typically found growing on soils that are saturated or inundated with little water.

II. Sensitivity to Oil Spills

Shallow marsh shrub habitats are highly sensitive to oil spills. This habitat provides a home to many plants and animals. Some of the many animal species that inhabit the emergent wetlands are amphibians, reptiles, fish, and a wide variety of invertebrates as well as a wide variety of migratory waterfowl. There are also a wide variety of plant species.

Oil spills that occur in or near shallow marsh shrub habitats are of particular concern because they are home to many endangered species of plants and animals. Many animal species use this habitat type for reproductive and early life purposes. These animals are most susceptible to the effects oil during these life stages. Significant loss of this habitat would negatively affect the populations of these animals and consequently, the local ecology.

References/Additional Information:

General Classification Handbook for Floodplain Vegetation in Large River Systems (http://pubs.usgs.gov/tm/2005/tm2A1/)

Inland Oil Spills: Options for Minimizing Environmental Impacts for Freshwater Spill Response (http://www.michigan.gov/documents/deq/deq-wb-wws-FreshwaterResponse_NOAA102706_265069_7.pdf)

NatureServe (natureserve.org)

Natural Wetland Inventory (http://www.fws.gov/wetlands/)

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III. Sensitivity to Response Methods

The following text describes potential adverse impacts to this habitat resulting from various oil spill response methods and provides recommendations to reduce impact when these methods are implemented. This is not intended to preclude the use of any particular methods, but rather to aid responders in balancing the need to remove oil with the possible adverse effects of removal. More detail about the response methods themselves can be found in the Inland Response Tactics Manual.

Least Adverse Habitat Impacts

Exclusion or Deflection Booming

- Boom can be used to exclude or deflect the spill away from sensitive resources.
- Effectiveness is increased by positioning boom at appropriate angles for the current speed.

Natural Attenuation

- Least impact for small to moderate spills and lighter oils; avoids damage often associated with cleanup activities.
- Some cleanup may be warranted where large numbers of wildlife are likely to become oiled during wetland use.
- Seeding or planting may be used to assist in oil degradation.

Sorbents

- Care is necessary during placement and recovery to minimize disturbance of substrate and vegetation.
- Overuse generates excessive waste.
- Forcing contact between pads and the oil drives the oil deeper into the soil.
- Appropriate approval required for chemical additives to sorbents.

Flooding

- Erosion of substrate and vegetation may be a problem.
- Can be used selectively to remove localized heavy oiling.
- Local topography may limit the ability to control where the water and released oil flow and effectiveness of recovery.
- Booms or other methods of trapping and containment are used to collect the oil for removal.
- Effectiveness increases with lighter oils because less residual oil is left in the environment.

Low-Pressure, Ambient-Water Flushing

- If water pressures are too high, the substrate and vegetation may be disturbed.
- Effectiveness increases with lighter oils because less residual oil is left in the environment.

Solidifiers

- Use likely to increase adherence to vegetation and slow weathering/removal rates of residual oil.
- Most effective on lighter oils, which have low viscosity and allow the product to mix into the oil.
- Appropriate approval required.

Some Adverse Habitat Impact

In-Situ Burning

- May be one of the least physically damaging means of heavy oil removal.
- Presence of a water layer on marsh surface can protect roots.
- Time of year (vegetation growth stage) is important consideration.
- Heavy ends will remain unburned and will need to be recovered.
- Requires RRT approval and a state air permit.

Vacuum

- Can be effective in removal of pooled oil from the marsh surface.
- Trampling of vegetation and substrate can be limited by placing boards on the ground and limiting traffic.

Debris/Vegetation Removal

- The removal of heavily oiled and mobile debris may reduce the tracking of oil off-site and contamination of wildlife.
- May be required in areas used by wildlife. Grass plants are damaged by oil at the root structure; removal of stained or oiled vegetation is to protect users of the habitat.
- Most appropriate for oils that form a thick, sticky coating on the vegetation, such as medium and heavy oils.
- Recovery of the vegetation due to both oil impact and physical destruction by cleanup crews may be reduced by avoiding excessive cutting/removal, controlling access routes, using boards placed on surface, or conducting operations from boats.

Hand Tool Oil Removal/Cleaning

- Used where persistent oil occurs in heavy amounts and where sensitive resources using the wetlands are likely to be oiled.
- Mixing of oil and trampling of vegetation may be reduced by controlling access routes, using boards placed on surface, or conducting operations from boats.
- This includes removal of surface soil contamination..

Most Adverse Habitat Impact

Light Equipment Oil Removal

- Use equipment such as swamp buggies or light equipment on pontoons.
- Damage to vegetation and substrate may be reduced by controlling access routes, using pontoons or mats, or using a helicopter to bring in equipment.

Sediment Removal

- Vacuum/dredge sediments and dewater using geotube/settling tank. Treat the water and dispose of sediment.
- Excavate the sediment. Dewater the area before excavation.
- The hydrology may change and it may be difficult to restore the plant community that existed prior to the spill incident.
- Permits will be required for sediment removal and for water discharge.
- May be difficult to keep excavation dewatered.

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Submersed Aquatic Vegetation

Indicator Species

Wild Celery
Vallisneria spp.

Coontail
Ceratophyflum spp.

Invasive Species

Eurasian Watermilfoil
Genus: *Myriophyllum*

Curly-leaf Pondweed
Genus: *Potamogeton*

I. Habitat Description

The submersed vegetation habitat is those portions of lakes, ponds, channel borders, or backwaters that appear more than 10% of vegetation fully underwater. Common vegetation types include wild celery (*Vallisneria*), coontail (*Ceratophyflum*), and the invasive curly pondweed (*Potamogeton*). While this habitat is dominated by submersed vegetation, it may have inclusions of nonrooted-floating aquatics, rooted-floating aquatics, or emergent vegetation. It generally is found in areas which are flooded year round and have water depths between 0.5 and 2 meters. Submersed vegetation occurring at depths greater than 2 meters may be classified as open water.

Water Star Grass (*Heteranthera*) beds.
Image: Kurt Carpenter, USGS

II. Sensitivity to Oil Spills

Due to proximity to shorelines and establishment in shallow water, submersed aquatic vegetation habitat is highly sensitive to oil spills. Submersed vegetation, especially wild celery, are an important food source for waterfowl such as canvasback (*Aythya valisneria*), and provide habitat and food sources for a variety of invertebrates, fish, and other wildlife. Many fish and amphibious species deposit eggs on submerged vegetation. Light refined oils with high amounts of water-soluble fractions can cause acute mortality to animals and plants in these shallow habitats. Heavier oils tend to coat vegetation and animals, though the vegetation may survive because the roots are not affected. It is more difficult for more viscous oils to penetrate dense vegetation beds. However, these oils can smother submersed grass beds. Above all, oil reduces plant and animal tolerance to other environmental stress factors.

References/Additional Information:

General Classification Handbook for Floodplain Vegetation in Large River Systems (http://pubs.usgs.gov/tm/2005/tm2A1/)
Inland Oil Spills: Options for Minimizing Environmental Impacts for Freshwater Spill Response (http://www.michigan.gov/documents/deq/deq-wb-wws-FreshwaterResponse_NOAA102706_265069_7.pdf)
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INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Submersed Aquatic Vegetation

III. Sensitivity to Response Methods

The following text describes potential adverse impacts to this habitat resulting from various oil spill response methods and provides recommendations to reduce impact when these methods are implemented. This is not intended to preclude the use of any particular methods, but rather to aid responders in balancing the need to remove oil with the possible adverse effects of removal. More detail about the response methods themselves can be found in the Inland Response Tactics Manual.

Least Adverse Habitat Impacts

Containment Booming

- Use containment boom to keep oil from spreading and to concentrate slicks for recovery.
- Effectiveness is increased by positioning boom at appropriate angles for the current speed and where water slows down and debris naturally collects, such as the outside of a meander or below a point bar.
- Recovery by skimmers or vacuum systems needs to accompany booming.

Sorbents/Sorbent Boom

- Deploy sorbent boom to recover sheens in low-current areas and along the shoreline.
- Overuse results in excess waste generation.
- Pom-pom type sorbents are best for heavy viscous oils that coat the strands; sorbent boom is best for light, low-viscosity oils that can penetrate into the sorbents.
- Absorbent boom must be changed frequently to prevent it from becoming a source of sheen.

Debris/Vegetation Removal

- Collect oiled free-floating vegetation. Minimize the cutting of rooted vegetation when possible.

Natural Attenuation

- Least impact for small spills and lighter oils; avoids damage often associated with cleanup activities.
- Consider impact to aquatic life in the area. Consultation with a Trustee is recommended.

Some Adverse Habitat Impact

In-Situ Burning

- Burn only in calm water with no current where containment and maintenance of minimum slick thickness (1-3 millimeters) is possible.
- "Heavy ends" of petroleum product remain unburned. This residue will begin to sink as it cools and should therefore be recovered as quickly as possible after the burn is complete.
- Authorization of in-situ burning is subject to RRT approval, consultation and concurrence from the state and the Department of the Interior.

Herding Agents/Physical Herding and Visco-Elastic Agents/Solidifiers

- Should be coupled with recovery.
- Most effective on lighter oils, which allow the product to mix into the oil.
- Care should be taken not to drive oil into the water column or sediment, or damage rooted vegetation.
- Visco-elastic agents improve overall oil recovery from water surfaces, reducing the potential for secondary shoreline oiling.
- Best used in calm water without debris/vegetation.
- Prior approval must be obtained from the RRT before use of these agents and solidifiers.

Most Adverse Habitat Impact

Sediment Removal

- Vacuum/dredge sediments and dewater using geotube/settling tank. Or, where feasible, dewater area and excavate the sediment
- Significant sediment removal may result in a change in the area's hydrology as well as make it difficult to fully restore the plant community that existed prior to the spill incident.
- Permits will be required for sediment removal and for water discharge.

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Wet Meadow

Indicator Species

Joe-Pye Weed
Eupatoriadelphus spp.

Bluejoint Grass
Calamagrostis spp.

Prairie Cordgrass
Spartina spp.

Invasive Species

Reed Canary Grass
Phalaris spp.

I. Habitat Description

The wet meadows habitat includes lowland areas that are close to 100% vegetated with perennial grasses and forbs. Vegetation is typically darker and/or greener than surrounding areas. Common vegetation types include reed canary grass (*Phalaris*), bluejoint grass (*Calamagrostis*), cordgrass (*Spartina alterniflora*) and goldenrod (*Solidago*). This habitat may have small incursions of woody vegetation, sedges, or emergent vegetation, such as smartweed or the invasive purple loosestrife. It is typically found growing on saturated soils and is often considered the transition zone between aquatic communities and uplands. Wet meadows are common along the shores of shallow lakes, stream margins, and the edges of marshes, and can occur in areas of restricted drainage. Though the soils remain saturated most of the year, there is little standing water present (except after flooding or precipitation events).

Wet meadow dominated by grasses.
Image: USDA NRCS

Goldenrods in a wet meadow.
Image: Bob Arnebeck

II. Sensitivity to Oil Spills

The wet meadows habitat is highly sensitive to oil spills. This transitional habitat is valuable to upland and wetland plants and animals. Many animal species use the wet meadows habitat for reproduction, feeding, and as winter cover. Significant loss of this habitat would greatly affect the populations of these animals and consequently, the local ecology. Light refined oils can spread downslope even through thick vegetation and can penetrate into the organic-rich soils. Light refined oils with high amounts of water-soluble fractions can cause acute mortality to animals and plants in this habitat. Heavier oils get trapped at the edge of thick vegetation and can be more persistent. They also tend to coat vegetation and animals, though the vegetation may survive if oil coats only the stems or if the roots are not affected.

References/Additional Information:

General Classification Handbook for Floodplain Vegetation in Large River Systems (http://pubs.usgs.gov/tm/2005/tm2A1/)

Inland Oil Spills: Options for Minimizing Environmental Impacts for Freshwater Spill Response (http://www.michigan.gov/documents/deq/deq-wb-wws-FreshwaterResponse_NOAA102706_265069_7.pdf)

MN DNR (http://www.dnr.state.mn.us/restoreyourshore/pg/meadow.html)

The U.S. National Vegetation Classification (http://usnvc.org/)

Wetland Plants and Plant Communities of MN & WI, 3rd Edition (http://www.bwsr.state.mn.us/wetlands/delineation/WPPC_MN_WI/index.html)

Oil Spills in Marshes: Planning and Response Considerations (http://response.restoration.noaa.gov/sites/default/files/Oil_Spills_in_Marshes.pdf)

Information compiled by UMRBA staff from NOAA, USFWS, and U.S. EPA sources, March 2016.

INLAND STRANDED OIL HABITAT FACT SHEET FOR RESPONSE:

Wet Meadow

III. Sensitivity to Response Methods

The following text describes potential adverse impacts to this habitat resulting from various oil spill response methods and provides recommendations to reduce impact when these methods are implemented. This is not intended to preclude the use of any particular methods, but rather to aid responders in balancing the need to remove oil with the possible adverse effects of removal. More detail about the response methods themselves can be found in the Inland Response Tactics Manual.

Least Adverse Habitat Impacts

Flooding

- Appropriate for locations with gentle gradient where persistent oil has pooled.
- Should only be used if released oil can be reliably directed towards sorbents or recovery devices and prevented from impacting other areas.
- Effectiveness increases with lighter oils because they are less viscous and less residual oil is left in the environment.
- Some oil may still be left stranded after flooding and will need to be collected through other means.

Collection by Direct Suction

- Adverse impact can be mitigated by limiting vehicles, hoses, and equipment to staging areas with firm substrate and sparse vegetation. If equipment must access other areas, precautions should be taken to avoid driving oil into sediment or softer substrate, and trampling vegetation. For example: limit access routes through the area; walk, drive, and station equipment on mats or boards instead of directly on top of vegetation; use boats in flooded areas; and use a helicopter to bring in equipment to areas that are difficult to access.
- Only useful where oil is thickly pooled (not appropriate for sheens).

Low-Pressure, Ambient-Water Flushing

- Effective for washing oil stranded on banks into the water for recovery.
- Vegetation cover minimizes the potential for sediment erosion from flushing. However, thick vegetation also reduces area of influence of flushing operations.
- Effectiveness increases with lighter oils because they are less viscous and less residual oil is left in the environment.

In-Situ Burning

- May be one of the least physically damaging means of moderate and heavy oil removal.
- "Heavy ends" of petroleum product remain unburned and must be recovered. This residue will sink once it is cool.
- Least adverse impact when used in grassy areas versus areas covered with trees and shrubs. Fires are a naturally occurring part of this habitat's plant lifecycle, so vegetation should be able to recover quickly from a burn as long as the roots are not damaged.
- Authorization of in-situ burning is subject to RRT approval, consultation and concurrence from the state and the Department of the Interior.

Some Adverse Habitat Impact

Natural Attenuation/Phytoremediation

- Least impact for small to moderate spills and lighter oils; avoids damage often associated with cleanup activities.
- Cleanup should be used in addition to attenuation in areas where using only attenuation would put sizable wildlife populations as risk for becoming oiled or re-oiled.

Debris/Vegetation Removal

- Most appropriate for oils that form a thick, sticky coating on the vegetation, such as medium and heavy oils.
- Remove stained or oiled vegetation to protect wildlife users of the habitat. Additionally, grass roots can by damaged by oil and may need to be removed as well.
- Damage by cleanup crews may be reduced by avoiding excessive cutting/removal.
- Response crews entering the marsh can inadvertently trample vegetation during cleanup/removal. To reduce this impact: control and minimize access routes through the marsh; have personnel stand or kneel on boards while working; and conduct operations from boats when possible.

Most Adverse Habitat Impact

Light Equipment Oil Removal

- May be needed where oil has heavily contaminated bottom sediments.
- Most effective where access is good and substrate can support vehicles.
- Avoid forcing oil into the substrate and trampling vegetation by limiting access routes through the area, traversing the area on boards/mats/pontoons, or using a helicopter to bring in equipment.

Hand Tool Oil Removal/Cleaning

- Used where persistent oil occurs in heavy amounts and animals using the wetland are likely to be oiled.
- Avoid forcing oil into substrate and trampling vegetation by limiting access routes through the area and walking on boards or mats.

Sorbents

- Overuse generates excess waste.
- Forcing contact between pads and oiled substrate can drive oil into the soil, making it more difficult to recover.

Sediment Removal

- For watered areas: vacuum/dredge sediments and dewater using geotube/settling tank; or, where feasible, dewater the area and excavate the sediment.
- Significant sediment removal may result in a change in the area's hydrology as well as make it difficult to fully restore the plant community that existed prior to the spill incident.
- Permits will be required for sediment removal and for water discharge.