

# In Situ Burning of Spilled Oil in Inland Regions of the United States

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# Why Burn? - Advantages

- Rapid removal of large amounts of oil
- Much less oil left for disposal
- High efficiency rates (up to 98-99%)
- Less equipment and labor required
- May be only viable option (marshes, ice)

# Disadvantages

- Large black smoke plume
- Heavily emulsified oils do not burn (not typical for inland spills)
- Minimum thickness needed for oil to ignite
- Risk of fire spreading (safety)
- Burn residue can be difficult to recover (may sink from burns of very heavy oils)

# Considerations for Use

- **SAFETY**
  - protect workers and public
- Ignition
- Plant and soil moisture
  - high moisture desirable
- Season
  - winter best, early summer worst
- Weather conditions
  - Low, steady winds; no weather fronts or storms
  - No atmospheric inversion to trap smoke
- Residue collection

# Burn from Hurricane Spill



# North Dakota Crude Burn



# North Dakota Spill after Burn



# Ignition with Propane Torch





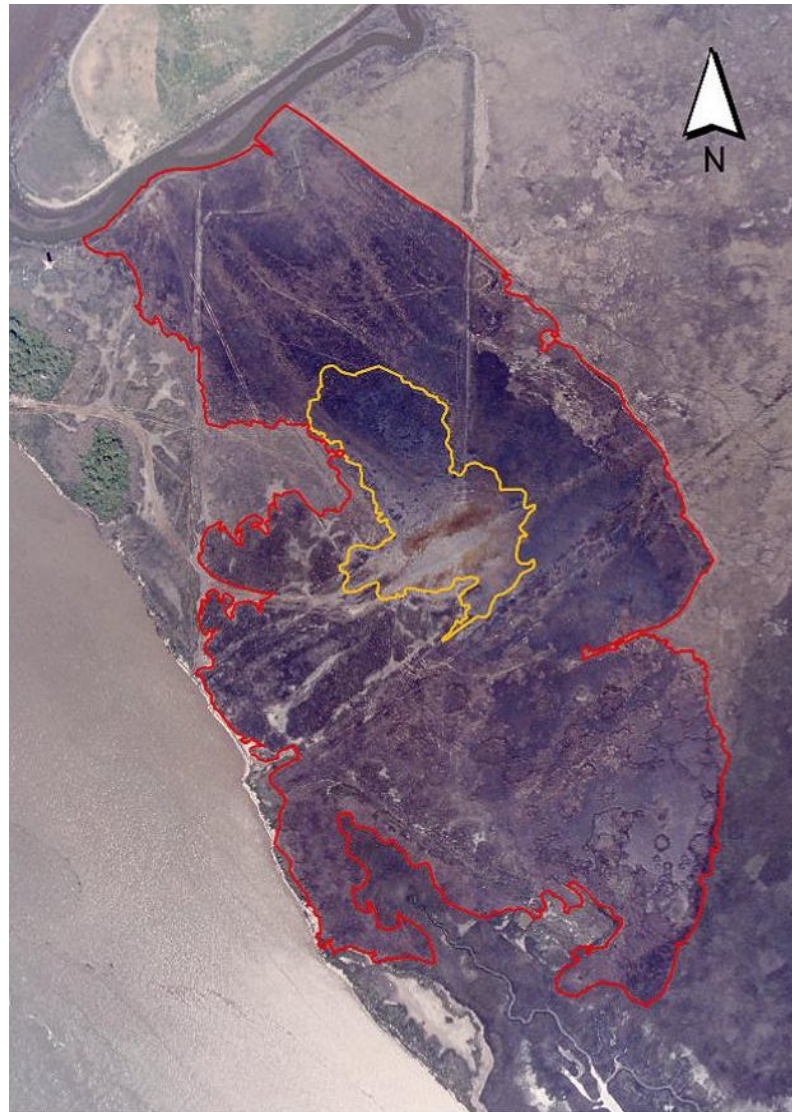
# Resulting Fire



# Moisture Protects Oiled Marsh



# Burned Area Much Larger Than Spill



200 0 200 Meters

■ Burned area  
■ Oiled area

# Recovery After 21 Months

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# Jet Fuel Burn in Marsh



# Ignition with Pad Soaked in JP-5



# Snow and Ice Protects Plants







# Immediately Post Burn



# Residue



# One Year Later (early spring)



# Two Years Later



# Diesel Spill in Marsh & Mud Flats



# Ignition with Propane Torch



# Ignition with Flare



# Utah Site after Burn





# Utah Site Recovery after 1.5 Years



# Condensate Spill in Salt Marsh



# Sorbents were Inadequate



# Mosquito Bay Burn



# Fire Spreading Beyond Oiled Area



# Site after Burn



# Burned Area Much Larger Than Spill



# Mosquito Bay Recovery





# Cohasset Crude Oil Burn



# US Forest Service Applying Flame Retardant to Prevent Fire Spread



# Ignition with Flare Gun



# Fire Spreads Slowly



# Fire Getting Larger



# Fire Fully Involved



# White Fire Retardant on Trees



# Fire Only Burned Oiled Area





# Moisture Protected Roots



# Air Inversion Causes Smoke to Fill Sky



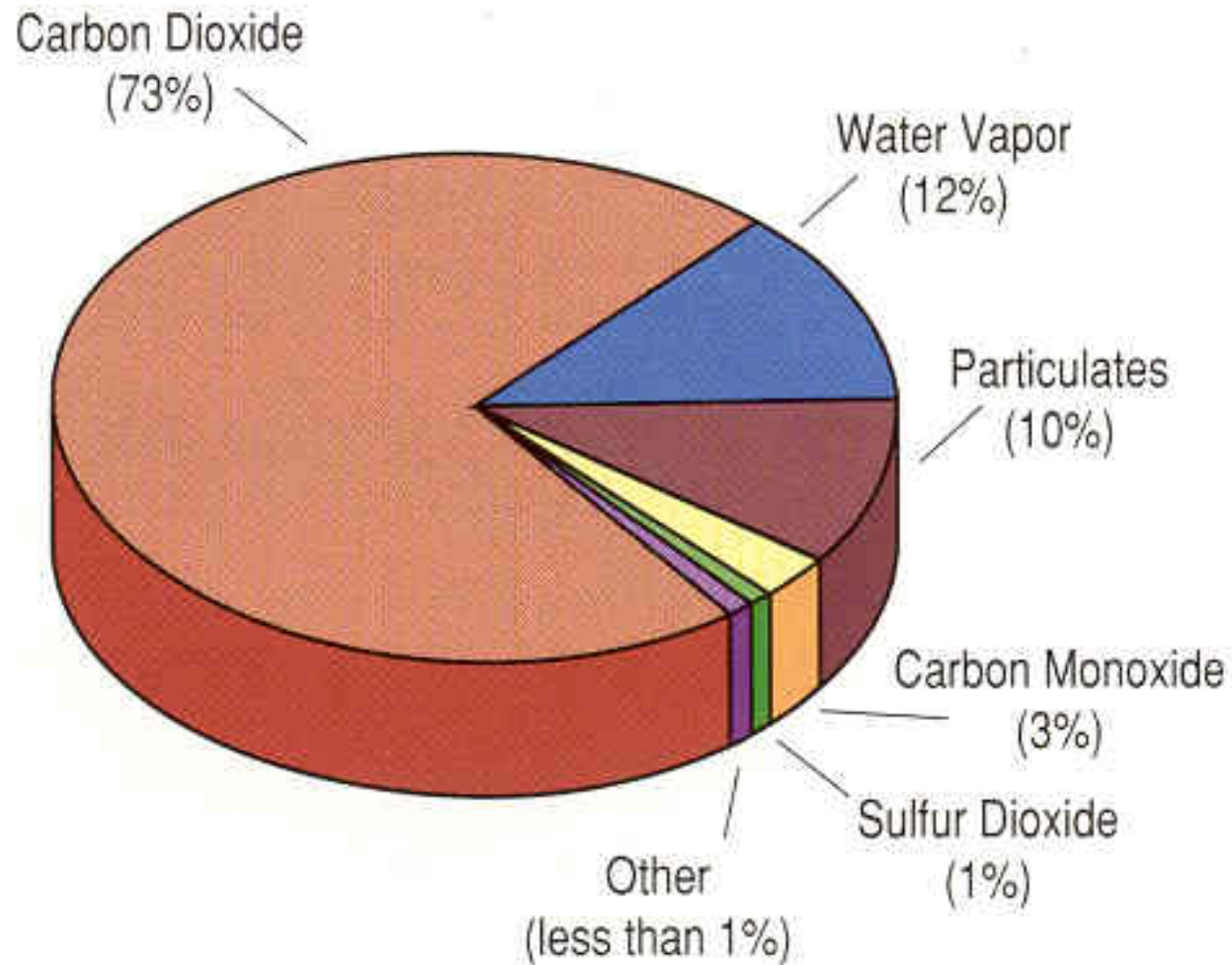
# Air Quality Concerns Result



# Emissions

- Soot is only real problem (10-15% of oil burned) and consists of carbon with other contaminants in ppm range
- VOC's are consumed by fire and are less than if oil left to evaporate
- PAH's are lower in soot and residue than original oil
- Metals and sulfur compounds are very low
- Within 500 meters downwind, ground concentrations less than  $150 \mu\text{m}/\text{m}^3$

# Combustion Components



# Residue Pickup



# Digging a New Pond



# Final Cleanup Created Pond





# Crude Oil Burn in Pond/Wetland



# Tarry Residue Picked Up in Sheets



# Recovery One Year later



# Summary

- In-Situ Burning is a useful cleanup method for inland oil spills
- Safety of the burn is paramount
- Weather and season must be considered
- Moisture is needed to prevent the fire from spreading and to protect the plants
- Ignition is “easy”
- Burn residue may still have to be recovered or treated (bioremediation)