

Clean-up and Management of Contaminated Soil in the North Dakota Oil Fields

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WPC – An Overview

- WPC is a North Dakota-based Environmental and Natural Resources Consulting Firm
- Services Offered
 - Incident Response, Excavation Observation, Sampling, Reporting, Overall Project Management
 - Environmental and Biological Assessments
 - Indoor Air Quality Services
 - Subsurface and Groundwater Assessments
 - Remediation and Reclamation Planning and Implementation
 - Wetland Delineation, 404 Permitting, Restoration, Mitigation
 - NEPA and FERC Projects

Oil Field Experience

- Response to Releases of Crude Oil, Salt-water, and Crude Oil & Salt-Water Emulsions, including NORM sampling
- Responsibilities ranging from simply sampling soils or waters after cleanup, to managing complex cleanups
- Biological Assessments on Federal Lands prior to Oil Field Development
- Baseline Water Well Sampling of Private Wells prior to Oil Field Development
- Serving on committees with the ND Petroleum Council related to emissions and safety issues
- Baseline soil studies/surveys – ONLY Canadian Oil Companies – and not all of them – requirement in Canada!

Types of Responses

- Pipeline Breaks of Oil Field products (crude oil/salt-water/emulsions)
- Drilling Pad releases – occasionally happen during work over activities
- LACT unit releases – always crude oil, often from overfilling LACT tanks, or fitting failures
- Impact to Livestock – Illegal Dumping of Salt-water occurrences
- Occasional Accidents
- Sewage Dumping

Who Regulates??

- Federal Lands – Regulated by Federal Agencies
- Tribal Lands – Tribal EPA, Federal Agencies
- Private and State Lands – Regulated by the Oil and Gas Division of the North Dakota Industrial Commission & the North Dakota Department of Health



The Rules!!

- Federal Policy on Federal Lands
 - Regulate to the standards set by Local Regulatory Standards – In North Dakota – the State of North Dakota Standards!!
- North Dakota Department of Health
 - Draft Standards – Never Promulgated!
- Oil and Gas Division

Oil and Gas Division Standards

Soil Impacts - Salt Water

- **Guide for Remediation of Salt/Hydrocarbon Impact Soils, North Dakota Industrial Commission Section VII Alternative Remediation Methods, A. Soil Removal**
- - When the average EC of the 0-6 inch samples is greater than 35,000 uS/cm, soil removal and replacement may be more economical than treatment. Additional EC measurements are required to determine precisely where the salt contamination is located within the soil profile. Use the same soil analysis procedures as presented previously; the only difference is that specific soil profile intervals are being tested.

Oil and Gas Division Standards

Soil Impacts - Salt Water

- Test EC at 0-1 inch
- Test EC at 1-2 inches
- Test EC at 2-3 inches
- Test EC at 6-7 inches
- If the EC tests indicate the majority of the salt is concentrated in the top of the soil profile, removal and replacement are the remediation of choice.
- -When removal and replacement remediation is used, the quality of the soil replacement is important. Electrical conductivity of replacement soil should be 1,000 $\mu\text{S}/\text{cm}$ or less. Test the replacement soil at the source before the soil arrives at the site.
- Landowner's consent is required for soil replacement!!
- Up to 4 years of Agency oversight on cleanups!

Oil and Gas Division Standards

Soil Impacts - Salt Water

- State does have a planning document – the information provided is not complete but for soil replacement only
- Other options are remedy in place – WPC does not recommend!
- Most of North Dakota has shallow water table – Driving Salts deeper, in our opinion, is NOT a solution
- Salts are mobile – will move laterally, and can wick up through capillary action and re-contaminate reclaimed soils – or move and impact previously un-impacted soils!

NDDH Standards – Never Published!

Soil Impacts - Salt Water

- The NDDH, in or about 2001, was working on “North Dakota Guidelines for Evaluation and Cleanup of Oilfield Releases”. The NDDH developed a draft of this document, but has never enacted or enforced these guidelines.
- Under these draft guidelines, the NDDH identified factors that may affect cleanup guidelines, including: soil type and permeability, distance to groundwater, relationship to surface water, distance to drinking water wells, volume of affected material, initial concentrations of contaminants in soils, biologic organisms considerations, **and** soil chemistry.

NDDH Standards – Never Published!

Soil Impacts - Salt Water

- The NDDH identified the most common methods of cleanup, which include: excavation/disposal and replacement, burning (crude oil), monitored natural attenuation, enhanced bioremediation, and enhanced leaching.
- The NDDH further states *Salts have been identified as one of the principal limiting constituents of concern relative to releases because they may induce a phytotoxicity or, in the case of sodium salts, may deteriorate soil structure interrupting normal soil-plant-water relationships and causing excessive erosion. Salts associated with Exploration and Production (E&P) wastes may also pose a significant threat to surface and groundwater resources if not properly managed.*

NDDH Standards – Never Published!

Soil Impacts - Salt Water

- The NDDH presented salt/sodium action levels for soils affected by salt water releases:
 - The NDDH stated the Action Level for EC was > 4 mmhos/cm or > 4 dS/m, which is approximately equivalent to the EC of a water with a total dissolved solids of 2600 mg/L. The NDDH stated the Action Level for SAR was > 13 .
- The NDDH did not provide any reclamation guidelines. The NDDH does go on to state: *If natural background soil characteristics show poorer quality than that depicted by these limits, or if a higher level consistent with intended land use can be demonstrated, then these limits can be exceeded. In very sensitive areas more restrictive limits for salinity may be applied on a case-by-case basis, especially for large volumes of waste.*

NDDH Standards – Never Published!

Soil Impacts - Salt Water

- The NDDH also states: *Important: Do not flush the soils with fresh water until you have measured the sodium level and, as needed, applied a soil amendment to prevent soil dispersion. Before beginning any remediation effort in salt affected soils, it is critical to understand the dynamics involved.*



Water Quality

- Will Not Discuss in Detail Today – Focus on Soils
- But – rules that apply are surface and drinking water standards enforced by the NDDH and the EPA – Often more restrictive for certain contaminants!



Text



Regulations

Soil Impacts – Crude Oil!

- Oil and Gas Division – reportedly action level is 10,000 ppm as TPH!!
 - Have yet to see in writing from Oil and Gas or on web page!
- NDDH
 - 100 ppm TPH!



WPC – What We Recommend!

- Crude oil!! We follow the NDDH cleanup guidance of 100 ppm – and in the field we remove ALL visually impacted soils, screen with a Photo-Ionization Detector, and pull confirmatory lab samples
- Salt-Water and Emulsions – Salt-water portion
 - Use hand-held EC meter in field – calibrated and lab samples for: EC, pH, major cations, major anions, SAR, CEC, CCE, ESP, metals!
 - Screen as best in field – leave holes open while samples being analyzed in case more soil needs to be removed!!
 - Chloride – Easily the best tracker in western ND – NOT naturally occurring!! Hanna Field Meter better than Oakton!

Reclamation!

- NO Clear Standards!
- What WPC does, at least on large scale projects:
 - Pull background samples on surrounding soils for reference
 - Use NRCS published soil surveys, web soil survey, electronic field guides – find published baseline data for specific soil types as a guide
 - For background on metals – studies by the USGS
 - <http://tin.er.usgs.gov/geochem/doc/home.htm>
 - <http://tin.er.usgs.gov/geochem/doc/home.htm>
 - NOTE – most North Dakota Soils – naturally high in metals – rarely do these spills present a concern related to metals!
- AND we go another step when possible!

Reclamation!

- WPC recommends that the guidelines for reclamation of Surface Coal Mines in North Dakota be used as reclamation guidance in many cases, specifically in regards to the zone of suitable plant growth material, which is typically the top four (4) feet of the landscape to be reclaimed. It is as follows:
 - The North Dakota Public Service Commission (PSC), working with professional soil classifiers input, developed guidance standards for reclaiming mineland soils for suitable future use. These guidelines, are from the North Dakota Administrative Code Article 69-05, specifically Chapter 69-05.2-08. Paragraph *a* deals with topsoil (suitable plant growth material), and paragraph *b* deals with subsoil. Depth for reclamation per these standards is typically four (4) feet from the surface down.

Reclamation!

- a. The location and the vertical and lateral (areal) extent of the suitable plant growth material (topsoil) within the permit area that is considered best for topdressing the area to be reclaimed. Suitable plant growth material considered best for topdressing is the noncalcareous surface horizon material that is dark-colored due to organic staining, has an **electrical conductivity of less than two millimhos per centimeter ($EC \times 10^3$)**, a **sodium adsorption ratio of less than four (exchangeable sodium percentage of less than five)** and an **organic matter percentage of one or more**.
- b. The location and the vertical and lateral (areal) extent of the remaining suitable plant growth material (subsoil) within the permit area, based on **electrical conductivity of the saturation extract of less than four millimhos per centimeter ($EC \times 10^3$)**, and **sodium adsorption ratios of less than ten (exchangeable sodium percentage of less than twelve)**.

Water Quality Issues

- Follow State and Federal Guidelines
- Generally focusing on surface water quality rules and clean water act
- Often involves sampling of runoff, ponds, rivers, lakes
- Involved in capturing and oil companies injecting waters
- Groundwater recovery/protection systems
- Almost always considered, and most projects do have a water quality component, unless no impacts noted

WPC Response Examples

- Crude Oil Emulsion Release – Missouri Breaks above Lake Sakakawea
- Crude Oil Emulsion Release – 2011 – Impacts to Lake Sakakawea
- Crude Oil Emulsion Release – 2012 Burke County – Farm Field
- Salt-water Pipeline Release – Mohall area – 2012
- Cattle mortality – Illegal Salt-water Dumping – Billings County North Dakota
- Crude Oil remediation – Billings County

WPC Experience with Oil Companies

- WPC's Oil field clientele – whether production or hauling companies – do what is necessary!
- They rely on our judgment
- When private landowners involved – at times we've been told by oil company – do what ever it takes – make them whole!
- At times – Oil companies have directed work voluntarily – even when they have no liability!
- We hear this is not always the case!
- Our experience – our clients want to maintain good landowner relationships – whether this is with private or government landowners!





























Thank you for your time!

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