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WORK PLAN

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Corrective Action Plan for F-33 Vent Junction Box Site

Hobbs Salt Water Disposal System

NMOCD Case #: 1R0428-58

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1.0 EXECUTIVE SUMMARY

This Corrective Action Plan presents the results of the characterization activities performed by R.T. Hicks Consultants (Hicks Consultants) and Rice Operating Company (ROC) at the F-33 Vent Junction Box site located in the Hobbs Salt Water Disposal System (SWD) and proposes closure of the site after implementation of the selected remedy.

The selected remedy includes excavation and blending of the upper 16 feet of hydrocarbon-impacted soil, placing a clay barrier beneath the root zone, creation of an infiltration barrier through surface restoration and re-vegetation of the site, and natural biodegradation of the small mass of hydrocarbons that may reside in the vadose zone between approximately 10 and 16 feet bgs (See Figure 3). Excavation and disposal of high concentration areas will be performed as required to facilitate. This remedy is protective of ground water quality, human health and the environment. After re-vegetation of the site, ROC will submit a final closure report.

Data Summary

1. Hicks Consultants supervised field activities at the F-33 Vent site in May 2006. This involved general reconnaissance as well as supervision of backhoe sampling of the upper vadose zone.
2. Due to safety concerns with the high voltage powerline immediately above the former vent, a backhoe was used to collect samples instead of a drilling rig, as originally proposed in the NMOCD-approved workplan. Even though investigators deviated from the original proposal, we believe the findings are sufficient to characterize the site. Samples were collected at 2 ft sample intervals from ground surface to a depth of 12 ft at points located approximately 10 feet east, west, north, and south of the former vent. In addition, samples were collected at 1 ft intervals to a depth of 16 ft at the former vent. Samples were field-tested for chloride content and screened with a photoionization detector (PID) for indications of hydrocarbons. Soil samples were also submitted to a laboratory for more detailed hydrocarbon analysis.
3. Chloride concentration data show concentrations in the vadose zone are less than 1,000 ppm. Chloride concentrations were highest (848

mg/kg) at a depth of 6 feet bgs directly beneath the vent location and declined below 6 feet bgs to a concentration of 230 ppm at 16 feet. In all sampling excavations 10 feet east, north, south and west, chloride concentrations were less than 500 ppm. Chloride levels showed a consistent decline with depth.

4. Hydrocarbon impact is confined to the close vicinity of the vent and within the upper portion of the vadose zone. Although some samples from excavations detected hydrocarbon vapors in excess of 100 ppm, laboratory analyses detected neither benzene nor toluene. At the vent site, concentrations of ethylybenzene and xylene were 37.7 and 65.3 mg/kg respectively at a depth of 12 feet below land surface. At 16 feet below land surface in this same sampling excavation, the ethylybenzene concentrations was 27.7 mg/kg and the xylene concentration was 0.3 mg/kg. At sampling sites north, south, east and west of the vent, ethylbenzene and xylene concentrations are less than 1 ppm.

5. On July 20, 2006, an air rotary drilling rig was used to advance two soil borings as close to the former vent as possible, in an attempt to provide more certainty that hydrocarbon impact did not extend laterally into the deep vadose zone. These borings confirmed no chloride or hydrocarbon impact to the vadose zone at these two locations 22 feet east and 30 feet west of the vent, respectively. The borings were terminated at a depth of 50 feet bgs.

6. Based on data from other nearby sites, particularly the E-33-1 junction box site, depth to groundwater at the F-33 vent site is estimated at approximately 65 feet bgs.

Conclusions

1. At the vent site, concentrations of hydrocarbons decline with depth, based upon PID readings. Laboratory analyses show that neither benzene nor toluene were detected in any samples. Xylene declines from 65.3 mg/kg at 14 feet bgs to 0.3 mg/kg at 16 feet bgs and ethylbenzene declines form 37.7 mg/kg to 27.7 mg/kg in this same depth interval. From these data we conclude that the mass of subsurface hydrocarbons is small and limited to the upper vadose zone.

2. We conclude that the mass of subsurface chloride release at this site

was not large enough to necessitate detailed simulation modeling of constituent fate and transport.

3. Re-vegetation of the site will reduce the infiltration of precipitation and minimize the potential for any constituents of concern to migrate downward to ground water.

Recommendations

1. Excavation of a 10-foot by 10-foot area at the former vent site to a depth of 12 feet and blending of material in the upper 12-feet of the vadose zone until field tests of the excavated soil mixture do not exceed 100 ppm of total organic vapors using a calibrated photo-ionization meter with the appropriate lamp (headspace method) and chloride concentrations in the backfill will not exceed 1,000 ppm. Disposal of high concentration zones of hydrocarbons may be necessary to meet the prescribed concentrations.

2. A minimum 10-12 inch thick clay layer will be installed at the base of the root zone, about 4 feet below ground surface. The clay layer will be sloped to the southeast, will extend laterally to deflect any potential infiltrating water from the surface and will be compacted according to protocols applied to backfill in new pipeline trenches. Topsoil will be placed above the clay layer to the ground surface.

3. Restoration and re-vegetation of the ground surface.

4. Upon documentation of these actions ROC will submit a closure report for the F-33 Vent Junction Box site and request closure of the regulatory file.

2.0 BACKGROUND

The Hobbs Salt Water Disposal System (SWD), which managed produced water from the late 1950s to the present, is now closed. Future releases from the system infrastructure are not possible. With the abandonment of the system in 2002, Rice Operating Company (ROC) excavated and removed the F-33 Vent. Closure of facilities like the F-33 Vent site within Hobbs SWD followed the July 16, 2003 NMOCD approved junction box investigation plan. This plan calls for delineation of any impact from these sites during the closure process and states:

> *If 12 feet vertical delineation at the source reveals Target Concentrations for TPH or BTEX will not meet NMOCD guidelines or TPH and BTEX will meet guidelines but there is not a significant decline vs. depth in chloride concentration, the site-impact is judged to be outside the scope of this work plan and will become a risk-based corrective action (RBCA) project-site.*

The investigation and characterization used the same protocols as described in the NMOCD-approved work plan for the Section 29 sites and the field protocols were consistent with the Investigation Characterization Plan (ICP) submitted for the site (see Appendix A). However, the presence of electrical lines over the site prevented the use of a drill rig for deep vadose zone sampling, as originally proposed. Instead, a backhoe collected samples from the former vent site and nearby locations to the maximum reach of the backhoe, which is 14-16 feet. To determine if operation of the site caused lateral migration of chloride or hydrocarbons at depth, two soil borings were advanced as close as possible to the site.

2.1 Location

Plate 1 is an aerial photograph of the site when it was active, taken between 1996 and 1998 that shows the location of the boring and nearby roads.

The site is within unit letter F, Section 33, Township 18S Range 38E.

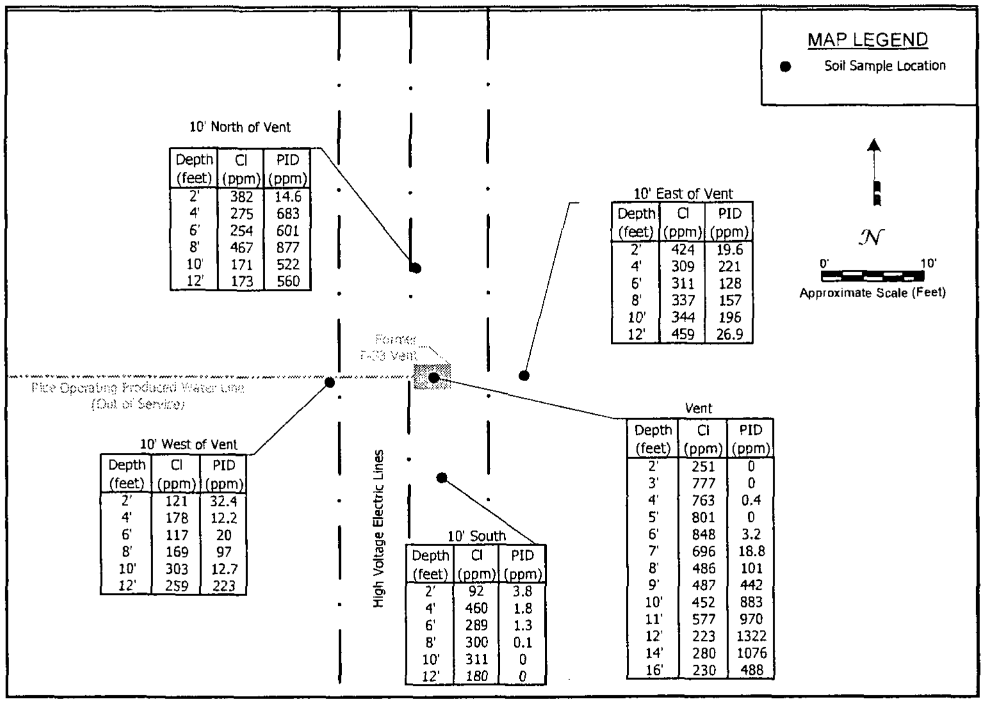
2.2 Characterization Activities

The investigation and characterization used the same protocols as described in the NMOCD-approved work plan for the Section 29 sites and was as consistent as possible with the Investigation Characterization Plan (ICP) submitted for the site (see Appendix A) as possible given the site limitations noted in section 2.0. In order to permit comparison of the results from site borings with the ambient chloride concentrations in the vadose zone, collection of samples from a background soil boring was a critical element of the ICP. Appendix B shows the results of field chloride measurements from the background soil boring located in Section 32, Unit A.

A backhoe under ROC supervision was used on May 22, 2006, to collect samples instead of a drilling rig. Samples were collected at 2 ft sample intervals from ground surface to a depth of 12 ft at points located approximately 10 feet east, west, north, and south of the former vent (Figure 1). In addition, samples were collected at 1ft intervals to a depth of 16 ft at the former vent. Samples were field-tested for chloride content and screened with a PID for indications of hydrocarbons.

On July 20, 2006, an air rotary drilling rig was used to advance two soil borings as close to the former vent as possible, in an attempt to delineate the hydrocarbon impact vertically identified by the previous backhoe sampling activities. The first boring (B-1) was advanced at a point 22 ft east of the vent. The second (B-2) was placed 30 ft west of the vent.

Based on the results from the backhoe and soil boring sampling activities hydrocarbon-impact was confirmed in the upper vadose zone and is confined within the near vicinity of the F-33 vent. All data shows that there is negligible chloride impact to the vadose zone. Appendix B presents the results of the field program.



10' North of Vent

Depth (feet)	Cl (ppm)	PID (ppm)
2'	382	14.6
4'	275	683
6'	254	601
8'	467	877
10'	171	522
12'	173	560

10' East of Vent

Depth (feet)	Cl (ppm)	PID (ppm)
2'	424	19.6
4'	309	221
6'	311	128
8'	337	157
10'	344	196
12'	459	26.9

10' West of Vent

Depth (feet)	Cl (ppm)	PID (ppm)
2'	121	32.4
4'	178	12.2
6'	117	20
8'	169	97
10'	303	12.7
12'	259	223

10' South

Depth (feet)	Cl (ppm)	PID (ppm)
2'	92	3.8
4'	460	1.8
6'	289	1.3
8'	300	0.1
10'	311	0
12'	180	0

Vent

Depth (feet)	Cl (ppm)	PID (ppm)
2'	251	0
3'	777	0
4'	763	0.4
5'	801	0
6'	848	3.2
7'	696	18.8
8'	486	101
9'	487	442
10'	452	883
11'	577	970
12'	223	1322
14'	280	1076
16'	230	488

Figure 1 Map Depicting the Preliminary Field Screening Results at the Site.

▼ 3.0 CHARACTERISTICS OF THE VADOSE ZONE

As the boring logs in Appendix B show, the upper 2 feet of the vadose zone at the site is composed a highly indurated caliche layer. Beneath the caliche is an 18 foot thick layer of calcic very fine-grained sand. An 8 foot thick layer of very fine to fine-grained sand with less calcic content lies below fine sand described earlier and this unit is underlain by calcic very-fine to fine-grained sand which continued to a depth of 50 feet bgs in boring B-2. A fine-grained sand with little or no calcium carbonate content was observed from 50 feet to the bottom of boring B-2 at 52 feet bgs. The lithologic logs for the two borings are included in Appendix B.

Although samples from the boreholes did not detect any chloride concentrations in samples from the five backhoe sampling trenches (see Figure 1) ranged from a maximum of 848 ppm at a point 6 ft below the vent source to a concentration of 92 ppm at a point 2 ft below a spot located 10 ft south of the former vent. The chloride concentration vs. depth profile is displayed in Figure 2.

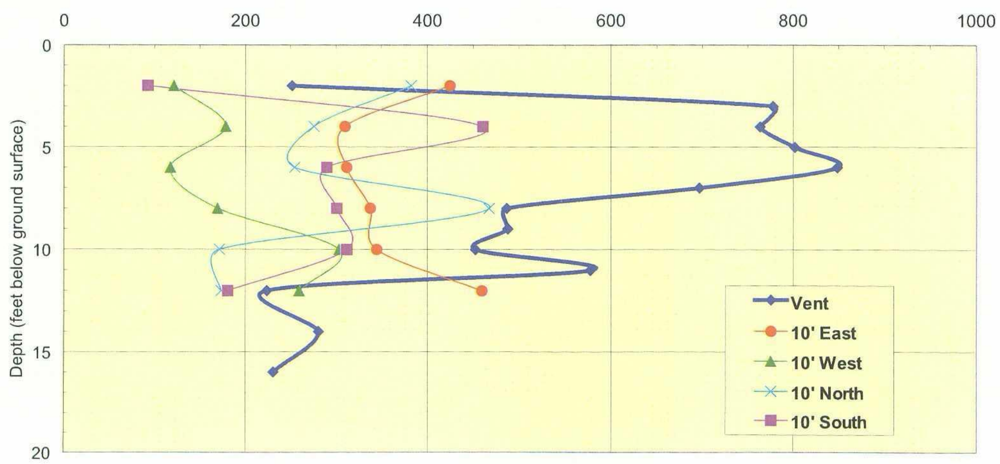


Figure 2: Chloride Concentrations (mg/kg) versus Depth

Soil samples with the highest PID readings and the deepest intervals were submitted to the laboratory for detailed hydrocarbon analysis using Methods 8260 for BTEX constituents and Method 1006 (a modified 8015 gas chromatography) for gas and diesel range organics (GRO and DRO) and carbon fractionation. The laboratory analytical reports and chain of custody documentation are included in Appendix C. The PID readings vs. depth profile is displayed in Figure 3.

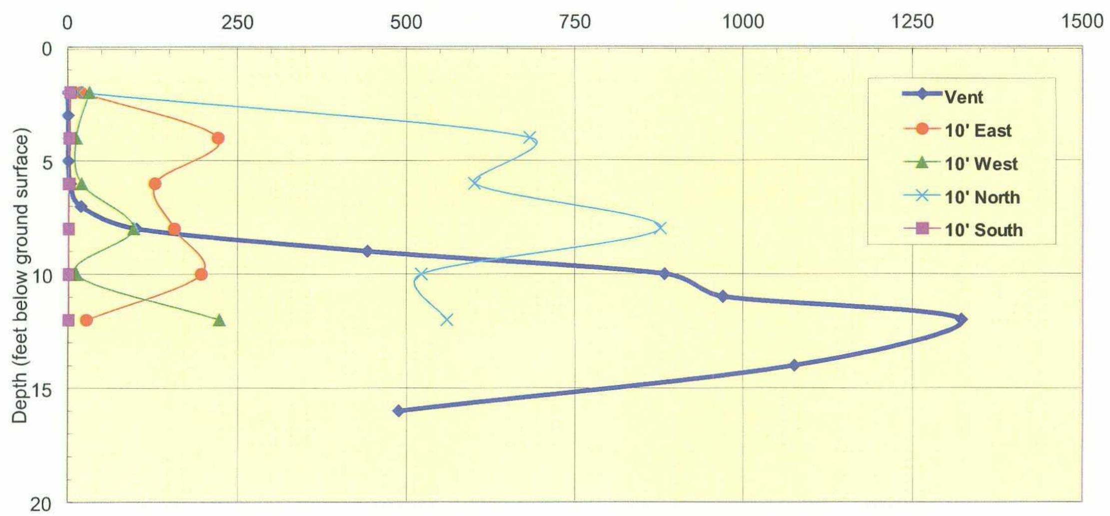


Figure 3: PID Readings (ppm) versus Depth

Based on the backhoe sampling results hydrocarbon-impact exists in the upper 16 feet of vadose zone and is confined within the near vicinity of the F-33 vent (less than 10-foot radius from the vent). Results of the laboratory analyses for regulated hydrocarbons are summarized in Table 1 below.

Location	Depth (Ft bgs)	Regulated Hydrocarbons (mg/kg)			
		B	T	E	X
Vent Source	12'	<0.025	<0.025	37.7	65.3
	16'	<0.025	<0.025	27.7	0.3
10 ft east of Vent	4'	<0.025	<0.025	0.513	0.429
	12'	<0.025	<0.025	0.516	<0.025
10 ft west of Vent	12'	<0.025	<0.025	0.117	0.058
10 ft north of vent	8'	<0.025	<0.025	0.094	0.590
	12'	<0.025	<0.025	0.073	0.293

Table 1: Summary of Regulated Hydrocarbons in the Vadose Zone

PID readings measured 0 ppm for each 2 ft interval sampled from 4 ft bgs to 20 ft bgs and then at 5 ft intervals from 20 ft bgs to 40 ft bgs in each boring. Chloride field-testing measurements varied from a minimum of 28 ppm in the 20-22 ft interval in boring B-2 to a maximum of 410 ppm in the 16-18 ft and 20-22 ft intervals of boring B-1. Results of the soil borings confirmed that any chloride and hydrocarbon impact to the vadose zone is confined to the near vicinity of the F-33 vent.

▼ 4.0 EVALUATION OF VERTICAL CHLORIDE FLUX

The chloride concentrations at the site are consistently well below 1,000 mg/kg. Moreover, chloride concentrations decrease with increasing depth, suggesting that saturated or near-saturated flow did not exist in the upper vadose zone. With the construction of the simple ET infiltration barrier described in section 6.0, unsaturated flow will decrease to near zero.

▼ 5.0 EVALUATION OF VERTICAL HYDROCARBON FLUX

With the construction of the simple ET infiltration barrier, unsaturated flow will decrease to near zero and any hydrocarbons in the upper vadose zone will not represent a threat to fresh water. Because of the low concentrations and attendant small mass of hydrocarbons neither unsaturated zone modeling or additional characterization is necessary at this site.

▼ 6.0 PROPOSED REMEDY

The proposed corrective action for this site is excavation of soils in the upper vadose zone to a depth of about 12 feet, which is the maximum reach of a standard backhoe, or to a shallower depth if field testing of soils shows that total organic vapors are less than 100 ppm. Field testing of soils employs the head-space method and a properly calibrated PID with a appropriate lamp. Soil with total organic vapor concentrations above 100 ppm as determined by field testing of soils will be hauled to an NMOCD-approved facility unless the volume of soil can be blended with clean soil and remediated on site. Upon completion of excavation activities, closure samples will be collected to verify hydrocarbon vapors do not exceed 100 ppm. Chloride concentrations in the back fill will not exceed 1,000 ppm.

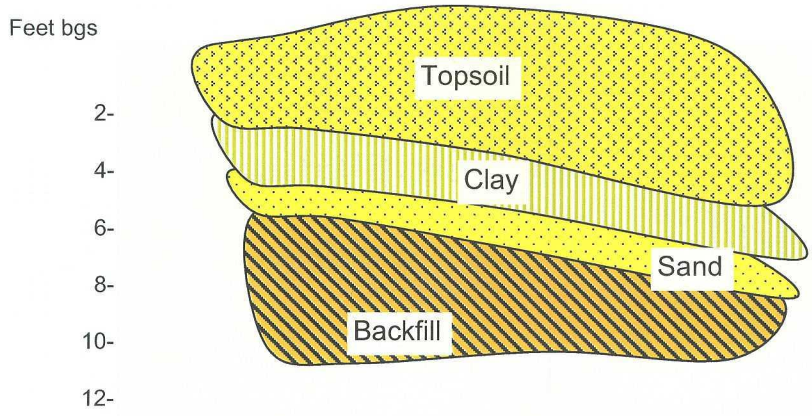


Figure 4: Schematic diagram of ET Infiltration Barrier

As shown in Figure 4, a minimum 10-12 inch thick clay layer will be installed at the base of the root zone, about 4-feet below ground surface. The clay layer will be sloped to the southeast and will extend laterally to insure sufficient deflection of any potential infiltrating water originating from the surface. The clay layer will be compacted using the same protocols employed to compact backfill in new pipeline trenches. Any excavated material that is not suitable as topsoil will be placed below the clay layer. If possible, a thin layer of coarse sand or caliche gravel excavated from the site will be placed immediately below the clay layer. The backfill (above the clay layer) will be composed of blended or remediated soil and will be placed up to a depth no higher than 2 feet bgs. This topsoil will also be compacted according to the same protocols employed for backfilling new pipeline trenches.

We propose incorporating clay and organic matter into the reserved topsoil and some sand/silt (as necessary) to create a 2-foot silt/loam topsoil surface layer, which will form an evapotranspiration (ET) barrier. HYDRUS-1D simulations of an ET infiltration barrier at other sites in the area and Sandia National Laboratory research of ET landfill covers demonstrate that vegetation on about 2-feet of fine-grained silt-loam effectively prevent measurable deep percolation of infiltration. This silt/loam soil combined with a vegetative cover will effectively sequester any residual hydrocarbons in the vadose zone. The surface will be contoured and reseeded with native vegetation to eliminate any ponding of precipitation and promote evapotranspiration, thereby minimizing natural infiltration. Over time, residual hydrocarbons will naturally biodegrade. Furthermore, the reduction of the deep percolation rate to essentially zero will prevent vertical migration of hydrocarbon constituents to ground water.

▼ 7.0 CRITERIA FOR CLOSURE

After completion of the proposed remedy, ROC will submit a final report documenting the work elements identified herein and request closure of the regulatory file.