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BASEWIDE REMEDIAL INVESTIGATION REPORT FOR SS003 OIL SATURATED AREA
KANSAS CITY MO
12/1/2000
CH2M HILL

Richards-Gebaur AFB
Basewide Remedial Investigation

SS 003 (Oil Saturated Area)

RI Report

December 2000

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1 SS 003 - RI Background

1.1 Site Description

SS 003, the Oil Saturated Area, is located in the southern portion of Richards-Gebaur Air Force Base (AFB), south of 155th Street and southwest of Building 704. The location of SS 003 is shown in Figure 1. The site area, inclusive of an existing monitoring well network, comprises roughly 1.4 acres. SS 003 is paved and flat, and a grassy swale runs parallel to the west and south fencelines.

1.2 Site History

From the mid-1950s to the late 1980s, the site was used to store waste oil products generated by routine maintenance of the Motor Pool vehicles (USAF, 1994). The site is part of the former waste oil storage area and originally covered approximately 1,600 square feet (Versar, 1996).

SS 003 was initially identified during a Phase I Records Search of the Richards-Gebaur AFB (CH2M HILL, 1983). The site was recognized at that time as being oil-stained. The site was further investigated in 1986 when soil and surface water samples were collected and analyzed (Ecology and Environment, 1988). Two additional field samples were collected in 1989 as part of a Remedial Investigation (O'Brien and Gere, 1991). In 1991, approximately 42 cubic yards of contaminated soil was removed from SS 003 (Burns and McDonnell, 1992). In 1996, a groundwater assessment was conducted at the site (Versar, 1996).

1.2.1 Surface Water

One surface water sample was collected during the 1986 site investigation and analyzed for total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), and metals (Ecology & Environment, 1988). The sample was collected from the stormwater drainage swale. No chemicals were detected above applicable action levels.

1.2.2 Sediments

No sediment samples were collected from SS 003 because the drainage swales are covered with grass.

1.2.3 Soil

Six surface soil samples and three subsurface soil samples were collected from SS 003 (Ecology & Environment, 1988). Three of the surface soil samples were collected from the nearby drainage swales. The samples were analyzed for TPH, VOCs, and metals. The three surface samples had concentrations of hydrocarbon constituents above the Missouri Department of Natural Resources (MDNR) action level of 50 parts per million (ppm), with a maximum TPH value of 3,800 ppm. Lead was also detected in one surface soil sample at a concentration of 343 ppm, exceeding the applicable MDNR action level of 240 ppm. No VOCs were detected in any of the soil samples.

Three surface soil samples were collected adjacent to the drainage swale in the second site investigation in 1989 (O'Brien & Gere, 1991). The samples were analyzed for VOCs, SVOCs, and metals. None of the above chemicals were found to exceed their respective MDNR action levels.

In November 1991, 27 cubic yards of soil was excavated from SS 003. The soil was removed in layers to a depth of two feet and was continuously screened for VOCs using a photoionization detector.

Following excavation, two soil samples were collected from the excavation base to confirm that the affected soils had been successfully removed. The samples were analyzed for TPH constituents and lead. One sample exceeded the MDNR action level for TPH of 50 ppm, indicating that further excavation was required at that location.

In February 1992, an additional 15 cubic yards of soil were excavated from SS 003. Approximate excavation limits are shown in Figure 2. Two post-excavation soil samples were taken from the undisturbed subgrade. The laboratory analytical results showed that residual soil concentrations of TPH constituents and lead were below the respective MDNR action levels of 50 ppm for TPH and 240 ppm for lead, with the exception of one sample at a TPH concentration of 53 ppm (Burns & McDonnell, 1992).

1.2.4 Groundwater

A preliminary groundwater assessment was conducted at SS 003 in 1996 to determine if the petroleum constituents found at SS 003 had affected groundwater quality (Versar, 1996). Three groundwater monitoring wells were installed to depths of 20 feet, 32 feet, and 34 feet below ground surface. One well was located in the center of the excavation and two wells were placed in the drainage swale south of the site. Monitoring well locations are displayed in Figure 2.

In addition to the monitoring wells, a piezometer was installed to a depth of 18 feet. However, the piezometer was dry after an elapsed time of 48 hours and was abandoned in accordance with applicable MDNR procedures.

Groundwater samples were collected from each well and analyzed for TPH constituents, VOCs, and metals. No TPH constituents were detected, and none of the analyzed compounds were detected at concentrations that exceeded Maximum Contaminant Levels (MCLs), (Versar, 1996).

1.3 Current Site Status

SS 003 is currently used as a parking area for the U.S. Marine Corps (USMC) motor pool. The USMC currently occupies Building 704.

1.4 RI Objectives

The primary objective of the RI at SS 003 was to obtain sufficient site-specific data to fill data gaps identified in the 1999 Evaluation and Consolidation Study (ECS) report to support a risk-based site management decision.

The objectives of the site investigation at SS 003 were to:

- Evaluate groundwater flow rate, groundwater flow direction, and hydraulic gradient

- Identify depth and lithology of uppermost bedrock unit
- Identify the uppermost water-bearing zone and associated groundwater elevation
- Evaluate presence and concentration of chemicals of potential concern (COPCs) in onsite soils
- Evaluate presence and concentration of COPCs in groundwater

1.5 RI Scope

To meet the objectives listed above, the following field activities were conducted at SS 003 during the Basewide RI in 1999:

- Installing one monitoring well (MW-004) to supplement the three existing wells
- Collecting groundwater samples from each monitoring well
- Collecting three soil samples from the new monitoring well boring
- Analyzing soil and groundwater samples for VOCs, semi-volatile organic compounds (SVOCs), TPH, and metals

Preliminary results from the 1999 Basewide RI indicated that VOCs in groundwater were not completely delineated by the existing monitoring well network. For this reason, additional investigative measures were performed at SS 003 during an RI Addendum that was conducted between June and August 2000. The following field activities were conducted during the RI Addendum:

- Installing four additional monitoring wells, MW-005 through MW-008
- Collecting groundwater samples from the four existing wells and four new wells
- Retaining one soil sample from each boring for laboratory analysis
- Analyzing soil and groundwater samples for VOCs
- Analyzing select groundwater samples for natural attenuation (NA) parameters

Soil borings and monitoring well borings were drilled by Layne-Western, Inc. of Kansas City, Missouri. The borings were continuously sampled and logged to evaluate subsurface geology.

Soil boring logs and monitoring well construction logs for SS 003 are provided in Appendices E and F, respectively. Monitoring well construction data are summarized in Table 1.

1.5.1 1999 Basewide RI

In November 1999, one monitoring well, MW-004, was installed west of Building 704, as shown in Figure 3. The well was installed using a hollow-stem auger drill rig, and it was terminated at the top of shale that underlies the site. Three soil samples were retained from the MW-004 borehole for laboratory analyses of VOCs, SVOCs, TPH, and metals. Because evidence of contamination (e.g., staining, odor, elevated photoionization detector readings) was not noted in the borehole, soil samples were retained from a near-surface depth and

from depth intervals immediately above bedrock. Following well development, groundwater samples were collected from MW-004 and from each existing monitoring well in November 1999. Groundwater samples were analyzed for VOCs, SVOCs, TPH, and metals.

1.5.2 2000 RI Addendum

To delineate VOCs that were detected in SS 003 groundwater samples, additional monitoring wells were installed at SS 003 during the 2000 RI Addendum. Monitoring wells MW-005 through MW-008 were installed in May 2000 at locations shown in Figure 3. In June 2000, all eight monitoring wells were sampled and analyzed for VOCs. Selected samples were also analyzed for NA parameters, consisting of sulfates / nitrates / chlorides, methane / ethane / ethene, ferrous iron, total dissolved solids (TDS), and alkalinity.

Monitoring wells completed during the 2000 RI Addendum were installed using air-rotary drilling techniques. Each well was terminated at the top of Lane shale that underlies the site.

1.5.3 Laboratory Analyses

The following laboratories provided analytical services for the soil and groundwater samples collected from SS 003:

- Columbia Analytical Services, Redding, California
- CH2M HILL Applied Sciences, Corvallis, Oregon

2 SS 003 – RI Results

2.1 Hydrogeology

Subsurface materials encountered at SS 003 during drilling and sampling generally consisted of 25 to 30 feet of low to medium-plastic silty clays and weathered Lane shale underlain by Raytown limestone. Evidence of groundwater was not observed in the boreholes during drilling.

A geologic cross-section was constructed using boring log information gathered during the 1999 Basewide RI. The location of the cross-section is displayed in Figure 4. Cross-section details are presented in Figure 5. The groundwater table shown in the cross-section was derived from groundwater level measurements taken in October 2000.

Groundwater levels have been measured monthly at SS 003. Seasonal groundwater levels are shown in Table 2. Groundwater levels for October 2000 were used to construct a potentiometric surface map, which is presented in Figure 6. The map indicates that groundwater flows to the east.

Groundwater appears to flow through weathered shale at the site. Based on Figure 6, the hydraulic gradient varies across the site. Gradients appear to be higher in the western portion of the site than in the eastern portion. For this reason, groundwater-flow velocities were estimated for each portion of the site. The hydraulic gradient was estimated to be 0.069 in the western part of the site and 0.017 in the eastern part of the site.

Because of the presence of chemical constituents in groundwater at SS 003, aquifer tests were conducted at the site. Based on aquifer test results, flow velocities in the weathered shale appear to range from 0.0022 feet per day (ft/day) to 0.028 ft/day. Aquifer tests are described in detail in Section 8 of the RI Report and in Appendix D.

The geology and hydrogeology of the Base is described in detail in Section 4 of the RI Report. The occurrence and distribution of groundwater at the Base is described further in Section 8 of the RI Report.

2.2 Surface Water

There is no surface water at the site, therefore surface water samples were not collected during the RI.

2.3 Sediment

There is no sediment at the site, therefore sediment samples were not collected during the RI.

2.2 Soil

In October 1999, three subsurface soil samples from SS 003 were retained for laboratory analysis of VOCs, SVOCs, TPH, and metals. In May 2000, four subsurface soil samples were retained for laboratory analysis of VOCs only. Soil sampling locations are provided in Figure 3. Soil samples collected from SS 003 in 1999 and 2000 are summarized in Table 3.

Analytical results for each chemical or chemical group (e.g., TPH) were compared against corresponding Tier 1 Screening Levels. Chemicals exceeding screening levels are listed individually in Appendix J. A summary of chemicals above screening levels is provided below in Table 4.

- **TPH**

TPH analyses were performed on soil samples collected from the MW-004 soil boring. Total petroleum hydrocarbons were not detected above reporting limits in any soil samples collected from this boring, so TPH compounds did not exceed screening levels.

- **VOCs**

VOC analyses were conducted on each soil sample collected from SS 003 in 1999 and 2000. VOCs were not detected above reporting limits in any of the soil samples and therefore, VOCs did not exceed screening levels in the samples.

- **SVOCs**

SVOC analyses were performed on soil samples collected from the MW-004 soil boring. SVOCs were not detected above reporting limits therefore did not exceed screening levels.

- **Metals**

Metals were analyzed in soil samples collected from the MW-004 soil boring. Arsenic was measured slightly above soil screening levels in one sample, MW-004C, collected between 19 and 21 feet below ground surface. The screening level for arsenic is 18 ppm; the detected level was 22.2 ppm.

Soil concentrations of arsenic have been found to exceed screening levels at multiple sites across the Base. For this reason, it appears unlikely that historic Base operations contributed to the soil arsenic exceedence observed at SS 003.

2.3 Groundwater

At SS 003, groundwater samples were collected in November 1999 and June 2000. Groundwater samples collected in November 1999 were analyzed for VOCs, SVOCs, TPH, and metals. Groundwater samples collected in June 2000 were analyzed for VOCs. Selected groundwater samples were also analyzed for NA parameters.

Analytical results from groundwater samples were compared against corresponding screening levels. Exceedences of screening levels are listed individually in Appendix J. Results of the screening exercise are summarized in Table 5. As shown in the table, one chemical, trichloroethene (TCE), was retained as a Chemical of Concern (COC), described in the Human Health Risk Assessment (Section 3). Groundwater COCs that exceeded Tier 1 Screening Levels are displayed in Figure 7.

- **TPH**

TPH analyses were performed on groundwater samples collected in November 1999 from MW-001, MW-002, and MW-003. Petroleum hydrocarbons were not detected above reporting limits and therefore did not exceed screening levels.

- **VOCs**

November 1999 groundwater samples from MW-001, MW-002, and MW-003, and June 2000 samples from MW 001 through MW 008, were analyzed for VOCs.

TCE was detected above screening levels in four out of eight monitoring wells. As shown in Figure 7, TCE groundwater exceedences occurred in the area west of Building 704, between the building and Bales Avenue. As indicated by the figure, the existing well network at SS 003 and CS 002 appears to sufficiently delineate TCE impacts in the area. This will be verified through subsequent quarterly groundwater monitoring at the site.

- **SVOCs**

SVOCs were analyzed in groundwater samples collected from MW-001 through MW-003 in November 1999. SVOCs were not detected above reporting limits and therefore did not exceed screening levels.

- **Metals**

Total and dissolved metals were analyzed in groundwater samples collected from MW-001 through MW-003 in November 1999. Total iron, total manganese, and dissolved manganese exceeded screening levels in each of these samples. Total lead, total cadmium, and dissolved cadmium exceeded screening levels in MW-001.

- **Natural Attenuation Parameters**

During the 2000 RI Addendum, select groundwater samples were collected for NA parameters to perform a preliminary assessment of NA processes at SS 003. Natural attenuation samples were collected in June 2000 from MW-004, located west of Building 704, because this well has historically had some of the highest concentrations of chlorinated VOCs at SS 003. NA analytical results are summarized in Table 6.

TCE and its degradation product, cis-1,2-DCE were detected at MW-004 in June 2000 at a concentration of 60.3 parts per billion (ppb) and 8.32 ppb, respectively. The detection of cis-1,2-DCE suggests that NA processes, via anaerobic biodegradation (Wiedemeier et al., 1998), have occurred or are occurring in the vicinity of MW-004. However, the absence of vinyl chloride, the degradation product of cis-1,2-DCE, may indicate that groundwater conditions are not sufficiently anaerobic and to complete the biodegradation process. Natural attenuation parameters from MW-004 support this observation, as nitrate, sulfate, and methane concentrations are not at the optimal values for anaerobic biodegradation (Wiedemeier et al., 1998). Dissolved oxygen concentrations suggest aerobic conditions but may not accurately represent groundwater conditions. Dissolved oxygen measurements were taken at ground surface, exposing the sample to oxygen in the atmosphere. Because of low well yield, a flow-through cell, which would isolate the sample from the atmosphere, could not be used to measure dissolved oxygen at MW-004.

Although many parameters suggest that conditions may not be optimal for anaerobic biodegradation, the presence of cis-1,2-DCE does indicate that some degradation has occurred or is occurring. Groundwater data from wells upgradient, within, and downgradient

of the area of highest VOC concentrations are needed to further evaluate natural attenuation processes at SS 003.

3 SS 003 - Human Health Risk Assessment

A tiered risk assessment was performed for SS 003 using results obtained during the 1999 Basewide RI. The Tier 1 risk assessment was conducted by evaluating the list of compounds with concentrations exceeding chemical-specific Tier 1 Screening Levels. As described in Section 5 of the RI Report, action levels were derived from United States Environmental Protection Agency (USEPA) Region IX Preliminary Remediation Goals (PRGs), MCLs and in the case of some metals, RI-specific background concentrations in soil. Samples with concentrations higher than screening levels were compiled from 1999 Basewide RI analytical results and are presented in Appendix J. Total site risks were evaluated for the complete exposure pathways identified in Section 4.7 of the RI Report. Methods for evaluating these exposure pathways are described in Section 5 of the RI Report and in Attachment 1.

3.1 COPCs

COPCs are those chemicals found at concentrations higher than action levels in at least one sample from a site. COPCs at SS 003 (i.e. chemicals with concentrations higher than screening levels) are listed in Tables 4 and 5.

The following paragraphs discuss COPCs and provide justification for whether or not each compound was retained as a COC for further evaluation in the risk assessment. Additional screening of the chemicals was conducted in accordance with applicable USEPA risk assessment guidance, as set forth in Section 5 of the RI Report, and is described below.

3.1.1 Soil

Arsenic was detected in one sample at a concentration above background, where 'background' is defined as two-fold higher than the upper confidence limit (UCL) on the average concentration measured in background soil and sediment samples (see Section 4.5.1 of the RI Report for a discussion of background levels of metals). However, the concentration higher than background was detected in deep soils (i.e., soil samples collected from depths of 21 feet – see Table 7). As described in Section 4.5.1 of the RI Report, releases of metals to surface soil would be expected to produce higher concentrations in shallow soils. The presence of elevated concentrations in deep soil, with lower concentrations at shallower depths, indicates that the elevated concentrations are not associated with a release, and are more likely to be naturally-occurring. Also, the elevated concentration of arsenic in deeper soils was not associated with fill, debris, or hydrocarbon-impacted soil, further indicating that it was not associated with a release. Based on these considerations, arsenic in soil at this site was not included as a COC in the risk assessment.

3.1.2 Groundwater

TCE was detected in groundwater at concentrations higher than the screening level (see Table 8), and was retained for further consideration in the site-specific risk evaluation for SS 003. Metals were detected in groundwater at concentrations above screening levels. However, as discussed in Section 4.5.3 of the RI Report, metals detected in groundwater are likely to reflect naturally-occurring levels rather than releases from sites. Therefore, the

metals detected in groundwater were not included as COCs. Analytical data for COCs in groundwater are presented in Table 8.

3.2 COCs

The only COC at SS 003 is TCE in groundwater.

3.3 Potential Exposure Pathways

Potential exposure pathways from soil and groundwater, under residential and industrial land uses at this site, are presented in Table 5-1 of the RI Report. The pathways and receptors presented in Table 5-1 of the RI Report were evaluated in the site-specific risk evaluation. Further discussion of potential exposure pathways and receptor populations is presented in Section 4.7 of the RI Report.

3.4 Estimation of Chemical Intake

This step involved estimating exposure concentrations in soil or water at the site. The exposure concentration was then combined with equations described in Section 5.7.1 of the RI Report to characterize potential risks. The exposure concentration in groundwater was estimated using the assumption that a well supplying drinking water could be installed where the highest VOC concentration was found. For SS 003, the location was MW-004.

3.5 Risk Characterization

The excess lifetime cancer risks and non-cancer hazard quotients for the potential exposure of residents to chemicals in groundwater are given in Table 9.

Potential exposures from residential ingestion and inhalation of volatiles from groundwater were estimated using standard default exposure factors for a residential exposure scenario. The excess lifetime cancer risks for the residential exposure scenario was 4×10^{-5} , associated with TCE. The non-cancer hazard quotient for potential residential exposure to groundwater was two.

Exposure pathways from groundwater to workers (specifically VOCs in groundwater-to-indoor air, and direct contact with water ponded in deep excavations) are potentially complete, as described in Section 4.7 of the RI Report. While quantitative risks were not calculated for these exposure pathways, it is reasonable to assume that risks to workers from VOCs in groundwater are lower than with the risks calculated for residential ingestion and inhalation of volatiles from groundwater. Please refer to Section 5.8.1 of the RI Report for further discussion of exposure pathways from groundwater to workers.

3.5.1 Uncertainties

The assumptions used to characterize health risks may either understate or overstate the potential risks associated with VOCs in groundwater. As described in Section 4.7 of the RI Report, dermal contact with groundwater may be a complete exposure pathway for residents. Potential exposure from this pathway was not included as in the calculation of total site risks (because dermal exposure is not included as a pathway in development of the tap water PRGs used to calculate total site risks). Excluding dermal exposure to VOCs in

groundwater potentially understates residential risks associated with VOCs in groundwater. The use of the maximum detected concentration of TCE in groundwater as the exposure concentration assumes that an individual is exposed to this concentration on a daily basis. Use of the maximum concentration to represent lifetime average concentrations in groundwater (since it is known that concentrations are lower at other locations) greatly overstates potential exposures and associated health risks.

3.6 Conclusions

Calculated risks in groundwater were higher than established risk thresholds of 1×10^{-5} (carcinogenic) and of a hazard index of one (non-carcinogenic). Assuming groundwater consumption from a water supply well placed where the highest TCE concentration was found, the estimated carcinogenic risk in groundwater is 4×10^{-5} , and the estimated non-cancer hazard index is two. Available information (see Section 4.6 of the RI Report) strongly suggests that there is little likelihood of future use of this shallow groundwater as a drinking water supply. Therefore, it is very unlikely that future residents would be exposed to this groundwater. There is a potential for complete exposure pathways to workers for VOCs in groundwater-to-indoor air, and for direct contact with water ponded in deep excavations. Considering minimal exposure times and possible use of protective equipment, it is reasonable to believe that risks from these pathways are lower than risks associated with residential ingestion and inhalation of volatiles from groundwater. For these reasons, further action for groundwater at this site may not be required.

4 SS 003 – Ecological Risk Assessment

A Tier 1 qualitative ecological exposure assessment was conducted for SS 003 according to guidance provided in the Cleanup Levels for Missouri (CALM) (MDNR, 1998). The purpose of the Tier 1 ecological exposure assessment was to determine whether the site is likely to pose a risk to ecological receptors and, in turn, determine whether a quantitative ecological risk assessment is warranted for the site.

The following ecological exposure assessment was performed in accordance with the Ecological Risk Assessment Approach described in Section 5.9 of the RI Report.

4.1 Phase I Screening

To screen for potential ecological receptors and habitat, the physical and biological site characteristics need to be considered. The site was evaluated based on the following factors, and the characteristics of the site were identified where appropriate.

- Considerations for Evaluating Known or Suspected Wetland Habitats (Table 10)
- Considerations for Evaluating Aquatic Habitats (Table 11)
- Considerations for Evaluating Terrestrial Habitats (Table 12)

SS 003, the Oil Saturated Area, is approximately 1,600 square feet in size (excluding the existing groundwater monitoring well network). The site is paved, and no vegetation is present. As such, there are no ecological receptors or habitat on the site (Table 13), nor are there any adjacent to the site. Therefore, a pathway evaluation is not necessary and no further ecological assessment is required.

5 SS 003 – Summary and Conclusions

SS 003, Oil Saturated Area, was investigated during the 1999 Basewide RI and 2000 RI Addendum to support a risk-based site management decision. Previous investigations at the site included remedial actions that were performed in 1991 and 1992. The remedial actions consisted of excavating 42 cubic yards of TPH-contaminated soil from the site.

During the 1999 Basewide RI, one groundwater monitoring well was installed, and three soil samples were retained from the well borehole for laboratory analyses. Groundwater samples were collected from the new well and from three existing wells at the site. Soil and groundwater samples were analyzed for TPH, VOCs, SVOCs, and metals. Preliminary results of the 1999 investigation revealed the presence of chlorinated VOCs in groundwater. To delineate groundwater impacts, four additional monitoring wells were installed during the 2000 RI Addendum. Each well in the monitoring well network was sampled for VOC analyses in June 2000. Select groundwater samples were also analyzed for NA parameters. Based on available data, it appears that chemical constituents were sufficiently delineated at SS 003. This will be verified through future quarterly groundwater monitoring at the site.

Subsurface materials encountered at SS 003 during drilling and sampling generally consisted of 25 to 30 feet of low to medium-plastic silty clays and weathered Lane shale underlain by Raytown limestone. Groundwater flows to the east through weathered shale. The estimated hydraulic gradient appears to be higher in the western portion of the site (0.069) than in the eastern portion (0.017).

Aquifer tests were conducted at SS 003 in July 2000. Based on aquifer test data, flow velocities in the weathered shale appear to range from 0.0022 ft/day to 0.028 ft/day.

Natural attenuation parameters suggest that conditions at SS 003 may not be optimal for anaerobic biodegradation. However, the presence of TCE degradation products does indicate that TCE degradation has occurred or is occurring.

Analytical results were evaluated in a tiered Human Health Risk Assessment (HHRA). COCs at the site were identified as chlorinated VOCs in groundwater. COCs were not identified in soil. Calculated risks in groundwater were higher than established risk thresholds of 1×10^{-5} (carcinogenic) and of a hazard index of one (non-carcinogenic). TPH, a principal contaminant at SS 003, could not be addressed quantitatively in the HHRA. TPH did not exceed CALM residential levels in any soil samples collected from SS 003 during the 1999 Basewide RI or the 2000 RI Addendum.

A Tier 1 qualitative ecological exposure assessment was conducted for SS 003 according to CALM guidance. The assessment consisted of Phase I screening. Ecological risks were not found because there are no ecological receptors or habitats at SS 003.

Because of human health risk associated with chlorinated VOCs in groundwater at SS 003, it is recommended that a Feasibility Study be performed to evaluate groundwater remedial options for this site. Because no COCs were identified in soil, and because soil TPH fell below CALM residential levels, further soil remedial action is not warranted at SS 003.

6 SS 003 – References

- Burns & McDonnell, 1992, *Interim Remedial Action for SS003, Oil Saturated Area & SS004, Hazardous Waste Drum Storage, Final Closure Report.*
- CH2M HILL, 1983, *Installation Restoration Program Records Search for Richard-Gebaur Air Force Base, Missouri.*
- Ecology & Environment, 1988, *Installation Restoration Program Phase II Confirmation/Quantification, Stage 2, Richards-Gebaur Air Force Base, Kansas City, Missouri-Final Report.* Volume I-II and Supplement.
- MDNR, 1998, *Cleanup Levels for Missouri (CALM)*, Division of Environmental Quality, Hazardous Waste Program, September, 1998.
- O'Brien & Gere Engineers, Inc., 1991, *Remedial Investigation (RI) at R-G AFB, Belton, MO for FT 002 - North Burn Pit, SS003 – Oil Saturated Area, SS004 – Hazardous Waste Drum Storage, ST005 – POL Storage Yard.*
- Versar, 1996d, *Final - Preliminary Groundwater Assessment, SS003, SS004, SS006, and SS009.*
- US Air Force, 1994a, *BRAC Clean-up Plan (BCP), Richards-Gebaur Air Force Base, Kansas City, Missouri.*

TABLE 1
Monitoring Well Construction Data at SS 003

Monitoring Well ID	Screened Depth Interval (feet)	Installation Contractor and Date	Screened Formation
SS003-MW001	9.5 – 19.5	Versar (1996)	Silty Clay
SS003-MW002	23.0 – 33.0	Versar (1996)	Weathered Lane Shale
SS003-MW003	19.0 – 31.0	Versar (1996)	Weathered Lane Shale
SS003-MW004	14.5 – 24.5	CH2M HILL (1999)	Weathered Lane Shale
SS003-MW005	17.0 – 27.0	CH2M HILL (2000)	Weathered Lane Shale
SS003-MW006	11.5 – 21.5	CH2M HILL (2000)	Weathered Lane Shale
SS003-MW007	13.0 – 23.0	CH2M HILL (2000)	Weathered Lane Shale
SS003-MW008	11.0 – 21.0	CH2M HILL (2000)	Weathered Lane Shale

TABLE 2
Groundwater Elevations at SS 003

Monitoring Well ID	Top of Casing Elevation (ft msl)	Groundwater Elevations (ft msl)			
		January 2000	April 2000	July 2000	October 2000
MW-001	1033.75	1,025.55	1,026.18	1,026.91	1,025.20
MW-002	1028.37	1,016.47	1,022.23	1,002.64 ¹	1,018.43
MW-003	1027.45	1,020.45	1,021.19	1,021.86	1,020.81
MW-004	1029.80	1,022.65	1,024.10	1,020.59	1,023.83
MW-005	1029.75	NM	NM	1,019.25	1,017.93
MW-006	1030.16	NM	NM	1,021.81	1,021.42
MW-007	1030.16	NM	NM	1,024.54	1,022.70
MW-008	1031.68	NM	NM	1,026.82	1,025.74

Water level measurements performed by Booz-Allen & Hamilton under contract to AFCEE

¹ – Water level in MW-002 was affected by well purging and sampling activities that occurred in June 2000

NM = Not measured because the monitoring well had not yet been installed

TABLE 3
Soil Samples Collected at SS 003

Boring ID	Total Depth (ft)	Sampling Depth Interval (ft)		
		A	B	C
MW-004	24.0	3.0 - 4.0	18.0 - 19.0	19.0 - 21.0
MW-005	27.5	19.0 - 21.0		
MW-006	22.0	18.5 - 20.5		
MW-007	23.5	18.0 - 20.0		
MW-008	21.5	17.0 - 19.0		

MW-004 were completed in October 1999. MW-005 through MW-008 were completed in May 2000.

TABLE 4
Selection of Chemicals of Concern in Soil at SS 003

Chemical Group or Compound	Tier 1 Screening Level (ppm)	Number of Tier 1 Exceedences	Number of Sampling Locations	Maximum Concentration (ppm)	Retained as COC?	Rationale for Exclusion
METALS						
Arsenic	18	1	3	22.2 J	No	Naturally-occurring constituent ¹

Lab Qualifiers:

J = analyte positively detected, quantitation is an estimate

Notes

¹ As discussed in Section 4.5.1 of the RI Report, concentrations of metals detected in soils and sediments are more likely to represent naturally-occurring levels rather than releases from sites at the Base

TABLE 5
Selection of Chemicals of Concern in Groundwater at SS 003

Chemical Group or Compound	Tier 1 Screening Level (ppb)	Number of Tier 1 Exceedences	Number of Sampling Locations	Maximum Concentration (ppb)	Retained as COC?	Rationale for Exclusion
VOCs						
Trichloroethene	5	4	8	71.2	Yes	
METALS						
Cadmium	5	1	4	20.5	No	Naturally-occurring constituent ¹
Cadmium, Dissolved	5	1	4	12.9	No	Naturally-occurring constituent ¹
Iron	300	3	4	25,700	No	Naturally-occurring constituent ¹
Lead	15	1	4	28.6	No	Naturally-occurring constituent ¹
Manganese	50	3	4	8,600	No	Naturally-occurring constituent ¹
Manganese, Dissolved	50	3	4	3,560	No	Naturally-occurring constituent ¹
Notes:						
¹ Detected constituent probably represents naturally-occurring levels. As discussed in Sections 4.5.1 and 4.5.3 of the RI Report, concentrations of metals detected in soils and groundwater are more likely to represent naturally-occurring levels rather than releases from sites at the Base.						

TABLE 6
Natural Attenuation Parameters in Groundwater at SS 003

Well ID	Chloride (ppm)	Nitrate (ppm)	Alkalinity (ppm)	TDS (ppm)	Sulfate (ppm)	Iron, ferrous (ppm)	Methane (ppb)	Ethane (ppb)	Ethene (ppb)	Dissolved Oxygen (mg/L)	pH	Conductivity (umhos/cm)
MW-004	41.1	2.11	288	397	22.4	NM	0.18 F	0.2 U	0.21 U	4.7	7.14	0.699

Lab Qualifiers:

F = analyte positively detected, but concentration is below the reporting limit (RL)

U = analyte not detected above the method detection limit (MDL)

TDS = Total Dissolved Solids

NM = Not measured due to insufficient water volume

TABLE 7
SS 003 - Concentrations of Arsenic in Soil

Location	Sample Beginning Depth (ft)	Sample Ending Depth (ft)	Units	Arsenic
MW-004	3	4	mg/kg	13.9
MW-004	18	19	mg/kg	7.3
MW-004	19	21	mg/kg	22.2J

Notes

Qualifiers (Flags) are as follows.

J - Analyte positively detected, quantitation is an estimate

TABLE 8
SS 003 - Contaminants of Potential Concern in Groundwater

Location	Units	Cadmium	Cadmium, Dissolved	Iron	Lead	Manganese	Manganese, Dissolved	TCE
MW-001	ug/L	20.5	12.9	25700	28.6	8600	3560	0.85F
MW-002	ug/L	2U	2U	5390	3.3F	200	163	0.08U
MW-003	ug/L	2U	2U	343J	1F	8.2J	3.6	1.7
MW-004	ug/L	2U	2U	254	1.3F	82.7	78.1	71.2
MW-006	ug/L	NA	NA	NA	NA	NA	NA	16.86
MW-007	ug/L	NA	NA	NA	NA	NA	NA	24.39
MW-008	ug/L	NA	NA	NA	NA	NA	NA	5.22

Notes

TCE = Trichloroethene

Qualifiers (Flags) are as follows:

J - Analyte positively detected, quantitation is an estimate

U - Analyte not detected, value presented in the minimum detected level (MDL)

F - Analyte positively identified, but concentration is below the analytical reporting limit (RL)

TABLE 9			
Estimated Health Risks for Chemicals in Groundwater at SS 003			
Residential Exposure Scenario			
Chemical	Concentration in Groundwater (ppb)	Excess Lifetime Cancer Risk	Non-cancer Hazard Quotient
Trichloroethene	71.2	4E-05	2
	Total Risk or HI	4E-05	2

Notes:

Exposure point concentration for trichloroethylene is the maximum concentration which occurs at MW-004.
Noncancer risks for chemicals at this site fall above a hazard index of one.

TABLE 10
Considerations for Evaluating Known or Suspected Wetland Habitats at SS 003

Consideration	Observation
• Obvious or designated wetlands present	No
• Wetlands suspected (e.g., site adjacent to water body, in floodplain, standing water present, dark, wet soils, mud cracks, debris line, water marks, etc)	No
• Vegetation present at suspected wetlands (e.g., submerged, emergent, scrub/shrub, wooded, prairie or grassland)	NA
• Size and depth of suspected wetlands	NA
• Source water at suspected wetlands (e.g., river, stream, creek, lake, pond, groundwater, industrial discharge, surface water runoff)	NA
• Known/suspected contaminant inputs to suspected wetlands	NA
• Discharge of water from wetland to river, stream, creek, estuary, groundwater, impoundment	NA
• Natural community classification ¹ of any obvious wetlands present	NA
• Observed biota (e.g., waterfowl, deer, rodents, etc)	NA

TABLE 11

Considerations for Evaluating Aquatic Habitats at SS 003

Consideration	Observation
NON-FLOWING (LENTIC)	
• Type of water body (e.g., pond, lake)	None
• Natural or man-made (e.g., lagoon, reservoir, canal, impoundment)	NA
• Size, depth, trophic status of water body	NA
• Nature of bottom (e.g., muddy, rocky, sand, concrete)	NA
• Uses of water body (e.g., recreation, flood control, drinking water, habitat)	NA
• Source water (e.g., river, stream, groundwater, industrial discharge, surface water runoff)	NA
• Known/suspected contaminant inputs to water body	NA
• Discharge of water to river, stream, creek, groundwater, wetlands impoundment	NA
• Nature of bottom (e.g., muddy, rocky, sand, concrete, etc.)	NA
• Vegetation present (e.g., submerged, emergent, floating)	NA
• Evidence/observations of benthic macroinvertebrates, fish, reptiles, amphibians, birds, mammals	NA
FLOWING (LOTIC)	
• Type of water body (e.g., river, stream, brook, creek, intermittent stream, dry wash)	None
• Natural or man-made (e.g., ditch or other channeled waterway).	NA
• Size, depth, flow rate, and order (e.g. primary, secondary, etc.) of water body	NA
• Bank environment (e.g., vegetated or bare, steep or gradual grade, height, etc.)	NA
• Natural community classification ¹ of any obvious wetlands present	NA
• Uses of water body (e.g., recreation, flood control, drinking water, habitat)	NA
• Source water (e.g., river, stream, groundwater, industrial discharge, surface water runoff)	NA
• Known/suspected contaminant inputs to water body	NA
• Discharge of water to river, stream, creek, groundwater, wetlands impoundment	NA
• Nature of bottom (e.g., muddy, rocky, sand, concrete)	NA
• Vegetation present (e.g., submerged, emergent, floating)	NA
• Evidence/observations of benthic macroinvertebrates, fish, herptiles, birds, mammals	NA

TABLE 12
Considerations for Evaluating Terrestrial Habitats at SS 003

Consideration	Observation
WOODED	
• Percentage of site that is wooded	0%
• Dominant vegetation (e.g., evergreen, deciduous, mixed)	NA
• Predominant tree size at breast height (e.g., <6 inches, 6-12 inches, >12 inches)	NA
• Evidence/observations of macroinvertebrates, reptiles or amphibians, birds, mammals	NA
• Natural community classification ¹	NA
SCRUB/SHRUB	
• Percentage of site that is scrub/shrub	0%
• Dominant vegetation	NA
• Predominant height of vegetation (e.g., <2 feet, 2-5 feet, >5 feet).	NA
• Characterize density of vegetation (e.g., dense, patchy or sparse)	NA
• Evidence/observations of macroinvertebrates, reptiles, amphibians, birds, mammals	NA
• Natural community classification ¹	NA
GRASSLAND AND AGRICULTURAL AREAS	
• Percentage of site that is open (grassed or cropped - no shrubs or trees)	100%
• Dominant vegetation (e.g., grasses, agricultural crops, other forbs)	None
• Predominant height of vegetation (e.g., <2 feet, 2-5 feet, >5 feet).	None
• Characterize density of vegetation (e.g., dense, patchy or sparse).	Sparse, pavement
• Evidence/observations of macroinvertebrates, reptiles, amphibians, birds, mammals	None
• Natural community classification ¹	-

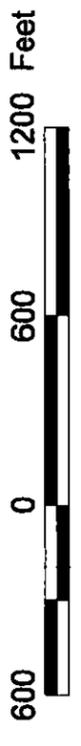
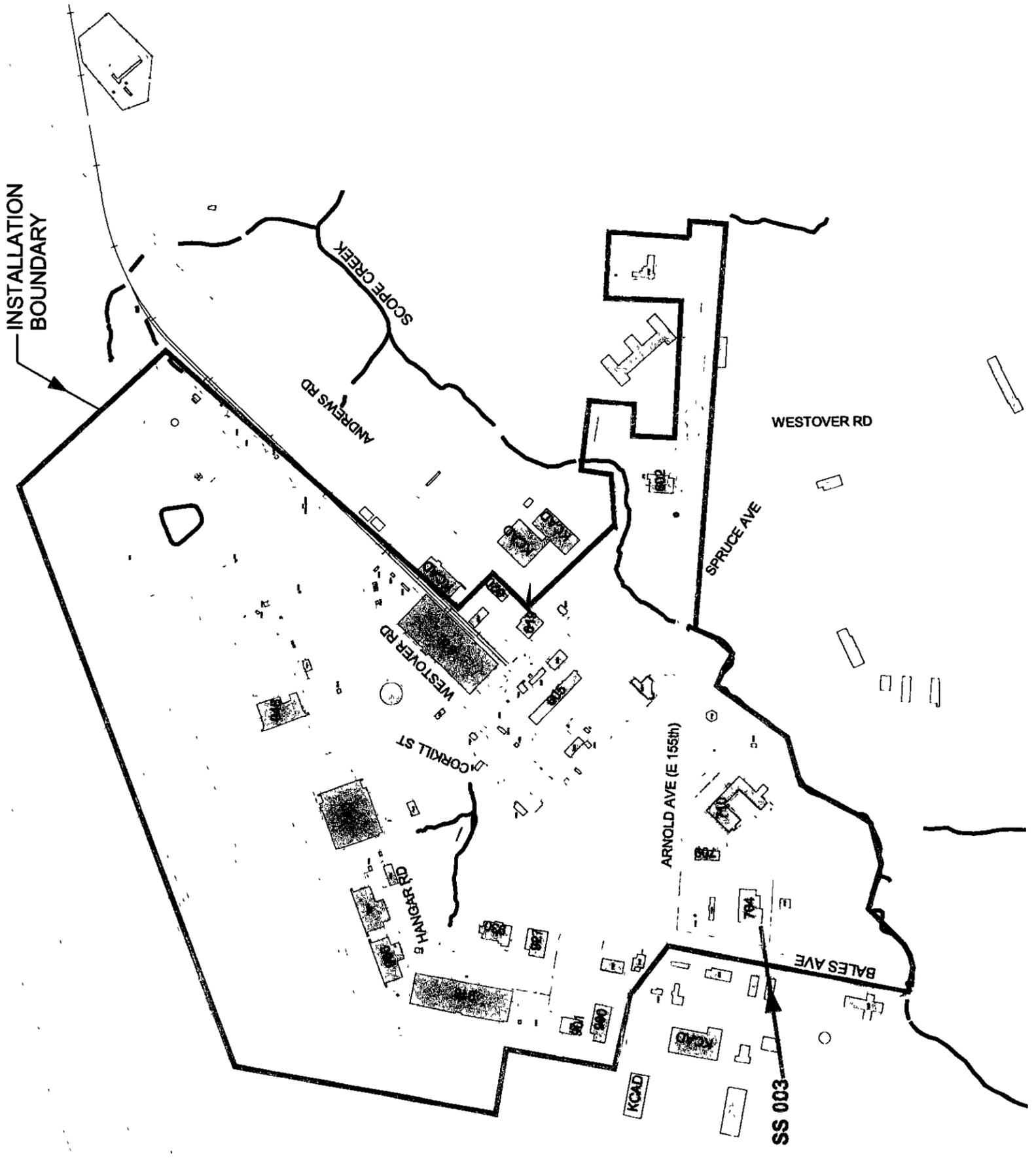
¹ From *Natural Communities of Missouri*, Nelson, Paul, Missouri Natural Areas Committee, Rev. 1987.

TABLE 13

Checklist for Potential Receptors and Habitats at SS 003

Item	Yes	No	Observation
Are wetlands such as marshes, swamps, or fens directly adjacent to the site?		X	
Are aquatic habitats such as rivers, lakes, or streams directly adjacent to the site?		X	
Are forested habitats directly adjacent to the site?		X	
Are grassland habitats directly adjacent to the site?		X	
Are there federal or state rare, threatened, or endangered species adjacent to or near		X	
Are there one or more environmentally sensitive areas (such as those listed in the text box on pg. F6) at, near, or adjacent to the site?		X	
Are commercially or recreationally important species on, adjacent to or near the site?		X	

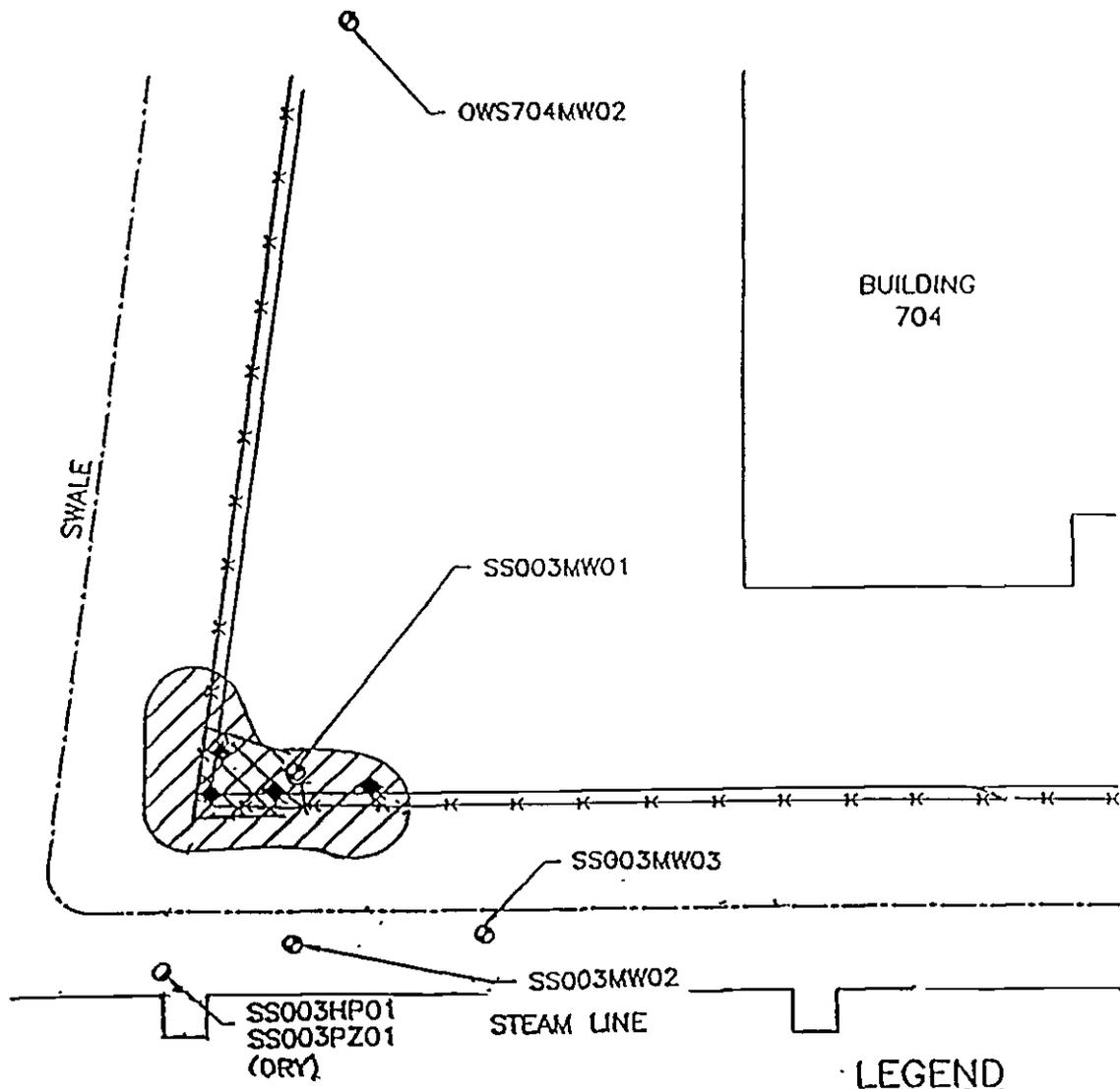
INTERPRETING RESULTS: If the answer to any one question is yes, then go to pathway evaluation
If the answer to all questions is no, then no further ecological assessment is required.



CH2MHILL FIGURE 1

SS 003 - OIL SATURATED AREA
SITE LOCATION MAP

Richards - Gebaur AFB, Kansas City, MO



LEGEND

-  CONTAMINATED SOILS
-  LIMIT OF 1992 EXCAVATION
-  SHALLOW SOIL SAMPLE
-  GROUNDWATER MONITORING WELL
-  DIRECT-PUSH BORING/ TEMPORARY WELL LOCATION

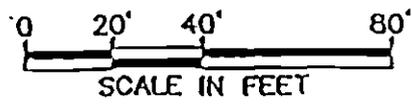
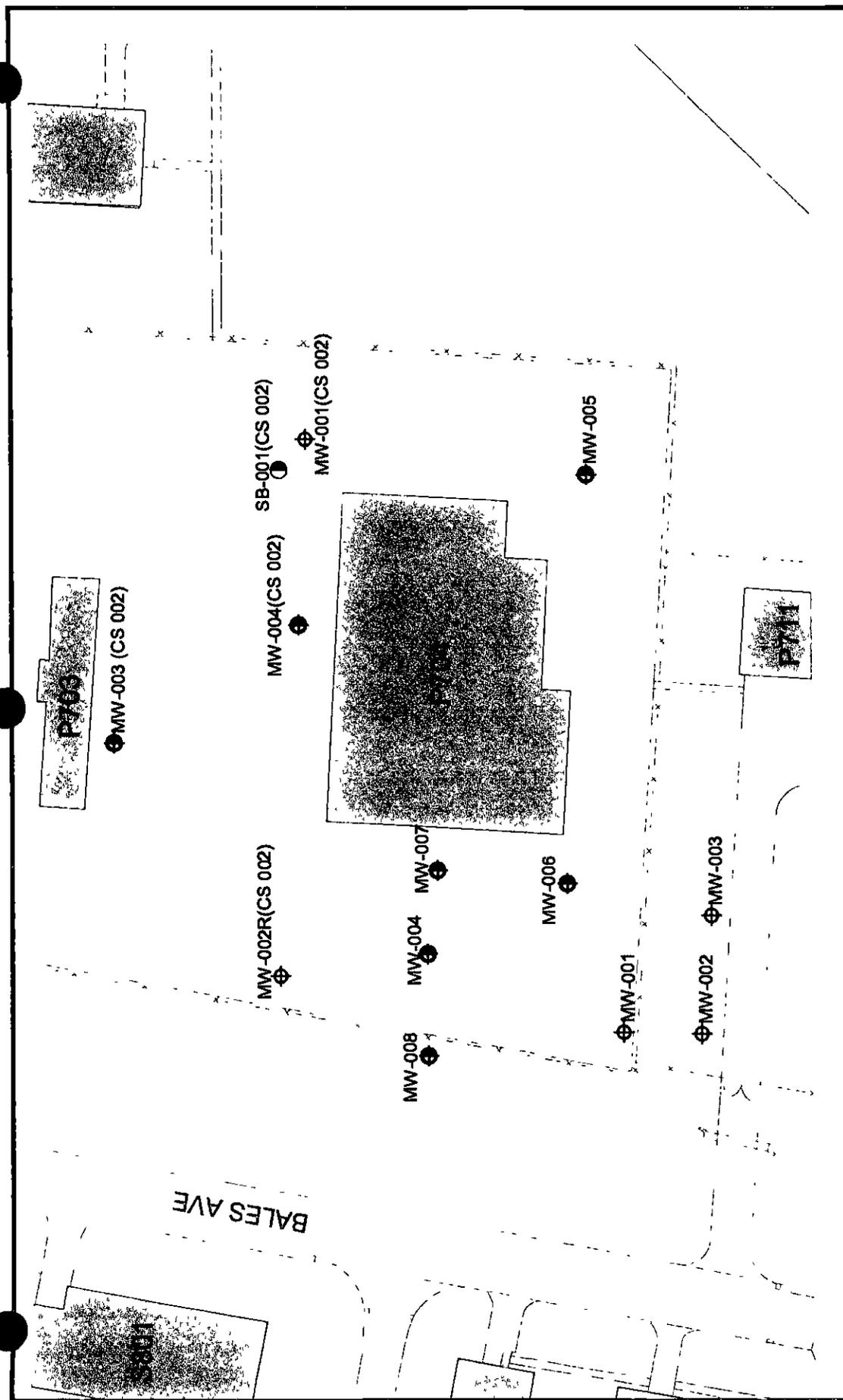


Figure 2

**MONITORING WELL AND
SOIL BORING LOCATIONS
SS 003
Richards-Gebaur AFB
Kansas City, Missouri**



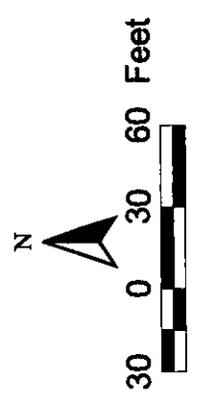
I:\144012\SS003B.DWG PLOT DATE: 10-26-98



CH2MHILL
FIGURE 3

SS 003 - OIL SATURATED AREA
 RI SAMPLE LOCATIONS

Richards - Gebaur AFB, Kansas City, MO



LEGEND

- ⊕ Monitoring Well Location
- Soil Boring Location



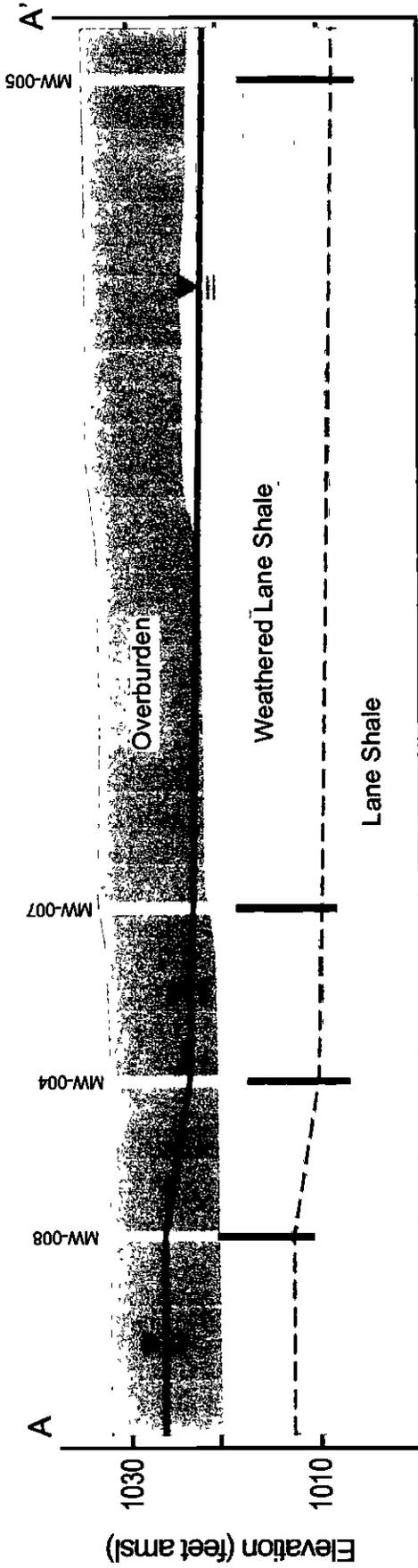
LEGEND

- ◆ Monitoring Well Location
- Soil Boring Location
- - - Cross Section Line
- Ground Surface Elevation Contour
- 1030 Ground Surface Elevation (ft amsl)



Figure 4

SS 003 - OIL SATURATED AREA
 LOCATION MAP OF GEOLOGIC CROSS SECTION: A - A'
 Richards - Gebaur AFB, Kansas City, MO



LEGEND

Groundwater Table (October 2000)

Well Screen Interval

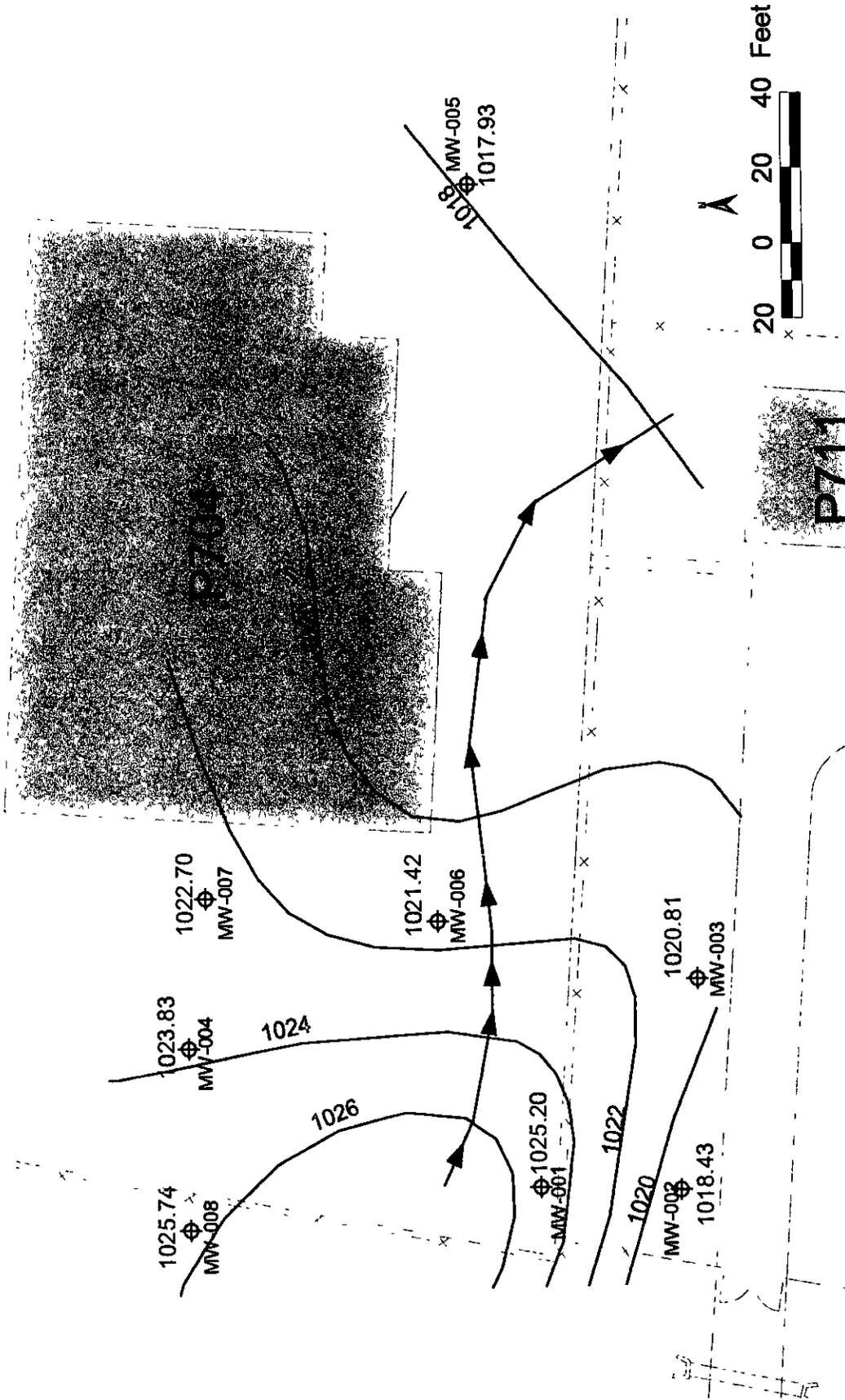
amsl Above Mean Sea Level



FIGURE 5

**SS 003 - Oil Saturated Area
Geologic Cross Section A-A'**

Richards - Gebaur AFB
Kansas City, MO



LEGEND

- ⊕ Monitoring Well Location
- 980 Groundwater Contour
- 980 Groundwater Elevation (ft. above mean sea level)
- ➔ Estimated Groundwater Flow Direction

Note: Groundwater levels for October, 2000 were used for the contour construction.



FIGURE 6

**SS 003 - OIL SATURATED AREA
POTENTIOMETRIC SURFACE MAP**

Richards - Gebaur AFB, Kansas City, MO



LEGEND

- ⊕ Groundwater Result < Tier I Screening Level
- ⊕ Groundwater Result > Tier I Screening Level
- TCE 24.4 Chemical Concentration in ppb
- █ Existing Building or Structure
- P 704 Building Number

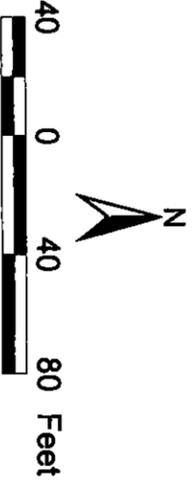


FIGURE 7

SS 003 - OIL SATURATED AREA - GROUNDWATER

COC > TIER I SCREENING LEVELS

Richards - Gebaur AFB, Kansas City, MO

TAB

38 004
