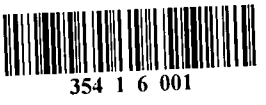
FINAL REPORT

BUILDING 354 SITE INVESTIGATION

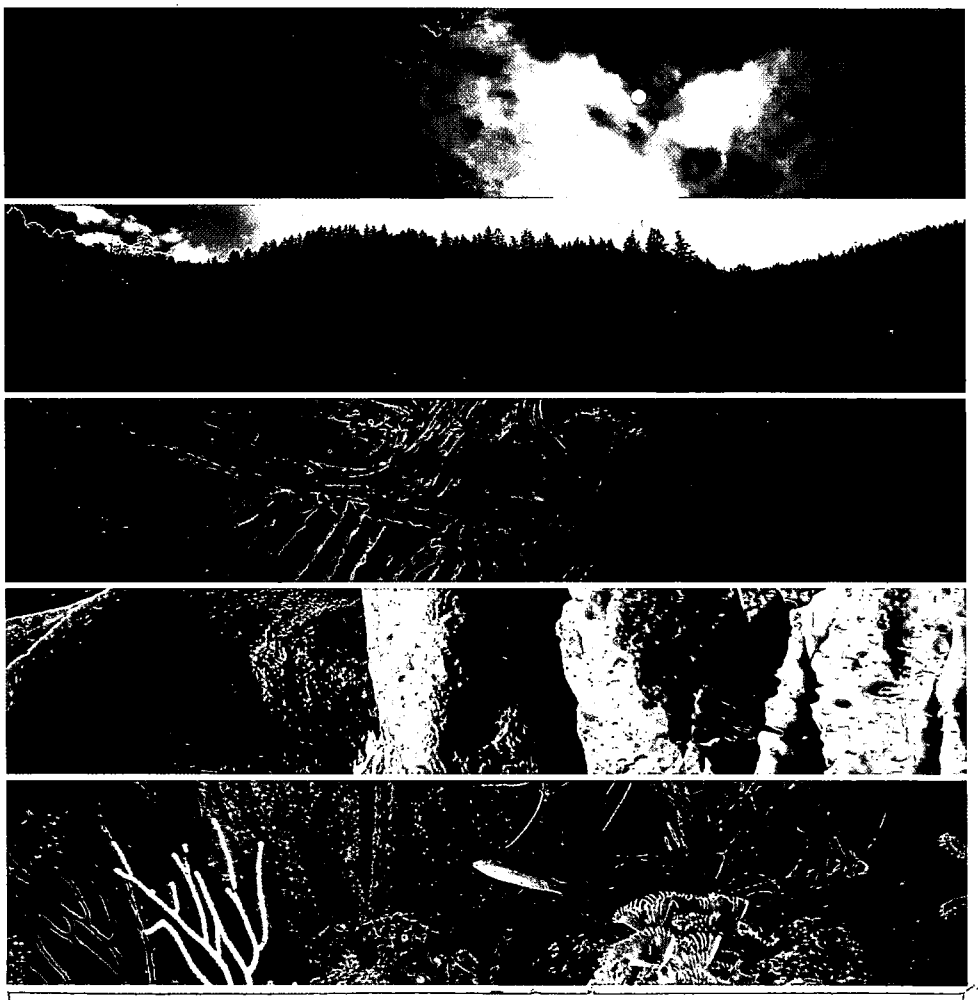
POL UST INVESTIGATIONS/REMEDIAL ACTION PLANS
FORT RILEY, KANSAS
DACW41-89-D-0122

DAMES & MOORE

PREPARED FOR
U.S. ARMY CORPS OF ENGINEERS
KANSAS CITY, MISSOURI



D&M Job No. 19577-019-149
August 4, 1995



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1,2-DCA	- 1,2-dichloroethane
1,1-DCE	- 1,1-dichloroethene
1,2-DCE	- 1,2-dichloroethene
1,1,1-TCA	- 1,1,1-trichloroethane
TCE	- trichloroethene
PCE	- tetrachloroethene
BETX	- benzene, ethylbenzene, toluene, and xylenes
bgs	- below ground surface
CAS	- Continental Analytical Services, Inc.
cm/sec	- centimeters per second
CME	- Central Mining Equipment
DEH	- Directorate of Engineering and Housing
DOT	- Department of Transportation
DRMO	- Defense Reutilization Marketing Office
gal	- gallon
GC	- gas chromatograph
HSA	- hollow stem augers
I.D.	- inside diameter
KDHE	- Kansas Department of Health and Environment
LCS	- Laboratory Control Sample
LUST	- leaking underground storage tank
M.C.L.	- maximum contaminant level
mg/kg	- milligram per kilogram
Mikon	- Mikon Consulting Engineers
µg/l	- microgram per liter
µmhos/cm	- micromhos per centimeter
MS	- matrix spike
MSD	- matrix spike duplicate
NAD	- North American Datum
NTU	- Nephelometric Turbidity Unit
OA-1	- modified USEPA Method 8015 for total purgeable petroleum
OA-2	- modified USEPA Method 8015 for semi-volatile petroleum
pcf	- pounds per cubic foot
PID	- photoionization detector
POL	- petroleum, oil and lubricants
ppm	- parts per million
PSA	- PSA Environmental, Inc.
QA	- quality assurance
QC	- quality control
RPD	- relative percent difference
TCLP	- toxicity characteristic leaching procedure
TPH	- total petroleum hydrocarbons
TVH	- total volatile hydrocarbons
TVOC	- total volatile organic compounds
USACE	- U.S. Army Corps of Engineers
USEPA	- United States Environmental Protection Agency
USGS	- United States Geological Survey
UST	- underground storage tank
VOC	- volatile organic compound

1.0 SITE BACKGROUND

1.1 SITE IDENTIFICATION AND LOCATION

The Fort Riley Military Reservation is in north-central Kansas approximately 120 miles west of Kansas City, Missouri (see Figure 1). Fort Riley is divided into six principal areas: Main Post, Camp Funston, Camp Forsyth, Camp Whitside, Custer Hill, and Marshall Airfield (see Figure 2). This site investigation was performed at Building 354 on Main Post.

Fort Riley was established prior to the implementation of the cadastral system (Section/Township/Range) in Kansas, therefore an alternate system, the 1000-meter Transverse Mercator grid, found on current United States Geological Survey (USGS) 7.5 Minute Series (Topographic) Quadrangle maps, is used to provide a legal description of the site location. This description will locate the site in relation to zone 14 of the 1927 North American Datum (NAD).

The Building 354 site is located 250 feet east of Marshall Avenue and 200 feet north of the Union Pacific Rail Line on Main Post, on the Fort Riley Military Reservation, Fort Riley, Kansas, 4,325,130 meters north and 692,375 meters east of the zone 14, 1927 NAD. The nearest larger city is Junction City, Kansas, located approximately 3.0 miles southwest of the site. A map of the site location is presented as Figure 3.

The Kansas Department of Health and Environment (KDHE) Bureau of Environmental Remediation assigned project code is 05031603 from the LUST Database. The KDHE facility and owner identification numbers are both 23650.

1.2 SITE HISTORY

Fort Riley was established to provide protection for the Santa Fe and Oregon Trails and has been utilized by the United States Army for various duties over its history. Construction of Army facilities began in 1853 and continues today. Fort Riley was the site of the Light Artillery School following the Civil War and subsequently the Cavalry Training School. During periods of national conflict Fort Riley functioned as a troop and equipment marshaling and training point. Fort Riley is currently home to the First Infantry Division (Mechanized) known as the "Big Red One".

Main Post was built during the mid to late nineteenth and early twentieth centuries on the north bank of the Kansas River, just east of the confluence of the Republican and Smoky Rivers. The Building 354 site was constructed in 1935 as a gasoline service station and possible storage site for

solvents and road oil (Phase II Field Investigation Work Plan, Dames & Moore, 1994). The USTs at Building 354 were removed from service in 1990 and 1991.

1.3 PETROLEUM STORAGE TANK HISTORY

Six underground storage tanks were located at Building 354, designated by Fort Riley as tanks 354A through 354F. The locations of the tanks are presented on Figure 4.

Tanks 354 A and 354 B (KDHE tank numbers 16 and 17), both 10,000 gallon steel tanks, were installed in 1980 and used to store diesel fuel. Removal of tanks 354 A and B was performed by Environmental Recovery, Inc. on November 19 and December 5, 1991. The excavated tanks were turned in to DRMO for sale as scrap metal. The Buried Tank Leak Assessment Report indicated the absence of contaminated soil under 354 A and less than 50 ppm total petroleum hydrocarbons (TPH) in the soil under 354 B as reported by a Dräger field test. Due to minimal contamination detected and concerns with the safety of the excavation, no further action regarding these tanks was required by KDHE.

Tanks 354 C, D, E and F, (KDHE number 169, 170, 171 and 172) which were two 10,000-gallon steel tanks, one 12,800 gallon steel tank and one 8,500-gallon steel tank, respectively, were installed at the site in 1933. The tanks were used to store diesel fuel and gasoline. Removal of tanks 354 C,D, and E was performed by Ed Reddins Excavating, Inc. on August 28 and 31, 1990. During the removal excavation, tank 354F (KDHE 172) was not found. The three tanks excavated were purged with dry ice and turned over to the Fort Riley Defense Reutilization Marketing Office (DRMO) to be salvaged as scrap metal. The Buried Tank Leak Assessment Report indicated the presence of contaminated soil at the base of the tank pits. Leaks from corroded pipe connections were thought to have contributed to contamination on site. Excavated soil was disposed in the Contractor's approved disposal area near Camp Whitside. KDHE placed the site on active status, that is, requiring further investigation.

KDHE action levels for petroleum contaminated sites are presented in Appendix A. The KDHE Buried Tank Leak Assessment reports and Permanent Tank Abandonment forms are presented in Appendix B. A summary of available UST information is presented in Table 1. A chronological description of investigative and corrective action work conducted at the site is presented in Table 2. A discussion of the work completed during this investigation is presented in Section 2.0.

1.4 REGIONAL GEOLOGY/HYDROGEOLOGY

The Fort Riley Military Reservation is in north-central Kansas and occupies approximately 83,500 acres in southern Riley County and 9,000 acres in northern Geary County. The geology of Riley and Geary Counties consists of Pennsylvanian and Permian Age sedimentary rock overlain by eolian and fluvial deposits of Pleistocene and Recent Age (Jewett, 1941). The primary ground water source for the area is the alluvium in the Kansas and Republican River valleys. Fort Riley and Junction City obtain their water from wells that tap the alluvium of the Republican River Valley (Latta, 1949).

The Building 354 site area lies approximately 3,000 feet north of the Kansas River in the terraced transition area between the floodplain (alluvial valley) and upland plateau. Sedimentary deposits in this transitional area consist of colluvial sediments and remnants of former fluvial sediments. Loess (wind-blown silt) may also exist in some areas. Permian Age limestone and shale sequences underlie these sediments.

The Nemaha Anticline, the major structural feature responsible for the topography of the Flint Hills, underlies the site. This Post-Mississippian Age faulted anticline trends northeast to southwest. The Nemaha Anticline was a prominent feature until Pennsylvanian Age shales and carbonates began to on-lap and cover the anticlinal feature (Merriam, 1988).

Soils in the site area are of the Eudora silty loam series. Eudora soils are commonly found on terraces above the Republican and Kansas River flood plains. These soils normally form in deep alluvium and rarely receive flooding. Eudora soils are well drained and have a moderate permeability (Jantz et al., 1975).

1.5 WATER USAGE AND SENSITIVE ENVIRONMENTS

Fort Riley obtains its potable water from wells located in Camp Forsyth. The ground water is contained within the sand and gravel alluvial materials which comprise the Republican River Alluvial Valley. Withdrawal rates from the wells average 1,000 gallons per minute. The nearest ground water production well is approximately 8,700 feet west of the Building 354 site.

A review of the Junction City, Kansas National Wetlands Inventory Map, which includes the Building 354 site, indicated no identified wetlands within a 1000-foot radius of the site. The portion of the Wetlands Inventory Map which includes the Building 354 site is presented as Figure 5.

2.0 FIELD INVESTIGATION

This section provides documentation of the field investigation methods and procedures which were followed during the field investigation of the former petroleum, oil, and lubricants (POL) USTs at the Building 354 site. The intent of this field investigation was to characterize and assess the extent of POL contamination in the soil and ground water at the site. This work was performed as part of the procedures necessary to bring the subject POL site into compliance with KDHE and Federal UST regulations.

The investigation of the Building 354 site was performed in accordance with the following documents:

- Task 2 and the general provisions of the Scope of Work provided by the U.S. Army Corps of Engineers (USACE), dated 29 May 1992, and its subsequent revisions.

- Field Investigation Work Plan, POL UST Investigations/Remedial Action Plans, Fort Riley, Kansas, DAC W 41-89-D-0122, D.O. 0013 (Work Plan), dated November 11, 1992, prepared by Dames & Moore for the USACE, Kansas City, Missouri.

- Phase II Field Investigation Work Plan, POL UST Investigations/Remedial Action Plans, Fort Riley, Kansas, DAC W 41-89-D-0122, D.O. 0013 (Work Plan), dated August 15, 1994, prepared by Dames & Moore for the USACE, Kansas City, Missouri.

- Field Investigation Methods and Procedures Plan, POL UST Investigations/Remedial Action Plans, Fort Riley, Kansas, DAC W 41-89-D-0122, D.O. 0013, dated August 15, 1994, prepared by Dames & Moore for the USACE, Kansas City, Missouri.

- Chemical Data Acquisition Plan, POL UST Investigations/Remedial Action Plans, Fort Riley, Kansas, DAC W 41-89-D-0122, D.O. 0013, dated November 5, 1992, prepared by Dames & Moore for the USACE, Kansas City, Missouri.

- Chemical Data Acquisition Plan, Phase II POL UST Investigations/Remedial Action Plans, Fort Riley, Kansas, DAC W 41-89-D-0122, D.O. 0013, dated August 15, 1994, prepared by Dames & Moore for the USACE, Kansas City, Missouri.

- *Site Health and Safety Plan, POL UST Investigations/Remedial Action Plans, Fort Riley, Kansas, DAC W 41-89-D-0122, D. O. 0013, dated August 15, 1994, prepared by Dames & Moore for the USACE, Kansas City, Missouri.*

2.1 SUMMARY OF WORK COMPLETED

A preliminary site assessment was conducted between November 23, 1992 and November 4, 1993. The assessment included a 28-point soil gas survey and the installation and sampling of two monitoring wells. Periodic ground water level/free product monitoring was performed from November 2, 1993 to September 28, 1994. Based upon the results of the preliminary site assessment, additional field investigation activities (Phase II) were performed *to further define the extent of POL contamination at the site. Discussion and summary of results is provided in Section 3.0*

The Phase II site investigation was conducted between September 9, 1994 and March 24, 1995. The investigation included the installation of four piezometers, the installation and sampling of three monitoring wells, advancement of 14 soil borings, the collection of five in situ ground water samples, *and sampling of monitoring wells installed during the preliminary site assessment.*

The soil gas survey, in situ ground water sampling, soil boring, piezometer, and monitoring well locations were cleared for underground utilities (e.g. natural gas pipelines, telephone and electric cables, and water and sewer lines) or other obstructions by Dames & Moore through Fort Riley personnel and Kansas One Call (Dig Safe) prior to the commencement of subsurface activities. The procedures used to complete the field activities are described in the following sections. A summary of the work completed is presented in Table 3.

2.2 PRELIMINARY SITE ASSESSMENT

2.2.1 Soil Gas Survey

The soil gas survey was conducted by PSA Environmental, Inc. (PSA) of Lee's Summit, Missouri on November 23 through 25, 1992 under the direction of a Dames & Moore field geologist.

A total of 28 locations were sampled (one sample per location) to assess benzene, ethyl benzene, toluene, xylene (BETX), 1,2-dichloroethane (1,2-DCA), and total volatile hydrocarbons (TVH) in the soil gases. The soil gas sampling locations and results are presented in Figure 6.

PSA used a van-mounted Geoprobe Systems® hydraulic probe unit to advance a ¾-inch diameter perforated galvanized pipe to a depth of 10 feet. A vacuum pump was used to purge 2 to 5 liters of soil gas from the collection system, after which a soil gas sample was obtained with the vacuum pump and analyzed on site using a gas chromatograph (GC) located in the van. Standardization of the GC was conducted each morning by injecting known concentrations of the selected analytes into the GC three times and checking the response factor.

2.2.2 Monitoring Well Installation

The monitoring well installation was performed by Mikon Consulting Engineers (Mikon) of St. Joseph, Missouri under the supervision and direction of a Dames & Moore field geologist. Mikon used a truck-mounted Acker ADII drill rig to advance the monitoring well borings on December 16 and 21, 1992. The monitoring well locations were submitted to the USACE and Fort Riley for approval prior to commencing drilling operations. Each monitoring well was identified by the task number, year of installation, and well number [e.g., TS0292-01 indicates the first monitoring well drilled in the Task 2 area in 1992]. Monitoring well TS0292-02 was installed approximately 140 feet to the southeast of TS0292-01-1 between the toe of the slope and the rail line area where visibly contaminated soil was noted on the soil gas probe rods in that area. The monitoring well locations are shown on Figure 7. The monitoring well installation details and KDHE water well records (Form WWC-5) are presented in Appendix D.

Monitoring well borings TS0292-01 and TS0292-02 were advanced to bedrock using 6¼-inch I.D. hollow stem augers (HSA). Soil samples were collected continuously at two foot intervals using a 2-inch I.D. split spoon sampler. The soil samples were collected for the purpose of soil classification and headspace analysis. Decontaminated augers and samplers were used to advance and sample the borings.

Limestone bedrock was encountered at a depth of 26.8 below ground surface (bgs) in TS0292-01 and 9.2 feet bgs in TS0292-02. Rock coring was performed using an NX size double tube core barrel and potable water as the drilling fluid. The borings were advanced by coring to depths of 33.0 feet bgs in TS0292-01 and 17.5 feet bgs in TS0292-02. Depth to ground water was

measured *in the stabilized borehole prior to installation of wells* at 24.30 feet and 11.30 feet bgs in TS0292-01 and TS0292-02, respectively,

During sample collection, the field geologist recorded a description of the penetrated soil profile based on visual observations and noted indications of possible contamination based on visual discoloration and/or odor. A portion of the sample was packed loosely into a clean glass jar, covered with foil, sealed with a cap, and placed in a warm location. After a period of at least 15 minutes, the headspace in the jars was screened for volatile organic compounds (VOCs) using a calibrated photoionization detector (PID) and the readings recorded on the boring logs. A brief discussion of the PID calibration method is provided in Appendix C.

TS0292-01 and TS0292-02 wells were installed to depths of 29.8 and 17.0 feet bgs, respectively. The monitoring wells were constructed of threaded flush joint 2-inch diameter Schedule 40 PVC riser pipes and 10 foot screen sections (0.010 inch slot). The riser and screen section were installed through the augers stem. The screen was positioned downhole to intercept the water table. While the augers were extracted, a silica sand pack was tremied from the bottom of the borehole to approximately 2 feet above the screened section. A bentonite seal with an approximate thickness of 2 feet was placed above the sand pack. The bentonite seal consisted of bentonite pellets which were poured slowly through the auger stem until the required depth was measured. The bentonite pellets were then hydrated with distilled water. A cement-bentonite grout with a ratio of approximately 94 parts Portland Cement and 3 parts bentonite (94:3 cement-bentonite grout) was then placed in the annulus around the well casing from the top of the bentonite seal to the surface. During installation, the depths of the wells, sand packs, and bentonite seals were verified by measuring downhole with a graduated tape. A flush mount protective steel collar with a bolted cap was placed over the top of the well casing and seated in a concrete pad to prevent damage to the well. The concrete pad also prevents surface water from flowing down the well annulus and being introduced into the well.

The monitoring wells were developed on January 12, 1993. Equipment used during the development included an Acker ADII truck mounted drilling rig, a 2-inch outside diameter surge block affixed to the bottom of the drill rods, and a Grundfos 2-inch diameter submersible pump. A rope connected to the drilling rods via a pulley mounted at the top of the drill rig mast was wrapped around the cat-head of the drill rig and used to lower the surge block to the bottom of the well. The surge block was then raised and allowed to fall to its initial position. This action was repeated continuously for approximately 15 minutes to draw water in and out of the well screen (surging) and to bring sediment into suspension. Following surging, a minimum of one well volume of water was purged from the well at a rate of approximately two gallons per minute using the submersible pump.

The purged water was pumped via tubing into a 55-gallon Department of Transportation (DOT)-approved 17-E/H drum.

Following each surge and purge cycle, pH, temperature, total dissolved solids (TDS), and turbidity of formation waters were measured and recorded [Note: TDS is proportional to conductivity]. A brief discussion of the instruments and calibration methods used for these measurements is provided in Appendix C. The surge and purge cycle was repeated for a minimum of four hours until three successive readings (taken at intervals of at least one well volume) of pH, temperature, and TDS had stabilized, and turbidity was reduced to less than 100 nephelometric turbidity units (NTUs). The final measurements were considered stable if they fell within the following tolerances:

TDS: ±100 ppm
pH: ±0.1
Temperature: ±1°F.
Turbidity: less than 100 NTUs

A total of 19.5 and 8.5 gallons of water were removed from wells TS0292-01 and TS0292-02, respectively, during development. The monitoring well development data is presented in Tables 4a and 4b, and also in Appendix D.

The monitoring wells were sampled on November 2 and 3, 1993. Prior to collecting the ground water samples, the wells were stabilized by purging them until three successive readings of pH, temperature, and specific conductance had stabilized, and turbidity was reduced to less than 100 NTUs. Approximately 24 and 16 gallons (three well volumes) were purged from wells TS0292-01 and TS0292- 02, respectively. The monitoring well stabilization data is presented in Tables 5a and 5b and Appendix D. From the sampling event, a sample from TS0292-01, TS0292-02, and one duplicate (TS0292-03) was submitted for off-site analysis. A summary of the test results is presented in Table 10.

Additional sampling events were in September, 1994 by Law Environmental, and March 1995 by Dames & Moore. Test results are provided in Table 10, and discussed in Section 3.0.

2.3 PHASE II SITE INVESTIGATION

2.3.1 Piezometer Installation

Four piezometers, PZ-A, -B, -C and -D, were installed to assess ground water flow direction and ground water quality (see Figure 7). The piezometer installation was conducted by PSA under the direction of a Dames & Moore field geologist. PSA used a van-mounted Geoprobe Systems® hydraulic probe unit to advance a 3/4-inch diameter galvanized pipe to the desired depths. The boreholes were then oversized by driving a pilot point down the length of the borings. Water levels were checked by lowering a water level indicator down the open boreholes. After the borings were completed to the desired depths, the PVC screen sections and casings were sleeved on the outside of the rod sections and driven to the desired depth. The piezometers were completed by withdrawing the drill rods leaving the PVC and expendable points in place. Results of the piezometer monitoring is provided in Table 8.

2.3.2 Immunoassay Soil Borings

The Phase II drilling operations were performed from October to December, 1994, by Mikon under the supervision and direction of a Dames & Moore field geologist. Mikon used a truck-mounted Acker ADII drill rig to advance the soil borings. The soil boring locations were selected to assess the lateral and vertical extent of soil contamination following a review of the soil gas survey results. The locations were submitted to the USACE and Fort Riley for approval prior to commencing drilling operations. The soil boring locations are shown on Figure 8, boring logs are provided in Appendix E. Immunoassay test results are provided in Table 9.

A total of ten soil borings, BLDG 354SB-01 through BLDG 354SB-10 were advanced to depths ranging from 9.3 to 34 feet below ground surface (bgs) using 3¼-inch inside diameter (I.D.) HSA. Soil samples were collected continuously at two-foot intervals using a Central Mining Equipment (CME) 3-inch I.D. continuous sampler. The soil samples were collected for the purpose of soil classification, headspace analysis, and possible laboratory analysis. Decontaminated augers and samplers were used to advance and sample each boring.

During sample collection, the field geologist recorded a description of the penetrated soil profile based on visual observations and noted indications of possible contamination based on visual discoloration and/or odor. Following completion of the soil sampling, the borings were backfilled

with bentonite chips to within five feet of ground surface. The remainder of each boring was then backfilled to the surface with 94:3 cement-bentonite grout.

Before each soil sample was logged, the sample was split using a stainless steel sampling knife and a portion of the sample immediately placed into laboratory-provided glass jars. Each jar for VOC analysis was filled completely to minimize sample headspace. The sample jars were then labeled appropriately, placed in a cooler containing ice, and kept at approximately 4°C during storage and shipment to the laboratory. The soil samples were identified by the building number, boring number, and sample interval [e.g., BLDG 354SB-01 (4-6') indicates the 4- to 6-foot sample interval from the first boring at the Building 354 site].

A portion of the remaining sample was packed loosely into a clean glass jar, covered with foil, sealed with a cap, and placed in a warm location. Soil sample headspace analysis was performed on these samples as described in Section 2.2.2. Test results are provided in Table 9.

A total of 30 soil samples (three from each boring) were selected for on-site immunoassay analysis as follows: (1) the first sample exhibiting a headspace reading above background *(reading of ambient air),* (2) the sample exhibiting the highest headspace reading, and (3) the first sample collected from below any apparent contamination (e.g. elevated head space, staining, or odor) which appears uncontaminated or the interval immediately above the water table or bottom of the borehole. Two duplicates [354SB-02A(11-13') and 354SB-02B(19-21')] were collected and submitted for off-site TPH analysis for comparison with the immunoassay results.

The selected soil samples were analyzed for petroleum hydrocarbons using an immunoassay field test. The designated field test kit, the EnSys PETRO RIS^{C}™ Soil Test System, conforms to proposed EPA Method 4030 for immunoassay-based field screening of petroleum compounds in soil. The test detection level was 100 mg/kg standardized to Number 6 fuel oil. This standardization provided a minimum detection level of 40 mg/kg for gasoline, 60 mg/kg for diesel, and 60 mg/kg for Number 2 fuel oil.

2.3.3 Confirmatory Soil Borings

Based on the results of the immunoassay analysis, four additional soil borings, BLDG 354SB-11 through BLDG 354SB-14, were advanced at the site. Each soil sample was identified by the building number, boring number, and sample interval [e.g., BLDG 354SB-11D indicates the fourth sample interval from the eleventh boring at Building 354]. Eight soil samples (two from each boring)

Table 3 indicated 9 soil samples

were selected from the borings for off-site laboratory analysis to confirm the immunoassay results. The soil borings were drilled and sampled as described in Section 2.2.2. *The locations were submitted to the USACE and Fort Riley for approval prior to commencing drilling operations.* The soil boring locations are shown on Figure 8. Test results are provided in Table 9.

The soil samples from the confirmatory borings were selected for off-site analysis as follows: (1) the sample exhibiting the highest headspace reading, and (2) the first sample collected from below any apparent contamination (e.g. elevated head space, staining, or odor) which appears uncontaminated or the interval immediately above the water table or bottom of the borehole. One duplicate was collected and submitted for off-site analysis.

Indicate the soil boring the soil sample duplicate

2.3.4 In Situ Ground Water Sampling

The in situ ground water sampling and on-site heated headspace analysis was conducted by PSA under the direction of a Dames & Moore field geologist. *Out of sixteen locations attempted, seven locations* (WS-3, WS-4, WS-5, WS-15(PZ-C), WS-16(PZ-D) WS-17, and WS-18) were successfully sampled on January 10 and 11, 1995. PSA was unable to collect water samples from nine of the sampling locations attempted and two locations could not be accessed by the sampling equipment. On September 12, 1994 piezometer PZ-A was sampled and head space analysis performed by PSA. The in situ ground water sampling locations and results, or depth to bedrock at refusal locations, are presented in Figure 9. Test results are provided in Appendix F.

PSA used a van-mounted Geoprobe Systems® hydraulic probe unit to advance a ¾-inch diameter perforated galvanized pipe fitted with an expendable probe point to the desired sampling depth. At the desired sampling depth the rod chain was withdrawn six inches from the expendable point to allow water to enter. A length of 3/8-inch Teflon tubing equipped with a stainless steel ball valve was then inserted into the probe rods from the ground surface to the bottom of the rods. The tubing was oscillated up and down to obtain a ground water sample. The ground water samples were then heated and a headspace sample collected and analyzed on site using a gas chromatograph (GC) located in the van. Standardization of the GC was conducted each morning by injecting known concentrations of the selected analytes into the GC three times and checking the response factor.

The headspace from each ground water sample was analyzed for BTEX, 1,2-DCA, total volatile organic compounds (TVOC), 1,1-Dichloroethene (1,1-DCE), 1,2-Dichloroethene (1,2-DCE), 1,1,1-Trichloroethane (1,1,1-TCA), Trichloroethene (TCE) and Tetrachloroethene (PCE).

2.3.5 Monitoring Well Installation

Monitoring well installation was performed by Mikon from February 10, 1995 through March 7, 1995 under the supervision and direction of a Dames & Moore field geologist. *The locations were submitted to the USACE and Fort Riley for approval prior to commencing drilling operations.* The four well borings were advanced to depths ranging from 33.7 to 36.0 feet bgs using 4¼-inch I.D. HSA and a 2-inch I.D. split spoon sampler. A Dames & Moore Type U Sampler was used to collect soil samples at selected intervals for physical testing. After sampling, the boreholes were then oversized to depth using 6¼-inch I.D. HSA to install the well. Soil sampling and well construction was conducted according to the methods described in Section 2.2.2. The monitoring wells, BLDG354MW95-3, BLDG354MW95-4, and BLDG354MW95-6 are located on Figure 7. The boring logs are provided in Appendix E and the monitoring well installation logs are provided in Appendix D. *Monitoring well BLDG354MW95-5 was damaged during well development, and replaced with well BLDG354MW95-6, at an approximate offset of 10 feet. Well abandonment procedures are outlined on the well installation log provided in Appendix D.*

Depth to ground water measured in the stabilized boreholes prior to well installation ranged from 26.30 to 28.10 feet. The monitoring wells were developed between February 20 and March 13, 1995. Each well was surged and purged according to the methods described in Section 2.2.2. Following each surge and purge cycle, pH, temperature, specific conductance, and turbidity of formation waters were measured and recorded. A brief discussion of the instruments and calibration methods used for these measurements is provided in Appendix C. The surge and purge cycle was repeated for a minimum of four hours until three successive readings (taken at intervals of at least one well volume) of pH, temperature, and specific conductance had stabilized, and turbidity was reduced to less than 30 nephelometric turbidity units (NTUs). The final measurements were considered stable if they fell within the following tolerances:

Specific Conductance (temperature corrected): ±10µmhos/cm
pH: ±0.1
Temperature: ±1°F.
Turbidity: less than 30 NTUs

A total of 323 gallons of water were removed from the wells during development (BLDG354MW95-3 - 148 gal, BLDG354MW95-4 -145 gal, BLDG354MW95-6 - 30 gal). The monitoring well development data is presented in Tables 4C through 4E and Appendix D.

Monitoring wells TS0292-01, TS0292-02, BLDG 354MW95-3, BLDG 354MW95-4, and BLDG 354MW95-6 were sampled on March 23, 1995. A minimum of three well volumes were purged from each well prior to sampling. One duplicate sample from BLDG 354MW95-4 (BLDG 354MW95-5) was also submitted for off-site analysis. The monitoring well stabilization data are presented in Tables 5c through 5e. *Analytical test results are provided in Table 10.*

2.4 SURVEYING AND WELL TAGGING

The soil borings, piezometers and monitoring well locations were surveyed by Schwab Eaton, P.A., of Manhattan, Kansas, a registered land surveyor. A summary of the survey data is presented in Table 6.

The monitoring wells have not been tagged by KDHE; therefore, a well tagging site identification number, provided by the State of Kansas Site I.D. Form, is unavailable. The completed Water Well Record Forms (WWC-5) are presented in Appendix D.

2.5 SITE GEOLOGY/HYDROGEOLOGY

Geologic information obtained during the site investigation indicates that the soils and sediments are colluvial and fluvial in origin. The upper one to four feet of soil is a gravel fill mixed with clayey top soil. Below this layer a silty fine sand with intermittent clay layers extends to a depth of 24 feet. A silty fine to medium sand with fine gravel and rock fragments was encountered beneath this layer to the top of bedrock or bottom of the borehole. The boring logs are presented in Appendix E. A cross sections of the site is located on Figures 10 and shown on Figure 11.

Depths to water level and free product data were collected from monitoring well TS0292-01 between November 2, 1993 and September 28, 1994 using an oil/water interface probe. The ground water elevation fluctuated between 1068.66 and 1070.04 feet. The measurements are presented in Table 7. Water level measurements obtained from the monitoring wells and piezometers are presented in Table 8. The ground water surface contours for the site are presented on Figure 12.

Soil samples from borings BLDG354SB-14, BLDG354MW95-3, and BLDG 354MW95-4 were submitted to the Dames & Moore soils laboratory in Salt Lake City, Utah, for physical testing. The samples were collected using the Dames & Moore Type U sampler. Tests were performed to determine moisture content, permeability, and grain size distribution. A summary of the physical testing results are presented in Figures 13a, 13b, and 13c.

Moisture determination was performed in accordance with ASTM Test Designation D-2216. Moisture content (water weight as a percentage of dry soil weight) in the samples from BLDG 354SB-14, BLDG354MW95-3, and BLDG354MW95-4 was 7.7, 14.0, and 16.1 percent, respectively, and the dry density was 106, 118, and 110 pounds per cubic foot, respectively.

Permeability testing was performed on the samples using the falling head method in accordance with EM 1110-2-1906. An initial hydraulic head of 50 inches was applied to the sample and then the volume of water passing through the sample over a period of time was measured and used to calculate the average permeability of the soil. Average permeability for the samples collected from BLDG 354SB-14, BLDG 354MW95-3, and BLDG 354MW95-4 was 2.42×10^{-4}, 2.09×10^{-4}, and 2.65×10^{-6} cm/s, respectively.

Mechanical grain size analysis was performed on the coarse fraction of the samples and a hydrometer analysis was performed on the fine fraction. The analyses were performed in accordance with ASTM Test Designation D-422-63. The gradation curves for the samples are presented in Figures 13a, 13b, and 13c.

2.6 ANALYTICAL METHODS AND RESULTS

The soil gas and in situ ground water samples collected from the Building 354 site were analyzed on site by PSA using a Gas Chromatograph. The soil gas samples were analyzed for BETX, 1,2-DCA, and TVH by modified USEPA Method 8020M. The in situ ground water samples were analyzed for BETX, 1,2-DCA, TVOCs, 1,2-DCA, 1,1-DCE, 1,2-DCE, 1,1,1-TCA, TCE and PCE by modified USEPA Method SW 846-8010M. PSA's soil gas and in situ ground water sampling written report, analytical results, and QA data are presented in Appendix F.

The soil samples collected from the Building 354 site were submitted to Continental Analytical Services, Inc. (CAS), Salina, Kansas following chain-of-custody protocols. The samples were analyzed for BETX and 1,2-DCA by EPA Method 8020M, and TPH. Two modified USEPA 8015 analytical methods from the University of Iowa Hygienic Laboratory, designated OA-1 and OA-2, were used for the TPH analysis. OA-1 determines total purgeable petroleum hydrocarbon concentrations and OA-2 determines semi-volatile petroleum hydrocarbon concentrations. A summary of the on-site and off-site soil analytical data is presented in Table 9. The laboratory reports and chain-of-custody forms are presented in Appendix G.

Ground water samples collected from monitoring wells TS0292-01, TS0292-02, BLDG 354MW95-3, BLDG 354MW95-4, and BLDG 354MW95-6 by Dames & Moore were submitted for off-site analysis. The samples were analyzed for VOC and metals by EPA Methods 624/8240 and 239.2/7421, respectively. A water sample from well TS0292-2 was tested off-site for iron, manganese, hardness, TDS, alkalinity, pH redox potential and conductance using EPA Methods 3060/6010, NPDES/SDWA 130.2 160.1, 310.1, EPA 9040NA, 9050, respectively. Laboratory results are provided in Appendix H. A summary of the ground water analytical data is presented in Table 10. The laboratory reports and chain-of-custody forms are presented in Appendix G.

Need Results

2.6.1 Quality Assurance Review

A review of the laboratory quality assurance (QA) analytical data and supporting documents was performed to validate the reported analytical results. The QA analytical data evaluated included the laboratory method blank, laboratory control/laboratory control duplicate, surrogate, matrix spike/matrix spike duplicate, and duplicate field sample analyses. The evaluation criteria were based on those outlined in the USEPA's National Functional Guidelines for Organic Data Review (June 1991) and Laboratory Data Validation Functional Guidelines for Evaluating Organic/Inorganic Analyses (February 1, 1988 and July 1, 1988, respectively). The results of the QA review follow.

The laboratory blank is a laboratory prepared analyte-free sample with a matrix (e.g. soil) similar to that of the samples being analyzed. The laboratory method blank analysis is used to assess whether contamination may have been introduced into the samples by the sample preparation and analysis methods used by the laboratory. The laboratory method blank analyses reported no analytes above the method detection limit in the method blanks associated with the project samples, indicating that no cross contamination occurred.

The laboratory control sample (LCS) is a matrix similar to that of the samples being analyzed which has been spiked with known concentrations of analytes, and then prepared and analyzed by the same methods as the samples. The LCS duplicate is a duplicate preparation and analysis of the LCS. The percent recovery of analytes from the LCS is a measure of the accuracy of the preparation and analysis method. The relative percent difference (RPD) between the percent recovery of analytes from the LCS and LCS duplicate is a measure of the precision of the preparation and analysis methods used by the laboratory. Review of the percent recovery and RPD for the LCS and LCS duplicate samples indicated that the evaluation criteria were met for each analyte, with the exception that the RPD for the semi-volatile hydrocarbons and xylenes was slightly above the recommended

limit of 20 percent. Because the RPD limit is advisory and the percent recovery from the LCS and LCS duplicate fell within the acceptable range, no requalification was taken.

A surrogate is a compound that is similar to the compounds of interest, but is not normally found in environmental samples. Surrogates are added to a sample prior to preparation and analysis. The surrogate percent recovery is a measure of the effectiveness of the preparation and analysis method on the individual sample. Surrogate recovery data was provided for each sample that required analysis for organic compounds. All criteria was met with the associated surrogate recovery data.

A matrix spike (MS) is an aliquot of a sample that has been spiked with a known concentration of target analytes and then prepared and analyzed by the same method as the sample. The matrix spike duplicate (MSD) is a duplicate preparation and analysis of the MS. The percent recovery of analytes from the MS sample is a measure of the accuracy of the preparation and analysis method for the specific sample matrix. The RPD between the percent recovery of analytes from MS and MSD samples is a measure of the precision of the preparation and analysis methods used by the laboratory. MS and MSD data are also used to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis. The MS and MSD data for the samples met the evaluation criteria.

Blind field duplicates, BLDG 354SB-12O (duplicate of BLDG 354SB-12N), TS0292-3 (duplicate of TS0292-1), and BLDG 354MW95-5 (duplicate of BLDG 354MW95-4) were submitted to the laboratory for an assessment of field and laboratory precision. Analytical results for the duplicates and their corresponding samples were within the RPD of 35 percent showing good field and laboratory handling.

The sample holding times were met for each of the analyses performed. Acetone was reported in sample BLDG 354SB-11D at 240 µg/kg. Acetone is a common solvent used by laboratories and can inadvertently be introduced into a sample during handling and analysis. Because the concentration of acetone in the samples is low, and because other analytes were not detected in the samples, it is likely that the acetone is the results of laboratory contamination. In summary, the analytical results generated by the laboratory meet the data quality requirements and objectives of the project and are deemed acceptable.

2.7 WASTE HANDLING

Trash generated during the site investigation activities (e.g. protective clothing, gloves, packing material, etc.) was placed in dumpsters for disposal in the Fort Riley sanitary landfill located in the Custer Hill area. The site was policed after completion of activities to ensure that no trash remained.

The soil cuttings and monitoring well development/purge water generated during the preliminary site assessment were containerized in properly labeled 55-gallon DOT-approved 17-E/H drums. Eight (8) drums of soil and two (2) drums of water generated at the site were placed in a temporary storage area located south of 4th Street between K and L Streets.

Composite soil samples were collected from a total of 103 drums, including the eight drums from Building 354, generated from various ongoing UST investigations at Fort Riley on July 15, 1993. Each composite sample consisted of grab samples from five to six drums of soil. The composite samples were submitted to CAS and analyzed for lead using the USEPA Toxicity Characteristic Leaching Procedure (TCLP) extraction Method 1311 and analytical Method 200.7/6010. Lead was below the method detection limit (2 mg/L) in each sample. The TCLP laboratory analytical reports are presented in Appendix H.

The soil cuttings were disposed of in the construction debris landfill on Camp Whitside in August 1993. The decontamination water was disposed of in the Camp Funston sanitary sewer system in December 1992 and December 1993, respectively.

Soil cuttings and personal protective equipment/plastic generated during Phase II activities were placed in drums 103, 146, 150 through 155, 223, and 294. The drums were placed in the temporary storage area located south of 4th Street between K and L Streets pending disposal. Analysis and disposal of waste generated during Phase II is under separate contract with ~~HydroGeoLogic, Inc.~~ this has been done?

3.0 DISCUSSION AND SUMMARY OF THE RESULTS

3.1 DISCUSSION OF THE RESULTS

The soil gas survey from the site investigation reported Total BETX (182 and 414 µg/l), TVH (3,632 µg/l and 9,170 µg/l) and 1,2-DCA (ND and 51 µg/l) at two of the 28 locations sampled. These locations were 10 and 90 feet east of the former UST site (see Figure 6). BETX, 1,2-DCA, and TVH were below method detection limits in the remaining samples. In addition, stained soil was noted on a soil gas probe driven to bedrock near the base of the slope 140 feet southeast of the former tank pit, indicating possible soil contamination. These results indicate that soil contamination exists adjacent to the southeast corner of the former tank pit and near the base of the slope to the south. Based upon these results, the locations for monitoring wells TS0292-01 and TS0292-02 were confirmed and the wells installed.

During installation of monitoring well TS0292-01, soil headspace readings, soil staining, and odors noted in soil samples indicated soil contamination. The contamination began at a depth of 12 feet and extended to the top of the limestone bedrock at 26.8 feet. During installation of monitoring well TS-0292-02, soil headspace readings, soil staining, and odors indicated soil contamination beginning at a depth of 8 feet and extending to the top of the limestone bedrock at 9.2 feet. An oily sheen was noted on rock fragments collected from the bottom of the boring. Soil samples from both monitoring well borings were not submitted for laboratory analysis.

On-site immunoassay analysis indicated TPH above the 100 mg/kg test kit detection level in 8 of the 30 soil samples analyzed from the site. These samples were collected from borings BLDG 354SB-01, BLDG354SB-02, BLDG354SB-06, BLDG354SB-09, and BLDG354SB-10. Two duplicate soil samples, one of a sample testing less than 100 mg/kg (BLDG354SB-02A) and one of a sample testing greater than 100 mg/kg (BLDG354SB-02B), were submitted to CAS for TPH by OA-1 and OA-2 analyses. The analyses reported TPH by OA-1 at 11,000 mg/kg in BLDG354SBB and TPH by OA-2 at 29 mg/kg in BLDG354SB-02A. The immunoassay results indicate POL soil contamination in the vicinity of the former tank pits and extending to the south downslope approximately 240 feet. Based on the immunoassay results, four confirmatory soil borings (BLDG 354SB-11 through BLDG354SB-14) were advanced at the site to confirm the approximate extent of soils above KDHE action levels as identified by the soil gas and immunoassay data.

Off-site laboratory analysis of soil samples collected from the confirmatory soil borings reported TPH exceeding the KDHE action levels of 100 mg/kg in three samples. BLDG354SB-12H reported TPH by OA-1 at 110 mg/kg, BLDG354SB-12N reported TPH by OA-1 at 2500 mg/kg, and BLDG354SB-12O, a duplicate of BLDG354SB-12N, reported TPH by OA-1 at 3100 mg/kg. TPH, VOCs, and PNAs were below KDHE action levels in the remaining samples. These results confirm the extent of soil contamination above KDHE action levels identified by the soil gas and immunoassay data.

On-site heated headspace analysis of five in situ ground water and three piezometer ground water samples reported total BETX (ND to 525 ppb), total VOC(Non-detect to 4800) 1,2-DCA (Non-detect to 4 ppb), TCE (Non-detect to 1 ppb), and PCE (Non-detect to 2 ppb) at the locations shown on Figure 9. Based upon these results, one up gradient and two down gradient monitoring wells were installed to define *the outer limits extent of ground water contamination.*

Initial ground water sampling and analysis of monitoring wells TS0292-01 and TS0292-02 was conducted by Dames & Moore in November 1993. Analysis of a ground water sample collected from monitoring well TS0292-01 reported benzene (37 µg/L) and tetrachloroethene (PCE) (13 µg/L) which are above the KDHE action levels. Ethylbenzene (30 µg/L), toluene (91 µg/L), xylenes (90 µg/L), and naphthalene (5.2 µg/L) were also detected, but were below KDHE action levels. Ethylbenzene and xylenes were reported in the ground water sample collected from monitoring well TS0292-02 at concentrations of 9 and 5.2 µg/L, respectively. Other VOCs were reported below the method detection limit. Free product was not detected in either well during this sampling event.

A second ground water sampling event and analysis of monitoring wells TS0292-01 and TS0292-02 was conducted by Law Environmental in September 1994. Analysis of a ground water sample collected from monitoring well TS0292-01 reported benzene (5.4 µg/L), and tetrachloroethene (PCE) (130 µg/L) which are above KDHE action levels. Toluene (6.2 µg/L) and xylenes (7.8 µg/L) were also detected but were below KDHE action levels. Carbon tetrachloride (1.1 µg/l, estimated value based on QC data) and chloroform (2.1 µg/l) were reported but do not have KDHE action levels. The ground water sample collected from monitoring well TS0292-02 reported benzene above KDHE action level at (59 µg/L). Ethylbenzene (34 µg/L), toluene (6.2 µg/L), and xylenes (23 µg/L)were reported below KDHE action levels. The following analytes were detected but do not have KDHE action levels: acetone (36 µg/l , estimated value based on QC data); cis-1,2-DCE (5.4 µg/l); and methylene chloride (7 µg/l, estimated value based on QC data). Other VOCs were reported below the method detection limit.

A minimal thickness (0.01 feet) of free product was detected in TS0292-01 on 8/26/94 and 09/09/94 during ground water elevation monitoring. This is the lowest detectable limit of free product thickness measurable by the field equipment.

Results of the off-site laboratory analysis of ground water samples collected by Dames & Moore in March 1995 from monitoring well TS0292-01, TS0292-02, BLDG 354MW95-3, BLDG 354MW95-4, and BLDG 354MW95-6 were as follows: TS0292-01 contained benzene (8.6 µg/l), TPH by OA-2 (160 µg/l), xylenes (23 µg/l), and PCE (tetrachloroethene) (170 µg/l); TS0292-02 contained 1,2-DCE (5.6 µg/l) and TPH by OA-2 (320 µg/l); BLDG 354MW95-3 contained no detectable VOCs; BLDG 354MW95-4 contained PCE (7.1 µg/l); BLDG 354MW95-6 (duplicate of BLDG 354MW95-4) contained PCE (10 µg/l); and BLDG 354MW95-6 contained PCE (tetrachloroethene) (150 µg/l). No other VOCs and PNAs were reported above the method detection limit in the samples. Lead (56 and 140 µg/l) which is the above KDHE action level was detected in monitoring well BLDG354MW95-04 and BLDG354 MW95-5 (duplicate of BLDG 354MW95-04).

3.2 SUMMARY OF RESULTS

3.2.1 Soil

Visible evidence of POL soil contamination was noted in wells TS0292-01 and TS0292-02, and immunoassay analysis indicated POL contamination in soil borings BLDG354SB-01, BLDG 354SB-02, BLDG354SB-06, BLDG354SB-09, BLDG354SB-10, and BLDG354SB-12. TPH above KDHE action levels was confirmed in soil samples collected from borings BLDG 354SB-02 and BLDG354SB-12, and TPH below KDHE action levels was confirmed in soil samples collected from borings BLDG354SB-11, BLDG354SB-13 and BLDG354SB-14. The approximate extent of TPH soil contamination above KDHE action levels is shown on Figure 14.

3.2.2 Ground Water

Benzene, detected in TS0292-01 at 8.6 µg/L, and lead, detected in BLDG354MW95-04 at 56 and 140 µg/L, were the only POL constituent above KDHE action levels detected in the monitoring wells during the most recent ground water sampling event. In addition, PCE above the KDHE and USEPA drinking water maximum contaminant level (MCL) was detected in three of the five monitoring wells.

POL related ground water contamination at the site is not extensive and appears to be diminishing with time due to natural attenuation. The PCE contamination appears to be related to an unidentified off-site source. Therefore, Dames & Moore recommends that Fort Riley request KDHE to place the ground water at the site in a monitoring status until the source and extent of PCE contamination can be determined.

The analytical data shows a decrease in BETX and naphthalene in TS0292-01 between November 1993 and March 1995, which may indicate a diminishing source of soluble POL constituents over time. On-site heated headspace analysis of ground water grab samples from the piezometers and well points reported benzene at 372, 3, and 6 µg/L in piezometer PZ-A and two down gradient well points, respectively. POL constituents were below KDHE action levels in the remaining piezometers and well point ground water samples. The data indicates that the contaminant plume is migrating southward from the former UST site. The approximate extent of benzene contamination above the KDHE action level is shown on Figure 15.

It is not likely that the site is the source of the lead detected in BLDG354MW95-04. Lead above KDHE action levels was not detected in the vicinity of the former tank pits. *High levels of lead are known to be naturally occurring in the alluvial deposits forming the subsurface stratigraphy and may be the source of the lead in the soil sample tested..*

3.3 OFF-SITE SOURCES

The results of the investigation are consistent with the historical use of the site, with the exception of PCE in ground water. PCE was detected in TS0292-01 adjacent to the former tank pits, 100 feet up gradient in BLDG 354MW95-6, and 600 feet down gradient in BLDG 354MW95-4. The analytical data from TS0292-01 show an increase in the PCE concentration between November 1993 and March 1995, while at the same time indicating a decrease in BETX constituents. These results indicate that the PCE in the ground water is likely the result of an off-site source. Based on the ground water flow direction (see Figure 12), the possible source of the PCE contamination is north northeast of the site

4.0 RECOMMENDATIONS

Dames & Moore recommends that Fort Riley address remediation of the TPH contaminated soil at the site under the Kansas Underground Storage Tank Program administered by KDHE. Discussions should continue with KDHE to negotiate site specific cleanup requirements and/or levels and to reach an agreement on an approved remedial action. In support of these discussions, Dames & Moore will prepare a site-specific remedial action plan (RAP). The RAP will discuss a minimum of three methods for addressing the POL soil contamination identified at the site and will recommend the most viable method or methods for achieving the KDHE soil cleanup objectives.

REFERENCES

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Latta, Bruce F., 1949, Ground-water Conditions in the Smoky Hill Valley in Saline, Dickinson, and Geary Counties, Kansas, State Geological Survey of Kansas, Bulletin 84.

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TABLE 1
UST INFORMATION

BUILDING 354 - MAIN POST
DAMES & MOORE - POL/UST INVESTIGATION
FORT RILEY, KANSAS

Tank Number	Number of Tanks	Date of Installation / Removal	Size (gallons)	Type of Product	Type of Tank	Type of Piping	Date of Leak Discovery	Condition of Tank
354A, B	2	1980/1991	10,000	diesel	steel	steel	no leaks detected	good
354C, D	2	1933/1990	10,000	gasoline	steel	steel	1990	unknown
354E	1	1933/1990	12,800	diesel	steel	steel	1990	unknown
354F	1	1933/Unknown	8,500	diesel	steel	steel	Tank not found	unknown

TABLE 2
CHRONOLOGICAL DESCRIPTION OF INVESTIGATIVE AND CORRECTIVE ACTION WORK

BUILDING 354 - MAIN POST
DAMES & MOORE - POL/UST SITE INVESTIGATION
FORT RILEY, KANSAS

DATE	INVESTIGATION/CORRECTIVE ACTION	CONTRACTOR
August 16, 1990	Three USTs removed. Tanks sold as scrap metal by Fort Riley DRMO. Petroleum contaminated soil disposed of in contractor's approved disposal location above Camp Whitside.	Ed Reddins Excavating, Inc.
November 19 and December 5, 1991	Two USTs removed. Tanks sold as scrap metal by Fort Riley DRMO. No petroleum contaminated soil.	Environmental Recovery, Inc.
December 15, 1992	Conducted a 28-point soil gas survey to assess the horizontal extent of petroleum contaminated soil. Soil gas samples analyzed by on-site GC for BETX, 1,2-DCA, and total volatile hydrocarbons.	PSA Environmental, Inc.
December 16 and 21, 1992	Installed two monitoring wells	Dames & Moore
November 2, 1993 - September 28, 1994	Periodic depth to ground water / free product measurements	Dames & Moore
November 3 and 4, 1993	Developed and sampled two existing monitoring wells. Benzene and tetrachloroethene detected above KDHE action levels in TS0292-01. No contaminants above KDHE action levels in TS0292-02.	Dames & Moore
September 9 and 15, 1994	Installed two piezometers	PSA Environmental, Inc. Text 4 PZ's
October 17, 1994 - December 7, 1994	Advanced and sampled ten soil borings to confirm the findings of the soil gas survey. Soil samples analyzed on-site for TPH using an immunoassay test kit.	Dames & Moore
January 10 and 11, 1995	Collected five in situ ground water samples. Samples analyzed by on-site GC for BETX, 1,2-DCA, and total volatile organic compounds.	PSA Environmental, Inc.
January 11, 1995	Installed two piezometers. Sampled three piezometers. Samples analyzed by on-site GC for BETX, 1,2-DCA, TVOCs, 1,1-DCE, 1,2-DCE, 1,1,1-TCA, TCE, and PCE.	PSA Environmental, Inc.
February 7 and 8, 1995	Advanced and sampled four soil borings to confirm the findings of the soil gas survey and immunoassay results. Soil samples analyzed by off-site laboratory for VOCs and TPH. Soil contamination in 354SB-12 detected above KDHE action levels. semi VOC	Dames & Moore
February 10, 1995 - March 6, 1995	Installed four monitoring wells. One monitoring well abandoned	Dames & Moore Text 3
March 24, 1995	Developed and sampled five existing monitoring wells. Benzene, tetrachloroethene, and lead detected above KDHE action levels in ground water.	Dames & Moore

TABLE 3
SUMMARY OF WORK COMPLETED

BUILDING 354 - MAIN POST
DAMES & MOORE - POL/UST INVESTIGATION
FORT RILEY, KANSAS

FIELD ACTIVITY	FIELD ANALYSES	LAB ANALYSES
Twenty-eight-point soil gas survey. Soil gas sampled from a depth of ten feet.	On-site gas chromatograph analysis of 28 soil gas samples for BETX, 1,2-DCA, and total volatile hydrocarbons.	None.
Advancement and sampling of 14 soil borings with a total footage of 295 feet.	On-site headspace analysis of 142 soil samples using a photoionization detector. On-site analysis of 12 soil samples using an immunoassay test kit.	Off-site laboratory analysis of 9 soil samples for BETX, 1,2-DCA, total purgeable hydrocarbons, and semi-volatile petroleum hydrocarbons. Three soil samples submitted for moisture-density, grain size, and permeability testing.
Collection of five in situ ground water samples using a Geoprobe® unit.	On-site heated headspace analysis of five in situ ground water samples using a gas chromatograph. Samples analyzed for BETX, TVOCs, 1,1-DCE, 1,2-DCE, 1,1,1-TCA, TCE, and PCE.	None. TVH
Installation of five monitoring wells. Borings advanced to depths ranging from 17.5 to 36 feet.	Temperature, pH, and total dissolved solids measurements of ground water purged from wells during development.	Ground water samples submitted to off-site laboratory for VOC and TPH analysis & semi volatile
Installed four piezometers using a Geoprobe® unit.	On-site heated headspace analysis of three water samples using a gas chromatograph. Samples analyzed for BETX, TVOCs, 1,1-DCE, 1,2-DCE, 1,1,1-TCA, TCE, and PCE. TVH	None.

TABLE 4a
MONITORING WELL TS0292-01 DEVELOPMENT DATA

BUILDING 354 - MAIN POST
DAMES & MOORE - POL/UST SITE INVESTIGATION
FORT RILEY, KANSAS

PARAMETER	WELL VOLUME EXTRACTED		
	1	2	3
Date	12/22/93	12/22/93	12/22/93
Total Dissolved solid (ppm)	600	600	500
pH: ± 0.1 pH unit	6.3	6.2	6.3
Temperature: ±1.0°F	64	64	64
Turbidity (NTUs)	42	33	29
Color	clear	clear	clear
Odor	strong	strong	strong

TABLE 4b
MONITORING WELL TS0292-02 DEVELOPMENT DATA

BUILDING 354 - MAIN POST
DAMES & MOORE - POL/UST SITE INVESTIGATION
FORT RILEY, KANSAS

PARAMETER	WELL VOLUME EXTRACTED		
	1	2	3
Date	11/3/93	11/3/93	11/3/93
Total Dissolved solid (ppm)	1980	1620	1730
pH: ± 0.1 pH unit	6.533	6.822	6.89
Temperature: ±1.0°F	56.3	64.8	63.1
Turbidity (NTUs)	off scale	13.08	21.13
Color	cloudy	clear	clear
Odor	oily	none	none

TABLE 4c
MONITORING WELL BLDG 354MW95-3 DEVELOPMENT DATA

BUILDING 354 - MAIN POST
DAMES & MOORE - POL/UST SITE INVESTIGATION
FORT RILEY, KANSAS

PARAMETER	WELL VOLUME EXTRACTED											
	1	2	3	4	5	6	7	8	9	10	11	12
Date	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3
Specific Conductance (temperature corrected) ±10 µmhos/cm	1400	1310	1286	1280	1250	1310	1410	1400	1420	1410	1410	1420
pH: ±0.1 pH unit	6.60	6.70	6.90	6.86	7.00	7.05	7.25	7.39	7.40	7.44	7.38	7.42
Temperature: ±1.0°F	58.1	60.0	61.5	61.7	58.9	60.1	60.1	60.7	60.5	61.3	62.1	62.1
Turbidity (NTUs)	64.5	11.3	5.40	306	25.4	9.75	280	18.6	7.3	42.7	9.9	---
Color	cloudy	clear	clear	cloudy	clear	clear	cloudy	clear	clear	cloudy	clear	clear
Odor	none	none	none	none	none	none	none	none	none	none	none	none

TABLE 4d
MONITORING WELL BLDG 354MW95-4 DEVELOPMENT DATA

BUILDING 354 - MAIN POST
DAMES & MOORE - POL/UST SITE INVESTIGATION
FORT RILEY, KANSAS

PARAMETER	WELL VOLUME EXTRACTED											
	1	2	3	4	5	6	7	8	9	10	11	12
Date	2/20	2/20	2/20	2/20	2/20	2/20	2/20	2/20	2/20	2/20	2/20	2/20
Specific Conductance (temperature corrected) ±10 µmhos/cm	1540	1540	1540	1610	1890	1830	1630	1730	1680	1730	1740	1730
pH: ±0.1 pH unit	7.30	6.98	7.35	7.90	7.93	8.05	8.75	9.24	8.99	9.08	9.10	9.13
Temperature: ±1.0°F	64.3	63.3	64.2	64.1	65.1	66.8	66.8	66.7	67.7	72.7	73.2	73.0
Turbidity (NTUs)	350	51.5	22.3	495	19.3	2.75	470	7.5	2.66	990	61.6	23.6
Color	brown	clear	clear	cloudy	clear	clear	cloudy	clear	clear	cloudy	cloudy	clear
Odor	none	none	none	none	none	none	none	none	none	none	none	none

TABLE 4e
MONITORING WELL BLDG 354MW95-6 DEVELOPMENT DATA

BUILDING 354 - MAIN POST
DAMES & MOORE - POL/UST SITE INVESTIGATION
FORT RILEY, KANSAS

PARAMETER	WELL VOLUME EXTRACTED											
	1	2	3	4	5	6	7	8	9	10	11	12
Date	3/13	3/13	3/13	3/14	3/14	3/14	3/15	3/15	3/15	3/15	3/15	3/16
Specific Conductance (temperature corrected) ±10 µmhos/cm	1310	1310	1320	1320	1330	1320	1320	1310	1160	1140	1140	1130
pH: ±0.1 pH unit	6.20	12.50	12.60	5.60	6.00	6.50	6.50	6.60	6.07	6.15	6.65	6.60
Temperature: ±1.0°F	64.0	63.5	63.5	62.5	63.5	66.5	66.5	66.0	61.3	62.0	62.2	63.5
Turbidity (NTUs)	>1000	>1000	>1000	1310	1300	1300	1300	1220	541	340	24.9	19.6
Color	yellow-brown	yellow-brown	yellow-brown	cloudy	cloudy	cloudy	cloudy	cloudy	cloudy	cloudy	clear	clear
Odor	none	none	none	none	none	none	none	none	none	none	none	none

TABLE 5a
MONITORING WELL TS0292-01 STABILIZATION DATA

BUILDING 354 - MAIN POST
DAMES & MOORE - POL/UST SITE INVESTIGATION
FORT RILEY, KANSAS

PARAMETER	WELL VOLUME EXTRACTED		
	1	2	3
Date	3/23/95	3/23/95	3/23/95
Specific Conductance (temperature corrected) ± 10 µmhos/cm	2020	1990	1990
pH: ± 0.1 pH unit	6.67	6.72	6.70
Temperature: ±0.5 °F	63.7	62.5	62.5
Turbidity (NTUs)	356	150	28.5
Color	cloudy	cloudy	clear
Odor	diesel	diesel	diesel

TABLE 5b
MONITORING WELL TS0292-02 STABILIZATION DATA

BUILDING 354 - MAIN POST
DAMES & MOORE - POL/UST SITE INVESTIGATION
FORT RILEY, KANSAS

PARAMETER	WELL VOLUME EXTRACTED		
	1	2	3
Date	3/23/95	3/23/95	3/23/95
Specific Conductance (temperature corrected) ± 10 µmhos/cm	1190	1180	1190
pH: ± 0.1 pH unit	5.98	5.92	5.94
Temperature: ±0.5°F	57.3	58.2	58.1
Turbidity (NTUs)	100.3	52.3	14.9
Color	cloudy	clear	clear
Odor	diesel	diesel	diesel

TABLE 5c
MONITORING WELL BLDG 354MW95-3 STABILIZATION DATA

BUILDING 354 - MAIN POST
DAMES & MOORE - POL/UST SITE INVESTIGATION
FORT RILEY, KANSAS

PARAMETER	WELL VOLUME EXTRACTED		
	1	2	3
Date	3/23/95	3/23/95	3/23/95
Specific Conductance (temperature corrected) ± 10 µmhos/cm	1320	1330	1320
pH: ± 0.1 pH unit	5.82	5.95	5.92
Temperature: ±0.5°F	62.3	64.0	62.1
Turbidity (NTUs)	36.7	7.24	2.92
Color	clear	clear	clear
Odor	none	none	none

TABLE 5d
MONITORING WELL BLDG 354MW95-4 STABILIZATION DATA

BUILDING 354 - MAIN POST
DAMES & MOORE - POL/UST SITE INVESTIGATION
FORT RILEY, KANSAS

PARAMETER	WELL VOLUME EXTRACTED		
	1	2	3
Date	3/23/95	3/23/95	3/23/95
Specific Conductance (temperature corrected) ± 10 µmhos/cm	1190	1180	1190
pH: ± 0.1 pH unit	7.42	7.37	7.35
Temperature: ±0.5°F	66.0	65.8	66.2
Turbidity (NTUs)	1000	114	21.9
Color	brown	cloudy	clear
Odor	none	none	none

TABLE 5e
MONITORING WELL BLDG 354MW95-6 STABILIZATION DATA

BUILDING 354 - MAIN POST
DAMES & MOORE - POL/UST SITE INVESTIGATION
FORT RILEY, KANSAS

PARAMETER	WELL VOLUME EXTRACTED		
	1	2	3
Date	3/23/95	3/23/95	3/23/95
Specific Conductance (temperature corrected) ± 10 µmhos/cm	1990	1980	1985
pH: ± 0.1 pH unit	6.45	6.52	6.53
Temperature: ±0.5°F	62.3	62.5	62.5
Turbidity (NTUs)	186.5	122	28
Color	cloudy	cloudy	clear
Odor	none	none	none

TABLE 6
SURVEY COORDINATES AND ELEVATIONS

BUILDING 354 - MAIN POST
DAMES & MOORE - POL/UST INVESTIGATION
FORT RILEY, KANSAS

SOIL BORING/ MONITORING WELL	NORTH	EAST	SURFACE ELEVATION	TOP OF CASING ELEVATION
TS0292-01	267708.54688	2347286.60702	1093.2300	1092.89
TS0292-02	267584.93509	2347356.78644	1075.4200	1075.29
354SB-01	267575.04430	2347336.12603	1075.2048	N/A
354SB-02	267740.78224	2347281.70345	1095.7593	N/A
354SB-03	267747.11933	2347406.81813	1091.5753	N/A
354SB-04	267685.38364	2347199.47131	1079.9387	N/A
354SB-05	267533.39187	2347211.31670	1076.4674	N/A
354SB-06	267464.44635	2347349.20195	1075.2688	N/A
354SB-07	267822.96312	2347258.61426	1099.3280	N/A
354SB-08	267684.29958	2347196.39454	1080.1068	N/A
354SB-09	267658.52448	2347307.94018	1089.7559	N/A
354SB-10	267543.87373	2347429.11315	1073.6223	N/A
354SB-11	267577.80138	2347251.35385	1078.5118	N/A
354SB-12	267708.96324	2347299.91922	1093.5941	N/A
354SB-13	267578.77395	2347347.40193	1075.4497	N/A
354SB-14	267548.35017	2347432.90145	1073.5220	N/A
354MW95-03	267260.91843	2347512.77497	1075.2763	1075.1009
354MW95-04	267545.38801	2347697.38703	1072.6271	1072.2694
354MW95-06	267832.89008	2347256.20038	1100.0748	1099.8815
Bldg354PZ(-1,14)	267292.85962	2347179.89992	1073.65	NA
Bldg354PZ(12,10)	267445.82647	2347713.61452	1072.07	NA
Bldg354PZ-A	267579.87745	2347242.93021	1077.89	NA
Bldg354PZ-B	267677.36884	2347471.56395	1075.66	NA

why? but you indicated in Table 8

N/A: Not Applicable

TABLE 7
MONITORING WELL TS0292-01 - GROUND WATER ELEVATION DATA

BUILDING 354 - MAIN POST
DAMES & MOORE - POL/UST INVESTIGATIONS
FORT RILEY, KANSAS

Date	Ground Water Elevation (Feet)	Free Product Thickness (Feet)	Ground Water Elevation (Corrected for Free Product) (Feet)
November 2, 1993	1070.04	0	1070.04
December 15, 1993	1069.63	0	1069.63
February 8, 1994	1069.28	0	1069.28
February 9, 1994	1069.26	0	1069.26
February 25, 1994	1069.19	0	1069.19
March 10, 1994	1069.11	0	1069.11
March 17, 1994	1069.17	0	1069.17
March 23, 1994	1069.11	0	1069.11
March 31, 1994	1069.08	0	1069.08
April 7, 1994	1069.05	0	1069.05
April 14, 1994	1069.07	0	1069.07
April 21, 1994	1069.01	0	1069.01
April 28, 1994	1069.00	0	1069.00
May 5, 1994	1069.02	0	1069.02
May 13, 1994	1069.02	0	1069.02
May 17, 1994	1069.01	0	1069.01
May 26, 1994	1068.97	0	1068.97
June 2, 1994	1068.95	0	1068.95
June 9, 1994	1068.94	0	1068.94
June 16, 1994	1068.93	0	1068.93
June 23, 1994	1068.91	0	1068.91
June 30, 1994	1068.89	0	1068.89
July 7, 1994	1068.90	0	1068.90
July 19, 1994	1068.88	0	1068.88
July 22, 1994	1068.89	0	1068.89
July 29, 1994	1068.87	0	1068.87
August 4, 1994	1068.87	0	1068.87
August 11, 1994	1068.84	0	1068.84
August 17, 1994	1068.83	0	1068.83
August 19, 1994	1068.82	0	1068.82
August 26, 1994	1068.79	0.01	1068.7975 ? What?!?
September 2, 1994	1068.77	0	1068.77
September 9, 1994	1068.73	0.01	1068.7375 ?
September 22, 1994	1068.73	0	1068.73
September 28, 1994	1068.66	0	1068.66

TABLE 8
GROUND WATER ELEVATION DATA

FORMER BUILDING 354 - MAIN POST
FORT RILEY, KANSAS

Monitoring Wells and Piezometers	Top of Casing Elevation (feet)	Ground Water Depth (feet)	Ground water Elevation (feet)
TS0292-1	1092.89	24.16	1068.73
TS0292-2	1075.29	12.64	1062.65
MW95-3	1075.1009	26.11	1048.9909
MW95-4	1072.2694	23.12	1049.1494
MW95-6	1099.8815	30.56	1069.3215
PZ-A	1077.89140	10.32	1067.57
PZ-B	1075.66352	8.17	1067.49
PZ-C	1073.64925	25.36	1048.28
PZ-D	1072.06641	-	-

Note: All readings taken May 9, 1995. No reading taken from PZ-D.

for the WDI

TABLE 9
SOIL SAMPLE ON-SITE AND OFF-SITE ANALYTICAL RESULTS

BUILDING 354 - MAIN POST
DAMES & MOORE - POL/UST SITE INVESTIGATION
FORT RILEY, KANSAS

SOIL IDENTIFICATION	354SB-01			354SB-02			354SB-03			354SB-04			KDHE ACTION LEVEL
	[4-6']	[6-8']	[8-9.3']	A [11-13']	B [19-21']	[27-29']	[3-5']	[13-15']	[23-25']	[4-6']	[10-12']	[12-14']	
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ON-SITE SOIL HEADSPACE ANALYSIS (ppm)	0	1	250	20	350	350	25	22	18	4	4	5	N/A
ON-SITE IMMUNOASSAY ANALYSIS	>100	>100	>100	<100	>100	>100	<100	<100	<100	<100	<100	<100	N/A
BENZENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.4
TOLUENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ETHYLBENZENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
XYLENES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DCA	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8
TPH by OA-1	N/A	N/A	N/A	0.26	11,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	100
TPH by OA-2	N/A	N/A	N/A	29	ND(50)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	100
ACETONE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2-METHYL NAPTHALENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NAPHTHALENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A: Not Analyzed
ND: Not detected above method detection limit
( ): Method Detection Limit

TABLE 9 (CONTINUED)

SOIL IDENTIFICATION	354SB-05			354SB-06			354SB-07			354SB-08			KDHE ACTION LEVEL
	[3-5']	[7-9']	[9-11']	[8-10']	[18-20']	[24-26']	[8-10']	[26-28']	[32-34']	[6-8']	[10-12']	[20-22']	
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ON-SITE SOIL HEADSPACE ANALYSIS (ppm)	3	3	3	3	6	350	1	1	1	2	3	0	N/A
ON-SITE IMMUNOASSAY ANALYSIS	<100	<100	<100	<100	<100	>100	<100	<100	<100	<100	<100	<100	N/A
BENZENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.4
TOLUENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ETHYLBENZENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
XYLENES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DCA	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8
TPH by OA-1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	100
TPH by OA-2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	100
ACETONE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2-METHYL NAPTHALENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NAPHTHALENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A: Not Analyzed
ND: Not detected above method detection limit
( ): Method Detection Limit

TABLE 9 (CONTINUED)

SOIL IDENTIFICATION	354SB-09			354SB-10			354SB-11		354SB-12	KDHE ACTION LEVEL
	[10-12']	[16-18']	[20-22']	[12-14']	[16-18']	[20-22']	D [6-8']	F [10-12']	H [14-16']	
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ON-SITE SOIL HEADSPACE ANALYSIS (ppm)	0	0	35	5	65	450	5	300	450	N/A
ON-SITE IMMUNOASSAY ANALYSIS	<100	<100	>100	<100	<100	>100	N/A	N/A	N/A	N/A
BENZENE	N/A	N/A	N/A	N/A	N/A	N/A	ND(.005)	ND(.005)	ND(.024)	1.4
TOLUENE	N/A	N/A	N/A	N/A	N/A	N/A	ND(.005)	ND(.005)	ND(.024)	N/A
ETHYLBENZENE	N/A	N/A	N/A	N/A	N/A	N/A	ND(.005)	ND(.005)	59	N/A
XYLENES	N/A	N/A	N/A	N/A	N/A	N/A	ND(.005)	ND(.005)	440	N/A
1,2-DCA	N/A	N/A	N/A	N/A	N/A	N/A	ND(.005)	ND(.005)	ND(.024)	8
TPH by OA-1	N/A	N/A	N/A	N/A	N/A	N/A	ND(.1)	ND(.1)	110	100
TPH by OA-2	N/A	N/A	N/A	N/A	N/A	N/A	ND(5.0)	ND(5.0)	13[1]	100
ACETONE	N/A	N/A	N/A	N/A	N/A	N/A	0.24	N/A	N/A	N/A
2-METHYL NAPHTALENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NAPHTHALENE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

1: Calculated from motor oil standard.
N/A: Not Analyzed
ND: Not detected above method detection limit
( ): Method Detection Limit

TABLE 9 (CONTINUED)

SOIL IDENTIFICATION	354SB-12				354SB-13		354SB-14		KDHE ACTION LEVEL
	N [26-28'] (initial)	N [26-28']	O duplicate of [26-28'] (initial)	O duplicate of [26-28']	D [6-8']	E [8-10']	L [20-22']	M [22-24']	
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ON-SITE SOIL HEADSPACE ANALYSIS (ppm)	500	500	500	500	5	2	500	425	N/A
ON-SITE IMMUNOASSAY ANALYSIS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BENZENE	ND(0.05)	ND(2.5)	ND(0.05)	ND(2.5)	ND(.005)	ND(.005)	ND(.01)	ND(.005)	1.4
TOLUENE	0.22	ND(2.5)	0.099	ND(2.5)	ND(.005)	ND(.005)	ND(.01)	ND(.005)	N/A
ETHYLBENZENE	*	6.5	1.9	ND(2.5)	ND(.005)	ND(.005)	ND(.01)	ND(.005)	N/A
XYLENES	*	39	*	10	ND(.005)	ND(.005)	ND(.01)	ND(.005)	N/A
1,2-DCA	ND(0.05)	ND(2.5)	ND(0.05)	ND(2.5)	ND(.005)	ND(.005)	ND(.01)	ND(.005)	8
TPH by OA-1	NA	2500	N/A	3100	ND(.1)	ND(.1)	81	42	100
TPH by OA-2	NA	ND(5.0)	N/A	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	100
ACETONE	ND(1.0)	N/A	ND(1.0)	N/A	N/A	N/A	N/A	N/A	N/A
2-METHYL NAPHTHALENE	N/A	1.8	N/A	1.9	N/A	N/A	N/A	0.6	N/A
NAPTHALENE	N/A	2.2	N/A	2.2	N/A	N/A	N/A	N/A	N/A

N/A: Not Analyzed
ND: Not detected above method detection limit
( ): Method Detection Limit
*: Reading exceeded calibration instrument range

TABLE 10
GROUND WATER ANALYTICAL RESULTS

BUILDING 354 - MAIN POST
DAMES & MOORE - POL/UST SITE INVESTIGATION
FORT RILEY, KANSAS

	TS0292-01 (11/3/93)	TS0292-03 Duplicate of TS0292-01 (11/3/93)	TS0292-01 (9/28/94)	TS0292-01 (3/24/95)	TS0292-02 (11/4/93)	TS0292-02 (9/28/94)	TS0292-02 (3/24/95)	BLDG 354 MW95-03	BLDG 354 MW95-04	BLDG 354 MW95-05 Duplicate of MW95-04	BLDG 354 MW95-06	KDHE ACTION LEVEL	MCL
ANALYSES	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
BENZENE	37	39	5.4	8.6	ND(5.0)	59	ND(5.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	5	5
ETHYLBENZENE	30	28	2.2	ND(5.0)	9	34	ND(5.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	680	700
TOLUENE	91	89	3.8	ND(5.0)	ND(5.0)	6.2	ND(5.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	2000	1000
XYLENES	90	85	7.8	23	5.2	23	ND(5.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	440	10000
1,2-DCA	ND(5.0)	ND(5.0)	N/A	ND(5.0)	ND(5.0)	N/A	ND(5.0)	ND(3.0)	ND(3.0)	ND(3.0)	ND(3.0)	5	5
LEAD	11	20	ND	ND(3.0)	9	ND	ND(3.0)	21	56	140	3	50	15
TPH (OA-2)	N/A	N/A	N/A	160	N/A	N/A	320	ND(100)	ND(100)	ND(100)	ND(100)	N/A	N/A
1,2-DCE (TOTAL)	ND(5.0)	ND(5.0)	ND	ND(5.0)	ND(5.0)	6.6	5.6	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	100	100
TETRACHLOROETHENE	13	12	130	170	ND(5.0)	ND	ND(5.0)	ND(5.0)	7.1	10	150	5	5
2-METHYL NAPHTHALENE	16	20	N/A	ND(5.0)	ND(5.0)	N/A	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	NA	NA
NAPHTHALENE	5.2	6.6	N/A	ND(5.0)	ND(5.0)	N/A	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	143	143

N/A: Not Analyzed
ND: Not detected above Method Detection Limit
( ): Method Detection Limit
Note: Sampling/analysis for 9/28/94 sampling event performed by Law Environmental

TABLE 10 (Continued)
GROUND WATER ANALYTICAL RESULTS

BUILDING 354 - MAIN POST
DAMES & MOORE - POL/UST SITE INVESTIGATION
FORT RILEY, KANSAS

	TS0292-01 (11/3/93)	TS0292-03 Duplicate of TS0292-01 (11/3/93)	TS0292-01 (9/28/94)	TS0292-01 (3/24/95)	TS0292-02 (11/4/93)	TS0292-02 (9/28/94)	TS0292-02 (3/24/95)	BLDG 354 MW95-03	BLDG 354 MW95-04	BLDG 354 MW95-05 Duplicate of MW95-04	BLDG 354 MW95-06	KDHE ACTION LEVEL	MCL
BIS-(2-Ethylhexyl)Phthalate	ND(5.0)	ND(5.0)	N/A	8.5	ND(5.0)	N/A	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	N/A	N/A
ACETONE	ND(100)	ND(100)	N/D	ND(100)	ND(100)	36**	ND(100)	ND(100)	ND(100)	ND(100)	ND(100)	N/A	N/A
CARBON TETRACHLORIDE	ND(5.0)	ND(5.0)	1.1**	ND(5.0)	ND(5.0)	1.1**	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	N/A	N/A
CHLOROFORM	ND(5.0)	ND(5.0)	2.1	ND(5.0)	ND(5.0)	ND	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	N/A	N/A
METHYLENE CHLORIDE	ND(5.0)	ND(5.0)	N/D	ND(5.0)	ND(5.0)	7.0**	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	ND(5.0)	N/A	N/A
CIS-1,2-DCE	N/A	N/A	N/D	ND(5.0)	N/A	5.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A: Not Analyzed
ND: Not detected above Method Detection Limit
( ): Method Detection Limit
Note: Sampling/analysis for 9/28/94 sampling event performed by Law Environmental
**: Estimated value based on QC data

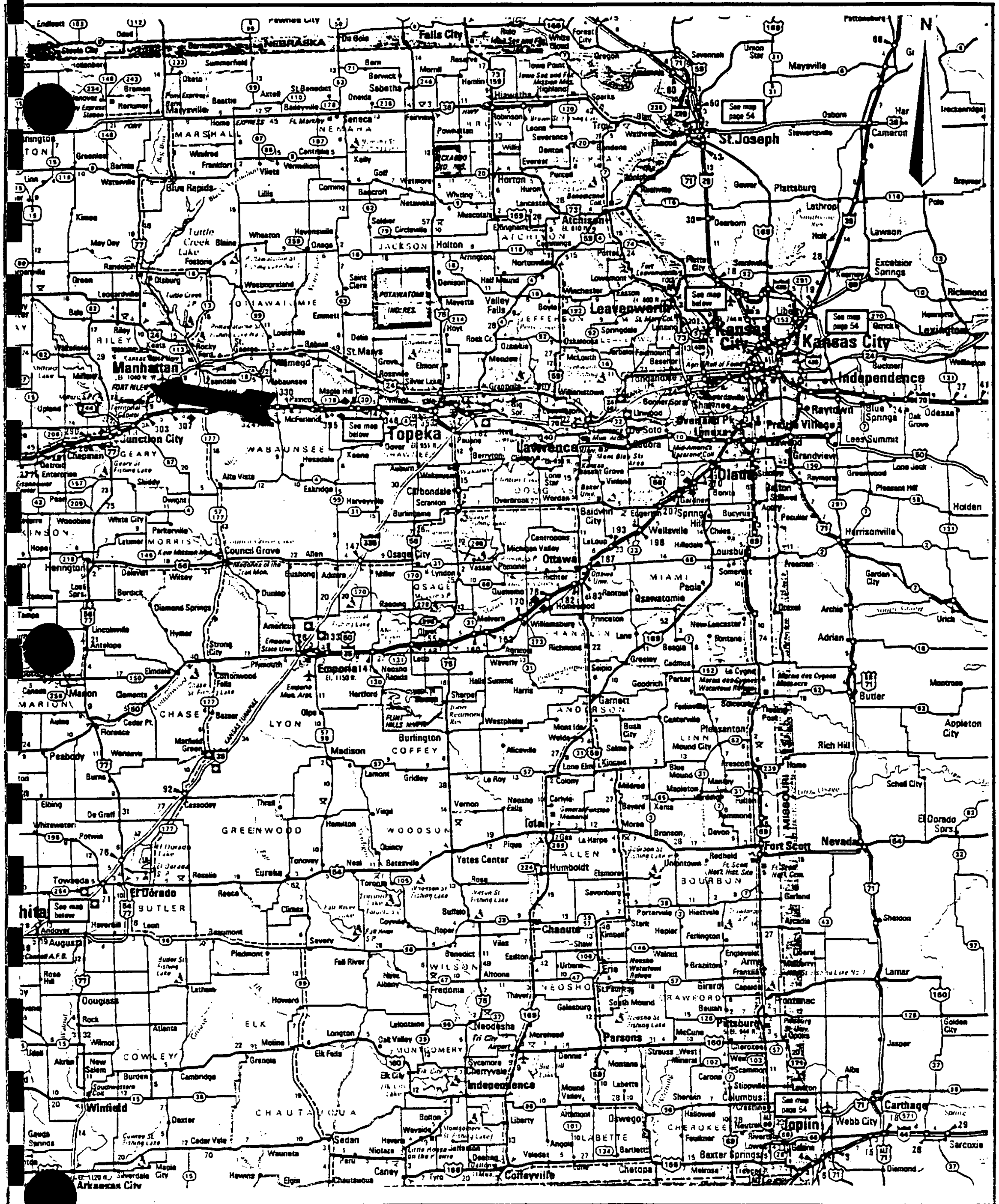
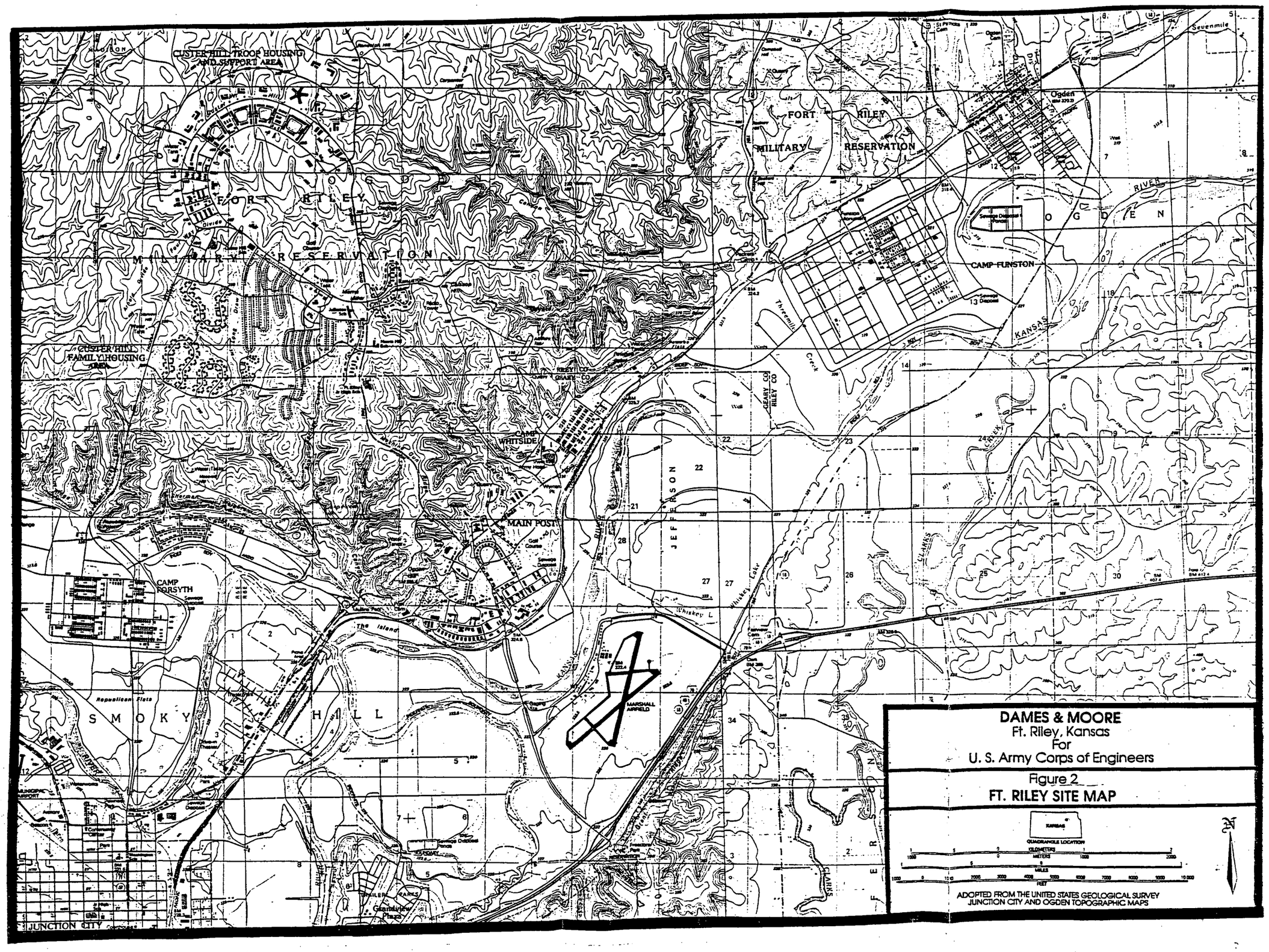


FIGURE 1
FORT RILEY LOCATION MAP
Scale: 1" = 23 miles
Adopted from Rand McNally Business Traveler's Road Atlas - 1992

DAMES & MOORE
Fort Riley, Kansas
for
U.S. Army Corps of Engineers


CUSTER HILL TROOP HOUSING AND SUPPORT AREA
FORT RILEY MILITARY RESERVATION
FORT RILEY MILITARY RESERVATION
CUSTER HILL FAMILY HOUSING AREA
CAMP WHITSIDE
MAIN POST
CAMP FORSYTH
Republican Flats
SMOKY HILL
JUNCTION CITY
FORT RILEY MILITARY RESERVATION
CAMP FUNSTON
OGDEN
Ogden
Sevenmile
RILEY CO
GEARY CO
JEFFERSON
CLARKE
MARSHALL AIRFIELD
Threemile Creek
Whiskey Creek
KANSAS RIVER
The Island
Gramview Plaza
DAMES & MOORE
Ft. Riley, Kansas
For
U. S. Army Corps of Engineers
Figure 2
FT. RILEY SITE MAP
KANSAS
QUADRANGLE LOCATION
KILOMETERS
METERS
MILES
FEET
ADOPTED FROM THE UNITED STATES GEOLOGICAL SURVEY
JUNCTION CITY AND OGDEN TOPOGRAPHIC MAPS

MAIN POST

TO CUSTER HILL

TO CAMP WHITSIDE

TO HUEBNER RD

BOUNDARY OF HISTORICAL DISTRICT

0 500 1000

UNDERGROUND WATER TANK

FT. RILEY ELEMENTARY SCHOOL

BUS STOP

1ST DIVISION RD

POST HQ

BKS.

KP & L SUBSTATION

OFFICERS FAMILY HOUSING

LEADERS CLUB

ARTILLERY PARADE FIELD

SEWAGE TREATMENT PLANT

SLUDGE DRYING BEDS

PET CEMETERY

OUTDOOR CHAPEL

HUEBNER RD

MONUMENT

CEMETERY

MULLINS PARK

BUFFALO CORRAL

STEAM PLANT

SUBSTATION

LAUNDRY

UNION PACIFIC RAILROAD

STURGIS STADIUM

POST CHAPEL

TC

B.O.Q.

V.O.Q.

CAVALRY PARADE FIELD

COMMISSARY

MUSEUM

TEL. EXCH.

BARRACKS

ENGR. FAC.

354

I.C.P.R.R. DEPOT

CONF FAC

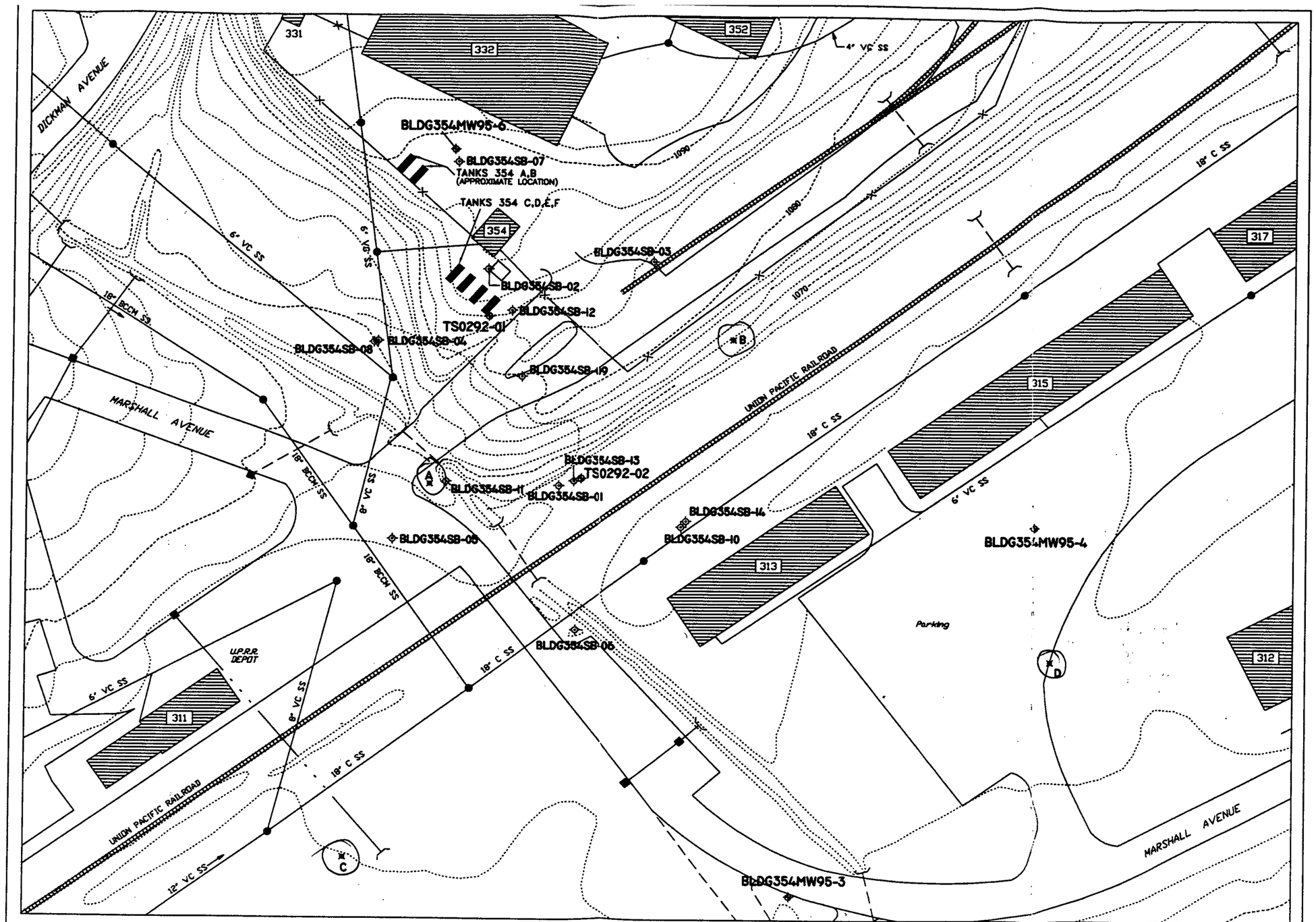
TO MARSHALL FIELD & INTERSTATE 70

BOUNDARY OF HISTORICAL DISTRICT

FIGURE 3
SITE LOCATION MAP

Fort Riley Building 354
Fort Riley, Kansas
for
U.S. Army Corps of Engineers

Dames & Moore
Adopted from Ft. Riley Directorate of Engineering and Housing



NORTH

0 25 50 100

SCALE IN FEET

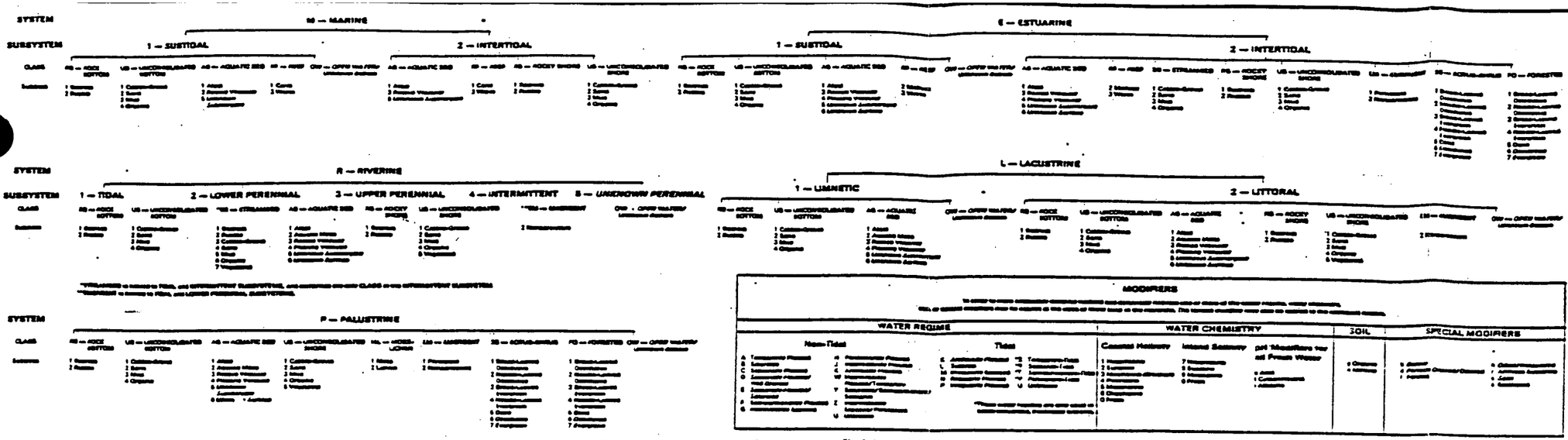
LEGEND:

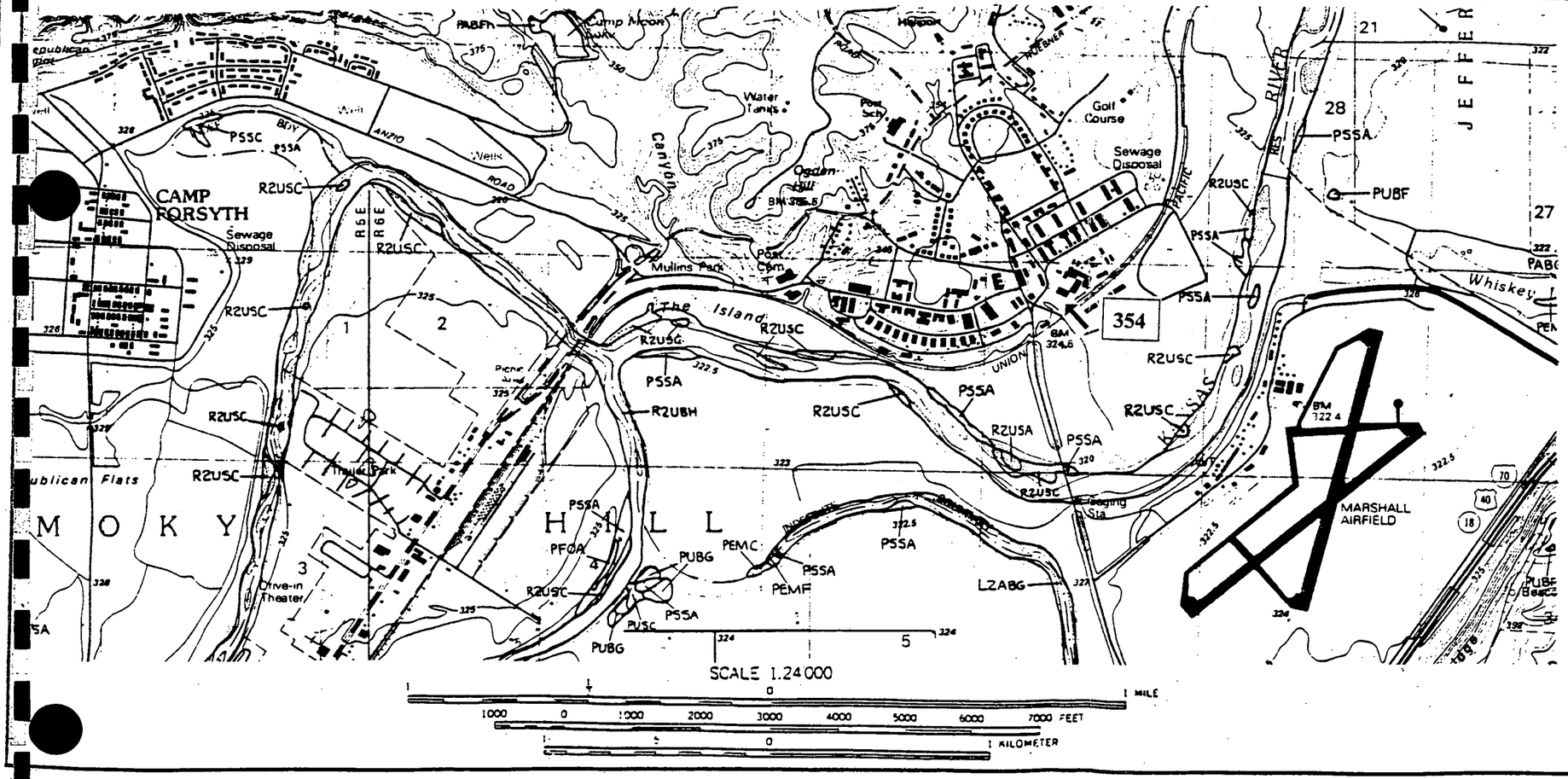
- = LOCATION OF FORMER USTs
- = EXISTING MONITOR WELL LOCATION
- = EXISTING SOIL BORING LOCATION
- = EXISTING PIEZOMETER LOCATION
- 1070 = 10 foot CONTOUR INTERVAL
- = 2 foot CONTOUR INTERVAL
- = STORM DRAIN INLET
- = SANITARY SEWER MANHOLE
- VCSS = VITRIFIED CLAY SANITARY SEWER
- CSS = CLAY SANITARY SEWER
- BCCM SS = B.C.C.M. SANITARY SEWER
- 354 = BUILDING NUMBER
- = EXISTING RAIL LINE
- = STORM SEWER LINE
- = INTERMITTENT STREAM/DRAINAGE
- = INLET/OUTLET FOR STORM WATER
- = FENCE LINE

FIGURE 4
BUILDING 354
SITE PLOT PLAN

DAMES & MOORE
BUILDING 354-MAIN POST
POL/UST INVESTIGATIONS

FORT RILEY, KANSAS
FOR
U.S. ARMY CORPS OF ENGINEERS





U.S. DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

Prepared by National Wetlands Inventory

1992

NOTES TO THE USER

- Subsystems, Classes, Subclasses, and Water Regimes in italics were developed specifically for NATIONAL WETLANDS INVENTORY mapping.
- Some areas designated as R4SB, R4SBW, OR R4SBJ (INTERMITTENT STREAMS) may not meet the definition of wetland.
- This map uses the class Unconsolidated Shore (US). On some NWI maps that class was designated Beach/Bar (BB) or Flat (FL). Subclasses remain the same in both versions.
- Numerous undesignated anthropic created wetlands exist within this artillery impact area

AERIAL PHOTOGRAPHY

DATE: 6/ /85	DATE:
SCALE: 1:58 000	SCALE:
TYPE: CIR	TYPE:

SPECIAL NOTE

This document was prepared primarily to depict wetlands on high altitude aerial photographs. Wetlands were identified on the photographs based on vegetation, visible hydrology, and geography in accordance with Classification of Wetlands and Deepwater Habitats of the United States (FWS/OBS - 79/31 December 1979). The aerial photographs typically reflect conditions during the specific year and season when they were taken. In addition, there is a margin of error inherent in the use of the aerial photographs. Thus, a determination on the ground and research analysis of a single site may result in a revision of the wetland boundaries established through photographic interpretation. In addition, some small wetlands and those obscured by dense forest cover may not be included on this document.

Federal, State and local regulatory agencies with jurisdiction over wetlands may define and delineate wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits or proper delineation of any Federal, State or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, State or local agencies concerning specified agency regulatory programs and proper agency jurisdictions that may affect such activities.

SYMBOLOGY EXAMPLE

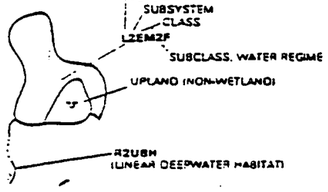
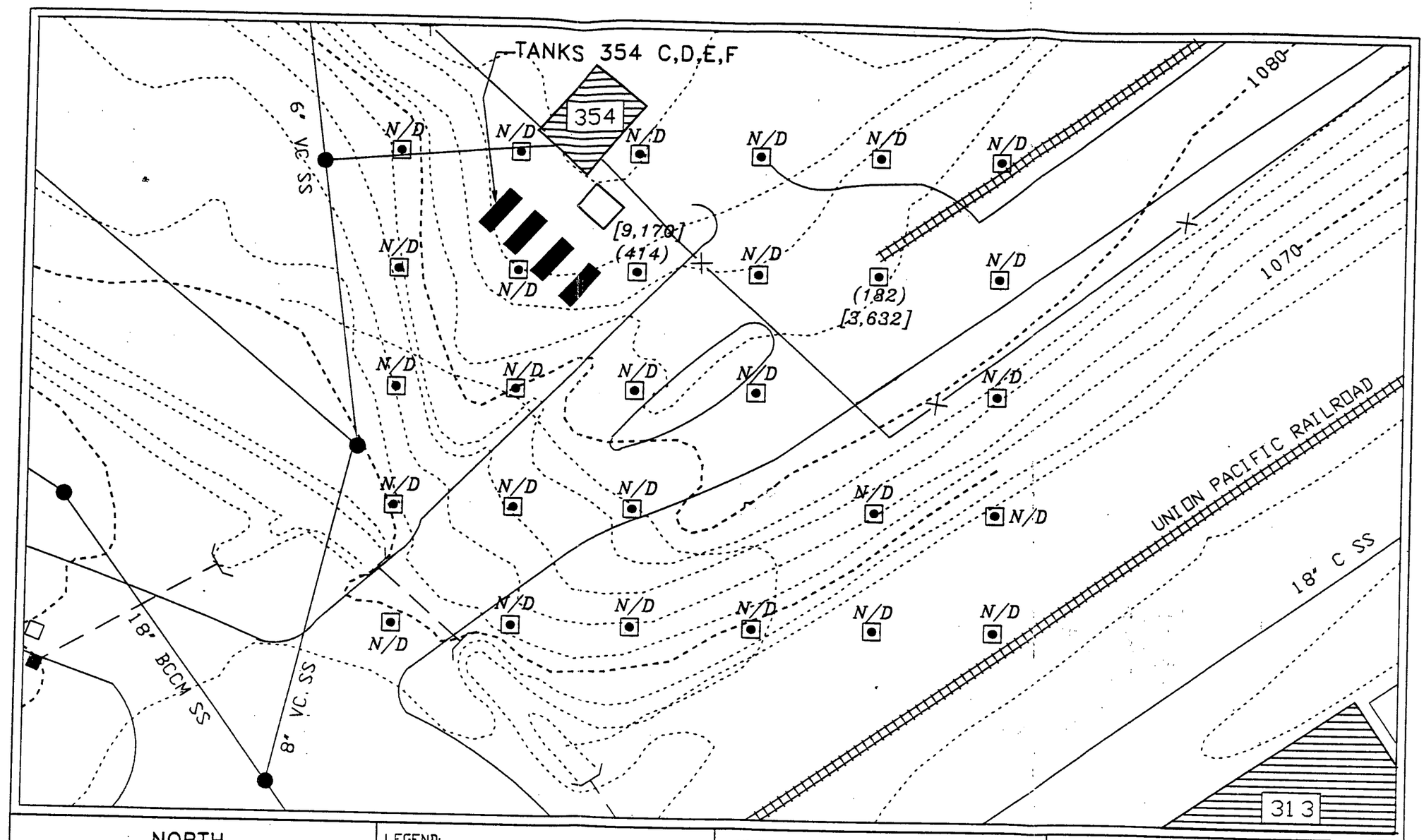


Figure 5
SITE WETLANDS INVENTORY MAP

Fort Riley Former Building 354
Fort Riley, Kansas
for
U.S. Army Corps of Engineers

Scale as shown Dames & Moore



NORTH

0 25 50 100

SCALE IN FEET

LEGEND:

- = LOCATION OF FORMER USTs
- = SOIL GAS SAMPLING LOCATION
- N/D = NON-DETECT
- (414) = SOIL GAS TOTAL BTEX IN ppb
- [3,632] = TVH IN ppb

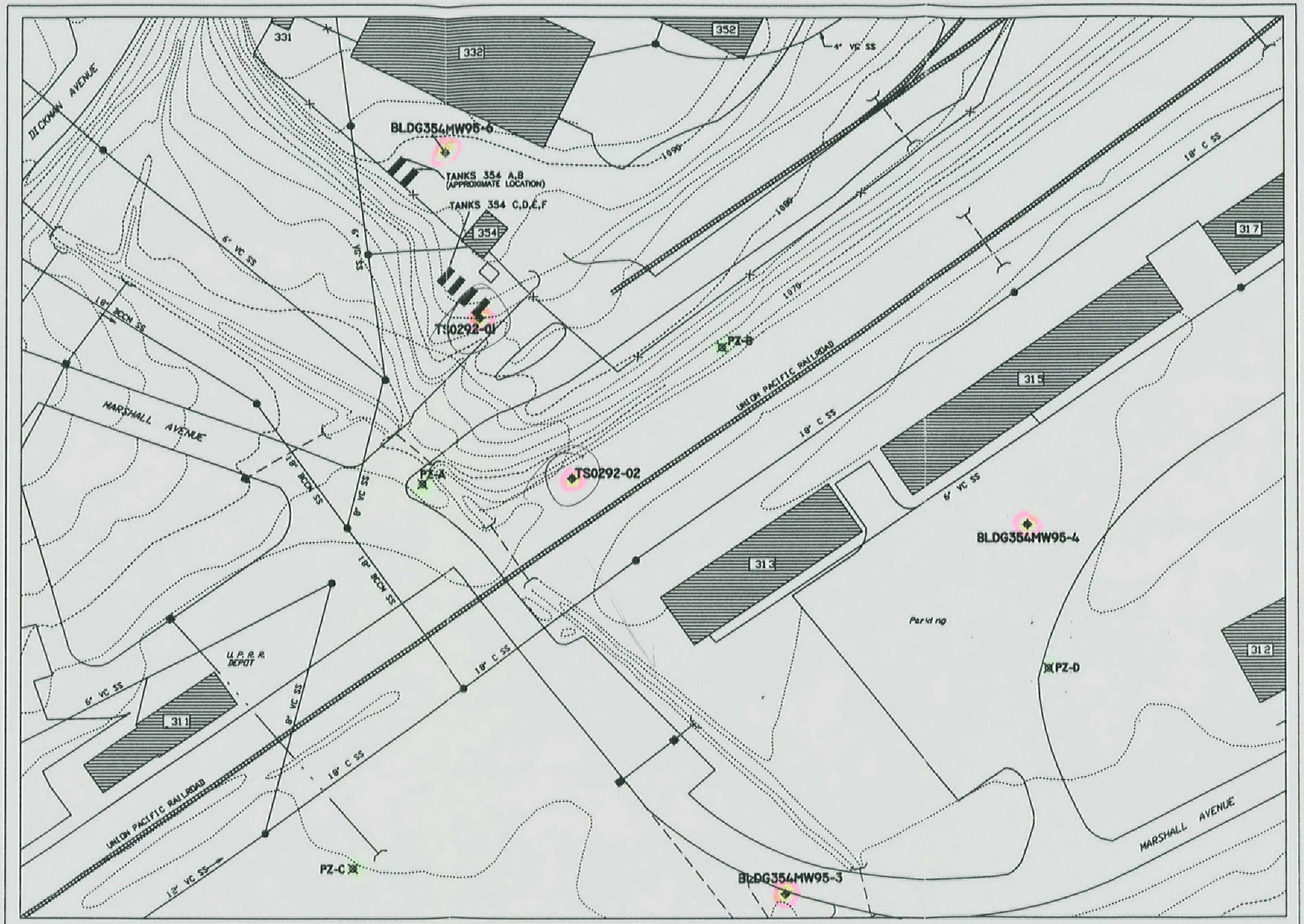
FIGURE 6
BUILDING 354
SOIL GAS SAMPLING LOCATIONS AND RESULTS

DATE: 5/3/95

DAMES & MOORE
BUILDING 354 - MAIN POST
POL/UST INVESTIGATIONS

FORT RILEY, KANSAS
FOR
U.S. ARMY CORPS OF ENGINEERS

DWG NO.: 354-F6.DWG



NORTH

0 25 50 100
SCALE IN FEET

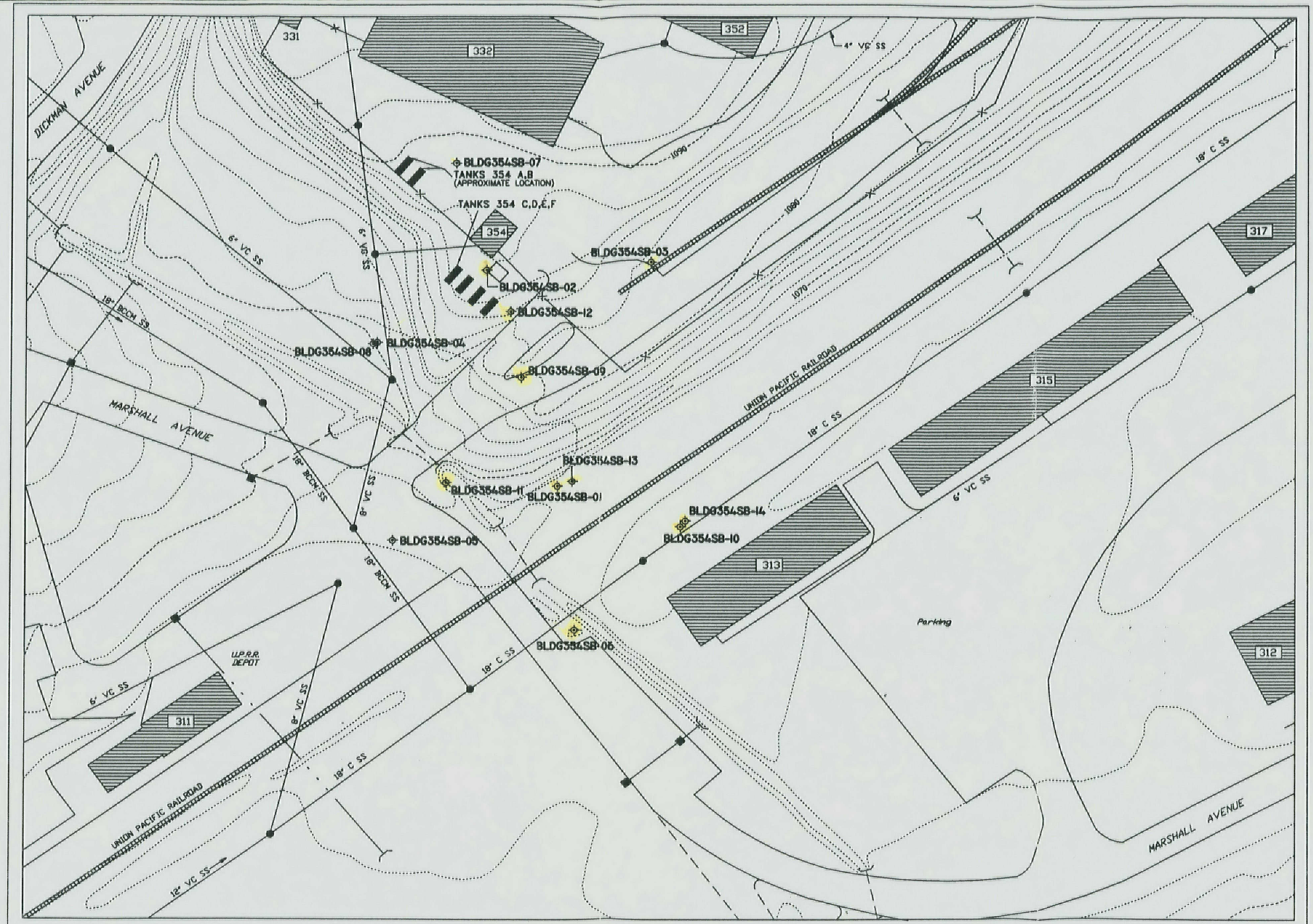
LEGEND:

= LOCATION OF FORMER USTs
= EXISTING MONITOR WELL LOCATION
= EXISTING PIEZOMETER LOCATION

FIGURE 7
BUILDING 354
MONITORING WELL AND PIEZOMETER LOCATIONS

DAMES & MOORE
BUILDING 354-MAIN POST
POL/UST INVESTIGATIONS

FORT RILEY, KANSAS
FOR
U.S. ARMY CORPS OF ENGINEERS



NORTH

0 25 50 100
SCALE IN FEET

LEGEND:

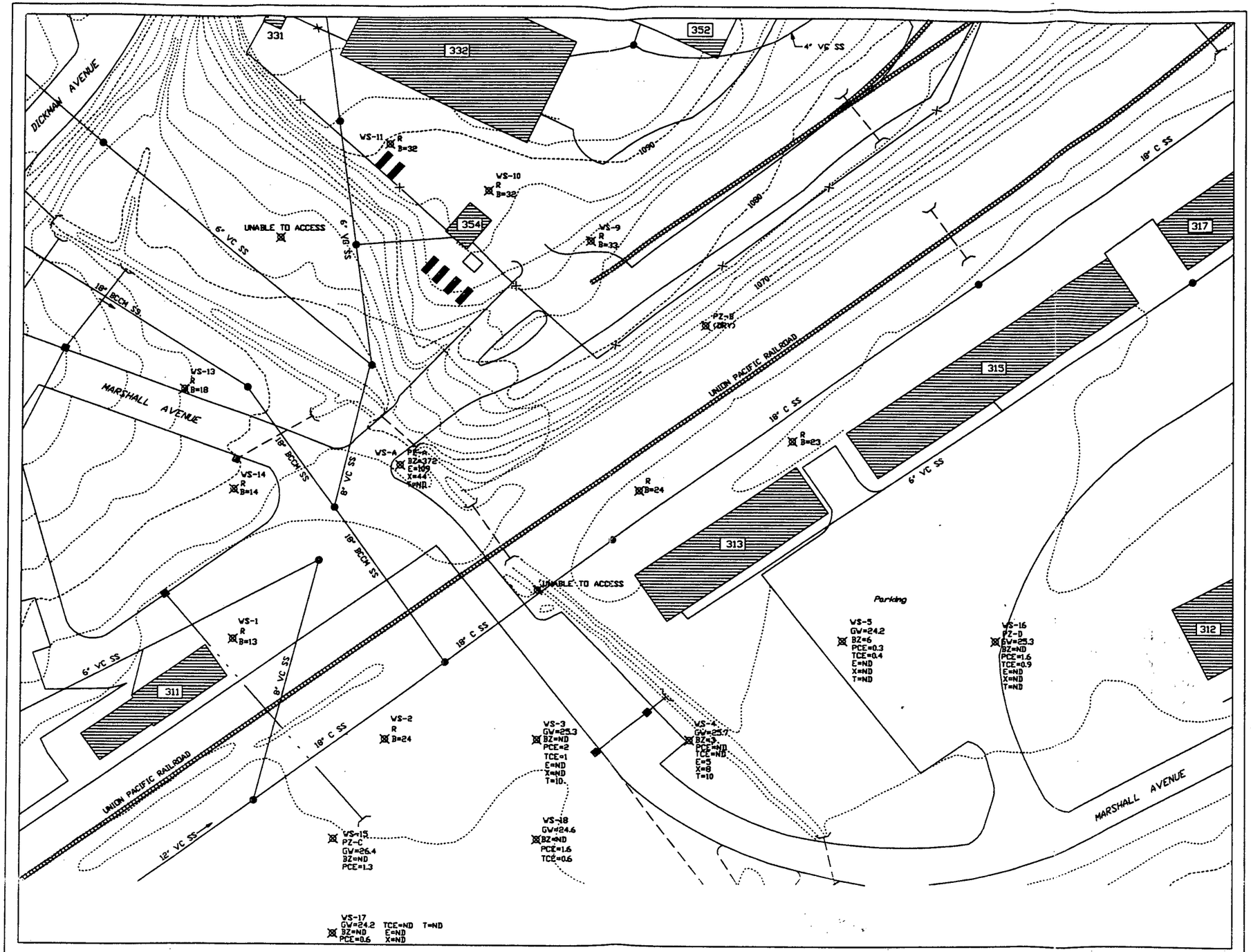
= LOCATION OF FORMER USTs

= SOIL BORING LOCATION

FIGURE 8
BUILDING 354
SOIL BORING LOCATIONS

DAMES & MOORE
BUILDING 354-MAIN POST
POL/UST INVESTIGATIONS

FORT RILEY, KANSAS
FOR
U.S. ARMY CORPS OF ENGINEERS



NORTH

0 25 50 100

SCALE IN FEET

LEGEND:

- ⊠ = WELL-POINT SAMPLING LOCATION
- B = DEPTH TO BEDROCK (FEET)
- R = REFUSAL= NO GROUNDWATER ABOVE BEDROCK
- GW = DEPTH TO WATER TABLE (FEET)
- BZ = BENZENE (PPB, HEATED HEADSPACE)
- ND = NON-DETECT
- PCE = TETRACHLORDETHANE (PPB, HEATED HEADSPACE)
- PZ = PIEZOMETER
- = LOCATION OF FORMER USTs
- TCE = TRICHLORDETHENE
- E = ETHYLBENZENE
- X = XYLENES
- T = TOLUENE

FIGURE 9

BUILDING 354

IN SITU GROUND WATER SAMPLING LOCATIONS AND DEPTHS TO BEDROCK

DAMES & MOORE

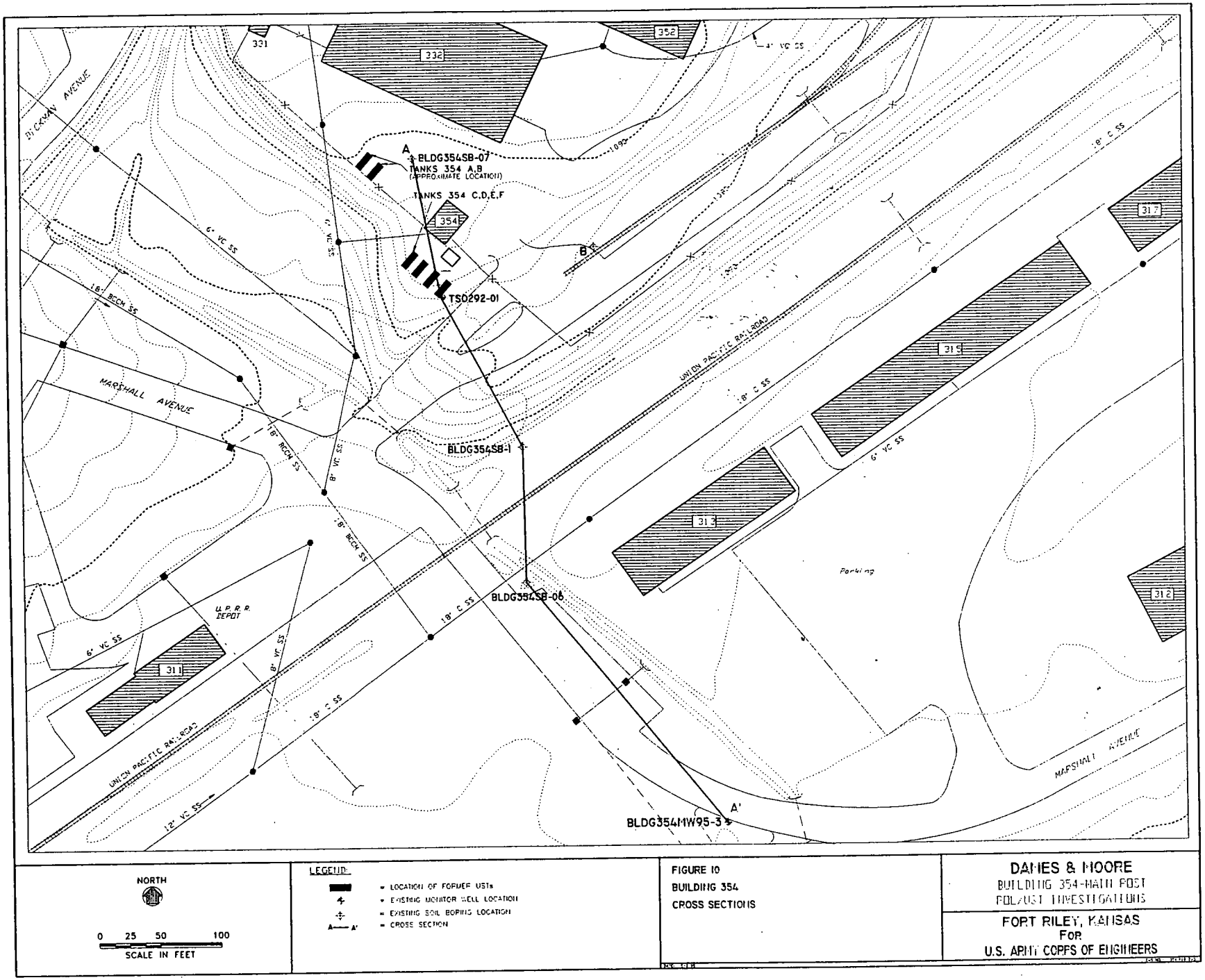
BUILDING 354-MAIN POST

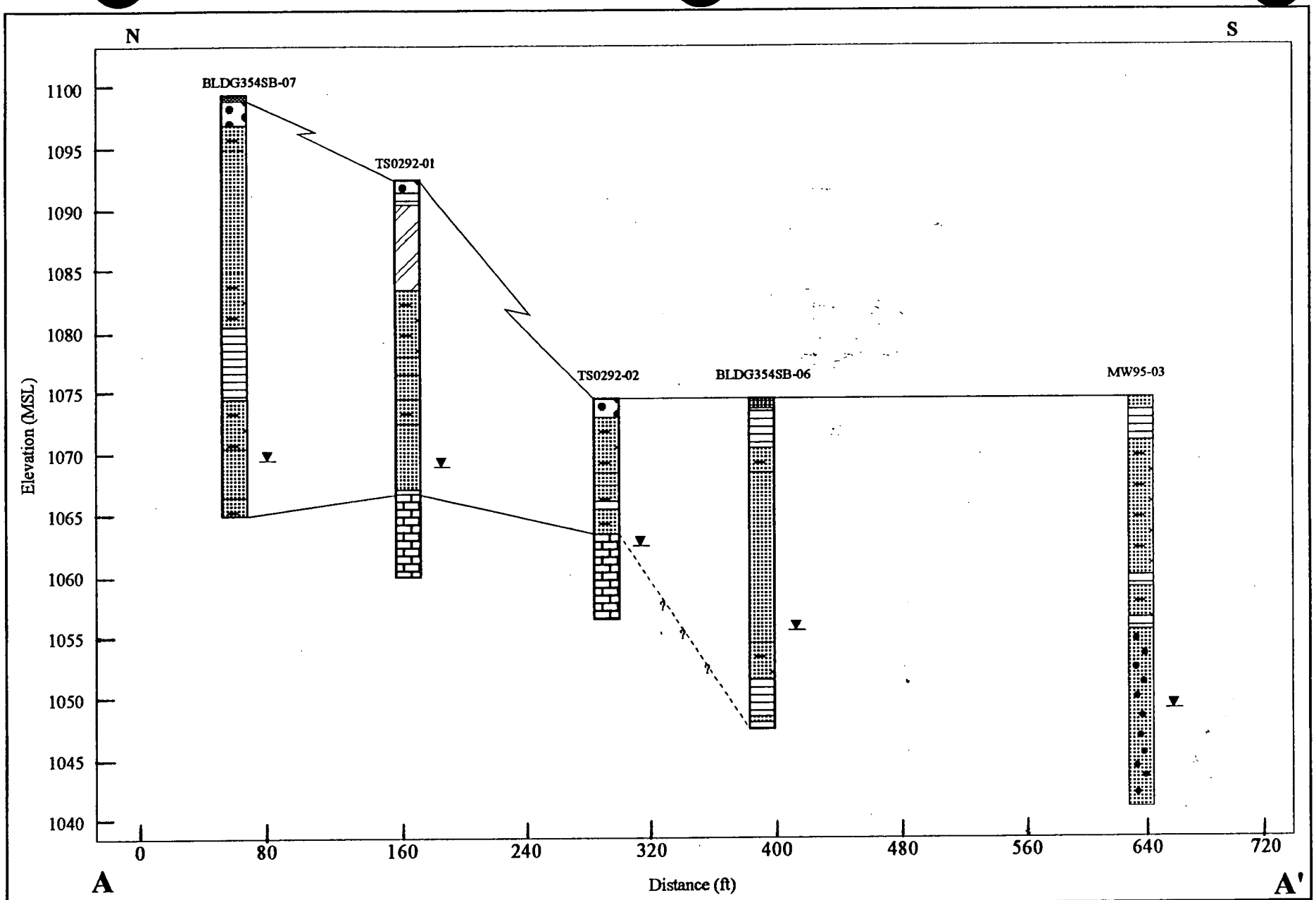
POL/UST INVESTIGATIONS

FORT RILEY, KANSAS

FOR

U.S. ARMY CORPS OF ENGINEERS


BLDG354SB-07
TANKS 354 A,B
(APPROXIMATE LOCATION)
TANKS 354 C,D,E,F
TS0292-01
BLDG354SB-1
BLDG354SB-08
BLDG354MW95-3
A
A'
B
B'
DICKMAN AVENUE
MARSHALL AVENUE
UNION PACIFIC RAILROAD
U.P.R.R. DEPOT
Parking
331
332
352
354
317
315
313
312
311
6" VC SS
8" VC SS
12" VC SS
18" RCCM SS
18" C SS
NORTH
0 25 50 100
SCALE IN FEET
LEGEND:
= LOCATION OF FORMER USTs
= EXISTING MONITOR WELL LOCATION
= EXISTING SOIL BORING LOCATION
= CROSS SECTION
FIGURE 10
BUILDING 354
CROSS SECTIONS
DAMES & MOORE
BUILDING 354-MAIN POST
POL/UST INVESTIGATIONS
FORT RILEY, KANSAS
FOR
U.S. ARMY CORPS OF ENGINEERS



Materials Symbols

Gravel (with coarse sand)	Sand (Silty)	Clay	Clay (silty)
Sand (Med. - Coarse)	Silt	Clay (sandy)	Backfill
Sand (Fine)	Sand with Gravel	Limestone	Asphalt

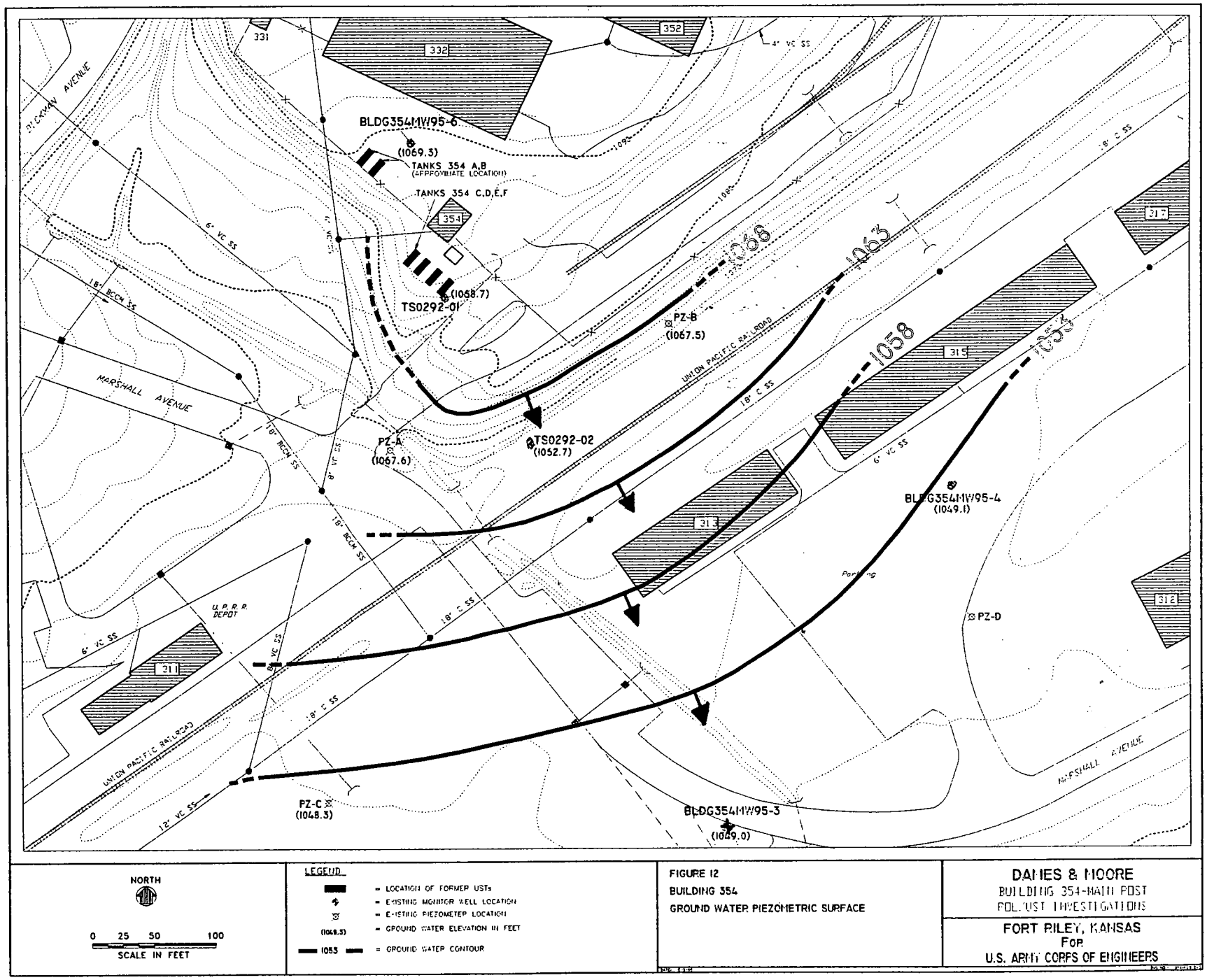
Dames & Moore
6310 Lamar #135
Overland Park, Kansas 66202
(913) 677-1490

FIGURE 11
SITE GEOLOGIC CROSS SECTION (A-A')

Building 354
Fort Riley, Kansas
for
U. S. Army Corps of Engineers

Scale as shown

Dames & Moore


331
332
352
354
317
315
313
311
312
BLDG354MW95-6
(1069.3)
TANKS 354 A,B
(APPROXIMATE LOCATION)
TANKS 354 C,D,E,F
TS0292-01
(1058.7)
PZ-B
(1067.5)
PZ-A
(1067.6)
TS0292-02
(1052.7)
BLDG354MW95-4
(1049.1)
PZ-D
PZ-C
(1048.3)
BLDG354MW95-3
(1049.0)
1068
1063
1058
1053
HICKMAN AVENUE
MARSHALL AVENUE
UNION PACIFIC RAILROAD
U.P.R.R. DEPOT
Parking
6" VC SS
8" VC SS
12" VC SS
18" BCCM SS
18" C SS
4" VC SS
NORTH
0 25 50 100
SCALE IN FEET
LEGEND
= LOCATION OF FORMER USTs
= EXISTING MONITOR WELL LOCATION
= EXISTING PIEZOMETER LOCATION
(1048.3) = GROUND WATER ELEVATION IN FEET
1053 = GROUND WATER CONTOUR
FIGURE 12
BUILDING 354
GROUND WATER PIEZOMETRIC SURFACE
DAMES & MOORE
BUILDING 354-MAIN POST
POL/UST INVESTIGATIONS
FORT RILEY, KANSAS
FOR
U.S. ARMY CORPS OF ENGINEERS

GRADATION CURVE

Boring BLDG 354, SB-14 at 10-12'

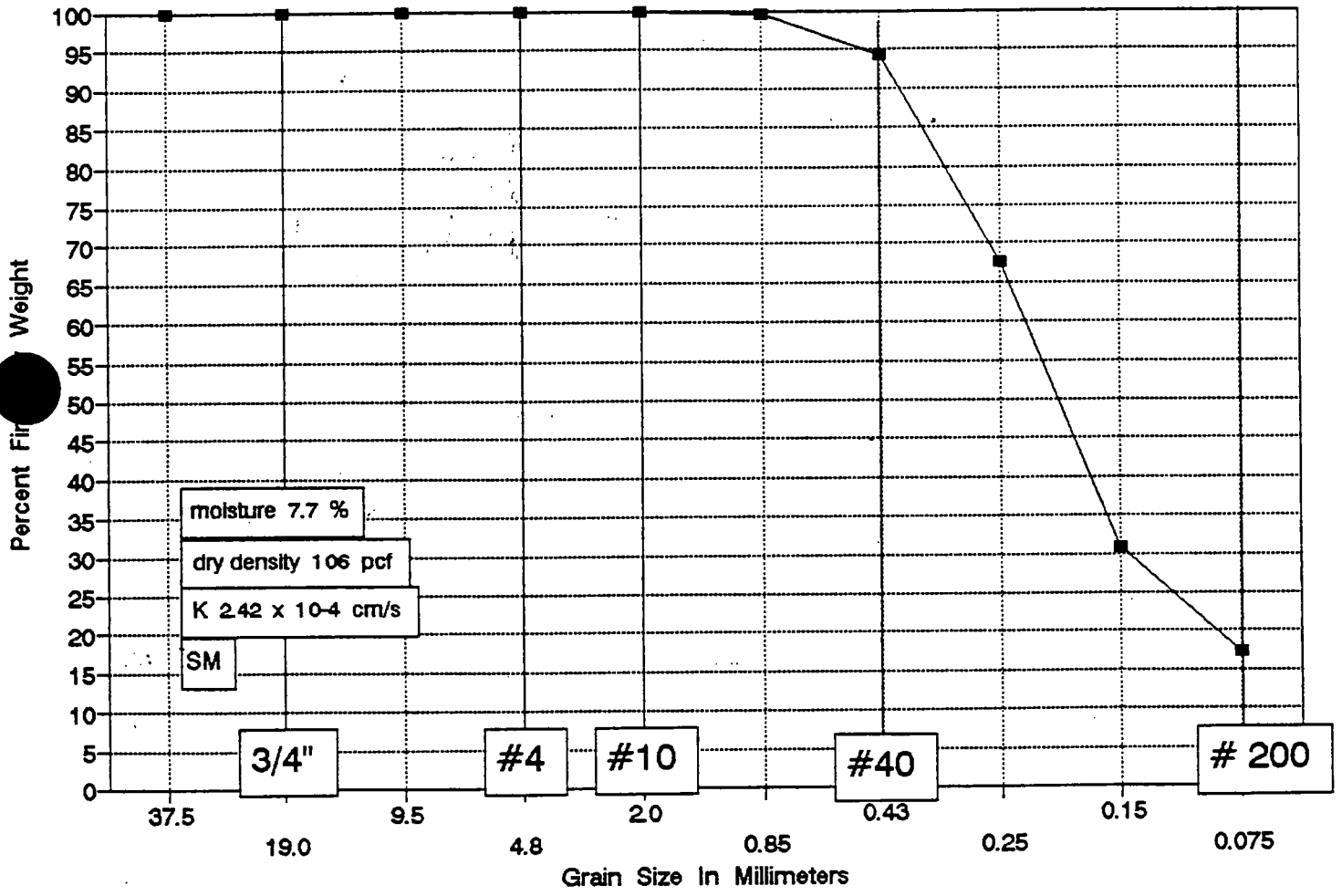


FIGURE 13a
SUMMARY OF PHYSICAL TESTING DATA

Fort Riley Building 354
Fort Riley, Kansas
for
U.S. Army Corps of Engineers

Dames & Moore

GRADATION CURVE

Boring BLDG 354, MW95-3 at 32-34'

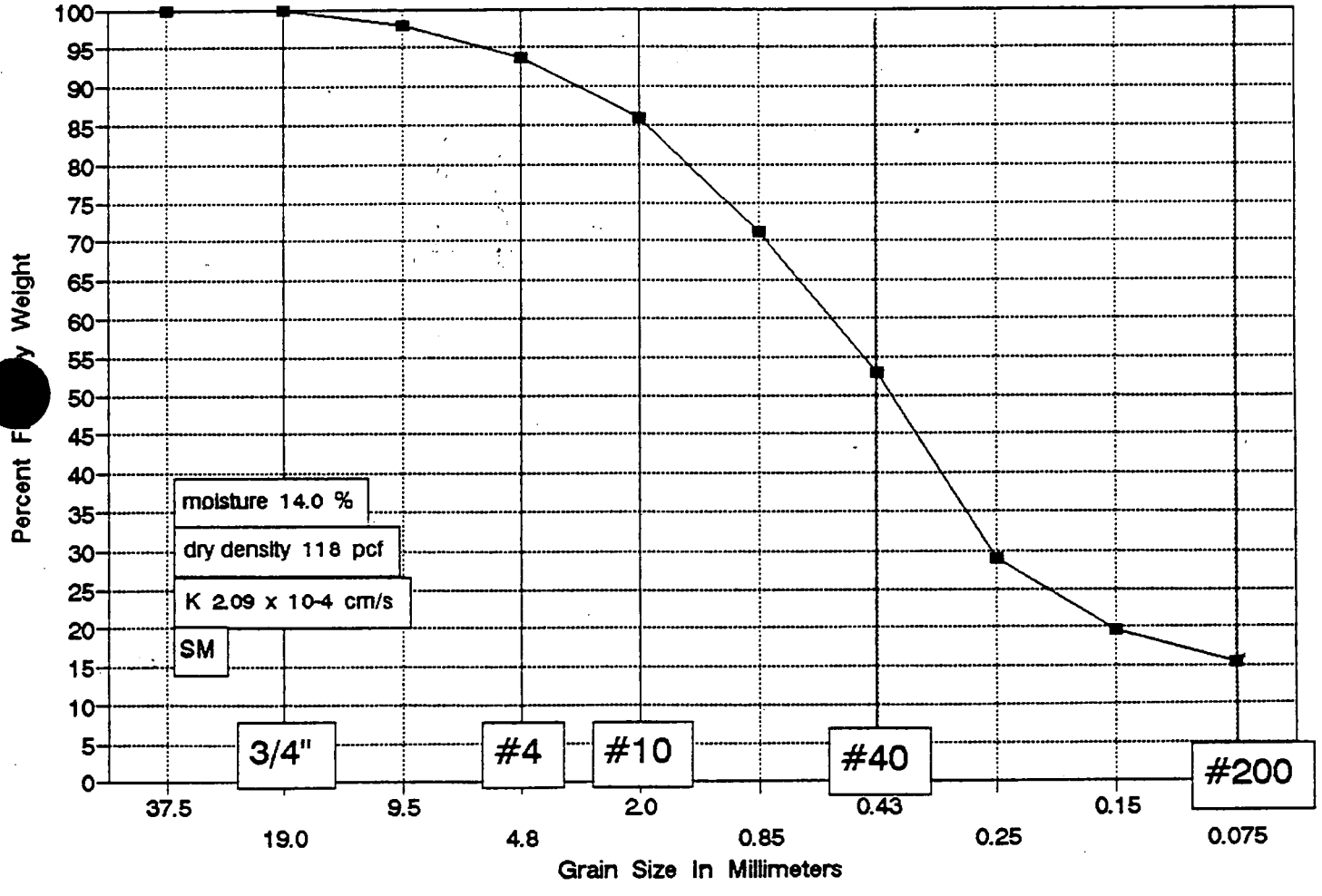


FIGURE 13b
SUMMARY OF PHYSICAL TESTING DATA

Fort Riley Building 354
Fort Riley, Kansas
for
U.S. Army Corps of Engineers

Dames & Moore

GRADATION CURVE

Boring BLDG 354, MW75-4 at 26-28'

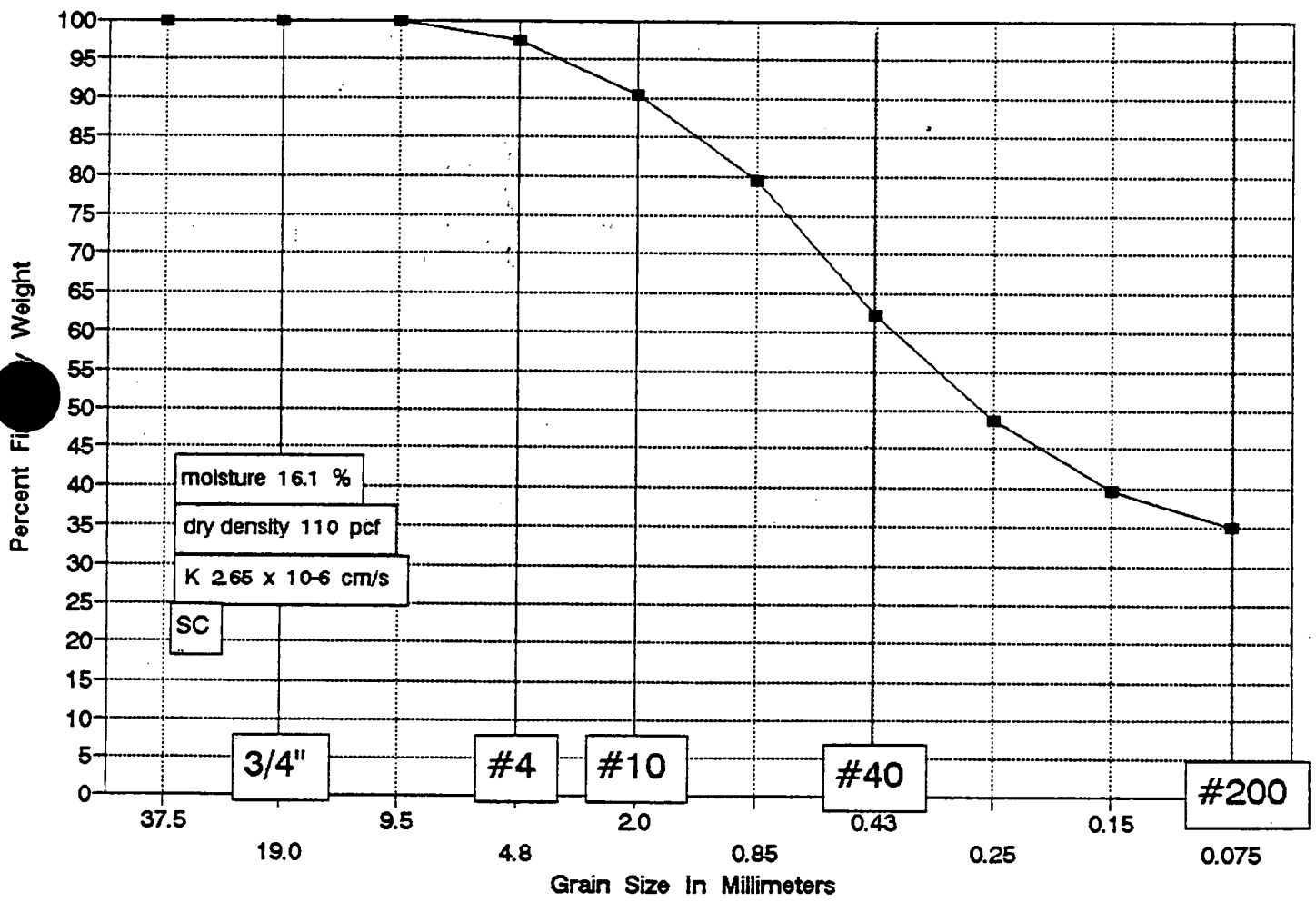
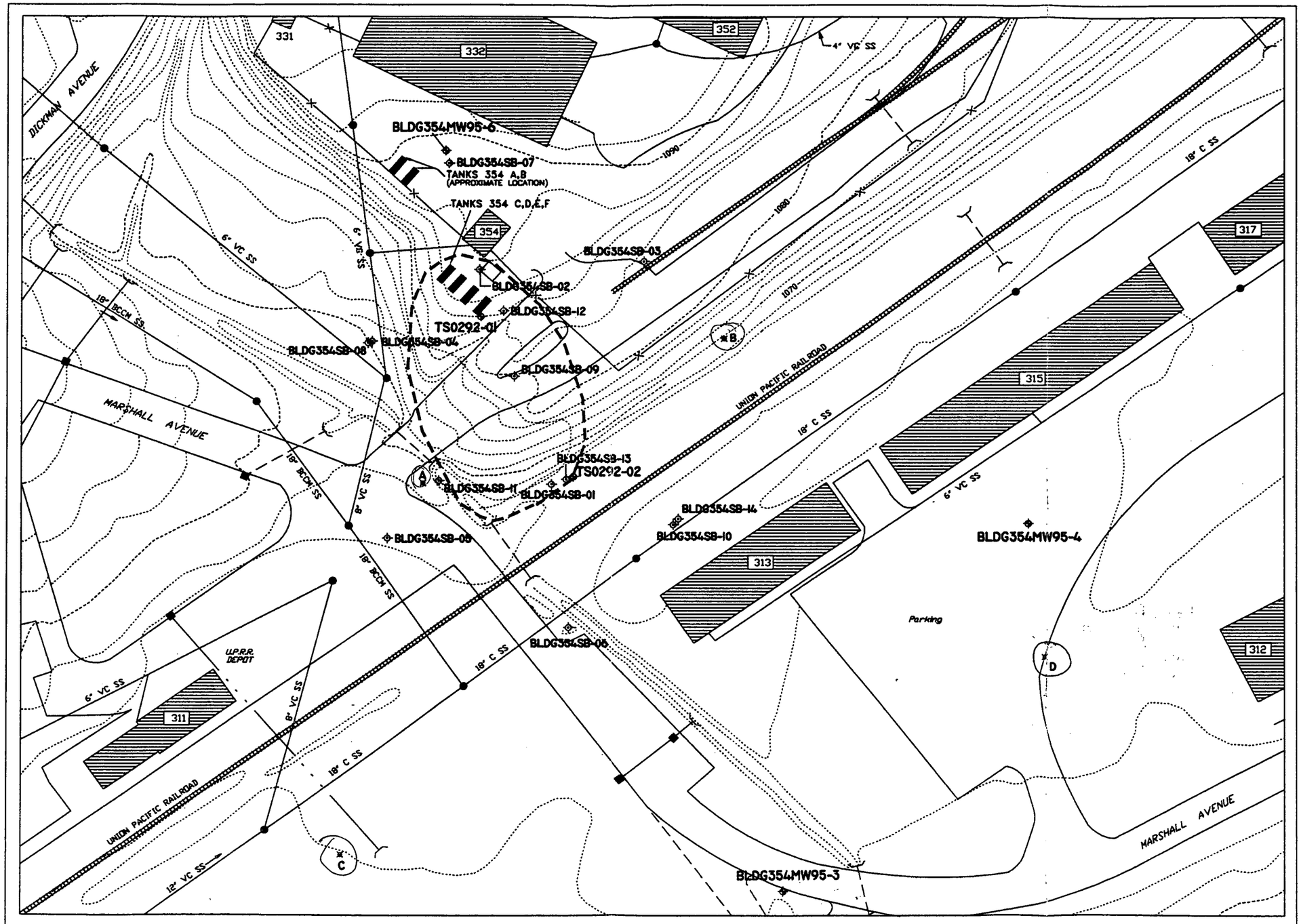


FIGURE 13c SUMMARY OF PHYSICAL TESTING DATA
Fort Riley Building 354 Fort Riley, Kansas for U.S. Army Corps of Engineers
Dames & Moore



NORTH

0 25 50 100

SCALE IN FEET

LEGEND:

- = LOCATION OF FORMER USTs
- = EXISTING MONITOR WELL LOCATION
- = EXISTING SOIL BORING LOCATION
- = EXISTING PIEZOMETER LOCATION
- = APPROXIMATE EXTENT OF SOIL CONTAMINATION ABOVE KDHE ACTION LEVELS

FIGURE 14

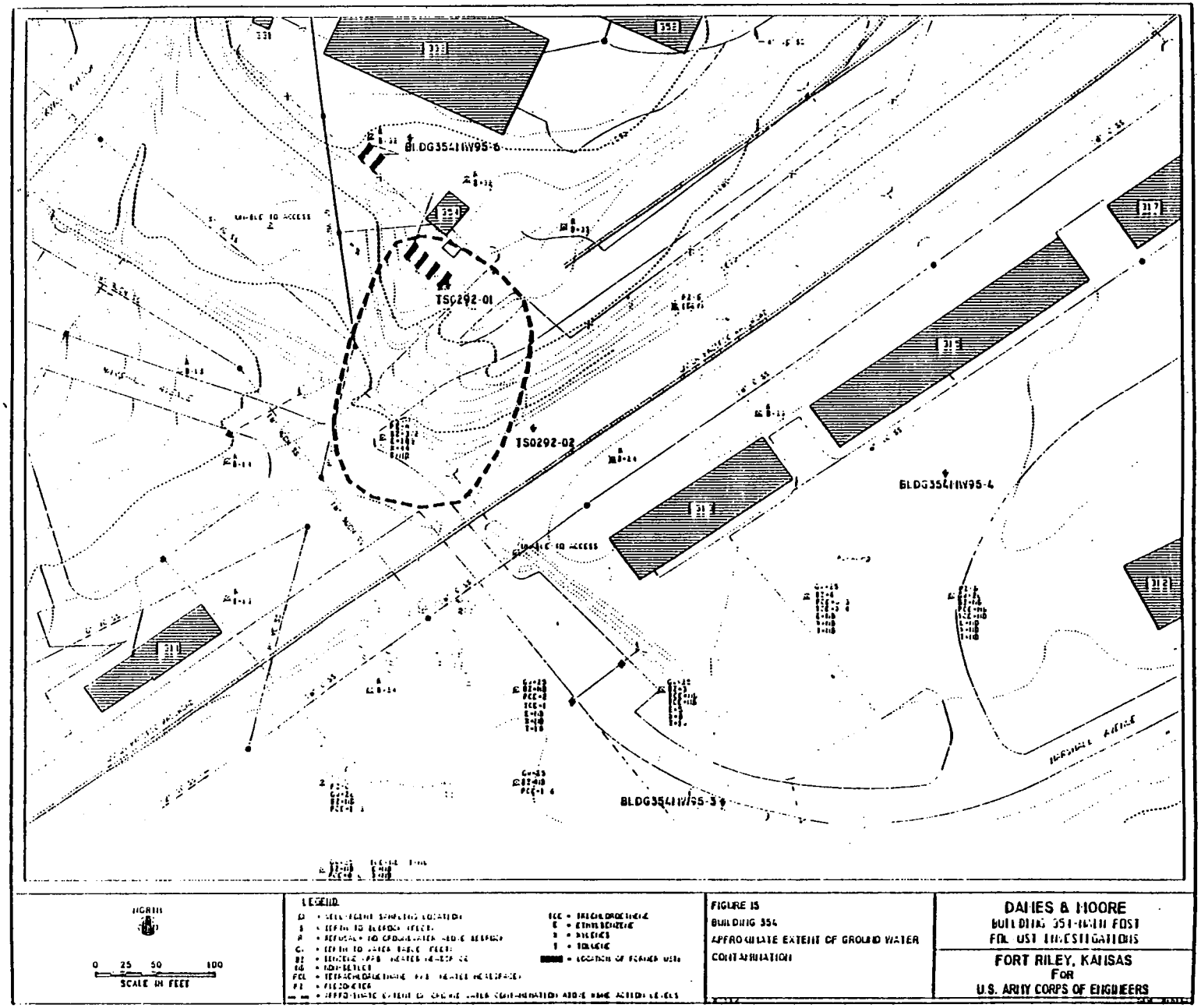
BUILDING 354

APPROXIMATE EXTENTS OF SOIL CONTAMINATION

DAMES & MOORE

BUILDING 354-MAIN POST POL/UST INVESTIGATIONS

FORT RILEY, KANSAS FOR U.S. ARMY CORPS OF ENGINEERS


BLDG354NW95-6
TS0292-01
TS0292-02
BLDG354NW95-4
BLDG354NW95-5
NORTH
0 25 50 100
SCALE IN FEET
LEGEND
FIGURE 15
BUILDING 354
APPROXIMATE EXTENT OF GROUND WATER CONTAMINATION
DAMES & MOORE
BUILDING 354-NORTH POST
FOL UST INVESTIGATIONS
FORT RILEY, KANSAS
FOR
U.S. ARMY CORPS OF ENGINEERS