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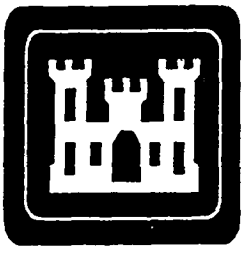
USACE/OR/DACA62-1040

GROUNDWATER CHARACTERIZATION REPORT OF BASELINE 1997 DATA FOR THE ST. LOUIS AIRPORT SITE

ST. LOUIS, MISSOURI

MAY 1998



U.S. Army Corps of Engineers
St. Louis District Office
Formerly Utilized Sites Remedial Action Prc

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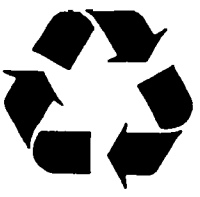
prepared by
U.S. Army Corps of Engineers, St. Louis District Office, Formerly Utilized Sites Remedial Action Program

with technical assistance from
Science Applications International Corporation ESC-FUSRAP
under Contract No. DACA62-94-D-0029



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1.0 INTRODUCTION

1.1 Purpose and Scope

This report has been prepared by Science Applications International Corporation (SAIC) to present the findings and interpretations of groundwater conditions at the St. Louis Airport Site (SLAPS), based on the 1997 baseline sampling and data collection effort. This new information is used in tandem with existing site hydrogeologic information to interpret site groundwater flow conditions, identify the distribution of potential constituents of concern (PCOCs), and compare the analytical data to regulatory and estimated background levels. The site groundwater sampling effort was performed by Bechtel National, Inc. (BNI) in July, August, and September 1997. This effort represented a comprehensive baseline sampling event for radiological and nonradiological constituents, and was a result of recommendations made by the groundwater technical working group (TWG) associated with the site. The task and procedures of the sampling work and other site-related tasks were described in a report entitled "Abbreviated Plan for Providing Baseline Sampling and Data Collection for Surface Water and Groundwater at the St. Louis Airport Site and the Hazelwood Interim Storage Site, St. Louis Missouri" (September 1997), as prepared by SAIC (SAIC, 1997). The complete set of field and laboratory data of this sampling event has been provided to the United States Army Corps of Engineers (USACE) by BNI as a separate document.

A brief description of the site setting and previous groundwater sampling work is included in the remaining part of Chapter 1.0. The monitoring well network at SLAPS is discussed in Chapter 2.0. Chapter 3.0 contains an evaluation of potentiometric (groundwater surface) and groundwater chemistry data to identify groundwater regimes at SLAPS. The occurrence and distribution of radiological and nonradiological PCOCs in site groundwater, as well as a comparison of the 1997 baseline data to historical data, are contained in Chapter 4.0. An evaluation of compliance with the abbreviated sampling plan requirements for the baseline groundwater sampling work is contained in Chapter 5.0. Conclusions regarding the hydrogeology and groundwater chemistry conditions at SLAPS are included in Chapter 6.0.

1.2 Site Setting

SLAPS occupies 8.8 hectares (ha) (22 acres) immediately north of the Lambert-St. Louis International Airport. As shown on Figure 1-1, SLAPS is bounded on the north and east by McDonnell Boulevard, and on the south by the Norfolk and Western Railroad, and Banshee Road. West of SLAPS is Coldwater Creek and then the McDonnell-Douglas Corporation property. This site is owned by the City of St. Louis, but is located in unincorporated St. Louis County. SLAPS is currently zoned "M-1" (light industrial). The area is dominated by industrial users, with most industry being related to transportation. The site is surrounded by a security fence. Various utilities, such as water and gas lines, cross various parts of the site. No structures currently exist at the site. The site is covered by existing gravel parking areas and vegetation.

The elevation at SLAPS varies from approximately 155 to 161 meters (m) (510 to 530 feet) from east to west, and land surface ranges from 4.5 to 6 m (15 to 20 feet) above Coldwater Creek. In general, the property surface is flat; however, some uneven surface has been formed by uneven

2.0 REVIEW OF GROUNDWATER MONITORING WELL NETWORK

The groundwater monitoring well network at SLAPS was reviewed and assessed to determine the composition of the monitoring well system and to identify its adequacy to monitor the identified groundwater zones beneath the site and contiguous properties. The locations of the monitoring wells at SLAPS and the contiguous properties are shown on Figure 2-1. Geologic and well construction logs of existing monitoring wells were reviewed to determine site stratigraphy and completion/screened depths of site wells. Monitoring well construction logs from the SLAPS site-wide RI (BNI, 1994) were the basic source for this information. Well construction logs were reviewed for monitoring wells A through E, but no lithologic descriptions were available. A summary of monitoring well information at SLAPS is provided in Table 2-1.

The generalized stratigraphy beneath SLAPS is presented on Figure 2-2. The site stratigraphic profile, used in the RI, which consists of units 1, 2, 3T, 3M, 3B, 4, 5, and 6 is suitable for the site. These units were interpreted from the lithologies described on the geologic logs.

Based on the interpretation of site information, three main hydrostratigraphic zones, which possess different groundwater flow and chemistry characteristics, occur in the non-lithified material beneath SLAPS. The upper hydrostratigraphic zone contains stratigraphic units 1, 2, and 3T. These units include fill, loess, and silty clay. The middle hydrostratigraphic zone is defined by the aquitard identified as the 3M unit. The 3M unit is composed of massive clay (occasionally varved) ranging in thickness between 0 feet beneath the east end of SLAPS and up to 26 feet beneath the western part of the site. The 3T, 3M, and 3B units have low hydraulic conductivities (K) (10^{-4} to 10^{-8} cm/sec) with the 3M unit exhibiting the lowest conductivities ($K_H = 10^{-5}$ cm/sec and $K_V = 10^{-8}$ cm/sec) (SAIC, 1995). Based on current information, the lower hydrostratigraphic zone beneath the 3M unit is interpreted to consist of stratigraphic units 3B, 4, and 5. The hydraulic relationship between each of the three units of the lower zone (non-lithified materials and shale bedrock) and the underlying limestone bedrock (unit 6) is not completely defined at this time.

The wells screened in the upper hydrostratigraphic zone at SLAPS are listed in Table 2-2. Wells with an S suffix designation monitor the upper hydrostratigraphic zone. To determine the monitored zone, the interval of sand pack around the screen was used to determine the stratigraphic units open to a monitoring well because every interval open to the screen can be expected to contribute water to the well. For the recent sampling event, 32 wells penetrated the upper hydrostratigraphic zone to a maximum depth of 49 feet below ground surface (bgs). These wells penetrate the surface rubble and fill, the loess (clayey silt) identified as stratigraphic unit 2, and the 3T (silty clay) unit. Several of these wells partially penetrate the 3M unit, but none penetrate the entire 3M unit. In most cases, wells constructed in this upper zone have their screened interval at least 10 feet below the static groundwater surface. Only eight wells (A, B, C, E, F, B53W19S, B53W18S, and B53W03S) have a screened or sand packed interval across the phreatic groundwater surface, based on September 1997 groundwater level measurements. Monitoring wells A, B, C, M13.5-8.5S, and MW13.5-8.5D at the western end of the site were closed in October 1997 as part of a soil remediation effort performed in the fall of 1997. Also, wells M11-21 and F were closed in April 1998 for installation of a rail spur in the south-central portion of the site.

The wells screened in the lower hydrostratigraphic zone are presented in Table 2-3. Wells designated with a D suffix monitor the lower zone. As of August 1997, 16 wells were completed in

3.0 EVALUATION OF GROUNDWATER REGIMES

The groundwater regimes and their flow patterns at SLAPS are evaluated based on various hydrogeologic information including their potentiometric surface and groundwater chemistry. The chemical parameters evaluated in this section are principally naturally occurring cations and anions.

3.1 Potentiometric Surfaces

Potentiometric surface elevations from wells completed in both the upper and the lower hydrostratigraphic zones were recorded for SLAPS in July and September 1997. Groundwater surface elevation contours were drawn using the September 1997 data for both the upper and lower hydrostratigraphic zones.

Potentiometric surface contours for the upper hydrostratigraphic zone, based on September 1997 data, are illustrated on Figure 3-1. The depth to groundwater as of September 1997 ranged between 2 and 23 feet below grade level. The highest potentiometric surface measurements are located in wells at the eastern end of SLAPS, which corresponds to the area of highest surface topography. A localized groundwater mound, possibly caused by a perched saturated condition, occurs near well D. This feature was also observed in previous site data. The groundwater flow direction from SLAPS in the upper zone, interpreted to be perpendicular to groundwater equipotential contours, is westerly to northwesterly towards Coldwater Creek. Shallow groundwater beneath properties located north of the creek also converges to the creek as shown on Figure 3-1. At the western portion of SLAPS, the contours indicate a westerly flow of groundwater at a gradient of 0.030 between wells B53W12S and B53W12D. Further east, the gradient is less (0.018 between wells M10-25S and B53W06S). The hydraulic gradient increased near the southern side of Coldwater Creek. The shallow-most groundwater of the unconfined upper zone is interpreted to discharge into Coldwater Creek, which divides the shallow groundwater system south and east of the creek from areas north and west of Coldwater Creek.

Potentiometric surface elevation for the lower hydrostratigraphic zone is highest at well M10-25D located at the southeastern corner of the site. The gradient varies slightly from about 0.008 in a northerly direction and 0.007 in a northwesterly direction. Figure 3-2 illustrates the potentiometric surface contours of the lower hydrostratigraphic zone. This contour configuration of two radial type of surface patterns northeast and west of SLAPS was also observed in September 1995. The potentiometric surface of the lower zone does not appear influenced by Coldwater Creek because the "confined" groundwater potentiometric surface of the lower zone is higher than the upper zone and the creek (creek elevation is about 500 feet above mean sea level [AMSL]). This condition is also supported by the absence of a potentiometric trend paralleling the creek, the apparent extension of the potentiometric surface beneath the creek, and other hydrogeologic data (presence of 3M unit). The configuration of the lower zone potentiometric surface is probably influenced by the orientation and thickness of the lower zone material in the buried channel system which is oriented similar to the present course of Coldwater Creek.

The current analysis of vertical gradients is similar to previous results. Groundwater levels recorded in well clusters M10-15D and M10-15S, M10-25D and M10-25S, and B53W16S and B53W11D along the southern perimeter of SLAPS indicate a downward gradient potential. The

3.2.1 Upper Hydrostratigraphic Zone

The upper hydrostratigraphic zone includes stratigraphic units 1, 2 and 3T. The chemical character of groundwater in the upper zone is complex and cannot be easily characterized into an average overall composition. The complex nature of groundwater chemistry in this zone is partially due to impacts to the upper zone from waste storage and other surficial activities.

The red-colored stiff diagrams on Figure 3-4 show the major cation and anion configuration for groundwater collected from wells completed in the upper zone. The overall average cation and anion balance of the upper zone groundwater is represented by the stiff diagrams shown in light red such as for wells F and B53W05S. The remaining upper zone wells such as wells E and B53W13S (shown in dark red) can be categorized as having some degree of impacted water quality by elevated sulfates, elevated calcium and nitrate, elevated sodium and chloride, or a combination of these parameters.

The most distinct upper zone groundwater character is the elevated concentrations of calcium and nitrate in many wells. This pattern is typically correlated to high relative total dissolved solids (TDS) concentrations. The cause of the elevated calcium and nitrate is unknown at this time, but it may be related to the former disposal of nitric acid waste products that were once neutralized by limestone or dolomite before being placed at SLAPS.

3.2.2 Lower Hydrostratigraphic Zone

Based on current information, the lower hydrostratigraphic zone includes stratigraphic units 3B, 4, and 5. In general, a fairly uniform chemical character is indicated from groundwater collected from this zone, as shown on Figure 3-5. The light blue diagrams are of 11 lower zone wells that have similar water quality. The lower zone groundwater typically has moderate concentrations of calcium with lower concentrations of potassium and sodium, magnesium, and iron. The dominant major anionic component is alkalinity. Sulfate and chloride are present only at very low to low concentrations. Nitrate was not detected or detected at less than one milligram per liter (mg/l) in groundwater from these lower zone wells.

The average, maximum, and minimum concentrations, and standard deviation of the major cations and anions from baseline groundwater samples collected at these 11 wells are presented in Table 3-2. Collectively, the concentrations were determined to represent the average groundwater quality of the lower zone. This interpretation is based on the relatively narrow range of TDS concentrations (sum of major cations and anions) and the uniquely similar calcium and alkalinity signature.

Groundwater quality that is outside the average TDS concentrations for the lower zone are shown as dark blue-colored diagrams on Figure 3-5. These wells can be grouped into three categories: (1) a calcium/alkalinity signature with slightly higher TDS concentrations (wells M10-25D and B53W10D); (2) a calcium/alkalinity signature with elevated sodium/potassium and sulfate concentrations (wells B53W09D and B53W11D); and (3) anomalous--no detectable alkalinity (well B53W12D). The character of groundwater in wells M10-25D and B53W10D

upper zone samples contain greater than 1 pCi/l of tritium with 10 of the 11 samples containing greater than 10 pCi/l of tritium.

Tritium is a Hydrogen-3 isotope with a half-life of 12.3 years. It is produced in the atmosphere by natural radiation and is brought to the earth's surface by precipitation. Additional tritium was introduced into the atmosphere during nuclear weapons testing in the 1950s and 1960s. Sufficient tritium was added to the global water cycle so as to make pre-1950 water distinguishable from post-1950 water. Higher concentrations of tritium are indicative of relatively young water that has not had the time to allow for tritium decay. Lower concentrations of tritium are indicative of relatively older water that has undergone longer residence times, greater amounts of tritium decay, and has not received tritium from man-made sources. At SLAPS, an order of magnitude or more difference in tritium concentrations exists between upper zone groundwater samples and lower zone groundwater samples. These results indicated that groundwater in the upper zone is recent (less than 50 years old) and the groundwater in the lower zone is older (at least 50 years). Rapid water recharge to the upper zone is evident with this data. The varied tritium concentrations also suggest no or limited hydraulic communication between the zones because more uniform concentrations would exist by groundwater mixing between zones.

3.2.4 Summary

Based on the groundwater chemical analyses, two distinct hydrostratigraphic groundwater zones (upper and lower) have been identified at SLAPS. Groundwater in the upper zone is mainly characterized by high calcium and nitrate, or high sodium/potassium and chloride concentrations which are likely caused by impacts from surficial sources. Groundwater in the lower zone is characterized by a calcium and alkalinity signature with low relative concentrations of sulfate, chloride, iron, and the absence of detectable nitrate-nitrogen and selenium. These zones appear to have negligible hydraulic communication and are separated by the 3M aquitard unit and/or other low conductivity units beneath SLAPS and the contiguous properties.

The detected concentrations of the cation and anion parameters of the 1997 baseline data from the lower zone groundwater do not indicate significant impacts from upper zone groundwater or site-related activities. Elevated nitrate and selenium concentrations in groundwater at SLAPS are apparently limited to the upper zone. Although arsenic is present at relatively high concentrations in the lower zone, it is likely indigenous to the native substrate and occurs at natural background concentrations as supported by its elevated presence in several off-site background lower zone wells. The tritium data supports the existence of two separate groundwater sources of different ages and indicates that mixing between upper and lower zone groundwater is not evident.

4.0 OCCURRENCE OF GROUNDWATER CONTAMINANTS

The type, occurrence, and distribution of groundwater contaminants at SLAPS are identified and evaluated in this section. Constituents that are known or suspected to occur in groundwater at SLAPS and contiguous properties based on historical information and groundwater data are initially considered to be analytes of interest. An assessment to determine PCOCs in site groundwater is then made based mainly on their detection in historical groundwater data. The occurrence and distribution of the determined PCOCs is discussed using the 1997 baseline data. A comparison of the PCOCs to historical groundwater data is also presented to help define any changes to chemical concentrations in site groundwater occurring over time.

4.1 Potential Constituents of Concern

4.1.1 Radionuclides

Various radionuclides and their daughter products were associated with former SLAPS storage and waste handling activities. The radionuclides identified in Table 4-1 were consistently part of historic groundwater analysis and are identified as analytes of interest. The following radioisotopes were analyzed in collected groundwater samples: total uranium, actinium-227, thorium-227, thorium-228, thorium-230, thorium-232, protactinium-231, radium-226, radium-228, and lead-210. These radionuclides were chosen because of their potential presence in the ore processing material or in the former waste that was placed at SLAPS.

Radionuclide PCOCs were chosen based on actual detections in groundwater and their exceedances of background and/or regulatory action levels. Radium-226, thorium-230, and total uranium are identified as potential radionuclides of concern for SLAPS. Total uranium is determined to be a PCOC since it has consistently exceeded its MCL in groundwater at several locations. Radium-226 and thorium-230 are not considered PCOCs due to their absence or very low detected concentrations in the 1997 data, and their previous detections below respective MCLs or at estimated background values. Total uranium and its associated regulatory action levels and estimated background values for the groundwater beneath SLAPS are provided in Table 4-2.

4.1.2 Non-Radionuclides

The following inorganics are included as analytes of interest due to their presence in the former uranium ore processing and associated waste streams and residues: aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, molybdenum, nickel, nitrate, potassium, selenium, silver, sodium, sulfate, vanadium, and zinc (Table 4-1).

Based on previous detections reported in existing groundwater analytical results and current regulatory action levels, the metals of interest were reduced to the following elements: aluminum, arsenic, barium, calcium, chromium, iron, manganese, nitrate, and selenium. Aluminum, calcium, and iron were eliminated as PCOCs due to their natural background presence in both the upper and lower hydrostratigraphic zones. Barium and chromium were detected historically at natural background concentrations below their MCLs. Based on historical data, manganese was detected in groundwater at SLAPS at concentrations ranging between 15 and 6,900 µg/l. Groundwater from

4.2.1 Radiological Data

Elevated total uranium concentrations above its MCL and estimated background values were detected in some groundwater samples from SLAPS and surrounding areas. The USEPA MCL for total uranium is 20 µg/l, and its estimated site-specific background concentrations for the upper and lower zone groundwaters are <5 and <1.5 µg/l, respectively. Detected uranium concentrations exceeded its MCL in 11 upper zone wells, 9 of them being within the boundaries of SLAPS. The highest concentrations of total uranium were detected in samples from shallow groundwater wells at the western portion of SLAPS. The highest concentration was 7,330 µg/l in Well B. The only off-site location which contained groundwater exceeding MCL for total uranium was well B53W06S at a concentration of 75.4 µg/l. This well is located north of SLAPS on the southern side of Coldwater Creek. The presence of uranium in the shallow groundwater at this well may be related to a source near the well, and is not interpreted to be a result of dissolved uranium migration in the groundwater from SLAPS. Further sampling will be completed near this location to evaluate the detection of uranium and better understand its source. Concentrations of total uranium above its estimated background values were detected at seven additional wells (B53W07S, B53W09S, B53W09D, B53W12S, B53W13S, B53W18S, and M10-25D). Wells B53W09D and M10-25D are completed in the shale bedrock, and 3M and 3B subunits, respectively. The detection of total uranium in groundwater samples is partially influenced by the Eh and pH of the groundwater. Groundwater with a lower Eh or pH may have more detectable uranium due to its increased solubility in a reducing or acidic environment. The distribution of total uranium in groundwater at SLAPS based on the 1997 baseline data is illustrated on Figure 4-1.

4.2.2 Nonradiological Data

Arsenic, manganese, nitrate, and selenium were detected above their respective MCLs in the baseline data. Dissolved arsenic was detected in eight wells above its MCL of 50 µg/l. Elevated concentrations of arsenic ranged from 71 µg/l in well B53W07D to 138 µg/l in well B53W10D. The elevated arsenic concentrations were only detected in the lower hydrostratigraphic zone (unit 4) (i.e., deeper than 57 feet bgs) beneath the western part of SLAPS and the western portion of the ball fields area, and in the deep wells north of Coldwater Creek. These arsenic concentrations are likely naturally occurring background levels in the lower zone because no arsenic concentrations above its MCL were detected in the upper hydrostratigraphic zone. The arsenic has likely originated from pyrite in the lower zone materials or underlying bedrock.

Concentrations of dissolved manganese ranged between less than 1 and 6,420 µg/l in groundwater samples of the 1997 baseline sampling. The highest concentration was detected in the on-site well D sample. Concentrations of manganese above 2,000 µg/l were detected in several on-site wells such as wells B, M11-9, and M10-25D, and in off-site wells B53W06S and B53W10S. Groundwater samples from approximately 35 wells at SLAPS contained manganese above its SMCL of 50 µg/l, including both upper and lower zone wells. The estimated background concentrations of manganese for the upper zone and lower zone groundwaters are 25 and 215 µg/l, respectively (BNI, 1998). A total of 27 upper zone wells contain manganese above its estimated background concentration, with 11 lower zone wells reported to have manganese above the lower zone background concentration. The occurrence of this metal is the upper zone groundwater beneath SLAPS, particularly at the western end, appears related to site activities; however, the

4.3.1 Radiological Data

A summary of historical concentrations of total uranium in wells at SLAPS is given in Table 4-3. Wells A (closed), M10-8S (closed), M10-25S, and B53W13S have shown increases in total uranium concentration with the comparison of 1980s and early 1990s data to the 1997 data. Eleven monitoring wells sampled in the summer 1997 had concentrations of total uranium exceeding the USEPA MCL of 20 µg/l. Three of these wells (A, B, and C) are now closed. The highest concentration of total uranium in well M10-25S was detected in 1997 at 113 µg/l compared to 51 µg/l in 1991. Most other wells with groundwater exceeding the MCL for total uranium have lower uranium concentrations in 1997 compared to previous results. For example, groundwater in well D had 1,242 µg/l of total uranium in 1991 compared to 540 µg/l in 1997. The overall concentration of total uranium in off-site wells is similar to historical results. A concentration of about 13 µg/l of total uranium was detected in groundwater from well B53W13S in 1991. A similar concentration of 14 µg/l was detected in this well in 1997. Similar results are observed at adjacent off-site wells B53W10S and B53W14S. All detections of total uranium exceeding its MCL, both current and historical, are in monitoring wells completed in the upper hydrostratigraphic zone.

Although total uranium is the only radiological PCOC, some information are also presented about radium-226 and thorium-230 in site groundwater. No groundwater samples analyzed for radium-226 in 1997 from SLAPS wells had concentrations exceeding its MCL of 20 pCi/l. All radium-226 concentrations reported in 1997 were less than the previous analyses. The reported concentration of 33.8 pCi/l of radium-226 in well B53W11D in 1992 has decreased to 0.12 pCi/l in 1997. Table 4-4 presents a summary of the historical groundwater analyses for radium-226.

Groundwater samples collected in 1997 from SLAPS did not contain thorium-230 concentrations exceeding 1 pCi/l. No USEPA MCL has been established for this radionuclide. All wells had lower concentrations of thorium-230 in 1997 compared to their previous sampling event, either in 1991 or 1992. Table 4-5 contains a summary of historical groundwater analyses for thorium-230 at SLAPS.

4.3.2 Nonradiological Data

Elevated manganese was detected in groundwater samples from numerous wells at SLAPS in 1997. Available historic data for this metal includes 1989 data from 15 existing wells (Table 4-6). The highest concentration of this metal in groundwater in 1989 was at well D, as also determined in 1997. Higher manganese concentrations were measured in wells D and M10-25D in the 1997 baseline sampling compared to previous results. In most wells, the baseline groundwater samples contained lower manganese concentrations compared to previous data.

The 1997 groundwater analyses indicated that 15 wells contained nitrate above its MCL of 10 mg/l. The highest nitrate concentration was measured in well M11-9 at 569 mg/l. Very limited historical data is available for nitrate; therefore, no comparisons of recent to historical concentrations can be made. The historic and recent nitrate concentrations in groundwater at SLAPS are given in Table 4-6.

5.0 REVIEW OF ABBREVIATED SAMPLING PLAN REQUIREMENTS

A review of the "Abbreviated Plan for Providing Baseline Sampling and Data Collection for Surface Water and Groundwater at the St. Louis Airport Site and the HISS Site" (Baseline Sampling), dated September 1997, was performed as part of the data validation protocol for this project. The Baseline Sampling Plan was compared to the actual field data collected and to groundwater laboratory analyses. Some concerns about the baseline data could be resolved by examining the original laboratory data reports and field logs. These data reports and logs have not been made available to SAIC for review as of this time. Future work by USACE and SAIC will address these issues by providing analytically verified and complete data sets. Comments about the proposed groundwater sampling work and associated laboratory data, as presented in the abbreviated plan, are as follows:

1. No laboratory analytical methods were supplied with the baseline data report provided to SAIC. The methods specified in the Baseline Sampling Plan are assumed to have been followed by the laboratory.

2. Specific detection limits given in the Baseline Sampling Plan were not always achieved in the reported analytical data. The specific detection limit of 0.2 µg/l was not achieved for most VOCs analyses. The alkalinity detection limit of 1 mg/l was not achieved. The actinium-227 detection limit of 1 pCi/l and the protactinium-231 detection limit of 50 pCi/l were not achieved. The limits of the plan may have been modified based on the used analytical method.

3. The baseline data report lacks consistency in the use of the F/UF (filtered/unfiltered) designation. For the reported well B53W04D results, each metal analysis consistently has the "filtered" concentration first. In contrast, well B53W06S data has two distinct analyses for each metal but attaches the "U" designation to each result.

4. No water quality or field parameter data were reported for wells A3 and A6. SAIC was informed by BNI staff that these two wells could not be adequately developed and were omitted from the sampling program.

5. The baseline data contained tritium groundwater analyses for 17 monitoring wells at SLAPS. Eleven locations were planned to be sampled for tritium in the Baseline Sampling Plan. Only 4 of the 11 wells were actually sampled and analyzed for tritium. Groundwater was collected for tritium analysis at 13 additional wells which were not specified in the work plan.

6. Certain compounds were reported as having a detection by the laboratory but were qualified by a "U" by the review qualifier. For example, aluminum for well B53W06S was reported as 242 µg/l with a lab detection limit of 18 µg/l and a sample quantitation limit of 8 µg/l. No lab qualifier was entered, but the reviewer qualified the data with a "U."

7. Analytical results of any split samples or other water samples collected by MDNR or USEPA were not evaluated as part of this report.

6.0 CONCLUSIONS

Based on existing hydrogeologic and groundwater chemistry information and the findings of the 1997 baseline groundwater sampling event at SLAPS, the following conclusions have been drawn regarding site hydrogeology and groundwater chemistry at the site.

1. Three main hydrostratigraphic zones are interpreted to occur in the non-lithified material beneath SLAPS. The upper hydrostratigraphic zone contains stratigraphic units 1, 2, and 3T. These units include fill, loess, and silty clay. The middle hydrostratigraphic zone is defined by the aquitard identified as the 3M unit. The 3M unit is composed of massive clay ranging in thickness between 0 and 26 feet. Based on current data, the lower hydrostratigraphic zone beneath the 3M unit consists of stratigraphic units 3B, 4, and 5.

2. Thirty-two monitoring wells sampled in 1997 penetrated the upper hydrostratigraphic zone to a maximum depth of 49 feet bgs. These wells penetrate fill and loess (clayey silt). Several of these wells partially penetrate the 3M unit, but none penetrate the entire 3M unit. In most cases, wells constructed in this upper zone have their screened interval at least 10 feet below the static groundwater surface. Seven upper zone wells were closed since September 1997.

3. As of September 1997, 16 wells were exposed to the lower hydrostratigraphic zone beneath the 3M unit. Of these wells, 14 wells are completed in the silty clay and clayey gravels of stratigraphic units 3B and 4. Two wells are completed in the shale bedrock beneath the eastern end of the site. No wells have been completed in the limestone bedrock.

4. The groundwater flow direction of the upper hydrostratigraphic zone of SLAPS is westerly to northwesterly towards Coldwater Creek at a fairly uniform gradient. A localized perched water table condition is apparent near well D. The shallow-most groundwater of the upper zone is interpreted to discharge into Coldwater Creek.

5. The potentiometric surface of the lower hydrostratigraphic zone has a radial pattern from the southeastern corner of SLAPS. The gradient varies slightly in northerly to northwesterly directions. The potentiometric surface of the lower zone does not appear to be influenced by Coldwater Creek.

6. An upward vertical gradient occurs beneath the northern portion of the site and adjacent off-site property near Coldwater Creek. A downward gradient potential exists along the southern perimeter of SLAPS and is interpreted to occur beneath most of SLAPS. The vertical gradient appears independent of the thicknesses of stratigraphic units.

7. The chemical character of groundwater in the upper zone is variable and cannot be easily characterized into an average overall composition. The complex nature of groundwater chemistry in this zone is apparently due to impacts from surficial sources.

8. The groundwater of lower hydrostratigraphic zone has a fairly uniform chemical character. Moderate concentrations of calcium are measured with lower concentrations of potassium and sodium, magnesium, and iron. The dominant major anionic

7.0 REFERENCES

Bechtel National, Inc. (BNI); 1994; *Remedial Investigation Report for the St. Louis Site, St. Louis, Missouri*; DOE/OR/21949-280; January.

BNI; 1998; *Summary and Analysis of the 1997 Baseline Groundwater Sampling Data for the St. Louis North County Sites*; January.

Science Applications International Corporation (SAIC); 1995; *Remedial Investigation Addendum for the St. Louis Site*; DOE/OR/ 21950-132; September.

SAIC; 1997; *Abbreviated Plan for Providing Baseline Sampling Data and Data Collection for Surface Water and Groundwater at the St. Louis Airport Site and the Hazelwood Interim Storage Site, St. Louis, Missouri*; September.

FIGURES

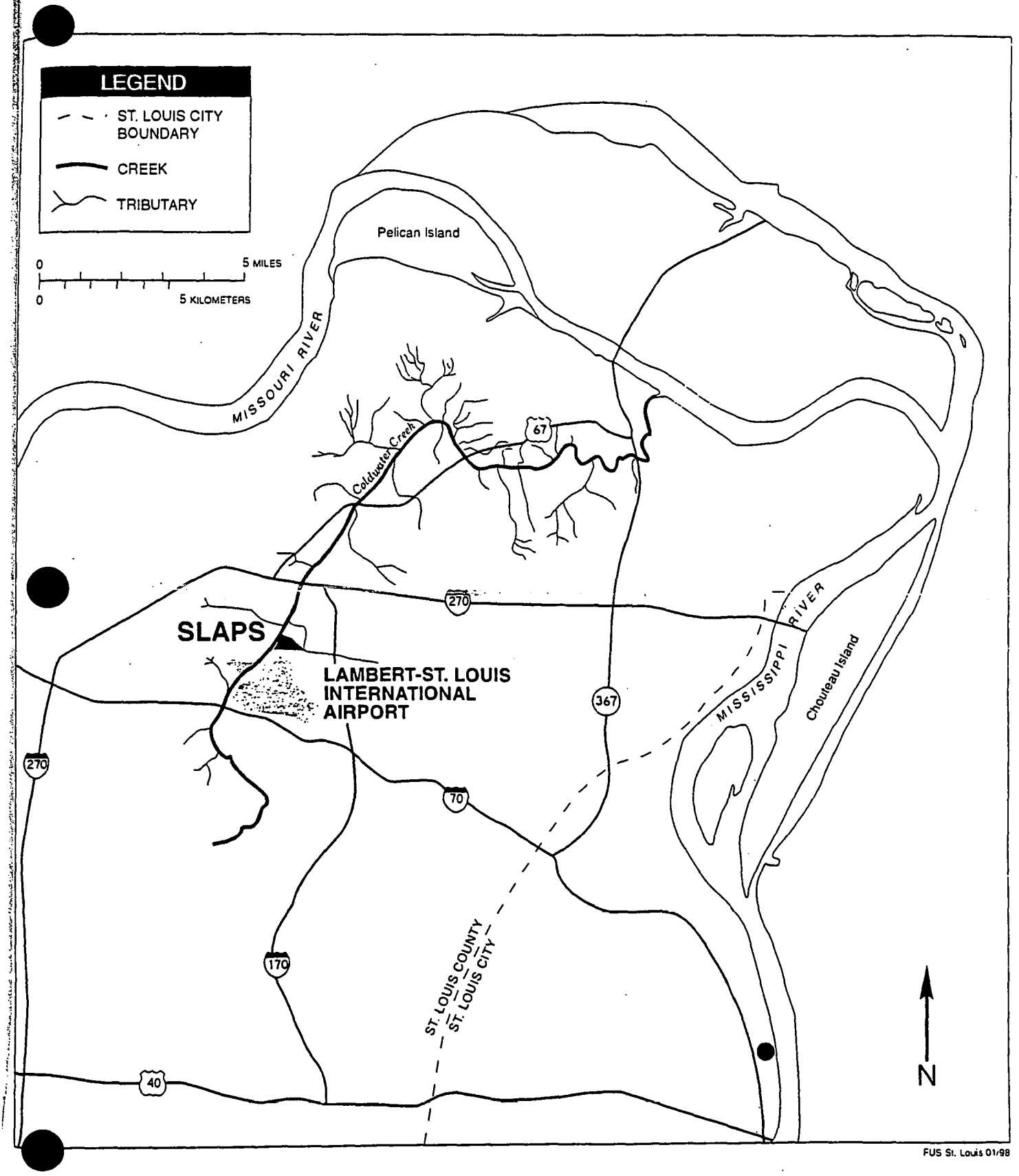


Figure 1-1. SLAPS Location Map

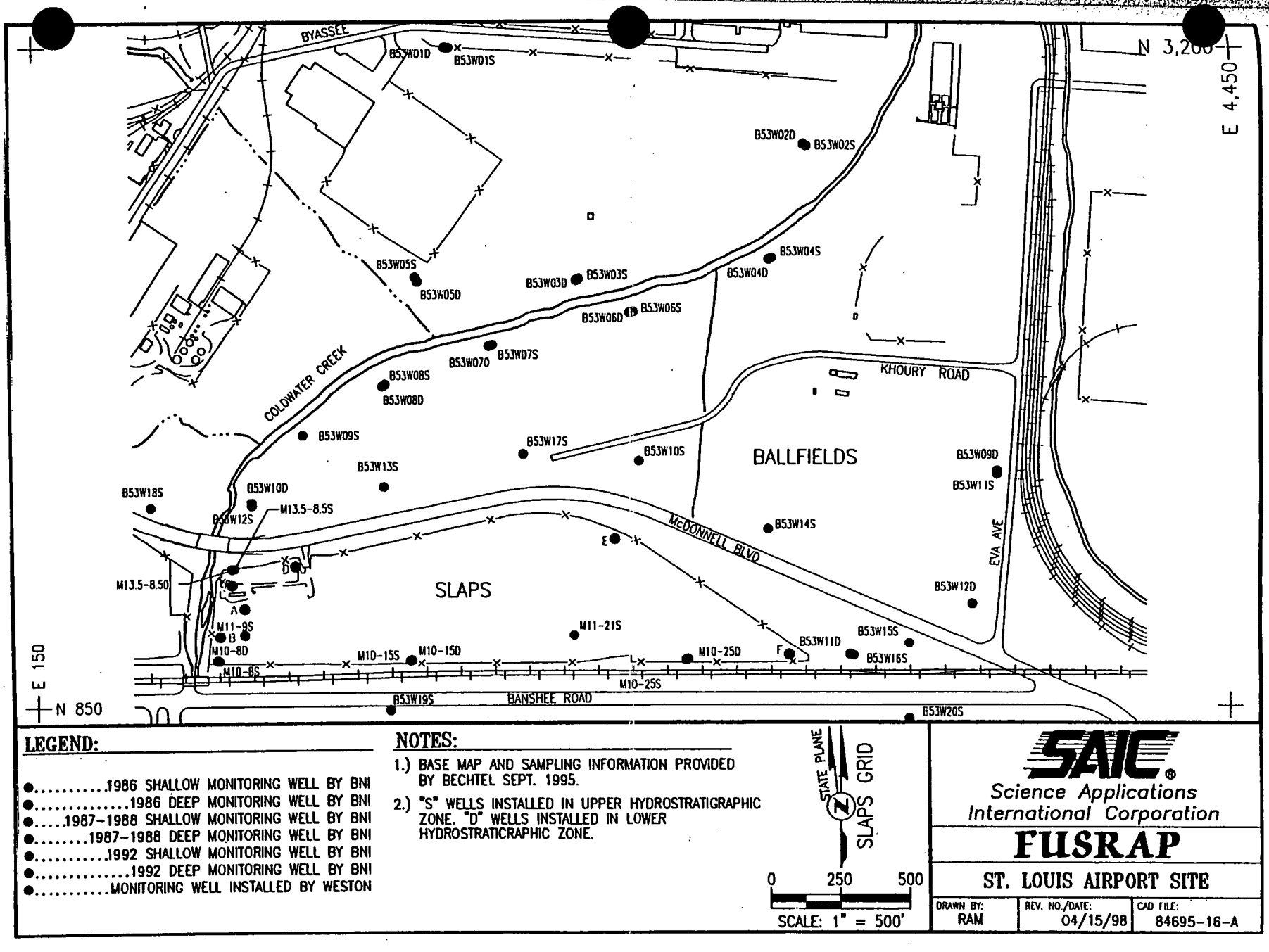


Figure 2-1

SLAPS Monitoring Well Location Map

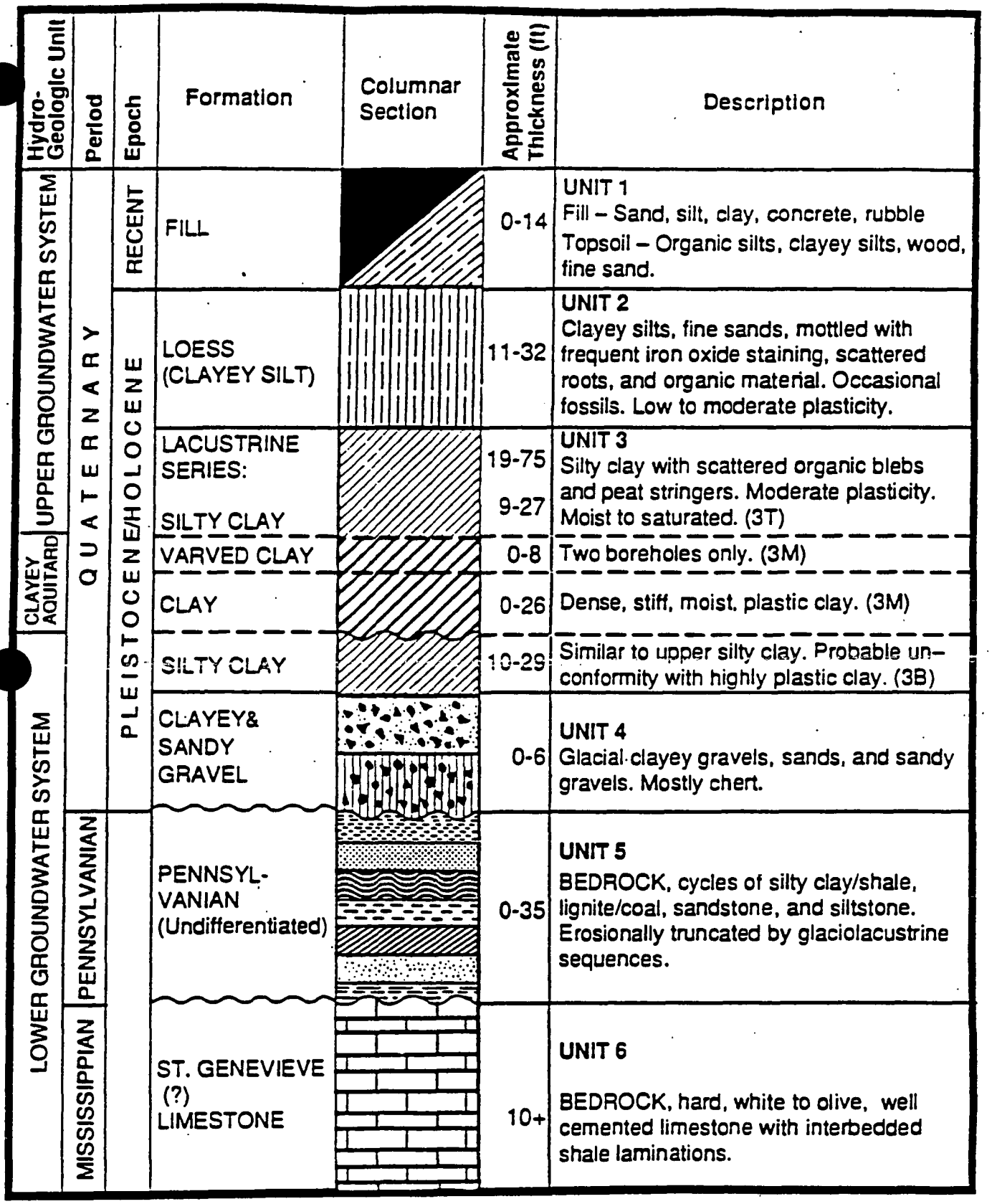
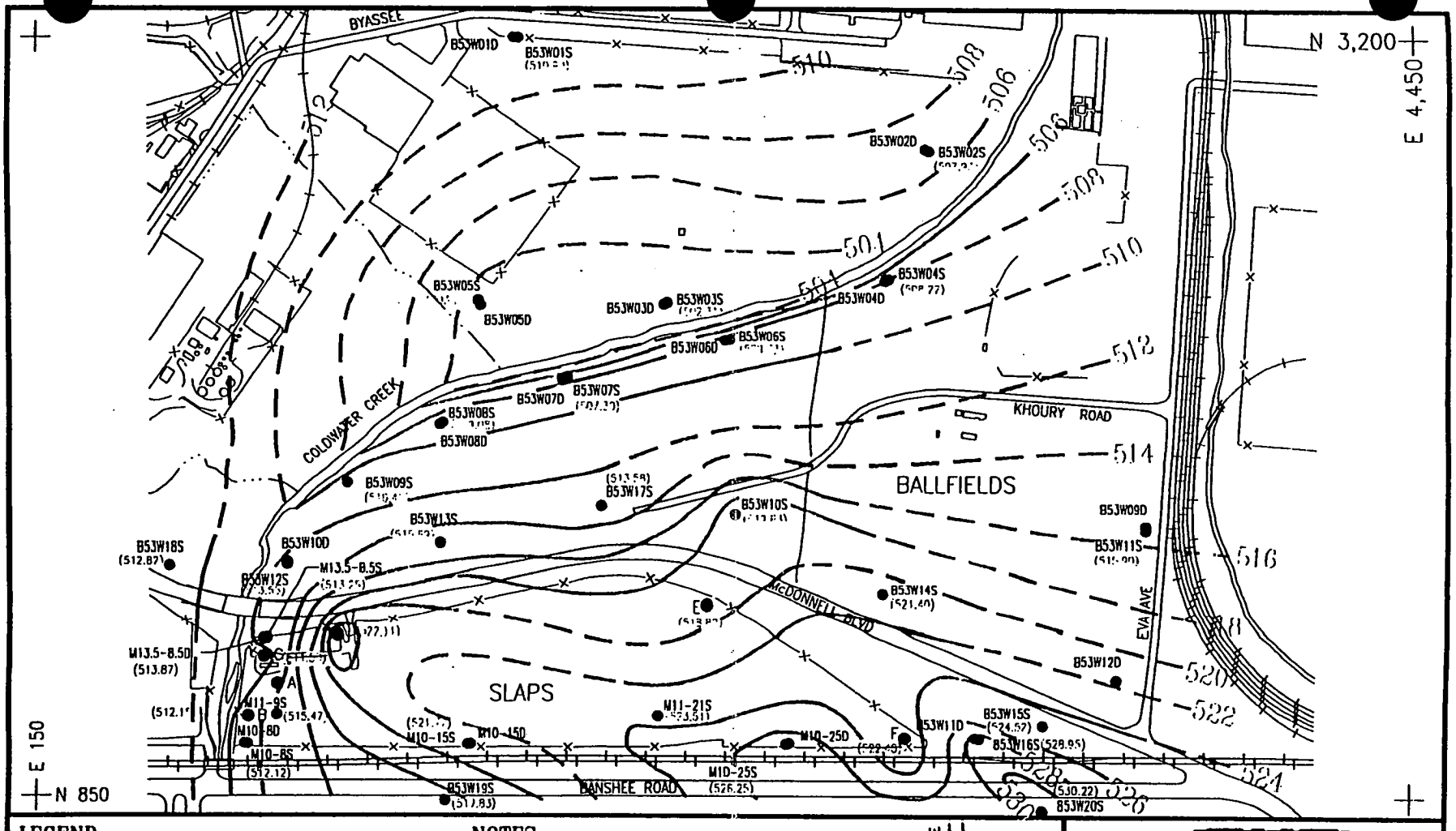


FIGURE 2-2

GENERALIZED STRATIGRAPHIC COLUMN FOR SLAPS AREA

(BECHTEL 1994)



LEGEND:

- ● MONITORING WELL LOCATION
- (530.22) ELEVATION OF POTENTIOMETRIC SURFACE IN FEET ABOVE MEAN SEA LEVEL
- -522- POTENTIOMETRIC SURFACE CONTOUR IN FEET ABOVE MEAN SEA LEVEL (DASHED WHERE INFERRED)

NOTES:

1.) BASE MAP AND SAMPLING INFORMATION PROVIDED BY BECHTEL SEPT. 1995.

2.) "S" WELLS INSTALLED IN UPPER HYOROSTRATIGRAPHIC ZONE. "D" WELLS INSTALLED IN LOWER HYDROSTRATIGRAPHIC ZONE.

STATE PLANE SLAPS GRID

0 250 500

SCALE: 1" = 500'

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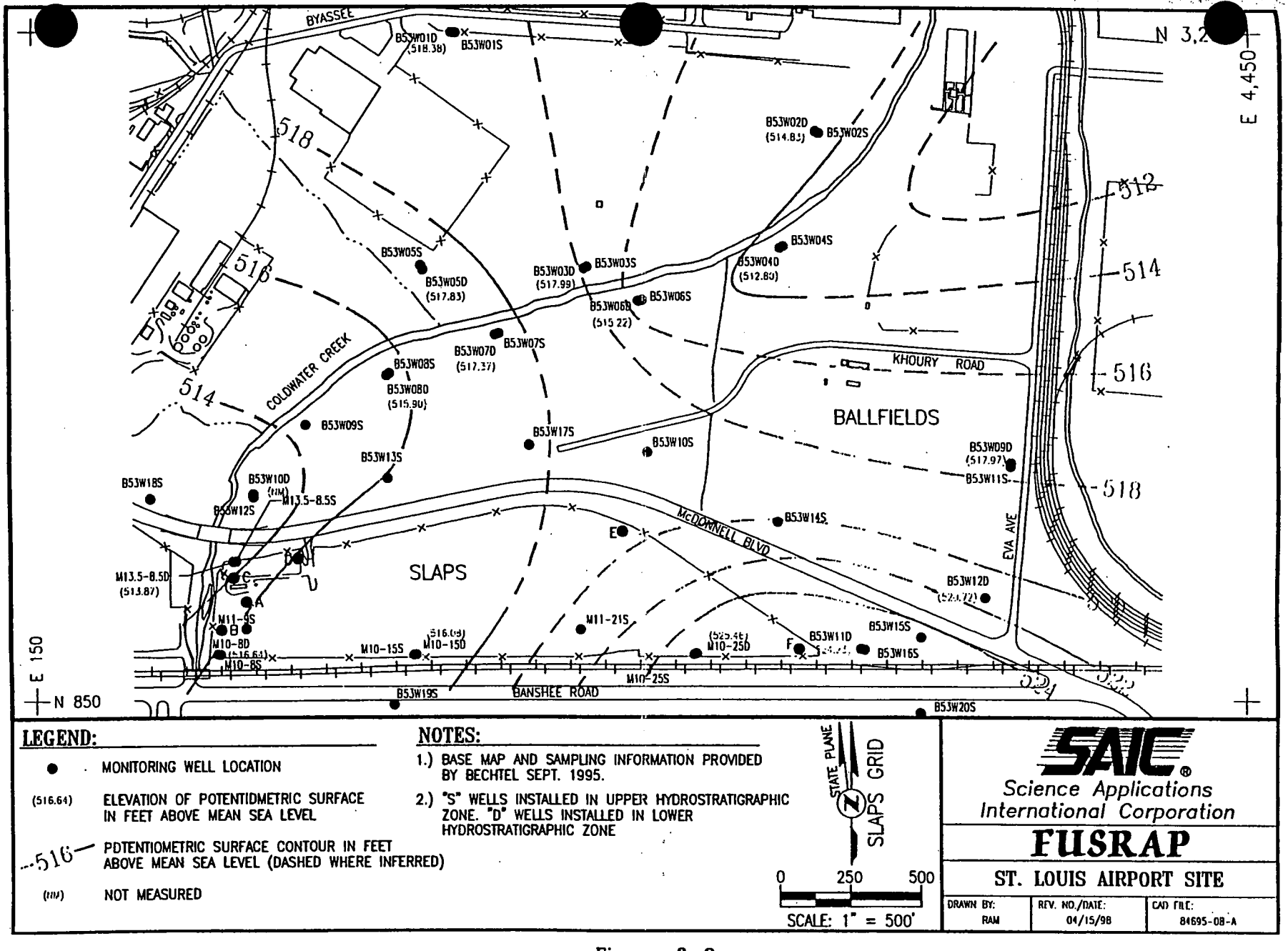
Figure 3-1

Potentiometric Surface Map of Upper Hydrostratigraphic Zone (9/97)



LEGEND:

- ● MONITORING WELL LOCATION
- (516.64) ELEVATION OF POTENTIDMETRIC SURFACE IN FEET ABOVE MEAN SEA LEVEL
- 516 POTENTIOMETRIC SURFACE CONTOUR IN FEET ABOVE MEAN SEA LEVEL (DASHED WHERE INFERRED)
- (NM) NOT MEASURED

NOTES:

1.) BASE MAP AND SAMPLING INFORMATION PROVIDED BY BECHTEL SEPT. 1995.

2.) "S" WELLS INSTALLED IN UPPER HYDROSTRATIGRAPHIC ZONE. "D" WELLS INSTALLED IN LOWER HYDROSTRATIGRAPHIC ZONE

STATE PLANE SLAPS GRID

0 250 500

SCALE: 1" = 500'

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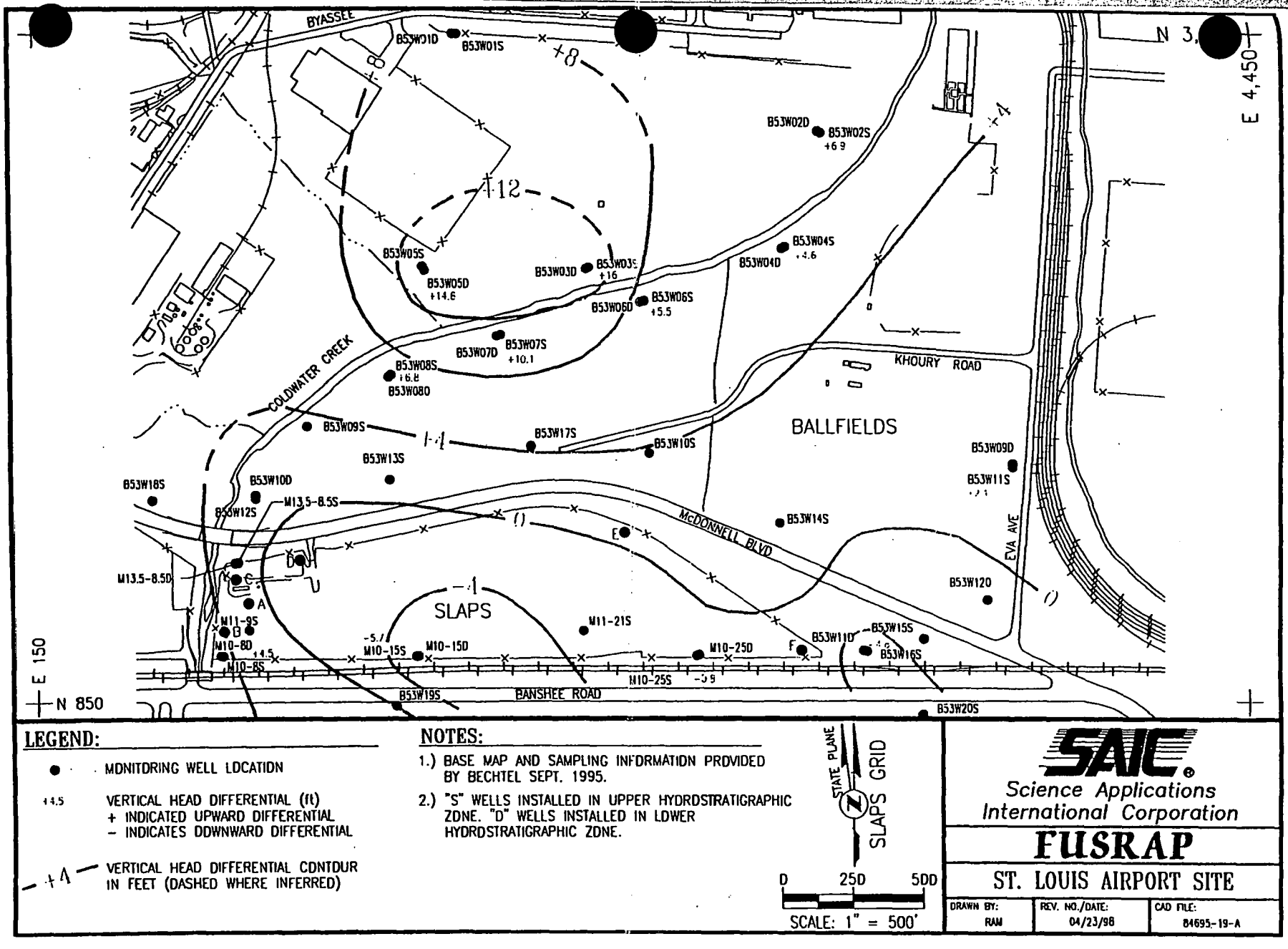
Figure 3-2

Potentiometric Surface Map of Lower Hydrostratigraphic Zone (9/97)



LEGEND:

- ● MONITORING WELL LOCATION
- +4.5 VERTICAL HEAD DIFFERENTIAL (ft)
  + INDICATED UPWARD DIFFERENTIAL
  − INDICATES DOWNWARD DIFFERENTIAL
- +4 VERTICAL HEAD DIFFERENTIAL CONTOUR IN FEET (DASHED WHERE INFERRED)

NOTES:

1.) BASE MAP AND SAMPLING INFORMATION PROVIDED BY BECHTEL SEPT. 1995.

2.) "S" WELLS INSTALLED IN UPPER HYDROSTRATIGRAPHIC ZONE. "D" WELLS INSTALLED IN LOWER HYDROSTRATIGRAPHIC ZONE.

STATE PLANE
SLAPS GRID
N
0 250 500
SCALE: 1" = 500'

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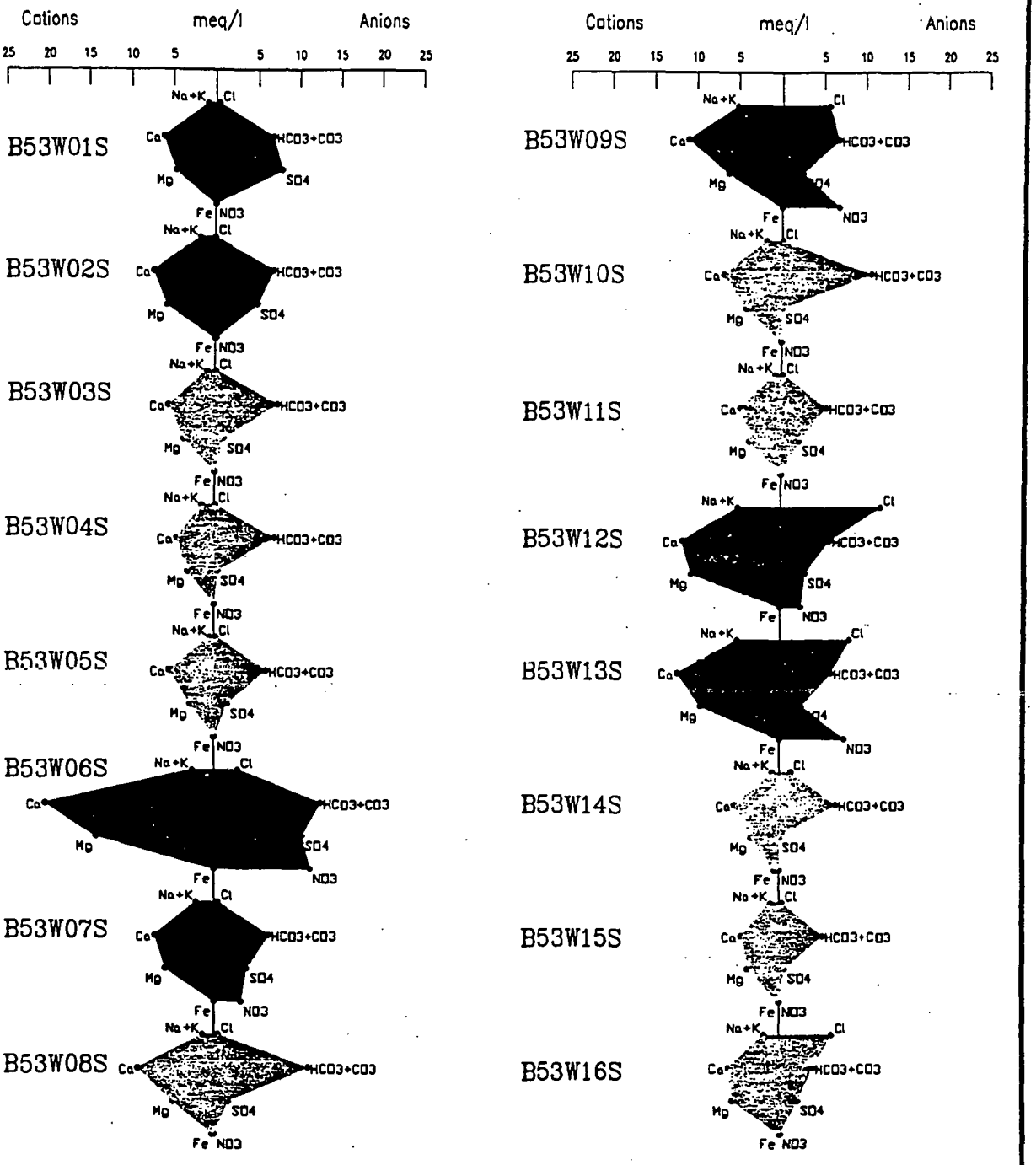
Figure 3-3
Distribution of Vertical Hydraulic Head Differential (9/97)



LEGEND

BASIC UPPER ZONE COMPOSITION

IMPACTED UPPER ZONE COMPOSITION

CATIONS	ANIONS
Na – Sodium	Cl – Chloride
K – Potassium	HCO_3+CO_3 – Alkalinity
Ca – Calcium	SO_4 – Sulfate
Mg – Magnesium	NO_3 – Nitrate
Fe – Iron	

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Figure 3-4

Groundwater Chemical Composition
Upper Hydrostratigraphic Zone

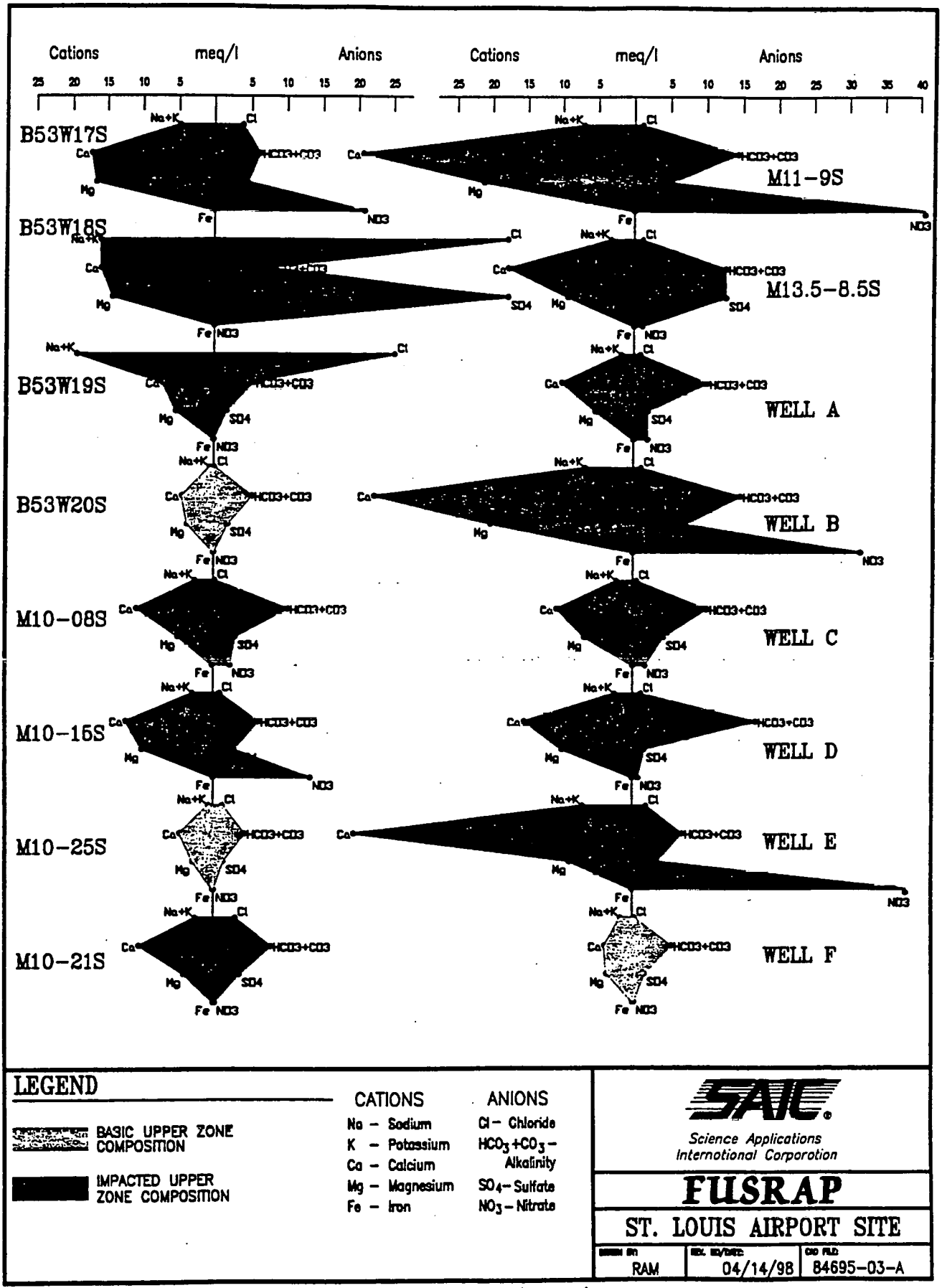
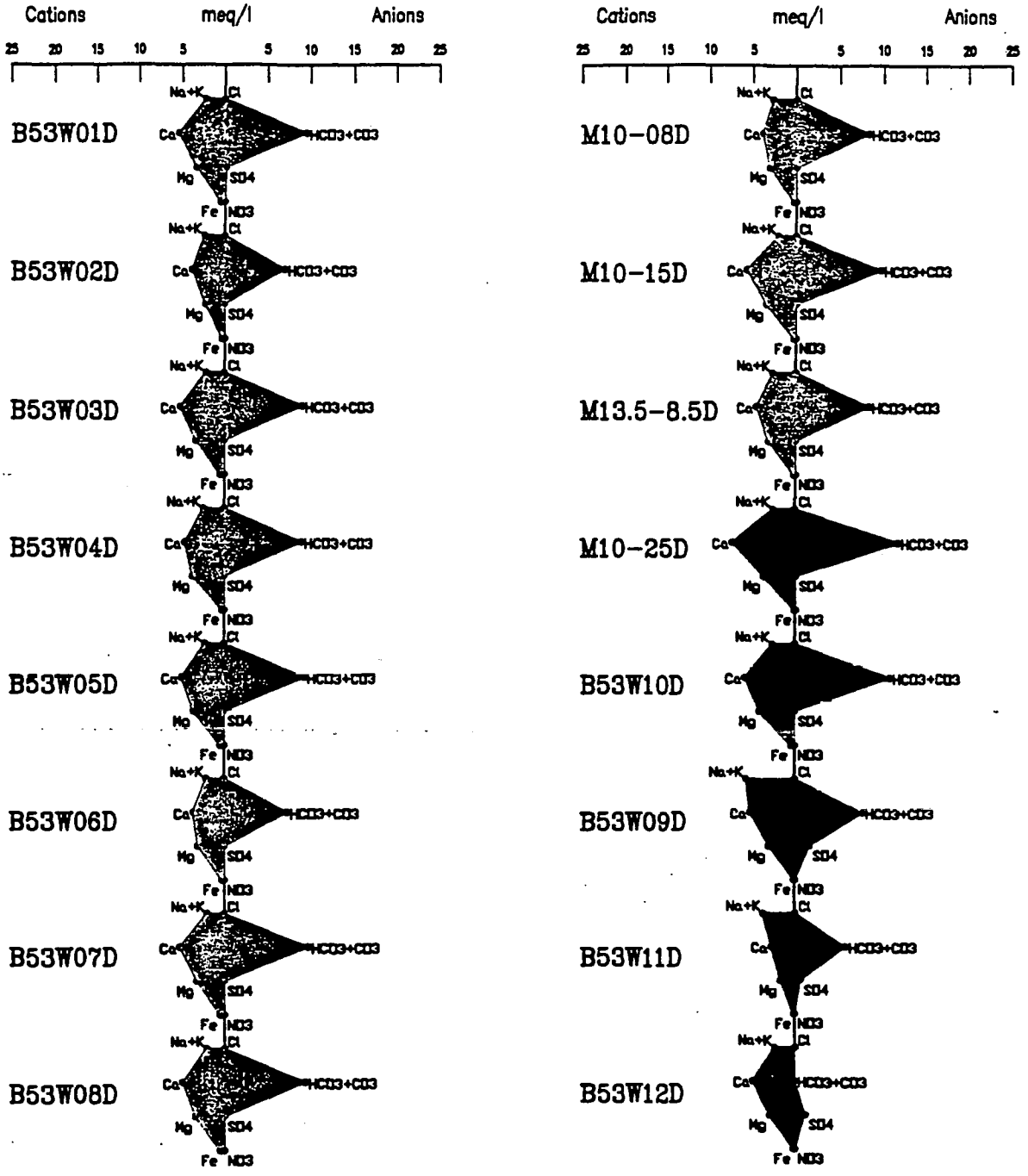


Figure 3-4 (Cont.)
Groundwater Chemical Composition
Upper Hydrostratigraphic Zone



LEGEND

BASIC LOWER ZONE COMPOSITION

ABOVE OR BELOW BASIC LOWER ZONE COMPOSITION

CATIONS	ANIONS
Na – Sodium	Cl – Chloride
K – Potassium	HCO_3+CO_3 – Alkalinity
Ca – Calcium	SO_4 – Sulfate
Mg – Magnesium	NO_3 – Nitrate
Fe – Iron	

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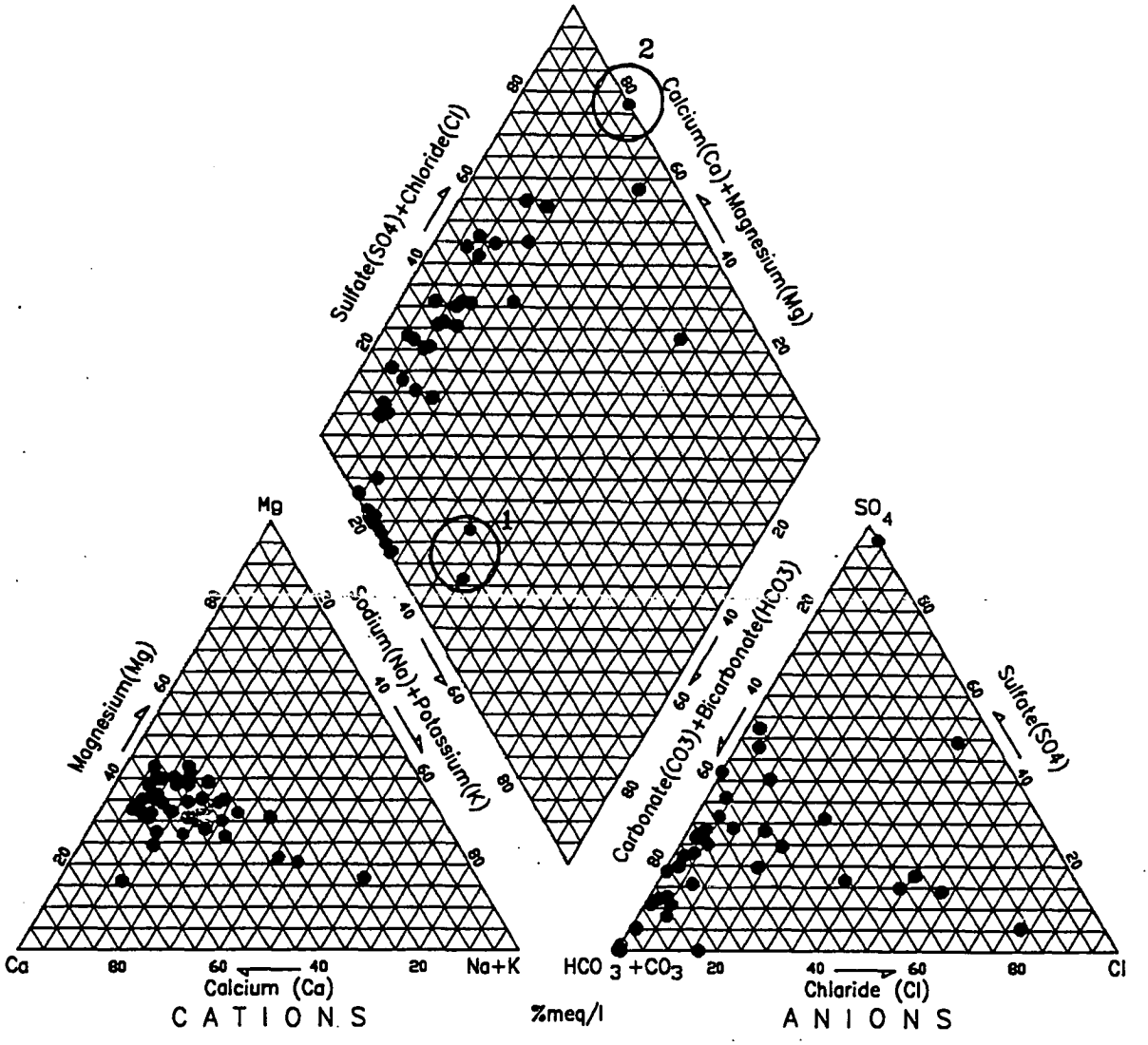
Figure 3-5

Groundwater Chemical Composition
Lower Hydrostratigraphic Zone



LEGEND:

- ● UPPER HYDROSTRATIGRAPHIC ZONE GROUNDWATER
- ● LOWER HYDROSTRATIGRAPHIC ZONE GROUNDWATER
- 1 LOWER HYDROSTRATIGRAPHIC ZONE WITH CHEROKEE SHALE INFLUENCE
- 2 ANOMALOUS DATA

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Figure 3-6

Tri-Linear Plot of Maior Ionic Species for Upper and Lower Zones

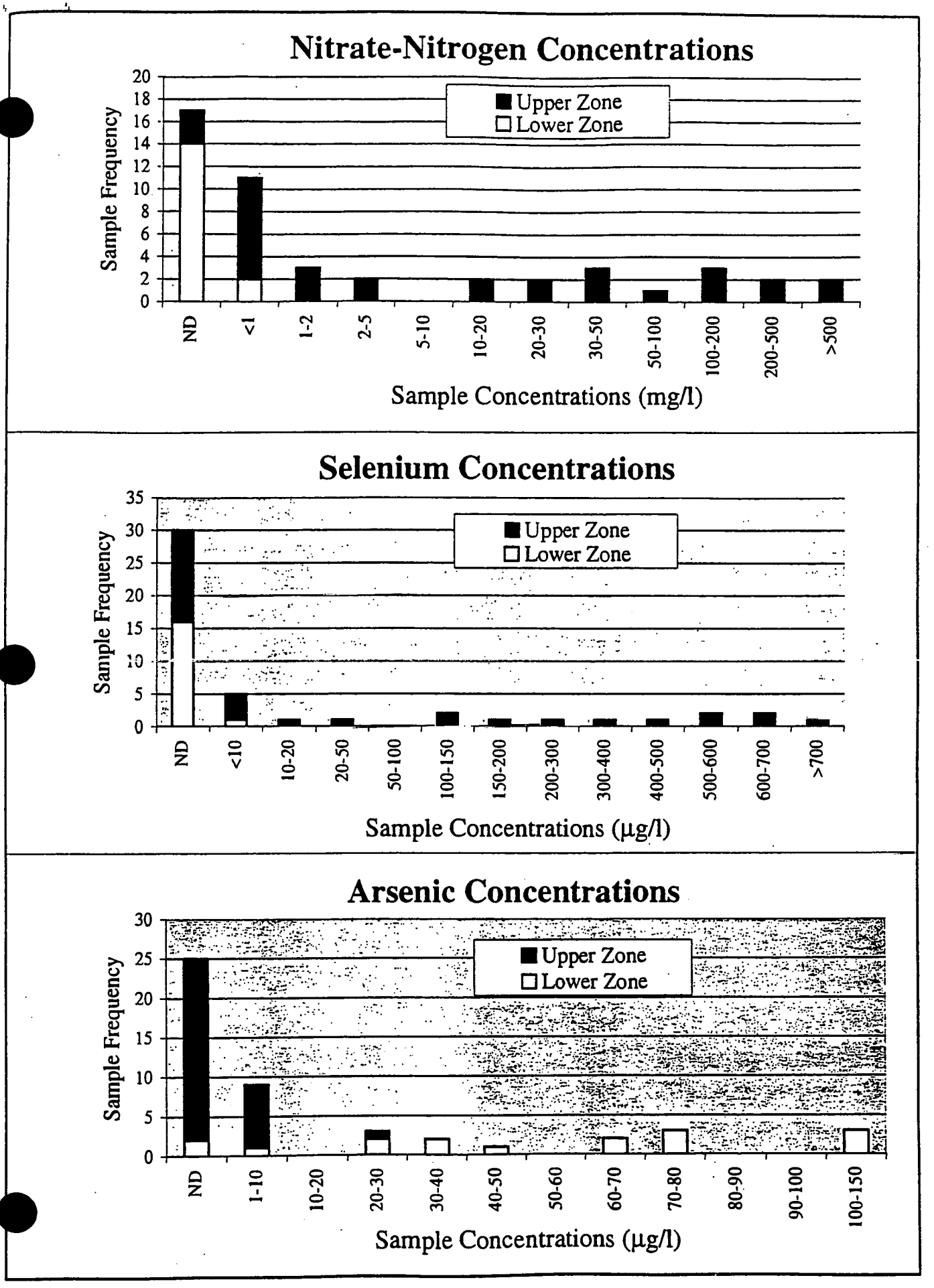


Figure 3-7. Distribution of nitrate-nitrogen, selenium, and arsenic groundwater concentrations at SLAPS.

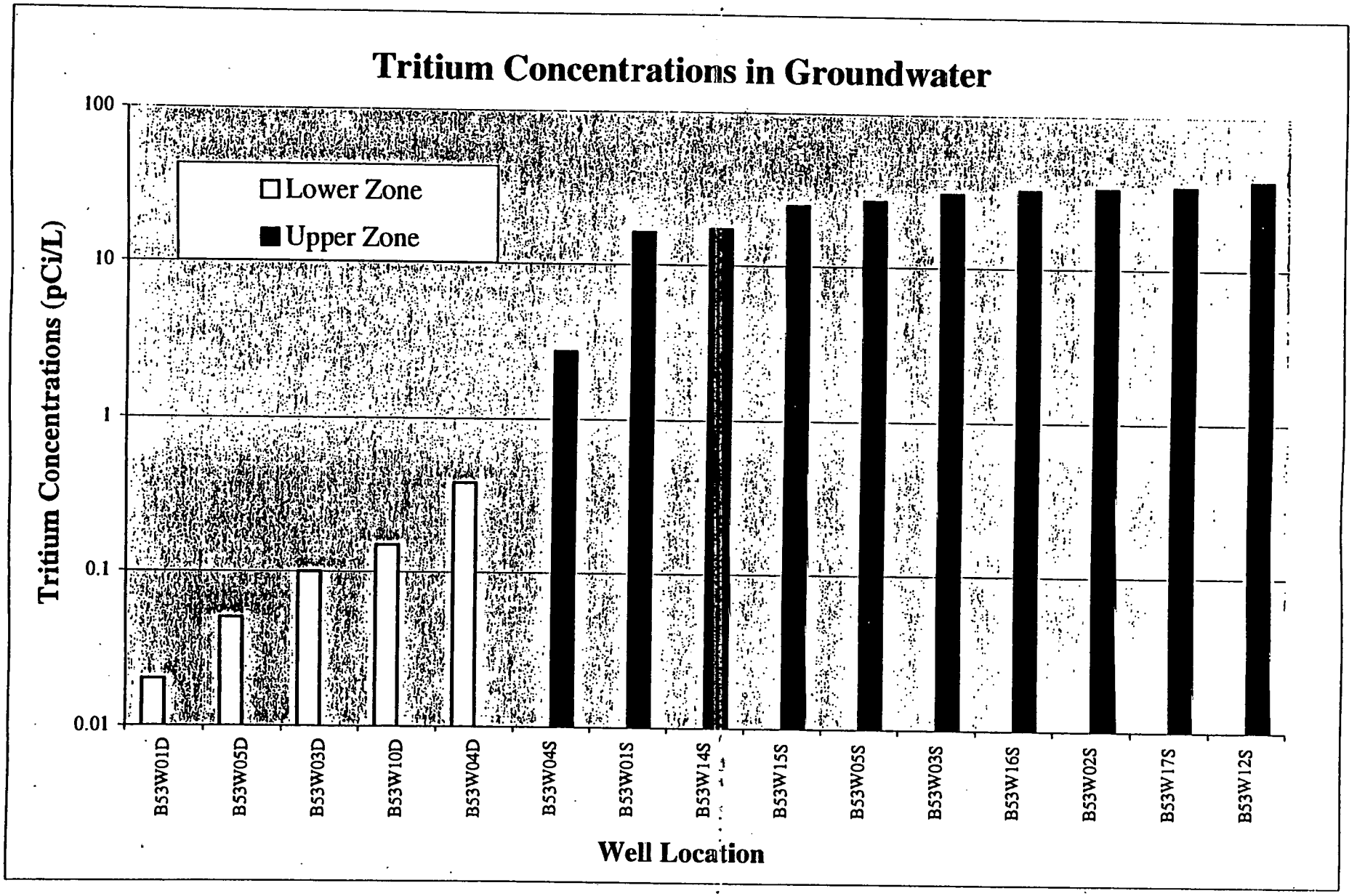
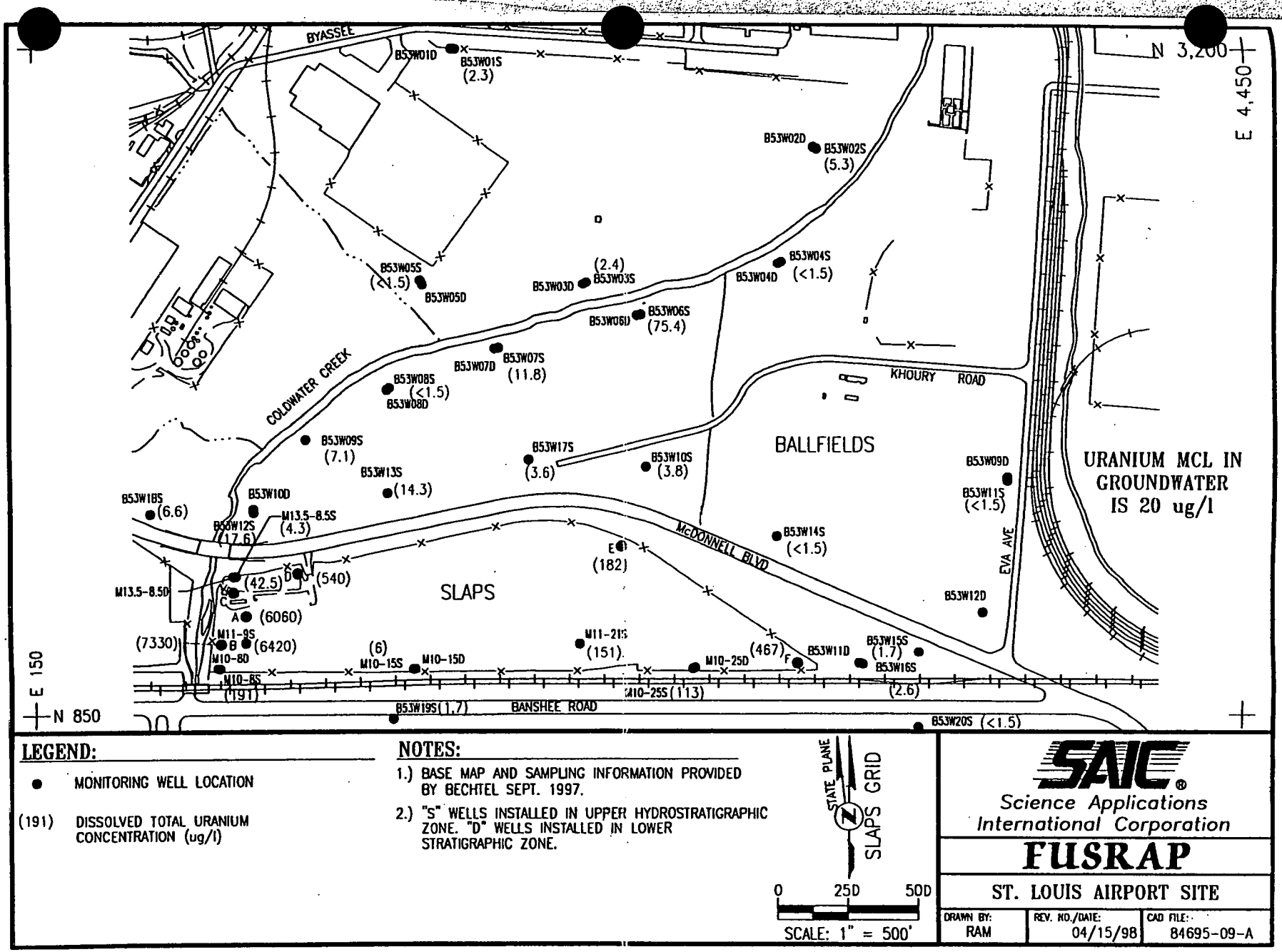


Figure 3-8. Distribution of tritium groundwater concentration at SLAPS.



LEGEND:

- ● MONITORING WELL LOCATION
- (191) DISSOLVED TOTAL URANIUM CONCENTRATION (ug/l)

NOTES:

1.) BASE MAP AND SAMPLING INFORMATION PROVIDED BY BECHTEL SEPT. 1997.

2.) "S" WELLS INSTALLED IN UPPER HYDROSTRATIGRAPHIC ZONE. "D" WELLS INSTALLED IN LOWER STRATIGRAPHIC ZONE.

STATE PLANE
N
SLAPS GRID

0 250 500

SCALE: 1" = 500'

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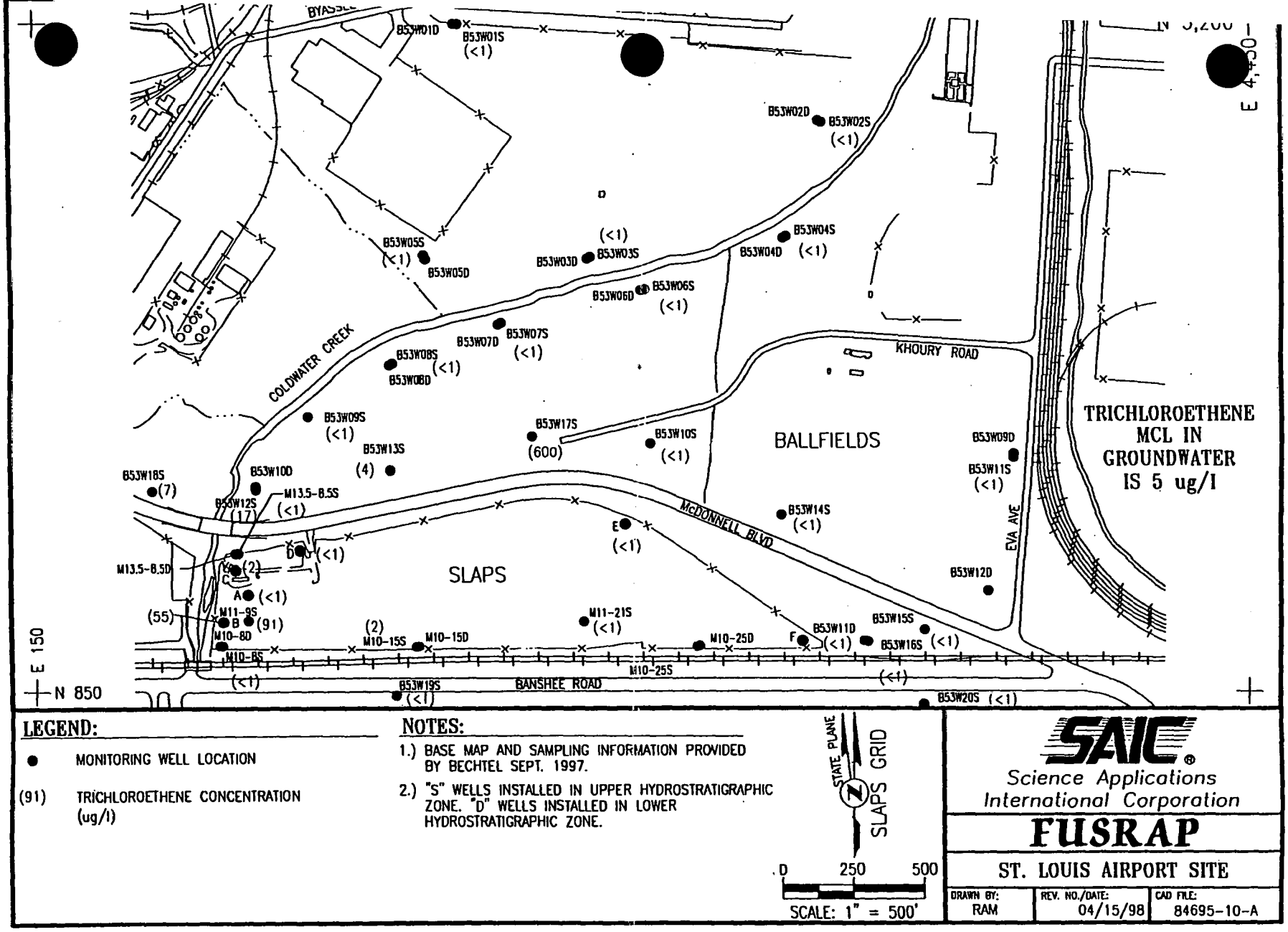
Figure 4-1
1997 Total Uranium Concentrations
in Shallow Groundwater



LEGEND:

- ● MONITORING WELL LOCATION
- (91) TRICHLOROETHENE CONCENTRATION (ug/l)

NOTES:

1.) BASE MAP AND SAMPLING INFORMATION PROVIDED BY BECHTEL SEPT. 1997.

2.) "S" WELLS INSTALLED IN UPPER HYDROSTRATIGRAPHIC ZONE. "D" WELLS INSTALLED IN LOWER HYDROSTRATIGRAPHIC ZONE.

STATE PLANE
N
SLAPS GRID

0 250 500
SCALE: 1" = 500'

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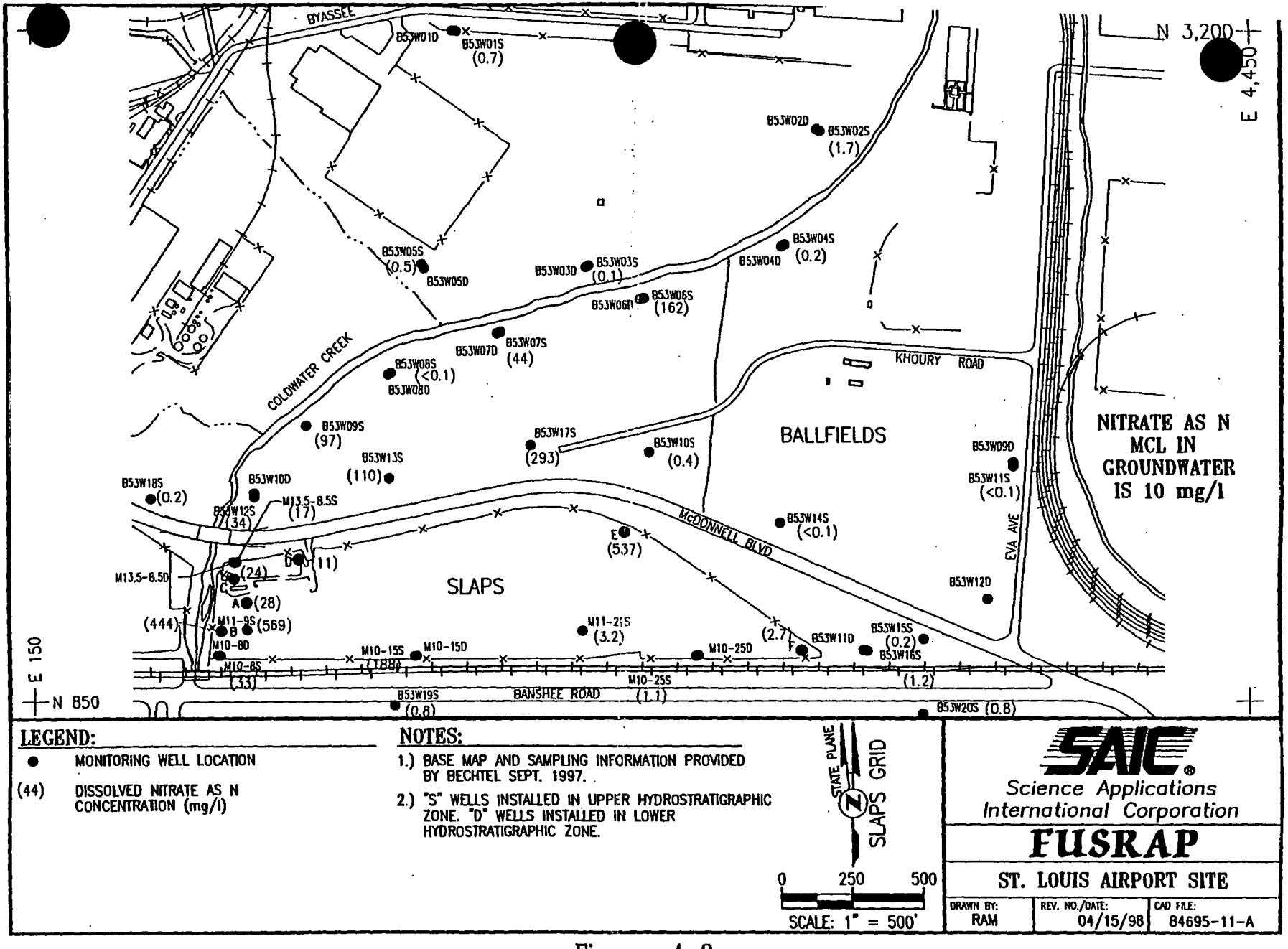
Figure 4-2

1997 Trichloroethene Concentrations in Shallow Groundwater



LEGEND:

- ● MONITORING WELL LOCATION
- (44) DISSOLVED NITRATE AS N CONCENTRATION (mg/l)

NOTES:

1.) BASE MAP AND SAMPLING INFORMATION PROVIDED BY BECHTEL SEPT. 1997.

2.) "S" WELLS INSTALLED IN UPPER HYDROSTRATIGRAPHIC ZONE. "D" WELLS INSTALLED IN LOWER HYDROSTRATIGRAPHIC ZONE.

STATE PLANE
SLAPS GRID

0 250 500

SCALE: 1" = 500'

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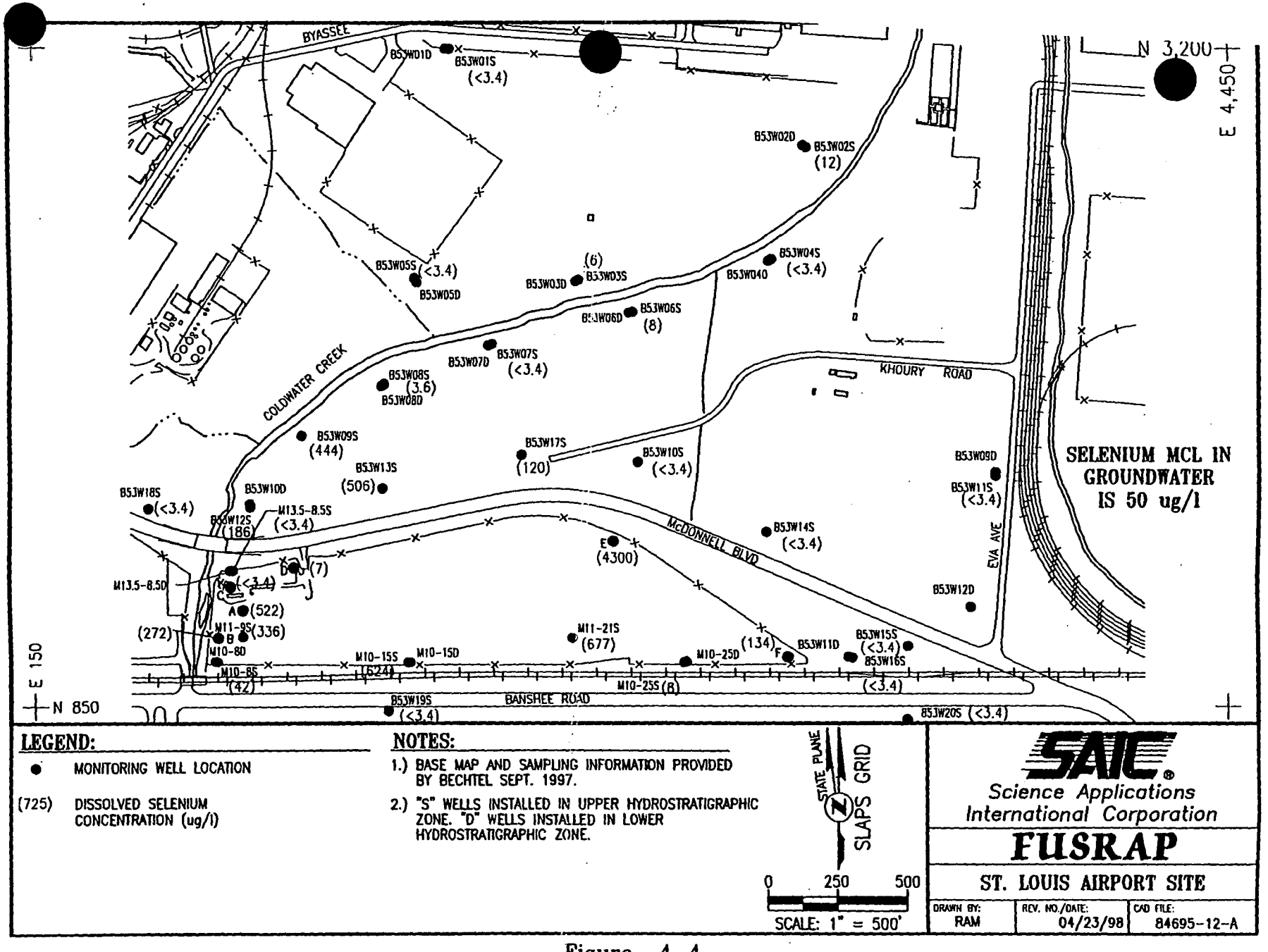
Figure 4-3
1997 Nitrate Concentrations
in Shallow Groundwater



LEGEND:

- ● MONITORING WELL LOCATION
- (725) DISSOLVED SELENIUM CONCENTRATION (ug/l)

NOTES:

1.) BASE MAP AND SAMPLING INFORMATION PROVIDED BY BECHTEL SEPT. 1997.

2.) "S" WELLS INSTALLED IN UPPER HYDROSTRATIGRAPHIC ZONE. "D" WELLS INSTALLED IN LOWER HYDROSTRATIGRAPHIC ZONE.

STATE PLANE N SLAPS GRID

0 250 500

SCALE: 1" = 500'

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Figure 4-4

1997 Selenium Concentrations in Shallow Groundwater

TABLES

TABLE 2-1
MONITORING WELL SUMMARY DATA FOR SLAPS

Well Information		Construction Parameters			Open Intervals				Monitored Stratigraphic Unit(s)
ID No.	Ground Elevation (feet MSL)	Type PVC or Steel	Diameter (inches)	Grout Depth (feet bgs)	Screen		Sand Pack		
					Top (bgs)	Bottom (bgs)	Top (bgs)	Bottom (bgs)	
B53W01D	524.6	STL (SS)	2	79.3	82.5	92.5	79.7	93.5	3M, 3B, 4
B53W01S	525	STL (SS)	2	17.0	20.1	25.1	17.0	27.5	2 & 3T
B53W02D	515	STL (SS)	2	67.1	70.1	80.1	67.1	81.9	3B & 6
B53W02S	515	STL (SS)	2	11.9	15.1	20.1	11.9	22.0	2 & 3T
B53W03D	517	STL (SS)	2	57.7	60.5	70.5	57.7	73.0	3B & 6
B53W03S	517	STL (SS)	2	12.4	15.6	20.6	12.9	23.5	2 & 3T
B53WO4S	529	STL (SS)	2	39.5	42.8	47.8	39.5	49.0	2 & 3M
B53W04D	530	STL (SS)	2	64.2	67.8	77.8	64.2	81.0	3B & 6
B53W05S	518	STL (SS)	2	18.0	22.5	27.5	18.0	28.5	3T
B53W05D	518	STL (SS)	2	67.5	70.6	80.6	67.5	83.5	3M, 3B, 6
B53W06S	527	STL (SS)	2	27.0	30.3	35.3	27.0	37.0	2 or 3T
B53W06D	527	STL (SS)	2	56.7	60.3	70.3	56.7	77.4	3B & 6
B53W07S	526	STL (SS)	2	25.5	28.9	33.9	25.5	35.0	3T & 3M
B53W07D	526	STL (SS)	2	73.7	76.0	86.0	73.7	89.0	3B & 6
B53W08S	525	STL (SS)	2	27.5	31.3	36.3	27.5	37.5	3T
B53W08D	525	STL (SS)	2	78.0	80.9	90.9	78.0	91.7	3M, 3B, 4
B53W09S	524	STL (SS)	2	25.5	28.9	33.9	25.5	35.0	2 & 3T
B53W09D	522	STL (SS)	2	57.5	61.1	71.1	57.5	74.5	5
B53W10S	529	STL (SS)	2	38.9	40.9	45.9	38.9	49.0	3T
B53W10D	526	STL (SS)	2	68.8	71.1	81.1	68.8	82.3	3B & 6
B53W11S	522	STL (SS)	2	13.8	15.9	20.9	13.8	24.0	3T & 3M
B53W11D	536	STL (SS)	2	65.7	68.5	78.5	65.7	79.8	5 & 6
B53W12S	525	STL (SS)	2	24.1	28.5	33.5	24.1	35.0	3M
B53W12D	527.6	STL (SS)	4	41.0	44.0	54.0	41	62.0	3M, 3B, 5
B53W13S	525	STL (SS)	2	18.0	20.8	25.8	18.0	29.5	3T & 3M
B53W14S	533	STL (SS)	2	18.7	22.7	27.7	18.7	34.0	3T & 3M

TABLE 2-1 (Cont'd)
MONITORING WELL SUMMARY DATA FOR ALL SLAPS WELLS

Well Information		Construction Parameters			Open Intervals				Monitored Hydro-stratigraphic Zone(s)
					Screen		Sand Pack		
ID No.	Ground Elevation (feet MSL)	Type PVC or Steel	Diameter (inches)	Grout Depth (feet bgs)	Top (bgs)	Bottom (bgs)	Top (bgs)	Bottom (bgs)	
B53W15S	532	STL (SS)	2	11.7	15.2	20.2	11.7	21.5	2 & 3M
B53W16S	536	STL (SS)	2	14.0	15.8	20.8	147.0	24.0	2 & 3T
B53W17S	527.1	STL (SS)	4	17.0	20.0	30.0	17.0	35.0	2, 3T, 3M
B53W18S	522.3	STL (SS)	4	8.0	10.0	20.0	8.0	37.0	2, 3T, 3M
B53W19S	526	STL (SS)	4	5.6	7.0	17.0	5.6	26.0	2, 3T, 3M
B53W20S	541.6	STL (SS)	4	7.5	10.0	20.0	7.5	35.0	2 & 3T
M10-8S	520.1	STL (SS)	2	16.0	18.9	23.9	16.0	29.0	3T
M10-8D	520	STL (SS)	2	61.0	64.3	69.3	61.0	73.5	3M & 3B
M10-15S	526	STL (SS)	2	13.0	14.2	24.2	13.0	26.2	3T
M10-15D	526	STL (SS)	2	77.0	80.6	85.0	77.0	87.1	3M, 4
M10-25S	533.3	STL (SS)	2	11.5	14.0	24.0	11.5	27.0	2, 3T
M10-25D	534	STL (SS)	2	35.5	39.3	44.3	35.5	52.1	3M, 3B, 5
M13S-8.5S*	521.8	STL (SS)	2	17.0	19.3	29.3	17.0	32.0	2 & 3T
M13S-8.5D*	521.8	STL (SS)	2	62	64.4	69.4	62	74	3M & 3B
M11-21S*	529	STL (SS)	2	11.0	13.8	18.8	11.0	23.0	3T & 3M
M11-9	525.5	STL (SS)	4	~ 17	19.3	29.3	~ 17	33	2
A*	526	PVC	3	~ 12	15	30	~ 12	30	2 & 3T
B*	528	PVC	3	~ 11	13	28	~ 11	28	2 & 3T
C*	526	PVC	3	~ 12	14	24	~ 12	24	2 & 3T
D	524	PVC	3	~ 10	12	24	~ 10	24	2 & 3T
E	531	PVC	3	~ 8	10	20	~ 8	20	2
F*	544	PVC	3	~ 10	12	24	~ 10	24	2

* - Well now sealed and closed.

TABLE 2-2
SLAPS MONITORING WELL SUMMARY DATA
WELLS COMPLETED TO MONITOR UPPER HYDROSTRATIGRAPHIC ZONE

Well Information		Construction Parameters			Open Intervals				Monitored Hydro-stratigraphic Zone(s)
					Screen		Sand Pack		
ID No.	Ground Elevation (feet MSL)	Type PVC or Steel	Diameter (inches)	Grout Depth (feet bgs)	Top (bgs)	Bottom (bgs)	Top (bgs)	Bottom (bgs)	
B53W01S	525	STL (SS)	2	17.0	20.1	25.1	17.0	27.5	2 & 3T
B53W02S	515	STL (SS)	2	11.9	15.1	20.1	11.9	22.0	2 & 3T
B53W03S	517	STL (SS)	2	12.4	15.6	20.6	12.9	23.5	2 & 3T
B53WO4S	529	STL (SS)	2	39.5	42.8	47.8	39.5	49.0	2 & 3M
B53W05S	518	STL (SS)	2	18.0	22.5	27.5	18.0	28.5	3T
B53W06S	527	STL (SS)	2	27.0	30.3	35.3	27.0	37.0	2 or 3T
B53W07S	526	STL (SS)	2	25.5	28.9	33.9	25.5	35.0	3T & 3M
B53W08S	525	STL (SS)	2	27.5	31.3	36.3	27.5	37.5	3T
B53W09S	524	STL (SS)	2	25.5	28.9	33.9	25.5	35.0	2 & 3T
B53W10S	529	STL (SS)	2	38.9	40.9	45.9	38.9	49.0	3T
B53W11S	522	STL (SS)	2	13.8	15.9	20.9	13.8	24.0	3T & 3M
B53W12S	525	STL (SS)	2	24.1	28.5	33.5	24.1	35.0	3M
B53W13S	525	STL (SS)	2	18.0	20.8	25.8	18.0	29.5	3T, 3M
B53W14S	533	STL (SS)	2	18.7	22.7	27.7	18.7	34.0	3T & 3M
B53W15S	532	STL (SS)	2	11.7	15.2	20.2	11.7	21.5	2 & 3M
B53W16S	536	STL (SS)	2	14.0	15.8	20.8	14.0	24.0	2 & 3T
B53W17S	527.1	STL (SS)	4	17.0	20.0	30.0	17.0	35.0	2, 3T, 3M
B53W18S	522.3	STL (SS)	4	8.0	10.0	20.0	8.0	37.0	2, 3T, 3M
B53W19S	526	STL (SS)	4	5.6	7.0	17.0	5.6	26.0	2, 3T, 3M
B53W20S	541.6	STL (SS)	4	7.5	10.0	20.0	7.5	35.0	2 & 3T
M10-8S	520.1	STL (SS)	2	16.0	18.9	23.9	16.0	29.0	3T
M10-15S	526	STL (SS)	2	13.0	14.2	24.2	13.0	26.2	3T
M10-25S	533.3	STL (SS)	2	11.5	14.0	24.0	11.5	27.0	2 & 3T
M13S-8.5S*	521.8	STL (SS)	2	17.0	19.3	29.3	17.0	32.0	2 & 3T
M11-21S*	529	STL (SS)	2	11.0	13.8	18.8	11.0	23.0	3T & 3M

TABLE 2 (Cont'd)
SLAPS MONITORING WELL SUMMARY DATA
WELLS COMPLETED TO MONITOR UPPER HYDROSTRATIGRAPHIC ZONE

Well Information		Construction Parameters			Open Intervals				Monitored Hydro-stratigraphic Zone(s)
					Screen		Sand Pack		
ID No.	Ground Elevation (feet MSL)	Type PVC or Steel	Diameter (inches)	Grout Depth (feet bgs)	Top (bgs)	Bottom (bgs)	Top (bgs)	Bottom (bgs)	
M11-9	525.5	STL (SS)	4	~ 17	19.3	29.3	~ 17	33	2
A*	526	PVC	3	~ 12	15	30	~ 12	30	2 & 3T
B*	528	PVC	3	~ 11	13	28	~ 11	28	2 & 3T
C*	526	PVC	3	~ 11	14	24	~ 12	24	2 & 3T
D	524	PVC	3	~ 10	12	24	~ 10	24	2 & 3T
E	531	PVC	3	~ 8	10	20	~ 8	20	2
F*	544	PVC	3	~ 10	12	24	~ 10	24	2

* - Well now sealed and closed.

TABLE 2-3
SLAPS MONITORING WELL SUMMARY DATA
WELLS COMPLETED TO MONITOR LOWER HYDROSTRATIGRAPHIC ZONE

Well Information		Construction Parameters			Open Intervals				Monitored Hydro-stratigraphic Zone(s)
					Screen		Sand Pack		
ID No.	Ground Elevation (feet MSL)	Type PVC or Steel	Diameter (inches)	Grout Depth (feet bgs)	Top (bgs)	Bottom (bgs)	Top (bgs)	Bottom (bgs)	
B53W01D	524.6	STL (SS)	2	79.3	82.5	92.5	79.7	93.5	3M; 3B, 4
B53W02D	515	STL (SS)	2	67.1	70.1	80.1	67.1	81.9	3B & 6
B53W03D	517	STL (SS)	2	57.7	60.5	70.5	57.7	73.0	3B & 6
B53W04D	530	STL (SS)	2	64.2	67.8	77.8	64.2	81.0	3B & 6
B53W05D	518	STL (SS)	2	67.5	70.6	80.6	67.5	83.5	3M; 3B, 6
B53W06D	527	STL (SS)	2	56.7	60.3	70.3	56.7	77.4	3B & 6
B53W07D	526	STL (SS)	2	73.7	76.0	86.0	73.7	89.0	3B & 6
B53W08D	525	STL (SS)	2	78.0	80.9	90.9	78.0	91.7	3M, 3B, 4
B53W09D	522	STL (SS)	2	57.5	61.1	71.1	57.5	74.5	5
B53W10D	526	STL (SS)	2	68.8	71.1	81.1	68.8	82.3	3B & 6
B53W11D	536	STL (SS)	2	65.7	68.5	78.5	65.7	79.8	5 & 6
B53W12D	527.6	STL (SS)	4	41.0	44.0	54.0	41	62.0	3M, 3B, 5
M10-8D	520	STL (SS)	2	61.0	64.3	69.3	61.0	73.5	3M & 3B
M10-15D	526	STL (SS)	2	77.0	80.6	85.0	77.0	87.1	3M & 4
M10-25D	534	STL (SS)	2	35.5	39.3	44.3	35.5	52.1	3M, 3B, 5
M13S-8.5D*	521.8	STL (SS)	2	62	64.4	69.4	62	74	3M & 3B

* - Well now sealed and closed.

TABLE 3-1

Charge Balance Analysis of Groundwater Samples

Well Locations:	B53W01D		B53W01S		B53W02D		B53W02S		B53W03D		B53W03S		B53W04D		B53W04S		B53W05D		B53W05S	
Parameter	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l
Sodium (Na)	50.0	2.17	22.0	0.96	52.1	2.27	40.1	1.74	47.8	2.08	21.9	0.95	54.5	2.37	33.0	1.44	49.3	2.14	11.4	0.50
Potassium (K)	2.0	0.05	1.0	0.03	2.4	0.06	1.0	0.03	1.7	0.04	0.7	0.02	1.3	0.03	1.7	0.04	1.9	0.05	1.7	0.04
Calcium (Ca)	109	5.44	122	6.09	76.9	3.84	145.0	7.24	104.0	5.19	109.0	5.44	92.5	4.62	88.7	4.43	99.9	4.99	104.0	5.19
Magnesium (Mg)	40.5	3.33	57.0	4.69	27.1	2.23	68.6	5.65	40.6	3.34	44.3	3.65	44.7	3.68	37.9	3.12	43.4	3.57	34.1	2.81
Iron (Fe)	13.1	0.47	0.0	0.0	8.2	0.29	0.2	0.01	13.5	0.48	1.1	0.04	4.7	0.17	0.0	0.0	12.0	0.43	0.1	0.0
Chloride (Cl)	0.0	0.0	13.4	0.38	1.7	0.05	0.4	0.01	0.0	0.0	6.2	0.17	1.4	0.04	3.0	0.08	0.0	0.0	6.8	0.19
Bicarbonate (HCO3)	580	9.51	4.2	6.75	428.0	7.01	418.0	6.85	553.0	9.06	451.0	7.39	547.0	8.97	430.0	7.05	567.0	9.29	372.0	6.10
Carbonate (CO3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sulfate (SO4)	6.9	0.14	376	7.83	0.0	0.0	239.0	4.98	0.0	0.0	50.0	1.04	1.2	0.02	19.1	0.40	0.0	0.0	74.0	1.54
Nitrate (NO3)	0.0	0.0	3.2	0.05	0.0	0.0	7.5	0.12	0.0	0.0	0.5	0.01	0.0	0.0	0.8	0.01	0.0	0.0	2.0	0.03
Total Dissolved Solids	801 mg/l		1,007 mg/l		596 mg/l		920 mg/l		761 mg/l		685 mg/l		747 mg/l		614 mg/l		773 mg/l		606 mg/l	
Ion Balance (Cations/Anions)	1.2		0.8		1.2		1.2		1.2		1.2		1.2		1.2		1.2		1.1	

Well Locations:	B53W06D		B53W06S		B53W07D		B53W07S		B53W08D		B53W08S		B53W09D		B53W09S		B53W10D		B53W10S	
Parameter	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l
Sodium (Na)	45.3	1.97	58.4	2.54	43.6	1.90	48.6	2.11	44.3	1.93	29.5	1.28	128.0	5.57	117.0	5.09	59.2	258	41.3	1.80
Potassium (K)	1.7	0.04	2.1	0.05	1.8	0.05	1.0	0.03	1.8	0.05	1.8	0.05	2.6	0.07	3.8	0.10	1.3	0.03	1.1	0.03
Calcium (Ca)	72.3	3.61	403.0	20.11	104.0	5.19	139.0	6.94	96.6	4.82	181.0	9.03	104.0	5.19	221.0	11.03	116.0	5.79	136.0	6.79
Magnesium (Mg)	36.9	3.04	170.0	13.99	38.7	3.18	69.3	5.70	40.9	3.37	58.8	4.84	36.1	2.97	77.2	6.35	49.9	4.11	49.7	4.09
Iron (Fe)	4.7	0.17	0.4	0.02	12.9	0.46	0.0	0.0	12.1	0.43	7.1	0.25	0.0	0.0	0.0	0.0	11.8	0.42	0.1	0.0
Chloride (Cl)	1.4	0.04	99.6	2.81	0.0	0.0	15.3	0.43	0.0	0.0	17.1	0.48	1.6	0.05	198.0	5.59	2.1	0.06	1.4	0.04
Bicarbonate (HCO3)	447.0	7.33	782.0	12.82	593.0	9.72	394.0	6.46	571.0	9.36	685.0	11.23	476.0	7.80	416.0	6.82	667.0	10.93	658.0	10.78
Carbonate (CO3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sulfate (SO4)	0.3	0.01	507.0	10.56	0.0	0.0	186.0	3.87	0.0	0.0	82.2	1.71	85.7	1.78	118.0	2.46	0.0	0.0	2.5	0.05
Nitrate (NO3)	0.0	0.0	717.4	11.57	0.0	0.0	195.7	3.16	0.0	0.0	0.0	0.0	2.6	0.04	427.4	6.89	0.0	0.0	1.9	0.03
Total Dissolved Solids	610 mg/l		2,740 mg/l		794 mg/l		1,049 mg/l		767 mg/l		1,062 mg/l		836 mg/l		1,578 mg/l		907 mg/l		892 mg/l	
Ion Balance (Cations/Anions)	1.2		1.0		1.1		1.1		1.1		1.2		1.4		1.0		1.2		1.2	

Notes:
mg/l - milligrams per liter
meq/l - milliequivalents per liter; millimoles of solute x valence/liter

TABLE 3-1 (cont'd)

Charge Balance Analysis of Groundwater Samples

Well Locations:	B53W11D		B53W11S		B53W12D		B53W12S		B53W13S		B53W14S		B53W15S		B53W16S		B53W17S		B53W18S	
Parameter	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l
Sodium (Na)	80.2	3.49	15.1	0.66	51.0	2.22	113.0	4.92	114.0	4.96	19.4	0.84	22.2	0.97	40.8	1.77	110.0	4.79	366.0	15.92
Potassium (K)	4.3	0.11	0.5	0.01	3.0	0.08	1.2	0.03	0.9	0.02	0.9	0.02	0.6	0.01	0.9	0.02	1.5	0.04	2.1	0.05
Calcium (Ca)	54.4	2.71	95.4	4.76	97.7	4.88	233.0	11.63	242.0	12.08	104.0	5.19	89.2	4.45	120.0	5.99	347.0	17.32	318.0	15.87
Magnesium (Mg)	19.8	1.63	44.6	3.67	35.8	2.95	129.0	10.62	114.0	9.38	40.2	3.31	44.4	3.65	66.4	5.46	202.0	16.62	173.0	14.24
Iron (Fe)	0.0	0.0	0.0	0.0	2.9	0.10	0.1	0.0	0.0	0.0	14.3	0.51	0.4	0.01	0.1	0.0	0.0	0.0	0.0	0.0
Chloride (Cl)	2.6	0.07	7.0	0.20	1.6	0.05	425.0	11.99	297.0	8.38	47.2	1.33	11.8	0.33	225.0	6.35	135.0	3.81	1,460.0	41.19
Bicarbonate (HCO3)	360.0	5.90	331.0	5.43	0.0	0.0	358.0	5.87	375.0	6.15	418.0	6.85	320.0	5.24	243.0	3.98	381.0	6.24	444.0	7.28
Carbonate (CO3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sulfate (SO4)	34.8	0.72	101.0	2.10	58.1	1.21	140.0	2.91	122.0	2.54	0.0	0.0	32.3	0.67	107.0	2.23	218.0	4.54	2,251.0	46.87
Nitrate (NO3)	0.0	0.0	0.0	0.0	0.0	0.0	150.1	2.42	487.1	7.86	0.0	0.0	0.9	0.02	5.3	0.09	1,297.6	20.93	1.0	0.02
Total Dissolved Solids	556 mg/l		595 mg/l		250 mg/l		1,549 mg/l		1,752 mg/l		644 mg/l		522 mg/l		808 mg/l		2,692 mg/l		5,015 mg/l	
Ion Balance (Cations/Anions)	1.2		1.2		8.1		1.2		1.1		1.2		1.5		1.0		1.1		0.5	

Well Locations:	B53W19S		B53W20S		M10-08D		M10-08S		M10-15D		M10-15S		M10-25D		M10-25S		M11-21S		M11-9S	
Parameter	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l
Sodium (Na)	444.0	19.31	10.7	0.47	60.3	2.62	56.0	2.44	43.7	1.90	65.2	2.84	58.8	2.56	13.1	0.57	56.5	2.46	160.0	6.96
Potassium (K)	1.6	0.04	1.0	0.03	1.3	0.03	2.9	0.07	3.4	0.09	0.7	0.02	1.1	0.03	0.6	0.01	0.5	0.01	1.5	0.04
Calcium (Ca)	146.0	7.29	88.8	4.43	77.9	3.89	215.0	10.73	114.0	5.69	244.0	12.18	147.0	7.34	94.0	4.69	207.0	10.33	768.0	38.32
Magnesium (Mg)	65.5	5.39	44.7	3.68	37.4	3.08	60.7	5.00	41.6	3.42	121.0	9.96	44.6	3.67	34.5	2.84	50.0	4.11	258.0	21.23
Iron (Fe)	0.8	0.03	0.0	0.0	6.8	0.24	4.0	0.14	5.7	0.20	0.0	0.0	0.0	0.0	0.3	0.01	0.0	0.0	0.0	0.0
Chloride (Cl)	896.0	25.28	6.3	0.18	1.0	0.03	10.1	0.28	1.7	0.05	31.8	0.90	0.0	0.0	46.8	1.32	109.0	3.07	41.2	1.16
Bicarbonate (HCO3)	330.0	5.41	321.0	5.26	505.0	8.28	630.0	10.33	595.0	9.75	378.0	6.20	722.0	11.83	265.0	4.34	489.0	8.01	870.0	14.26
Carbonate (CO3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sulfate (SO4)	84.2	1.75	94.7	1.97	0.0	0.0	145.0	3.02	0.8	0.02	138.0	2.87	5.2	0.11	66.2	1.38	173.0	3.60	248.0	5.16
Nitrate (NO3)	3.7	0.06	3.4	0.06	0.0	0.0	145.3	2.34	0.0	0.0	832.6	13.43	0.9	0.02	4.9	0.08	14.2	0.23	2,519.9	40.65
Total Dissolved Solids	1,972 mg/l		571 mg/l		690 mg/l		1,269 mg/l		806 mg/l		1,811 mg/l		980 mg/l		525 mg/l		1,099 mg/l		4,867 mg/l	
Ion Balance (Cations/Anions)	1.0		1.2		1.2		1.2		1.2		1.1		1.1		1.1		1.1		1.1	

Notes:
mg/l - milligrams per liter
meq/l - milliequivalents per liter; millimoles of solute x valence/liter

TABLE 3-1 (cont'd)

Charge Balance Analysis of Groundwater Samples

Well Locations:	M13.5-8.5D		M13.5-8.5S		A		B		C		D		E		F	
Parameter	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l	mg/l	meq/l
Sodium (Na)	59.2	2.58	71.9	3.13	38.9	1.69	153.0	6.66	49.9	2.17	56.6	2.46	161.0	7.00	37.3	1.62
Potassium (K)	1.4	0.04	3.6	0.09	0.7	0.02	1.1	0.03	3.1	0.08	2.1	0.05	0.8	0.02	0.8	0.02
Calcium (Ca)	91.4	4.56	354.0	17.66	203.0	10.13	732.0	36.53	215.0	10.73	307.0	15.32	789.0	39.37	77.8	3.88
Magnesium (Mg)	37.6	3.09	113.0	9.30	65.0	5.35	245.0	20.16	82.5	6.79	121.0	9.96	108.0	8.89	43.4	3.57
Iron (Fe)	4.3	0.15	0.5	0.02	0.0	0.0	0.0	0.0	0.3	0.01	0.0	0.0	0.0	0.0	0.0	0.0
Chloride (Cl)	1.0	0.03	43.4	1.22	33.9	0.96	39.3	1.11	18.9	0.53	40.4	1.14	69.2	1.95	10.3	0.29
Bicarbonate (HCO3)	513.0	8.41	770.0	12.62	621.0	10.18	905.0	14.83	627.0	10.28	1,040.0	17.05	424.0	6.95	332.0	5.44
Carbonate (CO3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sulfate (SO4)	0.0	0.0	612.0	12.74	98.8	2.06	353.0	7.35	207.0	4.31	77.7	1.62	168.0	3.50	81.7	1.70
Nitrate (NO3)	0.0	0.0	73.5	1.19	122.2	1.97	1,966.3	31.72	106.7	1.72	48.7	0.79	2,378.1	38.36	12.0	0.19
Total Dissolved Solids	708 mg/l		2,042 mg/l		1,184 mg/l		4,395 mg/l		1,310 mg/l		1,693 mg/l		4,098 mg/l		595 mg/l	
Ion Balance (Cations/Anions)	1.2		1.1		1.1		1.2		1.2		1.3		1.1		1.2	

Notes:
mg/l - milligrams per liter
meq/l - milliequivalents per liter; millimoles of solute x valence/liter

TABLE 3-2

Mass Balance Cation and Anion Comparisons for Average Composition of Lower Hydrostratigraphic Zone

All units are in milligrams per liter (mg/l)

Group	Parameter	n	Average Value	Minimum Value	Maximum Value	Standard Deviation
Cations	Sodium + Potassium	11	52.6	45.4	61.6	5.9
	Calcium	11	94.4	72.3	114	13.8
	Magnesium	11	39.0	27.1	44.7	4.7
	Iron	11	8.90	4.25	13.5	3.8
Anions	Alkalinity	11	536	428	595	57
	Chloride	11	0.75	<0.2	1.7	0.7
	Sulfate	11	0.84	<0.2	6.9	2.1
	Nitrate	11	<0.1	<0.1	<0.1	<0.1
Total		11	732	596	806	73

Note: Average groundwater composition determined by comparing well sites of similar water quality. Eleven wells were identified as having similar overall water quality: B53W01D, B53W02D, B53W04D, B53W06D, B53W05D, B53W07D, B53W08D, M10-08D, M10-15D, and M13.5-8.5D.

Table 4-1
Analytes of Interest for Groundwater at SLAPS

Radiological Constituent	Inorganic Chemical Constituent	
Actinium-227	Aluminum	Manganese
Lead-210	Antimony	Molybdenum
Proactinium-231	Arsenic	Nickel
Radium-226	Barium	Nitrate
Radium-228	Beryllium	Potassium
Thorium-227	Boron	Selenium
Thorium-228	Cadmium	Silver
Thorium-230	Calcium	Sodium
Thorium-232	Chromium	Sulfate
Total Uranium	Cobalt	Vanadium
	Copper	Zinc
Organic Chemical Constituent	Iron	
Volatile Organics	Lead	
Semi-Volatile Organics	Magnesium	

Table 4-2
Potential Radiological and Chemical Constituents of Concern with Regulatory and Estimated Background Values for Groundwater at SLAPS

Constituent	EPA MCL (ug/l)	Estimated Background* (ug/l)
Radiological		
Total Uranium	20	Upper Zone - <5; Lower Zone - <1.5
Inorganic		
Arsenic	50	Upper Zone - <5; Lower Zone - <120
Manganese	50(SMCL)	Upper Zone - <25; Lower Zone - <215
Nitrate	10,000	<2,000
Selenium	50	<5
Organic Chemical		
Trichloroethene	5	<5
1,2-Dichloroethene	70	<5

Notes:
EPA MCL - Environmental Protection Agency Maximum Contaminant Level
(USEPA Office of Water "Drinking Water Regulations and Health Advisories," October 1996)

* Estimated background concentrations of constituents are based on historical and 1997 baseline data collected from suspected background wells at SLAPS and contiguous properties. Estimated concentrations are for dissolved constituents.

Table 4-3
Historical Concentrations of Total Uranium in Groundwater at SLAPS (1989-1992 and 1997)
Total Uranium Concentration (ug/l)

Well ID	1984*	1985*	1986*	1987*	1988*	1989*	1990*	1991*	1992*	1997
A	1812.7	3345.1	1667.6	1604.2	2394.4	2908.5	3429.6	5312	--	6060
B	8028	6669	9254	8210	7873	7438	6413	9318	--	7330
C	56.3	50.7	22.5	18.3	25.4	28.2	26.8	22.5	--	42.5
D	328.2	667.6	1129.6	897.2	669	1088.7	971.8	1242	--	540
E	182	161	761	811	278	1154	266	287	--	182
F	199	249	206	149	373	375	285	569	--	467
B53W01D	--	--	--	--	5.6	--	--	7	--	<1.5
B53W01S	--	--	--	--	4.2	--	--	8.5	--	2.3
B53W02D	--	--	--	--	--	--	--	--	--	<1.5
B53W02S	--	--	--	--	--	--	--	--	--	5.3
B53W03D	--	--	--	--	--	--	--	--	--	<1.5
B53W03S	--	--	--	--	--	--	--	--	--	2.4
B53W04D	--	--	--	--	--	--	--	--	--	<1.5
B53W04S	--	--	--	--	--	--	--	--	--	<1.5
B53W05D	--	--	--	--	--	--	--	--	--	<1.5
B53W05S	--	--	--	--	--	--	--	--	--	<1.5
B53W06D	--	--	--	--	--	--	--	--	--	<1.5
B53W06S	--	--	--	--	--	--	--	--	--	75.4
B53W07D	--	--	--	--	--	--	--	--	--	<1.5
B53W07S	--	--	--	--	--	--	--	0.8	--	11.8
B53W08D	--	--	--	--	--	--	--	--	--	<1.5
B53W08S	--	--	--	--	--	--	--	--	--	<1.5
B53W09D	--	--	--	--	--	--	--	--	--	10.5
B53W09S	--	--	--	--	--	--	--	--	--	7.1
B53W10D	--	--	--	--	--	--	--	6.7	--	<1.5
B53W10S	--	--	--	--	--	--	--	3.1	3.9	3.8
B53W11D	--	--	--	--	--	--	5.6	23.9	26.2	3.6
B53W11S	--	--	--	--	--	--	--	--	--	<1.5
B53W12D	--	--	--	--	--	--	--	--	--	2.1
B53W12S	--	--	--	--	--	--	--	7.3	20	17.6
B53W13S	--	--	--	--	--	--	--	4.5	12.7	14.3
B53W14S	--	--	--	--	--	--	--	--	0.6	<1.5
B53W15S	--	--	--	--	--	--	--	11.3	8.7	1.7
B53W16S	--	--	--	--	--	--	--	8.5	--	2.6
B53W17S	--	--	--	--	--	--	--	--	7.1	3.6
B53W18S	--	--	--	--	--	--	--	--	8	6.6
B53W19S	--	--	--	--	--	--	--	--	2.9	1.7
B53W20S	--	--	--	--	--	--	--	--	5	<1.5
M10-8D	--	--	--	7	5.6	7	5.6	5.6	0.1	<1.5
M10-8S	--	--	--	45.1	26.8	29.6	8.5	46.5	8.6	191
M10-15D	--	--	--	12.7	7	4.2	8.5	8.5	--	<1.5
M10-15S	--	--	--	15.5	12.7	15.5	7	15.5	--	6
M10-25D	--	--	--	5.6	5.6	4.2	4.2	11.3	--	2.6
M10-25S	--	--	--	35.2	54.9	46.5	81.7	50.7	--	113
M11-9S	--	--	--	6448	6507	6770	2727	8654	7409	6420
M11-21S	--	--	--	63.4	103	135	117	231	--	151
M13.5-8.5D	--	--	--	--	--	--	8.5	7	0.8	<1.5
M13.5-8.5S	--	--	--	5.6	5.6	4.2	5.6	8.5	14.4	4.3

Notes:
-- Data not available.
* Yearly averaged data.
All results reported to the nearest 0.1 ug/l for concentrations below 100 ug/l.
The detection limit for 1997 results is 1.5 ug/l.
The EPA MCL for total uranium is 20 ug/l.
Historic data from BNI (1994) and SAIC (1995).
< - Reported concentration below sample quantitation limit based on either "Laboratory" or "Reviewer Qualifier".
All 1984-92 samples are assumed to be unfiltered.

Table 4-4

Historical Concentrations of Radium-226 in Groundwater at SLAPS (1989-1992 and 1997)

Radium-226 Concentration (pCi/l)

Well ID	1984*	1985*	1986*	1987*	1988*	1989*	1990*	1991*	1992*	1997
A	0.3	0.2	0.3	0.3	0.4	0.4	0.5	0.3	--	<0.1
B	0.3	0.2	0.3	0.3	0.6	0.6	0.6	0.4	--	0.2
C	0.3	0.2	0.3	0.4	0.5	0.5	0.5	0.3	--	0.4
D	0.2	0.1	0.3	0.1	0.3	0.5	0.4	0.2	--	0.2
E	0.6	0.2	0.5	0.3	0.6	0.6	0.5	0.5	--	0.4
F	0.2	0.1	0.2	0.3	0.6	0.4	0.5	0.2	--	0.1
B53W01D	--	--	--	--	1.1	1	1	0.9	--	0.8
B53W01S	--	--	--	--	0.6	0.7	0.4	0.9	--	<0.1
B53W02D	--	--	--	--	--	--	--	--	--	0.6
B53W02S	--	--	--	--	--	--	--	--	--	<0.1
B53W03D	--	--	--	--	--	--	--	--	--	0.7
B53W03S	--	--	--	--	--	--	--	--	--	0.1
B53W04D	--	--	--	--	--	--	--	--	--	0.4
B53W04S	--	--	--	--	--	--	--	--	--	<0.1
B53W05D	--	--	--	--	--	--	--	--	--	0.7
B53W05S	--	--	--	--	--	--	--	--	--	0.2
B53W06D	--	--	--	--	--	--	--	--	--	0.2
B53W06S	--	--	--	--	--	--	--	--	--	<0.1
B53W07D	--	--	--	--	--	--	--	--	--	0.6
B53W07S	--	--	--	--	--	--	--	0.8	--	0.1
B53W08D	--	--	--	--	--	--	--	--	--	0.8
B53W08S	--	--	--	--	--	--	--	--	--	0.8
B53W09D	--	--	--	--	--	--	--	--	--	0.5
B53W09S	--	--	--	--	--	--	--	--	--	0.3
B53W10D	--	--	--	--	--	--	--	0.2	--	0.3
B53W10S	--	--	--	--	--	--	--	0.3	1.3	0.5
B53W11D	--	--	--	--	--	--	0.8	0.5	33.8	0.1
B53W11S	--	--	--	--	--	--	--	--	--	<0.1
B53W12D	--	--	--	--	--	--	--	--	1.6	0.2
B53W12S	--	--	--	--	--	--	--	0.1	--	0.2
B53W13S	--	--	--	--	--	--	--	0.2	1.7	0.4
B53W14S	--	--	--	--	--	--	--	--	1.76	0.2
B53W15S	--	--	--	--	--	--	0.3	0.8	2.3	0.1
B53W16S	--	--	--	--	--	--	0.2	0.5	--	0.2
B53W17S	--	--	--	--	--	--	--	--	0.6	0.2
B53W18S	--	--	--	--	--	--	--	--	1	0.8
B53W19S	--	--	--	--	--	--	--	--	0.2	0.3
B53W20S	--	--	--	--	--	--	--	--	0.3	0.1
M10-8D	--	--	--	0.3	0.6	0.6	0.8	0.9	0.9	0.4
M10-8S	--	--	--	0.4	0.5	0.4	0.5	0.4	0.9	0.3
M10-15D	--	--	--	0.4	0.9	0.9	0.6	1.2	--	0.4
M10-15S	--	--	--	0.3	0.8	0.4	0.5	1.2	--	0.2
M10-25D	--	--	--	0.2	0.4	0.7	0.7	1.6	--	0.4
M10-25S	--	--	--	0.2	0.6	0.5	0.5	0.6	--	0.3
M11-9S	--	--	--	0.5	0.8	0.5	0.3	0.3	--	0.2
M11-21S	--	--	--	0.5	0.7	0.7	0.5	2.3	--	0.1
M13.5-8.5D	--	--	--	0.5	0.6	0.6	1.5	0.6	1.8	0.2
M13.5-8.5S	--	--	--	0.5	0.8	0.5	0.7	0.9	2.6	0.3

Notes:

-- Data not available.

* Yearly averaged data.

All results reported to the nearest 0.1 pCi/l.

The detection limit for 1997 results is 0.1 pCi/l.

The EPA MCL for Radium-226 is 20 pCi/l.

Historic data from BNI (1994) and SAIC (1995).

< - Reported concentration below sample quantitation limit based on either "Laboratory" or "Reviewer Qualifier".

All 1984-92 samples are assumed to be unfiltered.

Table 4-5
Historical Concentrations of Thorium-230 in Groundwater at SLAPS (1989-1992 and 1997)

Thorium-230 Concentration (pCi/l)

Well ID	1984*	1985*	1986*	1987*	1988*	1989*	1990*	1991*	1992*	1997
A	9.5	2.3	<0.4	0.8	2.8	2.9	4.1	2.7	--	0.2
B	0.3	0.3	1.2	1.4	2	1.1	1.2	0.9	--	<0.1
C	0.2	0.2	0.2	0.9	0.3	0.1	0.2	0.7	--	<0.1
D	0.9	1.3	0.3	0.9	0.9	1.4	1.4	1.5	--	<0.1
E	0.3	1	0.4	0.9	4.8	1.7	0.6	1.3	--	0.2
F	0.4	1.1	0.2	1.7	2	0.8	0.4	1.2	--	<0.1
B53W01D	--	--	--	--	0.2	0.4	0.4	0.6	--	<0.1
B53W01S	--	--	--	--	0.2	0.3	0.2	0.7	--	<0.1
B53W02D	--	--	--	--	--	--	--	--	--	<0.1
B53W02S	--	--	--	--	--	--	--	--	--	<0.1
B53W03D	--	--	--	--	--	--	--	--	--	<0.1
B53W03S	--	--	--	--	--	--	--	--	--	<0.1
B53W04D	--	--	--	--	--	--	--	--	--	<0.1
B53W04S	--	--	--	--	--	--	--	--	--	<0.1
B53W05D	--	--	--	--	--	--	--	--	--	<0.1
B53W05S	--	--	--	--	--	--	--	--	--	<0.1
B53W06D	--	--	--	--	--	--	--	--	--	<0.1
B53W06S	--	--	--	--	--	--	--	--	--	<0.1**
B53W07D	--	--	--	--	--	--	--	--	--	<0.1
B53W07S	--	--	--	--	--	--	--	0.2	--	<0.1
B53W08D	--	--	--	--	--	--	--	--	--	<0.1
B53W08S	--	--	--	--	--	--	--	--	--	<0.1
B53W09D	--	--	--	--	--	--	--	--	--	<0.1
B53W09S	--	--	--	--	--	--	--	--	--	<0.1
B53W10D	--	--	--	--	--	--	--	0.2	--	<0.1
B53W10S	--	--	--	--	--	--	--	0.2	0.9	<0.1
B53W11D	--	--	--	--	--	--	2	0.8	8.9	<0.1
B53W11S	--	--	--	--	--	--	--	--	--	<0.1
B53W12D	--	--	--	--	--	--	--	--	--	<0.1
B53W12S	--	--	--	--	--	--	--	0.2	2.6	<0.1
B53W13S	--	--	--	--	--	--	--	0.2	0.4	<0.1
B53W14S	--	--	--	--	--	--	--	--	0.34	<0.1
B53W15S	--	--	--	--	--	--	0.7	1.4	0.6	<0.1
B53W16S	--	--	--	--	--	--	0.2	0.7	--	<0.1
B53W17S	--	--	--	--	--	--	--	--	0.1	<0.1
B53W18S	--	--	--	--	--	--	--	--	<0.2	<0.1
B53W19S	--	--	--	--	--	--	--	--	0.1	<0.1
B53W20S	--	--	--	--	--	--	--	--	0.6	<0.1
M10-8D	--	--	--	<0.1	0.3	0.3	0.9	1	0.3	<0.1
M10-8S	--	--	--	0.2	0.5	0.3	0.2	0.6	0.9	<0.1
M10-15S	--	--	--	1.8	5.3	1.3	1	24.1	--	<0.1
M10-15D	--	--	--	0.4	1.3	1.1	0.5	0.8	--	<0.1
M10-25D	--	--	--	0.8	0.5	0.8	0.9	1.5	--	<0.1
M10-25S	--	--	--	0.2	0.4	0.1	0.3	1.2	--	<0.1
M11-9S	--	--	--	0.3	1	0.8	0.2	1.6	1.4	0.1
M11-21S	--	--	--	15.2	52	11	11.9	28	--	<0.1
M13.5-8.5D	--	--	--	<0.1	0.7	0.6	0.6	0.5	0.4	<0.1
M13.5-8.5S	--	--	--	0.4	0.7	0.2	0.3	1.6	0.8	<0.1

Notes:
-- Data not available.
* Yearly averaged data.
** Indicates analysis performed on unfiltered sample. Filtered sample analysis not available.
All results reported to the nearest 0.1 pCi/l.
The detection limit for 1997 results is 0.1 pCi/l.
There is no established EPA MCL for Thorium-230.
Historic data from BNI (1994) and SAIC (1995).
< - Reported concentration below sample quantitation limit based on either "Laboratory" or "Reviewer Qualifier".
All 1984-92 samples are assumed to be unfiltered.

Table 4-6

Historical Concentrations of Manganese, Nitrate, and Selenium in Groundwater at SLAPS

Well ID	Manganese (ug/l)		Nitrate (mg/l)		Selenium (ug/l)	
	1988-89*	1997	1989	1997	1988-89*	1997
A	487	349	–	27.6	448	522
B	1,360	2,070	–	444	184	272
C	659	553	–	24.1	118	<3.4
D	6,012	6,420	–	11	<82	7.4
E	33	<11.6	–	537	4,898	4,300
F	15	<3.9	–	<0.1	143	134
B53W01D	1,690	215**	BDL	<0.1	–	<3.4**
B53W01S	1,068	43.1**	0.2	0.7	–	<3.4**
B53W02D	–	245	–	<0.1	–	<3.4
B53W02S	–	<7.2**	–	1.7	–	12.4**
B53W03D	–	237**	–	<0.1	–	<3.4**
B53W03S	–	774**	–	0.1	–	6.1**
B53W04D	–	1,360	–	<0.1	–	<3.4
B53W04S	–	81	–	0.2	–	<3.4
B53W05D	–	229**	–	<0.1	–	<3.4**
B53W05S	–	431**	–	0.5	–	<3.4**
B53W06D	–	447**	–	<0.1	–	<3.4**
B53W06S	–	3660**	–	162	–	8.4**
B53W07D	–	218	–	<0.1	–	<3.4
B53W07S	–	<3.9	–	44.2	–	<3.4
B53W08D	–	277	–	<0.1	–	<3.4
B53W08S	–	747	–	<0.1	–	3.6
B53W09D	–	214	0.1	0.6	–	3.4
B53W09S	–	<5.6	–	96.5	–	444
B53W10D	–	358	–	<0.1	–	<3.4
B53W10S	–	2,310	–	0.4	–	<3.4
B53W11D	–	249	BDL	<0.1	–	<3.4
B53W11S	–	28.3	0.2	<0.1	–	<3.4
B53W12D	–	681	–	<0.2	–	<3.4
B53W12S	–	216**	–	33.9	–	186**
B53W13S	–	<0.3	–	110	–	506
B53W14S	–	1510**	–	<0.1	–	<3.4**
B53W15S	–	178**	–	0.2	–	<3.4**
B53W16S	–	28.3**	0.49	1.2	–	<3.4**
B53W17S	–	<3.3**	–	293	–	120**
B53W18S	–	553**	–	0.2	–	<3.4**
B53W19S	–	217**	–	0.8	–	<3.4**
B53W20S	–	<0.49	–	0.8	–	<3.4
M10-8D	2,190	400	–	<0.1	<82	<3.4
M10-8S	5,578	1,080	–	32.8	<82	42.4
M10-15D	4,336	1,130	–	<0.1	<83	<3.4
M10-15S	122	<22.6	–	188	414	623
M10-25D	2,232	4,090	–	0.2	<82	<3.4
M10-25S	1,911	<160	–	1.1	<84	8
M11-9S	4,270	3,460	–	569	140	336
M11-21S	295	<134	–	3.2	498	677
M13.5-8.5D	1,312	270	–	<0.1	<82	<3.4
M13.5-8.5S	3,286	1,220	–	17	<82	<3.4

Notes:

– Data not available.

BDL - Below detection limit.

* Yearly averaged data.

** Analysis performed on unfiltered sample. Filtered sample analysis not available.

All selenium results reported to the nearest 0.1 ug/l for concentrations below 100 ug/l.

The sample quantitation limit (SQL) for 1997 results is 3.4 ug/l for selenium and 0.3 ug/l for manganese.

The SQL for 1997 results is 0.1 to 100 mg/l for nitrate, depending on detected concentration.

EPA MCL and SMCL for selenium and manganese are 50 ug/l, and the EPA MCL for nitrate is 10 mg/l.

storic data from BNI (1994).

< - Reported concentration below SQL based on either "Laboratory" or "Reviewer Qualifier".

All 1988-89 samples are assumed to be unfiltered.