141882

COMBINED FINAL REPORTS

St. Louis Airport Site
Expert Geohydrologic Panel

And

Addendum Report
Prepared by
Mimi Garstang, member of the
St. Louis Airport Site
Expert Geohydrologic Panel

Notation: Brackets ([ ]) denote Ms. Garstang's deletions from Panel's text.
Underlining (<u>example</u>) denotes Ms. Garstang's addition to Panel's text.

File: SLAPS-mg.wp6

FINAL REPORT
ST. LOUIS AIRPORT SITE
EXPERT GEOHYDROLOGIC PANEL
March 12, 1996

INTRODUCTION

An Expert Geohydrologic Panel was established by the St. Louis Area Task Force in late 1995 to review pertinent site information regarding geology, hydrogeology, surface water hydrology, and contaminant transport at the St. Louis Airport Site. This report describes the results of that review. The first meeting of the panel was on September 15, 1995, and preliminary results of the panel's review were provided in an oral presentation to the St. Louis Area Task Force on January 16, 1996. The St. Louis Area Task Force is a citizens' group created to evaluate the options available for remediation of the sites in the St. Louis area that are contaminated with low-level radioactive waste. These locations include the Mallinckrodt Plant, the Hazelwood Interim Storage Site, the St. Louis Airport site (SLAPS), and various vicinity properties.

The panel consisted of the following members:

Mr. David W. Miller (Chairman), Geraghty & Miller, Inc.
Dr. John D. Rockaway, University of Missouri
Mr. Thomas Aley, Ozark Underground Laboratory Inc.
Mr. James Cox, Walsh Environmental Scientists and Engineers, Inc.
Ms. Mimi Garstang, Missouri Department of Natural Resources
Mr. Angel Martin, Jr., U.S. Geological Survey

The first four members listed above are professionally representing only themselves in a private capacity with regard to the various issues. Mr. Angel Martin, Jr., as an employee of the U.S. Geological Survey (USGS), can comment on the technical

aspects of the work. The USGS cannot make any recommendations regarding remediation of the site or alternatives or recommendations for the possible closure of the site. Also, the USGS will not comment on criteria for the disposal of additional contaminated soil and debris and the nature of immediate or long-term actions and site modifications.

Ms. Mimi Garstang, [who] currently is employed by the Missouri Department of Natural Resources, Division of Geology and Land Survey (MDNR/DGLS), as Deputy Division Director [has provided the Task Force with a separate report]. Working as a geologist for the department since 1978, her participation on the panel also provided a historical perspective on many of the technical investigations and documents.

The questions provided to the panel for their analysis were as follows:

1. Is shallow groundwater contamination at the St. Louis Airport Site having, or expected to have, any environmentally significant impact on water or sediment quality in Coldwater Creek?

2. Is surface water runoff from the St. Louis Airport Site having, or expected to have, any environmentally significant impact on water or sediment quality in Coldwater Creek?

3. Is contamination present at the St. Louis Airport Site expected to have any environmentally significant impact on the "deep" bedrock groundwater within the foreseeable future (e.g., next 100 years)?

The charge given to the panel was to restrict its review to the analysis of geologic and hydrologic issues related to SLAPS. These issues represent only some of the many factors that are typically considered with regard to decisions on future activities at

Superfund sites.

[During its deliberations, the panel also developed opinions on the following issues:]

1. Adequacy of available data on which to base future decisions on [potential] risk.

2. Suitability of the site for disposal of additional wastes contaminated with low-level radioactivity.

3. Immediate activities that might be considered for increased monitoring and for minimizing potential environmental impacts.

BACKGROUND

The SLAPS is a 21.7 acre property adjacent to the Lambert-St. Louis International Airport. The property is bounded to the west by Coldwater Creek, to the south by the Norfolk and Western Railroad and to the north and east by McDonnell Boulevard. From 1946 to 1966, residues from the processing and production of various forms of uranium compounds were placed in the area. In the mid 1960's an unknown quantity of the residues were removed from the property and the entire property was covered with up to 3 feet of clean fill. Additional fill and rubble were placed at the site in the 1970's and in the late 1980's a gabion wall was constructed to minimize erosion by Coldwater Creek. Stormwater runoff [from the SLAPS property presently flows in surface ditches and a pipe that all drain to Coldwater Creek] is presently uncontrolled. Surface ditches and a pipe all drain the site directly into Coldwater Creek. The property is fenced and is [environmentally monitored and routinely maintained] subject to environmental monitoring and routine maintenance.

Radioactive contamination of soil at SLAPS has been characterized and extends to a depth of about 18 feet, with the majority of contamination between 4 and 8 feet below land surface (bls). Levels of uranium-238, radium-226, thorium-230, and thorium-232 in soil samples from these depths significantly exceed background levels. Analytical [R]esults of groundwater [analyses] samples [in] from some monitoring wells, stormwater samples, and [Coldwater Creek sediment] sediment samples from Coldwater Creek also indicate elevated uranium levels. However, measured levels of radionuclides in surface water from Coldwater Creek were consistent with background levels and lower than proposed Department of Energy (DOE) clean-up guidelines. [¶] The results of sampling and monitoring at SLAPS are summarized in numerous reports on the property as referenced in the bibliographic attachment. [In addition, a current environmental program at SLAPS involves obtaining samples on a semi-annual basis for air, surface water, sediment, groundwater, and stormwater. The most recent sampling results, based on 10 monitoring wells, 8 surface-water sites, and two stormwater discharge points appear to be consistent with earlier investigation at SLAPS.]

[In the various investigations carried out at SLAPS, the geologic formations underlying the site have been divided into upper and lower aquifer systems, which are separated by confining unit composed of dense clay. The confining unit is greater than 25 feet thick along the western portion of the property, thins in an easterly direction, and pinches out near the eastern edge of SLAPS. The upper aquifer system consists of about 30 feet of clayey silts, fine sands, and silty clays. The lower aquifer system includes and unconsolidated unit of mostly silty clay and clayey gravel, up to 30 feet thick, and the underlying bedrock. The bedrock beneath the western portion of SLAPS consists of limestone. Shale overlies the limestone along the eastern portion of the site. Depth to bedrock ranges from 55 feet on the east side of the SLAPS to a maximum of 90 feet toward Coldwater Creek.]

The SLAPS ground surface is essentially flat. It lies on the southeastern edge of a topographic depression known as the Florissant Basin. The Florissant Basin was created through bedrock erosion by a Mississippi River tributary. Sand, silt, gravel, and clay-rich materials filled this basin as glaciers blocked the tributary millions of years ago creating a quiet lake environment. The SLAPS lies essentially on the edge of this now sediment-filled ancient lake.

The stratigraphy on the western portion of the site depicts silty materials at ground surface that grade into fine sand and silty clay. At the 40-50 feet depth, a clay-rich unit is present that has been inferred to hydrologically separate the saturated lake deposits into two groundwater systems in this area. The lake deposits below the clay-rich unit on the western portion of the site consist mostly of silty clay and clayey and sandy gravel. Limestone, the uppermost bedrock formation, exists at depths of approximately 90 feet. Static water levels are usually about 8-10 feet below ground surface.

Beneath the eastern portion of the site lies one continuous sequence of saturated unconsolidated material. The materials grade from clayey silt to clayey and sandy gravel. This is the true edge of the ancient lake where bedrock erosion left weathered shale and coal exposed until subsequently covered by the deposits of the glacial lake to depths of 55 feet. The weathered coal and shale overlie the deeper limestone unit that is the upper bedrock on the western part of the site. No clay-rich potential confining clay-rich layer has been identified as present in the glacial lake sediments in this area. Static water levels are as shallow as 2-5 feet below ground surface. Due to limited drilling, true stratigraphic conditions between the eastern and western edge of the site are unknown.

Minimal characterization of the bedrock beneath the site has occurred. A single well has been completed in the limestone bedrock aquifer. This bedrock aquifer has historically been utilized for potable water in the Florissant Basin Area. Eight producing wells are known to have existed within 3 miles of the site. Water quality is good in the limestone. This is characteristic of the glacial lake sediment area due to larger and more rapid recharge than in much of the St. Louis area geologic settings. The limestone is expected to produce enough water for private water usage and possibly some commercial usage.

PROCEDURES

To address the issues, the panel members reviewed the data, analyzed the conclusions drawn from previous DOE investigations and participated in a series of meetings focused on reviewing available site data. At these meetings, presentations were made by the technical personnel who had been associated with many of the previous [and ongoing] studies. [Requests from the panel members for supplementary information, explanation of assumptions or processes and further analysis of available data were submitted to the appropriate technical personnel.] Panel members often requested supplementary information, explanation of assumptions or processes and further analysis of available data. The responses to these requests were included as part of the panel review process. [¶] The panel members independently evaluated the data. [and reports provided and developed preliminary conclusions. Subsequently, the panel met as a group to identify those conclusions upon which a general concurrence was made and outlined the concepts upon which this report is based.] There were meetings and discussions to determine if a general concurrence existed relative to answers for the three questions reviewed by panel members.

The panel especially wants to thank David S. Miller of Science Applications International Corporation for his efforts in providing background information on the site to the panel and in responding to the panel's many requests for additional data [and analyses] analysis. Mr. Miller and the other DOE contractors involved in this process greatly simplified the panel's review through their thorough and timely presentations.

ANALYSIS

A number of factors were considered to be of major importance in supporting the conclusions and recommendations of the panel's review. [These factors included:] The following listing describes conclusive information that the panel concurred upon:

1. Radionuclides are present in groundwater [at SLAPS] with higher [activity levels] concentrations identified near Coldwater Creek. [Groundwater movement is] A potential avenue exists for direct groundwater discharge of radionuclides to the [Coldwater] creek.

2.[3] Soil contaminated with radionuclides is present below the water table. [Therefore,] Groundwater is in contact with a source of radionuclides under portions of SLAPS.

3.[4] Significant levels of radionuclides are present in the soil at very shallow depths (i.e., less than 0.5 feet bls along McDonnell Boulevard on the northern boundary of SLAPS and the railroad tracks along the southern boundary). Much of the area is easily accessed by the public.

4.[2] Groundwater monitoring has shown the migration of radionuclides in the direction of shallow groundwater flow across McDonnell Boulevard and under the formerly used ballfields property to the north. [Low levels of radionuclides are present in at least one monitoring well adjacent to Coldwater Creek in the ballfields area.] This factor raises concern over potential shallow discharges of radionuclides to Coldwater Creek to the west and the north [and potential vertical migration to the lower aquifer system]. Low concentrations of radionuclides have been regularly detected in monitoring well B53W075. This well is approximately 800 feet north of the SLAPS property boundary and is adjacent to Coldwater Creek. This might be expected, given the physical properties of the lacustrine (glacial lakebed) sediments.

5. Coldwater Creek sediments containing radionuclides extend downstream from the site for 7-8 miles. Although this condition may have resulted from historic erosion at the SLAPS before the present gabion wall was constructed, it may also be indicative of contaminated stormwater discharging from the present SLAPS drainage system. As late as the fourth quarter of 1994, one stormwater sample collected at SLAPS exceeded the DOE reference value for "Radiation Protection of the Public and the Environment."

6. Volatile organic chemicals have been found in groundwater at SLAPS. This poses two risk elements. [These are not only serious environmental contaminants;] These chemicals are individually important environmental contaminants. Second, they can provide the potential for facilitating transport of less mobile chemicals and other substances through the groundwater system.

7. Total carcinogenic risks from radionuclide exposure at SLAPS, as estimated in the baseline risk assessment prepared by Argonne National laboratory in 1993, were 9.4×10^{-5}, 1.1×10^{-3}, and 1.1×10^{-1} for a SLAPS trespasser, maintenance worker, and future resident, respectively. Although these are relatively high values, the report points out that conservative, worst case scenarios were assumed in arriving at these estimates, especially with regard to future land use.

8. Most of the unconsolidated lacustrine sediments beneath the site are fine-grained and exhibit moderate horizontal permeabilities with lower vertical permeabilities. They also tend to absorb radionuclides.

9. There is limited groundwater use in the immediate SLAPS area. Also, most potable water used for public water supplies is from surface water sources [the Missouri and Mississippi Rivers].

10. The unconsolidated lakebed sediments are serving as a reservoir of fresh water recharge to the bedrock beneath the site. Potable water is present in the limestone bedrock aquifer that is normally saline in this general area.

[In its evaluation of data the panel also took into account some very important characteristics of the SLAPS that are favorable in the potential to minimize adverse effects to the creek and groundwater. Most important of these is the fine grained nature of the unconsolidated sediments underlying the area. These deposits overlie the lower aquifer system. Horizontal and vertical flow of groundwater through fine-grained sediments is low, and the potential rate of discharge of groundwater to Coldwater Creek is low. In addition, radionuclides typically have low mobility in groundwater. The fine-grained nature of the geologic units would indicate a high potential for adsorption, further limiting the migration of radionuclides. Available water-quality data indicate the lack of a widespread plume of heavily contaminated groundwater after 50 years of the presence of the source. In addition, surface-water monitoring of Coldwater Creek has consistently shown radionuclide values both within DOE guidelines and below background levels. Finally, there is no groundwater use in the immediate area, which would affect natural groundwater flow.]

Inconclusive data and information lead the panel to identify the following concerns and inadequacies:

1. Little is known about the areal extent or thickness of the potential clay-rich unit due to limited drilling to depth.

2. True separation of the groundwater above and below the potential confining unit is unknown. Aquifer tests were not conclusive. Only one field permeability test was completed on the potential confining unit. This test was made off-site and varied considerably from laboratory results.

3. The vertical extent of groundwater contamination is unknown beneath the middle portion of SLAPS. The stratigraphy beneath the center of the site also is not clearly defined. It is important to understand the conditions in this area.

4. Characterization of the materials and groundwater flow below approximately 50 feet is poor. Only one well has been completed in the limestone near SLAPS. Potentiametric maps for the lower units cannot be created due to lack of information.

5. Vertical flow gradients indicated by monitoring wells are inconclusive. Sediment accumulation has impacted water levels in wells. Steep downward gradients have been indicated on the southern SLAPS boundary. It is important to understand where steep vertical gradients truly exist to identify where shallow contamination may more readily move to depth.

6. Historically groundwater within a 3 mile radius of SLAPS has been utilized for industrial and private consumption. A current door-to-door survey to document present day groundwater use will identify any users at risk and any water production that may influence contaminant migration.

7. Sampling programs at SLAPS have not been consistent. Organic and inorganic analysis has not been regularly documented. No sampling occurred from 1992-1995.

8. Stream gaging information for Coldwater Creek at SLAPS is minimal. A true relationship between the creek and shallow groundwater is unknown.

9. The source and extent of TCE, DCE, and toluene contamination at the site is unknown.

10. One bedrock well sporadically shows elevated uranium levels. This well is completed in the coal and shale units that may contain naturally-occurring radiation. This well also is at the eastern edge of the site where the potential confining unit is known to be absent. It is important to understand if this is evidence of radionuclides moving to depth or if it is a natural phenomena.

MODEL PROJECTIONS

Because the issues raised by the St. Louis Task Force involved future impacts, the panel [relied heavily] included in its deliberations [on a] the groundwater modeling study [carried out] conducted by the DOE contractors. During several meetings with the contractors, the model parameters were reviewed and suggestions were made for modification of some of the parameters. [see * below] The results of the modeling [support the assumed very slow movement of the contaminants in groundwater. Also,] projected little environmental impact on Coldwater Creek [was simulated in the model] or the bedrock aquifer [well beyond the 100-year time period the panel was asked to consider] for over 100 years. [The model indicates that most groundwater flow is above the primary low permeability clay confining unit, and that vertical migration into the lower aquifer system would not be significant for more than 100 years.] Conservative assumptions were utilized even if they were not totally representative of the true site conditions. * The panel [also] recommended [the] expansion of the model to provide a more complete picture of potential migration of radionuclides to Coldwater Creek and to the [lower aquifer system.] bedrock groundwater system as more data are obtained.

The panel concluded that the three-dimensional groundwater flow model completed to this point [was technically] is reasonably sound [and the hydrologic units underlying the site were simulated reasonably with the available data]. The calibration results based on simulating measured water levels [especially in the upper aquifer system] in the upper groundwater system were acceptable. However, model calibration was completed with only a limited data set for the lower [aquifer] groundwater system. Limitations of that data include the fact that the stratigraphy underlying SLAPS has not been fully characterized, and significant gaps in various data sets are present. For example, the [extent] continuity and thickness of the potential clay-confining layer across the site is not known. This unit has been thought to restrict[s] vertical flow between the upper and lower [aquifer] groundwater systems; and therefore, [the possible] also possibly restrict the movement of contamination. Determination of where this unit exists and its true permeability characteristics [This] is important in defining the hydrology and possible movement of contamination at this site. Also, [¶] the hydrology of the limestone and shale is not fully understood because of the lack of wells open to the bedrock at or near the site.

The flow model has not been verified in that the model has not been run with an independent set of data. This should be done so that the model can be utilized with confidence in the simulation of the distribution of [activity] concentration of radioactive constituents underlying the site. The current distance that radionuclides have already moved off-site must be simulated by the model with realistic assumptions. Comparison of streamflow in Coldwater Creek with simulated groundwater discharge to the creek is recommended in future calibrations.

CONCLUSIONS

As a result of the review of available data, analysis drawn from previous DOE investigations, and the modeling studies, the panel has developed a number of conclusions regarding [present] existing levels, distribution and [effect] impact of contamination at the site as well as conclusions regarding projected levels and distribution of contamination in the future (100 years].

1. Radionuclides are present in shallow groundwater at SLAPS, and the result[s] of the groundwater modeling study indicate that there will continue to be off-site migration of contaminants through the upper groundwater system toward Coldwater Creek. However, [results of the] groundwater modeling [also] indicates that [the] levels of contamination [that might eventually reach the Creek would not impact surface water or sediments so that DOE guidelines would be exceeded for at least 100 years] would not exceed DOE guidelines for at least 100 years. The model results are consistent with [available water quality data] the creek sampling data available for SLAPS, but not with shallow groundwater monitoring data.

2. The presence of radionuclides at the SLAPS has impacted sediment quality in the stream channel and banks of Coldwater Creek. [Sediment quality has been impacted as a result of both] This has been caused by stream bank erosion adjacent to the SLAPS and from sheet and gully erosion across the site. Also, stormwater flow and flooding along Coldwater Creek has resulted in periods of accelerated erosional activity. Contaminant migration from soil erosion appears to have been more significant in the past. Current rates of erosion have been reduced from previous levels as a result of the natural re-establishment of vegetation over parts of the site and the construction of the gabion wall to control bank erosion along Coldwater Creek. However, neither of these features has completely eliminated the contribution of radionuclides into the surface waters of Coldwater Creek. Although the impact of these sources is not acute at this time, it does present a chronic problem to environmental quality along Coldwater Creek and should be corrected or mitigated.

3. Results of the groundwater modeling study indicate that the presence of radionuclides in the soil and upper aquifer system at SLAPS will not have a significant impact on the [lower] bedrock aquifer [system] within the foreseeable future (100 years). However, the panel concluded that this deep groundwater system has not yet been sufficiently characterized, and that both the model and the conclusions drawn from the model will require verification as additional data become available.

4. The site is underlain by hydrogeological features that do not meet criteria for the location of a storage or disposal facility for radionuclide wastes. [Given that the wastes are already present,] It [nevertheless] is the conclusion of the panel that the site should not be used for the disposal of additional contaminated soil or other waste products. Physical, geological, and hydrological aspects of the site that do not meet present criteria for disposal of wastes include a shallow water table, a flood plain setting, the absence of a continuous and relatively thick confining layer, [the presence of linestone that may be karstic in nature] the unknown bedrock conditions, and finally, the accessibility of the site. It should be noted that the model and risk assessment assumed no additional waste material would be placed at the site.

IMMEDIATE ACTIONS

Although the results of previous studies indicate that the impact of radionuclide contamination from the SLAPS into Coldwater Creek and the deep groundwater system are not acute at this time, there are a number of actions that the panel believes should be implemented immediately. These actions would be designed both to mitigate the [present] existing situation and to facilitate future investigations of contaminant migration and remedial action studies. [¶] The actions suggested do not represent a conclusion from the panel with respect to a recommended level or method of remediation, but are comprehensive analysis of contaminant sources. This information is considered necessary to more thoroughly assess potential off-site contamination and to verify the results of groundwater modeling.

1. Two deep monitoring wells should be installed that extend into the limestone bedrock. These wells should be designed to provide additional information on the deeper subsurface stratigraphy and the [hydrologic continuity between the geologic units included in the lower aquifer system] hydraulics of the lower groundwater system. They should be included in the groundwater monitoring program.

2. Consideration should be given to installation of a (larger diameter) well so that it could yield sufficient water to stress the [lower aquifer system] groundwater deeper than the 50 foot depth. A controlled aquifer test [would] should be done to provide data that could be used to better characterize the various groundwater systems and the potential confining unit.

3. Continuously recording stream gages should be installed upstream and downstream of the site. These would be useful in providing data for model simulation and determination of flow characteristics in Coldwater Creek. More water quality sampling of creek water should be implemented.

4. Additional information should be acquired on the levels and types of groundwater contamination in the central region of the site. In this area high concentrations of contaminants are present in the soil, yet data on the underlying groundwater quality are limited and the extent of contamination is poorly defined. The known extent of the potential confining unit in this area is also limited.

5. Additional information should be obtained on the nature and distribution of both

organic and inorganic chemicals at the site. The data would be useful in helping to understand the hydraulic relation between the various geologic units and potential to enhance the migration of radionuclides.

6. A comprehensive long-range program should be established for the implementation of continued hydrogeologic assessment studies at the site. To date, the continuity of monitoring has been interrupted several times. Data collection and analysis must address surface and groundwater quality, static water levels, erosion, sedimentation, and contaminant migration through and from the site without continual interruption.

7. A door-to-door well survey documenting water use in the area will verify safety for the public and any potential influence on groundwater flow in the area.

8. Additional modeling of the site should be done. Once additional data are acquired on the lower unconsolidated units and bedrock beneath the site, projections on the vertical extent of contamination can be made. Modeling must also include the fate and migration of organic contaminants at the site as well as their impact on migration of radionuclides.

LONG RANGE PLANNING

The panel suggests that a comprehensive long-range program be established for the implementation of future hydrogeologic assessment studies at the site. To date, the continuity of monitoring has been interrupted from time-to-time. Data collection and analysis should address surface and groundwater quality and flow, erosion, sedimentation and contaminant migration through and from the site. [For example, additional wells on the ballfields property adjacent to Coldwater Creek should be included in future sampling. The data-collection program should be designed to provide the information necessary for groundwater modeling and risk assessment studies that will provide the basis for future decisions regarding the most appropriate remedial actions to be implements at SLAPS and other sites in the St. Louis area.]. Water dating, aquifer testing, permeability testing and flow analysis are just a few of the investigations to consider as future plans are made.

Refinements in appropriate actions can be made as additional data are compared to the anticipated results and model predictions. If changes in site conditions are made which invalidate the model assumptions (i.e., additional waste is stored at the site or excavation of the waste occurs) then additional characterization of the impact and a re-evaluation of additional data needed will be necessary.

Formerly Utilized Sites Remedial Action Program (FUSRAP)

ADMINISTRATIVE RECORD

for the St. Louis Site, Missouri

U.S. Department of Energy

141901

St. Louis Site Remediation Task Force

To: St. Louis Site Remediation Task Force Participants

From: James Dwyer, Facilitator

Date: April 18, 1996

Subject: Coldwater Creek Panel - Final Report

Enclosed is a copy of the final report of the Coldwater Creek Panel for your review and consideration. Also enclosed is a copy of the addendum report prepared by Mimi Garstang, which she discussed at the March Task Force meeting.

If you have any questions about these materials, please call me at 367-5707.

Enclosures: Final Coldwater Creek Panel - Final Report
Addendum Report - Mimi Garstang

9170 Latty Avenue Berkeley, Missouri 63134 314·524·4083

141431

FINAL REPORT
ST. LOUIS AIRPORT SITE
EXPERT GEOHYDROLOGIC PANEL
FEBRUARY 15, 1996

Prepared for

St. Louis Area Task Force

Prepared by

The St. Louis Airport Site
Expert Geohydrologic Panel

141431

CONTENTS

FINAL REPORT
ST. LOUIS AIRPORT SITE
EXPERT GEOHYDROLOGIC PANEL
FEBRUARY 15, 1996

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aspects of the work. The USGS cannot make any recommendations regarding remediation of the site or alternatives or recommendations for the possible closure of the site. Also, the USGS will not comment on criteria for the disposal of additional contaminated soil and debris and the nature of immediate or long-term actions and site modifications.

Ms. Garstang, who is employed by the Missouri Department of Natural Resources as Deputy Division Director, has provided the Task Force with a separate report.

The questions provided to the panel for their analysis were as follows:

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During its deliberations, the panel also developed opinions on the following issues:

1. Adequacy of available data on which to base future decisions on potential risk.

2. Suitability of the site for disposal of additional wastes contaminated at low levels of radioactivity.

3. Immediate activities that might be considered for increased monitoring and for minimizing potential environmental impacts.

BACKGROUND

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PROCEDURES

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The panel members independently evaluated the data and reports provided and developed preliminary conclusions. Subsequently, the panel met as a group to identify those conclusions upon which a general concurrence was made and outlined the concepts upon which this report is based.

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ANALYSIS

A number of factors were considered to be of major importance in supporting the conclusions and recommendations of the panel's review. These factors included:

1. Radionuclides are present in groundwater at SLAPS with higher activity levels identified near Coldwater Creek. Groundwater movement is a potential avenue for direct discharge of radionuclides to Coldwater Creek.

2. Groundwater monitoring has shown the migration of radionuclides in the direction of groundwater flow across McDonnell Boulevard and under the formerly used ballfields property to the north. Low levels of radionuclides are present in at least one monitoring well adjacent to Coldwater Creek in the ballfields area. This factor raises concern over potential shallow discharge of radionuclides to Coldwater Creek

to the west and the north, and potential vertical migration to the lower aquifer system.

3. Soil contaminated with radionuclides is present below the water table. Therefore, groundwater is in contact with a source of radionuclides.

4. Significant levels of radionuclides are present in the soil at very shallow depths, less than 0.5 foot bls along McDonnell Boulevard on the northern boundary of SLAPS and the railroad tracks along the southern boundary. Much of the area is easily accessed by the public.

5. Coldwater Creek sediments containing radionuclides extend downstream from the site. Although this condition may have resulted from historic erosion at the SLAPS before the present gabion wall was constructed, it may also be indicative of contaminated stormwater discharging from the present SLAPS drainage system. As late as the fourth quarter of 1994, one stormwater sample collected at SLAPS exceeded the DOE reference value for "Radiation Protection of the Public and the Environment."

6. Volatile organic chemicals have been found in groundwater at SLAPS. These are not only serious environmental contaminants; they can provide the potential for facilitating transport of less mobile chemicals through the groundwater system.

7. Total carcinogenic risks from radionuclide exposure at SLAPS, as estimated in the baseline risk assessment prepared by Argonne National Laboratory in 1993, were 9.4×10^{-5}, 1.1×10^{-3}, and 1.1×10^{-1} for a SLAPS trespasser, maintenance worker, and future resident, respectively. Although these are relatively high values, the report points out that conservative, worst case scenarios were assumed in arriving at these estimates, especially with regard to future land use.

In its evaluation of data the panel also took into account some very important characteristics of the SLAPS that are favorable in the potential to minimize adverse effects to the creek and groundwater. Most important of these is the fine-grained nature of the unconsolidated sediments underlying the area. These deposits overlie the lower aquifer system. Horizontal and vertical flow of groundwater through fine-grained sediments is slow, and the potential rate of discharge of groundwater to Coldwater Creek is low. In addition, radionuclides typically have low mobility in groundwater. The fine-grained nature of the geologic units would indicate a high potential for adsorption, further limiting the migration of radionuclides. Available water-quality data indicate the lack of a widespread plume of heavily contaminated groundwater after 50 years of the presence of the source. In addition, surface-water monitoring of Coldwater Creek has consistently shown radionuclide values both within DOE guidelines and below background levels. Finally, there is no groundwater use in the immediate area, which would affect natural groundwater flow.

Because the issues raised by the St. Louis Task Force involved future impacts, the panel relied heavily in its deliberations on a groundwater modeling study carried out by the DOE contractors. During several meetings with the contractors, the model parameters were reviewed and suggestions were made for modification of some of the parameters. The panel also recommended the expansion of the model to provide a more complete picture of potential migration of radionuclides to Coldwater Creek and to the lower aquifer system. The results of the modeling support the assumed very slow movement of the contaminants in groundwater. Also, little environmental impact on Coldwater Creek was simulated in the model, well beyond the 100-year time period the panel was asked to consider. The model indicates that most groundwater flow is above the primary low permeability clay confining unit, and that vertical migration into the lower aquifer system would not be significant for more than 100 years.

The panel concluded that the three-dimensional groundwater flow model completed to this point was technically sound, and the hydrologic units underlying the site were simulated reasonably with the available data. The calibration results based on simulating measured water levels, especially in the upper aquifer system were acceptable. However, model calibration was completed with only a limited data set especially for the lower aquifer system. The stratigraphy underlying SLAPS has not been fully characterized, and significant gaps in various data sets are present. For example, the extent and thickness of the clay confining layer across the site is not known. This unit restricts vertical flow between the upper and lower aquifer systems and, therefore, the possible movement of contamination. This is important in defining the hydrology and possible movement of contamination.

The hydrology of the limestone and shale is not fully understood because of the lack of wells open to the bedrock at the site. The flow model has not been verified in that the model has not been run with an independent set of data. This should be done so that the model can be utilized with confidence in the simulation of the distribution of activity of radioactive constituents underlying the site. Comparison of streamflow in Coldwater Creek with simulated groundwater discharge to the creek is recommended in future calibrations.

CONCLUSIONS

As a result of the review of available data, analysis drawn from previous DOE investigations, and the modeling studies, the panel has developed a number of conclusions regarding present levels, distribution and effect of contamination at the site as well as conclusions regarding projected levels and distribution of contamination in the future (100 years).

1. Radionuclides already are present in shallow groundwater at SLAPS, and the results of the groundwater modeling study indicate that there will continue to be off-site migration of contaminants through the upper groundwater system toward Coldwater Creek. However, results of the groundwater modeling also indicate that the levels

of contamination that might eventually reach the Creek would not impact surface water or sediments so that DOE guidelines would be exceeded for at least 100 years. The model results are consistent with available water quality data.

2. The presence of radionuclides at the SLAPS has impacted sediment quality in Coldwater Creek. Sediment quality has been impacted as a result of both stream bank erosion adjacent to the SLAPS and from sheet and gully erosion across the site. Stormwater flow and flooding along Coldwater Creek has resulted in periods of accelerated erosional activity. Contaminant migration from soil erosion appears to have been more significant in the past. Current rates of erosion have been reduced from previous levels as a result of the natural re-establishment of vegetation over parts of the site and the construction of a gabion wall to control bank erosion along Coldwater Creek. Neither of these features has completely eliminated the contribution of radionuclides into the surface waters of Coldwater Creek. Although the impact of these sources is not acute at this time, it does present a chronic problem to environmental quality along Coldwater Creek and should be corrected .

3. Results of the groundwater modeling study indicate that the presence of radionuclides in the soil and upper aquifer system at SLAPS will not have a significant impact on the lower aquifer system within the foreseeable future (100 years). However, the panel concluded that the deep groundwater system has not yet been sufficiently characterized, and that both the model and the conclusions drawn from the model will require verification as additional data become available.

4. The site is underlain by hydrogeological features that do not meet criteria for the location of a storage or disposal facility for radionuclide wastes. Given that the wastes are already present, it nevertheless is the conclusion of the panel that the site should not be used for the disposal of additional contaminated soil or other waste products. Physical, geological, and hydrological aspects of the site that do not meet

present criteria for disposal of wastes include a shallow water table, a flood-plain setting, the absence of a continuous and relatively thick confining layer, the presence of limestone that may be karstic in nature, and finally, the accessibility of the site. It should be noted that the model and risk assessment assumed no additional waste material would be placed at the site.

IMMEDIATE ACTIONS

Although the results of previous studies indicate that the impact of radionuclide contamination from the SLAPS into Coldwater Creek and the deep groundwater system is not acute at this time, there are a number of actions that the panel believes should be implemented immediately. These actions would be designed both to mitigate the present situation and to facilitate future investigations of contaminant migration and remedial action studies.

SITE MODIFICATIONS

The actions suggested do not represent a conclusion from the panel with respect to a recommended level or method of remediation, but are actions the panel feels could be implemented to reduce the off-site migration of radionuclide contamination from the present site.

1. The gabion wall which was constructed to prevent sediment erosion along the western creek bank appears to be accomplishing this purpose based upon a cursory visual observation. However, the proximity of the radioactive contamination to the creek and the presence of contaminated material within the flood plain and the stormwater runoff ditches and pipe provide a rapid pathway for potential contaminant migration into the creek. There continues to be direct discharge of impacted material into the creek as indicated by the water-quality samples collected from one on-site stormwater- sampling site. Therefore, at a minimum, a site

drainage control and prevention program should be designed and implemented to eliminate discharge of contaminated stormwater to Coldwater Creek.

2. The need for additional flood-protection facilities should be evaluated in order to maximize protection of the site from erosion during periods of flooding along Coldwater Creek.

3. The shallow soils contaminated with radionuclides found along McDonnell Road and the railroad right-of-way should be considered for removal as part of the ongoing remediation activities.

ADDITIONAL DATA ACQUISITION

The panel concluded that additional data will be required to develop a more complete hydrogeological assessment of the deep groundwater system and a more comprehensive analysis of contaminant sources. This information is considered necessary to more thoroughly assess potential off-site contamination and to verify the results of groundwater modeling.

1. Two deep monitoring wells should be installed that extend into the limestone bedrock. These wells should be designed to provide additional information on the deeper subsurface stratigraphy and the hydrologic continuity between the geologic units included within the lower aquifer system. They should be included in the ground-water monitoring program.

2. Consideration should be given to installation of a well of large enough diameter so that it could yield enough water to stress the lower aquifer system. A controlled aquifer test would provide data that could be used to better characterize the various aquifer systems and the confining unit.

3. Continuously recording stream gages should be installed upstream and downstream of the site. These would be useful in providing data for model simulation and determination of flow characteristics in Coldwater Creek.

4. Additional information should be acquired on the levels and types of groundwater contamination in the central region of the site. In this area, high concentrations of contaminants are present in the soil, yet data on the underlying groundwater quality are limited and the extent of contamination is poorly defined.

5. Additional information should be obtained on the nature and distribution of inorganic chemicals at the site. These data would be useful in helping to understand the hydraulic relation among the various geologic units.

LONG-RANGE PLANNING

The panel suggests that a comprehensive long-range program be established for the implementation of future hydrogeologic assessment studies at the site. To date, the continuity of monitoring has been interrupted from time to time. Data collection and analysis should address surface and groundwater quality, erosion, sedimentation and contaminant migration through and from the site. For example, additional wells on the ballfields property adjacent to Coldwater Creek should be included in future sampling. The data-collection program should be designed to provide the information necessary for groundwater modeling and risk assessment studies that will provide the basis for future decisions regarding the most appropriate remedial actions to be implemented at SLAPS and other sites in the St. Louis area.

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STATE OF MISSOURI
Mel Carnahan, Governor • David A. Shorr, Director
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY
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April 8, 1996

RECEIVED
APR 1 1

Mr. David Miller
Geraghty and Miller, Inc.
North Region
125 East Bethpage Road
Plainview, NY 11803

Dear David:

I am writing this letter in response to the Final Report prepared by the St. Louis Airport Site (SLAPS), Expert Geohydrologic Panel; dated February 15, 1996, (which is actually a March 1996 revision). This report was prepared for the St. Louis Area Task Force to clarify several outstanding geohydrologic issues. I regret that I must submit a separate report as an addendum to the panel's general report. The members of the Expert Geohydrologic Panel worked together in a conscientious manner and each member arrived at the same basic responses to the questions that were presented to the panel.

However, it is my position that the geohydrologic panel should provide the St. Louis Area Task Force with the best information, data, and recommendations that they possibly can for the task force to base their final report and site decisions upon. The general panel report omits some of the information/data and recommendations that I personally believe are vitally important to the understanding of the site. Many of these I consider of great value prior to suggesting a final remedy to the wastes and contamination present at the SLAPS.

I believe that the panel's report as submitted assumes too much without explicit references to previous reports and reads too much like a site permitting decision report; rather than a peer panel review. Given the long-term implications of the Task Forces charge, the experts should provide a review/critique of the data, methodology, decisions, and assumptions made to date rather than a review endorsement. I realize that a large amount of information was presented to the panel for consideration over a very short period of time which made a thorough critique difficult. I had a definite advantage due to the longevity of my work on the site and therefore, believe I should provide the Task Force that critique to consider.

The following listing explains outstanding issues that are important for site decisions.

1. The panel report needs more geohydrologic clarity. The importance of the overall geomorphic setting should be discussed, emphasizing the importance of why recharge and groundwater quality in the unconsolidated material and bedrock are different in this ancient lake setting than the rest of the St. Louis area.

2. The importance of differing stratigraphy from the east to the west end of the site is not clearly outlined and the significance not recognized.

3. The discussion of aquifer systems needs more explanation. There is currently minimal data that suggests more than one aquifer at the site. References to upper and lower systems are confusing and may mislead the reader. The reader (based upon common Missouri terminology) may assume that the shallow and deep unconsolidated materials, as well as the bedrock, are not hydrologically connected. This determination is currently unknown.

4. The location, thickness, and permeability of a potential confining unit are vitally important to the final decisions made for the wastes at the site. Data on a potential confining unit is sketchy. I envision the Task Force may be making critical decisions relative to the existence of a confining unit. Additional work must better define this unit before such vital decisions can be made.

5. The specifics of contamination migration needs to be thoroughly explained to the Task Force. Radionuclides have been detected 800 feet north of the site boundary in the shallow groundwater, showing evidence of off-site impacts. Contaminated sediments in Coldwater Creek have been detected 7-8 miles downstream. This information is significant to the final decision making process.

6. The inconclusive data and inadequacies of the modeling have not been well explained. We should not assume that the Task Force understands that models are only as good as the basic data and parameters that are utilized in the mathematical process. Data on the units below 50 feet in depth are of poor quality and quantity. Also, all of the contaminants present at the site have not been adequately evaluated, sampled, or modeled (this includes organics). The Task Force should be so advised.

The geohydrologic panel should review the strengths and weaknesses of previous investigations. I have tried to provide such a review in my addendum. Given the importance of the St. Louis Area Task Force charge of responsibilities and the importance of their recommendations, I believe they should be provided as much information as possible relative to the merits of previous investigations and the data that has been provided.

Sincerely,

DIVISION OF GEOLOGY AND LAND SURVEY

Mimi R. Garstang
Deputy/Division Director
Member, Expert Geohydrologic Panel, SLAPS
573/368-2101

c: David Shorr
Ron Kucera
John Young
Elsa Steward
Jim Dwyer
Sally Price
Jim Williams

STATE OF MISSOURI
Mel Carnahan, Governor • David A. Shorr, Director

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RECEIVED
APR 11 1996

March 18, 1996

Mr. Jim Dwyer
Facilitator, St. Louis Area Task Force
4515 Maryland Avenue
St. Louis, MO 63108

Dear Mr. Dwyer:

I appreciated the opportunity to serve as a member of the Expert Geohydrologic Panel chosen to evaluate the potential groundwater and surface water impacts from the contamination associated with the St. Louis Airport Site (SLAPS). As a geologist working for the Missouri Department of Natural Resources (MDNR), Division of Geology and Land Survey (DGLS); I have worked on this site since the late 1980's. My office has been involved with the site since the 1960's. I am very familiar with the site characterization, site conditions and past site investigations.

I am submitting a report separate from the majority of the geohydrologic panel members. I regret that my comments were not able to be included in the panel's original draft. I believe that it is vitally important to provide the St. Louis Area Task Force with a clear outline of what information is agreed to by the panel; what information is questionable and why; and what additional information will allow for better technical decisions to be made regarding the site. I believe the St. Louis Area Task Force needs specifics to support the conclusions and recommendations as stated so that they can formulate their final recommendation for the site as well informed as possible.

It is important to note that the conclusions in both my report and the panel's final report are basically the same. The three questions that were asked of the panel are essentially responded to in the same manner. However, additional background information, data documentation, and specific information supporting the final conclusions has been provided in my report. I have outlined the specific differences in geohydrological conditions from the eastern to western ends of the site. Also, a separate section on inconclusive data and data inadequacies has been prepared. It is my intent that the St. Louis Area Task Force will fully understand where conclusions have been formulated or where the data is still inconclusive at this point and conclusions may be only implied at this time.

If you have any questions, please feel free to call.

Sincerely,

DIVISION OF GEOLOGY AND LAND SURVEY

Mimi R. Garstang, P.G.
Deputy Division Director

MRG/dsb

FINAL REPORT
ST. LOUIS AIRPORT SITE
EXPERT GEOHYDROLOGIC PANEL
March 12, 1996

Report
Prepared for
St. Louis Area Task Force

Addendum Report
Prepared by
Mimi Garstang, member of the
The St. Louis Airport Site
Expert Geohydrologic Panel

FINAL REPORT
ST. LOUIS AIRPORT SITE
EXPERT GEOHYDROLOGIC PANEL
March 12, 1996

INTRODUCTION

An Expert Geohydrologic Panel was established by the St. Louis Area Task Force in late 1995 to review pertinent site information regarding geology, hydrogeology, surface water hydrology, and contaminant transport at the St. Louis Airport Site. This report describes the results of that review. The first meeting of the panel was on September 15, 1995, and preliminary results of the panel's review were provided in an oral presentation to the St. Louis Area Task Force on January 16, 1996. The St. Louis Area Task Force is a citizens' group created to evaluate the options available for remediation of the sites in the St. Louis area that are contaminated with low-level radioactive waste. These locations include the Mallinckrodt Plant, the Hazelwood Interim Storage Site, the St. Louis Airport site (SLAPS), and various vicinity properties.

The panel consisted of the following members:

Mr. David W. Miller (Chairman), Geraghty & Miller, Inc.
Dr. John D. Rockaway, University of Missouri
Mr. Thomas Aley, Ozark Underground Laboratory Inc.
Mr. James Cox, Walsh Environmental Scientists and Engineers, Inc.
Ms. Mimi Garstang, Missouri Department of Natural Resources
Mr. Angel Martin, Jr., U.S. Geological Survey

The first four members listed above are professionally representing only themselves in a private capacity with regard to the various issues. Mr. Angel Martin, Jr., as an employee of the U.S. Geological Survey (USGS), can comment on the technical

aspects of the work. The USGS cannot make any recommendations regarding remediation of the site or alternatives or recommendations for the possible closure of the site. Also, the USGS will not comment on criteria for the disposal of additional contaminated soil and debris and the nature of immediate or long-term actions and site modifications.

Ms. Mimi Garstang, currently is employed by the Missouri Department of Natural Resources, Division of Geology and Land Survey (MDNR/DGLS), as Deputy Division Director. Working as a geologist for the department since 1978, her participation on the panel also provided a historical perspective on many of the technical investigations and documents.

The questions provided to the panel for their analysis were as follows:

1. Is shallow groundwater contamination at the St. Louis Airport Site having, or expected to have, any environmentally significant impact on water or sediment quality in Coldwater Creek?

2. Is surface water runoff from the St. Louis Airport Site having, or expected to have, any environmentally significant impact on water or sediment quality in Coldwater Creek?

3. Is contamination present at the St. Louis Airport Site expected to have any environmental significant impact on the "deep" bedrock groundwater within the foreseeable future (e.g., next 100 years)?

The charge given to the panel was to restrict its review to the analysis of geologic and hydrologic issues related to SLAPS. These issues represent only some of the many factors that are typically considered with regard to decisions on future activities at

Superfund sites.

1. Adequacy of available data on which to base future decisions on risk.

2. Suitability of the site for disposal of additional wastes contaminated with low-level radioactivity.

3. Immediate activities that might be considered for increased monitoring and for minimizing potential environmental impacts.

BACKGROUND

The SLAPS is a 21.7 acre property adjacent to the Lambert-St. Louis International Airport. The property is bounded to the west by Coldwater Creek, to the south by the Norfolk and Western Railroad and to the north and east by McDonnell Boulevard. From 1946 to 1966, residues from the processing and production of various forms of uranium compounds were placed in the area. In the mid 1960's an unknown quantity of the residues were removed from the property and the entire property was covered with up to 3 feet of clean fill. Additional fill and rubble were placed at the site in the 1970's and in the late 1980's a gabion wall was constructed to minimize erosion by Coldwater Creek. Stormwater runoff is presently uncontrolled. Surface ditches and a pipe all drain the site directly into Coldwater Creek. The property is fenced and is subject to environmental monitoring and routine maintenance.

Radioactive contamination of soil at SLAPS has been characterized and extends to a depth of about 18 feet, with the majority of contamination between 4 and 8 feet below land surface (bls). Levels of uranium-238, radium-226, thorium-230, and thorium-232 in soil samples from these depths significantly exceed background levels. Analytical results of groundwater samples from some monitoring wells, stormwater samples, and sediment samples from Coldwater Creek also indicate elevated uranium levels. However, measured levels of radionuclides in surface water from Coldwater Creek were consistent with background levels and lower than proposed Department of Energy (DOE) clean-up guidelines. The results of sampling and monitoring at SLAPS are summarized in numerous reports on the property as referenced in the bibliographic attachment.

The SLAPS ground surface is essentially flat. It lies on the southeastern edge of a topographic depression known as the Florissant Basin. The Florissant Basin was created through bedrock erosion by a Mississippi River tributary. Sand, silt, gravel, and clay-rich materials filled this basin as glaciers blocked the tributary millions of years ago creating a quiet lake environment. The SLAPS lies essentially on the edge of this now sediment-filled ancient lake.

The stratigraphy on the western portion of the site depicts silty materials at ground surface that grade into fine sand and silty clay. At the 40-50 feet depth, a clay-rich unit is present that has been inferred to hydrologically separate the saturated lake deposits into two groundwater systems in this area. The lake deposits below the clay-rich unit on the western portion of the site consist mostly of silty clay and clayey and sandy gravel. Limestone, the uppermost bedrock formation, exists at depths of approximately 90 feet. Static water levels are usually about 8-10 feet below ground surface.

Beneath the eastern portion of the site lies one continuous sequence of saturated unconsolidated material. The materials grade from clayey silt to clayey and sandy gravel. This is the true edge of the ancient lake where bedrock erosion left weathered shale and coal exposed until subsequently covered by the deposits of the glacial lake to depths of 55 feet. The weathered coal and shale overlie the deeper limestone unit that is the upper bedrock on the western part of the site. No clay-rich potential confining clay-rich layer has been identified as present in the glacial lake sediments in this area. Static water levels are as shallow as 2-5 feet below ground surface. Due to limited drilling, true stratigraphic conditions between the eastern and western edge of the site are unknown.

Minimal characterization of the bedrock beneath the site has occurred. A single well has been completed in the limestone bedrock aquifer. This bedrock aquifer has historically been utilized for potable water in the Florissant Basin Area. Eight producing wells are known to have existed within 3 miles of the site. Water quality is good in the limestone. This is characteristic of the glacial lake sediment area due to larger and more rapid recharge than in much of the St. Louis area geologic settings. The limestone is expected to produce enough water for private water usage and possibly some commercial usage.

PROCEDURES

To address the issues, the panel members reviewed the data, analyzed the conclusions drawn from previous DOE investigations and participated in a series of meetings focused on reviewing available site data. At these meetings, presentations were made by the technical personnel who had been associated with many of the previous studies. Panel members often requested supplementary information, explanation of assumptions or processes and further analysis of available data. The responses to these requests were included as part of the panel review process. The panel members independently evaluated the data. There were meetings and discussions to determine if a general concurrence existed relative to answers for the three questions reviewed by panel members.

The panel especially wants to thank David S. Miller of Science Applications International Corporation for his efforts in providing background information on the site

to the panel and in responding to the panel's many requests for additional data analysis. Mr. Miller and the other DOE contractors involved in this process greatly simplified the panel's review through their thorough and timely presentations.

ANALYSIS

A number of factors were considered to be of major importance in supporting the conclusions and recommendations of the panel's review. The following listing describes conclusive information that the panel concurred upon:

1. Radionuclides are present in groundwater with higher concentrations identified near Coldwater Creek. A potential avenue exists for direct groundwater discharge of radionuclides to the creek.

2. Soil contaminated with radionuclides is present is present below the water table. Groundwater is in contact with a source of radionuclides under portions of SLAPS.

3. Significant levels of radionuclides are present in the soil at very shallow depths (i.e., less than 0.5 feet bls along McDonnell Boulevard on the northern boundary of SLAPS and the railroad tracks along the southern boundary). Much of the area is easily accessed by the public.

4. Groundwater monitoring has shown the migration of radionuclides in the direction of shallow groundwater flow across McDonnell Boulevard and under the formerly used ballfields property to the north. This factor raises concern over potential shallow discharges of radionuclides to Coldwater Creek to the west and the north. Low concentrations of radionuclides have been regularly detected in

monitoring well B53W075. This well is approximately 800 feet north of the SLAPS property boundary and is adjacent to Coldwater Creek. This might be expected, given the physical properties of the lacustrine (glacial lakebed) sediments.

5. Coldwater Creek sediments containing radionuclides extend downstream from the site for 7-8 miles. Although this condition may have resulted from historic erosion at the SLAPS before the present gabion wall was constructed, it may also be indicative of contaminated stormwater discharging from the present SLAPS drainage system. As late as the fourth quarter of 1994, one stormwater sample collected at SLAPS exceeded the DOE reference value for "Radiation Protection of the Public and the Environment."

6. Volatile organic chemicals have been found in groundwater at SLAPS. This poses two risk elements. These chemicals are individually important environmental contaminants. Second, they can provide the potential for facilitating transport of less mobile chemicals and other substances through the groundwater system.

7. Total carcinogenic risks from radionuclide exposure at SLAPS, as estimated in the baseline risk assessment prepared by Argonne National laboratory in 1993, were 9.4×10^{-5}, 1.1×10^{-3}, and 1.1×10^{-1} for a SLAPS trespasser, maintenance worker, and future resident, respectively. Although these are relatively high values, the report points out that conservative, worst case scenarios were assumed in arriving at these estimates, especially with regard to future land use.

8. Most of the unconsolidated lacustrine sediments beneath the site are fine-grained and exhibit moderate horizontal permeabilities with lower vertical permeabilities. They also tend to absorb radionuclides.

9. There is limited groundwater use in the immediate SLAPS area. Also, most potable water used for public water supplies is from surface water sources (the Missouri and Mississippi Rivers).

10. The unconsolidated lakebed sediments are serving as a reservoir of fresh water recharge to the bedrock beneath the site. Potable water is present in the limestone bedrock aquifer that is normally saline in this general area.

Inconclusive data and information lead the panel to identify the following concerns and inadequacies:

1. Little is known about the areal extent or thickness of the potential clay-rich unit due to limited drilling to depth.

2. True separation of the groundwater above and below the potential confining unit is unknown. Aquifer tests were not conclusive. Only one field permeability test was completed on the potential confining unit. This test was made off-site and varied considerably from laboratory results.

3. The vertical extent of groundwater contamination is unknown beneath the middle portion of SLAPS. The stratigraphy beneath the center of the site also is not clearly defined. It is important to understand the conditions in this area.

4. Characterization of the materials and groundwater flow below approximately 50 feet is poor. Only one well has been completed in the limestone near SLAPS. Potentiametric maps for the lower units cannot be created due to lack of information.

5. Vertical flow gradients indicated by monitoring wells are inconclusive. Sediment

accumulation has impacted water levels in wells. Steep downward gradients have been indicated on the southern SLAPS boundary. It is important to understand where steep vertical gradients truly exist to identify where shallow contamination may more readily move to depth.

6. Historically groundwater within a 3 mile radius of SLAPS has been utilized for industrial and private consumption. A current door-to-door survey to document present day groundwater use will identify any users at risk and any water production that may influence contaminant migration.

7. Sampling programs at SLAPS have not been consistent. Organic and inorganic analysis has not been regularly documented. No sampling occurred from 1992-1995.

8. Stream gaging information for Coldwater Creek at SLAPS is minimal. A true relationship between the creek and shallow groundwater is unknown.

9. The source and extent of TCE, DCE, and toluene contamination at the site is unknown.

10. One bedrock well sporadically shows elevated uranium levels. This well is completed in the coal and shale units that may contain naturally-occurring radiation. This well also is at the eastern edge of the site where the potential confining unit is known to be absent. It is important to understand if this is evidence of radionuclides moving to depth or if it is a natural phenomena.

MODEL PROJECTIONS

Because the issues raised by the St. Louis Task Force involved future impacts, The panel included in its deliberations the groundwater modeling study conducted by the DOE contractors. During several meetings with the contractors, the model parameters were reviewed and suggestions were made for modification of some of the parameters. The results of the modeling projected little environmental impact on Coldwater Creek or the bedrock aquifer for over 100 years. Conservative assumptions were utilized even if they were not totally representative of the true site conditions. The panel recommended expansion of the model to provide a more complete picture of potential migration of radionuclides to Coldwater Creek and to the bedrock groundwater system as more data are obtained.

The panel concluded that the three-dimensional groundwater flow model completed to this point is reasonably sound. The calibration results based on simulating measured water levels in the upper groundwater system were acceptable. However, model calibration was completed with only a limited data set for the lower groundwater system. Limitations of that data include the fact that the stratigraphy underlying SLAPS has not been fully characterized, and significant gaps in various data sets are present. For example, the continuity and thickness of the potential clay-confining layer across the site is not known. This unit has been thought to restrict vertical flow between the upper and lower groundwater systems; and therefore, also possibly restrict the movement of contamination. Determination of where this unit exists and its true permeability characteristics is important in defining the hydrology and possible movement of contamination at this site. Also, the hydrology of the limestone and shale are not fully understood because of the lack of wells open to the bedrock at or near the site.

The flow model has not been verified in that the model has not been run with an independent set of data. This should be done so that the model can be utilized with confidence in the simulation of the distribution of concentration of radioactive constituents underlying the site. The current distance that radionuclides have already moved off-site must be simulated by the model with realistic assumptions. Comparison of streamflow in Coldwater Creek with simulated groundwater discharge to the creek is recommended in future calibrations.

CONCLUSIONS

As a result of the review of available data, analysis drawn from previous DOE investigations, and the modeling studies, the panel has developed a number of conclusions regarding existing levels, distribution and impact of contamination at the site as well as conclusions regarding projected levels and distribution of contamination in the future (100 years).

1. Radionuclides are present in shallow groundwater at SLAPS, and the result of the groundwater modeling study indicate that there will continue to be off-site migration of contaminants through the upper groundwater system toward Coldwater Creek. However, groundwater modeling indicates that levels of contamination would not exceed DOE guidelines for at least 100 years. The model results are consistent with the creek sampling data available for SLAPS, but not with shallow groundwater monitoring data.

2. The presence of radionuclides at the SLAPS has impacted sediment quality in the stream channel and banks of Coldwater Creek. This has been caused by stream bank erosion adjacent to the SLAPS and from sheet and gully erosion across the site. Also, stormwater flow and flooding along Coldwater Creek has resulted in periods of accelerated erosional activity. Contaminant migration from soil erosion appears to have been more significant in the past. Current rates of erosion have been reduced from previous levels as a result of the natural re-establishment of vegetation over parts of the site and the construction of the gabion wall to control bank erosion along Coldwater Creek. However, neither of

these features has completely eliminated the contribution of radionuclides into the surface waters of Coldwater Creek. Although the impact of these sources is not acute at this time, it does present a chronic problem to environmental quality along Coldwater Creek and should be corrected or mitigated.

3. Results of the groundwater modeling study indicate that the presence of radionuclides in the soil and upper aquifer system at SLAPS will not have a significant impact on the bedrock aquifer within the foreseeable future (100 years). However, the panel concluded that this deep groundwater system has not yet been sufficiently characterized, and that both the model and the conclusions drawn from the model will require verification as additional data become available.

4. The site is underlain by hydrogeological features that do not meet criteria for the location of a storage or disposal facility for radionuclide wastes. It is the conclusion of the panel that the site should not be used for the disposal of additional contaminated soil or other waste products. Physical, geological, and hydrological aspects of the site that do not meet present criteria for disposal of wastes include a shallow water table, a flood plain setting, the absence of a continuous and relatively thick confining layer, the unknown bedrock conditions, and finally, the accessibility of the site. It should be noted that the model and risk assessment assumed no additional waste material would be placed at the site.

IMMEDIATE ACTIONS

Although the results of previous studies indicate that the impact of radionuclide contamination from the SLAPS into Coldwater Creek and the deep groundwater system are not acute at this time, there are a number of actions that the panel believes should be implemented immediately. These actions would be designed both to mitigate the existing situation and to facilitate future investigations of contaminant migration and remedial action studies. The actions suggested do not represent a conclusion from the panel with respect to a recommended level or method of remediation, but are actions the panel considers could be implemented to reduce the off-site migration of radionuclide contamination from the present site.

1. The gabion wall, which was constructed to prevent sediment erosion along the western creek bank, has resulted in significant reduced sediment contamination in Coldwater Creek. However, the proximity of the radioactive contamination to the creek, the presence of contaminated material within the floodplain, the stormwater runoff ditches and direct discharge pipe provide a rapid pathway for potential contaminant migration into the creek. There continues to be direct discharge of impacted material into the creek as indicated by the water-quality samples collected from one on-site stormwater sampling location. There is an immediate need to establish a site drainage control and prevention program to eliminate discharge of contaminated stormwater to Coldwater Creek.

2. The need for additional flood-protection facilities should be evaluated in order to maximize protection of the site from erosion during periods of flooding along Coldwater Creek.

3. The uncontrolled shallow soils contaminated with radionuclides found along McDonnell Road and the railroad right-of-way should be considered for removal as part of the ongoing remediation activities.

ADDITIONAL DATA ACQUISITION

The panel concluded that additional data will be required to develop a more complete hydrogeological assessment of the deep groundwater system and a more comprehensive analysis of contaminant sources. This information is considered necessary to more thoroughly assess potential off-site contamination and to verify the results of groundwater modeling.

1. Two deep monitoring wells should be installed that extend into the limestone bedrock. These wells should be designed to provide additional information on the deeper subsurface stratigraphy and the hydraulics of the lower groundwater system. They should be included in the groundwater monitoring program.

2. Consideration should be given to installation of a (larger diameter) well so that it could yield sufficient water to stress the groundwater deeper than the 50 foot depth. A controlled aquifer test should be done to provide data that could be used to better characterize the various groundwater systems and the potential confining unit.

3. Continuously recording stream gages should be installed upstream and downstream of the site. These would be useful in providing data for model simulation and determination of flow characteristics in Coldwater Creek. More water quality sampling of creek water should be implemented.

4. Additional information should be acquired on the levels and types of groundwater contamination in the central region of the site. In this area high concentrations of contaminants are present in the soil, yet data on the underlying groundwater quality are limited and the extent of contamination is poorly defined. The known extent of the potential confining unit in this area is also limited.

5. Additional information should be obtained on the nature and distribution of both organic and inorganic chemicals at the site. The data would be useful in helping

to understand the hydraulic relation between the various geologic units and potential to enhance the migration of radionuclides.

6. A comprehensive long-range program should be established for the implementation of continued hydrogeologic assessment studies at the site. To date, the continuity of monitoring has been interrupted several times. Data collection and analysis must address surface and groundwater quality, static water levels, erosion, sedimentation, and contaminant migration through and from the site without continual interruption.

7. A door-to-door well survey documenting water use in the area will verify safety for the public and any potential influence on groundwater flow in the area.

8. Additional modeling of the site should be done. Once additional data are acquired on the lower unconsolidated units and bedrock beneath the site, projections on the vertical extent of contamination can be made. Modeling must also include the fate and migration of organic contaminants at the site as well as their impact on migration of radionuclides.

LONG RANGE PLANNING

The panel suggests that a comprehensive long-range program be established for the implementation of future hydrogeologic assessment studies at the site. To date, the continuity of monitoring has been interrupted from time-to-time. Data collection and analysis should address surface and groundwater quality and flow, erosion, sedimentation and contaminant migration through and from the site. Water dating, aquifer testing, permeability testing and flow analysis are just a few of the investigations to consider as future plans are made.

Refinements in appropriate actions can be made as additional data are compared to the anticipated results and model predictions. If changes in site conditions are made which invalidate the model assumptions (i.e., additional waste is stored at the site or excavation of the waste occurs) then additional characterization of the impact and a re-evaluation of additional data needed will be necessary.

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St. Louis Site Remediation Task Force

APRIL MEETING SCHEDULE

Tuesday, April 23, 1996 9 a.m.	Alternative Sites Working Group, Berkeley City Hall, 6140 North Hanley Road, Berkeley The meeting will be devoted primarily to discussion of the information presented by representatives of Dawn Mining Co. and Envirocare of Utah. The working group will also develop a plan and schedule for all remaining tasks.
Wednesday, April 24, 1996 9 a.m.	Priorities Working Group, Berkeley City Hall, 6140 North Hanley Road, Berkeley The principal purpose of the meeting is to discuss the draft Engineering Evaluation and Cost Analysis (EE/CA) prepared by DOE for Task Force review. The working group will also develop a plan and schedule for all remaining tasks.
Thursday, April 25, 1996 1 p.m.	Technologies Working Group, World Trade Center, 121 South Meramec, Clayton The principal purpose of the meeting will be to continue discussion of potentially suitable technologies for the St. Louis Site.

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Other Technical Health, Safety, and Environment Studies and Reports

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Formerly Utilized Sites Remedial Action Program (FUSRAP)

ADMINISTRATIVE RECORD

for the St. Louis Site, Missouri

U.S. Department of Energy

4.14-1070.2

Technologies Working Group
Report to the St.Louis Remediation Task Force
August 18, 1996

I. Background

The principle goal of the Technologies Working Group (TWG) was to identify and evaluate technologies that offer a potential for reducing the cost of the remediation of the St. Louis FUSRAP site. It was expected that the suitability of innovative technologies would be tested initially by bench scale studies, followed by pilot tests, if warranted. (See TWG Goals/Objectives - Attachment 1).

The review process included:

1. Identification of technologies

2. Selection/evaluation of appropriate technologies

3. Recommendation of most promising technologies

Initial screening of technologies was based on:

- effectiveness
- implementability
- cost

The idea was to look for technologies that are faster, better, safer, and cheaper.

Further, it was decided to focus on remedial technologies applicable to soils, surface water and groundwater since these are the areas where the biggest cost savings could be generated.

First, potential technologies were identified from documents prepared by or for the DOE as well as from DOE contractors and TWG members. The list of key documents used for identification is presented in Attachment 2.

Lists of potential remedial options for soils/sediments, buildings and structures, and surface water and groundwater are presented in Attachments 3, 4, and 5 respectively.

Ultimately the TWG focused on the evaluation of volume reduction processes, soil washing and vitrification in particular, since these were the most promising technologies for application at the St. Louis FUSRAP Site.

Technologies Working Group
Report to the St. Louis Remediation Task Force
August 18, 1996

Review of Soil Washing and Ex-Situ Vitrification

Soil washing tests had been previously commissioned by the DOE. Physical and chemical soil washing were evaluated using soil samples from the St. Louis Airport Site (SLAPS). Based on these tests, it was determined that soil washing was not economically viable for SLAPS even without considering that major issues such as wastewater treatment, disposal of concentrated liquid waste, and use of chelating agents had not been resolved.

However, due to different soil characteristics at the St. Louis Downtown Site and Vicinity Properties (SLDS), physical soil washing particle size/gravity separation could potentially be viable for physical soil washing application at this site.

Ex-Situ microwave vitrification was evaluated based on information provided by Clean Earth Technologies (CET).

Detailed cost estimates were then prepared by SAIC, followed by updated cost estimates developed by CET. Both sets of data are presented in Attachment 6. Key factors are percent of volume reduction and disposal costs. If either of these factors were to change (i.e. per cent volume reduction goes down or disposal costs go up then) than cost estimates would be impacted. Details of the cost estimates are presented in Attachments 7 and 8.

Based on these estimates, vitrification is revenue neutral relative to disposal without treatment. But, vitrification does have the added benefit of stabilization.

Recommendations

- The TWG requests that the following treatment technologies be evaluated for application at the St. Louis FUSRAP site.

    1. Ex-Situ microwave vitrification

    2. Physical soil washing (particle size/gravity separation).

Technologies Working Group
Report to the St. Louis Remediation Task Force
August 18, 1996

- The TWG requests that the following analytical technologies be evaluated for use at the St. Louis FUSRAP site.

  1. Laser evaluation and neutralization spectroscopy.
  2. Mobile gamma-ray spectroscopy.

- The number of potentially available remedial technologies continues to increase as they are identified, developed, and proven in the field. The TWG recommends that the DOE continue to evaluate new and existing technologies to identify those that may become viable for use at the St. Louis Site. Further, the TWG believes the important characteristics to consider in evaluating technologies for potential application at the St. Louis FUSRAP site are:

  1. Volume reduction either through treatment of soils and/or through use of analytical tools to minimize materials for disposal or treatment.
  2. Stability of final waste.
  3. Management of groundwater and surface water. (In particular, through the use of engineering controls.)
  4. Control of contaminated emissions (air and water)
  5. Engineering controls. (e.g. Temporary enclosures, artificial frozen barriers, etc.)
  6. Cost effectiveness
  7. Analytical tools to optimize selection of materials for processing

Technologies Working Group

The principal goal of the Technologies Working Group is to identify and evaluate technologies that offer a potential for reducing the cost of the remediation of the St. Louis Site, and to develop recommendations for consideration by the Task Force. It is anticipated that various technologies potentially suitable for site characterization, remedial action, and post-remedial waste management will be evaluated.

The working group is currently developing a process to be used to identify technologies for evaluation. It is expected that the suitability of innovative technologies would be tested initially by bench-scale studies, followed by pilot tests, if warranted.

A primary objective of the working group is to identify efficient, practical ways to minimize the volume of waste that must be disposed of off site through better characterization, stabilization, and/or treatment, so as to reduce the overall cost of remediation.

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ATTACHMENT 2

List of Key Documents Used to Identify Potential Technologies

1. Initial Screening of Alternative Report for the St. Louis Site, October 1992

2. Review of Three Reports on FUSRAP Properties at St. Louis, Missouri, May 11, 1995

3. Characterization of the Soil Samples from the St. Louis, Missouri, FUSRAP Site, August 10, 1995

4. Field Screening Technology Demonstration Evaluation Report, Draft, November 1995

5. Oak Ridge National Laboratory Technology Logic Diagram, September, 1993

   a. Executive Summary

   b. Indexes

   c. Volume 1, Technology Evaluation (Parts A, B, and C)

   d. Volume 2, Technology Logic Diagram (Parts A, B, and C)

   e. Volume 3, Technology Evaluation Sheets (Parts A, B, and C)

6. Feasibility Study/Environmental Impact Statement for the St. Louis Site, April 1994

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Institutional Controls Site Maintenance	<u>Site Security</u>			
	• Fencing / Signs	Fencing may reduce direct contact with contaminated soil.	SLAPS, HISS, and SLDS are already fenced and security is already being implemented by owners. Implementation at other properties may be difficult.	Moderate capital; very low operation and maintenance costs
	<u>Land Use / Controls</u>			
	• Deed Restrictions	Effectiveness depends on continued future implementation .	Implementable	Negligible costs
	<u>Environmental Monitoring</u>			
	• Monitoring of Media	Useful for documenting and evaluating conditions, but does not reduce risk.	Implementable	Low capital; moderate operation and maintenance costs

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Attachment 3
Potential Remedial Options for Soils/Sediments

Response Action	Remedial Option	Effectiveness	Implementability	Cost
4. Treatment	Volume Reduction Processes			
	• Soil Washing	Will not be as effective in removing thorium. Potentially effective as pretreatment to other separations techniques.	Large quantities of water may be required. Locating site for treatment may require extensive permitting by the state.	Moderate
	• Screening	Potentially effective in separating particles based on size.	Implementable; however, substantial additional information will be required and pilot tests will have to be conducted.	High
	• Classification	Soils with high clay content as at SLDS and HISS will be difficult to process.	Implementable	Moderate

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Attachment 3
Potential Remedial Options for Soils/Sediments

Response Action	Remedial Option	Effectiveness	Implementability	Cost
5. Disposal / Discharge (continued)	<u>Offsite Disposal (continued)</u>			
	• Road Bed Dispersal	Potentially effective for soils with low radioactivity levels.	May not be easily implementable. Social and political issues may hinder implementability.	Moderate to High
	• Offsite Land Encapsulation at a Dedicated In-State Facility	Effective if an appropriate location can be found.	May not be easily implementable. Social and political issues may hinder implementability.	High

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Attachment 4
Potential Remedial Options for Buildings and Structures

Response Action	Remedial Option	Effectiveness	Implementability	Cost
1. Institutional Controls /Site Maintenance	Institutional Actions			
	• Deed Restrictions	Effectiveness depends on continued future implementation.	Implementable.	Negligible costs.
	Site Security			
	• Fencing/Signs	Fencing may reduce direct contact with contaminated soil.	Implementable	Low costs
	Environmental Monitoring			
	• Monitoring of Ambient Air	Useful for documenting and evaluating conditions.	Implementable.	Low capital; moderate O & M costs
2. Containment	Surface scaling			
	• Paints, resin/plastic or Other Impermeable Barriers	Limits dermal and inhalation exposure for a limited time.	Implementable	Low costs

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Attachment 5
Potential Remedial Options for Surface Water and Groundwater

Response Action	Remedial Option	Effectiveness	Implementability	Cost
1. Institutional Control/Site Maintenance	<u>Institutional Actions</u> • Deed Restrictions	Effectiveness depends on continued future implementation.	Implementable	Negligible cost
	<u>Environmental Monitoring</u> • Groundwater / Surface Water Monitoring	Useful for documenting and evaluating conditions.	Implementable..	Low capital; moderate operation and maintenance costs.
2. Containment and Surface Water Controls	<u>Vertical Barriers</u> • Slurry Walls	Barrier design would require consideration of groundwater contaminants that may degrade barrier materials.	Potentially implementable at SLDS.	High; however, is considered less expensive than other potential containment measures.
	<u>Horizontal Barriers</u> • Grout Injection	Could be useful in containing waste sources from contact with groundwater under buildings and structures	Potentially implementable; however, technique has not been proven to a large extent. Could be used in localized areas to contain source of contamination from contact with groundwater.	High capital costs. Low operation and maintenance costs.

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Attachment 5
Potential Remedial Options for Surface Water and Groundwater

Response Action	Remedial Option	Effectiveness	Implementability	Cost
2. Containment and Surface Water Controls (continued)	<u>Revegetation</u>			
	Grasses, Shrubs, and Trees	Effective in reducing erosion and stabilizing the surface of a covered disposal site, thereby improving the effectiveness of a cap.	Implementable. Applicable only to areas with soil cover.	Moderate capital; moderate operation and maintenance costs.
	<u>Vertical Barriers</u>			
	<u>Grading</u>			
	• Scarification and contour Furrowing	Effective in controlling infiltration, diverting runoff, and minimizing erosion.	Implementable in Coldwater Creek only at strategic locations; more easily implementable at drainage ditches from site.	Moderate costs

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Attachment 5
Potential Remedial Options for Surface Water and Groundwater

Response Action	Remedial Option	Effectiveness	Implementability	Cost
2. Containment and Surface Water Controls (continued)	Diversion Systems			
	• Dikes and Berms	Effective as a short-term measure in controlling and diverting flow.	Implementable. Not effective for unsloped drainage areas larger than 5 acres.	Moderate costs
3. Collection	Pumping			
	• Extraction Wells	Potentially effective, but removal times can be long.	Implementable, but care must be taken for proper placement of wells..	Moderate capital; moderate operation and maintenance costs
	• Extraction/Injection Wells	Potentially effective, but injection wells are proven to have operational problems.	Implementable, but "dead spots" of water movement can occur if injection wells are not placed properly.	Moderate capital; moderate operation and maintenance costs

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Attachment 5
Potential Remedial Options for Surface Water and Groundwater

Response Action	Remedial Option	Effectiveness	Implementability	Cost
4. Treatment	Physical Processes			
	• Air Stripping	Effective and proven method for removal of radon and VOCs.	Implementable	Low capital; low operation and maintenance costs
	• Carbon Absorption	Effective for attaining good removal and low effluent levels for organics and radionuclides. Suspended solids may require removal prior to treatment to avoid clogging of carbon bed.	Implementable	Low capital; high operation and maintenance costs
	• Ion Exchange	Effective for achieving low concentration of subject chemicals. Effective for removal of radionuclides.	Implementable	Moderate capital; high operation and maintenance costs
	• Evaporative Recovery	Effective in producing concentrated waste stream.	Implementable, but high energy requirements	Moderate capital; high operation & maintenance costs

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Attachment 5

Potential Remedial Options for Surface Water and Groundwater

Response Action	Remedial Option	Effectiveness	Implementability	Cost
5. Disposal/Discharge	Onsite Discharge/Disposal			
	• Surface Water Discharge	Effective and reliable discharge method.	Implementable	Low capital; Low operation and maintenance costs
	Offsite Discharge/Disposal			
	• 11(e)(2) Landfill or Mixed Waste (MW) Landfill	Effective for disposal of treatment residuals considered hazardous.	Implementable	High cost
	• Publically owned treatment works	Pretreatment may be required.	Implementable	High capital. Low operation and maintenance costs.

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ATTACHMENT 6

Vitrification Preliminary Cost Estimates

	Base Costs (St. Louis Airport Site - Task Force Option 4*	Vitrification Volume Reduction 25%	50%
SAIC (DOE Contractor)	$208,400,000	$295,800,000	$247,100,000
Clean Earth Tech.	$202,400,000	--	$200,700,000

* Complete excavation, shipment and disposal off-site.

ATTACHMENT 7

Comparison of Exsitu Vitrification and Taskforce option 4 for the SLAPS site.

Differences between these two estimates and the previous estimates are mostly due to a recomputation of the volume. Both estimates now deal with the same volume of material at SLAPS. (279,000 yd^3) This volume is the volume for SLAPS given in the FS.

The differences between the two estimates in terms of Monitoring Sampling and Analysis, Site Development, and Building and Services are due to differences in schedule and differences in assumptions that went into the estimates. MSA and Building and Services are schedule driven. For the Taskforce estimate, previously estimated costs from similar properties were used on a cost per week or cost per month basis. For the Exsitu Vitrification these same quantities were estimated based on the perceived needs for this particular project. The higher costs for the Taskforce estimate were due to interpretation of the Taskforce Matrix requirements and consequently the selection of higher weekly or monthly costs.

Site institutional controls Surveillance and Maintenance cost for the Taskforce estimates are mostly due to the presence of a full time security guard. In the Exsitu Vitrification estimate these costs (without the security guard) are captured in Site Development although some could be expanded into this line items as has been done for the 25% volume reduction case.

Two line items that may confuse the reader are the Reserved items WBS 1.1.1.3.1.14 and 1.1.1.10. These lines are costs for professional staff at the site and in the home office respectively. Differences between them reflect differences in the schedules (these items are schedule dependent) and differences in the staffing levels.

In Exsitu vitrification the two differing assumptions are that in one case there will be a 50% reduction of the exsitu volume for disposal and in the other there will be only a 25% reduction. The 50% is based on a vendor estimate. The 25% case is a sensitivity test.

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<u>Attachment 7</u>
(Continued)

Prepared by SAIC

St. Louis SLAPS
FUSRAP Remediation Alternatives
WBS Cost Summary
30 Year Cost, 1996$

WBS NUMBER	WBS NAME	COMPLETE EXCAVATION, EX SITU VITRIFICATION & COMMERCIAL DISPOSAL	SLAPS Taskforce OPTION 1
1	FUSRAP Program	$ 295,799,339	$ 208,363,818
1.1	FUSRAP Projects	205,773,453	144,948,743
1.1.1	St. Louis FUSRAP Project	205,773,453	144,948,743
1.1.1.1	Project Screening and Assessment	0	0
1.1.1.2	Remedial Design	18,596,962	13,015,647
1.1.1.3	Remedial Action	185,969,619	130,156,468
1.1.1.3.1	Remedial Action Sitework	185,969,619	130,156,468
1.1.1.3.1.1	Monitoring, Sampling and Analysis	715,102	851,792
1.1.1.3.1.2	Site Development	101,735	318,769
1.1.1.3.1.3	Building and Services	161,770	295,269
1.1.1.3.1.4	Excavation	15,125,843	15,298,761
1.1.1.3.1.5	Other Collection and Control	0	0
1.1.1.3.1.6	Disposal	52,610,472	75,992,904
1.1.1.3.1.7	Transportation	39,648,318	34,708,577
1.1.1.3.1.8	Treatment	75,330,000	0
1.1.1.3.1.9	Demolition, Decontamination and Decommissioning	0	0
1.1.1.3.1.10	Site Management	0	0
1.1.1.3.1.11	Site Engineering and Technical Support	0	0
1.1.1.3.1.12	Site Environmental Compliance	0	0
1.1.1.3.1.13	Site Institutional Controls, Surveillance and Maintenance	18,666	418,120
1.1.1.3.1.14	Reserved	2,257,713	2,272,277
1.1.1.3.2	Remedial Action Management	0	0
1.1.1.3.3	Remedial Action Engineering and Technical Support	0	0
1.1.1.3.4	Remedial Action Environmental Compliance	0	0
1.1.1.3.5	Remedial Action Institutional Controls, Surveillance and	0	0
1.1.1.3.6	Reserved	0	0
1.1.1.4	Post Remedial Action Activities	0	0
1.1.1.5	Disposal Siting	0	0
1.1.1.6	Project Management	0	0
1.1.1.7	Project Engineering and Technical Support	0	0
1.1.1.8	Project Environmental Compliance	0	0
1.1.1.9	Project Institutional Controls, Surveillance and Maintena	0	0
1.1.1.10	Reserved	1,206,872	1,776,628
1.2	Discovery and Designation	0	0
1.3	FUSRAP Program Management & Technical Support	38,582,522	27,177,889
1.4	Reserved	0	0
	CONTINGENCY (25%)	$ 51,443,363	$ 36,237,186

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<u>Attachment 7</u>
(Continued)

Prepared by SAIC

St. Louis SLAPS
FUSRAP Remediation Alternatives
WBS Cost Summary
30 Year Cost, 1996$

WBS NUMBER	WBS NAME	COMPLETE EXCAVATION: EX SITU VITRIFICATION & COMMERCIAL DISPOSAL	SLAPS Taskforce OPTION 4
1	FUSRAP Program	$ 247,141,753	$ 208,363,818
1.1	FUSRAP Projects	171,924,697	144,948,743
1.1.1	St. Louis FUSRAP Project	171,924,697	144,948,743
1.1.1.1	Project Screening and Assessment	0	0
1.1.1.2	Remedial Design	15,519,802	13,015,647
1.1.1.3	Remedial Action	155,198,023	130,156,468
1.1.1.3.1	Remedial Action Sitework	155,198,023	130,156,468
1.1.1.3.1.1	Monitoring, Sampling and Analysis	715,102	851,792
1.1.1.3.1.2	Site Development	101,735	318,769
1.1.1.3.1.3	Building and Services	161,770	295,269
1.1.1.3.1.4	Excavation	15,125,843	15,298,761
1.1.1.3.1.5	Other Collection and Control	0	0
1.1.1.3.1.6	Disposal	35,073,648	75,992,904
1.1.1.3.1.7	Transportation	26,432,212	34,708,577
1.1.1.3.1.8	Treatment	75,330,000	0
1.1.1.3.1.9	Demolition, Decontamination and Decommissioning	0	0
1.1.1.3.1.10	Site Management	0	0
1.1.1.3.1.11	Site Engineering and Technical Support	0	0
1.1.1.3.1.12	Site Environmental Compliance	0	0
1.1.1.3.1.13	Site Institutional Controls, Surveillance and Maintenance	0	418,120
1.1.1.3.1.14	Reserved	2,257,713	2,272,277
1.1.1.3.2	Remedial Action Management	0	0
1.1.1.3.3	Remedial Action Engineering and Technical Support	0	0
1.1.1.3.4	Remedial Action Environmental Compliance	0	0
1.1.1.3.5	Remedial Action Institutional Controls, Surveillance and	0	0
1.1.1.3.6	Reserved	0	0
1.1.1.4	Post Remedial Action Activities	0	0
1.1.1.5	Disposal Siting	0	0
1.1.1.6	Project Management	0	0
1.1.1.7	Project Engineering and Technical Support	0	0
1.1.1.8	Project Environmental Compliance	0	0
1.1.1.9	Project Institutional Controls, Surveillance and Maintena	0	0
1.1.1.10	Reserved	1,206,872	1,776,628
1.2	Discovery and Designation	0	0
1.3	FUSRAP Program Management & Technical Support	32,235,881	27,177,889
1.4	Reserved	0	0
	CONTINGENCY (25%)	$ 42,981,174	$ 36,237,186

Prepared by Clean Earth
Technologies

Review of the Cost Analysis Comparison Between the Non-treatment and Ex-situ Vitrification Alternatives for the St. Louis FUSRAP Sites

June 10, 1996

A Cost Analysis (CA) of two remedial action alternatives was prepared by SAIC for DOE and submitted to the St. Louis Remediation Taskforce, Alternative Technologies Working Group. The CA considered a non-treatment alternative: excavate, ship, and dispose and a treatment alternative: excavate, ex-situ vitrify on site, ship, and dispose. The results of the CA estimated that the treatment alternative cost to be 19 % higher than the non-treatment cost. However, this comparison is not valid because several assumptions used in the CA are incorrect. These concern the cost of vitrification and the anticipated volume reduction. Moreover, the CA leaves out estimated costs for the additional risks and liabilities associated with the non-treatment alternative which is a removal action and not a remedial action. Because of this, the cost analysis is flawed and should not be considered as satisfying the requirements of the remedial action selection criteria of the National Contingency Plan (NCP). In the present review, it is shown that the ex situ vitrification remedial action alternative has slightly lower cost than the non-treatment alternative when the costs associated with the risk and liabilities of the non-treatment alternative are ignored.

Several assumptions made in the CA are incorrect. These are the discussed below. The impact on treatment, transportation, and disposal costs are calculated.

1. The net volume reduction should not be reduced by an excavation density expansion factor. The 50 % volume reduction anticipated for St. Louis soil is based on benchtop tests of uncontaminated St. Louis soil. It is based on the in-ground density and assumes a 15 % moisture content. Thus, the 279,000 cu yd. of soil will result in 139,500 cu yd of glass-like wasteform to be shipped for disposal. At $209.52/cu yd for disposal, this leads to disposal cost of $29.23 M.

2. A density of 1.35 tons per cubic yard is quoted for the CA. This corresponds to a density of 100 pounds per cubic foot (pcf). This is high unless it already includes the moisture content. The *Remedial Investigation Report for the St. Louis Site* (RI) [DOE/OR/21949-280, Jan, 1994] lists typical dry density to be approximately 90 pcf. The *St. Louis County Soil Survey* by the Soil Conservation District lists the dry density for the Nevin soil group that is the type generally found in the SLAPS and its vicinity as being slightly less than the RI value.

3. Vitrification costs are based on the mass of wasteform produced per hour. The estimated cost is $200/metric ton (not $200/short ton of input waste feedstock). The total cost of treatment can be obtained by calculating the total input waste mass, assume a waste loading factor, and accounting for the physical changes and chemical reactions that cause reduction in waste feedstock mass that ends up in the wasteform. These changes include the loss of residual moisture (typically 15

% wt) and the loss of mass on vitrification (typically 15-20%). Consequently, glass forming additives will increase the feedstock mass by up to 15 %, but the wasteform mass will only be 65-70 % of this.

Using the density quoted by the CA, 279,000 cu yds corresponds to 376,650 tons. With the addition of glass forming additives (e.g., sand, borax, etc), the feedstock becomes 443,118 tons. This amount will become 310,182 tons of wasteform (.7 times 443,118) which leads to a treatment cost of $ 56.4 M. Because transport costs are based on the weight to be shipped, and the wasteform weight is 82% of the waste input weight, the transportation cost estimated in the CA should be reduced to $21.8 M.

5. The sensitivity test that assumes only 25 % volume reduction is not relevant. Even if the waste loading were only 70 %, benchtop tests have shown that a volume reduction of at least 36 % can be expected.

6. The CA does not include the additional cost factors of risk and liability. The non-treatment alternative is solely a removal action and is not a remedial action. It has a high potential for spills, inadvertent spread of the contamination along the haul route, rail line, and for dispersal at the disposal site. The treated wasteform, in contrast, has low solubility and is very difficult to disperse into the environment. A transport accident involving the untreated material will have serious associated costs in cleanup and liability, and may have serious, persistent, adverse health and economic impact. Such an event with the treated material will have only a minor cost associated with cleanup and would not have the dire consequences of the non-treatment case.

The costs of the non-treatment and ex-situ vitrification are summarized in the chart shown below. The non-treatment alternative, and the 'other costs' are taken to be the same as in the CA and are adjusted so that only the SLAPS soil volume is considered (i.e., the SLAPS ditches are not included in the estimate). The remedial design is computed at 10 % of the remedial action, the contingency cost is taken as 25 % of the Project Cost. According to accepted environmental cost estimating methods, the high risk and liability associated with the non-treatment alternative may be a large fraction of the total project cost, but it is not estimated here because it must be determined by detailed study by a qualified risk assessment experts.

It is clearly seen that the ex-situ vitrification alternative is less costly than the non-treatment alternative. The cost difference is about $2 M. Given the uncertainty in the cost estimates, it may be concluded that there is no significant cost difference between the non-treatment alternative and the ex-situ vitrification alternative. Of course, it is also necessary to qualify both estimates and state that further investigation of the alternatives may lead to significant changes in the estimated costs-- changes which may be up or down. The most significant uncertainty in the non-treatment alternative is the disposal cost. It is presently at an historical low. By DOE's own published statements, it has dropped by a factor of 5 during the last 5 months. This is apparently the result of a 'price-war' between disposal sites. Stakeholder and regulatory concerns over the newest of these sites may lead to an end to the competition in pricing. This may lead to a return to the 'old' prices which would make the non-treatment alternative economically unfeasible. For example, the price to dispose at the end of 1995 was cited in an article about St. Louis FUSRAP at $750 /cu yd instead of the presently cited $ 209.52 [see *DOE proposes to landfill tainted soil,* Defense Cleanup, vol 6, no. 49, Dec. 15, 1995]. This would increase the non-treatment alternative by almost $200 M to a total estimated cost of over $400 M.. In contrast, a return to the higher disposal price would increase the ex-situ vitrification alternative by $75.4 M to a total estimated cost of approximately $275 M, which is $125 M less than the non-treatment alternative.

St. Louis SLAPS
FUSRAP Alternatives
WBS COST Summary ($ 000,000's)

element	non-treatment excavate, ship, dispose	ex-situ vitrification treatment, ship, dispose
1 FUSRAP Program	$ 202.41	$ 200.69
1.1 FUSRAP Project	$ 140.81	$ 139.61
1.1.1 St. Louis FUSRAP Project	$ 140.81	$ 139.61
1.1.1.2 Remedial Design	$ 12.64	$ 12.58
1.1.1.3 Remedial Action	$ 126.39	$ 125.82
1.1.1.3.1 Remedial Action Sitework	$ 126.39	$ 125.82
1.1.1.3.1-5 'Other Costs'	$ 16.76	$ 16.10
1.1.1.3.1.6 Disposal	$ 75.99	$ 29.23
1.1.1.3.1.7 Transportation	$ 30.95	$ 21.81
1.1.1.3.1.8 Treatment	$ 0	$ 56.4
1.1.1.3.1.13 Site Inst. Controls, Surv, Maintenance	$ .42	$ .02
1.1.1.3.1.14 Reserved	$ 2.27	$ 2.26
1.1.1.10 Reserved	$ 1.776	$ 1.207
1.3 FUSRAP Prog. Mgmt & Tech Sup.	$ 26.40	$ 26.18
1.4 Contingency (25%)	$ 35.20	$ 34.90

There are significant remedial action selection process issues which must be considered when evaluating the Cost Analysis. The selection of technologies is a process that is guided by extensive and explicit public law. Preparation of the Record of Decision (ROD) must be preceded by an Environmental Impact Statement (EIS), a Remedial Investigation/Feasibility Study (RI/FS), a Baseline Risk Assessment (BRA), an Engineering Evaluation/Cost Analysis (EE/CA), and a Proposed Plan (PP). All of these must conform to rigid guidelines and overall goals stated for the governing Applicable or Relevant and Appropriate Requirements (ARARs) and environmental law.

As a National Priorities List site, the SLAPS remedial action process should be in accordance with CERCLA (Comprehensive Environmental Response and Liabilities Act) and the NCP (National Contingency Plan). The overall goal of CERCLA is to protect human health and the environment where releases of hazardous substances, pollutants, or contaminants [defined in CERLCA 101(14), 101(33)] have been documented. This goal has been expanded in NCP 300.430 (a) (1) (i), which states: The national goal of the remedy selection process is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste. The goals are met by conducting removal actions, and selecting and implementing appropriate remedial actions that meet explicit statutory requirements. NCP gives 9 explicit remedy selection criteria:

1. overall protection of human health & the environment
2. compliance with ARARs
3. long term effectiveness & permanence
4. short term effectiveness
5. reduction of toxicity, mobility, & volume
6. implementability
7. cost
8. state acceptance
9. community acceptance.

The non-treatment alternative is a removal action and does not comply with the stated objectives of the environmental laws. The ex-situ vitrification produces a wasteform which is acknowledged by regulatory agencies as a preferred wasteform. Moreover, the treatment alternative meets the requirements of the law, has superior environmental soundness, has lower risk and liability, and is lower cost.

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Contract Deliverables

00-2355

Formerly Utilized Sites Remedial Action Program (FUSRAP)

ADMINISTRATIVE RECORD

for the St. Louis Site, Missouri

U.S. Department of Energy

4.14-1070.2

06 02 10
Contract Deliverables

9810191009

SL-1297

Formerly Utilized Sites Remedial Action Program (FUSRAP)

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U.S. Department of Energy

4.14-1070.2

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SL-1297 1044.970912.002

Science Applications International Corporation
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September 12, 1997

U.S. Department of Energy
Information Office
9170 Latty Avenue
Berkeley, MO 63134

Attention: Mr. Ed Valdez
Deputy Site Manager, St. Louis

Subject: Contract DE-AC05-91OR21950
MISSOURI - 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- FINAL

Dear Mr. Valdez:

Enclosed are three copies of the Final 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. Four additional copies of the final document will be sent to you at a later date. By copy of this letter, three bound and one unbound copies of the document have been provided to BNI for recrods retention purposes. Also enclosed are the responses to comments provided by the Missouri Department of Natural Resources for the draft version of the document. The Word file for the transmittal letter to Gene Gunn of EPA will be e-mailed to you for your review and revision.

If you have any questions regarding this document, please feel free to call me at (423) 481-4710.

Sincerely,

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

David S. Miller, Ph.D.
Senior Environmental Scientist

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Administrative Record	☒ Yes	☐ No	

No. 1044.970912.002
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160046

FINAL
DOE/OR/21950-1028

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

Table of Contents

LIST OF TABLES AND FIGURES

ACRONYMS AND ABBREVIATIONS

Ac-227	Actinium-227
ASTM	American Standard Testing Methods
BIEDMS	Bechtel Integrated Environmental Data Management System
BNAEs	base/neutral and acid extractables
BNI	Bechtel National, Inc.
Ca	calcium
Cl	chlorine
COCs	constituents of concern
DOE	Department of Energy
DOE-ORO	Department of Energy, Oak Ridge Operations
EPA	Environmental Protection Agency
F	fluorine
FUSRAP	Formerly Utilized Sites Remedial Action Program
GAO	General Accounting Office
Hg	mercury
IG	instruction guide
K	potassium
Li	lithium
MDA	minimum detectable activity
MDNR	State of Missouri Department of Natural Resources
Mg	magnesium
MRPM	DOE Management Requirements and Policies Manual
Na	sodium
NH_3	ammonia
NO_2	nitrite
NO_3	nitrate
OPDM	Organization and Process Description Manual
Pa-231	protactinium
Pb-210	lead
PDCC	Project Document Control Center
PPE	personal protective equipment
QA	quality assurance
QAPmP	FUSRAP Quality Assurance Program Plan
QC	quality control
Ra-226	radium-226
Ra-228	radium-228
S/RID	Standards/Requirements Identification Document
SAP	sampling and analysis plan
SLDS	St. Louis Downtown Site
SO_4	sulfate
SOPs	Standard Operation Procedures
SMO	Sample Management Office
Sr	strontium
SVOCs	semi-volatile organic compounds
Th-230	thorium-230
Th-232	thorium-232
U-234	uranium-234
U-235	uranium-235
U-238	uranium-238
VOCs	volatile organic compounds

1.0 INTRODUCTION/PURPOSE

This purpose of this activity is to collect current baseline water quality data from existing groundwater and surface water sources at the St. Louis Airport Site (SLAPS) and the Hazelwood Interim Storage Site (HISS) (Figure 1-1). This plan also includes the recommendation to install and/or maintain infrastructure that will facilitate current and future surface water and groundwater sampling and monitoring at the sites. This document is only intended to concisely describe the most immediate and time critical activities that must occur during the last half of 1997 in order to develop a baseline understanding of the site. In the near future, additional documents, plans, and activities will be developed in conjunction with other stakeholders to describe past characterizations, to better understand the environmental conditions, and to provide a coherent rationale for directing future sampling and monitoring activities at the sites.

1.1 BACKGROUND

The activities described in this plan are the direct result of recommendations made by a technical working group which was formed to address technical issues critical to the remedy selection process for the St. Louis Site. Representatives of the U.S. Department of Energy (DOE), the State of Missouri Department of Natural Resources (MDNR), and the U.S. Environmental Protection Agency (EPA) met on Tuesday, 29 April 1997, in Rolla, Missouri, to make the recommendations described in this document. A brief account of that meeting is described in an attachment to a memorandum from Gene Gunn of EPA Region VII to the SLAPS Technical Working Group (STWG) members dated 30 May 1997. It should be noted that all of the activities were unanimously recommended by the attendees at the meeting of 29 April 1997. The recommendations are presented in Table 1-1.

Table 1-1. Unanimous Recommendations of Technical Working Group

No.	Recommendation	Timing
1	Maintain and upgrade as required the stream gage currently located adjacent to the McDonnell Boulevard bridge over Coldwater Creek.	The Department of Energy is to provide the necessary funding as soon as possible.
2	Redevelop and sample all existing groundwater wells. In addition to standard suite of radionuclides, include: *field*: pH, specific conductance, temperature, dissolved oxygen, turbidity, and collection of static water level data for each well on the same day. *lab*: target analyte list (includes metals), target compound list (includes VOAs, VOCs, and SVOCs), include Ca, Mg, Na, K, SO_4, Cl, F, NO_3, NO_2, NH_3, P, TOCs, Li, Sr, Pa, Ac, Fe, alkalinity, carbonate, TDS, bicarbonate, and tritium (only in specified wells) The detection limits of the analytes must be 0.2 μg/L VOCs, <1-10 μg/L BNAs, 1 pCi/L tritium, 1 μg/L metals, 1 mg/L major cations and ions, 0.1 mg/L nutrients. Perform the above analyses to distinguish both suspended and dissolved constituents through both filtered (0.45 μm) and unfiltered analyses.	Perform recommended sampling during summer of 1997 at both SLAPS and HISS.
3	Install stormflow discharge monitoring weirs with automatic samplers on the four principal SLAPS outfalls to Coldwater Creek. The weirs should be placed as close to Coldwater Creek as possible.	In FY97, install just north and south of McDonnell Blvd., and on the drainage that transects the ballfields in a north-south direction. Install on drainage that empties into creek at the southwest corner

No.	Recommendation	Timing
		of SLAPS preferably in FY97, but certainly ASAP in FY98.
4	Collect flow weighted samples from all stormflow weirs, HISS outfalls, and Coldwater Creek. Include same analytes as in recommendation No. 2. Several flow events of differing discharge magnitudes will have to be characterized. Link flow events to precipitation measurements made at the airport and HISS.	Attempt to characterize at least one flow event in FY97. Characterize others as flow conditions and availability of funds allow.
5	Produce a sampling and analysis plan (SAP) for the above activities with properly developed data quality objectives (DQOs). Be sure that detection limits are sufficient to meet DQOs. Development of SAP should be closely coordinated with the technical working group.	Prior to field activities.
6	Develop comprehensive long range sampling methods, objectives, and schedules as remedies are implemented. Make provisions to begin the exclusion of specific analytes and locations from analysis as it becomes clear that the specific data is unnecessary, redundant, or unusable. Exclusion or addition of analytes and/or locations should be closely coordinated with the technical working group.	Ongoing activity - to begin in FY97.
7	Compile all existing hydrogeochemical data for the St. Louis Site into one document. Provide history of sampling efforts, DQOs for each sampling event, data tables, and a comprehensive summary of appropriate information. This document should be a "living" document so that it can capture future sampling and monitoring data in a comprehensive and easily used form. Electronic accessibility to data would be especially useful. Development of this document should be closely coordinated with the technical working group.	Ongoing activity - to begin in FY97.

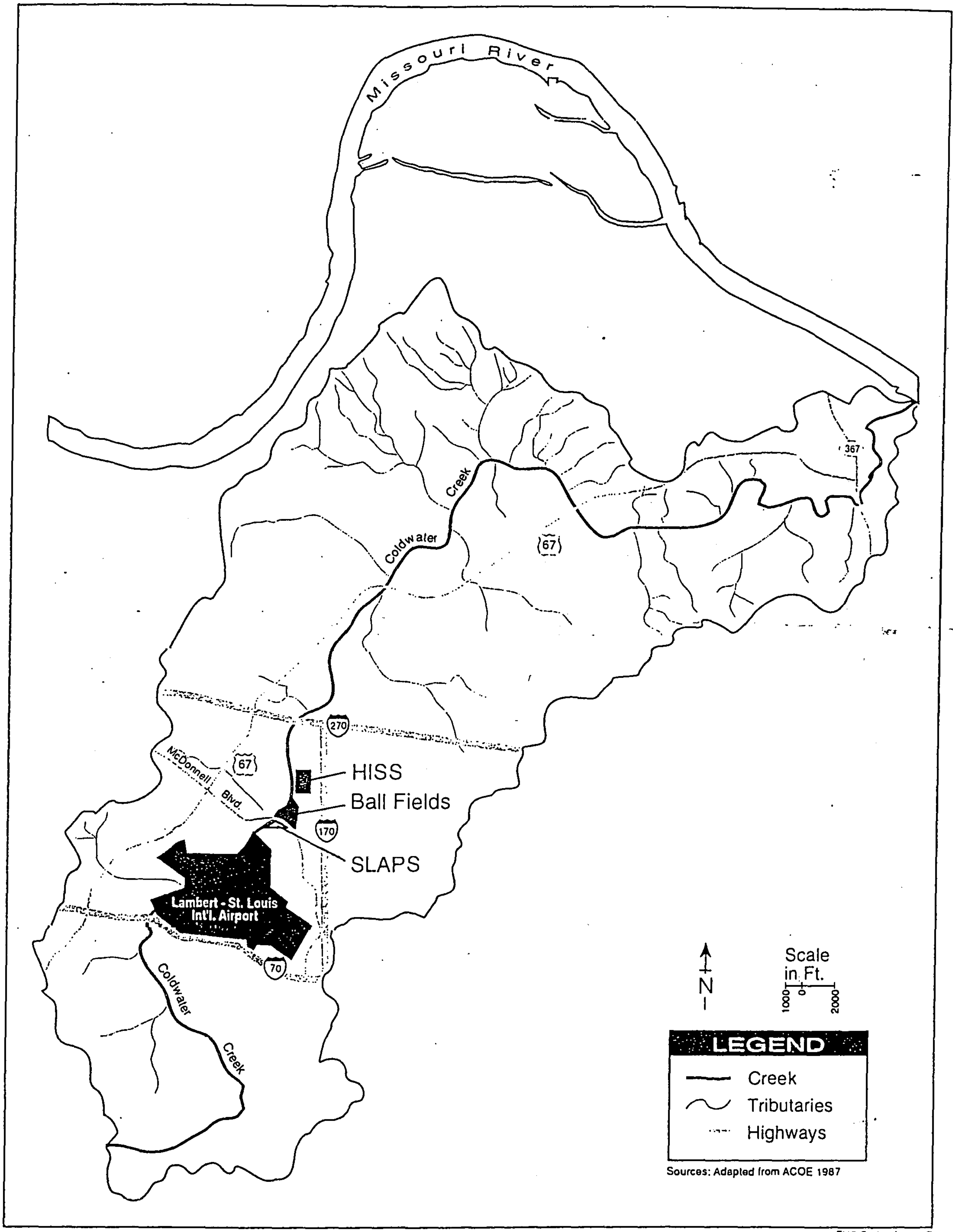

Figure 1-1. SLAPS/HISS Location Map

2.0 DATA QUALITY OBJECTIVES AND SAMPLING REQUIREMENTS

It is difficult to predict all of the ways in which baseline surface water and groundwater data will eventually be used. However, it should generally be recognized that the resulting data should be of the highest quality and the suite of analytes as comprehensive as is reasonably achievable. The objective of this SAP is to provide high quality comprehensive data.

2.1 DATA QUALITY OBJECTIVES AND PARAMETERS

The following objectives and parameters are prescribed for this sampling campaign.

Objectives

At a minimum, the data collected in this baseline sampling activity should contribute to a better understanding of:

a) potential constituents of concern (COCs) (e.g., radiological, chemical, and metal)
b) the extent and rate of migration of the COCs
c) potential migration pathways from the shallow saturated zone to Coldwater Creek and the Post-Maquoketa aquifer

In addition, this data and plan will be used to:

a) assess future sampling, monitoring, and modeling requirements
b) evaluate the impacts to the hydrologic resources by remedial activities
c) help judge the success of the selected remedy for the sites

Data Quality Parameters

Samples acquired from all locations will be analyzed for the analytes listed in Table 2-1 using the methods and detection limits specified in the table. Results will be reported for both filtered (0.45 μm) and unfiltered samples from every location. The only exception is that tritium analyses will only be immediately required for samples obtained from wells specified with a "T" in Table 3-1. All samples will be archived for later tritium or He/tritium analysis. A full suite of analyses will be performed on all unfiltered samples. All filtered samples will be analyzed for metals and radionuclides.

Table 2-1. Analytes, Methods, and Detection Limits for Laboratory Analyses

Analyte	Analysis Method	Specific Detection Limit Requirements*
VOCs	EPA 8260A	0.2 μg/L
SVOCs (includes BNAEs)	EPA 8270B	<1-10 μg/L for BNAEs
Metals	EPA 6010A	1 μg/L
Mercury	EPA 7470	1 μg/L
Ca	EPA 6010A	1 mg/L
Mg	EPA 6010A	1 mg/L
Na	EPA 6010A	1 mg/L
K	EPA 6010A	1 mg/L
SO_4	EPA 300.0 Ion Chromatography	1 mg/L
Cl	EPA 300.0 Ion Chromatography	1 mg/L
F	EPA 300.0 Ion Chromatography	1 mg/L
NO_3	EPA 300.0 Ion Chromatography	0.1 mg/L Must be analyzed within 48 hours.

Analyte	Analysis Method	Specific Detection Limit Requirements*
NO_2	EPA 300.0 Ion Chromatography	0.1 mg/L Must be analyzed within 48 hours.
NH_3	EPA 350.1	0.1 mg/L
PO_4	EPA 365.2	0.1 mg/L
Fe	EPA 6010A	1 mg/L
Alkalinity carbonate bicarbonate	EPA 310.1	1 mg/L
TOC	EPA 415.2	1 mg/L
Li	EPA 6010A	1 mg/L
Sr	EPA 6010A	1 mg/L
Tritium	EPA 906.0	1 pCi/L
Ra-226**	EPA 903.1 or EPA 903.0	0.1 pCi/L 1 pCi/L
Th-230	EPA 907.0	0.2 pCi/L
Total Uranium (U-234, U-235, U-238)	EPA 908.0	0.5 pCi/L
Th-232	EPA 907.0	0.2 pCi/L
Pa-231	EPA 907.0	50 pCi/L
Ac-227	EPA 907.0	1 pCi/L
Ra-228	EPA 903.0	<1 pCi/L
Pb-210***	DOE EML PB01	1 pCi/L

*The specified detection limits are not necessarily the method detection limits associated with the analytical method. Therefore, it will be necessary to contractually specify the detection limits required from the laboratory for this sampling effort for many of the analytes.
**EPA 903.1 should be used where sufficient (approx. 5 L) sample can be collected; otherwise use EPA 903.0.*
***20 day in-growth period may be required to reach MDA of 1.0 pCi/L.

The Missouri Department of Natural Resources has agreed to acquire a sample representative of background conditions in the Post-Maquoketa aquifer from a well near the SLAPS area. DOE will provide for the analysis of this sample according to the specifications described for all other groundwater sampling in this SAP (including tritium analysis).

2.2 INFRASTRUCTURE IMPROVEMENTS

Two critical infrastructure improvements will be required to perform baseline sampling and to facilitate future sampling, monitoring, and analysis activities. First, a stream gage will have to be installed on Coldwater Creek at the McDonnell Boulevard bridge. Second, stormflow discharge monitoring weirs with automatic samplers will have to be installed adjacent to Coldwater Creek at the outfalls of the principal stormflow channels draining the SLAPS.

While the installation of the gage, the development and maintenance of a stage-discharge rating for the gage, and installation of the stormflow weirs are separate activities from those of this sampling plan, the acquisition of Coldwater Creek water quality samples and stormflow samples should be coordinated with this activity so that discharge information is available for the creek and drainage channels at the time the samples are taken.

2.3 FIELD PROCEDURE RECOMMENDATIONS

The technical working group made the following recommendations regarding the sampling of the groundwater wells at the SLAPS and HISS.

1) Static water level measurements for all wells will be taken on a single day, after redevelopment and sampling are complete, and after the wells have reached an equilibrium state.

2) Redevelopment of the wells should begin at least two weeks prior to sampling to allow a sufficient recovery period.

3) Data turn-around times at the laboratories should be sufficient to allow fully validated data reports to be available by the middle of October 1997. This criterion only applies to the groundwater samples since collection of Coldwater Creek water quality samples and stormflow samples is contingent upon the installation of the gaging station and the stormflow weirs.

Table 2-2 lists the sampling methods to be used for those parameters requiring field measurements for both surface water and groundwater. Table 2-3 lists additional measurements to be made specifically for surface water and stormflow.

Table 2-2. Field Measurement Parameters and Methods

Parameter	Method
pH	EPA 150.1
temperature	EPA 170.1
conductivity	EPA 120.1
turbidity	EPA 170.1
dissolved oxygen	Colorimetric (USGS will provide specifications)
redox potential	Electrometric
static water level (groundwater)	ASTM D 4750-87

Table 2.3. Additional Measurements for Surface Water and Stormflow Samples

Parameter	Method
Settleable solids	EPA 9020B
Gross alpha	EPA 900.0
Gross beta	EPA 900.0

All wells identified on Table 3.1 shall be redeveloped prior to sampling. Wells will be developed according to the following general guidelines:

- The wells will be sounded to determine the depth to the bottom of the well. The measured depth will be compared to the constructed depth to determine the amount of sediment in the bottom of the well.

- If sediment is present in excess of 0.5 feet difference between the current measured depth and the constructed depth, a large diameter (2 in.) bottom intake pneumatic pump will be used to surge and pump the well initially.

- Following sediment removal either the pneumatic pump or a submersible (Grunfos) pump may be used to develop a minimum of five casing volumes from the well.

- Turbidity, conductivity, and pH of the developed water will be measured during development (approximately every 5 gallons) using a hydrolab/YSI or equivalent water quality meter.

FTC pH measurements will be checked against the readings from a hand held pH meter. The sample used for hand held analysis will be taken by diverting part of the inflow to the FTC into a beaker.

3.0 SAMPLING LOCATIONS

The following locations, described in Tables 3-1 through 3-3 and illustrated in Figures 3-1 through 3-5, will be sampled.

Table 3-1. Groundwater Monitoring Wells

HISS	SLAPS		
HISS 1	A^{*G}	B53W13S^{G}	B53W11D^{T,G}
HISS 2	B^{*G}	B53W14S^{G}	B53W12D^{G}
HISS 5	C^{*G}	B53W15S	M10-15S^{T}
HISS 5D^{T}	D^{G}	B53W16S^{T}	M10-15D^{T,G}
HISS 6	E^{G}	B53W17S^{T,G}	M10-25S
HISS 7	F^{G}	B53W18S	M10-25D^{G}
HISS 9	B53W01S	B53W19S	M10-8S^{*T}
HISS 10	B53W02S	B53W20S	M10-8D^{*G}
HISS 11	B53W03S	B53W01D^{G}	M11-21
HISS 12	B53W04S	B53W02D	M11-9^{*T,G}
HISS 13^{T}	B53W05S	B53W03D^{G}	M13.5-8.5S*
HISS 14	B53W06S	B53W04D	M13.5-8.5D^{*G}
HISS 15^{T}	B53W07S^{T}	B53W05D	A3^{G}
HISS 16	B53W08S	B53W06D^{G}	A6^{G}
HISS 17^{T}	B53W09S	B53W07D^{T}	
HISS 18	B53W10S^{G}	B53W08D	
HISS 19	B53W11S	B53W09D	
HISS 20^{T}	B53W12S^{T}	B53W10D^{T,G}	

* Indicates wells which will be abandoned during implementation of the SLAPS EE/CA
^{T} Indicates wells where samples will be initially analyzed for tritium only
^{G} Indicates wells which will be gamma logged
Note: All samples will be archived for later He/Tritium or Tritium analysis

As part of the upcoming removal action, a shallow pair and deep pair of wells will be installed near the western boundary of the SLAPS.

Wells listed with a "G" in the above table will be logged using a natural gamma tool to help define subsurface stratigraphy and to possibly define areas where contamination is present. The natural gamma tool will have an automatic retrieval mechanism for direct data recording to a portable computer. All wells will be logged from total depth to surface.

Table 3-2. Surface Water Sampling Locations

SWSD001	SWSD005
SWSD002	SWSD006
SWSD003	SWSD007
SWSD004	SWSD008

Table 3-3. Stormwater Sampling Locations

HISS	SLAPS
STW001	STW003
STW002	STW004
	STW005
	STW006

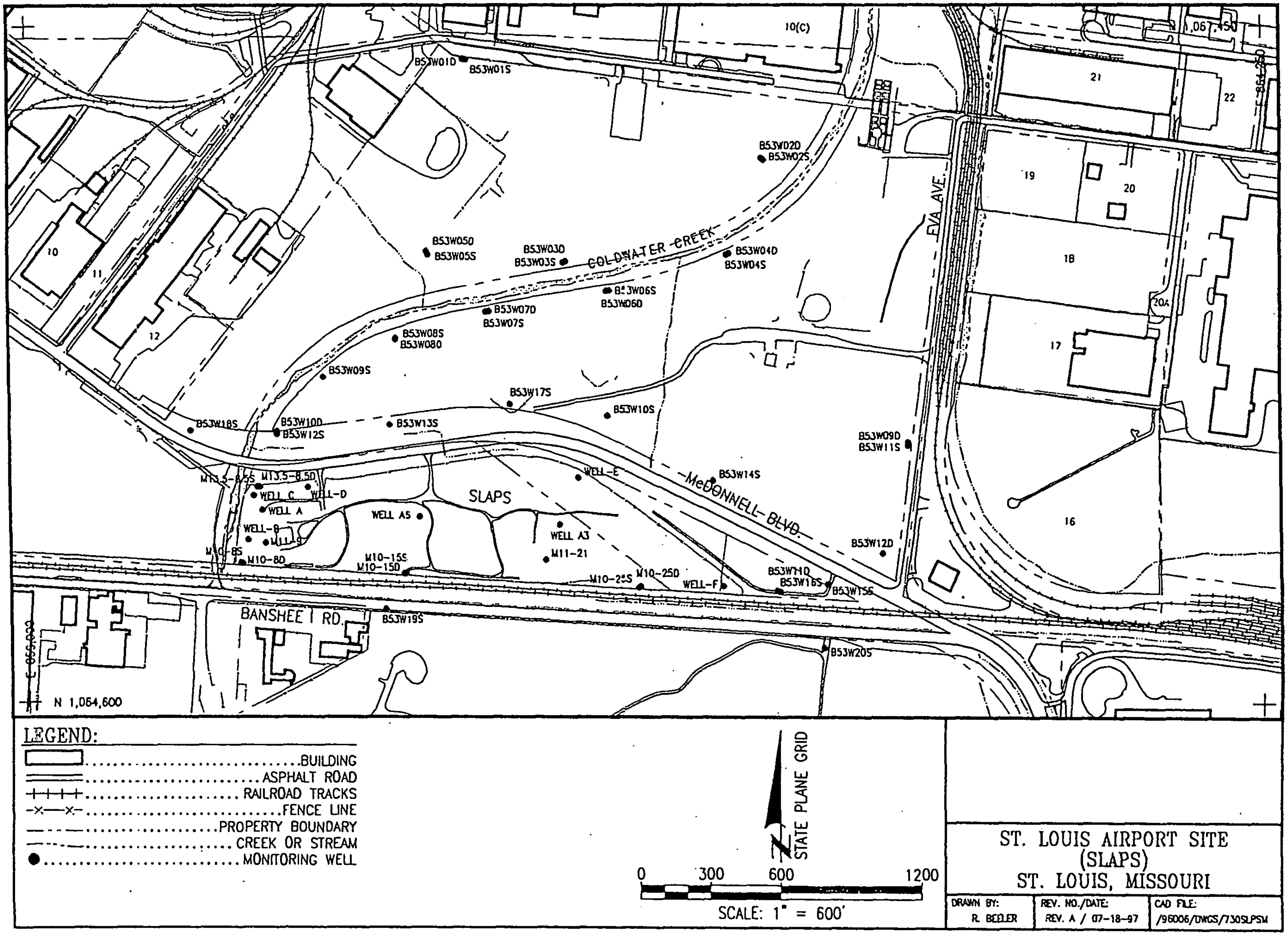

Figure 3-1. Groundwater Monitoring Wells at SLAPS and Adjacent Vicinity Properties

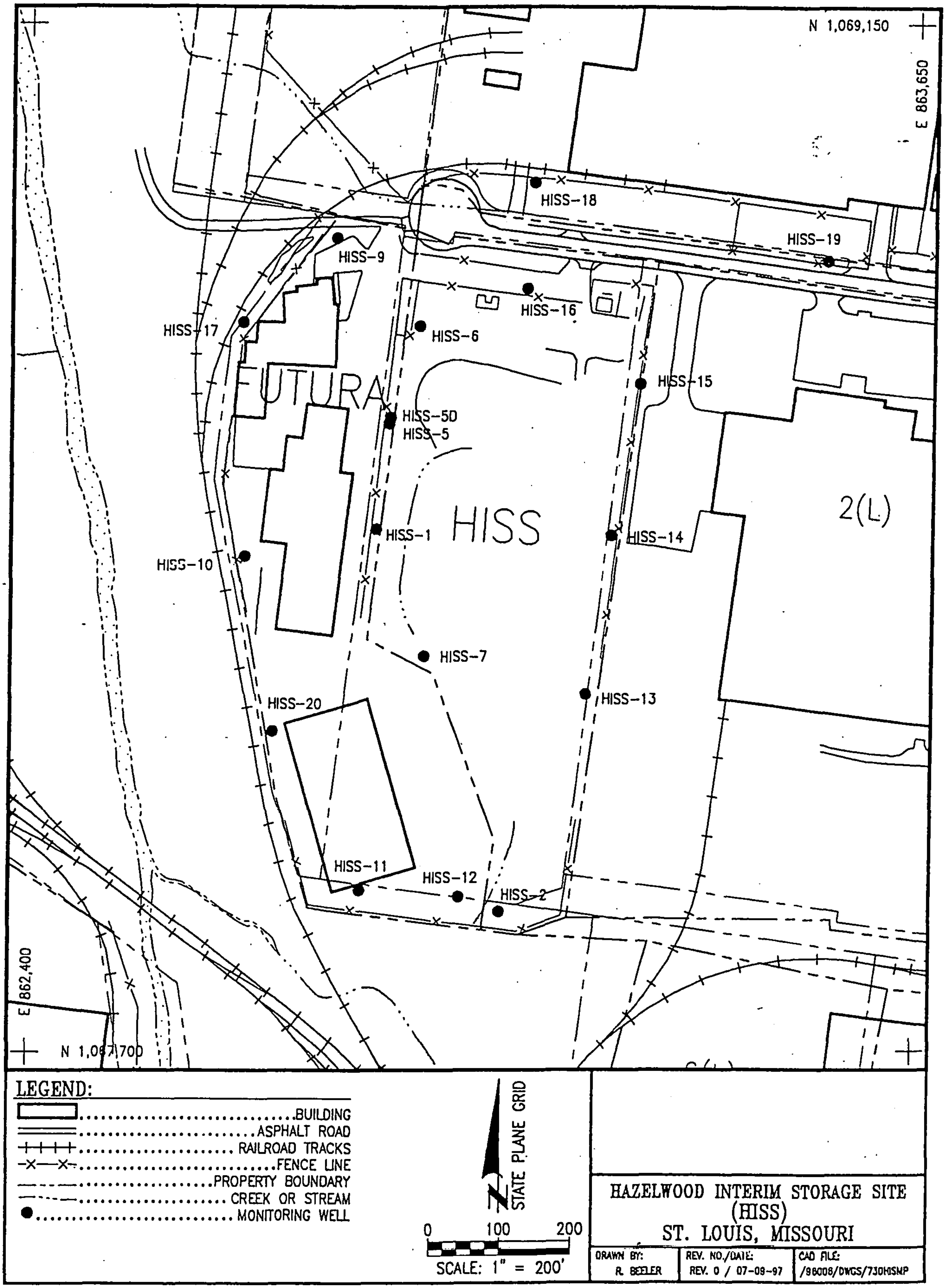

Figure 3-2. Groundwater Monitoring Wells at Hiss/Futura and Adjacent Vicinity Properties

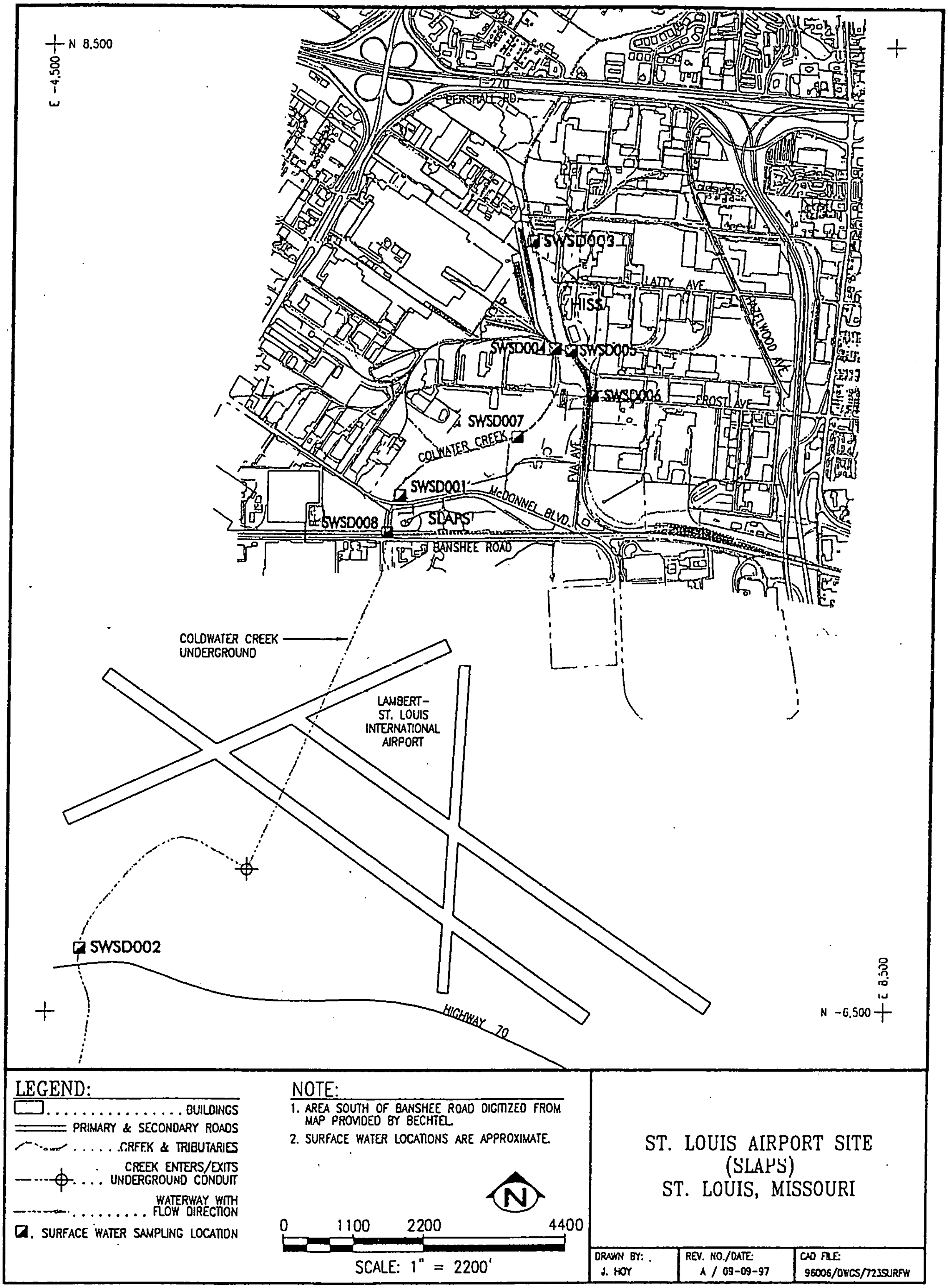

Figure 3-3. Surface Water Sampling Locations in the Vicinity of HISS/SLAPS

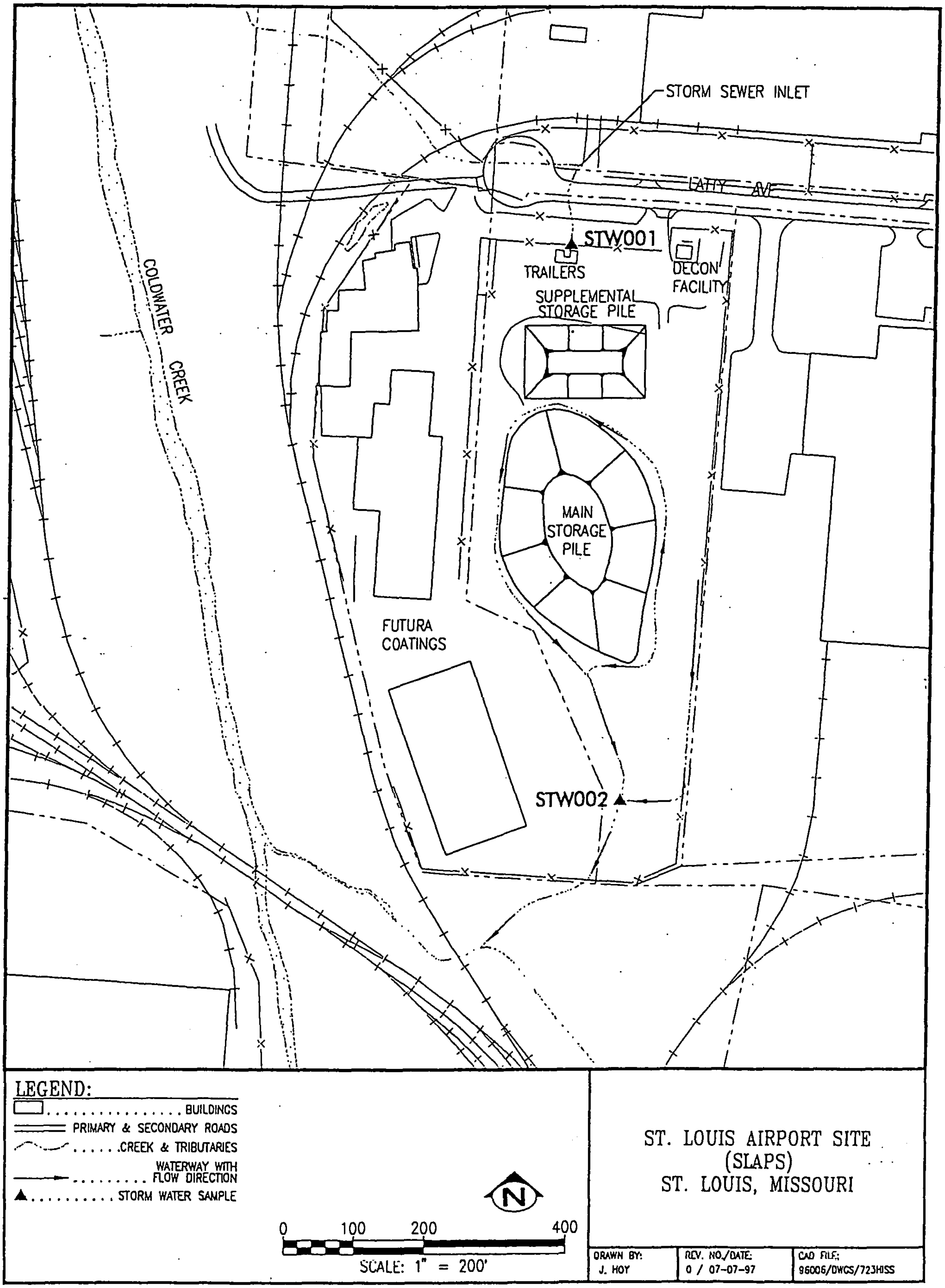

Figure 3-4. Stormwater Sampling Locations in the Vicinity of HISS

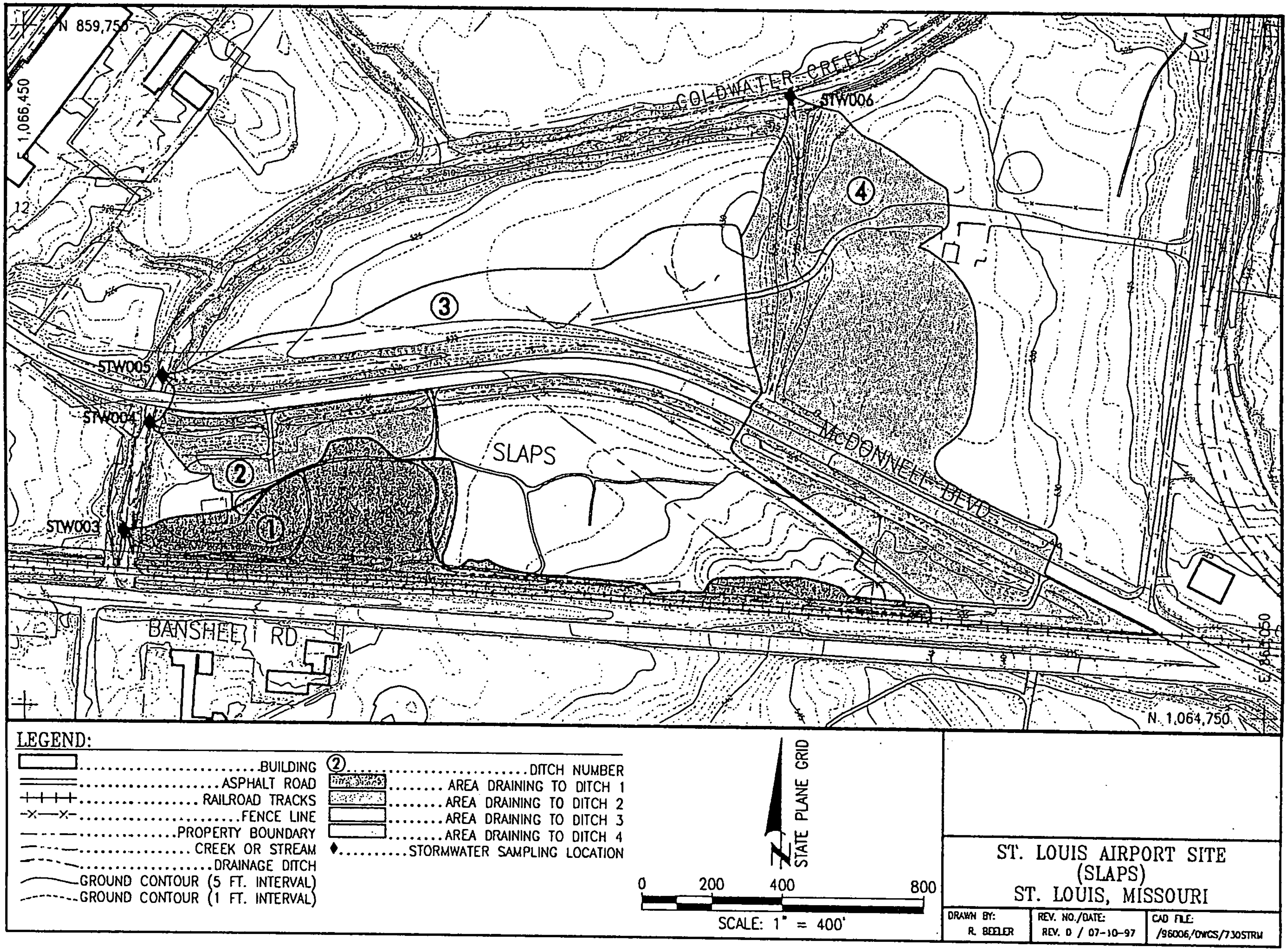

Figure 3-5. Stormwater Sampling Locations in the Vicinity of SLAPS

4.0 SAMPLE HANDLING, PACKAGING, AND SHIPPING

Sample handling, packaging, and shipping practices will be conducted in accordance with FUSRAP procedures. Samples shall be handled using the sample custody and labeling methodology described in the instruction guide (IG) 191-1G-028, "Instruction Guide for Surface Water and Sediment Sampling Activities" (BNI 1993) and the sample surveying, packaging, and shipping methodology in PI C7.7 "How to Ship Samples from a FUSRAP Site" (BNI 1996a).

Samples for routine off-project analysis will be routed through the Oak Ridge Sample Management Office (SMO) to approved environmental analytical laboratories. Split samples will be provided to MDNR or EPA upon request.

The SMO was established through a cooperative effort between the Department of Energy, Oak Ridge Operations, and Lockheed Martin Energy Systems, Inc. in response to a Government Accounting Office report (GAO/RCED-95-118). A memorandum issued by T. Grumbly on October 3, 1995, called for centralizing procurement of analytical resources, and a second memorandum issued by R. Guimond on May 14, 1996, established a policy for each DOE Operations/Field Office to establish a single sample management organization for environmental sample analyses.

Lockheed Martin Energy Systems, Inc. Analytical Services Organization provides management and operation of a single Oak Ridge SMO in a cooperative effort with the Department of Energy, Oak Ridge Operations (DOE-ORO). Further information may be found on the Internet at www.ornl.gov/smo/smohome.htm.

5.0 DECONTAMINATION

Decontamination procedures vary depending upon parameters for which samples will be analyzed. Decontamination will be conducted in accordance with the "Instruction Guide for Decontamination of Field Sampling Equipment at FUSRAP Sites" (BNI 1992) and "Radioactive Decontamination and Waste Control" (BNI 1996b)

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6.0 HANDLING OF INVESTIGATION-DERIVED WASTE

All waste generated during field activities will be handled in accordance with BNI waste disposal procedures (BNI 1996f). Efforts throughout the field program will be made to minimize not only the volume of waste derived from sampling and decontamination procedures, but the volume of personal protective equipment (PPE) waste as well. Prior to disposal, PPE will be scanned onsite using hand-held alpha and beta/gamma screening instruments to segregate radiological waste from clean waste.

7.0 QUALITY ASSURANCE (QA) PROJECT PLAN

FUSRAP work performed by BNI and its subcontractors is covered by the FUSRAP Quality Assurance Program Plan (QAPmP). The QAPmP describes management controls, objectives, and scope of the quality assurance (QA) program; outlines the general policies to be followed; and identifies responsibilities. It addresses the requirements of the DOE Management Requirements and Policies Manual (MRPM) for FUSRAP.

All FUSRAP activities shall be conducted in accordance with approved plans and procedures, applicable regulations, DOE policy, and other requirements identified in the Standards/Requirements Identification Document (S/RID). Defined management systems shall implement and control FUSRAP activities.

7.1 ORGANIZATION

The program organization, responsibilities, and interface relationships are defined in the MRPM. The BNI organization is described in the Organization and Process Description Manual (OPDM).

7.2 QA OBJECTIVES

To address the work scope outlined in this document, the QA objectives established for this project are listed below. Generally, the total error in the results derived from the data will be controlled to achieve an acceptable level of confidence in the decisions that are made from the data. The methods and procedures used to implement and accomplish the following objectives are described throughout the plan.

- Implement standard operating procedures (SOPs) for field sampling, sample custody, equipment operation and calibration, sample analysis, data reduction, and data reporting that will ensure consistency and thoroughness in data generated.

- Assess the quality of data generated to ensure that data are scientifically valid, of known and documented quality, and legally defensible, where appropriate.

- Achieve an acceptable level of confidence in the decisions that are made from data by controlling the degree of total error permitted in the data using quality control (QC) checks. Data that fail the QC checks, or do not fall within the acceptance criteria established, will be rejected from further use or qualified for limited use.

- Ensure that the QA processes outlined in this plan are properly implemented by conducting compliance inspections and audits. In addition, verify that corrective actions are executed and documented for any nonconformances identified. Further details are available in the FUSRAP Environmental Data Management Plan.

7.3 PROCESS CONTROL

Quality is ensured through appropriate planning and control of work operations. The group performing any activity is responsible for the achievement of quality and ensuring that the worker is provided the required resources and training. The execution and control of work activities at FUSRAP sites is governed by work-controlling documents such as procedures, technical specifications, and other standards. These documents provide measures and guidance for implementing work in accordance with required laws and regulations.

7.4 SAMPLING PROCEDURES

SOPs will be carefully followed during the field sampling activities to ensure that the samples collected are an accurate reflection of current site conditions. The advantage to following SOPs is that all samples are collected in a consistent manner, which supports the comparability of analytical results. Sampling procedures will follow instruction guides 191-IG-028 (BNI 1993a) *"Instruction Guide for Surface Water and Sediment Sampling Activities,"* 191-IG-033 (BNI 1996c) *"Instruction Guide for Groundwater Sampling Activities,"* and 191-IG-011 (BNI 1992) *"Instruction Guide for Decontamination of Field Sampling Equipment at FUSRAP Sites."*

QC samples will be collected at the same time and handled in the same manner as the regular sample. Environmental duplicate samples should be collected at a frequency of at least five percent (one for every 20 samples/measurements taken), or one per radiological or chemical sample set/batch (whichever is more frequent). Rinsate blanks should be collected from the sampling equipment for each day of sampling and analyzed for those parameters being sampled on that day. Rinsate blanks may be verified clean using gross alpha/beta analyses; if contamination is present, then speciation (via alpha or gamma spectroscopy) will be performed. When appropriate to the method, matrix spikes should be collected from at least one sampling location for every 20 locations sampled, or one per batch (whichever is more frequent). Trip blanks will accompany samples which will be analyzed for VOCs.

All field activity records will be kept in accordance with PI E2.9, "Control of Field Log Books" (BNI 1996d).

Appropriate sampling personnel will keep indelible black ink records of daily field activities in bound field logbooks. Field logbooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during projects and to refresh the memory of the field personnel if called upon to give testimony during legal proceedings. In a legal proceeding, logbooks are admissible as evidence, and consequently must be factual, detailed, and objective.

Logbooks must be permanently bound, the pages must be numbered, and all entries must be written with permanent ink, signed, and dated. If an error is made in a logbook, corrections can be made by the person who made the entry. A correction is made by crossing out the error with a single line, so as not to obliterate the original entry, and then entering the correct information. All corrections must be initialed and dated. The first page of the logbook should be used as a "Table of Contents" to facilitate the location of pertinent data. The first daily event entry should always be the date, followed by a detailed description of the weather conditions. All entries should always begin with the time of the entry.

To expedite sampling activities and to reduce the number of documentation errors made in the field, pre-printed sample collection logbooks are proposed to be used for this sampling program. Examples of the pre-printed information that will be contained within the sample logbooks include:

- Site name
- Sampling location
- Sampling interval
- Sample number
- Sample media (water, sediment, etc.)
- Type of sample (grab, composite, integrated)
- Analyses to be performed

Whenever possible, field sampling forms should be used to reduce documentation requirements and to remind field personnel of the type of information they need to collect. Examples of sampling forms are:

- Borehole log forms

- Well completion forms
- Well development forms
- Well purging and sampling forms
- Water level measurement forms

At the completion of field activities, all field documentation, analytical data, and reports generated from this data will be assigned a document control number and submitted to the Project Document Control Center (PDCC) as a permanent record.

7.5 SAMPLE CUSTODY

To ensure the court defensibility of analytical results, sample chain-of-custody will be maintained at all times, from the time the sample is collected to the time the analytical results are returned from the on-site or off-site laboratory. Sample custody will be maintained through the utilization of chain-of-custody forms, chain-of-custody labels and seals, assigning sample ownership, and locking samples in an area known to be free of COCs when not in the custody of the sample custodian.

7.6 EQUIPMENT OPERATION AND CALIBRATION

Sampling, field-screening, and analytical equipment used to support this effort will be calibrated to operate within the specifications provided by the manufacturer. Calibration or calibration verifications will be performed as stipulated by the manufacturer's calibration procedure or as specified by the analytical method. Continuing calibration or verification of field instruments will be conducted periodically throughout the work day as appropriate. For radiological screening instruments source/response checks will be performed. Instruments such as organic vapor analyses, pH meters, etc. will be calibrated or verified using traceable standard solutions.

7.7 SAMPLE ANALYSIS

FUSRAP radioanalytical methods as described in the Mobile Laboratory Procedures Manual will be followed for on-site gamma spectroscopy and all radioanalytical analyses performed at the FUSRAP Mobile Laboratory (currently located in Hazelwood, MO). Specific analytical quality requirements are called out in this Manual.

Samples submitted for radiological and chemical analysis by off-site laboratories will be analyzed in accordance with industry standards by appropriately licensed facilities.

Data resulting from this field effort will be loaded into the Bechtel Integrated Environmental Data Management System (BIEDMS). This system will assist the user in evaluating the data and will control changes made to the database.

7.8 DATA REPORTING

Streamlined data reports will be prepared for this data upon returning from the field. These reports shall include the following information:

- Sample number
- Sampling and analysis times and dates
- Data results
- Holding time results
- Instrument calibration data
- Copy of chain-of-custody record

The reporting requirements for analytical methods performed at an off-site laboratory will be more extensive, and will include:

- Sample number
- Sampling and analysis time and dates
- Data results
- Holding time results
- Instrument calibration data
- Summary of quality control check data
- Documentation of any nonconformances that may have affected the analytical results

7.9 QUALITY CONTROL CHECKS

Field quality control samples such as duplicates, rinsate blanks, and when appropriate trip blanks, will be collected as appropriate throughout the field effort as required by the Quality Action Plan (BNI 1996e). Data resulting from these blanks will be used to evaluate the precision of analytical methods, test the effectiveness of equipment decontamination procedures, test the quality of water used to support the sampling effort (decontamination water), and to confirm that VOC samples are not contaminated in transport to the laboratory.

QC checks such as analytical blank, spike, and duplicate samples will be performed routinely during sample analysis to assure that on-site and off-site analytical instruments are providing reliable data. These control checks will be performed at a frequency consistent with that specified by the analytical method.

7.10 AUDITS AND CORRECTIVE ACTIONS

A minimum of one audit will be performed during field operations to confirm that operations are being performed in accordance with this SAP and FUSRAP SOPs. The audit will pay particularly close attention to on-site analytical methods and the management of field data. Corrective actions shall be implemented immediately in the field to resolve any nonconformances identified by the audit.

8.0 HEALTH AND SAFETY

All field operations will be performed under the guidance and direction of the onsite Health and Safety Representative who will ensure the implementation of the health and safety requirements outlined in the site-specific Health and Safety Plan. Hazards of particular concern at the SLAPS and HISS include:

- Heat stress
- Inhalation of dust particles containing radioactivity
- Ingestion of dust particles containing radioactivity
- External radiological exposure
- Inhalation of VOCs and/or SVOCs
- Explosivity of VOCs and SVOCs

REFERENCES

BNI (Bechtel National, Inc.) 1992. *Instruction Guide for Decontamination of Field Sampling Equipment at FUSRAP Sites*, 191-IG-011, Revision 6.

BNI 1993a. *Instruction Guide for Surface Water and Sediment Sampling Activities*, 191-IG-028, Revision 0.

BNI 1993b. *Waste Management Program Plan for FUSRAP*, Oak Ridge, TN, June.

BNI 1996a. *How to Ship Samples from a FUSRAP Site*, PI C7.7.

BNI 1996b. *Radioactive Decontamination and Waste Control*, PI X2.4, Revision 0.

BNI 1996c. *Instruction Guide for Groundwater Sampling Activities*, 191-1G-033, Oak Ridge, TN.

BNI 1996d. *Control of Field Log Books*, PI E2.9, Revision 2.

BNI 1996e. *Quality Action Plan*, QAP 112a-01-00, June.

DOE (U.S. Department of Energy) 1992. *FUSRAP Management Requirements and Policies Manual*. Oak Ridge, TN. December.

DOE 1995. *Safety and Health Plan for the St. Louis Sites*, September, DOE-AC05-910R21949.

DOE 1996a. *FUSRAP Organization and Process Description Manual*, Oak Ridge, TN. January 5.

DOE 1996b. *FUSRAP Standards/Requirements Identification Document*, Oak Ridge, TN. April.

DOE 1997. *FUSRAP Project Procedures Manual*, Oak Ridge, TN. August.

Formerly Utilized Sites Remedial Action Program (FUSRAP)

ADMINISTRATIVE RECORD

for the St. Louis Sites, Missouri

US Army Corps of Engineers®

888-GOA-GAM-00028
SL-1393

STATE OF MISSOURI
Mel Carnahan, Governor • Stephen M. Mahfood, Director
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY
P.O. Box 176 Jefferson City, MO 65102-0176

March 10, 1998

Mr. Tom Freeman
Site Manager, USACE
FUSRAP Office
9170 Latty Avenue
Berkeley, MO 63134

RE: SLAPS/HISS Baseline Groundwater Sampling, 1997, Residential Well

Dear Mr. Freeman:

As part of the Baseline Groundwater Sampling conducted at SLAPS and HISS in 1997, MDNR volunteered to collect a groundwater sample from a residential well in the area. The Federal Facilities Section collected the groundwater sample on November 13, 1997, from an area resident's well (Several miles north of SLAPS).

Resident's well location: Ken Smith
#10 Jamestown Rd.
Florissant, MO 63034

The groundwater results have been attached to this letter.

If you have any questions or comments, please contact Scott Honig at (573) 751-3087. Thank you for the opportunity to participate in the FUSRAP project.

Sincerely,

HAZARDOUS WASTE PROGRAM

Scott F. Honig

Scott F. Honig
Environmental Engineer
Federal Facilities Section

SH:lg

Enclosure

HONIG SCOTT

From: GRAMLICH ERIC
Sent: Wednesday, January 14, 1998 9:57 AM
To: HONIG SCOTT
Cc: GRAMLICH ERIC
Subject: FUSRAP SLAP

Scott here is the information that you requested:

Sample # 97-6052
Collected from Ken Smith residential well
#10 Jamestown rd.
Florissant, MO 63034
on 11/13/97@1155 hours

field pH 6.76
field conductivity 1153uS/cm
field temp. 14.9 Celsius
field turbidity .25NTU

If you need a formal memo containing this information or anything else drop me a line.

MAXIM
TECHNOLOGIES INC

31 December 1997
SMP00038
9711043

Mr. Scott Honig
State of Missouri
DEPARTMENT OF NATURAL RESOURCES
Hazardous Waste Program
1738 East Elm Street, Lower Level
Jefferson City, Missouri 65101

RE: Analytical Report for Work Order 9711043

Dear Mr. Honig:

Enclosed, please find the analytical report for the analyses performed on the samples received at MAXIM Technologies, Inc. Saint Louis, Missouri on 13 November 1997, from Missouri Department of Natural Resources.

The following water sample was identified as follows:

MDNR ID	MAXIM ID	MATRIX	ANALYSES
97-6052	9711043-01A	Water	RAD
	9711043-01B	Water	BNA, PCB
	9711043-01C	Water	Metals
	9711043-01B	Water	Inorganic
	9711043-01C	Water	Bacti
	9711043-01B	Water	VOA
97-6051	9711043-02A	Trip Blank	VOA

VOA, volatile organic compounds were analyzed by USEPA SW846 method 8260A. BNA, semivolatile base-neutral/acid extractable organic compounds were analyzed by USEPA SW846 method 8270B. PCB, polychlorinated biphenyls were analyzed for by USEPA SW846 method 8081. Metals analyses were performed by USEPA SW846 method 6010A, and 7470.

The analyses were performed according to USEPA protocol, and the data are of known and documented quality.

Should you have any questions regarding this report, please feel free to call me at (314) 426-0880.

Sincerely,
MAXIM Technologies, Inc.

Gregory K. Reed
Senior Project Manager

sm381230.doc

1908 Innerbelt Business Center Drive · St. Louis, MO 63114-5700 · 314-426-0880 · 314-426-4212 FAX

CLIENT CODE MOONR
WORK ID AIRPORT
PROJECT CODE SMP00038
REPORT TO 72PJS
DATE RECEIVED 11/13/97
DATE REQUIRED 12/13/97
DUE TO PROJ MGMT 12/04/97
RECEIVED BY JSHETLEY

[ ] GC
[ ] MSVOA MSBNA
[ ] ORG PREP
[ ] METALS PREP
[ ] INORG MGR
[ ] ASST INORG MGR
[ ] LAB MGR
[ ] PROJECT MGR
[ ] DATA MGR
[ ] HG
[ ] Wet
[ ]

APPROVED ____ DATE 14 Nov 97

#	LAB NUMBER	SAMPLE ID	MAT	COLLECTED	BOTTLE	TESTS
1	9711043-01A	970052	W	11/13/97	6X QT CUBE	RAD
2	9711043-01B	970052	W	11/13/97	4X 1LITERE	BNA_W BNA_WX PCB_W PCB_WX
3	9711043-01C	970052	W	11/13/97	QT CUBE	AGWI ASWI BAWI CDWI CRWI HGW PBWI SEWI
4	9711043-01D	970052	W	11/13/97	QT CUBE	F NO3_W
5	9711043-01E	970052	W	11/13/97	3X 8OZ PL	HOLD
6	9711043-01F	970052	W	11/13/97	3X 40 ML	VOA_W
7	9711043-02A	97-0051	W	11/13/97	2X 40 ML	VOA_W

WORKORDER COMMENTS:
Lab-designated QC
Metals 6010, 7470
VOA 8260, BNA 8270, PCB 8081
F, NO3 IC 300.0

PROJECT COMMENTS:
MOONR WSRAP AND FUSRAP CONTRACT
SUMMARY REPORT. BATCH QC IF POSSIBLE.
REPORT blank, lcs, dup/ms or ms/msd (as applicable).
Insufficient sample volumes may prevent QC analyses.

#'s TRANSFERRED	RELINQUISHED BY	DATE AND TIME	RECEIVED BY	REASON FOR TRANSFER

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY

FIELD SHEET AND CHAIN OF CUSTODY RECORD

COLLECTOR'S NAME AND AFFILIATION (PLEASE PRINT)	DESCRIPTION OF SHIPMENT		PROJECT OR MAJOR FIELD CODE
Eric Gramlich 573-526-7638	NUMBER OF SAMPLES	2	
	NUMBER OF CONTAINERS	20	
MDNR - 2710 West Main, Jefferson City, MO 65109	HOW SEALED	Hand Carried	

SAMPLE NUMBER	SAMPLE DESCRIPTION	COLLECTED DATE	COLLECTED TIME	ANALYSES REQUESTED	FIELD ANALYSES pH	Cond µS/cm	Temp °C	Residual Cl2		SITE CODE
97-6051	Ken Smith Residential Well #10 Old Jamestown Lane, Florrisant, MO, 63034 Trip Blank	11/13/97	|	VOA						3665 / 3775
97-6052	Ken Smith Residential Well #10 Old Jamestown Lane, Florrisant, MO 63034	11/13/97	1155	VOA, (As, Be, Cd, Cr, Fl, Pb, Hg, Sb, Se) Nitrate As Total coliform, Fecal, E Coli) Semivolatiles, PCBs, Radionuclides (uranium, thorium, radium	6.76	1153 µS/cm	14.9 °C	.25 mg/l		" / "

CHAIN OF CUSTODY RECORD

RELINQUISHED BY	RECEIVED BY	DATE	TIME	IF SHIPPED CARRIER	DELIVERED DATE	DELIVERED TIME	PICKED UP DATE	PICKED UP TIME
E. Gramlich ☐ SEALED ☐ SHIPPED	J. Shetley ☐ SEALED	11/13/97	13:10					
☐ SEALED ☐ SHIPPED	☐ SEALED							
☐ SEALED ☐ SHIPPED	☐ SEALED							

MO 780-0320 (11-88) DISTRIBUTION: WHITE-LAB SERVICE PROGRAM CANARY-SAMPLER

Data Report for Fluoride

Matrix:	Water
Method:	EPA 340.2
Units:	mg/l
Date Received:	11/13/97
Analysis Date:	11/24/97

Sample ID	Dilution	Lab No.	Results
97-6052		9711043-01D	0.35
97-6052-Dup		9711043-01D	0.34

QC Data		% Recovery	
Method Blank	-	-	< .05
LCS (5.0 mg/l)	-	92.8	4.6
LCS (5.0 mg/l) Dup	-	96.8	4.8

Data Report for Nitrate

Matrix:	Water
Method:	EPA 300
Units:	mg/l
Date Received:	11/13/97
Analysis Date:	11/24/97

Sample ID	Dilution	Lab No.	Results
97-60052		9711043-01D	1.80

QC Data		% Recovery	
Method Blank		-	<0.225
LCS (4.5 mg/l)	-	99.3	4.47

Report Of Analyses

Prepared by:

Microbe Inotech Laboratories

the MiL, Inc.

Microbe Inotech Laboratories, Inc. • 12133 Bridgeton Square Drive • Saint Louis MO 63044
800-688-9144 Fax: 314-344-3031

Summary Report of Analysis
[5074]

Greg Reed
Maxim Technologies
1908 Innerbelt Business Center Drive
St. Louis, MO 63114

November 17, 1997

Description and Chain of Custody Record Information:
Thr. Nov. 13, 1997 - 4:45 PM: Received by courier 1 water samples for Total Coliform, Fecal coliform and E. coli. counts on samples 97-6052
MILB Report & Invoice No.: 5074
Contact No.: 9711043

Summary Final Results— Colony forming units per 100 milliliters

Sample Name	E. coli	Fecal Coliform	Total Coliform
97-6052	<1/100ml	8 cfu /100ml	9 cfu/100ml

Processing:
The BAM approved method of 3M petrifilm was used for the detection of Coliform organisms.

Thank you from the staff on project:

Dr. Bruce C. Hemming - Operations Director

Kirk M. Hartwein- Laboratory Manager

Warranty And Limits Of Liability

In accepting analytical work, we warrant the accuracy of test results under the conditions employed in the laboratory. The foregoing express warranty is exclusive and is given in lieu of all other warranties, expressed or implied. We disclaim any other warranties, expressed or implied, including a Warranty of Fitness for Particular Purpose and Warranty of Merchantability. We accept no legal responsibility for the purposes for which the client uses the test results.

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

970052

Lab Name: Maxim Technologies Contract: SMP00038

Lab Code: Maxim Case No.: MODNR SAS No.: SDG No.: 970051

Matrix (soil/water): WATER Lab Sample ID: 971104301C

Level (low/med): LOW Date Received: 11/13/97

% Solids: 100.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7440-36-0	Antimony				
7440-38-2	Arsenic	4.0	U		P
7440-43-9	Cadmium	2.0	U		P
7440-47-3	Chromium	10.7			P
7439-92-1	Lead	2.0	B		P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel				
7440-22-4	Silver	1.0	U		P
7440-28-0	Thallium				
7440-39-3	Barium	243			P
7440-50-8	Copper				
7440-66-6	Zinc				
7782-49-2	Selenium	5.0	U		P

Color Before: Clarity Before: Texture:

Color After: Clarity After: Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

3
BLANKS

Lab Name: Maxim Technologies   Contract: SMP00038

Lab Code: Maxim   Case No.: MODNR   SAS No.:   SDG No.: 970051

Preparation Blank Matrix (soil/water): WATER

Preparation Blank Concentration Units (ug/L or mg/kg): UG/L

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Preparation Blank	C	M
Antimony											
Arsenic									4.000	U	P
Cadmium									2.000	U	P
Chromium									2.000	U	P
Lead									2.000	U	P
Mercury									0.100	U	CV
Nickel											
Silver									1.000	U	P
Thallium											
Barium									2.000	U	P
Copper											
Zinc											
Selenium									5.000	U	P

ENVIROFORMS/INORGANIC CLP

5A
SPIKE SAMPLE RECOVERY

SAMPLE NO.

970052S

Lab Name: Maxim Technologies Contract: SMP00038

Lab Code: Maxim Case No.: MODNR SAS No.: SDG No.: 970051

Matrix (soil/water): WATER Level (low/med): LOW
% Solids for Sample: 100.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

Analyte	Control Limit %R	Spiked Sample Result (SSR)	C	Sample Result (SR)	C	Spike Added (SA)	%R	Q	M
Antimony									NR
Arsenic	75-125	2091.5101		4.0000	U	2000.00	104.6		P
Cadmium	75-125	49.6700		2.0000	U	50.00	99.3		P
Chromium	75-125	206.3700		10.6900		200.00	97.8		P
Lead	75-125	477.7800		2.0200	B	500.00	95.2		P
Mercury									NR
Nickel									NR
Silver	75-125	43.7400		1.0000	U	50.00	87.5		P
Thallium									NR
Barium	75-125	2215.5299		242.6200		2000.00	98.6		P
Copper									NR
Zinc									NR
Selenium	75-125	1995.4600		5.0000	U	2000.00	99.8		P

mments:

ENVIROFORMS/INORGANIC CLP

6
DUPLICATES

SAMPLE NO.

970052D

Lab Name: Maxim Technologies Contract: SMP00038

Lab Code: Maxim Case No.: MODNR SAS No.: SDG No.: 970051

Matrix (soil/water): WATER Level (low/med): LOW

% Solids for Sample: 100.0 % Solids for Duplicate: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	M
Antimony								
Arsenic		4.0000	U	4.0000	U			P
Cadmium		2.0000	U	2.0000	U			P
Chromium	10.0	10.6900		10.7400		0.5		P
Lead		2.0200	B	2.0000	U	200.0		P
Mercury								
Nickel								
Silver		1.0000	U	1.0000	U			P
Thallium								
Barium	200.0	242.6200		252.2200		3.9		P
Copper								
Zinc								
Selenium		5.0000	U	5.0000	U			P

ENVIROFORMS/INORGANIC CLP

7

LABORATORY CONTROL SAMPLE

Lab Name: Maxim Technologies Contract: SMP00038

Lab Code: Maxim Case No.: MODNR SAS No.: SDG No.: 970051

Solid LCS Source:

Aqueous LCS Source: SEE DIG. LOG

Analyte	Aqueous (ug/L) True	Found	%R	Solid (mg/kg) True	Found	C	Limits		%R
Antimony									
Arsenic	1000.0	1008.49	100.8						
Cadmium	1000.0	1022.80	102.3						
Chromium	1000.0	989.75	99.0						
Lead	1000.0	971.91	97.2						
Mercury	1.5	1.61	107.3						
Nickel									
Silver	1000.0	981.89	98.2						
Thallium									
Barium	1000.0	981.85	98.2						
Copper									
Zinc									
Selenium	1000.0	989.38	98.9						

Data Report for PCBs
Total

Sample ID:	97-6052
Lab ID:	9711043-01B
Matrix:	Water
Method:	8081
Units:	ug/l
Date Sampled:	11/13/97
Date Received:	11/13/97
Date Extracted:	11/19/97
Date Analyzed:	11/21/97
Percent Solids:	NA

Parameter	Results
Aroclor 1016	< 1
Aroclor 1221	< 1
Aroclor 1232	< 1
Aroclor 1242	< 1
Aroclor 1248	< 1
Aroclor 1254	< 1
Aroclor 1260	< 1

Surrogate Recoveries

TCX	94%
DCB	61%

Data File: /chem/d.i/D971124A.b/DD7545.d
Report Date: 25-Nov-1997 11:28

MAXIM TECHNOLOGIES

TARGET COMPOUNDS

Client Name:
Lab Smp Id: 9711043-01B
Sample Location:
Sample Date:
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info: IN#MSD; WSBLK11884 970052 970052

Client SDG: 970052
Client Smp ID: 970052
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW
Operator: JOHN SUPER GR BTL#

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
110-86-1	Pyridine	10	U
62-75-9	N-Nitrosodimethylamine	10	U
62-53-3	Aniline	10	U
108-95-2	Phenol	10	U
95-57-8	2-Chlorophenol	10	U
111-44-4	bis(2-Chloroethyl)ether	10	U
541-73-1	1,3-Dichlorobenzene	10	U
106-46-7	1,4-Dichlorobenzene	10	U
95-50-1	1,2-Dichlorobenzene	10	U
100-51-6	Benzyl alcohol	10	U
95-48-7	2-Methylphenol	10	U
108-60-1	2,2'-oxybis(1-Chloropropane)	2	U
67-72-1	Hexachloroethane	10	U
106-44-5	4-Methylphenol	10	U
621-64-7	N-Nitroso-di-n-propylamine	10	U
98-95-3	Nitrobenzene	10	U
78-59-1	Isophorone	10	U
88-75-5	2-Nitrophenol	10	U
105-67-9	2,4-Dimethyphenol	10	U
111-91-1	bis(2-Chloroethoxy)methane	10	U
120-83-2	2,4-Dichlorophenol	10	U
120-82-1	1,2,4-Trichlorobenzene	10	U
65-85-0	Benzoic acid	10	U
91-20-3	Naphthalene	10	U
106-47-8	4-Chloroaniline	10	U
87-68-3	Hexachlorobutadiene	10	U
59-50-7	4-Chloro-3-methylphenol	10	U
91-57-6	2-Methylnaphthalene	10	U
77-47-4	Hexachlorocyclopentadiene	10	U
88-06-2	2,4,6-Trichlorophenol	10	U
95-95-4	2,4,5-Trichlorophenol	25	U
91-58-7	2-Chloronaphthalene	10	U
88-74-4	2-Nitroaniline	25	U
131-11-3	Dimethylphthalate	10	U
208-96-8	Acenaphthylene	10	U
606-20-2	2,6-Dinitrotoluene	10	U
99-09-2	3-Nitroaniline	25	U

Data File: /chem/d.i/D971124A.b/DD7545.d
Report Date: 25-Nov-1997 11:28

MAXIM TECHNOLOGIES

TARGET COMPOUNDS

Client Name:
Lab Smp Id: 9711043-01B
Sample Location:
Sample Date:
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info: IN#MSD; WSBLK11884 970052 970052 BTL#

Client SDG: 970052
Client Smp ID: 970052
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW
Operator: JOHN SUPER GR

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
83-32-9	Acenaphthene	10	U
51-28-5	2,4-Dinitrophenol	25	U
132-64-9	Dibenzofuran	10	U
100-02-7	4-Nitrophenol	25	U
121-14-2	2,4-Dinitrotoluene	1	U
84-66-2	Diethylphthalate	10	U
86-73-7	Fluorene	10	U
7005-72-3	4-Chlorophenyl-phenylether	10	U
100-01-6	4-Nitroaniline	25	U
534-52-1	4,6-Dinitro-2-methylphenol	25	U
86-30-6	N-Nitrosodiphenylamine	10	U
122-66-7	1,2-Diphenylhydrazine	10	U
~~126-73-8~~	~~Tributyl Phosphate~~	~~41~~	
101-55-3	4-Bromophenyl-phenylether	10	U
118-74-1	Hexachlorobenzene	1	U
87-86-5	Pentachlorophenol	25	U
92-87-5	Benzidine	10	U
85-01-8	Phenanthrene	10	U
120-12-7	Anthracene	10	U
86-74-8	Carbazole	5	U
84-74-2	Di-n-butylphthalate	10	U
206-44-0	Fluoranthene	10	U
129-00-0	Pyrene	10	U
85-68-7	Butylbenzylphthalate	10	U
56-55-3	Benzo(a)anthracene	10	U
91-94-1	3,3'-Dichlorobenzidine	10	U
218-01-9	Chrysene	10	U
117-81-7	bis(2-Ethylhexyl)phthalate	10	U
117-84-0	Di-n-octylphthalate	10	U
205-99-2	Benzo(b)fluoranthene	10	U
207-08-9	Benzo(k)fluoranthene	10	U
50-32-8	Benzo(a)pyrene	10	U
193-39-5	Indeno(1,2,3-cd)pyrene	10	U
53-70-3	Dibenzo(a,h)anthracene	10	U
191-24-2	Benzo(g,h,i)perylene	10	U
367-12-4	2-Fluorophenol	36	

do not rpt
[illegible] 11.25

Data File: /chem/d.i/D971124A.b/DD7545.d
Report Date: 25-Nov-1997 11:28

MAXIM TECHNOLOGIES

TARGET COMPOUNDS

Client Name:
Lab Smp Id: 9711043-01B
Sample Location:
Sample Date:
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info: IN#MSD; WSBLK11884 970052 970052 BTL#

Client SDG: 970052
Client Smp ID: 970052
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW
Operator: JOHN SUPER GR

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
4165-62-2	Phenol-d5	24	
N/A	2-Chlorophenol-d4	54	
2199-69-1	1,2-Dichlorobenzene-d4	41	
4165-60-0	Nitrobenzene-d5	40	
321-60-8	2-Fluorobiphenyl	39	
118-79-6	2,4,6-Tribromophenol	58	
1718-51-0	Terphenyl-d14	33	

Data File: /chem/d.i/D971124A.b/DD7545.d
Report Date: 25-Nov-1997 11:28

MAXIM TECHNOLOGIES

INTERNAL STANDARD COMPOUNDS
AREA AND RT SUMMARY

Instrument ID: d.i
Lab File ID: DD7545.d
Lab Smp Id: 9711043-01B
Analysis Type: SV
Quant Type: ISTD
Operator: JOHN SUPER GR
Method File: /chem/d.i/D971124A.b/bna8270.m
Misc Info: IN#MSD; WSBLK11884 970052 970052 BTL#

Calibration Date: 11/24/97
Calibration Time: 1743
Client Smp ID: 970052
Level: LOW
Sample Type: WATER

COMPOUND	STANDARD	AREA LIMIT LOWER	AREA LIMIT UPPER	SAMPLE	% DIFF
11 1,4-Dichlorobenzene-	22457	11228	44914	19640	-12.54
30 Naphthalene-d8	83103	41552	166206	71938	-13.44
45 Acenaphthene-d10	49694	24847	99388	41257	-16.98
65 Phenanthrene-d10	92023	46012	184046	77322	-15.98
75 Chrysene-d12	72930	36465	145860	77463	6.22
83 Perylene-d12	59082	29541	118164	56229	-4.83

COMPOUND	STANDARD	RT LIMIT LOWER	RT LIMIT UPPER	SAMPLE	% DIFF
11 1,4-Dichlorobenzene-	10.99	10.49	11.49	11.01	0.17
30 Naphthalene-d8	13.74	13.24	14.24	13.74	-0.03
45 Acenaphthene-d10	17.60	17.10	18.10	17.61	0.06
65 Phenanthrene-d10	20.91	20.41	21.41	20.89	-0.08
75 Chrysene-d12	26.77	26.27	27.27	26.77	-0.01
83 Perylene-d12	30.47	29.97	30.97	30.47	-0.02

AREA UPPER LIMIT = +100% of internal standard area.
AREA LOWER LIMIT = - 50% of internal standard area.
RT UPPER LIMIT = + 0.50 minutes of internal standard RT.
RT LOWER LIMIT = - 0.50 minutes of internal standard RT.

MAXIM TECHNOLOGIES INC
SCIENTISTS ENGINEERS & ANALYTICAL SERVICES
1908 Innerbelt Business Center Drive
St. Louis, Missouri 63114-5700

CHAIN-OF-CUSTODY RECORD

CLIENT NAME: MAXIM
CLIENT ADDRESS (STREET NUMBER, SUITE, ETC.)
CLIENT ADDRESS (CITY, STATE, ZIP)
CLIENT CONTACT/ADDRESS IF DIFFERENT FROM ABOVE: G. REED PHONE: 426-6880
SAMPLED BY PRINT NAME / SIGNATURE

MAXIM CONTACT: 4711043
PROJECT NAME
CLIENT P.O. NUMBER / PROJECT NUMBER
BILL TO (COMPANY NAME, ADDRESS)
REPORT TO

LAB USE ONLY
PROJECT MANAGER
PRIORITY
TEMPERATURE OF CONTAINER
SAMPLE CONDITION

MAXIM PROJECT NUMBER

EXPECTED TURNAROUND TIME

POSSIBLE HAZARD: YES ____ NO ____ UNKNOWN ____ (COMMENT BELOW)

SAMPLE DISPOSAL: RETURN TO CLIENT ____ DISPOSAL BY LAB ____
(ADDITIONAL CHARGES MAY BE ASSESSED)

ANALYSES REQUESTED: F-COLI, T-COLI, E-COLI

LAB SAMPLE NUMBER	ITEM NO.	CLIENT SAMPLE ID.	MATRIX	F-COLI	T-COLI	E-COLI						DATE SAMPLED	TIME SAMPLED	NUMBER & TYPE OF CONTAINERS
	1	97-4602	W	X	X	X						11/13/97	1000	3 x 500 P1
	2													
	3													
	4													
	5													
	6													
	7													
	8													
	9													
	10													

RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	DATE/TIME	RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	DATE/TIME
[illegible]	11/13/97 1150						
		[illegible]	[illegible]				

ADDITIONAL COMMENTS:

WAYBILL #

Data File: /chem/d.i/D971124A.b/DD7545.d
Report Date: 25-Nov-1997 11:28

MAXIM TECHNOLOGIES

RECOVERY REPORT

Client Name:
Sample Matrix: LIQUID
Lab Smp Id: 9711043-01B
Level: LOW
Data Type: MS DATA
SpikeList File: WaterMsd.spk
Method File: /chem/d.i/D971124A.b/bna8270.m
Misc Info: IN#MSD; WSBLK11884 970052 970052 BTL#

Client SDG: 970052
Fraction: SV
Client Smp ID: 970052
Operator: JOHN SUPER GR
SampleType: SAMPLE
Quant Type: ISTD

SURROGATE COMPOUND	CONC ADDED ug/L	CONC RECOVERED ug/L	% RECOVERED	LIMITS
$ 3 2-Fluorophenol	75	36	47.35	21-110
$ 5 Phenol-d5	75	24	32.02	10-110
$ 7 2-Chlorophenol-d4	75	54	72.32	33-110
$ 13 1,2-Dichlorobenzen	50	41	82.81	16-110
$ 21 Nitrobenzene-d5	50	40	80.61	35-114
$ 39 2-Fluorobiphenyl	50	39	78.32	43-116
$ 59 2,4,6-Tribromophen	75	58	77.59	10-123
$ 72 Terphenyl-d14	50	33	66.13	33-141

Data File: /chem/d.i/D971124A.b/DD7541.d
Report Date: 25-Nov-1997 11:37

MAXIM TECHNOLOGIES

TARGET COMPOUNDS

Client Name:
Lab Smp Id: WSBLK11884
Sample Location:
Sample Date:
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info: IN#MSD; WSBLK11884

Client SDG: PW3300WB
Client Smp ID: WSBLK11884
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW
Operator: JOHN SUPER GR
BTL#

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
110-86-1	Pyridine	10	U
62-75-9	N-Nitrosodimethylamine	10	U
62-53-3	Aniline	10	U
108-95-2	Phenol	10	U
95-57-8	2-Chlorophenol	10	U
111-44-4	bis(2-Chloroethyl)ether	10	U
541-73-1	1,3-Dichlorobenzene	10	U
106-46-7	1,4-Dichlorobenzene	10	U
95-50-1	1,2-Dichlorobenzene	10	U
100-51-6	Benzyl alcohol	10	U
95-48-7	2-Methylphenol	10	U
108-60-1	2,2'-oxybis(1-Chloropropane)	2	U
67-72-1	Hexachloroethane	10	U
106-44-5	4-Methylphenol	10	U
621-64-7	N-Nitroso-di-n-propylamine	10	U
98-95-3	Nitrobenzene	10	U
78-59-1	Isophorone	10	U
88-75-5	2-Nitrophenol	10	U
105-67-9	2,4-Dimethyphenol	10	U
111-91-1	bis(2-Chloroethoxy)methane	10	U
120-83-2	2,4-Dichlorophenol	10	U
120-82-1	1,2,4-Trichlorobenzene	10	U
65-85-0	Benzoic acid	10	U
91-20-3	Naphthalene	10	U
106-47-8	4-Chloroaniline	10	U
87-68-3	Hexachlorobutadiene	10	U
59-50-7	4-Chloro-3-methylphenol	10	U
91-57-6	2-Methylnaphthalene	10	U
77-47-4	Hexachlorocyclopentadiene	10	U
88-06-2	2,4,6-Trichlorophenol	10	U
95-95-4	2,4,5-Trichlorophenol	25	U
91-58-7	2-Chloronaphthalene	10	U
88-74-4	2-Nitroaniline	25	U
131-11-3	Dimethylphthalate	10	U
208-96-8	Acenaphthylene	10	U
606-20-2	2,6-Dinitrotoluene	10	U
99-09-2	3-Nitroaniline	25	U

Data File: /chem/d.i/D971124A.b/DD7541.d
Report Date: 25-Nov-1997 11:37

MAXIM TECHNOLOGIES

TARGET COMPOUNDS

Client Name:
Lab Smp Id: WSBLK11884
Sample Location:
Sample Date:
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info: IN#MSD; WSBLK11884

Client SDG: PW3300WB
Client Smp ID: WSBLK11884
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW
Operator: JOHN SUPER GR
BTL#

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
83-32-9	Acenaphthene	10	U
51-28-5	2,4-Dinitrophenol	25	U
132-64-9	Dibenzofuran	10	U
100-02-7	4-Nitrophenol	25	U
121-14-2	2,4-Dinitrotoluene	1	U
84-66-2	Diethylphthalate	10	U
86-73-7	Fluorene	10	U
7005-72-3	4-Chlorophenyl-phenylether	10	U
100-01-6	4-Nitroaniline	25	U
534-52-1	4,6-Dinitro-2-methylphenol	25	U
86-30-6	N-Nitrosodiphenylamine	10	U
122-66-7	1,2-Diphenylhydrazine	10	U
126-73-3	Tributyl Phosphate	10	U
101-55-3	4-Bromophenyl-phenylether	10	U
118-74-1	Hexachlorobenzene	1	U
87-86-5	Pentachlorophenol	25	U
92-87-5	Benzidine	10	U
85-01-8	Phenanthrene	10	U
120-12-7	Anthracene	10	U
86-74-8	Carbazole	5	U
84-74-2	Di-n-butylphthalate	10	U
206-44-0	Fluoranthene	10	U
129-00-0	Pyrene	10	U
85-68-7	Butylbenzylphthalate	10	U
56-55-3	Benzo(a)anthracene	10	U
91-94-1	3,3'-Dichlorobenzidine	10	U
218-01-9	Chrysene	10	U
117-81-7	bis(2-Ethylhexyl)phthalate	10	U
117-84-0	Di-n-octylphthalate	10	U
205-99-2	Benzo(b)fluoranthene	10	U
207-08-9	Benzo(k)fluoranthene	10	U
50-32-8	Benzo(a)pyrene	10	U
193-39-5	Indeno(1,2,3-cd)pyrene	10	U
53-70-3	Dibenzo(a,h)anthracene	10	U
191-24-2	Benzo(g,h,i)perylene	10	U
367-12-4	2-Fluorophenol	40	

Data File: /chem/d.i/D971124A.b/DD7541.d
Report Date: 25-Nov-1997 11:37

MAXIM TECHNOLOGIES

TARGET COMPOUNDS

Client Name:
Lab Smp Id: WSBLK11884
Sample Location:
Sample Date:
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info: IN#MSD; WSBLK11884

Client SDG: PW3300WB
Client Smp ID: WSBLK11884
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW
Operator: JOHN SUPER GR BTL#

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
4165-62-2	Phenol-d5	27	
N/A	2-Chlorophenol-d4	60	
2199-69-1	1,2-Dichlorobenzene-d4	40	
4165-60-0	Nitrobenzene-d5	41	
321-60-8	2-Fluorobiphenyl	41	
118-79-6	2,4,6-Tribromophenol	72	
1718-51-0	Terphenyl-d14	35	

Data File: /chem/d.i/D971124A.b/DD7541.d
Report Date: 25-Nov-1997 11:37

MAXIM TECHNOLOGIES

INTERNAL STANDARD COMPOUNDS
AREA AND RT SUMMARY

Instrument ID: d.i
Lab File ID: DD7541.d
Lab Smp Id: WSBLK11884
Analysis Type: SV
Quant Type: ISTD
Operator: JOHN SUPER GR
Method File: /chem/d.i/D971124A.b/bna8270.m
Misc Info: IN#MSD; WSBLK11884 BTL#

Calibration Date: 11/24/97
Calibration Time: 1743
Client Smp ID: WSBLK11884
Level: LOW
Sample Type: WATER

COMPOUND	STANDARD	AREA LIMIT LOWER	AREA LIMIT UPPER	SAMPLE	% DIFF
11 1,4-Dichlorobenzene-	22457	11228	44914	19004	-15.38
30 Naphthalene-d8	83103	41552	166206	70435	-15.24
45 Acenaphthene-d10	49694	24847	99388	40473	-18.56
65 Phenanthrene-d10	92023	46012	184046	73774	-19.83
75 Chrysene-d12	72930	36465	145860	74384	1.99
83 Perylene-d12	59082	29541	118164	68730	16.33

COMPOUND	STANDARD	RT LIMIT LOWER	RT LIMIT UPPER	SAMPLE	% DIFF
11 1,4-Dichlorobenzene-	10.99	10.49	11.49	11.00	0.08
30 Naphthalene-d8	13.74	13.24	14.24	13.73	-0.10
45 Acenaphthene-d10	17.60	17.10	18.10	17.60	0.00
65 Phenanthrene-d10	20.91	20.41	21.41	20.90	-0.04
75 Chrysene-d12	26.77	26.27	27.27	26.75	-0.07
83 Perylene-d12	30.47	29.97	30.97	30.47	-0.02

AREA UPPER LIMIT = +100% of internal standard area.
AREA LOWER LIMIT = - 50% of internal standard area.
RT UPPER LIMIT = + 0.50 minutes of internal standard RT.
RT LOWER LIMIT = - 0.50 minutes of internal standard RT.

Data File: /chem/d.i/D971124A.b/DD7541.d
Report Date: 25-Nov-1997 11:37

MAXIM TECHNOLOGIES

RECOVERY REPORT

Client Name:
Sample Matrix: LIQUID
Lab Smp Id: WSBLK11884
Level: LOW
Data Type: MS DATA
SpikeList File: WaterMsd.spk
Method File: /chem/d.i/D971124A.b/bna8270.m
Misc Info: IN#MSD; WSBLK11884 BTL#

Client SDG: PW3300WB
Fraction: SV
Client Smp ID: WSBLK11884
Operator: JOHN SUPER GR
SampleType: BLANK
Quant Type: ISTD

SURROGATE COMPOUND	CONC ADDED ug/L	CONC RECOVERED ug/L	% RECOVERED	LIMITS
$ 3 2-Fluorophenol	75	40	53.21	21-110
$ 5 Phenol-d5	75	27	35.71	10-110
$ 7 2-Chlorophenol-d4	75	60	80.27	33-110
$ 13 1,2-Dichlorobenzen	50	40	79.78	16-110
$ 21 Nitrobenzene-d5	50	41	81.86	35-114
$ 39 2-Fluorobiphenyl	50	41	82.20	43-116
$ 59 2,4,6-Tribromophen	75	72	96.11	10-123
$ 72 Terphenyl-d14	50	35	69.52	33-141

Data File: /chem/d.i/D971124A.b/DD7542.d
Report Date: 25-Nov-1997 11:37

MAXIM TECHNOLOGIES

RECOVERY REPORT

Client Name:
Sample Matrix: LIQUID
Lab Smp Id: WSLCS11884
Level: LOW
Data Type: MS DATA
SpikeList File: WaterMsd.spk
Method File: /chem/d.i/D971124A.b/bna8270.m
Misc Info: IN#MSD; WSBLK11884 BTL#

Client SDG: PW3300WB
Fraction: SV
Client Smp ID: WSLCS11884
Operator: JOHN SUPER GR
SampleType: LCS
Quant Type: ISTD

SPIKE COMPOUND	CONC ADDED ug/L	CONC RECOVERED ug/L	% RECOVERED	LIMITS
6 Phenol	75	24	31.65	12-110
8 2-Chlorophenol	75	58	77.09	27-123
12 1,4-Dichlorobenzen	50	40	79.65	36-97
20 N-Nitroso-di-n-pro	50	38	76.39	41-116
28 1,2,4-Trichloroben	50	40	79.15	39-98
34 4-Chloro-3-methylp	75	55	73.57	23-97
47 Acenaphthene	50	43	86.03	46-118
51 2,4-Dinitrotoluene	50	43	86.61	24-96
50 4-Nitrophenol	75	25	33.68	10-80
63 Pentachlorophenol	75	50	66.22	9-103
71 Pyrene	50	36	71.96	26-127

SURROGATE COMPOUND	CONC ADDED ug/L	CONC RECOVERED ug/L	% RECOVERED	LIMITS
$ 3 2-Fluorophenol	75	38	50.64	21-110
$ 5 Phenol-d5	75	25	33.22	10-110
$ 7 2-Chlorophenol-d4	75	57	76.39	33-110
$ 13 1,2-Dichlorobenzen	50	42	84.78	16-110
$ 21 Nitrobenzene-d5	50	41	82.65	35-114
$ 39 2-Fluorobiphenyl	50	40	81.00	43-116
$ 59 2,4,6-Tribromophen	75	63	84.47	10-123
$ 72 Terphenyl-d14	50	32	64.97	33-141

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

970051

Lab Name: MAXIM TECHNOLOGIES Contract:

Lab Code: MAXIM Case No.: 970052 SAS No.: SDG No.: 970052

Matrix: (soil/water) WATER Lab Sample ID: 9711043-02A

Sample wt/vol: 5 (g/mL) mL Lab File ID: EE4161

Level: (low/med) LOW Date Received: 11/13/97

% Moisture: not dec. ________ Date Analyzed: 11/17/97

Column: (pack/cap) CAP Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L	Q
75-01-4	Vinyl Chloride	5	U
74-87-3	Chloromethane	5	U
74-83-9	Bromomethane	10	U
75-00-3	Chloroethane	5	U
75-69-4	Trichlorofluoromethane	5	U
75-35-4	1,1-Dichloroethene	5	U
75-15-0	Carbon Disulfide	5	U
67-64-1	Acetone	10	U
75-09-2	Methylene Chloride	3	J
75-34-3	1,1-Dichloroethane	5	U
108-05-4	Vinyl acetate	5	U
540-59-0	1,2-Dichloroethene (total)	5	U
78-93-3	2-Butanone	5	U
67-66-3	Chloroform	5	U
71-55-6	1,1,1-Trichloroethane	5	U
56-23-5	Carbon Tetrachloride	5	U
71-43-2	Benzene	5	U
107-06-2	1,2-Dichloroethane	5	U
79-01-6	Trichloroethene	5	U
78-87-5	1,2-Dichloropropane	5	U
75-27-4	Bromodichloromethane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	U
108-10-1	4-Methyl-2-pentanone	5	U
108-88-3	Toluene	5	U
10061-02-6	trans-1,3-Dichloropropene	5	U
79-00-5	1,1,2-Trichloroethane	5	U
127-18-4	Tetrachloroethene	5	U
591-78-6	2-Hexanone	5	U
124-48-1	Dibromochloromethane	5	U
108-90-7	Chlorobenzene	5	U
100-41-4	Ethylbenzene	5	U
1330-20-7	Xylene (total)	5	U
100-42-5	Styrene	5	U
75-25-2	Bromoform	5	U

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

970051

Lab Name: MAXIM TECHNOLOGIES   Contract:

Lab Code: MAXIM   Case No.: 970052   SAS No.:   SDG No.: 970052

Matrix: (soil/water) WATER   Lab Sample ID: 9711043-02A

Sample wt/vol: 5 (g/mL) mL   Lab File ID: EE4161

Level: (low/med) LOW   Date Received: 11/13/97

% Moisture: not dec. ________   Date Analyzed: 11/17/97

Column: (pack/cap) CAP   Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L	Q
79-34-5	1,1,2,2-Tetrachloroethane	5	U

FORM I VOA   1/87 Rev.

Data File: /chem/e.i/E971117A.b/EE4161.d
Report Date: 18-Nov-1997 07:25

MAXIM TECHNOLOGIES

INTERNAL STANDARD COMPOUNDS
AREA AND RT SUMMARY

Instrument ID: e.i
Lab File ID: EE4161.d
Lab Smp Id: 9711043-02A
Analysis Type: VOA
Quant Type: ISTD
Operator: MS2 SUPER GR
Method File: /chem/e.i/E971117A.b/voa8260.m
Misc Info: 59702E LAC 970051 VBLK321A 970052

Calibration Date: 11/17/97
Calibration Time: 1052
Client Smp ID: 970051
Level: LOW
Sample Type: WATER

COMPOUND	STANDARD	AREA LIMIT LOWER	AREA LIMIT UPPER	SAMPLE	% DIFF
31 Bromochloromethane	17119	8560	34238	16541	-3.38
41 1,4-Difluorobenzene	74668	37334	149336	66106	-11.47
62 Chlorobenzene-d5	53933	26966	107866	50647	-6.09

COMPOUND	STANDARD	RT LIMIT LOWER	RT LIMIT UPPER	SAMPLE	% DIFF
31 Bromochloromethane	11.35	10.85	11.85	11.26	-0.81
41 1,4-Difluorobenzene	13.54	13.04	14.04	13.47	-0.56
62 Chlorobenzene-d5	19.39	18.89	19.89	19.30	-0.43

AREA UPPER LIMIT = +100% of internal standard area.
AREA LOWER LIMIT = - 50% of internal standard area.
RT UPPER LIMIT = + 0.50 minutes of internal standard RT.
RT LOWER LIMIT = - 0.50 minutes of internal standard RT.

Data File: /chem/e.i/E971117A.b/EE4161.d
Report Date: 18-Nov-1997 07:25

MAXIM TECHNOLOGIES

RECOVERY REPORT

Client Name:
Sample Matrix: LIQUID
Lab Smp Id: 9711043-02A
Level: LOW
Data Type: MS DATA
SpikeList File: water.spk
Method File: /chem/e.i/E971117A.b/voa8260.m
Misc Info: 59702E LAC 970051 VBLK321A 970052

Client SDG: 970052
Fraction: VOA
Client Smp ID: 970051
Operator: MS2 SUPER GR
SampleType: SAMPLE
Quant Type: ISTD

SURROGATE COMPOUND	CONC ADDED ug/L	CONC RECOVERED ug/L	% RECOVERED	LIMITS
$ 37 1,2-Dichloroethane	50	46	91.01	76-114
$ 52 Toluene-d8	50	49	97.50	88-110
$ 73 4-Bromofluorobenze	50	48	95.48	86-115

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

970052

Lab Name: MAXIM TECHNOLOGIES Contract:

Lab Code: MAXIM Case No.: 970052 SAS No.: SDG No.: 970052

Matrix: (soil/water) WATER Lab Sample ID: 9711043-01F

Sample wt/vol: 5 (g/mL) mL Lab File ID: EE4158

Level: (low/med) LOW Date Received: 11/13/97

% Moisture: not dec. ________ Date Analyzed: 11/17/97

Column: (pack/cap) CAP Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L	Q
75-01-4	Vinyl Chloride	5	U
74-87-3	Chloromethane	5	U
74-83-9	Bromomethane	10	U
75-00-3	Chloroethane	5	U
75-69-4	Trichlorofluoromethane	5	U
75-35-4	1,1-Dichloroethene	5	U
75-15-0	Carbon Disulfide	5	U
67-64-1	Acetone	10	U
75-09-2	Methylene Chloride	5	U
75-34-3	1,1-Dichloroethane	5	U
108-05-4	Vinyl acetate	5	U
540-59-0	1,2-Dichloroethene (total)	5	U
78-93-3	2-Butanone	5	U
67-66-3	Chloroform	5	U
71-55-6	1,1,1-Trichloroethane	5	U
56-23-5	Carbon Tetrachloride	5	U
71-43-2	Benzene	5	U
107-06-2	1,2-Dichloroethane	5	U
79-01-6	Trichloroethene	5	U
78-87-5	1,2-Dichloropropane	5	U
75-27-4	Bromodichloromethane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	U
108-10-1	4-Methyl-2-pentanone	5	U
108-88-3	Toluene	5	U
10061-02-6	trans-1,3-Dichloropropene	5	U
79-00-5	1,1,2-Trichloroethane	5	U
127-18-4	Tetrachloroethene	5	U
591-78-6	2-Hexanone	5	U
124-48-1	Dibromochloromethane	5	U
108-90-7	Chlorobenzene	5	U
100-41-4	Ethylbenzene	5	U
1330-20-7	Xylene (total)	5	U
100-42-5	Styrene	5	U
75-25-2	Bromoform	5	U

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

970052

Lab Name: MAXIM TECHNOLOGIES Contract:

Lab Code: MAXIM Case No.: 970052 SAS No.: SDG No.: 970052

Matrix: (soil/water) WATER Lab Sample ID: 9711043-01F

Sample wt/vol: 5 (g/mL) mL Lab File ID: EE4158

Level: (low/med) LOW Date Received: 11/13/97

% Moisture: not dec. ________ Date Analyzed: 11/17/97

Column: (pack/cap) CAP Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L	Q
79-34-5	---------1,1,2,2-Tetrachloroethane___	5	U

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Data File: /chem/e.i/E971117A.b/EE4158.d
Report Date: 18-Nov-1997 07:25

MAXIM TECHNOLOGIES

INTERNAL STANDARD COMPOUNDS
AREA AND RT SUMMARY

Instrument ID: e.i
Lab File ID: EE4158.d
Lab Smp Id: 9711043-01F
Analysis Type: VOA
Quant Type: ISTD
Operator: MS2 SUPER GR
Method File: /chem/e.i/E971117A.b/voa8260.m
Misc Info: 59702E LAC 970052 VBLK321A 970052

Calibration Date: 11/17/97
Calibration Time: 1052
Client Smp ID: 970052
Level: LOW
Sample Type: WATER

COMPOUND	STANDARD	AREA LIMIT LOWER	AREA LIMIT UPPER	SAMPLE	% DIFF
31 Bromochloromethane	17119	8560	34238	16523	-3.48
41 1,4-Difluorobenzene	74668	37334	149336	66909	-10.39
62 Chlorobenzene-d5	53933	26966	107866	50907	-5.61

COMPOUND	STANDARD	RT LIMIT LOWER	RT LIMIT UPPER	SAMPLE	% DIFF
31 Bromochloromethane	11.35	10.85	11.85	11.08	-2.43
41 1,4-Difluorobenzene	13.54	13.04	14.04	13.36	-1.33
62 Chlorobenzene-d5	19.39	18.89	19.89	19.28	-0.57

AREA UPPER LIMIT = +100% of internal standard area.
AREA LOWER LIMIT = - 50% of internal standard area.
RT UPPER LIMIT = + 0.50 minutes of internal standard RT.
RT LOWER LIMIT = - 0.50 minutes of internal standard RT.

√

Data File: /chem/e.i/E971117A.b/EE4158.d
Report Date: 18-Nov-1997 07:25

MAXIM TECHNOLOGIES

RECOVERY REPORT

Client Name:
Sample Matrix: LIQUID
Lab Smp Id: 9711043-01F
Level: LOW
Data Type: MS DATA
SpikeList File: water.spk
Method File: /chem/e.i/E971117A.b/voa8260.m
Misc Info: 59702E LAC 970052 VBLK321A 970052

Client SDG: 970052
Fraction: VOA
Client Smp ID: 970052
Operator: MS2 SUPER GR
SampleType: SAMPLE
Quant Type: ISTD

SURROGATE COMPOUND	CONC ADDED ug/L	CONC RECOVERED ug/L	% RECOVERED	LIMITS
$ 37 1,2-Dichloroethane	50	44	87.92	76-114
$ 52 Toluene-d8	50	47	94.43	88-110
$ 73 4-Bromofluorobenze	50	46	91.47	86-115

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

VBLK321A

Lab Name: MAXIM TECHNOLOGIES Contract:

Lab Code: MAXIM Case No.: 970052 SAS No.: SDG No.: 970052

Matrix: (soil/water) WATER Lab Sample ID: MSA321A

Sample wt/vol: 5 (g/mL) mL Lab File ID: EE4150

Level: (low/med) LOW Date Received:

% Moisture: not dec. ________ Date Analyzed: 11/17/97

Column: (pack/cap) CAP Dilution Factor: 1.0

CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L

CAS NO.	COMPOUND	CONCENTRATION	Q
75-01-4	Vinyl Chloride	5	U
74-87-3	Chloromethane	5	U
74-83-9	Bromomethane	10	U
75-00-3	Chloroethane	5	U
75-69-4	Trichlorofluoromethane	5	U
75-35-4	1,1-Dichloroethene	5	U
75-15-0	Carbon Disulfide	5	U
67-64-1	Acetone	10	U
75-09-2	Methylene Chloride	5	U
75-34-3	1,1-Dichloroethane	5	U
108-05-4	Vinyl acetate	5	U
540-59-0	1,2-Dichloroethene (total)	5	U
78-93-3	2-Butanone	5	U
67-66-3	Chloroform	5	U
71-55-6	1,1,1-Trichloroethane	5	U
56-23-5	Carbon Tetrachloride	5	U
71-43-2	Benzene	5	U
107-06-2	1,2-Dichloroethane	5	U
79-01-6	Trichloroethene	5	U
78-87-5	1,2-Dichloropropane	5	U
75-27-4	Bromodichloromethane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	U
108-10-1	4-Methyl-2-pentanone	5	U
108-88-3	Toluene	5	U
10061-02-6	trans-1,3-Dichloropropene	5	U
79-00-5	1,1,2-Trichloroethane	5	U
127-18-4	Tetrachloroethene	5	U
591-78-6	2-Hexanone	5	U
124-48-1	Dibromochloromethane	5	U
108-90-7	Chlorobenzene	5	U
100-41-4	Ethylbenzene	5	U
1330-20-7	Xylene (total)	5	U
100-42-5	Styrene	5	U
75-25-2	Bromoform	5	U

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

VBLK321A

Lab Name: MAXIM TECHNOLOGIES Contract:

Lab Code: MAXIM Case No.: 970052 SAS No.: SDG No.: 970052

Matrix: (soil/water) WATER Lab Sample ID: MSA321A

Sample wt/vol: 5 (g/mL) mL Lab File ID: EE4150

Level: (low/med) LOW Date Received:

% Moisture: not dec. ________ Date Analyzed: 11/17/97

Column: (pack/cap) CAP Dilution Factor: 1.0

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L	Q
79-34-5	---------1,1,2,2-Tetrachloroethane___	5	U

Data File: /chem/e.i/E971117A.b/EE4150.d
Report Date: 17-Nov-1997 11:36

MAXIM TECHNOLOGIES

INTERNAL STANDARD COMPOUNDS
AREA AND RT SUMMARY

Instrument ID: e.i
Lab File ID: EE4150.d
Lab Smp Id: MSA321A
Analysis Type: VOA
Quant Type: ISTD
Operator: MS2 SUPER GR
Method File: /chem/e.i/E971117A.b/voa8260.m
Misc Info: 59702E LAC MSA321A VBLK321A

Calibration Date: 11/17/97
Calibration Time: 1052
Client Smp ID: VBLK321A
Level: LOW
Sample Type: WATER

COMPOUND	STANDARD	AREA LIMIT LOWER	AREA LIMIT UPPER	SAMPLE	% DIFF
31 Bromochloromethane	17119	8560	34238	16860	-1.51
41 1,4-Difluorobenzene	74668	37334	149336	68870	-7.77
62 Chlorobenzene-d5	53933	26966	107866	51141	-5.18

COMPOUND	STANDARD	RT LIMIT LOWER	RT LIMIT UPPER	SAMPLE	% DIFF
31 Bromochloromethane	11.35	10.85	11.85	11.60	2.15
41 1,4-Difluorobenzene	13.54	13.04	14.04	13.77	1.64
62 Chlorobenzene-d5	19.39	18.89	19.89	19.58	1.00

AREA UPPER LIMIT = +100% of internal standard area.
AREA LOWER LIMIT = - 50% of internal standard area.
RT UPPER LIMIT = + 0.50 minutes of internal standard RT.
RT LOWER LIMIT = - 0.50 minutes of internal standard RT.

Data File: /chem/e.i/E971117A.b/EE4150.d
Report Date: 17-Nov-1997 11:36

MAXIM TECHNOLOGIES

RECOVERY REPORT

Client Name:
Sample Matrix: LIQUID
Lab Smp Id: MSA321A
Level: LOW
Data Type: MS DATA
SpikeList File: water.spk
Method File: /chem/e.i/E971117A.b/voa8260.m
Misc Info: 59702E LAC MSA321A VBLK321A

Client SDG: E971117A.B
Fraction: VOA
Client Smp ID: VBLK321A
Operator: MS2 SUPER GR
SampleType: BLANK
Quant Type: ISTD

SURROGATE COMPOUND	CONC ADDED ug/L	CONC RECOVERED ug/L	% RECOVERED	LIMITS
$ 37 1,2-Dichloroethane	50	46	92.50	76-114
$ 52 Toluene-d8	50	50	99.48	88-110
$ 73 4-Bromofluorobenze	50	48	96.43	86-115

BARRINGER LABORATORIES INC.
15000 W. 6TH AVE., SUITE 300 GOLDEN, CO 80401 (303) 277-1687 FAX (303) 277-1689

26-Jan-98
Page: Q-1
Job: 974493E
Status: Final

MAXIM TECHNOLOGIES, INC.

QUALITY CONTROL REPORT

Sample Id	Gross Alpha Total pCi/l	+ 2σ	Gross Beta Total pCi/l	+ 2σ
Duplicate	5.9	±3.8	11	±4
Duplicate	1.1	±2.7	10	±4
RER	0.71		0.11	
Std (found value)	98	±4	99	±2
Std (true value)	103		90	
Std % rec.	95		110	
Blank	1.3	±0.6	1.6	±0.6
Spike % rec.	79		102	

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MAXIM TECHNOLOGIES, INC.

QUALITY CONTROL REPORT

Sample Id	Ra-226 Total pCi/l	± 2σ	Ra-228 Total pCi/l	± 2σ
Duplicate	1.9	±0.7	113	±8
Duplicate	2.4	±2.2	117	±13
RER	0.15		0.10	
Std (found value)	19.2	±1.6	16.1	±1.4
Std (true value)	22.4		15.3	
Std % rec.	86		105	
Blank	0.0	±0.2	0.8	±0.8
Spike % rec.	89		105	

Sample Id	Th-228 Total pCi/l	± 2σ	Th-230 Total pCi/l	± 2σ
Duplicate	1.6	±0.8	2.3	±1.0
Duplicate	1.3	±0.9	1.1	±0.7
RER	0.21		0.69	
Std (found value)	g16	±3	88	±7
Std (true value)	g19		97	
Std % rec.	g83		91	
Blank	0.0	±0.1	0.0	±0.1
Spike % rec.	89		93	

Sample Id	Th-232 Total pCi/l	± 2σ	U-234 Total pCi/l	± 2σ
Duplicate	1.5	±0.8	3.5	±1.2
Duplicate	0.6	±0.7	3.7	±3.0
RER	0.58		0.06	
Std (found value)	g14	±3	90	±4
Std (true value)	g18		95	
Std % rec.	g80		94	
Blank	0.0	±0.1	0.0	±0.1
Spike % rec.	97		94	

BARRINGER LABORATORIES INC.
15000 W. 6TH AVE., SUITE 300 GOLDEN, CO 80401 (303) 277-1687 FAX (303) 277-1689

26-Jan-98
Page: Q-3
Job: 974493E
Status: Final

MAXIM TECHNOLOGIES, INC.

QUALITY CONTROL REPORT

Sample Id	U-235 Total pCi/l	+ 2σ	U-238 Total pCi/l	+ 2σ
Duplicate	0.0	±0.2	2.0	±1.0
Duplicate	0.0	±1.6	2.7	±3.0
RER	0.00		0.16	
Std (found value)	4.0	±0.9	92	±4
Std (true value)	4.3		92	
Std % rec.	92		100	
Blank	0.0	±0.1	0.1	±0.2
Spike % rec.	116		98	

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15000 W. 6TH AVE., SUITE 300 GOLDEN, CO 80401 (303) 277-1687 FAX (303) 277-1689

26-Jan-98
Page: Q-4
Job: 974493E
Status: Final

MAXIM TECHNOLOGIES, INC.

QUALITY CONTROL REPORT

Sample Id	Ra-226 Total pCi/l	± 2σ	Ra-228 Total pCi/l	± 2σ
Duplicate	0.7	±0.5	2.0	±1.2
Duplicate	0.0	±1.4	6.2	±8.1
RER	0.35		0.45	
Std (found value)	23.5	±1.8	14.8	±1.4
Std (true value)	22.4		15.3	
Std % rec.	105		96	
Blank	0.0	±0.2	0.8	±0.8
Spike % rec.	104		105	

BARRINGER LABORATORIES INC.
15000 W. 6TH AVE., SUITE 300 GOLDEN, CO 80401 (303) 277-1687 FAX (303) 277-1689

26-Jan-98
Page: Q-5
Job: 974493E
Status: Final

MAXIM TECHNOLOGIES, INC.

QUALITY CONTROL REPORT

Sample Id	Th-228 Total pCi/l	± 2σ	Th-230 Total pCi/l	± 2σ
Duplicate	0.0	±0.4	0.1	±0.4
Duplicate	0.0	±1.2	0.0	±1.6
RER	0.00		0.16	
Std (found value)	g20	±4	106	±8
Std (true value)	g19		102	
Std % rec.	g103		109	
Blank	0.0	±0.2	0.0	±0.2
Spike % rec.	89		103	

Sample Id	Th-232 Total pCi/l	± 2σ
Duplicate	0.0	±0.3
Duplicate	0.0	±1.3
RER	0.00	
Std (found value)	g21	±4
Std (true value)	g18	
Std % rec.	g114	
Blank	0.0	±0.2
Spike % rec.	97	

BARRINGER LABORATORIES INC.
15000 W. 6TH AVE., SUITE 300 GOLDEN, CO 80401 (303) 277-1687 FAX (303) 277-1689

MAXIM TECHNOLOGIES, INC.

QUALITY CONTROL REPORT

Sample Id	Uranium Total pCi/l
Duplicate	100
Duplicate	100
RPD	0.0
Std (found value)	990
Std (true value)	1000
Std % rec.	99
Blank	U
Spike % rec.	97

BARRINGER LABORATORIES INC.
15000 W. 6TH AVE., SUITE 300 GOLDEN, CO 80401 (303) 277-1687 FAX (303) 277-1689

Gregory Reed
MAXIM TECHNOLOGIES, INC.
1908 Innerbelt Business Center Drive
St. Louis, MO 63114-5700

Attn:
Project: SMP00038

Received: 24-Dec-97 09:20
PO #: 9712019

Job: 974493E   Status: Final

Abbreviations:

Parameters:

Ra-226	:	Radium-226
Ra-228	:	Radium-228
Th-228	:	Thorium-228
Th-230	:	Thorium-230
Th-232	:	Thorium-232
U-234	:	Uranium-234
U-235	:	Uranium-235
U-238	:	Uranium-238

Units:

pCi/l	:	picoCuries per liter

Quality codes:

g	:	Picocuries per gram (pCi/g)
U	:	Undetected

BARRINGER LABORATORIES INC.
15000 W. 6TH AVE., SUITE 300 GOLDEN, CO 80401 (303) 277-1687 FAX (303) 277-1689

26-Jan-98
Page: Q-8

Gregory Reed
MAXIM TECHNOLOGIES, INC.
1908 Innerbelt Business Center Drive
St. Louis, MO 63114-5700

Attn: Received: 24-Dec-97 09:20
Project: SMP00038 PO #: 9712019

Job: 974493E Status: Final

QUALITY CONTROL DATA SHEET

Received by: kz Via: Airborne

Sample Container Type: 4000mL pl, 2000 mL pl, 1000mL pl
Additional Lab Preparation: None

Parameter	Method	Preservative	Init	Analysis Dates
Gross Alpha	900.0	HNO3	MK	01/15-01/20
Gross Beta	900.0	HNO3	MK	01/15-01/20
Ra-226	SM-705	HNO3	AL	01/06-01/09
Ra-228	Perc/Brooks	HNO3	MS	01/06-01/14
Th-228	USAEC	HNO3	MMS	01/02-01/08
Th-230	USAEC	HNO3	MMS	01/02-01/08
Th-232	USAEC	HNO3	MMS	01/02-01/08
U-234	908.0	HNO3	MMS	12/29-01/05
U-235	908.0	HNO3	MMS	12/29-01/05
U-238	908.0	HNO3	MMS	12/29-01/05
Ra-226	SM-705	HNO3	AL	01/08-01/12
Ra-228	Perc/Brooks	HNO3	MS	01/06-01/14
Th-228	USAEC	HNO3	MMS	01/02-01/08
Th-230	USAEC	HNO3	MMS	01/02-01/08
Th-232	USAEC	HNO3	MMS	01/02-01/08
U	ASTM D2907	HNO3	AM	01/13-01/15

Barringer Laboratories, Inc. will return or dispose of your samples 30 days from the date your final report is mailed, unless otherwise specified by contract. Barringer Laboratories, Inc. reserves the right to return samples prior to the 30 days if radioactive levels exceed our license.

Administrative Record for the Formerly Utilized Sites Remedial Action Program (FUSRAP) North St. Louis County Sites

St. Louis County, Missouri

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ADMINISTRATIVE RECORD

for the St. Louis Site, Missouri

U.S. Department of Energy