THIS PAGE INTENTIONALLY LEFT BLANK.

7. INVESTIGATION-DERIVED WASTE

During the performance of field investigation activities at the PDO Yard, IDW will be managed in accordance with RCRA requirements and the EPA IDW policy. IDW includes all materials generated during performance of an investigation that cannot be effectively reused, recycled, or decontaminated in the field. IDW consists of materials that could potentially pose a risk to human health and the environment (e.g., sampling and decontamination wastes) and materials that pose no risk to human health and the environment (e.g., sanitary solid wastes). The types of IDW anticipated to be generated during the field activities are: (1) soil cuttings, (2) residual soil samples, (3) monitoring well development and purge waters, (4) decontamination fluids, and (5) noncontaminated compactible and miscellaneous trash.

All soil cuttings generated during the hollow-stem augering of monitoring wells, monitoring well development and purge water, and decontamination fluids will be collected and drummed or contained. Analytical results from the field soil and groundwater samples submitted for laboratory analysis will be used for waste characterization of soil cuttings and monitoring well development or purge water. Characterization of decontamination fluids generated during the project will be accomplished through sampling and analysis of the decontamination fluids.

Soil and groundwater sample results will be reviewed by SAIC and a recommendation sent to the USACE, Savannah District, as to whether any drummed soil cuttings or monitoring well development or purge waters are considered potentially hazardous. The USACE, Savannah District, will then determine what waste is hazardous and notify SAIC of this decision. SAIC will (as soon as possible after the USACE, Savannah District, determination) label any hazardous waste drums.

7.1 IDW COLLECTION AND CONTAINERIZATION

7.1.1 Types of Waste

Indigenous IDW generated during the project will include soil cuttings from boreholes, sediment from dredge sampling, and groundwater from development/purging of monitoring wells. Non-indigenous IDW generated will include solid compactible trash [expendable sampling materials and disposable personal protective equipment (PPE)], decontamination solutions (water/isopropyl alcohol and water/soap) from the decontamination of equipment; and possibly sludge (water/soil) from the cleaning of equipment in the equipment decontamination area.

7.1.2 Waste Collection and Containment

7.1.2.1 Soil wastes and drill cuttings

All soil wastes and drill cuttings will be segregated by borehole and drummed at the point of generation. The drummed wastes will then be transported to a staging area established for the project and temporarily stored in accordance with requirements defined in Section 7.3 until the waste is transferred for final disposal.

7.1.2.2 Personal protective equipment and sanitary waste

Used PPE and sanitary waste that are noncontaminated will be placed in trash bags at the point of generation. These bags of sanitary PPE and waste will be collected in lined, sanitary trash cans

(30-gallon) with lids. PPE and sanitary waste visibly contaminated will be placed in a new 55-gallon DOT Specification 17C, open-top drum at the point of generation. The drummed wastes will then be transported to the staging area and temporarily stored in accordance with requirements defined in Section 7.3 until the waste is transferred for final disposal. Prior to the placement of any PPE into trash bags or drums, the PPE will be torn/cut in such a manner as to render it unusable.

7.1.2.3 Groundwater and decontamination water waste

Water derived from decontamination activities and monitoring well development/sampling activities will be segregated from each other and placed in polyethylene tanks or other temporary containment vessels. Monitoring well development and purge water will be placed into temporary containment vessels at the point of generation. These vessels then will be transported to the staging area and placed into the polyethylene tanks used to contain well development and purge waters. In the event that free petroleum product is encountered during the development or purging of a monitoring well, this waste will be segregated and stored separately from other purge/development water at the staging area.

7.1.2.4 Excess sample/sludge waste

Excess quantities of soil samples used for measurement of field parameters will be placed into the 55-gallon DOT Specification 17C drums used to contain the soil cuttings generated from the corresponding soil borehole. Excess quantities of groundwater samples used for measurement of field parameters during monitoring well development and sampling will be placed into temporary containment vessels at the point of generation. These vessels will then be transported to the staging area and placed into the polyethylene tanks used to contain well development and purge waters. Excess soil/sludge generated from decontamination of hollow-stem augers will be placed in a 55-gallon, DOT Specification 17C open-top drum at the staging area. The drummed wastes then will be temporarily stored in accordance with requirements defined in Section 7.3 until the waste is transferred for final disposal.

7.1.3 Waste Minimization

To minimize the amount of wastes generated during the investigation, the indigenous, uncontaminated soil cuttings wastes will be returned to the area of origin after characterization has occurred. During project activities, waste generation will be minimized at all times to the greatest extent practicable. Waste will be minimized by limiting access to restricted areas, reuse and decontamination of equipment, and use of nonhazardous materials.

7.2 IDW CONTAINER LABELING

Drums containing the same type of waste will be grouped and placed on pallets (four drums to a pallet) within the staging area with labels clearly visible for identification and inspection. Only one size of drum will be placed on each pallet. Labels will be applied adjacent to, but not covering, the container's seam to allow for visual inspection of the seam. Labels will not be placed on the top of the container lid. If a container is not actively being used for waste accumulation, an "Empty" label will be affixed to the container and the container will be stored inverted. Poly tanks will be labeled on opposite sides and easily visible for identification and inspection. Each poly tank will be labeled according to the type of waste that it contains (i.e., decontamination water or monitoring well water).

Drums will be staged in single rows of pallets with a minimum 3 feet of aisle space between each row for accessibility and with all labels clearly visible for inspection. All drums or other containers will be properly sealed when not in use and labeled in indelible, waterproof ink.

7.2.1 General Waste Labeling Requirements

Upon initial placement of IDW into a bag, drum, or poly tank, each container will be labeled indicating a description of the media, origin of the media, date the media was placed in the container, site identification, contact person, and any other pertinent information. The containers may be labeled using a paint pen or other indelible marker that will not fade when exposed to weather. A record of the number of containers and their contents will be completed at each generation site and will be included in the logbook before leaving each site.

7.2.2 Nonhazardous and Hazardous Waste Labeling Requirements

All IDW, with the exception of monitoring well purge waste containing free petroleum product, will be managed as nonhazardous waste until characterization and classification of the waste for disposal are completed in accordance with the requirements defined in Section 7.4. Prior to classification, the IDW waste container label will state that analysis for the purposes of classification of the waste is in progress. Containers of IDW determined to be nonhazardous will be labeled in accordance with the general waste labeling requirements defined in Section 7.2.1.

Containers of IDW determined to be contaminated but nonhazardous will be marked with a nonhazardous waste label in addition to the general waste labeling required. Containers of IDW determined to be hazardous will be marked with a hazardous waste label in addition to the general waste labeling required. Placement of nonhazardous waste and hazardous waste labels onto containers will be completed no later than 30 days after receipt of the final analytical results used for waste characterization and classification.

7.3 IDW FIELD STAGING

7.3.1 Staging Area Locations

The staging areas for project wastes will be established within an area or areas designated by the USACE, Savannah District, and Fort Stewart DPW prior to initiation of field activities. If possible, this location will have restricted access. SAIC will secure, to the greatest extent possible, the waste containers storage area to prevent unauthorized access.

7.3.2 Staging Area Descriptions

Special requirements for the staging areas will include sufficient space to stage all drums and tanks needed during the project. Labeling for these containers will follow requirements outlined in Section 7.2. The staging areas will be flagged or roped off, and applicable warning signs will be posted as needed. If required, materials identified as hazardous wastes will be transported to an approved storage area designated by the USACE, Savannah District, and/or Fort Stewart DPW, as applicable. All waste containers will be inspected to ensure container integrity and handled in a manner that is protective of human health and the environment.

All waste types generated at the various areas addressed during the project will be containerized as described in Section 7.1 and moved to a staging area within approximately 48 hours of containerization. The wastes will remain within the staging area until characterization and classification are completed and/or approval for disposal is granted by the USACE, Savannah District, and Fort Stewart DPW.

7.4 IDW CHARACTERIZATION AND CLASSIFICATION FOR DISPOSAL

7.4.1 Soil Waste

Analytical data gathered from environmental soil samples will be used to characterize indigenous soil IDW generated during the project. The characterization resulting from these data will be submitted to USACE, Savannah District, and/or Fort Stewart DPW for review and approval. If the investigation sample analytical data are insufficient for characterization of the containerized wastes, the wastes will be sampled and analyzed by SAIC for RCRA toxicity characteristic contaminants using the Toxicity Characteristic Leaching Procedure (TCLP).

Analytical data will be extrapolated to reflect TCLP values (i.e., 20 × divisor rule for soils). Generator knowledge may be used to evaluate the media's potential for corrosivity, ignitability, and reactivity. Except for listed hazardous wastes, if analytical results indicate contaminant levels below 75 percent of TCLP, no additional analytical testing will be performed, and the media will be considered nonhazardous. Nonhazardous media, however, might be considered contaminated. Analytical results will be used on a site-by-site basis to determine if media from a site should be classified as contaminated.

When analytical results indicate that elevated contaminant levels (i.e., greater than 75 percent of TCLP) are present, additional analyses will be performed. In these cases, composite samples will be taken for each specific generation location (i.e., soil borehole). Samples will be taken directly from the containers. The analytical suite to be run will be based on suspected contaminants and any prior available analytical data. Generator knowledge might be used to minimize the number of analytical tests required to adequately characterize the media. Soil waste will be considered hazardous if either of the following conditions are encountered: (1) contaminant concentrations exceed TCLP values, or (2) soil is found to contain solvent-constituents associated with listed hazardous wastes known to have been generated at the facility. Soil wastes that are characterized as hazardous will be stored in accordance with 40 CFR 262.34 and 40 CFR 265 as referenced by the Georgia Hazardous Waste Management Act and Rules.

7.4.2 Excess Sludge Waste

As noted in Section 7.1.2.4, excess soil/sludge generated from decontamination of hollow-stem augers will be stored in 55-gallon, open-top drums. Characterization of this material will be accomplished by extrapolating the analytical data from the individual locations and extrapolating to reflect TCLP values as described above. Based on these results, the contents of each drum will be classified according to the criteria presented in Section 7.4.1.

7.4.3 Liquid Waste

Analytical data gathered from grab samples collected directly from filled poly tanks will be used to characterize decontamination waters generated during the project. One sample will be collected from each filled poly tank and submitted to an off-site laboratory for analysis of VOCs, oil and grease, phenols and pH. For characterization of purge/development water, analysis of the environmental data will be supplemental with composite samples analyzed for oil, grease, and phenols.

The analytical data will be submitted to the Fort Stewart DPW water engineer for evaluation. Based on this evaluation, the water engineer will determine if the waste can be released into the facility industrial wastewater treatment system. If this type of disposal is approved, the Fort Stewart DPW will approve release of each poly tank contents on a case-by-case basis. SAIC will also notify the USACE, Savannah District, and Fort Stewart DPW of each proposed release prior to the release. Prior to the release, SAIC will coordinate the release with Mr. Randy Parks (767-8931) and provide information on the release date and quantity to be released.

In the event that the Fort Stewart DPW water engineer rejects the release of waste to the industrial wastewater treatment system, SAIC will transfer the contents of the subject poly tank into 55-gallon, 17E closed-top drums and label the waste as contaminated nonhazardous.

Characterization of containers containing monitoring well development/purge water contaminated with free petroleum product will be conducted through sampling and analysis of this type of waste. One waste characterization sample will be collected from each drum and submitted for analysis of TCLP and hazardous characteristics (i.e., pH, corrosivity, ignitability, and reactivity). Based on these results, the water will be classified as either contaminated nonhazardous material or hazardous material. Liquid wastes that are characterized as hazardous will be stored in accordance with 40 CFR 262.34 and 40 CFR 265 as referenced by the Georgia Hazardous Waste Management Act and Rules.

7.4.4 Sanitary/PPE Waste

Sanitary and PPE waste generated during the project will be handled as non-contaminated (i.e., used) or contaminated nonhazardous (i.e., visibly contaminated) waste, as applicable. This type of waste will be considered non-contaminated if it did not come into contact with contaminated media (i.e., media exhibiting detectable headspace gas readings as measured during field screening) and no visible contamination is present, or if visible contamination is present but it can be removed by decontamination. In the event that contaminated media cannot be removed from the waste by decontamination, the waste will be considered to be contaminated nonhazardous. With the exception of the criteria noted above, no other characterization of sanitary and PPE waste will be conducted.

7.5 IDW SAMPLING

IDW will be characterized to determine the appropriate disposal requirements. For containerized soil and sludges, if contaminant levels exceed 75 percent of TCLP (as discussed in Section 7.4.1), composite samples will be taken from all drums related to that location. These samples will be analyzed for TCLP metals and hazardous characteristics.

For containerized decontamination fluids or well development/purging water, grab samples will be collected from the poly tank. These samples will be analyzed for VOCs, oil, grease, phenols, and pH.

7.6 IDW DISPOSAL

7.6.1 Soil Waste

Soil cuttings will be managed as nonhazardous waste pending the results of analytical data. If analytical data establish that the soil is noncontaminated, the material will be transported from the staging area to the area of origin and spread on the ground. If analytical data indicate that the soil is contaminated nonhazardous or hazardous, the material will be disposed of off-site in accordance with all applicable EPA, DOT, and State of Georgia regulations at a permitted landfill capable of accepting the waste. Containerized hazardous waste will be transported off-site for disposal within 90 days of receipt of sample data indicating that the waste is hazardous.

7.6.2 Liquid Waste

All decontamination and monitoring well development/purge waters stored in poly tanks will be released on a regular basis during the course of field activities into the industrial wastewater treatment system as approved by the Fort Stewart DPW. The poly tanks will be transported to a disposal location designated by the USACE, Savannah District, and Fort Stewart DPW for liquid waste disposal. Release of liquid waste stored in poly tanks will not be conducted without benefit of prior analytical characterization.

With regard to decontamination and monitoring well development/purge waters transfer from poly tanks into 55-gallon closed-top drums (i.e., waste not approved for release into industrial waste water treatment system), and monitoring well development/purge water contaminated with free petroleum product and stored in drums, all of this material will be disposed of off-site in accordance with all applicable EPA, DOT, and State of Georgia regulations at a permitted treatment facility capable of accepting the waste. Containerized hazardous waste will be transported off-site for disposal within 90 days of receipt of sample data indicating that the waste is hazardous.

7.6.3 Sanitary/PPE Waste

Sanitary waste and PPE that are noncontaminated will be bagged and placed in a sanitary waste dumpster(s) specified for this use by USACE, Savannah District, and Fort Stewart DPW. Prior to disposal of waste into dumpsters, however, SAIC will obtain written permission from the Fort Stewart DPW for this activity. No free liquids or hazardous substances will be placed in the dumpster(s). In the event that use of Fort Stewart dumpsters is not approved for disposal of noncontaminated waste, SAIC will arrange for transportation of the waste off-site for disposal. Contaminated nonhazardous waste of this type will be disposed of off-site in accordance with all applicable EPA, DOT, and State of Georgia regulations at a permitted landfill capable of accepting the waste.

8. CONTRACTOR CHEMICAL QUALITY CONTROL PROGRAM

The Contractor Chemical Quality Control (CCQC) program to be used by SAIC for the project will consist of three phases. The three CCQC phases will be the preparatory phase, the initial phase, and the follow-up phase, all of which will be performed by SAIC, whether or not a USACE, Savannah District, representative is present. The following definable features of work will comprise the CCQC program:

- groundwater screening sampling,
- soil sampling,
- monitoring well construction,
- groundwater sampling, and
- surface water/sediment sampling.

8.1 PREPARATORY PHASE

The preparatory phase of the CCQC program will be conducted by the SAIC CQC Representative, in conjunction with SAIC and subcontractor field personnel, prior to the beginning of each definable feature of work. A summary of all activities performed during each preparatory phase meeting will be documented by the CQC Representative in a meeting minutes record.

Each preparatory phase meeting will address the points listed below.

- Review of all pertinent sections of the project Work Plan to ensure that all field personnel are cognizant of the overall project DQOs, specific project activities to be accomplished, and specific sampling and analysis requirements.

- Review of calibration procedures for all instruments to be used for measurement of field parameters.

- Physical examination of all materials and equipment required to accomplish the specific project activities.

- Review of equipment decontamination procedures in accordance with project Work Plan requirements.

- Review of how each sample type is to be collected, containerized, documented, and packaged.

- Review of proper IDW management and documentation.

- Review of the procedure for completing all required information to be recorded on sample custody forms, and discussion of the project sample numbering system. Completed examples of a COC form, sample container label, and IDW drum label will be provided to the field personnel for reference.

- Review and discussion of any other activities to be performed as deemed necessary by the CQC Representative.

- Examination of the work area(s) to ascertain if all preliminary work is complete.

- Review of preparatory-phase field equipment and support materials checklists. An example of the QA table that will be used to match up primary and QC samples is presented in Figure 8-1.

8.2 INITIAL PHASE

The initial phase of the CCQC program will be conducted by the CQC Representative and will include the points listed below.

- Oversight of direct-push installation, drilling, monitoring well installation, and/or sampling activities, and review of this work to ensure compliance with delivery order requirements.

- Inspection of individual sample labels and COC forms for accuracy, completeness, and consistency.

- Inspection of sample packaging and shipping activities.

- Observation, verification, and documentation of initial and ongoing field instrument calibration.

- Inspection of field logbooks and other field records/sketches to ensure that all pertinent data are recorded in accordance with delivery order requirements.

- Inspection of the QA sample match-up table to ensure that all samples collected during each day are properly documented.

8.3 FOLLOW-UP PHASE

The follow-up phase of the CCQC program will be conducted by the CQC Representative and will involve performance of the various activities noted for the initial phase on a daily basis until completion of the particular, definable feature of the work.

Sample Location	Sample Type	Contractor Laboratory				Government Laboratory		Requested Laboratory Analyses					
		Sample Number	Associated QC Duplicate Number	Associated QC Rinsate Number	Associated QC Trip Blank Number	Associated QA Split Number	Associated QC Trip Blank Number						

Figure 8-1. Example of the QA Sample Tracking Table

THIS PAGE INTENTIONALLY LEFT BLANK.

9. DAILY CHEMICAL QUALITY CONTROL REPORTS

During the field investigation activities performed for the project, SAIC will prepare Daily Quality Control Reports (DQCRs), which will be signed and dated by the SAIC CQC Representative. The contents of the DCQCRs will be incorporated into the DQCR. An example of the DQCR format to be used by SAIC is illustrated in Figure 9-1. These reports will be submitted to the USACE, Savannah District, Project Manager at the end of each work shift. The contents of each DQCR will include a summary of activities performed at the project site, weather information at the time of sampling, results of measurements made with field instruments, results of CQC activities performed including field instrument calibrations, departures from the approved Work Plan and its attachments, problems encountered during field activities, and any instructions received from government personnel. Any deviations that may affect the project DQOs will be immediately conveyed to the USACE, Savannah District, Project Manager. The following will be attached to each DQCR, as appropriate:

- the QA sample table that matches up primary and QA/QC samples collected,
- a summary of field-generated analytical results, and
- any other project-related forms used.

At the conclusion of the field investigation activities and laboratory analysis, SAIC will prepare a Quality Control Summary Report.

DAILY QUALITY CONTROL REPORT

DATE:________

DAY	S	M	T	W	TH	F	S

COE PROJECT MANAGER:

PROJECT:

JOB NO.:

CONTRACT NO.:

WEATHER	Bright Sun	Clear	Overcast	Rain	Snow
TEMP	<0°F	0-32°F	32-70°F	70-85°F	>85°F
WIND	Still	Moder.	High	Report No.	
HUMIDITY	Dry	Moder.	Humid		

SUBCONTRACTORS ON SITE:

EQUIPMENT ON SITE:

WORK PERFORMED (INCLUDING SAMPLING):

Figure 9-1. Example of Daily Quality Control Report

PROJECT: ______________________ REPORT NO.: __________

JOB NO.: ______________________ DATE: ______________

QUALITY CONTROL ACTIVITIES (INCLUDING FIELD CALIBRATIONS):
HEALTH AND SAFETY LEVELS AND ACTIVITIES:
PROBLEMS ENCOUNTERED/CORRECTIVE ACTION TAKEN:
SPECIAL NOTES:
TOMORROW'S EXPECTATIONS:

Recorded by: ____________ QA Check by: ____________

THIS PAGE INTENTIONALLY LEFT BLANK.

10. CORRECTIVE ACTIONS

10.1 SAMPLE COLLECTION AND FIELD MEASUREMENTS

Corrective actions will be implemented in the event that a discrepancy is discovered by field personnel, laboratory personnel, or during a field or desk audit. The initial responsibility for monitoring the quality of field activities and measurements lies with the field personnel. These personnel are responsible for following QA/QC procedures, while the SAIC CQC Representative is responsible for verifying that the procedures are being followed. This verification requires that the SAIC CQC Representative assess the correctness of the field methods and the ability of the field team to meet the QA objectives and to make a subjective assessment of the impact that a procedure has on the field objective and resulting data quality.

If a field problem occurs that might jeopardize the integrity of the project, cause a QA objective not to be met, or affect data quality, the first action taken will be an assessment of the severity of the problem by the SAIC CQC Representative. If the problem is determined to be minor, the SAIC CQC Representative will initiate an appropriate corrective action, which will be recorded in the field logbook and in an Field Change Request (FCR), in accordance with SAIC FTP-1220, "Documenting and Controlling Field Changes to Approved Work Plans." An example of the FCR form is illustrated in Figure 10-1. However, if the problem is determined to be significant or subject to reoccurrence, the SAIC CQC Representative will initiate an Nonconformance Report (NCR), in accordance with SAIC Quality Assurance Administrative Procedure (QAAP) 15.1, "Control of Nonconforming Items and Services," that will be submitted to the SAIC QA/QC Officer. An example of the NCR form to be used for the project is illustrated in Figure 10-2. SAIC's responsible person will then propose and implement an appropriate corrective action as documented on the NCR.

The SAIC QA/QC Officer will be responsible for ensuring that corrective action for nonconformances is initiated by

- evaluating all reported nonconformances,
- controlling additional work on nonconforming items,
- maintaining a log of nonconformances,
- reviewing NCRs and corrective actions taken, and
- ensuring that NCRs are included in the SAIC Engineering Central Records Facility.

If appropriate, the SAIC CQC Representative or the QA/QC Officer will ensure that no additional work that depends on the nonconforming activity or instrument is performed until corrective actions have been implemented.

10.2 LABORATORY ANALYSES

In the event that a laboratory problem occurs that might jeopardize the integrity of the project's analytical results, cause a QA objective not to be met, or affect data quality, the first action taken will be an assessment of the severity of the problem by the SAIC Laboratory Coordinator. If the problem is determined to be minor, the SAIC Laboratory Coordinator will initiate an appropriate corrective action, which will be recorded in a memorandum submitted to the SAIC Project Manager. The SAIC Project Manager will then relate the corrective action to be implemented to the SAIC CQC Representative and/or SAIC QA/QC Officer if the problem is associated with activities being performed in the field. If the problem, however, is determined to be significant or subject to reoccurrence, the SAIC Laboratory

Attachment I
Field Change Request (FCR) Form

Field Change Request (FCR)

FCR NO.__________ DATE INITIATED__________

PROJECT____________________

CONTRACT NO.____________________

REQUESTOR IDENTIFICATION

NAME__________ ORGANIZATION__________ PHONE__________
TITLE__________ SIGNATURE____________________

BASELINE IDENTIFICATION

BASELINE(S) AFFECTED O Cost O Scope O Milestone O Method of Accomplishment
AFFECTED DOCUMENT (TITLE, NUMBER AND SECTION)____________________
DESCRIPTION OF CHANGE:

JUSTIFICATION:

IMPACT OF NOT IMPLEMENTING REQUEST:

PARTICIPANTS AFFECTED BY IMPLEMENTING REQUEST:

COST ESTIMATE ($)________ ESTIMATOR SIGNATURE____________________
PHONE__________ DATE__________

PREVIOUS FCR AFFECTED O YES O NO; IF YES, FCR NO. __________

CLIENT PROJECT MANAGER ____________________ DATE__________
CLIENT QA SPECIALIST ____________________ DATE __________
SAIC H&S MANAGER SIGNATURE (IF APPLICABLE)__________ DATE __________

Figure 10-1. Example of Field Change Request Form

NONCONFORMANCE REPORT	DATE OF NCR	NCR NUMBER
	LOCATION OF NONCONFORMANCE	PAGE____OF ____
INITIATOR (NAME/ORGANIZATION/PHONE	FOUND BY	DATE FOUND
RESPONSIBLE ORGANIZATION / INDIVIDUAL		PROGRAM PROJECT
DESCRIPTION OF NONCONFORMANCE		CATEGORY __ __ __ __ __

A INITIATOR:	DATE	QA/QC OFFICER	DATE	CAR REQ'D YES NO

DISPOSITION:

PROBABLE CAUSE:

ACTIONS TAKEN TO PREVENT RECURRENCE:

B PROPOSED BY:	NAME	DATE

JUSTIFICATION FOR ACCEPTANCE

C INITIATOR:	NAME	DATE

VERIFICATION OF DISPOSITION AND CLOSURE APPROVAL

REINSPECTION/RETEST REQUIRED YES NO IF YES; DATE RESULT

D QUALITY ASSURANCE:	NAME	DATE

Figure 10-2. Example of a Nonconformance Report

Coordinator will initiate an NCR that will be submitted to the SAIC QA/QC Officer and addressed in the same manner as described in Section 10.1.

Laboratory personnel will be alerted that corrective actions might be necessary if one or more of the conditions listed below are encountered.

- QC data are outside the warning or acceptable windows for precision and accuracy.
- Blanks contain target analytes above acceptable levels.
- Undesirable trends are detected in spike recoveries or relative percent differences between duplicates.
- Unusual changes in detection limits are encountered.
- Deficiencies are detected during internal or external audits or from the results of performance evaluation samples.
- Inquiries concerning data quality are received.

10.3 FIELD VARIANCE SYSTEM

Procedures cannot fully encompass all conditions encountered during a field investigation. Variances from the operating procedures, FSP, and/or safety and health plan may occur. All variances that occur during the project investigations will be documented on an FCR or an NCR form and will be noted in the appropriate field logbooks. If a variance is anticipated (e.g., because of a change in the field instrumentation), the applicable procedure will be modified and the change noted in the field logbooks. Field changes fall into three categories: (1) minor, (2) major, and (3) other, all of which are described below.

10.3.1 Minor Field Change

A minor field change is one that does not affect the objectives of the FSP and may be approved by the SAIC Field Manager by noting the change in the appropriate field logbook. An example of a minor field change would be movement of a sampling point several feet from the originally defined location due to the presence of a subsurface obstruction.

Routine (minor) FCRs will be completed in the field and then routed to the SAIC Project Manager and SAIC QA/QC Officer for signature approval. A verbal approval from the USACE, Savannah District, Project Manager or designee will be noted in the field logbook.

10.3.2 Major Field Change

A major field change is one that affects the field sampling objectives and/or schedule and could require State of North Carolina approval. At a minimum, major field changes must be approved by the SAIC and USACE, Savannah District, Project Managers prior to implementation. These changes could require alteration of the FSP. An example of a major field change would be a decision to eliminate sampling points from the field investigation.

10.3.3 Other Field Change

Other field changes fall between the minor and major field change definitions in that they significantly affect the FSP without requiring a change to the plan. They are approved by the SAIC Project Manager and could require HAAF/Fort Stewart DPW and/or State of Georgia approval. An example of such a field change would be a decision to change the number of samples collected at a given borehole location due to sampling difficulties.

As appropriate, regulatory agencies will be notified by HAAF/Fort Stewart DPW of any variances that significantly affect the scope and/or objectives of the project, and approval from the agencies will be obtained, as necessary. Any variance from the safety and health plan will be approved by the SAIC Health and Safety Officer and the USACE, Savannah District, Project Manager or designee. FCR forms will be maintained by the SAIC Field Manager until the fieldwork is complete, at which time they will be forwarded to the SAIC Project Manager for inclusion in the project evidence file. Copies of the FCR forms will be sent to the USACE, Savannah District, Project Manager, as requested.

THIS PAGE INTENTIONALLY LEFT BLANK.

11. PROJECT SCHEDULE

The time scale for this project is in days after Notice to Proceed. Notice to Proceed for the fieldwork is dependent on approval of this FSP and the Site Safety and Health Plan (SSHP). Figure 11-1 presents the project schedule for the Corrective Action at the PDO Yard.

ACTIVITY ID	EARLY START	EARLY FINISH	REM DUR	MONTHS
				CONTRACT NEGOTIATIONS
PD000 000		25JUL00A	0	CAP Approved
PD000 010	26JUL00A	31AUG00A	0	Contract Negotiations
				BASELINE SAMPLING
PD100 010	18JUL00A	30AUG00A	0	Baseline Sampling
PD100 015	18JUL00A	26JUL00A	0	Install Additional Monitoring Wells
PD100 020	22AUG00A	30AUG00A	0	Sample Baseline Monitoring Wells
				WORKPLAN
PD100 100	17OCT00A	24JAN01	24	Work Plan
PD100 110	17OCT00A	29DEC00A	0	Draft Workplan
PD100 111		29DEC00A	0	Submit Draft Workplan
PD100 120	2JAN01	17JAN01	16	Review by Fort Stewart & USACE of Draft WorkPlan
PD100 130	17JAN01	24JAN01	8	Final Workplan
PD100 131		24JAN01	0	Submit Final Workplan
				REMEDIATION
PD200 100	16JAN01	15NOV01	304	Remediation
PD200 110	16JAN01	30JAN01	15	Mobilization
PD200 120	31JAN01	8FEB01	9	Install Wells/Injection Points
PD200 130	5MAR01	16MAR01	12	Inject Geo-Cleanse Reagent
PD200 140	1NOV01	15NOV01	15	Contingent Operation (Polishing Step)
				MONITORED NATURAL ATTENUATION
PD300 100	15MAY02	28APR05	1080	Monitored Natural Atte
PD300 110	15MAY02	13JUN02	30	1st Semiannual Sampling
PD300 120	11DEC02	9JAN03	30	2nd Semiannual Sampling
PD300 130	9JUL03	7AUG03	30	3rd Semiannual Sampling

Months scale: 1, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70

Plot Date	17JAN01
Data Date	1JAN01
Project Start	25JUL00
Project Finish	20NOV06

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

(c) Primavera Systems, Inc.

SCOE HAAG Sheet 1 of 3

CORRECTIVE ACTION SCHEDULE
PDO YARD
HUNTER ARMY AIRFIELD, GEORGIA

Date	Revision	Checked	Approved

Figure 11-1. Project Schedule for the Corrective Action at the PDO Yard, Hunter Army Airfield, Georgia

ACTIVITY ID	EARLY START	EARLY FINISH	REM DUR	Activity
				MONITORED NATURAL ATTENUATION
PD300 140	17JUL03	15AUG03	30	4th Semiannual Sampling
PD300 150	12FEB04	12MAR04	30	Contingency Sampling
PD300 160	9SEP04	8OCT04	30	Contingency Sampling
				CONFIRMATORY SAMPLING
PD400 000	25OCT01	6MAY05	1290	Confirmatory Sa
PD400 100	25OCT01	23NOV01	30	Confirmatory Sampling (PCE)
PD400 200	7APR05	6MAY05	30	Confirmatory Sampling (Benzene)
				CORRECTIVE ACTION COMPLETION REPORT
PD500 100	7MAY05	2MAY06	361	Corrective Action Completion Report
PD500 110	7MAY05	5JUL05	60	Draft CAC Report
PD500 111		5JUL05	0	Submit Draft CAC Report
PD500 120	6JUL05	5AUG05	31	Review by Ft Stewart & USACE of Draft CAC Report
PD500 130	6AUG05	4SEP05	30	Final CAC Report
PD500 131		4SEP05	0	Submit Final CAC Report
PD500 140	5SEP05	3DEC05	90	Review by GEPD, Fort Stewart, USACE of Final
PD500 150	4DEC05	2JAN06	30	Corrected Final CAC Report
PD500 151		2JAN06	0	Submit Corrected Final CAC Report
PD500 160	3JAN06	2APR06	90	Approval by GEPD, Fort Stewart, USACE
PD500 161		2APR06	0	Approved Corrected Final CAC Report
PD500 170	3APR06	2MAY06	30	Decommissioning of System
				PROGRESS REPORTS
PD600 000	28APR01	7NOV04	1290	Progress Reports
PD600 100	28APR01	27MAY01	30	Geo-Cleanse Treatment Completion Report
PD600 110	24NOV01	23DEC01	30	1st Semiannual Progress Report
PD600 120	22JUN02	21JUL02	30	2nd Semiannual Progress Report

MONTHS: 1 5 10 15 20 25 30 35 40 45 50 55 60 65 70

Plot Date	21DEC00
Data Date	1DEC00
Project Start	25JUL00
Project Finish	2MAY06

(c) Primavera Systems, Inc.

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

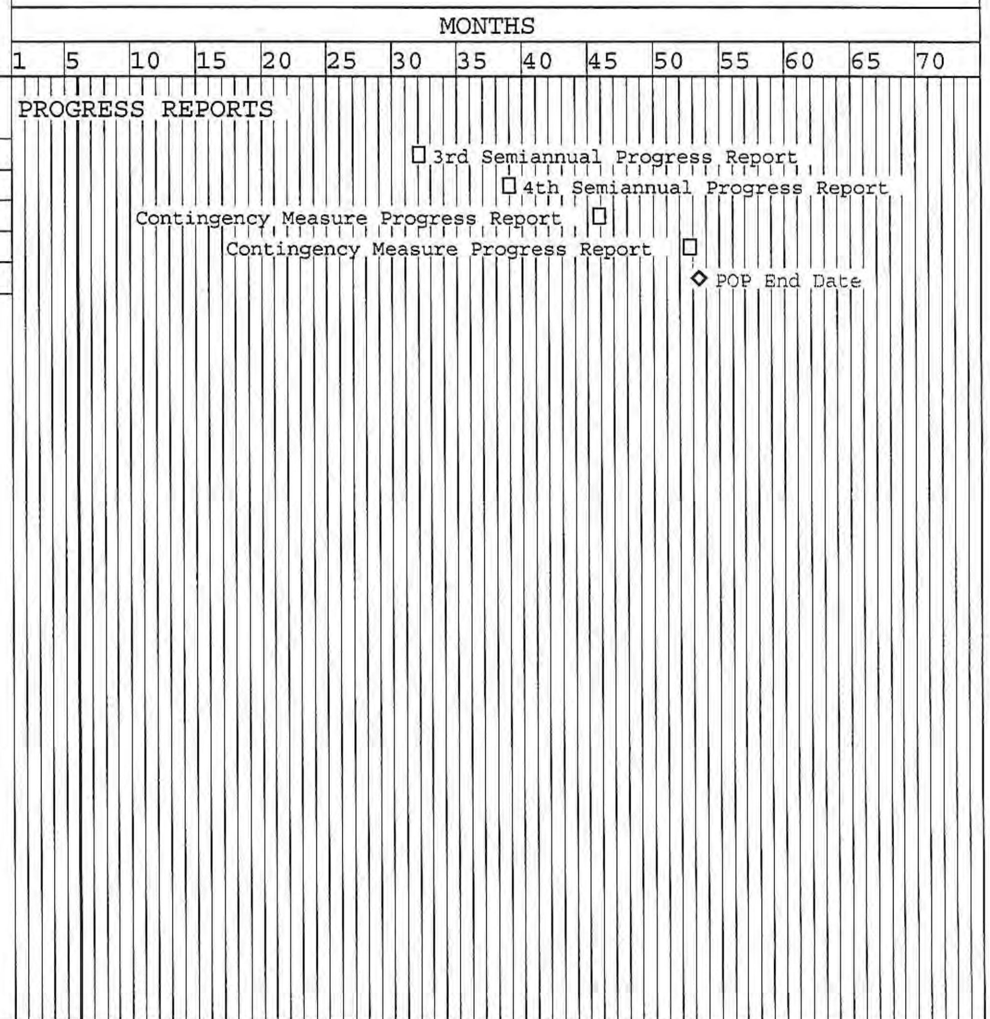
SCOE HAAO
Sheet 2 of 3

CORRECTIVE ACTION SCHEDULE
PDO YARD
HUNTER ARMY AIRFIELD, GEORGIA

Date	Revision	Checked	Approved

Figure 11-1. Project Schedule for the Corrective Action at the PDO Yard, Hunter Army Airfield, Georgia (continued)

ACTIVITY ID	EARLY START	EARLY FINISH	REM DUR
PD600 130	18JAN03	16FEB03	30
PD600 140	16AUG03	14SEP03	30
PD600 150	13MAR04	11APR04	30
PD600 160	9OCT04	7NOV04	30
PD900 100		14NOV04	0



Plot Date	21DEC00
Data Date	1DEC00
Project Start	25JUL00
Project Finish	2MAY06

(c) Primavera Systems, Inc.

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

SCOE HAAG

Sheet 3 of 3

CORRECTIVE ACTION SCHEDULE
PDO YARD
HUNTER ARMY AIRFIELD, GEORGIA

Date	Revision	Checked	Approved

Figure 11-1. Project Schedule for the Corrective Action at the PDO Yard, Hunter Army Airfield, Georgia (continued)

APPENDIX A

REFERENCES

THIS PAGE INTENTIONALLY LEFT BLANK.

REFERENCES

Metcalf & Eddy, Inc. 1999. *Revised Final RCRA Facility Investigation Report for the Old Property Disposal (PDO) Yard at Hunter Army Airfield, Georgia*, September.

Science Applications International Corporation 2000. *Final Corrective Action Plan for the Old Property Disposal (PDO) Yard at Hunter Army Airfield, Georgia*, April.

U.S. Army Corps of Engineers 1994. *Monitor Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites*, EM 1110-1-4000, Washington, D.C.

U.S. Environmental Protection Agency 1997. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* SW-846, 3rd edition, Revision 1, Update 2.

THIS PAGE INTENTIONALLY LEFT BLANK.

APPENDIX B

INJECTION WORK PLAN FOR THE

GEO-CLEANSE® TREATMENT PROGRAM

THIS PAGE INTENTIONALLY LEFT BLANK.

Geo-Cleanse International, Inc.

Final Injection Work Plan
Geo-Cleanse® Treatment Program

Old Property Disposal Yard
Hunter Army Airfield, GA

Prepared for:

Science Applications International Corporation
800 Oak Ridge Turnpike
Oak Ridge, TN 37831

December 19, 2000

Geo-Cleanse International, Inc
4 Mark Road, Suite C
Kenilworth, NJ 07033
Tel (908) 206-1250
Fax (908) 206-1251
contact@geocleanse.com
www.geocleanse.com

TABLE OF CONTENTS

LIST OF FIGURES

1. INTRODUCTION

Geo-Cleanse International, Inc. (GCI) has been contracted by Science Applications International Corporation (SAIC) to perform an in-situ chemical oxidation treatment to address chlorinated hydrocarbons identified in groundwater at the Old Property Disposal Yard (HAA-12), located at the Hunter Army Airfield, Georgia (HAAF). GCI will design and implement the in-situ chemical oxidation treatment program and will conduct process monitoring during the treatment. SAIC has conducted site investigations in preparation for the in-situ chemical oxidation treatment and will be conducting performance monitoring after the treatment to determine the effectiveness of the treatment.

Information sources detailing the site conditions upon which the Geo-Cleanse® Treatment Program was designed are:

- SAIC SOW dated 6/26/00 supplied via facsimile.
- SAIC Request for Proposal documents dated October 20, 2000
- Miscellaneous Maps and Tables from various reports

These documents form the basis of the facility and geologic summaries presented below. Based upon review of these documents and characterization of the geologic and hydrogeologic conditions of the affected areas, in addition to the chemical properties and concentrations of the compounds reported present at the site, GCI believes that in-situ chemical oxidation offers an appropriate remedial approach for groundwater at HAA-12. This work plan outlines site conditions, the basis of the Geo-Cleanse® Process, injector installation, injection activities and monitoring to be conducted at the HAA-12 as part of the Geo-Cleanse® Treatment Program.

The remainder of this work plan is organized as follows:

Section 1, Introduction (this section)— The remainder of Section 1 includes a description of the background of the site including geologic and hydrogeologic setting, nature and extent of contamination, and treatment goals.

Section 2, Summary of the Geo-Cleanse® Process— Describes the basic chemical reactions involved, treatment of specific contaminants identified at the site, and equipment used for the Geo-Cleanse® Process.

Section 3, Implementation of the Geo-Cleanse® Process— Describes design elements for the Geo-Cleanse® Treatment at the site, including monitoring, injector design and installation, and sequence of events.

1.1. FACILITY DESCRIPTION

The Old Property Disposal Yard (HAA-12) is located near the northwestern boundary of HAAF and consists of a fenced parcel containing approximately 0.955 acres (Figure 4). The area of the site is approximately 136 feet by 300 feet. Much of the site is paved with the remainder covered in crushed stone. The ground surface is relatively flat except for a manmade hill located to the southeast and southwest. Trees are scattered along this hill; otherwise, there is no vegetation at the site. A railroad track formerly ran along the northwest side of HAA-12. Lamar Canal lies further to the north, approximately 400 feet from the former bermed AST area. An area used to stockpile coal reserves for 20 to 30 years was located toward the north, outside the fenced area (Metcalf & Eddy 1999).

HAA-12 has been used as a storage facility for used oil and off-specification JP-4, for scrap metal storage, and as a temporary (i.e., 90-day) storage facility for hazardous waste. Originally, the site included an earthen bermed area located in the southeast corner of the fenced area. The bermed area contained two 20,000-gallon tanks used to store waste oil and one 18,000 gallon tank used to store off-specification JP-4.

During their visit to the site in April 1993, Georgia Environmental Protection Department (GEPD) noted that containers of freon, liquid petroleum gas, industrial debris, and waste solvent existed within the HAA-12. Containers of antifreeze, paint, acetone, electrolyte (potassium hydroxide), polychlorinated biphenyl (PCB) waste, jet propulsion (JP) pads, and filters were present in the 90-day hazardous waste storage area. Six transformers were also being stored in the hazardous waste storage area. The inspection led to the issuance of a CO (No. GA4210022733) in March 1994.

During the subsequent RFI investigation, oil staining of surface soils within the former earthen bermed area was observed. In July 1998, the AST's were removed from the facility, cleaned, and taken offsite for recycling. The soil around the former AST locations, including the berms, was excavated to a depth of about 3 feet bgs with the exception of the northeast corner where the excavation was taken down to a depth of 4.2 feet bgs. The excavation pit was approximately 50 feet by 75 feet and produced about 450 cubic yards of soil. The area was replaced to grade with clean, compacted fill material and covered with gravel (Metcalf & Eddy 1999).

Three new ASTs were installed in a newly constructed concrete-lined tank area on the north side of HAA-12 in July 1998. The three new ASTs, a 90-day hazardous waste storage area, and several paved open storage bays are currently located within HAA-12.

1.2. GEOLOGIC AND HYDROGEOLOGIC SETTING

The HAA-12 is underlain primarily by Chipley soils of the Chipley Urban Land Complex within the Chipley-Leon-Ellabelle soil association. The Chipley-Leon-Ellabelle soil association consists of moderately well and poorly drained, sandy soils on broad, low ridges and very poorly drained soils that have loamy underlying layers in depressions and drainage ways. Slopes range from about 0 to 2 percent (Metcalf & Eddy 1999).

According to the United States Department of Agriculture (USDA) report, the texture of the Chipley soils is a fine sand to a depth of 6 feet or more. A seasonal high water table is 15 to 36 inches bgs. In some places within the investigation area, the soil profile has been altered by cutting, filling, grading, and landscaping. In this urban land, the identification of soils is impractical due to the presence of urban facilities (Metcalf & Eddy 1999).

The Surficial Aquifer consists of widely varying amounts of sand and clay, ranging from 55 to 150 feet in thickness, and is composed primarily of the Satilla and Cypresshead Formations in the Savannah vicinity (Arora 1984). This aquifer is primarily used for domestic lawn and agricultural irrigation. Groundwater in the Surficial Aquifer system is under unconfined, or water table, conditions. The top of the water table typically ranges from approximately 2 to 10 feet bgs (Miller 1990) and was measured at a depth of 5 to 7 feet bgs at HAA-12 during the RFI. Based on the site potentiometric map (Figure 2-3), groundwater flow is north to northwest toward Lamar Canal (Metcalf & Eddy 1999).

Aquifer tests were not performed at HAA-12, but have been done at the former Building 728 site, which is similar and is located only 1800 feet east-northeast of HAA-12. The average laboratory hydraulic conductivity of two Shelby tube samples collected within the saturated zone at the former Building 728 site was 1.15 x 10-4 feet/second. The average hydraulic conductivity calculated from slug tests for shallow monitoring wells was 5.48 x 10-4 feet/second, and for the deep monitoring wells was 7.55 x 10-4 feet/second. Results of the HAA-12 Revised Final RFI Report indicated an average groundwater seepage velocity of 0.72 foot/day, which was calculated using a hydraulic gradient of 1.3 x 10-2 feet/feet, an average hydraulic conductivity of 1.15 x 10-4 feet/second, and an effective porosity of 0.18 (Metcalf & Eddy 1999).

2. SUMMARY OF THE GEO-CLEANSE® PROCESS

The Geo-Cleanse® Process is a patented technology to simultaneously inject hydrogen peroxide and trace quantities of metallic salts under pressure to the subsurface in order to destroy organic contaminants in soil and groundwater. U.S. patents 5,525,008 and 5,611,642 protect the technology. The Geo-Cleanse® Process delivers a calculated charge of hydrogen peroxide and catalyst to the contaminated region via specially designed injection equipment consisting of mixing heads and subsurface injectors. The injection methodology and equipment are the keys to the Geo-Cleanse® Process. The chemistry involved is based upon Fenton's reagent. Fenton's reagent oxidizes organic contaminants to carbon dioxide and water, plus chloride (in the case of chlorinated compounds). The basics of Fenton's reagent chemistry and application to site-specific contaminants are described in the following sections.

2.1. FENTON'S REAGENT CHEMISTRY

In 1894, H.J.H. Fenton reported that malic acid was rapidly oxidized by hydrogen peroxide in the presence of iron salts. Haber and Weiss (1934) identified the oxidation mechanism resulting from mixtures of hydrogen peroxide and ferrous iron (referred to as Fenton's reagent) as a hydroxyl free radical (OH·) formed by the reaction:

$$H_2O_2 + Fe^{+2} \rightarrow Fe^{+3} + OH\cdot + OH^- \tag{1}$$

where H_2O_2 is hydrogen peroxide, Fe^{+2} is ferrous iron, Fe^{+3} is ferric iron, $OH\cdot$ is hydroxyl free radical, and OH^- is hydroxyl ion. Since 1934, Fenton's reagent has been recognized as an effective means for destroying organic compounds in wastewater and most recently as an in-situ treatment method for soil and groundwater. Fenton's reagent chemistry is complex, involving a number of additional reactions producing both oxidants and reductants that contribute to contaminant destruction (e.g., Watts et al., 1999):

$$OH\cdot + Fe^{+2} \rightarrow OH^- + Fe^{+3} \tag{2}$$

$$Fe^{+3} + H_2O_2 \rightarrow H^+ + HO_2\cdot + Fe^{+2} \tag{3}$$

$$Fe^{+2} + HO_2\cdot \rightarrow Fe^{+3} + HO_2^- \tag{4}$$

$$Fe^{+3} + HO_2\cdot \rightarrow Fe^{+2} + O_2 + H^+ \tag{5}$$

$$OH\cdot + H_2O_2 \rightarrow H_2O + HO_2\cdot \tag{6}$$

where $HO_2\cdot$ is hydroperoxyl radical, HO_2^- is hydroperoxyl anion, O_2 is molecular oxygen, H^+ is hydronium ion, and H_2O is water. Additional reactions occur with organic compounds. The suite of reactions associated with Fenton's reagent is complex, but very effective at destroying many organic compounds dissolved in groundwater, sorbed to soil particles, or existing as non-aqueous phase liquids in subsurface environments. Intermediate compounds produced by Fenton's reagent oxidation are primarily naturally occurring carboxylic acids. The end products of petroleum hydrocarbon oxidation are primarily carbon dioxide and water, plus chloride (in the case of chlorinated compounds). None of the injected reagents pose an environmental hazard. Unconsumed hydrogen peroxide naturally degrades to oxygen and water within a few days of injection.

The hydroxyl free radical generated by Fenton's reagent is a powerful, non-selective oxidant. Oxidation of an organic compound by Fenton's reagent is a rapid and exothermic (heat-producing) reaction. Rate constants for reactions of hydroxyl free radical with common environmental pollutants are typically in the range of 10^7 to 10^{10} $M^{-1}s^{-1}$ (e.g., Buxton et al., 1988; Haag and Yao, 1992), and 100% mineralization is generally complete in minutes. Fenton's reagent is generally most efficient under acidic pH conditions (pH ~3) because oxidation of iron from the ferrous to ferric states by reactions other than that in equation 1 is minimized, ferric iron hydrous oxyhydroxides are less likely to precipitate (removing iron from solution), and bicarbonate (which competes with the organic compounds for the hydroxyl radical) is absent. An effective (although not chemically optimal) Fenton's reagent system can be established at a pH greater than 6.

2.2. TREATMENT OF SITE-SPECIFIC ORGANIC CONSTITUENTS

The VOC's reported in the targeted treatment area are chlorinated alkenes, primarily tetrachloroethene, and it's degradation products (trichloroethene, cis-1,2-dichloroethene, and vinyl chloride). Oxidation of tetrachloroethene ($Cl_2C{=}CCl_2$) by Fenton's reagent produces dichloroacetic acid ($CHCl_2COOH$) as the only significant intermediate product, which is further oxidized to water (H_2O), carbon dioxide (CO_2), hydrogen ions (H^+) and chloride ions (Cl^-), according to the following equations:

$$Cl_2C{=}CCl_2 + OH^{\cdot} + H_2O \rightarrow CHCl_2COOH + H^+ + Cl^- + Cl^{\cdot}$$
$$CHCl_2COOH + 4OH^{\cdot} \rightarrow 2H^+ + 2Cl^- + 2H_2O + 2CO_2$$

Leung et al. (1992) demonstrated that tetrachloroethene is rapidly and completely oxidized by Fenton's reagent, without generation of hazardous intermediate products, according to the preceding equations. Similar experiments by Gates and Siegrist (1995) and Ravikumar and Gurol (1994) demonstrate that Fenton's reagent effectively and completely oxidizes trichloroethene to stoichiometric quantities of carbon dioxide, water, and chloride in soil and groundwater in the under laboratory-simulated conditions. GCI field project experience to date includes 15 sites impacted by chlorinated solvents including tetrachloroethene and trichloroethene in soil and groundwater (e.g., Bryant and Wilson, 1998). A example oxidation pathway for PCE is shown in Figure 1.

2.3. GEO-CLEANSE INJECTION EQUIPMENT

GCI will stage a mobile treatment unit at the site. Hydrogen peroxide will be staged at the site in a specially designed stainless steel tank truck provided by the manufacturer. Additional services required at the site include water and power (a 60 kilowatt generator, or 100-amp, 220-volt, single-phase service).

The GCI mobile treatment unit (Figure 2) includes tanks, pumps, gauges and flow control valves to deliver reagents safely and effectively to mixing heads installed on the injectors. Safety features include redundant check valves to control reagent flow, construction materials to withstand the reagents and pressures encountered, and eyewashes and safety showers (safety features are described further in the Site-Specific Health and Safety Plan). Reagent injection to the subsurface is conducted via specially designed mixing heads that are attached to the riser pipe of the injector (Figure 3). The mixing heads are designed with redundant safety features including check valves, pressure gauges and flow-control ball valves and are constructed of stainless steel to withstand the reagents. Injector design and construction are described in Section 3.2.

3. IMPLEMENTATION OF THE GEO-CLEANSE® PROCESS

3.1. PERFORMANCE AND PROCESS MONITORING

The overall monitoring program consists of two parts; performance and process monitoring. Performance monitoring refers to pre-, during, and post-test analyses of groundwater samples collected within and adjacent to the treatment area, for target chlorinated hydrocarbon compounds, to evaluate overall treatment effectiveness. SAIC will conduct the performance monitoring as outlined in their separate work plan. GCI will conduct process monitoring. Process monitoring refers to analyses of groundwater and offgas samples collected within and adjacent to the treatment area, during implementation of the in-situ chemical oxidation treatment, for purposes of determining if appropriate geochemical conditions are established in the aquifer, reagents are distributed effectively, and an efficient oxidation reaction is occurring.

3.2. TREATMENT DESIGN

The treatment area has been separated into two areas for the injector design and installation. Figure 4 illustrates the two areas: a source area and a residual area:

Source Area

The first area is defined as the "source" area. This is the area that surrounds MW-26 and is approximately 50' x 70' x 90'x 85' and includes the rail bed. For the source area treatment, GCI plans to utilize five (5) shallow injectors (Figure 5) and eight (8) deep injectors (Figure 6). The number and location where these injectors are placed based upon the information that has been provided to GCI to date. The shallow injectors will be screened at approximately nine (9) to twelve (12) feet below ground surface (bgs) and the deep injectors will be screened at approximately seventeen (17) to twenty (20) feet bgs. The placement and projected depths of these injectors is based upon the information available to GCI at this time. Injector locations and depths may be adjusted based upon field conditions observed during injector installation. The anticipated placement of these injectors is shown in Figure 7.

Residual Area

The second area is defined as the "residual" area. This is the area that surrounds MW-27, MW-28, MW-5 & MW-10 and is approximately 90' x 70' x 200'x 160' and includes the road and is bound in the northwest by Lamar Canal. For the residual area treatment, GCI will utilize five (5) shallow injectors (Figure 8) and eleven (11) deep injectors (Figure 9). The number of and location where these injectors are placed is based upon the information that has been provided to GCI to date. The shallow injectors will be screened at approximately nine (9) to twelve (12) feet below ground surface (bgs) and the deep injectors will be screened at approximately seventeen (17) to twenty (20) feet bgs. The placement and projected depths of these injectors is based upon the information available to GCI at this time. Injector locations and depths may be adjusted based upon field conditions observed during injector installation.

The treatment design includes the installation of ten (10) shallow injectors and twenty nine (29) deep injectors for a total of 29 injectors. Soil cuttings and wastewater generated by drilling activities will be drummed and staged onsite for later disposal.

As part of the treatment design, GCI requests that during injector installation, SAIC sample half of the injectors being installed to help establish true pre-injection baseline numbers and to assist GCI in better defining the distribution of the contamination across the treatment zone. This additional information will assist GCI in determining the quantity of hydrogen peroxide to be injected into each injector and what the best possible picture for hydrogen peroxide needs will be for each area.

3.2.1. Injector Installation

An example injector construction detail is provided in Figure 10. Installation of the injectors is intended to be at a depth so that the top of the screen is at least one foot below the contaminated interval, corresponding to or below the zone of maximum contamination (the "smear zone"). The installation depths indicated in the figures are based upon available site information and may be adjusted in the field. Injectors are constructed with stainless steel 0.010-slot screens and Schedule 80 black iron riser pipe and couplings. The pipe and screen diameters are 1.25". The injectors will be installed with a 3-ft screen. The boreholes will be drilled and the injectors installed as described in Section 3.2.1.

3.2.2. Investigation Derived Waste Management

Soil cuttings and fluids resulting from installation of the injection and replacement monitoring wells and from sampling will be containerized and staged onsite. The cuttings will be screened by photoionization detector (PID) and the drums temporarily labeled by drilling location, date and PID reading. SAIC personnel will sample the drums for waste characterization. SAIC may determine that drums that meet regulatory standards will be dumped and the soil spread onsite, while those that exceed the standards will be disposed of appropriately.

3.3. TREATMENT PROGRAM PROCEDURES

3.3.1. Sequence of Events

The treatment program phases include mobilization, treatment and demobilization. Mobilization normally requires ½ day of onsite activities. Tasks required for mobilization include positioning the GCI mobile treatment unit, hydrogen peroxide tanker, and generator; establishing an exclusion zone; connecting the treatment unit to the water source and power generator or supply; and conducting leak- and safety-checks all hosing and fittings. A health and safety meeting with all personnel will be conducted prior to any injection activities.

Each day of injection typically begins with a tailgate health and safety meeting. Injection of catalyst and hydrogen peroxide solutions is then conducted through the course of the day, with monitoring as prescribed in Section 3.3.4 (below). Normal workdays are 8 to 10 hours or available daylight (whichever is shorter). At the end of each day, the mixing heads and lines may be returned to the mobile treatment unit, generator or power supply turned off and the site secured for the night.

Demobilization activities include clearing the site of any fluids or debris resulting from injection activities, dismantling the safety shower, disconnecting from water and power supplies, and securing the mobile treatment unit and generator. Demobilization activities typically require ½ day of onsite activities.

3.3.2. Duration of Treatment

The primary phase of the Geo-Cleanse® Treatment Program at the Old Property Disposal Yard is anticipated to require approximately 8 days for drilling and 9 days of injection activities, which include mobilization, injection and demobilization. An estimated 80,000 lbs (8,000 gal) of 50% hydrogen peroxide are anticipated for injection. Approximately twice the volume of catalyst solution is also anticipated for injection, but the exact volume required that is necessary to achieve the groundwater quality conditions will be determined based upon the process monitoring.

The primary treatment phase is intended to address the gross levels of contamination. Polishing treatments may be conducted if necessary. The objective of a polishing treatment is to address any residual contaminant mass that was not destroyed during the primary treatment phase. A polishing treatment phase, if necessary, will include installation of up to two additional injectors, injection of up to 10,000 lbs (1,000 gallons) of 50% hydrogen peroxide solution and a similar volume of catalyst solution, and up to 3 days of injection activities.

3.3.3. Reagents

The reagents used in the Geo-Cleanse® Process, and the purpose, injected concentrations and fate are summarized in this section.

Hydrogen peroxide: Staged at the site as 50% technical grade, used as oxidizing agent. Typically injected at concentrations ranging from 3 to 25%, with resultant concentrations to groundwater of «1%. This concentration quickly falls to less than 25 mg/L within several hours following injection and is typically completely consumed within three days.

Ferrous sulfate: Staged at the site in 50 lb bags of food grade reagent (powder), used as catalyst for Fenton's reagent. Typical injection concentrations are up to 100 mg/L iron in aqueous solution. The ferrous iron is oxidized in the subsurface to ferric iron and precipitates as an iron oxide or iron hydroxide. This component may not be used if sufficient natural dissolved iron (>20 mg/L) is present or if a stable reaction (as evidenced by liberated oxygen and carbon dioxide and distribution of hydrogen peroxide in groundwater) is established.

Sulfuric acid: Staged at the site in 15-gallon totes of 66° (98%) technical grade. This catalyst component is used to establish a mildly acidic pH (~4) in the catalyst by dilution with water. This is used in the catalyst solution to inhibit oxidation of ferrous iron to ferric iron in the catalyst solution prior to injection, and to adjust pH of the groundwater to the optimal range for Fenton's reagent (<6). Groundwater pH will return to ambient background conditions within a few days of injection. This reagent may not be utilized depending upon site-specific conditions, for example if pH is already in a mildly acidic range or initial field and laboratory tests indicate high reactivity towards sulfuric acid.

Phosphoric acid: Staged at the site in 15-gallon totes of 85% technical grade. This catalyst component may also be used to establish a mildly acidic pH (~4) in the catalyst by dilution with water. This is used in the catalyst solution to inhibit oxidation of ferrous iron to ferric iron in the catalyst solution prior to injection, and to adjust pH of the groundwater to the optimal range for Fenton's reagent (<6). Groundwater pH will return to ambient background conditions within a few days of injection. This reagent may not be utilized depending upon site-specific conditions, for example if pH is already reduced to a mildly acidic range or initial field and laboratory tests indicate high reactivity towards phosphoric acid.

Calcium phosphate: Staged at the site in 50-lb bags of food grade reagent (powder), used to stabilize the Fenton's reagent. Typical injection concentrations are up to 10 mg/L in aqueous solution. The calcium remains dissolved in solution and the phosphate is either precipitated or is utilized as a nutrient in biological reactions. This reagent may not be utilized depending upon site-specific conditions, for example if phosphate addition is desired in the absence of an acid.

3.3.4. Process Monitoring Parameters

As part of the process monitoring, GCI will collect field measurements during the injection to ensure that appropriate subsurface conditions exist for Fenton's reagent, that an efficient reaction is occurring, and to monitor the reaction progress. Parameters that are monitored include both groundwater quality and liberated gas measurements. At least two rounds of groundwater samples are collected each day, including one in the morning prior to beginning the injection and one in the afternoon prior to concluding injection for the day. Gas measurements are conducted at approximately 2-hour intervals throughout the day. Monitoring is performed only in the active treatment area (i.e., the entire site is not monitored during every round). Additional analyses may be performed as dictated by site conditions, but not at prescribed time intervals. Parameters that are monitored, and their purpose, method, resolution and range are as follows.

pH: Groundwater pH is monitored to ensure that appropriate pH conditions (pH <6) are established. A Hach test kit model 17-F is used. The test is a colorimetric method using bromothymol blue as an indicator. The range is 5.5 to 8.5 with resolution of ±0.1 units. The pH measurements may be supplemented with test strips (0 to 6 with resolution of ±0.5 units) if necessary. A pH meter is not used because the electrodes are damaged by hydrogen peroxide.

Alkalinity: Alkalinity affects Fenton's reagent treatment because dissolved bicarbonate (the predominant component of groundwater alkalinity) is an efficient hydroxyl free radical scavenger. A target value of <100 mg/L is desired. Alkalinity is also related to pH, because groundwater pH controls bicarbonate equilibrium and the capacity of the groundwater to contain bicarbonate. A Hach test kit model AL-AP/MG-L is used. The test is a titration method using a sulfuric acid reagent. The range is 0 to 100 mg/L (as $CaCO_3$) with resolution of ±5 mg/L, or 20 to 400 mg/L with resolution of ±20 mg/L.

Dissolved Iron: Dissolved iron (either as ferrous or ferric forms) is a catalyst for Fenton's reagent. A minimum of 10 mg/L is desired in groundwater, and dissolved iron monitoring determines if ferrous sulfate is used in the catalyst blend. A Hach test kit model IR-18B is used. The test is a colorimetric method using phenanthroline reagent. The range is 0 to 10 mg/L with resolution of ±0.2 mg/L.

Hydrogen Peroxide: Hydrogen peroxide is monitored to ensure that reagents are distributed throughout the treatment area. Hydrogen peroxide is measured with Merckoquant colorimetric test strips (E.M. Science, Gibbstown, NJ) with a measurable range of 0 to 100 mg/L. The test strips have indicators labeled at 0, 1, 3, 10, 30, and 100 mg/L peroxide, and intermediate concentrations can be interpolated.

Carbon dioxide: Oxidation of organic compounds yields carbon dioxide (see Section 2.1), which is liberated from the subsurface through vent wells, adjacent injectors and monitoring wells. Carbon dioxide production is a sensitive measure of the efficiency and progress of the treatment. At sites impacted by petroleum hydrocarbons, carbon dioxide production typically reaches maximum levels of approximately 10 to 15% in the early stages (first 2 to 4 days) of injection then decreases asymptotically to zero over the course of the treatment as the subsurface organic contaminants are destroyed. Carbon dioxide concentration is measured in headspaces of injectors, vent wells, and monitoring wells within and adjacent to the treatment area. If the aquifer is characterized by the presence of significant levels of carbonate minerals or high alkalinity, then the carbon dioxide measurement may be affected and yield an artificially high reading. The magnitude of this artifact is estimated by measuring background carbon dioxide during hydraulic testing conducted on the first day of treatment. The measurement is performed with a GasTech GT series carbon dioxide/oxygen/LEL meter. The meter uses a non-dispersive infrared absorbance detection method. Resolution is ±0.1% and range is 0 to 20%.

Oxygen: Reaction of hydroxyl free radicals with hydrogen peroxide, other radicals, or other non-organic compounds produces oxygen. Oxygen is liberated from the subsurface through adjacent injectors, vent wells, and monitoring wells. At sites impacted by petroleum hydrocarbons, oxygen production is typically low on the first day or two of injection (typically <20%), then increases to >30% over the course of the treatment as the subsurface organic contaminants are destroyed. Oxygen concentration is measured in headspaces of injectors, vent wells, and monitoring wells within and adjacent to the treatment area. The measurement is performed with a GasTech GT series carbon dioxide/oxygen/LEL meter. The meter uses an electrochemical detection method. Resolution is ±0.1% and range is 0 to 30%.

Volatile Organic Compounds: Fenton's reagent produces offgases, which pass through potentially contaminated water prior to liberation via adjacent wells. Gases passing through a contaminated groundwater may entrain relatively low concentrations of volatile organic compounds. Henry's Law predicts the maximum concentration of a volatile organic compound in a gas that has passed through a contaminated water sample. As a rule of thumb (supported by GCI field experience), the maximum concentration of a VOC in the offgas is approximately the same order of magnitude as the concentration of the VOC in groundwater. Thus the concentration of VOCs in offgases is typically a maximum in the initial stages (one to two days) of injection and then decreases over the course of the treatment. Volatile organic compounds are monitored with a PID meter. The PID meter reads a concentration in parts per million (ppm) by volume, however that reading does not correspond exactly to a concentration of VOCs in the air sample. The PID response varies among organic compounds, and the PID also responds to water vapor (resulting in a PID reading that is much higher than the actual VOC concentration in the offgas). PID readings are measured in headspaces of injectors and monitoring wells within and adjacent to the treatment area. The measurement is performed with a ThermoEnvironmental 580B PID meter with a 10.6 eV lamp. Resolution is ±0.1 ppm and range is 0 to 2,500 ppm.

Lower Explosive Limit (LEL): The LEL of the offgases may be monitored for health and safety purposes because of the possible presence of LNAPL and because volatile organic compounds are entrained in the offgases. The LEL measurement is performed with a GasTech GT series carbon dioxide/oxygen/LEL meter. The meter uses an heated element detection method. Resolution is ±1% and range is 0 to 100%.

3.3.5. Polishing Phase

Due to the inherent uncertainty of working in the subsurface and the characteristics of PCE as a DNAPL, polishing treatment(s) may be conducted in order to target any areas that may require additional treatment to achieve the treatment objectives. The necessity of the polish treatment will be determined based upon post-treatment sampling following the primary phase. One or more polishing treatments will be conducted if the 7-day or the 30-day post-treatment performance sampling conducted by SAIC indicates that the treatment goal has not been achieved across the site. The polish treatment may include installation of up to two new injectors and injection of 10,000 lbs (1,000 gal) of 50% hydrogen peroxide, plus a similar volume of catalyst solution.

3.4. POST-TREATMENT PERFORMANCE MONITORING

SAIC will conduct post-treatment performance monitoring. An initial round of groundwater samples will be collected approximately 7 days after injection operations cease. An additional round of groundwater samples will be collected approximately 30 days after the end of injection. The purpose of these sampling rounds is to monitor effectiveness and potential rebound to determine if the treatment is successful. Typically, groundwater samples collected within 7 days of the end of treatment will yield elevated petroleum hydrocarbon concentrations if the treatment is incomplete (i.e., polishing is necessary). The 30-day round provides a longer period for the aquifer to return to an ambient condition and for contaminant rebound (if rebound occurs).

3.5. REPORTING

Verbal updates will be provided to SAIC as requested during the course of the treatment program. All field notes will be recorded in a permanent field notebook. Types of information recorded in the field notebook include date, personnel onsite, health and safety issues or discussions, injection locations, quantities and rates, all monitoring data, and other pertinent observations of the GCI field crew. Photographs will be permanently archived with the field notebook.

At the conclusion of the injection program and upon receipt of post-injection confirmatory sampling results, a report will be prepared by GCI describing the observations, activities, and results of the injection. This report will include hydrogen peroxide injection totals by location and date, interpretations of the process and performance monitoring, and all field and laboratory analytical data in tabulated form. The final report shall specifically address the treatment objectives (Section 1.4). This report will be submitted to SAIC for review, and a final report will be issued that addresses any comments received.

4. REFERENCES

Bryant, J.D., and Wilson, J.T. 1998. Rapid delivery system completes oxidation picture. Soil & Groundwater Cleanup, August-September 1998, p. 6-11.

Fenton, H.J.H. 1894. Oxidation of tartaric acid in presence of iron. Journal of the Chemical Society, v. 65, p. 899-910.

Gates, D.D., and Siegrist, R.L. 1995. In-situ oxidation of trichloroethylene using hydrogen peroxide. Journal of Environmental Engineering, v. 121, p. 639-644.

Haag, W.R., and Yao, C.C.D. 1992. Rate constants for reaction of hydroxyl radicals with several drinking water contaminants. Environmental Science and Technology, v. 26, p. 1005-1013.

Haber,F., and Weiss, J. 1934. The catalytic decomposition of hydrogen peroxide by iron salts. Proceedings of the Royal Society of London, Series A, v. 147, p. 332-351.

Leung, S.W., Watts, R.J., and Miller, G.C. 1992. Degradation of perchloroethylene by Fenton's reagent: Speciation and pathway. Journal of Environmental Quality, v. 21, p. 377-381.

Ravikumar, J.X., and Gurol, M.D. 1994. Chemical oxidation of chlorinated organics by hydrogen peroxide in the presence of sand. Environmental Science and Technology, v. 28, p. 394-400.

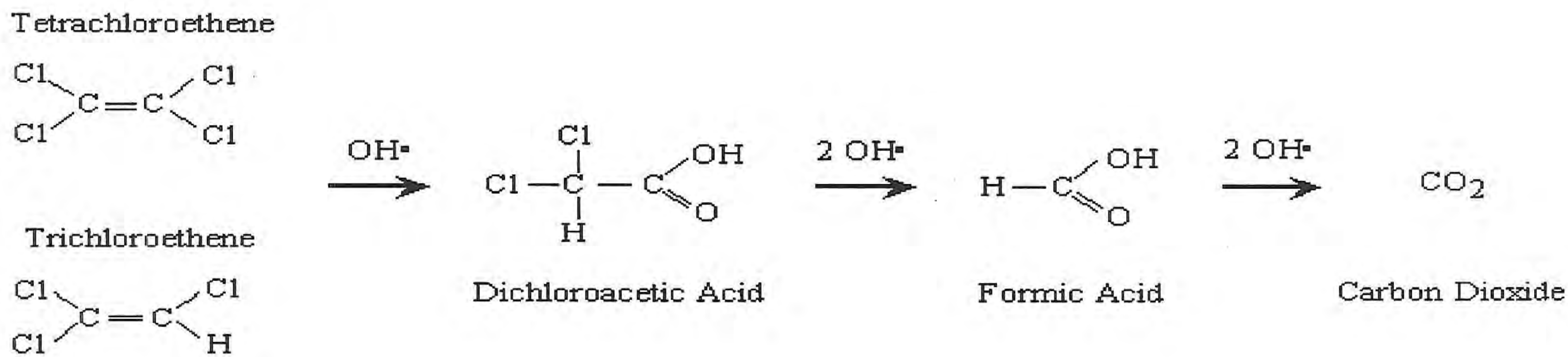
Table 1: Hunter Army Airfield, Old PDO Yard: Estimated Injection Amounts

Injector Location	Catalyst (gallons)	Peroxide (gallons)
1	600	300
2	600	300
3	600	300
4	600	300
5	600	300
6	600	300
7	600	300
8	600	300
9	600	300
10	600	300
11	600	300
12	600	300
13	600	300
14	600	300
15	600	300
16	600	300
17	600	300
18	600	300
19	600	300
20	600	300
21	600	300
22	600	300
23	600	300
24	600	300
25	600	300
26	600	300
27	600	300
28	600	300
29	600	300
Totals (gallons)	**17,400**	**8,700**

Figure 1: Oxidation Pathway

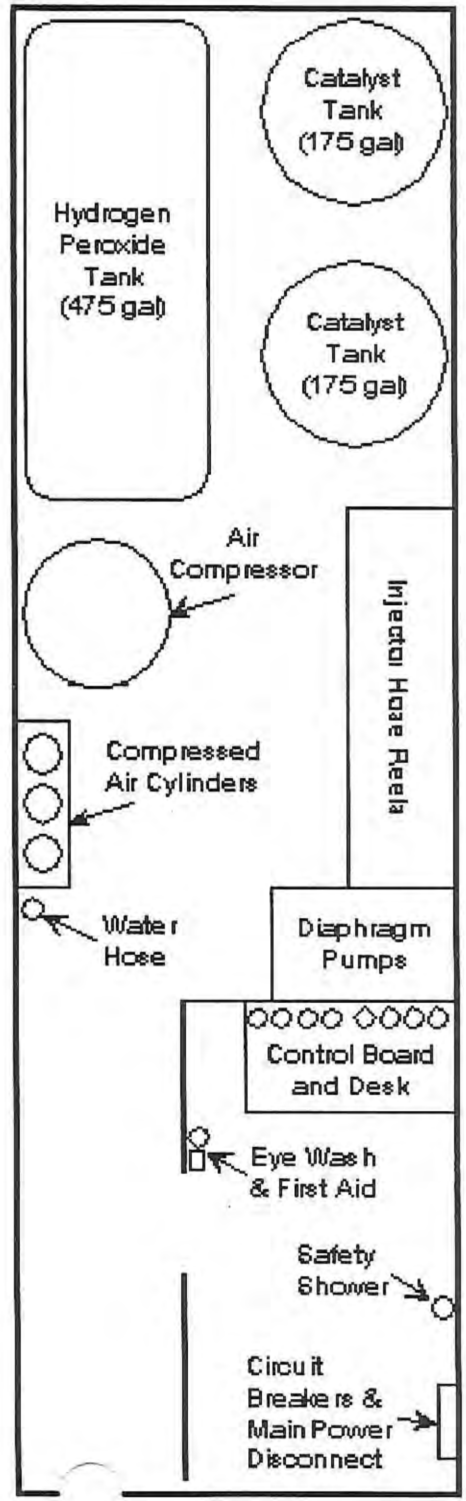
Fenton's Chemistry

Tetrachloroethene and Trichloroethene Oxidation Pathway



References: Leung et al. 1992; Sato et al. 1993

Figure 2: Typical Treatment Vehicle



Geo-Cleanse Treatment Rig Schematic

Scale: 3'

Figure 3: Injector Head

Geo-Cleanse International, Inc.
Injection and Mixing Head Design Schematic
(U.S. Patents 5,525,008 and 5,611,642)

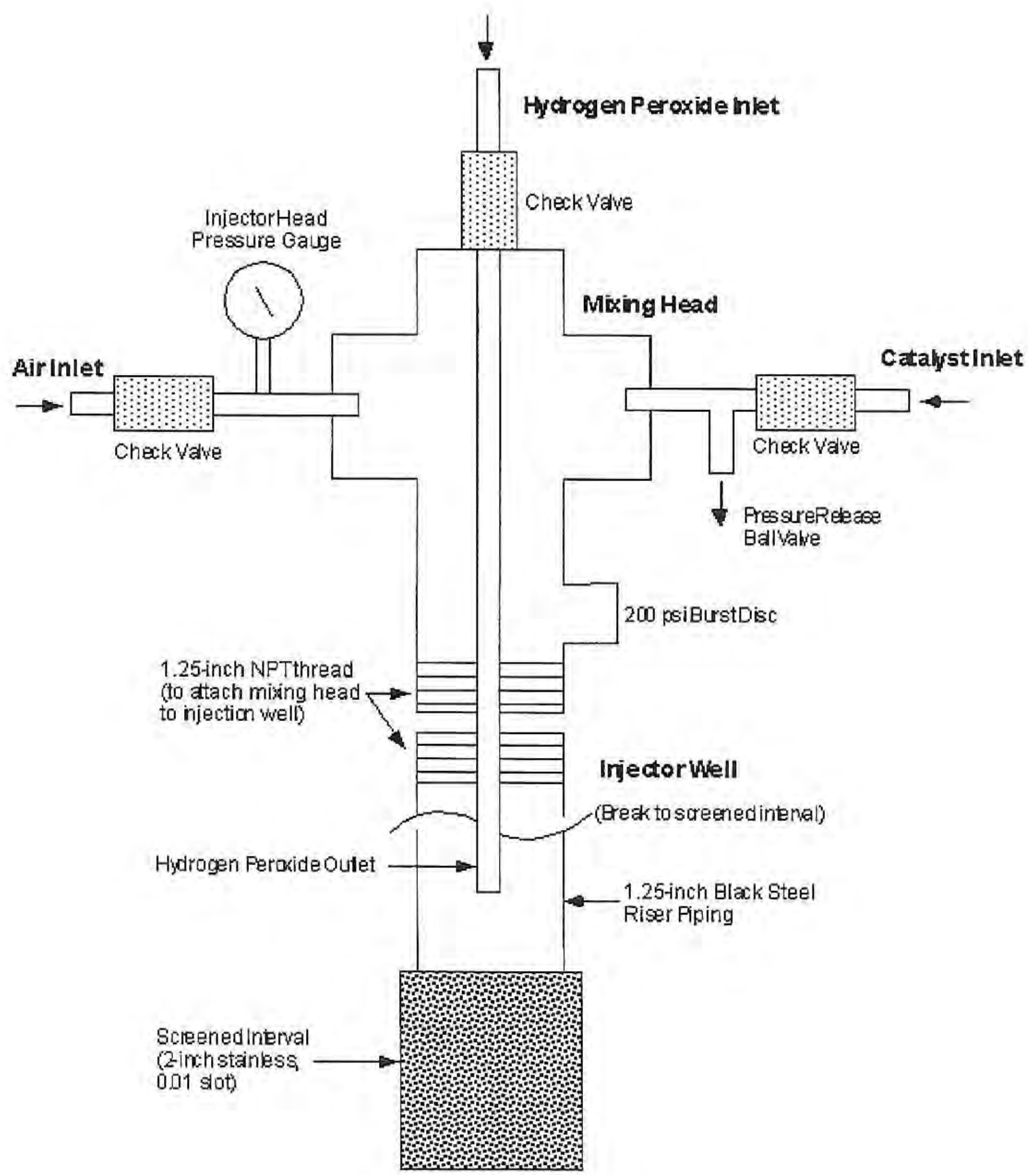
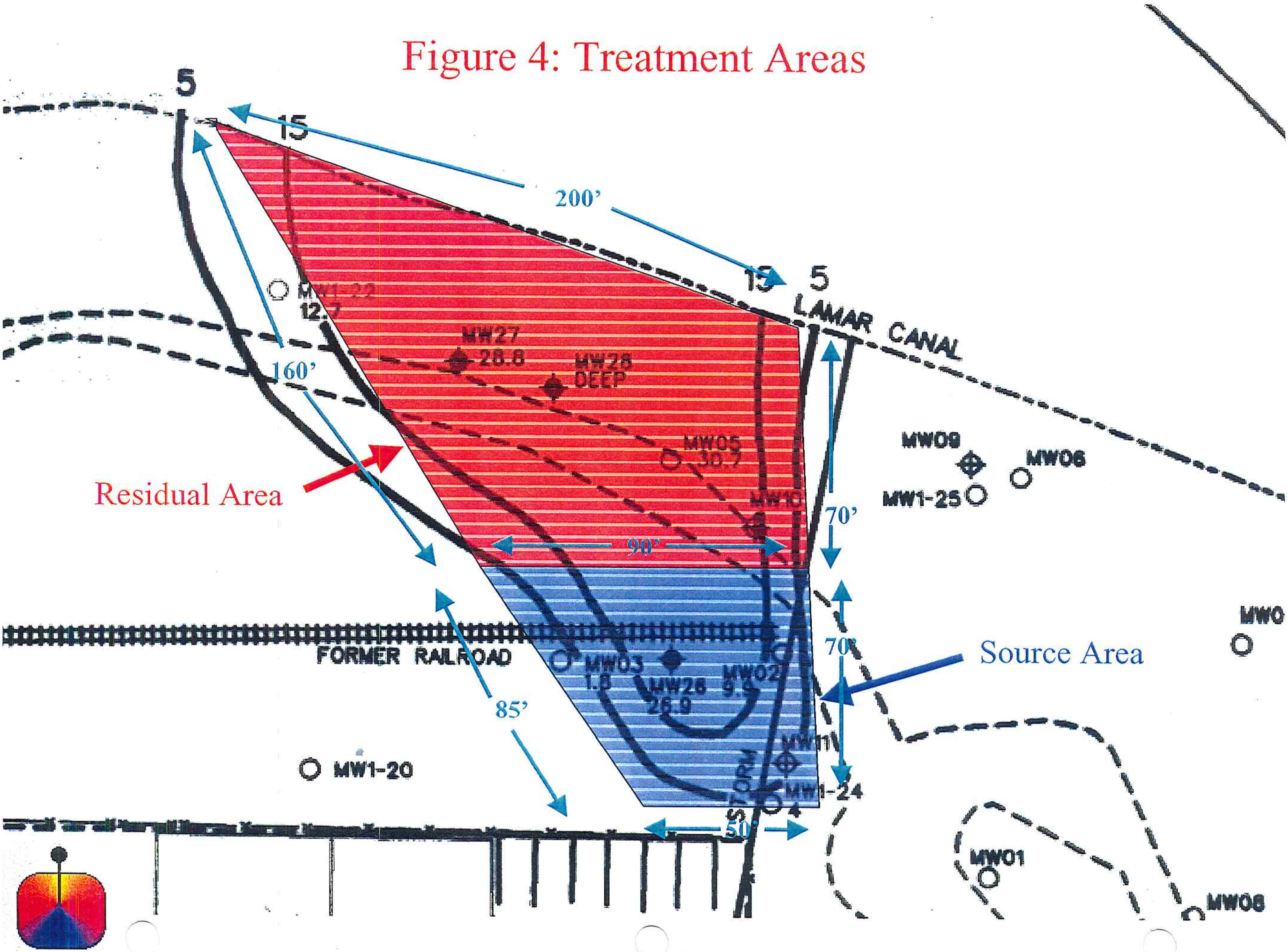
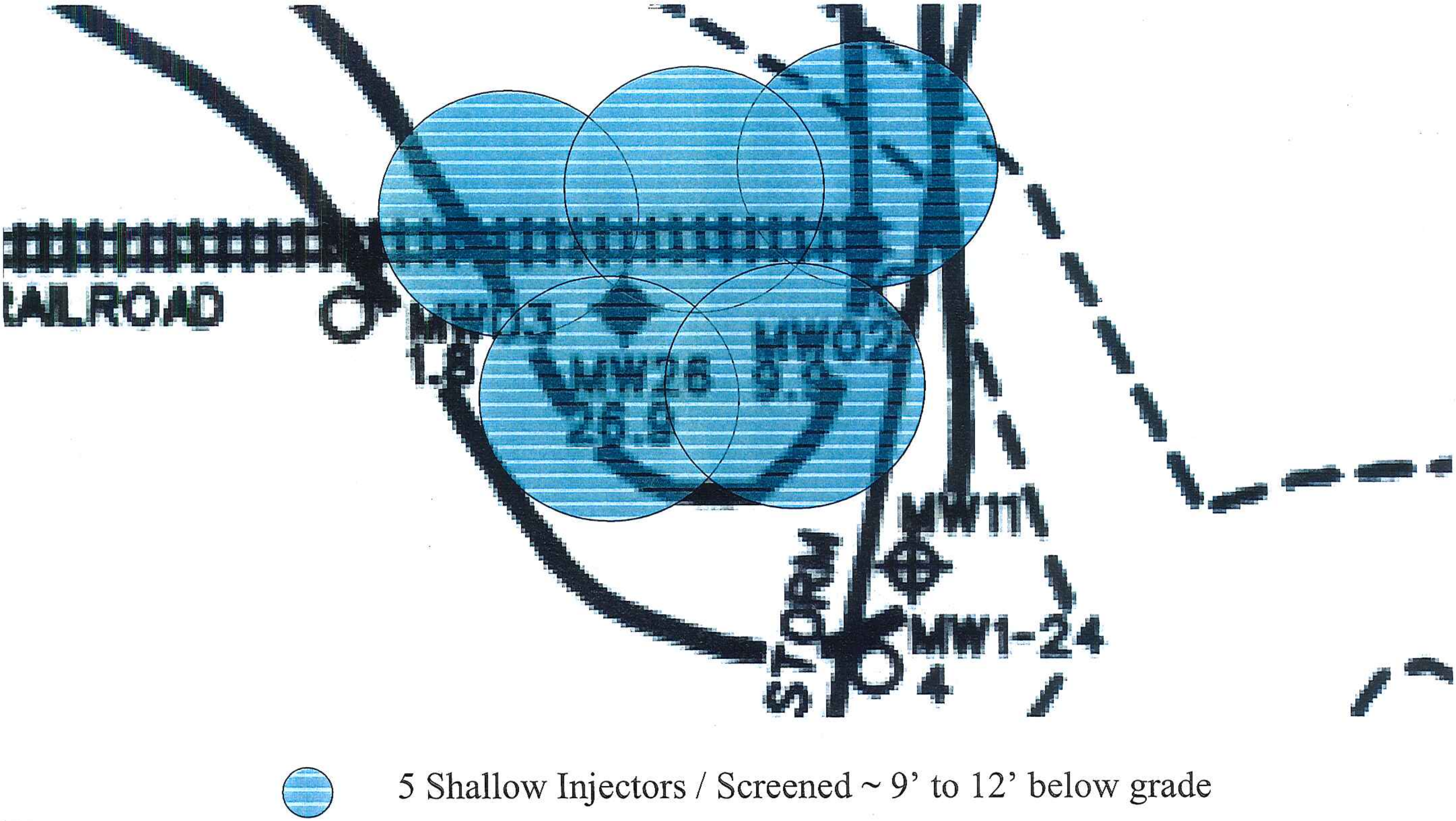


Figure 4: Treatment Areas



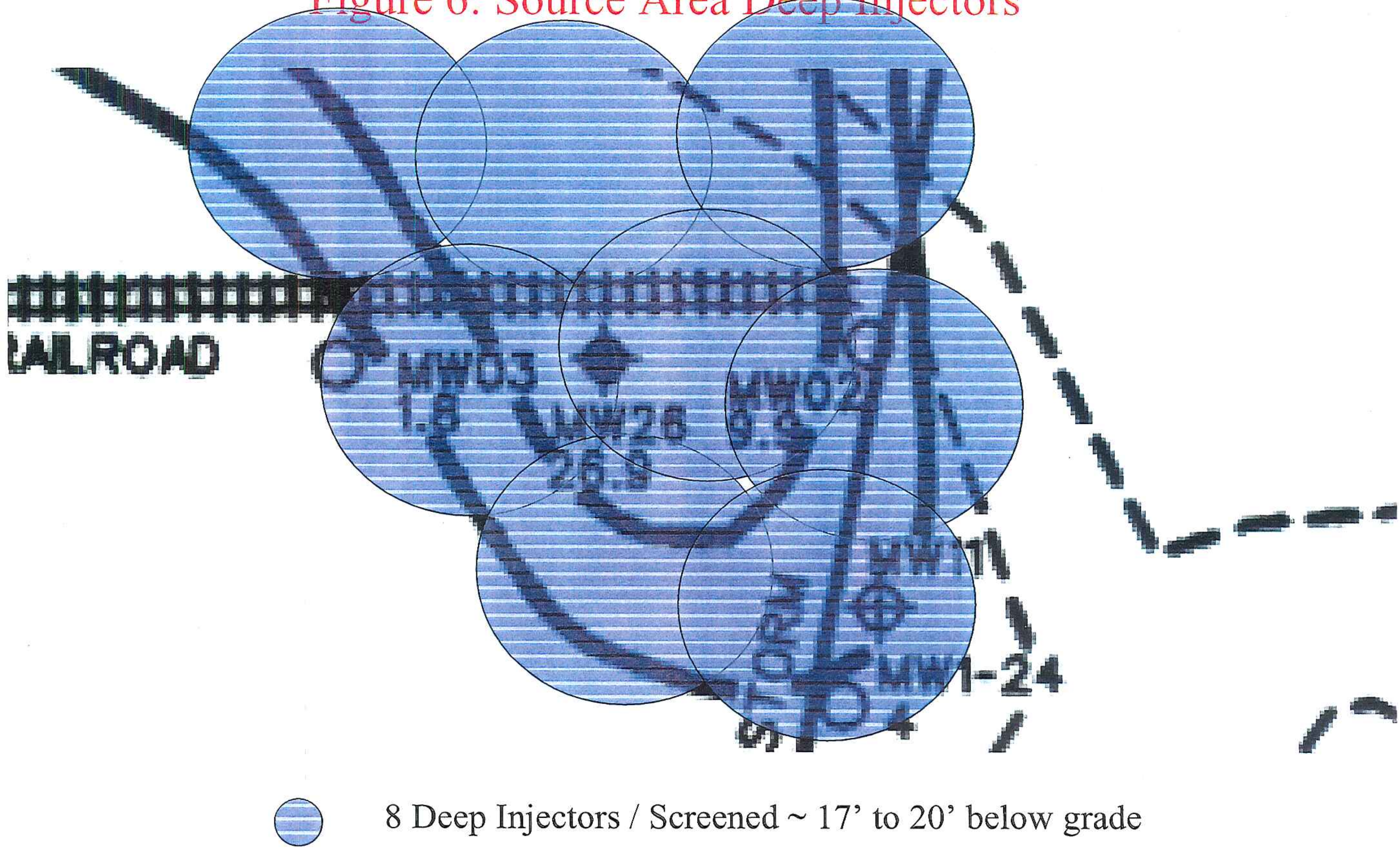
Draft / This Drawing is Not to Scale

Figure 5: Source Area Shallow Injectors



Draft / This Drawing is Not to Scale

Figure 6: Source Area Deep Injectors

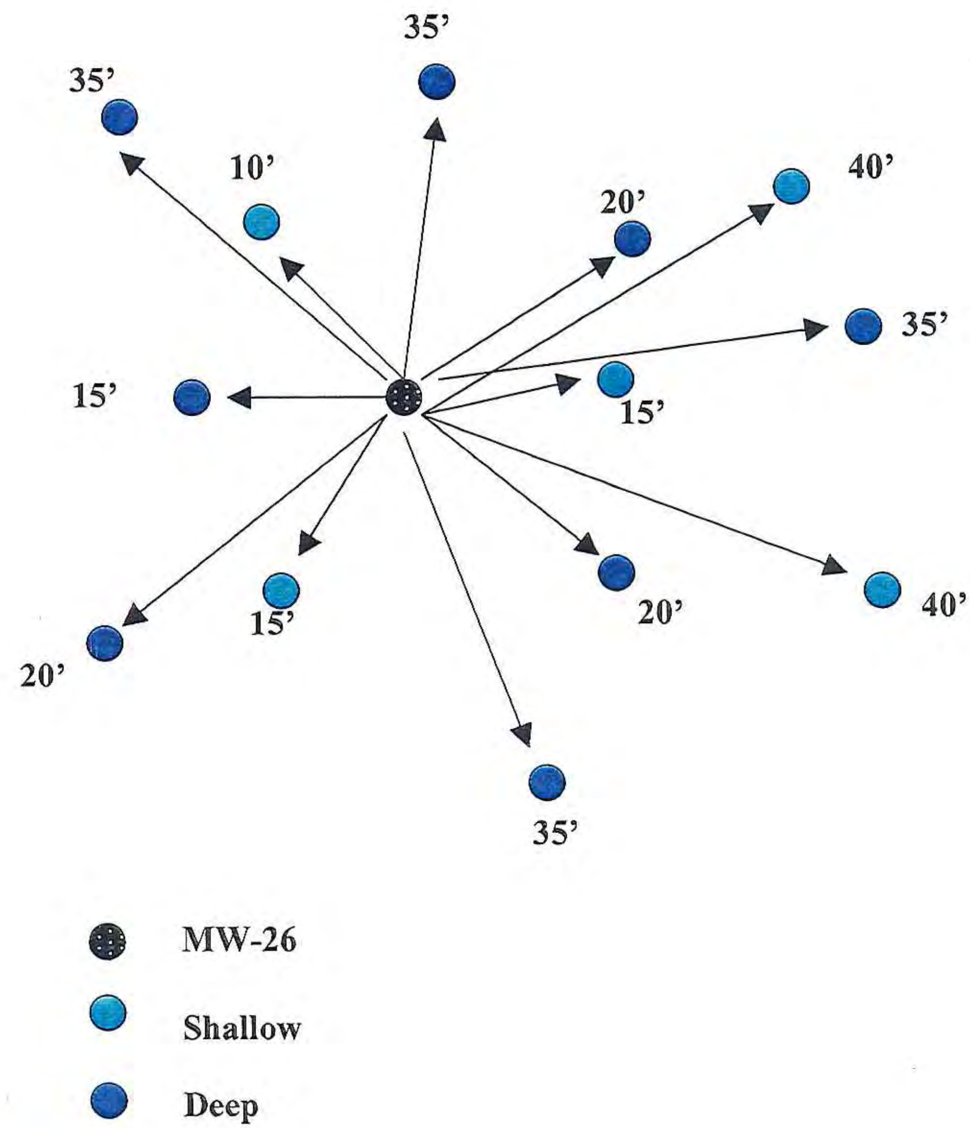


8 Deep Injectors / Screened ~ 17' to 20' below grade

Draft / This Drawing is Not to Scale

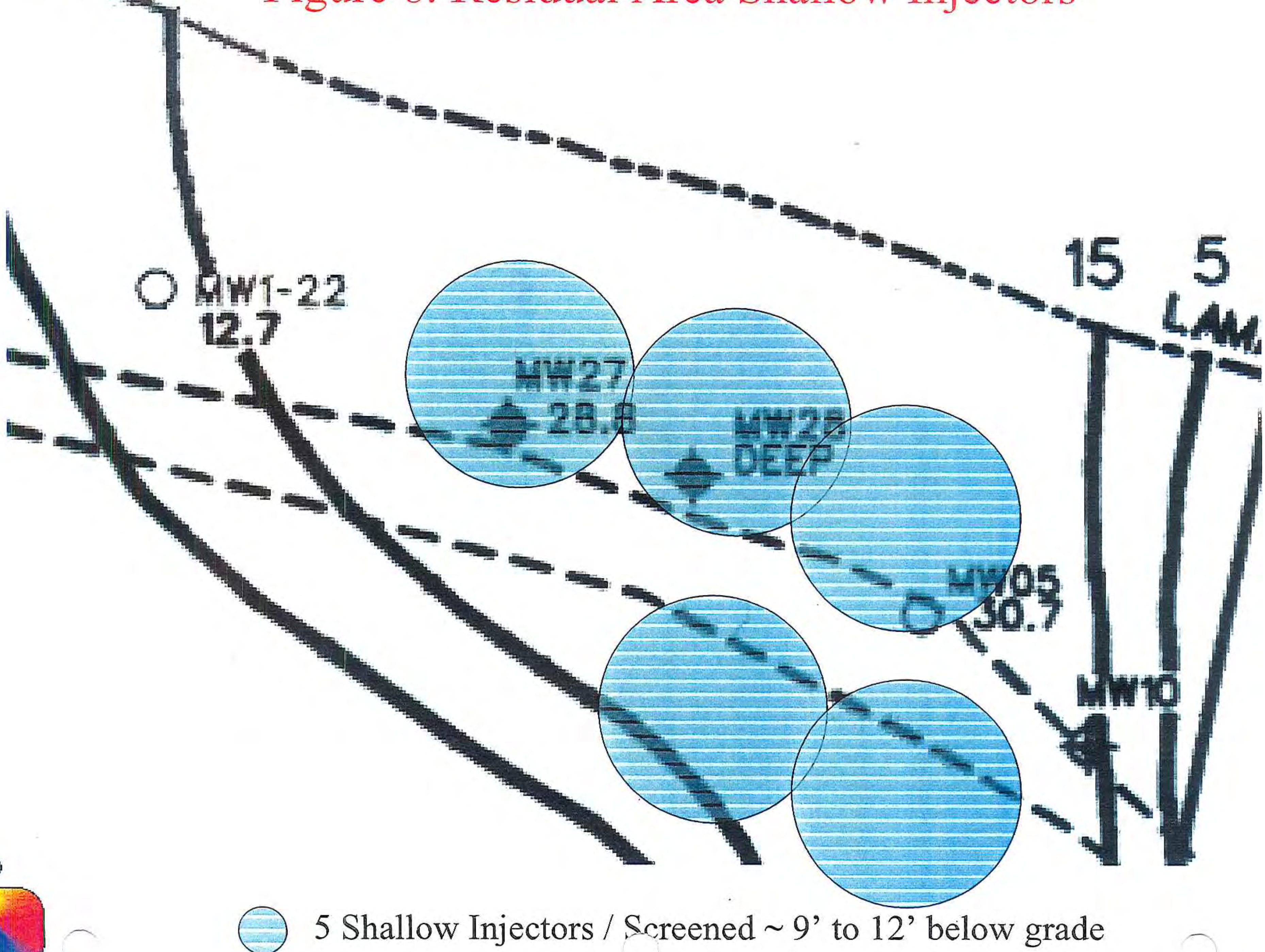
Figure 7: Source Area Locations

Feet from MW-26



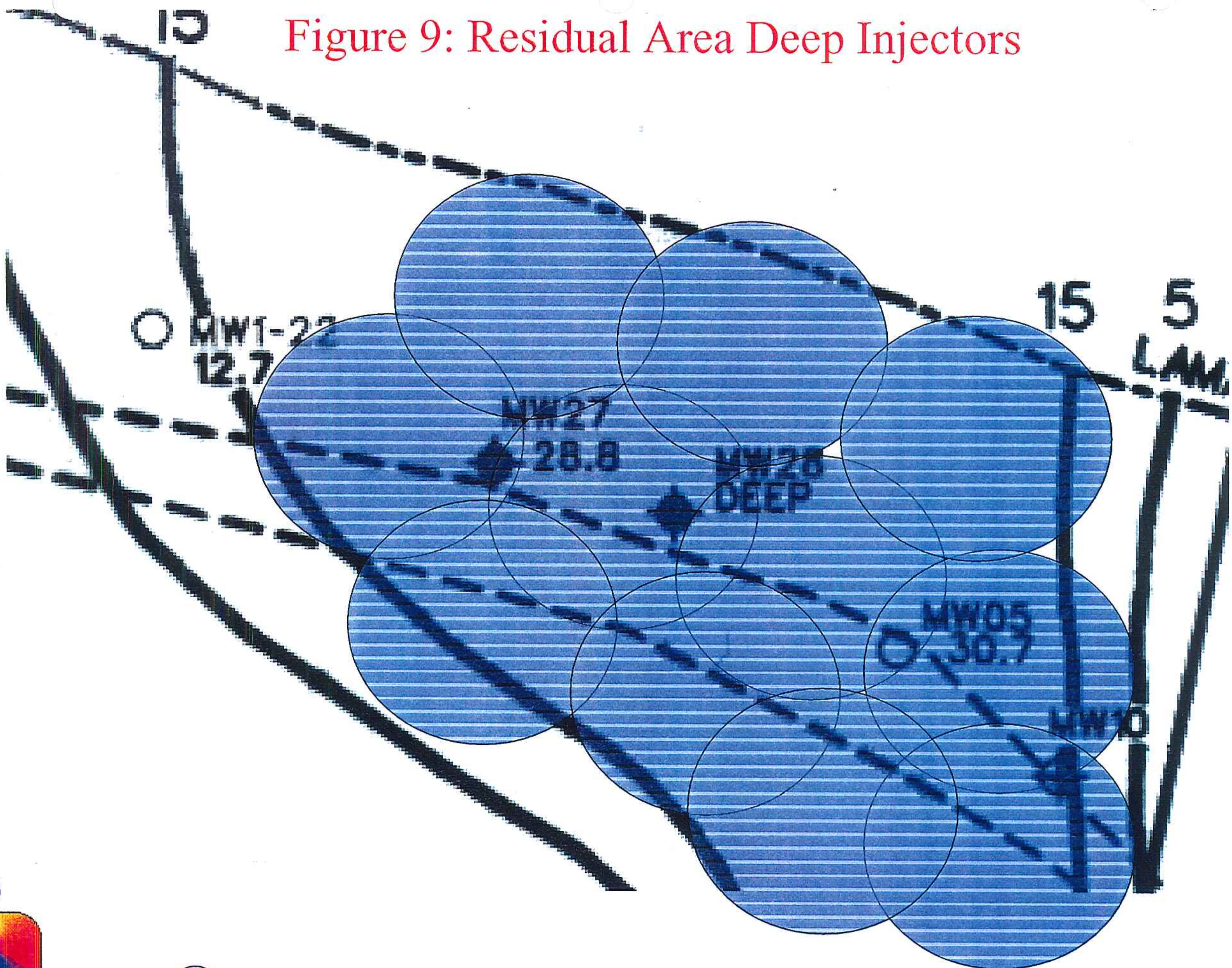
Draft / This Drawing is Not to Scale

Figure 8: Residual Area Shallow Injectors



Draft / This Drawing is Not to Scale

Figure 9: Residual Area Deep Injectors

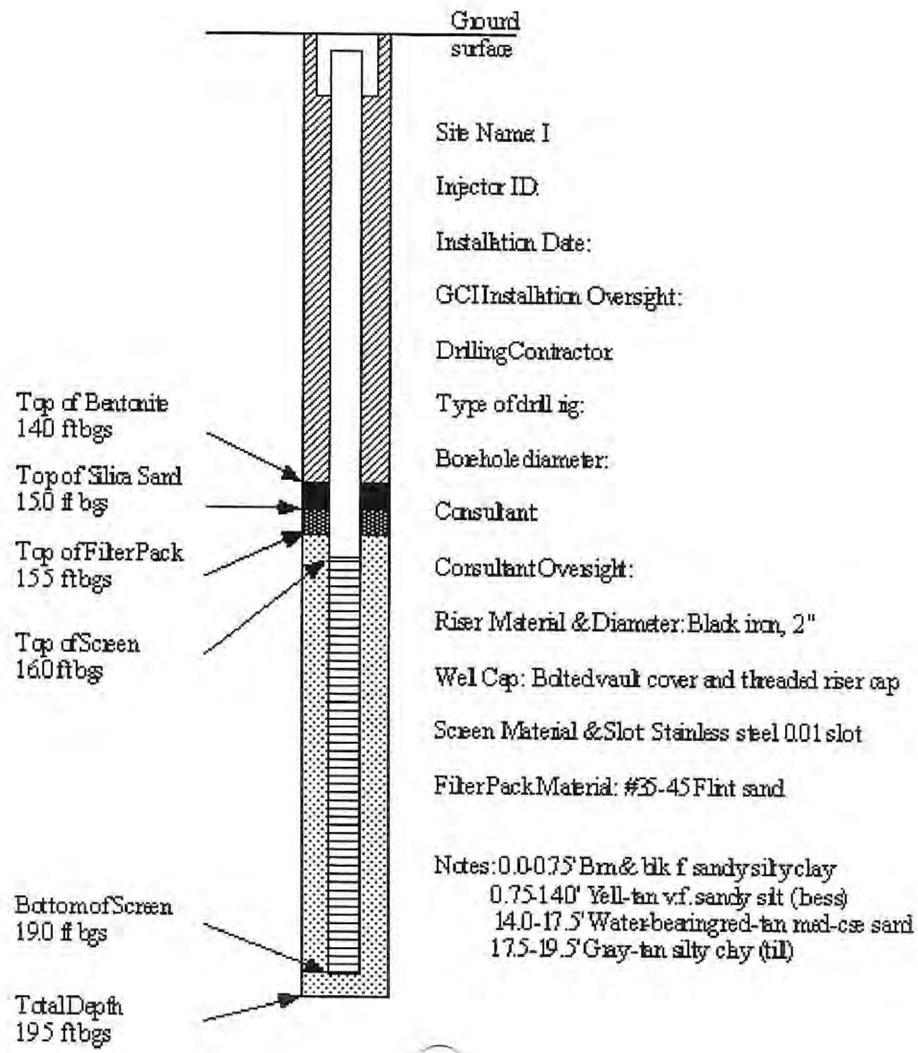


11 Deep Injectors / Screened ~ 17' to 20' below grade

Draft / This Drawing is Not to Scale

Figure 10: Injector Cross Section

GEO-CLEANSE® INJECTOR
CONSTRUCTION DETAIL
"Flush-Mount" Design



APPENDIX C

DATA MANAGEMENT PLAN

THIS PAGE INTENTIONALLY LEFT BLANK.

C.1 INTRODUCTION

This appendix of the Field Sampling Plan (FSP) represents the Data Management Plan (DMP) for project activities to be performed by Science Applications International Corporation (SAIC) for the corrective action at the PDO Yard, Hunter Army Airfield, Georgia. This plan describes the data management process to be implemented for this project. The DMP presents the process used for the planning, collection, tracking, verification, validation, analysis, presentation, and storage of site characterization data. The plan identifies required data documentation materials and procedures, as well as project file requirements. The plan also provides the reporting requirements for presenting the raw data and conclusions of the investigation.

Project activities will generate data, including sample locations, borehole information, measurements of field parameters, and results of sample analyses and data reviews. Important records regarding the collection and analysis of the samples and data will also be generated. The data management process requires the proper flow of data from field collection and processing by the analytical laboratory to those involved in the project evaluation and decision making. This DMP will ensure the validity and accessibility of data to support environmental data analysis and the evaluation of corrective measures.

C.2 INVESTIGATION DATA

C.2.1 DATA TYPES

Sampling activities proposed for the project will result in the collection of multiple data types from multiple sources. Data collection activities will include acquisition of historical data as appropriate, entry of sample collection data and field measurements from logbooks, loading of analytical data from laboratory electronic data deliverables, and entry of data validation result qualifiers. In addition, critical project records such as chain-of-custody forms, laboratory data packages, and validation results will be maintained in the project file.

C.2.2 KEY IDENTIFIERS

The key identifiers for project sampling data will be the sample location/station and a unique sample identification number. All samples will be assigned an area and station to identify the specific point at which the field measurements or samples were collected. Descriptions, geographic coordinates, and elevations will be obtained for these sampling stations.

Unique sample numbers are derived from the location, sampling station within the location, sample medium, and sample type, plus a sequential number. Field duplicates represent a separate sample type, and distinct depths receive different sequential numbers so no duplication of sample numbers will occur. The sample identification will appear on the sample collection log sheet, sample label, chain-of-custody form, and any correspondence related to the sample. Additional information regarding sample identification is presented in Section 5.3 of the FSP.

C.3 DATA MANAGEMENT SYSTEM

The data management system facilitates the information flow by providing a means of tracking, organizing, reporting, and archiving data and information. The system has four primary components:

1. A multi disciplinary team of data management professionals.

2. A process model that integrates activities relevant to ensuring that data are complete, consistent, and fully qualified and minimizes the uncertainties associated with the data, data products, or interpretations of results.

3. Guidance provided in SAIC's *SAIC Quality Assurance Technical Procedures, Volume 1: Data Management, Data Validation*, TP-DM-330-7, published in 1999.

4. A standardized database structure to support the collection, management, analysis, and presentation of site characterization data.

C.4 DATA MANAGEMENT AND TRACKING PROCESS

To meet the regulatory requirements for the acquisition of technically sound and legally admissible data, a traceable audit trail will be established from the development of the project Work Plan through the archiving of information and data. Each step of or variation from the sampling and analytical process will be documented. Standardized formats for electronic transfer and reporting will be used. To meet this requirement, the following data management process will be followed throughout the collection, management, storage, analysis, and presentation of the site environmental characterization data.

C.4.1 SAMPLING AND ANALYSIS PLANNING

Plans for the collection of field and laboratory quality control samples are detailed in the FSP, which specifies all applicable sampling and analytical data that will be entered into the database.

The interface with the analytical laboratory is crucial in achieving the goal of generating technically sound data. Based upon the laboratory data quality objectives presented in the FSP, the laboratory Statement of Work details the analytical methods, validation criteria, deliverables, and deliverable formats required of the analytical laboratory. The analytical laboratories that have been contracted with for chemical and geotechnical testing are identified in the FSP.

Prior to initiating fieldwork, the project database will be populated with sample locations, sample numbers, analytical parameters and detection limits, and associated sampling and laboratory information based on the requirements of the FSP. A report of all planned samples will be generated for review by the SAIC Field Manager. After approval of the presampling database, the data coordinator will generate field sampling forms, including preprinted sample information; bind and number the logbooks; and print and organize the required sample labels. This process will increase the accuracy of the final database and minimize the amount of information samplers must record in the field.

C.4.2 FIELD SAMPLE COLLECTION AND MEASUREMENT

Prior to beginning field sampling, field personnel will be trained as necessary and participate in a project-specific readiness review. These activities will ensure that standard procedures will be followed in sample collection and in completing field logbooks, chain-of-custody forms, labels, and custody seals. Documentation of training and readiness will be submitted to the project file.

The master field investigation documentation will be the site field logbooks. The primary purpose of these documents is to record each day's field activities, personnel on each sampling team, and any administrative occurrences, conditions, or activities that may have affected the fieldwork or data quality of any environmental samples for any given day.

Each field sampling team will have a field logbook in which it will record data collected in the field. To the extent possible, preprinted field logbook sheets will be generated from the data management system. If preprinted logbook sheets are not used for a given sample, the required information will be recorded manually. As samples are collected in the field, the field sampling team members will complete the logbooks with sample collection data and required field measurements as specified in the FSP. Standardized reporting formats will be used to document this information.

The field logbooks will be signed and dated by the data recorder and will specify whether field methods and procedures were followed. Entries will be verified by a sampling team member other than the recorder or by the SAIC Field Manager, who will perform a quality assurance review and sign and date the logbook to document the review.

Backup photocopies of the field logbooks will be made and submitted to the project file. Sample collection and measurement information from the logbooks and data forms will be manually entered into the database and checked for accuracy. Entries will be verified using double-entry and comparing protocols. As necessary, the actual forms used will be modified to include the appropriate information codes to facilitate data entry. Completed logbooks and appropriate field forms will be submitted to the project file upon completion of the project.

At any point in the process of sample collection or data or document review, a Nonconformance Report (NCR) may be initiated if nonconformances are identified, and data entered into the database may be flagged accordingly. Additional information regarding NCRs is presented in Chapter 10 of the FSP.

C.4.3 CHAIN-OF-CUSTODY DOCUMENTATION

Sample containers will be tracked from the field collection activities to the analytical laboratory following proper chain-of-custody protocols and using standardized chain-of-custody forms. Detailed instructions on documentation of chain-of-custody records are discussed in Section 5.3 of the FSP.

When the samples are received at the laboratory, the laboratory receiving staff will check and document the condition of the samples upon arrival, check that the sample identification numbers on containers and chain-of-custody forms match, and assign laboratory sample identification numbers traceable back to the field identification numbers. Within 2 days of receipt of the sample containers, the laboratory will send a letter of receipt to the SAIC Laboratory Coordinator or his/her designee. This letter will provide the following information:

- sample receipt date,
- problems noted at the time of receipt,
- list of sample identification numbers and corresponding laboratory identification numbers for all samples received,
- analyses requested for each sample received, and
- completed cooler receipt checklists for each cooler received.

The Letter of Receipt (LOR) will be accompanied by the completed and signed chain-of-custody form(s) for the samples, and both (all) documents will be submitted to the project file. Sample information recorded on the chain-of-custody form and in the LOR will be entered into the sample tracking database. This database will allow for tracking of the status of samples from the time of collection through analysis and validation. The database tracking program will produce reports that will inform the project team of potential delays or problems related to sample analysis and validation.

C.4.4 ANALYTICAL LABORATORY DOCUMENT AND DATA SUBMISSION

Prior to release of a data package, the analytical laboratory supervisor will review the data package for precision, accuracy, and completeness and will attest that it meets all data analysis and reporting requirements for the specific method used. The supervisor will then sign the hard-copy forms certifying that the data package and any electronic format deliverables have been reviewed and are approved for release.

Analytical results will be submitted to the SAIC Laboratory Coordinator or his/her designee on standardized forms in data packages in accordance with the subcontract scope of work for analytical services. These forms will contain results and required quality assurance/quality control information applicable to the analytical laboratory method used for analysis. In addition, as required by the scope of work, results of analyses will also be provided in electronic format on diskettes. The data coordinator receiving laboratory deliverables will make a copy of each data package and/or diskette and submit the originals to the project file. Results will be transferred to the database either electronically by diskette or manually from the hard copy into appropriate data tables within the database.

C.4.5 DATA VERIFICATION AND VALIDATION

All data packages received from the analytical laboratory will be reviewed, verified, and validated by data management personnel.

With regard to data reduction, any replicate measurements associated with a single sample will be averaged prior to further data reduction. Correction of extreme (outlier) values will be attempted if the cause for the outlier value can be documented. This type of data will be corrected if the outliers are caused by incorrect transcription and if the correct values can be obtained and documented from valid records. If the values can be documented as resulting from a catastrophic event or a problem in methodology, the values will be appropriately qualified. Documentation and validation of the cause of outliers will accompany any attempt to correct or delete these data values. Outlier values will not be omitted from the raw data reported to the U.S. Army Corps of Engineers, Savannah District, and valid values will be included in data summary tables. Analytical values determined to be at or below the detection limit will be reported numerically (e.g., ≤ 0.1 mg/L). The data presentation procedures will cite analytical methods used, including appropriate detection limits.

C.4.6 DATA CENTRALIZATION AND STORAGE

Once the data for a given sample or group of samples are complete and have been entered into the database, the data coordinator will check that logbooks, other field records, and all analytical data are complete and properly stored, including both the electronic form and associated data packages. Each piece of information will be documented as to its source, and hard-copy information will be appropriately indexed and filed.

Procedure-based routines for establishing data security, backup, archival, and maintaining proper database changes are also used to maintain database integrity. Classes of users will be defined, with access levels approved and controlled by the SAIC Data Manager. Once loaded the database will be secured from physical corruption (i.e., hardware or software failure) or from unauthorized access and illegal updating. Physical security requires recovery procedures, time-stamping, and other related standard operating processes and controls. Any changes made to the completed database will be documented on standardized forms that will be placed into the project file.

C.4.7 DATA SUMMARIZATION AND REPORTING

When field sampling has been completed and the analytical data have been received, validated, and transferred into the project database, project reports and Quality Control Summary Reports will be generated for each of the sites investigated.

Project data will be screened for potential data errors, compared to site-specific background values and applicable regulatory limits, and summarized in both tabular and graphical form to facilitate data interpretation. Data reduction and summation will be accomplished using quality-controlled and documentable reporting programs. Data summaries will generally be produced using predefined report formats available within the data management system. Statistical summaries will be generated by transferring data to a SAS data set and adapting exiting data analysis programs to include project-specific aggregation or screening criteria. Any new programs developed under this project will be tested, reviewed, and documented as error-free in accordance with SAIC quality assurance technical procedures. Data presented on maps, figures, or tables will be transferred electronically as far as possible to avoid introducing typographical errors.

C.4.8 RECORDS MANAGEMENT AND DOCUMENT CONTROL

Hard copies of all original site and field logbooks, chain-of-custody forms, data packages with analytical results and associated quality assurance/quality control information, data verification and validation forms, and other project-related information will be indexed, catalogued into appropriate file groups and series, and archived.

The SAIC Data Manager will archive the project data to the appropriate electronic media. A data archive information package will be prepared that describes the data system, file format, and method of archival. Sufficient documentation will accompany the archived data to fully describe the source, contents, and structure of the data to ensure future usability. Computer programs used to manipulate or report the archived data will also be included in the data archive information package to further enhance the data's future usability.

THIS PAGE INTENTIONALLY LEFT BLANK.