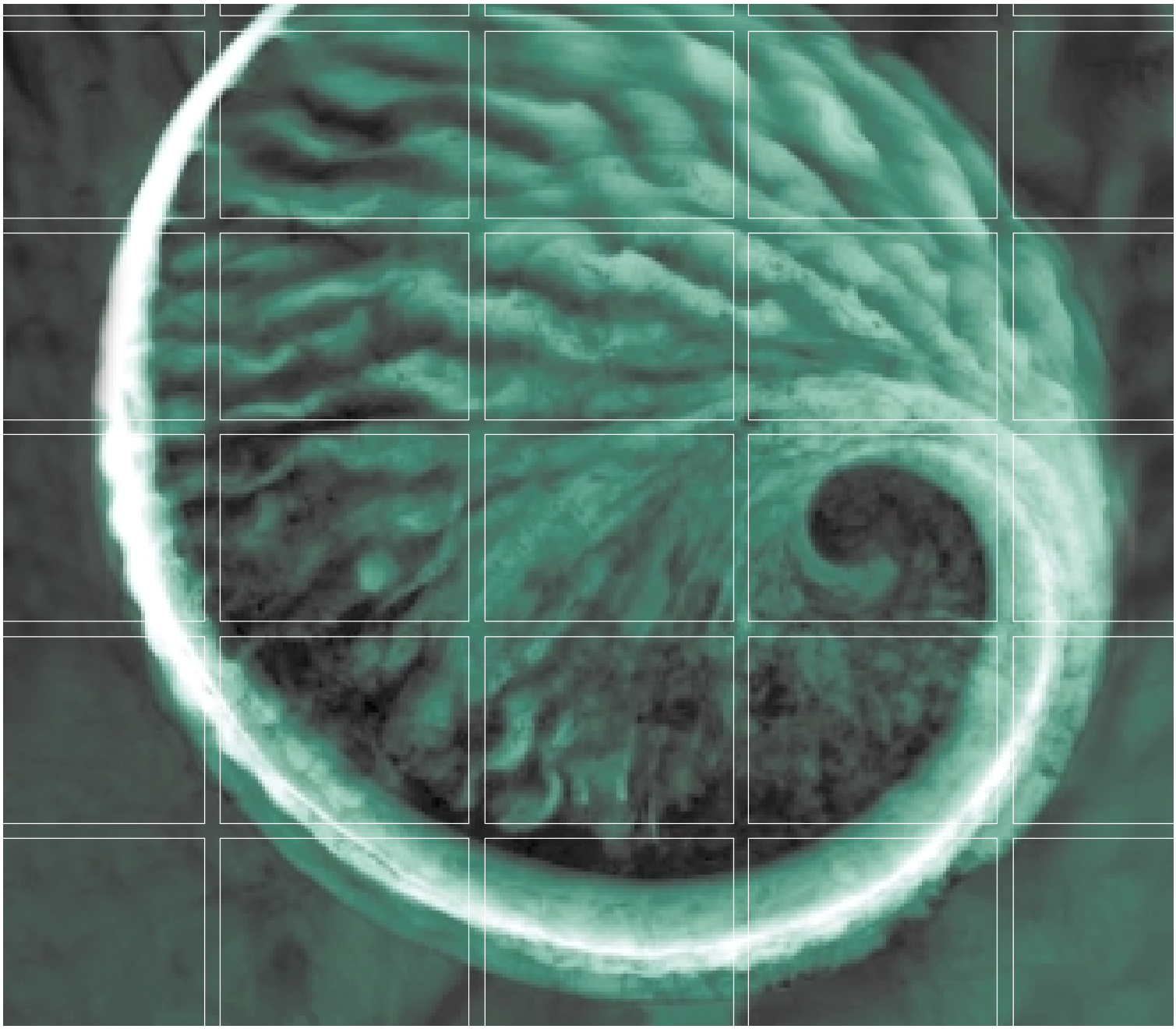

Interim Status Report and CAS Work Plan Revision

Whirlpool Facility, Ft. Smith, Arkansas
Prepared for Whirlpool Corporation

June 25, 2004

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Volume 1 of 3

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Whirlpool Corporation

Interim Status Report and CAS Work Plan Revision

June 25, 2004

Project No. 0014507
Whirlpool, Ft. Smith, Arkansas

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1.0 INTRODUCTION

This Interim Status Report and Corrective Action Strategy (CAS) Work Plan Revision describes the current status of offsite investigations at the Whirlpool Ft. Smith Facility (the Facility) and the activities the facility intends to conduct during CAS implementation. This submittal consists of:

- An off-site delineation status report;
- An annotated CAS Work Plan (Appendix A), and the
- Conceptual Site Model (CSM) Report with updates as requested by ADEQ (Appendix B).

As specified in guidance for development of the CAS work plan described in Section 2.4.2 of the USEPA Region 6 Corrective Action Strategy, this submittal includes site data relevant to assessment of performance standards that are sufficient to protect human health and the environment. Table 1-1 summarized the CAS work plan requirements outlined in Section 2.4.2 of the CAS and indicates where the information may be found in this submittal.

1.1 BACKGROUND INFORMATION

The Whirlpool Fort Smith facility is located at 6400 Jenny Lind Road on the south side of Fort Smith, Arkansas (Figure 1-1). The facility manufactures side-by-side household refrigerators, trash compactors and icemakers. The facility has been operated by Whirlpool for over 30 years.

Information concerning waste management practices, and site releases can be found in The CSM in Appendix B. In summary, a series of soil and ground water studies were initiated in the late 1980's at the site as part of a project to remove an underground fuel storage tank (UST). That work indicated that there was no evidence of releases of petroleum hydrocarbons from the UST. However, the analytical data showed the presence of trichloroethylene (TCE) and other solvents not related to the UST in the shallow ground water. Subsequent investigations, including a soil investigation to assess the potential source area, have been conducted to characterize the nature of TCE in soil and ground water. It is believed that constituents in the soils and ground water identified in the facility investigation are the result of historical practices prior to 1980. Additional information can be found in Section 1.1 and 2.2 of the CSM, Appendix B.

Analytical data from the monitoring well system show that affected ground water has migrated from the apparent source area (near MW-25) in a southerly direction under the northwest corner of the main manufacturing building. The extent of affected ground water to the south and southwest appears to be limited to the Whirlpool property; that is, the ground water plume does not extend off site in that direction. However, data from wells north of Ingersoll Avenue indicate that affected ground water has migrated off site and extends as far as 1300 ft. north of the site.

1.2 GROUND WATER MANAGEMENT PROGRAM

In order to fully characterize on- and off-site impacts to ground water and assess whether remedial actions are necessary, Whirlpool developed a Ground Water Management Program.

Following completion of initial site investigations, Whirlpool initiated discussions with the Arkansas Department of Environmental Quality (ADEQ) and entered into a letter of agreement (LOA) to implement a CAS for the off-site ground water plume at the Facility. A CAS Work Plan Outline was prepared that describes the activities the facility intends to conduct during the CAS implementation. The CSM and CSM addendum letter dated August 30, 2002 were developed as the framework on which the implementation of the CAS is based.

In accordance with the CAS process (illustrated in Figure 1-2), the CAS Work Plan, CSM, and CSM addendum were presented to ADEQ at the scoping meeting held at the Whirlpool facility on August 13, 2002. After reviewing the documents provided at the scoping meeting, Mr. Mike Hill contacted Whirlpool on February 10, 2003 and gave verbal authorization to proceed with the off-site delineation activities. To date, two phases of additional off-site ground water investigations (Figure 1-2 (7)) have been conducted.

1.3 SCOPE OF PREVIOUS INVESTIGATIONS AT THE WHIRLPOOL FACILITY

1.3.1 Voluntary Semiannual Ground Water Monitoring Program

As part of its Ground Water Management Program, Whirlpool has implemented a voluntary semiannual ground water sampling program to monitor ground water conditions at the site. Periodic ground water monitoring activities at the Whirlpool facility began in 1989. Semiannual ground water monitoring was started in March 2000 and continues to the present. The semiannual monitoring events have expanded to include additional monitoring wells installed during off-site delineation activities.

The semiannual ground water monitoring program at the Facility currently includes sampling of 24 on-site monitoring wells and 16 off-site monitoring wells during the first and fourth quarters of each year. During each monitoring event the water levels in all wells are gauged to provide data for evaluating ground water flow conditions. Locations of the wells that are part of the regular monitoring program are shown in Figure 1-3.

1.3.2 Off-Site Delineation

In 2000, data collected as part of the Initial On-site Ground Water Investigations (Phase I, Figure 1-2) from wells at the northern boundary of the Facility indicated the presence of a TCE plume near the Northern boundary of the Facility. In order to evaluate ground water conditions in this area, additional investigations were conducted in 2001 at the northern limit of Whirlpool property (an easement at the north side of Ingersoll Avenue). These investigations confirmed the presence of TCE and indicated that it may be moving off site.

After ADEQ's review and approval of the CAS Work Plan, Whirlpool conducted two phases of delineation that focused on assessing the extent of the off-site TCE plume.

- Off-site Delineation Phase A was conducted in July 2003 and included the installation, development and sampling of three off-site wells between Ingersoll Avenue and Jacobs Avenue; and
- Off-site Delineation Phase B was conducted in November 2003 and included 10 Membrane Interface Probe (MID) borings, 11 Geoprobe soil borings, and installation, development and sampling of four wells between Jacobs Avenue, Jenny Lind, and Brazil Avenue.

Procedures employed during ground water monitoring and off-site delineation activities are described in Sections 2 and 3 below.

2.0 GROUND WATER SAMPLING PROCEDURES

Ground water samples have been collected as part of the Facility ground water monitoring program and the off-site delineation activities. Procedures employed during ground water sampling are described below.

Prior to 2002, each monitor well was sampled using a traditional purge and sample method. This method involves purging three well volumes from each well prior to collecting the sample. Ground water field parameters, such as pH, SC, and temperature are monitored following the purging of each well volume and after sample collection. Samples were typically collected with a bailer.

Since the beginning of 2002, ground water samples have been collected using low-flow ground water sampling techniques in accordance with the Environmental Protection Agency (EPA) *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*. The change to low-flow sampling techniques followed a comparison study where numerous wells were sampled first by low-flow methods and then by traditional purge and sample techniques.

Low-flow ground water sampling techniques are performed using a peristaltic pump and dedicated polyethylene tubing. The tubing is placed in the middle of the screened interval, or water column depending on depth to water. Low-flow procedures are followed and wells are pumped at a rate generally less than 0.5 L/min in order to limit drawdown.

Water quality parameters are monitored using an YSI 650XL multiprobe and flow-thru cell or an equivalent meter. Readings are recorded approximately every 5 minutes until parameters stabilize over three successive readings. Stabilization parameters include:

- pH within 0.1 units;
- SC $\pm$ 3%;
- DO $\pm$ 10%; and
- ORP $\pm$ 10 mV.

In some cases, slow recovery rates prohibit the use of low-flow techniques. Wells with slow recovery rates are pumped dry once and then allowed to recover prior to sampling. Purge water generated during sampling is placed in containers for proper disposal by Whirlpool.

Samples are typically collected for analysis of the volatile organic compounds (VOCs) and natural attenuation parameters listed on Table 2-1. VOC samples are collected in 40-mL vials, labeled, stored on ice, and shipped to Severn Trent Laboratory (STL) in Houston, Texas for analyses by SW-846 Method 8260B. Chloride, nitrate and sulfate samples are collected in neat 250 to 500 mL plastic bottles, labeled, stored on ice, and delivered to Data Testing, Inc. in Fort Smith, Arkansas for analyses by EPA water/wastewater methods. Samples for ferrous

iron analysis are analyzed in the field by using a Hach DR820 colorimeter glass ampule method 8146. Chain of custody procedures are established and followed from the time of sample collection until the analyses are complete.

During ground water sampling activities, the following QA/QC samples are routinely collected:

- one blind duplicate per 20 samples; and
- one field blank per day.

Duplicates are analyzed for all site constituents. Field blanks are analyzed for VOCs only.

3.0 OFF-SITE DELINEATION PROGRAM

The purposes of the off-site delineation activities are to characterize the subsurface conditions and to delineate the extent of the off-site ground water plume. As discussed above, two phases of delineation have been conducted to date.

Off-site delineation Phase A (July 2003) involved the installation, development, and sampling of three wells between Ingersoll Avenue and Jacobs (Figure 3-1) This initial off-site work was focused on two properties immediately north of the known on-site extent of the plume.

Following confirmation of the off-site ground water flow directions and verification of the presence of an off-site TCE plume, a second phase of off-site delineation was conducted. Off-site Delineation Phase B, conducted in November 2003, included borings along the right-of-ways of Jacobs Avenue, Jenny Lind Street, and Brazil Avenue (Figure 3-2).

First, MIP screening borings were conducted at 11 locations to qualitatively assess the presence of TCE in ground water. Following qualitative delineation of the TCE plume with the MIP, geoprobe borings were conducted adjacent to 7 locations to evaluate the relationship between the site lithology and the location of the TCE Plume. Boring locations were selected both inside and outside of the suspected TCE plume and in areas where it was anticipated that additional data would help in delineating the gravel-rich units that appear to be influencing ground water flow.

Based on the MIP screening and geoprobe boring data, monitoring wells were installed in selected borings. Two monitoring wells were installed at locations near the suspected central area of the TCE plume as indicated by MIP screening data and two were installed near the suspected fringe. One well was also installed along Brazil Avenue in the suspected downgradient direction of the plume.

Procedures employed during off-site delineation activities for MIP screening, Geoprobe borings, and well installations are described in the following sections.

3.1 MIP SCREENING

A drill rig equipped with an MIP was used to screen for the presence of TCE in the ground water by detecting VOCs in the subsurface. MIP screening is conducted by advancing the MIP tool into the soil at a constant rate using a direct-push drill rig or Geoprobe. The MIP tool consists of a semipermeable membrane attached to tubing and a drive point. The drive point is pushed into the soil to place the semipermeable membrane into contact with soil and ground water. The drive point heats the soil causing volatilization of constituents in the soil or ground water. These constituents pass through the semipermeable membrane and into the tubing where a carrier gas transports the constituents to the surface and into photoionization (PID) or flame ionization (FID) detectors

where the concentration of the constituents are measured. A computer attached to the detector records the results on a graph that indicates the detections as a function of depth. A schematic drawing of the MIP system and a representative log are shown in Figure 3-3.

3.2 GEOPROBE SOIL BORINGS

Geoprobe soil borings were conducted using a direct push Geoprobe drill rig to collect continuous soil cores for evaluation of lithology in the area of concern. The borings were conducted to refusal, which was generally encountered at a depth of approximately 30 feet.

Prior to drilling, the locations were cleared with local utility company representatives and then hand probed to a minimum of 5-feet to verify absence of underground utilities.

Soil cores from the Geoprobe borings were examined in the field by a geologist who prepared lithologic logs including a description of the lithology, and physical characteristics such as texture, color, plasticity, and moisture content. In addition, the cores were field-screened for the presence of volatile organics by placing representative pieces of the core in a sealable plastic bag, which was allowed to sit at ambient conditions for approximately 10 minutes. The maximum headspace was then measured by inserting the probe of a PID equipped with an 11.8 eV bulb into the plastic bag. Boring logs are included in Appendix C.

Monitor wells were installed in selected borings. The remainder of the borings in roadways were tremie grouted to the surface using neat cement. Borings located outside of roadways were backfilled with bentonite.

Upon completion of sampling, all soil cuttings and any other waste generated during sampling was contained and transferred to an on-site rolloff container. All drilling and reusable sampling equipment was decontaminated before advancing to the next drilling location.

3.3 MONITORING WELL INSTALLATION

Monitoring wells were designed and constructed in accordance with the Arkansas Department of Pollution Control and Ecology Hazardous Waste Division Interim Policy PRCR 96-4. Each well installed during off-site delineation activities was constructed using ¾-inch diameter schedule 40 PVC casing and stainless steel, wire-wrapped, pre-pack screen.

Once the well casing and screen was installed in the borehole, a sand pack consisting of 20/40 sieve silica sand was poured into the annulus until the top of the sand pack was a minimum of two feet above the top of the well screen. A well seal consisting of a minimum three feet of pelletized bentonite was then added to the well annulus. Once the bentonite was hydrated, the remainder of the well annulus was filled to the surface with neat cement. A surface

completion was installed consisting of a concrete pad and a steel cover. Well completion details are included in Table 3-1 and Appendix C.

Sample locations and monitoring wells were marked and surveyed for horizontal position and elevation relative to an established benchmark. The top of casing elevation of each monitoring well was also recorded.

3.4 MONITORING WELL DEVELOPMENT

Following installation, each well was developed to remove fines present due to the drilling and completion activities. The wells were developed using a combination of surging and pumping using a Watera pump (tubing with a foot valve) and/or a peristaltic pump. During development, water quality parameters such as turbidity, pH, specific conductance, and temperature were monitored. Wells were considered developed when parameters stabilized and the water was relatively clear of silt. In some instances, due to slow recovery rates, wells were pumped dry. If a well went dry during development, it was allowed to recover overnight and then additional development was conducted. Well development records are included in Appendix D.

4.0 RESULTS

4.1 MONITORING PROGRAM

Data from ground water monitoring activities conducted since 1989 indicate that the predominate direction of shallow ground water flow across the majority of the site during fall is to the south/southwest (Figure 4-1). However, in the spring, flow shifts to the southeast (Figure 4-2).

Ground water elevations north of the Facility indicate that a ground water divide is present along an approximate line from MW-26 to MW-28 to MW-22. North of this divide, ground water appears to flow north and northeast away from Ingersoll Avenue. There does not appear to be any significant seasonal variation in ground water flow directions north of the site.

Analytical data from the monitoring well system show that affected ground water has migrated from the apparent source area (near MW-25) in a southerly and southwesterly direction under the northwest corner of the main manufacturing building (Figure 4-3). Based on the site analytical data, the ground water plume appears to be stable. Some wells show seasonal variation in concentration but the majority have decreasing or stabile trends (Table 4-1).

The extent of affected ground water to the south and southwest appears to be limited to the Whirlpool property; that is, the ground water plume does not extend off site in that direction. However, data from wells north of the main building, and off-site wells northwest of the facility indicate that affected ground water has migrated to the north of the facility across Ingersoll Avenue and Jacobs Avenue.

The area of concern for the off-site ground water investigation is defined as the apparent extent of ground water that exceeds 0.005 ppm TCE. This area is illustrated in Figure 4-3.

4.2 OFF-SITE DELINEATION

Off-site delineation activities have focused on two tasks, characterizing the lithology north of the facility and delineating the extent of the off-site ground water plume.

Data from the on-site investigations show that the Facility is generally underlain by alluvium composed of a shallow fine-grained unit, and a coarse-textured basal unit. This alluvial zone overlies the McAlester Shale which is generally encountered at depths between 25-30 feet. Additional detail concerning regional and local geology and hydrogeology is included in Section 4 of the CSM (Appendix B).

Based on the delineation completed thus far, the lithology off-site appears similar to that encountered on-site (Section 4.2 of the CSM (Appendix B)). The alluvial

deposits are 26 to 30 feet thick near the facility and thin to 10 to 15 feet thick to the north and east. As illustrated in cross sections, the aquifer generally consists of clayey gravels and silty clayey sands ranging from 3 to 5 feet thick near the site and appears to pinch out to the north and northeast (Figures 4-4 and 4-5). As shown in Figure 4-6, there appears to be a fan-shaped gravel-rich deposit that extends north from Ingersoll Avenue across Jacobs Avenue. Based on ground water gradients in the off-site wells, it appears that this more permeable portion of the aquifer may influence ground water flow in the area.

MIP screening data and analytical results from the off-site delineation activities indicate that the off-site TCE plume is generally located within the gravel-rich alluvial deposit. MIP screening data from outside the extent of the gravel-rich alluvial deposit do not indicate the presence of VOCs and, furthermore, ground water samples from wells installed outside of the gravel-rich portion of the unit have very low concentrations of TCE or are reported as non-detect (Figure 4-7).

5.0 PLANNED ACTIVITIES FOR OFF-SITE DELINATION PHASE C

Additional off-site ground water delineation tasks are required in order to delineate the off-site ground water plume and complete characterization of the off-site lithology and hydrogeology. This additional work includes conducting additional Geoprobe borings and MIP screening north of Jacobs and east along Jacobs. The technical approach, methods, and schedule for the additional work to complete the delineation are described below.

This work will be conducted under the Health and Safety Plan included in Appendix E.

5.1 TECHNICAL APPROACH

Off-Site Delineation Phase C will consist of three general tasks:

Task 1 –Geoprobe boring and MIP screening will be conducted between Jacobs and Brazil;

Task 2 – Based on the observations from Task 1, approximately five locations will be selected for completion of wellpoints. Ground water samples will be collected from new wells during two consecutive semiannual events.

The approximate locations of the proposed MIP screening borings and well installations are illustrated in Figure 5-1. The actual number and location of the borings may need to be modified due to access constraints and other field conditions encountered at the site. Final locations will be determined in the field.

Task 3 –Based on the results of the delineation, the CSM will be updated accordingly.

5.2 INVESTIGATION METHODS

Off-site delineation Phase C will include MIP screening, geoprobe borings and monitor well installations.

5.2.1 MIP Screening and Geoprobe Soil Borings

Initially up to eight MIP screening borings will be conducted between Jacobs Avenue and Brazil Avenue to screen for the presence of TCE at locations shown on Figure 5-1. Geoprobe borings will be conducted adjacent to selected MIP screening locations to delineate the gravel-rich unit that is expected to control ground water flow. The soil borings between Jacobs Avenue and Brazil Avenue will be conducted using a drill rig equipped with hollow stem augers or a Geoprobe. All borings will be continuously sampled and logged. Borings will be advanced to a depth of approximately 30 feet or to the top of bedrock.

Soil cores will be logged in the field for lithology, and physical characteristics such as texture, color, plasticity, and moisture content. The cores will also be field-screened for the presence of volatile organics using a PID.

5.2.2 Monitoring Well Installation, Development, and Sampling

Following evaluation of the MIP and soil boring data, up to five monitoring wells will be installed at selected locations near or downgradient of the expected fringe of the TCE plume. The additional monitoring wells will be designed and constructed in accordance with the Arkansas Department of Pollution Control and Ecology Hazardous Waste Division Interim Policy PRCR 96-4. Each well will be constructed using a ¾-inch diameter schedule 40 PVC casing with stainless-steel, wire-wrapped, pre-pack screens. The screen lengths will not exceed ten feet and will generally be placed to monitor the lower portion of the uppermost aquifer.

Once the well casing and screen is installed, a sand pack will be poured into the annulus until the top of the sand pack approximately two feet above the top of the well screen. The sand pack will be followed by a minimum of 3 feet of pelletized bentonite and the remainder will be grouted to the surface using neat cement.

Following installation, each well will be developed to remove fines present. Development techniques will include bailing, surging, and/or pumping. A minimum of eight borehole volumes will be removed or if the well goes dry, it will be allowed to recover over night and developed dry a second time. PH, specific conductance, and temperature will be monitored during development.

All drilling and sampling equipment will be decontaminated with laboratory-grade detergent before drilling each well and upon completion of drilling.

5.3 ANALYTICAL PROGRAM

Ground water samples for chemical analyses will be collected in accordance with EPA SW-846 Methods. The target constituents and associated laboratory detection limits are provided in Table 2-1. Ground water samples will be collected directly from the tubing into laboratory-supplied containers. Testing is in accordance with Laboratory Quality Assurance Manual.

All VOC analytical samples will be submitted to STL in Houston, Texas for analyses. The laboratory will be required to meet the data-quality requirements. Chain of custody procedures are established and followed from the time of sample collection until the analyses are complete.

5.4 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

In addition, to the chemical analytical samples, project quality assurance/quality control QA/QC samples will be collected. The QA/QC samples collected will include field blanks, equipment blanks, duplicates, matrix spikes, and matrix spike duplicates.

6.0 REPORTING

Following the investigation, the CSM will be updated to include new data. Based on the information from off-site delineation investigations, a risk assessment will be conducted and the risk management profile for the CSM will be developed. In addition, the ecological exclusion checklist and a Risk Evaluation Report will be prepared. The CAS procedures will then be followed to develop appropriate response actions to protect human health and the environment if necessary.

Tables

June 25, 2003
Project No. 0014507

Environmental Resources Management
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TABLE 1-1

Summary of Section 2.4.2 of USEPA Region 6 CAS - CAS Work Plan

Whirlpool Corporation
Fort Smith, Arkansas

Cas Work Plan Guidance	Relevant Sections of Attached Documents		
	CAS Work Plan June 6, 2003	CSM August 2, 2002	Status Report
Include performance standards for each release area with supporting facility-specific information	Section 1.3		Section 3.0
List and describe releases and potential releases	Section 1.1	Section 2.2 and Section 5.0	Section 4.0
List data quality objectives needed for achieving performance standards, including data quality project plans and sampling and analysis plans	Section 1.2, Section 1.3, Section 2.2, Section 2.3		
Describe proposed or planned release characterization activities, including, but not limited to :			
evaluation of existing data and assessment of whether additional data are necessary	Section 1.1	Section 4.2, Section 4.3, Section 5.0, and Section 6.0	Section 3.0
procedures for additional investigation and data collection including process for identifying additional data gaps and data collection	Section 2.2 and Section 2.3		Section 4.0
implementation of interim measures or stabilization of releases, if warranted	None warranted		
revision of the conceptual site model to reflect the new or updated information	Section 3.0	Section 7.0	Section 5.0
Describe how the facility intends to proceed through the CAS	Section 3.0 and Section 4.0	Section 7.0	Section 5.0
Include schedule of all facility activities for conducing and completing the CAS	Section 4.0		Section 5.0

TABLE 2-1

Ground Water Analyte List

Whirlpool Corporation
Fort Smith, Arkansas

Parameter	Target Practical Quantitation Limit (mg/l)
Volatile Organics - Method SE-846 8260B 0.005	
Benzene	0.005
Bromodichloromethane	0.005
Bromoform	0.005
Bromomethane	0.005
Carbon Tetrachloride	0.005
Chlorobenzene, Water	0.01
Chloroethane	0.005
Chloroform	0.01
Dichloromethane	0.005
1,1-Dichloroethane	0.005
1,2-Dichloroethane	0.005
1,1-Dichloroethene	0.005
1,2-Dichloroethene	0.01
cis-1,2-Dichloroethene	0.005
trans-1,2-Dichloroethene	0.005
1,2-Dichloropropane	0.005
Ethylbenzene	0.005
Methylene Chloride	0.01
Styrene	0.005
1,1,2,2-Tetrachloroethane	0.005
Tetrachloroethane	0.005
Toluene	0.005
1,1,1-Trichloroethane	0.005
1,1,2-Trichloroethane	0.005
Trichloroethene	0.005
Vinyl Chloride	0.01
Xylenes (Total)	0.01
Acetone	0.02
Carbon Disulfide	0.005
Methyl Ethyl Ketone (2-Butanone)	0.01
cis-1,3-Dichloropropene	0.005
trans-1,3-Dichloropropene	0.005
2-Hexanone	0.01
4-Methyl-2-pentanone (MIBK)	0.01
Natural Attenuation Parameters	
Nitrate	NA
Sulfate	NA
Chloride	NA
Potassium	NA
Iron	NA

TABLE 3-1

Monitor Well Completion Details

Whirlpool Corporation
Fort Smith, Arkansas

Well ID	Site Coordinates EASTING	Site Coordinates NORTHING	Ground Surface (ft MSL)	TOC (ft MSL)	As-Built TD (ft bgs)	Screen Interval (ft bgs)
ITMW-1	8259.51	9007.54	474.6	476.93	30.5	16.5 - 30.25
ITMW-2	8058.55	9103.07	475.1	477.58	27.5	12.75 - 27.2
ITMW-3	8169.81	9165.86	472.8	474.72	26	10.65 - 25.45
ITMW-4	8170.16	8296.26	477.6	478.19	32.5	18.2 - 32.2
ITMW-5	7902.33	8278.92	476.6	478.93	30	19.9 - 29.65
ITMW-6	7858.85	8042.21	481.1	483.04	36.7	21.65 - 36.15
ITMW-7	7461.02	8370.89	479.7	481.95	36.75	21.9 - 36.9
ITMW-9	8179.81	8237.69	479.5	481.90	34.5	19.95 - 33.45
ITMW-10	7901.42	8230.16	478.6	480.84	34.15	22.65 - 33.60
ITMW-11	7846.97	9109.44	474.0	476.50	29.45	15.25 - 28.7
ITMW-12	7869.05	9077.56	474.7	476.67	30.5	15.0 - 30.0
ITMW-13	7915.02	9124.81	475.4	477.79	29.5	14.0 - 29.0
ITMW-14	7966.02	9131.80	475.7	477.30	30	14.8 - 29.5
ITMW-15	7812.25	9109.60	474.8	476.49	30	15.0 - 30.0
ITMW-16	7831.59	9168.78	476.5	478.79	32	17.0 - 32.0
ITMW-17	7732.61	9112.96	476.1	477.90	31	16.0 - 31.0
ITMW-18	7849.92	9023.55	473.9	473.55	29.5	15.0 - 30.0
ITMW-19	7763.78	9024.94	474.3	476.25	31	16.0 - 31.0
ITMW-20	7238.94	9074.08	475.7	477.87	29	14.0 - 29.0
ITMW-21	7506.54	8945.65	474.4	476.52	31	16.0 - 31.0
MW-22	8726.94	9038.96	473.9	473.93	29	14.0 - 29.0
MW-23	7747.16	9303.10	475.8	475.80	29	14.0 - 29.0
MW-24	7738.13	9198.53	476.6	476.39	33	18.0 - 33.0
MW-25	7614.43	9060.33	474.7	476.89	32	17.0 - 32.0
MW-26	7421.64	9273.87	476.1	478.05	33	18.5 -33.5
MW-27	7932.29	9302.59	475.7	475.42	30	15.5 - 30.0
MW-28	8180.18	9301.14	470.6	470.49	28	13.0 - 28.0
MW-29	7092.87	8392.87	475.1	474.91	31	16.0 - 31.0
MW-30	7485.76	8480.10	479.2	478.99	36	21.0 - 36.0
MW-31	7675.36	9348.43	476.1	476.03	27.6	17.5 - 27.5
MW-32	7760.17	9347.50	475.7	475.68	27	17.0 - 27.0
MW-33	7845.31	9348.62	474.9	474.88	25.8	15.8 - 25.5
MW-34	7760.24	9404.60	474.4	474.29	29.5	19.5 - 29.5
MW-35	7841.74	9406.36	474.0	473.90	27	17.0 - 27.0
MW-36	7927.38	9405.11	473.4	473.30	27	17.0 - 27.0
MW-37	7839.60	9101.64	474.0	473.57	30	15.0 - 30.0
MW-38	7840.94	9115.29	474.9	474.60	30	15.0 - 30.0
MW-39	7675.49	9482.46	475.6	475.46	29.5	19.5 - 29.5
MW-40	7828.52	9693.07	473.4	473.35	27.8	17.75 - 27.75
MW-41	7900.63	9544.63	472.3	472.09	28.7	18.75 - 28.75
MW-42B	8009.04	9708.57	471.8	471.72	27	22.0 - 27.0
MW-43	8045.73	9709.08	471.0	470.94	26.5	21.0 - 26.0
MW-46	8302.01	9709.18	466.5	466.35	22	17.0 - 22.0
MW-50	8207.29	10306.14	463.2	463.11	18	8.0 - 18.0

TABLE 4-1

Historic Analytical Data, Selected VOCs in Ground Water

Whirlpool Corporation
Fort Smith, Arkansas

Well	Date	Sampler	PCE	TCE	c-1,2-DCE	t-1,2-DCE	1,1-DCE	VC	Toluene	1,1,1-TCE
ITMW-1	Nov-89	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Jan-90	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Nov-93	MP	ND	0.01	NT	ND	ND	ND	ND	ND
	Dec-96	MP	ND	0.021	NT	ND	ND	ND	ND	ND
	Feb-99	ERM	ND	0.037	ND	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	0.125	0.008	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	0.031	0.007	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	0.03	0.006	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	0.027	0.009	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	0.026	0.006	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	ND	0.025	0.007	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	0.035	0.009	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	0.0296	0.00714	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	0.0250	0.012	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	0.0422	0.011	ND	ND	ND	ND	ND
ITMW-2	Oct-89	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Nov-89	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Jan-90	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Nov-90	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Nov-90 (dupl.)	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Mar-91	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Nov-93	MP	ND	0.004	NT	ND	ND	ND	ND	ND
	Dec-96	MP	ND	0.0034	NT	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	ND	0.006	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	ND	ND	ND	ND	ND	ND	ND
ITMW-3	Oct-89	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Jan-90	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Nov-93	MP	ND	0.003	NT	ND	ND	ND	ND	ND
	Dec-96	MP	ND	0.0017	NT	ND	ND	ND	ND	ND
	Feb-99	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Mar-00 (Dup)	ERM	ND	**ND ***	ND	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	0.015	ND	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	ND	ND	ND	ND	ND	ND	ND

NOTES:

Units used are **mg/L**. **ND** = not detected **NT** = not tested **NA** = not available
(L) = Sample collected using low-flow sampling methods.
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MP = Malcolm Pirnie, Inc.
PCE = perchloroethylene (tetrachloroethene) **TCE** = trichloroethylene
c-1,2-DCE = cis-1,2-dichloroethylene (not an analytical parameter until May 1997)
t-1,2-DCE = trans-1,2-dichloroethylene
1,1-DCE = 1,1-dichloroethylene **VC** = vinyl chloride
***** = Analysis was re-run due to QA/QC concerns. Data reported is for the second run.
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TABLE 4-1 (Cont'd)

Historic Analytical Data, Selected VOCs in Ground Water

Whirlpool Corporation
Fort Smith, Arkansas

Well	Date	Sampler	PCE	TCE	c-1,2-DCE	t-1,2-DCE	1,1-DCE	VC	Toluene	1,1,1-TCE
ITMW-4	Oct-89	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Nov-89	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Jan-90	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Nov-93	MP	ND	ND	NT	ND	ND	ND	ND	ND
	Dec-96	MP	ND	0.075	NT	ND	ND	ND	ND	ND
	Feb-99	ERM	ND	0.093	0.054	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	0.022	0.016	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	0.014	0.011	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	0.009	ND	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	0.006	0.008	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	0.034	0.005	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	0.009	ND	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	ND	ND	ND	ND	ND	ND	ND
ITMW-5	Oct-89	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Jan-90	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Dec-96	MP	ND	0.021	NT	ND	ND	ND	ND	ND
	Feb-99	ERM	ND	0.086	0.039	ND	0.007	ND	ND	ND
	Mar-00	ERM	ND	0.073	0.059	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	0.085	0.064	ND	0.006	ND	ND	ND
	Mar-01	ERM	ND	0.1	0.046	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	0.072	0.064	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	0.093	0.066	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	ND	0.081	0.063	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	0.108	0.072	ND	0.007	ND	ND	ND
	Feb-03	ERM	ND	0.0904	0.0687	ND	0.00598	ND	ND	ND
	Sep-03	ERM	ND	0.0973	0.0737	ND	0.0062	ND	ND	ND
	Apr-04	ERM	ND	0.0839	0.0554	ND	0.00589	ND	ND	ND
ITMW-6	Oct-89	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Jan-90	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Dec-96	MP	ND	0.0068	NT	ND	ND	ND	ND	ND
	May-97	MP	ND	0.007	ND	ND	ND	ND	ND	ND
	Feb-99	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-99	ERM (CoreLab)	ND	0.025	ND	NT	ND	ND	ND	ND
	Feb-99	ERM (CoreLab Dupl.)	ND	0.006	ND	NT	ND	ND	ND	ND
	Mar-00	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	ND	ND	ND	ND	ND	ND	ND
ITMW-7	Nov-89	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Jan-90	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Dec-96	MP	ND	0.29	NT	ND	ND	0.003	ND	ND
	May-97	MP	ND	0.38	0.18	ND	ND	ND	ND	ND
	Feb-99	ERM (SPL)	ND	ND	ND	ND	ND	ND	ND	ND
	Jun-99	ERM (SPL)	ND	0.32	0.14	ND	ND	ND	ND	ND
	Jun-99	ERM (SPL Dupl.)	ND	0.3	0.14	ND	ND	ND	ND	ND
	Jun-99	ERM (CoreLab)	ND	0.306	0.144	ND	ND	ND	ND	ND

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MP = Malcolm Pirnie, Inc.
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t-1,2-DCE = trans-1,2-dichloroethylene
1,1-DCE = 1,1-dichloroethylene **VC** = vinyl chloride
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TABLE 4-1 (Cont'd)

Historic Analytical Data, Selected VOCs in Ground Water

Whirlpool Corporation
Fort Smith, Arkansas

Well	Date	Sampler	PCE	TCE	c-1,2-DCE	t-1,2-DCE	1,1-DCE	VC	Toluene	1,1,1-TCE
ITMW-7	Mar-00	ERM	ND	0.262	0.1	ND	ND	ND	ND	ND
(Cont'd)	Mar-00 (dup)	ERM	ND	0.207	0.092	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	0.207	0.1	ND	ND	ND	ND	ND
	Sep-00 (dup)	ERM	ND	0.109	ND	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	0.161	0.066	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	0.139	0.068	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	0.261	0.107	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	ND	0.119	0.070	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	0.137	0.056	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	0.172	0.0925	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	0.125	0.0573	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	0.201	0.0807	ND	ND	ND	ND	ND
ITMW-8	Jan-90	IT	ND	ND	NT	ND	ND	ND	ND	ND
ITMW-9	Jan-90	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Dec-96	MP	ND	0.23	NT	ND	0.015	ND	ND	ND
	May-97	MP	ND	0.007	ND	ND	ND	ND	ND	ND
	Feb-99	ERM	ND	0.04	0.024	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	0.069	0.045	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	0.057	0.014	ND	ND	ND	ND	ND
	Sep-00 (dup)	ERM	ND	0.055	0.014	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	0.04	0.012	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	0.04	0.012	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	0.046	0.023	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	0.061	0.021	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	0.0542	0.0372	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	0.091	0.0495	ND	ND	ND	ND	ND
	Sep-03(Dup-1)	ERM	ND	0.0976	0.0539	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	0.072	0.0388	ND	ND	ND	ND	ND
ITMW-10	Jan-90	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Dec-96	MP	ND	0.004	NT	ND	0.002	ND	ND	ND
	Feb-99	ERM	ND	0.025	0.013	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	0.023	0.017	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	0.018	0.016	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	0.04	0.021	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	0.029	0.028	ND	ND	ND	ND	ND
	Sep-01 (dup)	ERM	ND	0.027	0.03	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	0.056	0.048	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	ND	0.044	0.038	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	0.055	0.038	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	0.0576	0.0509	ND	ND	ND	0.0116	ND
	Jul-03	ERM	ND	0.0553	0.0492	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	0.0659	0.0565	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	0.0800	0.0574	ND	0.00532	ND	0.00978	ND
ITMW-11	Jan-90	IT	0.015	19	NT	3.6	ND	0.18	ND	ND
	Nov-90	IT	ND	4.7	NT	1.5	0.009	0.093	ND	ND
	Feb-91	IT	0.0089	3.4	NT	1	ND	ND	ND	ND
	Nov-93	MP	0.001	2.3	NT	ND	ND	0.043	ND	ND
	Dec-96	MP	ND	0.51	NT	0.011	ND	ND	ND	ND
	Feb-99	ERM	ND	0.65	0.01	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	3.37	0.206	ND	ND	ND	ND	ND
	Sep-00	ERM	0.006	8	0.330	ND	ND	0.01	ND	ND
	Mar-01	ERM	ND	7	0.200	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	6	0.183	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	6.8	ND	ND	0.010	ND	ND	ND
	Feb-02	ERM (L)	ND	2.48	0.123	ND	ND	ND	ND	ND

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1,1-DCE = 1,1-dichloroethylene **VC** = vinyl chloride
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TABLE 4-1 (Cont'd)

Historic Analytical Data, Selected VOCs in Ground Water

Whirlpool Corporation
Fort Smith, Arkansas

Well	Date	Sampler	PCE	TCE	c-1,2-DCE	t-1,2-DCE	1,1-DCE	VC	Toluene	1,1,1-TCE
ITMW-11	Sep-02	ERM (L)	ND	7.1	0.206	ND	ND	0.01	ND	ND
(Cont'd)	Sep-02	ERM (T)	ND	0.8	0.072	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	4.110	0.346	ND	ND	0.0588	ND	ND
	Feb-03 (dup 1)	ERM	ND	3.630	0.306	ND	ND	0.0607	ND	ND
	Sep-03	ERM	ND	3.990	0.269	ND	ND	0.0118	ND	ND
	Apr-04	ERM	ND	3.160	0.24	ND	ND	0.0378	ND	ND
ITMW-12	Nov-90	IT	ND	2.4	NT	1.3	0.0099	0.14	ND	ND
	Feb-91	IT	ND	2.1	NT	1	ND	ND	ND	ND
	Nov-93	MP	ND	2.5	NT	0.002	0.004	0.035	ND	ND
	Dec-96	MP	ND	1.2	NT	ND	ND	ND	ND	ND
	Feb-99	ERM	ND	3.1	0.48	ND	ND	0.034	ND	ND
	Mar-00	ERM	ND	3.11	0.32	ND	ND	0.019	ND	ND
	Sep-00	ERM	ND	3.3	0.18	ND	ND	0.01	ND	ND
	Mar-01	ERM	ND	3.9	0.2	ND	ND	0.02	ND	ND
	Sep-01	ERM	ND	3.1	0.159	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	1.76	0.138	ND	0.007	0.023	ND	ND
	Feb-02	ERM (L)	ND	3.6	ND	ND	0.008	0.019	ND	ND
	Sep-02	ERM	ND	4.2	0.3	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	3.460	0.287	ND	ND	ND	ND	ND
	Feb-03 (dup 2)	ERM	ND	3.940	0.308	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	2.920	0.242	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	2.410	0.245	ND	ND	ND	ND	ND
ITMW-13	Nov-90	IT	ND	0.034	NT	0.19	ND	0.018	ND	ND
	Feb-91	IT	ND	0.032	NT	0.17	ND	0.035	ND	ND
	Nov-93	MP	ND	NA	NT	NA	NA	0.029	ND	ND
	Dec-96	MP	ND	0.036	NT	0.0013	0.0016	0.036	ND	ND
	Feb-99	ERM	ND	0.036	0.14	ND	ND	0.048	ND	ND
	Mar-00	ERM	ND	0.037	0.121	ND	ND	0.053	ND	ND
	Sep-00	ERM	ND	0.022	0.112	ND	ND	0.05	ND	ND
	Mar-01	ERM	ND	0.044	0.092	ND	ND	0.04	ND	ND
	Sep-01	ERM	ND	0.035	0.111	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	0.129	0.195	ND	ND	0.035	ND	ND
	Feb-02	ERM (L)	ND	0.048	0.080	ND	ND	ND	ND	ND
	Sep-02	ERM (L)	ND	0.099	0.110	ND	ND	0.010	ND	ND
	Sep-02	ERM (T)	ND	0.081	0.086	ND	ND	0.020	ND	ND
	Feb-03	ERM	ND	0.070	0.0855	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	0.159	0.1300	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	0.048	0.0872	ND	ND	ND	ND	ND
ITMW-14	Nov-90	IT	ND	ND	NT	0.03	ND	0.013	ND	ND
	Feb-91	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Nov-93	MP	ND	0.006	NT	ND	ND	ND	ND	ND
	Dec-96	MP	ND	ND	NT	ND	ND	ND	ND	ND
	Feb-99	ERM	ND	ND	0.029	ND	ND	0.02	ND	ND
	Mar-00	ERM	ND	ND	0.024	ND	ND	0.012	ND	ND
	Sep-00	ERM	ND	ND	0.014	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	ND	0.024	ND	ND	0.01	ND	ND
	Sep-01	ERM	ND	ND	0.005	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	ND	0.023	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	0.041	0.006	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-03	ERM	0.00565	ND	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	0.00768	ND	ND	ND	ND	ND	ND	ND
ITMW-15	Nov-90	IT	ND	2.5	NT	1.5	0.0081	0.055	ND	ND
	Feb-91	IT	ND	1.7	NT	0.87	ND	ND	ND	ND
	15-Apr-91	IT	ND	2	NT	0.6	ND	ND	ND	ND
	19-Apr-91	IT	ND	2.1	NT	1	ND	ND	ND	ND
	20-Apr-91	IT	ND	2.4	NT	1.1	ND	ND	ND	ND

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TABLE 4-1 (Cont'd)

Historic Analytical Data, Selected VOCs in Ground Water

Whirlpool Corporation
Fort Smith, Arkansas

Well	Date	Sampler	PCE	TCE	c-1,2-DCE	t-1,2-DCE	1,1-DCE	VC	Toluene	1,1,1-TCE
ITMW-15	Nov-93	MP	ND	4.3	NT	0.001	ND	0.01	ND	ND
(Cont.)	Dec-96	MP	ND	0.24	NT	ND	ND	ND	ND	ND
	Feb-99	ERM	ND	0.4	0.12	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	0.339	0.097	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	0.36	0.093	ND	ND	ND	ND	ND
	Sep-00 (dup)	ERM	ND	0.38	0.091	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	0.29	0.057	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	0.38	0.087	ND	ND	ND	ND	ND
	Sep-01 (dup)	ERM	ND	0.37	0.08	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	0.186	0.064	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	ND	0.311	0.108	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	0.32	0.075	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	0.301	0.0987	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	0.490	0.0919	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	0.334	0.126	ND	ND	ND	ND	ND
ITMW-16	Feb-91	IT	ND	0.031	NT	0.06	ND	ND	ND	ND
	Nov-93	MP	ND	0.041	NT	ND	ND	0.007	ND	ND
	Dec-96	MP	ND	ND	NT	ND	ND	ND	ND	ND
	Feb-99	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	0.007	ND	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	ND	ND	ND	ND	ND	ND	ND
ITMW-17	Feb-91	IT	ND	21	NT	ND	ND	ND	ND	ND
	15-Apr-91	IT	ND	18	NT	0.76	ND	ND	ND	ND
	24-Apr-91	IT	ND	21	NT	0.58	ND	ND	ND	ND
	Nov-93	MP	0.004	18	NT	0.003	ND	0.015	ND	ND
	Dec-96	MP	ND	9.3	NT	ND	ND	ND	ND	ND
	Feb-99	ERM	ND	11	0.24	ND	0.013	ND	ND	ND
	Mar-00	ERM	ND	6.78	0.171	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	5.5	0.18	ND	0.009	ND	ND	ND
	Jan-01	ERM	ND	8.3	0.179	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	6.7	0.134	ND	0.007	ND	ND	ND
	Sep-01	ERM	ND	6.3	0.158	ND	0.007	ND	ND	ND
	Feb-02	ERM (T)	ND	6.07	0.149	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	ND	6.29	0.174	ND	0.011	ND	ND	ND
	Sep-02	ERM	ND	6.5	0.153	ND	0.008	ND	ND	ND
	Feb-03	ERM	ND	4.380	0.134	ND	0.00646	ND	ND	ND
	Sep-03	ERM	ND	6.090	0.136	ND	0.00719	ND	ND	ND
	Apr-04	ERM	ND	5.050	0.184	ND	0.01020	ND	ND	ND
ITMW-18	Feb-91	IT	ND	3.7	NT	0.33	ND	ND	ND	ND
	Nov-93	MP	ND	4.5	NT	ND	0.009	0.006	ND	ND
	Dec-96	MP	ND	1.6	NT	ND	ND	ND	ND	ND
	Feb-99	ERM	ND	6.3	0.48	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	3.56	0.401	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	4.1	0.4	ND	0.007	ND	ND	ND
	Mar-01	ERM	ND	4	0.4	ND	0.006	ND	ND	ND
	Sep-01	ERM	ND	4.1	0.3	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	5.26	0.426	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	6.7	0.3	0.007	0.008	ND	ND	ND
	Feb-03	ERM (T)	ND	5.11	0.29	ND	0.00870	ND	ND	ND
	Sep-03	ERM	ND	7.700	0.415	ND	0.0102	ND	ND	ND
	Apr-04	ERM	ND	7.740	0.41	ND	0.0158	ND	ND	ND

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TABLE 4-1 (Cont'd)

Historic Analytical Data, Selected VOCs in Ground Water

Whirlpool Corporation
Fort Smith, Arkansas

Well	Date	Sampler	PCE	TCE	c-1,2-DCE	t-1,2-DCE	1,1-DCE	VC	Toluene	1,1,1-TCE
ITMW-19	Feb-91	IT	ND	9.9	NT	ND	ND	ND	ND	ND
	Nov-93	MP	0.005	27	NT	ND	NA	0.007	ND	ND
	Dec-96	MP	ND	25	NT	ND	ND	ND	ND	ND
	Feb-99	ERM	0.008	33	0.15	ND	0.04	ND	ND	ND
	Mar-00	ERM	0.007	33.1	0.128	ND	0.029	ND	ND	ND
	Sep-00	ERM	0.01	36	0.197	ND	0.056	ND	ND	ND
	Jan-01	ERM	0.01	34	0.166	ND	0.04	ND	ND	ND
	Mar-01	ERM	0.01	38	0.119	ND	0.037	ND	ND	ND
	Sep-01	ERM	ND	19	0.132	ND	0.034	ND	ND	ND
	Feb-02	ERM (T)	0.00621	26.1	ND	0.006	0.047	ND	ND	ND
	Feb-02	ERM (L)	0.00512	24.6	0.192	ND	0.065	ND	ND	ND
	Sep-02	ERM	ND	27	0.167	ND	0.038	ND	ND	ND
	Feb-03	ERM	ND	16.200	0.126	ND	0.0270	ND	ND	ND
	Sep-03	ERM	ND	27.300	0.186	ND	0.0417	ND	ND	ND
	Apr-04	ERM	ND	19.400	0.186	ND	0.0387	ND	ND	ND
ITMW-20	Mar-91	IT	ND	ND	NT	ND	ND	ND	ND	ND
	Nov-93	MP	ND	ND	NT	ND	ND	ND	ND	ND
	Dec-96	MP	ND	0.29	NT	ND	ND	ND	ND	ND
	May-97	MP	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-99	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	0.021	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	ND	ND	ND	ND	ND	ND	ND
ITMW-21	Mar-91	IT	ND	0.021	NT	ND	ND	ND	ND	ND
	Nov-93	MP	ND	0.037	NT	ND	ND	ND	ND	ND
	Dec-96	MP	ND	0.15	NT	ND	ND	ND	ND	ND
	Feb-99	ERM	ND	0.19	ND	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	0.196	ND	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	0.192	ND	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	0.123	ND	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	0.116	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	0.152	ND	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	0.013	ND	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	0.0395	ND	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	0.00909	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	0.0529	ND	ND	ND	ND	ND	ND
MW-22	Dec-96	MP	ND	ND	NT	ND	ND	ND	ND	ND
	May-97	MP	ND	ND	0.005	ND	ND	ND	ND	ND
	Feb-99	ERM	ND	ND	0.005	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	0.009	ND	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-03(Dup-2)	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	ND	ND	ND	ND	ND	ND	ND

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TABLE 4-1 (Cont'd)

Historic Analytical Data, Selected VOCs in Ground Water

Whirlpool Corporation
Fort Smith, Arkansas

Well	Date	Sampler	PCE	TCE	c-1,2-DCE	t-1,2-DCE	1,1-DCE	VC	Toluene	1,1,1-TCE
MW-23	Dec-96	MP	ND	0.21	NT	ND	ND	ND	ND	ND
	May-97	MP	ND	2.4	NT	ND	ND	ND	ND	ND
	Feb-99	ERM	ND	0.35	0.01	ND	ND	ND	ND	ND
	Feb-99 (dup)	ERM	ND	0.44	0.01	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	0.147	ND	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	0.067	ND	ND	ND	ND	ND	ND
	Jan-01	ERM	ND	0.137	ND	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	0.087	ND	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	0.023	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	0.063	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	ND	0.098	ND	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	0.111	ND	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	0.054	ND	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	0.0839	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	0.0703	ND	ND	ND	ND	ND	ND
MW-24	Feb-99	ERM	ND	1.4	0.049	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	**0.403***	**0.025***	ND	ND	ND	ND	ND
	Mar-00 (dup)	ERM	ND	**0.595***	**0.024***	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	0.128	0.011	ND	ND	ND	ND	ND
	Jan-01	ERM	ND	0.25	0.012	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	0.33	0.011	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	0.124	0.006	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	0.204	0.006	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	0.199	0.006	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	0.253	0.007	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	0.155	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	0.181	0.00512	ND	ND	ND	ND	ND
MW-25	Feb-99	ERM	0.011	29	0.17	ND	0.069	0.1	ND	ND
	Feb-99 (dupl.)	ERM	0.012	27	0.18	ND	0.074	0.11	ND	ND
	Feb-99	ERM (CoreLab)	0.009	24.8	0.149	ND	0.057	0.074	ND	ND
	Dec-99	ERM (ERM)	ND	94.5	ND	ND	ND	ND	ND	ND
	Mar-00	ERM	0.011	35.9	0.245	ND	0.066	0.063	ND	ND
	Sep-00	ERM	0.014	59	0.3	ND	0.092	0.05	ND	ND
	Mar-01	ERM	0.012	34	0.117	ND	0.047	0.06	ND	ND
	Sep-01	ERM	0.011	60	0.3	ND	0.101	ND	ND	ND
	Feb-02	ERM (T)	ND	24.3	0.326	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	0.007	29.9	0.369	ND	0.052	0.052	ND	ND
	Sep-02	ERM (L)	0.036	157.0	0.44	ND	0.33	0.18	ND	ND
	Sep-02	ERM (T)	0.013	56.00	0.37	ND	0.119	0.200	ND	ND
	Feb-03	ERM	0.0107	45.90	0.557	0.00566	0.117	0.0757	ND	0.0199
	Jul-03	ERM	0.0144	62.20	0.621	ND	0.13	0.243	ND	0.0239
	Sep-03	ERM	0.0223	103.000	0.775	ND	ND	ND	ND	0.0347
	Apr-04	ERM	0.0093	25.600	0.255	ND	0.0827	0.0318	ND	0.0122
MW-26	Feb-99	ERM (SPL)	ND	0.36	0.15	ND	ND	ND	ND	ND
	Jun-99	ERM (SPL)	ND	ND	ND	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-01 (dup)	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	ND	ND	ND	ND	ND	ND	ND

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Whirlpool Corporation
Fort Smith, Arkansas

Well	Date	Sampler	PCE	TCE	c-1,2-DCE	t-1,2-DCE	1,1-DCE	VC	Toluene	1,1,1-TCE
MW-27	Dec-99	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Jan-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-03	ERM (T)	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	ND	ND	ND	ND	ND	ND	ND
MW-28	Dec-99	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	ND	ND	ND	ND	ND	ND	ND
MW-29	Dec-99	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	ND	ND	ND	ND	ND	ND	ND
MW-30	Dec-99	ERM	ND	0.115	0.034	ND	ND	ND	ND	ND
	Mar-00	ERM	ND	0.086	0.025	ND	ND	ND	ND	ND
	Sep-00	ERM	ND	0.102	0.025	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	0.043	0.011	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	0.063	0.018	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	0.067	0.021	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	0.048	0.014	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	0.0600	0.0203	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	0.0468	0.0137	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	0.0366	0.0118	ND	ND	ND	0.00828	ND
MW-31	Jan-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	ND	ND	ND	ND	ND	ND	ND

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Whirlpool Corporation
Fort Smith, Arkansas

Well	Date	Sampler	PCE	TCE	c-1,2-DCE	t-1,2-DCE	1,1-DCE	VC	Toluene	1,1,1-TCE
MW-32	Jan-01	ERM	ND	0.108	ND	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	0.174	ND	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	0.095	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	ND	0.0536	ND	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	0.109	ND	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	0.133	ND	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	0.0323	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	0.0769	ND	ND	ND	ND	ND	ND
MW-33	Jan-01	ERM	ND	0.12	0.034	ND	ND	ND	ND	ND
	Mar-01	ERM	ND	0.26	0.007	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	0.31	0.008	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	ND	0.115	ND	ND	ND	ND	ND	ND
	Sep-02	ERM	ND	0.45	0.008	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	0.274	0.00662	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	0.198	0.00595	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	0.871	0.0213	ND	ND	ND	ND	ND
MW-34	Mar-01	ERM	ND	0.083	ND	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	0.061	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	ND	0.0214	ND	ND	ND	ND	ND	ND
	Sep-02	ERM (L)	ND	0.084	ND	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	0.0284	ND	ND	ND	ND	ND	ND
	Nov-03	ERM	ND	0.121	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	0.119	ND	ND	ND	ND	ND	ND
MW-35	Mar-01	ERM	ND	0.91	0.034	ND	ND	ND	ND	ND
	May-01	ERM	ND	0.86	0.036	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	1.03	0.04	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	ND	0.325	0.0133	ND	ND	ND	ND	ND
	Sep-02	ERM (L)	ND	0.9	0.031	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	0.246	0.0151	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	0.297	0.0198	ND	ND	ND	ND	ND
	Nov-03	ERM	ND	0.99	0.0349	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	1.15	0.0458	ND	ND	ND	ND	ND
MW-36	Mar-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-01	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-02	ERM (L)	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Sep-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Nov-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	ND	ND	ND	ND	ND	ND	ND
MW-37	Sep-01	ERM	ND	5	0.34	ND	ND	ND	ND	ND
	Feb-02	ERM (T)	ND	ND	ND	ND	ND	ND	ND	ND
	Feb-02	ERM (L)	ND	0.773	3.25	0.025	0.01	ND	ND	ND
	Sep-02	ERM	ND	1.4	10	ND	ND	0.3	ND	ND
	Feb-03	ERM	ND	4.050	5.660	0.0280	0.0197	2.500	0.0510	ND
	Jul-03	ERM	ND	2.560	1.710	0.0052	0.00635	0.316	0.0107	ND
	Sep-03	ERM	ND	3.700	7.020	0.00739	0.0155	0.973	0.0164	ND
	Apr-04	ERM	ND	5.190	3.160	0.01130	0.0151	1.180	0.0504	ND
MW-38 (a)	Sep-01	ERM	ND	0.62	0.09	ND	ND	ND	ND	ND

(a) MW-38 was used as an injection well for the pilot study and has not been sampled using low-flow techniques.

NOTES:

Units used are **mg/L**. **ND** = not detected **NT** = not tested **NA** = not available
(L) = Sample collected using low-flow sampling methods.
(T) = Sample collected using traditional purge and sample methods.
IT = International Technology Corporation, Inc.
ERM = Environmental Resources Management
MP = Malcolm Pirnie, Inc.
PCE = perchloroethylene (tetrachloroethene) **TCE** = trichloroethylene
c-1,2-DCE = cis-1,2-dichloroethylene (not an analytical parameter until May 1997)
t-1,2-DCE = trans-1,2-dichloroethylene
1,1-DCE = 1,1-dichloroethylene **VC** = vinyl chloride
***** = Analysis was re-run due to QA/QC concerns. Data reported is for the second run.
SPL was used as the subcontract laboratory from 1996 to June 1999. ChemLab was used for earlier MP sampling events. The current laboratory is STL in Houston, Texas.
Pre-1999 data reproduced from "Remedial Investigation, North Side Ground Water, Whirlpool Corporation", Malcolm Pirnie, Inc., January 1997, (revised entry for MW-11, Jan-90) and SPL Certificates of Analysis, May 1997, supplied by Whirlpool Corporation.

TABLE 4-1 (Cont'd)

Historic Analytical Data, Selected VOCs in Ground Water

Whirlpool Corporation
Fort Smith, Arkansas

Well	Date	Sampler	PCE	TCE	c-1,2-DCE	t-1,2-DCE	1,1-DCE	VC	Toluene	1,1,1-TCE
MW-39	Sep-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Nov-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	ND	ND	ND	ND	ND	ND	ND
MW-40	Sep-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Nov-03	ERM	ND	ND	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	ND	ND	ND	ND	ND	ND	ND
MW-41	Sep-03	ERM	ND	0.722	0.0378	ND	ND	ND	ND	ND
	Nov-03	ERM	ND	0.331	0.205	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	0.760	0.0542	ND	ND	ND	ND	ND
MW-42	Nov-03	ERM	ND	0.481	0.0211	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	0.856	0.0293	ND	ND	ND	ND	ND
MW-43	Nov-03	ERM	ND	0.223	0.0185	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	0.51	0.0121	ND	ND	ND	ND	ND
MW-46	Nov-03	ERM	ND	0.0399	ND	ND	ND	ND	ND	ND
	Apr-04	ERM	ND	0.0771	0.0272	ND	ND	ND	ND	ND
MW-50	Apr-04	ERM	ND	0.00651	ND	ND	ND	ND	ND	ND

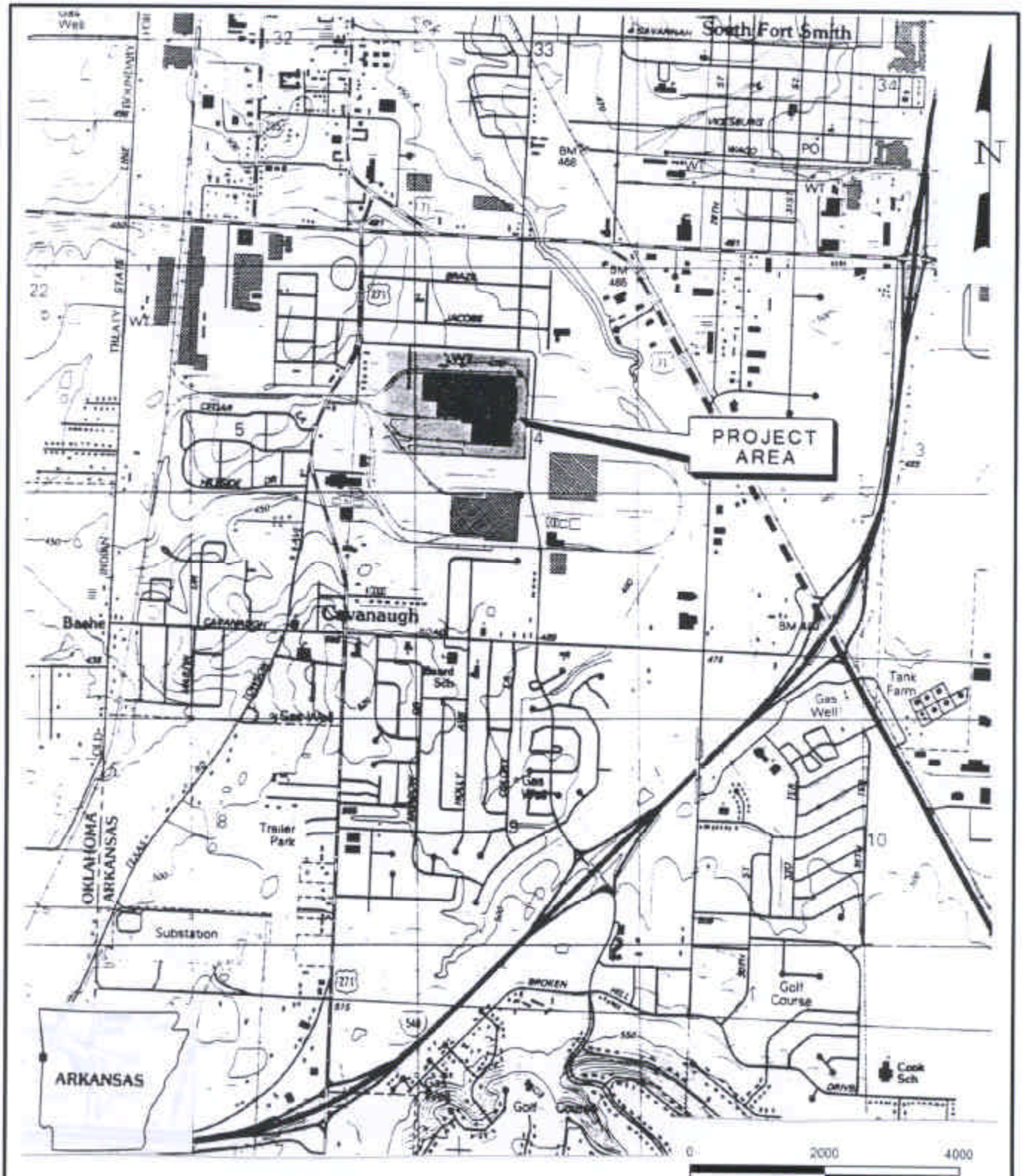
NOTES:

Units used are **mg/L**. **ND** = not detected **NT** = not tested **NA** = not available
(L) = Sample collected using low-flow sampling methods.
(T) = Sample collected using traditional purge and sample methods.
IT = International Technology Corporation, Inc.
ERM = Environmental Resources Management
MP = Malcolm Pirnie, Inc.
PCE = perchloroethylene (tetrachloroethene) **TCE** = trichloroethylene
c-1,2-DCE = cis-1,2-dichloroethylene (not an analytical parameter until May 1997)
t-1,2-DCE = trans-1,2-dichloroethylene
1,1-DCE = 1,1-dichloroethylene **VC** = vinyl chloride
***** = Analysis was re-run due to QA/QC concerns. Data reported is for the second run.
SPL was used as the subcontract laboratory from 1996 to June 1999. ChemLab was used for earlier MP sampling events. The current laboratory is STL in Houston, Texas.
Pre-1999 data reproduced from "Remedial Investigation, North Side Ground Water, Whirlpool Corporation", Malcolm Pirnie, Inc., January 1997, (revised entry for MW-11, Jan-90) and SPL Certificates of Analysis, May 1997, supplied by Whirlpool Corporation.

Figures

June 25, 2004
Project No. 0014507

Environmental Resources Management
15810 Park Ten Place, Suite 300
Houston, Texas 77084-5140
(281) 600-1000



SOURCE: U.S.G.S. 7.5' QUADRANGLE, SOUTH FORT SMITH, ARK.-OKLA., 1987.

ERM-Southwest, Inc.

HOUSTON · NEW ORLEANS · AUSTIN · DALLAS · BEAUMONT · BATON ROUGE

FIGURE 1-1
SITE LOCATION MAP
Whirlpool Corporation
Fort Smith, Arkansas

DESIGN:	CHKD.: SK	DATE: 10/23/00	REV.:
DRAWN: EFC	SCALE: AS SHOWN	W.O.NO.: 581002A001.J00	

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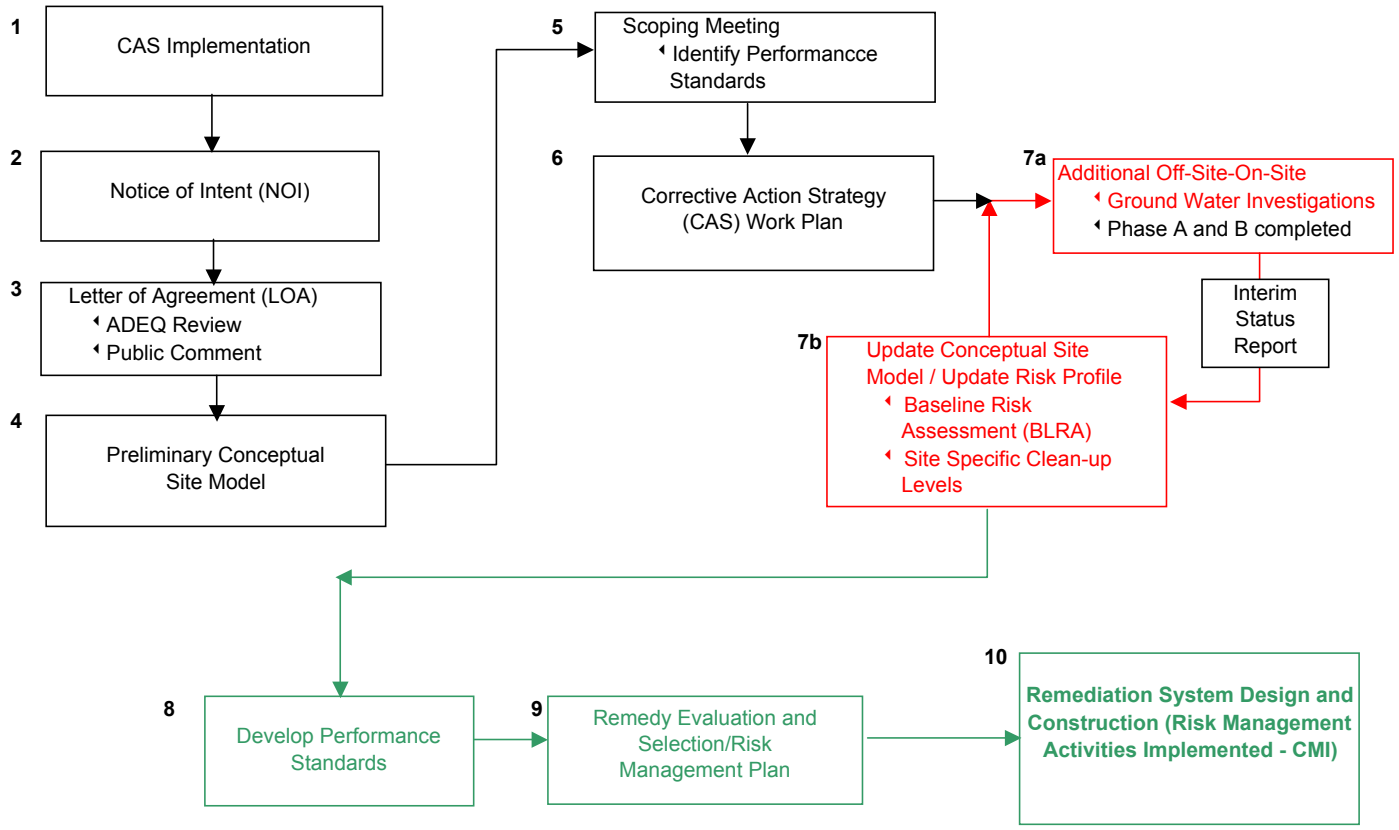
ERM

CAS Implementation for Off-Site Area of Concern



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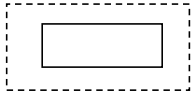
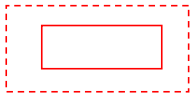


Completed Phases/Tasks



In Process Phases/Tasks

Pending Phases/Tasks

ERM-Southwest, Inc.

HOUSTON-NEW ORLEANS-AUSTIN-DALLAS-BEAUMONT-BATON ROUGE

FIGURE 1-2
CAS IMPLEMENTATION FOR OFF-SITE AREA OF CONCERN
Whirlpool Corporation
Fort Smith, Arkansas

DESIGN: TWM	CHKD:	DATE: 10/31/03	REV:
DRAWN: TWM	SCALE: AS SHOWN	W.O.NO: 0014507	

ERM

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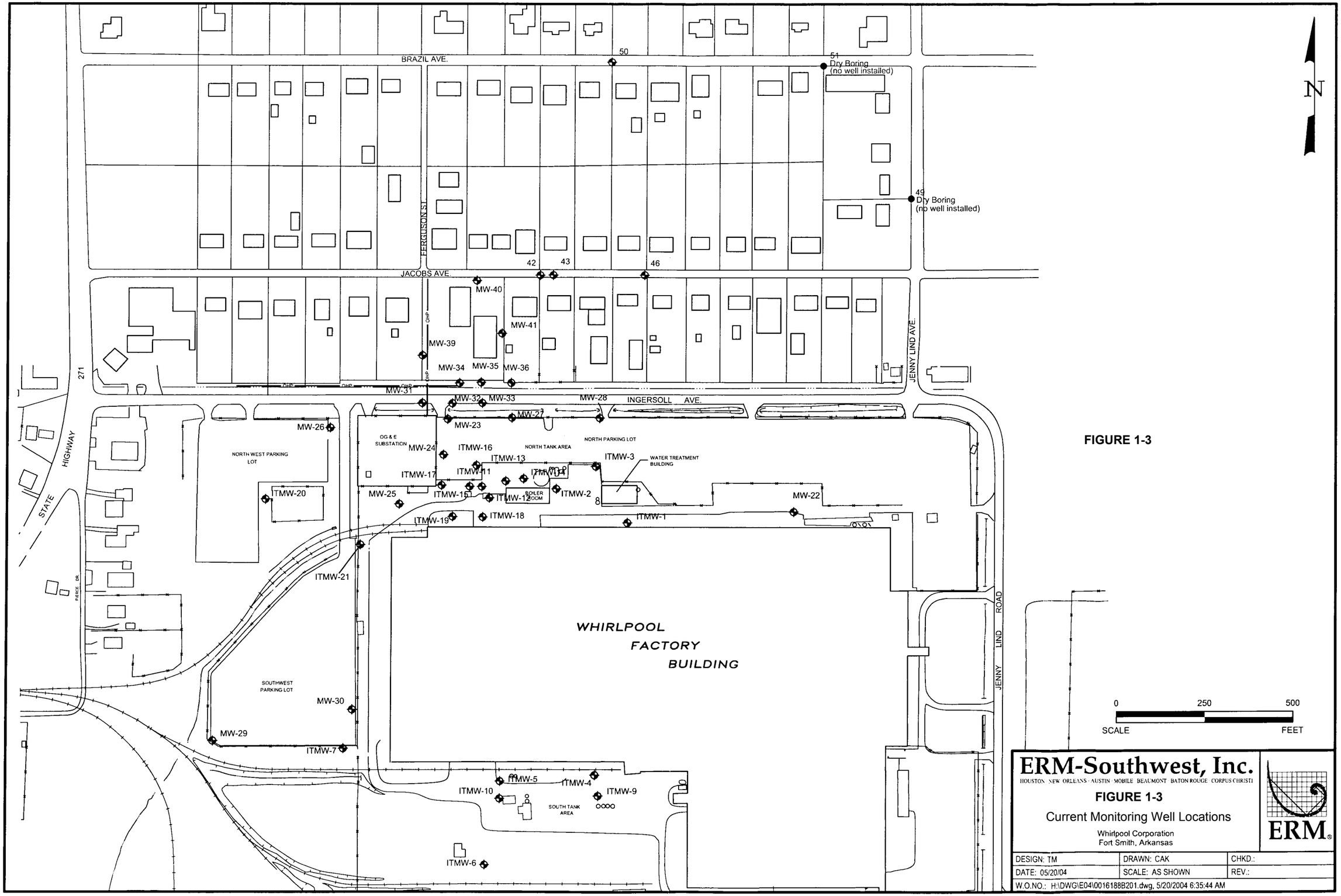

FIGURE 1-3

ERM-Southwest, Inc.

HOUSTON · NEW ORLEANS · AUSTIN · MOBILE · BEAUMONT · BATON ROUGE · CORPUS CHRISTI

FIGURE 1-3

Current Monitoring Well Locations

Whirlpool Corporation
Fort Smith, Arkansas

DESIGN: TM	DRAWN: CAK	CHKD.:
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W.O.NO.: H:\DWG\E04\0016188B201.dwg, 5/20/2004 6:35:44 AM		

ERM

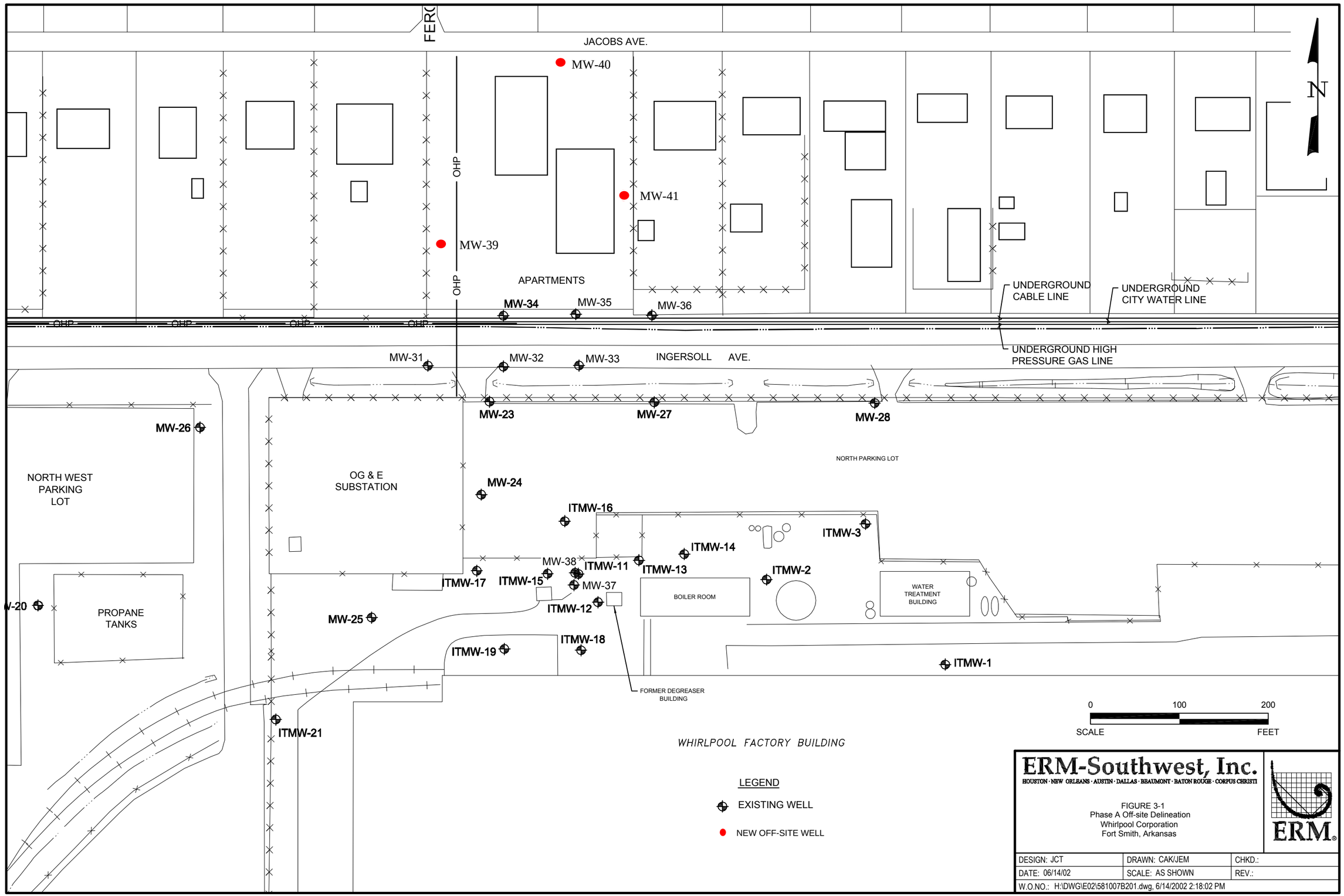

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FIGURE 3-1
Phase A Off-site Delineation
Whirlpool Corporation
Fort Smith, Arkansas

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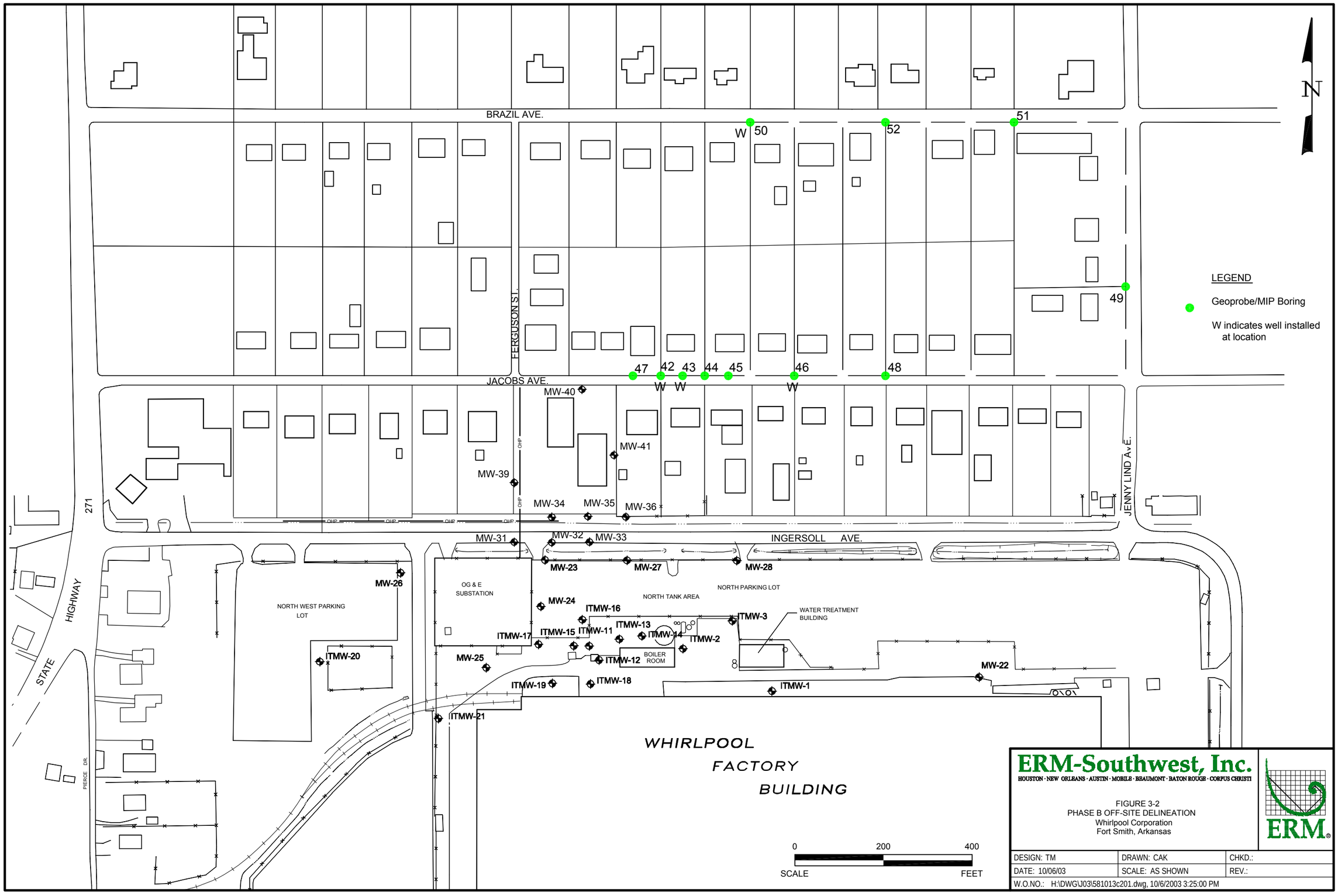

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FIGURE 3-2
PHASE B OFF-SITE DELINEATION
Whirlpool Corporation
Fort Smith, Arkansas

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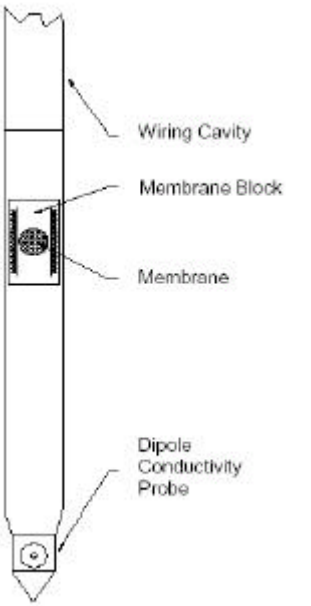
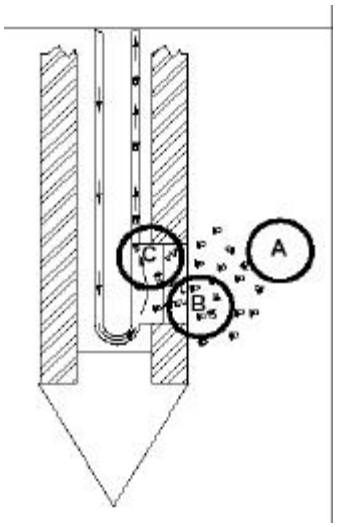
ERM

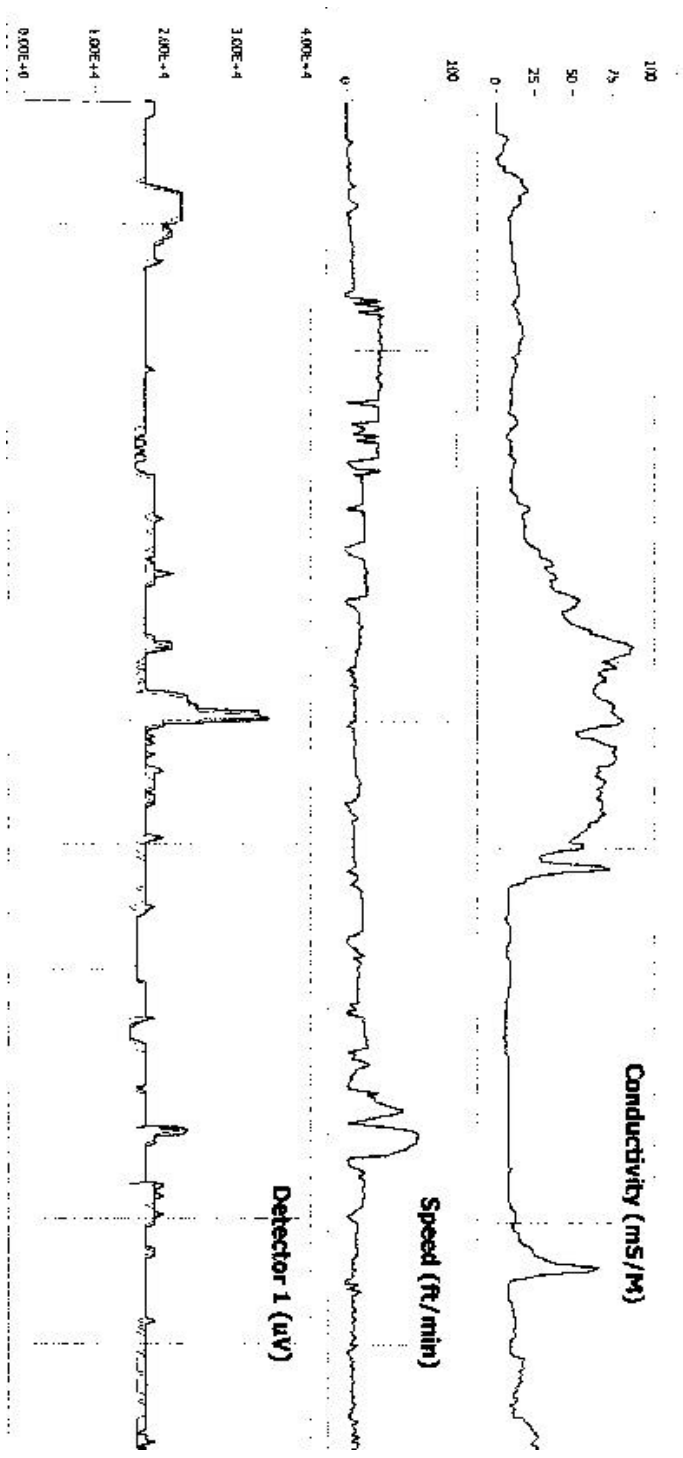
TYPICAL MIP LOG





A Subsurface Soil with VOCs
B Semi-Permeable Membrane
C Carrier Gas

Schematic Drawings of MIP Probe



Schematic drawings of MIP from the following web site:
http://www.geoprobe.com/literature/tech_papers/MIPpaperTMC.pdf

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FIGURE 3-3
SCHEMATIC DRAWINGS OF MIP AND TYPICAL LOG
Whirlpool Corporation
Fort Smith, Arkansas

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DRAWN: TWM	SCALE: AS SHOWN		W.O.NO: 0014507	

ERM

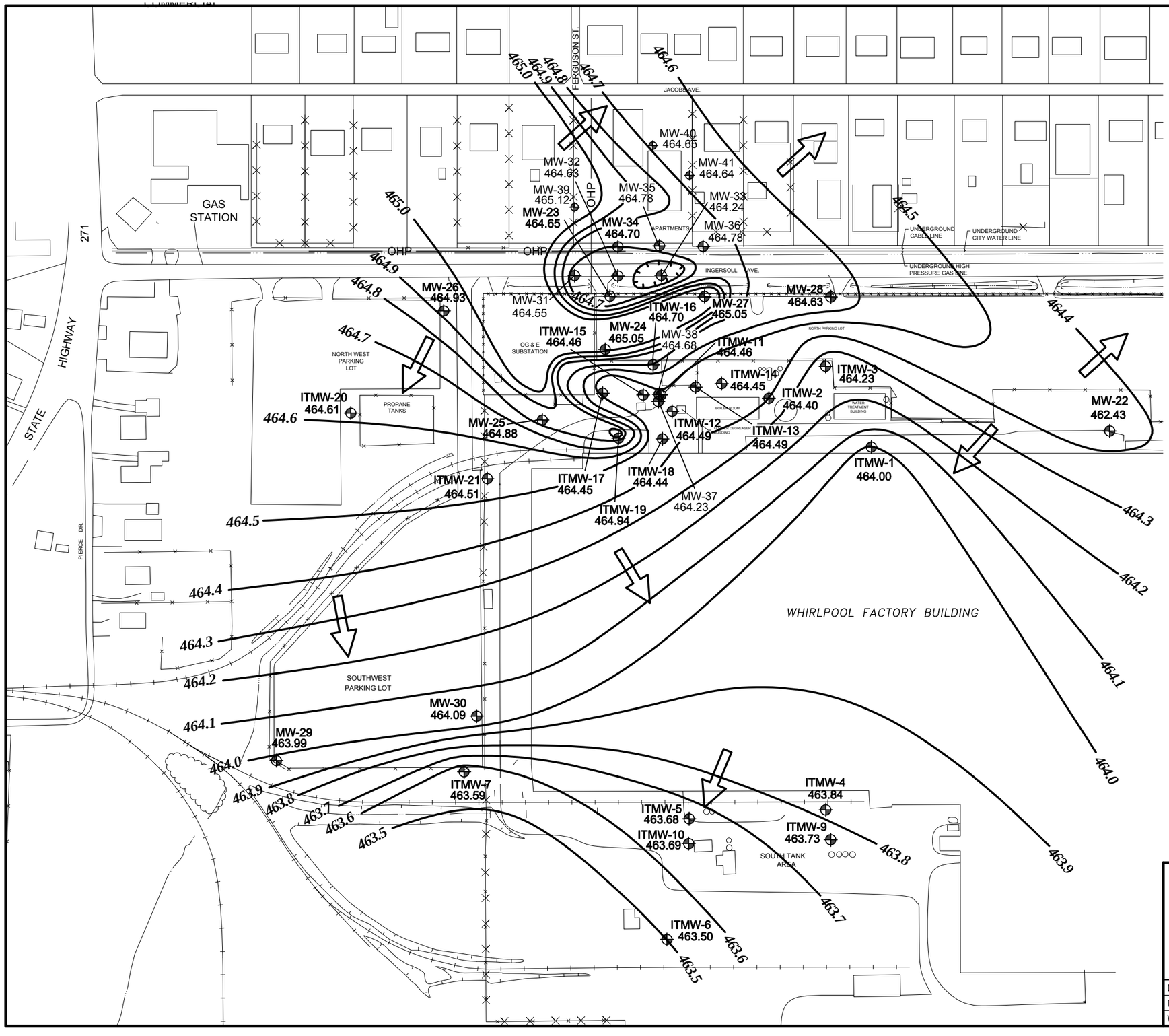

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FIGURE 4-1
FALL POTENTIOMETRIC SURFACE MAP
SEPTEMBER 2003
Whirlpool Corporation
Fort Smith, Arkansas

ERM

DESIGN: KWS	DRAWN: CAK	CHKD.:
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BRAZIL AVE.

JACOBS AVE.

INGERSOLL AVE

JENNY LIND AVE.

JENNY LIND ROAD

FERGUSON ST.

HIGHWAY 271

STATE

PERCE DR

50
456.88

51
Dry Boring
(no well installed)

49
Dry Boring
(no well installed)

42
463.25

43
464.64

46
460.20

MW-40
464.41

MW-41
464.44

MW-35
464.67

MW-39
464.46

MW-34
464.48

MW-36
464.50

MW-33
464.38

MW-31
464.46

MW-23
464.44

MW-32
464.34

MW-27
464.46

MW-28
464.40

MW-26
465.05

MW-24
464.46

MW-25
464.52

ITMW-16
464.46

ITMW-14
464.06

ITMW-17
464.24

ITMW-13
464.14

ITMW-2
463.84

ITMW-3
463.43

ITMW-15
464.24

ITMW-11
464.19

ITMW-20
464.90

ITMW-19
464.19

ITMW-12
464.14

ITMW-18
464.15

ITMW-1
462.91

MW-22
463.15

MW-21
464.72

MW-30
464.25

MW-29
464.71

ITMW-7
463.70

ITMW-5
462.82

ITMW-4
462.94

ITMW-9
462.81

ITMW-10
462.84

ITMW-6
462.77

NORTH WEST PARKING LOT

SOUTHWEST PARKING LOT

OG & E SUBSTATION

NORTH TANK AREA

NORTH PARKING LOT

SOUTH TANK AREA

BOILER ROOM

WATER TREATMENT BUILDING

WHIRLPOOL FACTORY BUILDING

OHP

457
458
459
460
461
462
463
463.5
464
464.5
465

N

Spring Potenti

0 250 500
SCALE FEET

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FIGURE 4-2

Spring Potentiometric Surface Map

APRIL 2004
Whirlpool Corporation
Fort Smith, Arkansas

ERM

DESIGN: K. Shultz	DRAWN: EFC	CHKD.:
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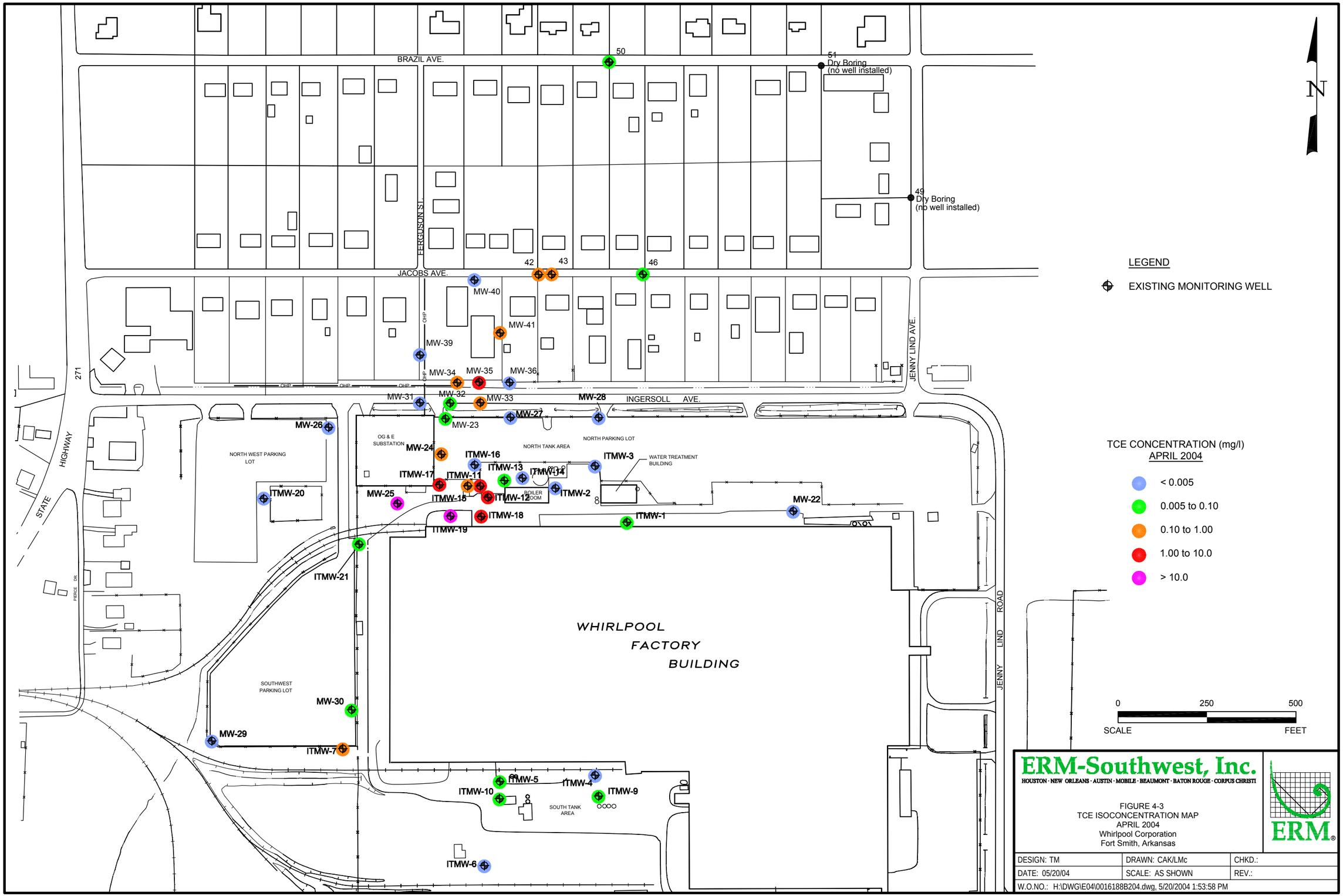

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FIGURE 4-3
TCE ISOCONCENTRATION MAP
APRIL 2004
Whirlpool Corporation
Fort Smith, Arkansas

DESIGN: TM	DRAWN: CAK/LMc	CHKD.:
DATE: 05/20/04	SCALE: AS SHOWN	REV.:
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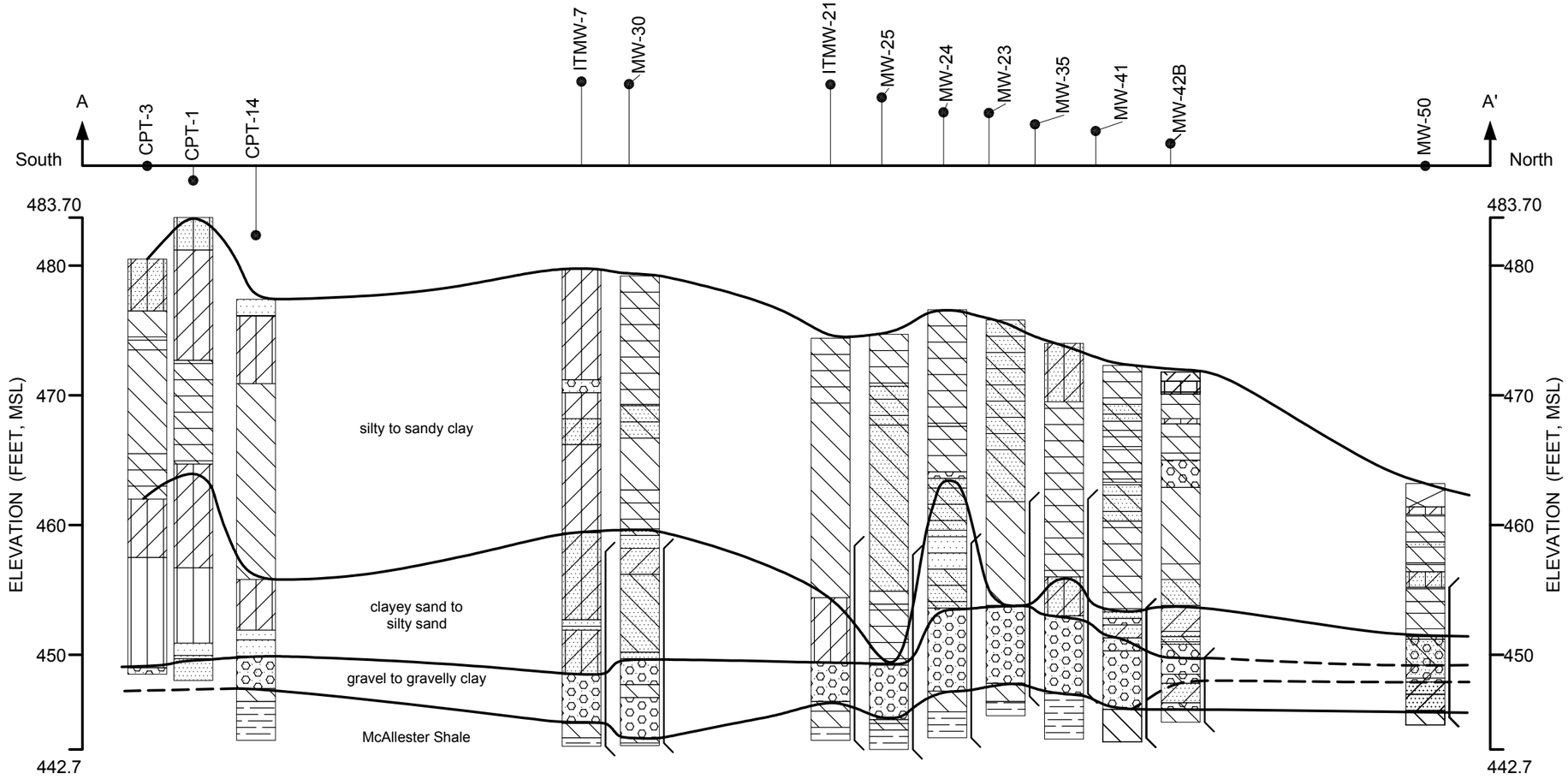
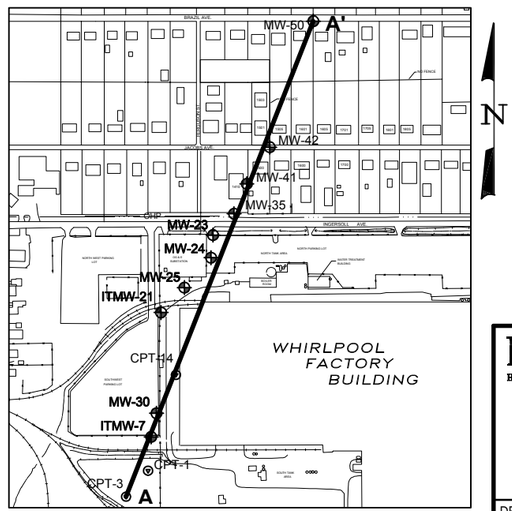


LEGEND

- CLAY
- CLAYEY SAND
- CLAYEY SILT
- FILL
- GRAVEL
- GRAVELLY SAND
- NO RECOVERY
- SAND
- SHALE
- SILTY CLAY
- SILTY CLAYEY SAND
- SILTY SAND
- SILT
- SANDY CLAY
- SANDY CLAYEY SILT
- SANDY SILTY CLAY
- SANDY SILT
- GRAVELLY CLAY



CROSS-SECTION LOCATION MAP
SCALE: 1" = 700'

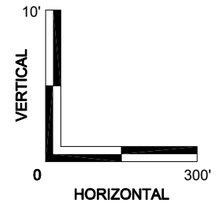


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FIGURE 4-4
CROSS-SECTION A-A'
Whirlpool Corporation
Fort Smith, Arkansas

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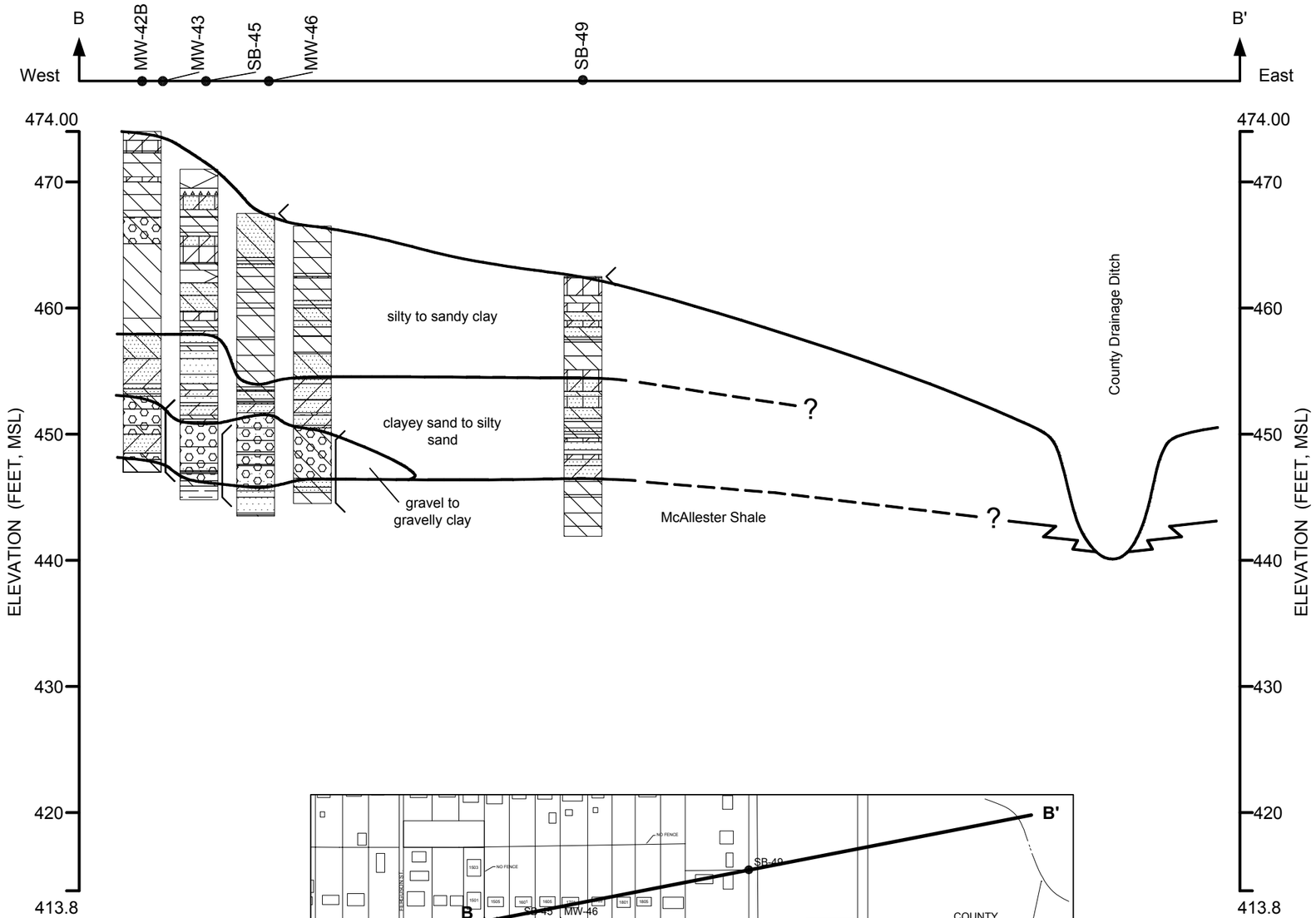
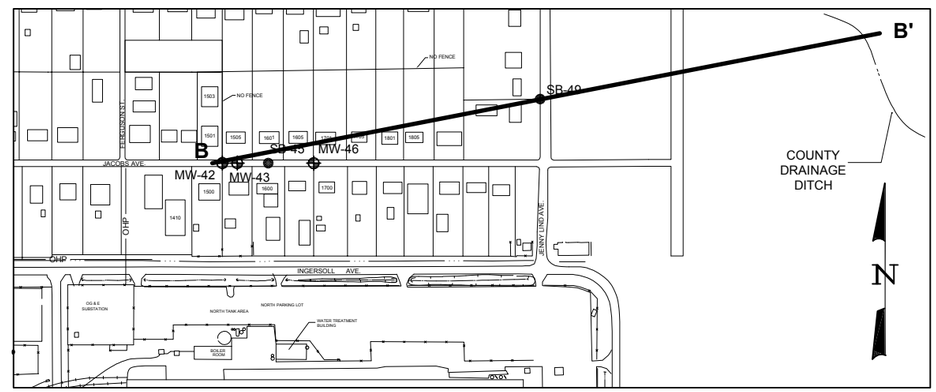
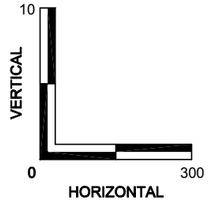


LEGEND

- CLAY
- CLAYEY SAND
- CLAYEY SILT
- CONCRETE
- COARSE SAND
- FILL
- GRAVEL
- GRAVELLY SAND
- NO RECOVERY
- SHALE
- SILTY CLAY
- SILTY CLAYEY SAND
- SILTY SAND
- SANDY CLAY
- SANDY CLAYEY SILT
- SANDY SILTY CLAY
- GRAVELLY CLAY



CROSS-SECTION LOCATION MAP
SCALE: 1" = 500'



ERM-Southwest, Inc.
HOUSTON · NEW ORLEANS · AUSTIN · MOBILE · BEAUMONT · BATON ROUGE · CORPUS CHRISTI

FIGURE 4-5
CROSS-SECTION B-B'
Whirlpool Corporation
Fort Smith, Arkansas

ERM

DESIGN: TM	DRAWN: LMc	CHKD.:
DATE: 01/15/04	SCALE: AS SHOWN	REV.:
W.O.NO.: H:\DWG\A04\581013BB.dwg, 1/15/2004 8:42:19 AM		

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LEGEND

AREAS ACCESSIBLE TO GEOPROBE RIG

1 GRAVEL UNIT ISOPACH CONTOUR (FT.)

MIP BORING LOCATION - NOVEMBER 2003

MONITOR WELL

0 150 300

SCALE FEET

ERM-Southwest, Inc.

HOUSTON · NEW ORLEANS · AUSTIN · MOBILE · BEAUMONT · BATON ROUGE · CORPUS CHRISTI

FIGURE 4-6
OFFSITE DELINEATION RESULTS
GRAVEL UNIT ISOPACH MAP
Whirlpool Corporation
Fort Smith, Arkansas

ERM

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DATE: 01/08/04	SCALE: AS SHOWN	REV.:
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BRAZIL AVE.

JACOBS AVE.

FERGUSON ST.

JENNY LIND AVE.

INGERSOLL AVE.

NORTH PARKING LOT

50

51
Dry Boring
(no well installed)

49
Dry Boring
(no well installed)

42

43

46

MW-40

MW-41

MW-39

MW-34

MW-35

MW-36

MW-31

MW-32

MW-33

MW-28

MW-27

MW-23

OHP

N

LEGEND

EXISTING MONITORING WELL

APPROXIMATE AREA OF GRAVEL UNIT

TCE CONCENTRATION (mg/l)
APRIL 2004

< 0.005

0.005 to 0.10

1.00 to 10.0

0.10 to 1.00

0 150 300

SCALE FEET

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FIGURE 4-7
OFFSITE DELINEATION RESULTS
TCE CONCENTRATIONS
Whirlpool Corporation
Fort Smith, Arkansas

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LEGEND

- PROPOSED MIP LOCATION
- PROPOSED WELL LOCATION (TO BE BASED ON MIP RESULTS)
- MIP BORING LOCATION - NOVEMBER 2003
- MW-43 (0.223) EXISTING MONITOR WELL WITH NOVEMBER 2003 TCE CONCENTRATION IN mg/L
- PROPERTIES ACCESSIBLE TO GEOPROBE RIG
- APPROXIMATE AREA OF GRAVEL UNIT

0 150 300
SCALE FEET

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FIGURE 5-1
OFF-SITE DELINEATION RESULTS
AND PROPOSED PHASE C MIP/WELL LOCATIONS
Whirlpool Corporation
Fort Smith, Arkansas

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Corrective Action Strategy Work Plan

Appendix A

Revised June 25, 2004
Project No. 0014507

Environmental Resources Management
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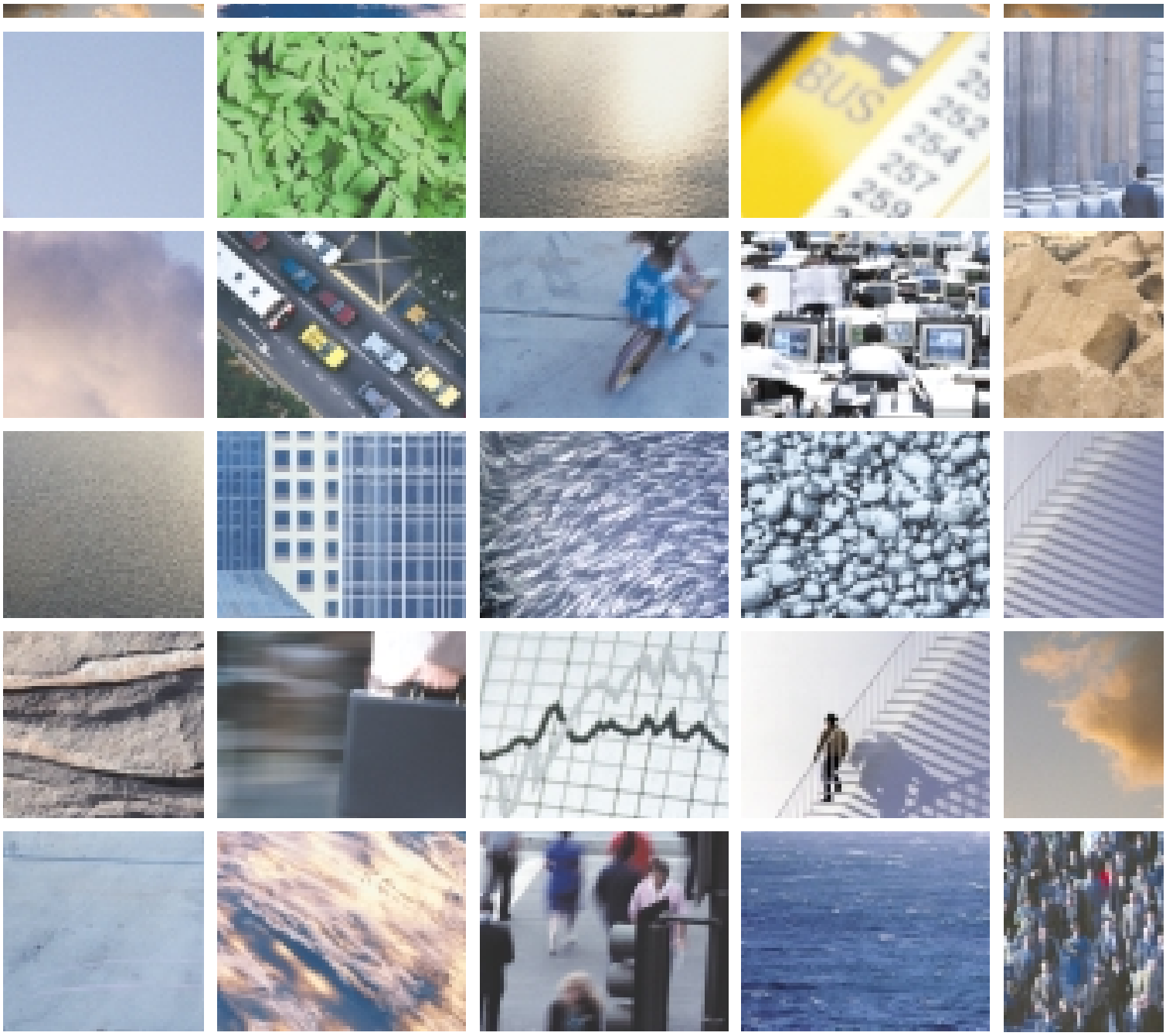

Corrective Action Strategy Work Plan

Fort Smith, Arkansas

Prepared for Whirlpool Corporation, Inc.

June 6, 2003
(Revised June 25, 2004)

www.erm.com

ERM

Delivering sustainable solutions in a more competitive world

CORRECTIVE ACTION STRATEGY
WORK PLAN

Whirlpool Corporation

1.0 INTRODUCTION

1.1 Background

- Historical data ***(located in CSM Section 1.1, Section 4.0, and Section 5.0)***
- Identification of Data Gaps
  - Lithology north of site
  - Ground water flow at northern site boundary
  - Delineation of TCE plume north of site

1.2 Objectives

- Present Data Quality Objectives
- Present proposed methods and procedures to
  - Delineate TCE in off-site area north of facility and
  - Collect additional data for use in developing the risk management profile for the site and conducting site-specific risk assessment
- Present QA/QC requirements for the project

1.3 Performance Standards and Data Quality Objectives (DQOs)

- Use of Data
  - Assess the extent of affected media north of the site
  - Develop a risk management profile for the site and conduct site-specific risk assessment
- Performance Standards
  - Source Control Performance Standard
    1. In-situ treatment if found to be necessary (chemical oxidation with Potassium Permanganate)
    2. Expand from pilot test to address remainder of source area, if necessary
    3. To be conducted as an Interim Stabilization Measure, if necessary
  - Statutory and Regulatory Performance Standard
    Off Site: MCL 0.005 mg/l TCE
  - Final Risk Goal Performance Standard
    1. On Site: Industrial land use
    2. Evaluate risk-based TCE concentration protective of human health and the environment
- DQOs
  - Table of laboratory quantitation limits for ground water (Table 1-1)

2.0 OFF-SITE INVESTIGATION SAMPLING PLAN

2.1 Technical Approach

See Section 4.0 of the Status Report for the Technical Approach for Off-Site Delineation Phase C

Technical approach for Off-Site Delineation Phase A

- Install three additional wells (Figure 2-1)
- Sample wells for two semiannual events
- Monitor potentiometric surface for two semiannual events
- Update CSM with findings
- If plume delineation not complete, obtain additional off-site property access agreements and install additional wells downgradient (north or east) of the initial wells

2.2 Investigation Methods

- Soil Borings
  - Drill rig equipped with hollow stem augers or geoprobe with continuous sampling and logging
  - Borings will be approximately 30 feet deep (to top of bedrock)
  - Soil cores will be collected continuously, lithology will be logged
  - Field screening for affected soils will be conducted every two feet using an organic vapor meter
- Well Installation, Development, and Sampling
  - Well Construction
  - 3/4–inch diameter well with pre-pack screen
  - Screen will be not more than 15 feet in length
  - Development will consist of surging, bailing, and/or pumping
  - A minimum of 8 borehole volumes will be removed (filter volume plus casing volume)
  - PH, specific conductance, and temperature will b e monitored during development
- Equipment Cleaning and Materials Management
  - Drilling equipment will be cleaned between boreholes with a pressure washer
  - Sampling equipment will be cleaned between samples with a laboratory-grade detergent
  - Investigation-derived material will be returned to the Whirlpool site for proper disposal
- Analytical Program
  - Testing for volatile organic compounds (VOCs) following SW-846 method 8260
  - List of target constituents and associated laboratory detection limits provided in Table (1-1)
  - Testing in accordance with Laboratory Quality Assurance Manual
- Quality Assurance/Quality Control Samples

- QA/QC samples will include field blanks, equipment blanks, duplicates, matrix spikes, and matrix spike duplicates
- QA/QC samples will be collected per SW-846 methods

- Sample Handling and Chain of Custody Procedures
  - Sample handling procedures per SW-846
  - Chain of Custody procedures per SW-846

2.3 Data Review, Validation, and Reporting Procedures

- Laboratory data screening to assess
  - Inclusion and frequency of the necessary QC supporting information
  - QC data outside established control limits
- Maintain data in a central location and/or database.
- Data Validation will be conducted in accordance with the National Functional Guideline for Organic Data Review and the National Functional Guideline for Inorganic Data Review
- QA/QC Audits

3.0 INVESTIGATION FOLLOWUP

- Update CSM with new data
- Prepare the risk management profile for the CSM
- Complete ecological exclusion checklist
- Conduct site-specific risk assessment and prepare Risk Evaluation Report
- Follow CAS procedures to develop appropriate response actions to protect human health and the environment
- Prepare Risk Management Plan

4.0 IMPLEMENTATION SCHEDULE AND COMMUNICATION STRATEGY

- Field work will be conducted during the week of July 7, 2003
- The CSM will be updated and a Risk Evaluation Report will be prepared approximately four weeks after final lab data is received
- A meeting with ADEQ will be scheduled following submission of the updated CSM and Risk Evaluation Report

APPENDICES

- Conceptual Site Model (***Appendix B***)
- Health and Safety Plan (***Appendix G***)
- Laboratory Quality Assurance Manual (***Appendix H)***

Tables

June 6, 2003
(Revised June 25, 2004)
W.O. #581-007

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TABLE 1-1

Planned Ground Water Analyte List

Whirlpool Corporation
Fort Smith, Arkansas

Parameter	Target Practical Quantitation Limit (mg/l)
Volatile Organics - Method SE-846 8260B 0.005	
Benzene	0.005
Bromodichloromethane	0.005
Bromoform	0.005
Bromomethane	0.005
Carbon Tetrachloride	0.005
Chlorobenzene, Water	0.01
Chloroethane	0.005
Chloroform	0.01
Dichloromethane	0.005
1,1-Dichloroethane	0.005
1,2-Dichloroethane	0.005
1,1-Dichloroethene	0.005
1,2-Dichloroethene	0.01
cis-1,2-Dichloroethene	0.005
trans-1,2-Dichloroethene	0.005
1,2-Dichloropropane	0.005
Ethylbenzene	0.005
Methylene Chloride	0.01
Styrene	0.005
1,1,2,2-Tetrachloroethane	0.005
Tetrachloroethane	0.005
Toluene	0.005
1,1,1-Trichloroethane	0.005
1,1,2-Trichloroethane	0.005
Trichloroethene	0.005
Vinyl Chloride	0.01
Xylenes (Total)	0.01
Acetone	0.02
Carbon Disulfide	0.005
Methyl Ethyl Ketone (2-Butanone)	0.01
cis-1,3-Dichloropropene	0.005
trans-1,3-Dichloropropene	0.005
2-Hexanone	0.01
4-Methyl-2-pentanone (MIBK)	0.01

Figures

June 6, 2003
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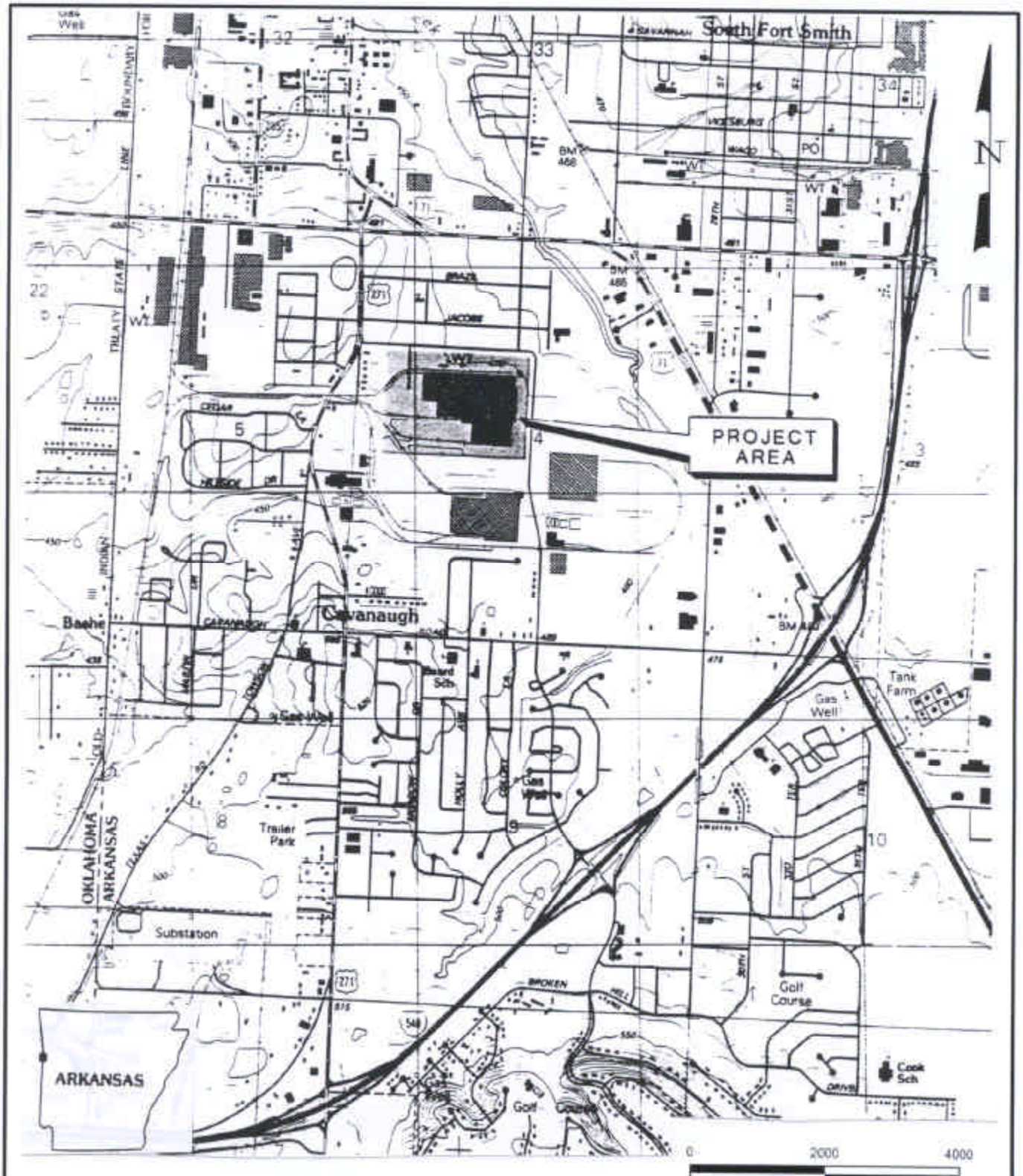

SOURCE: U.S.G.S. 7.5' QUADRANGLE, SOUTH FORT SMITH, ARK.-OKLA., 1987.

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FIGURE 1-1
SITE LOCATION MAP
Whirlpool Corporation
Fort Smith, Arkansas

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JACOBS AVE.

FERC

OHP

OHP

APARTMENTS

MW-34

MW-35

MW-36

OHP OHP OHP OHP

UNDERGROUND CABLE LINE

UNDERGROUND CITY WATER LINE

UNDERGROUND HIGH PRESSURE GAS LINE

MW-31

MW-32

MW-33

INGERSOLL AVE.

MW-23

MW-27

MW-28

MW-26

NORTH PARKING LOT

NORTH WEST PARKING LOT

OG & E SUBSTATION

MW-24

ITMW-16

ITMW-3

ITMW-14

MW-38

ITMW-11

ITMW-13

ITMW-2

ITMW-17

ITMW-15

MW-37

BOILER ROOM

WATER TREATMENT BUILDING

W-20

PROPANE TANKS

MW-25

ITMW-12

ITMW-18

ITMW-19

ITMW-1

FORMER DEGREASER BUILDING

ITMW-21

WHIRLPOOL FACTORY BUILDING

N

0 100 200

SCALE FEET

LEGEND

EXISTING WELL

Proposed Offsite Well

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FIGURE 2-1
OFFSITE INVESTIGATION LOCATIONS
Whirlpool Corporation
Fort Smith, Arkansas

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Laboratory Quality Assurance Manual

June 6, 2003
(Revised June 25, 2004)
W.O. #581-007

Environmental Resources Management
15810 Park Ten Place, Suite 300
Houston, Texas 77084-5140
(281) 600-1000

QUALITY MANAGEMENT PLAN
Revision: 5

July 2002

Approved by:

President and CEO: _____ Date: June 10, 2002
Rachel Brydon Janetta

Senior Vice President, Chief Operating Officer: _____ Date: June 10, 2002
Dr. Keith C. Wheatstone

Vice President, Client and Operation Services: _____ Date: June 10, 2002
Dr. Charles W. Carter

Director of Quality Assurance: _____ Date: June 10, 2002
Raymond J. Frederici

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Table of Contents

Tables

Figures

1. Introduction, Purpose, and Scope

1.1. Severn Trent Laboratories (STL) Overview

STL Inc. is a part of Severn Trent Plc , a major U.S. based company with 2,000 employees throughout the U.S., Europe and Asia. Severn Trent Plc., a British water, waste and utility services company, one of the top publicly traded companies in the United Kingdom, employing some 13,500 people.

STL offers a broad range of environmental testing services provided by over two thousand professionals in the US. STL's testing capabilities include chemical, physical, and biological analyses of a variety of matrices, including aqueous, solid, drinking water, waste, tissue, air and saline/estuarine samples. Specialty capabilities include dioxin and furan analysis, air toxics, radiological testing, geotechnical testing, tissue preparation and analysis, aquatic toxicology, asbestos analysis, microscopy services, High Resolution Mass Spectrometry (HRMS), Inductively Coupled Plasma/MS (ICP/MS), Liquid Chromatography/MS (LC/MS), and on-site technologies including mobile laboratories. STL facility locations and contact information are outlined in Table 1.

1.2. Quality Assurance Policy

It is STL's policy to:

- Provide high quality, consistent, and objective environmental testing services that meet all federal, state, and municipal regulatory requirements.
- Generate data that are scientifically sound, legally defensible, meet project objectives, and are appropriate for their intended use.
- Provide STL clients with the highest level of professionalism and the best service practices in the industry.
- Build continuous improvement mechanisms into all laboratory, administrative, and managerial activities.
- Maintain a working environment that fosters open communication with both clients and staff.

Table 1 STL Facility Locations

STL Austin
14046 Summit Drive
Suite 111
Austin, TX 78728
Phone: 512-244-0855
Fax: 512-244-0160

STL Billerica
149 Rangeway Road
N. Billerica, MA 01862
Phone: 978-667-1400
Fax: 978-667-7871

STL Buffalo
10 Hazelwood Drive
Suite 106
Amherst, NY 14228
Phone: 716-691-2600
Fax: 716-691-7991

STL Burlington
208 South Park Drive
Suite 1
Colchester, VT 05446
Phone: 802-655-1203
Fax: 802-655-1248

STL Connecticut
128 Long Hill Cross Road
Shelton, CT 06484
Phone: 203-929-8140
Fax: 203-929-8142

STL Chicago
2417 Bond Street
University Park, IL 60466
Phone: 708-534-5200
Fax: 708-534-5211

STL Corpus Christi
1733 N. Padre Island Drive
Corpus Christi, TX 78408
Phone: 361-289-2673
Fax: 361-289-2471

STL Denver
4955 Yarrow Street
Arvada, CO 80002
Phone: 303-421-6611
Fax: 303-431-7171

STL Edison
777 New Durham Road
Edison, NJ 08817
Phone: 732-549-3900
Fax: 732-549-3679

STL Houston
6310 Rothway Drive
Suite 130
Houston, TX 77040
Phone: 713-690-4444
Fax: 713-690-5646

STL Knoxville
5815 Middlebrook Pike
Knoxville, TN 37921
Phone: 865-291-3000
Fax: 865-584-4315

STL Los Angeles
1721 South Grand Avenue
Santa Ana, CA 92705
Phone: 714-258-8610
Fax: 714-258-0921

STL Miami
10200 USA Today Way
Miramar, FL 33025
Phone: 954-431-4550
Fax: 954-431-1959

STL Mobile
900 Lakeside Drive
Mobile, AL 36693
Phone: 334-666-6633
Fax: 334-666-6696

STL Newburgh
315 Fullerton Avenue
Newburgh, NY 12550
Phone: 845-562-0890
Fax: 845-562-0841

STL North Canton
4101 Shuffel Drive NW
North Canton, OH 44720
Phone: 330-497-9396
Fax: 330-497-0772

STL On-Site Technology
Westfield Executive Park
53 Southampton Road
Westfield, MA 01085
Phone: 413-572-4000
Fax: 413-572-3707

STL Pensacola
3355 McLemore Drive
Pensacola, FL 32514
Phone: 850-474-1001
Fax: 850-478-2671

STL Pittsburgh
450 William Pitt Way
Building 6
Pittsburgh, PA 15238
Phone: 412-820-8380
Fax: 412-820-2080

STL Richland
2800 George Washington Way
Richland, WA 99352
Phone: 509-375-3131
Fax: 509-375-5590

STL Sacramento
880 Riverside Parkway
West Sacramento, CA 95605
Phone: 916-373-5600
Fax: 916-372-1059

STL San Francisco
1220 Quarry Lane
Pleasanton, CA 94566-4756
Phone: 925-484-1919
Fax: 925-484-1096

STL Seattle
5755 8th Street East
Tacoma, WA 98424
Phone: 253-922-2310

STL St. Louis
13715 Rider Trail North
Earth City, MO 63045
Phone: 314-298-8566
Fax: 314-298-8757

STL Savannah
5102 LaRoche Avenue
Savannah, GA 31404
Phone: 912-354-7858
Fax: 912-351-3673

STL Tallahassee
2846 Industrial Plaza Dr.
Tallahassee, FL 32301
Phone: 850-878-3994
Fax: 850-878-9504

STL Tampa
6712 Benjamin Road
Suite 100
Tampa, FL 33634
Phone: 813-885-7427
Fax: 813-885-7049

STL Valparaiso
2400 Cumberland Drive
Valparaiso, IN 46383
Phone: 219-464-2389
Fax: 219-462-2953

STL Westfield
Westfield Executive Park
53 Southampton Road
Westfield, MA 01085
Phone: 413-572-4000
Fax: 413-572-3707

1.3. Management Commitment to Quality Assurance

STL management is committed to providing the highest quality data and the best service in the environmental testing industry. To ensure that the data produced and reported by STL meet the requirements of its clients and comply with the letter and spirit of municipal, state and federal regulations, STL maintains a quality system that is clear, effective, well communicated, and supported at all levels in the company.

STL Mission Statement

We enable our customers to create safe and environmentally favorable policies and practices, by leading the market in scientific and consultancy services. We provide this support within a customer service framework that sets the standard to which others aspire. This is achieved by people whose professionalism and development is valued as the key to success and through continued investments in science and technology.

1.4. Purpose

The purpose of the Quality Management Plan (QMP) is to describe the STL quality system and to outline how that system enables all employees of STL to meet the Quality Assurance (QA) policy. The QMP also describes specific QA activities and requirements and prescribes their frequencies. Roles and responsibilities of management and laboratory staff in support of the quality system are also defined in the QMP.

1.5. Scope

The requirements set forth in this document are applicable to all STL facilities. Where the document uses the terms “must” and “shall”, this denotes required activities. Practices described in this QMP denotes how those activities are performed in general; and each laboratory may have a more detailed description of that activity.

Each STL facility has the responsibility and authority to operate in compliance with regulatory requirements of the jurisdiction in which the work is performed. Where this QMP conflicts with those regulatory requirements, the regulatory requirements of the jurisdiction shall hold primacy. The facility’s Laboratory Quality Manual (LQM) shall take precedence over the QMP in those cases. Secondarily, each STL facility has the responsibility and authority to operate in compliance with documented client requirements, where they do not conflict with regulatory requirements. STL shall not enter any client agreements that conflict with regulatory requirements in the jurisdiction in which the work is performed. Where documented client agreements conflict with this QMP, but meet the regulatory requirements of the jurisdiction in which the work is performed, the client agreements shall supercede requirements in this QMP.

STL operates under the regulations and guidelines of the following federal programs:

- Air Force Center for Environmental Excellence (AFCEE)
- US Army Corp of Engineers, Hazardous, Toxic and Radioactive Waste (USACE HTRW)
- Clean Air Act (CAA)
- Clean Water Act (CWA)
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
- Department of Energy (DOE)
- Marine Protection, Research, and Sanctuaries Act (MPRSA)
- Navy Facilities Engineering Service Center (NFESC)
- National Pollutant, Discharge, and Elimination System (NPDES)
- Nuclear Regulatory Commission (NRC)
- Occupational Safety and Health Administration (OSHA)
- Resource Conservation and Recovery Act (RCRA)
- Safe Drinking Water Act (SDWA)
- Toxic Substances Control Act (TSCA)

STL also provides services under various state and local municipal guidelines. A listing of each laboratory's service offerings and certifications is presented on the MySTL webpage or available from the laboratory.

This QMP was written to comply with the National Environmental Laboratory Accreditation Conference (NELAC) standards. Refer to Table 2 for a cross-section comparison of this QMP to the NELAC standards.

Table 2 Correlation of QMP Sections with NELAC Quality Manual Requirements

NELAC Chapter 5.5.2 Quality Manual	Quality Management Plan Section
a. Quality policy statement, including objectives and commitments	1.2 Quality Assurance Policy 4.2.1 Objectives of the Quality System
b. Organization and management structure	4.1 Organization and Management
c. Relationship between management, technical operations, support services and the quality systems	4.1.2 Roles and Responsibilities 4.2 Quality System
d. Records retention procedures; document control procedures	4.3 Document Control 4.12.2 Record Retention
e. Job descriptions of key staff and references to job descriptions of other staff	4.1.2 Roles and Responsibilities
f. Identification of laboratory approved signatories	4.1 Organization and Management
g. Procedures for achieving traceability of measurements	5.5 Measurement Traceability
h. List of all test methods under which the laboratory performs its accredited testing	5.3.1 Method Selection
i. Mechanisms for assuring the laboratory reviews all new work to ensure that it has the appropriate facilities and resources before commencing such work	4.4.2 Project-Specific Quality Planning
j. Reference to the calibration and/or verification test procedures used	5.4.3 Equipment Verification and Calibration
k. Procedures for handling submitted samples	4.7.1 Sample Acceptance Policy 5.7 Sample Handling, Transport and Storage
l. Reference to the major equipment and reference measurement standards used as well as the facilities and services used in conducting tests	4.1.1 Laboratory Facilities 5.4.2 Equipment Maintenance 5.4.3 Equipment Verification and Calibration
m. Reference to procedures for calibration, verification and maintenance of equipment	5.4.2 Equipment Maintenance 5.4.3 Equipment Verification and Calibration
n. Reference to verification practices including interlaboratory comparisons, proficiency testing programs, use of reference materials and internal QC schemes	5.8.1 Proficiency Testing 5.8.2 Control Samples
o. Procedures for feedback and corrective action whenever testing discrepancies are detected, or departures from documented procedures occur	4.9 Control of Non-Conformances 4.10 Corrective Action 4.11 Preventive Action 5.8.5 Permitting Departures from Documented Procedures
p. Laboratory management arrangements for exceptionally permitting departures from documented policies and procedures	4.4.2 Project-Specific Quality Planning 5.8.5 Permitting Departures from Documented Procedures
q. Procedures for dealing with complaints	4.8 Complaints
r. Procedures for protecting confidentiality and proprietary rights	4.7.2 Client Confidentiality and Proprietary Rights
s. Procedures for audits and data review	4.13 Internal Audits 4.14 External Audits 5.3.6 Data Reduction and Review

Table 2 Correlation of QMP Sections with NELAC Quality Manual Requirements

NELAC Chapter 5.5.2 Quality Manual	Quality Management Plan Section
t. Process/procedures for establishing that personnel are adequately experienced in duties they are expected to carry out and are receiving any needed training	5.1.2 Training
u. Ethics policy statement developed by the laboratory and training personnel in their ethical & legal responsibilities	5.1.3 Ethics Policy
v. Reference to procedures for reporting analytical results	5.3.6 Data Review 5.9 Project Reports
w. Table of contents, listing reference, glossaries and appendices	TOC Table of Contents Appendix I: List of Cited SOPs and Work Instructions

2. References

The following references were used in preparation of this document and as the basis of the STL Quality System:

EPA Guidance for Preparing Standard Operating Procedures (SOPs) for Quality Related Documents, EPA QA/G-6, US EPA, Office of Environmental Information, March 2001.

EPA Requirements for Quality Management Plans, EPA QA/R-2, US EPA, Office of Environmental Information, March 2001.

EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5, US EPA, Office of Environmental Information, March 2001.

EPA Quality Manual for Environmental Programs, 5360 A1, US EPA Office of Research and Development, National Center for Environmental Research and Quality Assurance, Quality Assurance Division, May 2000.

General Requirements for the Competence of Testing and Calibration Laboratories, ISO/IEC 17025, December 1999.

Good Automated Laboratory Practices, EPA 2185, August 1995.

Quality Assurance Project Plan, HQ Air Force Center for Environmental Excellence, Version 3.1, August 2001.

National Environmental Laboratory Accreditation Conference, Constitution, Bylaws, and Standards, EPA600/R-98/151, US EPA Office of Research and Development, July 1999.

Navy Installation Restoration Laboratory Quality Assurance Guide, Interim Guidance Document, Naval Facilities Engineering Service Center, February 1996.

Navy Installation Restoration Chemical Data Quality Manual, Navy IR CDQM, September 1999.

Quality Systems Manual for Environmental Laboratories, Department of Defense, Version 1, October 2000.

Shell for Analytical Chemistry Requirements, US Army Corps of Engineers, December 1998.

3. Terms and Definitions

Accuracy: the degree of agreement between a measurement and true or expected value, or between the average of a number of measurements and the true or expected value.

Audit: a systematic evaluation to determine the conformance to specifications of an operational function or activity.

Batch: environmental samples, which are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of a similar matrix, meeting the above mentioned criteria. Where no preparation method exists (example, volatile organics, water) the batch is defined as environmental samples that are analyzed together with the same process and personnel, using the same lots of reagents, not to exceed 20 environmental samples. An analytical batch is composed of prepared environmental samples, extracts, digestates or concentrates that are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.

Chain of Custody (COC): A system of documentation demonstrating the physical possession and traceability of samples.

Clean Air Act: legislation in 42 U.S.C. 7401 et seq., Public Law 91-604, 84 Stat. 1676 Pub. L. 95-95, 91 Stat., 685 and Pub. L. 95-190, 91 Stat., 1399, as amended.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA/Superfund): legislation (42 U.S.C. 9601-9675 et seq., as amended by the Superfund Amendments and reauthorization Act of 1986 (SARA), 42 U.S.C. 9601et seq.

Compromised Sample: a sample received in a condition that jeopardizes the integrity of the results. See Section 4.7.1 for a description of these conditions.

Confidential Business Information (CBI): information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products.

Confirmation: verification of the presence of a component using an additional analytical technique. These may include second column confirmation, alternate wavelength, derivatization, mass spectral interpretation, alternative detectors, or additional cleanup procedures.

Corrective Action: action taken to eliminate the causes of an existing non-conformance, defect or other undesirable situation in order to prevent recurrence.

Data Audit: a qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality.

Demonstration of Capability (DOC): procedure to establish the ability to generate acceptable accuracy and precision.

Equipment Blank: a portion of the final rinse water used after decontamination of field equipment; also referred to as Rinsate Blank and Equipment Rinsate.

Document Control: the act of ensuring that documents (electronic or hardcopy and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.

Federal Insecticide, Fungicide and Rodenticide Act (FIFRA): legislation under 7 U.S.C. 135 et seq., as amended.

Federal Water Pollution Control Act (Clean Water Act, CWA): legislation under 33 U.S.C. 1251 et seq., Public Law 92-50086 Stat. 816.

Field Blank: a blank matrix brought to the field and exposed to field environmental conditions.

Field of Testing (FOT): a field of testing is based on NELAC's categorization of accreditation based on program, matrix, analyte.

Good Laboratory Practices (GLP): formal regulations for performing basic laboratory operations outlined in 40 CFR Part 160 and 40 CFR Part 729 and required for activities performed under FIFRA and TSCA.

Holding Time: the maximum time that a sample may be held before preparation and/or analysis as promulgated by regulation or as specified in a test method.

Instrument Blank: a blank matrix that is the same as the processed sample matrix (i.e. extract, digestate, condensate) and introduced onto the instrument for analysis.

Internal Chain of Custody: an unbroken trail of accountability that ensures the physical security of samples, data and records. Internal Chain of Custody refers to additional documentation procedures implemented within the laboratory that includes special sample storage requirements, and documentation of all signatures and/or initials, dates, and times of personnel handling specific samples or sample aliquots.

Instrument Detection Limit (IDL): the minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific instrument. The IDL is associated with the instrumental portion of a specific method only, and sample preparation steps are not considered in its derivation. The IDL is a statistical estimation at a specified confidence interval of the concentration at which the relative uncertainty is $\pm$100%. The IDL represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Laboratory Control Sample (LCS): a blank matrix spiked with a known amount of analyte(s), processed simultaneously with, and under the same conditions as, samples through all steps of the analytical procedure.

Laboratory Quality Manual (LQM): a document stating the quality policy, quality system and quality practices of the laboratory. The LQM may include by reference other documentation relating to the laboratory's quality system.

Limit of Detection (LOD): the minimum amount of a substance that an analytical process can reliably detect.

Matrix: the substrate of a test sample. Common matrix descriptions are defined in Table 3.

Matrix Duplicate (MD): duplicate aliquot of a sample processed and analyzed independently; under the same laboratory conditions; also referred to as Sample Duplicate; Laboratory Duplicate.

Matrix Spike (MS): field sample to which a known amount of target analyte(s) is added.

Matrix Spike Duplicate (MSD): a replicate matrix spike.

Table 3 Matrix Descriptions

Matrix	Description
Air	Air samples as analyzed directly or as adsorbed into a solution or absorption matrix and desorbed.
Aqueous	Aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine source. Includes surface water, groundwater and effluents.
Drinking Water	Aqueous sample that has been designated a potable water source.
Saline	Aqueous sample from an ocean or estuary, or other salt-water source such as the Great Salt Lake.
Liquid	Liquid with <15% settleable solids.
Solid	Soil, sediment, sludge or other matrices with ≥15% settleable solids.
Waste	A product or by-product of an industrial process that results in a matrix not previously defined.
Tissue	Sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Method Blank: a blank matrix processed simultaneously with, and under the same conditions as, samples through all steps of the analytical procedure.

Method Detection Limit (MDL): the minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific measurement system. The MDL is a statistical estimation at a specified confidence interval of the concentration at which the relative uncertainty is ±100%. The MDL represents a range where qualitative detection occurs using a specific method. Quantitative results are not produced in this range.

Non-conformance: an indication, judgement, or state of not having met the requirements of the relevant specifications, contract, or regulation.

Precision: an estimate of variability. It is an estimate of agreement among individual measurements of the same physical or chemical property, under prescribed similar conditions.

Preservation: refrigeration and/or reagents added at the time of sample collection to maintain the chemical, physical and/or biological integrity of the sample.

Proficiency Testing: determination of the laboratory calibration or testing performance by means of inter-laboratory comparisons.

Proficiency Test (PT) Sample: a sample, the composition of which is unknown to the analyst, that is provided to test whether the analyst/laboratory can produce analytical results within specified performance limits. Also referred to as Performance Evaluation (PE) Sample.

Proprietary: belonging to a private person or company.

Quality Assurance (QA): an integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence.

Quality Assurance Project Plan (QAPP): a formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved.

Quality Control (QC): the overall system of technical activities, the purpose of which is to measure and control the quality of a product or service.

Quality Control Sample: a control sample, generated at the laboratory or in the field, or obtained from an independent source, used to monitor a specific element in the sampling and/or testing process.

Quality Management Plan (QMP): a formal document describing the management policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an agency, organization or laboratory to ensure the quality of its product and the utility of the product to its users.

Quality System: a structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA/QC.

Quantitation Limit (QL): the minimum amount of a substance that can be quantitatively measured with a specified degree of confidence and within the accuracy and precision guidelines of a specific measurement system. The QL can be based on the MDL, and is generally calculated as 3-5 times the MDL, however, there are analytical techniques and methods where this relationship is not applicable. Also referred to as Practical Quantitation Level (PQL), Estimated Quantitation Level (EQL), Limit of Quantitation (LOQ).

Raw Data: any original information from a measurement activity or study recorded in laboratory notebooks, worksheets, records, memoranda, notes, or exact copies thereof and that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic/optical media, including dictated observations, and recorded data from automated instruments. Reports specifying inclusion of "raw data" do not need all of the above included, but sufficient information to create the reported data.

Record Retention: the systematic collection, indexing and storing of documented information under secure conditions.

Reference Standard: a standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived.

Reporting Limit (RL): The level to which data is reported for a specific test method and/or sample. The RL is generally related to the QL. The RL must be minimally at or above the MDL.

Resource Conservation and Recovery Act (RCRA): legislation under 42 USC 321 et seq. (1976).

Safe Drinking Water Act (SDWA): legislation under 42 USC 300f et seq. (1974), (Public Law 93-523).

Sampling and Analysis Plan (SAP): a formal document describing the detailed sampling and analysis procedures for a specific project.

Selectivity: the capability of a measurement system to respond to a target substance or constituent.

Sensitivity: the difference in the amount or concentration of a substance that corresponds to the smallest difference in a response in a measurement system using a certain probability level.

Spike: a known amount of an analyte added to a blank, sample or sub-sample.

Standard Operating Procedure (SOP): a written document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks.

Storage Blank: a blank matrix stored with field samples of a similar matrix.

Systems Audit: a thorough, systematic, on-site, qualitative review of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system.

Test Method: defined technical procedure for performing a test.

Toxic Substances Control Act (TSCA): legislation under 15 USC 2601 et seq., (1976).

Traceability: the property of a result of a measurement that can be related to appropriate international or national standards through an unbroken chain of comparisons.

Trip Blank: a blank matrix placed in a sealed container at the laboratory that is shipped, held unopened in the field, and returned to the laboratory in the shipping container with the field samples.

Verification: confirmation by examination and provision of evidence against specified requirements.

4. Management Requirements

4.1. Organization and Management

4.1.1. Organization

STL's organizational structure is presented in Figure 1. Corporate employees are located at various STL facilities as outlined in the organizational structure. A QA Manager shall be designated at each STL facility.

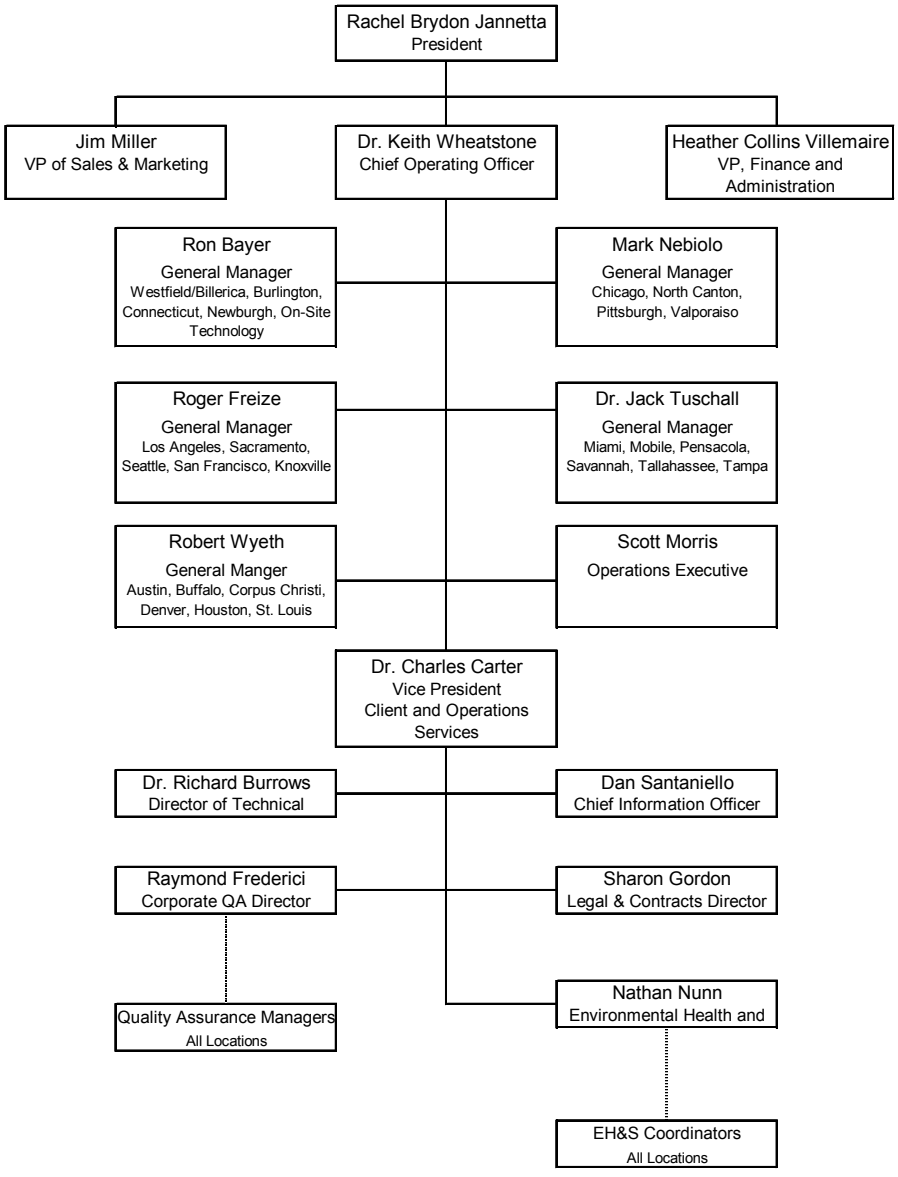
4.1.2. Roles and Responsibilities

President
The President of STL, Inc. has overall management responsibility and authority for Severn Trent's laboratory division, including responsibility for budgeting, resource allocation, long term planning, sales, marketing, and final approval on all management and administrative policies and management plans. The President authorizes the QMP and as such, sets the standards for the quality system.

Chief Operating Officer (COO)
The COO is responsible for daily management of all STL facilities. The COO's responsibilities include allocation of personnel and resources, long term planning, and development of technical policies and management plans. The COO authorizes the QMP and is responsible for ensuring that business and technical operations are conducted in accordance with its requirements.

Vice President Client and Operations Services (VP COS)
The VP of Operations Services is responsible for all essential elements of offerings to clients, including risk management, legal compliance and contract administration, quality assurance, information technology, and environmental health and safety. The VP COS authorizes the QMP and responsibilities include authorization of Manuals, Policies and Procedures, providing support and direction to the Managers of these areas, and supporting the COO in decisions regarding long term planning, resource allocation, and capital expenditures

Figure 1 STL Organizational Chart



QA Director
The QA Director is responsible for establishing, implementing and communicating STL's quality system. The QA Director monitors compliance with the QMP, provides regulatory and technical updates to the STL facilities, assists in development of management plans and technical policies to be approved by the COO, and coordinates training within STL. The QA Director is available to any employee in STL to resolve data quality or ethical issues. The QA Director is independent of operational functions.

Director of Technical Services
The Director of Technical Services is responsible for establishing, implementing and communicating STL's Technical Policies, Standard Operating Procedures, and Manuals. Other responsibilities include conducting technical assessments as required, acting as a technical resource in national contracts review, coordinating new technologies, establishing best practices throughout STL, advising STL staff on technology advances, innovations, and applications, and organizing and running STL's technical committee.

Chief Information Officer (CIO)
The CIO is responsible for establishing, implementing and communicating STL's IT Policies, Standard Operating Procedures, and Manuals. Other responsibilities include coordinating new technologies, development of electronic communication tools such as STL's intranet and internet sites, ensuring data security and documentation of software, ensuring compliance with Good Automated Laboratory Practices (GALP), and assistance in establishing, updating, and maintaining Laboratory Information Management Systems (LIMS) at the various STL facilities.

Environmental Health and Safety (EH&S) Director
The EH&S Director is responsible for establishing, implementing and communicating STL's Environmental Health and Safety Policies, Standard Operating Procedures, and Manuals. Other responsibilities include conducting EH&S assessments as required, acting as a resource for all STL facilities to ensure EH&S compliance, coordinating safety committees, providing guidance to the EH&S Coordinator at various STL facilities, and advising STL facilities on new EH&S regulations.

General Manager (GM)
The GM is directly responsible for the daily operations of one or more operating facilities within STL. The GM's responsibilities include allocation of personnel and resources, long term planning, setting goals, and achieving the financial, business, and quality objectives of STL. The GM ensures timely compliance with corporate management directives, policies, and management systems reviews.

Laboratory Director
The Laboratory Director oversees the daily operations of the laboratory. The Laboratory Director's responsibilities include supervision of staff, setting goals and objectives for both the business and the employees, and achieving the financial, business, technical and quality objectives of the facility. The Laboratory Director ensures timely compliance with audits and corrective actions, and is responsible for maintaining a working environment which encourages open, constructive problem solving and continuous improvement.

QA Manager
The QA Manager is responsible for ensuring that the laboratory's quality system and LQM meet the requirements set forth in the QMP, providing quality systems training to all new personnel, maintaining a Laboratory Quality Manual (LQM), and performing or overseeing systems, data, special, and external audits. The QA Manager performs, or supervises, the maintenance of QA records, the maintenance of certifications and accreditations, the submission of monthly QA Reports, and assists in reviewing new work as needed. The QA Manager shall have the final authority to accept or reject data, and to stop work in progress in the event that procedures or practices compromise the validity and integrity of analytical data. The QA Manager is available to any employee at the facility to resolve data quality or ethical issues. The QA Manager shall be independent of laboratory operations. The facility QA Manager has an indirect reporting relationship to the QA Director. Each LQM has further descriptions of roles and responsibilities at the facility level.

Technical Director
The Technical Director(s) of a laboratory has overall responsibility for a defined portion of the technical operations of the laboratory, and may or may not be the Laboratory Director. The Technical Director solves day to day technical issues, provides technical training and guidance to staff, project managers, and clients, investigates technical issues identified by QA, and directs evaluation of new methods.

4.2. Quality System

4.2.1. Objectives of STL Quality System

The goal of the STL quality system is to ensure that business and technical operations are conducted with the highest standards of professionalism in the industry.

To achieve this goal, it is necessary to provide STL clients with not only scientifically sound, well documented, and regulatory compliant data, but also to ensure that STL provides the highest quality service available in the industry. A well-structured and well-communicated quality system is essential in meeting this goal. STL's quality system is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

The QMP is the basis for STL's quality system and contains requirements and general guidelines under which all STL facilities shall conduct their operations. A table listing the minimum quality system policies and procedures is appended to this QMP. The table includes a citation to the applicable QMP section where a procedure or policy is discussed. It also includes a column indicating the document "Reference".

4.2.2. Laboratory Quality Manual (LQM)

Each STL facility shall have an LQM that further describes the specific QA program at the laboratory.

Each STL facility's LQM shall address:

1. Table of Contents, lists of references and glossaries, and appendices.
2. Quality policy statement, including objectives and commitments, by facility management.
3. Organization and management structure of the laboratory, its place in the STL organization and relevant organizational charts.
4. Relationship between management, technical operations, support services and the quality system.
5. Record retention procedure.
6. Document control procedure.
7. Job descriptions of essential staff and reference to job descriptions of other staff.
8. Identification of the laboratory's approved signatories.
9. Procedure for achieving traceability of measurements.
10. List of test methods under which the laboratory performs its testing.
11. Procedure for reviewing new work.
12. Reference to the calibration and/or verification test procedures used.
13. Sample handling procedure.
14. Reference to the major equipment, reference standards, facilities and services used by the laboratory in conducting tests.
15. Reference to procedures for calibration, verification and maintenance of equipment.

16. Reference to verification practices including inter-laboratory comparisons, proficiency testing programs, use of reference materials and internal QC practices.
17. Procedures for feedback and corrective action when testing discrepancies are detected, or departures from policies and procedures occur.
18. Procedure for exceptionally permitting departures from documented policies and procedures or from standard specifications.
19. Procedure for handling client complaints.
20. Procedure for protecting client confidentiality and proprietary rights.
21. Procedure for audits and data review.
22. Procedure for establishing that personnel are adequately experienced and trained.
23. Reference to procedures for reporting analytical results.

4.3. Document Control

4.3.1. Document Type

The following documents, at a minimum, must be controlled at each STL Facility:

- Laboratory Quality Manual
- Standard Operating Procedures (SOP)
- Quality Management Plan

4.3.2. Document Control Procedure

Security and control of documents are necessary to ensure that confidential information is not distributed and that all current copies of a given document are from the latest applicable revision. Unambiguous identification of a controlled document is maintained by identification of the following items in the document header: Document Name, Document Number, Revision Number, Effective Date, Number of Pages. Controlled documents are authorized by Management and/or the QA Department. Controlled documents are marked as such and records of their distribution are kept by the QA Department. Document control maybe achieved by either electronic or hardcopy distribution.

Controlled documents shall be available at all locations where the operational activity described in the document is performed.

4.3.3. Document Revision

Quality system policies and procedures will be reviewed at a minimum of every two years and revised as appropriate. Changes to documents occur when a

procedural change warrants a revision of the document. When an approved revision of a controlled document is ready for distribution, obsolete copies of the document shall be replaced with the current version of the document. The previous revision of the controlled document must be archived by the QA Department.

4.3.4. Official Documents

The STL Corporate Operations staff issues Corporate Manuals, Standard Operating Procedures, and Policies. These are collectively termed "Official Documents" and encompass the Policies and Procedures that all STL facilities are required to employ. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving Official Documents is found in Corporate SOP S-Q-001.

4.4. Request, Tender, and Contract Review

4.4.1. Contract Review

For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is STL's intent to provide both standard and customized environmental testing services to our clients. To ensure project success, technical staff shall perform a thorough review of technical and QC requirements contained in contracts. Contracts are reviewed for adequately defined requirements and STL's capability to meet those requirements.

Contract review shall include a review of the client's requirements in terms of compound lists, test methodology requested, sensitivity, accuracy, and precision requirements. The STL representative ensures that the laboratory's test methods are suitable to achieve these requirements and must ensure that the laboratory holds the appropriate certifications and approvals to perform the work. The review also includes the laboratory's capabilities in terms of turnaround time, capacity, and resources to provide the services requested, as well the laboratory's ability to provide the documentation, whether hardcopy or electronic. If the laboratory cannot provide all services but intends to subcontract such services, whether to another STL facility or to an outside firm, this must be documented and discussed with the client prior to contract approval.

All contracts entered into by STL shall be reviewed and approved by the appropriate personnel at the facility or facilities performing the work. Any contract requirement or amendment to a contract communicated to STL verbally must be documented and confirmed with the client in writing. Any discrepancy

between the client's requirements and STL's capability to meet those requirements is resolved in writing before acceptance of the contract. Contract amendments, initiated by the client and/or STL, are documented in writing for the benefit of both the client and STL.

All contracts, Quality Assurance Project Plans (QAPPs), Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the permanent project record as defined in Section 4.12.1.

4.4.2. Project Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, STL assigns a Project Manager (PM) to each client. The PM is the first point of contact for the client. It is the PM's responsibility to ensure that project specific technical and QC requirements are effectively communicated to the laboratory personnel before and during the project.

Each STL facility shall have established project planning procedures in order to ensure that communication is inclusive and effective. These include project memos, designation and meetings of project teams, and meetings between the laboratory staff and the client. STL has found it very effective to invite the client into this process. STL strongly encourages our clients to visit the laboratories and hold formal or informal sessions with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

4.4.3. Data Quality Objectives

Data Quality Objectives (DQO) are qualitative and quantitative statements used to ensure the generation of the type, quantity, and quality of environmental data that will be appropriate for the intended application. Typically, DQOs are identified before project initiation, during the development of QAPPs and SAPs. The analytical DQOs addressed in this section are precision, accuracy, representativeness, completeness, and comparability.

The components of analytical variability (uncertainty) can be estimated when QC samples of the right types and at the appropriate frequency are incorporated into measurement process at the analytical laboratory. STL incorporates numerous QC samples to obtain data for comparison with the analytical DQOs and to ensure that the measurement system is functioning properly. The QC samples and their applications, described in Section 5.8.2, are selected based on regulatory, method- or client-specific requirements. Analytical laboratory QC samples for inorganic,

organic, and radionuclide analyses may include calibration blanks, instrument blanks, method blanks, LCS, calibration standards, MS, MSD, surrogate spikes, and yield monitors.

The DQOs discussed below ensure that data are gathered and presented in accordance with procedures appropriate for its intended use, that the data is of known and documented quality, and are able to withstand scientific and legal scrutiny.

Precision is an estimate of variability. It is an estimate of agreement among individual measurements of the same physical or chemical property, under prescribed similar conditions. Precision is expressed either as Relative Standard Deviation (RSD) for greater than two measurements or as Relative Percent Difference (RPD) for two measurements. Precision is determined, in part, by analyzing data from aggregate LCS results, MS, MSD, and MD. For radiochemical determinations, counting statistics can also provide an estimate of uncertainty.

Precision also refers to the measurement of the variability associated with the entire process, from sampling to analysis. Total precision of the process can be determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations.

Accuracy is the degree of agreement between a measurement and the true or expected value, or between the average of a number of measurements and the true or expected value. It reflects the total error associated with a measurement.

Both random and systematic errors can affect accuracy. For chemical properties, accuracy is expressed either as a percent recovery (R) or as a percent bias (R - 100). Accuracy is determined, in part, by analyzing data from LCS, MS, and MSD. For radiochemical determinations, counting statistics can also provide an estimate of uncertainty.

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, a variation in a physical or chemical property at a sampling point, or an environmental condition. Data representativeness is primarily a function of sampling strategy; therefore, the sampling scheme must be designed to maximize representativeness. Representativeness also relates to ensuring that, through sample homogeneity, the sample analysis result is representative of the constituent concentration in the sample matrix. STL makes every effort to analyze an aliquot that is representative of the original sample, and to ensure the homogeneity of the sample before sub-sampling.

Completeness is defined as the percentage of measurements that are judged valid or useable. Factors negatively affecting completeness include the following: sample leakage or breakage in transit or during handling, loss of sample during laboratory analysis through accident or improper handling, improper documentation such that traceability is compromised, or sample result is rejected due to failure to conform to QC specifications. A completeness objective of greater than 90% of the data specified by the statement of work is the goal established for most projects.

Comparability is a measure of the confidence with which one data set can be compared to another. To ensure comparability, all laboratory analysts are required to use uniform procedures (e.g., SOPs) and a uniform set of units and calculations for analyzing and reporting environmental data.

4.5. Subcontracting

Subcontracting must be arranged with the documented consent of the client, in a timely response which shall not be unreasonably refused. All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. The originating laboratory shall obtain proof of certification from the subcontract facility, and retain in STL records. Where applicable, specific QC guidelines, QAPPs, and/or SAPs are transmitted to the subcontract laboratory. Samples are subcontracted under formal Chain of Custody (COC).

Subcontract laboratories may receive an on-site audit by a representative of STL's QA staff if it is deemed appropriate by the QA Manager. The audit involves a measure of compliance with the required test method, QC requirements, as well as any special client requirements. The originating laboratory may also perform a paper audit of the subcontractor, which would entail reviewing the LQM, the last two PT studies, and a copy of any recent regulatory audits with the laboratory's responses.

Intra-company subcontracting may also occur between STL facilities. Intra-company subcontracting within STL must be arranged with the documented consent of the client, in a timely response which shall not be unreasonably refused. The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as other contract needs.

Project reports from both STL and external subcontractors are discussed in Section 5.9.4.

4.6. Purchasing Services and Supplies

Evaluation and selection of suppliers and vendors is done, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a

continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, all purchases from specific vendors are approved by a member of the supervisory or management staff.

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Purchasing guidelines for equipment and reagents meet with the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with the Testing Solvents and Acids procedure S-T-001.

4.7. Service to the Client

4.7.1. Sample Acceptance Policy

Each STL facility shall maintain a sample acceptance policy that describes compromised sample receipt. Samples shall be considered "compromised" if the following conditions are observed upon sample receipt:

- Cooler and/or samples are received outside of temperature specification.
- Samples are received broken or leaking.
- Samples are received beyond holding time.
- Samples are received without appropriate preservative.
- Samples are received in inappropriate containers.
- COC does not match samples received.
- COC is not properly completed or not received.
- Breakage of any Custody Seal.
- Apparent tampering with cooler and/or samples.
- Headspace in volatiles samples.
- Seepage of extraneous water or materials into samples.
- Inadequate sample volume.
- Illegible, impermanent, or non-unique sample labeling.

When "compromised" samples are received, it must be documented in the project records and the client must be contacted for instructions. If the client decides to proceed with analysis, the project report shall clearly indicate any of the above conditions and the resolution.

4.7.2. Client Confidentiality and Proprietary Rights

Data and sample materials provided by the client or at the client's request, and the results obtained by STL, shall be held in confidence (unless such information is generally available to the public or is in the public domain or client has failed to pay STL for all services rendered or is otherwise in breach of the terms and conditions set forth in the STL and client contract) subject to any disclosure required by law or legal process. STL's reports, and the data and information provided therein, are for the exclusive use and benefit of client, and are not released to a third party without written consent from the client.

4.8. Complaints

Client complaints shall be documented, communicated to management, and addressed promptly and thoroughly. Client complaints are documented by the employee receiving the complaint. The documentation can take the form of a corrective action report (as described in Section 4.10) or in a format specifically designed for that purpose. The Laboratory Director, PM, Customer Service Manager, and QA Manager are informed of all client complaints, and assist in resolving the complaint.

The nature of the complaint is identified, documented, and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA department is required to conduct a special audit to assist in resolving the issue. A written confirmation, or letter to the client, outlining the issue and response taken is strongly recommended as part of the overall action taken.

The number and nature of client complaints shall be reported to the QA Director in the QA Monthly report submitted by each facility. The overall number of complaints received per facility is tracked and the appropriateness of the response to client complaints is assessed. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Management Systems Review.

4.9. Control of Non-conformances

Each STL facility shall have a procedure to control and document non-conformances. Non-conformances include any out of control occurrence. Non-conformances may relate to client specific requirements, procedural requirements, or equipment issues. All non-conformances in the laboratory are documented at the time of their occurrence.

All non-conformances that affect a sample and/or sample data become part of the affected project's permanent record. When appropriate, reanalysis is performed where QC data falls outside of specifications, or where data appears anomalous. If the reanalysis comes back within established tolerances, the results are approved. If the reanalysis is still outside tolerances, further reanalysis or consultation with the Supervisor, Manager, PM, Laboratory Director, or QA Manager for direction may be required. All records of reanalysis are kept with the project files.

Where non-conformances specifically affect a client's sample and/or data, the client shall be informed and action must be taken. Action can take the form of reporting and flagging the data, and including a description of the non-conformance in the project narrative or cover letter.

4.10. Corrective Action

4.10.1. General

Each STL facility shall maintain an established, documented corrective action process. Each corrective action is thoroughly investigated, and the investigation, outcome of the investigation, action taken, and follow-up is documented. Corrective action reports are reviewed, approved, and maintained by the QA department.

4.10.2. Initiation

Any employee in STL shall be authorized to initiate a corrective action. The initial source of corrective action can also be external to STL (i.e. corrective action because of client complaint, regulatory audit, or proficiency test). When a problem that requires corrective action is identified, the following items are identified by the initiator on the corrective action report: the nature of the problem, the name of the initiator, and the date. If the problem effects a specific client project, the name of the client and laboratory project number is recorded, and the PM is informed immediately.

4.10.3. Cause Analysis

The corrective action process must be embarked upon as a joint, problem solving, constructive effort. Identification of systematic errors, or errors that are likely to occur repetitively due to a defect or weakness in a system, is particularly valuable in maintaining an environment of continuous improvement in laboratory operations.

When a corrective action report is initiated, the initiator works with the affected employee(s) and/or department(s) to identify the root cause of the problem. An essential part of the corrective action process is to identify whether the problem occurred due to a systematic or isolated error.

If the initiator of the corrective action report is uncertain as to what would constitute appropriate corrective action or is unable to resolve the situation, the problem is identified to the Supervisor, Manager, Laboratory Director or the QA Manager who provides assistance in the corrective action process.

The root cause of the problem and associated cause analysis is documented on the corrective action form.

4.10.4. Corrective Action

Once the root cause of a problem is identified, the initiator and affected employee(s) and/or department(s) examine potential actions that will rectify the present problem to the extent possible, and prevent recurrence of future, similar occurrences. An appropriate corrective action is then recommended. The corrective action must be appropriate for the size and nature of the issue.

If the corrective action concerns a specific project related issue, the PM or Customer Service Manager approves the corrective action before its implementation.

Implementation of the corrective action and the date of implementation are documented on the corrective action report.

If a corrective action is related to a specific project report, it is included in the project file. An essential part of the corrective action process is communication and awareness of the problem, the cause, and the action taken to prevent future occurrences and/or rectify the immediate problem.

4.10.5. Monitoring Corrective Action

All corrective action reports are maintained by the QA Department. The QA department reviews all corrective actions and selects one or more of the more significant corrective actions for inclusion in the annual systems audit. The QA Department also may implement a special audit. The purpose of inclusion of the corrective action process in both routine and special audits is to monitor the implementation of the corrective action and to determine whether the action taken has been effective in overcoming the issue identified.

4.11. Preventative Action

Each STL facility shall maintain an established, documented preventative action process. Preventative action is defined as noting and correcting a problem before it happens, because of a weakness in a system, method, or procedure. Preventative action includes analysis of the quality system to detect, analyze, and eliminate potential causes of non-conformances. When potential problems are identified, preventative action is initiated to effectively address the problem to eliminate or reduce the risk identified

4.12. Records

4.12.1. Record Types

Record types are described in Table 4.

Table 4 STL Record Types

Raw Data	Controlled Documents	QC Records	Project Records	Administrative Records
See Section 3. Terms and Definitions	LQM	Audits/ Responses	COC Documentation	Accounting
	QMP	Certifications	Contracts and Amendments	EH&S Manual, Permits, Disposal Records
	SOPs	Corrective Action	Correspondence	Employee Handbook
		Logbooks*	QAPP	Personnel files, Employee Signature & Initials, Training Records
		Method & Software Validation, Verification data	SAP	
		Standards Certificates	Telephone Logbooks	Technical and Administrative Policies

*Examples of Logbook types: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature.

4.12.2. Record Retention

Table 5 outlines STL's standard record retention time. For raw data and project records, record retention shall be calculated from the date the project report is issued. For other records, such as Controlled Documents, QC, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the programs listed in Table 6 have lengthier retention requirements and are subject to the requirements in Section 4.12.3.

Table 5 STL Record Retention

Record Type		Archival Requirement
Raw Data	All*	5 Years from project completion
Controlled Documents	All*	5 Years from document retirement date
QC	All*	5 Years from archival
Project	All*	5 Years from project completion
Administrative	Personnel/Training	7 years
	Accounting	See Accounting and Control Procedures Manual

* Exceptions listed in Table 6.

Table 6 Special Record Retention Requirements

Program	Retention Requirement
Colorado – Drinking Water	10 years
Commonwealth of MA – All environmental data 310 CMR 42.14	10 years
FIFRA – 40 CFR Part 160	Retain for life of research or marketing permit for pesticides regulated by EPA
Housing and Urban Development (HUD) Environmental Lead Testing	10 years
Louisiana – All	10 years
Michigan Department of Environmental Quality – all environmental data	10 years
Minnesota – Drinking Water	10 years
Navy Facilities Engineering Service Center (NFESC)	10 years
NY Potable Water NYCRR Part 55-2	10 years
OSHA - 29 CFR Part 1910	30 years
Pennsylvania – Drinking Water	10 years
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement

4.12.3. Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the STL standard record retention time. These are detailed in Table 6 with their retention requirements. In these cases, the longer retention requirement must be implemented and noted in the archive. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box

containing that data is marked as to who to contact for authorization prior to destroying the data.

4.12.4. Archives and Record Transfer

Archives must be indexed such that records are accessible on either a project or temporal basis. Archives are protected against fire, theft, loss, deterioration, and vermin. Electronic records are protected from deterioration caused by magnetic fields and/or electronic deterioration. Access to archives is controlled and documented. On-site and/or off-site facilities may be used.

STL ensures that all records are maintained as required by the regulatory guidelines and per the QMP upon facility location change or ownership transfer. Upon STL facility location change, all archives are retained by STL in accordance with the QMP. Upon ownership transfer, record retention requirements shall be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established.

4.13. Internal Audits

4.13.1. Audit Types and Frequency

A number of types of audits shall be performed at STL. Audit type and frequency are categorized in Table 7.

Table 7 Audit Types and Frequency

Audit Type	Performed by	Frequency
Systems	QA Department or Designee	Annual
Data	QA Department	5% of all projects or as agreed upon with Corporate QA Director
Special	QA Department or Designee	As Needed

4.13.2. Systems Audits

Facility systems audits are technical in nature and are conducted on an ongoing basis by the QA Manager or his/her designee at each facility. Systems audits cover all departments of the facility, both operational and support.

The audit report is issued by internal auditor within 30 calendar days of the audit. The audit report is addressed to the Laboratory Director, and copied to the

General Manager . If the internal audit is performed by someone other than the facility's QA Manager, the report must also be addressed to the QA Manager.

Written audit responses are required within 30 calendar days of audit report issue. The audit response follows the format of the audit report, and corrective actions and time frames for their implementation are included for each deficiency. The audit response is directed to all individuals copied on the audit report. Where a corrective action requires longer than 30 days to complete, the target date for the corrective action implementation is stated and evidence of the corrective action is submitted to the QA Department in the agreed upon time frame.

4.13.3. Data Audits

Data audits are focussed to assess the level of customer service, SOP compliance, regulatory compliance, accuracy and completeness of test results and reports, documentation, and adherence to established QC criteria, laboratory SOPs, technical policy, and project specific QC criteria.

A data auditing frequency target of 5% has been established. The QA Department provides feedback and/or corrections and revisions to project reports where necessary. Data audits must include spot-checking of manual integrations by QA personnel in order to determine that the manual integration is appropriate and documented according to Section 5.3.6.

Records of the data audits shall be kept, and the frequency of data audits shall be included in the monthly QA report. In performing data audits, it is essential that data be assessed in terms of differentiating between systematic and isolated errors. Upon noting anomalous data or occurrences in the data audits, the QA Department is responsible for seeking clarification from the appropriate personnel, ascertaining whether the error is systematic or an isolated error, and overseeing correction and/or revision of the project report if necessary. Errors found in client project reports are revised and the revision sent to the client. The QA Department is also responsible for assisting in the corrective action process where a data audit leads to identification of the need for permanent corrective action.

Where specific clients and regulatory programs require more frequent data auditing, the individual facility must meet the data auditing frequency for that program.

4.13.4. Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, proficiency testing results, data audits, systems audits, validation comments, or regulatory audits. Special audits are focussed on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

4.14. External Audits

STL facilities are routinely audited by clients and external regulatory authorities. STL is available for these audits and makes every effort to provide the auditors with the personnel, documentation, and assistance required by the auditors. STL recommends that the audits be scheduled with the QA Department so that all necessary personnel are available on the day of the audit.

4.15. Management Reviews

4.15.1. QA Reports to Management

A monthly QA report shall be prepared by the QA Manager or their designee and forwarded to the Laboratory Director and the QA Director. The reports include statistical results that are used to assess the effectiveness of the quality system. At a minimum, the contents of the monthly report is shown in Figure 2.

A Corporate QA Monthly Report containing a compilation of the Facility QA reports statistics, information on progress of the Corporate QA program, and a narrative outlining significant occurrences and/or concerns shall be prepared by the QA Director and forwarded to the General Manager of Operational and Technical Services and the COO.

4.15.2. Management Systems Review

Each STL facility shall perform a management systems review at least annually. The management systems review ensures that the laboratory's quality system is adequate to satisfy the laboratory's policies and practices, regulatory requirements, certification, accreditation, approval requirements, and client expectations. Management systems reviews are accomplished through monthly quality assurance reporting, goal setting and an annual LQM review.

Figure 2 Monthly QA Report Format

1. Audits
   Internal systems audits performed.
   External systems audits performed.
   Data audits performed (in percent).
2. Revised Reports/Client Complaints
   Revised reports in percent.
   Total number of client complaints, reason, and resolution.
3. Certifications/Parameters Changes
4. Proficiency Testing
   Score for each PT as a percent.
   Note repeat failures and/or significant problems.
5. Miscellaneous QA and Operational Issues
   Narrative outlining improvements, regulatory compliance issues, general concerns, and assistance required from Corporate QA.
6. SOP Status: Report the percentage of SOPs that have been revised or reviewed within the last 24 months

5. *Technical Requirements*

5.1. Personnel

5.1.1. General

STL management believes that its highly qualified and professional staff is the single most important aspect in assuring the highest level of data quality and service in the industry.

STL staff consists of over two thousand professionals and support personnel that include the following positions:

- General Manager
- Customer Service Manager
- Quality Assurance Manager
- Laboratory Director
- Technical Director
- Laboratory Manager
- Department Supervisor

- Information Technology Manager
- Human Resources Manager
- Project Manager
- Department Manager
- Analyst
- Sample Custodian
- Technician
- Quality Assurance Specialist
- Data Review Specialist
- Information Technology Specialist

5.1.2. Training

STL is committed to furthering the professional and technical development of employees at all levels. Minimum training requirements for STL employees are outlined in Table 8.

Table 8 STL Employee Minimum Training Requirements

Required Training	Time Frame*	Employee Type
Environmental Health & Safety	Month 1	All
Quality Assurance	Quarter 1	All
Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

*From date of initial employment unless otherwise indicated.

Technical training is accomplished within each laboratory by management to ensure method comprehension. All new personnel shall be required to demonstrate competency in performing a particular method by successfully completing a Demonstration of Capability (DOC) before conducting analysis independently on client samples.

DOCs are performed by analysis of four replicate QC samples. Results of successive LCS analyses can be used to fulfill the DOC requirement. The accuracy and precision, measured as average recovery and standard deviation (using n-1 as the population), of the 4 replicate results are calculated and compared to those in the test method (where available). If the test method does not include accuracy and precision requirements, the results are compared to target criteria set by the laboratory. The laboratory sets the target criteria such that they reflect the DQOs of the specific test method or project. A DOC Certification Statement is recorded and maintained in the employee's training or personnel file. Figure 3 shows an example of a DOC Certification Statement.

The following evidence must be on file at the laboratory for each technical employee:

- DOC.
- The employee has read and understood the latest version of the laboratory's quality documentation.
- The employee has read and understood the latest, approved version of all test methods and/or SOPs for which the employee is responsible.
- Annual evidence of continued DOC that may include successful analysis of a blind sample on the specific test method, or a similar test method, or an annual DOC, or four successive, successful LCS.

Figure 3 Example Demonstration of Capability Certification Statement

Demonstration of Capability
Certification Statement

Date: Matrix:
Laboratory Name: Method:
Laboratory Address:
Analyst Name:

We the undersigned certify that:

1. The analyst identified above, using the cited test method, which is in use at this facility for the analysis of samples under the National Environmental Laboratory Accreditation Program, has met the Demonstration of Capability.
2. The test method was performed by the analyst identified on this certification.
3. Copies of the test method and SOP are available for all personnel on site.
4. The data associated with the DOC are true, complete and representative.
5. All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at the facility, and that the associated information is available for review by authorized inspectors.

Laboratory Manager/Supervisor _____ Signature _____ Date _____

5.1.3. Ethics Policy

Establishing and maintaining a high ethical standard is an important element of a quality system. In order to ensure that all personnel understand the importance the company places on maintaining high ethical standards at all times, STL has established an Ethics Policy P-L-006 and an Ethics Agreement (Figure 4). Each

employee shall sign the Ethics Agreement, signifying agreed compliance with its stated purpose.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize the Company's ability to do work on Government contracts, and for that reason, the Company has a Zero Tolerance approach to such violations.

Ethics is also a major component of the STL QA training program. Each employee must be trained in ethics within three months of hire in a QA training program that includes an overview of regulatory programs and program goals, a review of the ethics statement, and group discussions about data integrity and data misrepresentation. Employees must be trained as to the legal and environmental repercussions that result from data misrepresentation. A data integrity hotline is maintained by STL and administered by the QA Director.

Figure 4 STL Ethics Agreement

I understand that STL is committed to ensuring the highest standard of quality and integrity of the data and services provided to our clients. I have read the Ethics Policy of the Company.

With regard to the duties I perform and the data I report in connection with my employment at the Company, I agree that:

- I will not intentionally report data values that are not the actual values obtained;
- I will not intentionally report the dates, times, sample or QC identifications, or method citations of data analyses that are not the actual dates, times, sample or QC identifications, or method citations;
- I will not intentionally misrepresent another individual's work;
- I will not intentionally report data values that do not meet established quality control criteria as set forth in the Method and/or Standard Operating Procedures, or as defined by Company Policy;
- I agree to inform my Supervisor of any accidental reporting of non-authentic data by me in a timely manner; and I agree to inform my Supervisor of any accidental or intentional reporting of non-authentic data by other employees; and
- If a supervisor or a member of STL management requests me to engage in or perform an activity that I feel is compromising data validity or quality, I will not comply with the request and report this action immediately to a member of senior management, up to and including the President of STL.

As a STL employee, I understand that I have the responsibility to conduct myself with integrity in accordance with the ethical standards described in the Ethics Policy. I will also report any information relating to possible kickbacks or violations of the Procurement Integrity Act, or other questionable conduct in the course of sales or purchasing activities. I will not knowingly participate in any such activity and will report any actual or suspected violation of this policy to management.

The Ethics Policy has been explained to me by my supervisor or at a training session, and I have had the opportunity to ask questions if I did not understand any part of it. I understand that any violation of this policy subjects me to disciplinary action, which can include termination. In addition, I understand that any violation of this policy which relates to work under a government contract or subcontract could also subject me to the potential for prosecution under federal law.

EMPLOYEE SIGNATURE _____ Date _____

Supervisor/Trainer: _____ Date _____

5.2. Facilities

Each STL facility must be secure and access must be controlled and documented. Access is controlled by various measures including locked doors, passwords, electronic access cards, security codes, and staffed reception areas. All visitors sign in and are escorted by STL personnel while at an STL facility.

STL's facilities are designed for efficient, automated high-quality operations. All laboratories are equipped with Heating, Ventilation, and Air Conditioning (HVAC) systems appropriate to the needs of environmental testing laboratories. Environmental conditions in the facilities, such as hood flow, are routinely monitored and documented. Table 9 summarizes the square footage at each STL facility.

All STL facilities are equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. STL also provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, respirators, etc.

Table 9 STL Laboratory Square Footage

Facility	Square Footage
STL Austin	43,000
STL Billerica	10,000
STL Buffalo	32,000
STL Burlington	36,000
STL Chicago	51,000
STL Connecticut	17,000
STL Corpus Christi	12,000
STL Denver	54,000
STL Edison	30,000
STL Houston	28,000
STL Knoxville	29,000
STL Los Angeles	27,000
STL Miami	9,000
STL Mobile	14,000

Facility	Square Footage
STL Newburgh	8,000
STL North Canton	53,000
STL Pensacola	18,000
STL Pittsburgh	30,000
STL Richland	33,000
STL Sacramento	66,000
STL Savannah	55,000
STL San Francisco	21,000
STL Seattle	15,000
STL St. Louis	31,000
STL Tallahassee	22,000
STL Tampa	12,000
STL Valparaiso	7,000
STL Westfield	10,000

5.3. Test Methods

5.3.1. Method Selection

Most of the test methods performed at STL originate from test methods published by a regulatory agency such as the US EPA and other state and federal regulatory agencies. These include, but are not limited to, the following published compendiums of test methods:

Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, US EPA, January 1996.

Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and Appendix A-C; 40 CFR Part 136, USEPA Office of Water.

Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983.

Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993.

Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991. Supplement I: EPA-600/R-94/111, May 1994.

Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88-039, December 1988, Revised, July 1991, Supplement I, EPA-600-4-90-020, July 1990, Supplement II, EPA-600/R-92-129, August 1992.

NIOSH Manual of Analytical Methods, 4th ed., August 1994.

Statement of Work for Inorganics Analysis, ILM04.1, USEPA Contract Laboratory Program Multi-media, Multi-concentration.

Statement of Work for Organics Analysis, OLM04.2, USEPA Contract Laboratory Program, Multi-media, Multi-concentration.

Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration, OLMO4.1, USEPA Contract Laboratory Program, September 1998.

Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.

Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996.

Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.

National Status and Trends Program, National Oceanographic and Atmospheric Administration, Volume I-IV, 1985-1994.

5.3.2. SOPs

Each STL facility shall maintain an SOP Index for both Method and Process SOPs. Method SOPs are maintained to describe a specific test method. Process SOPs are maintained to describe function and processes not related to a specific test method.

Method SOPs contain the following information:

Title Page with Document Name, Document Number, Revision Number, Effective Date, Page Numbers and Total # of Pages, Authorized Signatures, Dates and Proprietary Information Statement (Figure 5).

1. Identification of Test Method	12. Calibration and Standardization
2. Applicable Matrix	13. Procedure
3. Reporting Limit	14. Calculations
4. Scope and Application, including test analytes	15. Method Performance
5. Summary of the Test Method	16. Pollution Prevention
6. Definitions	17. Data Assessment and Acceptance Criteria for Quality Control Measures
7. Interferences	18. Corrective Actions for Out-of-Control Data
8. Safety	19. Contingencies for Handling Out-of-Control or Unacceptable Data
9. Equipment and Supplies	20. Waste Management
10. Reagents and Standards	21. References
11. Sample Collection, Preservation, Shipment and Storage	22. Tables, Diagrams, Flowcharts and Validation Data
12. Quality Control	

Process SOPs may contain the following information:

Title Page with Document Name, Document Number, Revision Number, Effective Date, Page Numbers and Total # of Pages, Authorized Signatures, Dates and Proprietary Information Statement (Figure 5).

1. Scope
2. Summary
3. Definitions
4. Responsibilities
5. Safety
6. Procedure
7. References
8. Tables, Diagrams, and Flowcharts

The QA Department is responsible for maintenance of SOPs, archival of SOP historical revisions, maintenance of an SOP index, and records of controlled distribution. SOPs, at a minimum, must undergo periodic review as described the each facility's LQM or SOP. Where an SOP is based on a published method, the laboratory must maintain a copy of the reference method.

Figure 5 Proprietary Information Statement

This documentation has been prepared by Severn Trent Laboratories (STL) solely for STL's own use and the use of STL's customers in evaluating its qualifications and capabilities in connection with a particular project. The user of this document agrees by its acceptance to return it to STL upon request and not to reproduce, copy, lend, or otherwise disclose its contents, directly or indirectly, and not to use if for any other purpose other than that for which it was specifically provided. The user also agrees that where consultants or other outside parties are involved in the evaluation process, access to these documents shall not be given to said parties unless those parties also specifically agree to these conditions.

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SOP Appendix
In some cases, a standard laboratory procedure is modified slightly for a specific client or project at the client or regulatory agency's request. In these cases, an Appendix to the SOP may be attached that indicates the modifications to the SOP which are specific to that project. SOP appendices shall not be used to alter test methods required by regulation such that the modifications would result in non-compliance with the regulation.

5.3.3. Method Validation

Laboratory developed methods are validated and documented according to the procedure described in Section 5.3.5.

5.3.4. Method Verification

Method verification is required when a validated standard test method or a method modification is implemented. The level of activity required for method verification is dependent on the type of method being implemented, or on the level of method modification and its affect on a method's robustness. Method modification often takes advantage of a method's robustness, or the ability to make minor changes in a method without affecting the method's outcome. Method verification may require some, but not all, of the activities described in Section 5.3.5.

5.3.5. Method Validation and Verification Activities

Before analyzing samples by a particular method, method validation and/or method verification must occur. A complete validation of the method is required for laboratory developed methods. While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

Determination of Method Selectivity
Method selectivity is demonstrated for the analyte(s) in the specific matrix or matrices. In some cases, to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

Determination of Method Sensitivity
Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Where estimations and/or demonstrations of sensitivity are required by regulation or

client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act, these shall be followed. STL Facilities must have an SOP that details their approach to estimation and/or demonstration of sensitivity. Refer to the Method Detection Limits Study Procedure S-Q-003 for additional information.

Relationship of Limit of Detection (LOD) to the Quantitation Limit (QL)

Each laboratory shall have a procedure to relate the QL to the LOD (or MDL if appropriate). An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum level at which both the presence of an analyte and its concentration can be reliably determined. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

Determination of Interferences
A determination that the method is free from interferences in a blank matrix is performed.

Determination of Range
Where appropriate, a determination of the applicable range of the method may be performed. In most cases, range is determined and demonstrated by comparison of the response of an analyte in a curve to established or targeted criteria. The curve is used to establish the range of quantitation and the lower and upper values of the curve represent upper and lower quantitation limits. Curves are not limited to linear relationships.

Demonstration of Capability
DOCs are performed prior to method performance.

Determination of Accuracy and Precision
Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard

deviation, relative standard deviation) calculated and measured against a set of target criteria.

Documentation of Method

The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Appendix describing the specific differences in the new method is acceptable in place of a separate SOP.

Continued Demonstration of Method Performance

Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as LCS and Method Blanks.

5.3.6. Data Review

All data, regardless of regulatory program or level of reporting, shall be subject to a thorough review which involves a primary, secondary, and completeness review process. All levels of the review must be documented.

Primary Review

The primary review is often referred to as a "bench-level" review. In most cases, the analyst who generates the data (i.e. logs in, prepares and/or runs the samples) is the primary reviewer. In some cases, an analyst may be reducing data for samples run by an auto-sampler set up by a different analyst. In this case, the identity of both the analyst and the primary reviewer is identified in the raw data.

One of the most important aspects of primary review is to make sure that the test instructions are clear, and that all project specific requirements have been understood and followed.

Once an analysis is complete, the primary reviewer must ensure that:

- Sample preparation information is complete, accurate, and documented.
- Calculations have been performed correctly.
- Quantitation has been performed accurately.
- Qualitative identifications are accurate.
- Manual integrations are appropriate.
- Data flags to indicate manual integrations are recorded.
- Manual integrations are authorized by a date and signature or initials of primary analyst.
- Client specific requirements have been followed.
- Method and process SOPs have been followed.

- Method QC criteria have been met.
- QC samples are within established limits.
- Dilution factors are correctly recorded and applied.
- Non-conformances and/or anomalous data have been properly documented and appropriately communicated.
- COC procedures have been followed.
- Primary review is documented by date and initials/signature of primary analyst.

Any anomalous results and/or non-conformances noted during the Primary Review are communicated to the Supervisor and the PM for resolution. Resolution can require sample reanalysis, or it may require that data be reported with a qualification. Non-conformances are documented per Section 4.9.

Secondary Review

The secondary review shall be a complete technical review of a data set. The secondary review must be documented and the secondary reviewer identified. The following items are reviewed:

- Qualitative Identification
- Quantitative Accuracy
- Calibration
- QC Samples
- Method QC Criteria
- Adherence to method and process SOPs
- Accuracy of Final Client Reporting Forms
- Manual Integrations – Minimal requirement is to spot-check raw data files for manual integration, as verified by date and initials or signature of secondary data reviewer. Some regulatory programs require 100% secondary review of manual integrations.
- Completeness
- Special Requirements/Instructions

If problems are found during the secondary review, the reviewer must work with the appropriate personnel to resolve them. If changes are made to the data, such as alternate qualitative identifications, identifications of additional target analytes, re-quantitation, or re-integration, the secondary reviewer must contact the laboratory analyst and/or primary reviewer of the data so that the primary analyst and/or reviewer is aware of the appropriate reporting procedures.

Completeness Review

The completeness review shall include the generation of a project narrative and/or cover letter which outlines anomalous data and non-compliances using project narrative notes and non-compliance reports generated during the primary and secondary review. The completeness review addresses the following items:

- Is the project report complete?
- Does the data meet with the client's expectations?
- Were the data quality objectives of the project met?
- Are QC outages and/or non-conformances approved and appropriately explained in the narrative notes?

5.3.7. Data Integrity and Security

This section details those procedures that are relevant to computer systems that collect, analyze, and process raw instrumental data, and those that manage and report data.

Security and Traceability

Access to computer systems that collect, analyze, and process raw instrumental data, and those that manage and report data must be both controlled and recorded. There are various systems at STL to which this applies, which include the Laboratory Information Management System (LIMS), as well as specific systems such as chromatography data systems.

Control of the system is accomplished through limitation of access to the system by users with the education, training and experience to perform the task knowledgeably and accurately. System users are granted privileges that are commensurate with their experience and responsibilities.

Computer access is tracked by using unique login names and passwords for all employees that have access to the computer system. "General" or "multi-user" account access to computer systems that collect, analyze and process raw instrumental data, and those that manage and report data shall not be permitted. Entries and changes are documented with the identity of the individual making the entry, and the time and date. Where a computer system is processing raw instrumental data, the instrument identification number as described in Section 5.4.1 is recorded. Many of these systems have the capability of maintaining audit trails to track entries and changes to the data. This function is activated on any computer system that has that capability.

Verification
All commercially obtained software shall be verified prior to use and after version upgrade. Verification involves assessing whether the computer system accurately performs its intended function. Verification generally is accomplished by comparing the output of the program with the output of the raw data manually processed, or processed by the software being replaced. The records of the verification are required to contain the following information: software vendor, name of product, version, comparison of program output and manual output, raw data used to verify the program, date, and name of the individual performing the verification. Records of verification are retained as QC records.

Validation
Software validation involves documentation of specifications and coding as well as verification of results. Software validation is performed on all in house programs. Records of validation include original specifications, identity of code, printout of code, software name, software version, name of individual writing the code, comparison of program output with specifications, and verification records as specified above. Records of validation are retained as QC records.

Auditing
The QA Department systems audit includes review of the control, security, and tracking of IT systems and software.

Version Control
The laboratory shall maintain copies of outdated versions of software and associated manuals for all software in use at the laboratory for a period of five years from its retirement date. The associated hardware, required to operate the software, must also be retained for the same time period.

5.4. Equipment

5.4.1. Equipment Operation

STL is committed to routinely updating and automating instrumentation. STL facilities maintain state of the art instrumentation to perform the analyses within the QC specifications of the test methods. Each STL facility shall maintain an equipment list that must include the following information:

- Identity
- Date Installed or year placed in service
- Manufacturer's Name, Model Number, Serial Number
- Current Location
- Preventative Maintenance Schedule

All equipment is subject to rigorous checks upon its receipt, upgrade, or modification to establish that the equipment meets with the selectivity, accuracy, and precision required by the test method for which it is to be used. All manufacturer's operations and maintenance manuals are kept up to date and accessible for the use of the equipment operator. Documentation of equipment usage is maintained using analytical run and maintenance logbooks.

5.4.2. Equipment Maintenance

Each STL facility must employ a system of preventative maintenance in order to ensure system up time, minimize corrective maintenance costs and ensure data validity. All routine maintenance is performed as recommended by the manufacturer and may be performed by an analyst, instrument specialist or outside technician. Maintenance logbooks are kept on all major pieces of equipment in which both routine and non-routine maintenance is recorded. Notation of the date and maintenance activity is recorded each time service procedures are performed. The return to analytical control following instrument repair is documented. Maintenance logbooks are retained as QA records.

Maintenance contracts are held on specific pieces of equipment where outside service is efficient, cost-effective, and necessary for effective operation of the laboratory.

5.4.3. Equipment Verification and Calibration

All equipment shall be tested upon receipt to establish its ability to meet the QC guidelines contained in the test method for which the instrumentation is to be used. This testing shall be documented. Once an instrument is placed in routine service, ongoing instrument calibration is demonstrated at the appropriate frequency as defined in the test method. Refer to the Selection of Calibration Points SOP, P-T-001 for guidance on using calibration data. Any instrument that is deemed to be malfunctioning is clearly marked and taken out of service. When the instrument is brought back into control, acceptable performance is documented.

5.5. Measurement Traceability

5.5.1. General

Traceability of measurements shall be assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a

test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications ancillary equipment: balances, thermometers, temperature, Deionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. With the exception of Class A Glassware (including glass microliter syringes that have a certificate of accuracy), quarterly accuracy checks are performed for all mechanical volumetric devices. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards.

An external certified service engineer services laboratory balances on an annual basis. This service is documented on each balance with a signed and dated certification sticker. Balances are calibrated on each day of use. All mercury thermometers are calibrated annually against a traceable reference thermometer. Temperature readings of ovens, refrigerators, and incubators are checked on each day of use.

Laboratory DI and RO water systems have documented preventative maintenance schedules and the conductivity of the water is recorded on each day of use.

5.5.2. Reference Standards Traceability

The receipt of all reference standards must be documented. References standards are labeled with a unique Standard Identification Number, date received, and the expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All standards should be purchased with an accompanying Certificate of Analysis that documents the standard purity. If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The documentation of standard purity is archived, and references the Standard Identification Number.

All efforts are made to purchase standards that are $\geq$ 97.0% purity. If this is not possible, the purity is used in performing standards calculations.

The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a different lot is acceptable for use as a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or Laboratory Control Sample (LCS) is used as the second source confirmation.

5.5.3. Reagents

Reagents are, in general, required to be analytical reagent grade unless otherwise specified in method SOPs. Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the date the reagent was opened are documented.

5.6. Sampling

Sample representativeness and integrity are the foundations upon which meaningful analytical results rely. Where documented and approved SAPs and/or QAPPs are in place, they must be made available to the laboratory before sample receipt, and approved by laboratory management before sample receipt.

5.7. Sample Handling, Transport, and Storage

5.7.1. General

Chain of Custody (COC) can be established either when bottles are sent to the field, or at the time of sampling. STL can provide all of the necessary coolers, reagent water, sample containers, preservatives, sample labels, custody seals, COC forms, ice, and packing materials required to properly preserve, pack, and ship samples to the laboratory.

Samples are received at the laboratory by a designated sample custodian and a unique Laboratory Project Identification Number is assigned. The following information is recorded for each sample shipment: Client/Project Name, Date and Time of Laboratory Receipt, Laboratory Project Number, and Signature or initials of the personnel receiving the cooler and making the entries.

Upon inspection of the cooler and custody seals, the sample custodian opens and inspects the contents of the cooler, and records the cooler temperature. If the cooler arrival temperature exceeds the required or method specified temperature range by $\pm 2^{o}C$ (for samples with a temperature requirement of $4^{o}C$, a cooler temperature of just above the water freezing temperature to $6^{o}C$ is acceptable); sample receipt is considered "compromised" and the procedure described in Section 4.7.1 is followed. All documents are immediately inspected to assure agreement between the test samples received and the COC.

Any non-conformance, irregularity, or compromised sample receipt as described in Section 4.7.1 must be documented and brought to the immediate attention of the client. The COC, shipping documents, documentation of any non-

conformance, irregularity, or compromised sample receipt, record of client contact, and resulting instructions become part of the permanent project record.

Samples that are being tested at another STL facility or by an external subcontractor shall be appropriately packaged, and sent out under COC.

Following sample labeling as described in Section 5.7.2, the sample is placed in storage. Sample storage is required to be access controlled. All samples are stored according to the requirements outlined in the test method and in a manner such that they are not subject to cross contamination or contamination from their environment. Unless specified by method or state regulation, a tolerance range of $4 \pm 2^{o}C$ is used. Sample storage temperatures are monitored daily.

5.7.2. Sample Identification and Traceability

Each sample container shall be assigned a unique Sample Identification Number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a sample identification label.

All unused portions of samples, including empty sample containers, are returned to the secure sample control area.

5.7.3. Sub-sampling

Sample preparation procedures must be referenced in each STL facility's LQM and documented in the laboratory SOPs.

5.7.4. Sample Preparation

Sample preparation procedures must be referenced in each STL facility's LQM and documented in the laboratory SOPs.

5.7.5. Sample Disposal

Each facility shall have an SOP describing sample retention and disposal procedures. Samples should be retained in STL storage facilities for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for longer periods based on regulatory or client requirements (example, 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Samples may be returned to the client per written request. Unused

portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

Samples shall be disposed of in accordance with federal, state and local regulations. Each facility must have an SOP detailing the disposal of samples, digestates, and extracts.

5.8. Assuring the Quality of Test Results

5.8.1. Proficiency Testing

Each STL facility must analyze Proficiency Test (PT) samples as required for accreditation. As required by NELAC, each STL facility participates in the PT program semi-annually for each PT field of testing for which it is accredited, according to the NELAC PT field of testing published guidelines. Under SDWA, the laboratory also analyzes a PT sample by each method once per year, if the laboratory uses more than one method for the analyte.

In addition to the PT program required for NELAC accreditation, STL participates in a number of additional PT programs, as appropriate for the specific facility.

PT samples must be handled and tested in the same manner (procedural, equipment, staff) as environmental samples. PT test sample data is archived using the requirements for project and raw data record retention.

Each STL facility performing chemical analyses also participates in a double blind performance evaluation annually. An external vendor is contracted to submit double blind samples to the STL facility. Both the level of customer service and the accuracy of the test results are assessed objectively by the external contractor, who provides a detailed report to the QA Director and to each of the STL facilities. This is administered as a double blind program in order to assess all facets of STL operations.

5.8.2. Control Samples

Control samples are analyzed with each batch of samples to monitor laboratory performance in terms of accuracy, precision, sensitivity, selectivity, and interferences. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch. Control samples must be uniquely identified and correlated to unique batches. There are also a number of QC sample types that monitor field sampling

accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Control Sample types and typical frequency of their application are outlined in Table 10. Note that frequency and use of control samples vary with specific regulatory, methodology and project specific criteria. Table 10 does not define STL's approach to application of QC samples for each regulatory program or test method.

5.8.3. Calibration

Each STL Facility must define calibration protocols in STL facility SOPs.

5.8.4. Glassware Cleaning

Glassware cleaning must be described in STL facility SOPs.

5.8.5. Permitting Departures from Documented Procedure

Each STL facility must have a procedure that defines the process, documentation, and level of authorization required to permit departures from documented procedures.

Table 10 Control Samples

Laboratory QC Sample Type	Use	Required Frequency
Laboratory Control Sample (Laboratory Fortified Blank)	Measures accuracy of method in blank matrix	1 per batch of 20 or less samples per matrix type per sample extraction or preparation method[1]
Method Blank	Measures method contribution to any source of contamination	1 per batch of 20 or less samples per matrix type per sample extraction or preparation method[1]
Instrument Blank	Measures instrumental contribution to any source of contamination	As specified in test method
Cleanup Blank	Measures clean up step contribution to any source of contamination	As specified in test method
Storage Blank	Measures storage contribution to any source of contamination (Volatiles only)	As specified in test method or SOP
Control, Brine Control, or Dilution Water	Measures effect of blank water on test organisms (Aquatic toxicology)	As specified in test method and permit
Reference Toxicant	Measure sensitivity of test organisms (Aquatic toxicology)	Annually
Field QC Sample Type	**Use**	Typical Frequency
Matrix Duplicate	Measures effect of site matrix on precision of method	Per 20 samples per matrix or per SAP/QAPP[1,2]
Matrix Spike	Measures effect of site matrix on accuracy of method	Per 20 samples per matrix or per SAP/QAPP[1]
Matrix Spike Duplicate	Measures effect of site matrix on precision of method	Per 20 samples per matrix or per SAP/QAPP[1,2]
Equipment Blank (Equipment Rinsate)	Measures field equipment contribution to any source of contamination	Per SAP/QAPP
Trip Blank	Measures shipping contribution to any source of contamination (Volatiles only)	Per Cooler
Field Blank	Measures field environment contribution to any source of contamination	Per SAP/QAPP
Field Duplicate	Measures representativeness of sampling and effect of site matrix on precision	Per SAP/QAPP

[1] Denotes an STL required frequency
[2] Either an MSD or an MD is required per 20 samples per matrix or per SAP/QAPP.

Where a departure from a documented SOP, test method, or policy is determined to be necessary, or unavoidable, the departure shall be documented and be authorized by the appropriate level of management, which is defined in the policy. In some instances, it is appropriate to inform the client before permitting a departure. Any such occurrence is documented in the cover letter and/or project narrative.

5.8.6. Development of QC Criteria, Non-Specified in Method/Regulation

Where a method or regulation does not specify acceptance and/or rejection criteria, the laboratory must develop a policy for doing so. The policy must address how the laboratory examines the data user's needs and the demonstrated sensitivity, accuracy and precision of the available test methods in determining appropriate QC criteria.

Data users often need the laboratory's best possible sensitivity, accuracy, and precision using a routinely offered test method, or are unsure of their objectives for the data. For routine test methods that are offered as part of STL's standard services, the laboratory bases the QC criteria on statistical information such as determination of sensitivity, historical accuracy and precision data, and method verification data. The method SOP includes QC criteria for ongoing demonstration that the established criteria are met (i.e., acceptable LCS accuracy ranges, precision requirements, method blank requirements, initial and continuing calibration criteria, etc.).

In some cases, a routine test method may be far more stringent than a specific data user's needs for a project. The laboratory may either use the routinely offered test method, or may opt to develop an alternate test method based on the data user's objectives for sensitivity, accuracy, and precision. In this case, it can be appropriate to base the QC criteria on the data user's objectives, and demonstrate through method verification and ongoing QC samples that these objectives are met.

For example, a client may require that the laboratory test for a single analyte with specific DQOs for sensitivity, accuracy, and precision as follows: Reporting Limit of 10 ppm, accuracy $\pm$25%, and RSD of less than 30%. The laboratory may opt to develop a method that meets these criteria and document through the Method blank results, MDL study, and LCS results that the method satisfies those objectives. In this case, both the method and the embedded QC criteria have been based on the client's DQOs.

In some cases, the data user needs more stringent sensitivity, accuracy, and/or precision than the laboratory can provide using a routine test method. In this case, it is appropriate that the laboratory provide documentation of the sensitivity, accuracy, and precision obtainable to the data user and let the data user determine whether to use the best available method offered by the laboratory, or determine whether method development or further research is required.

5.9. Project Reports

5.9.1. General

All STL Project reports that are generated under NELAC requirements must contain the content as described in Section 5.9.2. The criteria described in Section 5.9.3 and 5.9.4 apply to all Project Reports.

5.9.2. Project Report Content

- Title
- Laboratory name, address, telephone number, contact person
- Unique Laboratory Project Number
- Total Number of Pages (report must be paginated)
- Name and address of Client
- Client Project Name (if applicable)
- Laboratory Sample Identification
- Client Sample Identification
- Matrix and/or Description of Sample
- Dates: Sample Receipt, Collection, Preparation and/or Analysis Date
- Definition of Data Qualifiers
- Reporting Units
- Test Method

The following are required where applicable to the specific test method or matrix:

- Solid Samples: Indicate Dry or Wet Weight
- Whole Effluent Toxicity: Statistical package used
- If holding time $\leq$ 48 hours, Sample Collection, Preparation and/or Analysis Time
- Indication by flagging where results are reported below the quantitation limit.

5.9.3. Project Narrative

A Project Narrative and/or Cover Letter shall be included with each project report and at a minimum includes an explanation of any and all of the following occurrences:

- Non-conformances
- "Compromised" sample receipt (see Section 4.7.1)
- Method Deviations
- QC criteria failures

Project Release

The Laboratory Director or his/her designee must authorize the release of the project report with a signature.

Where amendments to project reports are required after issue, these shall be in the form of a separate document and/or electronic data deliverable. The revised report is clearly identified as revised with the date of revision and the initials of the person making the revision. Specific pages of a project report may be revised using the above procedure with an accompanying cover letter indicating the page numbers of the project revised. The original version of the project report must be kept intact and the revisions and cover letter included in the project files.

5.9.4. Subcontractor Test Results

Project reports from external subcontract shall not be altered, and shall be included in original form in the final project report provided by STL. Data from subcontractors' reports may be added to an STL electronic deliverable.

Subcontracted data shall be clearly identified as such, and the name, address, and telephone number for the laboratory performing the test is included in the project report. If the report is being generated under NELAC requirements, all information outlined in Section 5.9.2 are required for both the originating laboratory and the subcontracting laboratory.

Data subcontracted within STL may be reported on the originating laboratory's report forms provided the following mandatory requirements are met:

- The name, address, and telephone number of the facility are provided.
- Analytical results produced by the STL intra-company subcontractor are clearly identified as being produced by the subcontractor facility.

- The intra-company subcontractor's original report, including the chain of custody is retained by the originating laboratory.
- Proof of certification is retained by the originating laboratory.
- All information as outlined in Section 5.9.2 is included in the final report where the report is required to be compliant with NELAC, for both the originating and subcontracting laboratory.

5.9.5. Electronic Data Deliverables

Electronic Data Deliverables (EDD) are routinely offered as part of STL's services. STL offers a variety of EDD formats including Environmental Restoration Information Management System (ERPIMS), New Agency Standard (NAS), Format A, Excel, Dbase, GISKEY, and Text Files.

EDD specifications are submitted to the IT department by the PM for review and undergo the contract review process in Section 4.4.1. Once the facility has committed to providing diskettes in a specific format, the coding of the format may need to be performed. This coding is documented and validated. The validation of the code is retained as a QC record.

EDDs shall be subject to a review to ensure their accuracy and completeness.

5.9.6. Project Report Format

STL offers a wide range of project reporting formats, including EDDs, short report formats, and complete data deliverable packages modeled on the Contract Laboratory Protocol (CLP) guidelines. More information on the range of project reports available can be obtained by contacting any STL facility. Regardless of the level of reporting, all projects must undergo the levels of review as described in Section 5.3.6.

Appendix: List of Quality System Policies and Procedures

QMP Citation	Description	Reference
1.2	Quality Policy	QMP
4.4	Contract Review	QMP
4.4.2	Project Planning Process	LAB Procedure
4.7.1	Sample Acceptance Policy	LAB Procedure
4.5	Subcontracting	QMP
5.3.2	Approved SOP Listing	LAB Procedure
4.3.2	Document Control	S-Q-001 & Lab Procedure
4.12.2	Record Retention & Purging	QMP
4.6	Purchasing Services and Supplies	QMP
4.7.2	Client Confidentiality	QMP
4.8	Complaints	QMP
4.9	Document and Control of Non-conformances	LAB Procedure
4.10	Corrective Action process	LAB Procedure
4.15.2	Quality Systems Management Review	QMP
4.11	Preventive Action Process	LAB Procedure
4.12.4	Archives and Record Transfer	QMP
4.13	Internal Audits	QMP
4.15	Management Reviews	QMP
5.1.2	Training	QMP
5.1.3	Ethics Policy	P-L-006
5.3.2	SOP Index	LAB Procedure
5.3.5	Method Detection Limit Studies	S-Q-003
5.3.5	Relationship of Limit of Detection to Quantitation Limit	LAB Procedure
5.3.7	Data Integrity and Security	QMP
5.3.6	Data Review	QMP
5.4.1	Equipment Operation	QMP
5.4.1	Equipment Tracking List	LAB Procedure
5.4.2	Equipment Maintenance	QMP
5.4.3	Equipment Verification and Calibration	QMP
5.4.3	Selection of Calibration Points	P-T-001
5.5	Measurement Traceability	QMP
5.5.1	Procedures for Checking Specifications for Ancillary Equipment	LAB Procedure
5.5.2	Reference Standards Traceability	QMP
5.7	Sample Handling, Transport and Storage	QMP
5.7.2	Sample Identification and Traceability	QMP
5.7.3	Subsampling	QMP
5.7.4	Sample Preparation	QMP
5.7.5	Sample Disposal	LAB Procedure
5.8.3	Calibration	LAB Procedure
5.8.4	Glassware Cleaning Procedures	LAB Procedure
5.8.5	Permitting Departures From Documented Procedures	LAB Procedure
5.8.6	Development of QC Criteria, Non-specified in Methods/Regulations	QMP
5.9	Reporting Analytical Results	QMP

Note: Where "QMP" is referenced it indicates the policy or procedure is covered by the QMP and not covered by a corporate procedure, and it does not require a laboratory specific procedure. However, when QMP is listed, the laboratories' may still address it in more detail in their LQM or laboratory quality system procedures. When "LAB Procedure" is indicated, it requires the laboratory to address the item in its LQM or have a have a specific laboratory quality system policy or procedure for that item. Where a procedure number is listed, it refers to a corporate policy or procedure.