Technical Work Plan - Post RI/FS
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JACOBS

EXPLORATORY BORINGS
MONITORING WELL INSTALLATIONS
AND
GROUNDWATER SAMPLING

AT

THE CITY OF STOUGHTON LANDFILL
STOUGHTON, WISCONSIN

JACOBS ENGINEERING GROUP INC.
ENVIRONMENTAL SYSTEMS DIVISION

U.S. ENVIRONMENTAL PROTECTION AGENCY
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REVISED TECHNICAL WORK PLAN ADDENDUM

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THE CITY OF STOUGHTON LANDFILL
STOUGHTON, WISCONSIN

U.S. EPA REGION V

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CITY OF STOUGHTON LANDFILL
TECHNICAL WORK PLAN ADDENDUM
EXPLORATORY BORINGS, MONITORING WELL INSTALLATIONS, AND GROUNDWATER SAMPLING

1.0 INTRODUCTION

Stoughton Landfill, near Stoughton, Wisconsin is currently owned by the City of Stoughton (*Figure 1*). It accepted solid and liquid waste from 1953 to 1978. The landfill was officially closed by the Wisconsin Department of Health in 1982. An Administrative Order on Consent (AOC) was negotiated between the U.S. Environmental Protection Agency (EPA), the Wisconsin Department of Natural Resources (WDNR), and the Respondents on May 2, 1988. The Respondents to the AOC are the City of Stoughton and Uniroyal Plastics Company, Inc.

During the Remedial Investigation (RI) conducted at the site, piezometers and monitoring wells were installed, ambient air monitoring conducted, and the following surveys performed: soil gas, methane gas, and geophysical. Round 1 of groundwater monitoring was conducted in May 1989. In August 1989, Round 2 of groundwater monitoring, and surface water and sediment sampling were conducted. Round 3 of groundwater monitoring was completed in October 1989. The Final RI Report and the Final Feasibility Study (FS) Report were submitted in June 1991. The Record of Decision (ROD) was signed in the fourth quarter of FY91.

According to the *Final Remedial Investigation Report* (ENSR, 1991), the Wisconsin Preventative Action Limits (PALs) were exceeded consistently in the vicinity of MW-3 (*Figure* 2) for the following contaminants: Tetrahydrofuran or THF (660 ppb), Barium (293 ppb), Selenium (7.4 ppb), and Chromium (8 ppb). Listed concentrations are the maximum detected. PALs for these compounds are as follows: THF (5 ppb), Barium (200 ppb), Selenium (1 ppb), and Chromium (5 ppb). Dichlorodifluoromethane, a non-standard volatile organic compound, was additionally detected at 87 ppb.

Prior to issuance of the ROD, U.S. EPA, in consultation with the WDNR, requested that additional field work be performed by the Respondents for the purpose of further addressing the presence of the contaminants listed above. This work was subsequently tasked by U.S. EPA to the TES X Contractor under Work Assignment No. C05030 because the Respondents have refused to perform the work. Metcalf & Eddy, Inc. (M&E) is the primary TES X Contractor to U.S. EPA. Jacobs Engineering Group Inc. (Jacobs), Subcontractor to M&E within the TES X Contract, is responsible for development and implementation of this technical work plan and the quality assurance project plan (QAPjP).

All activities conducted as part of this additional work shall comply with Wisconsin Administrative Code NR 141 except where a waiver is necessary to accommodate site conditions. A copy of NR 141 is included in *Appendix A* for reference.

1.1 ABBREVIATIONS

The following abbreviations are provided as an aid to the reader:

AMSL	Above Mean Sea Level
AOC	Administrative Order on Consent
BLS	Below Land Surface
CLP	Contract Laboratory Program
EB	Exploratory Boring
EPA	Environmental Protection Agency
FS	Feasibility Study
FTL	Jacobs Field Team Leader
HPLC	High Pressure Liquid Chromatography
ID	Inner Diameter
MW	Monitoring Well
PALs	Preventive Action Limits
ppb	parts per billion
PID	Photoionization Detector
QA/QC	Quality Assurance/Quality Control
QAPjP	Quality Assurance Project Plan
RI	Remedial Investigation
TAL	Target Analyte List
TCL	Target Compound List
THF	Tetrahydrofuran
WAM	U.S. EPA Work Assignment Manager
WDNR	Wisconsin Department of Natural Resources

2.0 PROJECT OBJECTIVE

The objective of the additional field work is to determine whether State of Wisconsin Enforcement Standards are exceeded at the point of standards application at the site, thereby warranting treatment of groundwater. The point of standards application is any point within the property boundaries but beyond the design management zone (DMZ), as defined by NR 140. The DMZ is the area within three-hundred (300) feet of the landfill boundary. The property boundaries referred to are those of the property owned by the City of Stoughton which encompass the landfill area, the property from the west edge of the landfill to the Yahara River, and the property north of the landfill for approximately six-hundred (600) feet.

MW-3 is located on the west-central side of the landfill, near the Yahara River (*Figure 2*). The river is approximately four-hundred (400) feet from the landfill at this point. In order to achieve the

project objectives, a total of at least four (4) exploratory borings shall be drilled; a three-well cluster shall be completed at either one of the four (4) pre-planned exploratory borings or an alternate field-selected location; a bedrock well shall be completed at well cluster MW-3; and groundwater and soil sampling shall be conducted.

2.1 SCOPE OF WORK

Consistent with the above objective, the scope of work to be completed is as follows:

1. Installation of one (1) monitoring well (designated as MW-3B in *Figure* 2) twenty (20) feet into bedrock at existing monitoring well cluster MW-3;

2. Placement of four (4) exploratory borings (designated as EB-1 through EB-4 in *Figure 2*) twenty (20) feet into bedrock; additional exploratory borings may be drilled per logistics in Section 4.0;

3. Collection of five (5) groundwater samples during drilling of each exploratory boring and MW-3B at the following approximate depths below land surface (BLS), for 24- to 48-hour turn-around analyses: 10, 40, 75, 125, and 200 feet;

4. Collection of split-spoon soil samples every five (5) feet during completion of exploratory borings and MW-3B for characterization of site lithology;

5. Installation of at least one (1) three-well cluster (to be designated MW-7) at the location of either one of the four (4) pre-planned exploratory borings or an alternate field-selected location. Selection of well cluster location(s) shall be based on results of 24- to 48-hour turn-around analyses and the logistics outlined in Section 4.0;

6. Collection and analyses of two (2) rounds of groundwater samples from the new and existing on-site monitoring wells; and

7. Collection and analyses of two (2) rounds of samples from City of Stoughton Municipal Well Nos. 3 and 6.

The above scope of work is based on a number of assumptions. These are discussed in the following paragraphs.

Firstly, the scope of work as outlined assumes that exploratory borings can successfully be drilled to depths of 220 feet, through boulder and bedrock formations, using drilling methods which do not require the use of fluids. Any use of drilling fluids would compromise the value of groundwater analytical data. If in the course of completing soil borings drilling either cannot proceed, or can proceed only at an unacceptable rate, one of two options shall require selection: 1) cease drilling and base selection of the well cluster location on samples collected to the depth drilled; or 2) proceed with drilling using fluids and qualify subsequent data.

Secondly, the scope of work assumes that sufficient groundwater sample quantities can be successfully collected during drilling activities. If difficulties are encountered due to technological or geological limitations, well cluster location(s) would have to be made based on limited data.

Thirdly, the above scope assumes use of temporary casing for borings when a significant confining layer is intercepted, regardless of whether the boring is to be developed into a monitoring well. This precaution is necessary to ensure that a pathway is not introduced for the migration of any upper aquifer contaminants into the lower aquifer.

Fourthly, field scheduling shall need to take into account the requirement for 24- to 48-hour turn-around analytical results before drilling equipment, supplies, and materials are staged at a new boring location. For a given boring, the first three (3) samples should not impact the schedule, as drilling can proceed in the same bore hole while analyses are conducted. However, it is possible that data for the fourth, and especially the fifth sample shall not be received prior to completion of a given boring to the anticipated 220 foot depth. A flexible work schedule shall be required so that days off coincide with such down time to the extent possible.

3.0 HYDROGEOLOGY

The following subsections describe the regional and site hydrogeologic settings of the Stoughton Landfill.

3.1 REGIONAL HYDROGEOLOGIC SETTING

Two principal aquifers have been identified in Dane County: the Cambrian sandstones and localized deposits of Quaternary sand and gravel alluvium/glacial outwash. Essentially, the aquifers are in hydraulic connection, but the Cambrian bedrock may be partially confined. Secondary permeability from fractures probably increases hydraulic conductivity in the bedrock aquifer, while small-scale depositional structures control localized permeability in the glacial aquifer. Groundwater is the principal source of potable water in Dane County (Cline, 1965). The

sandstone bedrock aquifer is used primarily for municipal water supplies, while the glacial aquifer is used for rural domestic supplies.

The water supply for the City of Stoughton is derived from four wells located in the deeper Cambrian sandstone strata. The closest municipal well is located about 3,000 feet west of the landfill across the Yahara River. The boring for this well penetrated a 75-foot-thick clay layer from 85 to 160 feet below the ground surface. Casing was installed from the surface to a depth of 950 feet.

The above-referenced 75-foot clay unit may effectively separate the glacial deposits into two separate hydraulic units in some areas. However, this unit was not penetrated by borings advanced during well installation during the RI. (See cross-sections in *Figures 3 and 3A*.) If it is present, it is interpreted to be deeper than the boulder unit encountered by the deep wells on site.

3.2 SITE HYDROGEOLOGY

Shallow groundwater flow at the Stoughton Landfill forms a radial pattern, and the water table level is roughly variable with the topography (*Figure 3A*). The recharge area and peak water level is located near the center of the landfill between the two knolls (topographic high points) on the east and west sides of the landfill. The steepest gradient is to the north/northeast toward the wetlands in that area. The surrounding wetland and the Yahara River serve as local receptors of the groundwater associated with the landfill.

Between the west knoll of the landfill and the Yahara River, the gradient is nearly horizontal, but groundwater is known to flow westward to the Yahara River and its adjacent wetlands.

The static water level varies from approximately 850 feet above mean sea level (AMSL) in the central recharge area down to approximately 844 feet AMSL around the perimeter of the landfill. Topographic elevations range from a high at the west side knoll of 866 feet AMSL to a low at the northern perimeter of 844 feet AMSL. These levels create an average depth to groundwater of approximately 10 feet. Water levels remained nearly constant from April 1989 to September 1989.

4.0 EXPLORATORY BORING AND WELL LOCATIONS - FIELD DECISION KEY

Selection of the well cluster location(s) shall be field determined based primarily on 24- to 48-hour turn-around analyses. Following is a 'decision key' which outlines the general order of drilling locations, and the logistics to be used for well cluster placement. For all borings except those

drilled for intermediate and shallow wells, groundwater samples shall be taken at five (5) depths BLS (10, 40, 75, 125, and 200 feet) and soil samples shall be taken every five (5) feet.

I. A bedrock monitoring well (designated MW-3B on *Figure 2*) shall be drilled and completed at the west-central edge of the landfill.

II. After completion of MW-3B, an exploratory boring (designated EB-1 on *Figure 2*) shall be drilled approximately 350 feet west of the landfill boundary.

If possible, completion of EB-1 should be timed such that field personnel are scheduled for down-time. This shall allow drilling equipment to remain in place until analytical data is received for all groundwater samples.

III. If groundwater samples from both EB-1 and MW-3B are contaminated at depth in excess WDNR PALs:

A. A bedrock monitoring well shall be placed at the EB-1 location. A shallow and an intermediate well shall be co-located in separate borings in the immediate vicinity for completion of a three-well cluster.

B. Three (3) additional exploratory borings (EB-2 through EB-4 on *Figure 2*) shall be completed. Based on field assessment of analytical data, one of the following procedures shall be implemented:

1. If samples adequately define the horizontal extent of groundwater contamination, the EPA WAM may request that one or more additional monitoring wells/clusters be completed at any of the three (3) boring locations.

2. If further definition of the horizontal extent of groundwater contamination is required, additional boring locations shall be selected via consultation with the Work Assignment Manager (WAM). The WAM may request that one or more monitoring wells/clusters be completed at any of these borings.

IV. If groundwater samples from EB-1 are contaminated at concentrations less than WDNR PALs and MW-3B indicates contamination at depth in excess of WDNR PALs:

A. Three (3) additional exploratory borings (EB-2 through EB-4 on *Figure* 2) shall be completed. Continue with iterations of III.B.1. and III.B.2.

B. A three-well cluster shall be completed at the exploratory boring location where contamination is found. If contamination is found at more than one location, or if contamination is not found, the location of the well cluster shall be selected via consultation with the WAM.

V. If groundwater samples from neither EB-1 nor MW-3B indicate concentrations in excess of WDNR PALs:

A. A three-well cluster shall not be completed at the EB-1 location unless otherwise decided in consultation with the WAM.

B. Three (3) additional exploratory borings (EB-2 through EB-4 on *Figure* 2) shall be completed. Continue with iterations of III.B.1. and III.B.2.

VI. It is highly unlikely that EB-1 samples would indicate contamination while MW-3B samples would be clean. However, should this situation arise, a field determination as to how to proceed shall be made in consultation with the WAM.

5.0 METHODS AND PROCEDURES

The following subsections outline methods and procedures to be followed during placement of exploratory borings and monitoring wells, and sampling activities.

5.1 DRILLING AND SAMPLING EQUIPMENT

Collection of groundwater samples during drilling operations is a critical element in selecting well locations. Consequently, preferred drilling methods shall be those which do not require use of fluids, e.g. air percussion, cable tool, or hollow stem auger. If hollow stem augers are used in unconsolidated formations, the inside working diameter shall be at least 2.25 inches greater than the well casing inside diameter (ID). If air percussion methods are used, the ID of the temporary outer casing shall be at least four (4) inches greater than the well casing ID. For wells installed

deeper than two (2) feet into bedrock, the same bore hole diameter as in unconsolidated formations should be used.

Sampling equipment to be used during drilling shall consist of a Geoprobe^{R} or Hydropunch^{R} for groundwater and split-spoons for soils. A submersible pump shall be used for sampling of monitoring wells. Field screening equipment shall include a pH meter, conductivity/temperature meter, electronic water level indicator, and a photoionization detector.

As indicated in Subsection 2.1, site geology may preclude use of the drilling methods referenced above to the total desired depth of 220 feet. If such conditions are encountered in the course of drilling, a field decision shall be made via consultation with the WAM as to whether to proceed using alternative methods which require use of fluids, or to limit data collection to that obtained to the depth drilled without fluids.

Drill rigs and equipment shall be inspected by the Jacobs Field Team Leader (FTL) prior to initiation of field work to determine if they are adequate. If new equipment is introduced in the course of drilling to accommodate site geology, it shall be inspected by the FTL prior to use.

5.2 DECONTAMINATION PROCEDURES

Decontamination procedures shall be conducted at a central decontamination area under the direction of the Jacobs FTL. A decontamination area for vehicles already exists at the site; however, the existing area is inadequate for the drilling equipment anticipated to be needed to place the deep borings. Prior to initiation of field work, either this area shall be upgraded or an alternate area shall be developed. The pad shall be lined and designed to prevent run-on and run-off. If necessary, it shall be designed with a collection sump that pumps to a storage tank.

If it becomes necessary to conduct decontamination of sampling devices or other equipment during the advancement of a boring, such that use of the central decontamination area is deemed to be an undue inconvenience, cleaning shall be conducted near the boring location. In such an event, a temporary decontamination area shall be prepared using plastic for ground/surface cover. All decontamination-derived wastes shall be containerized and staged at the central decontamination area.

Sample collection devices shall be decontaminated prior to sampling, and between sampling intervals/locations. Stainless steel screen and riser shall be decontaminated, both inside and out, prior to installation; clean gloves shall be used during installation. All other equipment shall be

deeper than two (2) feet into bedrock, the same bore hole diameter as in unconsolidated formations should be used.

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Sample collection devices shall be decontaminated prior to sampling, and between sampling intervals/locations. Stainless steel screen and riser shall be decontaminated, both inside and out, prior to installation; clean gloves shall be used during installation. All other equipment shall be

decontaminated prior to initiating drilling, and between drilling locations. Any additional decontamination shall be performed at the discretion of the Jacobs FTL.

For most equipment, decontamination shall be accomplished by completely removing all visible soil with a high pressure steam cleaner using fresh, clean, potable water which is available on site. Decontamination procedures specific to sampling equipment are discussed in Section 5.6.2.4.

Decontaminated equipment and materials shall be covered and stored on an elevated platform in a designated clean area. At no time shall this platform be walked on or allowed to have soil deposited on it in any way. If any equipment or materials come into contact with the ground or are otherwise potentially contaminated, they shall be decontaminated again.

Personal decontamination procedures shall be those described in the site-specific Health and Safety Plan (Section 8.0). All disposable personal protective equipment shall be containerized and managed as outlined in Section 5.7.

5.3 EXPLORATORY BORINGS

The depths and thickness discussed in this section are estimates derived from area well logs. There are no records of nearby borings penetrating the boulder layer at the Stoughton Landfill site.

Four (4) exploratory borings, designated as EB-1 through EB-4 in *Figure* 2, shall be placed twenty (20) feet into bedrock. During drilling of each boring, groundwater samples shall be collected from five (5) levels and soil samples shall be collected every five (5) feet. At least one (1) of the four (4) borings may be selected for completion into a bedrock monitoring well. However, if the logistics of the 'decision key' require placement of additional exploratory borings, one of these borings may be completed into a bedrock monitoring well either in lieu of or in addition to the well(s) completed at EB-1 through EB-4. Any borings not used for wells shall be properly abandoned per Wisconsin Administrative Code NR 141 (Section 5.7.2).

For each bedrock well completed at EB-1 through EB-4 or alternative boring locations, two (2) additional wells shall be completed as part of a three-well cluster. One (1) well shall be completed at the glacial till/boulder interface, approximately seventy-five (75) feet below grade (intermediate well). The second well shall be completed at approximately twenty (20) feet below grade (shallow well). One (1) soil sample shall be taken during drilling of each intermediate and shallow well for grain size analysis of the formation where the wells are to be screened.

In addition to the wells completed at the above referenced boring locations, a bedrock monitoring well shall be completed twenty (20) feet into bedrock at the west edge of the landfill (MW-3B In *Figure* 2). During drilling, groundwater samples shall be collected from five (5) levels and soil samples shall be collected every five (5) feet.

If a low permeability layer (clays or silty clays) exceeding five (5) feet in thickness is encountered in the course of drilling operations, and temporary casing is not being used for the drilling method employed, temporary casing shall be installed and grouted five (5) feet into the confining layer. If the boring is converted into a monitoring well, the temporary casing shall become permanent.

5.4 GROUNDWATER MONITORING WELLS

At a minimum, the following wells shall be completed:

- Two (2) bedrock wells at approximately 220 feet.
- One (1) intermediate well at approximately 75 feet
- One (1) shallow well at approximately 20 feet

As discussed in Sections 4.0 and 5.3, additional three-well clusters may be completed, each cluster consisting of a shallow, intermediate, and bedrock well in separate borings.

5.4.1 MONITORING WELL DESIGN AND CONSTRUCTION

The following specifications are presented for monitoring well installations that shall be constructed at the Stoughton Landfill site. Figures 4-8 contain well diagrams for reference.

It is anticipated a total of four (4) wells shall be set, including two (2) bedrock wells, each 220 feet deep; one (1) intermediate well, 75 feet deep; and one (1) shallow well, 20 feet deep. All wells shall have ten-foot long stainless steel screens, and two-inch ID Schedule 40 stainless steel risers. All casing couplings shall be constructed of flush threaded joints. Casings and couplings shall be inspected prior to use for cuts, deformations, gouges, deep scratches, damaged ends, or other imperfections. Any casing or coupling with such a defect shall not be used. The well screens shall be permanently joined to the well casings by watertight flush threaded joints. The well casing shall be sealed on top with a vented cap. Stainless steel centralizers shall be utilized at a rate of one per every 50 vertical feet.

The bedrock well screens shall be constructed with prefabricated filter packs in place around them. This is to ensure that the filter pack completely covers the screen. An additional amount of the specified filter pack sand shall be placed down hole by tremie pipe to fill any voids around the prefabricated filter pack to a level two (2) feet above the screened interval. Two (2) feet of fine

silica sand shall be placed atop the filter pack. The only exception to this shall be the shallow monitoring well, in which filter pack shall be placed only 0.5 feet above the top of the screen. A weighted tape measure shall be used to ensure the filter pack is to the proper depth. One-half (0.5) foot of fine sand shall then be placed above the filter pack.

A bentonite slurry shall be used to seal off the hole above the filter pack in all wells over twenty-five (25) feet in depth. The bentonite seal shall be at least three (3) feet, but not exceed five (5) feet in thickness, in all cases except the shallow well, as described below. The bentonite employed for the filter pack seal shall be hydrated through a combination of the clean, potable water utilized to create the slurry and the formation water encountered in the borehole. This hydration process shall be allowed to proceed at least two (2) hours before the onset of grouting activities.

After the bentonite seal has cured, the annulus shall be filled with a three- to five-percent bentonite grout to a level of six (6) feet below ground level. This grout shall be emplaced by pumping it through a side-discharging tremie pipe set within five (5) feet of the bentonite seal or per NR 141.10 procedures. It shall be allowed to cure at least 48 hours prior to initiation of well development activities and 12 hours prior to any further work commencing, to permit it to reach adequate strength.

5.4.1.1 SHALLOW MONITORING WELL

The shallow monitoring well varies slightly in construction due to the greatly reduced depth. There shall not be a prefabricated filter pack. No stainless steel centralizers shall be utilized. Filter pack shall be placed to 0.5 foot above the top of the well screen. A 0.5 foot layer of fine sand shall be placed directly atop the filter pack. The bentonite seal shall be only two (2) feet thick. The three- to five-percent bentonite grout shall be eliminated, and the three-inch slump concrete shall be placed directly on top of the bentonite seal. With only three (3) feet of concrete in the hole, the protective steel casing shall have to be cut off so that it does not extend into the bentonite seal. The casing shall be cut off on site to assure proper height.

5.4.1.2 INTERMEDIATE MONITORING WELL

The intermediate monitoring well shall be completed at the glacial till/boulder layer interface, which is approximately 75 feet below grade. The intermediate monitoring well shall be constructed as described in Section 5.4.1 (with no prefabricated filter pack).

5.4.1.3 BEDROCK MONITORING WELLS

The bedrock wells shall penetrate a slightly varied stratigraphy of glacial till to approximately 75 feet, where a boulder layer of unknown thickness shall be encountered. The boulder layer could continue down to the top of bedrock at approximately 200 feet, although this is not likely. The boulder layer probably shall be no more than 80 feet thick and shall overlie a clay layer that is present above the bedrock in other wells within the region. This clay layer is thought to overlie the bedrock at around 200 feet. Wells shall be completed at approximately 20 feet into the bedrock. If the clay layer is penetrated, the bedrock wells shall be cased five (5) feet into the clay with 6-inch steel outer casing grouted into place, and are to be constructed as described in Section 5.4.1, with prefabricated filter packs.

5.4.1.4 WELL HEAD CONSTRUCTION

The concrete pad surrounding the well head shall be four (4) feet square and a minimum of four (4) inches thick. However, the pad for the shallow monitoring well shall be six (6) inches thick. The pad shall slope away from the steel casing to enhance runoff. The outside edge of the pad shall be flush with the ground surface. Steel reinforcement within the concrete shall not be required. A five-inch protective steel casing with a locking cap shall be set around the riser pipe to protect each monitoring well and to prevent tampering. The protective steel casing shall extend from the bottom of the ground surface seal to three-and-one-half (3.5) feet above the ground surface to adequately cover the riser pipe. The single shallow well protective casing shall be cut to fit on site. The monitoring well numbers shall be stenciled on the protective casing.

5.4.1.5 BOLLARD POST CONSTRUCTION

Three (3) steel bollard posts, three (3) inches in diameter by eight (8) feet overall length, shall be set in a 120-degree pattern around the well at a distance of approximately five (5) feet from the protective casing. The post shall be encased in concrete 12" in diameter to a depth of 4'-0" below grade. The encasement hole shall extend 4'-3" below grade. The encasement concrete shall be trowelled to have a 1" pitch away from the post and be even with grade at the edge of the hole. The posts shall be 3" Schedule 40 carbon steel pipe filled with concrete. The protective casing and the posts shall be painted red.

5.4.1.6 WELL CONSTRUCTION MATERIALS

The well screen for the overburden monitoring wells shall be Schedule 40, factory-slotted, flush-threaded 304 stainless steel with a two-inch inner diameter (ID). Screens shall be ten-slot (.010-inch) for all overburden monitoring well holes. Screened intervals are specified in the well diagrams; however, a field determination shall be made as to final screen placement. Screen

length is ten (10) feet in all cases. Each well shall terminate with a flush-threaded stainless steel cap at the bottom. The well screen for the bedrock monitoring wells shall be Schedule 40, flush-threaded 304 stainless steel pre-packed screen, such as Johnson Filtration Systems Channel Pack^{R} or equivalent. This pre-packed screen shall utilize 20/40 pack with twelve-slot opening size.

The well riser pipe shall be two-inch (ID) Schedule 40, flush-threaded 304 stainless steel for all monitoring wells. The well riser shall extend to an approximately height of three (3) feet above grade. It shall be topped by a stainless slip cap.

Bedrock and intermediate well installation shall proceed by introducing all construction materials directly into the annular space between the stainless steel and the side walls via the use of a tremie pipe. A uniform and complete filling of the annular space with sand pack, bentonite slurry, and grout shall be achieved. A separate tremie pipe shall be used for cement and/or grout materials. A bottom-discharging tremie pipe shall be used for all other materials.

Washed Silica Sand #20-40, or equivalent material, shall be used as a backfill around the screened interval and shall extend to two (2) feet above the top of the screen section and six (6) inches below the bottom of the screen section, unless otherwise specified by the FTL. The filter pack sand shall conform to screen gradation analysis requirements of not less than 95 percent of the sand passing U.S. Standard sieve #40 and not more than 5 percent passing U.S. Standard sieve #20 . The fine sand above the filter packs shall be well sorted and conform to grain size gradation predominantly between .42 millimeters (mm) and .074 mm.

The bentonite shall consist of a minimum purity of 90 percent montmorillonite clay and a minimum dry bulk density of seventy-five (75) pounds per cubic foot. The bentonite grout mix shall consist of neat Type I Portland cement (ASTM C150) mixed with three (3) to five (5) pounds of commercial bentonite powder and 7.5 gallons of water to each ninety-four (94) pound bag of cement.

5.4.1.7 WELL DEVELOPMENT

After well installation is completed and the cement/bentonite grout has set for at least 48 hours, each well shall be fully developed using bailers or pumps in accordance with Wisconsin Administrative Code NR 141.21 (Appendix A). Air-lift methods are not acceptable for development due to the potential for aeration of volatile organic compounds (VOCs). All down-well equipment shall be decontaminated prior to use as described in Section 5.6.2.4.

5.5 SURVEY CONTROL

All monitoring well locations shall be mapped on a scaled drawing, specifying the exact vertical and horizontal location of each well. The vertical location of the top of each well casing shall be referenced to the nearest benchmark for the National Geodetic Survey Datum to an accuracy of 0.01 feet. The plan shall show the wells in location to each other, property and structure boundaries, nearby surface waters, and a common reference point on a horizontal grid system. The origin of the grid system shall be located according to the state plane coordinate system. The location of the installed wells on the horizontal grid system should be accurate to within one (1) foot. In addition, an 8.5" X 11" scaled site map showing the monitoring wells and horizontal grid system shall also be prepared for the WDNR.

5.6 SAMPLING AND ANALYSIS

Subsections of 5.6 outline the sampling programs to be conducted during: 1) drilling of exploratory borings and the soil boring for MW-3B (Section 5.6.1), and 2) Rounds 1 and 2 of monitoring well sampling (Section 5.6.2).

Note that sampling and analysis of investigation-derived wastes is covered under 'Site Restoration and Residuals Management' (Section 5.7).

5.6.1 EXPLORATORY BORING SAMPLING

Groundwater and soil samples shall be collected during drilling of the four (4) exploratory borings and the soil borings for MW-3B, MW-7S. and MW-7I. Details regarding this sampling program are presented in Sections 5.6.1.1 through 5.6.1.3.

5.6.1.1 SAMPLING LOCATIONS AND PARAMETERS

Sampling locations and parameters for the exploratory boring sampling program are summarized in Table 1. During drilling activities, five (5) groundwater samples shall be collected from each exploratory boring and from MW-3B (*Figure 2*) at the following depths/locations:

- Two (2) samples: Collected from within the glacial till at depths of approximately 10 feet and 40 feet.

- One (1) sample: Collected at the interface between the glacial till and the boulder layer at a depth of approximately 75 feet.

- One (1) sample: Collected at the boulder/clay interface at an approximate depth of 125 feet.

- One (1) sample: Collected from the clay and sandstone interface at an approximate depth of 200 feet.

The samples shall be analyzed by a subcontractor laboratory for low concentration volatile organic compounds tetrahydrofuran (THF) and dichlorodifluoromethane using non-standard methods, with a 24- to 48-hour turn-around time for verbal results.

Split-spoon soil samples shall be taken during drilling of exploratory borings and MW-3B at intervals of five (5) feet using the Standard Penetration Test (ASTM Method D1586-84). These samples shall be examined in the field and the lithology classified using the Unified Soil Classification System (USCS). They shall also be screened using a photoionization detector (PID).

One (1) soil sample shall be taken while drilling each intermediate and shallow well to determine particle size, using ASTM Method D-422.

Sample intervals are subject to change, based on field observations by the FTL.

5.6.1.2 SAMPLING PROCEDURES AND EQUIPMENT

Four (4) 40-ml VOA vials of groundwater shall be collected from each sampling depth. Three (3) of the vials are required for analyses; the fourth represents a contingency quantity in the event that it is required to resolve laboratory QA issues.

Each 40-ml vial shall be completely filled with no head space. Samples shall be cooled to four (4) degrees centigrade. They shall not be acidified as samples shall be analyzed within twenty-four to forty-eight hours to accommodate data-based field decisions; acidification could result in loss of volatiles.

Assuming five (5) groundwater samples from each of five (5) borings (including MW-3B), a total of twenty-five samples (100 40-ml containers) are expected. However, given that additional borings may be drilled, groundwater samples in excess of this number may be required.

A Geoprobe^{R} or Hydropunch^{R} shall be used to collect groundwater samples. Such sampling devices are inserted through a pilot hole, then driven into the formation. Due to the manner of sample collection, purging shall not be required.

Soil samples shall be taken with a split-spoon every five (5) feet during drilling for classification using the Unified Soil Classification. Each soil sample shall be screened with a photoionization detector and the results recorded on the soil boring log. The two soil samples collected for ASTM D-422 (MW-7S and MW-7I) particle size analysis shall be placed in 16-ounce containers and archived for potential future analyses.

A summary of equipment and supplies to be used for sampling is listed in *Table* 2.

5.6.1.3 SAMPLE HANDLING AND ANALYSES

Field identification numbers shall be assigned to each groundwater and soil sample. Additionally, each groundwater sample shall receive a unique control number assigned from the TES X sample number control log. The field identification nomenclature shall be formatted as follows:

SL-EB4-10
SL = Stoughton Landfill
EB4 = Exploratory Boring No. 4
10 = Depth of sample in feet (BLS)

The location from which each sample is taken shall be recorded with indelible ink in the field log book along with the sample number, date and time. Photographs and photographic log forms shall be used to document sampling sites and to verify written descriptions entered in the field log book. All routine measurements and observations, difficulties encountered, and deviations from the work plan also shall be recorded in the field log book.

All samples shall be hand delivered to the laboratory. The original copies of the chain-of-custody documents, along with a copy of the sample analysis request forms, shall accompany the samples.

A laboratory shall be subcontracted to conduct analyses of the groundwater samples for the low concentration non-standard volatile organic compounds tetrahydrofuran (THF) and dichlorodifluoromethane. The laboratory QA Officer shall be provided with a copy of the QAPjP and shall be responsible for conducting analyses of samples within its guidelines. Verbal analytical data shall be provided on a 24- to 48-hour turn-around basis, with hard copy data packages to follow.

5.6.2 WELL SAMPLING

Two rounds of groundwater samples shall be collected from the following wells:

- o New on-site monitoring wells
- o Existing on-site monitoring wells
- o City of Stoughton municipal well numbers 3 and 6

During both rounds of sampling, a sample also shall be collected from a well at the residence of Mr. Enoch Riendahl, located north of U.S. Highway 51 between Amundson Parkway and County Highway N.

Details regarding the above rounds of groundwater sampling are presented in Sections 5.6.2.1 through 5.6.2.6.

5.6.2.1 SAMPLING LOCATIONS AND PARAMETERS

Table 3 presents a summary of the type and number of samples, including QA/QC samples, anticipated to be collected during this field investigation. The location of existing on-site monitoring wells are indicated on *Figure 9*. New wells include MW-3B at existing cluster MW-3, and MW-7S, MW-7I, and MW-7B to be installed at a location west of the landfill.

Both field and analytical parameters are also identified on *Table 3*. Field parameters include pH, specific conductance, temperature, total well depth, and water levels. Laboratory parameters include THF, Dichlorodifluoromethane, TCL volatiles, TCL semi-volatiles, TAL inorganics, Mercury, and Cyanide.

5.6.2.2 SAMPLING PROCEDURES AND EQUIPMENT

Sample quantities, preservatives, holding times, and bottle types and sizes to be used are indicated in *Table 4*. Sampling equipment and supplies to be used are listed in *Table 2*. Jacobs' Standard Operating Procedures (SOP) are included in Appendix C. Sampling methods and equipment are described in the following paragraphs apply to all wells except for the well at Mr. Enoch Riendahl's residence. The residential well shall be purged by running the pump at least five (5) minutes prior to sampling. Groundwater samples shall then be collected as the water comes out of the pump and before discharge to the holding tank.

Prior to purging, static water level and total depth shall be measured in each well to 0.01 foot. Procedural details are given in Jacobs' SOP for field measurement of static water levels and total

depth (Jacobs, 1987; Section 38). The casing volume (V) of water that shall be evacuated for a two-inch ID well is calculated as:

V (gal) = 0.16 gal/ft X well water-column height (ft)

The volume of water that is purged from a well before sampling shall be an integral multiple of V, that multiple being a function of the recharge rate. Specifically, for a low-yield well incapable of yielding three casing volumes, the well shall be evacuated to dryness once, then sampled after physical parameters (pH, temperature, specific conductance) have been checked. For higher yielding wells, three casing volumes shall be evacuated and the physical parameters shall be reviewed for stability prior to sampling. Purge waters shall be containerized and managed as outlined in Section 5.7 of this work plan.

Field screening equipment shall include the following: pH meter, conductivity/temperature meter, and photoionization detector. A submersible pump shall be used for purging and sampling monitoring wells. At each sample location, volatile organic compound samples shall be collected first, in a manner limiting agitation and aeration of the sample. The remaining samples shall be collected for analysis in the order of most volatile to least volatile.

Jacobs' SOP for groundwater sampling (Jacobs, 1987; Section 25) shall be followed. If site conditions exist that preclude strict adherence to the SOP, modifications shall be made to preserve sample quality and integrity.

5.6.2.3 FIELD QA/QC SAMPLES

Field QA/QC samples are indicated in Table 3. These samples are discussed below:

Equipment Rinsate Blank: A bailer and submersible pump are the only non-dedicated sampling device to be used in this effort. After decontaminating the bailer, sampling personnel shall fill the bailer with high performance liquid chromatography (HPLC) grade water for organic analyte equipment blanks and with distilled water for the inorganic analyte equipment blanks. The water shall then be placed into the respective sample container for the analyte of interest.

Collocated/Replicate Samples: Duplicate samples shall be collected at the same time as investigative samples by alternately filling two sets of sample containers from the same well for each of the parameters to be analyzed.

Trip Blank: One trip blank shall be prepared for each shipment container of samples of volatile organic compounds. The analytical laboratory shall provide bottles filled with high performance liquid chromatography (HPLC) water for this purpose. Each trip blank bottle shall be analyzed for the same volatile organic compounds as the primary samples.

5.6.2.4 FIELD AND LABORATORY QA/QC

Decontamination of Equipment

All non-dedicated sampling equipment to be used on site shall be decontaminated prior to sampling and between each sampling location according to the procedures outlined below:

- Wash with non-phosphate detergent and potable water;
- Rinse with potable water;
- Thoroughly rinse with deionized/distilled water; and
- Remove excess water by shaking and air drying.

If the central decontamination area discussed in Section 5.2 cannot be used, a temporary decontamination area shall be prepared using plastic for ground/surface cover.

Decontaminated equipment shall be covered and stored in a designated clean area. If any equipment comes into contact with the ground or is otherwise potentially contaminated, the above outlined decontamination procedures shall be repeated.

All liquid decontamination wastes and disposable sampling equipment shall be containerized, staged at the central decontamination area, and further managed as outlined in Section 5.7.

Field Instrument Calibration

Instruments used for field screening shall be calibrated according to the procedures and frequency specified in Section 6.0 of the QAPjP. (See Appendix B for excerpt.)

Laboratory QA/QC

The laboratory(ies) shall prepare laboratory blanks, spikes, and duplicates and analyze them for the appropriate parameters to assure that quality analytical data are obtained. As indicated in footnote 1 of *Table 3*, MS/MSD analyses shall be conducted at a frequency of one per (20) or fewer investigative samples. For the volatile fraction, triple volumes shall be collected at the location selected for MS/MSD analyses. Double volumes shall be collected for MS/MSD analyses in the semi-volatile fraction.

5.6.2.5 SAMPLE HANDLING AND ANALYSES

Field identification numbers shall be assigned to each groundwater sample. Additionally, each groundwater sample shall receive a unique control number assigned from the TES X sample number control log. The field identification nomenclature shall be formatted as follows:

SL-MW3B-0793
SL = Stoughton Landfill
MW3B = Monitoring Well No. 3 - Bedrock
0793 = July 1993

Custody procedures fall into three categories: field, laboratory, and final evidence file. Requirements for these activities are included in the following sections of Revision 1 of the QAPjP:

- Field Procedures - QAPjP Section 5.2.1
- Laboratory Procedures - QAPjP Section 5.2.2
- Final Evidence File Procedures - QAPjP Section 5.2.3

The above sections of the QAPjP clearly outline required documentation, and are included for reference in Appendix B of this work plan.

All samples shall be shipped overnight by commercial carrier as low hazard environmental samples. They shall be sealed with U.S. EPA chain-of custody forms, securely wrapped in bubble pack wrap, individually sealed in plastic bags, and placed in ice in a cooler. Empty space in the ice chest shall be filled with bubble pack wrap to prevent breakage. The original copies of the chain-of-custody documents, along with a copy of the sample analysis request forms, shall accompany the sample shipment to the laboratory.

Samples shall be analyzed by a CLP laboratory(ies) designated by EPA prior to the time of sampling. CLP SOWs discussed in Section 7.0 of the QAPjP shall be used for CLP organics and inorganics. A Special Analytical Services (SAS) request has been prepared by Jacobs for THF and Dichlorodifluoromethane analyses (Attachment B of QAPjP).

5.7 SITE RESTORATION AND RESIDUALS MANAGEMENT

Jacobs shall coordinate arrangements for the analysis, treatment, and disposal of any investigation derived wastes. However, ultimate responsibility for such wastes is the responsibility of U.S. EPA.

5.7.1 RESIDUALS MANAGEMENT

Investigation derived wastes generated during the implementation of this work plan shall consist primarily of decontamination liquids, well development and purge waters, drill cuttings, and

potentially drilling fluids/muds. Other associated wastes shall include disposable sampling equipment and personal protective gear. The volume of the above wastes generated shall be minimized to the extent possible. Following is a discussion of management practices to be employed for those investigation wastes generated.

Soil Cuttings

Soil cuttings shall be segregated based on the depth of origin within the formation. They shall be screened at the time of generation using a photoionization detector (PID). Soils exceeding one (1) unit above background shall be containerized for sampling and TCLP analysis at a CLP laboratory. The containers shall be clearly identified as to the exact location and depths from which the soil came, and staged in a secure area.

If 55-gallon drum containers are used, one (1) sample shall be taken for every five (5) drums. The sample shall be taken from approximately the middle of the selected drum. If site conditions allow, larger containers, such as roll-offs, shall be used in lieu of 55-gallon drums. A minimum of two (2) samples would then be collected from opposite ends of the soil pile. Two additional samples would be collected for every additional 100 cubic yards of material collected and stored. The samples would be taken from at least 18 inches below the surface of the soil pile. An attempt would be made to identify those areas of the soil pile which may contain elevated concentrations; these areas shall be segregated and sampled individually.

Screened soils which do not exceed one (1) unit above background shall be returned to boring locations and graded to approximate the natural contours of the land. Soils analyzed for TC constituents, and which meet the Land Disposal Restrictions (LDR) treatment standard criteria, shall be disposed on site during remediation activities. Any soils not meeting LDR treatment standard criteria shall be shipped off site to a Subtitle C facility for further management.

Liquids

Liquids shall be segregated from soils. They shall be containerized at the point of generation. They shall be sampled representatively and analyzed by a CLP laboratory for TCL volatiles and semi-volatiles.

Most liquids should be acceptable for treatment at the City of Stoughton POTW. Acceptance criteria previously developed by the City and the Respondents' contractor appear in Appendix D. Any liquids refused by the POTW shall be shipped off site to a Subtitle C facility for appropriate

disposition. During on-site storage, the containers shall be clearly identified as to the origin of the liquids and staged in a secure area.

Miscellaneous Wastes

Due to the low hazards posed by the proposed field work, it is assumed that miscellaneous wastes such as disposable personal protective gear and sampling supplies would be non-hazardous. These wastes shall be containerized and staged on site for subsequent off-site disposition at a Subtitle D facility.

5.7.2 BORE HOLE ABANDONMENT

All bore hole abandonments shall comply with Wisconsin Administrative Code NR 141 (*Appendix A*). For this study, affected bore holes include those lost before the desired depth can be achieved and those which are not used for well completion. Time lines and procedures in NR 141.25 require that all borehole abandonments be reported to WDNR within sixty (60) days.

6.0 DUTIES OF PERSONNEL

Duties of Personnel are outlined in *Table 5*. Following is a description of general responsibilities of various entities.

The drilling subcontractor shall be responsible for boring and monitoring well construction, providing on-site decontamination facilities and toilets, waste handling, preparation of DNR-required boring and monitoring well construction documentation forms, preparation of soil and well construction logs, purging prior to sampling, well development, assisting Jacobs personnel with groundwater sampling and soil sampling, and project site security.

Jacobs shall be responsible for project coordination, providing an on-site hydrogeologist during all drilling operations, collection of soil and groundwater samples, field classification of earth materials, on-site field-testing/screening, acting as the U.S. EPA's representative on site, coordination of field and lab QA/QC activities, arranging for laboratory work to be performed by the subcontracted laboratories, initiating chain-of-custody documentation, liaison with representatives of the U.S. EPA and Respondents, providing project safety officer, and preparation of interim, draft and final reports and documentation.

The City of Stoughton shall provide overall site security, and shall secure the right of entry to adjacent lands as may be required during completion of field work. services related to transport of liquids generated during field work (to City POTW),

The laboratories shall provide sample containers and preservatives for groundwater and City well samples requiring analysis.

7.0 PROJECT SCHEDULE

The project schedule for completion of the work described herein is summarized in *Table 6*. The schedule shall be updated as required for the duration of the project.

8.0 HEALTH AND SAFETY

Field work covered by this work plan shall be conducted off site. Consequently, minimal hazards due to exposure to contaminants is anticipated. Level D protective clothing (steel-toed boots, outer gloves, eye protection, and hard hats) should be adequate for compliance with 29 CFR 1910.120 OSHA requirements.

Prior to initiation of site work, Jacobs shall prepare a site specific Health and Safety Plan. The Plan shall contain contingencies for the need to upgrade from Level **D** personal protection to modified Level D or Level C.

Subcontractors shall be responsible to either develop an independent Health and Safety Plan or adopt an existing plan.

9.0 REPORTING

The following reports and data presentations are planned:

- o During drilling of the exploratory borings, the WAM shall be advised of progress and results of the work, and shall be consulted relative to the location proposed for the MW-7 cluster and to the locations of additionally exploratory borings.
- o Within sixty (60) days of completion of the exploratory boring and monitoring well construction work, a construction report shall be submitted to the EPA and WDNR in accordance with NR 141.23 including:
  - Completing WDNR well construction and abandonment forms;
  - Mapping and elevations of borings and monitoring wells;
  - Boring and monitoring well geologic logs;
  - Particle size distributions data for MW-7S and MW-7I for the soil at the well screen depth;
  - PID data and groundwater analysis data;

- A written description of methods employed and significant observations made; and
- Well development procedures and documentation;

o Following completion and validation of analytical results from the first round of groundwater monitoring well sampling and sampling of City wells numbers 3 and 6, a report of data and validation results shall be submitted; and

o Following completion and validation of analytical results from the second round of groundwater sampling, a report of data and validation results shall be submitted.

FIGURES 1 - 9

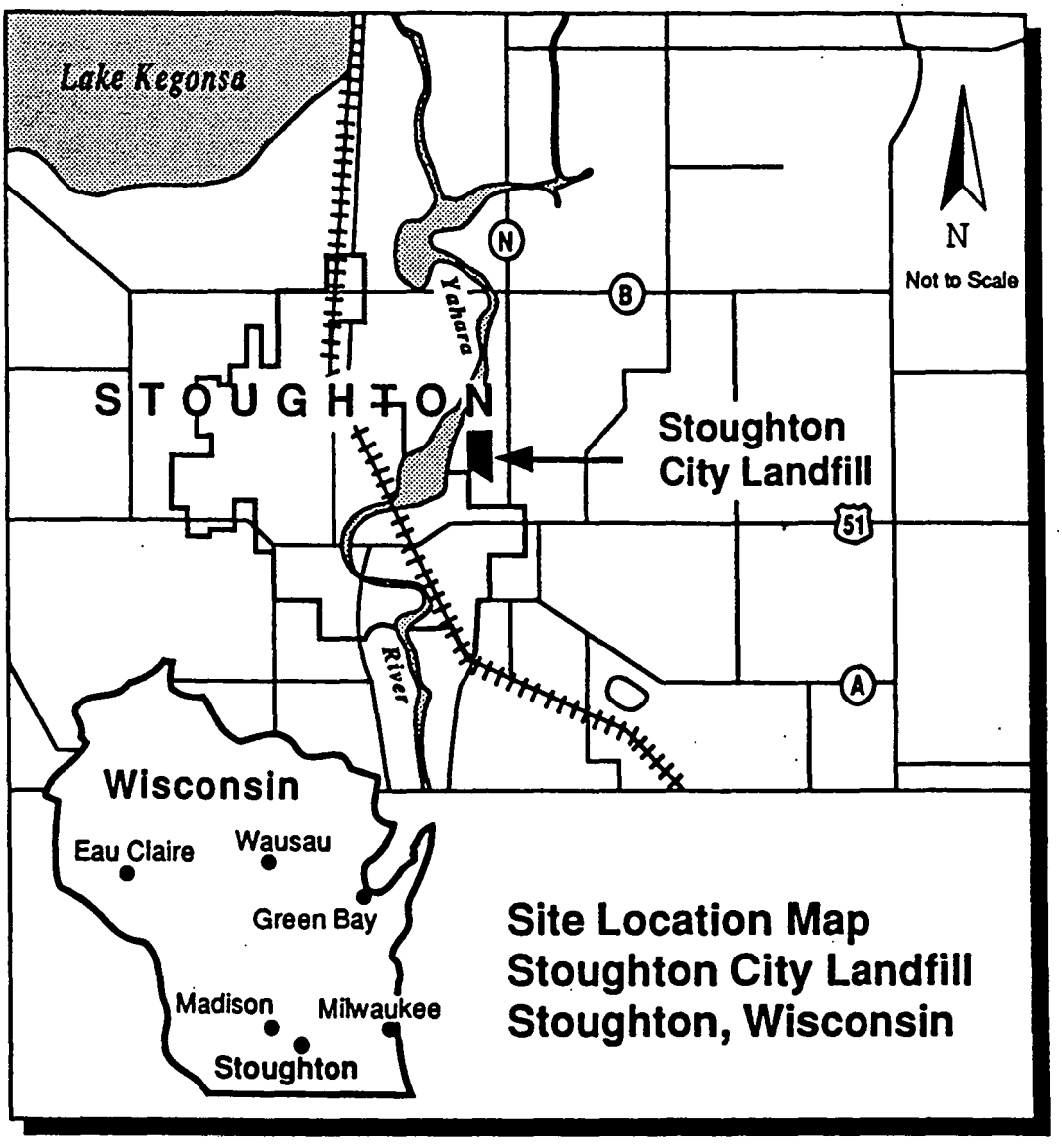
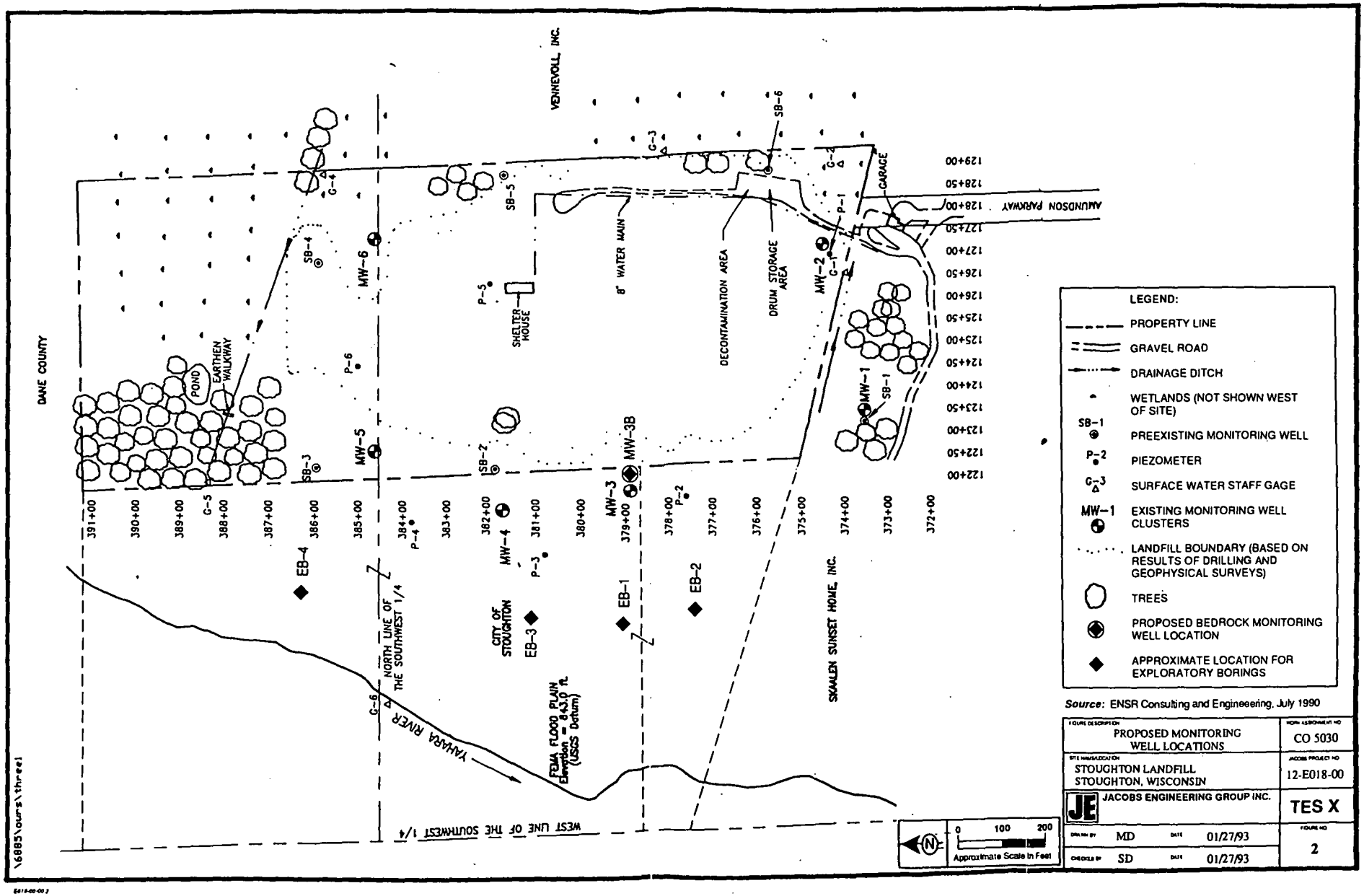


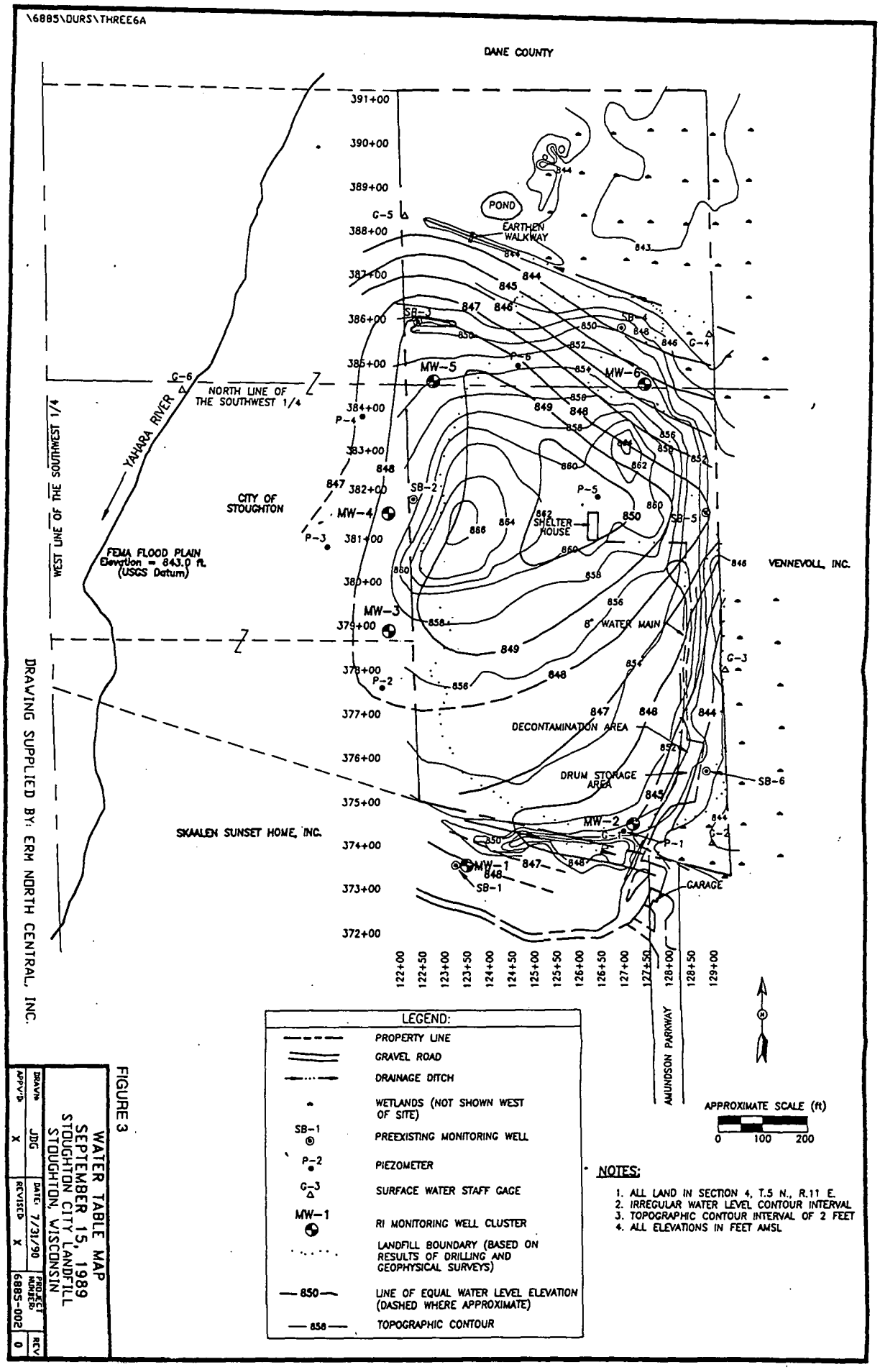
FIGURE DESCRIPTION: SITE LOCATION MAP			WORK ASSIGNMENT NO. CO 5030
SITE NAME/LOCATION: STOUGHTON LANDFILL STOUGHTON, WISCONSIN			JACOBS PROJECT NO. 12-E018-00
JE JACOBS ENGINEERING GROUP INC.			TES X
DRAWN BY: MD	DATE: 03/04/93		FIGURE NO. 1
CHECKED BY: TS	DATE: 03/04/93		

E018-00-007



Source: ENSR Consulting and Engineering, July 1990

FIGURE DESCRIPTION: PROPOSED MONITORING WELL LOCATIONS	WORK ASSIGNMENT NO: CO 5030
SITE NAME/LOCATION: STOUGHTON LANDFILL STOUGHTON, WISCONSIN	JACOBS PROJECT NO: 12-E018-00
JACOBS ENGINEERING GROUP INC.	TES X
DRAWN BY: MD DATE: 01/27/93	FIGURE NO: 2
CHECKED BY: SD DATE: 01/27/93	

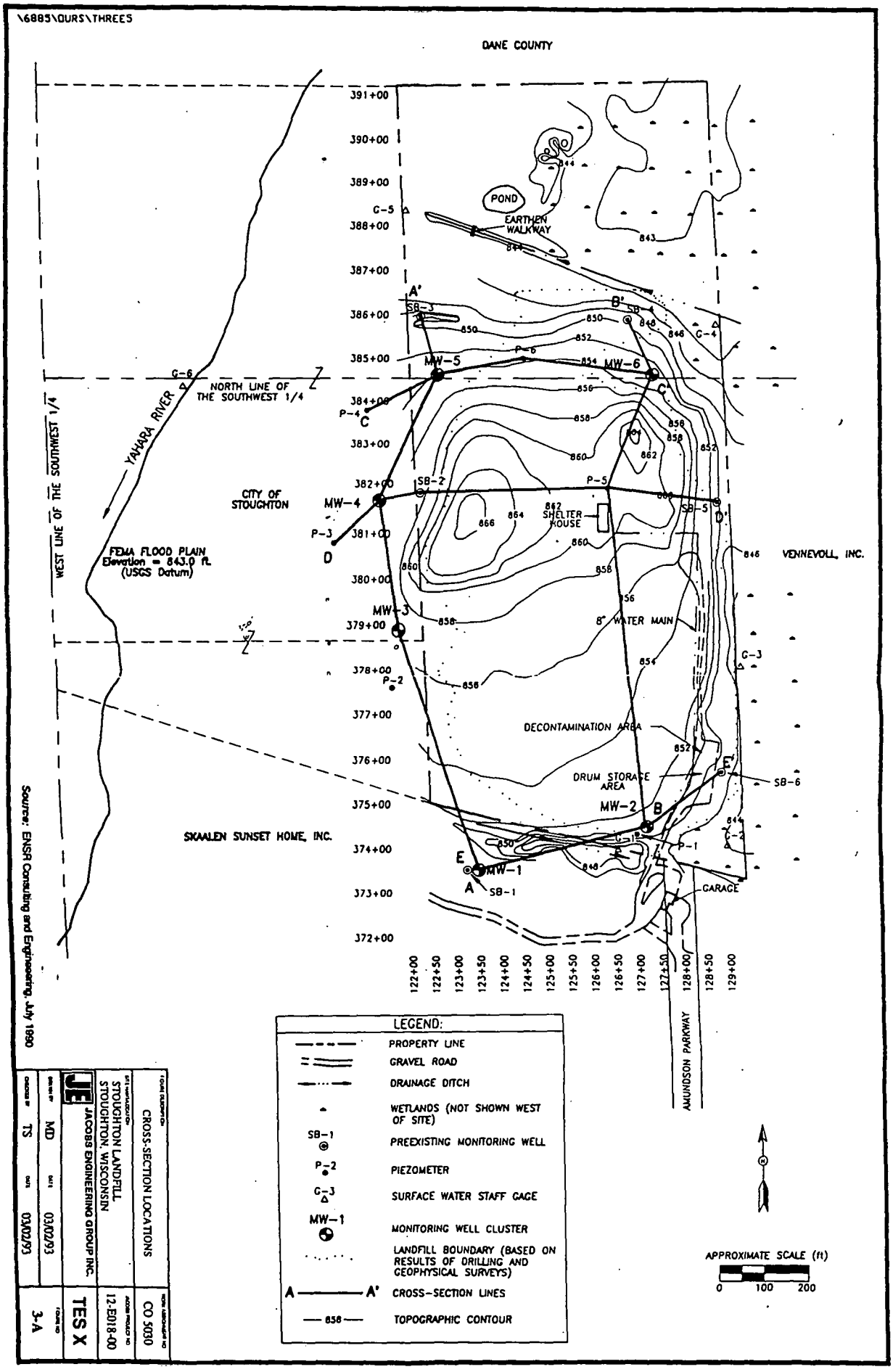


DRAWING SUPPLIED BY: ERM NORTH CENTRAL, INC.

FIGURE 3

WATER TABLE MAP
SEPTEMBER 15, 1989
STOUGHTON CITY LANDFILL
STOUGHTON, WISCONSIN

DRAWN	DATE:	PROJECT NUMBER	REV
JDG	7/31/90	6885-002	0
APPVD	REVISED		
X	X		



Source: ENSR Consulting and Engineering, July 1990

FIGURE DESCRIPTION	CROSS-SECTION LOCATIONS
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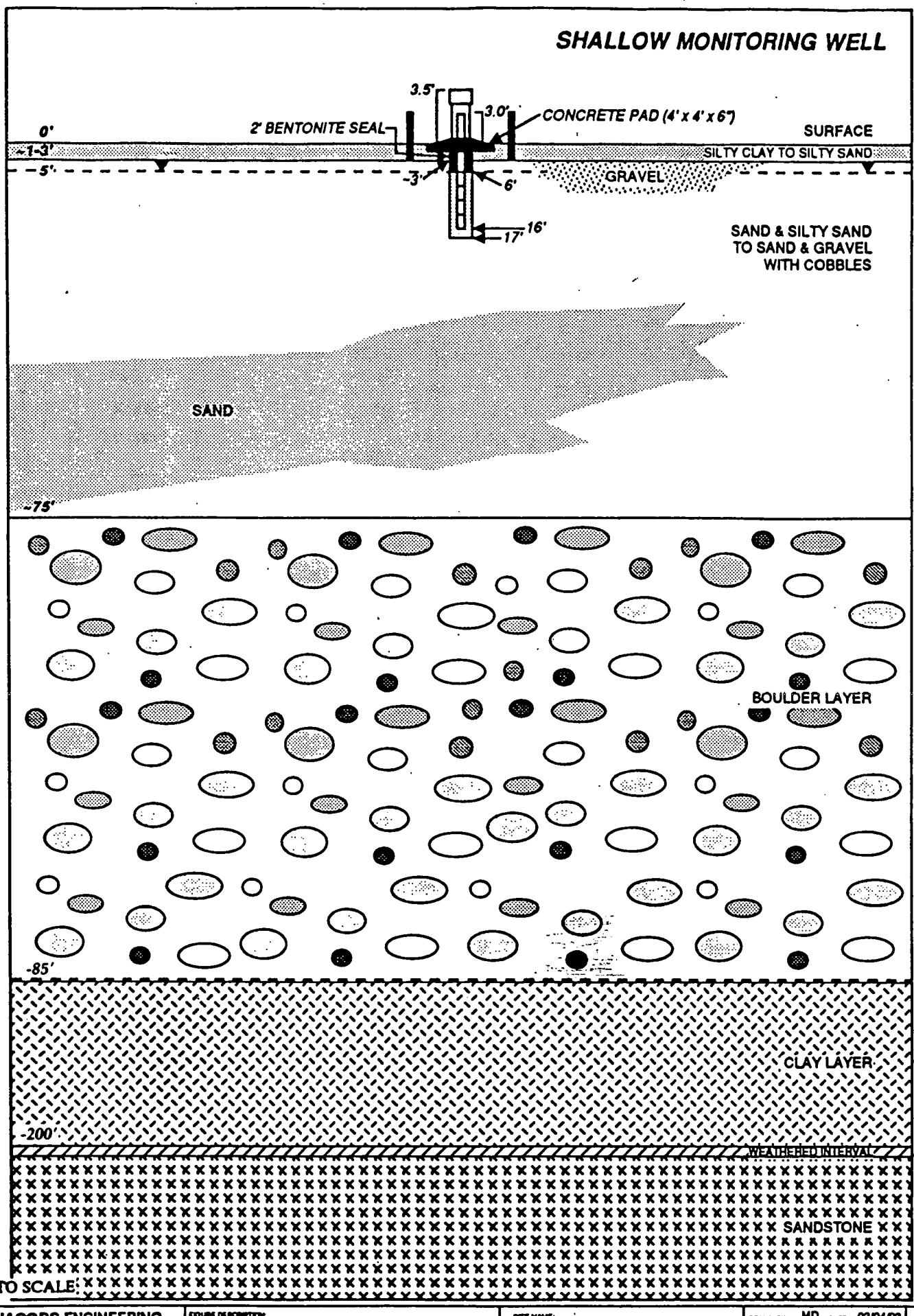
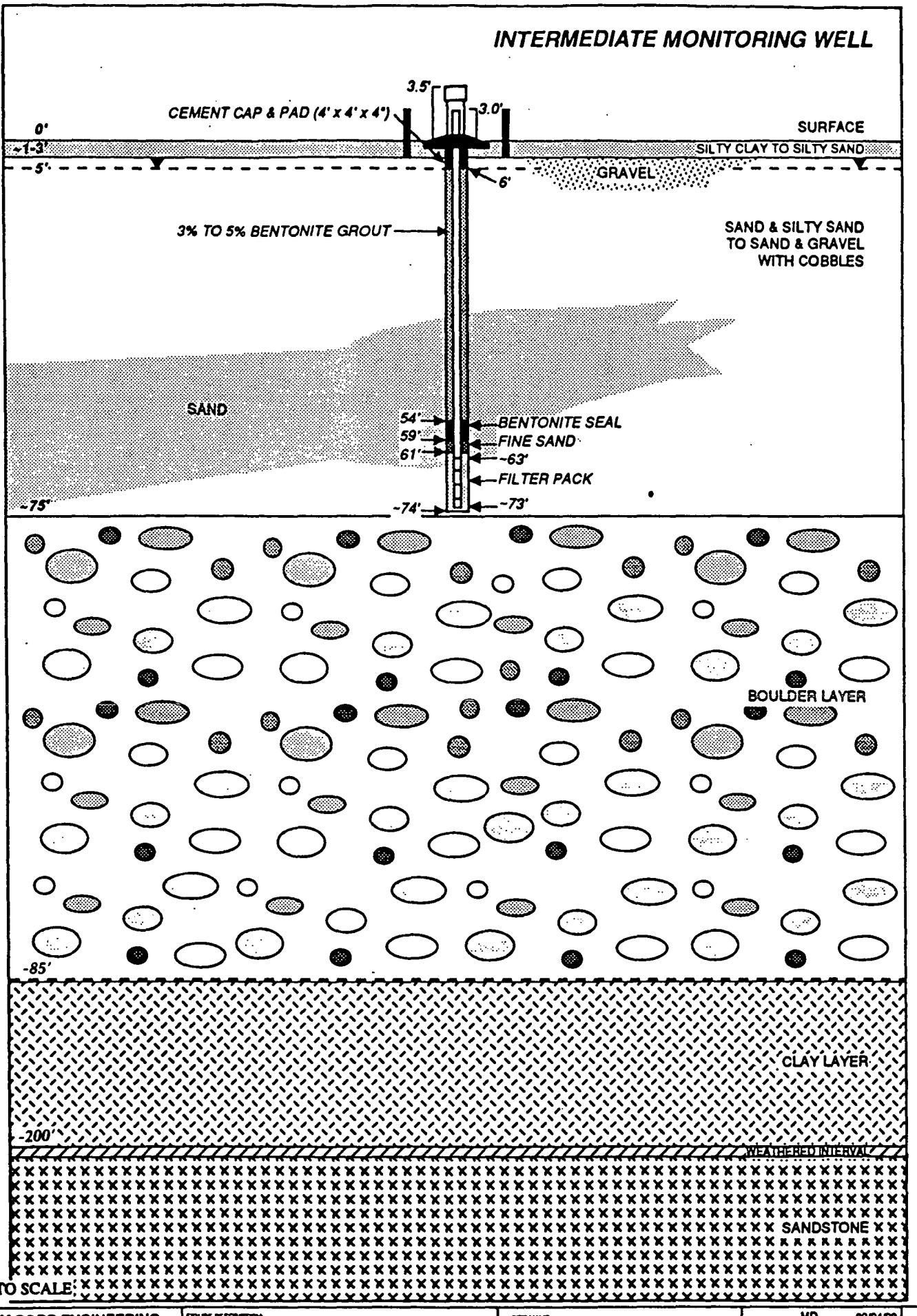
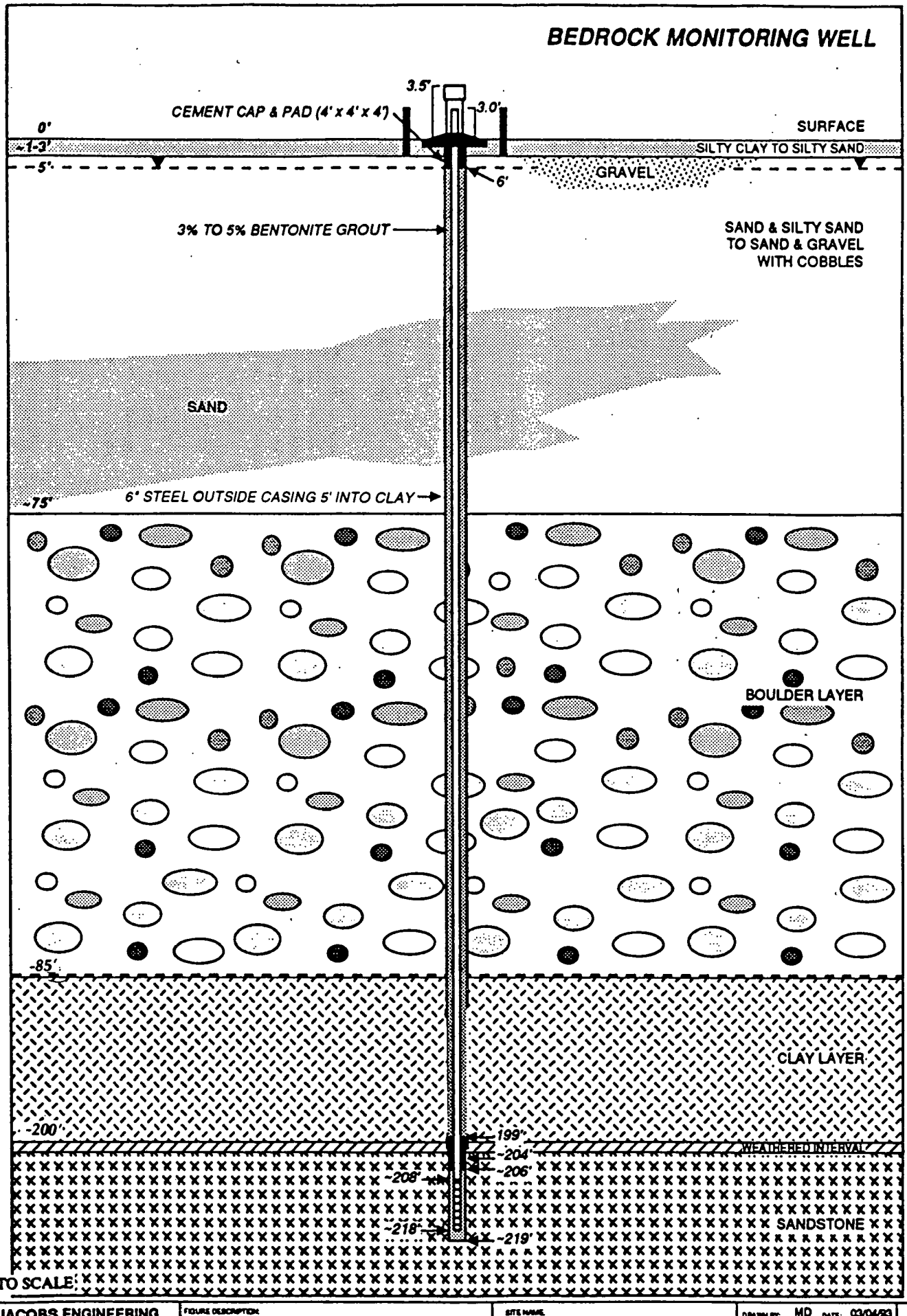
DRAWN BY	MD
DATE	03/02/93
CHECKED BY	TS
DATE	03/02/93
JACOBS ENGINEERING GROUP INC.	
TES X	
ACCESS PROJECT NO.	12-E018-00
FIGURE NO.	3-A
WORK ASSIGNMENT NO.	CO 5030



JACOBS ENGINEERING GROUP INC.	FIGURE DESCRIPTION: SHALLOW MONITORING WELL	SITE NAME: STOUGHTON LANDFILL STOUGHTON, WISCONSIN	DRAWN BY: MD DATE: 03/04/93 CHECKED BY: TS DATE: 03/04/93	4



JACOBS ENGINEERING GROUP INC.	FIGURE DESCRIPTION: INTERMEDIATE MONITORING WELL	SITE NAME: STOUGHTON LANDFILL STOUGHTON, WISCONSIN	DRAWN BY: MD DATE: 03/04/93 CHECKED BY: TS DATE: 03/04/93	5



JACOBS ENGINEERING GROUP INC.	FIGURE DESCRIPTION: BEDROCK MONITORING WELL	SITE NAME: STOUGHTON LANDFILL STOUGHTON, WISCONSIN	DRAWN BY: MD DATE: 03/04/93	6
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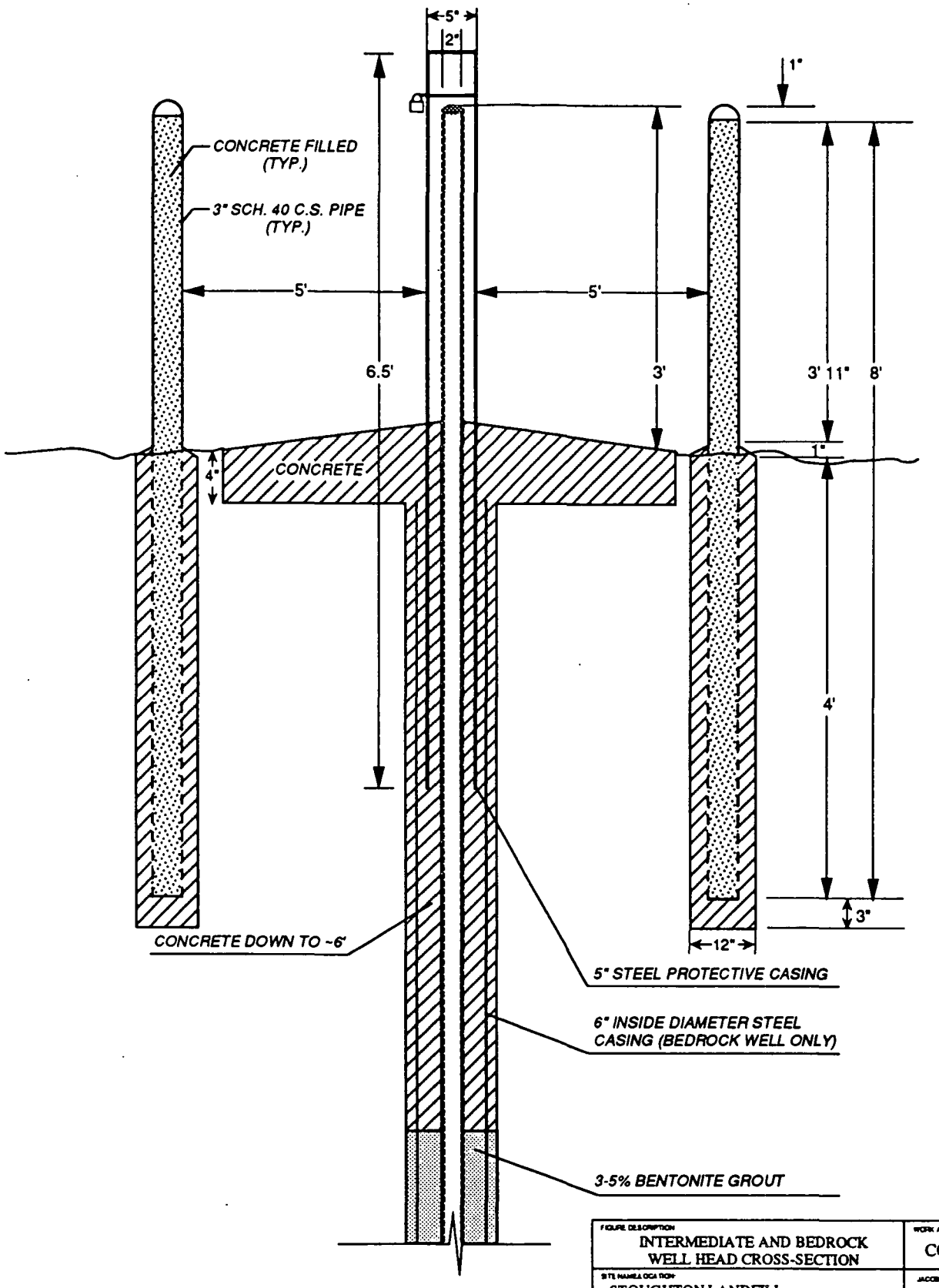

FIGURE DESCRIPTION: INTERMEDIATE AND BEDROCK WELL HEAD CROSS-SECTION	WORK ASSIGNMENT NO.: CO 5030
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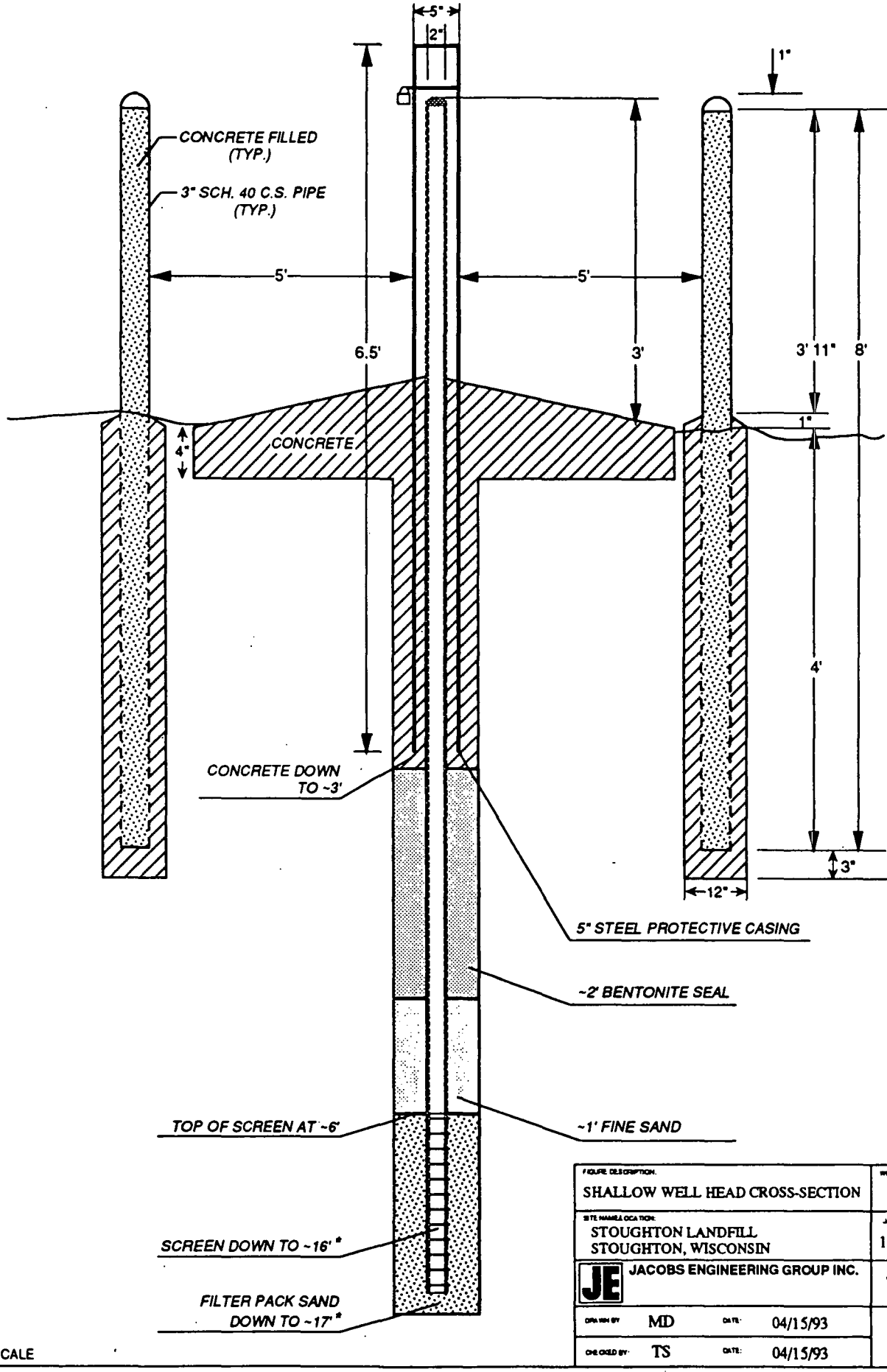
JACOBS ENGINEERING GROUP INC.	TES X
DRAWN BY: MD DATE: 04/15/93	FIGURE NO.: 7
CHECKED BY: TS DATE: 04/15/93	

NOT TO SCALE

E018-00-004



NOT TO SCALE

E018-00-005

FIGURE DESCRIPTION: SHALLOW WELL HEAD CROSS-SECTION	WORK ASSIGNMENT NO. CO 5030
SITE NAME/LOCATION: STOUGHTON LANDFILL, STOUGHTON, WISCONSIN	JACOBS PROJECT NO. 12-E018-00
JACOBS ENGINEERING GROUP INC.	TES X
DRAWN BY: MD DATE: 04/15/93	FIGURE NO. 8
CHECKED BY: TS DATE: 04/15/93	

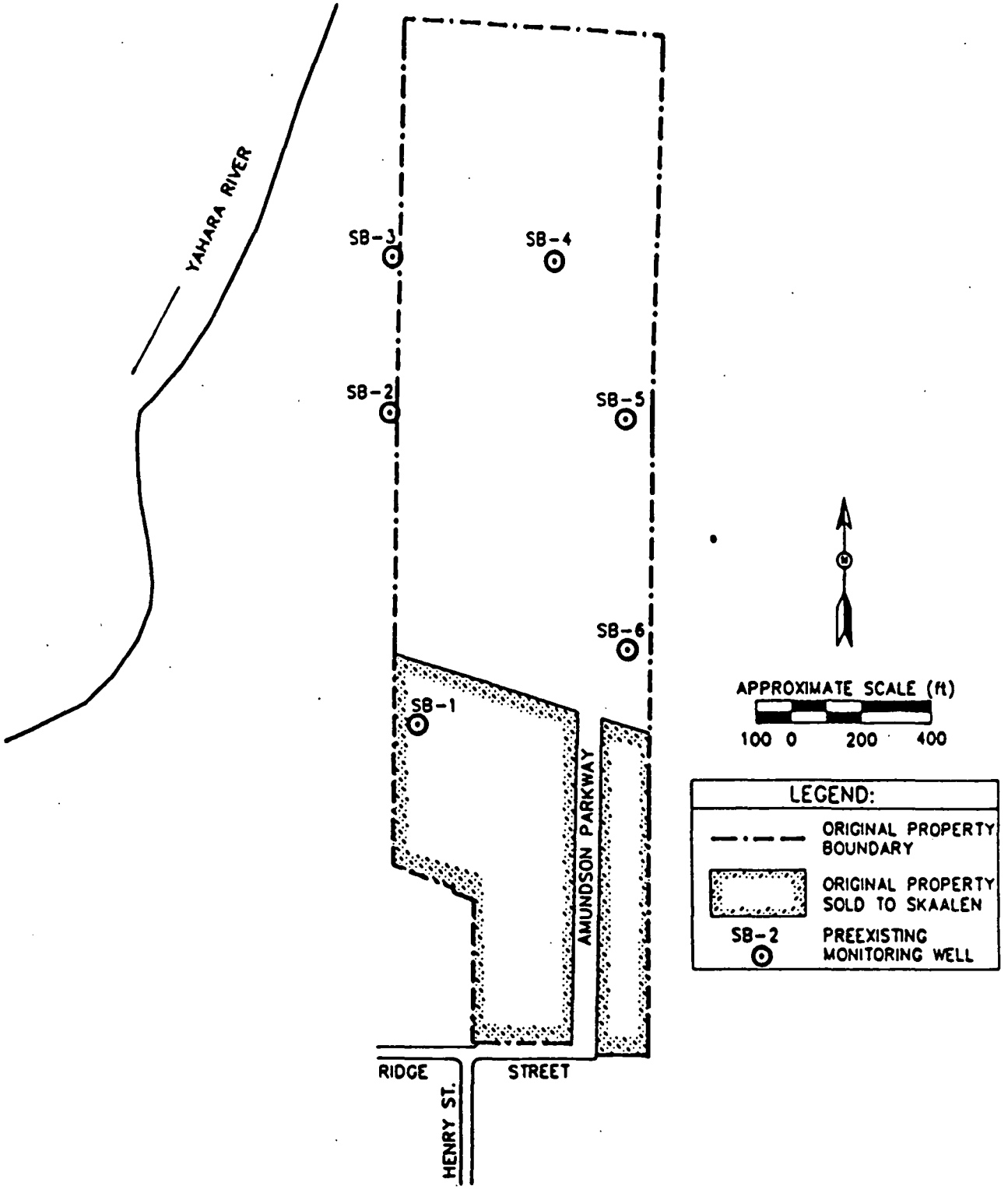


FIGURE 9

PREEXISTING MONITORING WELL LOCATIONS

STOUGHTON CITY LANDFILL
STOUGHTON, WISCONSIN

DRAWN: HWW	DATE: 7/31/90	PROJECT NUMBER: 6885-002
APPVD:	REVISED:	DRAWING NUMBER:

TABLES 1 - 6

TABLE 1

NON-CLP SAMPLE SUMMARY
STOUGHTON CITY LANDFILL

				QA/QC SAMPLES			
SAMPLE MATRIX	FIELD PARAMETERS	LABORATORY PARAMETERS	INVESTIGATIVE SAMPLES	COLLOCATED OR REPLICATE	EQUIPMENT RINSATE BLANKS	TRIP BLANKS	MATRIX TOTAL
Soil	PID Screening Lithologic Description (USCS)	Particle size analysis by ASTM D-422	2 220(1)	0 0	0 0	0 0	2 220(1)
Decontamination/ Purge Water	None	TCL Volatiles TCL Semi-volatiles	3	0	0	0	3
Drill Cuttings	PID Screening	TCLP	5	0	0	0	5
Groundwater (5 exploratory borings x 5 samples/boring)	None	THF, Dichlorodifluoromethane (Non-Standard Methods)	25	0(2)	0	0	25

Notes:

(1) Assumes five (5) soil borings to a total depth of 220 feet each.

(2) Extra volumes of the in-situ groundwater samples will be collected from the exploratory borings should re-analysis be necessary.

TABLE 2
STOUGHTON LANDFILL
REQUIRED EQUIPMENT

General Sampling Equipment

- X Well Keys
- X Laboratory-Cleaned Sample Containers
- X Preservatives (liquids in dropper bottles)
- X HPLC-Grade Water
- X Distilled Water
- X Measuring Tape (100 feet)
- X Thermometer
- X Sterile Disposable Pipets
- X pH Test Paper
- X pH Meter
- X pH 4.0 buffer solution
- X pH 7.0 buffer solution
- X pH 10.0 buffer solution
- X Conductivity meter
- X Conductivity meter calibration solution (KC1, water, & iodine)
- _ Bailer (Teflon)
- X Sampling Pump
- X 250 ml glass beaker (pre-cleaned and foil-wrapped)
- X Stainless steel/teflon-coated cable
- _ Geotech bladder pump
- _ Modular sequence time control
- _ Teflon tubing and connectors
- _ Air compressor
- X 12-volt DC power source
- _ Wrenches for fittings

Miscellaneous Equipment

- X Paper Towels
- X Camera and Film
- X Scissors & Utility Knife
- X Duct Tape
- X Indelible Marking Pens
- _ Grease Pencils
- X Calculator
- X Miscellaneous Tools
- _ Folding Table
- _ Squirt Bottle for Deionized Water
- X Kim-Wipes
- _ Knife
- _ Stopwatch
- _ Spray Paint and Stencils
- _ Bungie Cords/Tie-Downs
- _ Stainless Steel Trowel
- X Zip-loc bags
- X Large Trash Bags

[Table continued on next page]

TABLE 2 (continued)
REQUIRED EQUIPMENT

Shipping Equipment

X Coolers
X Bagged Ice
X Foam Packing Material
X Large Plastic Bags
X Package Tape
X Zip-Lock Bags
_ Twist Ties
_ Cubitainers
_ Thimbles (filled with activated carbon)
X Fiber Strapping Tape
_ Electrical Tape
_ Paint Cans (1 & 2 quart)
_ Can clips
X Bubble wrap

Health and Safety Equipment

X Hazardous waste drums
X Rain Gear
X Ear Plugs
X HNu (or other PID)
_ OVA (or other PID)
X First Aid Kit
_ Combustible Gas Indicator
_ Combustible Gas Indicator
_ Draeger Tubes (cyanide) and Hand Pump
_ Letters of Certification
X Steel-Toed Boots
X Inner Gloves
X Nitrile Outer Gloves
X Full-Face Respirator (Level C contingency)
X Comb. Organic Vapor Cartridges
_ Other Cartridges
X Face Shield and/or Safety Goggles or Glasses
X Hard Hat
X Disposable Boot Covers
_ Splash Apron
X Drinking Water
X Coated Tyvek (Level C contingency)
_ Cotton Coveralls

Paperwork, Labels, Etc.

_ Receipt for Samples Forms
X Plain 3 X 5 White Labels
X Label Tape (clear)
X Federal Express Airbills
X Sample Identification Labels
X Chain of Custody Forms
X U.S. EPA Region 5 Field Data Sheets
X Custody Seals
X This Side Up Labels
X UP Arrows
X U.S. EPA Do Not Tamper Labels
X Environmental Lab Sample Labels
X Inorganic Traffic Reports and Labels
X Organic Traffic Reports and Labels
X Well construction, abandonment forms

Manuals/Reports

X Technical Work Plan Addendum
X QAPP/SAP
X Health and Safety Plan
X Letters of Introduction/ Credentials
X Equipment Manuals
X Standard Operating Procedures for Field Measurements
_ OSHA Poster

[Table continued on next page]

TABLE 2 (continued)
REQUIRED EQUIPMENT

Decontamination Equipment

X Plastic Buckets (5-gallon)
X Non-phosphate Cleanser (Liquinox)
X Paper Towels
X Distilled/Deionized Water
X Methanol
X HPLC-Grade Water (Volatiles)
X Plastic Sheeting
X Decontamination Tubs
X Spray Bottles
X Scrub Brushes
X Drums, 55 gallon, decon. liq. storage

Filter Equipment

_ Filter flasks, cleaned
_ Rigid tubing, Y-connect (and extra lengths)
_ 0.45-micron filters
_ Fiber filters (prefilters)
_ Flask funnels (millipore) with washers intact
_ Geotech 2.4L Filter
_ Hand pump
_ Disposable Nalgene Filters

TABLE 3

CLP SAMPLE SUMMARY
STOUGHTON CITY LANDFILL

				QA/QC SAMPLES			
SAMPLE MATRIX	FIELD PARAMETERS	LABORATORY PARAMETERS	INVESTIGATIVE SAMPLES (2)	COLLOCATED OR REPLICATE	EQUIPMENT RINSATE BLANKS	TRIP BLANKS	MATRIX TOTAL
Groundwater (2 rounds x 17 wells)	pH	THF, Dichlorodifluormethane (Non-standard Methods) (1)	34	4	4	2	44
	Specific Conductance	TCL Volatiles (1) (CLP protocol)	34	4	4	4	46
	Temperature	TCL Semivolatiles (1) (CLP protocol)	34	4	4	0	42
	Water Levels	TAL Inorganics (CLP protocol - total metals)	34	4	4	0	42
		Cyanide	34	4	4	0	42
Municipal Well Water (2 rounds x 2 wells)	pH	THF, Dichlorodifluoromethane (Non-standard Methods)	4	0	0	0	4
	Specific Conductance	TCL Volatiles (1) (CLP protocol)	4	0	0	0	4
	Temperature	TCL Semivolatiles (1) (CLP protocol)	4	0	0	0	4
		TAL Inorganics (CLP protocol - total metals)	4	0	0	0	4
		Cyanide	4	0	0	0	4

Notes:

(1) MS/MD analyses will be conducted at a frequency of one per 20 or fewer investigative samples for TCL organics. For the volatile fraction, triple volumes will be collected at the location selected for MS/MSD analyses. Double volumes will need to be collected for MS/MSD analyses in the semi-volatile fraction.

(2) Assumes four additional monitoring wells. Indicated number of samples would increase with additional new wells.

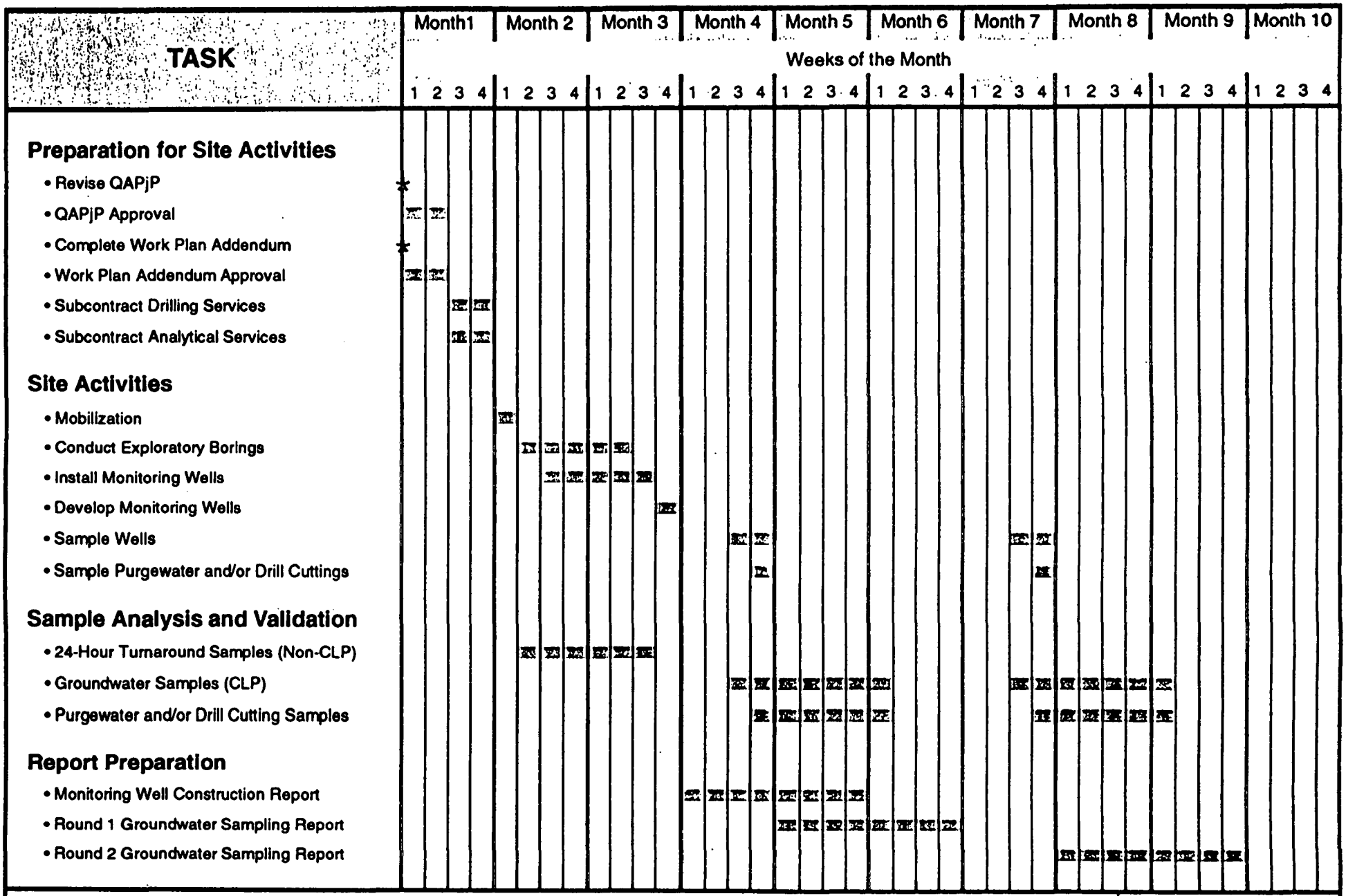
TABLE 4

SAMPLE PRESERVATIVES, CONTAINERS, AND HOLDING TIMES
STOUGHTON LANDFILL

ANALYTICAL PARAMETER	TOTAL METALS (unfiltered)	VOLATILE ORGANICS	THF, DICHLORO-DIFLUOROMETHANE	SEMI-VOLATILE ORGANICS	MERCURY	CYANIDE
Concentration Level	Low	Low	Low	Low	Low	Low
Packaging Level	Low	Low	Low	Low	Low	Low
Preservation	Add Nitric Acid to pH <2, Cool to 4°C	Add 2 drops 1:1 HCl Cool to 4°C	Add 2 drops 1:1 HCl Cool to 4°C	Store in dark, Cool to 4°C	Add nitric acid to a final concentration of 0.5% (V/V) nitric acid and 0.05% (W/V) potassium dichromate	Add NaOH to pH >10, Cool to 4°C
Technical Holding Time (from collection to analysis)	180 days	14 days	14 days	7 days for extraction; 40 days thereafter	28 days	14 days
Required Sample Volume	Container completely full	Container completely full NO HEADSPACE	Container completely full NO HEADSPACE	Container completely full	Container completely full	Container completely full
CONTAINER TYPE	1,1-L Cubitainers	4, 40-ml VOA vials	4, 40-ml VOA vials	2,80-oz. Amber Glass with PTFE Cap	1,1-L Cubitainers	1,1-L Cubitainers
No. of Containers Needed - Exploratory Borings	0	0	100	0	0	0
No. of Containers Needed - Round 1	24	100	96	48	24	24
No. of Containers Needed - Round 2	24	100	96	48	24	24

Table 5
Responsibilities of Key Project Personnel
Stoughton Landfill

Party	Responsibilities
U.S. EPA	Project oversight/review and approval
WDNR	Project oversight/review and approval
City of Stoughton	Arrange access to off-site properties; transport or arrange for transport of liquid wastes off site to City of Stoughton POTW; site security
Jacobs Engineering:	
Susan Lorenz	Project management; EPA, WDNR, PRP liaison
Lou Ehrhard	Field Team Leader; geologist; back-up project management; field oversight; sampling; data analysis and reporting; laboratory liaison
Jeff Bale	Environmental Scientist; oversight and sampling support
Bill Dytrych	Geologist; oversight and sampling support
Drilling Company	Boring and monitoring well construction and abandonment; waste handling; boring and monitoring well purging and development; boring and monitoring well construction; soil/geologic logs; DNR forms completion; provide on-site decon and toilet facilities; project site security
Laboratory	Provide sample containers and preservatives; laboratory analysis and data validation



ACTIVITIES SCHEDULE **STOUGHTON LANDFILL INVESTIGATION** **TABLE 6**

Jacobs Engineering Group Inc. Environmental Systems Division

Drawn: KL
Checked: LE
Date: 4/19/93

APPENDIX A
WISCONSIN ADMINISTRATIVE CODE NR 141

Chapter NR 141

GROUNDWATER MONITORING WELL REQUIREMENTS

NR 141.01	Purpose	NR 141.15	Drilling methods and fluids
NR 141.03	Applicability	NR 141.17	Disposal and decontamination
NR 141.05	Definitions	NR 141.19	Borehole diameter
NR 141.055	Borehole protection	NR 141.21	Well development
NR 141.06	Soil testing	NR 141.23	Well and borehole construction documentation
NR 141.065	Well location		
NR 141.07	Well casing	NR 141.25	Abandonment requirements
NR 141.09	Well screen	NR 141.27	Driven point wells
NR 141.10	Tremie pipes and sealing procedures	NR 141.29	Temporary groundwater monitoring wells
NR 141.11	Filter packs	NR 141.31	Special circumstances and exceptions
NR 141.13	Sealing requirements		

NR 141.01 Purpose. The purpose of this chapter is to establish minimum acceptable standards for the design, installation, construction, abandonment and documentation of groundwater monitoring wells. These rules are adopted under chs. 144, 160 and 227, Stats.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.03 Applicability. This chapter applies to all persons installing groundwater monitoring wells for purposes regulated by the department under ch. 144, 147 or 160, Stats., or in permits, plan approvals, licenses or orders issued under those chapters. In addition, this chapter applies to all persons installing groundwater monitoring wells in fulfillment of terms of a contract with the department.

Note: Additional requirements concerning soil testing and groundwater sampling are located in other chapters regulating wastewater and solid and hazardous waste disposal, see chs. NR 110, 181, 206, 213, 214, 508, 512 and 550.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.05 Definitions. In this chapter:

(1) "Air rotary drilling" means a drilling method whereby the borehole is advanced using a circular rotating action applied to a string of drilling rods which have a diffused discharge bit attached to the bottom of the rods. Pressurized air is forced through the drilling rods and cools the drilling tools and removes the cuttings from the borehole.

(2) "Annular space seal" means the following:

(a) For wells constructed with filter packs, it is the material placed above the top of the filter pack or the filter pack seal up to the surface seal and between the well casing and the adjacent formation; or

(b) For wells constructed into bedrock formations and without well screens, it is the material placed from the bottom of the enlarged borehole up to the surface seal, between the well casing and the adjacent formation.

(3) "ASTM" means american society for testing and materials.

(5) "Bedrock" means the solid rock underlying any loose surficial material such as soil, alluvium or glacial drift. Bedrock includes but is not limited to limestone, dolomite, sandstone, shale and igneous and metamorphic rock.

(6) "Bentonite" means a clay consisting of at least 85% sodium montmorillonite. Bentonite is available in the following forms:

(a) "Bentonite powder" means 200 mesh pure bentonite, without additives.

(b) "Bentonite granules" means 8 mesh pure bentonite, without additives.

(c) "Bentonite pellets" means commercially manufactured tablets made by compressing pure bentonite, without additives, into forms greater than ¼" in size.

(d) "Bentonite chips" means commercially processed angular fragments of pure bentonite, without additives.

(7) "Bentonite - cement grout" means a mixture with the ratio of 5 pounds of bentonite with 94 pounds of Portland cement and 5 to 6 gallons of water from a known safe and uncontaminated source.

(8) "Bentonite - sand slurry" means a mixture with the ratio of 55 pounds of bentonite with 100 gallons of water from a known safe and uncontaminated source and 10-25% sand by volume for a mud weight of 12 pounds per gallon.

(9) "Borehole" means a circular hole deeper than it is wide, constructed in earth material for the purpose of either installing a well or obtaining geologic or groundwater related data. Boreholes are also referred to as drillholes.

(10) "Clay" means an inorganic soil with low permeability characteristics and a plasticity index of 7 or more.

(11) "Coarse sand" means a well sorted sand with a predominant grain size between 4.76mm and 2.0mm as established by the unified soil classification system.

(12) "Concrete" means a slurry mixture with a ratio of 94 pounds of cement, equal volumes of dry sand and gravel and 5 to 6 gallons of water from a known safe and uncontaminated source. The ratio of sand and gravel to cement may not exceed 3 parts to one.

(13) "Department" means the department of natural resources.

(14) "Driven point well" means a well constructed by joining a drive point with lengths of pipe and driving the assembly into the ground with percussion equipment or by hand, without first removing material below the 10 foot depth.

(15) "Filter pack" means the sand, gravel or both placed in direct contact with the well screen.

(16) "Filter pack seal" means the sealing material placed in the annular space above the filter pack and below the annular space seal to prevent the migration of annular space sealant into the filter pack.

(17) "Fine sand" means a well sorted sand with a predominant grain size between .42mm and .074mm, as established by the unified soil classification system.

(18) "Granular bentonite slurry" means a mixture of 30 pounds of untreated bentonite powder added to 100 gallons of water from a known safe and uncontaminated source with 125 pounds of untreated bentonite granules mixed together with a Venturi-hopper mud mixer.

(19) "Gravel" means an unconsolidated material with the predominant grain size being between 76.2mm and 4.76mm, as established by the unified soil classification system.

(20) "Groundwater" means any waters of the state, as defined in s. 144.01 (19), Stats., occurring in a saturated geologic formaton of rock or unconsolidated material.

(21) "Groundwater monitoring well" means any cased excavation or opening into the ground made by digging, boring, drilling, driving, jetting or other methods for the purpose of determining the physical, chemical, biological or radiological properties of groundwater. Groundwater monitoring wells may be piezometers, water table observation wells or both.

(22) "Hollow stem auger drilling" means a drilling method where continuous flighting is welded to a hollow stem pipe. The flighting carries drill cuttings to the surface as the flighting is rotated and pushed down into the earth.

(23) "Inside diameter" means the horizontal distance between the inner walls of a well casing, hollow stem auger or tremie pipe.

(24) "Medium sand" means a well sorted sand with a predominant grain size between 2.0mm and .42mm, as established by the unified soil classification system.

(25) "Montmorillonite" means a group of expanding lattice clay minerals of the general formula: $R.33Al_2Si_40_{10}(OH)_2 \cdot H_2O$, where R means one or more cations of sodium, potassium, magnesium or calcium and where Al means aluminum, Si means silicon, O means oxygen and H means hydrogen.

(26) "Mud rotary drilling" means a drilling method whereby a borehole is advanced by using a circular rotating action applied to a string of drilling rods which have a diffused discharge bit attached to the bottom of the string. A bentonite and water mud slurry is used to provide borehole stability, to cool the bit and to carry cuttings to the ground surface.

(27) "Neat cement grout" means a slurry mixture with a ration of 94 pounds of Portland cement mixed with 5 to 6 gallons of water from a known safe and uncontaminated source.

(28) "Percussion drilling" means a drilling method using a cable tool drilling machine or a drilling method whereby the permanent or temporary well casing is driven, or is set into a borehole and then driven.

(29) "Permanent groundwater monitoring well" means any groundwater monitoring well in place for 60 days or longer.

(30) "Piezometer" means a groundwater monitoring well, sealed below the water table, installed for the specific purpose of determining either the elevation of the potentiometric surface or the physical, chemical, biological or radiological properties of groundwater at some point within the saturated zone or both.

(31) "Potentiometric surface" or "piezometric surface" means an imaginary surface representing the total head of groundwater and is the level to which water will rise in a well.

(32) "Psi" means pounds per square inch.

(33) "Purge" means an action that removes water from the well, commonly accomplished by using a pump or bailer.

(34) "Rotary wash drilling" means a drilling method whereby metal temporary casing is advanced into the borehole by driving. At selected intervals, the temporary casing is cleaned out using rotary drilling tools by pumping clean water through the rod to flush out accumulated cuttings. This drilling method is also known as wash bore or wash down drilling.

(35) "Sand-cement grout" means a mixture of cement, sand and water in the proportion of 94 pounds of Portland cement, one cubic foot of dry sand and 5 to 6 gallons of water from a known safe and uncontaminated source.

(36) "Sediment" means any solid material dropping from suspension in water, including clay, silt, sand and gravel sized particles.

(37) "Solid stem auger drilling" means a drilling method where continuous flighting is welded onto a solid stem pipe. The flighting carries drill cuttings to the surface as the flighting is rotated and pushed down into the earth. The borehole is created by a cutting bit located at the tip of the lead auger.

(38) "Specific gravity" means the weight of a particular volume of substance compared to the weight of an equal volume of water at a reference temperature.

(39) "Surge" means an action causing water to move rapidly in and out of the well screen, thereby removing fine material from the surrounding aquifer.

(40) "Temporary groundwater monitoring well" means any groundwater monitoring well in place for less than 60 days.

(41) "Top of bedrock" or "top of firm rock" means at least 70% of the drill cuttings being either:

(a) Angular rock fragments, as in the case of crystalline rock; or

(b) Rock fragments composed of individual grains or rock particles that are cemented together to form an aggregate as opposed to a single sediment particle.

(42) "Tremie pipe" means a pipe or hose used to install well construction materials in an annular space or a borehole.

(43) "Unconsolidated material" means that material found above firm bedrock, composed of single sediment particles, individual grains or rock fragments. Unconsolidated material includes but is not limited to clay, silt, sand, gravel, loess, peat and organic soil.

(44) "Unified soil classification system" means the soil designation system based on the physical properties of the soil developed from the air-field classification system in 1952 and adopted by the American society for testing and materials in standard test method D2487-83.

Note: A copy of this publication is available for inspection at the offices of the department of natural resources, the secretary of state and the rivisor of statutes and may be obtained for personal use from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

(45) "Water table" means the surface of unconfined groundwater where the water pressure is equal to atmospheric pressure.

(46) "Water table observation well" means any groundwater monitoring well, in which the screen or open borehole intersects a water table, which is installed for the specific purpose of determining either the elevation of the water table or the physical, chemical, biological or radiological properties of groundwater at the water table or both.

(47) "Well" means any borehole or other excavation or opening in the ground deeper than it is wide constructed for the purpose of obtaining or monitoring groundwater.

(48) "Well depth" means the distance from the ground surface to the bottom of the well screen or to the bottom of the open hole when a well screen is not used.

(49) "Well volume" means the volume of water contained in the well casing and the filter pack.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.055 Borehole protection. If a borehole is left open, protective measures shall be taken to prevent the borehole from acting as a conduit for contamination or becoming a safety hazard.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.06 Soil testing. Specific soil sampling and testing procedures are specified in other chapters related to wastewater and solid and hazardous waste disposal facilities.

Note: See chs. NR 110, 181, 206, 214, 508, 512 and 550, Wis. Adm. Code.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.065 Well location. (1) Monitoring wells installed where prior department approval is required shall be installed at the locations indicated on plans and specifications approved by the department prior to installation.

(2) Following installation of the wells, an as-built plan map shall be submitted specifying the exact vertical and horizontal location of the wells. All monitoring well locations shall be reported to the department on a plan map drawn to a specific scale. The map shall indicate structure boundaries, property boundaries, any nearby surface waters and a north arrow. The plan shall show the wells in relation to each other, to property and structure boundaries, and to a common reference point on a horizontal grid system. The origin of the grid system shall be located according to latitude or longitude or according to the state plane coordinate system. The exact vertical location of the top of the well casing shall be referenced to the nearest benchmark for the national geodetic survey datum to an accuracy of 0.01 feet. This plan map shall show the exact location of the installed well on a horizontal grid system which is accurate to

within one foot. Direction of groundwater flow shall be indicated. In addition, an 8.5-inch by 11-inch site map drawn to scale according to the horizontal grid system shall be submitted showing the location of wells and structures on the site.

(3) The well casings for wells constructed in a floodplain or floodway shall terminate a minimum of 2 feet above the regional flood elevation for the well site.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.07 Well casing. (1) SPECIFICATIONS. All permanent groundwater monitoring wells shall be constructed of new polyvinyl chloride (PVC) well casing materials except in situations where the rock, soil or groundwater may react with PVC, in which case an approval under s. NR 141.31 for alternative materials shall be requested. All PVC casing materials shall meet national sanitation foundation standard 14 and ASTM D1785 specifications for any one of the following cell classifications: 12454-B, 12454-C, 11443-B, 14333-D, 13233 or 15223-B. All casing shall have a minimum inside diameter of 1.9 inches. In unconsolidated geologic formations, all wells less than or equal to 100 feet in depth shall be constructed of at least schedule 40 PVC casing and all wells greater than 100 feet in depth shall be constructed of at least schedule 80 PVC casing. All groundwater monitoring wells that penetrate greater than 2 feet past the top of the bedrock shall be constructed of at least schedule 80 PVC. Groundwater monitoring wells shall be installed with well casing no larger than a 4-inch inside diameter.

(2) REFERENCE. The listed national sanitation foundation and ASTM references are available for inspection at the offices of the department of natural resources, the secretary of state and the revisor of statutes and may be obtained for personal use from the National Sanitation Foundation, 3475 Plymouth Road, P.O. Box 1468, Ann Arbor, Michigan 48106, and the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

(3) ASSEMBLY AND INSTALLATION. All casing couplings shall be constructed of flush threaded joints. Solvent welded joints may not be used without prior written approval by the department. The casing shall be centered in the borehole.

(4) INSPECTION. Prior to use, the casings and couplings shall be inspected for cuts, deformations, gouges, deep scratches, damaged ends and other imperfections. Any casing or coupling having such a defect may not be used.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.09 Well Screen. (1) SPECIFICATIONS. All permanent groundwater monitoring well screens shall be constructed of material which is nonreactive with the constituents in soils and groundwater at the monitoring location. The well screen may not be hand cut and may not be wrapped with filter cloth. The well screen slot size shall be sized to retain at least 50% of the grain size of the collapsed formation, based on a field sieve analysis, when collapsed formation is used as filter pack material or at least 90% of the grain size of the filter pack, based on a sieve analysis, if material other than collapsed formation is used. Well screens on water table observation wells may not exceed 15 feet in length. Well screens on

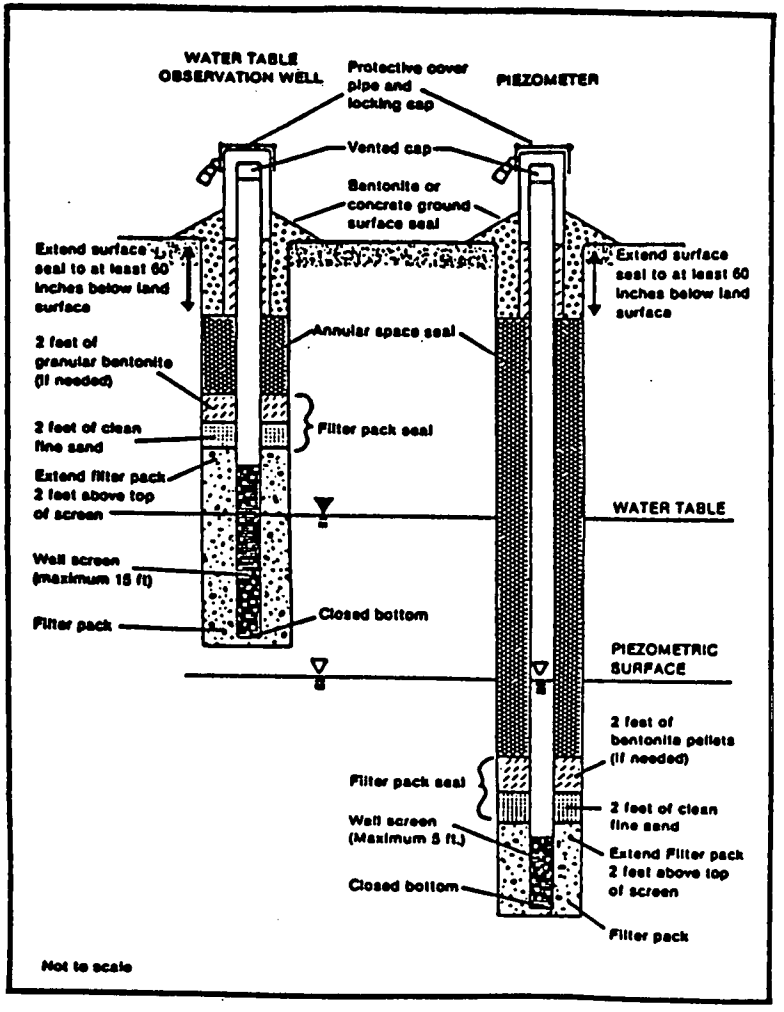
piezometers installed for the purpose of determining the elevation of the potentiometric surface may not exceed 5 feet in length.

Note: Well screens for wells other than the water table observation wells and piezometers identified above may vary in length.

(2) ASSEMBLY AND INSTALLATION. All well screens shall be permanently joined to the well casing by flush threaded joints. All joints shall be watertight. All well screens shall be centered in the borehole. Monitoring wells installed in bedrock using an open borehole may be constructed without a well screen.

Figure 1:

Typical water table observation well and piezometer construction details.



History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.10 Tremie pipes and sealing procedures. (1) MATERIALS. The tremie pipe used for the placement of sealant materials shall be one of the following materials:

(a) Metal pipe,

(b) Rubber-covered hose reinforced with braided fiber or steel and rated for at least 300 psi, or

(c) Thermoplastic pipe rated for at least 100 psi including:

1. Polyvinyl chloride (PVC)

2. Chlorinated polyvinyl chloride (CPVC),

3. Polyethylene (PE),

4. Polybutylene (PB), and

5. Acrylonitrite butadiene styrene (ABS).

(2) PROCEDURES. This subsection describes department approved sealant placement methods when a tremie pipe is used.

(a) The estimated and actual volume of sealing material used shall be calculated and reported to the department.

(b) The sealant material shall be placed in one continuous operation in such a manner as to not disturb the integrity of the filter pack and seal.

(c) When a tremie pipe is used, the bottom end shall be kept submerged in the sealant material throughout the sealing process.

(d) The sealant material shall be brought up to the ground surface. The density of the sealant material flowing from the annular space or borehole at the ground surface shall be the same as the density of the sealant material being placed. Any settling of the sealant material shall be topped off.

(e) Tremie pipe - gravity. As depicted in Figure 2, sealing material may flow by gravity through a funnel or hopper connected to a tremie pipe. The tremie pipe shall be lowered to the bottom of the annular space or borehole to be sealed and the sealing material placed from the bottom up. The end of the tremie pipe shall be kept submerged in the grout or slurry at all times.

(f) Tremie pipe - pumped. As depicted in Figure 3, the sealing material shall be placed by a pump through a tremie pipe into the annular space or borehole.

Figure 2.

Conductor (tremie) pipe — gravity method

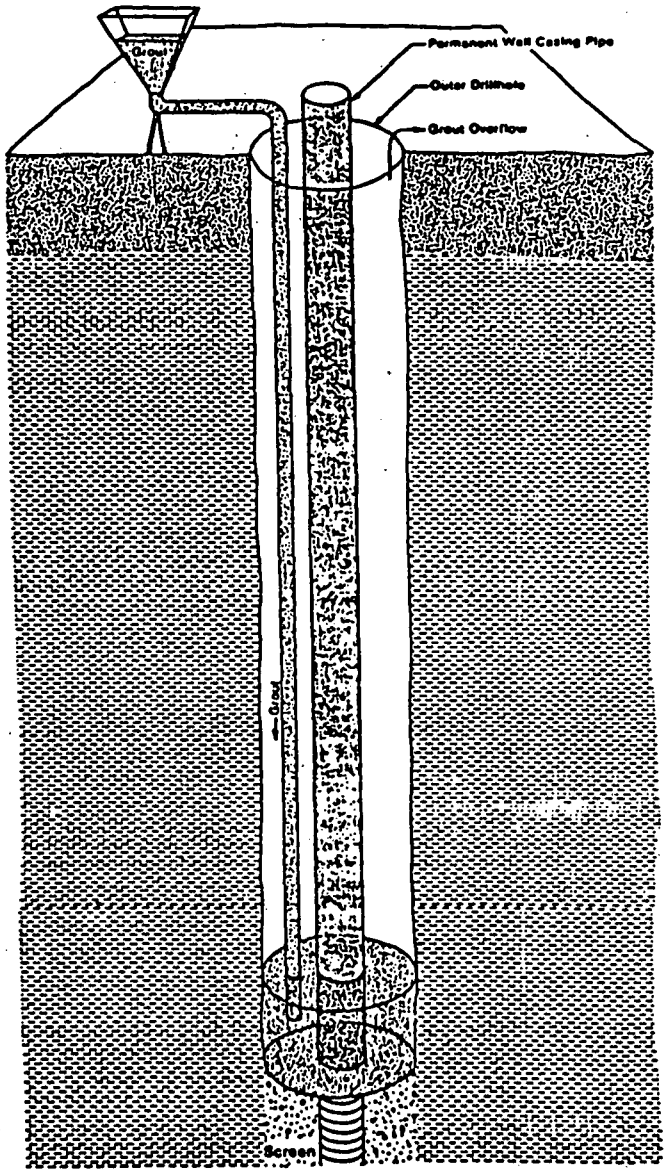
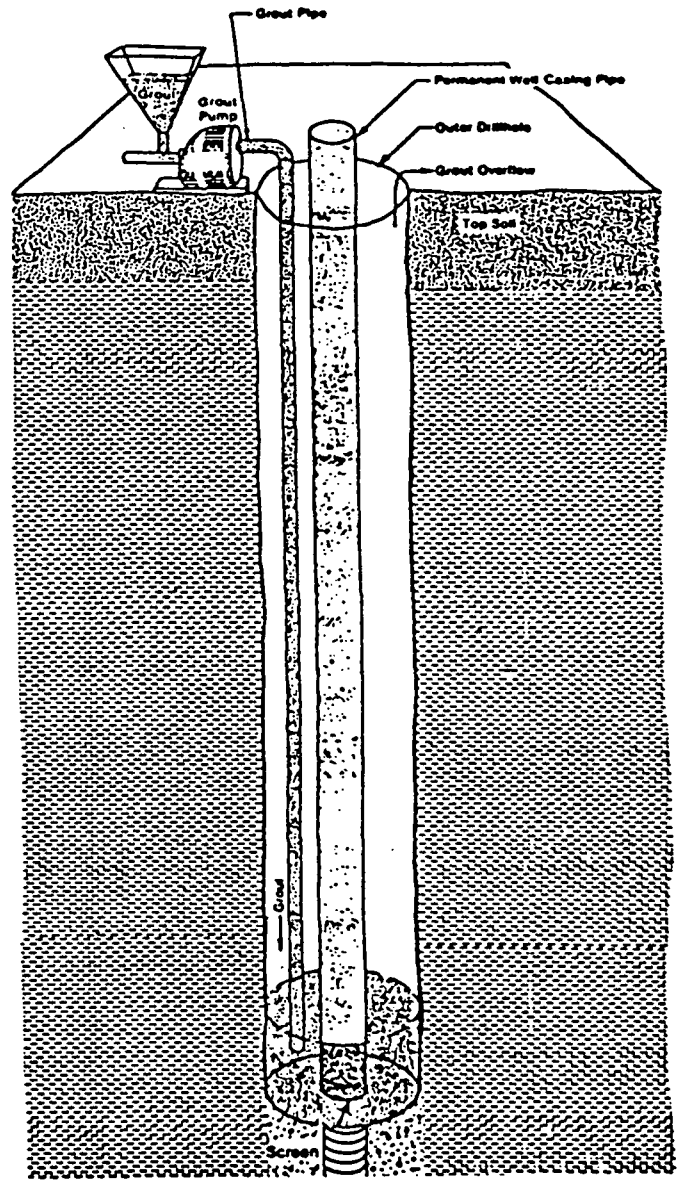


Figure 3.

Conductor (tremie) pipe — pumped method



History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.11 Filter packs. All permanent groundwater monitoring wells installed in unconsolidated material and used for the collection of water quality samples shall be constructed with filter packs. Permanent groundwater monitoring wells installed in bedrock may be constructed with filter packs. When used, the filter pack shall be the only material in contact with the well screen. The estimated and actual volume of filter pack material used shall be calculated and reported to the department. All commercially prepared filter packs installed in permanent groundwater monitoring wells shall meet the requirements in sub. (1). All other filter packs shall meet the requirements in sub. (3).

(1) SPECIFICATIONS. The filter pack shall be a well sorted, silica based sand or gravel. The sand or gravel used for filter packs shall be hard and durable and shall have an average specific gravity of not less than 2.50. The sand and gravel shall be visibly free of clay, dust and micaceous and organic matter. Not more than 5% of the sand or gravel shall be soluble in a 10% hydrochloric acid solution. Thin, flat or elongated pieces of gravel, the maximum dimension of which exceeds 3 times the minimum dimension, may not constitute more than 2% of the material by weight. The filter pack for wells installed in unconsolidated material shall be sized to retain at least 50% of the surrounding formation based on a sieve analysis. In bedrock, the filter pack shall be a medium or coarse sand or gravel. Crushed limestone, dolomite or any material containing clay or any other material that will adversely impact on the performance of the monitoring well may not be used as filter pack.

(2) INSTALLATION. The filter pack shall extend from 6 inches beneath the well point to 2 feet above the top of the well screen. For water table observation wells constructed in areas where the depth to water table is less than 5 feet, the required filter pack height above the top of the well screen may be reduced to 6 inches to allow for the required amount of annular space sealant to be placed. To ensure that the filter pack is installed evenly surrounding the well screen and casing over the proper depth interval, a tape measure, measurng rod or similar device shall be used to measure the height of the filter pack. The tape measure, measuring rod or similar device shall be carefully raised and lowered while the filter pack is being installed to identify bridging. If bridging occurs the filter pack material shall be tamped into place, surrounding the well screen and casing, using a measuring rod or similar device.

(3) COLLAPSED FORMATION. Collapsed formation may be used as filter pack material if the physical and chemical properties of the formation are consistent with the filter pack specifications stated in sub. (1) and if the collapsed formation will limit the passage of formation fines into the well screen. The grain size distribution of the collapsed formation shall be such that at least 50% of the formation will be retained by the well screen based on a field sieve analysis. If used as filter pack, the collapsed formation shall be visibly free of clay, dust and micaceous and organic matter. Analysis of the collapsed formation for specific gravity and particle size shall be performed during well construction and shall be submitted to the department to support its use as an acceptable filter pack. Following review of the submitted information, the department may require new well construction if the collapsed formation analysis is not consistent with the filter pack specifications in sub. (1) and this subsection.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.13 Sealing requirements. All materials and procedures used in the installation of seals for permanent groundwater monitoring wells shall meet the requirements of this section. The calculated and actual volume of sealant material used for the filter pack seal and annular space seal shall be reported to the department.

(1) FILTER PACK SEAL. (a) *Specifications.* All permanent groundwater monitoring wells installed with filter packs shall be constructed with a filter pack seal. For all water table observation wells and piezometers, the filter pack seal shall extend 2 feet upward from the top of the filter pack and shall consist of 2 feet of clean fine sand. When bentonite-cement grout or neat cement grout is used as the annular space sealant, 2 feet of bentonite shall be placed on top of the clean fine sand seal. Bentonite pellets shall be used for seals placed below the water table. Granular bentonite shall be used for seals placed above the water table.

(b) *Installation.* A tape measure, measuring rod or similar device shall be used to ensure that the filter pack seal is installed over the proper depth interval. The tape measure, measuring rod or similar device shall be carefully raised and lowered while the filter pack seal material is being placed to indentify bridging. If bridging occurs the filter pack seal material shall be tamped into place, surrounding the well casing, using a measuring rod or similar device. When a tremie pipe is used to place the filter pack seal the procedures of s. NR 141.10 (2) shall be followed.

(2) ANNULAR SPACE SEAL. (a) *Specifications.* All permanent groundwater monitoring wells shall be installed with an annular space seal designed to achieve a permeability of 1×10^{-7} centimeters per second or less. For permanent groundwater monitoring wells constructed with filter packs, the annular space seal shall extend from the filter pack seal to the ground surface seal and shall be at least 2 feet in length. For monitoring wells constructed into bedrock formations and without well screens, the annular space seal shall extend from the bottom of the outer borehole to the ground surface seal and shall be at least 2 feet in length. Sealant materials may not contain additives.

Note: The department does not recommend the use of neat cement grout or cement mixtures in fractured formations because they may impact water quality.

1. Granular bentonite slurry may be used as an annular space sealant in any type of monitoring well.

2. Bentonite sand slurry may be used as an annular space sealant in any type of monitoring well.

3. Bentonite pellets or granular bentonite may be used to seal the annular space under the following conditions:

a. Granular bentonite may be used when there is no standing water in the well above the filter pack seal and the total well depth is less than 25 feet.

b. Bentonite pellets may be used when the depth of standing water in the well is less than 30 feet and the total depth of the annular space seal is less than 50 feet.

4. If the well is constructed by circulating drilling mud containing no additives, the annular space may be sealed with bentonite slurry and cuttings if the mud weight is at least 12.0 pounds per gallon and the well is not constructed in contaminated material.

5. Neat cement grout may be used as an annular space sealant only if schedule 80 PVC or stainless steel well casing is used.

6. Bentonite-cement grout may be used as an annular space sealant in any type of monitoring well in which a bentonite seal above the filter pack has been installed.

(b) *Installation.* 1. When bentonite pellets or granules are used to seal the annular space, they may either be poured freely down the borehole or added through a tremie pipe, provided the specifications of par. (a) are met. When a tremie pipe, provided the specifications of par. (a) are met. When a tremie pipe is used to place the annular space sealant the procedures of s. NR 141.10 (2) shall be followed.

2. When grouts or slurries are used to seal the annular space, the material may be poured freely down a tremie pipe or pumped down a borehole with the use of a tremie pipe, provided the specifications of par. (a) are met. For wells 100 feet in depth or greater the sealant material shall be pumped down the borehole with the use of a tremie pipe. When a tremie pipe is used to place the annular space sealant the procedures of s. NR 141.10 (2) shall be followed.

3. When any slurry or grout is used, there shall be a 12-hour period between the time the annular space seal is installed and the time the protective cover pipe is installed. Any settling in the annular space seal shall be topped off before the protective cover pipe is installed.

4. The top of the well caasing shall be covered with a protective cap.

(3) GROUND SURFACE SEAL AND PROTECTIVE COVER PIPE. (a) *Ground surface seal.* All permanent groundwater monitoring walls shall be constructed with a bentonite or concrete ground surface seal. The ground surface seal shall extend to a minimum of 60 inches below the land surface, and the top shall be sloped away from the well casing. If bentonite is used, the top of the surface seal shall terminate 12 inches below the land surface and shall be covered with top soil or native soil to prevent drying out. The ground surface seal shall be installed around the protective cover and may not be placed between the protective cover pipe and the well casing. If the monitoring well depth is such that both a minimum 2 foot annular space seal and a minimum 5 foot ground surface seal cannot both be placed, the ground surface seal may be shortened.

Note: Certain soils are prone to frost heave and the department does not recommend use of concrete as a ground surface seal in these situations.

(b) *Protective cover pipe.* The protective cover pipe shall consist of a metal casing at least 2 inches larger in diameter than the well casing with a locking cap. The protective cover shall extend from the bottom of the ground surface seal to a minimum of 24 inches above the ground surface. If the monitoring well is located in a floodplain, the protective cover pipe shall be watertight. There may be no more than 4 inches between the top of the well casing and the top of the protective cover pipe. The protective cover pipe shall always extend above the top of the well casing. The department may require additional protective devices, such as rings of brightly colored posts around the well, as necessary. Weep holes or vents may be used in protective cover pipes.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.15 Drilling methods and fluids. The drilling method shall introduce the least possible amount of foreign material into the borehole, produce the least possible disturbance to the formation and permit the proper construction and development of the required diameter well. Only air, water from a known safe source free of bacterial and chemical contamination or bentonite drilling muds, mixed with water from a known safe and uncontaminated source, may be used as drilling fluids. The water used for drilling shall be stored in such a manner as to prevent contamination of the clean water. The department may require chemical analysis of the water used to produce drilling fluids. Hammer drill lubricants, used with air rotary drill rigs, may not be used for installing groundwater monitoring wells. If air is used as a drilling fluid, the air shall be filtered by a coalescing air filter. If water is used, the source of the water shall be reported. Drilling fluid additives may not be used without prior written department approval.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.17 Disposal and decontamination. (1) All drill cuttings and fluids and surge and wash waters from borehole and groundwater monitoring well construction and development shall be disposed of in a manner approved by the department.

(2) All borehole and groundwater monitoring well construction and development equipment shall be decontaminated by washing and triple rinsing or high pressure heat cleaning to prevent cross-contamination of boreholes or groundwater monitoring wells.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.19 Borehole diameter. (1) BOREHOLES IN UNCONSOLIDATED GEOLOGIC FORMATION. For all permanent groundwater monitoring wells in unconsolidated geologic formations, the borehole diameter shall meet the following requirements:

(a) If hollow stem augers are used, their inside working diameter shall be at least 2¼ inches greater than the inside diameter of the permanent well casing.

(b) If solid stem augers are used, their outside diameter shall be at least 4 inches greater than the inside diameter of the permanent well casing.

(c) If an air or mud rotary method is used, the borehole diameter shall be at least 4 inches greater than the inside diameter of the permanent well casing. If a temporary outer casing is used, the inside diameter of the temporary outer well casing shall be at least 4 inches greater than the inside diameter of the permanent well casing. The temporary outer casing shall be pulled as the annular space is being sealed.

(d) If percussion methods, including the rotary wash, wash down and wash bore methods, with a temporary outer casing are used, in unconsolidated geologic formations, the inside diameter of the temporary outer casing shall be at least 4 inches greater than the inside diameter of the permanent well casing. The temporary outer casing shall be removed during the sealing of the annular space.

(2) BOREHOLES IN BEDROCK GEOLOGIC FORMATIONS. For all permanent groundwater monitoring wells installed deeper than 2 feet past the top of

the bedrock, the borehole diameter shall meet the following requirements:

(a) If an air or mud rotary method is used to construct the monitoring well, the requirements of sub. (1) (c) shall be followed.

(b) If percussion methods are used to construct the monitoring well, the requirements of sub. (1) (d) shall be followed.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.21 Well development. All permanent groundwater monitoring wells shall be developed according to the requirements of section. Wells sealed with grout or slurry shall be developed after a minimum waiting period of 12 hours after installation is completed and before the initial water quality samples are taken. The goal of well development is to produce water free of sediment and all drill cuttings and drilling fluids.

(1) WELLS THAT CANNOT BE PURGED DRY. All permanent groundwater monitoring wells that cannot be purged dry shall be developed by the following procedure:

(a) Alternately surge and purge the well for a minimum of 30 minutes. The surge and purge cycle shall consist of several minutes of surging followed by several minutes of purging to remove the material collecting in the bottom of the well. The surging shall move formation water in and out of the well screen. The surging shall move formation water in and out of the well screen. The surging shall be accomplished by using either a bailer or surge block or by pumping the well sufficiently to cause a drawdown and then allowing the well to recover and repeating the process.

Note: When a surge block is used, care should be taken to avoid drawing the annular space seal material into the filter pack or well screen.

(b) After the final surge and purge cycle is completed, the well shall be pumped or bailed until 10 well volumes of water are removed or until the well produces sediment free water. If sediment free water is not obtained any remaining sediment shall be removed from the bottom of the well. Well volume shall be calculated in the following manner:

$V_1 + V_2$ = well volume

V_1 = volume of water in well casing

$$V_1 = \Pi \left(\frac{D_1}{2}\right)^2 H_1 \, ft^3$$

V_2 = volume of water in filter pack

$$V_2 = N \Pi H_2 \left(\frac{D_3}{2}\right)^2 - \left(\frac{D_2}{2}\right)^2$$

N = porosity of filter pack

D_1 = inside diameter of well casing

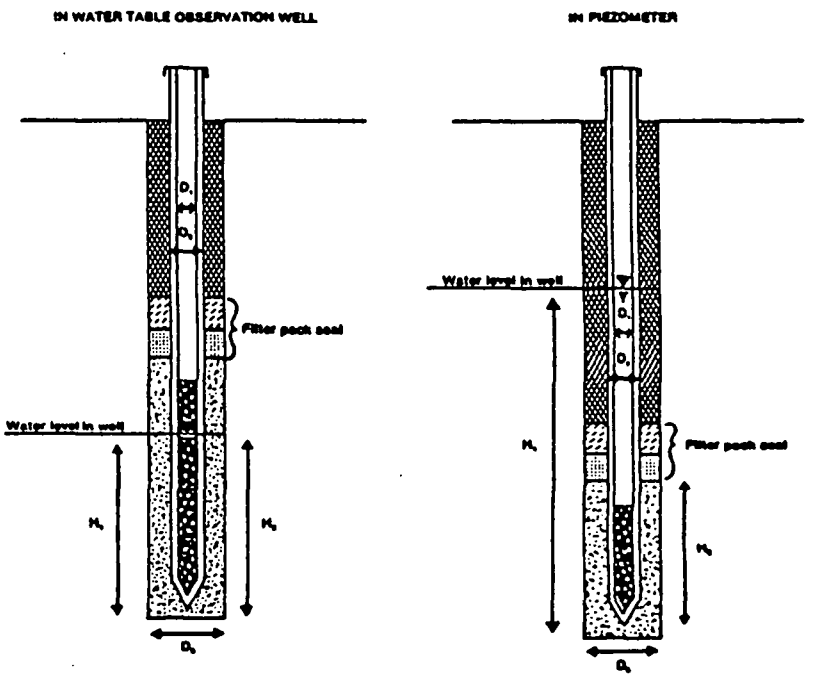
D_2 = outside diameter of well casing

D_3 = diameter of borehole

H_1 = height of water column

H_2 = length of filter pack or the height of the water column in water table observation wells.

CALCULATION OF WELL VOLUME



(2) WELLS THAT CAN BE PURGED DRY. All permanent groundwater monitoring wells that can be purged dry shall be developed in a manner which limits agitation by slowly purging the well dry. Wells which can be purged dry may not be surged and no water may be added to the well. The development procedure is complete when 5 volumes of well water have been removed or when the well produces sediment free water.

History: History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.23 Well and borehole construction documentation. (1) All permanent groundwater monitoring well construction shall be reported to the department, using forms and instructions provided by the department, within 60 days after the well has been installed. The completed report shall include the following information:

(a) Well location,

(b) Well casing material and installation procedures,

(c) Well screen materials and installation procedures,

(d) Filter pack materials and installation procedures,

(e) Sealing materials and installation procedures,

(f) Drilling methods and fluids used for installation,

(g) Borehole diameter,

(h) Well development procedures, and

(i) Any other information deemed necessary by the department.

(2) All permanent groundwater monitoring wells installed after February 1, 1990 shall be labeled with labels supplied by the department.

(3) All borehole construction data shall be reported to the department using forms and instructions supplied by the department within 60 days after construction. The completed report shall include the following data: the results of any soil tests done and a description of the soil structure, soil color, mottling, moisture content, layering, jointing, lenses, fractures, organic matter and voids and any other information deemed necessary by the department. The constructor shall report any decontamination procedures used between borehole installations.

History: History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.25 Abandonment requirements. The following requirements apply to the abandonment of all boreholes greater than 10 feet deep or which intersect a water table and all groundwater monitoring wells. The department may require, by order or other appropriate means, that any borehole or monitoring well be abandoned. The department shall consider the following factors in determining whether a borehole or monitoring well should be abandoned: purpose, location, groundwater quality, age and condition of the well or borehole potential for groundwater contamination and well or borehole construction.

(1) TIMELINES FOR ABANDONMENT. (a) A borehole shall be abandoned within 3 working days after its use has been discontinued.

(b) Any permanent groundwater monitoring well no longer being used to gather information on geologic or groundwater properties shall be abandoned within 60 days after its use has been discontinued.

(c) Any groundwater monitoring well found by the department to be acting as a conduit for groundwater contamination shall be abandoned within 15 working days after written notification by the department.

(d) Any groundwater monitoring well constructed after February 1, 1990 not meeting the requirements of this chapter shall be abandoned and replaced with a monitoring well meeting the requirements of this chapter or any department approval granted under this chapter within 60 days after installation of the noncomplying well or 15 days after written notification by the department that the well is noncomplying.

(2) ABANDONMENT PROCEDURES. (a) *Boreholes.* Any borehole intersecting the water table or greater than 10 feet deep, whose use has been discontinued, shall be abandoned according to the requirements of par. (d).

(b) *Monitoring wells - impermeable annular space seals.* A permanent groundwater monitoring well known to be constructed with an impermeable annular space seal shall be abandoned according to the requirements of par. (d) after the protective cover pipe and ground surface seal have been removed and the well casing cut off at least 4 feet below the ground surface. The well casing may be completely removed during abandonment by pulling the well casing, overdrilling around the casing and then pulling the well casing out of the ground or by drilling out the well casing completely. If the well casing is to be removed, the well shall be sealed as the casing is removed.

(c) *Monitoring wells - permeable annular space seals and wells in waste areas.* A groundwater monitoring well not known to be constructed with an impermeable annular space seal or located in an existing or planned future waste disposal or treatment area shall be abandoned by removing the protective cover pipe and the ground surface seal and then completely removing the well casing. The well casing shall be pulled out of the ground as the well is filled according to the requirements of par. (d).

(d) *Sealing requirements.* Boreholes and groundwater monitoring wells shall be abandoned by complete filling with neat cement grout, bentonite-cement grout, sand-cement grout, concrete or bentonite-sand slurry. When a tremie pipe is used to place the sealing material, the procedures of s. NR 141.10 (2) shall be followed. A tremie pipe shall be used to abandon groundwater wells and boreholes greater than 30 feet in depth or with standing water. Groundwater monitoring wells and boreholes greater than 100 feet in depth shall be sealed with a tremie pipe-pumped method. Bentonite may be used as a sealing material without the use of a tremie pipe under the following conditions:

1. Granular bentonite may be used for boreholes and groundwater monitoring wells less than 25 feet deep and when there is no standing water above the filter pack seal.

2. Bentonite pellets may be used for boreholes and groundwater monitoring wells less than 50 feet deep and the depth of standing water is less than 30 feet.

3. Bentonite chips may be used for boreholes and groundwater monitoring wells which are greater than 4 inches in diameter and less than 250 feet deep and the depth of standing water is less than 150 feet.

(3) SEALANT SETTLEMENT. Any settling of the sealant material shall be topped off. Sealing material may be terminated 4 feet below the ground surface in agricultural areas to avoid interference with agricultural activities. A native soil plug shall be placed on top of the settled sealing material in such cases.

(4) ABANDONMENT DOCUMENTATION. All borehole and permanent groundwater monitoring well abandonments shall be reported to the department within 60 days of the abandonment on forms supplied by the department. In addition to the information required on the form, the person performing the abandonment shall report any decontamination procedures used between borehole and well abandonments.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.27 Driven point wells. Driven point wells with galvanized steel drive pipes and contaminant compatible well screens may be used as permanent groundwater monitoring wells if prior department approval is obtained. Written documentation shall be supplied to the department prior to installation indicating:

(1) That the well is to be used only for water table elevation measurements or to monitor for parameters for which the well casing and screen material will not interfere with the analytical results;

(2) That the well will not provide a conduit for contaminants to enter the groundwater; and

(3) That information on subsurface stratigraphy is not needed. In situations where subsurface geologic information is needed, a separate borehole shall be constructed to collect the required data.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.29 Temporary groundwater monitoring wells. Temporary groundwater monitoring wells may be installed according to less stringent standards than specified for permanent groundwater monitoring wells. Any temporary monitoring well construction shall be approved by the department prior to its installation. All temporary monitoring wells shall be abandoned in accordance with s. NR 141.25 within 120 days after their installation.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.31 Special circumstances and exceptions. (1) The department may require or approve more restrictive or alternative well material, assembly, installation, development or abandonment if the contaminant concentrations or geologic setting require alternative construction. Prior written approval is required before any alternative materials are used in monitoring well installation.

(2) Exceptions to the requirements of this chapter may be approved by the department prior to installation or abandonment. An exception request shall state the reasons why compliance with the rule requirements is infeasible. The department may conditionally approve an exception by requiring materials or procedures which safeguard against contamination and result in groundwater monitoring well construction which is

substantially equivalent to the requirements of this chapter. Failure to comply with the conditions of an exception voids the department's approval of the exception.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

APPENDIX B
QAPjP EXCERPTS - SECTIONS 5.0 AND 6.0

5.0 SAMPLE CUSTODY

Sample identification and legal chain-of-custody procedures to be followed for this field investigation are described in the following sections.

5.1 Sample Identification

Each field sample will receive a discreet identification number. Sample nomenclature will be as follows:

- "SL" - Stoughton Landfill
- "EB" - Exploratory Boring
- "MW" - Monitoring Well
- "BK" - Background Well
- "MU" - Municipal Well
- "S" - Shallow groundwater sample
- "D" - Deep groundwater sample
- "B" - Bedrock groundwater sample
- "TB" - Trip Blank
- "DUP" - Duplicate
- "ER" - Equipment Rinsate
- "MS" - Matrix Spike
- "MSD" - Matrix Spike Duplicate

All samples will be identified to include the date and location of the sample. Examples of typical sample nomenclature are as follows:

Sample No.	Description
SL-MW1S-0393	Groundwater sample obtained from MW1S (shallow well of well cluster MW-1) in March, 1993
SL-EB4-20	Soil sample collected at a depth of 20 feet during drilling of exploratory boring EB4.

5.2 Sample Custody Procedures

It is EPA and Region V policy to follow the EPA Region V sample custody or chain-of-custody protocols as described in "NEIC Policies and Procedures", EPA-330/9-78DDI-R, Revised June 1985. This custody is in three parts: field procedures, laboratory procedures, and final evidence

file procedures. Final evidence files, including all originals of laboratory reports and purge files, are maintained under document control in a secure area.

A sample or evidence file is under your custody if it:

- o Is in your possession;
- o Is in your view, after being in your possession;
- o Is in your possession and you place it in a secured location; or
- o Is in a designated secure area.

5.2.1 Field Chain-of-Custody Procedures and Documentation

The sample packaging and shipment procedures summarized below will insure that the samples will arrive at the laboratory with the chain-of-custody intact. Field custody procedures are as follows:

(a) The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples.

(b) All bottles will be tagged with sample numbers and locations. CLP samples will be labeled with the appropriate Sample Management Office (SMO) number and stickers.

(c) Sample tags are to be completed for each sample using waterproof ink unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample tag because the ballpoint pen would not function in freezing weather.

(d) EPA will review all field activities to determine whether proper custody procedures were followed during the field work and decide if additional samples are required.

Examples of Chain-of-Custody forms to be utilized for CLP and subcontractor analytical services are provided in Attachments C and D, respectively.

Field logbooks will provide the means of recording data collection activities performed. As such, entries will be described in as much detail as possible so that persons going to the site could re-construct a particular situation without reliance on memory.

Field logbooks will be bound, field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in the document control center when not in use. Each logbook will be identified by the project-specific document number.

The title page of each logbook will contain the following:

- Person to whom the logbook is assigned;
- Logbook number;
- Project name;
- Project start date, and
- End date.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigation team personnel and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in ink and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark. Whenever a sample is collected, or a measurement is made, a detailed description of the location of the station, which includes compass and distance measurements, shall be recorded. The number of the photographs taken of the station, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures described in the Technical Work Plan Addendum provided as Attachment A. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume and number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description.

Transfer of custody and shipment procedures are as follows:

(a) Samples are accompanied by a properly completed chain-of-custody form. The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving

will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage area.

(b) Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in each sample box or cooler. Shipping containers will be locked and secured with strapping tape and EPA custody seals for shipment to the laboratory. The preferred procedure includes use of a custody seal attached to the front right and back left of the cooler. The custody seals are covered with clear plastic tape. The cooler is strapped shut with strapping tape in at least two locations.

(c) Whenever samples are co-located with a source or government agency, a separate Receipt for Samples Form is prepared for those samples and marked to indicate with whom the samples are being co-located. The person relinquishing the samples to the facility or agency should request the representatives signature acknowledging sample receipt. If the representative is unavailable or refuses, this is noted in the "Received By" space.

(d) All shipments will be accompanied by the Chain-of-custody Record identifying the contents. The original record and yellow copy will accompany the shipment, and the pink copy will be retained by the sampler.

(e) If the samples are sent by common carrier, a bill of lading should be used. Receipts of bills of lading will be retained as part of the permanent documentation. If sent by mail, the package will be registered with return receipt requested. Commercial carriers are not required to sign off on the custody form as long as the custody forms are sealed inside the sample cooler and the custody seals remain intact.

5.2.2 Laboratory Chain-of-custody Procedures

The chain-of-custody procedures for the CLP laboratory will be performed in accordance with the EPA SOWs for low level organics and inorganics. The subcontractor laboratory will follow the chain-of-custody procedures specified by the EPA SOP for "The Determination of Volatile Organic Compounds in Water by Gas Chromatography/PID/HECD" (EPA, 1988) and 55 FR 26986 (June 29, 1990) for the analysis of non-standard volatile organic compounds and TCLP, respectively.

The basic components for maintaining laboratory chain-of-custody (COC) are:

- Samples must be relinquished into the possession of an authorized laboratory staff member; or
- Samples must be within the authorized staff member's line-of-sight; or
- Samples must be locked in a secured storage area with restricted access.

Furthermore, any change of possession or custody must be documented on appropriate COC forms. This documentation must include both the initials of the individual relinquishing the sample and those of the individual receiving the sample, as well as the date of the custody transfer. Documentation regarding chain-of-custody procedures will be submitted with the CLP-type data package requested from the laboratory.

5.2.3 Final Evidence File Custody Procedures

The evidence file includes all relevant records, such as, but not limited to CLP data and CLP custody documents, CRL validation reports, logs, field logbooks, photographs, inspection and sampling reports, and data documentation and reviews. It will be compiled according to the protocols described in "NEIC Policies and Procedures", EPA-330/9-78DDI-R, revised June 1985. The EPA Region V CRL will maintain a portion of the evidence file, including, all CLP data, CLP custody documents, and CRL data validation reports. This file will be held by CRL for three years after which it will be sent to the federal records center for archiving. The CPM will maintain the remainder of the file including but not limited to, reports, field logbooks, photographs, correspondences, logs, and airbills during the project. The evidence file will be document controlled into Jacobs' TES X document control file and maintained in a secured, limited access area under the custody of the Jacobs TES X Document Control Officer. Upon the closure of the work assignment, the project document control file will be transferred to M&E's TES X document control system under custody of M&E's Document Control Officer.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

This section describes procedures for maintaining the accuracy of all the instruments and measuring equipment which are used for conducting field tests and laboratory analyses. These instruments and equipment should be calibrated prior to each use or on a scheduled, periodic basis.

6.1 Field Instruments/Equipment

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications.

Equipment to be used doing the field sampling will be examined to certify that it is in operating condition. This includes checking the manufacturer's operating manual and the instructions for each instrument to ensure that all maintenance requirements are being observed. Field notes from previous sampling trips will be reviewed so that the notation on any prior equipment problem are not overlooked, and all necessary repairs to equipment have been carried out. A spare electrode will be sent with each pH meter to be used for field measurements. Two thermometers will be sent to sampling locations where measurement of temperature is required, including those locations where a specific conductance probe/thermometer is required.

Calibration of field instruments is governed by the specific Standard Operating Procedure (SOP) for the applicable field analysis method, and such procedures take precedence over the following general discussion.

Calibration of field instruments will be performed at the intervals specified by the manufacturer or more frequently as conditions dictate. Field instruments will include a pH meter, thermometer, specific conductivity/temperature meter, and possibly either a flame ionization detector (FID) or photoionization detector (PID). In the event that an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be returned to the manufacturer for service.

6.1.1 pH Meter Calibration

The pH meter will be calibrated with standard buffer solutions prior to a field trip. In the field, the meter will be calibrated daily with two buffers before use. Thereafter, the meter will be checked against the two buffer solutions as needed. Calibration procedures and frequency will be recorded in a field log book along with the lot numbers of the buffer. A general procedures for pH meter, specific conductivity meter and thermometer are described below:

- Temperature of sample and buffer should be the same.
- Connect pH electrode into pH meter and turn on pH meter.
- Set temperature setting based on the temperature of buffer; place electrode in first buffer solution.
- After reading has stabilized, adjust "CALIB" knob to display correct value.
- Repeat procedure for second buffer solution.
- Place pH electrode in the sample and record the pH as displayed.
- Remove pH electrode from sample and rinse off with distilled water.
- The pH meter must be recalibrated every time it is turned off and turned back on, or if it starts giving erratic results.

The calibrations performed, standard used, and sample pH values are to be recorded in the field notebook. Appropriate new batteries will be purchased and kept with the meters to facilitate immediate replacement in the field as necessary.

6.1.2 Temperature Calibration

Temperature measurements are carried out utilizing a thermometer. The thermometers must be inspected before use to ensure there is no mercury separation. The thermometers should be rechecked in the field before and after use to see if the readings are logical and the mercury is still intact. The thermometers should be checked biannually for calibration, by immersing them in a bath of known temperature until equilibrium is reached. They should be discarded if found to have more than 10% error. The reference thermometer used for the bath calibration should be NIST traceable.

6.1.3 Conductivity Meter Calibration

The conductivity cells of the specific conductivity meter will be cleaned and checked against known conductivity standards before each field trip. In the field, the instrument will be checked daily with NIST traceable standards. The calibration procedure is described below.

- Place the probe in conductivity calibration standard solution.
- Set temperature knob for temperature of standard solution.
- Turn to appropriate scale and set the instrument for the value of calibration standard.
- Rinse off the electrode with distilled water.
- Measure the conductivity for distilled water to be used for a field blank, making sure temperature is set correctly for temperature of solution to be tested.
- If the conductivity of blank (distilled water) is high, it must be discarded and a new blank sample procured.

All readings and calibrations should be recorded in the field notebook.

6.1.4 FID/PID Instruments

The FID will be checked daily by use of the internal calibration mechanism. The PID will be calibrated daily with a gas of known concentration (i.e., calibration gas).

6.2 Laboratory Instruments

All laboratory calibration procedures will be performed by the CLP laboratory(les) in accordance with the CLP Statements of Work (SOWs) for CLP organic and inorganic analyses. Analytical equipment used for CLP organic analyses will be maintained and calibrated according to procedures specified in CLP SOW the "Superfund Analytical Methods for Low Concentration Water Organics Analysis" (EPA, 1991). Analytical equipment for CLP metals analyses will be maintained and calibrated in accordance with CLP SOW ILM01.0 (U.S. EPA, 1991).

For samples to be analyzed by the subcontractor laboratory, calibration procedures described by 55 FR 26986 (June 29, 1990) will be utilized for TCLP analyses and calibration for the analyses of low concentration volatile organics will be performed in accordance with "The Determination of Volatile Organic Compounds in Water by Gas Chromatography/PID/HECD" (EPA, 1988).

APPENDIX C
GROUNDWATER SAMPLING SOP'S

In the Field

Sampling of a monitoring well may be divided into three parts: 1) measurement of borehole volume and water level, 2) evacuation of borehole water, and 3) obtaining the sample. Information pertinent to sampling such as the well designation, the time the pump is turned on and off, the time of sampling, and volume of water pumped will be recorded in the field notebook. Photographs should be taken of each sampling location.

1. If the well to be sampled has a permanent pump and the well is currently in operation, (and has pumped long enough to evacuate a minimum of 3 borehole volumes) collect a sample directly from the discharge point into the appropriate sample container. The sampling procedure to be used is as follows:

   - Sample containers will be rinsed (except when collecting samples for extractable organic compounds and pesticide/PCBs) with sample water a minimum of three times to ensure that possible contaminants in the sample bottle are removed unless pre-preserved containers are used.

   - When sampling for volatile organic compounds (VOAs) the 40 ml sample vials will have no headspace. To avoid aeration, the glass sampler will be held at an angle so that the stream of water flows down the side. Fill the vial until it overflows to eliminate any air bubbles and replace the teflon-lined cap. A stainless steel cup may be used to fill the vial, if necessary. Two or three vials will be collected for each sample.

   - Turn the vial upside-down and tap it to check for air bubbles. If there are any bubbles, refill the vial and check for air bubbles again. Repeat this procedure until an acceptable sample is obtained.

     For other samples, such as inorganic compounds or other organic compounds, follow the descriptions of sample containers and preservation methods described in Sections 28.0 and 29.0.

   - Package the sample according to standard procedures described in Section 31.0.

   - Put samples on ice and ship to appropriate analytical laboratory using shipping procedures described in Section 31.0.

2. If the well to be sampled has a dedicated installed pump, but the well is not in operation at the time of sampling, a pre-sampling water level measurement will be taken, the pump

will be turned on and three borehole volumes will be evacuated. In addition, physical parameters (pH, conductivity, temperature) will be monitored until stable (±10 percent). If stabilization is not reached within 30 minutes after the three borehole volume evacuation, then the well will be sampled without stabilization. Prior to turning the pump on, measure the water level. The sampling procedure to be used is as follows:

- Take a water level measurement. The Sampling Plan will specify the applicable method for a specific well.
- Calculate the borehole water volume for well evacuation purposes (or use a previously prepared table or graph).
- Turn on the pump, evacuate a minimum of three borehole volumes, and monitor parameters for stabilization as described above.
- Collect water sample in appropriate sample container from the discharge valve at the wellhead after evacuation and stabilization.
- Turn off the pump.
- Measure recovery water levels as specified in Sampling Plan; this will only be implemented at the first sampling event of that well, and only if pumping tests have not occurred previously at that particular well.

3. If the well to be sampled does not have any downhole equipment in it, a portable pump will be used for well evacuation of at least three to five borehole volumes and parameters will be monitored for stabilization as described above. The sampling procedure to be used is as follows:

- Calculate the well water volume.
- Measure discharge rate from the pump, using the appropriate method, and calculate the time required for evacuation of three borehole volumes.
- Collect water sample directly from the pump discharge tubing into appropriate sample containers.
- Remove pump from well and decontaminate the pump by steam-cleaning.

- Measure recovery water levels as specified in the Sampling Plan. Recovery measurements will only be taken during the first sampling event of a well.

4. Wells which do not have downhole pumping equipment or are not large enough for a submersible pump (or do not yield much water) will be sampled with a stainless steel or teflon baller, field conditions permitting. The baller has a teflon ball-valve check system which enables sampling from a discrete depth within the well. The sampling procedure to be used is as follows:

   - Take a water level measurement prior to bailing. The method for a specific well will be determined in the Sampling Plan.

   - Attach the baller to a nylon rope and raise and lower by hand. Different ropes will be used for each well so that there will be no cross-contamination between wells. All sample collection ballers will be decontaminated prior to use and between well samplings using procedures described in Section 26.0.

SAMPLING WITH A BUCKET TYPE BAILER

Discussion

Bucket type bailers are tall narrow buckets equipped with a check valve on the bottom. This valve allows water to enter from the bottom as the bailer is lowered, then prevents its release as the bailer is raised (see Figure 25-2). Top filling bailers are also available and may be useful for well purging but generally result in increased sample turbulence and are not recommended for sample acquisition.

Uses

This device is particularly useful when samples must be recovered from depths greater than the range (or capability) of suction lift pumps, when volatile stripping is of concern, or when well casing diameters are too narrow to accept submersible pumps. It is the method of choice for the collection of samples which are susceptible to volatile component stripping or degradation due to the aeration associated with most other recovery systems. Samples can be recovered with a minimum of aeration if care is taken to gradually lower the bailer until it contacts the water surface and is then allowed to sink as it fills. Teflon is generally the best construction material but other materials (PVC, stainless steel, etc.) are acceptable if compatible with designated sample analysis. The primary disadvantages of bailers are their limited sample volume and inability to collect discrete samples from a depth below the water surface.

Procedures for Use

1. Using clean, noncontaminating equipment, i.e., an electronic level indicator (avoid indicating paste), determine the water level in the well, then calculate the fluid volume in the casing.

2. Purge a minimum of three to five borehole volumes or until discharge characteristics stabilize. See discussion on field measurements in Sections 12.0, 13.0 and 14.0.

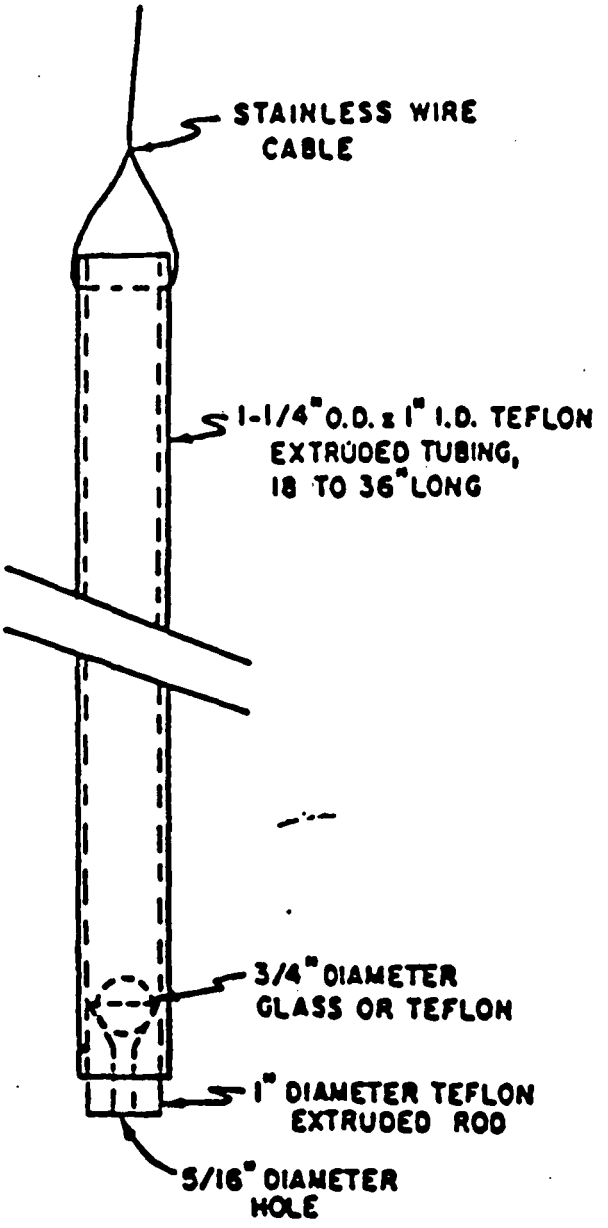
3. Attach precleaned bailer to cable or line for lowering.

4. Lower bailer slowly until it contacts water surface.

5. Allow bailer to sink and fill with a minimum of surface disturbance.

6. Slowly raise bailer to surface. Do not allow bailer line to contact ground.

FIGURE 25-2
BAILER



7. Tip bailer to allow slow discharge from top to flow gently down the side of the sample bottle with minimum entry turbulence.

8. Repeat steps 2-5 as needed to acquire sufficient volume.

9. Select sample bottles and preserve the sample, if necessary, according to the guidelines in Section 26.0.

10. Check that a Teflon-liner is present in cap if required. Secure the cap tightly.

11. Label the sample bottle with an appropriate tag. Be sure to complete the tag with all necessary information. Record the information in the field logbook and complete all chain-of-custody documents.

12. Thoroughly decontaminate the bailer after each use according to specific laboratory instructions, or the general guidelines in Section 26.0. In some cases, especially where trace analysis is desired, it may be prudent to use a separate bailer for each well.

SECTION 38.0

FIELD MEASUREMENT OF STATIC WATER LEVELS AND TOTAL DEPTH IN GROUNDWATER MONITORING WELLS

INTRODUCTION

Static water level and total depth measurements in groundwater monitoring wells enable the scientist or engineer to accurately determine the hydraulic gradient of a groundwater aquifer. The measurements are also useful guides that allow for monitoring of physical changes in an aquifer over time.

EVALUATIONS

Available Equipment

There is a variety of methods and devices available for recording static water levels and total depths in groundwater monitoring wells.

These methods and devices range from completely manual to fully automated. The most commonly employed instruments combine both manual and automatic features in an instrument ruggedly built for field operation. This type of instrument usually employs a battery powered probe assembly attached to a cable which is lowered into the well casing. When the probe makes contact with the water surface an electrical impulse is transmitted in the cable to either a meter or sound amplifier housed in the body of the instrument. The instrument is often equipped with a sensitivity adjustment switch that enables the operator to discern between actual and false readings due to the presence of saline, immiscible components on top of the groundwater.

The primary consideration in selection of the appropriate instrument should be the ability of the instrument to withstand rugged treatment.

Measurement Problems

The primary problem encountered during measurement of static water level and total depth in groundwater monitoring wells is properly recording the measurement at a common reference point. Common reference points are those points where the elevation is known with respect to mean sea level.

When measuring static water levels and total depths in groundwater monitoring wells, the measurement is taken at the top of the well casing which may be marked for future use.

APPARATUS

Water Level Measurement

The following apparatus are needed for the field measurement of static water level:

- Water level indicator equipped with a probe assembly capable of detecting static water levels at undetermined depths;
- Small (pocket) measuring tape capable of providing measurements to the 0.010 inch increment.

Total Depth Measurement

The following apparatus are needed for the measurement of total depth in groundwater monitoring wells:

- Measuring tape of sufficient length to provide measurements to 0.010 inch at undetermined lengths,
- Teflon-coated stainless steel line to be used as a plumb line,
- Stainless steel plumb for detecting bottom of groundwater monitoring wells.

MEASUREMENT PROCEDURE

Static Water Level

Recommended measurement procedures are outlined below:

- With the water level indicator sensitivity switch set at its full setting position, lower the probe until it contacts the water surface as indicated by audible alarm or dial needle reaction.
- Raise the probe out of the water until the indicator or alarm turns off. Repeat raising and lowering probe by hand until precise level is obtained.

- Record the increment reading at the designated reference point (for example, to adjacent ground surface, or to top of casing) to the nearest 0.10 feet.
- Following measurement of static water level, turn meter to the off position to conserve battery life.

Total Well Depth

Recommended measurement procedures are outlined below:

- Reel out the anticipated length of measuring tape on the ground surface.
- Attach stainless steel plumb to a plumb line and lower into well until the plumb encounters the base of the well.
- Record the position of the plumb line at the designated reference point
- Remove plumb line and plumb from well casing and place parallel to the measuring tape. Record total depth of groundwater monitoring well at the position where the measuring tape coincides with the measured reference point
- Decontaminate plumb and line.

QUALITY ASSURANCE

The following field measurement reference information must be recorded for quality assurance documentation:

- Designated reference point
- Elevation of designated reference point.

APPENDIX D
RESPONDENTS' RI WORK PLAN EXCERPTS

receiving the air/water/cuttings mixture from the drilling equipment. If a tank is used, it will be sized to allow settlement of cutting materials as well as to accommodate some settlings storage, and will include baffling of the inlet and overflow areas, or other provisions as may be required to minimize carryover of cuttings materials to the downstream tankage which will house the pump for transfer of the liquids to the on-site storage tank. A quiescent settling area having a hydraulic retention time of approximately 10 minutes would be provided with this approach. Should a lined earthen basin be employed, the surface area and depth would be sufficient to provide settlings storage and adequate quiescent hydraulic retention time (approx. 10 min) for good settling. With the earthen basin approach, it is anticipated that the bottom will be sloped to one corner of the basin where a sump would be located for pumping liquid to the on-site storage tank. Details of the final proposed installation (copies of approved Shop Drawings) will be provided to EPA and DNR when worked out with the Drilling Contractor.

2) Groundwater Monitoring Well Purge Water

About 500 gal of purge and decontamination water will be generated in one sampling round from the groundwater monitoring wells (assumes four new in addition to the twelve existing wells). This liquid will be containerized in DOT approved drums, clearly labeled, temporarily stored in the fenced and locked on-site drum storage area, sampled (composite) to verify acceptability at the City of Stoughton POTW (see Section 2.04 C, below), and hauled from the drum storage area to the POTW for disposal.

C. ACCEPTANCE OF LIQUIDS BY THE POTW

The City has computed limitations for acceptance of the liquids at the Stoughton POTW. These limitations were based upon available criteria (i.e. in the documentation for "PRELIM"-the software developed for EPA, issued DNR guidance on BETX, EPA "Quality Criteria for Water-1986", and NR 105/NR 106 based computations for potential toxics). Limitations were set for a list of pollutants of concern found in past groundwater sampling at the site. Note that barreled liquid wastes from previous RI work at the site was accepted at the Stoughton POTW following analysis which showed very low contaminant levels.

The DNR has drafted a WPDES Permit for re-issuance for the Stoughton POTW, which includes proposed effluent limitations for toxic substances based on NR 105 criteria. Final effluent limits (effective 1/1/94) are proposed for copper; zinc; mercury; pentachlorophenol; 1,2 diphenylhydrazine; hexachlorobenzene; benzo(a)pyrene; and total PAH. The proposed limits for copper, zinc and mercury are based on data which suggest that these substances may be present at levels which justify a limit. The need for limits for the remaining substances has not yet been established (no data), and data collected during the first monitoring period will be used to determine if there is a need for a limit.

In reviewing groundwater quality data from the previous RI work, and other available information, it was concluded by the City that: 1) mercury, zinc and copper were not detected; 2) no values for detected inorganics exceeded ambient water quality (NR 105) criteria; 3) pentachlorophenol was detected in one of 36

samples, at a qualified value less than 1/10 of the proposed limit; 4) PAH compounds were not detected; 5) hexachlorobenzene was not detected; 6) halomethanes were detected in some groundwater samples above NR 105 criteria, but at levels that would be reduced below criteria based on the dilution provided at the POTW headworks; 7) there are no NR 105 criteria for THF; and 8) no other organic compounds were detected at levels of concern relative to NR 105 criteria.

Limits for acceptance have been developed by the City for lead, zinc, mercury, nickel, halomethane, benzene, and total BETX based on a review of the previous RI groundwater data in conjunction with NR 105/NR 106 considerations. These limits are as follows:

Total BETX	30 mg/L
Benzene	10 mg/L
bis (2-ethylhexyl) Phthalate	no limit
Halomethanes	no limit
Tetrahydrofuran	no limit
Pentachlorophenol	20 µg/L
Benzoic Acid	no limit
Lead	40 mg/L
Mercury	3 µg/L
Nickel	125 mg/L
Zinc	200 mg/L

Note: Where "no limit" is indicated, there is no relevant surface water standard or/and computed limits are so high as to eliminate any grounds for concern.

Based on the above limits for acceptance, previous RI data, and the favorable analysis of the previous barreled waste, POTW acceptance of the liquid waste is not anticipated to be a concern.

To assess acceptability of the liquid waste generated during drilling operations, the following procedures have been developed by the City and will be followed:

1. Review 24 hr turnaround VOC/THF data from the exploratory boring samples (each set of data) for benzene, BETX, and halomethanes for acceptability relative to the established limits. A weighted average for the concentration of VOCs in the holding tank will be computed for each day on the basis of estimated liquid volume generated (from on-site tank measurements) associated with each groundwater sample from the exploratory borings.

2. Analyze initial sample (day 1) collected from storage tank, and daily composite samples (equal blend of samples from waste hauler tank), on a three times per week basis at DNR Certified Wastewater Laboratory-(Strand or RMT, depending upon workload) for lead, zinc, mercury and nickel on a 48 hr turnaround basis; and compare data relative to established limits.

3. If data review (from above steps 1. and 2.) indicates that the running weekly average of data is below established limits, continue to accept liquid wastes at the POTW.

4. If the data review (from above steps 1. and 2.) indicates that the running weekly average of data for one or more parameters exceeds the established limits, collect samples of POTW effluent (three times per week) for analysis for the parameter(s) of concern to allow an assessment as to whether or not NR 105/NR 106 based plant effluent criteria are being met. Use RMT lab for VOCs and Strand or RMT for metals. Use 48 hr turnaround timeframe.

5. If POTW effluent criteria are being met, continue sampling as for 1., 2. and 4. above, and continue to accept liquid waste.

6. If POTW effluent criteria are not being met, reject liquid waste and suspend additional RI work until response action (e.g. pretreatment of liquid waste) can be put in place.

Previous RI groundwater data and data from the analysis of previous liquid wastes from site RI work, compared to levels of acceptability at the POTW, make it very unlikely that the liquid wastes from the Additional RI Work will not be acceptable at the Stoughton POTW. In the unlikely event that the wastes would be unacceptable, however, the following steps would be employed to minimize any delays in completing the additional RI work:

1. Work would be suspended prior to the accumulation of a waste volume (approx. 10,000 gal) of unacceptable liquid that would not be feasible to containerize (DOT approved drums) and store on-site.

2. Unacceptable containerized liquid would be stored at the present fenced and locked drum storage area (enlarged as may be needed to handle number of drums).

3. Recognizing that unacceptable (at POTW) liquids would be an indication of highly contaminated groundwater, such that the boundary of the impacted zone has not been defined by the boring location, step out to a greater distance from the site and continue the exploratory boring work.

4. Investigate on-site treatments that could be quickly implemented, such as aeration or chemical precipitation, to allow POTW acceptance of liquids and to allow the investigation to continue in the highly contaminated zone so that data on magnitude/extent can be collected.

2.05 WELL SAMPLING AND ANALYSIS

All monitoring wells (locations MW-1 through MW-7) will be sampled in the ~~winter of 1991/2~~ spring of 1992 and again in the spring summer of 1992 for all TCL inorganics and organics, and for the non-standard VOCs as tested for as part of the previous RI work. See Tables 1-3 and 1-4 of the QAPP (Appendix C).