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PRELIMINARY DESIGN REPORT
LAKELAND DISPOSAL LANDFILL
CLAYPOOL, INDIANA

GERAGHTY
& MILLER, INC.
Environmental Services
A Heidemij Company

PRELIMINARY DESIGN REPORT
LAKELAND DISPOSAL LANDFILL
CLAYPOOL, INDIANA

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Lakeland Disposal Respondents

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PRELIMINARY DESIGN REPORT
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1. INTRODUCTION

This Preliminary Design Report has been prepared by Geraghty & Miller, Inc., on behalf of the Lakeland Disposal Respondents (Respondents), to describe and present the preliminary remedial design that has been completed for the Lakeland Disposal Landfill site in Claypool, Indiana. Submittal of this Preliminary Design Report is accordance with the remedial design reporting requirements specified in the Remedial Design/Remedial Action (RD/RA) Work Plan (Geraghty & Miller 1995a) as well as in accordance with the reporting requirements specified under Section IV of the Scope of Work (SOW), Attachment 3 to the Unilateral Administrative Order (UAO) for the Remedial Design and Remedial Action at the Lakeland Disposal Landfill Site, Claypool, Indiana.

As required by the RD/RA Work Plan and the SOW, the design documents for remedial action at the Lakeland Disposal Landfill are being prepared in phases. This Preliminary Design Report submittal corresponds to the design effort being approximately 30 percent complete. As such, the design information presented herein is to be considered conceptual in nature. The purpose of this submittal is to provide an opportunity for the United States Environmental Protection Agency (USEPA) and the Indiana Department of Environmental Management (IDEM) to review the conceptual design so that, if appropriate and necessary, adjustments or modifications to the design can be made prior to completing detailed design activities.

1.1 SELECTED REMEDY

The Record of Decision (ROD) for the Lakeland Disposal Landfill was issued by the USEPA on September 28, 1993. As defined in the ROD, the remedy selected by the USEPA for the Lakeland Disposal Site consists of a perimeter cut-off wall (i.e., slurry wall) in conjunction with an Indiana Sanitary Landfill Cap and targeted drum removal. Institutional controls such as deed restrictions, a perimeter fence, and groundwater monitoring are also included as part of the remedy. This remedy is intended to be the final action for this site, and addresses all contaminated media at the site. The major components of the selected remedy include:

- Construction of an Indiana Sanitary Landfill Cap, in accordance with Indiana Solid Waste Management Regulations contained in 329 IAC 2-14-19 and RCRA Subtitle D cover requirements for surface containment of the waste material.

- Construction of a soil-bentonite slurry wall and gradient control extraction wells for containment of the on-site groundwater in the upper aquifer.

- Storage and treatment, if necessary, to meet National Pollution Discharge Elimination System (NPDES) requirements, and discharge of recovered groundwater.

- Removal of drummed wastes in one hot-spot area of the landfill site (Waste Disposal Area 2), and off-site treatment and/or disposal of the drums and noncontainerized waste material.

- Fencing to prevent access, groundwater advisories (and possible well abandonment), and deed restrictions to prevent future development from interfering with remedial components, as provided for by Indiana regulations.

- Construction of an adjustable weir in Sloan Ditch, if necessary, to maintain proper water levels in the adjacent wetlands.

Section 5.0, Remedial Program for Waste Disposal Area 2, presents a discussion on the remedial options currently being considered for the remediation of Waste Disposal Area 2.

Section 6.0, Wetlands Mitigation Plan, presents a discussion on the wetlands that will be affected by remedy implementation and a description of the proposed plan for wetlands mitigation.

Section 7.0, Construction Drawings and Technical Specifications, introduces the construction drawings and specifications that have been prepared in conjunction with the preliminary design.

Section 8.0, Proposed Performance Evaluation Criteria, introduces performance evaluation criteria that will be used to evaluate performance of the remedial system.

Section 9.0, Long-term Monitoring and Operation Requirements, presents a summary of the anticipated long-term monitoring and operation requirements associated with the remedial system.

Section 10.0, Real Estate, Easement and Permit Requirements, presents a discussion on the real estate, easements, and permit requirements associated with implementing the remedial action.

Section 11.0, Preliminary Construction Schedule, presents a preliminary schedule for constructing the various remedial components that comprise the overall remedy for the site.

2. DESIGN OVERVIEW

This section presents a general overview of the proposed design for the remedial components that will comprise the overall remedy for the Lakeland Disposal Landfill and also introduces the groundwater modeling activities that were performed to develop the optimal design for the remedial system.

2.1 OVERVIEW OF THE REMEDIAL SYSTEM

The main function of the overall site remedy for the Lakeland Disposal Landfill is to contain the buried waste material and affected on-site groundwater in place, thereby preventing any exposure to and/or off-site migration of contaminants. The required containment features will fully encompass the lateral extent of the buried waste material (Figure 2-1). The containment features include a sanitary landfill cap covering a total area of approximately 22 acres and a groundwater containment system positioned along the downgradient edges of the landfill (Figure 2-2). The landfill cap will provide surface containment of the buried waste material, thereby minimizing the potential for direct contact with and/or surface releases of contaminants, and will also function to significantly minimize the transmission of infiltrating precipitation into the buried waste material. Details regarding the proposed design of the landfill cap are presented in Section 3 of this report.

The groundwater containment system incorporates a soil-bentonite slurry wall positioned along the northern, northeastern, southeastern, and southern boundaries of the landfill to contain potentially impacted groundwater within the upper unconfined aquifer at the site. A subsurface drain will be installed along the upgradient face of the slurry wall and will function to depress the water table within the containment system to ensure that inward gradients are maintained across the slurry wall. As discussed later in this report, comprehensive groundwater modeling was performed to determine the optimal design for the groundwater containment system. The results of the groundwater flow modeling indicate that a full perimeter slurry wall would not provide significant improvement in groundwater containment efficiency over that provided by a slurry wall positioned only along the northern, northeastern, southeastern, and southern boundaries of the landfill. Thus, the proposed groundwater containment system design does not include a full perimeter slurry wall, but rather a slurry wall that is positioned along the northern, northeastern, southeastern, and southern boundaries of the landfill (i.e., is positioned along the downgradient edges of the landfill). The groundwater flow modeling results also indicate that a subsurface drain would provide better gradient control than would a network of groundwater extraction wells.

In order to maintain inward gradients across the slurry wall, groundwater will have to be periodically recovered from the subsurface drain. The recovered groundwater will be conveyed to a groundwater treatment system which will be used to treat the groundwater prior to its subsequent discharge to Sloan Ditch or to the wetlands along Sloan Ditch (Figure 2-2). Details regarding the proposed design of the groundwater containment system are presented in Section 4 of this report.

Installation of the landfill cap and groundwater containment system will necessitate filling in two existing wetland areas at the site (Figure 2-2). Because of the loss of these two wetland areas, the remedial design includes a wetlands mitigation plan for expanding the wetland areas that currently exist within the low lying areas along Sloan Ditch. Details regarding the proposed wetland mitigation plan are presented in Section 6 of this report.

As stated in Section 1.1, the ROD currently specifies that the waste material contained in Waste Disposal Area 2 (Figure 2-1) be excavated and sent for off-site treatment and/or disposal. However, the results of the predesign study activities conducted at the Lakeland Disposal Landfill in February and March 1995, revealed that the volume and characteristics of the waste matrix found in Waste Disposal Area 2 are significantly different than originally anticipated. The characteristics of the waste matrix found in Waste Disposal Area 2 support the conclusion that an alternate on-site approach for remediating Waste Disposal Area 2 would be more appropriate than implementation of the excavation and off-site treatment remedy currently specified in the ROD. In this regard, the Respondents submitted a document to the USEPA entitled Alternate Remedy Proposal for Waste Disposal Area 2 (Geraghty & Miller 1995b) which identifies and evaluates alternate remedial measures for the remediation of Waste Disposal Area 2. The Alternate Remedy Proposal for Waste Disposal Area 2, which was submitted on January 19, 1995 is currently under review by the USEPA and IDEM. Because the remedy that will be applied to Waste Disposal Area 2 is subject to change pending USEPA's and IDEM's response to the Alternate Remedy Proposal, preliminary design information specific to the remedial program for Waste Disposal Area 2 is not presented in this Preliminary Design Report. Subsequent design report submittals will include design information, as appropriate, for the remedy that is selected for Waste Disposal Area 2.

2.2 GROUNDWATER MODELING RESULTS

As stated above, comprehensive groundwater modeling was performed to determine the optimal design for the groundwater containment system. The methods and results associated with the modeling activities conducted to support development of the optimal design for the groundwater containment system are presented in Appendix A of this report. Based on the modeling results presented in Appendix A, the landfill cap and groundwater containment system, as currently designed, will be fully effective in developing inward gradients across all boundaries of the containment system and thus provide complete containment of the groundwater within the upper aquifer.

3. COVER SYSTEM DESIGN

This section presents a description of the proposed cover system design and a discussion of the engineering analyses performed in developing the proposed design.

3.1 COVER SYSTEM DESIGN OVERVIEW

The final cover system design for the Lakeland Disposal Landfill was prepared in accordance with the applicable Indiana Solid Waste Rules for sanitary landfills (329 IAC 2-14-19), RCRA Subtitle D requirements, as well as the cover requirements specified in the ROD. The boundaries of waste placement at the landfill have been delineated based on the results of the exploration activities conducted during the remedial investigation and pre-design study investigations at the site. The field-determined boundaries of the former landfill, which covers approximately 22 acres, are depicted on Figure 2-2.

The final cover system is a remedial component intended to minimize the transmission of infiltrating precipitation into the waste, thus reducing the generation of leachate. The final cover system will also minimize or prevent the release of hazardous pollutants to the environment by preventing direct contact with or surface exposure of the waste contained in the landfill. The effectiveness of the landfill cover is governed by the performance and integrity of the individual layers which comprise the cover system; these layers consist of the following, in ascending order:

- Foundation layer;
- Barrier layer;
- Drainage layer;
- Protective layer;
- Topsoil layer; and
- Vegetative cover.

Passive gas vents will penetrate the cover system at the high points of the former waste disposal areas. Preliminary construction drawings for the cover system are included in Appendix B-1 of this report. A generalized cross section of the proposed cover design is illustrated on Drawing 6 in Appendix B-1. The functions and details of each cover system component are described in the following sections.

3.2 FOUNDATION LAYER

The function of the foundation layer is to provide a structurally stable subbase to support the overlying components. This will be accomplished by clearing, grubbing, proof-rolling, and/or adding common borrow soil to specified areas within the landfill boundaries. Fill material will be added over approximately 85 percent of the landfill surface to provide a suitable subbase for the cover system construction and to enhance storm water run-off, minimize channelized run-off, and eliminate ponding of precipitation on the cover system, in accordance with the Indiana Solid Waste Rules (329 IAC 2-14-18 (c) and 329 IAC 2-14-19 (1)). The existing materials will initially be cleared to provide a smooth and stable subbase for the placement of overlying geosynthetics and, where necessary, will be graded to provide a minimum slope of 4 percent toward the perimeter of the cover system and landfill.

3.3 BARRIER LAYER

The primary function of the barrier layer is to minimize the percolation of precipitation into the waste by minimizing infiltration and promoting lateral drainage across the upper layer boundary. The Indiana Solid Waste Management regulations require either a compacted, low-permeability soil or other suitable barrier material in order to achieve an adequate level of environmental protection. Following an evaluation of natural and geosynthetic materials, a 40-mil linear low-density polyethylene (LLDPE) geomembrane has been selected to serve as the barrier layer for the cover system design. This selection is based upon the LLDPE exhibiting the optimum combination of performance with respect to technical effectiveness and impermeability.

Both compacted soil (i.e., clay layers) and geomembranes are commonly used as barrier layer materials, and are generally widely-accepted by regulatory agencies. Critical factors that affected the selection of the barrier material included long-term performance, constructability, regional regulatory acceptability, climate, tolerance of differential settlement, and availability of materials.

As part of the pre-design studies, a borrow source investigation was conducted in February 1995 to identify potential sources of suitable materials that could be used for a compacted soil barrier layer. Samples were collected from a local borrow source, located approximately five miles from the site, and analyzed to establish baseline geotechnical parameters. Performance criteria established in the SOW for the final cover system design specify that the barrier layer must exhibit a coefficient of permeability of 1 x 10^{-7} centimeters per second (cm/sec). The results of physical testing of the borrow source materials indicated that the soil could not meet the permeability criteria. Laboratory permeability tests on recompacted samples of the clayey materials resulted in values for the coefficient of permeability greater than the 1 x 10^{-7} cm/sec criteria (test results ranged from 1.4 x 10^{-7} cm/sec to 8.3 x 10^{-6} cm/sec). A summary of the results of the physical testing performed on the potential borrow source materials is presented in Table 3-1 and the geotechnical laboratory data sheets are presented in Appendix C.

A second borrow source investigation was subsequently conducted in October 1995 as part of the preliminary design activities, in an effort to locate a suitable source of low permeability soils within a reasonable distance from the Lakeland Disposal Landfill. A second potential borrow source was identified approximately 15 miles from the site. Bulk soil samples from this borrow source were submitted to the project geotechnical laboratory for physical testing (including grain size distribution, moisture content, permeability, compaction and Atterberg limits). A summary of the permeability testing results for the second borrow source material is presented in Table 3-2 and the geotechnical laboratory data sheets are presented in Appendix C. Test results indicated that this soil, when compacted to 95 percent of the Standard Proctor density at the optimum moisture content in accordance with the American Society for Testing and Materials (ASTM) test designation D-698 would not provide a coefficient of permeability consistently less than 1 x 10^{-7} cm/sec. Permeability tests conducted on two soil samples recompacted to 98 percent of the Standard Proctor density resulted in coefficients of permeabilities of 4.8 x 10^{-8} cm/sec and 5 x 10^{-8} cm/sec, respectively. However, as a practical matter, consistently achieving compaction limits of 98 percent of the Standard Proctor density during placement of the soil barrier layer is considered to be problematic.

Due to the questionable suitability of the local borrow sources for low-permeability soil, geomembranes were evaluated as an alternative barrier layer material. Geomembranes, such as polyethylene, are manufactured to exhibit permeabilities equivalent to, or less than 1 x 10^{-10} cm/sec, virtually eliminating the infiltration of precipitation into the underlying waste. Polyethylene resin is resistant to most contaminants, including municipal and industrial wastes. LLDPE was considered for this site because of its flexibility which allows for ready placement over irregular surfaces.

In order to compare the performance of the two materials, the average annual percolation rate through the barrier layer was estimated for both a compacted soil layer and a geomembrane using the Hydrologic Evaluation of Landfill Performance (HELP) model (USEPA, 1994a). The average annual percolation (leakage) through the cover system simulated by the HELP model for the compacted soil barrier layer was 1.1 inches per year. The simulation for the geomembrane barrier resulted in an average annual percolation rate of 0.067 inches per year. These results indicate that both alternatives are relatively impermeable and suitable for use as a barrier layer. However, as indicated above, soil materials suitable for a compacted soil barrier layer are not available within a reasonable distance from the Lakeland

Disposal Landfill. The results of the HELP model runs are presented in Appendix B-3 of this report.

In summary, LLDPE was selected as an appropriate barrier layer due to its long-term effectiveness, chemical compatibility, ease of placement, and low permeability, and also because a suitable clay source is not available within a reasonable distance from the Lakeland Disposal Landfill.

3.4 DRAINAGE LAYER

The primary purpose of the drainage layer is to intercept precipitation which may collect and build-up hydraulic head on the underlying barrier layer. Water which accumulates immediately below the protective soil layer will be channeled through the permeable drainage layer for release to the storm water management collection system located at the perimeter of the cover system. As illustrated on Drawing 6 in Appendix B-1, the drainage layer will consist of 6 inches of rounded gravel placed above the LLDPE barrier layer.

The design of the drainage layer for the final cover system was divided into several steps. The first was to determine the type of material to be utilized. Drainage layer materials commonly consist of either a natural, clean sand or gravel (classified as SP or GP under the Unified Soil Classification System) possessing a coefficient of permeability greater than 1.0×10^{-2} cm/sec, or a synthetic geonet manufactured from materials similar to those of a synthetic membrane. Either material type is effective as a water-transmitting layer for drainage management; however due to the local availability, gravel was selected as the medium for the drainage layer.

The second step was to determine the thickness of the drainage layer. The HELP model was used to project the amount of hydraulic head build-up on the underlying barrier layer in order to determine the appropriate thickness of the drainage material. The HELP model projected an average annual hydraulic head build-up on the barrier layer of 0.24 inches; therefore a relatively thin thickness, 6 inches, was selected for the gravel drainage layer. A six-inch layer is considered minimal from a constructability standpoint.

The gravel drainage layer will be placed on a geotextile to protect the underlying synthetic membrane from potential damage due to any sharp edges. The gravel will consist of rounded or sub-rounded particles rather than crushed rock. A geotextile will also be placed above the drainage layer to prevent clogging of the drainage material from the overlying protective soil layer.

3.5 PROTECTIVE LAYER

The protective layer is intended to preserve the integrity of the barrier layer. A thickness of 12 inches of common borrow material was chosen to protect the underlying geomembrane from accidental punctures and tears, burrowing animals, and detrimental effects from freeze/thaw cycles. This layer, in conjunction with an overlying 6-inch topsoil layer and underlying 6-inch drainage material, will provide adequate cover protection from frost penetration. The regional frost penetration depth for this location is approximately 23 inches (USEPA 1989).

3.6 TOPSOIL LAYER/VEGETATIVE COVER

A six-inch thick topsoil layer will be included to promote and sustain vegetative growth in the uppermost layer of the final cover system. This vegetative layer will restrict the rate of soil erosion, promote drainage of the cover, and improve the overall appearance of the closed landfill. The vegetative layer will also remove a portion of the infiltration via evapotranspiration. Title 329, Section 2-14-19 of the Indiana Administrative Code (329 IAC 2-14-19) specifies a maximum projected erosion rate of 5 tons per acre per year. As summarized in the erosion potential calculation brief presented in Appendix D, the projected erosion rate for the proposed cover system is approximately one ton per acre per year.

3.7 SUBBASE GRADING

As stated in Section 3.2, the landfill area will require the addition of common borrow to provide a stable foundation for the cover system and to develop adequate elevation differences in order to meet the minimum slope requirement of 4 percent for promoting drainage (see Drawing Nos. 3 and 4, Appendix B-1). The subbase grading concept consists of a curved drainage divide spanning the southwest corner of the landfill area to both the northern and southwestern portions of the landfill area. This drainage divide reaches an elevation of 1024 feet (ft) above mean sea level (msl) and will slope at a minimum of four percent to meet the existing grade at the boundary of the landfill. Note that if any waste material or adversely impacted soils need to be reconsolidated into the landfill prior to landfill capping (e.g., waste material uncovered during installation of the subsurface drain or slurry wall), this material will be incorporated with the common borrow into the foundation layer for the landfill cap. Additional details regarding provisional measures for reconsolidating waste material and/or impacted soils into the landfill will be presented in the next design submittal.

3.8 FINAL GRADING

In general, the only difference between the contours of the subbase grades and the final contour elevations will be the thickness of the cover system. The final grading plan will be designed to meet the existing elevations along the perimeter of the landfill while maintaining cover system thickness and the minimum surface slope of four percent. Surface water will be routed along the outside of the cover system limits to perimeter ditches.

3.9 PASSIVE GAS VENTS

As discussed in the Pre-Design Studies Report, an active landfill gas collection system is not warranted for the site. Small, measurable quantities of methane gas were detected in only one interior soil boring, and two suspect readings were obtained at the perimeter of the landfill. A passive gas collection system is nevertheless recommended as a conservative design measure. Passive gas vents have been incorporated in the final cover system design to collect localized accumulations of methane within the waste. A total of five shallow vents will be installed at depths ranging from 5 to 15 feet in order to allow extension of the vents into the waste. The vents will be placed at the high points of the past disposal areas and will be spaced approximately 500 feet apart throughout the landfill area. A typical detail of these vents is presented on Drawing No. 6, Appendix B-1.

3.10 STORM WATER MANAGEMENT

Storm water run-off from the landfill cover will be conveyed via overland sheet flow. As stated above, the proposed landfill cap contours will provide a curved drainage divide spanning the southwest corner of the landfill area to both the northern and southwestern portions of the landfill area. Except for the storm water that will be collected in a small water shed within the western portion of the cap near Monitoring Well GMMW-10, all the storm water run-off will flow to the southern, eastern, and northern edges of the cap and discharge into the existing wetlands along Sloan Ditch. The final design of the landfill cap will include drainage swales, as necessary, for channeling the surface water run-off. If drainage swales are determined to be necessary, it is anticipated that a series of check dams will be installed along the swales to minimize storm water run-off velocity and, thereby, minimize erosion potential in the receiving wetlands.

The storm water collected in the small water shed within the western portion of the cap will flow to a drainage culvert to be installed near Monitoring Well GMMW-10. The drainage culvert will be installed under County Highway 450 West and will drain into a PVC storm water drainage line that will be installed along the western edge of the highway and discharge into Sloan Ditch (reference Drawing 2 in Appendix B-1).

The existing drain tile (Figure 2-2) which crosses the landfill and currently functions to drain the agricultural field immediately west of County Highway 450 West will be plugged and abandoned in place. The aforementioned PVC storm water drainage line to be installed along the western edge of County Highway 450 West will be used to drain the agricultural field, in addition to its function in draining a portion of the western area of the landfill cap (reference Drawing 2 in Appendix B-1). Preliminary calculations associated with sizing the PVC storm water drainage line are included in Appendix D.

4. GROUNDWATER CONTAINMENT SYSTEM

This section presents a description of the proposed groundwater containment system and a discussion of the engineering analyses performed in developing the proposed design.

4.1 GROUNDWATER CONTAINMENT SYSTEM DESIGN OVERVIEW

The proposed design of the groundwater containment system consists of a soil-bentonite slurry wall positioned along the northern, northeastern, southeastern, and southern boundaries of the landfill and a subsurface drain installed along the inside (upgradient) face of the slurry wall (Figure 2-2). The slurry wall and subsurface drain will function to fully contain the upper aquifer groundwater within the limits of the containment system. Thus, the groundwater containment system will prevent off-site releases of contaminants that could otherwise occur via groundwater migration. As stated earlier, comprehensive groundwater modeling was performed to determine the optimal design for the groundwater containment system. The groundwater flow modeling results indicate that that a subsurface drain would provide better gradient control than would a network of groundwater extraction wells. The results also indicate that a full perimeter slurry wall would not provide significant improvement in groundwater containment efficiency over that provided by a slurry wall positioned only along the northern, northeastern, southeastern, and southern boundaries of the landfill. Thus, the proposed groundwater containment system design incorporates a subsurface drain rather than a network of groundwater extraction wells, and a slurry wall that is positioned along the northern, northeastern, southeastern, and southern boundaries of the landfill (i.e., is positioned along the downgradient edges of the landfill) rather than a full perimeter slurry wall. Refer to Appendix A for a summary of the groundwater modeling activities and results which support development of the proposed design for the groundwater containment system.

In order to maintain inward gradients across the slurry wall, groundwater will have to be periodically recovered from the subsurface drain. The recovered groundwater will be conveyed to a groundwater treatment system which will be used to treat the groundwater prior to its subsequent discharge to Sloan Ditch or to the wetlands along Sloan Ditch. Details regarding the various components that comprise the groundwater containment system are presented in the following sections.

4.2 PERIMETER SLURRY WALL

The perimeter slurry wall will be a continuous soil-bentonite type slurry wall positioned along the northern, northeastern, southeastern, and southern boundaries of the landfill (Figure 2-2). The slurry wall width will be 30 inches and its centerline will be positioned approximately 10 feet in from the edge of the landfill cap, except for the northern leg of the slurry wall were it will be positioned approximately 5 feet in from the edge of the landfill cap (Drawing 6, Appendix B-1). For the slurry wall to provide an effective barrier to lateral groundwater flow, the base of the slurry wall will need to be keyed into the low conductivity glacial till unit that is present across the site. The pre-design studies soil boring program was conducted to delineate the geologic stratigraphy and the depth to the glacial till layer along the intended alignment of the slurry wall (Drawings 4, 5, and 6 in Appendix E-1).

In establishing the proposed depth of the slurry wall, consideration was given to the hydraulic conductivity values determined over different depths within the glacial till unit. As explained in Appendix A, the hydraulic conductivity of the glacial till unit decreases with depth, likely as a result of overcompaction. The groundwater modeling results indicate that effective lateral containment of groundwater occurs when the slurry wall penetrates layer 5 of the three-dimensional groundwater flow model, which corresponds to an elevation of approximately 969 ft (elevations are referenced to the locally recoverable datum of 1,000 ft; to obtain mean sea level elevation, subtract 162.6 ft). Thus, for the majority of its length, the bottom of the slurry wall will be set at elevation 969 ft. Because of the higher surface elevations at this area of the site, the bottom of the far western end of the southern slurry wall will be set at an elevation higher than 969 ft. In addition, because of the deep penetration of sandy material, a portion of the slurry wall near Soil Boring SWSB-20 will need to extend down to an elevation of 950. Drawings 4, 5, and 6 in Appendix E-1 illustrate the proposed depth and configuration of the slurry wall. In general, the slurry wall will range in depth from approximately 20 to 45 feet below grade and will extend approximately 5 to 20 feet into the glacial till unit.

An extended reach backhoe will be used to excavate a 30-inch wide trench to the required depth. The excavated soil will be mixed with bentonite and water to form the soil-bentonite slurry. The selected slurry wall installation contractor will establish the specific mix ratio based on the grain-size distribution data associated with the soil samples collected during the pre-design soil boring program (tabulated on Drawings 4, 5, and 6 in Appendix E-1). The slurry mix operation will occur adjacent to the trench and will proceed even with the rate of trench excavation. The installed slurry wall will have an effective permeability of 10^{-7} cm/sec, or less.

Several slurry wall installation contractors were contacted as part of the preliminary design activities to determine if there are any site-specific problems that will need to be addressed to ensure effective installation of the slurry wall. All three of the slurry wall installation contractors that were contacted stated that installation of the slurry wall at this site would not be a problem. The slurry wall contractors also stated that they would need a 20 to 30 feet wide working bench to properly install the slurry wall. Thus, a 20 to 30 feet wide graded aggregate working bench will be installed along the centerline of the slurry wall alignment prior to installation of the slurry wall.

4.3 GRADIENT CONTROL SUBSURFACE DRAIN

In order to develop and maintain inward gradients across the slurry wall, a subsurface drain will be installed along the inside (upgradient) face of the slurry wall. The drain will be installed along the northeastern, southeastern, and a portion of the southern section of the slurry wall as illustrated on Figure 2-2. The invert of the drain will range from an elevation of 983 ft. to 985 ft. Groundwater collected in the drain will flow via gravity to one of five collection sumps (Figure 2-2). Each collection sump will contain a sump pump that will be used to discharge the collected groundwater through a force main to the centrally located groundwater treatment system (Figure 2-2).

The subsurface drain will consist of a 6-inch diameter perforated high density polyethylene (HDPE) drainage pipe to be placed within a coarse-grained filter pack. The collection sumps will be 3-feet diameter HDPE manholes and will be placed at an invert elevation of approximately 979 ft.

As stated above, the purpose of the drain is to develop and maintain inward gradients across the slurry wall. Because of the relatively low conductance of the upland coarse till unit in which the drain will be placed, groundwater extraction from the drain will likely only need to be intermittent. A series of level sensors in the collection sumps will be used to control the operation of the sump pumps. These sensors will be adjusted to initiate pumpage when the inward gradient between the water level in the drain and the water level along the outside face of the slurry wall reaches a predetermined value (e.g., one foot differential gradient).

4.4 GROUNDWATER TREATMENT SYSTEM

The groundwater that will be periodically recovered from the subsurface drain will be conveyed through a buried force main to a groundwater treatment system to be located east of the containment system near Monitoring Well GMMW-12. The purpose of the treatment system is to treat the recovered groundwater prior to discharge to the adjacent wetlands or Sloan Ditch such that applicable effluent discharge standards are met. The type of treatment required is a function of the chemical composition of the recovered groundwater and the applicable effluent discharge standards that would be applied. The predicted chemical composition of the groundwater that will be recovered from the subsurface drain has been developed based on the groundwater quality measured in the monitoring wells screened in the upper unconfined aquifer along and upgradient of the proposed alignment of the drain and the analytical results for the composite groundwater samples that were collected during the pre-design well yield pump tests. A listing of the expected chemical composition of the recovered groundwater is presented in Appendix D, Calculation Brief 2: Estimated Composition of Recovered Groundwater.

Based on the expected chemical composition of the recovered groundwater, it is expected that treatment will need to be provided for the removal of volatile organic compounds (VOCs). It is further expected that treatment for the removal of inorganic constituents will not be necessary. A more definitive determination of the specific types of treatment that may be required cannot be made until after IDEM issues effluent discharge standards that will be applied to this discharge. Assuming that only VOC removal will be required, the preliminary design of the groundwater treatment system consists of a bag filter for suspended solids removal followed by a low-profile air stripper for VOC removal. Because of the low concentrations of total VOCs and the low flow rate (total estimated VOC discharge rate less than 0.5 pounds per day), it is assumed that treatment of the air stripper off-gas will not be required. The necessity for air treatment will be more thoroughly examined later in the design process. The groundwater treatment system will be designed for automated operation. A preliminary piping and instrumentation diagram for the groundwater treatment system is included as Drawing 8 in Appendix E-1.

4.5 REPLACEMENT OF DRAIN TILE SYSTEM

As stated in Section 3.10, the existing drain tiles at the site will be capped and abandoned in place. However, to facilitate installation of the slurry wall, several sections of the existing drain tiles (Figure 2-2) will be removed during the excavation for the slurry wall trench. As stated in Section 3.10, the storm water management system for the landfill cap will incorporate provisions for directing the storm water run-off that is currently conveyed by the existing drain tiles.

5. REMEDIAL PROGRAM FOR WASTE DISPOSAL AREA 2

As stated in Section 1.1, the ROD currently specifies that the waste material contained in Waste Disposal Area 2 (Figure 2-1) be excavated and sent for off-site treatment and/or disposal. It was further stated in Section 1.1 that the Respondents have submitted a document to the USEPA entitled Alternate Remedy Proposal for Waste Disposal Area 2 (Geraghty & Miller 1996) which identifies and evaluates alternate remedial measures for the remediation of Waste Disposal Area 2. The alternate remedial measures were developed based on the findings from the pre-design test pit investigation study of Waste Disposal Area 2 which was conducted as part of the pre-design studies in February 1995. The Alternate Remedy Proposal for Waste Disposal Area 2, which was submitted on January 19, 1996, is currently under review by the USEPA and IDEM. The remedies for Waste Disposal Area 2 identified and evaluated in the Alternate Remedy Proposal include the following:

- Excavation and off-site incineration remedy (ROD selected remedy)
- On-site containment remedy
- Soil vapor extraction remedy
- Excavation and on-site low temperature thermal desorption remedy

Because the remedy that will be applied to Waste Disposal Area 2 is subject to change pending USEPA's and IDEM's response to the Alternate Remedy Proposal, preliminary design information specific to the remedial program for Waste Disposal Area 2 is not presented in this Preliminary Design Report. Subsequent design report submittals will include design information, as appropriate, for the remedy that is selected for Waste Disposal Area 2.

6. WETLANDS MITIGATION PLAN

This section presents a discussion on the wetlands that will be affected by remedy implementation and a description of the proposed plan for wetlands mitigation.

6.1 DELINEATED WETLANDS

The results of the wetlands delineation performed as part of the pre-design studies revealed the presence of two wetland areas within the boundaries of the site. Wetland area "A" is associated with Sloan Ditch and runs along the length of the ditch and its floodplain. Wetland area "B" is a small depression within the boundaries of the landfill that has sufficient hydrology for a wetland to have developed (Figure 2-2). These wetland areas are characteristic of Palustrine Emergent (PEM) and Palustrine Forested (PFO1) wetland types per the National Wetlands Inventory (NWI) map (Burket, Indiana Quadrangle). Refer to Appendix F-1 of the Pre-Design Studies Report (Geraghty & Miller 1995a) for a listing of the plant species present in these wetland areas. Although not specifically delineated during the pre-design studies, additional wetland areas exist along both sides of Sloan Ditch immediately to the south of the site.

As stated in Appendix F-1 of the Pre-Design Studies Report (Geraghty & Miller 1995a), the findings from the wetlands delineation conducted as part of the pre-design studies indicate that the area surrounding Data Point 5 (Figure 2-2) does not meet applicable wetland criteria. As a result, the area surrounding Data Point 5 has not been identified as a wetland area. It is acknowledged, however, that IDEM staff contend that the immediate area surrounding Data Point 5 is a wetland because this area holds standing water at certain times of the year. As required under Section 3.1 of the RD/RA Work Plan (Geraghty & Miller 1995b), a supplemental delineation will be conducted near Data Point 5 during the spring of 1996 to resolve this wetland delineation issue. The Respondents will conduct this supplemental delineation by May 1, 1996. To avoid any potential disagreements regarding this supplemental delineation, representatives of the USEPA and IDEM should be present during the supplemental delineation.

6.2 SUMMARY OF WETLAND IMPACTS

Installation of the required landfill cap and perimeter slurry wall will necessitate filling in approximately 1.7 acres of wetlands. This includes approximately 0.5 acres of Wetland area "A" and the entire 1.2 acres of Wetland area "B" (Figure 2-2). Because of the required position of the landfill cap and slurry wall, filling in these wetland areas is unavoidable. However, potential adverse impacts to the wetlands that will remain (i.e., the wetlands that will not need to be filled in) will be minimal or non-existent. Although the groundwater containment system will serve to prevent the natural venting of groundwater from the landfill area into Sloan Ditch and the adjacent wetlands, the overall water balance in the Sloan Ditch water shed will be essentially unchanged. The groundwater that currently discharges from the landfill area to the wetlands along Sloan Ditch will now be conveyed to the Sloan Ditch water shed through one of three new mechanisms: 1) storm water run-off from the cap, 2) seepage from the drainage layer in the cap, and 3) discharge of treated groundwater recovered from the gradient control subsurface drain. These flow components will be channeled so that they discharge into various points within the wetlands. Sediment and erosion control features, such as check dams and sediment traps, will be used to minimize potential adverse impacts to existing wetlands associated with these flow components. Additional details regarding the flow channels that will be used to direct these flow components into the existing wetlands will be presented in the next design report submittal.

Another concern regarding potential adverse impacts to the wetlands is excessive sediment releases during installation of the landfill cap. This is a concern because a significant amount of earthwork will be required to install the cap. To minimize the release of sediments into the adjacent wetlands during construction of the landfill cap, the landfill cap construction contractor will have to develop and implement a Storm Water Management Plan for

Construction Activities consistent with the National Pollutant Discharge Elimination System (NPDES) storm water permitting program requirements. At a minimum, the Storm Water Management Plan will include provisions for dust control, slope stability, and placement of a silt fence, or a series of silt fences, along the perimeter of the construction zone. With proper implementation of the Storm Water Management Plan for Construction Activities, adverse impacts to the existing wetlands along Sloan Ditch stemming from installation of the required remedial components are not expected.

6.3 PROPOSED WETLAND MITIGATION PLAN

As required under Section 404 of the Clean Water Act (CWA), wetlands mitigation will be required as compensation for the 1.7 acres of wetlands that will be unavoidably filled in to facilitate installation of the landfill cap and slurry wall. Note that this acreage estimate could increase by approximately 0.3 acres if the area near Data Point 5 is determined to be a wetland. The Respondents propose to mitigate the lost wetlands by replacing them at an approximate 1:1 replacement ratio. The proposed mitigation plan consists of creating approximately 1.7 to 2 acres of wetlands along the edges of the existing wetlands present within the Sloan Ditch water shed. The replacement wetlands will be designed as a mixture of palustrine emergent and forested wetlands to match the existing wetlands along the Sloan Ditch water shed and to match the type of wetlands that will be filled in as a result of the remedial construction. Figure 2-2 illustrates the areas that could potentially be used for creating these additional wetlands within and immediately to the south of the site. It is anticipated that approximately 3.5 acres along the Sloan Ditch water shed within and immediately to the south of the site could potentially be used to create the additional wetlands. The benefits of using available area along the Sloan Ditch water shed for creating additional wetlands include being able to match the existing soils and plant species in the adjacent wetlands and the ability to effectively control wetland hydrology (e.g., installation and operation of adjustable weirs). Note that the USEPA recommends on-site wetlands mitigation wherever possible (USEPA 1994).

Specific details for the wetland mitigation plan (e.g., grading and soil requirements, planting plan, hydrologic controls, mitigation goals, monitoring) will be prepared once USEPA and IDEM issue concurrence on the proposed mitigation ratio. In addition, agreements will need to be reached with the applicable property owners for converting portions of their property into wetlands. The specific details of the wetland mitigation plan will be presented in the next submittal of the design report.

7. CONSTRUCTION DRAWINGS AND TECHNICAL SPECIFICATIONS

Preliminary construction drawings have been prepared for the landfill cover system (Appendix B-1) and groundwater containment system (Appendix E-1). Listings of the technical specifications that will be prepared for the landfill cover system and the groundwater containment system are included in Appendix B-2 and Appendix E-2, respectively.

Construction drawings and technical specifications associated with the wetlands mitigation plan will be developed once concurrence is reached on the required wetlands mitigation ratio, and will be included in the next design report submittal. In addition, construction drawings and technical specifications associated with the remedial program for Waste Disposal Area 2 will be prepared, if necessary, once USEPA selects a remedy specific to Waste Disposal Area 2. If construction drawings and technical specifications are necessary for the remedy selected specific to Waste Disposal Area 2, then they will be included in the next design report submittal.

8. PROPOSED PERFORMANCE EVALUATION CRITERIA

To accurately assess the performance of the various remedial components, periodic monitoring will be conducted and the collected data will be routinely assessed. For example, groundwater elevations will be periodically measured both within the gradient control subsurface drain and outside the slurry wall at selected locations. By comparing the elevations, it can be determined if the groundwater containment system is functioning in an effective manner (i.e., maintaining an inward gradient across the slurry wall). The performance of the groundwater treatment system will be assessed based on the results of periodic sampling and analysis of the treatment system influent and effluent and comparing the effluent concentrations against the applicable discharge criteria. Lastly, the effectiveness of the mitigated wetlands will be assessed based on the wetland plant coverage that develops over time.

Consistent with the remedial design being only 30 percent complete, the above discussion presents only generalized evaluation criteria to be used in assessing the performance of the various remedial components. Specific evaluation criteria will be presented in the Draft Performance Standard Verification Plan which will be included as part of the next design report submittal.

9. LONG-TERM MONITORING AND OPERATION REQUIREMENTS

As described in Section 10.0, various environmental monitoring activities will need to be periodically conducted so that the performance of the remedial components can be assessed. These environmental monitoring activities will be augmented by various inspection and operation activities that will need to be performed to properly maintain the remedial systems. For example, periodic inspections of the cover system will be necessary to ensure that the integrity of the cover system has not been breached, that the gas vents remain open, and that excessive soil erosion has not occurred. It is expected that periodic cleaning and/or flushing of the gradient control subsurface drain will be required, at a frequency to be determined based on operating performance. In addition, maintaining the groundwater treatment system will require periodic replacement of the bag filters as well as periodic cleaning of the air stripper. Both the gradient control subsurface drain and the groundwater treatment system will be designed for automated operation. Thus, a system operator will only be required for routine system maintenance activities and responding to shut-down conditions.

Consistent with the remedial design being only 30 percent complete, the above discussion presents only generalized monitoring, operation and maintenance activities that will be required to ensure that the remedial systems function as intended. Specific monitoring, operation and maintenance requirements will be presented, as applicable, in the Draft Performance Standard Verification Plan and the Draft Operation and Maintenance Plan, both of which will be included in the next design report submittal.

10. REAL ESTATE, EASEMENT AND PERMIT REQUIREMENTS

Implementation of the remedial action will require execution of access agreements and deed restrictions with several of the owners of the site property as well as with property owners to the north and, possibly to south of the site. The Respondents are currently working with USEPA and the various property owners to execute the access agreements and deed restrictions. Additional access agreements and easements will be required to facilitate installation of the new storm water drain line along the western edge of County Highway 450 West, which will discharge to Sloan Ditch, and, depending on the required wetlands mitigation ratio, construction of additional wetland areas along the Sloan Ditch water shed immediately to the south of the site. Additional details regarding execution of the access agreements and deed restrictions will be provided in the next design report submittal.

As this is a National Priorities List (NPL) site, operating permits will not need to be obtained, but compliance with the substantive requirements of the permitting process will be required. As such, the discharge of treated groundwater to the adjacent wetlands or to Sloan Ditch will need to comply with the substantive requirements of the NPDES permit process and the air discharge from the low-profile air stripper will need to comply with the substantive requirements of the State of Indiana air discharge permitting program. Also, the wetlands mitigation activities will have to comply with the substantive requirements of Section 404B(1) of the CWA. Additional discussions on compliance with these permitting programs will be included in the next design report submittal.

11. PRELIMINARY CONSTRUCTION SCHEDULE

Preliminary construction schedules have been prepared which illustrate the anticipated time frames for constructing the individual remedial components. Two separate schedules have been prepared to reflect the potential influence that the remedial program for waste Disposal Area 2 would have on the overall implementation schedule. Figure 11-1 presents a preliminary construction schedule that reflects leaving all waste material in place (i.e., no excavation of waste from Waste Disposal Area 2). Figure 11-2 presents a preliminary construction schedule that reflects the complete excavation of waste material from Waste Disposal Area 2.

12. REFERENCES

Geraghty & Miller, Inc., 1993. Final Feasibility Study Report, Lakeland Disposal Landfill, Claypool, Indiana.

Geraghty & Miller, Inc., 1995a. Predesign Studies Report, Lakeland Disposal Landfill, Claypool, Indiana.

Geraghty & Miller, Inc., 1995b. Remedial Design/Remedial Action Work Plan, Lakeland Disposal Landfill, Claypool, Indiana.

Geraghty & Miller, Inc., 1996. Alternate Remedy Proposal for Waste Disposal Area 2, Lakeland Disposal Landfill, Claypool, Indiana.

U.S. Environmental Protection Agency, 1989. Requirements for Hazardous Waste Landfill Design, Construction and Closure. Seminar Publication. EPA 625/4-89/022. August 1989.

U.S. Environmental Protection Agency, 1994. Considering Wetlands at CERCLA Sites. Office of Solid Waste and Emergency Response. Publication 9280.0-03. EPA540/R-94/019. May 1994.

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TABLES

Table 3-1. Borrow Pit Geotechnical Sampling Results (Clay Source 1), Lakeland Disposal Landfill, Claypool, Indiana.

	Sample Identification			
Parameter	BORW-1-1012	BORW-2-0406	BORW-3-0210	BORW-3-1012
USCS Classification	CL	SC-SM	CL-ML	SC-SM
Maximum Dry Density, pcf	125.6	128.6	125.7	134.9
Optimum Moisture Content, %	8.7	9.1	9.2	7.7
Wet Unit Weight, pcf	131.3	135.1	132.5	140
Dry Unit Weight, pcf	119	121.7	119.2	128.4
Moisture Content, %	10.4	11	11.1	9.1
Permeability (cm/sec)	5.7×10^{-6}	8.3×10^{-6}	1.5×10^{-7}	1.1×10^{-7}

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Table 3-2. Borrow Pit Geotechnical Sampling Results (Clay Source 2), Lakeland Disposal Landfill, Claypool, Indiana.

	Sample Identification					
Parameter	CAP-1			CAP-2	CAP-3	
USCS Classification	CL	CL	CL	CL	CL	CL
Maximum Dry Density, pcf	116.3	116.3	116.3	121.5	114.2	114.2
Optimum Moisture Content, %	14	14	14	13.6	13.5	13.5
Wet Unit Weight, pcf	127.8	129.3	132.4	131.5	126.1	129.5
Dry Unit Weight, pcf	110.5	112.6	114.4	114.5	109.7	112.2
Percent Compaction	94.8	96.8	98.3	94.2(a)	96	98.3
Moisture Content, %	15.6	14.8	15.8	14.8	15	15.4
Percent (+/-) Optimum Moisture	1.6	0.8	1.8	1.2	1.5	1.9
Permeability (cm/sec)	4.5×10^{-7}	5.8×10^{-7}	5.0×10^{-8}	5.0×10^{-8}	3.6×10^{-7}	4.8×10^{-8}

Notes:

(a) Reported as 94.2 percent of Standard Procter density, however geotechnical laboratory later indicated test was run at 98 percent compaction.

Table A-9. Simulated Flux and Gradient Results for Design #5 after 10 Years, Lakeland Disposal Landfill, Claypool, Indiana.

FLUX ACROSS SIDES and BASE OF WASTE AREA

LATERAL Flux (gpm) Out Of Capped Area
From Water Table Elevation to Elevation 969

SIDE	IN	OUT
NO	0.0030	-0.0001
NE	0.0281	0.0000
SE	0.0543	-0.0002
SO	0.0034	-0.0172
SW	0.1077	0.0000
NW	0.2299	0.0000

Total Horizontal Flux: QIN = .4264, QOUT = -.0175

VERTICAL Flux (gpm) Across Elevation 969
Below Capped Area (ft^2):

INFLOW		OUTFLOW		NOFLOW
Area	Qin	Area	Qout	Area
649600	9.1054	337600	-0.4344	0.0000

TOTAL INWARD Groundwater Flux to Waste Volume = 9.5318 gpm
TOTAL OUTWARD Groundwater Flux from Waste Volume = -.4518 gpm

GRADIENT ACROSS PAIRED WATER TABLE WELLS

Pair	Hout	Hin	Hdif	Grad
1	986.740	986.093	0.647	0.01617
2	986.907	985.006	1.901	0.04751
3	987.807	985.019	2.787	0.06968
4	994.593	986.138	8.455	0.21138
5	989.984	986.021	3.964	0.09909
6	988.578	994.898	-6.319	-0.15798
7	1001.157	1000.064	1.093	0.02732
8	1001.203	1000.583	0.620	0.01550
9	1000.548	999.892	0.656	0.01640
10	999.274	997.511	1.763	0.04406

Positive --> Inward, Negative --> Outward

1 inch/yr cap

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Slurry wall along north, northeast, southeast, south sides
No wells
Drain (along north, northeast, southeast sides) collects 10.26 gpm

Table A-8. Simulated Flux and Gradient Results for Design #4 after 10 Years, Lakeland Disposal Landfill, Claypool, Indiana.

FLUX ACROSS SIDES and BASE OF WASTE AREA

LATERAL Flux (gpm) Out Of Capped Area
From Water Table Elevation to Elevation 969

SIDE	IN	OUT
NO	0.0030	-0.0001
NE	0.0281	0.0000
SE	0.0543	-0.0002
SO	0.0043	-0.0171
SW	0.0208	0.0000
NW	0.0396	0.0000

Total Horizontal Flux: QIN = .1502, QOUT = -.0174

VERTICAL Flux (gpm) Across Elevation 969
Below Capped Area (ft^2):

INFLOW		OUTFLOW		NOFLOW
Area	Qin	Area	Qout	Area
668800	9.1706	318400	-0.2605	0.0000

TOTAL INWARD Groundwater Flux to Waste Volume = 9.3208 gpm
TOTAL OUTWARD Groundwater Flux from Waste Volume = -.2779 gpm

GRADIENT ACROSS PAIRED WATER TABLE WELLS

Pair	Hout	Hin	Hdif	Grad
1	986.740	986.093	0.648	0.01619
2	986.907	985.006	1.901	0.04752
3	987.807	985.019	2.787	0.06968
4	994.593	986.138	8.455	0.21138
5	989.984	986.021	3.964	0.09909
6	988.578	994.894	-6.316	-0.15789
7	1001.158	999.916	1.242	0.03106
8	1001.801	999.969	1.832	0.04580
9	1001.262	999.181	2.081	0.05204
10	999.911	996.349	3.562	0.08905

Positive --> Inward, Negative --> Outward

1 inch/yr cap
Fully-enclosing slurry wall
No wells
Drain (along north, northeast, southeast sides) collects 10.22 gpm

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Table A-7. Simulated Flux and Gradient Results for Design #3 after 10 Years, Lakeland Disposal Landfill, Claypool, Indiana.

FLUX ACROSS SIDES and BASE OF WASTE AREA

LATERAL Flux (gpm) Out Of Capped Area
From Water Table Elevation to Elevation 969

SIDE	IN	OUT
NO	0.0000	-0.0177
NE	0.0000	-0.1265
SE	0.0001	-0.0994
SO	0.0047	-0.0366
SW	0.2001	0.0000
NW	0.2274	-0.0275

Total Horizontal Flux: QIN = .4324, QOUT = -.3077

VERTICAL Flux (gpm) Across Elevation 969
Below Capped Area (ft^2):

INFLOW		OUTFLOW		NOFLOW
Area	Qin	Area	Qout	Area
649600	1.6334	337600	-0.1709	0.0000

TOTAL INWARD Groundwater Flux to Waste Volume = 2.0658 gpm
TOTAL OUTWARD Groundwater Flux from Waste Volume = -.4786 gpm

GRADIENT ACROSS PAIRED WATER TABLE WELLS

Pair	Hout	Hin	Hdif	Grad
1	986.767	995.260	-8.492	-0.21231
2	986.970	996.212	-9.242	-0.23106
3	987.899	994.105	-6.206	-0.15515
4	995.382	997.068	-1.686	-0.04216
5	990.367	998.382	-8.015	-0.20037
6	988.757	998.591	-9.834	-0.24585
7	1001.485	1000.046	1.439	0.03597
8	1001.415	1000.784	0.631	0.01577
9	1000.312	999.112	1.200	0.03000
10	999.406	998.419	0.987	0.02467

Positive --> Inward, Negative --> Outward

1 inch/yr cap
Slurry wall along north, northeast, southeast, south sides
Nine wells together pump 2.2 gpm
No drain

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Table A-6. Simulated Flux and Gradient Results for Design #2 after 10 Years, Lakeland Disposal Landfill, Claypool, Indiana.

FLUX ACROSS SIDES and BASE OF WASTE AREA

LATERAL Flux (gpm) Out Of Capped Area
From Water Table Elevation to Elevation 969

SIDE	IN	OUT
NO	0.0000	-0.0193
NE	0.0000	-0.1291
SE	0.0000	-0.1037
SO	0.0057	-0.0382
SW	0.0339	0.0000
NW	0.0375	-0.0038

Total Horizontal Flux: QIN = .0771, QOUT = -.2942

VERTICAL Flux (gpm) Across Elevation 969
Below Capped Area (ft^2):

INFLOW		OUTFLOW		NOFLOW
Area	Qin	Area	Qout	Area
542400	1.4408	444800	-0.2227	0.0000

TOTAL INWARD Groundwater Flux to Waste Volume = 1.5179 gpm
TOTAL OUTWARD Groundwater Flux from Waste Volume = -.5169 gpm

GRADIENT ACROSS PAIRED WATER TABLE WELLS

Pair	Hout	Hin	Hdif	Grad
1	986.768	995.478	-8.710	-0.21776
2	986.969	996.208	-9.238	-0.23095
3	987.899	994.091	-6.192	-0.15480
4	995.381	997.066	-1.684	-0.04210
5	990.367	998.377	-8.010	-0.20025
6	988.757	998.583	-9.826	-0.24564
7	1001.488	999.772	1.716	0.04290
8	1002.153	1000.036	2.117	0.05293
9	1001.576	997.661	3.915	0.09787
10	1000.375	997.474	2.901	0.07252

Positive --> Inward, Negative --> Outward

1 inch/yr cap
Fully-enclosing slurry wall
Nine wells together pump 2.2 gpm
No drain

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Table A-5. Simulated Flux and Gradient Results for Design #1 after 10 Years, Lakeland Disposal Landfill, Claypool, Indiana.

FLUX ACROSS SIDES and BASE OF WASTE AREA

LATERAL Flux (gpm) Out Of Capped Area
From Water Table Elevation to Elevation 969

SIDE	IN	OUT
NO	0.0069	-0.3747
NE	0.3155	-4.2957
SE	0.0000	-1.8906
SO	0.0183	-0.6757
SW	0.1030	0.0000
NW	0.2041	-0.0083

Total Horizontal Flux: QIN = .6478, QOUT = -7.2451

VERTICAL Flux (gpm) Across Elevation 969
Below Capped Area (ft^2):

INFLOW		OUTFLOW		NOFLOW
Area	Qin	Area	Qout	Area
577600	5.8507	409600	-0.5021	0.0000

TOTAL INWARD Groundwater Flux to Waste Volume = 6.4985 gpm
TOTAL OUTWARD Groundwater Flux from Waste Volume = -7.7472 gpm

GRADIENT ACROSS PAIRED WATER TABLE WELLS

Pair	Hout	Hin	Hdif	Grad
1	986.883	988.8030	-1.920	-0.04800
2	987.344	987.3900	-0.047	-0.00116
3	988.427	988.3960	0.030	0.00075
4	996.213	996.6920	-0.479	-0.01198
5	992.567	993.9900	-1.423	-0.03557
6	990.566	993.8650	-3.299	-0.08247
7	1001.212	1000.5900	0.622	0.01555
8	1001.456	1000.8550	0.601	0.01503
9	1000.794	1000.1540	0.640	0.01600
10	999.278	997.8110	1.467	0.03667

Positive --> Inward, Negative --> Outward

1 inch/yr cap
No slurry wall
No recovery wells
No drain

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Table A-4. Summary of Remedial Elements for Design Scenarios, Lakeland Disposal Landfill, Claypool, Indiana.

Run	Cap Infiltration	Slurry Wall Extent /*	Well Number	Drain Extent /**
BASELINE	---	---	---	---
Design #1	1 inch/yr	---	---	---
Design #2	1 inch/yr	All Sides	9	---
Design #3	1 inch/yr	NO,NE,SE,SO	9	---
Design #4	1 inch/yr	All Sides	---	NO,NE,SE
Design #5	1 inch/yr	NO,NE,SE,SO	---	NO,NE,SE
Design #6	1 inch/yr	All Sides	---	NO,NE,SE,SO /***
Design #7	0.067 inch/yr	All Sides	---	NO,NE,SE,SO /***
Design #8	0.067 inch/yr	NO,NE,SE,SO	---	NO,NE,SE,SO /***

Simulated Results after 10 years of remediations

/* Slurry wall assumed to extend vertically from land surface to 969 ft except in vicinity of SWSB20 where extends 10-20 ft deeper

/** Drain invert assumed to be 985 ft elevation

/*** For Designs #7,#8 and #9, the drain extends 200 ft along South side from Southeast Corner of Waste Area

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Table A-3. Simulated Flux and Gradient Results for Baseline Run, Lakeland Disposal Landfill, Claypool, Indiana.

FLUX ACROSS SIDES and BASE OF WASTE AREA

LATERAL Flux (gpm) Out Of Capped Area
From Water Table Elevation to Elevation 969

SIDE	IN	OUT
NO	0.0080	-0.3569
NE	0.3554	-4.1211
SE	0.0000	-2.1140
SO	0.0006	-0.7644
SW	0.0100	-0.0080
NW	0.1121	-0.0258

Total Horizontal Flux : QIN = .4861, QOUT = -7.3903

VERTICAL Flux (gpm) Across Elevation 969
Below Capped Area (ft^2):

INFLOW		OUTFLOW		NOFLOW
Area	Qin	Area	Qout	Area
398400	5.3052	588800	-1.8519	0.0000

Total Inward Groundwater Flux to Waste Volume = 5.7913 gpm
Total Outward Groundwater Flux from Waste Volume = -9.2421 gpm

GRADIENT ACROSS PAIRED WATER TABLE WELLS

Pair	Hout	Hin	Hdif	Grad
1	986.881	989.115	-2.233	-0.05583
2	987.342	987.388	-0.046	-0.00114
3	988.436	988.409	0.027	0.00066
4	996.870	997.867	-0.997	-0.02493
5	992.893	994.505	-1.613	-0.04032
6	990.814	994.382	-3.567	-0.08919
7	1001.779	1001.823	-0.044	-0.00110
8	1002.232	1002.183	0.049	0.00123
9	1002.240	1002.538	-0.298	-0.00745
10	999.615	999.280	0.334	0.00836

Positive --> Inward, Negative --> Outward

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Table A-2. Model Calibration to November 1991 Water Levels, Lakeland Disposal Landfill, Claypool, Indiana.

Well	$H_{Observed}$	$H_{Simulated}$	$H_{Observed}-H_{Simulated}$
DEEP WELLS[3]			
DW2	996.66	997.623	-0.963
DW4	999.06	999.047	0.013
DW6	997.92	997.352	0.568
DW8	997.44	998.225	-0.785

VERTICAL HEAD DIFFERENCE

WELL NEST	Observed	Simulated
MW1/PZ1	1.81	1.480
MW2/PZ2	-2.40	-4.660
MW3/PZ3	2.05	0.550
MW4/PZ4	-0.02	-0.150
MW5/PZ5	-11.15	-3.910
MW6/PZ6	-0.99	-5.470
MW7/PZ7	-1.28	-4.460
MW8/PZ8	2.60	1.780
MW9/PZ9	-3.29	-0.500
MW10/PZ10	1.67	2.100
MW11/PZ11	-0.06	0.750
MW12/PZ12	0.00	-4.630
MW13/PZ13	1.32	1.430
MW14/PZ14	-3.56	-5.370
MW15/PZ15	-5.16	-5.190
MW16/PZ16	-3.73	-5.650
MW17/PZ17	-0.17	0.000
MW18/PZ18	-7.07	-5.120

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[3] Sum of Errors = 1.17 ft, Root Mean Square Error = 0.61 ft.

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Table A-2. Model Calibration to November 1991 Water Levels, Lakeland Disposal Landfill, Claypool, Indiana.

Well	$H_{Observed}$	$H_{Simulated}$	$H_{Observed}-H_{Simulated}$
WATER TABLE WELLS[1]			
MW1	1004.590	1001.123	3.467
MW2	987.930	988.463	-0.533
MW3	1000.580	999.593	0.987
MW4	998.540	998.685	-0.145
MW5	988.830	990.987	-2.157
MW6	987.930	987.651	0.279
MW7	987.610	990.323	-2.714
MW8	1003.590	1002.939	0.651
MW9	995.490	998.373	-2.883
MW10	1003.630	1003.629	0.001
MW11	1001.550	1001.082	0.468
MW12	987.690	990.580	-2.890
MW13	1003.750	1001.546	2.204
MW14	987.010	987.312	-0.302
MW15	986.790	987.129	-0.339
MW16	986.960	987.615	-0.655
MW17	1001.000	998.197	2.803
MW18	989.070	988.578	0.492
WT1	997.450	997.914	-0.464
PIEZOMETERS[2]			
PZ1	1002.780	999.644	3.136
PZ2	990.330	993.121	-2.791
PZ3	998.530	999.045	-0.515
PZ4	998.560	998.834	-0.274
PZ5	999.980	994.895	5.085
PZ6	988.920	993.120	-4.200
PZ7	988.890	994.787	-5.897
PZ8	1000.990	1001.162	-0.172
PZ9	998.780	998.876	-0.096
PZ10	1001.960	1001.527	0.433
PZ11	1001.610	1000.327	1.283
PZ12	987.690	995.211	-7.521
PZ13	1002.430	1000.120	2.310
PZ14	990.570	992.684	-2.114
PZ15	991.950	992.318	-0.368
PZ16	990.690	993.267	-2.577
PZ17	1001.170	998.199	2.971
PZ18	993.698	996.140	2.442

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[1] Sum of Errors = 1.73 ft, Root Mean Square Error = 1.68 ft.

[2] Sum of Errors = 8.87 ft, Root Mean Square Error = 3.13 ft.

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Table A-1. Water Level Data: Selection of Representative Water Level Round, Lakeland Disposal Landfill, Claypool, Indiana.

	Model	Deviation from Global Average							
Piezometers	Layer	8/28/90	10/23/90	11/29/90	8/26/91	9/26/91	10/30/91	11/16/91	2/20/95
PZ1	5	3.13	2.25	1.51	-1.77	-2.52	-1.84	-1.48	0.70
PZ2	6	0.99	-0.56	1.05	-0.76	-0.89	-0.26	-0.29	0.74
PZ3	5	-8.43	4.26	4.51		-3.08	-0.75	-0.04	3.52
PZ4	6	2.67	2.18	2.28	-2.04	-2.60	-1.69	-1.13	0.33
PZ5	6						-0.63	0.05	0.57
PZ6	6	1.97	2.01	1.41	-2.40	-2.47	-0.39	-0.14	
PZ7	6		3.56	3.25	-1.32	-2.02	-1.86	-1.62	
PZ8	5	2.42	3.79	3.49	-10.97	-1.42	-0.24	1.24	1.69
PZ9	6	2.26	2.11	1.41	-2.72	-1.22	-1.13	-0.72	
PZ10	5	2.20	2.24	1.55	-2.48	-1.80	-1.23	-0.37	-0.12
PZ11	5	3.23	2.82	2.38	-1.99	-2.82	-2.18	-1.43	
PZ12	6	1.25	1.53	1.10	-1.54	-1.90	-0.51	-0.35	0.40
PZ13	5				0.00	-0.64	-1.89	-2.09	4.60
PZ14	6					-1.63	-0.04	0.22	1.44
PZ15	6				-2.19	-0.37	0.57	1.00	0.98
PZ16	6					-2.60	0.27	0.67	1.65
PZ17	5				-0.85	-1.50	-0.93	0.78	2.48
PZ18	6								0.28
Average Deviation		1.17	2.38	2.18	-2.39	-1.84	-0.86	-0.33	1.38

Deep	Model	Deviation from Global Average							
Wells	Layer	8/28/90	10/23/90	11/29/90	8/26/91	9/26/91	10/30/91	11/16/91	2/20/95
DW2	7						0.09	-0.09	
DW4	7				-2.42	-0.09	0.12	-0.10	2.50
DW6	7						-0.29	-0.44	0.73
DW8	7				0.51	-0.02	-0.38	-0.91	0.82
					-1.33	-1.27	-0.52	-0.24	1.32
Average Deviation					-1.08	-0.46	-0.20	-0.36	1.34

Table A-1. Water Level Data: Selection of Representative Water Level Round, Lakeland Disposal Landfill, Claypool, Indiana.

Piezometers	Model Layer	Average	STD	Water Level Data Base 8/28/90	10/23/90	11/29/90	8/26/91	9/26/91	10/30/91	11/16/91	2/20/95
PZ1	5	1004.25	2.02	1007.39	1006.51	1005.77	1002.49	1001.74	1002.42	1002.78	1004.96
PZ2	6	990.62	0.75	991.61	990.06	991.67	989.86	989.73	990.36	990.33	991.36
PZ3	5	998.57	4.34	990.14	1002.83	1003.08		995.49	997.82	998.53	1002.09
PZ4	6	999.69	2.01	1002.36	1001.87	1001.97	997.65	997.09	998.00	998.56	1000.02
PZ5	6	999.93	0.49	>995.35	>995.35	>995.35	>995.35	>995.35	999.30	999.98	1000.5
PZ6	6	989.06	1.77	991.03	991.07	990.47	986.66	986.59	988.67	988.92	
PZ7	6	990.51	2.42	>994.42	994.07	993.76	989.19	988.49	988.65	988.89	
PZ8	5	999.76	4.46	1002.18	1003.55	1003.24	988.79	998.33	999.52	1000.99	1001.44
PZ9	6	999.50	1.78	1001.76	1001.61	1000.91	996.78	998.28	998.37	998.78	
PZ10	5	1002.32	1.71	1004.53	1004.57	1003.88	999.85	1000.53	1001.10	1001.96	1002.21
PZ11	5	1003.04	2.47	1006.27	1005.86	1005.42	1001.05	1000.22	1000.86	1001.61	
PZ12	6	988.04	1.21	989.29	989.57	989.14	986.50	986.14	987.53	987.69	988.44
PZ13	5	1004.50	2.43		1004.52			1003.88	1002.63	1002.43	1009.12
PZ14	6	990.35	1.09					988.72	990.31	990.57	991.79
PZ15	6	990.95	1.20		988.76			990.58	991.52	991.95	991.93
PZ16	6	990.02	1.58					987.42	990.29	990.69	991.67
PZ17	5	1000.38	1.46		999.54			998.89	999.46	1001.17	1002.87
PZ18	6	995.79	0.58					994.78	996.16	996.14	996.07

Deep Wells	Model Layer	Average	STD	Water Level Data Base 8/28/90	10/23/90	11/29/90	8/26/91	9/26/91	10/30/91	11/16/91	2/20/95
DW2	7	996.74	0.08				>994.26	>994.26	996.83	996.66	
DW4	7	999.16	1.56				996.74	999.07	999.28	999.06	1001.66
DW6	7	998.36	0.52				>993.24	>993.24	998.07	997.92	999.09
DW8	7	998.35	0.62				998.86	998.33	997.97	997.44	999.17

Table A-1. Water Level Data: Selection of Representative Water Level Round, Lakeland Disposal Landfill, Claypool, Indiana.

Water Table Wells	Model Layer	Deviation from Global Average							
		8/28/90	10/23/90	11/29/90	8/26/91	9/26/91	10/30/91	11/16/91	2/20/95
MW1	1	2.68	1.85	1.94	-1.88	-2.78	-2.02	-0.99	1.20
MW2	4	0.19	1.70	1.28	-1.10	-1.49	0.24	-0.43	-0.39
MW3	2	2.64	2.53	2.81	-2.31	-3.32	-2.10	-1.54	1.31
MW4	2	2.08	1.81	2.08	-2.34	-2.84	-1.59	-1.16	1.98
MW5	4	0.98	1.99	1.72	-2.79	-2.23	-1.52	0.89	0.99
MW6	4	0.16	1.98	1.49	-1.40	-2.12	-0.04	0.13	-0.23
MW7	4	1.83	1.84	1.41	-2.03	-2.35	-0.81	-0.51	0.64
MW8	2	0.95	0.81	1.31	-3.07	-3.47	1.56	1.31	0.63
MW9	3	0.83	0.96	1.75	-1.12	-1.26	-0.61	-0.66	0.11
MW10	2	1.26	0.47	1.08	-2.96	-3.24	2.00	0.86	0.50
MW11	2	2.22	2.03	2.17	-2.62	-3.17	-0.26	-0.38	
MW12	4	1.29	1.53	1.11	-1.56	-1.92	-0.55	-0.36	0.43
MW13	1				0.42	-0.46	-2.28	-2.40	4.71
MW14	4				-0.02	-0.54	0.30	0.08	0.18
MW15	4				-0.02	-0.59	0.30	-0.03	0.32
MW16	4				-0.11	-0.37	0.20	-0.01	0.27
MW17	2				-1.07	-2.16	-0.17	0.32	3.06
MW18	4				-0.70	-0.82	0.94	0.24	0.33
WT1	2				0.28	-1.72	-2.99	-1.83	6.28
WT2	1								
Average Deviation		1.43	1.62	1.68	-1.39	-1.94	-0.49	-0.34	1.20

Water level round with minimum average deviance from global averages is highlighted.

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Table A-1. Water Level Data: Selection of Representative Water Level Round, Lakeland Disposal Landfill, Claypool, Indiana.

Water Table Wells	Model Layer	Average	STD	Water Level Data Base							
				8/28/90	10/23/90	11/29/90	8/26/91	9/26/91	10/30/91	11/16/91	2/20/95
MW1	1	1005.58	2.00	1008.26	1007.43	1007.52	1003.70	1002.80	1003.56	1004.59	1006.78
MW2	4	988.36	1.02	988.55	990.06	989.64	987.26	986.87	988.60	987.93	987.97
MW3	2	1002.12	2.40	1004.76	1004.65	1004.93	999.81	998.80	1000.02	1000.58	1003.43
MW4	2	999.70	2.04	1001.78	1001.51	1001.78	997.36	996.86	998.11	998.54	1001.68
MW5	4	987.94	1.76	988.92	989.93	989.66	985.15	985.71	986.42	988.83	988.93
MW6	4	987.79	1.26	987.96	989.78	989.29	986.40	985.68	987.76	987.93	987.57
MW7	4	988.12	1.57	989.95	989.96	989.53	986.09	985.77	987.31	987.61	988.76
MW8	2	1002.28	1.91	1003.23	1003.09	1003.59	999.21	998.81	1003.84	1003.59	1002.91
MW9	3	996.15	1.02	996.98	997.11	997.90	995.03	994.89	995.54	995.49	996.26
MW10	2	1002.76	1.84	1004.03	1003.24	1003.85	999.81	999.53	1004.77	1003.63	1003.27
MW11	2	1001.92	2.10	1004.15	1003.96	1004.10	999.31	998.76	1001.67	1001.55	
MW12	4	988.04	1.22	989.34	989.58	989.16	986.49	986.13	987.50	987.69	988.48
MW13	1	1006.14	2.59		1006.57			1005.69	1003.87	1003.75	1010.86
MW14	4	986.93	0.29		986.91			986.39	987.23	987.01	987.11
MW15	4	986.82	0.33		986.8			986.23	987.12	986.79	987.14
MW16	4	986.97	0.23		986.86			986.60	987.17	986.96	987.24
MW17	2	1000.67	1.75		999.61			998.52	1000.51	1001	1003.74
MW18	4	988.83	0.66		988.13			988.01	989.77	989.07	989.16
WT1	2	999.28	3.31		999.56			997.56	996.29	997.45	1005.56
WT2	1				<1000.4			4<1000.4	4<1000.44	<1000.44	1005.73
SG1				987.04					986.70	986.52	
SG2				987.82					987.17	987.01	
SG3				988.22					988.05	987.91	

Water level round with minimum average deviance from global averages is highlighted.

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APPENDIX A

TABLES

wetland, or by base flow to Sloan Ditch. The time of travel is predicted to average 19 years. The particles that do leak to the underlying confined aquifer emanate from an area equivalent to 40 percent of the waste surface located in the western portion of landfill. According to the model, the vertical time of travel averages 40 years.

Figures 25 and 26 for baseline conditions can be compared to the particle behavior for Design #8 illustrated in Figures 27 and 28. Under this design option, almost all the waste area contributes to surface discharge within the containment system, mostly to the subsurface drain. Only 5 percent of the area recharges the deep aquifer. The times of groundwater travel to the underlying deep aquifer for the these particles is much greater than under baseline conditions, averaging 212 years. The times are lengthened relative to baseline flow by the effect of the cap in reducing vertical gradients in the upland portion of the waste area. It is very likely that toxic substances that may be present in this leakage will be attenuated and/or transformed into innocuous compounds over the length of time needed to transport compounds through the aquitard to the deep aquifer.

Based on the groundwater modeling results presented above, Design #8 has been selected as the most appropriate design for the gradient control system at the Lakeland Disposal Landfill. In summary, the design will require a geomembrane type cap, a slurry wall enclosing the northern, northeastern, southeastern, and southern edges of the waste disposal area, and a subsurface drain.

slurry wall, drain), the outward flux after 1 year drops to 8 percent of the baseline value, as opposed to 3 percent after 10 years. Similarly under Scenario #8 (0.067 inch/yr geomembrane cap, partly-enclosing slurry wall, drain), the 1 year and 10 year reductions are to 6 percent and 2 percent of baseline values. These simulations indicate that the groundwater system, although dominated by fine-grained material, responds fairly quickly to the combination of a cap, slurry wall and drain. Inward gradients for both scenarios tested are established within 1 year over 100 percent of the waste area boundary.

Figures A-23 and A-24 show the simulated water table in the vicinity of the landfill after 1 year and 10 years for Design #8. The action of the drain in countering the head buildup caused by the slurry wall is well demonstrated. Both figures show a wedge of high heads outside the waste area just north of MW7. The mound is owing to the suspected presence of fine-grained material surrounded by more permeable material in this area.

Some further analysis was conducted to determine the vulnerability of the confined sand aquifer to even a small amount of downward leakage from the waste area. Particle tracking with the program PATH3D (a post-processor to MODFLOW published by S.S. Papadopulos & Associates, 1991) was used to trace the movement of particles released on 40 ft centers within the waste area from an elevation of 989.5 ft. A plane through this elevation, equivalent to the middle of model layer 3, intersects significant waste material and, therefore, is an appropriate starting point for determining the zones from which contaminated groundwater may migrate to the deep aquifer. In addition to the model parameters already input to the MODFLOW model, PATH3D requires a value for effective porosity. It was assumed to equal 25 percent in all layers.

The release of particles from within the waste volume under baseline conditions (i.e., in the absence of containment features) shows that a portion of the shallow groundwater stays within the shallow system and a portion leaks downward (compare Figure A-25 with Figure A-26). About 60 percent of the released particles circulate to surface discharge without entering the underlying sand aquifer. They exit the system by upward movement to the water table, by evapotranspiration in the

Designs #4, #5 and #6 replace the extraction wells with a long subsurface drain. Although the drain is not quite as efficient as extraction wells in eliminating downward flux out of the waste volume, it is a much more reliable method to reduce the head pressure on the internal side of the slurry wall because of its spatial continuity. It is particularly effective when extended some distance along the southern boundary as in Design #6. Under this last scenario, inward gradients are maintained along 100 percent of the lateral waste area boundary.

For all cases involving the subsurface drain, lateral outflow is cut almost to zero. The drain collects between 10 and 11 gpm. Part of this influx is circulated from within the waste volume, part represents upward flow from more distant or deeper parts of the system that would under natural conditions discharge to the wetland or to Sloan Ditch.

The replacement of the clay barrier cap with a cap incorporating a geomembrane would provide almost complete elimination of outward flux from the waste area. The application of the model to designs #7 and #8 shows that cutting infiltration to a minimum (as would be the case with a geomembrane type cap), when combined with a slurry wall and a drain that extends along the north, northeast, southeast and part of the south side, effectively isolates the waste volume. When the design elements include a fully enclosing slurry wall (Design #7), the system reduces the sum of lateral and vertical outward flux to very near zero. However, a partly enclosing wall (absent along the west side) (Design #8) eliminates outward lateral flux, allows very little vertical flux and reduces total outflow to only 2 percent of the natural condition. This reduction is accompanied by 100 percent inward gradients along the waste boundary. The success of Design #8 in fully isolating the waste volume while controlling the cost of slurry wall construction by eliminating the western wall make it the preferred groundwater containment system design.

The short-term response of the groundwater system to the remedial elements was examined by performing flux and gradient calculations on a subset of scenarios after only 1 year of remediation. The results are shown in Tables A-11 and A-14. Under Scenario #6 (1 inch/yr clay cap, fully-enclosing

The bottom of Table A-3 shows the predicted head differences and hydraulic gradients for the baseline run (i.e., in the absence of any containment features). Note that seven of the well pair locations show outward gradients, implying that about 70 percent of the lateral waste boundary under natural conditions discharges groundwater (i.e., has an outward flux). The pattern of inward and outward gradients corresponds generally to the upgradient position of the waste volume relative to local surface discharge. The outward gradient at location 9 along the western boundary is attributable to a localized water table mound simulated by the model within the waste area below an upland wetland.

Tables A-5 through A-14 provide detailed flux and gradient results from the modeling of the eight design options. For each option, calculated results are provided after 10 years of remediation. This period represents long-term equilibrium conditions. This information, summarized in Table A-15, is used to rank the efficiency of the design options.

Design #1, consisting of a cap with an infiltration rate of 1 inch/yr, has moderate effect on the amount of outflow from the waste area. The outward flux still amounts to 84 percent of the outward flux under baseline conditions. Because the principal effect of the cap is to lower the water table elevation within the waste area, the outflow reduction is attributable almost wholly to diminished downward flow. This remedy also has a moderately favorable impact on gradients: it increases the extent of the lateral boundary subject to inward gradients from 30 percent (baseline) to 50 percent.

The addition of a slurry wall in Designs #2 and #3 sharply reduce lateral outflow from the waste volume. The addition of extraction wells act to further reduce vertical outflow and to recover water infiltrating through the cap. The remedy with a fully-enclosing slurry wall (Design #2) cuts total outflow to 6 percent of natural flux while the remedy without a western slurry wall (Design #3) cuts total outflow to 8 percent of natural flux. Both remedies have the adverse effect of diminishing the percent of the lateral waste boundary with inward gradients relative to Design #1 (cap alone). The persistence of outward gradients is owing to the action of the slurry wall in building up head within the waste area that cannot be dissipated with operation of the extraction wells.

and a cell length dimension of 40 ft. The conductance selected for the drain is of little importance because the solution is insensitive to any value within an order of magnitude of 5000 ft^2/day.

In the second configuration, represented in Figure A-21, the drain is extended 200 ft along the southern boundary of the waste area. The drain elevation and conductance are as before. In both cases, the drain is adjacent to the slurry wall and is located along the inside (upgradient) side of the wall.

A particular combination of remedial elements defines a remedial design option. Table A-4 lists eight design options tested by modeling.

The first design is limited to a cap without a geomembrane. The second and third add a slurry wall and groundwater extraction by recovery wells. The fourth, fifth, and sixth investigate the effect of a drain in place of recovery wells. Finally the seventh and eight combine a geomembrane cap with a slurry wall and drain. In all scenarios it is assumed that the perennial portions of Sloan Ditch continue to flow and that the wetland continues to promote evapotranspiration.

Two criteria determine the effectiveness of each design option. The first depends on the flux calculations described previously. This test uses all the information available from the model to determine where and how much outward flux from the containment system can be expected. The second criterion selects particular transects across the lateral boundaries of the containment system to determine the direction of the simulated hydraulic gradient. This test can be misleading insofar as an outward gradient in itself may be insignificant (consider an outward gradient through an impermeable slurry wall that corresponds to a negligible flux). However, it has the advantage of predicting the outcome of field tests involving paired monitoring wells used to confirm that the waste area is bounded by inward hydraulic gradients, and, is, therefore, environmentally isolated. The location of the transects chosen for the gradient analysis are shown in Figure A-22.

(see Figure A-18). In both cases the slurry wall is assumed to be 2.5 ft thick and to consist of material with a hydraulic conductivity of $1x10^{-7}$ centimeters per second (cm/sec) (0.00028 ft/day).

In the modeled scenarios, the slurry wall is always accompanied either by extraction wells or by a subsurface drain on the upgradient side of the wall. In the scenarios involving extraction by wells, nine recovery wells are distributed on centers approximately 400 ft apart (Figure A-19). The pumping rates assigned to these wells are dictated by the hydraulic conductivity of the cells in the saturated layers they penetrate. A cell zoned as part of a till layer (the upland "B" unit or the aquitard "T" unit) is assumed to support an extraction rate of 0.05 gpm. A transitional cell is assumed to support an extraction rate of 0.10 gpm. Alluvial cells are assumed to support an extraction rate of 0.25 gpm.

The pairing of discharge rates with hydrostratigraphic units are based on the results of well yield pump tests conducted as part of the pre-design studies. Wells MW2 and MW6 screened in alluvium appeared to be capable of long-term pumping of 0.5 to 1.2 gpm. Wells MW3 and MW17 screened in till appeared to be capable of long-term pumping of 0.02 to 0.11 gpm (reference Appendix E; Pre-Design Studies Report for details of the estimated extraction rates). The tested monitoring wells are open over a length of about two model layers. The model rates for a hydrostratigraphic unit in a single layer were chosen to correspond to about half the estimated long-term pumping rates. The effects of vacuum extraction on enhanced pumping rates were not considered in the analysis.

The discharge rates for individual wells shown in Figure A-19 represent the sum of the available discharge from each saturated cell penetrated by a recovery well. The total estimated discharge from the well network is 2.2 gpm.

Two subsurface drain configurations were considered. In the first, the drain extends along the northern, northeastern, and southeastern sides as shown in Figure A-20. The drain invert elevation is set at 985 ft in model layer 4. The drain envelope is assumed to extend from land surface to just below the invert. The conductance of the envelope is set to 5000 ft^2/day, corresponding approximately to a drain radius of 2 inches, an envelope radius of 6 inches, an envelope hydraulic conductivity of 50 ft/day

- landfill cap
- slurry wall
- recovery wells
- subsurface drain

The landfill cap was simulated by the model through a reduced recharge term over the surface of the waste area. The slurry wall was input through the Horizontal Flow Barrier package of MODFLOW: it serves to impose a low-permeability surface along a vertical plane marking the boundary between two model cells. The recovery wells and subsurface drain were input through their corresponding MODFLOW packages.

Each remedial element has a spatial and an intensity component. Figure A-16 shows the extent of the proposed landfill cap at the Lakeland site. The cap is assumed to be compacted soil material with or without a geomembrane. In the case of the cap without a geomembrane, the infiltration rate is set to 1 inch/yr (a third of the natural rate to the upland areas indicated by the baseline model). This infiltration is equivalent to a flux of 1.17 gpm over the waste area. In the case of the cap with a geomembrane, the infiltration rate is assumed to be 0.067 inch/yr, equal to a flux of 0.078 gpm. The calculations used to generate these estimates are based on HELP model investigations described in Section 3.0 under Cover System Design and included as Appendix B-3 of this report.

Where the cap extends over wetland areas, discharge by evapotranspiration has been eliminated from the model.

Two possible configurations of the slurry wall are considered. In the first case shown in Figure A-17, the wall encloses the entire waste area from the land surface to an elevation of 969 ft at the bottom of model layer 5. Over a distance of about 300 ft in the vicinity of MW2 (where the SWSBs showed deep penetration of sandy material) it extends 20 ft deeper to the bottom of model layer 6. The second case is identical to the first, except that the western portion of the wall is omitted from the underlying aquitard and sand aquifer is on the order of 5.30 gpm, much larger than the downward leakage in upland areas of 1.85 gpm. The inward flux occurs over a smaller area than the outward flux, indicating convergence of upward flow lines toward the lowland discharge areas.

The total model recharge to the swales and upland portions of the waste area is 4.01 gpm. The evapotranspiration (ET) from the wetland nodes within the limits of the waste area is 0.46 gpm. Using these model results and the values in Table A-3, it possible to write a flux balance for the estimated divergence through the waste volume that needs to be contained:

Baseline conditions without containment features in place:

	FLUX IN (gpm)	FLUX OUT (gpm)
Lateral	0.49	7.39
Bottom	5.30	1.85
Recharge/ET	4.01	0.46
Total	9.80	9.70

The difference between IN and OUT is accounted for by a small amount of discharge in the form of upward flow to the water table in upland cells. Water-table discharge to wetland cells is already incorporated in the evapotranspiration term.

The remedial design scenarios evaluated with the updated model involve methods to largely eliminate the outward lateral and vertical flux from the waste volume by 1) reducing recharge, 2) impeding lateral flow, and 3) extracting groundwater.

EVALUATION OF REMEDIAL DESIGN OPTIONS

One or more of four remedial elements were added to the baseline model to produce a series of remedial design options. These remedial elements are:

A series of FORTRAN programs have been written to calculate the flux across the boundaries of the waste volume that needs to be contained and, thereby, determine the net outward or inward divergence of flow. For the purposes of this accounting, the vertical extent of the waste volume that needs to be contained is assumed to extend from the land surface to the bottom of model layer 5 at an elevation of 969 ft. (The choice of this horizon is conservative in the sense that it is below the assumed elevation at which waste was placed during landfill operations.) The horizontal extent of the waste volume that needs to be contained is coincident with the boundary defined by the SWSBs and described above. MODFLOW output provides simulated values for (inward or outward) fluxes across all six faces of each active model cell. The cell faces corresponding to the lateral edges of the waste volume that needs to be contained have been grouped into the following zones:

- north
- northeast
- southeast
- south
- southwest
- northwest

These edges are illustrated on Figure A-17. The bottom boundary of the waste volume that needs to be contained always corresponds to the bottom cell face for layer 5. The flux across a side is accumulated between the water table elevation and the bottom of layer 5. The flux through the bottom is accumulated across the 23-acres that encompass the area of the waste that needs to be contained.

Table A-3 shows the flux accumulated across each boundary for the updated, recalibrated solution under natural conditions (i.e., the "baseline" model without containment features in place). The calculations indicate that the simulated inward lateral flux to the waste volume that needs to be contained is 0.49 gallons per minute (gpm) and that the outward flux is 7.39 gpm. Most of the outward flux occurs through the northeast and southeast edges of the waste area. The vertical inflow

The model is very sensitive to the level of recharge. It was not possible to achieve an acceptable calibration with higher recharge rates than those reported above even when significantly higher hydraulic conductivities were assigned to the till units. For example, when hydraulic conductivities for the transitional, upland till and aquitard zones were each raised by 5 times, a recharge rate of only 3.5 inches/yr biased the simulated heads significantly higher than observed heads.

A very important element of the calibration is the preservation of the direction and magnitude of vertical gradients.

Previous studies of the site emphasized the sharp boundary between recharge conditions in the uplands and discharge conditions in the lowlands and pointed out the importance of this distribution in determining the fate of groundwater at the site. This hydraulic pattern corresponds to downward gradients from water table wells to piezometers in the uplands and upward gradients in the lowlands. The head differences between nested wells screened typically at elevations 20 to 30 ft apart is more than 2 ft at many locations. These pronounced gradients are reproduced by the model (Table A-2). Areas where the model simulates strong upward (negative) and downward (positive) gradients correlate well with observed conditions.

FLUX CALCULATIONS

The model indicates that part of the recharge to the uplands discharges locally to the wetland and Sloan Ditch, while some leaks downward over time to the underlying aquifer and either moves north toward Palestine Lake or recirculates upward to local discharge areas. The objective of the groundwater containment system is to isolate the circulation within the waste area so that contaminated groundwater is contained. Where the updated model for natural conditions shows outward flux and outward gradients across part of the boundaries of the waste area, the model runs that incorporate remedial elements are tested to determine if these fluxes are reversed.

- The maximum rate of evapotranspiration in the wetlands was raised from a rate of 27 inches/yr to 30 inches/yr (this maximum rate decreases linearly from land surface in the wetland to zero at a depth of 15 ft).

- All recharge was increased by 7 percent relative to original values. The wetland rate remains 0, the upland rate is raised from 2.7 to 3 inches/yr and the swales rate from 8.4 to 9 inches/yr.

Figures A-12 through A-15 show the simulated water levels for the water-table, model layer 5 (part aquitard, part transitional), model layer 6 (the aquitard) and model layer 7 (the deep aquifer horizon). Comparison of Figure A-12 to the observed water table configuration in Figure A-11 demonstrates that the model faithfully reproduces the spatial variation in the direction and magnitude of the water table gradient. The visual comparison also suggests that the simulated absolute elevations generally compare well with the observed elevations. This impression is supported by the direct comparison of simulated and observed heads listed in Table A-2. For the water-table wells, the typical deviation (measured by the root mean square error) is 1.68 ft. This value is about 10 percent of the total range of observed water levels (from 987 ft to 1004 ft). The bias in the error, measured by the sum of errors, is very small. The overestimated simulated values are well balanced by the underestimated values.

The simulated potentiometric surfaces shown in Figures A-13 and A-14 cannot be directly compared to a map of observed head levels in the aquitard because the piezometers cross both layers 5 and 6. The calibration statistics in Table A-2 show that the agreement between observed and simulated values for piezometers is not as good as for the water table wells with some bias to overpredict. The deep wells yield fairly good agreement between observed and simulated heads.

collected from wells set at three horizons - monitoring wells that represent water-table conditions, piezometers that, on the whole, represent the potentiometric surface in the aquitard ("T" unit), and deep wells that reflect confined heads in the underlying sand aquifer. Table A-1 summarizes the water level data for the three horizons. For each well in each horizon, the average water level and the standard deviation is reported. Table A-1 also lists the deviation of a water level at a particular date for a particular well from its overall average value. The deviations for all wells in a horizon for a particular date are then averaged. The date with the lowest average deviation across wells is selected as most representative of hydraulic conditions for that horizon. This method is intended to identify a water-level round that does not reflect low water conditions (generally associated with periods of high evapotranspiration in the summer) or high water conditions (associated with short-term recharge periods in rainy seasons or during winter snowmelt).

Inspection of Table A-1 shows that November 1991 is most representative for the water-table horizon and for the aquitard horizon. October 1991 is most representative for the sand aquifer, but November 1991 shows almost as low an average deviation across the deep wells. On the basis of the information presented in Table A-1, November 1991 was selected as the set of observed heads against which simulated heads would be compared to generate calibration statistics. Figure A-11 shows the observed water table configuration for the selected calibration date.

Because November 1991 was chosen for calibration, the river stage assigned to model cells representing Sloan Ditch were interpolated from the three staff gauge measurements collected during the November 1991 monitoring event.

In addition to the re-zonation of hydrostratigraphic units discussed above in connection with new field data, several other changes were made to the updated model to improve calibration. They are:

- The hydraulic conductivity of the alluvium was raised from 10 ft/day to 30 ft/day.

The SWSB logs clearly demarcated zones of fine-grained shallow deposits corresponding to the "B" unit from more coarse-grained shallow deposits corresponding chiefly to alluvium (the "C" unit) underlying the wetland areas adjacent to Sloan Ditch. The detail provided by the logs allowed the zonation of the upland till and the alluvium to be more precisely defined. Figures A-3 through A-9 show the hydraulic conductivity zonation for the updated version of the model. There are no changes in layers 1 and 7 from the original Feasibility Study version of the model. For layers 2, 3 and 4 the hydraulic conductivity zonation has been updated in the area around MW9 and MW12. The SWSB logs indicate that at the elevations corresponding to layers 2 through 4, this area is composed of predominantly fine-grained material. What was previously zoned as alluvium is now zoned in the updated model as "transitional" material with a hydraulic conductivity of 0.5 ft/day, a value closer to the hydraulic conductivity assigned to the "B" hydrostratigraphic unit than to the alluvium. The logs also identified an area in layer 5 around MW18, MW5 and MW6 as alluvium that had previously been assigned to unit "B". Finally the new field data indicated that some sandy material reaches as low as layer 6 in a small area represented by model cells near MW2. In the updated model this area was assigned to the "transitional" unit. All these updates to the hydraulic conductivity zonation are incorporated in Figures A-5 through A-8.

The recharge zonation boundaries shown in Figure A-10 for the low-lying wetlands, the upland area and the swales (depressions in the upland area associated with wetlands) are unchanged from the original model. The low-lying wetland still represents an area of active evapotranspiration. The location of river elements for the perennial portion of Sloan Ditch, the location and type of regional boundary conditions (corresponding to no-flow conditions at the basin divides and to general head boundaries along the basin outlet toward Palestine Lake) and the storage/porosity properties of each unit are also unchanged.

Before recalibrating the updated model, consideration was taken of the six rounds of water-level data collected between August 1990 and November 1991 and of a new round of water-level data collected in February 1995. A statistical analysis was conducted of the water levels to determine which of the seven rounds was most representative of hydraulic conditions at the site. The water levels are circuit of SWSBs. The required containment area encompasses about 990,000 square feet (ft^2), or 22.7 acres. The required containment area is illustrated on Figure 2-2 of this report.

The geologic logs developed from the SWSBs allowed preparation of detailed geologic cross sections along the northern, northeastern, southeastern and southern boundaries of the waste area (see Drawings 4, 5, and 6 in Appendix E-1 of this report). In addition, grain size analyses were conducted on samples collected from the SWSBs. These geologic data are generally consistent with the hydrostratigraphic interpretation of the site presented in the Feasibility Study (summarized in Figure A-2) and the hydraulic conductivity values assigned to the individual layers that comprise the original 1992 model. However, the new evidence does require some modifications to the model input. The full implications of the new data are discussed below.

The juxtaposition of grain size analyses from the SWSBs with slug test results collected during the remedial investigation confirmed the hypothesis that hydraulic conductivity of the various hydrostratigraphic units is strongly dependent on depth below land surface. In particular, Figure 3-5 of the Pre-Design Studies Report (Geraghty & Miller, April 1995) shows that the "B" hydrostratigraphic unit, alternatively described as "shallow upland till" or as brown clayey, sandy silt, is not clearly distinguished in terms of grain size distribution from the underlying "T" hydrostratigraphic unit, alternatively described as "the aquitard" or as gray till. However, the range of hydraulic conductivity values associated with the "B" unit is clearly different and higher than the range of conductivities associated with the "T" unit (see Figure 3-6 of the Pre-Design Studies Report). A likely explanation for this difference is that the "T" unit, which serves as a hydraulic barrier between more permeable overlying units and the underlying sand aquifer, is overcompacted relative to the "B" unit. The finding that overcompaction is a function of depth supports the key model assumption that fine-grained glacial units decrease in hydraulic conductivity with depth. The model presented in the Feasibility Study assigned hydraulic conductivity values (derived from averages of slug tests) to the "B" and "T" units of 0.10 ft/day and 0.02 ft/day, respectively. These values have been preserved in the updated version of the model.

APPENDIX A

GROUNDWATER MODELING RESULTS
PRELIMINARY DESIGN REPORT
LAKELAND DISPOSAL LANDFILL
CLAYPOOL, INDIANA

This appendix discusses the modeling performed in connection with developing the optimal design for the groundwater containment system which is one of the remedial components required for the Lakeland Disposal Landfill in Claypool, Indiana. The MODFLOW groundwater flow model used for this analysis was described in detail in Appendix A of the Feasibility Study (FS) Report for the Lakeland Disposal Landfill (Geraghty & Miller, 1992). The first part of this appendix presents changes made to the flow model to take account of geologic and hydrogeologic data collected as part of the pre-design studies in 1995 and describes the effect of these changes on model calibration. The second and third parts of this appendix detail the application of the model to test the suitability of different combinations of remedial elements (landfill cap, slurry wall, recovery wells, subsurface drain) to achieve inward groundwater gradients across the waste volume boundaries and, thereby, isolate and contain the on site groundwater that has been, or may become, impacted by the buried waste material at the landfill. Isolation and containment of the on site groundwater in the upper aquifer is the main function of the groundwater containment system required for the Lakeland Disposal Landfill.

CHANGES TO FLOW MODEL AND RECALIBRATION

The geometry, internal and external boundary conditions, and hydrostratigraphic units of the model are described in Appendix A of the Feasibility Study. Figure A-1 of this appendix shows the inner model grid superimposed on the monitoring wells in the vicinity of the landfill. It also shows the location of the slurry wall soil borings (SWSBs) installed during the pre-design studies. A line connecting the SWSBs generally defines the boundaries of the required containment area along the northern, northeastern, southeastern and southern sides of the landfill. The western side of the required containment area is defined by a north-side line intersecting MW1 and MW10 that completes the

APPENDIX A

GROUNDWATER MODELING RESULTS

APPENDIX A

FIGURE 11-2 PRELIMINARY CONSTRUCTION SCHEDULE B
CONTAMINANT REMEDY WITH EXCAVATION OF WASTE DISPOSAL AREA 2
LAKELAND DISPOSAL, CLAYPOOL, IN

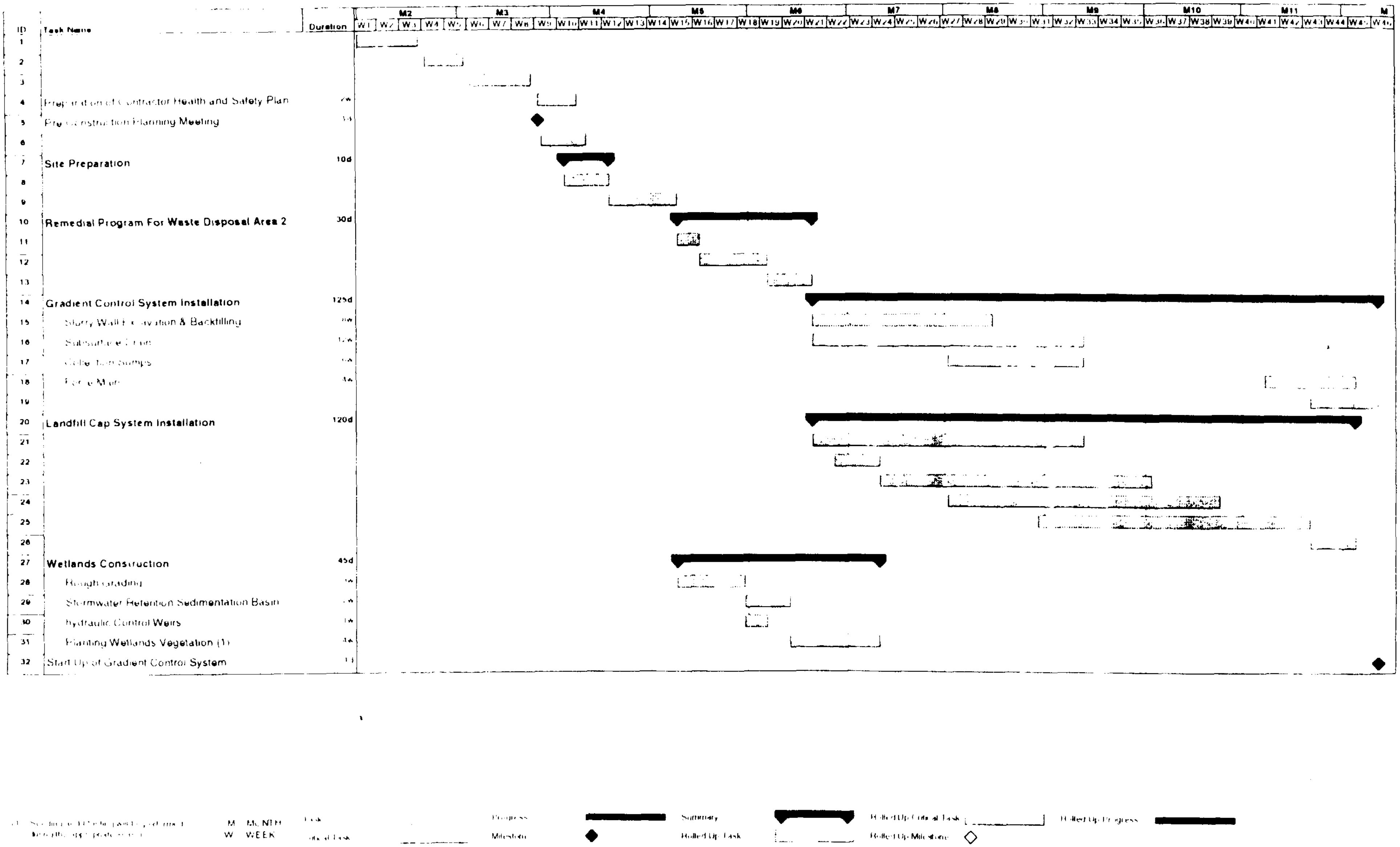
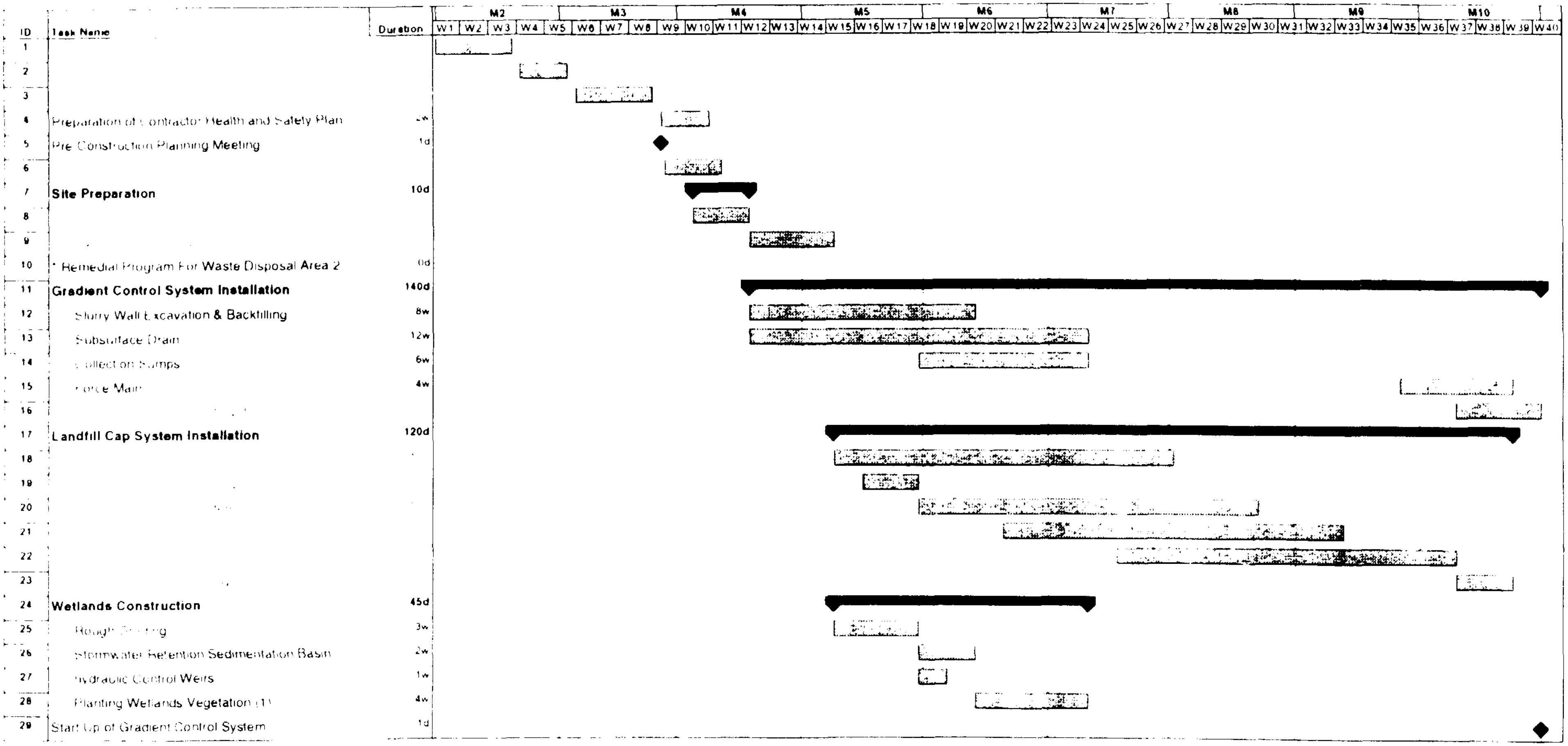


FIGURE 11-1. PRELIMINARY CONSTRUCTION SCHEDULE A
CONTAMINANT REMEDY WITHOUT EXCAVATION OF WASTE DISPOSAL AREA 2
LAKELAND DISPOSAL; CLAYPOOL, IN.



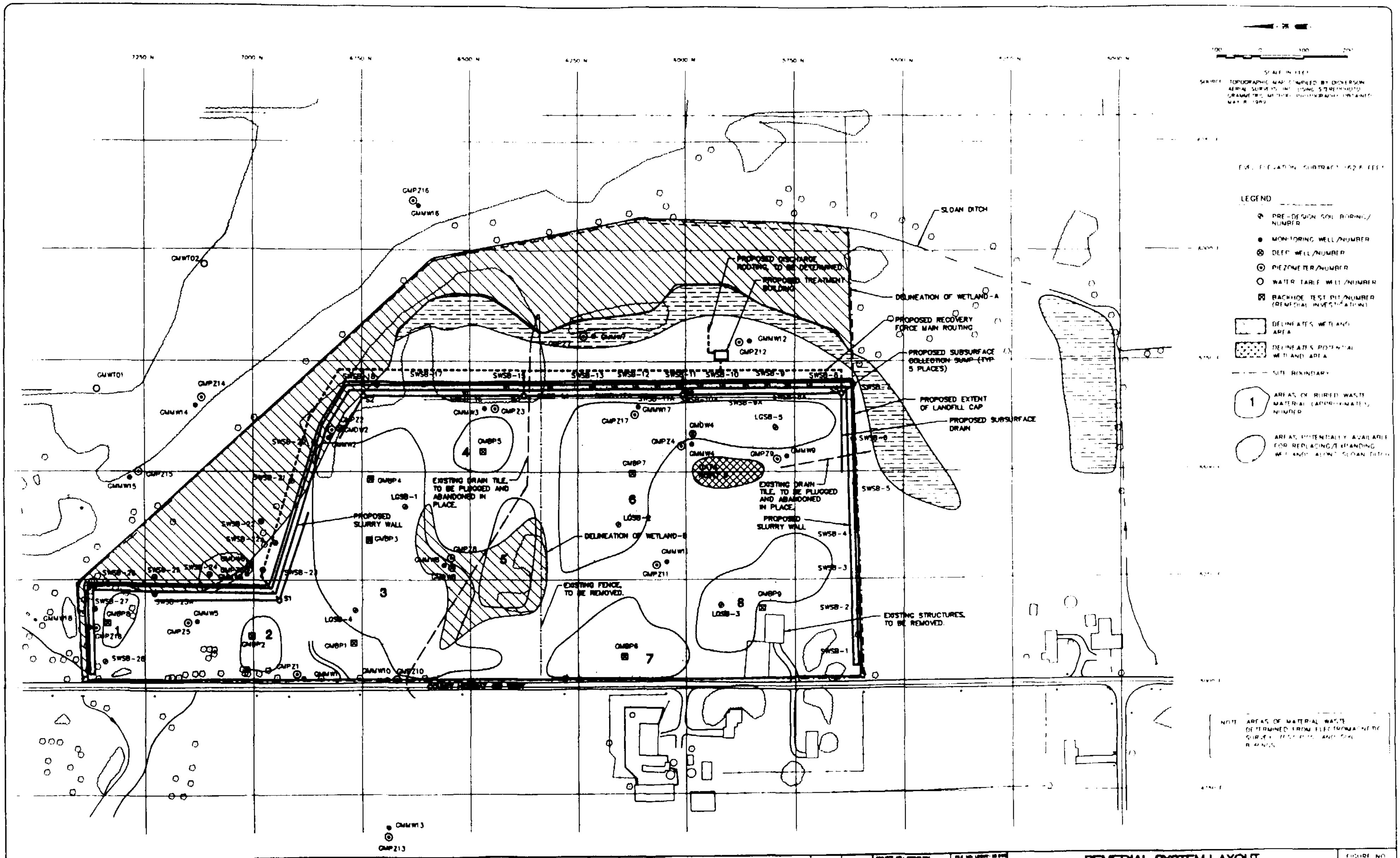
ID	Task Name	Duration
1		
2		
3		
4	Preparation of Contractor Health and Safety Plan	2w
5	Pre Construction Planning Meeting	1d
6		
7	**Site Preparation**	10d
8		
9		
10	* Remedial Program For Waste Disposal Area 2	0d
11	**Gradient Control System Installation**	140d
12	Slurry Wall Excavation & Backfilling	8w
13	Subsurface Drain	12w
14	Collection Sumps	6w
15	Force Main	4w
16		
17	**Landfill Cap System Installation**	120d
18		
19		
20		
21		
22		
23		
24	**Wetlands Construction**	45d
25	Rough Grading	3w
26	Stormwater Retention Sedimentation Basin	2w
27	Hydraulic Control Weirs	1w
28	Planting Wetlands Vegetation (1)	4w
29	Start Up of Gradient Control System	1d

(1) Seeding and Planting will be performed during the appropriate season

M MONTH
W WEEK

Task	▭	Progress	▬	Summary	▬	Rolled Up Critical Task	▭
Critical Task	▭	Milestone	◆	Rolled Up Task	▭	Rolled Up Milestone	◇
						Rolled Up Progress	▬

* ASSUMES NO EXCAVATION TREATMENT REQUIRED FOR WASTE DISPOSAL AREA 2



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SCALE VERIFICATION
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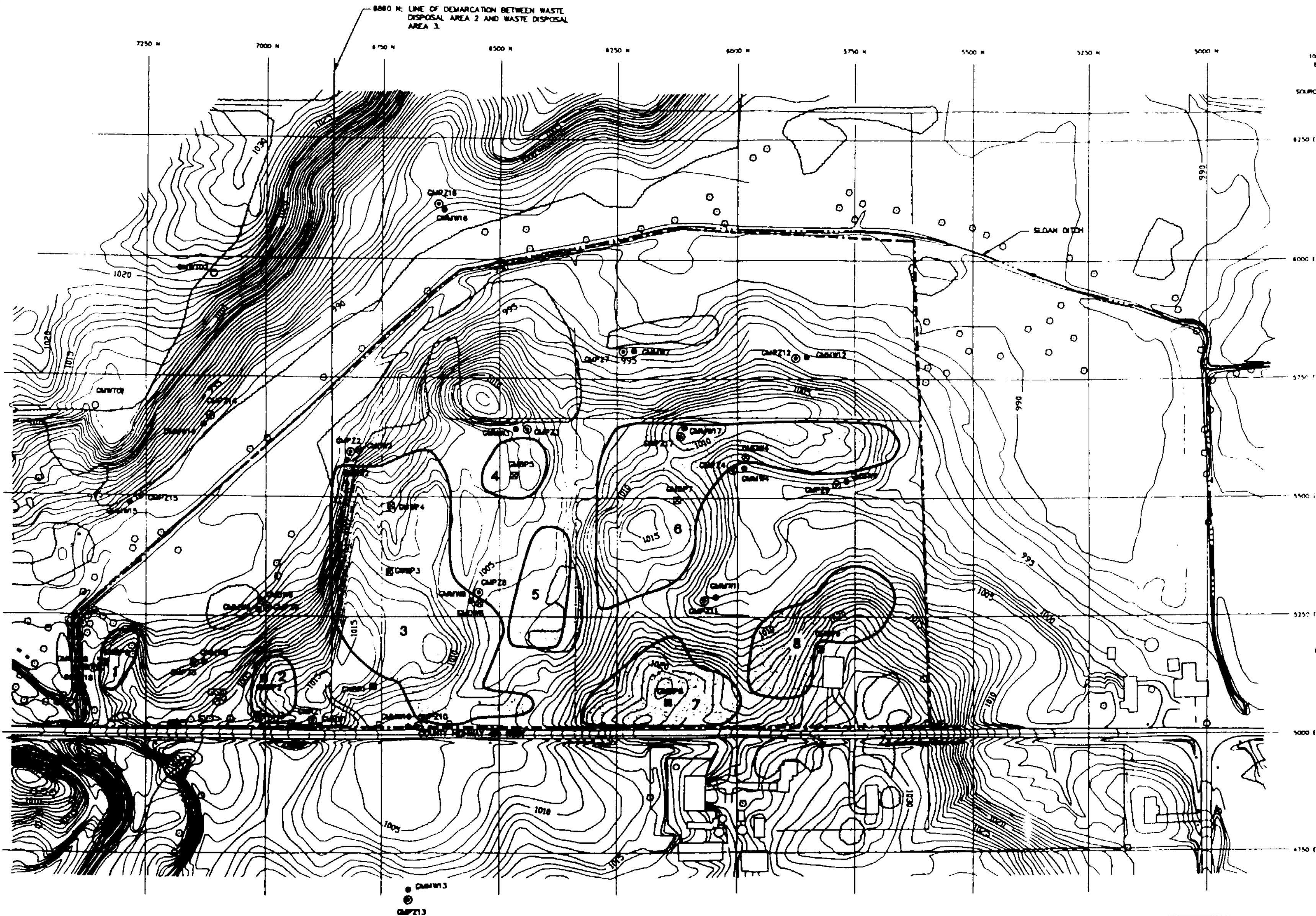
REV. NO.	DATE	DESCRIPTION	BY	APPR

REMEDIAL SYSTEM LAYOUT

LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE NO.
2-2



SCALE IN FEET

100 0 100 200

SOURCE: TOPOGRAPHIC MAP COMPILED BY DICKERSON AERIAL SURVEYS, INC. USING STEREOPHOTOGRAMMETRIC METHOD. PHOTOGRAPHY OBTAINED MAY 8, 1989

GENERAL ELEVATION NOTE:
INDICATED ELEVATIONS ARE REFERENCED TO THE LOCALLY RECOVERABLE DATUM OF 1,000 FEET. TO OBTAIN MEAN SEA LEVEL ELEVATION, SUBTRACT 162.6 FEET.

LEGEND

●	MONITORING WELL/NUMBER
⊕	DEEP WELL/NUMBER
⊙	PIEZOMETER/NUMBER
○	WATER TABLE WELL/NUMBER
☒	BACKHOE TEST PIT/NUMBER (REMEDIAL INVESTIGATION)
— · — —	SITE BOUNDARY
1	AREAS OF BURIED WASTE MATERIAL (APPROXIMATE)/NUMBER

NOTE: AREAS OF MATERIAL WASTE DETERMINED FROM ELECTROMAGNETIC SURVEY, TEST PITS, AND SOIL BORINGS.

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REV. NO.	DATE	DESCRIPTION	BY	APPR.

WASTE DISPOSAL AREAS

LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
2-1

FIGURES

Table A-10. Simulated Flux and Gradient Results for Design #6 after 10 Years, Lakeland Disposal Landfill, Claypool, Indiana.

FLUX ACROSS SIDES and BASE OF WASTE AREA

LATERAL Flux (gpm) Out Of Capped Area
From Water Table Elevation to Elevation 969

SIDE	IN	OUT
NO	0.0030	-0.0001
NE	0.0281	0.0000
SE	0.0547	-0.0002
SO	0.0096	-0.0025
SW	0.0211	0.0000
NW	0.0396	0.0000

Total Horizontal Flux: QIN = .1561, QOUT = -.0028

VERTICAL Flux (gpm) Across Elevation 969
Below Capped Area (ft^2):

INFLOW		OUTFLOW		NOFLOW
Area	Qin	Area	Qout	Area
678400	9.6881	308800	-0.2485	0.0000

TOTAL INWARD Groundwater Flux to Waste Volume = 9.8442 gpm
TOTAL OUTWARD Groundwater Flux from Waste Volume = -.2513 gpm

GRADIENT ACROSS PAIRED WATER TABLE WELLS

Pair	Hout	Hin	Hdif	Grad
1	986.739	986.093	0.647	0.01617
2	986.905	985.006	1.899	0.04747
3	986.803	985.019	2.784	0.06959
4	994.578	986.138	8.440	0.21100
5	989.974	986.020	3.954	0.09885
6	988.470	986.028	2.442	0.06104
7	1001.104	999.673	1.431	0.03578
8	1001.766	999.901	1.865	0.04663
9	1001.232	999.150	2.082	0.05205
10	999.886	996.328	3.558	0.08895

Positive --> Inward, Negative --> Outward

1 inch/yr cap
Fully-enclosing slurry wall
No wells
Drain (along north, northeast, southeast sides and 200 ft of south side) collects 10.77 gpm

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Table A-11. Simulated Flux and Gradient Results for Design #6 after 10 Years, Lakeland Disposal Landfill, Claypool, Indiana.

FLUX ACROSS SIDES and BASE OF WASTE AREA

LATERAL Flux (gpm) Out Of Capped Area
From Water Table Elevation to Elevation 969

SIDE	IN	OUT
NO	0.0031	-0.0001
NE	0.0283	0.0000
SE	0.0584	-0.0003
SO	0.0084	-0.0038
SW	0.0138	0.0000
NW	0.0334	0.0000

Total Horizontal Flux: QIN = .1454, QOUT = -.0041

VERTICAL Flux (gpm) Across Elevation 969
Below Capped Area (ft^2):

INFLOW		OUTFLOW		NOFLOW
Area	Qin	Area	Qout	Area
571200	9.3637	416000	-0.732	0.0000

TOTAL INWARD Groundwater Flux to Waste Volume = 9.5091 gpm
TOTAL OUTWARD Groundwater Flux from Waste Volume = -.7361 gpm

GRADIENT ACROSS PAIRED WATER TABLE WELLS

Pair	Hout	Hin	Hdif	Grad
1	986.747	986.145	0.602	0.01504
2	986.923	985.006	1.916	0.04791
3	987.833	985.020	2.813	0.07032
4	995.044	986.265	8.780	0.21949
5	990.264	986.075	4.189	0.10471
6	988.693	986.045	2.647	0.06618
7	1001.499	1000.600	0.899	0.02248
8	1002.123	1000.872	1.251	0.03127
9	1001.724	1000.702	1.022	0.02555
10	1000.026	997.073	2.953	0.07381

Positive --> Inward, Negative --> Outward

1 inch/yr cap
Fully-enclosing slurry wall
No wells
Drain (along north, northeast, southeast sides and 200 ft of south side) collects 10.77 gpm

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Table A-12. Simulated Flux and Gradient Results for Design #7 after 10 Years, Lakeland Disposal Landfill, Claypool, Indiana.

FLUX ACROSS SIDES and BASE OF WASTE AREA

LATERAL Flux (gpm) Out Of Capped Area
From Water Table Elevation to Elevation 969

SIDE	IN	OUT
NO	0.0030	-0.0001
NE	0.0281	0.0000
SE	0.0507	-0.0002
SO	0.0117	-0.0017
SW	0.0279	0.0000
NW	0.0443	0.0000

Total Horizontal Flux: QIN = .1656, QOUT = -.0020

VERTICAL Flux (gpm) Across Elevation 969
Below Capped Area (ft^2):

INFLOW		OUTFLOW		NOFLOW
Area	Qin	Area	Qout	Area
886400	10.1684	100800	-0.0155	0.0000

TOTAL INWARD Groundwater Flux to Waste Volume = 10.3340 gpm
TOTAL OUTWARD Groundwater Flux from Waste Volume = -.0175 gpm

GRADIENT ACROSS PAIRED WATER TABLE WELLS

Pair	Hout	Hin	Hdif	Grad
1	986.738	986.006	0.732	0.01830
2	986.902	985.006	1.896	0.04741
3	987.798	985.019	2.779	0.06946
4	994.595	986.013	8.582	0.21454
5	989.968	986.002	3.966	0.09915
6	988.457	986.002	2.455	0.06138
7	1001.032	998.853	2.179	0.05448
8	1002.672	999.042	2.630	0.06574
9	1001.143	998.252	2.891	0.07227
10	999.805	995.681	4.124	0.10310

Positive --> Inward, Negative --> Outward

0.067 inch/yr cap

dykmagos\ci0348\lakeland\tables\design6a.xls/S

Fully-enclosing slurry wall
No wells
Drain (along north, northeast, southeast sides and 200 ft of south side) collects 10.39 gpm

Table A-13. Simulated Flux and Gradient Results for Design #8 after 10 Years, Lakeland Disposal Landf Claypool, Indiana.

FLUX ACROSS SIDES and BASE OF WASTE AREA

LATERAL Flux (gpm) Out Of Capped Area
From Water Table Elevation to Elevation 969

SIDE	IN	OUT
NO	0.0030	-0.0001
NE	0.0281	0.0000
SE	0.0507	-0.0002
SO	0.0104	-0.0017
SW	0.1499	0.0000
NW	0.2594	0.0000

Total Horizontal Flux: QIN = .5014, QOUT = -.0020

VERTICAL Flux (gpm) Across Elevation 969
Below Capped Area (ft^2):

INFLOW		OUTFLOW		NOFLOW
Area	Qin	Area	Qout	Area
784000	10.0493	203200	-0.1934	0.0000

TOTAL INWARD Groundwater Flux to Waste Volume = 10.5508 gpm
TOTAL OUTWARD Groundwater Flux from Waste Volume = -.1954 gpm

GRADIENT ACROSS PAIRED WATER TABLE WELLS

Pair	Hout	Hin	Hdif	Grad
1	986.738	986.006	0.732	0.01829
2	986.902	985.006	1.896	0.04740
3	987.798	985.019	2.779	0.06946
4	994.595	986.013	8.582	0.21454
5	989.967	986.002	3.966	0.09915
6	988.457	986.002	2.455	0.06138
7	1001.027	999.069	1.958	0.04894
8	1000.837	999.917	0.920	0.02301
9	1000.203	999.218	0.985	0.02464
10	999.274	997.030	2.243	0.05609

Positive --> Inward, Negative --> Outward

0.067 inch/yr cap
Slurry wall along north, northeast, southeast, and south sides
No wells
Drain (along north, northeast, southeast sides and 200 ft of south side) collects 10.43 gpm

dykmagos\ci0348\lakeland\tables\design8 xls/S

Table A-14. Simulated Flux and Gradient Results for Design #8 after 1 Year, Lakeland Disposal Landfill, Claypool, Indiana.

FLUX ACROSS SIDES and BASE OF WASTE AREA

LATERAL Flux (gpm) Out Of Capped Area
From Water Table Elevation to Elevation 969

SIDE	IN	OUT
NO	0.0030	-0.0001
NE	0.0283	0.0000
SE	0.0574	-0.0003
SO	0.0091	-0.0030
SW	0.1194	0.0000
NW	0.2424	0.0000

Total Horizontal Flux: QIN = .4597, QOUT = -.0033

VERTICAL Flux (gpm) Across Elevation 969
Below Capped Area (ft^2):

INFLOW		OUTFLOW		NOFLOW
Area	Qin	Area	Qout	Area
620800	9.5704	366400	-0.5980	0.0000

TOTAL INWARD Groundwater Flux to Waste Volume = 10.0301 gpm
TOTAL OUTWARD Groundwater Flux from Waste Volume = -.6013 gpm

GRADIENT ACROSS PAIRED WATER TABLE WELLS

Pair	Hout	Hin	Hdif	Grad
1	986.746	986.060	0.686	0.01715
2	986.922	985.006	1.915	0.04788
3	987.831	985.020	2.811	0.07028
4	995.043	986.166	8.878	0.22194
5	990.261	986.057	4.204	0.10509
6	988.688	986.017	2.671	0.06679
7	1001.472	1000.158	1.314	0.03285
8	1001.585	1000.856	0.729	0.01823
9	1001.244	1000.612	0.632	0.01580
10	999.288	997.648	1.640	0.04099

Positive --> Inward, Negative --> Outward

0.067 inch/yr cap
dykmagos\ci0348\lakeland\tables\design8a.xls/S
Slurry wall along north, northeast, and southeast sides
No wells
Drain (along north, northeast, southeast sides and 200 ft of south side) collects 10.43 gpm

Table A-15. Summary of Model Flux Results for Design Scenarios, Lakeland Disposal Landfill, Claypool, Indiana.

Run	Cap Infiltration	Slurry Wall Extent /*	Well Number	Well gpm	Drain Extent /**	Drain gpm
BASELINE	---	---	---	---	---	---
Design #1	1 inch/yr	---	---	---	---	---
Design #2	1 inch/yr	All Sides	9	2.2	---	---
Design #3	1 inch/yr	NO,NE,SE,SO	9	2.2	---	---
Design #4	1 inch/yr	All Sides	---	---	NO,NE,SE	10.22
Design #5	1 inch/yr	NO,NE,SE,SO	---	---	NO,NE,SE	10.26
Design #6	1 inch/yr	All Sides	---	---	NO,NE,SE,SO/***	10.77
Design #7	1 inch/yr	All Sides	---	---	NO,NE,SE,SO /***	10.33
Design #8	0.067 inch/yr	All Sides	---	---	NO,NE,SE,SO /***	10.43

Simulated Results after 10 years of remediations

/*	Slurry wall assumed to extend vertically from land surface to 969 ft except in vicinity of SWSB20 where extends 10-20 ft deeper
/**	Drain invert assumed to be 985 ft elevation
/***	For Designs #6,#7 and #8, the drain extends 200 ft along South side from Southeast Corner of Waste Area
/****	Calculated on basis of simulated gradient between 10 pairs of water table wells uniformly distributed along waste boundary

dymagos\ci0348\lakeland\tables\sumflux.xls/S

Table A-15. Summary of Model Flux Results for Design Scenarios, Lakeland Disposal Landfill, Claypool, Indiana.

Run	Outflow Lateral gpm	 Vertical gpm	 Total gpm	Percent of Outflow to Baseline	Percent of Waste Bound with Inward Gradient
BASELINE	7.39	1.85	9.24		30
Design #1	7.25	0.50	7.75	84	50
Design #2	0.30	0.22	0.52	6	40
Design #3	0.32	0.39	0.71	8	40
Design #4	0.02	0.26	0.28	3	90
Design #5	0.02	0.43	0.45	5	90
Design #6	0.00	0.25	0.25	3	100
Design #7	0.00	0.02	0.02	0.2	100
Design #8	0.00	0.20	0.20	2	100

Simulated Results after 10 years of remediations

/* Slurry wall assumed to extend vertically from land surface to 969 ft except in vicinity of SWSB20 where extends 10-20 ft deeper

/** Drain invert assumed to be 985 ft elevation

/*** For Designs #6,#7 and #8, the drain extends 200 ft along South side from Southeast Corner of Waste Area

/**** Calculated on basis of simulated gradient between 10 pairs of water table wells uniformly distributed along waste boundary

/**** Calculated on basis of simulated gradient between 10 pairs of water table wells uniformly distributed along waste boundary

dymagos\ci0348\lakeland\tables\sumflux.xls/S

APPENDIX A

FIGURES

DRAFTER: ELS

APPROVED:

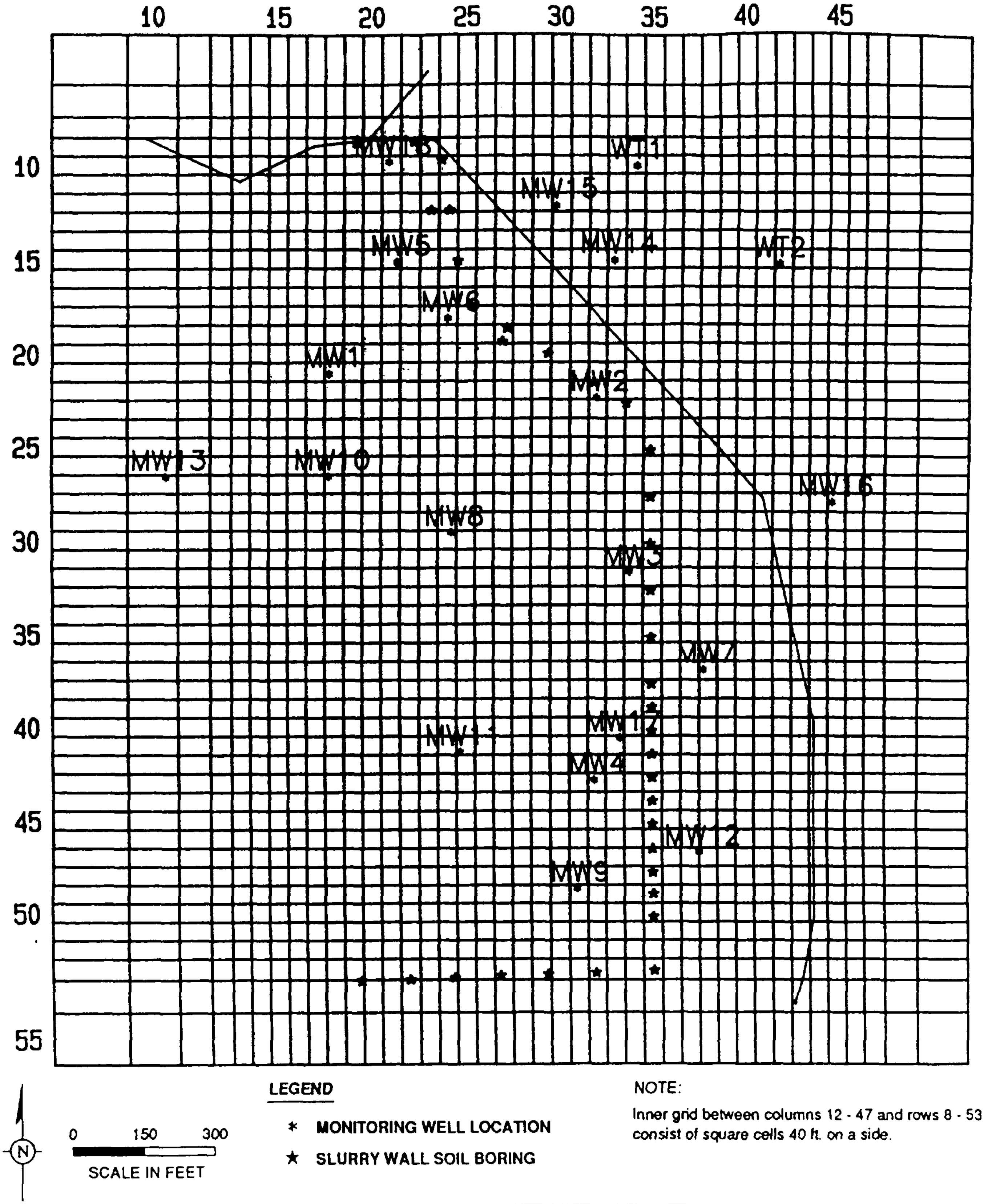
CHECKED: DF

DRAWING: 01P/U

FILE NO.: 1641

PRJCT NO.: CI0348.004.011

DWG DATE: 31JAN96



LEGEND

- * **MONITORING WELL LOCATION**
- ★ **SLURRY WALL SOIL BORING**

NOTE:

Inner grid between columns 12 - 47 and rows 8 - 53 consist of square cells 40 ft. on a side.

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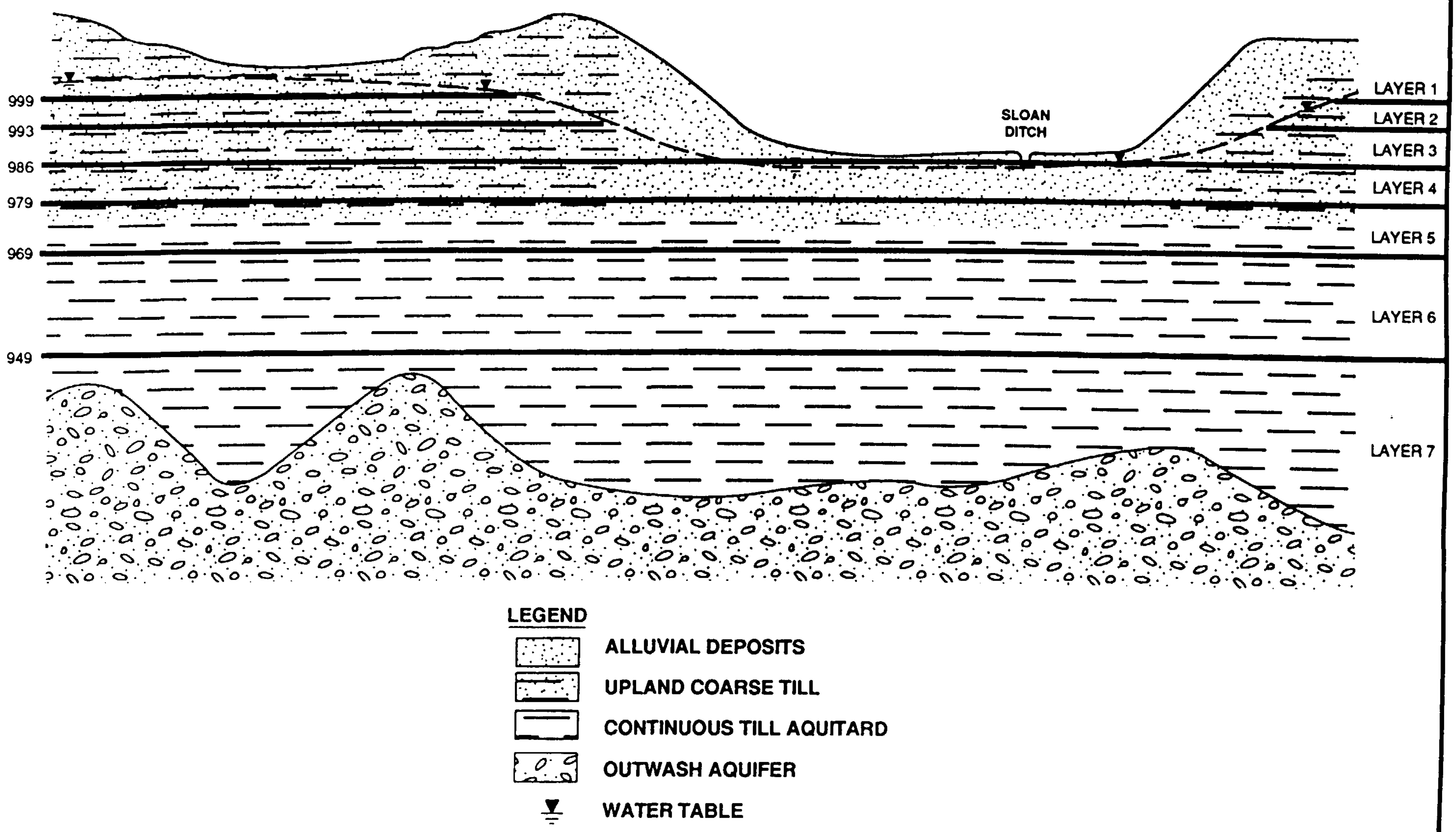
INNER MODFLOW GRID

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE

A-1

DWG DATE: 31JAN96 | PRJCT NO.: CI0348.004.011 | FILE NO.: 1641 | DRAWING: 02 | CHECKED: DF | APPROVED: | DRAFTER: ELS



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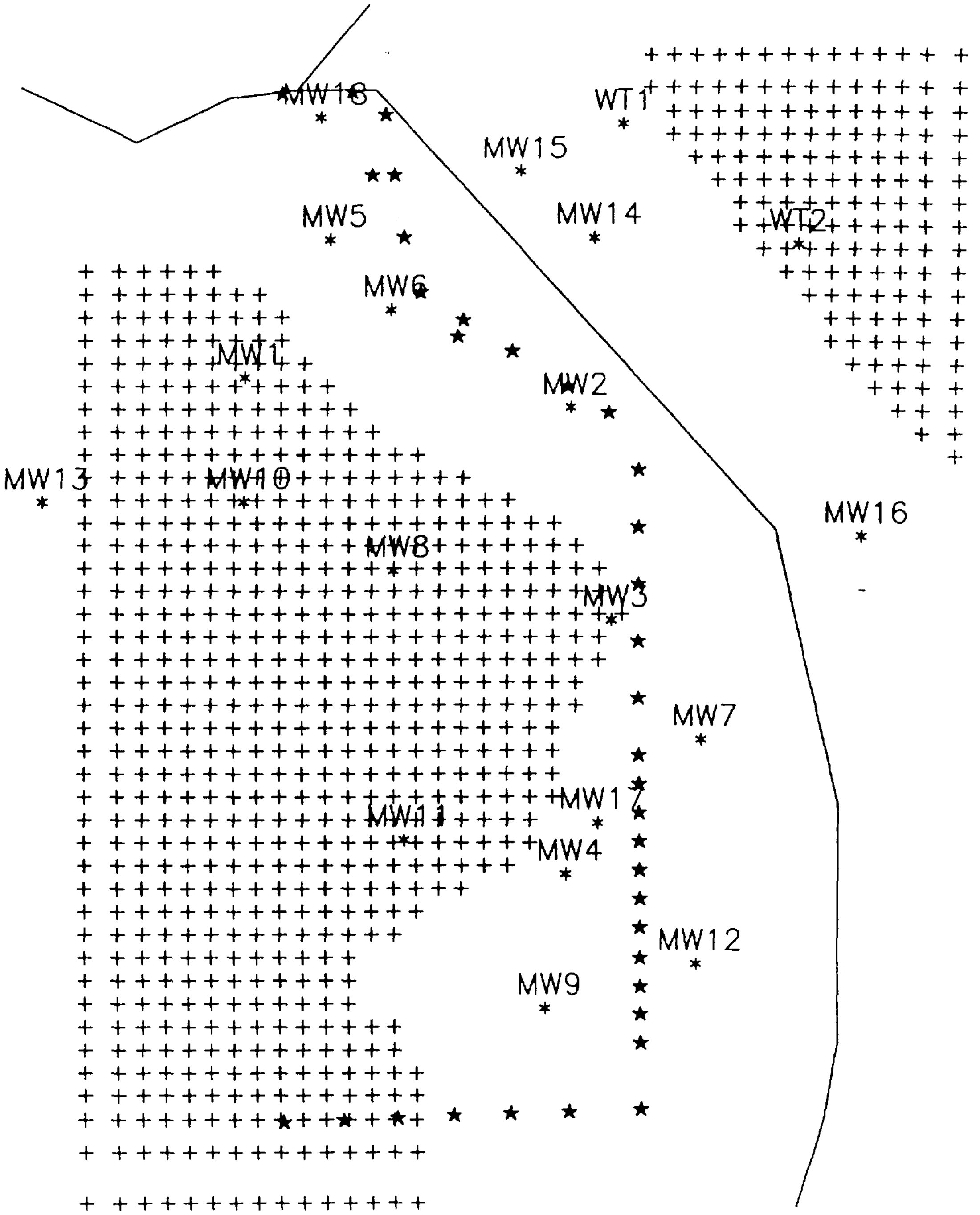
LAYERS IN NUMERICAL MODEL

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-2

DRAFTER: ELS | APPROVED: | CHECKED: DF | DRAWING: 03PJU | FILE NO.: 1641 | PRJCT NO.: CI0348.004.011 | DWG DATE: 02FEB96



LEGEND

- * MONITORING WELL LOCATION
- ★ SLURRY WALL SOIL BORING

K ZONES (ft/day)

\+ = .1 LOOSE UPLAND TILL

NOTE:

Blank zones above water table.

N

0 150 300

SCALE IN FEET

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HYDRAULIC CONDUCTIVITY FOR INNER GRID: LAYER 1 (ELEV. > 999 FT)

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE

A-3

DRAFTER: ELS

APPROVED:

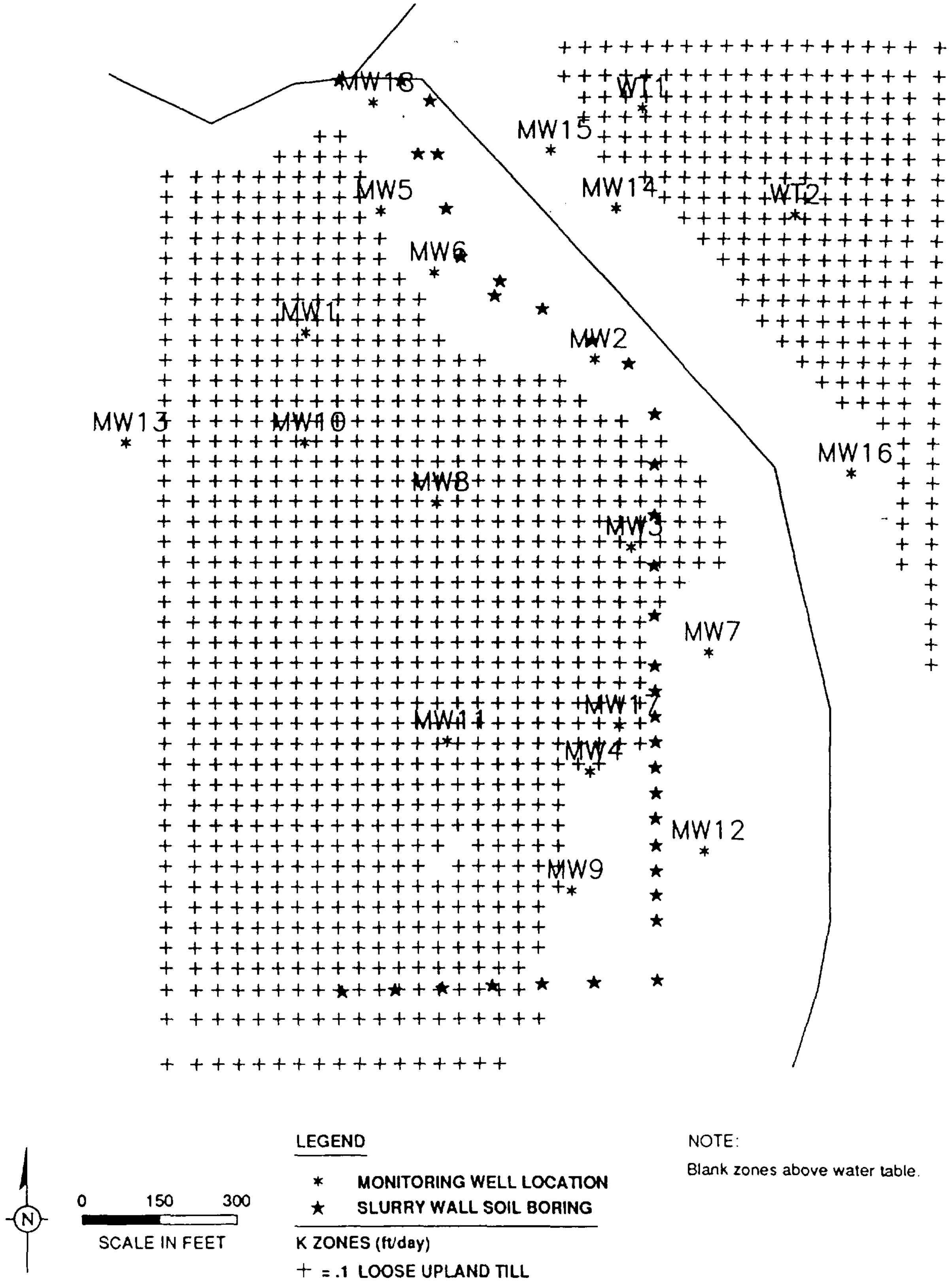
CHECKED: DF

DRAWING: 04P/U

FILE NO.: 1641

PRJCT NO.: CI0348.004.011

DWG DATE: 02FEB96



LEGEND

- * MONITORING WELL LOCATION
- ★ SLURRY WALL SOIL BORING

K ZONES (ft/day)

\+ = .1 LOOSE UPLAND TILL

NOTE:
Blank zones above water table.

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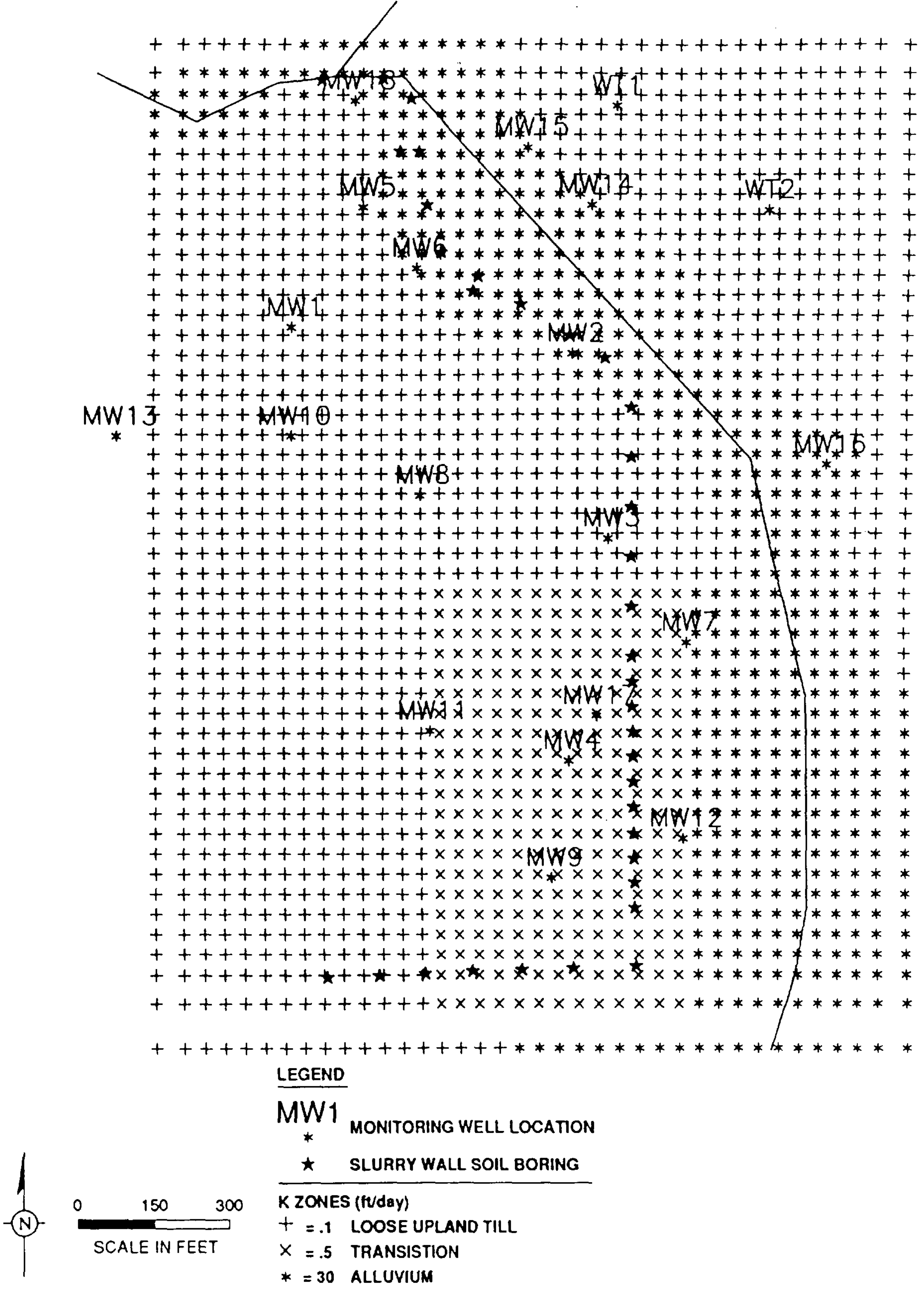
HYDRAULIC CONDUCTIVITY FOR INNER GRID: LAYER 2 (ELEV. 993 - 999)

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-4



DRAFTER: ELS
APPROVED:
CHECKED: DF
DRAWING: 05P/U
FILE NO.: 1641
PRJCT NO.: CI0348.004.011
DWG DATE: 02FEB96

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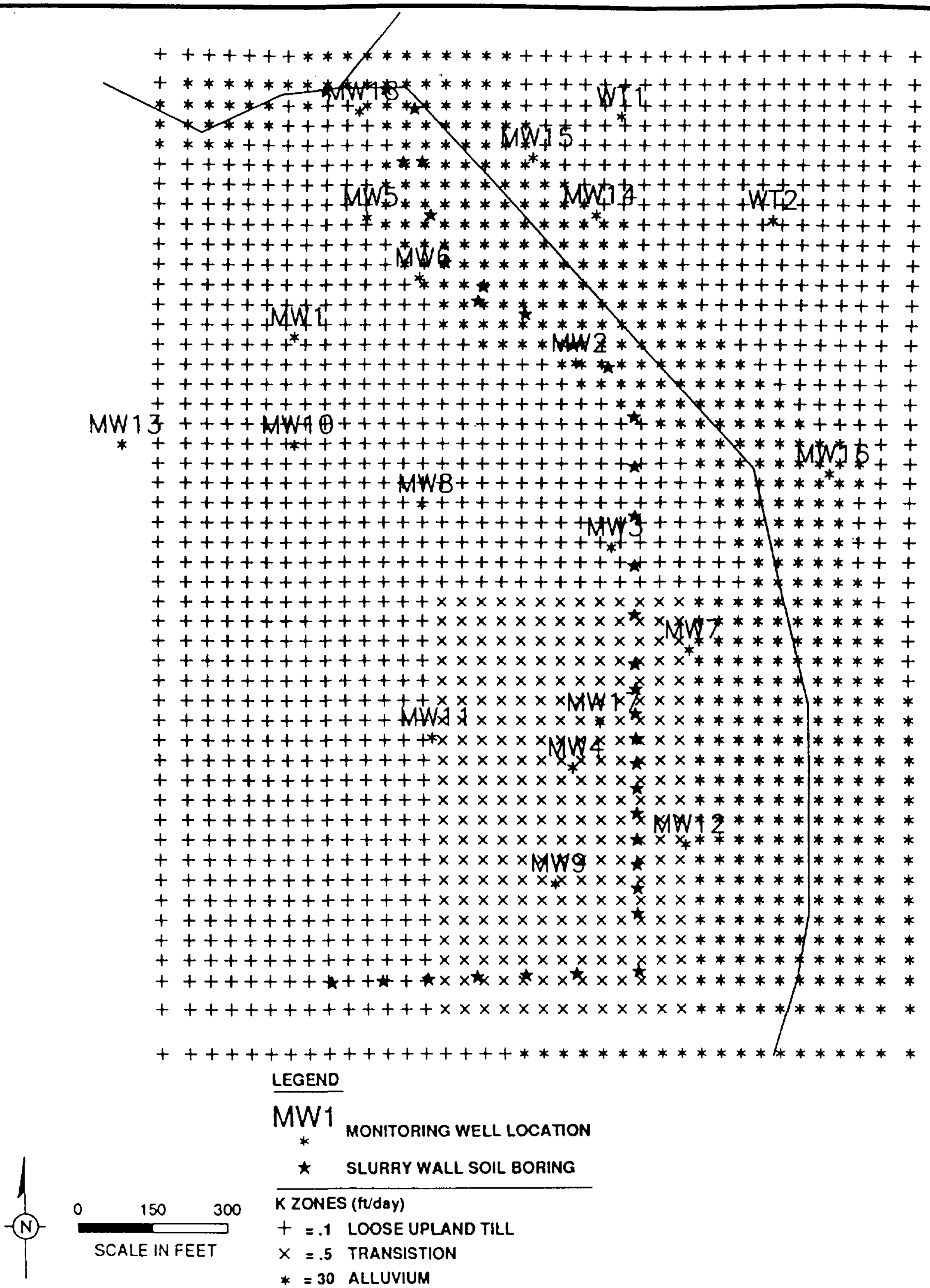
HYDRAULIC CONDUCTIVITY FOR INNER GRID: LAYER 3 (ELEV. 986 - 993)

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-5



DRAFTER: ELS

APPROVED:

CHECKED: DF

DRAWING: 06P/U

FILE NO.: 1641

PRJCT NO.: CI0348.004.011

DWG DATE: 02FEB96

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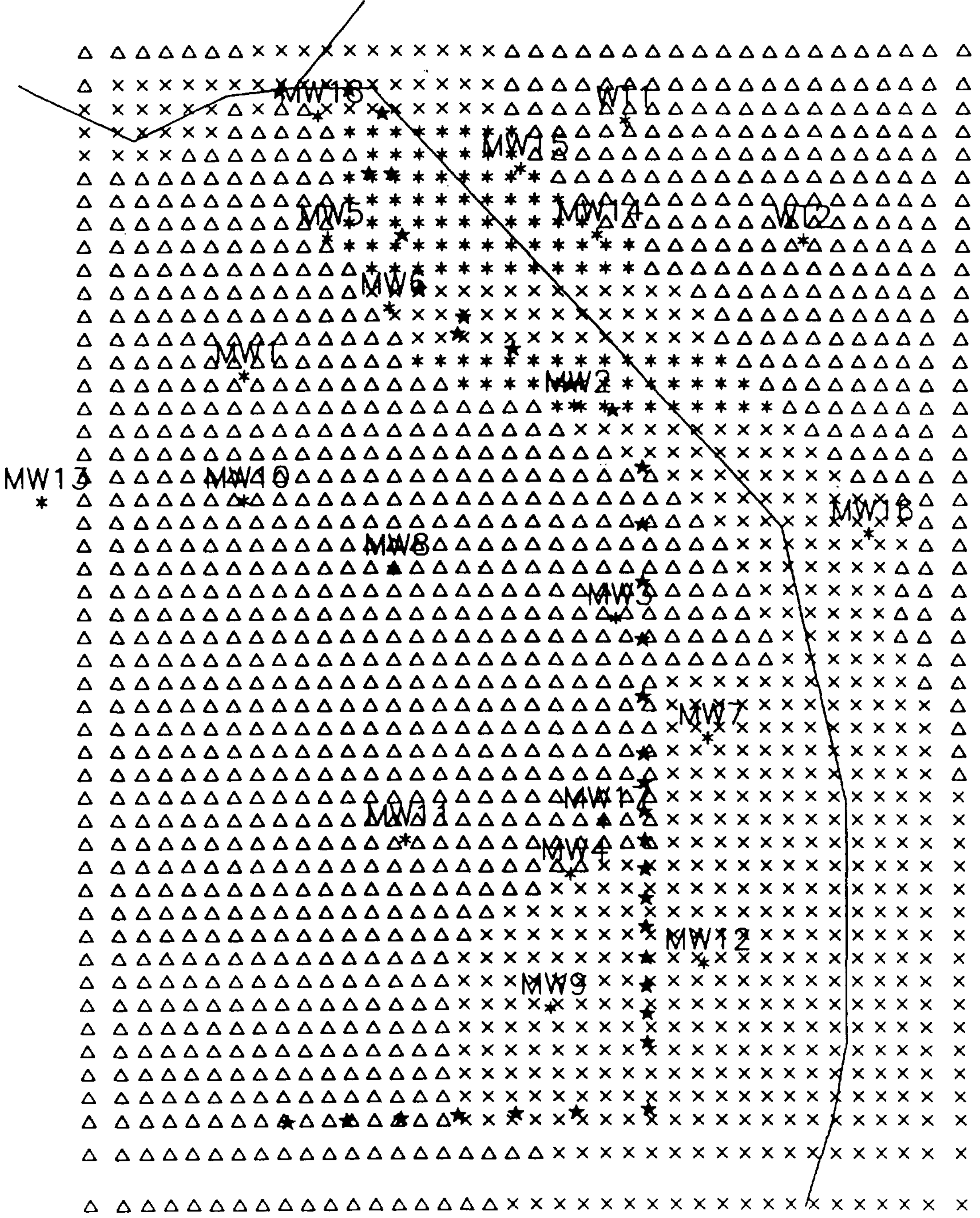
HYDRAULIC CONDUCTIVITY FOR INNER GRID: LAYER 4 (ELEV. 979 - 986)

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-6

DWG DATE: 02FEB96 | PRJCT NO.: CI0348.004.011 | FILE NO.: 1641 | DRAWING: 07P/U | CHECKED: DF | APPROVED: | DRAFTER: ELS



LEGEND

MW1 * MONITORING WELL LOCATION

★ SLURRY WALL SOIL BORING

K ZONES (ft/day)

△ = .02 AQUITARD

× = .5 TRANSISTION

∗ = 30 ALLUVIUM

0 150 300
SCALE IN FEET

N

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HYDRAULIC CONDUCTIVITY FOR INNER GRID: LAYER 5 (ELEV. 969 - 979)

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-7

DRAFTER: ELS

APPROVED:

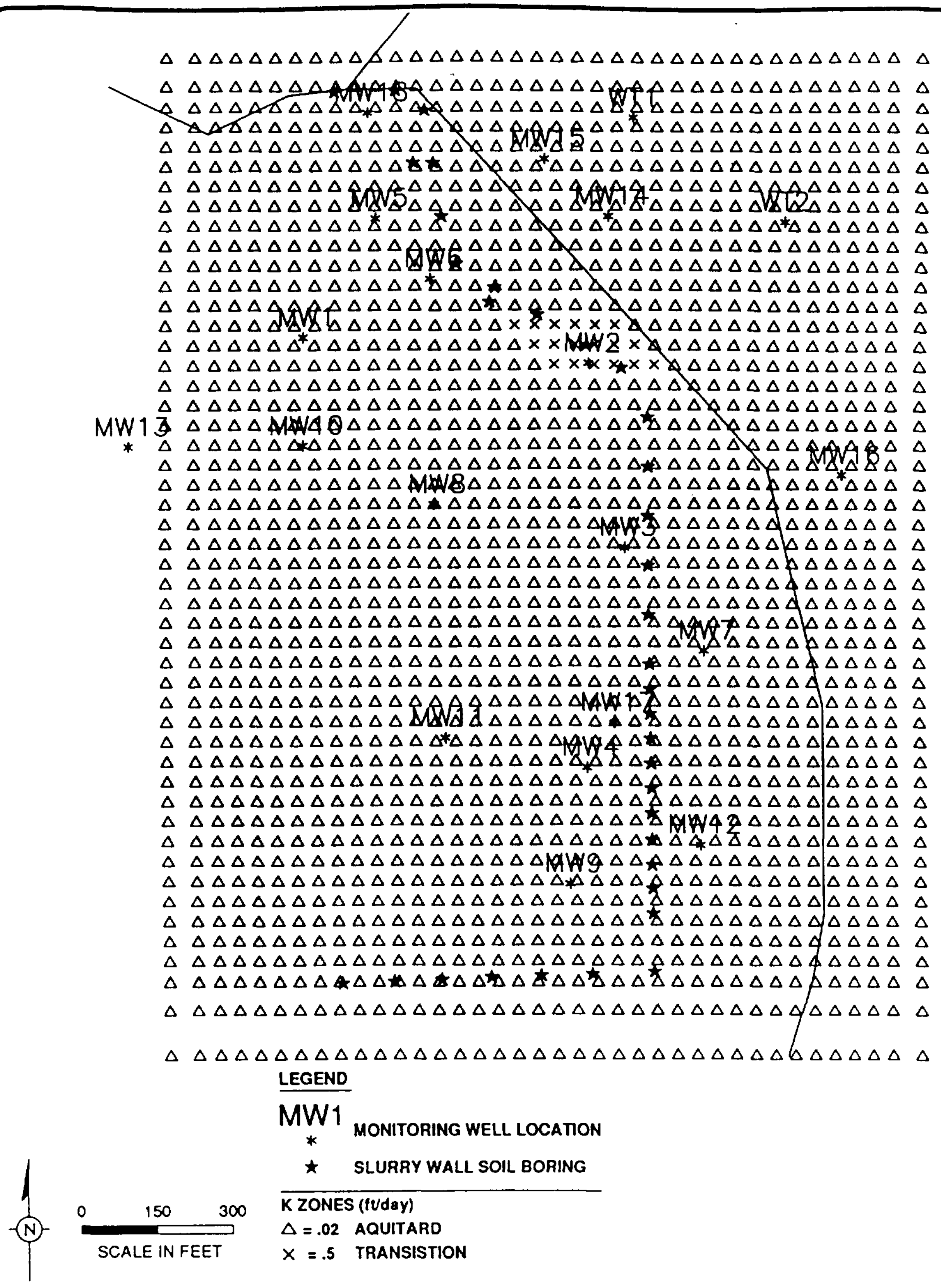
CHECKED: DF

DRAWING: 08PJ

FILE NO.: 1641

PRJCT NO.: CI0348.004.011

DWG DATE: 02FEB96



LEGEND

MW1 * MONITORING WELL LOCATION

★ SLURRY WALL SOIL BORING

K ZONES (ft/day)

△ = .02 AQUITARD

× = .5 TRANSISTION

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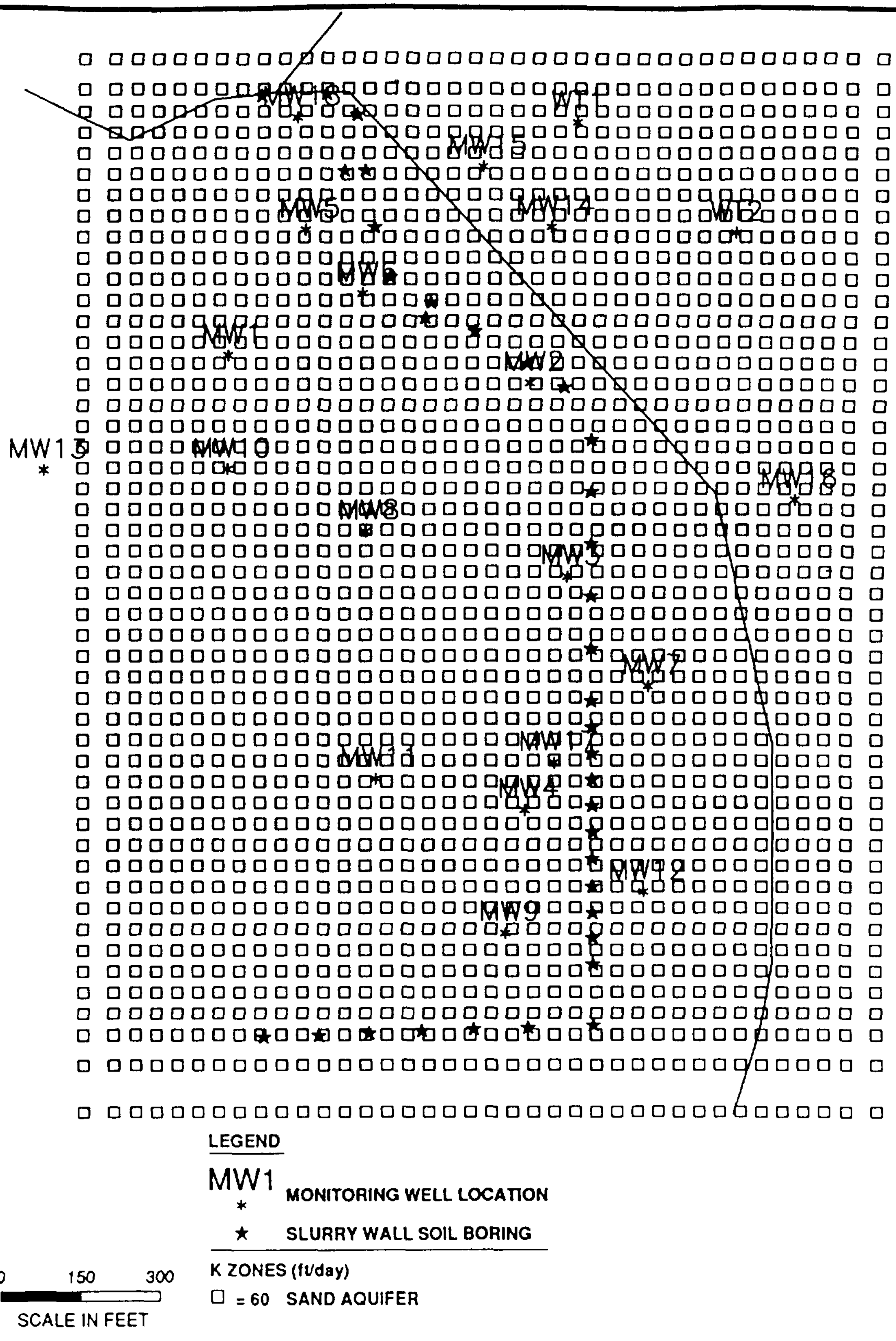
HYDRAULIC CONDUCTIVITY FOR INNER GRID: LAYER 6 (ELEV. 949 - 969)

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE

A-8

DRAFTER: ELS | APPROVED: | CHECKED: DF | DRAWING: 09P/U | FILE NO.: 1641 | PRJCT NO.: CI0348.004.011 | DWG DATE: 02FEB98



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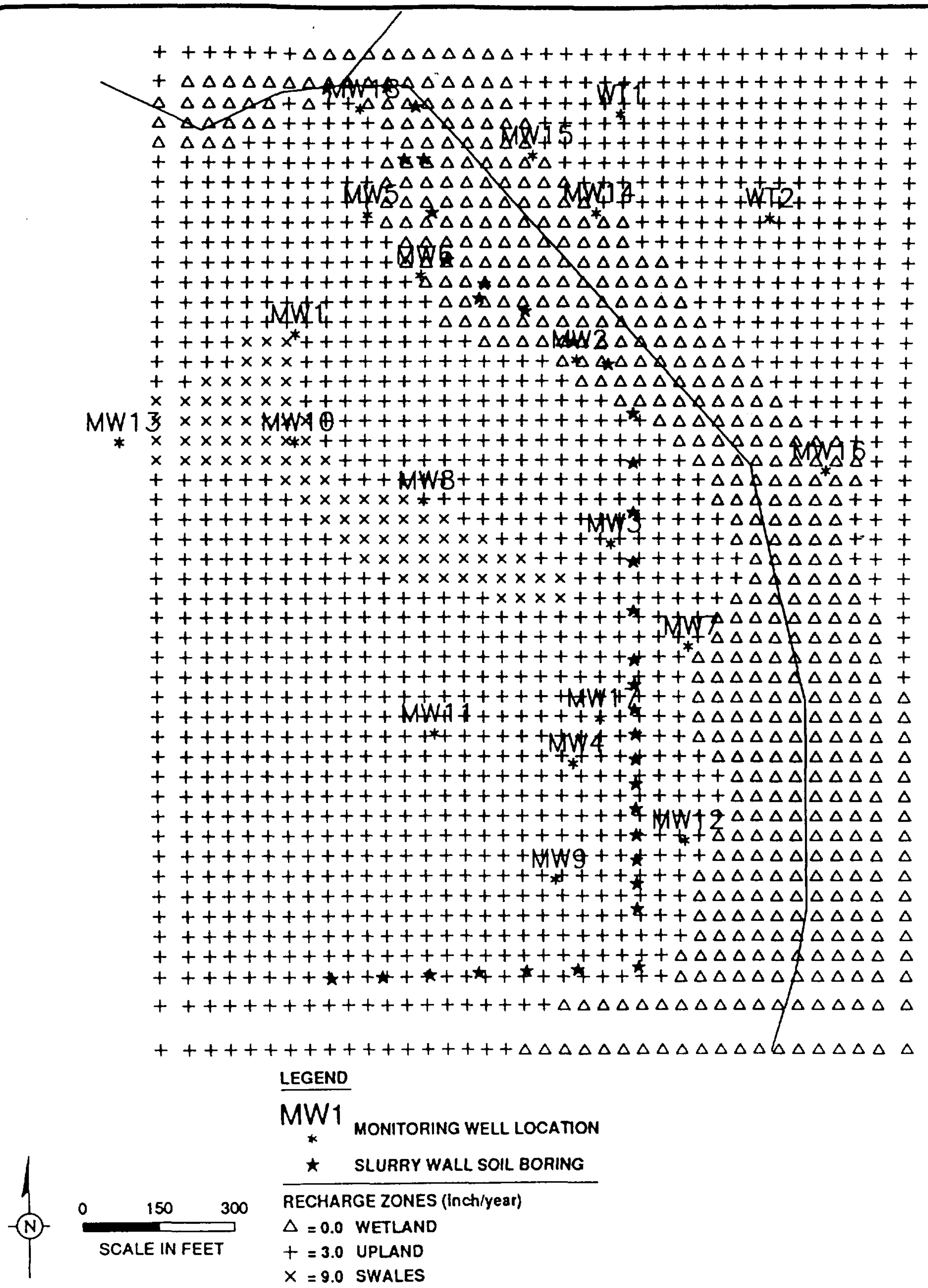
HYDRAULIC CONDUCTIVITY FOR INNER GRID: LAYER 7 (ELEV. 899 - 949)

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-9

DRAFTER: ELS
APPROVED:
CHECKED: DF
DRAWING: 10P/U
FILE NO.: 1641
PRJCT NO.: C10348.004.011
DWG DATE: 02FEB96



LEGEND

MW1 * MONITORING WELL LOCATION

★ SLURRY WALL SOIL BORING

RECHARGE ZONES (inch/year)

△ = 0.0 WETLAND

\+ = 3.0 UPLAND

× = 9.0 SWALES

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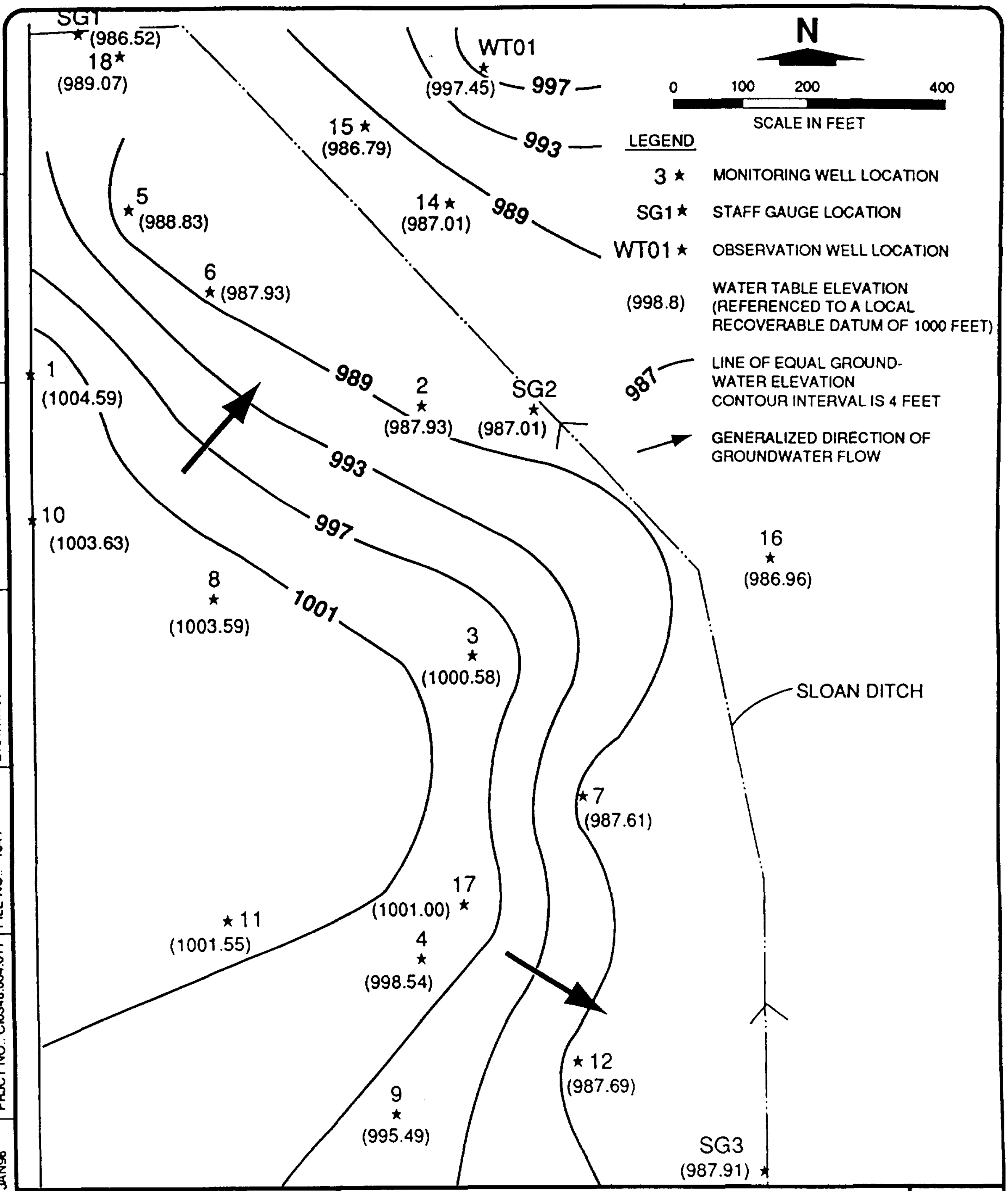
BACKGROUND RECHARGE TO WATER TABLE FOR INNER GRID

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-10



DRAFTER: ELS

APPROVED:

CHECKED: DF

DRAWING: 11

FILE NO.: 1641

PRJCT NO.: CI0348.004.011

DWG DATE: 31JAN96

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WATER TABLE CONFIGURATION
NOVEMBER 16, 1991

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE

A-11

DRAFTER: ELS

APPROVED:

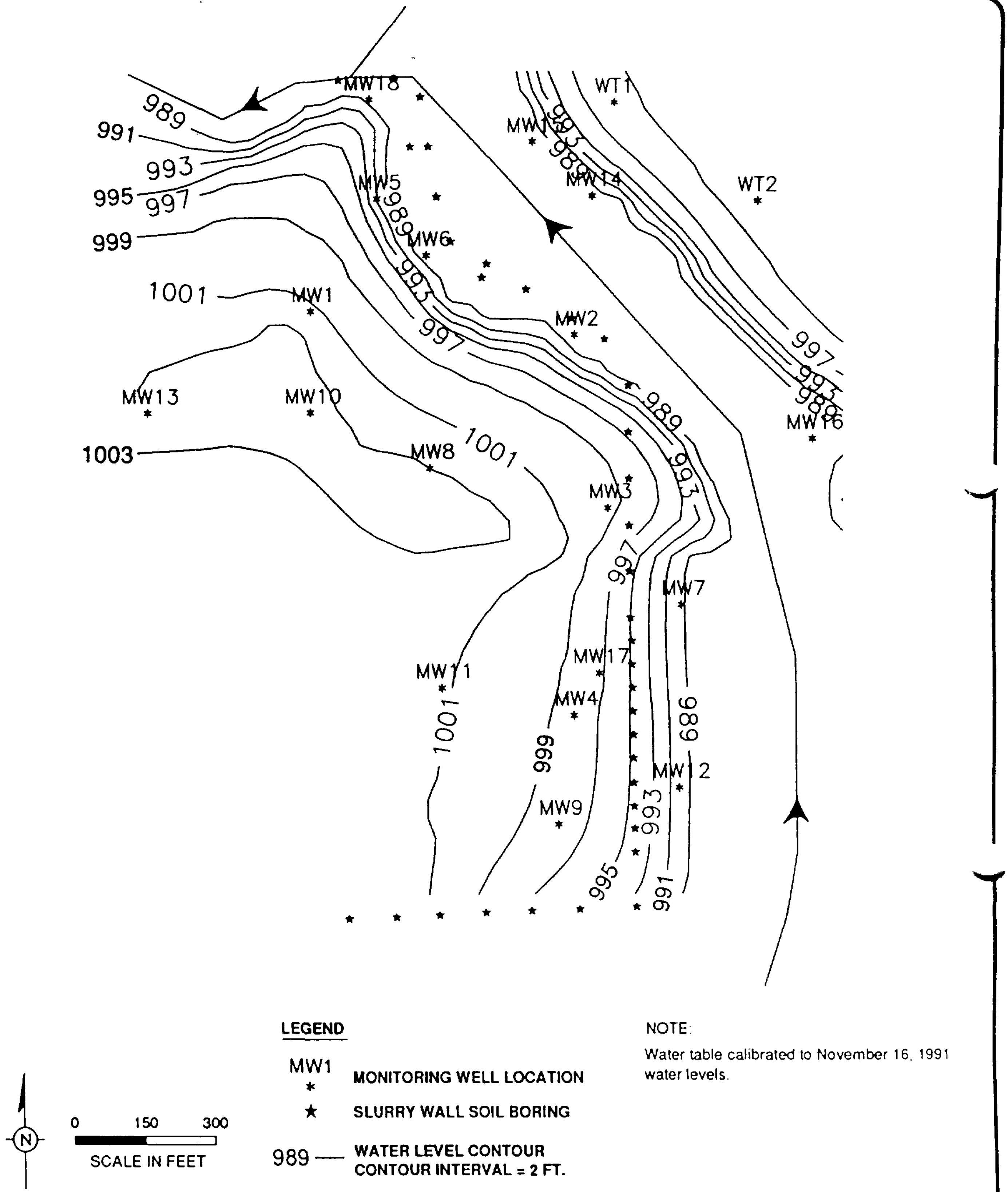
CHECKED: DF

DRAWING: 12P/U

FILE NO.: 1641

PRJCT NO.: CI0348.004.011

DWG DATE: 01FEB96



NOTE:

Water table calibrated to November 16, 1991 water levels.

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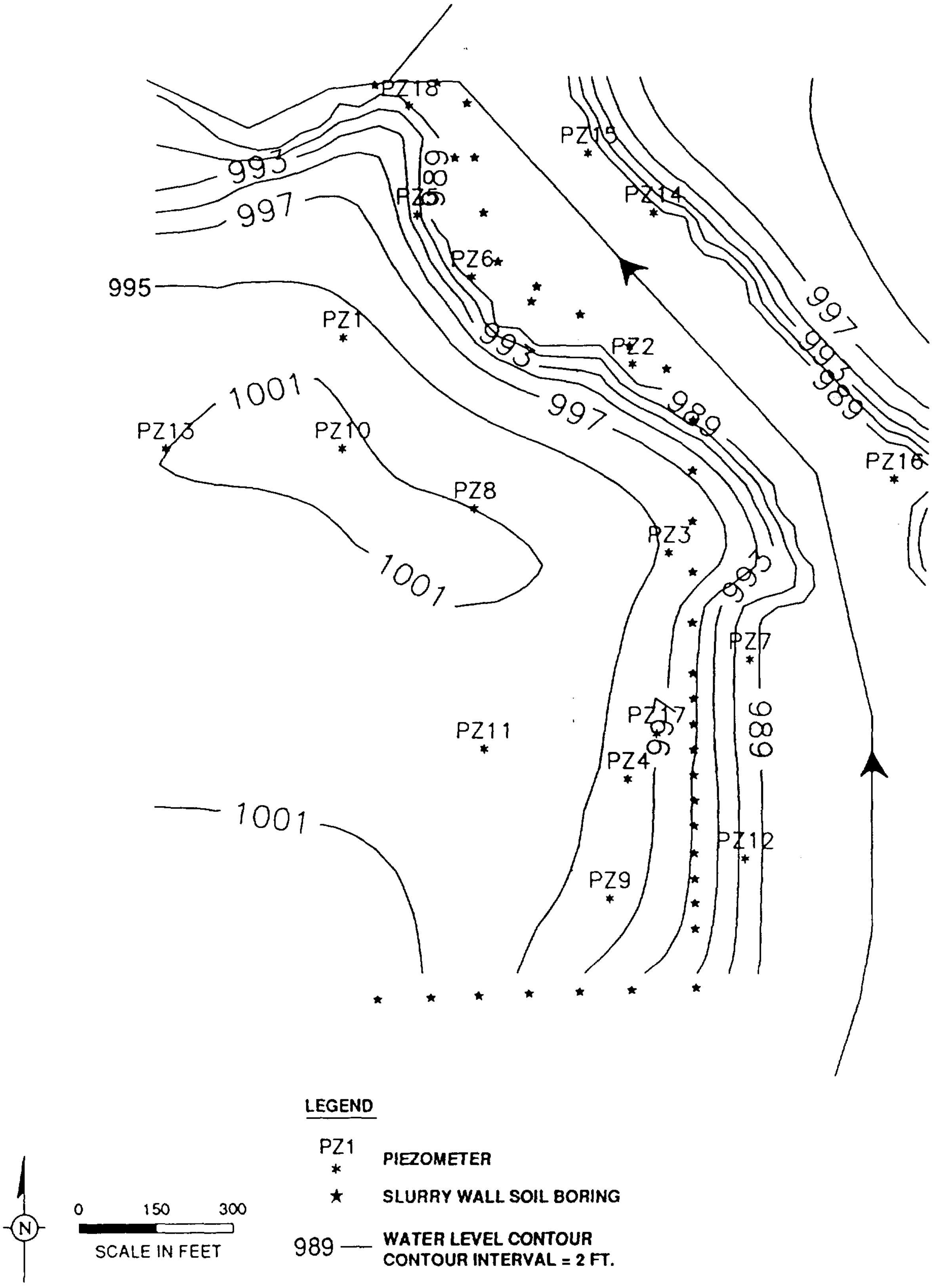
SIMULATED BASELINE WATER TABLE CONFIGURATION

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE

A-12

DRAFTER: ELS
APPROVED:
CHECKED: DF
DRAWING: 13P/U
FILE NO.: 1641
PRJCT NO.: CI0348.004.011
DWG DATE: 09FEB96



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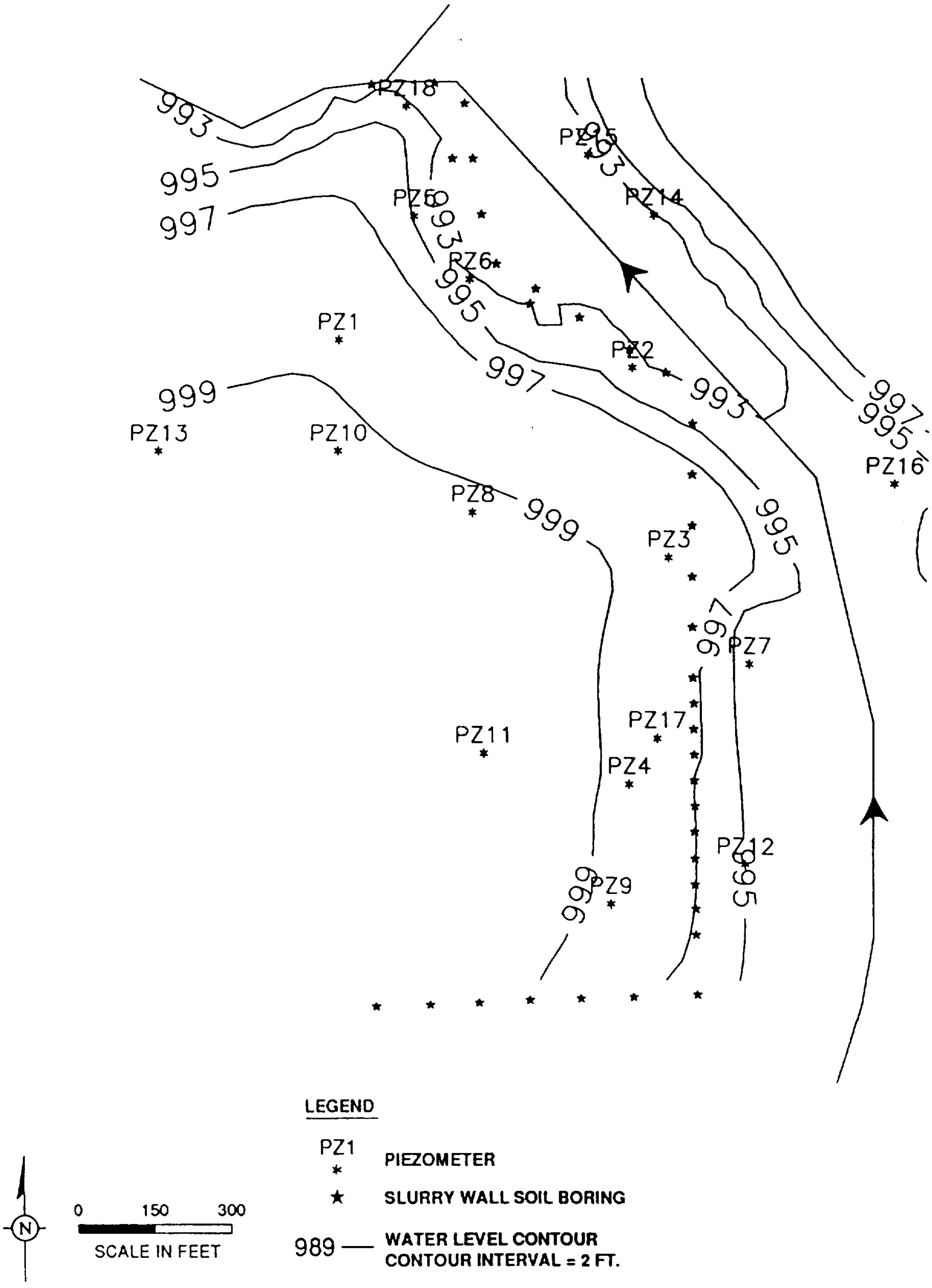
SIMULATED BASELINE
POTENTIOMETRIC SURFACE IN
MODEL LAYER 5 (ELEV. 969 - 979)
REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-13

DRAFTER: ELS | APPROVED: | CHECKED: DF | DRAWING: 14P/U | FILE NO.: 1641 | PRJCT NO.: C10348.004.011 | DWG DATE: 09FEB96



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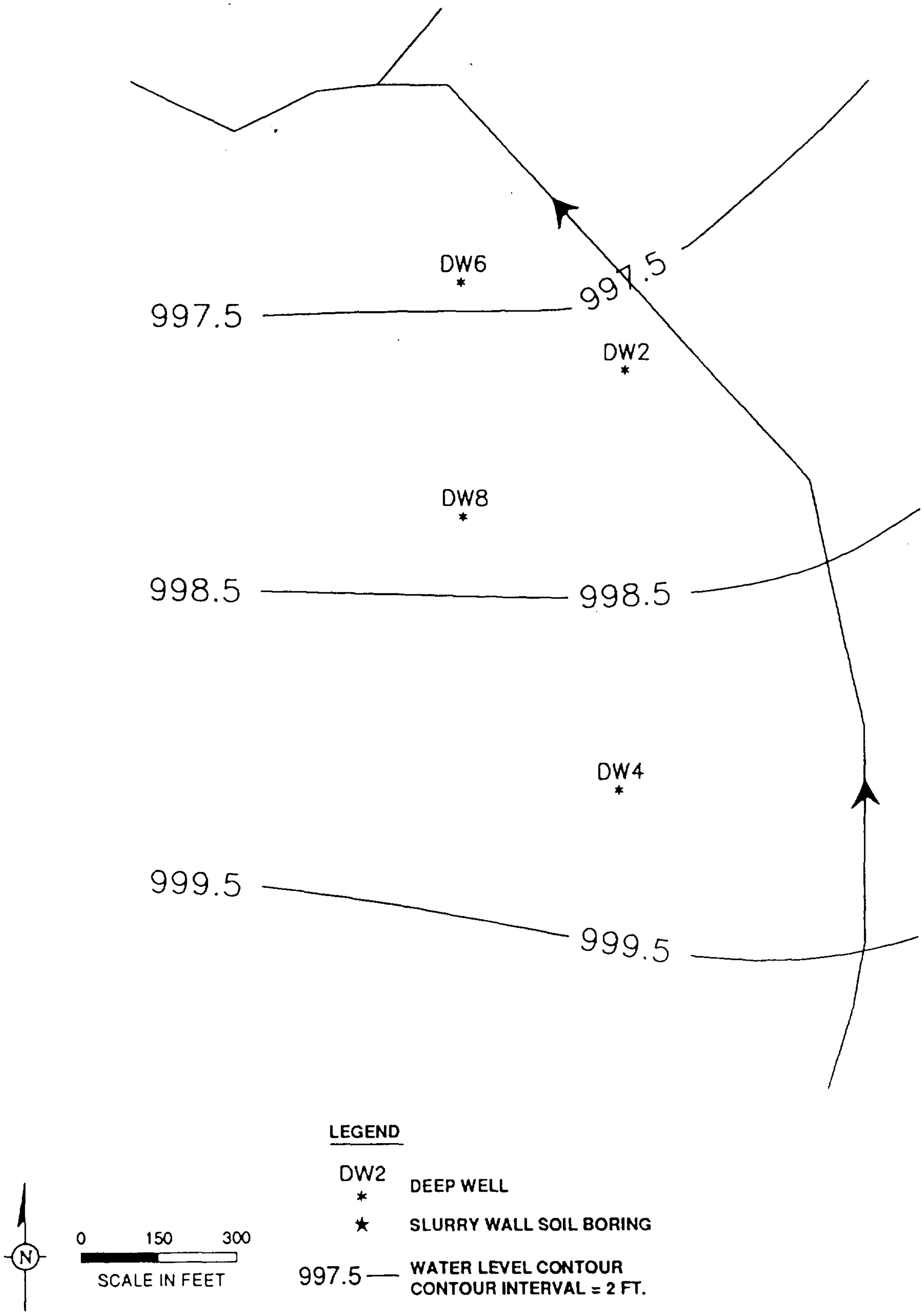
SIMULATED BASELINE POTENTIOMETRIC SURFACE IN MODEL LAYER 6 (ELEV. 949 - 969)

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE

A-14

DRAFTER: ELS
APPROVED:
CHECKED: DF
DRAWING: 15P/J
FILE NO.: 1641
PRJCT NO.: C10348.004.011
DWG DATE: 09FEB96



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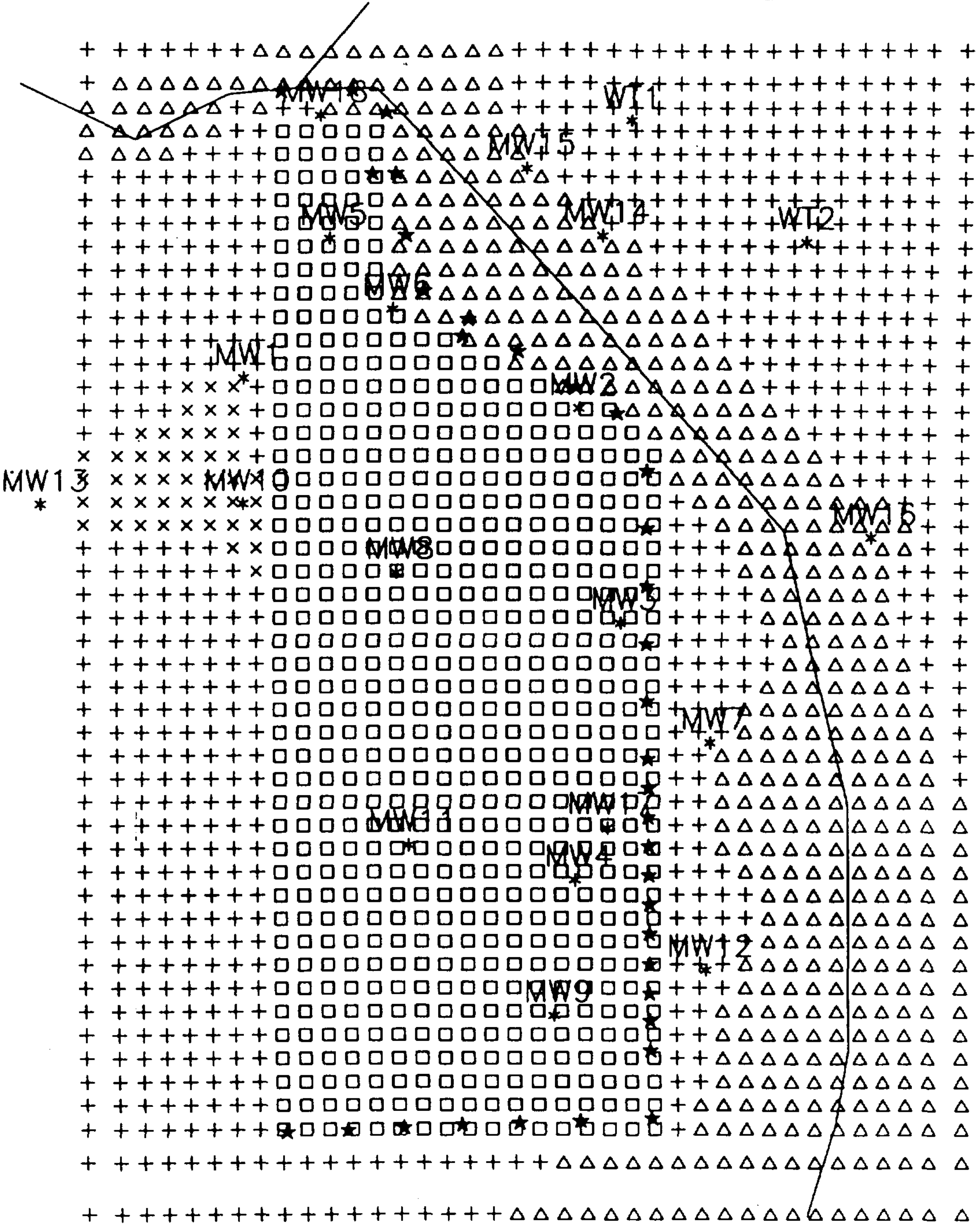
SIMULATED BASELINE POTENTIOMETRIC SURFACE IN MODEL LAYER 7 (ELEV. 899 - 949)

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-15

DRAFTER: ELS
APPROVED:
CHECKED: DF
DRAWING: 16P/U
FILE NO.: 1641
PRJCT NO.: C10348.004.011
DWG DATE: 02FEB96

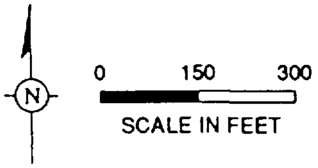


LEGEND

MW1 *	**MONITORING WELL**
★	**SLURRY WALL SOIL BORING**

RECHARGE ZONES (Inch/yr)

△	= 0.0	**WETLAND**
+	= 3.0	**UPLAND**
×	= 9.0	**SWALES**
☐	= 1.0/0.067	**CAPPED AREA**



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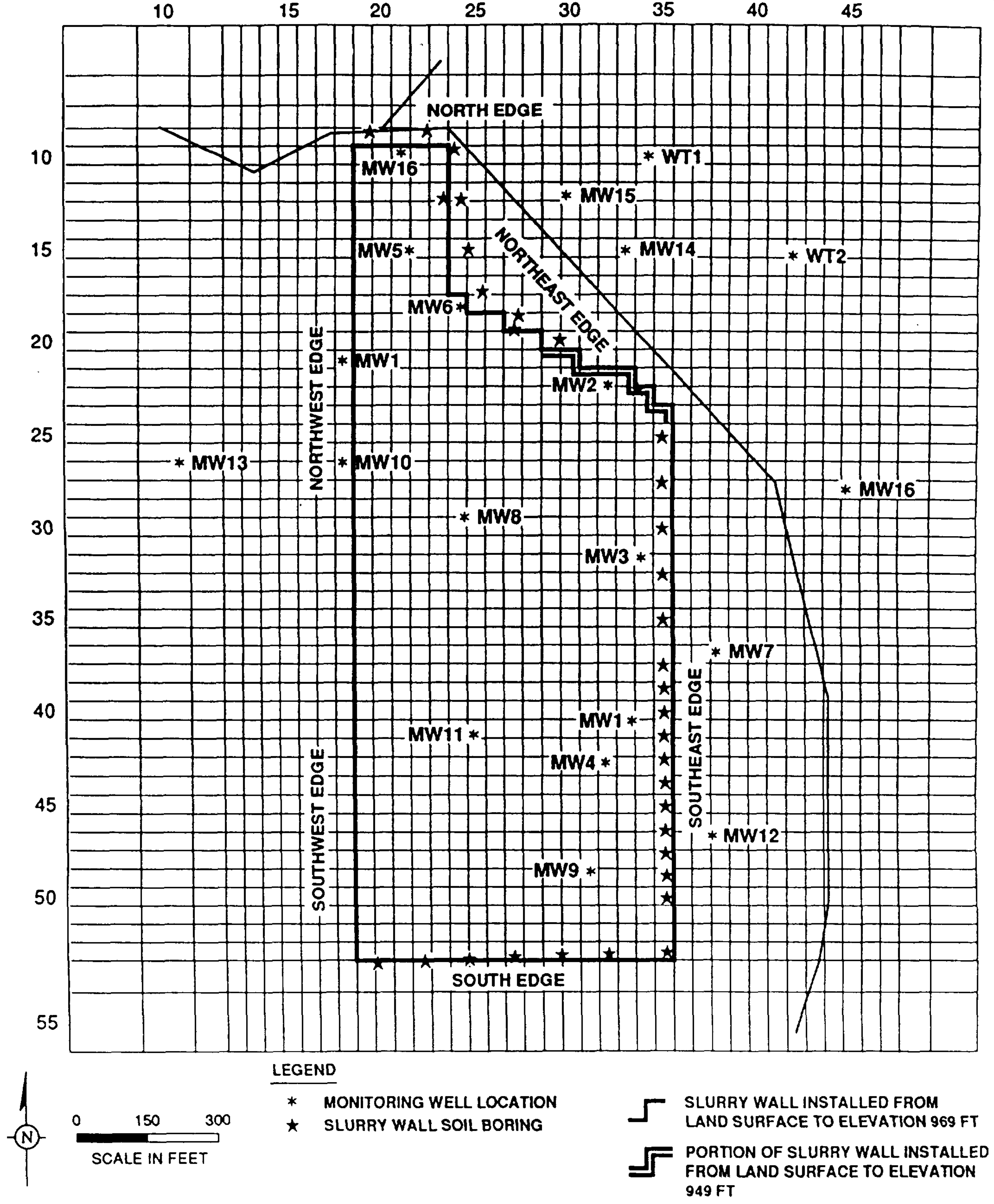
REMEDIAL ELEMENT: RECHARGE TO WATER TABLE IN PRESENCE OF CAP

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-16



DRAFTER: ELS
APPROVED:
CHECKED: DF
DRAWING: 17
FILE NO.: 1641
PRJCT NO.: C10348.004.011
DWG DATE: 09FEB96

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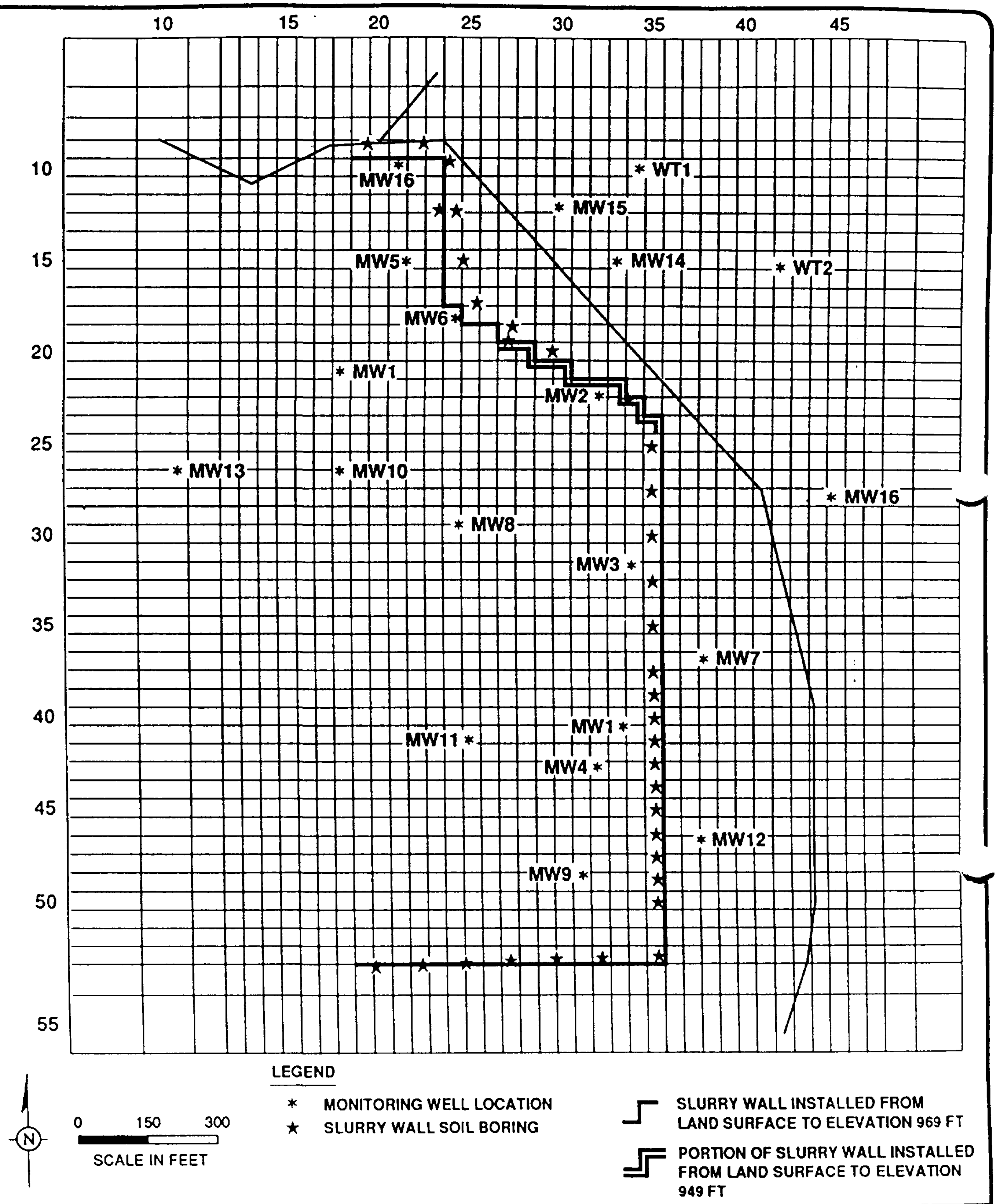
REMEDIAL ELEMENT: TRACE OF SLURRY WALL FULLY ENCLOSING WASTE AREA

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-17

DRAFTER: ELS
APPROVED:
CHECKED: DF
DRAWING: 18
FILE NO.: 1641
PRJCT NO.: C10348.004.011
DWG DATE: 09FEB96



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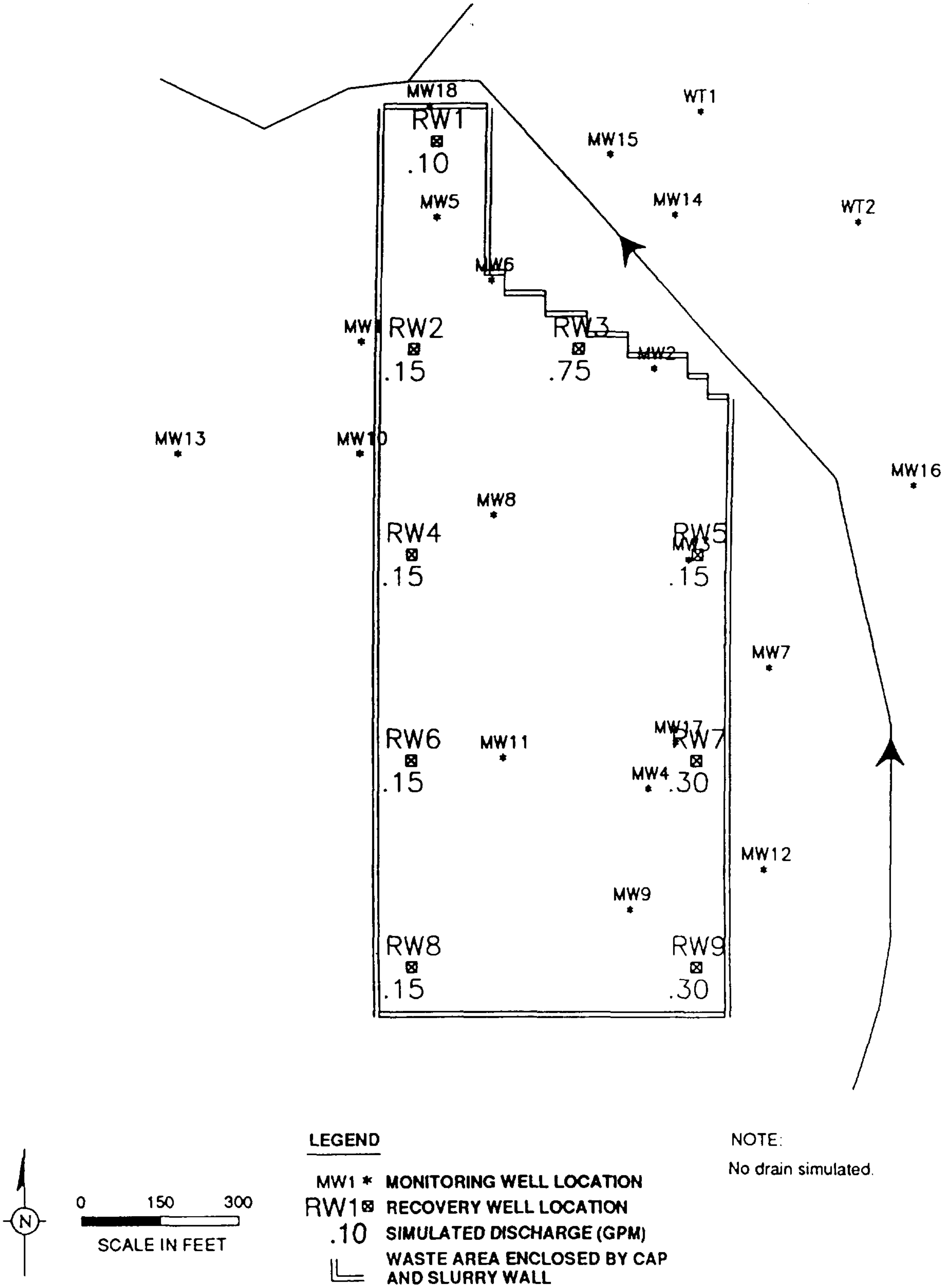
REMEDIAL ELEMENT: TRACE OF SLURRY WALL ENCLOSING NORTH, NORTHEAST, SOUTHEAST AND SOUTH SIDES OF WASTE AREA

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-18

DRAFTER: ELS
APPROVED:
CHECKED: DF
DRAWING: 19P/U
FILE NO.: 1641
PRJCT NO.: C10348.004.011
DWG DATE: 05FEB96



LEGEND

MW1 * **MONITORING WELL LOCATION**
RW1⊠ **RECOVERY WELL LOCATION**
.10 **SIMULATED DISCHARGE (GPM)**
∟ **WASTE AREA ENCLOSED BY CAP AND SLURRY WALL**

NOTE:
No drain simulated.

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REMEDIAL ELEMENT: RECOVERY WELLS

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-19

DRAFTER: ELS

APPROVED:

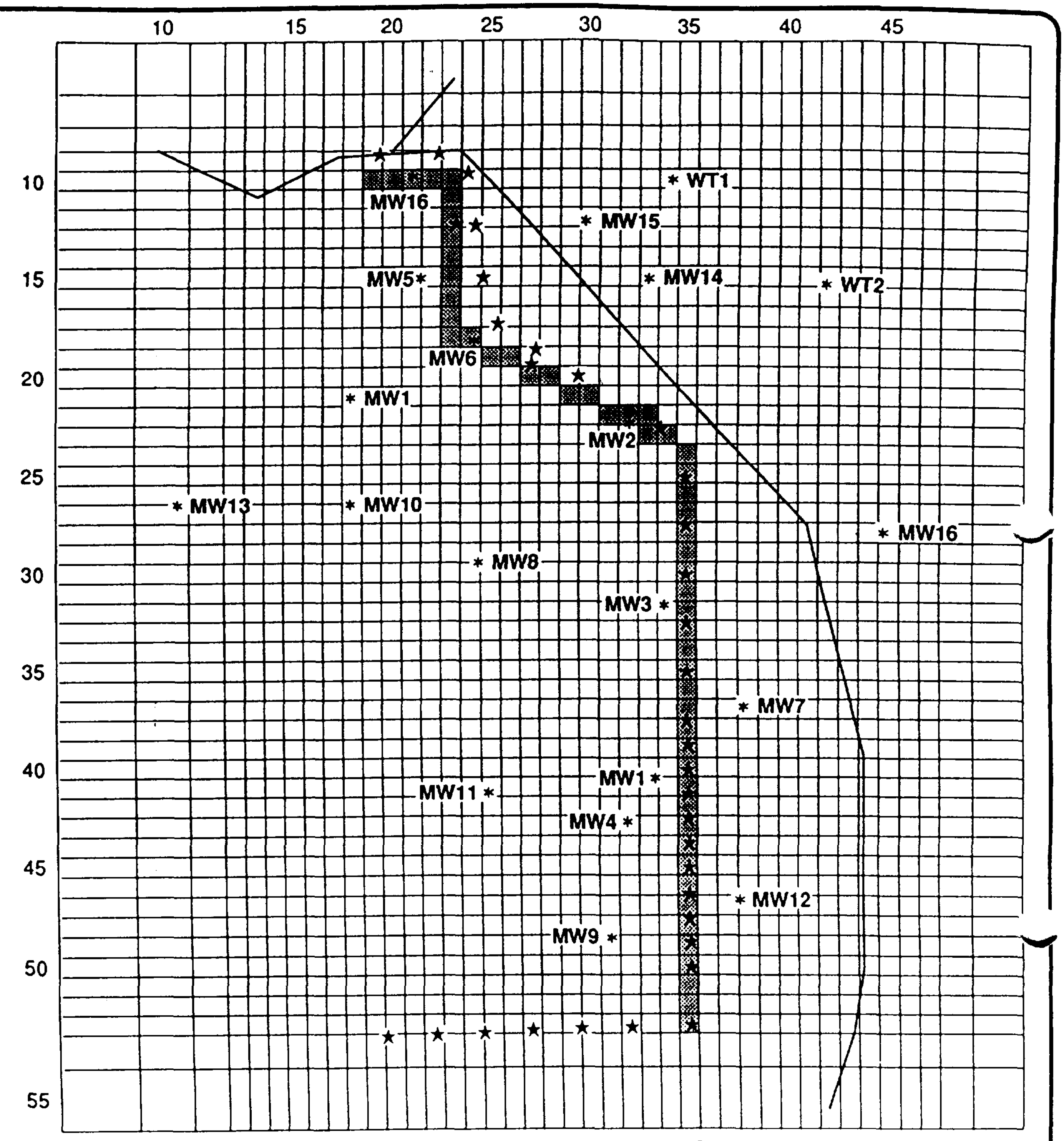
CHECKED: DF

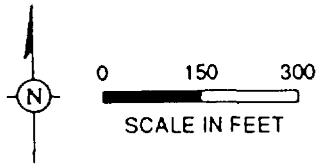
DRAWING: 20

FILE NO.: 1641

PRJCT NO.: CI0348.004.011

DWG DATE: 05FEB96





LEGEND

- * MONITORING WELL LOCATION
- ★ SLURRY WALL SOIL BORING
- ▨ DRAIN

NOTE:

Drain invert simulated at 985 ft elevation.
Drain located along upgradient side of slurry wall.

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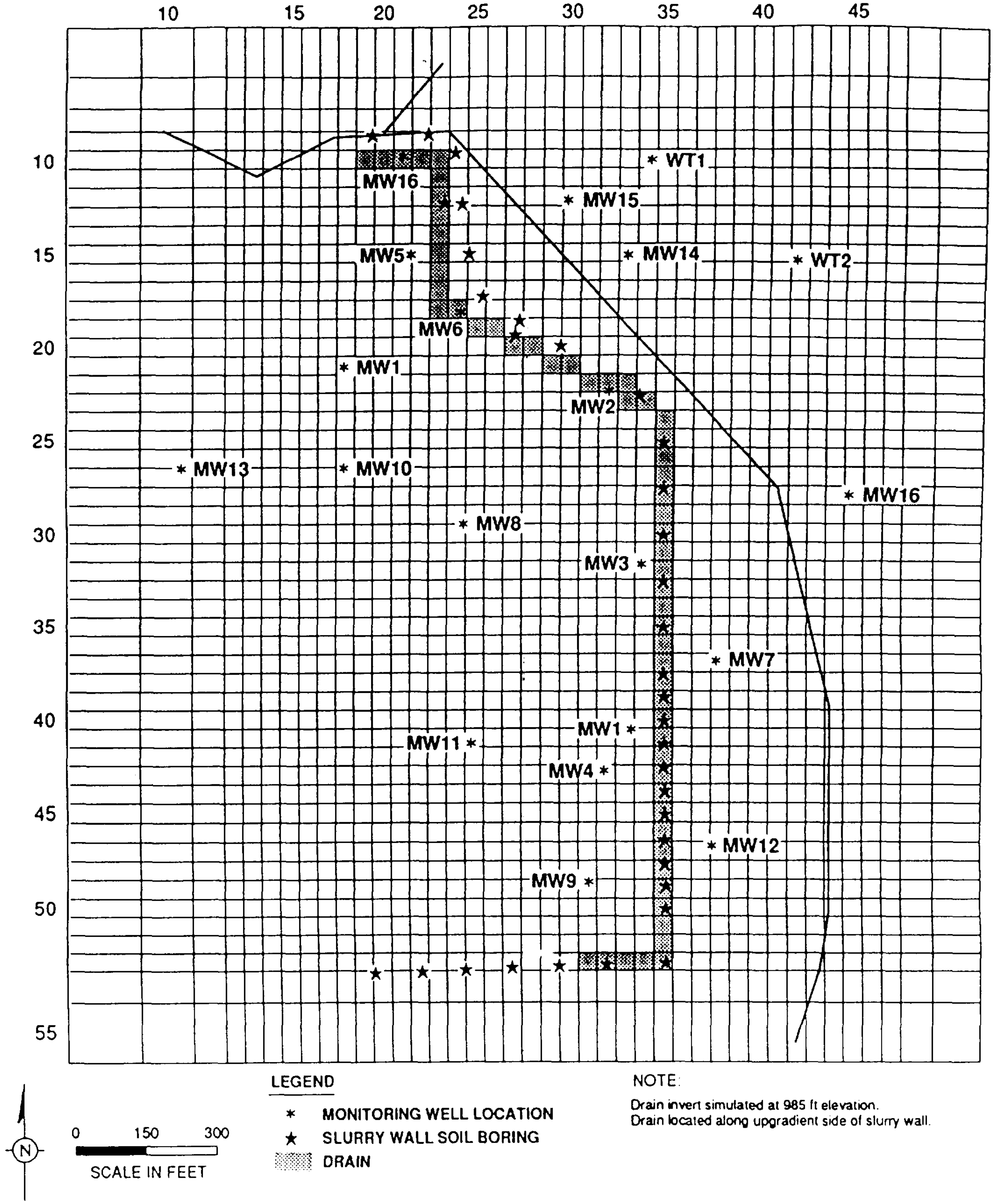
REMEDIAL ELEMENT: COLLECTOR DRAIN ALONG NORTH, NORTHEAST AND SOUTHEAST SIDES OF WASTE AREA

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-20

DRAFTER: ELS
APPROVED:
CHECKED: DF
DRAWING: 21
FILE NO.: 1641
PRJCT NO.: C10348.004.011
DWG DATE: 05FEB96



NOTE:
Drain invert simulated at 985 ft elevation.
Drain located along upgradient side of slurry wall.

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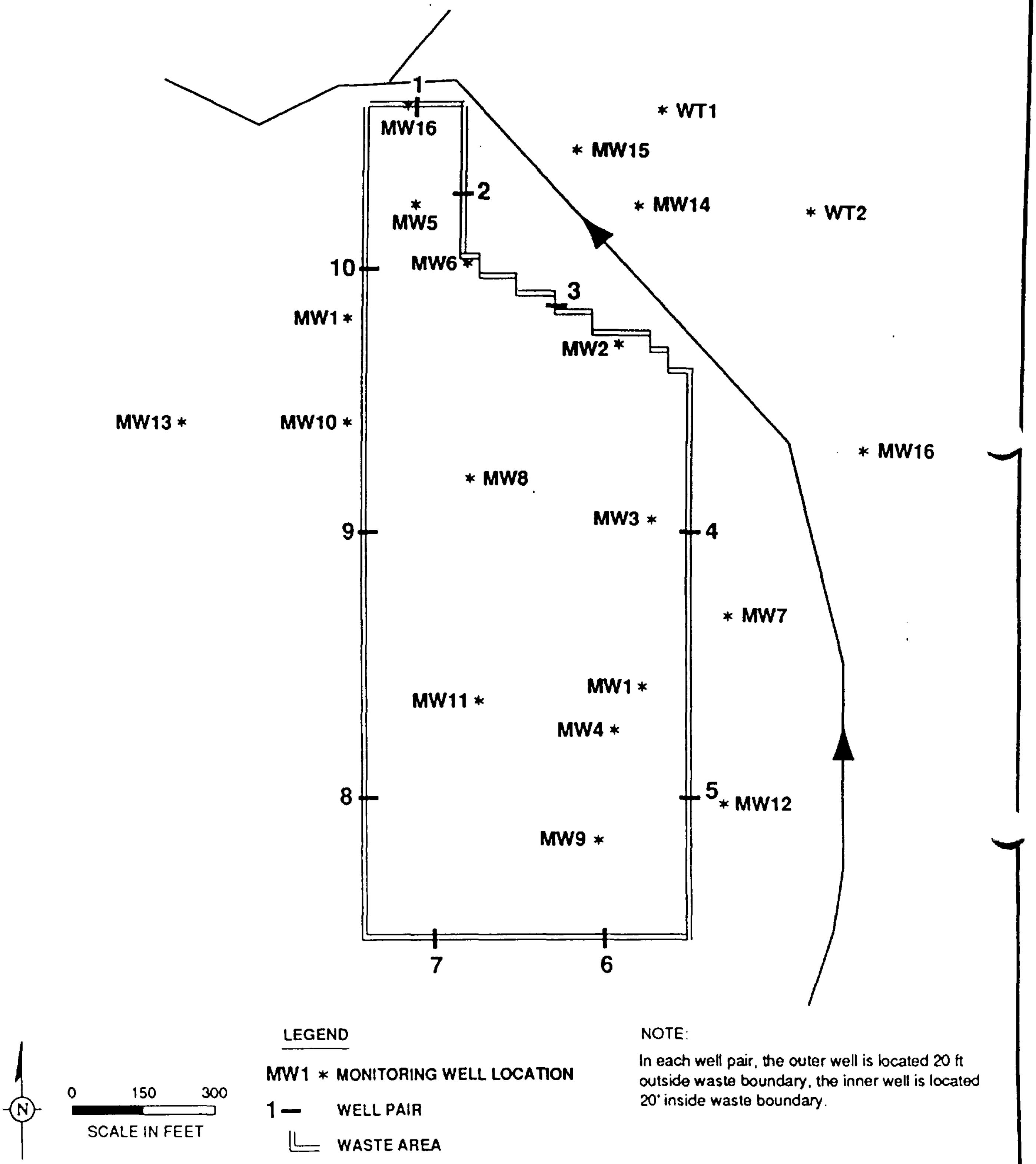
REMEDIAL ELEMENT: COLLECTOR DRAIN ALONG NORTH, NORTHEAST SOUTHEAST AND PART OF SOUTH SIDES OF WASTE AREA

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-21

DRAFTER: ELS
APPROVED:
CHECKED: DF
DRAWING: 22
FILE NO.: 1641
PRJCT NO.: CI0348.004.011
DWG DATE: 09FEB96



NOTE:
In each well pair, the outer well is located 20 ft outside waste boundary, the inner well is located 20' inside waste boundary.

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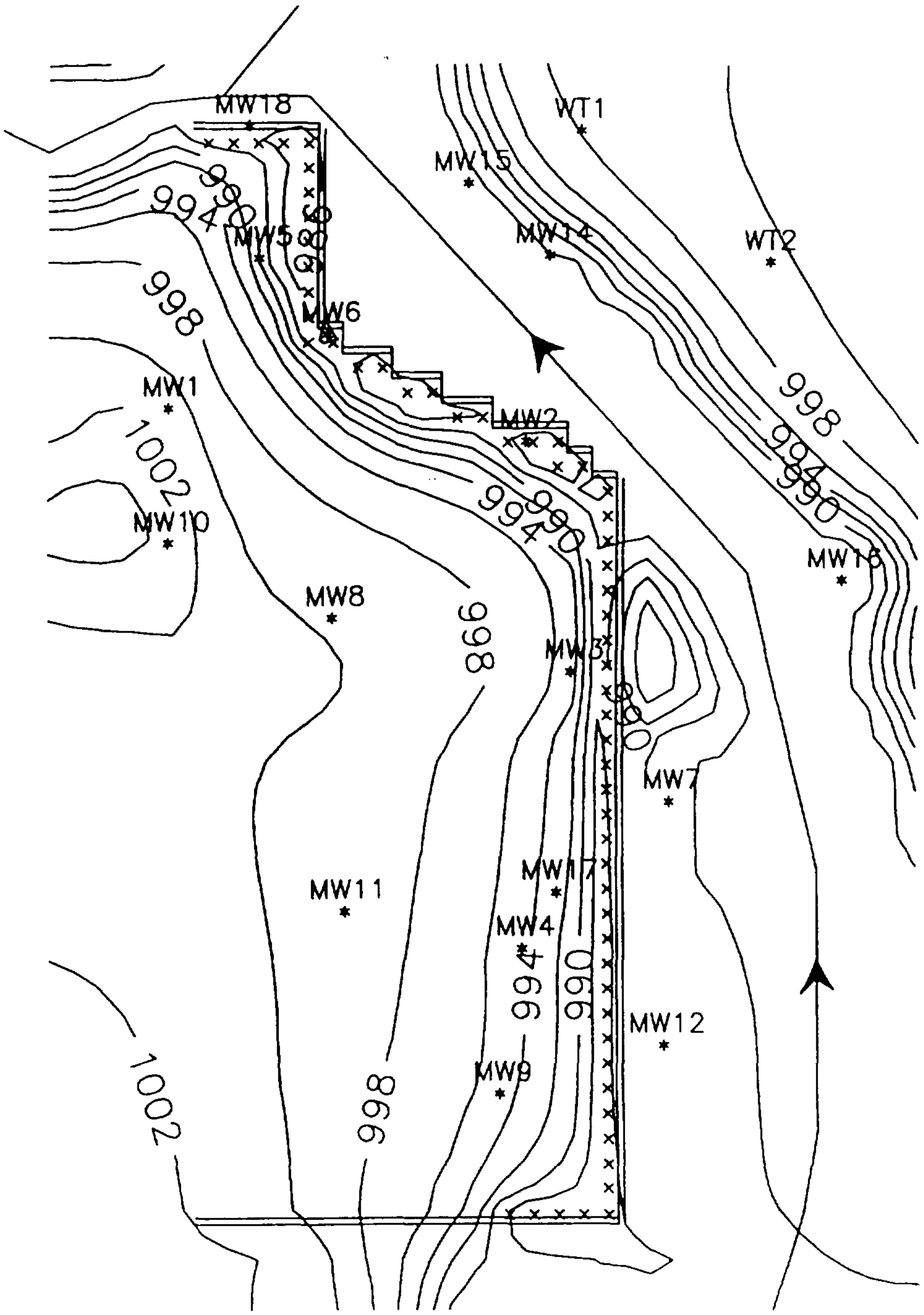
LOCATION OF PAIRS OF WATER TABLE WELLS USED IN GRADIENT CALCULATION

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-22

DRAFTER: ELS | APPROVED: | CHECKED: DF | DRAWING: 23P/U | FILE NO.: 1641 | PRJCT NO.: CI0348.004.011 | DWG DATE: 09FEB96



LEGEND

MW1 * **MONITORING WELL LOCATION**

998 — **SIMULATED WATER TABLE CONTOUR CONTOUR INTERVAL = 2 FT**

WASTE AREA ENCLOSED BY CAP AND SLURRY WALL

x x x **DRAIN LOCATION**

0 150 300
SCALE IN FEET

N

NOTE:

Slurry wall along north, northeast, southeast and south sides.
Cap infiltration = 0.067 inch/yr.
Drain invert at 985 ft.
No recovery wells.

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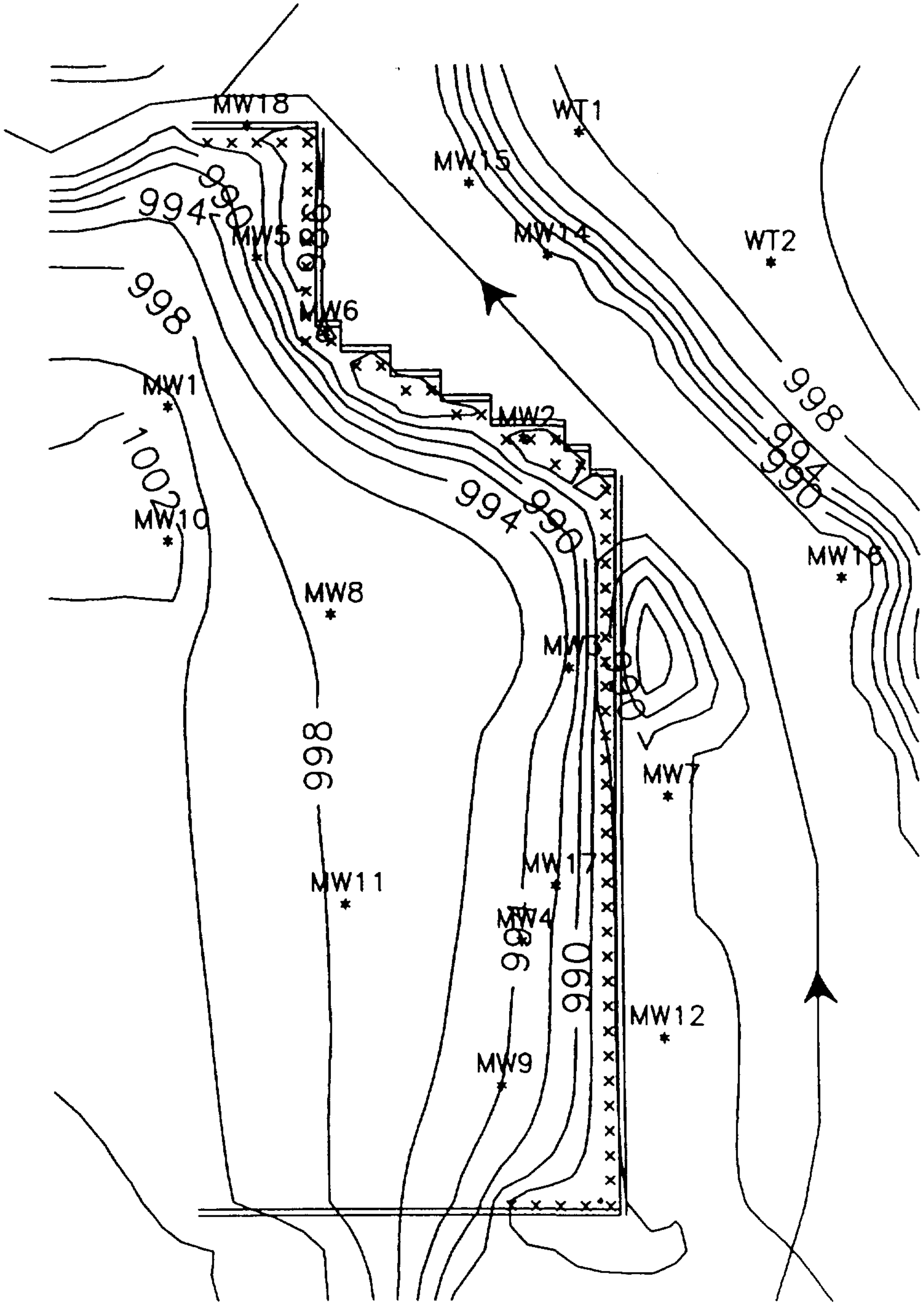
DESIGN #8: SIMULATED WATER TABLE AFTER 1 YEAR OF REMEDIATION

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-23

DRAFTER: ELS | APPROVED: | CHECKED: DF | DRAWING: 24P/J | FILE NO.: 1641 | PRJCT NO.: C10348.004.011 | DWG DATE: 09FEB96



LEGEND

MW1 * **MONITORING WELL LOCATION**

998 — **SIMULATED WATER TABLE CONTOUR CONTOUR INTERVAL = 2 FT**

WASTE AREA ENCLOSED BY CAP AND SLURRY WALL

x x x **DRAIN LOCATION**

N

0 150 300

SCALE IN FEET

NOTE:

Slurry wall along north, northeast, southeast and south sides.
Cap infiltration = 0.067 inch/yr.
Drain invert at 985 ft.
No recovery wells.

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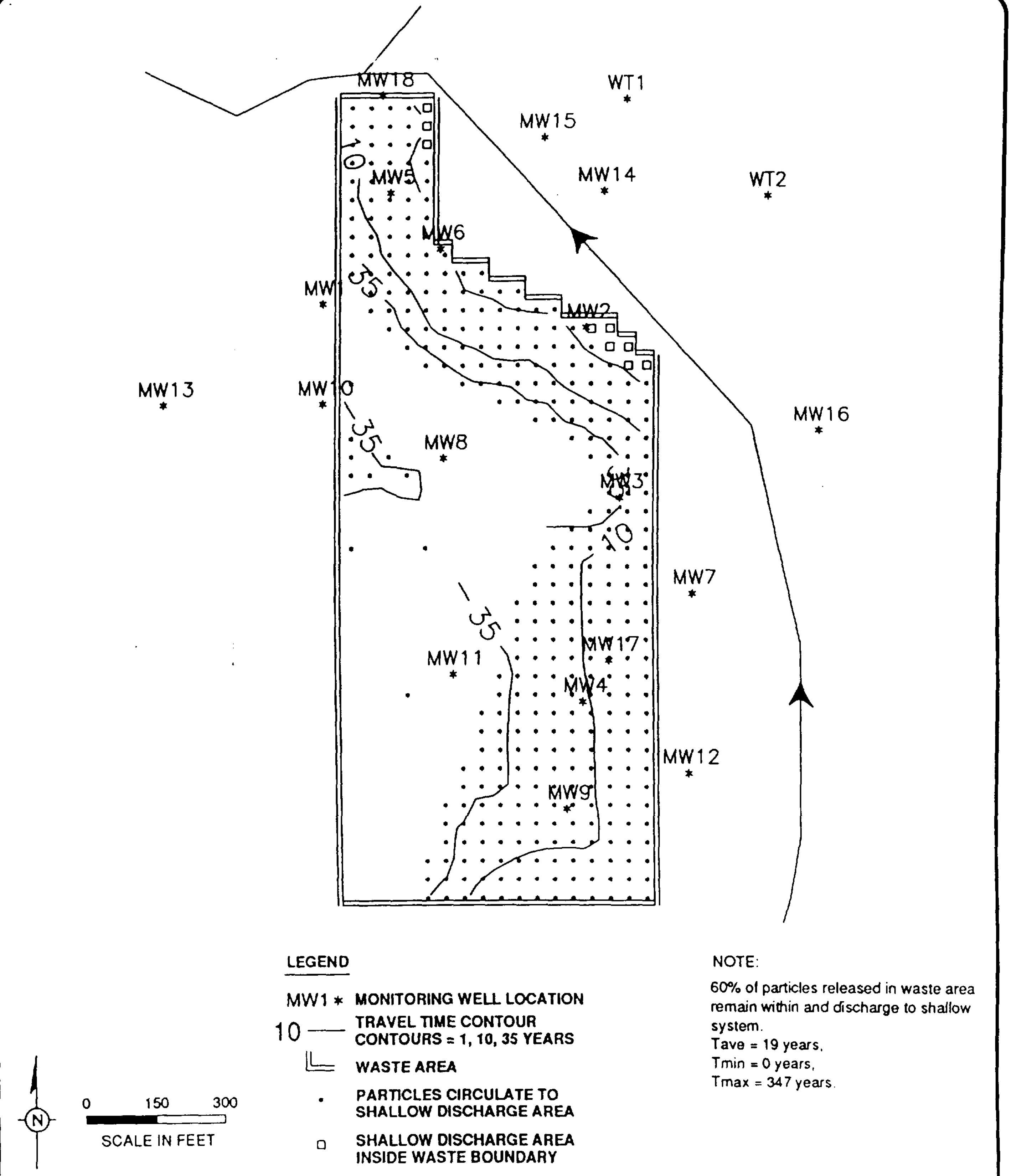
DESIGN #8: SIMULATED WATER TABLE AFTER 10 YEARS OF REMEDIATION

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE

A-24

DWG DATE: 09FEB96 | PRJCT NO.: CI0348.004.011 | FILE NO.: 1841 | DRAWING: 25P/U | CHECKED: DF | APPROVED: | DRAFTER: ELS



NOTE:

60% of particles released in waste area remain within and discharge to shallow system.
Tave = 19 years,
Tmin = 0 years,
Tmax = 347 years.

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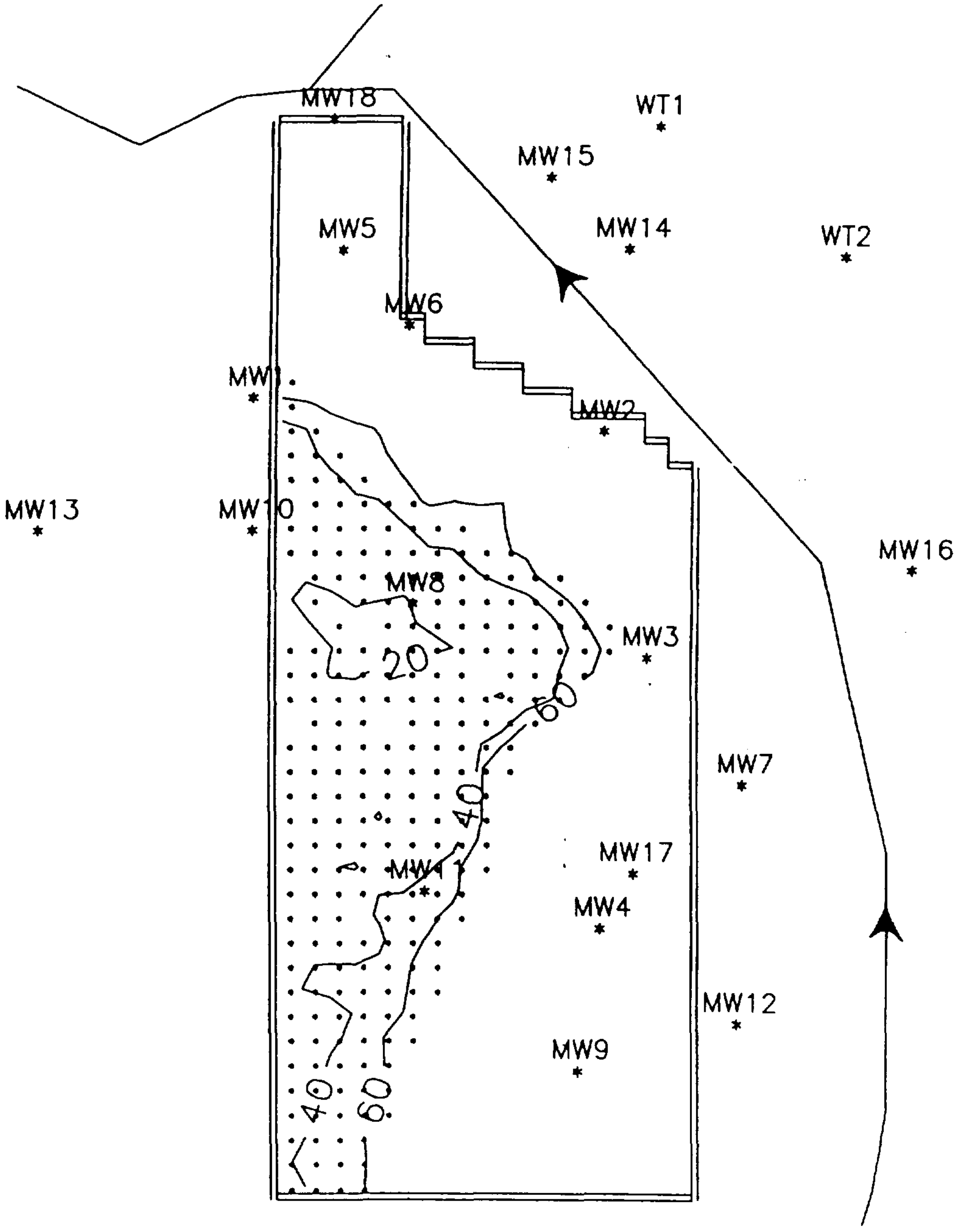
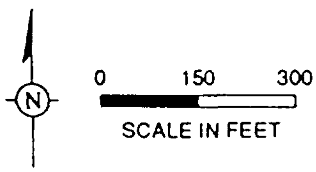
SIMULATED BASELINE CONDITIONS SHALLOW CIRCULATION AND CAPTURE OF GROUNDWATER FOR PARTICLES RELEASED FROM ELEVATION 989.5 FT

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-25

DRAFTER: ELS
APPROVED:
CHECKED: DF
DRAWING: 26P/J
FILE NO.: 1641
PRJCT NO.: CI0348.004.011
DWG DATE: 09FEB96





LEGEND

MW1 * MONITORING WELL LOCATION

10 —— TRAVEL TIME CONTOUR
CONTOURS = 20, 40, 60 YEARS

∟ WASTE AREA

• PARTICLES LEAK TO DEEP AQUIFER

NOTE:

40% of particles released from waste area circulate to deep aquifer.
Tave = 40 years,
Tmin = 14 years,
Tmax = 213 years.

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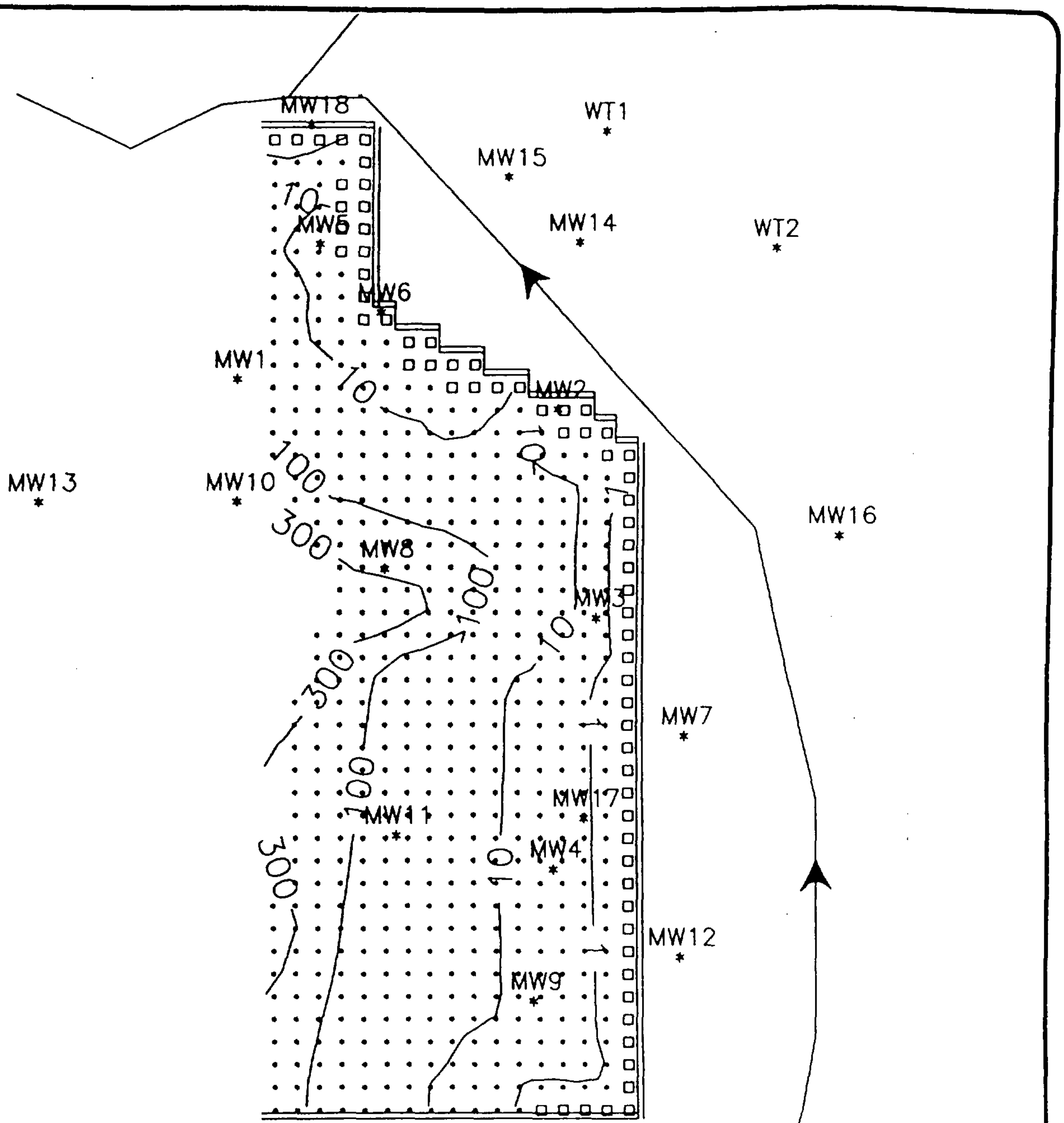
SIMULATED BASELINE CONDITIONS
DEEP AQUIFER CAPTURE OF GROUNDWATER
FOR PARTICLES RELEASED FROM ELEVATION 989.5 FT

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-26

DRAFTER: ELS | APPROVED: | CHECKED: DF | DRAWING: 27P/U | FILE NO.: 1641 | PRJCT NO.: C10348.004.011 | DWG DATE: 09FEB96



LEGEND

MW1 * **MONITORING WELL LOCATION**

10 —— **TRAVEL TIME CONTOUR**
CONTOURS = 1, 10, 100, 300 YEARS

WASTE AREA BOUNDARY WITH SLURRY WALL

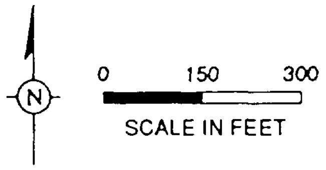
WASTE AREA BOUNDARY WITH SLURRY WALL AND DRAIN

• **PARTICLES CIRCULATE TO SURFACE DISCHARGE AREA**

□ **SHALLOW DISCHARGE AREA INSIDE WASTE BOUNDARY**

NOTE:

95% of particles released in waste area remain within and discharge to shallow system.
Tave = 66 years,
Tmin = 0 years,
Tmax = 1000 years.



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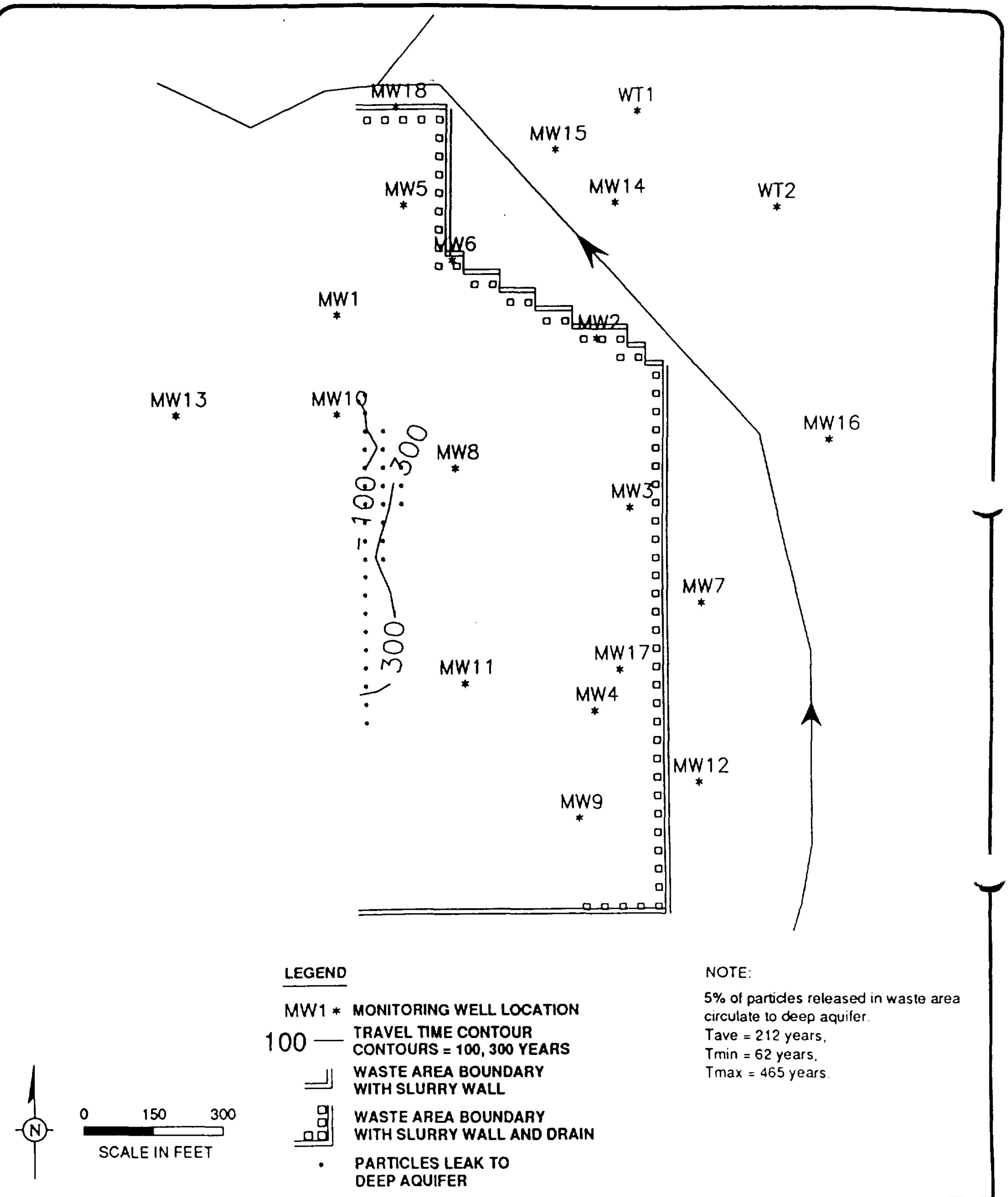
SURFACE CIRCULATION OF GROUNDWATER UNDER DESIGN #8 - PARTICLES RELEASED FROM ELEVATION 989.5 FT CAP WITH GEOMEMBRANE (INFILTRATION = 0.067 INCH/YR) SLURRY WALL ABSENT ALONG WEST SIDE

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-27

DRAFTER: ELS
APPROVED:
CHECKED: DF
DRAWING: 28P/J
FILE NO.: 1641
PRJCT NO.: C10348.004.011
DWG DATE: 09FEB96



NOTE:

5% of particles released in waste area circulate to deep aquifer.
Tave = 212 years,
Tmin = 62 years,
Tmax = 465 years.

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DEEP AQUIFER CAPTURE OF GROUNDWATER FROM WASTE DESIGN #8 - PARTICLES RELEASED FROM ELEVATION 989.5 FT CAP WITH GEOMEMBRANE (INFILTRATION = 0.067 INCH/YR) SLURRY WALL ABSENT ALONG WEST SIDE

REMEDIAL DESIGN
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

FIGURE
A-28

APPENDIX B

APPENDIX B-1

COVER SYSTEM CONSTRUCTION DRAWINGS

LAKELAND DISPOSAL LANDFILL
CLAYPOOL, INDIANA

PRELIMINARY DESIGN DRAWINGS
COVER SYSTEM

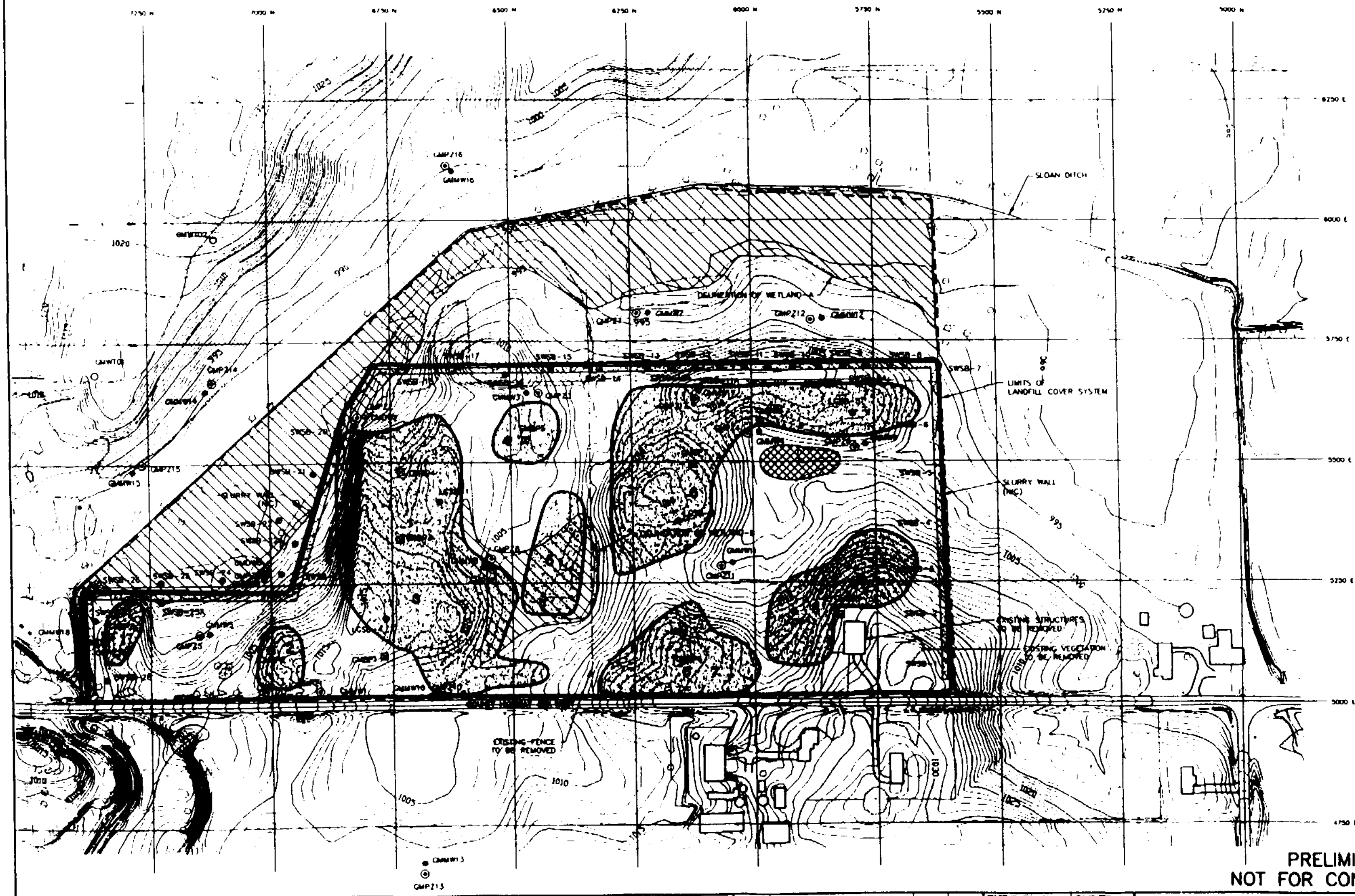
Prepared by:

GERAGHTY
& MILLER, INC.
Environmental Services
A Heidemij Company

CONSTRUCTION DRAWING LIST

DRAWING NO. 1	EXISTING CONDITIONS/SITE LAYOUT
DRAWING NO. 2	SUBBASE GRADING PLAN (NORTH)
DRAWING NO. 3	SUBBASE GRADING PLAN (SOUTH)
DRAWING NO. 4	FINAL GRADING PLAN (NORTH)—To be included in next submittal.
DRAWING NO. 5	FINAL GRADING PLAN (SOUTH)—To be included in next submittal.
DRAWING NO. 6	SECTIONS AND DETAILS
DRAWING NO. 7	SECTIONS AND DETAILS—To be included in next submittal.

PRELIMINARY
NOT FOR CONSTRUCTION



100 0 100 200

SCALE IN FEET

LEGEND

- ● PRE DESIGN SOIL BORING/NUMBER
- ● MONITORING WELL/NUMBER
- ⊗ DEEP WELL/NUMBER
- ⊙ PIEZOMETER/NUMBER
- ○ WATER TABLE WELL/NUMBER
- ⊠ BACKHOE TEST PIT/NUMBER (REMEDIAL INVESTIGATION)
- (NIC) NOT IN CONTRACT
- EXISTING VEGETATION
- EXISTING FENCE
- EXISTING STORMWATER DITCH
- SITE BOUNDARY
- LIMITS OF LANDFILL COVER SYSTEM
- SLURRY WALL
- ▨ DELINEATED WETLAND AREA
- ▩ LIMITS OF POTENTIAL WETLAND AREA
- (1) DISPOSAL AREA LIMITS AND DESIGNATION

GENERAL NOTES

1. COVER SYSTEM SHALL EXTEND A MINIMUM OF 10 FEET BEYOND SLURRY WALL EXCEPT ALONG NORTHERN BOUNDARY (BY SWSB-27 AND SWSB-28) WHERE COVER SYSTEM SHALL EXTEND 5 FEET BEYOND SLURRY WALL
2. TOPOGRAPHIC MAP COMPILED BY DICKERSON AERIAL SURVEYS INC USING STEREOPHOTOGRAMMETRIC METHOD. PHOTOGRAPHY OBTAINED MAY 8 1989
3. INDICATED ELEVATIONS ARE REFERENCED TO THE LOCALLY RECOVERABLE DATUM OF 1,000 FEET. TO OBTAIN MEAN SEA LEVEL ELEVATION, SUBTRACT 162.6 FEET

PRELIMINARY
NOT FOR CONSTRUCTION

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DRAWING CONFIDENTIAL. THIS DRAWING AND ALL INFORMATION CONTAINED THEREON IS AND SHALL REMAIN THE PROPERTY OF GERAGHTY & MILLER, INC. AS AN INSTRUMENT OF PROFESSIONAL SERVICE. THIS INFORMATION SHALL NOT BE USED IN WHOLE OR IN PART WITHOUT THE FULL KNOWLEDGE AND PRIOR WRITTEN CONSENT OF GERAGHTY & MILLER, INC.

SCALE VERIFICATION
THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING.
USE TO VERIFY FIGURE REPRODUCTION SCALE

REV NO	DATE	DESCRIPTION	BY	APPR.

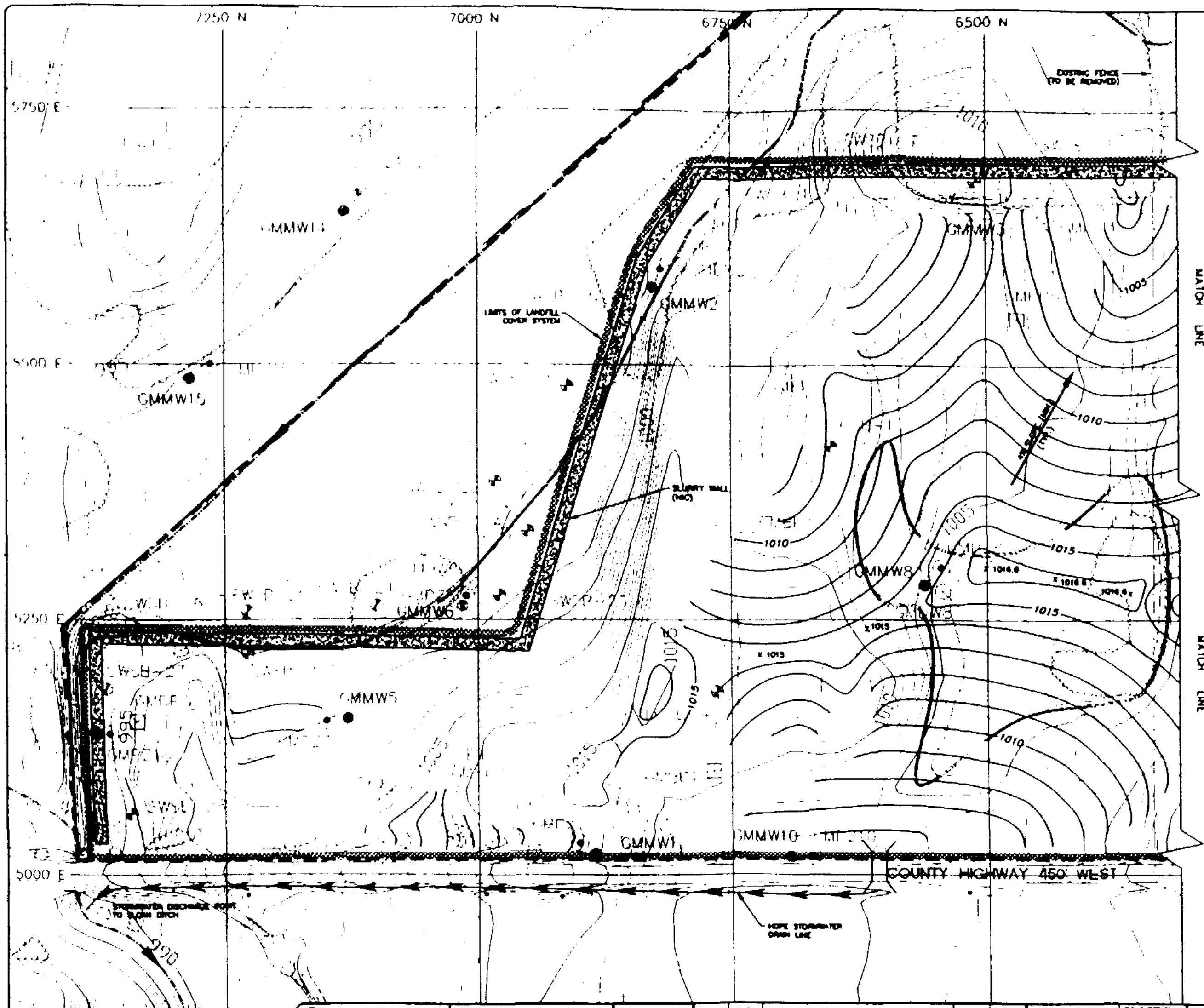
PROJECT NO. [illegible]
DRAWING NO. [illegible]
FILE NO. [illegible]
PLOT SCALE [illegible]
DRAFTED BY | DATE
CHECKED BY | DATE
APPROVED BY | DATE
LAST REVISION BY | DATE

EXISTING CONDITIONS/SITE LAYOUT

COVER SYSTEM

LAKELAND DISPOSAL
CLAYPOOL, INDIANA

DRAWING NO
1



50 0 50 100

SCALE IN FEET

DRAWING KEY:

LEGEND.

x 1016.6	SPOT ELEVATION
995	EXISTING CONTOUR
1015	SUBBASE CONTOUR
▨	SLURRY WALL
▨	LIMITS OF LANDFILL COVER SYSTEM
←	EXISTING STORMWATER DITCH
)(	CULVERT
←	STORMWATER DITCH

NOTES

1 SEE DRAWING NO 1 FOR GENERAL NOTES AND LEGEND

PRELIMINARY
NOT FOR CONSTRUCTION

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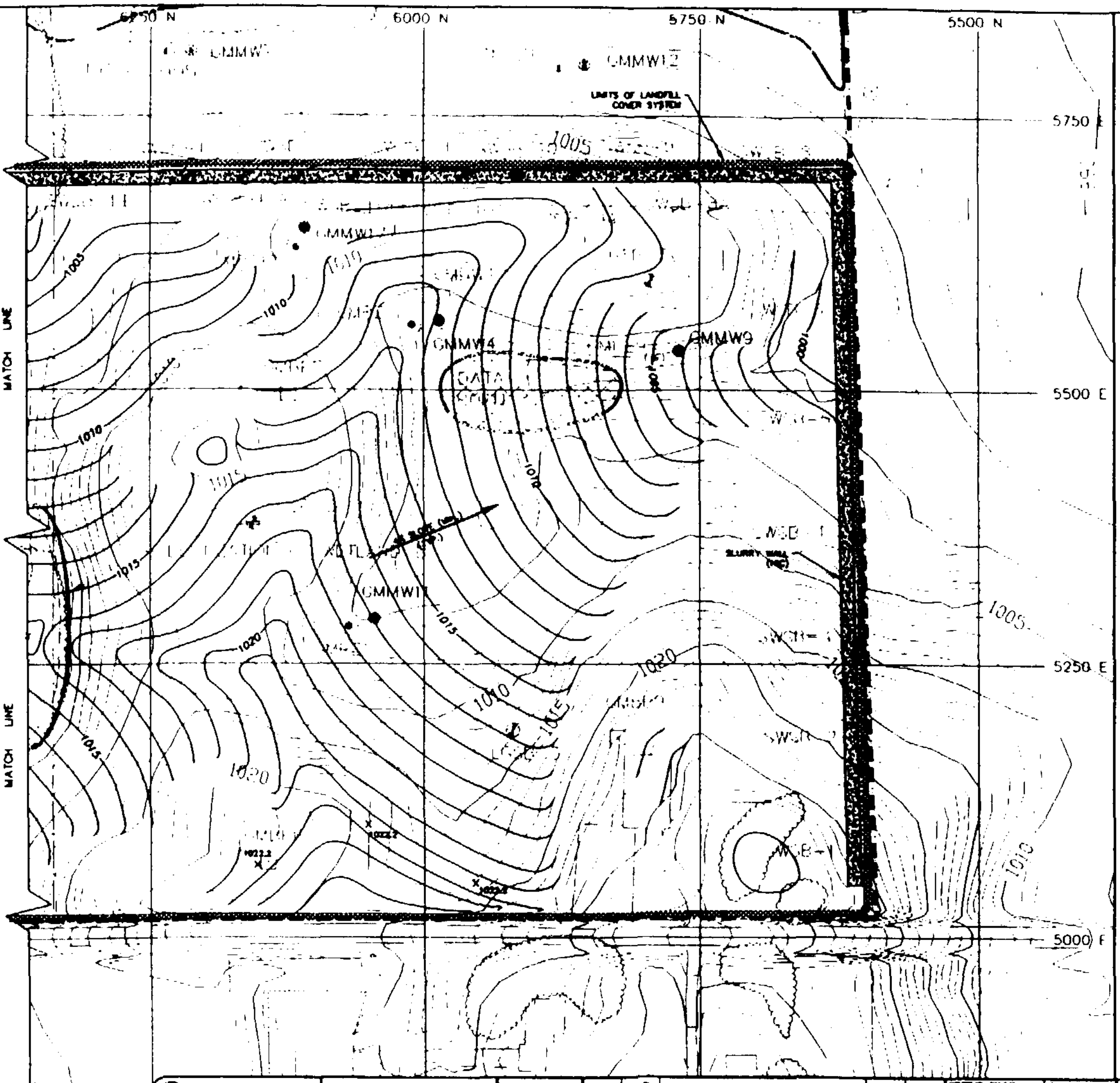
DRAWING CONFIDENTIAL

SCALE VERIFICATION

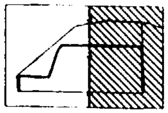
REV NO	DATE	DESCRIPTION	BY	APPR

SUBBASE GRADING PLAN (NORTH)
COVER SYSTEM
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

DRAWING NO
2



DRAWING KEY:



LEGEND:

x 1016.6	SPOT ELEVATION
--- 995 ---	EXISTING CONTOUR
— 1015 —	SUBBASE CONTOUR
▨	SLURRY WALL
▬	LIMITS OF LANDFILL COVER SYSTEM

NOTES:

1. SEE DRAWING NO. 1 FOR GENERAL NOTES AND LEGEND

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SCALE VERIFICATION
THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING.
USE TO VERIFY FIGURE REPRODUCTION SCALE

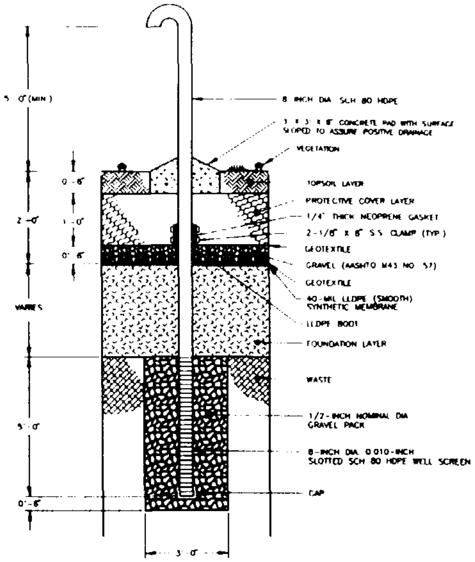
REV. NO.	DATE	DESCRIPTION	BY	APPR

SUBBASE GRADING PLAN (SOUTH)

COVER SYSTEM

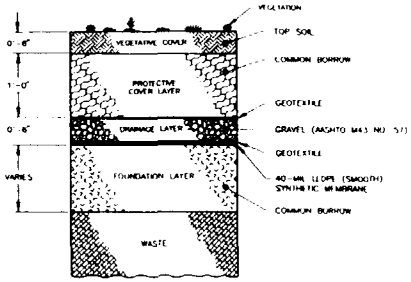
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

DRAWING NO.
3



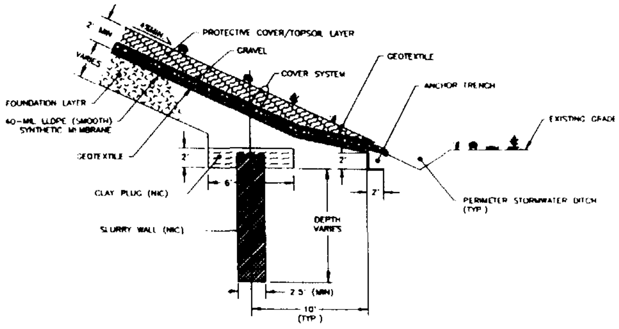
GAS VENT DETAIL

N T S



TYPICAL COVER SYSTEM DETAIL

N T S



NOTE: WASTE SHALL NOT DIRECTLY CONTACT CLAY PLUG OR SLURRY WALL AT ANY LOCATION

COVER SYSTEM/SLURRY WALL KEY DETAIL

N.T.S.

PRELIMINARY
NOT FOR CONSTRUCTION

GERAGHTY
& MILLER, INC.
Environmental Services
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DRAWING CONFIDENTIAL:

SCALE VERIFICATION

REV. NO.	DATE	DESCRIPTION	BY	APPR.

SECTIONS AND DETAILS
COVER SYSTEM
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

DRAWING NO.
6

APPENDIX B-2

COVER SYSTEM TECHNICAL SPECIFICATIONS (OUTLINE ONLY)

LANDFILL COVER SYSTEM

LIST OF TECHNICAL SPECIFICATIONS

APPENDIX B-3

HELP MODEL RESULTS

APPENDIX B-3

HELP MODEL SUMMARY

List of Components:

Single Barrier - Gravel

Alternative #1
- 6” Topsoil
- 12” Protective Cover
- 6” Gravel
- 40 mil LLDPE

Alternative #2
- 6” Topsoil
- 12” Protective Cover
- 6” Gravel
- 24” Compacted Clay Liner

Input Data:

- Nearest City: Indianapolis
- Slope: 4%
- Slope Length: 600 ft
- Vegetation: Fair
- Evaporative Zone Depth: 12 in
- Number of Years: 10
- Hydraulic Conductivity of Common Borrow: 1.0 X 10^{-3}
- Hydraulic Conductivity of Topsoil: 1.7 X 10^{-3}
- Thickness of existing foundation/subbase: 12 in

Summary Results:

COVER SYSTEM ALTERNATIVES	AVG. ANNUAL PERCOLATION/LEAKAGE THROUGH LINER		AVG. HEAD ACROSS TOP OF LINER	AVG. ANNUAL LATERAL DRAINAGE COLLECTED	
	IN/ACRE	CF/ACRE	IN	IN/ACRE	CF/ACRE
FML Barrier					
Gravel	0.06712	243.644	0.242	9.65138	35,34.516
Clay Barrier					
Gravel	1.10130	3997.719	0.217	8.61722	31,280.494

DEFAULT SOIL AND DESIGN DATA INPUT

6" TOPSOIL
12" PROT COVER
6" GRAVEL
24" CCL
12" FOUNDATION

TITLE: LAKELAND LANDFILL
WEATHER DATA: INDIANAPOLIS, IN

- Landfill area: 1 (acres)
- Percent of area where runoff is possible: 100 (%)
- Do you want to specify initial soil water? N (Y or N)
- Amount of water or snow on surface: ________ (in)
  (only answer if YES above)
- Number of layers: 5 (#)

LAYER DATA:

LAYER 1

a) Layer type: 1 (1 to 4)
b) Layer thickness: 6 (inches)
c) Soil texture number: 4 (1 to 42)
d) Initial soil water content: ________ (vol./vol.)
(not necessary if computer to initialize soil water content or layer type is 3 or 4)

LAYER 2

a) Layer type: 1 (1 to 4)
b) Layer thickness: 12 (inches)
c) Soil texture number: 5 (1 to 42)
d) Initial soil water content: ________ (vol./vol.)
(not necessary if computer to initialize soil water content or layer type is 3 or 4)

LAYER 3

(a) 2
(b) 6
(c) 21
(d) ______

LAYER 4

(a) 3
(b) 24
(c) 16
(d) ______

LAYER 5

(a) 1
(b) 12
(c) 7
(d) ______

LAYER 6

(a) ______
(b) ______
(c) ______
(d) ______

LAYER 7

(a) ______
(b) ______
(c) ______
(d) ______

LAYER 8

(a) ______
(b) ______
(c) ______
(d) ______

LAYER 9

(a) ______
(b) ______
(c) ______
(d) ______

LAYER 10

(a) ______
(b) ______
(c) ______
(d) ______

LAYER 11

(a) ______
(b) ______
(c) ______
(d) ______

LAYER 12

(a) ______
(b) ______
(c) ______
(d) ______

- For leachate recirculation and drainage in layer type 2, enter:

Layer: 2 (#)
Drainage length: 600 (ft.)
Drain Slope: 4 (%)
Leachate recirculation: – (%)
Recirculation to layer: – (#)
Subsurface inflow: – ($^{in}/_{yr.}$)

- If soil texture is #4, enter:

  Geomembrane Pinhole Density: __________ ($^{\#}/_{acre}$)

  Geomembrane Installation Defects: __________ ($^{\#}/_{acre}$)

  Geomembrane Placement: __________ (1 to 6)

  Geotextile Transmissivity: __________ ($^{cm2}/_{sec}$)
  (only if placement is 6)

- To determine curve number, enter:

  Slope: ____4____ (%)

  Slope length: ____600____ (ft.)

  Soil texture: ____4____ (1 to 42)

  Vegetation: __________ (1 to 5) FAIR

- For evapotranspiration data, enter:

  Evaporation zone depth: ____12____ (in)

  Maximum leaf area index: ____3.30____ (#)

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**               HELP MODEL VERSION 3.03  (31 DECEMBER 1994)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\HELP3\llpre.D4
TEMPERATURE DATA FILE:       C:\HELP3\lltemp.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\llrad.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\llet.D11
 OIL AND DESIGN DATA FILE:   C:\HELP3\llsoil2a.D10
OUTPUT DATA FILE:            C:\HELP3\llout2a.OUT


TIME:  18: 3     DATE:   1/25/1996


******************************************************************************

     TITLE:  Lakeland Landfill

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                       LAYER  1
                                       --------

                          TYPE 1 - VERTICAL PERCOLATION LAYER
                              MATERIAL TEXTURE NUMBER   4
                THICKNESS                   =       6.00   INCHES
                POROSITY                    =       0.4370 VOL/VOL
                FIELD CAPACITY              =       0.1050 VOL/VOL
                WILTING POINT               =       0.0470 VOL/VOL
                INITIAL SOIL WATER CONTENT  =       0.1746 VOL/VOL
                EFFECTIVE SAT. HYD. COND.   =   0.170000002000E-02 CM/SEC
             NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.48
                    FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

```
                        LAYER  2
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   5
THICKNESS                   =     12.00    INCHES
POROSITY                    =      0.4570 VOL/VOL
FIELD CAPACITY              =      0.1310 VOL/VOL
WILTING POINT               =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2081 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                        LAYER  3
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  21
THICKNESS                   =      6.00    INCHES
POROSITY                    =      0.3970 VOL/VOL
FIELD CAPACITY              =      0.0320 VOL/VOL
WILTING POINT               =      0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0415 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.300000012000      CM/SEC
SLOPE                       =      4.00    PERCENT
DRAINAGE LENGTH             =    600.0     FEET


                        LAYER  4
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  16
THICKNESS                   =     24.00    INCHES
POROSITY                    =      0.4270 VOL/VOL
FIELD CAPACITY              =      0.4180 VOL/VOL
WILTING POINT               =      0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000001000E-06 CM/SEC


                        LAYER  5
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   7
THICKNESS                   =     12.00    INCHES
POROSITY                    =      0.4730 VOL/VOL
FIELD CAPACITY              =      0.2220 VOL/VOL
WILTING POINT               =      0.1040 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2285 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.520000001000E-03 CM/SEC
```

```
                 GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                 ----------------------------------------

         NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
                  SOIL DATA BASE USING SOIL TEXTURE # 4 WITH A
                  FAIR STAND OF GRASS, A SURFACE SLOPE OF  4.%
                  AND A SLOPE LENGTH OF  600. FEET.

        SCS RUNOFF CURVE NUMBER                =     57.70
        FRACTION OF AREA ALLOWING RUNOFF       =    100.0    PERCENT
        AREA PROJECTED ON HORIZONTAL PLANE     =      1.000  ACRES
        EVAPORATIVE ZONE DEPTH                 =     12.0    INCHES
        INITIAL WATER IN EVAPORATIVE ZONE      =      2.408  INCHES
        UPPER LIMIT OF EVAPORATIVE STORAGE     =      5.364  INCHES
        LOWER LIMIT OF EVAPORATIVE STORAGE     =      0.630  INCHES
        INITIAL SNOW WATER                     =      0.000  INCHES
        INITIAL WATER IN LAYER MATERIALS       =     16.784  INCHES
        TOTAL INITIAL WATER                    =     16.784  INCHES
        TOTAL SUBSURFACE INFLOW                =      0.00   INCHES/YEAR


                  EVAPOTRANSPIRATION AND WEATHER DATA
                  -----------------------------------

         NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                  INDIANAPOLIS          INDIANA

             MAXIMUM LEAF AREA INDEX                       =  3.30
             START OF GROWING SEASON (JULIAN DATE)         =   107
             END OF GROWING SEASON (JULIAN DATE)           =   293
             AVERAGE ANNUAL WIND SPEED                     =  9.60 MPH
             AVERAGE 1ST QUARTER RELATIVE HUMIDITY         = 73.00 %
             AVERAGE 2ND QUARTER RELATIVE HUMIDITY         = 68.00 %
             AVERAGE 3RD QUARTER RELATIVE HUMIDITY         = 74.00 %
             AVERAGE 4TH QUARTER RELATIVE HUMIDITY         = 75.00 %


         NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR     INDIANAPOLIS        INDIANA

                  NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

      JAN/JUL      FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
      -------      -------     -------     -------     -------     -------
        2.65         2.46        3.61        3.68        3.66        3.99
        4.32         3.46        2.74        2.51        3.04        3.00


         NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR     INDIANAPOLIS        INDIANA

              NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)
```

```
     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
      26.00       29.90       40.00       52.40       62.50       71.60
      75.10       73.20       66.60       54.80       41.80       31.50


       NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                COEFFICIENTS FOR     INDIANAPOLIS         INDIANA

                         STATION LATITUDE  = 39.73 DEGREES




*******************************************************************************

       AVERAGE MONTHLY VALUES IN INCHES FOR YEARS     1 THROUGH   10
-------------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                  2.47     2.84     3.71     3.58     4.47     3.83
                            5.11     2.71     3.14     2.32     2.71     2.49

    STD. DEVIATIONS         1.38     0.90     1.70     2.10     2.26     2.19
                            2.10     1.68     1.21     1.18     1.09     0.66

  RUNOFF
  ------
    TOTALS                 1.003    1.231    0.881    0.000    0.000    0.005
                           0.000    0.000    0.000    0.000    0.000    0.331

    STD. DEVIATIONS        1.125    0.716    1.246    0.000    0.000    0.0[illegible]
                           0.000    0.000    0.000    0.000    0.000    0.415

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.748    1.008    2.115    2.747    3.781    3.779
                           3.597    2.713    2.472    1.670    0.964    0.624

    STD. DEVIATIONS        0.189    0.252    0.175    0.790    1.217    1.249
                           1.383    0.943    0.176    0.490    0.238    0.136

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  ----------------------------------------
    TOTALS                0.1780   0.1980   1.7302   1.3728   0.9681   0.5228
                          0.4435   0.4822   0.5431   0.4496   0.6915   1.0375

    STD. DEVIATIONS       0.2653   0.3369   0.5865   1.1422   0.8996   0.7862
                          0.6525   0.4856   0.5857   0.4085   1.3497   1.0022

  PERCOLATION/LEAKAGE THROUGH LAYER  4
  ------------------------------------
    TOTALS                0.0907   0.0569   0.0850   0.1036   0.1058   0.1011
```

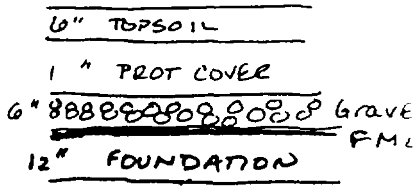
```
                          0.0959   0.0945   0.0878   0.0979   0.0848   0.0974

  STD. DEVIATIONS         0.0211   0.0226   0.0219   0.0018   0.0026   0.0045
                          0.0094   0.0171   0.0081   0.0170   0.0182   0.0184

 PERCOLATION/LEAKAGE THROUGH LAYER  5
 ------------------------------------
  TOTALS                  0.1030   0.0953   0.0708   0.0699   0.0912   0.0973
                          0.1059   0.1000   0.0934   0.0932   0.0984   0.0864

  STD. DEVIATIONS         0.0098   0.0139   0.0210   0.0271   0.0135   0.0054
                          0.0060   0.0063   0.0179   0.0138   0.0193   0.0172

-------------------------------------------------------------------------------
            AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


 DAILY AVERAGE HEAD ACROSS LAYER  4
 -------------------------------------
  AVERAGES                0.0503   0.0625   0.5759   0.4118   0.2759   0.1578
                          0.1264   0.1374   0.1599   0.1281   0.2188   0.2957

  STD. DEVIATIONS         0.0752   0.1063   0.3824   0.3525   0.2564   0.2433
                          0.1859   0.1384   0.1725   0.1164   0.4399   0.2856

*******************************************************************************


*******************************************************************************

   AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   10
-------------------------------------------------------------------------------
                                   INCHES            CU. FEET       PERCENT
                              -------------------  -------------   ---------
PRECIPITATION                  39.37     (   4.784)   142916.7      100.00

RUNOFF                          3.450    (  1.9876)    12522.39       8.762

EVAPOTRANSPIRATION             26.218    (  2.2388)    95172.66      66.593

LATERAL DRAINAGE COLLECTED      8.61722 (  2.29794)    31280.494    21.88722
  FROM LAYER  3

PERCOLATION/LEAKAGE THROUGH     1.10130 (  0.06255)     3997.719     2.79724
  LAYER  4

AVERAGE HEAD ACROSS TOP         0.217 (    0.072)
  OF LAYER  4

PERCOLATION/LEAKAGE THROUGH     1.10483 (  0.07851)     4010.550     2.80621
  LAYER  5

CHANGE IN WATER STORAGE        -0.019    (  0.8797)      -69.35      -0.049

*******************************************************************************
```

```
******************************************************************************

          PEAK DAILY VALUES FOR YEARS     1 THROUGH    10
------------------------------------------------------------------------
                                            (INCHES)      (CU. FT.)
                                           ----------    -------------
  PRECIPITATION                              4.55         16516.500

  RUNOFF                                     1.832         6648.4331

  DRAINAGE COLLECTED FROM LAYER  3           0.45819       1663.22595

  PERCOLATION/LEAKAGE THROUGH LAYER  4       0.004924        17.87329

  AVERAGE HEAD ACROSS LAYER  4              10.740

  PERCOLATION/LEAKAGE THROUGH LAYER  5       0.006502        23.60096

  SNOW WATER                                 2.97         10795.3018


  MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.3619

  MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.0323

******************************************************************************
```

```
******************************************************************************

                 FINAL WATER STORAGE AT END OF YEAR    10
        ----------------------------------------------------------------------
                     LAYER          (INCHES)         (VOL/VOL)
                     -----          --------         ---------
                       1             0.9181           0.1530

                       2             2.4750           0.2063

                       3             0.2452           0.0409

                       4            10.2480           0.4270

                       5             2.7065           0.2255

                   SNOW WATER        0.000

******************************************************************************
******************************************************************************
```

DEFAULT SOIL AND DESIGN DATA INPUT

TITLE: LAKELAND LANDFILL
INDIANAPOLIS, IN



- Landfill area: 1 (acres)
- Percent of area where runoff is possible: 100 (%)
- Do you want to specify initial soil water? N (Y or N)
- Amount of water or snow on surface: ______ (in)
  (only answer if YES above)
- Number of layers: 5 (#)

LAYER DATA:

LAYER 1

a) Layer type: 1 (1 to 4)
b) Layer thickness: 6 (inches)
c) Soil texture number: 4 (1 to 42)
d) Initial soil water content: ______ (vol./vol.)
(not necessary if computer to initialize soil water content or layer type is 3 or 4)

LAYER 2

a) Layer type: 1 (1 to 4)
b) Layer thickness: 12 (inches)
c) Soil texture number: 5 (1 to 42)
d) Initial soil water content: ______ (vol./vol.)
(not necessary if computer to initialize soil water content or layer type is 3 or 4)

- If soil texture is #4, enter:

Geomembrane Pinhole Density: 1 (#/acre)

Geomembrane Installation Defects: 2 (#/acre)

Geomembrane Placement: 3 (1 to 6)

Geotextile Transmissivity: — (cm2/sec)
(only if placement is 6)

- To determine curve number, enter:

Slope: 4 (%)

Slope length: 600 (ft.)

Soil texture: 4 (1 to 42)

Vegetation: ______ (1 to 5) FAIR

- For evapotranspiration data, enter:

Evaporation zone depth: 12 (in)

Maximum leaf area index: 3.30 (#)

LAYER 3

(a) 2
(b) 6
(c) 21
(d) ______

LAYER 4

(a) 4
(b) 0.04
(c) 35
(d) ______

LAYER 5

(a) 1
(b) 12
(c) 7
(d) ______

LAYER 6

(a) ______
(b) ______
(c) ______
(d) ______

LAYER 7

(a) ______
(b) ______
(c) ______
(d) ______

LAYER 8

(a) ______
(b) ______
(c) ______
(d) ______

LAYER 9

(a) ______
(b) ______
(c) ______
(d) ______

LAYER 10

(a) ______
(b) ______
(c) ______
(d) ______

LAYER 11

(a) ______
(b) ______
(c) ______
(d) ______

LAYER 12

(a) ______
(b) ______
(c) ______
(d) ______

- For leachate recirculation and drainage in layer type 2, enter:

  Layer: 3 (#)
  Drainage length: 600 (ft.)
  Drain Slope: 4 (%)
  Leachate recirculation: – (%)
  Recirculation to layer: – (#)
  Subsurface inflow: – ($^{in}/_{yr.}$)

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**               HELP MODEL VERSION 3.03  (31 DECEMBER 1994)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:      C:\HELP3\llpre.D4
TEMPERATURE DATA FILE:        C:\HELP3\lltemp.D7
SOLAR RADIATION DATA FILE:    C:\HELP3\llrad.D13
EVAPOTRANSPIRATION DATA:      C:\HELP3\llet.D11
SOIL AND DESIGN DATA FILE:    C:\HELP3\llsoil1a.D10
OUTPUT DATA FILE:             C:\HELP3\lloutla.OUT


TIME:  17:42      DATE:   1/25/1996


******************************************************************************

     TITLE:  Lakeland Landfill

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
                COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                       LAYER  1
                                       --------

                          TYPE 1 - VERTICAL PERCOLATION LAYER
                              MATERIAL TEXTURE NUMBER   4
                THICKNESS                     =      6.00   INCHES
                POROSITY                      =      0.4370 VOL/VOL
                FIELD CAPACITY                =      0.1050 VOL/VOL
                WILTING POINT                 =      0.0470 VOL/VOL
                INITIAL SOIL WATER CONTENT    =      0.1746 VOL/VOL
                EFFECTIVE SAT. HYD. COND.     =   0.170000002000E-02 CM/SEC
              NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.48
                       FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

```
                         LAYER  2
                         --------

           TYPE 1 - VERTICAL PERCOLATION LAYER
               MATERIAL TEXTURE NUMBER   5
THICKNESS                      =      12.00    INCHES
POROSITY                       =       0.4570 VOL/VOL
FIELD CAPACITY                 =       0.1310 VOL/VOL
WILTING POINT                  =       0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT     =       0.2081 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =   0.100000005000E-02 CM/SEC


                         LAYER  3
                         --------

             TYPE 2 - LATERAL DRAINAGE LAYER
               MATERIAL TEXTURE NUMBER  21
THICKNESS                      =       6.00    INCHES
POROSITY                       =       0.3970 VOL/VOL
FIELD CAPACITY                 =       0.0320 VOL/VOL
WILTING POINT                  =       0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT     =       0.0432 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =   0.300000012000      CM/SEC
SLOPE                          =       4.00    PERCENT
DRAINAGE LENGTH                =     600.0     FEET


                         LAYER  4
                         --------

             TYPE 4 - FLEXIBLE MEMBRANE LINER
               MATERIAL TEXTURE NUMBER  35
THICKNESS                      =       0.04    INCHES
POROSITY                       =       0.0000 VOL/VOL
FIELD CAPACITY                 =       0.0000 VOL/VOL
WILTING POINT                  =       0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT     =       0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.      =   0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY            =       1.00    HOLES/ACRE
FML INSTALLATION DEFECTS       =       2.00    HOLES/ACRE
FML PLACEMENT QUALITY          =   3 - GOOD


                         LAYER  5
                         --------

           TYPE 1 - VERTICAL PERCOLATION LAYER
               MATERIAL TEXTURE NUMBER   7
THICKNESS                      =      12.00    INCHES
POROSITY                       =       0.4730 VOL/VOL
FIELD CAPACITY                 =       0.2220 VOL/VOL
WILTING POINT                  =       0.1040 VOL/VOL
```

```
          INITIAL SOIL WATER CONTENT   =      0.1903 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.520000001000E-03 CM/SEC




                  GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                  ----------------------------------------

        NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
                 SOIL DATA BASE USING SOIL TEXTURE # 4 WITH A
                 FAIR STAND OF GRASS, A SURFACE SLOPE OF  4.%
                 AND A SLOPE LENGTH OF  600. FEET.

       SCS RUNOFF CURVE NUMBER                 =     57.70
       FRACTION OF AREA ALLOWING RUNOFF        =    100.0    PERCENT
       AREA PROJECTED ON HORIZONTAL PLANE      =      1.000  ACRES
       EVAPORATIVE ZONE DEPTH                  =     12.0    INCHES
       INITIAL WATER IN EVAPORATIVE ZONE       =      2.408  INCHES
       UPPER LIMIT OF EVAPORATIVE STORAGE      =      5.364  INCHES
       LOWER LIMIT OF EVAPORATIVE STORAGE      =      0.630  INCHES
       INITIAL SNOW WATER                      =      0.000  INCHES
       INITIAL WATER IN LAYER MATERIALS        =      6.088  INCHES
       TOTAL INITIAL WATER                     =      6.088  INCHES
       TOTAL SUBSURFACE INFLOW                 =      0.00   INCHES/YEAR



                   EVAPOTRANSPIRATION AND WEATHER DATA
                   -----------------------------------

        NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                 INDIANAPOLIS          INDIANA

            MAXIMUM LEAF AREA INDEX                      =  3.30
            START OF GROWING SEASON (JULIAN DATE)        =   107
            END OF GROWING SEASON (JULIAN DATE)          =   293
            AVERAGE ANNUAL WIND SPEED                    =   9.60 MPH
            AVERAGE 1ST QUARTER RELATIVE HUMIDITY        = 73.00 %
            AVERAGE 2ND QUARTER RELATIVE HUMIDITY        = 68.00 %
            AVERAGE 3RD QUARTER RELATIVE HUMIDITY        = 74.00 %
            AVERAGE 4TH QUARTER RELATIVE HUMIDITY        = 75.00 %


        NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
                 COEFFICIENTS FOR     INDIANAPOLIS        INDIANA

                 NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

     JAN/JUL      FEB/AUG      MAR/SEP      APR/OCT      MAY/NOV      JUN/DEC
     -------      -------      -------      -------      -------      -------
      2.65         2.46         3.61         3.68         3.66         3.99
      4.32         3.46         2.74         2.51         3.04         3.00


        NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
```

```
               COEFFICIENTS FOR     INDIANAPOLIS        INDIANA

          NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

    JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
    -------     -------     -------     -------     -------     -------
     26.00       29.90       40.00       52.40       62.50       71.60
     75.10       73.20       66.60       54.80       41.80       31.50


        NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
               COEFFICIENTS FOR     INDIANAPOLIS        INDIANA

                      STATION LATITUDE  = 39.73 DEGREES




*******************************************************************************

        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH   10
-------------------------------------------------------------------------------

                         JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                         -------  -------  -------  -------  -------  -------
 PRECIPITATION
 -------------
   TOTALS                  2.47     2.84     3.71     3.58     4.47     3.83
                           5.11     2.71     3.14     2.32     2.71     2.49

   STD. DEVIATIONS         1.38     0.90     1.70     2.10     2.26     2.19
                           2.10     1.68     1.21     1.18     1.09     0.66

 RUNOFF
 ------
   TOTALS                 1.003    1.231    0.881    0.000    0.000    0.00
                          0.000    0.000    0.000    0.000    0.000    0.331

   STD. DEVIATIONS        1.125    0.716    1.246    0.000    0.000    0.015
                          0.000    0.000    0.000    0.000    0.000    0.415

 EVAPOTRANSPIRATION
 ------------------
   TOTALS                 0.748    1.008    2.115    2.747    3.781    3.779
                          3.597    2.713    2.472    1.670    0.964    0.624

   STD. DEVIATIONS        0.189    0.252    0.175    0.790    1.217    1.249
                          1.383    0.943    0.176    0.490    0.238    0.136

 LATERAL DRAINAGE COLLECTED FROM LAYER  3
 ----------------------------------------
   TOTALS                0.2684   0.2547   1.7981   1.4683   1.0664   0.6189
                         0.5368   0.5721   0.6260   0.5434   0.7730   1.1254

   STD. DEVIATIONS       0.2733   0.3442   0.5905   1.1407   0.8971   0.7834
                         0.6502   0.4917   0.5842   0.4101   1.3521   1.0066
```

```
  PERCOLATION/LEAKAGE THROUGH LAYER  4
  ------------------------------------
    TOTALS                  0.0025   0.0020   0.0117   0.0093   0.0073   0.0046
                            0.0040   0.0044   0.0045   0.0043   0.0050   0.0075

    STD. DEVIATIONS         0.0019   0.0020   0.0047   0.0059   0.0048   0.0040
                            0.0036   0.0031   0.0031   0.0025   0.0070   0.0055

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  ------------------------------------
    TOTALS                  0.0092   0.0083   0.0038   0.0047   0.0056   0.0073
                            0.0081   0.0071   0.0068   0.0067   0.0073   0.0047

    STD. DEVIATIONS         0.0039   0.0020   0.0027   0.0040   0.0033   0.0030
                            0.0031   0.0030   0.0024   0.0022   0.0033   0.0033

-------------------------------------------------------------------------------
             AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


  DAILY AVERAGE HEAD ACROSS LAYER  4
  -------------------------------------
    AVERAGES                0.0759   0.0803   0.5969   0.4403   0.3039   0.1864
                            0.1530   0.1630   0.1843   0.1548   0.2432   0.3207

    STD. DEVIATIONS         0.0774   0.1086   0.3842   0.3530   0.2556   0.2435
                            0.1853   0.1401   0.1720   0.1169   0.4417   0.2868

*******************************************************************************


*******************************************************************************

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH   10
-------------------------------------------------------------------------------
                                     INCHES            CU. FEET      PERCENT
                               -------------------  -------------  ---------
 PRECIPITATION                  39.37     (   4.784)    142916.7     100.00

 RUNOFF                          3.450    (  1.9876)     12522.39      8.762

 EVAPOTRANSPIRATION             26.218    (  2.2388)     95172.66     66.593

 LATERAL DRAINAGE COLLECTED      9.65138 (  2.30249)    35034.516   24.51394
   FROM LAYER  3

 PERCOLATION/LEAKAGE THROUGH     0.06712 (  0.01409)      243.644     0.17048
   LAYER  4

 AVERAGE HEAD ACROSS TOP         0.242 (     0.072)
   OF LAYER  4

 PERCOLATION/LEAKAGE THROUGH     0.07958 (  0.02337)      288.888     0.20214
   LAYER  5

 CHANGE IN WATER STORAGE        -0.028    (  0.8628)      -101.71     -0.071
```

```
******************************************************************************

            PEAK DAILY VALUES FOR YEARS    1 THROUGH   10
      ------------------------------------------------------------------------
                                                (INCHES)      (CU. FT.)
                                               ----------    -------------
         PRECIPITATION                            4.55         16516.500

         RUNOFF                                   1.832         6648.4331

         DRAINAGE COLLECTED FROM LAYER  3         0.46357       1682.74573

         PERCOLATION/LEAKAGE THROUGH LAYER  4     0.004316        15.66732

         AVERAGE HEAD ACROSS LAYER  4            10.788

         PERCOLATION/LEAKAGE THROUGH LAYER  5     0.000591         2.14361

         SNOW WATER                               2.97         10795.3018


         MAXIMUM VEG. SOIL WATER (VOL/VOL)                0.3619

         MINIMUM VEG. SOIL WATER (VOL/VOL)                0.0323

******************************************************************************
```

```
*******************************************************************************

           FINAL WATER STORAGE AT END OF YEAR   10
    ----------------------------------------------------------------------
                LAYER          (INCHES)         (VOL/VOL)
                -----          --------         ---------
                  1             0.9181            0.1530

                  2             2.4750            0.2063

                  3             0.2554            0.0426

                  4             0.0000            0.0000

                  5             2.1593            0.1799

               SNOW WATER       0.000

*******************************************************************************
*******************************************************************************
```

APPENDIX C

APPENDIX C

CLAY SOURCE GEOTECHNICAL TESTING RESULTS

BOWSER-MORNER, INC.
CORPORATE: 4518 Taylorsville Road • P. O. Box 51 • Dayton, Ohio 45401 • 513/236-8805

LABORATORY REPORT

Report To:
Geraghty & Miller, Inc.
Attn: Ms. Kristina Lala
35 East Wacker Drive
Suite 1000
Chicago, Illinois 60601

Date January 26, 1996
Report No. 001373B
W.O. No. 107391

JAN 29

Report On:
Geotechnical Testing of Three Soil Samples
Geraghty & Miller Project No. CIO348.004 - Claypool, Indiana

On December 22, 1995, three soil samples were submitted for laboratory analysis.

Testing was performed as specified by your chain of custody dated December 20, 1995, and in accordance with the following procedures:

ASTM D422,	"Particle-Size Analysis of Soils".
ASTM D698,	"Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))".
ASTM D2216,	"Laboratory Determination of Water (Moisture) Content of Soil and Rock".
ASTM D2487,	"Classification of Soils for Engineering Purposes".
ASTM D4318,	"Liquid Limit, Plastic Limit, and Plasticity Index of Soils".
ASTM D5084,	"Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter".

Results are summarized in Tables I and II, and detailed on the attached data sheets.

Should you have any questions, or if we may be of further service, please contact us at (513) 236-8805.

Respectfully submitted,

BOWSER-MORNER, INC.

James W. Fletcher, Manager
Construction Materials and
Geotechnical Laboratories

JWF/jd
001373B
1-Client
1-File

GERAGHTY & MILLER, INC.

TABLE I

Summary of Results

Sample Identification:	CAP-1 12:95	CAP-2 12:95	CAP-3 12:95
Sieve Size	Percent Passing		
1 1/2"	100	100	
1"	98	98	100
3/4"	98	97	99
1/2"	96	97	98
3/8"	96	96	97
#4	94	94	97
#10	92	92	95
#20	89	89	92
#40	86	86	90
#60	82	81	85
#100	76	74	79
#200	69	68	72
Gravel, %:	6	6	4
Sand, %:	25	26	24
Silt, %:	42	43	41
Clay, % (<0.002mm):	27	25	31
Liquid Limit:	28	26	31
Plastic Limit:	15	15	16
Plasticity Index:	13	11	15
USCS Classification Symbol:	CL	CL	CL
As Received Moisture Content, %:	11.8	11.0	15.3
Standard Proctor Results			
Maximum Dry Density, pcf:	116.3	121.5	114.2
Optimum Moisture, %:	14.0	13.6	13.5

GERAGHTY & MILLER, INC.

TABLE II

Hydraulic Conductivity Results

Sample Identification:	CAP 1			CAP 2	CAP 3	
Wet Unit Weight, pcf:	127.8	129.3	132.4	131.5	126.1	129.5
Dry Unit Weight, pcf:	110.5	112.6	114.4	114.5	109.7	112.2
Percent Compaction:	94.8	96.8	98.3	94.2	96.0	98.3
Moisture Content, %:	15.6	14.8	15.8	14.8	15.0	15.4
Percent +/- Optimum Moisture, %:	+1.6	+0.8	+1.8	+1.2	+1.5	+1.9
Permeability, cm/sec:	4.5×10^{-7}	5.8×10^{-7}	5.0×10^{-8}	5.0×10^{-8}	3.6×10^{-7}	4.8×10^{-8}

ASTM D5084
FALLING HEAD
PERMEABILITY TEST
LABORATORY COMPACTED

Date:	January 24, 1996
Project No.:	107391
Client:	Geraghty & Miller, Inc.
Project:	CI0348.004 - Claypool, Indiana
Location:	CAP-1 12:95
Material Description:	brown CLAY with sand
ASTM D698, Standard Proctor	
Maximum Dry Density, pcf:	116.3
Optimum Moisture Content, %:	14.0

SPECIMEN DATA:

Dimension, Inches:	
Height:	2.870
Diameter:	2.797
Weight, lbs.:	
Initial:	1.304
Moisture Content, %:	
Initial:	15.6
Final:	19.0
Wet Unit Weight, pcf:	
Initial:	127.8
Final:	131.5
Dry Unit Weight, pcf:	110.5
% Compaction:	94.8
Permeability, cm/sec.:	
k:	4.5×10^{-7}

ASTM D5084
FALLING HEAD
PERMEABILITY TEST
LABORATORY COMPACTED

Date: January 16, 1996

Project No.: 107391

Client: Geraghty & Miller, Inc.

Project: CI0348.004 - Claypool, Indiana

Location: CAP-1 12:95

Material Description: "CL" brown sandy lean CLAY

ASTM D698, Standard Proctor
Maximum Dry Density, pcf: 116.3
Optimum Moisture Content, %: 14.0

SPECIMEN DATA:

Dimension, Inches:
    Height: 2.798
    Diameter: 2.800

Weight, lbs.:
    Initial: 1.289

Moisture Content, %:
    Initial: 14.8
    Final: 17.9

Wet Unit Weight, pcf:
    Initial: 129.3
    Final: 132.7

Dry Unit Weight, pcf: 112.6

% Compaction: 96.8

Permeability, cm/sec.:
    k: 5.8 x 10^{-7}

ASTM D5084 FALLING HEAD PERMEABILITY TEST LABORATORY COMPACTED

Date: January 24, 1996

Project No.: 107391

Client: Geraghty & Miller, Inc.

Project: CI0348.004 - Claypool, Indiana

Location: CAP-1 12:95

Material Description: brown lean CLAY with sand

ASTM D698, Standard Proctor
Maximum Dry Density, pcf: 116.3
Optimum Moisture Content, %: 14.0

SPECIMEN DATA:

Dimension, Inches:
- Height: 2.786
- Diameter: 2.810

Weight, lbs.:
- Initial: 1.324

Moisture Content, %:
- Initial: 15.8
- Final: 16.9

Wet Unit Weight, pcf:
- Initial: 132.4
- Final: 133.7

Dry Unit Weight, pcf: 114.4

% Compaction: 98.3

Permeability, cm/sec.:
- k: 5.0 x 10^{-8}

ASTM D5084
FALLING HEAD
PERMEABILITY TEST
LABORATORY COMPACTED

Date:	January 16, 1996
Project No.:	107391
Client:	Geraghty & Miller, Inc.
Project:	CI0348.004 - Claypool, Indiana
Location:	CAP-2 12:95
Material Description:	"CL" brown sandy lean CLAY
<u>ASTM D698, Standard Proctor</u>	
Maximum Dry Density, pcf:	121.5
Optimum Moisture Content, %:	13.6

SPECIMEN DATA:

Dimension, Inches:	
Height:	2.927
Diameter:	2.793
Weight, lbs.:	
Initial:	1.364
Moisture Content, %:	
Initial:	14.8
Final:	16.8
Wet Unit Weight, pcf:	
Initial:	131.5
Final:	133.8
Dry Unit Weight, pcf:	114.5
% Compaction:	94.3
Permeability, cm/sec.:	
k:	5.0×10^{-8}

ASTM D5084
FALLING HEAD
PERMEABILITY TEST
LABORATORY COMPACTED

Date:	January 16, 1996
Project No.:	107391
Client:	Geraghty & Miller, Inc.
Project:	CI0348.004 - Claypool, Indiana
Location:	CAP-3 12:95
Material Description:	"CL" brown lean CLAY with sand
<u>ASTM D698, Standard Proctor</u>	
Maximum Dry Density, pcf:	114.2
Optimum Moisture Content, %:	13.5

SPECIMEN DATA:

Dimension, Inches:	
Height:	2.734
Diameter:	2.801
Weight, lbs.:	
Initial:	1.229
Moisture Content, %:	
Initial:	15.0
Final:	19.4
Wet Unit Weight, pcf:	
Initial:	126.1
Final:	130.9
Dry Unit Weight, pcf:	109.7
% Compaction:	96.0
Permeability, cm/sec.:	
k:	3.6×10^{-7}

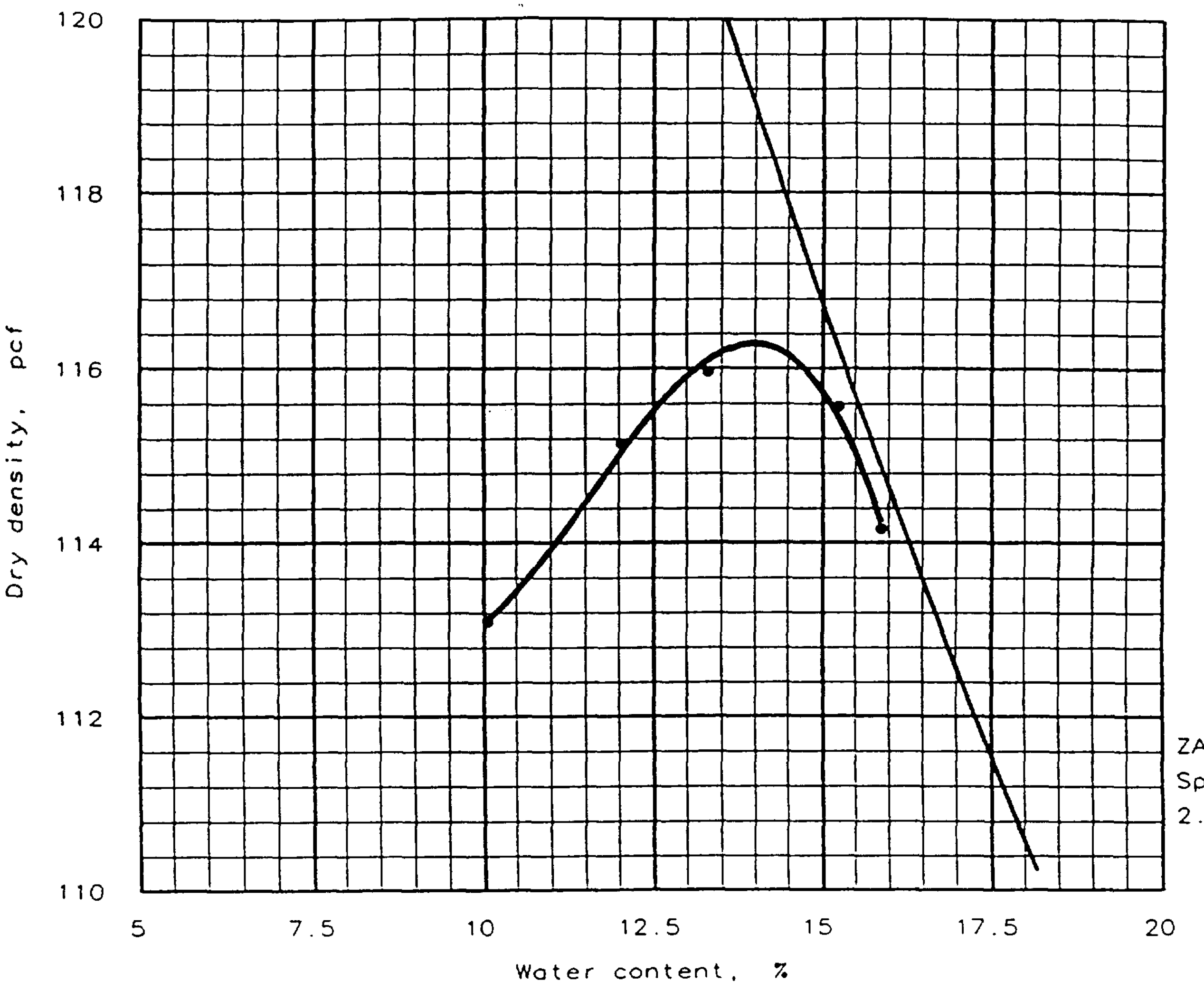
ASTM D5084
FALLING HEAD
PERMEABILITY TEST
LABORATORY COMPACTED

Date:	January 24, 1996
Project No.:	107391
Client:	Geraghty & Miller, Inc.
Project:	CI0348.004 - Claypool, Indiana
Location:	CAP-3 12:95
Material Description:	brown lean CLAY with sand
ASTM D698, Standard Proctor	
Maximum Dry Density, pcf:	114.2
Optimum Moisture Content, %:	13.5

SPECIMEN DATA:

Dimension, Inches:	
Height:	2.721
Diameter:	2.801
Weight, lbs.:	
Initial:	1.256
Moisture Content, %:	
Initial:	15.4
Final:	18.3
Wet Unit Weight, pcf:	
Initial:	129.5
Final:	132.8
Dry Unit Weight, pcf:	112.2
% Compaction:	98.3
Permeability, cm/sec.:	
k:	4.8×10^{-8}

PROCTOR TEST REPORT



Test specification: ASTM D 698-91 Method A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	CL	A-6			28	13	6 %	69 %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 116.3 pcf Optimum moisture = 14.0 %	brown sandy lean CLAY

Project No.: 107391 GERAGHTY & MILLER

Project: C10348.004 - CLAYPOOL, INDIANA

Location: CAP-1 12:95

Date: 01-07-96

Remarks:

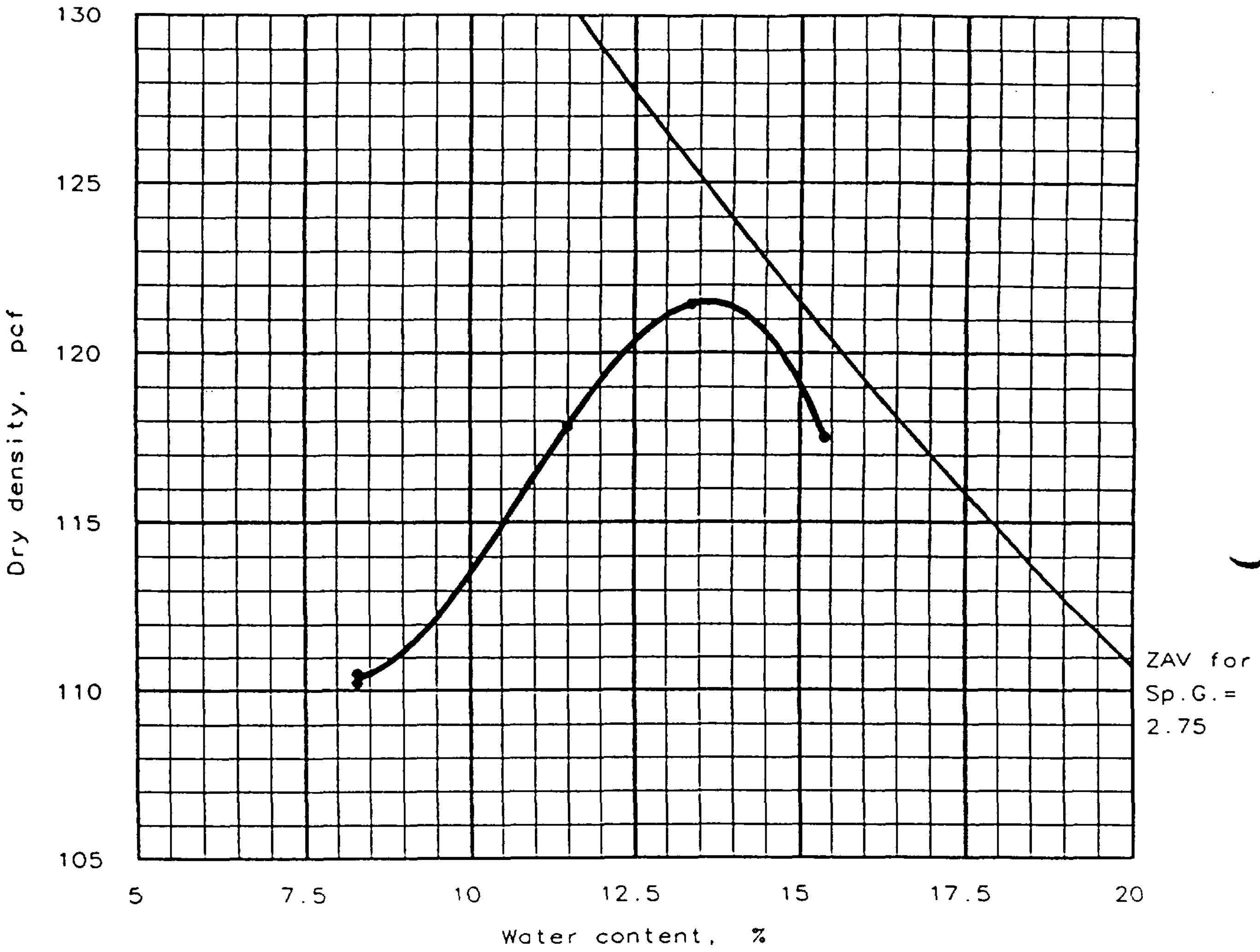
RECEIVED: 12-22-95

PROCTOR TEST REPORT

BOWSER-MORNER, INC.

TEST NO. 921

PROCTOR TEST REPORT



Test specification: ASTM D 698-91 Method A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	CL	A-6			26	11	6 %	68 %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 121.5 pcf Optimum moisture = 13.6 %	brown sandy lean CLAY

Project No.: 107391 GERAGHTY & MILLER

Project: C1034.004 - CLAYPOOL, INDIANA

Location: CAP-2 12:95

Date: 01-07-96

Remarks:

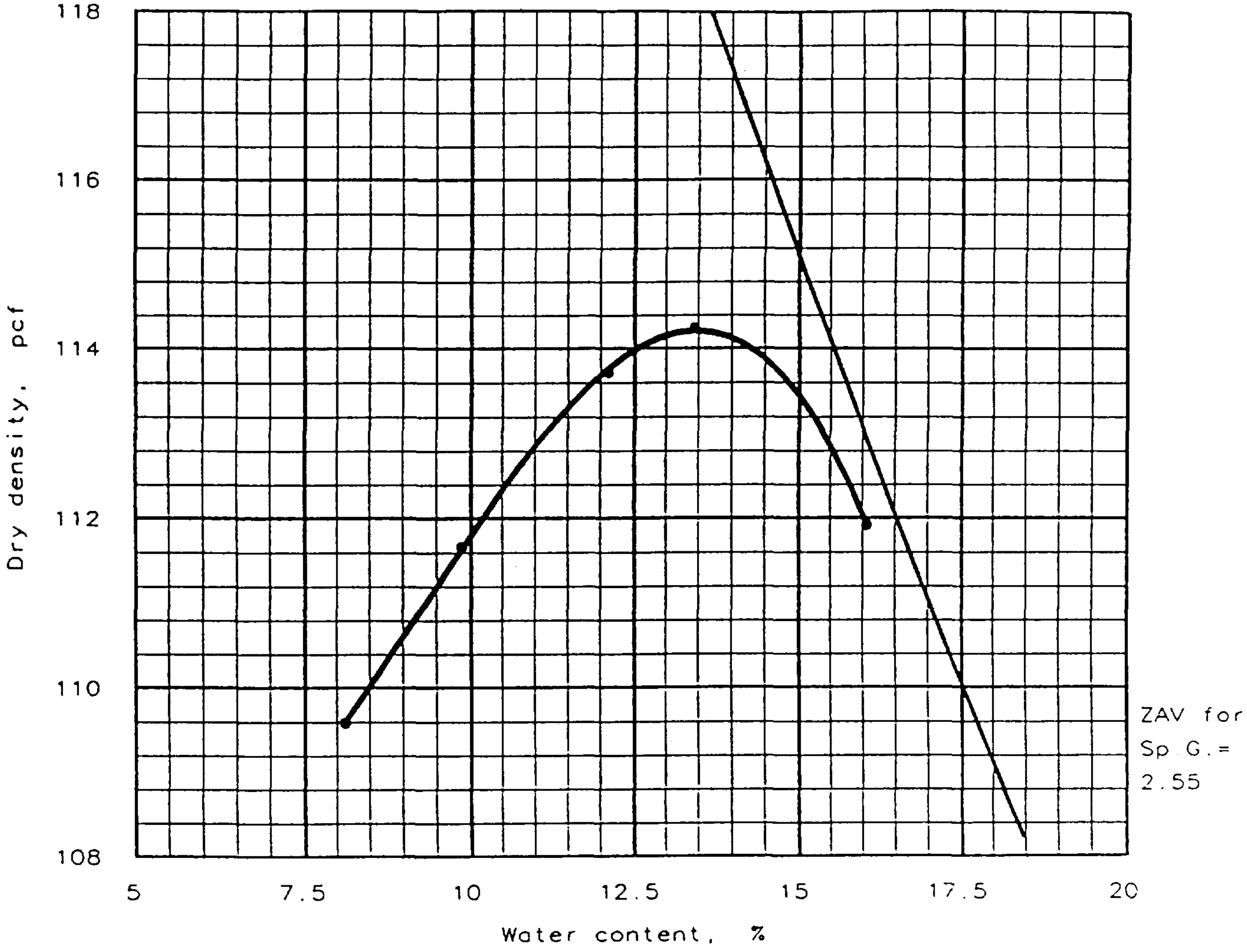
RECEIVED: 12-22-95

PROCTOR TEST REPORT

BOWSER-MORNER, INC.

TEST NO. 922

PROCTOR TEST REPORT



Test specification: ASTM D 698-91 Method A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	CL	A-6			31	15	3 %	72 %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 114.2 pcf Optimum moisture = 13.5 %	brown lean CLAY with sand

Project No.: 107391 GERAGHTY & MILLER
Project: C10348.004 - CLAYPOOL, INDIANA
Location: CAP-3 12:95

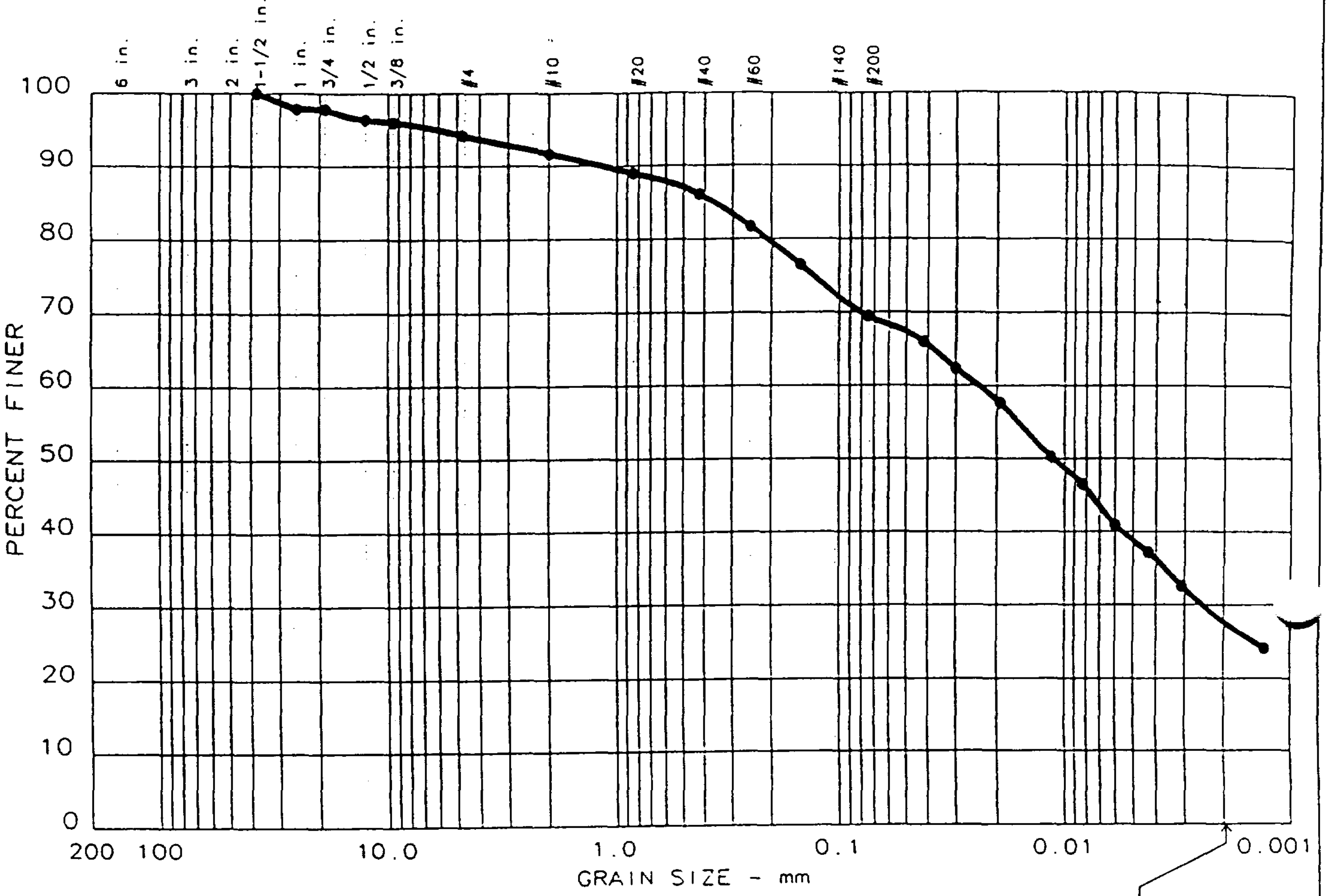
Date: 01-07-96

Remarks:
RECEIVED: 12-22-95

PROCTOR TEST REPORT
BOWSER-MORNER, INC.

TEST NO. 923

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	15	0.0	5.8	24.8	41.8	27.6

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	28	13	0.363		0.011	0.002				

MATERIAL DESCRIPTION	USCS	AASHTO
● brown sandy lean CLAY	CL	A-6

Project No.: 107391 G & M
Project: C10348.004-CLAYPOOL, INDIANA
● Location: CAP 1 - 12:95

Date: 12-29-95

Remarks:

AS RECEIVED

MOISTURE CONTENT: 1: 8%

GRAIN SIZE DISTRIBUTION TEST REPORT

BOWSER-MORNER, INC.

Figure No ______

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 15

Date: 12-29-95
Project No.: 107391 G & M
Project: CI0348.004-CLAYPOOL, INDIANA

Sample Data

Location of Sample: CAP 1 - 12:95
Sample Description: brown sandy lean CLAY
USCS Class: CL
Liquid limit: 28
AASHTO Class: A-6
Plasticity index: 13

Notes

Remarks: AS RECEIVED MOISTURE CONTENT: 11.8%

Fig. No.:

Mechanical Analysis Data

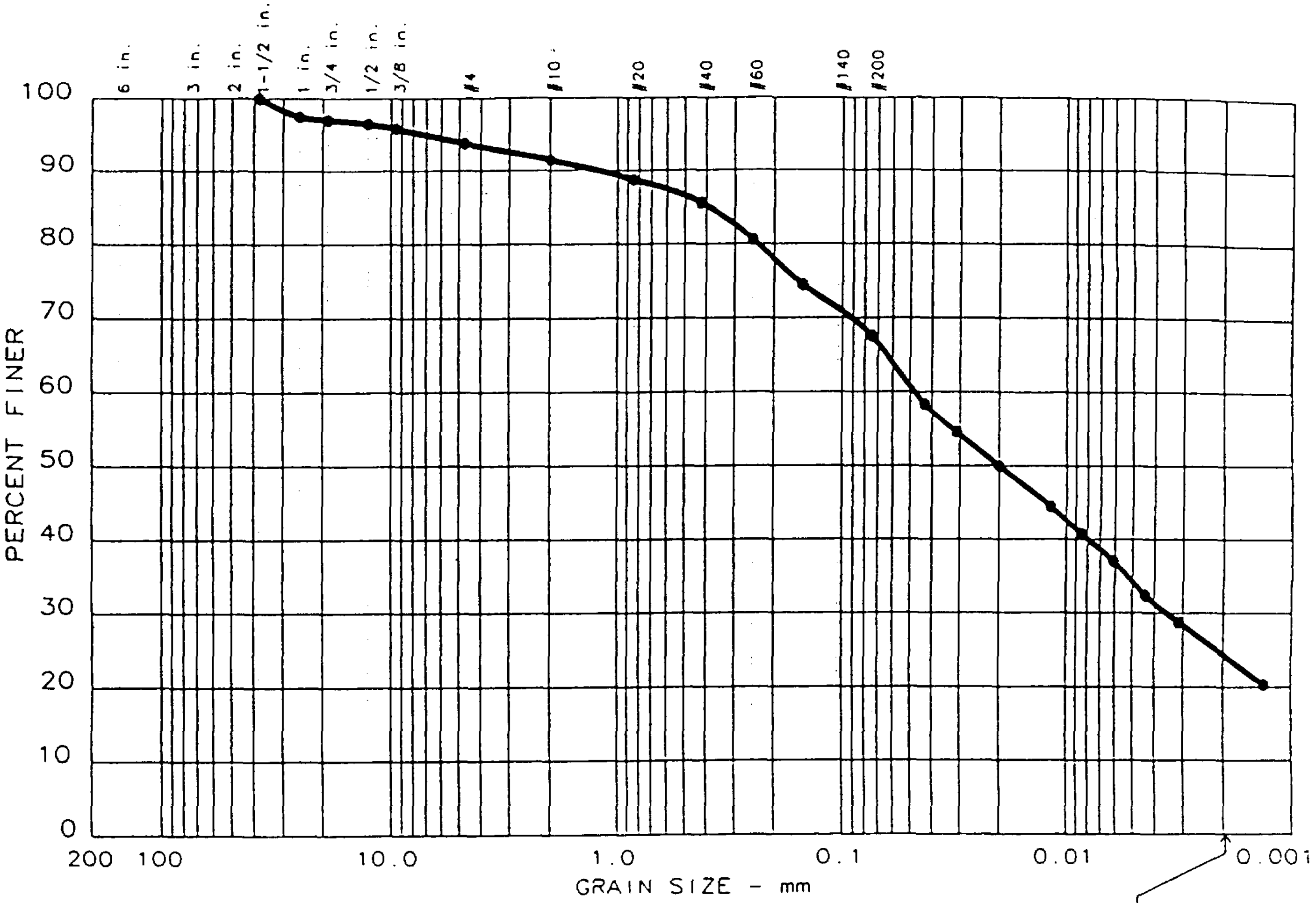
	Initial
Dry sample and tare=	2695.00
Tare =	216.47
Dry sample weight =	2478.53

Sample split on number 10 sieve
Split sample data:
Sample and tare = 50.02 Tare = 0 Sample weight = 50.02
Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
1.5 inches	0.00	100.0
1 inches	52.64	97.9
0.75 inches	52.64	97.9
0.5 inches	88.86	96.4
0.375 inches	97.93	96.0
# 4	143.50	94.2
# 10	205.19	91.7
# 20	1.49	89.0
# 40	3.05	86.1
# 60	5.49	81.7
# 100	8.33	76.4
# 200	12.15	69.4

```
-----------------------------------------------------------------------------
                         Hydrometer Analysis Data
-----------------------------------------------------------------------------
Separation sieve is number 10
Percent -# 10 based on complete sample=  91.7
Weight of hydrometer sample: 50.02
Hygroscopic moisture correction:
  Moist weight & tare =  57.54
  Dry weight & tare   =  57.28
  Tare                =  28.52
  Hygroscopic moisture=   0.9 %
Calculated biased weight=  54.05
Automatic temperature correction
  Composite correction at 20 deg C =-5

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H   Effective depth L= 16.294964 - 0.164 x Rm

  Elapsed     Temp, Actual   Corrected  K         Rm     Eff.   Diameter   Percent
  time, min   deg C reading  reading                     depth  mm         finer
     1.0      21.0  40.5     35.7       0.0135   40.5    9.7   0.0419     66.0
     2.0      21.0  38.5     33.7       0.0135   38.5   10.0   0.0301     62.3
     5.0      21.0  36.0     31.2       0.0135   36.0   10.4   0.0194     57.7
    15.0      20.9  32.0     27.2       0.0135   32.0   11.0   0.0116     50.2
    30.0      20.8  30.0     25.1       0.0135   30.0   11.4   0.0083     46.5
    60.0      20.7  27.0     22.1       0.0135   27.0   11.9   0.0060     40.9
   120.0      20.7  25.0     20.1       0.0135   25.0   12.2   0.0043     37.2
   240.0      20.8  22.5     17.6       0.0135   22.5   12.6   0.0031     32.6
  1440.0      20.3  18.0     13.0       0.0136   18.0   13.3   0.0013     24.1
-----------------------------------------------------------------------------
                          Fractional Components
-----------------------------------------------------------------------------
Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. =  0.0     % GRAVEL =  5.8   % SAND = 24.8
% SILT = 41.8    % CLAY = 27.6

D85=   0.36  D60=    0.024  D50=   0.011
D30=   0.0025
```

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	18	0.0	6.2	26.2	43.2	24.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	26	11	0.389		0.020	0.004				

MATERIAL DESCRIPTION	USCS	AASHTO
● brown sandy lean CLAY	CL	A-6

Project No.: 107391 G & M
Project: C10348.004-CLAYPOOL, INDIANA
● Location: CAP 2 - 12:95

Date: 12-29-95

Remarks:

AS RECEIVED

MOISTURE CONTENT: 11 0%

GRAIN SIZE DISTRIBUTION TEST REPORT

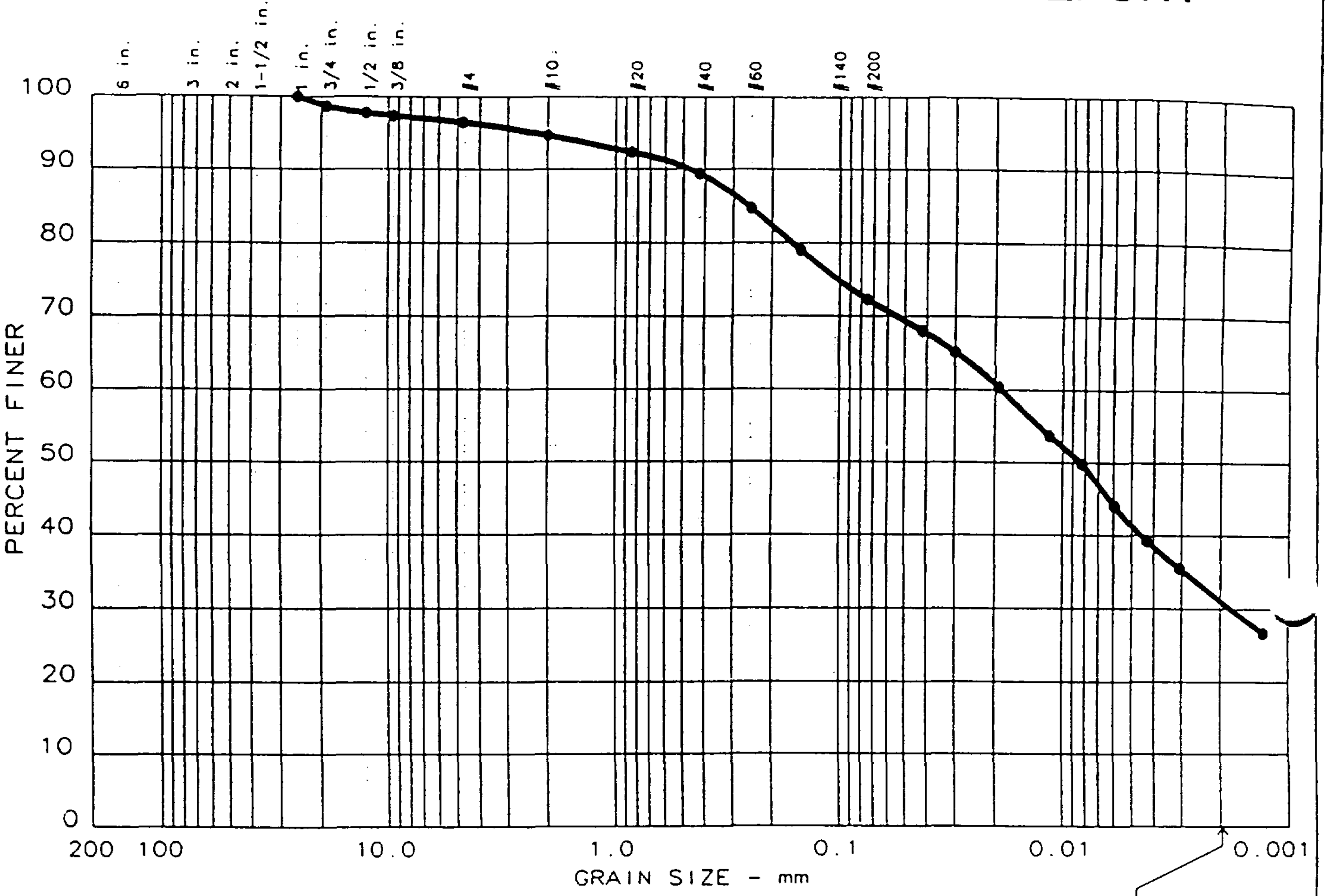
BOWSER-MORNER, INC.

Figure No. ______

```
==============================================================================
                        GRAIN SIZE DISTRIBUTION TEST DATA           Test No.: 18
------------------------------------------------------------------------------
Date: 12-29-95
Project No.: 107391    G & M
Project: CI0348.004-CLAYPOOL, INDIANA
==============================================================================

------------------------------------------------------------------------------
                                    Sample Data
------------------------------------------------------------------------------
Location of Sample: CAP 2 - 12:95
Sample Description: brown sandy lean CLAY
USCS Class: CL                        Liquid limit: 26
AASHTO Class: A-6                     Plasticity index: 11
------------------------------------------------------------------------------
                                       Notes
------------------------------------------------------------------------------
Remarks: AS RECEIVED  MOISTURE CONTENT:  11.0%

Fig. No.:
------------------------------------------------------------------------------
                              Mechanical Analysis Data
------------------------------------------------------------------------------
                         Initial
Dry sample and tare=  2764.00
Tare               =   343.42
Dry sample weight  =  2420.58
Sample split on number 10 sieve
Split sample data:
  Sample and tare = 50.14  Tare =  0  Sample weight = 50.14
  Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0
  Sieve               Cumul. Wt.   Percent
                      retained     finer
  1.5   inches          0.00       100.0
  1     inches         60.72        97.5
  0.75  inches         71.52        97.0
  0.5   inches         83.69        96.5
  0.375 inches        100.60        95.8
  # 4                 150.28        93.8
  # 10                205.81        91.5
  # 20                  1.48        88.8
  # 40                  3.24        85.6
  # 60                  5.98        80.6
  # 100                 9.37        74.4
  # 200                13.12        67.6
```

```
------------------------------------------------------------------------------
                          Hydrometer Analysis Data
------------------------------------------------------------------------------
Separation sieve is number 10
Percent -# 10 based on complete sample=  91.5
Weight of hydrometer sample: 50.14
Hygroscopic moisture correction:
  Moist weight & tare =  67.18
  Dry weight & tare   =  66.85
  Tare                =  29.98
  Hygroscopic moisture=   0.9 %
Calculated biased weight=  54.31
Automatic temperature correction
  Composite correction at 20 deg C =-5

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H   Effective depth L= 16.294964 - 0.164 x Rm

  Elapsed    Temp, Actual   Corrected  K         Rm     Eff.   Diameter  Percent
  time, min  deg C reading  reading                     depth  mm        finer
     1.0     21.0  36.5     31.7       0.0135   36.5   10.3   0.0433    58.3
     2.0     21.0  34.5     29.7       0.0135   34.5   10.6   0.0311    54.6
     5.0     20.9  32.0     27.2       0.0135   32.0   11.0   0.0201    50.0
    15.0     20.9  29.0     24.2       0.0135   29.0   11.5   0.0118    44.5
    30.0     20.8  27.0     22.1       0.0135   27.0   11.9   0.0085    40.7
    60.0     20.7  25.0     20.1       0.0135   25.0   12.2   0.0061    37.0
   120.0     20.7  22.5     17.6       0.0135   22.5   12.6   0.0044    32.4
   240.0     20.8  20.5     15.6       0.0135   20.5   12.9   0.0031    28.8
  1440.0     20.3  16.0     11.0       0.0136   16.0   13.7   0.0013    20.3
------------------------------------------------------------------------------
                           Fractional Components
------------------------------------------------------------------------------
Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. =   0.0     % GRAVEL =   6.2   % SAND = 26.2
% SILT = 43.2     % CLAY = 24.4

D85=    0.39  D60=    0.048  D50=    0.020
D30=    0.0035
```

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	17	0.0	3.5	24.3	41.2	31.0

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	31	15	0.254		0.008	0.002				

MATERIAL DESCRIPTION	USCS	AASHTO
● brown lean CLAY with sand	CL	A-6

Project No.: 107391 G & M
Project: C10348.004-CLAYPOOL, INDIANA
● Location: CAP 3 - 12:95

Date: 12-29-95

Remarks:

AS RECEIVED

MOISTURE CONTENT: 15.3%

GRAIN SIZE DISTRIBUTION TEST REPORT

BOWSER-MORNER, INC.

Figure No ______

```
==============================================================================
                       GRAIN SIZE DISTRIBUTION TEST DATA        Test No.: 17
------------------------------------------------------------------------------
Date: 12-29-95
Project No.: 107391    G & M
Project: CI0348.004-CLAYPOOL, INDIANA
==============================================================================

------------------------------------------------------------------------------
                                  Sample Data
------------------------------------------------------------------------------
Location of Sample: CAP 3 - 12:95
Sample Description: brown lean CLAY with sand
USCS Class: CL                        Liquid limit: 31
AASHTO Class: A-6                     Plasticity index: 15
------------------------------------------------------------------------------
                                     Notes
------------------------------------------------------------------------------
Remarks: AS RECEIVED  MOISTURE CONTENT:  15.3%

Fig. No.:
------------------------------------------------------------------------------
                            Mechanical Analysis Data
------------------------------------------------------------------------------
                      Initial
Dry sample and tare=  1664.80
Tare               =   211.30
Dry sample weight  =  1453.50
Sample split on number 10 sieve
Split sample data:
  Sample and tare = 50.13  Tare =  0  Sample weight = 50.13
  Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0
  Sieve          Cumul. Wt.   Percent
                 retained     finer
  1     inches      0.00      100.0
  0.75  inches     19.12       98.7
  0.5   inches     32.35       97.8
  0.375 inches     38.20       97.4
  # 4              50.50       96.5
  # 10             77.06       94.7
  # 20              1.25       92.3
  # 40              2.76       89.5
  # 60              5.28       84.7
  # 100             8.34       78.9
  # 200            11.87       72.3
------------------------------------------------------------------------------
                            Hydrometer Analysis Data
------------------------------------------------------------------------------
Separation sieve is number 10
Percent -# 10 based on complete sample=  94.7
Weight of hydrometer sample: 50.13
Hygroscopic moisture correction:
  Moist weight & tare =  75.97
```

```
  Dry weight & tare     =  75.54
  Tare                  =  31.66
  Hygroscopic moisture=   1.0 %
Calculated biased weight=  52.42
Automatic temperature correction
  Composite correction at 20 deg C =-5

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H   Effective depth L= 16.294964 - 0.164 x Rm

  Elapsed    Temp, Actual   Corrected  K       Rm     Eff.   Diameter  Percent
  time, min  deg C reading  reading                   depth  mm        finer
     1.0     20.9  40.5     35.7       0.0135  40.5    9.7   0.0419    68.0
     2.0     20.9  39.0     34.2       0.0135  39.0    9.9   0.0300    65.2
     5.0     20.9  36.5     31.7       0.0135  36.5   10.3   0.0194    60.4
    15.0     20.9  33.0     28.2       0.0135  33.0   10.9   0.0115    53.7
    30.0     20.8  31.0     26.1       0.0135  31.0   11.2   0.0083    49.8
    60.0     20.7  28.0     23.1       0.0135  28.0   11.7   0.0060    44.1
   120.0     20.7  25.5     20.6       0.0135  25.5   12.1   0.0043    39.3
   240.0     20.8  23.5     18.6       0.0135  23.5   12.4   0.0031    35.5
  1440.0     20.3  19.0     14.0       0.0136  19.0   13.2   0.0013    26.7
-------------------------------------------------------------------------------
                            Fractional Components
-------------------------------------------------------------------------------
Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. =  0.0    % GRAVEL =  3.5   % SAND = 24.3
% SILT = 41.2    % CLAY = 31.0

D85=   0.25  D60=   0.019  D50=   0.008
D30=   0.0018
```

Geraghty & Miller Associates - Project No. CIO348.002

TABLE I

Summary of Hydraulic Conductivity and Moisture Density Relations

Sample Identification:	BORW-1-1012	BORW-2-0406	BORW-3-0210	BORW-3-1012
	Standard Proctor Results			
Maximum Dry Density, pcf:	125.6	128.6	125.7	134.9
Optimum Moisture Content, %:	8.7	9.1	9.2	7.7
	Permeability Results			
Moisture Content, %:	10.4	11.0	11.1	9.1
Wet Unit Weight, pcf:	131.3	135.1	132.5	140.0
Dry Unit Weight, pcf:	119.0	121.7	119.2	128.4
Permeability, cm/sec.:	5.7×10^{-6}	8.3×10^{-6}	1.5×10^{-7}	1.1×10^{-7}

W.O. No. 10
Report No. 00u246A
April 3, 1995
Page 3

Geraghty & Miller Associates - Project No. CIO348.002

TABLE II

Summary of Physical Index Properties

Sample Identification:	BORW-1-1012	BORW-2-0406	BORW-3-0210	BORW-3-1012	SWSB-1-0608	SWSB-1-1012	SWSB-1-2024	SWSB-2-0810
Sieve Size	Percent Passing							
1 1/2"						100		
1"				100		95	100	100
3/4"		100	100	94	100	95	98	99
1/2"	100	99	99	94	98	94	97	98
3/8"	99	98	99	92	98	93	96	97
#4	97	96	96	87	95	90	93	95
#10	93	92	93	82	90	86	88	90
#20	89	87	88	77	85	81	84	86
#40	85	81	83	72	79	73	78	80
#60	79	71	74	64	70	61	70	70
#100	72	60	65	56	59	51	59	59
#200	64	48	54	47	48	40	48	46
Gravel, %:	3	4	4	13	5	10	7	5
Sand, %:	33	49	42	40	47	50	45	48
Silt, %:	45	33	37	35	35	28	35	32
Clay (<0.002 mm), %:	19	14	17	12	13	12	13	15
Liquid Limit:	20	19	20	16	19	18	17	19
Plastic Limit:	12	13	13	11	13	12	11	12
Plasticity Index:	8	6	7	5	6	6	6	7
USCS Classification:	CL	SC-SM	CL-ML	SC-SM	SC-SM	SC-SM	SC-SM	SC-SM
Moisture Content, %:	---	---	---	---	11.9	10.9	8.2	12.4

ASTM D5084
FALLING HEAD
PERMEABILITY TEST
LABORATORY COMPACTED

Date:	March 20, 1995
Project No.:	105292
Client:	Geraghty & Miller
Project:	CIO348.002
Location:	BORW-1-1012
Material Description:	"CL" Gray Sandy Lean Clay
<u>ASTM D698, Standard Proctor</u>	
Maximum Dry Density, pcf:	125.6
Optimum Moisture Content, %:	8.7

SPECIMEN DATA:

Dimension, Inches:	
Height:	2.802
Diameter:	2.760
Weight, lbs.:	
Initial:	1.274
Moisture Content, %:	
Initial:	10.4
Final:	13.8
Wet Unit Weight, pcf:	
Initial:	131.3
Final:	135.5
Dry Unit Weight, pcf:	119.0
% Compaction:	94.7
Permeability, cm/sec.:	
k:	5.7×10^{-6}

ASTM D5084
FALLING HEAD
PERMEABILITY TEST
LABORATORY COMPACTED

Date:	March 20, 1995
Project No.:	105292
Client:	Geraghty & Miller
Project:	CIO348.002
Location:	BORW-2-0406
Material Description:	"SC-SM" Brown Silty, Clayey Sand
<u>ASTM D698, Standard Proctor</u>	
Maximum Dry Density, pcf:	128.6
Optimum Moisture Content, %:	9.1

SPECIMEN DATA:

Dimension, Inches:	
Height:	2.919
Diameter:	2.761
Weight, lbs.:	
Initial:	1.366
Moisture Content, %:	
Initial:	11.0
Final:	14.1
Wet Unit Weight, pcf:	
Initial:	135.1
Final:	138.9
Dry Unit Weight, pcf:	121.7
% Compaction:	94.6
Permeability, cm/sec.:	
k:	8.3×10^{-6}

ASTM D5084
FALLING HEAD
PERMEABILITY TEST
LABORATORY COMPACTED

Date: March 20, 1995

Project No.: 105292

Client: Geraghty & Miller

Project: CIO348.002

Location: BORW-3-0210

Material Description: "CL-ML" Brown Silt, Some Clay, Some Sand, Some Gravel

<u>ASTM D698, Standard Proctor</u>
Maximum Dry Density, pcf: 125.7
Optimum Moisture Content, %: 9.2

SPECIMEN DATA:

Dimension, Inches:
- Height: 3.165
- Diameter: 2.776

Weight, lbs.:
- Initial: 1.468

Moisture Content, %:
- Initial: 11.1
- Final: 14.3

Wet Unit Weight, pcf:
- Initial: 132.5
- Final: 136.3

Dry Unit Weight, pcf: 119.2

% Compaction: 94.8

Permeability, cm/sec.:
- k: 1.5 x 10^{-7}

ASTM D5084
FALLING HEAD
PERMEABILITY TEST
LABORATORY COMPACTED

Date: April 3, 1995

Project No.: 105292

Client: Geraghty & Miller

Project: CIO348.002

Location: BORW-3-1012

Material Description: "CL-ML" Gray Silty, Clayey Sand

<u>ASTM D698, Standard Proctor</u>
Maximum Dry Density, pcf: 134.9
Optimum Moisture Content, %: 7.7

SPECIMEN DATA:

Dimension, Inches:
- Height: 2.607
- Diameter: 2.769

Weight, lbs.:
- Initial: 1.272

Moisture Content, %:
- Initial: 9.1
- Final: 10.7

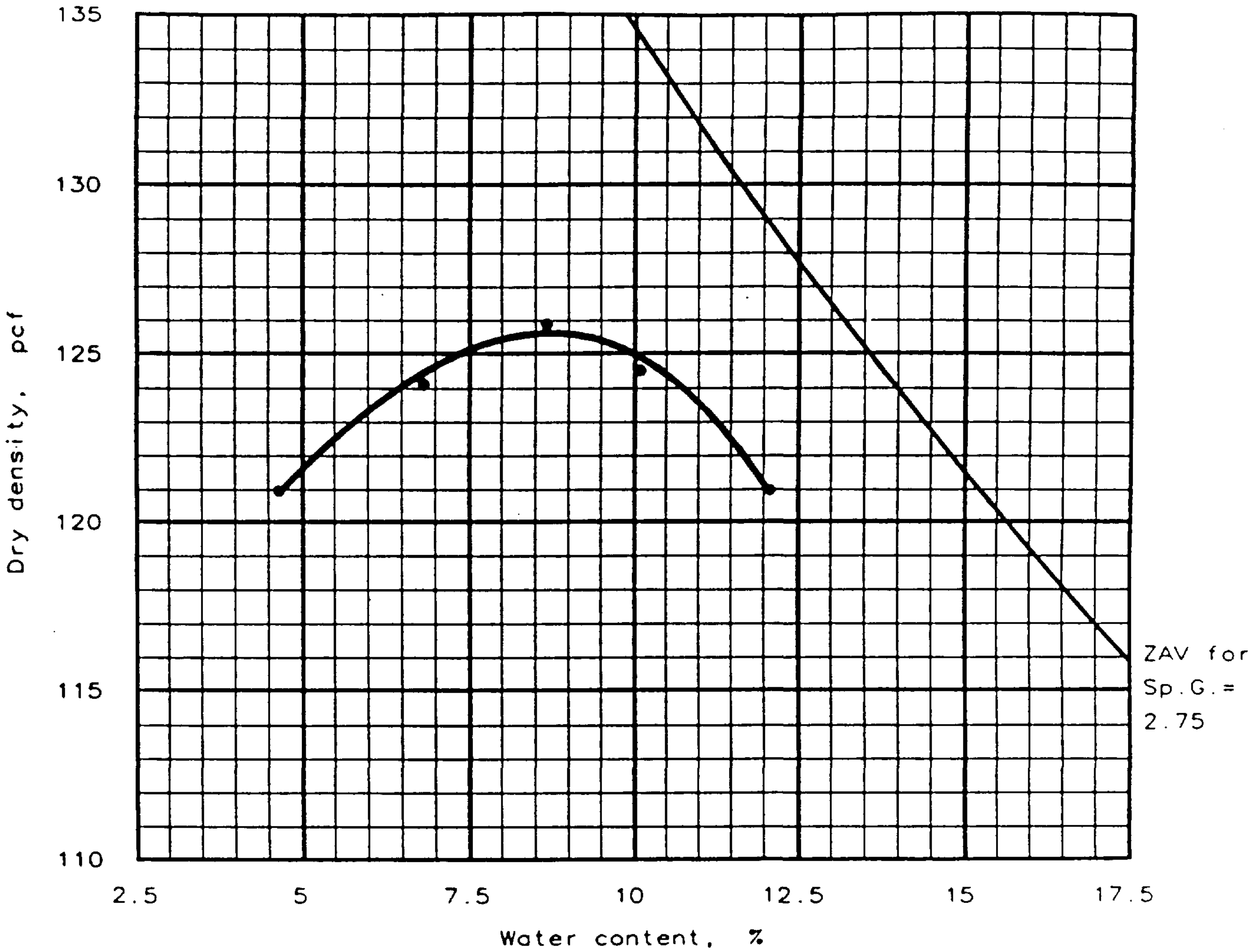
Wet Unit Weight, pcf:
- Initial: 140.0
- Final: 142.1

Dry Unit Weight, pcf: 128.4

% Compaction: 95.2

Permeability, cm/sec.:
- k: 1.1 x 10^{-7}

PROCTOR TEST REPORT



Test specification: ASTM D 698-91 Method A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	CL				20	8	3 %	64 %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 125.6 pcf Optimum moisture = 8.7 %	GRAY SANDY LEAN CLAY

Project No.: 105292 GERAGHTY & MILLER

Project: C10348.002

Location: BORW-1-1012

Date: 3-02-1995

Remarks:

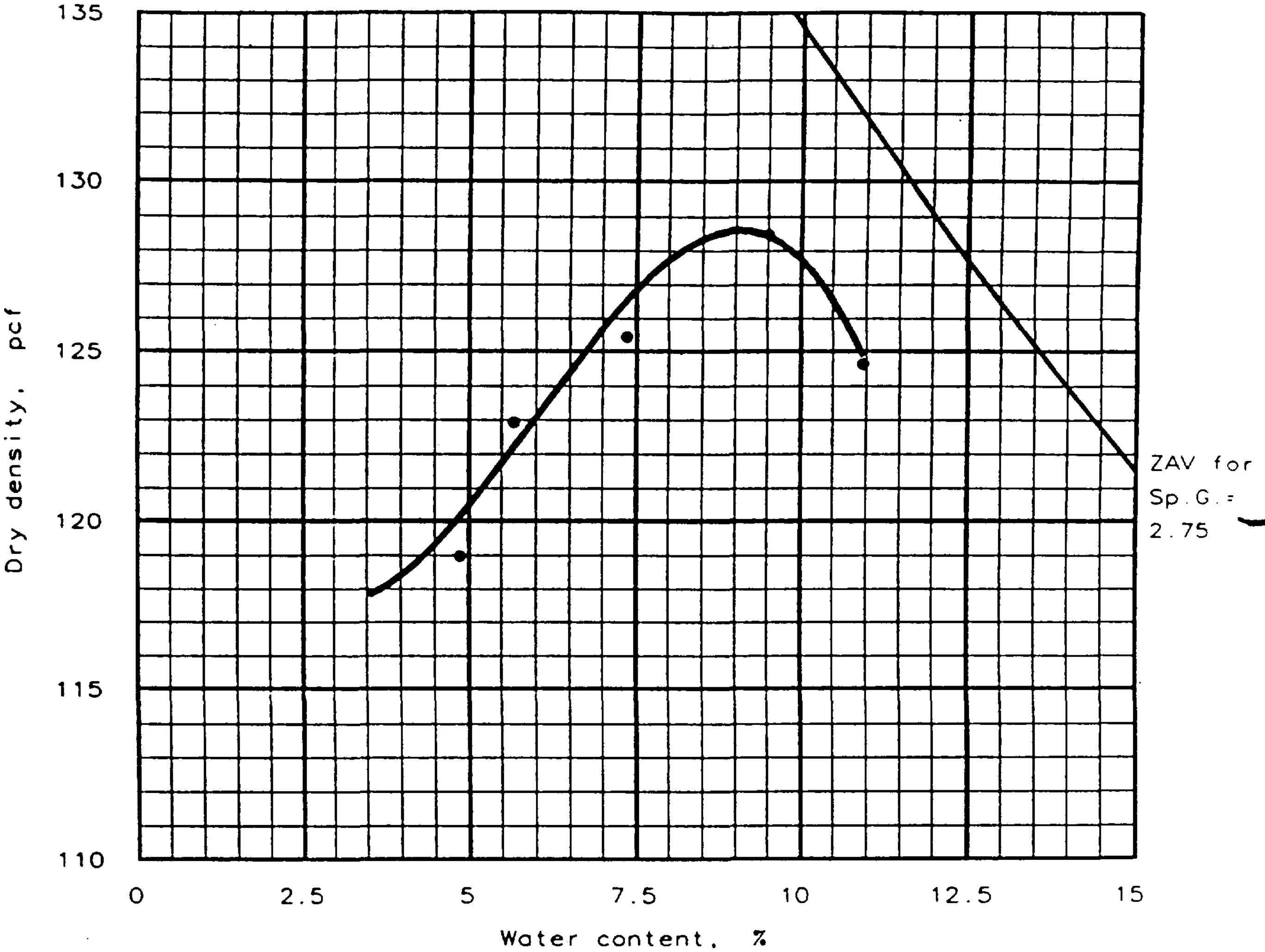
BAG SAMPLE

PROCTOR TEST REPORT

BOWSER-MORNER, INC.

TEST NO. 569

PROCTOR TEST REPORT



Test specification: ASTM D 698-91 Method A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	SC-SM				19	6	4 %	48 %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 128.6 pcf Optimum moisture = 9.1 %	BROWN SILTY, CLAYEY SAND

Project No.: 105292 GERAGHTY & MILLER

Project: C10348.002

Location: BORW-2-0406

Date: 3-02-1995

Remarks:

BAG SAMPLE

PROCTOR TEST REPORT

BOWSER-MORNER, INC.

TEST NO. 568

PROCTOR TEST REPORT

Test specification: ASTM D 698-91 Method A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	CL-ML				20	7	4 %	54 %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 125.7 pcf Optimum moisture = 9.2 %	BROWN SANDY SILTY CLAY

Project No.: 105292 GERAGHTY & MILLER

Project: C10348.002

Location: BORW-3-0210

Date: 3-02-1995

Remarks:

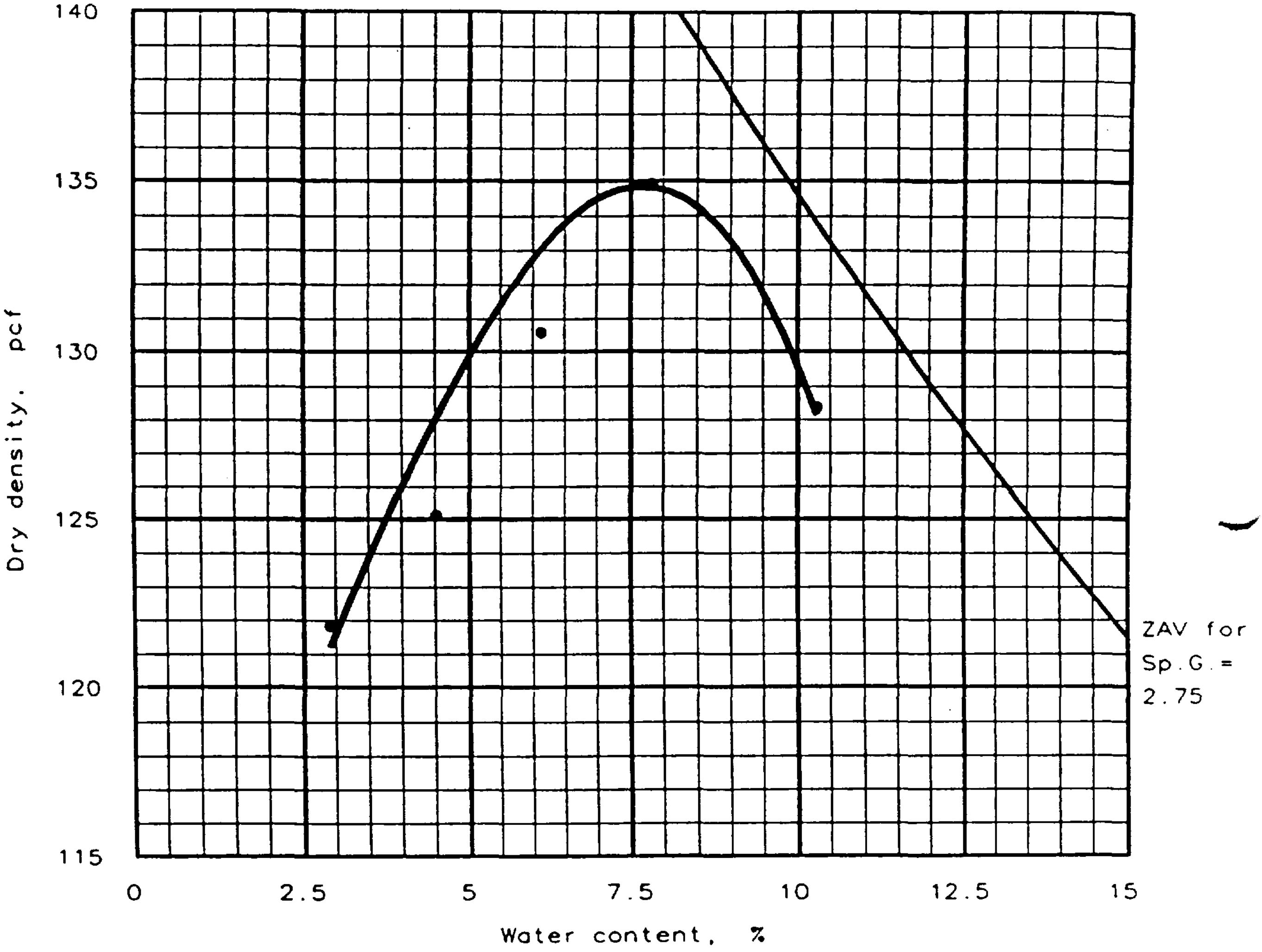
BAG SAMPLE

PROCTOR TEST REPORT

BOWSER-MORNER, INC.

TEST NO. 567

PROCTOR TEST REPORT



Test specification: ASTM D 698-91 Method A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	SC-SM				16	5	13 %	47 %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 134.9 pcf Optimum moisture = 7.7 %	GRAY SILTY, CLAYEY SAND

Project No.: 105292 GERAGHTY & MILLER
Project: C10348.002
Location: BORW-3-1012

Date: 3-02-1995

PROCTOR TEST REPORT

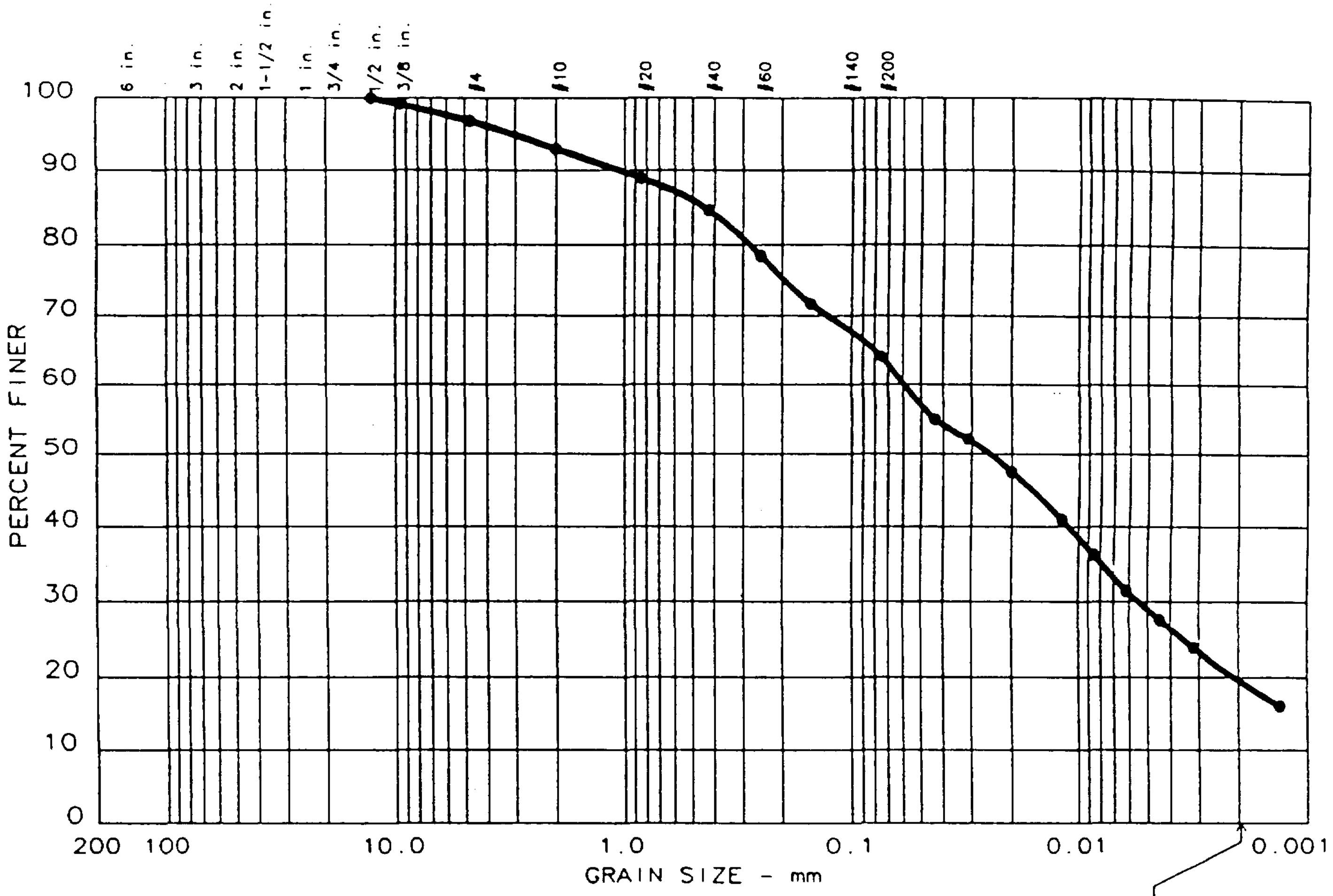
BOWSER-MORNER, INC.

Remarks:

BAG SAMPLE

TEST NO. 570

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	8	0.0	3.2	32.8	44.5	19.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	20	8	0.442		0.025	0.005				

MATERIAL DESCRIPTION	USCS	AASHTO
● GRAY SANDY LEAN CLAY	CL	

Project No.: 105292 G & M
Project: C10348.002
● Location: BORW-1-1012

Date: 03-09-95

Remarks:

BAG SAMPLE

GRAIN SIZE DISTRIBUTION TEST REPORT

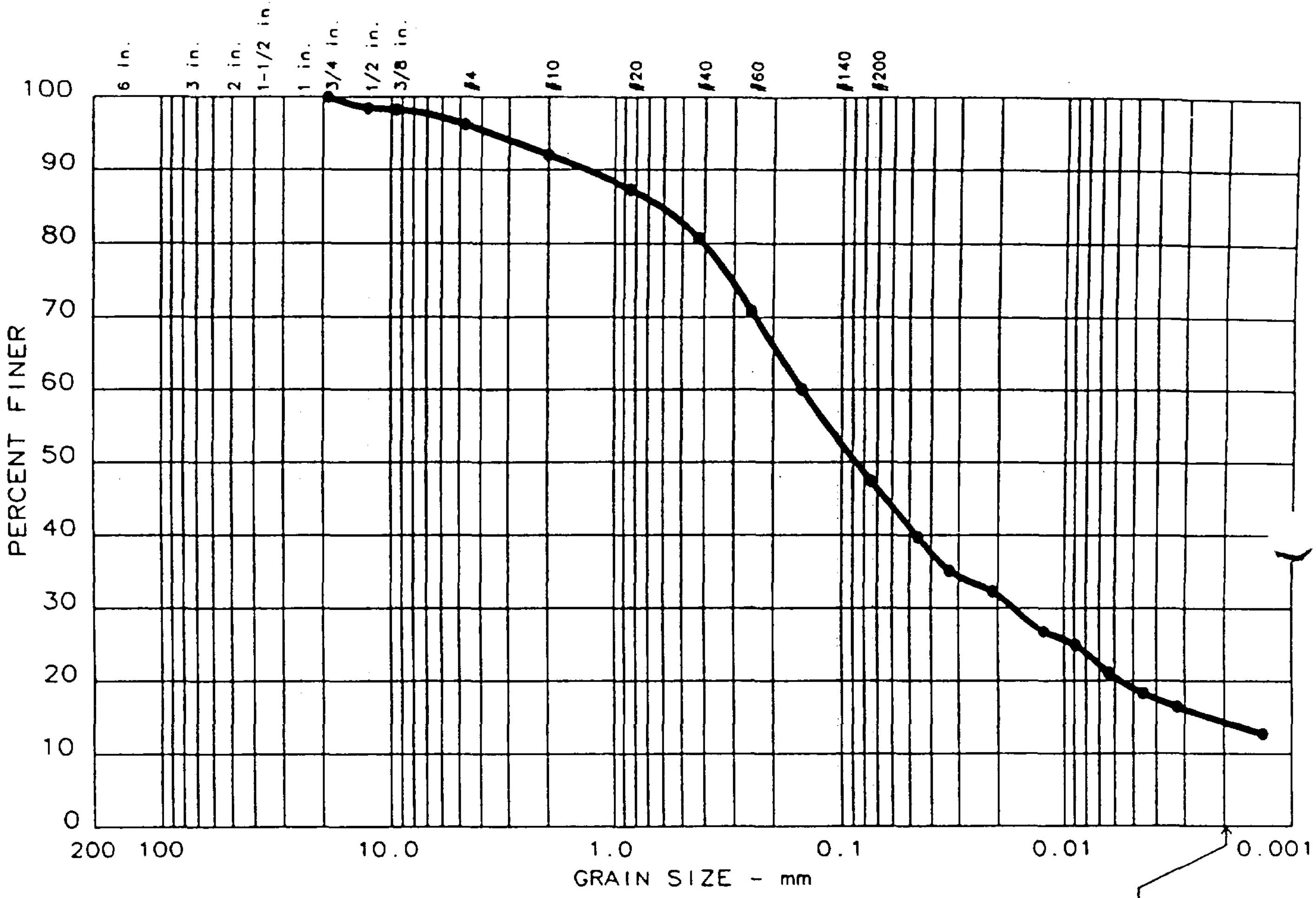
BOWSER-MORNER, INC.

Figure No. ______

```
==============================================================================
                     GRAIN SIZE DISTRIBUTION TEST DATA            Test No.: 8
------------------------------------------------------------------------------
   e: 03-09-95
Project No.: 105292     G & M
Project: CIO348.002
==============================================================================

------------------------------------------------------------------------------
                                 Sample Data
------------------------------------------------------------------------------
Location of Sample: BORW-1-1012
Sample Description: GRAY SANDY LEAN CLAY
USCS Class: CL                        Liquid limit: 20
AASHTO Class:                         Plasticity index: 8
------------------------------------------------------------------------------
                                    Notes
------------------------------------------------------------------------------
Remarks:
         BAG SAMPLE
Fig. No.:
------------------------------------------------------------------------------
                           Mechanical Analysis Data
------------------------------------------------------------------------------
                        Initial
Dry sample and tare=  1462.60
Tare              =    217.30
Dry sample weight  =  1245.30
Sample split on number 10 sieve
   it sample data:
  Sample and tare = 50.05  Tare =  0  Sample weight = 50.05
  Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0
  Sieve               Cumul. Wt.   Percent
                      retained     finer
  0.5   inches          0.00       100.0
  0.375 inches         11.35        99.1
  # 4                  40.11        96.8
  # 10                 87.47        93.0
  # 20                  2.15        89.0
  # 40                  4.49        84.6
  # 60                  7.81        78.5
  # 100                11.44        71.7
  # 200                15.59        64.0
------------------------------------------------------------------------------
                          Hydrometer Analysis Data
------------------------------------------------------------------------------
Separation sieve is number 10
Percent -# 10 based on complete sample=  93.0
Weight of hydrometer sample: 50.05
Hygroscopic moisture correction:
  Moist weight & tare =  48.05
  Dry weight & tare   =  47.98
  Tare                =  28.53
```

```
  Hygroscopic moisture=   0.4 %
Calculated biased weight=  53.64
Automatic temperature correction
   omposite correction at 20 deg C =-4.5

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H   Effective depth L= 16.294964 - 0.164 x Rm

  Elapsed     Temp, Actual   Corrected  K          Rm     Eff.   Diameter   Percent
  time, min   deg C reading  reading                      depth  mm         finer
     1.0      22.3  33.5     29.5       0.0133     33.5   10.8   0.0436     55.0
     2.0      22.3  32.0     28.0       0.0133     32.0   11.0   0.0312     52.2
     5.0      22.3  29.5     25.5       0.0133     29.5   11.5   0.0201     47.5
    15.0      22.2  26.0     22.0       0.0133     26.0   12.0   0.0119     40.9
    30.0      22.1  23.5     19.4       0.0133     23.5   12.4   0.0086     36.2
    60.0      21.9  21.0     16.9       0.0133     21.0   12.9   0.0062     31.5
   120.0      21.7  19.0     14.8       0.0134     19.0   13.2   0.0044     27.7
   240.0      21.7  17.0     12.8       0.0134     17.0   13.5   0.0032     23.9
  1440.0      22.7  12.5      8.6       0.0132     12.5   14.2   0.0013     16.0
-------------------------------------------------------------------------------
                              Fractional Components
-------------------------------------------------------------------------------
Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. =   0.0     % GRAVEL =   3.2    % SAND = 32.8
% SILT = 44.5     % CLAY = 19.5

-  =   0.44   D60=    0.060  D50=    0.025
D30=   0.0054
```

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	1	0.0	3.8	48.7	33.2	14.3

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	19	6	0.617	0.149	0.087	0.017	0.0023			

MATERIAL DESCRIPTION	USCS	AASHTO
● BROWN SILTY, CLAYEY SAND	SC-SM	

Project No.: 105292 G & M
Project: C10348.002
● Location: BORW-2-0406

Date: 03-11-95

Remarks:

BAG SAMPLE

GRAIN SIZE DISTRIBUTION TEST REPORT

BOWSER-MORNER, INC.

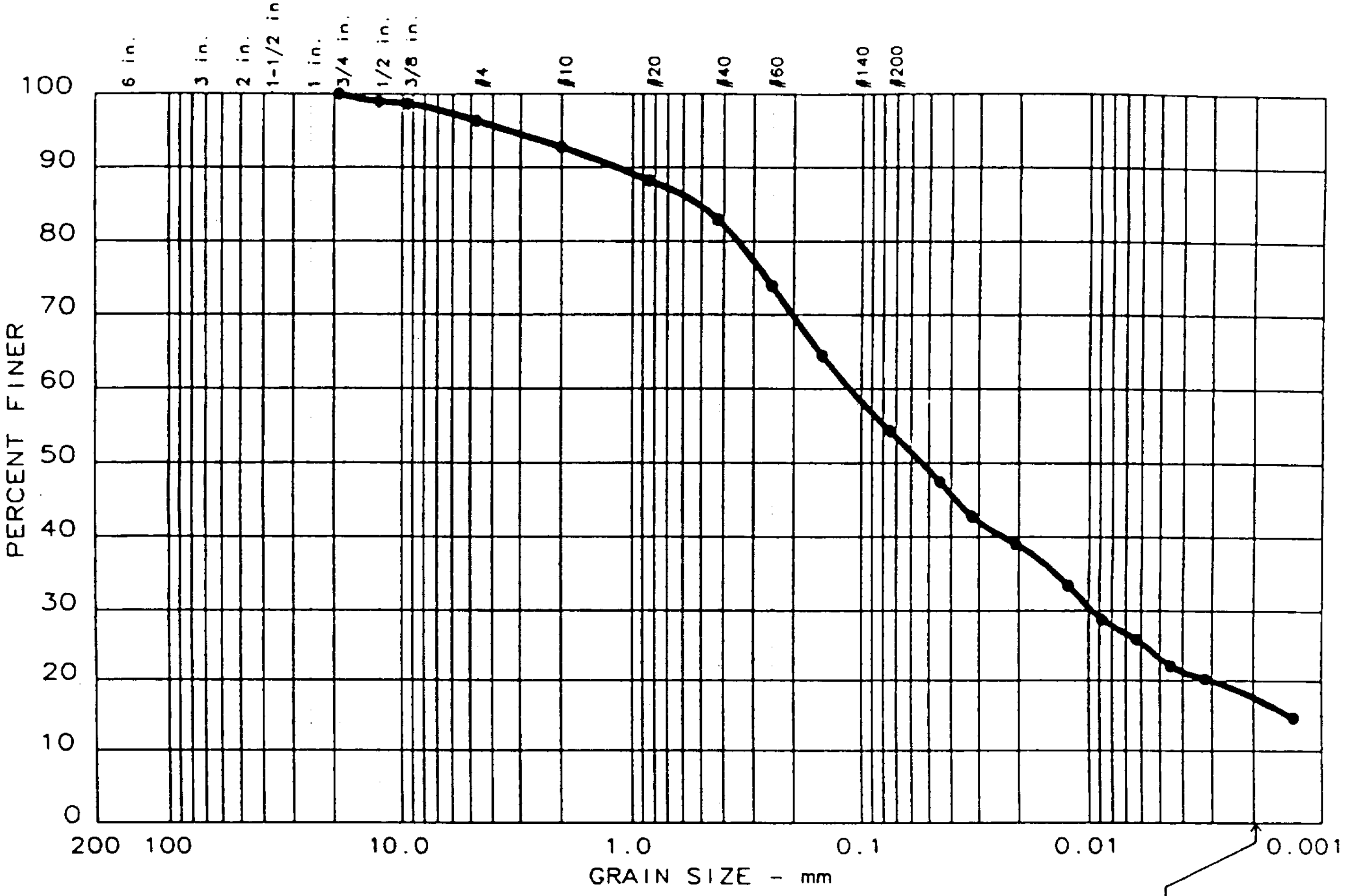
Figure No. ______

```
===========================================================================
                        GRAIN SIZE DISTRIBUTION TEST DATA        Test No.: 1
---------------------------------------------------------------------------
  e: 03-11-95
Project No.: 105292    G & M
Project: CI0348.002
===========================================================================

---------------------------------------------------------------------------
                                   Sample Data
---------------------------------------------------------------------------
Location of Sample: BORW-2-0406
Sample Description: BROWN SILTY, CLAYEY SAND
USCS Class: SC-SM                         Liquid limit: 19
AASHTO Class:                             Plasticity index: 6
---------------------------------------------------------------------------
                                      Notes
---------------------------------------------------------------------------
Remarks:
        BAG SAMPLE
 g. No.:
---------------------------------------------------------------------------
                             Mechanical Analysis Data
---------------------------------------------------------------------------
                        Initial
Dry sample and tare=  1458.40
Tare                =   216.20
Dry sample weight   =  1242.20
  ple split on number 10 sieve
Split sample data:
  Sample and tare = 50.04  Tare =  0  Sample weight = 50.04
  Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0
  Sieve            Cumul. Wt.   Percent
                   retained     finer
  0.75  inches       0.00       100.0
  0.5   inches      19.12        98.5
  0.375 inches      21.64        98.3
  # 4               47.24        96.2
  # 10              98.51        92.1
  # 20               2.58        87.3
  # 40               6.19        80.7
  # 60              11.59        70.7
  # 100             17.40        60.1
  # 200             24.23        47.5
---------------------------------------------------------------------------
                             Hydrometer Analysis Data
---------------------------------------------------------------------------
Separation sieve is number 10
Percent -# 10 based on complete sample=  92.1
Weight of hydrometer sample: 50.04
Hygroscopic moisture correction:
  Moist weight & tare =  53.99
  Dry weight & tare   =  53.85
```

```
  Tare                       =  28.62
  Hygroscopic moisture=   0.6 %
Calculated biased weight=  54.05
   omatic temperature correction
   omposite correction at 20 deg C =-5

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H   Effective depth L= 16.294964 - 0.164 x Rm

  Elapsed     Temp, Actual   Corrected  K          Rm     Eff.    Diameter   Percent
  time, min   deg C reading  reading                      depth   mm         finer
     1.0      22.3  26.0     21.5        0.0133    26.0   12.0    0.0460     39.7
     2.0      22.3  23.5     19.0        0.0133    23.5   12.4    0.0331     35.1
     5.0      22.3  22.0     17.5        0.0133    22.0   12.7    0.0211     32.3
    15.0      22.2  19.0     14.5        0.0133    19.0   13.2    0.0124     26.7
    30.0      22.1  18.0     13.4        0.0133    18.0   13.3    0.0089     24.9
    60.0      21.9  16.0     11.4        0.0133    16.0   13.7    0.0064     21.1
   120.0      21.7  14.5      9.8        0.0134    14.5   13.9    0.0046     18.2
   240.0      21.7  13.5      8.8        0.0134    13.5   14.1    0.0032     16.3
  1440.0      21.7  11.5      6.8        0.0134    11.5   14.4    0.0013     12.6  ✓
-------------------------------------------------------------------------------
                              Fractional Components
-------------------------------------------------------------------------------
Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. =   0.0     % GRAVEL =   3.8    % SAND = 48.7
% SILT = 33.2     % CLAY = 14.3

D85=     0.62  D60=     0.149  D50=     0.087
D30=     0.0168  D15=    0.00229
```

✓

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	10	0.0	3.7	42.0	36.8	17.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	20	7	0.513	0.112	0.053	0.010	0.0014			

MATERIAL DESCRIPTION	USCS	AASHTO
● BROWN SANDY SILTY CLAY	CL-ML	

Project No.: 105292 G & M
Project: CI0348.002
● Location: BORW-3-0210

Date: 03-09-95

GRAIN SIZE DISTRIBUTION TEST REPORT

BOWSER-MORNER, INC.

Remarks:

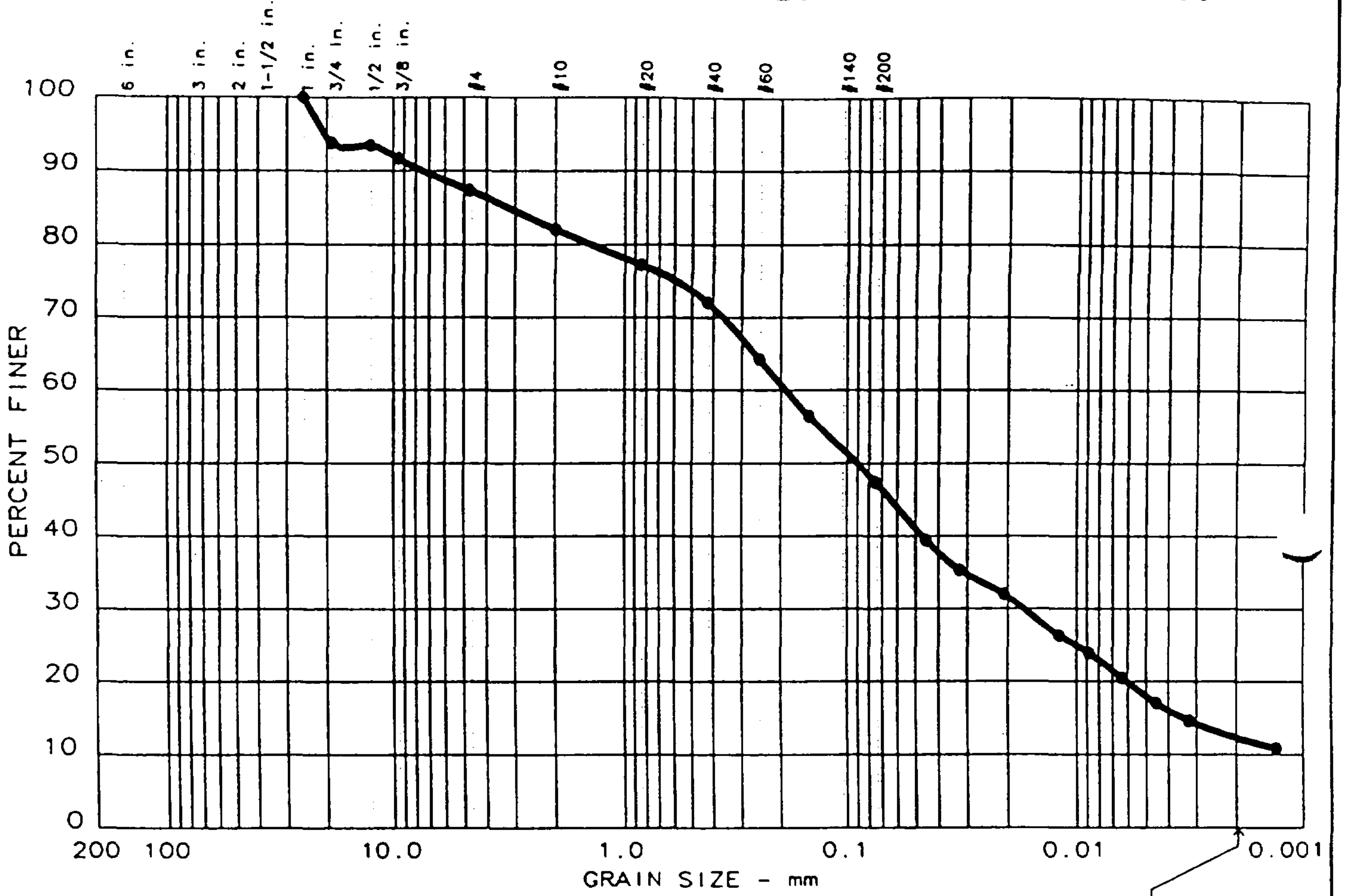
BAG SAMPLE

Figure No. ______

```
==============================================================================
                    GRAIN SIZE DISTRIBUTION TEST DATA          Test No.: 10
------------------------------------------------------------------------------
   e: 03-09-95
Project No.: 105292    G & M
Project: CI0348.002
==============================================================================

------------------------------------------------------------------------------
                                  Sample Data
------------------------------------------------------------------------------
Location of Sample: BORW-3-0210
Sample Description: BROWN SANDY SILTY CLAY
USCS Class: CL-ML                    Liquid limit: 20
AASHTO Class:                        Plasticity index: 7
------------------------------------------------------------------------------
                                     Notes
------------------------------------------------------------------------------
Remarks:
        BAG SAMPLE
Fig. No.:
------------------------------------------------------------------------------
                           Mechanical Analysis Data
------------------------------------------------------------------------------
                     Initial
Dry sample and tare=  1508.50
Tare               =   221.00
Dry sample weight  =  1287.50
 mple split on number 10 sieve
  it sample data:
  Sample and tare = 50.07  Tare =  0  Sample weight = 50.07
  Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0
  Sieve           Cumul. Wt.   Percent
                  retained     finer
  0.75  inches       0.00      100.0
  0.5   inches      13.54       98.9
  0.375 inches      17.22       98.7
  # 4               47.03       96.3
  # 10              93.38       92.7
  # 20               2.41       88.3
  # 40               5.30       82.9
  # 60              10.19       73.9
  # 100             15.27       64.5
  # 200             20.74       54.3
------------------------------------------------------------------------------
                          Hydrometer Analysis Data
------------------------------------------------------------------------------
Separation sieve is number 10
Percent -# 10 based on complete sample=  92.7
Weight of hydrometer sample: 50.07
Hygroscopic moisture correction:
  Moist weight & tare =  53.89
  Dry weight & tare   =  53.75
```

```
  Tare                     =  28.18
  Hygroscopic moisture=   0.5 %
Calculated biased weight=  53.69
  :omatic temperature correction
  Composite correction at 20 deg C =-4.5

Meniscus correction only= 0
Specific gravity of solids= 2.65
Specific gravity correction factor= 1.000
Hydrometer type: 152H   Effective depth L= 16.294964 - 0.164 x Rm

  Elapsed     Temp, Actual    Corrected  K          Rm     Eff.    Diameter  Percent
  time, min   deg C reading   reading                      depth   mm        finer
     1.0      22.3  29.5      25.5       0.0133    29.5   11.5    0.0449    47.5
     2.0      22.3  27.0      23.0       0.0133    27.0   11.9    0.0323    42.8
     5.0      22.3  25.0      21.0       0.0133    25.0   12.2    0.0207    39.1
    15.0      22.2  22.0      18.0       0.0133    22.0   12.7    0.0122    33.4
    30.0      22.1  19.5      15.4       0.0133    19.5   13.1    0.0088    28.7
    60.0      21.9  18.0      13.9       0.0133    18.0   13.3    0.0063    25.9
   120.0      21.7  16.0      11.8       0.0134    16.0   13.7    0.0045    22.0
   240.0      21.7  15.0      10.8       0.0134    15.0   13.8    0.0032    20.2
  1440.0      21.7  12.0       7.8       0.0134    12.0   14.3    0.0013    14.6
-------------------------------------------------------------------------------
                             Fractional Components
-------------------------------------------------------------------------------
Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. =  0.0     % GRAVEL =  3.7    % SAND = 42.0
% SILT = 36.8     % CLAY = 17.5

D85=   0.51  D60=   0.112  D50=   0.053
D30=   0.0097  D15=   0.00140
```

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	9	0.0	12.6	39.9	35.2	12.3

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	16	5	3.199	0.191	0.090	0.017	0.0035			

MATERIAL DESCRIPTION	USCS	AASHTO
● GRAY SILTY, CLAYEY SAND	SC-SM	

Project No.: 105292 G & M
Project: C10348.002
● Location: BORW-3-1012

Date: 03-09-95

Remarks:

BAG SAMPLE

GRAIN SIZE DISTRIBUTION TEST REPORT
BOWSER-MORNER, INC.

Figure No. ______

```
================================================================================
                        GRAIN SIZE DISTRIBUTION TEST DATA          Test No.: 9
--------------------------------------------------------------------------------
   e: 03-09-95
Project No.: 105292    G & M
Project: CIO348.002
================================================================================

--------------------------------------------------------------------------------
                                   Sample Data
--------------------------------------------------------------------------------
Location of Sample: BORW-3-1012
Sample Description: GRAY SILTY, CLAYEY SAND
USCS Class: SC-SM                     Liquid limit: 16
AASHTO Class:                         Plasticity index: 5
--------------------------------------------------------------------------------
                                      Notes
--------------------------------------------------------------------------------
Remarks:
         BAG SAMPLE
  g. No.:
--------------------------------------------------------------------------------
                             Mechanical Analysis Data
--------------------------------------------------------------------------------
                         Initial
Dry sample and tare=   1620.80
Tare               =    205.80
Dry sample weight  =   1415.00
   ple split on number 10 sieve
  lit sample data:
  Sample and tare = 50.02  Tare =  0  Sample weight = 50.02
  Cumulative weight retained tare= 0
Tare for cumulative weight retained= 0
  Sieve              Cumul. Wt.   Percent
                      retained    finer
  1     inches          0.00      100.0
  0.75  inches         86.80       93.9
  0.5   inches         91.82       93.5
  0.375 inches        116.77       91.7
  # 4                 178.89       87.4
  # 10                253.94       82.1
  # 20                  2.97       77.2
  # 40                  6.10       72.0
  # 60                 10.88       64.2
  # 100                15.62       56.4
  # 200                21.12       47.4
--------------------------------------------------------------------------------
                             Hydrometer Analysis Data
--------------------------------------------------------------------------------
Separation sieve is number 10
Percent -# 10 based on complete sample=  82.1
Weight of hydrometer sample: 50.02
Hygroscopic moisture correction:
  Moist weight & tare =  57.25
```

```
   Dry weight & tare     =  57.17
   Tare                  =  31.09
   Hygroscopic moisture=   0.3 %
    culated biased weight=  60.77
 Automatic temperature correction
   Composite correction at 20 deg C =-5

 Meniscus correction only= 0
 Specific gravity of solids= 2.65
 Specific gravity correction factor= 1.000
 Hydrometer type: 152H   Effective depth L= 16.294964 - 0.164 x Rm

   Elapsed     Temp, Actual    Corrected  K          Rm     Eff.    Diameter   Percent
   time, min   deg C reading   reading                      depth   mm         finer
      1.0      22.3  28.5      24.0       0.0133     28.5   11.6    0.0452     39.5
      2.0      22.3  26.0      21.5       0.0133     26.0   12.0    0.0325     35.3
      5.0      22.3  24.0      19.5       0.0133     24.0   12.4    0.0209     32.1
     16.0      22.2  20.5      16.0       0.0133     20.5   12.9    0.0119     26.3
     30.0      22.2  19.0      14.5       0.0133     19.0   13.2    0.0088     23.8
     60.0      21.9  17.0      12.4       0.0133     17.0   13.5    0.0063     20.4
    120.0      21.7  15.0      10.3       0.0134     15.0   13.8    0.0045     17.0
    240.0      21.7  13.5       8.8       0.0134     13.5   14.1    0.0032     14.5
   1440.0      22.7  11.0       6.6       0.0132     11.0   14.5    0.0013     10.8
 ------------------------------------------------------------------------------------
                              Fractional Components
 ------------------------------------------------------------------------------------
 Gravel/Sand based on #4 sieve
 Sand/Fines based on #200 sieve
   + 3 in. =   0.0     % GRAVEL = 12.6    % SAND = 39.9
   SILT = 35.2     % CLAY = 12.3

 D85=    3.20  D60=    0.191  D50=    0.090
 D30=    0.0168  D15=    0.00347
```

APPENDIX D

APPENDIX D

CALCULATION BRIEFS

SUBJECT:
PROJECT:
CLIENT/PROJECT: NO:

BY: MDM DATE: 2/1
CHKD: DATE:
REV: DATE:

PAGE

SHEET 1/2

Calculation Brief 1: Erosion Potential

Objective

Estimate the long term soil loss of the proposed final cover.

Considerations

The United States Department of Agriculture Universal Soil Loss Equation (USLE) is designed to predict the long-term average soil loss.

Calculations

The average annual value of the rainfall erosion index R from Figure 12.10.1 (reference 1) for the Claypool, Indiana Area is 150.

The soil erodibility factor K in tons/acre is based on the soil textural class. For loamy sand and sand loam the erodibility factors are 0.12 and 0.27 respectively.

The length and steepness of the cap varies across the site. The average slope is estimated at 5.0% and the average length of the slopes is approximately 418 feet. The length and slopes were approximated by calculating the slope and it's associated length approximately every 300 feet and then taking the average of these values. Worksheet 1 shows the approximated values. The average length and slope was used in Figure 12.10.3 in Reference 1. to get the Steepness Factor LS. The Steepness Factor is estimated at 1.3 .

Worksheet 1

Sample	Length (feet)	Slope %
1	600	4
2	600	4
3	450	4
4	200	6.5
5	350	4
6	350	4
7	300	4
8	450	4
9	450	5.1
10	500	5.2
11	350	10.3
Avg.	418.2	5.0
Std. Dev.	123.0	1.9

The Cropping Management Factor C was taken from Table 12.10.2 in Reference 1 and is estimated at 0.038. The Cropping Management Factor is estimated for surface of grass and grass like plants and brush covering approximately 60 percent of the surface area with a drop fall height of 20 inches.

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SHEET 2/2

The Conservation Practice Factor P is estimated at 0.50. The Conservation Practice Factor was estimated for land slopes of 2-7 percent and for erosion-control planting practices.

Solution

A= R*K*LS*C*P

Loamy Sand - A= **0.4446** tons/acre/year
Sandy Loam- A= **1.0004** tons/acre/year

The predicted erosion loss is less than the maximum allowable erosion rate of 5 tons/acre/year specified in 329 Indiana Administrative Code 2-14-19.

References

1. Handbook of Hydrology, David R. Maidment Editor in Chief, McGraw Hill, 1993

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PAGE

SHEET 1

Calculation Brief 2: Estimated Composition Of Recovered Groundwater

Lakeland Disposal Landfill
Claypool, Indiana

Objective: To estimate the chemical composition of the groundwater recovered by the subsurface drain (Figure 2-1), based on groundwater data from the 1990/1991 Remedial Investigation, the February 1995 Pre-Design Study investigation and the October 1995 monitoring event.

Assumptions:

- The flow rate of the groundwater entering the drain is approximately equal at all sections of the drain; thus, flow-weighted averages will not be utilized;
- Groundwater data from monitoring wells nearest in proximity to the drain will be utilized to determine groundwater composition: GMMW-2, GMMW-3, GMMW-4, GMMW-5, GMMW-6, GMMW-9, and GMMW-17;
- Because the above-listed wells are located along the length of the drain at relatively regular intervals, spacial-weighted averages will not be utilized;
- The March 1995 analytical data for the composite sample collected during the pump yield test will be utilized as representative of inorganic constituent concentrations in the recovered groundwater;
- The March and October 1995 analytical data for the above-listed well locations will be averaged to determine organic constituent concentrations in the recovered groundwater; and
- The organic constituents present in the recovered groundwater include:
  acetone, benzene, carbon disulfide, chloroethane, chloromethane, TCE, 1,1-DCA, cis-1,2-DCE, toluene

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Predicted Constituent Concentrations (mg/L) in Recovered Groundwater

	Groundwater Monitoring Well GMMW-								
Constituent	2	3	4	5	6	9	17	Average Concentration	Composite Sample
Acetone	0.0125	0.0125	0.9375	0.0125	0.0125	0.0125	0.0125	0.140	
Benzene	0.0025	0.0045	0.1875	0.0025	0.0025	0.0025	0.0025	0.030	
Carbon disulfide	0.0025	0.0025	0.1875	0.0025	0.0025	0.0025	0.0025	0.030	
Chloroethane	0.0105	0.031	0.375	0.005	0.005	0.005	0.005	0.060	
Chloromethane	0.005	0.0375	0.1875	0.005	0.005	0.005	0.005	0.040	
Toluene	0.0025	0.0285	0.1875	0.0025	0.0025	0.0025	0.0025	0.030	
TCE	0.0025	0.0025	8.85	0.0025	0.0025	0.0057	0.0025	1.270	
1,1-DCA	0.0025	0.0405	0.1875	0.0025	0.0075	0.0025	0.0025	0.040	
cis-1,2-DCE	0.0025	0.0025	0.435	0.0025	0.0025	0.0208	0.0025	0.070	
Aluminum	19	65	12	39.55	9.3	4.6	13	23.210	4.900
Antimony	0.003	0.003	0.003		0.003	0	0	0.000	0.050
Arsenic	0.0295	0.052	0.025	0.024	0.018	0.005	0.011	0.020	0.005
Barium	0.86	0.54	0.13	0.615	0.18	0.08	0.2	0.370	0.300
Beryllium	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.003	0.003
Cadmium	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.003	0.003
Calcium	490	670	200	356	170	130	220	319.430	210.000
Chromium	0.0395	0.13	0.045	0.0675	0.013	0.012	0.05	0.050	0.039
Cobalt	0.0245	0.069	0.012	0.03	0.005	0.005	0.051	0.030	0.029
Copper	0.0825	0.19	0.078	0.0713	0.035	0.0125	0.035	0.070	0.034
Iron	47.5	192.5	19.5	66.15	19.5	9.4	21	53.650	14.000
Lead	0.0433	0.16	0.0205	0.0368	0.019	0.005	0.0125	0.040	0.005
Magnesium	115	200	130	60	37	42	95	97.000	77.000
Manganese	2.35	3.5	0.5	1.4155	0.67	0.17	0.48	1.300	0.550
Mercury	0.0001	0.00018	0.0001	0.0001	0.0001	0.0001	0.0001	0.000	0.000
Nickel	0.0565	0.17	0.064	0.085	0.02	0.02	0.42	0.120	0.240
Potassium	19.5	15	4.7	10.05	2.7	4.5	7.4	9.120	11.000
Silver	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Selenium	0.005	0.025	0.005	0.005	0.005	0.005	0.005	0.010	0.005
Sodium	43.5	40.75	15.5	11.45	8.75	7	380	72.420	230.000
Thallium	0.005	0.005	0.005	0.005	0.005	0.005	0.01	0.010	0.010
Vanadium	0.0675	0.16	0.04	0.0925	0.031	0.012	0.026	0.060	0.014
Zinc	0.115	0.43	0.175	0.205	0.041	0.0185	0.063	0.150	0.610
Cyanide	0.005	0.005	0.005	0.005	0.005	0.005	0.19	0.030	0.110
pH	6.88	7.1	6.97	7.51	6.98	7.29	7.26	7.14	
Nitrate									3
Chloride									210
Sulfate as SO4									220
Suspended Solids									350
Dissolved Solids									1,400
Hardness									17

G:\APROJECT\DYKMAGOS\C10348\LAKELAND\WORKING\[BACKUP XLS]Estimated composition

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SHEET 1/3

Calculation Brief 3: Stormwater Drainage Design

Objective:
Determine the characterics of a stormwater basin to replace the existing drain tile.

Considerations:
Replacing the drain tile using a PVC gravity flow pipeline. The elevation from the stormwater catch basin inlet to the sloan ditch is 1005 and 990 feet respectively. The basin should support a 1 inch 4 hour storm event.

Calculations:

$T := 4 \cdot hr$	**Duration of Storm Event**
$C := 0.45$	**Runoff Coefficient, Using Developed Grassy Areas, with grass cover less than 50% of the area, and slopes over 7%.**
$i := .25 \cdot \frac{in}{hr}$	**Rainfall intensity based on 25 year, 1 hour storm event.**
$Area_A := 22 \cdot acre$	**Estimated Watershed for for storm water catch basin.**
$Q_A := C \cdot i \cdot Area_A$	**Estimated Watershed sheet flow runoff, using the Rational Method (Reference 2).**

$$Q_A = 2.496 \cdot \frac{ft^3}{sec}$$

$V_{runoff} := Q_A \cdot T$	**Inflow Volumes during 1 hour storm event from the surface runoff**

$$V_{runoff} = 0.8 \cdot acre \cdot ft$$

$D := 4 \cdot in$	**Assumed diameter of detention Basin outflow pipe**
$R := \frac{D}{4}$	**Hydraulic Radius (assuming sewer flows half full).**

G&M Form 30 6-89

Southprint 95-0070

$n := 0.011$ **Mannings n, roughness coefficient for HDPE pipe.**

$\Delta E := 15 \cdot ft$ **The change in elevation between basin inflow and the sloan dicth.**

$Depth_{basin} := 6 \cdot ft$ **Depth of basin**

$Length_{pipe} := 475 \cdot ft$ **Length of pipe from the outlet of the basin to the inlet of the sloan ditch.**

$Slope := \frac{\Delta E - Depth_{basin}}{Length_{pipe}}$ **Slope of the PVC basin outlet pipeline.**

$Slope = 0.019$

Calculation Table 1

For Pipeline flowing Half full

Mannings n=	0.011
Slope S=	0.019

Diam (inches)	**R (inches)**	**V (ft/sec)**	**Q Gpm**
1	0.02	1.41	1.72
2	0.04	2.24	10.95
3	0.06	2.93	32.29
4	0.08	3.55	69.53
5	0.10	4.12	126.07
6	0.13	4.66	205.01
7	0.15	5.16	309.24
8	0.17	5.64	441.51
9	0.19	6.10	604.44
10	0.21	6.54	800.52
11	0.23	6.97	1032.17
12	0.25	7.39	1301.73

$Q_{pipe} := 69.5 \cdot \frac{gal}{min}$ **Using 4" PVC velocity**

$V_{basin} := Q_{pipe} \cdot T$ **Finding the volume discharged from the 4 inch pipeline flowing half full in a 4 hour period.**

$V_{basin} = 0.051 \cdot acre \cdot ft$

Caculation Table 2

For Pipeline Flowing Full

Hazen-Williams Coefficient

for Plastic Conduits 150

Slope 0.019

Diam (inches)	Q (gpm)
1	4.96
2	30.71
3	89.22
4	190.12
5	341.90
6	552.27
7	828.36
8	1176.90
9	1604.25
10	2116.48
11	2719.42
12	3418.69

$Q_{Full\_pipe} := 190.12 \cdot \frac{gal}{min}$ **Using 4" PVC velocity**

$V_{basin} := Q_{Full\_pipe} \cdot T$ **Finding the volume discharged from the 4 inch pipeline flowing Full in a 4 hour period.**

$$V_{basin} = 0.14 \cdot acre \cdot ft$$

The volume of water detained in 1 inch 4 hour storm event.

$V_{Storage} := V_{runoff} - V_{basin}$ $V_{Storage} = 0.685 \cdot acre \cdot ft$

Conclusion:

A catch basin with depth of 6 feet and a PVC outflow pipeline of 4 inches in diameter, with a slope of approximately 2%, will provide sufficient stormwater drainage during a 4 hour 1 inch storm event for the 22 acre water shed.

APPENDIX E

APPENDIX E-1

GROUNDWATER CONTAINMENT SYSTEM CONSTRUCTION DRAWINGS

LAKELAND DISPOSAL
CLAYPOOL, INDIANA

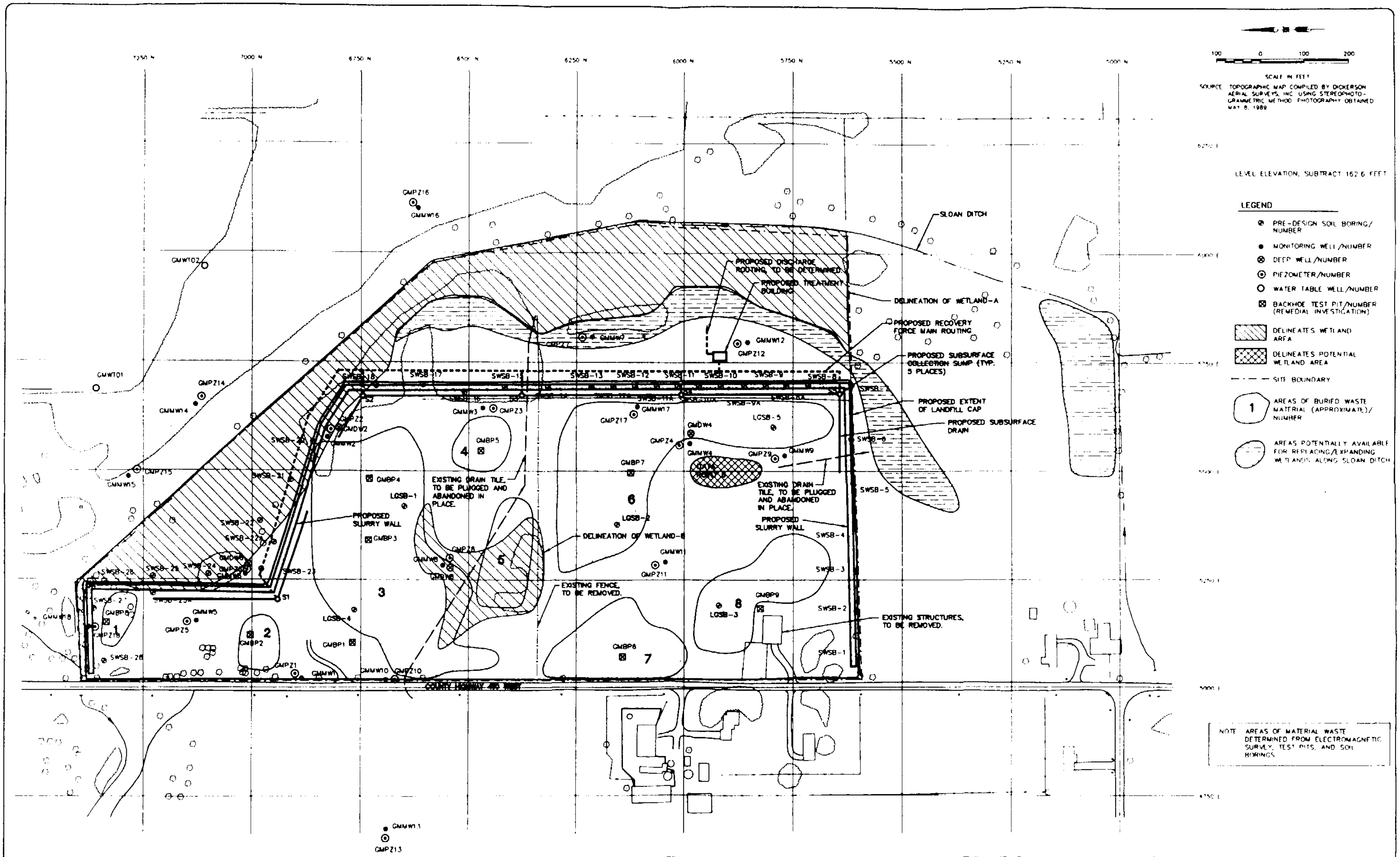
GROUNDWATER CONTAINMENT SYSTEM CONSTRUCTION DRAWINGS

Prepared by:

GERAGHTY & MILLER, INC.
Environmental Services
A **Heidemij** Company

CONSTRUCTION DRAWING LIST

DRAWING NO. 1	REMEDIAL SYSTEM LAYOUT
DRAWING NO. 2	GENERAL NOTES/ABBREVIATIONS/LEGENDS
DRAWING NO. 3	SITE PLAN/SLURRY WALL POSITION – To be included in next submittal.
DRAWING NO. 4	GEOLOGIC CROSS-SECTION A-A' – SOUTH WALL
DRAWING NO. 5	GEOLOGIC CROSS-SECTION B-B' – EAST WALL
DRAWING NO. 6	GEOLOGIC CROSS-SECTIONS C-C' THROUGH H-H' – NORTH WALL
DRAWING NO. 7	SUBSURFACE DRAIN – PLAN/PROFILE – To be included in next submittal.
DRAWING NO. 8	PIPING AND INSTRUMENTATION DIAGRAM
DRAWING NO. 9	MISCELLANEOUS DETAILS – To be included in next submittal.



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FILE NO. [illegible]
PLOT SCALE 1=100
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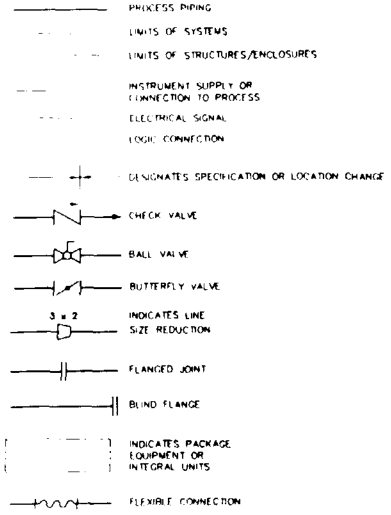
DATE
DATE
DATE FEB 12, 1994

REMEDIAL SYSTEM LAYOUT

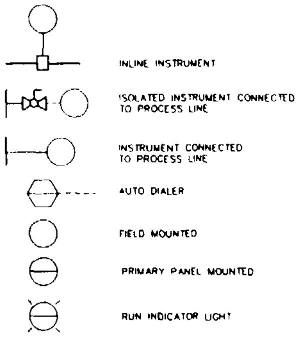
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

DRAWING NO.
1

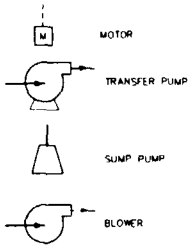
PIPING SYMBOLS



INSTRUMENT SYMBOLS



EQUIPMENT SYMBOLS



GENERAL ABBREVIATIONS

APPROX	APPROXIMATELY
AS	AIR STRIPPER
B	BLOWER
BF	BAG FILTER
BFV	BUTTERFLY VALVE
BV	BALL VALVE
CI	CAST IRON
CS	CARBON STEEL
CSP	COLLECTION SUMP PUMP
CV	CHECK VALVE
EL	ELEVATION
FE	FLOW MONITORING ELEMENT
FI	FLOW RATE INDICATOR
FIN.FLR	FINISHED FLOOR
FL	FAULT LIGHT
FRP	FIBERGLASS REINFORCED PLASTIC
FQI	FLOW TOTALIZER INDICATOR
GALV	GALVANIZED
GW	GROUNDWATER
HDPE	HIGH DENSITY POLYETHYLENE
H-O-A	HAND-OFF-AUTO
HS	HAND SWITCH
I.D.	INSIDE DIAMETER
LAH	LEVEL ALARM LIGHT HIGH
LAHH	LEVEL ALARM LIGHT HIGH HIGH
LAL	LEVEL ALARM LIGHT LOW
LE	LEVEL ELEMENT
LSH	LEVEL SWITCH HIGH
LSHH	LEVEL SWITCH HIGH HIGH
LSL	LEVEL SWITCH LOW
M	MOTOR
NTS	NOT TO SCALE
O.D	OUTSIDE DIAMETER
PAH	PRESSURE ALARM LIGHT HIGH
PAL	PRESSURE ALARM LIGHT LOW
PI	PRESSURE INDICATOR
PSH	PRESSURE SWITCH HIGH
PVC	POLYVINYL CHLORIDE
S	SUMP
SCH	SCHEDULE
SP	SAMPLE PORT
STN STL	STAINLESS STEEL
T/	TOP OF
TOW	TOP OF WALL
TP	TRANSFER PUMP
TYP	TYPICAL
UN	UNION
W.C.	WATER COLUMN
YAL	INDICATING ALARM LIGHT
YL	INDICATING LIGHT

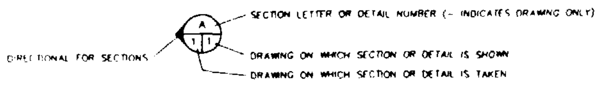
INTERLOCK DESCRIPTIONS

INSTRUMENT NUMBERING SYSTEM

THE FIRST NUMBER FOR EACH INSTRUMENT NUMERICAL IDENTIFICATION REFERS TO THE FUNCTION OF THE INSTRUMENT

1 AIR FLOW
2 LIQUID FLOW
3 PRESSURE/VACUUM
4 LEVEL
5 TEMPERATURE
6 TIME

SECTION OR DETAIL IDENTIFICATION SYMBOL



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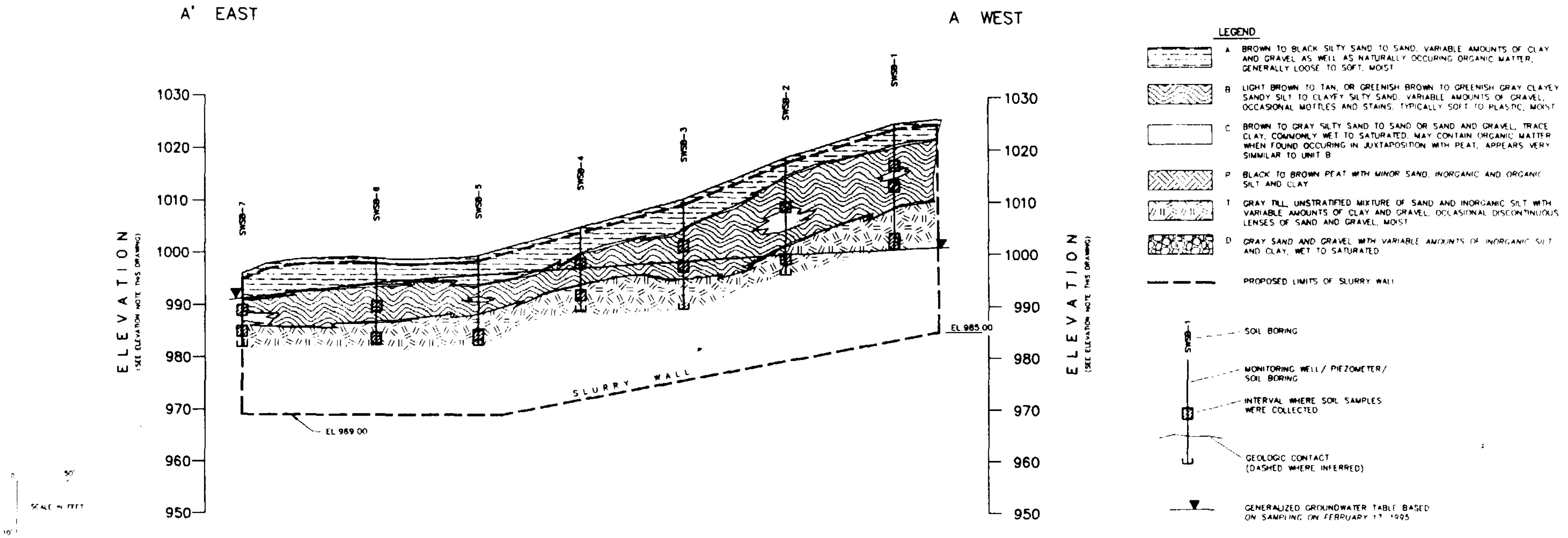
GENERAL NOTES/ABBREVIATIONS/LEGENDS

GROUNDWATER CONTAINMENT SYSTEM
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

DRAWING NO
2



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Sieve Size	PERCENT PASSING													
1 1/2"		100						100						
1"		95	100	100		100		95						
3/4"	100	95	98	99		96	100	95				100	100	100
1/2"	98	94	97	98		93	99	95	100	100	100	99	99	97
3/8"	98	93	96	97	100	91	97	95	99	99	97	98	96	97
#4	95	90	93	95	97	83	93	93	98	96	91	95	91	94
#10	90	86	88	90	93	73	88	90	92	91	81	91	81	89
#20	85	81	84	86	87	64	81	85	86	86	71	86	67	84
#40	79	73	78	80	81	57	73	80	80	79	64	80	54	78
#60	70	61	70	70	72	47	60	73	71	70	55	70	45	69
#100	59	51	59	59	61	38	46	63	60	60	48	59	39	59
#200	48	40	48	46	49	29	38	51	48	48	40	48	31	47
Gravel, %	5	10	7	5	3	18	7	7	4	4	10	4	9	6
Sand, %	47	50	45	48	48	53	57	42	48	48	50	48	60	47
Silt, %	35	28	35	32	35	17	23	35	33	35	28	34	24	32
Clay (<0.002mm), %	13	12	13	15	14	12	13	16	15	13	12	14	7	15
Liquid Limit:	19	18	17	19	16	19	17	18	16	16	19	15	15	15
Plastic Limit	13	12	11	12	11	12	12	12	11	11	14	11	14	11
Plasticity Index:	6	6	6	7	5	7	5	6	5	5	5	4	1	4
USCS Classification:	SC-SM	SC-SM	SC-SM	SC-SM	SC-SM	SC-SM	SC-SM	CL-ML	SC-SM	SC-SM	SC-SM	SC-SM	SM	SC-SM
Moisture Content, %	11.9	10.9	8.2	12.4	9.9	11.2	11.9	11.1	7.1	8.4	14.5	9.5	9.1	9.4

SLURRY WALL NOTE
ALIGNMENT OF SOIL BORINGS AND CROSS-SECTION MAY DIFFER FROM ALIGNMENT OF SLURRY WALL SHOWN IN CROSS-SECTION. REFER TO DRAWING NO.3 (GROUNDWATER CONTAINMENT SYSTEM) FOR LOCATION OF CROSS-SECTION AND COORDINATE/STATIONING OF SLURRY WALL

GENERAL ELEVATION NOTE
INDICATED ELEVATIONS ARE REFERENCED TO THE LOCALLY RECOVERABLE DATUM OF 1,000 FEET. TO OBTAIN MEAN SEA LEVEL ELEVATION, SUBTRACT 162.6 FEET

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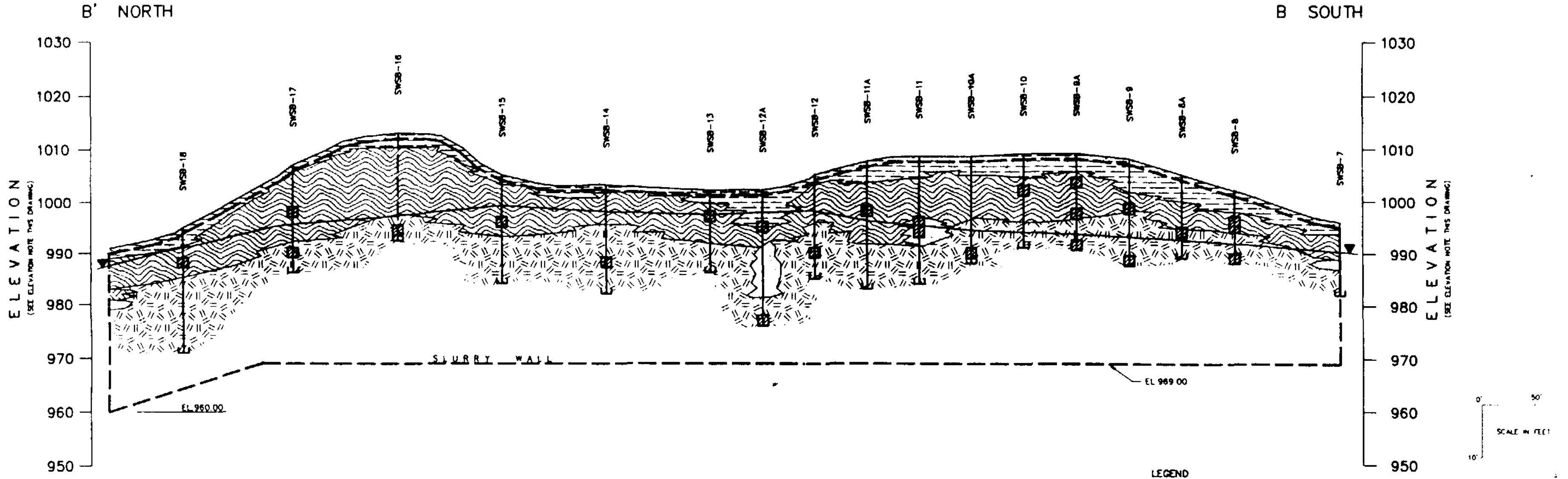
GEOLOGIC CROSS-SECTION A-A' - SOUTH WALL

GROUNDWATER CONTAINMENT SYSTEM
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

DRAWING NO.
4



LEGEND

SWSB-1 — SOIL BORING

MONITORING WELL / PIEZOMETER / SOIL BORING

INTERVAL WHERE SOIL SAMPLES WERE COLLECTED

GEOLOGIC CONTACT (DASHED WHERE INFERRED)

▼ GENERALIZED GROUNDWATER TABLE BASED ON SAMPLING ON FEBRUARY 17, 1995.

A. BROWN TO BLACK SILTY SAND TO SAND, VARIABLE AMOUNTS OF CLAY AND GRAVEL AS WELL AS NATURALLY OCCURING ORGANIC MATTER, GENERALLY LOOSE TO SOFT, MOIST.

B. LIGHT BROWN TO TAN, OR GREENISH BROWN TO GREENISH GRAY CLAYEY SANDY SILT TO CLAYEY SILTY SAND, VARIABLE AMOUNTS OF GRAVEL, OCCASIONAL MOTTLES AND STAINS, TYPICALLY SOFT TO PLASTIC, MOIST.

C. BROWN TO GRAY SILTY SAND TO SAND OR SAND AND GRAVEL, TRACE CLAY, COMMONLY WET TO SATURATED, MAY CONTAIN ORGANIC MATTER WHEN FOUND OCCURING IN JUXTAPOSITION WITH PEAT, APPEARS VERY SIMMILAR TO UNIT B.

P. BLACK TO BROWN PEAT WITH MINOR SAND, INORGANIC AND ORGANIC SILT AND CLAY.

T. GRAY TILL, UNSTRATIFIED MIXTURE OF SAND AND INORGANIC SILT WITH VARIABLE AMOUNTS OF CLAY AND GRAVEL, OCCASIONAL DISCONTINUOUS LENSES OF SAND AND GRAVEL, MOIST.

O. GRAY SAND AND GRAVEL WITH VARIABLE AMOUNTS OF INORGANIC SILT AND CLAY, WET TO SATURATED

— — — PROPOSED LIMITS OF SLURRY WALL

SLURRY WALL NOTE:
ALIGNMENT OF SOIL BORINGS AND CROSS-SECTION MAY DIFFER FROM ALIGNMENT OF SLURRY WALL SHOWN IN CROSS-SECTION. REFER TO DRAWING NO 3 (GROUNDWATER CONTAINMENT SYSTEM) FOR LOCATION OF CROSS-SECTION AND COORDINATE/STATIONING OF SLURRY WALL

Sample Identification	SWSB-8-0508	SWSB-8-1214	SWSB-8A-1012	SWSB-9-0810	SWSB-9-1820	SWSB-9A-0408	SWSB-9A-1012	SWSB-9A-1818	SWSB-10-0608	SWSB-10A-1820	SWSB-11-1218	SWSB-11A-0810	SWSB-12-1416	SWSB-12A-0606	SWSB-12A-2426	SWSB-13-0408	SWSB-14-1416	SWSB-15-0810	SWSB-16-1820	SWSB-17-0810	SWSB-17-1818	SWSB-18-0608
Sieve Size	PERCENT PASSING																					
1 1/2"	100									100						100						
1"	97				100	100				94					100	96						
3/4"	96			100	98	97	100	100	100	94	100			100	97	96	100	100				
1/2"	94	100	100	99	97	96	99	99	99	91	94	100	100	99	96	94	99	98	100	100	100	100
3/8"	93	99	99	98	96	95	99	97	98	89	93	98	98	98	95	94	97	97	99	99	96	99
#4	90	95	95	97	94	93	96	95	96	87	83	96	96	97	92	91	94	94	98	97	95	97
#10	88	91	91	92	89	88	91	91	94	83	65	92	92	93	88	87	89	90	91	92	91	93
#20	81	85	84	88	84	85	88	85	89	77	50	87	87	90	82	82	84	84	86	88	85	88
#40	76	80	77	79	78	80	80	78	83	72	41	80	81	85	77	78	79	78	80	79	78	82
#60	67	71	68	68	69	73	69	70	79	65	33	70	72	77	68	68	70	69	71	70	69	73
#100	54	60	58	54	60	65	59	60	71	56	24	59	63	67	59	57	61	59	61	59	58	62
#200	38	48	46	42	48	53	47	48	61	46	17	46	52	53	49	45	49	48	50	47	47	49
Gravel, %	10	5	5	3	6	7	4	5	4	13	17	4	4	3	8	9	6	6	4	3	4	3
Sand, %	52	47	49	55	45	40	48	47	35	41	66	50	44	44	43	46	45	48	47	50	48	48
Silt, %	30	36	31	30	34	39	32	34	40	33	11	30	37	43	33	31	37	38	33	34	31	33
Clay (<0.002mm), %	8	12	15	12	15	14	15	14	21	14	6	16	15	10	16	14	12	13	16	13	17	16
Liquid Limit	14	16	16	16	16	18	17	16	20	16	15	17	17	16	17	16	16	18	16	19	16	18
Plastic Limit	13	11	11	11	11	13	12	11	13	11	14	12	11	14	11	12	11	12	11	13	11	12
Plasticity Index	1	5	5	5	5	5	5	5	7	5	1	5	6	2	6	4	5	6	5	6	5	6
USCS Classification	SM	SC-SM	SC-SM	SC-SM	SC-SM	CL-ML	SC-SM	SC-SM	CL-ML	SC-SM	SM	SC-SM	CL-ML	ML	SC-SM	SC-SM	SC-SM	SC-SM	SC-SM	SC-SM	SC-SM	SC-SM
Moisture Content, %	11.7	8.3	8.9	11.5	8.7	11.9	8.9	8.3	12.7	8.8	9.8	11.1	8.8	12.6	8.9	9.3	9.3	9.3	8.4	11.2	10.9	10.8

GENERAL ELEVATION NOTE:
INDICATED ELEVATIONS ARE REFERENCED TO THE LOCALLY RECOVERABLE DATUM OF 1,000 FEET. TO OBTAIN MEAN SEA LEVEL ELEVATION, SUBTRACT 162.6 FEET

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Environmental Services
A Heidemij Company

SCALE VERIFICATION
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USE TO VERIFY FIGURE REPRODUCTION SCALE

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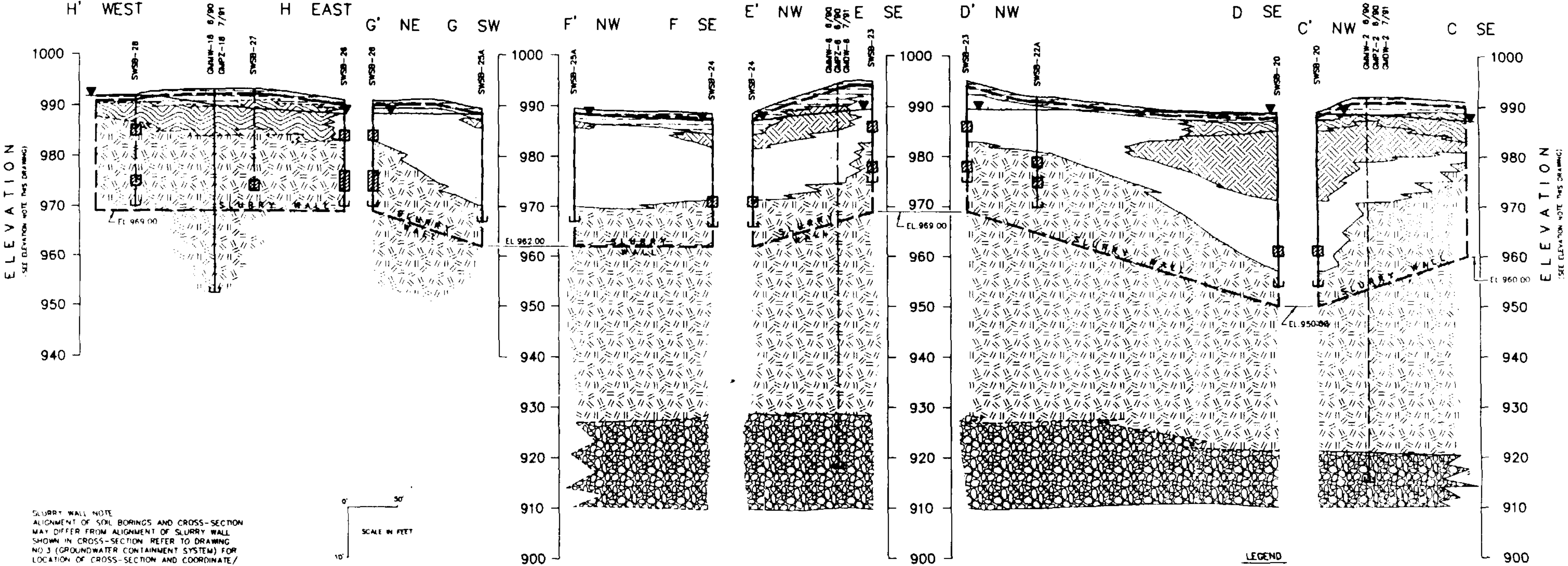
DRAWING NO. [illegible]
FILE NO. [illegible]
PLOT SCALE [illegible]
DRAFTED BY: [illegible]
DATE: [illegible]
CHECKED BY:
DATE:
APPROVED BY:
DATE:
LAST REVISION BY: [illegible]
DATE: FEB 7, [illegible]

GEOLOGIC CROSS-SECTION B-B' - EAST WALL

GROUNDWATER CONTAINMENT SYSTEM
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

DRAWING NO
5



SLURRY WALL NOTE
ALIGNMENT OF SOIL BORINGS AND CROSS-SECTION MAY DIFFER FROM ALIGNMENT OF SLURRY WALL SHOWN IN CROSS-SECTION. REFER TO DRAWING NO 3 (GROUNDWATER CONTAINMENT SYSTEM) FOR LOCATION OF CROSS-SECTION AND COORDINATE/STATIONING OF SLURRY WALL.

Sample Identification	SWSB-20-2628	SWSB-22A-1214	SWSB-22A-1818	SWSB-23-0810	SWSB-23-1618	SWSB-24-1818	SWSB-26-0606	SWSB-26-1418	SWSB-27-1820	SWSB-28-0608	SWSB-28-1618
Sieve Size	PERCENT PASSING										
1 1/2"								100			
1"	100			100	100			98	100		
3/4"	98	100		98	99	100	100	98	99	100	100
1/2"	97	99	100	97	97	99	99	97	97	99	99
3/8"	94	98	99	96	97	98	99	96	95	98	98
#4	90	94	96	92	95	96	95	93	91	95	96
#10	85	89	92	87	91	92	90	88	86	90	91
#20	78	84	85	81	84	87	83	82	79	85	86
#40	72	78	79	75	78	81	77	76	72	79	79
#60	63	69	70	66	69	73	69	67	62	70	71
#100	54	59	60	57	59	63	59	57	53	59	60
#200	44	47	47	46	48	52	46	46	44	47	48
Gravel, %	10	6	4	9	5	4	5	7	9	5	5
Sand, %	46	47	49	46	47	44	49	47	47	48	47
Silt, %	33	35	34	31	36	35	32	33	32	34	37
Clay (<0.002mm), %	11	12	13	14	12	17	14	13	12	13	11
Liquid Limit	15	16	15	16	15	17	14	16	15	16	16
Plastic Limit	11	11	10	11	10	11	12	11	10	11	11
Plasticity Index	4	5	5	5	5	6	2	5	5	5	5
USCS Classification:	SC-SM	SC-SM	SC-SM	SC-SM	SC-SM	CL-ML	SM	SC-SM	SC-SM	SC-SM	SC-SM
Moisture Content, %	9.8	7.9	8.9	7.7	7.9	11.6	11.3	8.9	9.6	8.7	8.2

LEGEND

▤	A	BROWN TO BLACK SILTY SAND TO SAND, VARIABLE AMOUNTS OF CLAY AND GRAVEL AS WELL AS NATURALLY OCCURING ORGANIC MATTER, GENERALLY LOOSE TO SOFT, MOIST
▧	B	LIGHT BROWN TO TAN, OR GREENISH BROWN TO GREENISH GRAY CLAYEY SANDY SILT TO CLAYEY SILTY SAND, VARIABLE AMOUNTS OF GRAVEL, OCCASIONAL MOTTLES AND STAINS, TYPICALLY SOFT TO PLASTIC, MOIST
□	C	BROWN TO GRAY SILTY SAND TO SAND OR SAND AND GRAVEL, TRACE CLAY, COMMONLY WET TO SATURATED, MAY CONTAIN ORGANIC MATTER WHEN FOUND OCCURING IN JUXTAPOSITION WITH PEAT, APPEARS VERY SIMMILAR TO UNIT B
▨	P	BLACK TO BROWN PEAT WITH MINOR SAND, INORGANIC AND ORGANIC SILT AND CLAY
▥	T	GRAY TILL, UNSTRATIFIED MIXTURE OF SAND AND INORGANIC SILT WITH VARIABLE AMOUNTS OF CLAY AND GRAVEL, OCCASIONAL DISCONTINUOUS LENSES OF SAND AND GRAVEL, MOIST
▩	D	GRAY SAND AND GRAVEL WITH VARIABLE AMOUNTS OF INORGANIC SILT AND CLAY, WET TO SATURATED
— — —		PROPOSED LIMITS OF SLURRY WALL

SWSB-1 — SOIL BORING

MONITORING WELL/ PIEZOMETER/ SOIL BORING

INTERVAL WHERE SOIL SAMPLES WERE COLLECTED

GEOLOGIC CONTACT (DASHED WHERE INFERRED)

▼ GENERALIZED GROUNDWATER TABLE BASED ON SAMPLING ON FEBRUARY 17, 1995

GENERAL ELEVATION NOTE
INDICATED ELEVATIONS ARE REFERENCED TO THE LOCALLY RECOVERABLE DATUM OF 1,000 FEET. TO OBTAIN MEAN SEA LEVEL ELEVATION, SUBTRACT 162.6 FEET

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PLOT SCALE 1=50
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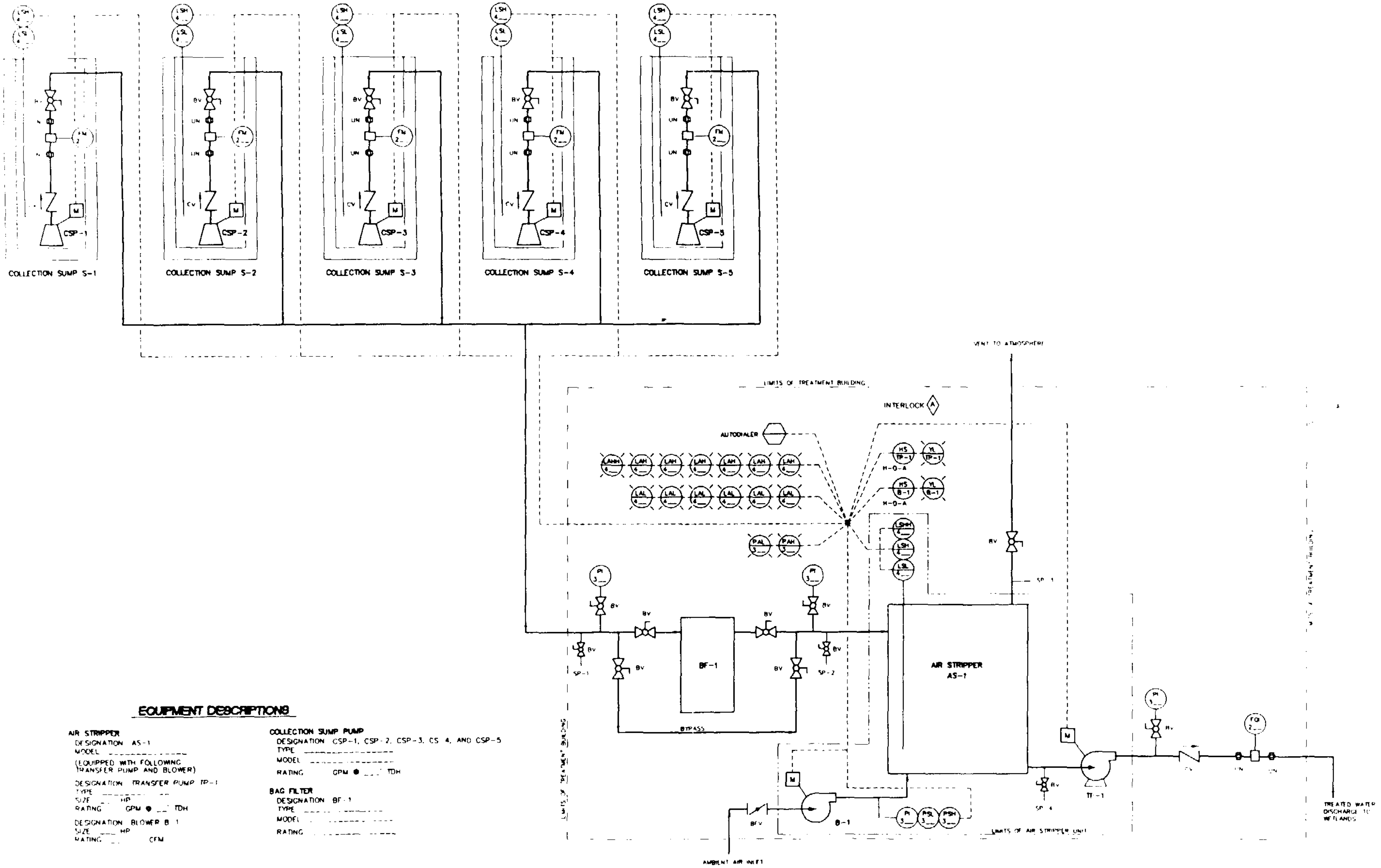
DATE
CHECKED BY
DATE
APPROVED BY
DATE
LAST REVISION BY
DATE

GEOLOGIC CROSS-SECTIONS C-C', D-D', E-E', F-F', G-G' AND H-H' - NORTH WALL

GROUNDWATER CONTAINMENT SYSTEM
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

DRAWING NO
6



EQUIPMENT DESCRIPTIONS

AIR STRIPPER
DESIGNATION AS-1
MODEL ______________
(EQUIPPED WITH FOLLOWING TRANSFER PUMP AND BLOWER)

DESIGNATION TRANSFER PUMP TP-1
TYPE ____________
SIZE __ HP
RATING GPM @ __ TDH

DESIGNATION BLOWER B-1
SIZE ___ HP
RATING __ CFM

COLLECTION SUMP PUMP
DESIGNATION CSP-1, CSP-2, CSP-3, CS 4, AND CSP-5
TYPE ______________
MODEL ______________
RATING GPM @ __ TDH

BAG FILTER
DESIGNATION BF-1
TYPE ______________
MODEL ______________
RATING ______________

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APPROVED BY
LAST REVISION BY: [illegible]
FILE NO. [illegible]
PLOT SCALE [illegible]
DATE [illegible]
DATE
DATE
DATE [illegible]

PIPING AND INSTRUMENTATION DIAGRAM
GROUNDWATER CONTAINMENT SYSTEM
LAKELAND DISPOSAL
CLAYPOOL, INDIANA

8

APPENDIX E-2

GROUNDWATER CONTAINMENT SYSTEM TECHNICAL SPECIFICATIONS (OUTLINE ONLY)

GROUNDWATER CONTAINMENT SYSTEM

LIST OF TECHNICAL SPECIFICATIONS

APPENDIX F

APPENDIX F-1

WETLANDS MITIGATION CONSTRUCTION DRAWINGS

TO BE INCLUDED IN NEXT SUBMITTAL

APPENDIX F-2

WETLANDS MITIGATION TECHNICAL SPECIFICATIONS (OUTLINE ONLY)

TO BE INCLUDED IN NEXT SUBMITTAL