REPORT OF
Subsurface Exploration

CLARKSBURG TOWN CENTER

Sand Filter #14 and Groundwater Recharge Facilities
Montgomery County, Maryland

April 9, 2001

Prepared For:

Terrabrook
c/o DSS, Inc.
P.O. Box 287
Clarksburg, Maryland 20871

GTA Job Number: 99530

Prepared By:

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GEO-TECHNOLOGY ASSOCIATES, INC.

GEOTECHNICAL AND
ENVIRONMENTAL CONSULTANTS

A Practicing ASFE Member Firm

April 9, 2001

Terrabrook
c/o DSS, Inc.
P.O. Box 287
Clarksburg, Maryland 20871

Attn: Mr. Jim Richmond

Re: Sand Filter #14 and Groundwater Recharge Facilities
Clarksburg Town Center
Montgomery County, Maryland

Gentlemen:

In accordance with your request, Geo-Technology Associates, Inc. (GTA) has performed an exploration on the referenced property in Montgomery County, Maryland, in order to characterize subsurface conditions in the vicinity of proposed Sand Filter #14, which will be connected to existing Stormwater Management Pond No. 1. Also, subsurface conditions at three other locations were explored, in conjunction with the proposed installation of groundwater recharge facilities. A Site Location Map is included as Figure 1 in Appendix A. The work was performed in general accordance with GTA's geotechnical services proposal dated February 28, 2001.

Proposed Construction

1) Sand Filter #14

Based on plans entitled Clarksburg Town Center, Revised Water Quality Plan, by Charles P. Johnson & Associates (CPJ), the site civil engineer, the facility will receive 'first flush' run-off at two points. Excavations up to 7 feet, and fill of approximately 2 feet, will be required to establish the proposed basin bottom elevation of 619.5 feet above Mean Sea Level (MSL). Fills up to 9 feet will be required to achieve the proposed embankment top elevation of 624.0 MSL. The facility is to be constructed to meet State of Maryland requirements for stormwater management facilities (MD 378), as adopted by Montgomery County.

2) Groundwater Recharge Facilities

GTA understands that several groundwater recharge facilities are planned for the development. The facilities are designed to store and allow infiltration of accumulated roof and yard-drainage. GTA's exploration was based on the referenced drawings by CPJ, which indicate recharge facilities at three locations. However, based on conversations with CPJ, the precise location of the

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☐ 45000 UNDERWOOD LANE, SUITE M, STERLING, VA 20166 ☎ 703-478-0055 FAX: 703-478-0137
☐ 5702 INDUSTRY LANE, SUITE A-3, FREDERICK, MD 21701 ☎ 301-682-5226 FAX: 301-682-9254
☐ 18 BOULDEN CIRCLE, SUITE 34, WILMINGTON, DE 19720 ☎ 302-326-2100 FAX: 302-326-2399

proposed facilities has not been finalized at the date of this report. The facilities will essentially include trenches excavated to dimensions sufficient to retain a portion of the anticipated run-off volume. The trenches will be filled with crushed stone, and will generally be located within community open space.

Subsurface Exploration

Four SPT borings were drilled by GTA at locations selected and field-located by CPJ. The approximate locations of the borings are indicated on the Exploration Location Plan included as Figure 2 in Appendix A. Standard Penetration Test (SPTs) were performed and soil samples were taken at approximate 2.5-foot intervals in the top ten feet of each boring, and at approximate 5-foot intervals thereafter. Samples recovered from the borings were classified using visual/manual methods, supplemented by limited laboratory testing.

In-situ borehole permeability testing was performed in each boring, at depths ranging from 7.5 to 16.5 feet below existing surface grades. The permeability test consists of measuring the drop in water level within a solid 4-inch PVC pipe for a period of 4 hours subsequent to a 24-hour pre-soak. The in-situ testing indicated that the average infiltration rate varied between 0.30 and 0.42 inches per hour at the boring locations. The results of each permeability test are displayed on the respective boring logs.

Subsurface Conditions

1) Sand Filter #14

GTA drilled one test boring, labeled SWM-1, in the vicinity of the proposed sand filter, to a depth of 11.5 feet below existing grade. Material encountered from the ground surface to a depth of approximately six feet was identified as fill, and consisted of sand- and gravel-sized rock fragments with some clayey silt. The fill was very loose to medium-dense, based on SPT 'N' values ranging from 4 to 13 blows per foot (bpf). Similar, undisturbed materials were present from approximately six feet to the bottom of the boring. SPT 'N' values in the natural materials ranged from 11 to 13 bpf. Groundwater was not observed while drilling, or after 24 hours. Please refer to the boring log presented in Appendix B for further information.

2) Groundwater Recharge Facilities

Three borings, designated GW-1 thru GW-3, were drilled in the vicinity of the proposed groundwater recharge areas, to depths of 16.5, 20.5, and 17.0 feet, respectively. Materials present near existing surface elevations were characterized as medium-stiff to stiff silt and clay, referencing SPT 'N' values ranging from 5 to 11 bpf. The clayey soils were present in Borings GW-1 thru GW-

3, to depths of 2.5, 5.0 and 7.0 feet, respectively. Coarse-grained soil and weathered rock consisting primarily of medium-dense to very dense sand, silt and fine- to coarse-grained rock fragments was present to the bottom of each boring. SPT 'N' values ranged from 11 to 67 bpf in these materials. Groundwater was not observed while drilling, or after 24 hours. Please refer to the boring logs presented in Appendix B for further information.

Laboratory Testing

Grain-size and plasticity testing was performed on four specimens recovered from the borings. Based on the results of the testing, the specimens were classified in accordance with the Unified Soil Classification System (USCS), and the United States Department of Agriculture (USDA) system. Minimum infiltration rates provided here-in are based on correlation with the USDA classification in accordance with the Standard Specification for Infiltration Practices. A summary of the index property testing is provided in the following table. Please see the laboratory test data sheets in Appendix C for further details.

Table I: Index Properties Testing Results

Test Boring #	Depth (ft)	Liquid Limit	Plasticity Index	Unified Classification	USDA Classification	Minimum Infiltration Rate (in/hr)**
GW-1	14.5 -16.0	NP*	NP	SM, SAND and SILT	Sandy Loam	1.02
GW-2	18.5 - 20.5	NP	NP	SM, SAND, some silt	Sandy Loam/ Loamy Sand	1.02
GW-3	15.5 - 17.0	NP	NP	SM, SAND, little silt	Loamy Sand	2.41
SWM-1	2.5 - 4.0	39	16	CL, low plasticity CLAY and SILT	Loam/ Silt Loam	0.27
	11.0 - 11.5	NP	NP	GM, ROCK FRAGS, little silt	Sandy Loam	1.02

*NP= Non-Plastic soil
**Based on DNR methods

CONCLUSIONS AND RECOMMENDATIONS

Based on analysis of the test boring and laboratory test data, construction of the proposed facilities is feasible. The following recommendations regarding construction of the sand filter and recharge facilities are based on GTA's understanding of the currently proposed configuration. If the planned location, size, or bottom level of the proposed facilities are modified, GTA's recommendations should not be considered valid unless verified in writing. GTA's preliminary recommendations are provided in the following paragraphs.

1) Sand Filter #14

Based on the results of field and laboratory testing, infiltration stormwater management techniques are not feasible at the location explored. According to Montgomery County criteria, the minimum acceptable average infiltration rate for a borehole permeability test is 0.5 inch per hour. Based on the observed average infiltration rate of 0.42 inches per hour during the borehole permeability test in Boring SWM-1, infiltration techniques at this location are not feasible at the proposed depth of 7.5 feet.

GTA understands that the Soil Conservation Service of Maryland (SCS), Specification 378 (MD 378), as accepted by Montgomery County governs design and construction of this facility. MD 378 specifies that soils for use in cutoff trench construction meet USCS Classification CL (low plasticity clay), CH (high plasticity clay), SC (clayey sand), or GC (clayey gravel). Furthermore, GTA recommends that similar materials be used for backfill adjacent to the outfall structure. The use of the fine-grained plastic material adjacent to the pipe should decrease the potential for embankment failure induced by "piping" erosional processes.

GTA's exploration identified soils classified as USCS GM, SM, ML, CL-ML, and CL. A test pit exploration to locate sufficient quantities of suitable (CL) soils should be performed prior to the construction phase. Based on the recent construction of the cut-off trench and embankment for the existing pond, sufficient quantities of material suitable for cutoff trench construction are likely not available on site. Any on-site materials for use in the cut-off trench should be approved by GTA.

If sufficient materials suitable for cutoff trench construction are not available on site, off-site borrow meeting the required classifications may be used. Off-site borrow should meet the classifications required by MD 378, and be approved by GTA prior to placement as fill. Based on experience with similar projects, GTA recommends a contingency plan for off-site borrow.

MD 378 specifies that all of the referenced soil classifications suitable for cutoff trench construction are also suitable for embankment construction. USCS ML and SM soils are also deemed suitable. GTA recommends that the most plastic material available be used for embankment construction. Non-cohesive or very low plasticity silts, sandy soils or gravels may be prone to seepage, and are generally not recommended for use in embankment construction.

2. Pond Excavation and Embankment Construction

Extrapolation of the boring data indicates that excavations to the sand filter bottom can be accomplished by ordinary means, i.e. scraping or ripping. Groundwater was not observed in Boring SWM-1, and is not likely to be encountered during excavation of the basin, however, the contractor should be prepared to implement a dewatering scheme as needed to facilitate construction.

Prior to the placement of compacted fill or the construction of the outfall cradle and structures, areas supporting the proposed pond embankment and structures should be stripped and grubbed to remove all topsoil and other organic matter. After stripping, the subgrade should be proof-rolled as directed by a geotechnical engineer or his qualified representative. Unstable soils identified by proofrolling should be removed from subgrade. No fills should be placed or foundations constructed until the subgrade is approved by the geotechnical engineer.

Fills for cutoff trench and embankment construction should be placed in eight-inch loose lifts, and compacted to at least 95 percent of the maximum dry density in accordance with the Standard Proctor, ASTM D-698. Fills around the outfall pipe should be placed in 4-inch lifts and compacted to the same standard with hand equipment. On-site soils may be wet of the optimum moisture for compaction, and moisture conditioning may be required. Compactive effort should be monitored with in-place density testing as performed by a qualified representative under the direction of a professional engineer.

2) Recharge Facilities - Hydrogeologic Evaluation

An analysis of the hydrogeologic conditions in the vicinity of Soil Borings GW-1 and GW-3 was performed to evaluate the feasibility of enhanced recharge at these locations. A set of site plans entitled Revised Water Quality Plan, Phase 1B - Part Two, Clarksburg Town Center (Water Quality Plan), prepared by Charles P. Johnson & Associates, Inc. (CPJ), and dated September 2000, indicate that recharge facilities are proposed in 3 areas: Facilities CW-6A and CW-6B near GTA's Soil Boring GW-2; Facility CW-4 near Soil Boring GW-3;

and Facility CW-3, approximately 350 feet west of proposed Facility CW-4. During a March 27, 2001, correspondence, Mr. Jeffrey Seidleck of CPJ indicated that Facilities CW-6A and CW-6B will be consolidated into one facility (CW-6), and shifted to the location of GTA's Soil Boring GW-1. In addition, Mr. Seidleck indicated that the location of proposed Facility CW-3 may change, and that evaluation of this facility for recharge feasibility should not be performed. This Section presents the results of the hydrogeologic evaluation, with a discussion of the recharge capacity of the proposed facilities followed by a summary of the groundwater mounding analysis results.

A) Facility Recharge Capacity

Table 1 summarizes pertinent data associated with each of the proposed facilities, based on information indicated on the Water Quality Plan, discussions with Mr. Seidleck, and the results GTA's March 7, 2001, subsurface exploration. It should be noted that GTA's infiltration rate estimates are primarily for vertical flow across the base of the soil borings, providing relatively conservative estimates of potential infiltration rates. According to Additional Hydrogeological Investigations for Design of Stormwater Management Structures, Proposed Clarksburg Town Center, prepared by Schnabel Engineering and dated October 31, 1997 (Schnabel Engineering, 1997), previous infiltration tests were performed at the site through the base, as well as through the walls of soil borings, resulting in residual soil infiltration rates which ranged from approximately 0.3 to > 2 in/hr. In their 1997 Report, Schnabel Engineering indicates that within an area the size of a typical infiltration trench, "1.0 in/hr will be met or exceeded at each location."

Table II: Proposed Recharge Facility Data

Facility Name (Boring)	Contributing Drainage Area (ac.)	Dimensions (feet)	Storage-Top Elev. (ft msl)	Storage-Base Elev. (ft msl)	Min. Adjacent Basement Elev. (ft msl)	Infiltration Rate (inches/hour)
CW-4 (GW-3)	0.57	20 x 50	644	639.75	643.9	0.30
CW-6 (GW-1)	0.30	25 x 40	646	643	651.5	0.33

Based on the proposed facility sizes and GTA's estimated infiltration rates, it is estimated that proposed Facility CW-4 is capable of recharging approximately 0.36 inches per day (in/day) of runoff from the 0.57-acre contributing drainage area, and 0.55 in/day of rainfall on the 0.3-acre area may be recharged through proposed Facility CW-6. These estimates are based on infiltration through facility floors only.

B) Groundwater Mounding Analysis

The groundwater mounding analysis was performed to evaluate the potential for the proposed recharge facilities to induce high groundwater conditions which may impact the basements of nearby proposed residential units. The mounding analysis was performed based on estimates of hydraulic conductivity (K), at approximately 0.6 ft/day, groundwater elevations of approximately 627 and 630 ft MSL, for Facilities CW-4 and CW-6, respectively, and an underlying aquifer thickness of approximately 50 feet. The hydraulic conductivity estimate is based on the infiltration rates measured by GTA at Soil Borings GW-1, GW-2 and GW-3, and falls within the range of values reported for silt and sand in the hydrogeologic literature. Groundwater elevations were estimated based on the results of GTA's March 7, 2001, subsurface exploration, and the depth to groundwater reported for Boring B-6 in GTA's Report of Preliminary Geotechnical Exploration, Clarksburg Town Center, dated November 29, 1999. Aquifer thickness is likely conservative, as relatively well developed fractures may be encountered in the Piedmont at depths of 300 feet below the existing ground surface (ft bgs) or greater.

The groundwater mounding analysis was performed by utilizing Growth and Decay of Groundwater Mounds in Response to Uniform Percolation, Hantush (1967). A computer program that provides an iterative solution to the Hantush (1967) method, developed by Dr. E.J. Finnemore, of Santa Clara University, was used. It should be noted that mound heights calculated by the aforementioned program are maximum heights. The shape of a groundwater mound beneath a re-charge area will tend to be convex-up, with the maximum mound height occurring beneath the center of the recharge area and relatively less mounding occurring away from the recharge area.

Groundwater mounding below each of the proposed recharge facilities was simulated based on two storm water influx scenarios: 1) recharge from annual average rainfall of approximately 41 inches per year (in/yr; Schnabel Engineering, 1997) or approximately 0.0094 feet per day (ft/day) on the proposed drainage areas over a period of approximately 25 years; and 2) a 30-day period of recharge at the estimated infiltration rates of 0.60 and 0.66 ft/day through the base of Facilities CW-4 and CW-6, respectively. The recharge rate utilized in the second scenario represents approximately 10.8 and 16.5 inches of rainfall over a 30-day period from the respective drainage areas to Facilities CW-4 and CW-6, respectively. The mounding analysis included a sensitivity analysis for variations in the K-values from 0.3 to 1.2 ft/day. The results of the analysis are attached to this Report as Appendix D, and are summarized in Table 3.

Table III: Estimated Mounding Levels

Facility (Boring)	K = 0.3 ft/day Input = 41 in/yr	K = 0.6 ft/day Input = 41 in/yr	K = 1.2 ft/day Input = 41 in/yr	K = 0.6 ft/day Input = Est. Infiltration Rate
	Estimated Groundwater Mound Elevation (ft MSL)			
CW-4 (GW-3)	638.5	633.4	630.5	637.1
CW-6 (GW-1)	636.3	633.4	631.9	637.8

Based on the results of the groundwater mounding analysis, groundwater elevations are unlikely to rise close to or above the proposed basement levels due to operation of the recharge facilities. According to Mr. Seidleck, systems for conveyance of overflow from the recharge facilities are proposed at an elevation approximately coincident with that of the top of facility storage. This should preclude the occurrence of groundwater mounding due to surcharging the recharge facilities to levels above the top of facility storage. It should be noted that the groundwater levels/elevations in the immediate vicinity of the proposed recharge facilities have not been measured. Groundwater table elevations in the vicinity of the proposed facilities which are higher than estimated for this analysis would result in higher mound elevations.

LIMITATIONS

This report has been prepared for the exclusive use of Terrabrook, in accordance with generally accepted geotechnical engineering practice. No other warranty, express or implied, is made.

The analysis and recommendations contained in this report are based on the data obtained from limited observation and testing of the recovered materials. The test pits indicate soil conditions only at specific locations and times, and only to the depths penetrated. They do not necessarily reflect strata variations that may exist between the test pit locations. Consequently, the analysis and recommendations must be considered preliminary until the subsurface conditions can be verified by direct observation at the time of construction. If variations in subsurface conditions from those described are noted during construction, recommendations in this report may need to be re-evaluated.

In the event that any changes in the nature, design, or location of the facilities are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and conclusions of this report are verified in writing. Geo-Technology Associates, Inc. is not responsible for any claims, damages, or liability associated with interpretation of subsurface data or reuse of the subsurface data or engineering analysis without the express written authorization of Geo-Technology Associates, Inc.

In accordance with the guidelines of ASFE/The Association of Engineering firms Practicing in the Geosciences, it is recommended that Geo-Technology Associates, Inc. be retained to provide continuous soils engineering services for this project. Participation of GTA will facilitate compliance with GTA's recommendations, and allow changes to be made in these recommendations, in the event that subsurface conditions are found to vary from those anticipated prior to construction.

This report and the attached logs are instruments of service. If certain conditions or items are noted during our exploration, Geo-Technology Associates, Inc. may be required by prevailing statutes to notify and provide information to regulatory or enforcement agencies. Geo-Technology Associates, Inc. will notify our Client should a required disclosure condition exist.

This report was prepared by Geo-Technology Associates, Inc. (GTA) for the sole and exclusive use of Geo-Technology Associates, Inc. and Terrabrook Use and reproduction of this report by any other person without the expressed written permission of GTA and Terrabrook is unauthorized and such use is at the sole risk of the user.

We thank you for the opportunity to be of assistance to you on this project. If you have any questions or require additional information, please do not hesitate to contact this office.

Very truly yours,

GEO-TECHNOLOGY ASSOCIATES, INC.

Scott C. Rowe
Staff Engineer

for

J. Patrick Klima, P.E.
Vice President

STATE OF MARYLAND
RAVINDRA P. MALVIYA
No. 24495
PROFESSIONAL ENGINEER

F:\Docs\ROWE\CLARKBRG\RECHARGE.WPD
J.O# 99530

cc: Mr. Jeff Seidleck - CPJ

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one—not even you*—should apply the report for any purpose or project except the one originally contemplated.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report* that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions *only* at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an *opinion* about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject To Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, but preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce such risks, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations", many of these provisions indicate where geotechnical engineers responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Rely on Your Geotechnical Engineer for Additional Assistance

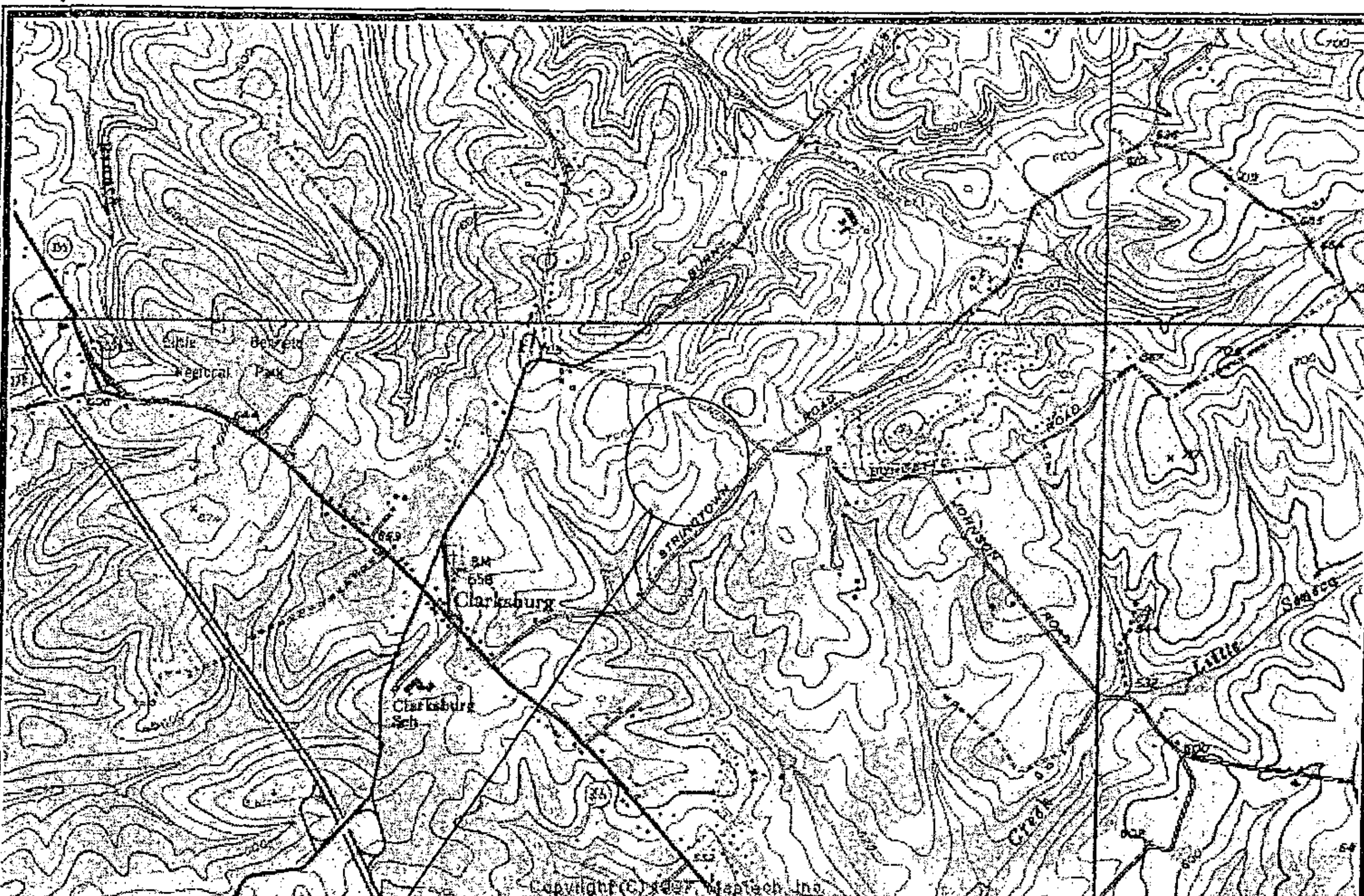
Membership in ASFE exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE PROFESSIONAL FIRMS PRACTICING IN THE GEOSCIENCES

8811 Colesville Road Suite G106 Silver Spring, MD 20910
Telephone: 301-565-2733 Facsimile: 301-589-2017
email: info@asfe.org www.asfe.org

APPENDIX A

FIGURES



Project Site

Base map obtained from MAPTECH TERRAIN NAVIGATOR CD-ROM
USGS 7.5 Minute Series (Topographic)
Germantown Quadrangle, Maryland
1953, Photorevised 1979

North

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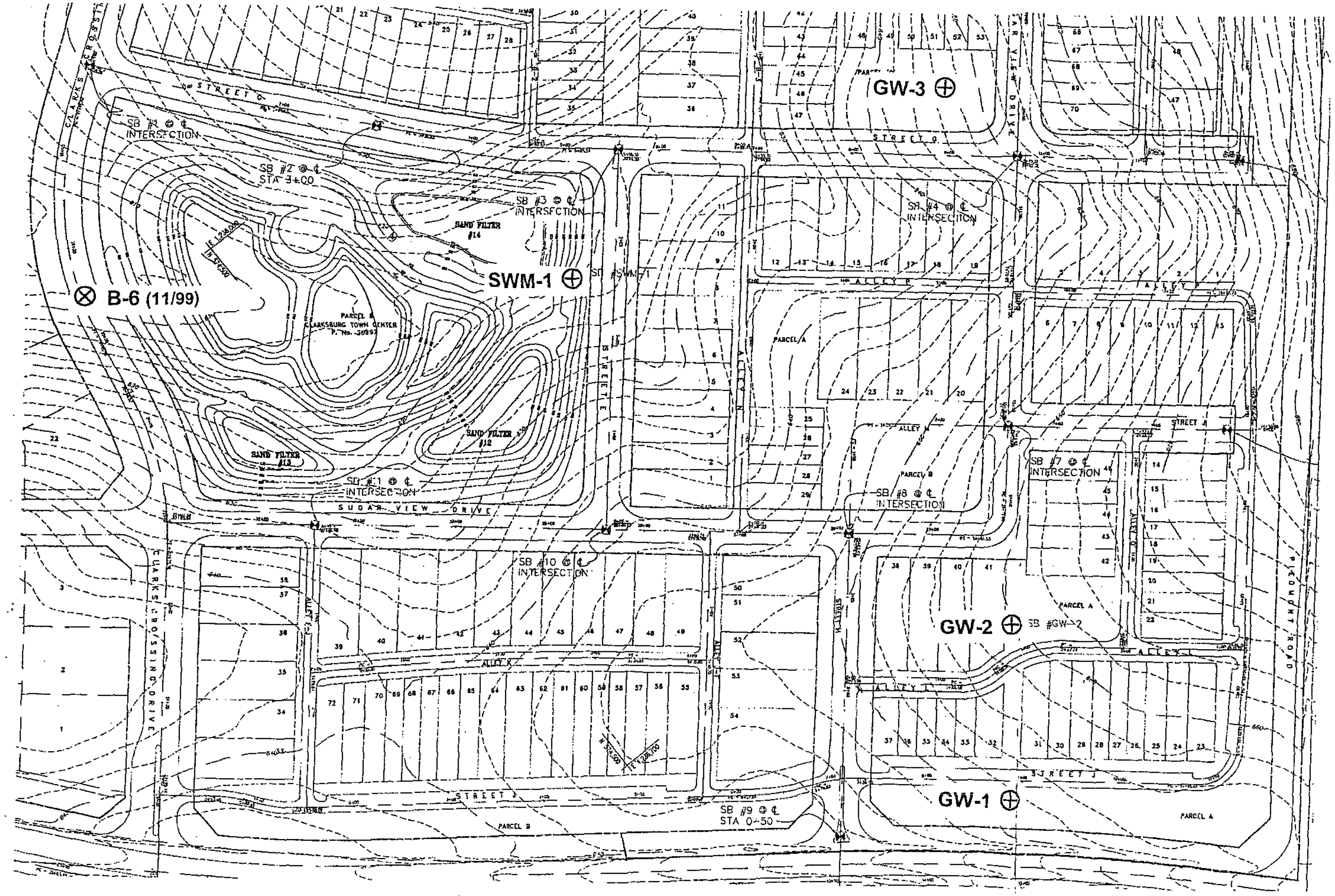
CLARKSBURG TOWN CENTER

MONTGOMERY COUNTY, MD

SITE LOCATION MAP

JOB NO:	DATE:	SCALE:	DRAWN BY:	REVIEWED BY:	FIGURE NO:
99530	Apr. 5, 2001	Not To Scale	SCR	JPK	1



Base Plan Prepared By Charles P. Johnson Associates Inc, 09/01

Figure 2

LEGEND:

⊕ = APPROXIMATE BORING LOCATION - PERFORMED FEB 2001.

GEO-TECHNOLOGY ASSOCIATES, INC. *Geotechnical and Environmental Consultants* 9090 Junction Drive, Suite 9 Annapolis Junction, MD 20701 (410) 792-9446 or (301) 470-4470 Fax: (410) 792-7395		CLARKSBURG TOWN CENTER EXPLORATION LOCATION PLAN Montgomery County, Maryland			
SCALE: NTS	DATE: 04/04/05	DRAWN BY: SCR	DESIGN BY: ---	REVIEWED BY: JPK	JOB NO. 99530

APPENDIX B

SOIL BORING LOGS

FIELD CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

NON COHESIVE SOILS
(Silt, Sand, Gravel and Combinations)

Density

Very Loose	- 5 blows/ft. or less
Loose	- 6 to 10 blows/ft.
Medium Dense	- 11 to 30 blows/ft.
Dense	- 31 to 50 blows/ft.
Very Dense	- 51 blows/ft. or more

Relative Proportions

Descriptive Term	Percent
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

Particle Size Identification

Boulders		- 8-inch diameter or more
Cobbles		- 3- to 8-inch diameter
Gravel	- Coarse	- 1 to 3 inch
	- Medium	- 1/2 to 1 inch
	- Fine	- 1/4 to 1/2 inch
Sand	- Coarse	- 0.6mm to 1/4 inch
	- Medium	- 0.2 mm to 0.6 mm
	- Fine	- 0.05 mm to 0.2 mm
		- 0.06 mm to 0.002 mm

COHESIVE SOILS
(Clay and Silt Combinations)

Consistency

Very Soft	- 3 blow/ft.
Soft	- 4 to 5 blows/ft.
Medium Stiff	- 6 to 10 blows/ft.
Stiff	- 11 to 15 blows/ft.
Very Stiff	- 16 to 30 blows/ft.
Hard	- 31 blows/ft. or more

Plasticity

Degree of Plasticity	Plasticity Index
None to slight	0 - 4
Slight	5 - 7
Medium	8 - 50
High to Very High	Over 50

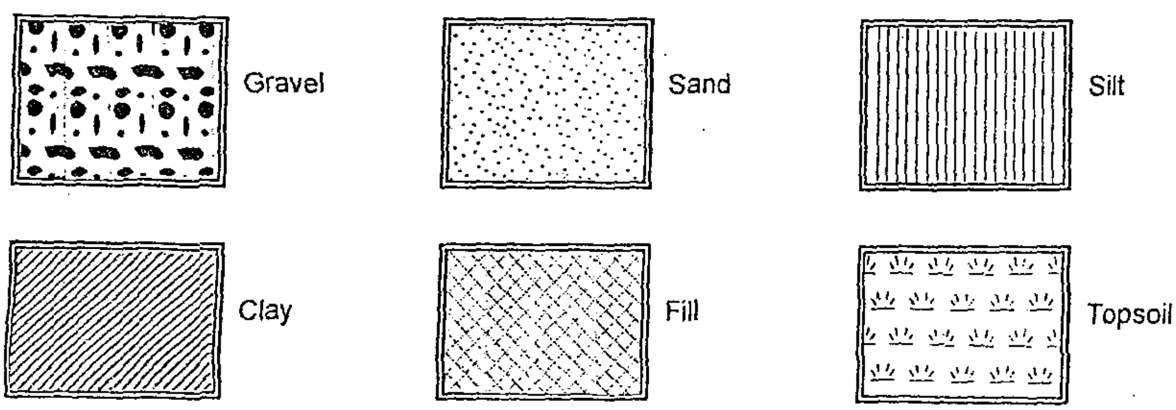
Classification on logs are made by visual inspection.

Standard Penetration Test - Driving a 2.0" O.D., 1 3/8" I.D., sampler a distance of one foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the drill log. The standard penetration test results can be obtained by adding at last two figures.

Strata Changes - In the column "Soil Descriptions" on the drill log, the horizontal lines represent approximate strata changes.

Groundwater observations were made at the times indicated. Porosity of soil strata, weather conditions, site topography, etc. may cause changes in the water levels indicated on the logs.

Graphic Legend:



LOG OF BORING NO. SWM-1

PROJECT: Clarksburg Town Center
PROJECT NO: 99530
PROJECT LOCATION: Montgomery County, Maryland

WATER LEVEL: Dry | Dry |
DATE: 3/07/01 | 03/08/01 |
CAVED (ft): 7.5

DATE STARTED: March 7, 2001
DATE COMPLETED: March 7, 2001
DRILLING CONTRACTOR: GTA
DRILLER: GTA
DRILLING METHOD: HSA
SAMPLING METHOD: Split Spoon

GROUND SURFACE ELEVATION: 626.0
DATUM: MSL
EQUIPMENT: CME 45
LOGGED BY: S. Cunningham
CHECKED BY: S. Rowe

SAMPLE NUMBER	SAMPLE DEPTH (ft)	SAMPLE RECOVERY (in)	SAMPLE BLOWS/6 inches	N (blows/ft)	ELEVATION (ft)	DEPTH (ft)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
1	0.0	3	1-2-2	4	626.0	0	CL		Dark brown, moist, loose, coarse to fine CLAY & SILT and SAND, little Rock Fragments. (Fill) AASHTO: A-6	Topsoil: N/A
2	2.5	10	7-5-7	12						Water Not Encountered While Drilling.
3	5.0	6	6-6-7	13	620.0	5				
							GM		Dark red-brown, medium dense, medium to fine ROCK FRAGMENTS, some coarse to fine Sand, little Silt. AASHTO: A-1-b	Permeability Test set at 7.5 ft.
4	8.5	7	4-5-7	12						
5	10.0	9	5-5-6	11	614.5	10				

Bottom of Hole at 11.5 ft.

Permeability Test at 7.5 ft.

Hour	Water Level Drop (in.)
1	0.60
2	0.36
3	0.24
4	0.48

Average Infiltration Rate: 0.42 in/hr.

Coordinates:

N:

E:

NOTES:

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Annapolis Junction, MD 20701

LOG OF BORING NO. GW-1

PROJECT: **Clarksburg Town Center - GW Recharge**
PROJECT NO: **99530**
PROJECT LOCATION: **Montgomery County, Maryland**

WATER LEVEL:	▽ 12.5	▼	▼
DATE:	03/07/01	03/08/01	
CAVED (ft):	Dry	Dry	

DATE STARTED: **March 7, 2001**
DATE COMPLETED: **March 7, 2001**
DRILLING CONTRACTOR: **GTA**
DRILLER: **GTA**
DRILLING METHOD: **HSA**
SAMPLING METHOD: **Split Spoon**

GROUND SURFACE ELEVATION: **651.5**
DATUM: **MSL**
EQUIPMENT: **CME 45**
LOGGED BY: **S. Cunningham**
CHECKED BY: **S. Rowe**

SAMPLE NUMBER	SAMPLE DEPTH (ft)	SAMPLE RECOVERY (in)	SAMPLE BLOWS/6 inches	N (blows/ft)
1	0.0	4	1-2-3	5
2	2.5	12	4-7-7	14
3	5.0	10	7-9-11	20
[illegible]	8.5	8	14-12-14	26
[illegible]	14.5	18	17-16-12	28

ELEVATION (ft)	DEPTH (ft)	USCS	DESCRIPTION	REMARKS
651.5 – 649.0	0 – 2.5	CL ML	Brown to yellow-brown, moist, medium stiff, SILT & CLAY, some coarse to fine Sand and Rock Fragments. AASHTO: A-4; USDA: Silt Loam	Topsoil: 2 in.
649.0 – 644.5	2.5 – 7.0	ML GM	Yellow-brown, moist, medium dense, SILT and medium to fine ROCK FRAGMENTS. AASHTO: A-4; USDA: Silt Loam	Water Not Encountered While Drilling. Bag Sample: 1.0 - 8.5 ft.
644.5 – 635.0	7.0 – 16.5	SM	Multicolored, moist to dry, medium dense, coarse to fine SAND and SILT, trace fine Rock Fragments. AASHTO: A-4; USDA: Sandy Loam	Permeability Test set at 12.5 ft. ▽

Bottom of Hole at 16.5 ft.

Permeability Test at 12.5 ft.

Hour	Water Level Drop (in.)
1	0.36
2	0.24
3	0.36
4	0.36

Average Infiltration Rate: 0.33 in/hr.

Coordinates:

N:

E:

NOTES:

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LOG OF BORING NO. GW-1

LOG OF BORING NO. GW-2

PROJECT: **Clarksburg Town Center - GW Recharge**
PROJECT NO: **99530**
PROJECT LOCATION: **Montgomery County, Maryland**

WATER LEVEL: ▽ **12.5** ▼ ▼
DATE: **03/07/01** **03/08/01**
CAVED (ft): **Dry** **Dry**

DATE STARTED: **March 7, 2001**
DATE COMPLETED: **March 7, 2001**
DRILLING CONTRACTOR: **GTA**
DRILLER: **GTA**
DRILLING METHOD: **HSA**
SAMPLING METHOD: **Split Spoon**

GROUND SURFACE ELEVATION: **659.4**
DATUM: **MSL**
EQUIPMENT: **CME 45**
LOGGED BY: **S. Cunningham**
CHECKED BY: **S. Rowe**

SAMPLE NUMBER	SAMPLE DEPTH (ft)	SAMPLE RECOVERY (in)	SAMPLE BLOWS/6 inches	N (blows/ft)	ELEVATION (ft)	DEPTH (ft)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
1	0.0	5	2-3-3	6	659.4	0	CL		Red-brown, moist, medium stiff, CLAY & SILT, some medium to fine Sand and Rock Fragments. AASHTO: A-4 / A-6 USDA: Clay Loam	Topsoil: 3 in. Water Not Encountered While Drilling.
2	2.5	9	3-5-5	10						
3	5.0	11	5-5-6	11	654.4	5	SM		Multicolored, moist to dry, medium dense to very dense, coarse to fine SAND, some Silt, little Rock Fragments. AASHTO: A-2-4 USDA: Sandy Loam/Loamy Sand	Bag Sample: 5.0 - 8.5 ft.
4	8.5	10	10-12-14	26		10				Permeability Test set at 16.5 ft. ▽
5	14.5	11	15-12-11	23		15				
6	18.5	13	33-38-29	67	638.9	20				

Bottom of Hole at 20.5 ft.

Permeability Test at 16.5 ft.

Hour	Water Level Drop (in.)
1	0.48
2	0.36
3	0.24
4	0.24

Average Infiltration Rate: 0.33 in/hr.

Coordinates:

N:

E:

NOTES:

GEO-TECHNOLOGY ASSOCIATES, INC.

9090 Junction Drive, Suite 9
Annapolis Junction, MD 20701

LOG OF BORING NO. GW-2

LOG OF BORING NO. GW-3

PROJECT: Clarksburg Town Center - GW Recharge
PROJECT NO: 99530
PROJECT LOCATION: Montgomery County, Maryland

WATER LEVEL: ∇ 13.5 ▼ ▼
DATE: 03/07/01 03/08/01
CAVED (ft): Dry Dry

DATE STARTED: March 7, 2001
DATE COMPLETED: March 7, 2001
DRILLING CONTRACTOR: GTA
DRILLER: GTA
DRILLING METHOD: HSA
SAMPLING METHOD: Split Spoon

GROUND SURFACE ELEVATION: 647.2
DATUM: MSL
EQUIPMENT: CME 45
LOGGED BY: S. Cunningham
CHECKED BY: S. Rowe

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMPLE RECOVERY (in)	SAMPLE BLOWS/6 inches	N (blows/ft)	ELEVATION (ft)	DEPTH (ft)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
	0.0	7	2-2-2	4	647.2	0	CL ML		Brown, moist, medium stiff to stiff, SILT and CLAY, some coarse to fine Sand and medium to fine Rock Fragments. AASHTO: A-4 USDA: Silt Loam	Topsoil: 4 in. Water Not Encountered While Drilling.
2	2.5	8	5-5-6	11						
3	5.0	9	7-6-5	11		5				
					640.2		SM		Multicolored, moist to dry, medium dense to very dense, coarse to fine SAND, little Silt, trace fine Rock Fragments. AASHTO: A-1-b USDA: Loamy Sand	Permeability Test set at 13.5 ft.
4	8.5	3	7-9-12	21		10				
5	13.5	13	17-7-23	30						∇
6	15.5	11	23-13-30	43		15				
					630.2				Bottom of Hole at 17.0 ft.	

Permeability Test at 13.5 ft.

Hour	Water Level Drop (in.)
1	0.24
2	0.36
3	0.24
4	0.36

Average Infiltration Rate: 0.30 in/hr.

Coordinates:

N:

E:

NOTES:

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Annapolis Junction, MD 20701

APPENDIX C

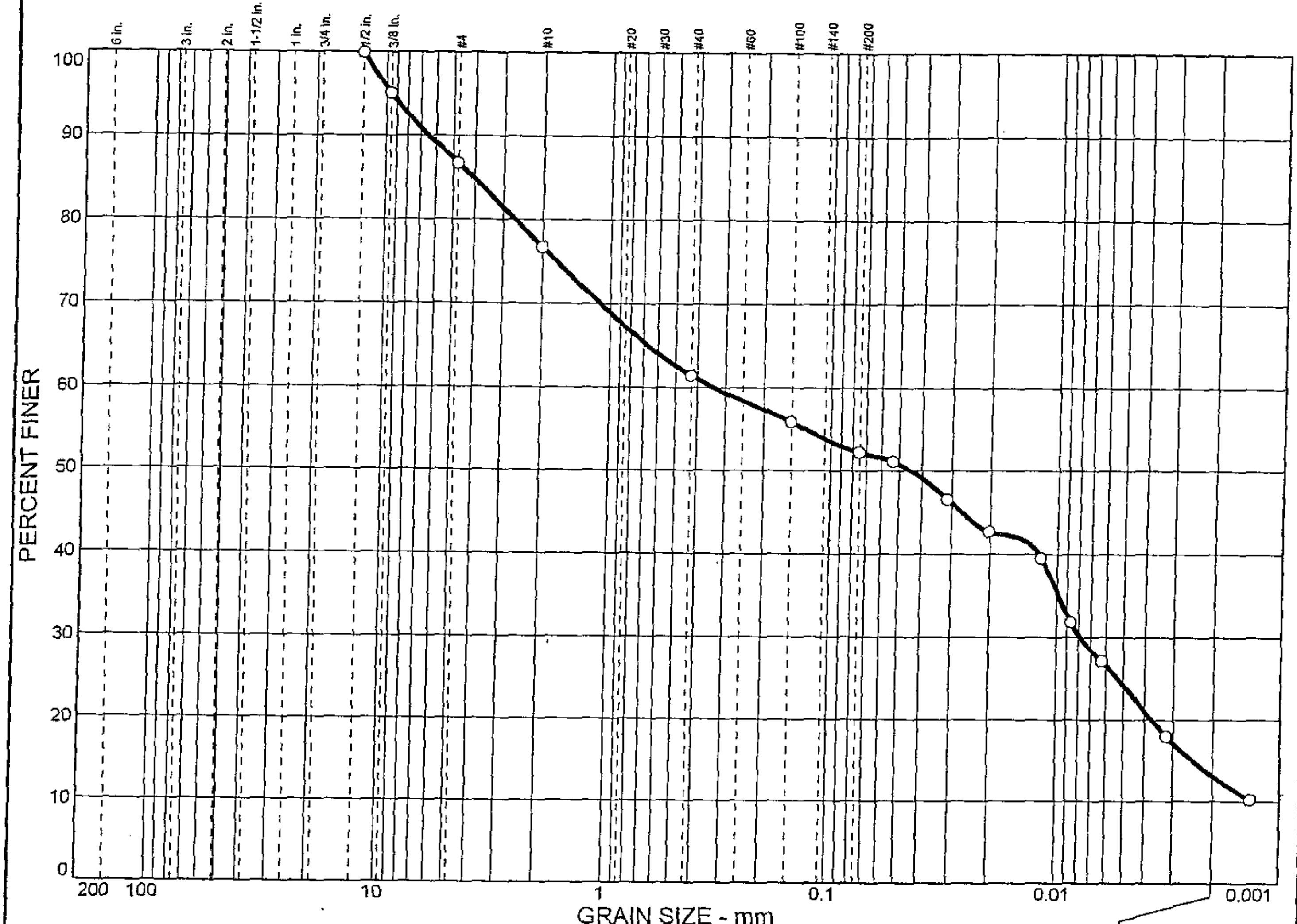
LABORATORY TEST RESULTS

GEO-TECHNOLOGY ASSOCIATES, INC.
Natural Moisture Content Summary

Clarksburg Town Center
March 12, 2001
Job Number: 99530

BORING #	SAMPLE #	DEPTH (FT)	NATURAL MOISTURE CONTENT %
SWM-1	S-1	0.0-1.5	19.5
	S-2	2.5-4.0	20.2
	S-3	5.0-6.5	15.3
	S-4	8.5-10.0	14.7
	S-5	10.0-11.5	12.1
GW-1	S-1	0.0-1.5	24.8
	S-2	2.5-4.0	15.2
	S-3	5.0-6.5	13.3
	S-4	8.5-10.0	7.6
	S-5	14.5-16.0	10.6
GW-2	S-1	0.0-1.5	22.3
	S-2	2.5-4.0	14.4
	S-3	5.0-6.5	10.4
	S-4	8.5-10.0	9.8
	S-5	13.5-15.0	9.5
	S-6	18.5-20.5	9.5
GW-3	S-1	0.0-1.5	19.9
	S-2	2.5-4.0	18.8
	S-3	5.0-6.5	19.9
	S-4	8.5-10.0	9.4
	S-5	13.5-15.0	10.3
	S-6	15.5-17.0	9.7

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
o	0.0	23.3	25.6	37.9	13.2

☒	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	39	16	4.07	0.339	0.0445	0.0078	0.0025			

MATERIAL DESCRIPTION	USCS	AASHTO
o Dark Brown CLAY & SILT and coarse to fine SAND, little fine gravel.	CL	A-6(6)

Project No. 99530 **Client:** Terrabrook

Project: Clarksburg Town Center

o **Source:** SWM-1 **Sample No.:** S-2 **Elev./Depth:** 2.5'-4.0'

Remarks:

oNatural Moisture: 20.2

April 5, 2001

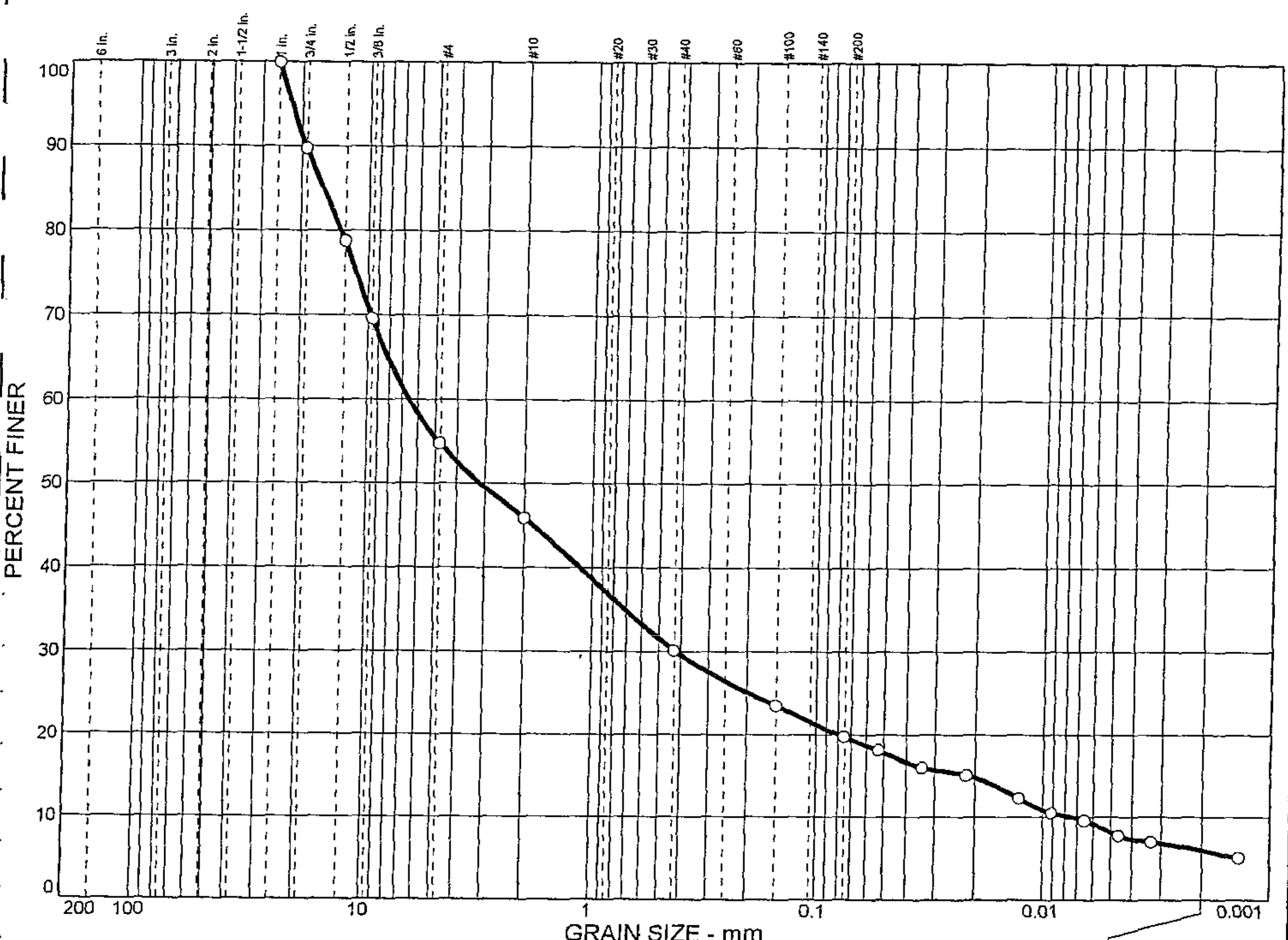
USDA = Loam/Silt Loam

PARTICLE SIZE DISTRIBUTION TEST REPORT

GEO-TECHNOLOGY ASSOCIATES, INC.

Plate 6

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	54.1	27.8	12.1	6.0

LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
NP	NP	16.1	6.53	3.14	0.420	0.0210	0.0074	3.63	880.34

MATERIAL DESCRIPTION	USCS	AASHTO
Dk red medium to fine ROCK FRAGMENTS (saprolite), some coarse to fine sand, little silt.	GM	A-1-b

Project No. 99530 **Client:** Terrabrook
Project: Clarksburg Town Center

Source: SWM-1 **Sample No.:** S-5 **Elev./Depth:** 10.0'-11.5'

Remarks:
○ Natural Moisture: 12.1%

March 15, 2001

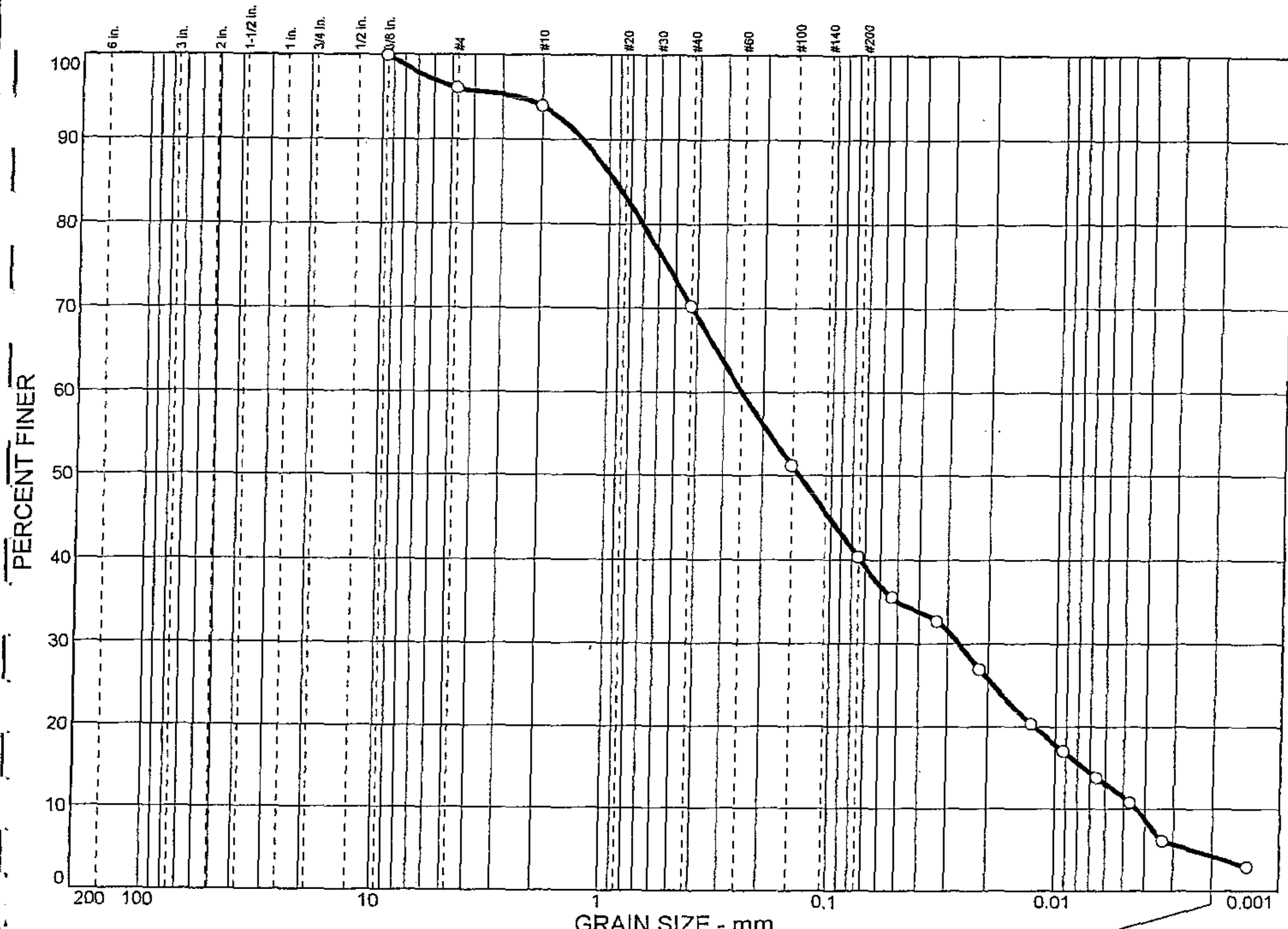
USDA = Sandy Loam

PARTICLE SIZE DISTRIBUTION TEST REPORT

GEO-TECHNOLOGY ASSOCIATES, INC.

Plate 1

PARTICLE SIZE DISTRIBUTION TEST REPORT



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	6.0	58.5	31.2	4.3

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	NP	NP	0.940	0.248	0.139	0.0266	0.0075	0.0044	0.65	56.73

MATERIAL DESCRIPTION	USCS	AASHTO
○ Multicolored coarse to fine SAND and SILT, trace fine rock fragments.	SM	A-4(0)

Project No. 99530 **Client:** Terrabrook

Project: Clarksburg Town Center

○ **Source:** GW-1 **Sample No.:** S-5 **Elev./Depth:** 14.5'-16.0'

Remarks:

○ Natural Moisture: 10.6%

March 15, 2001

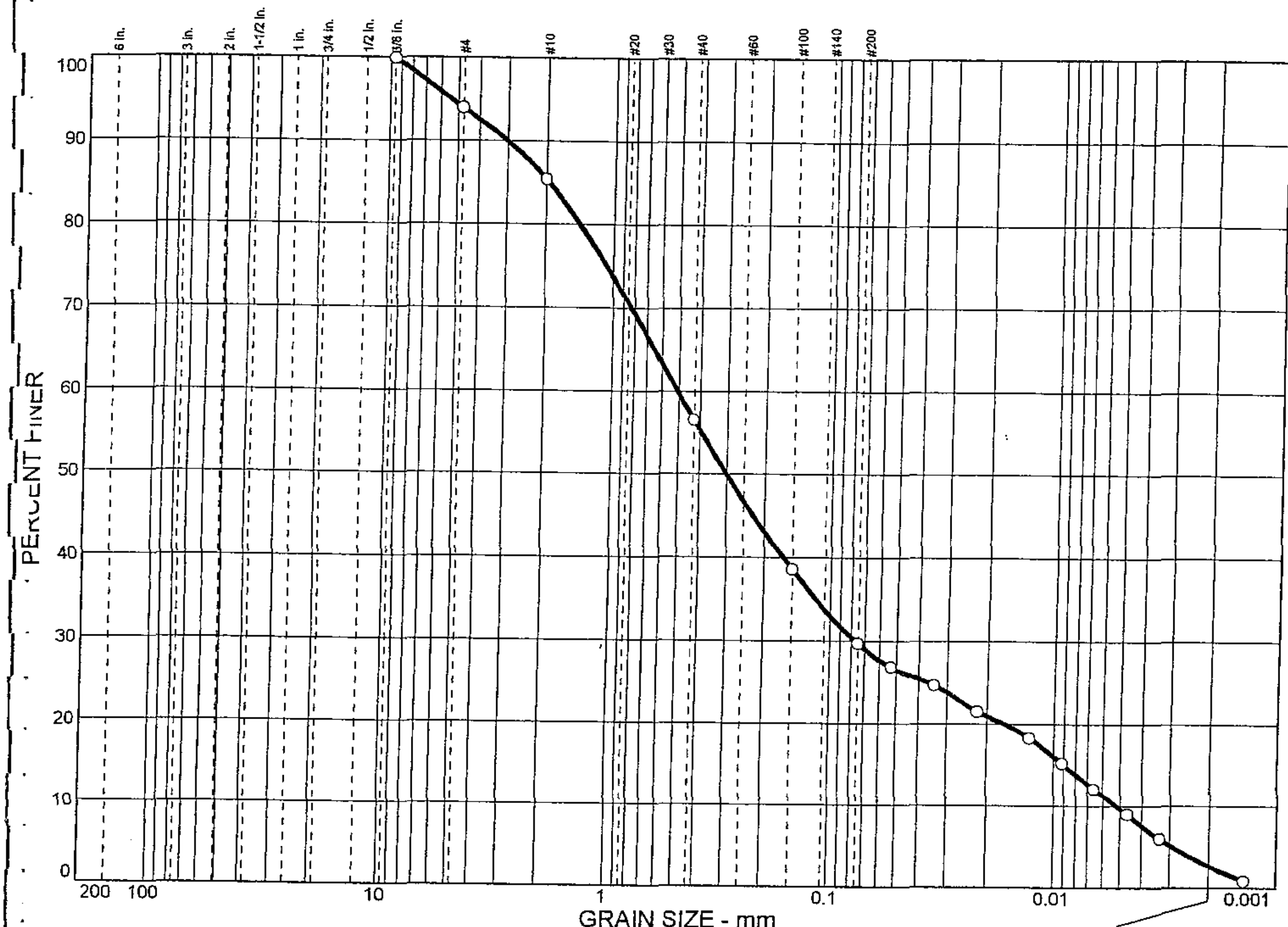
USDA = Sandy Loam

PARTICLE SIZE DISTRIBUTION TEST REPORT

GEO-TECHNOLOGY ASSOCIATES, INC.

Plate 4

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	14.6	58.6	24.1	2.7

LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
NP	NP	1.94	0.507	0.300	0.0772	0.0090	0.0052	2.26	97.60

MATERIAL DESCRIPTION	USCS	AASHTO
Multicolored coarse to fine SAND, some silt, little rock fragments.	SM	A-2-4(0)

Project No. 99530 **Client:** Terrabrook

Project: Clarksburg Town Center

Source: GW-2 **Sample No.:** S-6 **Elev./Depth:** 18.5'-20.5'

Remarks:

o Natural Moisture: 9.5%

March 15, 2001

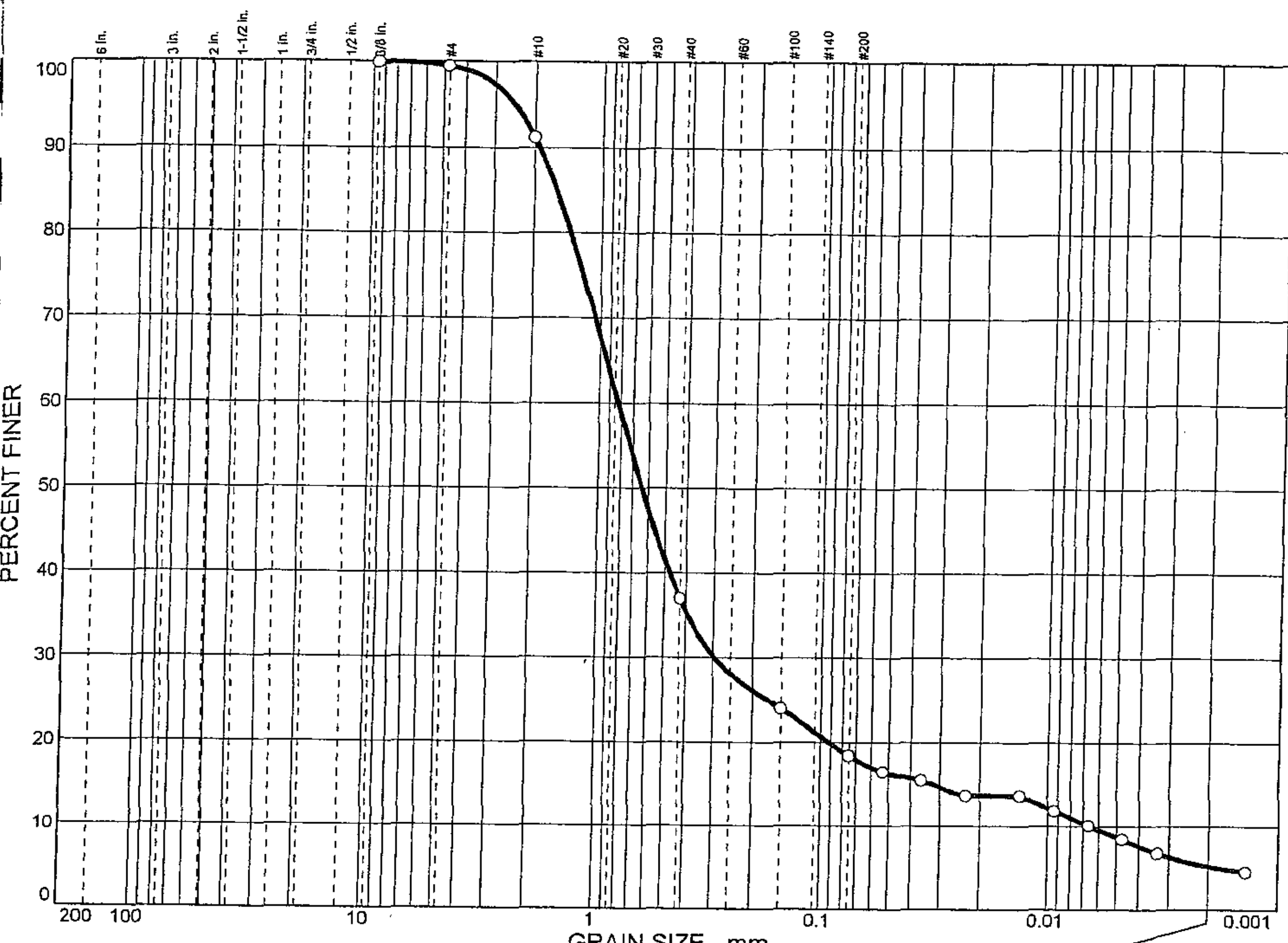
USDA = Sandy Loam/ Loamy sand

PARTICLE SIZE DISTRIBUTION TEST REPORT

GEO-TECHNOLOGY ASSOCIATES, INC.

Plate 3

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	8.8	74.7	11.3	5.2

LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
NP	NP	1.59	0.823	0.637	0.294	0.0319	0.0065	16.14	126.20

MATERIAL DESCRIPTION	USCS	AASHTO
Multicolored coarse to fine SAND, little silt, trace fine rock fragments (saprolite).	SM	A-1-b

Project No. 99530 **Client:** Terrabrook
Project: Clarksburg Town Center

Source: GW-3 **Sample No.:** S-6 **Elev./Depth:** 15.5'-17.0'

Remarks:
Natural Moisture: 9.7%

March 15, 2001

USDA = Loamy sand

PARTICLE SIZE DISTRIBUTION TEST REPORT

GEO-TECHNOLOGY ASSOCIATES, INC.

Plate 2

APPENDIX D

MOUNDING ANALYSIS

CW-4\ GW-3

Ver. 1.1 MOUNDHT April 1994

Accurately computes the maximum height of a ground-water mound forming on an extensive and initially near-horizontal saturated zone beneath a rectangular recharge area. Uses the method of Hantush (Water Res. Research, vol. 3, no. 1, 1967, pp. 227-234) (see Ground Water journal, vol. __, no. _, 1994, pp. _______)

Run 9

DATA ENTERED:

Recharge area width,	W =	25.0	ft
Recharge area length,	L =	50.0	ft
Saturated depth of aquifer,	H =	50.0	ft (no mound)
Specific yield of aquifer,	Sy =	.080	
Aquifer hydraulic conductivity,	K =	.300	ft/day
Constant rate of recharge,	I =	.1900	ft/day
Input mound-growth time,	TYR =	25.00	years
Name of file written	=	ctcgw3_b	

COMPUTED RESULTS:

Mound height results:

YEARS	MAX MOUND HEIGHT (FT)	# N-R ITERS	Z/H	ACCURACY RANGE
25.0	11.451	4	.22902	1
.1	5.450	4	.10900	1
.2	6.235	4	.12470	1
.5	7.260	4	.14520	1
1.0	8.024	4	.16049	1
2.0	8.779	4	.17558	1
5.0	9.762	4	.19525	1
10.0	10.495	4	.20991	1
20.0	11.220	4	.22439	1
50.0	12.164	4	.24328	1
100.0	12.869	4	.25738	1

Accuracy ranges:

RANGE	Z/H	SOURCE	ACCURACY
1	0 - 0.5	Rao & Sarma (1980)	To 2%
"	"	Hantush (1967b)	To 6%
2	0.5 - 3.3	Rao & Sarma (1980)	To 2%
3*	> 3.3	None	No claims

4 GW-3

r. 1.1 MOUNDHT April 1994

cc rately computes the maximum height of a ground-water mound orming on an extensive and initially near-horizontal saturated one beneath a rectangular recharge area. Uses the method of ar ush (Water Res. Research, vol. 3, no. 1, 1967, pp. 227-234) se Ground Water journal, vol. __, no. _, 1994, pp. _______)

Run 8

'A ENTERED:

R charge area width,	W =	25.0	ft
Recharge area length,	L =	50.0	ft
Saturated depth of aquifer,	H =	50.0	ft (no mound)
S ecific yield of aquifer,	Sy =	.080	
A uifer hydraulic conductivity,	K =	.600	ft/day
Constant rate of recharge,	I =	.1900	ft/day
I out mound-growth time,	TYR =	25.00	years
N ne of file written	=	ctcgw3_a	

P TED RESULTS:

height results:

YEARS	MAX MOUND HEIGHT (FT)	# N-R ITERS	Z/H	ACCURACY RANGE
25.0	6.381	4	.12763	1
.1	3.192	4	.06384	1
.2	3.602	4	.07203	1
.5	4.140	4	.08279	1
1.0	4.544	4	.09087	1
2.0	4.944	4	.09889	1
5.0	5.470	4	.10940	1
10.0	5.864	4	.11729	1
20.0	6.256	4	.12512	1
50.0	6.769	4	.13538	1
100.0	7.155	4	.14309	1

racy ranges:

RANGE	Z/H	SOURCE	ACCURACY
1	0 - 0.5	Rao & Sarma (1980)	To 2%
"	"	Hantush (1967b)	To 6%
2	0.5 - 3.3	Rao & Sarma (1980)	To 2%
3*	> 3.3	None	No claims

CW-4\ GW-3

Ver. 1.1 MOUNDHT April 1994

Accurately computes the maximum height of a ground-water mound forming on an extensive and initially near-horizontal saturated zone beneath a rectangular recharge area. Uses the method of Hantush (Water Res. Research, vol. 3, no. 1, 1967, pp. 227-234) (see Ground Water journal, vol. __, no. _, 1994, pp. _______)

Run 2

DATA ENTERED:

Recharge area width,	W =	25.0	ft
Recharge area length,	L =	50.0	ft
Saturated depth of aquifer,	H =	50.0	ft (no mound)
Specific yield of aquifer,	Sy =	.080	
Aquifer hydraulic conductivity,	K =	1.200	ft/day
Constant rate of recharge,	I =	.1900	ft/day
Input mound-growth time,	TYR =	25.00	years
Name of file written	=	ctcgw3_f	

Mound height results:

YEARS	MAX MOUND HEIGHT (FT)	# N-R ITERS	Z/H	ACCURACY RANGE
25.0	3.483	4	.06965	1
.1	1.827	3	.03654	1
.2	2.037	3	.04075	1
.5	2.315	3	.04629	1
1.0	2.523	3	.05047	1
2.0	2.731	3	.05463	1
5.0	3.005	4	.06010	1
10.0	3.211	4	.06423	1
20.0	3.417	4	.06833	1
50.0	3.687	4	.07374	1
100.0	3.890	4	.07781	1

Accuracy ranges:

RANGE	Z/H	SOURCE	ACCURACY
1	0 - 0.5	Rao & Sarma (1980)	To 2%
"	"	Hantush (1967b)	To 6%
2	0.5 - 3.3	Rao & Sarma (1980)	To 2%
3*	> 3.3	None	No claims

CW-4\ GW-3

Ver. 1.1 MOUNDHT April 1994

Accurately computes the maximum height of a ground-water mound forming on an extensive and initially near-horizontal saturated zone beneath a rectangular recharge area. Uses the method of Hantush (Water Res. Research, vol. 3, no. 1, 1967, pp. 227-234) (see Ground Water journal, vol. __, no. _, 1994, pp. _______)

Run 2

DATA ENTERED:

Recharge area width,	W =	25.0	ft
Recharge area length,	L =	50.0	ft
Saturated depth of aquifer,	H =	50.0	ft (no mound)
Specific yield of aquifer,	Sy =	.080	
Aquifer hydraulic conductivity,	K =	.600	ft/day
Constant rate of recharge,	I =	.6600	ft/day
Input mound-growth time,	T =	30.00	days
Name of file written	=	ctcgw3_r	

Mound height results:

DAYS	MAX MOUND HEIGHT (FT)	# N-R ITERS	Z/H	ACCURACY RANGE
30.0	10.129	4	.20257	1

Accuracy ranges:

RANGE	Z/H	SOURCE	ACCURACY
1	0 - 0.5	Rao & Sarma (1980)	To 2%
"	"	Hantush (1967b)	To 6%
2	0.5 - 3.3	Rao & Sarma (1980)	To 2%
3*	> 3.3	None	No claims

CW-6/ GW-1

Ver. 1.1 MOUNDHT April 1994

Accurately computes the maximum height of a ground-water mound forming on an extensive and initially near-horizontal saturated zone beneath a rectangular recharge area. Uses the method of Hantush (Water Res. Research, vol. 3, no. 1, 1967, pp. 227-234) (see Ground Water journal, vol. __, no. _, 1994, pp. _______)

Run13

DATA ENTERED:

Recharge area width,	W =	20.0	ft
Recharge area length,	L =	45.0	ft
Saturated depth of aquifer,	H =	50.0	ft (no mound)
Specific yield of aquifer,	Sy =	.080	
Aquifer hydraulic conductivity,	K =	.300	ft/day
Constant rate of recharge,	I =	.1350	ft/day
Input mound-growth time,	TYR =	25.00	years
Name of file written	=	ctcgw1_b	

COMPUTED RESULTS:

Mound height results:

YEARS	MAX MOUND HEIGHT (FT)	# N-R ITERS	Z/H	ACCURACY RANGE
25.0	6.285	4	.12569	1
.1	3.014	3	.06028	1
.2	3.434	4	.06868	1
.5	3.986	4	.07972	1
1.0	4.400	4	.08800	1
2.0	4.811	4	.09623	1
5.0	5.350	4	.10701	1
10.0	5.755	4	.11509	1
20.0	6.156	4	.12312	1
50.0	6.682	4	.13365	1
100.0	7.077	4	.14154	1

Accuracy ranges:

RANGE	Z/H	SOURCE	ACCURACY
1	0 - 0.5	Rao & Sarma (1980)	To 2%
"	"	Hantush (1967b)	To 6%
2	0.5 - 3.3	Rao & Sarma (1980)	To 2%
3*	> 3.3	None	No claims

CW-6/ GW-1

Ver. 1.1 MOUNDHT April 1994

Accurately computes the maximum height of a ground-water mound forming on an extensive and initially near-horizontal saturated zone beneath a rectangular recharge area. Uses the method of Hantush (Water Res. Research, vol. 3, no. 1, 1967, pp. 227-234) (see Ground Water journal, vol. __, no. _, 1994, pp. _______)

Run12

DATA ENTERED:

Recharge area width,	W =	20.0	ft
Recharge area length,	L =	45.0	ft
Saturated depth of aquifer,	H =	50.0	ft (no mound)
Specific yield of aquifer,	Sy =	.080	
Aquifer hydraulic conductivity,	K =	.600	ft/day
Constant rate of recharge,	I =	.1350	ft/day
Input mound-growth time,	TYR =	25.00	years
Name of file written	=	ctcgw1aa	

Mound height results:

YEARS	MAX MOUND HEIGHT (FT)	# N-R ITERS	Z/H	ACCURACY RANGE
25.0	3.436	4	.06873	1
.1	1.740	3	.03481	1
.2	1.956	3	.03912	1
.5	2.240	3	.04480	1
1.0	2.454	3	.04908	1
2.0	2.667	3	.05334	1
5.0	2.947	4	.05895	1
10.0	3.159	4	.06317	1
20.0	3.369	4	.06738	1
50.0	3.646	4	.07291	1
100.0	3.854	4	.07708	1

Accuracy ranges:

RANGE	Z/H	SOURCE	ACCURACY
1	0 - 0.5	Rao & Sarma (1980)	To 2%
"	"	Hantush (1967b)	To 6%
2	0.5 - 3.3	Rao & Sarma (1980)	To 2%
3*	> 3.3	None	No claims

CW-6/ GW-1

Ver. 1.1 MOUNDHT April 1994

Accurately computes the maximum height of a ground-water mound forming on an extensive and initially near-horizontal saturated zone beneath a rectangular recharge area. Uses the method of Hantush (Water Res. Research, vol. 3, no. 1, 1967, pp. 227-234) (see Ground Water journal, vol. __, no. _, 1994, pp. _______)

Run15

DATA ENTERED:

Recharge area width,	W =	20.0	ft
Recharge area length,	L =	45.0	ft
Saturated depth of aquifer,	H =	50.0	ft (no mound)
Specific yield of aquifer,	Sy =	.080	
Aquifer hydraulic conductivity,	K =	1.200	ft/day
Constant rate of recharge,	I =	.1350	ft/day
Input mound-growth time,	TYR =	25.00	years
Name of file written	=	ctcgwldd	

COMPUTED RESULTS:

Mound height results:

YEARS	MAX MOUND HEIGHT (FT)	# N-R ITERS	Z/H	ACCURACY RANGE
25.0	1.852	3	.03704	1
.1	.986	3	.01972	1
.2	1.095	3	.02191	1
.5	1.240	3	.02479	1
1.0	1.349	3	.02698	1
2.0	1.458	3	.02915	1
5.0	1.601	3	.03202	1
10.0	1.709	3	.03419	1
20.0	1.817	3	.03635	1
50.0	1.960	3	.03920	1
100.0	2.067	3	.04135	1

Accuracy ranges:

RANGE	Z/H	SOURCE	ACCURACY
1	0 - 0.5	Rao & Sarma (1980)	To 2%
"	"	Hantush (1967b)	To 6%
2	0.5 - 3.3	Rao & Sarma (1980)	To 2%
3*	> 3.3	None	No claims

CW-6\GW-1

Ver. 1.1 MOUNDHT April 1994

Accurately computes the maximum height of a ground-water mound forming on an extensive and initially near-horizontal saturated zone beneath a rectangular recharge area. Uses the method of Hantush (Water Res. Research, vol. 3, no. 1, 1967, pp. 227-234) (see Ground Water journal, vol. __, no. _, 1994, pp. _______)

Originally developed in 1992-93 by
Professor E. John Finnemore
Department of Civil Engineering
Santa Clara University
Santa Clara, California 95053
Tel: 408-554-4924, Fax: 408-554-5474

Run 1

DATA ENTERED:

Recharge area width,	W =	20.0	ft
Recharge area length,	L =	45.0	ft
Saturated depth of aquifer,	H =	50.0	ft (no mound)
Specific yield of aquifer,	Sy =	.080	
Aquifer hydraulic conductivity,	K =	.600	ft/day
Constant rate of recharge,	I =	.6600	ft/day
Input mound-growth time,	T =	30.00	days
Name of file written	=	ctcgw1_r	

Mound height results:

DAYS	MAX MOUND HEIGHT (FT)	# N-R ITERS	Z/H	ACCURACY RANGE
30.0	7.827	4	.15654	1

Accuracy ranges:

RANGE	Z/H	SOURCE	ACCURACY
1	0 - 0.5	Rao & Sarma (1980)	To 2%
"	"	Hantush (1967b)	To 6%
2	0.5 - 3.3	Rao & Sarma (1980)	To 2%
3*	> 3.3	None	No claims

MEMO

To:	Mr. Jim Richmond - Terrabrook Mr. Jeff Strulic – CPJ
From:	Mr. Scott Rowe
Date:	March 22, 2002
Re:	Groundwater Recharge Facilities CW-7 and CW-8

As requested, GTA has provided soils and laboratory data for two groundwater recharge facilities, designated CW-7 and CW-8. Data for these locations was provided in two previous reports, as described in the following paragraphs:

- <u>Recharge Facility CW-8</u>

  A summary of subsurface conditions at this location was provided in GTA's <u>Report of Subsurface Exploration</u>, dated April 9, 2001. Boring GW-3 was located near this facility. A borehole permeability test was performed at this location, at an approximate elevation of 634 MSL. An infiltration rate of 0.3 inches per hour was measured in medium-dense to dense Loamy Sand soils. Groundwater was not encountered in this boring.

- <u>Recharge Facility CW-7</u>

  A summary of subsurface conditions at this location was provided in GTA's <u>Report of Montgomery County Department of Permitting Services Study</u>, dated August 27, 2001. Boring GW-3 was located near this facility. Medium-dense to very dense Sandy Loam soils were encountered from a depth of 7 feet to the bottom of the boring. No permeability test was performed at this location, however, based on permeability test results recorded in similar materials in Boring GW-~~3~~4, an infiltration rate less on the order of 0.3 inches per hour is anticipated at this location.

A reproduction of the Boring Location Plan provided with GTA's August 2001 report, indicating the locations of Borings GW-3 and GW-4, has been attached to this memo. If you require any additional information, please contact our office.

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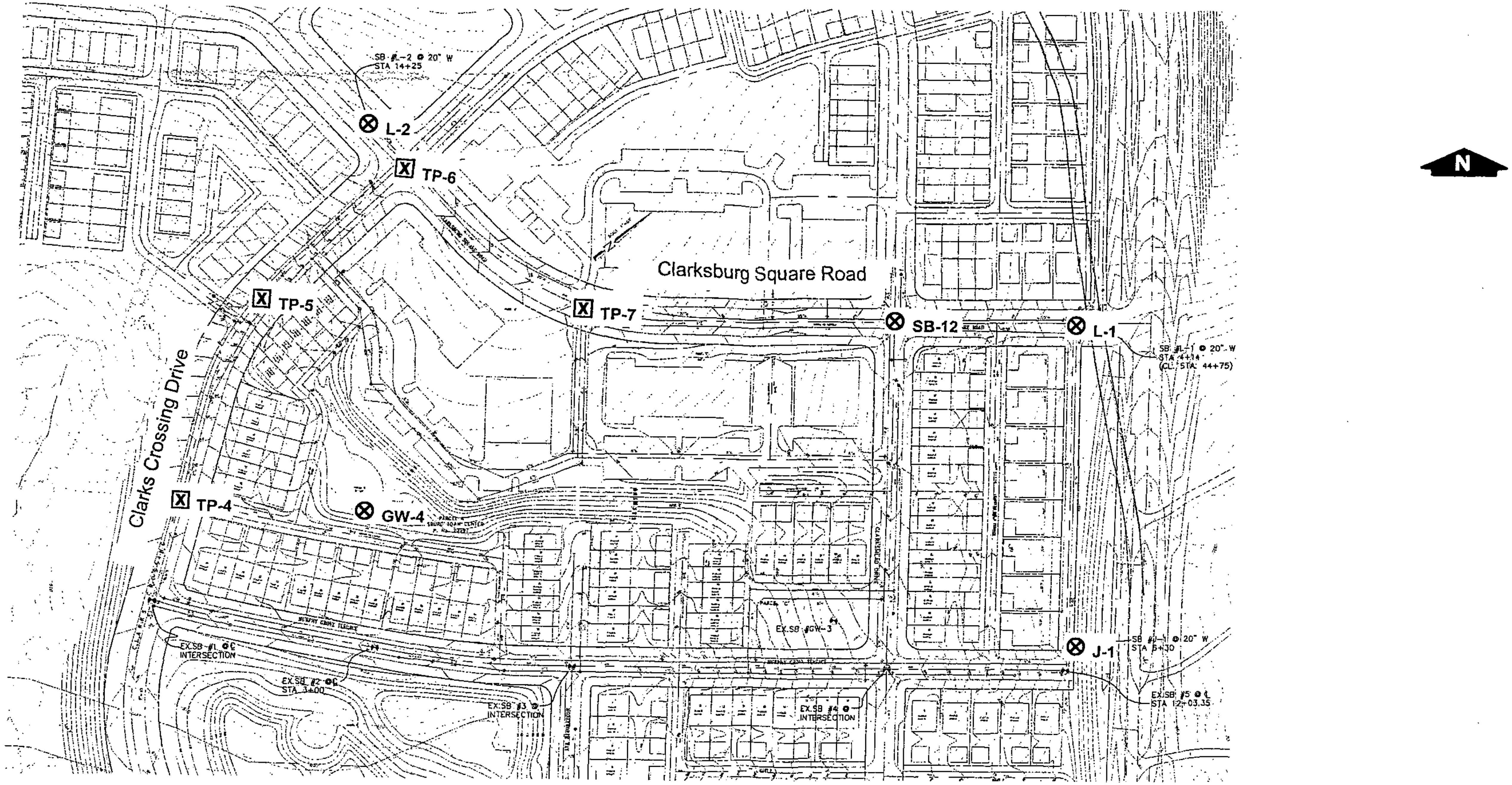
99530

Geo-Technology Associates, Inc. 9090 Junction Drive, Suite 9, Annapolis Junction, MD 20701
Phone: 410-792-9446 / 301-470-4470 Fax: 410-792-7395



LEGEND:

⊗: APPROXIMATE BORING LOCATION - PERFORMED JULY 2001.

☒: APPROXIMATE TEST PIT LOCATION - PERFORMED DECEMBER 2000

NOTES:

1. BASE MAP DEVELOPMENT FROM A SITE PLAN PROVIDED BY CPJ. ORIGINAL SCALE 1"=50'.
2. THE TEST BORINGS AND TEST PITS WERE FIELD-LOCATED BY CPJ BASED ON A FIELD SURVEY. THE DATA SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.

GEO-TECHNOLOGY ASSOCIATES, INC.

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Clarksburg Town Cente

TEST LOCATION PLAN

Montgomery County, Mary

SCALE	DATE	DRAWN BY	DESIGN BY	REVIEW BY	JOB
1" = 150'	8/18/01	SCR		JPK	