Project 04466

SUBSURFACE INVESTIGATION

Proposed New Additions
75th Street Waste Water
Treatment Plant
Boulder, Colorado

Prepared For:

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November 2004

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Table of Contents
Project 04466

SUBSURFACE INVESTIGATION
PROPOSED NEW ADDITIONS
75TH STREET WASTE WATER TREATMENT PLANT
BOULDER, COLORADO

PURPOSE

This report presents the results of a subsurface investigation performed on July 31 and August 1, 2002, at the site of proposed new additions to the 75th Street Waste Water Treatment Plant in Boulder, Colorado. This investigation was made to provide engineering data for typical foundation systems for proposed structures to be constructed at the site. A total of thirteen (13) borings were completed during the course of the investigation in the vicinity of the proposed new structure envelopes. The locations of the borings are indicated on the Boring Location Map (Figure 1).

Factual data gathered during the field and laboratory work is summarized in Figure 2 and Table 1, attached. The results of this investigation, our opinions that are based on this investigation, and our experience in the general area are summarized in this report.

INVESTIGATION DETAILS

The field investigation consisted of drilling thirteen (13) borings in the area of the structures. The borings were completed with 4-inch diameter, continuous flight power augers using a truck mounted drill rig.

The augers are utilized to bore and clean the hole to the desired sampling depth. The augers are then removed, and a 2-inch I.D. California spoon sampler is inserted to the desired testing depth. The sampler is then driven with blows of a standard 140-pound hammer falling a distance of 30 inches.

The sampler is driven a total of 12 inches, or a maximum of 50 blows. The number of blows required to drive the sampler 12 inches, or a fraction thereof, constitutes the penetration test. The test is similar to the Standard Penetration Test described in ASTM D1586. This test, when properly evaluated, is a measure of the soil strength and density. The results of these tests are shown on the Graphic Boring Logs (Figure 2). Bulk auger samples were also taken from some of the borings.

All soil samples recovered were inspected, and some samples were selected for testing by the project engineer. The testing program consisted of performing the following tests where appropriate:

Consolidation/Swell

- Consolidation/Swell tests were performed to determine the relative stability of the different subsurface soil types.

Natural Dry Density

- The dry density of the soils provides us with an indication of the relative compaction of the surficial soils.

Natural Moisture Content

- The moisture content test provides us with information which may indicate the probability of instability due to consolidation or swell that may be caused by excessive wetting or drying.

Unconfined Compressive Strength

- The approximate unconfined compressive strength was determined by us of a calibrated hand penetrometer. The unconfined compressive strength can be useful in determining the bearing capacity of a soil.

PROPOSED DEVELOPMENT

The structures on this site are to consist of at or above grade concrete or masonry structures, or below grade tanks, concrete basins and influent or effluent channels. The structures are assumed to be one to two story buildings along with associated piping. The basins and tanks are to extend 15 to 25 feet below existing grade. The loadings are anticipated to vary from light to heavy, depending on the structure.

SITE CONDITIONS

At the time of the investigation, the site consisted of the existing waste water treatment facility on 75th Street. The facility is bordered on the north by Boulder Creek, to the south and west by undeveloped open space and ponds and to the east by 75th Street and undeveloped property. The site was relatively flat, however had varying slopes next to existing structures. Vegetation on the site consisted of a sparse to moderate growth of grasses and weeds long with some trees.

SUBSOILS

The subsoils on the site generally consisted of approximately 3 to 11½ feet of dark brown to mottled brown fill consisting of, silty, sand and clay with gravel and cobbles containing some organics. Underlying the layer of fill in all of the borings was a brown, silty, slightly clayey sand and gravel, which extended to depths of approximately 13 to 24½ feet. Bedrock was encountered beneath the surficial soils in all of the borings, at depths of approximately 13 to 24½ feet. The bedrock consisted of gray, silty, claystone with some very hard layers.

A detailed description of the soils encountered in this investigation is presented in the Graphic Boring Log (Figure 2).

GROUNDWATER CONDITIONS

Groundwater was encountered during our investigation, in all of the borings, at depths of approximately 10 to 18 feet below the existing ground surface. We are past the time of seasonal high groundwater table and some rise of the groundwater table is anticipated. It is not possible to forecast the seasonal high groundwater table based on short duration monitoring. The only sure method of such determination is monitoring of the water table through the springs and early summer (typical seasonal high groundwater levels occur about July 1). Groundwater will be of major concern on some portions of the site where the excavations are anticipated to extend below the water level. Additionally, improper drainage could result in a "perched" groundwater table. This is discussed further in the "Site Drainage Considerations" section that is included later in this report. Also, Boulder Creek and the adjacent ponds will influence the groundwater level at the site.

We understand that a cut-off wall (dike) was placed around the facility to help reduce the amount of groundwater entering the site. Historical groundwater fluctuation limits are beyond the scope of this investigation however will likely fluctuate with the levels of water in Boulder Creek and the water elevations in the adjacent ponds. You have requested that we provide you with an estimate of the high groundwater level for buoyancy calculations. This has been a relatively wet year and the investigation was performed just past the time of the seasonal high water table. Therefore, we would recommend using at least 2 feet higher than that encountered in this investigation.

FOUNDATION RECOMMENDATIONS

The existing fill materials are not considered suitable to support any foundation loadings due to their unknown placement and level of compaction. The silty slightly clayey sand and gravel is considered to be very low to non-expansive.

The bedrock has a low to very high expansive potential. Spread footings may be used at the site for lightly loaded structures with some mitigation necessary due to existing fill soils, or the structures may be founded on drilled piers. The two different foundations are outlined in the following sections.

Footings

In general, naturally occurring silty, slightly clayey sand and gravel below the existing fill are of very low expansive potential under light loads. We recommend the footings be designed for a maximum soil bearing pressure of 2,500 psf based on dead load plus full anticipated live load. Remedial work may need to be done due to the existing fill soils encountered. Such remediation would consist of removing the fill and placing footings down on the sand and gravel or placing back a controlled granular structural fill to support the footings. The structural fill should be placed back in lifts and compacted to a minimum of 100% of maximum density, ASTM D698. Also a 4-foot offset above expansive bedrock needs to be monitored if footings are to be used. This can be verified in the field by use of a backhoe and digging test pits at the time of inspection.

Differential settlement must be considered in the design of the foundation system. Differential settlement should be kept to a minimum, which can be achieved by keeping loads as uniform as possible throughout the foundation elements.

Foundation walls supported by footings should be designed as grade beams capable of spanning a minimum distance of 12 feet. The amount of reinforcing steel used should not be less than two No. 5 bars, both top and bottom of the foundation wall. Reinforcement should be continuous around corners. Differential settlement will be minimized by proper reinforcement of foundation walls. Minimum cover for frost protection should be 30 inches.

It is our understanding that none of the existing structures at the site are on drilled piers, however are also not as deep as some of the proposed new structures. Additionally, the added cost of piers is quite substantial; approximately 1 million dollars.

Therefore, you have requested we clarify the risks involved with placing some of the structures on the potentially expansive claystone bedrock without the use of piers. This would require that the entire structure bears on the bedrock not a combination of bedrock and native sand and gravel.

The structures involved would be the Aeration Basins and possibly the secondary clarifier. We understand the structures will have minimum dead loads of 500 PSF and 150 PSF respectively. Therefore, we have evaluated potential movements based upon different depths of wetting of the claystone beneath the structures. These values are very subjective due to the variability in the testing results and the unknown actual depth of wetting that may occur. Outlined below are the potential movements and assumptions.

% of Swell Under 500 PSF	Assumed Depth of Wetting (feet)	Heave Prediction (inches)
Low (0 to 2)	1	0.4
	3	1.0
	5	1.6
	7	2.0
	10	2.7
Moderate (2 to 4)	1	0.6
	3	1.7
	5	2.6
	7	3.5
	10	4.7
High (4 to 6)	1	0.8
	3	2.3
	5	3.6
	7	4.8
	10	6.3
Very High (>6)	1	1.1 to 1.9
	3	3.4 to 5.3
	5	5.3 to 8.6
	7	7.2 to 11.6
	10	9.7 to 15.8

% of Swell Under 150 PSF	Assumed Depth of Wetting (feet)	Heave Prediction (inches)
Low (0 to 2)	1	0.4
	3	1.2
	5	1.9
	7	2.5
	10	3.3
Moderate (2 to 4)	1	0.7
	3	2.0
	5	3.1
	7	4.1
	10	5.4
High (4 to 6)	1	1.0
	3	2.8
	5	4.4
	7	5.7
	10	7.5
Very High (>6)	1	1.4 to 2.0
	3	3.9 to 5.9
	5	6.2 to 9.5
	7	8.3 to 12.8
	10	11.0 to 17.4

These values were calculated using the expansive potentials of the bedrock samples tested. It should again be noted that the assumed depth of wetting is extremely subjective since it is relatively easy to saturate the upper 3 feet of materials as opposed to saturating the upper 10 feet.

Drilled Piers

Drilled piers are considered the safest means to support the structure where they are in or close proximity to the potentially expansive bedrock. However, in some instances they will be deep and will require drilling through wet caving soils, and will require casing. The piers should be designed for an end bearing of 30,000 PSF and side shear of 3,000 PSF based on bedrock embedments of greater than 2 feet. The design pressures should be based on the dead load plus 100% of the maximum anticipated live load. No minimum dead load is required, as the pier analysis has been done assuming a minimum dead load condition.

The piers should be designed for a minimum bedrock embedment of 10 feet. In addition, we recommend that a minimum pier length of 20 feet be maintained under all circumstances. The minimum embedment lengths should be taken below any weathered portions of the bedrock. A minimum spacing of 3 pier diameters should be utilized for drilled piers. The recommended modulus of subgrade reaction for the sand and gravel soils is 75 TCF (tons per cubic foot) for dry condition and 45 TCF for a saturated condition, and for the bedrock, 300 TCF should be utilized.

The piers should be reinforced with a minimum of one #5 bar (grade 60 or equivalent reinforcement) for each 10 inches of pier perimeter for their full length. A 6-inch minimum void space should be provided beneath the grade beams to assure effective concentration of the loads upon the piers. The grade beams should be centered upon the piers and the tops of the piers should not be enlarged. The grade beams spanning the piers should be designed for appropriate loading conditions and reinforced accordingly. In our opinion, casing will be required during drilling of some of the piers for the site due to the caving soils and groundwater conditions. In no case should concrete be poured with more than 4 inches of water present in the holes.

SEISMIC SOIL PROFILE TYPES

In accordance with the 2000 IBC, Table 1615.1.1, the onsite soils have been classified as follows:

Fill – F

Silty, slightly clayey sand and gravel – D – stiff soil profile

Silty claystone – C – very dense soil and soft rock

SLABS-ON- GRADE

Some of the soils anticipated to be beneath the slabs-on-grade will have some swell (claystone bedrock) and consolidation potential (existing fill soils). Therefore, slab movement is anticipated if the soils beneath the slab become wetted. The possibility for wetting can be mitigated by following the site drainage recommendations presented in this report. However, it is probable that some slab damage (such as cracking and heaving) will take place if slab-on-grade construction is utilized.

The actual amount of possible slab heave is very subjective due to variability in the soils resulting in variability in expansion and also the degree and depth of wetting beneath the slabs. Outlined below is a prediction of the possible slab movements for the general soils at this site based upon a typical maximum wetting depths of five feet, which is an average worse case scenario. There were typically three different soils types at the site, which could influence the slabs-on-grade. The first being a silty, sand and clay fill material, which cannot be predicted due to its highly variable characteristics. The second would be a very low to non-expansive sand and gravel stratum, and the third being the very highly expansive claystone.

Sand and Gravel, (Low to non-expansion potential) – approximately ½ inches
Claystone, (Low to Very High expansion potential) – approximately 2 to 10 inches

It should be noted that these potential movements are only a prediction based upon the soils tested and typical slab movements seen from similar soils and wetting conditions.

However, it is out opinion that significant damage to slabs placed in this site can be minimized by strict adherence to the recommendations made in the "Site Drainage Considerations" section of this report. The owner needs to be made aware they are responsible for future adherence to the above-mentioned recommendations.

If slabs-on-grade are utilized, we would recommend that the following construction techniques be utilized to help prevent secondary damage that could be caused by slab movement.

1. Separate slabs from the foundation elements with a slip joint. One method of doing this is to use two layers of tempered hardboard with a silicone lubricant between the boards. A slip joint should be used around the perimeter of the slab and adjacent to any other structural elements.

2. Moderately reinforce slabs with reinforcement continuous through interior slab joints. Slab joints must be provided to control the cracking. The floor joint grid should be designed to allow no more than 200 square feet of continuous slab.

3. Any load bearing partitions must be provided with their own foundation system and the slab separated as outlined above.

4. Provide a 3-inch minimum air space below any interior non-load bearing partition to provide for slab movement without immediate damage to the structure. If unsure of the proper construction methods to achieve the

recommended air space, we should be contacted for further recommendations.

5. Any pipes rising through the slab should be provided with flexible couplings or other means to allow substantial movement without damage to the piping. Any ducts connecting to equipment founded on the slab should be equipped with flexible or crushable connections to allow for some slab movement.

6. Equipment and other building appurtenances constructed on the slab should be constructed so that slab movement will not cause damage.

Following the recommendations given above will not prevent movement of the floor slabs in the event that the moisture content of the soil beneath the slab changes. However, if movement occurs, damage will have been reduced for a relatively small investment.

Prior to pouring any slab, it is essential that all debris, topsoil, and organic materials be removed and all loose fill either removed or compacted to 95% of maximum density as determined by the standard moisture/density relationship test ASTM D698. If any fill is required beneath the proposed slab, we recommend using a granular fill compacted in 12" maximum lifts to the standard referenced above.

SITE DRAINAGE CONSIDERATIONS

It is essential that site grading be provided to infiltration of surface water into the foundation system. The following methods of preventing this infiltration are recommended. These recommendations will also assist in preventing a "perched" groundwater table.

1. Mechanically compact all fill around the building, including the backfill. Compaction by ponding or saturation must not be permitted. The backfill should be compacted to not less than 90% of maximum density as determined by the standard moisture/density relationship ASTM D698. Note that some moisture may need to be added to the soils in order to obtain the proper compaction. Improper backfill compaction can cause settlement of exterior slabs such as walks, patios and driveways.

2. Provide an adequate grade for rapid runoff of surface water away from the structure (10 percent minimum for the first 10 feet away from the structure is recommended, 2 percent if it is paved).

3. A well constructed, leak-resistant series of gutters, or other roof drainage system, is recommended.

4. Discharge roof downspouts and all other water collection systems well beyond the limits of the backfill.

5. No irrigation within five feet of the foundation. Avoid heavy watering of any foundation plantings.

6. Observe and comply with any other precautions, which may be indicated during design and construction.

It is our opinion that perimeter drainage systems should be installed if the structures are to have below grade space. The perimeter drainage system should consist of 4 inch perforated pipe, surrounded by ¾ to 1 ½ inch washed rock. The drains should be placed a minimum of 12 inches below the surface of the adjacent concrete slab or crawlspace level and should drain to a positive gravity discharge (surface discharge strongly recommended) or to a sump from which water can be pumped.

Attached to this report (Figures 3 and 4) are drawings, which illustrate typical perimeter drain configurations for footing and drilled pier foundation systems. Additionally, more extensive drainage systems, such as underslab drainage systems may be necessary if the excavations are to extend within 4 feet of the seasonal high groundwater table. Attached are drawings, which illustrate typical underslab drainage systems for footing and drilled pier foundation systems. Refer to Figures 5 and 6.

EARTH RETAINING STRUCTURES

At this site we recommend that the walls above the groundwater table (including foundation walls and other grade beams) be designed using a lateral earth pressure equivalent to that developed by a fluid weighing 40 pcf plus any additional surcharge loads. Use of this value assumes that the wall will be backfilled with the site soils and that these soils will not be allowed to become saturated at any time during the life of the wall. Proper site grading and drainage, and installation of drainage systems at the base of any walls that are to retain soil above grade, will help to prevent saturation of the soils behind the walls. This value is valid for walls up to 10 feet in height. If the walls are to extend below the groundwater table and if no dewatering of the site is to take place, the lateral fluid pressure will need to be increased to 60 to 90 pcf plus any additional surcharge loads. We should be called to provide recommendations in such cases.

SPECIAL SITE CONSTRAINTS

Due to the shallow nature of groundwater on this site, and the fact that some of the structures will be 15 to 25 feet below the existing ground surface, the buoyancy of the structures needs to be taken into consideration, when tanks are empty during construction or maintenance.

Trenching and deep excavations should follow current OSHA regulations. The soils at the site generally are considered to be Type C. Where shoring is utilized, the following active and passive soil pressure in lbs./ft/ft of depth should be utilized

General Soil Type	Active	Passive
Fill - Silty, sandy clay to clayey sand	60	N/A
Silty, slightly clayey sand and gravel	40	200
Claystone	80	180

These values are suitable for unsaturated soils above the groundwater table. Also, passive values are valid only for undisturbed natural soils. Where conditions encounter groundwater or have surcharged loading, we should be contacted.

Groundwater across most of the site, with cuts less than 10 feet, does not appear to be a major problem. However if dewatering is necessary, the contractor should develop a sump and pump system with an appropriate gravel blanket to collect the water and direct it away from the trenching or excavation operations. Groundwater will be of concern at isolated areas where deeper cuts are planned.

Also of concern is the fact that some of the excavation soils will have a high moisture content. It is possible that some of the excavated soils will have to be dried before they can be satisfactorily compacted, or that replacement materials will have to be used to allow the timely backfilling of the excavations.

Three samples were tested for corrosiveness and the claystone samples indicated that pipes and structures in contact with these should have corrosion protection. The results are outlined below:

Boring Number	Chloride%	PH	Resistivity (ohm.cm)	Sulfate %
4 @ 11	0.0008	8.0	8264	0.002
6 @ 19	0.0009	8.1	629	0.045
12 @ 24	0.0007	8.0	509	0.064

PAVEMENT RECOMMENDATIONS

The silty, clay and sand soils anticipated to be beneath pavements are of low to moderate strength and are moisture sensitive. Samples were classified by laboratory analysis. The results are presented below.

Boring No.	Unified Classification	AASHTO Classification	Plastic Index
TH-9	SM	A-1-b (0)	3.1
TH-10	CL	A-6 (10)	19.5

Testing has indicated that an "R" value of 5 is appropriate for use at this site for the subgrade soils.

For the purpose of this report, we are presenting two different pavement sections; one for light traffic use for parking lots and the other for heavy traffic loadings, which will be subject to semi-trucks, delivery trucks/vans and garbage trucks. We have used an 18 KIP EDLA value of 5 for the parking lots and an 18 KIP EDLA value of 20 for the heavy truck use. These values should be confirmed when traffic studies are completed.

A design ESAL of 36,500 (EDLA of 5) is used for car and light truck parking and a design ESAL of 146,000 (EDLA of 20) is used for travelways and truck access. Therefore, the design parameters are as shown on the table below.

	Car & Light Truck Parking	Travelways & Truck Access
ESAL	36,500	146,000
Reliability	80.00	80.00
Overall Deviation	0.440	0.440
Resilient modulus of subgrade	3,025	3,025
PSI Loss due to traffic	2.500	2.500

Utilizing the CDOH flexible pavement computer design program, we obtained a design structural number of 2.55 for the car and light truck parking and a design structural number of 3.12 for travelways and truck access. These values are the basis for the design calculations.

Groundwater was encountered during our investigation at depths greater than 5 feet. It is our opinion is that groundwater is not a major factor in the pavement design provided no major cuts are required to bring the site to construction grade.

Following are the pavement sections recommendations:

<u>Car and Light Truck Parking Only</u>

Alternative 1	3.0" Asphaltic Concrete over 9.0" Aggregate Base Course (Class 6)
Alternative 2	6.0" Full Depth Asphaltic Concrete
Alternative 3	5.5" Portland Cement concrete

<u>Travelways and Truck Access</u>

Alternative 1	4.0" Asphaltic Concrete over 10.0" Aggregate Base Course (Class 6)
Alternative 2	7.5" Full Depth Asphaltic Concrete
Alternative 3	7.0 " Portland Cement Concrete

Additionally, we recommend that the areas subject to loadings, such as a trash truck stopping, turning, and off-loading dumpsters be designed with concrete pads. The pads should be a minimum of 10 inches thick and reinforced with a minimum of #4 bars at 12-inch centers, both directions. The bars should be placed 3 inches above the bottom of the pad.

It should be noted that this design is based on typical strength coefficients for road pavement materials being utilized in the area. The assumptions are as follows:

Material	Strength Coefficient (per inch)
Asphaltic concrete pavement	.43
Base Course	.14

The strength coefficients of the materials to be used in the construction should be obtained from the contractor supplying the materials. Adjustment in the pavement section should be made to reflect the actual strength of the materials being utilized.

Subgrade Preparation

It is important to note that successful implementation of any of the pavement sections assumes a properly prepared subgrade. In connection with subgrade preparation, we recommend that:

1. Topsoil, any organic materials and any debris should be stripped from all areas to be paved.

2. The subgrade soils should be brought to proper grade for the selected section.

3. The subgrade materials should be scarified to the minimum depth of 6 inches to a minimum of 95% of maximum dry density as determined by the ASTM D698 specification. Further, any fills that are required should utilize, if available, on-site materials with a classification equal to or greater than the subgrade soils on which the design is based. Any fill material shall be subject to the approval of the geotechnical engineer. Compaction of any fill should be to the above requirements. When compaction of the subgrade is achieved, the pavement section should be placed on the compacted subgrade. We recommend that the base course be compacted to a minimum of 95% as determined by the modified moisture/density test ASTM D1557 and the asphalt compacted to a minimum of 95% as determined by the standard Marshall Test ASTM D1559.

Due to the relative moisture sensitivity of the on-site soils, it is extremely important that proper site grading and drainage by maintained on and around the areas to be paved. Water should not be allowed to pond on top of the pavement, and landscaping should not create negative drainage toward the edge of the paved area. Care should be taken so that landscaping which requires irrigation does not create adverse effects to the pavement.

We recommend that all work be inspected by a qualified geotechnical engineer and that density tests be performed to assure that the required compaction is being obtained.

LIMITATIONS

The borings in this investigation are believed to present a reasonably general. knowledge of the existing subsoils. However, variations of subsoils not indicated by the borings are always possible. Therefore, we recommend that all excavations be inspected by an engineer knowledgeable in foundation soils to confirm that the soils actually are as indicated by the investigation and to make recommendations if differences are noted.

Identification of potential hazardous waste material at this site is beyond the scope of work for which the activities of this project were intended.

It should be noted that the foundation design and slab design recommendations are assumed to be implemented as recommended. Damage to the foundation system and/or slabs-on-grade can take place if the soils supporting these elements become inundated over a substantial period of time due to improper site drainage.

Due to the changing nature of geotechnical engineering practices, the information and recommendations provided in this report shall only be valid for two (2) years following the date of issue. After that time, our office should be contacted to review the information presented in this report and provide updated recommendations and design criteria appropriate for the engineering methodologies used in standard practice at that time.

INSPECTION AND QUALITY CONTROL

Placement of any significant thickness of fill, particularly fill that is to remain in place beneath loaded slabs or other structural elements, should be inspected and tested in order to verify proper compaction is being obtained. All excavations and drilled piers should be inspected by an engineer from our office.

Sincerely,

SCOTT, COX & ASSOCIATES, INC.

By: ______________________
Kevin L. Hinds, P.E.

11/24/09

Reviewed

By: ______________________
M. Edward Glassgow, P.E.

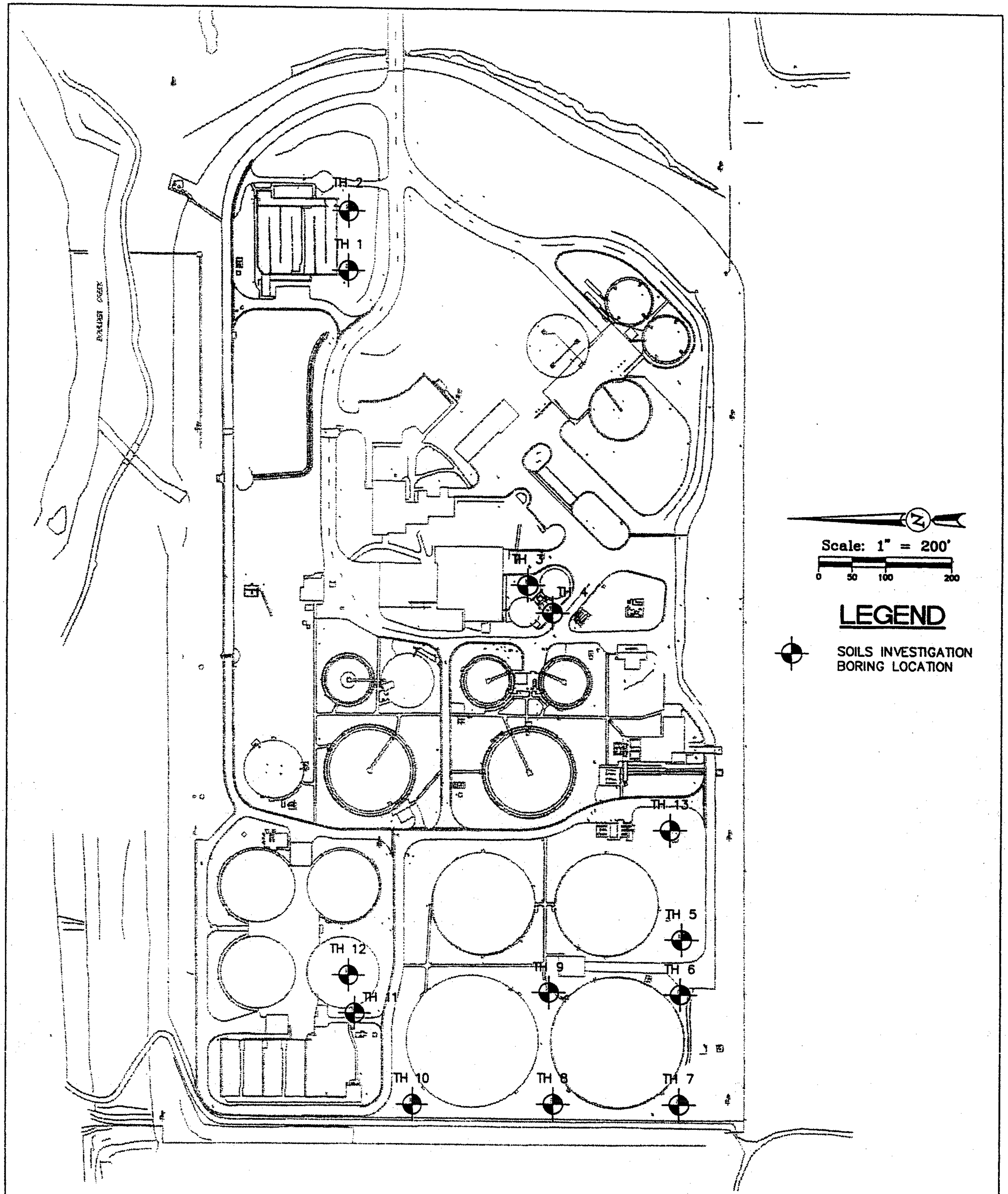

FIGURE 1
BORING LOCATION MAP

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9/21/04 JOB NO. 04466 DRAWING NO. 04466

Graphic Boring Logs

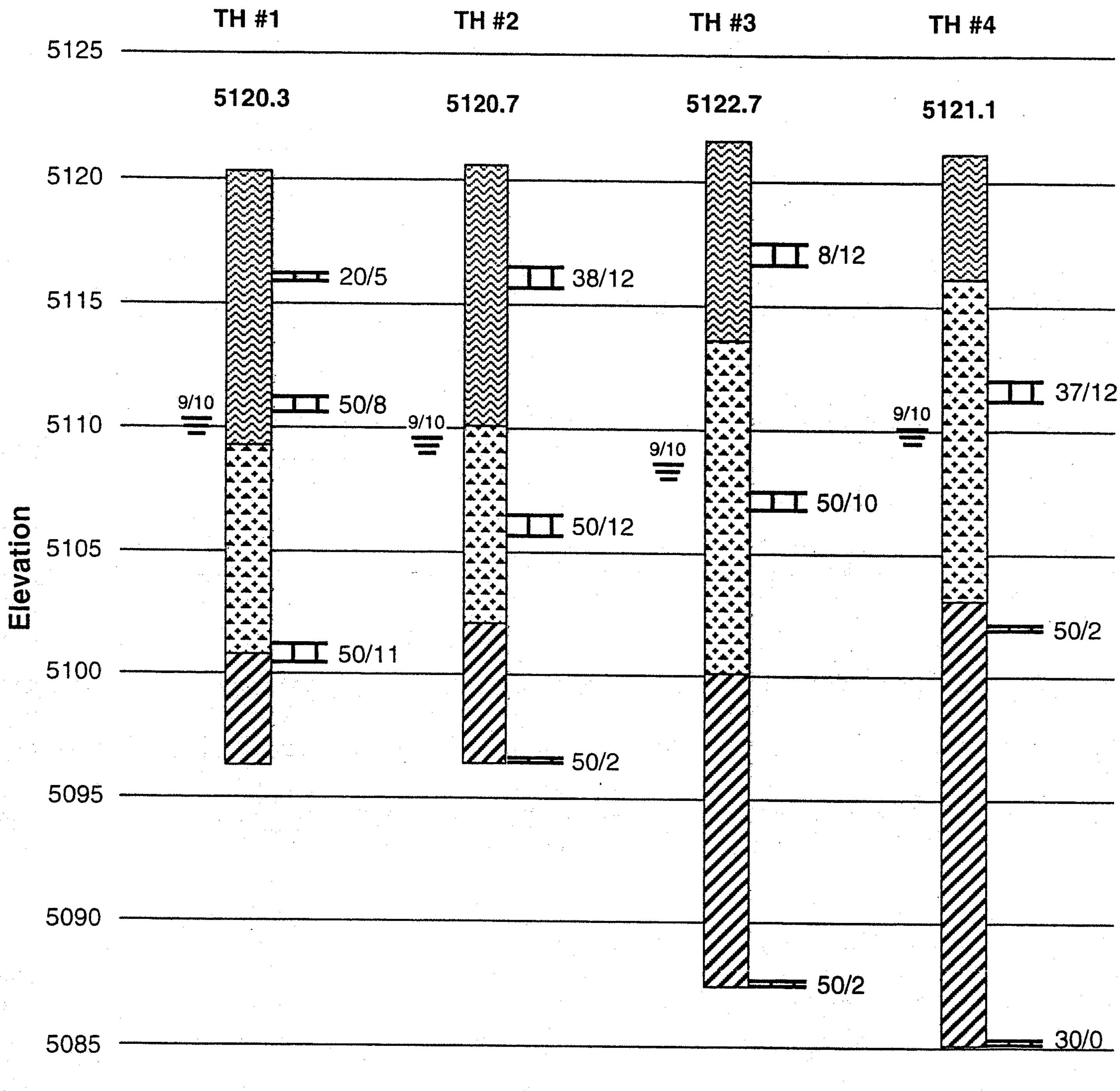

Figure 2
Page 1

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Graphic Boring Logs

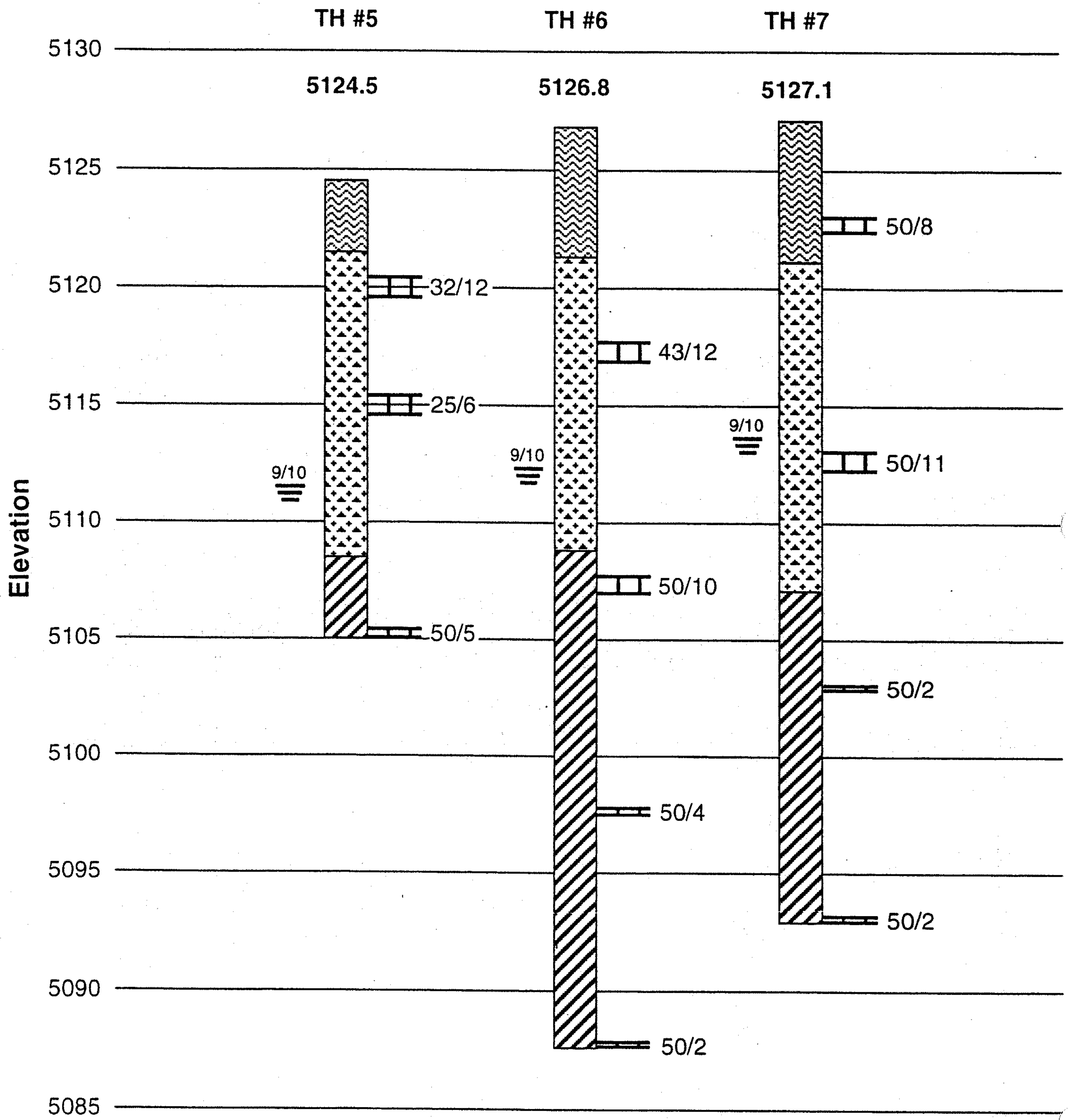

Figure 2
Page 2

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Graphic Boring Logs

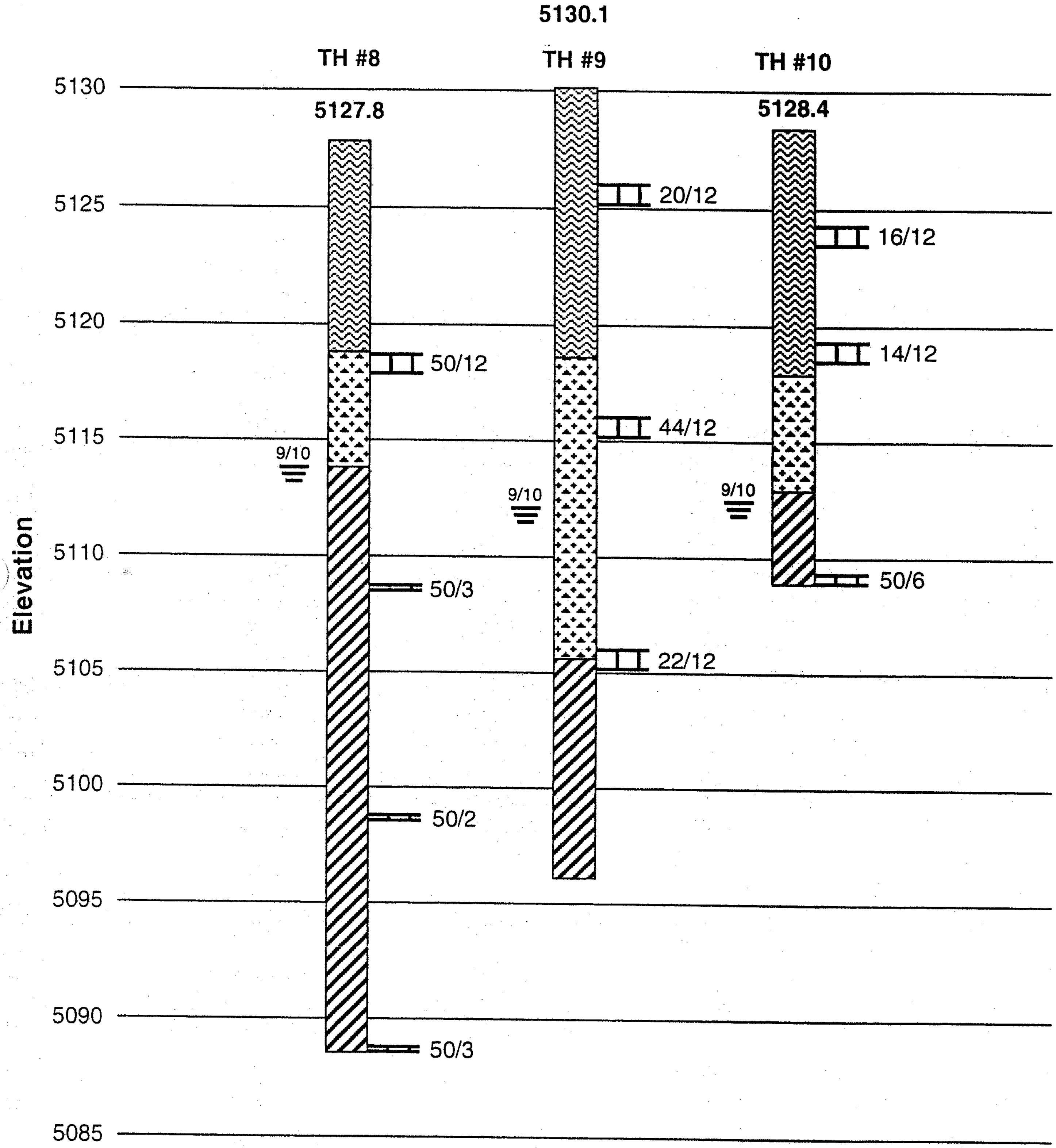

Figure 2
Page 3

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Graphic Boring Logs

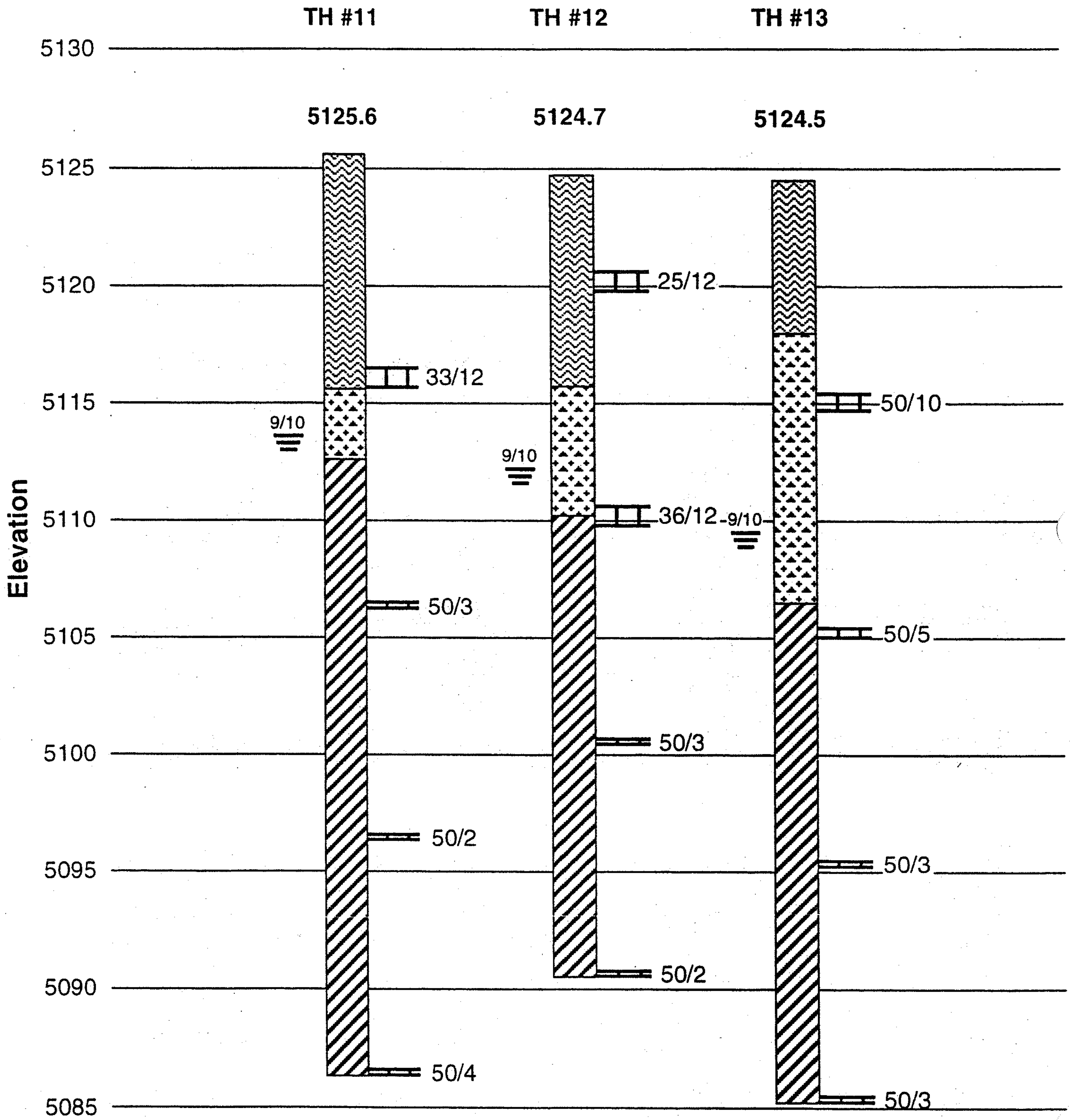

Figure 2
Page 4

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Description of Soil Types

Fill - Dark brown to mottled brown, silty, sand and clay with gravel and cobbles - Contains some organics

Brown, silty, slightly clayey sand and gravel - Contain some cobbles

Gray, silty claystone - May contain some very hard layers

TH #1 Soils investigation boring number

5120.3 Indicates elevation of top of boring - Provided by Brown and Coldwell

Indicates a change in soil type - May be gradual.

12/12 — 12/12 indicates that 12 blows of a 140-pound hammer falling 30 inches were required to drive a 2-inch, inside diameter sampler 12 inches.

9/10 — Indicates the groundwater table and the date that the measurement was taken

Notes

1. Borings were performed August 31 and September 1, 2004 with four-inch diameter, continuous flight power augers.
2. Boring logs shown in this report are subject to the limitations, explanations and conclusions of the report.

Figure 2

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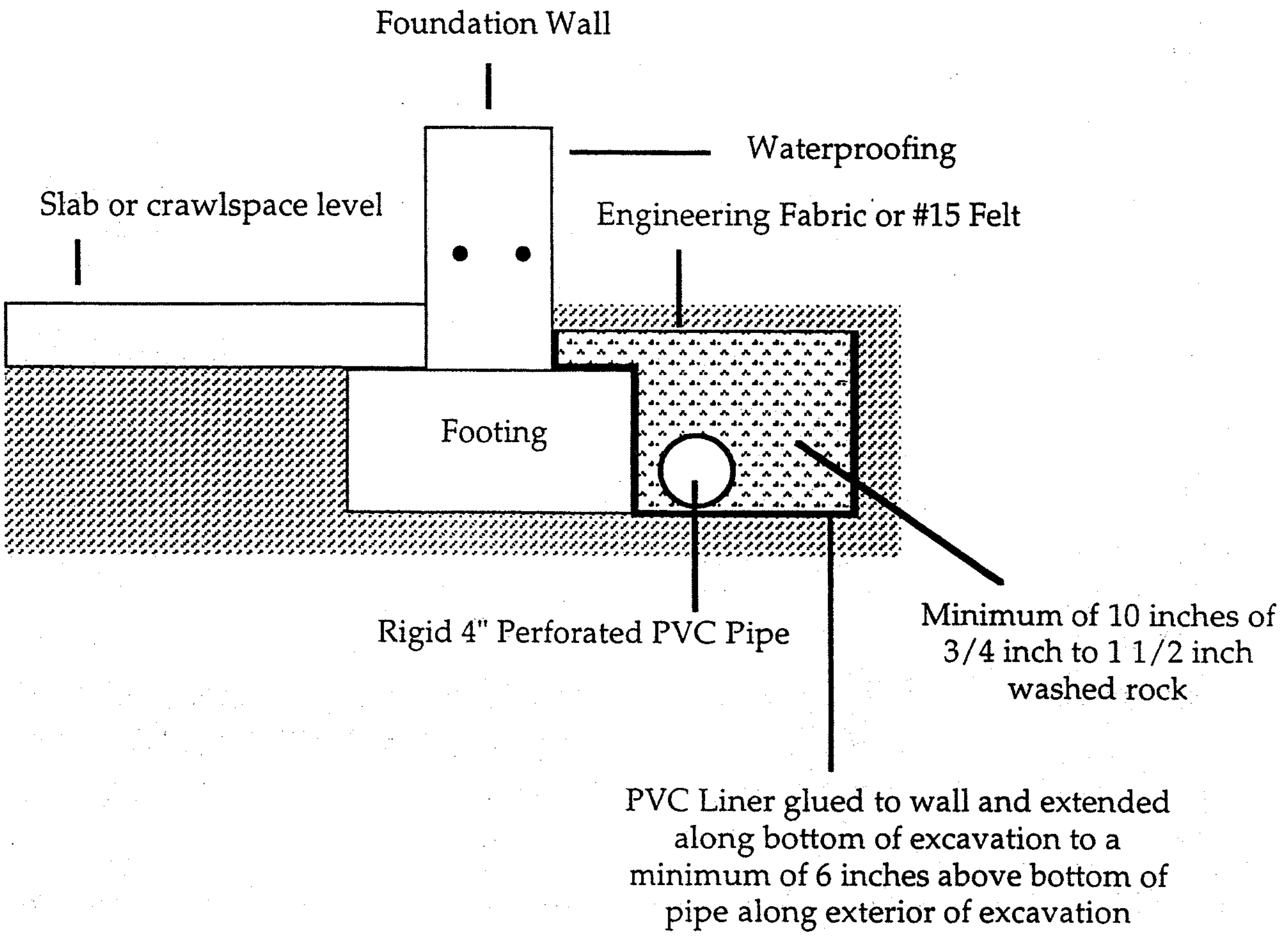
Typical Perimeter Drain Installation Footing Foundation System



Notes:

1. **Slope drain and pipe at a minimum of 1/8 inch per foot to suitable outfall (sump pit or daylight outfall).**

2. **Glue all vertical T's and standpipes.**

3. **Install non-perforated pipe from perimeter pipe into sump pit.**

Figure 3

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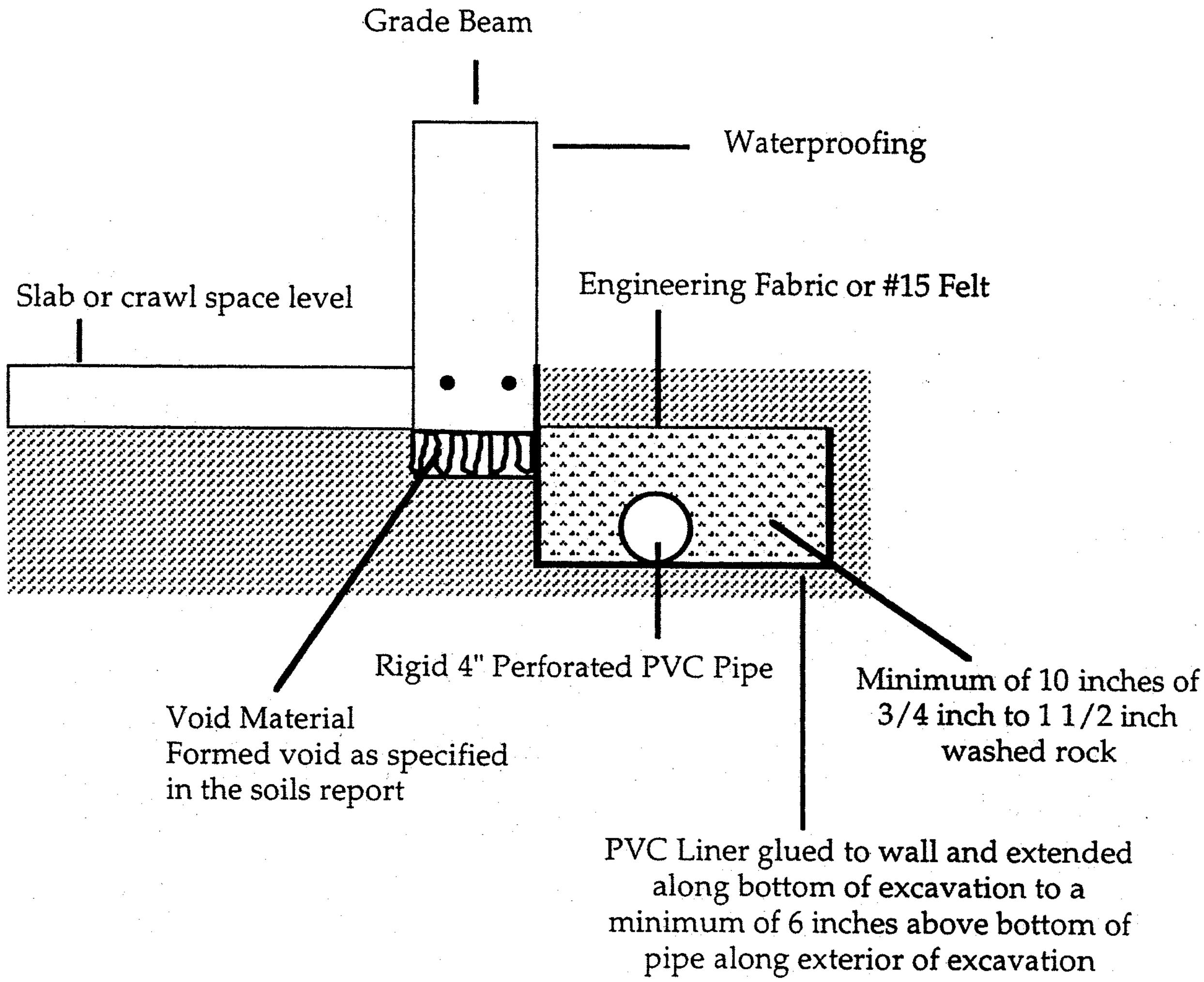
Typical Perimeter Drain Installation
Drilled Pier Foundation System



Notes:

1. **Slope drain and pipe at a minimum of 1/8 inch per foot to suitable outfall (sump pit or daylight outfall).**

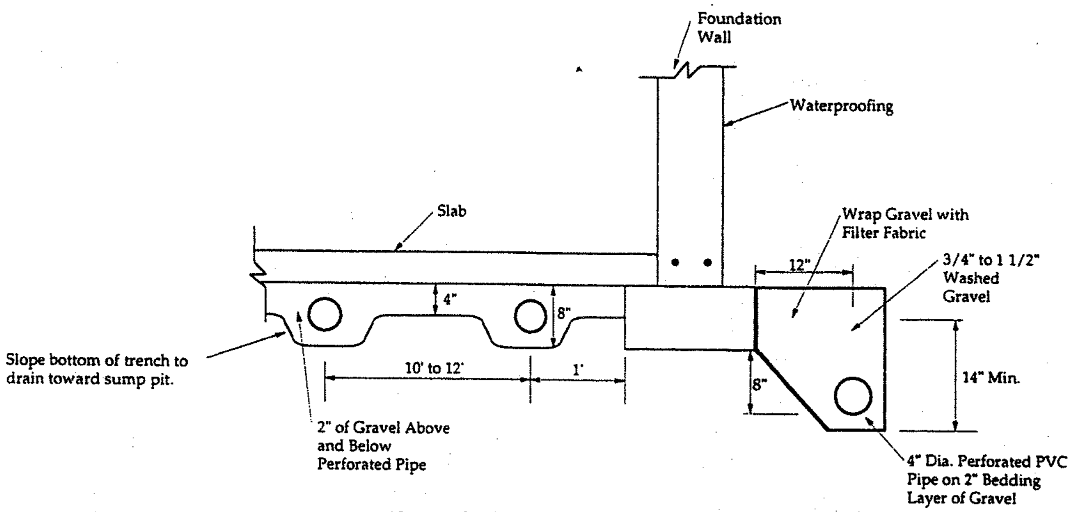
2. **Glue all vertical T's and standpipes.**

3. **Install non-perforated pipe from perimeter pipe into sump pit.**

Figure 4

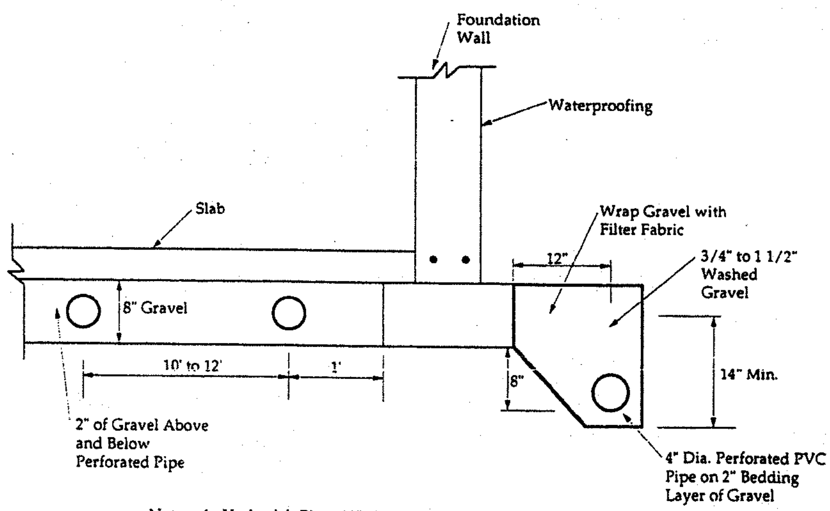
SCOTT, COX & ASSOCIATES, INC.
consulting engineers • surveyors
1530 55th Street • Boulder, Colorado 80303
(303) 444-3051

Typical Perimeter and Underslab Drain System Footing Foundation System for Slab-on-Grade Construction



Note: 1. Underslab Pipes 10"Above Perimeter Pipes.
2. Gravel for Perimeter Drain to Extend from Foundation Wall to Side of Excavation.

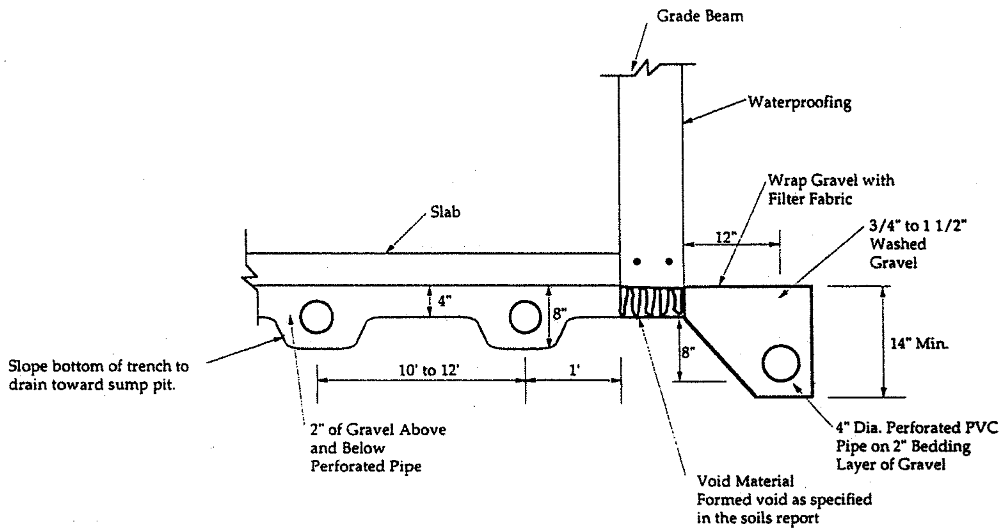
OPTION



Note: 1. Underslab Pipes 10"Above Perimeter Pipes.
2. Gravel for Perimeter Drain to Extend from Foundation Wall to Side of Excavation.

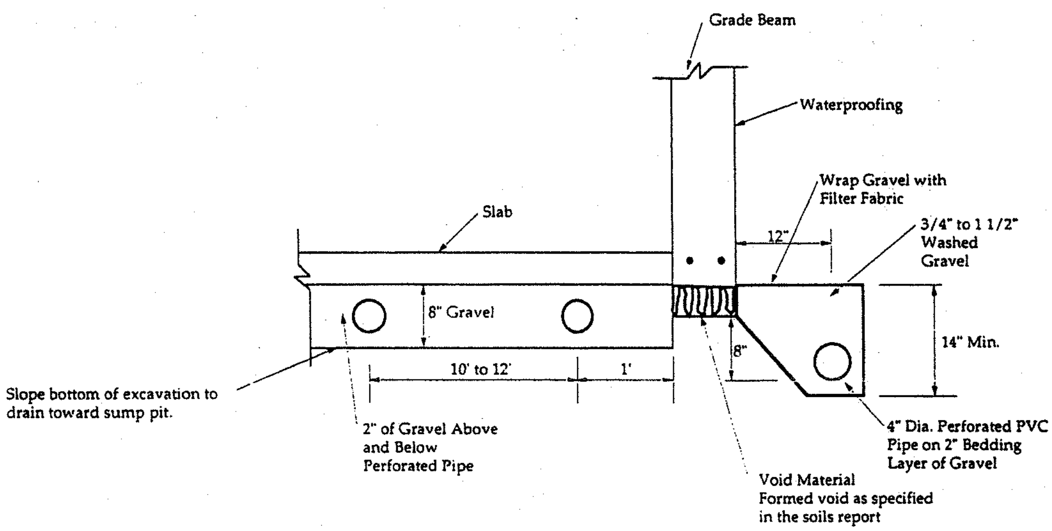
Figure 5

Typical Perimeter and Underslab Drain System
Drilled Pier Foundation System for Slab-on-Grade Construction



Note: 1. Underslab Pipes 6" Above Perimeter Pipes.
2. Gravel for Perimeter Drain to Extend from Foundation Wall to Side of Excavation.

OPTION



Note: 1. Underslab Pipes 6" Above Perimeter Pipes.
2. Gravel for Perimeter Drain to Extend from Foundation Wall to Side of Excavation.

Figure 6

Table 1
Summary of Soils Properties
Page 1/1
Project
04466

PROPERTIES AT NATURAL MOISTURE CONTENT			CONSOLIDATION/SWELL				DESCRIPTION
Natural Moisture (%)	Natural Dry Density (PCF)	Unconfined Compression (PSF)	Loading (PSF)	Settlement (Dry) (%)	Settlement (Saturated) (%)	Swell (%)	
TH # 2 @ 4							
8.3	117.3	>9000	100	0.30		0.90	Fill - Dark brown, silty, sand and clay with gravel
			1000		0.50		
			2000		1.20		
1.2 % Swell upon the addition of water							
TH # 5 @ 19							
11.8	116.0	>9000	100	0.60		8.00	Gray, silty claystone
			1000			4.70	
			2000			2.90	
			4000			0.90	
			8000		1.00		
8.6 % Swell upon the addition of water							
TH # 8 @ 19							
12.3	115.2	>9000	100	0.80		12.90	Gray, silty claystone
			1000			8.50	
			2000			6.20	
			4000			3.70	
			8000			1.30	
			16000		1.60		
13.7 % Swell upon the addition of water							
TH # 9 @ 24							
19.1	100.8	>9000	100	1.30		4.70	Gray, silty claystone
			1000			2.60	
			2000			1.30	
			4000		0.20		
			6000		1.10		
6.0 % Swell upon the addition of water							
TH # 10 @ 19							
9.0	109.9	>9000	100	0.60		11.20	Gray, silty claystone
			1000			7.60	
			2000			5.10	
			4000			2.00	
			8000		1.20		
11.8 % Swell upon the addition of water							
TH # 11 @ 39							
8.0	118.9	>9000	100	0.30		17.20	Gray, silty claystone
			1000			13.10	
			2000			10.00	
			4000			6.40	
			8000			3.20	
			16000		1.40		
17.5 % Swell upon the addition of water							
TH # 12 @ 14							
15.0	105.4	>9000	100	1.40		2.30	Gray, silty claystone
			1000			0.90	
			2000		0.20		
3.7 % Swell upon the addition of water							
TH # 13 @19							
9.4	116.9	>9000	100	0.10		2.30	Gray, silty claystone
			1000			0.40	
			2000		0.50		
2.4 % Swell upon the addition of water							

SCOTT, COX & ASSOCIATES, INC. consulting engineers • surveyors

December 7, 2004

Brown and Caldwell
1697 Cole Boulevard, Suite 200
Golden, CO 80401

Attn: Mr. Boyd D. Hanzon, P.E.

Project: 04466

Dear Mr. Hanzon:

On December 6, 2004, Scott, Cox & Associates, Inc. attended a design meeting for the proposed new additions to the 75th Street Waste Water Treatment Plant in Boulder, Colorado. A number of topics were discussed, however, it was requested that we clarify the offset to bedrock since one of the design schemes involves raising and refiguring the aeration basins.

Our original report called for a minimum 4-foot offset above the potentially expansive bedrock in order to utilize a footing foundation system. Based upon the proposed elevations and the depths to claystone bedrock encountered in the borings, it appears that an offset of 1½ feet could be maintained on the west side of the new aeration basins to greater than 4 feet on the east side. Since the site has an existing groundwater table above the bedrock contact, the upper portions of the bedrock are essentially in a steady state/wetted condition. Therefore, provided the minimum 1½ foot offset is maintained, then the potential expansion of the claystone by wetting should be significantly minimized.

It should be noted that these elevations are based upon the borings drilled and that it is still possible that the bedrock is higher at some locations. Therefore, if bedrock is encountered during construction, the owner and appropriate parties should be contacted and the risks re-evaluated.

1530 55th Street • Boulder, Colorado 80303 • (303) 444-3051 • Fax: (303) 444-3387

December 7, 2004
Project No. 04466

Thank you for consulting with us on this phase of the project. If there are any questions, please contact us.

Sincerely,

SCOTT, COX & ASSOCIATES, INC.

Kevin L. Hinds
12/7/04

By: Kevin L. Hinds
Kevin L. Hinds, P.E.

Reviewed

By: Ed Glassgow
M. Edward Glassgow, P.E.

SCOTT, COX & ASSOCIATES, INC. consulting engineers • surveyors

August 15, 2005

RECEIVED
AUG 1 8 2005
BROWN & CALDWELL

Brown and Caldwell
1697 Cole Boulevard, Suite 200
Golden, CO 80401

Attn: Mr. Chris Douville

Project: 04466

Dear Mr. Douville:

The letter is in response to your e-mail we received on August 10, 2005 regarding the suitability of native site soils for pipe bedding material. According to the Earthwork Specifications we received in July of 2005, the type of material suitable for pipe bedding was a fill Class A-1 which has a relatively specific grading of clean gravel-sand mixture typically needing to be plant produced.

Based upon the soils encountered in the borings drilled for the project, there were generally three different soils types encountered at the site. The first type being a fill material which would generally not meet the Class A-1 gradation. The second type being a silty, slightly clayey sand and gravel material which in some cases may meet the Class A-1 gradation but will typically have too many fines (ie: material passing the no 200 sieve). However, it could be suitable as backfill and other site fill (Type B). The third type was a claystone bedrock material which would not be considered suitable.

Thank you for consulting with us on this phase of the project. If there are any questions, please contact us at your convenience.

Sincerely,

SCOTT, COX & ASSOCIATES, INC.

Kevin L. Hinds 8/15/05

By: Kevin L. Hinds
Kevin L. Hinds, P.E.

Reviewed

By: Ed Glassgow
M. Edward Glassgow, P.E.