Appendix G
Percolation Study

ALBUS-KEEFE & ASSOCIATES, INC
GEOTECHNICAL CONSULTANTS

March 4, 2020
J.N.: 2848.00

Mr. Chris Borland
Melia Homes
8951 Research Drive
Irvine, California 92618

Subject: **Percolation Study, Proposed Residential Development, 13633 Vermont Avenue, Gardena, California.**

Dear Mr. Borland,

Pursuant to your request, ***Albus-Keefe & Associates, Inc***. has completed a geotechnical investigation of the site for evaluation of the percolation characteristics of the site soils. The scope of this investigation consisted of the following:

- Exploratory drilling, soil sampling, and percolation test well installation
- Field percolation testing
- Laboratory testing of selected soil samples
- Engineering analysis of the data
- Preparation of this report

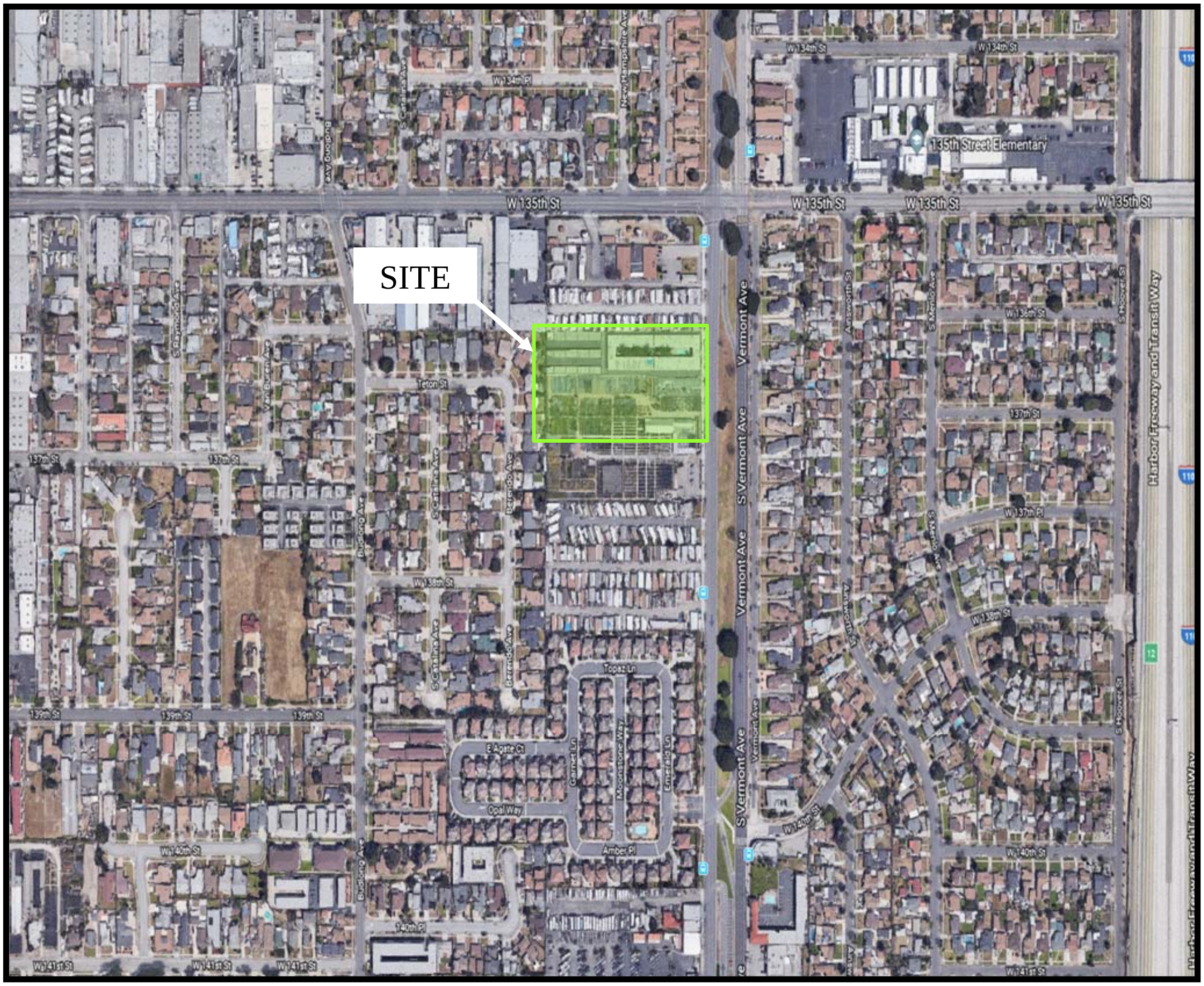
SITE DESCRIPTION AND PROPOSED DEVELOPMENT

Site Location and Description

The site is located at 13633 Vermont Ave, within the city of Gardena, California. The property is bordered by Vermont Avenue to the east, multi-family buildings to the north, single family homes to the west and a mobile home community to the south. The location of the site and its relationship to the surrounding areas is shown on Figure 1, Site Location Map.

The site consists of a rectangular-shaped property containing approximately 4 acres of land. The site is relatively flat with elevations ranging from EL 66 to EL 73 above mean sea level (based on Google Earth) descending to the southwest. The site is currently occupied by a plant nursery. A single-story building that is part of the nursery is situated at the east portion of the site. A single-story motel building is located on the northeast corner of the site. Other site improvements also include asphalt-paved driveways, minor underground utilities, and asphalt-paved parking lots located at the northeast and southeast corners of the site.

Surface drainage within the site is generally directed as a sheet flow toward the southwest corner of the site. Most of the vegetation in the site are sold for commercial purposes and kept in the nursery pots.



N

SITE LOCATION MAP

Melia Homes
Proposed Residential Development
13633 Vermont Avenue
Gardena, California

NOT TO SCALE

FIGURE 1

Proposed Development

Based on the architectural site plans by SUMMA Architecture dated on November 4, 2019, the proposed development for the site will consist of 3-story residential townhomes. Associated underground utilities are also planned. The proposed drywell is located at the southwest portion of the site, based on the drywell location plan provided by C&V Consulting dated on March 2, 2020.

No grading or structural plans were available in preparing of this report. However, we anticipate that minor rough grading of the site will be required to achieve future surface configuration. We understand the general elevation will still descend to the southwest. We expect the proposed residential dwellings will be wood-framed structures with concrete slabs on grade yielding relatively light foundation loads.

SUMMARY OF FIELD AND LABORATORY WORK

Subsurface Investigation

Subsurface exploration for this investigation was conducted on October 2, 2019, and consisted of the drilling of five (5) soil borings to depths ranging from approximately 21.5 to 51.5 feet below the existing ground surface (bgs). The borings were drilled using a truck-mounted, continuous flight, hollow-stem-auger drill rig. Representatives of Albus-Keefe & Associates, Inc. logged the exploratory borings. Visual and tactile identifications were made of the materials encountered, and their descriptions are presented in the Exploration Logs in Appendix A. The approximate locations of the exploratory excavations completed by this firm are shown on the enclosed Geotechnical Map, Plate 1.

Bulk, relatively undisturbed and Standard Penetration Test (SPT) samples were obtained at selected depths within the exploratory borings for subsequent laboratory testing. Relatively undisturbed samples were obtained using a 3-inch O.D., 2.5-inch I.D., California split-spoon soil sampler lined with brass rings. SPT samples were obtained from the boring using a standard, unlined SPT soil sampler. During each sampling interval, the sampler was driven 18 inches with successive drops of a 140-pound automatic hammer falling 30 inches. The number of blows required to advance the sampler was recorded for each six inches of advancement. The total blow count for the lower 12 inches of advancement per soil sample is recorded on the exploration log. Samples were placed in sealed containers or plastic bags and transported to our laboratory for analyses. The borings were backfilled with auger cuttings upon completion of sampling.

In addition, one percolation test well, P-1, was installed for subsequent percolation testing. P-1 was excavated to an approximate depth of 30 feet and was installed within exploratory boring B-1. The percolation test well was later backfilled with auger cuttings upon completion of testing.

Percolation Testing

Percolation testing was performed on October 2, 2019, in general conformance with the constant-head test procedures outlined in the referenced Well Permeameter Method (USBR 7300-89). A water hose attached to a water source on site was connected to an inline flow meter to measure the water flow. The flow meter is capable of measuring flow rates up to 13 gallons per minute and as low as 0.06 gallons per minute. A valve was connected in line with the flow meter to control the flow rate. A filling hose was used to connect the flow meter and the test wells. Water was introduced by the filling hose near the bottom of the test well. A water level meter with 1/100-foot divisions was used to measure the depths to the water surface from the top of well casing. Flow to the well was terminated upon either completion of testing of all the pre-determined water levels or the flow rate exceeded the maximum capacity of the flow meter. Measurements obtained during the percolation testing are provided on Plate C-1 (Appendix C).

Laboratory Testing

Selected samples of representative earth materials from our borings were tested in the laboratory. Tests consisted of USCS classification, in-situ moisture content and dry density, and sieve analysis. Descriptions of laboratory testing and the test results are presented in Appendix B and on the Exploration Logs in Appendix A.

ANALYSIS OF DATA

Subsurface Conditions

Descriptions of the earth materials encountered during our investigation are summarized below and are presented in detail on the Exploration Logs presented in Appendix A.

Soil materials encountered at the subject site consisted of approximately 3.5 feet of artificial fill over older alluvial soils. The artificial fill is predominately comprised of dark brown and reddish-brown sandy clay/clayey sand and silt. These fill materials typically were observed to be slightly moist and very stiff.

The older alluvial soils encountered are comprised of light brown to brown and reddish-brown silt with variable amounts of sand and clay. A layer of sandy clay/clayey sand was observed overlying the silt. Deeper portions of the older alluvium consist of gray-brown to light brown sand overlying interlayers of silty sand and sandy silt/silt.

Groundwater

Groundwater was not encountered during this firm's subsurface exploration to the depth of 51.5 feet. Based on a review of the referenced CDMG Special Report, the site is mapped with a historical groundwater depth of 30 feet.

We obtained and reviewed historic groundwater data made available by the County of Los Angeles Department of Public Works through their online services. Two wells, 3S14W13J03 and 3S14W13J04, were located approximately 1,000 feet north of the site. Based on the two wells spanning a time period from 1940 to 2003, the groundwater has essentially remained below a depth of 96 feet since 1943. A plot of the data from the two wells is provided on Figure 2.

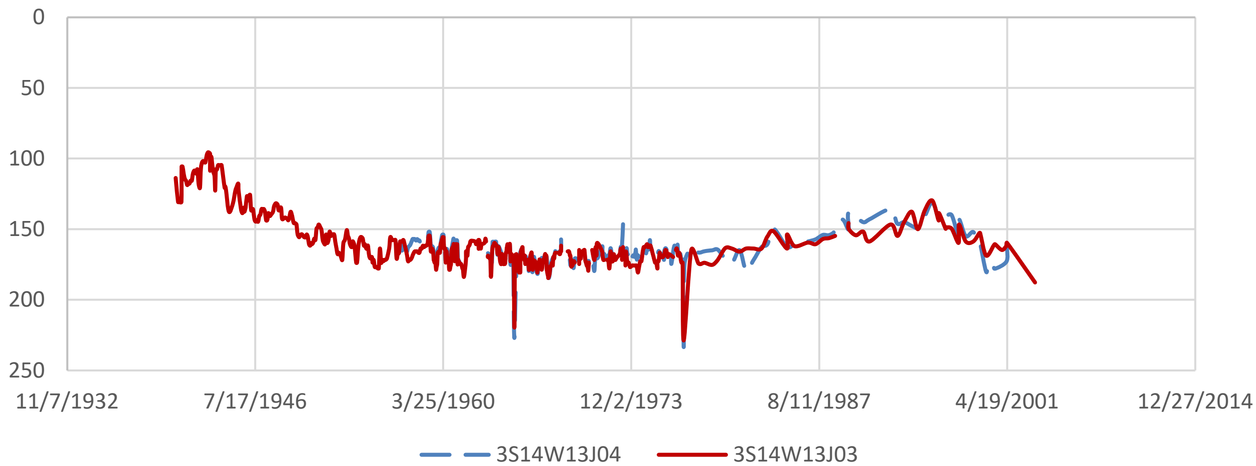


FIGURE 2- Historical Water Well Data

Percolation Data

Analyses were performed to evaluate permeability using the flow rate obtained at the end of the constant-head stage of field percolation testing. These analyses were performed in accordance with the procedures provided in the referenced USBR 7300-89. The procedure essentially uses a closed-form solution to the percolation out of a small-diameter well.

Using the USBR method, we calculated a composite permeability value for the head condition maintained in the well. The result is summarized in Table 1 below and the supporting analyses are included in Appendix C, Plate C-2.

TABLE 1
Summary of Back-Calculated Permeability Coefficient from Constant Head Test

Location	Total Depth of Well (ft)	Depth to Water in Well (ft)	Height of Water in Well (ft)	Static Flow Rate (gal/min)	Estimated Permeability, k_s (in/hr)
P-1	30	25	5.0	1.36	4.4

Design of Dry Well

The ***infiltration rate*** in a BMP is dependent upon several factors including the soil permeabilities of the various soil layers throughout the soil mass, hydraulic gradient of water pressure head in the soil mass, and depth to groundwater. The infiltration rate is related to the permeability by Darcy's equation:

$V = ki$

Where:

V= water velocity (infiltration rate)
k= permeability
i=hydraulic gradient

We have performed the Well Permeameter tests in accordance with the USBR 7300-89 test method. This test provides a means to estimate the ***Permeability Rate*** of the soils being tested, not the infiltration rate. Therefore, the effective infiltration rate must be determined using the relationship between permeability and infiltration rate as expressed by Darcy's equation. Generally, solution of Darcy's equation would require solving a differential equation. Where the BMP is a shallow basin with homogenous soil conditions and no groundwater within the influence of infiltration, the hydraulic gradient is approximately 1 and therefore, the infiltration rate would simply be equal to the permeability rate. However, where these conditions are not met such as the presence of variable permeability characteristics with depth, shallow groundwater, or the BMP has significant water head conditions such as a dry well, the hydraulic gradient could be more or less than 1 and a more complex approach is required to determine the effective infiltration rate. The site lithology is not homogeneous and the suitable BMP is a dry well. Given these factors, a more complex approach is needed.

Infiltration in a dry well was modeled using the software Seep/W, version 2007, by Geo-Slope International. The program allows for modeling of both partially-saturated and saturated porous medium using a finite element approach to solve Darcy's Law. The program can evaluate both steady-state and transient flow in planer and axisymmetric cases. Regions within the model can be set to represent a finite area or to extend in a direction infinitely. Boundaries of the model can be identified with various conditions including fix total head, fix pressure head, fix flow rate, and head as a function of flow. Soil conductivity properties can be modeled with either Fredlund et al. (1994), Green and Corey (1971), Van Genuchten (1980), or Saxton et al. (1986). The parameters suggested by Saxton et al. (1986) were selected for use in our model and were based on test results of particle-size analyses and estimated in-place densities.

A Seep/W model was setup for a well configuration with the bottom of the dry well at a depth of 47 below ground surface. The top 20 feet of the dry well assumed a shaft that is 6 feet in diameter and contains a settling chamber that is 18 feet in depth, has an inside diameter of 4 feet, and outside diameter of 4.5 feet. Below 20 feet, the shaft is assumed to be 4 feet in diameter. The annular space around the chamber from the surface to a depth of 15 feet is assumed to consist of grout. Below 15 feet, the annular space around the chamber and below the chamber is assumed to consist of gravel. A more detailed configuration of the dry well design can be found on Plate 2.

The model consisted of six (6) zones using four (4) material types for the general soil profile. The first and fourth layer (Material # 1) represents the upper 8 feet and 31 to 38 feet where infiltration will not be allowed due to the variability of the artificial fill materials in the upper 8 feet and fine-grained nature of the material at 31 to 38 feet. The saturated conductivity of this layer is represented by a set of input parameters to be nearly impermeable. The second (Material # 2) represents a sandy silt layer that was typically encountered between approximate depths of 8 to 24 feet. A saturated conductivity of 0.1 in/hr was utilized for this layer based on correlation with grain-size testing. The third and fifth layers (Material # 3) represents the sand layers encountered near a depth of 24 to 31 feet and 38 to 48 feet. A saturated conductivity of 4.0 in/hr was utilized for this layer based on the percolation test and correlation with laboratory testing. The final layer (Material # 4) represents the material greater than

48 feet. A saturated conductivity of 1.0 in/hr was utilized for this layer and was based on typical values for this material type. A summary of the well model parameters is provided in Table 2.

TABLE 2
Summary of Characteristic Curve Parameters

Zone No.	Material No.	USCS Classification	Depth (ft)	Ks (in/hr)	Van Genuchten Parameters				
					a (1/cm)	n	m	Sat. Water Content	Residual Water Content
1	1	Impermeable	0 – 8	0.001	0.000	1.22	0.18	0.41	0.01
2	2	ML	8 – 24	0.10	0.002	1.12	0.11	0.38	0.025
3	3	SP	24 – 31	4.0	0.037	1.36	0.27	0.30	0.025
4	1	Impermeable	31 – 38	0.001	0.000	1.22	0.18	0.41	0.01
5	3	SP	38 – 48	4.0	0.037	1.36	0.27	0.30	0.025
6	4	SM	>48	1.0	0.007	1.24	0.19	0.29	0.025

A steady state analysis was performed to estimate the maximum inflow that the well can accommodate. Using a well as described above and inflow invert of 7 feet below grade, we obtain a static total flow of 0.13 ft³/sec. A plot depicting the resulting pressure head contours and flow vectors for the model is provided on Plate C-3.

To evaluate the time required to empty the well chamber once no more water is introduced, the model was reanalyzed with a variable head condition that was dependent upon the volume of water leaving the well. As water infiltrates into the surrounding soil, both the volume of water remaining in the well and the total head in the well drop. A graph of the well head versus exit volume for the well is provided in Figure 3. The function assumes a void ratio of 0.4 within the zones occupied by gravel. If some other well configuration is used, the analyses will require updating.

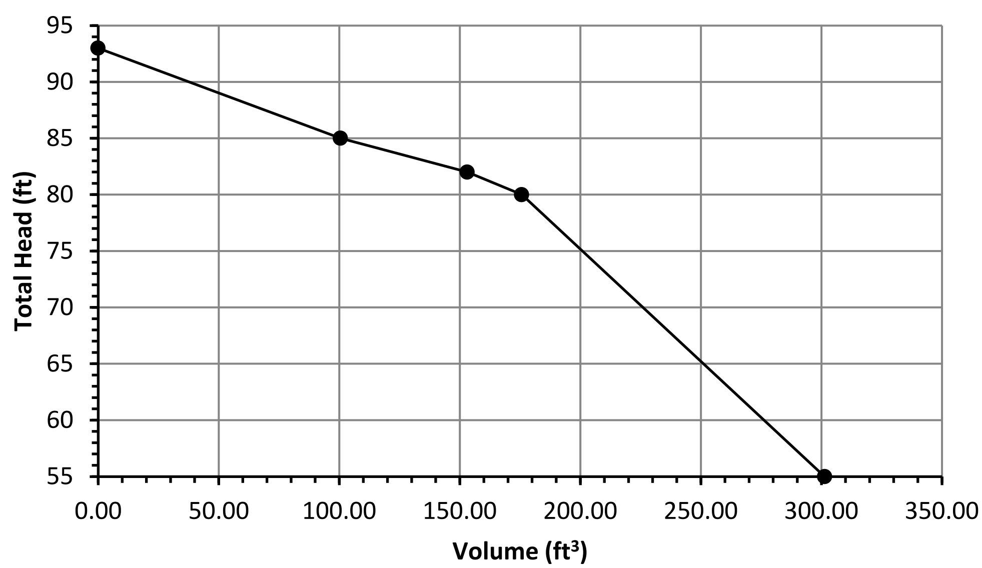


Figure 2 - Well Head Function

The analysis was performed as a transient case over a maximum time of approximately 2.5 hours. The conditions in the model were evaluated in various increments of time over the total duration. From our analyses, the water in the well chamber is completely evacuated in approximately 0.53 hour. Plots depicting the resulting pressure head contours and flow vectors at selected times are provided in Appendix C on Plate C-4 through C-6. A plot of time versus water height in the well is shown on Figure 4.

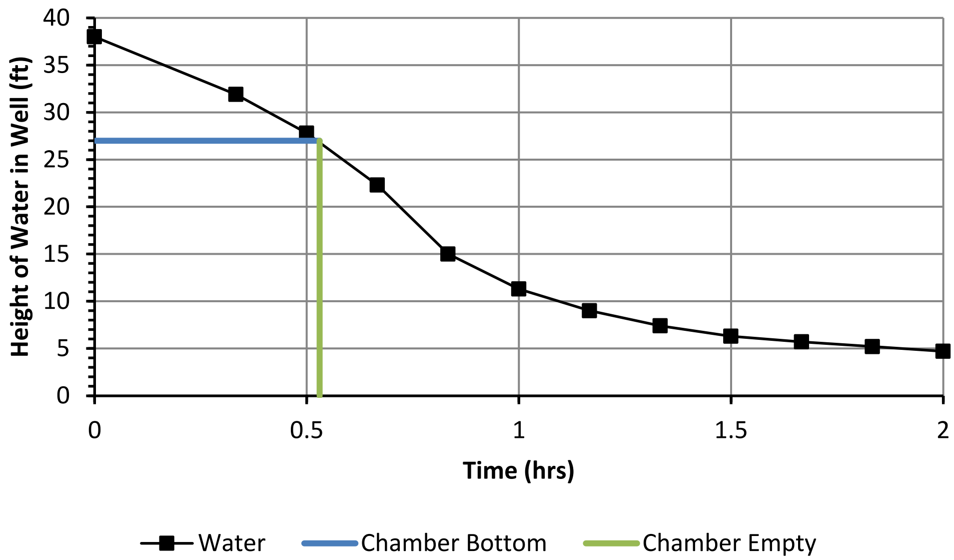


Figure 4 - Height of Water in Dry Well

CONCLUSIONS AND RECOMMENDATIONS

Results of our work indicate a storm water disposal system consisting of a dry well is feasible within the site. The use of dry wells is not anticipated to result in worsening any adverse conditions or hazards that may be present for the proposed site development or adjacent properties including subsidence, landsliding, or liquefaction. Groundwater is anticipated to remain below a depth of 100 feet during the lifetime of the dry well. As such, a dry well having a total depth of 47 feet will provide a minimum clearance of 10 feet above the shallow seasonal groundwater level.

Based on the results of percolation testing and analyses, the percolation rate for the well configuration as depicted on Plate 2 may utilize an unfactored (measured) peak flow rate of 0.13 ft^3/sec. An appropriate factor of safety should be applied to the flow rate as required by the appropriate governmental authority. Based on this peak flow, the maximum average infiltration rate around the wetted perimeter of the well is the flow divided by the area which equals 13.1 in./hr.

The design infiltration rate requires the application of a Reduction Factor in accordance with the County of Los Angeles GS200.2 guidelines. Based on the county requirements, the reduction factor (safety factor) is determined by multiplying the partial reduction factors as indicated in Table 1 below.

The RFt value is prescribed by the test method used. The RFv value is based on the fact that soil conditions are uniform within the infiltration zone, that a test was performed in close proximity to the proposed dry well location, and correlations with laboratory testing of site materials confirm the selected permeability rate obtained by the field test. The RFs value is based on the dry well providing a chamber that traps sediments and removes oils via an absorptive pillow or some other system providing for the removal of most sediment and oils before entering the dry well.

TABLE 1
Reduction Factor

Factor	Value
RFt	2.0
RFv	1.0
RFs	1.0
Total Reduction Factor (RF)	**2.0**
Note: Total Reduction Factor, RF= RFt x RFv x RFs	

Based on the above reduction factor, design of the system should be based on a peak "design" flow of 0.13 cfs/2 = **0.065 cfs.** Once water flow to the well has ceased, we estimate the time to empty the chamber will be approximately 0.53 hour. Assuming an allowable total drawdown time of 96 hours, the maximum total design capture volume (DCV) one dry well can dispose would be approximately (96-0.53) hrs x 0.065 cfs x 3600 s/hr = 22,340 cubic feet.

This infiltration rate only applies to the well configuration described above including the water invert depth of 7 feet. If some other configuration of the dry well or water invert depth is used, the above flow rate and average infiltration rate will not apply and should be updated accordingly.

The actual flow capacity of the dry well could be less or more than the estimated value. As such, provisions should be made to accommodate excess flow quantities in the event the dry well does not infiltrate the anticipated amount. The design also assumes that sediments will be removed from the inflowing water through an upper chamber or other device. Sediments that are allowed to enter the dry well will tend to degrade the flow capacity by plugging up the infiltration surfaces.

In general, the dry well may consist of a concrete inner chamber surrounded by ½-inch open graded gravel. The concrete chamber should have perforations to allow the well to drain. The holes should be sized to prevent piping of the gravel into the chamber. A general diagram of the dry well is provided on Plate 2.

In general, the dry well shaft is anticipated to be adequately stable under temporary construction conditions for uncased drilling. However, granular portions of the older fan deposits are friable and will be prone to sloughing and caving especially if left open for a prolonged period of time. In the event of caving, casing will be required to install the well. Workers should not enter the shaft unless the excavation is laid back or shored in accordance with OSHA requirements. The placement and compaction of backfill materials, including the gravel, should be observed by the project geotechnical consultant.

LIMITATIONS

This report is based on the geotechnical data as described herein. The materials encountered in our boring excavations and utilized in our laboratory testing for this investigation are believed representative of the study area, and the conclusions and recommendations contained in this report are presented on that basis. However, soil and bedrock materials can vary in characteristics between points of exploration, both laterally and vertically, and those variations could affect the conclusions and recommendations contained herein. As such, observations by a geotechnical consultant during the construction phase of the storm water infiltration systems are essential to confirming the basis of this report.

This report has been prepared consistent with that level of care being provided by other professionals providing similar services at the same locale and time period. The contents of this report are professional opinions and as such, are not to be considered a guaranty or warranty.

This report should be reviewed and updated after a period of one year or if the site ownership or project concept changes from that described herein. This report has been prepared for the exclusive use of the **Melia Homes** to assist the project consultants in the design of the proposed development. This report has not been prepared for use by parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes.

This report is subject to review by the controlling governmental agency.

We appreciate this opportunity to be of service to you. If you should have any questions regarding the contents of this report, please do not hesitate to call.

Sincerely,

ALBUS-KEEFE & ASSOCIATES, INC.

David E. Albus
Principal Engineer
G.E. 2455

REGISTERED PROFESSIONAL ENGINEER
DAVID E. ALBUS
No. 2455
Exp. 12/31/20
GEOTECHNICAL
STATE OF CALIFORNIA

Enclosures:
- Plate 1- Geotechnical Map
- Plate 2- Dry Well Design
- Appendix A - Exploratory Logs
- Appendix B - Laboratory Testing
- Appendix C - Percolation Testing and Analyses

REFERENCES

Publications and Reports

California Department of Conservation, Division of Mines and Geology, Seismic Hazard Report 027, "Seismic Hazard Zone Report for the Inglewood 7.5-Minute Quadrangle, Los Angeles County, California", 1998.

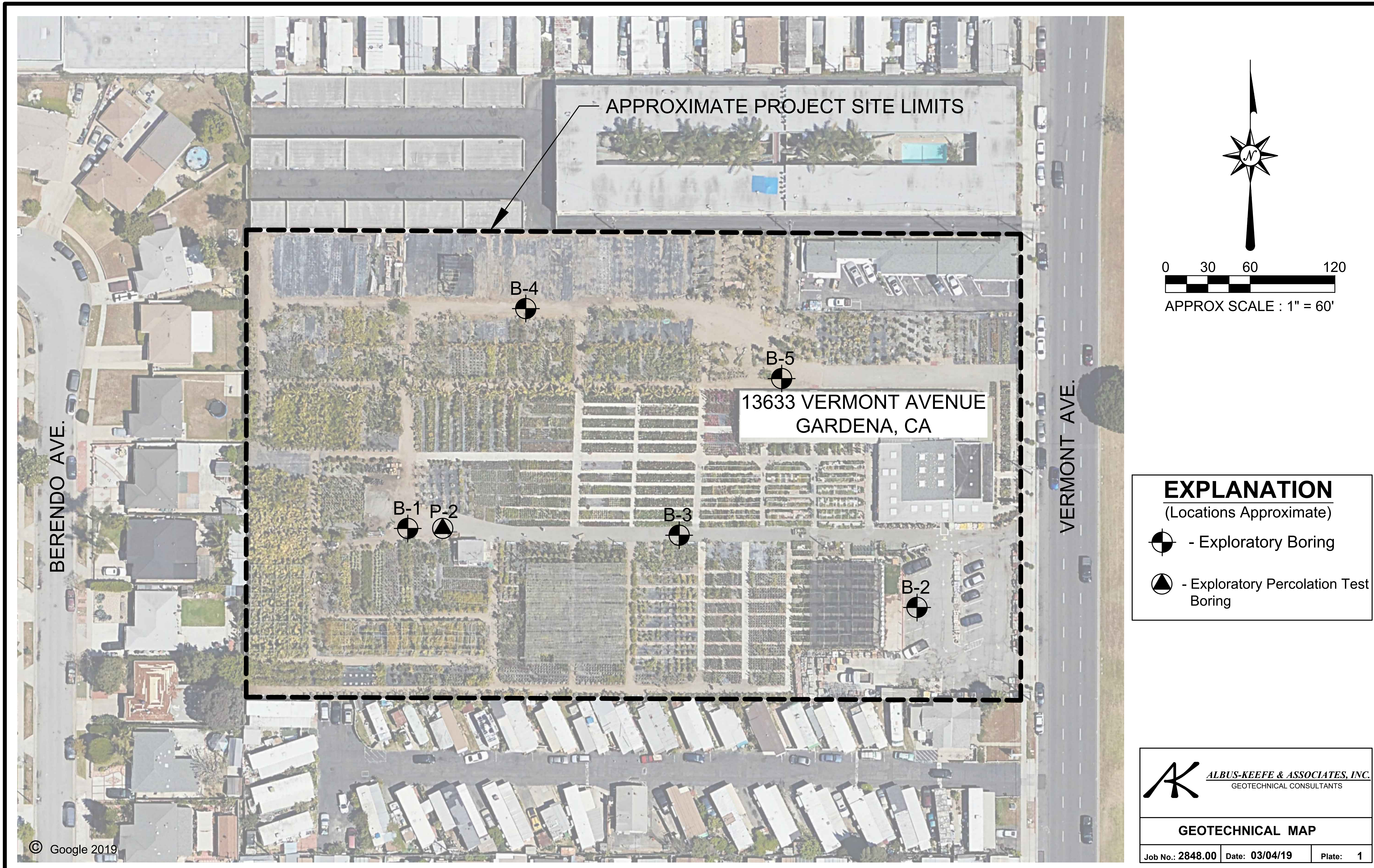
Procedure for Performing Field Permeability Testing by the Well Permeameter Method, by United States Department of The Interior, Bureau of Reclamation (USBR 7300-89).

Saxton, K.E., W.J. Rawls, J.S. Romberger, and R.I. Papendick. 1986. Estimating generalized soil-water characteristics from texture. Soil Sci. Soc. Am. J. 50(4):1031-103

Plans

Drywell Location, VTTM No. 83037, 13615 & 13633 S Vermont Ave., Gardena, CA 90249, prepared by C&V Consulting, dated March 2, 2020

Site Plan, Vermont Ave – Row Townhomes, prepared by Summa Architecture, dated November 19, 2019

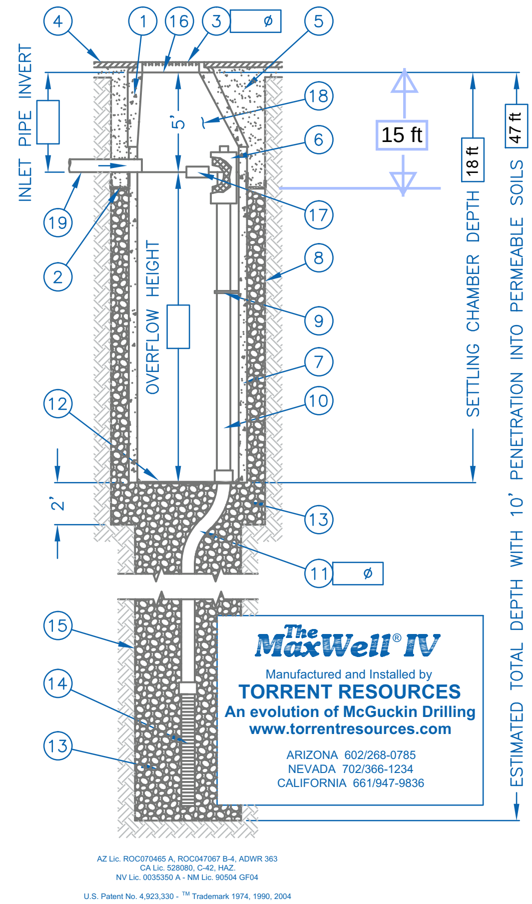

APPROXIMATE PROJECT SITE LIMITS
B-4
B-5
13633 VERMONT AVENUE
GARDENA, CA
B-1
P-2
B-3
B-2
BERENDO AVE.
VERMONT AVE.
© Google 2019
0 30 60 120
APPROX SCALE : 1" = 60'
EXPLANATION
(Locations Approximate)
- Exploratory Boring
- Exploratory Percolation Test Boring
ALBUS-KEEFE & ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS
GEOTECHNICAL MAP
Job No.: 2848.00
Date: 03/04/19
Plate: 1

MAXWELL® IV DRAINAGE SYSTEM DETAIL AND SPECIFICATIONS

ITEM NUMBERS

1. **Manhole Cone** - Modified Flat Bottom.
2. **Moisture Membrane** - 6 Mil. Plastic. Applies only when native material is used for backfill. Place membrane securely against eccentric cone and hole sidewall.
3. **Bolted Ring & Grate** - Diameter as shown. Clean cast iron with wording **"Storm Water Only"** in raised letters. **Bolted in 2 locations** and secured to cone with mortar. Rim elevation ±0.02' of plans.
4. **Graded Basin or Paving** (by Others).
5. **Compacted Base Material** - 1-Sack Slurry except in landscaped installtions with no pipe connections.
6. **PureFlo® Debris Shield** - Rolled 16 ga. steel X 24" length with vented anti-siphon and Internal .265" Max. SWO flattened expanded steel screen X 12" length. **Fusion bonded epoxy coated.**
7. **Pre-cast Liner** - 4000 PSI concrete 48" ID. X 54" OD. **Center in hole** and align sections **to maximize bearing surface.**
8. **Min. 6' Ø Drilled Shaft.**
9. **Support Bracket** - Formed 12 Ga. steel. **Fusion bonded epoxy coated.**
10. **Overflow Pipe** - Sch. 40 PVC mated to drainage pipe at base seal.
11. **Drainage Pipe** - ADS highway grade with TRI-A coupler. **Suspend pipe** during backfill operations to prevent buckling or breakage. Diameter as noted.
12. **Base Seal** - Geotextile or concrete slurry.
13. **Rock** - Washed, sized between 3/8" and 1-1/2" to **best complement soil conditions.**
14. **FloFast® Drainage Screen** - Sch. 40 PVC 0.120" slotted well screen with 32 slots per row/ft.Diameter varies 120" overall length with TRI-B coupler.
15. **Min. 4' Ø Shaft** - Drilled to **maintain permeability** of drainage soils.
16. **Fabric Seal** - U.V. resistant geotextile - **to be removed by customer** at project completion.
17. **Absorbent** – Hydrophobic Petrochemical Sponge. Min. to 128 oz. capacity.
18. **Freeboard Depth** Varies with inlet pipe elevation. Increase settling chamber depth as needed to maintain all inlet pipe elevations above overflow pipe inlet.
19. **Optional Inlet Pipe** (Maximum 4", by Others). Extend moisture membrane and compacted base material or 1 sack slurry backfill below pipe invert.

The referenced drawing and specifications are available on CAD either through our office or web site. This detail is copyrighted (2004) but may be used as is in construction plans without further release. For information on product application, individual project specifications or site evaluation, contact our Design Staff for no-charge assistance in any phase of your planning.



CALCULATING MAXWELL IV REQUIREMENTS

The type of property, soil permeability, rainfall intensity and local drainage ordinances determine the number and design of MaxWell Systems. For general applications draining retained stormwater, use one standard **MaxWell IV** per the instructions below for up to 3 acres of landscaped contributory area, and up to 1 acre of paved surface. For larger paved surfaces, subdivision drainage, nuisance water drainage, connecting pipes larger than 4" Ø from catch basins or underground storage, or other demanding applications, refer to our **MaxWell® Plus** System. For industrial drainage, including gasoline service stations, our **Envibro® System** may be recommended. For additional considerations, please refer to **"Design Suggestions For Retention And Drainage Systems"** or consult our Design Staff.

COMPLETING THE MAXWELL IV DRAWING

To apply the **MaxWell IV** drawing to your specific project, simply fill in the blue boxes per instructions below. For assistance, please consult our Design Staff.

45 feet

ESTIMATED TOTAL DEPTH

The Estimated Total Depth is the approximate depth required to achieve 10 continuous feet of penetration into permeable soils. Torrent utilizes specialized **"crowd"** equipped drill rigs to penetrate difficult, cemented soils and to reach permeable materials at depths up to **180 feet.** Our extensive database of drilling logs and soils information is available for use as a reference. Please contact our Design Staff for site-specific information on your project.

18 feet

SETTLING CHAMBER DEPTH

On MaxWell IV Systems of over 30 feet overall depth and up to 0.25cfs design rate, the **standard** Settling Chamber Depth is **18 feet .** For systems exposed to greater contributory area than noted above, extreme service conditions, or that require higher design rates, chamber depths up to 25 feet are recommended.

'

OVERFLOW HEIGHT

The Overflow Height and Settling Chamber Depth determine the effectiveness of the settling process. The higher the overflow pipe, the deeper the chamber, the greater the settling capacity. For normal drainage applications, an overflow height of **13 feet** is used with the standard settling chamber depth of **18 feet**. Sites with higher design rates than noted above, heavy debris loading or unusual service conditions require greater settling capacities

"Ø

DRAINAGE PIPE

This dimension also applies to the **PureFlo®** Debris Shield, the **FloFast®** Drainage Screen, and fittings. The size selected is based upon system design rates, soil conditions, and the need for adequate venting. Choices are 6", 8", or 12" diameter. Refer to "Design Suggestions for Retention and Drainage Systems" for recommendations on which size best matches your application.

"Ø

BOLTED RING & GRATE

Standard models are quality cast iron and available to fit 24" Ø or 30" Ø manhole openings. All units are bolted in two locations with wording "Storm Water Only" in raised letters. For other surface treatments, please refer to "Design Suggestions for Retention and Drainage Systems."

"Ø

INLET PIPE INVERT

Pipes up to 4" in diameter from catch basins, underground storage, etc. may be connected into the settling chamber. Inverts deeper than 5 feet will require additional settling chamber depth to maintain effective overflow height.

TORRENT RESOURCES INCORPORATED

1509 East Elwood Street, Phoenix Arizona 85040~1391
phone 602~268~0785 fax 602~268~0820

Nevada 702~366~1234

AZ Lic. ROC070465 A, ROC047067 B-4; ADWR 363
CA Lic. 528080 A, C-42, HAZ ~ **NV Lic.** 0035350 A ~ **NM Lic.** 90504 GF04

1/12

TORRENT RESOURCES (CA) INCORPORATED

phone 661~947~9836

CA Lic. 886759 A, C-42

www.TorrentResources.com

An evolution of McGuckin Drilling

The watermark for drainage solutions.®

PLATE 2

TORRENT® RESOURCES

APPENDIX A

EXPLORATORY LOGS

EXPLORATION LOG

Project:		Location:
Address:		Elevation:
Job Number:	Client:	Date:
Drill Method:	Driving Weight:	Logged By:

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		EXPLANATION							
		Solid lines separate geologic units and/or material types.							
5		Dashed lines indicate unknown depth of geologic unit change or material type change.							
		Solid black rectangle in Core column represents California Split Spoon sampler (2.5in ID, 3in OD).			■				
		Double triangle in core column represents SPT sampler.			⧗				
10		**Vertical Lines** in core column represents Shelby sampler.			▥				
		Solid black rectangle in Bulk column respresents large bag sample.				■			
15		**Other Laboratory Tests:** Max = Maximum Dry Density/Optimum Moisture Content EI = Expansion Index SO4 = Soluble Sulfate Content DSR = Direct Shear, Remolded DS = Direct Shear, Undisturbed SA = Sieve Analysis (1" through #200 sieve) Hydro = Particle Size Analysis (SA with Hydrometer)							
20		200 = Percent Passing #200 Sieve Consol = Consolidation SE = Sand Equivalent Rval = R-Value ATT = Atterberg Limits							

EXPLORATION LOG

Project:		Location: B-1
Address: 13633 Vermont Ave, Gardena, CA 90247		Elevation: 76
Job Number: 2848.00	Client: Melia Homes	Date: 11/1/2019
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: SD/SB

Depth (feet)	Material Description	Water	Blows Per Foot	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
	ARTIFICIAL FILL (Af) Sand (SP): Gray, dry					
	Sandy Clay/ Clayey Sand (CL/SC): Reddish brown, moist, very stiff/ medium dense, trace medium grained sand, some pinhole pores		35	14	118	
5	**OLDER ALLUVIUM (Qoal)** Silty Sand (SM): Light brown, moist, medium dense, fine grained sand, trace medium grained sand, mica present, iron oxide stainings, magnesium oxide stainings		44	15.5	115.8	Consol
			55	11.7	121.2	
	Sandy Clay (CL): Light brown, slightly moist, very stiff, caliche, magnesium oxide stainings					
10	Clayey Sand (SC): Light brown, moist, hard, fine to medium grained sand, increased sand content toward sampler tip, trace coarse grained sand, mica present		44	16.1	115.3	
	Clayey Silt (ML): Light brown, slightly moist, hard, pinhole pores					
15	@ 15 ft, increased silt content, magnesium oxide stainings		34			
	Silt with Sand (ML): Light brown, moist, mica present					
20			14			Hydro
	@ 23.5 ft, becomes very moist to wet					

EXPLORATION LOG

Project:	Location: B-1
Address: 13633 Vermont Ave, Gardena, CA 90247	Elevation: 76
Job Number: 2848.00 / Client: Melia Homes	Date: 11/1/2019
Drill Method: Hollow-Stem Auger / Driving Weight: 140 lbs / 30 in	Logged By: SD/SB

Depth (feet)	Lithology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Silty Sand : Mottled gray and light brown, moist, dense, fine grained sand, trace silt, mica present, no groundwater observed		31					
				36					SA
30				23					
		Clay (CL): Reddish brown, slightly moist, hard, trace fine grained sand, mica present, iron oxide stainings							
35		@ 35 ft, magnesium oxide stainings		26					
		Sand (SP): Gray, slightly moist, very dense, fine grained sand, mica present							
40				72					
		Sandy Silt (ML): Mottled grayish brown and light brown, moist, very stiff, mica present, increased silt content toward sampler tip and decreased sand content							
45				11					

EXPLORATION LOG

Project:		Location: B-1
Address: 13633 Vermont Ave, Gardena, CA 90247		Elevation: 76
Job Number: 2848.00	Client: Melia Homes	Date: 11/1/2019
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: SD/SB

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Core	Bulk	Laboratory Tests: Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
50		<u>Silty Sand (SM):</u> Light brown, moist, medium dense, increased silt content toward sampler tip		15					
		End of boring at depth of 51.5 ft. Backfilled with soil cuttings. No groundwater.							

EXPLORATION LOG

Project:		Location: B-2
Address: 13633 Vermont Ave, Gardena, CA 90247		Elevation: 78
Job Number: 2848.00	Client: Melia Homes	Date: 11/1/2019
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: SD/SB

Depth (feet)	Material Description	Water	Samples: Blows Per Foot	Laboratory Tests: Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
	Asphalt (AC): 1 inch					SO4 DS ATT pH Resist Ch
	Crushed Aggregate Base (CAB): 5 inch					
	ARTIFICIAL FILL (Af) Sandy Clay (CL): Brown, moist, very stiff		34	12.6	121.8	
5	**OLDER ALLUVIUM (Qoal)** Sandy Silt/ Silty Sand (ML/SM): Brown, moist, hard/ very dense, fine grained sand, trace clay, some medium grained sand		91/ 10"	11.9	120.6	
	@ 6 ft, mottled light brown and brown		73/ 11"	13.8	119.2	
10	Silt (ML): Light brown, moist, hard, pinhole pores, mica present, magnesium oxide stainings		49	17.3	112.8	
15	Sand (SP): Light brown, moist, dense, fine grained sand, trace silt nodules, pinhole pores		24			
	Sandy Silt/ Silty Sand (ML/SM): Light brown, moist, very stiff/ medium dense, fine to medium grained sand, iron oxide stainings		18			
20	Silt (ML): Olive, moist, very stiff, iron oxide stainings, trace fine grained sand		16			
	Silty Sand (SM): Brown, moist, dense					

Albus-Keefe & Associates, Inc.

EXPLORATION LOG

Project:		Location: B-2
Address: 13633 Vermont Ave, Gardena, CA 90247		Elevation: 78
Job Number: 2848.00	Client: Melia Homes	Date: 11/1/2019
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: SD/SB

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Core	Bulk	Laboratory Tests: Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
				27					
		End of the boring at depth of 26.5. No groundwater encountered. Backfilled with soil cuttings and patched with cold patch asphalt cold patch.							

EXPLORATION LOG

Project:		Location: B-3
Address: 13633 Vermont Ave, Gardena, CA 90247		Elevation: 75
Job Number: 2848.00	Client: Melia Homes	Date: 11/1/2019
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: SD/SB

Material Description

Asphalt (AC): 2.5 inch

Crushed Aggregate Base (CAB): 2 inch

ARTIFICIAL FILL (Af)
Sandy Clay (CL): Reddish brown to brown, moist, very stiff, fine grained sand, trace pinhole pores

OLDER ALLUVIUM (Qoal)
Sandy Clay/ Clayey Sand (CL/SC): Reddish brown to brown, moist, very stiff/ medium dense, fine grained sand, some medium grained sand, trace pinhole pores

Sandy Silt (ML): Brown to reddish brown, moist, very stiff, fine grained sand, trace clay, pinhole pores, glass debris in 6 ft cuttings

@ 10 ft, hard

Silty Sand (SM): Brown, moist, medium dense, fine grained sand, some medium grained sand

@ 16.5 ft, increased silt content

Sandy Silt (ML): Pale brown, moist, very stiff, fine grained sand, pinhole pores, trace medium grained sand

End of boring at depth of 21.5 feet. No groundwater encountered. Backfilled with soil cuttings and patched with cold patch asphalt.

Samples and Laboratory Tests

Depth (feet)	Blows Per Foot	Sample	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
2	25	Core	13.5	119	
4	31	Core	12.5	120.8	
6	39	Core	13.5	118.5	Consol
10	50	Core	13.3	114.5	
15	19	Core			
16.5	20	Core			
20	18	Core			

EXPLORATION LOG

Project:		Location: B-4
Address: 13633 Vermont Ave, Gardena, CA 90247		Elevation: 77
Job Number: 2848.00	Client: Melia Homes	Date: 11/1/2019
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: SD/SB

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0–3.8		**ARTIFICIAL FILL (Af)** Sandy Clay (CL): Dark brown, dry to slightly moist, very stiff, fine grained sand, pinhole pores, black stainings		26			13.7	117.9	SO4 ATT pH Resist Ch
5		**OLDER ALLUVIUM (Qoal)** Sandy Clay/ Sandy Silt (CL/ML): Reddish brown, dry to slightly moist, hard, fine grained sand, caliche		67			14.4	119.8	
							15.5	118.6	
		@ 6 ft, iron oxide stainings, increased sand toward sampler tip		74					
10		Silt (ML): Light brown, dry to slightly moist, very stiff, trace fine grained sand, pinhole pores		36			14.1	118.4	
15		@ 15 ft, slightly moist to moist		15					
20		Sand (SP): Grayish brown to light brown, slightly moist, dense, trace clay nodules		32					
		End of boring at depth of 21.5 feet. No groundwater encountered. Backfilled with soil cuttings.							

Albus-Keefe & Associates, Inc.

EXPLORATION LOG

Project:		Location: B-5
Address: 13633 Vermont Ave, Gardena, CA 90247		Elevation: 77
Job Number: 2848.00	Client: Melia Homes	Date: 11/1/2019
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: SD/SB

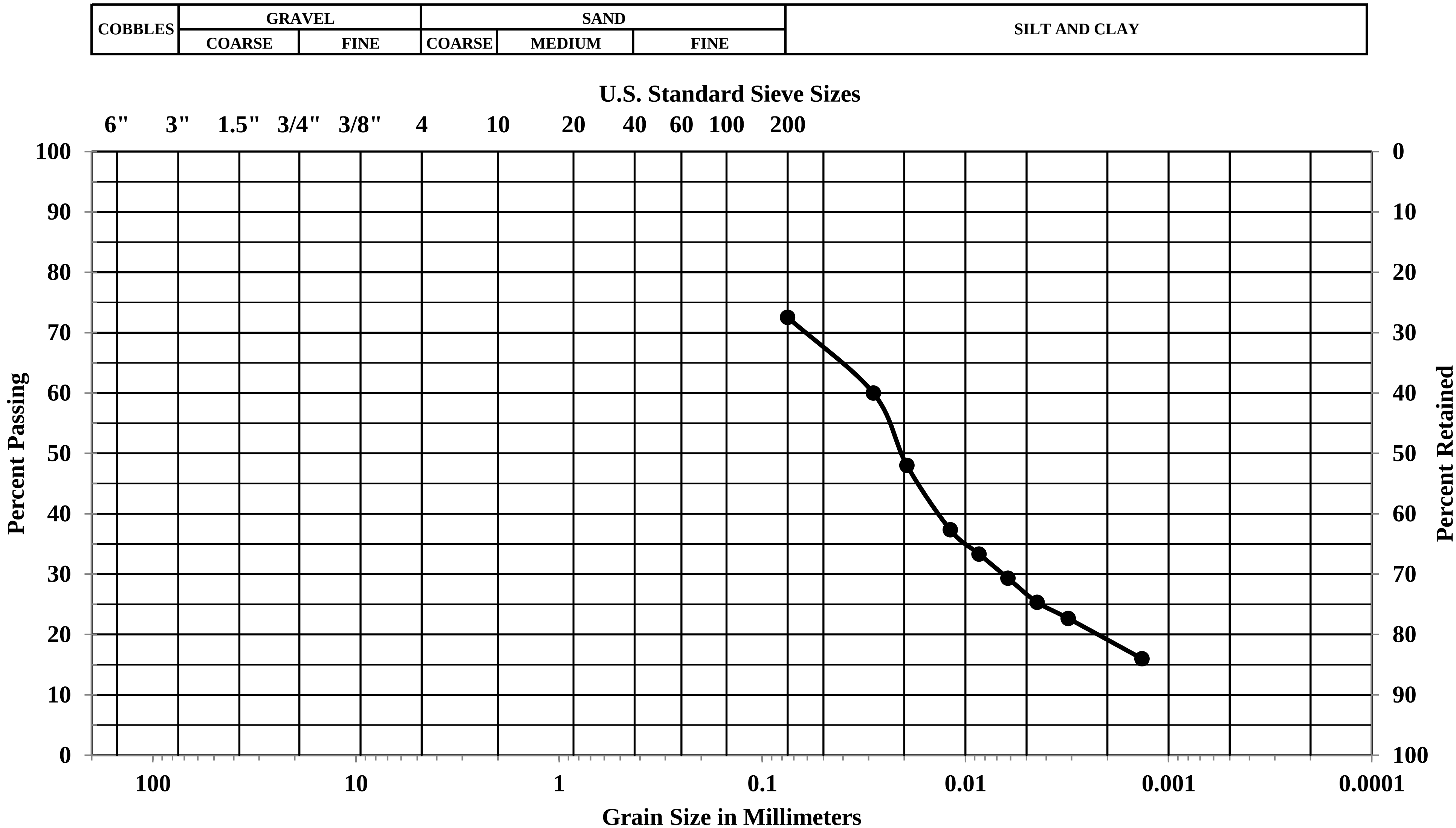
Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ARTIFICIAL FILL (Af) Sandy Silt (ML): Mottled dark brown and light brown, moist, medium stiff, rootlets		11			11.8	117.2	
5		**OLDER ALLUVIUM (Qoal)** Sandy Clay (CL): Dark brown, moist, very stiff, pinhole pores, increased fine to medium grained sand toward sampler tip		37			13.5	117.4	Consol
		Silt with Clay(ML): Brown, dry to slightly moist, hard, magnesium oxide stainings, caliche, pinhole pores		73			14.9	117.5	
10		@ 10 ft, light brown, moist, very stiff, mica present, magnesium oxide stainings		31			16.5	115	
15		@ 15 ft, hard		28					
20		Sand (SP): Brown to grayish brown, slightly moist, dense, fine to medium grained sand, trace silt		28					
		End of boring at depth of 21.5 feet. No groundwater encountered. Backfilled with soil cuttings.							

Albus-Keefe & Associates, Inc.

APPENDIX B

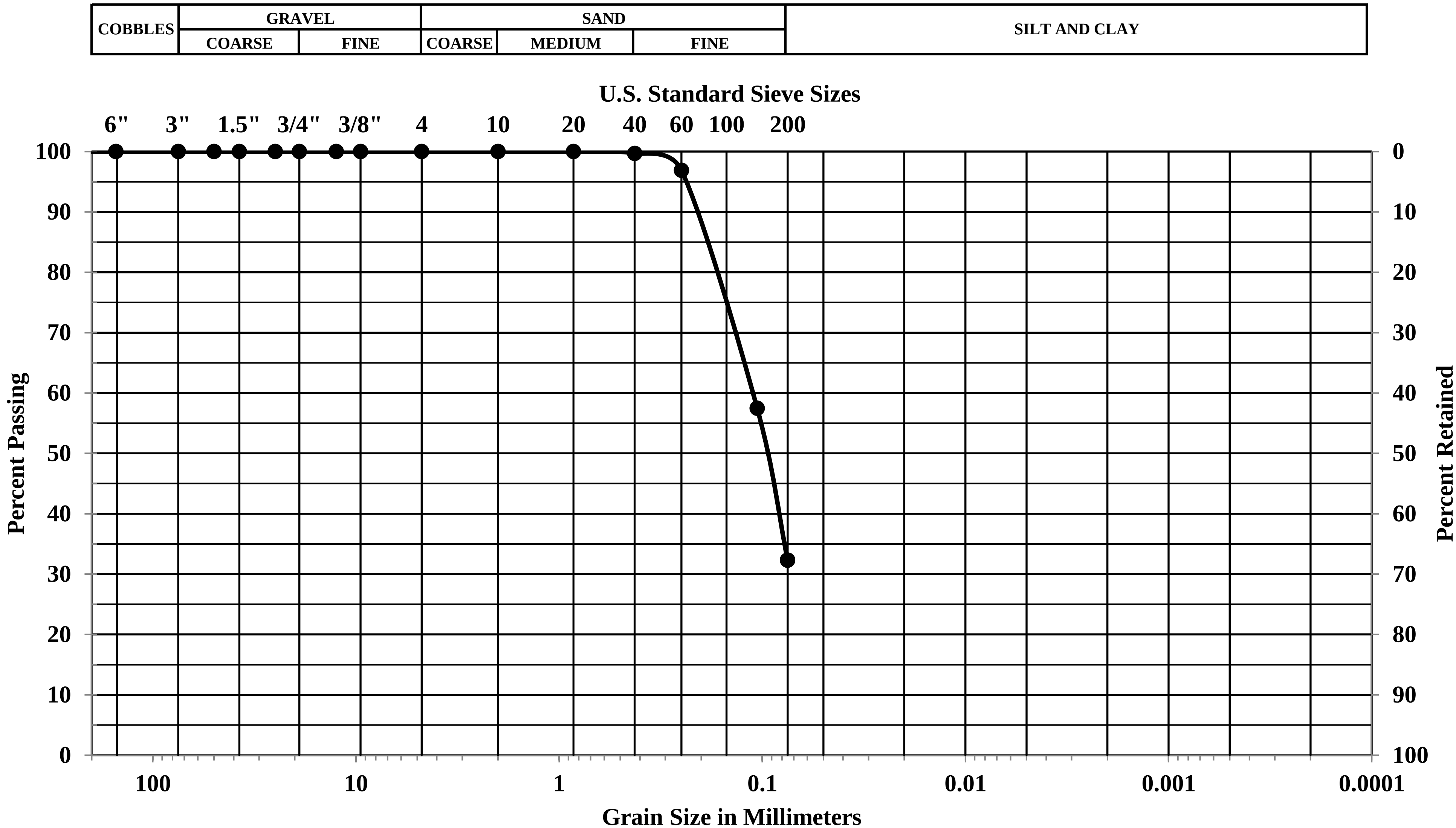
LABORATORY TESTING

GRAIN SIZE DISTRIBUTION



Job Number	Location	Depth	Description
2848.00	B-1	20	Silt with Sand (ML)

GRAIN SIZE DISTRIBUTION



Job Number	Location	Depth	Description
2848.00	B-1	27	Silty Sand (SM)

APPENDIX C

PERCOLATION TESTING AND ANALYSES

Field Percolation Testing - Constant Head

Client: Melia Homes

Job. No.: 2848.00

Date Tested: 11/1/2019

Test by: SD

Location: P-1

Top of Casing to Bottom of Well (ft): 30

Elev. of Ground Surface (ft): 76

Diam. of Test Hole (in): 8

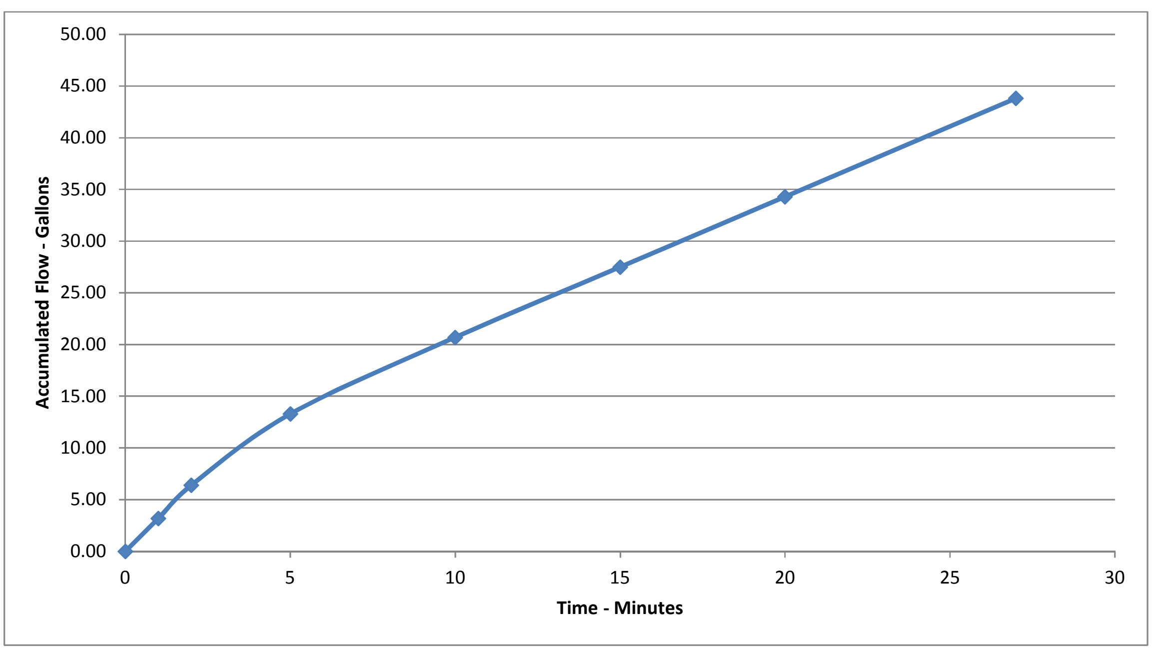
Diam. of Casing (in): 3

Ht. to Top of Casing (ft): 0

Water Tempurature (C°): 21

Constant Head

Elapsed Time (minutes)	Time	Depth to H2O (ft)	Flow Rate (gal./min.)	Total H_2O used (gal)
0	3:50	25	3.40	0.00
1	3:51	25	3.00	3.20
2	3:52	25	1.60	6.40
5	3:55	25	1.36	13.30
10	4:00	25	1.36	20.70
15	4:05	25	1.36	27.50
20	4:10	25	1.36	34.30
27	4:17	25	1.36	43.82



INFILTRATION WELL DESIGN

Constant Head
USBR 7300-89 Method

J.N.: 2848.00
Client: Melia Homes
Well No.: P-1

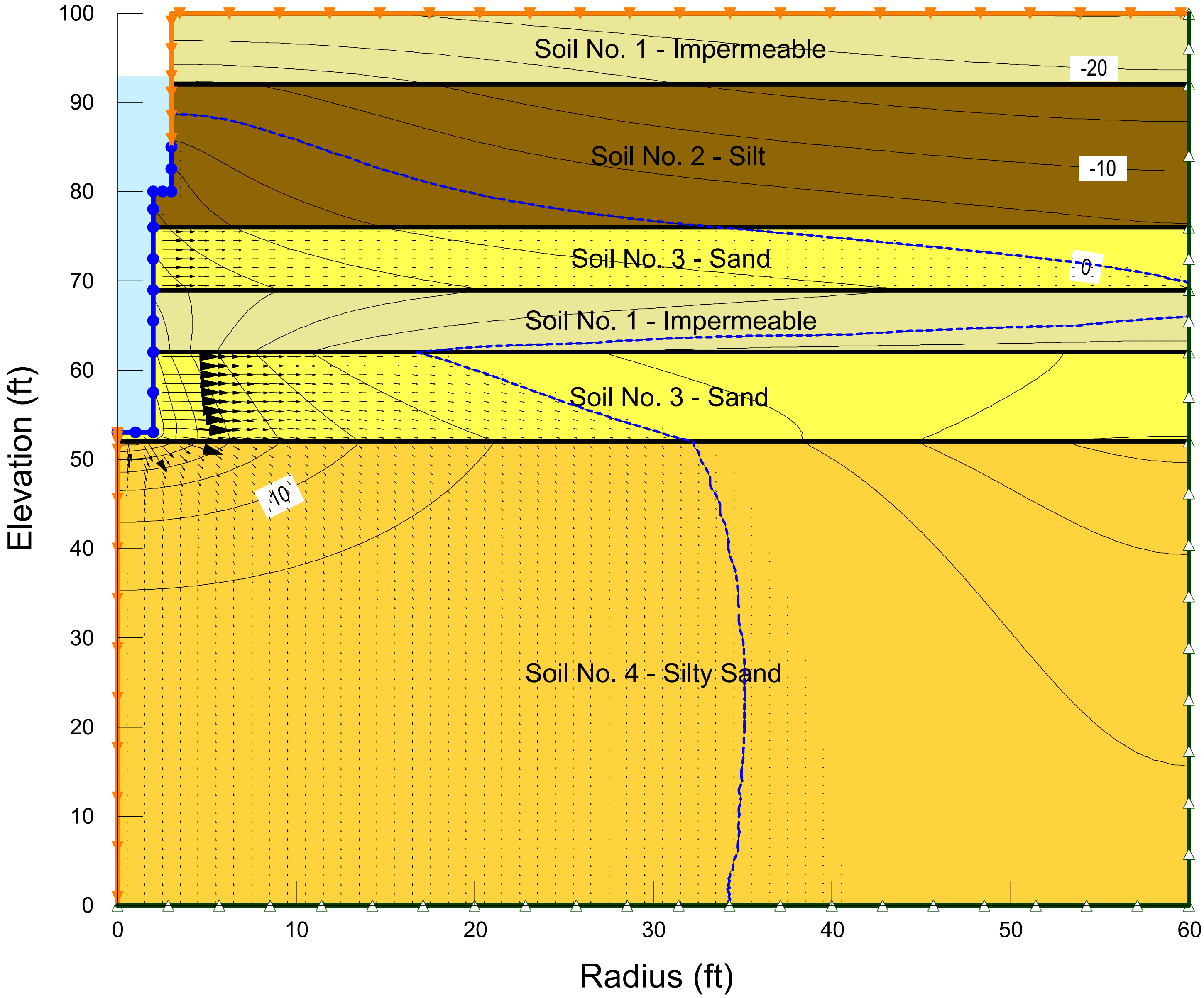
Low Water Table	Condition 1	
High Water Table & Water Below Bottom of Well	Condition 2	
High water Table with Water Above the Well Bottom	Condition 3	
		Units:
Enter Condition (1, 2 or 3):	2	
Ground Surface to Bottom of Well (**h_1**):	30	feet
Depth to Water (**h_2**):	25	feet
Height of Water in the Well (h_1-h_2=**h**):	5	feet
Radius of Well (**r**):	4.0	Inches
Minimum Volume Required:	1473.4	Gal.
Discharge Rate of Water Into Well for Steady-State Condition (**q**):	1.36	Gal/min.
Temperature (**T**):	21	Celsius
(Viscosity of Water @ Temp. T) / (Viscosity of water @ 20° C) (**V**):	0.9647	ft^3/min.
Unsaturated Distance Between the Water Surface in the Well and the Water table (**T_u**):	5	
Factor of Safety:	1	
Coefficient of Permeability @ 20° C (**k_{20}**):	6.11E-03	ft/min.
Design k_{20}:	4.40	in./hr.

The presence or absence of a water table or impervious soil layer within a distance of less than three times that of the water depth in the well (measured from the water surface) will enable the water table to be classified as **Condition I**, **Condition II**, **Condtion III**.

Low Water Table-When the distance from the water surface in the test well to the ground water table, or to an impervious soil layer which is considered for test puposes to be equivalent to a water table, is greater than three times the depth of water in the well, classify as **Condition I**.

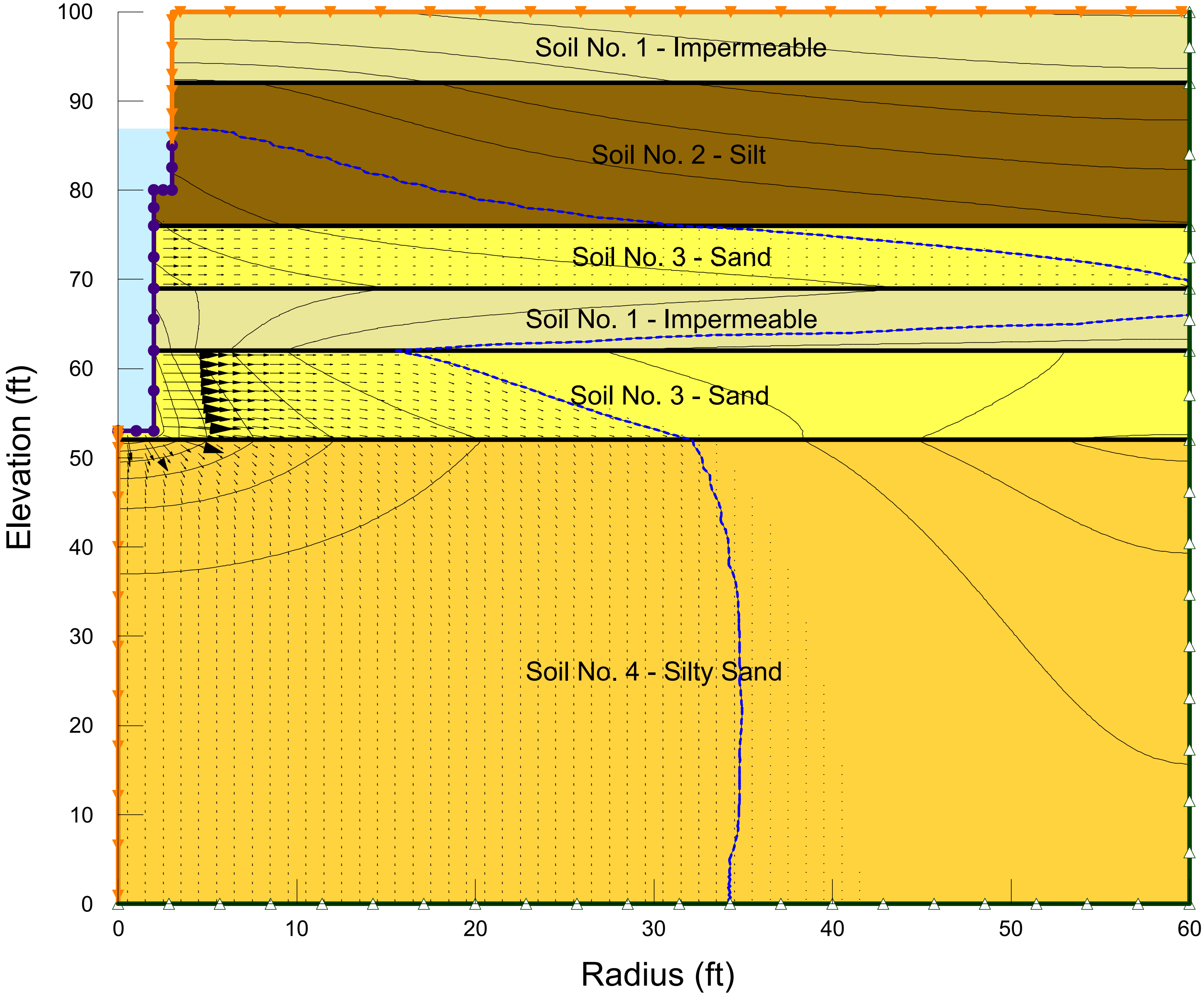
High Water Table-When the distance from the water surface in the test well to the ground water table or to an impervious layer is less than three times the depth of water in the well, a high water table condition exists. Use **Condition II** when the water table or impervious layer is below the well bottom. Use **Condition III** when the water table or impervious layer is above the well bottom.

STEADY STATE
FLOW ANALYSIS OF 45 ft DEEP DRY WELL

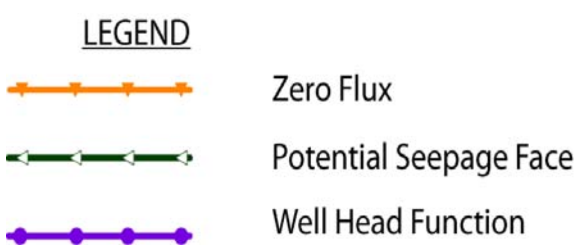


Contours are Pressure Head in Feet.
Arrows indicate direction of flow and relative magnitude of velocity.

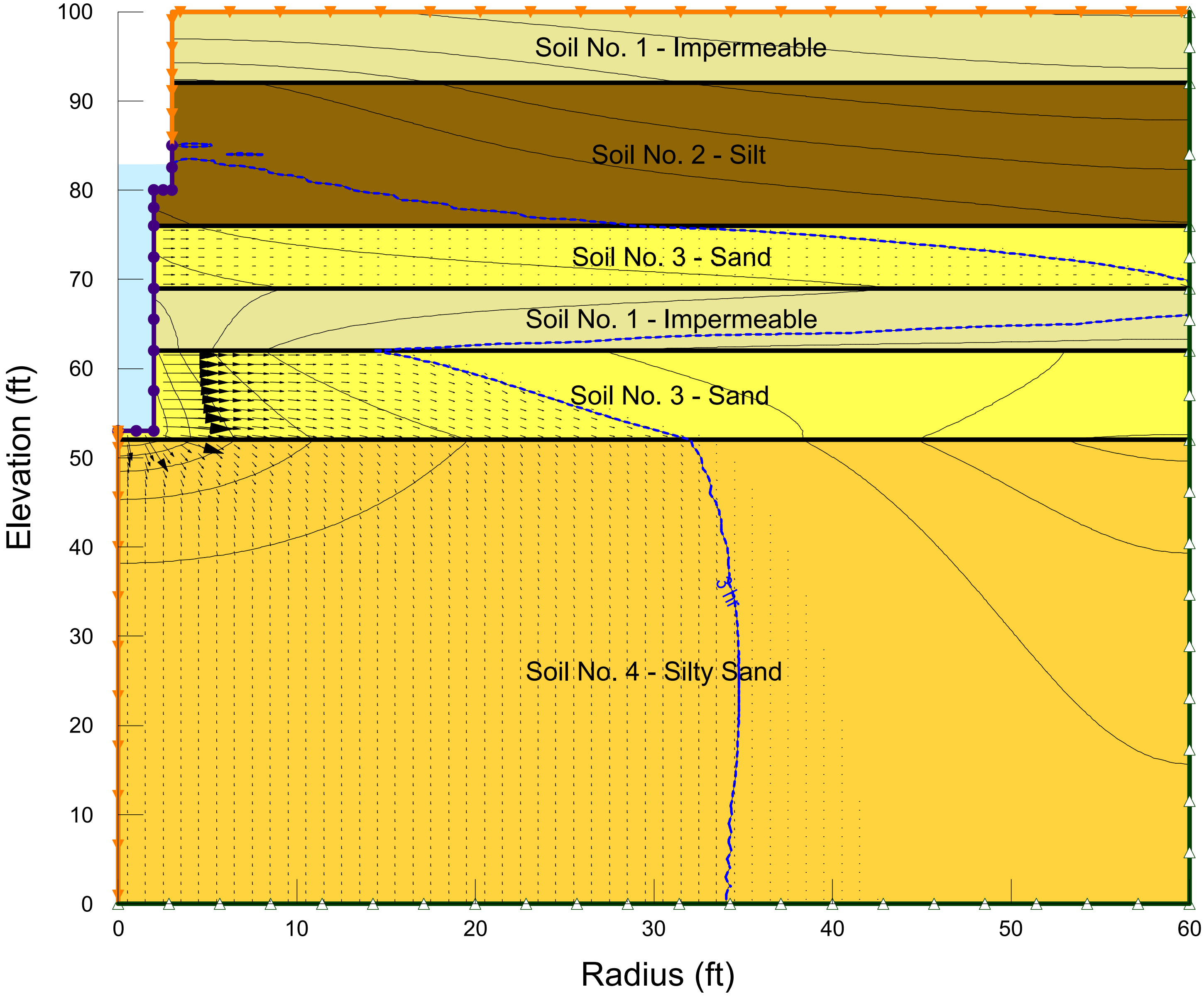
TRANSIENT @ 0.3 hour
FLOW ANALYSIS OF 45 ft DEEP DRY WELL



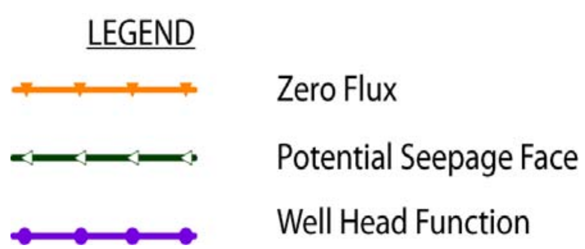
Contours are Pressure Head in Feet.
Arrows indicate direction of flow and relative magnitude of velocity.



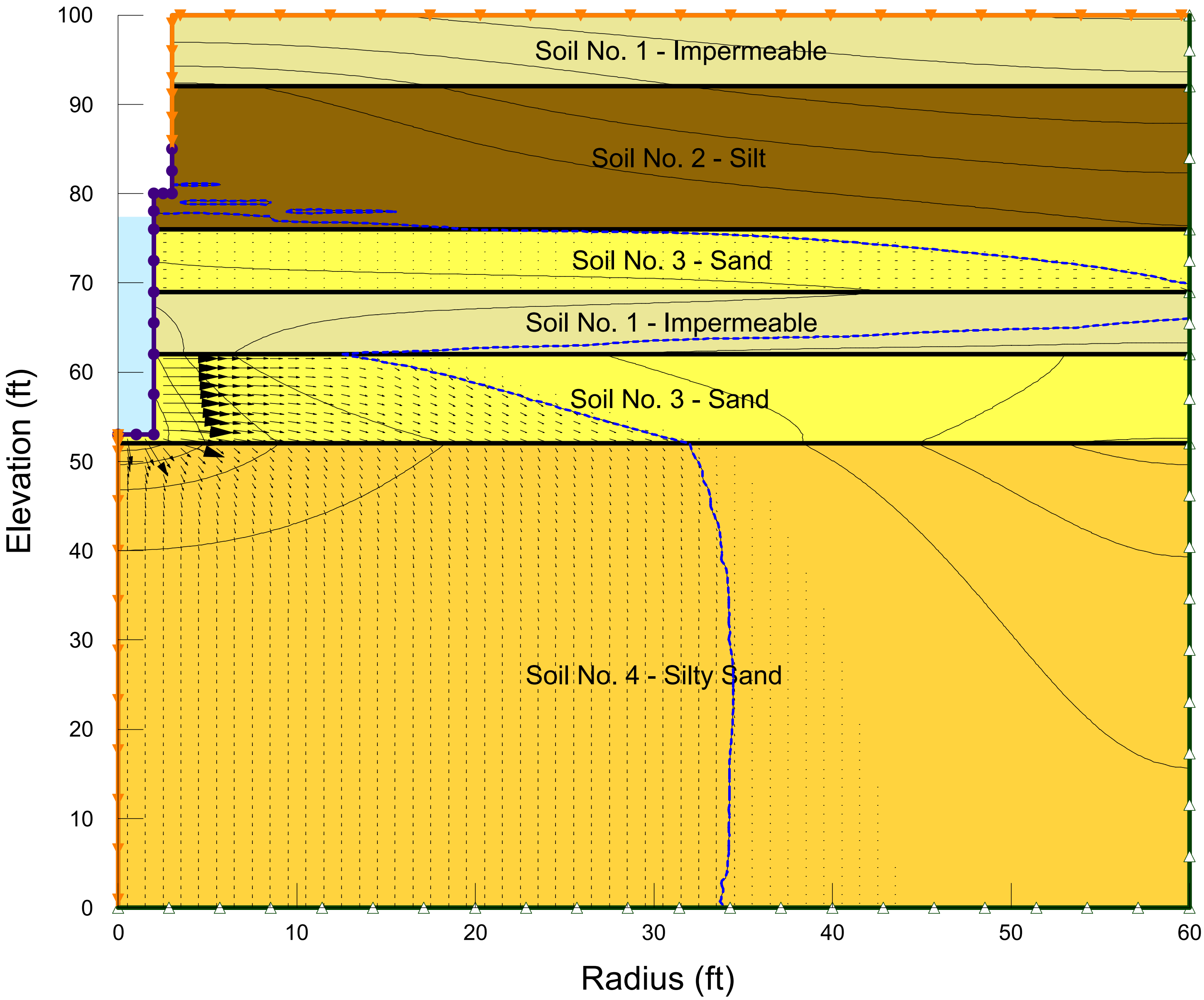
TRANSIENT @ 0.5 hour
FLOW ANALYSIS OF 45 ft DEEP DRY WELL



Contents are Pressure Head in Feet.
Arrows indicate direction of flow and relative magnitude of velocity.



TRANSIENT @ 0.7 hour
FLOW ANALYSIS OF 45 ft DEEP DRY WELL



Contours are Pressure Head in Feet.
Arrows indicate direction of flow and relative magnitude of velocity.