NorCal Engineering

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September 7, 2017 Project Number 19834-17

Alere Property Group, LLC
100 Bayview Circle, Suite 310
Newport Beach, California 92660

Attn: Clark Neuhoff

RE: **Soil Infiltration Study** - Proposed Warehouse Development - Located at the Southwest Corner of Slover Avenue and Cactus Avenue, Bloomington, in the County of San Bernardino, California

Dear Mr. Neuhoff:

Pursuant to your request, this firm has performed a Soil Infiltration Study for the above referenced project. The purpose of this study is to evaluate the feasibility of on-site drainage disposal systems on the subject site. The scope of current work included the following: 1) site reconnaissance; 2) subsurface geotechnical exploration; 3) double ring infiltration testing at two locations; 4) engineering analysis of field test data; and 5) preparation of this report.

Proposed Development

It is currently proposed to a new concrete tilt-up structure totaling 257,915 square feet on the property. Asphaltic and concrete pavement areas and landscaping will also be installed. It is also proposed to install detention/infiltration basin along the east side of the property to capture and infiltrate storm water runoff. Depth of system will be on the order of 5 to 8 feet below existing grades.

Site Description

The rectangular shaped property is located at the southwest corner of Slover Avenue and Cactus Avenue, in the Bloomington area of the County of San Bernardino, as shown on the Vicinity Map, Figure 1.

The site is largely vacant except for four residences and a detached garage located on the east and west sides of the site. Some improvements related to the houses include concrete pavement, landscaping and other associated improvements.

The site topography is generally flat and drainage appears to be via sheetflow in a southerly and easterly directions.

Field Exploration

The excavations were completed on August 19, 2017 and testing was completed on that day. The testing consisted of using the double ring infiltrometer at two locations to determine the infiltration rate of the proposed retention/infiltration system. The locations of the tests are shown on the attached Figure 2. The test locations were excavated by backhoe to depths of 5 and 8 feet below existing ground surface (bgs). Excavations were trimmed at 1:1 (horizontal to vertical) inclinations in order to provide safe entry into the excavations. No significant caving occurred to the depths of these test excavations. Detailed descriptions of the subsurface soils are given in the attached test excavations logs in Appendix B. The excavations were backfilled at the conclusion of testing with the soil cuttings and tamped, but were *not* compacted to 90% relative compaction.

In general, the test areas were found to be underlain by surficial fill soils overlying native soils. The soils at test locations consisted of silty SANDS with some gravel and small cobbles. These soils were noted to be medium dense and dry to damp.

Groundwater

Groundwater was not encountered in any of our test excavations. Historic high groundwater in the vicinity has been recorded greater than 100 to 200 feet below grade at wells approximately ¾ mile northwest of the site and 1¼ mile southeast, based upon information from the California Department of Water Resources database http://www.water.ca.gov/waterdatalibrary/.

Infiltration Test Procedure

The infiltration test consisted of the double ring infiltration test per ASTM Method D 3385. The double ring infiltrometer method consists of driving two open cylinders, one inside the other, into the ground, partially filling the ring with water, and then maintaining the liquid at a constant level. The volume of liquid added to the inner ring, to maintain the liquid level constant is the measure of the volume of liquid that infiltrates into the soil.

The volume infiltrated during timed intervals is converted to an incremental infiltration velocity, usually expressed in centimeters per hour or inches per hour and plotted verses elapsed time. The maximum-steady state or average incremental infiltration velocity, depending on the purpose/application of the test is equivalent to the infiltration rate.

Water levels were maintained at a constant level in both the inner ring and annular space between rings throughout the test, to prevent flow of water from one ring to the other.

The volume of liquid used during each measured time interval was converted into an incremental infiltration velocity of both the inner ring in the annular space using the following equations:

For the inner ring calculated as follows:

$Vir = \Delta Vir/(Air\Delta t)$

where:

Vir = inner ring incremental infiltration velocity, cm/hr

ΔVir = volume of water used during time interval to maintain constant head in the inner ring, cm^3

Air = internal area of the inner ting, cm^2

Δt = time interval, hr

The last reading obtained was used for design purposes in each of the basin. The testing data sheets are attached in Appendix B and summarized in the *Discussion of Results* section below.

Discussion of Results

The use of on-site disposal system by means of retention/infiltration basins appears to be geotechnically feasible for future development. The field infiltration rates given below may be utilized in the basin design with a safety factor of 2.0 or greater.

Test No.	Depth (feet bgs)	Soil Type	Infiltration Rate (cm/hr)	Infiltration Rate (in/hr)
T-1	5	silty SAND	64.6	25.8
T-2	8	silty SAND	60.9	24.4

It is our opinion that the site is suitable for stormwater infiltration without increasing the potential of settlement of proposed and existing structures or adversely affecting retaining/basement walls located either on or adjacent to the subject site. In addition, the potential for hydro-consolidation and the susceptibility for any ground settlements are considered low. All systems shall meet the California Regional Water Quality Control Board (CRWQCB) requirements.

Closure

The recommendations and conclusions contained in this report are based upon the soil conditions uncovered in our test excavations. No warranty of the soil condition between our excavations is implied. NorCal Engineering should be notified for possible further recommendations if unexpected to unfavorable conditions are encountered during construction phase. This firm should have the opportunity to review the final plans to verify that all our recommendations are incorporated.

This report and all conclusions are subject to the review of the controlling authorities for the project. Our representative should be present during the grading operations and construction phase to certify that such recommendations are complied within the field.

This infiltration study has been conducted in a manner consistent with the level of care and skill exercised by members of our profession currently practicing under similar conditions in the Southern California area. All work was performed under the supervision of the Geotechnical Engineer. No other warranty, expressed or implied is made. No other warranty, expressed or implied is made.

We appreciate this opportunity to be of service to you. If you have any further questions, please do not hesitate to contact the undersigned.

Respectfully submitted,
NORCAL ENGINEERING

Keith D. Tucker
Project Engineer
R.G.E. 841

Mark A. Burkholder
Project Manager

List of Appendices
(in order of appearance)

Appendix A

Vicinity Map and Test Location Exhibits – Figures 1 and 2

Appendix B

Logs of Test Excavations T-1 and T-2

Field Test Data

Calculations

Appendix A

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VICINITY MAP

FIG. 1

Appendix B

MAJOR DIVISION			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL, SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVEL-LY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINE (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

UNIFIED SOIL CLASSIFICATION SYSTEM

KEY:

- Indicates 2.5-inch Inside Diameter. Ring Sample.
- Indicates 2-inch OD Split Spoon Sample (SPT).
- Indicates Shelby Tube Sample.
- Indicates No Recovery.
- Indicates SPT with 140# Hammer 30 in. Drop.
- Indicates Bulk Sample.
- Indicates Small Bag Sample.
- Indicates Non-Standard
- Indicates Core Run.

COMPONENT PROPORTIONS

DESCRIPTIVE TERMS	RANGE OF PROPORTION
Trace	1 - 5%
Few	5 - 10%
Little	10 - 20%
Some	20 - 35%
And	35 - 50%

COMPONENT DEFINITIONS

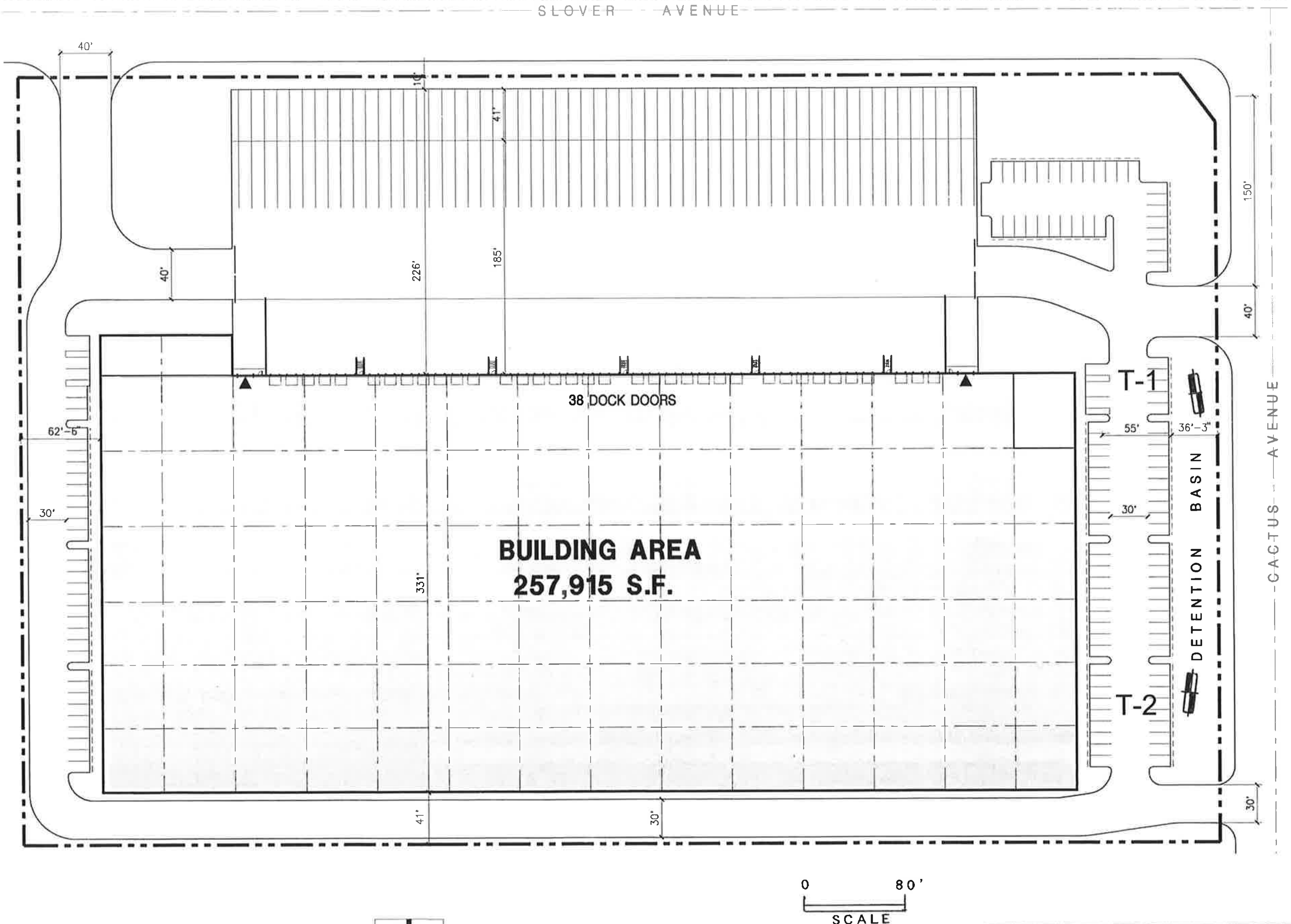
COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No 4 (4.5mm)
Sand	No. 4 (4.5mm) to No. 200 (0.074mm)
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074 mm)

MOISTURE CONTENT

DRY	Absence of moisture, dusty, dry to the touch.
DAMP	Some perceptible moisture; below optimum
MOIST	No visible water; near optimum moisture content
WET	Visible free water, usually soil is below water table.

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N -VALUE

COHESIONLESS SOILS		COHESIVE SOILS		
Density	N (blows/ft)	Consistency	N (blows/ft)	Approximate Undrained Shear Strength (psf)
Very Loose	0 to 4	Very Soft	0 to 2	< 250
Loose	4 to 10	Soft	2 to 4	250 - 500
Medium Dense	10 to 30	Medium Stiff	4 to 8	500 - 1000
Dense	30 to 50	Stiff	8 to 15	1000 - 2000
Very Dense	over 50	Very Stiff	15 to 30	2000 - 4000
		Hard	over 30	> 4000



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APPROXIMATE LOCATIONS OF SOIL BORINGS

FIG. 2

Alere Property Group LLC 19834-17	Log of Trench T-1

Boring Location: Slover & Cactus, Bloomington	
Date of Drilling: 8/19/17	Groundwater Depth: None Encountered
Drilling Method: Backhoe	
Hammer Weight:	Drop:
Surface Elevation: Not Measured	

Depth (feet)	Lith-ology		Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		GWT not encountered	FILL SOILS Silty SAND with gravel, small cobbles, roots Brown, loose, dry					
			NATURAL SOILS Slightly silty SAND with gravel, occasional cobbles Light brown, medium dense, dry to damp					
5			Boring completed at depth of 5'					
10								
15								
20								
25								
30								
35								

Alere Property Group LLC 19834-17	Log of Trench T-2

Boring Location: Slover & Cactus, Bloomington	
Date of Drilling: 8/19/17	Groundwater Depth: None Encountered
Drilling Method: Backhoe	
Hammer Weight:	Drop:
Surface Elevation: Not Measured	

Depth (feet)	Lithology	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		FILL SOILS Silty SAND with gravel, small cobbles, roots Brown, loose, dry					
	GWT not encountered	NATURAL SOILS Slightly silty SAND with gravel, occasional cobbles Light brown, medium dense, dry to damp					
5							
		Silty SAND Light brown, medium dense, damp					
		Boring completed at depth of 8'					
10							
15							
20							
25							
30							
35							

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Project:	**Alere, LLC**
Project No:	19834-17
Date:	8/19/17
Test No.	T-1
Depth:	5'
Tested By:	J.S.

	TIME (hr/min)	CHANGE TIME (min)	CUMULATIVE TIME (min)	INNER RING READING (cm)	INNER RING CHANGE	INNER RING FLOW (cc)	OUTER RING READING (cm)	OUTER RING CHANGE (cm)	OUTER RING FLOW (cc)	INNER RING INF RATE (cm/hr)	OUTER RING INF RATE (cm/hr)	INNER RING INF RATE (ft/hr)
1	7:59			38.4			103.3					
	8:04	5	5	47.7	9.3		112.5	9.2				
2	8:04			39.8			104.9					
	8:09	5	10	47.1	7.6		112.7	7.8				
3	8:09			41.0			106.2					
	8:14	5	15	47.0	6.0		112.6	6.4				
4	8:14			38.9			104.1					
	8:19	5	20	45.8	6.9		111.2	7.1				
5	8:19			37.5			102.6					
	8:24	5	25	44.1	6.6		109.0	6.4				
6	8:24			37.9			102.8					
	8:29	5	30	43.7	5.8		109.1	6.3				
7	8:29			37.2			102.9					
	8:34	5	35	42.9	5.7		108.6	5.7		68.4	68.4	
8	8:34			38.5			104.0					
	8:39	5	40	44.2	5.7		109.3	5.3		68.4	63.6	
9	8:39			38.6			104.3					
	8:44	5	45	43.8	5.2		109.6	5.3		62.4	63.6	
10	8:44			38.3			104.6					
	8:49	5	50	43.6	5.3		109.5	4.9		63.6	58.8	
11	8:49			38.3			104.0					
	8:54	5	55	43.7	5.4		109.2	5.2		64.8	62.4	
12	8:54			39.0			104.9					
	8:59	5	60	44.0	5.0		109.6	4.7		60.0	56.4	
									Average =	64.6	62.2	

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Project:	**Alere, LLC**
Project No:	19834-17
Date:	8/19/17
Test No.	T-2
Depth:	8'
Tested By:	J.S.

	TIME (hr/min)	CHANGE TIME (min)	CUMULATIVE TIME (min)	INNER RING READING (cm)	INNER RING CHANGE	INNER RING FLOW (cc)	OUTER RING READING (cm)	OUTER RING CHANGE (cm)	OUTER RING FLOW (cc)	INNER RING INF RATE (cm/hr)	OUTER RING INF RATE (cm/hr)	INNER RING INF RATE (ft/hr)
1	9:30			40.2			103.9					
	9:35	5	5	48.8	8.6		112.0	8.1				
2	9:35			39.8			103.5					
	9:40	5	10	45.3	5.5		109.8	6.3				
3	9:40			40.5			104.6					
	9:45	5	15	46.2	5.7		110.0	5.4				
4	9:45			41.0			104.5					
	9:50	5	20	45.7	4.7		109.4	4.9				
5	9:50			40.4			103.9					
	9:55	5	25	45.4	5.0		109.0	5.1				
6	9:55			40.3			103.6					
	10:00	5	30	45.0	4.7		108.8	5.2		56.4	62.4	
7	10:00			40.2			103.0					
	10:05	5	35	45.1	4.9		108.5	5.5		58.8	66.0	
8	10:05			40.0			103.5					
	10:10	5	40	45.2	5.2		108.9	5.4		62.4	64.8	
9	10:10			39.9			103.3					
	10:15	5	45	45.1	5.2		108.7	5.4		62.4	64.8	
10	10:15			40.5			103.8					
	10:20	5	50	45.7	5.2		109.0	5.2		62.4	62.4	
11	10:20			40.0			104.0					
	10:25	5	55	44.9	4.9		109.5	5.5		58.8	66.0	
12	10:25			39.8			103.5					
	10:30	5	60	45.2	5.4		109.0	5.5		64.8	66.0	
									Average =	60.9	64.6	