

NorCal Engineering
Soils and Geotechnical Consultants
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March 14, 2017

Project Number 19431-17

LDC Industrial Realty, LLC
Avenida San Dimas
San Clemente, California 92672

Attn: Larry Cochrun

RE: **Soil Infiltration Study** - Proposed Warehouse Building Development - Located West of La Cadena Drive, North and South of Tropic Rancho Road, in the City of Colton, California

Dear Mr. Cochrun:

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 four locations; 4) engineering analysis of field test data; and 5) preparation of this report.

Proposed Development

It is currently proposed to construct three new concrete tilt-up structures totaling 256,030 square feet on the property. Asphaltic and concrete pavement areas and landscaping will also be installed. Grading for the development will include cut and fill procedures.

It is also proposed to install detention/infiltration systems on the property to capture and infiltrate rainwater runoff. Location of the system will likely be in the central portion of the property under new truck court area.

Site Description

The irregular shaped properties are located north and south of Tropica Rancho Road, west of La Cadena Drive, in the City of Colton, as shown on the Vicinity Map, Figure 1. The Santa Ana riverbed is located to the north of smaller parcel at the northwest corner of Tropica Rancho Road and La Cadena Drive.

The properties are currently vacant and covered with a low vegetation growth. An electrical easement extends west to east through the southern portion of the site.

The site topography is generally flat and drainage pattern is not discernible. Land to the west and south of the southern parcel slope up, as shown on Figure 2. Slope inclinations vary but are generally 2:1 (horizontal to vertical) with areas of steeper inclinations.

Field Exploration

The excavations were completed on February 20, 2017 and testing was completed on that day. The testing consisted of using the double ring infiltrometer at all three locations to determine the infiltration rate of the proposed retention/infiltration systems. The locations of the tests are shown on the attached Figure 2. The test locations were excavated by extension backhoe to depths ranging from 5 to 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 description of the subsurface soils is shown on 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 to sandy SILTS. These soils were noted to be medium dense/stiff and damp to moist.

Groundwater

Groundwater was not encountered in any of our test excavations. In addition, a deep boring placed as a part of our Geotechnical Investigation (NorCal report dated March 13, 2017) did not encounter any groundwater to a depth of 35.5 feet below existing grade.

Infiltration Test Procedure and Results

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 versus 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.

Along the bottom of the infiltration test pits, dual infiltration rings were inserted 7 cm vertically into the soil by an impact-absorbing hammer. 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:

$$V_{ir} = \Delta V_{ir} / (A_{ir} \Delta t)$$

where:

V_{ir} = inner ring incremental infiltration velocity, cm/hr

ΔV_{ir} = volume of water used during time interval to maintain
constant head in the inner ring, cm³

A_{ir} = internal area of the inner ring, cm²

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 infiltration rates given below may be utilized in the basin design after applying a safety factor of 2.0 or greater.

<u>Test No.</u>	<u>Depth (feet bgs)</u>	<u>Soil Type</u>	<u>Infiltration Rate</u>	
			<u>(cm/hr)</u>	<u>(in/hr)</u>
IT-1	5	silty SAND/sandy SILT	6.1	2.4
IT-2	8	silty SAND/sandy SILT	6.9	2.7
IT-3	7	silty SAND/sandy SILT	4.5	1.8

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

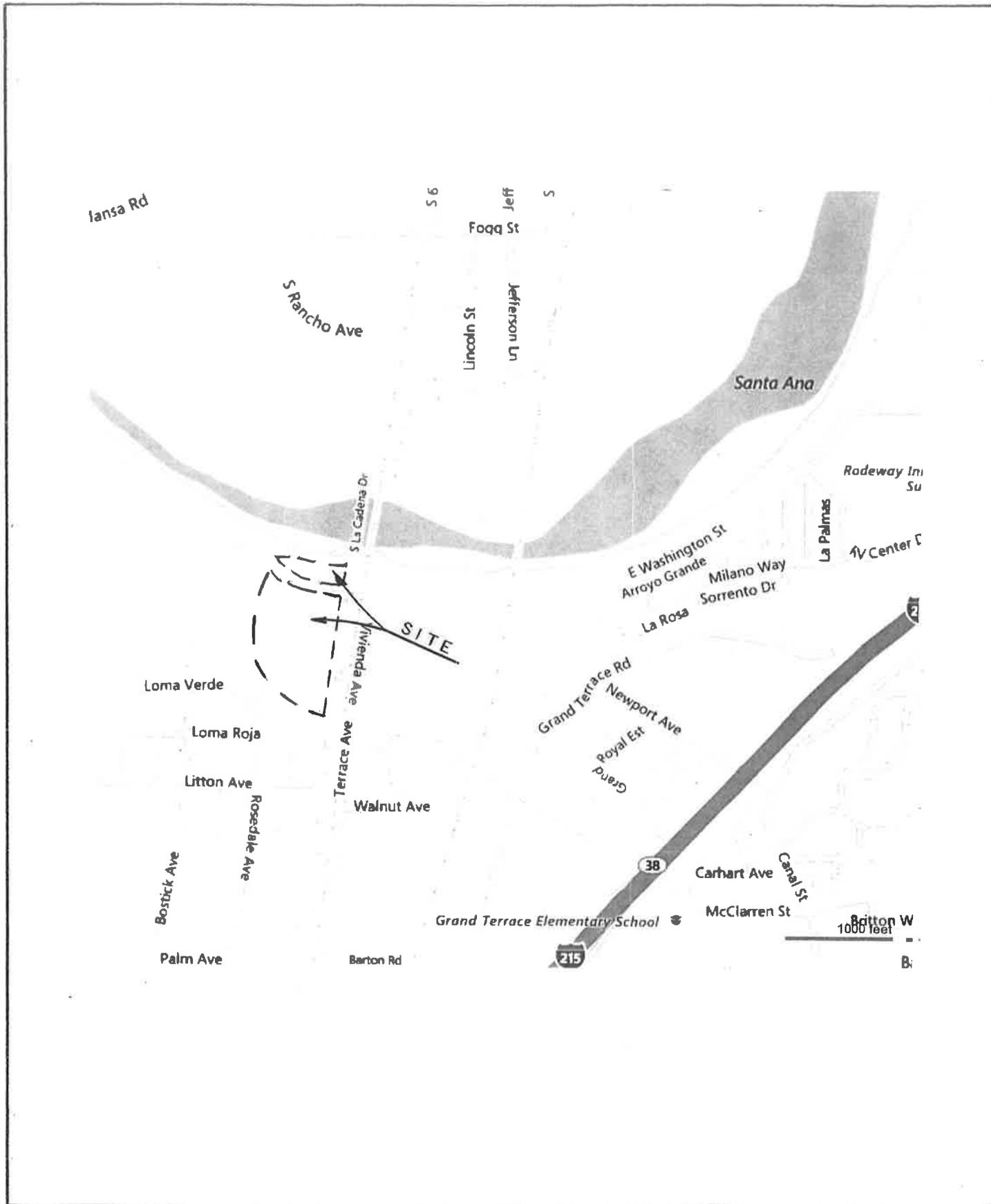
Appendix B

Logs of Test Pits IT-1 to IT-3

Field Test Data

Calculations

Appendix A

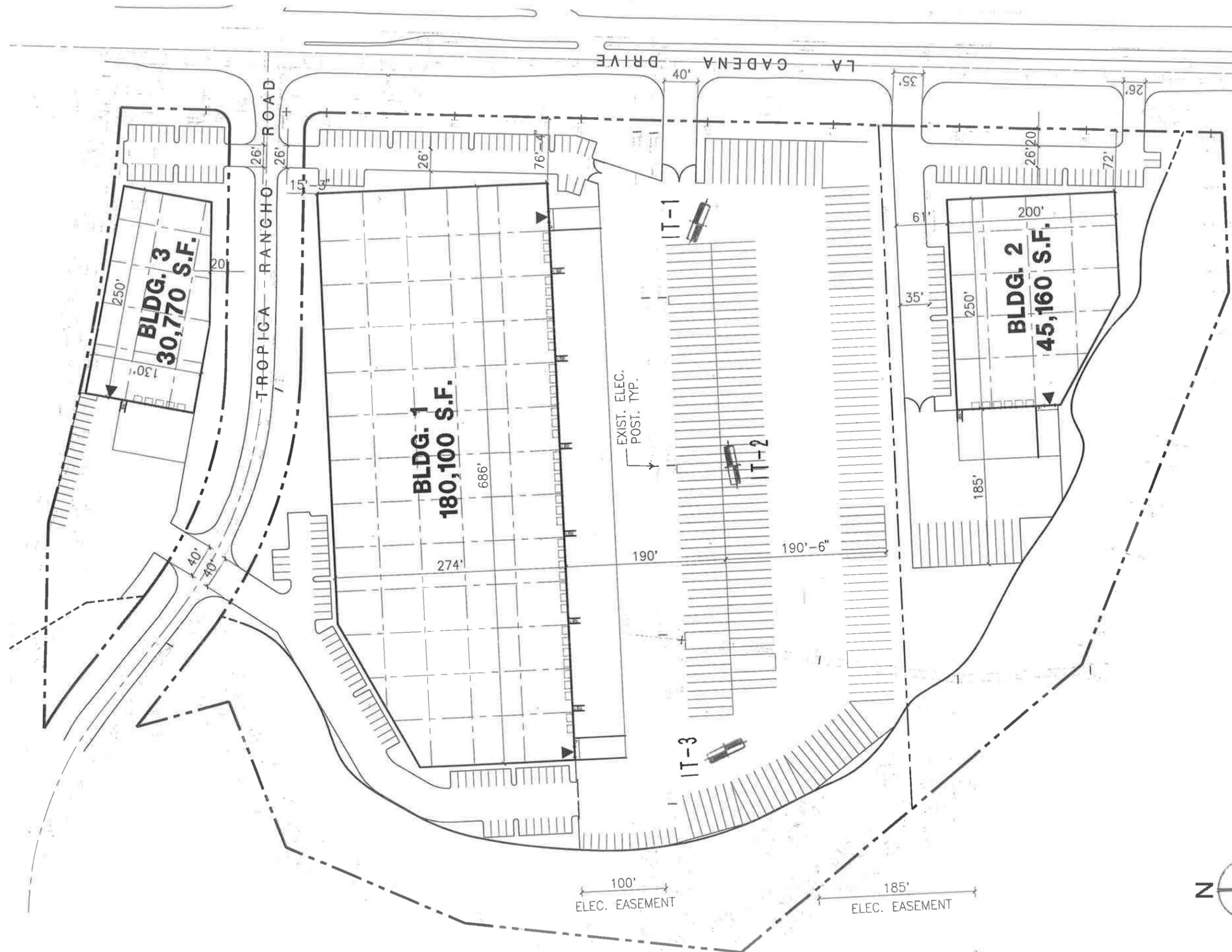


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VICINITY MAP

FIG. 1



BLDG. 3
30,770 S.F.

BLDG. 1
180,100 S.F.

BLDG. 2
45,160 S.F.

100'
ELEC. EASEMENT

185'
ELEC. EASEMENT



0 120'
SCALE

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PROJECT 19431-17 DATE 3/2017

LOCATION OF FIELD EXPLORATIONS

FIG. 2

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		
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES		
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES		
	SAND AND SANDY SOILS	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
			CLEAN SAND (LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
		MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINE (APPRECIABLE AMOUNT OF FINES)	SANDS WITH FINE (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SANDS WITH FINE (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND-CLAY MIXTURES
			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					
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 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)

COMPONENT PROPORTIONS

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

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

Boring Location: La Cadena & Tropic Rancho Road

Date of Drilling: 2/20/17

Groundwater Depth: Not Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured

Depth (feet)	Lithology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Relative Compaction
0	 GWT not encountered	FILL SOILS Sandy SILT to Silty SAND with roots, organics Brown, soft/loose, damp	☑				
5		Silty SAND to Sandy SILT Light brown, medium dense/stiff, damp Trench completed at depth of 5'					
10							
15							
20							
25							
30							
35							

Boring Location: La Cadena & Tropic Rancho Road

Date of Drilling: 2/20/17

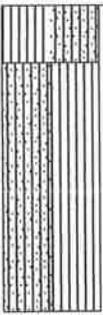
Groundwater Depth: Not Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured

Depth (feet)	Lithology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Relative Compaction
0		FILL SOILS					
5		Sandy SILT to Silty SAND with roots, organics Brown, soft/loose, damp Silty SAND to Sandy SILT Light brown, medium dense/stiff, damp					
8		Trench completed at depth of 8'					
10							
15							
20							
25							
30							
35							

Boring Location: La Cadena & Tropic Rancho Road

Date of Drilling: 2/20/17

Groundwater Depth: Not Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured

Depth (feet)	Lithology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Relative Compaction
0		FILL SOILS Sandy SILT to Silty SAND with roots, organics Brown, soft/loose, damp Silty SAND to Sandy SILT Light brown, medium dense/stiff, damp					
5							
10							
15							
20							
25							
30							
35							

Trench completed at depth of 7'



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Project: LDC Industrial Realty LLC
Project No: 19431-17
Date: 2/20/17
Test No. IT-1
Depth: 5'
Tested By: D.R.

	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	7:48			105.0			48.1					
	7:55	7	7	106.9	1.9		49.0	0.9				
2	7:55			102.9			45.4					
	8:02	7	14	104.6	1.7		46.7	1.3				
3	8:02			103.7			46.1					
	8:09	7	21	104.8	1.1		47.0	0.9				
4	8:09			102.1			45.0					
	8:16	7	28	103.1	1.0		46.7	1.2				
5	8:16			102.4			45.6					
	8:23	7	35	103.2	0.8		46.6	1.0				
6	8:23			101.9			45.6					
	8:30	7	42	102.3	0.9		46.4	1.0				
7	8:30			101.4			41.4					
	8:37	7	49	102.1	0.7		42.3	0.9		6.0	7.7	
8	8:37			100.8			46.0					
	8:44	7	56	101.6	0.8		46.8	0.8		6.9	6.9	
9	8:44			100.6			46.8					
	8:51	7	63	101.3	0.9		47.4	0.6		7.7	5.1	
10	8:51			100.5			47.4					
	8:58	7	70	101.2	0.7		48.1	0.7		6.0	6.0	
11	8:58			100.2			48.1					
	9:05	7	77	100.8	0.6		48.8	0.7		5.1	6.0	
12	9:05			100.8			48.8					
	9:12	7	84	101.4	0.6		49.6	0.8		5.1	6.9	



SOILS AND GEOTECHNICAL CONSULTANTS

Project: LDC Industrial Realty LLC

Project No: 19431-17

Date: 2/20/17

Test No. IT-2

Depth: 8'

Tested By: D.R.

	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	9:33			100.5			44.2					
	9:40	7	7	103.4	2.9		47.8	3.6				
2	9:40			100.1			44.0					
	9:47	7	14	101.3	1.2		46.3	2.3				
3	9:47			100.0			42.7					
	9:54	7	21	100.9	0.9		44.7	2.0				
4	9:54			99.0			44.0					
	10:01	7	28	100.3	1.3		45.8	1.8				
5	10:01			98.7			44.1					
	10:08	7	35	99.8	1.1		45.6	1.5				
6	10:08			99.8			45.6					
	10:15	7	42	100.7	0.9		47.3	1.7		7.7	14.6	
7	10:15			100.7			47.3					
	10:22	7	49	101.7	1.0		48.9	1.6		8.6	13.7	
8	10:22			101.7			48.9					
	10:29	7	56	102.6	0.9		50.6	1.7		7.7	14.6	
9	10:29			102.6			50.6					
	10:36	7	63	103.4	0.8		52.1	1.5		6.9	12.9	
10	10:36			103.4			43.8					
	10:43	7	70	104.1	0.7		45.4	1.6		6.0	13.7	
11	10:43			104.1			45.4					
	10:50	7	77	104.7	0.6		46.9	1.5		5.1	12.9	
12	10:50			100.2			46.9					
	10:57	7	84	100.9	0.7		48.5	1.6		6.0	13.7	



SOILS AND GEOTECHNICAL CONSULTANTS

Project: LDC Industrial Realty LLC

Project No: 19431-17

Date: 2/20/17

Test No. IT-3

Depth: 7'

Tested By: D.R.

	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	11:26			101.2			44.2					
	11:33	7	7	103.3	2.1		46.2	2.0				
2	11:33			103.3			46.2					
	11:40	7	14	103.7	0.4		47.8	1.6				
3	11:40			101.2			44.2					
	11:47	7	21	102.1	0.9		45.4	1.2				
4	11:47			100.2			44.5					
	11:54	7	28	100.8	0.6		45.5	1.0				
5	11:54			100.1			43.8					
	12:01	7	35	100.6	0.5		44.7	0.9				
6	12:01			99.8			43.8					
	12:08	7	42	100.1	0.3		44.7	0.9		2.6	7.7	
7	12:08			99.5			43.3					
	12:15	7	49	100.0	0.5		43.7	0.4		4.3	3.4	
8	12:15			100.0			43.7					
	12:22	7	56	100.8	0.8		44.8	1.1		6.9	9.4	
9	12:22			100.8			44.8					
	12:29	7	63	101.4	0.6		45.6	0.8		5.1	6.9	
10	12:29			100.0			43.2					
	12:36	7	70	100.5	0.5		43.7	0.5		4.3	4.3	
11	12:36			100.5			43.7					
	12:43	7	77	100.9	0.4		44.8	0.9		3.4	7.7	
12	12:43			100.9			44.8					
	12:50	7	84	101.5	0.6		45.4	0.6		5.1	5.1	