APRIL 26, 2012 **12-6148**

SOILS ENGINEERING REPORT

Prepared for

CORONUS HESPERIA WEST

On

SOLAR PHOTOVOLTAIC FACILITY
APN 0405-372-40
HESPERIA, SAN BERNARDINO COUNTY
CALIFORNIA

5/9/12

AESI

Arrow Engineering Services, Inc.

CIVIL ENGINEERING ▪ SURVEYING ▪ SOILS ▪ MAPPING/GIS

Certified SBE and WBE

42140 Tenth Street West
Lancaster, CA 93534

661-940-0043
Fax: 661-949-9775

aesi@aesi-consulting.com

TABLE OF CONTENTS

1.0 INTRODUCTION

This report presents the results of the soil investigation services performed relative to the proposed Solar Photovoltaic Facility to be constructed on APN 0405-372-40, located within the City of Hesperia, San Bernardino County, California.

The purpose of our services includes the review of site conditions as well as comments and recommendations relative to:

- Site grading
- Estimates of settlement
- Foundation support
- Support of slab-on-grade

No building plans have been submitted to this office at the writing of this report. It is our understanding the development will consist of photovoltaic solar panels supported on columns and electrical equipment pads. No buildings are proposed. Site grading is expected to be minimal to moderate.

1.1 Site Description

The approximate 20 acre site is located on the northeast corner of Fuente Avenue and El Centro Road, in Hesperia, San Bernardino County, California. The site is bordered on the north and south by single-family residences and bordered on the east and west by vacant land.

The site topography is relative flat, with the majority of the site sloping approximately two percent to the northeast. The site was vacant of structures at the time of our investigation. Vegetation consisted of sparse grass and native desert flora.

2.0 FIELD EXPLORATION

2.1 Subsurface Exploration

The field exploration program consisted of eight (8) exploratory borings, drilled to a maximum depth of approximately thirty (30) feet below existing ground surface. Test holes were drilled on April 18, 2012, utilizing a Mobile B-61 drill rig.

Bulk disturbed samples of the near-surface soils were obtained during boring of the test holes for classification purposes and represent a mixture of soils within the noted depths.

Relatively undisturbed samples were obtained to test for:

- Hydroconsolidation potential
- Shear strength
- *In situ* moisture and density determination
- Expansion characteristics of the natural soils

A Boring Location Map (Appendix A) was prepared to illustrate the approximate locations of the borings drilled across the site. The approximate locations of the borings were determined by pacing and sighting from existing streets.

Boring Logs (Appendix B) represent the strata encountered by our field technician. Samples of the material were brought to our laboratory for identification and further testing.

2.2 Laboratory Testing

Subsequent to visual classification in the field, samples were delivered to our laboratory. Samples were reviewed along with field logs to assess which would be analyzed further. Samples considered as representative of soils which would be exposed and/or used in grading and those deemed within structural influence were chosen for further analysis.

Classifications were evaluated in accordance with the Unified Soil Classification System and a testing program was established. The following tests were performed (see Appendix C for test results):

Laboratory Test	Test Method
Moisture Content and Unit Weight	ASTM D 2937
Percent Passing #200 Sieve	ASTM D 1140-92
Direct Shear	ASTM D 3080
Consolidation	ASTM D 2435
Expansion Index	ASTM D 4829
Maximum Density-Optimum Moisture	ASTM D 1557
Sand Equivalent Value	ASTM D 2419

2.3 Groundwater

Free groundwater was not encountered at the time of drilling. Fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature and other factors. Water well data indicates the static water table in this area to be over 100 feet from a surface elevation.

3.0 CONCLUSIONS

Based on the field exploration, laboratory analysis and literature review, the proposed construction is considered feasible from a geotechnical standpoint provided that the recommendations provided herein are followed. The local Department of Building and Safety should be contacted prior to start of any construction to assure the project is properly permitted and inspected during construction.

Field observations and testing during rough grading operations should be provided by Arrow Engineering so that a decision can be formed regarding the adequacy of the site preparation, the acceptability of fill materials, and the extent to which the earthwork construction and the degree of compaction comply with the project geotechnical specifications. Any work related to grading performed without the full knowledge of, and under the supervision of Arrow Engineering, may render the recommendations of this report invalid.

All grading and foundation plans should be reviewed by Arrow Engineering, hereinafter described as the Soils Engineer, prior to contract bidding. This review should be performed to determine whether the recommendations contained in this report are incorporated into the project plans and specifications.

The following conclusions are based on the data collected and represent professional opinions.

- Soils conditions at the site consist of silty sands and clayey sands. Soils were loose within the upper layers but exhibited an increase in density with depth.

- Consolidation test results reveal that soils sampled have a low to moderate tendency to hydroconsolidate. Refer to Section 4.1.3 for procedures to mitigate the potential for differential settlement.

- Soluble sulfate tests indicate that the upper soil layers have 19 mg/kg of sulfate and 1.0 mg/kg of chloride. No special considerations are necessary for protection of concrete against sulfates.

- A soil sample was tested in accordance with CTM 643. Results indicate pH levels of 7.8 S.U. and resistivity results indicate 14,400 ohms-cm within the native soil. No special considerations are necessary for protection of underground iron or steel pipe against corrosion**.**

- A soil sample was tested for ammonium and nitrate content. Results indicate levels of 1.8mg/kg ammonium and 1.9 mg/kg of nitrates within the native soil. No special considerations against corrosion by nitrates for copper underground utilities are necessary.

- Expansion index tests (ASTM D 4829) indicate that the upper soil layers have a "very low" expansion potential. Refer to Section 4.6 for foundation design recommendations.

- Provided the recommendations from this report are incorporated into the site grading and development, it is our opinion that the proposed grading on this property will not be subject to hazards from landslides, settlement, or slippage, and the grading will not adversely affect the stability of the site or adjacent properties. Test findings and statements of professional opinion do not constitute a guarantee or warranty, expressed or implied.

4.0 RECOMMENDATIONS

Based on the field reconnaissance, borings and other data collected, the following recommendations are provided for structure support:

4.1 Site Preparation

The grading requirements necessary to prepare the site for the proposed construction are outlined in the following paragraphs. Site grading should be in compliance with existing city, county and state building codes and as recommended in Section 4.1.3. An Arrow Engineering soils technician should observe rough site grading to ensure that field conditions are as expected and to provide additional recommendations if required.

4.1.1 Clearing and Grubbing

Prior to site grading, the top surface should be stripped of any existing stumps, roots, foundations, pavements, fill, trash piles and abandoned underground utilities should be removed.

4.1.2 Preparation of Areas to Receive Fill

In order to help minimize potential settlement problems associated with structures supported on a non-uniform thickness of compacted fill, an Arrow Engineering soils technician should be consulted for site grading recommendations relative to backfilling large and/or deep depressions resulting from any removal referred to in Section 4.1.1. In general, all proposed construction should be supported by a uniform thickness of compacted soil.

4.1.3 Recommendations for Remediation

To provide a more uniform bearing soil for the electrical equipment pads we recommend the following:

Slab-on-Grade: Isolated Equipment Pads / Transformer Pads

Soils beneath any proposed slab-on-grade areas, including a distance of five (5) feet beyond the limits of the proposed slab, shall be excavated twenty four (24) inches below existing ground surface. The exposed surface shall be scarified an additional twelve (12) inches. If during removals loose materials are encountered in isolated areas, deeper excavations may be required. **The bottoms of all over-excavated areas shall be a level plane from the deepest removal elevation. Approval by Arrow Engineering of all removals is required prior to placement of fill.**

The excavated soil should be moisture conditioned or aerated to optimum moisture content, placed in eight (8) inch maximum uncompacted lifts and uniformly compacted with vibratory compaction equipment to 90% of the maximum dry density as determined by ASTM D 1557 test procedure. **Compaction should be verified by Arrow Engineering through testing**.

Soil shall not contain organic material, rocks, concrete, or asphalt larger than six (6) inches. Anything larger than six (6) inches shall be removed from the site.

Positive drainage should be planned for the site. Drainage should be directed away from structures via non-erodible conduits to suitable disposal areas. Based on the laboratory test results **No irrigation** or landscaping shall be permitted within **25 feet** of any slab on grade or structures including transformer pads, equipment pads etc.

Any import soils used to raise site grades should be equal to, or better than on-site soils in strength, expansion, and compressibility characteristics. Import soils will not be pre-qualified by our Soils Engineer. Acceptance of any import will be given after the material is on the project, either in place or in stockpiles of adequate quantity to complete the project. The Soils Engineer shall be notified of the source of import soils prior to delivery to the project, for preliminary testing.

Suitable fill soils should be moisture conditioned to optimum moisture content and mechanically compacted to 90% of the maximum dry density as determined by the ASTM D 1557 test procedure.

The above recommendations apply to the electrical equipment pads only. At the time of our reporting, information had not been provided for the PV structures or planned landscaping. Arrow Engineering shall be consulted for further recommendations for any other structure or improvements on this site.

Projected Settlement

A shrinkage factor of approximately ten to fifteen (5-10) percent will occur when using the top three (3) feet as compacted fill for the two electrical equipment pads. Operation of grading equipment will also cause subsidence of the surface material, which is estimated to be approximately 0.10 foot in graded areas. These losses do not consider stripping of vegetation from the site or differences between actual and mapped elevations.

Final site grade should be adequate to divert all water away from structures and not allow ponding on paving sections or near structures. Positive drainage devices should be constructed to divert tributary drainage from structures. No irrigation or landscaping within 100' feet of any structures shall be permitted.

An Arrow Engineering soils technician should be retained to provide geotechnical services during construction of the grading, excavation and foundation phases of the work. This is to observe compliance with the design concepts, specifications or recommendations and to allow design changes in the event that conditions change from those anticipated prior to the start of construction.

4.2 Utility Trenches

Backfill of public utilities within road right-of-ways or on the subject site should be placed in strict conformance with the requirements of the governing agency.

The provisions of this report relative to minimum compaction standards should govern utility trench backfill within the project boundary. In general, service lines extending inside the site should be backfilled with native soil and uniformly compacted to a minimum of 90% of maximum density as determined by the ASTM D 1557 test procedure. Jetting will not be allowed. **Compaction shall be verified by testing.**

Backfill operations should be observed and tested by an Arrow Engineering soils technician to monitor compliance with these recommendations.

4.3 Slope Stability and Grading

Slope stability calculations were not performed due to the anticipated height of less than three (3) feet for cut and fill slopes.

Slopes should not exceed a steepness of two horizontal to one vertical (2:1) unless soil test data and engineering calculations substantiate the stability of the slope and slope surface. Fill slopes should be overfilled and trimmed back to firm material.

4.4 Slab-on-Grade

Interior concrete slab-on-grade should be supported by compacted soil prepared as recommended in Section 4.1.3.

Exterior concrete (sidewalk, porches, etc.) immediately adjacent to structures should be poured independent of buildings (free-floating) and be supported by a minimum of eighteen (18) inches compacted soil.

Reinforcement of slab-on-grade is contingent upon the structural engineer's recommendations and the expansion index of the supporting soil. Since the mixing of import soil with native soils could change the expansion index, additional tests should be conducted during rough grading to determine the expansion index of the subgrade soil. **Reinforcement should be placed at the slab mid-height.**

In areas which will be covered with flooring (carpet, tile, etc.), an appropriate vapor barrier (6 mil polyethylene or equal) should be installed in order to minimize vapor transmission from the sub-grade soil to the slab. The membrane should be covered with two (2) inches of sand to help protect it during construction. The sand should be lightly moistened just prior to placing the concrete.

4.5 Settlement Considerations

Maximum anticipated post construction settlement, based on footings founded on compacted soils as specified, should be less than one half inch. Differential settlement between exterior and interior load bearing members should be less than one-quarter inch. Most settlement should occur during construction.

4.6 Foundations

It is recommended that any buildings or structures constructed on this site be designed to at least the minimum code standards of the latest edition of the 2010 California Building Code. The following table and values are a summary of the seismic design parameters required for structural design per the 2010 CBC Section 1613.5.4 "Design Spectral Response Acceleration Parameters".

Seismic Design Parameters	
Longitude	-117.36
Latitude	34.39
Site Class	D
Description	stiff soil profile
Site Coefficients	
F_a	1.0
F_v	1.5
Spectral Accelerations	
S_{DS}	1.000
S_{D1}	0.600

Conventional Foundations

Foundation design parameters for the proposed construction shall be designed in accordance with the following table and values, per the 2010 CBC Section 1806.2 "Presumptive Load-Bearing Values".

Presumptive Load-Bearing Values

Class of Material	Vertical Foundation Pressure psf	Lateral Bearing psf/f below natural grade	Lateral Sliding	
			Coefficient of Friction	Resistance (psf)
Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2,000	150	0.25	--

Actual depth, size and reinforcing will be dependent on applicable sections of the governing building code and requirements of the structural engineer. To mitigate potential major cracking in foundations caused by differential settlement, footings should be reinforced at top and bottom and as required by the structural engineer.

Continuous foundations shall be supported by compacted soil prepared as delineated in Section 4.1.3.

4.7 Expansion

The design of foundations should be based on the weighted expansion index (ASTM D 4829) of the soil. As stated previously, the preliminary expansion index of the on-site soil is in the "very low" classification. However, if the soil is thoroughly mixed during site preparation, the expansion index may change. Therefore, the expansion index should be evaluated after the site preparation has been completed, and the final foundation design adjusted accordingly.

Reinforcement should be as required by the structural engineer. Reinforcement shall be verified when building plans are available.

The following recommendations for foundations are provided as guidelines for foundation design:

Classification of "very low" (0-20)

No special considerations necessary for expansion

Classification of "low" (21-50)

Continuous and isolated foundations shall be supported by a minimum of twenty four (24) inches of compacted soil. **Reinforcement should be as required by the structural engineer based upon site specific conditions such as foundation loading and engineering characteristics of the subgrade soils.** Slab-on-grade reinforcement shall be as required by the structural engineer. All slabs shall be designed for any specific loading conditions by the structural engineer. As a minimum, we recommend two #4 on top and two #4 at bottom of continuous foundations. Soil should be moistened to above optimum moisture to a depth of six (6) inches prior to placing concrete.

5.0 ADDITIONAL SERVICES

The recommendations made in this report are based on the assumption that an adequate program of tests and inspections will be made during construction to verify compliance with these recommendations. Such tests and inspections should include, but not necessarily be limited to the following:

- Observation and testing during site preparation, grading and placement of fill
- Inspection of footing excavations
- Consultation as may be required during construction
- Special inspection of concrete, pile driving, masonry, or welding

The cost of these services is not included in our present fee arrangements. Budgets, which are dependent on design and construction schedules, can be provided when requested.

6.0 LIMITATIONS

The recommendations contained in this report are based on our field exploration, laboratory testing, and our understanding of the proposed construction. Conditions revealed by excavation may be at variance with the preliminary findings of this surficial investigation. Therefore, if any soil conditions are encountered at this site which are different from those assumed in the preparation of this report, our firm should be notified immediately so that we may review the situation and make supplementary recommendations, if needed. Our firm should also be notified if the scope of the proposed construction, including the proposed loading or structure locations, changes from that described in this report.

This report was prepared in accordance with generally accepted standards of practice in the southern California area at the time the report was written. No other warranty, express or implied, is made or intended.

It is the responsibility of the owner or of his representative, to ensure that the information and recommendations contained herein are brought to the attention of all parties to the project.

The findings of this report are valid as of the present date. However, changes in the conditions of the property can occur with the passage of time, whether they are due to natural processes or the works of man on this or adjacent properties.

This report has been prepared for the exclusive use of Sycamore Energy Partners West and their agents for specific application to the proposed development.

APPENDIX A

BORING LOCATION MAP

BORE HOLE LOCATIONS
FOR
HESPERIA SOLAR WEST 1 & 2

LEGEND

B3 – BORE HOLE LOCATION & NUMBER

ARROW ENGINEERING SERVICES

AESI

LANCASTER OFFICE:
42140 TENTH STREET WEST
LANCASTER, CA 93534
PHONE: (661) 940-0043

LAS VEGAS OFFICE:
2753 S. HIGHLAND DR. #1031
LAS VEGAS, NV 89109
PHONE: (702) 221-0625

SIGNATURE

DATE

DRAWING NAME: 12-6148\BoreHoles.dwg

PLOT DATE: 05/01/12

APPENDIX B

SOILS CLASSIFICATION KEY
BORING LOGS

Major Divisions				Typical Names	
Coarse Grained Soils 50% or more larger than #200 sieve	**Gravels** More than half coarse-fraction is larger than No. 4 sieve size	Clean gravels with little or no fines	GW	Well graded gravels, gravel-sand mixtures	
			GP	Poorly graded gravels, gravel-sand mixtures	
		Gravel with over 12% fines	GM	Silty gravels, poorly graded gravel-sand-silt mixtures	
			GC	Clayey gravels, poorly graded gravel-sand-clay mixtures	
	Sands More than half coarse-fraction is smaller than No. 4 sieve size	Clean sands with little or no fines	SW	Well graded sands, gravelly sands	
			SP	Poorly graded sands, gravelly sands	
		Sands with over 12% fines	SM	Silty sands, poorly graded sand-silt mixtures	
			SC	Clayey sands, poorly graded sand-clay mixtures	
Fine Grained Soils 50% or more smaller than #200 sieve	**Silts and Clays** Liquid limit less than 50		ML	Inorganic silts, rock flour, clayey silts	
			CL	Inorganic clays of low to medium plasticity, sandy clays, silty clays	
			OL	Organic clays and organic silty clays of low plasticity	
	Silts and Clays Liquid limit greater than 50		MH	Inorganic silts, micaceous or diatomaceous fine sandy/silty soils, elastic silts	
			CH	Inorganic clays with high plasticity, fat clays	
			OH	Organic clays of medium to high plasticity, organic silts	
Highly Organic Soils			PT	Peat and other highly organic soils	
Sample Locations				Designates in-situ sample	
				Designates bulk sample	
				Bedrock	

CLASSIFICATION SYSTEM BASED ON UNIFIED SOIL CLASSIFICATION SYSTEM

ARROW ENGINEERING
KEY TO GRAPHIC SYMBOLS

AESI Arrow Engineering Services,
Civil Engineering ■ Surveying ■ Soils
42140 Tenth St West
Lancaster, CA 93534
661-940-0043
Fax: 661-949-9775
aesi@aesi-consulting.com

	IN-PLACE DENSITY (PCF)	MOISTURE CONTENT %	DEPTH (FT.)	SAMPLE	CLASSIFICATION	
3/6	114.2	2.8	1'		SM	moderate brown silty fine to coarse sand
7/10	116	2.7	3'		SM	moderate brown silty fine to coarse sand
11/12	116.7	2.6	5'		SM	moderate yellowish brown silty fine to coarse sand
10/18	118.2	4.6	7'		SM	light brown silty fine to coarse sand with clay
22 50-6"	118.8	4.2	9'		SC	light brown clayey fine to coarse sand
			13'			
27/31	126.9	4.9	15'		SC	light brown clayey fine to coarse sand
			17'			
19/32	120.6	5.5	20'		SC	moderate brown clayey fine to coarse sand with #4 to ½" gravel
			23'			
23/31	121.3	3.0	25'		SP	moderate brown #4 to ½" fine to coarse sand with some clay
			27'			
			29'			
26/32	115.6	3.3	30'		SM	moderate yellowish brown silty fine to coarse sand

NO GROUNDWATER ENCOUNTERED

BORING LOG

DATE OF DRILLING: 4/18/12
DEPTH OF HOLE: 30 FEET
JOB NUMBER: 12-6148

B-1

AESI Arrow Engineering Services,
Civil Engineering ■ Surveying ■ Soils
42140 Tenth St West 661-940-0043
Lancaster, CA 93534 Fax: 661-949-9775
aesi@aesi-consulting.com

BLOW COUNTS/FOOT	IN-PLACE DENSITY (PCF)	MOISTURE CONTENT %	DEPTH (FT.)	CLASSIFICATION	
7/10	115.9	2.5	2'	SM	moderate yellowish brown silty fine to coarse sand
10/22	121.6	3.1	4'	SC	moderate brown clayey fine to coarse sand with silt
8/12	Dist	3.0	6'	SM	light brown silty fine to coarse sand
13/16	113.4	3.3	8'	SM	light brown silty fine to coarse sand
9/17	114.3	2.1	10'	SM	Light brown silty fine to coarse sand
			12'		
29/50-5"	117.7	5.3	15'	SC	moderate brown clayey fine to coarse sand
			18'		
			19'		
30/50-6"	118.7	5.2	20'	SC	moderate brown clayey fine to coarse sand

NO GROUND WATER ENCOUNTERED

BORING LOG

DATE OF DRILLING: 4/18/12
DEPTH OF HOLE: 20 FEET
JOB NUMBER: 12-6148

B-2

AESI Arrow Engineering Services,
Civil Engineering ■ Surveying ■ Soils
42140 Tenth St West
Lancaster, CA 93534
661-940-0043
Fax: 661-949-9775
aesi@aesi-consulting.com

BLOW COUNTS/FOOT	IN-PLACE DENSITY (PCF)	MOISTURE CONTENT %	DEPTH (FT.)	SAMPLE	CLASSIFICATION		
2/2	113.4	5.2	1'	■		SM	moderate yellowish brown silty fine to coarse sand
4/6	115.1	3.9	3'	■		SM	moderate brown silty fine to coarse sand
5/7	117.3	3.2	5'	■		SM	moderate brown silty fine to coarse sand
5/7	111.1	3.6	7'	■		SM	moderate yellowish brown silty fine to coarse sand with #4 to 3/8" gravel
4/6	115.0	3.4	9'	■		SM	moderate yellowish brown silty fine to coarse sand
6/12	113.7	3.3	15'	■		SM	moderate brown silty fine to coarse sand
16/21	122.4	5.4	20'	■		SC	moderate brown clayey fine to coarse sand
			23'				
22/50-6"	119.5	5.2	25'	■		SC	moderate brown clayey fine to coarse sand with silt

NO GROUNDWATER ENCOUNTERED

BORING LOG

DATE OF DRILLING: 4/18/12
DEPTH OF HOLE: 25 FEET
JOB NUMBER: 12-6148

B-3

AESI Arrow Engineering Services,
Civil Engineering ▪ Surveying ▪ Soils
42140 Tenth St West
Lancaster, CA 93534
661-940-0043
Fax: 661-949-9775
aesi@aesi-consulting.com

BLOW COUNTS/FOOT	IN-PLACE DENSITY (PCF)	MOISTURE CONTENT %	DEPTH (FT.)	SAMPLE	CLASSIFICATION		
2/3	116.3	5.2	2'			SM	moderate brown silty fine to coarse sand
3/6	113.6	3.4	4'			SP	moderate brown #4 to 3/8" gravelly fine to coarse sand with slight silt
			5'				
7/15	124.8	12.9	6'			SC	light brown clayey fine to coarse sand
18/29	128.9	9.4	8'			SC	light brown clayey fine to coarse sand
16/25	128.6	8.6	10'			SC	light brown clayey fine to coarse sand
9/20	124.6	6.9	15'			SC	light brown clayey fine to coarse sand with silt

NO GROUND WATER ENCOUNTERED

BORING LOG

DATE OF DRILLING: 4/18/12
DEPTH OF HOLE: 15 FEET
JOB NUMBER: 12-6148

B-4

AESI Arrow Engineering Services,
Civil Engineering ■ Surveying ■ Soils
42140 Tenth St West
Lancaster, CA 93534
661-940-0043
Fax: 661-949-9775
aesi@aesi-consulting.com

BLOW COUNTS/FOOT	IN-PLACE DENSITY (PCF)	MOISTURE CONTENT %	DEPTH (FT.)	SAMPLE	CLASSIFICATION		
2/5	117.7	3.4	1'	■		SM	moderate yellowish brown silty fine to coarse sand
7/9	113.3	3.0	3'	■		SM	moderate brown silty fine to coarse sand
11/17	120.6	3.2	5'	■		SM	light brown silty fine to coarse sand
14/23	114.5	3.4	7'	■		SM	light brown silty fine to coarse sand with clay
5/30	111.6	12.1	9'	■		SC	moderate brown clayey fine to coarse sand with silt
22/50-6"	111.0	5.4	15'	■		SC	moderate brown clayey fine to coarse sand
19/28	118.1	5.2	20'	■		SC	light brown clayey fine to coarse sand

NO GROUNDWATER ENCOUNTERED

BORING LOG

DATE OF DRILLING: 4/18/12
DEPTH OF HOLE: 20 FEET
JOB NUMBER: 12-6148

B-5

AESI Arrow Engineering Services,
Civil Engineering ■ Surveying ■ Soils
42140 Tenth St West
Lancaster, CA 93534
661-940-0043
Fax: 661-949-9775
aesi@aesi-consulting.com

BLOW COUNTS/FOOT	IN-PLACE DENSITY (PCF)	MOISTURE CONTENT %	DEPTH (FT.)	SAMPLE	CLASSIFICATION		
10/14	118.4	1.4	2'	■		SM	moderate brown silty fine to coarse sand
11/24	120.6	1.8	4'	■		SM	light brown silty fine to coarse sand
19/30	118.7	4.0	6'	■		SC/SM	light brown clayey fine to coarse sand with silt
32/50-6"	113.3	4.1	8'	■		SC	light brown clayey fine to coarse sand
27/50-6"	Dist	4.4	10'	■		SM	moderate brown cemented highly voided silty fine to coarse sand with clay
15/27	116.0	3.6	15'	■		SM	light brown silty fine to coarse sand
29/50-6"	116.3	5.1	20'	■		SC	moderate brown clayey fine to coarse sand with silt and #4 to ½" gravel
31/34	116.3	3.6	25'	■		SM	light brown silty fine to coarse sand with clay
21/34	115.4	2.2	30'	■		SW	moderate yellowith brown #4 to ½" gravelly fine to coarse sand with silt

NO GROUND WATER ENCOUNTERED

BORING LOG

DATE OF DRILLING: 4/18/12
DEPTH OF HOLE: 30 FEET
JOB NUMBER: 12-6148

B-6

BLOW COUNTS/FOOT	IN-PLACE DENSITY (PCF)	MOISTURE CONTENT %	DEPTH (FT.)	SAMPLE	CLASSIFICATION	
3/6	113.9	2.2	1'		SM	moderate brown silty fine to coarse sand with slight #4 to ½" gravel
7/8	115.2	2.2	3'		SM	moderate brown silty fine to coarse sand with slight #4 to ½" gravel
3/5	108.9	2.7	5'		SM	light brown silty fine to coarse sand with slight #4 to ½" gravel
3/7	126.8	2.8	7'		SM	moderate brown #4 to ½" gravelly fine to coarse sand with silt
6/11	115.5	4.7	9'		SC	moderate brown clayey fine to coarse sand with #4 to ½" gravel and silt
5/15	105.4	2.8	15'		SP	medium brown fine to coarse sand with slight clay
22 50-6"	116.4	4.3	20'		SC	light brown clayey fine to coarse sand

AESI Arrow Engineering Services,
Civil Engineering ▪ Surveying ▪ Soils
42140 Tenth St West
Lancaster, CA 93534
661-940-0043
Fax: 661-949-9775
aesi@aesi-consulting.com

NO GROUNDWATER ENCOUNTERED

BORING LOG

DATE OF DRILLING: 4/18/12
DEPTH OF HOLE: 20 FEET
JOB NUMBER: 12-6148

B-7

AESI Arrow Engineering Services,
Civil Engineering ■ Surveying ■ Soils
42140 Tenth St West
Lancaster, CA 93534
661-940-0043
Fax: 661-949-9775
aesi@aesi-consulting.com

BLOW COUNTS/FOOT	IN-PLACE DENSITY (PCF)	MOISTURE CONTENT %	DEPTH (FT.)	CLASSIFICATION	
6/12	118.9	2.6	2'	SM	light brown silty fine to coarse sand
10/13	123.5	1.7	4'	SM	light brown silty fine to coarse sand with #4 to 1" gravel
			5'		
20/31	123.4	6.7	6'	SC	light brown clayey fine to coarse sand
17/19	119.7	3.1	8'	SM	light brown silty fine to coarse sand
19/20	117.5	2.9	10'	SM	light brown silty fine to coarse sand with #4 to ¾" gravel
15/21	124.4	3.8	15'	SM	moderate brown silty fine to coarse sand with #4 to ½" gravel with slight clay

NO GROUND WATER ENCOUNTERED

BORING LOG

DATE OF DRILLING: 4/18/12
DEPTH OF HOLE: 15 FEET
JOB NUMBER: 12-6148

B-8

APPENDIX C

SUMMARY OF LABORATORY TESTS

SUMMARY OF LABORATORY TESTS

MAXIMUM-DENSITY-OPTIMUM MOISTURE (ASTM D 1557)

Boring #	Depth	Optimum Moisture	Maximum Density	Classification	Description
4	0-5'	7.6	132.0	SM	Moderate brown silty fine to coarse sand
8	0-5'	7.3	134.2	SM	Moderate yellowish brown fine to coarse sand with #4 to ¾" gravel

EXPANSION INDEX (ASTM D 4829)

Sample I.D.	Expansion	Expansion Potential
B4 @ 0-5'	0	Very low
B8 @ 0-5'	9	Very low

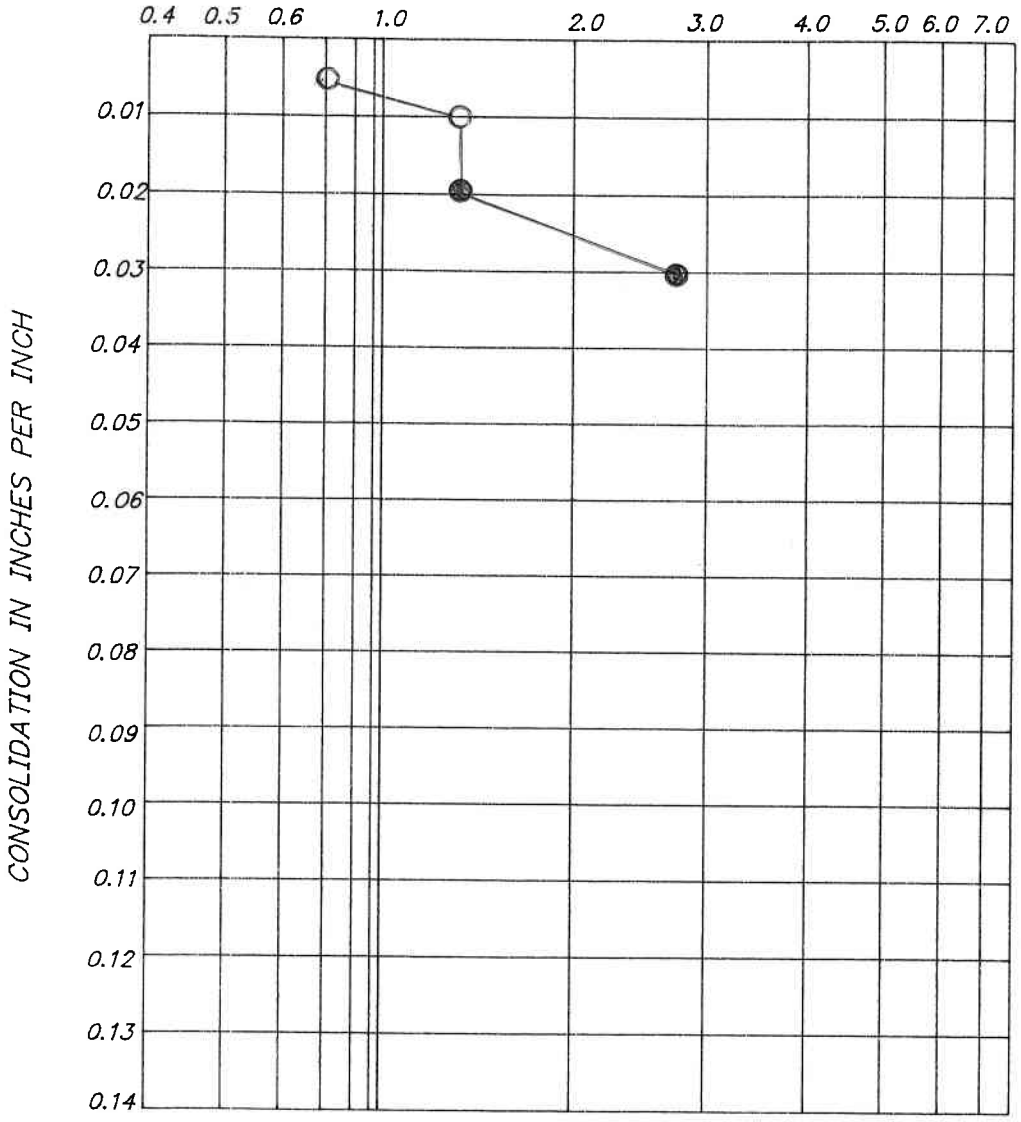
SIEVE ANALYSIS (ASTM 422)

PERCENT PASSING INDIVIDUAL SIEVES

Sample I.D.	1-1/2"	1"	3/4"	1/2"	3/8"	#4	#10	#40	#100	#200
B3 @ 3'					100	97	88	50	30	21
B4 @ 4'				100	98	92	75	27	11	7
B8 @ 10'		100	89	85	82	75	60	28	17	13
B7 @ 15'					100	98	85	25	10	7

12-6148
4@4'

LOAD IN KIPS PER SQUARE FOOT

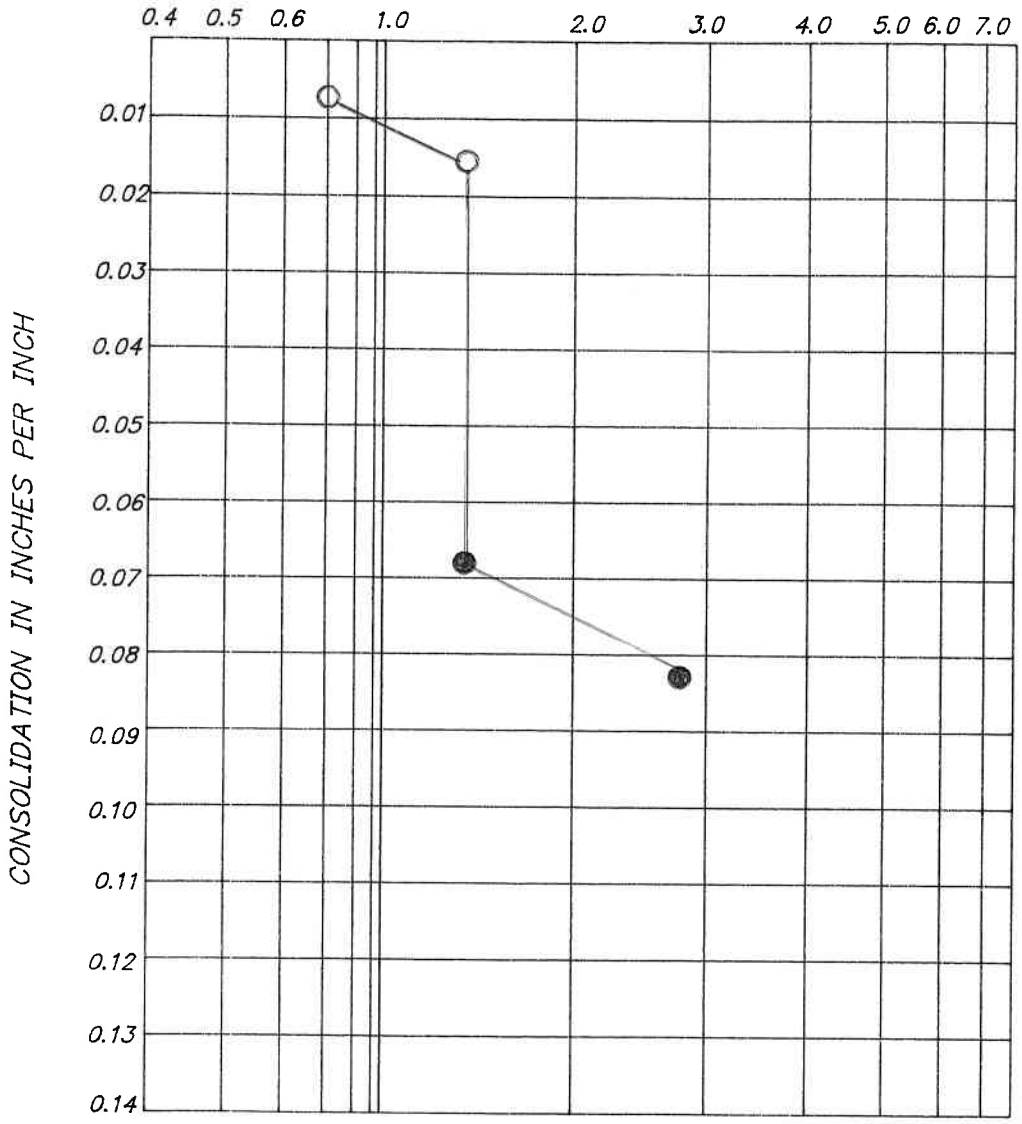


CONSOLIDATION DIAGRAM

ARROW ENGINEERING

12-6148
1@5'

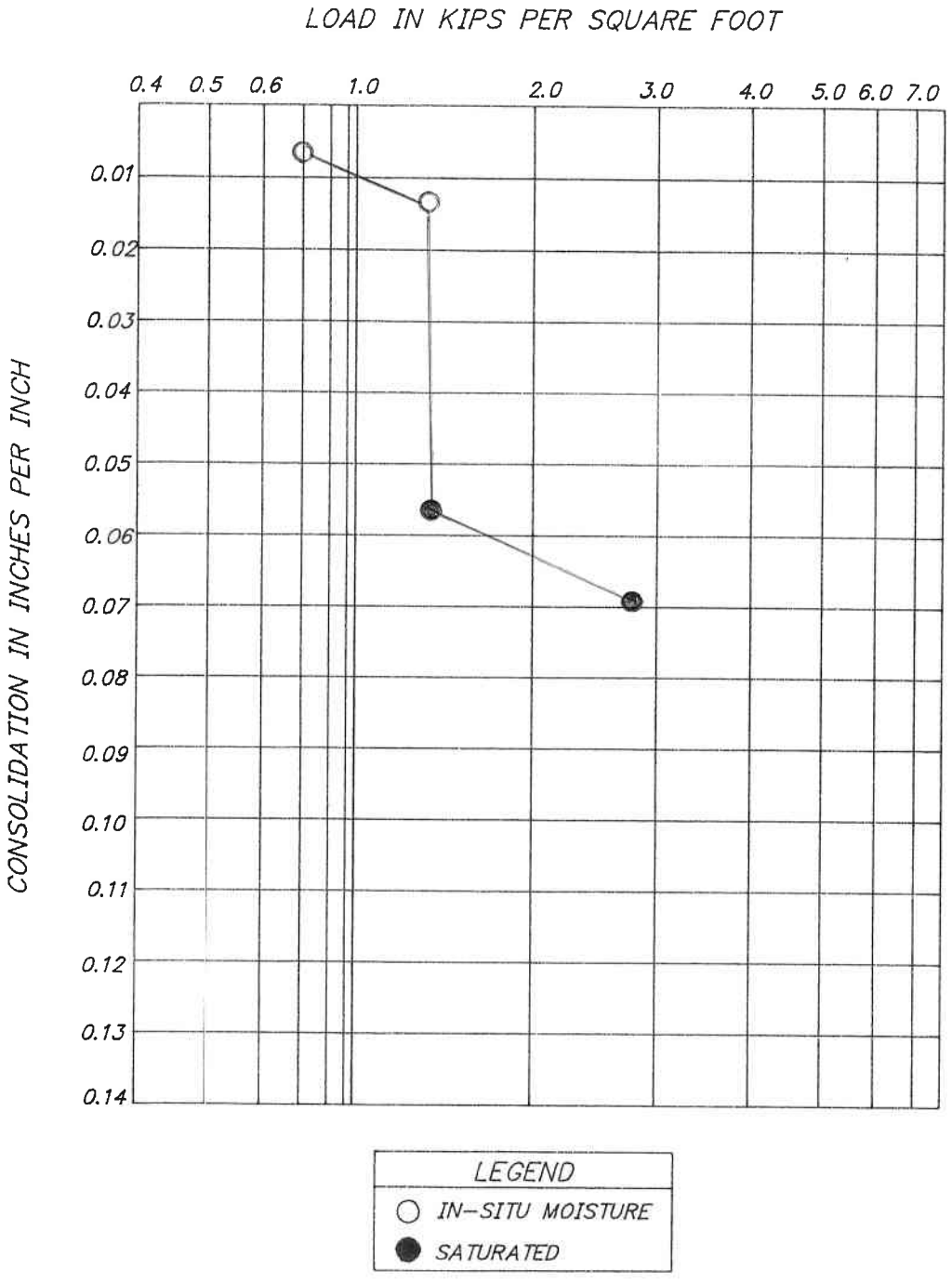
LOAD IN KIPS PER SQUARE FOOT



CONSOLIDATION DIAGRAM

ARROW ENGINEERING

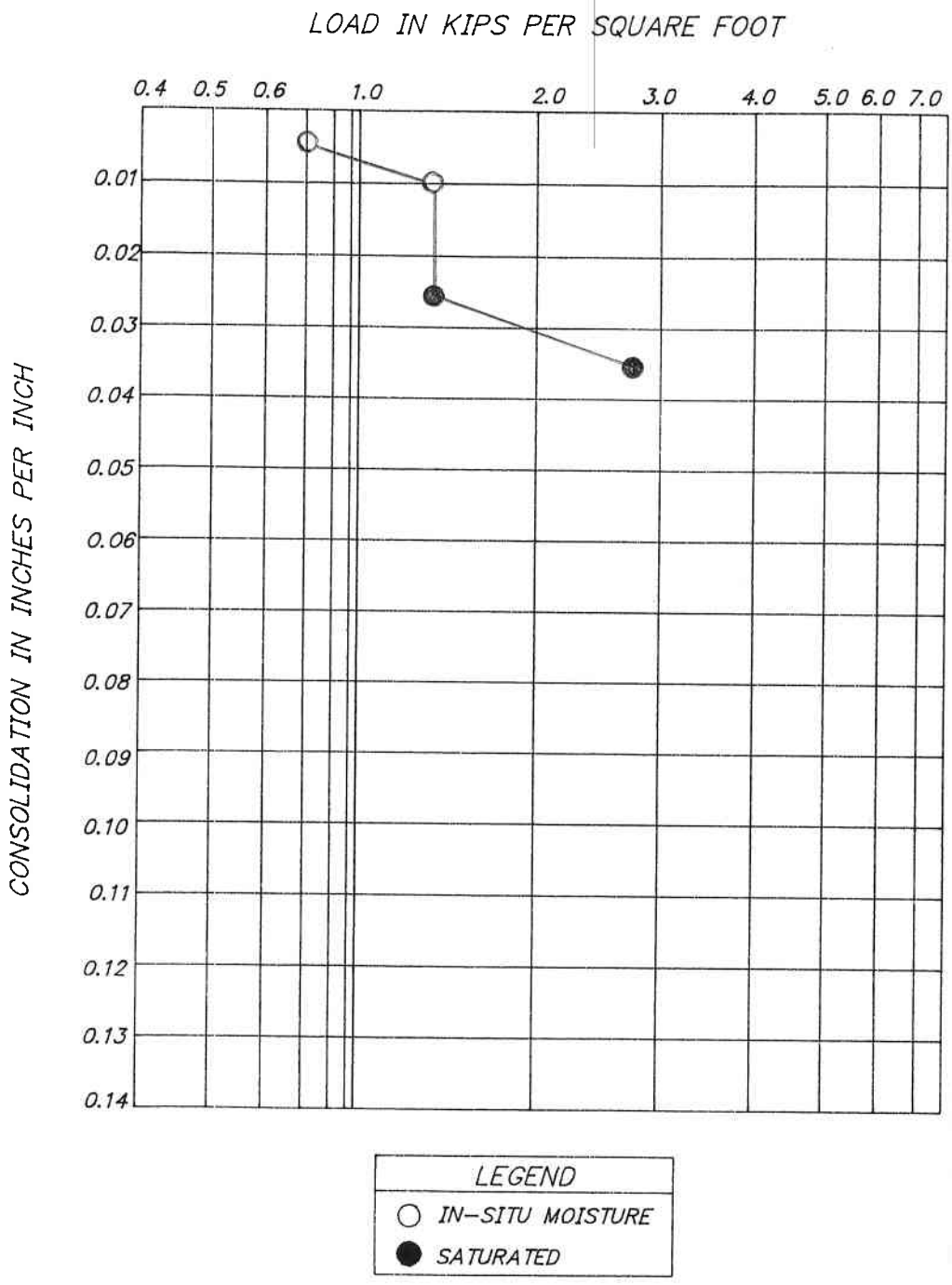
12-6148
3@7'



CONSOLIDATION DIAGRAM

ARROW ENGINEERING

12-6148
7@7'

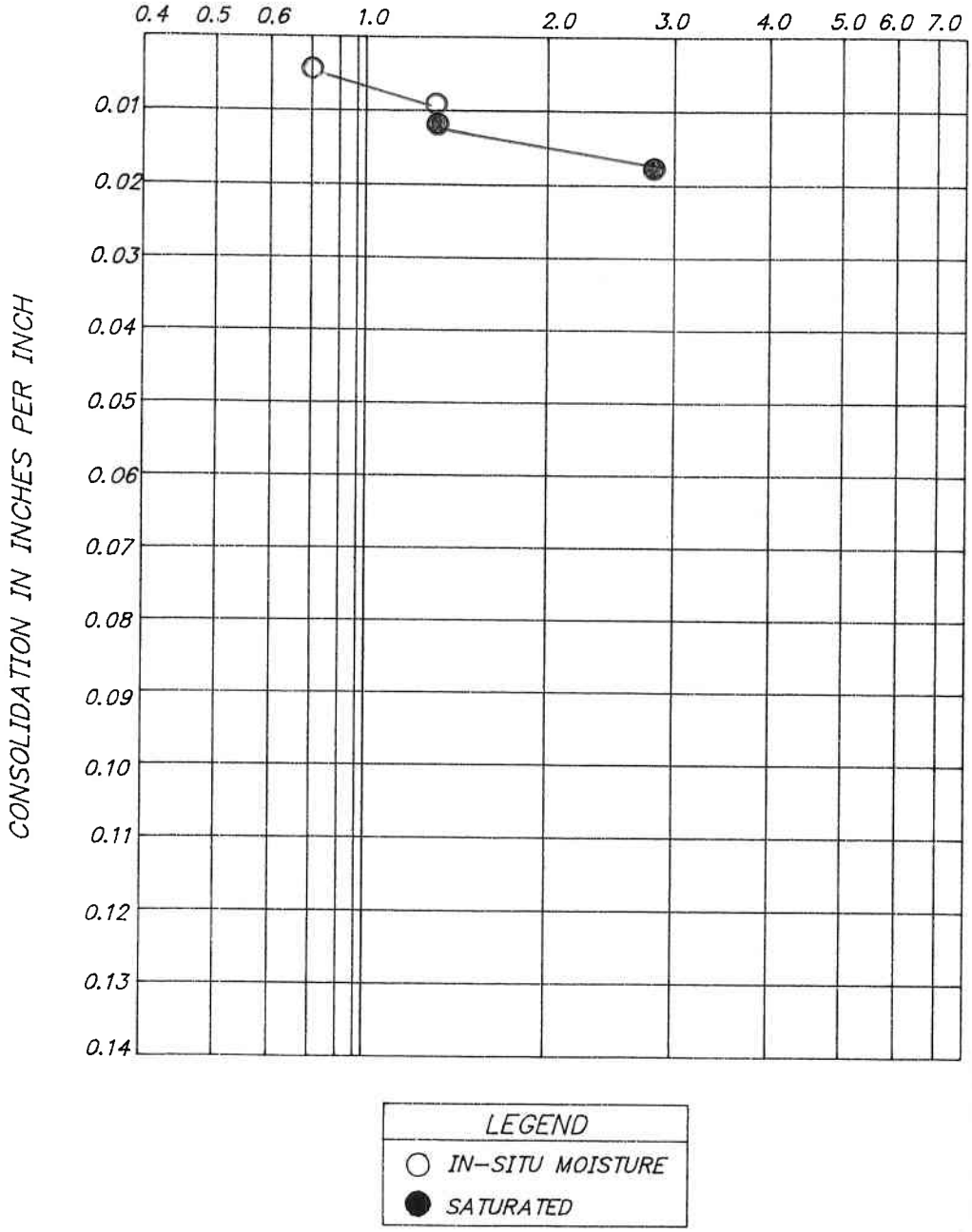


CONSOLIDATION DIAGRAM

ARROW ENGINEERING

12-6148
4@8'

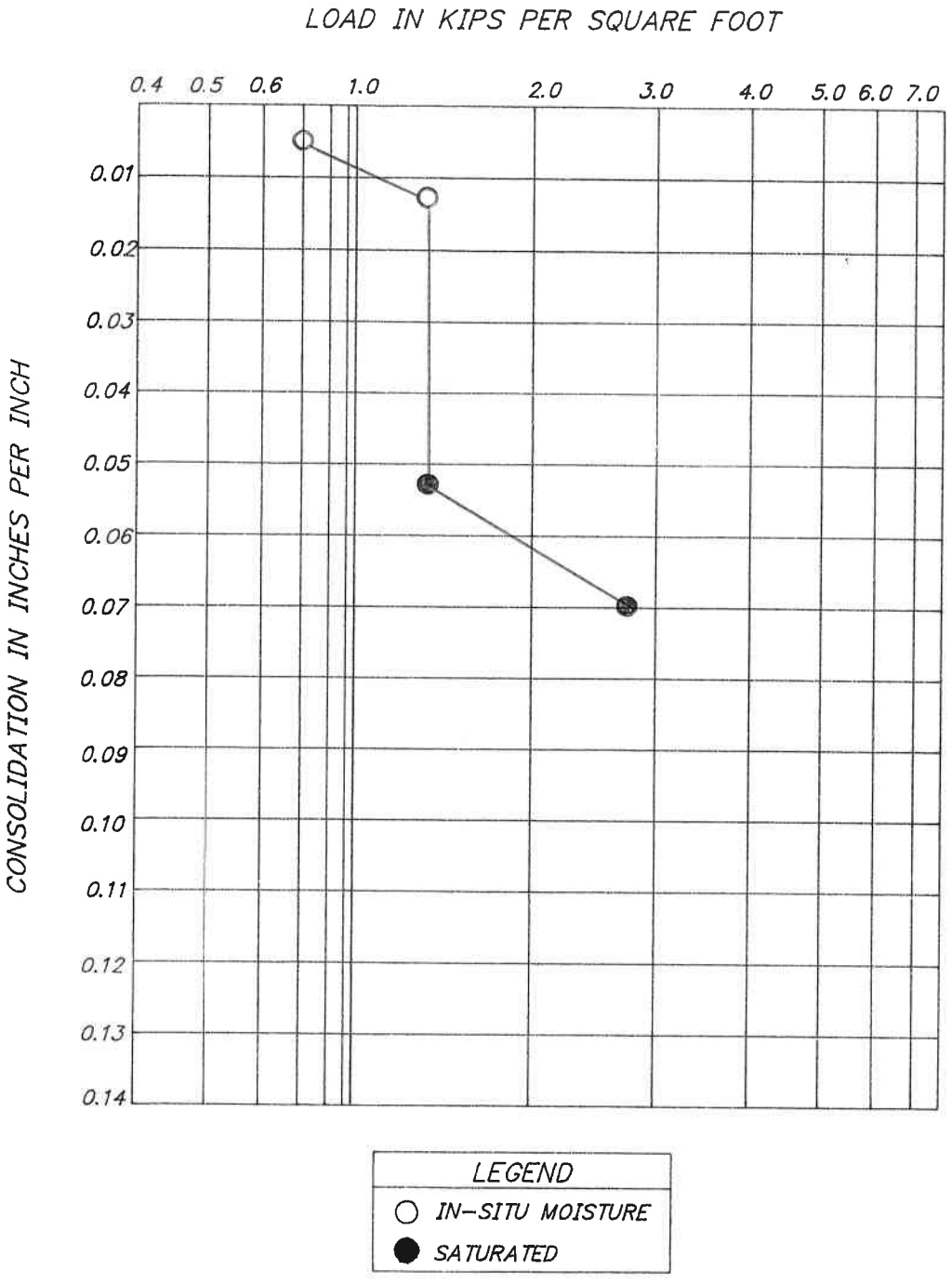
LOAD IN KIPS PER SQUARE FOOT



CONSOLIDATION DIAGRAM

ARROW ENGINEERING

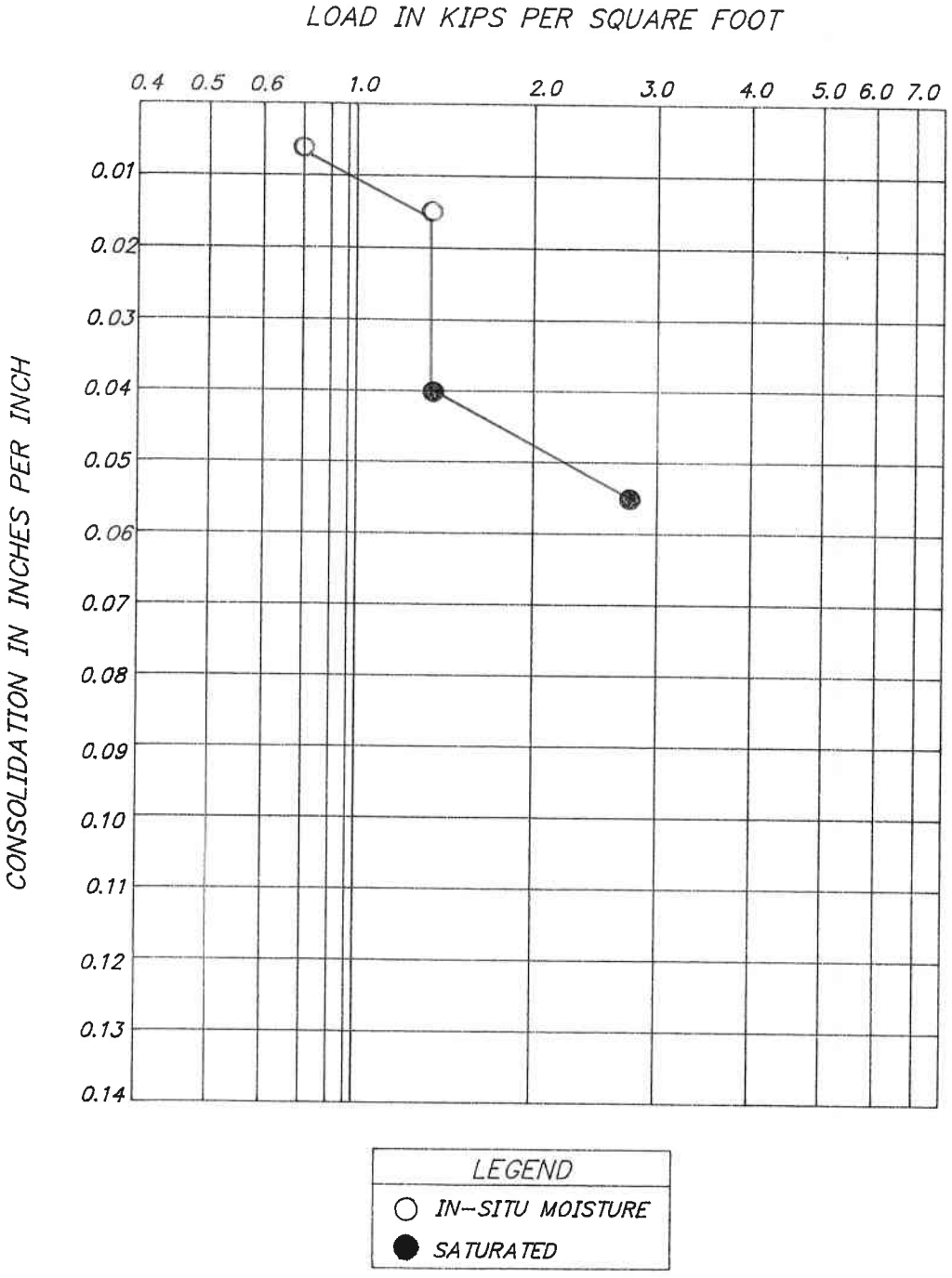
12-6148
6@8'



CONSOLIDATION DIAGRAM

ARROW ENGINEERING

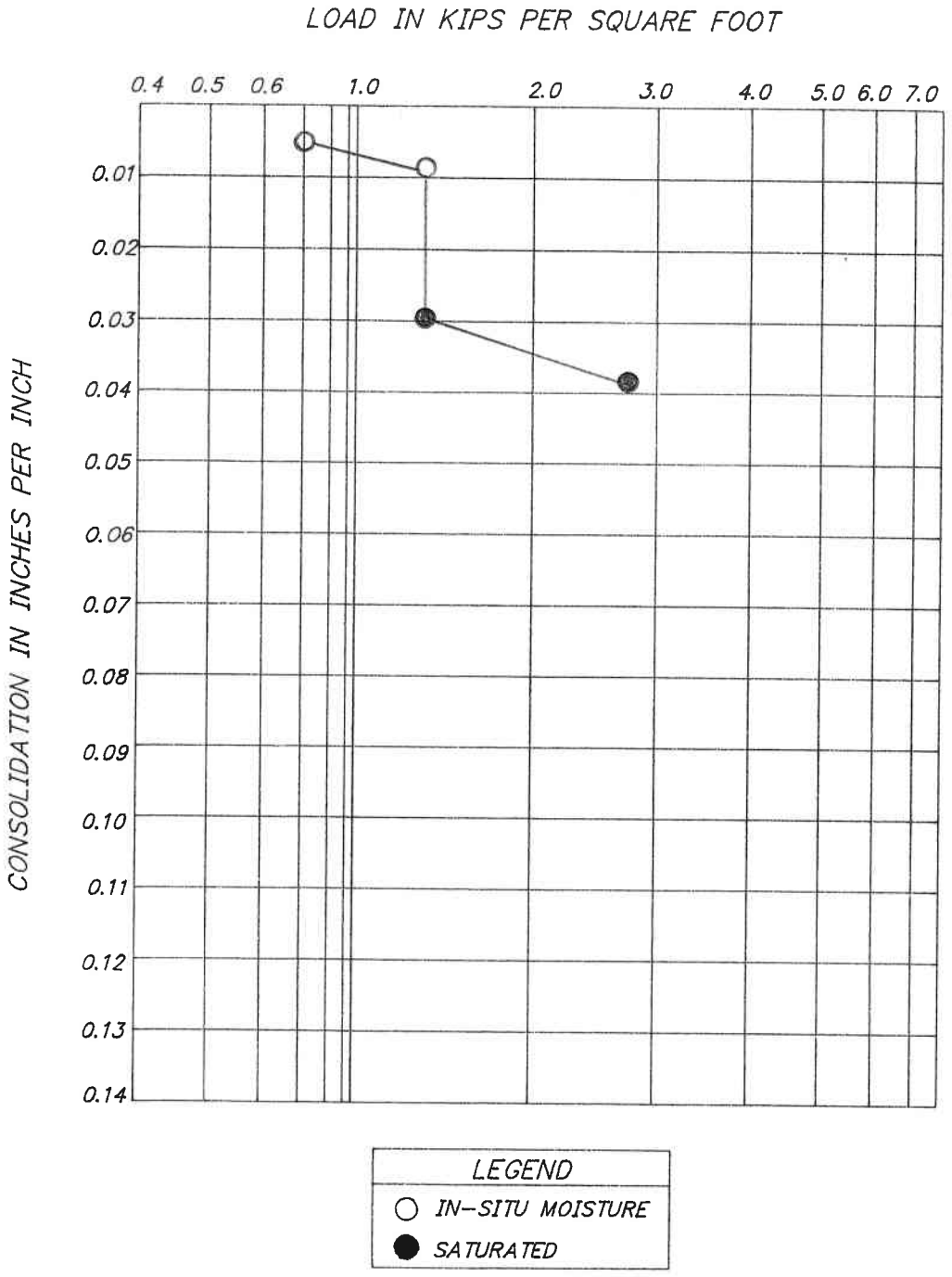
12-6148
1@9'



CONSOLIDATION DIAGRAM

ARROW ENGINEERING

12-6148
2@10'

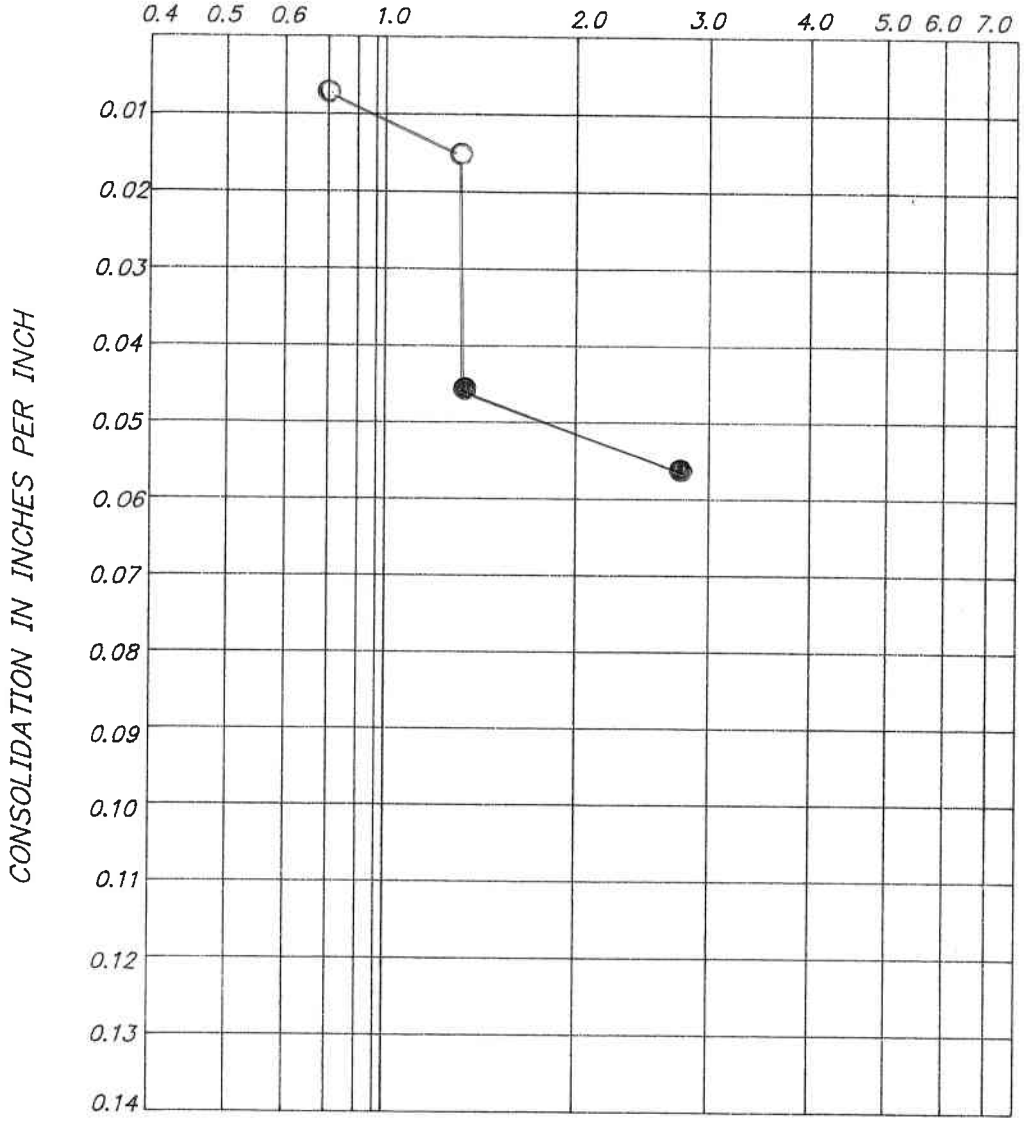


CONSOLIDATION DIAGRAM

ARROW ENGINEERING

12-6148
8@10'

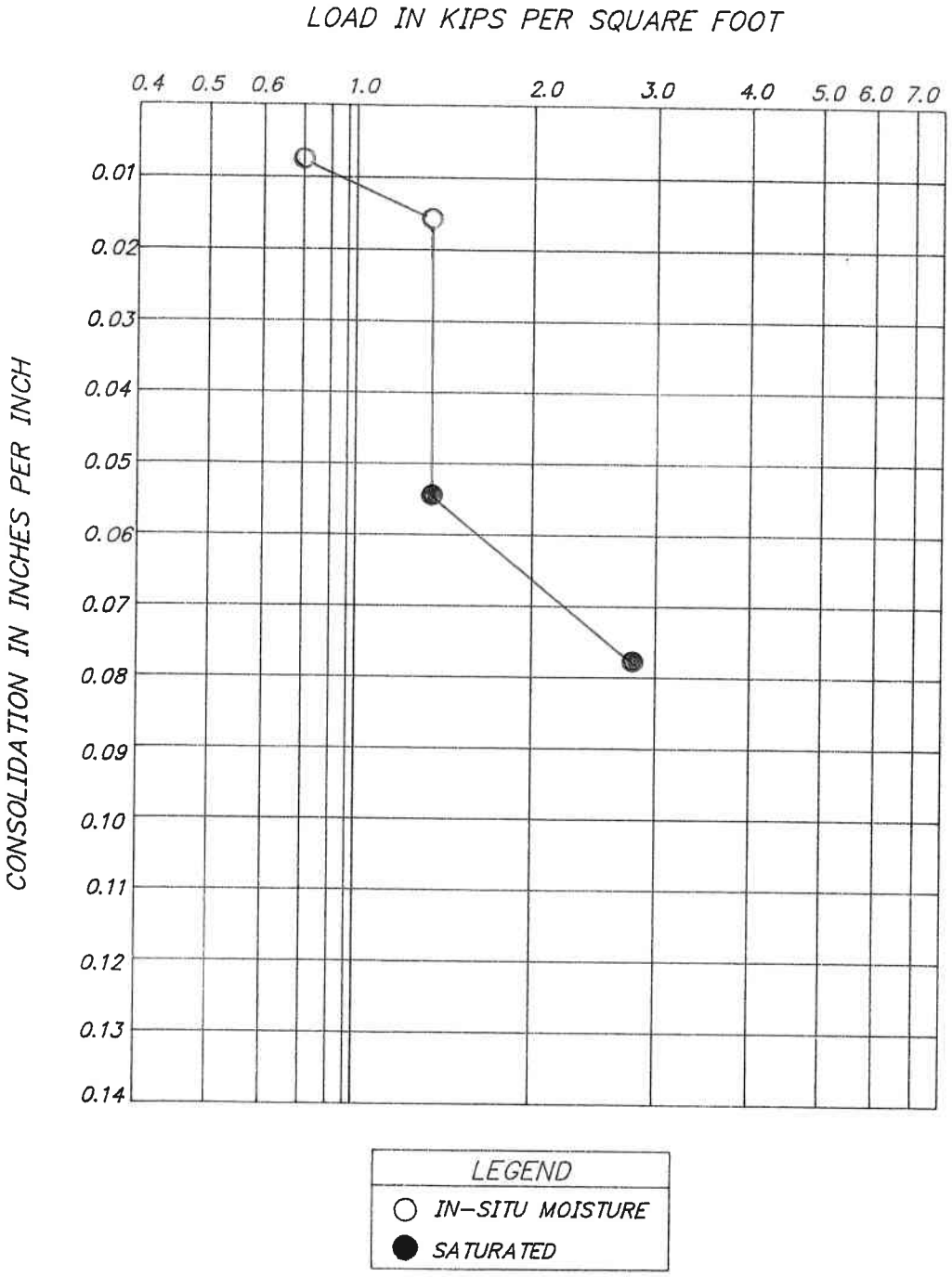
LOAD IN KIPS PER SQUARE FOOT



CONSOLIDATION DIAGRAM

ARROW ENGINEERING

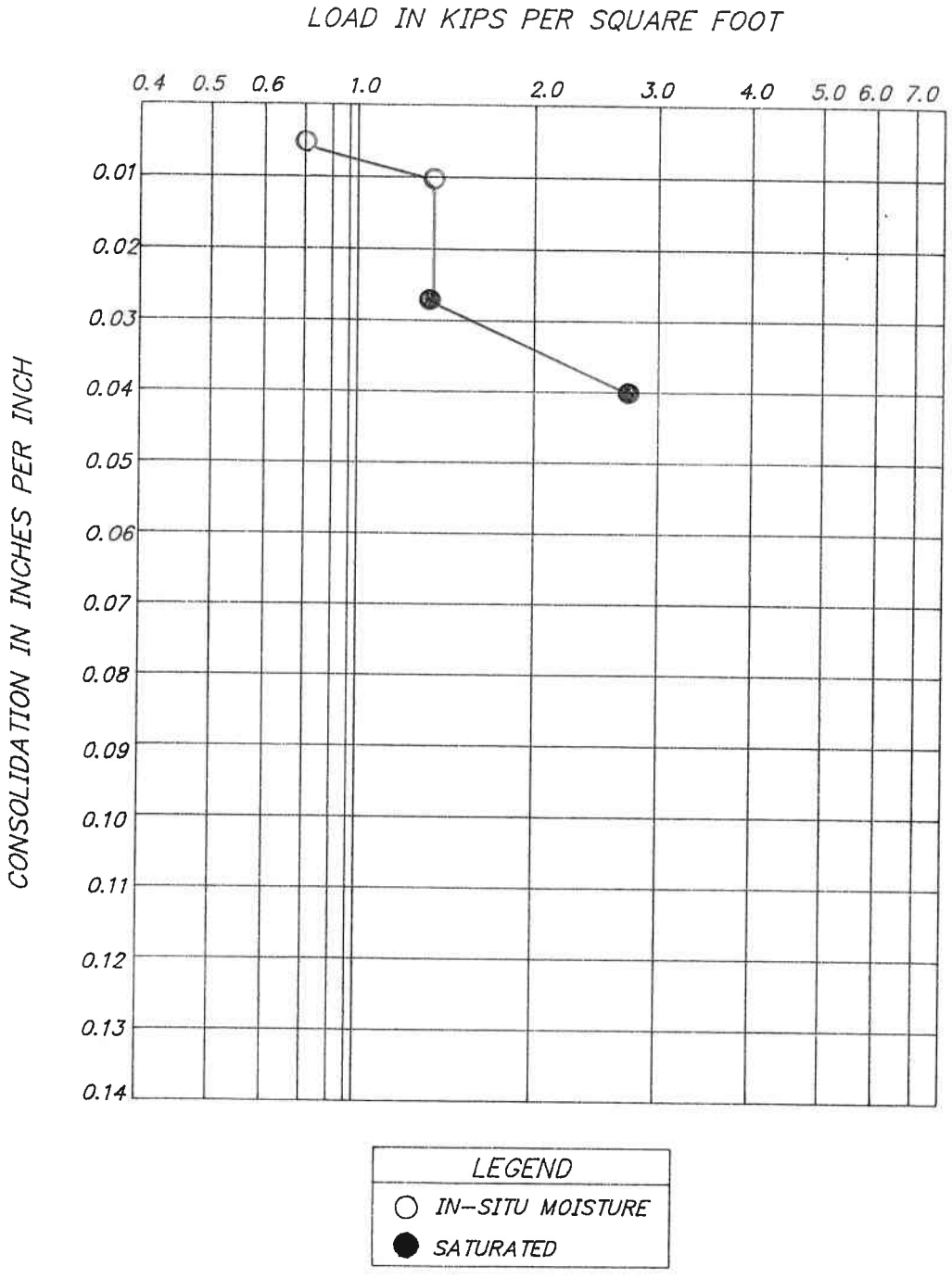
12-6148
5@15'



CONSOLIDATION DIAGRAM

ARROW ENGINEERING

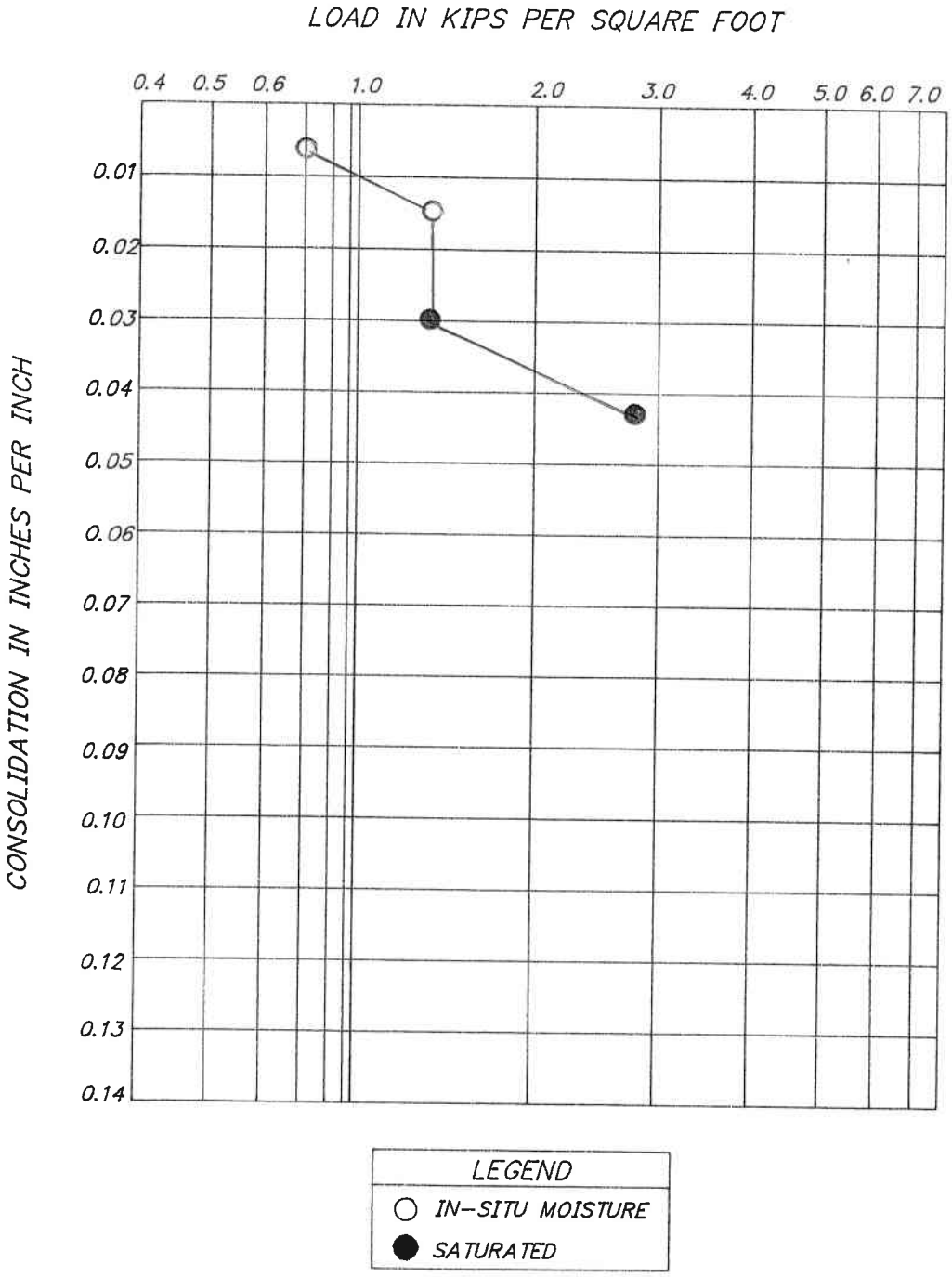
12-6148
8@15'



CONSOLIDATION DIAGRAM

ARROW ENGINEERING

12-6148
3@15'



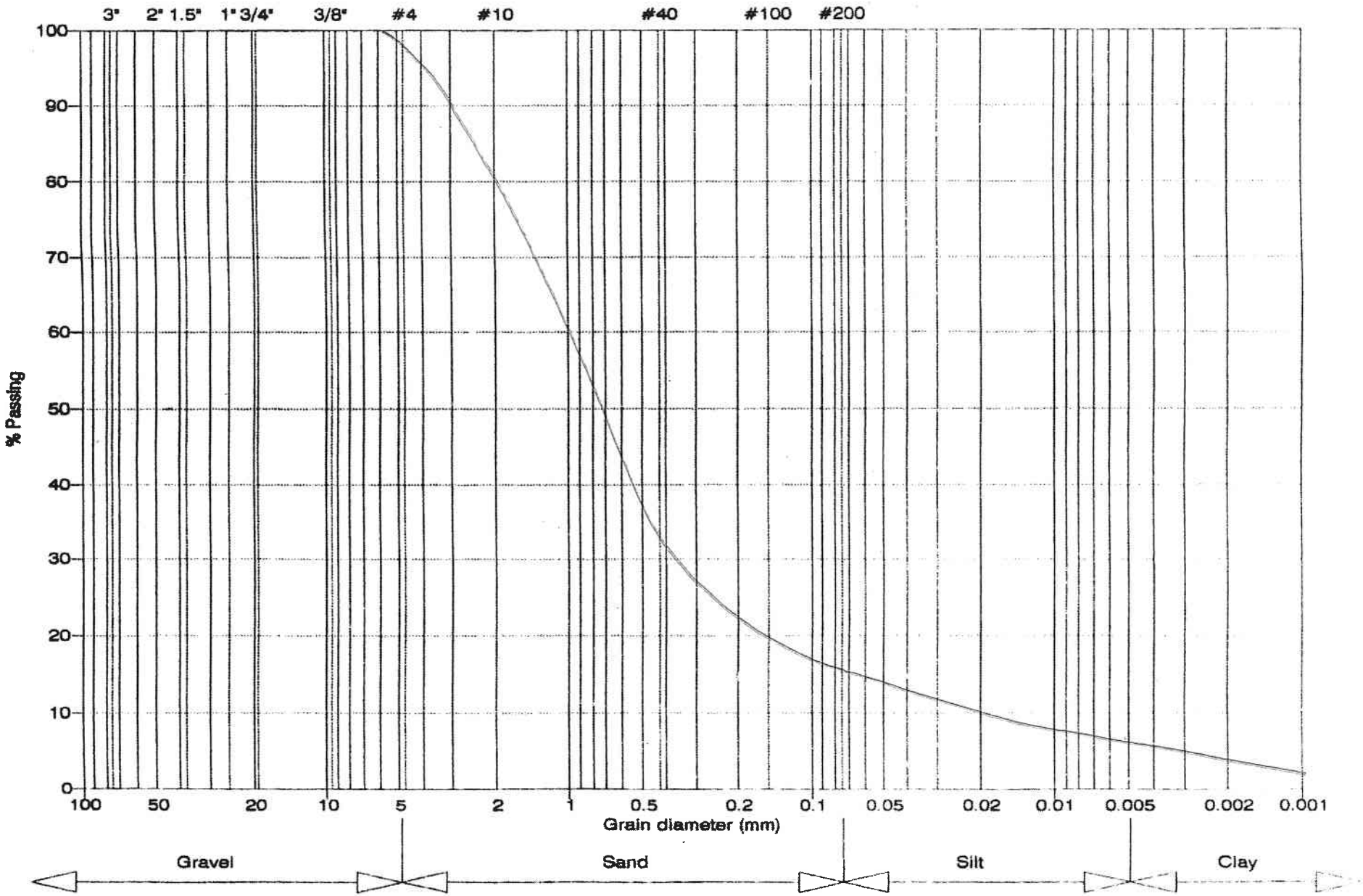
CONSOLIDATION DIAGRAM

ARROW ENGINEERING

Job name: _____
Location: _____

Arrow Engineering Geotechnical Services
Grain Size Distribution Curve

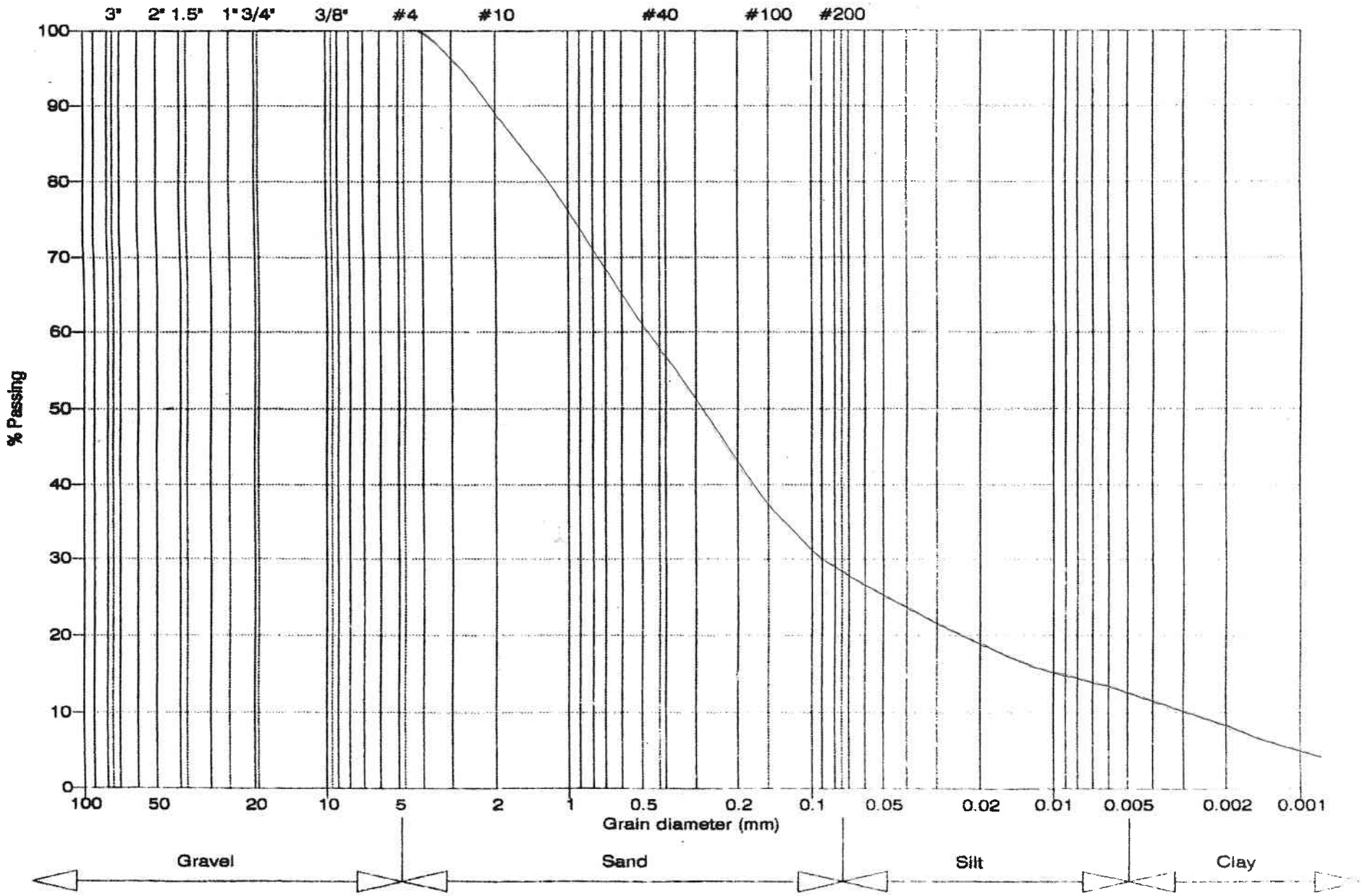
Job number: 12-6148
Sample number: 2@4'



Job name: _____
Location: _____

Arrow Engineering Geotechnical Services
Grain Size Distribution Curve

Job number: 12-6148
Sample number: 6@6'



Job name: _____

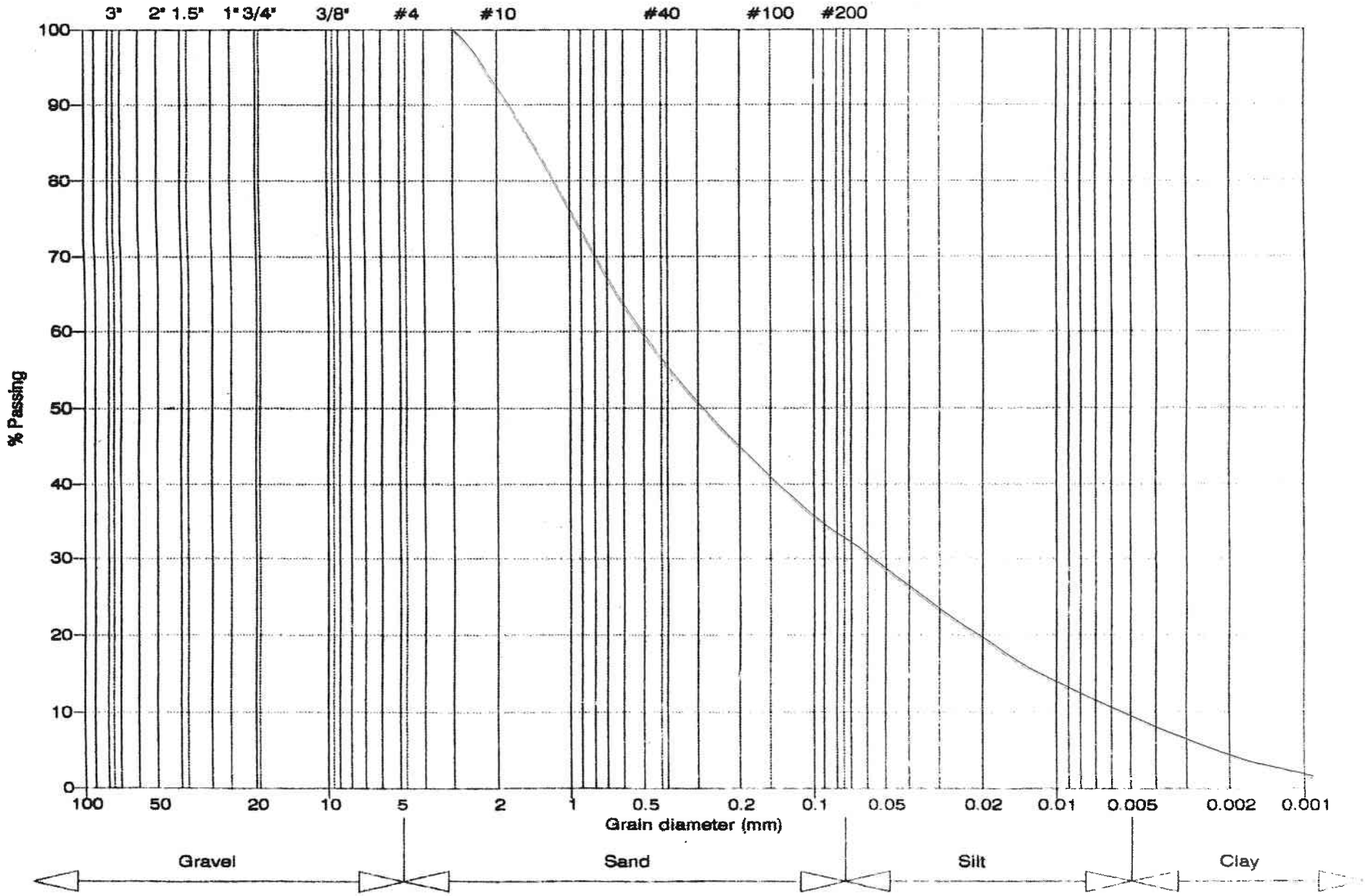
Location: _____

Arrow Engineering Geotechnical Services

Grain Size Distribution Curve

Job number: 12-6148

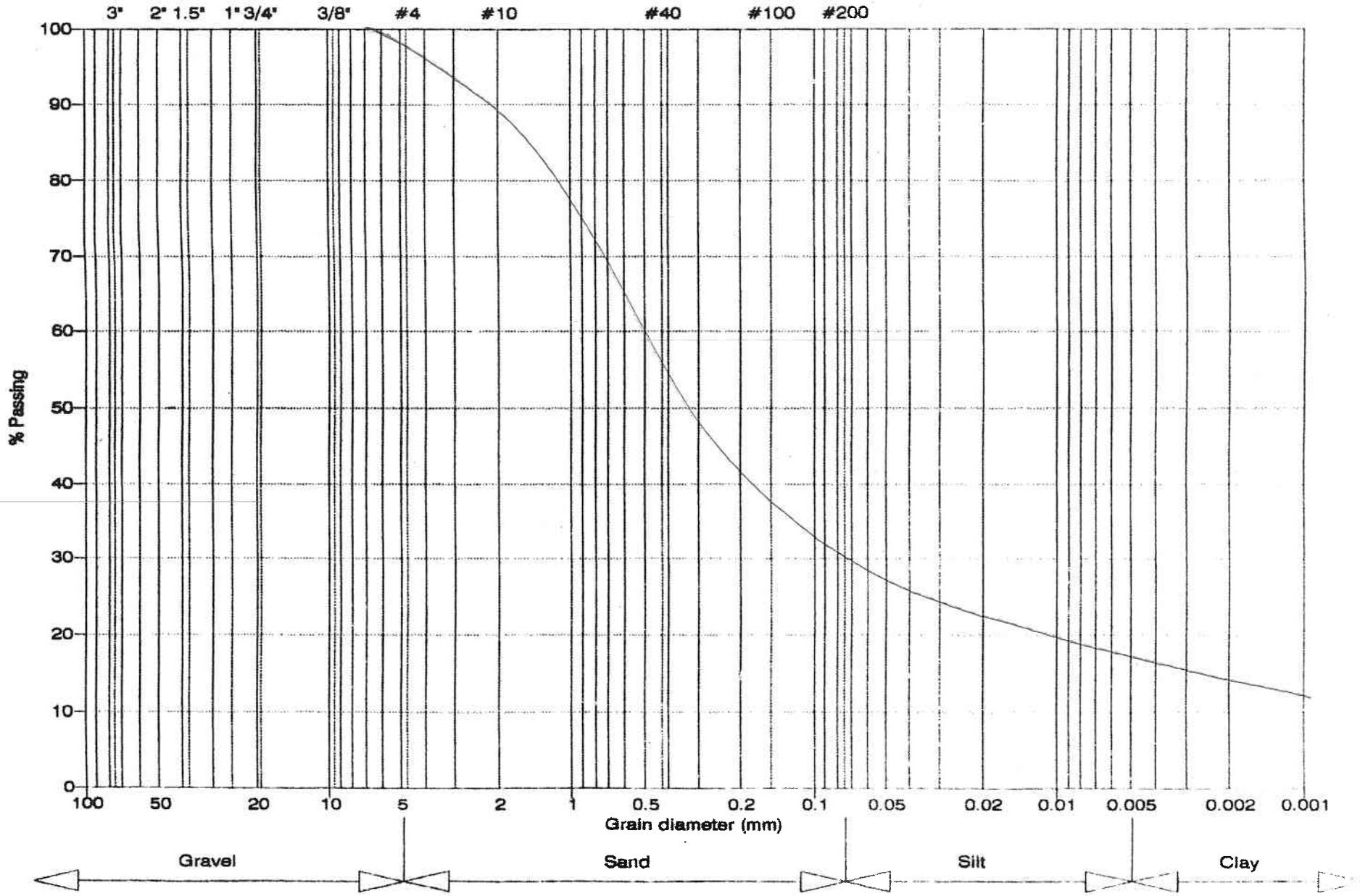
Sample number: 1@7'



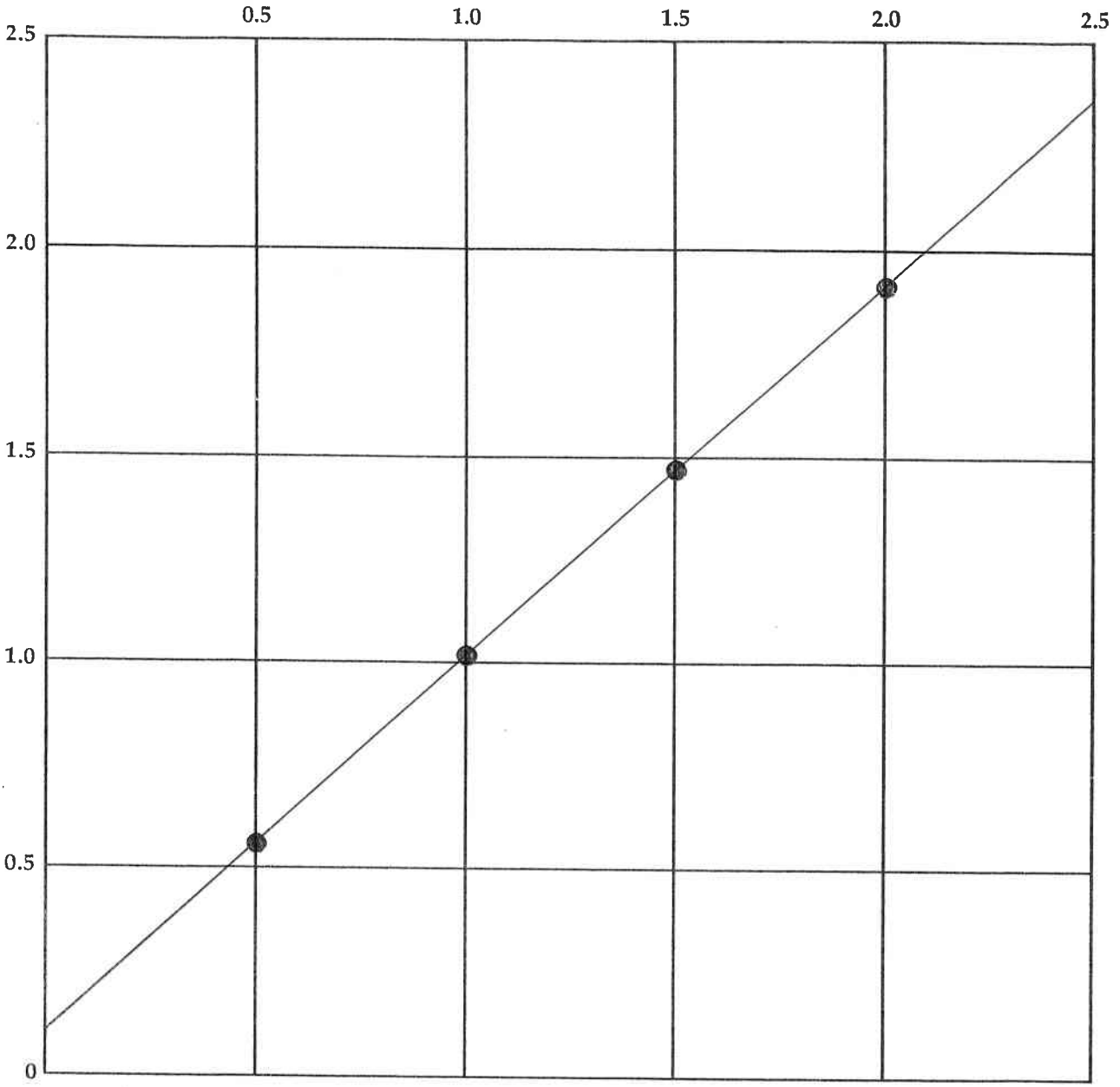
Job name: _____
Location: _____

Arrow Engineering Geotechnical Services
Grain Size Distribution Curve

Job number: 12-6148
Sample number: 5@9'



NORMAL LOAD IN KIPS PER SQUARE FOOT



SHEARING STRESS IN KIPS PER SQUARE FOOT

DIRECT SHEAR DATA

BORING	SYMBOL	DEPTH (FT.)	DRY DENSITY (PCF)	ANGLE OF FRICTION (DEGREES)	COHESION (PSF)
8	●	0-5	120.8	42	100

Remolded to 90% of maximum density as determined by ASTM D1557.

12-6148

Table 1 - Laboratory Tests on Soil Samples

Arrow Engineering
Coronus Energy
Your #12-6148, HDR|Schiff #12-0339LAB
19-Apr-12

Sample ID			1 @ 0-5'
Resistivity		**Units**	
as-received		ohm-cm	64,000
saturated		ohm-cm	14,400
pH			7.8
Electrical Conductivity		mS/cm	0.07
Chemical Analyses			
Cations			
calcium	Ca^{2+}	mg/kg	42
magnesium	Mg^{2+}	mg/kg	10
sodium	Na^{1+}	mg/kg	22
potassium	K^{1+}	mg/kg	8.5
Anions			
carbonate	CO_3^{2-}	mg/kg	ND
bicarbonate	HCO_3^{1-}	mg/kg	85
fluoride	F^{1-}	mg/kg	0.7
chloride	Cl^{1-}	mg/kg	1.0
sulfate	SO_4^{2-}	mg/kg	19
phosphate	PO_4^{3-}	mg/kg	5.8
Other Tests			
ammonium	NH_4^{1+}	mg/kg	1.8
nitrate	NO_3^{1-}	mg/kg	1.9
sulfide	S^{2-}	qual	na
Redox		mV	na

Electrical conductivity in millisiemens/cm and chemical analysis were made on a 1:5 soil-to-water extract.
mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction potential in millivolts
ND = not detected
na = not analyzed