



Intermountain GeoEnvironmental Services, Inc.  
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June 15, 2017

Horrocks Engineers  
c/o Mr. Shawn Shuler, P.E.  
4905 South 1500 West, Suite 100  
Riverdale, Utah 84005

IGES Project No.: 02542-001  
RE: Geotechnical Engineering Evaluation  
Snow Basin Parking Lot Expansion  
Weber County, Utah

Mr. Shuler:

This report presents the results of a geotechnical investigation performed to evaluate the engineering properties of native soils for use in the design and construction of the overflow parking area at Snowbasin Resort.

As part of the investigation six test pits were excavated from which samples were taken to perform laboratory testing. Testing was performed to determine soil classifications, moisture density relationships, and California Bearing Ratio (CBR). In order to utilize AASHTO pavement design methods, support characteristics of soils are related to CBR values. In addition to laboratory CBR testing, two Drop Cone Penetrometer (DCP) tests (which correlate to the CBR) were performed. Existing asphalt thickness was measured by drilling several small diameter holes through the paved portions of the lot. Representative samples of native site soils were collected and for laboratory testing.

### **Existing Conditions**

The overflow parking area is located north of Snow Basin Rd. (Weber County Road 226) opposite the entrance to the Snowbasin Lodge and main resort parking areas. It is our understanding that the proposed lots supported a concrete batch plant that was utilized for facility improvements prior to the 2002 Winter Olympics. The northern half of the lot was likely paved to maintain surface conditions around batch plant; the southern half has a gravel surface comprised of previously imported roadbase. The area has been previously "leveled" to facilitate parking, it is not flat, but northern and southern halves of the property have been graded to provide a relatively uniform working/parking area. It appears that runoff from both sides of the lot would flow towards a low area in the southeast corner of the paved (northern) half.

Existing asphalt thickness was measured at 3 to 4 inches thick at six different locations in the paved northern half of the parking area. Test pits were generally completed near the perimeter of the existing parking areas to avoid excessive damage to the existing lot. Native soils encountered

consisted of mixtures of Clay, Sand and Gravel. Soils were frequently moist-wet with a maximum measured water content of 25.6%.

An infiltration test was initiated to assist with design of site run-off controls. Initial reports from Snowbasin personnel indicated that soils in the area were likely granular and would drain rapidly. However, our explorations encountered a significant portion of fine-grained, lower permeability soils. Based on our observations of existing grading and discussions with Horrocks personnel, the test was located in Test Pit 3, an area where it appears both paved and unpaved sections of the existing parking lot would drain toward. Future grading is likely to maintain this same general flow direction. Given the fine-grained nature of the deposits in this area, standard infiltration testing would have required a 24-hour pre-soaking period. Representatives from Horrocks were on-site during the testing. After observing the conditions and the relatively slow initial infiltration rates (120-448 minutes/inch) a joint decision was made to terminate the test and consider other options for run-off management.

**Pavement Section Design**

DCP testing was performed at two locations along with observation, sampling and laboratory testing in order to assess the CBR for use in pavement design. Exploration locations are shown on Attachment 1 which accompanies this letter. Bedrock was not encountered in any of the shallow explorations which reached a maximum depth of 5 feet below the existing grade. From DCP data and laboratory data it appears that the subgrade will provide relatively poor pavement support. Laboratory CBR's were performed on three bulk samples obtained at 1-2 feet deep from test pits 1, 3 and 5. The CBR's obtained from laboratory testing in addition to the CBR obtained from the two DCP's over a depth of approximately 18 inches are summarized in the following table:

**Table 1 – Field and Laboratory CBR Values**

Location	Depth Tested (in)	Minimum. CBR Value (%)
TP-1	18	2.8 <sup>A</sup>
TP-3	12	4.2 <sup>A</sup>
TP-5	24	9.4 <sup>A</sup>
DCP-1	0-42	2.1 <sup>B</sup>
DCP-2	0-56	2.7 <sup>B</sup>

A – Laboratory CBR Test (ASTM D-1883, AASHTO T-193)

B – Correlated CBR value from field DCP Test

Based on these test results, our pavement section recommendations have been prepared using a subgrade CBR value of 2%.

Anticipated traffic volume was not provided for the parking lot. We assume that the lot will be initially be utilized only as an overflow lot on busiest days at the resort, and that the majority of traffic will consist of passenger vehicles. After construction is complete, we anticipate that heavy traffic would largely consist of snow removal vehicles. Based on the dimensions of the lot(s), we anticipate that they will be capable of holding 225-250 passenger vehicles when completely full. We assume that it will likely be full only on weekends and holidays during ski season and for occasional events in the remainder of the year. The total number of ESAL's used in design is therefore relatively low (see Appendix C).

The pavement alternatives which follow assume a 20-year design life, reliability of 80% and 0.5% growth rate. Applying these design assumptions and soil properties listed in the previous paragraphs to the AASTO (1993) design method, we recommend one of the two alternate pavement sections be constructed:

**Table 2 – Pavement Section Alternatives**

	Asphalt Thickness (in)	UTBC -Crushed	
		Rock Base Thickness (in)	Recycled Asphalt (in)
Option 1	4	6	~2
Option 2	3	10	~2

We have assumed that the existing asphalt from the northern half of the parking lot can be repurposed as part of the new pavement section. It should first be pulverized and stockpiled while the subgrade is prepared for construction.

After removal of existing asphalt and previously imported roadbase, it is recommended that the existing subgrade soils be scarified to a minimum depth of 8 inches, brought to within 2 percent of the OWC and compacted to at least 95 percent of the MDD as determined by AASHTO T 180.

All imported fill placed for the support of pavements, should consist of a relatively well-graded road base type fill or Untreated Base Course (UTBC). At a minimum, the UTBC should meet Utah Department of Transportation (UDOT) requirements. We also recommend that UTBC be free of vegetation and debris, and contain no inert materials larger than 1-inch in nominal size. UTBC should have a minimum CBR value of 70 as determined by AASHTO T 193. Granular borrow may consist of imported soil which has a minimum CBR value of 30 as determined by AASHTO T 193, a maximum particle size of 3-inches, and a maximum fines content of 15%. Recycled Asphalt Pavement (RAP) may be used as a substitute for granular borrow.

Existing roadbase may be recovered and reused for granular borrow or UTBC if it meets the gradation and minimum CBR requirements outlined in the preceding paragraph. The existing section including the asphalt and roadbase may be used as roadbase for the new pavement section if appropriately processed to meet the required parameters. It should be noted here that the gradation recommendations provided herein are intended to indicate soils that will provide the desired strength proportions; however, these soils may not meet gradation requirements of other governing agencies. If other regulating agencies will be involved in the reconstruction of the parking lot, their minimum recommended gradation of fill materials should be met

The pavement section design is based on the following assumptions: crushed aggregate road base will have a minimum CBR value of 70 and granular borrow sub-base will have a minimum CBR value of 30. Asphalt should be compacted to a minimum of 95 percent of the "Rice" maximum density. Field and laboratory testing should be performed to determine whether applicable requirements have been met. The pavement should be constructed and compacted with a slope to divert water away from the paved surface and into a ditch that will convey water away from the pavement section; stormwater run-on from surrounding areas should not be allowed to infiltrate uphill of the parking lot.

## Limitations

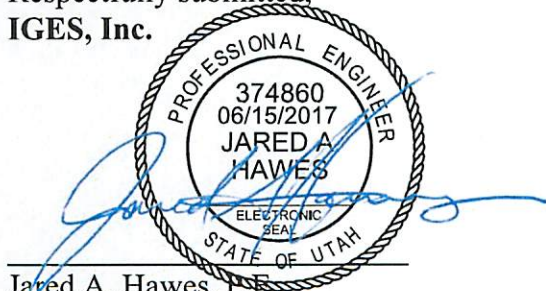
The recommendations contained in this report are based on our limited field exploration, laboratory testing, and understanding of the proposed construction. The subsurface data used in the preparation of this report were obtained from the explorations made for this investigation. It is possible that variations in the soil and groundwater conditions could exist between and beyond the points explored. The nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at this site that are different from those described in this report, we should be immediately notified so that we may make any necessary revisions to recommendations contained in this report. In addition, if the scope of the proposed construction changes from that described in this report, we should be notified.

This report was prepared in accordance with the generally accepted standard of practice at the time the report was written. No warranty, expressed or implied, is made.

It is the Client's responsibility to see that all parties to the project including the Designer, Contractor, Subcontractors, etc. are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk.

We appreciate the opportunity to provide you with our services. If you have any questions, please contact us at your convenience.

Respectfully submitted,  
**IGES, Inc.**



Jared A. Hawes, P.E.  
Project Manager

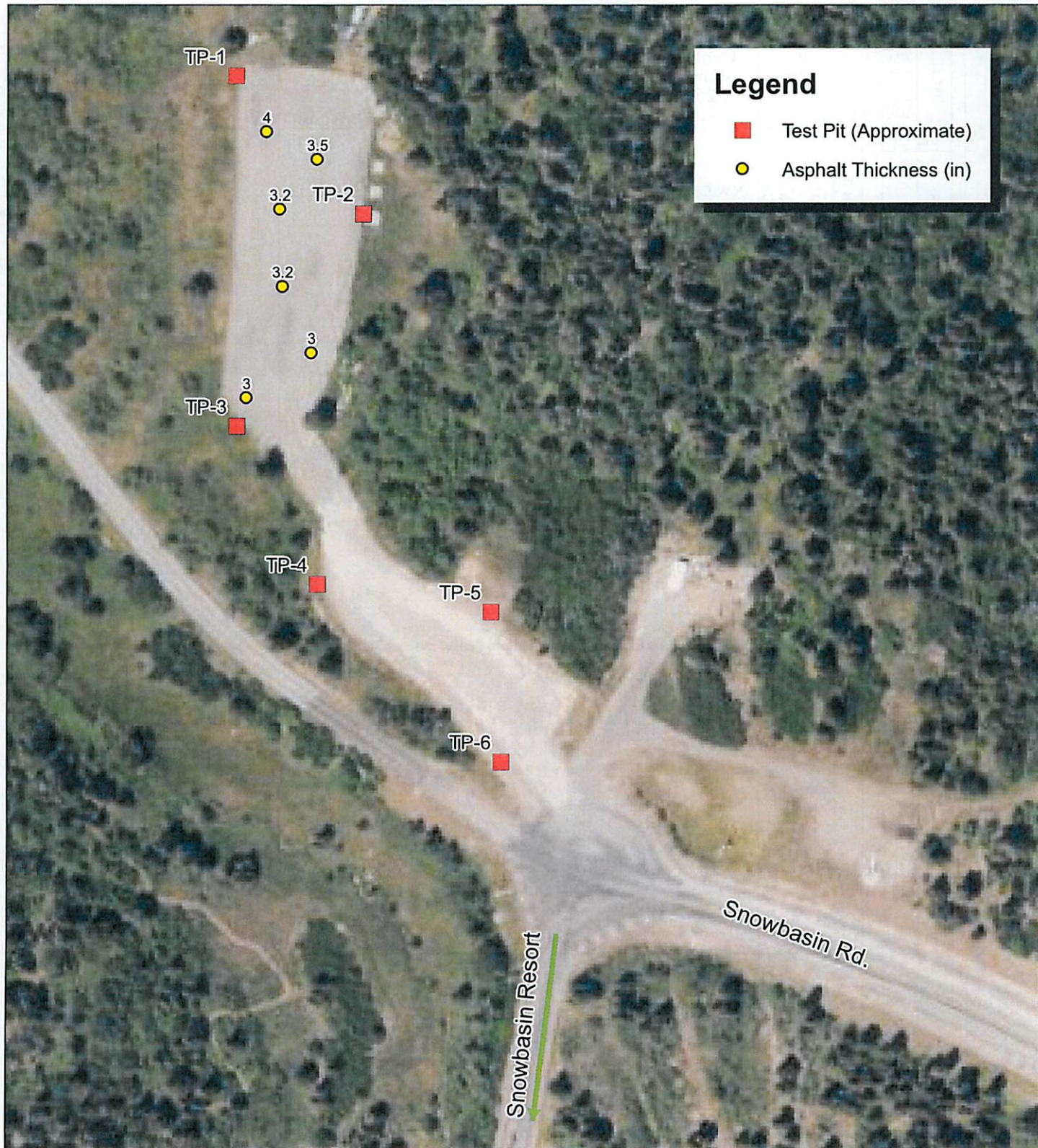
### Attachments:

Appendix A – Site Exploration Map  
Exploration Logs  
Field DCP Test Results

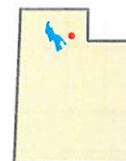
Appendix B – Laboratory Testing

Appendix C – Pavement Design

# APPENDIX A



BASE IMAGE: from AGRC Utah  
 q0920\_nw-NAIP2016\_RGB.tif (1m)  
 National Agrigultural Imaging Program  
 (2016)



**IGES**<sup>®</sup>  
 Project Number - 02542-001

Geotechnical Evaluation  
 Snowbasin Parking Lot Expansion  
 3925 Snowbasin Road  
 Huntsville, Utah

**EXPLORATION LOCATION MAP**

**Attachment**  
**1**

LOG OF TEST PITS ATTACHMENT - 4-LINE HDR 02542-001.GPJ IGES.GDT 6/14/17

DATE		STARTED: 5/25/17		<b>Geotechnical Evaluation</b> <b>Snowbasin Parking Lot Expansion</b> 3925 Snowbasin Road Huntsville, Utah				IGES Rep: DNB		TEST PIT NO: <b>TP-1</b> Sheet 1 of 1								
DATE		COMPLETED: 5/25/17						Project Number 02542-001				Rig Type: Backhoe						
DATE		BACKFILLED: 5/25/17																
DEPTH		LOCATION		NORTHING EASTING ELEVATION		Dry Density(pcf)		Moisture Content %		Percent minus 200		Liquid Limit		Plasticity Index		Moisture Content and Atterberg Limits		
METERS	FEET	SAMPLES	WATER LEVEL													GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION
0	0					TOPSOIL - 5-in												
						Clayey SAND - medium dense, moist, dark brown												
						-bucket, bag and tube sample			103.1	14.5	53.8	21	5	●				
						Clayey SAND with gravel - medium dense, moist, brown												
						Clayey GRAVEL with sand - medium dense, moist, reddish-brown												
						Bottom of Test Pit @ 5.5 Feet												

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**SAMPLE TYPE**  
 ▭ - GRAB SAMPLE  
 ▩ - 3" O.D. THIN-WALLED HAND SAMPLER

**WATER LEVEL**  
 ▼ - MEASURED  
 ▽ - ESTIMATED

**NOTES:**

**Attachment**



**2**





DATE		STARTED: 5/25/17		Geotechnical Evaluation Snowbasin Parking Lot Expansion 3925 Snowbasin Road Huntsville, Utah			IGES Rep: DNB			TEST PIT NO: <b>TP-2</b>					
		COMPLETED: 5/25/17					Project Number 02542-001			Rig Type: Backhoe			Sheet 1 of 1		
		BACKFILLED: 5/25/17													
DEPTH				LOCATION						Moisture Content and Atterberg Limits					
				NORTHING EASTING ELEVATION						Plastic Limit Moisture Content Liquid Limit					
				East central portion of paved lot						102030405060708090					
				MATERIAL DESCRIPTION											
0		0		TOPSOIL - 8-in											
				Lean CLAY with sand - medium soft-soft, moist, dark brown											
				CL											
				-bucket, bag and tube sample											
				Clayey SAND with gravel - medium dense, moist, light brown			85.6 25.6 82.2 37 13								
				SC											
				Clayey GRAVEL with sand - medium dense (stiff clay infill) wet, brown											
				GC											
1															
							12.9								
5				Bottom of Test Pit @ 5 Feet											
2															

LOG OF TEST PITTS ATTACHMENT - 4-LINE HDR 02542-001.GPJ IGES.GDT 6/14/17

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**SAMPLE TYPE**  
 - GRAB SAMPLE  
 - 3" O.D. THIN-WALLED HAND SAMPLER

**WATER LEVEL**  
 - MEASURED  
 - ESTIMATED

**NOTES:**

**Attachment**  
**3**

LOG OF TEST PITS ATTACHMENT - 4-LINE HDR 02542-001.GPJ IGES.GDT 6/14/17

DATE		STARTED: 5/25/17		<b>Geotechnical Evaluation</b> <b>Snowbasin Parking Lot Expansion</b> 3925 Snowbasin Road Huntsville, Utah				IGES Rep: DNB				TEST PIT NO: <b>TP-3</b> Sheet 1 of 1							
		COMPLETED: 5/25/17						Project Number 02542-001								Rig Type: Backhoe			
		BACKFILLED: 5/25/17																	
DEPTH				LOCATION								Moisture Content and Atterberg Limits							
				NORTHING EASTING ELEVATION								Plastic Limit Moisture Content Liquid Limit							
				SW Corner of paved lot, infiltration test															
				MATERIAL DESCRIPTION				Dry Density(pcf)		Moisture Content %		Percent minus 200		Liquid Limit		Plasticity Index			
METERS	FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION														
0	0			(FILL)	SM	Silty SAND - medium dense, moist to dry, light gray/brown													
				Clayey SAND with gravel	SC	medium dense, moist, dark brown					66.4	35	13	H					
				Clayey SAND with gravel	SC	medium dense, wet, light brown					45.7								
						Bottom of Test Pit @ 4 Feet													
1																			
5																			
2																			

**SAMPLE TYPE**  
 - GRAB SAMPLE  
 - 3" O.D. THIN-WALLED HAND SAMPLER

**WATER LEVEL**  
 - MEASURED  
 - ESTIMATED

**NOTES:**

LOG OF TEST PIT ATTACHMENT - 4-LINE HDR. 02542-001.CPJ IGES.GDT 6/14/17

DATE		STARTED: 5/25/17		<b>Geotechnical Evaluation</b> <b>Snowbasin Parking Lot Expansion</b> <b>3925 Snowbasin Road</b> <b>Huntsville, Utah</b>			IGES Rep: DNB		TEST PIT NO:			
		COMPLETED: 5/25/17					Project Number 02542-001		Rig Type: Backhoe		<b>TP-4</b>	
		BACKFILLED: 5/25/17							Sheet 1 of 1			
DEPTH		LOCATION		NORTHING		EASTING		ELEVATION				
METERS		MATERIAL DESCRIPTION		Dry Density(pcf)		Moisture Content %		Plasticity Index				
FEET				Moisture Content %		Percent minus 200		Liquid Limit				
SAMPLES				Liquid Limit		Plasticity Index		Moisture Content and Atterberg Limits				
WATER LEVEL				Plastic Limit		Moisture Content		Liquid Limit				
GRAPHICAL LOG				10		30		40				
UNIFIED SOIL CLASSIFICATION				50		60		70				
				80		90		100				
0		(FILL-Roadbase) Silty GRAVEL with sand - dense, moist-dry, grayish brown				10.6						
		GM										
		Clayey GRAVEL with sand - medium dense, moist, dark brown		21.8		41		15				
		GC										
1												
		Bottom of Test Pit @ 4.5 Feet										
5												
2												

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<p><b>SAMPLE TYPE</b></p> <p>☐ - GRAB SAMPLE</p> <p>☒ - 3" O.D. THIN-WALLED HAND SAMPLER</p> <p><b>WATER LEVEL</b></p> <p>▼ - MEASURED</p> <p>▽ - ESTIMATED</p>
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NOTES:

Attachment

**5**

LOG OF TEST PIT ATTACHMENT - 4-LINE HDR - 02542-001.GPJ IGES.GDT 6/14/17

DATE		STARTED: 5/25/17		<b>Geotechnical Evaluation</b> <b>Snowbasin Parking Lot Expansion</b> <b>3925 Snowbasin Road</b> <b>Huntsville, Utah</b>			IGES Rep: DNB		TEST PIT NO:						
		COMPLETED: 5/25/17					Project Number 02542-001		Rig Type: Backhoe		<b>TP-5</b>				
		BACKFILLED: 5/25/17											Sheet 1 of 1		
DEPTH				LOCATION			Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits			
METERS	FEET	SAMPLES	WATER LEVEL	NORTHING	EASTING	ELEVATION						Plastic Limit	Moisture Content	Liquid Limit	
0	0			North central portion of paved lot											
				MATERIAL DESCRIPTION											
				TOPSOIL - 4-5-in											
				Sandy CLAY with gravel - medium stiff, moist, brown; some cobbles (12 to 18-in diam.)											
				CL											
				-bag and bucket sample											
				Clayey GRAVEL with sand - medium dense, moist, brown; some cobbles (6 to 8-in diam.)					41.8	38	20				
				GC				13.4							
				Bottom of Test Pit @ 4.5 Feet											
5															
2															

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**SAMPLE TYPE**  
 ▭ - GRAB SAMPLE  
 ▩ - 3" O.D. THIN-WALLED HAND SAMPLER

**WATER LEVEL**  
 ▼ - MEASURED  
 ▽ - ESTIMATED

**NOTES:**

**Attachment**

**6**

LOG\_OF\_TEST\_PITS\_ATTACHMENT - 4-LINE HDR\_02542-001.GPJ IGES.GDT 6/14/17

DATE		STARTED: 5/25/17		<b>Geotechnical Evaluation</b> <b>Snowbasin Parking Lot Expansion</b> <b>3925 Snowbasin Road</b> <b>Huntsville, Utah</b>				IGES Rep: DNB				TEST PIT NO:						
		COMPLETED: 5/25/17						Project Number 02542-001				Rig Type: Backhoe				<b>TP-6</b>		
		BACKFILLED: 5/25/17														Sheet 1 of 1		
DEPTH				LOCATION								Moisture Content and Atterberg Limits						
				NORTHING                      EASTING                      ELEVATION														
				SE Corner of unpaved lot, near entrance														
				MATERIAL DESCRIPTION														
METERS		FEET		SAMPLES		WATER LEVEL		GRAPHICAL LOG		UNIFIED SOIL CLASSIFICATION								
0		0						Roadbase (4-in)										
								Poorly-graded GRAVEL with clay and sand - dense, moist, reddish-brown; cobbles (8 to 12-in diam.)		GP-GC								
								Clayey GRAVEL with sand - medium dense, moist, dark brown; cobboes (8 to 12-in diam.)		GC								
1								Bottom of Test Pit @ 3.5 Feet										
5																		
2																		
												Dry Density(pcf)      Moisture Content %      Percent minus 200      Liquid Limit      Plasticity Index						
												Plastic Limit      Moisture Content      Liquid Limit						
												10 20 30 40 50 60 70 80 90						

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**SAMPLE TYPE**  
 □ - GRAB SAMPLE  
 ▣ - 3" O.D. THIN-WALLED HAND SAMPLER

**WATER LEVEL**  
 ▼ - MEASURED  
 ▽ - ESTIMATED

**NOTES:**

**Attachment**

**7**

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		USCS SYMBOL	TYPICAL DESCRIPTIONS	
COARSE GRAINED SOILS  (More than half of material is larger than the #200 sieve)	GRAVELS  (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES	
		GRAVELS WITH OVER 12% FINES	GP POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES	
		SANDS  (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LITTLE OR NO FINES	GM SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			SANDS WITH OVER 12% FINES	GC CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	FINE GRAINED SOILS  (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS  (Liquid limit less than 50)	ML INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY	ML
			CL INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	CL
			OL ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY	OL
		SILTS AND CLAYS  (Liquid limit greater than 50)	MH INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT	MH
CH INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS			CH	
OH ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY			OH	
HIGHLY ORGANIC SOILS	PT PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS	PT		

LOG KEY SYMBOLS

	BORING SAMPLE LOCATION		TEST-PIT SAMPLE LOCATION
	WATER LEVEL (level after completion)		WATER LEVEL (level where first encountered)

CEMENTATION

DESCRIPTION	DESCRIPTION
WEAKLY	CRUMBLES OR BREAKS WITH HANDLING OR SLIGHT FINGER PRESSURE
MODERATELY	CRUMBLES OR BREAKS WITH CONSIDERABLE FINGER PRESSURE
STRONGLY	WILL NOT CRUMBLE OR BREAK WITH FINGER PRESSURE

OTHER TESTS KEY

TEST	DESCRIPTION	TEST	DESCRIPTION
C	CONSOLIDATION	SA	SIEVE ANALYSIS
AL	ATTERBURG LIMITS	DS	DIRECT SHEAR
UC	UNCONFINED COMPRESSION	T	TRIAXIAL
S	SOLUBILITY	R	RESISTIVITY
O	ORGANIC CONTENT	RV	R-VALUE
CBR	CALIFORNIA BEARING RATIO	SU	SOLUBLE SULFATES
COMP	MOISTURE/DENSITY RELATIONSHIP	PM	PERMEABILITY
CI	CALIFORNIA IMPACT	-200	% FINER THAN #200
COL	COLLAPSE POTENTIAL	Gs	SPECIFIC GRAVITY
SS	SHRINK SWELL	SL	SWELL LOAD

MODIFIERS

DESCRIPTION	%
TRACE	<5
SOME	5 - 12
WITH	>12

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil conditions between individual sample locations.
3. Logs represent general soil conditions observed at the point of exploration on the date indicated.
4. In general, Unified Soil Classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
DRY	ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH
MOIST	DAMP BUT NO VISIBLE WATER
WET	VISIBLE FREE WATER, USUALLY SOIL BELOW WATER TABLE

STRATIFICATION

DESCRIPTION	THICKNESS	DESCRIPTION	THICKNESS
SEAM	1/16 - 1/2"	OCCASIONAL	ONE OR LESS PER FOOT OF THICKNESS
LAYER	1/2 - 12"	FREQUENT	MORE THAN ONE PER FOOT OF THICKNESS

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT (blows/ft)	MODIFIED CA. SAMPLER (blows/ft)	CALIFORNIA SAMPLER (blows/ft)	RELATIVE DENSITY (%)	FIELD TEST
VERY LOOSE	<4	<4	<5	0 - 15	EASILY PENETRATED WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
LOOSE	4 - 10	5 - 12	5 - 15	15 - 35	DIFFICULT TO PENETRATE WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
MEDIUM DENSE	10 - 30	12 - 35	15 - 40	35 - 65	EASILY PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
DENSE	30 - 50	35 - 60	40 - 70	65 - 85	DIFFICULT TO PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
VERY DENSE	>50	>60	>70	85 - 100	PENETRATED ONLY A FEW INCHES WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPT (blows/ft)	TORVANE	POCKET PENETROMETER	FIELD TEST
		UNTRAINED SHEAR STRENGTH (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	
VERY SOFT	<2	<0.125	<0.25	EASILY PENETRATED SEVERAL INCHES BY THUMB. EXUDES BETWEEN THUMB AND FINGERS WHEN SQUEEZED BY HAND.
SOFT	2 - 4	0.125 - 0.25	0.25 - 0.5	EASILY PENETRATED ONE INCH BY THUMB. MOLDED BY LIGHT FINGER PRESSURE.
MEDIUM STIFF	4 - 8	0.25 - 0.5	0.5 - 1.0	PENETRATED OVER 1/2 INCH BY THUMB WITH MODERATE EFFORT. MOLDED BY STRONG FINGER PRESSURE.
STIFF	8 - 15	0.5 - 1.0	1.0 - 2.0	INDENTED ABOUT 1/2 INCH BY THUMB BUT PENETRATED ONLY WITH GREAT EFFORT.
VERY STIFF	15 - 30	1.0 - 2.0	2.0 - 4.0	READILY INDENTED BY THUMBNAIL.
HARD	>30	>2.0	>4.0	INDENTED WITH DIFFICULTY BY THUMBNAIL.

Attachment

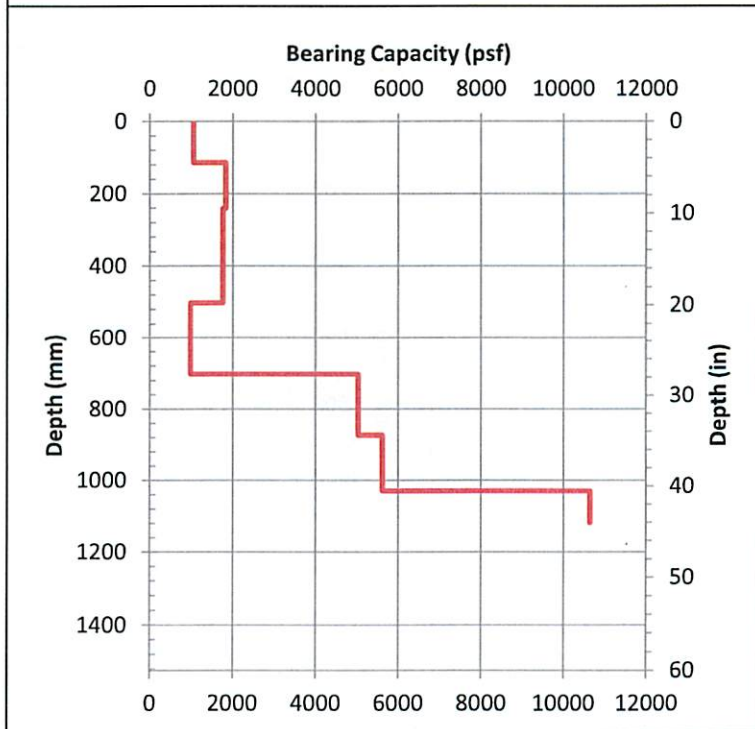
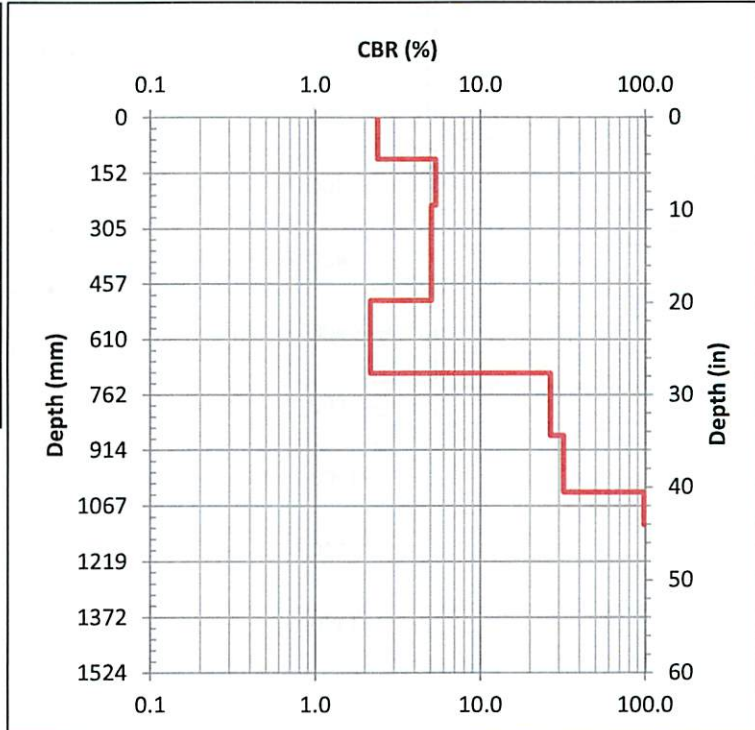


### DCP TEST DATA

Project: Snowbasin Parking Lot  
 Location: DCP-1  
 Date: 05/25/17

Soil Type: CL  
 Pavement: None

No. of Blows	Accumulative Penetration (mm)	Hammer Blow Factor *
0	0	1
3	114	1
5	241	1
10	502	1
5	702	1
15	873	1
15	1029	1
15	1118	1



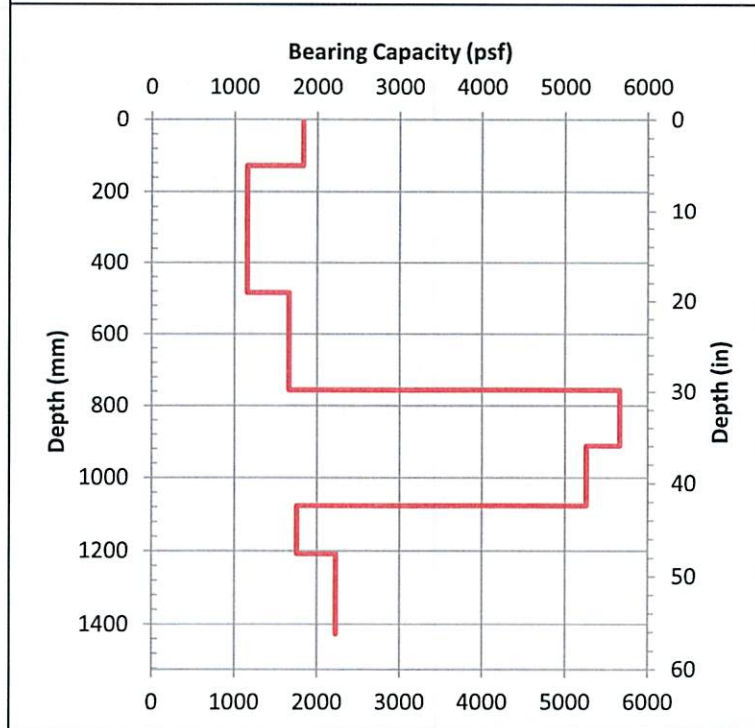
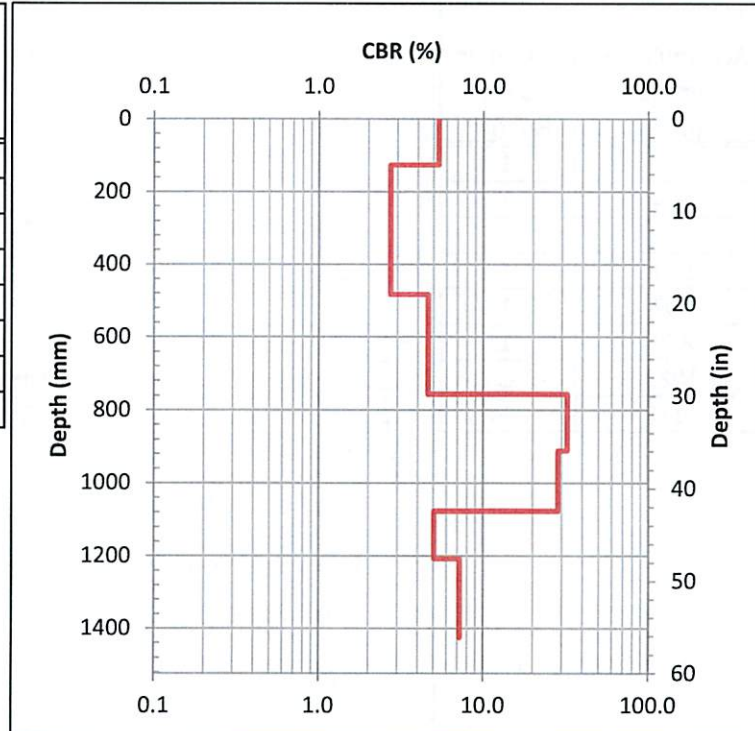
\* Enter 1 = 17.6 lb hammer;  
 2 = 10.1 lb hammer

### DCP TEST DATA

Project: Snowbasin Parking Lot  
 Location: DCP-2  
 Date: 05/25/17

Soil Type: CL  
 Pavement: None

No. of Blows	Accumulative Penetration (mm)	Hammer Blow Factor *
0	0	1
5	127	1
10	483	1
10	756	1
15	911	1
15	1076	1
5	1207	1
10	1426	1



\* Enter 1 = 17.6 lb hammer;  
 2 = 10.1 lb hammer

CBR Values from - US Army Corps of Engineers, Technical Report No. GL-94-17  
 Bearing Capacity - Design of Concrete Airport Pavement, Portland Cement Association, 1955



## Data Record For Soil Infiltration Test

Job Name: Snow Basin Parking

Job No: 02542-001

Date: 5/25/2017

Test No: 1

Total Depth of Hole: 12-in

Hole Width or Diameter: 8-in

Depth of Water Table n/a

Time interval used for measuring water drop: \_\_\_\_\_

Period of time hole was presoaked \_\_\_\_\_

Period of time soil allowed to swell after presoak: \_\_\_\_\_

	Initial Dist. to Water (in)	Beginning Time	Final Depth to Water (in)	Ending Time	$\Delta$ depth (in)	$\Delta$ time (min)	Infiltration Rate (min/in)
0.	14	10:02					
1.	14.25	10:10	14.25				
2.	14.25	10:40	14.5		0.25	30	120
3.	14.5	11:36	14.625		0.125	56	448
4.	14.625	11:58	14.75		0.125	22	176
5.	14.75	12:24	14.875		0.125	26	208
6.							
7.							
8.							
9.							
10.							
11.							
12.							

Stabilized Infiltration Rate n/a\* (min/inch)

**Notes:**

Pre-soaking not performed, considering clayey nature of soils client asked for test to be terminated after 2.3 hrs

# APPENDIX B

**SUMMARY OF LABORATORY TEST RESULTS TABLE**

Geotechnical Evaluation: Snowbasin Parking Lot

Project Number: 02542-001

Sample Location ID	Depth (ft)	Dry Density (pcf)	Water Content (%)	% Gravel >#4 & <3"	% Sand >#200 & <#4	% Fines <#200	Liquid Limit	PI	Proctor MDD (psf)	Proctor OMC (%)	CBR %
TP-1	1.5	103.1	14.5	16.6	29.6	53.8	21	5	130.2	8.7	2.8
TP-2	1.5	85.6	25.6	5	12.8	82.2	37	13			
TP-2	4		12.9								
TP-3	1			9.7	23.9	66.4	35	13	113.1	13.4	4.2
TP-3	3			12	39.4	45.7					
TP-4	1			47.5	37.3	10.6					
TP-4	2		21.8				41	15			
TP-5	2			42.6	15.6	41.8	38	20	134.8	8	9.4
TP-5	3		13.4								
TP-6	2			54.7	25.6	16.3					
TP-6	3			35.7	23.9	40.4					

**Liquid Limit, Plastic Limit, and Plasticity Index of Soils**

(ASTM D4318)

**Project:** Snowbasin Parking Lot  
**No:** 02542-001  
**Location:** Snowbasin Resort, Huntsville, Utah  
**Date:** 6/2/2017  
**By:** BRR  
**Grooving tool type:** Plastic  
**Liquid limit device:** Mechanical  
**Rolling method:** Hand

**Boring No.:** TP-1  
**Sample:**  
**Depth:** 1.5'  
**Description:** Brown silty clay

**Preparation method:** Wet  
**Liquid limit test method:** Multipoint  
**Screened over No.40:** Yes  
**Larger particles removed:** Wet sieved  
**Approximate maximum grain size:** 1-1/2"  
**Estimated percent retained on No.40:** See Particle Size Distribution  
**As-received water content (%):** 14.5

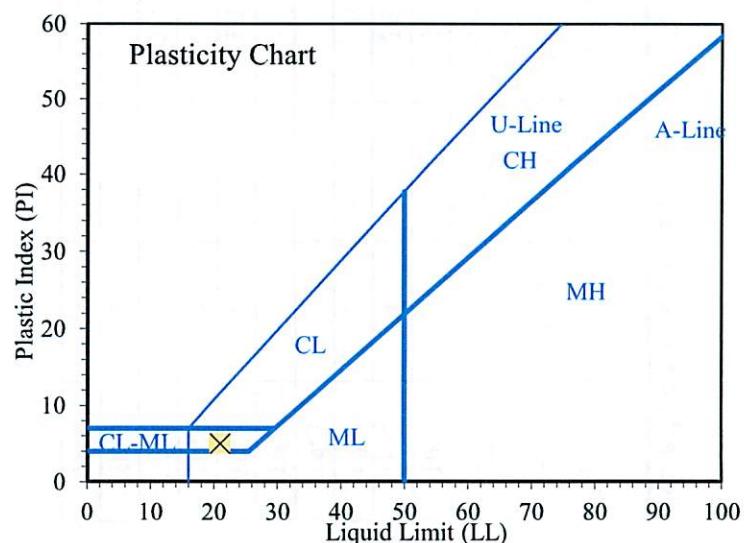
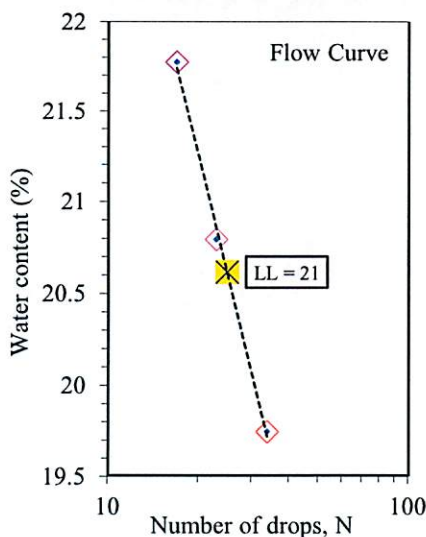
**Plastic Limit**

Determination No	1	2				
Wet Soil + Tare (g)	29.11	30.17				
Dry Soil + Tare (g)	28.07	29.05				
Water Loss (g)	1.04	1.12				
Tare (g)	21.56	22.28				
Dry Soil (g)	6.51	6.77				
Water Content, w (%)	15.98	16.54				

**Liquid Limit**

Determination No	1	2	3			
Number of Drops, N	34	23	17			
Wet Soil + Tare (g)	33.42	33.05	32.51			
Dry Soil + Tare (g)	31.54	31.17	30.67			
Water Loss (g)	1.88	1.88	1.84			
Tare (g)	22.02	22.13	22.22			
Dry Soil (g)	9.52	9.04	8.45			
Water Content, w (%)	19.75	20.80	21.78			
One-Point LL (%)		21				

<b>Liquid Limit, LL (%)</b>	<b>21</b>
<b>Plastic Limit, PL (%)</b>	<b>16</b>
<b>Plasticity Index, PI (%)</b>	<b>5</b>



Entered by: \_\_\_\_\_  
 Reviewed: \_\_\_\_\_

# Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

**Project:** Snowbasin Parking Lot

**No:** 02542-001

**Location:** Snowbasin Resort, Huntsville, Utah

**Date:** 6/2/2017

**By:** BRR

**Grooving tool type:** Plastic

**Liquid limit device:** Mechanical

**Rolling method:** Hand

**Boring No.:** TP-2

**Sample:**

**Depth:** 1.5'

**Description:** Brown lean clay

**Preparation method:** Wet

**Liquid limit test method:** Multipoint

**Screened over No.40:** Yes

**Larger particles removed:** Wet sieved

**Approximate maximum grain size:** 3/4"

**Estimated percent retained on No.40:** See Particle Size Distribution

**As-received water content (%):** 25.6

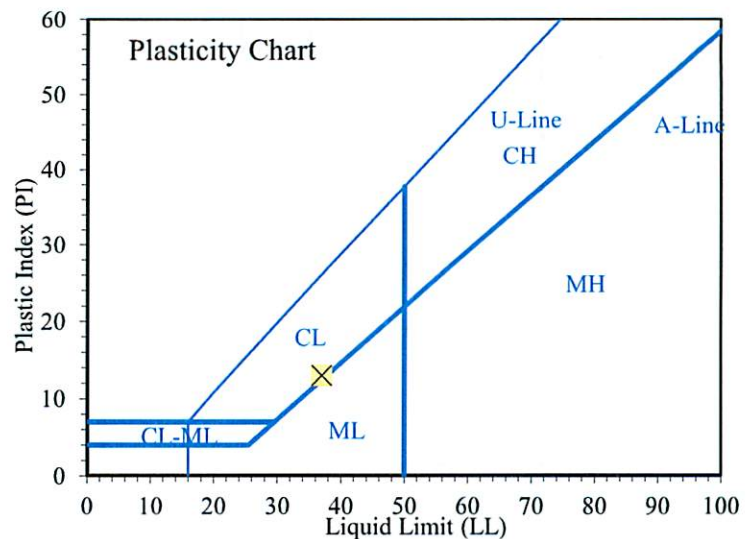
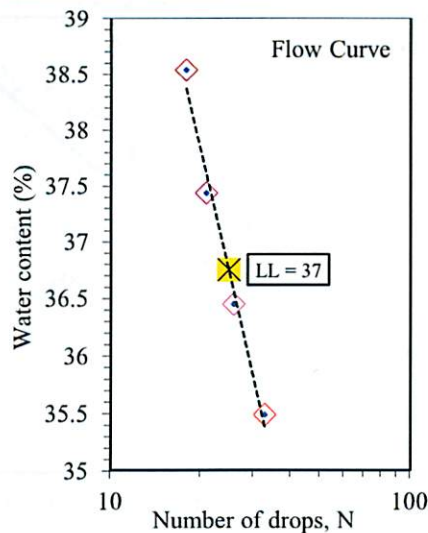
## Plastic Limit

Determination No	1	2				
Wet Soil + Tare (g)	28.75	29.37				
Dry Soil + Tare (g)	27.42	27.91				
Water Loss (g)	1.33	1.46				
Tare (g)	21.88	21.78				
Dry Soil (g)	5.54	6.13				
Water Content, w (%)	24.01	23.82				

## Liquid Limit

Determination No	1	2	3	4		
Number of Drops, N	33	26	21	18		
Wet Soil + Tare (g)	31.26	31.57	30.61	30.11		
Dry Soil + Tare (g)	28.85	29.04	28.30	27.89		
Water Loss (g)	2.41	2.53	2.31	2.22		
Tare (g)	22.06	22.10	22.13	22.13		
Dry Soil (g)	6.79	6.94	6.17	5.76		
Water Content, w (%)	35.49	36.46	37.44	38.54		
One-Point LL (%)		37	37			

<b>Liquid Limit, LL (%)</b>	<b>37</b>
<b>Plastic Limit, PL (%)</b>	<b>24</b>
<b>Plasticity Index, PI (%)</b>	<b>13</b>



Entered by: \_\_\_\_\_  
Reviewed: \_\_\_\_\_

# Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

**Project:** Snowbasin Parking Lot  
**No:** 02542-001  
**Location:** Snowbasin Resort, Huntsville, Utah  
**Date:** 6/2/2017  
**By:** BRR  
**Grooving tool type:** Plastic  
**Liquid limit device:** Mechanical  
**Rolling method:** Hand

**Boring No.:** TP-3  
**Sample:**  
**Depth:** 1'  
**Description:** Dark brown lean clay

**Preparation method:** Wet  
**Liquid limit test method:** Multipoint  
**Screened over No.40:** Yes  
**Larger particles removed:** Wet sieved  
**Approximate maximum grain size:** 3/4"  
**Estimated percent retained on No.40:** See Particle Size Distribution  
**As-received water content (%):** Not requested

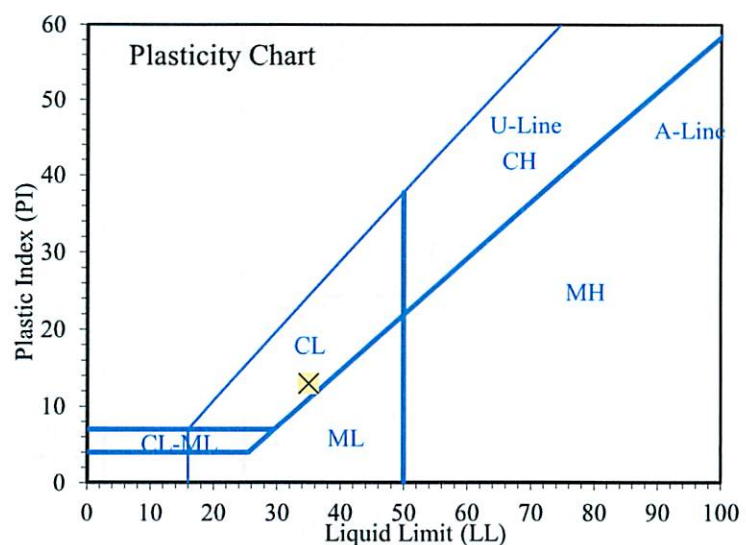
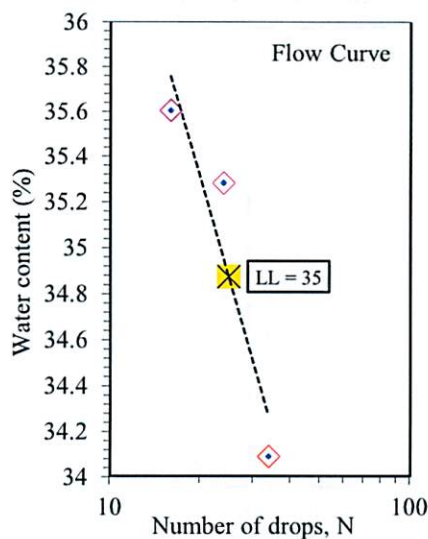
## Plastic Limit

Determination No	1	2				
Wet Soil + Tare (g)	28.21	28.66				
Dry Soil + Tare (g)	27.07	27.43				
Water Loss (g)	1.14	1.23				
Tare (g)	21.73	21.79				
Dry Soil (g)	5.34	5.64				
Water Content, w (%)	21.35	21.81				

## Liquid Limit

Determination No	1	2	3			
Number of Drops, N	34	24	16			
Wet Soil + Tare (g)	30.37	29.57	30.75			
Dry Soil + Tare (g)	28.27	27.64	28.40			
Water Loss (g)	2.10	1.93	2.35			
Tare (g)	22.11	22.17	21.80			
Dry Soil (g)	6.16	5.47	6.60			
Water Content, w (%)	34.09	35.28	35.61			
One-Point LL (%)		35				

<b>Liquid Limit, LL (%)</b>	<b>35</b>
<b>Plastic Limit, PL (%)</b>	<b>22</b>
<b>Plasticity Index, PI (%)</b>	<b>13</b>



Entered by: \_\_\_\_\_  
 Reviewed: \_\_\_\_\_

**Liquid Limit, Plastic Limit, and Plasticity Index of Soils**

(ASTM D4318)

**Project:** Snowbasin Parking Lot

**No:** 02542-001

**Location:** Snowbasin Resort, Huntsville, Utah

**Date:** 6/2/2017

**By:** BRR

**Grooving tool type:** Plastic

**Liquid limit device:** Mechanical

**Rolling method:** Hand

**Boring No.:** TP-4

**Sample:**

**Depth:** 2'

**Description:** Brown lean clay

**Preparation method:** Wet

**Liquid limit test method:** Multipoint

**Screened over No.40:** Yes

**Larger particles removed:** Wet sieved

**Approximate maximum grain size:** 3/4"

**Estimated percent retained on No.40:** Not requested

**As-received water content (%):** 21.8

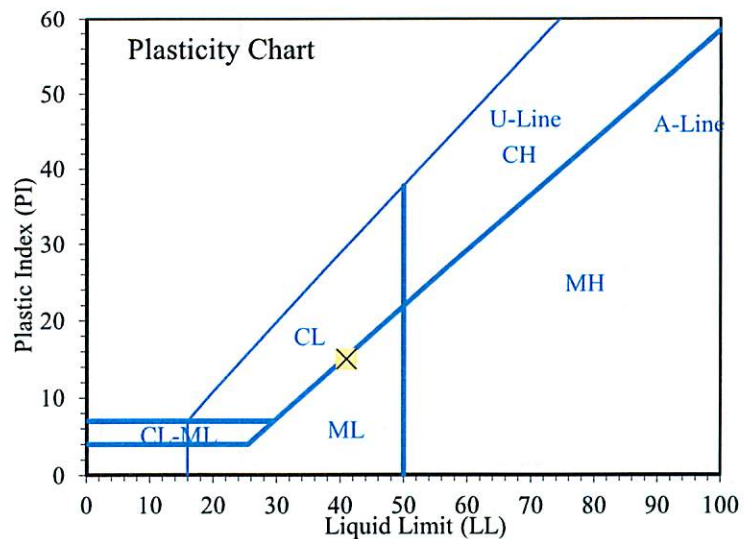
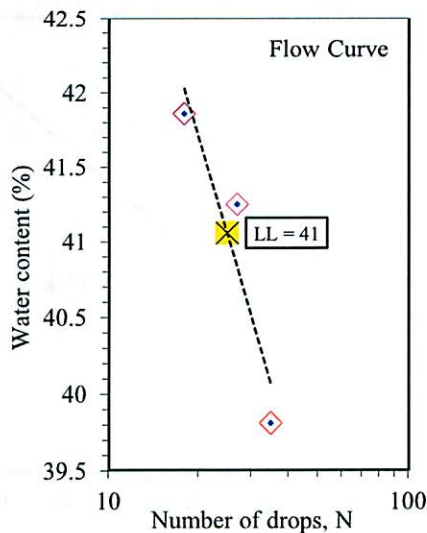
**Plastic Limit**

Determination No	1	2			
Wet Soil + Tare (g)	28.26	28.55			
Dry Soil + Tare (g)	26.96	27.18			
Water Loss (g)	1.30	1.37			
Tare (g)	21.85	21.89			
Dry Soil (g)	5.11	5.29			
Water Content, w (%)	25.44	25.90			

**Liquid Limit**

Determination No	1	2	3		
Number of Drops, N	35	27	18		
Wet Soil + Tare (g)	34.26	30.61	31.26		
Dry Soil + Tare (g)	30.84	28.11	28.56		
Water Loss (g)	3.42	2.50	2.70		
Tare (g)	22.25	22.05	22.11		
Dry Soil (g)	8.59	6.06	6.45		
Water Content, w (%)	39.81	41.25	41.86		
One-Point LL (%)		42			

<b>Liquid Limit, LL (%)</b>	<b>41</b>
<b>Plastic Limit, PL (%)</b>	<b>26</b>
<b>Plasticity Index, PI (%)</b>	<b>15</b>



Entered by: \_\_\_\_\_  
Reviewed: \_\_\_\_\_

**Liquid Limit, Plastic Limit, and Plasticity Index of Soils**

(ASTM D4318)

**Project:** Snowbasin Parking Lot

**No:** 02542-001

**Location:** Snowbasin Resort, Huntsville, Utah

**Date:** 6/2/2017

**By:** BRR

**Grooving tool type:** Plastic

**Liquid limit device:** Mechanical

**Rolling method:** Hand

**Boring No.:** TP-5

**Sample:**

**Depth:** 2'

**Description:** Brown lean clay

**Preparation method:** Wet

**Liquid limit test method:** Multipoint

**Screened over No.40:** Yes

**Larger particles removed:** Wet sieved

**Approximate maximum grain size:** 3/4"

**Estimated percent retained on No.40:** See Particle Size Distribution

**As-received water content (%):** Not requested

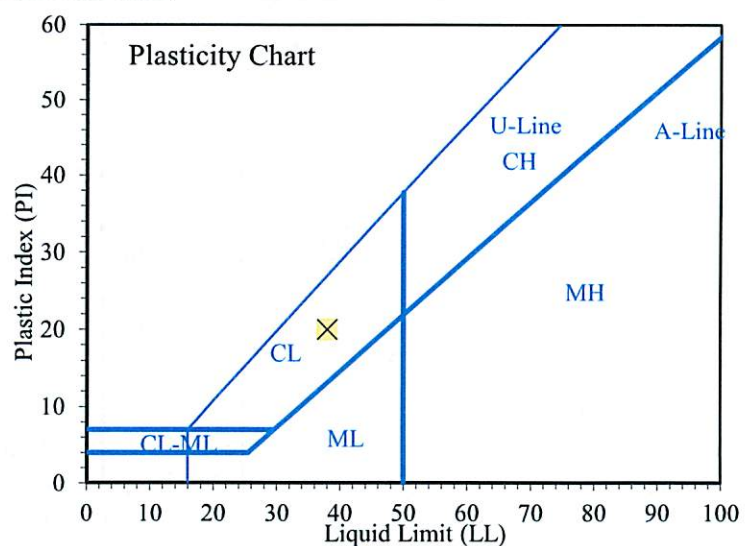
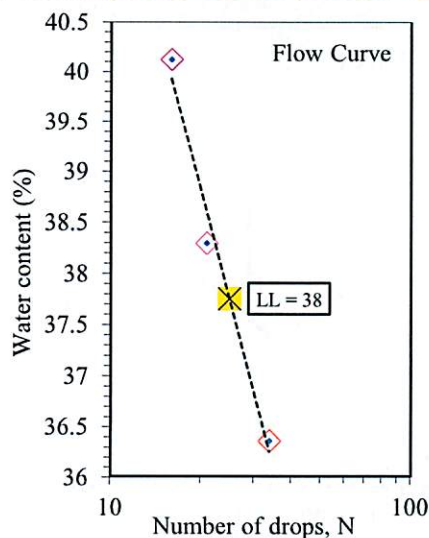
**Plastic Limit**

Determination No	1	2				
Wet Soil + Tare (g)	28.10	27.98				
Dry Soil + Tare (g)	27.15	27.00				
Water Loss (g)	0.95	0.98				
Tare (g)	21.62	21.55				
Dry Soil (g)	5.53	5.45				
Water Content, w (%)	17.18	17.98				

**Liquid Limit**

Determination No	1	2	3			
Number of Drops, N	34	21	16			
Wet Soil + Tare (g)	29.86	29.02	31.29			
Dry Soil + Tare (g)	27.86	27.04	28.69			
Water Loss (g)	2.00	1.98	2.60			
Tare (g)	22.36	21.87	22.21			
Dry Soil (g)	5.50	5.17	6.48			
Water Content, w (%)	36.36	38.30	40.12			
One-Point LL (%)		37				

<b>Liquid Limit, LL (%)</b>	<b>38</b>
<b>Plastic Limit, PL (%)</b>	<b>18</b>
<b>Plasticity Index, PI (%)</b>	<b>20</b>



Entered by: \_\_\_\_\_  
Reviewed: \_\_\_\_\_



# Water Content and Unit Weight of Soil

(In General Accordance with ASTM D7263 Method B and D2216)

**Project: Snowbasin Parking Lot**

**No: 02542-001**

**Location: Snowbasin Resort, Huntsville, Utah**

**Date: 6/2/2017**

**By: BRR**

Sample Info.	Boring No.	TP-1	TP-2	TP-2	TP-4	TP-4			
	Sample:								
	Depth:	1.5'	1.5'	4'	2'	3'			
Unit Weight Info.	Sample height, H (in)	4.069	4.894						
	Sample diameter, D (in)	2.416	2.416						
	Sample volume, V (ft <sup>3</sup> )	0.0108	0.0130						
	Mass rings + wet soil (g)	835.37	887.16						
	Mass rings/tare (g)	257.46	253.59						
	Moist soil, W <sub>s</sub> (g)	577.91	633.57						
	Moist unit wt., γ <sub>m</sub> (pcf)	118.02	107.58						
Water Content	Wet soil + tare (g)	704.20	847.49	1188.90	694.68	922.48			
	Dry soil + tare (g)	631.04	718.39	1097.94	592.37	828.47			
	Tare (g)	126.57	214.98	391.11	122.07	127.86			
<b>Water Content, w (%)</b>		<b>14.5</b>	<b>25.6</b>	<b>12.9</b>	<b>21.8</b>	<b>13.4</b>			
<b>Dry Unit Wt., γ<sub>d</sub> (pcf)</b>		<b>103.1</b>	<b>85.6</b>						

Entered by: \_\_\_\_\_

Reviewed: \_\_\_\_\_

# Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

**Project:** Snowbasin Parking Lot

**No:** 02542-001

**Location:** Snowbasin Resort, Huntsville, Utah

**Date:** 6/8/2017

**By:** BSS

**Boring No.:** TP-1

**Sample:**

**Depth:** 1.5'

**Description:** Brown sandy silty clay with gravel

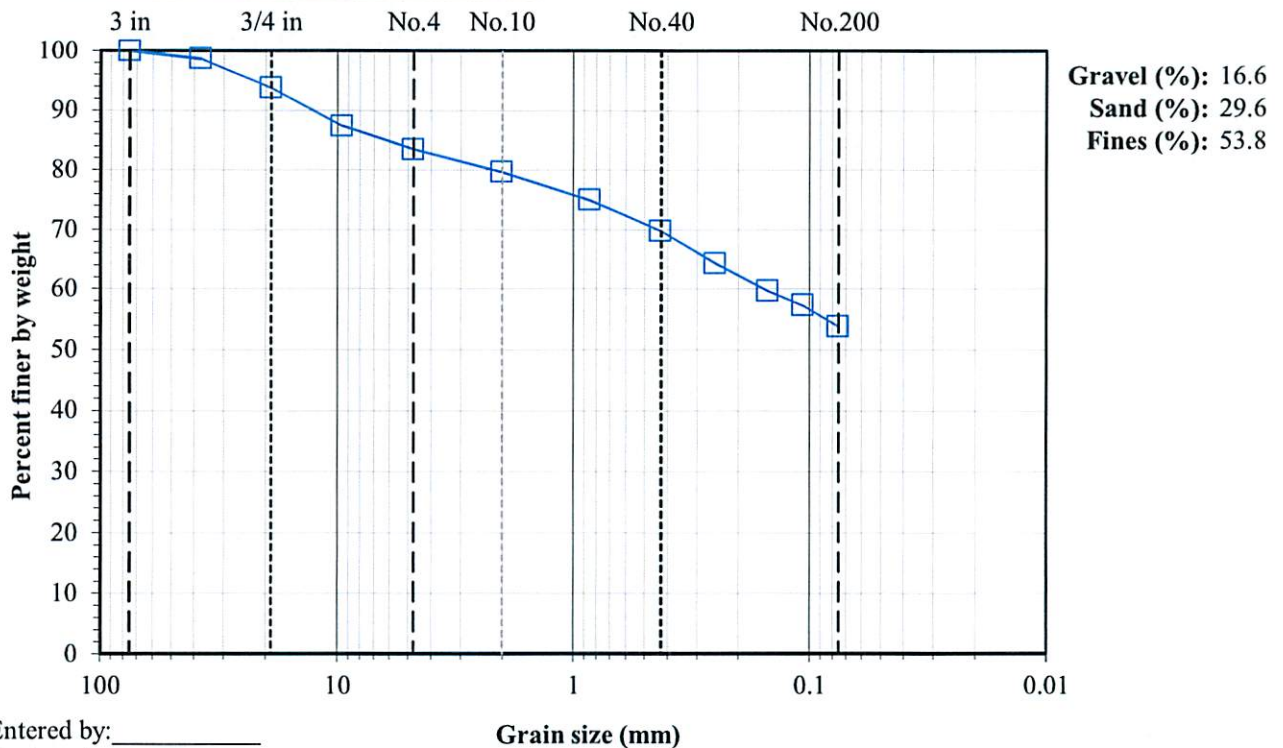
Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	100.0
1.5"	612.35	37.5	98.6
3/4"	2787.51	19	93.8
3/8"	105.08	9.5	87.4
No.4	170.05	4.75	83.4
No.10	232.06	2	79.6
No.20	309.51	0.85	74.9
No.40	394.48	0.425	69.7
No.60	483.57	0.25	64.3
No.100	558.72	0.15	59.7
No.140	598.43	0.106	57.3
No.200	654.89	0.075	53.8

Water content data		C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	3139.45	2039.70	
Dry soil + tare (g):	3120.42	1848.10	
Tare (g):	333.17	310.49	
Water content (%):	0.7	12.5	

Split:	Yes
Split sieve:	3/4"
Total sample wt. (g):	50000.24
+3/4" Coarse fraction (g):	2806.54
-3/4" Split fraction (g):	1729.21
Moist	Dry
44752.05	2787.51
1537.61	
Split fraction:	0.938



Entered by: \_\_\_\_\_  
Reviewed: \_\_\_\_\_

# Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

**Project:** Snowbasin Parking Lot

**No:** 02542-001

**Location:** Snowbasin Resort, Huntsville, Utah

**Date:** 6/5/2017

**By:** BRR

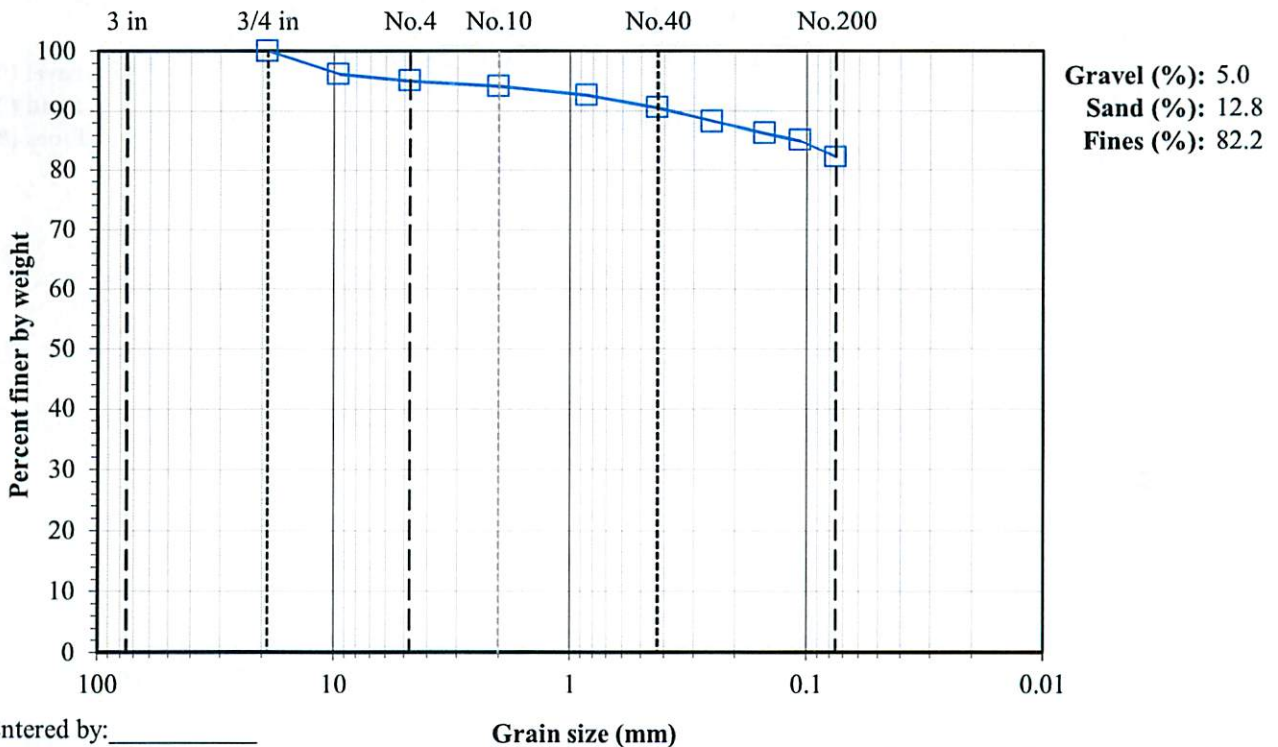
**Boring No.:** TP-2

**Sample:**

**Depth:** 1.5'

**Description:** Brown clay with sand

Split: No		Moist		Dry	
-		-		-	
Total sample wt. (g): 632.51		320.00		312.51	
Split fraction: 1.000					
<u>Water content data</u>					
Moist soil + tare (g): -		847.49			
Dry soil + tare (g): -		718.39			
Tare (g): -		214.98			
Water content (%): 0.0		25.6			
Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer		
8"	-	200	-		
6"	-	150	-		
4"	-	100	-		
3"	-	75	-		
1.5"	-	37.5	-		
3/4"	-	19	100.0		
3/8"	19.58	9.5	96.1		
No.4	25.08	4.75	95.0		
No.10	29.67	2	94.1		
No.20	37.24	0.85	92.6		
No.40	47.67	0.425	90.5		
No.60	59.24	0.25	88.2		
No.100	68.92	0.15	86.3		
No.140	75.26	0.106	85.0		
No.200	89.42	0.075	82.2		



Entered by: \_\_\_\_\_  
Reviewed: \_\_\_\_\_

# Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

**Project:** Snowbasin Parking Lot

**Boring No.:** TP-3

**No:** 02542-001

**Sample:**

**Location:** Snowbasin Resort, Huntsville, Utah

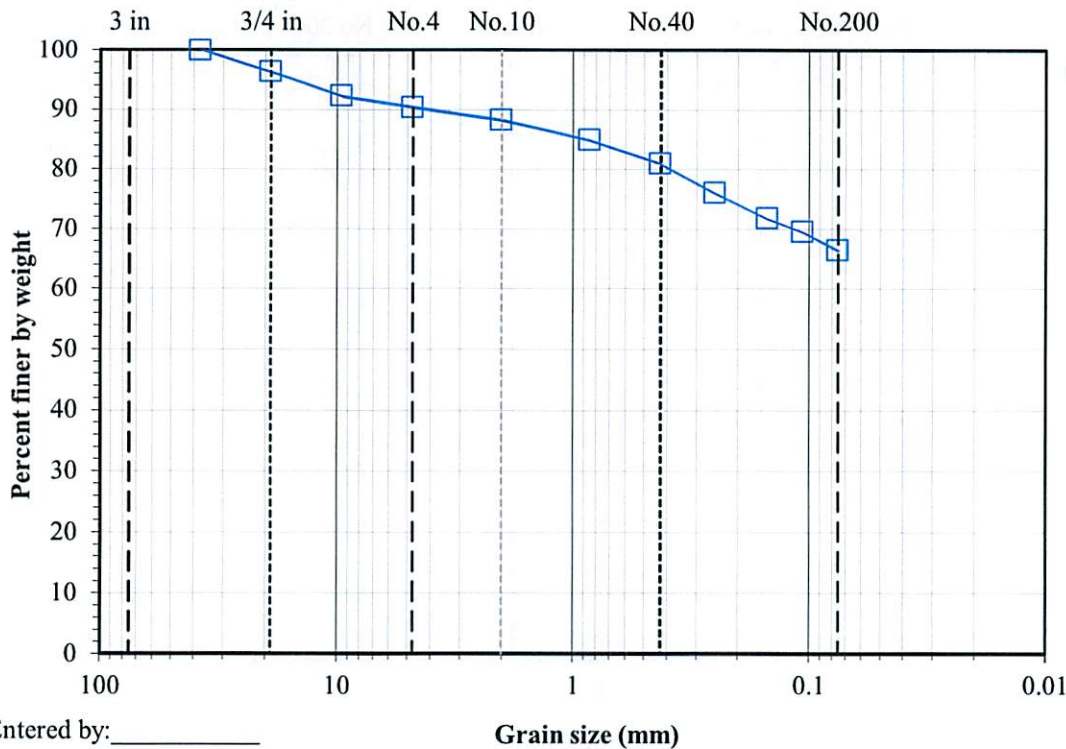
**Depth:** 1'

**Date:** 6/2/2017

**Description:** Dark brown sandy clay

**By:** BSS

		Water content data		C.F.(+3/8")	S.F.(-3/8")
Split: Yes				2088.46	683.66
Split sieve: 3/8"				2063.90	606.43
		Moist	Dry	Tare (g): 467.94	312.11
Total sample wt. (g): 25449.29		20471.73		Water content (%): 1.5      26.2	
+3/8" Coarse fraction (g): 1620.63		1596.07			
-3/8" Split fraction (g): 371.55		294.32			
Split fraction: 0.922					
Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer		
8"	-	200	-		
6"	-	150	-		
4"	-	100	-		
3"	-	75	-		
1.5"	-	37.5	100.0		
3/4"	763.16	19	96.3		
3/8"	1596.07	9.5	92.2	←Split	
No.4	5.96	4.75	90.3		
No.10	12.69	2	88.2		
No.20	23.48	0.85	84.8		
No.40	36.09	0.425	80.9		
No.60	51.71	0.25	76.0		
No.100	65.48	0.15	71.7		
No.140	72.58	0.106	69.5		
No.200	82.30	0.075	66.4		



Entered by: \_\_\_\_\_  
Reviewed: \_\_\_\_\_

# Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

**Project:** Snowbasin Parking Lot

**No:** 02542-001

**Location:** Snowbasin Resort, Huntsville, Utah

**Date:** 6/6/2017

**By:** DKS

**Boring No.:** TP-3

**Sample:**

**Depth:** 3'

**Description:** Brown clayey sand

		Moist		Dry	
Split:		Yes			
Split sieve:		3/8"			
Total sample wt. (g):		26192.19		24474.61	
+3/8" Coarse fraction (g):		2812.18		2799.31	
-3/8" Split fraction (g):		556.14		515.59	
Split fraction:		0.886			

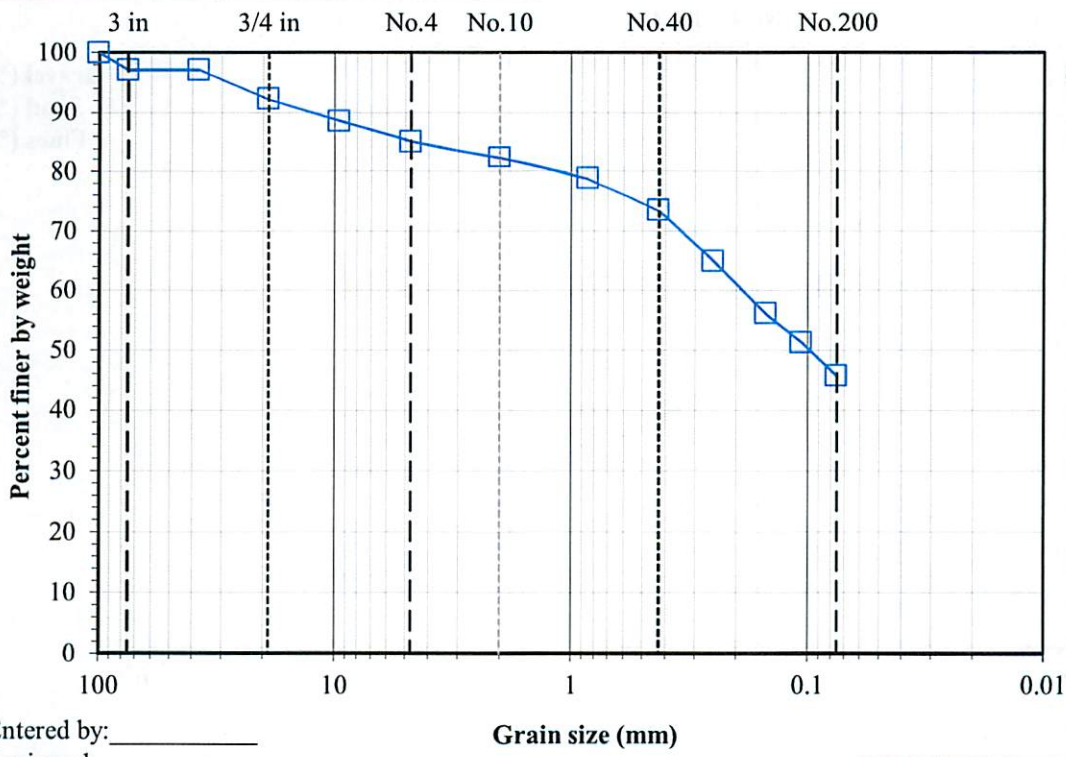
  

		C.F.(+3/8")		S.F.(-3/8")	
Moist soil + tare (g):		3875.76		771.47	
Dry soil + tare (g):		3862.30		730.92	
Tare (g):		934.97		215.33	
Water content (%):		0.5		7.9	

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	100.0
3"	716.08	75	97.1
1.5"	716.08	37.5	97.1
3/4"	1908.16	19	92.2
3/8"	2799.31	9.5	88.6
No.4	20.06	4.75	85.1
No.10	36.01	2	82.4
No.20	57.11	0.85	78.8
No.40	88.18	0.425	73.4
No.60	137.65	0.25	64.9
No.100	188.86	0.15	56.1
No.140	217.17	0.106	51.3
No.200	249.77	0.075	45.7

← Split



**Gravel (%):** 14.9  
**Sand (%):** 39.5  
**Fines (%):** 45.7

Entered by: \_\_\_\_\_  
Reviewed: \_\_\_\_\_

**Grain size (mm)**

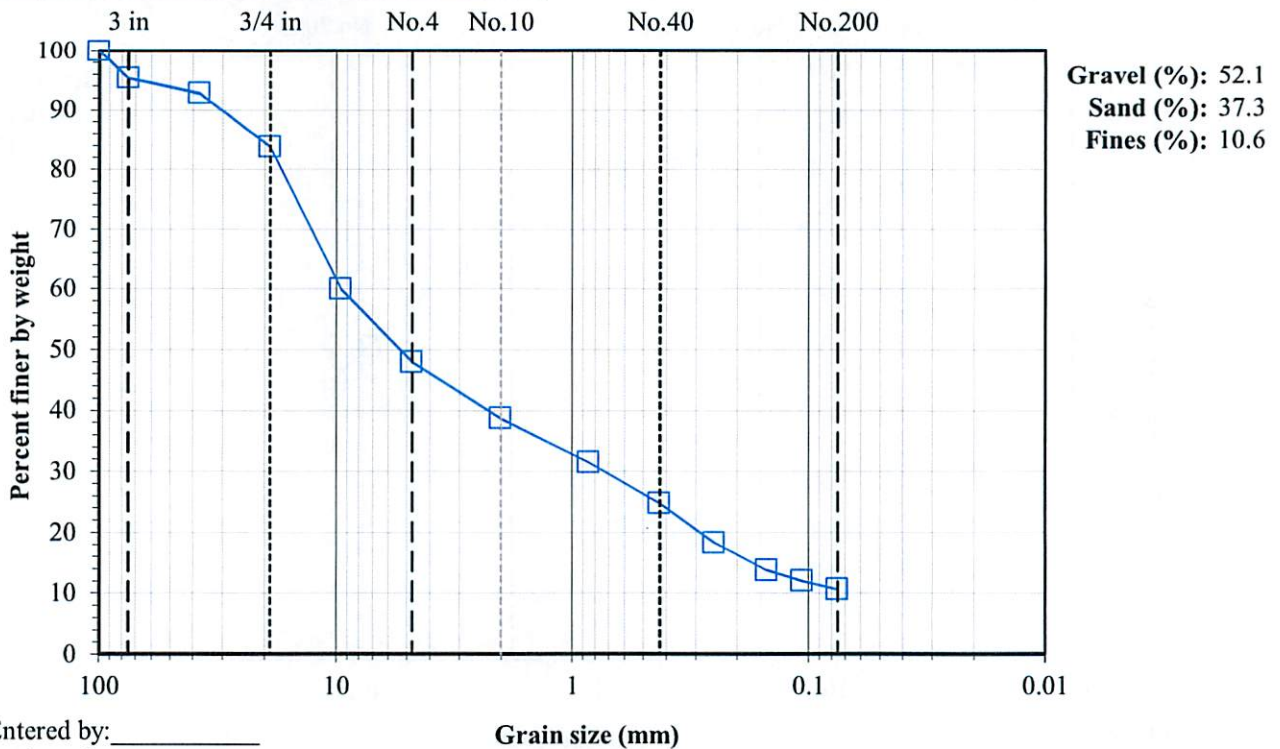
**Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis**

(ASTM D6913)

**Project:** Snowbasin Parking Lot  
**No:** 02542-001  
**Location:** Snowbasin Resort, Huntsville, Utah  
**Date:** 6/5/2017  
**By:** BRR

**Boring No.:** TP-4  
**Sample:**  
**Depth:** 1'  
**Description:** Brown gravel with clay and sand

Split: Yes Split sieve: 3/4" Moist                      Dry Total sample wt. (g): 30446.40    28467.12 +3/4" Coarse fraction (g): 4901.60    4603.11 -3/4" Split fraction (g): 1593.82    1488.95  Split fraction: 0.838		<u>Water content data</u> C.F.(+3/4") S.F.(-3/4") Moist soil + tare (g): 1760.71    2004.25 Dry soil + tare (g): 1678.37    1899.38 Tare (g): 408.58    410.43 Water content (%): 6.5    7.0	
Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	100.0
3"	1317.09	75	95.4
1.5"	2057.86	37.5	92.8
3/4"	4603.11	19	83.8
3/8"	423.68	9.5	60.0
No.4	637.61	4.75	47.9
No.10	801.43	2	38.7
No.20	929.59	0.85	31.5
No.40	1049.24	0.425	24.8
No.60	1165.21	0.25	18.2
No.100	1245.02	0.15	13.7
No.140	1275.52	0.106	12.0
No.200	1300.65	0.075	10.6



Entered by: \_\_\_\_\_  
 Reviewed: \_\_\_\_\_

# Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

**Project:** Snowbasin Parking Lot

**No:** 02542-001

**Location:** Snowbasin Resort, Huntsville, Utah

**Date:** 6/6/2017

**By:** DKS

**Boring No.:** TP-5

**Sample:**

**Depth:** 2'

**Description:** Brown clayey gravel with sand

		Moist		Dry	
Split: Yes		24007.70		22697.53	
Split sieve: 3/4"		6213.30		6206.87	
Total sample wt. (g):		24007.70		22697.53	
+3/4" Coarse fraction (g):		6213.30		6206.87	
-3/4" Split fraction (g):		1690.80		1566.92	
Split fraction:		0.727			

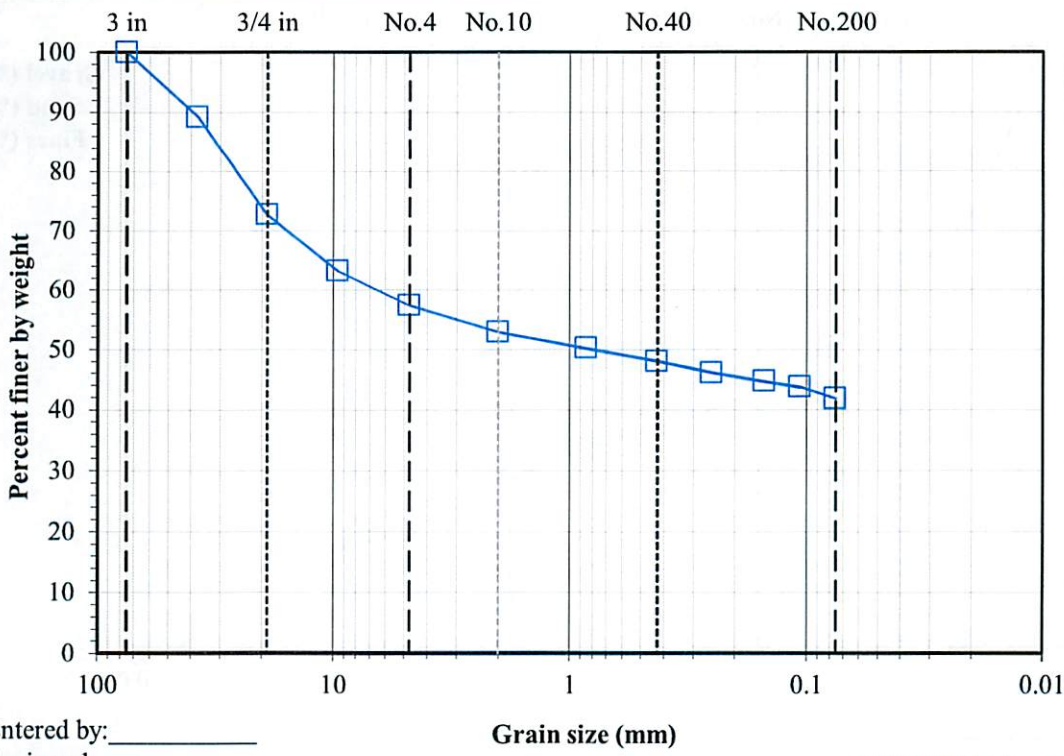
  

		C.F.(+3/4")		S.F.(-3/4")	
Moist soil + tare (g):		2872.45		2158.70	
Dry soil + tare (g):		2869.96		2034.82	
Tare (g):		465.10		467.90	
Water content (%):		0.1		7.9	

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	100.0
1.5"	2455.96	37.5	89.2
3/4"	6206.87	19	72.7
3/8"	204.64	9.5	63.2
No.4	329.20	4.75	57.4
No.10	425.95	2	52.9
No.20	483.04	0.85	50.3
No.40	530.99	0.425	48.0
No.60	572.18	0.25	46.1
No.100	603.57	0.15	44.7
No.140	623.98	0.106	43.7
No.200	664.77	0.075	41.8

← Split



**Gravel (%):** 42.6  
**Sand (%):** 15.6  
**Fines (%):** 41.8

Entered by: \_\_\_\_\_  
Reviewed: \_\_\_\_\_

**Grain size (mm)**

# Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

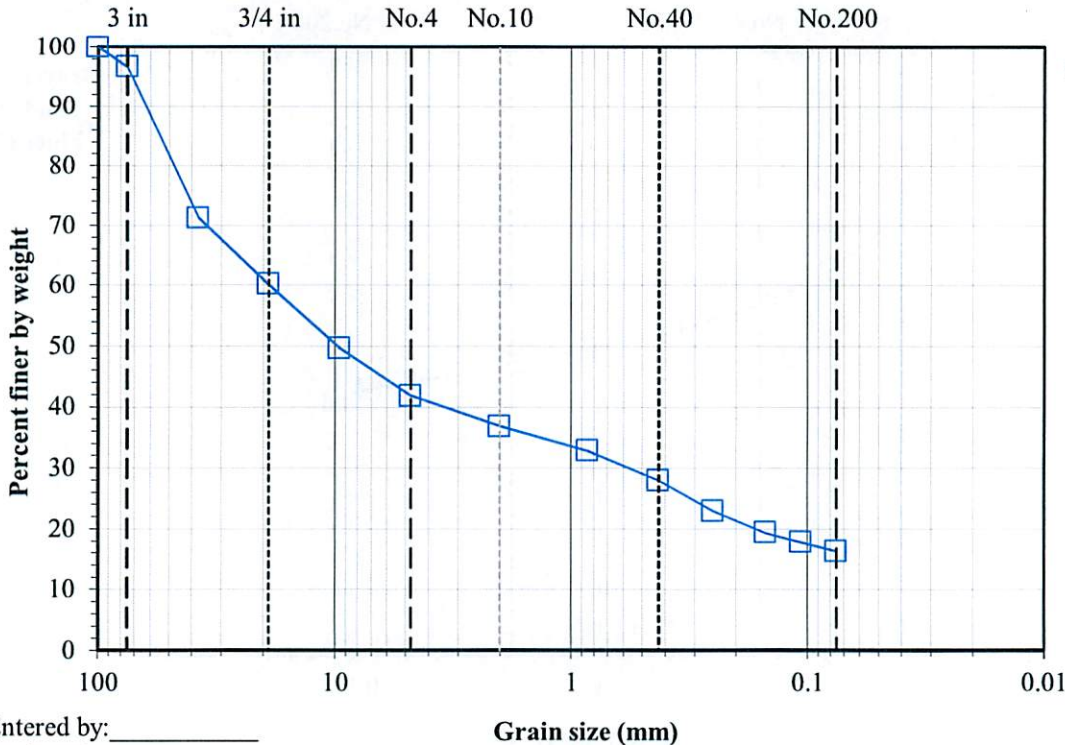
**Project:** Snowbasin Parking Lot  
**No:** 02542-001  
**Location:** Snowbasin Resort, Huntsville, Utah  
**Date:** 6/5/2017  
**By:** BRR

**Boring No.:** TP-6  
**Sample:**  
**Depth:** 2'  
**Description:** Brown clayey gravel with sand

Split: Yes Split sieve: 3/4" Moist                  Dry Total sample wt. (g): 21421.30    20729.59 +3/4" Coarse fraction (g): 8294.60    8259.37 -3/4" Split fraction (g): 1592.45    1512.81 Split fraction: 0.602		Water content data C.F.(+3/4") S.F.(-3/4") Moist soil + tare (g): 2175.15    1916.65 Dry soil + tare (g): 2167.25    1837.01 Tare (g): 315.07    324.20 Water content (%): 0.4    5.3	
---	--	---	--

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	100.0
3"	696.53	75	96.6
1.5"	5961.67	37.5	71.2
3/4"	8259.37	19	60.2
3/8"	264.35	9.5	49.6
No.4	459.75	4.75	41.9
No.10	587.10	2	36.8
No.20	687.34	0.85	32.8
No.40	809.97	0.425	27.9
No.60	936.45	0.25	22.9
No.100	1025.63	0.15	19.4
No.140	1065.48	0.106	17.8
No.200	1103.16	0.075	16.3

← Split



**Gravel (%):** 58.1  
**Sand (%):** 25.6  
**Fines (%):** 16.3

Entered by: \_\_\_\_\_  
 Reviewed: \_\_\_\_\_



# Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

**Project:** Snowbasin Parking Lot

**No:** 02542-001

**Location:** Snowbasin Resort, Huntsville, Utah

**Date:** 6/6/2017

**By:** DKS

**Boring No.:** TP-6

**Sample:**

**Depth:** 3'

**Description:** Dark brown clayey gravel with sand

		Moist		Dry	
Split:		Yes			
Split sieve:		3/4"			
Total sample wt. (g):		22726.78		19792.16	
+3/4" Coarse fraction (g):		3644.73		3580.18	
-3/4" Split fraction (g):		1530.25		1300.09	
Split fraction:		0.819			

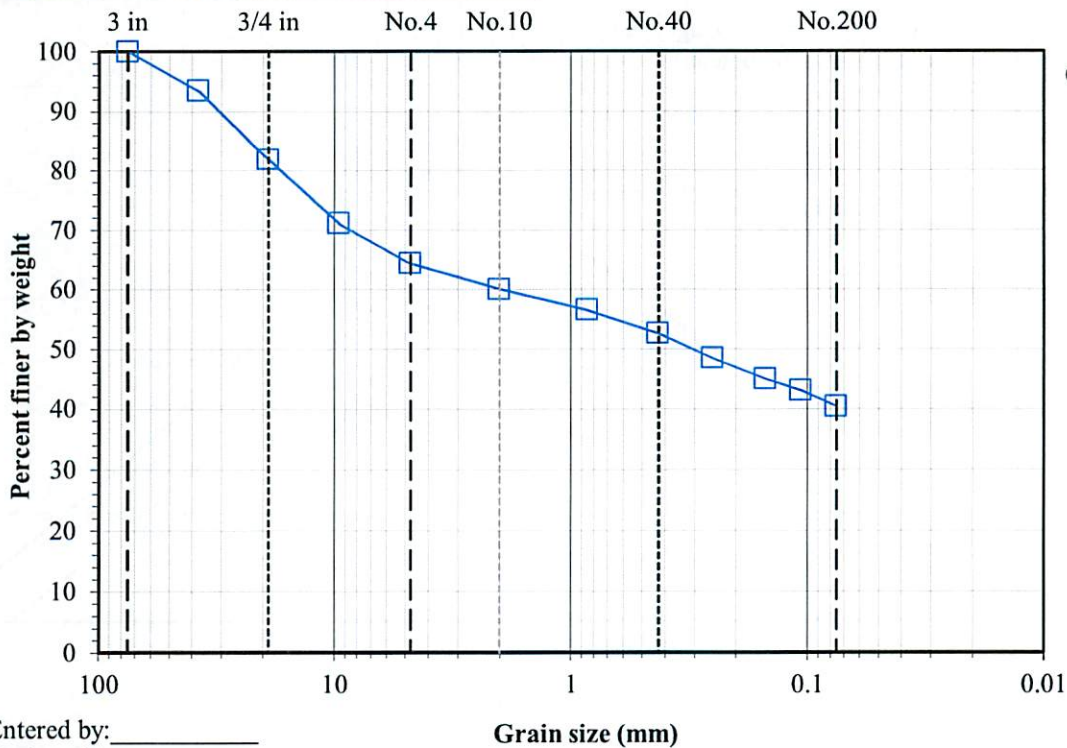
  

		C.F.(+3/4")		S.F.(-3/4")	
Moist soil + tare (g):		4693.80		1856.88	
Dry soil + tare (g):		4623.70		1626.72	
Tare (g):		735.72		326.63	
Water content (%):		1.8		17.7	

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	100.0
1.5"	1308.52	37.5	93.4
3/4"	3580.18	19	81.9
3/8"	172.17	9.5	71.1
No.4	279.20	4.75	64.3
No.10	347.84	2	60.0
No.20	403.03	0.85	56.5
No.40	465.48	0.425	52.6
No.60	531.70	0.25	48.4
No.100	586.83	0.15	44.9
No.140	618.05	0.106	43.0
No.200	659.18	0.075	40.4

← Split



Entered by: \_\_\_\_\_  
Reviewed: \_\_\_\_\_

**Laboratory Compaction Characteristics of Soil**

(ASTM D698 / D1557)

**Project:** Snowbasin Parking Lot

**No:** 02542-001

**Location:** Snowbasin Resort, Hunstville, Utah

**Date:** 6/2/2017

**By:** BSS

**Method:** ASTM D1557 C

**Mold Id.** Inc 7

**Mold volume (ft<sup>3</sup>):** 0.0752

**Boring No.:** TP-1

**Sample:**

**Depth:** 1.5'

**Sample Description:** Brown sandy silty clay

**Engineering Classification:** Not requested

**As-received water content (%):** Not requested

**Preparation method:** Moist

**Rammer:** Mechanical-sector face

**Rock Correction:** Yes \* See results below

**Percent fraction retained, P<sub>c</sub> (%)** 6.3

**Percent fraction passing, P<sub>f</sub> (%)** 93.7

**Optimum water content (%):** 9.2

**Maximum dry unit weight (pcf):** 128.4

Point Number	-4%	-2%	-6%	As Is	-8%			
Wt. Sample + Mold (g)	11227.9	11194.1	11030.4	11016.2	10784.2			
Wt. of Mold (g)	6504.1	6504.1	6504.1	6504.1	6504.1			
Wet Unit Wt., $\gamma_m$ (pcf)	138.5	137.5	132.7	132.3	125.5			
Wet Soil + Tare (g)	1976.26	2068.15	2312.55	2241.87	1868.15			
Dry Soil + Tare (g)	1855.90	1898.56	2196.51	2023.05	1803.01			
Tare (g)	408.72	311.01	408.26	310.29	310.37			
Water Content, w (%)	8.3	10.7	6.5	12.8	4.4			
Dry Unit Wt., $\gamma_d$ (pcf)	127.8	124.2	124.6	117.3	120.2			

**\*Correction of Unit Weight and Water Content for Soils Containing Oversize Particles**

(ASTM D4718)

**Oversized fraction, +3/4-in. (%)**: 6.3

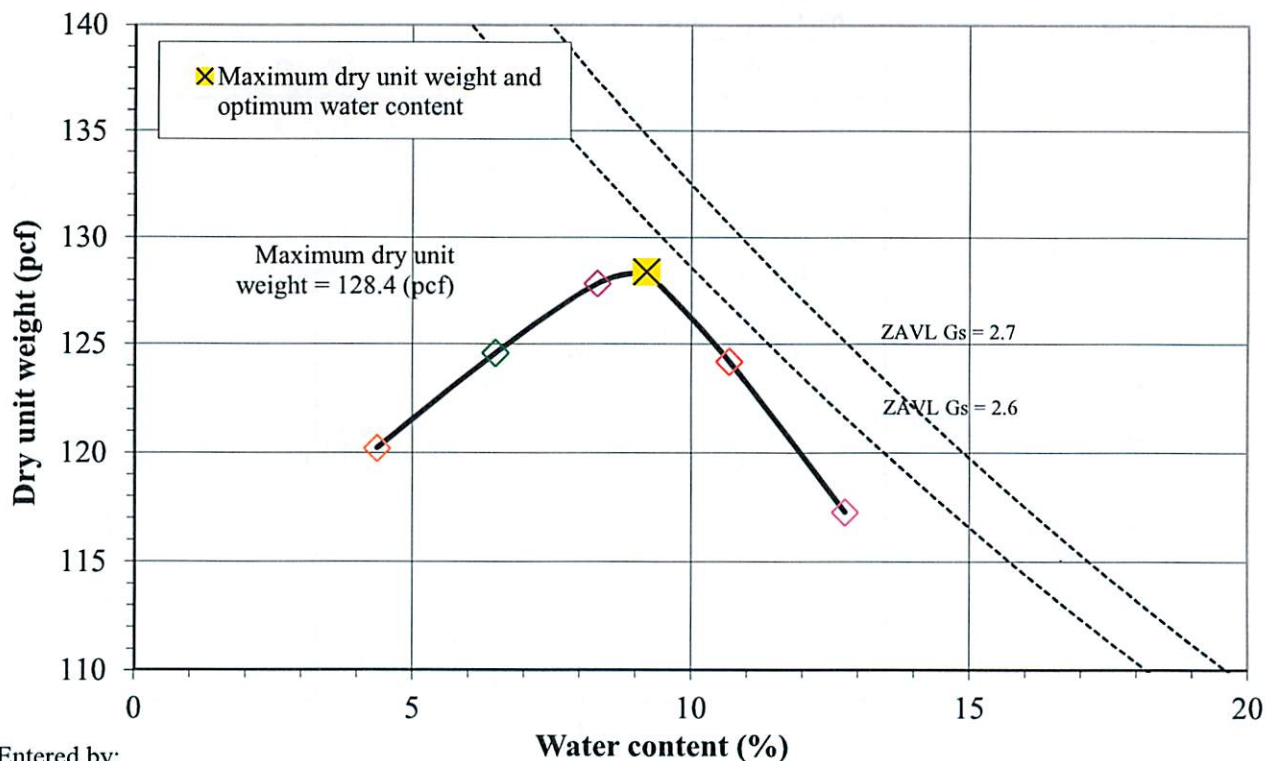
**Water content, +3/4-in. (%)**: 0.7

**Sieve for oversized fraction:** 3/4-in.

**Bulk specific gravity, G<sub>s</sub>:** 2.65 Assumed

**Corrected water content (%):** 8.7

**Corrected dry unit weight (pcf):** 130.2



Entered by: \_\_\_\_\_

Reviewed: \_\_\_\_\_

**Laboratory Compaction Characteristics of Soil**

(ASTM D698 / D1557)

**Project:** Snowbasin Parking Lot  
**No:** 02542-001  
**Location:** Snowbasin Resort, Hunstville, Utah  
**Date:** 6/6/2017  
**By:** BSS

**Boring No.:** TP-3

**Sample:**

**Depth:** 1'

**Sample Description:** Dark brown sandy clay

**Engineering Classification:** Not requested

**As-received water content (%):** Not requested

**Preparation method:** Moist

**Rammer:** Mechanical-circular face

**Rock Correction:** Yes \* See results below

**Percent fraction retained, Pc (%)** 7.8

**Percent fraction passing, Pf (%)** 92.2

**Method:** ASTM D1557 B  
**Mold Id.** Inc 2  
**Mold volume (ft<sup>3</sup>):** 0.0332

**Optimum water content (%):** 14.4  
**Maximum dry unit weight (pcf):** 110.2

Point Number	-4%	-6%	-8%	-2%	-10%	-12%	-14%	-16%
Wt. Sample + Mold (g)	5979.2	6017.2	6054.1	5937.9	6048.4	6027.1	5983.2	5896.5
Wt. of Mold (g)	4148.6	4148.6	4148.6	4148.6	4148.6	4148.6	4148.6	4148.6
Wet Unit Wt., $\gamma_m$ (pcf)	121.4	124.0	126.4	118.7	126.0	124.6	121.7	116.0
Wet Soil + Tare (g)	1392.98	1414.36	1194.66	1190.83	1350.22	1147.26	1036.17	1045.66
Dry Soil + Tare (g)	1229.78	1250.64	1068.84	1022.26	1233.02	1039.81	955.95	978.09
Tare (g)	462.90	408.92	331.46	310.52	464.13	221.75	214.17	223.38
Water Content, w (%)	21.3	19.5	17.1	23.7	15.2	13.1	10.8	9.0
Dry Unit Wt., $\gamma_d$ (pcf)	100.1	103.8	108.0	96.0	109.4	110.1	109.8	106.4

**\*Correction of Unit Weight and Water Content for Soils Containing Oversize Particles**

(ASTM D4718)

Oversized fraction, +3/8-in. (%): 7.8

Water content, +3/8-in. (%): 1.5

Sieve for oversized fraction: 3/8-in.

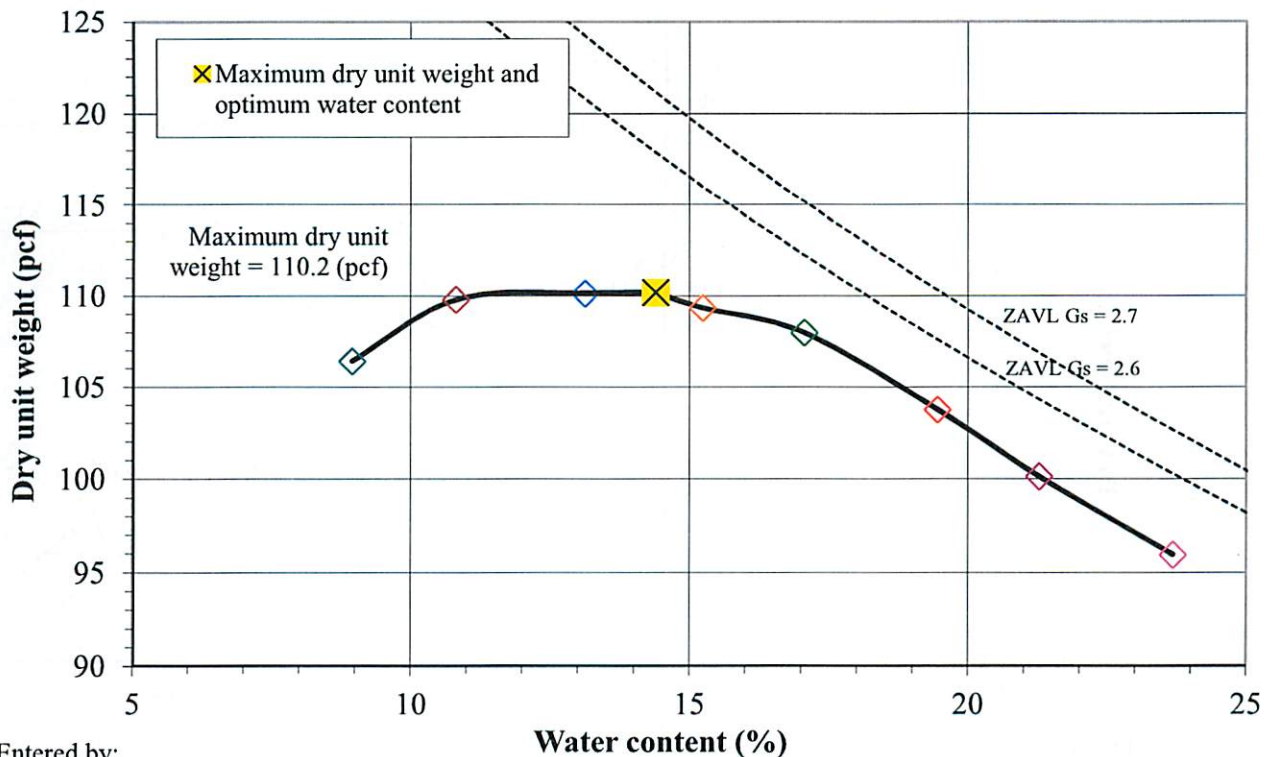
Bulk specific gravity, Gs: 2.65 Assumed

**Corrected water content (%):** 13.4

**Corrected dry unit weight (pcf):** 113.1

**Comments:**

Due to insufficient sample quantity points -12%, -14%, and -16% contained previously compacted material.



Entered by: \_\_\_\_\_

Reviewed: \_\_\_\_\_

**Laboratory Compaction Characteristics of Soil**

(ASTM D698 / D1557)

**Project:** Snowbasin Parking Lot

**No:** 02542-001

**Location:** Snowbasin Resort, Hunstville, Utah

**Date:** 6/6/2017

**By:** DKS

**Method:** ASTM D1557 C

**Mold Id.** Inc 4

**Mold volume (ft<sup>3</sup>):** 0.0750

**Boring No.:** TP-5

**Sample:**

**Depth:** 2'

**Sample Description:** Brown clayey gravel with sand

**Engineering Classification:** Not requested

**As-received water content (%):** Not requested

**Preparation method:** Moist

**Rammer:** Mechanical-sector face

**Rock Correction:** Yes \* See results below

**Percent fraction retained, Pc (%)** 27.3

**Percent fraction passing, Pf (%)** 72.7

**Optimum water content (%):** 11

**Maximum dry unit weight (pcf):** 126

Point Number	As Is	+2%	+4%	+6%	-2%			
Wt. Sample + Mold (g)	10072.1	10264.1	10284.5	10167.3	9671.2			
Wt. of Mold (g)	5581.5	5581.5	5581.5	5581.5	5581.5			
Wet Unit Wt., $\gamma_m$ (pcf)	132.0	137.6	138.2	134.8	120.2			
Wet Soil + Tare (g)	2277.87	1799.72	2032.47	1650.51	1651.14			
Dry Soil + Tare (g)	2122.91	1665.65	1845.84	1503.45	1590.33			
Tare (g)	310.99	314.99	310.21	408.23	327.85			
Water Content, w (%)	8.6	9.9	12.2	13.4	4.8			
Dry Unit Wt., $\gamma_d$ (pcf)	121.6	125.2	123.2	118.8	114.7			

**\*Correction of Unit Weight and Water Content for Soils Containing Oversize Particles**

(ASTM D4718)

**Oversized fraction, +3/4-in. (%):** 27.3

**Water content, +3/4-in. (%):** 0.1

**Corrected water content (%):** 8.0

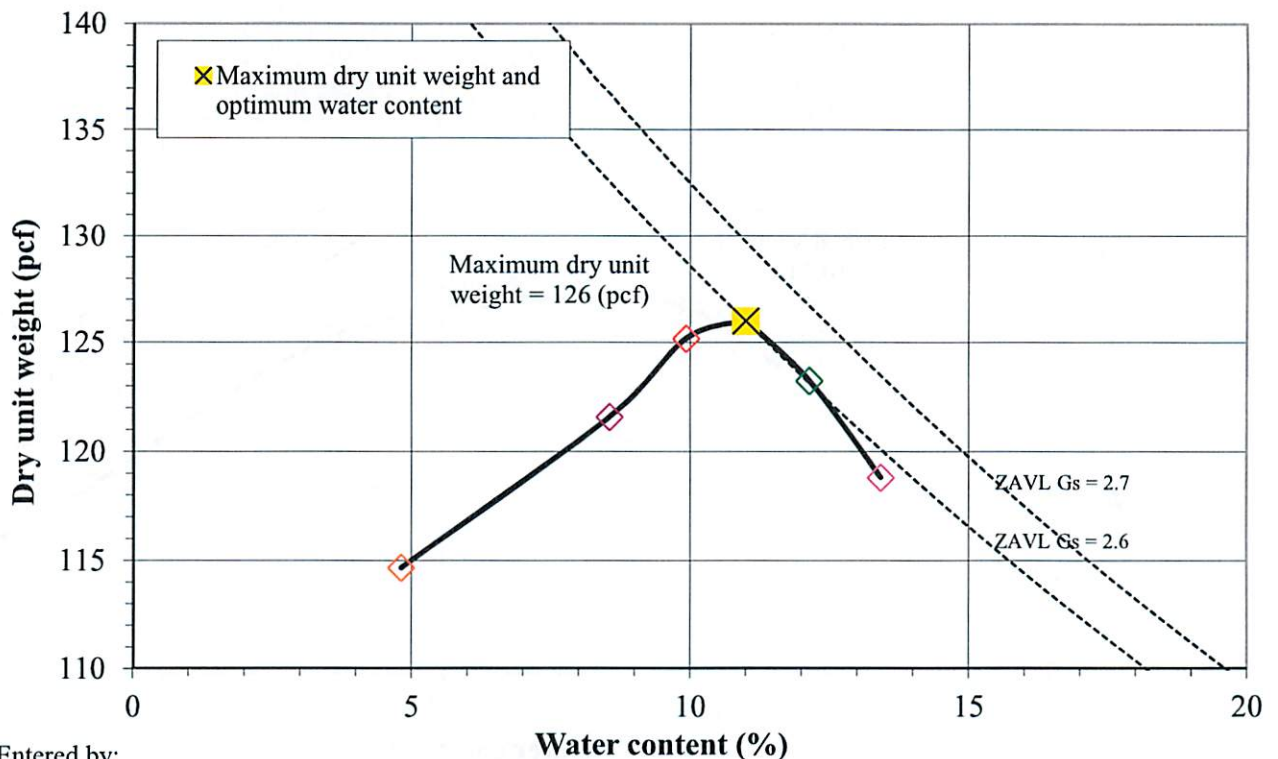
**Corrected dry unit weight (pcf):** 134.8

**Sieve for oversized fraction:** 3/4-in.

**Comments:**

**Bulk specific gravity, Gs:** 2.65 Assumed

Due to insufficient sample quantity points +2%, +4%, +6% and -2% contained previously compacted material.



Entered by: \_\_\_\_\_

Reviewed: \_\_\_\_\_

**California Bearing Ratio**

(ASTM D 1883)



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**Project:** Snowbasin Parking Lot  
**Number:** 02542-001  
**Location:** Snowbasin Resort, Huntsville, Utah  
**Date:** 6/12/2017  
**By:** BSS

**Boring No.:** TP-1  
**Sample:**  
**Depth:** 1.5'  
**Original Method:** ASTM D1557 C  
**Engineering Classification:** Not requested  
**Condition of Sample:** Unsoaked  
**Scalp and Replace:** No

Maximum Dry Unit Weight (pcf): 128.4  
 Optimum Water Content (%): 9.2  
 Relative Compaction (%): 94.8  
**0.1 in. CBR (%): 2.8**  
**0.2 in. CBR (%): 2.8**

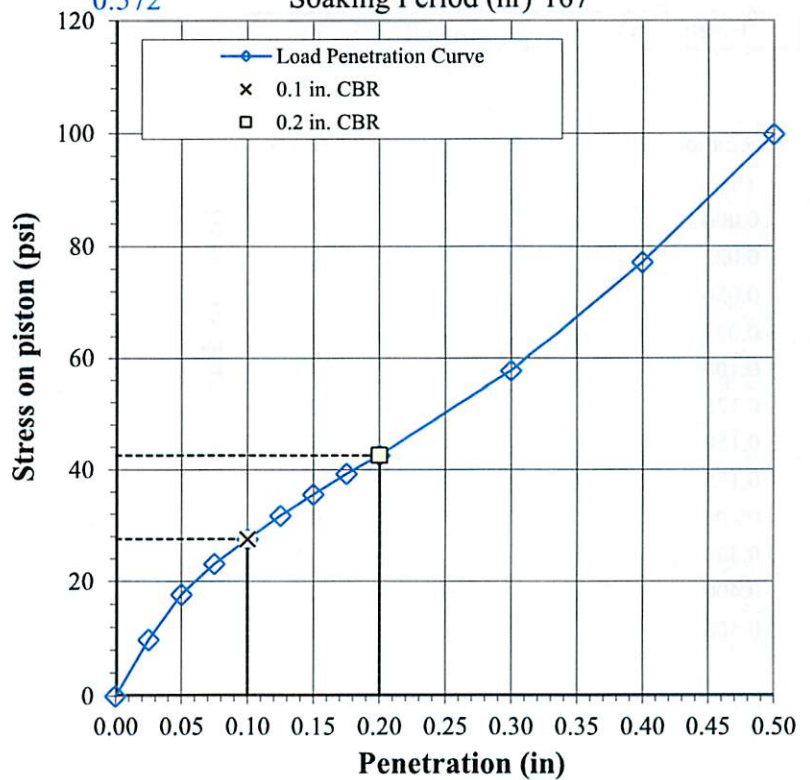
As Compacted Data		Before	After
Mold Id. PR-909	Wet Soil + Tare (g)	1387.51	1347.13
Wt. of Mold + Sample (g) 11627.3	Dry Soil + Tare (g)	1296.38	1266.18
Wt. of Mold (g) 7097.3	Tare (g)	332.28	409.77
Dry Unit Weight (pcf) 121.8	Water Content (%)	9.5	9.5
After Soaking Data		Average	Top 1 in.
Wt. of Mold + Sample (g) 11761.6	Wet Soil + Tare (g)	1799.49	1555.69
Dry Unit Weight (pcf) 121.2	Dry Soil + Tare (g)	1643.62	1421.74
	Tare (g)	316.59	467.94
	Water Content (%)	11.7	14.0

Swell Data			
Date	Time	Dial	Surcharge (psf) 50
6/2/2017	16:52	0.552	Swell (%) 0.44
6/9/2017	15:31	0.572	Soaking Period (hr) 167

Penetration Data	Piston ID	CBR T1
------------------	-----------	--------

Zero load (lb) = 0  
 Area of Piston (in<sup>2</sup>) = 3.0

Penetration (in.)	Raw Load (lb)	Piston Stress (psi)	Std. Stress (psi)
0.000	0	0	
0.025	30	10	
0.050	53	18	
0.075	69	23	
0.100	83	28	1000
0.125	95	32	1125
0.150	107	36	1250
0.175	118	39	1375
0.200	128	43	1500
0.300	173	58	1900
0.400	232	77	2300
0.500	299	100	2600



**Comments**

Soaking period exceeded the recommended time of 96 hours.

Entered By: \_\_\_\_\_  
 Reviewed: \_\_\_\_\_

**California Bearing Ratio**

(ASTM D 1883)



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**Project:** Snowbasin Parking Lot  
**Number:** 02542-001  
**Location:** Snowbasin Resort, Huntsville, Utah  
**Date:** 6/13/2017  
**By:** DKS

**Boring No.:** TP-3  
**Sample:**  
**Depth:** 1'  
**Original Method:** ASTM D1557 B  
**Engineering Classification:** Not requested  
**Condition of Sample:** Unsoaked  
**Scalp and Replace:** No

Maximum Dry Unit Weight (pcf): 110.2  
 Optimum Water Content (%): 14.4  
 Relative Compaction (%): 94.6  
**0.1 in. CBR (%): 3.4**  
**0.2 in. CBR (%): 4.2**

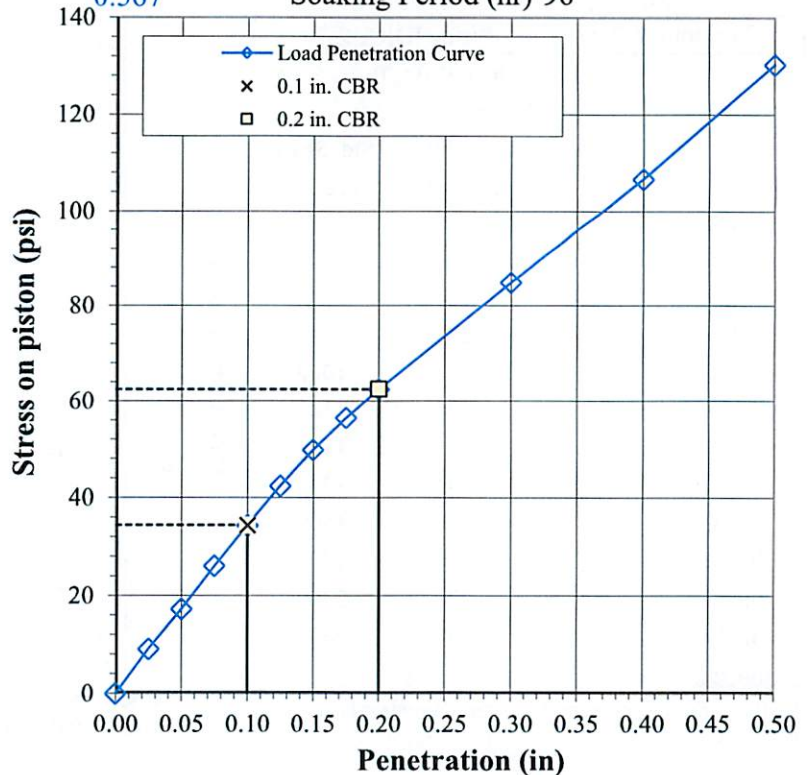
As Compacted Data		Before	After
Mold Id. E	Wet Soil + Tare (g)	1287.59	1673.31
Wt. of Mold + Sample (g) 11293.2	Dry Soil + Tare (g)	1162.22	1501.37
Wt. of Mold (g) 7231.1	Tare (g)	310.25	324.21
Dry Unit Weight (pcf) 104.3	Water Content (%)	14.7	14.6
After Soaking Data		Average	Top 1 in.
Wt. of Mold + Sample (g) 11499.7	Wet Soil + Tare (g)	749.95	319.08
Dry Unit Weight (pcf) 102.4	Dry Soil + Tare (g)	644.33	280.09
	Tare (g)	122.32	127.17
	Water Content (%)	20.2	25.5

Swell Data			
Date	Time	Dial	Surcharge (psf) 50
6/8/2017	14:41	0.483	Swell (%) 1.83
6/12/2017	14:45	0.567	Soaking Period (hr) 96

Penetration Data	Piston ID	CBR T1
------------------	-----------	--------

Zero load (lb) = 0  
 Area of Piston (in<sup>2</sup>) = 3.0

Penetration (in.)	Raw Load (lb)	Piston Stress (psi)	Std. Stress (psi)
0.000	0	0	
0.025	27	9	
0.050	52	17	
0.075	78	26	
0.100	103	34	1000
0.125	127	42	1125
0.150	149	50	1250
0.175	169	56	1375
0.200	187	62	1500
0.300	255	85	1900
0.400	320	107	2300
0.500	391	130	2600



Entered By: \_\_\_\_\_  
 Reviewed: \_\_\_\_\_

**California Bearing Ratio**

(ASTM D 1883)



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**Project:** Snowbasin Parking Lot  
**Number:** 02542-001  
**Location:** Snowbasin Resort, Huntsville, Utah  
**Date:** 6/13/2017  
**By:** DKS

**Boring No.:** TP-5

**Sample:**

**Depth:** 2'

**Original Method:** ASTM D1557 C

**Engineering Classification:** Not requested

**Condition of Sample:** Unsoaked

**Scalp and Replace:** No

**Maximum Dry Unit Weight (pcf):** 126  
**Optimum Water Content (%):** 11  
**Relative Compaction (%):** 95.4  
**0.1 in. Corrected CBR (%):** 10.5  
**0.2 in. Corrected CBR (%):** 9.4

As Compacted Data		Before	After	
Mold Id.	CBR-8	Wet Soil + Tare (g)	2436.76	2165.82
Wt. of Mold + Sample (g)	11127.9	Dry Soil + Tare (g)	2237.85	1983.92
Wt. of Mold (g)	6597.8	Tare (g)	408.23	312.09
Dry Unit Weight (pcf)	120.1	Water Content (%)	10.9	10.9
After Soaking Data		Average	Top 1 in.	
Wt. of Mold + Sample (g)	11229.9	Wet Soil + Tare (g)	1934.58	803.52
Dry Unit Weight (pcf)	119.6	Dry Soil + Tare (g)	1744.9	745.62
		Tare (g)	309.45	312.82
		Water Content (%)	13.2	13.4

**Swell Data**

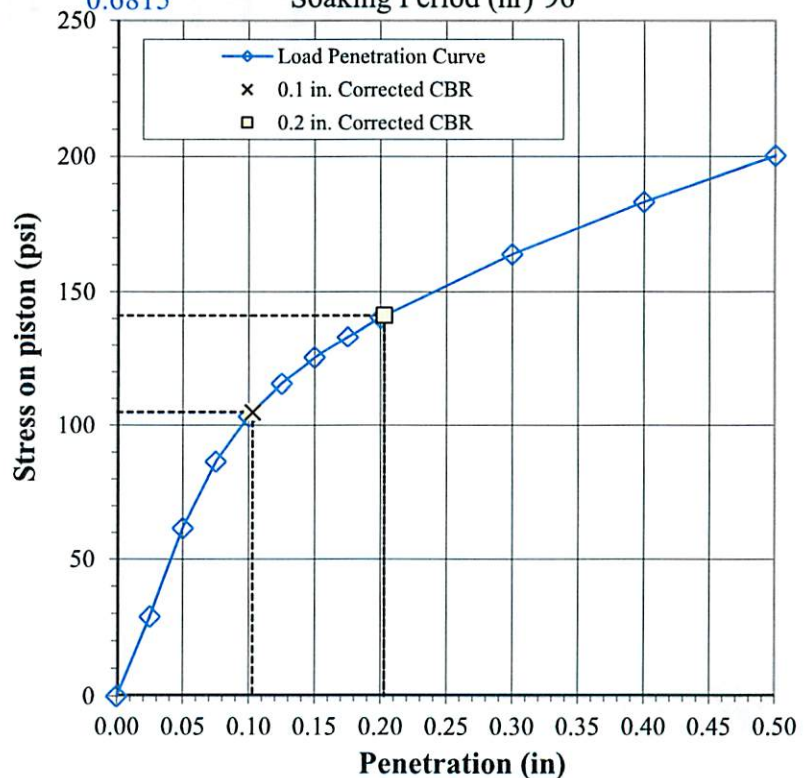
**Date:** 6/8/2017 **Time:** 15:20 **Dial:** 0.659 **Surcharge (psf):** 50  
 6/12/2017 **Time:** 15:37 **Dial:** 0.6815 **Swell (%):** 0.49  
**Soaking Period (hr):** 96

Penetration Data	Piston ID
	CBR T1

Zero load (lb) = 0

Area of Piston (in<sup>2</sup>) = 3.0

Penetration (in.)	Raw Load (lb)	Piston Stress (psi)	Std. Stress (psi)
0.000	0	0	
0.025	87	29	
0.050	185	62	
0.075	260	87	
0.100	310	103	1000
0.125	347	116	1125
0.150	376	125	1250
0.175	400	133	1375
0.200	422	141	1500
0.300	492	164	1900
0.400	549	183	2300
0.500	601	200	2600



Entered By: \_\_\_\_\_

Reviewed: \_\_\_\_\_

# APPENDIX C



# WinPAS 12

Pavement Thickness Design According to  
**1993 AASHTO Guide for Design of Pavements Structures**  
 American Concrete Pavement Association

## SAL Data by Vehicle Type






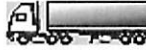

Project Name: 02542-001  
 Route: Snowbasin Parking Lot  
 Location: Near Huntsville Utah  
 Owner/Agency: Snowbasin Resort  
 Design Engineer: Parking are North of main entrance

### Traffic Factor

Estimated Rigid Thickness	4.00 inches
Estimated Structural Number	2.5
Terminal Serviceability	2.0
Design Life	20 years
Annual Growth Rate	0.50 percent
Traffic Input by	Year

### Traffic Input by

Total Traffic	2-way
Design Lane Distribution	100.00 percent
Directional Distribution	50.00 percent

Vehicle	Axle Load	Axle Type	Number	Vehicle	Axle Load	Axle Type	Number
	2.00	Single	34,390		12.00	Single	0
	0.00	Single			24.00	Single	
	2.00	Single			34.00	Tandem	
	10.00	Single	724		0.00	Single	0
	0.00	Single			0.00	Single	
	24.00	Single			0.00	Single	
	12.00	Single	1,086		0.00	Single	0
	0.00	Single			0.00	Single	
	34.00	Tandem			0.00	Single	
					0.00	Single	0
					0.00	Single	
<b>Total Rigid ESALs</b>			<b>52,039</b>	<b>Total Flexible ESALs</b>			<b>42,019</b>

# WinPAS

Pavement Thickness Design According to  
**1993 AASHTO Guide for Design of Pavements Structures**  
 American Concrete Pavement Association

## Flexible Design Inputs

Project Name: 02542-001  
 Route: Snowbasin Parking Lot  
 Location: Near Huntsville Utah  
 Owner/Agency: Snowbasin Resort  
 Design Engineer: Parking are North of main entrance

## Flexible Pavement Design/Evaluation

Structural Number	2.54	Subgrade Resilient Modulus	3,120.20 psi
Total Flexible ESALs	42,019	Initial Serviceability	5.00
Reliability	80.00 percent	Terminal Serviceability	2.00
Overall Standard Deviation	0.45		

## Layer Pavement Design/Evaluation

Layer Material	Layer Coefficient	Drainage Coefficient	Layer Thickness	Layer SN
Asphalt Cement Concrete	0.44	1.00	3.00	1.32
Graded Stone Base	0.11	1.00	10.00	1.10
Bitum. Treated Agg. Base	0.11	1.00	2.00	0.22
			$\Sigma$ SN	2.64

# WinPAS

Pavement Thickness Design According to  
**1993 AASHTO Guide for Design of Pavements Structures**  
American Concrete Pavement Association

## Flexible Design Inputs

Project Name: 02542-001  
Route: Snowbasin Parking Lot  
Location: Near Huntsville Utah  
Owner/Agency: Snowbasin Resort  
Design Engineer: Parking are North of main entrance

## Flexible Pavement Design/Evaluation

<b>Structural Number</b>	2.54	<b>Subgrade Resilient Modulus</b>	3,120.20 psi
<b>Total Flexible ESALs</b>	42,019	<b>Initial Serviceability</b>	5.00
<b>Reliability</b>	80.00 percent	<b>Terminal Serviceability</b>	2.00
<b>Overall Standard Deviation</b>	0.45		

## Layer Pavement Design/Evaluation

Layer Material	Layer Coefficient	Drainage Coefficient	Layer Thickness	Layer SN
Asphalt Cement Concrete	0.44	1.00	4.00	1.76
Graded Stone Base	0.11	1.00	6.00	0.66
Bitum. Treated Agg. Base	0.11	1.00	2.00	0.22
			$\Sigma$ SN	2.64

Administrative

1988-1989

1988-1989	Administrative	1988-1989	Administrative
1988-1989	Administrative	1988-1989	Administrative
1988-1989	Administrative	1988-1989	Administrative
1988-1989	Administrative	1988-1989	Administrative

1988-1989	Administrative	1988-1989	Administrative
1988-1989	Administrative	1988-1989	Administrative
1988-1989	Administrative	1988-1989	Administrative
1988-1989	Administrative	1988-1989	Administrative

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