FINAL
PAVEMENT DESIGN REPORT
FLAGSTAFF - CLINT'S WELL ROAD
AZ PRA 3-1(2)

ARIZONA FOREST SERVICE HIGHWAY 3
COCONINO NATIONAL FOREST
COCONINO COUNTY, ARIZONA

March 6, 2012
YA Project No. 211-203

Prepared for:
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Central Federal Lands Highway Division
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Lakewood, Colorado 80228

Prepared by:
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Prepared by:

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1.0 PURPOSE AND SCOPE OF STUDY

Yeh and Associates, Inc. were retained by the Atkins to provide geotechnical pavement recommendations for preliminary and final design of improvements for Arizona Forest Highway 3 (FH3), Flagstaff to Clint's Well Road. The south terminus of the project is at the junction of FH 3 with US 87 near Clint's Well, Arizona. The road is maintained by the Coconino County and the entire project lies within Coconino National Forest and Coconino County, Arizona. The project location southeast of Flagstaff is shown on Figure 1.1.

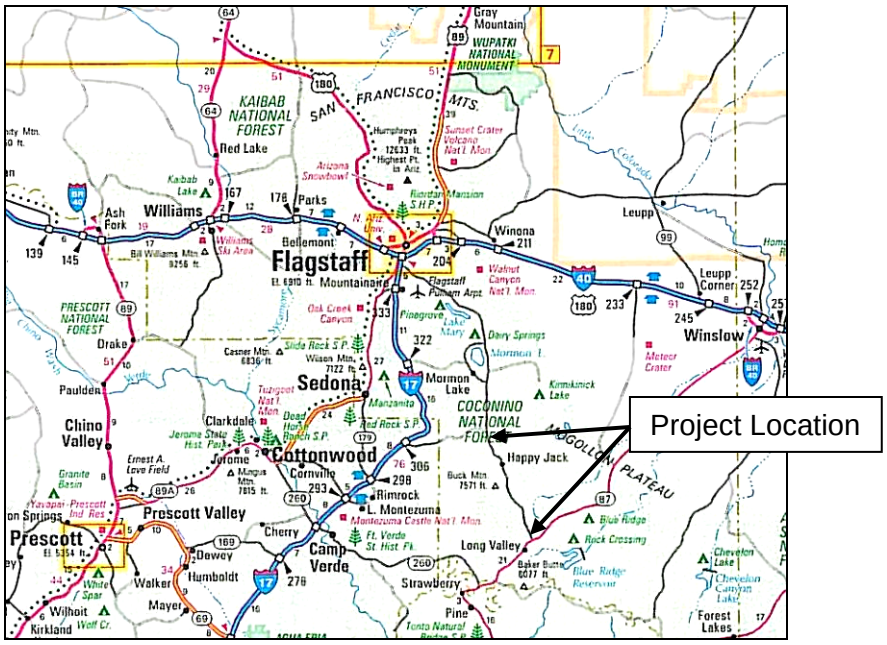


Figure 1.1 - Project Location

The proposed road reconstruction will consist of rehabilitating the existing roadway surface. The project includes only minor roadside grading, drainage features, placement of pulverized base and asphalt pavement, minor signing, striping, and other safety-related features necessary to meet current design practice.

2.0 SITE CONDITIONS

2.1 Pavement Condition

The surface of the two-lane asphalt-paved road is in fair condition on the south portion and poor condition at the north portion. The dividing line between fair and poor condition is at approximately Mile Post (MP) 302. From the start of the project at US 87 near MP 291 to MP 302, the pavement is in fair condition. The predominant distress is linear cracking which is somewhat masked by chip seals.

Figure 2.1: Typical linear cracking (US 87) MP 191 to 302

Figure 2.1 shows a typical condition in the southern portion of FH 3 between US 87 and approximately MP 302. The chip seal masks some of the cracks and the pavement is in fair condition. Note in Figure 2.1 the chip seal is in good condition in the southbound lane. Further north, a dark colored chip was used, but the pavement condition is similar.

From approximately MP 302 north to the end of the project near MP 308, the observed pavement distresses include transverse thermal cracking spaced at approximately 15 to 30 feet with extensive block and fatigue cracking across the entire pavement. Sometime in the past, the pavement has received a slurry seal or micro-surfacing treatment as well as extensive crack filling. There are also numerous locations where the slurry seal has delaminated exposing the pavement below. Figure 2.2 presents shows a typical pavement condition on the portion of FH3 from MP 302 to 308. The condition photographs in Appendix A show various distresses throughout the project.

Figure 2.2: Typical thermal and block cracking MP 302 to 308

3.0 SUBSURFACE INVESTIGATION

During the visit on November 3, 2011, Yeh and Associates personnel took shallow samples adjacent to the pavement. These samples were to determine the presence of aggregate base course (ABC) throughout the project length and also two samples outside the roadway prism to compare with the borings taken by Western Technologies, Inc in their report for Coconino County dated April 16, 2009.

3.1 Exploratory Samples

Samples were dug by hand to depth approximately 6 inches below the bottom to the existing pavement at five locations along FH 3. In addition two samples were taken of the native material outside the roadway to obtain soil classifications to compare with deeper samples reported in the Western Technologies Report.

Table 1 lists the approximate sample locations and a brief description of the samples. Complete testing of the soil samples is presented in Appendix B.

Table 3.1 - Sample Locations and Descriptions

Sample Number	Location	Description	Pavement Thickness (Inches)
1	MP 308 NB	ABC	6
2	MP 305 SB	ABC	6
3	MP 302+ NB	ABC	6
3 Native	MP 302+ E/O Pavement	Silty Sand	-
4	MP 298 NB	ABC	7
4 Native	MP 298 E/O Pavement	Clay	-
5	MP 292 SB	ABC	6

3.2 Laboratory Testing

Soil samples were returned to the Yeh and Associates' laboratory for testing. Laboratory tests performed included gradation (ASTM D 421, C 136 and AASHTO T 27), Atterberg limits (AASHTO T 89/T 90), moisture content (AASHTO T 265) and R-value (ASTM D 2844). In addition to the soil tests resistivity, soluble sulfate content (AASHTO T290), pH (ASTM D 4972/AASHTO T 289) and soluble chloride content (ASTM D 4327) were performed to address any potential sulfate attack on concrete or potential corrosion problems. Gradation and Atterberg limits test results were used to classify the soils in accordance with the AASHTO classification system and the Unified Soil Classification System (USCS). Moisture content provides an estimate of the moisture conditions of the aggregate base course and subgrade. The R-value (AASHTO T 190) is a measure of soil subgrade strength used for pavement design. Tests for soluble sulfate content, pH, resistivity and soluble chlorides are used to evaluate the potential of the soil to be aggressive to concrete and to corrode buried metal.

As listed in Table 1, each sample taken below the existing pavement was identified as ABC and had an AASHTO Classification of A-1-b(0). The R-value tested in accordance with AASHTO T190 on combined samples 1, 2 and 3 was 77. This value compares well with one R-value of 82 reported in the Western Technologies Report for boring No. 3 for a bulk sample collected from 1 to 3 feet. An additional R-value of 21 was measured on a bulk sample taken at a depth of 4 to 5 feet from the same boring.

Another result from the ABC testing was that the amount of material passing the #200 sieve ranged from 7 percent to 14 percent. One of the proposed rehabilitation treatments is full depth reclamation which requires that the material underlying the asphalt pavement must have less than 25 percent passing the #200 sieve or the strength of the pulverized materials would be lowered.

3.3 Subgrade Improvement

Two localized areas of subgrade-related pavement distress were observed between MP 302 and 303. These areas had been previously identified during the scoping tour with both county and forest service personnel present. In these two areas, we recommend a deep patch consisting of removal of 18 inches below the existing pavement and replacement with select material such as ABC Class D as defined in Table 703-2 of the Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects, (FP-03). We also recommend that reinforcement such as a geogrid or stabilization geotextile be placed 6 inches below the new Hot Asphalt Concrete Pavement (HACP).

3.4 Soil Corrosivity

Samples from Soil Sample 4 (Native) contained water a soluble sulfate concentration 0.001 percent. This is a low percentage of water soluble sulfates and this soil will be passive toward buried concrete. No special sulfate resistant cement will be required for concrete mixes in this project area.

The pH of the same sample was 7.2 and the water soluble chloride content was 0.0009 percent showing very low chloride concentrations and a nearly neutral pH.

A resistivity of 2,915 ohm-cm was measured indicating that the soil may be non-aggressive to buried metal pipes.

4.0 PAVEMENT RECOMMENDATIONS

4.1 Subgrade Strength

The resilient modulus, M_R is used as one of the inputs to the DARWin pavement design program. The following equations from the NCHRP Report 128 were used to calculate the resilient modulus using the R-value from AASHTO T190.

$$S_1 – [(R-5)/11.29] +3$$

$$M_R = 10^{[(S_1 + 18.72)/6.24]}$$

Where: M_R – resilient modulus (psi)
S_1 = the soil support value
R = the R-value obtained from the Hveem Stabilometer (AASHTO T 190)

For this project, the two R-values reported in the Western Technologies Report of 82 and 21 were averaged to determine a design resilient modulus. The average R-value of 51.5 was rounded down to R-value = 50 for the pavement thickness designs. This relatively conservative value was used because of the limited amount of subgrade soils data available for this project. This value will be used in the design program to represent the strength of the soils immediately below the HACP. Using the above equations, the R-value = 50 yields a Resilient Modulus, M_R of 13,168 psi.

Other structural layer coefficients used in design were found in the "FHWA CFL Project Development and Design Manual (PDDM)", March 2008. The input values for the pavement designs are listed in Table 4.3.

4.2 Traffic Loading

Traffic information provided in the Western Technologies was used to calculate 20-Year 18-kip Equivalent Single Axle Loads (ESAL) for this section of FH 3.

The volumes, growth factors, and ESAL factors were used to develop 20-Year Design ESALs for the determination of the minimum HACP thickness. The 20-year design ESAL value is 874,589 ESALs. Complete traffic volume information and ESAL calculations are presented in Appendix C.

4.3 Recommended Pavement Thickness

Four different pavement treatments were considered for this project: full depth reclamation to a depth of 8 inches, cold recycling to a 4 inch depth and milling to a depth of either of 2 inches or 1 inch. Each of these treatments was to be followed by a Hot Asphalt Concrete Pavement Overlay. The DARWin pavement design program output for each treatment is presented in Appendix D.

Following discussions with FHWA Central Federal Lands Division personnel on December 14, 2011 and February 22, 2012, the preferred option is to pulverize to a depth of 8 inches followed by placement of an HACP pavement.

Table 4.3 contains the input parameters used for the pavement thickness design as well as the recommended HACP thickness for the pulverization treatment option. The parameters were taken from the FHWA Project Development and Design Manual (PDDM), March 2008 based on the traffic loading and recommended treatment for this pavement. The output from the DARWin Pavement Design Program is presented in Appendix D.

Table 4.3 Pavement Design Parameters and Section Thicknesses

Design Parameter	Parameter Value	Design Parameter	Parameter Value
18-kip ESALs	874,589	Resilient Modulus M_R, psi	13,168
Initial Serviceability	4.2	Terminal Serviceability	2.5
Reliability	75%	Structural Number	2.49
Pulverization Depth, in.	8	HACP Thickness, in.	3.5

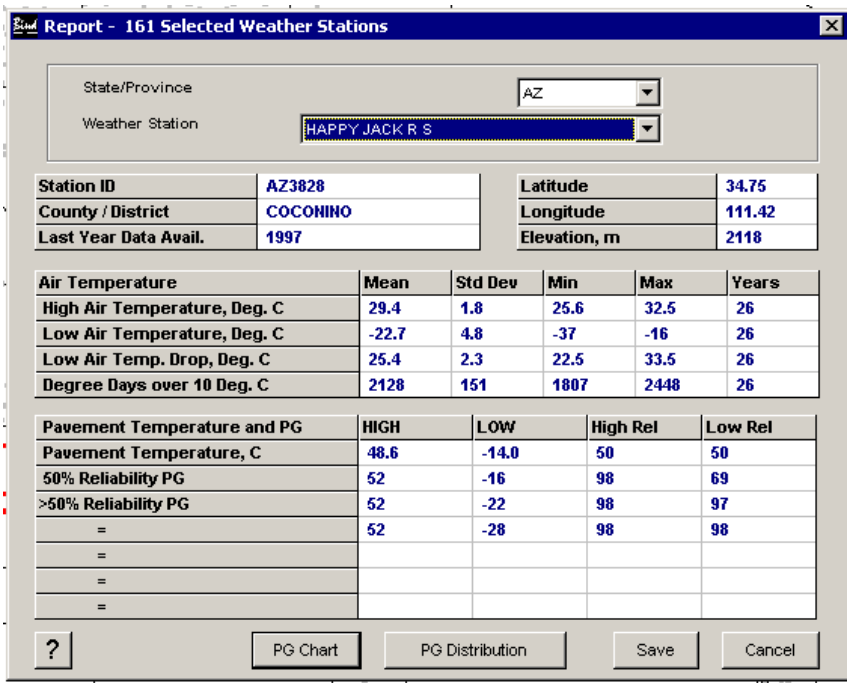
Using the strength information based on the soils testing in the Western Technologies Report, and the strength coefficients from the PDDM for the treatments, the recommended treatment is to pulverize the existing pavement to a depth of 8 inches followed by placement of a

3.5 inch HACP pavement. As noted in the soils testing in Appendix B, all of the soil samples taken from immediately below the existing pavement contained less than 25% material passing the # 200 sieve.

4.4 Binder and Mix Recommendations

Using the Long Term Pavement Performance binder selection program LTPPBind, the 98% reliability binder recommended for the closest weather station at Happy Jack Reservoir is PG 52-28. Figure 4.4 shows the print-out from the LTPP Binder Selection program based on historic weather information from Happy Jack Reservoir.

Figure 4.4 - Recommended Mix Binder



Report - 161 Selected Weather Stations

State/Province: AZ
Weather Station: HAPPY JACK R S

Station ID	AZ3828	Latitude	34.75
County / District	COCONINO	Longitude	111.42
Last Year Data Avail.	1997	Elevation, m	2118

Air Temperature	Mean	Std Dev	Min	Max	Years
High Air Temperature, Deg. C	29.4	1.8	25.6	32.5	26
Low Air Temperature, Deg. C	-22.7	4.8	-37	-16	26
Low Air Temp. Drop, Deg. C	25.4	2.3	22.5	33.5	26
Degree Days over 10 Deg. C	2128	151	1807	2448	26

Pavement Temperature and PG	HIGH	LOW	High Rel	Low Rel
Pavement Temperature, C	48.6	-14.0	50	50
50% Reliability PG	52	-16	98	69
>50% Reliability PG	52	-22	98	97
=	52	-28	98	98
=				
=				
=				

? PG Chart PG Distribution Save Cancel

The LTPP Binder Selection program shows that the 98 percent reliability binder for this area is PG 52-28 which is not readily available in Arizona, so we recommend that PG 58-28 performance graded binder be used on this project. The PG 58-28 binder meets the 98 percent reliability for low temperature crack resistance and exceeds the 98 percent reliability for high temperature rut resistance. The PG 58-28 is readily available in this area.

The new HACP overlay should be either a nominal l/2-inch or 3/4-inch mix with the above recommended binder. Grading Designation C or E mix is recommended (as per FP-03). The Superpave Mix Design system and a 75-gyration mix design is recommended. The quantity of binder can be estimated at 6% by weight of the mix and the unit weight can be estimated at 145 lbs/ft^3.

This project is in a relatively remote location and the asphalt batch plant may be several miles from the construction site. Loss of temperature and segregation of the hot asphalt mix can

occur during long distance transport. We recommend the project specifications require the use of a material transfer device at the point of placement to insure uniform temperatures and prevent segregation of the mix during placement. Use of a material transfer device is especially important if the mix is placed in cool weather.

The application of tack coat (at 0.10 gallons/ yd^2) is required on the pulverized base material prior to paving. The tack coat material should be CSS-1, CSS-1h, SS-1, or SS-1h. A tack coat at the above rate should be included between each lift of HACP.

If aggregate base course (ABC) is used for repairs on this project, the compacted ABC should receive a prime coat of an emulsion blended as a penetrating prime at a rate of 0.33 gallons/yd^2. If an emulsion such as CSS-1 is used for prime coat, it should be disked into the top 2-3 inches of ABC and re-compacted prior to placement to the new HACP.

5.0 REFERENCES

Federal Highway Administration (FHWA), 2003, *Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects*, FP-03.

CFL Project Development and Design Manual, March 2008

Geotechnical Evaluation, Lake Mary Road Improvements, Western Technologies, Inc. April 16, 2009

AASHTO 1993 Pavement Design Guide

6.0 LIMITATIONS

This study was conducted in accordance with generally accepted geotechnical engineering practices in this area for use by the client for design and construction purposes. The conclusions and recommendations submitted in this report are based upon the data obtained from soil samples, field review, the Western Technologies Inc. Report and the proposed type of construction. Subsurface variations across the site are likely and may not become evident until excavation is performed. If during construction, fill, soil, rock or water conditions appear to be different from those described herein, this office should be advised at once so reevaluation of the recommendations may be made. We recommend on-site observation of excavations and pavement subgrade conditions by a representative of the geotechnical engineer.

Appendix A – Pavement Condition Photographs

Flagstaff - Clint Wells Road Pavement Condition Photographs

MP 191- / Typical pavement condition for north end of project slight to moderately deteriorated transverse and block cracking

MP 191+ / Deteriorated transverse crack at center line - south end of project

MP 193+ / Slight to moderately deteriorated longitudinal crack at centerline

MP 193 / CCR #2 Approach - Slight to moderately deteriorated linear cracking near transition from red chips to black seal

MP 300+ / Typcial block cracking near center section of Forest Highway 3

MP 302 / Start Slurry Seal with severly deteriorated block cracking

MP 302 - 303 / Severe block and fatigue cracking

MP 303+ / Settlement at widening or utility cut with differential settlement and severe fatigue cracking

MP 304 / Severely deteriorated block and fatigue cracking

MP 305+ / Severe fatigue (alligator) cracking near removal and deep patch area

MP 306 / Slurry seal delaminated and also patched with hot poured crack sealant

MP 307+ / Typical cracking on most of north 1/3 of project - block cracking deteriorating to alligator (fatigue) cracking across the total pavement width

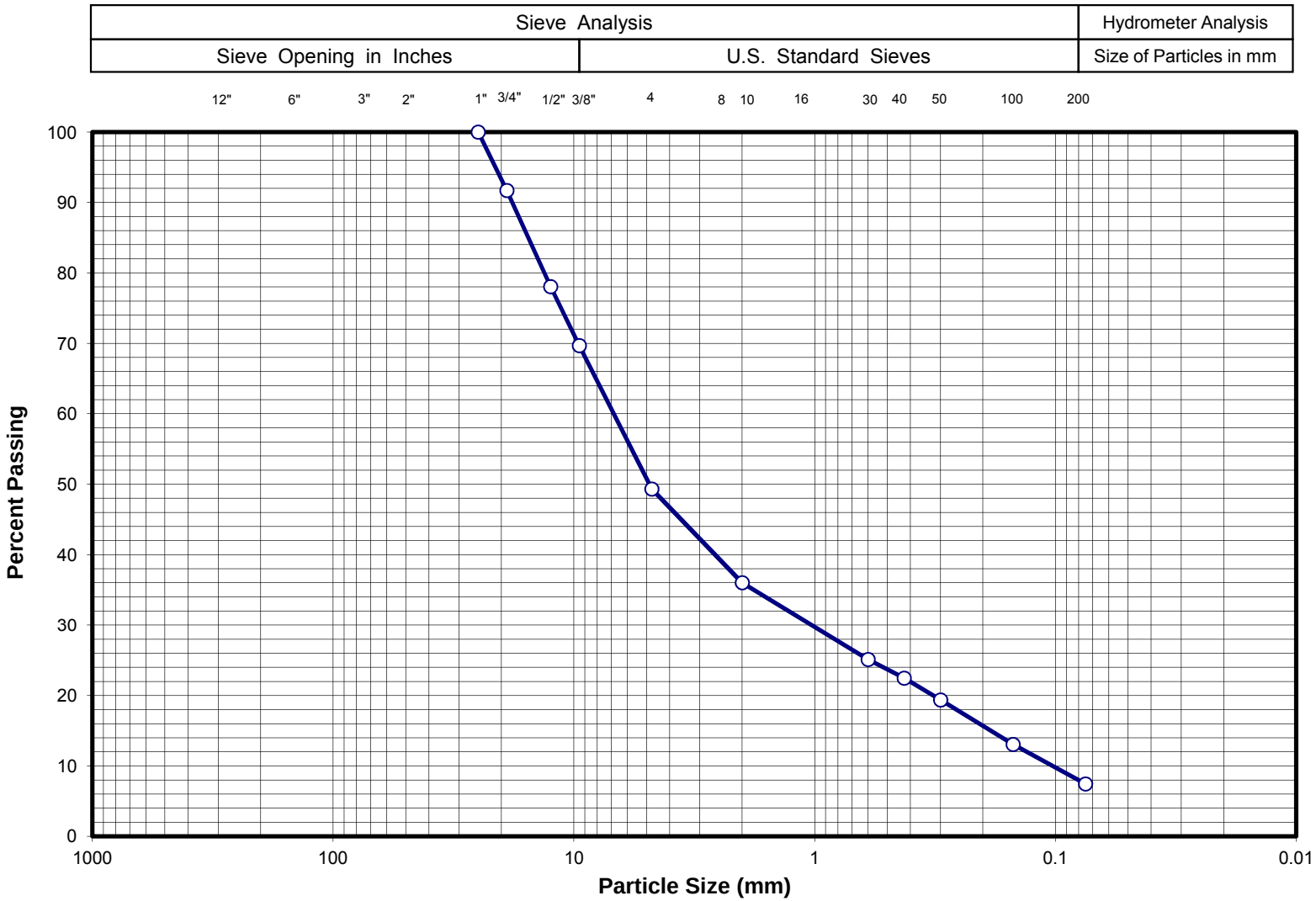
Appendix B – Laboratory Test Results

YEH & ASSOCIATES, INC

Summary of Laboratory Test Results

Project No: 211 - 203 Project Name: Flagstaff Clint Wells Road Date: 11/11/2011

Sample Location			Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg			pH	Water Soluble Sulfate %	Resistivity ohm.cm	Chloride %	R-VALUE	CLASSIFICATION	
Boring NO.	Depth (ft)	Sample Type			Gravel > #4 (%)	Sand (%)	Fines < #200 (%)	LL	PL	PI						AASHTO	USCS
1	1-1.5	Bulk	7.6	–	18	75	7	NV	NP	NP	–	–	–	–	–	A-1-a (0)	SW-SM
2	1-1.5	Bulk	13.1	–	42	49	9	NV	NP	NP	–	–	–	–	–	A-1-a (0)	SW-SM
3		Bulk	15.3	–	35	56	9	NV	NP	NP	–	–	–	–	–	A-1-a (0)	SW-SM
3 Native		Bulk	17.6	–	36	53	11	NV	NP	NP	–	–	–	–	–	A-1-a (0)	SP-SM
4	0.5-1	Bulk	9.7	–	38	48	14	NV	NP	NP	–	–	–	–	–	A-1-a (0)	SM
4 Native		Bulk	8.2	–	11	32	57	31	19	12	7.2	0.001	2915	0.0009	–	A - 6 (4)	CL
5		Bulk	5.6	–	72	22	6	NV	NP	NP	–	–	–	–	–	A-1-a (0)	GP-GM
Mix (1+2+3)		Bulk	–	–	–	–	–	–	–	–	–	–	–	–	77	A-1-a (0)	SW-SM



Sieve Size	% Passing
3"	-
2 ½"	-
2"	-
1 ½"	-
1"	100
¾ "	92
½"	78
⅜"	70
#4	49
#10	36
#40	22
#200	7

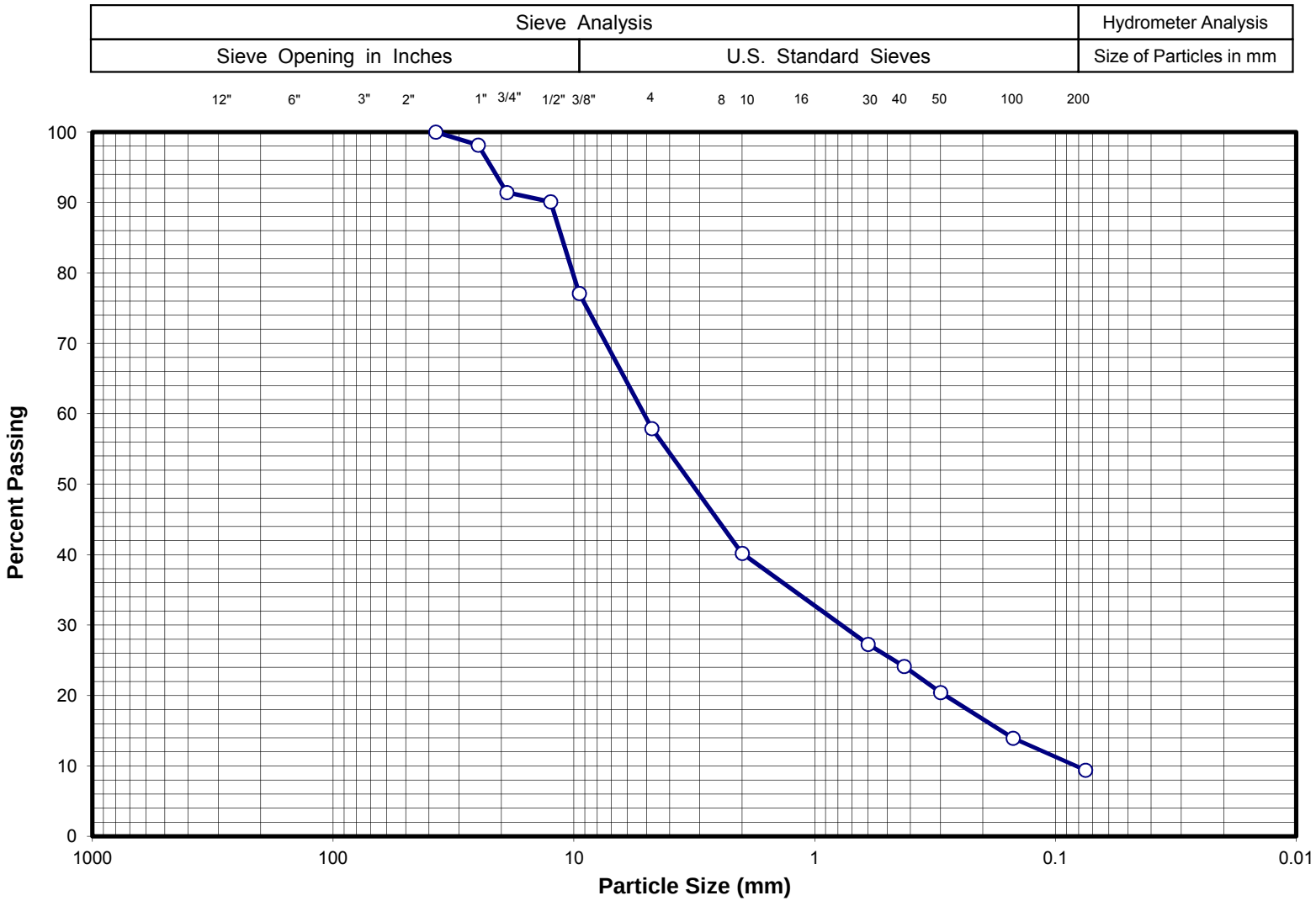
Gravel (%)	51	LL	NV	Project Name:	Flagstaff Clint Wells Road
Sand (%)	42	PL	NP	Sample ID:	1
Fines (%)	7	PI	NP	Sample Depth (ft.):	1-1.5
Sample Description:	GW-GM / A-1-a (0)				

Yeh & Associates, Inc.
Geotechnical Engineering Consultants

SIEVE ANALYSIS

Drawn By:	MA	Project No.:	211 - 203
Checked By:	RFL		
Date:	11/08/11	Figure No.:	-

Revised 04/27/2004



Sieve Size	% Passing
3"	-
2 ½"	-
2"	-
1 ½"	100
1"	98
¾ "	91
½"	90
⅜"	77
#4	58
#10	40
#40	24
#200	9

Gravel (%)	42	LL	NV	Project Name:	Flagstaff Clint Wells Road
Sand (%)	49	PL	NP	Sample ID:	2
Fines (%)	9	PI	NP	Sample Depth (ft.):	1-1.5
Sample Description:	SW-SM / A-1-a (0)				

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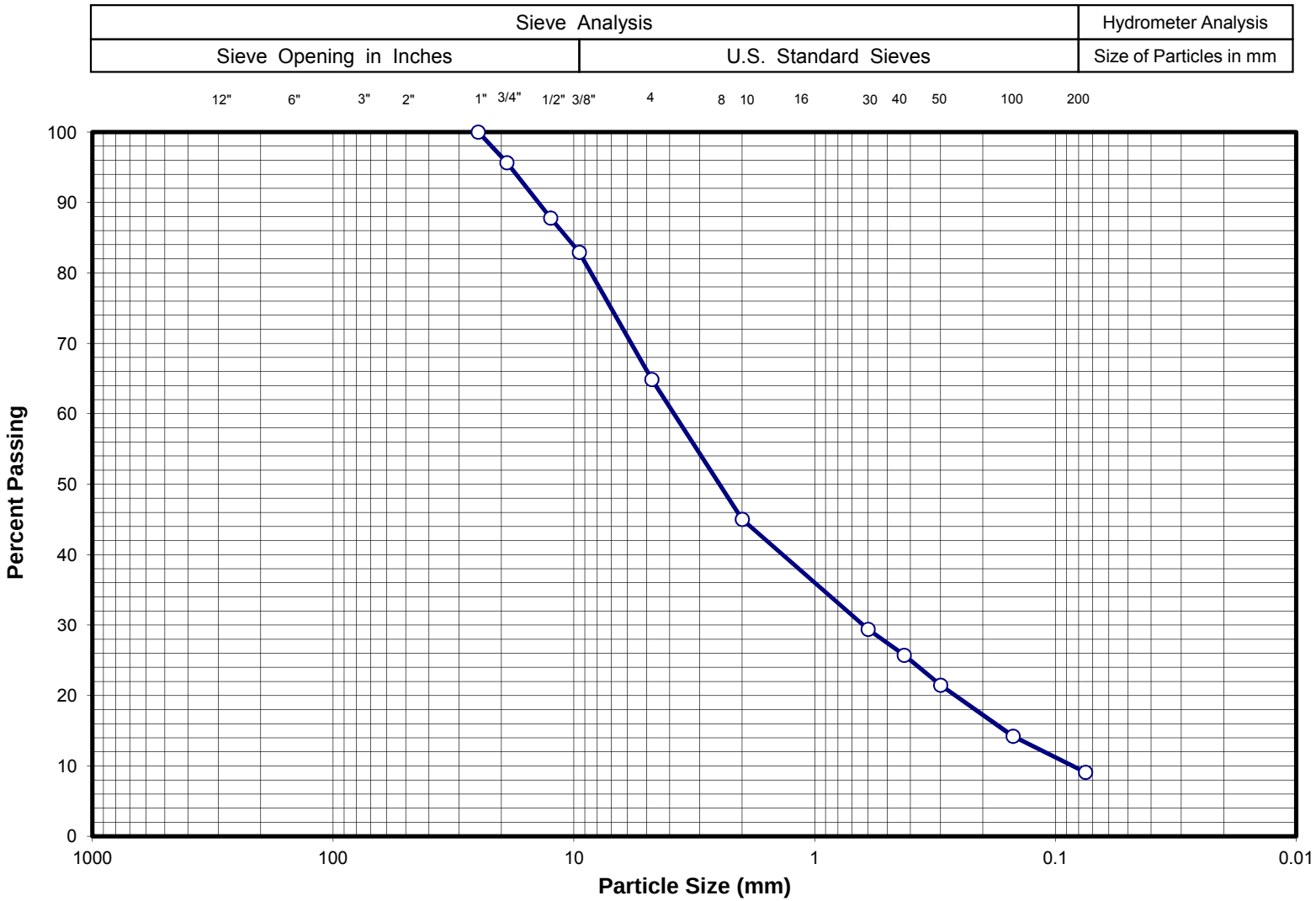
SIEVE ANALYSIS

Drawn By:	MA	Project No.:	211 - 203
Checked By:	RFL		
Date:	11/08/11	Figure No.:	-

Revised 04/27/2004



Sieve Size	% Passing
3"	-
2 ½"	-
2"	-
1 ½"	-
1"	100
¾ "	96
½"	88
⅜"	83
#4	65
#10	45
#40	26
#200	9

Gravel (%)	35	LL	NV	Project Name:	Flagstaff Clint Wells Road
Sand (%)	56	PL	NP	Sample ID:	3
Fines (%)	9	PI	NP	Sample Depth (ft.):	
Sample Description:	SW-SM / A - 1 - a (0)				

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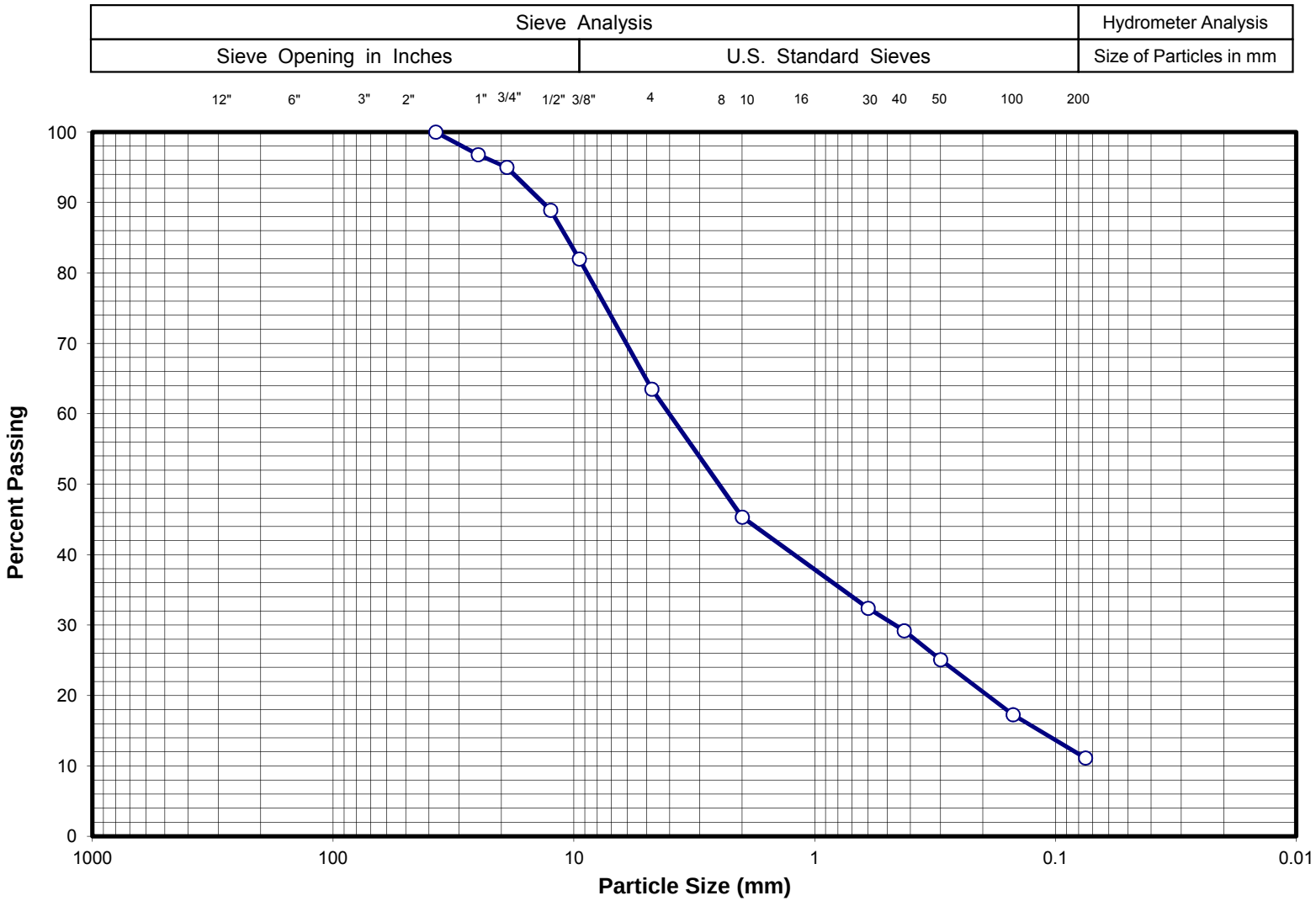
SIEVE ANALYSIS

Drawn By:	MA	Project No.:	211 - 203
Checked By:	RFL		
Date:	11/08/11	Figure No.:	-

Revised 04/27/2004



Sieve Size	% Passing
3"	-
2 ½"	-
2"	-
1 ½"	100
1"	97
¾ "	95
½"	89
⅜"	82
#4	64
#10	45
#40	29
#200	11

Gravel (%)	36	LL	NV	Project Name:	Flagstaff Clint Wells Road
Sand (%)	53	PL	NP	Sample ID:	3 Native
Fines (%)	11	PI	NP	Sample Depth (ft.):	
Sample Description:	SP - SM / A - 1 - a (0)				

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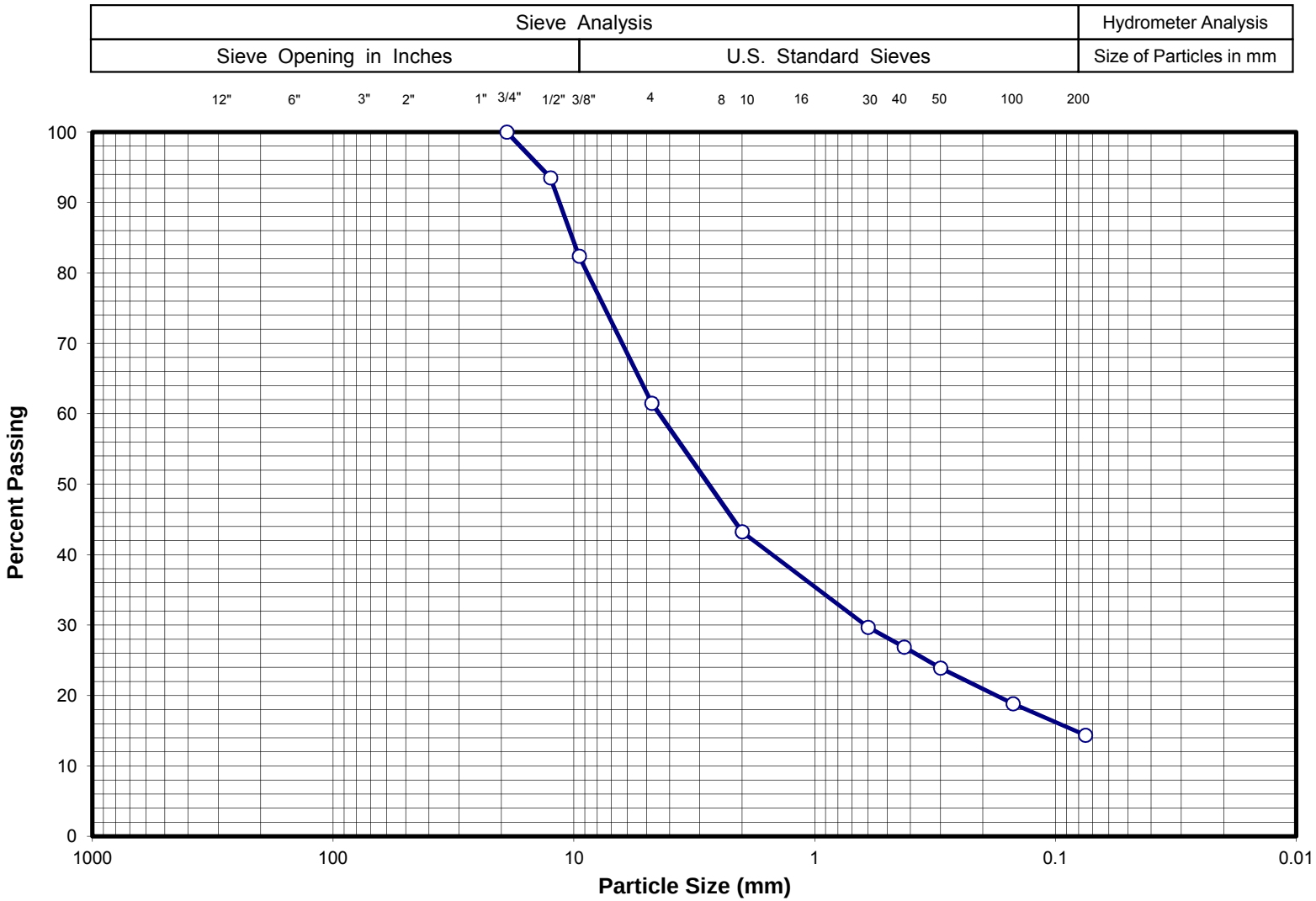
SIEVE ANALYSIS

Drawn By:	MA	Project No.:	211 - 203
Checked By:	RFL		
Date:	11/08/11	Figure No.:	-

Revised 04/27/2004



Sieve Size	% Passing
3"	-
2 ½"	-
2"	-
1 ½"	-
1"	-
¾ "	100
½"	94
⅜"	82
#4	62
#10	43
#40	27
#200	14

Gravel (%)	38	LL	NV	Project Name:	Flagstaff Clint Wells Road
Sand (%)	48	PL	NP	Sample ID:	4
Fines (%)	14	PI	NP	Sample Depth (ft.):	0.5-1
Sample Description:	SM / A - 1 - a (0)				

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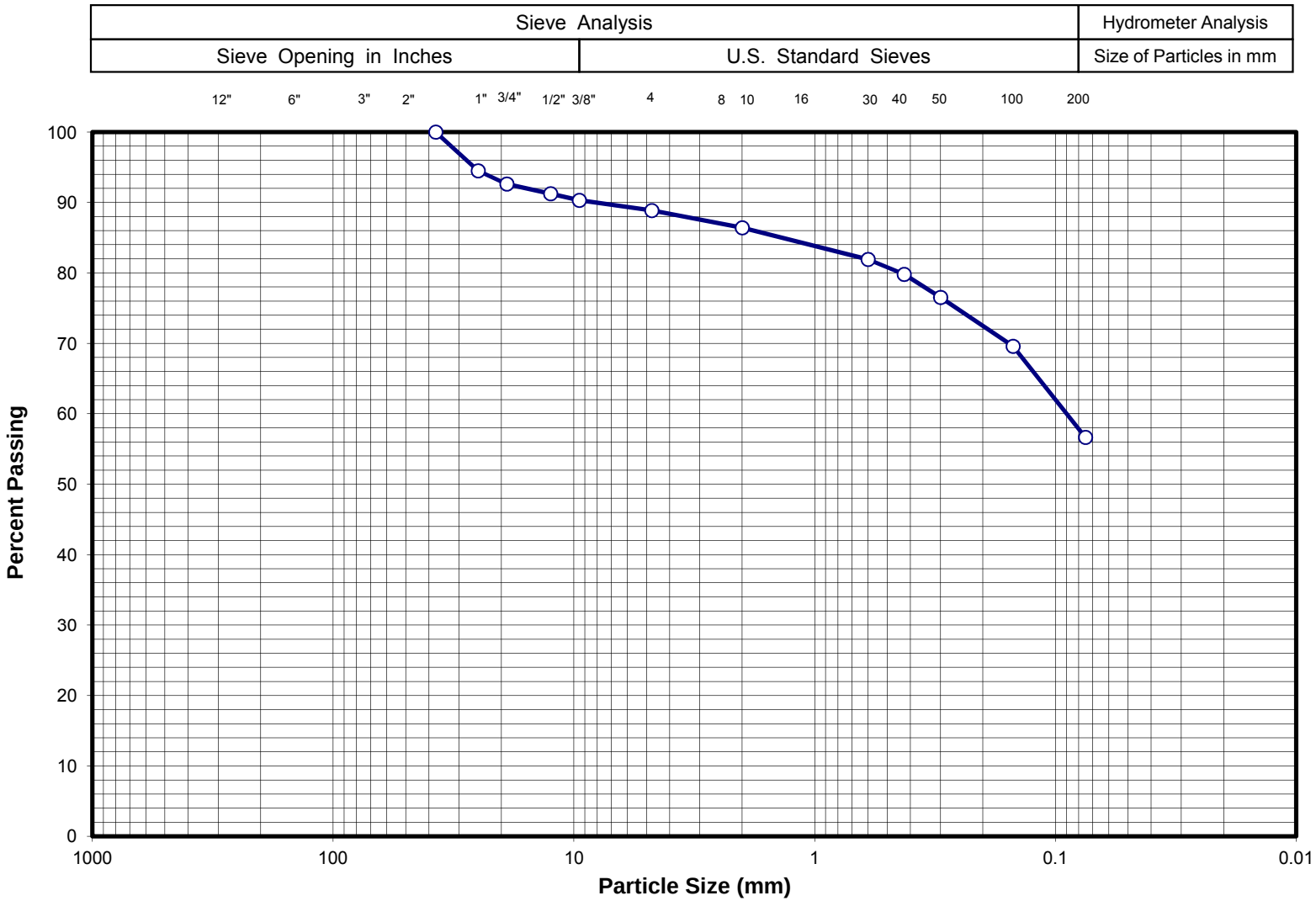
SIEVE ANALYSIS

Drawn By:	MA	Project No.:	211 - 203
Checked By:	RFL		
Date:	11/08/11	Figure No.:	-

Revised 04/27/2004



Sieve Size	% Passing
3"	-
2 ½"	-
2"	-
1 ½"	100
1"	95
¾ "	93
½"	91
⅜"	90
#4	89
#10	86
#40	80
#200	57

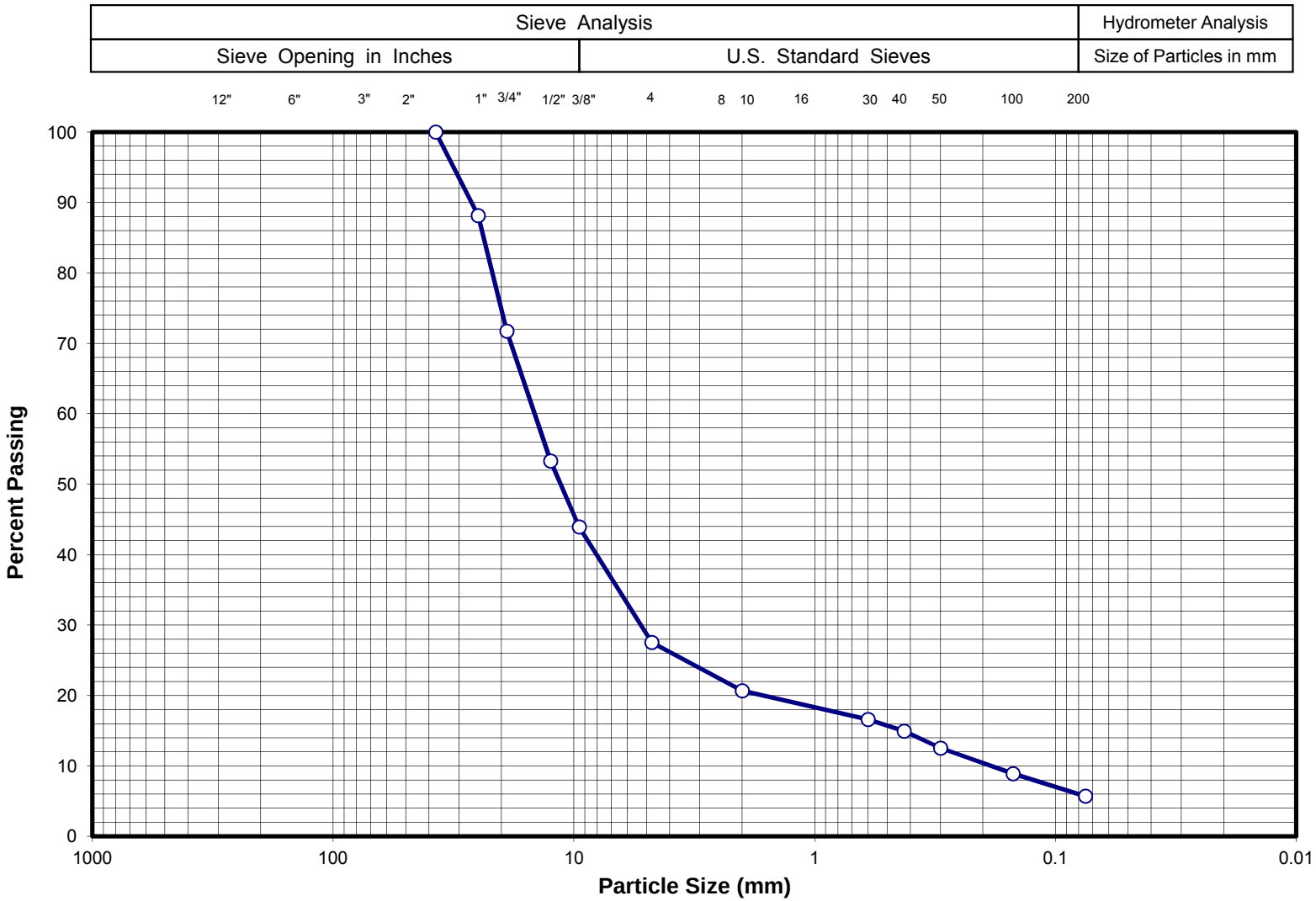
Gravel (%)	11	LL	31	Project Name:	Flagstaff Clint Wells Road
Sand (%)	32	PL	19	Sample ID:	4 Native
Fines (%)	57	PI	12	Sample Depth (ft.):	
Sample Description:	CL / A - 6 (4)				

Yeh & Associates, Inc.
Geotechnical Engineering Consultants

SIEVE ANALYSIS

Drawn By:	MA	Project No.:	211 - 203
Checked By:	RFL		
Date:	11/08/11	Figure No.:	-

Revised 04/27/2004



Sieve Size	% Passing
3"	-
2 ½"	-
2"	-
1 ½"	100
1"	88
¾ "	72
½"	53
⅜"	44
#4	28
#10	21
#40	15
#200	6

Gravel (%)	72	LL	NV	Project Name:	Flagstaff Clint Wells Road
Sand (%)	22	PL	NP	Sample ID:	5
Fines (%)	6	PI	NP	Sample Depth (ft.):	
Sample Description:	GP - GM / A - 1 - a (0)				

Yeh & Associates, Inc.
Geotechnical Engineering Consultants

SIEVE ANALYSIS

Drawn By:	MA	Project No.:	211 - 203
Checked By:	RFL		
Date:	11/08/11	Figure No.:	-

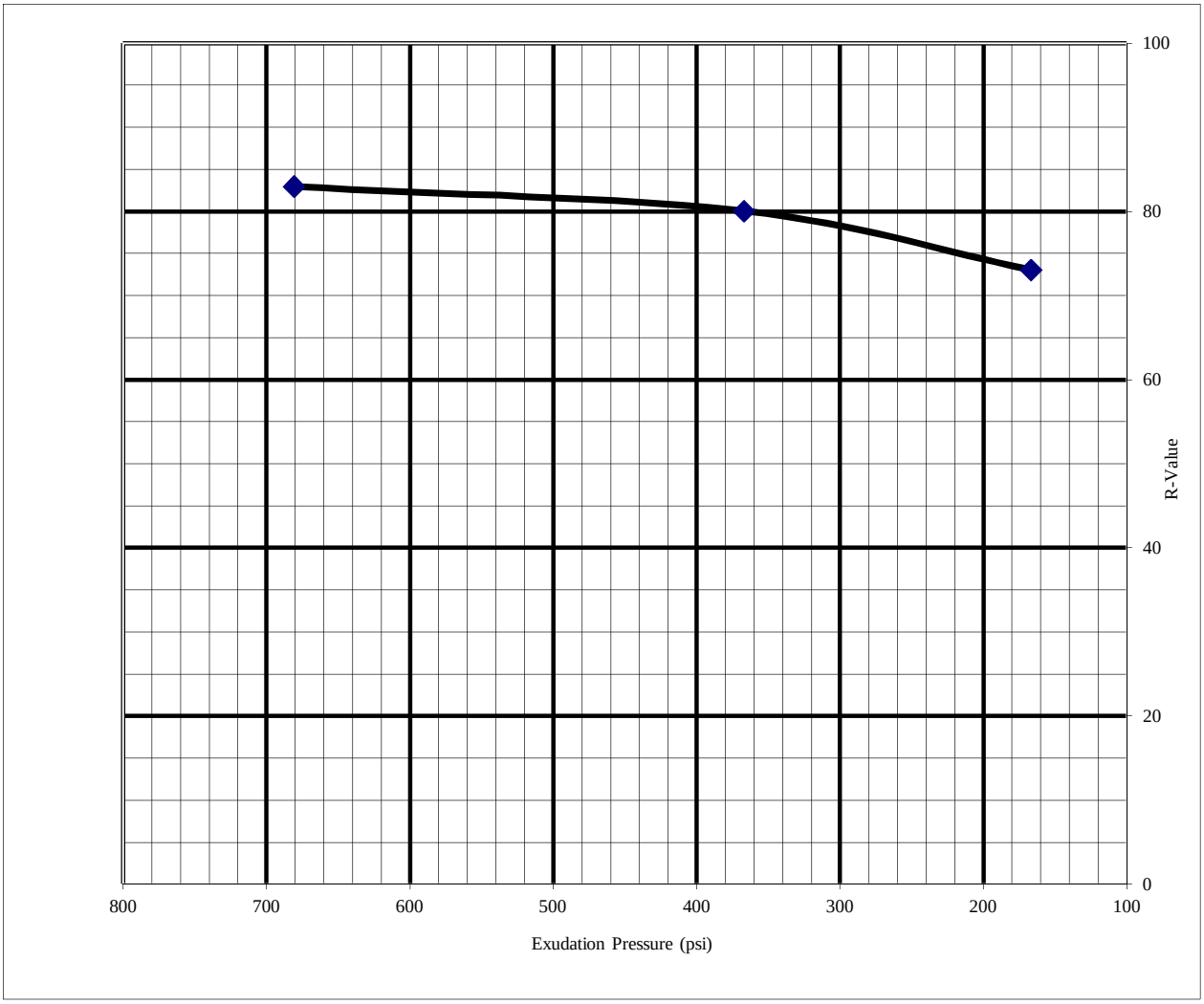
Revised 04/27/2004

YEH AND ASSOCIATES, INC

R-Value Test Report

Project Number: 211-203 **Project Name:** Flagstaff Clint Wells Road
Sample Id: Mix (1+2+3) **Depth (ft):**
Soil Description: well graded SAND with silt **Classification:** A-1-a (0) / SW-SM

R-Value at 300 psi exudation pressure = 77



Test No.	Compact. Press. (psi)	Density (pcf)	Moist. (%)	Horizont. Pressure (psi)'@ 160 psi	Sample Height (in).	Exud. Pressure (psi)	R Value	R Value Correct.
1	300	110.6	15	17	2.31	681	84	83
2	300	110.3	17	20	2.58	367	78	80
3	300	110.0	18	22	2.45	167	74	73

Tested by: Lev Bekker **Checked by:** Mustapha Aichiouene

Rev.2-2/2011

Colorado Analytical Laboratories, Inc.

Analytical Results

TASK NO: 111114007

Report To: Mustafa Aichiouene
Company: Yeh & Associates, Inc.
5700 E. Evans Ave
Denver CO 80222

Bill To: Mustafa Aichiouene
Company: Yeh & Associates, Inc.
5700 E. Evans Ave
Denver CO 80222

Task No.: 111114007
Client PO:
Client Project: Flagstaff Clint Wells Road 211-203

Date Received: 11/14/11
Date Reported: 11/23/11
Matrix: Soil - Geotech

Customer Sample ID 4 Bulk Native
Sample Date/Time:
Lab Number: 111114007-01

Test	Result	Method
Chloride - Water Soluble	0.0009 %	AASHTO T291-91/ ASTM D4327
pH	7.2 units	AASHTO T289-91
Resistivity	2915 ohm.cm	AASHTO T288-91
Sulfate - Water Soluble	0.001 %	AASHTO T290-91/ ASTM D4327

Abbreviations/ References:

AASHTO - American Association of State Highway and Transportation Officials.
ASTM - American Society for Testing and Materials.
ASA - American Society of Agronomy.
DIPRA - Ductile Iron Pipe Research Association Handbook of Ductile Iron Pipe.

DATA APPROVED FOR RELEASE BY

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Appendix C – Traffic Loading

Flagstaff to Clint Wells Road
Arizona Forest Highway 3

20-Year ESAL Calculations

Given:

ADT =	1336	weekday	X 5 =	6680				
	2378	Weekend	X 2 =	4756				
			total	11436	/ 7 =	1634	AADT	**Yr 2012**
% Trucks =		5-10% with substantial campers & RVs						
20-Year Growth Factor =			0.15			1879		**Yr 2032**

Design volume = (2012 volume + 2032 volume) /2 = 1756 vehicles/day
= [(2012 vol + 2032 vol)/2] X 365 days/yr X 20 years = 12820573 veh / 20-yrs
Assumed for Traffic Loading Calculations:

% of Total Volume		Volume	ESAL Factor	ESAL Loading
2%	semis	256411	2.15	551285
3%	light trucks	384617	1	384617
8%	campers & RVs	1025646	0.5	512823
87%	cars and Pick-ups	11153898	0.0008	8923
			Total ESALs =	1457648
			Design Lane Factor =	0.6

20-Year Design ESALs = 874589 ESALs

Yeh No. 211-203

Appendix D – Pavement Design Calculations

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Flexible Structural Design Module

Flagstaff to Clint's Well
211-203
Pulverization to 8 Inches
R = 50

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	874,589
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	75 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	13,168 psi
Stage Construction	1
Calculated Design Structural Number	2.49 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HACP	0.44	1	3.5	24	1.54
2	Pulverized Base	0.12	1	8	24	0.96
Total	-	-	-	11.50	-	2.50

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Flexible Structural Design Module

Flagstaff to Clint Wells Road
211-203
Cold Recyle
R = 50

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	874,589
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	75 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	13,168 psi
Stage Construction	1
Calculated Design Structural Number	2.49 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HACP	0.44	1	3	12	1.32
2	Cold Recycle	0.25	1	4	12	1.00
3	Old Pavement	0.15	1	2	12	0.30
Total	-	-	-	9.00	-	2.62

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Flexible Structural Design Module

Flagstaff to Clint Wells Road
211-203
Mill and Overlay
1" Milling
R = 50

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	874,589
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	75 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	13,168 psi
Stage Construction	1
Calculated Design Structural Number	2.49 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HACP	0.44	1	3	12	1.32
2	Old Pavmenet	0.26	1	5	12	1.30
Total	-	-	-	8.00	-	2.62

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Flexible Structural Design Module

Flagstaff to Clint Wells Road
211-203
Mill and Overlay
2" Milling
R = 50

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	874,589
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	75 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	13,168 psi
Stage Construction	1
Calculated Design Structural Number	2.49 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HACP	0.44	1	3.5	12	1.54
2	Old Pavmenet	0.26	1	4	12	1.04
Total	-	-	-	7.50	-	2.58