PROJECT:	**Index-Galena Road Flood Repair**	**PROJECT #:**	**RC1532, RC1774, RR6322**
PROJECT ENGINEER:	**Sam Chi**	**FED AID #:**	**ER-0701(063)**

WRITTEN JUSTIFICATION

1. DESCRIPTION OF CHANGE.

This Change Order modifies the contract to compensate the Contractor for the added costs to excavate and install drilled shafts in bedrock with compressive strength greater than that shown in the Contract.

2. WHAT IS REQUIRED BY CONTRACT? WHY THE CHANGE? (REFERENCE PLAN SHEETS & SPEC SECTIONS.)

The foundation for the new bridge is supported by two drilled shafts at each pier. The depths of the shafts are 72 feet at Pier 1 and 112 feet at Pier 2 according to plan sheet BR04. The Contract documents include Geotechnical reports and boring logs in Appendix 2. During the Geotechnical investigation for this project, bedrock was encountered approximately 55' below ground at Pier 1 according to boring B-13; bedrock was not encountered at Pier 2. The bedrock is described in the geotechnical report as Tertiary granodiorite (Tig) with expected unconfined compressive strengths (UCS) of 5,000 to 20,000 psi based on a handful of samples taken elsewhere along the project limits; **however, no specific UCS tests were completed for Pier 1 B-13 bore location**. The shafts for Pier 1 are designed to be seated approximately 17 feet into the bedrock. A bid item is provided in the contract, Item 172 - Rock Excavation for Shaft Including Haul, 38 LF for the two shafts in bedrock, with a bid price of $2,300 per LF. During installation of the drilled shafts in the bedrock, drilling progress was negatively impacted taking longer than expected. Using the available B-13 core samples taken during preconstruction, the County agreed to have the UCS test completed by an independent laboratory on October 27, 2021 (see attached) to compare it with the UCS results listed in Geotechnical reports. The results of the unconfined compressive strengths ranged from 11,837 psi upwards to 28,790 psi, marginally higher than what the geotechnical report indicated. It was determined that the Contractor was entitled to an equitable adjustment for excavation through higher strength bedrock.

3. HOW IS CHANGE ORDER THE SOLUTION?

This change order fairly compensates the contractor for their additional efforts to install drilled shafts in higher strength bedrock.

4. ALTERNATIVE(S) CONSIDERED.

No other alternatives were considered.

5. REASON FOR ENTITLEMENT AND WHY IT CANNOT BE PAID UNDER EXISTING CONTRACT.

The contract documents specify bedrock strengths lower than what was encountered. The Contractor is entitled to an equitable adjustment for the added work associated with installing drilled shafts in bedrock with compressive strengths greater than that indicated in the contract documents.

6. APPROVALS: PROJECT MANAGER, TECHNICAL ADVISOR (TRAFFIC, STRUCTURAL), JURISDICTION, OTHER AGENCY.

Standard change order approval (Construction Manager, Engineering Services Director).

7. TIME: INCREASE OR DECREASE WORKING DAYS.

Contract time is not affected by this change.

PROJECT:	**Index-Galena Road Flood Repair**	**PROJECT #:**	**RC1532, RC1774, RR6322**
PROJECT ENGINEER:	**Sam Chi**	**FED AID #:**	**ER-0701(063)**

8. COST: ESTABLISH OR VERIFY INCREASE OR DECREASE.
(CONTRACTOR PROPOSAL, ENGINEER'S ESTIMATE, NEGOTIATED, SUPPLIER, BID ITEM, ETC.)

A reimbursement cost was proposed for the additional effort incurred to drill shafts through bedrock. The County concurs with this cost and has reached an equitable adjustment of $26,250 (Malcom $25K + GBI markup 1.25K). See the independent cost estimate attached.

ATTACH BACKUP DOCUMENTATION:
Independent Cost Estimate, 2 pages
Core B-13 - UCS Test Results, 15 pages

Prepared by: Dave Lindberg
Checked/Modified by: Sam Chi

Date	Pier 1 Left Progress	time drilling bedrock	Pier 1 Right Progress	time drilling bedrock
9/28/2021				
9/29/2021				
9/30/2021	Top of Bedrock El. 829 confirmed 3 PM	3hrs		
10/1/2021	Casing seated at elevation 827.8 at 8 AM. + 4 feet to elevation 823.78	10 hrs		
10/4/2021	6 feet, Elev 817.28	10 hrs		
10/5/2021	2 feet, Elev 815.28	10 hrs		
10/6/2021	1.5 feet, 813.78	6 hrs - Drill Broke		
10/7/2021	1 feet	7 hrs - Drill Broke		
10/8/2021	1 ft to Elev 812	9 hrs, drill broke 1 hr.		
10/11/2021	1.5 ft	10 hrs		
10/12/2021	0 ft	repair rock cutting heads		
10/13/2021	1 feet	10 hrs		
10/14/2021	0.5 feet, elev 809	10 hrs		
10/29/2021			Casing seated into bedrock at 836.24. Four (4) feet into bedrock today	10 hrs
11/1/2021			3 feet into bedrock	10 hrs
11/2/2021			4 feet bedrock	10 hrs
11/3/2021			3 feet into bedrock, Elev. 822 achieved @ 10:00 AM	2.5 hrs
Total Drilling Hours	20 feet bedrock	85 hours	14 feet bedrock	32.5 hours

	Pier 1 Left		Pier 1 Right	
Total Drilling Hours	20 feet bedrock	85 hours	14 feet bedrock	32.5 hours

CHANGE ORDER #7
6/17/2022
Justification Attachment 1
Page 3 of 19

Equipment	Bauer BG 40 equip rate $472.16/hr plus arc welder at $9.00= $481.16	$40,898.6 +21%= **$49,487.31**		$15,637.70+21%= **$18,921.62**
2 Operators +1.5 Welders	$318.50	27072.50+29%= **$34,923.52**		$10,351.25+29%= **$13,353.11**
total Dollars	bid $2,300*20 LF = **$46,000**	**$84,410.84***	Bid $2,300 *14 LF = **$32,200**	**$32,274.73**

* Tracked cost doesn't reflect: 1) duration when equipment/tooling was down for repairs (18 hrs). Standby Rate is $126.28 x 18 hrs = $2,273. 2) Prime markup on subcontractor is 10% (between 25K and 100K) = $8,400.

Pier 1 Left Shaft - Evaluation of bid costs vs FA costs shows a significant amount of effort was spent drilling through bedrock and supports their claim of bedrock hardness especially the last 3 days of production only accomplishing 3 ft of depth. The delta in cost exceeded $38k which does not include costs associated with equipment down time.

20 LF at bid price	$	46,000.00
FA cost	$	84,410.84
Delta betweend bid and actual FA (additional effort)	$	38,410.84

Pier 1 Right Shaft Summary - Evaluation of bid costs vs FA costs shows the work being relatively equal in comparison. Engineer of Record provided concurrence to raise drilled shaft tip elevation.

14 LF at bid price	$	32,200.00
FA cost	$	32,274.73
Delta betweend bid and actual FA (additional effort)	$	74.73

Client:	Shannon & Wilson, Inc.				
Project:	Index-Galena Road				
Location:	Index, WA			Project No:	GTX-314452
Boring ID:	---	Sample Type:	---	Tested By:	tlm
Sample ID:	---	Test Date:	10/27/21	Checked By:	smd
Depth :	---	Test Id:	633779		

Bulk Density and Compressive Strength of Rock Core Specimens by ASTM D7012 Method C

Boring ID	Sample Number	Depth	Bulk Density, pcf	Compressive strength, psi	Failure Type	Meets ASTM D4543	Note(s)
B13 R9	1	55.04-55.49 ft	168	11837	1	Yes	---
B13 R10	2	60.07-60.25 ft	168	16733	1	Yes	---
B13 R11	3	62.2-62.65 ft	167	14045	1	Yes	---
B13 R11	4	63.24-63.69 ft	168	21044	1	Yes	---
B13 R11	5	64.3-64.75 ft	169	20784	1	Yes	---
B13 R12	6	66.5-66.95 ft	169	19933	1	Yes	---
B13 R12	7	70.73-71.18 ft	168	28790	1	Yes	---

Notes: Density determined on core samples by measuring dimensions and weight and then calculating.

All specimens tested at the approximate as-received moisture content and at standard laboratory temperature.

The axial load was applied continuously at a stress rate that produced failure in a test time between 2 and 15 minutes.

Failure Type: 1 = Intact Material Failure; 2 = Discontinuity Failure; 3 = Intact Material and Discontinuity Failure (See attached photographs)

GeoTesting EXPRESS

Client:	Shannon & Wilson, Inc.	Test Date:	10/26/2021
Project Name:	Index-Galena Road	Tested By:	ak
Project Location:	Index, WA	Checked By:	smd
GTX #:	314452		
Boring ID:	B13 R9		
Sample ID:	1		
Depth:	55.04-55.49 ft		
Visual Description:	See Photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	5.40	5.40	5.40
Specimen Diameter, in:	2.40	2.40	2.40
Specimen Mass, g:	1077.92		
Bulk Density, lb/ft^3	168	**Minimum Diameter Tolerence Met?**	**YES**
Length to Diameter Ratio:	2.3	**Length to Diameter Ratio Tolerance Met?**	**YES**

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? **YES**

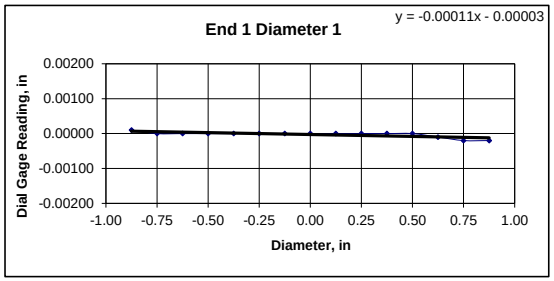
END FLATNESS AND PARALLELISM (Procedure FP1)

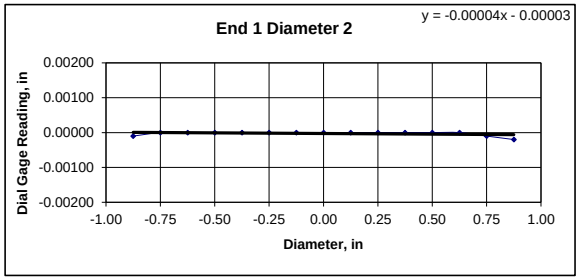
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00020	-0.00020
Diameter 2, in (rotated 90°)	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00020

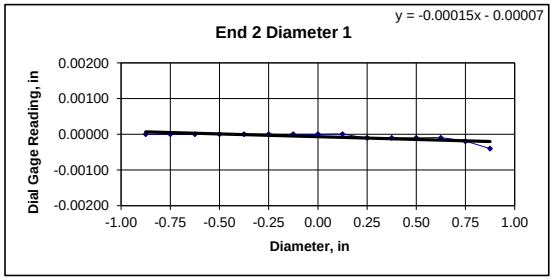
Difference between max and min readings, in:
0° = 0.00030 90° = 0.00020

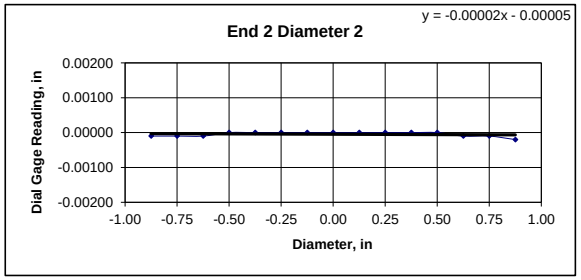
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00010	-0.00010	-0.00020	-0.00040
Diameter 2, in (rotated 90°)	-0.00010	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00020

Difference between max and min readings, in:
0° = 0.0004 90° = 0.0002
Maximum difference must be < 0.0020 in. Difference = ± 0.00020
Flatness Tolerance Met? **YES**









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00011
Angle of Best Fit Line: 0.00622

End 2:
Slope of Best Fit Line 0.00015
Angle of Best Fit Line: 0.00884

Maximum Angular Difference: 0.00262

Parallelism Tolerance Met? **YES**
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00004
Angle of Best Fit Line: 0.00213

End 2:
Slope of Best Fit Line 0.00002
Angle of Best Fit Line: 0.00115

Maximum Angular Difference: 0.00098

Parallelism Tolerance Met? **YES**
Spherically Seated

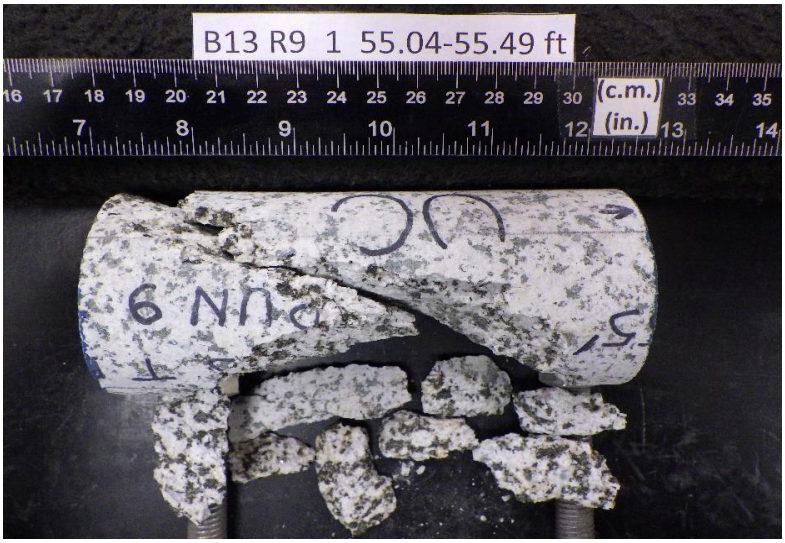
PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00030	2.400	0.00013	0.007	YES
Diameter 2, in (rotated 90°)	0.00020	2.400	0.00008	0.005	YES
END 2					
Diameter 1, in	0.00040	2.400	0.00017	0.010	YES
Diameter 2, in (rotated 90°)	0.00020	2.400	0.00008	0.005	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? **YES**

Client:	Shannon & Wilson, Inc.
Project Name:	Index-Galena Road
Project Location:	Index, WA
GTX #:	314452
Test Date:	10/26/2021
Tested By:	kdp
Checked By:	smd
Boring ID:	B13 R9
Sample ID:	1
Depth, ft:	55.04-55.49

After cutting and grinding



After break

CHANGE ORDER #7
6/17/2022
Justification Attachment 2
Page 7 of 19

GeoTesting EXPRESS

Client:	Shannon & Wilson, Inc.	Test Date:	10/26/2021
Project Name:	Index-Galena Road	Tested By:	ak
Project Location:	Index, WA	Checked By:	smd
GTX #:	314452		
Boring ID:	B13 R10		
Sample ID:	2		
Depth:	60.07-60.25 ft		
Visual Description:	See Photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	5.39	5.38	5.39
Specimen Diameter, in:	2.40	2.40	2.40
Specimen Mass, g:	1075.35		
Bulk Density, lb/ft^3	168	**Minimum Diameter Tolerence Met?**	**YES**
Length to Diameter Ratio:	2.2	**Length to Diameter Ratio Tolerance Met?**	**YES**

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? **YES**

END FLATNESS AND PARALLELISM (Procedure FP1)

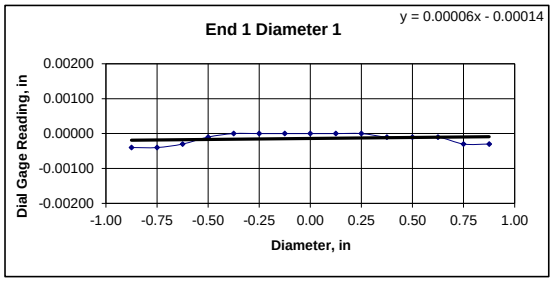
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00040	-0.00040	-0.00030	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00010	-0.00030	-0.00030
Diameter 2, in (rotated 90°)	-0.00020	-0.00010	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

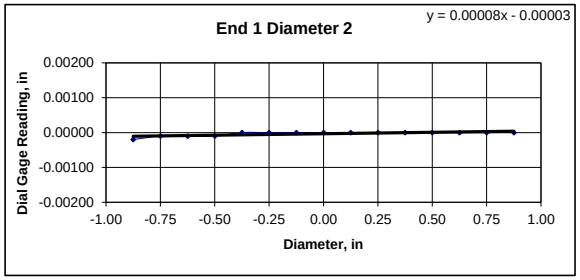
Difference between max and min readings, in:
0° = 0.00040 90° = 0.00020

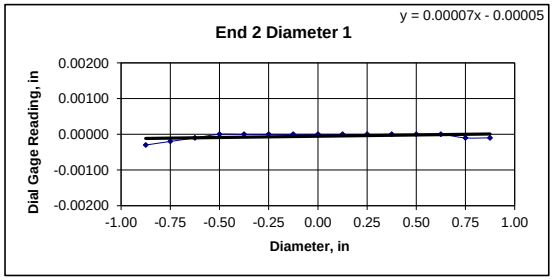
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00030	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010
Diameter 2, in (rotated 90°)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00010	-0.00010	-0.00010

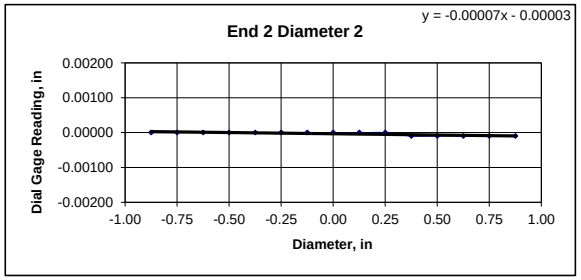
Difference between max and min readings, in:
0° = 0.0003 90° = 0.0001

Maximum difference must be < 0.0020 in. Difference = ± 0.00020
Flatness Tolerance Met? **YES**









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00006
Angle of Best Fit Line: 0.00327

End 2:
Slope of Best Fit Line 0.00007
Angle of Best Fit Line: 0.00409

Maximum Angular Difference: 0.00082

Parallelism Tolerance Met? **YES**
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00008
Angle of Best Fit Line: 0.00475

End 2:
Slope of Best Fit Line 0.00007
Angle of Best Fit Line: 0.00409

Maximum Angular Difference: 0.00065

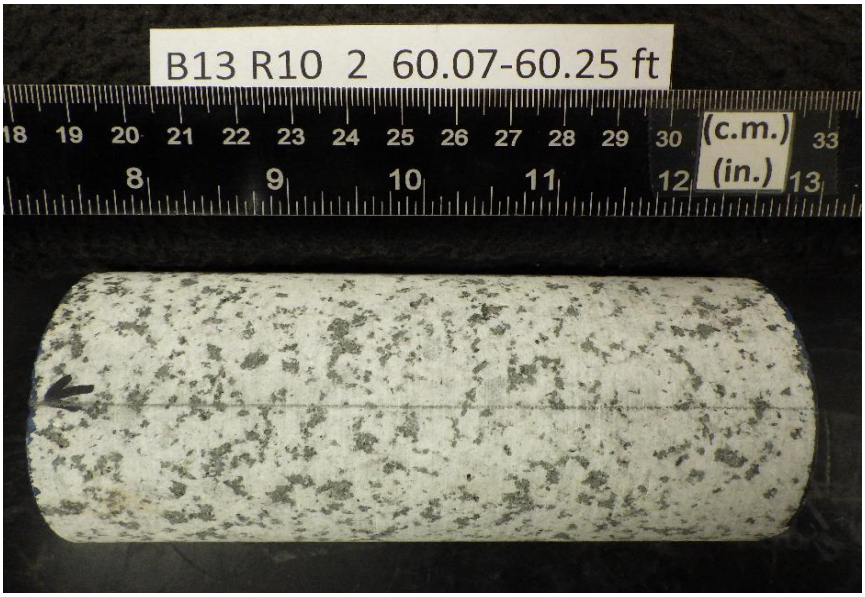
Parallelism Tolerance Met? **YES**
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00040	2.400	0.00017	0.010	YES
Diameter 2, in (rotated 90°)	0.00020	2.400	0.00008	0.005	YES
END 2					
Diameter 1, in	0.00030	2.400	0.00013	0.007	YES
Diameter 2, in (rotated 90°)	0.00010	2.400	0.00004	0.002	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? **YES**

Client:	Shannon & Wilson, Inc.
Project Name:	Index-Galena Road
Project Location:	Index, WA
GTX #:	314452
Test Date:	10/27/2021
Tested By:	kdp
Checked By:	smd
Boring ID:	B13 R10
Sample ID:	2
Depth, ft:	60.07-60.25 ft



After cutting and grinding

After break

GeoTesting EXPRESS

Client:	Shannon & Wilson, Inc.	Test Date:	10/26/2021
Project Name:	Index-Galena Road	Tested By:	ak
Project Location:	Index, WA	Checked By:	smd
GTX #:	314452		
Boring ID:	B13 R11		
Sample ID:	3		
Depth:	62.2-62.65 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	5.55	5.55	5.55
Specimen Diameter, in:	2.41	2.40	2.41
Specimen Mass, g:	1110.14		
Bulk Density, lb/ft^3	167	**Minimum Diameter Tolerence Met?**	**YES**
Length to Diameter Ratio:	2.3	**Length to Diameter Ratio Tolerance Met?**	**YES**

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? **YES**

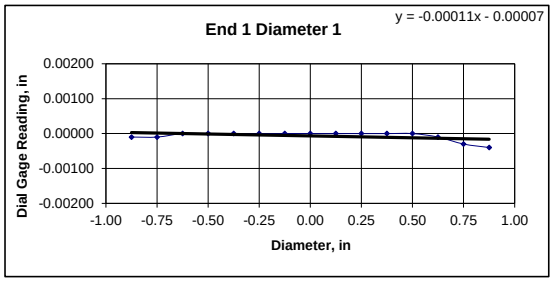
END FLATNESS AND PARALLELISM (Procedure FP1)

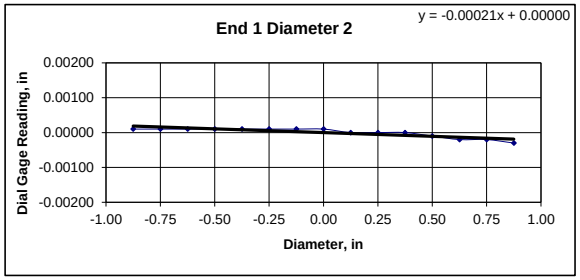
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00030	-0.00040
Diameter 2, in (rotated 90°)	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00000	0.00000	-0.00010	-0.00020	-0.00020	-0.00030

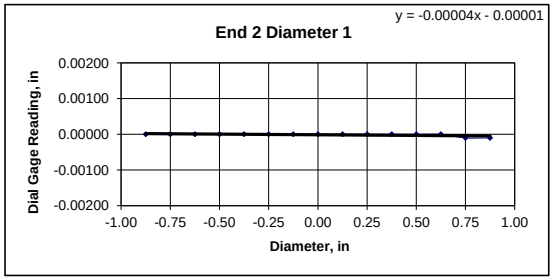
Difference between max and min readings, in:
0° = 0.00040 90° = 0.00040

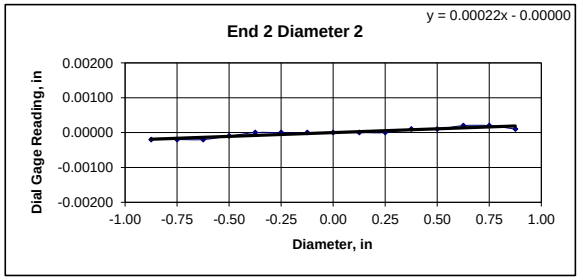
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010
Diameter 2, in (rotated 90°)	-0.00020	-0.00020	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00010	0.00020	0.00020	0.00010

Difference between max and min readings, in:
0° = 0.0001 90° = 0.0004
Maximum difference must be < 0.0020 in. Difference = ± 0.00020
Flatness Tolerance Met? **YES**









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00011
Angle of Best Fit Line: 0.00622

End 2:
Slope of Best Fit Line 0.00004
Angle of Best Fit Line: 0.00213

Maximum Angular Difference: 0.00409

Parallelism Tolerance Met? **YES**
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00021
Angle of Best Fit Line: 0.01228

End 2:
Slope of Best Fit Line 0.00022
Angle of Best Fit Line: 0.01244

Maximum Angular Difference: 0.00016

Parallelism Tolerance Met? **YES**
Spherically Seated

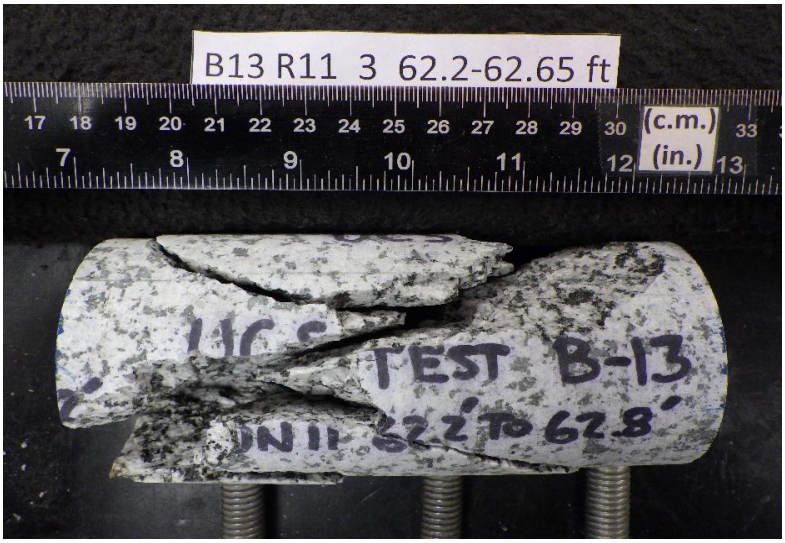
PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00040	2.405	0.00017	0.010	YES
Diameter 2, in (rotated 90°)	0.00040	2.405	0.00017	0.010	YES
END 2					
Diameter 1, in	0.00010	2.405	0.00004	0.002	YES
Diameter 2, in (rotated 90°)	0.00040	2.405	0.00017	0.010	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? **YES**

Client:	Shannon & Wilson, Inc.
Project Name:	Index-Galena Road
Project Location:	Index, WA
GTX #:	314452
Test Date:	10/26/2021
Tested By:	kdp
Checked By:	smd
Boring ID:	B13 R11
Sample ID:	3
Depth, ft:	62.2-62.65

After cutting and grinding



After break

CHANGE ORDER #7
6/17/2022
Justification Attachment 2
Page 11 of 19

GeoTesting EXPRESS

Client:	Shannon & Wilson, Inc.	Test Date:	10/26/2021
Project Name:	Index-Galena Road	Tested By:	ak
Project Location:	Index, WA	Checked By:	smd
GTX #:	314452		
Boring ID:	B13 R11		
Sample ID:	4		
Depth:	63.24-63.69 ft		
Visual Description:	See Photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	5.39	5.39	5.39
Specimen Diameter, in:	2.40	2.40	2.40
Specimen Mass, g:	1080		
Bulk Density, lb/ft^3	168	**Minimum Diameter Tolerence Met?**	**YES**
Length to Diameter Ratio:	2.2	**Length to Diameter Ratio Tolerance Met?**	**YES**

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? **YES**

END FLATNESS AND PARALLELISM (Procedure FP1)

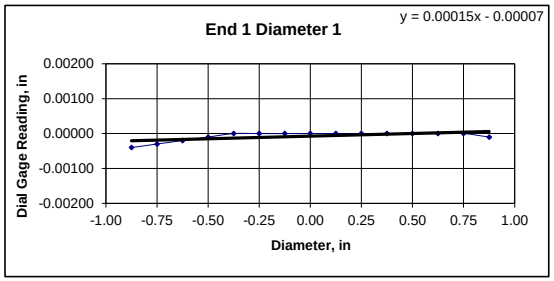
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00040	-0.00030	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010
Diameter 2, in (rotated 90°)	-0.00030	-0.00020	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010

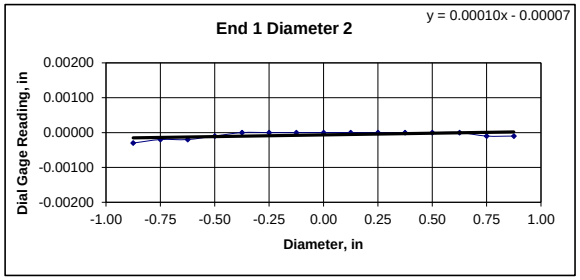
Difference between max and min readings, in:
0° = 0.00040 90° = 0.00030

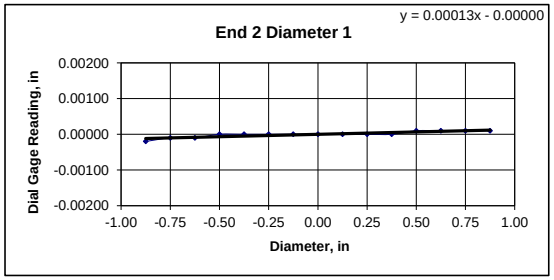
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00020	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00010	0.00010	0.00010	0.00010
Diameter 2, in (rotated 90°)	-0.00030	-0.00020	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010

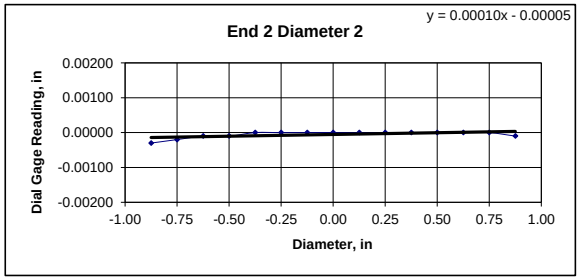
Difference between max and min readings, in:
0° = 0.0003 90° = 0.0003

Maximum difference must be < 0.0020 in. Difference = ± 0.00020
Flatness Tolerance Met? **YES**









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00015
Angle of Best Fit Line: 0.00868

End 2:
Slope of Best Fit Line 0.00013
Angle of Best Fit Line: 0.00769

Maximum Angular Difference: 0.00098

Parallelism Tolerance Met? **YES**
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00010
Angle of Best Fit Line: 0.00557

End 2:
Slope of Best Fit Line 0.00010
Angle of Best Fit Line: 0.00573

Maximum Angular Difference: 0.00016

Parallelism Tolerance Met? **YES**
Spherically Seated

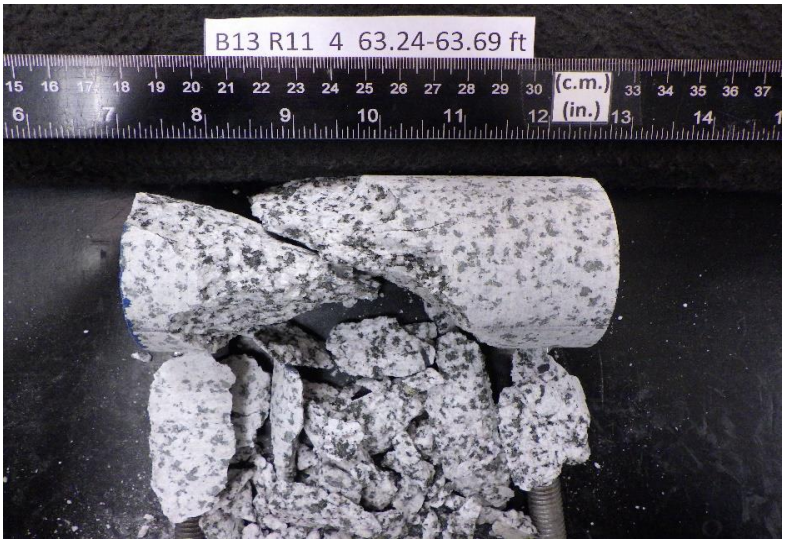
PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00040	2.400	0.00017	0.010	YES
Diameter 2, in (rotated 90°)	0.00030	2.400	0.00013	0.007	YES
END 2					
Diameter 1, in	0.00030	2.400	0.00013	0.007	YES
Diameter 2, in (rotated 90°)	0.00030	2.400	0.00013	0.007	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? **YES**

Client:	Shannon & Wilson, Inc.
Project Name:	Index-Galena Road
Project Location:	Index, WA
GTX #:	314452
Test Date:	10/26/2021
Tested By:	kdp
Checked By:	smd
Boring ID:	B13 R11
Sample ID:	4
Depth, ft:	63.24-63.69

After cutting and grinding



After break

CHANGE ORDER #7
6/17/2022
Justification Attachment 2
Page 13 of 19

GeoTesting EXPRESS

Client:	Shannon & Wilson, Inc.	Test Date:	10/26/2021
Project Name:	Index-Galena Road	Tested By:	ak
Project Location:	Index, WA	Checked By:	smd
GTX #:	314452		
Boring ID:	B13 R11		
Sample ID:	5		
Depth:	64.3-64.75 ft		
Visual Description:	See Photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	5.44	5.45	5.45
Specimen Diameter, in:	2.40	2.40	2.40
Specimen Mass, g:	1094.43		
Bulk Density, lb/ft^3	169	**Minimum Diameter Tolerence Met?**	**YES**
Length to Diameter Ratio:	2.3	**Length to Diameter Ratio Tolerance Met?**	**YES**

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? **YES**

END FLATNESS AND PARALLELISM (Procedure FP1)

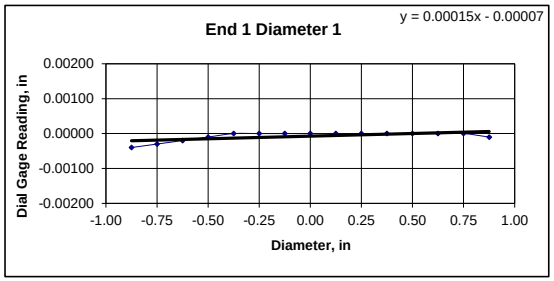
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00040	-0.00030	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010
Diameter 2, in (rotated 90°)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00020	-0.00030	-0.00040

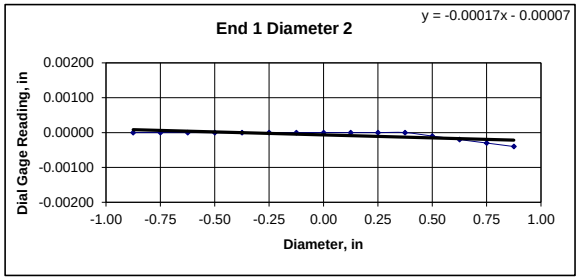
Difference between max and min readings, in:
0° = 0.00040 90° = 0.00040

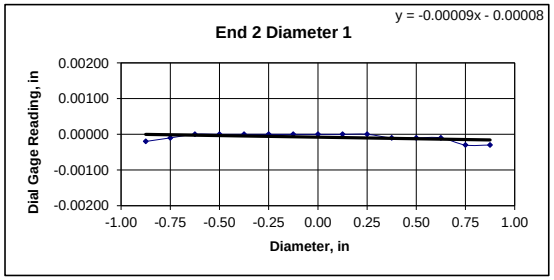
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00010	-0.00030	-0.00030
Diameter 2, in (rotated 90°)	-0.00040	-0.00030	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

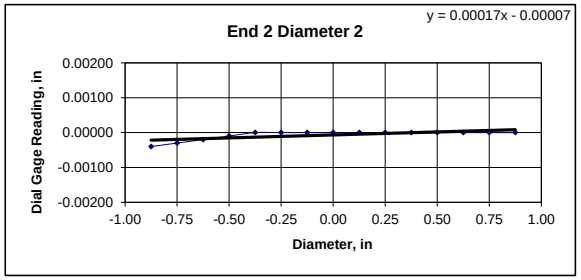
Difference between max and min readings, in:
0° = 0.0003 90° = 0.0004

Maximum difference must be < 0.0020 in. Difference = ± 0.00020
Flatness Tolerance Met? **YES**









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00015
Angle of Best Fit Line: 0.00868

End 2:
Slope of Best Fit Line 0.00009
Angle of Best Fit Line: 0.00507

Maximum Angular Difference: 0.00360

Parallelism Tolerance Met? **YES**
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00017
Angle of Best Fit Line: 0.00982

End 2:
Slope of Best Fit Line 0.00017
Angle of Best Fit Line: 0.00982

Maximum Angular Difference: 0.00000

Parallelism Tolerance Met? **YES**
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00040	2.400	0.00017	0.010	YES
Diameter 2, in (rotated 90°)	0.00040	2.400	0.00017	0.010	YES
END 2					
Diameter 1, in	0.00030	2.400	0.00013	0.007	YES
Diameter 2, in (rotated 90°)	0.00040	2.400	0.00017	0.010	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? **YES**

Client:	Shannon & Wilson, Inc.
Project Name:	Index-Galena Road
Project Location:	Index, WA
GTX #:	314452
Test Date:	10/26/2021
Tested By:	kdp
Checked By:	smd
Boring ID:	B13 R11
Sample ID:	5
Depth, ft:	64.3-64.75

After cutting and grinding

After break

CHANGE ORDER #7
6/17/2022
Justification Attachment 2
Page 15 of 19

GeoTesting EXPRESS

Client:	Shannon & Wilson, Inc.	Test Date:	10/26/2021
Project Name:	Index-Galena Road	Tested By:	ak
Project Location:	Index, WA	Checked By:	smd
GTX #:	314452		
Boring ID:	B13 R12		
Sample ID:	6		
Depth:	66.5-66.95 ft		
Visual Description:	See Photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	5.30	5.31	5.31
Specimen Diameter, in:	2.40	2.40	2.40
Specimen Mass, g:	1067.43		
Bulk Density, lb/ft^3	169	**Minimum Diameter Tolerence Met?**	**YES**
Length to Diameter Ratio:	2.2	**Length to Diameter Ratio Tolerance Met?**	**YES**

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? **YES**

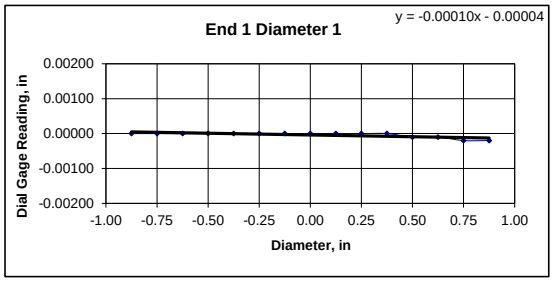
END FLATNESS AND PARALLELISM (Procedure FP1)

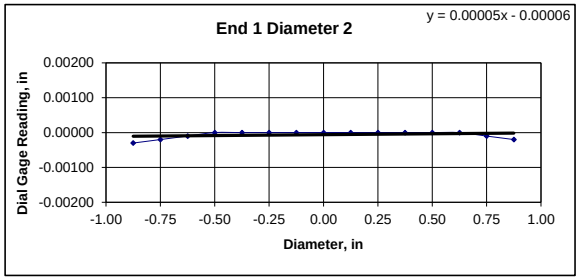
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00020	-0.00020
Diameter 2, in (rotated 90°)	-0.00030	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00020

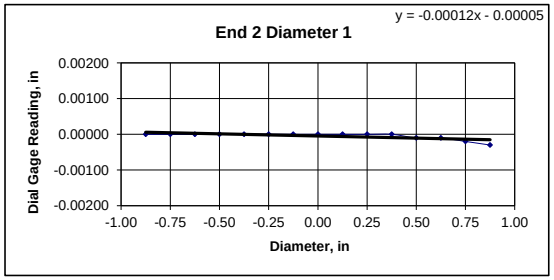
Difference between max and min readings, in:
0° = 0.00020 90° = 0.00030

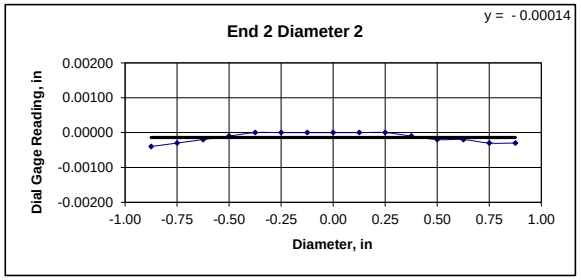
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00020	-0.00030
Diameter 2, in (rotated 90°)	-0.00040	-0.00030	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00020	-0.00020	-0.00030	-0.00030

Difference between max and min readings, in:
0° = 0.0003 90° = 0.0004
Maximum difference must be < 0.0020 in. Difference = ± 0.00020
Flatness Tolerance Met? **YES**









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00010
Angle of Best Fit Line: 0.00573

End 2:
Slope of Best Fit Line 0.00012
Angle of Best Fit Line: 0.00688

Maximum Angular Difference: 0.00115

Parallelism Tolerance Met? **YES**
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00005
Angle of Best Fit Line: 0.00295

End 2:
Slope of Best Fit Line 0.00000
Angle of Best Fit Line: 0.00000

Maximum Angular Difference: 0.00295

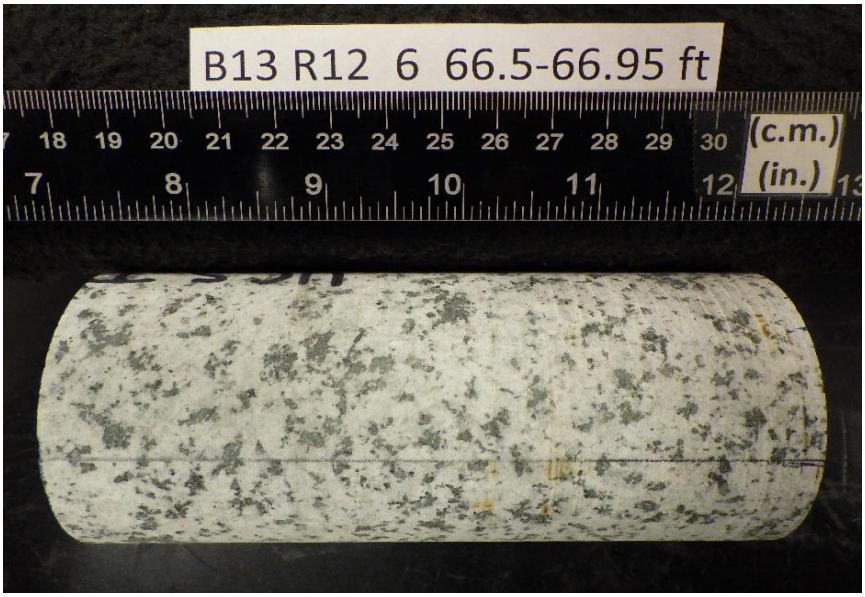
Parallelism Tolerance Met? **YES**
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

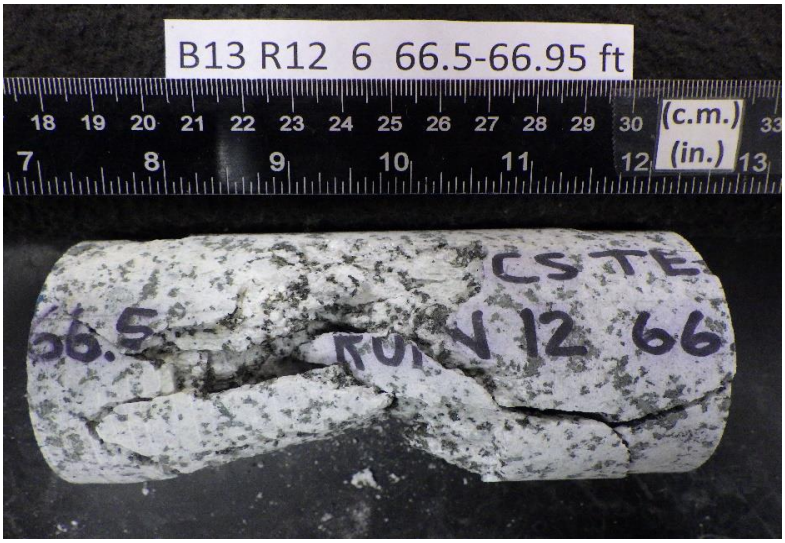
END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00020	2.400	0.00008	0.005	YES
Diameter 2, in (rotated 90°)	0.00030	2.400	0.00013	0.007	YES
END 2					
Diameter 1, in	0.00030	2.400	0.00013	0.007	YES
Diameter 2, in (rotated 90°)	0.00040	2.400	0.00017	0.010	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? **YES**

Client:	Shannon & Wilson, Inc.
Project Name:	Index-Galena Road
Project Location:	Index, WA
GTX #:	314452
Test Date:	10/27/2021
Tested By:	kdp
Checked By:	smd
Boring ID:	B13 R12
Sample ID:	6
Depth, ft:	66.5-66.95



After cutting and grinding



After break

CHANGE ORDER #7
6/17/2022
Justification Attachment 2
Page 17 of 19

GeoTesting EXPRESS

Client:	Shannon & Wilson, Inc.	Test Date:	10/26/2021
Project Name:	Index-Galena Road	Tested By:	ak
Project Location:	Index, WA	Checked By:	smd
GTX #:	314452		
Boring ID:	B13 R12		
Sample ID:	7		
Depth:	70.73-71.18 ft		
Visual Description:	See Photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average
Specimen Length, in:	5.45	5.45	5.45
Specimen Diameter, in:	2.40	2.40	2.40
Specimen Mass, g:	1091.83		
Bulk Density, lb/ft^3	168	**Minimum Diameter Tolerence Met?**	**YES**
Length to Diameter Ratio:	2.3	**Length to Diameter Ratio Tolerance Met?**	**YES**

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap ≤ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? **YES**

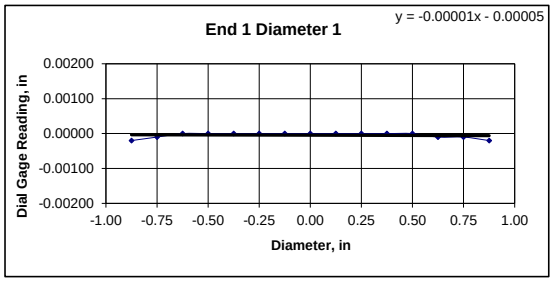
END FLATNESS AND PARALLELISM (Procedure FP1)

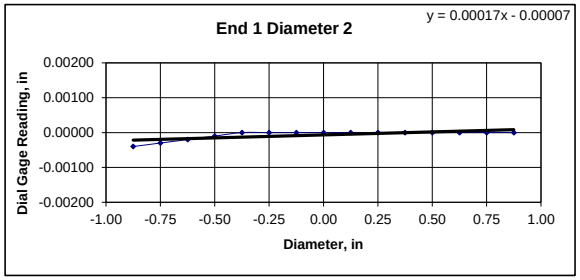
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00020
Diameter 2, in (rotated 90°)	-0.00040	-0.00030	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

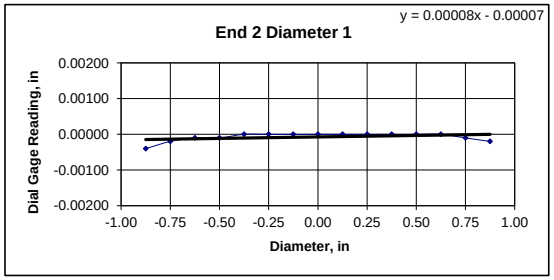
Difference between max and min readings, in:
0° = 0.00020 90° = 0.00040

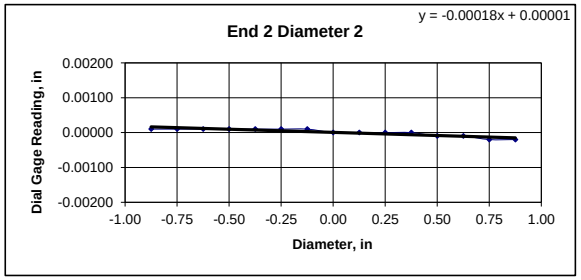
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00040	-0.00020	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00020
Diameter 2, in (rotated 90°)	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00020	-0.00020

Difference between max and min readings, in:
0° = 0.0004 90° = 0.0003
Maximum difference must be < 0.0020 in. Difference = ± 0.00020
Flatness Tolerance Met? **YES**









DIAMETER 1

End 1:
Slope of Best Fit Line 0.00001
Angle of Best Fit Line: 0.00082

End 2:
Slope of Best Fit Line 0.00008
Angle of Best Fit Line: 0.00475

Maximum Angular Difference: 0.00393

Parallelism Tolerance Met? **YES**
Spherically Seated

DIAMETER 2

End 1:
Slope of Best Fit Line 0.00017
Angle of Best Fit Line: 0.00982

End 2:
Slope of Best Fit Line 0.00018
Angle of Best Fit Line: 0.01031

Maximum Angular Difference: 0.00049

Parallelism Tolerance Met? **YES**
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00020	2.400	0.00008	0.005	YES
Diameter 2, in (rotated 90°)	0.00040	2.400	0.00017	0.010	YES
END 2					
Diameter 1, in	0.00040	2.400	0.00017	0.010	YES
Diameter 2, in (rotated 90°)	0.00030	2.400	0.00013	0.007	YES

Maximum angle of departure must be ≤ 0.25°
Perpendicularity Tolerance Met? **YES**

Client:	Shannon & Wilson, Inc.
Project Name:	Index-Galena Road
Project Location:	Index, WA
GTX #:	314452
Test Date:	10/27/2021
Tested By:	kdp
Checked By:	smd
Boring ID:	B13 R12
Sample ID:	7
Depth, ft:	70.73-71.18

After cutting and grinding

After break

CHANGE ORDER #7
6/17/2022
Justification Attachment 2
Page 19 of 19