Attachment H-3: Seismic Tables and Maps

APPENDIX D

SEISMIC TABLES AND MAPS

TABLES

D1 Summary of Quaternary Faults within 5 Miles of the Proposed Alignments
D2 Earthquakes Reported To Cause Greater Than MMI III
D3 Earthquakes Estimated To Cause MMI III or Greater

FIGURES

D1 Peak Ground Acceleration - 500 Year Return Period - 2002 USGS PSHA
D2 Peak Ground Acceleration - 2,500 Year Return Period - 2002 USGS PSHA
D3 0.2 sec Period Spectral Acceleration - 2,500 Year Return Period - 2002 USGS PSHA
D4 1.0 sec Period Spectral Acceleration - 2,500 Year Return Period - 2002 USGS PSHA
D5 Peak Ground Acceleration - 5,000 Year Return Period - 2002 USGS PSHA
D6 Peak Ground Acceleration - 500 Year Return Period - 2014 USGS PSHA
D7 Peak Ground Acceleration - 2,500 Year Return Period - 2014 USGS PSHA
D8 0.2 sec Period Spectral Acceleration - 2,500 Year Return Period - 2014 USGS PSHA
D9 1.0 sec Period Spectral Acceleration - 2,500 Year Return Period - 2014 USGS PSHA
D10 Peak Ground Acceleration - 5,000 Year Return Period - 2014 USGS PSHA
D11 Quaternary Faults
D12 Historical Earthquakes

TABLE D1: SUMMARY OF QUATERNARY FAULTS WITHIN 5 MILES OF THE PROPOSED ALIGNMENTS

Fault Name	Fault ID	Primary County, State	Time of Most Recent Deformation[1]	Slip Rate (mm/yr)	Slip Sense[2]	Dip Direction	Length (km)
Owyhee Mountains fault system	636	Owyhee County, ID	<1.6 Ma	<0.2	Normal	NE	206
South Grande Ronde Valley faults	709	Union County, OR	<750 ka	<0.2	Normal	SW / NE	23
Unnamed East Baker Valley faults	712	Baker County, OR	<750 ka	<0.2	Normal	SW	27
West Baker Valley faults	804	Baker County, OR	<130 ka	<0.2	Normal	NE	33
Cottonwood Mountain fault	806	Malheur County, OR	<15 ka	<0.2	Normal, Sinistral	NE	42
Faults near Owyhee Dam (Class B)	808	Malheur County, OR	<1.6 Ma	<0.2	Normal	E / W	37
West Grande Ronde Valley fault zone, Mount Emily section	802a	Union County, OR	<15 ka	<0.2	Normal, Dextral	E	29
West Grande Ronde Valley fault zone, La Grande section	802b	Union County, OR	<15 ka	<0.2	Normal, Dextral	NE	15
West Grande Ronde Valley fault zone, Craig Mountain section	802c	Union County, OR	<15 ka	<0.2	Normal, Dextral	NE / SW	10
Hite fault system, Thorn Hollow section	845c	Umatilla County, OR	<130 ka	<0.2	Sinistral, Normal	NW	44
Hite fault system, Agency section	845d	Umatilla County, OR	<1.6 Ma	<0.2	Sinistral, Normal	NW	28

1. Ma = million years ago; ka = thousand years ago
2. Sense of movement on a fault is based on the angle of the dip of the fault plane and the relative direction of movement across the fault. Terms used to describe the sense of movement include dip-slip, normal, reverse, thrust, strike-slip, dextral (right-lateral), sinistral (left-lateral), and oblique.

TABLE D2: EARTHQUAKES REPORTED TO CAUSE GREATER THAN MMI III

Year	Month	Day	Hour	Minute	Second	Lattitude	Longitude	Depth (kilometers)	Magnitude	MMI	City Where Felt	State	City Lat.	City Lon.	Distance to Epicenter (kilometers)
1893	3	7	1	3	0	46.000	-119.000			7	UMATILLA	OR	45.92	-119.34	27
1916	5	13	2	30	0	43.700	-116.200			4	IDAHO CITY	ID	43.83	-115.83	33
1916	5	25	13	36	0	43.567	-115.967			5					
1916	5	26	6	36	0	43.800	-116.000			4	PAYETTE	ID	43.97	-116.72	60
1921	9	14	11	0	0	46.067	-118.333			6					
1924	1	6	13	9	0	46.067	-118.333			4					
1924	1	6	23	10	0	45.833	-118.333			5					
1924	5	27	0	19	0	46.067	-118.333			4					
1926	4	23	13	56	0	46.067	-118.333			4					
1927	4	9	5	0	0	44.800	-117.200			5	HALFWAY	OR	44.88	-117.11	11
1927	4	9	7	0	0	44.833	-117.317			4					
1927	4	9	9	30	0	44.817	-117.083			4					
1927	4	9	14	0	0	44.750	-117.233			4					
1936	7	16	7	7	48	46.000	-118.500		5.8	4	BOVILL	ID	46.86	-116.4	187
1936	7	18	16	30	0	46.000	-118.300			5					
1936	7	30	11	20	0	45.933	-118.317			4					
1936	8	4	9	19	0	45.917	-118.783			5					
1936	8	28	4	39	0	45.950	-118.317			5					
1937	2	9	22	20	0	46.067	-118.333			4					
1937	6	4	14	43	0	46.067	-118.333			4					
1938	8	11	18	52	0	45.950	-118.300			4					
1938	10	27	23	10	0	45.950	-118.283			4					
1939	1	26	7	59	0	45.667	-118.667			4					
1941	12	23	17	48	0	44.750	-117.000			4					
1941	12	23	22	20	0	44.667	-117.100			4					
1942	6	12	9	30	0	44.900	-117.100			5	EAGLE VALLEY	OR	44.75	-117.3	22
1944	9	2	2	25	14	46.067	-118.333			4					
1944	9	20	3	0	0	43.200	-117.083			4					
1945	9	23	3	40	0	46.067	-118.333			4					
1948	12	20	16	18	0	45.050	-120.167			4					
1951	1	7	22	45	0	45.917	-119.233			5					
1959	1	21	7	15	0	46.067	-118.333			4					
1959	11	9	21	10	0	45.333	-119.533			4					
1971	7	13	23	29	25	44.800	-117.900	33.0	3.9	4	HAINES	OR	44.91	-117.94	12

TABLE D2: EARTHQUAKES REPORTED TO CAUSE GREATER THAN MMI III

Year	Month	Day	Hour	Minute	Second	Lattitude	Longitude	Depth (kilometers)	Magnitude	MMI	City Where Felt	State	City Lat.	City Lon.	Distance to Epicenter (kilometers)
1978	4	3	10	10	8	44.050	-116.360	5.0	3.6	4	SWEET	ID	43.97	-116.32	9
1979	4	8	7	29	38	46.000	-118.450	5.0	4.1	4	MILTON FREEWATER	OR	45.93	-118.39	9
1981	9	29	5	39	48	44.690	-116.990	5.0	3.3	4	CAMBRIDGE	ID	44.57	-116.68	27
1983	3	22	12	47	3	46.000	-118.440	4.0	3.9	4	HELIX	OR	45.85	-118.66	23
1984	8	10	7	26	38	44.990	-116.950	5.0	4.0	4	HALFWAY	OR	44.88	-117.11	17
1985	2	10	20	29	32	45.700	-119.630	18.0	3.9	4	HERMISTON	OR	45.84	-119.28	31

Data Sources: National Geophysical Data Center (NGDC), 1985, Earthquake Intensity Database Search, 1638 – 1985, NOAA Satellite and Information Service: http://www.ngdc.noaa.gov/hazard/earthqk.shtml; Johnson, A.G., Scofield. D.H., 1993, Earthquake Database for Oregon, 1833 through October 25, 1993: Oregon Department of Geology and Mineral Industries Open-File Report 94-04; and Advanced National Seismic System (ANSS), 2016, Composite Catalog: http://earthquake.usgs.gov/earthquakes/search/.

TABLE D3: EARTHQUAKES ESTIMATED TO CAUSE MMI III OR GREATER

Year	Month	Day	Hour	Minute	Second	Epicenter		EQ Depth (kilometers)	Magnitude	Estimated MMI
						Lattitude	Longitude			
1986	2	4	1	59	7	46.044	-118.810	7.80	3.2	III
1987	9	8	5	2	16	45.184	-120.085	1.00	3.1	III
1988	9	29	8	9	20	45.850	-120.260	13.89	3.5	III
1989	3	27	20	17	22	45.816	-120.262	12.25	3.1	III
1989	5	30	22	7	37	43.762	-116.930	11.00	3.1	III
1989	7	20	13	50	50	44.173	-117.184	5.00	3.7	III
1989	12	20	8	52	46	44.620	-117.073	5.00	3.2	III
1990	1	4	18	1	5	44.701	-117.887	20.40	3.2	III
1991	11	28	1	8	59	45.990	-118.317	9.47	4.3	IV
1991	12	15	22	14	53	45.995	-118.329	7.98	3.3	III
1992	1	26	5	35	48	45.019	-116.808	5.00	3.2	III
1992	6	16	12	31	17	44.827	-117.022	6.80	3.9	III - IV
1992	7	14	20	1	51	45.993	-118.309	11.62	4.1	IV
1992	8	7	17	23	18	45.860	-119.590	0.57	3.9	III - IV
1992	10	1	11	7	38	45.561	-117.311	3.40	3.3	III
1993	3	10	14	39	42	44.383	-116.255	11.10	3.2	III
1993	12	16	12	21	34	45.196	-120.090	6.69	3	III
1993	12	24	11	21	3	44.934	-117.303	5.00	3	III
1994	4	19	23	8	6	44.806	-116.890	6.80	3.1	III
1994	8	12	19	3	48	44.571	-116.670	10.00	3.5	III
1994	10	25	17	55	48	44.835	-117.009	10.00	3.1	III
1994	10	27	3	35	54	44.814	-117.001	10.00	4	IV
1995	3	16	16	44	55	44.802	-116.905	8.20	3.3	III
1995	6	12	1	48	24	46.404	-119.263	0.95	3.3	III
1995	8	29	13	2	49	46.208	-119.906	15.34	3.1	III
1995	11	2	14	30	14	46.150	-119.564	21.30	3.1	III
1997	1	27	19	10	44	44.821	-117.020	6.50	3.3	III

TABLE D3: EARTHQUAKES ESTIMATED TO CAUSE MMI III OR GREATER

Year	Month	Day	Hour	Minute	Second	Epicenter		EQ Depth (kilometers)	Magnitude	Estimated MMI
						Lattitude	Longitude			
1997	3	22	6	5	35	45.197	-120.067	0.83	3.9	III - IV
1997	3	23	4	39	51	45.195	-120.051	0.02	3.1	III
1997	3	23	4	40	13	45.246	-120.049	17.96	3.1	III
1997	4	17	17	30	37	45.188	-120.082	3.19	3.2	III
1997	10	13	15	45	34	46.114	-120.376	17.86	3.1	III
1997	11	18	1	53	6	46.143	-120.471	15.63	3.9	III - IV
1997	11	18	9	55	11	46.137	-120.461	15.83	3.3	III
1998	2	3	23	45	14	45.814	-120.192	16.29	3.1	III
1998	3	18	0	52	20	44.980	-116.924	7.90	3.4	III
1998	7	19	18	34	45	44.847	-117.015	11.50	3.5	III
1998	7	20	1	48	46	44.849	-117.015	12.20	3.7	III
1998	7	20	3	38	35	44.850	-117.016	11.50	3.3	III
1998	7	20	21	1	21	44.842	-117.021	10.60	3.6	III
1998	7	21	23	13	31	44.841	-117.017	11.40	3.5	III
1999	3	3	8	15	38	45.285	-117.076	10.00	3.5	III
1999	3	3	8	25	3	45.230	-117.100	5.00	3.5	III
1999	5	23	3	57	49	44.945	-116.976	10.00	3.1	III
1999	6	11	15	44	8	44.506	-116.333	18.30	3.3	III
1999	8	31	23	3	7	45.186	-120.091	3.55	3.5	III
1999	9	19	4	21	44	46.441	-119.626	19.88	3.1	III
1999	9	19	11	11	53	46.392	-120.106	12.38	3.2	III
2000	1	30	19	10	23	45.197	-120.125	0.03	4.1	IV
2000	1	30	20	46	6	45.183	-120.103	0.03	3.4	III
2000	2	1	0	11	8	45.190	-120.113	0.02	3.6	III
2000	2	27	22	26	24	44.310	-116.250	10.00	3.1	III
2000	7	13	22	29	59	44.451	-118.246	67.50	3.1	III
2000	8	17	1	58	24	45.312	-120.042	15.07	3.2	III

TABLE D3: EARTHQUAKES ESTIMATED TO CAUSE MMI III OR GREATER

Year	Month	Day	Hour	Minute	Second	Epicenter		EQ Depth (kilometers)	Magnitude	Estimated MMI
						Lattitude	Longitude			
2000	8	27	21	20	26	44.667	-117.511	23.50	3.5	III
2000	9	6	6	54	17	46.075	-118.365	0.05	3	III
2002	10	4	0	56	6	44.434	-116.268	10.00	4	IV
2002	11	6	16	4	41	45.193	-117.078	10.00	3.1	III
2002	11	16	0	46	59	45.034	-116.942	15.20	3.5	III
2002	11	16	9	24	58	45.018	-116.942	8.90	3.1	III
2002	11	16	9	37	38	45.024	-116.952	16.20	3.2	III
2003	10	1	13	27	35	44.656	-117.730	10.00	3.6	III
2004	2	28	2	1	48	46.036	-119.021	1.00	3.3	III
2004	12	14	15	49	9	44.524	-116.312	3.50	3.6	III
2004	12	15	0	17	15	44.539	-116.300	7.00	3.8	III
2005	2	4	13	10	23	44.523	-116.282	14.30	3	III
2005	3	27	6	16	18	44.507	-116.287	3.00	3.1	III
2006	12	20	9	43	27	46.095	-118.513	13.57	3.4	III
2006	12	22	16	43	0	44.777	-116.647	9.50	3	III
2008	5	18	22	19	55	46.168	-119.550	20.10	3.7	III
2008	11	4	22	39	30	44.816	-117.053	14.60	3.5	III
2009	5	4	10	47	43	46.413	-119.273	0.40	3	III
2009	7	25	8	57	23	44.289	-117.655	7.60	3.8	III
2010	7	30	13	51	9	44.809	-117.072	16.70	3.3	III
2011	5	1	4	13	55	46.404	-119.255	1.91	3.3	III
2011	9	4	4	13	40	46.411	-119.260	1.77	3.7	III
2011	10	15	6	11	29	46.408	-119.262	1.43	3.4	III
2012	4	10	4	43	35	46.045	-118.712	14.36	3.2	III
2013	11	17	14	47	6	46.411	-119.271	0.00	3.2	III
2013	12	23	2	55	46	45.360	-118.206	8.70	3	III
2014	11	3	16	43	58	45.351	-117.189	3.90	3.4	III

TABLE D3: EARTHQUAKES ESTIMATED TO CAUSE MMI III OR GREATER

Year	Month	Day	Hour	Minute	Second	Epicenter		EQ Depth (kilometers)	Magnitude	Estimated MMI
						Lattitude	Longitude			
2015	1	23	13	47	52	45.711	-118.550	20.62	3.6	III
2015	4	24	3	49	14	44.943	-116.740	4.70	3.2	III

Data Source: Advanced National Seismic System (ANSS), 2016, Composite Catalog: http://earthquake.usgs.gov/earthquakes/search/.

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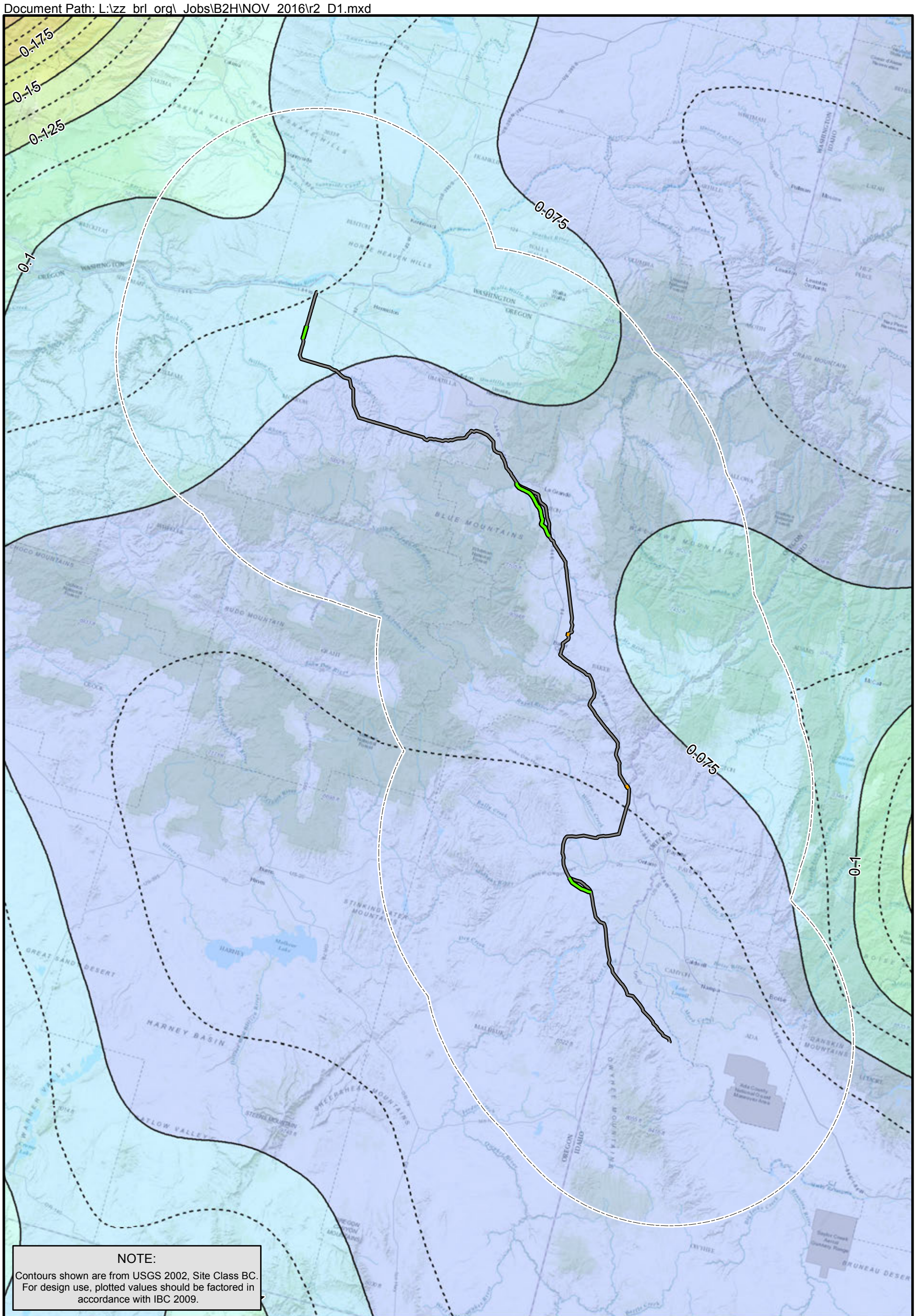

LEGEND

ALIGNMENTS

Alternative Route

IPC Proposed Route

Proposed Rebuild

PEAK GROUND ACCELERATION (g)

- 0.025 - 0.050
- 0.050 - 0.075
- 0.075 - 0.100
- 0.100 - 0.125
- 0.125 - 0.150
- 0.150 - 0.175
- 0.175 - 0.200
- 0.200 - 0.225
- 0.225 - 0.250

BOUNDS

50 Mile Project Buffer

Source: USGS 2002

N W E S

0 12.5 25

Miles

Boardman - Hemingway
500kV Transmission Line
Oregon - Idaho

PEAK GROUND ACCELERATION
500 YEAR RETURN PERIOD
2002 USGS PSHA

January 2018 24-1-03820-006

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FIG. D1

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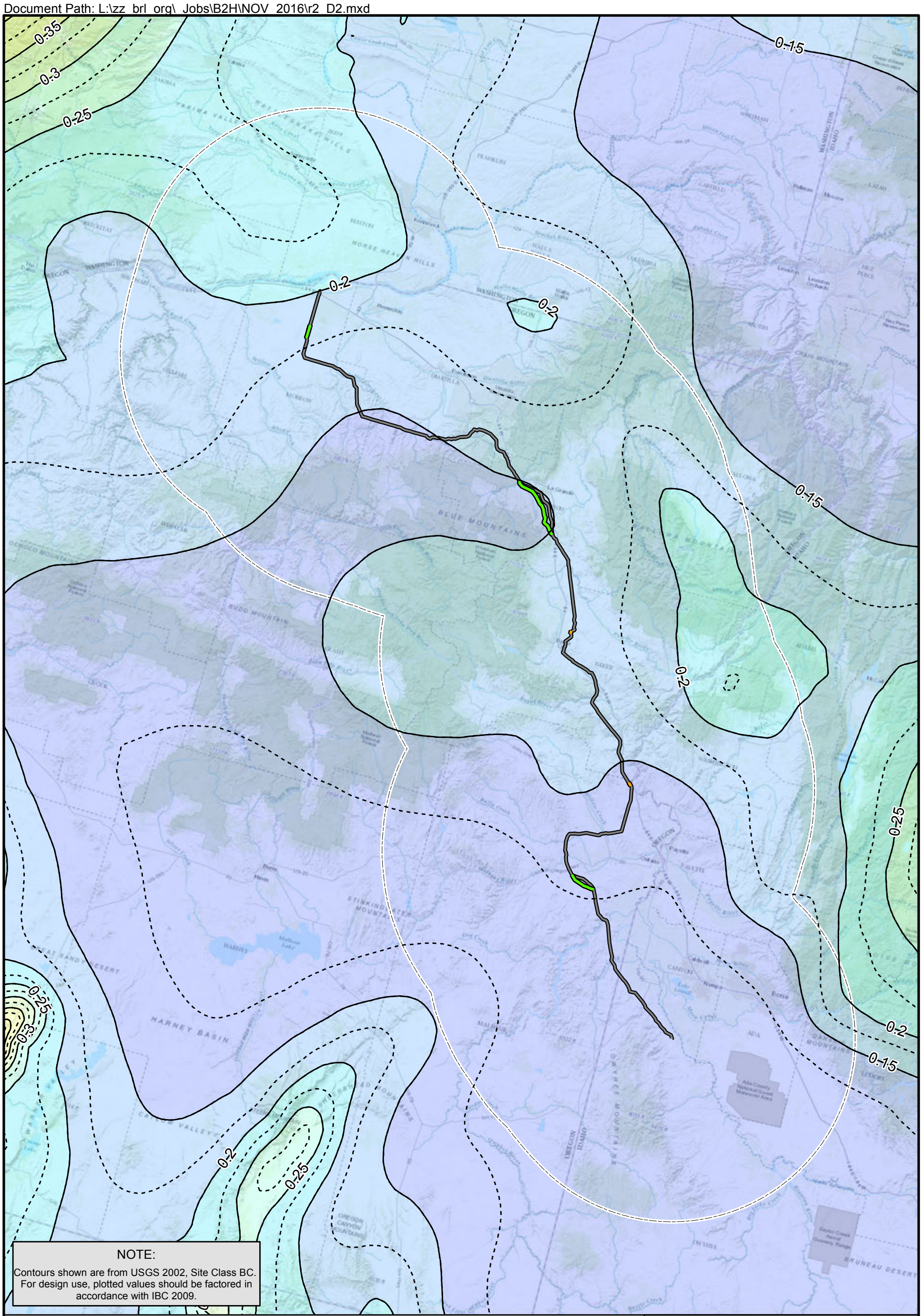

LEGEND

ALIGNMENTS

Alternative Route

IPC Proposed Route

Proposed Rebuild

PEAK GROUND ACCELERATION (g)

0.05 - 0.10
0.10 - 0.15
0.15 - 0.20
0.20 - 0.25
0.25 - 0.30
0.30 - 0.35
0.35 - 0.40
0.40 - 0.45
0.45 - 0.50
0.50 - 0.55
0.55 - 0.60

BOUNDS

50 Mile Project Buffer

Source: USGS 2002

N W E S

0 12.5 25

Miles

Boardman - Hemingway
500kV Transmission Line
Oregon - Idaho

PEAK GROUND ACCELERATION
2,500 YEAR RETURN PERIOD
2002 USGS PSHA

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FIG. D2

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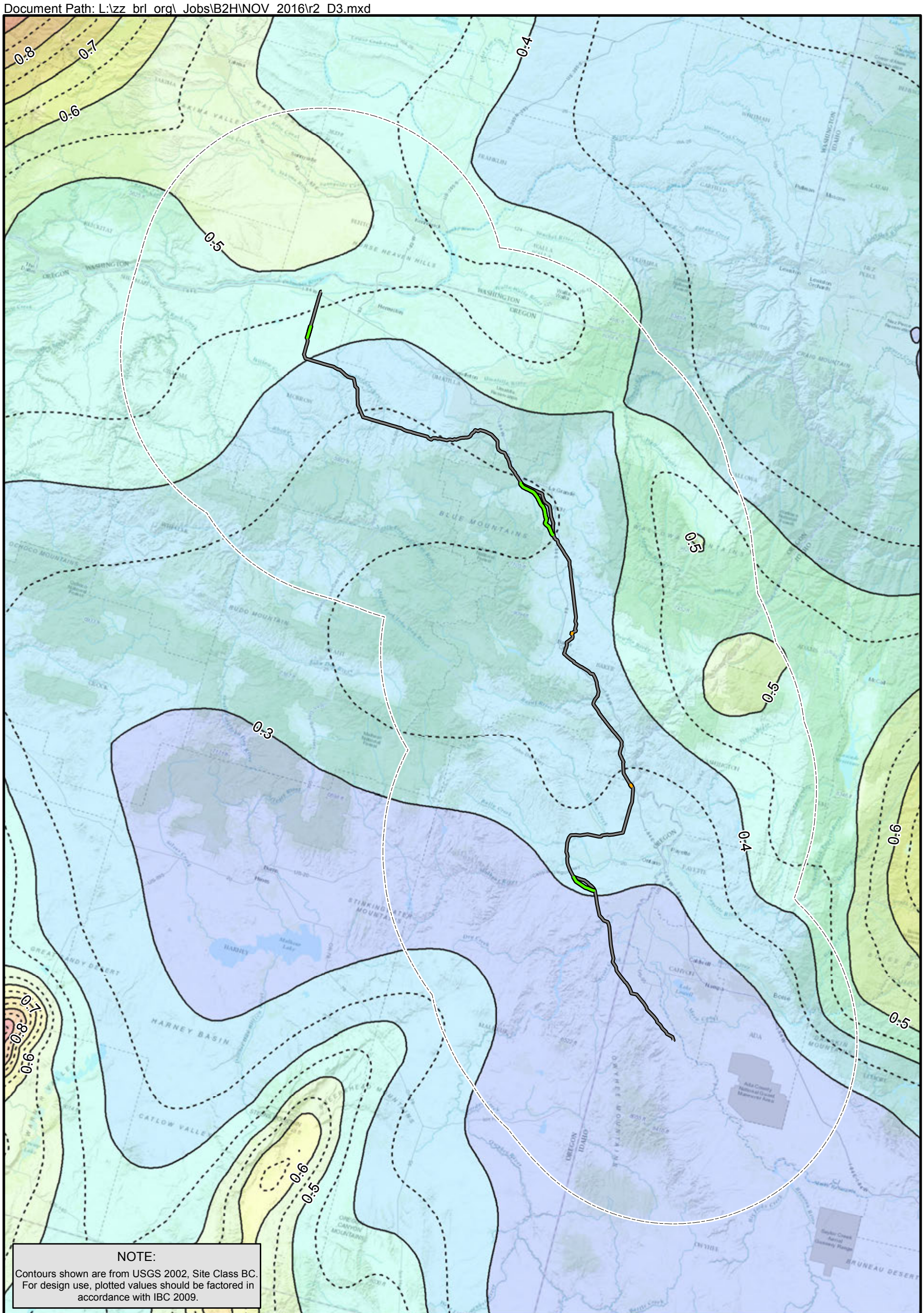

LEGEND

ALIGNMENTS

Alternative Route

IPC Proposed Route

Proposed Rebuild

SPECTRAL ACCELERATION (g)

0.1 - 0.2
0.2 - 0.3
0.3 - 0.4
0.4 - 0.5
0.5 - 0.6
0.6 - 0.7
0.7 - 0.8
0.8 - 0.9
0.9 - 1.0

BOUNDS

50 Mile Project Buffer

Source: USGS 2002

N W E S

0 12.5 25

Miles

Boardman - Hemingway
500kV Transmission Line
Oregon - Idaho

0.2 SEC PERIOD
SPECTRAL ACCELERATION
2,500 YEAR RETURN PERIOD
2002 USGS PSHA

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FIG. D3

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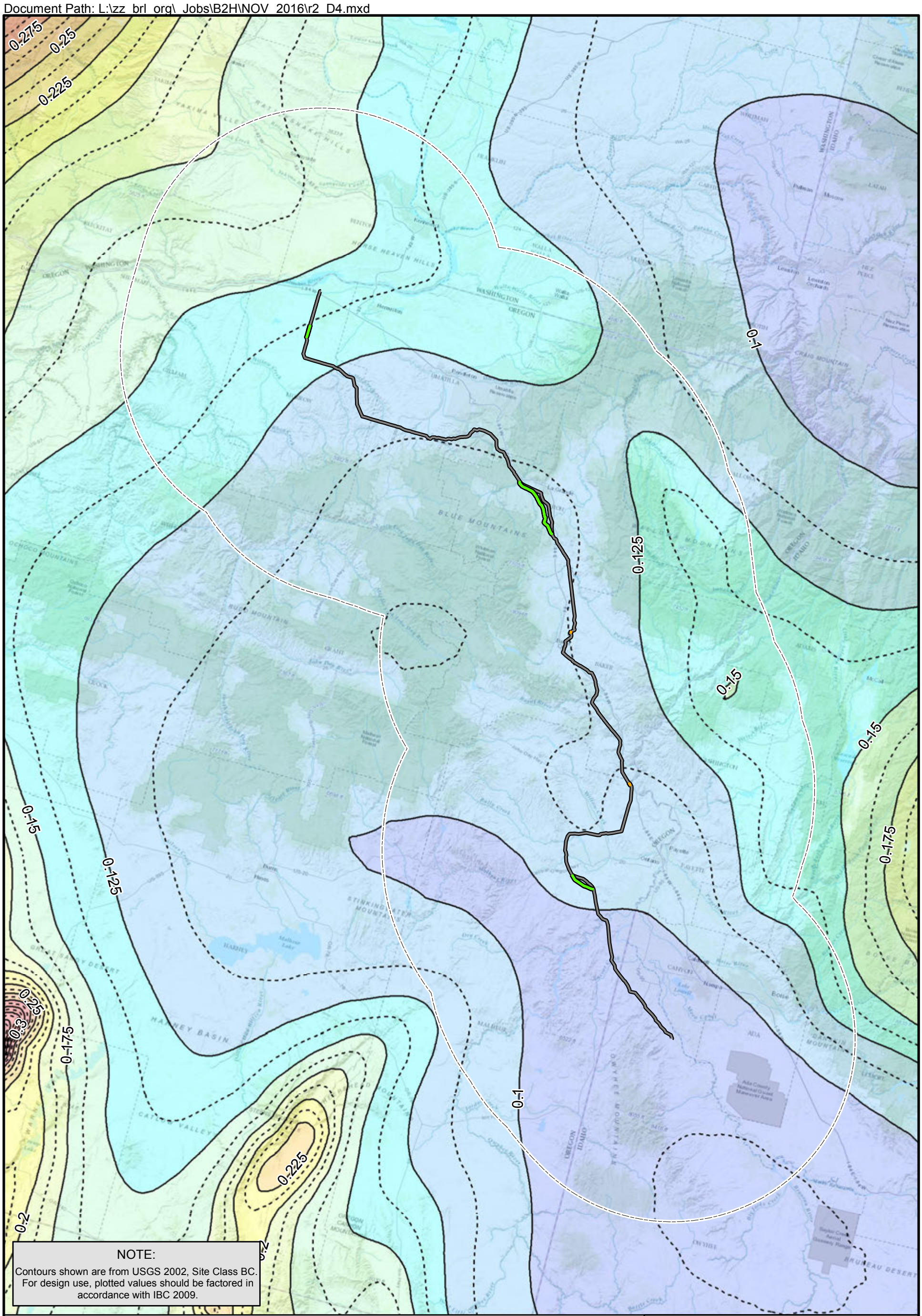

LEGEND

ALIGNMENTS

Alternative Route

IPC Proposed Route

Proposed Rebuild

SPECTRAL ACCELERATION (g)

0.050 - 0.075
0.075 - 0.100
0.100 - 0.125
0.125 - 0.150
0.150 - 0.175
0.175 - 0.200
0.200 - 0.225
0.225 - 0.250
0.250 - 0.275
0.275 - 0.300
0.300 - 0.350

BOUNDS

50 Mile Project Buffer

Source: USGS 2002

N W E S

0 12.5 25

Miles

Boardman - Hemingway
500kV Transmission Line
Oregon - Idaho

1.0 SEC PERIOD
SPECTRAL ACCELERATION
2,500 YEAR RETURN PERIOD
2002 USGS PSHA

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FIG. D4

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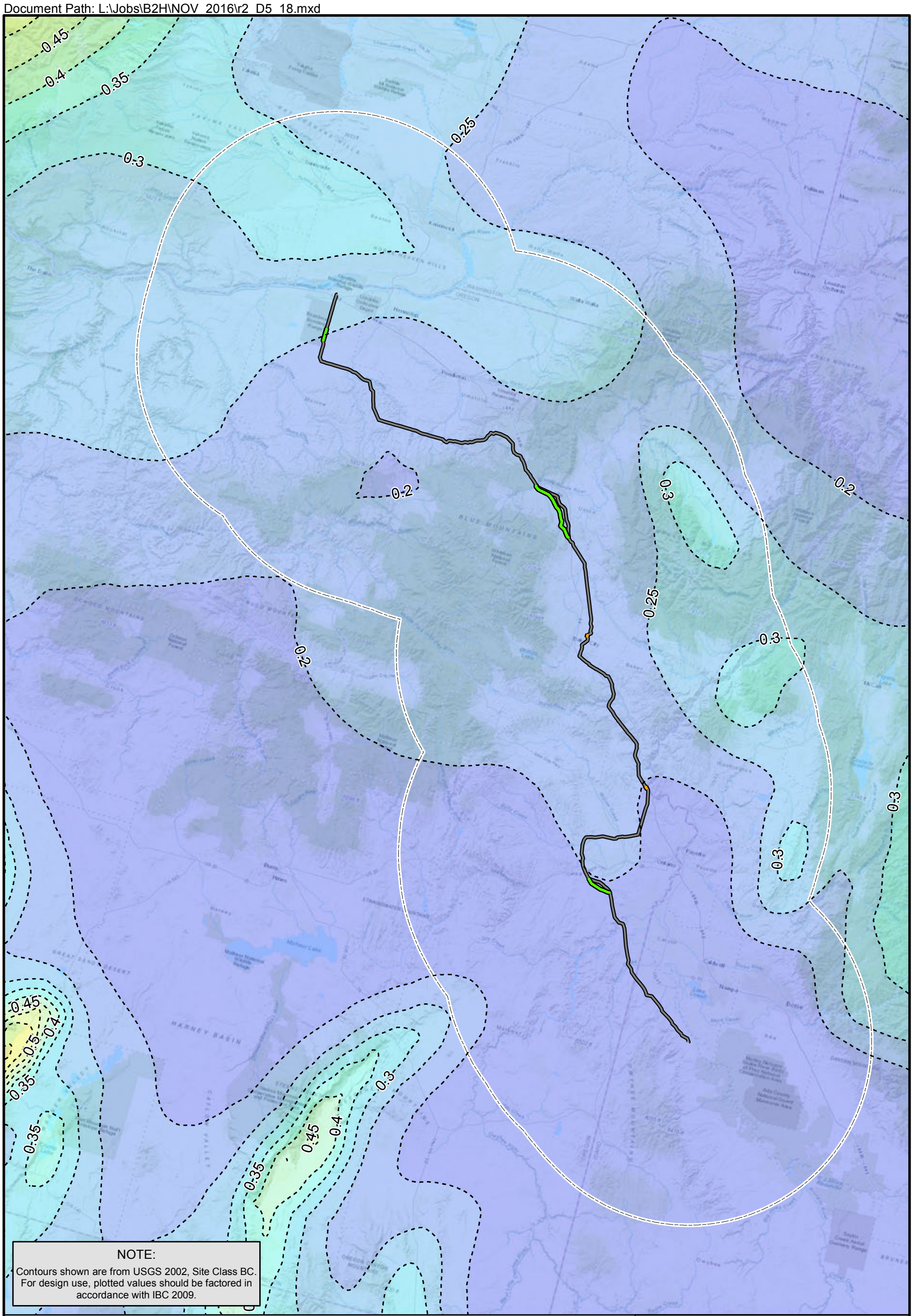

LEGEND

ALIGNMENTS

Alternative Route

IPC Proposed Route

Proposed Rebuild

PEAK GROUND ACCELERATION (g)

0.10
0.2
0.3
0.4
0.5
0.6
0.7
0.8

BOUNDS

50 Mile Project Buffer

Source: USGS 2002

N W E S

0 12.5 25

Miles

Boardman - Hemingway
500kV Transmission Line
Oregon - Idaho

PEAK GROUND ACCELERATION
5000 YEAR RETURN PERIOD
2002 USGS PSHA

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FIG. D5

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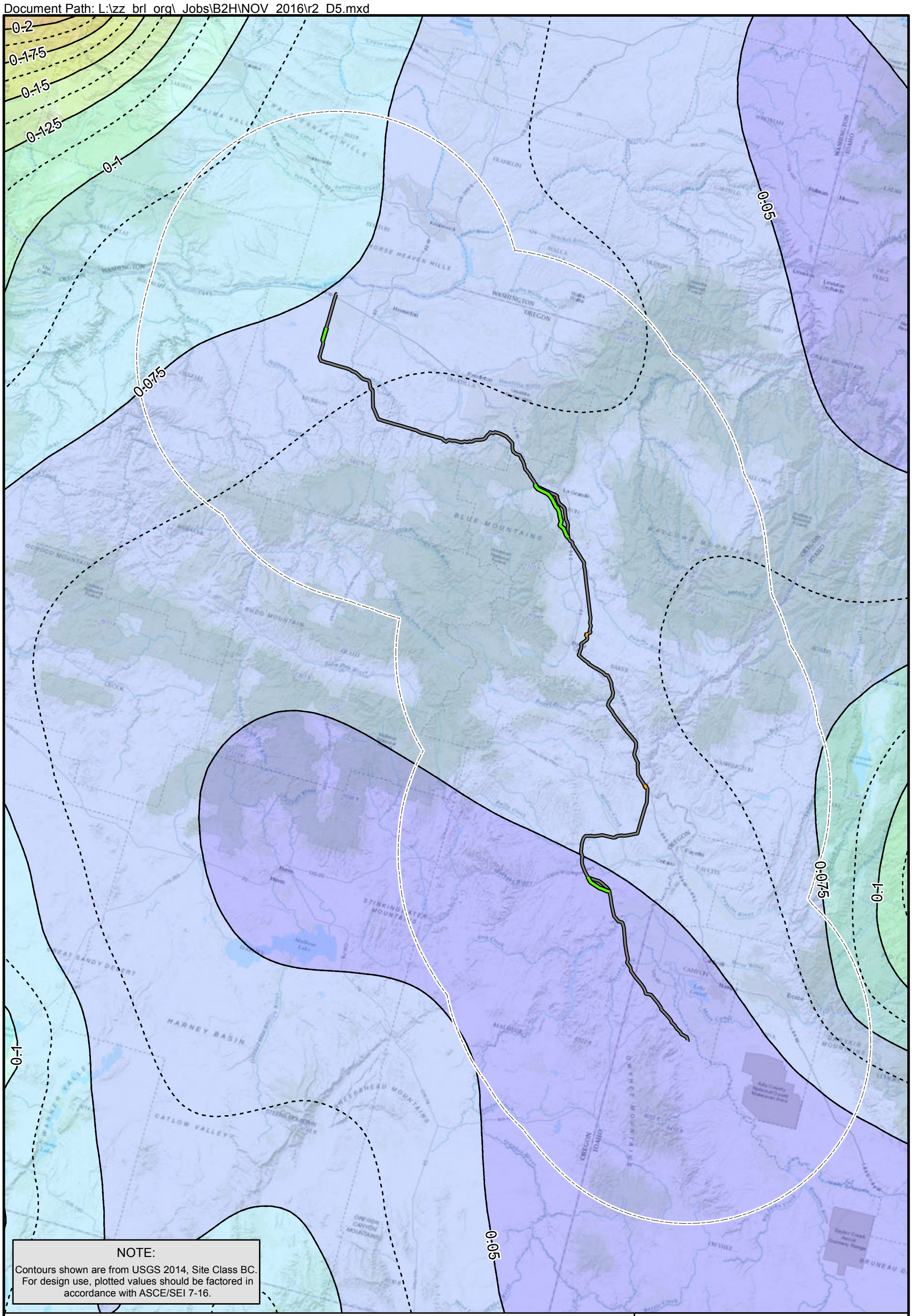

LEGEND

ALIGNMENTS

Alternative Route

IPC Proposed Route

Proposed Rebuild

PEAK GROUND ACCELERATION (g)

0.025 - 0.050
0.050 - 0.075
0.075 - 0.100
0.100 - 0.125
0.125 - 0.150
0.150 - 0.175
0.175 - 0.200
0.200 - 0.225
0.225 - 0.250

BOUNDS

50 Mile Project Buffer

Source: USGS 2014

N W E S

0 12.5 25

Miles

Boardman - Hemingway
500kV Transmission Line
Oregon - Idaho

PEAK GROUND ACCELERATION
500 YEAR RETURN PERIOD
2014 USGS PSHA

January 2018 24-1-03820-006

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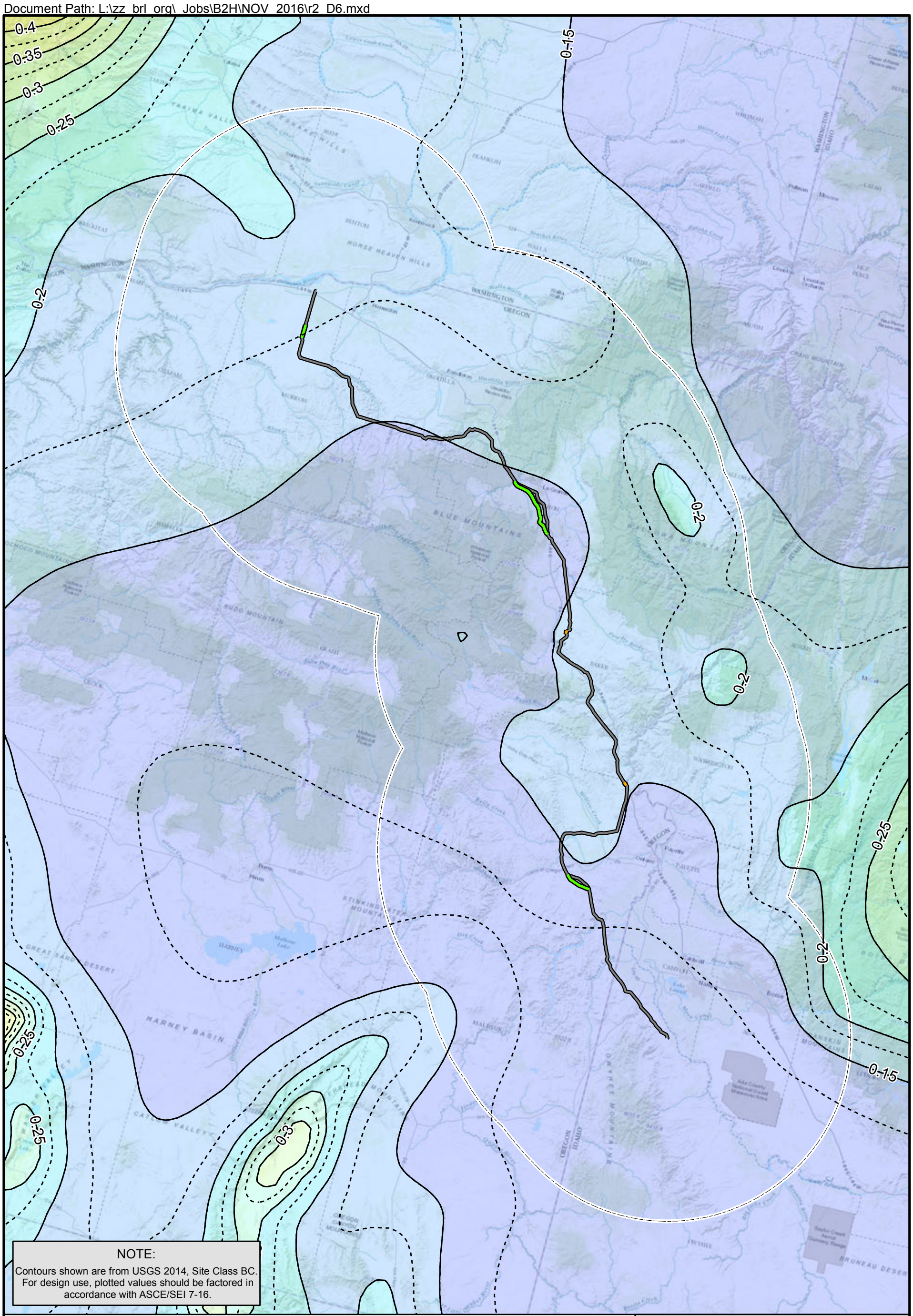
FIG. D6

Document Path: L:\zz_brl_org_Jobs\B2H\NOV_2016\r2_D6.mxd



LEGEND

ALIGNMENTS

Alternative Route

IPC Proposed Route

Proposed Rebuild

PEAK GROUND ACCELERATION (g)

0.05 - 0.10
0.10 - 0.15
0.15 - 0.20
0.20 - 0.25
0.25 - 0.30
0.30 - 0.35
0.35 - 0.40
0.40 - 0.45
0.45 - 0.50
0.50 - 0.55
0.55 - 0.60

BOUNDS

50 Mile Project Buffer

Source: USGS 2014

N W E S

0 12.5 25

Miles

Boardman - Hemingway
500kV Transmission Line
Oregon - Idaho

PEAK GROUND ACCELERATION
2,500 YEAR RETURN PERIOD
2014 USGS PSHA

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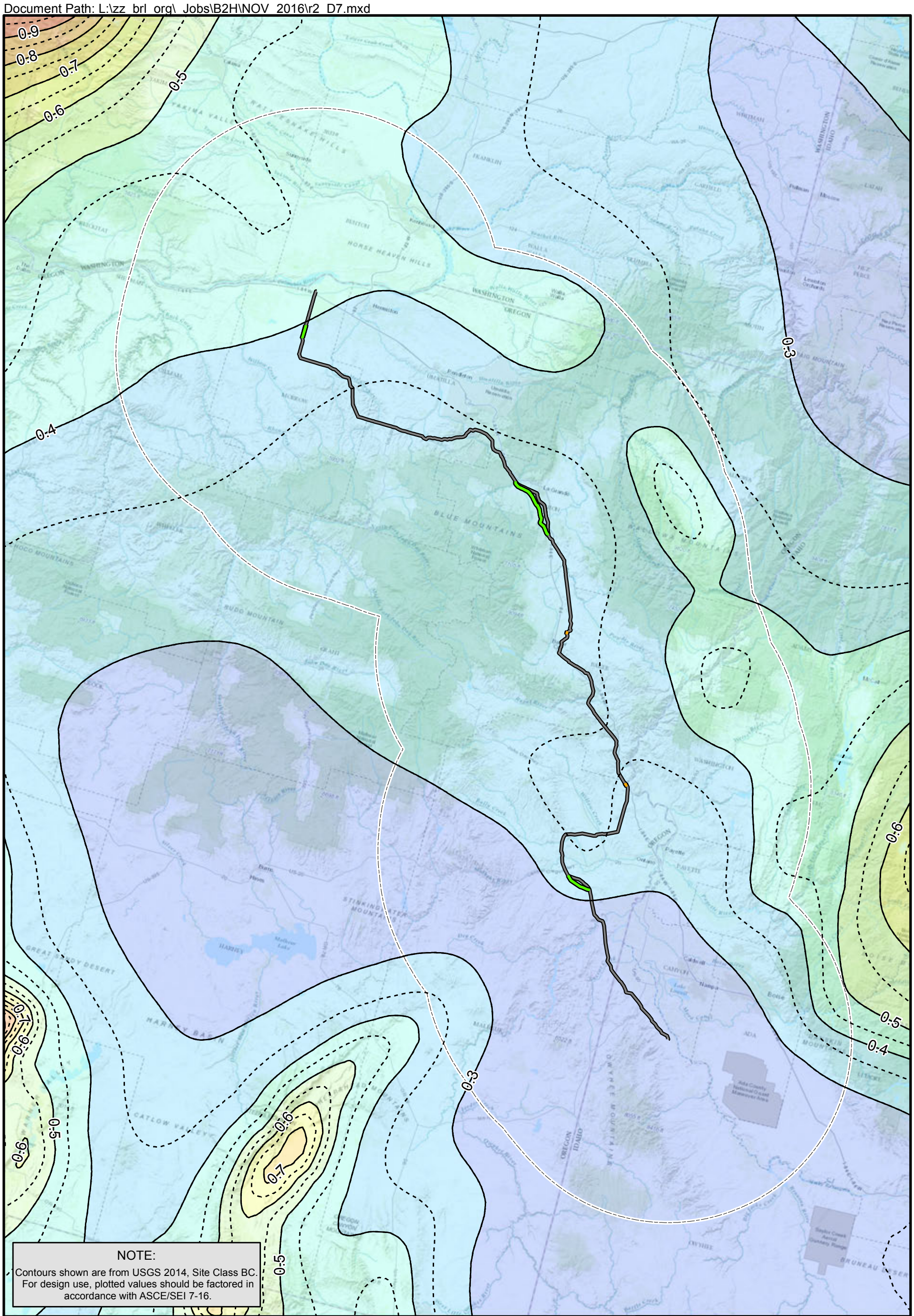
FIG. D7

Document Path: L:\zz_brl_org_Jobs\B2H\NOV_2016\r2_D7.mxd



LEGEND

ALIGNMENTS

Alternative Route

IPC Proposed Route

Proposed Rebuild

SPECTRAL ACCELERATION (g)

0.1 - 0.2
0.2 - 0.3
0.3 - 0.4
0.4 - 0.5
0.5 - 0.6
0.6 - 0.7
0.7 - 0.8
0.8 - 0.9
0.9 - 1.0

BOUNDS

50 Mile Project Buffer

Source: USGS 2014

N W E S

0 12.5 25

Miles

Boardman - Hemingway
500kV Transmission Line
Oregon - Idaho

0.2 SEC PERIOD
SPECTRAL ACCELERATION
2,500 YEAR RETURN PERIOD
2014 USGS PSHA

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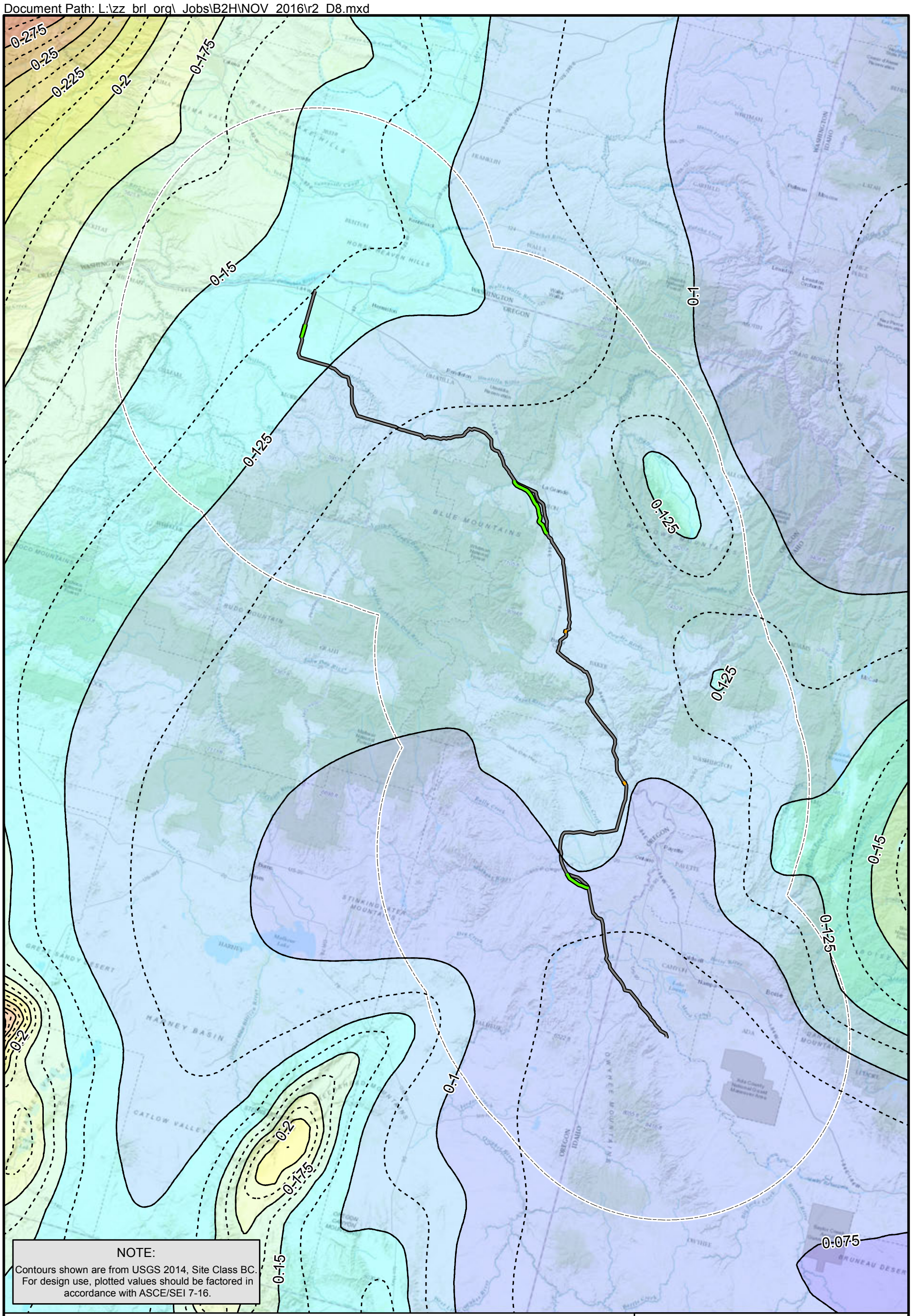
FIG. D8

Document Path: L:\zz_brl_org_Jobs\B2H\NOV_2016\r2_D8.mxd



LEGEND

ALIGNMENTS

Alternative Route

IPC Proposed Route

Proposed Rebuild

SPECTRAL ACCELERATION (g)

0.050 - 0.075
0.075 - 0.100
0.100 - 0.125
0.125 - 0.150
0.150 - 0.175
0.175 - 0.200
0.200 - 0.225
0.225 - 0.250
0.250 - 0.275
0.275 - 0.300
0.300 - 0.350

BOUNDS

50 Mile Project Buffer

Source: USGS 2014

N W E S

0 12.5 25

Miles

Boardman - Hemingway
500kV Transmission Line
Oregon - Idaho

1.0 SEC PERIOD
SPECTRAL ACCELERATION
2,500 YEAR RETURN PERIOD
2014 USGS PSHA

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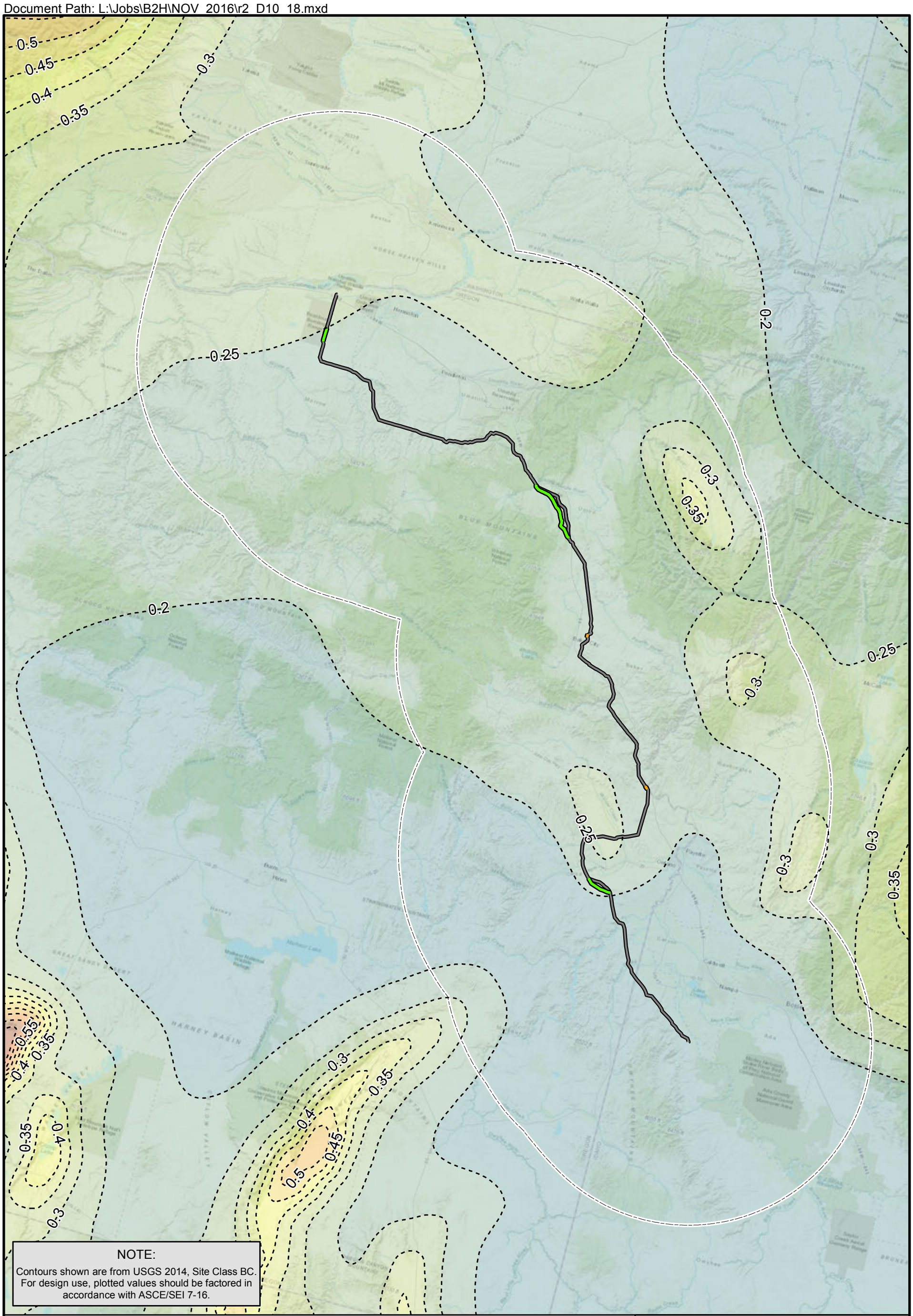
FIG. D9

Document Path: L:\Jobs\B2H\NOV_2016\r2_D10_18.mxd



LEGEND

ALIGNMENTS

Alternative Route

IPC Proposed Route

Proposed Rebuild

PEAK GROUND ACCELERATION (g)

0.05 - 0.10
0.10 - 0.15
0.15 - 0.20
0.20 - 0.25
0.25 - 0.30
0.30 - 0.35
0.35 - 0.40
0.40 - 0.45
0.45 - 0.50
0.50 - 0.55
0.55 - 0.60

BOUNDS

50 Mile Project Buffer

Source: USGS 2014

N
W
E
S

0 12.5 25

Miles

Boardman - Hemingway
500kV Transmission Line
Oregon - Idaho

PEAK GROUND ACCELERATION
5,000 YEAR RETURN PERIOD
2014 USGS PSHA

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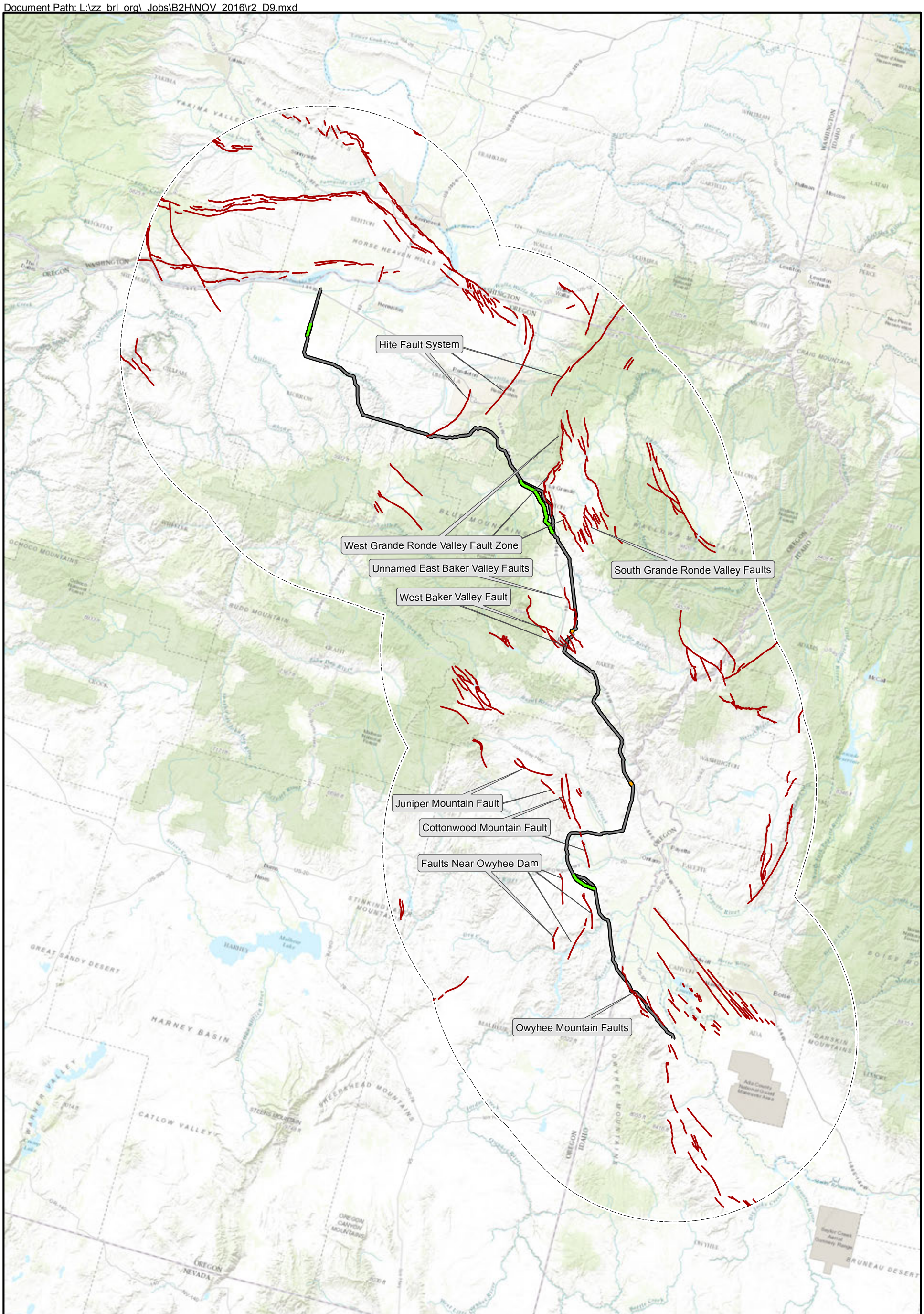
FIG. D10

Document Path: L:\zz_brl_org_Jobs\B2H\NOV_2016\r2_D9.mxd



LEGEND

ALIGNMENTS

Alternative Route

IPL Proposed Route

Proposed Rebuild

FEATURES

50 Mile Project Buffer

Fault

Source:
USGS Quternary Fault and Fold Database of the United States.

N W E S

0 12.5 25
Miles

Boardman - Hemingway
500kV Transmission Line
Oregon - Idaho

QUATERNARY FAULTS

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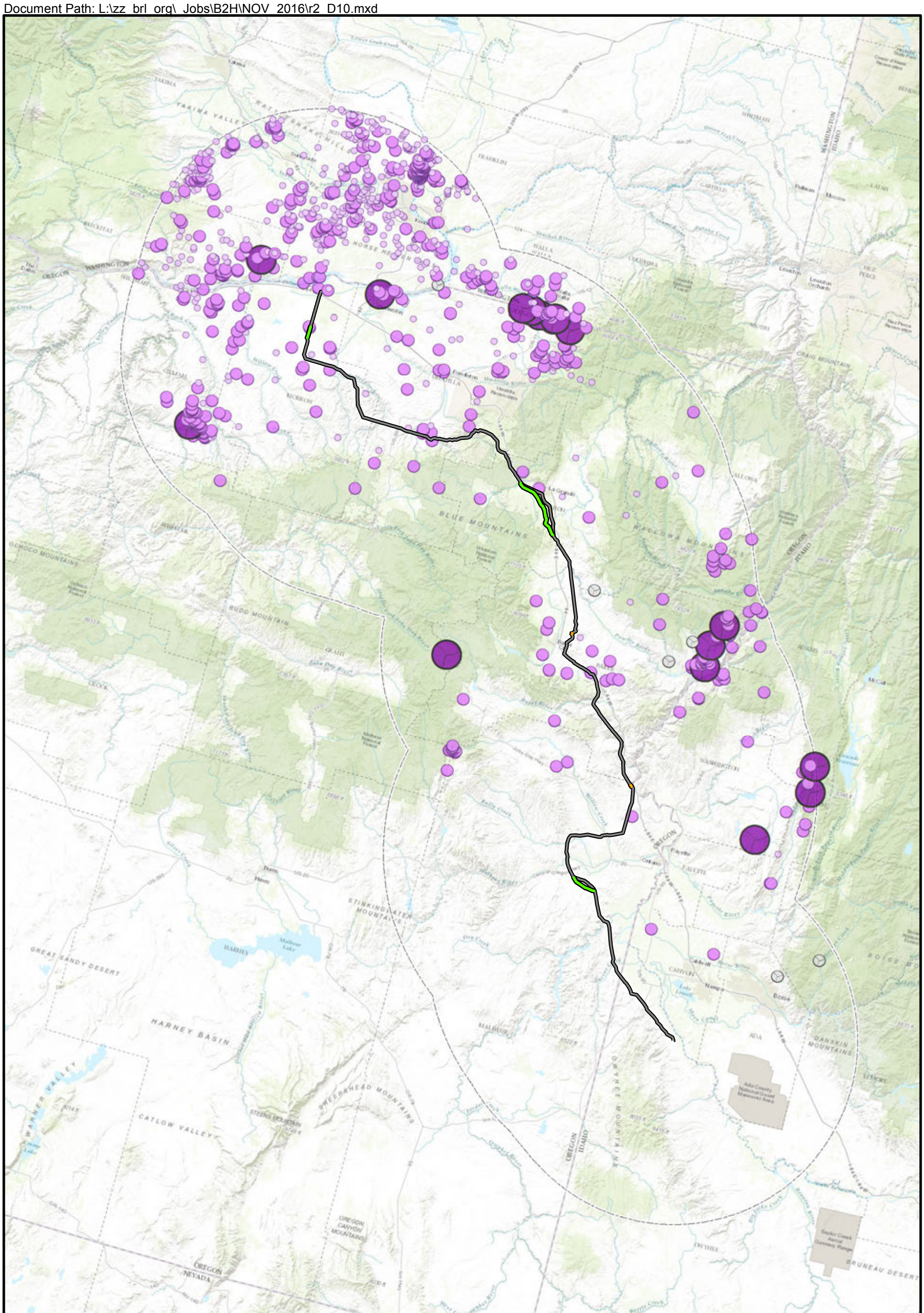
FIG. D11

Document Path: L:\zz_brl_org_Jobs\B2H\NOV_2016\r2_D10.mxd



LEGEND

ALIGNMENTS
- Alternative Route
- IPL Proposed Route
- Proposed Rebuild

MAGNITUDE
- Unknown
- Less Than 2.0
- 2.1 - 3.9
- Greater Than 4.0

BOUNDS
- 50 Mile Project Buffer

Source: USGS

N W E S

0 12.5 25
Miles

Boardman - Hemingway
500kV Transmission Line
Oregon - Idaho

HISTORICAL EARTHQUAKES

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FIG. D12