Wyoming State Geological Survey
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Structure contour and isopach maps of the Fox Hills Sandstone, northern Powder River Basin, northeastern Wyoming

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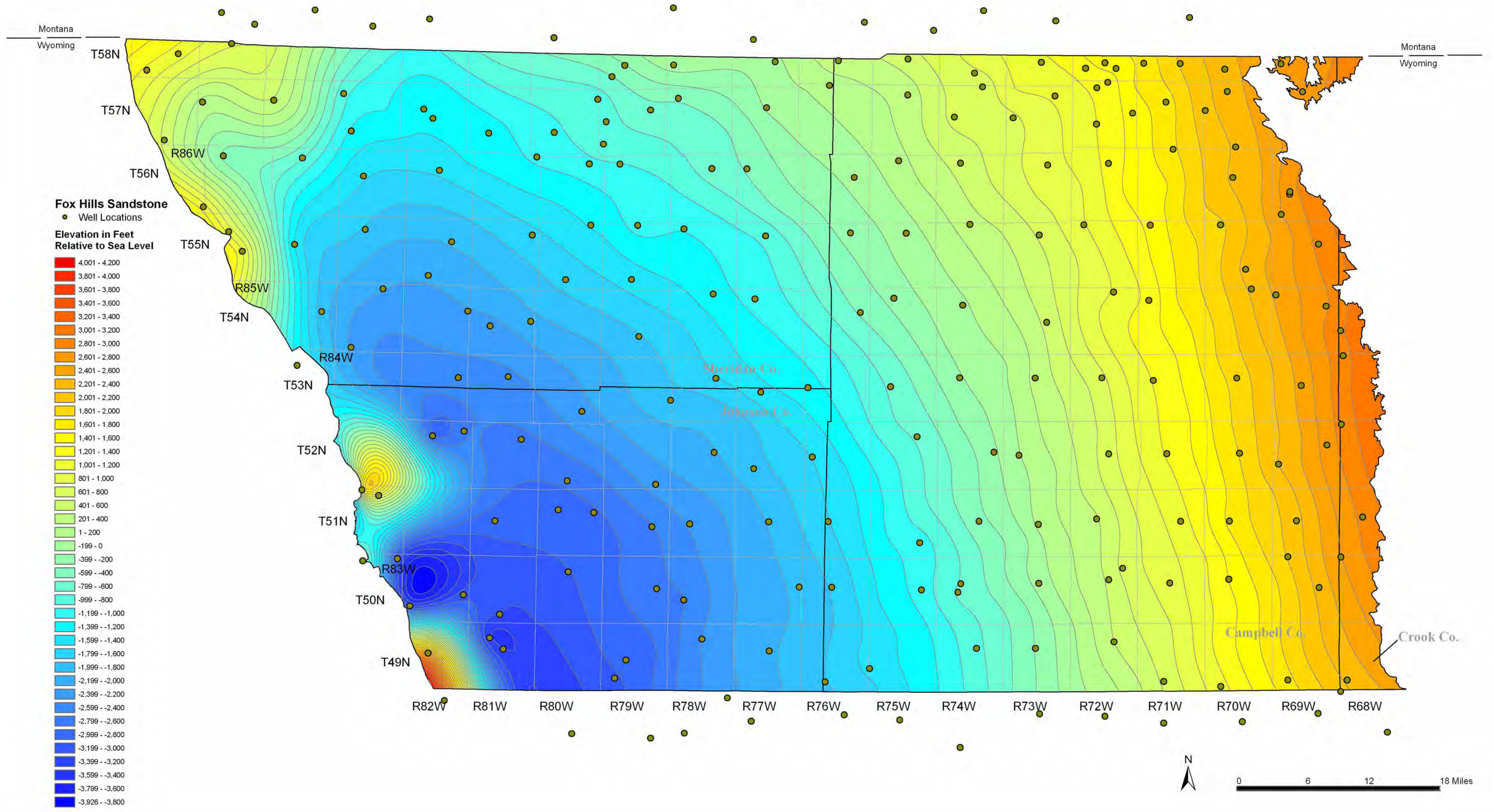
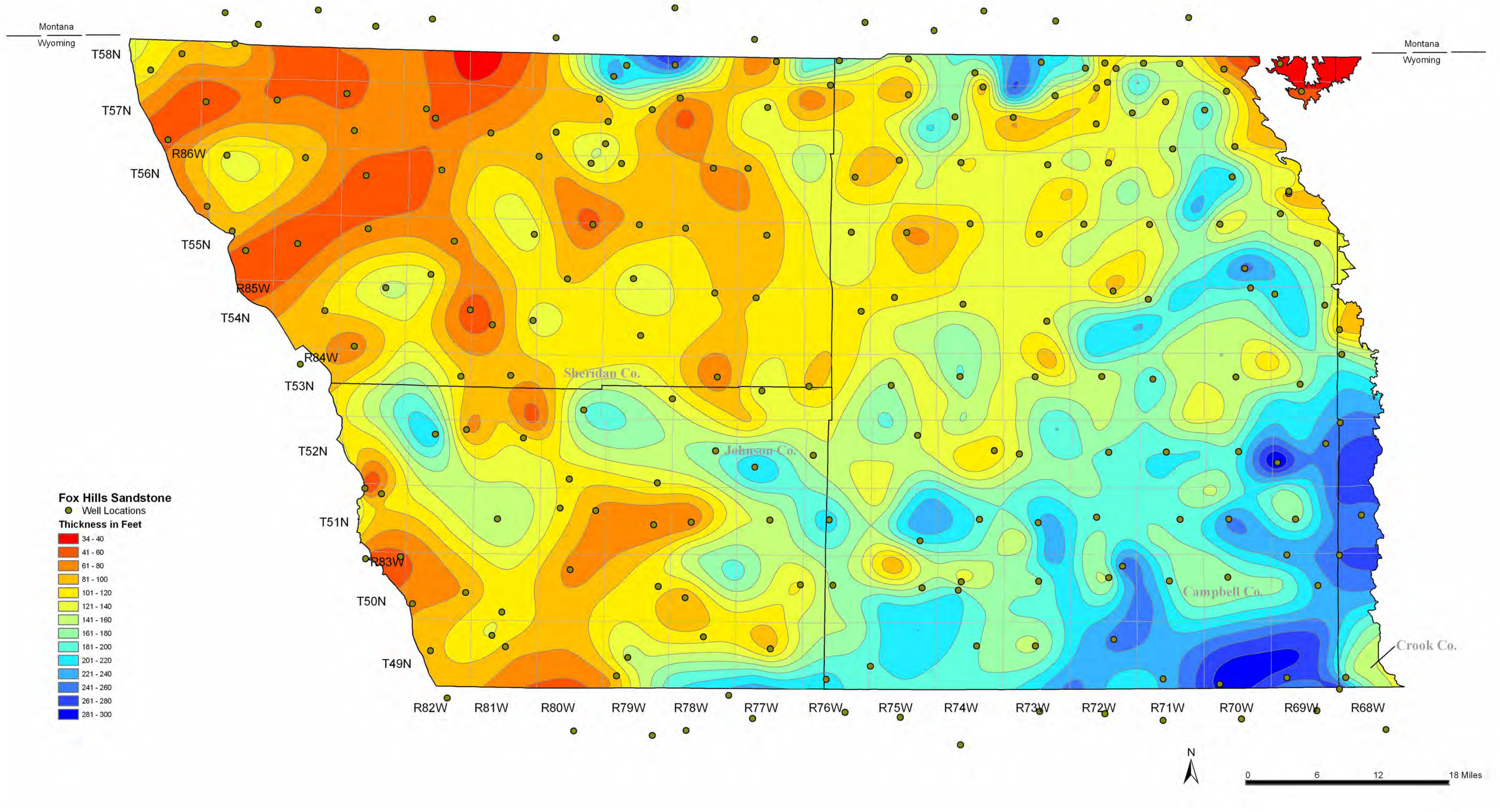
Open File Report
03-1

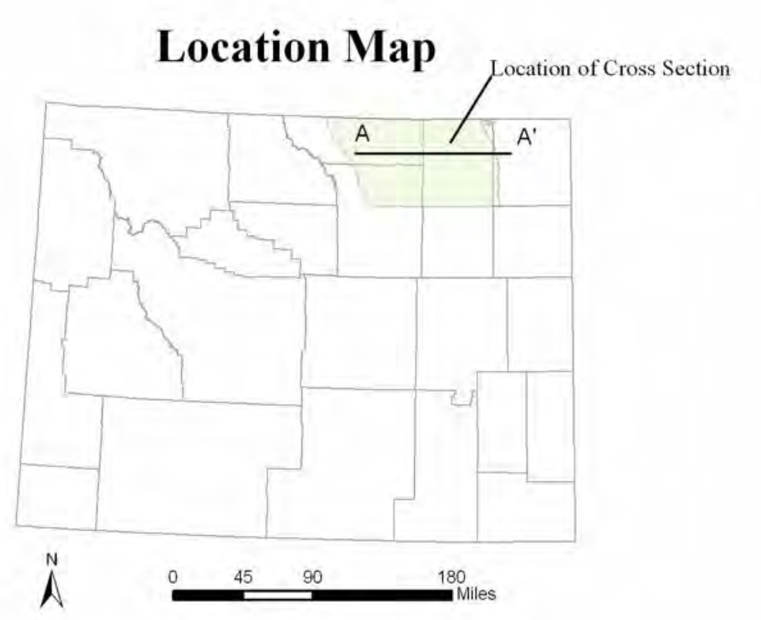
Structure Contour Map, Top of Fox Hills Sandstone



Isopach Map of the Fox Hills Sandstone



Location Map



Coordinate System: Lambert Conformal Conic
GCS_North_American_1983
Datum: D_North_American_1983
Prime Meridian: 0

Additional copies of this map can be obtained from:

Wyoming State Geological Survey
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Data Sources

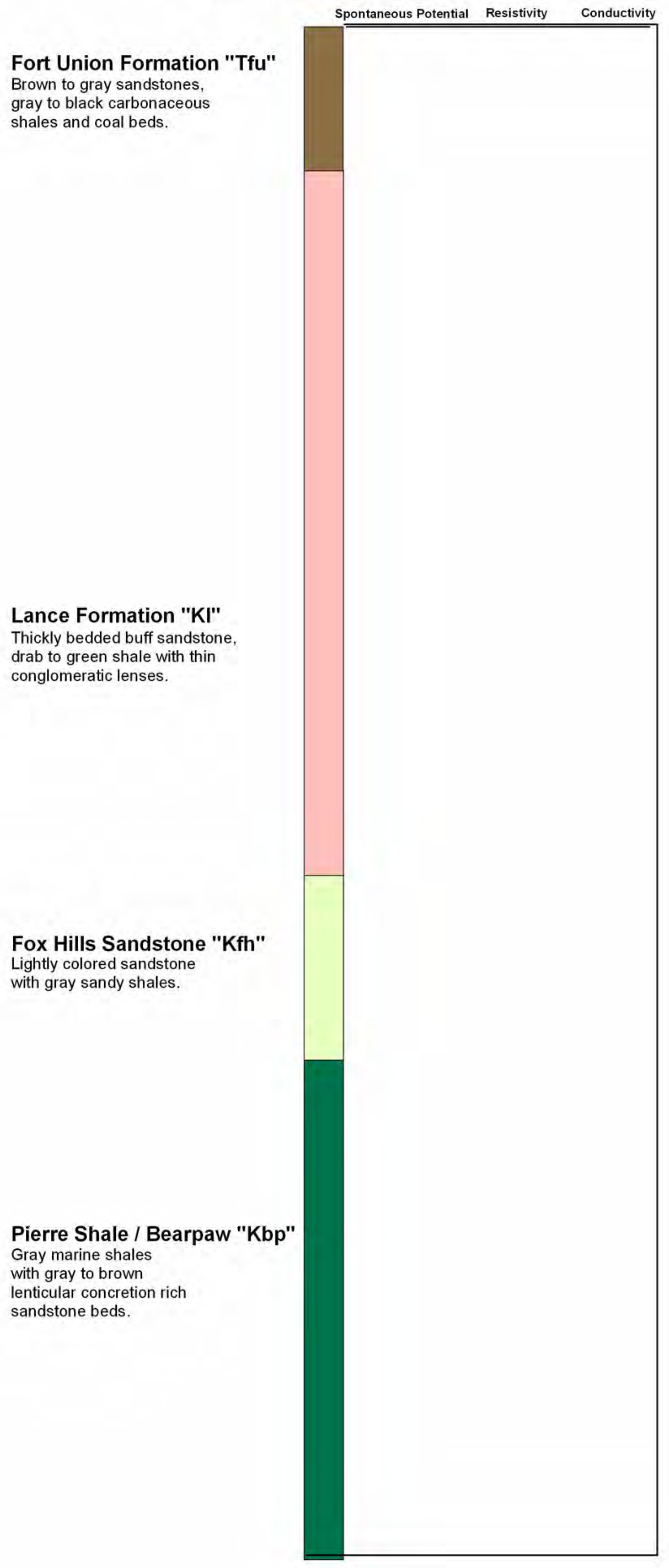
Wyoming Oil & Gas Conservation Commission
Wyoming State Geological Survey

References

Seeland, D., Hardie, J.K., Gibbons, A.B.,Johnson, E.A., Biewick, L.R.H., McLellan, M.W., Molnia, C.L., and Pierce, F.W.,1993, Geophysical log signatures of lower Tertiary and Upper Cretaceous rocks in the Powder River Basin, Wyoming and Montana: U.S. Geological Survey Oil and Gas Investigations Chart OC-140, 1 sheet.

Type Log Illustrating Formation Signatures

API # 521821 #156 in table, T58N R73W



Fort Union Formation "Tfu"
Brown to gray sandstones,
gray to black carbonaceous
shales and coal beds.

Lance Formation "Kl"
Thickly bedded buff sandstone,
drab to green shale with thin
conglomeratic lenses.

Fox Hills Sandstone "Kfh"
Lightly colored sandstone
with gray sandy shales.

Pierre Shale / Bearpaw "Kbp"
Gray marine shales
with gray to brown
lenticular concretion rich
sandstone beds.

Discussion

This characterization of the Fox Hills Sandstone is part of a larger study that provides a stratagraphic framework for the Wasatch Formation and its coal beds, the Fort Union Formation and its many coal beds, the Lance Formation, the Fox Hills Sandstone, and the Bearpaw / Pierre Shale. That larger study, when completed, will include information about the water quality of various coal aquifers as well as aquifers in sands in the Wasatch and Fort Union formations. The study will be available from the Wyoming State Geological Survey as an interactive product on the Internet. The present study encompasses approximately 1850 square miles in the northern Powder River Basin of Wyoming and extends from Township 49N to 58N and from Range 69W to 87W (see Location Map).

The Powder River Basin of northeastern Wyoming and southeastern Montana is a deep, asymmetric, mildly deformed trough that is about 250 miles long and 100 miles wide. This Laramide foreland basin is bordered on the west by the Bighorn Mountains and the Casper arch, on the south by the Laramie Mountains, on the east by the Hartville and Black Hills uplifts, and the north by the Miles City arch in Montana. The axis of the basin trends northwest-southeast as expressed on the structure contour map of the Fox Hills Sandstone. The basin axis is close to the more steeply dipping western margin of the basin. Paleozoic, Mesozoic, and Cenozoic rocks are present in the basin and have a total thickness that exceeds 18,000 feet along the basin's axis.

The Fox Hills Sandstone is a late Cretaceous, massive, regressive marine sandstone that usually coarsens upward. There may be more than one upward coarsening sandstone unit separated by thin marine shales in the Fox Hills Sandstone. These thin shale units represent minor regressions of the Pierre Seaway. The Fox Hills Sandstone overlies the Late Cretaceous and Bearpaw / Pierre Shale. The Fox Hills underlies the Late Cretaceous nonmarine Lance Formation (see Schematic Cross Section A-A'). The contact between the Fox Hills and the Bearpaw / Pierre Shale typically separates a major sandstone unit from a major underlying shaly sequence (see Type Log on this sheet). The contact is placed at the base of the lowest sandstone unit that is associated with the Fox Hills sandstone sequence. In boreholes where the Fox Hills consists of a coarsening upward shoreline sandstone sequence above a transition zone to shale, the contact is placed at the base of the transition zone (Seeland and others, 1993). The Lance-Fox Hills contact is placed at an abrupt change between massive sandstone in the Fox Hills and overlying mudstone in the Lance Formation (Seeland and others, 1993). The Lance typically contains sandstone beds of intermediate thickness that are either somewhat regularly spaced or concentrated in the lower part of the formation. The Lance may also contain a few thin coal beds.

The Fox Hills structure contour map was constructed by picking the top of the formation from geophysical logs and converting the formation depth to sea level by subtracting the depth from the ground elevation of the well. Geophysical logs in the township south of the area of this study and in the southernmost township in Montana were also used to discern trends at the edges of the maps. The structure contour map shows that the Fox Hills is fairly shallow on the eastern edge of the basin, becomes much deeper in the axis of the basin on the western side, and then turns sharply upward farther west on the flanks of the Bighorn Mountains. The isopach contour map of the Fox Hills Sandstone was constructed by picking the top of the Fox Hills and the top of the Bearpaw / Pierre Shale in a total of 378 geophysical logs (see Table of Well Data, below) and calculating the thickness of the Fox Hills by subtracting their depths. The isopach map shows that the Fox Hills varies from 34 feet thick to 300 feet thick. Many of the thicker areas are where the Fox Hills contains more that one coarsening upward sandstone sequence and / or a fairly thick transition zone above the Bearpaw / Pierre Shale.

Schematic Cross Section A - A'
Powder River Basin Study Area, Wyoming
Vertical exaggeration approximately 30x

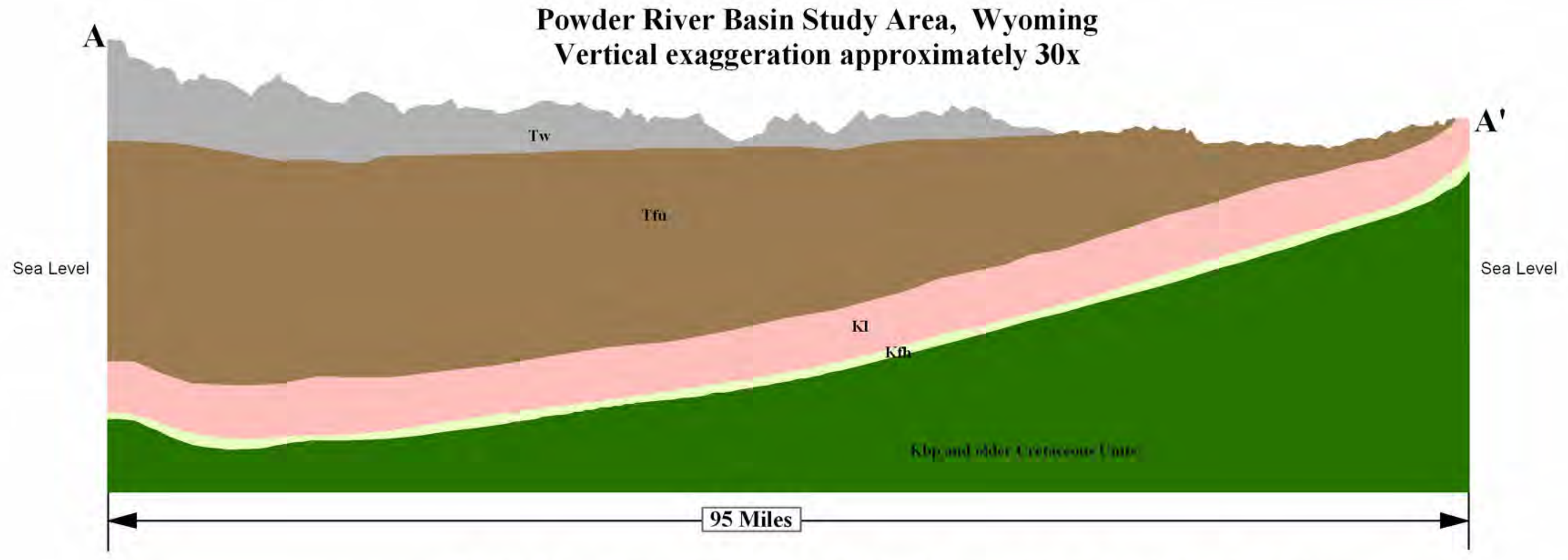


Table Containing Well Data for the Powder River Basin Study Area

WELL ID	API_NO	TWP	RNG	ELEV	TOP	THICKNESS
1	505507	49	69	4370	1820	260
2	505461	49	69	4367	2177	260
3	505450	49	70	4570	1250	250
4	526014	49	71	4615	785	220
5	529279	49	72	4619	-1	210
6	523513	49	72	4785	-95	245
7	521294	49	72	4720	265	205
8	527207	49	73	4803	-412	195
9	523571	49	74	4890	-1150	185
10	505519	49	75	4457	-1298	220
11	505261	49	75	4440	-1510	195
12	505533	49	76	4405	-1660	165
13	505290	49	76	4292	-1673	185
14	1906105	49	77	4398	-1962	140
15	1920668	49	77	3977	-2118	195
16	1920587	49	78	4438	-2647	185
17	1920198	49	79	4659	-2856	135
18	505678	50	69	4369	1849	180
19	523202	50	69	4262	1952	210
20	526619	50	70	4669	1254	175
21	505582	50	70	4440	1350	185
22	522083	50	71	4416	1031	175
23	524844	50	71	4505	705	250
24	525798	50	72	4802	147	210
25	520168	50	73	4609	-311	175
26	521897	50	73	4694	-446	185
27	522426	50	74	4665	-835	190
28	526785	50	75	4463	-1252	85
29	523658	50	75	4589	-1381	195
30	1920077	50	77	4350	-1970	145
31	1906118	50	78	4135	-2220	185
32	505814	51	69	4383	2663	260
33	524795	51	69	4008	2088	185
34	520104	51	70	4190	1800	235
35	523247	51	70	4489	1484	160
36	523010	51	71	4161	876	185
37	522091	51	71	4414	874	180
38	520743	51	72	4220	370	175
39	505759	51	72	4348	363	165
40	521677	51	73	4575	-115	180
41	520563	51	73	4535	-270	150
42	520785	51	73	4433	33	230
43	520609	51	74	4686	-709	175
44	526902	51	75	4240	-770	220
45	527528	51	75	4513	-1252	135
46	527185	51	75	4688	-1097	205
47	CP	51	83	4236	-1859	145
48	1906131	51	77	4061	-2104	145
49	1920395	51	78	4253	-2467	150
50	522322	52	69	4070	2350	215
51	506378	52	69	4103	2483	230
52	525542	52	70	4061	1761	150
53	528946	52	71	4082	1097	180
54	524032	52	71	4179	1449	200
55	521864	52	71	4443	1123	200
56	520449	52	71	4452	1212	180
57	525938	52	72	4239	599	160
58	520906	52	73	4213	318	200
59	526388	52	73	4361	161	175
60	520269	52	74	4501	-379	160
61	527008	52	74	4498	-487	105
62	520405	52	75	4162	-838	180
63	522373	52	75	4192	-1048	140
64	1920138	52	77	4016	-1819	100
65	1920528	52	81	4677	-2603	100
66	1120422	53	68	4451	2946	220
67	524121	53	70	3906	2216	110
68	505905	53	69	4006	2236	210
69	523164	53	70	3748	1863	160
70	526525	53	71	4493	1373	145
71	505892	53	71	3959	1394	135
72	520389	53	72	4058	528	150
73	505906	53	72	4274	894	165
74	523772	53	72	3975	1145	170
75	520224	53	73	4019	389	90
76	521637	53	73	4118	48	130
77	520409	53	74	4125	-75	130
78	527459	53	74	4303	-487	125
79	520211	53	74	4440	-95	155
80	524600	53	75	4136	-514	135
81	521829	53	76	4151	-914	115
82	1920076	53	76	4065	-1425	130
83	1920240	53	78	4271	-1884	105
84	3305000	53	80	4278	-2077	105
85	1920152	53	81	4212	-2553	55
86	521526	54	69	4254	2614	210
87	520423	54	70	3740	1860	200
88	506421	54	70	3800	2010	150
89	525342	54	71	3749	1614	210
90	526324	54	71	3791	1291	220
91	505990	54	71	3857	1687	160
92	522910	54	72	4126	1016	170
93	520996	54	72	3886	826	210
94	522329	54	73	3898	726	130
95	522803	54	73	4120	265	125
96	521093	54	74	4417	-113	170
97	523991	54	75	4252	-458	140
98	523157	54	75	3978	-182	110
99	3320191	54	76	3847	-1043	100
100	3320134	54	77	3681	-1194	115
101	3320110	54	78	4294	-1646	110
102	506072	55	70	3803	2493	145
103	506054	55	70	3998	2458	220
104	506422	55	71	3706	1861	165
105	527240	55	71	3790	1450	130
106	523557	55	72	4166	1086	130
107	520980	55	72	4077	817	150
108	520182	55	73	4164	454	130
109	522274	55	74	4118	98	90
110	529788	55	74	4184	164	130
111	522343	55	75	3863	-162	100
112	520462	55	76	4013	-377	130
113	3305012	55	79	4395	-1384	80
114	3320226	55	83	4496	-2064	100
115	520291	56	70	3837	2452	130
116	521207	56	70	3662	2172	150
117	520259	56	71	3711	1596	125
118	525997	56	71	3590	1945	225
119	522388	56	72	4150	1070	150
120	523115	56	72	3948	1176	140
121	523209	56	72	4029	1469	170
122	525214	56	73	3846	741	135
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124	523252	56	73	4011	921	100
125	523942	56	74	4019	559	130
126	524406	56	74	4082	312	130
127	521903	56	75	4102	162	140
128	523230	56	75	4081	-139	120
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130	3320622	56	77	3863	-557	100
131	3320137	56	79	3969	-1056	95
132	3305021	56	80	4333	-1227	80
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134	3320022	56	81	4408	-1412	115
135	3320230	56	82	4404	-1346	90
136	3305016	56	82	3990	-1795	100
137	521198	57	71	3984	1639	200
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140	520086	57	74	3763	673	170
141	520821	57	74	3721	651	110
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143	520454	57	75	3601	166	115
144	521038	57	76	3545	-5	110
145	522516	57	76	3692	112	100
146	3320047	57	76	3964	4	80
147	3320203	57	77	3948	-522	120
148	3320046	57	77	3649	-301	125
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153	3320072	58	81	4124	-841	35
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155	522566	58	75	3987	512	138
156	521821	58	73	3931	1151	220
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158	506160	58	70	3540	2308	78
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160	520927	58	72	3975	1320	175
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166	3320107	58	78	3960	-110	258
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168	3320067	58	77	3975	-45	90
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172	520922	57	72	3848	1253	102
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192	3305046	57	85	3950	142	42
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195	3320052	57	80	4352	-1033	105
196	506128	57	70	3743	2230	119
197	3320025	57	81	4140	-1290	80
198	3320225	57	83	3923	-1227	72
199	3320195	57	79	4010	-885	135
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204	520263	56	74	4121	476	120
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208	3320057	56	79	4403	-1007	110
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211	521538	56	76	4070	-135	95
212	3320098	56	77	4042	-583	85
213	3320127	56	82	4423	-1562	65
214	3320170	56	78	4057	-708	79
215	506104	56	70	3703	2231	208
216	3320042	56	83	3729	-1571	50
217	524624	56	69	4100	2704	93
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221	506076	55	70	3699	1971	132
222	520961	55	71	3827	1455	135
223	523085	55	72	4098	983	133
224	521446	55	73	4103	628	115
225	520527	55	74	4035	315	110
226	520278	55	75	4027	-85	78
227	525614	55	76	4039	-321	135
228	3305013	55	78	4075	-1187	98
229	3305014	55	79	4127	-1141	87
230	3320014	55	80	4331	-1384	55
231	3320070	55	77	3873	-932	90
232	3320093	55	81	4556	-1649	125
233	3320012	55	85	4138	928	90
234	3320115	55	83	4272	-1818	65
235	506066	55	69	4208	2848	143
236	3320081	55	82	4110	-1975	69
237	3320064	55	84	4066	-1394	45
238	3305007	55	85	4261	1021	50
239	521193	55	70	3918	2256	245
240	3320096	55	82	4078	-2170	122
241	3320032	55	79	4039	-1511	128
242	3320089	55	80	4383	-1729	98
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245	520438	54	72	3961	1016	100
246	521980	54	75	4239	-339	112
247	3305207	54	77	3804	-1138	100
248	3320034	54	78	4307	-1283	100
249	3320244	54	83	4589	-2188	143
250	506016	54	69	4158	2775	157
251	506021	54	71	3740	1268	158
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256	3320088	54	81	4371	-2062	125
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261	3320086	54	83	4699	-2235	71
262	1106046	53	68	4300	2927	174
263	3320176	53	84	6739	-1296	95
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266	527628	53	70	3831	1891	147
267	524859	53	71	4315	1213	198
268	521828	53	72	4175	760	145
269	506568	53	73	4028	258	137
270	520584	53	74	4326	-224	180
271	520281	53	75	4221	-764	160
272	3320079	53	76	3896	-1279	98
273	3320083	53	78	4292	-1618	65
274	3320108	53	82	4528	-2477	103
275	1906139	53	77	4061	-1479	138
276	1906137	53	79	4434	-1866	130
277	1920085	53	80	4203	-2262	178
278	1920509	52	82	4468	-2630	82
279	523604	52	75	4101	-767	142
280	1920357	52	81	4332	-2648	106
281	1906207	52	82	4688	-2762	211
282	521998	52	69	4222	2690	247
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285	522290	52	72	4081	719	184
286	521657	52	73	4216	-12	141
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288	1906135	52	78	3867	-2007	173
289	523317	52	69	3969	2199	298
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291	1920134	52	77	3779	-1871	220
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293	1920128	52	80	4490	-2755	112
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295	1920125	51	83	5164	902	88
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313	1920814	50	83	6776	-447	57
314	1920427	50	83	5442	-3082	56
315	522935	50	72	4472	645	246
316	1920114	50	80	4659	-3006	75
317	525857	50	69	4257	2267	227
318	522722	50	70	4675	1405	170
319	521130	50	72	4440	440	165
320	521299	50	71	4555	905	190
321	521755	50	73	4661	-129	178
322	522222	50	74	4526	-784	140
323	524813	50	75	4721	-1104	168
324	1906116	50	77	4226	-1944	120
325	505652	50	76	4237	-1778	165
326	1920073	50	79	4607	-2643	110
327	521056	50	74	4483	-779	187
328	1920116	50	78	4188	-2605	84
329	1906108	50	82	4871	-3107	84
330	1920207	50	82	5456	-3154	75
331	1920366	50	81	5050	-3213	117
332	528891	49	72	4730	400	245
333	1920257	49	78	4336	-2394	110
334	1920275	49	81	5043	-3357	120
335	521319	49	73	4789	-389	157
336	522989	49	74	4733	-855	182
337	1920212	49	77	4087	-2035	98
338	1920083	49	82	5175	2490	95
339	1920222	49	81	4900	-3390	95
340	505334	49	76	4395	-1530	195
341	1920340	49	79	4558	-2897	145
342	1920099	49	79	4570	-3040	95
343	1105072	49	68	4230	2230	190
344	525595	49	69	4376	1746	270
345	526635	49	70	4751	1131	285
346	525579	49	71	4697	637	225
347	507043	49	76	4355	-1807	208
348	1920305	48	78	4273	-2262	230
349	505268	49	68	4267	2129	272
350	1920409	48	80	4536	-3434	115
351	1920344	48	79	4525	-2860	157
352	1920255	48	78	4445	-2552	143
353	1920343	48	77	4027	-2160	208
354	523173	48	76	4600	-1780	165
355	505179	48	75	4423	-1585	130
356	505137	48	74	4839	-1071	182
357	521660	48	73	4821	-391	181
358	505190	48	72	4668	40	184
359	523450	48	71	4612	510	236
360	505180	48	70	4691	1079	191
361	505201	48	69	4314	1821	162
362	250752180	Montana	Well	3407	2101	103
363	250752177	Montana	Well	3588	1894	89
364	250752181	Montana	Well	3884	1199	94
365	250752128	Montana	Well	3845	882	95
366	250752134	Montana	Well	3573	682	104
367	250752154	Montana	Well	3598	368	85
368	250752161	Montana	Well	4016	355	71
369	250752174	Montana	Well	4237	-8	84
370	250321063	Montana	Well	3994	-134	82
371	250321037	Montana	Well	3669	-102	87
372	250321046	Montana	Well	3817	-435	88
373	250321042	Montana	Well	3718	-478	89
374	250305030	Montana	Well	3701	-410	69
375	250305037	Montana	Well	4140	-29	51
376	250305028	Montana	Well	4400	886	57
377	250305033	Montana	Well	4646	1534	89
378	1920008	48	82	4948	2553	115

[1] CP in Table indicates control point