APPENDIX 10—SURFACE DISTURBANCE ASSOCIATED WITH OIL AND GAS ACTIVITIES

The following general guidelines for reasonably foreseeable development, access roads, drill pads, and pipelines were used to determine acres of surface disturbance associated with oil and gas exploration and development activities. The assumptions are based on existing oil and gas development across the Pinedale Field Office.

REASONABLY FORESEEABLE DEVELOPMENT

- Approximately two-third of the projected wells would occur in the Jonah and Pinedale Anticline Fields.
- The Pinedale Anticline would be developed with multiple wells per pad on an average surface spacing of 4 to 6 well pads per square mile (120- to 160-acre surface spacing per pad).
- The Jonah Field would predominantly be developed with single well pads at an average of 64 pads per square mile (10-acre surface spacing per pad).
- The greater Big Piney-LaBarge area, Castle Creek Field, and the rest of the planning area would be developed with single well pads on an average surface spacing of 16 or fewer well pads per square mile (40-acre surface spacing per pad).

ACCESS ROADS

- Average initial 40 feet total width disturbance for 0.4 mile per well (1.9 acres)
- Average long-term 23.5 feet total width disturbance for 0.4 mile per well (1.14 acres).

DRILL PADS

- Average initial disturbance would be 3.7 acres per single-well pad (coalbed natural gas (CBNG) and non-CBNG wells).
- Average initial disturbance would be 10 acres per well pad with multiple wells (projected size range: 4.0 acres for 2 well pads to 20 acres for pads with up to 32 wells).
- Average long-term disturbance would be 1.5 acres per single-well pad (CBNG and non-CBNG wells).
- Average long-term disturbance would be 5 acres per pad with multiple wells (projected long-term disturbance range: 1.5 acres per single-well pad to 8 acres for a pad with 32 wells).
- One-hundred percent of the CBNG wells would be vertical wells from single-well pads.
- Approximately 65% of the non-CBNG wells would be vertical wells from single well pads.
- Approximately 35% of the non-CBNG wells would be directional wells from multiple-well pads. This assumption is based on the fact that vertical well development on the Pinedale Anticline Project Area (PAPA) has generally reached the number threshold for single-well pads in each of

the PAPA Management Areas and that approximately 30% of the total reasonably foreseeable development (RFD) would occur in the PAPA BLM (Lanning and Stilwell 2006).

- An estimated average of seven wells would be developed from a multiple-well pad. (The Pinedale Field Office in 2006 has multiple-well pads with as few as 2 wells drilled and as many as 21 wells authorized—approved applications for permit to drill [APD]—from an individual well pad.)
- The major collection and transportation pipeline system would double in Alternative 2 from the current level. Projected major pipeline development for the other Alternatives would be prorated based on the RFD projections. (Current major pipeline system in the Pinedale Field Office include the Anticline-Jonah System: approximately 36 miles long, 300 feet wide, 1300 acres in size; the Merna/Big Piney-LaBarge System: approximately 40 miles long, 150 feet wide, 720 acres in size; and the ExxonMobil system: approximately 24 miles long, 150 feet wide, 430 acres in size).

PIPELINES

- Average initial disturbance of 1.5 acres per average single-well pad and 3.0 acres for multiple-well pads and stabilized after 3 years—assumes that pipelines serving single-well pads would average 0.4 miles in length per pad and have an average surface disturbance width of 30 feet. Pipeline disturbance associated with multiple-well pads would be double the disturbance for single-well pads (3.0 acres). These figures are based on four well pads per square mile.

Acres of projected surface disturbance are calculated using the guidelines above and the total number of well locations by alternative projected by BLM Wyoming Reservoir Management Group (Table A10-1). Projection period is from the base analysis year of 2001 through 2020 (note 560 wells have been developed from 2001 through July 2006).

Table A10-1. Projected Total Number of Well Pads by Alternative for Federal Surface and Federal Minerals (2001 to 2020)

Alternative	Total Number of Single-Well Locations (CBNG)	Total Number of Single-Well Locations (non-CBNG)	Total Number of Multiple-Well Locations (non-CBNG)	Total Number of Well Pads
Unrestricted Development	518	4,800	369 pads (2,585 wells)	5,687 pads (7,903 wells)
Alternative 1	430	4,732	290 pads (2,030 wells)	5,452 pads (7,192 wells)
Alternative 2	504	5,110	310 pads (2,190 wells)	5,924 pads (7,804 wells)
Alternative 3	300	3,436	210 pads (1,473 wells)	3,946 pads (5,209 wells)
Alternative 4	465	4,671	285 pads (2,000 wells)	5,421 pads (7,136 wells)

Source: BLM Wyoming Reservoir Management Group, 2006.

Table A10-2 and Table A10-3 show the initial and long-term surface disturbance by alternative associated with the projected number of oil and gas wells in Table A10-1.

Table A10-2. Initial Surface Disturbance from Oil and Gas Activity for Federal Surface and Federal Minerals

Alternative	Roads (acres)	CBNG Drill Pads (acres)	Non-CBNG Single-Well Pads (acres)	Multiple-Well Pads (acres)	Well Pad-Related Pipelines (acres)	Collector/ Transportation Pipeline Trunk Lines (acres)	Total Surface Disturbance for Life of Plan (acres)
Alternative 1	10,360	1,191	17,508	2,900	8,613	2,450	43,022
Alternative 2	11,256	1,865	18,907	3,100	9,351	2,260	46,739
Alternative 3	7,497	1,110	12,713	2,100	6,084	1,635	31,139
Alternative 4	10,300	1,720	17,283	2,850	8,327	1,700	42,180

Table A10-3. Long-Term Surface Disturbance from Oil and Gas Activity for Federal Surface and Federal Minerals

Alternative	Roads (acres)	CBNG Drill Pads (acres)	Non-CBNG Single-Well Pads (acres)	Multiple-Well Pads (acres)	Well Pad-Related Pipelines (acres)	Collector/ Transportation Pipeline Trunk Lines (acres)	Total Surface Disturbance for Life of Plan (acres)
Alternative 1	6,897	750	7,725	2,000	0	0	17,372
Alternative 2	7,434	900	8,250	2,105	0	0	18,689
Alternative 3	5,300	600	5,925	1,500	0	0	13,325
Alternative 4	6,890	825	7,650	1,965	0	0	17,330

Table A10-4 shows the historical (2001 through 2005) and future gas production (in billions of cubic feet [BCF]) for the Pinedale Field Office area, estimated for the base line and each alternative. Table A10-5 shows the historical (2001 through 2005) and future oil production (in millions of barrels) for the Pinedale Field Office area, estimated for the base line and each alternative.

Table A10-4. Historical and Future Gas Production (in billions of cubic feet)

Year	Base Line	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4 (Preferred)
2001	496	496	496	496	496
2002	573	573	573	573	573
2003	659	659	659	659	659
2004	734	734	734	734	734
2005	818	818	818	818	818
2006	863	844	863	794	842
2007	964	934	964	856	932
2008	1,046	1,005	1,046	903	1,005

Year	Base Line	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4 (Preferred)
2009	1,099	1,050	1,098	931	1,052
2010	1,137	1,082	1,137	950	1,086
2011	1,187	1,127	1,186	965	1,131
2012	1,229	1,163	1,228	980	1,169
2013	1,245	1,177	1,244	993	1,182
2014	1,280	1,207	1,279	1,019	1,213
2015	1,258	1,180	1,256	985	1,187
2016	1,162	1,080	1,160	893	1,087
2017	1,113	1,028	1,112	843	1,038
2018	1,087	998	1,085	813	1,009
2019	1,091	999	1,089	794	1,010
2020	1,044	950	1,024	729	946
Total	**20,084**	**19,104**	**20,052**	**16,730**	**19,168**

Table A10-5. Historical and Future Oil Production (in millions of barrels)

Year	Base Line	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4 (Preferred)
2001	3.945	3.945	3.945	3.945	3.945
2002	4.468	4.468	4.468	4.468	4.468
2003	4.632	4.632	4.632	4.632	4.632
2004	4.737	4.737	4.737	4.737	4.737
2005	5.166	5.166	5.166	5.166	5.166
2006	6.901	6.741	6.901	6.325	6.723
2007	7.759	7.508	7.758	6.853	7.480
2008	8.423	8.085	8.422	7.238	8.079
2009	8.854	8.454	8.852	7.465	8.461
2010	9.171	8.722	9.169	7.617	8.737
2011	9.589	9.100	9.587	7.743	9.119
2012	9.942	9.409	9.937	7.864	9.432
2013	10.078	9.520	10.071	7.978	9.543
2014	10.372	9.774	10.361	8.196	9.798
2015	10.149	9.515	10.135	7.880	9.547
2016	9.267	8.603	9.252	7.044	8.634
2017	8.814	8.116	8.798	6.589	8.176
2018	8.555	7.833	8.540	6.302	7.902
2019	8.565	7.822	8.551	6.123	7.889

Year	Base Line	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4 (Preferred)
2020	8.195	7.435	8.044	5.606	7.384
Total	**157.582**	**149.586**	**157.324**	**129.772**	**149.853**

CUMULATIVE SURFACE DISTURBANCE ASSOCIATED WITH OIL AND GAS ACTIVITIES (FEDERAL, STATE, AND FEE SURFACE, AND MINERAL ESTATES)

The general guidelines and assumptions discussed above for surface disturbance related to fluid mineral development on federal surface and minerals also apply to and guide projections of cumulative surface disturbance.

There were 2,419 existing wells (all mineral ownerships) in the Pinedale planning area on January 1, 2001. Although there were a few multiple-well pads in the planning area before 2001, the practice of developing multiple wells from an individual well pad was largely nonexistent. The exact number of multiple-well pads at that time is not known, but it was likely in the 2-to-5 pad range. To project the acres of well pad-related disturbance on January 1, 2001 (Table A10-6), it was assumed that each well was from a single well. Because each of these wells is a minimum of 5 years old, it is also assumed that the pads, roads, and pipelines have been reclaimed to the long-term disturbance level.

Table A10-6. Projected Long-term Disturbance of Well Pads and Roads (All Mineral Ownerships in the Planning Area Before 2001)

Number of Wells/Well Pads	Well Pad Disturbance (acres)	Well pad-related Roads (acres)	Well Pad-related Pipelines (acres)	Collector/ Transportation Pipeline Trunk Lines (acres)	Total Disturbance (acres)
2,491	3,737	2,840	0	0	6,577

Table A10-7 shows the projected number of well pads by alternative for all mineral ownerships in the planning area.

Table A10-7. Projected Total Number of Well Pads by Alternative (All Mineral Ownerships in the Planning Area 2001–2020)

Alternative	Total Number of Single Well Locations (CBNG)	Total Number of Single Well Locations (non-CBNG)	Total Number of Multiple Well Locations (non-CBNG)	Total Number of Well Pads
Alternative 1	512	5,153	396 pads (2,774 wells)	6,061 pads (8,439 wells)
Alternative 2	586	5,502	423 pads (2,963 wells)	6,511 pads (9,051 wells)
Alternative 3	382	3,944	304 pads (2,130 wells)	4,630 pads (6,456 wells)
Alternative 4	547	5,093	392 pads (2,743 wells)	6,032 pads (8,383 wells)

Source: BLM Wyoming Reservoir Management Group, 2006.

Table A10-8 and Table A10-9 show the initial and long-term surface disturbance by alternative associated with the projected number of oil and gas wells in Table A10-5.

Table A10-8. Projected Initial Surface Disturbance from Oil and Gas Activity (All Mineral Ownerships in the Planning Area)

Alternative	Roads (acres)	CBNG Drill Pads (acres)	Non-CBNG Single Well Pads (acres)	Multiple Well Pads (acres)	Well Pad-Related Pipelines (acres)	Collector/ Transportation Pipeline Trunk Lines (acres)	Total Surface Disturbance for Life of Plan (acres)
Alternative 1	11,516	1,894	19,066	3,960	9,675	2,450	48,561
Alternative 2	12,371	2,168	20,357	4,230	10,413	2,260	51,798
Alternative 3	8,797	1,413	14,593	3,040	7,425	1,635	36,903
Alternative 4	11,461	2,024	18,844	3,920	9,654	1,700	47,603

Table A10-9. Long-Term Surface Disturbance from Oil and Gas Activity (All Mineral Ownerships in the Planning Area)

Alternative	Roads (acres)	CBNG Drill Pads (acres)	Non-CBNG Single Well Pads	Multiple Well Pads	Well Pad-Related Pipelines (acres)	Collector/ Transportation Pipeline Trunk Lines (acres)	Total Surface Disturbance for Life of Plan (acres)
Alternative 1	6,909	768	7,730	1,980	0	0	17,387
Alternative 2	7,423	879	8,253	2,115	0	0	18,670
Alternative 3	5,278	573	5,916	1,520	0	0	13,287
Alternative 4	6,876	820	7,643	1,960	0	0	17,299