KEMMERER
PROPOSED RESOURCE MANAGEMENT PLAN AND
FINAL ENVIRONMENTAL IMPACT STATEMENT

Appendix K

Economic Impact Analysis Methodology

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This appendix describes the detailed data used in the economic impact modeling analysis. Input-output models such as the Impact Analysis for Planning (IMPLAN) model, an economic impact analysis model, provide a quantitative representation of the production relationships between individual economic sectors. Thus, the economic modeling analysis uses information about physical production quantities and the prices and costs for goods and services. The inputs required to run the IMPLAN model are described in the following narrative and tables. The resulting estimates from the IMPLAN model, by alternative, can be found in the Economic Conditions section in Chapter 4. The first section, below, provides details of how the IMPLAN model was used to estimate economic impacts. The remaining sections provide additional detailed data used in the analysis for oil and gas, coal, livestock grazing, and recreation.

1.0 THE IMPLAN MODEL

IMPLAN is a regional economic model that provides a mathematical accounting of the flow of money, goods, and services through a region's economy. The model provides estimates of how a specific economic activity translates into jobs and income for the region. It includes the ripple effect (also called the "multiplier effect") of changes in economic sectors that may not be directly impacted by management actions, but are linked to industries that are directly impacted. In IMPLAN, these ripple effects are termed indirect impacts (for changes in industries that sell inputs to the industries that are directly impacted) and induced impacts (for changes in household spending as household income increases or decreases due to the changes in production).

The IMPLAN model classifies economic activity into over 500 sectors. This analysis involved direct changes in economic activity across many of these economic sectors, including sectors related to oil and gas production (primarily Natural Gas and Crude Petroleum, Maintenance and Repair of Oil and Gas Wells, and Wholesale Trade, which captures purchases of tangible equipment such as pipe, casing, valves, and meters). (The distribution of expenditures across IMPLAN sectors is based on information from actual expenditures obtained from operators for wells drilled in southwest Wyoming (Taylor 2007)). In addition, the analysis involved direct changes in sectors related to livestock production (Ranch Cattle, and Sheep, Lambs, and Goats) and sectors related to off-highway vehicle (OHV) use and recreation: Hotels and Lodging Places, Eating and Drinking, Amusement and Recreation Services, Food Stores, Service Stations, and Miscellaneous Retail. Based on the relationships between and among sectors in the IMPLAN model, the direct changes in these economic sectors translate into indirect changes in all other related sectors due to the ripple effect.

The IMPLAN production coefficients were modified (calibrated) to reflect the interaction of producing sectors in the three county (Lincoln, Sweetwater, Uinta) study area. As a result, the calibrated model does a better job of generating multipliers and the subsequent impacts that reflect the interaction between and among the sectors in the study area compared to a model using unadjusted national coefficients. Specifically, worker productivity in oil and gas production is higher in Wyoming than nationally, and more of the hay used for livestock feed is produced within the region, compared with national averages. Key variables used in the IMPLAN model were filled in using data specific to Wyoming, including employment estimates, labor earnings, and total industry output (Taylor 2004). Due to price fluctuations, the value of cattle and sheep production was based on the average value from 1993 to 2002, calculated based on data from the Wyoming Agricultural Statistics Service (Taylor 2004). This analysis used IMPLAN 2000; prior to running the model, cost and price data were converted to a consistent dollar year (2000) using regional and sector-specific adjustment factors from the IMPLAN model. The values in this appendix generally are expressed in year 2004 dollars so that the earnings and employment estimates can be easily compared to the latest (i.e., 2004) earnings and employment data available from the Bureau of Economic Analysis.

2.0 OIL AND GAS

The economic impacts analysis for oil and gas reflects drilling, completion, and production activities.

The Minerals – Leasable section in Chapter 4 provides information on the number of oil and gas wells drilled and number of wells completed (i.e., productive wells). Estimated oil and gas production on Bureau of Land Management (BLM)-administered land and mineral estate from 2001 to 2020 in the planning area is shown at the end of this section (Tables K-5 and K-6). The costs of drilling and completing wells and producing oil and gas also are relevant for the economic impact analysis.

The IMPLAN model assumes that workers involved in well drilling and completion in the oil and gas fields spend a portion of their earnings within the planning area. This spending generates additional output, jobs, and earnings in the planning area due to the multiplier effect. However, some oil and gas drilling and completion workers may spend less of their wages in the planning area than is reflected by the IMPLAN model. Due to this uncertainty, the analysis of indirect and induced impacts due to oil and gas drilling and completion reflects two alternative assumptions about the portion of earnings that field workers spend within the planning area. The "high scenario" reflects the default assumption in IMPLAN about how much of their earnings field workers spend in the planning area, while the "low scenario" reflects an assumption that workers involved in oil and gas drilling and completion do not spend any of their income within the planning area.

Table K-1 provides a summary of the assumptions used for the economic analysis relative to the costs of drilling, completion, and production of conventional wells in the Moxa Arch and Overthrust Belt regions, as well as for coalbed natural gas wells.

Table K-1. Assumptions for Analysis of Economic Impacts for Oil and Gas Well Drilling and Completion According to Well Type

Assumption	Conventional Wells		Coalbed Natural Gas Wells
	Moxa Arch	Overthrust Belt	
Drilling Impacts			
Drilling Cost ($/well)	$549,916	$2,429,407	$50,918
Local Drilling Costs[1]	87%	87%	87%
Local Direct Impact ($/well)	$478,427	$2,113,584	$44,299
Local Total Impact ($/well)[2] – High Scenario[3]	$642,964	$2,840,473	$59,533
Multiplier (total impact/direct impact) – High Scenario[3]	1.34	1.34	1.34
Local Total Impact ($/well)[2] – Low Scenario[3]	$604,604	$2,671,006	$55,982
Multiplier (total impact/direct impact) – Low Scenario[3]	1.26	1.26	1.26
Completion Impacts			
Completion Cost ($/well)	$256,125	$1,059,227	$40,980
Local Completion Costs[1]	41%	41%	41%
Local Direct Impact ($/well)	$105,011	$434,283	$16,802
Local Total Impact ($/well)[2] – High Scenario[3]	$137,837	$570,036	$22,054
Multiplier (total impact/direct impact) – High Scenario[3]	1.31	1.31	1.31
Local Total Impact ($/well)[2] – Low Scenario[3]	$132,959	$549,865	$21,273
Multiplier (total impact/direct impact) – Low Scenario[3]	1.27	1.27	1.27

Source: Drilling and completion costs are from BLM 2006a, adjusted from 2003 to 2004 dollars using IMPLAN adjustment factors. Moxa Arch well costs correspond to 9,000-10,000 foot Frontier wells, and Overthrust Belt well costs correspond to a weighted average of 12,000-foot Frontier wells (70%) and 15,000 to 16,000-foot Dakota/Frontier wells (30%). Local drilling and completion costs are calculated using data provided by Taylor (2004).

[1] The local cost shares were based on the percent of total drilling or completion costs that would be spent on goods and services purchased from the local economy.

[2] Total impacts estimated using IMPLAN include direct, indirect, and induced impacts.

[3] As described in the text, the high scenario reflects the default assumption in IMPLAN about how much of their earnings field workers spend in the planning area, while the low scenario reflects an assumption that workers involved in oil and gas drilling and completion do not spend any of their income within the planning area.

The assumptions in Table K-2 were used to determine the values of natural gas and oil production. In addition, the analysis used a figure of $0.89 (year 2000 dollars) per thousand cubic feet (mcf) for gas production costs based on data from the Energy Information Administration (Taylor 2004).

Table K-2. Assumptions for Analysis of Economical Impacts on Output for Oil and Gas Production

Economic Impact	Oil Production (per million barrels)	Gas Production (per billion cubic feet)
Direct Economic Impact[1]	$39,369,760[2]	$5,901,380[3]
Indirect Economic Impact[4]	$3,868,866	$579,929
Induced Economic Impact[5]	$426,060	$63,865
Total Economic Impact	$43,664,686	$6,545,173
Multiplier (total impact/direct impact)	1.11	1.11

Note: All dollar values are in 2004 dollars. Production cost is calculated based on data from the Energy Information Administration, as documented in Taylor (2004).
[1] Direct economic impact is the market value of output.
[2] Based on oil price forecast of $40 per barrel for beyond 2006 (CREG 2006), adjusted to 2004 dollars using IMPLAN adjustment factors.
[3] Based on natural gas price forecast of $6.00 per thousand cubic feet for beyond 2006 (CREG 2006), adjusted to 2004 dollars using IMPLAN adjustment factors.
[4] Indirect impacts from IMPLAN reflect increased demand in sectors that directly or indirectly provide supplies to the oil and gas industry.
[5] Induced impacts from IMPLAN reflect increased demand in the consumer and government sectors.

The forecasted number of wells and production used for estimating employment impacts is the same as for estimating impacts on labor earnings and output. Table K-3 shows the direct and total employment impacts attributable to drilling and completion. Table K-3 also shows two alternative assumptions about where oil and gas drilling and completion workers spend their earnings: the high scenario reflects the default assumption in IMPLAN about how much of their earnings field workers spend in the planning area, while the low scenario reflects an assumption that workers involved in oil and gas drilling and completion do not spend any of their income within the planning area.

Table K-3. Assumptions for Employment Impact Analysis for Oil and Gas Well Drilling and Completion According to Well Type

Employment Impact	Conventional Wells		Coalbed Natural Gas Wells
	Moxa Arch	Overthrust Belt	
Drilling Impacts			
Direct Employment (jobs/well)	3.3	14.7	0.3
Total Employment Impact (jobs/well) – High Scenario[1]	5.3	23.2	0.5
Multiplier (Total Impact/Direct Impact) – High Scenario[1]	1.59	1.59	1.59
Average Earnings per Job (2004 dollars) – High Scenario[1]	$36,107	$36,107	$36,107
Total Employment Impact (jobs/well) – Low Scenario[1]	4.7	20.9	0.4
Multiplier (Total Impact/Direct Impact) – Low Scenario[1]	1.43	1.43	1.43
Average Earnings per Job (2004 dollars) – Low Scenario[1]	$37,758	$37,758	$37,758
Completion Impacts			
Direct Employment (jobs/well)	0.9	3.8	0.1
Total Employment Impact (jobs/well) – High Scenario[1]	1.3	5.5	0.2
Multiplier (Total Impact/Direct Impact) – High Scenario[1]	1.47	1.47	1.47
Average Earnings per Job (2004 dollars) – High Scenario[1]	$34,603	$34,603	$34,603
Total Employment Impact (jobs/well) – Low Scenario[1]	1.3	5.3	0.2
Multiplier (Total Impact/Direct Impact) – Low Scenario[1]	1.39	1.39	1.39
Average Earnings per Job (2004 dollars) – Low Scenario[1]	$35,309	$35,309	$35,309

Note: Direct and total employment impact and average earnings per job are calculated using IMPLAN.
[1]As described in the text, the high scenario reflects the default assumption in IMPLAN about how much of their earnings field workers spend in the planning area, while the low scenario reflects an assumption that workers involved in oil and gas drilling and completion do not spend any of their income within the planning area.

Table K-4 shows the direct and total employment impacts associated with production.

Table K-4. Assumptions for Employment Impacts Analysis for Oil and Gas Production

Employment Impact (annual number of jobs)	Oil Production (per million barrels)	Gas Production (per billion cubic feet)
Direct Employment	3.9	0.6
Indirect Employment	19.3	2.9
Induced Employment	7.7	1.2
Total Employment	30.8	4.6
Multiplier (Total Impact/Direct Impact)	8.0	8.0
Average Earnings per Job (2004 dollars)	$40,238	$40,238

Note: Direct, indirect, and induced employment impact and average earnings per job are calculated using IMPLAN.

The analysis of potential changes in tax revenues is based on tax rates of 12.5 percent of taxable value for federal mineral royalties, 6 percent of taxable value for state severance taxes (WY DOR 2001), and 6.3 percent of taxable value for local ad valorem production taxes (based on averaging local mineral tax rates for Lincoln, Sweetwater, and Uinta Counties from WY DOR (2006), and reported in the Economic Conditions section of Chapter 3. Taxable value refers to value of sales minus allowable deductions, including certain costs of production and transportation. For analysis purposes, taxable value was estimated based on the average taxable value per unit sold from the three counties in the planning area for July 2005 through June 2006 using data from WY DOR (2006). Taxable value was estimated as $49.02 per barrel for oil, and $5.09 per mcf for natural gas (2004 dollars).

Table K-5 shows estimated gas production, and Table K-6 shows estimated oil production, on Bureau of Land Management (BLM)-administered land and mineral estate from 2001 to 2020 in the planning area, which was used as an input for the IMPLAN analysis of oil and gas production.

Table K-5. Estimated Federal Gas Production in the Planning Area (billions of cubic feet)

Year	Alternative A	Alternative B	Alternative C	Alternative D (Proposed RMP)
2001	3.56	2.58	3.56	3.56
2002	4.29	2.79	4.29	4.29
2003	11.51	6.49	11.51	11.51
2004	17.68	9.78	17.78	17.61
2005	23.85	12.94	24.01	23.69
2006	29.20	15.88	29.29	28.99
2007	34.26	18.45	34.39	33.96
2008	38.99	20.95	39.17	38.61
2009	43.64	23.28	43.85	43.17
2010	47.68	25.42	47.79	47.32
2011	51.70	27.40	51.82	51.24
2012	55.15	29.22	55.34	54.64
2013	58.58	30.90	58.82	58.02
2014	61.50	32.45	61.63	60.88
2015	64.45	33.88	64.61	63.78
2016	66.93	35.19	67.01	66.25
2017	69.47	36.41	69.60	68.74
2018	71.54	37.53	71.58	70.95
2019	73.40	38.56	73.64	73.06
2020	75.19	39.51	75.38	74.79
Total	902.59	479.61	905.07	895.05

Source: BLM 2006b.

Table K-6. Estimated Federal Oil Production in the Planning Area (millions of barrels)

Year	Alternative A	Alternative B	Alternative C	Alternative D (Proposed RMP)
2001	0.07	0.07	0.07	0.07
2002	0.07	0.07	0.07	0.07
2003	0.19	0.15	0.19	0.19
2004	0.29	0.21	0.29	0.29
2005	0.38	0.26	0.38	0.37
2006	0.44	0.30	0.44	0.44
2007	0.51	0.33	0.51	0.50
2008	0.56	0.36	0.56	0.55
2009	0.60	0.38	0.61	0.60
2010	0.64	0.41	0.64	0.63
2011	0.67	0.42	0.68	0.67
2012	0.70	0.44	0.70	0.69
2013	0.72	0.45	0.73	0.72
2014	0.74	0.46	0.74	0.73
2015	0.76	0.47	0.76	0.75
2016	0.77	0.48	0.77	0.76
2017	0.79	0.49	0.79	0.78
2018	0.79	0.49	0.80	0.79
2019	0.80	0.50	0.81	0.80
2020	0.81	0.50	0.81	0.80
Total	11.29	7.24	11.35	11.22

Source: BLM 2006b.

3.0 LIVESTOCK GRAZING

Economic impacts due to changes in livestock grazing are a function of the amount of forage available and the economic value of the forage. For livestock grazing, long-term surface-disturbing actions from actions listed in Appendix M could affect the authorized animal unit months (AUMs). In addition, land disposal actions could have economic impacts; however, those impacts were not analyzed quantitatively because it is difficult to predict the net change in AUMs. Subsequent landowners may continue to graze the land, leaving overall livestock production and output in the region unaffected.

Table K-7 provides a summary, according to alternatives, of initial AUMs and total AUMs lost by 2020 due to surface-disturbing activities. Based on current allocations of AUMs to cattle and sheep (BLM 2003), 62 percent of the AUM reduction is allocated to cattle and 38 percent to sheep, for the purpose of estimating changes in output and employment.[1] The base number of AUMs available is 157,249 (Netherly 2004). Surface-disturbance acres were converted to AUMs using a conversion factor of 9.3 acres per AUM (Netherly 2004).

[1] In some years, actual use of grazing leases may be less than 100 percent of authorized use. If surface disturbance impacts land that is authorized for grazing, but not actually used in a given year, then no economic impacts would result from the loss of that grazing land.

Table K-7. Estimated Animal Unit Month Losses

Item	Alternative A	Alternative B	Alternative C	Alternative D (Proposed RMP)
Initial AUMs	157,249	157,249	157,249	157,249
AUMs lost from surface-disturbing activities (total)	15,556	5,079	15,534	8,338
Incremental AUMs lost from surface-disturbing activities (per year)	778	254	777	417
Net AUMs in 2020	141,693	152,170	141,715	148,911

Note: Acres are converted to AUMs using a conversion factor of 9.3 acres per AUM (Netherly 2004).

Due to price fluctuations, average per-AUM values for cattle and sheep are based on the 1993 to 2002 average value of production estimates from the Wyoming Agricultural Statistics Service (Taylor 2004). The value for cattle is $36.91 per AUM and the value for sheep is $23.97 per AUM (in 2004 dollars). Including indirect and induced impacts, the value of one AUM for cattle is $64.71 and for sheep $41.08 (in 2004 dollars). Table K-8 shows the economic impact assumptions for cattle and sheep. The direct economic impact is the estimated change in livestock output per AUM; IMPLAN generates the indirect and induced impacts.

Table K-8. Assumptions for Analysis of Impacts on Output for Livestock Grazing

Economic Impact	Cattle	Sheep
Direct Economic Impact ($/AUM)[1]	$36.91	$23.97
Indirect Economic Impact ($/AUM)[2]	$20.99	$12.74
Induced Economic Impact ($/AUM)[3]	$6.81	$4.37
Total Economic Impact ($/AUM)	$64.71	$41.08
Multiplier (Total Impact/Direct Impact)	1.75	1.71

Note: All dollar values are in 2004 dollars.

[1] Direct economic impact is the market value of output, based on data for 1993-2002 from Wyoming Agricultural Statistics Service (Taylor 2004).

[2] Indirect impacts reflect increased demand in sectors that directly or indirectly provide supplies to the livestock industry.

[3] Induced impacts reflect increased demand in the consumer and government sectors.

AUM Animal Unit Month

Table K-9 provides a summary of the employment impacts assumed according to unit changes in livestock AUMs.

Table K-9. Assumptions for Analysis of Employment Impacts for Livestock Grazing

Employment Impact	Cattle	Sheep
Direct Employment (Jobs/1,000 AUMs)	0.307	0.700
Indirect Employment (Jobs/1,000 AUMs)	0.335	0.252
Induced Employment (Jobs/1,000 AUMs)	0.106	0.069
Total Employment (Jobs/1,000 AUMs)	0.747	1.021
Multiplier (Total Impact/Direct Impact)	2.44	1.46
Average Earnings per Job (2004 dollars)	$26,626	$12,341

Note: Direct, indirect, and induced employment impacts and average earnings per job are calculated using IMPLAN.

4.0 RECREATION

The analysis of economic impacts considers only recreation expenditures of nonresidents of the three-county study area. This is based on the assumption that expenditures of residents would occur in the region regardless of the BLM's actions that impact recreational opportunities; however, changes in nonresident recreation patterns would alter the amount of money entering the local region.

Economic impacts from recreation are a function of recreation visitor days (RVDs) and expenditures per day. Future RVDs were estimated based on current RVDs and estimated growth rates, both of which were provided by BLM (Mierzejewski 2006). These estimates of current and future RVDs were based on multiple sources, including a U.S. Forest Service (USFS) study that provides forecasts of recreation activity for the Rocky Mountain region (Bowker et al. 1999), contacts with neighboring BLM field offices, and the professional judgment of BLM staff (Mierzejewski 2006). Nonresident RVDs in 2003 on BLM land were estimated at 5,145 for OHV; 26,478 for hunting; 18,377 for fishing; and 7,130 for other nonconsumptive recreation (including heritage tourism, hiking, viewing wildlife, biking and horseback riding) (Mierzejewski 2006). Table K-10 provides a summary of estimated annual growth rates by alternative.

Table K-10. Estimated Annual Growth Rates for Nonresident Recreation Visitor Days

Recreation Activity	Alternative A	Alternative B	Alternative C	Alternative D (Proposed RMP)
OHV	1.54%	1.20%	1.50%	2.00%
Hunting	1.10%	1.10%	1.10%	1.10%
Fishing	1.28%	1.28%	1.28%	1.28%
Other Nonconsumptive	1.30%	1.30%	1.30%	1.30%

Source: Mierzejewski 2006

OHV Off-highway vehicle

The estimates for average expenditure per visitor day are $94.03 for fishing in 2002 dollars (WGFD 2003); $179.63 for hunting in 2002 dollars (Burkett 2004); $51.55 for wildlife watching in 2001 dollars (USFWS 2003; expenditures excluding equipment costs); and $130.60 for OHV use in 2000 dollars (Colorado OHV Coalition 2001). Table K-11 shows the direct, indirect, and induced output per RVD for each recreation activity, adjusted to 2004 dollars using adjustment factors from IMPLAN.

Table K-11. Assumptions for Analysis of Impacts on Output for Recreation Activities

Economic Impact	OHV (per RVD)	Hunting (per RVD)	Fishing (per RVD)	Other (per RVD)
Direct Economic Impact[1]	$143.79	$188.03	$98.28	$55.04
Indirect Economic Impact[2]	$22.76	$27.64	$10.89	$6.41
Induced Economic Impact[3]	$15.16	$25.11	$10.64	$5.36
Total Economic Impact	$181.70	$240.78	$119.81	$66.81
Multiplier (total impact/direct impact)	1.26	1.28	1.22	1.21

Note: Detail may not add to total due to rounding. All dollar values are in 2004 dollars.

[1]Direct economic impact is the average expenditure per visitor day.

[2]Indirect impacts from IMPLAN reflect increased demand in sectors that directly or indirectly provide support for the recreation industry.

[3]Induced impacts from IMPLAN reflect increased demand in the consumer and government sectors.

IMPLAN Impact Analysis for Planning
OHV Off-highway vehicle
RVD Recreation visitor day

Table K-12 provides a summary of employment impacts assumed according to unit changes in RVDs.

Table K-12. Assumptions for Employment Impacts Analysis for Recreation Activities

Employment Impact (annual number of jobs)	OHV (per 1,000 RVDs)	Hunting (per 1,000 RVDS)	Fishing (per 1,000 RVDS)	Other (per 1,000 RVDS)
Direct Employment	2.5	5.2	1.7	0.8
Indirect Employment	0.3	0.4	0.1	0.1
Induced Employment	0.2	0.4	0.2	0.1
Total Employment	3.1	5.9	2.0	1.0
Multiplier (Total Impact/Direct Impact)	1.22	1.14	1.17	1.21
Average Earnings per Job (2004 dollars)	$15,152	$12,950	$16,100	$16,125

Note: Direct, indirect, and induced employment impact and average earnings per job are calculated using IMPLAN.

IMPLAN Impact Analysis for Planning
OHV Off-highway vehicle
RVD Recreation visitor day

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