U.S. Department of the Interior
Bureau of Land Management

Social and Economic Impact Analysis Methodology Technical Report

Royal Gorge Field Office

A Supplement to the Draft Eastern Colorado Resource Management Plan

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Prepared by

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ACRONYMS AND ABBREVIATIONS

AUM	Animal unit month
BBL	Barrel
BLM	Bureau Land Management
CBM	Coalbed methane
EAA	Economic analysis area
EIS	Environmental impact statement
IMPLAN	IMPact analysis for PLANning
MCF	Million cubic feet
mmbl	Million barrels
mmcf	Million cubic feet
NVUM	National visitor use monitoring
PA	Planning area
RFD	Reasonable foreseeable development
RGFO	Royal Gorge Field Office
RMIS	Recreation Management Information System
RMP	Resource management plan
USFS	United States Forest Service

1. GENERAL ASPECTS OF THE METHODOLOGIES

This technical report focuses on the methodologies used to assess conditions, trends, and impacts described in the Eastern Colorado Resource Management Plan & Environmental Impact Statement (RMP/EIS) for surface lands and federal minerals managed by the Bureau of Land Management (BLM), Royal Gorge Field Office (RGFO).[1] It provides additional detail beyond that found in the *Basis for Analysis* (BLM 2018) prepared for the RMP/EIS.

Methodologies used in the Eastern Colorado RMP/EIS include quantitative economic analysis using an economic impact model, IMPLAN (IMpact analysis for PLANning model). The quantitative impact analysis focuses on three resource uses: recreation, livestock grazing, and fluid energy mineral (oil and gas) development and production. The methods also include qualitative economic impact analysis based on identifying the logic of economic effects and economic relationships. Economic analysis methodology also includes qualitative consideration of nonmarket values. Social impact analysis is based in part on assessing the alternatives against the different points of view of several broad categories of stakeholders. The social impact analysis also considers the effects of economic impacts on social conditions; for instance, whether economic growth from resource development would overtax local public services. Finally, the methodologies include qualitative environmental justice impact analysis. This technical report addresses the quantitative economic analysis methodology in greatest detail. The other methodologies are mainly described as needed in the body of the RMP/EIS and are summarized here.

2. DESCRIPTION OF THE PROJECT AREA

2.1. Assumptions

The following basic assumptions underlie all of the social and economic analyses:

- Market-based economic relationships, such as purchases between industries and relationships between value added, economic output, labor income, and employment, will remain similar to current relationships throughout the planning period.
- BLM-administered land will continue to provide ecosystem services, and people will continue to experience nonmarket values from those services, at similar rates to those now

[1] The Affected Environment sections of the Eastern Colorado RMP/EIS describe social and economic conditions and trends using a number of demographic, social, and economic indicators and using qualitative information. The RMP/EIS also qualitatively characterizes different social values, attitudes, and beliefs regarding BLM-administered land in the socioeconomic study area by using public input from the public scoping period and the envisioning workshops, both conducted in 2015. The RMP/EIS also characterizes the social and economic uses and values of BLM-administered land. The *Socioeconomic Baseline Report* (BLM 2017) provides considerable additional information on the affected environment of the Eastern Colorado RMP/EIS planning area.

provided and experienced unless the conditions producing the ecosystem services or nonmarket values are altered by management actions.

- Housing supply and costs, and community infrastructure and services, may be constraints on population growth and quality of life in some locations within the planning area.
- The pace and timing of mineral development activities is dependent on a variety of factors outside the management decisions of BLM. These include national and international energy demand and prices, production factors within the planning area, and business strategies of operators. The reasonably foreseeable development (RFD) scenario for oil and gas (Richter, Annable, and Pike 2018) projects expected rates of oil and gas well drilling, and future production volumes. Actual economic impacts could vary if actual development or production varies from the projections, or if prices change.
- Tax and royalty revenues derived from activities on BLM-administered land would continue to be distributed among communities within the planning area, the state, and the Federal Government at the same or similar distribution shares as currently.
- Demand for use of BLM-administered land for livestock grazing will continue through the study period at similar rates as currently, with supply of land and forage for this purpose subject to provisions of the management alternatives.
- Demand for use of BLM-administered land for recreational activities throughout the planning area will increase through the study period, with supply of land for this purpose subject to provisions of the management alternatives.

Many of the socioeconomic effects of the management alternatives will result from continuing or changed levels and types of resource use and associated resource conditions and trends. Therefore, the socioeconomic analysis also encompasses many of the assumptions noted in the RMP/EIS subsections for specific resource uses.

The discussions below of the specific methodologies for each resource use provide additional assumptions used in the analyses.

2.2. Quantitative Economic Impact Analysis Using IMPLAN

Quantitative economic analysis is used when possible given adequate available information and resources. For the Eastern Colorado RMP/EIS, adequate data were available for three resource uses:

- Recreation
- Livestock grazing
- Fluid minerals, specifically, oil and gas development and production

The basic strategy used in quantitative economic impact analysis is to first identify the direct impacts of an economic activity affected by management decisions. For instance, direct impacts include expenditures made by oil and gas companies to drill a well, and to complete the well for

production. Direct impacts also include the value of the oil and gas that is produced and sold. Next, where direct impacts can be quantified, they can generally also be run through an economic model to estimate the total economic activity that is generated as the primary impact ripples through the economy, as the directly affected industries purchase goods and services that are necessary inputs to production, and as labor income generated from production is spent by the households that receive the income.

The total economic effects are estimated in this study through use of the IMPLAN model. The IMPLAN model was originally developed by the U.S. Forest Service (USFS) and is commonly used by the BLM and many other government and private sector organizations to estimate the total economic impacts of various activities, actions, and policies. The model tracks inter-industry and consumer spending in a local (or regional) economy, allowing estimation of indirect and induced economic impacts in the local economy that result from the original economic activity or a change in economic activity. Indirect impacts result from local inter-industry purchases caused by the direct impact, and induced impacts results from re-spending of labor income (i.e., local purchases by households of employees and proprietors of the affected industries).

Outputs of the IMPLAN model include economic output, labor income, and employment. These are defined as follows:[2]

- **Employment (jobs) –** A job in IMPLAN equals the annual average of monthly jobs in that industry.[3] Thus, 1 job lasting 12 months equals 2 jobs lasting 6 months each, equals 3 jobs lasting 4 months each. It is important to note that IMPLAN, based on some of its data sources, does not distinguish between full-time and part-time jobs. Sectors with higher labor earnings per job are likely to reflect a high proportion of full-time jobs, while sectors with low labor earnings per job often reflect a significant number of part-time jobs.
- **Labor Income (earnings) –** All forms of employment income, including Employee Compensation (wages and benefits) and Proprietor Income.
- **Economic Output (gross regional economic output) –** Output represents the value of industry production. In IMPLAN these are annual production estimates for the year of the data set and are in producer prices. For manufacturers, output is sales plus or minus change in inventory. For service sectors, output equals sales. For retail and wholesale trade, output equals gross margin, not gross sales.

By constructing "social accounts" that describe the structure and function of a specific economy, IMPLAN creates a *localized* model to investigate the consequences of projected economic activity in a geographic region. The IMPLAN model uses data specific to the local economy

[2] Based on the glossary from the website of the previous publisher of IMPLAN, the Minnesota IMPLAN Group. This website is no longer available.
[3] This is the same definition used nationally by the Quarterly Census of Employment and Wages, United States Bureau of Labor Statistics, and United States Bureau of Economic Analysis.

wherever possible, but also uses some data based on national-level economic relationships. Therefore, the model benefits from modification ("calibration") of some of its parameters to better reflect the local economy. For this study, IMPLAN was calibrated based on best practices from multiple other BLM RMP/EIS IMPLAN analyses and Colorado-specific data. The specific IMPLAN impact analysis methodologies, assumptions, and modifications for each resource use are described below.

The analyses used Version 3.0 of the IMPLAN modeling system. The IMPLAN model is managed by and available from the IMPLAN Group, LLC (http://implan.com/).

2.2.1. Study Areas

The economic impact analyses for the three resource uses were conducted for activities on federal lands and minerals managed by the RGFO. The economic impacts for each resource use were calculated for an economic analysis area consisting of specific counties where most of the economic activity attributable to BLM-administered land occurs, as determined by analyses conducted for the *Socioeconomic Baseline Report* (BLM 2017) prepared for the Eastern Colorado RMP/EIS. The sections below on the methods for each resource use address the economic analysis areas further.

2.2.2. Time Frame for the Analyses

Economic impacts were estimated across the 20-year planning period (2018-2037).

2.2.3. Base Year Dollars

All dollar figures in the quantitative economic analysis results are in constant 2017 dollars. The base year of the IMPLAN model is 2014. IMPLAN model results were converted to 2017 dollars using inflators within the model.

2.3. Qualitative Economic Impact Analysis

Where primary impacts cannot be readily quantified, often the economic impacts can still be described qualitatively based on the nature of specific economic relationships and the logic of economic effects based on those relationships. This approach may be used with impacts to market values and is often used with impacts to nonmarket values. The term nonmarket values refers to the benefits individuals attribute to experiences of the environment or uses of natural and cultural resources that do not involve market transactions and therefore lack prices. Because these values are not priced, they are difficult to estimate but nonetheless BLM guidance calls for efforts to be made to identify and assess impacts to nonmarket values in the planning process (BLM 2013).

Some of the management decisions under this planning action would result in increased costs to operators—the firms or individuals who undertake the activities—or to project proponents. The economic impacts of decisions that increase costs for operators and/or project proponents are many and can be complex. Cost increases may cut into profitability and drive delays to, reductions in, or cessation of operations or projects. However, where operations or projects are not delayed, reduced, or terminated, increased costs also represent increased economic activity. For instance, if restrictions under an alternative result in a new power line having to take a longer route, additional expenditures for materials, equipment, and labor would be made. These increased expenditures would support some amount of additional income and employment. However, increased costs may also represent opportunity costs; that is, the project proponent or society may have benefited more if the additional funds were used in another way. In the socioeconomic analysis for the Eastern Colorado RMP, where management actions would potentially increase costs to operators or project proponents, these increased costs are pointed out and discussed qualitatively. Readers should keep in mind that these increased costs may negatively affect operators, may benefit others in society, and may incur opportunity costs.

2.4. Social Impact Analysis

Some social impacts, especially those impacts related to certain demographic characteristics (such as population and age distribution), housing, and community services, are driven in large part by changes in economic activity. Other social impacts may arise with or without effects to economic activity including, for example, impacts on quality of life, recreation and amenity values, and traditional land uses and associated cultural values. Social impacts may be marginal or substantial, depending on the degree to which new and revised management actions alter the course set in previous BLM decisions.

Sometimes social impacts can be quantified; however, in the Eastern Colorado RMP, socioeconomic analysis social impacts are described qualitatively. This is in part because it is difficult to reliably translate decisions that support resource development into population change estimates. In addition, social impacts of BLM management decisions may vary considerably depending on the nature of the community(ies) involved. For a planning effort that covers as large a geographic area as this effort, analysis of social impacts must necessarily use a broad brush.

A key aspect of the social impacts analysis approach is to address impacts based on the varying points of view of key types of stakeholders. The *Socioeconomic Baseline Report* (BLM 2017) identifies several broad categories of stakeholders to BLM management decisions in the RGFO. These categories reflect different linkages people have to public lands. They also reflect distinct sets of attitudes, beliefs, values, opinions, and perceptions about public resources and the effects of various management policies and actions. The Eastern Colorado RMP socioeconomic analysis assesses how the management alternatives would affect the interests and values of the different stakeholder groups. Categorization of stakeholders is not meant to imply that all individuals and

social groups fit neatly into a single category; many specific individuals or organizations may have multiple interests and would see themselves reflected in more than one stakeholder category. The point of categorization is to allow differentiation of social impacts based on broad differences in points of view.

2.5. Environmental Justice Impact Analysis

Definitions and methods for analysis of potential environmental justice issues are described in the *Socioeconomic Baseline Report* (BLM 2017). In short, the socioeconomic study area was screened to identify geographic subareas with minority and low-income populations that qualify as potential environmental justice populations based on guidance for environmental justice analysis from the Council on Environmental Quality and other best practices for environmental justice analysis. These subareas and their potential environmental justice populations are noted in the RMP/EIS as well as in the *Socioeconomic Baseline Report*. Further assessment of the likelihood of impacts to these populations was conducted as described in the RMP/EIS.

With respect to environmental consequences, environmental justice impacts occur if there are disproportionately high and adverse environmental or human health effects on the environmental justice populations. As discussed in the RMP/EIS, no such disproportionate adverse impacts were identified for the Eastern Colorado RMP alternatives because the programmatic nature of this planning action does not identify exact locations of implementation actions. Implementing decisions and authorizing on-the-ground activities would require appropriate site-specific NEPA review in order to proceed, including additional environmental justice analysis.

3. METHODOLOGIES BY RESOURCE USE

3.1. Recreation

3.1.1. Introduction

The recreation economic analysis involved:

- Determining the appropriate economic analysis area.
- Estimating recreation usage (annual recreation visits) of BLM-administered land in the recreation economic analysis area.
- Calculating total recreation-related expenditures (direct impacts) in the recreation economic analysis area.
- Estimating the total economic impacts based on recreation expenditures.

The recreation economic analysis presents two perspectives on economic effects used by economists: economic contribution and economic impact. Economic contribution measures gross changes in economic activity and in the case of recreation includes: a) expenditures made by visitors from outside the economic analysis area, and b) expenditures made by local residents

(roughly, individuals who live within the recreation economic analysis area). Local residents make considerable recreation-related expenditures (gas, food, and so on) on local recreation, so the economic contribution perspective includes those expenditures in an analysis of the economic role of recreation. Put another way, expenditures by local and non-local recreationists alike help keep local businesses going. Economic impact measures only the net new changes in economic activity within the economic analysis area; in the case of recreation, net new economic activity is only generated by the spending within the economic analysis area of recreational visitors from outside the economic analysis area. Net new economic activity is not generated by local resident spending on local recreation, as these residents would generally make other expenditures locally if they did not make expenditures on local recreation. Economic impact is the measure used in the analyses of livestock grazing and oil and gas development and production because these industries are predominantly export industries. Local residents buy only a very small proportion of the total output of those industries, so a measure of economic contribution would be only slightly greater than the measure of economic impact.

3.1.2. Definition of the Economic Analysis Area

The recreation economic analysis area was defined based on examination of recent historical recreation visitation estimates for the RGFO taken from the BLM's Recreation Management Information System (RMIS). Analysis of site-specific RMIS data for 2014 conducted for the *Socioeconomic Baseline Report* (BLM 2017) showed that 98.9 percent of all recreation visits in the RGFO occurred in the following six counties: Chaffee, El Paso, Fremont, Lake, Park, and Teller. This area was defined as the recreation economic analysis area.

3.1.3. Estimation of Recreation Usage

Recreation usage data in RMIS are expressed in "visits." A visit is defined as one individual who enters and recreates on BLM-administered land for an indeterminate period. A visit ends when that individual spends a night off the BLM unit. The fact that some visits are of a single day or less, and some are for multiple days, is accounted for in the approach to estimating the direct impacts (expenditures) of visitors, as discussed below. Table 3.1 shows the total visits in the RGFO in recent years.

Table 3.1. Total Recreation Visits to the RGFO, 2013-2017

Fiscal Year	Visits*
2013	1,699,216
2014	1,674,328
2015	1,506,403
2016	1,598,912
2017	1,586,622
Five-Year Average	1,613,096
Adjusted Five-Year Average (Recreation Economic Analysis Area)**	1,595,610

Source: RMIS data.

*Not including visits to Browns Canyon National Monument, which is not included in the Eastern Colorado RMP. Browns Canyon National Monument is developing its own management plan.
**See text below.

The economic impact analysis assumes that the 2014 figure of 98.9 percent of all recreation visits in the RGFO occurring within the recreation economic analysis area also reflects the average for 2013-2017, and will remain constant throughout the 20-year planning period. Based on this percentage, the 2013-2017 5-year annual average of visits to the economic analysis area was 1,595,610. This figure was used as the 2018 level of recreation visits in the economic analysis area.

The BLM anticipates that recreation visitation will increase within the planning area as populations increase, particularly in the Front Range urban centers, and as interest in outdoor recreation continues (CPW 2015). This is likely the case for the majority of sites and activities, depending on social trends, technological advances, and the degree of external promotion. The economic analysis uses Colorado's future population growth rate, as projected by the Colorado Department of Local Affairs, State Demography Office (2017), to estimate future levels of recreation visits. The Colorado Department of Local Affairs' projections of the annual population growth rate range from 1.63 percent for 2018 to 2019 to 1.12 percent for 2036 to 2037. Based on the Colorado population growth rates from Department of Local Affairs, the recreation economic analysis projects that recreation visits to the economic analysis area will increase from the 2018 estimate of 1,595,610 to 2,097,590 visits in 2037.

While the alternatives differ in terms of recreation management actions, there is no basis for reliably estimating how the management actions will affect recreation visitation numbers. Therefore, the RMP/EIS addresses differences between the alternatives on a qualitative basis only.

3.1.4. Estimation of the Direct Economic Impacts of Recreation (Expenditures)

Due to the lack of recreation expenditure data for recreation on BLM-administered land in Eastern Colorado, data from the National Visitor Use Monitoring (NVUM) program of the USFS were used to estimate recreation-related expenditures for the recreation economic analysis area. The NVUM program provides a robust data source that is widely used for recreation economic impact analysis for areas besides USFS-managed lands. This is done by identifying national forest units that are reasonably analogous to another recreation management area and applying the recreational expenditure data from NVUM to other area-specific recreation use data or estimates.

The USFS unit deemed most analogous to recreation on BLM-administered land in the recreation economic analysis area was the Pike-San Isabel National Forest. The BLM used NVUM recreation market segment data and expenditure profiles for the Pike-San Isabel National Forest from the latest iteration, Round 3, of the NVUM surveys (White 2017). The NVUM Round 3 surveys for the Pike-San Isabel National Forest were conducted in 2012.

The NVUM recreation segment and expenditure data were applied to the recreation economic analysis area as described below. All NVUM expenditures as were assumed to be local expenditures (within the recreation economic analysis area), based on how the NVUM data were collected (surveys asked interviewees for their expenses within 50 miles of the recreation site).

- The allocation of recreation economic analysis area visitation to two overarching NVUM "broad visit activity" types was assumed to equal the allocation for the Pike-San Isabel National Forest of 13.5 percent to wildlife-related recreation and 86.5 percent to all other recreation. This is after adjustments to take out all data for downhill skiing visits and recalculate the allocations since there is no downhill skiing on BLM-administered land.
- The allocation of BLM recreation visits within each of the broad visit activity types was further allocated to each of seven different recreation "trip types" according to the NVUM data for the Pike-San Isabel National Forest. Table 3.2 provides the percentage allocations to trip types.
- The estimates of visits by trip type for each broad activity type were then converted to party visits based on average party size for each trip type from the NVUM data for the Pike-San Isabel National Forest.
- Total party visits were multiplied by party spending figures from the NVUM for each broad visit activity type and trip type to estimate direct spending by visitors. The party spending figures from NVUM were the averages for an "average-expenditure forest," which is the forest expenditure profile applicable to the Pike-San Isabel National Forest. NVUM researchers have determined that expenditure figures based on averages across multiple forests are more reliable than individual forest expenditures.
- Total direct spending across all broad visit activity types and visit types was summed to yield the total direct economic contribution estimates.

- Total direct spending was adjusted (reduced) for the local trip segments to reflect estimated out-of-area substitution, based on NVUM national data (White and Stynes 2010). The remaining direct spending across all segments was then summed to yield the total direct economic impact estimates.

Table 3.2. Allocation of Visits to Trip Types

Broad Visit Activity	Non-Local Visitor			Local Visitor			Non-Primary Visit*
	Day	***Overnight on BLM***	***Overnight off BLM***	***Day***	***Overnight on BLM***	***Overnight off BLM***	
Wildlife (13.5% of Total Visits)	3.0%	13.0%	15.0%	61.0%	0.0%	1.0%	7.0%
Other (86.5% of Total Visits)	12.0%	7.0%	8.0%	54.0%	3.0%	1.0%	15.0%

Source: NVUM survey data for the Pike-San Isabel National Forest (White 2017).

*Visits for which recreation on BLM-administered land was an incidental activity rather than a primary activity.

The BLM acknowledges that certain recreation activities on BLM-administered land may generate visitor expenditure patterns that differ from the NVUM expenditure values. However, the BLM believes that in total—averaged across the many different recreation activities that take place in the RGFO—the per visit expenditure values from the NVUM are reasonably close to the per visit expenditures that occur in the socioeconomic study area due to recreation on BLM-administered land in the RGFO. Some activity-specific expenditure data may be available from other sources. For the Eastern Colorado RMP/EIS, the BLM chose an expenditure data source (NVUM) and methodology that provide a consistent analysis across all activity types. This approach is also consistent with most BLM RMP/EISs. Where appropriate, impacts of management actions on different types of recreation are addressed qualitatively.

3.1.5. IMPLAN Model Modifications

No modifications were made to the IMPLAN model for recreation-related sectors. The coefficients used by the model for these sectors are generally considered reliable for Colorado.

3.1.6. Recreation Economic Contributions and Impacts

As noted earlier, the economic importance of recreation in the RGFO was considered both in terms of "economic contribution," which is a descriptive analysis that simply tracks the gross economic activity as the dollars cycle through the region's economy, and "economic impact," which estimates the net economic activity that would be lost from the local economy without the resource. The total direct economic contributions or impacts that were developed as described above were used in the IMPLAN model to estimate the indirect, induced, and total economic effects of recreation.

The total direct economic contributions or impacts were entered into the IMPLAN model using distributions of expenditures by trip type to different recreation-affected industries. These distributions were developed by the USFS from the NVUM surveys. Specifically, the direct recreation spending was disaggregated across the following 10 IMPLAN sectors based on the spending distributions from NVUM (White 2016). Following standard regional economic analysis practices, expenditures in retail trade sectors were "margined" (reduced to account for the cost of goods from outside the study area) by the IMPLAN model.[4]

Number	Sector Name
400	Retail – Food and Beverages (margin of 27.7 percent)
402	Retail – Gasoline Stations (margin of 11.6 percent)
404	Retail – Sporting Goods, Hobby, Book, Music (margin of 41.7 percent)
406	Retail – Miscellaneous (margin of 47.2 percent)
442	Automotive Equipment Rental and Leasing
493	Museums, Historical Sites, Zoos, and Parks
496	Other Amusement and Recreation Industries
499	Hotels and Motels
500	Other Accommodations
501	Full-Service Restaurants

3.2. Livestock Grazing

3.2.1. Introduction

The livestock grazing economic analysis involved these high-level steps:

- Determining the appropriate economic analysis area.
- Estimating the amounts of forage utilized on BLM-administered land in the livestock grazing economic analysis area and the planning area under each management alternative.
- Estimating the economic value of forage use.
- Estimating the economic impacts based on the value of production.

The analysis was based on cattle grazing only. No animal unit months (AUMs)[5] were billed for sheep grazing in the RGFO in the years evaluated for baseline grazing data (2010-2014). Only small percentages of AUMs were billed for bison (3.0 percent), yearling cattle (0.9 percent) and domestic horses (0.2 percent); therefore, the economic parameters for cattle were applied to these livestock types. The BLM allocates forage for wildlife and wild horses separately.

[4] Margin represents sales receipts less the cost of the goods sold.
[5] An AUM is equal to the approximate amount of forage consumed by a cow and calf during a 1-month grazing period.

3.2.2. Definition of the Economic Analysis Area

The livestock grazing economic analysis area was defined based on examination of recent historical billed AUMs data for the RGFO taken from the BLM's Rangeland Administration System. Analysis of Rangeland Administration System data for 2014 conducted for the *Socioeconomic Baseline Report* (BLM 2017) showed that 90 percent of the economic impact of livestock grazing in the planning area most likely occurs within the following six counties: Chaffee, Fremont, Huerfano, Park, Pueblo, and Teller. This assessment was developed by RGFO grazing program staff based on knowledge of the location of the base ranching operations of each allotment permittee and professional judgement regarding where each operation most likely makes most of its grazing related expenditures. The 2014 grazing year was considered by RGFO grazing program staff to be the most representative year within the 2010-2014 Rangeland Administration System data. These counties also comprise 85.7 percent of all billed AUMs in 2014 the RGFO based on allotment location. This six-county area was defined as the livestock grazing economic analysis area. In addition, economic analyses were also conducted for 100 percent of the AUMs across the 37-county planning area.

3.2.3. Estimation of Forage Utilization

The economic activity generated by grazing is directly related to the number of AUMs actually used by livestock operators. Each AUM of forage consumed contributes to the weight of marketable cattle and therefore affects the value of livestock production. Billed AUMs are the closest available approximation of actual use of AUMs. Billed use may exceed actual grazing use, so the economic analysis may overstate the actual economic impacts of grazing to some degree. Billed AUMs will vary from year to year, based on weather and market conditions. Because these variations cannot be predicted, the impact estimates assume a constant level of use throughout the planning period.

An economic impact analysis was also conducted based on hypothetical use of all permitted AUMs in the planning area. This represents the maximum possible economic impact of livestock grazing on BLM-administered lands in the RGFO. For analysis purposes only, this hypothetical scenario would not vary from year to year. It is highly unlikely that this maximum economic impact scenario would ever occur. According to RGFO rangeland specialists, based on knowledge of the allotments and grazing practices in the planning area, there are many reasons why billed AUMs are currently much less than total permitted AUMs and would remain so in the future. Many allotments are inactive (no operator holds a license to use the allotment) because of difficult terrain for cattle grazing operations, lack of water, lack of fencing, and other reasons. In many cases, the return on investment to install water, fencing, or other infrastructure would be negative. Many operators use active allotments at less than capacity for similar reasons—portions of the allotment(s) may have similar conditions as just described.

In summary, economic impact estimates for livestock grazing were prepared for the following analysis scenarios:

a) The 5-year average (2010-2014) of billed AUMs in the six-county livestock grazing economic analysis area;
b) The 5-year average (2010-2014) of billed AUMs in 37-county planning area; and
c) Total permitted AUMs in 37-county planning area.

Under Alternative B, some currently active allotments would be closed. These allotments have a total of 4,143 permitted AUMs and 2,363 billed AUMs. Therefore, the AUM totals for alternative B were reduced by these amounts. No other differences between the alternatives could be confidently quantified based on the nature of the management decisions. However, differences between the alternatives were addressed qualitatively. Table 3.3 provides the number of AUMs used for each analysis scenario and alternative.

Table 3.3. AUMs in the Grazing Economic Impact Analysis

	Alternative A	Alternative B	Alternative C	Alternative D
Livestock Grazing AUMs, EAA Billed AUMs[1,2]	17,272	14,909	17,272	17,272
Livestock Grazing AUMs, PA Billed AUMs[1,2]	19,192	16,829	19,192	19,192
Livestock Grazing AUMs, PA Total Permitted AUMs[2]	34,836	31,192	34,836	34,836

Source: BLM grazing data (Rangeland Administration System) and RMP alternatives.

[1]AUMs for the 6-county EAA are based on analysis of 2014 billed use and livestock operator locations by field office range management staff, adjusted to average billed use 2010-2014. AUMs for the 37-county PA are average billed use 2010-2014.
[2]Based on the available data, the analysis assumes a constant annual activity level.

AUM animal unit month
EAA livestock grazing economic analysis area
PA planning area

3.2.4. Estimation of the Economic Value of Forage Use

The value of grazing in a specific area can be estimated based on the grazing use of the area in AUMs as described above, and the economic value of an AUM. The direct value of production per AUM was estimated based on regional livestock production value data and ratios in the livestock economics literature. According to Workman (1986), 16 AUMs of feed are required per bred cow. Thus, the average value of an AUM can be estimated using data on the value of cattle production per bred cow and dividing by 16. In addition, a cow-calf operation adjustment is made by multiplying the value by 1.2 (NASS 2015). This adjustment is made to convert from an animal unit basis to a cow-calf basis since billed AUMs do not count livestock under 6 months of age. In Colorado, most livestock operators run cow-calf operations.

The value per AUM for cattle was based on a 10-year average (2007-2016) of the annual value of production per bred cow estimates from the United States Department of Agriculture Economic Research Service's Commodity Cow-Calf Costs & Returns estimates for the Basin and Range portion of the United States. 2016 was the latest year that the Economic Research Service data were available. A 10-year average was used to account for price variability due to the cattle cycle – the long-term expansion and reduction in the total number of U.S. beef cattle due to producers' profitability-driven herd management decisions (Wikipedia 2016). The methodology and data for calculation of the average value of cattle production from one AUM of forage are shown in Table 3.4. The IMPLAN inflator adjusts the nominal dollar values for value of production to constant 2016 dollars, which were then converted to 2017 dollars for the analysis.

Table 3.4. Value of an AUM for Cattle Production, Basin and Range Region

Year	Value of Production Per Bred Cow[1]	AUMs Per Cow[2]	Value of Production Per AUM	IMPLAN Inflator	Inflated Value of Production Per AUM*	Cow-Calf Adjustment[3]	Adjusted Value of Production per AUM
2007	$681.50	16	$42.59	0.687	$62.00	1.20	$74.40
2008	$496.02	16	$31.00	0.689	$44.99	1.20	$53.99
2009	$472.00	16	$29.50	0.603	$48.92	1.20	$58.71
2010	$570.50	16	$35.66	0.695	$51.30	1.20	$61.56
2011	$648.59	16	$40.54	0.846	$7.92	1.20	$57.50
2012	$744.93	16	$46.56	0.881	$52.85	1.20	$63.42
2013	$780.50	16	$48.78	0.903	$54.02	1.20	$64.83
2014	$1,076.00	16	$67.25	1.081	$62.21	1.20	$74.65
2015	$1,015.79	16	$63.49	0.993	$63.93	1.20	$76.72
2016	$704.62	16	$44.04	1.000	$44.04	1.20	$ 52.85
10-year Average (2016$)							**$63.86**
10-year Average Adjusted to 2017$							**$64.31**

[1]U.S. Department of Agriculture Economic Research Service, Commodity Costs and Returns, data for Basin and Range region, cow-calf pair, http://www.ers.usda.gov/data-products/commodity-costs-and-returns.aspx. All figures stated in 2017$.
[2]Workman 1986.
[3]NASS 2015.

*Value times inflator.

The figures for the value per AUM for cattle grazing were multiplied by the number of AUMs under each analysis scenario and alternative. The result was the total economic value of livestock production, which was used as the direct impact input to the IMPLAN model.

3.2.5. IMPLAN Model Modifications

The value-added components of the All Other Crop Farming sector (Sector 10) in IMPLAN were modified to better reflect hay production in the study area. The modifications were based on a grass hay budget for western Colorado from the Colorado State University (Sharp 2011).

3.2.6. Livestock Production Impacts

The economic impacts of livestock grazing were estimated in IMPLAN using analysis-by-parts methodology. The total value of production from the steps described above was allocated to different IMPLAN sectors based on a 2016 cattle production budget from the University of Idaho (Eborn et al. 2016).

The value of production was disaggregated across the following 11 IMPLAN sectors. Following standard regional economic analysis practices, expenditures in the wholesale trade sector were "margined" (reduced to account for the cost of goods from outside the study area).[6]

Number	Sector Name
10	All Other Crop Farming
11	Cattle Ranching and Farming
19	Support Activities for Agriculture and Forestry
63	Maintenance & Repair Construction of Residential Structures
395	Wholesale Trade (margin of 17.3%)
411	Truck Transportation
433	Monetary Authorities and Depository Credit Intermediation
440	Real Estate
448	Accounting, Tax Preparation, Bookkeeping
459	Veterinary Services
507	Commercial and Industrial Machinery and Equipment Repair

3.3. Oil and Gas

3.3.1. Introduction

The analysis for oil and gas economic impacts was divided into two phases of oil and gas economic activity:

- Development (Drilling and Completion)
- Production

Different methodologies were used for analyzing each phase. Analysis in each phase utilized a primary oil and gas economic analysis area and a secondary oil and gas economic analysis area. In addition, the IMPLAN model was modified for analysis of both phases as described below.

It is very important to note that the analysis focuses only on *new* BLM-managed oil and gas wells on federal mineral estate within the RGFO. This is because the management decisions under

[6] Margin represents sales receipts less the cost of the goods sold.

consideration in the Eastern Colorado RMP essentially only apply to new oil and gas leasing and not to existing leases, and only to federal mineral estate that the BLM manages. The BLM also administers federal mineral estate beneath National Forest System lands where the USFS administers the surface, but the BLM does not establish overall management direction of such mineral estate. Thus, the economic impact figures for the new BLM-managed oil and gas wells are a subset of the economic impacts of all oil and gas wells (new *and existing*) on all federal mineral estate in the field office. These, in turn, are a subset of the economic impacts of all oil and gas wells on all federal *and non-federal* mineral estate in the field office (i.e., including wells on privately and state-owned mineral estate). Put another way, the impact estimates do *not* include the economic impacts of any existing wells on federal mineral estate, nor new wells on USFS-managed federal mineral estate, nor any wells (new or existing) on non-federal mineral estate.[7]

Likewise, the percentage differences for Alternatives B, C, and D in comparison to Alternative A only represent changes for new BLM-managed wells on federal mineral estate; they do *not* represent the percentage change to *total* economic activity resulting from all oil and gas development and production. The percentage change to total oil- and gas-related economic activity would be smaller, because although the absolute difference between alternatives in dollars or jobs would be as described in the analysis, the basis for comparison—all oil- and gas-related economic activity—would be larger. This is because it would include the contributions of existing wells on federal mineral estate, new wells on USFS-managed federal mineral estate, and wells on non-federal mineral estate.

3.3.2. Definition of the Economic Analysis Area

The vast majority of oil and gas production in the planning area is currently taking place in Weld County in the Denver Basin, also referred to the Denver-Julesburg basin. The BLM expects this trend to continue through the planning period. For the purposes of quantitative economic analysis, the economic analysis area for oil and gas development and production for the Eastern Colorado RMP is defined as a primary economic analysis area consisting of Weld and Larimer counties and a secondary economic analysis area consisting of Adams and Denver counties. The *Socioeconomic Baseline Report* (BLM 2017) details the rationale for identification of these areas. In short, the primary area includes Larimer County because of large labor flows in the oil and gas industry from Larimer to Weld County. The secondary area captures impacts from drilling and production in Weld County on upstream and midstream oil and gas companies, and service industry companies and workers, located in Adams and Denver Counties. (Many of these companies also serve other basins within and outside of Colorado).

[7] The cumulative impact analysis gives qualitative consideration to the impacts of BLM-managed wells in this larger context.

3.3.3. IMPLAN Model Modifications

The IMPLAN modeling system utilizes national production coefficients. To better reflect local production practices, the following oil and gas sectors of each model were modified. In IMPLAN, oil and gas development and production is divided into three sectors (due to a lack of data on production and price, Sector 21, Extraction of Natural Gas Liquids was included in Sector 20, Extraction of Natural Gas & Crude Petroleum):

Number	Sector Name
20	Extraction of Natural Gas & Crude Petroleum
37	Drilling Oil and Gas Wells
38	Support Activities for Oil and Gas Operations

The following protocol was used to modify the individual sectors. Total output for the Oil and Gas Extraction sector was based on county level production quantities reported by the Colorado Oil and Gas Commission and the U.S. Energy Information Administration 2018-2037 oil and gas price projections for the Dakotas/Rocky Mountain Region, adjusted to 2017 dollars (EIA 2018). Total output for the other two sectors was estimated from output per employee ratios derived from the United States Census Bureau's Economic Census. Employment estimates were based on United States Bureau of Labor Statistics covered employment data. These estimates were adjusted to account for self-employment using United States Bureau of Economic Analysis data. Earnings were also based on United States Bureau of Labor Statistics data. These estimates were adjusted to account for benefits by using United States Bureau of Economic Analysis data. Intermediate payments for oil and gas production were scaled based on BLM petroleum program staff knowledge of monthly per well operating costs from interactions with producers. Additional industry sectors that receive some direct expenditures from oil and gas development did not require modification.

3.3.4. Development (Drilling and Completion) Impacts

The 2018 Addendum to the RFD scenario for oil and gas (Richter, Annable, and Pike 2018) provided the projected number of wells drilled under each alternative. The RFD projections were broken down between conventional oil and gas wells (both horizontal and vertical/directional) and coalbed methane (CBM) wells, and by Bureau-managed wells and all wells. As noted above, only Bureau-managed wells were considered in this analysis.

The RFD estimated total wells drilled across the planning period. As shown by recent history, drilling activity can vary substantially from year to year. Therefore, the total estimated wells from the RFD were allocated equally to each year of the study period for the purposes of conducting the economic impact analysis.

Based on the RFD and professional judgment of BLM petroleum engineers, the economic impact analysis assumed 95 percent of conventional (non-CBM) wells will be drilled in the primary economic analysis area (primarily in Weld County; the primary economic analysis area also includes Larimer County due to labor flows). The very small number of non-conventional (CBM) wells projected in the RFD were assumed to all occur outside of the primary economic analysis area, most likely in Las Animas County, where all recent CBM activity has taken place. The economic impact results do not include the impacts of the small number of wells assumed to occur outside the primary economic analysis area.

The trends for oil and gas development in eastern Colorado, as with anywhere, are market driven. Rapidly advancing technology also plays a factor in what resources can be economically developed. In recent years, the oil and gas industry has moved rapidly into drilling wells with horizontal laterals up to several miles long. The recent average lateral length for wells permitted by the RGFO is 1.5 miles. Often there are multiple wells on a single pad. Based on recent trends, the BLM anticipates that approximately 98 percent of the BLM-permitted conventional (non-CBM) wells projected in the RFD for the 2018-2037 planning period will be horizontal wells.

According to the RFD, the current success (completion) rate for horizontal wells is 96 percent. The current success rate for vertical/directional wells is essentially 100 percent. To estimate the impacts of well completion, the RFD-projected numbers of wells drilled were adjusted by these success rates, yielding the numbers of wells completed.

Most BLM-permitted wells access federal mineral estate and also access private ("fee") and/or state mineral estate. The proportion of production that comes from federal mineral estate varies considerably from well to well. Analysis of current leases in the Denver-Julesburg basin by BLM petroleum staff revealed the following general pattern. BLM-permitted horizontal wells that access federal mineral estate under railroad rights-of-way average six (6) percent federal mineral estate. Other BLM-permitted horizontal wells average 48.9 percent federal mineral estate. BLM petroleum staff estimate that vertical/directional wells and CBM wells average 75 percent federal mineral estate.

Given these patterns, the annual wells drilled and annual wells completed by type were reduced by the estimated percentage of federal minerals by well type. This adjusts the economic impact analysis to the amount of impact that is attributable to BLM management. This accounts for the following considerations:

(a) Where the percentage of federal minerals is very small (6 percent for BLM-permitted horizontal wells that access federal mineral estate under railroads), these wells would almost certain be drilled regardless of BLM management, so only a small portion of the associated economic activity is truly attributable to BLM management.

(b) Where the percentage of federal minerals is moderate (49.8 percent for non-railroad horizontal wells), the range for these wells could be from a very small percentage of federal minerals to a very high percentage; therefore, whether these wells are truly

attributable to BLM management varies, and an average based on the federal mineral percentage reflects this.

Table 3.5 provides the total number of wells per year under each alternative that are attributable to BLM management based on the data and assumptions described above.

Table 3.5. Annual Wells Attributable to BLM Eastern Colorado RMP Management

Well Type	Alternative A	Alternative B	Alternative C	Alternative D
Oil and Gas Wells Drilled				
Horizontal – Railroad	1.414	1.414	1.414	1.414
Horizontal – Other	9.570	7.131	9.895	8.780
Vertical/Directional	0.784	0.570	0.784	0.713
Total	**11.8**	**9.1**	**12.1**	**10.9**
Oil and Gas Wells Completed				
Horizontal – Railroad	1.357	1.357	1.357	1.357
Horizontal – Other	9.187	6.846	9.499	8.429
Vertical/Directional	0.784	0.570	0.784	0.713
Total	**11.3**	**8.8**	**11.6**	**10.5**

Source: BLM oil and gas development projections (RFD Scenario) and additional analyses and assumptions by BLM petroleum staff.

Based on data from industry, RGFO petroleum staff estimate that the current average cost of a horizontal well in the Denver-Julesburg Basin in 2017 dollars is $5.9 million, with approximately 26 percent for drilling costs and 74 percent for completion costs. BLM petroleum staff estimate that current average cost of a vertical/directional well is $800,000, with approximately 50 percent each for drilling and completion costs. They estimate CBM wells have a current average cost of $300,000 each, with approximately 33 percent for drilling costs and 67 percent for completion costs. However, no CBM wells are projected for the primary oil and gas economic analysis area. Table 3.6 summarizes average development costs per well. The table includes figures for a "composite" or average well, reflecting the relative prevalence of vertical/directional and horizontal wells as noted above (approximately 98 percent of the wells will be horizontal wells.)[8]

Table 3.6. Estimated Oil and Gas Well Development Costs (2017 dollars)

Well Type	Conventional Drilling	Conventional Completion	Conventional Total
Vertical/ Directional Well	$400,000	$400,000	$800,000
Horizontal Well	$1,556,726	$4,343,274	$5,900,000

[8] The cost structure of a composite or average well is weighted by the expected ratio between vertical/directional wells and horizontal wells,

Well Type	Conventional Drilling	Conventional Completion	Conventional Total
Average Well	$1,481,539	$4,079,075	$5,560,613

Source: RGFO Petroleum staff.

The percent of total well costs that were spent within the socioeconomic study area was estimated to be 71.4 percent for vertical/directional well drilling, 74.6 percent for vertical/direction well completion, 59.7 percent for horizontal well drilling, and 90.4 percent for horizontal well completion. The percentages for the vertical/directional well estimates were developed from Authority for Expenditure data for horizontal wells in the economic analysis area and Authority for Expenditure data for vertical/directional wells in the Rock Springs Field Office in Wyoming (due to lack of data for the Eastern Colorado RMP oil and gas economic analysis area). The local expenditures percentage for the average well was calculated as 60.0 percent for drilling and 90.3 percent for completion. Based on the well costs in Table 3.6 and the percentages of local expenditures as described above, the direct economic impact per average well in the economic analysis area was determined to be $888,253 for drilling and $3,681,597 for completion.

The direct economic impact (i.e., local spending) per average well was parsed into various industrial sectors of the IMPLAN model based on breakdowns of the different types of costs for drilling and completion (each addressed separately) taken from various sources – mainly Authority for Expenditures provided by industry. The expenditure data were disaggregated across the following 18 IMPLAN sectors. Following standard regional economic analysis practices, expenditures in the wholesale and retail trade sectors were "margined" (reduced to account for the cost of goods from outside the study area) by the IMPLAN model.[9]

Number	Sector Name
37	Drilling Oil and Gas Wells
38	Support Activities for Oil and Gas Operations
51	Water, Sewage, and Other Systems
56	Construction of New Highways & Streets
57	Commercial Structures
64	Maintenance and Repair of Highways, Streets, Bridges, and Tunnels
395	Wholesale Trade (margin of 17.3 percent)
400	Retail – Food and Beverage Stores (margin of 27.7 percent)
411	Truck Transportation
445	Commercial & Industrial Machinery & Equipment Rental and Leasing
447	Legal Services
449	Architectural, Engineering, and Related Services
465	Business Support Services

[9] Margin represents sales receipts less the cost of the goods sold.

469	Landscape and Horticultural Services
471	Waste Management and Remediation Services
520	Other Federal Government Enterprises
HH	Households (for Right of Way Payments)
LI	Contract Labor

The IMPLAN analysis as described above provided estimates of direct, indirect, and induced output, employment, and labor earnings per average well. Once these economic impacts per average well were estimated for drilling and for completion, those figures were multiplied by the total number of wells drilled or completed each year under each alternative (Table 3.5) to derive the total annual impacts.

3.3.5. Production Impacts

The 2018 Addendum to the RFD scenario for oil and gas (Richter, Annable, and Pike 2018) provided the annual volumes of oil and gas production in each alternative. According to BLM petroleum staff, key components of the volume projections included the following:

- Decline curves for several Weld County Wells were generated using PowerTools and an "average" decline curve was generated.
- The average decline curve was used to predict yearly production of BLM wells over the 20-year planning period.
- Production from vertical and directional wells was ignored, as they account for 2 percent of total wells, and production from these wells is minor when compared with horizontal wells.
- It was assumed that an equal number of wells was drilled per year over the 20-year planning period.
- As in the economic analysis for oil and gas development, values were adjusted by the estimated percentage of federal minerals for railroad and non-railroad wells, in order to focus the analysis on only the production directly attributable to BLM management of federal mineral estate.

Each year of the planning period represents a new cohort of wells to which the average decline curve was applied. The production from each cohort of wells for all wells in production in a given year was then summed to yield the total production volume for that year. These calculations were carried out for oil volumes and for gas volumes. Total production volumes were estimated to increase in every year of the planning period because new wells come into production every year. Table 3.7 presents the calculated total oil and gas production volumes by alternative for the first, middle, and final years of the planning period.

Table 3.7. Total Oil and Gas Production by Alternative for Representative Years

Indicator	Alternative A	Alternative B	Alternative C	Alternative D
Annual Activity – 2018*				
Crude Oil Produced (mmbl)	0.739	0.575	0.760	0.686
Natural Gas Produced (mmcf)	1,812	1,408	1,862	1,681
Annual Activity – 2027*				
Crude Oil Produced (mmbl)	1.956	1.520	2.011	1.815
Natural Gas Produced (mmcf)	5,398	4,195	5,550	5,008
Annual Activity – 2037*				
Crude Oil Produced (mmbl)	2.343	1.821	2.409	2.174
Natural Gas Produced (mmcf)	6,494	5,047	6,677	6,025

Source: BLM oil and gas development projections (RFD Scenario) and additional analyses and assumptions by BLM petroleum staff.

*Reflects conventional wells in the primary oil and gas economic analysis area. Only reflects the activity attributable to BLM management, based on the estimated average percentage of federal mineral rights for future leases and wells under the Eastern Colorado RMP.

mmbl million barrels (of oil)
mmcf million cubic feet (of natural gas)

The production volume data were then multiplied by price estimates to estimate the total annual sales value for oil and gas production for each year. The market prices for oil and gas were based on U.S. Energy Information Administration 2018-2037 oil and gas price projections for the Dakotas/Rocky Mountain Region, using the average of the price projections for the 20-year period, expressed in 2017 dollars. These revenue streams were then entered into the IMPLAN model, Sector 20, Extraction of Natural Gas & Crude Petroleum, to estimate the total economic impacts from production.

Production of oil and gas from federal mineral estate generates revenues for local, state, and federal government. Federal mineral royalties from oil and gas production were based on the standard rate of 12.5 percent, with 48 percent of federal mineral royalties returned to the state. All other revenues were based on data in a 2014 Leeds School of Business report on the Colorado Oil and Gas Industry (Wobbekind and Lewandoski 2015). These data take into account the tax rates and various exemptions allowed by laws and regulations, with statewide rates averaging as follows: property taxes, 2.8 percent; severance taxes, 2.1 percent; Colorado Oil and Gas Conservation Commission levies, 0.1 percent. These rates were applied to the projected production sales values, with the assumption that the Colorado tax structure will remain constant over the analysis period, to produce the estimates of government revenues under each alternative. Table 3.8 summarizes the prices and revenue rate estimates used in the analysis.

Table 3.8. Prices and Tax Revenue Estimates for Oil and Gas Production

Indicator	Oil ($/BBL)	Gas ($/MCF)
Market Price[1]	$78.45	$3.63
Ad Valorem Tax[2]	$2.20	$0.102
Severance Tax[2]	$1.65	$0.076
Colorado Oil and Gas Conservation Commission	$0.08	$0.004
Federal Mineral Royalties, Federal Share	$5.10	$0.236
Federal Mineral Royalties, Colorado Share[3]	$4.71	$0.218

[1]Average U.S. Energy Information Administration Dakota/Rocky Mountain Region 2018-2037 forecast (adjusted to 2017$).
[2]Leeds School of Business 2014 Report adjusted to market prices.
[3]Assumes Colorado's share is 6 percent of market value.

BBL Barrel
MCF Million Cubic Feet

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