

2.0 Methodology

To the extent possible, identification parameters (e.g., proponent/project name and/or location) and impact-causing parameters were identified for each of the past and present and RFD actions identified in this report. These parameters include factors that are common to all resources and resource-specific factors, as discussed below. This information was used to describe the past and present actions and RFD scenarios analyzed in this study and is summarized in the tables in **Appendices A** through **C**. These summaries have been revised for the Phase II effort and formatted to facilitate the development of Task 1 (current conditions) and Task 3 (impact analyses) information, which will be used for future land use planning efforts and for the cumulative impact sections of future coal mine LBA EISs in compliance with NEPA.

The existing disturbance acreages were based on the Phase II data spreadsheets compiled for this Task 2 report and, where resource-specific data were required, the associated Geographical Information System (GIS) data. Existing disturbance acreages generated through GIS vary from the disturbance acreages in the Task 2 data spreadsheets due to the following variables.

- The information in the data spreadsheets was compiled based on information obtained from the data sources and the applied assumptions identified in this Task 2 report. As a result, the data spreadsheets specify a discrete disturbance acreage for each of the development activities (e.g., coal mines, individual oil and gas wells, etc.) identified for the study. Conversely, the GIS analysis accounted for the spatial relationship of the various development activities, thereby avoiding double counting of disturbance acreages where mapped disturbance areas overlap.
- Slight variations between the GIS study area boundary and GIS resource-specific layers may result in some under-counting of disturbance acreages.

The existing disturbance acreages presented in the summary tables in **Appendices A** and **C** were generated using the Task 2 data spreadsheets; those presented in **Appendix B** were generated through GIS. Where disturbance acreages are presented elsewhere in this study, the appropriate source is noted.

Future disturbance and reclamation acreages for the RFD scenarios in this study were based on the data spreadsheets compiled for this report with the following variables and uncertainties of using GIS analysis for defining this information. The methodology and assumptions in **Appendix D** relative to oil and gas development provide a means of identifying the number of new wells to be developed and the number of wells to be plugged and abandoned (P&A) within each of the subwatersheds for the target years of this study (i.e., 2020 and 2030). However, discrete locations for new and P&A well sites for these future time periods are not available. For coal mines, the methodology and assumptions presented in Section 3.2 provide for calculation of future disturbance and reclamation acreages. However, although the general area of potential future coal mine-related disturbance can be identified based on projected reserves, the actual disturbance footprint associated with future mining and the actual locations of future reclaimed areas for the target years are not known. As a result, based on existing information, the spatial relationship between projected future disturbance and reclamation areas and the resource-specific information in the GIS layers for these industries cannot be determined. Conversely, the data spreadsheet information does provide for quantification of future disturbance and reclamation acreages on a subwatershed basis and, with other information (e.g., projected locations of future coal reserves), a means of qualitatively analyzing future resource-specific impacts for those resources that are site-specific (e.g., vegetation, soils, wildlife habitat). The disturbance acreages for the RFD scenarios (based on the Task 2 data spreadsheets) are presented in the tables in **Appendices A** and **C**.

2.1 Factors Common to All Resources

Proponent/Project Name. The proponent or operator and associated project name have been identified for tracking purposes in the data spreadsheets for all past, present, and RFD actions with the exception of oil and natural gas (conventional and CBNG) projects and facilities; the latter typically are geographically dispersed and, therefore, are more appropriately tracked on a general location basis.

Location. Based on the inclusion of project-specific locations in the data spreadsheets, and the structuring of the data spreadsheets using 4th level sub-basins (referred to as subwatersheds in this study for consistency with the Phase I reports) as a common denominator, the impact-causing parameters within specified areas have been summarized to facilitate cumulative impact evaluations. Mapped locations of the past, present, and RFD projects analyzed in this study are presented in Chapter 3.0 in association with the industry-specific discussions.

Timeframe. Past and present actions have been summarized based on base year 2008 data; parameters for RFD scenarios have been established for 2020 and 2030 based on available information through mid 2010.

Land Ownership. Surface ownership in the Wyoming PRB study area primarily is private, with federal and state lands comprising approximately 14 and 8 percent of the area, respectively (see **Figure 1-3**). In the Montana PRB study area, the majority of the land is privately owned, with federal and state lands comprising approximately 25 and 5 percent, respectively.

Acreage. Mining activity has been projected forward in 5-year increments based on available reserves and high and low projected production levels to facilitate a more accurate estimate of future coal mine disturbance and reclamation for 2020 and 2030. The projected mining activity was combined with industry input from the PRB coal producers, and public historical and permitted reclamation activity data, to forecast future disturbance and reclamation acreages.

Future disturbance and reclamation acreages related to coal railroad transportation infrastructure and coal technology projects were estimated from numerous information sources as listed in Sections 3.5 and 3.6, respectively.

Acreages for other past, present, and RFD actions were obtained from permit applications, EISs or EAs, or estimated based on typical facility sizes.

Schedule. The estimated schedule for the construction, operation, and closure/reclamation of proposed coal mines, non-coal mines, coal technology projects, and coal railroad transportation infrastructure was derived from public information on record with the Wyoming Department of Environmental Quality (WDEQ) and Montana Department of Environmental Quality (MDEQ), industry input (including information contained on corporate and agency websites) regarding mine-specific reserve sequencing projections, and press releases and other published articles. Given the projected high and low production rates, there are adequate economic reserves to sustain all proposed coal mining activity through the year 2030.

Schedules for other past, present, and RFD actions have been based on industry input, permitting documents, and assumptions related to trends for related industries (e.g., coal production forecasts in relation to rail capacity).

Production Estimate. Analysis of historic PRB coal production levels, and current reports forecasting future PRB coal market activity from sources including IHS Global Insight, U.S. Energy Information Administration, Wood McKenzie, and International Energy Agency, were combined with input from the PRB coal mine operators and regulatory agency input from specialists within the Wyoming and Montana BLM, WDEQ, and MDEQ to project the upper and lower total coal production scenarios for the

PRB. Individual mine production then was allocated based on historic market share performance, current air quality permit limitations, proposed expansion applications on file with the WDEQ and MDEQ Air Quality Divisions (AQDs), coal rail loadout capacities, and coal mine operator input.

Capital Investment. Capital investment information relative to RFD actions is presented in the text portion of this report, as available. Capital investment related to coal mine development was estimated based on requirements for site-specific mine infrastructure (e.g., rail loop and loadout facilities, major mobile equipment purchases, and highway relocations within permitted mine boundaries). Estimated costs are based on historic costs for similar facilities and equipment.

Likelihood. Following identification of the RFDs through year 2030 for the study area, each capital project was assigned a rating for the likelihood of development or occurrence. Both private and public sector activities have been considered. Likelihood ratings were assigned to the identified actions based on the numerical rating system presented below. The numerical rating for each action is identified in the Chapter 3.0 discussion, with the exception of oil and gas activities. Oil and gas activities differ from individual capital projects due to the dispersed nature of the facilities; therefore, the projection of these activities reflects their likelihood and timeframe.

- Certain/highly likely (1) – Inclusive of actions that have been fully funded, permitted, are under construction, or are necessitated to achieve expanded coal output. These actions have an identified proponent/sponsor, project location, and specific details regarding capacity, output, and/or costs.
- Moderately likely (2) – Inclusive of actions for which applications have been submitted to an agency, that are part of a defined capital improvement plan/program, involve an established technology or process, have an identified proponent/sponsor with a demonstrated track record in undertaking/completing similar or related projects, or for which an EIS or EA is in preparation.
- Low likelihood (3) – Inclusive of actions that are undergoing market or feasibility analyses, previously were proposed but failed to proceed and are now under reconsideration, or for which some descriptive information is available but for which no formal regulatory or administrative approval processes have been initiated.
- Speculative (4) – Projects for which insufficient information is available for analysis purposes, or to determine the likelihood of the project moving forward, have been assigned a likelihood of speculative. These actions are identified in text with an explanation for their elimination from consideration.

Included in this Task 2 report is information on potential future development for which specific projects have not been identified but for which the potential for development or expansion of a specific industry (e.g., carbon sequestration) has been identified. This potential for development or expansion was based on increased activity in an industry sector or new technologies, and the resources in the PRB conducive to their future development.

2.2 Resource-specific Factors

Air Emissions Estimates. Information relative to current conditions will be based on air emissions inventories obtained from a variety of sources as detailed in the Air Quality Assessment Protocol for this study (AECOM 2010a). Air emissions for RFDs will be based on average operations in base year 2008, as well as air emissions estimates published in air permits or EISs. For each group of sources, an average emissions profile will be developed for modeling purposes, based on production and design data. Air emissions data will be summarized in technical support documents prepared in support of the Task 1A and 3A reports.

Water Production/Disposal. During Phase I of the study, coal mine-related groundwater production data were obtained from individual mine operators and data as reported to the Wyoming State Engineer's

Office for permitted wells through 2002. Based on the ongoing groundwater pumpage associated with CBNG development in the eastern Wyoming PRB study area in advance of coal mine development, it is assumed that the Phase I coal mine-related groundwater production data provide a conservative estimate of ongoing coal mine-related groundwater production. Therefore, the data have been carried forward for use in Phase II. This data and the assumptions presented in Section 3.2 of this report were used to determine the future coal mine-related groundwater pumping rates.

Current water production and disposal volumes associated with conventional oil and gas and CBNG development have been based on data in the IHS Global Insight™ (HIS) (2010) and Wyoming Oil and Gas Conservation Commission databases, as well as discharge data provided by the WDEQ – Water Quality Division (WQD). Future CBNG water production and discharge was estimated by the BLM (2010b), based on actual permitted pumping rates and the scaling down of pumping rates over the 9-year life cycle of a pod of wells.

Water Consumption. Dust suppression practices at active coal mines are the single largest factor in water consumption, accounting for an estimated 85 percent of the total water used. Wyoming mine operators are required to submit an annual fugitive emissions control report to the WDEQ/AQD that summarizes the annual gallons of water consumed, dust suppression additives, and application techniques used to control dust emissions. For coal mines in the Wyoming PRB, the past several years of reports (which reflect water consumption levels in recent drought years) were reviewed and analyzed, and future water consumption was projected forward based on current practices and forecasted production levels. As a result, the projections for water consumption reflect potential higher use rates in the event dry conditions persist. Water consumption projections for Montana mines were based on the information for Wyoming mines and adjusted for annual production and mining method.

Current and future non-coal mine, coal technology projects, and coal railroad transportation-related water consumption is expected to be minimal. Power plant-related water consumption was estimated based on recent analyses at other facilities.

Workforce. Current and future PRB coal mine-related Wyoming employment was estimated by reviewing the past annual reports of the Wyoming State Mine Inspector and U.S. Mine Safety and Health Administration (MSHA) records, correlating productivity gains to changes in mine production, and forecasting total employment forward as a function of mine productivity and production. Montana employment information was based on information for Wyoming mines and adjusted for annual production and mining method.

Current and future non-coal mine employment is expected to increase only moderately above current levels and was estimated from existing data on file with the WDEQ and MDEQ, as available, or based on similar existing operations, as applicable.

Due to the lack of existing commercial-scale coal beneficiation facilities, current and future coal technology employment is based on information from company press releases, securities filings, and information relative to proposed projects, as available. These estimates are of necessity “order of magnitude” and subject to revision as any future projects move forward into the environmental permitting process.

Current and future Wyoming workforce requirements for the oil and gas industry are a function of the pace of drilling, number of producing wells, anticipated production life of the wells, and future reclamation activities. Employment assumptions for modeling of social and economic impacts are discussed in the Task 3C report.

Current and future Wyoming workforce requirements for power plants in the PRB are based on information obtained from the operators, project application filings, local economic development organizations, the Wyoming Department of Employment, and the WDEQ/Industrial Siting Division.

2.3 Assumptions

Industry-specific assumptions were developed to provide a basis for quantification of impact-causing parameters where actual data, or the basis for projected data, were lacking. The assumptions were developed, as needed, for past and present development and RFD activities as summarized at the end of each industry-specific section in Chapter 3.0. These assumptions were based on typical industry-specific standards, permit criteria for similar existing industries, and professional judgment.