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

Principles and Practices
of Integrating Science into Land Management

CASE STUDIES

The case studies in this series showcase examples of integrating science into Bureau of Land Management (BLM) decisions and activities. They highlight how science has helped the bureau successfully manage diverse programs across many geographical areas. These examples are not intended as programmatic guidance or policy direction; the application of science will be unique to each circumstance. Rather, they reflect the critical thinking and systematic, transparent process advocated by the BLM's "Principles and Practices of Integrating Science into Land Management: Guidelines." By using that document's recommended Checklist of actions, they demonstrate key principles and practices of effective science integration at work in a variety of fields and resource areas. Individual case studies differ in how they satisfy Checklist objectives, illustrating that the Checklist is intended to be a flexible tool—one that can be customized to meet the unique aspects and needs of different projects. Comprehensive details about individual studies (including related articles and publications) can be found on the BLM's Science in Practice Portal, through the BLM Library and the Alaska Resources Library & Information Services, and through links in these documents.

CHECKLIST

☐ **1. DEFINE THE MANAGEMENT QUESTION(S)**, including related management objectives. All interested parties must clearly understand the management issue(s) if the five guiding principles and practices are to be successfully applied.

☐ **2. FIND** available science relevant to the management question(s). Be systematic, rigorous, and objective, and use a method that is easy for others to follow and that is well-documented.

☐ **3. EVALUATE** the potential relevance and reliability of the science identified in Step 2.

☐ **4. SUMMARIZE** the science, address any conflicting science, and identify any information gaps.

☐ **5. APPLY** your science-based conclusions to the management question(s) to decide the best course of action for achieving management objectives.

☐ **6. ASSESS** how the application of science affected public support, the sustainability and effectiveness of the decision, confidence in the course of action selected, and further learning about the system and the effects of management actions. Plan any future assessments and/or develop and implement a monitoring plan.

Snapshot of Checklist actions from "Principles and Practices of Integrating Science into Land Management: Guidelines." The numbered actions in the case study below track with this list and show how the BLM implemented the principles and practices for integrating science into the BLM's work. Please refer to the full document for details.

CASE STUDY 6: Assessing Environmental Impacts at a Proposed Phosphate Mine in Southeastern Idaho

1. DEFINE THE MANAGEMENT QUESTION(S).
Federal phosphate leases give lease owners the right to develop the phosphate resource in a manner that ensures maximum resource recovery and minimum environmental impacts, in accordance with applicable laws and regulations. The BLM must evaluate applications to mine the leases based on the provisions of the Mineral Leasing Act of 1920, the Federal Land Policy and Management Act, and the National Environmental Policy Act (NEPA).


Rasmussen Valley Mine Project Area, showing linear aspen stands typical of a southwestern Idaho phosphate geologic outcrop.

In 2011 BLM Idaho's Pocatello Field Office received a Mine and Reclamation Plan (M&RP) application to mine a federal lease. The BLM determined that an Environmental Impact Statement (EIS) was required before an informed decision could be made about the method to develop the lease and alternative mining approaches. To ensure NEPA compliance and sound decisionmaking, the BLM needed a comprehensive answer to the management question:

- *What are the potential environmental consequences of the proposed mine?*


The BLM drills a groundwater monitoring well.

2. FIND.

To ensure an effects analysis that would lead to a well-informed decision, the team identified the environmental standards, resource management goals, and action levels relevant to each type of resource (e.g., water, vegetation, wildlife, visual, and cultural) in the area. Relevant data were compiled from state statutes, federal regulations and policies, resource management plans, and public input. Next, the team reviewed data about each resource to determine if impacts could be expected from the proposed activities. Since phosphate mines in southeastern Idaho are common, the team possessed considerable understanding of the resources that might be affected and the primary concerns: potential impacts to water quality, wetlands, wildlife, and socioeconomic conditions in the surrounding area. For example, the expected percolation of water through mine waste could leach chemicals of concern into groundwater and surface water at concentrations exceeding allowable regulatory standards. The same leached chemicals could also accumulate in vegetation, harming foraging wildlife and grazing livestock. Wildlife and wildlife habitat were major issues because a portion of the mine is located on a state Wildlife Management Area. In addition, past mining in the area had already impacted more than 16,000 acres of wildlife habitat. Socioeconomic impacts were a concern because the mining industry is one of the primary economic drivers in Caribou County, and the mine and associated fertilizer plant directly employs more than 500 people.


Testing for mine waste leachability.

Available studies and documents containing information about the resources of concern in the study area were collected and reviewed. The team then identified important gaps in the available data, and there was relatively little site-specific natural resource information available. To fill the data gap, baseline data were collected at the site, including data about existing vegetation and wildlife species, groundwater, and surface water; cultural resources; and the leachability of chemicals of concern. The team obtained socioeconomic information from public

Team members sample a groundwater well.

data sources and from an industry study of the impacts of phosphate mining on the economy of southeastern Idaho. As baseline information was received, it was assessed and validated to ensure it was suitable and sufficient for the effects analysis.

Lab leach tests were performed that identified the leaching rate of the mine waste rock for use in subsequent water quality modeling. Model results included maps showing the location and concentration of chemicals of concern in groundwater at various times during and after mining for both the originally proposed mining plan and for alternative designs that included more protective geologic or synthetic reclamation covers over backfill and other waste rock storage areas to minimize deep percolation through mine waste.

The team used a Habitat Equivalency Analysis (HEA) model to quantify wildlife services likely to be lost during mining and then regained through reclamation. The proposed mine and associated infrastructure were calculated as removing more than 500 acres of existing habitat consisting of sagebrush, high rangeland, and aspen groves for 7 years, and subsequently reclaiming it with grasses, forbs, and some shrubs. The HEA model predicted that reclamation and revegetation would take decades to mature, and would never reach the level of wildlife habitat services that would exist if no mining occurred.

3. EVALUATE.

Baseline data were compared to the resource conditions predicted both during and after mining activity and reclamation. The water modeling analysis indicated potential for increased amounts of chemicals of concern entering groundwater and surface waters in the project area. The team used maps showing predicted contaminant concentrations to identify potential impacts to groundwater and connected surface waters and to evaluate best management practices (BMPs) that were practical to implement and that would effectively protect groundwater quality and beneficial uses. The team compared the predicted water quality impacts to regulatory, statutory, and resource management plan goals, action levels, and standards to determine if mitigation would be required.

Using the HEA, the team evaluated potential impacts of altered wildlife habitat. The team also evaluated the potential for the chemicals released from mine waste rock to accumulate in plants at concentrations that would be harmful to wildlife and livestock. Modeling and empirical data from other phosphate mines were used to predict the performance of the waste rock cover design. The evaluation determined that the cover selected by the BLM would be thick enough to minimize root penetration into the mine waste, thus limiting the plant uptake to acceptable levels that would not harm wildlife or livestock.

4. SUMMARIZE.

To approve the alternative M&RP that included more protective BMPs, BLM managers needed to be confident that the proposed alternative minimized impacts to the environment and met applicable laws, regulations, statutes, resource management plans, policies, and guidelines. Gaps in the information required to assess potential impacts were filled, to the extent practical, by performing field and lab studies. Of greatest concern were methods for assessing the flow of groundwater, areas where groundwater connects with surface waters, and the release of chemicals of concern from the mine waste that could negatively affect groundwater, surface waters, aquatic habitats, fisheries, and beneficial uses. Where uncertainty existed, the team used conservative inputs in its analyses to provide more protective results for selection of appropriate BMPs.

Water quality modeling results, from the effects analysis in the EIS, were used by the state agency regulating water quality to determine the location for groundwater monitoring wells that would ensure compliance and protect the beneficial uses of groundwater in the project area. The EIS described the methods, inputs, and assumptions used to predict the concentrations of chemicals of concern in groundwater. Maps were prepared showing the groundwater concentration plumes exceeding the applicable groundwater quality standards to help management, responsible agencies, and the public understand the intensity and extent of impacts and how compliance would be met.

The results of the HEA were used to estimate the cost of funding a nonprofit conservation organization to perform wildlife habitat improvement projects.

5. APPLY.

The team used high-quality information and robust analyses based on both quantitative and qualitative information to evaluate potential impacts of this proposed phosphate mine. Whenever relevant scientific literature or collected data were available, the team assessed potential impacts quantitatively and used tables and graphics to present results to BLM managers, the applicant, participating agencies, and the public. When quantitative data were unavailable, the team used qualitative information to compare alternatives. The transparency of the NEPA EIS process helped ensure that appropriate scientific principles and practices were used and applied.

For this southeastern Idaho phosphate mine, decisions on mine waste cover design, wetland avoidance, and wildlife habitat restoration were of prime importance. HEA results using various cover designs (e.g., geosynthetic and different onsite earthen materials) allowed management to select a design that reduced chemical leaching and that was economically viable. HEA conclusions, along with the estimated costs of conducting offsite habitat mitigation, were considered in calculating and establishing a trust fund with an appropriate amount to fund offsite wildlife habitat mitigation to offset residual impacts.

6. ASSESS.

Decisions regarding the sustainability of permitted uses under the BLM's multiple-use mandate are often confounded by a lack of information, which can lead to uncertainty and undermine the strength of these decisions. The team sought to minimize such uncertainties by developing and implementing a systematic, transparent, and repeatable process for collecting, analyzing, and interpreting baseline data and predicted impacts. The process greatly enhanced the team's ability to make efficient and well-informed decisions that were founded in science and that were both understood and supported by management, resource staff, and participating agencies. Using available information and newly collected data, the team was able to identify areas predicted to not meet standards and to evaluate alternatives to ensure project compliance with laws, regulations, statutes, Resource Management Plans, policies, and guidelines. A balanced, informed decision was reached in which proposed mining activities were adjusted to achieve compliance while maintaining economic feasibility. To ensure compliance with environmental requirements, a comprehensive monitoring plan was developed that allows for adaptive management and actions as necessary.

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Photos by BLM staff unless otherwise noted.

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