Phoonswadi-Brewer, Sean

From: NPL_AR
Subject: FW: NPL scoping comments again
Attachments: FINAL scoping Comments 5-11-11.doc; AFWA mitigation guidelines rev 4 (2).docx

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Linda Baker <linda@uppergreen.org>
05/13/2011 01:12 PM

To: NPL_EIS_WY@blm.gov
cc:
Subject: NPL scoping comments again

Kellie:

Please accept these comments from the UGRA re: the NPL scoping period.

thanks,
Linda

--
Linda F. Baker
Executive Director
Upper Green River Alliance
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(See attached file: FINAL scoping Comments 5-11-11.doc)(See attached file: AFWA mitigation guidelines rev 4 (2).docx)

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Kellie Roadifer
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1625 W. Pine St.
P.O. Box 768
Pinedale, WY 82941

May 12, 2011

Re: Scoping comments for Proposed Normally Pressured Lance Project

Dear Kellie:

Thank you for the opportunity to comment on the proposed Normally Pressured Lance project. Please accept these comments from the Upper Green River Alliance on Encana's proposal to drill approximately 3,500 natural gas wells within the 141,080 acre Normally Pressured Lance (NPL) natural gas field in Sublette County over a 10-year period.

Greater Sage-Grouse

Utilize Best Available Science
We request that BLM utilize the latest and most informed sage-grouse scientic data and study results from projects conducted in the Upper Green River Basin to carry out appropropriate and responsible sage-grouse management.

Best available science indicates that, "yearling males tended to avoid leks highly immersed into developing gas fields."[1] This study was conducted by Rusty Kaiser, now a BLM biologist in the Pinedale BLM Field Office. BLM has the in-house expertise to fully inform responsible sage-grouse management which it should not hesitate to call upon.

[1] Kaiser, Rusty C., Recruitment by greater sage-grouse in association with natural gas development in western Wyoming, M.S., Department of Zoology and Physiology, University of Wyoming, Laramie, Wyoming. August, 2006.

"Hens captured on the disturbed leks demonstrated lower nest initiation rates, traveled twice as far to nest sites, and selected higher total shrub canopy cover and live sagebrush canopy cover than hens captured off of undisturbed leks."[2]

"Greater sage-grouse in western Wyoming appeared to be excluded from attending leks situated within or near the development boundaries of natural gas fields. Declines in the number of displaying males were positively correlated with decreased distance from leks to gas-field-related sources of disturbance, increased levels of development surrounding leks, increased traffic volumes within 3 km of leks, and increased potential for greater noise intensity at leks. Displacement of adult males and low recruitment of juvenile males contributed to declines in the number of breeding males on impacted leks. Additionally, responses of predatory species to development of gas fields could be responsible for decreased male survival on leks situated near the edges of developing fields and could extend the range-of-influence of gas fields. Generally, nesting females avoided areas with high densities of producing wells, and brooding females avoided producing wells. This suggests that the long-term response of nesting populations is avoidance of natural gas development."[3]

Scientific studies noted above indicate that development at a density of no more than one well per section throughout the NPL field is the only way to prevent local extirpation of sage-grouse, as apparently has happened in the Jonah Field.

We therefore request that BLM require no more than one well per section, not only in Core Sage-Grouse Areas, but throughout the NPL field to help prevent listing under the Endangered Species Act.

This is important to retain landscape-scale use by sage-grouse, by preserving connectivity between all areas that sage-grouse require for population maintenance and enhancement. We also request that BLM consider how the NPL area could be planned to retain ecosystem connectivity for all sagebrush-dependent species.

Wintering Areas

We request that sage-grouse winter areas be assessed and mapped, and that these areas be avoided by field development and infrastructure to prevent important sagebrush habitats from being fragmented, especially since it appears that wintering sage-grouse have likely been pushed out of the Jonah Field to the Mesa area of the Pinedale Anticline field. Together with impacts

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[2] Lyon, Alison. G., Potential effects of natural gas development on sage grouse near Pinedale, Wyoming. M.S., Department of Zoology and Physiology, May, 2000.

[3] Holloran, Matthew J., Greater Sage-Grouse (*Centrocercus urophasianus*) Population Response to Natural Gas Field Development in Western Wyoming. PhD, Department of Zoology and Physiology, December, 2005.

from the LaBarge infill, the NPL area of the Little Colorado Desert may be one of the last winter strongholds for grouse in the Upper Green.

Leks

We request that within the entire NPL area, leks be afforded a three-mile NSO buffer that also extends to leks that are within three miles of the NPL boundary.

Seasonal Stipulations

We request that within the entire NPL area seasonal stipulations be applied for nesting sage-grouse, and that waivers of seasonal stipulations be denied.

Noise

We request that a true baseline for noise in the NPL area be monitored and a limit be established by BLM throughout the NPL field, as it applies to all sage-grouse annual life cycles. Current noise standards for humans are inappropriately applied to sage-grouse, and there has not been a true noise baseline established using on-the-ground monitoring anywhere in the Upper Green River Basin.

We request that noise impacts to sage-grouse be thoroughly examined, and the effects of noise from energy exploration and development on the breeding biology of the greater sage-grouse be established. We understand that Gail L. Patricelli, Assistant Professor, at the University of California, Davis has begun this work, but results have not been established nor published.

Conservation Assessment

According to the range-wide Conservation Assessment of Greater Sage-Grouse and Sagebrush Habitats (Connelly et al. 2004), sage-grouse have declined across their range during the past 50 years, as has the quality and distribution of the bird's requisite sagebrush-steppe habitat.

Since it appears that Encana's operations in the adjacent Jonah Field have resulted in the local extirpation of sage-grouse there, and because the U.S. Fish & Wildlife Service will decide whether to list the greater sage-grouse as an Endangered Species in the next few years, a habitat conservation assessment should be conducted, and the results made publicly available.

Following a habitat conservation assessment, general area maps showing important sage-grouse habitats, population monitoring, and trends should be published at the BLM website to keep the public informed. Habitat mapping will help area wildlife managers make more informed decisions on which habitats should be avoided and/or where additional stipulations may be applied.

<u>Pronghorn</u>

The NPL project area contains an important migratory area for pronghorn that travel through the Greater Green River Basin as far north as Grand Teton National Park in the longest terrestrial migratory pathway in the Western Hemisphere outside of Alaska. We request that this pathway be avoided by developmental infrastructure of all kinds, including powerlines, pipelines, compressor stations, produced water facilities, etc.

Elk

We request that BLM conduct an inventory and habitat assessment of the desert elk herd in the NPL area, and make this information publicly available. We ask that BLM require avoidance of important areas where elk winter in the NPL, to prevent habitat fragmentation and avoidance.

Eagles, Raptors & Songbirds

We request that BLM require pitless development at all well sites to prevent bird mortality.

We also request that BLM require complete adherence to the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act, without granting exceptions. We request that BLM work with USFWS to enforce NPL and area-wide prevention of disturbance to foraging areas, to preserve these important sites for eagle sustainability during all annual cycles, not just during nesting season.

The Bald and Golden Eagle Protection Act provides criminal penalties for persons who "take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle ... [or any golden eagle], alive or dead, or any part, nest, or egg thereof." The Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb."

For purposes of these guidelines, "disturb" means: “to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

In addition to immediate impacts, this definition also covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle's return, such alterations agitate or bother an eagle to a degree that interferes with or interrupts normal breeding, feeding, or sheltering habits, and causes injury, death or nest abandonment.

Compensatory Mitigation

To the greatest extent possible, we urge the BLM to abide by the CEQ mitigation hierarchy for all wildlife species that are likely to be impacted by NPL development, which includes 1) avoiding crucial wildlife habitats, 2) minimizing operational impacts and 3) mitigating the remaining impacts from oil and gas development.

We request that BLM implement a 4-step process to assess compensatory mitigation acreage, which includes: 1) discuss operator's objectives for the wildlife mitigation plan, identify crucial wildlife habitats, and delineate the area of operations, 2) analyze spatial data using Geographical Information Systems (GIS) to calculate direct and indirect impact compensatory mitigation acreage, 3) negotiate with the operator to reduce the impacts through avoidance and minimization measures (BMPs), and 4) resolve remaining mitigation needs through negotiations with the operator on mutually agreeable compensatory mitigation projects.

Please refer to the attached draft document entitled, "Compensatory Mitigation Guidelines" from the Association of Fish and Wildlife Agencies for more detailed information. We request that BLM read and utilize these recommendations from experienced, professional biologists.

Air Quality Mitigation

Gathering Systems

We request that BLM require routing produced water, oil and gas directly from wells and/or separation equipment into underground central gathering systems to eliminate air pollution from production equipment and from heavy trucks and general traffic.

Field Electrification

We request that BLM consider requiring underground electrification of the NPL field, to the extent that it does not directly or indirectly impact sage-grouse leks, wintering and nesting areas. Underground electrification will eliminate pollution emission sources:

1) Process controllers (liquid level controllers, pressure controllers and temperature controllers) may be electrically operated rather than pneumatically operated with natural gas, eliminating volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions vented from natural gas-operated devices.
2) Pneumatic pumps normally operated with natural gas can be electric or can be operated with compressed air generated by electric air compressors. This would eliminate VOC and HAP emissions vented from natural gas-driven pneumatic pumps.

3) Natural gas vapors containing VOCs and HAPs that are released from oil and produced water storage tanks may be captured using electric vapor recovery units (VRU). The captured gas can fuel production equipment burners or can be compressed and routed into gas collection/sales lines. Not only would VOC and HAP emissions be eliminated, natural gas would be conserved. Also, emissions of nitrogen oxides (NO_X) and carbon monoxide (CO) resulting from the flaring of these “waste streams” would be eliminated.
4) NO_X and CO pollutants in the exhaust of natural gas fired compressor, pumping unit and generator engines would be eliminated when these engines are driven by electric motors.
5) At electrified facilities, electronic remote monitoring can be used to reduce site visits by field operators. For example, tank levels and equipment operating parameters may be monitored by computer. Electronic monitors can detect impending conditions or operating problems that result in pollution emissions to the air, land or water.

Centralized Facilities

We request that BLM require centralized facilities. Centralized facilities will 1) eliminate a number of pollution sources; 2) increase technical feasibility; 3) increase economically feasible emission control devices; and 4) reduce field traffic.

1) There are numerous pollution emission sources at individual wellsite facilities that are associated with production, separation and treatment, storage or sales. Each wellstream must be separated into three streams, oil, water and gas, using traditional production equipment (water knockouts, separators and treaters). Then each stream must be routed into separate storage tanks, into gathering or sales lines, to an emissions control device or vented to the atmosphere. When two wells share equipment the number of emission sources can be cut in half.
2) The most common method for controlling VOC and HAP pollutants associated with tank vapors is to route the waste vapors to a combustion device. The volume and pressure of tank vapors can be low making it difficult to get the vapors to a combustor. Sometimes supplemental gas must be used to energize the waste stream. This is a waste of resources and increases NO_X and CO emissions associated combustion waste streams. Waste stream volumes and pressures are increased when facilities are consolidated, making it easier to get the vapors to a control device and eliminating or reducing the need for supplemental motive gas.
3) The cost to control pollutants must be evaluated on a dollar-per-ton basis when establishing controllable emission thresholds. If the cost to control is too high the DEQ Air Quality Division must deem it economically unfeasible to control certain levels or types of emissions. The cost to control emissions decreases with consolidation.

4) Production sites must be visited on a regular basis by field operators. Also, it is common for produced water and oil to be transported by truck. Consolidation reduces truck traffic.

Pace of Development

We believe that many problems in the Upper Green, including ozone exceedances, wildlife declines and groundwater contamination could have been avoided had a more moderate pace of development been planned and required by BLM. It is within BLM's authority to require this, especially to prevent further threats to human health from high ozone levels and Toxic Air Contaminants.

This not only makes sense to protect and preserve all natural resources that BLM is required under FLPMA to consider during the NEPA process, but also because the U.S. now has more natural gas in reserve than at any previous time in history. There is simply more gas in storage than is needed by consumers. Additionally, the State of Wyoming does not have the pipeline capacity to allow it to receive the higher prices for its gas than other states, and so more gas produced immediately results in fewer royalties to the state in the long-term than waiting for additional, future pipeline capacity. The gas will still be there when prices are higher, and our community's respiratory health will benefit with a slower pace.

We therefore request that BLM limit the number of spuds allowed within a single year to protect human health, wildlife and groundwater.

Groundwater

We request that BLM contract with a third-party hydrologist with no conflict of interest or association with the regulated community to conduct baseline groundwater monitoring on all water wells. We also request that BLM require that an aquifer characterization be conducted. This monitoring data should be analyzed, and a thorough public report be made available at the BLM website that shows groundwater chemical and physical properties. These baseline groundwater properties should be rigorously protected and maintained by BLM and all cooperating agencies to ensure clean water supplies for all future, beneficial uses.

Human Health Issues

We request that BLM conduct a thorough Health Impact Assessment (HIA) during the NPL NEPA process. The World Health Organization has published rationale and common-sense guidelines on why and how to conduct a Health Impact Assessment, which are excerpted below.

World Health Organization

http://www.who.int/hia/about/why/en/index.html

Why use HIA?

HIA is based on four values. These values provide a platform from which the benefits of HIA can be derived, and link HIA to the policy environment in which HIA is being undertaken.

1. **Democracy –** allowing people to participate in the development and implementation of policies, programmes or projects that may impact on their lives.
2. **Equity –** HIA assesses the distribution of impacts from a proposal on the whole population, with a particular reference to how the proposal will affect vulnerable people (in terms of age, gender, ethnic background and socio-economic status).
3. **Sustainable development –** that both short and long term impacts are considered, along with the obvious, and less obvious impacts.
4. **Ethical use of evidence –** the best available quantitative and qualitative evidence must be identified and used in the assessment. A wide variety of evidence should be collected using the best possible methods.

Reasons to use HIA

Promotes cross-sectoral working

The health and wellbeing of people is determined by a wide range of economic, social and environmental influences. Activities in many sectors beyond the health sector influence these determinants of health. HIA is a participatory approach that helps people from multiple sectors to work together. HIA participants consider the impacts of the proposed action on their individual sector, and other sectors – and the potential impact on health from any change. Overlaps with other policy and project initiatives are often identified, providing a more integrated approach to policy making. 'Joined up thinking' and 'cross-sectoral working' are catch phrases of some Governments, and HIA offers one mechanism to promote this way of working.

A participatory approach that values the views of the community

An initial stage within the HIA process is to identify the relevant stakeholders to the HIA. This process usually produces a large number of relevant people, groups and organisations. The HIA can be used as a framework to consult meaningfully with stakeholders, allowing their messages to be heard.

Common stakeholders include:

- The local community/public, particularly vulnerable groups
- Developers
- Planners
- Local/national Government
- Voluntary agencies/NGOs

- Health workers at local, national or international levels
- Employers and unions
- Rrepresentatives of other sectors that are affected by the proposal.
- The commissioner(s) of the HIA
- The decision makers.
- The network of people and organisations who will carry out the HIA.

In particular the HIA provides a way to engage members of the public affected by a particular proposal. HIAs can send a clear signal that an organisation or partnership genuinely wants to involve a community and is willing to respond constructively to their concerns. Because an HIA values many different types of evidence during the assessment of a proposal, the views of the public can sit alongside other evidences such as expert opinion and scientific data, with each presented and valued equally within the HIA. It is important to note that the decision makers may value certain types of evidence more than others, and community expectations must be managed to avoid 'over-promising what an HIA can deliver. An HIA does not make decisions; it provides information in a clear and transparent way for decision makers'.

The best available evidence is provided to decision makers

The purpose of an HIA is to provide decision makers with a set of evidence-based recommendations about the proposal. The decision makers can then make decisions about accepting, rejecting, or amending the proposal secure in the knowledge that they have the best available evidence before them. Evidence used in an HIA can be both qualitative and quantitative, and each is valuable. HIA should consider a range of different types of evidence – going beyond published reviews and research papers, to include the views and opinions of key players who are involved or affected by a proposal. Often, evidence of the quality and quantity demanded by decision makers is not available, this is noted within the HIA and the best available evidence is provided.

Improves health and reduces inequalities

Addressing inequalities and improving health is a goal for many organisations and all Governments. One way of contributing to the health and inequalities agenda is through the use of HIA. At the very least, HIA ensures that proposals do not inadvertently damage health or reinforce inequalities. HIA uses a wider model of health and works across sectors to provide a systematic approach for assessing how the proposal affects a population – but particularly, the distribution of those effects between the different subgroups of the population. Recommendations can specifically target improvement of health, particularly for vulnerable groups.

It is a positive approach

HIA does not only look for negative impacts of developments (to prevent or reduce them), but it also looks for positive health impacts of proposals. This often provides decision-makers with options to strengthen and extend these features of the proposal. Developments offer the opportunity to improve the health of a population, and an HIA is one way to maximise such potential health benefits.

Appropriate for policies, programmes and projects

HIA is suitable for use at many different levels. HIA can be used on projects, programmes (groupings of projects) and policies, though it has most commonly been used on projects. The flexibility of HIA allows these projects, programmes and policies to be assessed at either a local, regional, national or international level – making HIA suitable for almost any proposal. Therefore, choosing when to carry out an HIA is important (see screening).

Timeliness

To influence the decision making process, the HIA recommendations must reach the decision makers well before any decisions about the proposal will be made. This basic principle of HIA highlights the practical nature of the approach. Experienced HIA practitioners can work with most timeframes, undertaking comprehensive (longer) or rapid (shorter) HIAs.

Links with sustainable development and resource management

When HIA is undertaken early in the development process of a proposal it can be used as a key tool for sustainable development. HIA allows the identification and prevention of possible health (and other) impacts right from the start in policy and decision-making. For example, for an HIA on road building, it enables the inclusion of health and other sustainability aspects to be built in from the very beginning, such as cycle lanes, noise and speed reduction interventions, rather than solving the health impacts at a later date. This enables health objectives to be considered on a par with socio-economic and environmental objectives, bringing sustainable development closer. Another feature of HIA is its possible combination with other impact assessment methods. This integration allows proposals to be assessed from a sustainable development perspective including: health; education; employment; business success; safety and security; culture, leisure and recreation; and environment. Drawing on the wider determinants of health, and working across different sectors, HIA has the ability to link well with the sustainability agenda.

Correct map data

The map of the NPL project area available at the BLM website is not accurate, and includes sections that are not presently held by oil and gas leases (see T29 N., R.109 W). We request that this map should be corrected and a new map published at the BLM website.

We look forward to continued discussions regarding future NPL development. Please contact us at the above address with any questions or concerns. Again, thank you for the opportunity to comment on the NPL scoping process.

Sincerely,

/s/
Linda F. Baker
Director

Attachment

COMPENSATORY MITIGATION GUIDELINES

To address oil and gas development impacts on wildlife resources

Prepared by the AFWA Onshore Oil and Gas/Oil Shale Subcommittee
August 2010

Revision 4

Executive Summary

These compensatory mitigation guidelines were prepared with the intent of recognizing and resolving wildlife impacts that result from oil and gas development. These guidelines were developed mostly to address oil and gas impact issues in the western states. The principles and framework contained within this document are applicable to other regions and industrial operations, based on regional research and findings.

This document provides a means for assessing and applying compensatory mitigation in a simplistic, reasonable, and consistent manner. Compensatory mitigation, as detailed in this document, encompasses the width and breadth of potential mitigatory actions including restoration, creation, or other habitat enhancements and draws upon the extensive body of research and literature that describes wildlife impacts from oil and gas activities. This compensatory mitigation guidance is intended to be applied within crucial wildlife habitats.

A hierarchical approach for reducing impacts from disturbance include: 1) avoiding crucial wildlife habitats, 2) minimizing operational impacts and 3) mitigating the remaining impacts from oil and gas development. "Avoidance" is operating outside of biologically sensitive habitats; "minimization" is reducing impacts through application of best management practices (BMPs); and "mitigation" is offsetting the remaining impacts through implementation of exceptional operational practices and/or other compensatory measures. While BMPs can in some instances be construed as mitigation, those occurrences are very unique, and this document provides a basis for assessing compensatory mitigation to offset impacts to wildlife that cannot be avoided or minimized.

This document provides an alternative mechanism to assess compensatory mitigation for the impacts that cannot be avoided or minimized, and draws upon the extensive body of research and literature that describes wildlife impacts from oil and gas activities. A compensatory mitigation metric was developed to evaluate the indirect impacts associated with oil and gas development and to allow the calculation of compensatory mitigation acreage. This metric applies mostly to terrestrial species in crucial wildlife habitat and does not account for the high degree of variability associated with aquatic resources.

A 4-step process to assess compensatory mitigation acreage includes: 1) discuss operator's objectives for the wildlife mitigation plan

, identify crucial wildlife habitats, and delineate the area of operations, 2) analyze spatial data using Geographical Information Systems (GIS) to calculate direct and indirect impact compensatory mitigation acreage, 3) negotiate with the operator to reduce the impacts through avoidance and minimization measures (BMPs), and 4) resolve remaining mitigation needs through negotiations with the operator on mutually agreeable compensatory mitigation projects.

The objective of the compensatory mitigation assessment guidance is to assure that the compensatory mitigation recommendations are effective and commensurate with the species, habitats, and populations impacted, and to create a repeatable process which is based upon scientific literature, the judgment of natural resource professionals, and other resource management agency guidelines.

Compensatory mitigation is most appropriately applied on a landscape scale, as the impacts to wildlife are greater than the footprint of a single oil and gas facility. Compensatory mitigation is most effective when applied within the larger scale context of a Wildlife Mitigation Plan (WMP).

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List of Acronyms

AFWA- Association of Fish and Wildlife Agencies

BMPs- Best Management Practices

CDOW- Colorado Division of Wildlife

EWPC- Energy and Wildlife Policy Committee

GIS- Geographic Information Systems

NSO- No Surface Occupancy

WGFD- Wyoming Game and Fish Department

WMP- Wildlife Mitigation Plan

Introduction

The purpose of this document is to outline a process for states or agencies to develop wildlife compensatory mitigation guidelines related to impacts associated with oil and gas development. Mineral leasing and energy development has increased nationwide as a result of America's demand for energy resources. The nation has experienced a significant increase in oil and gas production and development. Wildlife agencies recognize both the important societal need for, and benefits of, energy development, but also recognize the potential for energy development to have significant impacts to wildlife and their habitat.

Energy and Wildlife Policy Committee Background

The Association of Fish and Wildlife Agencies (AFWA) formed the Energy and Wildlife Policy Committee (EWPC) in 2006. This committee's charge is to address issues associated with energy development and wildlife. The EWPC has four subcommittees and include: 1) Onshore Oil and Gas/Oil Shale, 2) Wind/Transmission, 3) Coal, and 4) Nuclear

The mission of the EWPC is to "work cooperatively with public and private interests to adequately protect fish and wildlife resources and their habitats during energy exploration, development and production."

Onshore Oil and Gas/Oil Shale Subcommittee Background

The Onshore Oil and Gas/Oil Shale Subcommittee's mission is to "work cooperatively with wildlife and land management agencies, industry and other public and private interests to conserve fish and wildlife resources (maintain diverse, abundant, well distributed fish and wildlife populations) and their habitats impacted by onshore oil and gas/oil shale exploration, development and production."

Some of the major undertakings of the Onshore Oil and Gas/Oil Shale Subcommittee include:

- Focusing on oil shale development issues and wildlife issues.
- Recommending oil and gas leasing reform to more fully consider wildlife issues.
- Communicating recommendations for wildlife agency involvement relative to oil and gas to the Presidential Transition Team.
- Advising the Department of Interior on leasing reform and mitigation policies.
- Coordinating resources relative to best management practices.
- Recommending and reviewing National Conservation Needs.
- Providing policy direction on wildlife and energy-related legislation.
- Involvement with Western Governors Association relative to mapping crucial wildlife corridors.
- Assimilating information on BMPs, and mitigation policies and guidelines.

The Onshore Oil and Gas/Oil Shale Subcommittee has observed that once states' determine the need for addressing wildlife and energy impact issues, they typically progress through a 3 stage process which includes:

1. Identifying and mapping crucial wildlife habitats (defining areas of avoidance);
2. Defining impacts and BMPs (identification of measures to minimize impacts);

3. Development of compensatory mitigation policies and/or guidelines (to determine means to mitigate residual impacts).

Most states are in various stages of this process. Many of the western states have completed stages one and two and are currently focused on stage three, while other states are currently focused on stages one and two.

Guidelines Overview

Because the topic of compensatory mitigation is both diverse and complicated, there is an interest within the EWPC and Onshore Oil and Gas/Oil Shale Subcommittee to provide recommendations to develop a consistent approach for implementing mitigation strategies to address unavoidable impacts to fish and wildlife so that healthy populations and the habitats they depend upon can be maintained while facilitating development of important domestic energy resources.

The objectives identified by the EWPC in preparing these guidelines include:

- Incorporate a hierarchical approach to mitigation: seek first to avoid the impact, next minimize the impact, then mitigate remaining or unavoidable impacts to the extent practicable on site, and finally mitigate impacts off site as required. Focus on developing guidelines for the mitigation components.
- Create a consistent, understandable, practical mitigation protocol for assessing mitigation needs and detailing specific measures for reducing unavoidable impacts.
- Create mitigation guidelines that are scientifically valid, socially acceptable, user friendly in terms of required inputs and resources, and economically feasible.
- Produce concise mitigation guidelines for use by state wildlife agencies, while working in concert with industry and state and federal permitting agencies.
- Maintain the most current, scientifically valid guidance by conducting an annual review of the document and making revisions to adjust for evolving or changing information.
- Identify and incorporate best features and commonalities of existing mitigation policies and guidelines and provide information to strengthen weaknesses in existing guidelines.
- Initially, focus primarily on mitigation relative to oil and gas development since the greatest body of research exists for this subject; but maintain an eye toward the applicability of transferring the approach and process to mitigation of other energy development disturbances.
- Create a systematic approach for mitigation assessment for states and other stakeholders to use as a resource.
- Provide a linkage between mitigation guidelines, information from various state wildlife action plans and the decision support tools being developed under the Western Governors Association initiative.
- Develop guidelines with the involvement of appropriate stakeholders: state agencies, federal agencies, industry, NGOs, etc.

Purpose and Need

State fish and wildlife agencies and federal land management agencies often employ vastly different compensatory mitigation approaches, as myriad approaches exist for assessing compensatory mitigation. Some of these approaches include models such as the Habitat Evaluation Procedure (developed by the U.S. Fish and Wildlife Service), Habitat Equivalency Analysis (developed by National Oceanic and Atmospheric Administration), and the wetlands banking (often a 1:1 ratio) and mitigation credits system (developed by the U.S. Army Corps of Engineers). The Bureau of Land Management often applies a 3:1 ratio (mitigation: disturbance) to assess mitigation for direct impacts, however, this ratio does not account for indirect impacts. Other metrics for compensatory mitigation include straight cash payment for acres of disturbance.

Although there is no one size fits all approach to mitigation, the goal of the metric contained within these guidelines is to provide a means to assess mitigation which is easy, time-friendly, and requires minimal resources to assess mitigation within crucial wildlife habitats. The metric can be used for assignment of mitigation credits which can be utilized or banked. Wildlife habitats that are not identified as crucial are not recommended for compensatory mitigation.

Some states are constructing compensatory mitigation guidelines unique from the aforementioned approaches, and some states have compensatory mitigation policies only. AFWA's Onshore Oil and Gas/Oil Shale Subcommittee performed a comparative review which highlighted that each state recommended a different approach toward mitigation. Only Utah and Colorado had endeavored to produce compensatory mitigation guidelines, and these are both currently in draft form. The states of Utah, New Mexico, Wyoming and Colorado have mitigation documents in various stages of preparation.

Of the four states that have produced guidelines, Utah emphasized communication and coordination, New Mexico detailed best management practices, Wyoming provided species and habitat thresholds, and Colorado provided background information on direct and indirect impacts as well as BMPs.

States are keenly aware of the challenges associated with maintaining and mitigating crucial habitats, although each state is implementing a very different approach. Information within these state guidelines could include identification of species and maps of crucial wildlife habitats, an overview or discussion of impacts (or reference to compendiums) relative to species of concern, a discussion of appropriate thresholds, recommendations for avoidance and minimization measures (BMPs), species-specific BMPs, and plans for monitoring.

Compensatory Mitigation Guidelines Philosophy and Use

These guidelines provide a tool for compensatory mitigation assessment to provide consistency, recognizing that impacts and outcomes differ between states, geologic basins and projects. Oil and gas operators frequently identify the need for "certainty and predictability" with respect to mitigation assessment. These guidelines and their application retain enough flexibility to account for differences in oil and gas resource development while maintaining fluidity to adapt to improvements in technology through time. These guidelines are intended to serve as a resource to simplify the evaluation of compensatory mitigation. These guidelines should be updated as new technology and knowledge become available.

The value of compensatory mitigation actions and BMPs are outlined within these guidelines. These guidelines attempt to convert the assessment of compensatory mitigation as well as creditable actions to acreage through definition of a unique metric that can be applied to all species of concern that occur within crucial habitats.

Crucial wildlife habitats are the small subset of habitats that are fragile and limited, and the species within them (e.g. migration corridors, certain raptor nests, and cutthroat trout streams) are extremely sensitive to any level of disturbance. Avoidance of development in crucial habitats is the primary method of protection. Crucial wildlife habitats are those areas where oil and gas development has a high impact (e.g. nesting, fawning, cutthroat trout streams, and calving).

In order to account for variability between geologic basins and development scenarios, the applicability of the range to a specific development project resides with the judgment of the project team. Implementation of these guidelines will require a collaborative approach from within agencies as well as industry and federal agencies where applicable.

These guidelines define "avoidance" as operating outside of biologically sensitive habitats; "minimization" as reducing impacts through application of BMPs; and "mitigation" as offsetting the remaining impacts through implementation of selected mitigative operational practices and/or other compensatory measures.

Avoidance on Federal surface is most effectively managed by lease stipulations such as "No Surface Occupancy" and "No Lease." Impacts can be ***minimized*** by lease stipulations such as "Controlled Surface Use" and "Timing Limitations." Impacts are also further ***minimized*** through oil and gas rules and/or regulations, Application for Permit to Drill Conditions of Approval, and by implementation of BMPs. ***Mitigation*** can be achieved by implementation of field-effective BMPs (such as liquids gathering and distribution systems), and by compensatory mitigation projects.

As outlined by Wyoming Game and Fish Department (WGFD 2009), "adverse effects of oil and gas development can be divided into 7 categories: 1) direct loss of habitat; 2) physiological stress to wildlife; 3) disturbance and displacement of wildlife; 4) habitat fragmentation and isolation; 5) alteration of environmental functions and processes (e.g., stream hydrology, water quantity/quality); 6) introduction of competitive and predatory organisms; and 7) secondary effects created by work force assimilation and growth of service industries." These 7 categories constitute the various direct and indirect impact mechanisms that can affect wildlife and represent the disturbance spectrum that form the basis of these compensatory mitigation guidelines.

The goal of the compensatory mitigation guidelines is to outline an approach ensuring that compensatory mitigation actions implemented to offset the effects of the unavoidable adverse impacts from oil and gas development are ecologically equivalent to and will persist at least as long as on-site impacts, and that they will achieve a positive outcome. WGFD (2009) stated, "… the area of land needed to mitigate an impact will depend on the types of treatments applied, the expected improvement to the functional capacity of the land, and the effectiveness of impact abatement (management) practices being applied within the project area." Timing Limitations provide a mitigating effect for wildlife on a permit basis; however, they do not address impacts at a landscape scale. This mitigation metric does not assess compensatory mitigation relative to Timing Limitations waivers, and in this case, additional mitigation should be assessed.

Compensatory mitigation must be linked to regional ecological and spatial scales to be effective, because spatial scale and habitat fragmentation are totally dependent on each other (Dale et al. 2000). In other words, the ecological process to be mitigated must be evaluated over an appropriate scale in order to be effective, and the mitigation must be at a sufficiently large scale to positively offset ecological impacts. In addition, compensatory mitigation should ideally precede project development and the associated actual impacts in order to avoid a temporal lag in maintaining functional wildlife habitat.

Thresholds: Background and Justification for Compensatory Mitigation

General

Wildlife impacts from oil and gas development occur in two distinct forms: direct impacts and indirect impacts. Direct impacts include the effects of actual habitat conversion or loss from ground disturbance and are generally concentrated in close proximity to the well pad, road, pipeline or other development site. A description of the indirect impacts of natural gas development on terrestrial wildlife is provided by WGFD (2009):

> *As densities of wells, roads, and facilities increase, habitats within and near well fields become progressively less effective until most animals no longer use these areas. Animals that remain within the affected zones are subjected to increased physiological stress. This avoidance and stress response impairs habitat function by reducing the capability of wildlife to use the habitat effectively. In addition, physical or psychological barriers lead to fragmentation of habitats, further limiting access to effective habitat. An area of intensive activity or construction becomes a barrier when animals can't or won't move through it to use otherwise suitable habitat. These impacts are especially problematic when they occur within or adjacent to limiting habitats such as crucial winter ranges and reproductive habitats.*

Mule Deer, Elk, Pronghorn, and Bighorn Sheep

In a literature review of more than 160 scientific and technical reports conducted to review the effects of energy development on ungulates, Hebblewhite (2008) concludes, "across studies, ungulates showed avoidance responses to human development an average of 3,000 feet (1,000 meters) from the human disturbance." It is important to note that this zone of influence does not denote 100% avoidance, nor population level impacts. Very few studies utilizing an experimental design have been conducted to verify population level impacts from oil and gas development. Nonetheless, a thorough review of the literature suggests that significant impacts begin to manifest on ungulate species, including mule deer, pronghorn and elk, at well densities between 0.26 and 1.04 wells/mile^2 and road densities between 0.29 and 1.7 miles/mile^2.

Lyon (1983) developed a general model of habitat effectiveness for elk that modeled percent habitat effectiveness as a function of road density. Declines in habitat effectiveness were non-linear, indicating that much of the loss of habitat effectiveness occurred in the first 2.6 mile/miles^2 of increasing road densities.

Sawyer et al. (2006) found lower predicted probabilities of habitat use by mule deer within 1.7 to 2.3 miles (8,976 feet to 12,144 feet) of an oil or gas well site, confirming that indirect effects of habitat loss from energy development were much greater than the direct footprint of energy developments. Sawyer et al. (2009) found that indirect habitat loss for active drill pads is three times greater than a producing pad without a liquid gathering system and eight times greater than a producing pad with a liquid gathering system. Additionally, overlap between well sites and roads compounds the effect of habitat loss due to avoidance and is important because of the spatial configuration of habitats in determining road impacts (Rowland et al. 2000, Frair 2005).

For mule deer crucial winter range, WGFD (2009) concluded that a density of 1 well pad per square mile causes a moderate impact and a density of 2-4 well pads per square mile causes a high impact. The impact is considered extreme when densities exceed 4 well pads per square mile.

Grouse

Several publications and manuscripts regarding sage-grouse and energy development have predicted and/or documented negative effects of energy infrastructure on sage-grouse habitat use, demographic rates (including survival). Several direct and indirect effects of energy development on sage-grouse and other native grouse species have been documented (e.g., disturbance, collisions, increased disease), and many other types of impacts are possible (e.g., from dust, pollution, noise, etc.). The main concerns are: (1) well-pad, road, and pipeline construction reduces available habitat for long periods of time (decades); (2) increased disturbance at leks and within key seasonal habitats may cause birds to move into adjacent areas of lower habitat quality, or lead to lower recruitment, increased physiological stress, and lower productivity or survival among birds that remain; (3) direct impacts from collisions with vehicles, power lines, and fences reduce survival; (4) drinking toxic water from pits may reduce survival or productivity; and (5) indirect effects of energy development reduce long-term habitat quality and demographic rates (e.g., increases in weed infestation, predator abundance, spread of West Nile virus, etc.) (Remington and Braun 1991, Braun 1986, Braun 1987, Braun 1998, Braun et al. 2002, Lyon and Anderson 2003, Holloran 2005, Kaiser 2006, Holloran et al. 2007, Walker et al. 2007, Aldridge and Boyce 2007, Doherty et al. 2008, Doherty 2008, Naugle et al. 2009).

Sage-grouse appear to avoid areas with energy development. Avoidance of large areas with energy development reduces the distribution of sage-grouse and may result in a true population decline if density-dependence or reduced habitat suitability in adjacent areas lowers survival or reproduction of displaced birds (Aldridge and Boyce 2004, Holloran and Anderson 2004). As reported by WGFD (2009, after Doherty et al. 2008), sage-grouse in the Powder River Basin were less likely to use otherwise suitable winter habitats that had been developed for energy at a density of 12 wells/1.5 mile^2, and differences were most pronounced in high quality winter habitat with abundant sagebrush cover. Population level impacts occur when demographic rates are affected.

In contrast, birds that remain in developed areas due to high site fidelity experienced reduced survival, reduced productivity, or both. Intensive energy development can have severe negative impacts on sage-grouse populations, as evidenced by male lek attendance (Walker et al. 2007). In their recent decision to list sage grouse as warranted but precluded, the USFWS cited a 79% decline in sage grouse within the Powder River Basin area in Wyoming following intensive gas development. A development density of less than one well-pad per section showed no detectable impact on sage-grouse populations in Wyoming and Montana (Naugle et al. 2006a; Doherty 2008, WGFD 2009). Walker et al. (2007) and Doherty et al. (2008) concluded that the density of well pads is highly correlated with other features of development and therefore comprises a suitable index representing the extent of development.

Other grouse species generally have similar biology, mating systems, and demographic rates as sage-grouse and are also known to be negatively impacted by habitat loss, habitat fragmentation, and man-made structures (e.g., fences and power lines; Patten et al. 2005, Pitman et al. 2005, Wolfe et al. 2007, Pruett et al. 2009 a, b).

Aquatic and Riparian

Direct and indirect impacts to aquatic life and riparian zones were comprehensively described by WGFD (2009).

> *Oil and gas developments also affect aquatic ecosystems. The overall health of an aquatic habitat derives from the condition of the entire watershed including the uplands, riparian corridor and the stream channel. Impacts to the upland plant community and environment can have a very immediate impact on an aquatic system, because the condition of vegetation throughout a watershed is the major factor determining the quantity and quality of the associated flow regime. In essence the runoff is naturally regulated by healthy, diverse vegetation. Vegetation in good condition provides greater ground cover, which reduces runoff and increases infiltration rates. Furthermore, diverse plant communities contain various microsites that enable snow to melt at differing rates, thereby extending the runoff period. Collectively, these factors produce more stable base flows essential for healthy fish and riparian habitats. Reduced sedimentation is another major benefit to aquatic organisms. Healthy vegetation naturally produces a healthy water cycle. However, some unimpacted stream systems in Wyoming have a natural flow regime dominated by sharply fluctuating runoff, high sediment loads and unstable channel. These types of systems sustain a native biotic community adapted to this harsh environment. When developments alter physical conditions (i.e., stabilize flow regimes, reduce sediment loads), the opportunity exists for native species to be replaced by detrimental, non-native species.*

Some unimpacted streams in the west have natural flow regimes similar to those described for Wyoming and support equally well adapted biotic communities.

Providing riparian buffers of sufficient width protects and improves water quality by intercepting non-point source pollutants in surface and shallow subsurface water flow (e.g., Lowrance et al., 1984; Castelle et al., 1994). Healthy riparian buffer strips are widely recognized for their ability to perform a variety of functions other than water quality including stabilization of stream channels, providing erosion control by regulating sediment storage, transport, and distribution; providing organic matter (e.g., leaves and large woody debris) that is critical for aquatic organisms; serving as nutrient sinks for the surrounding watershed; providing water temperature control through shading; reducing flood peaks; and serving as key recharge points for renewing groundwater supplies (DeBano and Schmidt 1989; O'Laughlin and Belt 1995). Buffer strips also provide habitat for a large variety of plant and animal species and have become a popular tool in efforts to mitigate fragmentation by increasing connectivity of isolated habitat patches and conserving biodiversity (Rosenberg et al., 1997).

Wildlife habitat and movement corridors in riparian zones are also an important consideration. Appropriate designs for species conservation depend on several factors, including type of stream and taxon of concern (Spackman and Hughes 1995). Recommended widths for ecological concerns in buffer strips typically are much wider than those recommended for water quality concerns (Fischer 1999; Fischer et al., 1999), often exceeding 100 m in width. These recommendations usually apply to either side of the channel in larger river systems and to total width along smaller streams where the canopy is continuous across the channel. Management for long, continuous buffer strips rather than fragments of greater width should also be an important consideration. Continuous buffers are more effective at moderating stream temperatures, reducing gaps in protection from non-point source pollution, and providing better habitat and movement corridors for wildlife.

In their discussion of no surface occupancy (NSO) zones for wetlands and riparian corridors, WGFD (2009) recommended an NSO zone of 500 feet from the outermost perimeter of potentially affected areas.

We recommend an NSO zone extending 500 ft from the outermost perimeter of wetlands and riparian corridors to maintain habitat effectiveness and functional integrity. This distance is considered minimal given the sensitivity of many wildlife species that utilize riparian corridors and wetlands for nesting, foraging, movement corridors, and cover. For example, Ingelfinger and Anderson (2004) detected species specific impacts to breeding passerines within distances ranging from 40-1,500 m from roads in a natural gas field. Reijnen et al. (1995) documented 20-98% reductions in bird densities within 250 m of roadways within wooded habitats. Nesting raptors are sensitive to disturbances up to several hundred meters depending on species (Fyfe and Olendorff 1976; White and Thurow 1985; Richardson and Miller 1997). Mule deer can be sensitive to human and equipment disturbances at distances ranging from 0.2-0.3 miles (Freddy 1986) to well over a mile (Sawyer 2009). While comprehensive data are not available to identify the specific wildlife occupying any given tract of riparian habitat, it can be assumed all riparian habitats support high levels of species diversity and provide nesting habitat for a variety of passerine species. Trees are suitable nesting habitat for several raptor species if they are sufficiently isolated from disturbance, and deer occupy most riparian tracts throughout the state. In addition, a large percent of species of greatest conservation need are wetland/riparian dependent or associated. A 500-ft NSO buffer provides minimal protection to wetland and riparian habitat functions (WGFD 2009).

Raptors

Oil and gas development at well densities greater than 1 well pad per square mile can adversely impact the breeding success of raptors. Raptors generally have high year-to-year nest site and nest territory fidelity (i.e., they return to the same nest location year-after-year), and nest sites are often limiting. This makes annual breeding success for these species sensitive to direct and indirect human disturbance and habitat alteration at existing nest sites (Olendorff 1973, Howard 1975, Jones 1979, Newton 1979, Craighead and Mindell 1981, Gilmer and Stewart 1983, Gaines 1985, Scott 1985, Millsap et al. 1987, Harlow and Bloom 1989, Bechard et al. 1990, Dalton et al. 1990, Leslie 1992, Hansen 1994, White 1994, Harmata 2001, Megown et al. 2007). This is particularly true during active reproductive periods (courtship, nest site selection, egg-laying, incubation, and nestling phase) (Call 1979, Gilmer and Stewart 1983, White and Thurow 1985, Bechard et al. 1990, Richardson and Miller 1997, Romin and Muck 1999, BLM 2006). Nest site abandonment due to direct and indirect disturbance or habitat alteration may cause local or regional population declines where suitable nest sites are limited due to lack of nesting substrate or limited abundance of prey species (Swenson 1979, Craighead and Mindell 1981, Whitcomb et al. 1981, Cline 1988, Newton 1989, Watson and Langslow 1989, White 1994, Romin and Muck 1999, BLM 2006).

Human activities, if allowed to encroach on raptor nest sites, may cause raptors to abandon nest sites during courtship, nest site-selection or egg-laying reproductive periods (Weston 1968, Snow 1972, Fitzner et al. 1977, Call 1979, Olsen and Olsen 1980, Gilmer and Stewart 1983, White and Thurow 1985, Knight and Skagen 1988, Richardson and Miller 1997, Romin and Muck 1999, BLM 2006). Disturbance of raptor nest sites during the incubation or nestling phase also increases the probability of nest failure due to increased adult flushing frequency and time away from the nest, which increases the probability of egg incubation failure and predation on the eggs or nestlings (Fyfe and Olendorff 1976, Call 1979, Sutter and Jones 1981, Bortolotti et al. 1984, White and Thurow 1985, Knight and Skagen 1988, Richardson and Miller 1997, Romin and Muck 1999). Even if the nest does not completely fail, several studies have suggested that human activities and habitat alteration that encroach upon active raptor nest sites, including those disturbances associated with oil and gas activities, change raptor behavior and reduce nest productivity (i.e., numbers of chicks fledged), and can result in local or regional population declines (Olendorff 1973, Gaines 1985, White and Thurow 1985, Knight and Skagen 1988, Harmata 1991, Holmes et al. 1993, Olendorff 1993, White 1994, Romin and Muck 1999).

There is a considerable amount of variability in the susceptibility to nest disturbance, both between and within individual species of raptors (Holmes et al. 1993, Richardson and Miller 1997). Colorado Division of Wildlife (CDOW) has developed recommended buffer zones and seasonal restrictions for Colorado raptors in 2002 (CDOW 2002, revised 2008). In Utah, the United States Fish and Wildlife Service (USFWS) has established guidelines for raptor protection from human and land use disturbances that include spatial and temporal buffers around occupied and unoccupied nest sites (Romin and Muck 1999). The BLM in Utah has also adopted guidelines for raptor protection that includes spatial and temporal buffers around nest sites (BLM 2006). In general, a 0.5 mile disturbance-free buffer around active nests is the minimum used to adequately protect breeding activities at the nest site for the most sensitive species of raptors (e.g., ferruginous hawk, prairie falcon, goshawk, and peregrine falcon) [Holmes et al. 1993, Richardson and Miller 1997, Romin and Muck 1999, BLM 2006, Whittington and Allen 2008 (unpublished draft)]. This 0.5 mile disturbance-free buffer cannot be maintained once well densities exceed 1 well pad per square mile.

Summary

In general, the agencies endorse and supports the findings of Sawyer et al. (2006, 2009), Hebblewhite (2008), WGFD (2009), Naugle et al. (2006), Walker et al. (2007a), Romin and Muck (1999), and BLM (2006) as a basis for asserting that unavoidable adverse impacts on ungulates, grouse, and raptors result from oil and gas development at surface densities of 1 well pad per section or more. We also endorse the findings of Lowrance et al. (1984), Castelle et al. (1994), DeBano and Schmidt (1989), O'Laughlin and Belt (1995), and WGFD (2009) in our conclusion that unavoidable adverse impacts on aquatic species and riparian systems can result from oil and gas development. The fundamental premise is that, at well densities higher than 1 well per section, avoidance and minimization measures alone are not likely to be sufficient to compensate for adverse impacts and compensatory mitigation is needed. However, the extent of compensatory mitigation measures needed can by reduced substantially by measures taken to avoid and minimize impacts to wildlife during development.

The preceding thresholds sections summarize research findings for big game ungulates, and sage-grouse. Literature, research and testimony describe the range of distances at which oil and gas disturbance affects wildlife. The oil and gas disturbance impact ranges include up to 2.3 miles for big game ungulates (Sawyer et. al. 2006), and up to 2 miles for sage-grouse (Holloran 2005, Walker et al. 2007). However, demographic effects that constitute the most severe impacts generally occur at shorter distances.

Hebblewhite (2008) reviews more than 160 scientific and technical reports that summarize the effects of energy development on ungulates, and concludes, “across studies, ungulates showed avoidance responses to human development an average of 3,280 feet (1,000 meters) from the human disturbance.” An indirect impacts buffer of 1,640 feet (500 meters) is conservative because the literature and technical reports are not explicit about how disturbance varies along the 3,280-foot (1,000 meter) distance. It is reasonable to assume that the severity of the impact is greatest closer to the point of disturbance and that some impacts also occur beyond 1,640 feet (500 meters).

Direct impacts (~100-foot buffer) are assessed for the footprint of future proposed oil and gas facilities (e.g., roads, pipelines, compressor stations, etc.); and indirect impacts are assessed for a 1,640-foot buffer around existing oil and gas facilities (because the habitat is already disturbed) as well as future proposed oil and gas facilities.

The compensatory mitigation assessment process is simplified by applying one consistent, average indirect impact buffer of 1,640 feet (500 meters) within crucial species habitats. This indirect impact buffer is intended to be applied to terrestrial species, as aquatic resources vary significantly from region to region. Aquatic habitat impacts buffers should be determined on a case by case basis (e.g., aquatic habitat buffers could include the appropriate impacted stream reach plus an outside buffer, or could include an entire watershed), as appropriate for the sensitivity of the species and habitats affected.

This compensatory mitigation buffer was calculated from a distance (indirect impacts buffer) of 1,640 feet (500 meters) and it captures the most significant impacts from the oil and gas facility. The 1,640-foot indirect impact distance (buffer) is small (15%) compared to the documented impact distances described above (Sawyer 2006, Holloran 2005, and Walker et al. 2007). This buffer is conservative because it represents only half the distance documented in Hebblewhite (2008). Compensatory mitigation is not assessed for impacts that occur beyond 1,640 feet (500 meters) from the oil and gas facility. To simplify the process, the 1,640-foot buffer is not intended to be weighted or gradual, but rather is intended to be applied for the range of species for which compensatory mitigation is necessary (excluding aquatic habitat).

Compensatory Mitigation Strategies

Three strategies to mitigate impacts are 1) landscape scale designated “protected areas,” 2) habitat creation; restoration or enhancement and 3) direct monetary payments contributed to research or other key compensatory mitigation actions. Each of the three strategies relies on an array of objective measures to implement the strategy successfully. The strategies are described below.

A preferred strategy is the “protected area” mitigation concept detailed by Hebblewhite (2008). This type of mitigation identifies core areas for multiple species (e.g., pronghorn, mule deer, sage-grouse, sagebrush habitat, riparian habitat) that are then protected from oil and gas development to provide crucial habitat for the identified species and the ecosystems on which they depend. Protected areas should be designed to ensure viable populations at landscape scale that maintains populations and connectivity among populations, while allowing incremental development outside of protected core areas. Thus, the conservation value of a protected area should reflect its contribution of sustainability measured at the regional scale (Bruggeman 2005). The protected area concept can be utilized in designing and implementing onsite and offsite habitat treatments. The protection of wildlife habitat by acquisition of fee title and conservation easements, or suspension of grazing leases and/or existing oil and gas leases may be an important element for an effective long-term strategy to preserve wildlife habitat. In many cases, this may provide the only permanent solution to conflicts between the needs of wildlife and other uses (WGFD 2009). The “protected area” strategy is scalable; it can be tailored to a single project or multiple projects across the landscape. Fundamental compensatory mitigation components of this strategy also include phased development and clustered development within the development area. Other on-and-off-site mitigation components may be included as well.

Another high priority strategy is to replace lost habitat or habitat functionality by improving habitat conditions through treatments that create, restore or enhance habitat. It is vital that any habitat improvement projects be focused on factors that limit populations. If this approach is taken, the alleviation of limiting factors can increase population performance, and not just shift the distribution of wildlife populations. Because of seasonal migratory movements by many wildlife species, enhanced habitat developed through mitigation must be large and intensive enough to restore ecological integrity, so as to avoid a downward spiral of continued functional habitat loss despite compensatory mitigation (Race and Fonseca 1996). Habitat enhancement efforts must be at a sufficiently large scale to avoid population "sink" situations, or ecological traps, where demographic rates actually decline instead of improve because of unforeseen factors. For example, small-scale improvements in duck nesting habitat may not result in improvements in nest success rates because concentrating duck nesting activities may make predators more efficient at locating nests (Phillips et al. 2003). Functional landscapes provide habitat that produces rates of subpopulation growth and migration rates similar to those observed prior to habitat loss and fragmentation (Bruggeman 2005). Restoration of watersheds is extremely difficult as even small compromised areas contribute to downstream consequences as siltation increases, water temperatures fluctuate, and species diversity decreases.

Restoring, enhancing, or creating additional habitat at a large enough scale to be relevant to impacted populations within intensive energy developments is exceptionally difficult, and nearly impossible at small scales. This argues for larger scale conservation planning and collaboration across land ownerships to facilitate participation among energy companies in an equitable manner. Although beyond the scope of these guidelines, we strongly encourage that larger scale conservation planning begins now. A third compensatory mitigation strategy to consider is the direct payment of money to high priority compensatory actions. The mitigation metric will be used to calculate compensatory mitigation acreage. This acreage amount would be divided by the acre equivalent to determine cash value. Payment could be made to existing well-established programs established to protect and enhance habitat for a particular species or group of species that are impacted, to conduct research on oil and gas development impacts, and/or to fund other programs that provide suitable benefit to wildlife.

Compensatory mitigation would result in a one-time cost to the operator per permit. In these examples, the operator would know the cost up front and be able to set aside mitigation funds upon permit approval. Operators who offer more than the minimum amount of compensatory mitigation required to offset unavoidable impacts will have the opportunity to bank these mitigation measures to compensate for future development activity. The above mentioned strategies could involve participation and collaboration with private industry, non-governmental organizations, and federal/state governments.

Compensatory Mitigation Priorities

Compensatory mitigation efforts through habitat enhancement and protection from development should be located in as close proximity to the affected area as possible and should, in all cases, benefit the wildlife population or herd unit affected by the development. On-site or localized off-permit mitigation is preferred over long distance off-site mitigation, provided that suitable blocks of undeveloped habitat exist on-site or locally that are not at risk from future development. Off-site and off-lease mitigation should only be considered when feasible mitigation options are not available within or immediately adjacent to the impacted area, or when the off-site or off-lease location would provide more effective mitigation than can be achieved on-site (WGFD 2009). Off-site solutions to watershed disturbances are largely impractical as a mitigation strategy, as damaged areas will continue to degrade and damage downstream areas unless mitigative efforts are sustained within the damaged watershed.

Compensatory mitigation efforts should focus on areas where the greatest gains can be achieved, and where protection from future development can be assured to preserve mitigation efforts. Potential habitat-based compensatory mitigation approaches are listed below:

1) Protect or limit impacts to existing functional habitats from future development. This strategy may not have the greatest population or landscape-level response to improve existing conditions, but should be considered the highest priority if enough undisturbed habitat exists within the affected area to maintain objectives for the wildlife populations or herd units affected by development. A principal mechanism to protect habitats is through conveyance of surface and/or mineral rights through perpetual conservation easement or other forms of deed restrictions.

   Another method used to implement landscape scale protection efforts is through development of specific wildlife mitigations or by using a phased and/or clustered approach to development and additional mitigation measures will address site specific impacts.

   As compensatory mitigation projects expand, the goal is to positively impact major portions of the landscape through compensatory mitigation projects that are specific to crucial habitats and benefit populations effected. These approaches have the highest chance of success, but may have limited application due to the lack of available undisturbed habitat, and/or the lack of available regulatory mechanisms to protect the available habitat from future development.

2) Create new habitats or restore lost habitat (e.g., cheatgrass or piñon-juniper sites that were previously sagebrush; reclamation and restocking of waters) will likely have the greatest population and landscape-level response. Creation of habitat in areas not currently occupied (i.e., "vacant or unknown") or in areas that are potentially suitable should concentrate on relatively large-scale efforts, as opposed to numerous small-scale efforts. Efforts to create habitat should focus on areas that (1) have been type-converted, such as cheatgrass monocultures, extensive areas lost to fire, etc.; or (2) have successional progression to non-productive wildlife habitat for the species of concern. Construction of migration barriers and the establishment of new conservation-quality stocks of cutthroat trout in waters previously not treated as Designated Cutthroat Trout Habitat is a high priority for creation of aquatic habitat. Mitigation actions directed toward creating new habitat may consist of on- or off-site measures and may include very site specific intensive management actions, or more generalized projects.

3) Restore healthy plant communities on degraded sites will have the next highest population and landscape-level response. Restoring degraded habitats should attempt to reestablish ecological function and biotic diversity. Careful analysis must be given to the root causes of the current community condition, the local site capability, whether ecological thresholds have been crossed, and likely limiting factors for wildlife populations. Treatments should be extensive enough (large in spatial extent, range, scope or quantity) to contribute towards solving the ecological problem. However, in occupied habitats, size and distribution of treatments should be designed to minimize impacts to existing wildlife populations. Initial wildlife population response to treatments in degraded habitat may not be positive. Stream restoration actions may include placement of Rosgen-type in-stream structures to increase suitable habitat for native species, and repairing riparian zone damage by implementing measures designed to reduce sedimentation, preserve water quality, and restore vegetation and normal riparian functions.

Mitigation actions directed toward restoration of habitat may include very site specific intensive management actions or more generalized projects.

4) Enhance functioning habitats. These types of treatments will have a low or non-measureable population and landscape-level response, and should be avoided where other options are present. If adopted for compensatory mitigation, treatments of functioning habitats should be small and distributed irregularly across the landscape. The exception may be where treating functional habitats is necessary to maintain connectivity between two large blocks of habitat at risk from current or future development. This mitigation approach has a limited subset of mitigation opportunities. These projects would be site specific and intensive management actions.

Assessment of Compensatory Mitigation Needs

Oil and gas development typically progresses from a single exploratory well through an initial production phase to infill development. The development timeline is variable and dependent upon the extent and productivity of the resource, economic factors, etc., and can last for fifty years or longer. The first well pad that is constructed in undeveloped habitat has disproportionately high disturbance effects. Subsequent development leads to acute disturbance impacts to wildlife with every drilling cycle and additive cumulative impacts from habitat fragmentation.

As density increases beyond one well pad per section, the literature strongly suggests that avoidance and minimization measures alone no longer suffice to compensate for adverse impacts, and as development progresses to full field (which can be greater than 32 well pads per section), impacts on the wildlife resource progress from acute and isolated to chronic and widespread. As the number of well pads per section increases, the unavoidable impacts expand and the mitigation priority shifts from site specific impacts to landscape scale restoration of habitat.

Compensatory Mitigation Valuation for Wildlife Mitigation Plans

There are significant operational differences between geological basins within the west. For instance, deep gas development is vastly different than coal bed methane development. Well-designed compensatory mitigation actions are built upon an understanding of complex systems. As a result, successful compensatory mitigation actions in one development cannot necessarily be directly applied to another development. Successful mitigation of each oil and gas development is dependent on its own set of facts, potential impact issues and involved parties.

Appendix A contains a listing of potential compensatory mitigations that can be performed by an operator and their relative value to wildlife. Final determination of the credit for compensatory mitigation actions and BMPs applied to alleviate compensatory mitigation acreage will be decided by a team of energy professionals, senior biologists, and area staff. Implementation of these guidelines will require a collaborative approach from within agencies as well as industry.

The column headings in Appendix A include:

- **Compensatory Mitigation Action** proposed to alleviate compensatory mitigation acreage.

Categories under this heading include:

a. Habitat treatment
b. Habitat management
c. Land tenure adjustment
d. Application of mitigative BMPs
e. Enhanced reclamation
f. Public access for hunting/fishing
g. Research participation
h. Cash mitigation
i. Planning documents

- **Wildlife Resource Benefit** identifies the specific benefit of the mitigative action.

- **Credit Percentage Relative to Compensatory Mitigation Acreage for BMPs** identifies the percent of acreage that would be discounted through application of BMPs and the compensatory mitigative acreage reductions. Different geological basins will have different operational practices, and some BMPs may qualify for more or less credit. Certain BMPs are mutually exclusive of each other and cannot be combined and they include; application of seasonal timing restrictions and phased development, use of high efficiency rigs and seasonal timing restrictions, and implementation of clustered and phased development. The following BMP percentages could be applied for mitigation credit; operators may receive greater credit if they clearly demonstrate to the team that their practices result in greater impact reduction. The sum of mitigative BMP credits will not exceed 85%. Industry will not receive credit for standard industry practices that are necessary to successfully produce a field, such as water collection and distribution systems within a CBM field, or practices that are necessary to comply with local, state, or federal rules, regulations, stipulations or conditions of approval.

There are three categories of mitigative BMPs that reduce impacts on a landscape scale and therefore should be implemented:

Traffic Reduction

a. Centralized fluid distribution systems: 3-phase gathering (produced water, condensate, and natural gas).)- up to 50%.
b. Fluids collection and distribution systems during exploration and production- up to 40%.
c. Remote well site monitoring ("SCADA")- up to 12%.
d. Man camps- up to 3%.
e. Voluntary application of seasonal timing restrictions on federal lands- up to 16%.
f. Voluntary application of seasonal timing restrictions on private lands- up to 32%.

Drilling Time Reduction

a. High efficiency drilling operations which cluster development and rapidly drill out a well pad- up to 25%.
b. Phased development- up to 25%.

Other Impact Reduction

a. Closed loop drilling or pitless operations- up to 5%.

- **Mitigation Project Options** lists examples of the types of projects. Please see the footnotes at the end of Appendix A for estimates of project costs and a relative value to wildlife.

- **Acreage Equivalent** converts cash to acres for awarding compensatory mitigation acreage credit. Mitigation credit can be accounted for either in acres or in cash value for mitigation actions performed. This mitigation document uses acres as the measure for assessing compensatory mitigation acreage and awarding compensatory mitigation acreage credit. The credit basis for most habitat treatment and land tenure compensatory mitigation actions is the acreage created, enhanced, or protected, regardless of the cost incurred. The values listed in the footnotes to Appendix A are presented only as an example of the relative costs of various habitat treatments. Many of the compensatory mitigation actions listed in Appendix A do not easily translate to acreage enhanced or protected (e.g., research contributions, cash-based mitigation, etc.), or are high cost/small acreage treatments (e.g., water developments, riparian/stream improvements). Compensatory mitigation credit for these actions is awarded by dividing the amount spent on the mitigation action by a standard value per acre to convert the amount of cash-based compensatory mitigation to acres so that these actions receive commensurate credit with acreage-based mitigation actions. This mitigation metric uses a standard acreage equivalent value of $500/acre for these compensatory mitigation actions, and was developed from representative habitat treatment costs (e.g., pinyon-juniper removal at $300/acre, plus seeding costs at $120/acre, plus weed control costs at $90/acre equals approximately $500). The acreage equivalent is applied to all cash-based compensatory mitigation actions to determine the acre value of compensatory mitigation credit awarded for the action.

- **Credit Multipliers** identify the relative benefit attributed to the proposed compensatory mitigation action. The multiplier reflects mitigation priorities and ranges from 0.5-5. For example, a multiplier of 1 implies lower priority than a multiplier of 5.

Assessment and Compensatory Mitigation Application Example for Unconventional Natural Gas Resource Development

For example, consider a WMP with a boundary encompassing 21,833 acres. The WMP proposes 83 new surface locations and reoccupation of 11 existing well pads with the associated network of roads and pipelines to develop the gas resource. The entire development is in an area where the existing and proposed well density exceeds one gas facility per square mile; therefore, compensatory mitigation is necessary to alleviate unavoidable adverse impacts. To account for direct impacts, a buffer of 50 feet is applied on either side of the center line of linear disturbances and to the well pad perimeter. This results in a direct disturbance of 358 acres within crucial wildlife habitats. Development is also proposed within a no surface occupancy area within crucial wildlife habitat; therefore, this entire wildlife habitat acreage (863 acres) is added to the 358 crucial wildlife habitat direct disturbance acreage for total direct disturbance acreage of 1,221.

To account for indirect impacts, a buffer of 1,640 feet is applied on either side of the center line of linear disturbances and from the center of the well pad. Direct impacts are subtracted from indirect impacts and any overlap of indirect impact buffer area is removed, resulting in indirect impact acreage amount of 6,165 acres. This GIS analysis determines the compensatory mitigation acreage (direct and indirect impacts) to be equal to 7,386 acres.

The operator has implemented field-wide three phase gathering pipelines (reduces compensatory mitigation acreage by 50%), they have installed remote well site monitoring (“SCADA”) (reduces compensatory mitigation acreage by 12%), and utilize man camps (reduces compensatory mitigation acreage by 3%), and implemented field-wide pitless drilling operations (reduces compensatory mitigation acreage by 5%). The field wide application of these mitigative BMPs allows the operator to reduce the compensatory mitigation acreage from 7,386 acres to 2,216 acres (70% reduction).

The compensatory mitigation acreage could further be reduced by an amount equal to 40% of the direct impact acreage if enhanced/wildlife friendly seed mixes were applied during the interim reclamation phase. Only 40% of the facility footprint is available for interim reclamation, as the remainder is unavailable to reclamation during the productive life of the well. Therefore, the direct impact acreage available would be 143 acres (40% of 358 acres). Assuming that the above measures were implemented, the compensatory mitigation acreage would be reduced to a total of 2,073 acres.

Additionally, the operator, in consultation with the team, has determined they would like to create a new irrigated hayfield within mule deer critical winter range and elk winter concentration area. The 20 acres of new hayfield will provide additional winter range forage. Creation of new habitat has a multiplier of 5; therefore the 20 acres created will provide 100 acres of compensatory mitigation acreage credit which will be subtracted from the total compensatory mitigation acreage. The compensatory mitigation acreage is further reduced to 1,973 acres.

The operator has also agreed to set aside occupation of the surface of 1,500 acres of land they had planned to develop but deferred for the 6-year life of the WMP. Credit for this deferral is achieved by applying a 1 multiplier to the 1,500 acres of crucial wildlife habitat. The compensatory mitigation acreage is further reduced to 473 acres.

Finally, the operator has chosen to restore stream habitat for cutthroat trout (crucial wildlife habitat) (multiplier of 3) with a total project cost of $78,833 that would be divided by the acre equivalent ($500/acre) and multiplied by the credit multiplier of 3, retiring the remaining 473 acres of compensatory mitigation acreage ($78,833/$500 per acre times a multiplier of 3 equals 473 acres).

The successful implementation of these projects would eliminate the compensatory mitigation acreage. Projects must be evaluated and monitored to ensure successful implementation, and guarantee attainment of mitigative goals.

A process for developing a Wildlife Mitigation Plan is contained within Appendix B.

Monitoring of Mitigation Sites

The flexibility needed to develop the oil and gas resource must be balanced with the necessity to ensure functioning wildlife habitats. Evaluation and monitoring are integral and necessary components of all successful compensatory mitigation and are used to assess progress toward the objectives of the mitigation.

Monitoring must assess whether the objectives of the compensatory mitigation actions are being achieved. The goal of compensatory mitigation is to conserve wildlife populations, and the measure of success for habitat-based mitigation projects should include habitat quality, quantity, use and other population demographics as deemed necessary. State agencies should encourage project monitoring as well as third party auditing to ensure compliance with plans and agreements.

The following process is recommended to create and implement a monitoring plan for a compensatory mitigation project:

1) Describe how key physical and biological habitat components are functionally interconnected or interdependent, how the key habitat components affect the population demographics and objectives for wildlife included in the plan, and which of these components are limiting in the project area.
2) Assess the existing condition of all major ecological components of the compensatory mitigation site based on quantitative inventory and monitoring data. Suitable references areas and baseline conditions should be established early in the process. If adequate resource data are not available, include a means of collecting the information in the monitoring plan.
3) Identify specific, measurable goals (success criteria) for the compensatory mitigation site based on the habitat components at the site that limit wildlife populations, and the desired condition (properly functioning condition) of those habitat components.
4) Establish a timeline for achieving the identified success criteria and articulate that timeline in a formal monitoring plan. The monitoring plan should include:
    a. A timeline for achieving the goals (success criteria) established for the compensatory mitigation site.
    b. Annual goals that must be met each year to move towards achieving the ultimate success criteria.
    c. Remedial actions that will be taken if the annual goals are not achieved.
    d. A monitoring protocol that describes the quantitative and qualitative methods that will be used to measure success and the frequency of monitoring until success is achieved.
    e. A monitoring report (see Appendix C).

A fundamental requirement of successful evaluation and monitoring is to incorporate these tools into an adaptive management framework. Careful attention to sampling design and analysis (including the appropriate sampling scales, covariates, and power analysis) and the potential for replicating studies will be necessary to monitor mitigation adequately (Kotliar 2008).

Adaptive Management/Compliance

The uncertainty surrounding the effectiveness of compensatory mitigation for impacts to the wildlife resource makes an adaptive management framework necessary. Successful mitigation may require more than the mere execution of a compensatory mitigation action (e.g., number of acres treated). Adaptive management requires that the compensatory mitigation actions have defined, measureable objectives which can be evaluated with performance standards. Assumptions about the type and quantity of habitat or other improvements needed to mitigate a given level of impact must be field verified and consistently monitored and evaluated.

Within the framework of adaptive management, all compensatory mitigation actions have an experimental component that is monitored for success by measuring the response of vegetative communities, demographics of wildlife populations, or other outcomes. Based on the measured response, subsequent mitigation actions will be adjusted to meet management goals. Thus, it is critical that the proponent of a compensatory mitigation action commit to the achievement of specific success criteria.

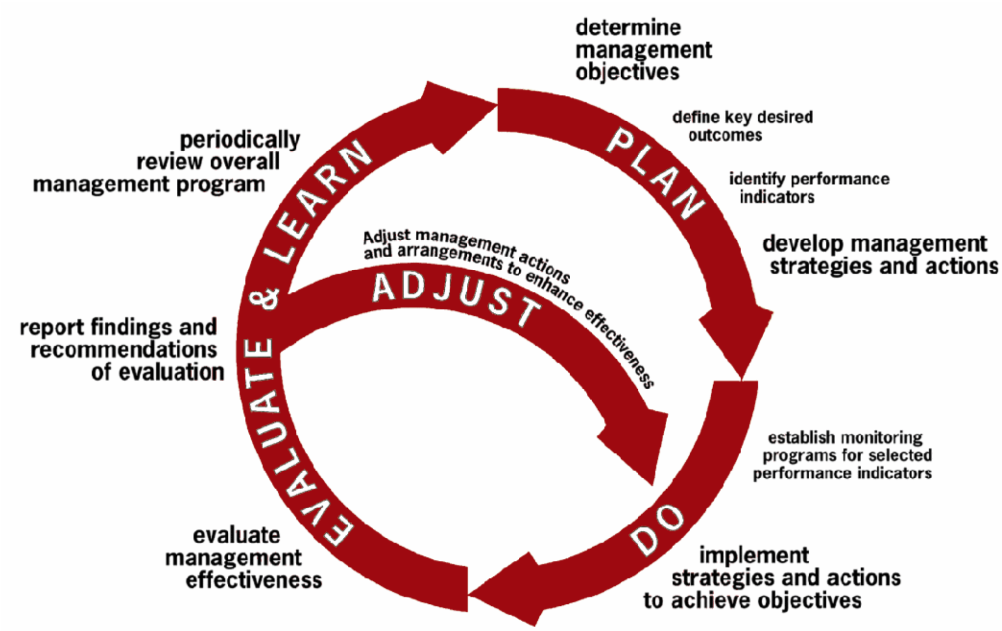
Walters (1997) criticizes many management agencies for missing the critical point of adaptive management – experimentation, controls, and adequate monitoring. Without these key steps, there is no difference between adaptive management and “regular‟ management that seeks only to satisfy short-term objectives without ensuring that long-term problems are adequately addressed.

Nichols and Williams (2006) highlight the key components of adaptive management and their relevance to monitoring, which are summarized below [see Hebblewhite (2008) Adaptive Management Cycle Diagram below].

- *Adaptive management is a sequential decision process that is especially useful when there is a high degree of uncertainty about the outcome of management actions.*
- *Management decisions are informed through a process that includes:*
  - *-developing management objectives;*
  - *-identifying potential management actions;*
  - *-developing or adapting models of system response to management actions;*
  - *-measures of confidence in the models; and*
  - *-monitoring data that provide estimates of system states.*
- *At each decision point, the appropriate management actions are evaluated for particular management objectives; the appropriate action is based on the estimated state of the system and the predicted responses of the system to management actions.*
- *Once the management action is implemented, monitoring is used to test the predictions of the model.*
- *This approach is iterative and implemented at each subsequent decision point, based on new estimates of system states and updated models.*

Adaptive management is a paradigm fundamental to the success of implementing compensatory mitigation. Without proper evaluation, the success or failure of mitigation cannot be determined, and the regulatory intent to prevent adverse impacts to wildlife will not be met.

Hebblewhite (2008) Adaptive Management Cycle Diagram



From Hebblewhite, M. 2008. Conceptual diagram of adaptive resource management as defined by Walters (1986, adapted from http://www.cmar.csiro.au/research/mse). Critically, management experiments are designed to contrast results of management experiments on key ecological indicators between control and treatment areas.

Conclusion

The purpose of these guidelines is to provide a metric or tool to define and implement a process that assesses mitigation for unavoidable impacts from oil and gas operations on wildlife resources. The compensatory mitigation metric contained within this document was derived from an extensive body of scientific literature which describes impacts to wildlife from oil and gas operations. The advantage of applying the metric is to ensure repeatability between oil and gas operations, and to provide a mechanism to not only assess compensatory mitigation acreage, but also provide a means to credit BMPs and wildlife-related projects. The metric should only be used to assess compensatory mitigation within crucial wildlife habitats and target compensatory mitigation projects which are commensurate with the habitats and species affected. Operators that commit more mitigation than was assessed could retain mitigation credits that they could bank for future operations and that would have a market value.

These guidelines endorse a hierarchical approach toward assessing compensatory mitigation which includes: a) avoid impacts to crucial wildlife habitats, b) minimize the extent and severity of impacts within crucial wildlife habitat, and c) mitigate the remaining effects of unavoidable impacts in crucial wildlife habitats. In application, the metric provides a reasonable and equitable approach to assess impacts and balance oil and gas development with conservation of the wildlife resources with the goal of maintaining consistency between agencies and operations.

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APPENDIX A

Compensatory Actions Valuation Table

COMPENSATORY MITIGATION ACTION (performed by operator)	WILDLIFE RESOURCE BENEFIT	CREDIT PERCENTAGE RELATIVE TO COMPENS-ATORY MITIGATION ACREAGE (for BMPs)	MITIGATION PROJECT OPTIONS (see table footnotes for types of projects and approximate costs)	ACRE EQUIVALENT	CREDIT MULIPLIERS (credit = no. of acres implemented times multiplier)
Habitat Treatment					
Creation of new habitat Opportunities to create new habitats are rare. Successful projects require additional collaboration between the operator and agency.	Would reduce impacts to wildlife habitat by creating new habitat that was previously unsuitable for the species or season that is impacted.	N/A	New hay meadow New aquatic habitat Food plots	Number of acres treated	5
Restore degraded terrestrial habitat (i.e., unoccupied/non functional habitat)	Would reduce impact to wildlife habitat by expanding/enhancing the carrying capacity of impacted type or season of habitat. However, an extended lag period may occur before beneficial remediation occurs.	N/A	Vegetation treatments	Number of acres treated	3
Enhance existing terrestrial habitat	Habitat is already providing a functional benefit. An	N/A	Vegetation treatments	Number of acres treated	2

COMPENSATORY MITIGATION ACTION (performed by operator)	WILDLIFE RESOURCE BENEFIT	CREDIT PERCENTAGE RELATIVE TO COMPENS-ATORY MITIGATION ACREAGE (for BMPs)	MITIGATION PROJECT OPTIONS (see table footnotes for types of projects and approximate costs)	ACRE EQUIVALENT	CREDIT MULIPLIERS (credit = no. of acres implemented times multiplier)
(i.e., occupied and functioning habitat)	extended lag period may occur before any beneficial remediation occurs.				
Water developments	Increases utilization of range or pasture resources and improves animal distribution over the landscape, including development of aquatic resources.	N/A	Springs/seeps development Wetland development Ponds/reservoirs Guzzlers Wells/windmills Pothole blasting	Cost of project /$500 an acre	2
Riparian & in stream enhancements	Maintains and restores function of aquatic habitats	N/A	In-stream structures Stream bank protection Fencing – livestock exclusions Restore riparian vegetation	Cost of project /$500 an acre	3
Habitat Management					
Integrated weed and vegetation management Plan development and implementation	Effective Implementation of plan improves /maintains quality of revegetated areas and promotes effective weed control.	N/A	Develop and successfully implement weed and vegetation management actions.	Cost of project /$500 an acre	1
Livestock management for benefit of wildlife	Improves quality/quantity/distribution of range for wildlife	N/A	Grazing deferral for life of WMP Change of duration and timing Cross fence Rotational grazing	N/A	1
Annual reclamation	Monitors and assesses	N/A	Monitoring activities and reporting	Cost of	1

COMPENSATORY MITIGATION ACTION (performed by operator)	WILDLIFE RESOURCE BENEFIT	CREDIT PERCENTAGE RELATIVE TO COMPENS-ATORY MITIGATION ACREAGE (for BMPs)	MITIGATION PROJECT OPTIONS (see table footnotes for types of projects and approximate costs)	ACRE EQUIVALENT	CREDIT MULIPLIERS (credit = no. of acres implemented times multiplier)
monitoring	reclamation success relative to habitat quality			monitoring/ $500 an acre	
Land Tenure Adjustments					
Fee Title Conservation Easement acquisition or donation—surface rights in perpetuity without enhancement projects	No remediation of impacts created by oil and gas development, but provides future protection from other types of surface development	N/A	N/A	Number of acres conserved	3
Fee Title/Conservation Easement acquisition or donation—surface rights in perpetuity with dedicated commitment to wildlife enhancement projects	Potential remediation of impacts created by oil and gas development. Provides future protection and enhanced management to benefit wildlife.	N/A	N/A	Number of acres conserved	5
Purchase, retirement, donation, of mineral development rights in perpetuity	No remediation of impacts created by a specific development but could create refuges where habitat would be protected forever from future oil and gas development.	N/A	N/A	Number of acres conserved	5
No surface occupancy in sensitive wildlife habitat for defined time period	Temporal and spatial protection for specified term to sustain wildlife populations	N/A	N/A	Number of acres conserved	1

COMPENSATORY MITIGATION ACTION (performed by operator)	WILDLIFE RESOURCE BENEFIT	CREDIT PERCENTAGE RELATIVE TO COMPENS-ATORY MITIGATION ACREAGE (for BMPs)	MITIGATION PROJECT OPTIONS (see table footnotes for types of projects and approximate costs)	ACRE EQUIVALENT	CREDIT MULIPLIERS (credit = no. of acres implemented times multiplier)
Application of Mitigative BMPs					
Field-wide application of operational practices that result in major reduction of disturbance to wildlife and that far exceed the industry standard (e.g., 3-phase gathering, centralized water distribution/fracturing)	Provides a level of impact minimization (especially the reduction of disturbance) that far exceeds the industry standard—does not provide for remediation of unavoidable impacts.	Centralized fluid distribution and collection systems: 3 phase gathering (produced water, condensate, gas)- up to 50% [1] Liquids distribution systems during exploration and production- up to 40% [2] Remote well site monitoring (SCADA)- up to 12% [3]	N/A	N/A	N/A

COMPENSATORY MITIGATION ACTION (performed by operator)	WILDLIFE RESOURCE BENEFIT	CREDIT PERCENTAGE RELATIVE TO COMPENS-ATORY MITIGATION ACREAGE (for BMPs)	MITIGATION PROJECT OPTIONS (see table footnotes for types of projects and approximate costs)	ACRE EQUIVALENT	CREDIT MULIPLIERS (credit = no. of acres implemented times multiplier)
		Man camps – up to 3% [4] Closed loop pitless operations – up to 5% [5] Voluntary application of seasonal timing restrictions - up to 16% (federal land) and up to 32% (private)[6] Use of high efficiency rig used to completely drill out a well pad – up to 25% [7]			
Phased development through the plan area (rapid drill out	Allows refuge areas to be maintained for wildlife and	Up to 25% acreage	N/A	N/A	N/A

COMPENSATORY MITIGATION ACTION (performed by operator)	WILDLIFE RESOURCE BENEFIT	CREDIT PERCENTAGE RELATIVE TO COMPENS-ATORY MITIGATION ACREAGE (for BMPs)	MITIGATION PROJECT OPTIONS (see table footnotes for types of projects and approximate costs)	ACRE EQUIVALENT	CREDIT MULIPLIERS (credit = no. of acres implemented times multiplier)
plus set-aside areas) defined by agency	shortens the drilling/disturbance window and concentrates drilling activity	reduction[8]			
Enhanced Reclamation					
On-site reclamation/restoration efforts of demonstrable benefit to affected wildlife and that far exceed the industry standard (e.g., greatly enhanced native seed mix, establishment of mature plants, irrigation, etc.)	No immediate remediation of development specific impacts, but could significantly improve both the time required to restore productive habitat for certain species or seasonal habitats affected and the eventual effectiveness of those habitats. However, these benefits may be offset in time by many years due to the operational life of well pads or other facilities.	Up to 40% acreage reduction for direct impacts for future proposed development[9]	N/A	N/A	0.5 for existing infrastructure
Public Access for Hunting/Fishing					
Provide or ensure continuation of public access hunting or fishing areas on private lands	Provides no remediation of unavoidable oil and gas related impacts, but would provide an important benefit for that may be an	N/A	N/A	N/A	0.25

COMPENSATORY MITIGATION ACTION (performed by operator)	WILDLIFE RESOURCE BENEFIT	CREDIT PERCENTAGE RELATIVE TO COMPENS-ATORY MITIGATION ACREAGE (for BMPs)	MITIGATION PROJECT OPTIONS (see table footnotes for types of projects and approximate costs)	ACRE EQUIVALENT	CREDIT MULIPLIERS (credit = no. of acres implemented times multiplier)
	appropriate exchange for those impacts.				
Provide sportsman outreach opportunities on private lands (e.g., turkey, fishing, cow elk, pronghorn, etc.)	Provides no remediation of unavoidable oil and gas related impacts, but would provide an important benefit that may be an appropriate exchange for those impacts.	N/A	N/A	N/A	0.25
Research Participation					
Financial and/or operational assistance with wildlife research programs.	Provides no remediation of unavoidable oil and gas related impacts, but would answer questions that would lead to better future planning, impact minimization, and impact remediation.	N/A	Examples: - Research technician funding - Graduate student support - Operation funding - Purchase of equipment	Research contribution /$500 an acre	3
Cash Mitigation					
Cash payment or an approved and endorsed mitigation bank or wildlife mitigation trust fund as compensation for unavoidable impacts to wildlife and wildlife habitat.	Provides the resources necessary to complete one or more of the mitigation activities listed above, and to pool resources to complete large scale or expensive key projects. However, it	N/A	Examples: - Payment to a land conservation fund - Seed bank funding - Donation of equipment (e.g., trucks, collars, ATVs) - Third party auditing of mitigation commitments	Cash contribution/ $500 an acre	5 wildlife rehabilitation for crucial wildlife habitat 1 wildlife

COMPENSATORY MITIGATION ACTION (performed by operator)	WILDLIFE RESOURCE BENEFIT	CREDIT PERCENTAGE RELATIVE TO COMPENS-ATORY MITIGATION ACREAGE (for BMPs)	MITIGATION PROJECT OPTIONS (see table footnotes for types of projects and approximate costs)	ACRE EQUIVALENT	CREDIT MULIPLIERS (credit = no. of acres implemented times multiplier)
	removes all responsibility for achieving the mitigation from industry and transfers it to someone else, and burdens the recipient with administrative responsibilities.		- Population monitoring (e.g., helicopter funding for grouse counts) - Property management technicians - Operation game thief - Education - Cash payment for every acre of disturbance		rehabilitation for sensitive wildlife habitat (e.g., big game) 1 for all other cash mitigation projects
Planning Documents					
Raptor mitigation plans, monitoring and reporting	Monitors effects on raptor populations	N/A	Raptor monitoring	Acres valued at $500/acre	2
Transportation plan	Reduces effects from habitat fragmentation due to road networks	N/A	Temporary worker housing Road and transportation design and modeling	Cost of plan/$500 an acre	2
Water quality sampling and analysis plan, and aquatic quality monitoring and testing	Monitors effects on water quality, aquatic habitats and sensitive species	N/A	Sampling and analysis	Cost of sampling /$500 an acre	2
Sage grouse monitoring plan develop and implement	Monitors effects on sage-grouse and guides development practices	N/A	Sage-grouse monitoring plan and monitoring and updates	Cost of plan/ $500 an acre	2
Livestock/grazing management plans	Improves quality of range for wildlife and livestock	N/A	Fencing, grazing deferral, herding moving	Cost of plan/ $500 an acre	1

COMPENSATORY MITIGATION ACTION (performed by operator)	WILDLIFE RESOURCE BENEFIT	CREDIT PERCENTAGE RELATIVE TO COMPENS-ATORY MITIGATION ACREAGE (for BMPs)	MITIGATION PROJECT OPTIONS (see table footnotes for types of projects and approximate costs)	ACRE EQUIVALENT	CREDIT MULIPLIERS (credit = no. of acres implemented times multiplier)
develop and implement					
Wildlife management plan develop and implement	Comprehensive planning. Provides direction for management actions and measurable responses.	N/A	Vegetation treatment, weed management, Plantings/treatments	Cost of plan/ $500 an acre	1
Landscape weed control plan develop and implement	Reduction of noxious weed infestations improves overall Improves/maintains quality of revegetated areas and promotes effective weed control habitat quality	N/A	Integrated weed management to include mapping control, and monitoring. Herbicide application Tamarisk removal and control	Cost of plan/ $500 an acre	1

Purple Shading- Applies to Direct Impacts Only
Green Shading- Applies to Indirect Impacts Only
No Shading- Applies to Both Direct and Indirect Impacts

Footnotes: Relative effectiveness of BMPs

The following BMPs reduce compensatory mitigation necessary for indirect impacts only.

1 and 2. Fluids Distribution and Collection Systems, 3-Phased Gathering. The only research available documenting the effectiveness of a liquids distribution system BMP is Sawyer 2009. He demonstrated a 38%-63% increase in the probability of use by mule deer when implementing a post drilling, production only liquid gathering system. It's important to note that the liquids gathering system evaluated by Sawyer is less than a 3-phase system which includes produced water, condensate and natural gas, and can be used for all phases of development including drilling and production. Since other species such as grouse are more sensitive to oil and gas impacts than mule deer this mitigative BMP would be less effective at mitigating these disturbances. Considering these factors, up to 50% compensatory mitigation acreage credit will be applied to reduce the compensatory mitigation acreage where 3-phase liquids distribution systems are in place and up to 40% acreage credit will be applied to reduce the compensatory mitigation acreage for liquids distribution systems used during the exploration and production phases only.

3. Remote Well Site Monitoring (SCADA). Indirect disturbance to wildlife from monitoring oil and gas locations is caused by vehicular traffic and the associated human activity. This disturbance takes place for a short period but can occur at all times of the day and night. Remote well monitoring reduces the frequency of disturbance and is a valuable operational and compensatory mitigation practice. A credit can be calculated up to 12%.

4. Man Camps. Implementation of this mitigative BMP can result in up to 3% reduction in vehicle disturbance and reduces incidents of direct wildlife mortality during the drilling period. Man camps established in remote areas shortens the length of vehicle trips overall and encourages carpooling opportunities. Establishment of well site man camps reduces vehicle trips and habitat fragmentation effects.

5. Closed Loop Drilling and Pitless Operations. The foremost benefit of closed loop/pitless operation is the elimination of potential wildlife entrapment or death from entering a pit. Closed loop drilling and pitless operations are valued at up to 5%.

6. Application of Seasonal Timing Restrictions. The temporary suspension of drilling operations has positive effects on nesting, fawning, calving and the winter survival of wildlife. The voluntary application of seasonal timing restrictions on federal lands is valued at up to 16% and up to 32% on private lands.

7. High Efficiency Rigs. It should be recognized that if seasonal timing limitations are waived, the use of high efficiency rigs is highly beneficial as the well pad drilling window is shortened. It also significantly reduces the vehicle traffic associated with rig moves. Implementation of this mitigative BMP can reduce the compensatory mitigation acreage by up to 25% because operators can drill the pad faster.

8. Phased Development. Implementing a phased development approach directs activity within a prescribed area versus haphazard occurrences across the landscape. Phased development creates refuge areas, promotes opportunities for earlier reclamation, consolidates traffic patterns and volumes, and is more effective at allowing the operator to implement liquids distribution systems, closed loop, and remote fracing. This mitigative BMP can reduce compensatory mitigation acreage by up to 25%.

This BMP reduces the compensatory mitigation acreage associated with direct impacts only.

9. Enhanced Reclamation. Enhanced reclamation differs from standard reclamation in that enhanced reclamation reclaims the disturbed area with native species with a composition, density, and canopy cover that is favorable to wildlife species of concern. A monitoring protocol should be used to quantify and assure that enhanced reclamation is being achieved. The value of the compensatory mitigation acreage credit can be as much as 40% of the direct impact acreage.

Examples of Average Project/Habitat Treatment Costs

The following list of implementation items/actions and associated cost references/estimates were partially taken from *"Recommendations for Development of Oil and Gas Resources within Important Wildlife Habitats,"* Version 3.0 revised September 2009, Wyoming Game and Fish Department, Cheyenne, Wyoming and 2008 and/or Custom Rates for Colorado Farms and Ranches, *Agriculture & Business Management Notes ...*

Habitat Creation

New food plots
New hay meadow
New aquatic habitat

Habitat Management

Hay meadow planting including disking, replanting, leveling, marking $2,000/acre
Irrigation system expansion:
- Gated pipe installation $500-$2,000/acre
- Ditch improvement $10-$100/foot
- Installation of wheel lines $10,000-$50,000/acre
- Installation of irrigation pivot $100,000-$500,000/acre

Other examples of habitat management
- Aspen $120/acre
- Conifer $150/acre
- Sagebrush/mountain shrub $55/acre
- Willow $120/acre
- Clear cut $200/acre
- Pinon-juniper removal $300/acre

Seeding grass, legumes, forbs $120/acre
Shrub/tree planting/transplants$22,000 tree row/mile
Prescribed burn:
- Shrub lands $25-$50/acre
- Juniper $50-$100/acre
- Mixed conifer $100-$500/acre
- Herbicide applications $20/acre

Range pitting $65/acre
Springs/seeps $2,500/acre
Wetland development $4,000/acre

Ponds/reservoirs $20,000/reservoir
Guzzlers $3,000 each
Wells/windmills $20,000-$100,000 each
Pothole blasting $1,000/pothole
In-stream structures $500-$3,000/structure
Stream bank protection and in-stream structures
- Small streams $6.50-$7.50/lineal foot
- Large streams$23-$33/lineal foot

Tamarisk removal and control $250/acre
Mapping weed control and monitoring $500/acre
Herbicide application only $90/acre
Approximate cost of planning documents $50,000
Permanent fencing $6,000/mile
Temporary fencing $2,500/mile
Grazing deferral/herding/moving livestock $2,000/month
Approximate cost of plan $150,000

Cash Mitigation

Project examples:
- Operation game thief
- Education
- Conservation easement
- Seed bank funding
- Research technician funding
- Donation of equipment (e.g., trucks, collars, ATVs)
- Third party monitoring of projects

Population monitoring (e.g., funding for grouse counts)
Property management technicians

Planning Support for Environmental and Biological Monitoring

Raptor monitoring approximately $50,000 each/plan, monitoring and annual updates $15,000 each/plan
Transportation plan approximately $25,000/each
Sampling and analysis plan $50,000/plan, water quality sample collection and testing $2,000/sample, and macro invertebrate sample collection and analysis $2,000/sample
Approximately $25,000 each /plan for sage-grouse monitoring plan and monitoring and updates $25,000/annually

APPENDIX B

Procedure for Development of a Wildlife Mitigation Plan (WMP) and GIS Analysis

The benefit to wildlife from developing a WMP is to mitigate impacts from oil and gas operations over a large geographic area. Benefits from a WMP could include:

- Expedited permitting following WMP approval.
- Pre-consultation on permits.
- Blanket approval of wildlife associated conditions of approval.
- Economic benefits associated with advanced detailed planning.
- Potential lease stipulation waivers.
- Development of relationships valuable for project development.

Following initial contact with the agency, the operator is encouraged to bring as much information as is practicable (including locations of current and future operations) to the initial planning meeting. The project leader will coordinate appropriate staff and advise them of the meeting date.

A basic 4-step process to progress through a WMP from the initial meeting through final approval:

1. Discuss, identify, and delineate the operator's objectives for the plan, affected wildlife species and crucial wildlife habitats, and overall area of operations.

   Discuss area of operations, crucial wildlife habitats and operations plans
   - Maps of well pads, pipelines, access roads, and other infrastructure.
   - Current and future development plans.
   - Shape files, well pads, pipelines, access roads, and other infrastructure of project area boundary.
   - Lists of BMPs.
   - Discuss crucial wildlife habitats and species, etc.

   Discuss BMPs and operations plans
   - Evaluate operations and BMPs
   - Consider planning documents that may be relevant such as:
     - Environmental Assessments.
     - Environmental Impact Statements.
     - Geographic Area Plans.
     - Master Development Plans.
     - 13-point Surface Use Plans of Operation.
     - Surface Use Agreements.
   - Plans of exceptional quality that could be included are:
     - Water sampling and analysis plan.
     - Transportation plan (including plans for man camps).
     - Food/E&P waste management plan.
     - Livestock utilization and management plan.
     - Wildlife (e.g., sage-grouse, mule deer, raptors) management plan.
     - Reclamation and noxious weed management plan.

- o Environmental monitoring plan.

2. Analyze spatial data using GIS and apply the metric described below to determine direct (footprint of the future proposed facilities) and indirect impact (1,640-foot buffer around existing and future proposed facilities).

Generalized Process for GIS Analysis

Direct Impacts Determination

a. Obtain GIS shape files from operator showing plan boundary, and future and existing well pads, access roads, pipelines, and other infrastructure such as evaporation ponds, lay down yards, compressor stations, etc. ("oil and gas facilities").
b. Overlay GIS data crucial wildlife habitats on the project area.
c. Trim back the impact area assessed to within the crucial wildlife habitats and the project boundary.
d. Assess the direct impacts from future proposed development. Apply 50-foot buffer on either side of the proposed oil and gas facilities.
e. Merge all direct impact buffers and dissolve overlaps.
f. Trim back direct impact areas to the crucial wildlife habitats within the plan boundary.
g. Assess entire acreage of crucial habitat (all parts of an intersecting polygon) for any facilities that intersect these habitats within the plan boundary.
h. Calculate and summarize the total acreage area of disturbance associated with direct impacts from future proposed development relative to crucial wildlife habitats.
i. Summarize acres for each species and activity for crucial wildlife habitats and total.

Indirect Impacts from Proposed Infrastructure Determination

a. Apply a 1,640-foot buffer to future proposed oil and gas facilities.
b. Merge and dissolve all buffers into one polygon so that overlapping areas do not create a double counting situation.
c. Overlay crucial wildlife habitats within the project area.
d. Trim back the proposed indirect impact areas to crucial wildlife habitats within the project area.
e. Erase overlapping direct impact areas from future proposed indirect impacts and calculate and summarize total acreage of indirect impacts from proposed infrastructure acreage keeping individual species and activities separate for crucial wildlife habitats.

Indirect Impacts from Existing Infrastructure Determination

a. Apply a 1,640-foot buffer to existing pad outlines (remaining pads that are not drilled out).
b. Merge and dissolve all pad buffers into one polygon so that overlapping areas do not create a double counting situation.
c. Overlay crucial wildlife habitats within the project area.
d. Trim back the existing indirect impact areas to within the crucial wildlife habitats within the project area.
e. Erase overlapping direct impact areas and future proposed indirect impacts from existing indirect impact areas and calculate and summarize total acreage of indirect impacts from

existing infrastructure acreage keeping individual species and activities separate for crucial wildlife habitats.

3. Negotiate means to reduce compensatory mitigation acreage through avoidance and minimization measures (BMPs) with the operator.

4. Resolve remaining compensatory mitigation acreage through mitigation projects negotiated and agreed to with the operator.

A fundamental component of a WMP is a detailed evaluation and monitoring plan. Specific objectives and benchmarks, in relationship to the commitments contained in the WMP should be identified and the evaluation criteria developed. Objective monitoring and systematic evaluation assures that wildlife protections are effective and identifies deficiencies that need correction or remediation (see link for guidance on monitoring http://pubs.usgs.gov/of/2008/1024/).

APPENDIX C

Compensatory Mitigation Habitat Improvement Projects Monitoring Report Outline

I. Monitoring Report Content

A. Project Information

1. Project name
2. Applicant name, address, and phone number
3. Consultant name, address, and phone number (if appropriate)
4. Acres of impact and type(s) of habitat impacted
5. Date project construction commenced
6. Indication of mitigation monitoring year (i.e., first, second, third, etc.)
7. Amount and information on any required performance bond or surety, if any

B. Compensatory Mitigation Site Information

1. Location of the site (regional map may be appropriate)
2. Specific purpose/goals for the compensatory mitigation site
3. Dates planting and/or construction began
4. Dates of any construction milestones
5. What type of equipment was used at the site
6. Detail of site topography and present vegetation
7. Seed mix, application type (i.e., broadcast, drilled etc), and seeding rate
8. Detail of any deviations from proposed plan
9. Date mitigation site construction and planting completed
10. Dates summary of previous maintenance and monitoring visits
11. Name, address, and contact number of responsible parties for the site
12. Summary of remedial action, if any

C. Location Map

D. Site Map (usually no larger than 11 x 17 unless a different scale is requested by the project manager).

The map should include the following information:

1. Habitat types as described in the approved mitigation plan
2. Locations of any photographic record stations
3. Landmarks
4. Location of sample points

E. List of Approved Success Criteria

F. Tabulated Results of Monitoring Visits, Including Previous Years, Versus Success Criteria

G. Summary of Field Data Taken to Determine Compliance with Success Criteria

H. Problems Noted and Proposed Remedial Measures