U.S. Fish and Wildlife Service

National Wildlife Refuge System
Revision of Regulations Governing
Non-Federal Oil and Gas Activities

Draft Environmental Impact Analysis

November 2015

EXECUTIVE SUMMARY

This draft Rule/Environmental Impact Statement (EIS) presents and analyzes the potential impacts of three alternatives for managing non-Federal oil and gas operations on National Wildlife Refuge System (NWRS) lands, which are surface estate lands held in fee or less-than fee (excluding coordination areas) as well as to operations on any waters within the boundaries of the refuge. These alternatives include: the no-action alternative, and two action alternatives involving revisions to the existing regulatory provisions contained within Title 50 of the Code of Federal Regulations (CFR), Part 29, Subpart C (29C). The EIS provides an assessment of the impacts that could result from the no-action alternative (continuing under the current regulations) or implementation of either of the action alternatives.

Upon conclusion of the EIS and decision-making process, one of the alternatives, or a combination of different parts of the various alternatives, could be adopted through a rulemaking process, which would guide future non-Federal oil and gas development on NWRS lands and waters for the foreseeable future.

This EIS is programmatic in nature, which means that it provides a framework for taking a range of actions, but that actions relating to new non-Federal oil and gas development would require more site-specific analyses before they could be permitted. In implementing these proposed regulatory revisions on specific NWRS lands and waters, additional analyses and environmental compliance, including consultation and an opportunity for public comments, would be completed under a separate National Environmental Policy Act (NEPA) and decision-making process.

BACKGROUND

There are over 5,000 oil and gas wells in a total of 107 refuge units. Based on the presence of split estates, exploration, and production occurring on adjacent or nearby lands, and future increases in energy prices, we believe that non-Federal oil and gas operations on refuges could affect many additional refuges.

In 1960, the U.S. Fish and Wildlife Service (Service) promulgated the current regulations to govern the exercise of non-Federal mineral rights on lands and waters in the NWRS. These regulations have not been updated since it was originally published and are ineffective at protecting refuge resources and at giving operators and Service employees clear guidance on requirements for operating on refuge lands. The existing regulations lack a specific process for operators and Service employees to plan operations that would both minimize impacts to refuge resources and allow operators to conduct efficient operations on refuges. As a result, management of non-Federal oil and gas operations on NWRS lands and water has been inconsistent and resulted in avoidable impacts to refuge resources from non-Federal oil and gas operations.

The Service is proposing to revise, clarify and expand the current regulations to reflect current laws, policies, and practices.

PURPOSE AND NEED FOR ACTION

The purpose of the proposed revisions to the current regulations is to ensure that non-Federal oil and gas operations, conducted on NWRS lands and waters, avoid or minimize adverse effects on fish, wildlife, and plant resources on refuges to the greatest extent practicable. Additionally, the Service intends to ensure that operations are conducted in a manner that protects employee and public health and safety, as well as wildlife-dependent recreational uses. The final purpose of the revisions is to improve understanding, application, and effectiveness of the regulations for the Service, the regulated community, and the public.

The Service has identified the following key reasons for proposing revisions to the existing 29C regulations:

- The Service has not formally asserted its authority to regulate non-Federal oil and gas rights currently being exercised on refuge lands and waters.
- The existing regulations serve as a general policy statement, but do not provide a comprehensive and functional regulatory framework for the exercise of non-Federal oil and gas rights.
- The current regulations do not provide comprehensive operating standards.
- The Service has limited means under the existing regulations to address violations.
- The existing regulations do not clearly state the scope of Service jurisdiction for directional oil and gas wells drilled beneath refuges from a surface location on lands or waters outside refuge boundaries.
- The existing regulations are not consistent with practices of other Federal agencies and private landowners concerning compensation to the United States for privileged access across federally owned lands beyond the boundary of an operator's non-Federal oil and gas property interest.
- The proposed regulations rectify the existing regulatory inconsistencies with the practices of other Federal agencies (e.g., NPS).
- The existing regulations do not address the Service's ability to require financial assurance from operators to ensure that funds are available to properly restore oil and gas operation sites in the event operators fail to fulfill their reclamation obligations.
- The existing regulations do not provide a means for the Service, as appropriate, to recover the costs for processing applications and monitoring non-Federal oil and gas operations on refuges.

Objectives must be achieved for an action to be considered a success. All alternatives selected for detailed analysis in this EIS must meet all objectives as well as resolve the purpose and need for action. Objectives for adequate regulatory oversight of non-Federal oil and gas operations must be grounded in the enabling legislation, purpose, significance, and mission of refuges affected under the proposed revisions. The Service has identified the following primary objectives to be met by revising the regulations:

- The Service's authority to specifically regulate the exercise of non-Federal oil and gas rights is clarified.
- The regulation provides consistent, functional, and understandable procedures and provisions to the regulated operating community, public, and refuge staff.
- Performance-based standards provide flexibility to resource managers and operators to achieve resource protection across various environments and uses of technology.
- The regulations provide a practical and effective means for dealing with acts of noncompliance or with illegally conducted operations (unauthorized operations) in refuges.
- The regulation addresses Service jurisdiction for directional oil and gas wells drilled beneath refuges from a surface location on lands or waters outside refuge boundaries

- All future non-Federal oil and gas operations conducted on federally owned or administered lands, and any waters within refuges utilize the least damaging methods to prevent or minimize damage to refuge resources and uses.
- All existing non-Federal oil and gas operations conducted on federally owned or administered lands, and any waters within refuges do not create additional unnecessary impacts on refuge resources and uses by maintaining full compliance with Federal and State laws, regulations, and permits.
- The regulation addresses existing operations by balancing the incremental level of protection for refuge resources and uses with the incremental administrative and cost burden imposed on both the regulated community and the Service.
- All non-Federal oil and gas operations conducted on federally owned or administered lands, and any waters within refuges are eventually reclaimed in a manner consistent with the purposes for which the refuge was established.
- The public and refuge staff are protected from health and safety hazards associated with non-Federal oil and gas operations.
- The United States is fairly compensated by operators for use of federally owned land outside the boundary of their non-Federal oil and gas property interest.
- Financial assurance provided by non-Federal oil and gas operators is adequate to ensure the public does not incur reclamation costs in the event of an operator default.
- The regulations provide a means for the Service, as appropriate, to recover the costs for processing applications and monitoring non-Federal oil and gas operations on refuges.

ALTERNATIVES

NEPA requires Federal agencies to explore a range of reasonable alternatives that address the purpose and need for the action. The alternatives under consideration must include the no-action alternative as prescribed by 40 CFR 1502.14. Action alternatives may originate from the proponent agency, local government officials, or members of the public at public meetings or during the early stages of project development. Alternatives may also be developed in response to comments from coordinating or cooperating agencies.

The alternatives analyzed in this document, in accordance with NEPA, are the result of internal and public scoping. These alternatives meet the overall purpose and need for the proposed action. Alternative elements that were considered but were not technically or economically feasible did not meet the purpose and need for the project, or created unnecessary or excessive adverse impacts on resources were dismissed from further analysis.

Three alternatives were developed which meet the stated objectives of this EIS and provide a reasonable range of options to manage exploration, drilling, production and transportation of non-Federal oil and gas within the refuges. These alternatives are described briefly below and presented in greater detail in Chapter 2.

ALTERNATIVE A: NO-ACTION

The no-action alternative retains the current level of regulation and oversight of oil and gas activities. The Service currently has no clear and defined process for managing these activities, resulting in most management of non-Federal oil and gas operations being conducted on a refuge-specific basis and varying widely. Current policy and training have not established performance-based standards for protection of refuge resources and uses, contributing to the variation in oil and gas practices and the levels of environmental protections across the NWRS.

Non-Federal oil and gas operations would continue without requiring performance bonds or access fees from operators. Under current conditions, if a transfer of rights and responsibilities for the operations has occurred, there are no general requirements to notify the refuge manager. The use of third-party monitors to ensure operator compliance is not addressed. Procedures for wells that are no longer active but not yet scheduled to be plugged would continue to vary by refuge and could result in well abandonment without plugging and site restoration in some cases.

The Service currently does not regulate oil and gas operations on conservation easements, inholdings, or operations involving directional drilling from a surface location outside a refuge to reach non-Federal oil and gas rights within a refuge.

ALTERNATIVE B: PROPOSED RULE (PREFERRED ALTERNATIVE)

Under Alternative B, the proposed rule would require an operations permit for all new operations and for any modifications to existing operations that would have additional, notable impacts on refuge resources or uses. Existing oil and gas operations with and without a Service-issued permit or ROW may continue as long as they comply with Federal, State, and local laws and the terms of their permit or ROW, if applicable. All operators must obtain an operation permit or update an existing Service-issued permit or ROW at the time of reclamation to ensure the surface area is restored to Service standards. Wells drilled from outside refuge boundaries or on private inholdings are exempt from the proposed regulation. Analysis in this EIS supports that this proposed permitting process is the best way to manage oil and gas operations and protect refuge resources on NWRS lands and waters.

Under Alternative B, the proposed rule would establish performance-based standards for avoiding or minimizing impacts to refuge resources or visitor uses during operations. Operators would be required to conduct operations in the technologically feasible, least damaging manner. Specifically, the proposed rule would include standards for surface use and site management; resource protections; spill prevention, response, and restoration; and waste management. The rule would also include standards for achieving successful surface reclamation once operations end. These specific standards would all be considered and incorporated into project design so that, overall, operations are conducted in a manner most protective of refuge resources and uses while ensuring human health and safety.

Under Alternative B, the Service also proposes to create an incentive for operators using directional drilling from a surface location outside a refuge to reach their oil and gas rights within a refuge by exempting them from the regulations. Also, it would authorize the Service to charge a fee for commercial vehicles using Service-administered roads and for new access (e.g., roads or gathering lines) across Federal lands where operators have no pre-existing property or other legal right to do so. Fees would be the fair market value of the use of Federal property and would reflect maintenance costs of roads and cost of mitigating any impacts to habitat on the refuge.

The proposed rule would require an operator to file a performance bond, or other acceptable method of financial assurance, as a condition of obtaining an operations permit. This would ensure adequate funds are available to restore the site, remove any equipment or contaminated soil, and revegetate the area in the event an operator defaults on their reclamation obligations. The financial assurance amount would be set equal to the estimated cost of reclamation. The proposed rule would allow the Service to reduce an operator's financial assurance by the amount of in-kind reclamation the operator may provide during the operations. The objective is to ensure that, in the event of an operator default, the public is not burdened with the cost of plugging and reclamation, and that refuge resources and uses are ultimately restored to pre-disturbance levels.

ALTERNATIVE C: MODIFIED PROPOSED RULE

Alternative C would include all the proposed changes in Alternative B, with a few notable exceptions. Service jurisdiction would expand to regulate non-Federal oil and gas operations that occur on private surface within the boundary of a refuge (i.e., inholdings) and to operations on non-Federal surface locations that use directional drilling to access non-Federal oil and gas underneath the surface of a refuge. Additionally, the operations permit requirement would be expanded from Alternative B to include not only new operations, but also existing operations that are and are not under a current Service-issued permit. Therefore, under Alternative C, all pre-existing and new operations within the boundary of the refuge or directional drilling beneath a refuge would be required to obtain an operations permit, meet all relevant operating standards, and post suitable financial assurance, in compliance with the provisions of the proposed rule. Also under Alternative C, performance-based standards and the permitting process would expand to actively regulate downhole operations such as well cementing, well casing, and well integrity testing, as a matter of course.

The exemption for operators using directional drilling would be removed under Alternative C. The Service could require actions, such as noise abatement or visual screening, which serve to reduce cross-boundary effects on Service resources and uses.

Detailed discussion of the alternatives considered is in Chapter 2: Alternatives.

AFFECTED ENVIRONMENT

The regulations implementing NEPA require agencies to describe the areas to be affected by the alternative actions being considered (40 CFR §1502.15). As this EIS is programmatic in nature, it broadly describes the following aspects of the NWRS lands and waters that may be affected by the alternatives considered:

- **Natural Resources:**
    - Geology and soils (including paleontology)
    - Air quality
    - Water resources (including surface and groundwater, both quality and quantity)
    - Wetlands
    - Floodplains
    - Vegetation (including plant species of special management concern)
    - Wildlife and aquatic species (including animal species of special management concern)
    - Natural soundscapes and acoustic environment
- **Visitor Use and Experience**
    - Human health and safety
    - Visitation patterns
    - Wildlife-dependent recreation opportunities
    - Scenic views and night sky resources
- **Cultural Resources**
    - Archaeological sites

    - Prehistoric/historic structures
    - Cultural landscapes,
    - Ethnographic resources
- **Refuge Management & Operations**
    - Processing permit applications
    - Monitoring operations to ensure that operators are in compliance with all applicable laws, regulations, and Service permits
    - Addressing incidents of noncompliance
    - Maintaining records
    - Providing information to the public and Congress, and addressing legal issues
    - Preparing guidance and policy documents and participating in training or workshops related to oil and gas management.
- **Socioeconomics**
    - Oil and gas operator costs and project financial viability
    - Regional and local economies

The full description of the affected environment is in Chapter 3: Affected Environment.

ENVIRONMENTAL CONSEQUENCES

Impacts of the alternatives on the affected environment were assessed in accordance with CEQ regulations implementing NEPA (40 CFR § 1508) and the Service's *NEPA for National Wildlife Refuge: A Handbook*. The analysis provides the public and decision-makers with an understanding of the implications of regulatory revisions in the short and long term, cumulatively, and within context, based on an understanding and interpretation by resource professionals and specialists.

Each alternative was evaluated for overall impacts and compared to the baseline to determine the context, duration, and intensity of resource impacts. The baseline is the condition that has resulted from implementation of the current 29C regulations.

Some general conclusions can be drawn about the adverse and beneficial impacts of implementing the various alternatives on refuge resources and uses, refuge management and operations, and socioeconomics

***Overall Impacts of Alternatives on Natural Resources, Visitor Use and Experience, and Cultural Resources*.**

Alternative A: No-Action

Under Alternative A, the current regulations and implementation practices would continue and result in no change in effects on refuge resources and uses from the existing condition. Occasional seismic surveys would have short-term and generally localized effects on refuge resources and uses, such as disturbance from human and vehicle activity. Also, other longer term impacts, such as habitat fragmentation, could possibly occur depending on species inhabiting the area, habitat, and the number and width of seismic survey lines.

Beneficial effects would continue from refuge managers negotiating with oil operators to place new operations under SUPs or ROW permits. However, unnecessary, adverse effects may continue to occur from operations not under SUPs or ROW permits, or from the inability to secure an operating standard in an SUP or ROW that provides adequate protection for refuge resources and uses.

Ongoing impacts on refuge resources and uses from pre-existing operations would be expected during the drilling and production phases. Adverse impacts to:

- Natural resources would include soil compaction, erosion, effects on water quality, noise, impacts from oil and brine spills, spread of invasive species, wildlife displacement, habitat alteration and fragmentation, and potentially wildlife mortality.
- Visitor use and experience would include visual impacts of sites exacerbated by site erosion and/or abandoned equipment; the risk of exposure to chemical or safety hazards at contaminated or unsecured sites; and noise and visual impacts from equipment and crews due to the lack of setbacks from visitor use and culturally sensitive areas, as well as lack of equipment maintenance or muffling devices.
- Cultural resources would include the risk of destruction of cultural resources or the degradation of their integrity, as well as visual impacts of sites that may be exacerbated by site erosion and lack of adequate distance between sites and areas of intensive cultural resource presence.

The lack of consistent requirements or processes to ensure wells are plugged and sites are reclaimed to Service standards would continue to result in long-term, adverse impacts on natural and cultural resources, including ongoing contamination of soil, air, and water from leaking wells, and permanent damage to refuge landscapes and hydrology. Impacts on visitor use and experiences would result from an increased risk of abandoned equipment, debris, and wastes left on the sites.

The lack of requirements under the current regulations for financial assurance, compensation for use of Federal property, and enforcement and penalties would continue to have indirect effects on refuge resources and uses, such as delays in reclamation because of lack of funding or enforcement.

Alternative B: Proposed Rule (Preferred Alternative)

Alternative B, the proposed rule would result primarily in long-term direct and indirect beneficial impacts on refuge resources and uses, compared to the existing condition. Benefits would accrue primarily from reduced risk to resources and uses due to new operations being subject to a consistent permitting process that includes performance standards that ensure new operations are conducted in the most technologically feasible, least damaging manner. Beneficial impacts to:

- Natural resources would include improved erosion/sedimentation control, storm water management, reduced air emissions, reduced fire hazards, reduced disturbance to wildlife, reduced impacts to wetlands and floodplains as well as wildlife habitat in general, improved water quality, and improved spill prevention, control, and countermeasure actions compared to the existing condition.
- Visitor use and experience would include improved site appearance from erosion/sedimentation control, cleanup of spills, removal of wastes and debris, removal of unused equipment, reduced fire hazards, and improved spill prevention, control and countermeasure actions compared to the existing condition.
- Cultural resources would include improved site appearance from erosion/sedimentation control, protection of cultural resources during site development, and adequate distances between sites and culturally sensitive areas.

Alternative B would extend regulation of oil and gas operations to tracts where the Federal interest is less than fee (e.g., wetland or grassland easements) to the extent necessary to protect Federal interest in those lands. As a result of active regulation by the Service, natural resources associated with interests acquired on easements, such as wetlands or native prairie, would have a consistent and higher level of protection compared to Alternative A.

Additionally, the Service would eliminate many of the ongoing, unnecessary impacts to refuge resources and uses resulting from pre-existing operations by assimilating State laws into the proposed rule and other proposed revisions to enforcement and penalties. For instance, the Service would be able to ensure that operators comply with State laws that would require secondary containment facilities, equipment that meets certain air quality standards, spill reporting and remediation, corrective action for noncompliance, and tank removal and site restoration.

As discussed above, the Service also proposes to create an incentive for operators to use directional drilling from a surface location outside a refuge by exempting such operations from the regulations. The exemption is expected to result in fewer wells drilled on refuge lands and waters. Removing the surface activities associated with oil and gas operations from within refuge boundaries serves to accomplish the objectives of regulation (avoidance or minimization of impacts) while relieving both the Service and operators from the costs of regulation.

Finally, Alternative B would require that all operations are reclaimed to Service standards, such as plugging all wells, removing all above-ground structures, equipment, roads, well pads, and contaminating substances, reestablishing native vegetation, restoring conditions to pre-disturbance hydrologic functions, and restoring natural systems using native soil material that would reduce impacts to refuge resources and uses within the refuge units. Eventually, the disturbance associated with the 4,000 pre-existing wells, as well as any new and existing operations under a Service-issued permit or ROW would be restored to Service standards, providing a substantial long-term reduction or removal of adverse impacts to refuge resources and uses.

Other regulatory changes would result in an improved process of handling minor acts of noncompliance, accelerated reclamation of sites compared to the existing condition, and funding sources that could indirectly benefit refuges and visitors using and viewing those resources.

Overall, these regulatory improvements would result in long-term direct and indirect beneficial impacts on refuge resources and uses compared to the existing condition, analyzed under Alternative A. Alternative B would result in primarily beneficial effects due to the regulation of new operations and the regulation of the reclamation phase of pre-existing operations, as well as stricter compliance with other Federal and State laws. Additionally, any adverse effects of regulated operations would be very limited when compared to the entire refuge area, and mitigation measures or stipulations would reduce the loss or degradation of natural resources, visitor use and experience, and cultural resources. Therefore, the impacts of this alternative would generally not be significant, though there may be some minor level of impact to the smallest operators.

When combined with the effects of all other actions in the study area, cumulative impacts from the actions under Alternative B would be long term and both adverse and beneficial, with Alternative B contributing mainly beneficial impacts to overall cumulative impacts from the change in regulations. Adverse impacts of oil and gas development would be localized, subject to regulatory review, and limited, and would not be significant.

Alternative C: Modified Proposed Rule

Alternative C, when compared to the existing condition, would also result in primarily beneficial impacts. Under Alternative C, the proposed rule would be modified to require that both existing and pre-existing operations on refuges obtain an operations permit and operate under the Service's performance based standards. This may result in some direct beneficial impacts to refuge resources and uses because the Service would be able to impose mitigation measures on pre-existing operations for any ongoing, unnecessary adverse impacts to natural resources. However, the Service believes that ensuring pre-existing operations comply with applicable Federal and State laws, as proposed under Alternative B, would provide adequate protection of refuge resources and uses from these ongoing, unnecessary adverse impacts.

As discussed above, under Alternative C, all operations on an inholding or on a non-Federal surface drilling underneath a refuge would also be required to obtain an operations permit and meet all relevant operating and reclamation standards. These modifications to the proposed rule could result in long-term beneficial indirect impacts on refuge resource uses because the Service standards would apply to operations outside the refuge to the extent necessary to protect refuge resources and uses. However, these benefits to resources and uses could evaporate, and many adverse consequences could occur, if just a small percentage of wells that otherwise would have been located outside a refuge are drilled inside the boundary. Gains in resource protection from these operations under Alternative C would likely be lost due to loss of the incentive to locate operations outside the refuge.

Operating standards and the permitting process under Alternative C would be the same as Alternative B, except the Service would actively regulate downhole operations, such as well cementing, well casing, and well integrity testing, as a matter of course. The Service's goals in regulating downhole aspects of oil and gas well drilling, production, and plugging are to 1) prevent escape of fluids to the surface, and 2) isolate and protect usable quality water zones throughout the life cycle of the well. The Service found that these regulatory goals can adequately be met by current state regulatory programs, and that Service regulation would slightly reduce already very low risks to usable quality water zones. Refuge resources and uses, other than usable quality water zones, would only be impacted by accidents associated with well control, and as discussed above, these events are extremely rare. For these other resources and uses, the Service does not expect any reduction of impacts or risks of impacts to refuge resources and uses related to our regulation of downhole operations. The Service finds that State requirements for well control and the expectation that companies will act in their own best interest provide adequate protections.

Similar to Alternative B, other regulatory changes would result in an improved process of handling minor acts of noncompliance, accelerated reclamation of sites compared to the existing condition, and funding sources that could indirectly benefit resources at the refuges.

The regulatory improvements in Alternative C would result mainly in long-term direct and indirect beneficial impacts on refuge resources and uses primarily from bringing previously exempt operations under regulation. However, Alternative C would largely eliminate the regulatory incentive for operators to locate operations outside refuge units by eliminating the exemption for operations on non-Federal surfaces. So, this alternative would likely result in more wells being drilled on refuge lands and waters, and thus would have more direct impacts on resources and uses within refuge boundaries. The impacts of Alternative C would not be significant because it would result in primarily beneficial effects, and any adverse effects of regulated operations would be limited in extent compared to the entire refuge area with mitigation measures or stipulations reducing the loss or degradation of natural resources, visitor use and experience, and cultural resources.

Overall under Alternative C, beneficial cumulative impacts would accrue from projects, plans, and actions considered in the cumulative scenario. When combined with the effects of all other actions in the study area, cumulative impacts would be long term and and beneficial.

Overall Impacts of Alternatives on Refuge Management and Operations

As discussed in further detail above, refuge management and operations that may be affected by the Service's proposed action to revise the Service's current regulations for management of oil and gas activities on the NWRS include processing permit applications, monitoring operations to ensure that operators are in compliance with all applicable laws, regulations, and Service permits; addressing incidents of noncompliance; maintaining records, providing information to the public and Congress, and addressing legal issues; and preparing guidance and policy documents and participating in training or workshops related to oil and gas management. The following general conclusions can be drawn about possible impacts of implementing the various alternatives on refuge management and operations.

Alternative A: No-Action

Under Alternative A, the current regulations and implementation practices would continue and there would be no change in the administration of currently regulated operations. Alternative A would result in no change to refuge management and operations. The Service estimates it spends approximately $3.6 million annually, which is less than 1 percent of the NWRS operating budget, managing activities associated with the exercise of non-Federal oil and gas rights. The costs to the Service in terms of staff and resources of ensuring operational compliance with current requirements would continue under Alternative A, and would result in long-term adverse impacts on refuge management and operations, although these impacts would vary depending on local conditions. For example, exposed well casings and abandoned oilfield equipment and flowlines can limit management options for refuge managers due to safety risks. Tall, dense vegetation can hide flowlines and protruding well casings which can damage refuge equipment and vehicles and potentially injure refuge employees. Therefore, on a refuge-specific level, management of oil and gas operations can have a notable impact on refuge management and operations. However, because Alternative A would not change any impacts to refuge management and operations and impacts are generally manageable and minimal in context of Service-wide refuge management and operations, these impacts would not be significant.

Alternative A would contribute only slightly too adverse cumulative impacts occurring to refuge management and operations as a result of cumulative plans and actions.

Alternative B: Proposed Rule (Preferred Alternative)

The administration of Alternative B could require some reallocation of refuge staff and resources, but would also benefit from cost recovery provisions, such that the overall administrative burden of non-Federal oil and gas management would increase somewhat compared to the existing condition. There would be additional responsibilities involved in processing operations permit applications and monitoring operations. The Service estimates that the equivalent of an additional three FTE could be necessary to provide management at the level needed to meet the objectives of Alternative B. This represents approximately a 10 percent increase in program management costs from $3.6 million under Alternative A to $4 million under Alternative B. Provisions for cost recovery and compensation for access across federally owned lands would result in the potential for a reduced financial and administrative burden, resulting in long-term beneficial impacts on refuge management and operations.

Within the broader context of all cumulative plans and actions affecting refuge management and operations, implementation of Alternative B would contribute a small but noticeable amount to adverse and beneficial cumulative impacts. Impacts would likely be greater to refuge operations for those units with a high number of current and/or exempt operations and for those units which exhibit a greater potential for future operations due, for instance, to their proximity to Marcellus shale or the Tuscaloosa shale.

Alternative C: Modified Proposed Rule

Under Alternative C, all new and existing operations within the scope of the modified proposed rule would be required to obtain an operations permit and meet all relevant operating and reclamation standards. Operating standards and the permitting process under Alternative C would be the same as Alternative B, except the Service would actively regulate downhole operations as a matter of course.

Under Alternative C, the degree of administrative burden would increase. New operations, pre-existing operations in the production phase, and operations utilizing directional drilling to access private minerals outside the refuge administrative boundaries, would require the regulatory oversight of the Service.

Impacts include the additional responsibilities involved in the oversight and management of all operations, and an increase in the existing workload of refuge staff when compared to the existing condition and Alternative B. This would require additional FTE or other administrative or material resources. Additional responsibilities involved in addressing new, existing, and pre-existing operations would require expansion of dedicated refuge and NWRS Energy Team staff. Provisions for cost recovery and compensation for access across federally owned lands could result in the potential for a reduced financial and administrative burden, resulting in long-term beneficial impacts on refuge management and operations. Overall, management and administration costs would increase substantially, perhaps to a $7 to $8 million range annually, to gain the intended incremental resource protections of the Modified Proposed Rule, resulting in substantial adverse and long-term impacts on refuge operations due to the added cost burdens.

The contribution to cumulative impacts of Alternative C would be notable, but still small given the wider context of cumulative actions affecting refuge management and operations. Adverse impacts of the additional staff and operational need could be significant on a local level, but not on a Service-wide refuge management basis.

Overall Impacts of Alternatives on Socioeconomics

Socioeconomics that may be affected by the Service’s proposed action to revise the Service’s current regulations for management of oil and gas activities on the NWRS may include oil and gas operator costs and project financial viability and local and regional economies. The following general conclusions can be drawn about possible impacts of implementing the various alternatives on socioeconomics.

Alternative A: No-Action

Under Alternative A, the current regulations and implementation practices would continue and there would be no change in effects on operator costs and local and regional economies from the existing condition. Most new operations would continue to be conducted under a voluntary SUP or a ROW.

Operations are currently benefiting local and regional economies in adjacent communities, although their production is fairly minimal within the local and state context. Additionally, the production supports ad valorem and severance taxes, benefitting communities, counties, and sometimes states, although this benefit is also small within the local and regional context. Since the Service receives no compensation from operators to cross federally owned lands, the operator benefits by obtaining access at no cost. Because Alternative A would not change current level of impacts, impacts to communities are generally beneficial, and adverse impacts to operators are generally manageable and minimal, the impacts of Alternative A would not be significant.

Both adverse and beneficial cumulative impacts would occur from actions considered in the cumulative scenario. However, the contribution to cumulative impacts of Alternative A would be slight given the considerable oil and gas development occurring in the regions outside refuge boundaries; additional Federal, State, and local oil and gas permitting and operational requirements; and the many other cumulative impacts affecting operator costs and local and regional economies.

Alternative B: Proposed Rule (Preferred Alternative)

Under Alternative B, operators would incur additional costs to comply with the proposed rule. The additional costs stem primarily from provisions that require operators under an operations permit to maintain financial assurance and reimburse the Service for costs associated with processing and administering the operations permit. Operators of pre-existing wells would incur costs at the time of well plugging and reclamation due to the requirement to conduct reclamation to Service standards under an operations permit. Access fees for use of Federal surfaces beyond an operator's oil and gas rights boundary would be a small additional expense for all operations. The administrative and operational costs of the proposed rule on operators are typically small relative to the total project costs and revenues. Additionally, the increased expenses are not expected to affect most company operations as these expenses are (1) a fraction of a percentage of company revenue, and (2) the number of wells a company operates in a refuge is typically a small percentage of its business portfolio. A very small percentage of small operations could be affected, depending on their financial reserves.

Compared to Alternative A, costs for operators could affect individual well economics. Perhaps up to 1,000 marginally producing and idle wells are likely to be plugged and reclaimed sooner under Alternative B as a result of regulatory costs changing individual well economics. Since these wells currently have little or no associated oil and gas production, wells being plugged and reclaimed would have no noticeable impacts on local and regional economies. The same would apply to royalty revenues to leaseholders.

The socioeconomics of Alternative B provides an even greater incentive for operators to choose a surface location outside a refuge to explore for and produce non-Federal oil and gas resources inside a refuge. Since it includes provisions for maintaining financial assurance, access fees, and cost recovery, among others, the operator's costs increase, as does the incentive to avoid those costs.

The proposed rule would allow the Service to recover fees for processing permits and for refuge maintenance and other impacts necessitated by oil and gas operations. Because Alternative B would result in no noticeable impacts on local and regional economies and any adverse effects on individual operators would be limited in extent, the impacts of this alternative would not be significant.

The additional compliance costs associated with Service requirements under Alternative B would have minor cumulative adverse impacts on operators because of the small contribution of these operational costs compared to company revenue and the small percentage of a company's portfolio represented by wells in a refuge unit. Under limited circumstances, very small companies could potentially be affected by the additional compliance costs, although the number of these operations would be a very small percentage of overall operations.

The contribution to cumulative impacts of Alternative B would be slight given the considerable oil and gas development occurring in the regions and the many other cumulative impacts affecting the local and regional economies, and any adverse impacts of the alternative would not be significant.

Alternative C: Modified Proposed Alternative

Alternative C would impose substantial costs on a larger number of operators compared to Alternative B. Primarily, the modified proposed rule would impose costs for permitting, cost recovery, maintenance of financial assurance, and compliance with Service operating standards on up to 4,500 existing wells on both Federal and private surface estate. Using cost estimates for the regulatory provisions described in Alternative B, and applying them to 1,000 operations permit applications and 4,500 wells, operators of pre-existing wells could incur costs over $20 million initially and $15 million annually thereafter.

Alternative C would expand Service jurisdiction under the regulations to encompass surface and subsurface directional drilling operations outside the boundary of a refuge, subjecting operators of these wells to the full regulatory requirements of a new operation inside a refuge. With little incentive for operators to choose surface drilling locations outside a refuge, some of the additional operations permit applications would be changed to surface operations inside a refuge which would likely increase the cost to operators.

Compared to Alternative B, the expansion of Service regulation to downhole activities under the modified proposed rule could generally increase operator costs by 10 to 30 percent in cost categories of permitting, cost recovery fees, maintenance of financial assurance, and meeting Service standards that are above and beyond other Federal and State requirements.

The contribution to cumulative impacts of Alternative C would be slight given the considerable oil and gas development occurring in the regions and the many other cumulative impacts affecting the local and regional economies, and any adverse impacts of the alternative would not be significant.

Conclusion: Alternative B is Preferred Alternative

Three general conclusions can be drawn from the analysis about impacts of the alternatives:

1. The action alternatives do not authorize any activities that create additional adverse impacts on natural resources, visitor use and experience, and cultural resources compared to the no-action alternative.

2. Overall beneficial impacts on natural resources, visitor use and experience, and cultural resources are expected from the action alternatives.
3. The beneficial impacts come in conjunction with some increased financial considerations for both the Service and operators.

Based on our analysis, we have determined that Alternative B is the preferred alternative because it best meets the purposes and needs of revising the existing rule and will provide the maximum protection of refuge resources when balanced with the cost to operators and to the Service for administration. Alternative C would also have beneficial impacts to refuge resources and uses. In some cases, Alternative C would provide more benefits and protection than Alternative B. However, the Service does not believe that the relatively small, incremental environmental benefits of Alternative C are worth the significant additional administrative costs associated with the implementation of Alternative C on the Service and operators.

The full impact analysis is in Chapter 4: Environmental Consequences.

TABLE 1. THE EFFECTS OF THE THREE ALTERNATIVES DESCRIBED IN THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

	Alternative A	Alternative B (Preferred Alternative)	Alternative C
Natural Resources	No change in impacts. Some ongoing, unnecessary adverse impacts continue from operations not under a voluntary Service-issued SUP or ROW or the inability to secure an operating standard in an SUP or ROW that provides adequate protection for refuge natural resources.	Adverse impacts minimized to the greatest extent practicable for new operations due to permitting requirements and performance-based standards that ensure operations are conducted using technologically feasible, least damaging methods. Some unnecessary, ongoing adverse impacts from pre-existing operations may continue, but stricter compliance with Federal and State laws should minimize or avoid these ongoing impacts. Long-term beneficial impacts due to requirement that all operations will be reclaimed to meet Service standards	Adverse impacts minimized to the greatest extent practicable by permitting requirements and performance-based standards applied to all operations on refuges, inholdings, and non-Federal surface locations adjacent to a refuge with directional drilling extending beneath a refuge. This ensures operations are conducted using technologically feasible, least damaging methods. Long-term beneficial impacts due to requirement that all operations will be reclaimed to meet Service standard Some additional, direct adverse impacts due to removal of incentive to locate operations on non-Federal surfaces.
Visitor Use and Experience	No change in impacts. Some ongoing, unnecessary adverse impacts continue from operations not under a Service-issued SUP or ROW or the inability to secure an operating standard in an SUP or ROW that provides adequate protection for visitor use and experience.	Adverse impacts minimized to the greatest extent practicable for new operations due to permitting requirements and performance-based standards that ensure operations are conducted using technologically feasible, least damaging methods. Some unnecessary, ongoing adverse impacts from pre-existing operations may continue, but stricter compliance with Federal and State laws should minimize or avoid these ongoing impacts. Long-term beneficial impacts due to requirement that all operations will be reclaimed to meet Service standards	Adverse impacts minimized to the greatest extent practicable by permitting requirements and performance-based standards applied to all operations on refuges, inholdings, and non-Federal surface locations adjacent to a refuge with directional drilling extending beneath a refuge. This ensures operations are conducted using technologically feasible, least damaging methods. Long-term beneficial impacts due to requirement that all operations will be reclaimed to meet Service standard Some additional, direct adverse impacts due to removal of incentive to locate

	Alternative A	Alternative B (Preferred Alternative)	Alternative C
			operations on non-Federal surfaces.
Cultural Resources	No change in impacts. Some ongoing, unnecessary adverse impacts continue from operations not under a voluntary Service-issued SUP or ROW or the inability to secure an operating standard in an SUP or ROW that provides adequate protection for cultural resources.	Increased protection on easements due to Federal nexus and applicability of Federal cultural resource protection laws.	Increased protection from operations on private inholdings within a refuge and on non-Federal surface locations due to Federal nexus and applicability of Federal cultural resource protection laws.
Refuge Management and Operations	Administrative costs remain the same. Increased cost of management and operations as Service continues to bear cost of plugging and reclamation from insolvent operators	No material change in administrative costs, but could require reallocation of some refuge staff and resources. Costs of operations may decrease due to access fees and cost reimbursement provisions.	Great increase in administrative costs due to processing of operations permits for all operations (new, existing and pre-existing), regulation of downhole operations, and enforcement of proposed rule. Costs of operations may decrease due to access fees and cost reimbursement provisions.
Socioeconomics (Cost to Operators and Local Economy)	Costs remain the same.	Increased costs to new operators due to compliance with financial assurance, cost recovery, and access fees provisions. Increased costs for existing wells due to reclamation to Service standards. .	Greatly increased costs to all operators due to compliance with modified proposed rule

CONSULTATION AND COORDINATION

The Service engages in internal, external, and public scoping as an essential aspect of the NEPA process. Internal scoping involves discussions among Service personnel regarding the purpose and need for management actions, issues, management alternatives, mitigation measures, the analysis boundary, appropriate level of documentation, available references and guidance, and other related topics. Public scoping is the early involvement of the interested and affected public in the environmental analysis process. Based on internal and public scoping, the Service developed the objectives of revising the regulations and a list of resources and concerns to evaluate in this draft rule revision/EIS.

Internal scoping for the EIS began in January 2013 with the establishment of an interdisciplinary team comprising Service subject matter experts, practitioners, and natural and cultural resource management professionals. The team has continued to meet regularly to provide input to the process, including framing the analysis to focus on main areas of change in the regulations and identifying impact topics for detailed analysis.

Public participation in the scoping process officially began through publication of an advance notice of proposed rulemaking and the notice of intent to develop an environmental impact statement (ANPR/NOI/EIS) in the Federal Register (79 FR 10080) on February 24, 2014. The purpose of issuing the ANPR was to advise the public of the Service's intent to develop a proposed rule to revise the 50 CFR 29.32 regulations, and to seek comments and suggestions related to several topics, including regulation of new and pre-existing operations; directional drilling beneath refuges from surface locations outside refuges; operating standards; operator financial assurance; access fees; and assessments for operator noncompliance with the regulations. The Service also issued an official news release on February 24, 2014, advising the public on publication of the ANPR/NOI/EIS in the Federal Register. The Service received 79,612 responses to the ANPR, containing comments from business interests, professional societies, conservation organizations, unaffiliated individuals, and State agencies. The comments received were primarily supportive of the revisions.

Further details on consultation and coordination for this EIS are described in Chapter 5: Consultation and Coordination.

THE NEXT STEP

The public review and comment period for this draft rule revision/EIS will be 60 days. Written comments on the draft rule revision/EIS will be fully considered and evaluated in preparing the final rule revision/EIS. The final rule revision /EIS will then be issued, which will be approved by the Service after a minimum 30-day no-action period. The final rule revision /EIS will include agency and organization letters and responses to all substantive comments.

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ABBREVIATIONS

ACOE	U.S. Army Corps of Engineers
ANPR	Advance Notice of Proposed Rulemaking
API	American Petroleum Institute
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BMP	Best management practices
BOR	Bureau of Reclamation
BTEX	Benzene, toluene, ethylbenzene, and xylene
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CWA	Clean Water Act
D.O.	Director's order
dBA	A-weighted decibel
DOI	Department of the Interior
DOT	U.S. Department of Transportation
E.O.	Executive order
EIA	U.S. Energy Information Administration
EIS	Environmental impact statement
EPA, USEPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
FLM	Federal land manager
FS	Forest Service
GWPC	Ground Water Protection Council
IOGCC	Interstate Oil and Gas Compact Commission
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOI	Notice of intent
NORM	Naturally occurring radioactive material
NPS	National Park Service

NWR	National Wildlife Refuge
NWRS	National Wildlife Refuge System
NWRSAA	National Wildlife Refuge System Administration Act
NWRSIA	National Wildlife Refuge System Improvement Act
ORV	Off-road vehicle
PCB	Polychlorinated biphenyl
PSD	Prevention of significant deterioration
ROW	Right-of-way
Service, USFWS	U.S. Fish and Wildlife Service
SUP	Special use permit
TRRC	Texas Railroad Commission (Railroad Commission of Texas)
USGS	U.S. Geological Survey
VOC	Volatile organic compound
WMD	Wetland Management District
WPAP	Wetlands Policy and Action Plan

CHAPTER 1: PURPOSE AND NEED FOR ACTION

INTRODUCTION

This Purpose and Need for Action chapter describes why the U.S. Fish and Wildlife Service (Service) is proposing revising regulations for governing non-Federal oil and gas activities within the boundaries of National Wildlife Refuge System (NWRS) lands (refuges). The Service evaluated a range of alternatives for the revision and expansion of its rules at 50 CFR Part 29, which apply to non-Federal oil and gas development on NWRS lands. The Service has prepared this environmental impact statement (EIS) pursuant to the National Environmental Policy Act (NEPA) in order to assess potential environmental impacts associated with a range of reasonable alternatives for regulating non-Federal oil and gas development on refuges.

Refuge resources that could be affected include fish and wildlife, geology and soils, air quality, water resources, wetlands, floodplains, vegetation, scenic views and night sky resources, natural soundscapes and the acoustic environment, and cultural resources. Effects on visitor use and experience, refuge management and operations, and socioeconomics have also been analyzed. Changes to the regulations are expected to affect both current and future non-Federal oil and gas operations occurring on Service-administered lands.

This EIS presents and analyzes the potential impacts of three alternatives: a no-action alternative (current management) and two action alternatives for the regulatory oversight of non-Federal oil and gas development. Upon conclusion of the EIS and decision-making process, one of the alternatives, or parts of each, could be adopted through a rulemaking process, which would guide management and oversight of future non-Federal oil and gas development at refuge units for the foreseeable future.

This EIS is programmatic in nature, which means that it provides an analysis of a framework for taking a range of actions, but specific actions relating to new or expanded non-Federal oil and gas development would require more site-specific analyses before they could be permitted. Environmental compliance on the project level, including additional consultation and an opportunity for public comments, will be completed under a separate NEPA and decision-making process.

PURPOSE AND NEED FOR ACTION

The purpose of this action is to develop goals and objectives that the Service intends to fulfill by management activities. The need for this action arises from existing conditions that need to be changed, problems that need to be remedied, decisions that need to be made, and policies or mandates that need to be implemented. *Purpose* is what we want to do; *need* is why we want to do it. The following purpose and need statements were developed by the Service for this EIS with input from the public and other agencies. Additional information that supports the purpose and need is provided throughout the other sections of this chapter.

PURPOSE OF THE REGULATION REVISION

The purpose of the regulation revision is to ensure that non-Federal oil and gas operations conducted on NWRS lands and waters avoid or minimize, to the greatest extent practicable, adverse effects on refuge land, water, and resources, as well as refuge wildlife-dependent recreational uses, and are conducted in a manner that protects employee and public health and safety. In addition, the purpose is to improve understanding, application, and effectiveness of the regulations for the Service, the regulated community, and the public. This is accomplished by revising the 50 CFR 29.32 regulations.

NEED FOR ACTION

The Service has identified the following key reasons for proposing revisions to the existing 50 CFR 29.31-32 regulations:

- The Service has not formally and publicly asserted its authority to regulate non-Federal oil and gas rights currently being exercised within the authorized boundaries of refuges.
- The existing regulations serve as a general policy statement, but do not provide a comprehensive and functional regulatory framework for the exercise of non-Federal oil and gas rights.
- The current regulation does not provide comprehensive operating standards.
- The Service has limited means under the existing regulations to address violations.
- The existing regulations do not address Service jurisdiction for directional oil and gas wells drilled beneath refuges from a surface location on lands or waters outside refuge boundaries.
- Inconsistencies and uncertainties in non-Federal oil and gas rights management results in unnecessary adverse impacts on refuge resources and uses.
- The existing regulations are not consistent with practices of other Federal agencies and private landowners concerning compensation to the United States for privileged access across federally owned lands beyond the boundary of an operator’s non-Federal oil and gas property interest.
- The existing regulations do not address the Service’s ability to require financial assurance from operators to ensure that funds are available to properly restore oil and gas operation sites in the event operators fail to fulfill their reclamation obligations.
- The existing regulations do not provide a means for the Service, as appropriate, to recover the costs for processing applications and monitoring non-Federal oil and gas operations on refuges.

OBJECTIVES IN TAKING ACTION

Objectives must be achieved, to a large degree, for an action to be considered a success. All alternatives selected for detailed analysis in this EIS must meet objectives, to a large degree, as well as resolve purpose and need for action. Objectives for adequate regulatory oversight of non-Federal oil and gas operations must be grounded in the enabling legislation, purpose, significance, and mission of refuges affected under the proposed revisions.

The Service has identified the following primary objectives to meet by revising the 50 CFR §29.32 regulations:

- The Service’s authority to specifically regulate the exercise of non-Federal oil and gas rights is clarified.

- The regulation provides consistent, functional, and understandable procedures and provisions to the regulated operating community, public, and refuge staff.

- Performance-based standards provide flexibility to resource managers and operators to achieve resource protection across various environments and uses of technology
- The regulations provide a practical and effective means for dealing with acts of noncompliance or with illegally conducted operations (unauthorized operations) in refuges.
- The regulation addresses Service jurisdiction for directional oil and gas wells drilled beneath refuges from a surface location on lands or waters outside refuge boundaries in a way that utilizes the least-damaging methods to prevent or minimize damage to refuge resources and uses.
- All future non-Federal oil and gas operations conducted on federally owned or administered lands and waters within refuges utilize the least-damaging methods to prevent or minimize damage to refuge resources and uses.
- All existing non-Federal oil and gas operations conducted on federally owned or administered lands, and any waters within refuges do not create additional unnecessary impacts on refuge resources and uses by maintaining full compliance with Federal and State laws, regulations, and permits.
- The regulation addresses existing operations by balancing the incremental level of protection for refuge resources and uses with the incremental administrative and cost burden imposed on both the regulated community and the Service.
- All non-Federal oil and gas operations conducted on federally owned or administered lands, and any waters within refuges are eventually reclaimed in a manner consistent with the purposes for which the refuge was established.
- The public and refuge staff are protected from health and safety hazards associated with non-Federal oil and gas operations.
- The United States is fairly compensated by operators for use of federally owned land outside the boundary of their non-Federal oil and gas property interest.
- Financial assurance provided by non-Federal oil and gas operators is adequate to ensure the public does not incur reclamation costs in the event of an operator default.
- The regulations provide a means for the Service, as appropriate, to recover the costs for processing applications and monitoring non-Federal oil and gas operations on refuges.

UTILITY OF REGULATIONS

Because of the vagueness of the current regulations, they lack utility for oil and gas operations. The regulations have led to inconsistent processes in permit applications, operating standards, approval standards, and general terms and conditions. Administrative inefficiencies can detract from the primary objective of avoiding and minimizing the effects of oil and gas activities on refuge resources. While the Service has had many local successes working with oil and gas operators to achieve appropriate resource protections, there are many more examples of unnecessary impacts on trust resources and refuge management. These same impacts have caused delays and additional costs for operators.

A fundamental aspect of a revised rule would be to improve regulatory consistency and functionality to the benefit of refuge resources, refuge administration, and oil and gas operators.

PURPOSE AND SIGNIFICANCE OF NATIONAL WILDLIFE REFUGES

The NWRS, managed by the Service, is the world's premier system of public lands and waters set aside to conserve America's fish, wildlife, and plants. Since President Theodore Roosevelt designated Florida’s Pelican Island as the first wildlife refuge in 1903, the NWRS has grown to more than 150 million acres, 562 national wildlife refuges and other units, plus 38 wetland management districts.

The mission of the Service is:

> *Working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people.*

To accomplish this mission, the Service established the National Wildlife Refuge System, whose mission is:

> *To administer a national network of lands and waters for the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (National Wildlife Refuge System Administration Act of 1966).*

The NWRS provides habitat for threatened and endangered species, migratory birds, and some of the Nation’s most important fishery resources. Fifty-nine refuges have been established specifically to protect endangered species. The NWRS also includes about 20 percent of the designated Wilderness areas in the U.S.

Refuges offer outstanding wildlife-dependent recreational opportunities, including fishing, hunting, wildlife observation and photography, and environmental education and interpretation. Around 40 million people visit refuges annually.

BACKGROUND

NON-FEDERAL OIL AND GAS DEVELOPMENT ON NATIONAL WILDLIFE REFUGES

Oil and gas exploration and development occur in specific situations on refuges. These activities most often occur where the Service acquired the surface rights to the land and the mineral estate remained in non-Federal ownership. The owners of these “non-Federal” mineral rights (they may be individuals, corporations, State or local governments, or Indian tribes) have the legal right to explore for and extract their oil and gas resources.

Such rights are a form of real property and fall under the protection of the Fifth Amendment to the U.S. Constitution, which states, “No person shall be …deprived of … property, without due process of law; nor shall private property be taken for public use, without just compensation.” (U.S. Const. amend. V). The Service nonetheless may regulate the exercise of these property rights within the NWRS pursuant to the authority described in the next section. That is, the proposed regulations apply reasonable time, place, and manner avoidance and mitigation measures to the exercise of mineral rights, but do not deny the operator access.

The types of non-Federal oil and gas development activities conducted on refuge lands generally include geophysical (seismic) exploration; exploratory well drilling; field development; well drilling; oil and gas well production operations, including installation and operation of well flowlines and gathering lines; well plugging and abandonment; and surface restoration. Each of these types of development has occurred or continues to occur. We currently have 103 refuges and 4 wetland management districts (WMDs) with oil and gas production. Appendix C presents a description of each type of operation that typically occurs during exploration and production of oil and gas resources.

SERVICE LAW AND POLICY GOVERNING NON-FEDERAL OIL AND GAS

The authority of the Service to regulate non-Federal oil and gas operations on NWRS lands is broadly derived from the Property Clause of the United States Constitution (Art. VI, Sec. 3), in carrying out the statutory mandates of the Secretary of the Interior, as delegated to the Service, to manage Federal lands and resources under the National Wildlife Refuge System Administration Act (NWRSAA), as amended by the National Wildlife Refuge System Improvement Act (NWRSIA), 16 USC 668dd et seq. The NWRSIA directs that, in administering the System, the Secretary of the Interior shall, among other things:

- Provide for the conservation of fish, wildlife, and plants, and their habitats within the NWRS;
- Ensure that the biological integrity, diversity, and environmental health of the NWRS are maintained for the benefit of present and future generations of Americans;
- Ensure that the mission of the NWRS described at 16 U.S.C. 668dd(a)(2) and the purposes of each refuge are carried out;
- Ensure effective coordination, interaction, and cooperation with owners of land adjoining refuges and the fish and wildlife agency of the States in which the units of the NWRS are located;
- Assist in the maintenance of adequate water quantity and water quality to fulfill the mission of the NWRS and the purposes of each refuge;
- Recognize wildlife-dependent recreational uses as the priority general public uses of the NWRS through which the American public can develop an appreciation for fish and wildlife;
- Ensure that opportunities are provided within the NWRS for wildlife-dependent recreational uses;
- Monitor the status and trends of fish, wildlife, and plants in each refuge.

The NWRSIA also gives the Service, through the Secretary of the Interior, broad authority to promulgate regulations to carry out these responsibilities: “In administering the System, the Secretary is authorized to . . . issue regulations to carry out this Act” (16 U.S.C. § 688dd(b)(5)). This includes the authority to regulate the exercise of non-Federal oil and gas rights within refuge boundaries for the purpose of protecting wildlife and habitat, water quality and quantity, wildlife-dependent recreational opportunities, and the public health and safety of employees and visitors on NWRS lands

The existing Service regulations for management of non-Federal oil and gas activities are contained at 50 CFR, § 29.32. These regulations have not been revised for more than 50 years. The regulation reads in its entirety:

> "Persons holding mineral rights in wildlife refuge lands by reservation in the conveyance to the United States and persons holding mineral rights in such lands which rights vested prior to the acquisition of the lands by the United States shall, to the greatest extent practicable, conduct all exploration, development, and production operations in such a manner as to prevent damage, erosion, pollution, or contamination to the lands, waters, facilities and vegetation of the area. So far as is practicable, such operations must also be conducted without interference with the operation of the refuge or disturbance to the wildlife thereon. Physical occupancy of the area must be kept to the minimum space compatible with the conduct of efficient mineral operations. Persons conducting mineral operations on refuge areas must comply with all applicable Federal and State laws and regulations for the protection of wildlife and the administration of the area. Oil field brine, slag, and all other waste and contaminating substances must be kept in the smallest practicable area, must be confined so as to prevent escape as a result of rains and high water or otherwise, and must be removed from the area as quickly as practicable in such a manner as to prevent contamination, pollution, damage, or injury to the lands, waters, facilities, or vegetation of the refuge or to wildlife. Structures and equipment must be removed from the area when the need for them has ended. Upon the cessation of operations the area shall be restored as nearly as possible to its condition prior to the commencement of operations. Nothing in this section shall be applied so as to contravene or nullify rights vested in holders of mineral interests on refuge lands." (50 CFR § 29.32).

Service policy is outlined in the Service Manual Part 612 FW 2, Oil and Gas. In the case of non-federally owned oil and gas rights, it is the policy of the Service "to protect project [i.e., refuge lands] resources to the maximum extent possible without infringing upon the rights of sub-surface owners." The Service's existing regulations and policy lack the clarity and specificity to consistently and effectively manage non-Federal oil and gas operations to protect refuge resources and uses, as well as the health and safety of visitors, Service employees, and the general public as directed under the NWRSIA. Therefore, the proposed revisions to the regulations are a valid exercise of Service authority to carry out the mandates delegated to the agency under the NWRSIA.

NON-FEDERAL OIL AND GAS RIGHTS IN REFUGES AND PROJECT STUDY AREA

Non-Federal oil and gas mineral rights are known to exist in many refuges. Current development consists of approximately 5,000 oil and gas wells located on 107 refuges, including four WMDs (Figure 1). The 5,002 wells included not only oil, gas, and oil and gas wells but also "other wells" consisting of injection wells for enhanced oil recovery, saltwater disposal wells, or wastewater disposal, coalbed methane wells, observation wells, stratigraphic wells, dry wells, and water wells used for oil and gas operations. Based on the analysis of the 2011 data, the Service determined the need to obtain additional information on approximately 1,100 wells. Preliminary follow up investigations by the Service identified many of these wells were plugged and abandoned with site conditions such that they warrant no further management actions. Until the follow up investigation is completed, we can estimate the number of wells not subject to Service permits at approximately 4,000. Our investigations may also identify a small number of refuges with wells that are "legacy wells" that could be categorized as "other" wells including plugged and abandoned wells that warrant no further management action. One-third of the wells are active, either producing oil or gas, or injecting gas, oilfield brine, or other fluids underground. Appendix D provides statistics of existing non-Federal oil and gas operations on refuges. Future exploration and development, as well as reclamation activities, are expected in these same areas.

Future development of non-Federal oil and gas rights on refuges that do not currently have oil and gas activities is possible based on: (1) the presence of oil and gas resources in close proximity or within the authorized boundaries of the refuge; (2) the non-Federal oil and gas mineral rights acreage in the refuges is large enough to support development activity; and (3) technological improvements to extract reserves from those currently uneconomically recoverable. The Service estimates another 32 refuges and 5 WMDs could potentially experience oil and gas proposals at some point. In addition to the geologic (e.g., reservoir, source rock, hydrocarbons) and ownership factors, future non-Federal oil and gas development is also largely dependent upon economic elements.

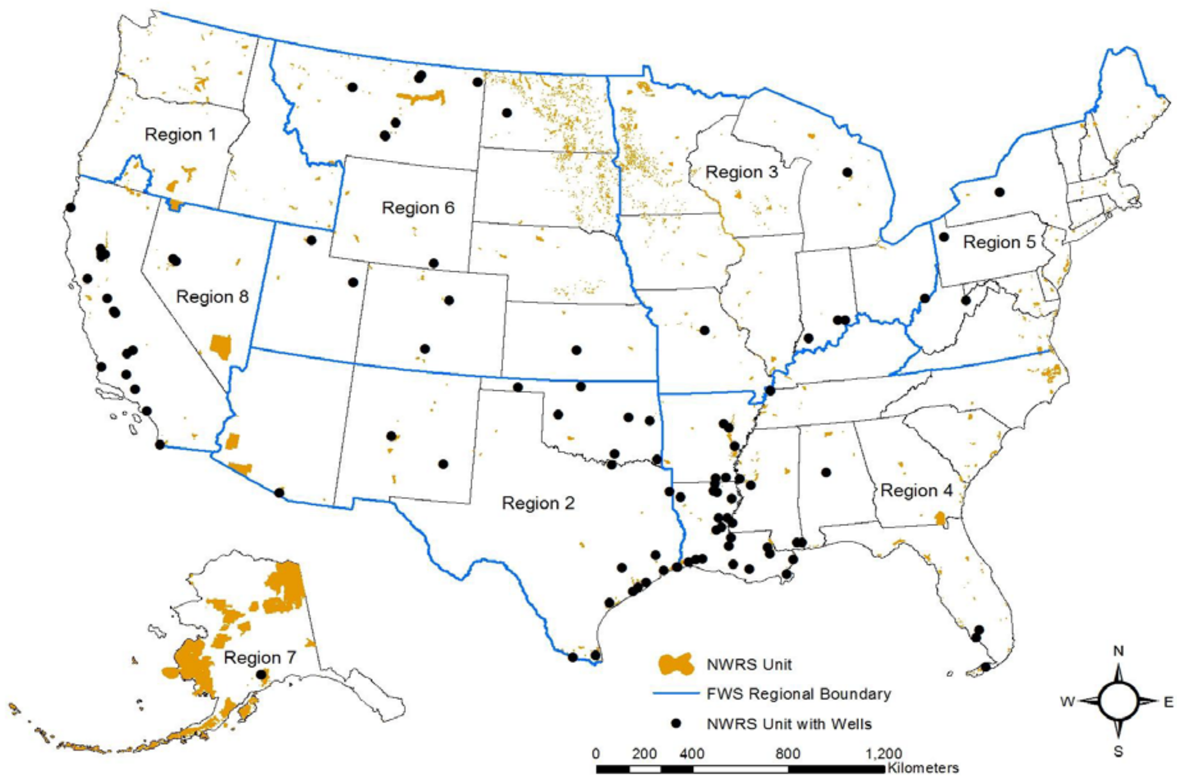


FIGURE 1-1. NWRS UNITS WITH NON-FEDERAL OIL AND GAS WELLS. THE WELLS INCLUDE: OIL, GAS, OIL AND GAS, INJECTION WELLS FOR ENHANCED OIL RECOVERY, SALTWATER DISPOSAL WELLS, OR WASTEWATER DISPOSAL, COALBED METHANE WELLS, OBSERVATION WELLS, STRATIGRAPHIC WELLS, DRY WELLS, AND WATER WELLS USED FOR OIL AND GAS OPERATIONS.

RELEVANT ISSUES PERTAINING TO NON-FEDERAL OIL AND GAS ON NATIONAL WILDLIFE REFUGES

The following discussion provides rationale for the revisions to the Service's regulations, as well as a summary of the analyses presented in this EIS. It includes a description of exempt operational status for wells, the Service's regulatory jurisdiction, new operating technologies allowing directional drilling for longer distances than that which was previously possible, and financial aspects of operations.

SCOPE OF REGULATION AND PERMIT REQUIREMENT

The proposed regulations would apply to all operators conducting non-Federal oil and gas operations within refuges, on lands held by the United States in fee title, and to property interests in such land in less than fee (excluding coordination areas), such as easements, and the waters occurring on those lands. For areas held in less than fee, the Service would apply regulations only to the extent that the property interest held by the United States may be affected. For example, a proposed drilling operation on a wetland easement held by the Service could significantly alter the wetland and thus the value for which the easement was acquired. Therefore, the regulations would provide a tool to help the Service guide time, place and manner of such operations to avoid or minimize adverse impacts to such easement interests. For instance, the proposed drilling operation could be located in an upland area to prevent impacts to the wetland. The Service is evaluating the benefits of exercising its jurisdiction on drilling and production operations conducted on lands outside refuge boundaries, including private inholdings and neighboring lands that use directional drilling to access oil and gas beneath a refuge.

The heart of the proposed regulations, as well as action alternatives being considered, is a permit system centered on operations designed and conducted to meet applicable operating standards. Before 2000, Service-issued special use permits were rarely required for conducting non-Federal oil and gas operations on refuges. Less than half of the operations initiated in the past 10 to 15 years have been conducted under a special use permit. When permits have been issued, the conditions have varied widely.

There are two primary reasons for the inconsistency across the Service in past management of oil and gas permits. First, the Service had not formally determined its position regarding its authority to require permits for oil and gas activities. Therefore, various interpretations of how much regulatory control the Service has over non-Federal oil & gas rights created variations in Refuge management of such operations. Second, Refuge Managers have lacked sufficient guidance, resources, and training to properly monitor oil and gas operations. Therefore, the proposed regulations would help remedy this inconsistency and provide refuge managers and operators clearer guidance about permit requirements for non-Federal oil and gas operations on Refuges.

The Service is considering exempting pre-existing operations from the permit requirement. For purposes of this document, *pre-existing operations* means those operations being conducted without an approved permit or right-of-way (ROW) from the Service prior to implementation of the proposed regulations. In this document, the Service considers the environmental benefits of imposing a permit requirement on pre-existing operations in relation to the administrative costs to the Service and the administrative and operational costs that operators might incur.

DIRECTIONAL DRILLING OPERATIONS FROM LANDS OUTSIDE REFUGES

Advances in oil and gas directional drilling technologies have resulted in the ability of some wells to be drilled into non-Federal mineral estates beneath refuges from surface operation locations outside refuge boundaries. Directional drilling removes surface activities from the refuge and has less visual and surface disturbance. Directional drilling is not specifically addressed in current regulations. However, since the primary goal of the new regulations is avoidance or minimization of impacts, directional drilling guidance will be explored. Figure 2 presents a diagram of a directional well drilled beneath a refuge from a surface location outside the refuge boundary.

It is important to note that, as stated above, the Service is considering not exercising jurisdiction on drilling and production operations conducted on lands outside refuge boundaries, including, but not limited to, access routes, well pad location, drilling and production equipment on the surface, and produced product transportation routes and methods. This analysis also considers an alternative to expand Service jurisdiction to both surface and subsurface activities outside of a refuge boundary in instances where the wellbore passes beneath Service fee title land.

In this analysis, the Service considers a recent analysis by NPS of wells drilled from surface locations outside a park to points beneath the park. The review identified no known instances of impacts to park resources resulting from the 68 wellbores drilled and operated beneath parks.

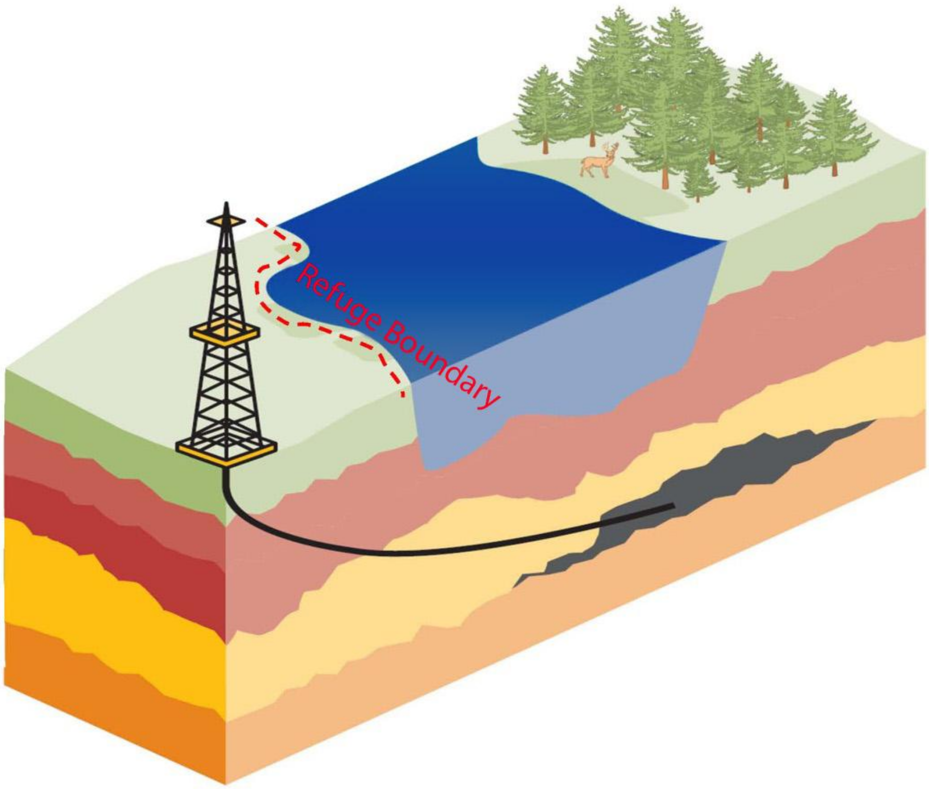


FIGURE 1- 2. SCHEMATIC OF A DIRECTIONALLY DRILLED WELL BENEATH A PARK THAT IS DRILLED FROM A SURFACE LOCATION OUTSIDE THE REFUGE SOURCE: ENGINEERCE.COM 2013

FINANCIAL ASSURANCE FROM OPERATORS

Currently, if a refuge obtains financial assurance for reclamation of oil and gas development, it comes in various forms: bonds administered by the Service, bonds administered by another Federal agency, or State bonds. The variance in practice provides different degrees of financial assurance. For example, the bonds in some States may or may not cover certain damages caused by oil and gas activities if the effects are considered to be “reasonable impacts” to the land. Reasonable impacts are not consistently defined among States because impacts to property are determined by what are usual and customary practices in the area.

Requiring financial assurance from operators under proposed regulation, would ensure that the operators would be held to a consistent standard on all Refuges to ensure that cost of reclamation to Service standards does not fall to the public. In addition, the financial assurance held by the Service provides an incentive for operators to maintain compliance with the permit and applicable regulations. This, in turn, leads to improved protection of refuge resources.

ACCESS AND COST RECOVERY

Operators often need to cross Federal or private lands where they have no pre-existing rights to do so. Operators must obtain permission from the Service for such access to NWR lands (50 CFR 29.21). In most cases, refuges have not charged fees for access to non-Federal oil and gas rights, leaving the Service, and ultimately the taxpayers, the burden of the costs associated with providing this access. In contrast, NPS, FS, and BLM, as well as private landowners, in most cases, charge fees. Fees would compensate the Service for impacts to surface resources caused by access. Fees could be used to offset maintenance costs, such as purchasing fuel for a road grader, gravel for a road, maintaining refuge equipment used in road maintenance, or allowing for new access (e.g., roads or gatherings lines) across Federal lands. The fees also offset the costs of improving habitat on the refuge, purchasing additional lands to compensate for the loss of use, or reclaiming other oil and gas sites.

The Service would set the fee amount using generally accepted practices. For example, the Service could set fees consistent with current Service regulations regarding fees for access and rights-of-ways (50 CFR 29.21), calculate fees using the BLM's Linear Rights-of-way Fee Schedule, or use an appraisal. The Service needs to be consistent with other agencies and practices to ensure the public is properly compensated for surface uses of those exercising non-Federal oil and gas rights.

The Service is proposing a requirement for operators to reimburse the Service for the costs of processing and administering temporary access permits and operations permits. The amount of reimbursement would be determined by the actual staff time spent directly processing permit applications and subsequently monitoring the operation for compliance. The Service has the authority to collect reasonable fees and recover administrative costs. In Texas and Louisiana, the Service can retain and expend funds at the refuge-specific level from operators who cause refuge damage. Reimbursable agreements and other similar agreements may be used in all states to help retain and expend those fees on a refuge-specific level.

COMPLIANCE PROCEDURES AND PENALTIES FOR DEALING WITH VIOLATIONS AND UNAUTHORIZED OPERATIONS

Noncompliance is not addressed in current regulations, resulting in unnecessary impacts to refuge resources. Acts of noncompliance from recalcitrant operators may require undue refuge administration efforts and increased operational costs. An effective regulatory framework needs to provide the foundation for consistent application of compliance procedures and penalties. These procedures and penalties need to be workable and adaptable to various levels of noncompliance and the resultant impacts that may arise from them.

SCOPING PROCESS AND PUBLIC PARTICIPATION

NEPA requires an "early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action (40 CFR 1501.7)." Refer to Chapter 5 of this document for a more detailed summary of the public comments received during public scoping. The description below provides a summary of this process.

Scoping began in January 2013 with the establishment of an interdisciplinary team composed of Service subject matter experts, practitioners, and natural and cultural resource management professionals to determine the purpose, need and objectives of new management actions for non-Federal oil and gas operations on Refuges. Public participation in the scoping process officially began through publication of an Advance Notice of Proposed Rulemaking and Notice of Intent to Prepare an Environmental Impact Statement (ANPR/NOI/EIS) in the Federal Register (79 FR 10080) on February 24, 2014. The Service also issued an official news release, advising the public of publication of the ANPR in the Federal Register.

The ANPR/NOI/EIS solicited ideas from the public on ways the Service could improve existing management and oversight of non-Federal oil and gas operations. In addition, the Service sought input in identifying the significant issues and NEPA alternatives that should be considered in determining the scope of the EIS for this rulemaking initiative. Specifically, the public was asked to comment on approaches for a permitting system, application of operating standards, requirements for financial assurance and access fees, addressing instances of noncompliance, regulation of existing operations, and impact topics for analysis. A summary of the agency and public scoping activities is available in Chapter 5: Consultation and Coordination.

IMPACT TOPICS

As a result of this scoping effort, issues related to potential impacts on refuge resources and values were identified as requiring further analysis in this Proposed Rulemaking. Issues are described in terms of the relationship between actions and environmental resources. They are usually problems caused by one of the alternatives considered, but can also include existing concerns, questions, or other relationships, including those that may be beneficial, which were identified by the Service through internal, public, and agency scoping. Agencies such as EPA, as well as tribes, oil and gas operators, and members of the public have provided their input into these issues through the public scoping process.

Impact topics are derived from the issues, and should be specific, based on the degree to which a resource may be affected. The impact topics developed from the list of issues are discussed in Chapter 3: Affected Environment, and Chapter 4: Environmental Consequences. They examine the extent to which the resources associated with each impact topic would be affected by the proposed actions in a particular alternative.

The following impact topics have been identified for detailed analysis in this Proposed Rule/EIS:

- **Geology and Soils** (including paleontology)**—**Oil and gas activities can result in increased surface runoff and soil erosion and compaction, affecting the permeability of soils (and other soil characteristics). Poorly maintained well pads, roads, and other oil and gas operations are currently causing erosion, sedimentation, compaction, and loss of soil productivity. Sensitive geologic features (such as rock shelters, arches, and chimneys) and paleontological resources can also be affected by oil and gas operations that involve ground-disturbing activities. The implementation of revised regulations could result in beneficial effects to geology, soils, and sensitive geologic features from improved oversight of oil and gas operations that occur near sensitive soils and geologic resources.

- **Air Quality—**Because oil and gas operations can contribute to incremental effects to local and regional air quality, the implementation of revised regulations could result in beneficial effects in regional conformity with the National Ambient Air Quality Standards (NAAQS) and prevention of significant deterioration (PSD) of air quality in refuge units with oil and gas operations.

- **Water Resources** (including surface and groundwater and both water quality and quantity)—Oil and gas operations can affect both surface and groundwater quality by the release of hydrocarbons and other contaminating substances and from soil erosion and sedimentation. These operations may also create an increased demand for water use. The implementation of revised regulations could result in beneficial effects to water resources from improved oversight of operations.

- **Wetlands—**Oil and gas operations may affect wetlands directly through siting of facilities in wetland areas or indirectly through releases of hydrocarbons or other contaminants in wetland areas. The implementation of revised regulations could result in beneficial effects to wetlands from improved oversight of operations that occur within or near these features.

- **Floodplains—**The siting of oil and gas facilities in floodplains can adversely affect floodplain functions and values and have safety implications if facilities are not adequately designed to withstand flooding. The implementation of revised regulations could result in beneficial effects to floodplains from improved oversight of operations that occur near these features.

- **Vegetation** (including plant species of special management concern)—Effects on vegetation can occur from site development and from spills and leaks at oil and gas facilities. The implementation of revised regulations could result in beneficial effects to vegetation (including plant species of special management concern) with improved oversight and enforcement of violations.

- **Wildlife and Aquatic Species** (including animal species of special management concern)—Effects on fish and wildlife can occur from site development and from spills and leaks at oil and gas facilities. The implementation of revised regulations governing non-Federal oil and gas operations could result in beneficial effects to wildlife and aquatic species with improved oversight and enforcement of violations.

- **Visitor Use and Experience** (including human health and safety, visitation patterns, visitor activities, recreation, interpretation)—Revisions to the regulations governing non-Federal oil and gas operations could result in beneficial changes to operations that currently pose a threat to human health and safety from a number of sources, including the use of roads by commercial vehicles (particularly vehicles with less maneuverability and visibility); hazardous equipment at wells and production facilities; flowline or pipeline failure; and release of gases from wells (hydrogen sulfide). The spill or release of hydrocarbons or other contaminants could be inhaled, absorbed, or ingested by humans.

- **Scenic Views and Night Sky Resources—**Visual resources are impacted by oil and gas operations, which create a visual effect on the landscape and affect scenic viewsheds. Impacts on night skies can occur from the effects of artificial lighting near oil and gas operations. Implementation of revised regulations could result in beneficial effects to scenic views and night skies by implementation of mitigation techniques.

- **Natural Soundscapes and Acoustic Environment—**Human-caused sounds from oil and gas operations can adversely affect natural soundscapes in refuges. Effects to natural soundscapes, cultural soundscapes, and the overall acoustic environment from noise generated from oil and gas operations could be influenced by the implementation of revised regulations governing non-Federal oil and gas operations. The revised rule could result in beneficial changes to the frequency and intensity of human-caused sound from activities associated with oil and gas development such as well drilling, compressor stations, well servicing, pump jacks, construction and earth-moving activities, and truck traffic.

- **Cultural Resources** (including archeological sites, prehistoric/historic structures, cultural landscapes, ethnographic resources)—Oil and gas operations can directly impact cultural resources through ground disturbance or leaks and spills. Indirect damage can by caused by increasing or introducing noise, visual intrusions, or possibly noise or odors, into the cultural landscape. The implementation of revised regulations could result in beneficial effects to cultural resources resulting from improved oversight of operations that occur near cultural resources.

- **National Wildlife Refuge Management and Operations—**Refuge staff currently manage non-Federal oil and gas operations to varying degrees. Revised regulations could positively affect refuge operations and management as staff adapt to the new regulations, implement and enforce them, and improve national consistency in their application.

- **Socioeconomics** (including non-Federal oil and gas exploration and development, and regional and local economies)—The implementation of revised regulations governing non-Federal oil and gas operations could facilitate cost recovery and compensation from abandoned operations, and potentially increase the financial burden to operators and decrease impacts to local economies. Potential impacts of regulations are analyzed in regard to oil and gas well operators, and local and regional economies.

ISSUES AND IMPACT TOPICS CONSIDERED BUT DISMISSED FROM FURTHER ANALYSIS

- **Utilities—**Impacts on utilities, such as electrical transmission lines and pipelines, are not addressed in this programmatic EIS. The Federal Energy Regulatory Commission (FERC) and U.S. Department of Transportation (DOT) have jurisdiction over trans-refuge pipelines. The Service typically includes regulation of gathering lines under its special use or ROW permits. In addition, the proposed rule requires the operator to provide every aspect of design and construction. If pipelines include ancillary facilities inside a refuge, such as compressor stations or pumping stations, air pollution controls would be considered against a technologically feasible, least damaging standard.

- **Unique Ecosystems, Biosphere Reserves, and World Heritage Sites—**Refuges considered in this EIS protect unique ecosystems (including free-flowing rivers) that support habitat for many species of management concern. Impacts on these ecosystems would be discussed and analyzed as part of impacts on species of management concern or their habitats. The alternatives considered represent variations in the proposed revisions to existing regulatory provisions, ensuring adequate protection to resources. As such, the regulatory actions proposed do not have the potential to affect unique ecosystems, biosphere reserves, and world heritage sites, and the issues related to natural resources capture any potential impacts on these resources, which are evaluated in Chapter 4: Environmental Consequences.

- **Environmental Justice—**Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires all Federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high or adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. Guidelines for implementing this executive order under NEPA are provided by the Council on Environmental Quality (CEQ) (CEQ 1997).

  According to EPA, environmental justice is the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, State, local, and tribal programs and policies. The goal of fair treatment is not to shift risks among populations, but to identify potentially disproportionately high and adverse effects and identify alternatives that may mitigate these impacts (USEPA 2011).

  Evaluating whether a proposed action has the potential to have disproportionately high and adverse impacts on minority and/or low income populations typically involves the following: (1) identifying any potential high and adverse environmental or human health impacts; (2) identifying any minority or low income communities within the potential high and adverse impact areas; and (3) examining the spatial distribution of any minority or low income communities to determine if they would be disproportionately affected by these impacts.

  The Service does not anticipate that any effects from the proposed rule changes would result in disproportionately high or adverse impacts on low-income populations or communities. The Service analyzed the anticipated costs of the regulation on operators compared to data from the U.S. Economic Census and found regulatory costs to represent less than 1 percent of average annual receipts for typical businesses conducting oil and gas operations in the NWRS. Based on that, the Service anticipates that the rule would not be a major factor in an operator's decision to develop wells or continue production for existing wells. With the expectation that implementation of the proposed rule would not noticeably affect the level of activity or the level of oil and gas production, the Service does not anticipate that any effects from the proposed rule changes would result in disproportionately high or adverse impacts on low-income populations or communities. Moreover, additional analysis would be conducted under the revised rule during NEPA analyses of any permit applications associated with oil and gas activities in order to assess any potential impacts. Therefore, environmental justice was eliminated as an impact topic in this EIS.

- **Wilderness—**In accordance with Service policy (610 FW 1-5), the Service conducts wilderness eligibility assessments using the Service's governing criteria of eligibility to determine which areas, if any, meet the criteria for designation as wilderness. Based on the findings of the assessments, the Service makes a determination whether lands contained within Refuge System units warrant further study for possible inclusion in the national wilderness preservation system. The alternatives considered in this EIS represent variations in the proposed revisions to existing regulatory provisions, ensuring adequate protection to resources. As such, regulatory actions proposed do not have the potential to affect wilderness designations. Issues related to natural resources and visitor use and experience capture any potential impacts on these resources, which are evaluated in Chapter 4: Environmental Consequences.

- **Climate Change—**Global climate change refers to a suite of changes occurring in Earth's atmospheric, hydrologic, biologic, and oceanic systems. These changes, including increased global air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level, provide unequivocal evidence that the global climate system is warming (IPCC 2007).

  Although the Intergovernmental Panel on Climate Change affirms that climate change is occurring, the rate and severity of impacts at refuge units are unknown. A disrupted climate could affect natural and cultural resources, and would likely interfere with public use and enjoyment of refuges. Although many places in the world have already observed and recorded changes that can be attributed to climate change, the impacts on individual refuges have not been specifically determined and the actual implications within the lifespan of this EIS have not yet been determined.

  The EIS evaluates climate change in two ways. First, the effects of climate change on refuge resources are considered and addressed in Chapter 3: Affected Environment. Climate change can affect refuge resources, especially vegetation, wildlife and wildlife habitat (including special-status species), and water resources, and this effect is discussed in the introduction to Chapter 3. Second, the Service has considered the contribution of the proposed rule changes to greenhouse gas (GHG) emissions and potentially related impacts on climate change. Currently, non-Federal oil and gas producing (active) wells on refuges comprise 0.16 percent of the total number of producing wells (1,050,637) in the United States in 2011 as reported by the EPA (EPA 2015). EPA estimates GHG emissions from oil and gas production in the United States at 2.8 million tons of volatile organic compounds (VOCs) and 185 million metric tons (MMt) CO_2 equivalent of methane (EPA 2015). The contribution of GHG emissions from non-Federal oil and gas wells on refuges is unknown. However, the proposed rule changes will generally result in a beneficial net impact on GHGs, though overall incremental contributions reductions to GHGs from operations located on refuge lands are relatively low. For example, operations permits issued under the proposed rule might include provisions to minimize flaring of natural gas or stipulate use of control equipment that does not vent natural gas.

  Additionally, permits would ensure operators comply with any Federal, State, and local laws related to GHG emissions. For example, permitting requirements implemented under new State GHG regulations, which are currently being promulgated by several States, will have the effect of mitigating these emissions, thereby lowering overall contributions. These greenhouse gas permitting actions are discussed under cumulative impacts in the analysis. Because the proposed action would have negligible beneficial impacts related to greenhouse gas contributions and associated climate change, GHG emissions related to climate change were dismissed from further detailed evaluation. Evaluation of GHG emissions for future actions under the proposed rule and alternative would be performed at the individual permit level as necessary to comply with NEPA.

- **Adjacent Land Uses and Resources—**Potential impacts on lands adjacent to refuges following implementation of revised regulations governing non-Federal oil and gas operations are addressed under each impact topic in the EIS as part of the discussion of directional drilling. Additionally, refuge resources may be adversely affected by the intensity of development on adjacent lands. The influence of oil and gas development on adjacent lands and, in particular, the use of directional drilling techniques for recovering oil and gas reserves on adjacent lands has the potential to result in adverse impacts on refuge resources. Impacts on refuge resources and adjacent lands stemming from these scenarios are described for each resource topic in this EIS.

FEDERAL LAWS, POLICIES, AND REGULATIONS DIRECTLY RELATED TO NON-FEDERAL OIL AND GAS DEVELOPMENT IN UNITS OF THE NATIONAL WILDLIFE REFUGE SYSTEM

Table 1 summarizes the Service's legal and policy mandates that govern non-Federal oil and gas operations on refuges. The legal and policy mandates include statutes, regulations, executive orders, and Service policies.

TABLE 1-1. U.S. FISH AND WILDLIFE SERVICE LEGAL AND POLICY MANDATES GOVERNING NON-FEDERAL OIL AND GAS OPERATIONS

Authorities	Resources and Values Afforded Protection
Fish and Wildlife Service Laws and Applicable Regulations	
NWRS Administration Act of 1966 (NWRSA) as amended by the NWRS Improvement Act of 1997 (NWRSIA)16 U.S.C. 668dd–668ee; 50 CFR Parts 25-29	Provides for the conservation of Federal resources on the NWRS, including air resources, water resources, natural resources, threatened and endangered species, cultural and historic resources, biological diversity, human health and safety, visitor use and experience, and visual resources.
Alaska National Interest Lands Conservation Act (ANILCA), 16 USC 3101 et seq.; 43 CFR Part 36	Provides for protection of over 100 million acres of public lands, fully one-third of which was set aside as wilderness areas. Lands claimed by Alaska Natives under the Alaska Native Claims Settlement Act are officially recognized.
Fish and Wildlife Service Policies, Guidelines, and Procedures	
Minerals and Mining (612 FW 1)	Surface resources against unnecessary or unreasonable damages from prospecting, exploration, development, mining, and processing operations and refuge resource values
Oil and Gas (612 FW 2)	Wildlife populations, habitats, and other resources
Biological Integrity, Diversity and Environmental Health (601 FW 3)	Fish, wildlife, and habitat resources
Refuge Planning Overview (602 FW 1)	Conservation of fish, wildlife, plants, and their habitats

Wilderness Policy (610 FW 1-5)	What needs to be accomplished to meet refuge purposes, then ensure that these activities comply with the Endangered Species Act, and then ensure that these activities comply with the Wilderness Act

OTHER APPLICABLE FEDERAL LAWS, POLICIES, AND REGULATIONS

Table 2 summarizes other Federal laws, regulations, executive orders, policies, guidelines, and procedures apply to the conduct of such operations on refuges.

TABLE 1-2. OTHER FEDERAL LEGAL AND POLICY MANDATES GOVERNING NON-FEDERAL OIL AND GAS OPERATIONS IN NATIONAL WILDLIFE REFUGE SYSTEM UNITS

Authorities	Resources and Values Afforded Protection
Other Applicable Federal Laws and Regulations	
American Indian Religious Freedom Act, as amended, 42 U.S.C. 1996 – 1996a; 43 CFR Part 7	Cultural and historic resources.
Antiquities Act of 1906, 16 U.S.C. 431-433; 43 CFR Part 3	Cultural, historic, archeological, and paleontological resources.
Archaeological Resources Protection Act of 1979, 16 U.S.C. 470aa – 470mm; 18 CFR Part 1312; 32 CFR Part 229; 36 CFR Part 296; 43 CFR Part 7	Archeological resources.
Bald and Golden Eagle Protection Act, as amended, 16 U.S.C. 668-668c, 50 CFR 22	Bald and Golden Eagles
Clean Air Act, as amended, 42 U.S.C. 7401-7671q; 40 CFR Parts 23, 50, 51, 52, 58, 60, 61, 82, and 93; 48 CFR Part 23	Air resources.
Coastal Zone Management Act of 1972, 16 U.S.C. 1451 et seq.; 15 CFR Parts 923, 930, 933	Coastal waters and adjacent shoreline areas.
Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. 9601-9675; 40 CFR Parts 279, 300, 302, 355, and 373	Human health and welfare and the environment.
Endangered Species Act of 1973, as amended, 16 U.S.C. 1531-1544; 36 CFR Part 13; 50 CFR Parts 10, 17, 23, 81, 217, 222, 225, 402, and 450	Plant and animal species or subspecies (and their habitat), which have been listed as threatened or endangered by the Service or the National Marine Fisheries Service.
Federal Insecticide, Fungicide, and Rodenticide Act, as amended (commonly referred to as Federal Environmental Pesticide Control Act of 1972), 7 I U.S.C. 136 et seq.; 40 CFR Parts 152-180, except Part 157	Human health and safety and the environment.
Federal Land Policy and Management Act of 1976, 43 U.S.C. 1701 et seq.; 43 CFR Part 2200 for land exchanges and 43 CFR Parts 1700-9000 for all other BLM activities	Federal lands and resources administered by BLM.
Fish and Wildlife Act of 1956, 16 U.S.C. 742 a-m	Fish, shellfish, and wildlife resources.
Federal Water Pollution Control Act of 1972 (commonly referred to as Clean Water Act), 33 U.S.C. 1251 et seq.; 33 CFR Parts 320-330; 40 CFR Parts 110, 112, 116, 117, 230-232, 323, and 328	Water resources, wetlands, and waters of the United States.
Historic Sites, Buildings, and Antiquities Act (Historic Sites Act of 1935), 16 U.S.C. 461-467; 18 CFR Part 6; 36 CFR Parts 1, 62, 63, and 65	Historic sites, buildings and objects.
Lacey Act, as amended, 16 U.S.C. 3371 et seq.; 15 CFR Parts 10, 11, 12, 14, 300, and 904	Fish and wildlife, vegetation.

Authorities	Resources and Values Afforded Protection
Migratory Bird Treaty Act, as amended, 16 U.S.C. 703-712; 50 CFR Parts 10, 12, 20, and 21	Migratory birds.
National Environmental Policy Act of 1969, 42 U.S.C. 4321 et seq.; 40 CFR Parts 1500-1508	The human environment (e.g., cultural and historic resources, natural resources, biodiversity, human health and safety, socioeconomic environment, visitor use and experience). Human environment is the natural and physical environment and the relationship of the people with that environment (CEQ 2007).
National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470-470x-6; 36 CFR Parts 60, 63, 78, 79, 800, 801, and 810	Cultural and historic properties listed in or determined to be eligible for listing in the National Register of Historic Places (National Register).
Native American Graves Protection and Repatriation Act, 25 U.S.C. 3001-3013; 43 CFR Part 10	Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony.
Noise Control Act of 1972, 42 U.S.C. 4901-4918; 40 CFR Part 211	Human health and welfare.
Oil Pollution Act, 33 U.S.C. 2701-2761; 15 CFR Part 990; 33 CFR Parts 135, 137, and 150; 40 CFR Part 112; 49 CFR Part 106	Water resources, natural resources.
Paleontological Resources Protection Act, 16 U.S.C. 470aaa – 470aaa-11	Paleontological resources.
Pipeline Safety Act of 1992, 49 U.S.C. 60101 et seq.; 49 CFR Subtitle B, Chapter 1, Parts 190-199	Human health and safety, and the environment.
Resource Conservation and Recovery Act, 42 U.S.C. 6901 et seq.; 40 CFR Parts 240-280; 49 CFR Parts 171-179	Natural resources, human health and safety.
Rivers and Harbors Act of 1899, as amended, 33 U.S.C. 401 et seq.; 33 CFR Parts 114, 115, 116, 321, 322, and 333	Shorelines and navigable waterways, tidal waters, wetlands.
Safe Drinking Water Act of 1974, 42 U.S.C. 300f et seq.; 40 CFR Parts 141-148	Human health, water resources.
Wilderness Act, 16 U.S.C. 1131 et seq.	All natural resources located in the area designated by Congress as Wilderness or Potential Wilderness.
Wild and Scenic Rivers Act, 16 U.S.C. 1271 et seq.	Designated rivers and their immediate environments.
Executive Orders	
Executive Order 11593 – Protection and Enhancement of the Cultural Environment, 36 Fed. Reg. 8921 (1971)	Cultural resources.
Executive Order 11988 – Floodplain Management, 42 Fed. Reg. 26951 (1977)	Floodplains; human health, safety, and welfare.
Executive Order 11990 – Protection of Wetlands, 42 Fed. Reg. 26961 (1977)	Wetlands.
Executive Order 12088 – Federal Compliance with Pollution Control Standards, 43 Fed. Reg. 47707 (1978)	Natural resources, human health and safety.
Executive Order 12630 – Governmental Actions and Interference with Constitutionally Protected Property Rights, 53 Fed. Reg. 8859 (1988)	Private property rights, public funds.
Executive Order 12898 – Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, amended by Exec. Order No. 12948, 60 Fed. Reg. 6379 (1995)	Human health and safety; minority populations and low-income populations.
Executive Order 12996 – Management and General Public	Establishes public use, habitat, partnerships, and public

Authorities	Resources and Values Afforded Protection
Use of the National Wildlife Refuge System, 61 Fed. Reg. 13647 (1996)	involvement as guiding principles for the management and general public use of the Refuge System
Executive Order 13007 – Indian Sacred Sites, 61 Fed. Reg. 26771 (1996)	Native American sacred sites.
Executive Order 13112 – Invasive Species, 64 Fed. Reg. 6183 (1999)	Vegetation and wildlife.
Executive Order 13186 – Responsibilities of Federal Agencies to Protect Migratory Birds, 66 Fed. Reg. 3853 (2001)	Migratory birds.
Executive Order 13212 – Actions to Expedite Energy-Related Projects, 66 Fed. Reg. 28357 (2001)	Production, transmission, and conservation of energy.
Policies, Guidelines, and Procedures	
Department of the Interior, Implementation of the National Environmental Policy Act – 43 CFR Part 46 (2008)	All resources including cultural resources, historic resources, natural resources, human health and safety.
Department of the Interior, Departmental Manual, DM 517 – Pesticides (DOI 1981)	Human health and safety, and the environment.
Department of the Interior, Departmental Manual, DM 519 – Protection of the Cultural Environment (DOI 1994)	Archeological, prehistoric resources, historic resources, Native American human remains, and cultural objects.
Department of the Interior, Onshore Oil and Gas Order Number 2, Section III, Drilling Abandonment Requirements, 53 Fed. Reg. 46,810 - 46,811 (DOI 1988)	Human health and safety.
Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation, 48 Fed. Reg. 44716 (DOI 1983), also published as Appendix C of NPS Director's Order 28 – Cultural Resource Management	Cultural and historic resources.
Government-to-Government Relations with Native American Tribal Governments, Presidential Memorandum (Clinton 1994)	Native Americans – Tribal rights and interests.
Department of the Interior Secretarial Order 3226 – Climate Change and the Department of the Interior	Ensures that climate change impacts are taken into account in connection with DOI planning and decision making
Department of the Interior Secretarial Order 3289 – Addressing the Impacts of Climate Change on America's Water, Land, and Other Natural and Cultural Resources	Establishes a framework through which DOI bureaus will coordinate climate change science and resource management strategies to address climate change
National Oil and Hazardous Substances Pollution Contingency Plan – 40 CFR Subpart D	Establishes procedures for operational response phases for oil removal for the protection of the environment as well as human health and safety
The President's Climate Action Plan, Executive Office of the President, June 2013	Directs Federal agencies to "protect biodiversity, and conserve natural resources in the face of a changing climate, and manage our public lands and natural systems to store more carbon."

RELATIONSHIP TO STATE LAWS, REGULATIONS, AND POLICIES

Operators conducting non-Federal oil and gas operations on refuges must comply with Service laws and regulations, as well as all applicable Federal and State laws, regulations, and policies. In general, the Service regulations and policies focus on surface protection of refuges by requiring operators to use oil and gas development methods that will avoid or minimize adverse impacts on refuge resources, values, and human health and safety.

State laws, regulations, and policies typically focus on conservation of the oil and gas resource through the application of well spacing and density rules, and protection of the associated ownership interests. In addition, State oil and gas development rules often address protection of groundwater and surface water through the application of well drilling, cementing, completion and plugging requirements; protection of wildlife potentially exposed to open-top oil storage tanks or various types of earthen pits; oil spill cleanup and remediation requirements for soils; and public and worker safety requirements.

Because the Service and State oil and gas regulatory agencies have fundamentally different legal and policy mandates and objectives, the Service requirements pertaining to non-Federal oil and gas development in refuges would often be complementary to and beyond State requirements.

CHAPTER 2: MANAGEMENT ALTERNATIVES

INTRODUCTION

This chapter describes the alternatives under consideration for proposed revisions to the existing regulations governing the management of non-Federal oil and gas rights within the NWRS. NEPA requires Federal agencies to explore a range of reasonable alternatives for implementing proposed actions and to analyze what impacts those alternatives could have on the human environment, which NEPA defines as “the natural and physical environment and the relationship of people with that environment.” The existing conditions of the human environment that may be affected by the alternatives are described in Chapter 3: Affected Environment. The analysis of impacts is presented in Chapter 4: Environmental Consequences.

The alternatives under consideration must include a no-action alternative, as prescribed by NEPA regulations at 40 CFR 1502.14. The no-action alternative in this document is the continuation of the current regulations and the practices associated with implementing those regulations. Proposed changes to the regulations are presented as two action alternatives, developed by the Service, taking into consideration comments obtained from the public and other entities during the planning process. These alternatives meet, to varying degrees, the objectives developed for this effort, as well as the purpose and need for action (refer to Chapter 1: Purpose and Need for Action). Upon conclusion of the EIS and decision-making process, one of the alternatives, or a combination of different parts of the various alternatives, will be adopted as the Service non-Federal oil and gas regulations for refuges for the foreseeable future. If an action alternative is selected, the Service will issue a final rule.

This EIS is programmatic in nature, which means that it will analyze the regulations as a framework for taking a range of actions, and it will set forth requirements for the implementation of the actions. Before any specific oil and gas operation is approved under the provisions of a new, finalized rule, the Service will conduct further analysis and consultation in accordance with NEPA, NHPA, ESA, and other Federal laws, as applicable.

The no-action and action alternatives selected for detailed analysis are briefly described below, with emphasis on the major changes that would be made to the regulations. This is followed by a summary table (Table 1) of the substantive changes that would result from specific components of the proposed alternatives under the rule change. The remainder of this chapter describes how the alternatives meet project objectives, addresses NEPA consistency, and presents additional alternatives that were considered but eliminated from detailed analysis. Finally, the agency’s preferred alternative and the environmentally preferable alternative are identified.

OVERVIEW OF ALTERNATIVES

ALTERNATIVE A: NO-ACTION

The no-action alternative is the continued implementation of the current Service regulations and policies now used to govern the exercise of non-Federal oil and gas rights located within refuges. These consist of the regulation at 50 CFR §29.32, Service policy at 612 FW 2, and the guidance document titled *Management of Oil and Gas Activities on National Wildlife Refuge System Lands*.

The discussion below focuses on those areas of management in existing provisions that the Service is proposing to change through this rulemaking.

Purpose and Scope

Under the no-action alternative, the Service would continue to apply its regulations, policy, and guidance to non-Federal oil and gas operations on lands and waters within the NWRS where the Service owns the surface estate in fee title. The Service has not sought permits for non-Federal oil and gas operations on lands and waters where Federal ownership is less than fee.

Accessing Oil and Gas Rights from a Surface Location Outside The Refuge Boundary

The Service currently does not apply regulation to operators who use directional drilling from a surface location outside a refuge to reach their oil and gas rights within a refuge.

Requirement to Obtain a Service Permit to Conduct Operations

The regulations at 50 CFR 29.32 do not address any requirements or processes related to permits. The Service has developed policy and guidance for requiring permits for various situations. Under current policy, the Service first looks to the deed language to determine whether it recognizes the Service's right to require a Special Use Permit (SUP). If recognized, an SUP is required. If a deed does not recognize the Service's permitting authority, the Service next looks to clarify its power as a holder of the surface estate under State law. State statutes or case law may give rights to surface owners beyond the usual common law to protect the surface estate from the impacts of oil and gas operations. Where States require surface use agreements between landowners and operators, the Service may interpret that as having the authority to require an SUP.

Absent a permitting requirement in the deed or under State rules, Service policy recommends voluntary permitting arrangements with an operator who demonstrates a valid oil and gas right to specify the reasonable limits of the intended operations. The operator's incentive for entering into such an agreement is a degree of protection from later being found to have acted unreasonably and to possibly be subjected to civil or criminal liabilities.

If neither mandatory nor voluntary permitting is possible, Service policy is to give operators written notice of all reasonable alternatives, which would minimize impacts of the activity. This enables the Service to establish, if necessary, that these less-damaging alternatives were disregarded without due consideration of the Service's interests as surface owner, should damage occur.

Finally, when the operation exceeds the boundaries of what is reasonably necessary to recover the minerals, or fails to take reasonable precautions to minimize the surface damage, the Service may take legal action for damages, secure an injunction, and where appropriate, seek criminal penalties. In refuge units in Alaska, per 43 CFR Part 36, operators must obtain a Service permit if crossing Federal lands or waters to access their oil and gas right. The Service uses its ROW regulation as the permit vehicle.

As discussed in Chapter 1, under the current regulations and policy, most non-Federal oil and gas operations initiated in the past 10 to 15 years have been conducted under an SUP or ROW issued by the Service. However, the permit requirement itself has not been consistent across the Service, and where permits have been issued, the permit conditions have varied widely. Prior to 2000, permits were rarely required for conducting non-Federal oil and gas operations.

Pre-existing operations are defined in the proposed rule as “operations conducted as of the effective date of the regulations in accordance with local, State, and Federal laws and regulations and without an approved SUP or ROW from the Service.” Of the 5,002 non-Federal wells within the NWRS, only 115 are being conducted under an SUP or ROW. The Service is currently investigating the status of over 1,000 wells, but estimates that over 4,000 wells would meet the definition of a pre-existing operation.

Under the no-action alternative, these wells would continue to be unregulated by the Service. Managers would address impacts to refuge resources and uses (primarily from spills, accidents, or new, unauthorized use of Federal surface) as needed using general Service regulations, cooperation with other Federal or State permitting agencies, and cooperation with the operators. The level of monitoring and cooperation with operators to address impacts on refuge resources and uses would vary widely across the Service, generally resulting in many unnecessary impacts to the environment.

Performance-Based Standards

Currently the Service has no performance-based standards for oil and gas operations. Consequently, oil and gas activities are managed on an individual unit basis, with protective stipulations developed in a site-specific manner. Generally, stipulations are applied to Service permits to include protection of air quality, soils, water, wildlife, wildlife habitat, and other refuge resources.

There are many best management practices (BMPs) (prescriptive measures) that could and have been used to accomplish resource protection standards. The Service has established and published an oil and gas management handbook outlining existing policy and developed a formal training program for refuge managers and other Service personnel in managing oil and gas operations. BMPs are included in the handbook and training course.

Current policy and training, however, have not established a suite of performance-based standards for protection of refuge resources and uses. As a result, the levels of protection required in SUPs can vary across the NWRS.

Permitting Process

The *Management of Oil and Gas Activities on National Wildlife Refuge System Lands* handbook provides guidance for obtaining an SUP. The recommended steps in the process are described as follows:

1. Operator contacts refuge regarding interest in conducting oil and gas operations. Operator provides written documentation demonstrating right to conduct operations.
2. Refuge provides operator copies of regulations, performance standards, plan of operations requirements, and other information, as appropriate.
3. Operator meets with refuge personnel to scope resource issues relevant to the proposed operation to determine resources that could be affected by the operation; identify environmental planning and compliance requirements; and determine affected Federal, State, and local agencies.

4. Operator meets with refuge personnel and affected Federal, State, and local agencies to identify resource issues, permitting requirements, and mitigation strategies for potential impacts.
5. Operator submits written request for temporary access to gather basic information needed to complete the plan of operations.
6. Refuge issues 60-day data collection permit with refuge resource and visitor protection requirements.
7. Operator conducts necessary surveys, including natural and cultural surveys, as applicable, and surveys and stakes the operations area.
8. Operator submits draft plan of operations to refuge.
9. Service performs a completeness and technical review of the plan of operations. Refuge accepts plan of operations as complete or returns the plan to the operator with specific directions on how to revise the plan.
10. Operator revises plan of operations, as necessary.
11. Service prepares NEPA documentation or adopts operator or consultant-prepared NEPA documents, incorporating other environmental compliance requirements (e.g., NHPA, wetlands, floodplains, ESA, and Coastal Zone Management Act) and initiates mandated consultations with other agencies. Refuge completes public review process, finalizes decision documents, and notifies the operator if the plan has been approved, conditionally approved, or rejected.
12. Operator agrees to conditions of approval (if any), submits applicable State and Federal permits, and files suitable performance bond with the Service.
13. Service issues the SUP.

The information contents of a permit application are not defined for non-Federal oil and gas SUPs, but would at least include:

1. Names, addresses, and phone numbers of owner(s) and operator;
2. Proof of mineral rights in the form of a copy of the lease, deed, designation of operator, or assignment of rights;
3. Map(s) showing the location of mineral rights;
4. Maps showing the location of proposed activity and facilities;
5. Estimated timetable for completion and periods of activity;
6. Description of potential hazards to persons and/or the environment;
7. Methods for disposal of all waste, including drilling mud;
8. Provisions for rehabilitation; and
9. Any additional information required by the refuge manager for evaluation of the operation.

The policy does not specify timelines in which the Service will respond to an operator’s submission of information.

Performance Bond (Financial Assurance)

The Service does not typically require financial assurance as a condition of an SUP issued for non-Federal oil and gas operations. Operators in Alaska are permitted using ROW under 43 CFR part 36, which does provide a requirement for financial assurance.

Access Fees

Under current regulations and policy, the Service does not assess fees for an operator's use of a Federal surface for access to their oil and gas rights boundary.

Change of Operators

Under current conditions, there are no general requirements of either the former operator or the new operator to notify the refuge manager that a transfer of rights and responsibilities for the operation has occurred. Some SUPs or ROWs may contain a requirement to provide notification of a change in operator.

Refuge managers are most often made aware of a change in operator when signs at oil and gas production sites are changed and include the new operator's name and contact information.

Cost Recovery

The Service does not seek cost recovery for administration of SUPs for non-Federal oil and gas operations. Operators in Alaska are typically permitted using ROW under 43 CFR Part 36, which does provide for cost recovery.

Third-Party Monitoring

Current regulation does not address the use of third-party monitors to monitor operator compliance with an SUP or ROW permit. Service policy guides refuge managers to use third party monitors to help ensure that the Service receives unbiased, reliable, and timely monitoring information demonstrating an operator's compliance with its permit. Thus, the ability to use third-party monitors would continue to rely on the Service's ability to secure an SUP or ROW as described earlier.

Well Plugging (Maintenance of Idle or Shut-In Wells)

Current regulations and policy do not address procedures for wells that are no longer active but are not scheduled to be plugged in the near future. Instead, the Service relies on State rules for maintaining wells in shut-in status.

Administration of a Permit

Regulations and policy for SUPs and ROWs would apply. These generally provide the Service or operator a means to modify permit terms to account for unexpected conditions or operational needs. Regulations and policy for SUPs and ROWs also provide a means for the Service to ensure the operator's compliance with the terms and conditions of the permit.

If an operator disagrees with a decision made by the Service, the appeals process in 50 CFR § 25.45 would apply. For ROW permits or applications for ROWs, §29.22 for the hearing and appeals procedure would apply. For ROW permits or applications in Alaska, see §43 CFR 36.8 for the hearing and appeals process. The operator must exhaust these remedies before the Service decision is considered a final agency action that is subject to review under the Administrative Procedure Act.

ALTERNATIVE B: PROPOSED RULE (PREFERRED ALTERNATIVE)

Alternative B includes proposed changes to the regulations that: provide a regulatory framework to achieve necessary protections for ecosystems and wildlife, to conserve fish and wildlife resources, and enhance public enjoyment and improve regulatory consistency and functionality to the benefit of both refuge managers and oil and gas operators.

To effect these changes, the Service must comply with applicable rulemaking provisions of the Administrative Procedures Act, 5 USC 551 – 559.

The discussion below focuses on those areas of management that the Service is proposing to change through this rulemaking.

Purpose and Scope

The proposed rule would clarify that the revised regulations are designed to protect Service-owned or administered lands, waters, or wildlife resources of refuges, visitor uses or experiences, and visitor and employee health and safety, as outlined in the mission of the NWRS.

As in the no-action alternative, the proposed rule would apply to all operators conducting non-Federal oil and gas operations within refuges on lands held by the United States in fee title, or any waters within refuges. Additionally, the proposed regulation would clarify that operations conducted on lands where the property interests held by the United States are less than fee, such as easements, also fall within the scope to the extent necessary to protect those property interests. For example, where the Service has purchased a wetland easement, the regulations would be applied only as necessary to protect the values and functions of wetlands that could be affected by proposed operations on that property. For areas where the United States does not hold a property interest but are within the boundaries of a refuge (i.e., inholdings), the regulations would not apply.

Accessing Oil and Gas Rights from a Surface Location Outside The Refuge Boundary

The Service proposes to provide an incentive for operators to use directional drilling from a surface location outside a refuge to reach their oil and gas rights within a refuge by exempting them from these regulations. Removing the surface activities associated with oil and gas operations from inside refuges serves to accomplish the objectives of regulation (avoidance or minimization of impacts). The effect of the proposed regulatory exemption would be essentially the same as Alternative A.

Requirement to Obtain a Service Permit to Conduct Operations

The proposed rule would further clarify the Service's authority and the responsibility of operators regarding permitting non-Federal oil and gas operations. Under the proposed rule, the Service would require the following:

New Operation: An operator conducting new operations on refuge lands or waters must obtain an Operations Permit before commencing non-Federal oil and gas operations within a refuge.

***Operations Under an Existing Service-issued SUP or ROW*:** Operations under an existing Service permit may continue under the terms of that permit or ROW so long as they comply with existing

Federal, State, and local laws and regulations, and the General Terms and Conditions outlined in their SUP and the proposed rule. Additionally, these operations would be required to obtain or update the existing permit at the time of well plugging and reclamation to ensure the surface area is restored to Service standards.

Pre-existing Operations**:** Operations not under a Service permit that are being conducted prior to the finalization of the revised regulations would be considered “pre-existing operations” and could continue as they have been as long as they comply with existing Federal, State, and local laws and regulations and the General Terms and Conditions outlined in the proposed rule.

Under the proposed rule, operators of pre-existing operations would be required to provide the Service with documentation that they hold the right to conduct operations, company contact information, a map delineating the existing area of operations (the area of operations defines the area for which an operator would be responsible for reclamation), and copies of the plans and permits required by Federal, State, and local agencies relative to their operations. The Service uses this information for future monitoring of the approved operations to ensure compliance with existing standards (Federal, State, and local).

The Service would manage pre-existing operations during the production phase by assimilating State laws and regulations into the rule, thereby increasing the Service’s enforcement ability on refuge lands. Many of the unnecessary impacts occurring from existing operations without permits can be addressed more cost effectively through stricter adherence to existing Federal (e.g., Spill Prevention, Control, and Countermeasure plans) and State rules. For example, the state of Louisiana rules require oil leaks be appropriately repaired and spills reported within 24 hours. We have documented operators who fail to comply with these rules. This approach to permitting allows the Service to focus its limited time and resources on those new operations that create the highest level of incremental impacts. Also, requiring all operations to have a permit for plugging and reclamation ensures long-term rehabilitation of habitat damaged by all operations.

Pre-existing operations would also be subject to general terms and conditions of the proposed rule addressing responsibility for subcontractors’ compliance, use of water obtained within a refuge, hold-harmless provisions, responsibility for unauthorized damages to refuge resources or facilities, and notifications of spills and accidents. The proposed provisions on prohibitions and penalties, changes of operators, well plugging, and appeals would also apply to pre-existing operations.

Additionally, the proposed regulations would require pre-existing operators to obtain an operations permit if they are proposing to conduct new activities or modify pre-existing operations in a manner that has a would result in additional, notable impacts on refuge resources, visitor uses, refuge administration, or human health and safety. The operator must consult with the Service to determine if a change to a pre-existing operation is a “modification”. Examples of a modification could include drilling additional wells from the existing pad, creating additional surface disturbance (expanding the footprint of a well pad, realigning a road), or converting a natural gas well into a wastewater disposal well. This provision is not intended to apply to minor actions, such as repositioning of surface facilities within the footprint of pre-existing operations, minor changes in color schemes, or non-routine maintenance actions.

Once production ends and the operator intends to plug the well, pre-existing operations, like all other operations on refuge lands, would be required to obtain an operations permit for plugging and reclamation. This requirement would ensure that plugging and reclamation are performed to Service standards and that federally owned or administered lands and waters are restored and protected over the long-run from impacts of non-Federal oil and gas operations,

Operations on Non-Federal Surfaces or Private Inholdings**:** Operations on non-Federal surfaces outside of refuge boundaries or private inholdings within a refuge are exempt from the proposed regulation. However, if an operator needs to physically cross Service land for access to an inholding, then the operator must comply with the applicable provisions of this subpart, including obtaining an operations permit for new access or amending existing authorization for access.

Performance-Based Standards

The proposed regulations establish performance-based standards for avoiding or minimizing impacts to refuge resources or visitor uses during operations. The rule also includes standards for achieving successful surface reclamation once operations end.

The use of performance-based standards or performance goals provides flexibility to resource managers and operators to achieve standards across various environments using new and evolving technology. In contrast, prescriptive regulations define specific requirements of time, place, and manner without considering how these measures achieve a desired level of resource protection or how they may apply in different environments. The Service examined other Federal and State oil and gas regulations and determined the standards-based approach provided the most efficient means of successfully avoiding or minimizing the effects of oil and gas operations on refuge resources and visitor uses. A one-size-fits-all (i.e., prescriptive) approach would not work due to the widely differing environments and national extent of refuges with oil and gas.

The proposed rule includes standards for surface use and site management, specific resource protections, spill prevention and response, waste management, and reclamation. These specific standards are all considered and incorporated into project design so that, overall, operations are conducted in a manner most protective of refuge resources and uses while ensuring human health and safety. Use of the technologically feasible, least damaging methods takes into consideration all relevant factors, including environmental, economic, and technological factors and the requirements of applicable law.

Permitting Process

The proposed rule establishes the process for obtaining an operations permit, including:

- initial steps in developing a permit application,
- contents of the application,
- the Service’s review of the application including timelines,
- the Service’s approval standards, and
- actions the Service may take on the application including timelines.

Initial Steps**:** The proposed rule recommends operators first participate in a pre-application meeting with the refuge manager to allow for an early exchange of information with the intent of understanding initial concerns of both the refuge manager and the operator, as well as avoiding unnecessary delays in the application process. The first requirement in the permitting process is for the applicant to provide documentation demonstrating a valid and current right to operate. The operator would also provide an overview of the proposed operation and its timing. Also, oil operators are encouraged to provide information on mineral ownership, operation schedules, contact information for company officials and their contractors, a map of the proposed area of operations, description of access, and transportation plans. At this time, the refuge would provide guidance on the permitting process and information on available resource data and identify additional data needs.

Reconnaissance Surveys: The proposed rule defines a process for obtaining a temporary access permit to collect basic information needed to prepare an application for the operations permit. A temporary access permit would be issued for reconnaissance surveys for a period not to exceed 60 days, but may be extended for a reasonable additional period when justified by an operator.

***Contents of the Application for an Operations Permit*:** The proposed rule contains several information requirements. The objectives of these information requirements are to clearly and completely define all proposed actions, provide a comprehensive description of the refuge resources and uses that could potentially be affected by the proposed actions, and document the expected effects on the refuge resources and uses by the proposed actions, as well as expected effects from other feasible alternatives. The information collected by the refuge provides a means to evaluate whether the actions would be conducted in a manner that meets the operating standards defined in the proposed rule.

The proposed rule would codify existing practices requiring an operator to submit all necessary information to ensure protection of federally owned or administered lands, waters, or resources of refuges, refuge visitor uses or experiences, or visitor or employee health or safety.

The proposed rule defines information requirements organized by the type of activity for which approval is being sought. It lists information requirements common to all operations, which include:

- documentation of the right to operate,
- company contacts,
- estimated cost that a third party would charge to complete reclamation. The Service uses the estimate in determining performance bond amount,
- source, quantity, access route, and transportation/conveyance method for all water needed,
- maps identifying natural features, existing and proposed structures, pipelines, new surface disturbances, proposed area of operations,
- a description of environmental conditions and mitigation actions, and
- spill control and emergency plans.

The proposed rule includes additional information requirements grouped for geophysical, drilling, and production operations.

***Review Process*:** The proposed rule establishes a two-stage permit application review process, provides realistic timeframes to provide notice to an operator, and consolidates the final decisions the Service can make on an operator’s permit application.

The proposed regulation describes the Service’s initial review of an operator’s permit application. During initial review the Service would determine whether the applicant has supplied all information necessary for the Service to evaluate the operation’s potential effects on federally owned or administered lands, or any waters or resources of Service units, visitor uses or experiences, or visitor or employee health and safety. The Service would respond within 30 days and tell the operator whether the information contained in the permit application is complete. Once a permit application is complete, the Service conducts a formal review.

During the formal review process, the Service would coordinate and consult with a variety of State and Federal regulatory agencies to ensure that the operation plan complies with applicable Federal statutes, such as NEPA, ESA, and NHPA.

Approval Standards and Actions**:** The proposed regulations require that, before approving an operations permit, the Service determine that the operator uses technologically feasible, least damaging methods that provide for protection of the refuge's resources and public health and safety. Two additional prerequisites to approval are (1) an operator's submittal of adequate financial assurance and (2) proof of adequate liability insurance.

The proposed regulations establish a 180-day timeframe for the Service to complete its formal review. The proposed regulations would allow for a longer period of time if the parties agree to it, or if the Service determines that it needs more time to comply with applicable laws, Executive Orders, and regulations. The rule would establish two final actions: (1) approved, with or without conditions, or (2) denial, and the justification for the denial. The Service would notify the operator in writing of the final action.

Performance Bond (Financial Assurance)

The proposed rule would require an operator to file a performance bond, or other acceptable method of financial assurance, for all types of non-Federal oil and gas operations and all phases of the operation(s). The financial assurance amount would be set equal to the estimated cost of reclamation. The proposed rule allows the Service to reduce an operator's financial assurance by the amount of in-kind reclamation the operator may provide prior to or during its operations.

The objective of the proposed rule is to ensure that, in the event of an operator default, the public is not burdened with the cost of plugging and reclamation, and that refuge resources and uses are ultimately restored to pre-disturbance levels.

The proposed rule includes a process for adjusting the amount of financial assurance due to changed conditions. For example, if an operator elects to conduct interim reclamation, the bond amount for full reclamation could be reduced based on the amount of the site reclaimed.

The Service would release the bond when the operator has met all applicable reclamation standards. The proposed rule holds that failure to comply with any provision of an operations permit could result in forfeiture of the financial assurance. This provides the Service with an enforcement tool and provides an operator with additional incentive to remain in compliance with its permit.

Access Fees

The proposed rule authorizes the Service to charge a fee for commercial vehicles using Service-administered roads. This fee would be used to offset maintenance costs, such as purchasing fuel for a road grader, gravel for a road, or maintaining refuge equipment used in road maintenance.

The proposed regulation also would allow a fee for new access (e.g., roads or gatherings lines) across Federal lands. This fee would be used to offset the cost of improving habitat on the refuge, obtaining additional lands to offset the loss of use, or reclaiming other oil and gas sites. The Service would set the fee amount using generally accepted practices. For example, the Service could set fees consistent with current regulations regarding fees for access and ROW (50 CFR 29.21), or calculate fees using the BLM's Linear Rights-of-way Fee Schedule. Other methods could be used, such as appraisal or Habitat Equivalency Analysis, which bases compensation on the loss of resource services and the cost to restore those services.

Change of Operators

A Change of Operator occurs anytime an entity exercising non-Federal oil and gas rights transfers those rights to another party who assumes responsibility for operations. The proposed rule outlines the steps for both the transferring party and the new operator. All operators would be required to notify the Service within 30 calendar days of the transfer, the contact information of the party to whom the operation was transferred, the effective date of the transfer, and a description of the rights transferred. The former operator must also provide written acknowledgement from the new operator that the contents of the notification are true and correct.

If the operations are being conducted under a Service-issued permit, in addition to the notification requirements above, the former operator would remain responsible for compliance with its permit until the new operator agrees in writing to adopt the permit with all its terms and conditions. In addition, if financial assurance is a component of the permit, the Service would not release the financial assurance until the new operator replaces it.

In a transfer, the new operator may continue operating under the same conditions of the previous operator, but within 30 calendar days from the date of the transfer, must provide to the Service its right to operate documentation and company contact information. If the operations were being conducted under a Service-issued permit, the new operator would need to agree in writing to conduct operations in accordance with all terms and conditions of the previous operator's permit, and file any financial assurance required under the permit with the Service.

New operators have the ability to propose modifications to their operations as outlined in the proposed rule.

Cost Recovery

The Service is proposing a requirement for operators to reimburse the Service for the costs of processing and administering temporary access permits and operations permits. The amount of reimbursement would be determined by the actual staff time spent directly processing permit applications and subsequently monitoring the operation for compliance. The Service has the authority to collect reasonable fees and recover administrative costs. In Texas and Louisiana, the Service can retain and expend funds at the refuge-specific level from operators who cause refuge damage. Reimbursable agreements and other similar agreements may be used in all states to help retain and expend those fees on a refuge-specific level.

Third-Party Monitoring

The proposed rule would allow the Service to require that operators hire third-party monitors when they are necessary to ensure compliance and protect refuge resources and uses. The use of third party monitors helps ensure that the Service receives unbiased, reliable, and timely monitoring information demonstrating an operator's compliance with its permit. The rule would describe the criteria that the

Service would consider when deciding to require an operator pay for a third-party monitor. The criteria could include an operator's proposal for self-monitoring. The third-party monitor would report directly to the Service to ensure oversight and accountability and prevent the appearance of a conflict of interest. Use of a third-party monitor is a common industry practice.

Well Plugging (Maintenance of Idle or Shut-In Wells)

The proposed procedures would be consistent with the way many states approach the issue of inactive wells. The Service would recognize that certain economic or logistical reasons exist to justify maintenance of wells in shut-in status for extended periodsof time. Rather than a "produce or plug" policy, the proposed regulation would provide assurance that shut-in wells are maintained in an environmentally sound and safe manner.

Operators would be required to plug a well when any of the following occurs:

(a) The drilling operations have ended and the operator has taken no further action on its well within 60 calendar days;
(b) A well, which has been completed for production operations, is continuously inactive for a period of 1 year; or
(c) The period approved in an operations permit to maintain a well in shut-in status has expired.

The operator could apply for either an operations permit or a modification of its approved operations permit to maintain its well in a shut-in status for up to 5 years. The application to extend the plugging requirement would describe why drilling or production operations have ceased and the reasonable future use of the well, demonstrate the well's mechanical integrity, and describe how relative operating standards would be maintained while the well is idle. Additional extensions can be obtained by submitting a new application as long as operating standards can be maintained.

Administration of an Operations Permit

Modification of an Operations Permit: The proposed rule would provide the Service or operator a method to modify an operations permit to address new or unanticipated changes in operational or environmental conditions. Any modification to an approved permit must meet the same criteria that apply to an operations permit as outlined in the Application Review Process.
A modification is an action outside the scope of an existing operation in a manner that has notable impacts on refuge resources, visitor uses, refuge administration, or human health and safety. Examples of a modification could include drilling additional wells from the same pad, creating additional surface disturbance (expanding the footprint of a well pad, realigning a road), or converting a production well into a wastewater disposal well.

Minor actions that are not specifically addressed in the operations permit but are within the scope of the impacts analyzed are not considered modifications subject to additional review and approval. Examples of such minor actions would include repositioning of surface facilities within the permitted area of operations, minor changes in color schemes, or non-routine maintenance actions.

Prohibited Acts and Penalties: The proposed rule lists the prohibited acts that would constitute a violation of these regulations, as well as the penalties associated with violations. Prohibited acts include operating in violation of terms or conditions of an operations permit or a Service-approved

SUP or ROW, damaging Federal property, conducting operations without Service authorization, failure to comply with suspension or revocation orders, or failure to comply with Federal, State, and local statutes or regulations.

The refuge manager in coordination with Service law enforcement would have the discretion to fine, suspend, or revoke an operation if the operator engages in a prohibited act. Any violation that results in a threat to public safety or risk of damage to refuge resources and values should be addressed by the refuge manager.

Appeals: As in Alternative A, if an operator disagrees with a decision made by the Service, the appeals process in 50 CFR § 25.45 would apply. For ROWs, appeals would still be governed by 50 CFR 29.22; in Alaska, appeals would still be governed by 43 CFR 36.8. The operator must exhaust these remedies before the Service decision is considered a final agency action that is subject to review under the Administrative Procedure Act.

ALTERNATIVE C: MODIFIED PROPOSED RULE

Alternative C would include all the proposed changes in Alternative B, except as follows.

Purpose and Scope

Alternative C would expand Service jurisdiction to regulate non-Federal oil and gas operations that occur on private surface within the boundary of a refuge (i.e., inholdings). Operational standards would be applied only to the extent necessary to avoid or minimize impacts to refuge resources and uses.

This alternative would require operators of new wells or seismic operations on inholdings to submit certain information that would allow the Service to fully analyze potential impacts on federally owned or administered lands or waters, resources, or visitor health and safety. If the Service determines that it does not reasonably expect that operational requirements are needed to protect against expected impacts or risk of damage to federally owned, administered, or controlled lands, or any waters or resources of the unit, or refuge visitor and employee health and safety, then the operator would not be required to obtain an operations permit, provided that the operator would still be subject to the general terms and conditions, prohibitions and penalties, and appeals provisions in the proposed rule. This provision would also apply to existing operations that are located on private surfaces within the boundary of a refuge.

Accessing Oil and Gas Rights from a non-Federal Surface Location

Alternative C would expand Service jurisdiction to encompass surface and subsurface directional drilling operations on non-Federal surfaces. Directional drilling operations would be subject to the full regulatory requirements of a new operation. The Service would impose operational standards on activities outside of the refuge to the extent necessary to avoid or minimize impacts on refuge resources and uses. Financial assurance would likely not be required as reclamation to Service standards on non-Federal surfaces because it would not be necessary to protect Federal interests. Operators may be responsible for reimbursing the Service for costs associated with administering the operations permit. Access fees would not apply since there would be no use of Federal surface.

Requirement to Obtain a Service Permit to Conduct Operations

Under Alternative C, all operations, including those on non-Federal surfaces, within a refuge boundary would be required to obtain an operations permit under the proposed regulations. The operations permit requirement would be expanded from Alternative B to include not only new operations, but also existing operations that are under a current Service-issued permit and pre-existing operations not under a Service-issued permit.

Alternative C would require existing operations with or without Service-issued SUPs or ROWs to submit applications for obtaining an operations permit within 1 year from the effective date of the new rule. The Service would be allowed discretion on processing priorities based on operational and environmental conditions at the existing sites. Operators would be allowed to continue operating as provided in Alternative B until the Service processed their application. All existing operations would have to comply with all regulatory provisions including the relevant operating and reclamation standards, maintenance of financial assurance, reimbursement to the Service for its costs associated with administering the operations permit, and payment to the Service for access to the oil and gas right boundary.

Performance-Based Standards and the Permitting Process

Under Alternative C, performance-based standards and the permitting process would be the same as Alternative B, except the Service would actively regulate downhole operations. The modified proposed rule would establish standards and information requirements regarding downhole operations.

Under Alternative C, additional downhole information requirements for operations permit applications would include:

<u>Drilling Information</u>

- The drilling program, including hole size for each section and the directional program, if applicable;
- The proposed drilling depth and the estimated depths and names of usable water, brine, hydrocarbon, geothermal, or other mineral-bearing zones;
- The casing program, including the size, grade, weight, and setting depth of each string;
- The cementing program, including downhole location of any stage equipment, cement types, volumes, and additives to be used, and a description of pressure tests and cement evaluation logs that will be run to verify cement placement and integrity;
- The minimum specifications for pressure control equipment function and pressure testing frequency and the blowout preventer stack arrangement;
- The proposed logging, coring, and testing programs;
- The proposed completion program, including completion type (open-hole, perforated, slotted liner, etc.) and procedures, including considerations for well control;
- A description of the equipment, materials, and procedures proposed for well plugging, including plug depths, plug types, and minimum mud weight.

<u>Well Stimulation Information</u>

- The top and bottom of intervals at which well stimulation fluids are to be injected;

- Geological names, depths, and properties of formations that serve to confine fracture height growth;
- Steps to be taken before treatment to verify mechanical integrity of all downhole tubulars and tools and cement quality, including pressure tests and cement bond logs (or other logs acceptable to the refuge manager) demonstrating that the occurrences of usable water zones have been isolated to protect them from contamination;
- Proposed stimulation fluid including, but not limited to, the base fluid and each additive by trade name and purpose of such additive;
- Proposed proppant (i.e., solid material, such as sand or ceramic beads, that serves to keep a fracture propped open) system;
- Estimated total volume of fluid to be used;
- Anticipated surface treating pressure range;
- Maximum injection treating pressure;
- Estimated or calculated fracture length and fracture height;
- Any microseismic monitoring planned or proposed in conjunction with well stimulation;
- Source, quantity, access route, and transportation method for all water anticipated for use in stimulating the well;
- Storage, mixing, pumping, and control equipment needed to perform the stimulation;
- Estimated volume of stimulation fluids to be recovered during flow back;
- Chemical composition and properties of flowback fluid;
- Methods of handling the recovered fluids, including any onsite treatment for reuse of fluids in other stimulation activities; and
- Proposed disposal method of the recovered fluids, including, but not limited to, injection, hauling by truck, or transporting by pipeline.

Production Operations Information

- The size, grade, weight, and setting depth of all casing and tubing strings; cementing history; type and size of packers and subsurface flow control devices; top and bottom depths of each completed interval; and method of completion;
- Well history, including completions, stimulations, servicing, and workovers;
- Minimum specifications for any downhole pressure-control equipment, function, and pressure-testing frequency.

The above information would be used by the Service to evaluate compliance with the following operating standards and reporting requirements:

1. The operator must design, implement, and maintain integrated casing, cementing, drilling fluid, completion, stimulation, and blowout prevention programs. These programs must be based upon sound engineering principles to prevent escape of fluids to the surface and to isolate and protect usable water zones throughout the life of the well, taking into account all relevant geologic and engineering factors.

2. The operator must maintain the well to prevent escape of fluids to the surface and to isolate and protect usable water zones throughout the life of the well, taking into account all relevant geologic and engineering factors.

3. For stimulation operations including hydraulic fracturing, the operator must not begin injection activities before they demonstrate the mechanical integrity of all surface and downhole tubulars and equipment to differential pressures equal to at least those calculated at the maximum anticipated treating pressure.

4. The operator must continuously monitor and record the treating pressures and all annular pressures before, during, and after the treatment to ensure that treatment materials are directed to the intended zone.

5. If mechanical integrity is lost during the treatment, the operator must immediately cease the operation and notify the refuge manager no later than 24 hours after the incident. Within 15 days after the occurrence, the operator must submit to the refuge manager a report containing all details pertaining to the incident, including corrective actions taken.

6. The operator must plug all wells to prevent a pathway of migration for fluids along any portion of the bore.

Performance Bond (Financial Assurance)

Under Alternative C, the requirements for an operator to maintain acceptable financial assurance would be the same as for Alternative B. Additionally, all pre-existing and new operations within the boundary of the refuge or directional drilling beneath a refuge would be required to post financial assurance as necessary to protect refuge resources and uses.

Table 2-1 presents a side-by-side comparison of the three alternatives.

TABLE 2-1. DESCRIPTION OF ALTERNATIVES COMPONENTS FOR IN-DEPTH ANALYSIS

Regulatory Provision	Alternative A: No Action	Alternative B: Proposed Rule	Alternative C: Modified Proposed Rule
Purpose and Scope	Apply to NWRS lands held by the Service in fee title, or any waters on the refuge.	Same as Alternative A plus: ● NWRS lands held by Service in less than fee (i.e., easements), or any waters on the refuge.	Same as Alternative B plus: ● Operations on private inholdings within a refuge ● Directional drilling operations from non-Federal surface locations to access oil and gas rights within a refuge.
Accessing Oil and Gas Rights from Non-Federal Surface Locations	Service does not regulate.	Similar to Alternative A, exemption from regulations would provide an incentive for operators to choose surface locations outside the refuge.	Expand Service jurisdiction to regulate surface and subsurface directional drilling operations accessing oil and gas rights from non-Federal surfaces. These operations would be subject to the full regulatory requirements of a new operation to the extent necessary to avoid or minimize impacts on refuge resources and uses.
Requirement to Obtain a Service Permit to Conduct Operations	● Most new operations are under a Service-issued voluntary SUP or a ROW, because of deed language, State law, voluntary agreement, or ANILCA regulations ● Most operations prior to 2000 do not have Service-issued permit (pre-existing operations). These operations	● All new operations require operations permit. ● Existing operations under an SUP or ROW may continue under those terms and conditions and would be adjusted as necessary to meet reclamation standards of the proposed rule. ● Pre-existing operations may	All new, existing operations with a Service-issued permit, and pre-existing operations within the scope of the modified proposed rule would be required to obtain an operations permit, including operations on private inholdings and directionally drilling from non-Federal surfaces.

Regulatory Provision	Alternative A: No Action	Alternative B: Proposed Rule	Alternative C: Modified Proposed Rule
	are unregulated with unnecessary impacts to refuge resources and uses addressed inconsistently through application of other laws and regulations, and cooperation with other permitting agencies and operator.	continue with current operations (e.g. production), but would be required to obtain an operations permit for any modification to operations. Eventually, pre-existing operations would have to obtain an operations permit for reclamation to ensure reclamation standards of the proposed rule are met.	
Performance-Based Standards	Not defined, but prescriptive measures (i.e., BMPs) developed on a case-by-case basis to achieve protection of refuge resources and use where permits are issued.	● Proposed rule establishes a defined suite of performance-based standards for protection of refuge resources and uses, including surface use and site management, specific resource protections, spill prevention and response, waste management, and reclamation.	Same as Alternative B, except performance-based standards would be established for downhole operations.
Permitting Process	Defined by policy in general terms and applied in various ways across the Service.	Establishes the process for obtaining an operations permit including: ● initial steps in developing a permit application, ● contents of the application, ● the Service's review of the application including timelines, ● the Service's approval	Same as Alternative B, but Service would actively regulate downhole operations as a matter of course. Alternative C would establish standards and information requirements related to downhole operations.

Regulatory Provision	Alternative A: No Action	Alternative B: Proposed Rule	Alternative C: Modified Proposed Rule
		standards, and ● the actions the Service may take on the application including timelines.	
Performance Bond (Financial Assurance)	Typically not required and applied inconsistently when required.	Performance bond required as condition of permit approval. Bond amount equal to cost of surface reclamation, but may be reduced by amount of upfront reclamation in-kind (mitigation).	Same as Alternative B.
Access Fees	No provisions for collection of access fees.	Establishes provisions for charging a fee for use of Service roads and for new access across Federal lands and waters (e.g., roads or gatherings lines) outside of the oil and gas mineral right.	Same as Alternative B.
Change of Operators	No general notification or performance requirements of either former or new operator.	Specific procedures and requirements defined to ensure all regulatory and permit responsibilities of former operator are imposed on the new operator.	Same as Alternative B.
Cost Recovery	No provisions for cost recovery.	Provisions for cost recovery for Service expenses associated with administration of permits.	Same as Alternative B, noting that permits and associated cost recovery would include operations on private surface estate within a refuge and operations that use directional drilling from surface locations outside a refuge to access oil and gas rights within a refuge.

Regulatory Provision	Alternative A: No Action	Alternative B: Proposed Rule	Alternative C: Modified Proposed Rule
Third-Party Monitoring	Common requirement for 3D seismic surveys conducted under an SUP.	Provisions that operators hire third-party monitors when they are necessary to ensure compliance with any operations permit.	Same as Alternative B.
Well Plugging (Maintenance of Idle or Shut-In Wells)	Defer to State requirements for well plugging or maintenance of wells in a nonproducing state.	Defines conditions under which non-producing wells must be plugged, and includes procedures for obtaining approval for maintaining wells in an idle or shut-in status.	Same as Alternative B.
Administration of Permit	Provisions of SUPs and ROWs would apply when issued.	Establishes suite of administrative procedures to address general terms and conditions common to all permits, modifications to permits, prohibited acts and penalties, and appeals.	Same as Alternative B.

HOW ALTERNATIVES MEET OBJECTIVES

As stated in Chapter 1: Purpose and Need for Action, all action alternatives selected for analysis must meet all objectives to a large degree. The action alternatives must also address the stated purpose of taking action and resolve the need for action; therefore, the alternatives were individually assessed in light of how well they would meet the objectives for this rulemaking and EIS (refer to Chapter 1: Purpose and Need for Action). Alternatives that did not meet the objectives were not analyzed further (refer to the Alternatives Eliminated from Further Consideration section in this chapter).

Alternatives B and C, the action alternatives, meet the Service's purpose and need for the action, as well as the Service's objectives to a large degree. Alternative B, the Service's preferred alternative, meets the Service's objectives to a greater degree than Alternative C. Table 2 is a comparison of how each of the alternatives described in this chapter would meet the Service's objectives of the proposed action.

TABLE 2-2. OBJECTIVES MET BY PROJECT ALTERNATIVES.

Objective	Alternatives		
	A: No Action	B: Proposed Rule	C: Modified Proposed Rule
1. Clarification of Service authority	NO	YES	YES
Consistent, functional, and understandable procedures and provisions	NO	YES	YES
Performance-based standards provide flexibility to resource managers and operators to achieve resource protection	NO	YES	YES
Practical and effective means for dealing with acts of noncompliance or with illegally conducted operations	NO	YES	YES
Regulation addresses directional oil and gas wells drilled beneath refuges from surface locations outside refuge boundaries in a way that is most protective of refuge resources and uses.	NO	YES	NO
All future operations on Service fee title and less than fee title lands and waters utilize the least damaging methods to prevent or minimize damage to refuge resources and uses.	NO	YES	YES
All existing operations on Service fee title and less than fee title lands and waters do not create unnecessary impacts on refuge resources and uses by maintaining full compliance with Federal and State laws, regulations, and permits.	NO	YES	YES
The regulation addresses existing operations by balancing the incremental level of protection for refuge resources and uses with the incremental administrative and cost burden imposed on both the regulated community and the Service.	NO	YES	NO
All operations are eventually reclaimed in a manner consistent with the purposes for which the refuge was established.	NO	YES	YES
The public and refuge staff are fully protected from health and safety hazards associated with operations.	NO	YES	YES

Alternatives Eliminated from Further Consideration

The following alternatives were brought forth by the planning team during the development of the proposed regulations or were suggested by the public in their comments on the Advanced Notice of Proposed Rulemaking (ANPR) or the Notice of Intent (NOI) to prepare this EIS. These alternatives or alternative components were considered but dismissed from further detailed analysis for reasons explained below.

Uniform Acquisition of Oil and Gas Rights in All Refuge Units Where Mineral Development is Ongoing or Likely in the Future

This alternative, which would have involved the purchase of private mineral rights, was deemed financially infeasible and unnecessary. The Service has the authority to purchase the non-Federal mineral rights on a case-by-case basis if needed, so purchasing all rights on all units is not needed to provide protection of resources, values, and human health and safety. Also, it would be cost prohibitive to purchase all of the mineral rights where mineral development is ongoing or likely in the future.

In addition to financial infeasibility, in the event that there were unwilling sellers, this alternative would possibly require condemnation of mineral rights and would thus create substantial conflicts with private property rights. Finally, this alternative would also be inconsistent with the objective of providing owners and operators of private oil and gas rights reasonable access for exploration, production, maintenance, and surface reclamation. Therefore, this alternative was eliminated from further analysis.

Uniform Acquisition of All Mineral Rights in Refuge Units (Rights Other than Oil and Gas Rights)

For the same financial reasons discussed above, this alternative was dismissed from further analysis.

Consistency with the Purposes of the National Environmental Policy Act

NEPA requires an analysis of how each alternative meets or achieves the responsibility of the agency to carry out the policies set forth in NEPA. As outlined in section 101(b) of the Act, in order to carry out the policies of NEPA, Federal agencies have the continuing responsibility to improve and coordinate Federal plans, functions, programs, and resources so the Nation may:

1. fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
2. assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings;
3. attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences;

4. preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice;
5. achieve a balance between population and resource use that would permit high standards of living and a wide sharing of life's amenities; and
6. enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources. (42 USC 4331(b))

CEQ has promulgated regulations for Federal agencies' implementation of NEPA (40 CFR Parts 1500–1508). Section 1502.2 asserts that "environmental impact statements shall state how alternatives considered in it and decisions based on it will or will not achieve the requirements of sections 101 and 102(1) of the Act and other environmental laws and policies" (40 CFR 1502.2); therefore, other acts and Service policies are referenced as applicable in the following discussion.

ALTERNATIVE A: NO-ACTION

Alternative A fails to meet the above stated responsibilities of the Service as outlined in section 101(b) of NEPA. Oil and gas operations not currently under an SUP or ROW would continue to pose current and potential future impacts on public safety and refuge resources (e.g., impacts resulting from accidental spills and releases, or lack of full site reclamation). Lack of consistency for operations under a SUP or ROW may continue to result in unnecessary impacts to refuge resources and uses. Lack of Service consistency for those operations under SUPs or ROWs and lack of oversight in the form of inspections and monitoring for these exempt operations would not ensure healthful, productive, or aesthetically pleasing surroundings. Upon completion of operations, reclamation to Service standards would not be guaranteed. As a result, Alternative A would not attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences or help to achieve a balance between population and resource use, nor would it enhance the quality of renewable resources. As a result, this alternative would not fulfill the responsibilities of each generation as the trustee of the environment for succeeding generations, and in preserving important aspects of our national heritage.

ALTERNATIVE B: PROPOSED RULE (PREFERRED ALTERNATIVE)

This alternative would fulfill the Service's continuing responsibilities as outlined in Section 101(b) of NEPA. By requiring all new operations obtain a permit and meet the standard of technologically feasible, least damaging methods. , stricter compliance with Federal and state laws for pre-existing operations, and all operations be reclaimed to Service standards, this alternative would help achieve all the necessary protections for ecosystems and wildlife to conserve fish and wildlife resources and enhance public enjoyment, as well as allow access to non-Federal mineral rights (purpose 4), enhance the quality of renewable resources, and help to ensure safe, healthful, productive, and esthetically pleasing surroundings. Additionally, Alternative B would incentivize operators to locate surface operations off refuge lands and waters, resulting in avoiding most direct impacts to refuge resources and uses.

By providing for the fair compensation for new privileged access across Federal lands outside the boundary of an operator's mineral right, as well as including the authority for Service to accept in-kind reclamation in lieu of fees, Alternative B would also help to achieve a balance between population and resource use. Overall, this alternative would go further than Alternative A towards fulfilling the responsibilities of each generation, as a trustee of the environment, for succeeding generations.

Alternative C: Modified Proposed Rule

Similar to Alternative B, this alternative would fulfill the Service's continuing responsibilities as outlined in Section 101(b) of NEPA. By requiring all operations, including surface and subsurface directional drilling operations outside the boundary of a refuge, to obtain a permit and meet the standard of technologically feasible, least damaging methods, Alternative C would help preserve important historic, cultural, and natural aspects of our national heritage, and would maintain an environment that supports diversity and variety of individual choice by allowing access to non-Federal mineral rights, enhance the quality of renewable resources, and help to ensure safe, healthful, productive, and esthetically pleasing surroundings. However, the lack of incentives to locate operations outside refuge boundaries using directional drilling could result in less protection of important historic, cultural, and natural aspects of our national heritage.

By providing for the fair compensation for privileged access across Federal lands outside the boundary of an operator's mineral right, as well as including the authority for Service to accept in-kind reclamation in lieu of fees, Alternative C would also help to achieve a balance between population and resource use. Like Alternative B, this alternative would go further than Alternative A toward fulfilling the responsibilities of each generation, as a trustee of the environment, for succeeding generations.

Environmentally Preferable Alternative

The Service typically identifies the environmentally preferable alternative in its NEPA documents for public review and comment. Guidance from CEQ states that the environmentally preferable alternative means it is "the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources" (CEQ 1981). Alternative C is the environmentally preferable alternative as it will likely have incremental environmental benefits (primarily due to the regulation of pre-existing operations during the production phase) compared to Alternative B.

U.S. Fish and Wildlife Service Preferred Alternative

To identify the preferred alternative, the planning team evaluated each alternative based on its ability to meet the objectives set forth for this rulemaking (Table 2), considering potential impacts on the environment and on existing and future operations. Alternative B (Proposed Rule) is selected as the Service's preferred alternative, because it is the only alternative that meets all of the Service's objectives for the rulemaking.

CHAPTER 3: AFFECTED ENVIRONMENT

INTRODUCTION

This chapter describes the existing conditions of the natural and cultural environments that would be affected by implementing the alternatives considered in this EIS.

Impacts for each of the following topics are analyzed in Chapter 4: Environmental Consequences.

- Geology and soils (including paleontology)
- Air quality
- Water resources (including surface and groundwater, both quality and quantity)
- Wetlands
- Floodplains
- Vegetation (including plant species of special management concern)
- Wildlife and aquatic species (including animal species of special management concern)
- Visitor use and experience (including human health and safety, visitation patterns, visitor activities, recreation, interpretation)
- Scenic views and night sky resources
- Natural soundscapes and acoustic environment
- Cultural resources (including archeological sites, prehistoric/historic structures, cultural landscapes, ethnographic resources)
- Refuge management and operations
- Socioeconomics (including non-Federal oil and gas exploration and development, and regional and local economies)

The availability of data and information on these topics varies across refuges discussed in this EIS. Moreover, the uniqueness of the natural and cultural environments in individual refuges presents an obstacle to the level of detail with which these topics can be addressed programmatically.

EFFECTS OF CLIMATE CHANGE ON NATIONAL WILDLIFE REFUGE SYSTEM UNITS

Climate change refers to a suite of changes occurring in the earth's atmospheric, hydrologic, and oceanic systems. These changes, including increased global air and ocean temperatures, widespread melting of snow and ice, and rising global average sea levels, provide evidence that the climate system is warming (IPCC 2007). While the warming trend, commonly referred to as global warming, is discernible over the past century and a half, recent decades have exhibited an accelerated warming rate with 11 of the last 12 years ranking among the 12 warmest years on record. Global mean surface temperatures have increased nearly 1.0°C (1.8°F) from 1890 to 2006 (Goddard Institute for Space Studies, 2007). Observations and predictive models indicate that average temperature changes are likely to be greater in the Northern Hemisphere. Without additional meteorological monitoring and modeling systems, it is difficult to determine the spatial and temporal variability and change of climatic conditions. What is known is that increasing concentrations of greenhouse gasses (GHGs) are likely to accelerate the rate of climate change.

Greenhouse gases that are included in the US Greenhouse Gas Inventory are: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Carbon dioxide and methane (CH_4) are typically emitted from combustion activities or are directly emitted into the atmosphere. On-going scientific research has identified the potential impacts of greenhouse gas emissions (including CO_2; CH_4; nitrous oxide (N_2O; and several trace gasses) on global climate. Through complex interactions on regional and global scales, these greenhouse gas emissions cause a net warming effect of the atmosphere (which makes surface temperatures suitable for life on Earth), primarily by decreasing the amount of heat energy radiated by the Earth back into space. Although greenhouse gas levels have varied for millennia (along with corresponding variations in climatic conditions), recent industrialization and burning of fossil carbon sources have caused CO_2 concentrations to increase dramatically, and are likely to contribute to overall climatic changes. Increasing CO_2 concentrations may also lead to preferential fertilization and growth of specific plant species.

In 2007, the Intergovernmental Panel on Climate Change (IPCC) predicted that by the year 2100, global average surface temperatures would increase 1.4 to 5.8°C (2.5 to 10.4°F) above 1990 levels (IPCC 2007). The National Academy of Sciences (2006) supports these predictions, but has acknowledged that there are uncertainties regarding how climate change may affect different regions. Computer model predictions indicate that increases in temperature will not be equally distributed, but are likely to be accentuated at higher latitudes. Warming during the winter months is expected to be greater than during the summer, and increases in daily minimum temperatures are more likely than increases in daily maximum temperatures.

As climate changes, changes in weather conditions will impact the natural environment of refuges by shifting patterns of precipitation, promoting extremes in storm behavior, altering seasonal temperatures, and influencing the triggers for bird migration, wildlife breeding, insect emergence, and plant dormancy.

Some refuges are already seeing changes to vegetation, wildlife habitat, and water resources as a result of climate change, and research predicts that many refuges will see changes to these resources in upcoming decades (Czech et al. 2014). Climate change can also result in sea level rise and increased frequency and intensity of storm events (IPCC 2013). For example, according to a resource vulnerability assessment for the Eastern Shore of Virginia NWR and Fisherman Island NWR, sea level rise due to climate change will impact coastal marshes and other low-lying areas, increase flooding from storm surges, and cause shoreline erosion (Bulluck et al. 2011). Those same changes will affect refuges in the Gulf Coast (Yang et al. 2014). Climate change could raise sea levels in coastal refuges containing oil and gas resources, such as Delta NWR in Louisiana, and increase flooding along rivers such as found at Deep Fork NWR in Oklahoma, which has wells in and around the Deep Fork River floodplain. Habitat potentially lost due to sea level rise includes beaches and wetlands that surround the landward boundaries of the refuges (Glick et al. 2013, Palaneasu-Lovejoy et al. 2013, Williams 2013). Storm events also have the potential to cause substantial land and habitat loss by exacerbating erosion rates and changing hydrologic and sediment dynamics.

Changing patterns in precipitation and temperature have the potential to shift the latitudinal and elevational distribution of some plant communities and threaten the persistence of others. As temperature and precipitation patterns affect the abundance, type, and distribution of vegetation cover in watersheds, changes in flood magnitude and duration, sediment loads, and water chemistry will likely occur.

Climate change will alter ecosystems in fundamental ways, which will vary depending on locations and resources. It is not, however, possible at this time to predict with any certainty the causal connection of site specific emissions from sources to impacts on the global/regional climate relative to the proposed regulation of non-Federal oil and gas operations on national wildlife refuges. The effect of climate change on many of the resources discussed in the EIS is recognized and the Service will continue to evaluate as new science becomes available and the future of climate change unfolds.

GEOLOGY AND SOILS

National wildlife refuges lie within 13 physiographic provinces. The type and distribution of geologic features vary widely across refuges, and the extent to which unique soil types are present can be vastly different between two refuges located within the same physiographic province. A description of each of the physiographic provinces associated with refuges follows. These descriptions are derived from Bailey (1995) unless otherwise noted.

APPALACHIAN PLATEAUS PROVINCE

The Appalachian Plateaus province encompasses several refuges. It extends from Alabama to beyond the glacial border in Ohio and Pennsylvania and is bounded on all sides by escarpments, giving the plateau an overall synclinal (trough-like) structure. Most rocks found in this province are clastic sedimentary rocks (i.e., made from fragments of older rocks). They include conglomerates, sandstones, and shales, with some interbedded coal. Limestones are uncommon. Strata are mainly Mississippian (359–323 million years old) and Pennsylvanian age (323–299 million years old), although some northern areas are underlain by younger Permian age rocks (299–252 million years old) (FEN 2008).

BASIN AND RANGE PROVINCE

The Basin and Range Province includes almost all of Nevada, Southern California, western Utah, the southern half of Arizona, southwestern New Mexico, and west Texas. Most, if not all, of the streams in the Great Basin Section of this province do not flow to the ocean (USGS 2014).

CENTRAL LOWLANDS PROVINCE

The Central Lowlands province is the largest geomorphic province in the United States, covering the north-central portion from just east of the Great Lakes west to the Great Plains in the Dakotas. The Central Lowlands are part of the stable continental interior, an area where only minor deformation of the sediments and rocks has occurred since Precambrian time. The geologic structures characteristic of this region are broad uplifts and basins filled with gently dipping sedimentary rocks on its flanks.

INTERIOR LOW PLATEAUS PROVINCE

The Interior Low Plateaus province is characterized by geologic structures similar to those of the Central Lowlands. This province is at the southeastern edge of the stable continental interior and lies between the Central Lowlands on the northwest, the Mississippi embayment part of the Coastal Plain province on the southwest, and the Cumberland Escarpment at the edge of the Appalachian Plateaus province to the east.

Coastal Plain Province

The Coastal Plain province, where a majority of existing oil and gas operations on NWRS lands currently occur, consists of the seaward-sloping, lowland sediments along the Atlantic Ocean and Gulf of Mexico and the submerged section, the continental shelf. Rocks of the Coastal Plain province fall into one of three groups. Around the inner border of the province are marine sedimentary rocks deposited when the Cretaceous sea (145–66 million years old) inundated this part of the continent. In the middle section of the province, younger marine, Tertiary-age (66–29 million years old) rocks overlie the Cretaceous rocks and dip gently towards the sea. Along the coastal areas, sediments of Quaternary age (2.6–0.01 million years old) form a more or less continuous band of varying width from southern Texas to Long Island.

Colorado Plateaus Province

The Colorado Plateaus province, a province with a high potential for oil and gas operations in the future, is mostly arid or semiarid and is largely devoid of vegetation and thick soils that obscure the geologic record that exists in other areas of the country. In addition to extensive flat-topped plateaus, other major landforms in the province include canyons produced by the Colorado River and its tributaries, colorful exposed sedimentary rocks, plateau edges and basins localized by fault scarps and folds, igneous mountains produced by both intrusive and extrusive geologic processes, and lava fields.

Columbia Plateau Province

The Columbia Plateau province includes the Snake River plain and the Columbia River basin in Idaho, Oregon, and Washington, and consists of basalts, igneous, or volcanic rock. Basalt was formed by the rapid cooling of basaltic lava deposited on the surface by volcanic activity. The lava flows in this province were deposited between 6 and 17 million years ago (USGS 2014).

Great Plains Province

The Great Plains province is characterized by extensive low-relief topography with some localized mountains and volcanic deposits near its western edge. Running water has eroded the sediments and formed the colorful badland topography which also contains Tertiary-age sedimentary debris shed from erosion of the Rocky Mountains.

Middle Rocky Mountains Province

The Middle Rocky Mountain Province is made up of the mountains, plateaus, and basins of western Wyoming, northeastern Utah, and a small portion of Montana and northwest Colorado. In this province, overlying Paleozoic (541–252 million years old) and younger Mesozoic (252–66 million years old) sedimentary rocks over 20,000 feet thick are exposed along the flanks of the folded and thrust-faulted mountain ranges of the Uintas, Beartooths, and central Wyoming.

Ouachita-Ozark Interior Highlands Province

The Ouachita-Ozark Interior Highlands consists of rocky outcrops in eastern Oklahoma, the southern half of Missouri, and Arkansas. Carbonate and other sedimentary rocks of Paleozoic origin were originally deposited on the seafloor. This highland province is marked by folds and faults.

Pacific Border Provinces

The Pacific Border provinces extend from the tip of the Aleutian Islands chain southeastward through California, and include four major tectonic components, one of which is the California San Andreas transform fault system. This province is characterized by active geologic processes at the continental and oceanic plate boundaries (mountain-building and volcanism).

Southern Rocky Mountains Province

This province contains broad anticlinal uplifts (rocks folded during mountain-building episodes) with thrust faults on one or both flanks that formed during the late Mesozoic-early Tertiary Laramide orogeny approximately 70 to 40 million years ago. Baca NWR represents the only true desert in the southern Rocky Mountains and lies along the east edge of the San Luis Valley within the Southern Rocky Mountains physiographic province.

Superior Upland Province

Repeated glaciation modified the geology of the Superior Upland Province (USGS 2014), which includes portions of northern Minnesota and Wisconsin. This province contains mostly Precambrian metamorphic rocks and overlying Paleozoic rocks (Cambrian). A thin veneer of glacial deposits covers the older Precambrian and Cambrian rocks.

Soils in the National Wildlife Refuge System

Dominant soil orders occurring in the NWRS vary depending on the location and include Alfisols, Andisols, Aridisols, Entisols, Histosols, Inceptisols, Mollisols, Spodosols, Ultisols, and Vertisols (USDA 2006).

Air Quality

Air quality is important for natural resources. Natural resources can be harmed by the air pollution emitted by power plants, factories, automobiles, and other sources. Pollutants transported with the wind can come from local sources or from sources hundreds of miles away. These include pollutants emitted directly from sources (primary pollutants) and those that are formed as a result of chemical reactions in the atmosphere (secondary pollutants). Primary pollutants include sulfur dioxide (SO_2), nitrogen oxides (NO_x), particulate matter (PM_{10} and $PM_{2.5}$), and volatile organic compounds (VOCs), while secondary pollutants include sulfates, nitrates, and ozone. Sources of air pollution include stationary sources, such as power plants, industrial facilities, and factories; mobile sources, such as cars, buses, planes, trucks, and trains; and natural sources, such as wind-blown dust, wildfires, and volcanoes.

Many resources and values of the NWRS are affected by air pollution. Air pollutants can cause injury to vegetation, change terrestrial and aquatic ecosystems, degrade sensitive Service-protected flora and fauna, and impair visibility. Visibility is affected by the physical interaction of light with particles and gases in the atmosphere; it is also one of the primary air-related attributes that people associate with refuges. Many visitors come to refuges to enjoy the spectacular vistas, which can be obscured by pollutants, especially fine particles in the atmosphere.

Air pollutants can also harm ecological resources, including, water quality, soils, plants, animals, and geological, archeological, and historical resources. Ozone, for example, causes foliar injury and reduced growth in some sensitive plant species. Atmospheric deposition of sulfur and nitrogen compounds can cause significant ecosystem effects such as acidification, eutrophication, and changes in soil and water chemistry.

Acidification of soils, lakes, and streams can result in changes in community structure, biodiversity, reproduction, and decomposition. Documented impacts in some refuges include stressed trees, acidified streams, and a reduction in species of fish and other aquatic life in affected waters. Although nitrogen is an essential plant nutrient, increased levels of atmospheric nitrogen deposition can stress ecosystems. Excess nitrogen acts as fertilizer, favoring some types of plants and leaving others at a competitive disadvantage. This creates an imbalance in natural ecosystems, and long-term effects of these changes may include shifts in types of plant and animal species, increases in insect and disease outbreaks, and disruptions of ecosystem processes such as nutrient cycling, and changes in fire frequency.

Metals, such as mercury, and persistent organic compounds deposited from the atmosphere can bioaccumulate in the food chain, causing behavioral, neurological, and reproductive effects in fish, birds, and wildlife.

CLEAN AIR ACT

Under the Clean Air Act (CAA), the Federal Land Manager (FLM) (i.e., Secretary of the Interior) and the federal official with direct responsibility for management (i.e., Refuge Manager) have an affirmative responsibility to protect the air quality-related values of Federal lands.

Congress gave the greatest degree of air quality protection, Class I, to certain national parks and wilderness areas. These Class I areas are national parks or national wilderness areas that were so designated as of August 7, 1977, and that are greater than 6,000 acres (parks) or 5,000 acres (wilderness). There are 21 units of the NWRS, 48 units of the NPS, and 88 U.S. Forest Service Wilderness Areas designated as Class I areas. Only a small amount of new pollution is allowed in these areas. All other clean air regions, except some tribally designated Class I areas, are designated Class II areas with moderate pollution increases allowed.

There are 21 Class I areas located in 19 NWRS units:

- Alaska Maritime (AK) There are 3 Class I areas located within the Alaska Maritime NWR: Tuxedni, Simeonof and Bering Sea Wilderness
- Bitter Lake NWR (NM)
- Bosque del Apache NWR (NM)
- Breton NWR (LA)

- Cape Romain NWR (SC)
- Chassahowitzka NWR (FL)
- Edwin B. Forsythe NWR (NJ)
- Lostwood NWR (ND)
- Medicine Lake NWR (MT)
- Mingo NWR (MO)
- Moosehorn NWR (ME)
- Okefenokee NWR (GA)
- Red Rocks Lakes NWR (MT)
- St. Marks NWR (FL)
- Seney NWR (MI)
- Swanquarter NWR (NC)
- UL Bend NWR (MT)
- Wichita Mountains NWR (OK)
- Wolf Island NWR (GA)

The remaining NWRS units are designated class II areas. The major CAA regulatory programs that the Service has active responsibilities for include the National Ambient Air Quality Standards, New Source Review (NSR)/Prevention of Significant Deterioration (PSD) permit program, and Regional Haze.

National Ambient Air Quality Standards: Sections 108 and 109 of the CAA required the EPA to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. NAAQS represent the minimum standards for these air pollutants throughout the United States. CAA identifies two types of NAAQS: primary and secondary. Primary standards provide public health protection, including protecting the health of sensitive populations, such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. EPA established NAAQS for seven pollutants: fine particles ($PM_{2.5}$) and inhalable coarse particles (PM_{10}), sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ground level ozone (O_3), and lead (Pb). EPA periodically updates NAAQS.

State, local, and tribal agencies have primary responsibility for ensuring attainment of NAAQS. In addition, the Service ensures that Service and Service-authorized activities are consistent with NAAQS and applicable State, local and tribal air pollution requirements. The current NAAQS are presented in Table 1. The standards are expressed as either micrograms per cubic meter or parts per million, over a specified period of time (averaging period).

TABLE 3-1. NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Standard	Averaging Period	Metric	Threshold for Nonattainment
Carbon monoxide	Primary	8-hour	9 ppm	Not to be exceeded more than once per year
		1-hour	35 ppm	Not to be exceeded

Lead (Pb)	Primary and Secondary	Rolling 3-month Average	0.15 μg/m^3	98th percentile, averaged over 3 years
Nitrogen dioxide	Primary	1-hour	100 ppb	Annual Mean
	Primary and Secondary	Annual	53 ppb	
Ozone (O_3)	Primary and Secondary	8-hour	0.075 ppm	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particulate matter of 2.5 micron particle size ($PM_{2.5}$)	Primary	Annual	12 μg/m^3	annual mean, averaged over 3 years
	Secondary	Annual	15 μg/m^3	annual mean, averaged over 3 years
	Primary and Secondary	24-hour	35 μg/m^3	98th percentile, averaged over 3 years
Particulate matter of 10 micron particle size (PM_{10})	Primary and Secondary	24-hour	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur dioxide (SO_2)	Primary	1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

Source: USEPA 2013a.

Refuges located in nonattainment areas are identified in Appendix E. If the concentration of one or more criteria pollutants in a geographic area is found to exceed the regulated or threshold level for one or more NAAQS, the area may be classified as a nonattainment area. Areas with concentrations of criteria pollutants that are below the levels established by NAAQS are considered either attainment or unclassifiable areas. An implementation plan describing the approach to reduce the air pollutant levels must be prepared for areas designated as nonattainment. These plans ensure emission sources meet emission goals.

WATER RESOURCES

Water resources refer to surface waters such as lakes, rivers, ponds, streams, and springs, as well as underground aquifers and seeps. Almost every refuge has water resources within its designated boundaries. In many cases, the water resources contained within refuge units constitute one of the reasons for which the refuge was established. For example, many refuges were established for the preservation of important aquatic resources, such as the coastal wetlands at Delta and Sabine NWRs in Louisiana and the bottomland hardwood forests at Deep Fork NWR in Oklahoma and Upper Ouachita NWR in Louisiana. Additionally, some refuges have congressionally designated wild and scenic rivers or other outstanding natural resource waters as designated by each state.

WATER QUALITY

In 2009, EPA conducted a national assessment (USEPA 2009) of waters within Service properties, including refuges, with waters listed as impaired under Section 303(d) of the Clean Water Act (CWA) . Impaired waters under the CWA include waterbodies or streams that fail to meet water quality standards. EPA found that 303(d) listed waters occurred within the boundaries of approximately one-third of the refuges (Table 2). The 449 impaired waters totaled 3,982 km and 1,255 km^2 of length and area, respectively. The top 10 causes of impairment of streams included pathogens, nutrients, oxygen depletion, pesticides, mercury, sediment, metals (other than mercury), habitat alteration, polychlorinated biphenyls (PCBs) , and turbidity. The top 10 causes of impairment in lakes and ponds included nutrients, metals (other than mercury), mercury, oxygen depletion, salinity/TDS/chlorides, noxious aquatic plants, PCBs, selenium, pH, and pesticides (USEPA 2009).

TABLE 3-2. SUMMARY OF IMPAIRED WATERS IN NATIONAL WILDLIFE REFUGES AND WATERFOWL PRODUCTION AREAS (FROM USEPA 2009).

	In NWR	In WPA	Total
Number of impaired waters	429	20	449
Impaired length (km)	3,968	14	3,982
Impaired area (km^2)	1,251	4	1,255
Number of NWRS units affected	178	17	195

GROUNDWATER

Groundwater is water located beneath the ground surface in soil pore spaces and in the fractures of rock formations. When a unit of rock or sediment can yield a usable quantity of water, it is called an aquifer. Aquifers are also able to transmit groundwater via the relatively porous substrate that characterizes them. When water can flow directly between the surface and the saturated zone of an aquifer, the aquifer is unconfined. The deeper parts of unconfined aquifers are usually more saturated with groundwater since gravity causes water to flow downward. The depth at which soil pore spaces or fractures and voids in rock become completely saturated with water is called the water table. Groundwater is recharged from, and eventually flows to, the surface naturally. This natural discharge often occurs at springs and seeps, and can form oases or wetlands. Groundwater is also often withdrawn for agricultural, municipal, and industrial use by drilling and operating extraction wells.

Many of the refuge units are in areas where these groundwater aquifers are present. Surficial aquifers are shallow aquifers typically less than 50 feet in thickness and comprised mostly of beds of unconsolidated sand, cavity-riddled limestone and shells, sandstone, sand, and clay sand with minor clay or silt from the Pliocene to Holocene periods. These aquifers principally supply large municipalities for domestic and commercial uses. The thickness of this surficial aquifer system in Florida is as much as 400 feet in some areas and consists mostly of unconsolidated sand, shelly sand, and shell deposits. The most productive parts of the surficial aquifer system are in southwestern Florida, where complex interbedding of fine- and coarse-textured rocks ranging from late Miocene to Holocene in age and the limestone beds of the Tamiami and Fort Thompson Formations form an important and highly permeable part of the system.

Data and information on groundwater (absence/presence, quality, recharge, depth, and uses) varies widely across NWRS units. Each refuge's unique needs would therefore need to be assessed for location during the planning for site-specific oil and gas projects. Principal aquifers associated with refuge units addressed in this draft EIS include those of the Colorado Plateaus, the Coastal Lowlands, and the Low Tertiary, Mississippian, Pennsylvanian, and Valley and Ridge geologic provinces. These principal aquifers can be comprised of carbonate rock, igneous and metamorphic rock, sandstone, or unconsolidated sand and gravel. The geographic distribution associated with these rock types is illustrated in Figure 3. Multiple aquifers are present within, and distributed throughout, each of these formations.

Sole source aquifers that are located underneath Refuges with oil and gas wells include the Chicot Aquifer System and the Southern Hills Regional Aquifer System. Refuges underlain by the Chicot Aquifer System include: Bayou Teche, Cameron Prairie, Grand Cote, Lacassine, Lake Ophelia, and Sabine National Wildlife Refuges (NWRs) in southern Louisiana. Refuges underlain by the Southern Hills Regional Aquifer System include: Saint Catherine Creek NWR in southwestern Mississippi, and Big Branch Marsh and Cat Island NWRs in southeastern Louisiana. EPA defines a sole source aquifer as "an aquifer that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer." Sole source aquifers are protected under the Safe Drinking Water Act of 1974 (Public Law 93-523, 42 U.S.C. 300 et seq.). Certain proposed projects located in areas underlain by sole source aquifers and receiving federal funds are subject to review to ensure that they do not endanger the water source.

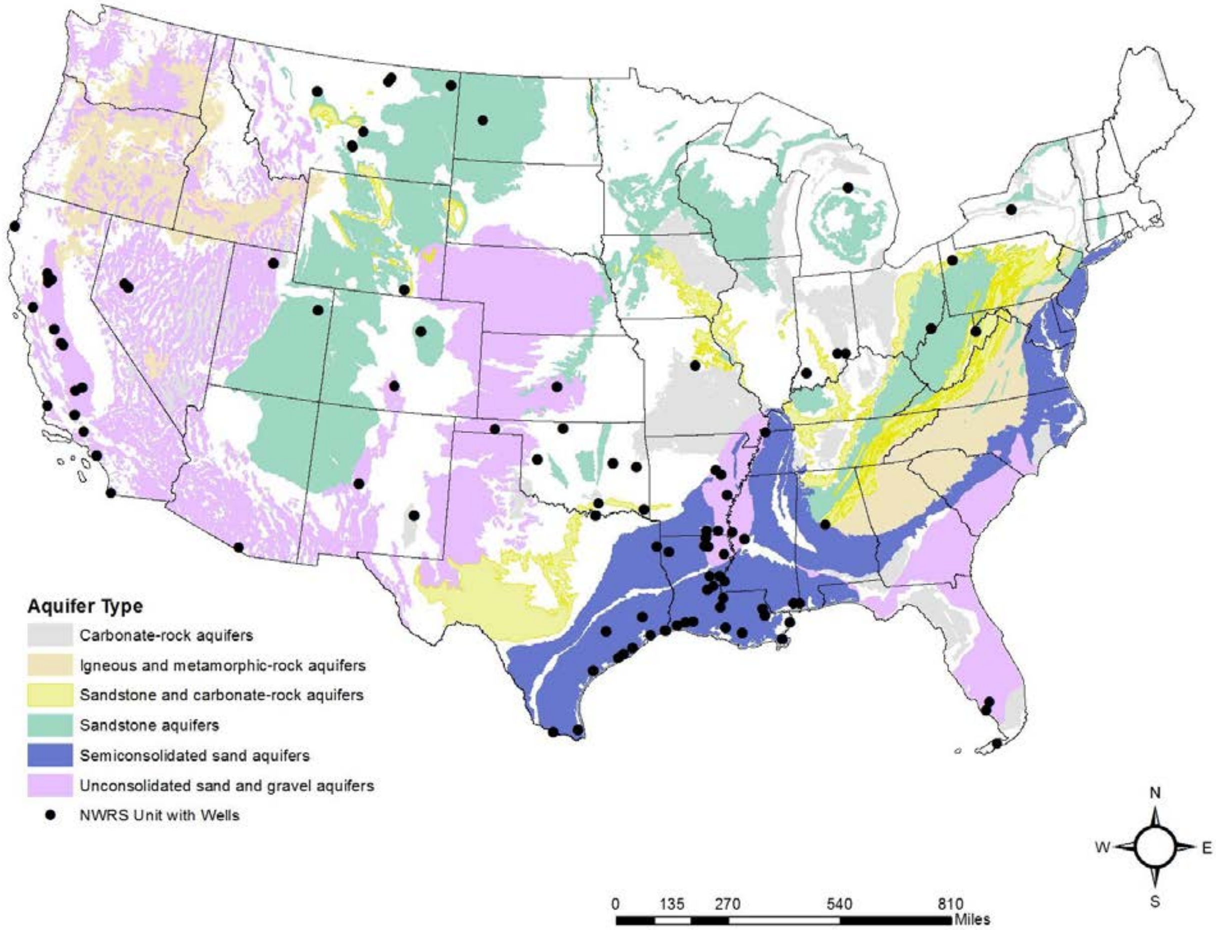


FIGURE 3-1. AQUIFER TYPES ASSOCIATED WITH REFUGE UNITS

WETLANDS

Wetlands include areas inundated or saturated by surface or groundwater for a sufficient length of time during the growing season to develop and support characteristic soils and vegetation. The NWRS classifies wetlands based on the Service's *Classification of Wetlands and Deepwater Habitats of the United States*, also known as the Cowardin classification system (Cowardin et al. 1979). Based on this classification system, a wetland must have one or more of the following attributes:

The habitat at least periodically supports predominately hydrophytic vegetation (wetland vegetation);
The substrate is predominantly undrained hydric soil;

The substrate is nonsoil and saturated with water, or covered by shallow water at some time during the growing season.

The specific wetlands that occur within refuge units are dependent upon the physiographic and climatologic features of the individual refuge and location within the refuge. Descriptions of the major wetland types in refuges are in Appendix F.

Executive Order 11990 was issued by President Carter in 1977 in order "…to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative…" Despite these protection efforts by government and private organizations, significant wetland losses are still occurring.

President Bush further addressed wetland impacts in 1989, which prompted the Service to draft a strategy to consolidate, better coordinate, and improve Service wetlands conservation programs to contribute to the goal of No Net Loss of wetlands. This strategy, called the Wetlands Policy and Action Plan (WPAP), is the basis of our existing wetlands policy (660 FW1). The WPAP identifies strategies the Service will pursue toward the goal of No Net Loss and proposes solutions to many of the current federal wetlands programs that contribute to wetland losses. The WPAP also outlines new opportunities to conserve wetlands.

FLOODPLAINS

Floodplains consist of flat or nearly flat land adjacent to a water body that experiences occasional or periodic flooding. Flood insurance rate maps produced by the Federal Emergency Management Agency delineate areas of potential flooding. The Service protects and preserves the natural resources and functions of floodplains by avoiding environmental effects associated with the occupancy and modification of floodplains, avoiding actions that could adversely affect wetland functions, and restoring floodplain values previously affected by activities in floodplains.
The Service, in complying with Executive Order (EO) 11988 and its implementing guidance in the management of floodplains will advise and will advise operators of the Service's responsibility to evaluate the potential effects of any actions they may conduct or authorize in a floodplain.

In compliance with Service policy (613 FW 1) in regards to EO 11988, the Service will:

- Avoid long- and short-term adverse effects caused by the human occupancy and modification of floodplains.
- Avoid direct or indirect support of floodplain development whenever there is a practicable alternative.
- Reduce the risk of flood loss and minimize the impacts of floods on human health, safety, and welfare.
- Restore, preserve, and enhance the natural and beneficial values served by floodplains.
- Inform the public of flood hazards on Service property, including any appropriate floodplain references or restrictions in conveyances of property proposed for lease, easement, right-of-way, or disposal to non-Federal public or private parties.
- Incorporate the concepts, strategies, and management tools of the Unified National Program for Floodplains Management into the Service's programs and actions.
- Use an integrated process to involve the public in the planning of all actions and decisions.
- Monitor Federal actions undertaken, funded, or permitted to ensure that they are carried out in accordance with the EO. The Service, in its review of other federal agency proposals, will address the basic requirements of the EO when the protection of floodplains may affect aquatic and terrestrial invertebrates, anadromous fish, migratory birds, threatened and endangered species, candidate species, and other fish, wildlife, and plant species and their habitats that come under the jurisdiction of the Service.
- Ensure all Service personnel, when working with other agencies and the public, advocate compliance with the spirit and intent of the EO.

Some portions of individual refuges addressed in this EIS are likely to be located within 100-year floodplains and are subject to high water table conditions and the drainage and flooding issues that often result from storm events. Generally, lands along the ocean beaches or adjacent to estuaries (at wide points) are located in flood insurance rate areas that correspond to 100-year floodplains that have additional hazards associated with flooding. Data and information on specific flood zones vary widely across refuge units.

VEGETATION

The U.S. Department of Agriculture and other federal agencies identify natural resources of the United States within specific geographically delineated “ecoregions” classified by geographer Robert G. Bailey (1995). Within this classification system, four levels of detail show a hierarchy of ecosystems. The largest ecosystems are domains, four groups of related climates that are differentiated based on precipitation and temperature. Divisions represent the climates within domains and are differentiated based on precipitation levels and patterns as well as temperature. Divisions are subdivided into provinces, which are differentiated based on vegetation or other natural land covers. The finest level of detail is described by sub regions, called sections, which are subdivisions of provinces based on terrain features. Also identified are mountainous areas that exhibit different ecological zones based on elevation.

VEGETATION TYPES IN POTENTIALLY AFFECTED REFUGE UNITS

Each refuge contains a unique assemblage of vegetation types, which can be categorized by the U.S. Department of Agriculture ecoregion within which the refuge unit is contained. The units and ecoregions are presented below, along with a discussion about the vegetation types that are generally associated with these ecoregions.

Arizona-New Mexico Mountains Semi-Desert--Open Woodland--Coniferous Forest--Alpine Meadow Province

Vegetational zones resemble those of the Rocky Mountains but occur at higher elevations. The foothill zone, which reaches as high as 7,000 feet, is characterized by mixed grasses, chaparral brush, oak-juniper woodland, and pinyon-juniper woodland. At about 7,000 feet, open forests of ponderosa pine are found, although pinyon and juniper occupy south-facing slopes. At 8,000 feet, pine forest is replaced on north-facing slopes by Douglas fir. Aspen is common in this zone. At about 9,000 feet, the Douglas-fir zone merges into a zone of Engleman spruce and corkbark fir. Limber pines and bristlecone pines grow in the rockier places.

The mountain foothills and surrounding plains are characterized by Chihuahuan Desert vegetation, including specialized desert scrub communities found in the salt flat and dune areas.

California Coastal Chaparral Forest and Shrub Province

Monterey cypress, Torrey pine, Monterey pine, and bishop pine are endemic to the ecoregion. Coastal plains and valleys have sagebrush and grassland communities. Riparian forests containing many broadleaf species grow along streams. Live and white oak are found on hills and lower mountains. Chaparral forest consisting of chamise and various manzanitas is found on steep hill and mountain slopes. Exposed coastal areas support desert-like shrub communities dominated by coyote bush, California sagebrush, and bush lupine.

Central Appalachian Broadleaf Forest-Coniferous Forest-Meadow Province

Valleys support mixed oak-pine forest, above which lies the Appalachian oak forest, dominated by a dozen species each in the white oak and black oak groups. Above this zone lies the northeast hardwood forest, composed of birch, maple, elm, red oak, and basswood, with a mixture of hemlock and white pine. Spruce-fir forest and meadows are found on the highest peaks of the Allegheny and Great Smoky Mountains. Mixed forest of mesophytic type (that is, containing terrestrial plants which are adapted to neither a particularly dry nor particularly wet environment) extends into narrow valleys of the southern Appalachians, where oak predominates.

Coastal Trough Humid Tayga Province

Throughout the Cook Inlet Lowlands, lowland spruce-hardwood forests are abundant. Bottom land spruce-poplar adjoins the larger river drainages, along with thickets of alder and willow. There are wet tundra communities along the Cook Inlet coastline. The Copper River Lowland is characterized by black spruce forest interspersed with large areas of brushy tundra. White spruce forests occur on south-facing gravelly moraines, and cottonwood-tall bush communities are common in large floodplains.

Colorado Plateaus Semi-Desert Province

Arid grasslands occupy the lowest zone with shortgrass sod seldom covering the ground completely. Xeric shrubs grow in open stands along the grasses, and sagebrush is dominant over extensive areas. In this zone, a profusion of annuals and perennial plants bloom during the summer rainy season and several kinds of cactus and yucca are common at low elevations in the south. Cottonwoods commonly occupy riparian areas. Pinyon pine and juniper dominate the woodland zone, while the montane zone is characterized by ponderosa pine in the south and lodgepole pine and aspen in the north.

Eastern Broadleaf Forest (Oceanic) Province

This province is characterized by winter deciduous forest dominated by tall broadleaf trees that provide dense continuous summer canopy and shed their leaves completely in winter. Forest vegetation is divided into three major associations: mixed mesophytic (with American beech, tulip tree, basswood, sugar maple, and eastern hemlock dominant), Appalachian oak (with white oak and northern red oak dominant), and pine–oak.

Eastern Broadleaf Forest (Continental) Province

This province is similar to its oceanic counterpart but is savanna-like in the northern reaches and characterized by the more drought-resistant oak-hickory association, with both species occurring in abundance. Widespread dominants are white oak, red oak, black oak, bitternut hickory, and shagbark hickory. Understory species include flowering dogwood, sassafras, and hophornbeam. Northern reaches of the oak-hickory forest contain increasing numbers of maple, beech, and basswood.

Everglades Province

Tropical moist hardwood forest covers one-fifth of the area. Cypress forest is extensive, with mangrove widespread along the eastern and southern coasts. Much of the area is open marsh covered by phreatophytic grasses, reeds, sedges, and other aquatic herbaceous plants. Mahogany, redbay, and several palmettos are common, as well as strangler fig and abundant epiphytes.

Florida Panther NWR includes a wetland mosaic with cypress strands and domes, pines, wet prairies, marshes, sloughs, and hardwood hammocks.

Great Plains Steppe and Shrub Province

Tall grasses predominate, extending west from the oak savanna of the eastern edge. Bluestem grama prairie covers the finer textured soils that characterize most of the province. Oak savanna occurs along the eastern border and along some of the major river valleys. Sandsage-bluestem prairies are dominant on the coarse textured soils near the provinces western edge.

Great Plains Steppe Province

This province contains a mixture of shortgrass and tallgrass species. Shorter dominants include blue grama, hairy grama, and buffalo grass. Taller grasses include little bluestem and needle-and-thread grass. Woody vegetation is rare, except on the cottonwood floodplains. In mixed grass steppe, additional species include green needlegrass, sand dropseed, slender wheatgrass, galleta, and purple three-awn.

Great Plains-Palouse Dry Steppe Province

This province consists of formations of short grasses, usually bunched and sparsely distributed in dry steppe or shortgrass prairie with 6 to 7 arid months per year. The Great Plains grasslands east of the Rockies have scattered trees and shrubs, such as sagebrush and rabbitbrush. The typical grass is buffalo grass; sunflower and locoweed are typical plants. Gradations of cover vary from semi-desert to woodland.

Intermountain Semi-Desert and Desert Province

Sagebrush dominates at lower elevations. Other important plants in the sagebrush belt are antelope bitterbrush, shadescale, fourwing saltbush, rubber rabbitbrush, spiny hopsage, horsebrush, and short-statured Gambel oak. A woodland zone dominated by pinyon pine and juniper lies above the sagebrush belt. Above the woodland zone, a montane belt occurs in which ponderosa pine generally occupies the lower and more exposed slopes and Douglas-fir the higher and more sheltered ones. In the rare occurrences of subalpine above the woodland zone, the characteristic trees are fir and Englemann spruce.

Laurentian Mixed Forest Province

This province is transitional, as it lays between the boreal forest and broadleaf deciduous forest zones. It consists partly of mixed stands of a few coniferous species (mainly pine) and a few deciduous species (mainly yellow birch, sugar maple, and American beech). Mixed stands have several species of conifer, mainly northern white pine in the Great Lakes region, with an admixture of eastern hemlock. Eastern redcedar is found in the southeast. Pine trees are often the pioneer woody species that flourish in burned-over areas or on abandoned arable land.

Outer Coastal Plain Mixed Forest Province

Temperate rainforest consisting of evergreen oaks, laurels, and magnolias is typical in this province. Lower stratum of vegetation includes tree ferns, small palms, shrubs and herbaceous plants. Lianas and epiphytes are abundant. Along the Atlantic coast, the extensive coastal marshes and interior swamps are dominated by gum and cypress.

Prairie Parkland (Temperate) Province

Vegetation is forest-steppe, characterized by intermingled prairie, groves, and strips of deciduous trees. Trees are commonly found near streams and on north-facing slopes. Grasses are the dominant prairie vegetation. Most are moderately tall and usually grow in bunches. The most prevalent type of grassland is bluestem prairie, dominated by such plants as big bluestem, little bluestem, switchgrass, and Indian grass, along with many species of wildflowers and legumes. The upland forest is dominated by oak and hickory. Cottonwood, black willow, and American elm dominate floodplains and moist hillsides in the western part of the province.

Southeastern Mixed Forest Province

Climax vegetation is provided by medium-tall to tall forests of broad-leaf deciduous and needleleaf evergreen trees. At least 50 percent of the stands are made up of loblolly pine, shortleaf pine, and other southern yellow pine species. Common associations include oak, hickory, sweetgum, blackgum, red maple, and winged elm. Main grasses are bluestem, panicums, and longleaf uniola. Dogwood, viburnum, haw, blueberry, American beautyberry, youpon, and numerous woody vines are common.

Southern Rocky Mountain Steppe-Open Woodland-Coniferous Forest-Alpine Meadow Province

Englemann spruce and subalpine fir dominate the subalpine zone, while ponderosa pine and Douglas-fir occupy the montane zone. Aspen or lodgepole pine replaces original forest trees after fire in the subalpine zone. Grass, often mixed with sagebrush, regularly covers the ground in open ponderosa pine forests and some treeless areas.

National Elk Refuge contains riparian forest of cottonwood, willow, and aspen along the Snake River floodplain.

Southwest Plateau and Plains Dry Steppe and Shrub Province

This province contains arid grasslands in which shrubs and low trees grow singly or in bunches. Other species include blue grama, buffalo grass, mesquite, oak, juniper, and needlegrass. The endangered sabal palm is native to the Rio Grande delta.

Several units of the Lower Rio Grande Valley NWR are located at the southern tip of Texas, which is characterized by broad coastal prairie carpeted with clumps of razor-sharp cord grass and other low-lying grasses and flowers.

INVASIVE VEGETATION

Invasive vegetation refers to nonindigenous species that have colonized a particular habitat due to its suitability for survival of the species. Many invasive species adversely affect the habitats they invade economically, environmentally, or ecologically. Such vegetation is present in every refuge unit and various management efforts are ongoing to deal with the establishment and spread of invasive species.

SPECIES OF SPECIAL MANAGEMENT CONCERN

Under the Endangered Species Act of 1973 (ESA), the Service has the responsibility to address impacts on federally listed threatened and endangered species, and species proposed for listing. The terms “threatened” and “endangered” describe the official Federal status of certain species as defined by ESA.

Under ESA, candidate species receive no statutory protection, but the Service encourages cooperative conservation efforts for these species because they are, by definition, species that may warrant future protection under ESA. The term “candidate” is used officially by the Service when describing those species for which it has sufficient information on biological vulnerability and threats to support issuance of a proposed rule to list, but issuance of a proposed rule to list is precluded due to other higher priority listings.

The term “proposed” describes species for which a proposed rule to list has been published in the Federal Register; however, a finalized rule has not yet been issued.

Refuges provide habitats that support hundreds of species that are threatened, endangered, or of special concern at the national, regional, and State levels. Some of these species and their habitats may occur in areas suitable for oil and gas development.

WILDLIFE AND AQUATIC SPECIES

Each refuge contains a variety of habitats that support various wildlife assemblages, including diverse populations of mammals, amphibians, reptiles, fish, invertebrates, and birds. Because geographic provinces contain similar wildlife species, general wildlife characteristics of individual refuges can be ascertained by their associated region.

Arizona-New Mexico Mountains Semi-Desert-Open Woodland-Coniferous Forest-Alpine Meadow Province

In this region, the most common large mammal is the mule deer. Mammalian predators include mountain lions, coyotes, and bobcats. Small mammals are the deer mouse, long-tailed weasel, porcupine, golden-mantled ground squirrel, Colorado chipmunk, red squirrel, wood rat, pocket gopher, longtailed vole, Abert squirrel, and cottontail. Some of the more common birds are the northern pygmy-owl, olive warbler, red-faced warbler, hepatic tanager, mountain bluebird, pygmy nuthatch, white-breasted nuthatch, Mexican junco, Stellar’s jay, red-shafted flicker, and the Rocky Mountain sapsucker. Goshawks and red-tailed hawks are also present. The only common reptile in this ecoregion is the short-horned lizard.

California Coastal Chaparral Forest and Shrub Province

Brushy rabbit and opossum are common in this ecoregion. Several species of seals and sea lions live along the California coast. Sea otters and blue whale also inhabit the coastal waters. Coastal California is a major migration route for water and land birds. Shore birds, ducks, and geese inhabit coastal estuaries, lagoons, and mudflats. Other birds include the lesser goldfinch and golden-crowned sparrow.

Central Appalachian Broadleaf Forest-Coniferous Forest-Meadow Province

Black bear and white-tailed deer are very common throughout the Appalachians. At higher elevations in boreal forest, red-breasted nuthatches, black-throated green warblers, golden-crowned warblers, golden-crowned kinglets, and northern juncos forage in red spruce and Frasier fir trees. In hardwood forests, pileated woodpeckers, downy, hairy, and red-bellied woodpeckers, common flickers, and wild turkeys are common. The region hosts 27 species of salamanders.

Coastal Trough Humid Tayga Province

In this region, muskrats and red foxes are common, as well as moose in lowland areas, and Dall sheep in the uplands. Black bear populations are dense throughout the region. Trumpeter swans nest and tundra swans are present during migration. King, sockeye, and silver salmon are common.

Colorado Plateaus Semi-Desert Province

Mule deer, mountain lion, coyote, bobcat, elk, and antelope share this province with smaller species such as the blacktail jackrabbit, Colorado chipmunk, rock squirrel, wood rat, white-footed mouse, cliff chipmunk, cottontail, porcupine, and gray fox. Ringtail and spotted skunk occur rarely in this region. Common birds include the bushtit, pinyon jay, hummingbird, red-tailed hawk, and rock wren.

Eastern Broadleaf Forest (Oceanic) Province

Bird populations are large in this region, with the most abundant breeding birds being the cardinal, tufted titmouse, and woodthrush. Important mammals include the white-tailed deer, black bear, bobcat, gray fox, raccoon, gray squirrel, fox squirrel, eastern chipmunk, white-footed mouse, pine vole, short-tailed shrew, and cotton mouse. Box turtles, common garter snakes, and timber rattlesnakes are characteristic reptiles.

Eastern Broadleaf Forest (Continental) Province

In this region, gray squirrel, fox squirrel, and eastern chipmunks are found in abundance. Birds include wild turkey, blue jay, tanager, grosbeaks, and ovenbirds. The cerulean warbler is common in the beech-maple forest.

Everglades Province

Mammals in this region include white-tailed deer, Florida panther, black bear, raccoon, bobcat, opossum, skunk, various bats, marsh and swamp rabbits, cotton rat, and fox squirrel. Manatees inhabit estuaries and interlacing channels. Numerous species of birds are present. Characteristic lizards are the Carolina anole and the brown red-tailed skink. American alligator, rough green snake, key rat snake, and southern Florida coral snake also inhabit the province.

Great Plains Steppe and Shrub Province

This region shares some species with the Great Plains Steppe Province (see below). No bird or mammal species is uniquely abundant.

Great Plains Steppe Province

Large mammals include antelope and coyotes. Jackrabbits are numerous on the steppe, and cottontails are present near streams and cover. Burrowing rodents include ground squirrels, prairie dogs, pocket gophers, and many smaller species. Burrowing predators include the badger and the black-footed ferret. Mourning doves are abundant in shelterbelt plantings. Sharp-tailed grouse, greater prairie chicken, and bobwhite are also present.

Great Plains-Palouse Dry Steppe Province

Antelope are the most abundant large mammal; mule deer and white-tailed deer are also common where brush cover is available. White-tailed and black-tailed jackrabbit are found, as well as the desert cottontail. Two bird species, the mountain plover and McCown's longspur, are unique to the shortgrass prairies east of the Rockies.

Intermountain Semi-Desert and Desert Province

Few large mammals live in this region, but mule deer, mountain lion, bobcats, and badgers occasionally occur. Antelope and prairie dog occur in sagebrush habitat. Other common species include ground squirrels, jackrabbits, kangaroo mice, wood rats, and kit fox. Bird species include burrowing owl, sage sparrow, sage thrasher, American kestrel, golden eagle, ferruginous hawk, and sage grouse.

Laurentian Mixed Forest Province

Mammalian species include short-tailed weasel, snowshoe hare, beaver, muskrat, black bear, striped skunk, marmot, chipmunk, and jumping mouse. Ptarmigan are present year-round; summer resident birds include the white-throated sparrow, northern junco, and yellow-bellied sapsucker.

Outer Coastal Plain Mixed Forest Province

Among the numerous bird species are the prothonotary warbler, white-eyed vireo, wood duck, yellow-billed cuckoo, Louisiana waterthrush, and all the species found in the Southeastern Mixed Province.

Prairie Parkland (Temperate) Province

Mink and river otter occupy riverine forest areas. Ground squirrels and prairie dogs are common in prairies. Birds include the belted kingfisher, bank swallow, spotted sandpiper, and green-backed heron. Upland birds include the horned lark, eastern meadowlark, and mourning dove.

Southeastern Mixed Forest Province

White-tailed deer and cottontail rabbits are widespread. Other species include fox squirrel, gray squirrel, raccoon, fox, and, in the western part of the province, the nine-banded armadillo. The eastern wild turkey, bobwhite, and mourning dove are widespread.

Southern Rocky Mountain Steppe-Open Woodland-Coniferous Forest-Alpine Meadow Province

Common large mammals include elk, deer, bighorn sheep, mountain lion, bobcat, beaver, porcupine, and black bear. Grizzly bear and moose inhabit the northern portions of the province. Small mammals include mice, squirrels, martens, chipmunks, mountain cottontails, and bushy-tailed woodrats. Common birds include the mountain bluebird, chestnut-backed chickadee, red-breasted nuthatch, ruby-crowned kinglet, pygmy nuthatch, gray jay, Steller's jay, and Clark's nutcracker.

Southwest Plateau and Plains Dry Steppe and Shrub Province

Mexican ground squirrel and gray fox are characteristic of this province. White-tailed deer are abundant and armadillo are present. Fox squirrel, raccoon, and free-tailed bats also occur. Wild turkey, mourning dove, scaled quail, and bobwhite are common game birds, and several species of hawks and owls are present.

SPECIES OF SPECIAL MANAGEMENT CONCERN

As described in the Vegetation section, the Service has the responsibility to address impacts on federally listed threatened and endangered species, and species proposed for listing under ESA. The terms “threatened” and “endangered” describe the official federal status of certain species as defined by the ESA.

Refuges provide habitat that supports hundreds of species of animals that are threatened, endangered, or of special concern at the national, regional, and State levels. Special-status species types vary widely across refuges. Some of these species and their habitats may occur in areas suitable for oil and gas development. For instance, the federally endangered whooping crane winters at Aransas and Matagorda Island NWRs in coastal Texas.

VISITOR USE AND EXPERIENCE

Refuges attract over 45 million visitors each year (Sexton et al. 2012).Visitation varies across refuges, and the amount of annual visitation a refuge receives is a function of several factors, including its relative proximity to large population centers and popularity as a destination. Many refuges have large numbers of seasonal and annual visitors. For example, Kenai and Laguna Atascosa NWRs received 572,584 and 440,042 visits, respectively, in 2011 (Carver and Caudill 2013). People visit refuges primarily for recreational purposes, such as wildlife observation, fishing, and hunting.

NIGHT SKY RESOURCES

Dark night skies contribute to ecosystem health and important wildlife behaviors. In addition, visitor interest in and public concern for a particular area’s visual resources, an area’s high degree of public visibility, the level and type of use of an area by the public, all play a part in the visual quality of a particular refuge.

Several regulatory provisions serve to protect visual quality in refuges. The Clean Air Act of 1970 (CAA) establishes goals for visibility in national parks, wilderness areas, and international parks. The CAA recognizes the importance of integral vistas, which are those views perceived from within class I areas of a specific landmark or panorama located outside the boundary of the class I area. Additionally, EPA’s Regional Haze Rule of 1999 (USEPA 1999) calls for states to work together to improve visibility in all mandatory class I national parks and wilderness areas. Clear viewsheds and dark night skies are critical to wilderness character.

As a result of their proximity to active oil and gas drilling and production activities, some refuges currently have existing sources of artificial nighttime lighting associated with oil and gas operations.

These sources may include light created by natural gas burn-off operations (flares) and electric lights used during nighttime activities.

Over the past few decades, artificial lighting has spread measurably across the United States. Figure 4 demonstrates the 1996 average luminance from anthropogenic sky glow at night in the United States based on satellite imagery taken by the Air Force Defense Meteorological Satellite Program. Of particular note is an area of oil and gas development around the Bakken production region of North Dakota. Satellite imagery from 1997 (Figure 5) reveals an area of naturally dark skies, while imagery from 2012 (Figure 6) illustrates how oil and gas development has directly impacted night sky resources in the area through the proliferation of artificial lighting related to mineral production activities.

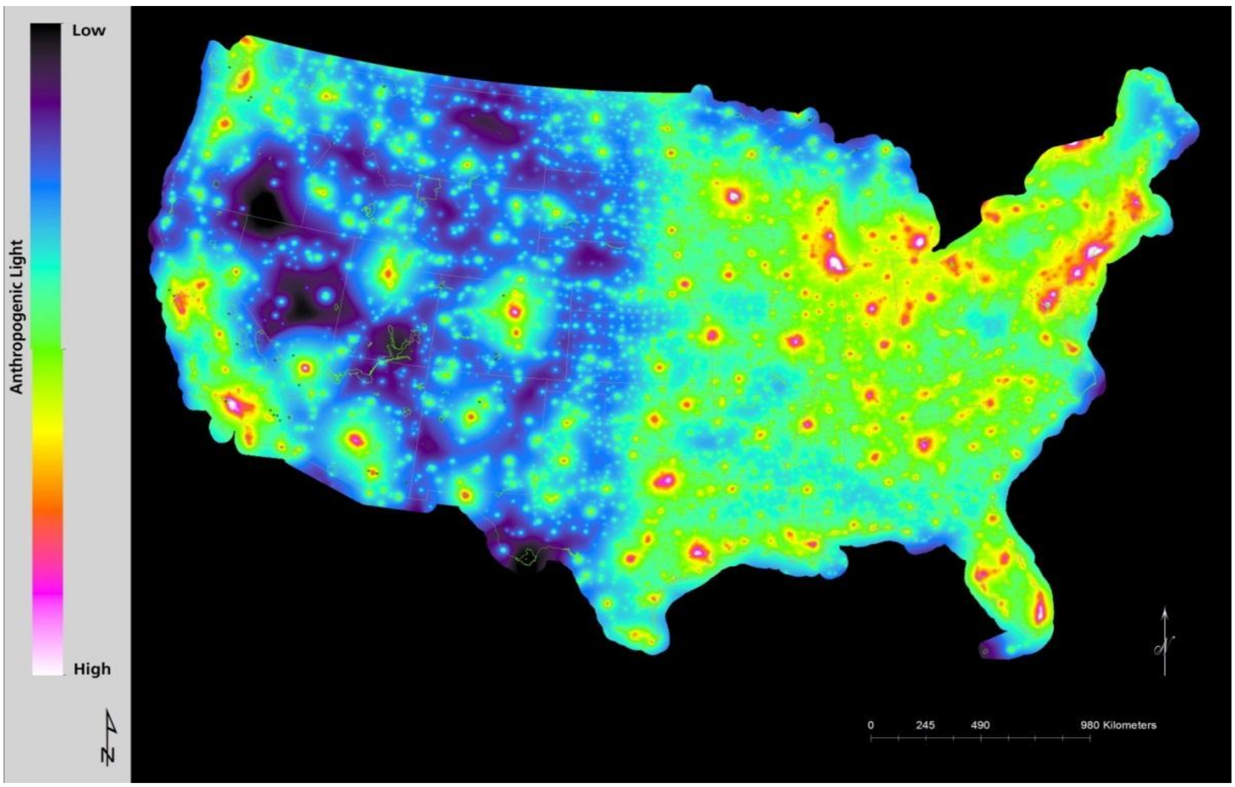


FIGURE 3-2. PREDICTED AVERAGE LUMINANCE FROM ANTHROPOGENIC SKY GLOW IN THE UNITED STATES

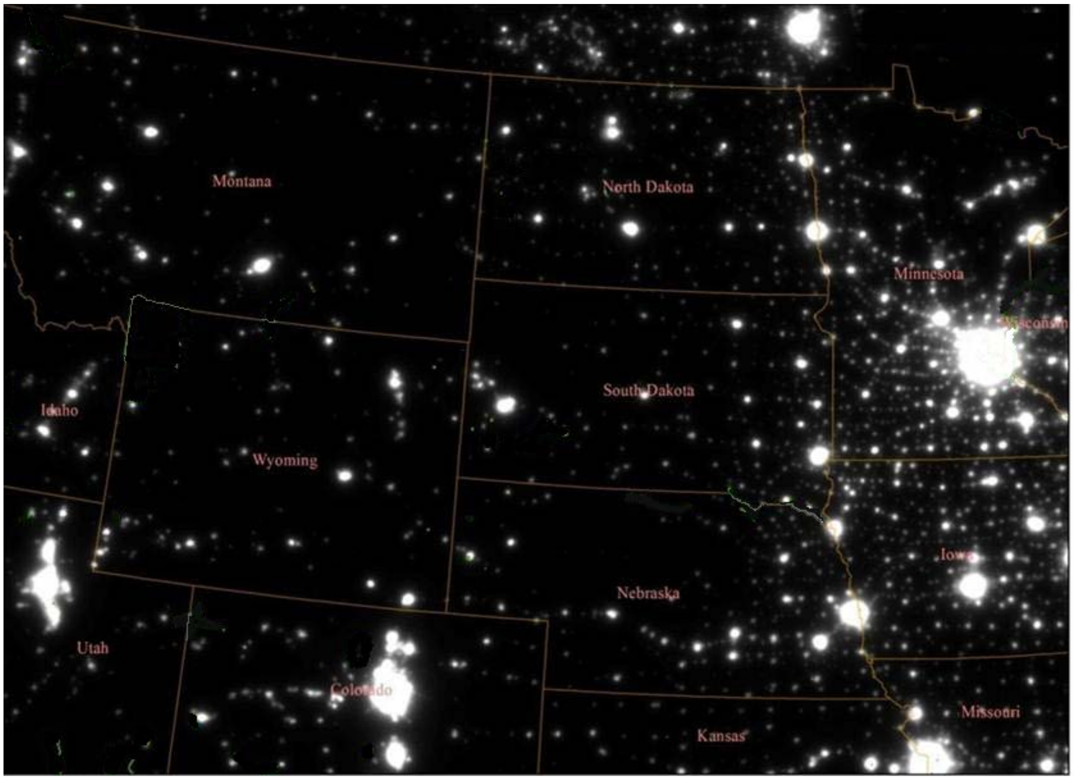


FIGURE 3-3. LIGHT AT NIGHT IN THE ROCKIES AND UPPER GREAT PLAINS IN 1997

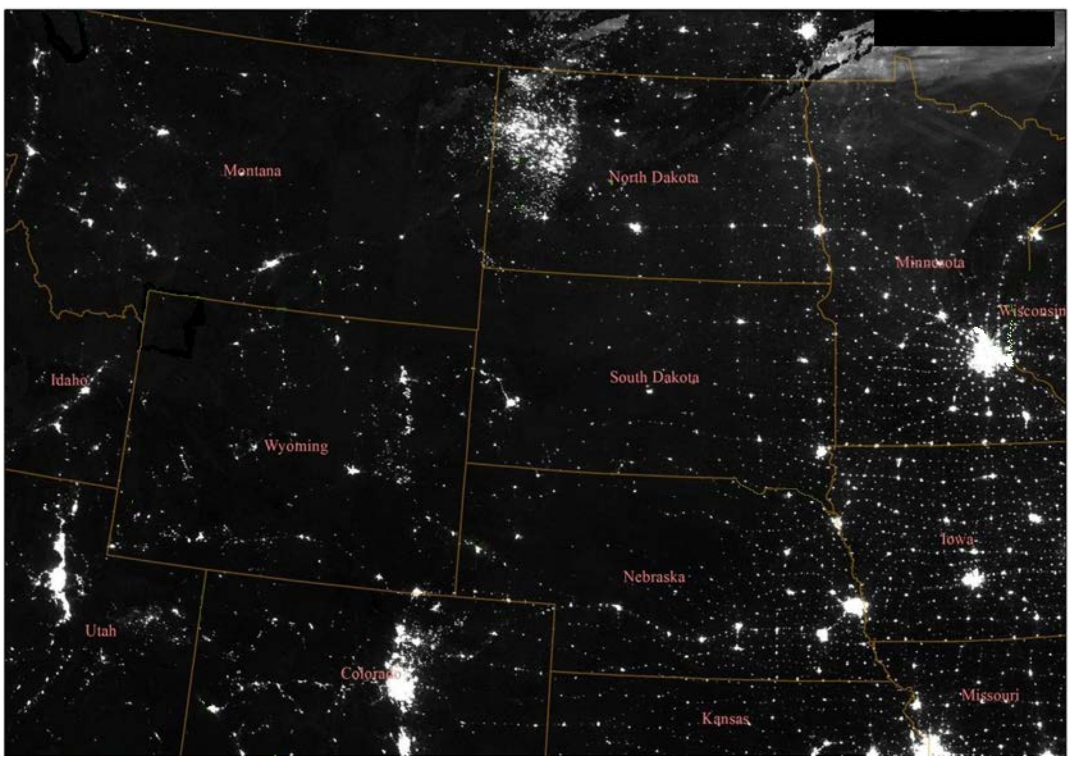


FIGURE 3-4. LIGHT AT NIGHT IN THE ROCKIES AND UPPER GREAT PLAINS IN 2012

NATURAL SOUNDSCAPES AND ACOUSTIC ENVIRONMENT

It is important to distinguish and define certain key terms in regard to natural soundscapes and the acoustic environment.

Acoustic resources—physical sound sources, including both natural sounds (wind, water, wildlife, vegetation) and cultural and historic sounds (battle reenactments, tribal ceremonies, quiet reverence).

Acoustic environment—the combination of all the acoustic resources within a given area—natural sounds as well as human-caused sounds. The acoustic environment includes sound vibrations made by geological processes, biological activity, and even sounds that are inaudible to most humans, such as bat echolocation calls.

Soundscape—the component of the acoustic environment that can be perceived and comprehended by the humans. The character and quality of the soundscape influence human perceptions of an area, providing a sense of place that differentiates it from other regions.

Cultural soundscape—opportunity for appropriate transmission of cultural and historic sounds that are fundamental components of the purposes and values for which the refuges were established.

Noise—sound which is unwanted, either because of its effects on humans and wildlife, or its interference with the perception or detection of other sounds.

Sound levels in refuges vary greatly, depending on location, topography, vegetation, biological activity, weather conditions, and other factors.

The acoustic environment is a natural resource that is integral to wildlife communication, behavior, and many other ecological processes. Exposure to relatively high noise levels that typically occur close to a sound source can produce potentially harmful physiological responses in humans and other animals, including hearing loss, elevated stress hormone levels, and hypertension. Even low levels of noise can interfere with ecological processes in surprising and complex ways. When ambient sound levels are increased, the listening area for wildlife is reduced. A reduction in wildlife communication distance created by noise might decrease the effectiveness of social behaviors such as predator detection, prey location, mating, and migration. Preserving the acoustic environment and natural sounds of such areas is critical to effective wilderness management and can have important effects on wilderness character. Natural soundscapes and the absence of anthropogenic noise are crucial components of the wilderness qualities of solitude, naturalness, untrammeled, and undeveloped character.

Increases in frequency, amplitude, and duration of sound levels can impact human health, visitor experience, wildlife, and ecological systems in a variety of ways. The effects of noise on people can be classified into three general categories: (1) social/psychological effects such as annoyance, nuisance, and dissatisfaction; (2) interference with activities such as speech, sleep, and learning; and (3) physiological effects such as anxiety or hearing loss. The sound levels associated with environmental noise generally produce effects only in the first two categories.

The standard measurement unit of noise is the decibel (dB), which represents the acoustical energy present. Audible sounds range from 0 dB (threshold of human hearing at 1000 Hz) to about 140 dB

(threshold of pain in humans). The normal audible frequency range for humans is approximately 20 hertz (Hz) to 20 kilohertz (kHz). For the purpose of establishing noise regulation and standards, noise levels are measured in A-weighted decibels (dBA), a logarithmic scale which approaches the sensitivity of the human ear across the frequency spectrum. Noise thresholds are provided by various agencies for specific activities such as snowmobiles (NPS) hearing protection on worksites (Occupational Safety and Health Administration) and sound levels in classrooms (EPA).
Typical sources of noise within refuges include trucks and automobiles, aircraft, boat motors, motorcycles, all-terrain vehicles, various types of equipment (e.g., tractors, chainsaws, lawn mowers, oil and gas artificial lift equipment, compressors), high-voltage power lines and transformers, and firearms. Sources of noise within refuges are often localized and/or seasonal in duration. High altitude aircraft and roadway noise are pervasive in all seasons and throughout the day.

NOISE FROM OIL AND GAS OPERATIONS

Typical noise sources associated with oil and gas exploration, development, and production include, but are not limited to, compressor stations, pumping units, fuel and water trucks, cranes for hoisting rigs, and concrete pumps used during drilling (La Plata County 2002). Noise levels measured at a distance of 50 feet from the source of oil and gas operations have been reported to be approximately 83 dBA for well drilling and pump jack operations, 71 dBA for produced water injection facilities, and 89 dBA for gas compressor facilities (BLM 2006).

Noise decreases by 6 dB with the doubling of distance from the source under “hard” surface conditions (no intervening ground attenuation) (Caltrans 2013). For example, without considering any attenuation from intervening vegetation or topography, a noise source of 83 dB at a well drilling site (measured within 50 feet of the equipment) would decrease to 35 dB at a distance of 6,400 feet from the site (Table 3).

TABLE 3-3. NOISE DISSIPATION AS A FUNCTION OF INCREASING DISTANCE FROM THE SOURCE

Distance from Source (feet)	Well Drilling (83 dB at 50 feet) Hard Surface Attenuation of 6 dB with Doubling of Distance	Well Drilling (83 dB at 50 feet) Soft Surface Attenuation of 7.5 dB with Doubling of Distance	Gas Compressor Facilities (83 dB at 50 feet) Soft Surface Attenuation of 7.5 dB with Doubling of Distance
50	83	83	89
100	77	75.5	81.5
200	71	68	74
400	59	60.5	66.5
800	53	53	59
1600	47	45.5	51.5
3200	41	38	44
6400	35	30.5	36.5

CULTURAL RESOURCES

The National Historic Preservation Act of 1966 (as amended) (NHPA) is the principal legislative authority for managing cultural resources associated with Service projects. Generally, section 106 of

NHPA requires all Federal agencies to consider the effects of their actions on cultural resources listed on or determined eligible for listing on the National Register of Historic Places (National Register). In addition, federal agencies must minimize harm to historic properties that would be adversely affected by a federal undertaking. Section 110 of NHPA requires Federal agencies to establish preservation programs for the identification, evaluation, and nomination of historic properties to the National Register.

Cultural resources, which are defined as the material evidence of past human activities, are found in nearly every refuge. Cultural resources that are or could be present in refuges are described below:

Archeological Resources—Archeological resources are the remains of past human activity and also the records documenting the scientific analysis of these remains, including the record of the effects of human activities on the environment. An archeological resource is capable of revealing scientific or humanistic information through archeological research. Archeological resources can show the spread of ideas over time and the development of settlements from place to place. Many refuges have inventoried some of their lands for archeological resources, but many of these resources (especially subsurface resources) have not yet been identified and may occur in areas where oil and gas development is happening or in areas proposed for oil and gas development.

Cultural Landscapes—Cultural landscapes are settings that humans have created in the natural world. A cultural landscape is a geographic area (including both cultural and natural resources and the wildlife or domestic animals therein) associated with a historic event, activity, or person, or exhibiting other cultural or aesthetic values. There are four general types of cultural landscapes, not mutually exclusive: historic sites, historic designed landscapes, historic vernacular landscapes, and ethnographic landscapes.

Historic/Prehistoric Structures—Structures are material assemblies that extend the limits of human capability. Structures can be buildings, bridges, and temple mounds.

Ethnographic Resources—Ethnographic resources are basic expressions of human culture and the basis for continuity of cultural systems. These items include objects and places, such as sites, structures, landscapes, and natural resources, with traditional cultural meaning and value to associated peoples. Research and consultation with associated people identifies and explains the places and things they find culturally meaningful. Ethnographic resources eligible for the National Register are called traditional cultural properties.

The types of cultural resources at each refuge differ and are subject to regional and local influences. As previously mentioned, some refuges may hold yet undiscovered cultural resources, especially archeological resources.

REFUGE MANAGEMENT AND OPERATIONS

Refuge operations refer to the adequacy of staffing levels and the quality and effectiveness of refuge infrastructure in protecting and preserving vital resources and providing for the effective conservation of fish, wildlife, and plants. Refuge operations encompass actions such as resource stewardship, fire management, maintenance, visitor services, administration, research and monitoring, and law enforcement. Refuge facilities include visitor centers, administrative buildings (refuge staff offices and workspace), roads that provide access to and within the refuge (for administrative, visitor, and emergency use), housing for staff required to work and live in the refuge, management-support facilities (garages, shops, storage buildings and yards used to house and store equipment, tools, and materials), and utilities (phones, sewer, water, and electricity).

Each refuge has amenities and operations commensurate with the size and type of refuge. For example, a refuge the size of the Tensas River NWR has many more roads and maintenance facilities than a smaller refuge unit such as Two Ponds NWR. Related to the EIS, specific features within refuges for which the Service is responsible and which could be affected by the proposed rule revisions include visitor amenities, utilities, refuge roads and turnouts, parking areas, overlooks, and trails, as well as natural resource management and protection.

ADMINISTRATION OF NON-FEDERAL OIL AND GAS REGULATIONS

Management of the oil and gas program in refuges is accomplished by refuge staff with technical support from regional oil and gas specialists in the following regions: Alaska, Southwest, Southeast, and Mountain-Prairie, as well as the national Energy Program specialists in Headquarters, and in Fort Collins and Denver, CO. The majority of fieldwork and coordination with individual oil and gas operators is performed by field staff at each refuge. Field staff typically also have other tasks to perform as part of their regular duties.

Table 4 shows the refuge or complex with full-time staff for oil and gas management and their responsibilities.

TABLE 3-4. NATIONAL WILDLIFE REFUGES WITH STAFF PROVIDING OVERSIGHT OF OIL AND GAS OPERATIONS.

Refuge	State	Staffing	Responsibilities
Hagerman	TX	Regional oil and gas specialist	Provides technical assistance to refuges in the Southwest Region, conducts oversight of oil and gas activities at Hagerman NWR.
Texas Chenier Plains Refuge Complex	TX	Oil and gas specialist	Conducts oversight of oil and gas activities at Anahuac, McFaddin, Moody, and Texas Point NWRs.
Lower Rio Grande Valley	TX	Biological science technician/oil and gas specialist	Conducts oversight of oil and gas activities at Lower Rio Grande Valley NWR.
Southeast Louisiana Refuge Complex	LA	Regional oil and gas specialist	Provides technical assistance to refuges in the Southeast Region, conducts oversight of oil and gas activities at Atchafalaya, Bayou Sauvage, Big Branch Marsh, Bogue Chitto, Breton, and Delta NWRs.
Southwest Louisiana Refuge Complex	LA	Wildlife biologist/oil and gas specialist	Conducts oversight of oil and gas activities at Cameron Prairie, Lacassine, Sabine, and Shell Keys NWRs.
Kenai	AK	Fish and wildlife biologist/oil and gas specialist	Conducts oversight of oil and gas activities at Kenai NWR.

SOCIOECONOMICS

Non-Federal oil and gas development is currently being conducted in 107 units of the NWRS. A total of approximately 5,000 non-Federal oil and gas wells are located within these units. Appendix X is a report of nonfederal oil and gas operations within the NWRS. Service data indicates that 1,665 of these wells are actively producing oil and gas or injecting fluids, 2,196 are idle, and the status of the remaining 1,141 wells is being investigated. Initial investigations indicate that perhaps over 1,000 wells in our data will prove to be plugged and abandoned with surface conditions requiring no further management actions. Therefore, the Service expects that approximately 4,000 existing wells could be affected by the Proposed Rule. Only 115 of these wells are subject to an SUP or ROW leaving the vast majority unregulated by the Service.

Future development of non-Federal oil and gas rights on refuges that do not currently have oil and gas activities is possible based on: (1) the presence of oil and gas resources in close proximity or within the authorized boundaries of the refuge; and (2) the non-Federal oil and gas mineral rights acreage in the refuges is large enough to support development activity. Based on existence of non-federal oil and gas rights and proximity to active or emerging oil and gas plays, the Service estimates another 32 refuges and 5 WMDs could potentially experience oil and gas proposals at some point. In addition to the geologic (e.g., reservoir, source rock, hydrocarbons) and ownership factors, future non-Federal oil and gas development is also largely dependent upon economic elements.

Current Service policy is to secure permits for new non-Federal oil and gas development. Operators develop a plan of operations that outlines the specific location, process, protection measures, and other information that will be employed during geophysical surveys, oil and gas drilling, production, and plugging and reclamation activities. As part of the plan of operations, mitigation measures are developed to minimize or eliminate the impacts on refuge resources and uses for all regulated operations within park boundaries.

Oil and Gas Drilling and Production

A recent survey of drilling and seismic activity in units of the NWRS indicates an annual average of 10 seismic surveys and 25 new wells have been completed over the past 10 years. For comparison, an average of over 40,000 wells has been drilled each year in the United States over the same timeframe. Similarly, the level of geophysical seismic survey activity in NWRS units is certainly a fraction of a percentage of overall industry activity.

The Service does not track actual oil and gas production from non-Federal oil and gas wells within the NWRS. Based on average production rates from oil and gas wells in the United States (data obtained from U.S. Energy Information Administration) multiplied by the number of active oil and gas wells on refuge lands, non-Federal oil production from refuge lands is estimated to be 3,500 barrels of oil per day, and natural gas production is approximately 220,000 thousand cubic feet per day. While this method of estimating production could vary from actual production by several fold, the percentage of production from refuge lands compared to U.S production is only a small fraction of a single percentage point. [Note: U.S. oil and gas production rate in 2013 was 7,450,000 barrels of oil per day and 82,000,000 thousand cubic feet per day. Actively producing wells was approximately 570,000 oil wells and 487,000 gas wells, yielding average production rates of 13 barrels of oil per day per oil well and 170 thousand cubic feet per day per gas well.]

These estimates provide a context for the oil and gas activity in the NWRS relative to oil and gas activity at the Federal level. Generally, the oil and gas operations within NWRS boundaries are located in regions with considerable oil and gas activity. As a result, NWRS production and drilling activity also represents a very small percentage of overall oil and gas activities within each associated state.

Oil and Gas Economic Contributions to Local Economies

Oil and gas exploration and development support jobs and income in nearby communities for drill rig operators, geophysical seismic companies, construction companies, landmen, and oil and gas support companies that hydraulically fracture and complete wells, among others. Oil and gas production supports industry jobs, including inspecting and maintaining equipment and operations, complying with mitigation standards in terms of vegetation, erosion, and other on-going production and operational needs. These residential and nonresidential workers spend their wages in local and regional communities, supporting local businesses, downstream jobs and income. Oil and gas production also provides economic benefits to oil and gas companies, benefiting economies where these companies are headquartered and the nation overall. Many energy-related jobs provide higher wages and earnings than service sector jobs.

During production, the oil and gas value of production is often taxed through severance taxes and ad valorem taxes, although these taxes vary by state. Additionally, local governments often benefit from property and sales and use taxes on oil and gas equipment. These tax receipts typically benefit state and county agencies, providing funding for schools, roads, social services, and other public service and infrastructure. Other potential social and economic linkages with local oil and gas production include contributions to tax revenues and royalty income for private mineral rights owners.

Oil and Gas Compliance Costs for Operators

Industry currently faces an additional cost to operate in units of the NWRS compared to operating on lands outside refuges. These additional costs currently apply to future operations and the 115 currently regulated operations that are approved under SUPs or ROWs.

Cost categories specific to conducting non-Federal oil and gas operations under a Service-issued permit include:

1. SUP or ROW application preparation (permitting),
2. Compliance with Service operating standards that may exceed other Federal, State, and local requirements, and
3. Compliance with Service reclamation standards that may exceed other Federal, State, and local requirements.

These regulatory costs may exceed those expenditures necessary to comply with other applicable Federal, State, and local laws and regulation.

Further explanation for each cost category is provided below. It must be noted that actual costs incurred by operators are not commonly available to the Service. Further, the costs associated strictly with compliance with Service regulations versus other Federal, State, and local laws and regulations are often combined, making the specific costs associated with compliance with Service regulations difficult to distinguish. The Service makes these estimates based upon the costs of typical services an operator might need to procure in order to meet the administrative and operational requirements of Service regulations and policy.

Permitting Costs— Permitting costs apply to future operations. The costs described here include only those permitting costs that occur strictly due to the need to comply with the Service regulation and policy. For example, under the Safe Drinking Water Act, operators of underground injection wells must obtain a permit under the Underground Injection Control permit program established by EPA. Although the Service permit would only be approved when injection wells have a valid Underground Injection Control permit, the cost of obtaining the Underground Injection Control permit is not considered a cost of compliance with the Service permit.

Permitting costs consist of compiling and presenting the operational information and obtaining the data and providing the results of reconnaissance surveys. Permitting costs can vary considerably, depending on the complexity of the operation and whether the permit application is prepared in-house or contracted to an environmental consulting firm. Permitting costs include collection of information via reconnaissance surveys, which can account for the majority of the permitting cost. Surveys often include several or all of the following: location surveys, biological surveys including threatened and endangered species, cultural resource surveys, soundscape surveys, soil and water quality measurements, and wetland and floodplain delineations. Depending on the availability of qualified persons to conduct the surveys in the area of operations and the availability of existing resource information, reconnaissance survey costs can range from several thousand dollars to tens of thousands of dollars. For example, a widespread three-dimensional (3D) seismic survey may involve all of the surveys listed above over large geographic areas possibly costing up to $100,000. The area of operations for drilling operations is much smaller than a seismic survey and so reconnaissance surveys for drilling proposals will typically cost from $10,000 to $30,000 with the length of the access road being a primary factor.

When compared to other Federal, State, and local laws and regulations permitting processes, the time to obtain an approved Service permit can possibly extend an operator’s overall permitting process by up to 6 months.

Costs to Comply with Service Operating Standards—This applies to new well drilling conducted under a Service-approved permit and includes costs for those operational requirements that exceed other Federal, State, and local requirements. Under the current regulation and policy, the Service seeks application of best management practices from operators. These operating standards may result in additional operational costs for operators, which are further described by the type of operation. Requirements to meet operating standards can vary significantly depending on the proposed operation and its associated topography, access needs, water and wetland features, location of minerals, and other considerations.

For seismic operations, some mitigation examples that an operator might employ to meet permit standards include off-trail travel by foot along receiver lines to avoid impacts to soils and vegetation, use of third-party monitors, and use of less disruptive (but possibly less efficient) shothole drilling equipment. Such mitigation measures can add $1,000 to $2,000 per day to a survey operation. As an example, additional costs of $1,500 per day for a 2-month long survey could add approximately $100,000 to project costs and might amount to a 5 percent increase to the overall project cost.

For drilling operations, additional permit-required mitigation strategies might include mud handling and container systems; multiple liner systems on the drilling pad; material requirements for road base; storm water management; testing and evaluation; and noise and light abatement. These added mitigation measures can vary substantially depending on the topography, proximity to water features, site selection relative to downhole target location, and access to the refuge.

The Service estimates that the percentage increase to comply with permit operating standards is typically a small percentage of a project's total cost (e.g., less than 10 percent). Additionally, the higher the overall drilling costs, the lower the percentage of cost increase caused by Service regulation of the operation.

Operating standards for compliance with production requirements include site security and public safety; pressure and flow control equipment; produced water storage and disposal; maintenance of access roads and pads, including vegetation management; among others. These standards for production operations could increase initial site costs up to $2,000, with an average cost of $500 per year increased maintenance per operation.

Cost to Comply with Service Well Plugging and Reclamation Standards—The Service does not require operators to plug wells in a manner beyond State requirements. Thus, operators do not incur additional costs specific to the downhole aspects of well plugging in units of the NWRS. When conducted under a permit, the Service seeks a process that ensures wells sites are reclaimed properly. Meeting permit requirements of leaving the site in a clean and safe condition in preparation for surface reclamation often involves placing liners underneath plugging equipment, using steel tanks instead of earthen pits, removing ground structures (e.g., berms), equipment, and debris, restoring natural contour of the land, and reestablishing native vegetative communities. Using NPS experience with these activities as an analogy to the NWRS, these additional plugging and reclamation costs are estimated to be $25,000 per well site. The reclamation costs can vary by refuge depending on the soils, vegetation, and topography.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This chapter analyzes beneficial and adverse impacts that would result from implementing any of the alternatives considered in this EIS. It is organized by resource topic and provides a standardized comparison among alternatives based on topics discussed in Chapter 1: Purpose and Need for Action, and further described in Chapter 3: Affected Environment. In accordance with CEQ regulations, direct, indirect, and cumulative impacts are described and the significance of the impacts is assessed in terms of context, intensity, and duration (40 CFR 1502.16). The analysis for each impact topic includes the methods used to assess the type of impact.

For a complete discussion of guiding authorities, refer to the sections titled Federal Laws, Policies, and Regulations Directly Related to Non-Federal Oil and Gas Development in Units of the National Wildlife Refuge System, and Other Applicable Federal Laws, Policies, and Regulations in Chapter 1: Purpose and Need for Action. Collectively, these guiding laws and corresponding regulations provide a framework and process for evaluating the impacts of the alternatives considered in this EIS.

GENERAL APPROACH FOR ASSESSING IMPACTS BY RESOURCE

This impact analysis evaluates the difference in impacts between how oil and gas operations are currently managed on Service lands and how those operations would be managed under either of the two alternatives described in Chapter 2: Alternatives. For natural resource topics addressed in this EIS, the impact of the actual physical changes to natural resources resulting from each of the alternative regulatory rule scenarios is analyzed. Other non-resource topics deal more directly with the economic effects of the proposed rule changes. This approach includes the following elements:

- Focusing the analysis on those rule changes that have measurable impacts on the resources or values being evaluated, and not analyzing administrative rule changes for topics with no impacts.
- Using general analysis methods that follow CEQ and DOI guidelines to comply with NEPA regulations.
- Following basic assumptions used in NEPA analysis relating to the area of analysis, timeframe, and types of impacts.
- Evaluating cumulative impacts for each impact topic from each alternative in combination with other actions that can affect the same resource or value.
- Determining significance of the impacts resulting from each alternative and disclosing any significant impacts found.

These elements are described in more detail in the following sections.

FUNDAMENTAL FACTORS IN ANALYSES OF ACTION ALTERNATIVES

Three key facts are fundamental to the impact analysis of Alternative B: Proposed Rule (Preferred Alternative) and Alternative C: Modified Proposed Rule:

1. The action alternatives do not authorize any activities that create additional adverse impacts on natural and cultural resources or refuge uses compared to Alternative A: No Action.
2. Overall beneficial impacts on natural and cultural resources are expected for the action alternatives.
3. The beneficial impacts come in conjunction with some increased financial considerations for both the Service and operators.

RULE CHANGES ADDRESSED IN THE ANALYSIS OF IMPACTS

Although the proposed rule changes are a substantial revision from the existing regulations and associated policy and practices, not all changes are anticipated to have measurable effects on refuge resources and/or oil and gas operators. In accordance with NEPA guidance to focus analysis on the most important issues, the interdisciplinary team identified those rule changes with the potential for measurable impacts on refuge resources and/or oil and gas operations. Those regulatory provisions and rule changes are described below.

Note that each of these proposed changes to the regulations is discussed under each impact topic, but the details of each are not repeated throughout the analysis, to avoid duplicative text and to make the document easier to read. The reader is asked to refer back to this section or to Chapter 2 for details on the regulatory content of the existing and proposed regulations.

REGULATORY PROVISIONS ADDRESSED UNDER EACH TOPIC

Purpose and Scope

Currently, the Service applies its regulations to areas within the NWRS where the surface estate is held in fee title. Alternative B: the Proposed Rule would expand the area to include tracts where the Federal interest is less than fee (e.g., wetland or grassland easements). Alternative C: the Modified Proposed Rule would further expand application of regulations to include operations on non-Federal surface locations drilling underneath a refuge or any operation on private land within a refuge (i.e. an inholding). Under this expanded scope, regulations would be applied only to the extent necessary to protect Federal interests.

Accessing Oil and Gas Rights from a Non-Federal Surface Location

Advances in oil and gas directional drilling technologies allow wells to be drilled into non-Federal mineral estates beneath refuges from surface operation locations outside refuge boundaries. The decision for an operator to use this approach is based on both logistical, and cost and time factors related to compliance with Service regulations.

In developing alternatives on how to handle operations that directionally drill from a non-Federal surface location to a bottomhold beneath a refuge to access their oil and gas rights, the Service considered a recent NPS study on operations directionally drilling into parks. Currently, for these operations, NPS regulates the downhole activities inside a park. However, it can issue a waiver from the regulation if it finds those downhole operations do not pose a significant threat of damage to park resources. NPS conducted a review of all 68 wells drilled from surface locations outside a park to bottomholes beneath the park and identified no known instances of impacts to park resources resulting from wellbores drilled and operated beneath parks. The review also revealed that NPS found no cause to require actions beyond compliance with State rules and common industry practices to protect subsurface resources (i.e., usable quality water zones). Waivers were granted in all 68 instances.

Perhaps the most notable aspect of the NPS review was finding that a waiver from the regulations provided a demonstrable incentive to locate operations outside park units. According to NPS analysis of operations directionally drilling into a park, 37 percent of operations showed surface logistics that favored a location in the park and 37 percent of operations showed neutral surface logistics. Thus, of all of the operations that directionally drilled from outside a park unit, only 26 percent showed unfavorable surface logistics for locating operations inside a park unit. Therefore, you can conclude that the other 74 % were incentivized by the waiver from regulations to locate their operations outside of the park units. The Service expects similar results.

The Service currently does not apply regulations to operators who use directional drilling from a surface location outside a refuge to reach their oil and gas rights within a refuge. Under existing regulations and policy, the Service generally secures SUPs or ROWs for new drilling operations. Consequently, there exists a current incentive for operators to locate surface operations outside a refuge when feasible in order to avoid Service regulations and their associated administrative and operational costs. Time requirements inherent to the permitting process may also influence an operator's decision.

Alternative B, the proposed rule and preferred alternative, provides an even greater incentive for operators to locate their operations outside refuge units by providing a full exemption from the proposed rule. The proposed rule includes provisions for maintaining financial assurance, access fees, and cost recovery, if operating on a refuge. So, as the operator’s costs of operating on NWRS lands increase, so does the incentive to avoid those costs. Removing the surface activities associated with oil and gas operations from inside refuges serves to accomplish the objectives of regulation (avoidance or minimization of impacts).

Alternative C would expand the Service jurisdiction under the regulations to encompass surface and subsurface operations outside the boundary of a refuge. These operations would be subject to the full regulatory requirements of a new operation. The Service would impose operational standards on activities outside the refuge to the extent necessary to avoid or minimize impacts on refuge resources and uses. As a result, much of the incentive to locate operations outside the refuge provided by avoiding Service regulations would be lost.

Requirement to Obtain a Service Permit to Conduct Operations

Under current regulations and policy, the Service generally secures either an SUP or ROW for new operations, such as seismic surveys or new well drilling. Under Alternatives B and C, a clear requirement for operators to have an approved operations permit prior to conducting new operations would be codified. Thus, for new operations, the requirement to obtain a Service permit varies under each alternative only due to the changes in scope and impacts.

New Operations and Existing Operations under a Service-issued SUP or ROW

An analysis of Service statistics indicates 115 existing production operations (i.e., individual wells) are being conducted under either an SUP or ROW; from a total of approximately 4,000 existing wells. Alternative A assumes new operations would be, in most cases, under a Service-issued permit. Because there would not be a formal and consistent permitting process required for operations on a refuge, the protections for refuge resources and uses would continue to be inconsistent and based, in large part, on an operator's willingness to cooperate with a refuge manager in avoiding or minimizing impacts from their operations to refuge resources and uses.

Under Alternative B, existing operations under an SUP or ROW may continue producing under the terms of that permit, which invariably include a means to ensure that operational standards of the proposed rule can be achieved. If the existing SUP or ROW does not cover reclamation operations to the extent that such operations will meet Service reclamation standards outlined in the proposed rule, operators must amend their permit or apply for a new operations permit.

Under Alternative C, all new and existing operations accessing oil and gas rights beneath a refuge would be required to obtain an operations permit, including those operations that use directional drilling from non-Federal surface locations adjacent to or within a refuge boundary (i.e., inholding).

Pre-existing Operations

Existing operations not under a Service permit conducted prior to the finalization of the revised regulations would be considered "pre-existing operations." Pre-existing operations merit discussion under a separate sub-heading because they represent as many as 4,000 wells. Though the Service is confident in the total number of wells in refuges being approximately 5,000, we are investigating the status of about 1,100 wells. Initial investigations have identified many wells that have been plugged and abandoned with site conditions such that they warrant no further management actions. Until that investigation is completed, we can estimate the number of operations that would need further management actions and be subject to Service regulation to be approximately 4,000.

Pre-existing operations are managed on a case-by-case basis. When substantial and unnecessary impacts to refuge resources and uses occur, such as as spills or unauthorized use of Federal surface, we address these through application of other laws and regulations, and cooperation with other permitting agencies and operators. As a result, the levels of protection are inconsistent across the Service, and even across individual refuges since the levels of cooperation among operators can vary.

Additionally, operators with these pre-existing operations would need to obtain an operations permit before modifying a pre-existing operation or beginning any new operation. This requirement would ensure that any new, adverse impacts to refuge resources from new or modified activities would be avoided or minimized to the maximum extent possible.

Eventually, all pre-existing operations would be required to obtain a permit for plugging and reclamation and comply with all Service reclamation standards. Ensuring that all operations are reclaimed to Service standards is the most important aspect of ensuring that refuge resources, such as geology and soils, water, and wetlands will be protected or restored long-term from the impacts of the activities associated with oil and gas.

Under Alternative C, as described in the preceding section, pre-existing operations would be required to obtain an operations permit and comply with all regulatory provisions including the relevant operating and reclamation standards, maintenance of financial assurance, reimbursement to the Service for its costs associated with administering the operations permit, and payment to the Service for access to the oil and gas right boundary. Compared to Alternative B, the further protections afforded to refuge resources and uses under Alternative C would be minimal for several reasons. First, most of the impacts to refuge resources and uses [or you could substitute specific impact topic] occurred when the operation location was chosen and developed. Most continuing impacts can be avoided or minimized through compliance with applicable State and Federal laws. Finally, because pre-existing operations must be reclaimed to Service standards, most of the impacts to refuge resources and uses from these operations would be mitigated over the long-term.

Time, Place, and Manner

The best tool refuge managers have to avoid or minimize oil and gas impacts is to use time, place, and manner stipulations. These considerations are available for issuing permits for new operations and have already been implemented for those existing operations already under a Service-issued permit. However, the majority of existing operations are not under a Service-issued permit, and the opportunity to mitigate impacts using timing and locational considerations has passed. So, the Service recognizes the need to apply different permit requirements for these classes of operations.

The *place* factor in the "time, place, and manner" equation is often most important in terms of ability to protect an environmental resource. Most of the impacts to refuge resources and uses from operations occur when the operator chooses and develops a site to accommodate their drilling and production operations. The risks created by a poorly selected location cannot easily be overcome with even the best operational methods (Lawson et al. 2011). Conversely, proper site selection can do much to mitigate the effects of accidents or environmentally unsound practices (Sawyer et al. 2006).Timing and spatial restrictions may reduce impacts on a resource (Bradshaw et al. 1997), but typically are poorly understood and apply to too small an area to be effective for wide ranging species in decline (Walker et al. 2007).

Since new operations create the greatest additional impacts, proper site planning, timing restrictions, and BMPs can accomplish a great improvement in resource protection, thus justifying a permit system, as advocated by Alternatives B and C. In Alternative B, the permit process focuses on the full suite of time, place, and manner considerations on those new operations that create the highest level of incremental impacts. By requiring a reclamation standard for all operations, regardless of status, it also ensures long-term rehabilitation of habitat damaged by all operations.

While Alternative C may provide some additional protection to refuge resources and uses, it would not be able to remedy a majority of the impacts to refuge resources and uses caused when the operators chose the time, place, and manner of these pre-existing operations. For example, on existing operations, the operator's well has already been drilled and the area of operations (access route, well site, production facilities, and routes for gathering lines) were established and impacts to refuge resources, such as geology and soils, wetlands, and wildlife-dependent recreation, occurred prior to the acquisition of a refuge.

Many of the continuing unnecessary impacts occurring from existing operations (e.g., inadequate containment of spills) without permits can more cost effectively be addressed through stricter adherence to existing Federal (e.g., SPCC) and State laws.

Enforcing Existing Regulations Can Reduce Impacts

Currently, Service Law Enforcement does not have the authority to enforce State oil and gas regulations on refuge lands and waters. Many State oil and gas agencies lack adequate staff to inspect operations and enforce regulations (Keel 2007; Purpera 20142014). Therefore, it is difficult to ensure that pre-existing operations are in compliance with laws and regulations that may provide varying degrees of protection for refuge resources and uses. For example, most States provide for protection of surface and groundwater via well design requirements and oil pollution control measures, and have requirements for plugging and abandoning wells (State Regulation Summary, FWS Report 2013).

Under Alternative B, our proposed rule, pre-existing operations could continue as long as they comply with applicable existing Federal, State, and local laws, as well as the General Terms and Conditions outlined in the proposed rule. Though not required to obtain a Service operations permit during production, the Service would maintain an active management role by assimilating nonconflicting State laws and regulations into the proposed rule, giving the Service greater authority to ensure these operations are in compliance with applicable laws. For example, in an assessment of State regulations conducted by the Ground Water Protection Council (GWPC) for the U.S. Department of Energy (DOE), the GWPC found that 23 of 27 oil-producing States assessed required oil production site storage tanks to have secondary containment dikes to contain leaks and spills (GWPC 2014). Additionally, the GWPC (2014) reported that 23 of the 27 States require reporting and remediation of spills and 13 of the 27 States specify clean-up standards for spills.

Some States also have siting or setback requirements for pits (production skim pits and reserve pits) with some States prohibiting the use of pits in the 100-year floodplains or in areas with shallow aquifers (GWPC 2014). An operator's compliance with these types of laws and the Service's ability to assist in the enforcement of these laws would provide additional protection to refuge resources and uses.

Assimilating nonconflicting State laws and regulations would provide the respective States with much needed assistance in ensuring compliance with their oil and gas regulations as well as enforcement to ensure corrective action is taken in the event of noncompliance. The need for this type of assistance is borne out by an audit report of inspection and enforcement of oil and gas field operations by the Texas Railroad Commission (TRRC) (Keel 2007). The Texas State Auditor’s report found that 25 percent of the TRRC district offices conducted onsite inspections on 70 percent of complaints and spill notifications related to oil and gas exploration and production activities (Keel 2007).

The Louisiana Legislature published a report documenting that the Office of Conservation “did not conduct routine inspections in accordance with timeframes established by the Commissioner of at least 26,828 (53%) of 50,960 oil and gas wells at least once every three years from fiscal years 2008 through 2013” (Purpera 20142014). In addition, 12,702 (25%) were not inspected at all during this timeframe.” The report also found that the Office of Conservation “did not consistently or timely address violations cited on inspections. Of the 7,665 routine inspections that failed from fiscal years 2008 to 2013, 1,179 (15%) did not receive a compliance order to correct the violation.” Although assimilating nonconflicting State laws and regulations into the proposed rule would provide protection to refuge resources and uses, State laws and regulations vary considerably, particularly in addressing impacts to surface owners and wildlife (Engesser 2013).

Complying with existing State oil and gas regulations can reduce oil and gas impacts on refuge resources. For example, Louisiana oil and gas regulations require “reconditioning... on any well ... leaking gas or oil between the oil string and next larger size casing string…” (La. Admin. Code tit. 43, Part XIX, §113). This requirement, when enforced, may stop potential leaks before they contaminate surface and groundwater. Another example from Louisiana oil and gas regulations is the “unpermitted or unauthorized onsite or offsite storage, treatment, disposal or discharge of E and P Waste,” which is prohibited (La. Admin. Code tit. 43, Part XIX, §503). Enforcement of this provision provides an additional layer of protection from leaks or spills of waste materials. Additionally, limiting “access to exploration and production waste transported on land shall be provided by a lockable gate system" (La. Admin. Code tit. 43, Part XIX, §509) would protect most wildlife and visitors from accidental exposure.

Performance-Based Standards

Current policy recognizes that the diverse nature of proposals and the environments in which they are conducted does not allow for the complete standardization of stipulations and conditions to impose on oil and gas operations. Consequently, oil and gas activities are managed on an individual unit basis, with protective stipulations developed in a site-specific manner. Generally, stipulations are applied to Service permits to include protection of air quality, soils, water, wildlife, wildlife habitat, and other refuge resources.

Current policy and training, however, have not established a suite of performance-based standards for protection of refuge resources and uses. As a result, the levels of protection required in SUPs can vary widely across the NWRS. So, under Alternative A, the level of protection for refuge resources and uses would continue to vary.

Under Alternative B, the preferred alternative, the proposed regulations establish performance-based standards for avoiding or minimizing impacts to refuge resources or visitor uses during operations. The proposed rule also includes standards for achieving successful surface reclamation once operations end.

Operating standards and the permitting process under Alternative C would be the same as Alternative B, except the Service would actively regulate downhole operations as a matter of course. The modified proposed rule would establish standards relative to downhole operations including drilling, well stimulation, and well maintenance during production, and well plugging. However, as most of these regulations would overlap with State regulations of downhole operations, this would not offer much additional protection to refuge resources and uses.

Well Plugging (Maintenance of Idle or Shut-In Wells)

Current regulations and policy do not address procedures for wells that are no longer active, but are not scheduled to be plugged in the near future. Instead, the Service relies on State rules for maintaining wells in shut-in status. Therefore, under Alternative A, there is no guarantee that an operator will plug or shut-in their wells in a manner that ensures protection of refuge resources and uses.

Under Alternative B, the proposed procedures would be consistent with the way many States approach the issue of inactive wells, and recognize that certain economic or logistical reasons exist to justify maintenance of wells in shut-in status for extended periods of time. Rather than a "produce or plug" policy, the proposed regulations would provide assurance that shut-in wells are maintained in an environmentally sound and safe manner. Operators would be required to plug a well when any of the following occurs:

(a) The drilling operations have ended and the operator has taken no further action on its well within 60 calendar days;

(b) A well, which has been completed for production operations, is continuously inactive for a period of 1 year; or

(c) The period approved in an operations permit to maintain a well in shut-in status has expired.

The operator could apply for either an operations permit or a modification of its approved operations permit to maintain its well in a shut-in status for up to 5 years. The application to extend the plugging requirement would describe why drilling or production operations have ceased and the reasonable future use of the well, demonstration of the well's mechanical integrity, and a description of how relative operating standards would be maintained while the well is idle. Additional extensions can be obtained by submitting a new application so long as operating standards can be maintained.

The process for well plugging under Alternative C would be the same as Alternative B, except the Service would actively regulate downhole plugging operations as a matter of course. As previously discussed, an operator's compliance with State law should be sufficient in protecting refuge resources and uses.

REGULATORY AREAS ANALYZED IN DETAIL ONLY IN REFUGE MANAGEMENT AND OPERATIONS AND SOCIOECONOMICS TOPICS

Several provisions common to all alternatives have notable financial and administrative consequences on the Service and the regulated community that are both adverse and beneficial. These include the permitting process and provisions covering financial assurance, cost recovery, access fees, and third-party monitoring as discussed in this section. A detailed analysis is provided under the Refuge Management and Operations and Socioeconomic impact topic sections.

Though the effects of these provisions could indirectly benefit refuge resources and uses, the connection between the provision and resource protection is less direct. Therefore, it is more suitable for a general discussion of benefits to all natural and cultural resources and refuge uses rather than a repetition in each impact topic area. The general analysis is provided here.

Permitting Process

Currently, the permitting process is described in policy in general terms and applied in various ways across the Service. The *Management of Oil and Gas Activities on National Wildlife Refuge System Lands* handbook provides guidance for obtaining an SUP as well as the minimum information contents that should be included in an SUP application. The policy does not specify timelines in which the Service will respond to an operator's submission of information.

The proposed rule establishes a uniform process for obtaining an operations permit, including:

- initial steps in developing a permit application,
- comprehensive description of contents of the application,
- the Service's review of the application, including timelines,
- the Service's approval standards, and
- the actions the Service may take on the application including timelines.

The permitting process under Alternative C would be the same as Alternative B, except the Service would actively regulate downhole operations as a matter of course.

Performance Bond (Financial Assurance)

The Service does not typically require financial assurance as a condition of an SUP issued for non-Federal oil and gas operations. Operators in Alaska are permitted using ROWs under 43 CFR part 36, which provides a requirement for financial assurance.

Alternative B, the preferred alternative would require financial assurance set equal to the estimated cost of reclamation. The Service would release the bond when the operator has met all applicable reclamation standards. The proposed rule also holds that failure to comply with any provision of an operations permit could result in forfeiture of a portion of the financial assurance needed to remedy the condition of noncompliance. This provides the Service with an enforcement tool and provides an operator with additional incentive to remain in compliance with its permit.

The performance bond under Alternative C would be the same as Alternative B.

Cost Recovery

The Service does not currently seek cost recovery for administration of SUPs for non-Federal oil and gas operations. Operators in Alaska are typically permitted using ROWs under 43 CFR Part 36, which provides for cost recovery.

Under Alternative B, the preferred alternative, the Service is proposing to reserve the right to require for operators to reimburse the Service for the costs of processing and administering temporary access permits and operations permits where administrative costs of processing applications are significant. The Service would determine the amount of reimbursement by the actual staff time spent directly processing permit applications and subsequently monitoring the operation for compliance.

The process for Cost recovery under Alternative C would be the same as Alternative B.

Access Fees

Under current regulations and policy, the Service does not generally assess fees for an operator’s use of a Federal surface for access to their oil and gas rights boundary, except in Alaska. For refuges in Alaska, administration fees are charged for the issuance of SUPs for seismic surveys. For other oil and gas activities in refuges in Alaska, such as road and well pad construction, the Service issues a ROW permit and charges access fees.

The proposed rule, Alternative B, recommends the Service charge a fee for commercial vehicles using Service-administered roads. This fee could be used to reduce maintenance costs, such as purchasing fuel for a road grader, gravel for a road, or maintaining refuge equipment used in road maintenance. The proposed regulation would also set a fee for new access (e.g., roads or gatherings lines) across Federal lands. This fee would reduce the cost of improving habitat on the refuge, purchasing additional lands to offset the loss of use, or reclaiming other oil and gas sites. The Service would set the fee amount using generally accepted practices. For example, the Service could set fees consistent with Service current regulations regarding fees for access and rights-of-ways (50 CFR 29.21), or calculate fees using the BLM’s Linear Rights-of-way Fee Schedule, or appraisal.

The access fees under Alternative C would be the same as Alternative B.

Third-Party Monitoring

The *Management of Oil and Gas Activities on National Wildlife Refuge System Lands* handbook provides guidance for third party monitoring of seismic surveys and drilling operations; however, the use of monitors at the expense of an operator is not required, but can be negotiated between the refuge manager and the operator. The use of third party monitors is a common industry practice and has become a typical component of seismic surveys conducted in refuges pursuant to a special use permit. Third-party monitoring is effective in ensuring compliance and minimizing impacts (Howard et al. 2014).

The proposed rule, Alternative B, would codify existing practices by allowing the Service to require that operators hire third party monitors when they are necessary to ensure compliance and protect refuge resources and values. The use of third party monitors helps ensure that the Service receives unbiased, reliable, and timely monitoring information demonstrating an operator's compliance with its permit. The rule would describe the criteria that the Service would consider when making the decision to require an operator to pay for a third party monitor. The criteria could include an operator's proposal for self-monitoring. The third party monitor would report directly to the Service to ensure oversight and accountability and prevent the appearance of a conflict of interest.

Third-party monitoring under Alternative C would be the same as Alternative B.

Regulatory Areas not Analyzed in Detail under Each Topic

Other regulatory provisions and proposed rule changes addressed in Chapter 2: Alternatives are relatively minor or administrative in nature and would have no appreciable impacts on any of the impact topics included in this EIS. These areas are discussed briefly below, but are not analyzed further in this chapter.

Change of Operators

A change of operator occurs anytime an entity exercising non-Federal oil and gas rights transfers those rights to another party who would assume responsibility for operations. Under current conditions, there are no general requirements of either the former operator or the new operator to notify the refuge manager that a transfer of rights and responsibilities for the operation has occurred. Other than SUPs or ROWs that contain a requirement to provide notification of a change in operator, refuge managers are most often made aware of a change in operator when signs at operations sites change names.

The proposed rule, Alternative B, outlines the steps for both the transferring party and the new operator. All operators would be required to notify the Service within 30 calendar days of the transfer, the contact information of the party to whom the operation was transferred, the effective date of the transfer, and a description of the rights transferred. The former operator must also provide written acknowledgement from the new operator that the contents of the notification are true and correct. If the operations are being conducted under a Service-issued permit, in addition to the notification requirements above, the former operator would remain responsible for compliance with its SUP or ROW or operations permit until the new operator agrees in writing to adopt the permit with all its terms and conditions. Also, if financial assurance is a component of the permit, the Service would not release the financial assurance until the new operator replaces it.

In a transfer, the new operator may continue operating under the same conditions of the previous operator, but within 30 calendar days from the date of the transfer, must provide to the Service its right to operate documentation and company contact information. If the operations were being conducted under a Service-issued permit, the new operator would need to agree in writing to conduct operations in accordance with all terms and conditions of the previous operator's permit, and file any financial assurance required under the permit with the Service. New operators have the ability to propose modifications to their operations as outlined in the proposed rule.

The process for a change of operators under Alternative C would be the same as Alternative B.

Administration of a Permit

Under current regulation and policy, the Service's administration of SUPs and ROWs, found at 50 CFR Parts 25-29, would apply. These permit vehicles provide processes for modifying permit terms to account for unexpected or changed conditions, addressing conditions of noncompliance, and appealing decisions made by the Service.

Under Alternative B, the proposed rule, the Service would administer a permit as follows:

- ***Modification of an Operations Permit.*** The proposed rule would provide the Service or operator a method to modify an operations permit to address new or unanticipated changes in operational or environmental conditions. Any modification to an approved permit must meet the same criteria that apply to an operations permit as outlined in the application review process. A modification is an action not considered or included in the original permit and that would cause additional, notable impacts on refuge resources. Examples of a modification could include drilling additional wells from the same pad, creating additional surface disturbance (expanding the footprint of a well pad, realigning a road), or converting a natural gas well into a wastewater disposal well. Operators must consult with a Refuge Manager to determine whether proposed change in activities would be considered a modification.
  Minor actions that are not specifically addressed in the operations permit but are within the scope of the impacts analyzed are not considered modifications subject to additional review and approval. Examples of such minor actions would include repositioning of surface facilities within the permitted area of operations, minor changes in color schemes, or nonroutine maintenance actions.

- ***Prohibited Acts and Penalties.*** The proposed rule lists the prohibited acts that would constitute a violation of these regulations, as well as the penalties associated with violations. Prohibited acts include: operating in violation of terms or conditions of an operations permit or a Service-approved SUP or ROW under § 29.43, damaging Federal property, conducting operations without Service authorization, failure to comply with suspension or revocation orders, or failure to comply with Federal, State and local statutes or regulations.
  The refuge manager, in coordination with Service law enforcement, would have the discretion to fine, suspend, or revoke an operation if the operator engages in a prohibited act. Any violation that results in a threat to public safety or risk of damage to refuge resources and values will be addressed by the Refuge Manager.

- ***Appeals.*** As in Alternative A, if an operator disagrees with a decision made by the Service, the appeals process in 50 CFR § 25.45 would apply. The operator must exhaust these remedies before the Service decision is considered a final agency action that is subject to review under the Administrative Procedure Act.

The administration of a permit under Alternative C would be the same as Alternative B.

GENERAL ANALYSIS METHODS

The analysis of impacts follows CEQ and DOI recommendations to comply with NEPA regulations. The analysis incorporates the best available scientific literature applicable to the region and setting, species and areas being evaluated, and actions being evaluated in the alternatives.

Primary steps for assessing impacts include identifying potential impacts on refuge resources and values from oil and gas exploration, drilling, production, and reclamation under Alternative A, and then assessing the change (if any) to those impacts under the action alternatives. The degree of potential impacts on resources from oil and gas development depends on the type and location of operations and mitigation measures used to reduce impacts. As a result, a qualitative analysis of the potential impacts of oil and gas operations on the resources was conducted based on actual experience of the Service in managing non-Federal oil and gas operations, best professional judgment, and information available in the literature.

Impacts on resources and values from oil and gas development can occur during geophysical exploration, drilling and production, and reclamation phases of development. Current operations consist of pre-existing oil and gas production sites with and without SUPs. There are currently 5,002 oil and gas wells in 107 refuge units. Actions at some of these refuges also include ongoing or planned geophysical surveys and well plugging/reclamation.

Typical impacts on resources and values that could occur from current and future operations during the various phases of oil and gas development (geophysical exploration, drilling and production, and plugging/reclamation) are described in the analysis.

Basic Assumptions Used in this Analysis

The following guiding assumptions were made to provide context for this analysis:

Analysis Period—This EIS assumes that the proposed regulations would be in effect for at least the next 20 to 30 years.

Analysis Area—The geographic study area for all topics addressed in this EIS comprises the refuge units that currently have oil and gas operations (107 refuge units) and those units that are considered more likely to be affected by future oil and gas operations, based on their proximity to existing oil and gas development outside the refuge units, and their immediately adjacent neighboring properties, except for the socioeconomics topic, which covers a broader area of analysis to address impacts on the local and regional economies. Table 1-1 in Chapter 1 lists the refuge units.

Duration and Type of Impacts—For the purpose of the analysis provided in this EIS, the following assumptions are used for all impact topics:

Duration describes the length of time an effect will occur, either short term or long term.

Short-term: Impacts are those that occur up to one year.

Long-term: Impacts are those occurring over several seasons through the next 20 to 30 years.

Type describes the classification of the impact as beneficial or adverse, direct or indirect.

Beneficial: A positive change in the condition of the resource or a change that moves the resource toward a desired condition.

Adverse: A change in the condition of the resource that detracts from its condition or that moves the resource away from a desired condition.

Direct: An effect that is caused by an action and occurs in the same time and place.

Indirect: An effect that is caused by an action but occurs later in time or is farther removed in distance, but is still reasonably foreseeable.

Context describes the action relative to the area or location in which the impact will occur. The effects may be site-specific, local, regional, or even broader in scale. We are analyzing the impacts in several contexts when the impact varies geographically, over time, or in some other way.

SIGNIFICANCE OF THE IMPACTS

According to the NEPA regulations adopted by the President's CEQ (40 CFR 1500–1508), the term "significantly" is based on the twin criteria of context and intensity (40 CFR 1508.27).

Context—This means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant.

Intensity—This refers to the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. The following should be considered in evaluating intensity:

- Impacts that may be both beneficial and adverse. A significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial.
- The degree to which the proposed action affects public health or safety.
- Unique characteristics of the geographic area such as proximity to historic or cultural resources, refuge lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.
- The degree to which the effects on the quality of the human environment are likely to be highly controversial.
- The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.
- The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.
- Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.

- The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act (ESA) of 1973.
- Whether the action threatens a violation of Federal, State, or local law or requirements imposed for the protection of the environment.

Significance is addressed in the conclusion section at the end of the chapter.

CUMULATIVE IMPACTS ANALYSIS METHOD

CEQ regulations for implementing NEPA require the assessment of cumulative impacts in the decision-making process for Federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for all alternatives, including Alternative A.

Cumulative impacts were determined by considering the combined effects of the impacts of the alternative being considered with the impacts of other past, present, and reasonably foreseeable future actions and assessing the contribution that the alternative makes to the overall cumulative impact on a resource or value. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects and plans that would affect the units in question and, if applicable, the surrounding region. In accordance with CEQ guidance, past actions were included "to the extent that they are relevant and useful in analyzing whether the reasonably foreseeable effects of the agency proposal for the actions and its alternatives may have a continuing, additive, and significant relationship to those effects" (CEQ 2005). Cumulative actions that could affect the various impact topics addressed in this chapter are presented below, both at a programmatic level and a more site-specific level for those refuge units with exempt operations.

The planning team identified programmatic level actions for all refuges and adjacent lands in the overall area of analysis from general literature and knowledge of the refuges and the regions in which they are located. These include the following:

TABLE 4-1. PROGRAMMATIC-LEVEL ACTIONS IN REFUGE UNITS.

Past, Present, and Reasonably Foreseeable Activity in Area of Analysis	Descriptions of Cumulative Actions
Prescribed fires and fire management actions	Controlled burns and mechanical fuel reduction to reduce fuel loads; plus other fire management actions such as fire line construction for suppression
Service facility and road construction	Construction of buildings, visitor use and administrative facilities, and road construction and repair
Vegetation management	Treatment of areas with herbicides or mechanical methods to reduce exotic plants; other vegetation management includes removal and control of vegetation for utility lines
Trails development and maintenance	Clearing, grading, and surfacing of trails
Off-road vehicle (ORV) use	Use of ORVs (all-terrain vehicles, 4-wheel drives) off road and in areas around the refuges

Past, Present, and Reasonably Foreseeable Activity in Area of Analysis	Descriptions of Cumulative Actions
Abandoned mine lands reclamation	Reclamation of abandoned mine land sites, including contouring, revegetation, cleanup of contaminated materials; installation of safety features and wildlife protection at shafts
Mining and logging activities	Vegetation removal; creation of deep openings or stripped lands; spoil piles, acid mine drainage at certain locations; clearing and harvesting of trees in forests around refuges; change in natural vegetation; road construction; some replanting and surface reclamation
Recreational use	Wide range of recreational activities including camping, hiking, hunting, boating, etc., that are sources of trampling, noise, wildlife effects
Ranching, agricultural land uses	Grazing and planting of crops – change in natural vegetation and land use
Land development: residential and nonresidential (commercial, industrial) land uses, including road construction	Clearing for development and permanent footprint of development; sources of noise, lighting, pollution during construction and use; industrial uses can include air or water emissions
Future oil and gas development on adjacent lands	Oil and gas wells and associated roads and pipelines, transportation and collection/storage facilities on adjacent lands (see trends information, in text below)
Oil and gas well plugging and reclamation activities inside and outside refuges	Site reclamation, including restoration of natural contours, topsoil and vegetation cover, and removal of sources of contamination and contaminated soils
Recovery actions against operators that damage refuge resources	Cleanup of areas and recovery of natural resources that have been damaged from oil and gas spills that affected refuge lands and resources

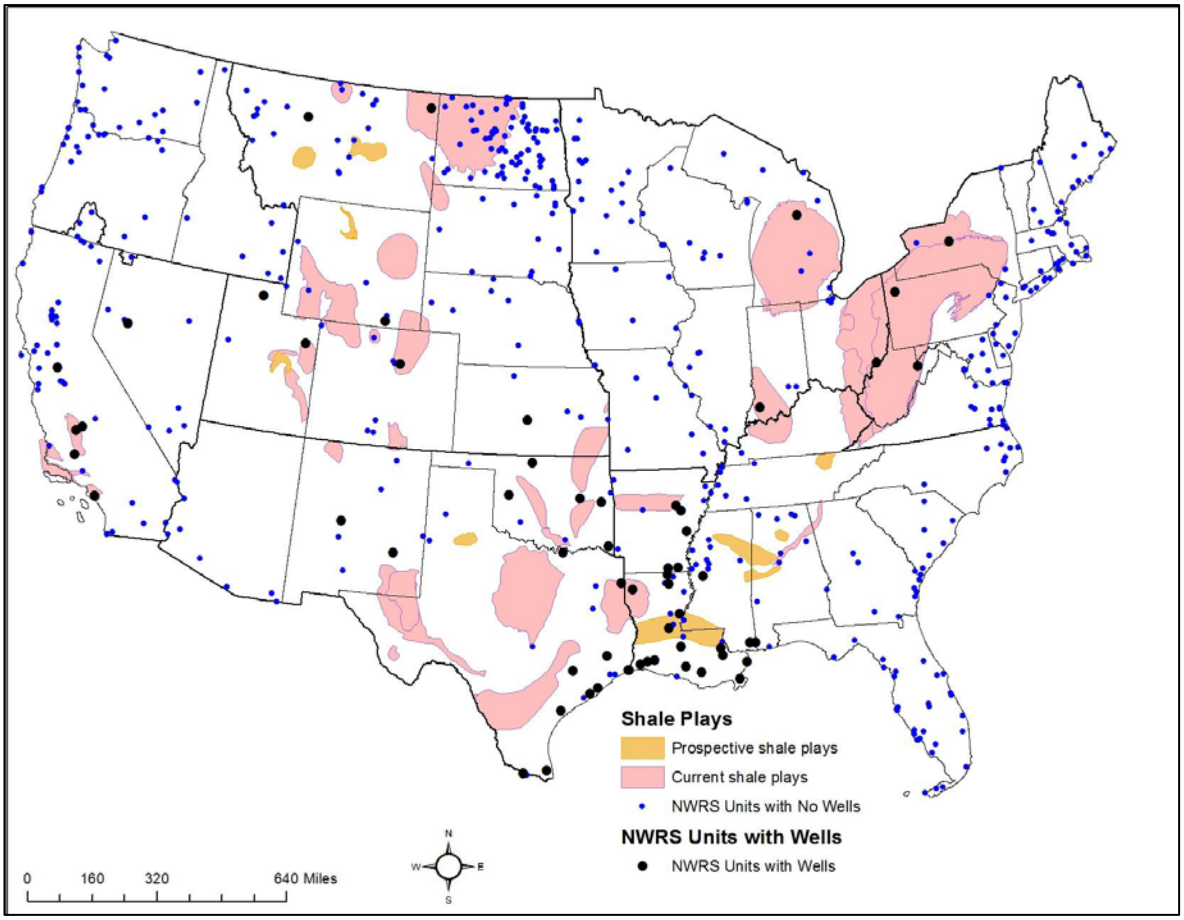
The cumulative actions above would be expected in or near the refuge units included in this EIS and are addressed generally in a programmatic manner.

Trends in oil and gas development can also affect cumulative impacts. Energy development on lands adjacent to Service lands is expected to continue into the foreseeable future. The exploration and production of shale oil and gas, in particular, is anticipated to increase dramatically over the next 30 years. The U.S. Energy Information Administration's *Annual Energy Outlook 2015 Early Release* projects U.S. natural gas production to increase from 23.0 trillion cubic feet in 2011 to 33.1 trillion cubic feet in 2040, a 44 percent increase. Almost all of this increase in domestic natural gas production is due to projected growth in shale gas production, which is expected to grow from 7.8 trillion cubic feet in 2011 to 16.7 trillion cubic feet in 2040 (EIA 2013).

Currently active and prospective shale plays that underlie or are located in close proximity to refuge units include the Utica and Marcellus (which underlie the Iroquois and Montezuma NWRs in New York, Erie NWR in Pennsylvania, Ohio River Islands and Canaan Valley NWRs in West Virginia), and Tuscaloosa (which underlies Bayou Cocodrie, Bogue Chitto, Cat Island, Catahoula, Grand Cote, and Lake Ophelia NWRs in Louisiana and St. Catherine Creek NWR in Mississippi). Refuge units with shale oil or gas underlying or located nearby include the following refuge units: Red River NWR in Louisiana, Caddo Lake NWR in Texas, Tishomingo NWR in Oklahoma, Holla Bend NWR in Arkansas. Other refuges lie within shale formations include Patoka River NWR in Indiana, Lake Thibadeux and Creedman Coulee NWRs in Montana, Ouray NWR in Utah, and numerous refuges and easements in North Dakota.

Figure 4-1 illustrates the geographic distribution of these shale plays in the United States. Because there are shale gas resources on adjacent lands, this increase in exploration and production activities represents a cumulative action and impact.

FIGURE 4-1. GEOGRAPHIC DISTRIBUTION OF SHALE PLAYS IN THE UNITED STATES



GEOLOGY AND SOILS

METHODOLOGY

Potential impacts on geology and soils are assessed based on the actions being proposed and characteristics of the geology and soils in the refuge units, as well as the disturbance to unique geologic features that may be affected. Paleontological features are also included in this section by their association to sensitive geologic formations. Resource-specific context for assessing impacts of the alternatives to geology and soils resources includes the following:

- the susceptibility of certain soil types to disturbance (particularly high erosion or shrink/swell potential, compaction characteristics)
- the uniqueness of the geologic features found in the refuges
- the susceptibility of certain geology and soils to vibration, contamination, or other effects of oil and gas activities

Typical Impacts of Oil and Gas Operations on Geology and Soils

Impacts from Geophysical Exploration

During the geophysical exploration phase, adverse impacts on geology and soils can result from vegetation clearing, which increases the potential for soil erosion by exposing the soil surface to water and wind. Surface disturbance from survey crews traversing the area during geophysical exploration could also cause soil compaction, reducing the soil's water-holding and infiltration capacities. Compacted soils increase runoff of surface waters and accelerate soil erosion (Duiker 2004; Pennsylvania State University 2009). Ground vibrations from seismic survey technologies used during exploration to obtain images of target formations could adversely impact sensitive geologic features by creating soil movement or settling or ground vibrations. The majority of impacts associated with these surveys would be limited in extent and severity because of the temporary nature of the disturbance and localized area disturbed by shotholes, foot traffic, and all-terrain vehicles.

Impacts of Well Drilling and Production

The primary impact on soils from existing oil and gas wells is a direct loss of soil productivity in the footprint of the site and access roads. During site preparation, impacts on geology and soils occur as a result of removing acreage from natural conditions and transferring that area to an industrial use to accommodate the drilling rig and associated equipment. Site preparation may include extensive vegetation clearing, grading, cutting, filling, and leveling of the site using heavy construction equipment. Soil material suitable for plant growth is often removed and stockpiled for use in reclamation. Slopes are particularly susceptible to erosion caused from road and well pad construction.

During drilling and production, the construction, maintenance, and use of access roads, well pads, flowlines, and pipelines could increase soil erosion and affect soil productivity from vehicle compaction and vegetation clearing (Duiker 2004; Pennsylvania State University 2009). Surface disturbances during drilling and production activities could cause soil compaction, thereby reducing the soil's water-holding and infiltration capacities. This would in turn reduce the root penetration capabilities of vegetation and hinder plant growth and further soil formation (Crush and Thom 2011).

These compacted soils would also increase runoff of surface waters and accelerate soil erosion (DeJong-Hughes et al. 2001, McBroom et al. 2012).

In addition to construction-related impacts associated with development of access roads and well pads, there is a risk of impact on soils from releases of hazardous or contaminating substances during drilling or production operations, including well workovers and servicing. These releases could occur from leaking equipment. In most cases, however, primary and secondary containment on a well pad, if implemented, should prevent the release of drilling muds, diesel fuel, oil and gas, and other substances beyond the well pad. The risk of releases reaching more area of the well pad or offsite locations is greater for pre-existing wells that would not be required to have some of the more protective measures that would be required for new operations under the proposed regulations. The unintentional or accidental release of hazardous or contaminated materials also includes the risk of the release of drilling mud. Although drilling mud may pose a risk for impacts on geology and soils if there are spills, its contained presence alone does not represent an impact. Drilling mud, which may contain water and chemical additives such as alkalis, bactericides, soluble chromates, and corrosion inhibitors used to optimize well drilling (Fink 2003), and cuttings from the well account for the largest volume of waste generated at the well site.

Contamination from the release of produced waters containing salts, naturally-occurring radioactive materials (NORM) such as radium-226, trace elements, oil and other hydrocarbons, and other well drilling fluids could also impact soils and other geology and soils in the refuge units. For example, such instances of leaks from oilfield brine flowlines and subsequent contamination resulting from mechanical problems and improper operating practices have been documented at the Anderson Waterfowl Production Area in Montana, and Hagerman and Aransas NWRs in Texas (M Maddux and Mike Borgreen pers. comm.). Oilfield brines released onto soils can increase the bioavailability of some heavy metals as well as destroy the soil structure resulting in the significant reduction of infiltration rates(Vavrek et al. 2004). These brine impacted soils are usually devoid of vegetation and are susceptible to erosion. Impacts to the soils from oilfield brine spills remain for years (Vavrek et al. 2004).

The types of impacts related to soil erosion and runoff for directionally drilled wells outside the refuge boundaries are expected to be similar to those described for operations inside the refuge units; however, direct impacts to geology and soils in refuge units would not occur. The risk of indirect impacts and their intensity would vary with the location of the well with respect to the refuge boundary and direction of surface runoff. The risk of impacts on refuge resources would be greater for directionally drilled operations sited closer to refuge boundaries with surface gradients toward the refuge, where water and sediment can be transported downslope into refuge units through adjacent streams, gullies, or overland flow. Severity of impacts would depend on proximity of operations to the refuge units; site-specific environmental conditions, such as steepness and direction of slope and surface hydrology; sensitivity of resources; and mitigation measures being employed.

Impacts of Plugging and Reclamation

When drilling and production operations end, well plugging and surface reclamation result in overall beneficial impacts on geology and soils. Although plugging actions could result in surface disturbance from earth-moving equipment, these disturbances are temporary and occur in previously disturbed areas. There are also beneficial effects on geology and soils once cleanup is successfully completed and the site is reclaimed to natural conditions and processes. Reclamation involves returning the topography of a site to approximate the original contours, replacing any stockpiled soils, and re-establishing natural vegetation. Revegetating disturbed areas provides erosion control in areas of previous impacts from oil and gas operations. Sources of potential leakage such as wellhead equipment and flowlines are also removed during plugging and reclamation. Beneficial impacts of plugging and reclamation are realized in both the short and long term.

IMPACTS OF ALTERNATIVES ON GEOLOGY & SOILS

Purpose and Scope

The purpose of the regulation in all alternatives is to ensure that non-Federal oil and gas operations conducted on NWRS lands and waters avoid or minimize, to the greatest extent practicable, adverse effects on geology and soil.

Under Alternative A, the Service scope of application of its regulation and policy provides protection of geology and soils on Service fee title lands.

Alternative B, the proposed rule, would expand the area of regulatory application to include tracts where the Federal interest is less than fee (e.g., wetland or grassland easements). As a result of active regulation by the Service, geology and soils resources associated with interests acquired on easements would have a consistent and higher level of protection compared to Alternative A.

Alternative C would expand the scope of regulation to operations conducted on non-Federal surface locations drilling under a refuge or any operation on private land within a refuge (i.e., an inholding). The level of increased protection for geology and soils would vary from slight to moderate depending on proximity of those operations to refuge boundaries, as well as State rules (and operator's compliance with those rules) in place that serve to reduce such impacts (e.g., spill control and cleanup requirements, erosion control).

Accessing Oil and Gas Rights from a Non-Federal Surface Location

Under Alternative A the incentive for operators to locate their operations outside refuge units would remain in place as described at the beginning of this chapter. The location of surface operations outside refuge units avoids direct impacts to soils and other geologic resources within refuge units. However, depending on the proximity of these operations to the refuge, some indirect impacts to geology and soils on a refuge could occur because the Service would not be imposing preventive measures, such as spill containment standards. Intensity of impacts on refuge resources would depend on proximity of operations to the refuge units; site-specific environmental conditions, such as steepness and direction of slope and surface hydrology; and any mitigation measures the operator puts in place. For instance, water and sediment could be transported downslope into refuge units through streams, gullies, or overland flow.

As previously discussed, Alternative B provides an even greater incentive for operators to locate their operations outside refuges. Therefore, it is likely that direct impacts to geology and soils from new production and drilling operations would be avoided to a greater extent than in Alternative A. Indirect impacts on geology and soils from those wells located on non-Federal surface locations would be same as Alternative A.

Under Alternative C, directional drilling operations on non-Federal surface locations would be subject to the full regulatory requirements of the proposed rule. The Service would impose operational standards on activities outside the refuge to the extent necessary to avoid or minimize impacts on refuge resources and uses. Alternative C would provide some additional protection from the indirect impacts of these operations to refuge geology and soils by requiring mitigation measures that would reduce water and sediment transport downslope into refuge units through streams, gullies, or overland flow. However, Alternative C eliminates the incentive to locate operations outside of a refuge, so there would likely be a significant increase in the number of drilling and production operations located on refuges, as well as the direct impacts to geology and soils associated with these operations. Therefore, compared to Alternatives A and B, Alternative C would increase the instances where new drilling operations create direct, adverse, and long-term impacts to refuge soils and geology resources.

Requirement to Obtain a Service Permit to Conduct Operations

Under Alternative A, the Service would continue to work to ensure new operations are under a Service-issued SUP or ROW, which would reduce the impacts of geophysical operations and new drilling and production operations. When an operator obtains a Service permit prior to conducting operations, it provides additional protection for geology and soils. The permitting process ensures ongoing communication between Refuge staff and the operator; that an operator includes mitigation measures to avoid or minimize impacts to refuge resources and uses; and that an operator is aware of expectations to reclaim a site to restore refuge resources and ensure long-term protection of refuge resources and uses. However, the permit requirement itself has not been consistent across the Service; and, where permits have been issued, the permit conditions have varied widely resulting in the possibility of unnecessary impacts to geology and soils.

Under Alternative A, there would be unnecessary impacts on geology and soils from the estimated 4,000 pre-existing oil and gas production operations not under an SUP or ROW, including those described above under Typical Impacts of Oil and Gas Operations on Geology and Soils. The Service estimates that the 4,000 pre-existing wells in 107 refuges have created approximately 6,000 acres of direct disturbance associated with well sites and access roads. Direct surface disturbances from well pads and roads in refuges range from 1 to 6 acres with the average area of disturbance estimated at approximately 1.5 acres per operation.

The primary effects on soils from oil and gas operations stem from the fact that soils are taken out of beneficial use where they have been disturbed. Within the footprint of the disturbance, potential impacts include the loss of soils from grading or construction of facilities, soil compaction, soil erosion and sedimentation associated with disturbed areas, and possible soil contamination from leaks and spills, leading to adverse impacts on soil chemistry and productivity. As previously discussed regarding time/place/manner considerations, most of the impacts to geology and soils occurred when the operator chose and developed the site to accommodate their drilling and production operations.

However, some continuing unnecessary impacts may occur under Alternative A due to the lack of any requirement that these pre-existing operations have ongoing mitigation measures to protect geology and soils and the fact the Service does not currently have a way to ensure operations are complying with any State laws that would protect geology and soils. Typical mitigation measures that would minimize ongoing impacts from pre-existing operations on geology and soils could include removal of contaminated soils, effective erosion control, proper secondary containment around storage tanks, regular pump jack maintenance, and removal of debris, waste, and equipment no longer needed in operations.

Under Alternative B, all new operations would be under a consistent permitting process that would include required consultation with the Service, performance-based standards to avoid or minimize impacts to geology and soil, and other administrative provisions such as financial assurance, cost recovery, and access fees that would ensure protection of geology and soils from the typical impacts of oil and gas development to the greatest extent practicable.

Similar to Alternative A, pre-existing operations would not be required to obtain an operations permit during the production phase. However, in contrast to Alternative A, the Service would manage these operations by assimilating State laws and regulations into the rule, thereby increasing the Service's enforcement ability on refuge lands. So, during the production phase, impacts to geologic and soil resources would be reduced compared to Alternative A due to improved compliance with State rules that serve to lower such impacts, such as State rules addressing pit closure as well as the removal of oil-contaminated soils from tank battery sites to protect soils and water, and clean-up standards for soils contaminated by oil spills (GWPC 2014; La. Admin. Code tit. 43, Part XIX, §503). Overall, the Service expects that the large majority of issues related to ongoing impacts on geology and soils would be resolved by compliance with State laws and regulations.

Additionally, under Alternative B, all operations, including pre-existing operations, would be required to have a Service-issued permit for reclamation that would ensure all operations meet Service's reclamation standards, which would also greatly reduce any long-term impacts on refuge geology and soils as discussed further below in Performance-Based Standards.

Assimilation of State laws and regulations during the production phase combined with reclamation to Service standards ensures a substantial and consistent long-term benefit to geology and soils compared to Alternative A.

Alternative C would require all operators on refuges to obtain a permit for their operations, including pre-existing operations. Compared to Alternative B, Alternative C may provide additional protections for geology and soils from impacts associated with pre-existing operations. Since the greatest impacts to geology and soils have already occurred, the Service would be focusing on maintenance issues, such as erosion control, in those cases where State laws and regulations do not meet Service operating standards. Alternative C would also require operations on inholdings and those directionally drilling underneath a refuge from non-Federal surface locations to obtain a permit to the extent necessary to protect refuge geology and soils. In most cases, since the activity is occurring directly on private surface estate, the Service would not identify operational measures to protect geology and soils on adjacent Federal surface estate. Thus, for these operations, the impacts on geology and soils would be similar to Alternative B. \

Performance-Based Standards

Under Alternative A, oil and gas operations would be managed on an individual unit basis, with protective stipulations developed in a site-specific manner. New operations would be subject to operating practices, as defined in SUPs or ROWs that serve to minimize or avoid impacts on geology and soils. These could include erosion control measures and spill prevention and control equipment and practices; however, the operating practices included in the SUPs or ROWs are usually negotiated between the refuge manager and the oil operator. Thus, the levels of protection may vary somewhat from permit to permit and by refuge as the existing regulations do not provide specific operating standards for the protection of refuge resources. The level of monitoring and cooperation with operators to address impacts on refuge resources and uses would continue to vary widely, resulting in unnecessary impacts to geology and soils. For the 4,000 pre-existing operations, reclamation is conducted without regard for Service goals or only to the extent a refuge manager is able to negotiate to have reclamation goals addressed. Reclamation for these wells often falls short of Service reclamation standards.

Under Alternatives B and C, the proposed rule establishes performance-based standards for avoiding or minimizing impacts to geology and soils. All new operations on NWRS lands and waters would be subject to consistent standards and requirements of the proposed rule for protecting geology and soils. So, as previously discussed, new operations create the greatest additional impacts on geology and soils, so establishing performance-based standards that would include proper site planning, timing restrictions, and the best management practices would avoid or minimize many of the typical impacts to geology and soil resources from oil and gas development. Also, the proposed rule includes additional standards that would protect geology and soils, such as designing, constructing, operating, and maintaining access to the operational site to cause the minimum amount of surface disturbance needed to safely conduct operations and to avoid areas identified as containing sensitive geology and soil resources.

Additionally, under the proposed rule operators on easements would be required to comply with these standards to the extent necessary to protect that easement interest. This would likely include protections for geology and soils on these easements (e.g., hydric soils on wetland easements, or soils supporting native steppe on grassland easements).

The proposed rule also includes standards for achieving successful surface reclamation once operations end. All operations, including pre-existing operations, would have to meet Service reclamation standards, such as plugging all wells; removing all above-ground structures, equipment, roads, well pads, and contaminating substances; re-establishing native vegetation; restoring conditions to predisturbance hydrologic functions; and restoring natural systems using native soil material that would reduce impacts to geologic and soil resources within the refuge units. Therefore, eventually, the disturbance associated with the 4,000 pre-existing wells would be restored to Service standards, providing a substantial long-term reduction or removal of adverse impacts on geology and soils compared to Alternative A.

Under Alternative C, pre-existing operations would be required to abide by the performance-based standards established under the proposed rule during the production phase. Compared to Alternative B, Alternative C may provide for implementation of higher standards for protection of geology and soils. Since the greatest impacts to geology and soils have already occurred, the Service would be focusing on maintenance issues, such as erosion control, in those cases where State laws and regulations do not meet Service operating standards.

Also, operations on inholdings and operations on non-Federal surfaces directionally drilling underneath a refuge would be subject to the performance-based standards established in the proposed rule to the extent necessary to protect refuge geology and soils. The level of increased protection would vary from slight to moderate depending on State rules in place that serve to reduce such impacts (e.g., spill control and cleanup requirements, erosion control), and the proximity of the surface location of operations on non-Federal surfaces to the refuge and the presence of pathways (e.g., waters that may be hydrologically connected to waters within a refuge).

Finally, under Alternative C, performance-based standards would also be established for downhole operations. Geology and soils would only be impacted by accidents associated with well control. Given present day technology, events that result in loss of well control (blowouts) are extremely rare. Service regulation could possibly serve to lower an already low risk of a well blowout, but in practice, the Service finds that State requirements for well control and the expectation that companies will act in their own best interest would preclude the need for the Service to regulate aspects of drilling and production related to well control. Thus, the Service does not expect any reduction of impacts or risks of impacts to geology and soils related to our downhole regulation under Alternative C.

Cumulative Impacts

Actions inside and outside refuges and local trends in oil and gas development can cumulatively affect geology and soils. Management planning, such as fire management, vegetation management, and ORV plans, can result in greater protection for these resources. Conversely, actions that cause disturbance of these resources include activities such as prescribed burns, ORV use, mining, agricultural and logging activities, as well as any general development activities that include excavation, grading, or construction. Past, present, and reasonably foreseeable activities that would have beneficial or adverse impacts on geology and soils in the area of analysis (including both refuge lands and adjacent lands) and a brief summary of the cumulative impacts of these actions on geology and soils are listed in Table 4-2.

TABLE 4-2. CUMULATIVE IMPACTS ON GEOLOGY AND SOILS (PROGRAMMATIC LEVEL FOR REFUGES)

Past, Present, and Reasonably Foreseeable Activity	Impacts on Geology and Soils
Prescribed fires and fire management actions	Short- and long-term adverse effects on soils from loss of productivity following removal of vegetation that may be preventing erosion and sedimentation; short- and long–term impacts from fire line construction that requires digging and displacement of soils and loss of organic matter from burning of surface litter and topsoil. Long-term beneficial effects of reduced fire occurrences with managed burns that reduce the possibility of catastrophic and high intensity fire; improved productivity and erosion control from vegetative cover that is established after these treatments.
Service facility and road construction	Short- and long-term adverse effects on soils from direct loss of soils when they are removed for development and compaction during road grading and construction using heavy equipment.
Vegetation management	Long-term beneficial effects of erosion control from improved vegetative cover, which holds soils in place.
Trails development and maintenance	Short- and long-term adverse effects on soils from compaction during clearing, grading and surfacing of trails, and removal of vegetation in trail footprint, exposing soils to wind and water erosion.
ORV use	Short- and long-term adverse effects on soils from compaction, erosion, and sedimentation following vehicle-related disturbances to the soil surface; possible damage to unique geological features from collision, ground vibration, or vandalism.
Abandoned mine lands reclamation	Short-term adverse effects on soils from compaction during reclamation-related disturbances.

Past, Present, and Reasonably Foreseeable Activity	Impacts on Geology and Soils
	Long-term beneficial effects of improved surface (revegetation) and reduced erosion following re-establishment of vegetation cover and natural contours.
Mining and logging activities	Long-term adverse effects on soils from erosion stemming from past surface disturbances and vegetation removal and long-term effects of acid mine drainage on soils (change in chemistry, productivity).
Recreational use	Short- and long-term adverse effects on soils from visitor activities including trampling and associated compaction; possible vandalism to unique geological features.
Ranching, agricultural land uses	Short- and long-term adverse effects from operations that remove vegetation cover, compact soils, create ruts that increase potential for erosion.
Land development: residential and nonresidential (commercial, industrial) land uses, including road construction	Short- and long-term adverse effects on soils from direct loss of soils in development footprint and compaction, erosion and sedimentation following construction-related disturbances.
Future oil and gas development on adjacent lands	Direct effects on soils on adjacent property and indirect adverse impacts on refuge soils from “spill-over effects” of sedimentation and contamination from surface runoff; trends indicate that the exploration and production of shale gas, in particular, is anticipated to increase dramatically over the next 30 years.
Oil and gas well plugging and reclamation activities inside and outside uges	Short-term adverse effects on soils from reclamation related disturbances due to use of equipment onsite and grading. Long-term beneficial effects of restoration of natural contours, topsoil and vegetation cover that protects soils from erosion; removal of sources of contamination and contaminated soils.

Under all three alternatives, there would be adverse and beneficial cumulative impacts from projects, plans, actions, and trends in oil and gas development as discussed in the cumulative scenario above (Table 4-2).

Alternative B would contribute to cumulative impacts from the continued operations of pre-existing operations not under an SUP or ROW, which would continue to have long-term direct adverse impacts on geology and soils, as described in the above analysis. On the other hand, bringing new operations and the reclamation phase of pre-existing operations under regulation would add substantial beneficial impacts on geology and soils. When combined with the effects of all other actions in the study area, cumulative impacts from the actions under Alternative B would be long term and both adverse and beneficial, with Alternative B contributing mainly beneficial impacts on overall cumulative impacts from the change in regulations.

Under Alternative C, similar to Alternative B, there would be effects on geology and soils as a result of oil and gas operations that would continue to affect geology and soils where impacts cannot be avoided, and benefits from bringing new operations and the reclamation phase of pre-existing operations under regulation and the resultant reduction in adverse impacts, as described in the Alternative B analysis. Alternative C would contribute to cumulative impacts mostly by adding beneficial impacts of bringing new operations and all phases of pre-existing operations under regulation, but also by possibly adding adverse impacts from the change in directional drilling regulations that could result in more oil and gas development within refuge units as opposed to outside refuge boundaries. Overall under Alternative C, both adverse and beneficial cumulative impacts would accrue from projects, plans, and actions considered in the cumulative scenario. When combined with the effects of all other actions in the study area, cumulative impacts would be long term and both adverse and beneficial.

AIR QUALITY

METHODOLOGY

The degree of potential impacts on air quality from oil and gas development depends on the type and location of operations and mitigation measures used to reduce impacts.

The exploration and production of oil and gas has the potential to impact air quality from a variety of sources, which are considered in this analysis:

- suspended particulate matter (dust) generated from construction of access roads, well pads, production facilities, flowlines, gathering lines and pipelines, and site reclamation activities; combustion of diesel-powered equipment; the oil and gas itself; routine emission of noxious vapors from storage tanks; vehicle exhaust; and traffic on paved and unpaved roads;
- accidental spills of volatile petroleum products, resulting in emissions of hydrocarbons or volatile organic compounds, and other pollutants such as hydrogen sulfide (H_2S);
- emissions of carbon monoxide (CO), and oxides of nitrogen (NO_x) from vehicle and stationary gasoline and diesel engines (including electric generators from construction machinery and vehicles transporting equipment); and
- flaring of gas during well testing and production operations.

CRITERIA POLLUTANT INFORMATION

Ozone

Ground level or "bad" ozone is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight. Emissions from industrial facilities and electric utilities, motor vehicle exhaust, gasoline vapors, and chemical solvents are some of the major sources of NOx and VOCs. Breathing ozone can trigger a variety of health problems, particularly for children, the elderly, and people of all ages who have lung diseases such as asthma. Ground level ozone can also have harmful effects on sensitive vegetation and ecosystems.

Particulate Matter

"Particulate matter," also known as particle pollution or PM, is a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles.

The size of particles is directly linked to their potential for causing health problems. EPA is concerned about particles that are 10 micrometers in diameter or smaller because those are the particles that generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. EPA groups particle pollution into two categories:

- "Inhalable coarse particles," such as those found near roadways and dusty industries, are larger than 2.5 micrometers and smaller than 10 micrometers in diameter.
- "Fine particles," such as those found in smoke and haze, are 2.5 micrometers in diameter and smaller. These particles can be directly emitted from sources such as forest fires, or they can form when gases emitted from power plants

Health

The size of particles is directly linked to their potential for causing health problems. Small particles less than 10 micrometers in diameter pose the greatest problems because they can get deep into your lungs, and some may even get into your bloodstream.

Exposure to such particles can affect both your lungs and your heart. Small particles of concern include "inhalable coarse particles" (such as those found near roadways and dusty industries), which are larger than 2.5 micrometers and smaller than 10 micrometers in diameter; and "fine particles" (such as those found in smoke and haze), which are 2.5 micrometers in diameter and smaller.

The Clean Air Act requires EPA to set air quality standards to protect both public health and the public welfare (e.g. visibility, crops and vegetation). Particle pollution affects both.

Particle pollution - especially fine particles - contains microscopic solids or liquid droplets that are so small that they can get deep into the lungs and cause serious health problems. Numerous scientific studies have linked particle pollution exposure to a variety of problems, including:

- premature death in people with heart or lung disease,
- nonfatal heart attacks,
- irregular heartbeat,
- aggravated asthma,
- decreased lung function, and
- increased respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing.

People with heart or lung diseases, children, and older adults are the most likely to be affected by particle pollution exposure. However, even if you are healthy, you may experience temporary symptoms from exposure to elevated levels of particle pollution. For more information about asthma, visit www.epa.gov/asthma.

Environmental Effects

Visibility impairment - Fine particles ($PM_{2.5}$) are the main cause of reduced visibility (haze) in parts of the United States, including many of our treasured national parks and wilderness areas. For more information about visibility, visit www.epa.gov/visibility.

Environmental damage - Particles can be carried over long distances by wind and then settle on ground or water. The effects of this settling include making lakes and streams acidic; changing the nutrient balance in coastal waters and large river basins; depleting the nutrients in soil; damaging sensitive forests and farm crops; and affecting the diversity of ecosystems. More information about the effects of particle pollution and acid rain.

Aesthetic damage - Particle pollution can stain and damage stone and other materials, including culturally important objects such as statues and monuments. More information about the effects of particle pollution and acid rain.

Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless gas emitted from combustion processes. Nationally and, particularly in urban areas, the majority of CO emissions to ambient air come from mobile sources. CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues. At extremely high levels, CO can cause death.

EPA first set air quality standards for CO in 1971. For protection of both public health and welfare, EPA set an 8-hour primary standard at 9 parts per million (ppm) and a 1-hour primary standard at 35 ppm.

In a review of the standards completed in 1985, EPA revoked the secondary standards (for public welfare) due to a lack of evidence of adverse effects on public welfare at or near ambient concentrations.

The last review of the CO national ambient air quality standards (NAAQS) was completed in 1994 and EPA chose not to revise the standards at that time.

Health

CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues. At extremely high levels, CO can cause death.

Exposure to CO can reduce the oxygen-carrying capacity of the blood. People with several types of heart disease already have a reduced capacity for pumping oxygenated blood to the heart, which can cause them to experience myocardial ischemia (reduced oxygen to the heart), often accompanied by chest pain (angina), when exercising or under increased stress. For these people, short-term CO exposure further affects their body’s already compromised ability to respond to the increased oxygen demands of exercise or exertion.

Nitrogen Oxides

Nitrogen dioxide (NO_2) is one of a group of highly reactive gases known as "oxides of nitrogen," or "nitrogen oxides (NOx)." Other nitrogen oxides include nitrous acid and nitric acid. EPA’s NAAQS uses NO_2 as the indicator for the larger group of nitrogen oxides. NO_2 forms quickly from emissions from cars, trucks and buses, power plants, and off-road equipment. In addition to contributing to the formation of ground-level ozone, and fine particle pollution, $NO_2$is linked with a number of adverse effects on the respiratory system.

EPA first set standards for NO_2 in 1971, setting both a primary standard (to protect health) and a secondary standard (to protect the public welfare) at 0.053 parts per million (53 ppb), averaged annually. EPA has reviewed the standards twice since that time, but chose not to revise the annual standards at the conclusion of each review. In January 2010, EPA established an additional primary standard at 100 ppb, averaged over 1 hour. Together the primary standards protect public health, including the health of sensitive populations: people with asthma, children, and the elderly. No area of the country has been found to be out of compliance with the current NO_2 standards.

The Clean Air Act requires EPA to set national ambient air quality standards for “criteria pollutants.” Currently, nitrogen oxides and five other major pollutants are listed as criteria pollutants. The others are ozone, lead, carbon monoxide, sulfur oxides, and particulate matter. The law also requires EPA to periodically review the standards and revise them if appropriate to ensure that they provide the requisite amount of health and environmental protection and to update those standards as necessary.

All areas presently meet the current (1971) NO_2 NAAQS, with annual NO_2 concentrations measured at area-wide monitors well below the level of the standard (53 ppb). Annual average ambient NO_2 concentrations, as measured at area-wide monitors, have decreased by more than 40 percent since 1980. Currently, the annual average NO_2 concentrations range from approximately 10-20 ppb.

EPA expects NO_2 concentrations will continue to decrease in the future as a result of a number of mobile source regulations that are taking effect. Tier 2 standards for light-duty vehicles began phasing in during 2004, and new NOx standards for heavy-duty engines are phasing in between 2007 and 2010 model years. Current air quality monitoring data reflects only a few years of vehicles entering the fleet that meet these strict N_Ox standards.

Health

Current scientific evidence links short-term NO_2 exposures, ranging from 30 minutes to 24 hours, with adverse respiratory effects including airway inflammation in healthy people and increased respiratory symptoms in people with asthma.

Also, studies show a connection between breathing elevated short-term NO_2 concentrations, and increased visits to emergency departments and hospital admissions for respiratory issues, especially asthma.

NO_2 concentrations in vehicles and near roadways are appreciably higher than those measured at monitors in the current network. In fact, in-vehicle concentrations can be 2-3 times higher than measured at nearby area-wide monitors. Near-roadway (within about 50 meters) concentrations of NO_2 have been measured to be approximately 30 to 100 percent higher than concentrations away from roadways.

Individuals who spend time on or near major roadways can experience short-term NO_2 exposures considerably higher than measured by the current network. Approximately 16 percent of U.S housing units are located within 300 ft of a major highway, railroad, or airport (approximately 48 million people). This population likely includes a higher proportion of nonwhite and economically-disadvantaged people.

NO_2 exposure concentrations near roadways are of particular concern for susceptible individuals, including people with asthma asthmatics, children, and the elderly

The sum of nitric oxide (NO) and NO_2 is commonly called nitrogen oxides or NO_x. Other oxides of nitrogen, including nitrous acid and nitric acid, are part of the nitrogen oxide family. While EPA's NAAQS covers this entire family, NO_2 is the component of greatest interest and the indicator for the larger group of nitrogen oxides.

NO_x react with ammonia, moisture, and other compounds to form small particles. These small particles penetrate deeply into sensitive parts of the lungs and can cause or worsen respiratory disease, such as emphysema and bronchitis, and can aggravate existing heart disease, leading to increased hospital admissions and premature death.

Ozone is formed when NOx and VOCs react in the presence of heat and sunlight. Children, the elderly, people with lung diseases such as asthma, and people who work or exercise outside are at risk for adverse effects from ozone. These include reduction in lung function and increased respiratory symptoms as well as respiratory-related emergency department visits, hospital admissions, and possibly premature deaths.

Emissions that lead to the formation of NO_2 generally also lead to the formation of other NOx. Emissions control measures leading to reductions in NO_2 can generally be expected to reduce population exposures to all gaseous NOx. This may have the important co-benefit of reducing the formation of ozone and fine particles both of which pose significant public health threats.

Sulfur Dioxide

Sulfur dioxide (SO_2) is one of a group of highly reactive gases known as "oxides of sulfur." The largest sources of SO_2 emissions are from fossil fuel combustion at power plants (73 percent) and other industrial facilities (20 percent). Smaller sources of SO_2 emissions include industrial processes such as extracting metal from ore, and the burning of high sulfur containing fuels by locomotives, large ships, and nonroad equipment. SO_2 is linked with a number of adverse effects on the respiratory system.

EPA first set standards for SO_2 in 1971. EPA set a 24-hour primary standard at 140 ppb and an annual average standard at 30 ppb (to protect health). EPA also set a 3-hour average secondary standard at 500 ppb (to protect the public welfare). In 1996, EPA reviewed the SO_2 NAAQS and chose not to revise the standards.

In 2010, EPA revised the primary SO_2 NAAQS by establishing a new 1-hour standard at a level of 75 parts per billion (ppb). EPA revoked the two existing primary standards because they would not provide additional public health protection given a 1-hour standard at 75 ppb.

The Clean Air Act requires EPA to set national ambient air quality standards for "criteria pollutants." Currently, sulfur dioxide (SO_2) and five other major pollutants are listed as criteria pollutants. The others are ozone, lead, carbon monoxide, nitrogen oxides, and particulate matter. The law also requires EPA to periodically review the standards and revise them if appropriate to ensure that they provide the requisite amount of health and environmental protection and to update those standards as necessary.

EPA first set standards for SO_2 in 1971. EPA set a 24-hour primary standard at 140 parts per billion (ppb) and an annual average standard at 30 ppb (to protect health). EPA also set a 3-hour average secondary standard at 500 ppb (to protect the public welfare). In 1996, EPA reviewed the SO_2 NAAQS and chose not to revise the standards.

In 2010, EPA revised the primary SO_2 standards by establishing a new 1-hour standard at a level of 75 ppb. EPA revoked the two existing primary standards because they would not provide additional public health protection given a 1-hour standard at 75 ppb.

In 2012, EPA took final action to retain the current secondary standard for SO_2 of 500 ppb averaged over three hours, not to be exceeded more than once per year

Health

Current scientific evidence links short-term exposures to SO_2, ranging from 5 minutes to 24 hours, with an array of adverse respiratory effects including bronchoconstriction and increased asthma symptoms. These effects are particularly important for asthmatics at elevated ventilation rates (e.g., while exercising or playing.)

Studies also show a connection between short-term exposure and increased visits to emergency departments and hospital admissions for respiratory illnesses, particularly in at-risk populations including children, the elderly, and asthmatics.

EPA's NAAQS for SO_2 is designed to protect against exposure to the entire group of sulfur oxides (SO_x). SO_2 is the component of greatest concern and is used as the indicator for SO_x. Other gaseous sulfur oxides (e.g. SO_3) are found in the atmosphere at concentrations much lower than SO_2.

Emissions that lead to high concentrations of SO_2 generally also lead to the formation of other SO_x. Control measures that reduce SO_2 can generally be expected to reduce people's exposures to all gaseous SO_x. This may have the important co-benefit of reducing the formation of fine sulfate particles, which pose significant public health threats.

SOx can react with other compounds in the atmosphere to form small particles. These particles penetrate deeply into sensitive parts of the lungs and can cause or worsen respiratory disease, such as emphysema and bronchitis, and can aggravate existing heart disease, leading to increased hospital admissions and premature death. EPA's NAAQS for particulate matter (PM) are designed to provide protection against these health effects.

TYPICAL IMPACTS OF OIL AND GAS OPERATIONS ON AIR QUALITY

Impacts from Geophysical Exploration

During the geophysical exploration phase, adverse effects on air quality would result from increased vehicle use to transport seismic work crews and equipment to drill shotholes. Combustion engine emissions include VOCs, NO_x, CO, PM_{10} and PM $_{2.5}$ and SO_2. The primary pollutants of concern are NO_x , which are formed in the high temperature, pressure, and excess-air environment of combustion in diesel engines. Lesser amounts of CO and hydrocarbons are also emitted. Some SO_2 is emitted due to the burning of gasoline and diesel (which can contain minor amounts of sulfur). The amount of engine emissions depends on the number and type of gasoline or diesel-fueled vehicles, shothole drilling equipment used, and the length of use. The majority of impacts associated with 3D seismic surveys are limited in extent because of the temporary nature of the survey. For- particulates impacts tend to be localized and for other pollutants VOCs and NO_x (or even SO_2, which transforms to SO_4 fine particles downwind), these impacts may be localized, but could contribute to regional air quality impacts. In general, for small scale oil and gas operations, emissions tend to be small and will not significantly impact air quality. However, for oil and projects that require a NEPA analysis, the air quality impacts will be evaluated during the NEPA process.

Impacts of Well Drilling and Production

The primary impacts on air quality from well drilling and production include emissions from vehicles and heavy equipment during construction and maintenance, as well as, emissions released during drilling and production activities. Vehicles and heavy equipment used for the construction and maintenance of access roads, well pads, flowlines, and pipelines, and well drilling could introduce NO_x ,VOCs, CO, SO_2, PM_{10}, $PM_{2.5}$, and odors from operating large engines, pumps and auxiliary equipment. This can result in short-term (construction activities and drilling operations) to long-term (roads, production operations, and flowlines and pipelines) impacts on air quality.

Hydrocarbons and volatile components of well treatment chemicals would continue to be released at existing drilling, production, or transport operations.

Drilling activities can involve continuous operation of combustion engines over a 15- to 120-day period depending on the depth and complexity of the well drilled. This activity would introduce emissions of NO_x, CO, and SO_2. Large diesel engines, which are used to power the drill, rigs, pumps, and auxiliary equipment emit NO_x as primary pollutants of concern. Nitrogen oxides are formed in the high temperature, pressure, and excess-air environment of combustion diesel engines. Smaller amounts of CO and hydrocarbons would also be emitted. Some SO_2 would be emitted due to the burning of gasoline and diesel (which contain minor amounts of sulfur). The amount of engine emissions depends on the drilling rig size (horsepower), percent sulfur in the fuel burned, gallons of diesel fuel burned per hour, the hours per day, number of days the diesel rigs operate, and the use of any emission control devices. For a comparison, a recent analysis of existing impacts on air quality from drilling operations at NPS's Big South Fork National River and Recreation Area determined the amount of NO_x and VOCs that would be produced per well for oil drilling. Using a typical horsepower of 350 hp and the assumption of 7 days to drill a well, the Big South Fork analysis estimated that emissions from one drilling operation would be about 0.7 tons per year of NO_x (USNPS 2012). VOC emissions would be minimal.

Hazardous air pollutants that can be released during oil and gas operations are benzene, toluene, ethylbenzene, and xylene (known as the "BTEX" chemicals); hydrogen sulfide (H_2S); arsenic (As); and mercury (Hg). These pollutants demonstrate a high toxicity and can lead to increased rates of cancer and respiratory disease in humans either acutely or chronically exposed to high concentrations in the environment. Existing concentrations of and potential exposures to these pollutants vary widely depending upon the physical characteristics of the site, the proximity of human populations, the level of oil and gas production, and the type of production equipment employed (Mall et al. 2007).

Drilling activities can produce H_2S when equipment encounters gas or fluids under pressure. Hydrogen sulfide presents a serious localized air quality concern because it is extremely toxic at very small concentrations. If encountered H_2S is extremely hazardous to normal oil field operations because of its potential adverse health effects and its contribution to drilling equipment metal fatigue. When zones containing gas or fluids under pressure are encountered, the drilling mud system can be adjusted (mud weight is increased) to prevent the release of hydrogen sulfide. Drilling can be discontinued until the pressure is stabilized and there is essentially no gas entering the hole. The small amount of gas that could reach the surface is then vented from the system by using a de-gaser unit and a flare to combust the gas. Drilling and producing of hydrocarbons containing toxic gases can be performed safely if the appropriate safety and precautions procedures are followed.

Odors from drilling and production operations could affect visitors and refuge employees. The possibility and extent for odor would depend on wind speed and direction and the nature of the drilling equipment and material encountered during drilling operations (particularly the presence of H_2S -bearing zones). Odor would be more noticeable during light breezes and less evident during periods of stronger winds.

For both existing and future operations, hydrocarbons could volatize and enter the atmosphere as the result of a leak or spill. In the vicinity of the leak or spill, concentrations of gas and other constituents could present health hazards to animal and plant life. In addition, a leak or spill could provide a source for explosion or fire. These impacts could be serious on a very local level; however, with mitigation, and prompt response in the event of a spill, impacts would be short-term. These impacts could be localized event but can contribute to regional air quality impacts.

Photochemical reactions between hydrocarbons and NO_x produce ozone (Bradbury et al. 2013). Although the concentration of all these pollutants would increase as the fields are developed, the levels are expected to be low and are required to comply with Federal and State standards and conform to all local air quality State implementation plans (SIPs). The extent of impacts caused by increases in pollutants may range from areas near each well to longer ranges with low-level contributions to regional impacts, like ozone and haze formation.

In some areas of the country, ambient levels of ozone cause visible injury to vegetation, including dark stippling and chlorosis (i.e., bleaching), and decreased plant growth and productivity. Elevated ozone levels have also been linked to significant changes in plant community composition due to the effect of ozone on growth and reproduction, and to reduced ecosystem water quantity, due to ozone's effect on water use efficiency in plants (USEPA 2013b).

NO_x and So_x in the air can damage the leaves of plants, decreasing their ability to produce food – photosynthesis- and decrease their growth. In addition to directly affecting plants, atmospheric nitrogen deposition acts as fertilizer, favoring some plants, including invasive species, and leaving others at a competitive disadvantage. Sulfur oxides can acidify sensitive ecosystems resulting in a range of harmful deposition-related effects on plants, soils, water quality and fish and wildlife. This creates an imbalance in natural ecosystems, and over time may lead to shifts in the types of plant and animal species present, increases in insect and disease outbreaks, disruption of ecosystem processes (such as nutrient cycling), and changes in fire frequency. Arid grasslands and shrublands are particularly vulnerable to changes caused by nitrogen deposition. Nitrogen deposition may disrupt soil nutrient cycling and alter plant communities. Invasive grasses thrive in areas with high nitrogen deposition, displacing native vegetation adapted to low nitrogen conditions. The fire risk subsequently increases due to extensive areas of weedy grasses.

Greater use of motor vehicles during construction of access roads and pads, and during drilling, would increase particulate matter from vehicle exhaust and dust from paved and unpaved roads. Exhaust from machinery used during construction and drilling also would contribute to an increase in particulate matter. As a result of increased particulate matter emissions, visibility may be slightly impacted during construction and drilling in any localized area where these activities are undertaken.

There could be some added impact on regional visibility due to transport of fine particulate matter and haze produced by secondary aerosols (i.e., particulate matter formed from gaseous emissions of SO_2, NO_x, and VOCs, in particular). Particulate matter emissions would be greatest during any necessary construction of roads, pads, flowlines and oil and gas pipelines, due to the higher number of vehicles and earthmoving activities.

The amount of air pollution generated over the productive life of oil or gas wells depends on the characteristics of the product and the production practices used. Emissions associated with production are usually considerably less than the emissions from well drilling. However, over the life of some production operations, emissions could exceed those of drilling operations. Oil and gas production operations release gaseous pollutants such as CO, hydrocarbons, NO_x, and SO_2. These production operation air pollutants are released from separation facilities, disposal of liquid waste and unwanted gas, burning of waste petroleum products, routine emission of objectionable odors, and venting of noxious vapors from storage tanks.

Impacts of Plugging and Reclamation

Increased vehicle use and removal of roads, pads, flowlines, and pipelines could increase particulate matter emissions as well as emissions from vehicle engines. Leaks and spills of hydrocarbons could occur during well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities. These activities would result in emissions of gaseous pollutants and present a potential source for explosion or fire. Plugging and reclamation impacts generally are short-term and localized, but can contribute to regional air quality impacts.

Impacts on air quality from reclamation of wells directionally drilled from outside the refuge boundaries could vary based on the distance from the refuge boundary. These impacts would be expected to be similar to those described above. Impacts could be localized as well as contribute to regional air quality impacts.

Once wells are plugged and sites reclaimed, there would be no future emission associated with that operation.

Impacts of Alternatives on Air Quality

Purpose and Scope

The purpose of the regulation in all alternatives is to ensure that non-Federal oil and gas operations conducted on NWRS lands and waters avoid or minimize, to the greatest extent practicable, adverse effects on air quality.

Under Alternative A, the Service scope of application of its regulation and policy provides protection of air quality on Service fee title lands.

Alternative B, the proposed rule, would expand the area of regulatory application to include tracts where the Federal interest is less than fee (e.g., wetland or grassland easements). As a result of active regulation by the Service, air quality associated with interests acquired on easements would have a consistent and higher level of protection compared to Alternative A.

Alternative C would expand the scope of regulation to operations conducted on non-Federal surface locations drilling under a refuge or any operation on private land within a refuge (i.e., an inholding). The level of increased protection for air quality would vary from slight to moderate depending on proximity of those operations to refuge boundaries, as well as state rules (and operator's compliance with those rules) in place that serve to reduce such impacts (e.g., emissions standards).

Accessing Oil and Gas Rights from a Non-Federal Surface Location

Under Alternative A the incentive for operators to locate their operations outside refuge units would remain in place as described at the beginning of this chapter. The location of surface operations outside refuge units avoids direct impacts to air quality on refuges depending on the proximity of the operations. The impact on air quality from wells directionally drilled and produced from outside refuge boundaries are expected to be similar to those described for operations within refuge boundaries; however, the intensity of impacts on air quality inside the refuge would vary with the location of the well and any prevailing winds.

Under Alternative A, direct impacts to air quality within the refuge from these operations would be avoided because there is some incentive for operators to locate their operations outside refuge units. The location of surface operations outside refuge boundaries avoids direct impacts to air resources within the refuge. However, depending on the proximity of these operations to the refuge, some indirect impacts to air quality on a refuge could occur, because the Service would not be imposing preventive measures on these operations. For example, the use of diesel fuel with a higher sulfur content or poorly maintained construction equipment could result in greater emissions impacting the regional air quality. Intensity of impacts on refuge resources would depend on proximity of operations to the refuges; site-specific environmental conditions, such as steepness and direction of slope; and mitigation measures being employed.

As discussed previously, Alternative B provides an even greater incentive for operators to locate their operations outside refuges. Therefore, it is likely that direct impacts to air quality from new production and drilling operations would be avoided to a greater extent than in Alternative A. Indirect impacts on air quality from those wells located on non-Federal surface locations would be same as Alternative A.

Under Alternative C, directional drilling operations on non-Federal surface locations would be subject to the full regulatory requirements of the proposed rule. The Service would impose operational standards on activities outside the refuge to the extent necessary to avoid or minimize impacts on refuge resources and uses. The Service would impose operational standards on activities outside the refuge to the extent necessary to avoid or minimize impacts on refuge resources and uses. Alternative C would provide some additional protection from the indirect impacts of these operations to refuge air quality by requiring mitigation measures that would reduce air emissions adjacent to refuge units, and thus their transport across the refuge boundary. However, Alternative C eliminates the incentive to locate an operation outside of a refuge, so there would likely be a significant increase in the number of drilling and production operations located on refuges, as well as the direct impacts to the air quality associated with these operations. Therefore, compared to Alternatives A and B, Alternative C would increase the instances where new drilling operations create direct, and long-term impacts to refuge air quality.

Requirement to Obtain a Service Permit to Conduct Operations

Under Alternative A, the Service would continue to work to ensure new operations are under a Service-issued SUP or ROW, which would reduce the impacts of geophysical operations and new drilling and production operations. When an operator obtains a Service permit prior to conducting operations, it provides additional protection for air quality. The permitting process ensures ongoing communication between Refuge staff and the operator; that an operator includes mitigation measures to avoid or minimize impacts to refuge resources and uses; and that an operator is aware of expectations to reclaim a site to restore refuge resources and ensure long term protection of refuge resources and uses. However, the permit requirement itself has not been consistent across the Service and, where permits have been issued, the permit conditions have varied widely resulting in the possibility of unnecessary impacts to air quality.

Under Alternative A, there would be unnecessary impacts to air quality from the estimated 4,000 pre-existing oil and gas production operations not under an SUP or ROW, including those described above under Typical Impacts of Oil and Gas Operations on Air Quality due to the lack of any requirement that these pre-existing operations have ongoing mitigation measures to protect air quality and the fact the Service does not currently have a way to ensure operations are complying with any State laws that would protect air quality.

The primary effects on air quality are related to heavy equipment use, including the continuous use of a combustion engine during drilling activities, and releases of hydrocarbons from oil storage and venting. Operations under an SUP could experience a reduction in impacts to air quality if the SUP included stipulations for reducing air emissions, avoiding or minimizing the use of flares, and controlling the venting of VOCs.

Under Alternative B, all new operations would be under a consistent permitting process that would include required consultation with the Service, evaluation of air quality impacts, performance-based standards to avoid or minimize impacts to air quality, and other administrative provisions such as financial assurance, cost recovery, and access fees that would ensure protection of geology and soils from the typical impacts of oil and gas development to the greatest extent practicable.

Similar to Alternative A, pre-existing operations would not be required to obtain an operations permit during the production phase. However, in contrast to Alternative A, the Service would manage these pre-exisiting operations by assimilating State laws and regulations into the rule, thereby increasing the Service’s enforcement ability on refuge lands. So, during the production phase, impacts to air quality would be reduced compared to Alternative A due to improved compliance with State rules that serve to lower such impacts, such as State air quality standards. The Service expects that issues related to ongoing impacts on air quality could be resolved by compliance with State laws and regulations in States that have oil and gas regulations specific to air emissions.

Additionally, under Alternative B, all operations, including pre-existing operations, would be required to have a Service-issued permit for reclamation. The requirement for an operations permit during the reclamation phase of pre-existing operations could slightly reduce impacts on air quality (e.g., requiring dust suppression during plugging operations). Reclamation standards such as plugging all wells would eliminate any direct, long-term impacts to air quality within the refuge units by preventing releases of VOCs from these closed wells.

Assimilation of State laws and regulations during the production phase combined with reclamation to Service standards ensures a substantial and consistent long-term benefit to air quality compared to

Alternative A. For example, Colorado requires oil operators to install devices that capture 95 percent of emissions, including VOCs and methane.

Alternative C would require all operators on refuges to obtain a permit for their operations; including pre-existing operations. Compared to Alternative B, Alternative C would reduce impacts to air quality caused by pre-existing wells during the production phase. Impacts to air quality would be reduced in the same manner as described under Alternative B for new operations. Alternative C would also require operations on inholdings and those directionally drilling underneath a refuge from non-Federal surface locations to obtain a permit to the extent necessary to protect refuge geology and soils. In most cases, since the activity is occurring directly on private surface estate, the Service would not identify operational measures to protect air quality on adjacent Federal surface estate. Thus, for these operations, the impacts on air quality would be similar to Alternative B.

Performance Based Standards

Under Alternative A, oil and gas operations would be managed on an individual unit basis, with protective stipulations developed in a site-specific manner. New operations would be subject to operating practices, as defined in SUPs or ROWs that serve to minimize or avoid impacts on air quality. For instance, impacts to air quality could be reduced if the SUPs include prescriptive measures to reduce air emissions, flaring, and the venting of VOCs, if such measures are not already required under state law. Thus, the levels of protection may vary somewhat from permit to permit and by refuge as the existing regulations do not provide specific operating standards for the protection of refuge resources. The level of monitoring and cooperation with operators to address impacts on refuge resources and uses would continue to vary widely, resulting in unnecessary impacts to air quality. For the 4,000 pre-existing operations, reclamation is conducted without regard for Service goals or only to the extent a refuge manager is able to negotiate to have reclamation goals addressed. Reclamation for these wells often falls short of Service reclamation standards.

Under Alternatives B and C, the proposed rule establishes performance-based standards for avoiding or minimizing impacts to air quality. All new operations on NWRS lands and waters would be subject to consistent standards and requirements of the proposed rule for protecting air quality.

Additionally, under the proposed rule operators on easements would be required to comply with these standards to the extent necessary to protect that easement interest. However, since mitigation of air quality impacts above those required by Federal and State rules are typically not necessary to protect the Service's property interests in easements (e.g., wetlands, native prairie), Alternative B would not likely provide any further protection of air quality on easements.

The proposed rule also includes standards for achieving successful well plugging and surface reclamation once operations end. As described above, reclamation may result in short term air quality impacts but in the end ensuring wells are plugged according to Service standards would result in no future emission associated with that operation.

Under Alternative C, pre-existing operations would be required to abide by the performance-based standards established under the proposed rule during the production phase. Compared to Alternative B, Alternative C may provide for implementation of higher standards for protection of air quality during the production phase.

Also, operations on inholdings and operations on non-Federal surfaces directionally drilling underneath a refuge would be subject to the performance-based standards established in the proposed rule to the extent necessary to protect refuge air quality. However, since mitigation of air quality impacts above those required by Federal and State rules are typically not necessary to protect refuge resources and uses from locations on inholdings and non-Federal surfaces, Alternative B would not likely provide any further protection of air quality from these operations.

Finally, under Alternative C, performance-based standards would also be established for downhole operations. Air quality would mainly be impacted by accidents associated with well control. Given present day technology, events that result in loss of well control (blowouts) are extremely rare. Service regulation could serve to lower an already low risk of a well blowout, but in practice, the Service finds that State requirements for well control and the expectation that companies will act in their own best interest would preclude the need for the Service to regulate aspects of drilling and production related to well control. Thus, the Service does not expect any reduction of impacts or risks of impacts to air quality related to our downhole regulation under Alternative C.

Cumulative Impacts

Actions inside and outside the refuge units and local trends in oil and gas development can cumulatively affect air quality of the refuges. Management planning, such as fire management, ORV, and oil and gas management plans, can result in greater protection for an airshed. Conversely, actions that cause disturbance of air quality would include activities such as prescribed burns, ORV use, mining, agricultural and logging activities, as well as any general development activities that include heavy construction equipment. Past, present, and reasonably foreseeable activities that would have beneficial or adverse effects on air quality in the area of analysis (including both refuge lands and adjacent lands) and a brief summary of the cumulative impacts of these actions on air quality are listed in Table 4-3.

TABLE 4-3. CUMULATIVE IMPACTS ON AIR QUALITY (PROGRAMMATIC LEVEL FOR REFUGE UNITS)

Past, Present, and Reasonably Foreseeable Activity	Impacts on Air Quality
State greenhouse gas regulations	Long-term beneficial effects of reductions in greenhouse gas emissions as a result of new statewide regulatory revisions concerning greenhouse gas emissions requirements for the permitting of oil and gas operations.
Prescribed fires and fire management actions	Short-term adverse effects on air quality from controlled burns, namely, particulate matter; short- and long-term impacts from fire line construction that requires digging and burning of surface litter, resulting in decreased visibility and increased particulate matter. Long-term beneficial effects of reduced fire occurrences with managed burns that reduce the possibility of catastrophic and high intensity fire and associated emissions.
Service facility and road construction	Short-term adverse effects on air quality during road grading and construction using heavy equipment.
Trails development and maintenance	Short-term adverse effects on air quality from construction equipment during clearing, grading, and surfacing of trails.

Past, Present, and Reasonably Foreseeable Activity	Impacts on Air Quality
ORV use	Long-term adverse effects on air quality from the vehicle emissions
Increased on-road vehicle use	Short- and long-term adverse effects on air quality from increased regular traffic and vehicle use in and around refuges.
Abandoned mine lands reclamation	Short-term adverse effects on air quality from any equipment use during reclamation-related disturbances.
Mining and logging activities	Short-term adverse effects on air quality from heavy equipment use
Ranching, agricultural land uses	Short- and long-term adverse effects from operations that require heavy equipment for agricultural uses or emissions, as well as methane emission from concentrated livestock operations.
Land development: residential and nonresidential (commercial, industrial) land uses, including road construction	Short-term adverse effects on air quality from construction equipment and increased vehicle emissions.
Future oil and gas development on adjacent lands	Direct effects on airshed from additional operations; trends indicate that the exploration and production of shale gas, in particular, is anticipated to increase dramatically over the next 30 years.
Oil and gas well plugging and reclamation activities inside and outside refuges	Short-term adverse effects on air quality from reclamation related construction activities due to use of equipment and grading

Under all three alternatives, there would be adverse and beneficial cumulative impacts from projects, plans, actions, and trends in oil and gas development as discussed in the cumulative scenario above (Table 4-3).

Alternative B would contribute to cumulative impacts from the continued operations of permitted and newly regulated operations, which would continue to have long-term direct adverse effects on air quality, as described in the above analysis. Bringing new operations and the reclamation phase of pre-existing operations under regulation would potentially add beneficial impacts on air quality. When combined with the effects of all other actions in the study area, cumulative impacts from the actions under Alternative B would be long term and both adverse and beneficial, with Alternative B contributing potential beneficial impacts on overall cumulative impacts from the change in regulations.

Under Alternative C, similar to Alternative B, there would be effects on air quality as a result of oil and gas operations that would continue to affect air quality where impacts cannot be avoided, and benefits from bringing new operations and the reclamation phase of pre-existing operations under regulations and the resultant reduction in adverse impacts, as described in the Alternative B analysis. Alternative C would contribute to cumulative impacts mostly by adding beneficial impacts of bringing new operations and the reclamation phase of pre-existing operations under regulation, but also by possibly adding adverse impacts from the change in directional drilling regulations that could result in more oil and gas development within refuge units as opposed to outside refuge boundaries.

Under all alternatives, GHG emissions would continue. EPA (2015) estimates GHG emissions from oil and gas production at 2.8 million tons of VOCs, 185 million metric tons (MMt) CO_2 equivalent (CO2 Eq.) of methane (EPA 2015). Currently, non-Federal oil and gas producing (active) wells on refuges comprise 0.16 percent of the total number of producing wells (1,050,637) in the United States in 2011 as reported by the EPA (EPA 2015). Though the Service does not have the data necessary to calculate GHG from non-Federal oil and gas operations on refuges, the volume could be a similar ratio. Alternatives B and C could result in permit requirements that serve to reduce GHG emissions such as limitations on flaring or required use of control valves that do not vent natural gas.

WATER RESOURCES

METHODOLOGY

Potential impacts on water resources are assessed based on the actions being proposed and characteristics of the water resources in refuges. Resource-specific context for assessing impacts of the alternatives to water resources includes the following:

- the susceptibility of surface waters to pollution from runoff and spills from oil and gas sites
- the susceptibility of groundwater resources to contamination from drilling, including hydraulic fracturing operations
- special designations given to surface or groundwaters found in the refuges, such as Wild and Scenic Rivers or Outstanding Natural Resource Waters

For the programmatic analysis, a qualitative analysis of the potential impacts of oil and gas operations on water resources was conducted based on actual experience of the Service in management of non-Federal oil and gas operations and their effects on water resources.

TYPICAL IMPACTS OF OIL AND GAS OPERATIONS ON WATER RESOURCES

Impacts from Geophysical Exploration

During the geophysical exploration phase, the loss or modification of vegetation, ORV use, and shothole drilling and detonation could result in increased sedimentation and turbidity and degrade water quality in nearby surface waters. For example, vegetation clearing would increase the potential for runoff into nearby surface waters by exposing the surface to water and wind, and survey crews traversing the area could also cause soil compaction, reducing the soil’s water-holding and infiltration capacities. Cleared areas with compacted soils would be more subject to runoff of surface waters and accelerated erosion (Duiker 2004; Pennsylvania State University 2009). This could lead to an increase in sediment load to nearby receiving surface waters. Also, the use of overland vehicles to transport equipment and personnel could increase the potential for turbidity if vehicles need to cross surface waters to access shothole locations and stir up bottom sediments.

Seismic operations generally have slight impacts on groundwater quantity or quality. Shothole detonation could dislodge or mobilize clays within an aquifer and cause a decrease in water quality or a reduction in flow. These effects are very uncommon and usually of short duration, unless the aquifer has limited geographic extent such as a localized perched watertable. Explosives that are occasionally left undetonated in shotholes could introduce small quantities of organic chemical compounds that are biodegradable in a few years. The quantities of explosives used in each individual shothole vary from one-half to 12 pounds and are typically spaced approximately 110 to 440 feet apart and therefore are not expected to appreciably affect groundwater chemistry. Soils such as fragipans that support surface waters in wetland areas (called aquitards) could conceivably be disturbed by shothole drilling and possibly fractured from shothole detonation. Design of shothole depths and explosive sizes used with respect to depths of aquitards would serve to minimize the risk of adverse effects, as would proper plugging of shotholes.

Impacts of Well Drilling and Production

During drilling and production, the construction, maintenance, and use of access roads, well pads, flowlines, and pipelines could increase soil erosion and consequently increase sedimentation and turbidity in nearby water bodies (McBroom et al. 2012). Clearing of vegetation for these activities would expose soils to erosion, which could move downslope and increase turbidity and sedimentation in nearby surface waters. This could also create ruts or gullies that channel surface water flows. Road construction and the use of compacted road fill could also reduce infiltration rates on road surfaces, increasing surface runoff (Trombulak and Frissell 2000). Access roads and pads could also disrupt natural surface flow patterns and might result in an increase or decrease in the amount of water in some areas. Additional roads in the refuges could increase access, which in turn could result in unauthorized additional land disturbance and erosion. If roads are used during wet conditions, rutting could result and might concentrate surface water flows. Slopes are particularly susceptible to erosion caused from road and well pad construction.

In addition to impacts associated with soil erosion and sedimentation, water resources could become contaminated if hazardous substances are released into them during drilling, production, servicing, or transport. In some locations, drilling operations could encounter formations with H_2S or high pressures and associated uncontrolled flows of oil, gas, brine, or freshwater. Blowouts could occur during drilling and release hydrocarbons, water, and drilling mud. The Service recognizes that unplanned incidents associated with oil and gas operations such as well blowouts present a risk of release of contaminants that can adversely impact water resources. However, the incident rates for such incidents are low and are not a typical expectation of project implementation. In the event that the refuge’s resources or values are damaged, the Service could seek remedy both in the form of reclamation and monetary compensation.

There could also be accidental spills of drilling mud, diesel fuel, and other chemicals during drilling operations, or leaks from containers or flow lines. If drilling mud, fuels, or other chemicals are spilled on the ground and there is no impermeable liner on the well pad, the fluids could infiltrate into shallow aquifers or reach nearby surface waters, resulting in changes in water quality and possible violations of water quality standards if these are not detected and remediated. Contamination from the release of produced waters that contain salts and other well drilling fluids and chemicals could also impact surface and groundwaters. For example, such instances of leaks from salt-water disposal wells and flowlines conveying oilfield brine, subsequent contamination from mechanical problems and improper operating practices have been documented at Hagerman and Aransas National Wildlife Refuges in Texas and the Anderson Waterfowl Production Area in northeastern Montana (M. Maddux and M. Borgreen pers. comm.). The risk of releases reaching more area of the well pad or offsite locations is greater for those wells that are not under an SUP or ROW permit because these wells are not required to have some of the more protective measures that are required under SUPs or ROW permits.

Risks to groundwater resources include leaching of surface oil and produced water leaks and spills into shallow groundwaters, and groundwater contamination from poorly cased or cemented wells. Well drilling and servicing can include the use of hydraulic fracturing well stimulation operations. These operations require large quantities of water, use a variety of chemicals to stimulate well production, and generate produced flowback or waste water. The term “hydraulic fracturing” has been expanded by the public beyond just the actual stimulation process to become the term for all activities associated with a well that is hydraulically fractured—from site construction through waste disposal. With the surge in the use of hydraulic fracture stimulation for shale development, the subject has drawn recent controversy.

The U.S. Environmental Protection Agency (USEPA 2004) began a study on hydraulic fracturing used in coalbed methane reservoirs in 1999 to evaluate the potential risks to underground sources of drinking water. The study focused on coalbed methane reservoirs because they are typically closer to the surface and in greater proximity to underground sources of drinking water compared to conventional gas reservoirs. EPA published the coalbed methane study, entitled *Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reservoirs* (USEPA 2004). The published study received both internal and external peer review, and public comment on study design and incident information. EPA concluded that there was little to no risk of fracturing fluid contaminating underground sources of drinking water during hydraulic fracturing of coalbed methane production wells. EPA retained the right, however, to conduct additional studies in the future. As a precautionary measure, EPA also entered into a Memorandum of Agreement in 2003 with companies that conduct hydraulic fracturing of coalbed methane wells to eliminate use of diesel fuel in fracturing fluids.

EPA conducted an expanded study to include all aspects of well development that use hydraulic fracturing at the request of Congress to better understand the potential impacts of hydraulic fracturing on drinking water resources. Many States have added or are in the process of adding to regulations to address potential environmental impacts of these operations. Release of a draft assessment report for public comment and peer review by EPA occurred in June 2016 (External Review Draft | EPA/600/R-15/047a | June 2015 | www.epa.gov/hfstudy). The assessment considered potential impacts to sources of drinking water related to 1) water acquisition needed for hydraulic fracturing, 2) mixing of chemicals, sand, and water to create the fracturing fluid, 3) well injection, 4) flowback of fracturing fluid and produced fluids, and 5) wastewater treatment and waste disposal. Major findings were summarized in the Executive Summary of the report:

> “From our assessment, we conclude there are above and below ground mechanisms by which hydraulic fracturing activities have the potential to impact drinking water resources. These mechanisms include water withdrawals in times of, or in areas with, low water availability; spills of hydraulic fracturing fluids and produced water; fracturing directly into underground drinking water resources; below ground migration of liquids and gases; and inadequate treatment and discharge of wastewater.

> We did not find evidence that these mechanisms have led to widespread, systemic impacts on drinking water resources in the United States. Of the potential mechanisms identified in this report, we found specific instances where one or more mechanisms led to impacts on drinking water resources, including contamination of drinking water wells. The number of identified cases, however, was small compared to the number of hydraulically fractured wells.
>
> This finding could reflect a rarity of effects on drinking water resources, but may also be due to other limiting factors. These factors include: insufficient pre- and post-fracturing data on the quality of drinking water resources; the paucity of long-term systematic studies; the presence of other sources of contamination precluding a definitive link between hydraulic fracturing activities and an impact; and the inaccessibility of some information on hydraulic fracturing activities and potential impacts."

Hydraulic fracturing requires large volumes of water; hydraulic fracturing fluids are usually water-based, with approximately 90 percent of the injected fluid composed of water (GWPC and ALL Consulting 2009). Estimates of water needs per well have been reported to range from 65,000 gallons for coalbed methane production up to 13 million gallons for shale gas production, depending on the characteristics of the formation being fractured and the design of the production well and fracturing operation (GWPC and ALL Consulting 2009; Nicot et al. 2011). Hydraulic fracturing operations require large quantities of supplies, equipment, water, and vehicles. Onsite storage, mixing, and pumping of hydraulic fracturing fluids may result in accidental releases, such as spills or leaks. Released fluids could then flow into nearby surface water bodies or infiltrate into the soil and near-surface groundwater, potentially reaching drinking water resources.

The hydraulic fracturing fluid is pumped down the well at pressures great enough to fracture the oil- or gas-containing rock formation, and leaks could result from well construction failure. When the injection pressure is reduced, the direction of fluid flow reverses, leading to the recovery of flowback and produced water. This water may contain chemicals injected as part of the hydraulic fracturing fluid, substances naturally occurring in the oil- or gas-producing formation, hydrocarbons, and potential reaction and degradation products. Onsite transfer and storage of hydraulic fracturing wastewater may result in accidental releases, such as spills or leaks, which may reach nearby drinking water resources. The potential impacts on drinking water resources from flowback and produced water are similar to the potential impacts identified in the chemical mixing stage of the hydraulic fracturing operation, with the exception of different fluid compositions for injected fluids and wastewater (USEPA 2012).

Poor well construction, substandard well control practices, and surface mismanagement of contaminants have generally caused the impacts on ground and surface waters from hydraulic fracturing operations (Rozell and Reaven 2012, AWWA 2013, Darrah et al. 2014). Hydraulic fracturing of older wells that are not constructed to withstand the pressure of the operation could contaminate groundwater if the casing is breached.

Because production could continue for 20 years or longer, the potential for leaks and spills of hazardous substances from production operations (including flowlines and pipelines) is greater than for any other phase of oil and gas operations. Adverse impacts on water quality could occur from accidental leaks and spills of drilling fluids or waste waters, hazardous waste spills (including diesel fuel), well blowouts, ruptures of flowlines and pipelines, and spills from tanker trucks. Chronic small leaks and spills could spread through various pathways, and over an extended period of time could become substantial and costly to remediate. The chances of undetected spills are greater if routine inspections are not performed. Faulty installation or corrosion of production casing might go undetected and could adversely impact groundwater, if hydrocarbons and/or produced waters migrate into an aquifer and contaminate groundwater. The severity of the impact would depend on the type of substance spilled (hydrocarbons, produced waters, chemicals, solvents, and fuels) and the size of area impacted, but impacts could be substantial. Oilfield brine spills can increase the bioavailability of some heavy metals as well as destroy the soil structure resulting in the significant reduction of infiltration rates (Vavrek et al. 2004). These brine impacted soils are usually devoid of vegetation and are susceptible to erosion. The loss of infiltration will result in increased runoff with impacts to nearby surface water in terms of salinity, and siltation. Impacts to the soils from oilfield brine spills remain for years (Vavrek et al. 2004).

The types of impacts related to runoff of sediments and contaminants for directionally drilled wells are expected to be similar to those described above for operations inside refuges. However, direct impacts to water resources in the refuge would not occur. The risk of indirect impacts and their intensity would vary with the location of the well with respect to the refuge boundary and direction of surface runoff. The risk of impacts on refuge resources would be greater for directionally drilled operations sited closer to refuge boundaries with surface gradients toward the refuge, where sediments and contaminants can be transported downslope into a refuge through adjacent streams, gullies, or overland flow. Severity of impacts would depend on proximity of operations to the refuge, site-specific environmental conditions, such as steepness and direction of slope and surface hydrology, sensitivity of resources, and mitigation measures being employed.

Impacts of Plugging and Reclamation

In cases involving older, idle wells in which roads and well pads have become overgrown with vegetation, clearing vegetation from oil and gas access roads and well pads and the use of heavy equipment and vehicles would temporarily increase localized erosion potential. In addition, there is the potential for release of liquid hydrocarbons and/or contaminating or hazardous substances into surface and groundwater from vehicles, wellhead equipment, or flowlines during well plugging and reclamation activities. These temporary activities could cause detectable, localized changes to water quality in the case of wells located near surface waters.

When drilling and production operations end, well plugging and surface reclamation results in overall beneficial impacts on water resources. Surface disturbance from earth-moving equipment also occurs during plugging operations, which could result in sedimentation and turbidity in nearby waterways. However, these disturbances are temporary. There are also beneficial effects on water resources once cleanup is successfully completed and the site is reclaimed to natural conditions and processes. Reclamation involves returning the topography of a site to approximate the original contours, replacing any stockpiled soils, and re-establishing natural vegetation communities. Revegetating disturbed areas provides erosion control in areas of previous impacts from oil and gas operations, thus limiting impacts from runoff. Sources of potential leakage such as wellhead equipment and flowlines are also removed during plugging and reclamation. Based on site history and conditions, refuge staff would conduct a more thorough testing for contamination at each site. If contamination is found, subsequent steps would be taken to remove or neutralize contaminating substances. As a result, there would be long-term beneficial effects on water resources once reclamation is complete.

IMPACTS OF ALTERNATIVES ON WATER RESOURCES

Purpose and Scope

The purpose of the regulation in all alternatives is to ensure that non-Federal oil and gas operations conducted on NWRS lands and waters avoid or minimize, to the greatest extent practicable, adverse effects on water resources.

Under Alternative A, the Service scope of application of its regulation and policy provides protection of water resources on Service fee title lands.

Alternative B, the proposed rule, would expand the area of regulatory application to include tracts where the Federal interest is less than fee (e.g., wetland or grassland easements). As a result of active regulation by the Service, water resources associated with interests acquired on easements would have a consistent and higher level of protection compared to Alternative A.

Alternative C would expand the scope of regulation to operations conducted on non-Federal surface locations drilling under a refuge or any operation on private land within a refuge (i.e., an inholding). The level of increased protection for water resources would vary from slight to moderate depending on the proximity of those operations to refuge boundaries, as well as State rules (and operator's compliance with those rules) in place that serve to reduce such impacts (e.g., spill control and cleanup requirements, erosion control).

Accessing Oil and Gas Rights from a Non-Federal Surface Location

Under Alternative A the incentive for operators to locate their operations outside refuge units would remain in place as described at the beginning of this chapter. The location of surface operations outside refuge boundaries avoids direct impacts to water resources within the refuge. However, wells directionally drilled and produced from outside refuges to bottomholes beneath the refuge would directly impact water resources on adjacent lands as well as present a risk of indirect impacts within the refuges. Under current regulations, the Service cannot impose preventative measures such as mitigation. The risk and intensity of indirect impacts on refuge resources would increase for operations sited closer to refuge boundaries where water and sediment could be transported downslope into a refuge through streams, gullies, or overland flow. Intensity of impacts on refuge resources would depend on proximity of operations to the refuge units; site-specific environmental conditions, such as steepness and direction of slope and surface hydrology; and mitigation measures.

Alternative B provides an even greater incentive for operators to locate their operations outside refuges since the proposed rule includes provisions for maintaining financial assurance, access fees, and cost recovery, among others. So, as the operator's costs of operating on NWRS lands increase, so does the incentive to avoid those costs. Therefore, it is likely that impacts to water resources from new production and drilling operations within refuges would be avoided to a greater extent than in Alternative A. Impacts on water resources from those wells located on non-Federal surface locations would be same as Alternative A.

Under Alternative C, directional drilling operations on non-Federal surface locations would be subject to the full regulatory requirements of the proposed rule. The Service would impose operational standards on activities outside the refuge to the extent necessary to avoid or minimize impacts on refuge resources and uses. Operational standards would reduce water and sediment transport downslope into refuge units through streams, gullies, or overland flow and thus impacts to water resources within the refuge boundary.

However, application of regulation to surface and subsurface operations outside a refuge would largely remove an operator's incentive to avoid surface use in a refuge, so the number of drilling and production operations located on refuges would likely increase. Therefore, compared to Alternatives A and B, Alternative C would increase the instances where new drilling operations create direct, adverse, and long-term impacts to refuge water resources.

Requirement to Obtain a Service Permit to Conduct Operations

Under Alternative A, the Service would continue to work to ensure new operations are under a Service-issued SUP or ROW, which would reduce the impacts of geophysical operations and new drilling and production operations. When an operator obtains a Service permit prior to conducting operations, it provides additional protection for water resources. The permitting process ensures ongoing communication between Refuge staff and the operator; that an operator includes mitigation measures to avoid or minimize impacts to refuge resources and uses; and that an operator is aware of expectations to reclaim a site to restore refuge resources and ensure long term protection of refuge resources and uses. However, the permit requirement itself has not been consistent across the Service; where permits have been issued, the permit conditions have varied widely resulting in the possibility of unnecessary impacts to water resources.

Under Alternative A, there would be unnecessary impacts on water resources from the estimated 4,000 pre-existing oil and gas production operations not under an SUP or ROW, including those described above under Typical Impacts of Oil and Gas Operations on Water Resources. The Service estimates that the 4,000 pre-existing wells in 107 refuges have created approximately 6,000 acres of direct disturbance associated with well sites and access roads. Direct surface disturbances from well pads and roads in refuges range from 1 to 6 acres with the average area of disturbance estimated at approximately 1.5 acres per operation.

The primary effects on water resources from oil and gas operations include soil erosion and sedimentation associated with disturbed areas, and possible water contamination from leaks and spills, leading to adverse impacts on water quality. As previously discussed, most of the impacts to water resources occurred when the operation was originally chosen and developed by the operator to accommodate their drilling and production operations.

However, some continuing unnecessary impacts may occur under Alternative A due to the lack of any requirement that these pre-existing operations have ongoing mitigation measures to protect water resources and the fact the Service does not currently have a way to ensure operations are complying with any State laws that would protect water resources. Typical mitigation measures that would minimize ongoing impacts from pre-existing operations on water could include removal of contaminated soils, effective erosion control, proper secondary containment around storage tanks, regular pump jack maintenance, siting operations a minimum distance from surface waters, and removal of debris, waste, and equipment no longer needed in operations.

Under Alternative B, all new operations would be under a consistent permitting process that would include required consultation with the Service, performance-based standards to avoid or minimize impacts to water resources, and other administrative provisions such as financial assurance, cost recovery, and access fees that would ensure protection of water resources from the typical impacts of oil and gas development to the greatest extent practicable.

Similar to Alternative A, pre-existing operations would not be required to obtain an operations permit during the production phase. However, in contrast to Alternative A, the Service would manage these operations by assimilating State laws and regulations into the rule, thereby increasing the Service's enforcement ability on refuge lands. So, during the production phase, impacts to water resources would be reduced compared to Alternative A due to improved compliance with State rules that serve to lower such impacts, such as State rules addressing pit closure as well as the removal of oil-contaminated soil from tank battery sites to protect soils and water, and clean-up standards for soils contaminated by oil spills (GWPC 2014; La. Admin. Code tit. 43, Part XIX, §503). Overall, the Service expects that the large majority of issues related to impacts on water resources would be resolved by compliance with State laws and regulations.

Additionally, under Alternative B, all operations, including pre-existing operations, would be required to have a Service-issued permit for reclamation that would ensure all operations meet the Service's reclamation standards, which would also greatly reduce any long-term impacts on refuge water resources as discussed further below in "Performance-Based Standards".

Assimilation of State laws and regulations during the production phase combined with reclamation to Service standards ensures a substantial and consistent long-term benefit to water resources compared to Alternative A.

Alternative C would require all operators on refuges to obtain a permit for their operations, including pre-existing operations. Compared to the proposed rule, Alternative C may provide additional protections for water resources from impacts associated with pre-existing operations. Since the greatest impacts to water resources have already occurred, the Service would be focusing on maintenance issues, such as erosion control, spill containment and remediation, and removal of debris, waste, and equipment no longer needed in operations, in those cases where State laws and regulations do not meet Service operating standards. Alternative C would also require operations on inholdings and those directionally drilling underneath a refuge from non-Federal surface locations to obtain a permit to the extent necessary to protect refuge water resources. In most cases, since the activity is occurring directly on private surface estate, the Service would not identify operational measures to protect water resources on adjacent Federal surface estate. Thus, for these operations, the impacts on water resources would be similar to Alternative B.

Performance-Based Standards

Under Alternative A, oil and gas operations would be managed on an individual unit basis, with protective stipulations developed in a site-specific manner. New operations would be subject to operating practices, as defined in SUPs or ROWs, that serve to minimize or avoid impacts on water resources. These could include erosion control measures and spill prevention and control equipment and practices; however, the operating practices included in the SUPs or ROWs are usually negotiated between the refuge manager and the oil operator. Thus, the levels of protection may vary somewhat from permit to permit and by refuge as the existing regulations do not provide specific operating standards for the protection of refuge resources. The level of monitoring and cooperation with operators to address impacts on refuge resources and uses would continue to vary widely, resulting in unnecessary impacts to water resources. For the 4,000 pre-existing operations, reclamation is conducted without regard for Service goals or only to the extent a refuge manager is able to negotiate to have reclamation goals addressed. Reclamation for these wells often falls short of Service reclamation standards.

Under Alternatives B and C, the proposed rule establishes performance-based standards for avoiding or minimizing impacts to water resources. All new operations on NWRS lands and waters would be subject to consistent standards and requirements of the proposed rule for protecting water resources. As previously discussed, new operations create the greatest additional impacts on water, so establishing performance-based standards that would include proper site planning, timing restrictions and the best management practices to avoid or minimize many of the typical impacts to water resources from oil and gas development**.** Also, the proposed rule includes additional standards that would protect water resources, such as designing, constructing, operating, and maintaining access to the operational site to cause the minimum amount of surface disturbance needed to safely conduct operations.

Additionally, under the proposed rule operators on easements would be required to comply with these standards to the extent necessary to protect that easement interest. This would likely include protections for water resources on these easements (e.g., ponds and marshes on wetland easements, or ephemeral streams on grassland easements).

The proposed rule also includes standards for achieving successful surface reclamation once operations end. All operations, including pre-existing operations, would have to meet Service reclamation standards, such as plugging all wells, removing all above-ground structures, equipment, roads, well pads, and contaminating substances, re-establishing native vegetation, restoring conditions to pre-disturbance hydrologic functions, and restoring natural systems using native soil material that would indirectly reduce impacts to water resources within the refuge units. Therefore, eventually, the disturbance associated with the 4,000 pre-existing wells would be restored to Service standards, providing a substantial long-term reduction or removal of adverse impacts on water resources compared to Alternative A

Under Alternative C, pre-existing operations would be required to abide by the performance-based standards established under the proposed rule during the production phase. Compared to the proposed rule, Alternative C may provide for implementation of higher standards for protection of water resources. Since the greatest impacts to water resources have already occurred, the Service would be focusing on maintenance issues, such as erosion control, removal or remediation of contaminated soils, removal of debris, waste, and equipment no longer needed in operations, in those cases where State laws and regulations do not meet Service operating standards.

Also, operations on inholdings and operations on non-Federal surfaces directionally drilling underneath a refuge would be subject to the performance-based standards established in the proposed rule to the extent necessary to protect refuge water resources. The level of increased protection would vary from slight to moderate depending on State rules in place that serve to reduce such impacts (e.g., spill control and cleanup requirements, erosion control), and the proximity of the surface location of operations on non-Federal surfaces to the refuge and the presence of pathways (e.g., waters that may be hydrologically connected to waters within a refuge).

Finally, under Alternative C, performance-based standards would also be established for downhole operations. Water resources would only be impacted by accidents associated with well control. Given present day technology, events that result in loss of well control (blowouts) are extremely rare. Service regulation could possibly serve to lower an already low risk of a well blowout, but in practice, the Service finds that State requirements for well control and the expectation that companies will act in their own best interest would preclude the need for the Service to regulate aspects of drilling and production related to well control. Thus, the Service does not expect any reduction of impacts or risks of impacts to water resources related to our downhole regulation under Alternative C.

Cumulative Impacts of Alternative A: No-Action

Actions inside and outside the refuge units and local trends in oil and gas development can cumulatively affect water resources of the refuges. Management planning, such as fire management, vegetation management, and ORV plans, can result in greater protection for these resources. Conversely, actions that cause disturbance of these resources would include activities such as prescribed burns, ORV use, mining, agricultural and logging activities, as well as any general development activities that include excavation, grading, or construction. Past, present, and reasonably foreseeable activities that would have beneficial or adverse impacts on water resources in the area of analysis (including both refuge lands and adjacent lands) and a brief summary of the cumulative impacts of these actions on water resources are listed in Table 4-4.

TABLE 4-4. CUMULATIVE IMPACTS ON WATER RESOURCES (PROGRAMMATIC LEVEL FOR REFUGE UNITS)

Past, Present, and Reasonably Foreseeable Activity	Impacts on Water Resources
Prescribed fires and fire management actions	Short-term and long-term adverse effects on surface waters from erosion and sedimentation from burned sites and sites disturbed by fire line construction. Long-term beneficial effects of reduced fire occurrences with managed burns that reduce the possibility of catastrophic and high intensity fire and thereby improve vegetation cover and reduce runoff.
Service facility and road construction	Possible short-term and long-term adverse effects on surface waters from site runoff, although would be minimized with proposer erosion and sedimentation control measures.
Vegetation management	Long-term beneficial effects of erosion control from improved vegetative cover, which hold soils in place and reduce sedimentation in nearby water bodies.
Off refuge industrial discharges	Discharges of a variety of pollutants to receiving streams that can enter refuges.
ORV use	Short- and long-term adverse effects on surface waters if affected by runoff from compacted and eroded surface following vehicle-related disturbances to the soil surface.
Abandoned mine lands reclamation	Long-term beneficial effects of reduced erosion/runoff of contaminants to adjacent streams following re-establishment of vegetation cover; improvements to water quality through control and treatment of water discharges.
Mining and logging activities	Long-term adverse effects on surface waters from erosion and sedimentation stemming from legacy surface disturbances and vegetation removal and long-term effects of acid mine drainage.
Ranching, agricultural land uses	Short- and long-term adverse effects from operations that remove vegetation cover, compact soils, create ruts that increase potential for increased runoff to surface waters containing sediments, pesticides, and nutrients (fertilizers).

Past, Present, and Reasonably Foreseeable Activity	Impacts on Water Resources
Land development: residential and nonresidential (commercial, industrial) land uses, including road construction	Short- and long-term adverse effects from compaction, erosion and sedimentation following construction-related disturbances, non point pollution from fertilizers, oils, chemicals used in lawn and grounds maintenance, plus continuing discharges to groundwater from septic systems and to surface waters from runoff containing pesticides and fertilizers.
Future oil and gas development on adjacent lands	Indirect adverse impacts on refuge waters from “spill-over effects” of sedimentation and contamination from surface runoff from nearby sites; possible contamination of groundwater resources from improperly designed or installed wellbores; trends indicate that the exploration and production of shale gas, in particular, is anticipated to increase dramatically over the next 30 years.
Oil and gas well plugging and reclamation activities inside and outside refuges	Long-term beneficial effects of restoration of natural contours, topsoil and vegetation cover that minimizes surface runoff and removes sources of contamination and contaminated soils.

Alternative B would contribute to cumulative impacts from the continued operations of pre-existing operations not under an SUP or ROW, which would continue to have long-term direct adverse impacts on water resources, as described in the above analysis. On the other hand, bringing new operations and the reclamation phase of pre-existing operations under regulation would add substantial beneficial impacts on water resources. When combined with the effects of all other actions in the study area, cumulative impacts from the actions under Alternative B would be long term and both adverse and beneficial, with Alternative B contributing mainly beneficial impacts on overall cumulative impacts from the change in regulations.

Under Alternative C, similar to Alternative B, there would be effects on water resources as a result of oil and gas operations that would continue to affect water resources where impacts cannot be avoided, and benefits from bringing new operations and the reclamation phase of pre-existing operations under regulation and the resultant reduction in adverse impacts, as described in the Alternative B analysis. Alternative C would contribute to cumulative impacts mostly by adding beneficial impacts of bringing new operations and all phases of pre-existing operations under regulation, but also by possibly adding adverse impacts from the change in directional drilling regulations that could result in more oil and gas development within refuge units as opposed to outside refuge boundaries. Overall under Alternative C, both adverse and beneficial cumulative impacts would accrue from projects, plans, and actions considered in the cumulative scenario. When combined with the effects of all other actions in the study area, cumulative impacts would be long term and both adverse and beneficial.

WETLANDS

METHODOLOGY

Potential impacts on wetlands are assessed based on the actions being proposed and characteristics of the wetland resources in refuges, and disturbance to unique features that may be affected. Resource-specific context for assessing impacts of the alternatives on wetland resources includes the following:

- Disturbance or loss of wetland vegetation caused by the oil/gas development.
- Uniqueness of wetland functions and values (groundwater recharge, stormwater storage and discharge, unique habitats, etc.) that are intrinsic to wetlands and cannot be easily duplicated or replaced.
- Quality of the particular wetland being impacted related to the functions and values performed by that wetland and their ability to recover.

TYPICAL IMPACTS OF OIL AND GAS OPERATIONS ON WETLANDS

Overall impacts on wetlands would include changes to wetland functions and values, impacts on rare and unique wetland communities; changes to hydrology; impacts on water quality from runoff and sedimentation; stormwater impacts; changes to the abundance and diversity of wetland plant species and wildlife use; the size and type of wetland affected; the area of disturbance; and wetland connectivity to adjacent habitats. Although soil, water, vegetation, and floodplain resources are addressed as separate topics in this EIS, they are also mentioned here because wetland areas often coincide with these other sensitive and ecologically important resources. For all phases of development, impacts to wetlands would be avoided, mitigated, or compensated for under Federal regulations, executive order directives, and Service policy.

Impacts from Geophysical Exploration

During the geophysical exploration phase, adverse impacts on wetland communities can result from localized vegetation clearing, ground disturbance, and crossing of small wetlands and would depend on the type of survey done, the equipment and vehicles used, the type of vegetation, and the season of the year. Vegetation clearing and trimming for surveying and increased vehicular traffic associated with seismic investigations would be minimized to the extent possible. Vegetation trimmed during line placement would be minimal and expected to recover over the short term. The introduction or spread of nonnative invasive vegetation could occur during this phase as a result of vehicular traffic, but this would be relatively limited in extent during this phase.

Leaks and spills from refueling vehicles used in the surveys could pollute soil and water, and harm or kill vegetation. Surface disturbance from survey crews traversing the area during geophysical exploration could cause localized soil compaction and rutting and damage to vegetation. Soil Hydrologic Groups C and D typically found in lowland areas (wetlands and floodplains) are very susceptible to adverse impacts from oil and gas operations. In general, these soils have high clay contents, low permeability, are moderately to highly compactable, and have low infiltration rates and recharge potentials (NRCS 2007). Wet or saturated soils are the most sensitive to disturbance from vehicle use. As described in Geology and Soils, compaction reduces the soil’s water-holding and infiltration capacities which could increase runoff of surface waters and accelerate soil erosion (Duiker 2004; Pennsylvania State University 2009) and ultimately degrade existing soil and wetland communities. Disturbance of existing unpaved surfaces and resultant road runoff or the crossing of small areas of wetlands along tributary streams may also affect surface water and wetland resources. Where soils are compacted or rutted, surface hydrology and plant growth could be altered (DeJong-Hughes et al. 2001, McBroom et al. 2012).

The majority of impacts associated with these surveys are limited in extent and severity, because of the temporary nature of the disturbance and localized area disturbed by survey crews.

Impacts of Well Drilling and Production

In areas where drilling and production operations would be permitted, the construction and maintenance of roads, well pads, flowlines, and pipelines in or adjacent to wetlands could require the placement of fill material, removal of vegetation, and disruption of soils and surface hydrology, which would alter beneficial wetland functions and values. Under Federal regulations, executive order, and/or Service policy, impacts to wetlands would be avoided, mitigated, or compensated for, but impacts could still occur. The types of impacts on wetlands associated with drilling and production could include not only the visible loss of vegetation and disruption to soils, but the effects on the functions and values of the wetland community. Wetland functions that may be affected include surface water storage; shoreline stabilization; stream flow maintenance; groundwater recharge; sediment removal and nutrient cycling; aquatic productivity support; and provision of plant and wildlife habitat.

The degree to which a given wetland and its functions are impaired depends on a number of factors, including wetland type (e.g., wet meadow versus forested), landscape position (riverine versus wet meadow), level of impairment or impact, and success of restoration efforts (FERC 2004, DeJong-Hughes et al. 2001, McBroom et al. 2012). Different wetland types have different levels of importance and performance for these various functions, and site-specific functions and values would be assessed and included in the development of mitigation plans for any wetland disturbance that triggers Clean Water Act Section 404 permitting.

During site preparation, impacts on wetlands occur as a result of vegetation clearing, grading, cutting, filling, and leveling of the site using heavy construction equipment. Use of smaller, light-weight, or other low-impact vehicles as well as timber or artificial mats would reduce impacts on soil and wetland resources and protect wetland functions such as shoreline stabilization, groundwater recharge, and plant and wildlife habitat. During drilling and production, the construction, maintenance, and use of access roads, well pads, flowlines, and pipelines could cause soil compaction and rutting, thereby degrading wetland function through reducing the soil's water-holding and infiltration capacities (Duiker 2004). This would in turn reduce the root penetration capabilities of vegetation and hinder plant growth and affect wetland function. Compaction and rutting of existing unpaved surfaces and resultant road runoff or the crossing of small areas of wetlands along tributary streams may also affect wetland functions by altering surface hydrology and degrading plant communities and potential wildlife habitat (DeJong-Hughes et al. 2001, McBroom et al. 2012).

In addition to construction-related impacts associated with development of access roads and well pads, there is a risk of impact on wetlands from releases of hazardous or contaminating substances during drilling or production operations. These releases could occur from leaking equipment. As described in Geology and Soils, the unintentional or accidental release of hazardous or contaminated materials also includes the risk of release of drilling mud, and contamination from the release of produced waters containing salts, NORM, hydrocarbons and other well drilling fluids could also impact wetland vegetation in the refuge units. These substances may contain relatively large concentrations of dissolved salts, particularly sodium chloride, and can have salt concentrations greater than ocean water (Vavrek et al. 2004).

Salt stress is the major environmental factor that affects all vital plant processes such as growth, photosynthesis, protein synthesis, energy and lipid metabolism, and productivity (Parida and Das 2005). Instances of leaks from salt-water disposal wells and subsequent contamination occurring as the result of mechanical problems and improper operating practices have been documented at

Hagerman and Aransas NWRs and the Anderson WPA (M. Maddux and M. Borgreen, pers. comm.). Oilfield brine spills can increase the bioavailability of some heavy metals as well as destroy the soil structure resulting in the significant reduction of infiltration rates(Vavrek et al. 2004). These brine impacted soils are usually devoid of vegetation and are susceptible to erosion. The loss of infiltration will result in increased runoff with impacts to nearby wetlands in terms of salinity, and siltation. Impacts to the soils and wetlands from oilfield brine spills remain for years (Vavrek et al. 2004).

Release of drilling muds, hydrocarbons, produced waters, or treatment chemicals could occur during drilling, production, or transport, with notable adverse impacts.

The types of impacts related to wetland resources for directionally drilled wells are expected to be similar to those described for operations inside the refuge units; however, direct impacts to wetlands in refuge units would not occur. The risk of indirect impacts and their intensity would vary with the location of the well with respect to the refuge boundary and direction of surface runoff. The risk of impacts on refuge resources would be greater for directionally drilled operations sited closer to refuge boundaries with surface gradients toward the refuge, where water and sediment can be transported downslope into refuge unit wetlands through adjacent streams, gullies, or overland flow. Severity of impacts would depend on proximity of operations to the refuge units; type of construction; site-specific environmental conditions, such as steepness and direction of slope and surface hydrology; sensitivity of resources; and mitigation measures being employed.

Impacts of Plugging and Reclamation

When drilling and production operations end, well plugging and surface reclamation results in overall beneficial impacts on wetlands if conduct of operations had impacted wetlands. Although damage and loss of vegetation and soil disturbance during ground disturbing equipment occurs from plugging actions, these disturbances are temporary. There are also beneficial effects on wetland functions and values once cleanup is successfully completed and the site is reclaimed to natural conditions and processes. Reclamation involves returning the topography of a site to approximate the original contours, and re-establishing natural wetlands communities. Allowing vegetation in disturbed areas to recover provides erosion control in areas of previous impacts from oil and gas operations.

Clearing vegetation from oil and gas access roads and well pads and the use of heavy equipment and vehicles would temporarily increase localized erosion potential, causing increased turbidity and sedimentation in waterways, and alter surface water flows. In addition, there is the potential for release of liquid hydrocarbons and/or contaminating or hazardous substances into wetlands from vehicles, wellhead equipment, or flowlines during well plugging and reclamation activities. These temporary activities could cause detectable, localized changes to wetlands for wells located near surface waters. However, sources of potential leakage from wellhead equipment and flowlines are removed during the plugging and reclamation phase, reducing the overall impact.

Recovery of wetland communities would be primarily dependent on location, site conditions, precipitation, and type of wetland community desired. Except for forested and scrub-shrub wetlands, which are slow to regenerate, most wetland communities in the refuge units would be expected to re-establish in a relatively short time. If access roads are not reclaimed, but continue to be used for other administrative purposes, adverse impacts on adjacent wetlands could occur if visitors travel off established routes. Despite this potential effect, restoration of native wetland communities associated with plugging and reclamation would ultimately have long-term beneficial impacts.

Impacts are based on the assumption that post-construction restoration efforts would be successful and no unforeseen conditions resulting from proposed oil and gas operations (e.g., potential spills) delay anticipated recovery rates. Note that a long-term or permanent effect or impact does not necessarily mean a permanent loss of wetlands habitat. For example conversion of scrub-shrub or forested wetlands to herbaceous wetlands is considered a permanent impact on those woody wetlands classes, but does not represent a complete loss of wetlands habitat; whereas a permanent wetlands loss would be a conversion of a wetland to an upland as a result of the construction of a well pad or access road.

In forested and scrub-shrub wetlands, the effects of plugging and reclamation would be longer term due to the longer period needed to regenerate a mature forest or shrub community. Scrub-shrub and forested wetlands that would be initially cleared (cut to ground surface) for oil and gas operations would be allowed to regrow over time following plugging and reclamation. This would be considered a long-term impact based on the slower growth rate of trees and shrubs, which may require decades for complete regeneration, if at all (Stanturf et al. 2001). Impacts on emergent wetlands affected within the refuge units would likely be short-term to long-term, with successful re-establishment within 3 to 5 years.

Reclaiming the well pads and access roads would have a beneficial impact on wetlands by reducing soil erosion and re-establishing surface drainage flows, once re-contouring and planting and establishment of native vegetation in disturbed areas is complete. As a result, there would be long-term beneficial effects on wetlands once reclamation is complete.

Indirect impacts on wetlands in the refuge units from reclamation of wells directionally drilled from outside the Service boundary to bottomholes beneath Service land could result in impacts similar to those described above for operations, but the intensity of impact would depend on proximity to the refuge unit, site-specific environmental conditions, and mitigation measures employed; therefore, impacts could range from no impact on wetlands, to localized or widespread short- to long-term adverse impacts.

IMPACTS OF ALTERNATIVES ON WETLANDS

Purpose and Scope

The purpose of the regulation in all alternatives is to ensure that non-Federal oil and gas operations conducted on NWRS lands and waters avoid or minimize, to the greatest extent practicable, adverse effects on wetland resources.

Under Alternative A, the Service scope of application of its regulation and policy provides protection of wetland resources on Service fee title lands.

Alternative B, the proposed rule, would expand the area of regulatory application to include tracts where the Federal interest is less than fee (e.g., wetland or grassland easements). As a result of active regulation by the Service, wetland resources associated with interests acquired on easements would have a consistent and higher level of protection compared to Alternative A.

Alternative C would expand the scope of regulation to operations conducted on non-Federal surface locations drilling under a refuge or any operation on private land within a refuge (i.e., an inholding). The level of increased protection for wetland resources would vary from slight to moderate depending on the proximity of those operations to refuge boundaries, as well as State rules (and operator's compliance with those rules) in place that serve to reduce such impacts (e.g., spill control and cleanup requirements, erosion control).

Accessing Oil and Gas Rights from a Non-Federal Surface Location

Under Alternative A the incentive for operators to locate their operations outside refuge units would remain in place as described at the beginning of this chapter. The location of surface operations outside refuge units avoids direct impacts to wetlands within the refuge. However, wells directionally drilled and produced from outside refuges to bottomholes beneath the refuge would directly impact wetlands on adjacent lands as well as present a risk of indirect impacts within the refuges. Under current regulations, the Service cannot impose preventative measures such as mitigation. The risk and intensity of indirect impacts on refuge resources would increase for operations sited closer to refuge boundaries where water and sediment could be transported downslope into a refuge through streams, gullies, or overland flow. Intensity of impacts on refuge resources would depend on proximity of operations to the refuge units; site-specific environmental conditions, such as steepness and direction of slope and surface hydrology; and mitigation measures.

Alternative B provides an even greater incentive for operators to locate their operations outside refuges since the proposed rule includes provisions for maintaining financial assurance, access fees, and cost recovery, among others. So, as the operator's costs of operating on NWRS lands increase, so does the incentive to avoid those costs. Therefore, it is likely that impacts to wetlands from new production and drilling operations within refuges would be avoided to a greater extent than in Alternative A. Impacts on wetlands from those wells located on non-Federal surface locations would be same as Alternative A.

Under Alternative C, directional drilling operations on non-Federal surface locations would be subject to the full regulatory requirements of the proposed rule. The Service would impose operational standards on activities outside the refuge to the extent necessary to avoid or minimize impacts on refuge resources and uses. Operational standards would reduce water and sediment transport downslope into refuge units through streams, gullies, or overland flow and thus impacts to wetlands within the refuge boundary.

However, application of regulation to surface and subsurface operations outside a refuge would largely remove an operator's incentive to avoid surface use in a refuge, so the number of drilling and production operations located on refuges would likely increase. Therefore, compared to Alternatives A and B, Alternative C would increase the instances where new drilling operations create direct, adverse, and long-term impacts to refuge wetlands.

Requirement to Obtain a Service Permit to Conduct Operations

Under Alternative A, the Service would continue to work to ensure new operations are under a Service-issued SUP or ROW, which would reduce the impacts of geophysical operations and new drilling and production operations. When an operator obtains a Service permit prior to conducting operations it provides additional protection for wetland resources. The permitting process ensures ongoing communication between Refuge staff and the operator; that an operator includes mitigation measures to avoid or minimize impacts to refuge resources and uses; and that an operator is aware of expectations to reclaim a site to restore refuge resources and ensure long term protection of refuge resources and uses. However, the permit requirement itself has not been consistent across the Service; where permits have been issued, the permit conditions have varied widely resulting in the possibility of unnecessary impacts to wetland resources.

Under Alternative A, there would be unnecessary impacts on wetland resources from the estimated 4,000 pre-existing oil and gas production operations not under an SUP or ROW, including those described above under Typical Impacts of Oil and Gas Operations on Wetland Resources. The Service estimates that the 4,000 pre-existing wells in 107 refuges have created approximately 6,000 acres of direct disturbance associated with well sites and access roads. Direct surface disturbances from well pads and roads in refuges range from 1 to 6 acres with the average area of disturbance estimated at approximately 1.5 acres per operation.

The primary effects on wetland resources from oil and gas operations include soil erosion and sedimentation associated with disturbed areas, and possible wetland contamination from leaks and spills, leading to adverse impacts on wetland and sediment quality in wetlands. As previously discussed, most of the impacts to wetland resources occurred when the operation was originally chosen and developed by the operator to accommodate their drilling and production operations.

However, some continuing unnecessary impacts may occur under Alternative A due to the lack of any requirement that these pre-existing operations have ongoing mitigation measures to protect wetland resources and the fact the Service does not currently have a way to ensure operations are complying with any State laws that would protect wetland resources. Typical mitigation measures that would minimize ongoing impacts from pre-existing operations on wetlands could include removal of contaminated soils, effective erosion control, proper secondary containment around storage tanks, regular pump jack maintenance, siting operations a minimum distance from wetlands, and removal of debris, waste, and equipment no longer needed in operations.

Under Alternative B, all new operations would be under a consistent permitting process that would include required consultation with the Service, performance-based standards to avoid or minimize impacts to wetland resources, and other administrative provisions such as financial assurance, cost recovery, and access fees that would ensure protection of wetland resources from the typical impacts of oil and gas development to the greatest extent practicable.

Similar to Alternative A, pre-existing operations would not be required to obtain an operations permit during the production phase. However, in contrast to Alternative A, the Service would manage these operations by assimilating State laws and regulations into the rule, thereby increasing the Service’s enforcement ability on refuge lands. So, during the production phase, impacts to wetland resources would be reduced compared to Alternative A due to improved compliance with State rules that serve to lower such impacts, such as State rules addressing pit closure as well as the removal of oil-contaminated soil from tank battery sites, and clean-up standards for areas contaminated by oil spills (GWPC 2014; La. Admin. Code tit. 43, Part XIX, §503). Overall, the Service expects that the large majority of issues related to impacts on wetland resources would be resolved by compliance with State laws and regulations.

Additionally, under Alternative B, all operations, including pre-existing operations, would be required to have a Service-issued permit for reclamation that would ensure all operations meet the Service’s reclamation standards, which would also greatly reduce any long-term impacts on refuge wetland resources as discussed further below in Performance-Based Standards.

Assimilation of State laws and regulations during the production phase combined with reclamation to Service standards ensures a substantial and consistent long-term benefit to wetland resources compared to Alternative A.

Alternative C would require all operators on refuges to obtain a permit for their operations, including pre-existing operations. Compared to the proposed rule, Alternative C may provide additional protections for wetland resources from impacts associated with pre-existing operations. Since the greatest impacts to wetland resources have already occurred, the Service would be focusing on maintenance issues, such as erosion control, spill containment and remediation, and removal of debris, waste, and equipment no longer needed in operations, in those cases where State laws and regulations do not meet Service operating standards. Alternative C would also require operations on inholdings and those directionally drilling underneath a refuge from non-Federal surface locations to obtain a permit to the extent necessary to protect refuge wetland resources. In most cases, since the activity is occurring directly on private surface estate, the Service would not identify operational measures to protect wetland resources on adjacent Federal surface estate. Thus, for these operations, the impacts on wetland resources would be similar to Alternative B.

Performance-Based Standards

Under Alternative A, oil and gas operations would be managed on an individual unit basis, with protective stipulations developed in a site-specific manner. New operations would be subject to operating practices, as defined in SUPs or ROWs, that serve to minimize or avoid impacts on wetland resources. These could include erosion control measures and spill prevention and control equipment and practices; however, the operating practices included in the SUPs or ROWs are usually negotiated between the refuge manager and the oil operator. Thus, the levels of protection may vary somewhat from permit to permit and by refuge as the existing regulations do not provide specific operating standards for the protection of refuge resources. The level of monitoring and cooperation with operators to address impacts on refuge resources and uses would continue to vary widely, resulting in unnecessary impacts to wetland resources. For the 4,000 pre-existing operations, reclamation is conducted without regard for Service goals or only to the extent a refuge manager is able to negotiate to have reclamation goals addressed. Reclamation for these wells often falls short of Service reclamation standards.

Under Alternatives B and C, the proposed rule establishes performance-based standards for avoiding or minimizing impacts to wetland resources. All new operations on NWRS lands and waters would be subject to consistent standards and requirements of the proposed rule for protecting wetland resources. As previously discussed, new operations create the greatest additional impacts on wetlands, so establishing performance-based standards that would include proper site planning, timing restrictions, and best management practices to avoid or minimize many of the typical impacts to wetland resources from oil and gas development. Also, the proposed rule includes additional standards that would protect wetland resources, such as designing, constructing, operating, and maintaining access to the operational site to cause the minimum amount of surface disturbance needed to safely conduct operations.

Additionally, under the proposed rule operators on easements would be required to comply with these standards to the extent necessary to protect that easement interest. This would likely include protections for wetland resources on these easements (e.g., ponds and marshes on wetland easements, or ephemeral streams on grassland easements).

The proposed rule also includes standards for achieving successful surface reclamation once operations end. All operations, including pre-existing operations, would have to meet Service reclamation standards, such as plugging all wells, removing all above-ground structures, equipment, roads, well pads, and contaminating substances, re-establishing native vegetation, restoring conditions to predisturbance hydrologic functions, and restoring natural systems using native soil material that would indirectly reduce impacts to wetland resources within the refuge units. Therefore, eventually, the disturbance associated with the 4,000 pre-existing wells would be restored to Service standards, providing a substantial long-term reduction or removal of adverse impacts on wetland resources compared to Alternative A.

Under Alternative C, pre-existing operations would be required to abide by the performance-based standards established under the proposed rule during the production phase. Compared to the proposed rule, Alternative C may provide for implementation of higher standards for protection of wetland resources. Since the greatest impacts to wetland resources have already occurred, the Service would be focusing on maintenance issues, such as erosion control, removal or remediation of contaminated soils, removal of debris, waste, and equipment no longer needed in operations, in those cases where State laws and regulations do not meet Service operating standards.

Also, operations on inholdings and operations on non-Federal surfaces directionally drilling underneath a refuge would be subject to the performance-based standards established in the proposed rule to the extent necessary to protect refuge wetland resources. The level of increased protection would vary from slight to moderate depending on State rules in place that serve to reduce such impacts (e.g., spill control and cleanup requirements, erosion control), and the proximity of the surface location of operations on non-Federal surfaces to the refuge and the presence of pathways (e.g., waters that may be hydrologically connected to wetlands within a refuge).

Finally, under Alternative C, performance-based standards would also be established for downhole operations. Wetland resources would only be impacted by accidents associated with well control. Given present day technology, events that result in loss of well control (blowouts) are extremely rare. Service regulation could possibly serve to lower an already low risk of a well blowout, but in practice, the Service finds that State requirements for well control and the expectation that companies will act in their own best interest would preclude the need for the Service to regulate aspects of drilling and production related to well control. Thus, the Service does not expect any reduction of impacts or risks of impacts to wetland resources related to our downhole regulation under Alternative C.

Cumulative Impacts of Alternative A: No-Action

Actions inside and outside the refuge units and local trends in oil and gas development can cumulatively affect wetland resources. Management planning, such as fire management, vegetation management, and ORV plans, can result in greater protection for these resources. Conversely, actions that cause disturbance of these resources would include activities such as prescribed burns, ORV use, mining, agricultural and logging activities, as well as any general development activities that include excavation, grading, or construction. Past, present, and reasonably foreseeable activities that would have beneficial or adverse impacts on wetland resources in the area of analysis (including both refuge lands and adjacent lands) and a brief summary of the cumulative impacts of these actions on wetlands are listed in Table 4-5.

TABLE 4-5. CUMULATIVE IMPACTS ON WETLANDS (PROGRAMMATIC LEVEL FOR REFUGES)

Past, Present, and Reasonably Foreseeable Activity	Impacts on Wetlands
Prescribed fires and	Short-term and long-term adverse effects on wetland function and values from loss of

Past, Present, and Reasonably Foreseeable Activity	Impacts on Wetlands
fire management actions	productivity following removal of vegetation that may be preventing erosion and sedimentation; short- and long-term impacts from fire line construction that requires digging and displacement of soils and loss of organic matter from burning of surface litter and topsoil and altered hydrology. Long-term beneficial effects of reduced fire occurrences with managed burns that reduce the possibility of catastrophic and high intensity fire; improved productivity and erosion control from vegetative cover that is established after these treatments.
Service facility and road construction	Short-term and long-term adverse effects on wetland function and values from direct loss of soils and vegetation when removed for development, altered hydrology, and compaction and rutting of soils during road grading and construction using heavy equipment; increased road runoff and crossing of small areas of floodplains along tributary streams.
Vegetation management	Long-term beneficial effects of erosion control from improved vegetative cover, which hold soils in place. 500-foot setbacks and use of buffers for workspaces and siting.
Trails development and maintenance	Short-term and long-term adverse effects on wetland function and values from compaction and rutting during clearing, grading and surfacing of trails, and removal of vegetation in trail footprint, altered hydrology.
ORV use	Short- and long-term adverse effects on wetland function and values from compaction and rutting, erosion and sedimentation following vehicle-related disturbances to surfaces; altered hydrology.
Abandoned mine lands reclamation	Short-term adverse effects on wetland function and values from compaction and rutting during reclamation-related disturbances; altered hydrology. Long-term beneficial effects of improved surface (revegetation) and reduced erosion following re-establishment of natural contours and wetland restoration.
Mining and logging activities	Long-term adverse effects on wetland function and values from erosion stemming from legacy surface disturbances and vegetation removal and long-term effects of acid mine drainage on wetland function and values (degradation).
Recreational use	Short- and long-term adverse effects on wetland function and values from visitor activities including trampling and associated compaction and rutting. Long-term beneficial effects on wetland-dependent wildlife viewing and aesthetics.
Ranching, agricultural land uses	Short- and long-term adverse effects from operations that remove vegetation cover, compact soils, create ruts that increase potential for erosion.
Land development: residential and nonresidential (commercial, industrial) land uses, including road construction	Short- and long-term adverse effects on wetland function and values from direct loss of soils and vegetation in development footprint and compaction, rutting, erosion and sedimentation following construction-related disturbances; altered hydrology. Many private developments may not undergo rigorous regulatory oversight or permitting and have more impacts on wetlands, especially small, isolated wetlands.
Future oil and gas development on adjacent lands	Direct effects on wetlands on adjacent property and indirect adverse impacts on wetlands soils from “spill-over effects” of sedimentation and contamination from surface runoff; possible severe adverse impacts in the unlikely event of a well blowout, fire, or major release; trends indicate that the exploration and production of shale gas, in particular, is anticipated to increase dramatically over the next 30 years.

Past, Present, and Reasonably Foreseeable Activity	Impacts on Wetlands
Oil and gas well plugging and reclamation activities inside and outside refuges	Short-term adverse effects on wetland function and values from reclamation related disturbances due to use of equipment on site and grading. Long-term beneficial effects of restoration of natural contours and hydrology, topsoil and vegetation cover that protects soils from erosion; removal of sources of contamination and contaminated soils, wetland restoration.

Under all three alternatives, there would be adverse and beneficial cumulative impacts from projects, plans, actions, and trends in oil and gas development as discussed in the cumulative scenario above (Table 4-5).

Alternative B would contribute to cumulative impacts from the continued operations of pre-existing operations not under an SUP or ROW, which would continue to have long-term direct adverse impacts on wetlands, as described in the above analysis. On the other hand, bringing new operations and the reclamation phase of pre-existing operations under regulation would add substantial beneficial impacts on wetlands. When combined with the effects of all other actions in the study area, cumulative impacts from the actions under Alternative B would be long term and both adverse and beneficial, with Alternative B contributing mainly beneficial impacts on overall cumulative impacts from the change in regulations.

Under Alternative C, similar to Alternative B, there would be effects on wetlands as a result of oil and gas operations that would continue to affect wetlands where impacts cannot be avoided, and benefits from bringing new operations and the reclamation phase of pre-existing operations under regulation and the resultant reduction in adverse impacts, as described in the Alternative B analysis. Alternative C would contribute to cumulative impacts mostly by adding beneficial impacts of bringing new operations and all phases of pre-existing operations under regulation, but also by possibly adding adverse impacts from the change in directional drilling regulations that could result in more oil and gas development within refuge units as opposed to outside refuge boundaries. Overall under Alternative C, both adverse and beneficial cumulative impacts would accrue from projects, plans, and actions considered in the cumulative scenario. When combined with the effects of all other actions in the study area, cumulative impacts would be long term and both adverse and beneficial.

FLOODPLAINS

METHODOLOGY

Potential impacts on floodplains are assessed based on the actions being proposed and characteristics of the floodplains in refuges, and disturbance to unique features that may be affected. Resource-specific context for assessing impacts of the alternatives on floodplains includes the following:

- the susceptibility of soil types found in floodplains to disturbance (particularly high erosion or shrink/swell potential, compaction characteristics)
- the susceptibility of floodplains to contamination or other effects of oil and gas activities
- disturbance or loss of riparian vegetation caused by the oil/gas development
- the type and amount of disturbance (such as type and location of access roads and pads)

For the programmatic analysis, a qualitative analysis of the potential impacts of oil and gas operations on floodplains was conducted based on actual experience of the Service in management of non-Federal oil and gas operations and their effects on floodplains.

TYPICAL IMPACTS OF OIL AND GAS OPERATIONS ON FLOODPLAINS

Impacts from Geophysical Exploration

The primary impacts from geophysical exploration on floodplains are similar to those described for geology and soils, water resources, wetlands, and vegetation, and would be from the use of vehicles to transport equipment and personnel. Vehicles, if permitted to travel within the floodplains, could damage vegetation, reduce the soil's water-holding and infiltration capacities, increase compaction and rutting of soils, reduce the vegetation's root-penetration capabilities, and hinder plant growth and soil formation. Soil Hydrologic Groups C and D typically found in lowland areas (wetlands and floodplains) are very susceptible to adverse impacts from oil and gas operations. In general, these soils have high clay contents, low permeability, are moderately to highly compactable, and have low infiltration rates and recharge potentials. Wet or saturated soils are the most sensitive to disturbance from vehicle use. Exposed, compacted soils increase runoff of surface waters and accelerate soil erosion. Erosion of floodplain soils could increase turbidity and sedimentation in surface waters and wetlands.

In many areas of the refuge units, the use of vehicles for geophysical exploration operations would not meet a technologically feasible, least damaging standard, thereby eliminating the adverse impacts associated with their use. Drilling shotholes with a hand-held auger could be done in areas where vehicle access would cause damage and unnecessary loss of vegetation, or where soils would be damaged by vehicle use. The drilling of seismic shotholes is expected to have localized adverse impacts on floodplain resources. There could be small blowouts measuring up to several feet in diameter from the detonation of explosives in seismic shotholes.

During the geophysical exploration phase, adverse impacts on floodplains can also result from localized vegetation clearing, ground disturbance, and crossing of floodplains and small areas of tributary floodplains, and would depend on the type of survey done, the equipment and vehicles used, and the season of the year. As noted in Geology and Soils, compaction reduces the soil’s water-holding and infiltration capacities which could increase runoff of surface waters and accelerate soil erosion (Duiker 2004; Pennsylvania State University 2009) and ultimately degrade existing soil and floodplain resources. Disturbance of existing unpaved surfaces and resultant road runoff or the crossing of small areas of tributary floodplains may also affect floodplain resources. Where soils are compacted or rutted, surface hydrology and plant growth could be altered (DeJong-Hughes et al. 2001, McBroom et al. 2012). Leaks and spills from ORVs could damage vegetation, contaminate soils, and degrade surface and groundwater.

Impacts of Well Drilling and Production

Where drilling and production operations are permitted in floodplains, the construction and maintenance of access roads, well pads, flowlines, and pipelines could remove vegetation, expose soils to erosion and contamination, compact and rut soils, and introduce nonnative construction materials (i.e., gravel) and nonnative vegetation, reduce soil permeability, and introduce sediments in waterways. Impacts on floodplain resources would be short-term for construction activities and drilling operations and long-term for roads, production operations, and flowlines and pipelines.

During site preparation, impacts on floodplains occur as a result of vegetation clearing, grading, cutting, filling, and leveling of the site using heavy construction equipment. Use of timber mats would reduce impacts on soil and floodplain resources. During drilling and production, the construction, maintenance, and use of access roads, well pads, flowlines, and pipelines could cause soil compaction and rutting, thereby reducing the soil's water-holding and infiltration capacities. This would in turn reduce the root penetration capabilities of vegetation and hinder plant growth and affect floodplain function. Compaction and rutting of existing unpaved surfaces and resultant road runoff or the crossing of small areas of tributaries may also affect floodplains by altering surface hydrology and degrading plant communities and potential wildlife habitat (DeJong-Hughes et al. 2001, McBroom et al. 2012).

In addition to construction-related impacts associated with development of access roads and well pads, there is a risk of impact on floodplains from releases of hazardous or contaminating substances such as drilling muds, hydrocarbons, produced waters, or treatment chemicals, during drilling or production operations, or during the transportation of hydrocarbons. These releases could occur from leaking equipment or flowlines. As described in Geology and Soils, the risk of releases reaching more area of the well pad or offsite locations is greater for those wells that are not under an SUP or ROW permit because these wells are not required to have the more protective measures that are required under SUPs or ROWs. Wet or saturated soils are the most sensitive to disturbance from overland vehicle use. Exposed, compacted soils increase runoff of surface waters and accelerate soil erosion. Degradation of the floodplain function and value would result from erosion of floodplain soils resulting in increased turbidity and sedimentation in surface waters. Leaks and spills from ORVs crossing floodplains could harm or kill vegetation, and contaminate soils and surface and groundwater. Siting of drilling or production operations in a floodplain could also pose a safety hazard to oil and gas operator's workers and contractors, Service staff, and visitors due to the potential for soil instability and the potential for flooding events.

Indirect effects on floodplains may also result if sites are developed outside, but adjacent to, floodplains/riparian areas when lateral drainage is interrupted by road or well-site construction or increased erosion impacts the water quality of streams.

The types of impacts related to floodplain resources for directionally drilled wells are expected to be similar to those described for operations inside the refuge units. Direct impacts to floodplains within the refuges would be avoided, but the intensity of impacts on floodplains would vary with the location of the well and its proximity to a floodplain. Impacts on refuge resources would be greater for directionally drilled operations sited closer to refuge boundaries, where water and sediment can be transported downslope into refuge unit floodplains through adjacent streams, gullies, or overland flow. The degree of impacts on floodplains would depend proportionally on proximity of operations to the refuge units; type of construction; site-specific environmental conditions, such as steepness and direction of slope and surface hydrology; and mitigation measures being employed.

Impacts of Plugging and Reclamation

When drilling and production operations end, well plugging and surface reclamation results in overall beneficial impacts on floodplains. Well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could, however, increase soil erosion, alter surface water flows and hydrology, increase sedimentation in waterways, and contaminate soils, surface, and groundwater. Abandonment and reclamation could require cutting and clearing of vegetation. Reclamation involves returning the topography of a site to approximate the original contours, and re-establishing the natural floodplain. Allowing vegetation in disturbed areas to recover provides erosion control in areas of previous impacts from oil and gas operations.

Indirect impacts on floodplains in the refuge units from reclamation of wells directionally drilled from outside the refuge units to bottomholes beneath the refuge units could result in impacts similar to those described above for operations inside the refuge unit, but the intensity of impact would depend on proximity to the refuge unit, site-specific environmental conditions, and mitigation measures employed; therefore, adverse impacts could range from no impact on floodplains, to localized or widespread impacts that are short- to long-term in duration.

ALTERNATIVES COMPARISON OF IMPACTS TO FLOODPLAINS

Purpose and Scope

The purpose of the regulation in all alternatives is to ensure that non-Federal oil and gas operations conducted on NWRS lands and waters avoid or minimize, to the greatest extent practicable, adverse effects on floodplains.

Under Alternative A, the Service scope of application of its regulation and policy provides protection of floodplains on Service fee title lands.

Alternative B, the proposed rule, would expand the area of regulatory application to include tracts where the Federal interest is less than fee (e.g., wetland or grassland easements). As a result of active regulation by the Service, floodplains associated with interests acquired on easements would have a consistent and higher level of protection compared to Alternative A.

Alternative C would expand the scope of regulation to operations conducted on non-Federal surface locations drilling under a refuge or any operation on private land within a refuge (i.e., an inholding). The level of increased protection for floodplains would vary from slight to moderate depending on the proximity of those operations to refuge boundaries, as well as State rules (and operator's compliance with those rules) in place that serve to reduce such impacts (e.g., spill control and cleanup requirements, erosion control).

Accessing Oil and Gas Rights from a Non-Federal Surface Location

Under Alternative A the incentive for operators to locate their operations outside refuge units would remain in place as described at the beginning of this chapter. The location of surface operations outside refuge units avoids direct impacts to floodplains within refuge units. However, wells directionally drilled and produced from outside refuge units to bottomholes beneath the refuge units could still directly impact floodplains on adjacent lands as well as present a risk of indirect impacts within the refuge units, if poorly sited. Under current regulations, the Service cannot impose preventative measures such as mitigation. The risk and intensity of impacts on refuge resources would increase for operations sited closer to refuge boundaries where spills, leaks, water, and sediment could be transported downslope into refuge units through streams, gullies, or overland flow. Intensity of impacts on refuge resources would depend on proximity of operations to the refuge units; site-specific environmental conditions, such as steepness and direction of slope and surface hydrology; and mitigation measures.

Under Alternative C, all phases of pre-existing operations within the refuge boundary would be subject to all provisions of the proposed rule as described under Alternative B. Pre-existing operations on private surface estate within a refuge boundary, as well as pre-existing operations outside and adjacent to the refuge boundary, would continue production activities but would eventually require an operations permit to ensure compliance with the reclamation standards of the proposed rule. Impacts to floodplains would be reduced as described under Alternative B.

Alternative C would expand Service jurisdiction under the regulations to encompass surface and subsurface directional drilling operations outside the boundary of a refuge and operations on private surface estate within a refuge boundary. Directional drilling operations would be subject to the full regulatory requirements of a new operation. The Service would impose operational standards on activities outside the refuge to the extent necessary to avoid or minimize impacts on refuge resources and uses. Operational standards would reduce water and sediment transport downslope into refuge units through streams, gullies, or overland flow and thus impacts to floodplains within the refuge boundary.

Requirement to Obtain a Service Permit to Conduct Operations

Under Alternative A, the Service would continue to work to ensure new operations are under a Service-issued SUP or ROW, which would reduce the impacts of geophysical operations and new drilling and production operations. When an operator obtains a Service permit prior to conducting operations, it provides additional protection for floodplains. The permitting process ensures ongoing communication between Refuge staff and the operator; that an operator includes mitigation measures to avoid or minimize impacts to refuge resources and uses; and that an operator is aware of expectations to reclaim a site to restore refuge resources and ensure long term protection of refuge resources and uses. However, the permit requirement itself has not been consistent across the Service; where permits have been issued, the permit conditions have varied widely resulting in the possibility of unnecessary impacts to floodplains.

Under Alternative A, there would be unnecessary impacts on floodplains from the estimated 4,000 pre-existing oil and gas production operations not under an SUP or ROW, including those described above under Typical Impacts of Oil and Gas Operations on Floodplains. The Service estimates that the 4,000 pre-existing wells in 107 refuges have created approximately 6,000 acres of direct disturbance associated with well sites and access roads. Direct surface disturbances from well pads and roads in refuges range from 1 to 6 acres with the average area of disturbance estimated at approximately 1.5 acres per operation.

The primary effect on floodplains is similar to that of geology and soils and wetlands from oil and gas operations and stems from the fact that soils are taken out of beneficial use where they have been disturbed. Within the footprint of the disturbance, potential impacts include the loss of soils from grading or construction of facilities, soil compaction, soil erosion and sedimentation associated with disturbed areas, and possible soil contamination from leaks and spills, leading to adverse impacts on soil chemistry and productivity. So, as previously discussed regarding time/place/manner considerations, most of the impacts to floodplains occurred when the operator chose and developed the site to accommodate their drilling and production operations.

However, some continuing unnecessary impacts may occur under Alternative A due to the lack of any requirement that these pre-existing operations have ongoing mitigation measures to protect floodplains and the fact the Service does not currently have a way to ensure operations are complying with any State laws that would protect floodplains. Typical mitigation measures that would minimize ongoing impacts from pre-existing operations on floodplains could include removal of contaminated soils, effective erosion control, proper secondary containment around storage tanks, regular pump jack maintenance, and removal of debris, waste, and equipment no longer needed in operations.

Under Alternative B, all new operations would be under a consistent permitting process that would include required consultation with the Service, performance-based standards to avoid or minimize impacts to floodplains, and other administrative provisions such as financial assurance, cost recovery, and access fees that would ensure protection of floodplains from the typical impacts of oil and gas development to the greatest extent practicable.

Similar to Alternative A, pre-existing operations would not be required to obtain an operations permit during the production phase. However, in contrast to Alternative A, the Service would manage these operations by assimilating State laws and regulations into the rule, thereby increasing the Service's enforcement ability on refuge lands. So, during the production phase, impacts to floodplains would be reduced compared to Alternative A due to improved compliance with State rules that serve to lower such impacts, such as State rules addressing pit closure as well as the removal of oil-contaminated soils from tank battery sites to protect soils and water, and clean-up standards for soils contaminated by oil spills (GWPC 2014; La. Admin. Code tit. 43, Part XIX, §503). Overall, the Service expects that the large majority of issues related to ongoing impacts on floodplains would be resolved by compliance with State laws and regulations.

Additionally, under Alternative B, all operations, including pre-existing operations, would be required to have a Service-issued permit for reclamation that would ensure all operations meet the Service's reclamation standards, which would also greatly reduce any long-term impacts on floodplains as discussed further below in Performance-Based Standards. Assimilation of State laws and regulations during the production phase combined with reclamation to Service standards ensures a substantial and consistent long-term benefit to floodplains compared to Alternative A.

Alternative C would require all operators on refuges to obtain a permit for their operations, including pre-existing operations. Compared to Alternative B, Alternative C may provide additional protections for floodplains from impacts associated with pre-existing operations. Since the greatest impacts to floodplains have already occurred, the Service would be focusing on maintenance issues, such as erosion control, in those cases where State laws and regulations do not meet Service operating standards. Alternative C would also require operations on inholdings and those directionally drilling underneath a refuge from non-Federal surface locations to obtain a permit to the extent necessary to protect floodplains. In most cases, since the activity is occurring directly on private surface estate, the Service would not identify operational measures to protect floodplains on adjacent Federal surface estate. Thus, for these operations, the impacts on floodplains would be similar to Alternative B.

Performance-Based Standards

Under Alternative A, oil and gas operations would be managed on an individual unit basis, with protective stipulations developed in a site-specific manner. New operations would be subject to operating practices, as defined in SUPs or ROWs, that serve to minimize or avoid impacts on floodplains. These could include erosion control measures and spill prevention and control equipment and practices; however, the operating practices included in the SUPs or ROWs are usually negotiated between the refuge manager and the oil operator. Thus, the levels of protection may vary somewhat from permit to permit and by refuge as the existing regulations do not provide specific operating standards for the protection of refuge resources. The level of monitoring and cooperation with operators to address impacts on refuge resources and uses would continue to vary widely, resulting in unnecessary impacts to geology and soils. For the 4,000 pre-existing operations, reclamation is conducted without regard for Service goals or only to the extent a refuge manager is able to negotiate to have reclamation goals addressed. Reclamation for these wells often falls short of Service reclamation standards.

Under Alternatives B and C, the proposed rule establishes performance-based standards for avoiding or minimizing impacts to floodplains. All new operations on NWRS lands and waters would be subject to consistent standards and requirements of the proposed rule for protecting floodplains. As previously discussed, new operations create the greatest additional impacts on floodplains, so establishing performance-based standards that would include proper site planning, timing restrictions and best management practices would avoid or minimize many of the typical impacts to floodplains from oil and gas development. Also, the proposed rule includes additional standards that would protect floodplains, such as designing, constructing, operating, and maintaining access to the operational site to cause the minimum amount of surface disturbance needed to safely conduct operations and to avoid areas identified as floodplains.

Additionally, under the proposed rule operators on easements would be required to comply with these standards to the extent necessary to protect that easement interest. This would likely include protections for floodplains on these easements (e.g., hydric soils on wetland easements).

The proposed rule also includes standards for achieving successful surface reclamation once operations end. All operations, including pre-existing operations, would have to meet Service reclamation standards, such as plugging all wells, removing all above-ground structures, equipment, roads, well pads, and contaminating substances, re-establishing native vegetation, restoring conditions to predisturbance hydrologic functions, and restoring natural systems using native soil material that would reduce impacts to floodplains within refuges. Therefore, eventually, the disturbance associated with the 4,000 pre-existing wells would be restored to Service standards, providing a substantial long-term reduction or removal of adverse impacts on floodplains compared to Alternative A.

Under Alternative C, pre-existing operations would be required to abide by the performance-based standards established under the proposed rule during the production phase. Compared to Alternative B, Alternative C may provide for implementation of higher standards for protection of floodplains. Since the greatest impacts to floodplains have already occurred, the Service would be focusing on maintenance issues, such as erosion control, in those cases where State laws and regulations do not meet Service operating standards.

Also, operations on inholdings and operations on non-Federal surfaces directionally drilling underneath a refuge would be subject to the performance-based standards established in the proposed rule to the extent necessary to protect refuge floodplains. The level of increased protection would vary from slight to moderate depending on State rules in place that serve to reduce such impacts (e.g., spill control and cleanup requirements, erosion control), and the proximity of the surface location of operations on non-Federal surfaces to the refuge and the presence of pathways (e.g., waters that may be hydrologically connected to waters within a refuge).

Finally, under Alternative C, performance-based standards would also be established for downhole operations. Floodplains would only be impacted by accidents associated with well control. Given present day technology, events that result in loss of well control (blowouts) are extremely rare. Service regulation could possibly serve to lower an already low risk of a well blowout, but in practice, the Service finds that State requirements for well control and the expectation that companies will act in their own best interest would preclude the need for the Service to regulate aspects of drilling and production related to well control. Thus, the Service does not expect any reduction of impacts or risks of impacts to floodplains related to our downhole regulation under Alternative C.

CUMULATIVE IMPACTS

Actions inside and outside the refuge units and local trends in oil and gas development can cumulatively affect floodplain resources. Management planning, such as fire management, vegetation management, and ORV plans, can result in greater protection for these resources. Conversely, actions that cause disturbance to these resources would include activities such as prescribed burns, ORV use, mining, agricultural and logging activities, as well as any general development activities that include excavation, grading, or construction. Past, present, and reasonably foreseeable activities that would have beneficial or adverse impacts on floodplain resources in the area of analysis (including both refuge lands and adjacent lands) and a brief summary of the cumulative impacts of these actions on floodplains are listed in Table 4-6.

TABLE 4-6. CUMULATIVE IMPACTS ON FLOODPLAINS (PROGRAMMATIC LEVEL FOR REFUGES)

Past, Present, and Reasonably Foreseeable Activity	Impacts on Floodplains
Prescribed fires and fire management actions	Short-term and long-term adverse effects on floodplain function and values from loss of productivity following removal of vegetation that may be preventing erosion and sedimentation; short- and long-term impacts from fire line construction that requires digging and displacement of soils and loss of organic matter from burning of surface litter and topsoil and altered hydrology. Long-term beneficial effects of reduced fire occurrences with managed burns that reduce the possibility of catastrophic and high intensity fire; improved productivity and erosion control from vegetative cover that is established after these treatments.
Service facility and road construction	Short-term and long-term adverse effects on floodplain function and values from direct loss of soils and vegetation when removed for development; altered hydrology; compaction and rutting of soils during road grading and construction using heavy equipment; improper flood-proofing; increased road runoff and crossing of small areas of tributary floodplains.
Vegetation management	Long-term beneficial effects of erosion control from improved vegetative cover, which hold soils in place. Setbacks and restricting staging areas, access roads, and restricting placement of staging, well pads, and flowlines to areas outside the 100-year floodplain, where practicable.
Trails development and maintenance	Short-term and long-term adverse effects on floodplain function and values from compaction and rutting during clearing, grading and surfacing of trails, and removal of vegetation in trail footprint, altered hydrology.
ORV use	Short- and long-term adverse effects on floodplain function and values from compaction and rutting, erosion and sedimentation following vehicle-related disturbances to surfaces; altered hydrology.

Past, Present, and Reasonably Foreseeable Activity	Impacts on Floodplains
Abandoned mine lands reclamation	Short-term adverse effects on floodplain function and values from compaction and rutting during reclamation-related disturbances; improper flood-proofing; altered hydrology. Long-term beneficial effects of improved surface (revegetation) and reduced erosion following re-establishment of natural contours and floodplain restoration.
Mining and logging activities	Long-term adverse effects on floodplain function and values from erosion stemming from legacy surface disturbances and vegetation removal and long-term effects of acid mine drainage on floodplain function and values (degradation)
Recreational use	Short- and long-term adverse effects on floodplain function and values from visitor activities including trampling and associated compaction and rutting. Long-term beneficial effects on floodplain-dependent wildlife for enhanced viewing and aesthetics.
Ranching, agricultural land uses	Short- and long-term adverse effects from operations that remove vegetation cover, compact soils, create ruts that increase potential for erosion, and alteration of hydrology.
Land development: residential and nonresidential (commercial, industrial) land uses, including road construction	Short- and long-term adverse effects on floodplain function and values from direct loss of soils and vegetation in development footprint and compaction, rutting, erosion and sedimentation following construction-related disturbances; altered hydrology Construction may increase erosion and deposition of sediments that could alter the topography, modify surface water flows and hydrology, and indirectly adversely affect vegetation, fish, and wildlife. Excavation activities associated with construction, the installation of subsurface drainage, and extensive groundwater or surface water withdrawals for agricultural, industrial, or residential uses may disrupt surface and subsurface water flow, which could cause reductions in water levels and/or changes in frequency, duration, or extent of water distribution.
Future oil and gas development on adjacent lands	Direct effects on floodplain on adjacent property and indirect adverse impacts on floodplain soils from “spill-over effects” of sedimentation and contamination from surface runoff and improper flood-proofing; possible severe adverse impacts in the unlikely event of a well blowout, fire, or major release; trends indicate that the exploration and production of shale gas, in particular, is anticipated to increase dramatically over the next 30 years.
Oil and gas well plugging and reclamation activities inside and outside refuges	Short-term adverse effects on floodplain function and values from reclamation-related disturbances due to use of equipment on site and grading. Long-term beneficial effects of restoration of natural contours and hydrology, topsoil and vegetation cover that protects soils from erosion; removal of sources of contamination and contaminated soils, floodplain restoration. Recontouring and revegetating disturbed areas should reduce soil erosion and re-establish surface drainage flows.

Under Alternative B, there would be adverse and beneficial cumulative impacts from projects, plans, actions, and trends in oil and gas development that were considered in the cumulative scenario. These are described under Alternative A and would be the same under Alternative B. Alternative B would contribute to cumulative impacts from the continued operations with SUPs and ROWs and of pre-existing operations, which would continue to have long-term direct adverse impacts on floodplains, as described in the above analysis. Bringing operations with SUPs and ROWs, new operations and the reclamation phase of pre-existing operations under regulation would add substantial beneficial impacts on floodplains. When combined with the effects of all other actions in the study area, cumulative impacts from the actions under Alternative B would be long term and both adverse and beneficial, with Alternative B contributing mainly beneficial impacts on overall cumulative impacts from the change in regulations.

Cumulative impacts from actions under the cumulative impact scenario would be the same as described under alternative A. Similar to Alternative B, there would be effects on floodplains as a result of oil and gas operations that would continue to affect floodplains where impacts cannot be avoided, and benefits from bringing all operations under regulations and the resultant reduction in adverse impacts, as described in the Alternative B analysis. Alternative C would contribute to cumulative impacts mostly by adding beneficial impacts of bringing all operations under regulation, but also by possibly adding adverse impacts from the change in directional drilling regulations that could result in more oil and gas development within refuge units as opposed to outside refuge boundaries. Overall under Alternative C, both adverse and beneficial cumulative impacts would accrue from projects, plans, and actions considered in the cumulative scenario. When combined with the effects of all other actions in the study area, cumulative impacts would be long term and both adverse and beneficial.

VEGETATION (INCLUDING PLANT SPECIES OF SPECIAL MANAGEMENT CONCERN)

METHODOLOGY

Potential impacts on vegetation and plant species of management concern (also referred to as “special-status species”) are assessed in this section, based on the actions being proposed and characteristics of the vegetation in the refuge units. Resource-specific context for assessing impacts of the alternatives to vegetation and special-status plant species includes the following:

- the type and amount of disturbance (such as duration of operation and type and location of access roads and pads)
- the potential for nonnative invasive species-related impacts occurring from oil and gas activities.
- the susceptibility of vegetation, including special-status species, to disturbance, removal, contamination, or other effects of oil and gas activities.
- the presence of special-status species in refuge units and their potential to be present in areas of oil and gas development

For the programmatic level analysis, a qualitative analysis of the potential impacts of oil and gas operations on the species was conducted based on actual experience of the Service in management of non-Federal oil and gas operations, professional judgment, and information available in the literature.

TYPICAL IMPACTS OF OIL AND GAS OPERATIONS ON VEGETATION (INCLUDING PLANT SPECIES OF SPECIAL MANAGEMENT CONCERN)

Impacts from Geophysical Exploration

During the geophysical exploration phase, adverse impacts on vegetation can result from localized clearing and trimming for surveying and increased vehicular traffic associated with seismic investigations. The introduction or spread of nonnative invasive vegetation could occur as a result of vehicular traffic, but this would be relatively limited in extent during this phase. Surface disturbance from survey crews traversing the area during geophysical exploration could also cause localized soil compaction. Compaction reduces the soil's water-holding and infiltration capacities, which could increase runoff of surface waters and accelerate soil erosion (Duiker 2004; Pennsylvania State University 2009). Erosion and loss of soil could ultimately degrade existing plant communities. The majority of impacts associated with geophysical surveys is limited in extent and severity because of the temporary nature of the disturbance and localized area disturbed by survey crews.

Impacts of Well Drilling and Production

Vegetation removal and ground disturbance associated with the construction and installation of well pads, pipelines, access roads, and other facilities would affect vegetation both directly and indirectly. Direct effects would include removal of vegetation by clearing, grading, cutting, filling, and leveling of the site using heavy construction equipment during site preparation. This activity may also modify habitat structure, species composition, and the extent of vegetation cover types. Site clearing to accommodate a well drilling rig and associated equipment would remove about 1.5 to 4 acres of vegetation for each well pad, resulting in a permanent conversion of the vegetation cover type to an industrial use. The degree of impact would depend on the type and amount of vegetation affected, the rate at which the vegetation would regenerate after construction, and the frequency of vegetation maintenance conducted during operation.

During drilling and production, the construction, maintenance, and use of access roads, well pads, flowlines, and pipelines could directly impact vegetation and plant root system integrity by removal or crushing of plants. Indirect effects associated with disturbances to vegetation could include increased soil erosion and compaction (see Geology and Soils section). Increased erosion rates and reduction in soil stability and productivity could prevent successful reclamation with native species and composition. Surface disturbances could cause soil compaction, thereby reducing the soil's water-holding and infiltration capacities. This, in turn, would reduce the root penetration capabilities of vegetation and hinder plant growth and further soil formation (Crush and Thom 2011). Vegetation established at the edges of well pads could also experience "edge effect," such as changes in microclimate (e.g., sunscald or scorch) in the adjacent open areas and potential changes in herbivory (Adams et al. 2011).

In addition to construction-related impacts associated with development of access roads and well pads, there is a risk of impact on vegetation from releases of hazardous or contaminating substances during drilling or production operations, including well workovers and servicing. The presence of oils and other well development chemicals in soils and site runoff could kill vegetation or adversely impact overall plant health.

Contamination from the release of produced waters containing salts and other well drilling fluids could also impact vegetation in the refuge units. These substances may contain relatively large concentrations of dissolved salts, particularly sodium chloride, and can have salt concentrations greater than ocean water. Salt stress is the major environmental factor that affects all vital plant processes such as growth, photosynthesis, protein synthesis, energy and lipid metabolism, and productivity (Parida and Das 2005).

Accidental release of produced waters would likely damage or kill vegetation in the immediate area and possibly adjacent areas. Immediate adverse impacts on vegetation could occur through direct contact of foliage with the released material. Long-term, systemic impacts could also occur through uptake of the material from the soil by plant roots, thereby reducing the species' ability to recover and re-establish (Adams et al. 2011). Instances of leaks from salt-water disposal wells and subsequent contamination occurring as the result of mechanical problems and improper operating practices have been documented at the Anderson Waterfowl Production Area in Montana, and Hagerman and Aransas NWRs in Texas (M. Maddux and M. Borgreen, pers. comm.).

Ground disturbance and removal of existing vegetation could also promote the introduction of nonnative plant species. Invasive species actively outcompete and replace native species and are a threat to the overall ecological health of the refuge units. Introduction of invasive plant species through seeds or other propagules may increase due to greater vehicular traffic for well site construction and maintenance, improper erosion control and restoration methods, and through other ground-disturbing/clearing activities that would disturb fallow seed (weed) banks. Such introductions could negatively affect native plant communities, reduce diversity, reduce forest health and productivity, and degrade native wildlife habitat (Vila 2011; Tylianakis 2008). Such vegetation is present in every Service refuge and various management efforts are ongoing to deal with the establishment and spread of invasive species.

The types of impacts related to vegetation for directionally drilled wells are expected to be similar to those described for operations inside the refuge units; however, direct impacts to vegetation in the refuges would not occur. The risk of indirect impacts and their intensity would vary with the location of the well with respect to the refuge boundary and direction of surface runoff. The risk of impacts on refuge resources would be greater for directionally drilled operations sited closer to refuge boundaries with surface gradients toward the refuge, where water and sediment can be transported downslope into refuge units through adjacent streams, gullies, or overland flow. Severity of impacts would depend on proximity of operations to the refuge units; type of construction, site-specific environmental conditions, such as steepness and direction of slope and surface hydrology; the presence of hazardous substances in the runoff, sensitivity of resources, and mitigation measures being employed.

Impacts of Plugging and Reclamation

When drilling and production operations end, well plugging and surface reclamation results in overall beneficial impacts on vegetation. Although damage and loss of vegetation during ground-disturbing equipment occurs from plugging actions, these disturbances are temporary and occur in previously disturbed areas. Accidental spread and establishment of exotic species in the project area during well plugging and surface reclamation would be minimized through monitoring and best management practices. There are also beneficial effects on vegetation once cleanup is successfully completed and the site is reclaimed to natural conditions and processes. Reclamation involves returning the topography of a site to approximate the original contours, and re-establishing natural vegetation communities. Allowing vegetation in disturbed areas to recover provides erosion control in areas of previous impacts from oil and gas operations. Sources of potential leakage such as wellhead equipment and flowlines are also removed during plugging and reclamation. Beneficial impacts of plugging and reclamation are realized in the short term and over the long term.

Recovery of vegetation communities would be primarily dependent on location, soil conditions, precipitation, and type of community desired. Except for rare vegetation communities that are susceptible to the adverse impacts of oil and gas operations, most vegetation communities in the refuge units would be expected to re-establish in a relatively short time. If access roads are not reclaimed, but continue to be used for other administrative purposes, adverse impacts to vegetation could occur if visitors travel off established routes.

TYPICAL IMPACTS OF OIL AND GAS OPERATIONS ON SPECIAL-STATUS PLANT SPECIES

The refuges addressed in this EIS provide habitat that supports many species of plants that are threatened, endangered, or of special concern at the national, regional, and local levels. The Service recognizes that the conservation of special-status plants and their habitats, as well as natural communities, is integral to maintaining biological diversity (601 FW 3). Consistent with DOI policy, the Service manages State and locally listed species within refuge units in a manner that assists those States and localities meet their planning objectives (43 CFR 24.4).

Some of these species and their habitats may occur in areas suitable for oil and gas development. Given the programmatic nature of this analysis, the exact locations of future operations are unknown, and site-specific data for presence or absence of special-status species at existing wells may not be available. Wells with current SUPs or ROW permits would have gone through a review for the presence of special-status species at the time of permitting.

Impacts on special-status plants from oil and gas operations can occur during geophysical exploration, drilling and production, or reclamation phases of development. Impacts such as damage and loss of vegetation resulting in modification of the existing plant community structure and composition in the project area, soil compaction and rutting, reduced soil permeability and root integrity, increased erosion and reduced vegetation health and productivity, and potential contamination of soils and vegetation from leaks and spills could occur as a result of oil and gas operations.

As noted in the following analysis, impacts to special-status plants are usually avoided or mitigated through intra-Service consultation with the Service’s Ecological Services field office, use of project area surveys, and completion of biological assessments where adverse impacts could occur.

Impacts from Geophysical Exploration

During the geophysical exploration phase, adverse impacts on special-status plant communities would be similar in nature to those of common vegetation communities. Localized vegetation clearing and trimming for surveying and increased vehicular traffic associated with seismic investigations could lead to injury or destruction of sensitive plant species and habitat where exploration operations are permitted. These operations would be required to avoid affecting species of special concern and their habitat, which would be identified through consulting refuge biologists or biological surveys, if determined necessary by the Service through consultation with Federal or State agency biologists. When species of special concern and their habitat are found to be within the project area, application of mitigation measures, including sufficient setbacks and/or timing restrictions for sensitive periods in a given species' life cycle, would likely result in avoiding or minimizing potential adverse effects.

Surface disturbance from survey crews traversing the area during geophysical exploration could introduce or spread nonnative invasive vegetation, but this would be relatively limited in extent during this phase. Surface disturbance could also cause localized soil compaction and dust emissions which would ultimately degrade existing sensitive plant communities. Upon the completion of operations, reclamation of disturbed areas would be required, and recovery of any vegetation disturbed is expected to occur over the short term. The majority of impacts associated with geophysical exploration is limited in extent and minor because of the temporary nature of the disturbance and localized area disturbed by survey crews.

Impacts of Well Drilling and Production

Drilling and production operations would not likely directly affect species of special concern or their habitat in areas afforded protection under current SUPs or ROW permits, including ESA regulations. However, operations could result in indirect impacts on special-status plant species, primarily from the disturbance related to construction of new well pads, access roads, flowlines, and pipelines. Impacts would be similar in nature to those of common vegetation communities, including loss of vegetation and habitat, surface disturbances leading to soil compaction, erosion and sedimentation, and nonnative species introduction. If vegetation clearing is unavoidable, it would be limited in extent and mitigation would require that least damaging methods are used for site preparation. In sensitive plant communities, a large effort would be made during the planning of new operations to avoid or minimize alteration of the surface area more than necessary.

Releases of hazardous or contaminating substances and any maintenance activities that are needed pose the greatest threat to special-status plant species. Potential source and nonpoint source pollution from releases and runoff could kill plants or impact the overall health and survival of affected special-status species.

Drilling and production operations could range in duration from short-term (weeks or months for well drilling and construction of roads, well pads, flowlines, and pipelines) to long-term (lasting 20 years or more for road, flowline, pipeline, well, and production operations). Construction and maintenance of roads, pads, flowlines, and pipelines could require vegetation clearing and could result in loss of special-status plants if these are not identified.

Potential effects on special-status plant species would depend on where drilling and production operations are located within refuges. Careful siting of developments based on biological survey and/or assessment results could avoid or minimize these impacts substantially. Through biological surveys and/or assessments and intra-Service consultations, potential impacts on special-status species and their habitat would be identified, and the application of appropriate mitigation measures would reduce or eliminate adverse impacts.

Impacts of Plugging and Reclamation

Well plugging, removing flowlines and pipelines, and use of heavy equipment and vehicles to reclaim sites could have the potential for releases of oil and other contaminating and hazardous substances, which could harm or kill protected plants. However, ongoing consultation under the ESA; performing biological surveys of the area that could be potentially impacted by proposed plugging, abandonment, and reclamation operations; identifying listed species; and applying appropriate mitigation would result in reduction or elimination of adverse impacts on listed species.

Plugging and reclamation would require clearing vegetation at the well and access roads, which may temporarily affect nearby sensitive vegetation communities. However, reclamation would result in overall beneficial impacts to sensitive vegetation similar to those of common vegetation communities. With minimal use of equipment used to clear well pads and access roads, and revegetation of the area with weed-free native seed mix, the area affected would be small. Access roads that have been developed or allowed to remain open for the primary purpose of allowing access for oil and gas operations would be reclaimed at the completion of operations, returning the area to its natural conditions. Wherever possible, habitats would be improved to perpetuate the viability of the plant communities and habitats and increase the survivability of nearby special-status species. The outcome of these activities, in returning natural conditions to the operations area, would have long-term beneficial impacts.

If restored properly, few effects on sensitive plant community size, integrity, or continuity would be anticipated and impacts would not affect the overall viability of these plant communities. Avoiding areas of known sensitive species and timing of reclamation to avoid conflicts with critical growth periods would reduce impacts on special-status vegetation and encourage restoration success during this phase. Monitoring site recovery and success would be determined by measuring species survival, native vegetation density and diversity, percent cover, etc. Allowing sensitive vegetation in disturbed areas to recover also provides erosion control in areas of previous impacts from oil and gas operations.

IMPACTS OF ALTERNATIVES ON VEGETATION (INCLUDING PLANT SPECIES OF SPECIAL MANAGEMENT CONCERN)

Purpose and Scope

The purpose of the regulation in all alternatives is to ensure that non-Federal oil and gas operations conducted on NWRS lands and waters avoid or minimize, to the greatest extent practicable, adverse effects on vegetation and plant species of special management concern.

Under Alternative A, the Service scope of application of its regulation and policy provides protection of vegetation and plant species of special management concern on Service fee title lands.

Alternative B, the proposed rule, would expand the area of regulatory application to include tracts where the Federal interest is less than fee (e.g., wetland or grassland easements). As a result of active regulation by the Service, vegetation and plant species of special management (e.g., emergent and submergent vegetation on wetland easements, or native vegetation on grassland easements) concern associated with interests acquired on easements would have a consistent and higher level of protection compared to Alternative A.

Alternative C would expand the scope of regulation to operations conducted on non-Federal surface locations drilling under a refuge or any operation on private land within a refuge (i.e., an inholding). The level of increased protection for vegetation and plant species of special management concern would vary from slight to moderate depending on the proximity of those operations to refuge boundaries, as well as State rules (and operator’s compliance with those rules) in place that serve to reduce such impacts (e.g., installation and maintenance of secondary containment for all equipment and facilities using or containing contaminating substances such as oil, brine, formation water, or well stimulation chemicals, the removal of any contaminating substances, requiring operators to control the introduction of noxious and invasive species on their area of operations, and directing operators to use methods that minimize the need for vegetative trimming).

In addition to the further protection and consistency afforded under Alternative B, Alternative C would reduce unnecessary impacts to vegetation and plant species of management concern caused by operations conducted on non-Federal surface location drilling under a refuge. The level of increased protection would vary from slight to moderate depending on proximity of those operations to refuge boundaries, as well as State rules (and operator's compliance with those rules) in place that serve to reduce such impacts.

Accessing Oil and Gas Rights from a Non-Federal Surface Location

Under Alternative A the incentive for operators to locate their operations outside refuge units would remain in place as described at the beginning of this chapter. The location of surface operations outside refuge units avoids direct impacts to vegetation and plant species of management concern within refuge units. However, wells directionally drilled and produced from outside refuge units to bottomholes beneath the refuge units would directly impact vegetation and plant species of management concern on adjacent lands as well as present a risk of indirect impacts within the refuge units. Under current regulations, the Service cannot impose preventative measures such as mitigation. The risk and intensity of impacts on refuge resources would increase for operations sited closer to refuge boundaries where soil disturbance could increase erosion potential and exacerbate the spread of invasives if not properly controlled. Intensity of impacts on refuge resources would depend on proximity of operations to the refuge units, site-specific environmental conditions, and mitigation measures.

Alternative B provides an even greater incentive for operators to locate their operations outside refuges since the proposed rule includes provisions for maintaining financial assurance, access fees, and cost recovery, among others. So, as the operator's costs of operating on NWRS lands increase, so does the incentive to avoid those costs. Therefore, it is likely that impacts to vegetation and plant species of management concern from new production and drilling operations within refuges would be avoided to a greater extent than in Alternative A. Impacts on vegetation and plant species of management concern from those wells located on non-Federal surface locations would be same as Alternative A.

Under Alternative C, directional drilling operations on non-Federal surface locations would be subject to the full regulatory requirements of the proposed rule. The Service would impose operational standards on activities outside the refuge to the extent necessary to avoid or minimize impacts on refuge resources and uses. Operational standards would require better control of erosion and noxious plants, thus reducing impacts to vegetation and plant species of management concern within the refuge boundary.

However, application of regulation to surface and subsurface operations outside a refuge would largely remove an operator's incentive to avoid surface use in a refuge, so the number of drilling and production operations located on refuges would likely increase. Therefore, compared to Alternatives A and B, Alternative C would increase the instances where new drilling operations create direct, adverse, and long-term impacts to refuge vegetation and plant species of management concern.

Requirement to Obtain a Service Permit to Conduct Operations

Under Alternative A, the Service would continue to work to ensure new operations are under a Service-issued SUP or ROW, which would reduce the impacts of geophysical operations and new drilling and production operations. When an operator obtains a Service permit prior to conducting operations it provides additional protection for vegetation and plant species of management concern. The permitting process ensures ongoing communication between Refuge staff and the operator; that an operator includes mitigation measures to avoid or minimize impacts to refuge resources and uses; and that an operator is aware of expectations to reclaim a site to restore refuge resources and ensure long term protection of refuge resources and uses. However, the permit requirement itself has not been consistent across the Service; and, where permits have been issued, the permit conditions have varied widely resulting in the possibility of unnecessary impacts to vegetation and plant species of management concern.

Under Alternative A, there would be unnecessary impacts on vegetation and plant species of management concern from the estimated 4,000 pre-existing oil and gas production operations not under an SUP or ROW, including those described above under Typical Impacts of Oil and Gas Operations on Vegetation (Including Plant Species of Special Concern. The Service estimates that the 4,000 pre-existing wells in 107 refuges have created approximately 6,000 acres of direct disturbance associated with well sites and access roads. Direct surface disturbances from well pads and roads in refuges range from 1 to 6 acres with the average area of disturbance estimated at approximately 1.5 acres per operation.

The primary effects on vegetation and plant species of management concern is similar to that of geology and soils, and wetlands from oil and gas operations and stems from the fact that soils are taken out of beneficial use where they have been disturbed. Within the footprint of the disturbance, potential impacts include the loss of soils from grading or construction of facilities, soil compaction, soil erosion and sedimentation associated with disturbed areas, and possible soil contamination from leaks and spills, leading to adverse impacts on soil chemistry and productivity. So, as previously discussed regarding time/place/manner considerations, most of the impacts to vegetation and plant species of management concern occurred when the operator chose and developed the site to accommodate their drilling and production operations.

However, some continuing unnecessary impacts may occur under Alternative A due to the lack of any requirement that these pre-existing operations have ongoing mitigation measures to protect vegetation and plant species of management concern and the fact the Service does not currently have a way to ensure operations are complying with any State laws that would protect vegetation and plant species of management concern. Typical mitigation measures that would minimize ongoing impacts from pre-existing operations on vegetation and plant species of management concern could include removal of contaminated soils, effective erosion control, proper secondary containment around storage tanks, regular pump jack maintenance, and removal of debris, waste, and equipment no longer needed in operations, and control of noxious weeds.

Under Alternative B, all new operations would be under a consistent permitting process that would include required consultation with the Service, performance-based standards to avoid or minimize impacts to vegetation and plant species of management concern, and other administrative provisions such as financial assurance, cost recovery, and access fees that would ensure protection of vegetation and plant species of management concern from the typical impacts of oil and gas development to the greatest extent practicable.

Similar to Alternative A, pre-existing operations would not be required to obtain an operations permit during the production phase. However, in contrast to Alternative A, the Service would manage these operations by assimilating State laws and regulations into the rule, thereby increasing the Service's enforcement ability on refuge lands. So, during the production phase, impacts to vegetation and plant species of management concern would be reduced compared to Alternative A due to improved compliance with State rules that serve to lower such impacts, such as State rules addressing pit closure as well as the removal of oil-contaminated soils from tank battery sites to protect soils and water, and clean-up standards for soils contaminated by oil spills (GWPC 2014; La. Admin. Code tit. 43, Part XIX, §503). Overall, the Service expects that the large majority of issues related to ongoing impacts on vegetation and plant species of management concern would be resolved by compliance with State laws and regulations.

Additionally, under Alternative B, all operations, including pre-existing operations, would be required to have a Service-issued permit for reclamation that would ensure all operations meet the Service's reclamation standards, which would also greatly reduce any long-term impacts on vegetation and plant species of management concern as discussed further below in Performance-Based Standards. Assimilation of State laws and regulations during the production phase combined with reclamation to Service standards ensures a substantial and consistent long-term benefit to vegetation and plant species of management concern compared to Alternative A.

Alternative C would require all operators on refuges to obtain a permit for their operations, including pre-existing operations. Compared to Alternative B, Alternative C may provide additional protections for vegetation and plant species of management concern from impacts associated with pre-existing operations. Since the greatest impacts to vegetation and plant species of management concern have already occurred, the Service would be focusing on maintenance issues, such as erosion control, in those cases where State laws and regulations do not meet Service operating standards. Alternative C would also require operations on inholdings and those directionally drilling underneath a refuge from non-Federal surface locations to obtain a permit to the extent necessary to protect vegetation and plant species of management concern. In most cases, since the activity is occurring directly on private surface estate, the Service would not identify operational measures to protect vegetation and plant species of management concern on adjacent Federal surface estate. Thus, for these operations, the impacts on vegetation and plant species of management concern would be similar to Alternative B.

Performance-Based Standards

Under Alternative A, oil and gas operations would be managed on an individual unit basis, with protective stipulations developed in a site-specific manner. New operations would be subject to operating practices, as defined in SUPs or ROWs that serve to minimize or avoid impacts on vegetation and plant species of management concern. These could include erosion control measures and spill prevention and control equipment and practices; however, the operating practices included in the SUPs or ROWs are usually negotiated between the refuge manager and the oil operator. Thus, the levels of protection may vary somewhat from permit to permit and by refuge as the existing regulations do not provide specific operating standards for the protection of refuge resources. The level of monitoring and cooperation with operators to address impacts on refuge resources and uses would continue to vary widely, resulting in unnecessary impacts to vegetation and plant species of management concern. For the 4,000 pre-existing operations, reclamation is conducted without regard for Service goals or only to the extent a refuge manager is able to negotiate to have reclamation goals addressed. Reclamation for these wells often falls short of Service reclamation standards.

Under Alternatives B and C, the proposed rule establishes performance-based standards for avoiding or minimizing impacts to wetland resources. All new operations on NWRS lands and waters would be subject to consistent standards and requirements of the proposed rule for protecting vegetation and plant species of management concern. As previously discussed, new operations create the greatest additional impacts on vegetation and plant species of management concern, so establishing performance-based standards that would include proper site planning, timing restrictions, and best management practices to avoid or minimize many of the typical impacts to vegetation and plant species of management concern from oil and gas development. Also, the proposed rule includes additional standards that would protect vegetation and plant species of management concern, such as designing, constructing, operating, and maintaining access to the operational site to cause the minimum amount of surface disturbance needed to safely conduct operations.

Additionally, under the proposed rule operators on easements would be required to comply with these standards to the extent necessary to protect that easement interest. This would likely include protections for vegetation and plant species of management concern on these easements (e.g., ponds and marshes on wetland easements, or vegetative community and ephemeral streams on grassland easements).

The proposed rule also includes standards for achieving successful surface reclamation once operations end. All operations, including pre-existing operations, would have to meet Service reclamation standards, such as plugging all wells, removing all above-ground structures, equipment, roads, well pads, and contaminating substances, re-establishing native vegetation, restoring conditions to predisturbance hydrologic functions, and restoring natural systems using native soil material that would indirectly reduce impacts to vegetation and plant species of management concern within the refuge units. Therefore, eventually, the disturbance associated with the 4,000 pre-existing wells would be restored to Service standards, providing a substantial long-term reduction or removal of adverse impacts on vegetation and plant species of management concern compared to Alternative A.

Under Alternative C, pre-existing operations would be required to abide by the performance-based standards established under the proposed rule during the production phase. Compared to the proposed rule, Alternative C may provide for implementation of higher standards for protection of vegetation and plant species of management concern. Since the greatest impacts to vegetation and plant species of management concern have already occurred, the Service would be focusing on maintenance issues, such as erosion control, removal or remediation of contaminated soils, removal of debris, waste, and equipment no longer needed in operations, control of noxious weeds, in those cases where State laws and regulations do not meet Service operating standards.

Also, operations on inholdings and operations on non-Federal surfaces directionally drilling underneath a refuge would be subject to the performance-based standards established in the proposed rule to the extent necessary to protect vegetation and plant species of management concern. The level of increased protection would vary from slight to moderate depending on State rules in place that serve to reduce such impacts (e.g., spill control and cleanup requirements, erosion control, invasive species control), and the proximity of the surface location of operations on non-Federal surfaces to the refuge and the presence of pathways (e.g., waters that may be hydrologically connected to wetlands within a refuge).

Finally, under Alternative C, performance-based standards would also be established for downhole operations. Vegetation and plant species of management concern would only be impacted by accidents associated with well control. Given present day technology, events that result in loss of well control (blowouts) are extremely rare. Service regulation could possibly serve to lower an already low risk of a well blowout, but in practice, the Service finds that State requirements for well control and the expectation that companies will act in their own best interest would preclude the need for the Service to regulate aspects of drilling and production related to well control. Thus, the Service does not expect any reduction of impacts or risks of impacts to vegetation and plant species of management concern related to our downhole regulation under Alternative C.

CUMULATIVE IMPACTS

Alternative A: No-Action

Actions inside and outside the refuge units and local trends in oil and gas development can cumulatively affect vegetation in the refuges. Management planning, such as fire management, vegetation management, and ORV plans, can result in greater protection for these resources. Conversely, actions that cause disturbance of these resources would include activities such as prescribed burns, ORV use, mining, agricultural and logging activities, as well as any general development activities that include excavation, grading, or construction. Past, present, and reasonably foreseeable activities that would have beneficial or adverse impacts on vegetation in the area of analysis (including both refuge lands and adjacent lands) and a brief summary of the cumulative impacts of these actions on vegetation are listed in Table 4-7.

TABLE 4-7. CUMULATIVE IMPACTS ON VEGETATION (PROGRAMMATIC LEVEL FOR REFUGES)

Past, Present, and Reasonably Foreseeable Activity	Impacts on Vegetation
Prescribed fires and fire management actions	Short-term and long-term adverse effects on vegetation from loss of productivity following removal of vegetation; short and long–term impacts from fire line construction that requires digging and displacement of vegetation matter Long-term beneficial effects of reduced fire occurrences with managed burns that reduce the possibility of catastrophic and high intensity fire; improved productivity and erosion control from vegetative cover that is established after these treatments.
Service facility and road construction	Short-term and long-term adverse effects on vegetation from direct loss or damage to vegetation when removed for development and compaction of soils and damage to vegetation during road grading and construction using heavy equipment. Short-term to long-term adverse impacts from the loss of vegetation and ground disturbance/soil erosion and compaction.
Vegetation management	Short-term adverse impacts due to vegetation clearing and effects on soils. Long-term beneficial effects of erosion control from improved vegetative cover. Short term adverse impacts with long-term beneficial effects from site reclamation. Long-term beneficial effects of controlling the introduction and spread of nonnative invasive plant species.
Trails development and maintenance	Short-term and long-term adverse effects on vegetation from clearing, grading, and surfacing of trails, removal of vegetation in trail footprint for maintenance, and potential introduction of nonnative plant species.
ORV use	Short- and long-term adverse effects on vegetation from compaction and vehicle-related disturbances to the plant communities.

Past, Present, and Reasonably Foreseeable Activity	Impacts on Vegetation
Abandoned mine lands reclamation	Short-term adverse effects on vegetation during reclamation-related disturbances. Long-term beneficial effects of improved surface (revegetation) and reduced erosion following re-establishment of vegetation cover and natural contours.
Mining and logging activities	Long-term adverse effects on soils from erosion stemming from legacy surface disturbances and vegetation removal and long-term effects of acid mine drainage on vegetation (change in health and productivity).
Recreational use	Short- and long-term adverse effects on vegetation from visitor activities including trampling and associated compaction; possible introduction of nonnative plant species.
Ranching, agricultural land uses	Short- and long-term adverse effects from operations that remove vegetation cover, compact soils, grazing pressure.
Land development: residential and nonresidential (commercial, industrial) land uses, including road construction	Short- and long-term adverse effects on vegetation from direct loss in development footprint and compaction, erosion and sedimentation. Benefit from re-establishment of vegetation following construction-related disturbances.
Future oil and gas development on adjacent lands	Direct effects on vegetation on adjacent property and indirect adverse impacts on refuge vegetation from "spill-over effects" of erosion, sedimentation, and contamination from surface runoff; trends indicate that the exploration and production of shale gas, in particular, is anticipated to increase dramatically over the next 30 years.
Oil and gas well plugging and reclamation activities inside and outside refuges	Short-term adverse effects on vegetation from reclamation-related disturbances due to use of equipment on site and grading. Long-term beneficial effects of restoration of natural contours, topsoil and vegetation cover that protects soils from erosion; removal of sources of contamination and contaminated soils to reduce impact on vegetation.

Under all three alternatives, there would be adverse and beneficial cumulative impacts from projects, plans, actions, and trends in oil and gas development as discussed in the cumulative scenario above (Table 4-7).

Alternative B would contribute to cumulative impacts from the continued operations of pre-existing operations not under an SUP or ROW, which would continue to have long-term direct adverse impacts on vegetation, as described in the above analysis. On the other hand, bringing new operations and the reclamation phase of pre-existing operations under regulation would add substantial beneficial impacts on vegetation and plant species of management concern. When combined with the effects of all other actions in the study area, cumulative impacts from the actions under Alternative B would be long term and both adverse and beneficial, with Alternative B contributing mainly beneficial impacts on overall cumulative impacts from the change in regulations.

Under Alternative C, similar to Alternative B, there would be effects on vegetation and plant species of management concern as a result of oil and gas operations that would continue to affect vegetation and plant species of management concern where impacts cannot be avoided, and benefits from bringing new operations and the reclamation phase of pre-existing operations under regulation and the resultant reduction in adverse impacts, as described in the Alternative B analysis. Alternative C would contribute to cumulative impacts mostly by adding beneficial impacts of bringing new operations and all phases of pre-existing operations under regulation, but also by possibly adding adverse impacts from the change in directional drilling regulations that could result in more oil and gas development within refuge units as opposed to outside refuge boundaries. Overall under Alternative C, both adverse and beneficial cumulative impacts would accrue from projects, plans, and actions considered in the cumulative scenario. When combined with the effects of all other actions in the study area, cumulative impacts would be long term and both adverse and beneficial.

WILDLIFE AND AQUATIC SPECIES (INCLUDING ANIMAL SPECIES OF SPECIAL MANAGEMENT CONCERN)

METHODOLOGY

Potential impacts on wildlife and aquatic species (including species of special management concern, also referred to as "special-status species") are assessed in this section, based on the actions being proposed and characteristics of the wildlife and aquatic species in the refuge units, and disturbance to their habitat that may be affected. Resource-specific context for assessing impacts of the alternatives to wildlife and aquatic species resources includes the following:

- the type and amount of disturbance (threats) to wildlife and aquatic species and their habitat, including nonnative invasive species-related impacts occurring from oil and gas activities.
- the susceptibility of certain wildlife and aquatic species (including species of special management concern) to disturbance, loss, or modification of habitat from oil and gas activities.
- the presence of special-status wildlife and aquatic species in refuge units and their potential to be present in areas of oil and gas development.

For the programmatic level analysis, a qualitative analysis of the potential impacts of oil and gas operations on the species was conducted based on actual experience of the Service in management of non-Federal oil and gas operations, professional judgment, and information available in the literature. Impacts on special-status animal species are addressed in a subsection following the discussion of impacts on wildlife in general.

TYPICAL IMPACTS OF OIL AND GAS OPERATIONS ON WILDLIFE AND AQUATIC SPECIES

Impacts from Geophysical Exploration

During the geophysical exploration phase, adverse impacts on wildlife and aquatic species habitat can result from localized vegetation clearing and trimming for surveying and increased vehicular traffic associated with seismic investigations. Wildlife and aquatic species could be displaced or could experience increased stress and mortality and decreased production as a result of work crews trimming vegetation or laying lines, and there could be temporary disturbance during the use of the seismic survey technologies due to noise and ground vibration. The removal of vegetation, particularly in forest communities, to accommodate seismic surveys can create linear corridors that fragment the landscape. These linear corridors can change wildlife movement patterns, species interactions, and abundance (Brittingham 2014). Seismic detonations or vibrations could disturb fossorial or burrowing wildlife species. Impacts related to noise are usually temporary, with most wildlife avoiding or moving away from the source, but returning after noise is reduced or eliminated. Seismic survey disturbance would be very localized and intermittent, with the level of impact dependent on the strength of the vibration and proximity to the source. This impact would be relatively limited in extent during this phase. The introduction or spread of nonnative invasive vegetation could occur as a result of vehicular traffic. Invasive species have the ability to outcompete native plant communities and could influence the quality and availability of suitable wildlife habitat within the refuge sites through its invasion.

Surface disturbance from survey crews could also cause localized soil compaction which can increase runoff of surface waters and accelerate soil erosion (Duiker 2004; Pennsylvania State University 2009), ultimately degrading wildlife habitat and nearby aquatic environments. The majority of impacts associated with these surveys are limited in extent and severity, because of the temporary nature of the disturbance and localized area disturbed by survey crews and their activity.

Impacts of Well Drilling and Production

Vegetation removal and soil disturbance associated with the construction and installation of well pads, pipelines, access roads, and other facilities would affect wildlife both directly and indirectly. Indirect effects would include loss of habitat through removal of vegetation by clearing, grading, cutting, filling, and leveling of the site using heavy construction equipment during site preparation. This activity may also affect habitat structure, species composition, and the extent of vegetation available to wildlife. The removal of vegetation, particularly in forest communities, for road construction can create linear corridors that fragment the landscape. These linear corridors can change wildlife movement patterns, species interactions, and abundance (Brittingham 2014). Other indirect impacts may include changes in distribution, stress, or activity caused by increased human disturbances associated with energy development (e.g., traffic, noise, human use) (Sawyer et al. 2002). Site clearing to accommodate a well drilling rig and associated equipment would remove 1.5 to 4 acres of vegetation for each well pad resulting in a long-term conversion of the habitat type to an industrial use.

The degree of impact would depend on the type and amount of habitat affected, the rate at which the site would regenerate after construction, and the frequency of maintenance conducted during operation. For example, surface disturbance to sagebrush steppe vegetation may adversely affect wildlife species that depend on sagebrush for some life history function, as it may take 10 to 20 years for the vegetation to become re-established. Loss of a specific habitat type may also affect neotropical migrant bird species, many of which prefer a more mature tree canopy that could be removed in more heavily forested areas. Also, disturbances or habitat loss in refuge units with larger holdings of wetlands and floodplains, such as Upper Ouachita, Deep Fork, Tensas River, and Atchafalaya NWRs, could affect migratory bird species during seasonal stopovers by reducing the quality and availability of resting and feeding grounds.

Fragmentation of existing wildlife habitats, which can occur from oil and gas well development, can also decrease an area’s functional capacity to support wildlife populations at nonimpacted levels (Trombulak and Frissell 2000). Fragmentation refers to breaking up contiguous areas of vegetation/habitat into smaller patches that become progressively smaller and isolated over time. The removal of vegetation, particularly in forest communities, to install flowlines or pipelines, can create linear corridors that fragment the landscape. These linear corridors can change wildlife movement patterns, species interactions, and abundance (Brittingham 2014). Among other effects, fragmentation of habitat allows predator access to breeding sites used by birds and small mammals along newly created corridors and through edges of habitats that were previously continuous (Johnson 2001).

Direct impacts to wildlife include increased mortality that could result from vehicles, construction activities, and increased access into previously inaccessible areas. Wildlife and aquatic species, particularly small mammals, invertebrates, and herpetofauna (reptiles and amphibians), that cannot escape an area during construction, could be killed, and increased mortality of small mammals is also likely to occur along access roads. New access roads may increase ease of access by humans into formerly remote areas, opening up areas to increased poaching and legal hunting and fishing, and possibly promote new uses such as logging, agriculture, mining, and development (Trombulak and Frissell 2000). Such changes in land cover and land and water use may result in severe and persistent adverse effects on wildlife and wildlife habitat in the refuge units. The refuge unit management, however, can close or restrict motorized public access on roads that are to be used for oil and gas development, if necessary. With this authority, the Service can mitigate the effects of increased public access via oil and gas access roads.

Species that inhabit or frequent areas with sites that have had releases of oil or other chemicals could be harmed or killed through direct exposure with the released materials or indirectly through degraded water quality (e.g., low pH, reduced dissolved oxygen, or sediment toxicity). If releases are transported into waterways, wildlife and aquatic species occupying or using the water could be directly impacted. The severity of impacts would depend on the type and amount of pollutant released, physical and environmental factors of the site, the method and speed with which cleanup occurs, and the sensitivity of wildlife and aquatic species to these impacts during different stages of their life cycle. The Service recognizes that unplanned incidents associated with oil and gas operations such as well blowouts, fires, and major spills within the boundaries of the refuge present a risk of release of contaminants that can adversely impact wildlife and aquatic species.

Contamination from the release of produced waters containing salts and other well drilling fluids could impact wildlife resources in the refuge units. For example, such instances of leaks from oilfield brine flowlines and subsequent contamination resulting from mechanical problems and improper operating practices have been documented at the Anderson Waterfowl Production Area in Montana, and Hagerman and Aransas NWRs in Texas (M. Maddux and M. Borgreen, pers. comm.). These substances may contain relatively large concentrations of dissolved salts, particularly sodium chloride, and can have salt concentrations greater than ocean water. Releases of produced waters (brine) can create salt licks, which may affect the behavior of large mammals and ungulates (Wiles and Weeks 1986). Oilfield brine spills can increase the bioavailability of some heavy metals as well as destroy the soil structure resulting in the significant reduction of infiltration rates (Vavrek et al. 2004). These brine impacted soils are usually devoid of vegetation and are susceptible to erosion. The loss of infiltration will result in increased runoff with impacts to nearby surface water in terms of salinity, and siltation. Releases of produced water with high salinity levels may cause mortality of aquatic organisms such as invertebrates, freshwater mussels, and fish sensitive to increased levels of salinity (Brittingham et al. 2014).

Ground disturbance could also promote the introduction of nonnative plant species by altering habitats, stressing native species, and providing movement corridors (Trombulak and Frissell 2000). A landscape invaded by nonnative species would not support native wildlife populations as effectively as a landscape with native vegetation. Construction that alters the canopy structure of forests, for example, can promote invasion by understory plants, which affects animal communities (e.g., food, nesting, and screening). Such vegetation is present in every Service refuge and various management efforts are ongoing to deal with the establishment and spread of invasive species.

There may be aquatic species habitat degradation from road construction and use, construction of well pads, and placement of pipelines in drainages where these species occur. These effects could decrease the long-term viability of populations as a result of increased sedimentation from construction activities and long-term use. Some risk of direct mortality of aquatic species could occur if a pipeline ruptures at a stream crossing or if toxic materials (such as diesel fuel or produced waste water) are spilled into streams.

Noise from drilling or well servicing operations would also impact wildlife. Potential adverse effects from well drilling and production could include changes in species distribution and use of the area, increased energy expenditure, decreased reproductive success (breeding and nesting success), deafness in species with specialized hearing, and increased stress levels from the noise and disturbance associated with these activities (Sawyer et al. 2002). Increased noise levels during the breeding season can create acoustic masking for species, such as birds, that communicate by sound (Bayne et al. 2008, Francis et al. 2009, Brittingham 2014). Drilling operations introduce noise with the highest measurements in the 90 dBA (A-weighted decibel) range for a period of a week or two up to a few months, with noise coming mostly from multiple diesel engines. Therefore, noise impacts could be severe, but limited to a localized area and of relatively short duration.

Some facilities associated with production operations (i.e., heater treater units, separator units) kill bats, migratory birds, and raptors through asphyxiation or incineration.

Impacts of Plugging and Reclamation

Although well plugging and surface reclamation results in overall beneficial impacts on wildlife and aquatic species, activities associated with the reclamation process may have negative effects. Plugging and abandonment operations and site preparation during reclamation would introduce heavy equipment, along with increased noise levels, for a short time. This could disturb wildlife and aquatic species and cause them to temporarily avoid the area. Vehicle use on and vegetation clearing of access roads and well pads may adversely affect wildlife and aquatic species by increasing poaching in open areas and may temporarily disrupt feeding, denning, spawning/reproduction, and other wildlife behaviors. Plugging and reclamation activities may increase human access and edge effects and temporarily alter wildlife and aquatic species composition and migration. The use of heavy equipment and vehicles to plug and reclaim sites could have the potential for releases of oil and other contaminating and hazardous substances, which could harm or kill aquatic and wildlife species. Recovery of vegetation communities, and ultimately habitat, would be primarily dependent on location, soil conditions, precipitation, and type of community desired. Except for rare vegetation communities that are susceptible to the adverse impacts of oil and gas operations, most vegetation communities in the refuge units would be expected to become re-established.

Wherever access roads have been built or are used for the primary purpose of allowing access for oil and gas operations, access roads would be reclaimed at the completion of operations. This should return the area to its natural conditions, thereby having a beneficial impact on the refuge environment. As oil and gas operations are plugged and abandoned, wildlife and aquatic species habitat would be reclaimed. Wherever possible, habitats would be improved to perpetuate the viability of habitats and increase the survivability of species. The reclamation of the previously disturbed areas, including monitoring and control of exotic species, would also enhance native plant communities in the project areas, and over time, reduce fragmentation. Reclamation of sites would have a beneficial impact on habitat for many species, including many birds and small mammals, when the areas have regrown. This would result in long-term beneficial impacts on native species, their habitat, and the natural processes sustaining them.

Typical Impacts of Oil and Gas Operations on Special-Status Species

The refuges included within the network provide habitat that supports many species of wildlife and aquatic species that are threatened, endangered, or of special concern at the national, regional, and local levels. The Service will manage State and locally listed species within refuge units in a manner similar to its treatment of federally listed species to the greatest extent possible. The conservation of special-status species and their habitats is integral to maintaining biological diversity.

Some of these species and their habitats may occur in areas suitable for oil and gas development. For instance, the federally endangered ocelot is present in South Texas, including Laguna Atascosa, Santa Ana, and Lower Rio Grande Valley NWRs. Given the programmatic nature of this analysis, the exact locations of future operations are unknown and site-specific surveys for presence or absence of special-status species at all existing wells may not have been completed. Wells with current permits would have gone through a review for the presence of special-status species at the time of permitting.

Impacts to special-status animals from oil and gas operations can occur during geophysical exploration, drilling and production, or reclamation phases of development. As noted in the following analysis, impacts on special-status animals are usually avoided or mitigated through intra-Service consultation with the Service's Ecological Services field office, use of project area surveys, and completion of biological assessments where adverse impacts could occur.

Impacts from Geophysical Exploration

During the geophysical exploration phase, adverse impacts on special-status species and their habitat would be similar in nature to those of common wildlife and aquatic species habitats if exploration activities are permitted. Localized trampling of vegetation for surveying and increased vehicular traffic associated with nearby seismic investigations could lead to injury or destruction of sensitive species and their habitat. These operations would be required to avoid impacting species of special concern and their habitat, which would be identified through consulting refuge biologists or through biological surveys, if determined necessary by the Service through consultation with Federal or State agency biologists. When species of special concern and their habitat are found to be within the project area, application of mitigation measures, including sufficient setbacks and/or timing restrictions for sensitive periods in a given species' life cycle, would result in avoiding or minimizing potential adverse effects.

Potential effects from exploration operations could include increased displacement, increased risk of mortality, decreased reproductive succession, and increased stress levels from the noise and disturbance associated with nearby seismic survey activities (Sawyer et al. 2002). These effects could be caused by seismic crews traveling to access the area to be surveyed and by pedestrian travel along receiver lines, as well as the vibrations from the seismic operations, trimming vegetation, and using vehicles on existing roads. Surface disturbance from vehicles could also cause localized soil compaction which can increase runoff of surface waters and accelerate soil erosion (Duiker 2004; Pennsylvania State University 2009), ultimately degrading sensitive habitats. Surface disturbance from survey crews traversing the area during geophysical exploration could also introduce or spread nonnative invasive vegetation. The majority of impacts associated with these surveys would be limited in extent and severity, because of the temporary nature of the disturbance and localized area disturbed by survey crews and their activity.

Listed species could be particularly impacted by the noise associated with seismic survey work, especially vehicle noise. Impacts related to noise are usually temporary, with nearby species avoiding or moving away from the source but returning after noise is reduced or eliminated. Geophysical operations are short term and would have very limited impact on animals given the short duration of operations and pre-operations surveys.

The current regulations do not specifically require minimization of erosion, sedimentation, and other impacts on water quality and quantity that could adversely impact aquatic species such as invertebrates and fish. Mitigation measures included in existing SUPs and ROWs can include setbacks and/or timing restrictions, which result in avoiding or minimizing potential adverse effects on many special-status species. Additionally, upon the completion of exploration operations, reclamation of any disturbed areas could be required by the SUPs or ROWs, and recovery of any habitat that was disturbed is expected to occur over the short term. Application of these requirements would result in short-term and small adverse impacts on special-status species or their habitat from geophysical exploration.

Impacts of Well Drilling and Production

Although drilling and production operations could directly impact species of special concern or their habitat in general, these operations would not be permitted under the ESA if the operations would result in excessive take or jeopardy of the species. However, operations could result in indirect impacts on special-status species, primarily from the disturbance related to construction of new well pads, access roads, flowlines, and pipelines. These impacts would be similar in nature to those of common wildlife and aquatic species. Drilling and production operations could range in duration from short term (weeks or months for well drilling and construction of roads, well pads, flowlines, and pipelines) to long term (lasting 20 years or more for road, flowline, pipeline, well, and production operations). Construction and maintenance of roads, pads, flowlines, and pipelines could require the clearing of vegetation and could result in habitat loss or fragmentation. Construction of open pits to hold large volumes of drilling mud and drill cuttings could also be a source of mortality for birds, reptiles, amphibians, and other wildlife within the refuge units.

Habitat (forest) fragmentation could adversely affect some neotropical migrants that are species of special concern. Potential effects on species of special concern would depend on where drilling and production operations are located. Careful siting of development based on biological survey and/or site assessment results could avoid or minimize these impacts substantially.

If vegetation clearing is unavoidable, it would be limited in extent and mitigation would require that least damaging methods are used for site preparation. In sensitive communities, a large effort would be made during planning and operation to avoid or minimize alteration of the surface area more than necessary, which might include drilling multiple wells from one pad.

Water-dependent species (including fish, mussels, and other invertebrates) could be impacted by the construction and long-term maintenance of roads, pads, flowlines, and pipelines if stream crossings result in alteration of streamflow, water quality, or temperature or in increased sedimentation. Waterways are inherently a part of floodplains (riparian corridors) and wetland areas, and as such receive added protection under various regulatory and policy requirements which protect, streamflows, water quality, and water temperature. When there are no practicable alternatives to locating an operation or activity in floodplains and wetlands, careful siting of facilities and application of stringent mitigation measures would be expected to avoid potential adverse impacts on special-status species and their habitat. Required mitigation for direct and indirect impacts on wetlands could be used to restore wetland habitats and increase species of special concern habitat values.

Displacement of wildlife would continue from initial well pad construction to exploratory drilling, and if the well is placed in production, during the life of the producing well. The increase and ease of public access routes may serve to increase public motorized travel, or if the roads are closed to public motorized travel, they would still serve as access routes on foot, horseback, and mountain bike.

Noise from drilling operations would also impact protected wildlife species. Drilling operations introduce noise with the highest measurements in the 90 dBA range for a period of a week or two up to a few months, with noise coming mostly from multiple diesel engines. Therefore, noise impacts on terrestrial species would be moderate, but limited to a localized area and of relatively short duration. Preconstruction surveys would be done to ensure that impacts on species of special concern, such as bats and birds, would not be excessive.

Some facilities associated with production operations (i.e., heater treater units/separator units) could cause the mortality of special-status bats or birds through asphyxiation or incineration, and mitigation such as a cone device placed on top of all vent stacks could be required to prevent perching and access. Open containers that collect stormwater may be required to have netting or covers to prevent wildlife species from accessing stormwater that may have contacted and mixed with oil, gas, and other contaminating and hazardous substances.

Releases of hazardous or contaminating substances could also pose a threat to special-status species, because exposure to or ingestion of these substances could result in death of a species or impact overall health and survival of affected special-status species and their habitats.

Potential effects on special-status species would depend on where drilling and production operations are located within the units. Careful siting of developments based on biological survey and/or assessment results could avoid or minimize these impacts substantially. Through the required biological surveys and/or assessments and consultations with the Service and other State agency biologists, potential impacts on special-status species and their habitat would be identified, and the application of appropriate mitigation measures would reduce impacts.

Impacts of Plugging and Reclamation

Reclamation actions such as well plugging; shutting down, abandoning, and removing flowlines and pipelines; and the use of heavy equipment and vehicles to reclaim sites could potentially release oil and other contaminating and hazardous substances which could harm or kill special-status species. However, ongoing consultation under the ESA, performing biological surveys of the area that could be potentially impacted by proposed plugging, abandonment, and reclamation operations, identifying protected species, and applying appropriate mitigation would likely result in localized and minimal adverse impacts on special-status species.

Plugging operations and site preparation during reclamation would introduce heavy equipment and people, along with increased noise levels, for a short time. These operations would generally result in localized minimal adverse impacts, but the effect would depend on the season, the background sound levels, and the proximity of operations to species of special concern. Seasonal restrictions would include delaying activities until after a species' nesting or spawning seasons. Access roads that have been developed or allowed to remain open for the primary purpose of allowing access for oil and gas operations would be reclaimed at the completion of operations, returning the area to its natural condition. Wherever possible, habitats would be improved to perpetuate the viability of habitats and increase the survivability of special-status species. The outcome of these activities, in returning natural conditions to the operations area, would have long-term beneficial impacts.

If restored properly, few effects on special-status species would be anticipated and impacts would not affect the overall viability of these species and their habitats. Avoiding areas of known sensitive species and timing of reclamation to avoid conflicts with critical growth periods would reduce impacts on special-status species and encourage restoration success during this phase. Overall, reclamation of the sites would promote beneficial effects on wildlife and their habitat over the long term.

IMPACTS OF ALTERNATIVES ON WILDLIFE AND AQUATIC SPECIES

Purpose and Scope

The purpose of the regulation in all alternatives is to ensure that non-Federal oil and gas operations conducted on NWRS lands and waters avoid or minimize, to the greatest extent practicable, adverse effects on wildlife and aquatic species.

Under Alternative A, the Service scope of application of its regulation and policy provides protection of wildlife and aquatic species on Service fee title lands.

Alternative B, the proposed rule, would expand the area of regulatory application to include tracts where the Federal interest is less than fee (e.g., wetland or grassland easements). As a result of active regulation by the Service, wildlife and aquatic species associated with interests acquired on easements would have a consistent and higher level of protection compared to Alternative A.

Alternative C would expand the scope of regulation to operations conducted on non-Federal surface locations drilling under a refuge or any operation on private land within a refuge (i.e., an inholding). The level of increased protection for wildlife and aquatic species would vary from slight to moderate depending on proximity of those operations to refuge boundaries, as well as State rules (and operator's compliance with those rules) in place that serve to reduce such impacts (e.g., seasonal restrictions).

Accessing Oil and Gas Rights from a Non-Federal Surface Location

Under Alternative A the incentive for operators to locate their operations outside refuge units would remain in place as described at the beginning of this chapter. The location of surface operations outside refuge units avoids direct impacts to wildlife and aquatic species within refuge units. However, wells directionally drilled and produced from outside refuge units to bottomholes beneath the refuge units would directly impact wildlife and aquatic species on adjacent lands as well as present a risk of indirect impacts within the refuge units. Depending on the proximity of these operations to the refuge, some indirect impacts to wildlife and aquatic species on a refuge could occur because the Service would not be imposing preventive measures, such as noise abatement standards. The risk and intensity of impacts on refuge resources would increase for operations sited closer to refuge boundaries where human activity could disturb wildlife and aquatic species, or affect important habitats. Intensity of impacts on refuge resources would depend on proximity of operations to the refuge units; site-specific environmental conditions, such as habitat quality; and mitigation measures.

Alternative B, the preferred alternative, would provide an increased incentive for operators to locate their operations outside refuges. Therefore, it is likely that direct impacts from new production and drilling operations would be avoided to a greater extent than in Alternative A. The risk and intensity of indirect impacts on refuges resources would similar to Alternative A.

Under Alternative C, directional drilling operations on non-Federal surface locations would be subject to the full regulatory requirements of the proposed rule. The Service would impose operational standards on activities outside the refuge to the extent necessary to avoid or minimize impacts on refuge resources and uses. Operational standards could require better control of erosion and noxious plants thus reducing impacts to wildlife and aquatic species within the refuge boundary.

However, application of regulation to surface and subsurface operations outside a refuge would largely remove an operator’s incentive to avoid surface use in a refuge, so the number of drilling and production operations located on refuges would likely increase. Therefore, compared to Alternatives A and B, Alternative C would increase the instances where new drilling operations create direct, adverse, and long-term impacts to refuge wildlife and aquatic species .

Requirement to Obtain a Service Permit to Conduct Operations

Under Alternative A, the Service would continue to work to ensure new operations are under a Service-issued SUP or ROW, which would reduce the impacts of geophysical operations and new drilling and production operations. When an operator obtains a Service permit prior to conducting operations, it provides additional protection for wildlife and aquatic species. The permitting process ensures ongoing communication between refuge staff and the operator; that an operator includes mitigation measures to avoid or minimize impacts to refuge resources and uses; and that an operator is aware of expectations to reclaim a site to restore refuge resources and ensure long term protection of refuge resources and uses. However, the permit requirement itself has not been consistent across the Service; where permits have been issued, the permit conditions have varied widely resulting in the possibility of unnecessary impacts to wildlife and aquatic species.

Under Alternative A, there would be unnecessary impacts on wildlife and aquatic species from the estimated 4,000 pre-existing oil and gas production operations not under an SUP or ROW, including those described above under Typical Impacts of Oil and Gas Operations on Wildlife and Aquatic Species. The Service estimates that the 4,000 pre-existing wells in 107 refuges have created approximately 6,000 acres of direct disturbance associated with well sites and access roads. Direct surface disturbances from well pads and roads in refuges range from 1 to 6 acres with the average area of disturbance estimated at approximately 1.5 acres per operation.

The primary effects on wildlife and aquatic species from oil and gas operations include noise and human activity associated with disturbed areas, injuries and mortality from traffic and activities on the pad, and potential for poisoning from chemical leaks and spills. As previously discussed, most of the impacts to wildlife and aquatic species occurred when the operation was originally chosen and developed by the operator to accommodate their drilling and production operations.

However, some continuing unnecessary impacts may occur under Alternative A due to the lack of any requirement that these pre-existing operations have ongoing mitigation measures to protect wildlife and aquatic species and the fact the Service does not currently have a way to ensure operations are complying with any State laws that would protect wildlife and aquatic species. Typical mitigation measures that would minimize ongoing impacts from pre-existing operations on wildlife and aquatic species could include use of telemetry to reduce traffic, enforce speed limits, implement effective interim reclamation, or siting operations a minimum distance from important habitats.

Under Alternative B, all new operations would be under a consistent permitting process that would include required consultation with the Service, performance-based standards to avoid or minimize impacts to wildlife and aquatic species, and other administrative provisions such as financial assurance, cost recovery, and access fees that would ensure protection of wildlife and aquatic species from the typical impacts of oil and gas development to the greatest extent practicable.

Similar to Alternative A, pre-existing operations would not be required to obtain an operations permit during the production phase. However, in contrast to Alternative A, the Service would manage these operations by assimilating State laws and regulations into the rule, thereby increasing the Service's enforcement ability on refuge lands. So, during the production phase, impacts to wildlife and aquatic species would be reduced compared to Alternative A due to improved compliance with State rules that serve to lower such impacts, such as requirements to address leaks and spills, handling of chemicals and fencing exploration and production waste sites (GWPC 2014; La. Admin. Code tit. 43, Part XIX, §509). Overall, the Service expects that the large majority of issues related to impacts on wildlife and aquatic species would be resolved by compliance with State laws and regulations.

Additionally, under Alternative B, all operations, including pre-existing operations, would be required to have a Service-issued permit for reclamation that would ensure all operations meet Service's reclamation standards, which would also greatly reduce any long-term impacts on wildlife and aquatic species as discussed further below in Performance-Based Standards.

Assimilation of State laws and regulations during the production phase combined with reclamation to Service standards ensures a substantial and consistent long-term benefit to wildlife and aquatic species compared to Alternative A.

Alternative C would require all operators on refuges to obtain a permit for their operations, including pre-existing operations. Compared to the proposed rule, Alternative C may provide additional protections for wildlife and aquatic species from impacts associated with pre-existing operations. Since the greatest impacts to wildlife and aquatic species have already occurred, the Service would be focusing on maintenance issues, such as spill containment and remediation, and removal of debris, waste, and equipment no longer needed in operations, as well as potential seasonal activity restrictions in those cases where State laws and regulations do not meet Service operating standards. Alternative C would also require operations on inholdings and those directionally drilling underneath a refuge from non-Federal surface locations to obtain a permit to the extent necessary to protect wildlife and aquatic species. In most cases, since the activity is occurring directly on private surface estate, the Service would not identify operational measures to protect wildlife and aquatic species on adjacent Federal surface estate. Thus, for these operations, the impacts on vegetation and plant species of management concern would be similar to Alternative B.

Performance-Based Standards

Under Alternative A, current policy, which does not allow for the complete standardization of stipulations and conditions on oil and gas operations, would remain in effect. Oil and gas operations would be managed on an individual unit basis, with protective stipulations developed in a site-specific manner. Generally, stipulations are applied to Service permits to include protection of air quality, soils, water, wildlife, wildlife habitat, and other refuge resources; however, a suite of performance-based standards for protection of refuge resources and uses would not be available. As a result, the levels of protection would vary widely across the NWRS with continued impacts on refuge resources.

Under Alternative B, the proposed regulations establish performance-based standards for avoiding or minimizing impacts to refuge resources or visitor uses during operations. The proposed regulations also include standards for achieving successful surface reclamation once operations end. The use of standards or performance goals provides flexibility to resource managers and operators to achieve standards across various environments using new and evolving technology. The proposed rule includes standards for surface use and site management, specific resource protections, spill prevention and response, waste management, and reclamation. These specific standards are all considered and incorporated into project design so that overall, operations are conducted in a manner most protective of refuge resources and uses while ensuring human health and safety. Use of the technologically feasible, least damaging methods takes into consideration all relevant factors, including environmental, economic, and technological factors and the requirements of applicable law. Performance-based standards would serve to ensure that impacts on wildlife and aquatic species within refuge units are avoided or minimized.

Alternative C would expand Service jurisdiction under the regulations to encompass surface and subsurface directional drilling operations outside the boundary of a refuge and operations on private surface estate within a refuge boundary. Directional drilling operations would be subject to the full regulatory requirements of a new operation. The Service would impose operational standards on activities outside the refuge to the extent necessary to avoid or minimize impacts on refuge resources and uses. Operational standards would requirement minimization of human disturbance, reducing overall footprint of the operation, reductions in noise and adjusting lighting, and where appropriate, applying seasonal or spatial buffers, and thus reducing impacts to wildlife and aquatic species within the refuge boundary.

Under Alternative C, all phases of pre-existing operations within the refuge boundary would be subject to all provisions of the proposed rule as described under Alternative B. Pre-existing operations on private surface estate within a refuge boundary as well as pre-existing operations outside and adjacent to the refuge boundary would continue production activities but would eventually require an operations permit to ensure compliance with the reclamation standards of the proposed rule. Impacts to wildlife and aquatic species would be reduced as described under Alternative B.

CUMULATIVE IMPACTS

Alternative A: No-Action

Actions inside and outside the refuge units and local trends in oil and gas development can cumulatively affect wildlife and aquatic species of the refuges. Management planning, such as fire management, vegetation management, and ORV plans, can result in greater protection for these resources. Conversely, actions that cause disturbance of these resources would include activities such as prescribed burns, ORV use, mining, agricultural and logging activities, as well as any general development activities that include excavation, grading, or construction. Past, present, and reasonably foreseeable activities that would have beneficial or adverse impacts on wildlife and aquatic species in the area of analysis (including both refuge lands and adjacent lands) and a brief summary of the cumulative impacts of these actions on wildlife and aquatic species are listed in Table 4-8.

TABLE 4-8. CUMULATIVE IMPACTS ON WILDLIFE AND AQUATIC SPECIES (PROGRAMMATIC LEVEL FOR REFUGES)

Past, Present, and Reasonably Foreseeable Activity	Impacts on Wildlife
Prescribed fires and fire management actions	Short-term and long-term adverse effects on species productivity following removal of vegetation and habitat; short- and long–term impacts from fire line construction that requires digging and displacement of vegetation matter from burning of surface litter and topsoil. Long-term beneficial effects of reduced fire occurrences with managed burns that reduce the possibility of catastrophic and high intensity fire; improved productivity and erosion control from vegetative cover that is established after these treatments.
Service facility and road construction	Short-term and long-term adverse effects on species from direct loss or damage to soils and habitat when removed for development; compaction of soils and damage or loss of wildlife and habitat during road grading and construction using heavy equipment. Short-term to long-term adverse impacts from the loss of habitat and ground disturbance/soil erosion and compaction.
Vegetation management	Short-term adverse impacts due to vegetation clearing, habitat fragmentation, and effects on soils. Long-term beneficial effects of erosion control from improved habitat quality. Short term adverse impacts with long-term beneficial effects from site reclamation. Long-term beneficial effects of controlling the introduction and spread of nonnative invasive species.
Trails development and maintenance	Short-term and long-term adverse effects on wildlife habitat from clearing, grading and surfacing of trails, removal of vegetation in trail footprint for maintenance, habitat fragmentation, increased disturbance and predation, and potential introduction of nonnative plant species.
ORV use	Short- and long-term adverse effects on habitat from compaction and vehicle-related disturbances and mortality of wildlife species.
Abandoned mine lands reclamation	Short-term adverse effects on habitat during reclamation-related disturbances. Long-term beneficial effects of improved surface (revegetation) and reduced erosion following re-establishment of vegetation cover/habitat and natural contours.
Mining and logging activities	Long-term adverse effects on soils from erosion stemming from legacy surface disturbances and vegetation removal and long-term effects of acid mine drainage on wildlife and aquatic species.
Recreational use	Short- and long-term adverse effects on wildlife from visitor activities including trampling and associated compaction, noise and human disturbance, possible introduction of nonnative plant species.
Ranching, agricultural land uses	Short- and long-term adverse effects from operations that remove vegetation cover, compact soils, grazing pressure, and reduce habitat quality.
Land development: residential and nonresidential	Short- and long-term adverse effects on wildlife from direct loss of habitat in development footprint and compaction, erosion and sedimentation, habitat fragmentation, noise. Benefit from re-establishment of vegetation and habitat following construction-related

Past, Present, and Reasonably Foreseeable Activity	Impacts on Wildlife
(commercial, industrial) land uses, including road construction	disturbances.
Future oil and gas development on adjacent lands	Direct effects on wildlife from adjacent property and indirect adverse impacts on refuge resources from “spill-over effects” of erosion, sedimentation, and contamination from surface runoff; trends indicate that the exploration and production of shale gas, in particular, is anticipated to increase dramatically over the next 30 years.
Oil and gas well plugging and reclamation activities inside and outside refuges	Short-term adverse effects on wildlife from reclamation related disturbances due to use of equipment on site and grading. Long-term beneficial effects of restoration of natural contours, topsoil and vegetation cover that protects soils from erosion and improves habitat quality; removal of sources of contamination and contaminated soils and water to reduce impact on wildlife habitat.
Industrial discharges to air and water from sources outside the refuge unit	Short- and long-term direct adverse effects on wildlife from discharges on adjacent property and indirect adverse impacts on refuge resources from “spill-over effects” of contamination.

Alternative B: Proposed Rule (Preferred Alternative)

Under Alternative B, there would be adverse and beneficial cumulative impacts from projects, plans, actions, and trends in oil and gas development that were considered in the cumulative scenario. These are described under Alternative A and would be the same under Alternative B. Alternative B would contribute to cumulative impacts from the continued operations of pre-existing operations not under an SUP or ROW, which would continue to have long-term direct adverse impacts on wildlife and aquatic species, as described in the above analysis. Bringing new operations and the reclamation phase of pre-existing operations under regulation would add substantial beneficial impacts on wildlife and aquatic species. When combined with the effects of all other actions in the study area, cumulative impacts from the actions under Alternative B would be long-term and both adverse and beneficial, with Alternative B contributing mainly beneficial impacts on overall cumulative impacts from the change in regulations.

Alternative C

Cumulative impacts from actions under the cumulative impact scenario would be the same as described under Alternative A. Similar to Alternative B, there would be effects on wildlife and aquatic species as a result of oil and gas operations that would continue to affect these species where impacts cannot be avoided. However, there would be benefits from bringing new operations and the reclamation phase of pre-existing operations under regulations and the resultant reduction in adverse impacts, as described in the Alternative B analysis. Alternative C would contribute to cumulative impacts mostly by adding beneficial impacts of bringing new operations and the reclamation phase of pre-existing operations under regulation, but also by possibly adding adverse impacts from the change in directional drilling regulations that could result in more oil and gas development within refuge units as opposed to outside refuge boundaries. Overall, under Alternative C, both adverse and beneficial cumulative impacts would accrue from projects, plans, and actions considered in the cumulative scenario. When combined with the effects of all other actions in the study area, cumulative impacts would be long term and both adverse and beneficial.

VISITOR USE AND EXPERIENCE

METHODOLOGY

Potential impacts on visitor use and experience are assessed based on the actions being proposed and the various visitor use and experiences available at refuges, with attention to characteristics such as health and safety, noise, visibility, and access that may affect visitor use and experience. Topic-specific context for assessing impacts of the alternatives to visitor use and experience includes the following:

- the type of visitor experience desired (as noted in chapter 3, refuges are visited by people desiring a range of uses and experiences, from passive or casual use, to very active use and backcountry experiences)
- the proximity of the areas used by visitors to oil and gas operations (this can especially affect noise and visual impacts, which are addressed in more detail under separate topics)
- the particular health and safety issues related to oil and gas operations, including exposure to oils, gases, and other hazardous chemicals that are used in oil and gas exploration and development

TYPICAL IMPACTS OF OIL AND GAS OPERATIONS ON VISITOR USE AND EXPERIENCE

Impacts from Geophysical Exploration

During the geophysical exploration phase, adverse impacts on visitor use and experience result primarily from the presence of seismic survey crews and equipment in and around the refuge, and the detonation of explosives. The following describes typical impacts that can occur:

Access—Seismic operations may preclude use of the survey areas including some refuge roads by refuge visitors while survey crews are working. Access limitations would be temporary because most surveys last a few weeks to a few months and affect only certain areas of the refuges at one time. For example, visitor access and seismic activity creates a use conflict during hunting seasons or times of prime bird watching.

Scenic Views—During geophysical operations, the presence of seismic survey personnel and their vehicles and equipment could cause adverse visual impacts for visitors that are seeking a refuge-like or natural experience. Flagging used to mark site lines can be distracting, and the cutting of survey lines through dense vegetation can require creation of paths for vehicles and crews and clear a line of sight that is not natural.

Noise—The noise associated with seismic surveys would occur from the use of vehicles, crews, and Vibroseis® trucks. Chainsaws are often used to clear a survey line of sight, and helicopters may be used to transport equipment. Noise generated by these seismic survey activities would be intermittent and typically occurs over a period of 3 weeks to 3 months. Helicopters, when used, are the primary noise source in seismic operations. Often two or more helicopters are used to support a seismic shoot.

In these cases, the noise would be continuous during daytime operations, but limited to a 2- to 3-week time frame within the active area of operations.

Health and Safety—Seismic surveys can introduce some health and safety concerns by exposing refuge visitors to hazards associated with increased vehicular traffic and safety hazards to crews working with explosives. Visitor access is limited to areas to reduce the possibility of encounters.

Overall, given the short duration (weeks to a few months) of seismic surveys, the majority of impacts associated with geophysical surveys would be limited in extent.

Impacts of Well Drilling and Production

Access—the primary effect of well drilling and production is a reduction in access to any well pads and associated production facilities or access roads. All drilling and production operations would be closed to visitor access. Due to safety concerns, there may be additional restrictions to visitor access immediately adjacent to these sites. Indirect impacts, such as increased traffic, noise, dust, odors, night lighting, and human activity, would not necessarily preclude recreational access, but would decrease the quality of the visitor experience in the vicinity of the operation, especially in more remote portions of the refuges. Workovers and servicing of existing operations could also cause access delays or restrictions.

Scenic Views—Visual impacts on visitor experience from drilling and production operations could be more substantial than other types of impacts on visitors, especially if well pads were placed in relatively undisturbed or popular settings where visitors would be readily able to see the operation and all associated equipment and tanks, and visitors to that area were expecting or desiring a more natural experience. Drill rigs can reach heights of 180 feet, which would most likely be visible from several locations within the refuges. Initial site clearing would remove approximately 1.5 to 4 acres of vegetation for each well pad (SHIP 2013), and access road construction would often result in visible cuts through refuge vegetation or creation of a definitive pathway, depending on the location and refuge. The operations, especially drilling, would increase the presence of work crews and equipment. Since drilling is a 24-hour, 7-day a week operation, these impacts would be continuous, and could last a week or two up to a few months. Hydraulic fracturing operations would require a few more weeks for completion. Production operations, although having a less intrusive human presence compared to drilling, could be visible for 20 years or longer. Please see the scenic views and night sky resources topic for more details on this aspect of visitor experience.

Coming across an oil drilling rig or production site could be an unpleasant experience for visitors seeking a natural, outdoor experience. The visual presence of oil and gas operations in a natural setting could adversely impact the areas by displacing the visitor or lessening the quality of the visitor experience. The impacts would be less for those visitors who are less concerned with the presence of such operations, and where operations are naturally screened from view.

Noise—As discussed in more detail under the Natural Soundscapes and Acoustic Environment topic, there would be increased noise from construction activities (vehicles, chainsaws, and earthmoving equipment), drilling rigs, and the drilling or workover crew that could adversely affect human health, visitor use and experience, wildlife, and the overall acoustic environment. Operations involving hydraulic fracturing would result in greater truck traffic and associated vehicular and compressor noise, which could cause temporary disturbance to visitors using the same roadways in the refuge or areas located near these operations, and could last an additional 2 to 4 weeks compared to regular drilling operations. These noises would be different from the types of noises common in the visitor use areas, or general background noises elsewhere in the refuge. As noted in the Natural Soundscapes and Acoustic Environment section, noise from a typical rotary drilling rig is estimated to be approximately 63 dBA at a distance of 200 feet. Noise impacts would be unavoidable if they were close enough to a visitor use area to cause interference with the enjoyment or use of the area, and would conflict with a variety of refuge goals. In refuges where operations are located close to active recreation (e.g., motor boating), the noise associated with the oil and gas operations would not be as noticeable.

Noise from exploration, development, and extraction activities can be mitigated through a variety of ways including, but not limited to, use of quieter engines, quieter machinery, noise barriers, noise enclosures, and timing of operations to avoid the quietest times of day or certain seasons for which impacts would be greater (i.e., nesting season for sage grouse).

Production operations would also cause impacts because of the noise associated with production equipment and the short-term use of loud machinery and workover rigs onsite. These impacts would result from high sound levels while being temporary in nature. However, most noise levels associated with production would have lower sound levels than those generated by a drilling operation, yet would be continuous and could have other impacts to the soundscape, acoustic environment or the wildlife that rely on natural acoustic conditions.

Odors/Health and Safety—The primary source of odors would be from drilling or production operations, especially if spills or leaks occurred and oil or other chemicals were not quickly cleaned up and removed from the site. Drilling and production have the potential for well blowouts and releases of hydrocarbons or other hazardous substances, including drilling muds and gases such as hydrogen sulfide (H_2S). Pumpjacks with automatic timers are also a safety hazard, as they can be activated at any moment. Visitors could also be drawn to well pads and sites out of curiosity, resulting in potential exposure to dangerous equipment or stored chemicals. Hunters, in particular, need to keep a safe distance from oil and gas operations; there is an inherent hazard of shooting near drilling rigs and production facilities (i.e., storage tanks, wellheads, and pumpjacks) where bullets could penetrate equipment or cause ignition of flammables. There is the possibility of storm damage to drilling and production operations, which could spread hazardous and contaminating substances. Perforating or rupturing a storage tank containing oil or treatment chemicals at a production facility would increase the threat of spills and subsequent harm to the public if they were to venture onto the site.

A potential impact on human health and safety is the possible exposure to hazardous substances. Materials stored at well sites include oils, chemicals, and lubricants. Also, oil and gas wells can release hydrogen sulfide gas. If well sites are not fenced and are open to the public, there is a chance of visitor exposure to these substances if visitors enter the unsecured site. Most wells would operate under an emergency response plan that would address hydrogen sulfide releases and other possible scenarios. For those wells that may emit hydrogen sulfide, a radius-of-exposure analysis would likely be performed prior to site selection. However, the Service recognizes that unplanned incidents associated with oil and gas operations such as well blowouts, fires, and major spills within the boundaries of the refuge present a risk of release of contaminants that can adversely impact visitor use and experience by actual exposure to chemicals or from lack of access following an incident, depending on the location of the release.

For directionally drilled wells, the location of these wells outside the refuge boundary means that most of the impacts addressed above would not be experienced by visitors in the refuge. However, if these wells are close enough to the refuge boundary, noise and even lighting can carry into the refuge, and effects could be similar to those described for operations inside the refuge units. However, the intensity of impacts would vary with the location of the well. Impacts on refuge visitors could also occur if operations bordering the refuges but visible to visitors created unsightly and/or unnatural conditions Severity of impacts would depend on proximity of operations to the refuge units; site specific environmental conditions, such as topography and vegetative cover that would provide natural screening; and mitigation measures being employed.

Impacts of Plugging and Reclamation

Access—Plugging and reclamation operations would have public access impacts similar to those described for drilling and production, but would be limited in duration to the time needed to plug and reclaim each operations site. Reclamation operations would not interfere substantially with visitor access, and when completed, would restore access to areas previously off-limits to visitors.

Scenic Views—The presence of heavy equipment and a service rig associated with plugging and reclamation activities would have similar impacts on scenic views and night sky resources as described for drilling and production operations. However, plugging and reclamation would end disturbances from production activities, and the sites would be restored to a more natural character, although some roads may be left in place for future use. Reclamation of the well pads following plugging of the wells would serve to eliminate the unnatural views of the site over time. The actual time required to reclaim the site's scenic views would depend on many factors, including the erosion potential of the site, productivity of the vegetation, topography, and soil characteristics, including the presence of any contamination. Artificial lighting would be removed and flaring activities would cease. Ultimately, the removal of the rig and associated structures and equipment, in conjunction with site reclamation, would improve the scenic views near the well sites. The effects on visitor experience would range from a beneficial effect of having a natural setting restored, to essentially no effect on visitors for those wells in areas far from visitor uses or in locations where visitors have not been bothered by the presence of the wells.

Noise—The operations involved in site closure would cause temporary increases in noise from earthmoving, demolition, and other equipment, as described for drilling and production. However, when closure and reclamation are completed, noise levels would return to ambient levels similar to those before the installation of the oil and gas operation and would have overall beneficial impacts to the soundscape and acoustic environment.

Odors/Health and Safety—There could be odors during plugging and reclamation operations from heavy-equipment exhaust and emanating from leaks and spills. Once plugging and reclamation is complete, plugging and reclamation of wells would remove threats associated with exposure to hazardous wellhead equipment, ignition of flammable gases, possible flowline ruptures, and ingestion, inhalation, or absorption of spilled or released hydrocarbons, contaminants, or hazardous substances and remove a risk to visitor health and safety.

Purpose and Scope

The purpose of the regulation in all alternatives is to ensure that non-Federal oil and gas operations conducted on NWRS lands and waters avoid or minimize, to the greatest extent practicable, adverse effects on visitor use and experience.

Under Alternative A, the Service scope of application of its regulation and policy provides protection of visitor use and experience on Service fee title lands.

Alternative B, the proposed rule, would expand the area of regulatory application to include tracts where the Federal interest is less than fee (e.g., wetland or grassland easements). Because most easements are not open to visitors, this expanded scope would not result in further protections for visitor use and experience.

The level of increased protection for visitor use and experience would vary from slight to moderate depending on the proximity of those operations to refuge boundaries, as well as State rules (and operator's compliance with those rules) in place that serve to reduce such impacts (e.g., minimizing lighting, siting well pads so they are screened from view by vegetation and topography if possible, painting drilling and production equipment to blend in with the surrounding environment, keeping sites clean, promptly cleaning up spills, and removing debris, waste, and equipment no longer needed in operations,).

Accessing Oil and Gas Rights from a Non-Federal Surface Location

Under Alternative A the incentive for operators to locate their operations outside refuge units would remain in place as described at the beginning of this chapter. The primary effects on visitor use and experience from oil and gas operations stem from the fact that these operations by their very nature exclude visitor use from refuge areas where these activities are located, therefore, operators locating operations off refuge lands and waters will provide the greatest protections to visitor use and experience. However, wells directionally drilled and produced from outside refuge units to bottomholes beneath the refuge units could indirectly impact visitor use and experience within the refuge units, primarily due to noise and the visibility of these operations. Depending on the proximity of these operations to the refuge, some indirect impacts to visitor uses on a refuge could occur because the Service would not be imposing preventive measures, such as noise abatement standards. The risk and intensity of impacts on refuge resources would increase for operations sited closer to refuge boundaries where noise and visibility would diminish the experience for refuge visitors.

Alternative C would expand Service jurisdiction under the regulations to encompass drilling operations on inholdings and non-Federal surface locations drilling underneath a refuge. The Service would impose operational standards on activities outside the refuge to the extent necessary to avoid or minimize impacts on refuge resources and uses. Operational standards could reduce noise, and visual impacts to visitor use and experience within the refuge boundary. The further protections afforded by Alternative C on visitor use and experience would vary depending on the proximity of the operation to refuge boundaries.

However, Alternative C eliminates the incentive to locate an operation outside a refuge, so there would likely be a significant increase in the number of drilling and production operations located on refuges, as well as the direct impacts to visitor use and experience. Therefore, compared to Alternatives A and B, Alternative C would increase the instances where new drilling operations create direct, adverse, and long-term impacts to refuge visitor use and experience.

Requirement to Obtain a Service Permit to Conduct Operations

Under Alternative A, the Service would continue to work to ensure new operations are under a Service-issued SUP or ROW, which would reduce the impacts of geophysical operations and new drilling and production operations. When an operator obtains a Service permit prior to conducting operations, it provides additional protection of visitor use and experience. The permitting process ensures ongoing communication between Refuge staff and the operator; that an operator includes mitigation measures to avoid or minimize impacts to refuge resources and uses; and that an operator is aware of expectations to reclaim a site to restore refuge resources and ensure long term protection of refuge resources and uses. However, the permit requirement itself has not been consistent across the Service; where permits have been issued, the permit conditions have varied widely resulting in the possibility of unnecessary impacts to visitor use and experience.

Under Alternative A, there would be unnecessary impacts on visitor use and experience from the estimated 4,000 pre-existing oil and gas production operations not under an SUP or ROW, including those described above under Typical Impacts of Oil and Gas Operations on Visitor Use and Experience. The Service estimates that the 4,000 pre-existing wells in 107 refuges have created approximately 6,000 acres of direct disturbance associated with well sites and access roads. Direct surface disturbances from well pads and roads in refuges range from 1 to 6 acres with the average area of disturbance estimated at approximately 1.5 acres per operation.

The primary effects on visitor use and experience stem from the fact that those land and waters where operations are located can no longer be used by visitors. So, as previously discussed regarding time/place/manner considerations, most of the impacts to visitor use and experience occurred when the operator chose and developed the site to accommodate their drilling and production operations.

However, some continuing unnecessary impacts may occur under Alternative A due to the lack of any requirement that these pre-existing operations have ongoing mitigation measures to protect visitor use and experience and the fact the Service does not currently have a way to ensure operations are complying with any State laws that would protect visitor use and experience. For instance, a typical mitigation measure that would minimize ongoing impacts from pre-existing operations on visitor use and experience would be timing restrictions on certain activities to minimize noise disturbances to visitors.

Under Alternative B, all new operations would be under a consistent permitting process that would include required consultation with the Service, performance-based standards to avoid or minimize impacts to visitor use and experience and other administrative provisions such as financial assurance, cost recovery, and access fees that would ensure protection of visitor use and experience from the typical impacts of oil and gas development to the greatest extent practicable.

Similar to Alternative A, pre-existing operations would not be required to obtain an operations permit during the production phase. However, in contrast to Alternative A, the Service would manage these operations by assimilating State laws and regulations into the rule, thereby increasing the Service’s enforcement ability on refuge lands. So, during the production phase, impacts to visitor use and experience would be reduced compared to Alternative A due to improved compliance with State rules that serve to lower such impacts, such as State rules addressing pit closure as well as the removal of oil-contaminated soils from tank battery sites to protect soils and water, and clean-up standards for soils contaminated by oil spills (GWPC 2014; La. Admin. Code tit. 43, Part XIX, §503). Overall, the Service expects that the large majority of issues related to ongoing impacts on visitor use and experience would be resolved by compliance with State laws and regulations.

Additionally, under Alternative B, all operations, including pre-existing operations, would be required to have a Service-issued permit for reclamation that would ensure all operations meet the Service’s reclamation standards, which would also greatly reduce any long-term impacts on visitor use and experience as discussed further below in Performance-Based Standards.

Assimilation of State laws and regulations during the production phase combined with reclamation to Service standards ensures a substantial and consistent long-term benefit to visitor use and experience compared to Alternative A.

Alternative C would require all operators on refuges to obtain a permit for their operations, including pre-existing operations. Compared to Alternative B, Alternative C may provide additional protections for visitor use and experience from impacts associated with pre-existing operations. Alternative C would also require operations on inholdings and those directionally drilling underneath a refuge from non-Federal surface locations to obtain a permit to the extent necessary to protect visitor use and experience. In most cases, since the activity is occurring directly on private surface estate, the Service would not identify operational measures to protect visitor use and experience on adjacent Federal surface estate. Thus, for these operations, the impacts on visitor use and experience would be similar to Alternative B.

Performance-Based Standards

Under Alternative A, oil and gas operations would be managed on an individual unit basis, with protective stipulations developed in a site-specific manner. New operations would be subject to operating practices, as defined in SUPs or ROWs that serve to minimize or avoid impacts on visitor use and experience. These could include site security to protect visitors from hazardous conditions, and seasonal restrictions to avoid periods of high visitor use; however, the operating practices included in the SUPs or ROWs are usually negotiated between the refuge manager and the oil operator. Thus, the levels of protection may vary somewhat from permit to permit and by refuge as the existing regulations do not provide specific operating standards for the protection of refuge resources. The level of monitoring and cooperation with operators to address impacts on refuge resources and uses would continue to vary widely, resulting in unnecessary impacts to visitor use and experience. For the 4,000 pre-existing operations, reclamation is conducted without regard for Service goals or only to the extent a refuge manager is able to negotiate to have reclamation goals addressed. Reclamation for these wells often falls short of Service reclamation standards.

Under Alternatives B and C, the proposed rule establishes performance-based standards for avoiding or minimizing impacts to visitor use and experience. All new operations on NWRS lands and waters would be subject to consistent standards and requirements of the proposed rule for protecting visitor use and experience. So, as previously discussed, new operations create the greatest additional impacts on visitor use and experience, so establishing performance-based standards that would include proper site planning, timing restrictions and the best management practices would avoid or minimize many of the typical impacts to visitor use and experience from oil and gas development. Also, the proposed rule includes additional standards that would protect visitor use and experience, such as installation and maintenance of secondary containment for all equipment and facilities using or containing contaminating substances such as oil, brine, formation water, or well stimulation chemicals, the removal of any contaminating substances, noise reduction, and requiring operators to minimize the appearance of their facilities by blending the operations with the background environment Standards would also include designing, constructing, operating, and maintaining access to the operational site to cause the minimum amount of surface disturbance needed to safely conduct operations and to avoid areas identified as important for wildlife-dependent recreation.

The proposed rule also includes standards for achieving successful surface reclamation once operations end. All operations, including pre-existing operations, would have to meet Service reclamation standards, such as plugging all wells, removing all above-ground structures, equipment, roads, well pads, and contaminating substances, re-establishing native vegetation, restoring conditions to predisturbance hydrologic functions, and restoring natural systems using native soil material that would reduce impacts to geologic and soil resources within the refuge units. Therefore, eventually, the disturbance associated with the 4,000 pre-existing wells would be restored to Service standards, providing a substantial long-term reduction or removal of adverse impacts on visitor use and experience compared to Alternative A

Under Alternative C, pre-existing operations would be required to abide by the performance-based standards established under the proposed rule during the production phase. Compared to Alternative B, Alternative C may provide for implementation of higher standards for protection of visitor use and experience. Since the greatest impacts to visitor use and experience have already occurred, the Service would be focusing on ongoing issues, such as timing restrictions to avoid noise disturbances, and proper storage and removal of hazardous substances to ensure visitor health and safety where State laws and regulations do not meet Service operating standards.

Also, operations on inholdings and operations on non-Federal surfaces directionally drilling underneath a refuge would be subject to the performance-based standards established in the proposed rule to the extent necessary to protect visitor use and experience. The level of increased protection would vary from slight to moderate depending on State rules in place that serve to reduce such impacts (e.g., spill control and cleanup requirements), and the proximity of the surface location of operations on non-Federal surfaces to the refuge (e.g., noise disturbances).

Finally, under Alternative C, performance-based standards would also be established for downhole operations. Visitor use and experience would only be impacted by accidents associated with well control. Given present day technology, events that result in loss of well control (blowouts) are extremely rare. Service regulation could possibly serve to lower an already low risk of a well blowout, but in practice, the Service finds that State requirements for well control and the expectation that companies will act in their own best interest would preclude the need for the Service to regulate aspects of drilling and production related to well control. Thus, the Service does not expect any reduction of impacts or risks of impacts to visitor use and experience related to our downhole regulation under Alternative C.

Cumulative Impacts

Actions inside and outside the refuge units and local trends in oil and gas development can cumulatively affect visitor use and experience on refuges. Management planning, such as fire management, vegetation management, and ORV plans, can result in greater protection for these resources. Conversely, actions that cause disturbance of these resources would include activities such as prescribed burns, ORV use, mining, agricultural and logging activities, as well as any general development activities that include excavation, grading, or construction. Past, present, and reasonably foreseeable activities that would have beneficial or adverse impacts on visitor use and experience in the area of analysis (including both refuge lands and adjacent lands) and a brief summary of the cumulative impacts of these actions on visitor use and experience are listed in Table 4-9.

TABLE 4-9. CUMULATIVE IMPACTS ON VISITOR USE AND EXPERIENCE (PROGRAMMATIC LEVEL FOR REFUGES)

Past, Present, and Reasonably Foreseeable Activity	Impacts on Visitor use and Experience
Prescribed fires and fire management actions	Short-term and long-term adverse effects from loss of access to certain areas during burns, reduction in visibility from smoke, reduction in air quality/presence of strong odors from smoke and fires; visible burned areas detract from visitor experience. Long-term beneficial effects of reduced fire occurrences with managed burns that reduce the possibility of catastrophic and high intensity fire that can affect visitor safety and continued use of the refuges.
Service facility and road construction	Short-term adverse effects on visitor use from loss of access, noise, and visible disturbance during construction, but long-term benefits from addition of visitor use facilities and roads.
Vegetation management	Short-term disturbance from presence of vegetation management crews (possible access disruption, noise, chemical use, odors); long-term beneficial effects of improved vegetative cover (improvement in the visible landscape).
Trails development and maintenance	Short-term adverse effects on visitor use from loss of access, noise, and visible disturbance during construction or maintenance, but long term benefits from addition of trails and improvement of condition.
ORV use	Short- and long-term disturbances to some visitor uses where the noise and presence of ORVs is disturbing, also visible damage to soils, vegetation; benefits to those visitors desiring this type of recreation where permitted.
Abandoned mine lands reclamation	Short-term adverse effects on visitors from lack of access to areas during reclamation. Long-term beneficial effects of addition of safety features and signage following re-establishment of vegetation cover and natural contours and closure of mine shafts.
Future oil and gas development on adjacent lands	Indirect long-term adverse impacts on refuge visitors if the operations are close enough to have any impacts from “spill-over effects” of sedimentation and contamination from surface runoff, or if noise carries into refuge or operations are visible from refuge visitor use areas
Oil and gas well plugging and reclamation activities inside and outside refuges	Short-term adverse effects on visitors from noise, visual disturbance and access restrictions that can occur on roads during reclamation. Long-term beneficial effects of restoration of sites, removal of sources of contamination and contaminated soils that are a safety hazard and visual eyesore

Under all three alternatives, there would be adverse and beneficial cumulative impacts from projects, plans, actions, and trends in oil and gas development as discussed in the cumulative scenario above (Table 4-9).

Under Alternative B, both adverse and beneficial cumulative impacts would occur from projects, plans, actions and trends in oil and gas development that were considered in the cumulative scenario. These are described under Alternative A and would be the same under Alternative B. Alternative B would contribute to cumulative impacts from the continued operations of permitted and newly regulated operations, which would continue to have long-term direct adverse impacts on visitor use and experience, as described in the above analysis. Bringing previously exempt operations under regulation would beneficially impact resources that form the basis for many types of visitor use and enjoyment. When combined with the effects of all other actions in the study area, cumulative impacts from the actions under Alternative B would be long term and both adverse and beneficial, with

Alternative B contributing mainly beneficial impacts on overall cumulative impacts from the change in regulations.

Cumulative impacts from actions under the cumulative impact scenario would be the same as described under Alternative A. Similar to Alternative B, there would be effects on visitor use and experience as a result of oil and gas operations that would continue to affect visitor use and experience where impacts cannot be avoided, and benefits from bringing new operations and the reclamation phase of pre-existing operations under regulations and the resultant reduction in adverse impacts, as described in the Alternative B analysis. Alternative C would contribute to cumulative impacts mostly by adding beneficial impacts of bringing new operations and the reclamation phase of pre-existing operations under regulation, but also by possibly adding adverse impacts from the change in directional drilling regulations that could result in more oil and gas development within refuge units as opposed to outside refuge boundaries.

Overall, under Alternative C, both adverse and beneficial cumulative impacts would accrue from projects, plans, and actions considered in the cumulative scenario. When combined with the effects of all other actions in the study area, cumulative impacts would be long term and both adverse and beneficial. However, Alternative C would remove regulatory incentives for operators to locate operations outside refuge units; thus, this alternative would have more impacts on resources within refuge boundaries.

SCENIC VIEWS AND NIGHT SKY RESOURCES

METHODOLOGY

Potential impacts on scenic views and night sky resources are assessed based on the actions being proposed and the various scenic qualities available at refuges, with attention to nighttime lighting, visual sensitivities and the natural lightscape. Topic-specific context for assessing impacts of the alternatives to scenic qualities and night skies includes:

- the type of scenic qualities available (as noted in Chapter 3, refuges contain an unusually large number of areas that possess a high degree of scenic quality and visual sensitivity)
- the proximity of the areas with scenic qualities and areas with no artificial light sources to oil and gas operations.
- The potential for light pollution in the form of sky glow or light trespass/glare to travel to the refuge unit and impact natural lightscapes.

TYPICAL IMPACTS OF OIL AND GAS OPERATIONS ON SCENIC VIEWS AND NIGHT SKY RESOURCES

Impacts from Geophysical Exploration

During geophysical operations, the presence of oil and gas personnel and their vehicles and equipment could cause adverse visual impacts for visitors that are seeking a refuge-like or natural experience. Flagging used to mark site lines can be distracting, and the cutting of survey lines through dense vegetation can require creation of paths for vehicles and crews and clear a line of sight that is not natural. Overall, given the short duration (weeks to a few months) of conventional surveys, the majority of impacts associated with geophysical surveys would be limited in both duration and geographic extent, although the line-of-sight cuts can persist until vegetation regrows. Based on the nature of exploration activities and their general limitations to the day-time hours impacts on night skies are not expected to occur.

Impacts of Well Drilling and Production

Visual impacts from drilling and production operations would be more substantial than other types of impacts, especially if well pads were placed in relatively undisturbed settings where visitors would be readily able to see the operation and all associated equipment and tanks. Although the type of rig used is highly variable, dependent on location and site-specific use requirements drill rigs can reach heights of 180 feet, which would be visible from multiple locations at greater distances and could intrude on a number of different viewsheds within different refuge units. Site clearing for well pad and access road construction would result in visible removal of refuge vegetation, creation of a pathway and an overall change in the natural scenery of the area, depending on the amount of clearing, location of the clearing and the refuge unit.

Lighting of drilling operations, which is typically provided using fluorescent high pressure sodium or metal halide lamps, could interfere with night sky resources. Depending on where the operations are sited, the design and installation of lighting, and the amount of activity and type of equipment used during the night, impacts include disturbance of night-sky views, increase in overall sky glow and anthropogenic light rations, and disruption of wildlife behaviors like migration, predation and mating. The operations, especially drilling, would increase the presence of work crews and equipment. Since drilling is a 24-hour, 7-day a week operation, these impacts would be continuous, and could last a week or two up to a few months. Hydraulic fracturing operations would require a few more weeks for completion. Hydraulic fracturing requires significant road traffic which increases nighttime lighting from vehicles and can negatively impact night resources in those corridors.

Production operations, although having a less intrusive human presence, would be visible for 20 years or longer. Coming across an oil production rig could be an unpleasant experience for visitors seeking a natural, outdoor experience at the refuge unit. The visual presence of oil and gas operations in a natural setting would adversely impact the areas by intruding on scenic qualities and viewsheds and overall adversely impacting refuge unit scenic qualities in the area of the rig. Oil and gas facilities, pads, and roads introduce forms, lines colors, and textures that contrast with the natural visual setting. In other circumstances where visitors are passing through refuges and not focused on the natural setting, these impacts would not be as pronounced. The impacts would be less for those visitors who are less concerned with the presence of such operations, and where operations are naturally screened from view. Although unlikely in the event of oil spills, adverse impacts on visual qualities could occur, and depending on the severity and type of event could be long-term in nature and could potentially alter the viewshed.

Impacts of Plugging and Reclamation

The presence of earthmoving, demolition, and other equipment associated with plugging and reclamation activities would have similar impacts on scenic views and night sky resources as described for drilling and production operations. However, considering the smaller equipment that would be used compared to a drilling rig and the limited duration of reclamation, impacts would likely be shorter in nature and would only adversely impact scenic qualities during the time of site reclamation. Plugging and reclamation would end disturbances from production activities, and the site would be restored to its original character. Reclamation of the well pads following plugging of the wells would serve to reduce long-term visual impacts and eliminate the unnatural views of the site. The actual time required to reclaim the site's scenic views would depend on many factors, including the amount and severity of the area impacted, the erosion potential of the site, productivity of the vegetation, topography, and soil characteristics, including contamination. Ultimately, the removal of the rig and associated structures and equipment, in conjunction with site reclamation, would have long-term localized beneficial effects on scenic views near the well sites. The effects on scenic views would range from a beneficial effect of having a natural setting restored, to essentially no effect on visitors for those wells in areas far from visitor uses or in locations where visitors have not been bothered by the presence of the wells. Beneficial impacts on night sky resources would also occur as a result of plugging and reclamation as all activities and night skies intrusions that occurred would cease and artificial lighting would be removed.

IMPACTS OF ALTERNATIVES ON SCENIC VIEWS AND NIGHT SKY RESOURCES

Purpose and Scope

The purpose of the regulation in all alternatives is to ensure that non-Federal oil and gas operations conducted on NWRS lands and waters avoid or minimize, to the greatest extent practicable, adverse effects on scenic views and night sky resources.

Under Alternative A, the Service scope of application of its regulation and policy provides protection of scenic views and night sky resources on Service fee title lands.

Alternative B, the proposed rule, would expand the area of regulatory application to include tracts where the Federal interest is less than fee (e.g., wetland or grassland easements). As a result of active regulation by the Service, scenic views and night sky resources associated with interests acquired on easements would have a consistent and higher level of protection compared to Alternative A.

Alternative C would expand the scope of regulation to operations conducted on non-Federal surface locations drilling under a refuge or any operation on private land within a refuge (i.e., an inholding). The level of increased protection for scenic views and night sky resources would vary from slight to moderate depending on the proximity of those operations to refuge boundaries, as well as State rules (and operator's compliance with those rules) in place that serve to reduce such impacts (e.g., minimizing lighting, shielding lights, directing lighting, screening operations from view by vegetation and topography if possible, and removal of debris, waste, and equipment no longer needed in operations).

Accessing Oil and Gas Rights from a Non-Federal Surface Location

Under Alternative A the incentive for operators to locate their operations outside refuge units would remain in place as previously described. The location of surface operations outside refuge units minimizes direct impacts to scenic views and night sky resources within refuge units. The risk and intensity of impacts on refuge resources would increase for operations sited closer to refuge boundaries where human activity and oil operation activities could disrupt scenic views and light pollution could affect night sky resources. Intensity of impacts on refuge resources would depend on proximity of operations to the refuge units; site-specific environmental conditions, such as habitat quality; and mitigation measures.

Alternative B provides an even greater incentive for operators to locate their operations outside refuges since the proposed rule includes provisions for maintaining financial assurance, access fees, and cost recovery, among others. So, as the operator's costs of operating on NWRS lands increase, so does the incentive to avoid those costs. Therefore, it is likely that impacts to scenic views and night sky resources from new production and drilling operations within refuges would be avoided to a greater extent than in Alternative A. Impacts on scenic views and night sky resources from those wells located on non-Federal surface locations would be same as Alternative A.

Under Alternative C, directional drilling operations on non-Federal surface locations would be subject to the full regulatory requirements of the proposed rule. The Service would impose operational standards on activities outside the refuge to the extent necessary to avoid or minimize impacts on refuge resources and uses. Operational standards would reduce or minimize light pollution, screen operations from view, and require the removal of debris, waste, and equipment no longer needed in operations, thus reducing impacts to scenic views and night sky resources within the refuge boundary.

However, application of regulation to surface and subsurface operations outside a refuge would largely remove an operator's incentive to avoid surface use in a refuge, so the number of drilling and production operations located on refuges would likely increase. Therefore, compared to Alternatives A and B, Alternative C would increase the instances where new drilling operations create direct, adverse, and long-term impacts to refuge scenic views and night sky resources.

Requirement to Obtain a Service Permit to Conduct Operations

Under Alternative A, the Service would continue to work to ensure new operations are under a Service-issued SUP or ROW, which would reduce the impacts of geophysical operations and new drilling and production operations. When an operator obtains a Service permit prior to conducting operations it provides additional protection for scenic views and night sky resources. The permitting process ensures ongoing communication between Refuge staff and the operator; that an operator includes mitigation measures to avoid or minimize impacts to refuge resources and uses; and that an operator is aware of expectations to reclaim a site to restore refuge resources and ensure long term protection of refuge resources and uses. However, the permit requirement itself has not been consistent across the Service; where permits have been issued, the permit conditions have varied widely resulting in the possibility of unnecessary impacts to scenic views and night sky resources.

Under Alternative A, there would be unnecessary impacts on scenic views and night sky resources from the estimated 4,000 pre-existing oil and gas production operations not under an SUP or ROW, including those described above under Typical Impacts of Oil and Gas Operations on Scenic Views and Night Sky Resources. The Service estimates that the 4,000 pre-existing wells in 107 refuges have created approximately 6,000 acres of direct disturbance associated with well sites and access roads. Direct surface disturbances from well pads and roads in refuges range from 1 to 6 acres with the average area of disturbance estimated at approximately 1.5 acres per operation.

The primary effects on scenic views and night sky resources from oil and gas operations include dead vegetation and oil-stained soils from contamination from leaks and spills, light pollution from drilling rig lights and gas flares. As previously discussed, most of the impacts to scenic views and night sky resources occurred when the operation was originally chosen and developed by the operator to accommodate their drilling and production operations.

However, some continuing unnecessary impacts may occur under Alternative A due to the lack of any requirement that these pre-existing operations have ongoing mitigation measures to protect scenic views and night sky resources. Typical mitigation measures that would minimize ongoing impacts from pre-existing operations on scenic views and night sky resources could include removal of contaminated soils, minimizing lighting, shielding lights, directing lighting, screening operations from view by vegetation and topography if possible, siting operations a minimum distance from visitor use areas, and removal of debris, waste, and equipment no longer needed in operations.

Under Alternative B, all new operations would be under a consistent permitting process that would include required consultation with the Service, performance-based standards to avoid or minimize impacts to scenic views and night sky resources, and other administrative provisions such as financial assurance, cost recovery, and access fees that would ensure protection of scenic views and night sky resources from the typical impacts of oil and gas development to the greatest extent practicable.

Similar to Alternative A, pre-existing operations would not be required to obtain an operations permit during the production phase. However, in contrast to Alternative A, the Service would manage these operations by assimilating State laws and regulations into the rule, thereby increasing the Service's enforcement ability on refuge lands. So, during the production phase, impacts to scenic views and night sky resources would be reduced compared to Alternative A due to improved compliance with State rules that serve to lower such impacts, such as State rules addressing site lighting and visual impact mitigation. Overall, the Service expects that the large majority of issues related to impacts on scenic views and night sky resources would be resolved by compliance with State laws and regulations.

Additionally, under Alternative B, all operations, including pre-existing operations, would be required to have a Service-issued permit for reclamation that would ensure all operations meet Service's reclamation standards, which would also greatly reduce any long-term impacts on refuge scenic views and night sky resources as discussed further below in Performance-Based Standards.

Assimilation of State laws and regulations during the production phase combined with reclamation to Service standards ensures a substantial and consistent long-term benefit to scenic views and night sky resources compared to Alternative A.

Alternative C would require all operators on refuges to obtain a permit for their operations, including pre-existing operations. Compared to the proposed rule, Alternative C may provide additional protections for scenic views and night sky resources from impacts associated with pre-existing operations. Since the greatest impacts to scenic views and night sky resources have already occurred, the Service would be focusing on maintenance issues, such as erosion control, spill containment and remediation, and removal of debris, waste, and equipment no longer needed in operations, in those cases where State laws and regulations do not meet Service operating standards. Alternative C would also require operations on inholdings and those directionally drilling underneath a refuge from non-Federal surface locations to obtain a permit to the extent necessary to protect refuge scenic views and night sky resources. In most cases, since the activity is occurring directly on private surface estate, the Service would not identify operational measures to protect scenic views and night sky resources on adjacent Federal surface estate. Thus, for these operations, the impacts on scenic views and night sky resources would be similar to Alternative B.

Performance-Based Standards

Under Alternative A, oil and gas operations would be managed on an individual unit basis, with protective stipulations developed in a site-specific manner. New operations would be subject to operating practices, as defined in SUPs or ROWs that serve to minimize or avoid impacts on scenic views and night sky resources. These could include minimizing lighting, shielding lights, directing lighting, screening operations from view by vegetation and topography if possible, and removal of debris, waste, and equipment no longer needed in operations; however, the operating practices included in the SUPs or ROWs are usually negotiated between the refuge manager and the oil operator. Thus, the levels of protection may vary somewhat from permit to permit and by refuge as the existing regulations do not provide specific operating standards for the protection of refuge resources. The level of monitoring and cooperation with operators to address impacts on refuge resources and uses would continue to vary widely, resulting in unnecessary impacts to scenic views and night sky resources. For the 4,000 pre-existing operations, reclamation is conducted without regard for Service goals or only to the extent a refuge manager is able to negotiate to have reclamation goals addressed. Reclamation for these wells often falls short of Service reclamation standards.

Under Alternatives B and C, the proposed rule establishes performance-based standards for avoiding or minimizing impacts to scenic views and night sky resources. All new operations on NWRS lands and waters would be subject to consistent standards and requirements of the proposed rule for protecting scenic views and night sky resources. As previously discussed, new operations create the greatest additional impacts on scenic views and night sky resources, so establishing performance-based standards that would include proper site planning, timing restrictions and the best management practices to avoid or minimize many of the typical impacts to scenic views and night sky resources from oil and gas development**.** Also, the proposed rule includes additional standards that would protect scenic views and night sky resources, such as minimizing lighting, shielding lights, directing lighting, screening operations from view by vegetation and topography if possible, and removal of debris, waste, and equipment no longer needed in operations.

Additionally, under the proposed rule operators on easements would be required to comply with these standards to the extent necessary to protect that easement interest.

The proposed rule also includes standards for achieving successful surface reclamation once operations end. All operations, including pre-existing operations, would have to meet Service reclamation standards, such as plugging all wells, removing all above-ground structures, equipment, roads, well pads, and contaminating substances, re-establishing native vegetation, restoring conditions to predisturbance hydrologic functions, and restoring natural systems using native soil material that would indirectly reduce impacts to scenic views within the refuge units. Therefore, eventually, the disturbance associated with the 4,000 pre-existing wells would be restored to Service standards, providing a substantial long-term reduction or removal of adverse impacts on scenic views compared to Alternative A

Under Alternative C, pre-existing operations would be required to abide by the performance-based standards established under the proposed rule during the production phase. Compared to the proposed rule, Alternative C may provide for implementation of higher standards for protection of scenic views and night sky resources. Since the greatest impacts to scenic views and night sky resources have already occurred, the Service would be focusing on maintenance issues, such removal or remediation of contaminated soils, removal of debris, waste, and equipment no longer needed in operations, in those cases where State laws and regulations do not meet Service operating standards.

Also, operations on inholdings and operations on non-Federal surfaces directionally drilling underneath a refuge would be subject to the performance-based standards established in the proposed rule to the extent necessary to protect refuge scenic views and night sky resources. The level of increased protection would vary from slight to moderate depending on State rules in place that serve to reduce such impacts (e.g., spill control and cleanup requirements, erosion control), and the proximity of the surface location of operations on non-Federal surfaces to the refuge and the presence of pathways (e.g., waters that may be hydrologically connected to wetlands within a refuge).

Finally, under Alternative C, performance-based standards would also be established for downhole operations. Scenic views and night sky resources would only be impacted by accidents associated with well control (e.g., indirect impacts associated with fires and damaged equipment, light pollution from burning oil and gas). Given present day technology, events that result in loss of well control (blowouts) are extremely rare. Service regulation could possibly serve to lower an already low risk of a well blowout, but in practice, the Service finds that State requirements for well control and the expectation that companies will act in their own best interest would preclude the need for the Service to regulate aspects of drilling and production related to well control. Thus, the Service does not expect any reduction of impacts or risks of impacts to scenic views and night sky resources related to our downhole regulation under Alternative C.

Cumulative Impacts

Actions inside and outside the refuge units and local trends in oil and gas development can cumulatively affect scenic views and the night sky resources in the refuges. Management planning, such as fire management, vegetation management, ORV plans, can result in greater protection for refuge resources that are the basis for much of the refuges' scenic views and night sky resources. Conversely, actions that cause disturbance of these resources would include activities such as prescribed burns, ORV use, and any general construction or maintenance activities that include excavation, grading, or presence of work crews. Past, present, and reasonably foreseeable activities that would have beneficial or adverse impacts on scenic views and night sky resources in the area of analysis and a brief summary of the cumulative impacts of these actions on scenic views and night sky resources are listed in Table 4-10.

TABLE 4-10. CUMULATIVE IMPACTS ON SCENIC VIEWS AND NIGHT SKY RESOURCES (PROGRAMMATIC LEVEL FOR REFUGES)

Past, Present, and Reasonably Foreseeable Activity	Impacts on Scenic Views and Night Sky Resources
Prescribed fires and fire management actions	Short-term and long-term adverse effects during controlled burns, which lead to a reduction in visibility from smoke. Visibly burned areas detract from scenic views. Long-term beneficial effects of reduced fire occurrences with managed burns that reduce the possibility of catastrophic and high intensity fire that can affect scenic views and the night sky.
Service facility and road construction	Short-term adverse effects on scenic views from visible disturbance during construction. Headlights from vehicles can have a short-term adverse effect on wildlife and visitors.
Vegetation management	Short-term disturbance from presence of vegetation management crews, long-term beneficial effects of improved vegetative cover leading to an improvement in the visible landscape.
Trails development and maintenance	Short-term adverse effects on scenic views from visible disturbance during construction or maintenance, and long-term adverse effects from addition of trails and development.
ORV use	Short- and long-term disturbances from dust and pollution emissions from ORV use and visible damage to soils and vegetation; benefits to those visitors desiring this type of recreation to obtain access to viewsheds. Headlights from vehicles can have a short-term adverse effect on wildlife and visitors.

Past, Present, and Reasonably Foreseeable Activity	Impacts on Scenic Views and Night Sky Resources
Abandoned mine lands reclamation	Short-term adverse effects on viewsheds from construction during reclamation. Long-term beneficial effects to scenic views after the re-establishment of vegetation cover and natural contours and closure of mine shafts.
Future oil and gas development on adjacent lands	Indirect long-term adverse impacts on scenic views of refuges if the operations are close enough to have any impacts from “spill-over effects” of sedimentation and contamination from surface runoff, or if operations are visible from refuge visitor use areas and if lighting from these operations impacts the night sky resources within the refuge unit.
Oil and gas well plugging and reclamation activities inside and outside refuges	Short-term adverse effects on scenic views from presence of construction equipment during reclamation. Long-term beneficial effects of restoration of sites, removal of sources of contamination and contaminated soils that are visually detracting from the surrounding natural environment. Any lighting or flaring activities would cease and therefore have a long-term beneficial effect on night sky resources.
Development on lands adjacent to refuge units	Long-term adverse impacts on night skies from spill-over effects of lighting for commercial and residential development.

Under all three alternatives, there would be adverse and beneficial cumulative impacts from projects, plans, actions, and trends in oil and gas development as discussed in the cumulative scenario above (Table 4-10).

Alternative B would contribute to cumulative impacts from the continued operations of pre-existing operations not under an SUP or ROW, which would continue to have long-term direct adverse impacts on scenic views and night sky resources, as described in the above analysis. On the other hand, bringing new operations and the reclamation phase of pre-existing operations under regulation would add substantial beneficial impacts on scenic views and night sky resources. When combined with the effects of all other actions in the study area, cumulative impacts from the actions under Alternative B would be long term and both adverse and beneficial, with Alternative B contributing mainly beneficial impacts on overall cumulative impacts from the change in regulations.

Under Alternative C, similar to Alternative B, there would be effects on scenic views and night sky resources as a result of oil and gas operations that would continue to affect scenic views and night sky resources where impacts cannot be avoided, and benefits from bringing new operations and the reclamation phase of pre-existing operations under regulation and the resultant reduction in adverse impacts, as described in the Alternative B analysis. Alternative C would contribute to cumulative impacts mostly by adding beneficial impacts of bringing new operations and all phases of pre-existing operations under regulation, but also by possibly adding adverse impacts from the change in directional drilling regulations that could result in more oil and gas development within refuge units as opposed to outside refuge boundaries. Overall under Alternative C, both adverse and beneficial cumulative impacts would accrue from projects, plans, and actions considered in the cumulative scenario. When combined with the effects of all other actions in the study area, cumulative impacts would be long term and both adverse and beneficial.

NATURAL SOUNDSCAPES AND ACOUSTIC ENVIRONMENT

METHODOLOGY

Certain key terms are important to this impacts analysis. *Acoustic resources* are physical sound sources, including both natural sounds (wind, water, wildlife, vegetation) and cultural and historic sounds (battle reenactments, tribal ceremonies, quiet reverence). The *acoustic environment* is the combination of all the acoustic resources within a given area—natural sounds as well as human-caused sounds. The acoustic environment includes sound vibrations made by geological processes, biological activity, and even sounds that are inaudible to most humans, such as bat echolocation calls. *Soundscape* is the component of the acoustic environment that can be perceived and comprehended by humans. The character and quality of the soundscape influence human perceptions of an area, providing a sense of place that differentiates it from other regions. *Noise* refers to sound which is unwanted, either because of its effects on humans and wildlife, or its interference with the perception or detection of other sounds. *Cultural soundscapes* include opportunities for appropriate transmission of cultural and historic sounds that are fundamental components of the purposes and values for which the refuges were established.

Impacts on natural soundscapes and the acoustic environment can be compared to natural ambient conditions and are typically assessed based on the distance between a sound source and the receptor, the characteristics of the land located between the source and the receptor, the nature of the receptor's activity, and the increase in sound level above natural ambient sound levels. Frequency, amplitude, and duration should all be considered when describing impacts.

Potential sound levels at various distances from pieces of heavy construction equipment typically used during geophysical exploration, drilling and production, and plugging and reclamation associated with oil and gas operations were estimated (Table 4-11). Additional sound sources that occur during production but are not addressed in Table 4-11 include generators, compressors, and pumps. The Federal Highway Administration's Roadway Construction Noise Model contains a database of common construction equipment. The database includes a list of the noise levels produced by each piece of construction equipment at a distance of 50 feet, per the equipment specifications. This database is an accepted resource for common construction equipment sound levels. Additionally, the Federal Transportation Administration Transit Noise and Vibration Impact Assessment guidelines contain typical equipment noise levels at 50 feet from the source (FHWA 2006). These references were subsequently used to approximate noise levels at distances beyond 50 feet, which may be audible within the refuge units. As the construction equipment may be thought of as point sources of noise, the radiation pattern is such that the sound level would drop off at a rate of 6 dBA per doubling of distance from the source, based solely on source geometry without taking site surface conditions into consideration (Caltrans 2013).

TABLE 4-11. EQUIPMENT NOISE LEVEL PREDICTIONS (DBA)

Distance from Source (feet)	Grader/Bulldozer/ Concrete Pump Truck/Chainsaw	Dump Truck	Front-End Loader	Drill Rig/Rotary Drilling	Concrete Mixer Trucks	Diesel Truck
50	85	84	80	75	82	88
100	79	78	74	69	76	82

Distance from Source (feet)	Grader/Bulldozer/ Concrete Pump Truck/Chainsaw	Dump Truck	Front-End Loader	Drill Rig/Rotary Drilling	Concrete Mixer Trucks	Diesel Truck
200	73	72	68	63	70	76
400	67	66	62	57	64	70
800	61	60	56	51	58	64
1,600	55	54	50	45	52	58
3,200	49	48	44	39	46	52
6,400	43	42	38	33	40	46
12,800	37	36	32	27	34	40
25,600	31	30	26	21	28	34

Notes:

Equipment noise levels represent specification values for a reference distance of 50 feet from the equipment source.

Predicted noise levels beyond 50 feet from the source were estimated assuming a 6 dBA drop-off rate per doubling of distance for a point source (stationary equipment sources may be regarded as point sources) based solely on source geometry (Caltrans 2013).

Equipment noise levels at the distances shown in this table will vary based on additional attenuation measures, including vegetation, topography, and climate conditions.

Noise from a drill rig/rotary drilling was estimated based on a measured level of 63 dBA at 200 feet for a typical drill in Wyoming. This noise level is consistent with a report on air-rotary drilling published by the National Institute for Occupational Safety and Health Reinke and Ingram 2009). The report identified noise levels of approximately 90 dBA measured within 6 feet of the rig. This level was extrapolated to 50 feet and compared to the extrapolated level at 50 feet from the Wyoming data. The levels were within 2 decibels of each other.

Typical Impacts of Oil and Gas Operations on Natural Soundscapes and Acoustic Environment

Impacts from Geophysical Exploration

During the geophysical exploration phase, adverse impacts on natural soundscapes and the acoustic environment can result from equipment noise generated during vegetation clearing and road building, and noise from vehicles delivering survey equipment and personnel. Vehicles may include trucks, helicopters or ORVs. Chainsaws are often used to clear a survey line of sight. Additionally, noise associated with seismic surveys would occur from the use of Vibroseis® trucks (vehicle-mounted vibrators) or, alternatively, drilling holes in the earth, and detonating explosive charges in the holes.

Noise generated by these seismic survey activities would be intermittent and typically occur over a period of 3 weeks to 3 months. Helicopters, when used, are the primary noise source in seismic operations. Often two or more helicopters are used to support a seismic shoot. In these cases, the noise would be continuous during daytime operations but limited to a 2- to 3-week time frame within the active area of operations. However, these operations have the potential to produce sounds of considerable amplitude. Helicopter noise would be intermittent and limited to certain flight paths to and from the survey operations, but would increase sound levels near flight paths.

Impacts of Well Drilling and Production

Most of the adverse impacts associated with oil and gas operations within refuge units would result from the drilling and production phase, because construction of the well necessitates the majority of the heavy construction equipment that have considerable sound levels, and production has a long duration. Potential sources of noise associated with drilling and production include the construction of roads and trails for accessing the site, preparation of the drill site, drilling operations, cement work, well servicing, and workover operations. Truck traffic would also add to noise. In the event that hydraulic fracturing is used for extraction, this would produce additional sound impacts, since that technology requires large truckloads of water, produced water, and chemicals and larger trucks to transport the equipment needed for drilling. Hydraulic fracturing operations also tend to take longer to drill and produce, which would add to the duration of the noise impacts to the soundscape and acoustic environment, although the effect would still be a short-term impact.

Table 4-11 presents some of the typical construction equipment associated with each of these activities and their associated noise levels predicted at various distances from the source. As described in the Methodology section above, predicted levels are representative of noise attenuation at a rate of 6 dBA per doubling of distance from the sound source (the noise level drop-off rate from a stationary point source purely due to the geometry of the source). Though additional attenuation could be realized due to vegetation cover, intervening topography and meteorological conditions, low frequency sounds commonly produced by mechanized equipment (like vehicles, pumps, and drill rigs) travel great distances.

Accessing new well locations in remote areas could require upgrading of existing roadways and/or construction of new roads and trails to accommodate heavy construction equipment and increased truck traffic. Subsequently, once the drill site is accessed, clearing, grading, cutting, filling, and leveling of the well pad is required to prepare the drill site to accommodate the rig and other equipment. Common equipment used for the construction of access roads as well as preparation of the well pad includes graders, bulldozers, front-end loaders, and dump trucks. Concrete mixer and pump trucks may also be used for the cementing of oil-well casing. As shown in Table 4-11, graders, bulldozers, concrete mixer trucks, and dump trucks all produce similar noise levels (graders, bulldozers, and concrete mixer trucks produce 85 dBA at 50 feet, while dump trucks produce 84 dBA) and would be the loudest pieces of equipment used for site access and well pad preparation.

Generally, when numerous pieces of equipment are in use concurrently, the loudest piece of equipment dominates, especially when a large difference exists between the noise generated by each piece of equipment. Conversely, when sound power levels from two pieces of equipment in concurrent operation are the same, the combined level is approximately 3 dB higher. As such, during drilling and well construction activities, it can be expected that noise levels would reach 88 or 90 dBA at 50 feet from the operation. During production, noise would be generated by gas compressors or jack pumps (approximately 89 dBA and 82 dBA, respectively), depending on the resource being extracted.

Compared to this range of measured ambient noise levels within refuge units of 17 to 35 dBA, and considering a worst case condition of a hard, flat surface and no intervening vegetation, drilling and production noise levels could still exceed 17 dBA at a distance of 20 miles from such equipment. However, as identified in Chapter 3, under typical conditions where the surface is soft and vegetation is present, noise levels would decrease at a rate of approximately 7.5 dB or more per doubling of distance. At a distance of 12,000 to 25,000 feet (2.3 to 4.7 miles), sound levels would start to decrease to natural ambient sound levels, although under conditions where little vegetation occupies flat landscapes, this distance could be as much as 10 miles or more, and the low frequency component of sounds may be audible even further. Actual sound levels produced during site access and well pad preparation activities would be highly dependent, however, on the number of pieces of equipment used, combinations of equipment used in conjunction with one another, and the percentage of time the equipment is operating at full power. Additionally, actual noise levels at a distance from the sound sources would vary considerably depending on the frequency and amplitude of the sound, topographic features, surface conditions, and the types and density of vegetation cover.

After establishing access to the site and prepping the well pad, mobilizing the drill rig and beginning the drill work would elevate sound levels. Specifically, hauling the drill rig and other equipment to the location would require about 10 to 25 large truckloads, thereby resulting in a temporary increase in vehicular sources of sound. Diesel trucks operating around the site typically produce a noise level of 88 dBA at 50 feet, which would begin to decrease to the natural ambient sound levels at a distance of 12,000 to 25,000 feet (2.3 to 4.7 miles), without considering attenuation from intervening topography, vegetation, and terrain. Elevated noise levels would also arise during drilling, which is a continuous, 24-hour-a-day, 7-day-a-week operation. Rotary drilling is used almost universally in modern drilling. Based on the noise levels indicated in Table 4-11, noise from a rotary drill would begin to attenuate to approximately 33 dBA at a distance of 6,400 feet (1.2 miles), not accounting for additional attenuating factors such as vegetation and topography. Diesel-powered pumper trucks are used in hydraulic fracturing operations to pressurize the hydraulic fracturing fluid and create fractures in the oil and gas-bearing formations. The trailer-mounted compressor pumps in these pumper trucks can generate excessive noise during the actual fracturing process. Up to 20 pumper trucks operating simultaneously to fracture the formation can generate noise levels from 110 to 115 dBA at a distance of three feet and 73 to 78 dBA at a distance of 1,000 feet (NYDEC 2011); however, the these noise levels are temporary, occurring for the duration of the actual fracturing operation.

As described above, vegetation, certain meteorological conditions, and topography could reduce the distance at which noise levels from heavy construction equipment would attenuate to the natural ambient level. Although noise levels associated with drilling operation equipment are similar to noise levels produced by construction and earthmoving equipment during the site access and well pad prepping activities, the intensity of the impacts during drilling would potentially be greater due to the continuous nature of the drilling operation. If the drilled wells are advanced to the production stage, the use of heavy construction equipment to lay pipelines would result in elevated sound levels similar to those described above for the site access, preparation, and drilling.

The production phase would necessitate the use of some equipment that produces considerable amounts of noise, including gas compressors and jack pumps. Noise from compressors (approximately 89 dBA at 50 feet), attenuating at 7.5 dB per doubling of distance, would be approximately 37 dBA at 6,400 feet and noise from jack pumps (approximately 82 dBA at 50 feet) would be approximately 30 dBA at 6,400 feet. These impacts would be continuous and long term, as pumping or gas compression would occur continuously over the life of the well. Additionally, over the course of time that the well is in production, well servicing and workover operations may be necessary. Depending on the maintenance necessary, well servicing may last only 1 or 2 days, requiring minor equipment and a workover rig (a scaled-down drilling rig). Major workover operations may last more than a month and could require some limited drilling operations.

Impacts of Plugging and Reclamation

In addition to the exploration, construction, and production phases, oil and gas extraction activities would generate noise in the plugging and reclamation phase. Activities associated with this phase that would potentially result in adverse impacts include the use of heavy construction equipment and trucks to reopen and repair access roads, remove production equipment and plug wells, and restore contours. Specifically, typical equipment used in opening up and/or repairing access roads includes a small bulldozer, backhoe, and hand tools (gas-powered chainsaw, shovels, axes, etc.). As indicated in Table 4-11, bulldozers and chainsaws could produce 85 dBA at a distance of 50 feet from the source, while a backhoe would produce a sound level of 80 dBA (FHWA 2006). If a chainsaw and bulldozer were used concurrently, generating sound levels of approximately 88 dBA, sound levels would begin to decrease to approximately 36 dBA at a distance of 6,400 feet, although attenuating factors including vegetation and topography could reduce this distance. Reopening and/or repair of access roads would likely be short term, lasting only a few days to weeks, depending on the condition of the roads.

During reclamation, similar earthmoving equipment would be necessary in addition to a small dump truck for the potential removal of contaminated soils. The dump truck would produce noise levels similar to that of the earthmoving equipment. Depending on the degree of contamination at the well site, reclamation could last a few days to a few years. During plugging, trucks and cement mixer and/or pumping trucks would be used, producing similar noise levels to the earthmoving equipment used during site access and reclamation. Plugging would be short term, lasting only 2 to 5 days, depending on the equipment in the well, wellbore conditions, number of plugs to be set, and other factors. Additional sources of noise associated with this phase would include the use of ORVs or pick-up trucks to transport people and supplies.

Impacts of Alternatives on Natural Soundscapes and the Acoustic Environment

Purpose and Scope

The purpose of the regulation in all alternatives is to ensure that non-Federal oil and gas operations conducted on NWRS lands and waters avoid or minimize, to the greatest extent practicable, adverse effects on natural soundscapes and the acoustic environment.

Under Alternative A, the Service scope of application of its regulation and policy provides protection of natural soundscapes and the acoustic environment on Service fee title lands.

Alternative B, the proposed rule, would expand the area of regulatory application to include tracts where the Federal interest is less than fee (e.g., wetland or grassland easements). As a result of active regulation by the Service, natural soundscapes and the acoustic environment associated with interests acquired on easements would have a consistent and higher level of protection compared to Alternative A.

Alternative C would expand the scope of regulation to operations conducted on non-Federal surface locations drilling under a refuge or any operation on private land within a refuge (i.e., an inholding). The level of increased protection for natural soundscapes and the acoustic environment would vary from slight to moderate depending on the proximity of those operations to refuge boundaries, as well as State rules (and operator's compliance with those rules) in place that serve to reduce such impacts (e.g., the incorporation of sound-absorbing materials and/or mufflers).

Accessing Oil and Gas Rights from a Non-Federal Surface Location

Under Alternative A the incentive for operators to locate their operations outside refuge units would remain in place as described at the beginning of this chapter. The location of surface operations outside refuge units avoids direct impacts to natural soundscapes and the acoustic environment within refuge units. However, wells directionally drilled and produced from outside refuge units to bottomholes beneath the refuge units would directly impact natural soundscapes and the acoustic environment on adjacent lands as well as present a risk of indirect impacts within the refuge units. Under current regulations, the Service cannot impose preventative measures such as mitigation. The risk and intensity of impacts on refuge resources would increase for operations sited closer to refuge boundaries where human activity and the operation of equipment would transmit noise onto the refuge. Intensity of impacts on refuge resources would depend on proximity of operations to the refuge units; site-specific environmental conditions, such as habitat quality; and mitigation measures.

Alternative B provides an even greater incentive for operators to locate their operations outside refuges since the proposed rule includes provisions for maintaining financial assurance, access fees, and cost recovery, among others. So, as the operator's costs of operating on NWRS lands increase, so does the incentive to avoid those costs. Therefore, it is likely that impacts to natural soundscapes and the acoustic environment from new production and drilling operations within refuges would be avoided to a greater extent than in Alternative A. Impacts on natural soundscapes and the acoustic environment from those wells located on non-Federal surface locations would be same as Alternative A.

Under Alternative C, directional drilling operations on non-Federal surface locations would be subject to the full regulatory requirements of the proposed rule. The Service would impose operational standards on activities outside the refuge to the extent necessary to avoid or minimize impacts on refuge resources and uses. Operational standards would reduce noise transmitted into refuge units depending on the proximity of the operation to the refuge and thus impacts to natural soundscapes and the acoustic environment within the refuge boundary.

However, application of regulation to surface and subsurface operations outside a refuge would largely remove an operator's incentive to avoid surface use in a refuge, so the number of drilling and production operations located on refuges would likely increase. Therefore, compared to Alternatives A and B, Alternative C would increase the instances where new drilling operations create direct, adverse, and long-term impacts to refuge natural soundscapes and the acoustic environment.

Requirement to Obtain a Service Permit to Conduct Operations

Under Alternative A, the Service would continue to work to ensure new operations are under a Service-issued SUP or ROW, which would reduce the impacts of geophysical operations and new drilling and production operations. When an operator obtains a Service permit prior to conducting operations it provides additional protection for natural soundscapes and the acoustic environment. The permitting process ensures ongoing communication between Refuge staff and the operator; that an operator includes mitigation measures to avoid or minimize impacts to refuge resources and uses; and that an operator is aware of expectations to reclaim a site to restore refuge resources and ensure long term protection of refuge resources and uses. However, the permit requirement itself has not been consistent across the Service; where permits have been issued, the permit conditions have varied widely resulting in the possibility of unnecessary impacts to natural soundscapes and the acoustic environment.

Under Alternative A, there would be unnecessary impacts on natural soundscapes and the acoustic environment from the estimated 4,000 pre-existing oil and gas production operations not under an SUP or ROW, including those described above under Typical Impacts of Oil and Gas Operations on Natural Soundscapes and Acoustic Environment. The Service estimates that the 4,000 pre-existing wells in 107 refuges have created approximately 6,000 acres of direct disturbance associated with well sites and access roads. Direct surface disturbances from well pads and roads in refuges range from 1 to 6 acres with the average area of disturbance estimated at approximately 1.5 acres per operation.

The primary effects on natural soundscapes and the acoustic environment from oil and gas operations include noise generated from equipment and vehicles during road and well pad construction, and diesel engines powering the drilling rig equipment, hydraulic fracturing compressor pumps, vehicles, gas compressors, and pump jacks. Wildlife displacement can occur due to noise impacts. Noise from oil and gas operations can also be detrimental to visitor experiences. As previously discussed, most of the impacts to natural soundscapes and the acoustic environment occurred when the operation was originally chosen and developed by the operator to accommodate their drilling and production operations.

However, some continuing unnecessary impacts may occur under Alternative A due to the lack of any requirement that these pre-existing operations have ongoing mitigation measures to protect natural soundscapes and the acoustic environment. Typical mitigation measures that would minimize ongoing impacts from pre-existing operations on natural soundscapes and the acoustic environment could include sufficient setbacks and/or timing restrictions for sensitive periods in a given wildlife species' life cycle, and scheduling geophysical exploration and drilling activities during periods of lower visitor use.

Under Alternative B, all new operations would be under a consistent permitting process that would include required consultation with the Service, performance-based standards to avoid or minimize impacts to natural soundscapes and the acoustic environment, and other administrative provisions such as financial assurance, cost recovery, and access fees that would ensure protection of natural soundscapes and the acoustic environment from the typical impacts of oil and gas development to the greatest extent practicable.

Similar to Alternative A, pre-existing operations would not be required to obtain an operations permit during the production phase. However, in contrast to Alternative A, the Service would manage these operations by assimilating State laws and regulations into the rule, thereby increasing the Service's enforcement ability on refuge lands. So, during the production phase, impacts to natural soundscapes and the acoustic environment would be reduced compared to Alternative A due to improved compliance with State rules that serve to lower such impacts, such as State rules addressing noise impacts from oil and gas operations. Overall, the Service expects that the large majority of issues related to impacts on natural soundscapes and the acoustic environment would be resolved by compliance with State laws and regulations.

Additionally, under Alternative B, all operations, including pre-existing operations, would be required to have a Service-issued permit for reclamation that would ensure all operations meet Service's reclamation standards, which would also greatly reduce any long-term impacts on refuge natural soundscapes and the acoustic environment as discussed further below in Performance-Based Standards.

Assimilation of State laws and regulations during the production phase combined with reclamation to Service standards ensures a substantial and consistent long-term benefit to natural soundscapes and the acoustic environment compared to Alternative A.

Alternative C would require all operators on refuges to obtain a permit for their operations, including pre-existing operations. Compared to the proposed rule, Alternative C may provide additional protections for natural soundscapes and the acoustic environment from impacts associated with pre-existing operations. Since the greatest impacts to natural soundscapes and the acoustic environment have already occurred, the Service would be focusing on maintenance issues, such as the incorporation of sound-absorbing materials and/or mufflers and placing enclosures around loud equipment and/or earthen berms situated between the sound source and receptors, in those cases where State laws and regulations do not meet Service operating standards. Alternative C would also require operations on inholdings and those directionally drilling underneath a refuge from non-Federal surface locations to obtain a permit to the extent necessary to protect refuge natural soundscapes and the acoustic environment. In most cases, since the activity is occurring directly on private surface estate, the Service would not identify operational measures to protect natural soundscapes and the acoustic environment on adjacent Federal surface estate. Thus, for these operations, the impacts on natural soundscapes and the acoustic environment would be similar to Alternative B.

Performance-Based Standards

Under Alternative A, oil and gas operations would be managed on an individual unit basis, with protective stipulations developed in a site-specific manner. New operations would be subject to operating practices, as defined in SUPs or ROWs that serve to minimize or avoid impacts on natural soundscapes and the acoustic environment. These could include the incorporation of sound-absorbing materials and/or mufflers and placing enclosures around loud equipment and/or earthen berms situated between the sound source and receptors. However, the operating practices included in the SUPs or ROWs are usually negotiated between the refuge manager and the oil operator. Thus, the levels of protection may vary somewhat from permit to permit and by refuge as the existing regulations do not provide specific operating standards for the protection of refuge resources. The level of monitoring and cooperation with operators to address impacts on refuge resources and uses would continue to vary widely, resulting in unnecessary impacts to natural soundscapes and the acoustic environment. For the 4,000 pre-existing operations, reclamation is conducted without regard for Service goals or only to the extent a refuge manager is able to negotiate to have reclamation goals addressed. Reclamation for these wells often falls short of Service reclamation standards.

Under Alternatives B and C, the proposed rule establishes performance-based standards for avoiding or minimizing impacts to natural soundscapes and the acoustic environment. All new operations on NWRS lands and waters would be subject to consistent standards and requirements of the proposed rule for protecting natural soundscapes and the acoustic environment. As previously discussed, new operations create the greatest additional impacts on natural soundscapes and the acoustic environment, so establishing performance-based standards that would include proper site planning, timing restrictions and best management practices to avoid or minimize many of the typical impacts to natural soundscapes and the acoustic environment from oil and gas development**.** Also, the proposed rule includes additional standards that would protect natural soundscapes and the acoustic environment, such as the installation of sound abatement equipment, such as hospital-grade mufflers, and constructing sound buffers.

Additionally, under the proposed rule operators on easements would be required to comply with these standards to the extent necessary to protect that easement interest.

The proposed rule also includes standards for achieving successful surface reclamation once operations end. All operations, including pre-existing operations, would have to meet Service reclamation standards, such as plugging all wells, removing all above-ground structures, equipment, roads, well pads, and contaminating substances, re-establishing native vegetation, restoring conditions to predisturbance hydrologic functions, and restoring natural systems using native soil material that would indirectly reduce impacts to scenic views within the refuge units. Therefore, eventually, the disturbance associated with the 4,000 pre-existing wells would be restored to Service standards, providing a substantial long-term reduction or removal of adverse impacts on scenic views compared to Alternative A

Under Alternative C, pre-existing operations would be required to abide by the performance-based standards established under the proposed rule during the production phase. Compared to the proposed rule, Alternative C may provide for implementation of higher standards for protection of natural soundscapes and the acoustic environment. Since the greatest impacts to natural soundscapes and the acoustic environment have already occurred, the Service would be focusing on maintenance issues, such removal or remediation of contaminated soils, removal of debris, waste, and equipment no longer needed in operations, in those cases where State laws and regulations do not meet Service operating standards.

Also, operations on inholdings and operations on non-Federal surfaces directionally drilling underneath a refuge would be subject to the performance-based standards established in the proposed rule to the extent necessary to protect refuge natural soundscapes and the acoustic environment. The level of increased protection would vary from slight to moderate depending on State rules in place that serve to reduce such impacts (e.g., spill control and cleanup requirements, erosion control), and the proximity of the surface location of operations on non-Federal surfaces to the refuge and the presence of pathways (e.g., waters that may be hydrologically connected to wetlands within a refuge).

Finally, under Alternative C, performance-based standards would also be established for downhole operations. Natural soundscapes and the acoustic environment would only be impacted by accidents associated with well control (e.g., noise associated with fire suppression activities and equipment noise). Given present day technology, events that result in loss of well control (blowouts) are extremely rare. Service regulation could possibly serve to lower an already low risk of a well blowout, but in practice, the Service finds that State requirements for well control and the expectation that companies will act in their own best interest would preclude the need for the Service to regulate aspects of drilling and production related to well control. Thus, the Service does not expect any reduction of impacts or risks of impacts to natural soundscapes and the acoustic environment related to our downhole regulation under Alternative C.

Cumulative Impacts of Alternative A: No-Action

Actions inside and outside the refuge units and local trends in oil and gas development can cumulatively affect soundscapes and the acoustic environment of the refuges. Management planning, such as fire management, vegetation management, and ORV plans can result in greater protection for these resources. Conversely, actions that cause disturbance of these resources would include activities such as prescribed burns, ORV use, mining, agricultural and logging activities, as well as any general development activities that include excavation, grading, or construction. Past, present, and reasonably foreseeable activities that would have beneficial or adverse impacts on natural soundscapes and the acoustic environment in the area of analysis (including both refuge lands and adjacent lands) and a brief summary of the cumulative impacts of these actions on natural soundscapes and the acoustic environment are listed in Table 4-12.

TABLE 4-12. CUMULATIVE IMPACTS ON NATURAL SOUNDSCAPES AND ACOUSTIC ENVIRONMENT (PROGRAMMATIC LEVEL FOR REFUGE UNITS)

Past, Present, and Reasonably Foreseeable Activity	Impacts on Natural Soundscapes and Acoustic Environment
Prescribed fires and fire management actions	Short-term adverse effects due to removal of vegetation that may be attenuating noise and noise related to firefighting actions. Long-term beneficial effects of improved noise attenuation from vegetative cover that is established after these treatments.
Service facility and road construction	Short-term and long-term adverse effects on soundscapes during road grading and construction using heavy equipment.
Vegetation management	Short-term adverse effects due to removal of vegetation that may be attenuating noise and noise related to firefighting actions. Long-term beneficial effects of improved sound attenuation from vegetative cover that is established after these treatments.
Trails development and maintenance	Short-term and long-term adverse effects on natural soundscapes and the acoustic environment during road grading and construction using heavy equipment.
ORV use	Long-term beneficial effects from improved vegetative cover due to increased noise attenuation.
Abandoned mine lands reclamation	Short-term adverse effects on natural soundscapes and the acoustic environment during clearing, grading, and surfacing of trails, and removal of vegetation in trail footprint.
Mining and logging activities	Short- and long-term adverse effects on natural soundscapes and the acoustic environment due to mobile sources of noise capable of affecting large areas.
Recreational use	Short-term adverse effects on natural soundscapes and the acoustic environment due to reclamation-related noise. Long-term beneficial effects of improved surface vegetation, removal of noise sources, and related noise attenuation.
Ranching, agricultural land uses	Short-term adverse effects due to noise from mining and logging machinery. Long-term adverse effects on natural soundscapes and the acoustic environment due to loss of noise-attenuating vegetation.
Land development: residential and nonresidential (commercial, industrial) land uses, including road construction	Short- and long-term adverse effects soundscapes and the acoustic environment from human activities.

Past, Present, and Reasonably Foreseeable Activity	Impacts on Natural Soundscapes and Acoustic Environment
Future oil and gas development on adjacent lands	Short- and long-term adverse effects on natural soundscapes and the acoustic environment from operations that remove vegetation cover and the associated noise-attenuating effects.
Oil and gas well plugging and reclamation activities inside and outside refuges	Short-term adverse effects on natural soundscapes and the acoustic environment due to construction equipment noise, and possible long-term adverse effects on natural soundscapes and the acoustic environment due to the introduction of noise generators.
Industrial operations outside refuge boundaries	Long-term adverse impacts from noise generated by industrial activity, especially that from surface mineral extraction activities and manufacturing.
Traffic noise	Long-term adverse impacts due to increasing visitorship to refuges and increased travel to and from developments near refuge boundaries.

Under all three alternatives, there would be adverse and beneficial cumulative impacts from projects, plans and actions, and trends in oil and gas development as discussed in the cumulative scenario above (Table 4-12).

Alternative B would contribute to cumulative impacts from the continued operations of pre-existing operations not under an SUP or ROW, which would continue to have long-term direct adverse impacts on natural soundscapes and the acoustic environment, as described in the above analysis. On the other hand, bringing new operations and the reclamation phase of pre-existing operations under regulation would add substantial beneficial impacts on natural soundscapes and the acoustic environment. When combined with the effects of all other actions in the study area, cumulative impacts from the actions under Alternative B would be long term and both adverse and beneficial, with Alternative B contributing mainly beneficial impacts on overall cumulative impacts from the change in regulations.

Under Alternative C, similar to Alternative B, there would be effects on natural soundscapes and the acoustic environment as a result of oil and gas operations that would continue to affect natural soundscapes and the acoustic environment where impacts cannot be avoided, and benefits from bringing new operations and the reclamation phase of pre-existing operations under regulation and the resultant reduction in adverse impacts, as described in the Alternative B analysis. Alternative C would contribute to cumulative impacts mostly by adding beneficial impacts of bringing new operations and all phases of pre-existing operations under regulation, but also by possibly adding adverse impacts from the change in directional drilling regulations that could result in more oil and gas development within refuge units as opposed to outside refuge boundaries. Overall under Alternative C, both adverse and beneficial cumulative impacts would accrue from projects, plans, and actions considered in the cumulative scenario. When combined with the effects of all other actions in the study area, cumulative impacts would be long term and both adverse and beneficial.

CULTURAL RESOURCES

METHODOLOGY

Potential impacts on cultural resources are assessed based on the actions being proposed and the various cultural resources present at refuges, with attention to characteristics that may have an adverse effect upon the integrity of cultural resources. Resource-specific context for assessing impacts of the alternatives on cultural resources include:

- The type and amount of disturbance from oil and gas operations (such as type and location of well pads and access roads).
- The type of cultural resources affected and their susceptibility to disturbance, contamination, and noise or visual intrusion. Avoiding the destruction of a historic structure or an archeological site of modest size and defined boundaries could be expected to be relatively easy, while the issues posed by an extensive cultural landscape or ethnographic zone could be more problematic.

For the programmatic analysis, a qualitative analysis of the potential impacts of oil and gas operations on cultural resources was conducted based on actual experience of the Service in management of non-Federal oil and gas operations and their effects cultural resources and professional judgment.

The following is a discussion of the potential adverse impacts on one or more subcategories of cultural resource that oil and gas operations might cause. It is not a determination that they actually would occur; mitigation and consultation under section 106 of the National Historic Preservation Act (NHPA) are discussed under the Regulated Operations (Current and Future) section. Note that all currently regulated operations have been evaluated for compliance with section 106, and subjected to consultation if required.

TYPICAL IMPACTS OF OIL AND GAS OPERATIONS ON CULTURAL RESOURCES

Impacts from Geophysical Exploration

During the geophysical exploration phase, adverse impacts on cultural resources result primarily from the presence of seismic survey crews in and around the refuge, and the presence and detonation of explosives.

Historic Structures—Possible impacts on historic structures located within a vibration zone include cracking of foundations, breaking of glass window panes, settling and burial of artifacts located in soft soils, and collapse of structures and features due to oscillation and ground motion.

Cultural Landscapes—The presence of oil and gas personnel and their vehicles and equipment could cause adverse visual impacts for visitors that are seeking a cultural experience from the natural landscape of a refuge. Flagging used to mark site lines can be distracting, and the cutting of survey lines through dense vegetation can require creation of paths for vehicles and crews and clear a line of sight that is not natural. The noise from the seismic survey operations could adversely impact how visitors experience the cultural landscape at these sites. These impacts would be localized to the seismic survey area and short-term in duration.

Archeological Resources—Impacts on archeological resources could occur as a result of the vibrations caused by truck traffic and seismic survey technology, including settling and burial of artifacts located in soft soils, and collapses of features due to oscillation and ground motion. Increased access to areas by exploration crews could lead to intentional and unintentional vandalism and illegal collection of or damage to previously unidentified cultural resources listed or eligible for listing on the National Register.

Ethnographic Resources—Seismic surveys can introduce explosives into a refuge environment. Visitor access is limited to areas to reduce the possibility of encounters. It is possible that the geophysical exploration in a certain location could be seen by an Indian tribe as transgressing the character of a sacred site.

Impacts of Well Drilling and Production

Similar to geophysical surveys, drilling operations are relatively short term. However, the intensity of impacts is much higher, due to the equipment and materials needed to drill a well and the potential duration of the operation, which can be longer for hydraulic fracturing operations. Site preparation may include extensive clearing, grading, cutting, filling, and leveling of the well pad using heavy construction equipment that can destroy or disturb cultural resources. Soil material suitable for plant growth is often removed first and stockpiled for later use in reclamation. The operator may also dig reserve pits to hold large volumes of drilling mud and drill cuttings. Impacts on refuge cultural resources could also occur if water and sediment or contaminants were transported downslope into refuge units through adjacent streams, gullies, or overland flow, causing unsightly and/or unnatural conditions and providing a source of exposure to contaminated water or soils. Severity of impacts would depend on proximity of operations to the refuge units; site-specific environmental conditions, such as steepness and direction of slope and surface hydrology; and mitigation measures being employed.

Drilling and production operations could be more substantial than other types of impacts on cultural resources, especially if well pads are placed in locations that intrude upon historic structures or districts, cultural landscapes, areas of ethnographic significance, or archeological sites. Drill rigs can reach heights of 180 feet, which would most likely be visible from several locations within the refuges. Initial site clearing would remove approximately 1.5 to 4 acres of vegetation for each well pad (NYDEC 2011) and access road construction would often result in visible cuts through refuge vegetation or creation of a definitive pathway, depending on the location and refuge. The operations, especially drilling, would increase the presence of work crews and equipment. As drilling is a 24-hour, 7-day-a-week operation, these impacts would be continuous, and could last a week or two up to a few months. Production operations entail permanent equipment arrays such as pump jacks, oil tanks, and containment apparatus. Although these have a less intrusive human presence compared to drilling, they would be visible for 20 years or longer.

All Cultural Resources—Unplanned incidents associated with oil and gas operations such as well blowouts, fires, and major spills within the boundaries of a refuge present a risk of release of contaminants that can adversely impact cultural resources, especially historic structures and cultural landscapes if they are in the vicinity of the release or fire. However, the incident rates for such incidents are low and are not a typical expectation of project implementation. Therefore, no matter which type of operation is used for drilling and production (conventional or fracturing), there is a reasonable expectation that long-term adverse impacts from contamination would not occur or be limited to low levels of intensity, although there could be severe adverse impacts that could be considered long-term as impacts on cultural resources are generally not reversible. In the event that the refuge’s resources or values are damaged, the Service could seek remedy both in the form of reclamation and monetary compensation.

Historic Structures—Structures and districts potentially eligible for the National Register, which have not been evaluated for National Register, may have their eligibility damaged by construction or operational activities associated with drilling and production. Impacts could include the visual intrusion, either temporary or permanent, of oil and gas operations and equipment into the setting of a historic structure/district; and the introduction of vibration, noise, odors, inappropriate artificial lighting, potentially detrimental gases or chemicals, and access routes into the setting of a historic structure or a historic district. Site alterations and destruction or collection of objects and structures at sites of historical, archeological, or cultural value could occur during drilling and operation activities associated with oil and gas development. Direct impacts could occur through removal, destruction or alteration of historic structures contained within a historic district. Road construction and well drilling and production may indirectly impact historic structures and districts through vibrations which may result in accelerated deterioration of the resources.

Cultural Landscapes—Impacts on cultural landscapes from drilling and production operations could include visual intrusion, either temporary or permanent, of oil and gas operations and equipment into a cultural landscape; the introduction of vibration, noise, odors, inappropriate artificial lighting, potentially detrimental gases or chemicals, and access routes into a cultural landscape; and/or the alteration or destruction of a cultural landscape during drill site preparation. It should be noted that cultural landscapes in national wildlife refuges can be quite large and include many types of contributing features, such as natural systems and features, circulation patterns, spatial organization, land use, topography, buildings and structures, views and vistas, vegetation, and water features. Visual impacts from drilling and production operations on cultural landscapes would be more substantial if well pads were placed relatively close to the sites, where visitors would be able to see the operation and all associated equipment and tanks. Exploratory drill rigs can reach heights of 180 feet, which would be readily visible through clearings and open spaces. The operations, especially drilling, would increase the presence of work crews and equipment. Wells that would be developed using hydraulic fracturing would involve more equipment, more traffic, and a longer period of time (2 to 4 weeks) for drilling and development. Long term adverse impacts could occur to cultural landscapes from the visual presence of well pads and associated equipment.

Archeological Resources—Potential adverse impacts on archeological resources are possible from the construction and maintenance of access roads, well pads, flowlines, and pipelines. The destruction of archeological sites from the ground disturbing activities associated with oil and gas operations and equipment, including the passage of heavy trucks over access roads, can result in long-term adverse impacts on cultural resources. Refuge units typically have archeological survey data from past cultural resource investigations, but they are not necessarily comprehensive, nor is it possible to accurately predict the location of all subsurface resources. Increased access to sensitive areas could contribute to intentional and unintentional vandalism and looting of artifacts. Collection of or damage to previously unidentified cultural resources potentially eligible for listing on the National Register would constitute an indirect adverse impact. As indicated above, it is possible that important cultural sites may not be visible from the surface and could be damaged by construction activities associated with drilling and production. This would have a long-term adverse impact on individual archeological sites.

Ethnographic Resources—Ethnographic resources consist mainly of the cultural values of the tribes and other communities of interest claiming traditional associations with the area. New drilling and production could result in adverse impacts on potential ethnographic resources in the absence of appropriate consultation with communities of interest. Oil and gas drilling and production occurring in areas with significance to tribes, for example, would prevent access and cause interruptions to the symbolic associations between the people and the place itself. The intrusion of oil and gas operations into an ethnographic area, particularly an Indian sacred site, or the destruction or displacement of objects of Indian patrimony would result in adverse impacts on cultural resources, resulting in short- to long-term adverse impacts on cultural resources.

For directionally drilled wells, the location of these wells outside the refuge boundary means that most of the impacts addressed above would not be experienced in the refuge. However, if these wells are close enough to the refuge boundary, noise and even lighting can carry into the refuge, and indirect effects would be similar to those described for operations inside the refuge units. The risk of indirect impacts and their intensity would vary with the location of the well with respect to the refuge boundary.

Impacts of Plugging and Reclamation

Full-scale reclamation could include the following removal of structures, equipment and debris used or generated during operations; replanting of vegetation; removal or remediation of contaminated soils; and recontouring of disturbed areas to near original grade.

Historic Structures—Potential adverse impacts on historic structures from plugging, abandonment, and reclamation operations include the displacement of or damage to built features from vibrations and/or movement of soils containing structural remains, resulting in localized long-term adverse impacts on historic structures throughout the refuge.

Cultural Landscapes—The presence of earthmoving, demolition, and other equipment associated with plugging and reclamation activities would have similar impacts on cultural resources as described for drilling and production operations. The noise from the drill rigs and the sight of the work crews and their equipment could adversely the cultural landscape at these sites and introduce ground disturbance to the landscape. However, plugging and reclamation would end disturbances from production activities, and the sites would be restored to a more natural character. Reclamation of the well pads following plugging of the wells would serve to eliminate the unnatural views of the site over time. The actual time required to reclaim the site’s scenic views would depend on many factors, including the erosion potential of the site, productivity of the vegetation, topography, and soil characteristics, including the presence of any contamination. Ultimately, the removal of the rig and associated structures and equipment, in conjunction with site reclamation, would improve the scenic views near the well sites. Reclamation of sites and replanting with native vegetation would restore the natural character of the area, and may lessen any impacts related to disturbance in cultural setting or landscape. Overall, there could be both short-term adverse impacts and long-term beneficial impacts on cultural landscapes as a result of plugging and reclamation.

Archeological Resources—The use of heavy equipment and vehicles during reclamation activities—including well plugging and shutting down, abandoning, and removing flowlines and pipelines—could disturb and compact soil, increase soil erosion, and release oil and other contaminating and hazardous substances, resulting in short-term adverse impacts. It is assumed that previously some drilled wells may have already disturbed extant cultural sites. Ultimately, the removal of the rig and associated structures and equipment, in conjunction with site reclamation, would improve the scenic views near the well sites. Reclamation of sites and replanting with native vegetation would restore the natural character of the area, and may lessen any impacts related to disturbance in cultural setting or landscape. However, during reclamation activities, it is possible that soils containing cultural material would be disturbed, thus displacing or destroying subsurface artifacts and resulting in long-term adverse impacts. Overall, there could be both short-term and long-term adverse and beneficial impacts on archeological resources as a result of plugging and reclamation.

Ethnographic Resources—As described for other phases of oil and gas development, impacts could include limited access to or use of sacred sites or effects on the physical integrity of the sites. As a result, plugging and reclamation activities would result in adverse impacts on potential ethnographic resources.

Purpose and Scope

The purpose of the regulation in all alternatives is to ensure that non-Federal oil and gas operations conducted on NWRS lands and waters avoid or minimize, to the greatest extent practicable, adverse effects on cultural resources.

Under Alternative A, the Service scope of application of its regulation and policy provides protection of cultural resources on Service fee title lands.

Alternative B, the proposed rule, would expand the area of regulatory application to include tracts where the Federal interest is less than fee (e.g., wetland or grassland easements). As a result of active regulation by the Service, cultural resources associated with interests acquired on easements would have a consistent and higher level of protection compared to Alternative A.

Alternative C would expand the scope of regulation to operations conducted on non-Federal surface locations drilling under a refuge or any operation on private land within a refuge (i.e. an inholding). As a result of active regulation by the Service, cultural resources associated with these non-Federal lands would have a consistent and higher level of protection compared to Alternatives A and B.

Accessing Oil and Gas Rights from a Non-Federal Surface Location

Under Alternative A, there would be an incentive for operators to locate their drilling and production operations outside refuge units. The location of surface operations outside refuge units avoids direct impacts to cultural resources within refuge units, because the primary effects on cultural resources from oil and gas operations stem from the fact that cultural resources could be displaced or destroyed during the construction of roads and well pads, the installation of flowlines, tanks, and other infrastructure, or during spill response activities. While unknown subsurface archaeological resources could be damaged by drilling through sites and cultural materials at drilling locations on adjacent lands outside refuges,it is unlikely that archeological sites in refuges would be disturbed, due to the depth of the directional boreholes. However, depending on the proximity of these operations to the refuge, some indirect impacts to cultural resources on a refuge could occur, because the Service would not be imposing preventive measures. Runoff or erosion could occur, impacting surface archeological sites within the refuge units. Visual effects and noise and vibration could impact historic sites, ethnographic resources, and cultural landscapes located on refuges adjacent to drilling operations. Highly unlikely, but possible, would be severe, adverse effects in the case of a well blowout, fire or uncontrolled release on these operations that reach cultural resources in the refuge.

As previously discussed, Alternative B provides an even greater incentive for operators to locate their operations outside refuges. Therefore, it is likely that direct impacts to cultural resources from new production and drilling operations would be avoided to a greater extent than in Alternative A. Indirect impacts from those wells located on non-Federal surface locations would be the same as Alternative A.

Under Alternative C, directional drilling operations on non-Federal surface locations would be subject to the full regulatory requirements of the proposed rule. The Service would impose operational standards on activities outside the refuge to the extent necessary to avoid or minimize impacts on refuge resources and uses. Alternative C would provide some additional protection from the indirect impacts of these operations to cultural resources by requiring mitigation measures that would, for instance, reduce the risk of runoff or erosion damaging archaeological sites or possibly minimize noise and visual disturbances on cultural landscapes or ethnographic resources.

However, Alternative C eliminates the incentive to locate an operation outside of a refuge, so there would likely be a significant increase in the number of drilling and production operations located on refuges, as well as the direct impacts to cultural resources on refuges. Therefore, compared to Alternatives A and B, Alternative C would increase the instances where new drilling operations create direct, adverse, and long-term impacts to refuge cultural resources.

Requirement to Obtain a Service Permit to Conduct Operations

Under Alternative A, the Service would continue to work to ensure new operations are under a Service-issued SUP or ROW, which would reduce the impacts of geophysical operations and new drilling and production operations. When an operator obtains a Service permit prior to conducting operations it provides additional protection for cultural resources. The permitting process ensures ongoing communication between Refuge staff and the operator; that an operator includes mitigation measures to avoid or minimize impacts to refuge resources and uses; and that an operator is aware of expectations to reclaim a site to restore refuge resources and ensure long term protection of refuge resources and uses. However, the permit requirement itself has not been consistent across the Service; where permits have been issued, the permit conditions have varied widely resulting in the possibility of unnecessary impacts to cultural resources.

Under Alternative A, there would be unnecessary impacts on cultural resources from the estimated 4,000 pre-existing oil and gas production operations not under an SUP or ROW, including those described above under Typical Impacts of Oil and Gas Operations on Cultural Resources. The Service estimates that the 4,000 pre-existing wells in 107 refuges have created approximately 6,000 acres of direct disturbance associated with well sites and access roads. Direct surface disturbances from well pads and roads in refuges range from 1 to 6 acres with the average area of disturbance estimated at approximately 1.5 acres per operation.

The primary effects on cultural resources from operations stem from the fact that cultural resources could be displaced or destroyed during the construction of roads and well pads, the installation of flowlines, tanks, and other infrastructure, or during spill response activities. So, as previously discussed regarding time/place/manner considerations, most of the impacts to cultural resources occurred when the operator chose and developed the site to accommodate their drilling and production operations.

However, some continuing unnecessary impacts may occur under Alternative A due to the lack of any requirement that these pre-existing operations have ongoing mitigation measures to protect cultural resources and the fact the Service does not currently have a way to ensure operations are complying with any State laws that would protect cultural resources. Typical mitigation measures that minimize further impacts from existing wells on cultural resources include removal of contaminated soils, effective erosion control, proper secondary containment around storage tanks, regular pump jack maintenance, and removal of debris, waste, and equipment no longer needed in operations. The level of monitoring and cooperation with operators to address impacts on cultural resources would continue to vary widely, resulting in unnecessary impacts to the environment.

Under Alternative B, all new operations would be under a consistent permitting process that would include required consultation with the Service, performance-based standards to avoid or minimize impacts to geology and soil, and other administrative provisions such as financial assurance, cost recovery, and access fees that would ensure protection of geology and soils from the typical impacts of oil and gas development to the greatest extent practicable.

Similar to Alternative A, pre-existing operations would not be required to obtain an operations permit during the production phase. However, in contrast to Alternative A, the Service would manage these operations by ensuring operations are in compliance with Federal laws concerning cultural resources and by assimilating State laws and regulations into the rule, thereby increasing the Service’s enforcement ability on refuge lands. So, during the production phase, impacts to cultural resources would be reduced compared to Alternative A due to improved compliance with section 106 of NHPA. Overall, the Service expects that the large majority of issues related to ongoing impacts on geology and soils would be resolved by compliance with State laws and regulations.

Additionally, under Alternative B, all operations, including pre-existing operations, would be required to have a Service-issued permit for reclamation that would ensure all operations meet Service’s reclamation standards, which would also greatly reduce any long-term impacts on cultural resources as discussed further below in Performance-Based Standards.

Requiring that all pre-existing operations be in compliance with Federal laws, such as section 106 of NHPA, and other proposed revisions that would give the Service greater enforcement authority during the production phase, combined with the requirement that all reclamation be done to Service standards ensures a substantial and consistent long-term benefit to cultural resources compared to Alternative A.

Alternative C would require all operators on refuges to obtain a permit for their operations, including pre-existing operations. Compared to Alternative B, Alternative C may provide additional protections for geology and soils from impacts associated with pre-existing operations. Since the greatest impacts to cultural resources have already occurred, the Service would be focusing on ongoing issues, such as erosion control, in those unlikely cases where compliance with Federal and State laws and regulations do not meet Service operating standards for protecting cultural resources.

Alternative C would also subject operations on inholdings and those directionally drilling underneath a refuge from non-Federal surface locations to the full requirements of the proposed rule to the extent necessary to protect cultural resources. This would likely include further protections for cultural resources on these operations under section 106 of NHPA and other Federal laws concerning protection of cultural resources.

Performance-Based Standards

Under Alternative A, oil and gas operations would be managed on an individual unit basis, with protective stipulations developed in a site-specific manner. New operations would be subject to operating practices, as defined in SUPs or ROWs that serve to minimize or avoid impacts on cultural resources. These could include erosion control measures and spill prevention and control equipment and practices, as well as timing restrictions and visual standards for equipment; however, the operating practices included in the SUPs or ROWs are usually negotiated between the refuge manager and the oil operator. Thus, the levels of protection may vary somewhat from permit to permit and by refuge as the existing regulations do not provide specific operating standards for the protection of refuge resources. The level of monitoring and cooperation with operators to address impacts on refuge resources and uses would continue to vary widely, resulting in unnecessary impacts to cultural resources. For the 4,000 pre-existing operations, reclamation is conducted without regard for Service goals or only to the extent a refuge manager is able to negotiate to have reclamation goals addressed. Reclamation for these wells often falls short of Service reclamation standards.

Under Alternatives B and C, the proposed rule establishes performance-based standards for avoiding or minimizing impacts to cultural resources. All new operations on NWRS lands and waters would be subject to consistent standards and requirements of the proposed rule for protecting cultural resources. As previously discussed, new operations create the greatest additional impacts on cultural resources, so establishing performance-based standards that would include proper site planning, timing restrictions and the best management practices would avoid or minimize many of the typical impacts to cultural resources from oil and gas development. Also, the proposed rule includes additional standards that would protect cultural resources, such as designing, constructing, operating, and maintaining access to the operational site to cause the minimum amount of surface disturbance needed to safely conduct operations and to avoid areas identified as containing sensitive cultural resources.

Additionally, under the proposed rule operators on easements would be required to comply with these standards to the extent necessary to protect that easement interest. This would likely include further protections for cultural resources on these easements under section 106 of the NHPA and other Federal laws concerning protection of cultural resources.

The proposed rule also includes standards for achieving successful surface reclamation once operations end. All operations, including pre-existing operations, would have to meet Service reclamation standards, such as plugging all wells, removing all above-ground structures, equipment, roads, well pads, and contaminating substances, re-establishing native vegetation, restoring conditions to predisturbance hydrologic functions, and restoring natural systems using native soil material that would reduce impacts to cultural resources within the refuge units. Therefore, eventually, the disturbance associated with the 4,000 pre-existing wells would be restored to Service standards, providing a substantial long-term reduction or removal of adverse impacts on cultural resources compared to Alternative A.

Under Alternative C, pre-existing operations would be required to abide by the performance-based standards established under the proposed rule during the production phase. Compared to Alternative B, Alternative C may provide for implementation of higher standards for protection of cultural resources. Since the greatest impacts to cultural resources have already occurred, the Service would be focusing on ongoing issues, such as erosion control and noise and visual restrictions, in those cases where Federal or State laws and regulations do not meet Service operating standards.

Also, operations on inholdings and operations on non-Federal surfaces directionally drilling underneath a refuge would be subject to the performance-based standards established in the proposed rule to the extent necessary to protect cultural resources. The level of increased protection would vary from slight to moderate depending on State rules in place that serve to reduce such impacts (e.g., spill control and cleanup requirements, erosion control), and the proximity of the surface location of operations on non-Federal surfaces to the refuge.

Finally, under Alternative C, performance-based standards would also be established for downhole operations. Cultural resources would only be impacted by accidents associated with well control. Given present day technology, events that result in loss of well control (blowouts) are extremely rare. Service regulation could possibly serve to lower an already low risk of a well blowout, but in practice, the Service finds that State requirements for well control and the expectation that companies will act in their own best interest would preclude the need for the Service to regulate aspects of drilling and production related to well control. Thus, the Service does not expect any reduction of impacts or risks of impacts to cultural resources related to our downhole regulation under Alternative C.

Cumulative Impacts

Actions inside and outside the refuge units and local trends in oil and gas development can cumulatively affect cultural resources in the refuges. Past, present, and reasonably foreseeable activities that would have beneficial or adverse impacts on cultural resources in the area of analysis and a brief summary of the cumulative impacts of these actions on cultural resources are listed in Table 4-13.

TABLE 4-13. CUMULATIVE IMPACTS ON CULTURAL RESOURCES (PROGRAMMATIC LEVEL FOR REFUGE UNITS)

Past, Present, and Reasonably Foreseeable Activity	Impacts on Cultural resources
Abandoned mine lands reclamation	Long-term beneficial effects of addition of safety features and signage following re-establishment of vegetation cover and natural contours and closure of mine shafts.
Future oil and gas development on adjacent lands	Indirect adverse impacts on refuge cultural resources if the operations are close enough to result in “spill-over effects” such as sedimentation and contamination from surface runoff or noise and visual impacts that are audible or visible from cultural landscapes or ethnographic resources located within the refuge
Oil and gas well plugging and reclamation activities inside and outside refuges	Short-term adverse effects on cultural resources from noise, visual disturbance and access restrictions that can occur on roads during reclamation. Long-term beneficial effects of restoration of sites, removal of sources of contamination, and contaminated soils that are a visual eyesore. However, the frequent inability to restore or replace cultural resources that have lost integrity may render the effect negligible.
Other/private development not subject to federal cultural resource laws	Indirect adverse impacts on refuge cultural resources if development is close enough to result in “spill-over effects” such as sedimentation and contamination from surface runoff or noise and visual impacts that are audible or visible from cultural landscapes or ethnographic resources located within the refuge. Direct adverse effects on cultural resources located on private lands if no protection, including destruction of archeological and/or historic resources.

Under all three alternatives, there would be adverse and beneficial cumulative impacts from projects, plans and actions, and trends in oil and gas development as discussed in the cumulative scenario above (Table 4-13).

Under Alternative B, both adverse and beneficial cumulative impacts would occur from projects, plans and actions and trends in oil and gas development that were considered in the cumulative scenario. These are described under Alternative A and would be the same under Alternative B. Alternative B would contribute to cumulative impacts from the continued operations of pre-existing operations not under an SUP or ROW which would continue to have long-term direct adverse impacts on cultural resources, as described in the above analysis. Bringing new operations and the reclamation phase of pre-existing operations under regulation would add substantial beneficial impacts on cultural resources. When combined with the effects of all other actions in the study area, cumulative impacts from the actions under Alternative B would be long term and both adverse and beneficial, with Alternative B contributing mainly beneficial impacts on overall cumulative impacts from the change in regulations.

Cumulative impacts from actions under the cumulative impact scenario would be the same as described under Alternative A. Similar to Alternative B, there would also be effects that would occur as a result of oil and gas operations that would continue to affect cultural resources where impacts cannot be avoided, and benefits from bringing new operations and the reclamation phase of pre-existing operations under regulations and the resultant reduction in adverse impacts, as described in the Alternative B analysis. Alternative C would contribute to cumulative impacts mostly by adding beneficial impacts of bringing new operations and the reclamation phase of pre-existing operations under regulation, but also by possibly adding adverse impacts from the change in directional drilling regulations that could result in more oil and gas development within refuge units as opposed to outside refuge boundaries. Overall under Alternative C, both adverse and beneficial cumulative impacts would accrue from projects, plans and actions considered in the cumulative scenario. When combined with the effects of all other actions in the study area, cumulative impacts would be long term and both adverse and beneficial. However, Alternative C would remove regulatory incentives for operators to locate operations outside refuge units; thus, this alternative would have more impacts on cultural resources within refuge boundaries.

REFUGE MANAGEMENT AND OPERATIONS

METHODOLOGY

Potential impacts on refuge management and operations are assessed based on the actions being proposed and by determining whether the administrative ability of refuge units would be adequate to manage the required permitting activities for surface uses that would be permitted for oil and gas development within the refuge units, as well as other natural-resource-related activities mandated by law, regulation, agreement or litigation. Because oil and gas development is driven to a large degree by individual operator’s financial considerations within the context of the global petroleum economy, and because specific locations of hydrocarbon accumulations in all of the refuge units are unknown, the Service cannot speculate where individual operators would conduct their operations. It is therefore only possible to qualitatively assess impacts on refuge management and operations assuming that oil and gas development for which Service administrative oversight is required would continue into the foreseeable future. As previously discussed, in addition to the 107 refuge areas where existing development occurs, new development on 32 refuges and five WMDs is a reasonable expectation. In cases where oil and gas resources exist, this analysis assumes that all potentially productive areas would remain open for oil and gas activities.

Impacts of Alternatives

The main aspects of refuge management and operations that may be affected by actions under the alternatives include staffing and use of other refuge administrative resources and material support. refuges staff workloads and priorities may need to be rearranged to implement oil and gas management actions, and funding for management actions may exceed the current oil and gas management budget and would require additional personnel over and above what would normally be expected to be funded.

Typical Impacts of Oil and Gas Operations on Refuge Management and Operations

Service management incurs costs related to implementation of current regulations and policy by engaging refuge service personnel in activities such as the following:

- Processing permit applications;
- Monitoring operations to ensure that operators are in compliance with all applicable laws, regulations, and Service permits;
- Addressing incidents of noncompliance;
- Maintaining records, providing information to the public and congress, and addressing legal issues; and
- Preparing guidance and policy documents and participating in training or workshops related to oil and gas management.

As shown in Table 4-14, the Service has estimated the overall annual cost related to the administration of oil and gas management responsibilities to be approximately $3.6 million. This baseline cost to the Service of implementing the proposed regulations was assessed by compiling the salaries, benefits, and expenses of refuge personnel and central office personnel engaged in the above activities and allocating time to each of the above categories on a refuge-by-refuge and office-by-office basis.

Table 4-14. Annual Cost of Service Administration of Oil and Gas Management Program

Program Sector	Annual Cost
Permitting	$850,000
Monitoring and Compliance	$1,685,000
Administration and Legal Issues	$515,000
Planning and Guidance and Training	$590,000
Total Cost	$ 3,640,000

Impacts from Geophysical Exploration

During the geophysical exploration phase, adverse impacts on refuge management and operations could result from increased workloads and demands for Service employees administering to the permitting and compliance, including conducting site inspections to monitor adherence to mitigation measures outlined in approved plans of operations. These demands may result in adverse impacts on refuge management and operations in cases where there are insufficient personnel available to staff these responsibilities at individual refuge units.

Impacts of Well Drilling and Production

During the operational phases of drilling and production, refuge staff and resources would be required to evaluate drilling and production. The effect on refuge resources, and problems, leaks and violations would be handled through base workload inspections and monitoring. These requirements extending over the operational lifetime of oil and gas facilities can result in continued adverse impacts on refuge management and operations, depending on the number of operations and level of activity occurring within the refuge at any one time. In addition, the enforcement of timing stipulations for drilling and production operations in special management areas of the refuge units would require dedicated time and resources of Service staff. Similarly, the increased truck traffic associated with drilling and production operations, especially those involving hydraulic fracturing, would require additional Service staff and resources to ensure effective management of roadway conditions and minimize impacts on visitor traffic. Accidents associated with oil and gas operations such as well blowouts, fires, and major spills within the boundaries of refuge units could pose a severe impact on refuge management and operations. Depending on the degree of response and the amount of resources needed, these incidences could require additional staffing and the use of other refuge administrative and material resources.

Impacts of Plugging and Reclamation

The plugging and reclamation of wells impacts refuge management and operations because such activities may or may not be conducted under a Service SUP or ROW. Those not conducted under a Service permit can require more extensive staff time to cooperate and consult with, and ultimately convince, operators and other permitting agencies with varying objectives to implement surface reclamation that is acceptable to the Service. The effectiveness of staff time can vary widely. Service staff is then required to monitor site reclamation to ensure that refuge resources are returned to approximate pre disturbance conditions and that natural conditions and processes are restored. The administration of these requirements results in short-term adverse impacts on refuge management and operations. Once wells are plugged and reclaimed, there are typically long-term beneficial impacts due to prevention of further pollution and degradation associated with the unplugged wells that would require additional time and expense at the refuge level.

Purpose and Scope

The purpose of the regulation in all alternatives is to ensure that non-Federal oil and gas operations conducted on NWRS lands and waters avoid or minimize, to the greatest extent practicable, adverse effects on refuge land, water, and resources, as well as refuge wildlife-dependent recreational uses, and are conducted in a manner that protects employee and public health and safety.

Currently, the Service scope of application of its regulation and policy is to all operators conducting non-Federal oil and gas operations within refuges on lands or waters held by the United States in fee title.

Alternative B, the proposed rule, would also apply as Alternative A and additionally clarifies that operations conducted on lands and waters where the property interests held by the United States are less than fee, such as easements, also fall within the scope to the extent necessary to protect those property interests. For example, where the Service has purchased a wetland easement, the regulations would be applied only as necessary to protect the values and functions of wetlands that could be affected by proposed operations on that property.

Region 6 (primarily in western North Dakota and eastern Montana) contains the vast majority of easement properties in the NWRS that also coincide with occurrence of oil and gas resources and industry activity. The Service estimates that expanding the scope of regulation to include easements could increase the number of projects for seismic by 1 to 2 and new well drilling by 5 to 20 per year respectively. However, the regulatory management of such activities would be limited to the resource (e.g., wetland, grassland) for which the easement was purchased. In most cases, oil and gas operations could be conducted to avoid impacts to the specific resource and also avoid conflict with the terms of the easement agreements. Thus, the administrative burden on refuge management and operations where the federal interest is less than fee would be substantially less on a permit-by-permit basis than for fee lands. Additionally, the Service currently spends much staff time in a non-regulatory role coordinating with operators on their proposed activities, and have largely been successful in avoiding direct impacts to the federal interests on easements.

Overall, expansion of scope under Alternative B could increase administrative costs somewhat compared to current practices, resulting in a long-term, slight adverse impact refuge management and operations. Given the resource specific focus for easements and potential for a much reduced permitting process, the regulatory program for protecting the Federal interest on easements could be highly efficient and effective.

Alternative C would further expand Service jurisdiction to regulate non-Federal oil and gas operations that occur on private surface within refuges (i.e., inholdings). The Service does not currently maintain statistics for the number of nonfederal oil and gas wells on inholdings. We estimate that inholdings compose less than 5% of land areas within refuges, and thus could represent up to a 5% increase in the number of wells (+200 wells) affected by Service regulation under the Proposed Modified Rule. Alternative C would also expand Service jurisdiction under the regulations to encompass surface and subsurface directional drilling operations outside the boundary of a refuge as described in the next subtopic. We expect up to 5 drilling projects of this nature annually, or a 15% increase in permit applications for new operations compared to Alternatives A and B.

The.$3.6 million for management and administration costs presented in Table 4-14 would need to increase proportionally, perhaps to a $3.8 million range annually, to gain the intended incremental resource protections of the expanded scope in the Modified proposed rule, resulting in additional adverse and long-term impacts on refuge operations.

Accessing Oil and Gas Rights from a Non-Federal Surface Location

Under Alternative A the incentive for operators to locate their operations outside refuge units would remain in place as described at the beginning of this chapter. Under existing regulations and policy, the Service has secured SUPs or ROWs for most new drilling operations. Consequently, there exists a current incentive for operators to locate surface operations outside a refuge when feasible in order to avoid Service regulation and its associated administrative and operational costs. A surface location outside a refuge invariably meets intent of regulation (use of technologically feasible methods least damaging to refuge resources), while also relieving the Service of the administrative burdens of oil and gas management described above.

Alternative B, the proposed rule, would result in an increased incentive for operators to locate their operations outside refuges. Under Alternative B, operators could face additional regulatory costs due to financial assurance, cost recovery, and access fees requirements. As in the no action alternative, the Service would be relieved of the administrative burdens of oil and gas management described above when operators choose to locate surface operations outside a refuge.

Alternative C would expand Service jurisdiction under the regulations to encompass surface and subsurface directional drilling operations outside the boundary of a refuge. Directional drilling operations would be subject to the full regulatory requirements of a new operation. The Service would impose operational standards on activities outside the refuge to the extent necessary to avoid or minimize impacts on refuge resources and uses.

The historical number of wells being drilled beneath refuge lands to reach non-Federal oil and gas is not maintained by the Service, but is thought to range from 1 to 5 wells per year. This would increase the administrative burden of processing operations permit applications by nearly 15 percent from the current expected 35 permit applications ($850,000 * 15% = $130,000 increase). More important, with little incentive for operators to choose surface drilling locations outside a refuge, some of the additional operations permit applications would be changed to surface operations inside a refuge. The Service’s increased oversight and administrative burden would likely result in a higher degree of impacts to refuge resources and use.

The overall result of Alternative C would be a greater long-term adverse impact on park management and administration compared to Alternatives A and B.

Requirement to Obtain a Service Permit to Conduct Operations

Under Alternative A, current regulations and policy would remain in effect where the Service has been able to secure either an SUP or ROW for the large majority of new operations such as seismic surveys or new well drilling. However, the permit requirement itself has not been consistent across the Service, and where permits have been issued, the permit conditions have varied widely.

The historical average of new drilling operations is about 25 well proposals per year, though yearly numbers can vary widely. That projected level of activity on Federal fee land is expected to stay at the same level. The level of seismic activity is expected to be approximately 10 proposals per year, which would typically be portions of larger 3D projects that include refuge lands and waters. As described in Table 4-14, the Service estimates that it incurs costs of approximately $850,000 per year in the permit process.

Currently, pre-existing operations are not actively managed as a whole, but addressed on a case-by-case basis when substantial and unnecessary impacts to refuges resources and uses occur. Problems such as spills and unauthorized use of Federal surface are addressed through application of other laws and regulations, and cooperation with other permitting agencies and operators. Lacking clearly defined authorities and procedures, major issues such as spills and leaks would likely continue to require large Service resource expenditures and high demands for staff, resulting in long term adverse effects to refuge management and operations.

The Service estimates that the 4,000 pre-existing wells in 107 refuges create an estimated 6,000 acres of direct disturbance associated with well sites and access roads. The level of monitoring and cooperation with operators to address impacts on refuge resources and uses would continue to vary widely, resulting in unnecessary impacts on refuge management and operations.

Under Alternative B, all new operations would require an operations permit. Operations under an SUP or ROW would continue under those terms, which could be modified as necessary to meet the reclamation standards of the proposed rule. Pre-existing operations would continue production activities with no permit requirement, but could eventually require an operations permit if an operator proposes major modifications to existing operations. Pre-existing operations would also require an operations permit to ensure compliance with the reclamation standards of the proposed rule.

The Service has been successful in obtaining SUPs for new operations, so the permit requirement for new operations under Alternative B would be similar to Alternative A. The management and administrative costs are expected to be commensurate with Alternative A for new operations.

Existing operations under an SUP or ROW would continue under those terms which could be modified as necessary to meet the reclamation standards of the proposed rule. The management and administrative costs are expected to be commensurate with Alternative A for operations currently under a Service permit.

The requirement for an operations permit during the reclamation phase of pre-existing operations would create long-term benefits for refuge resources; however, this would result in increased demands on refuge management and operations. The demand would naturally be staggered as wells move from the production phase to reclamation.

Under Alternative B, the Service would manage pre-existing operations during the production phase by assimilating State laws and regulations into the rule, thereby increasing the Service’s enforcement ability on refuge lands. Assimilating State oil and gas laws and regulations would create efficiencies in monitoring and enforcement providing a slight benefit to management and administrative costs compare to current conditions.

Also for pre-existing operations on easements, there would be increased management and administrative costs if such operations required action to remedy impacts to the Federal interest. Additionally, assimilating State oil and gas laws and regulations would also result in increased management and administrative costs in some cases where ongoing production was unnecessarily impacting the acquired easement interest.

Alternative C would require all new and existing operations within the scope of the Modified proposed rule (both on federal and private surface estate within a refuge) to obtain an operations permit, including those operations that use directional drilling from private property surface locations to access oil and gas rights beneath the refuges.

Approximately 4,200 wells operated by perhaps 400 different operators on Federal surface estate in 107 refuges would fall under the operations permit requirement. Wells on private surface estate that are affecting Federal interests would also be subject to an operations permit requirement. Many wells could be grouped under a single operations permit by an operator, but the volume of operations permit applications required would likely exceed 1,000. Under Alternative B, the Service is expected to process about 40 to 50 operations permit applications per year, so it is evident that the Service would need to obtain funding for new staff to handle the workload or reallocate existing resources. In either event, there would be substantial adverse impacts on refuge management and administration costs in the short-term after implementation of this alternative. The permitting cost estimate of $850,000 in Alternatives A and B could easily increase by $1.7 million (tripling of current estimate) and the monitoring and compliance effort could double, adding another $1.6 million to maintain the same level of oversight for the expanded permitting program under Alternative C.

Performance-Based Standards

Current regulation, policy and training have not established a suite of performance-based standards for protection of refuge resources and uses. Consequently, oil and gas permits are managed on an individual unit basis, with protective stipulations developed in a site-specific manner. This creates inefficiencies in the permitting process, which are included in the annual costs in Table 4-14 for permitting.

Under Alternative B, the proposed regulations establish performance-based standards for avoiding or minimizing impacts to refuge resources or visitor uses during operations. The proposed regulations also include standards for achieving successful surface reclamation once operations end.

The use of standards or performance goals provides flexibility to resource managers and operators to achieve standards across various environments using new and evolving technology. The proposed rule includes standards for surface use and site management, specific resource protections, spill prevention and response, waste management, and reclamation. These specific standards are all considered and incorporated into project design so that overall, operations are conducted in a manner most protective of refuge resources and uses while ensuring human health and safety. Use of the technologically feasible, least damaging methods takes into consideration all relevant factors, including environmental, economic, and technological factors and the requirements of applicable law.

Having a comprehensive suite of performance-based standards to evaluate and modify proposals creates efficiencies in the permitting process compared to current conditions.

Ensuring compliance with performance-based standards would have long term adverse impacts on management and administrative costs to refuge operations similar to Alternative A.

Under Alternative C, the expanded scope and permitting requirements would substantially increase the overall adverse burden on refuge management and operations. In addition to the impacts described for expanded permit requirements, the Service would expand its regulation to downhole activities. This would require hiring of staff with appropriate skills to review permit application and monitor operations for compliance. The Service estimates additional costs for specialized staff to be approximately $270,000 annually.

Well Plugging (Maintenance of Idle or Shut-In Wells)

Current regulations and policy do not address procedures for addressing wells that are no longer active, but are not scheduled to be plugged in the near future. Instead, the Service relies on State rules for maintaining wells in shut-in status. This adds to administrative costs for monitoring as operators have been able to leave wells idle or shut-in for decades in some cases.

Under Alternative B, the Service would be taking a more active role in managing wells that have been idle for extended periods of time. Currently, there are approximately 2,226 wells in the Service's database listed as inactive or shut in. Service staff would spend time researching and updating well status, contacting operators, processing applications to maintain wells in shut in status, and monitoring. This will create long-term, adverse impacts on refuge operations costs, which would be partially offset by less monitoring required as operators choose to plug and reclaim wells.

Under Alternative C, the Service would consider downhole conditions when processing applications to maintain wells in shut in status, which would involve approving and monitoring of mechanical integrity tests. Given the number of wells listed as inactive or shut in, the Service estimates an additional burden of approximately $100,000 annually on refuge management and operations.

Permitting Process

Currently, the permitting process is described in policy in general terms and applied in various ways across the Service. The Management of Oil and Gas Activities on National Wildlife Refuge System Lands handbook provides guidance for obtaining a SUP as well as the minimum information contents that should be included in an SUP application. Refuge staff must often develop lists of information requirements based on the specific needs of individual projects only to identify gaps in information once the operator submits the application.

This creates back and forth communications between refuge and operator and adds to inefficiencies in the permitting process, which are included in the annual costs in Table 4-14 for permitting.

The proposed rule establishes a uniform process for obtaining an operations permit. Since the processes used currently vary widely across the Service, the new efficiencies from a uniform process will alleviate workload in some cases and create workload in other cases. Overall, establishing a uniform process process is expected to result in slightly beneficial impacts on refuge management and administrative costs compared to the no action alternative.

Under Alternative C, the permitting process would be the same as Alternative B, but the Service would actively regulate all phases of pre-existing and new operations and would regulate downhole operations as a matter of course. The modified proposed rule would establish standards and information requirements relative to downhole operations. The expansion of permitting, monitoring, and well plugging to include downhole aspects of operations could easily expand program requirements (staff and expenses) by 50% over Alternatives A and B, creating a greater adverse long-term effect on refuge management and administration.

Performance Bond (Financial Assurance)

The Service does not typically require financial assurance as a condition of an SUP issued for non-federal oil and gas operations. Operators in Alaska are permitted using ROW under 43 CFR part 36, which does provide a requirement for financial assurance.

Under Alternative A, in the event of operator default on its reclamation responsibilities, the Service would need to seek and acquire additional funding if necessary for reclamation. As a result, dedicated funding would be required along with additional staff and resources to perform the activities related to reclamation. The potential for additional administrative and financial burden and expanded responsibilities placed upon Service refuge resource specialists would result in adverse effects to refuge operation and management. These costs are included in Table 4-14 as a small, negligible portion of the administrative and legal issues cost estimate.

Alternative B would require financial assurance as a condition of approval for an operations permit. Financial assurance would be set equal to the estimated cost of reclamation. Service staff would spend time estimating the cost of reclamation, handling the performance bonds or other legal documents related to financial assurance, and monitoring for successful reclamation. These administrative costs are expected to have a negligible adverse cost effect on refuge operations.

The proposed rule also holds that failure to comply with any provision of an Operations Permit could result in forfeiture of a portion of the financial assurance needed to remedy the condition of noncompliance. This provides the Service with an enforcement tool and provides an operator with additional incentive to remain in compliance with its permit. The effect on refuge management and administrative costs is expected to be negligible, but beneficial.

Alternative C would require financial assurance as a condition of approval for an operations permit as described under Alternative B, but would not consider an operator's in-kind reclamation as a means to reduce the bond amount. The effect on refuge management and administrative costs is expected to be the same as Alternative B.

Cost Recovery

The Service does not seek cost recovery for administration of SUPs for non-Federal oil and gas operations. Operators in Alaska are typically permitted using ROW under 43 CFR Part 36, which does provide for cost recovery.

Under the no–action alternative, lack of cost recovery and additional money that could be collected to support Service permitting, monitoring, and compliance programs would continue, resulting in administrative burdens upon Service refuge resource specialists. Consequently, adverse effects would accrue to refuge operation and management under the Alternative A.

Under alternatives B and C, the Service is proposing a requirement for operators to reimburse the Service for the costs of processing and administering temporary access permits and operations permits. The Service would determine the amount of reimbursement by the actual staff time spent directly processing permit applications and subsequently monitoring the operation for compliance.

The Service costs associated with administering a permit consist of a one-time fee for processing a permit application, and then a recurring annual fee for monitoring operations for compliance with the permit.

The one-time fee for processing permits would vary largely depending on the complexity of the permit, site location, and proximity to sensitive resources (i.e., species habitat, wetlands and water features, cultural resources, etc.). The Service estimates this one-time fee to range from $500 to $5,000, but trend towards the high-end of the range since most operations will have notable implications on refuge resources and visitor values. Monitoring cost are expected to fall within $100 to $500 per well annually.

As a result of this provision, the refuge permitting, monitoring, and compliance program costs would be reduced. This would create long-term beneficial impacts on refuge management and operations under the proposed rule and the Modified proposed rule.

Access Fees

Under current regulations and policy, the Service does not assess fees for an operator's use of a Federal surface for access to their oil and gas rights boundary.

Under Alternative A, the Federal government would not be compensated for damages and any associated loss of resources that result from privileged use of Federal surface estate. The responsibility of road maintenance would fall upon the Service, which must seek and acquire additional funding to perform the work required to protect refuge resources. In addition to dedicated funding, additional staff and resources to perform the activities would also be required. Under the no–action alternative, the potential for this additional administrative burden would result in adverse effects to refuge operation and management.

Under alternatives B and C, the Service would be compensated for use of Federal lands and waters outside the boundary of an operator's mineral right. The amount of the fee could vary widely mostly due to the differences in the amount of Federal acreage used, which could range from only a fraction of an acre up to dozens of acres for very long access roads. Also, the refuge could accept reclamation in kind or road maintenance agreements in lieu of fees. These options would require administrative costs to manage these activities, but would reduce Service costs of reclamation and maintenance. As a result, there would be both beneficial impacts from receipt of compensation and adverse impacts on refuge management and administration, with overall impacts being negligible on refuge operations budget.

Third-Party Monitoring

The use of monitors at the expense of an operator is not required, but is a common consideration in SUPs issued for 3D seismic operations. Under the no–action alternative, the continued practice lowers the administrative burden for monitoring resulting in beneficial effects to refuge operation and management.

Alternatives B and C would codify existing practices related to geophysical projects by allowing the Service to require that operators hire third party monitors when they are necessary to ensure compliance and protect refuge resources and values. Similar to Alternative A, this reduces the monitoring burden on refuge management and administration.

Third-party monitors could also be used in other phases of operations such as drilling, production, or well plugging and reclamation. The Service expects these instances to be rare, only occurring when refuge staff could not fulfill the monitoring role and an operator's self-reporting was deemed insufficient. Therefore, the ability to use third-party monitors in other phases beside geophysical is expected to cause negligible, but beneficial impacts on refuge management and administration.

Cumulative Impacts of Alternative A: No-Action

Actions inside and outside the refuge units and local trends in oil and gas development can cumulatively affect refuge management and operations at the refuges. Management planning, such as fire management, vegetation management, and ORV plans can result in beneficial impacts on refuge management and operations by providing guidance for improved management strategies and proper allocation of Service resources. However, preparation and administration of these plans creates a sizable demand on staff time. Actions that cause additional burdens on refuge administrative resources (such as prescribed burns, facility construction and mine reclamation) can result in adverse effects on refuge resources and management by placing additional demands on Service staff and material resources. Past, present, and reasonably foreseeable activities that would have beneficial or adverse impacts on refuge management and operations in the area of analysis (including both refuge lands and adjacent lands) and a brief summary of the cumulative impacts of these actions on refuge management and operations are listed in Table 4-15.

TABLE 4-15. CUMULATIVE IMPACTS REFUGE MANAGEMENT AND OPERATIONS (PROGRAMMATIC LEVEL FOR REFUGE UNITS)

Past, Present, and Reasonably Foreseeable Activity	Impacts on Water Resources
Prescribed fires and fire management actions	Possible short-term adverse effects to refuge management and operations from increased administrative and financial burden during the period of management action. Long-term beneficial impacts on refuge management and operations by providing guidance for improved management strategies and proper allocation of Service resources.
Service facility and road construction	Possible short-term adverse effects to refuge management and operations from increased administrative and financial burden during the period of construction. Long-term beneficial impacts on refuge management and operations following improvements to infrastructure that provides for more efficient operations within refuge units.
Abandoned mine lands reclamation	Possible short-term adverse effects to refuge management and operations from increased administrative and financial burden during the period of reclamation. Long-term beneficial effects of improvements to refuge resources, resulting in a decrease of administrative and financial burden that would have been associated with deferred reclamation
Vegetation management	Long-term beneficial impacts on refuge management and operations by providing guidance for improved management strategies and proper allocation of Service resources.
Oil and Gas Management	Long-term beneficial impacts on refuge management and operations by providing guidance for improved management strategies and proper allocation of Service resources.
ORV use management	Long-term beneficial impacts on refuge management and operations by providing guidance for improved management strategies and proper allocation of Service resources.
Future oil and gas development on adjacent lands	Short and long-term indirect adverse impacts on refuge management and operations from the potential for damage to refuge resources from nearby sites and the need for administrative action, leading to an increase in administrative and financial burden to refuges

Cumulative Impacts of Alternative B

Under Alternative B, both adverse and beneficial cumulative impacts would occur from actions considered in the cumulative scenario. These are described under Alternative A and would be the similar under Alternative B. Alternative B would contribute to cumulative impacts from the continued administrative need to oversee permitted operations, which would have adverse impacts on refuge management and operations, as described in the above analysis. Additionally, bringing new operations and the reclamation phase of pre-existing operations under regulation would add some administrative burden on refuge resource staff pertaining to the requirements entailed in overseeing permitting and inspections of newly nonexempt oil and gas operations. Provision for cost recovery, access fees, financial assurance, and third-party monitoring would contribute beneficially to cumulative impacts. As a result, cumulative impacts on refuge management and administration would be slightly less adverse under the proposed alternative compared to the no action alternative.

Cumulative Impacts of Alternative C

Cumulative impacts from actions under the cumulative impact scenario would be the same as described under Alternative A. Similar to Alternative B, both adverse and beneficial cumulative impacts would occur from actions considered in the cumulative scenario. Alternative C would contribute to cumulative impacts from the continued administrative need to oversee permitted operations, which would have adverse impacts on refuge management and operations, as described in the above analysis. Bringing new operations and all phases of pre-existing operations under regulation would add a large administrative burden on refuge resource staff pertaining to the requirements entailed in overseeing permitting and inspections of oil and gas operations. Moreover, the addition of directionally drilled operations that would previously have opted to locate outside refuge boundaries but would now be located within the refuge would further contribute to this burden. Additional responsibilities involved in attending to new operations would increase the existing workload of refuge staff and would require additional full-time employees or other administrative or material resources. Overall, however, the contribution to cumulative impacts of Alternative C would be significant, given the wider context of cumulative actions affecting refuge management and operations. Impacts would likely be greater to refuge operations for those units with a high number of new operations and pre-existing operations and for those units that exhibit a greater potential for future operations due, for instance, to their proximity to Marcellus shale or the Tuscaloosa shale.

SOCIOECONOMICS

METHODOLOGY

Socioeconomic parameters that are being analyzed in this EIS include (1) oil and gas operator costs and project financial viability; and (2) local and regional economies. Potential impacts on socioeconomic resources are assessed based on the impacts that compliance with the proposed regulations would have on operator costs and project viability. Impacts associated with local and regional economies are tied to project viability and production for affected operations.

A key component of assessing impacts to local and regional economies is the expectation that implementation of either action alternative would not affect the level of new development or the volume of oil and gas production.

The primary method for assessing impacts on operators and project viability include describing the potential compliance costs associated with the alternatives, as described in the Service cost-benefit analysis (Service 2015) and identifying the number of operations and operators affected. Impacts on local and regional economies are based on an assessment of the impact that the compliance costs have on financial viability of the operation and the relative importance of production levels within the refuge.

The degree of potential impacts on local and regional economies from compliance costs depends on level of expenditures within the local economy, the impact of costs on project viability, the relative level of oil and gas activity in surrounding areas, and many other factors. Oil and gas production and development activity within the refuge, within the region, and within the State can provide an indication of how important these oil and gas activities are to the surrounding counties and the State. The Service does not track actual oil and gas production from non-Federal oil and gas wells within the NWRS. Based on average production rates from oil and gas wells in the United States (Energy Information Administration) multiplied by the number of active oil and gas wells on refuge lands, non-Federal oil production from refuge lands is estimated to be 3,500 barrels of oil per day, and natural gas production is approximately 220,000 thousand cubic feet per day. While this method of estimating production could vary from actual production by several fold, the percentage of production from refuge lands compared to U.S production is only a small fraction of a single percentage point. [Note: U.S. oil and gas production rate in 2013 was 7,450,000 barrels of oil per day and 82,000,000 thousand cubic feet per day. Actively producing wells was approximately 570,000 oil wells and 487,000 gas wells, yielding average production rates of 13 barrels of oil per day per oil well and 170 thousand cubic feet per day per gas well.]

A quantitative analysis is provided on compliance costs on a per well/operation basis, if possible, and aggregated to reflect costs across all refuges. Impacts on local and regional economies are described qualitatively.

People can attribute values and benefits to experiences of the environment, uses of natural resources, or the existence of particular ecological or environmental conditions, which often-times do not involve market transactions, and therefore lack prices. These nonmarket values for improved environmental qualities can be considerable but are often difficult and time-consuming to estimate. As a result, these values are described briefly in this methodology section and are further described in the relevant sections in the document, including visitor use and experience, geology and soils, water resources, health and safety, etc.

The current regulations and policies provide benefits to natural resources, the environment, and ecosystem services, including resource protection, visitor experience and recreation values, health and safety, soils, water resources, aesthetics, and others. The Service has been able to secure either an SUP or ROW for the large majority of new operations, such as seismic surveys or new well drilling. However, the permit requirement itself has not been consistent across the Service, and where permits have been issued, the permit conditions have varied widely. Where SUPs or ROWs have not been issued, there could be unnecessary adverse effects on natural resources, the environment, and ecosystem services. For example, operations not under SUPs or ROWs have the potential for continuing adverse impacts from improper operations, which could lead to spills, leaks and other releases of oils, produced water, or other chemicals that can contaminate soils and other refuge resources. Releases of oils or chemicals have contaminated resources and have not been cleaned up because of lack of regulation and oversight. These continuing environmental adverse effects can adversely affect the nonmarket values that the refuge provides (i.e., visitor use and experience, aesthetics and viewscapes, geology and soils, water resources, health and safety, and others).

Study Area

The study area for socioeconomics includes the refuge units listed in Table 1 in Chapter 1 and communities and areas adjacent to the refuge units supporting oil and gas operations.

Impacts of Alternatives

Both permitted (SUP or ROW) and unpermitted oil and gas operations contribute to local and regional economies. Currently operations under an SUP or ROW pose additional costs to operators to comply with the current permit conditions. Typical socioeconomic impacts associated with oil and gas activity located within refuges include economic benefits, including jobs, income, taxes, and sales. The decision to develop and operate in an area is based on the financial viability of the operation or new investment. Operators assess individual well and field economics, such as the revenues or value of production, capital investment and other upfront costs, on-going production costs, and costs of plugging and abandonment in their decision. In addition to complying with many Federal, State, and local regulations for oil and gas activity, the oil and gas industry currently faces additional costs to comply with SUPs and ROWs in refuges that secure these permits compared to operating on lands outside refuge units.

Typical Impacts of Oil and Gas Operations on Socioeconomics

Operator Costs and Project Financial Viability

Industry currently faces an additional cost to comply with Service regulations in refuges. Table X provides a summary of estimated additional costs by categories based on operation type and regulatory status.

Currently, costs categories specific to conducting private oil and gas operations under an SUP or ROW include the following:

1. Plan of operations preparation or permitting,
2. Compliance with Service permit requirements that exceed other Federal, State, and local requirements,
3. Compliance with Service reclamation standards that exceed other Federal, State, and local requirements, and
4. Maintenance of performance bonds or equivalent surety, if required.

These costs are normally a small percentage of a typical operator's total expenses, but for some individual operations, these costs can become economically significant as production declines and profit margins constrict.

Although these administrative and operational costs are a part of the decision to develop wells and/or continue production for existing wells, they are not a major factor. The price of oil and gas, however, is an essential factor. The most important component is the operational and geological risk assessment that exploration and drilling will lead to successful and economical oil and gas production, and if so, at what level.

Local and Regional Economies

Oil and gas exploration and development support jobs and income in nearby communities for drill rig operators, geophysical seismic companies, construction companies, landmen, and oil and gas support companies that complete wells, among others. Oil and gas production supports industry jobs, including inspecting and maintaining equipment and operations, complying with mitigation standards and other on-going production and operational needs. These residential and nonresidential workers spend their wages in local and regional communities, supporting downstream jobs and income. Oil and gas production also provides economic benefits to oil and gas companies, benefiting economies where these companies are headquartered and the nation overall. Many energy-related jobs provide higher wages and earnings than service sector jobs.

During production, the oil and gas value of production is often taxed through severance taxes and ad valorem taxes, although these taxes vary by State. Additionally, local governments often benefit from property and sales and use taxes on oil and gas equipment. These tax receipts typically benefit State and county agencies, providing funding for schools, roads, social services, and other public service and infrastructure.

Purpose and Scope

Currently, the Service applies its regulation to areas within the NWRS where the surface estate is held in fee title. Alternative A would continue that policy. Information collected from refuges indicates that an annual average of 10 seismic surveys and 25 drilling projects have been conducted over the past 10 years on Federal lands and waters within the NWRS. Although the number of permit applications has and will continue to vary widely from year to year, in this analysis, the Service expects the same average level of activity going forward for all alternatives.

Alternative B, the proposed rule, would expand the area of regulatory application to include tracts where the Federal interest is less than fee (e.g., wetland or grassland easements).

Region 6 (primarily in western North Dakota and eastern Montana) contains the vast majority of easement properties in the NWRS that also coincide with occurrence of oil and gas resources and industry activity. The Service estimates that expanding the scope of regulation to include easements could increase the number of operations permit applications for seismic by 1 to 2 and new well drilling by 10 to 20 annually. However, the regulatory requirements of such activities would be limited to the resource (e.g., wetland, grassland) for which the easement was purchased. In most cases, oil and gas operations could be conducted to avoid impacts to the specific resource and also avoid conflict with the terms of the easement agreements. Thus, the cost burden on operators where the Federal interest is less than fee would be substantially less on a permit-by-permit basis than wells drilled on federal fee surface.

There could be some increased costs to operators of pre-existing oil and gas production wells on easements during the reclamation phase, if such operations required action to remedy impacts to the Federal interest.

Overall, expansion of scope under Alternative B could increase costs operators on easements where they could not avoid impacts to the Federal interest resulting in a slightly higher long-term adverse impact compared to Alternative A.

Alternative C would further expand Service jurisdiction to regulate non-Federal oil and gas operations that occur on private surface within the boundary of a refuge (i.e. inholdings). Alternative C would also expand Service jurisdiction under the regulations to encompass surface and subsurface directional drilling operations outside the boundary of a refuge as described in the next subtopic.

The Service does not keep statistics of wells and operators on inholdings, but estimates the management approach under this alternative would increase the level of non-Federal oil and gas wells by approximately 200 wells. Operators with no wells on refuge lands or waters could be affected by having to incur costs necessary to comply with Service regulation under the Proposed Modified Rule.

Accessing Oil and Gas Rights from a Non-Federal Surface Location

Under Alternatives A and B, the incentive for operators to locate their operations outside refuge units would remain in place as described at the beginning of this chapter. The incentive for operators to locate their operations outside refuge units to avoid Service permitting and operational costs would remain in place. Additionally, the incentive for operators to select this method of access would be greater under the proposed rule when compared to current conditions. Since the proposed rule includes provisions for maintaining financial assurance, access fees, and cost recovery, among others, the operators costs increase as does the incentive to avoid those costs.

Alternative C would expand Service jurisdiction under the regulations to encompass surface and subsurface directional drilling operations outside the boundary of a refuge. Directional drilling operations would be subject to the full regulatory requirements of new operations. The Service would impose operational standards on activities outside the refuge to the extent necessary to avoid or minimize impacts on refuge resources and uses.

The historical number of wells being drilled beneath refuge lands to reach non-Federal oil and gas is not maintained by the Service, but is thought to range from 1 to 5 wells per year. With little incentive for operators to choose surface drilling locations outside a refuge, some of the additional operations permit applications would be changed to surface operations inside a refuge. The overall result would be a long-term adverse impact on operators that otherwise could have avoided Service regulation.

An operator’s decision to go forward with a drilling project would not be affected by any of the alternatives, and there would be no expected effects on local and regional economies.

Requirement to Obtain a Service Permit to Conduct Operations

Under Alternative A, the Service would continue its policy of securing either an SUP or ROW for the large majority of new operations such as seismic surveys or new well drilling.

Operators seeking approval for and conducting new seismic or drilling projects would continue to incur costs for obtaining permits. Permitting costs include collection of information via reconnaissance surveys, which can be the bulk of the permitting cost. Surveys often include several or all of the following: location surveys, biological surveys including threatened and endangered species, cultural surveys, soundscape surveys, soil and water quality measurements, and wetland and floodplain delineations. Depending on resources present in the area of operations and availability of existing resource information, reconnaissance survey costs can range from only several thousand dollars to tens of thousands of dollars. For example, a widespread 3D seismic survey may involve all of the surveys listed above over large geographic areas possibly costing up to a high-side scenario of $100,000. The area of operations for drilling operations is much smaller than a seismic survey and so reconnaissance surveys for drilling proposals will typically add a lower range of $10,000 to $30,000 to the overall permitting cost. Of course, some proposed operations may not require any surveys depending on available information and expected impacts from the proposed activity.

Compiling and presenting the operational information and results of reconnaissance surveys in a plan of operations can vary from $5,000 to $20,000 depending on the complexity of the operation and whether the plan is prepared in-house or contracted to an environmental consulting firm.

Estimates of an operator's permitting costs thus range from a low of $5,000 for a straightforward drilling permit prepared in-house, where natural and cultural data is available, to over $100,000 for a complex 3D seismic survey permit prepared by consultants where the full suite of reconnaissance surveys is necessary.

These costs represent adverse effects on operators and project viability. Though adverse, the costs typically represent a small percentage of overall project costs, and do not materially affect an operator's decision to go forward with a project. Thus, there are no expected impacts on production, and local and regional economies.

Currently, pre-existing operations are not actively managed as a whole, but addressed on a case-by-case basis when substantial and unnecessary impacts to refuge resources and uses occur. Problems such as spills and unauthorized use of Federal surface are addressed through application of other laws and regulations, and cooperation with other permitting agencies and operators. As a result, under Alternative A, operators of pre-existing operations would not incur costs specific with compliance with Service regulation of non-Federal oil and gas rights.

Under Alternatives B, the practice of securing permits for new operations would be codified by a clear requirement for operators to have an approved operations permit prior to conducting new operations. Thus, the impacts on operators proposing new activities would be the same as in Alternative A.

Service statistics show that 115 existing production operations are being conducted under either an SUP or ROW. Under Alternative B, existing operations under an SUP or ROW may continue producing under the terms of that permit, which invariably include a means to ensure that operational and reclamation standards of the proposed rule can be achieved. Therefore, operators under current Service permits would not be affected.

Under Alternative B, pre-existing operations could continue as they have been as long as they comply with existing Federal, State, and local laws and regulations and the General Terms and Conditions outlined in the proposed rule. The proposed rule requires operators of pre-existing operations to submit documentation demonstrating their right to operate, company contact information, a scaled map of the existing area of operations, and copies of all plans and permits associated with their operations. The Service estimates the information could be developed at cost of about $300 per well site. Though not required to obtain a Service operations permit during production, the Service would maintain an active management role by assimilation of State laws and regulations into the proposed rule. Thus, operators that are in compliance with applicable laws and regulations would not be affected.

At the end of production operations, operators of pre-existing wells would be required to obtain a permit for plugging and reclamation and comply with all Service reclamation standards. Operators of pre-existing wells would be adversely affected due to costs incurred to obtain an operations permit. The operations permit application process would not involve reconnaissance surveys and the Service would provide site-specific reclamation standards and acceptable methods to achieve them. The Service estimates the adverse effect on operators due to permitting to be approximately $500 per well site.

Overall, implementation of Alternative B could adversely affect operators of pre-existing wells by creating costs of approximately $30,000 per well. These cost are described in the related subsections and consist of costs for providing initial information ($300 per well), obtaining an operations permit for plugging and reclamation ($500 per well), maintaining a performance bond throughout reclamation ($3,000 per well site), and conducting reclamation to Service standards ($23,000).

Under Alternative C, the requirement to obtain an operations permit would expand to the production phase of pre-existing operations within the scope of the modified proposed rule, which would include wells on federal and private surface estate within refuge acquisition boundaries, as well as those operations accessing oil and gas rights from a surface location outside the refuge boundary.

Approximately 4,000 wells on federal lands and waters operated by perhaps 400 different operators in 107 refuges would fall under the operations permit requirement. As described under Purpose and Scope, another 200 wells could fall under the operations permit requirement.

Many wells could be grouped under a single operations permit by an operator, but the volume of operations permit applications required would likely exceed 1,000. The operators of these pre-existing wells would be adversely affected by permitting costs, cost recovery fees, expenses to maintain financial assurance, and costs to maintain sites to Service standards that are above and beyond other Federal and State requirements. Using cost estimates for the regulatory provisions described in Alternative B, and applying them to 1,000 operations permit applications and 6,500 wells, operators of pre-existing wells could incur costs over $20 million initially and $15 million annually thereafter.

Performance-Based Standards

Under current policy, new oil and gas projects are permitted and managed on an individual refuge or refuge complex basis, with protective stipulations developed in a site-specific manner. Current policy and training, however, have not established a suite of performance-based standards for protection of refuge resources and uses. As a result, stipulations required in an SUP or ROW can vary widely across the NWRS and may be developed on a project-by-project basis. Operators may not be provided flexibility on how they may achieve resource protections. Inconsistencies and lack of flexibility may lead to permitting inefficiencies and implementation of more costly protective measures.

A lack of performance-based standards under Alternative A causes adverse effects on operators seeking and conducting operations under a SUP or ROW. There are no expected impacts on production, and local and regional economies.

Under Alternative B, the proposed regulations establish performance-based standards for avoiding or minimizing impacts to refuge resources or visitor uses during operations. The proposed rule also includes standards for achieving successful surface reclamation once operations end.

Compared to Alternative A, this will result in a more consistently high level of resource protection in concert with generally higher costs of implementing actions to meet Service standards for those operators subject to operations permit requirements. These higher operating costs could be partially or wholly offset by permitting efficiencies afforded by a uniform suite of standards and a flexible means for operators to achieve them. Overall, operators implementing new activities would likely experience only slightly higher adverse cost effects compared to Alternative A.

Operators of the 115 wells currently under an SUP or ROW would not be impacted by defined performance-based standards in the proposed rule.efficiencies in the permitting process

Operator of pre-existing operations would need to meet reclamations standards generally not required under Alternative A. During well plugging operations, operators would be required to leave the site in a clean and safe condition in preparation for surface reclamation, which could involve placing liners underneath plugging equipment, using steel tanks instead of earthen pits, catching well fluids and solids in steel tanks and disposing of these materials outside of the refuge, and employing erosion control measures on the access road and well site. These measures could add $2,000 to $4,000 per plugging operation.

The proposed rule includes reclaiming the site to standards that many States and individual landowners do not require of operators. Assuming that any surface reclamation standards are above and beyond other Federal, State, and local requirements will provide a high side estimate of costs associated with meeting Service standards. The NPS recently assessed oil and gas site reclamation costs based on operator estimates for reclamation or actual NPS oil and gas site reclamation project costs, and found the weighted average for surface reclamation in the 12 parks with oil and gas operations to be $23,000 per well site. The Service has a similar range of conditions as NPS (various well site conditions in various types of environments) and can expect operators to incur similar average costs to meet Service reclamation standards.

Thus under Alternative B, operators of pre-existing wells could experience adverse cost effects of $26,000 per well to meet performance standards at the future time of well plugging and surface reclamation.

Under Alternative C, the application of performance-based standards above and beyond other Federal, State, and local requirements would apply to pre-existing operations during the production phase. The Service estimates that most operations on federal surface estate could be improved to meet standards at initial costs between $0 and $4,000 initially, and then maintained to those standards for between $0 and $500 annually. Using a $2,000 initial cost and $500 annual cost thereafter and 4,000 wells results in adverse impacts on operators of $8 million initially, and $2 million annually.

Operational standards for the estimated 200 wells on private property within refuge boundaries would be limited to minimizing or avoiding impacts to federal interests. The Service expects that nearly all issues related to indirect effects on federal property can be removed if operations were run in compliance with all other federal, State, and local laws and regulations. Because compliance costs of existing federal, State, and local laws and regulations cannot be attributed to the proposed rule change, it follows that the incremental operational costs of imposing operational standards on private property are expected to be negligible.

Performance Bond (Financial Assurance)

The Service does not typically require financial assurance as a condition of an SUP issued for non-Federal oil and gas operations. Operators in Alaska are permitted using ROW under 43 CFR part 36, which does provide a requirement for financial assurance, but the percentage of ROW issued versus SUP is very low at less than 5 percent. As a consequence, operators only rarely incur costs associated with financial assurance and thus are adversely affected.

The proposed rule would require financial assurance as a condition of approval for operations permits. The financial assurance would be set equal to the estimated cost of reclamation, which includes well plugging. Analogous NPS statistics indicate well plugging and surface reclamation costs vary widely, from $10,000 to over $400,000 per well, with an overall weighted average of about $50,000 per well.

The annual cost for an operator to maintain a performance bond with a surety company varies substantially depending on an operator's credit standing. These costs are not available to the Service and are difficult to estimate. For this analysis, the Service assumes that if annual costs amount to much over 10 percent of the bond amount, operators will use other vehicles, such as an irrevocable line of credit or cash. Using the same 10 percent of bond amount as the "cost" for an operator not having that cash available, it appears reasonable to use 10 percent of the bond amount as a conservative (i.e., high side) estimate of the annual cost of maintaining the bond.

Though subject to a wide range, operators of wells under an operations permits could therefore incur an average of $5,000 per well ($50,000 * 10%) annually to maintain financial assurance. Well operators could lower the annual costs by conducting partial reclamation or in-kind reclamation.

Operators conducting geophysical surveys would experience much lower financial assurance costs, perhaps the one-time annual equivalent of $100 to $2,000. Geophysical surveys are conducted such that reclamation actions/costs are minimized leading to minimal financial assurance requirements.

As more wells fall under operations permits and financial assurance requirements, adverse effects on operator costs would grow and apply to an increasing number of operators. The long-term adverse effects on operators due to financial assurance requirements are not expected to have noticeable impacts on local and regional economies.

Alternative C would require financial assurance as a condition of approval for an operations permit as described under Alternative B, but would not consider an operator's in-kind reclamation as a means to reduce the bond amount. Pre-existing wells would be subject to operations permits and financial assurances requirements, and those cost estimates are included in the "Requirement to Obtain a Service Permit to Conduct Operations" section for Alternative C. Also, the expansion of scope to regulate operations on private property would not create additional financial assurance burdens on those affected operators since it would be rare for a Service reclamation standard to be imposed on private property to protect the federal interest. No Service reclamation requirements leads to no required performance bond. The effect on long-term adverse costs effects on operators is the same as Alternative B with no reduction for in-kind reclamation.

There are no expected impacts on production, and local and regional economies.

Well Plugging (Maintenance of Idle or Shut-In Wells)

Current regulations and policy do not address procedures for addressing wells that are no longer active, but are not scheduled to be plugged in the near future. Instead, the Service relies on State rules for maintaining wells in shut-in status. As a consequence, operators do not incur costs related to maintenance of idle or shut-in wells under Alternative A. There are no expected impacts on production, and local and regional economies.

Under Alternative B, the preferred alternative, operators wishing to maintain wells in idle or shut-in status would face incremental costs due to this provision.

Service statistics indicate over 2,200 wells in the NWRS are in idle or shut-in status. An important consideration in this analysis is that many operators who have wells that are producing no income may decide to plug and reclaim rather than undertake the expenses necessary to maintain wells to Service standards. The Service believes it to be reasonable to expect perhaps one-half, approximately

1,000, of these wells would be plugged and reclaimed in the initial years following implementation of the proposed rule.

Our analysis does not attribute any incremental cost effects related to permitting or Service reclamation standards due to this regulatory provision. Operators are required to plug wells under State law, and costs to obtain operations permits and comply with Service reclamation standards are described in those sections.

Operators would incur costs to maintain sites to Service standards. Incremental actions/costs specific to this provision that are above and beyond other Federal or State regulatory requirements could include fencing around a facility in a visitor use area, vegetation control, and removal of debris, waste, or equipment no longer needed in operations. These initial improvements might cost operators from $0 to $4,000 per well site with negligible incremental maintenance costs after that. Many sites might not meet requirements of other Federal and State requirements (e.g., Spill Prevention Control and Countermeasure, access maintenance, erosion control, signing, stormwater runoff). Even though the rule change provides the Service a regulatory means to require operators to comply with other Federal, State, and local laws and regulations, the costs are not viewed as incremental.

Overall, operators maintaining wells in idle or shut-in status would be adversely affected by one-time costs incurred to bring sites up to Service standards ($0-$4,000 per well) and annual costs of $5,000 as described under Financial Assurance. The provision is not expected to have effects on local or regional economies.

Also, the expansion of scope to regulate operations on private property would not create additional cost burdens on those affected operators since it would be rare for a Service standard to be imposed on idle wells on private property to protect the federal interest. The effect on long-term adverse costs effects on operators is the same as Alternative B with no reduction for in-kind reclamation.

Permitting Process

Currently, the permitting process is described in policy in general terms and applied in various ways across the Service. The Management of Oil and Gas Activities on National Wildlife Refuge System Lands handbook provides guidance for obtaining an SUP as well as the minimum information contents that should be included in an SUP application. The policy does not specify timelines in which the Service will respond to an operator’s submission of information.

Under Alternative A, operators experience some benefit by the Service’s use of guidance on obtaining an SUP, but may be adversely affected by a lack of timelines for processing of permit applications.

The proposed rule establishes a uniform process for obtaining an operations permit and logically only affects those operators seeking an operations permit. The proposed rule establishes the process for taking initial steps in developing a permit application, contents of the application, the Service’s review of the application including timelines, the Service’s approval standards, and the actions the Service may take on the application including timelines.

Service data indicates we can expect about 40 to 50 operations permit applications annually. These operators will benefit from the efficiencies of a uniform process and greater predictability in the length of time needed to secure approval compared to the no action alternative.

Operating standards and the permitting process under Alternative C would be the same as Alternative B, except the Service would actively regulate downhole operations as a matter of course. The modified proposed rule would establish standards and information requirements relative to downhole operations. The expansion of Service regulation to downhole activities could generally increase operator costs by 10 to 30 percent in cost categories of permitting, cost recovery fees, maintenance of financial assurance, and meeting Service standards that are above and beyond other Federal and State requirements. These adverse cost effects would be long-term.

Cost Recovery

Under Alternative A, the Service does not recover costs for processing proposed plans of operations or monitoring approved operations for regulated operations. There would be no resulting impacts on operators or local and regional economies.

Under Alternative B, the Service may require operators to reimburse the Service for the costs of processing and administering temporary access permits and operations permits. The Service would determine the amount of reimbursement by the actual staff time spent directly processing permit applications and subsequently monitoring the operation for compliance.

The Service costs associated with administering a permit consist of a one-time fee for processing a permit application, and then a recurring annual fee for monitoring operations for compliance with the permit.

The one-time fee for processing permits would vary largely depending on the complexity of the permit, site location, and proximity to sensitive resources (i.e., species habitat, wetlands and water features, cultural resources, etc.). The Service estimates this one-time fee to range from $200 for simple temporary access permits to over $5,000 for complex proposals having notable implications on refuge resources and uses.

Annual monitoring costs consist of staff time to visit and document conditions at operations sites, compile information into a monitoring report, and conduct follow up correspondence with operators where conditions of non-compliance exist. These costs will also vary depending on complexity of operations, ease of access, and rates of non-compliance issues. The Service estimates the range to be between $120 and $500 with an average cost of $250 per well per year.

These fees would adversely affect operators proposing and conducting new operations, although the fees would be small relative to the total project and operational costs.

Cost recovery fees under Alternative C would be 10 to 30% higher than described for Alternative B for operations on federal lands and waters due to regulation of downhole activities. For operations on private property, cost recovery fees would trend to the low ranges for processing permits and monitoring since the scope of these permits would be substantially less.

Access Fees

Under Alternative A, there are no provisions for collecting access fees, resulting in no impacts on operators or local and regional economies.

The proposed rule authorizes the Service to charge a fee for commercial vehicles using Service-administered roads and a fee for new access (e.g., roads or gatherings lines) across Federal lands.

The Service does not possess the data to precisely assess how many operations use Federal access beyond their mineral right boundary or how many acres of use are involved. The NPS recently evaluated the same set of conditions for non-Federal oil and gas operations in units of the National Park System. That study found that 75 well operations (of 534 total) currently use about 90 acres of surface disturbance (NPS 2013). Assuming that 10 to 20 percent of the 4,000 operations that could be affected by this provision use about 1 acre per well of surface disturbance provides an estimate ranging from 400 to 800 acres that may be subject to access fees.

The Service would set the fee amount using generally accepted practices. For example, the Service could set fees consistent with Service current regulations regarding fees for access and rights-of-ways (50 CFR 29.21), or calculate fees using BLM's Linear Rights-of-way Fee Schedule. Other methods could be used, such as appraisal or Habitat Equivalency Analysis, which bases compensation on the loss of resource services and the cost to restore those services. The NPS study used BLM's Linear Rights-of-way Fee Schedule and found average annual fees would be about $80/acre. Similarly, the Service expects that access fees would be minimal on a well-by-well basis and applied to a lower fraction of wells that use Federal access beyond the boundary of the associated mineral rights. Additionally, operators would benefit by privileged use of Federal surface by a fair-market-based amount equivalent to the assessed fee. As a result, the costs to the operator are fully offset by the value of the beneficial use of the Federal surface and the long-term effects on the operator are neutral. The provision fairly compensates the public for such use, but is not expected to have effects on local or regional economies.

Seismic operations are conducted only on lands where permissions from non-Federal mineral rights holders have been granted to the geophysical companies. The large scale 3D seismic surveys that are conducted in today's industry rarely rely upon access across Federal lands in refuges where grants of permission have not been obtained. Therefore, the access fee provisions of the proposed rule will not substantially apply to seismic operations.

Since access fees only apply on federal lands and waters, the fees under Alternative C would be the same as Alternative B.

Third-Party Monitoring

The use of a third party monitor is a common industry practice and has become a common component of seismic surveys currently conducted in refuges pursuant to a special use permit. Based on the Service experiencing 10 surveys per year, a range of 5 to 90 days of monitoring, and a range of monitoring costs of $500 to $2,500 per day, third-parting monitoring costs could range from as low as $25,000 up to $2.25 million annually. It is difficult to determine what, if any, additional operators' costs of providing third-party monitors is specifically due to those operations being conducted on a refuge, but it is reasonable to assume that some additional costs are associated with work on refuges, and thus cause adverse impacts on operators under Alternative A.

The provision for third-party monitors under Alternative B and C provides more certainty that refuges would implement the requirement when appropriate, but otherwise has the same impacts on operators described under Alternative A.

Resultant impacts on local and regional economies would be negligible.

Cumulative Impacts of Alternative A: No-Action

Actions inside and outside the refuge units and local trends in oil and gas development can cumulatively affect impacts on local, regional, and national economies. Other past, present and future planned actions within and adjacent to refuges have the potential to impact local and regional economies. Increased development within the refuge boundaries and in adjacent communities generally have beneficial impacts on local and regional economies. Recreation and visitor spending also beneficially affect local communities as visitors stay and spend their income in gateway communities. Actions that induce or discourage visitation and visitor spending can affect local economies.

Generally, economies are subject to business cycles with upturns and downturns affecting economic activity across most regional economies. To the extent that economic activity increases, there would be beneficial effects, and if it decreases there could be adverse effects to regional economies, affecting jobs, income, fiscal receipts, and downstream economic activity.

Oil and gas development and production are also affected by cumulative actions or circumstances, many of which are beyond the operators or Service control, such as oil and natural gas prices, State oil and gas regulation, other development costs, the risks of successful well development, production costs, and many others. Other Federal and State requirements can also cumulatively affect the costs of oil and gas operations within refuge boundaries, which can indirectly affect development and production decisions.

Past, present, and reasonably foreseeable activities that would have beneficial effects on local, regional, and national economies with increases in the activity listed, and conversely, would have adverse effects with decreases in the activity are listed in Table 4-16.

TABLE 4-16. CUMULATIVE IMPACTS ON SOCIOECONOMICS (PROGRAMMATIC LEVEL FOR REFUGE UNITS)

Past, Present, and Reasonably Foreseeable Activity	Impacts on Socioeconomics
Service facility and road construction	Short-term beneficial effects on local and regional economies during construction associated with jobs, income, fiscal receipts, and the workforce spending wages in local economies supporting downstream economic activity. Construction activities can temporarily and adversely affect visitor experience and possibly visitation and visitor spending in local economies.
Vegetation management	Short-term and long-term beneficial effects on local and regional economies during management activities associated with jobs, income, and the workers spending wages in local economies supporting downstream economic activity. Habitat management activities, if they temporarily disrupt refuge activities, can adversely affect visitor experience and possibly visitation and visitor spending in local economies.
Trails development and maintenance	Short-term and long-term beneficial effects on local and regional economies during development and maintenance activities associated with jobs, income, and the workforce and personnel spending wages in local economies supporting downstream economic activity. Construction activities can temporarily adversely affect visitor experience and possibly visitation and visitor spending in local economies.
ORV use	ORV use can provide short- and long-term beneficial effects from visitor spending on local economies, but could also adversely affect non-motorized visitor experience, possibly decreasing visitation and visitor spending for these types of visitors.

Past, Present, and Reasonably Foreseeable Activity	Impacts on Socioeconomics
Abandoned mine lands reclamation	Short-term beneficial effects on local and regional economies during reclamation activities associated with jobs, income, and the workforce spending wages in local economies supporting downstream economic activity. Construction or reclamation activities can temporarily and adversely affect visitor experience and possibly visitation and visitor spending in local economies.
Mining and logging activities	Beneficial effects of mining and logging activities associated with jobs, income, fiscal receipts, and the workforce spending wages in local economies supporting downstream economic activity. Mining and logging activities can adversely affect visitor experience and possibly visitation and visitor spending in local economies.
Recreational use	Short- and long-term beneficial effects on jobs, income, and fiscal receipts from visitor spending on local economies.
Ranching, agricultural land uses	Beneficial effects of agricultural production and ranching activities associated with jobs, income, and the households spending wages in local economies supporting downstream economic activity.
Land development: residential and nonresidential (commercial, industrial) land uses, including road construction	Short-term beneficial effects on local and regional economies during construction associated with jobs, income, and the workforce spending wages in local economies supporting downstream economic activity. Construction activities can also temporarily and adversely affect visitor experience and possibly visitation and visitor spending in local economies. Changes in landscapes and viewscapes can adversely affect visitor experiences and possibly visitation and visitor spending in local economies.
Current and future oil and gas development and production on adjacent lands	Short- and long-term beneficial effects on local and regional economies during development and production associated with jobs, income, fiscal receipts, and the oil and gas workforce spending wages in local economies supporting downstream economic activity. Changes in landscapes and viewscapes can adversely affect visitor experiences and possibly visitation and visitor spending in local economies.
Oil and gas well plugging and reclamation activities inside and outside refuges	Short-term beneficial effects on local and regional economies during plugging and reclamation activities associated with jobs, income, fiscal receipts, and the workers spending wages in local economies supporting downstream economic activity. Construction or reclamation activities can temporarily and adversely affect visitor experience and possibly visitation and visitor spending in local economies, although in the long-term these reclamation activities are expected to benefit visitors.
Other Federal, State, and local requirements and authorities for oil and gas operations	There are additional Federal, State, and local requirements for oil and gas operations above and beyond those required for Service compliance. Generally, these include State regulations related to erosion control, water discharge, and wildlife. Some Federal permits are also required, such as ESA section 9 and U.S. Army Corps of Engineers 404 Permits for wetlands. Permitting and requirements for floodplain development are generally administered at the county-level. Although operators' expenditures to comply with these regulations benefit local economies through jobs and income opportunities, the increased permitting and operational costs can have adverse effects on operators and project financial viability.

Cumulative Impacts of Alternative B

Under Alternative B, both adverse and beneficial cumulative impacts would occur from actions considered in the cumulative scenario for these refuge units depending on their effects on jobs, income, visitor spending, and nonmarket environmental values. These are described under

Alternative A and would be the same under Alternative B. Additional federal, State, and local requirements for oil and gas operations above and beyond those required to comply with Service regulations (e.g., erosion control, water discharge, wildlife, wetlands, floodplain development) increase permitting and operational costs for operators and can also affect project financial viability.

Alternative B would contribute to cumulative impacts from the continued operations of permitted operations, which would have adverse impacts on operator costs and project financial viability, but would not be expected to have notable effects on the businesses as a whole. These conclusions are based on (1) cost of regulatory compliance being a very small percentage of average annual receipts, and (2) operations in refuges being a small percentage of a business' asset portfolio.

When compared to the existing condition, the economic benefits to local and regional communities associated with oil and gas production could be reduced as 100 previously grandfathered wells are plugged and reclaimed. This adverse effect is expected to be slight since plugging and reclamation activities would have slight benefits on local and regional economies through jobs and incomes. The contribution to the cumulative impacts on local and regional economies of Alternative B would be slight given the considerable oil and gas development and production occurring in adjacent regions and the many other cumulative impacts, both beneficial and adverse, affecting the local and regional economies.

Cumulative Impacts of Alternative C

Cumulative impacts from actions under the cumulative impact scenario would be similar to those described under Alternatives A and B. Under Alternative C, both adverse and beneficial cumulative impacts would occur from actions considered in the cumulative scenario for these refuge units depending on their effects on jobs, income, visitor spending, nonmarket environmental values, and regulatory requirements. These are described under Alternatives A and B and would be the same under Alternative C. As in Alternative B, Alternative C would contribute to cumulative impacts from the continued operations of permitted operations, which would have adverse impacts on operator costs and project financial viability, but would not be expected to have notable effects on the businesses as a whole. These conclusions are based on (1) cost of regulatory compliance being a very small percentage of average annual receipts, and (2) operations in refuges being a small percentage of a business' asset portfolio.

Compared to the existing condition and Alternative B, more new operations are expected to be located within the refuge boundaries under Alternative C, as operators do not have an incentive to locate wells outside the refuge and directionally drill to access minerals under the refuge boundaries. Due to increased regulatory burdens on pre-existing operations, many more marginally producing and idle wells are assumed to be plugged and reclaimed under Alternative C. Cumulative actions, in combination with Alternative C, could add to project costs to pre-existing wells affecting the viability of marginal and idle wells, resulting in additional plugging and reclamation of wells. Though individual well economics could lead to increased plugging and reclamation costs, the impact on the businesses conducting operations would remain a very small percentage of company revenue.

When compared to the existing condition, the economic benefits to local and regional economies associated with oil and gas production could be reduced as over 1,000 pre-existing wells are plugged and reclaimed. This adverse effect is expected to be slight since marginal producing and idle wells are anticipated to be plugged and reclaimed. Plugging and reclamation activities would have slight benefits on local and regional economies through jobs and incomes. Additionally, Alternative C, and the compliance costs for operations within refuge boundaries as well as for those that are directionally drilled, may encourage new operations to be located within refuge boundaries or could also delay development in the region. When compared to the existing condition and Alternative B, this possible reduction in new development could have adverse impacts on local and regional economies. However, the contribution to cumulative impacts of Alternative C would be minor given the considerable oil and gas development occurring in the regions and the many other cumulative impacts affecting the local and regional economies.

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

NEPA regulations (40 CFR 1502.16) require an EIS to consider the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. Special attention should be given to impacts that narrow the range of beneficial uses of the environment or pose a long-term risk to human health or safety.

Common to All Alternatives with Oil and Gas Well Development. For all alternatives in this EIS, many impacts would be relatively short-term and all impacts on refuge resources would be mitigated to both preserve refuge resources and uses and allow the purposes of each refuge and the Service to be achieved. Land disturbed during oil and gas operations would be reclaimed, equipment and contamination or wastes removed, and the ground restored to its natural contours. However, some surface disturbances resulting from oil and gas development may cause long-term effects, if the areas are not totally reclaimed or are reclaimed after a very long period of time. For example, access roads may be used for more than one well pad or for other multiple uses. In such cases, long-term productivity of soils and vegetation would likely decrease and possibly be lost in the areas used for access roads. Also, in the unlikely case that wetlands cannot be avoided and the mitigation required is not successful in compensating for the original productivity of areas lost, there could be a loss in long-term productivity in these areas. This would be the case if certain out-of-kind wetland mitigation is approved for replacement of productive wetland acreage. Finally, short-term use related to oil and gas development could affect land and water resources and associated wildlife in the longer-term if substantial leaks or spills were to occur and require extended time for cleanup and remediation.

Alternative A: No Action—The Service would not make changes to the non-Federal oil and gas regulations. The long-term productivity of refuge resources could decline in certain areas because of the inability to regulate exempt operations. Habitat degradation would continue due to contamination on sites that are not subject to more stringent cleanup requirements.

Alternative B: Proposed Rule (Preferred Alternative)**—**Implementation of the new regulations is expected to result in long-term increases in the productivity of refuge resources since all operations would either be subject to more stringent environmental standards, or current standards could be more efficiently enforced. Service managers would be able to better manage for habitat, wildlife, and special-status species and this would increase the productivity of refuge resources. Though regulation of pre-existing operations to State standards during the production phase could result in some unnecessary adverse impacts, reclamation to Service standards would assure maintenance and enhancement of long-term productivity.

Alternative C: Modified Proposed Rule—This would have the similar impacts as Alternative B with regard to new and existing operations. With regard to directionally drilled wells, the overall effect would be adverse compared to the existing condition and Alternative B. Long-term benefits to productivity would accrue from the application of more stringent standards to any wells that access minerals under refuge surfaces. However, this alternative could result in short-term uses of refuge lands and some loss in refuge resource productivity because of the potential for more wells to be drilled within refuge boundaries.

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

NEPA regulations (40 CFR 1502.16) require an EIS to address the irreversible and irretrievable commitment of resources caused by the alternatives. An *irreversible* commitment of resources is defined as the loss of future options. The term applies primarily to the effects of using nonrenewable resources (such as minerals or cultural resources) or resources that are renewable only over long periods (such as soil productivity). It could also apply to the loss of an experience as an indirect effect of a “permanent” change in the nature or character of the land. An *irretrievable* commitment of resources is defined as the loss of production, harvest, or use of natural resources; irretrievable resource commitments may or may not be irreversible. The following identifies commitments of resources that are either irreversible or irretrievable.

For all alternatives, there would be an irreversible commitment of the hydrocarbon resources underlying the refuges, since oil and gas are being depleted at a much faster rate than they are being formed in the subsurface. Another irreversible commitment of resources would occur if any significant cultural resources were destroyed during any phase of oil and gas development. However, the use of the seismic vibration technique instead of shotholes as the source of seismic waves would reduce the chances of irreversible impacts due to earth disturbance and drilling, although some resources could be lost within the wellbores during well drilling or from vibration impacts. Based on the small size of the wellbores and the historic average of new drilling operations of 25 proposals per year, impacts from well drilling would be relatively minimal. If buried cultural resources cannot be avoided, impacts would be mitigated by the recovery of data (excavation) and preservation of recovered materials and associated records, an irreversible adverse impact. Where seismic vibration is proposed, refuge staff would identify areas that require subsurface surveying prior to operations commencing to minimize the chances of impact, although unknown resources could be irreversibly affected.

For all alternatives, there would be an irretrievable loss of undeveloped areas for visitor use where the ground is cleared and disturbed for oil and gas exploration and development, including access roads and well pads. The potential for these lands to produce vegetation or be viewed in an undisturbed State would be irretrievably committed for the duration of the oil and gas development operations, and until the site(s) have been reclaimed. Changes to rare and unique communities and important foraging and nesting habitat could be considered an irretrievable resource commitment if construction activities permanently alter the resource such that it can no longer support special-status species or function as a rare and unique community. However, application of the standard of least damaging methods would prevent irreversible impacts to special-status species.

Because the land used for development of oil and gas wells or other facilities could be converted to another use at a future date if the wells were removed, these effects could be characterized as irretrievable. However, in some cases, the level of restoration effort needed could be intensive and would not restore sites to previous conditions. Therefore, some of the impacts are likely irreversible.

For example, wetland impacts resulting from removal of soils and compaction in areas such as Gulf Coast swamps and marshes may not be reversible even if the fill is removed and the site is revegetated. Restored wetland habitats would have different plant species composition, hydrology, and/or different soil characteristics depending on how restoration was completed.

Alternative A: No Action—The Service would not make changes to the non-Federal oil and gas regulations. Continued site degradation and possible contamination at existing operations would continue in limited locations, and reclamation to Service standard would no be assured, which could result in irretrievable losses of wetlands, soils, habitat, and wildlife in the refuges.

Alternative B: Proposed Rule (Preferred Alternative)—Implementation of the new regulations is not expected to result in any irretrievable or irreversible commitments of resources within the refuges except for the continued extraction of the mineral resources. Reclamation of all operations on Federal surface estate would allow the refuges to assure resource protection over the long term. Directionally drilled wells constructed outside refuge boundaries would minimize impacts on refuge resources, but construction of the wells would have similar irretrievable or irreversible impacts on resources located outside the refuges. The type and extent of those impacts would depend on the location of the well pads.

Alternative C: Modified Proposed Rule—This would have the same impacts as Alternative B. However, the potential for more wells to be drilled within refuge boundaries could result in more construction-related irreversible or irretrievable effects on refuge resources.

Unavoidable Adverse Impacts

Unavoidable adverse impacts are adverse impacts that cannot be avoided and cannot be mitigated, and, therefore, would remain throughout the duration of the oil and gas operation.

For any of the alternatives, there may be unavoidable adverse impacts if the mitigation proposed for any impacted wetlands or water resources is not successful and/or does not compensate for the original wetland functions and values or loss of water-dependent species. However, all alternatives would require avoidance or no net loss of wetlands as the first mitigation measure, as required by Service policy. In the unlikely case that avoidance or no net loss of wetlands is not possible, it may be difficult to ensure that either the restoration of wetlands required through compensation or the reclamation of the wetlands after operations would have similar functions or values. Water resources would be protected by adherence to regulatory requirements for spill prevention and cleanup, but unexpected releases that breach containment could cause unavoidable adverse impacts until response is initiated and completed.

There may also be unavoidable adverse impacts on the refuge, as well as soundscapes and the acoustic environment, if the setbacks and other mitigation measures do not provide enough of a restricted area between oil and gas operations and visitor use areas. There is a possibility that the noise from drilling rigs, compressors, and other oil and gas operations could adversely impact refuge uses, especially on a short-term basis. This would depend on the specific location, intervening topography and vegetation, noise mitigation techniques utilized, and the existing background noise levels in the vicinity of the operation.

Finally, there may be unavoidable adverse impacts related to unplanned releases (blowouts, spills, leaks, and fires). The Service recognizes that unplanned incidents associated with oil and gas operations such as well blowouts, fires, and major spills within the boundaries of refuges present a risk of release of contaminants that can adversely impact refuge resources and values, depending on the location of the release. However, the rate of such incidents is low and if such an incident did occur, required mitigation measures such as use of blowout preventers and implementation of spill prevention, control, and countermeasure plans would be expected to result in lessening the potential for spilled substances or a well fire to spread into the refuge, and for timely response and cleanup. Therefore, no matter which type of operation is used for drilling and production (conventional or fracturing), there is a reasonable expectation that long-term adverse impacts would not occur or be limited in intensity, although there could be substantial short-term adverse effects during the release.

Alternative A: No Action—The Service would not make changes to the non-Federal oil and gas regulations. The inability to regulate existing operations and consistently regulate new operations would result in continued adverse effects on refuge natural and cultural resources in some locations. Adverse impacts could result from well construction inside and outside the refuge, even those operations under regulation, and would include changes to hydrological patterns, changes in water quality, soil disturbance, disturbance of wetlands that could not be avoided, changes to natural soundscapes and the acoustic environment due to construction, loss of habitat for wildlife, changes to the visual landscape, and changes in visitor use if the area restricted access.

Alternative B: Proposed Rule (Preferred Alternative)—Implementation of the proposed regulations would result in no new adverse impacts and would have primarily beneficial impacts for natural and cultural resources and refuge uses. Continuing unavoidable adverse impacts would result from ongoing exploration and production operations and construction inside and outside the refuges, and include the same effects as described under Alternative A. Operators would be unavoidably adversely affected by additional costs incurred to comply with the proposed rule.

Alternative C: Modified Proposed Rule—This would have the same impacts as Alternative B, with no adverse effects and primarily beneficial effects. However, the potential for more wells to be drilled within refuge boundaries could result in unavoidable adverse effects on refuge resources. Refuge management and operations would be unavoidably adversely impacted by the expanded scope of regulatory application to private surface estate within refuges and to downhole operations for all operations. Operators would be unavoidably adversely affected by additional costs incurred to comply with the proposed rule.

CONCLUSION: ENVIRONMENTAL CONSEQUENCES

This chapter analyzed each alternative for overall impacts to the affected environment, including natural resources, visitor use and experience, cultural resources, refuge management and operations, and socioeconomics. The following is a summary of the beneficial and adverse impacts that would result from implementing any of the alternatives considered in this EIS.

Summary of Impacts of Alternatives on Natural Resources, Visitor Use and Experience, and Cultural Resources

Due to the programmatic nature of this EIS, the general beneficial and adverse impacts of the alternatives on natural resources, visitor use and experience, and cultural resources would be generally the same.

As discussed in further detail in this chapter, natural resources that may be affected by the Service's proposed action to revise the Service's current regulations for management of oil and gas activities on the NWRS include: geology and soils (including paleontology), air quality, water resources (including surface and groundwater, both quality and quantity), wetlands, floodplains, vegetation (including plant species of special management concern), wildlife and aquatic species (including animal species of special management concern), and natural soundscapes and acoustic environment.

Cultural resources that may be affected by the Service's proposed action to revise the Service's current regulations for management of oil and gas activities on the NWRS may include: archaeological sites, prehistoric/historic structures, cultural landscapes, and ethnographic resources.

Visitor use and experience that may be affected by the Service's proposed action to revise the Service's current regulations for management of oil and gas activities on the NWRS may include: human health and safety, visitation patterns, wildlife-dependent recreation opportunities, and scenic views and night sky resources.

Some general conclusions can be drawn about the adverse and beneficial impacts of implementing the various alternatives on these refuge resources and uses.

Alternative A: No-Action

Under Alternative A, the current regulations and implementation practices would continue and result in no change in effects on refuge resources and uses from the existing condition. Occasional seismic surveys would have short-term and generally localized effects on refuge resources and uses, such as disturbance from human and vehicle activity. Also, other longer term impacts, such as habitat fragmentation, could possibly occur depending on species inhabiting the area, habitat, and the number and width of seismic survey lines.

Beneficial effects would continue from Refuge Managers negotiating with oil operators to place new operations under SUPs or ROW permits. However, unnecessary, adverse effects may continue to occur from operations not under SUPs or ROW permits, or from the inability to secure an operating standard in an SUP or ROW that provides adequate protection for refuge resources and uses. Ongoing impacts on refuge resources and uses from pre-existing operations would be expected during the drilling and production phases. Adverse impacts:

- Natural resources would include: soil compaction, erosion, effects on water quality, noise, impacts from oil and brine spills, spread of invasive species, wildlife displacement, habitat alteration and fragmentation, and potentially wildlife mortality.
- Visitor use and experience would include : visual impacts of sites exacerbated by site erosion and/or abandoned equipment, the risk of exposure to chemical or safety hazards at contaminated or unsecured sites; and noise and visual impacts from equipment and crews due to the lack of setbacks from visitor use and culturally sensitive areas, as well as lack of equipment maintenance or muffling devices.
- Cultural resources would include: the risk of destruction of cultural resources or the degradation of their integrity, as well as visual impacts of sites that may be exacerbated by site erosion and lack of adequate distance between sites and areas of intensive cultural resource presence.

Operations directionally drilling from inholdings or non-Federal surfaces underneath a refuge would continue to be a potential source of indirect, adverse effects on refuge resources and uses when the drilling operations are sited close to refuges as contaminants in soils, water, or air could be transported onto the refuge. Additionally, the lack of adequate distance between these operations and visitor use or culturally sensitive areas could result in erosion of these sites due to runoff from the operations as well as noise and light pollution effects on visitor use areas . However, beneficial effects would continue to result from operators locating new operations off of refuges, avoiding any direct impact to natural resources on refuges.

The lack of consistent requirements or processes to ensure wells are plugged and sites are reclaimed to Service standards would continue to result in long-term, adverse impacts on natural and cultural resources, including ongoing contamination of soil, air, and water from leaking wells, and permanent damage to refuge landscapes and hydrology. Impacts on visitor use and experiences would result from an increased risk of abandoned equipment, debris, and wastes left on the sites.

The lack of requirements under the current regulations for financial assurance, compensation for use of Federal property, and enforcement and penalties would continue to have indirect effects on refuge resources and uses, such as delays in reclamation because of lack of funding or enforcement.

Alternative B: Proposed Rule (Preferred Alternative)

Alternative B, the proposed rule, would result primarily in long-term direct and indirect beneficial impacts on refuge resources and uses, compared to the existing condition. Benefits would accrue primarily from reduced risk to resources and uses due to new operations being subject to a consistent permitting process that includes performance standards that ensure new operations are conducted in the most technologically feasible, least damaging manner. Beneficial impacts to:

- Natural resources would include: improved erosion/sedimentation control, storm water management, reduced air emissions, reduced fire hazards, reduced disturbance to wildlife, reduced impacts to wetlands and floodplains as well as wildlife habitat in general, improved water quality, and improved spill prevention, control, and countermeasure actions compared to the existing condition.
- Visitor use and experience would include: improved site appearance from erosion/sedimentation control, cleanup of spills, removal of wastes and debris, removal of unused equipment, reduced fire hazards, and improved spill prevention, control and countermeasure actions compared to the existing condition.
- Cultural resources would include: improved site appearance from erosion/sedimentation control, protection of cultural resources during site development , and adequate distances between sites and culturally sensitive areas.

Alternative B would extend regulation of oil and gas operations to tracts where the Federal interest is less than fee (e.g., wetland or grassland easements) to the extent necessary to protect Federal interest in those lands. As a result of active regulation by the Service, natural resources associated with interests acquired on easements, such as wetlands or native prairie, would have a consistent and higher level of protection compared to Alternative A.

Additionally, the Service would eliminate many of the ongoing, unnecessary impacts to refuge resources and uses resulting from pre-existing operations by assimilating State laws into the proposed rule and other proposed revisions to enforcement and penalties. For instance, the Service would be able to ensure that operators comply with State laws that would require secondary containment facilities, equipment that meets certain air quality standards, spill reporting and remediation, corrective action for noncompliance, and tank removal and site restoration.

Finally, Alternative B would require that all operations are reclaimed to Service standards, such as plugging all wells, removing all above-ground structures, equipment, roads, well pads, and contaminating substances, re-establishing native vegetation, restoring conditions to predisturbance hydrologic functions, and restoring natural systems using native soil material that would reduce impacts to refuge resources and uses within the refuge units. Eventually, the disturbance associated with the 4,000 pre-existing wells, as well as any new and existing operations under a Service-issued permit or ROW would be restored to Service standards, providing a substantial long-term reduction or removal of adverse impacts to refuge resources and uses.

Other regulatory changes would result in an improved process of handling minor acts of noncompliance, accelerated reclamation of sites compared to the existing condition, and funding sources that could indirectly benefit refuges and visitors using and viewing those resources.

Overall, these regulatory improvements would result in long-term direct and indirect beneficial impacts on refuge resources and uses compared to the existing condition, analyzed under Alternative A. Alternative B would result in primarily beneficial effects due to the regulation of new operations and the regulation of the reclamation phase of pre-existing operations, as well as stricter compliance with other Federal and State laws. Additionally, any adverse effects of regulated operations would be very limited when compared to the entire refuge area, and mitigation measures or stipulations would reduce the loss or degradation of natural resources, visitor use and experience, and cultural resources. Therefore, the impacts of this alternative would not be significant.

When combined with the effects of all other actions in the study area, cumulative impacts from the actions under Alternative B would be long term and both adverse and beneficial, with Alternative B contributing mainly beneficial impacts to overall cumulative impacts from the change in regulations. Adverse impacts of oil and gas development would be localized, subject to regulatory review, and limited, and would not be significant.

Alternative C: Modified Proposed Rule

Alternative C, when compared to the existing condition, would also result in primarily beneficial impacts. Under Alternative C, the proposed rule would be modified to require that both existing and pre-existing operations on refuges obtain an operations permit and operate under the Service's performance based standards. This may result in some direct beneficial impacts to refuge resources and uses because the Service would be able to impose mitigation measures on pre-existing operations for any ongoing, unnecessary adverse impacts to natural resources. However, the Service believes that ensuring pre-existing operations comply with applicable Federal and State laws, as proposed under Alternative B, would provide adequate protection of refuge resources and uses from these ongoing, unnecessary adverse impacts.

Under Alternative C, all operations on an inholding or on a non-Federal surface drilling underneath a refuge would also be required to obtain an operations permit and meet all relevant operating and reclamation standards. These modifications to the proposed rule could result in long-term beneficial indirect impacts on refuge resource uses because the Service standards would apply to operations outside the refuge. However, regulating operations on inholdings and non-Federal surfaces drilling underneath a refuge removes the incentive to locate operations outside refuges, and would likely result in a much greater concentration of direct, adverse impacts on refuge resources and uses, as the location of an oil and gas operation on the surface of refuge has the greatest impact to refuge resources and uses, as discussed in the analysis.

Operating standards and the permitting process under Alternative C would be the same as Alternative B except the Service would actively regulate downhole operations, such as well cementing, well casing, and well integrity testing, as a matter of course. The Service's goals in regulating downhole aspects of oil and gas well drilling, production, and plugging are to: 1) prevent escape of fluids to the surface, and 2) isolate and protect usable quality water zones throughout the life cycle of the well. The Service found that these regulatory goals can adequately be met by current state regulatory programs, and that Service regulation would slightly reduce already very low risks to usable quality water zones. Refuge resources and uses, other than usable quality water zones, would only be impacted by accidents associated with well control, and as discussed above, these events are extremely rare. For these other resources and uses, the Service does not expect any reduction of impacts or risks of impacts to refuge resources and uses related to our regulation of downhole operations. The Service believes that State requirements for well control and the expectation that companies will act in their own best interest provide adequate protections.

Similar to Alternative B, other regulatory changes would result in an improved process of handling minor acts of noncompliance, accelerated reclamation of sites compared to the existing condition, and funding sources that could indirectly benefit resources at the refuges.

The regulatory improvements in Alternative C would result mainly in long-term direct and indirect beneficial impacts on refuge resources and uses primarily from bringing previously exempt operations under regulation. However, Alternative C would remove regulatory incentives for operators to locate operations outside refuge units; thus, this alternative would have more direct impacts on resources and uses within refuge boundaries. The impacts of Alternative C would not be significant because it would result in primarily beneficial effects, and any adverse effects of regulated operations would be limited in extent compared to the entire refuge area with mitigation measures or stipulations reducing the loss or degradation of natural resources, visitor use and experience, and cultural resources.

Overall under Alternative C, both adverse and beneficial cumulative impacts would accrue from projects, plans, and actions considered in the cumulative scenario. When combined with the effects of all other actions in the study area, cumulative impacts would be long term and both adverse and beneficial. Adverse impacts of oil and gas development would be localized and limited, and, subject to regulatory review, and therefore would not be significant.

Overall Impacts of Alternatives on Refuge Management and Operations

As discussed in further detail above, refuge management and operations that may be affected by the Service's proposed action to revise the Service's current regulations for management of oil and gas activities on the NWRS include: processing permit applications, monitoring operations to ensure that operators are in compliance with all applicable laws, regulations, and Service permits; addressing incidents of noncompliance; maintaining records, providing information to the public and Congress, and addressing legal issues; and preparing guidance and policy documents and participating in training or workshops related to oil and gas management. The following general conclusions can be drawn about possible impacts of implementing the various alternatives on refuge management and operations.

Alternative A: No-Action

Under Alternative A, the current regulations and implementation practices would continue and there would be no change in the administration of currently regulated operations. Alternative A would result in no change to refuge management and operations. The Service estimates it spends approximately $3.6 million annually, which is less than 1% of the NWRS operating budget, managing activities associated with the exercise of non-Federal oil and gas rights. The costs to the Service in terms of staff and resources of ensuring operational compliance with current requirements would continue under Alternative A, and would result in long-term adverse impacts on refuge management and operations, although these impacts would vary depending on local conditions. For example, exposed well casings and abandoned oilfield equipment and flowlines can limit management options for refuge managers due to safety risks. Tall, dense vegetation can hide flowlines and protruding well casings which can damage refuge equipment and vehicles and potentially injure refuge employees. Therefore, on a refuge-specific level, management of oil and gas operations can have a notable impact on refuge management and operations. However, because Alternative A would not change any impacts to refuge management and operations and impacts are generally manageable and minimal in context of Service-wide refuge management and operations, these impacts would not be significant.

Alternative A would contribute only slightly to adverse cumulative impacts occurring to refuge management and operations as a result of cumulative plans and actions.

Alternative B: Proposed Rule (Preferred Alternative)

Under Alternative B, the administration of the proposed regulations would require the reallocation and addition of refuge staff and resources, but would also benefit from cost recovery provisions, such that the administrative burden of non-Federal oil and gas management would not change materially compared to the existing condition. There would be additional responsibilities involved in addressing operations, and these would fall under the existing workload of dedicated refuge staff and the national NWRS Energy Team. Provisions for cost recovery and compensation for access across federally owned lands would result in the potential for a reduced financial and administrative burden, resulting in long-term beneficial impacts on refuge management and operations. Additionally, any additional administrative responsibilities related to implementing the proposed regulations under Alternative B would fall under the existing workload of refuge staff and would not require additional FTE or other administrative or material resources.

Within the broader context of all cumulative plans and actions affecting refuge management and operations, implementation of Alternative B would contribute a small but noticeable amount to adverse and beneficial cumulative impacts. Impacts would likely be greater to refuge operations for those units with a high number of current and/or exempt operations and for those units which exhibit a greater potential for future operations due, for instance, to their proximity to Marcellus shale or the Tuscaloosa shale.

Alternative C: Modified Proposed Rule

Under Alternative C, all new and existing operations within the scope of the modified proposed rule would be required to obtain an operations permit and meet all relevant operating and reclamation standards. Operating standards and the permitting process under Alternative C would be the same as Alternative B, except the Service would actively regulate downhole operations as a matter of course. Under Alternative C, similar to Alternative B, the addition of all operations as well as directionally drilled operations that would previously have opted to locate outside refuge boundaries but would now be located within the refuge would further contribute additional responsibilities involved in the oversight and management of new operations, and would increase the existing workload of refuge staff when compared to the existing condition. This would require additional FTE or other administrative or material resources. Additional responsibilities involved in addressing new and existing operations would require expansion of dedicated refuge and the national Energy Team staff. Provisions for cost recovery and compensation for access across federally owned lands would result in the potential for a reduced financial and administrative burden, resulting in long-term beneficial impacts on refuge management and operations. The potential degree of administrative burden would increase under Alternative C, as both new operations and the production phase of pre-existing operations, as well as those operations utilizing directional drilling to access private minerals under the incentive to locate outside the refuge administrative boundaries, would require the regulatory oversight of the Service. Overall, management and administration costs would increase substantially, perhaps to a $6 to $7 million range annually, to gain the intended incremental resource protections of the modified proposed rule, resulting in substantial adverse and long-term impacts on refuge operations due to the added cost burdens.

The contribution to cumulative impacts of Alternative C would be notable, but still small given the wider context of cumulative actions affecting refuge management and operations. Adverse impacts of the additional staff and operational need could be significant on a local level, but not on a Service-wide refuge management basis.

Overall Impacts of Alternatives on Socioeconomics

Socioeconomics that may be affected by the Service’s proposed action to revise the Service’s current regulations for management of oil and gas activities on the NWRS may include: oil and gas operator costs and project financial viability; and local and regional economies. The following general conclusions can be drawn about possible impacts of implementing the various alternatives on socioeconomics.

Alternative A: No-Action

Under Alternative A, the current regulations and implementation practices would continue and there would be no change in effects on operator costs and local and regional economies from the existing condition. Most new operations would continue to be conducted under an SUP or ROW. Current Service regulations and other federal requirements continue to provide incentives for new wells to be directionally drilled from outside refuge boundaries, and this is expected to continue under Alternative A.

Operations are currently benefiting local and regional economies in adjacent communities, although their production is fairly minimal within the local and state context. Additionally, the production supports ad valorem and severance taxes, benefitting communities, counties, and sometimes states, although this is also small within the local and regional context. No compensation for access across federally owned lands would continue to benefit operator access costs. Because Alternative A would not change current level of impacts, impacts to communities are generally beneficial, and adverse impacts to operators are generally manageable and minimal, the impacts of Alternative A would not be significant.

Both adverse and beneficial cumulative impacts would occur from actions considered in the cumulative scenario. However, the contribution to cumulative impacts of Alternative A would be slight given the considerable oil and gas development occurring in the regions outside refuge boundaries, additional federal, state, and local oil and gas permitting and operational requirements, and the many other cumulative impacts affecting operator costs and local and regional economies.

Alternative B: Proposed Rule (Preferred Alternative)

Under Alternative B, operators would incur additional costs to comply with the proposed rule. The additional costs stem primarily from provisions that require operators under an operations permit to maintain financial assurance and reimburse the Service for costs associated with processing and administering the operations permit. Operators of pre-existing wells would incur costs at the time of well plugging and reclamation due to the requirement to conduct reclamation to Service standards under an operations permit. Access fees for use of Federal surface beyond an operator's oil and gas rights boundary would be a small additional expense for all operations. The administrative and operational costs of the proposed rule on operators are typically small relative to the total project costs and revenues. Additionally, the increased expenses are not expected to affect company operations as these expenses are: (1) a fraction of a percentage of company revenue, and (2) the number of wells a company operates in a refuge is typically a small percentage of its business portfolio.

Compared to Alternative A, costs for operators could affect individual well economics. Perhaps up to 1,000 marginally producing and idle wells are likely to be plugged and reclaimed sooner under Alternative B as a result of regulatory costs changing individual well economics. Since these well currently have little or no associated oil and gas production, wells being plugged and reclaimed would have no noticeable impacts on local and regional economies. The same would apply to royalty revenues to leaseholders.

The proposed rule provides a greater incentive for operators to choose a surface location outside a refuge to explore for and produce non-Federal oil and gas resources inside a refuge. Since it includes provisions for maintaining financial assurance, access fees, and cost recovery, among others, the operators' costs increase, as does the incentive to avoid those costs.

SUPs would allow the Service to recover fees for processing permits and for refuge maintenance and other impacts.. Because Alternative B would result in no noticeable impacts on local and regional economies and any adverse effects on individual operators would be limited in extent, the impacts of this alternative would not be significant.

The additional compliance costs associated with Service requirements under Alternative B would have minor cumulative adverse impacts on operators because of the small contribution of these operational costs compared to company revenue and the small percentage of a company's portfolio represented by wells in a refuge unit.

The contribution to cumulative impacts of Alternative B would be slight given the considerable oil and gas development occurring in the regions and the many other cumulative impacts affecting the local and regional economies, and any adverse impacts of the alternative would not be significant.

Alternative C: Modified Proposed Alternative

Alternative C would impose substantial costs on a larger number of operators compared to Alternative B. Primarily, the modified proposed rule would impose costs for permitting, cost recovery, maintenance of financial assurance, and compliance with Service operating standards on up to existing wells 4,500 wells on both Federal and private surface estate. Using cost estimates for the regulatory provisions described in Alternative B, and applying them to 1,000 operations permit applications and 4,500 wells, operators of pre-existing wells could incur costs over $20 million initially and $15 million annually thereafter.

Alternative C would expand Service jurisdiction under the regulations to encompass surface and subsurface directional drilling operations outside the boundary of a refuge, subjecting operators of these wells to the full regulatory requirements of a new operation inside a refuge. With little incentive for operators to choose surface drilling locations outside a refuge, some of the additional operations permit applications would be changed to surface operations inside a refuge.

Compared to Alternative B, the expansion of Service regulation to downhole activities under the modified proposed rule could generally increase operator costs by 10 to 30 percent in cost categories of permitting, cost recovery fees, maintenance of financial assurance, and meeting Service standards that are above and beyond other Federal and State requirements.

The contribution to cumulative impacts of Alternative C would be slight given the considerable oil and gas development occurring in the regions and the many other cumulative impacts affecting the local and regional economies, and any adverse impacts of the alternative would not be significant.

Conclusion: Alternative B is Preferred Alternative

Three general conclusions can be drawn from the analysis about impacts of the alternatives:

1. The action alternatives do not authorize any activities that create additional adverse impacts on natural resources, visitor use and experience, and cultural resources compared to the no-action alternative.
2. Overall beneficial impacts on natural resources, visitor use and experience, and cultural resources are expected from the action alternatives.
3. The beneficial impacts come in conjunction with some increased financial considerations for both the Service and operators

Based on our analysis, we have determined that Alternative B is the *Preferred Alternative*, because it meets the purposes and needs of revising the proposed rule and will provide the maximum protection of refuge resources when balanced with the cost to operators and to the Service for administration.

CHAPTER 5: CONSULTATION AND COORDINATION

The intent of the National Environmental Policy Act (NEPA) is to encourage the participation of Federal and State-involved agencies and affected citizens in the assessment procedure, as appropriate. This section describes the consultation that occurred during development of this environmental impact statement (EIS), including consultation with scientific experts and other agencies. This chapter also includes a description of the public involvement process.

HISTORY OF PUBLIC INVOLVEMENT

The public involvement activities for this EIS fulfill the requirements of NEPA.

THE SCOPING PROCESS

The Service divides the scoping process into two parts: internal scoping and external or public scoping. Taken together, internal and public scoping are essential elements of the NEPA planning process. Internal scoping involves discussions among Service personnel regarding the purpose and need for management actions, issues, management alternatives, mitigation measures, the analysis boundary, appropriate level of documentation, available references and guidance, and other related topics. Public scoping is the early involvement of the interested and affected public in the environmental analysis process. The public scoping process helps ensure that people have an opportunity to comment and contribute early in the decision-making process. For this planning document and impact statement, project information was distributed to individuals, agencies, and organizations early in the scoping process, and people were given opportunities to express concerns or views and identify important issues or even other alternatives.

The following sections describe the various ways scoping was conducted for this EIS.

INTERNAL SCOPING

Internal scoping for the proposed rule revisions/EIS began in January 2013 with the establishment of an interdisciplinary team comprising Service subject matter experts, practitioners, and natural and cultural resource management professionals. Initial interdisciplinary team discussions focused on the purpose and need for action, objectives for taking action, identification of preliminary issues, and development of a public involvement plan. The team has continued to meet regularly to provide input to the process, including framing the analysis to focus on the main areas of change in the regulations and identifying impact topics for detailed analysis.

PUBLIC SCOPING

Public Notification and Response

Public participation in the scoping process officially began through publication of an advance notice of proposed rulemaking and the notice of intent to develop an environmental impact statement (ANPR/NOI/EIS) in the Federal Register (79 FR 10080) on February 24, 2014. The purpose of issuing the ANPR was to seek comments and suggestions related to several topics, including regulation of new and pre-existing operations, directional drilling beneath refuges from surface locations outside refuges, operating standards, operator financial assurance, access fees, and assessments for operator noncompliance with the regulations. This information could be used to revise the 50 CFR 29.32 regulations, if the Service elects to pursue a rulemaking. The Service also issued an official news release on February 24, 2014, advising the public on publication of the ANPR/NOI/EIS in the Federal Register. The Service received comments from unaffiliated private citizens (36), conservation organizations (14), State agencies (8), counties (2), Alaska Native Corporations (2), a tribal agency, oil and gas owners and operators (6), business associations (5), and a Federal agency, along with almost 80,000 form letter comments from members of two environmental organizations. The majority of commenters were in favor of strengthening and expanding the regulations to better protect refuge resources and values. Some commenters requested that we not revise the existing regulations, while others questioned the legality of regulating non-Federal oil and gas operations on refuges.

The NOI specifically solicited public comment on draft purpose and need statements, objectives, and issues and concerns related to revisions of the Service regulations governing non-Federal oil and gas development on units of the Refuge System. The NOI also requested public comment on possible alternatives the Service should consider in revising the regulations.

Comments received during the public scoping period addressed a number of topics. The majority of comments expressed support for revising the proposed regulations. Several suggested that pre-existing operations should be regulated under the revised rule. One commenter suggested that the revised rule should bring all operators into compliance with the regulations as soon as possible.

The next largest topic discussed in the comments was the various requirements for special use permits and plans of operations. For example, we received opposing views of incorporating a National Park Service-like (NPS) permitting system. Many commenters supported adopting a similar permitting requirement, while others opposed the NPS approach because they believe it duplicates State regulations. One commenter suggested that all operations fall under a permit, while others suggested developing a memorandum of understanding with each State to enforce State rules in lieu of a permit system.

Comments were also received regarding the objectives for taking action. Comments noted that the purpose set forth for the proposed regulations should explicitly state that the regulations are designed to avoid and minimize the adverse effects on fish, wildlife, and associated habitat and to ensure the effective management of species and habitat within refuge boundaries, in addition to other reasons listed.

Commenters made suggestions for carefully outlining reclamation objectives in the EIS and called for reclamation plans that include both interim and final plans using defined benchmarks and comparisons to undisturbed reference sites to measure success. Finally, commenters presented new alternatives or elements to the proposed rule. These included several suggestions for additional standards for oil and gas operators, such as requiring operators to manage their well-sites until the sites have been fully rehabilitated; implementing capture and recapture technologies; prohibiting water withdrawals; requiring full disclosure of the identity and volume of all compounds used in hydraulic fracturing fluids and drilling muds; and avoiding vegetation removal.

Based on internal and public scoping, the Service developed the objectives of revising the 29C regulations and a list of resources and concerns to evaluate in this proposed rule revisions/EIS.

AGENCY SCOPING AND CONSULTATION

United States Fish and Wildlife Service

We have determined that the proposed rule revisions will have no effect on threatened or endangered species and their associated designated critical habitats since the proposed rule does not specifically authorize ground-disturbing activities. The revisions would also lead to enhanced protections for natural resources, including ESA-listed species. Section 7 consultations will occur at the project-specific level upon implementation of the rule.

State Historic Preservation Offices

The proposed revisions to this rule are not likely to adversely affect cultural resources due to the fact that the revisions are programmatic in nature and no ground-disturbing activities would be authorized. Moreover, the proposed rule changes would provide for additional resource protection and mitigation measures, thus resulting in beneficial impacts on cultural resources. Future actions will be analyzed separately and will be subject to further site-specific consultation and compliance, including section 106, as amended.

Tribal consultation letters were sent to each of the tribes within all eight regions of the Service. Letters provided information to the tribes concerning the proposed action and inquired as to their desire to consult with the Service. No letters were received from the tribes in response to this initial consultation.

LIST OF RECIPIENTS OF THE DRAFT RULE REVISION/ ENVIRONMENTAL IMPACT STATEMENT

This programmatic proposed rule revisions/EIS will be sent to the following agencies, organizations, and businesses, as well as to other entities and individuals who requested a copy.

FEDERAL DEPARTMENTS AND AGENCIES

- Department of the Interior
  - National Park Service
  - United States Fish and Wildlife Service
- United States Environmental Protection Agency
- Advisory Council on Historic Preservation

TRIBAL GOVERNMENTS

- No tribal governments requests received

STATE GOVERNMENTAL AGENCIES

- Virginia, Department of Environmental Quality

ORGANIZATIONS/OTHERS

- ConocoPhillips, Inc.
- Bjork Lindley Little, PC

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An Assessment of Oil and Gas Wells and Pipelines on National Wildlife Refuge System Lands

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June 2014

Abstract

In 2003 the U.S. General Accounting Office assessed the extent of oil and gas activities (oil and gas wells, pipelines, seismic exploration) on lands managed by the U.S. Fish and Wildlife Service's (Service) National Wildlife Refuge System (NWRS) and evaluated the Service's management and oversight of these activities. The current increase in oil and gas exploration and production (E&P) prompted the Service to update the information on the number of pipelines and wells associated with oil and gas E&P present in NWRS lands. We obtained geospatial data on oil and gas well locations within NWRS lands (units) acquired as fee simple (i.e., absolute title to the surface lands) as well as wells located within one-half mile of the NWRS unit boundaries. These data indicate that oil and gas activities (5,002 wells and 595 pipelines) occur in 195 of the 599 NWRS units. Of the 195 NWRS units, 87 NWRS units have only pipelines and no wells associated with oil and gas. Almost half (44 percent or 2,196 wells) of the wells are inactive and one-third (33 percent or 1,665 wells) are active. An estimated 595 pipelines cross a total of 1,339 miles of NWRS units. Approximately 6,723 additional wells are located within one-half mile outside of the NWRS unit boundary. Almost half (42 percent) of these wells are inactive (2,741) and 28 percent (1,893 wells) are active. The high level of activities warrants follow-up assessments for wells lacking information on production type or well status with emphasis on identifying abandoned and unplugged wells. The Service should also assess NWRS units for impacts from brine, oil and other hydrocarbon spills, as well as habitat alteration, and other impacts associated with the E&P of oil and gas, including the identification of abandoned oil and gas facilities requiring equipment removal and site restoration.

Background

In 2003 the U.S. General Accounting Office (GAO) found that approximately 25 percent of lands managed by the U.S. Fish and Wildlife Service (Service, FWS) for the primary purpose of the conservation and management of fish, wildlife, and plants and their habitats had past or ongoing oil and gas activities (GAO 2003). Oil and gas activities included seismic exploration, drilling, oil and gas wells, pipelines, tank batteries, and compressor stations. The Service's National Wildlife Refuge System (NWRS) includes 555 national wildlife refuges (NWRs); 38 wetland management districts (WMDs) and 206 waterfowl production areas (WPAs) (Figure 1). The NWRS also includes conservation easements totaling approximately 3.5 million acres acquired for wildlife conservation. For purposes of this report, the term "NWRS unit" includes lands in the NWRS obtained through acquisition as fee simple (i.e., absolute title to the surface land) via purchase or donation of full ownership of the property) or lands withdrawn from public domain and included in NWRS lands (NWRs, WMDs, WPAs, and wildlife ranges). Although the surface lands in NWRS units are federally owned, private individuals, corporations, state or local governments, Indian tribes, or native corporations own the subsurface minerals in many NWRS units. The owners of subsurface minerals, or "mineral rights," have the legal right to explore for and extract oil and gas from their mineral estate. In many NWRS units, oil and gas wells and pipelines were already present when the Service acquired the property.

According to the GAO (2003), 105 refuges contained 4,406 oil and gas wells in 2002. The GAO defined "refuge" as any unit of the NWRS, including national wildlife refuges, wildlife ranges, wildlife management areas, and waterfowl production areas. Over half (59 percent) of the oil and gas wells were inactive and either permanently plugged and abandoned or temporarily shut-in. Actively producing wells comprised 41 percent (1,806 wells) of the total and were located on 36 refuges. Approximately 57 percent of all wells were located on five refuges located in Gulf coast states and Oklahoma (Table 1) in the Service's Regions 2 (Southwest Region) and 4 (Southeast Region) (GAO 2003). The GAO (2003) also reported that 35 refuges contained only pipelines.

Figure 1. National Wildlife Refuges and U.S. Fish and Wildlife Service Regional Boundaries (Pacific Islands – Region 1 and Puerto Rico – Region 4 excluded).

Table 1. Refuges containing the highest number of oil and gas exploration and production wells (GAO 2003).

Refuge	FWS Region	State	Number of Wells
Upper Ouachita NWR	4	Louisiana	1,120
St. Catherine's Creek NWR	4	Mississippi	465
Deep Fork NWR	2	Oklahoma	362
Delta NWR	4	Louisiana	338
Lower Rio Grande Valley NWR	2	Texas	217
		Total	2,502

The National Wildlife Refuge System Administration Act of 1966 (16 U. S. C. 668dd-668ee) (Refuge Administration Act), and subsequent amendments, authorizes the Service to regulate all activities on refuges. Under the Refuge Administration Act, the Service determines if activities within a refuge are compatible with the purposes of the refuge and the mission of the NWRS. If the Service determines that the activity is not compatible with the refuge purpose and mission, the activity is not allowed. The Service, by policy, does not apply the compatibility requirement to the exploration and extraction of oil and gas from privately owned mineral rights within NWRS lands (65 FR 62484-62496). The GAO (2003) found "Federal management and oversight of oil and gas activities varies widely among refuges—some refuges take extensive measures, while others exercise little control or enforcement." The GAO (2003) attributed this variation in oversight and management of oil and gas activities to the lack of guidance, insufficient resources, and little to no training for refuge managers. Additionally, refuges varied in how extensively they identified risks from oil and gas activities and how they managed those risks in order to minimize impacts to the refuges (GAO 2003). Each refuge can issue a Special Use Permit (SUP) to allow the use of any area within NWRS lands for "any purpose, including but not limited to hunting, fishing, public recreation and accommodations, and access" whenever the Service "determines that such uses are compatible with the major purposes for which such areas were established" (Refuge Administration Act (16 USC 668dd (d)(1)(A))). The GAO (2003) found that refuge managers differed in the issuance of SUPs with seasonal, vehicle, or other restrictions to oil and gas operators to protect refuge resources such as wildlife habitat, water, soil, and air quality. At the time of the GAO report (GAO 2003), the Service had refuge staff dedicated to the oversight of oil and gas activities on only two refuges within the NWRS.

The GAO made the following recommendations to the Service:

- collect and maintain better data on oil and gas activities on NWRS lands;
- collect and maintain better data on the effects of oil and gas activities on refuge resources;
- determine staffing necessary for adequate oversight of oil and gas activities and seek necessary funding to meet those staffing needs;
- train refuge staff overseeing oil and gas activities; and
- clarify guidance and improve oversight of the land acquisition process to identify all hazardous substances, environmental problems, and potential cleanup costs associated with lands proposed for acquisition into the NWRS.

The GAO also recommended "…*the Secretary of the Interior and the Director of the Fish and Wildlife Service work with the Department of the Interior's Office of the Solicitor to*

(1) determine FWS's existing authority to issue permits and set reasonable conditions regarding outstanding mineral rights, reporting the results of its determination to Congress, and

(2) *seek from Congress, in coordination with appropriate Administration officials, including those within the Executive Office of the President, any necessary additional authority over such rights, and over reserved mineral rights, so that FWS can apply a consistent and reasonable set of regulatory and management*

> *controls over all oil and gas activities occurring on national wildlife refuges to protect the public's surface interests*."

In the 11 years since publication of the GAO report, the Service has developed a guidance manual and trained refuge personnel in the management of oil and gas activities on NWRS lands. The guidance manual *Management of Oil and Gas Activities in National Wildlife Refuge System Lands* includes the following information to assist Service personnel with the management of oil and gas activities in NWRS lands:

- legal authorities, including mineral ownership and implementing regulations;
- negotiation of permits and agreements that protect surface rights;
- environmental compliance requirements;
- physical infrastructure of oil and gas activities;
- minimization of environmental damage; and
- pertinent health and safety issues.

The Service also developed a weeklong training course held at the following locations since 2005: Corpus Christi, Texas (2005); Minot, North Dakota (2006); Sulphur, Louisiana (2007); Pottsboro, Texas (2008); Williston, North Dakota (2009); Shreveport, Louisiana (2011); Fort Collins, Colorado (2012); and Winnie, Texas (2013).

Refuge managers, refuge oil and gas specialists, and realty specialists have attended the week-long course. The training course includes an overview of issues that refuge personnel should consider in managing oil and gas activities on NWRS lands and provides examples of procedures, protocols, and SUP stipulations successfully implemented on refuges. Additionally, the Service currently has six staff dedicated to the oversight of oil and gas activities in NWRS units as well as regional oil and gas specialists in Texas, Louisiana, and Colorado.

Since publication of the GAO report (GAO 2003), oil and gas E&P has increased significantly (EIA 2012). The number of drilling rigs increased by 84 percent, from 1,032 rigs in 2003 to 1,925 rigs in 2011. Annual oil production increased by 55 percent, from 1.87 billion barrels (Bbbls) in 2003 to 2.9 Bbbls in 2010. Annual production of natural gas rose from 19.4 trillion cubic feet (TCF) in 2003 to 33.8 TCF in 2010, an increase of 74 percent. The increase is primarily due to technological advancements in horizontal drilling techniques and hydraulic fracturing, which have allowed the exploration and development of shale for oil and gas (EIA 2011). The expansion of oil and gas E&P necessitates a reexamination of the number of oil and gas wells and pipelines affecting NWRS lands. The purpose of this report is to document the number of oil and gas wells in NWRS lands, the status of the oil and gas wells (active, inactive, shut-in, plugged and abandoned, abandoned, or unknown), and the number of pipelines.

Identification of the location of abandoned oil and gas wells and or equipment associated with those wells will enable the Service to assess the ongoing and potential impacts to NWRS lands from abandoned oil and gas facilities and use the data to prioritize which ones need corrective action. The data will also assist refuge managers with oversight of oil and gas facilities on NWRS lands.

Methods

The Service's Natural Resource Program Center (NRPC) in Fort Collins, Colorado, obtained spatial data on oil and gas wells in NWRS lands in June 2012 from the U.S. Environmental Protection Agency's (EPA) Land-Based Oil and Gas Extraction database (Database) in the Online Tracking Information System (OTIS) administered by the Office of Compliance (EPA 2013). The NRPC obtained data on pipelines crossing NWRS lands in February 2012 from the U.S. Department of Transportation (DOT) Office of Pipeline Safety's National Pipeline Mapping System. The NRPC requested spatial data on wells located within NWRS unit boundaries and within ½ mile outside NWRS unit boundaries. Only NWRS lands obtained through acquisition of fee title (purchase of full ownership of the property, property donated to the Service, or lands withdrawn from public domain and included in NWRS lands) and property where the Service holds a secondary interest to another federal agency (overlay refuge) were included in the analysis of oil and gas well data and pipelines. "Secondary Interest" is defined as property where the Service holds a secondary interest to another federal agency. For example, Hagerman NWR in Texas was established in 1946 on lands originally purchased by the U.S. Department of the Army Corps of Engineers for the Denison Dam Project (Lake Texoma). Conservation easements in the NWRS were not included in this assessment.

EPA obtained the oil and gas well data from HPDI, Inc., now known as DrillingInfo, Inc., a private sector data gathering firm from Austin, Texas (http://info.drillinginfo.com/). DrillingInfo, Inc., obtained data on over 3 million oil and gas-associated wells from 30 state regulatory agencies or geological agencies and the Arizona Geological Society in January 2012. Data included all oil and gas-producing states, with the exception of Illinois and Indiana. EPA obtained well data from the Illinois State Geological Survey and Indiana Geological Survey in February 2011.

The EPA oil and gas well database categorizes the wells according to production type and status. The "Production Type" field includes numerous codes depicting the type of fluid or gas that is either produced or injected from or into the well (e.g., oil, gas, oil and gas, coal bed methane, carbon dioxide injection, water injection) (EPA 2013). The "Status" field includes codes depicting the current status or condition of the well (e.g., active, inactive, abandoned, dry hole, shut-in, plugged and abandoned, or unknown). Active wells are actively producing, injecting, or disposing of fluids. Inactive wells are defined as unplugged wells that have had no reported production of oil and or gas or injection for a period of one year or more. A shut-in well is a well capable of production or injection that can be readily placed into production by activating existing equipment. Plugged and abandoned wells are plugged with cement and heavy mud, and the wellhead removed. Abandoned wells include wells that have been abandoned by oil operators due to lack of production or wells that have "failed beyond repair." The EPA Database does not specify if wells designated as "abandoned" were plugged and abandoned. If no oil or gas was produced following well completion, the well is categorized as a dry hole.

We analyzed the spatial distribution of wells and pipelines across NWRS lands using geographic information system (GIS) software (ArcGIS 10.1, ESRI, Redlands, CA). For purposes of this study, we grouped wells as follows:

- "Gas" whenever the Production Type listed "Gas" as a type regardless of other Production Type codes listed for that well.
- "Oil" whenever the Production Type listed "Oil" as a type regardless of other Production Type codes listed for that well.
- "Other" whenever the Production Type was something other than "Gas, Oil, or Oil and Gas."

Wells categorized as "Other" included injection wells for enhanced oil recovery or wastewater disposal, coalbed methane wells, observation wells, stratigraphic wells, and water wells. Wells classified as Status = "Cancelled" or "Cancel" were excluded from the analysis as the permits for these "wells" were cancelled by the operator and not drilled. We calculated the number of wells by production category and status for each NWRS unit and Service region.

In 2013 and 2014, we visited oil and gas facilities at the following NWRs: Anahuac, McFaddin, and Hagerman in Texas; Deep Fork in Oklahoma; Delta, Atchafalaya, Catahoula, Lake Ophelia, and Tensas River in Louisiana; and St. Catherine Creek in Mississippi. During those field visits, we interviewed refuge managers and oil and gas specialists to identify issues with the oversight of oil and gas activities on NWRS units. Refuge managers and oil and gas specialists provided information on environmental effects of oil and gas E&P. We also obtained information on oil and gas E&P environmental compliance incidents from reports provided by refuge managers and oil and gas specialists. Using GIS, we measured the sizes of a subset of well pads from the following NWRs: Deep Fork (n=14), Hagerman (n=20), Tensas River (n=15), Catahoula (n=11), St. Catherine Creek (n=13), Anahuac (n=12), and McFaddin (n=15). We selected no more than 10 well sites and 10 tank battery sites at each of the 7 NWRs.

Results

Oil and Gas Wells

Approximately 195 NWRS units (38 percent) of the 599 (561 NWRs and 38 WMDs) NWRS units have oil and gas activities (wells and pipelines) and 107 NWRS units (18 percent) have wells associated with oil and gas E&P (wells) (Table 2) (Figures 2 and 3). The Southeast Region (Region 4) has the most NWRS lands with oil and gas activities (55 NWRS units) followed by the Southwest Region (Region 2) (31 NWRS units). The Southeast Region has the most number of NWRS units (43 NWRS units) with pipelines followed by the Mountain-Prairie Region (28 NWRS units), the Southwest Region (26 NWRS units), and Midwest Region (21 NWRS units).

The Southwest, Southeast, and Mountain-Prairie Regions have the most number of NWRS units with active wells, 16, 14, and 9 NWRS units respectively (Table 3). The Southeast, Southwest, Pacific, and Mountain-Prairie Regions have the most number of NWRS units with inactive wells, 35, 23, 18, and 17, respectively. The Pacific Region has the most NWRS units with plugged and abandoned, dry, and shut-in wells (Table 4).

Table 2. Number of NWRS units, listed by FWS region, with oil and gas activities within fee interest boundaries.

FWS Region	Oil & Gas wells	Other wells	Total # NWRS units with Wells	# of NWRS units with Pipelines	Total # NWRS units with Wells and or Pipelines
1 (Pacific)	0	0	0	6	6
2 (Southwest)	20	16	23	26	31
3 (Midwest)	2	4	5	21	24
4 (Southeast)	20	31	35	43	55
5 (Northeast)	3	3	4	12	12
6 (Mountain-Prairie)	11	14	18	28	39
7 (Alaska)	1	4	4	1	4
8 (Pacific Southwest)	6	18	18	12	24
Totals	63	90	107	149	195

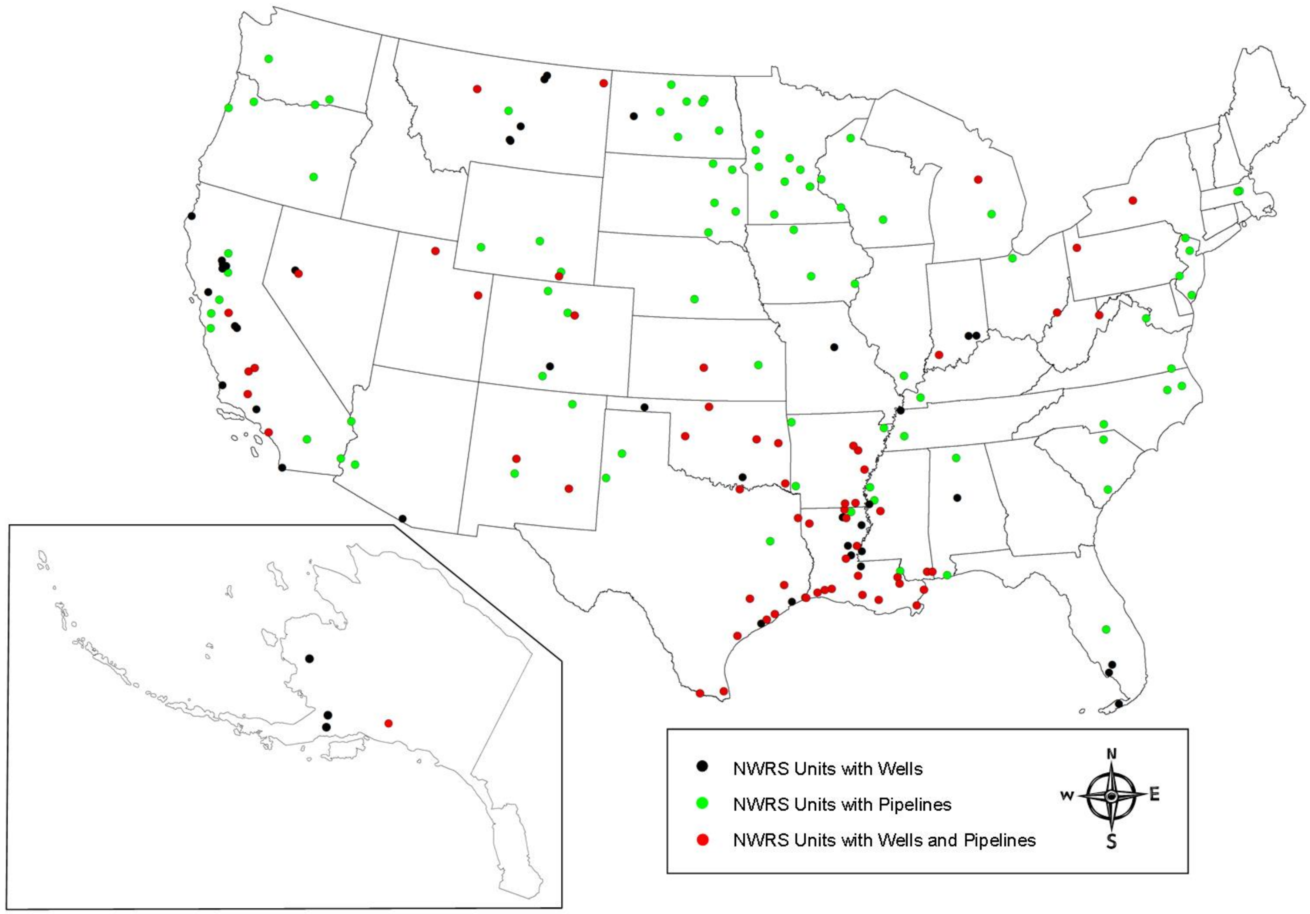

Figure 2. NWRS units with pipelines and oil and gas exploration and production wells.

Table 3. Number of NWRS units with active and inactive wells by region.

FWS Region	Active[1] Wells			Inactive[2] Wells		
	Oil & Gas wells	Other[3] wells	Total # NWRS units	Oil & Gas wells	Other wells	Total # NWRS units
1 (Pacific)	0	0	0	0	0	0
2 (Southwest)	15	6	16	16	15	23
3 (Midwest)	2	2	2	1	4	5
4 (Southeast)	14	1	14	20	31	35
5 (Northeast)	0	0	0	3	3	4
6 (Mountain-Prairie)	9	0	9	8	14	18
7 (Alaska)	1	1	1	1	4	4
8 (Pacific Southwest)	3	1	3	6	18	18
Totals	44	11	45	55	89	107

[1]Active wells = includes oil & gas wells that are producing oil and gas and other wells that are injecting gas or fluids underground.
[2]Inactive wells = includes all wells with a status ≠ active (e.g., inactive, plugged and abandoned, shut-in, dry hole, unknown, etc.).
[3]Other wells = includes wells other than oil and gas: injection, saltwater disposal, enhanced oil recovery, dry, observation, stratigraphic, other, and production type data not available (N/A).

Table 4. Number of NWRS units with non-producing oil and gas wells.

FWS Region	Number of NWRS units by well status category			
	Abandoned[1]	Plugged & Abandoned[2]	Dry[3]	Shut-in[4]
1 (Pacific)	0	0	0	0
2 (Southwest)	1	8	1	0
3 (Midwest)	1	0	3	0
4 (Southeast)	0	5	6	1
5 (Northeast)	0	2	3	0
6 (Mountain-Prairie)	0	3	0	1
7 (Alaska)	0	4	0	1
8 (Pacific Southwest)	0	16	16	4
Totals	2	38	29	7

[1]Abandoned = well no longer in use, whether dry, inoperable or no longer productive, and operators have intentionally relinquished interest in the well.
[2]Plugged & Abandoned = well that has been plugged with cement & mud and wellhead removed.
[3]Dry = well with no economically producible oil and/or gas.
[4]Shut-in = a well capable of production or injection by opening valves or powering equipment.

The production type in 1,771 (36 percent) of the 5,002 wells present in NWRS units is grouped as "Other" and one percent (75 wells) have other status codes, including application for permit to drill, drilling active, drilling suspended, dry, dry hole, other, suspended, temporarily abandoned, unknown, and "blank" or no data present in that field.

Table 5. Number of wells by Production Type and Status within NWRS unit boundaries.

Well Status	Gas	Oil	Oil & Gas	Other	Total
Active	1,282	257	8	118	1,665
Inactive	779	446	37	934	2,196
P&A[1]	81	129	9	499	718
Shut-in	3	26	0	1	30
N/A[2]	53	106	3	156	318
Other[3]	3	7	2	63	75
Grand Total	2,201	971	59	1,771	5,002

[1]P&A = plugged and abandoned
[2]N/A = status data not available
[3]Other = includes other status codes not listed in table, such as dry hole, suspended, temporarily abandoned, unknown, or "blank" (i.e. no data)

Active and inactive wells comprise 33 and 44 percent, respectively, of all wells on NWRS lands, and only 14 percent of the wells are plugged and abandoned. Oil and gas wells make up 65 percent of all wells on NWRS lands. Other wells include wells with Production Type listed as abandoned, injection, coalbed methane, observation, stratigraphic, dry hole, suspended, temporarily abandoned, unknown, or blank (i.e., no data). Most of the wells (93 percent or 776 wells) designated as production type = N/A and status = inactive, N/A, unknown, or blank are in the Southeast Region in 21 NWRS units with half of the wells in the following NWRs: Upper Ouachita (128 wells); D'Arbonne (100); Delta (86); and Tensas (75) (Table 6).

Injection wells make up 5 percent (206 wells) of all wells on NWRS units (Table 7) with half (51 percent or 121 wells) designated as active. The Southwest Region has the most NWRS units (11) with injection wells. Deep Fork and Hagerman NWRs have the highest number of injection wells in the NWRS, 82 and 68, respectively. Almost all (78) of the injection wells at Deep Fork NWR are designated as active. Only 21 of the 68 injection wells at Hagerman NWR are active. Of the 21 active injection wells at Hagerman NWR, one is used for saltwater (oilfield brine) disposal and the remainder are used for secondary recovery (water flood) of oil.

Table 6. NWRS units with wells with production type = not available (N/A) and status = inactive, N/A, unknown, or blank.

Region / State / NWRS unit	Number of Wells
Region 2	
New Mexico	
Sevilleta National Wildlife Refuge	2
Oklahoma	
Deep Fork National Wildlife Refuge	120
Tishomingo National Wildlife Refuge	8
Sequoyah National Wildlife Refuge	4
Little River National Wildlife Refuge	1
Region 3	
Missouri	
Big Muddy National Fish And Wildlife Refuge	1
Region 4	
Florida	
Florida Panther National Wildlife Refuge	2
National Key Deer Refuge	1
Ten Thousand Islands National Wildlife Refuge	1
Louisiana	
Upper Ouachita National Wildlife Refuge	128
D'Arbonne National Wildlife Refuge	100
Delta National Wildlife Refuge	86
Tensas River National Wildlife Refuge	75
Catahoula National Wildlife Refuge	54
Lake Ophelia National Wildlife Refuge	51
Sabine National Wildlife Refuge	51
Bayou Cocodrie National Wildlife Refuge	49
Lacassine National Wildlife Refuge	42
Red River National Wildlife Refuge	27

Table 6. Continued

Region / State / NWRS unit	Number of Wells
Louisiana	
Mandalay National Wildlife Refuge	25
Atchafalaya National Wildlife Refuge	23
Bayou Teche National Wildlife Refuge	18
Cameron Prairie National Wildlife Refuge	14
Black Bayou Lake National Wildlife Refuge	7
St. Catherine Creek National Wildlife Refuge	6
Big Branch Marsh National Wildlife Refuge	4
Breton National Wildlife Refuge	3
Cat Island National Wildlife Refuge	3
Grand Cote National Wildlife Refuge	2
Region 5	
West Virginia	
Ohio River Islands National Wildlife Refuge	15
Region 6	
Colorado	
Baca National Wildlife Refuge	2
Rocky Mountain Arsenal National Wildlife Refuge	1
Montana	
Northeast Montana Wetland Management District	9
Benton Lake Wetland Management District	7
Halfbreed Lake National Wildlife Refuge	4
Medicine Lake National Wildlife Refuge	3
Benton Lake National Wildlife Refuge	2
Bowdoin Wetland Management District	2
Lake Mason National Wildlife Refuge	2
Bowdoin National Wildlife Refuge	1
Hailstone National Wildlife Refuge	1
Hewitt Lake National Wildlife Refuge	1

Table 6. Continued

Region / State / NWRS Unit	Number of Wells
Alaska	
Kenai National Wildlife Refuge	7
Region 8	
Nevada	
Stillwater National Wildlife Refuge	4
Fallon National Wildlife Refuge	1
Total	**974**

Five NWRS units contain 42 percent of all oil and gas wells in the NWRS with three of the top five NWRS units located in the Southeast Region (Table 8). The status of 93 percent of the wells at Delta NWR is either inactive, N/A, unknown, or blank. Seventy percent of the wells at Deep Fork NWR are designated as either inactive, N/A, unknown, or blank. One hundred wells at Deep Fork NWR have no data on well status or production type. Within the NWRS, Deep Fork NWR has the highest number of active oil wells (68) and Upper Ouachita NWR has the highest number of active gas wells (928) in the NWRS. Gas wells comprise 77 percent of all active oil and gas wells with 86 percent of these wells located in NWRS units in Louisiana.

Table 7. Number of injection wells on NWRS lands.

FWS Region	# of NWRS units	Number of Wells	Active	Inactive	Plugged & Abandoned	Other Status[1]
1 (Pacific)	0	0	0	0	0	0
2 (Southwest)	11	161	112	21	15	13
3 (Midwest)	1	5	1	4	0	0
4 (Southeast)	2	33	5	1	20	7
5 (Northeast)	0	0	0	0	0	0
6 (Mountain-Prairie)	1	2	0	2	0	0
7 (Alaska)	1	2	2	0	0	0
8 (Pacific Southwest)	1	3	1	1	0	1
Totals	17	206	121	29	35	21

[1]Other Status - temporarily abandoned, drilling, well status not available, or shut-in.

Table 8. NWRS units with the highest number of oil and gas wells (excluding other wells such as injection wells).

NWRS unit	State	Number of Wells: Oil Wells		Gas Wells		Oil & Gas Wells		Total
		Active	Inactive	Active	Inactive	Active	Inactive	All Wells
Upper Ouachita	LA	0	2	928	352	0	0	1,282
Delta	LA	18	196	3	49	0	11	277
D'Arbonne	LA	0	0	100	83	0	0	183
Deep Fork	OK	68	79	2	24	0	0	173
Lower Rio Grande Valley	TX	4	19	60	79	2	8	172
	Total	90	296	1,093	587	2	19	2,087

Approximately 6,723 oil and gas E&P wells, all wells related to oil and gas production, occur within one-half mile outside of NWRS unit boundaries (Table 9). Twenty-eight percent (1,890) of these wells are active wells and 48 percent (2,741) are inactive.

Table 9. Number of wells by Production Type and Status located within ½ mile of the NWRS unit boundaries.

Well Status	Number of Wells by Production Type: Gas	Oil	Oil & Gas	Other	Total
Active	977	419	399	95	1,893
Inactive	829	520	70	1,322	2,741
P&A[1]	110	83	166	509	868
Shut-in	42	45	0	46	87
N/A[2]	107	177	65	358	707
Other[3]	41	20	218	151	427
Grand Total	2,106	1,264	918	2,481	6,723

[1]P&A = plugged and abandoned
[2]N/A = status data not available
[3]Other = includes other status codes not listed in table, such as cancelled, dry hole, suspended, temporarily abandoned, unknown, or "blank" (i.e. no data)

Pipelines

There are 595 pipelines totaling approximately 1,339 miles cross 149 NWRS units (Table 10). Seven percent (87 NWRS units) of the 599 NWRS units have only pipelines crossing NWRS units and no wells associated with oil and gas production. Some of the pipelines were constructed before the Service acquired the property. The Southeast Region (Region 4) contains the most number of NWRS units (43) with pipelines followed by Regions 2, 3, and 6. Over half (68 percent) of the pipelines transport gas products (Table 11). The pipelines transport a variety of petroleum products including crude oil, refined petroleum products, and natural gas.

Table 10. Number of pipelines crossing NWRS units.

FWS Region	Total # Pipelines	# NWRS units with Pipelines	# NWRS units with Pipelines Only	Miles of Pipeline
1 (Pacific)	8	6	6	26
2 (Southwest)	182	26	8	463
3 (Midwest)	98	21	19	147
4 (Southeast)	190	43	19	450
5 (Northeast)	25	12	8	33
6 (Mountain-Prairie)	60	28	21	98
7 (Alaska)	7	1	0	101
8 (Pacific Southwest)	25	12	6	20
Totals	595	149	87	1,338

Table 11. Number of pipelines by type crossing NWRS units.

FWS Region	Liquids Pipelines[1]	Gas Pipelines[2]
1 (Pacific)	3	5
2 (Southwest)	76	106
3 (Midwest)	28	70
4 (Southeast)	34	156
5 (Northeast)	4	21
6 (Mountain-Prairie)	23	37
7 (Alaska)	2	5
8 (Pacific Southwest)	1	24
Totals	194	424

[1]Liquids pipelines transport crude oil, and refined products such as gasoline, diesel, and jet fuel.
[2]Gas pipelines transport natural gas and other gases such as carbon dioxide.
[3]Liquids & gas pipelines transport liquefied natural gas, liquefied petroleum gas, and anhydrous ammonia (in liquid state in pipeline but vaporize into gas when released from pipe).

Almost three-quarters (72 percent) of the pipelines traversing NWRS units transport natural gas. Over half of the natural gas pipelines in NWRS units occur in Regions 2 (Southwest) and 4 (Southeast). Almost all of the gas pipelines (96 percent) transport natural gas and the remainder convey carbon dioxide, hydrogen, or other gases. Liquids pipelines transport crude oil, anhydrous ammonia, liquefied petroleum gas, natural gas liquids, highly volatile liquids, and non-highly volatile liquid products. Most pipelines are buried underground and range in size from 2 to 42 inches in diameter. The larger pipelines (diameter > 25 inches) typically convey either natural gas or crude oil. Six percent (23 pipelines) are idle, abandoned, or retired.

Environmental Effects of Oil and Gas on NWRS Units

Environmental impacts associated with oil and gas E&P on NWRS units range from small, chronic leaks and trash at production sites to larger and significant incidents such as removal of vegetation, spills resulting in soil and vegetation damage, leaking abandoned wells, and abandoned oilfield equipment. Hagerman NWR reported six brine spills in 2010 caused by flowline leaks due primarily to corrosion. A corroded flowline discharged 75 bbls of oilfield brine at Hagerman NWR in February 29, 2012, and affected 2 acres of habitat. The brine killed 84 hardwood trees, 2 of which were over 150 years old, and caused an estimated $154,000 in damages (M. Maddux, pers. comm.). In March 2013, a drilling operation spilled 25 bbls of oil-based drilling mud at a drilling rig at the Lower Rio Grande Valley NWR. The drilling mud spill contaminated soil and vegetation next to the well pad (M. Maddux, pers. comm.).

Refuge staff documented soil and water contamination from improperly plugged and abandoned wells. An oil well plugged and abandoned in 1983 at St. Catherine Creek NWR leaked in April 2012, necessitating replugging the well and restoring the site at a cost exceeding $260,000 (M. Cupit, pers. comm.). At the Lower Rio Grande Valley NWR, leaking abandoned oil wells threatened East Lake, a saline lake of critical importance to migrating shorebirds. The state oil and gas regulatory agency (Texas Railroad Commission) spent $1.2 million to plug the wells and remove the abandoned oilfield equipment.

Oil spills due to stream flooding and hurricane storm tides have also occurred on NWRS units. Hurricane storm tides in Texas and Louisiana resulted in extensive damage to oil and gas production sites. The storm tides damaged oil storage tanks causing oil releases onto wetlands on NWRs. Storm tides also moved storage tanks from the well pads inland into sensitive areas of the NWRs. E&P wells located in floodplains could cause releases of oil and brine during flood events. Catahoula, Deep Fork, Patoka River, St. Catherine Creek, Tensas River, and Upper Ouachita NWRs have wells located within floodplains subject to seasonal flooding. The total number of spills associated with oil and gas E&P on NWRS units is unknown.

Well pad sizes at Anahuac, McFaddin, and Hagerman NWRs in Texas; Deep Fork NWR in Oklahoma; Atchafalaya, Catahoula, and Tensas River NWRs in Louisiana; and St. Catherine Creek NWR averaged 0.4 acres for well sites and 1 acre for well pads with tank batteries. We documented abandoned oilfield equipment including pump jacks, pipes, separators, flowlines, and storage tanks in the following NWRs: Atchafalaya, Delta, and Tensas River in Louisiana; Deep Fork in Oklahoma; and Anahuac, Brazoria, Hagerman, McFaddin, and San Bernard in Texas. NWRS unit managers and oil and gas specialists reported improvement in working with oil and gas operators to achieve resource protection; however, they added that unnecessary impacts on NWRS units still occur.

Discussion

In the 11 years since the publication of the GAO findings (GAO 2003), the NWRS has increased from 575 to 599 NWRS units. We cannot attribute this increase to an expansion in the number of NWRS units as none of the 24 NWRS units acquired since 2003 have any wells within the fee interest boundaries. The increase may be due to the acquisition of additional land for existing NWRS units or the drilling of additional wells. We cannot directly compare the well numbers reported by the GAO (2003) to our data, as we do not have specific information on the actual NWRS unit fee interest boundaries used in the 2003 analysis nor how GAO imported the well data from the data sources. In addition, well data vary as the production type and the status of wells change as the wells age. For the purposes of assessing trends, however, we offer some general contrasts with the GAO findings.

Data on oil and gas-related wells in and adjacent to NWRS units reflect the history and trends of oil and gas E&P in the United States. Regions 2 and 4 encompass the Gulf coast states, which historically and currently have extensive oil and gas E&P. Most of the oil and gas development on NWRS units occurred prior to the acquisition of these lands by the Service. The Southeast Region (Region 4) has the largest number of pipelines and wells and the largest number of actively producing oil and gas wells followed by the Southwest Region (Region 2). This is similar to the GAO findings in 2003 (GAO 2003). The Southeast and Southwest regions encompass the Gulf of Mexico coast, which historically has been a major oil and gas-producing region for the United States (Advanced Resources International 2006). Texas and Oklahoma (Southwest Region) account for 32 and 10 percent, respectively, of all oil and gas wells in the United States (EIA 2011). Historically, the oil-producing states of Texas, Oklahoma, and Louisiana in the Southeast and Southwest regions have led the United States in the production of crude oil and natural gas (Boyd 2002, Kim and Ruppel 2005). Oil production in Texas and Louisiana dates back to 1901 with the discovery of oil at Beaumont, Texas, near McFaddin and Texas Point NWRs, and Jennings, Louisiana, near Laccasine NWR (Louisiana Geological

Survey 2001). Oil and gas wells on some NWR units in Texas and Louisiana were completed during the 1920s and 1930s.

As oil and gas production in the well declines, its status changes from active to shut-in, abandoned, or plugged and abandoned. Changes in well status may explain the eight percent decline in active wells from 1,806 wells in 2003 to 1,665 wells in 2011. The percentage of inactive wells and plugged and abandoned wells did not change considerably from 2003. Active wells can adversely affect NWRS units because of disturbance from routine operations and facility maintenance in addition to oil and brine spills. Although inactive, shut-in, or abandoned wells are not producing or injecting fluids, the risk of leakage onto the surface or contamination of aquifers due to the loss of wellbore integrity still exists. Delaying the plugging and abandonment of inactive wells increases the risk of well integrity failure. Oil operators can abandon inactive wells and place the burden of plugging and abandonment and site reclamation on the taxpayer.

Three of the five refuges with the highest number of wells are located in the Southeast Region (Region 4): Upper Ouachita, Delta, and D'Arbonne National Wildlife Refuges. This is also similar to the findings of the GAO (2003). Upper Ouachita and D'Arbonne NWRs are located in north-central Louisiana in the Ouachita River Basin. The wells in these NWRs produce natural gas from the Monroe gas field, Louisiana's largest gas field at approximately 365 sq. miles producing 7.3 TCF of natural gas since its discovery in 1917 (Williams 2005). The Upper Ouachita NWR in Louisiana has the highest number of active gas wells (928 wells) in the NWRS and comprises 56 percent of all active wells in the NWRS. Some of the gas wells in the Upper Ouachita NWR have been in production since the 1920s. Approximately 781 wells in Upper Ouachita NWR were completed between 1970 and 1989 with over half of those wells completed between 1970 and 1978 prior to the acquisition of the NWR. Prior to the 1970s, gas wells in the Upper Ouachita NWR were restricted by state regulations to one well per 40 acres. However, changes in the regulation of natural gas prices (Natural Gas Supply Association 2011) and the resultant increase in natural gas prices led to an increase in drilling in the NWR during the 1970's with some wells drilled within 600 feet of other wells (FWS 2008a). Twenty-three wells were drilled 83 to 93 years ago and 468 wells are from 41 to 78 years old. Forty-two percent of the wells older than 40 years are designated as inactive. The EPA dataset does not specify if these wells are plugged and abandoned. The impacts of gas development at Upper Ouachita NWR include brine spills, improperly closed reserve pits, abandoned or poorly maintained wells and equipment, and mercury contamination from manometers used to measure gas production (FWS 2008a). Black Bayou Lake and D'Arbonne NWRs are also located in the Monroe Gas Field and have a large number of active gas wells, 60 and 100 gas wells, respectively. Over half of the gas wells at D'Arbonne NWR were completed after 1980.

St. Catherine Creek NWR, located in Adams and Wilkinson Counties, in southwestern Mississippi, has 514 wells and 90 percent of the wells (464) have been plugged and abandoned. Sixty-seven percent of the wells (338 wells) at the NWR were dry and 25 percent (130 wells) are oil wells. The NWR has eight active oil wells and five active saltwater disposal wells. The NWR staff has worked with the Mississippi Oil and Gas Board in coordinating the removal of inoperable and abandoned oil production equipment (FWS 2006).

Delta NWR, located in Plaquemines Parish at the mouth of the Mississippi River in southeast Louisiana, has a total of 363 wells of which 71 percent are designated as inactive. Over half of the wells are oil wells (62 percent or 196 wells) with 18 producing or active oil wells and 3 active gas wells. Oil and gas development in Delta NWR began in 1942, 7 years after the refuge was established in 1935 (FWS 2008b). Over half (65 percent or 237) of the wells at Delta NWR were completed prior to 1980. Of the wells with data on the last production date, 166 wells apparently stopped producing prior to the year 2000. Seven oil wells have been active for over 50 years. Seven oil wells and two gas wells have been in production for less than 20 years.

Deep Fork NWR, located in Okmulgee County, Oklahoma, has a total of 400 wells with 68 active oil wells and 2 active gas wells. Most of the well completions at Deep Fork NWR occurred in the 1920s and between 1950 and 1969. Some of the oil wells at Deep Fork NWR have been in production since the early 1900s. Twenty-eight percent of all wells have data on the last production date; of those, 68 percent (77 wells) ceased production between 1979 and 1999. The status of 41 percent of the wells is unknown. The refuge also has 78 active injection wells. Fifty-one percent (35 wells) of the active injection wells in the refuge were completed during the 1950s.

Deep Fork NWR in Oklahoma and Hagerman NWR in Texas have the highest number of injection wells, 82 and 68, respectively. The Southwest Region (Region 2) has the highest number of NWRS units with injection wells (11 NWRS units) and the highest total number of injection wells (161 wells). As wells become less productive in other regions, dry holes or unproductive oil and gas wells could be converted into injection wells for enhanced oil recovery or wastewater disposal.

The GAO (2003) reported 59 percent of wells in NWRS units as “inactive with an unknown number of these wells abandoned but not plugged,” but did not provide the number of abandoned wells. Unplugged and improperly plugged wells are a potential source of groundwater contamination and can serve as a pathway for oil and other hydrocarbons and brine to reach the surface and contaminate soils, vegetation, and surface waters. Nearby hydraulic fracturing operations at new or existing well sites can force oil, brine, and fracturing fluids into aquifers or the surface through unplugged and improperly plugged wells. The Interstate Oil and Gas

Compact Commission (IOGCC) defines an inactive or abandoned well as “orphan” if the well is not producing or injecting fluids, does not have approval from the appropriate state regulatory agency to remain inactive, and if the operator is unknown or insolvent (IOGCC 2008). Vegetation can obscure orphan wells with no surface markers or visible equipment such as pump jacks. Well casing extending above the surface presents a safety risk to refuge staff and the public and can impede or damage equipment such as vehicles or mowers. Additionally, unplugged orphan wells can increase the risk and intensity of wildfires (IOGCC 2008). The IOGCC states that “many wells pre-dating 1952 were probably plugged improperly” as cement plugs from that time period “were not always effective as their compounds lacked the chemical components to withstand down-hole temperatures and pressure” and thus, probably failed to harden and seal the wells properly (IOGCC 2008). The number of orphan wells on NWRS units remains unknown.

Environmental effects of oil and gas E&P activities remain unchanged as those reported in 2003 (GAO 2003). The frequency of oil operator noncompliance with state oil and gas regulations as well as the number of oil and brine spills in NWRS units remains unknown. Oilfield brine spills generally cause long-term impacts to soils and groundwater and are difficult to remediate (Preston et. al. 2013). Existing vegetation in areas subjected to a brine spill will die as the saline conditions in the contaminated soil inhibit water uptake by plant roots. A brine spill onto clay soils alters the soil structure by clogging soil pores, thus, creating an impermeable hard pan (Harris et. al. 2005). Erosion eventually results from the brine-impacted soil’s inability to support vegetation and absorb water from precipitation. These conditions are slower to recover than impacts by E&P oil spills because unlike E&P oil spills, microbial decomposition, leaching, and volatilization will not restore the soil to conditions that will support vegetation (Jager et. al. 2005). These areas, also known as “salt scald,” remain as permanent scars on the landscape.

The rate of E&P oil and brine spill incidents ranges from 1 spill for every 53 active wells to 1 spill for every 76 active wells (Fisher and Sublette 2005) (NDDH 2014). Fisher and Sublette (2005) reviewed E&P spill incident reports in Oklahoma and found the average size of E&P-associated spills ranged from 34 to 46 bbl of oil and 89 to 158 bbl of brine per spill. On average, E&P operations resulted in the release of 62,000 bbl of oil and 146,000 bbl of brine. Fisher and Sublette (2005) found that crude oil and brine made up 76 percent of all fluids released from E&P facilities, with 34 percent of the spills causing injury to surface water, soil, crops, livestock, fish, or wildlife. Although states like Oklahoma and North Dakota maintain records on the number of E&P-associated spills, not all states track the smaller oil and brine spills that do not result in some impact on surface waters.

Advances in oil and gas exploration and production technology have made previously uneconomical oil and gas plays, such as shale oil and shale gas, economically viable to extract.

Consequently, the development of shale oil and shale gas plays, in particular the Bakken in North Dakota and Eastern Montana and the Marcellus in Ohio, West Virginia, Pennsylvania, and New York, could impact NWRS lands in these states. Oil and gas exploration and drilling in prospective shale plays like the Tuscaloosa marine shale in central Louisiana could also impact several NWRs. Bogue Chitto, Cat Island, Catahoula, Grand Cote, Lake Ophelia, and St. Catherine's Creek NWRs are located in the Tuscaloosa marine shale play. The development of these shale plays will most likely involve the use of horizontal drilling and hydraulic fracturing, requiring large well pads and large quantities of water. The construction of new well pads and compaction of the sites can increase precipitation runoff and can cause erosion and siltation of streams and wetlands (McBroom et. al. 2012). Intensive water use and the risk of hydraulic fracturing flowback fluid spills would also pose a risk to NWRS resources.

Conclusions and Management Recommendations

The updated data obtained on oil and gas wells and pipelines in and adjacent to NWRS lands will assist the Service in determining follow-up assessments on the status of these wells and impacts to individual NWRS units. Although the updated data is useful, errors are inherent in the collection of data on thousands of wells due to inaccurate data transcription, typing errors, errors made during the data collection process, programming errors, unclear definitions for data items, or not adhering to the data collection protocol. Given the likelihood of errors, the Service should, at a minimum, conduct follow-up assessments on NWRS units with oil and gas wells with no data on well status (status = N/A). Deep Fork NWR, Felsenthal NWR (Arkansas), and Ohio River Islands NWR (West Virginia) have the most wells with no data on status, 252, 57, and 23 wells, respectively. The Service should also follow-up on wells designated as inactive. Sixty-nine percent of wells designated as inactive are located in NWRS units in Louisiana with one-quarter of those wells in the Upper Ouachita NWR. It is not known if inactive wells and wells with no data on well status are plugged. The Interstate Oil and Gas Compact Commission (IOGCC) states that "*many wells pre-dating 1952 were probably plugged improperly*" as cement plugs from that time period "*were not always effective as their compounds lacked the chemical components to withstand down-hole temperatures and pressure*" and thus, probably failed to harden and seal the wells properly (IOGCC 2008). Unplugged wells and improperly plugged wells can provide a pathway for oil and other hydrocarbons, well stimulation chemicals, and oilfield brine to aquifers or to the surface and contaminate ground water, water wells, soils, vegetation, and surface waters. In addition to the environmental risks, unplugged and improperly plugged wells pose a risk to public safety as surface seeps can increase risk and intensity of wildfires (IOGCC 2008). Updated information on well status should be obtained from the pertinent state oil and gas regulatory agencies.

The Service should conduct onsite ecological assessments on NWRS units with oil and gas activities to determine impacts from brine, oil, and other hydrocarbon spills, as well as habitat alteration, and other impacts associated with the exploration and production of oil and gas. The onsite ecological assessments should also identify abandoned oil and gas facilities necessitating equipment removal and site restoration. Several states have programs for the removal of abandoned oil and gas equipment and site restoration. The onsite ecological assessments should determine the nature and extent of contamination, the sources, and causes of spills and releases, injury to NWRS resources, and corrective measures to prevent continued or potential harm to NWRS units. Refuge managers should forward information on abandoned oil and gas facilities requiring removal and site restoration to the appropriate state regulatory agencies and oil operators and request removal of equipment and site restoration.

Refuge managers should also work with oil operators to develop operation and maintenance plans for existing oil and gas production facilities with the goal of protecting NWRS resources. The operation and maintenance plans should include, at a minimum, spill prevention, control, and countermeasures (SPCC); waste management and disposal; procedures for reporting spills or releases to the refuge manager; and procedures for routine maintenance of the facilities and for maintenance of the well using workover rigs or other heavy equipment. The Service should work with pipeline operators to ensure that they develop spill contingency plans for pipelines traversing NWRS units or for pipelines crossing waterways upstream of NWRS unit boundaries.

The NWRS's mission is to "administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." Wildlife conservation, the primary purpose of the NWRS, is challenging at best and severely diminished at worst with oil and gas exploration and production activities on NWRS units. The Service has made much progress in training refuge staff in the oversight of oil and gas activities with the goal of avoiding or minimizing impacts to NWRS resources. However, given the increase in oil and gas development, the need for Service authority to "*require reasonable permit conditions and oversee oil and gas activities*" as recommended by the GAO (2003) to "*strengthen and provide greater consistency*" in management and oversight and "*to protect the public's surface interests*" is justified.

Literature Cited

Advanced Resources International. 2006. Basin Oriented Strategies for CO2 Enhanced Oil Recovery: Onshore Gulf Coast. Prepared for U.S. Dept of Energy, Office of Fossil Energy – Office of Oil and Natural Gas. Available: http://www.adv-res.com/pdf/Basin%20Oriented%20Strategies%20-%20Onshore_Gulf_Coast.pdf

[AOPL] Association of Oil Pipe Lines. 2007. Pipeline 101, Overview. Available: http://www.pipeline101.com/Overview/energy-pl.html

Boyd, D.T. 2002. Oklahoma oil: past, present, and future. Oklahoma Geology Notes 62 (3):97-106. Available: http://www.ogs.ou.edu/fossilfuels/pdf/OKOilNotesPDF.pdf

[EIA] U.S. Energy Information Administration. 2011. Review of Emerging Resources: U.S. Shale Gas and Shale Oil Plays. Available: http://www.eia.gov/analysis/studies/usshalegas/

[EIA] U.S. Energy Information Administration. 2012. Distribution and production of oil and gas wells by state. Available: http://www.eia.gov/pub/oil_gas/petrosystem/petrosysog.html.

[EPA] U.S. Environmental Protection Agency. 2013. Land-based oil and gas extraction – data dictionary. Online Tracking Information System, Office of Enforcement and Compliance, Washington, DC. Available: http://www.epa-otis.gov/knowledge_base/oilandgas/data_dictionary_oil_gas.html

Fisher J.B., K.L Sublette. (2005) Environmental releases from exploration and production operations in Oklahoma: Type, volume, causes, and prevention. Environmental Geosciences 12: 89-99.

[FWS] U.S. Fish and Wildlife Service. 2006. Comprehensive Conservation Plan, St. Catherine Creek National Wildlife Refuge, Adams and Wilkinson Counties, Mississippi. U.S. Fish and Wildlife Service, Southeast Region, Atlanta, GA. 156 pp.

[FWS] U.S. Fish and Wildlife Service. 2008a. Comprehensive Conservation Plan, Upper Ouachita and Handy Brake National Wildlife Refuges, Including Farm Service Agency Tracts. U.S. Fish and Wildlife Service, Southeast Region, Atlanta, GA. 207 pp.

[FWS] U.S. Fish and Wildlife Service. 2008b. Comprehensive Conservation Plan, Delta and Breton National Wildlife Refuges, St. Bernard and Plaquemines Parishes, Louisiana. U.S. Fish and Wildlife Service, Southeast Region, Atlanta, GA. 140 pp.

[GAO] U.S. General Acounting Office. 2003. National Wildlife Refuges – Opportunities to Improve the Management and Oversight of Oil and Gas Activities on Federal Lands. GAO-03-517, Washington, DC. 73 pp.

Harris T.M., J.B. Tapp, and K.L. Sublette. 2005. Remediation of oil-field brine-impacted soil using a subsurface drainage system and hay. Environmental Geosciences 12(2):101-113.

[IOGCC] Interstate Oil and Gas Compact Commission. 2008. Protecting Our Country's Resources: The State's Case. Interstate Oil and Gas Compact Commission Oklahoma City, OK 62 pp. Available: http://iogcc.publishpath.com/Websites/iogcc/pdfs/2008-Protecting-Our-Country's-Resources-The-States'-Case.pdf

Jager H.I., R.A. Efroymson, K.L. Sublette, T.L. Ashwood. (2005). Unnatural landscapes in ecology: generating the spatial distribution of brine spills. Environmetrics 16:687-698

Kim, E.M. and S.C. Ruppel. 2005. Oil and gas production in Texas. Bureau of Economic Geology, Univ. Texas, Austin, TX. Available: http://www.beg.utexas.edu/UTopia/images/pagesizemaps/oilgas.pdf

Louisiana Geological Survey. 2001. Jennings Field – the birthplace of Louisiana's Oil Industry. Public Information Series No. 9. 27 pp. Available: http://www.lgs.lsu.edu/deploy/uploads/9jennings.pdf

McBroom M., T. Thomas and Y. Zhang. Soil erosion and surface water quality impacts of natural gas development in East Texas, USA. Water 4: 944-958.

Natural Gas Supply Association. 2011. Natural Gas Regulations, The History of Regulation. Available: http://naturalgas.org/regulation/history/

NDDH (North Dakota Department of Health) (2014) Environmental incident reports. North Dakota Dept of Health, Bismarck, ND. http://www.ndhealth.gov/ehs/spills/. Accessed 4 March 2014

Preston T.M., T.L. Chesley-Preston, and J.N. Thamke. 2013. A GIS-based vulnerability assessment of brine contamination to aquatic resources from oil and gas development in eastern Sheridan County, Montana. Science of the Total Environment. Available: http://pubs.er.usgs.gov/publication/70048186

Williams, P. 2005. Prolific and Proud: A Century of E&P in Louisiana. Louisiana Proud Past; Promising Future. A Supplement to Oil and Gas Investor. Hart Energy Publishing, Houston, TX. 2 pp. Available: http://www.oilandgasinvestor.com/pdf/LASuplement.pdf

Appendix 1

Number of oil and gas exploration and production wells and interstate pipelines on National Wildlife Refuge System fee simple lands (i.e., absolute title to the surface land).

Region / State / NWRS Unit	Gas	Oil	Oil and Gas	Other	Total	Pipelines
Northwest Region (1)	**0**	**0**	**0**	**0**	**0**	**8**
Oregon						**4**
Malheur National Wildlife Refuge						1
McNary National Wildlife Refuge						1
Siletz Bay National Wildlife Refuge						1
Tualatin River National Wildlife Refuge						1
Washington						**4**
McNary National Wildlife Refuge						2
Nisqually National Wildlife Refuge						1
Umatilla National Wildlife Refuge						1
Southwest Region (2)	**358**	**282**	**26**	**308**	**974**	**182**
Arizona				**1**	**1**	**14**
Buenos Aires National Wildlife Refuge				1	1	
Havasu National Wildlife Refuge						10
Kofa National Wildlife Refuge						4
New Mexico	**5**	**10**		**2**	**17**	**6**
Bitter Lake National Wildlife Refuge	5	10			15	2
Bosque Del Apache National Wildlife Refuge						1
Maxwell National Wildlife Refuge						1
Sevilleta National Wildlife Refuge				2	2	2
Oklahoma	**62**	**149**		**255**	**466**	**9**
Deep Fork National Wildlife Refuge	26	147		227	400	4
Little River National Wildlife Refuge		1		7	8	1
Optima National Wildlife Refuge	13			2	15	
Salt Plains National Wildlife Refuge	11	1		1	13	2
Sequoyah National Wildlife Refuge				4	4	1
Tishomingo National Wildlife Refuge	2			12	14	
Washita National Wildlife Refuge	10			2	12	1
Texas	**291**	**123**	**26**	**50**	**490**	**153**
Anahuac National Wildlife Refuge	5	7		3	15	
Aransas National Wildlife Refuge	58	8	4	2	72	2
Attwater Prairie Chicken National Wildlife Refuge	19	1			20	5
Big Boggy National Wildlife Refuge	1				1	
Brazoria National Wildlife Refuge	12	4	3		19	29
Buffalo Lake National Wildlife Refuge						1
Caddo Lake National Wildlife Refuge	2	2		1	5	2
Hagerman National Wildlife Refuge	3	71	4	38	116	1
Laguna Atascosa National Wildlife Refuge	11				11	1
Lower Rio Grande Valley National Wildlife Refuge	139	23	10	3	175	23

Region / State / NWRS Unit	Gas	Oil	Oil and Gas	Other	Total	Pipelines
McFaddin National Wildlife Refuge	14	4		2	20	3
Muleshoe National Wildlife Refuge						1
Neches River National Wildlife Refuge						3
San Bernard National Wildlife Refuge	24	3	2	1	30	58
Texas Point National Wildlife Refuge			2		2	4
Trinity River National Wildlife Refuge	3		1		4	20
Midwest Region (3)	**2**	**7**		**93**	**102**	**98**
Illinois						**8**
Crab Orchard National Wildlife Refuge						2
Port Louisa National Wildlife Refuge						2
Upper Mississippi River National Wildlife And Fish Refuge						4
Indiana		**7**		**89**	**96**	**7**
Big Oaks National Wildlife Refuge				5	5	
Muscatatuck National Wildlife Refuge				1	1	
Patoka River National Wildlife Refuge		7		83	90	7
Iowa						***20***
Iowa Wetland Management District						14
Neal Smith National Wildlife Refuge						1
Port Louisa National Wildlife Refuge						2
Upper Mississippi River National Wildlife And Fish Refuge						3
Michigan	**2**				**2**	**18**
Kirtlands Warbler Wildlife Management Area	2				2	17
Shiawassee National Wildlife Refuge						1
Minnesota						**33**
Crane Meadows National Wildlife Refuge						1
Detroit Lakes Wetland Management District						1
Fergus Falls Wetland Management District						7
Litchfield Wetland Management District						2
Minnesota Valley National Wildlife Refuge						5
Minnesota Valley Wetland Management District						2
Morris Wetland Management District						5
Sherburne National Wildlife Refuge						1
Upper Mississippi River National Wildlife And Fish Refuge						1
Windom Wetland Management District						8
Missouri				**4**	**4**	
Big Muddy National Fish And Wildlife Refuge				4	4	
Ohio						**1**
Ottawa National Wildlife Refuge						1

Region / State / NWRS Unit	Gas	Oil	Oil and Gas	Other	Total	Pipelines
Wisconsin						**11**
Leopold Wetland Management District						7
St. Croix Wetland Management District						2
Upper Mississippi River National Wildlife And Fish Refuge						1
Whittlesey Creek National Wildlife Refuge						1
Southeast Region (4)	**1709**	**530**	**16**	**1172**	**3427**	**190**
Alabama				**14**	**14**	**4**
Cahaba River National Wildlife Refuge				14	14	
Grand Bay National Wildlife Refuge						2
Wheeler National Wildlife Refuge						2
Arkansas	**8**	**51**		**6**	**65**	**25**
Bald Knob National Wildlife Refuge	3				3	13
Big Lake National Wildlife Refuge						1
Cache River National Wildlife Refuge	2				2	3
Felsenthal National Wildlife Refuge	3	48		6	57	1
Logan Cave National Wildlife Refuge						2
Overflow National Wildlife Refuge		1			1	1
Pond Creek National Wildlife Refuge						1
White River National Wildlife Refuge		2			2	3
Florida				**4**	**4**	**1**
Florida Panther National Wildlife Refuge				2	2	
Lake Wales Ridge National Wildlife Refuge						1
National Key Deer Refuge				1	1	
Ten Thousand Islands National Wildlife Refuge				1	1	
Georgia						**1**
Savannah National Wildlife Refuge						1
Kentucky				**1**	**1**	**3**
Clarks River National Wildlife Refuge						3
Reelfoot National Wildlife Refuge				1	1	
Louisiana	**1693**	**349**	**16**	**772**	**2830**	**130**
Atchafalaya National Wildlife Refuge	9	12	2	23	46	8
Bayou Cocodrie National Wildlife Refuge				49	49	1
Bayou Sauvage National Wildlife Refuge				4	4	10
Bayou Teche National Wildlife Refuge	14	3		18	35	26
Big Branch Marsh National Wildlife Refuge				4	4	5
Black Bayou Lake National Wildlife Refuge	78			7	85	7
Bogue Chitto National Wildlife Refuge						1
Breton National Wildlife Refuge				3	3	2
Cameron Prairie National Wildlife Refuge				14	14	3

Region / State / NWRS Unit	Gas	Oil	Oil and Gas	Other	Total	Pipelines
Cat Island National Wildlife Refuge	2			3	5	
Catahoula National Wildlife Refuge	1	20		54	75	
D'Arbonne National Wildlife Refuge	183			100	283	8
Delta National Wildlife Refuge	52	214	11	86	363	14
Grand Cote National Wildlife Refuge				2	2	1
Handy Brake National Wildlife Refuge						6
Lacassine National Wildlife Refuge	32	5	1	42	80	14
Lake Ophelia National Wildlife Refuge		5		51	56	
Mandalay National Wildlife Refuge	13	5		25	43	4
Red River National Wildlife Refuge	6	24		27	57	8
Sabine National Wildlife Refuge	22	23	2	51	98	10
St. Catherine Creek National Wildlife Refuge				6	6	
Tensas River National Wildlife Refuge	1	36		75	112	
Upper Ouachita National Wildlife Refuge	1280	2		128	1410	2
Mississippi	**8**	**130**		**375**	**513**	**16**
Dahomey National Wildlife Refuge						4
Grand Bay National Wildlife Refuge				1	1	2
Holt Collier National Wildlife Refuge						1
Mississippi Sandhill Crane National Wildlife Refuge				1	1	2
Panther Swamp National Wildlife Refuge				2	2	4
St. Catherine Creek National Wildlife Refuge	8	130		370	508	
Sam D. Hamilton Noxubee National Wildlife Refuge						3
Yazoo National Wildlife Refuge				1	1	
North Carolina						**6**
Pee Dee National Wildlife Refuge						3
Pocosin Lakes National Wildlife Refuge						2
Roanoke River National Wildlife Refuge						1
South Carolina						**3**
Carolina Sandhills National Wildlife Refuge						1
Ernest F. Hollings Ace Basin National Wildlife Refuge						1
Savannah National Wildlife Refuge						1
Tennessee						**1**
Hatchie National Wildlife Refuge						1
Northeast Region (5)	**7**	**4**	**11**	**28**	**50**	**25**
Massachusetts						**2**
Assabet River National Wildlife Refuge						1
Great Meadows National Wildlife Refuge						1

Region / State / NWRS Unit	Gas	Oil	Oil and Gas	Other	Total	Pipelines
New Jersey						**6**
Cape May National Wildlife Refuge						1
Great Swamp National Wildlife Refuge						4
Wallkill River National Wildlife Refuge						1
New York				**1**	**1**	**5**
Montezuma National Wildlife Refuge				1	1	5
Pennsylvania	**2**				**2**	**8**
Erie National Wildlife Refuge	2				2	1
John Heinz National Wildlife Refuge At Tinicum						7
Virginia						**2**
Featherstone National Wildlife Refuge						1
Great Dismal Swamp National Wildlife Refuge						1
West Virginia	**5**	**4**	**11**	**27**	**47**	**2**
Canaan Valley National Wildlife Refuge	4			3	7	1
Ohio River Islands National Wildlife Refuge	1	4	11	24	40	1
Mountain - Prairie Region (6)	**42**	**37**	**2**	**41**	**122**	**60**
Colorado				**3**	**3**	**7**
Arapaho National Wildlife Refuge						1
Baca National Wildlife Refuge				2	2	
Monte Vista National Wildlife Refuge						1
Rocky Flats National Wildlife Refuge						2
Rocky Mountain Arsenal National Wildlife Refuge				1	1	3
Kansas	**1**	**25**	**1**		**27**	**9**
Flint Hills National Wildlife Refuge						7
Quivira National Wildlife Refuge	1	25	1		27	2
Montana	**40**	**9**		**34**	**83**	**4**
Benton Lake National Wildlife Refuge				2	2	
Benton Lake Wetland Management District	4			7	11	1
Bowdoin National Wildlife Refuge	1			1	2	
Bowdoin Wetland Management District	21			2	23	
Charles M. Russell National Wildlife Refuge						2
Hailstone National Wildlife Refuge				1	1	
Halfbreed Lake National Wildlife Refuge	1			4	5	
Hewitt Lake National Wildlife Refuge	13			1	14	
Lake Mason National Wildlife Refuge				2	2	
Medicine Lake National Wildlife Refuge		2		3	5	
Northeast Montana Wetland Management District		7		11	18	1
Nebraska						**6**
Rainwater Basin Wetland Management District						6

Region / State / NWRS Unit	Gas	Oil	Oil and Gas	Other	Total	Pipelines
North Dakota			**1**		**1**	**16**
Audubon Wetland Management District						2
Chase Lake Wetland Management District						2
Devils Lake Wetland Management District						5
J. Clark Salyer Wetland Management District						2
Lake Ilo National Wildlife Refuge			1		1	
Long Lake Wetland Management District						1
Sullys Hill National Game Preserve						1
Valley City Wetland Management District						3
South Dakota						**10**
Huron Wetland Management District						2
Lake Andes Wetland Management District						1
Madison Wetland Management District						4
Sand Lake Wetland Management District						2
Waubay Wetland Management District						1
Utah	**1**	**3**		**3**	**7**	**2**
Bear River Migratory Bird Refuge				3	3	1
Colorado River Wildlife Management Area	1	2			3	
Ouray National Wildlife Refuge		1			1	1
Wyoming				**1**	**1**	**6**
Bamforth National Wildlife Refuge						1
Mortenson Lake National Wildlife Refuge				1	1	1
Pathfinder National Wildlife Refuge						3
Seedskadee National Wildlife Refuge						1
Alaska Region (7)	**75**	**66**	**4**	**54**	**199**	**7**
Alaska	**75**	**66**	**4**	**54**	**199**	**7**
Alaska Peninsula National Wildlife Refuge				5	5	
Becharof National Wildlife Refuge				2	2	
Kenai National Wildlife Refuge	75	66	4	46	191	7
Yukon Delta National Wildlife Refuge				1	1	
Pacific Southwest Region (8)	**8**	**45**		**75**	**128**	**25**
California	**8**	**45**		**70**	**123**	**24**
Antioch Dunes National Wildlife Refuge						1
Bitter Creek National Wildlife Refuge				12	12	1
Butte Sink Wildlife Management Area				1	1	
Cibola National Wildlife Refuge						1
Coachella Valley National Wildlife Refuge						1
Colusa National Wildlife Refuge	1			3	4	

Region / State / NWRS Unit	Gas	Oil	Oil and Gas	Other	Total	Pipelines
Delevan National Wildlife Refuge	1			7	8	
Don Edwards San Francisco Bay National Wildlife Refuge						1
Ellicott Slough National Wildlife Refuge						1
Grasslands Wildlife Management Area				6	6	
Guadalupe-Nipomo Dunes National Wildlife Refuge		2		1	3	
Havasu National Wildlife Refuge						11
Hopper Mountain National Wildlife Refuge		17		2	19	
Humboldt Bay National Wildlife Refuge				1	1	
Kern National Wildlife Refuge				2	2	1
Merced National Wildlife Refuge				1	1	
North Central Valley Wildlife Management Area	6			22	28	
Pixley National Wildlife Refuge				1	1	1
Sacramento River National Wildlife Refuge						1
San Joaquin River National Wildlife Refuge				5	5	1
San Pablo Bay National Wildlife Refuge				1	1	
Seal Beach National Wildlife Refuge		26		4	30	1
Sutter National Wildlife Refuge						2
Tijuana Slough National Wildlife Refuge				1	1	
Nevada				**5**	**5**	**1**
Fallon National Wildlife Refuge				1	1	
Stillwater National Wildlife Refuge				4	4	1
Grand Total	**2201**	**971**	**59**	**1771**	**5002**	**595**

Appendix 2

Photographs of oil and gas exploration and production facilities on National Wildlife Refuge System fee simple lands fee simple lands (i.e., absolute title to the surface land).

Figure A2-1. Open-topped tank at oil production facility on Deep Fork NWR, OK.
P Ramirez /FWS Photo

Figure A2-2. Abandoned wellhead at Deep Fork NWR, OK. *P Ramirez /FWS Photo*

Figure A2-3. Abandoned pump jack at Deep Fork NWR, OK. *P Ramirez /FWS Photo*

Figure A2-3. Inactive well at Hagerman NWR, TX. *P Ramirez /FWS Photo*

Figure A2-4. Inactive well at Tensas River NWR, LA. *P Ramirez /FWS Photo*

Figure A2-5. Saltwater disposal well (injection well) inundated by floodwaters at St. Catherine Creek NWR, MS. *P Ramirez /FWS Photo*

Figure A2-6. Oil production facility elevated above floodplain at Catahoula NWR, LA. *P Ramirez /FWS Photo*

Figure A2-7. Two-acre well pad at Atchafalaya NWR, LA. *P Ramirez /FWS Photo*

Figure A2-8. Gas well at Delta NWR, LA. *P Ramirez /FWS Photo*

Figure A2-9. Inactive oil and gas production infrastructure at Delta NWR, LA. *P Ramirez /FWS Photo*

An Assessment of State Oil and Gas Regulations

U.S. Fish and Wildlife Service
August 2013

Introduction

State oil and gas regulations vary extensively, but can be used to limit impacts on wildlife resources, in some cases. This report summarizes State oil and gas regulations, which (if available) were analyzed for specific criteria, and compared among each state.

Several sources were accessed for this report in addition to each State agency's oil and gas regulations. These include:

1. Interstate Oil and Gas Compact Commission (IOGCC);
2. State Review of Oil and Natural Gas Environmental Regulations (STRONGER); and
3. American Petroleum Institute (API).

Methods

The data used in this research were taken primarily from each State's oil and gas regulations. This included extracting information directly from either the State's administrative code or State statute, depending on which was available or more inclusive/detailed. For some States, both the administrative code and the State statute were used to supplement each other. The administrative code includes the rules written by the State's oil and gas agency, while State statutes are produced by the State legislature. Additionally, the oil and gas regulations for the U.S. territories of Puerto Rico, Guam, U.S. Virgin Islands, Marianas Islands, and American Samoa were researched and included in the States regulations matrix. Sources for State and territory regulations are cited in the States regulations matrix.

The second major source of information was the IOGCC, which is a "multi-State government agency…that works to ensure our nation's oil and natural gas resources are conserved and maximized" (IOGCC 2013). The IOGCC produced a summary of State statutes and regulations for its 38 member States. Information was taken directly from this summary and included in the State regulations matrix in this report. The summary did not include every State or every element to be researched, so it was used in conjunction with the data taken directly from State regulations to complete the matrix.

In order to clarify in the State regulations matrix whether the data came directly from State regulations or the IOGCC summary, the citations are color-coded: citations in black are from the IOGCC summary and citations in red are from the State regulation itself. The IOGCC summary did not provide citations for some of the elements. In such instances, if the same information was found directly in the regulation, then it is cited in the matrix as being taken from the regulation (red) instead of from the IOGCC report.

The data collected from the IOGCC report and the State regulations were compiled into an excel spreadsheet (referred to in this report as the "State regulations matrix"). The spreadsheet includes 35 elements divided into 9 different categories (Table 1). These elements were chosen based on recommendations from the Service's oil and gas team and include a selection of elements from the IOGCC summary and the *Resources for the Future* report. They were determined to be the most appropriate oil and gas elements relevant for management of oil and gas. These elements were used as the foundation to evaluate State regulations by drawing comparisons, identifying similarities among States, and determining areas in which State regulations are generally lacking.

The *Resources for the Future* report was also used as a source for four of the elements included in the State regulations matrix. While this report is primarily concerned with shale gas development, several of the regulatory elements evaluated relate to oil and gas drilling. The elements taken from this report include pit liner requirements, water withdrawal regulations for hydraulic fracturing, maximum time a well can remain idle, and whether temporary well abandonment is allowed. The report examined 31 States; information for the remaining States, when available in the State regulation, was added to the matrix.

Drilling Requirements	Drilling Site Completion
License Required	Completion Requirements
Permit Required/Fees	Site Reclamation/Restoration/Remediation
Bond Purpose/Type	Reclamation Fees
Bond Amounts	Removal of Abandoned Equipment
Land Leasing Information	Maximum Time a Well Can Remain Idle[1]
Site Selection/Preparation	Temporary Well Abandonment[1]
Setback Requirements	Well Plugging Requirements
Spacing Requirements	Plugging/Abandonment Costs
Production Activities	**Noncompliance**
Oil Production	Penalty/Fees/Violations
Gas Production	Noncompliance Procedures
Pit Liner Requirements[1]	Well Shut-in from Repeated Noncompliance
Pit Use (Reserve Pits)	**Surface Owner Impacts**
Pit Closure (Reserve Pits)	Addresses Impacts to Surface Owner
Pit Use (Produced Water)	Requires Surface Owner's Permission/Notification
Pit Closure (Produced Water)	Access Fees
Oil and Gas Transportation Method	**Wildlife Impacts**
Hydraulic Fracturing	Addresses Impacts to Wildlife Resources/Wildlife Protection Requirements
Hydraulic Fracturing Requirements	**Emergency Reporting**
Water Source for Fracking Requirements	Brine Spill Reporting/Cleanup Requirements
Water Withdrawal Regulations[1]	Oil Spill Reporting/Cleanup Requirements

[1]These categories were taken from the *Resources for the Future* report (Richardson et al. 2013).

Table 1. These 35 elements were used to assess the States' regulations and are included in the State regulations matrix.

In addition to State regulations, oil and gas regulations for the Federal land management agencies within the Department of the Interior (DOI) and several other Federal agencies were examined. The DOI agencies used in this report include the Bureau of Land Management (BLM), National Park Service (NPS), Bureau of Indian Affairs (BIA), and Bureau of Reclamation (BOR). Other agencies include the Environmental Protection Agency (EPA), U.S. Geological Survey (USGS), U.S. Forest Service (USFS), and the U.S. Army Corps of Engineers (USACE). Similar to the State regulations, the Federal agencies' regulations are assembled in a matrix and include the same elements as the State regulations matrix, in addition to several others.

Finally, the State regulations were compared to the State Review of Oil and Natural Gas Environmental Regulations (STRONGER) guidelines. STRONGER is "a non-profit, multi-stakeholder organization whose purpose is to assist states in documenting the environmental regulations associated with the exploration, development and production of crude oil and natural gas" (STRONGER 2013). STRONGER has produced several versions of guidelines for State regulatory programs, and has done its own review of 22 States' regulations to determine whether they meet their guidelines. Of these

States, 10 have done follow-up reviews, which determine if they have met the recommendations made in the initial STRONGER report. When available, the follow-up reports were used in this evaluation, while the initial reviews were used for the remaining States. For this report, the State reviews were examined (Table 4), which indicate the degree to which each guideline was met (fully met/partially met/not met). The actual guidelines were not used in this evaluation; rather, the State reviews that STRONGER did were used as they have already determined if the regulations have met the guidelines. STRONGER also did reviews for six States' hydraulic fracturing regulations, which are also included in this report.

Results

Forty-three States have oil and gas regulations[1]. Most States have an oil and gas commission/minerals division, or their oil and gas activities are regulated by the State natural resources/environment department. Twenty-six States have hydraulic fracturing regulations, with 5 States currently developing regulations. The States' regulations vary greatly. Table 2 represents the number of States that have each element included in their oil and gas regulations, demonstrating the inconsistency in the regulatory elements in State oil and gas regulations.

The assessment of STRONGER guidelines revealed whether State regulations have met specific standards developed by STRONGER. Twenty-two States' regulations were compared to the guidelines (Table 4), in addition to six States' hydraulic fracturing regulations (Table 5). While not every standard was a part of all the States' regulations, this assessment gives a general idea of which regulations generally meet STRONGER guidelines. The results vary among categories (administrative, technical, abandoned sites, wildlife/environmental impacts, naturally occurring radioactive material, and stormwater management) and whether the States met the standards on a scale of 1–3 (met/partially met/not met). For a standard to have been met, either STRONGER directly Stated in their report that it was met or did not provide any recommendations; partially met standards included those that have parts that both met and did not meet STRONGER standards; and a standard was determined not to have been met if it was directly Stated by STRONGER or none of the parts to the standard had been met. For example, of the 18 States whose permitting regulations were mentioned in STRONGER's review, 4 had met the permitting standard, 7 had partially met it, and 7 had not met the standard. Refer to Table 5 for the total numbers of States that met the guidelines for each category.

[1] The States for which oil and gas regulations could not be identified include Hawaii, Maine, Massachusetts, Minnesota, New Hampshire, New Jersey, and Rhode Island. Minnesota does have a statute that allows the State natural resources department to create oil and gas regulations, and Rhode Island has a statute for oil spills, both of which are included in the States regulations matrix, but are considered in this report to not have regulations.

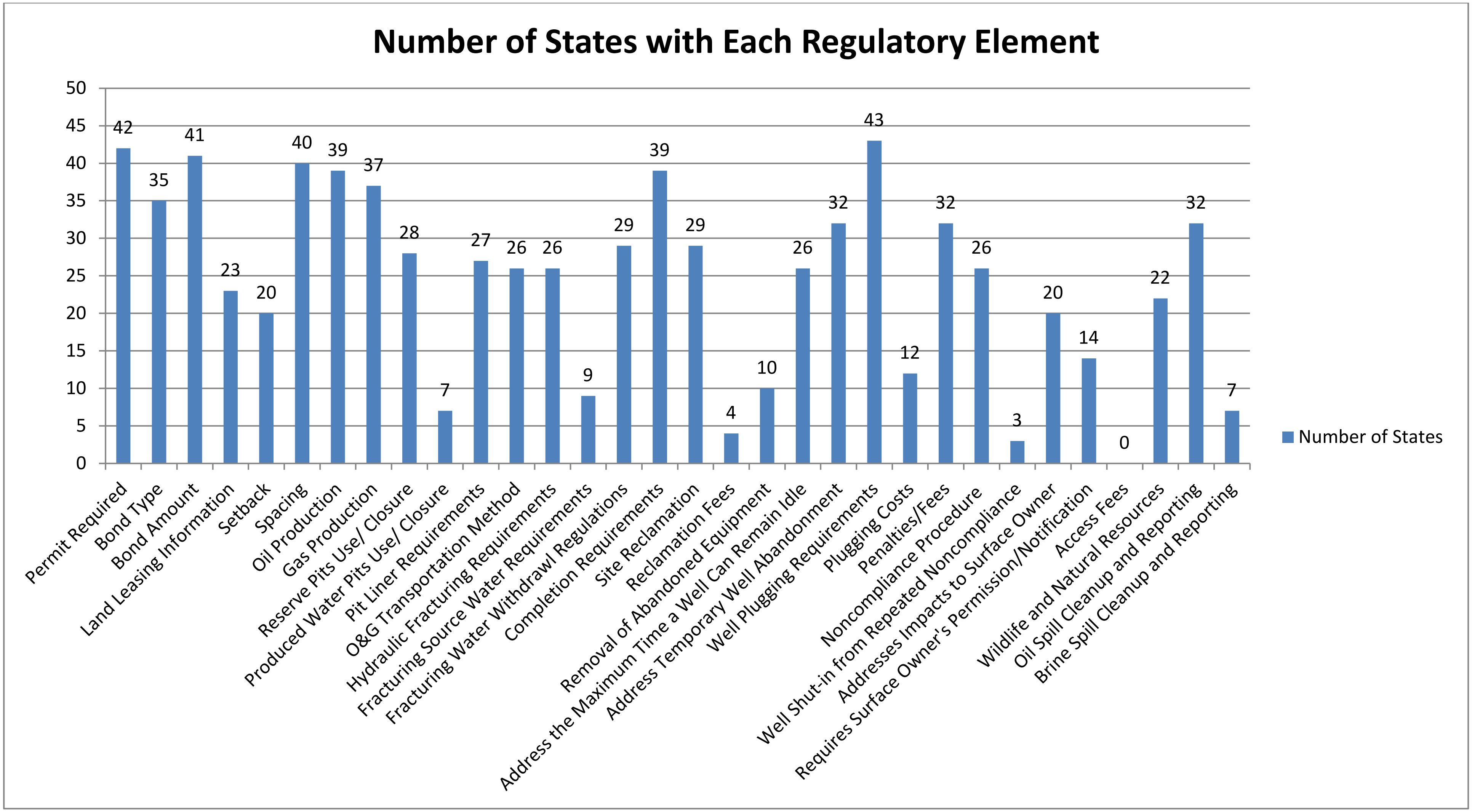

Table 2. This table shows the number of State regulations that were assessed using the 35 elements.

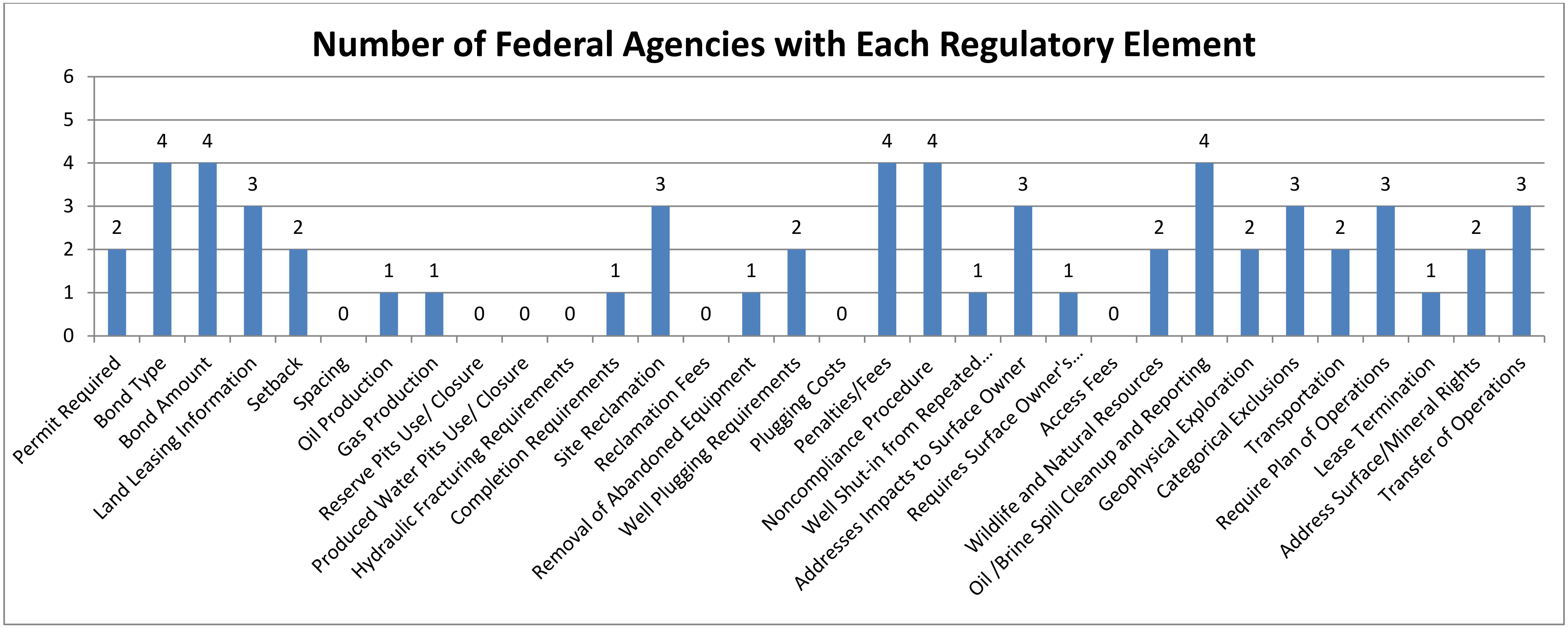

Table 3. This table shows the number of federal agency regulations that were assess for each element. The elements used for the federal agencies differ slightly from those used for the State regulations.

	Alaska	Arkansas	California	Colorado	Illinois	Indiana	Kansas	Kentucky	Louisiana	Michigan	New Mexico
Source	Alaska State Initial Review; 1992 (no follow-up review was done)	Arkansas Initial Review; 1992	CA Follow-up State Review; 2002	Colorado State Review; 1996	Illinois State Review; 1996	Indiana State Review; 2005	Kansas State Review; 1993	Kentucky State Follow-Up Review; 2006	Louisiana State Follow-up Review; 2004	Michigan Initial State Review, 2003	New Mexico Follow-up and Supplemental Review, 2001
Version of STRONGER guidelines used for comparison	1990	1990	2000	1994	1994	2000	1990	2000	2000	2000	2000
Administrative											
Permitting	3	2	1	2	2	3	2	1			1
Bond Standards	1	2	1	2	2	1	3		2		1
Bond/Surety Amounts		2	1	1		1	3				
Operating Plan Required											
Brine Spill Reporting/Cleanup Requirements											
Oil Spill Reporting/Cleanup Requirements	2	3	1	2			3	1	2		1
Noncompliance-Penalty/ Fees/Violations	3	3	3	1	3		3	3	2		3
Noncompliance Procedures	3	3		1	2	1	2				2
Requires Surface Owner's Permission/Notification								3			
Technical											
Pit Use (Reserve Pits)/standards	2	2	3	2	3	3	2	3	2	1	2
Pit Closure (Reserve Pits)	1	1	1	2		3	2	3			3
Landspreading	1	2		3	2	3	3	3	3		1
Roadspreading	1	1		3	3		3				
Burial/Landfilling		3		3	2	3	2	3			3
Site Reclamation/Restoration Requirements/Remediation											
Removal of Abandoned Equipment											
Well Plugging Requirements											2
Plugging/Abanodonment Costs			1					3			
Pollution prevention/prohibition	2										1
Waste disposal/E&P waste regulations	2	2	2	2	2		2	2		2	1
Abandoned Sites											
Abandoned Sites				3	3	1		3	3	1	1
Wildlife/Environmental Impacts											
Addresses Impacts to Wildlife Resources/Wildlife Protection Requirements	3	2						3	3		
General environmental impacs	1			2				1	1	1	3
Nautrally Occurring Radioactive Material											
Nautrally Occurring Radioactive Material	3		2		2	1		3	1	2	1
Stormwater Management											
Stormwater Management								2			

	New York	North Carolina	North Dakota	Ohio	Oklahoma	Pennsylvania	Tennessee	Texas	Virginia	West Virginia	Wyoming
Source	New York State Initial Review, 1994	North Carolina State Review, 2012	North Dakota Initial State Review, 1997	Ohio Follow-up and Supplemental Review, 2005	Oklahoma Follow-up and Supplemental Review, 2005	Pennsylvania Follow-up State Review, 2004	Tennessee Initial State Review, 2007	Texas State Review Follow Up, 2003	Viriginia Initial State Review, 2004	West Virginia Follow-Up State Review; 2003	Wyoming Follow-up State Review, 1994
Version of STRONGER guidelines used for comparison	1990	2010	1994	2000	2000	2000	2000	2000	2000	2000	1994
Administrative											
Permitting	3	2	3	1	3		2	3	3	2	
Bond Standards	3			2	2			1			1
Bond/Surety Amounts		2	1				2	1			
Operating Plan Required								2			
Brine Spill Reporting/Cleanup Requirements				1			3				
Oil Spill Reporting/Cleanup Requirements	1	2	2	2	1			3	2	1	1
Noncompliance-Penalty/ Fees/Violations	2		3	1	1		3	1	3		3
Noncompliance Procedures	1				3		3		1	1	2
Requires Surface Owner's Permission/Notification					1			3			
Technical											
Pit Use (Reserve Pits)/standards	2	3	2	1	1	2	2	3	1	1	1
Pit Closure (Reserve Pits)	2				1			3	2		1
Landspreading	2	2	3		3			2	2	1	
Roadspreading	3		3		2			3	2	1	
Burial/Landfilling	1	3						3		1	
Site Reclamation/Restoration Requirements/Remediation			3		1				1		
Removal of Abandoned Equipment					1						
Well Plugging Requirements											
Plugging/Abanodonment Costs											
Pollution prevention/prohibition								1			
Waste disposal/E&P waste regulations	3	2		1	2		3	1	1	3	3
Abandoned Sites											
Abandoned Sites		3		1	2	2	2	2	3	2	
Wildlife/Environmental Impacts											
Addresses Impacts to Wildlife Resources/Wildlife Protection Requirements					3						
General environmental impacs	3				2		3			1	
Nautrally Occurring Radioactive Material											
Nautrally Occurring Radioactive Material	3	3	2	3	3	1	3	2	2	3	
Stormwater Management											
Stormwater Management		2					1		1		

Table 4 (page 7&8). This table (divided into two parts) illustrates which States have met STRONGER oil and gas standards. The values 1–3 indicate the degree to which the regulation has met STRONGER standards:

1= The standard was determined to be met through initial review, and no recommendation was needed

2= At least one standard was met for a category (some categories have multiple regulations, some of the regulations might not meet the standard)

3= None of the standards were met for a category, or it was expressly Stated that the standard has not yet been met

	Arkansas	Colorado	Louisiana	Ohio	Oklahoma	Pennsylvania
Source	Arkansas Hydraulic Fracturing Review, 2012	Colorado Hydraulic Fracturing State Review, 2011	Louisiana Hydraulic Fracturing State Review, 2011	Ohio Hydraulic Fracturing State Review, 2011	Oklahoma Hydraulic Fracturing State Review, 2011	Pennsylvania Hydraulic Fracturing State Review, 2010
Version of STRONGER guidelines used for comparison	2010	2010	2010	2010	2010	2010
Standards						
Depth to surface casing		3	2			
Inventory well site chemicals/provide to gov't officials		1				
Cememt used in well construction			3			
Reporting						
Public disclosure of chemicals used in fracturing	1					
Notification prior to fracturing	3	2	1	1	1	3
Report well completion		2		1	2	
Public Information						
Provide information to public via website	1	2	1	1	1	1
Maintain database of complaints	3		1			2
Water/Waste Management						
Gather information used to protect streams/water quality testing	1					2
Manage the potential risk of induced/triggered seismicity	1					
Evaluation of NORM in hydraulic fracturing wastes		3		2		
Recycling of flowback water				1	1	
Use surface water for fracturing			1	2		

Table 5. This table represents which States have met, partially met, or not met STRONGER *hydraulic fracturing* guidelines.

1= The standard was determined to be met through initial review, and no recommendation was needed
2= At least one standard was met for a category (some categories have multiple regulations, some of the regulations might not meet the standard)
3= None of the standards were met for a category, or it was expressly Stated that the standard has not yet been met

Number of States- Oil and Gas Regulations			
	The standard has been met (#1)	The standard has been partially met (#2)	The standard has NOT been met (#3)
Administrative			
Permitting	4	7	7
Bond Standards	6	6	2
Bond/Surety Amounts	5	3	1
Operating Plan Required	-	1	-
Brine Spill Reporting/Cleanup Requirements	1	-	1
Oil Spill Reporting/Cleanup Requirements	7	7	3
Noncompliance-Penalty/ Fees/Violations	4	2	11
Noncompliance Procedures	5	4	4
Requires Surface Owner's Permission/Notification	1	-	2
Technical			
Pit Use (Reserve Pits)/standards	6	10	6
Pit Closure (Reserve Pits)	5	4	4
Landspreading	3	6	7
Roadspreading	3	2	6
Burial/Landfilling	2	2	7
Site Reclamation Requirements	2	-	1
Removal of Abandoned Equipment	1	-	-
Well Plugging Requirements	-	1	-
Plugging/Abandonment Costs	1	-	1
Pollution prevention/prohibition	2	1	-
Waste disposal/E&P waste regulations	4	10	4
Abandoned Sites			
Abandoned Sites	3	5	6
Wildlife/Environmental Impacts			
Addresses Impacts to Wildlife	-	1	4
General environmental impacts	5	2	3
Naturally Occurring Radioactive Material			
Naturally Occurring Radioactive Material	4	6	8
Stormwater Management			
Stormwater Management	2	2	-

Table 6. This table shows the number of States that have regulations for the given categories, and whose regulations meet the STRONGER standards. This analysis is based on a review of the State initial and follow-up review reports that STRONGER conducted on each of the States' oil and gas regulations. For example, only five

States had regulations relating to impacts to wildlife, only one of which had only partially met STRONGER standards.

Number of States- Hydraulic Fracturing Regulations			
	The standard has been met (#1)	The standard has been partially met (#2)	The standard has NOT been met (#3)
Standards			
Depth to surface casing		1	1
Inventory well site chemicals/provide to gov't officials	1		
Cememt used in well construction			1
Reporting			
Public disclosure of chemicals used in fracturing	1		
Notification prior to fracturing	3	1	2
Report well completion	1	2	
Public Information			
Provide information to public via website	5	1	
Maintain database of complaints	1	1	1
Water/Waste Management			
Gather information used to protect streams/water quality testing	1	1	
Manage the potential risk of induced/triggered seismicity	1		
Evaluation of NORM in hydraulic fracturing wastes		1	1
Recycling of flowback water	2		
Use surface water for fracturing	1	1	

Table 7. This table shows the number of States that have regulations for the given categories, and whose regulations meet the STRONGER standards. This analysis is based on a review of the State initial and follow-up review reports that STRONGER conducted on six States' hydraulic fracturing regulations. For example, five States provide information to the public via their website, meeting STRONGER standards, while one State has partially met that standard.

The bond type and amount was researched for each State's oil and gas regulation, in addition to three federal agencies for which bond amounts were found. The bond is important financial assurance for both the oil and gas operator and the surface owner. Table 8 shows the bond types and amounts for each State and NPS, BLM, and BIA.

	Type of Bond								Other Financial Assurances		
State/Agency	Single Well Bond ($)	Blanket Bond ($)	Performance	Surety, Indemnity, Compliance	Plugging	Restoration	Personal	Collateral Bond	Letter of Credit	Certificate of Deposit	Cash
Alabama[1]	5,000-50,000	100,000		X							
Alaska	>100,000	>200,000		X			X		X	X	
Arizona	10,000-20,000	25,000-250,000	X	X	X					X	
Arkansas	3,000	25,000-100,000		X					X	X	X
California	15,000 - 30,000	100,000 - 1 million		X	X						
Colorado	10,000-20,000	60,000-100,000			X	X					
Connecticut	25,000		X	X							
Delaware											
Florida	50,000-100,000	1 million		X	X				X		
Georgia	10,000-40,000	50,000		X							
Hawaii											
Idaho[7]	10,000	50,000-150,000		X							
Illinois[8–9]	1,500-3,000	25,000-100,000			X	X			X	X	
Indiana	2,500	45,000			X	X				X	X
Iowa	15,000	30,000									
Kansas	$0.75x well	15,000-45,000	X						X		
Kentucky	500-5,000	10,000-100,000							X	X	X
Louisiana[6]	1.00-3.00/ft	25,000-250,000	X						X		
Maine											
Maryland	100,000 max	500,000 max		X					X	X	X
Massachusetts											
Michigan	10,000 - 30,000	100,000 - 250,000		X					X	X	X
Minnesota											
Mississippi	10,000	100,000		X	X						
Missouri	1,000-5,000	20,000-30,000		X			X			X	
Montana	1,500-10,000	50,000		X	X	X			X	X	
Nebraska	10,000	25,000		X	10,000					X	X
Nevada	10,000	50,000		X	X						
New Hampshire											
New Jersey											
New Mexico	10,000	50,000		X	X				X		
New York	2,500-5,000	2,500-150,000		X			X				
North Carolina	500-5,000	500,000									
North Dakota	50,000	100,000		X	X	X					
Ohio	5,000	15,000	X	X					X	X	X
Oklahoma[5]	25,000	25,000	X						X	X	X
Oregon	25,000-50,000	150,000									
Pennsylvania	2,500	25,000		X				equal to surety bond amount	X	X	
Rhode Island											
South Carolina[3]	20,000-50,000	100,000	X								
South Dakota	10,000-50,000	30,000-100,000			X	X					
Tennessee	2,000-3,000	20,000-30,000		X		1,500/well			X	X	X
Texas[2]	25,000	50,000-250,000	X	X					X		X
Utah	1,500-60,000	15,000-120,000		X				X	X		
Vermont			X								
Virginia	10,000	25,000-100,000		X						X	
Washington	50,000	250,000		X					X	X	X
West Virginia	5,000-50,000	50,000-250,000	X	X				X			X
Wisconsin	50,000			X							
Wyoming[4 – 7]	10,000-20,000	75,000		X					X	X	
NPS	up to 200,000		X						X		X
BLM	$10,000	25,000 (statewide) 50,000(nationwide)							X	X	X
BIA	75,000	150,000		X			X				

Table 8. State and Federal agencies' bond types and amounts.

[1]Alabama also requires a $2,000 bond for wells used for fresh water

[2]Texas also requires a bond for bay wells for $60,000 plus the regular bond amount

[3]South Carolina also requires a bond for drilling an underground injection well

[4]Wyoming also requires a bond for produced water/pit performance

[5]Oklahoma also requires a $50,000 bond for the land application of deleterious substances

[6]Louisiana also requires a $125,000–$1.25 million bond for water wells (inland lakes/bays)

[7]Idaho and Wyoming also require a bond for an inactive/idle well ($10,000 and $10.00/ft. (depth), respectively)

[8]Illinois also requires a $10,000 bond for operating a Liquid Oilfield Waste Transportation System

[9]Illinois also requires a $2,500–25,000 bond for drilling a test hole

Table 9 shows a sample of violation types and associated fees. This table does not include every violation for all of the States. The violations here include many of those in the State regulations matrix. Most States have a long list of violations, some with appendices devoted to the violations. Therefore, the violations included here and in the State regulations matrix are only a sample and not all-inclusive. The goal of this table is to demonstrate the variation among the States in the amount of fees required for each type of violation.

Violation Type	Fees
Violation of Permit	$100,000
	$10,000
	$5,000
	$2,000
	$1000 (2)
Violation of any O&G Regulation	$25,000
	$10,000 (6)
	$5,000
	$4,000
	$1,000 (4)
	$500
Operating Violation	$2,500
	$100-2,500
Sell illegal O&G	$12,500
Purposely Waste Gas	$1,000
Administrative Violation	$50-500
Discharge oil into environment	$25,000
Damage to water/wildlife	$1,000 (2)
Falsify Records	$1,000
	$5,000
Failure to Plug Well	$15,000
	$1,000 (3)
Drilling and/or fracking without permit	$25,000
	$1,000
Violating Reclamation Procedure	$15,000
Failure to Remove Equipment	$1,000
	$10,000

Table 9. This table includes a sampling of violations and associated fees. The numbers in parentheses indicate the number of States with that fee amount.

Enforcement Background Research

Earthworks, a nonprofit organization that seeks to protect people from the impacts of oil and gas drilling and change State drilling regulations by working with STRONGER, produced a report on six States' enforcement policies. The States are Colorado, New Mexico, New York, Ohio, Pennsylvania, and Texas. The report found that these States' enforcement policies are not always carried out, and that some of the main factors inhibiting proper enforcement include budgets, not having enough staff, and that other aspects of drilling, such as permitting, generally receive more resources than enforcement (Earthworks 2012).

Earthworks' report describes all of the States' inspection capacities as "egregiously lacking." All of the States have a large number of wells that are not inspected each year. For example, in Pennsylvania in 2010, 91 percent of the State's active wells had not been inspected. None of the States require periodic inspection of wells. Additionally, the States have been slow to respond to oil and gas complaints from citizens and follow up with them. For all the States, it was found that it is often very difficult for a State oil and gas agency to get drilling companies to come into compliance, and that the same rules are often violated. The penalty fees are generally too low to deter operators from noncompliance, and many of the States have outdated penalty schedules. Earthworks believe that the States' lack of strong enforcement has created a feeling of betrayal among the public, and that the public's confidence in the States' ability to regulate oil and gas drilling is low (Earthworks 2012).

Table 10. Questions that should be addressed in the State regulations.

The Service oil and gas team recommended several questions to extract relevant information from each State's regulations. The questions and answers (in yes/no form) are shown in Tables 11 and 12. For a few of the questions, answers were taken directly from information in the State regulations matrix. To answer the remaining questions, the State regulations had to be searched again for the specific information.

	Total Number of States
Requires mitigation for any surface disturbance and lost use of the surface?	28
Allow use of open pits (Reserve Pits, Mud Pits, etc.) for any phase of operations?	28
Prescribe operating standards specifically to geophysical, drilling and production, construction, operation, or abandonment of a pipeline, reclamation/restoration? (oil and gas production/reclamation)	41
Require operators to submit a plan of operations for proposals to drill/produce a well? (mostly required to obtain drilling permits, usually a plat)	29
Require operators to provide financial assurance to the State? (*bond/surety)*	42
Adjust operators' financial assurance if their plans or permits are revised?	5
Prescribe when will the State release an operators' financial assurance?	28
Describe what the previous operator's responsibilities are after transfer of operations?	21
Describe what the new operator must do after a transfer of operations?	24
Describe what an operator must do if they acquire operations that do not have an approved permit?	0
Describe what operators do if they want to temporarily suspend operations? (temprary abandonment)	16
Describe plugging/abandoning procedures/ who is responsible for well plugging and abandonment?	43
Describe under what conditions will the State require operators to plug and abandon a well? (well plugging requirements)	43
Describe how operators get an exception to a plugging determination?	5
Describe what will the State do if operators fail to comply with regulations? (includes penalties/violation fees)	37
Describe when the State can require an operator to suspend their operation?	9
Describe when the State can revoke an operator's permit?	27
Describe what assessments may an operator be subject to if they commit one or more of the prohibited acts? (penalties/fees)	32
Describe if an operator can obtain a permit if they are in or have been in violation of State regulations or in violation of a permit?	2

	Alabama	Alaska	Arizona	Arkansas	California	Colorado	Connecticut	Delaware	Florida	Georgia	Hawaii	Idaho	Illinois	Indiana	Iowa	Kansas	Kentucky	Louisiana	Maine	Maryland	Massachusetts	Michigan	Minnesota	Mississippi	Missouri
Requires mitigation for any surface disturbance and lost use of the surface?	yes	no	no	yes	no	yes	no	no	yes	no		yes	yes	yes	no	yes	yes	yes		yes		yes		no	no
Allow use of open pits (Reserve Pits, Mud Pits, etc.) for any phase of operations?	yes	yes	yes	yes	no	yes	no	no	no	yes		yes	yes	no	no	yes	no	yes		no		yes		yes	no
Prescribe operating standards specifically to geophysical, drilling and production, construction, operation, or abandonment of a pipeline, reclamation/restoration? (oil and gas production/reclamation)	yes	yes	yes	yes	yes	yes	yes	yes	yes	no		yes	yes	yes	no	yes	yes	yes		yes		yes		yes	yes
Require operators to submit a plan of operations for proposals to drill/produce a well? (mostly required to obtain drilling permits, usually a plat)	yes	yes	yes	yes	yes	yes	yes	no	yes	yes		yes	yes	no	yes	no	yes	yes		yes		yes		no	yes
Require operators to provide financial assurance to the State? *(bond/surety)*	yes	yes	yes	yes	yes	yes	yes	no	yes	yes		yes	yes	yes	yes	yes	yes	yes		yes		yes		yes	yes
Adjust operators' financial assurance if their plans or permits are revised?	no	no	yes	no	no	no	no	no	no	no		yes	no	no	no	no	no	no		no		no		no	no
Prescribe when will the State release an operators' financial assurance?	yes	yes	no	yes	yes	no	no	no	no	no		yes	yes	yes	yes	no	yes	yes		yes		yes		no	yes
Describe what the previous operator's responsibilities are after transfer of operations?	yes	no	no	no	no	no	no	no	no	no		yes	yes	no	yes	yes	no	yes		yes		no		yes	no
Describe what the new operator must do after a transfer of operations?	yes	yes	no	yes	no	no	no	no	no	yes		yes	yes	no	yes	yes	no	yes		yes		no		yes	no
Describe what an operator must do if they acquire operations that do not have an approved permit?	no	no	no	no	no	no	no	no	no	no		no	no	no	no	no	no	no		no		no		no	no
Describe what operators do if they want to temporarily suspend operations? (temprary abandonment)	yes	yes	yes	yes	no	yes	no	no	no	no		no	yes	yes	no	no	no	yes		no		yes		no	no
Describe plugging/abandoning procedures/ who is responsible for well plugging and abandonment?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		yes	yes	yes	yes	yes	yes	yes		yes		yes		yes	yes
Describe under what conditions will the State require operators to plug and abandon a well? (well plugging requirements)	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes		yes	yes	yes	yes	yes	yes	yes		yes		yes		yes	yes
Describe how operators get an exception to a plugging determination?	no	no	no	no	no	no	no	no	no	no		no	no	yes	no	no	no	yes		no		yes		no	no
Describe what will the State do if operators fail to comply with regulations? (includes penalties/violation fees)	yes	yes	no	yes	yes	yes	no	no	yes	yes		yes	yes	yes	no	yes	yes	yes		yes		yes		yes	yes
Describe when the State can require an operator to suspend their operation?	yes	yes	no	no	no	no	no	no	no	no		no	yes	no	no	no	no	no		no		yes		no	no
Describe when the State can revoke an operator's permit?	yes	yes	no	yes	no	yes	no	no	no	yes		no	yes	yes	no	no	no	yes		yes		yes		yes	yes
Describe what assessments may an operator be subject to if they commit one or more of the prohibited acts? (penalties/fees)	yes	yes	no	yes	yes	yes	no	no	yes	yes		yes	yes	yes	no	yes	yes	yes		yes		yes		yes	yes
Describe if an operator can obtain a permit if they are in or have been in violation of State regulations or in violation of a permit?	no	no	no	no	no	no	no	no	no	no		no	no	yes	no	no	no	no		no		no		no	no

Table 11. This table indicates the first 25 States and whether their regulations address the 19 questions listed on the left.

	Montana	Nebraska	Nevada	New Hampshire	New Jersey	New Mexico	New York	North Carolina	North Dakota	Ohio	Oklahoma	Oregon	Pennsylvania	Rhode Island	South Carolina	South Dakota	Tennessee	Texas	Utah	Vermont	Virginia	Washington	West Virginia	Wisconsin	Wyoming
Require mitigation for any surface disturbance and lost use of the surface?	yes	yes	yes	no	no	yes	no	yes	yes	yes	yes	yes	yes	no	no	no	yes	no	yes	no	yes	yes	yes	no	yes
Allow use of open pits (Reserve Pits, Mud Pits, etc.) for any phase of operations?	yes	yes	yes	no	no	yes	no	no	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	no	yes	yes	no	no	yes
Prescribe operating standards specifically to geophysical, drilling and production, construction, operation, or abandonment of a pipeline, reclamation/restoration? (oil and gas production/reclamation)	yes	yes	yes	no	no	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Require operators to submit a plan of operations for proposals to drill/produce a well? (mostly required to obtain drilling permits, usually a plat)	no	no	no	no	no	no	yes	no	yes	yes	yes	no	no	no	yes	yes	yes	yes	no	yes	no	yes	yes	no	yes
Require operators to provide financial assurance to the State? *(bond/surety)*	yes	yes	yes	no	no	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Adjust operators' financial assurance if their plans or permits are revised?	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	yes	no
Prescribe when will the State release an operators' financial assurance?	no	yes	yes	no	no	yes	yes	no	yes	yes	yes	yes	yes	no	yes	no	no	no	yes	no	no	yes	yes	yes	yes
Describe what are the previous operator's responsibilities after transfer of operations?	yes	no	yes	no	no	yes	no	no	yes	yes	yes	yes	yes	no	yes	yes	no	no	no	no	no	yes	yes	no	yes
Describe what must the new operator do after a transfer of operations?	no	yes	yes	no	no	yes	no	no	yes	yes	yes	yes	yes	no	yes	yes	no	no	no	no	no	yes	yes	no	yes
Describe what an operator must do if they acquire operations that do not have an approved permit?	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
Describe what operators do if they want to temporarily suspend operations? (temprary abandonment)	no	no	no	no	no	yes	yes	no	yes	no	no	no	no	no	no	no	yes	no	yes	no	no	no	no	yes	yes
Describe plugging/abandoning procedures/ who is responsible for well plugging and abandonment?	yes	yes	yes	no	no	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Describe under what conditions will the State require operators to plug and abandon a well? (well plugging requirements)	yes	yes	yes	no	no	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Describe how operators get an exception to a plugging determination?	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	yes	no	no	no	no	no	no	no
Describe what will the State do if operators fail to comply with regulations? (includes penalties/violation fees)	no	yes	yes	no	no	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes
Describe when can the State require an operator to suspend their operation?	no	no	yes	no	no	yes	no	no	no	no	no	yes	no	no	no	no	no	no	yes	no	no	yes	no	no	no
Describe when the State can revoke an operator's permit?	no	no	no	no	no	no	no	no	yes	yes	yes	yes	no	no	yes	no	no	no	yes	no	yes	yes	yes	yes	yes
Describe what assessments may an operator be subject to if they commit one or more of the prohibited acts? (penalties/fees)	no	yes	yes	no	no	no	yes	yes	yes	yes	yes	no	no	yes	no	yes	yes	yes	no	yes	yes	no	yes	yes	no
Describe if an operator can obtain a permit if they are in or have been in violation of State regulations or in violation of a permit?	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no

Table 12. This table indicates the remaining 25 States and whether their regulations address the 19 questions listed on the left.

Discussion

U.S. Territories and Federal Agency Regulations

In addition to the State oil and gas regulations, the regulations for U.S. territories and several Federal agencies were researched and included in the State regulations matrix. No regulations could be found for the Northern Marianas, while only water well regulations were found for both Guam and American Samoa. Puerto Rico and the U.S. Virgin Islands have some regulations, although they are not extensive. There are oil spill regulations for Puerto Rico, Guam, and the U.S. Virgin Islands.

Eight Federal agencies' regulations were researched. BLM, NPS, BIA, USFS, and BOR all have regulations related to oil and gas drilling. EPA has oil spill regulations; there were no relevant regulations found for USGS. The Army Corps of Engineers has regulations, which were not available in time to complete this analysis.

Bond Requirements

There was extensive variation among the States in the bond amounts required for drilling activities. The majority of States required a surety/compliance bond to ensure operators comply with drilling regulations. This type of bond was usually the first bond mentioned in the regulations, as it was often one of the requirements for operators to begin oil and gas operations. Almost all States with bonding requirements stated amounts for both individual well bonds and blanket bonds. Other common forms of bonds that were either required in addition to surety bonds, or as the main type of bond, were plugging and restoration bonds. Other types of financial assurances required by most States, in addition to a bond, include a letter of credit, certificate of deposit, or cash assurance. In order to show the differences in bond amounts, a table was created which summarizes the range of bond amounts and the number of States that fall into each range (Table 13).

There are three categories for bond amounts for both individual and blanket bonds (low, medium, high). For both bond types, there are overwhelmingly more States that have bonds with medium-range amounts. For individual well bonds, the majority of States required bonds between $10,000 and $50,000 (with exceptions), while the majority of blanket bonds fall into the $25,000 to $100,000 range (with exceptions). Because blanket bonds include multiple wells, they are generally much more expensive, as much as $1 million. The highest individual well bond is $100,000. It is surprising that several States have very large ranges for individual bond amounts (e.g., Utah $1,500–$60,000, Alaska <$100,000), implying that bonds may be set on a case- by-case basis. The blanket bond ranges are also generally large; however, the amount depends on the number of wells included in the bond.

The States with the lowest individual well bonding requirements include Kentucky, with a minimum of $500, and Missouri, with a minimum of $1,000. The highest bond amounts for individual well bonds include Florida and Alaska, both of which have $100,000 maximum amounts. Likewise, the States with the lowest blanket bond requirements include New York ($2,500) and Kentucky ($10,000). States with the highest blanket bonds include Florida and California, both at $1 million. Kentucky has the lowest bonding requirements of any State, while Florida has the highest (both individual and blanket bonds).

Questions to consider further:

1. Do high or low bond amounts correlate with the level of stringency in State oil and gas regulations?
2. What other factors would influence high or low bonding requirements (i.e., cost of living, land values, number of operators statewide)?

Summary of General Drilling Bond Amounts			
	Amount Range ($)	**Number of States**	**Exceptions**
Individual Well Bond[1]	500–9,999	14	Includes: Montana ($1,500–10,000) Utah ($1,500–60,000) Alabama ($5,000–50,000) West Virginia ($5,000–50,000)
	10,000–50,000	26	Includes: Utah ($1,500–60,000) Alabama ($5,000–50,000) West Virginia ($5,000–50,000)
	Less than 100,000	3	Includes: Florida ($50,000–100,000)
Blanket Bond	2,500–25,000	10	Includes: Kansas ($15,000–45,000) Kentucky ($10,000–100,000) New York ($2,500–150,000) Utah ($15,000–120,000)
	25,000–100,000	25	Includes: Kansas ($15,000–45,000) Kentucky ($10,000–100,000) New York ($2,500–150,000) Utah ($15,000–120,000) Arizona ($25,000–250,000) Idaho ($50,000–150,000) Louisiana ($25,000–250,000) Texas ($50,000–250,000) West Virginia (50,000–250,000)
	Greater than 100,000	15	Includes: New York ($2,500–150,000) Utah ($15,000–120,000) Arizona ($25,000–250,000) Idaho ($50,000–150,000) Louisiana ($25,000–250,000) Texas ($50,000–250,000) West Virginia ($50,000–250,000)

Table 13. Because of the variation in the range of bond amounts, it was difficult to divide the amounts into clean categories in which every State would fit. Therefore, some States are included more than once because they fit into multiple categories, and are noted as exceptions in the right hand column.

[1]Two States (Kansas and Louisiana) do not have fixed bond amounts and instead measure the amount by foot. These States are not included in the table for the individual well bond.

STRONGER Interpretation

STRONGER has reviewed 22 States' oil and gas regulations, which represents 94 percent of oil and gas production in the United States. Therefore, the States reviewed are generally representative of oil and gas operations in the U.S. Approximately 76 percent of STONGER's recommendations for States' regulations have been implemented, indicating progress and responsiveness on the part of the States (STRONGER 2013). The STRONGER analysis in this report is based on the State reviews that STRONGER conducted, and is therefore not based on this report's reported review of how each State's regulations compare to the STRONGER guidelines. The review of every State did not always include the same elements. Because STRONGER produced several versions of their guidelines, the State review reports varied as to what was included in them. Therefore, not all of the States had the same main elements included in their State review reports.

To summarize the six categories used for State oil and gas regulations (administrative, technical, abandoned sites, wildlife/environmental impacts, naturally occurring radioactive material, and stormwater management), the percentage of States which had either met, partially met, or not met the standards within the six categories was determined (Table 14). For the administrative and technical categories, percentages were generally fairly even on the spectrum of meeting to not meeting the standards. However, many States did not meet the wildlife/environmental impacts or the naturally occurring radioactive material standards. Overall, none of the standards have been completely met for every State.

Based on Table 3, which gives an overview of the standards each State met or did not meet, some conclusions can be drawn that show which States might have more lenient regulations or regulations that are not comprehensive enough when compared to STRONGER's standards. It is important to keep in mind, however, that in some instances the State was developing a specific regulation at the time of the STRONGER review, so at that time that standard would not have been met. Some of the States that stood out as not meeting many of STRONGER's standards include Illinois, Kentucky, North Dakota, and Tennessee. For instance, Kentucky did not meet 10 of the standards; it only met 3 standards. Similarly, Illinois did not fully meet any of the standards. On the other hand, there were several States that did meet many of the standards. For example, of the categories found in each State's regulations, both New Mexico and West Virginia met the majority of STRONGER standards.

Table 14. Percentages of States whose oil and gas regulations either met, partially met, or did not meet STRONGER guidelines for each category.

	The standard has been met (#1)	The standard has been partially met (#2)	The standard has NOT been met (#3)
Administrative	35	32	33
Technical	29	36	36
Abandoned Sites	21	36	43
Wildlife/Environmental Impacts	33	20	47
Naturally Occurring Radioactive Material	22	33	44
Stormwater Management	50	50	-

STRONGER also reviewed six State's hydraulic fracturing regulations to see if they met their 2010 guidelines (STRONGER is currently revising and updating the hydraulic fracturing guidelines). Four categories were used (standards, reporting, public information, and water/waste management). The same review was completed for hydraulic fracturing regulations as for oil and gas regulations, and the percentages of States that met the standards within each category were determined. The majority of States (although not by much) had met the standards for public information and water/waste management, while half of the States had not met the standards requirements.

Table 5 presents an overview of the standards each State met or did not meet for hydraulic fracturing, and some conclusions can be drawn that show which States might have more lenient regulations or regulations that are not comprehensive when compared to STRONGER's standards. Overall, the hydraulic fracturing regulations for all six States largely met STRONGER standards. For Ohio and Oklahoma, all of their regulations either fully or partially met STRONGER standards, while Arkansas, Louisiana, and Pennsylvania each had only one regulation that was not up to standard.

After conducting a search of the most stringent hydraulic fracturing regulations in the country, Illinois's newly created regulation (June 2013) appears to be the strictest of all the States. Illinois's regulation has the best protection against water pollution from fracking activities, including the requirement of closed tanks to store wastewater. It also has the strictest chemical disclosure policy in the country, requiring chemical disclosure before and after fracking (Environmental Law and Policy Center 2013).

Table 15. Percentage of States whose hydraulic fracturing regulations either met, partially met, or did not meet STRONGER guidelines for each category.

	The standard has been met (%)	The standard has been partially met (%)	The standard has NOT been met (%)
Standards	**25**	**25**	**50**
Reporting	**50**	**30**	**20**
Public Information	**67**	**22**	**11**
Water/Waste Management	**56**	**33**	**11**

The review of State oil and gas/hydraulic fracturing regulations by STRONGER is valuable because it offers an outside/unbiased analysis of State regulations. However, very few States have volunteered to have STRONGER review their regulations, therefore lessening the validity of STRONGER reviews (Gilmer 2012). API has said it "supports and works closely with" STRONGER and other organizations such as FracFocus.org (Porter 2012).

Questions to further consider:

1. How do State regulations compare to API standards (which must be purchased)?
2. Most of the State reviews that STRONGER did are outdated (from the 1990's/early 2000's). How would the State regulations compare to STRONGER's 2013 standards?

Regional Comparison

In addition to the data on the State regulations, the oil and gas regulations were examined at the regional level. In order to show the presence of the 35 elements in State regulations by region, the percentage of States per region that regulate each element was determined (Table 1 in appendix). This information might be useful for interpreting which States/regions have the strictest regulations and which States are most lenient based on which elements are included in the regulations.

The regions that consistently had the highest percentages of the regulatory elements included were regions 2, 3, 6, and 7. The elements under the "drilling requirements" and "production activities" categories were included the most in State regulations. Regions 2, 3, 7, and 8 had the highest percentages of States that have each drilling regulation, and regions 2, 3, 4, and 6 have the most production activity regulations.

One-hundred percent of States in regions 2, 4, 6, 7, and 8 have well spacing requirements. All States in region 6 have oil spill reporting and site reclamation requirements, the highest of all regions. There is no region where all States have regulations for surface owner impacts or address impacts to wildlife. These two categories seem to be the most lacking across all States.

Two of the regulatory elements were chosen to show their inclusion in State regulations regionally. Hydraulic fracturing regulations and impacts to wildlife were used to show the number of States in each region that have addressed both elements in their oil and gas regulations. Chart 1 indicates that all States within region 6 have hydraulic fracturing requirements or address it, while there are only three

States in region 5. Hydraulic fracturing occurs more in some regions, so geography is important to consider when looking at the fracking regulations. Chart 2 shows that of all the regions, regions 2 and 6 have the most States with regulations that address impacts to wildlife from oil and gas drilling. Based on this and some of the other elements mentioned above, regions 2 and 6 seem to regulate the most of all the elements (35 total) included in this assessment.

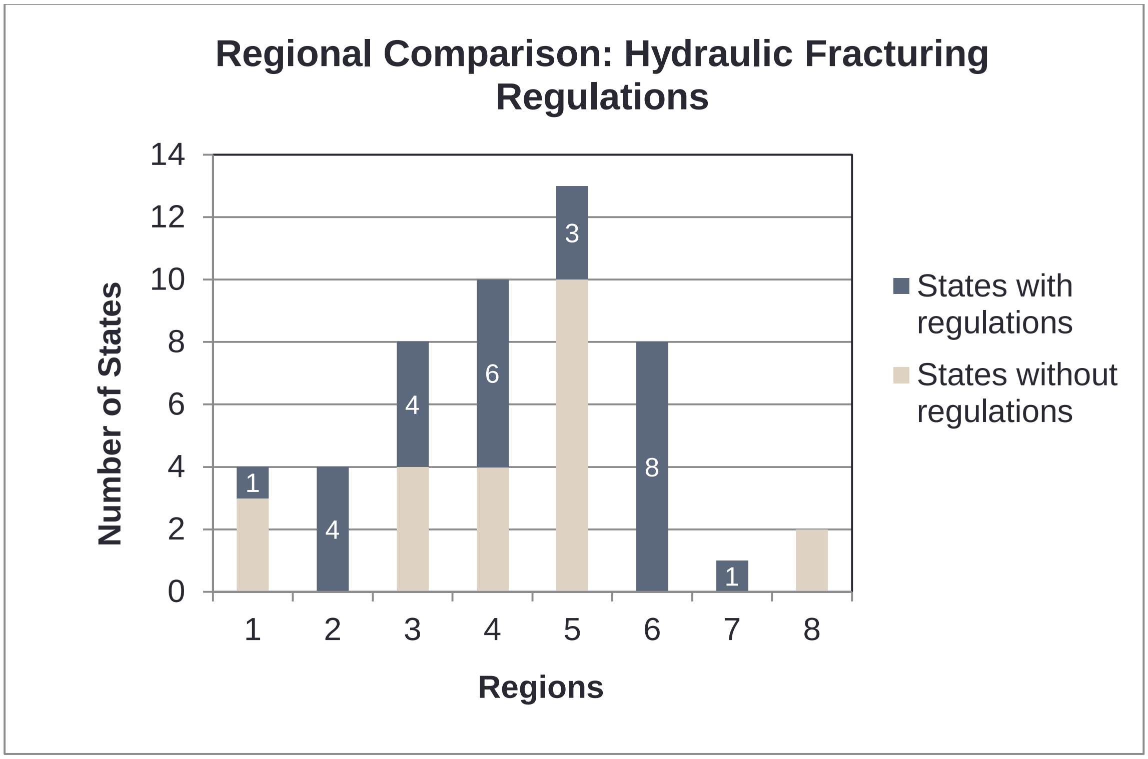

Chart 1. Hydraulic fracturing regulations across regions.

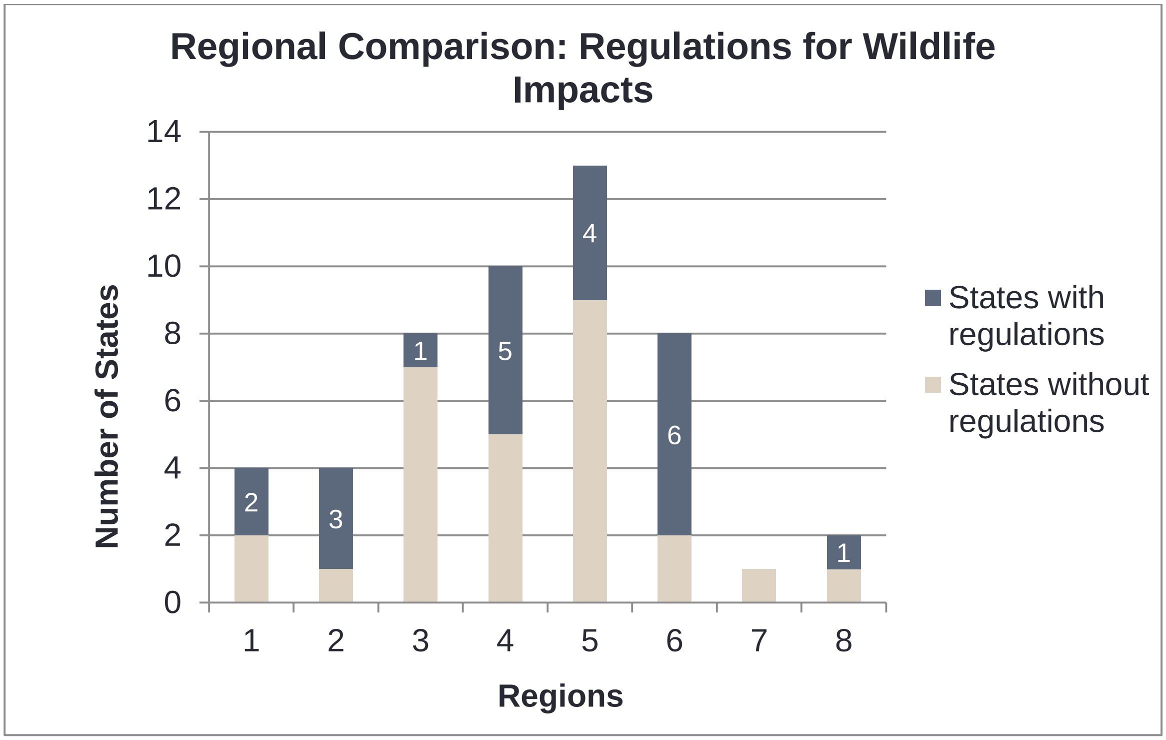

Chart 2. Impacts to wildlife across regions.

Questions that State Regulations Should Address

The majority of the States' regulations addressed many of the main questions posed by Service staff (Table 10). The goal of these questions was to show to what extent the State regulations addressed topics that the Service thought were important. They are used as a supplement to the State regulations matrix.

The majority of the States addressed the following questions:

1. Is mitigation required for any surface disturbance or lost use of the surface?
2. Is the use of open pits allowed for any phase of operations?
3. Are operating standards for drilling production and operation prescribed?
4. Are operators required to submit a plan of operations for proposals to drill/produce a well?
5. Are operators required to provide financial assurance to the State?
6. Do the regulations prescribe when the State will release an operator's financial assurance?
7. Are plugging/abandoning procedures described?
8. Do the regulations describe under what conditions the State will require operators to plug/abandon a well?
9. Does it describe what the State will do if operators fail to comply with regulations?

10. Do the regulations describe when the State can revoke an operator's permit?
11. Do the regulations describe what assessments an operator may be subject to if they commit one or more prohibited acts?

Five or fewer States addressed the following questions:

1. Is the operator's financial assurance adjusted if their plans/permits are revised?
2. What should an operator do if they acquire operations that don't have an approved permit?
3. Can an operator get an exception to a plugging determination?
4. Can an operator obtain a permit if they are or have been in violation of State regulations or a permit?

The questions that most State regulations fail to answer are related to the Service's need to address its statutory mission to protect wildlife and their habitat. Many State regulations are not intended to address such specific issues. This indicates that some State regulations may help reduce oil and gas impacts, but not as specific as regulations tailored to address this need. These responses spotlight the gap in protection of state oil and gas resources and the wildlife resources managed by refuges.

Conclusion

State oil and gas regulations vary extensively in the regulatory elements they address. The regulations also differ regionally, with regions 2 and 6 having the most detailed and stringent regulations. The differences in State regulations are important for bringing to light the uneven oil and gas regulating practices throughout the country. This will hopefully add to the justification for the Service's need to re-establish its oil and gas drilling rule for refuges.

It is recommended that information on State regulations be added to regional sharepoint sites so Service employees who are confronted with oil and gas drilling issues will have an additional resource. The State regulations matrix is a good resource for this type of use (there is also a spreadsheet that has the matrix broken down into regions). Other sources might be useful as well, such as the *Resources for the Future* report or the OIGCC summary of oil and gas regulations.

Bibliography

Earthworks 2012. Breaking All the Rules: The Crisis in Oil and Gas Regulatory Enforcement. Earthworks Oil and Gas Accountability Project. Accessed August 2013 at *http://www.earthworksaction.org/files/publications/FINAL-US-enforcement-sm.pdf*

Environmental Law and Policy Center. 2013. Understanding the Illinois Hydraulic Fracturing Regulatory Act (HB 2615). Accessed August 2013 at *http://elpc.org/illinoisfrackingbill*

Gilmer, Ellen M. 2012. Few States Submitting Oil and Gas Rules for Review. EnergyWire, E&E Publishing. Accessed August 2013 at *http://www.eenews.net/stories/1059969654*

InterState Oil and Gas Compact Commission (IOGCC). 2013. Accessed June 2013 at *http://iogcc.publishpath.com/*

Porter, Reid. 2012. API: New Interior Hydraulic Fracturing Rules Must Not Ignore Effective State Efforts. American Petroleum Institute. Accessed August 2013 at *http://www.api.org/news-and-media/news/newsitems/2012/may-2012/api-new-interior-hydraulic-fracturing-rules-must-not-ignore-effective-State-efforts.aspx*

Richardson, Nathan et. al 2013. The State of State Shale Gas Regulation. *Resources for the Future.* Accessed August 2013 at *http://www.rff.org/rff/documents/RFF-Rpt-StateofStateRegs_Report.pdf*

Southern States Energy Board. A Guide to State Oil & Gas Regulatory Entities in the South. Accessed August 2013 at *http://www.sseb.org*

State Review of Oil and Natural Gas Environmental Regulations (STRONGER). 2013. Accessed July 2013 at *http://strongerinc.org*

Appendix- additional tables

Table 1.

Percentage of States By Region that Regulate each Element								
	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7 (1 State)	Region 8 (2 States)
Drilling Requirements								
License Required	0	75	25	20	15	38	100	50
Permit Required/Fees	75	100	88	100	54	100	100	100
Bond Purpose/Type	75	100	63	80	46	88	100	100
Bond Amounts	75	100	88	100	46	8	100	100
Land Leasing Information	75	100	38	40	23	50	100	50
Site selection/preparation								
Setback Requirements	0	25	50	50	38	0.25	100	50
Spacing Requirements	75	100	75	100	46	100	100	100
Production Activities								
Oil Production	75	100	75	90	62	88	100	100
Gas Production	75	100	63	90	54	88	100	100
Pit Liner Requirements (from RFF report)	0	75	38	70	38	100	0	0
Pit Use (Reserve Pits)	75	100	38	60	15	88	100	50
Pit Closure (Reserve Pits)	50	75	25	50	15	88	100	0
Pit Use (Produced Water)	0	0	13	30	0	50	0	0
Pit Closure (Produced Water)	0	0	0	20	0	38	0	0
O&G Transportation Method	25	75	50	60	23	88	0	100
Hydraulic Fracturing								
Hydraulic Fracturing Requirements	25	100	50	60	23	100	100	100
Water Source for Fracking Requirements	25	75	13	30	23	37	100	0
Water withdrawl Regulations (Yes/No) (from RFF Report)	0	50	50	70	46	100	0	50
Emergency Reporting								
Brine Spill Reporting/Cleanup Requirements	0	25	25	10	8	25	0	0
Oil Spill Reporting/Cleanup Requirements	75	75	63	70	31	100	0	50

Drilling Site Completion								
Completion Requirements	75	100	88	90	46	88	100	100
Site Reclamation/ Restoration Requirements /Remediation	75	50	50	60	31	100	0	50
Reclamation Fees	0	50	0	30	0	0	0	0
Removal of Abandoned Equipment	25	75	13	20	0	38	0	0
Maximum time a well can remain idle (from RFF report)	0	75	50	60	38	75	0	50
Temporary Well Abandonment (from RFF report)	0	75	50	60	31	88	0	0
Well Plugging Requirements	75	100	88	100	62	100	100	100
Plugging/Abandonment Costs	0	0	25	20	15	63	0	50
Noncompliance								
Noncompliance-Penalty/ Fees/Violations	25	50	75	90	46	63	100	100
Noncompliance Procedures	75	75	50	60	15	63	100	100
Well Shut-in from Repeated Noncompliance	0	25	0	0	0	13	0	0
Surface Owner Impacts								
Addresses Impacts to Surface Owner	50	75	13	50	31	50	0	50
Requires Surface Owner's Permission	25	50	25	50	15	25	0	0
Measures protecting the surface owner from the subsurface mineral owner (ie. Financial liability)	0	0	0	10	0	1	0	0
Access Fees	25	0	0	0	0	0	0	0
Wildlife Impacts								
Addresses Impacts to Wildlife Resources/Wildlife Protection Requirements	50	75	13	50	31	75	0	50

* States without regulations are included

* It's important to keep in mind for the percentages that each region has a different number of States (i.e., regions 7 and 8)

APPENDIX C: TYPES OF NON-FEDERAL OIL AND GAS DEVELOPMENT CONDUCTED BY THE NATIONAL WILDLIFE REFUGE SYSTEM

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INTRODUCTION

The petroleum industry is a continuous cycle of searching for new oil and gas reservoirs, developing and producing them, and finally abandoning the property once the hydrocarbons are depleted.

There are four general phases of petroleum development. The phases are (1) exploration, (2) drilling, (3) production, and (4) abandonment/reclamation. Surface uses vary for each phase in terms of intensity and duration. Also, operations related to one or all of the phases may be occurring in the same area at any given time. In Lower Rio Grande National Wildlife Refuge and Upper Ouachita National Wildlife Refuge, most oil and gas activities will likely be part of the production and abandonment/reclamation phases. Drilling is expected to occur on a less frequent basis. Although described below, exploration work such as geophysical surveys is not expected because zones of interest in the area are shallow (economics of seismic survey versus just drilling an explorations well) and there is a good number of wells that provide information for interpreting the subsurface.

To be of interest to the petroleum industry, petroleum deposits must be commercially valuable. There must be a reasonable chance of making a profit on the eventual sale of the oil and gas. Factors such as the market price of oil and gas, the amount of recoverable petroleum, the expected production rates, and the cost of drilling wells, producing, and transporting the product to market all determine the economic viability of developing a deposit once it is discovered.

The following sections are meant to provide the reader with a general understanding of common activities associated with each phase of oil and gas development.

EXPLORATION OPERATIONS

OCCURRENCE OF PETROLEUM

Petroleum deposits are not large underground caverns filled with oil and gas as the term reservoir might suggest. Rather, petroleum accumulates in tiny spaces within the buried rock layers. Most scientists today agree that petroleum was formed from large amounts of very small plant and animal life. These organic materials accumulated in ancient seas, which, over great periods of time, have covered much of the present land area. As time passed, sediments rich in organic matter were buried deeper and deeper. The increased pressure and temperature caused these organic remains to change into oil and natural gas. Once formed, the oil and gas migrated upward until certain forms and shapes of underground rocks halted the upward movement, trapping the hydrocarbons in large quantities. The search for these traps is the focus of the first phase of oil and gas development and exploration.

GEOLOGICAL EXPLORATION

The search for oil and gas often begins with geological exploration. The exploration geologist is looking for clues on the surface that would suggest the possibility of petroleum deposits below. Surface studies comprise the first stage of exploratory fieldwork. Geological surveys of the land surface are made using aerial photographs, satellite photographs, maps of surface outcrops of specific formations or rock types, and geochemical analyses. Field crews map surface attributes and collect surface samples of rock for analysis.

Creating maps of surface outcrops and geochemical analyses requires fieldwork. Little equipment is needed other than surveying gear and rock and soil sampling supplies. These activities require a small field party of two to four persons who can work out of a single vehicle or on foot. Access to remote areas can be gained by a four-wheel-drive vehicle, small all-terrain vehicles, helicopter, pack animals, or by walking. A small boat may be used where navigable water occurs near the area being studied. Constructing roads or channels in shallow water areas is not required at this early stage.

Geochemical analysis often requires subsurface samples to be taken from a ditch or a shallow corehole. The coreholes are usually shallow, but may generate some cuttings.

GEOPHYSICAL EXPLORATION

Geological exploration can narrow the area being searched, but subsurface geology may or may not be accurately indicated by surface outcrops. Geophysical prospecting extends the search beneath the earth’s surface. The surveys identify and map characteristics favorable to oil and gas accumulation deep underground. Geophysical operations include gravitational, magnetic, and seismic surveys. Of these, the seismic survey is most common.

Gravitational and Magnetic Surveys—Gravitational and magnetic field studies yield regional or reconnaissance-type data. These surveys detect variation in gravitational attractions and magnetic fields of the various types of rock below the surface.

Gravity surveys are generally done with small, portable instruments called gravity meters or gravimeters. The number and placement of measurement points in a gravity survey depend on the site’s characteristics. These include feasibility of access and the spacing pattern necessary to detail the features selected for mapping. The field party required is not large, usually 3 to 6 people. Travel on foot is possible with the smaller portable gravimeters. Progress, however, is slow, so most surveys use four-wheel-drive vehicles. In marshy areas, the use of special swamp or marsh buggies is quite common with gravity survey crews. Airborne survey operations are not yet practical due to present instrument limitations and the relatively large and rapid changes in altitude and acceleration characteristic to aircraft.

The objective of most surveys can be achieved when gravity stations are confined to existing roads or waterways. Where roads or waterways do not exist, a large level of latitude in positioning stations is possible to account for logistical or environmental constraints. Disturbance of the land surface is minimal when established access is already available. Methods of access to roadless areas are similar to those required for geological explorations described above. The surveying technique itself does not require any physical disturbance of the surface.

Magnetic surveys are often used in place of or to supplement gravity surveys. These surveys are done with relatively small airborne or portable ground instruments called magnetometers. Flight patterns usually consist of a series of parallel lines at 1- to 2-mile intervals.

Airborne surveys require geodetic and ground control points. These must be installed on the ground before the survey can take place, if not already present. A majority of the lower 48 states have been surveyed, so these points are already in place. If not, however, the area must be accessed by overland vehicles or helicopters. The size of the field party required is not large. The access to roadless areas is similar to that required for geological exploration described above. The surveying technique itself does not require any physical disturbance of the surface.

Seismic Surveys—Whereas gravity and magnetic surveys provide regional information, seismic survey can provide enough subsurface detail to locate potential oil and gas traps.

A seismic survey gathers subsurface geological information by recording impulses from an artificially generated shock wave. The energy waves travel downward toward underground formations. A series of sensitive instruments, called geophones, set out at surveyed points on the ground, record the energy waves as they are reflected off the subsurface formations and back to the surface. Cables or radio transmitters transfer information from the geophones to a recorder truck that receives and records the reflected seismic energy. Sophisticated computers analyze the data and generate a “picture” of the rocks underground. Each survey line provides a cross-section of the rock formations beneath it, and many lines may be run to create a complete picture.

In remote areas where there is little known subsurface data, a series of short seismic lines may be required to determine the attitude of the subsurface formations. After this, the pattern of seismic lines or grids is designed to make the final data more accurate and valuable. Although alignment is fairly critical, some source and recording stations may be moved or skipped for environmental or logistical reasons without seriously affecting the results of the investigation.

A more recent technique called 3-D Seismic works on the same principle as conventional seismic, but energy and recording stations are placed at a much denser spaced grid. There may be up to 150 energy source locations and 200 recording stations per square mile on a 3-D seismic project. Surveys commonly exceed a 25-square-mile-area. The 3D-Seismic surveys can provide enough detail to locate traps that have been “missed” by conventional geophysical methods and exploratory drilling. Even in areas that have been heavily explored and developed, 3D-Seismic is helping to optimize new field development and find new targets within producing fields. New life is being brought to areas thought to have been played out.

Seismic methods are usually referred to by the various methods of generating the shock wave. These include weight drop, vibrators, dinoseis (combustible gas expansion), and explosives. No matter what method of generating energy is used, the procedures for preparing the line and recording the data are relatively similar. The procedure typically consists of first surveying and flagging the locations for the geophones and the positions of the energy sources. Second, the geophones and the connecting cable are laid down. The cable is either connected with more cable to the recording truck or to a radio transmitter to send the data to the recording truck. Normally the recording truck will be within a short distance of the transmitter or within line of sight. Once the geophones and ground cable are in place, the energy source is put in place. The initiation of the energy source, whether by a “vibroseis” truck or by explosive, is controlled by the recording truck. The shock wave is set off, and the seismic signal recorded by multiple geophones. Once the signal is recorded, the ‘shooting crew travels to the next source point, and the process is repeated.

The most common energy source in seismic work is explosives placed in holes drilled to depths of several feet up to 200 feet. Explosives may range from ½- to 50-pound charges and typically increase in size with increased setting depths. Drills can be mounted on trucks, boats, or specially designed airboats or all-terrain vehicles, depending on the type of access required. In rugged topography, or to reduce surface disturbance associated with access, portable drills are sometimes carried by helicopter or by hand. Other field equipment can include vehicles to carry water for drilling operations, personnel, surveying equipment, recording equipment, and computers.

Existing roads are used if possible, but reaching some lines may require clearing vegetation and loose rock to improve access for the crews and the trucks. Each mile of seismic line cleared to a width of 8 to 15 feet represents disturbance of about an acre of land. A network of low-standard temporary roads and trails can result from these operations. The alignment of these trails usually consists of straight lines dictated by the grid, often with little regard for steep slopes or rough terrain. Level topography with few trees and shrubs would require little or no trail construction. An area with rugged topography or larger vegetative types such as trees and large shrubs would require more trail preparations. Temporary roads and trails are usually constructed with bulldozers.

Seismic crews consist of several surveying people, people for laying and retrieving the cable and geophones, the truck drivers and drillers for the energy source, personnel in the recording truck and miscellaneous water truck drivers, cleanup people, and field crew managers. The size of the seismic crews varies from 15 to 80 people. On most seismic jobs, the people and equipment are transported in trucks or four-wheel-drive vehicles. However, the surveying, cable laying, and sometimes the drilling can be done on foot in some situations.

Under normal conditions, 3 to 5 miles of line can be surveyed each day using the explosive methods. Crews may be in the field for 1 to 4 weeks for an average conventional survey. An average 3-D survey may take several months to complete.

DRILLING AND PRODUCTION OPERATIONS

OIL AND GAS WELL DRILLING

Classification of Wells—Wells drilled for oil and gas are classified as either exploratory or development wells. An exploratory well is drilled either in search of an as-yet-undiscovered pool of oil or gas (a wildcat well) or to extend greatly the limits of a known pool. Exploratory wells may be classified as (1) wildcat, drilled in an unproven area; (2) field extension or step-out, drilled in an unproven area to extend the proved limits of a field; or (3) deep test, drilled within a field area but to unproven deeper zones. Development wells are wells drilled in proven territory in a field to complete a pattern of production.

Similar to geophysical surveys, drilling operations are relatively short-term. However the intensity of impacts is much higher due to the equipment and materials needed to drill a well and the potential duration of the operation. At a common height of 180 feet, the rig stands as tall as a 12-story building. An average drilling rig needs a level location of about 3 acres. The drilling pad and access road must be capable of supporting thousands of tons of equipment. Existing access roads may need to be widened and upgraded to accommodate heavy loads. Rigs commonly used in Louisiana are somewhat smaller and locations perhaps 1 to 2 acres in size.

Choosing the Site—Once exploration activities have narrowed the search to specific drilling targets, the operator must select an exact spot on the surface to drill the well. The industry prefers to drill vertically, and usually chooses a drill site directly above the desired bottomhole location. When topographical, geological, or environmental constraints prevent a drill site from being located directly above the bottomhole location, the use of direction drilling can achieve the objective. Reaches of over a mile are common for 10,000-foot-deep wells, and extended reach wells have been drilled with over 2 miles of horizontal departure.

Directional drilling involves deviating a wellbore from its vertical along a predetermined course to a target located at some depth and some horizontal distance away. It is a common practice in the industry today, with a number of uses. Directional drilling techniques can be applied if the target zone lies underneath an inaccessible location such as a heavily urbanized area, mountain, or water body, and the drill rig must be located elsewhere. The technique is most often used in offshore applications to allow many wells to be drilled from one location. It can be used to drill around or through fault planes, salt domes, or obstructions in the hole, and to provide relief to a nearby well that has blown out. More recently, the technique has been used to move surface locations as an environmental protection measure.

While directional drilling allows flexibility in the selection of the drill site, there are technical, physical, and economic constraints on its use. Geological factors such as target depths, formation properties (stability, type, dip angle, etc.), and contemplated horizontal departures physically complicate and restrict the opportunities for using directional drilling. Sophisticated equipment and specialized personnel are needed to monitor and guide the direction of the well as it is being drilled. The cost of using this technique typically ranges from 10 percent to 50 percent higher than the cost of a vertical well. While directional drilling can be applied in a wide variety of situations, project specific conditions must always be taken into account.

Accessing the Site—Wildcat drilling often takes place in remote areas. Preliminary exploration work will not have contributed any new roads to an area, although there may be some cross-country trails. Temporary access roads will have to be constructed. Existing roads may need upgrading to accommodate the heavier loads associated with truck traffic. One lane is usually adequate, but turnouts and/or traffic control are necessary to accommodate two-way traffic on longer routes. Installation of culverts or other engineering structures will be needed in steep terrain or when crossing stream channels. Soil texture, topography, and moisture conditions might dictate that roads be surfaced with material such as gravel, oyster shells, caliche, or ground limestone. Heavy equipment such as graders, bulldozers, front-end loaders, and dump trucks are commonly used in constructing roads. In marshy areas, a roadbed may be laid with heavy boards.

Preparing the Drill Site—To accommodate the rig and equipment, the drill site must be prepared. Site preparation may include extensive clearing, grading, cutting, filling, and leveling of the drill pad using heavy construction equipment. Soil material suitable for plant growth is often removed first and stockpiled for later use in reclamation. The operator may also dig reserve pits to hold large volumes of drilling mud and drill cuttings. In environmentally sensitive areas, a large effort is made not to alter the surface area comprising the drill site more than is necessary. For example, reserve pits may not be dug. Instead, large steel bins are placed on the site to receive the cuttings and other materials that are normally dumped into the reserve pits. These bins can then be trucked away from the site and the material inside them disposed of properly. Also, even in areas where reserve pits are excavated, they are often lined with thick plastic sheeting to prevent any contaminated water or other materials from seeping into the ground. The drill pad typically occupies about 2 to 3 acres.

Directional drilling may require a larger-sized rig and additional support facilities that may lead to larger pad sizes. For inland water sites, drilling barges that sit on the bottom may be used as a foundation for the drill rig. Some dredging may be done on these sites to create a slip, and protective skirts or pilings may be installed around the barge to prevent erosion by currents and tidal flow. In deeper water, jack-up, submersible and semi-submersible, rigs and drill ships may be used to drill wildcat wells. An offshore platform is typically used to drill development wells in deep water.

Since a source of freshwater is required for the drilling mud and for other purposes, a water well is sometimes drilled prior to moving the rig onto the location. If other sources are available, the water may be piped or trucked to the site.

At the exact spot on the surface where the hole is to be drilled, a rectangular pit called a cellar is dug, or culvert-like pipe is driven into the ground. If the cellar is dug, it may be lined with boards, or forms may be built and concrete poured to make walls for the cellar. The cellar is needed to accommodate drilling accessories that will be installed under the rig later.

In the middle of the cellar, the top of the well is started, sometimes with a small truck-mounted rig. The conductor hole is large in diameter, perhaps as large as 36 inches or more; is about 20 to 100 feet deep; and is lined with conductor casing, which is also called conductor pipe. If the topsoil is soft, the conductor pipe may be driven into the ground with a pile driver. In either case, the conductor casing keeps the ground near the surface from caving in. Also, it conducts drilling mud back to the surface from the bottom when drilling begins, thus the name conductor pipe.

Usually, another hole considerably smaller in diameter than the conductor hole is dug beside the cellar and also lined with pipe. Called the rathole, it is used as a place to store the kelly (a square or hexagonal rod used in drilling) when it is temporarily out of the borehole during certain operations. Sometimes on small rigs, a third hole, called the mousehole, is dug. On large rigs, it is not necessary to dig a mousehole because of the rig floor's height above the ground. In either case, the mousehole is lined with pipe and extends upward through the rig floor and is used to hold a joint of pipe ready for makeup.

Rigging Up—With the site prepared, the contractor moves in the rig and related equipment. The process, known as rigging up, begins by centering the base of the rig, called the substructure, over the conductor pipe in the cellar. The substructure supports the derrick or mast, pipe, drawworks, and sometimes the engines. If a mast is used, it is placed into the substructure in a horizontal position and hoisted upright. A standard derrick is assembled piece by piece on the substructure. Meanwhile, other drilling equipment such as the mud pumps are moved into place and readied for drilling.

Other rigging-up operations include erecting stairways, handrails, and guardrails; installing auxiliary equipment to supply electricity, compressed air, and water; and setting up storage facilities and living quarters for the toolpusher and company man. Further, drill pipe, drill collars bits, mud supplies, and many other pieces of equipment and supplies must be brought to the site before the rig can make hole.

Mobilizing the drill rig to the location requires moving 10 to 25 large truckloads of equipment over public highways and smaller roads. In very remote locations, entire drilling crews and service personnel may be temporarily housed onsite. A typical drilling crew consists of five people. Drilling operations are continuous, 24 hours a day and 7 days a week. The crews usually work two 12-hour shifts. With the drilling crew, geologists, engineers, supervisors, and specialized service providers, there may be anywhere from 5 to over 20 people on a drilling location at any given time. An irregular stream of traffic to and from the rig occurs day and night.

Drilling the Surface Hole—Rotary drilling is used almost universally in modern-day drilling. Drilling is accomplished by rotating special bits under pressure. Starting to drill is called “spudding in” the well. To spud in, a large bit, say 17 ½ inches in diameter as an example, is attached to the first drill collar and is lowered into the conductor pipe by adding drill collars and drill pipe one joint at a time until the bit reaches the bottom. While drilling, the rig derrick and associated hoisting equipment support the drill string’s weight. The combination of rotary motion and weight on the bit causes rock to be chipped away at the bottom of the hole.

The rotary motion is created by a square or hexagonal rod, called a kelly, which fits through a square or hexagonal hole in a large turntable, called a rotary table. The rotary table sits on the drilling rig floor and as the hole advances, the kelly slides down through it. With the kelly attached to the top joint of pipe, the pump is started to circulate mud, the rotary table is engaged to rotate the drill stem and bit, and weight is set down on the bit to begin making hole. When the kelly has gone as deep as it can, it is raised, and a joint of drill pipe about 30 feet long is attached in its place. The drill pipe is then lowered, the kelly is attached to the top of it, and drilling recommences. By adding more and more drill pipe, the hole can steadily penetrate deeper.

Large volumes of fluid, generically called drilling mud, circulate down the drill pipe to the drill bit and back to the surface. The mud lubricates and cools the bit and carries drill cuttings to the surface. The composition of the mud system depends on the types of formations being drilled, economics, water availability, pressure, temperature, and many other significant factors. Mud can be as simple as freshwater, or a complex emulsion of water, oil, chemicals, clays, and weighting material. Chemicals added to the mud help drill and protect the hole’s integrity. Weighting material is often added to prevent formation fluids from flowing into the well as it is being drilled. Mud systems can be highly toxic or relatively benign. The drilling mud along with cuttings from the well account for the largest volume of waste generated at the well site. Wells may also be drilled using compressed air instead of drilling mud. Drill cuttings and fluids produced from formations while drilling are blown into a lined pit next to the drilling rig through what is known as a blooey line.

The first part of the hole is known as the surface hole. Even though the formation that contains the hydrocarbons may lie many thousands of feet below this point, drilling ceases temporarily because steps must now be taken to protect and seal off the formations that occur close to the surface. For example, freshwater zones must be protected from contamination by drilling mud. To protect them, special pipe called casing is run into the hole and cemented.

Tripping Out—The first step in running casing is to pull the drill stem and bit out of the hole. Pulling the drill stem and bit out of the hole in order to run casing, change bits, or perform some other operation in the borehole is called tripping out. To trip out, the drilling crew uses the rig’s hoisting system, or drawworks, to raise the drill stem out of the hole.

Attached to the traveling block is a set of drill pipe lifting devices called elevators. Elevators are gripping devices that can be latched and unlatched around the tool joints of the drill pipe. The crew latches the elevators around the drill pipe, and the driller raises the traveling block to pull the pipe upward. When the third joint of pipe clears the rotary table, the rotary helpers set the slips and use the tongs to break out the pipe. The pipe is usually removed in stands of three joints. Removing pipe in three-joint stands, rather than in single joints, speeds the tripping out process. With the stand of pipe broken out, the crew guides it into position on the rig floor to the side of the mast or derrick.

The derrickman unlatches the elevators from the top of the pipe and stands the pipe back in the derrick. Working as a close-knit team, the driller, rotary helpers, and derrickman continue tripping out until all the drill pipe, the drill collars, and the bit are out of the hole. At this point, the only thing in the hole is drilling mud, because mud was pumped into the hole while pipe was tripped out.

Running Surface Casing—Once the drill stem is out, often a special casing crew moves in to run the surface casing. Casing is large-diameter steel pipe, and is run into the hole with the use of special heavy-duty casing slips, tongs, and elevators. Casing accessories include centralizers, scratchers, a guide shoe, a float collar, and plugs.

Centralizers keep the casing in the center of the hole so that when the casing is cemented, the cement can be evenly distributed around the outside of the casing. Scratchers help remove mud cake from the side of the hole so that the cement can form a better bond. The guide shoe guides the casing past debris in the hole, and has an opening in its center out of which cement can exit the casing. The float collar serves as a receptacle for special cementing plugs, and allows drilling mud to enter the casing at a controlled rate.

The plugs begin and end the cementing job, and serve to keep cement separated from the mud so that the mud cannot contaminate the cement. The casing crew, with the drilling crew available to help as needed, runs the surface casing into the hole one joint at a time. Casing is available in joints of about 40 feet. Once the hole is lined from bottom to top with casing, the casing is cemented in place.

Cementing—The cementing of oil well casing annuli is a universal practice done for a number of reasons, depending on casing type. Conductor casings can be cemented to prevent the drilling fluid from circulating outside the casing, causing the very surface erosion the casing was intended to prevent. Surface casings must be cemented to seal off and protect freshwater formations, provide an anchor for blowout preventer equipment, and give support at the surface for deeper strings of casing. Intermediate strings of casing are cemented in order to seal off abnormal pressure formations, effectively isolate incompetent formations that might cause drilling problems unless supported by casing and cement, and shut off zones of lost circulation. Production casing is cemented to prevent the migration of fluids to thief zones, to prevent sloughing of formations that could result in reduced production, and to isolate productive zones for future development.

An oilwell cementing service company usually performs the job of cementing the casing in place. The cement used to cement oilwells is not too different from the cement used as a component in ordinary concrete. Basically, oilwell cement is Portland cement with special additives to make it suitable for various conditions of pumping, pressure, and temperature.

Cementing service companies stock various types of cement and use special trucks to transport the cement in bulk to the well site. Bulk cement storage and handling at the rig location make it possible to mix the large quantities needed in a short time. The cementing crew mixes the dry cement with water, often using a recirculating mixer. This device thoroughly mixes the water and cement by recirculating part of the already-mixed components through a mixing compartment. Powerful cementing pumps move the liquid cement (slurry) through a pipe to a special valve made up on the topmost joint of casing. This valve is called a cementing head, or plug container. As the cement slurry arrives, the bottom plug is released from the cementing head and precedes the slurry down the inside of the casing. The bottom plug keeps any mud that is inside the casing from contaminating the cement slurry where the two liquids interface. Also, the plug wipes off mud that adheres to the inside wall of the casing and prevents it from contaminating the cement.

The plug travels ahead of the cement until it reaches the float collar. At the collar the plug stops, but continued pump pressure breaks a seal in the top of the plug and allows the slurry to pass through a passageway in it. The slurry flows out through the guide shoe, and starts up the annulus between the outside of the casing and the wall of the hole until the annulus is filled.

A top plug is released from the cementing head and follows the slurry down the casing. The top plug keeps the displacement fluid, usually drilling mud, from contaminating the cement slurry. When the top plug comes to rest on the bottom plug in the float collar, the pumps are shut down and the slurry is allowed to harden. Allowing time for the cement to set is known as waiting on cement and varies in length. In some cases, it may be only a matter of a few hours; in other cases, it may be 24 hours or even more, depending on well conditions. Adequate waiting on cement time must be given to allow the cement to set properly and bond the casing firmly to the wall of the hole. After the cement hardens and tests indicate that the job is good – that is, that the cement has made a good bond and no voids exist between the casing and the hole – drilling can be resumed.

Tripping In—To resume drilling, the drill stem and a new, smaller bit that fits inside the surface casing must be tripped back into the hole. The bit is made up on the bottommost drill collar. Then, working together, the driller, floormen, and derrickman make up the stands of drill collars and drill pipe and trip them back into the hole.

When the drill bit reaches bottom, circulation and rotation are begun and the bit drills through the small amount of cement left in the casing, the plugs, the guide shoe, and into the new formation below the cemented casing. As drilling progresses and hole depth increases, formations tend to get harder; as a result, several round trips (trips in and out of the hole) are necessary to replace worn bits.

Controlling Formation Pressure—During all phases of drilling, an important consideration is well control. Well control is preventing the well from blowing out by using proper procedures and equipment. A blowout is the uncontrolled flow of fluids – oil, gas, water, or all three – from a formation that the hole has penetrated.

Blowouts threaten lives, property, and pollution of the environment. Rig crews receive extensive training in how to recognize and react to impending blowouts, making them relatively rare events.

The key to well control is understanding pressure and its effects. Pressure exists in the borehole because it contains drilling mud and in some formations because they contain fluids. All fluids --drilling mud, water, oil, gas, and so forth – exert pressure. The denser the fluid (the more the fluid weighs), the more pressure the fluid exerts. A heavy mud exerts more pressure than a light mud. For effective control of the well, the pressure exerted by the mud in the hole should be higher than the pressure exerted by the fluids in the formation.

Pressure exerted by mud in the hole is called hydrostatic pressure. Pressure exerted by fluids in a formation is called formation pressure. The amount of hydrostatic pressure and formation pressure depends on the depth at which these pressures are measured and the density, or weight, of each fluid. Regardless of the depth, hydrostatic pressure must be equal to or slightly greater than formation pressure, or the well kicks. The well kicks, formation fluids enter the hole, if hydrostatic pressure falls below formation pressure. Thus, one of the crew's main concerns during all phases of the drilling operation is to keep the hole full of mud whose weight is sufficiently high to overcome formation pressure.

However, unexpectedly high formation pressures can be encountered. Formation fluids can be swabbed, or pulled, into the hole by the piston-like action of the bit as pipe is tripped out of the hole. Also, the mud level in the hole can fall so that the hole is no longer full of mud. Whatever the reason, when hydrostatic pressure falls below formation pressure, crew members have a kick on their hands, and they must take quick and proper action to prevent the kick from becoming a blowout.

Helping the crew keep an eye on the rig's operation are various control instruments located on the driller's console. Some rigs have data processing systems that utilize slave computer display terminals, or CRTs (short for cathode ray tubes), on the rig floor, in the mud logging trailer, in the toolpusher's trailer, and in the company man's trailer. When limits that have been programmed into the system are exceeded, the system goes into an alarm condition.

Whether the kick warning signs come from electronic monitors, a computer printout, or the behavior of the mud returning from the hole, an alert drilling crew detects the signs and takes proper action to shut the well in. To shut a well in, large valves called blowout preventers, which are installed on top of the cemented casing, are closed to prevent further entry of formation fluids into the hole. Once the well is shut in, procedures are begun to circulate the intruded kick fluids out of the hole. Also, weighting material is added to the mud to increase its density to the proper amount to prevent further kicks, and the weighted up mud is circulated into the hole. If the mud has been weighted the proper amount, then normal operations can be resumed.

When drilling with air, there is very little hydrostatic pressure exerted downhole, and formations are drilled through in an “underbalanced” mode. This means the formations can flow into the wellbore as drilling progresses. With air drilling, well control is more dependent on the blowout preventers. It is prudent and often a regulatory requirement to have 1) extra storage capacity to hold formation fluids and 2) materials and equipment on location to “mud up” if necessary to maintain well control and wellbore integrity.

Running and Cementing Intermediate Casing—At a predetermined depth, drilling stops again in order to run another string of casing. Depending on the depth of the hydrocarbon reservoir, this string of casing may be the final one, or it may be an intermediate one. Intermediate casing is smaller than surface casing because it must be run inside the surface string and to the bottom of the intermediate hole. In general, it is run and cemented in much the same way as surface casing.

Final Depth and Well Evaluation—Using a still smaller bit that fits inside the intermediate casing, the next part of the hole is drilled. Often, the next part of the hole is the final part of the hole unless more than one intermediate string is required. After cementing the intermediate casing, drilling resumes by tripping the new bit and drill stem back in the hole. The intermediate casing shoe is drilled out, and drilling the new hole resumes.

While drilling and once reaching the total depth of the well, the operator collects information to determine if hydrocarbons have been encountered. To help the operator decide whether to abandon the well or to set a final, or production, string of casing, several techniques can be used. A thorough examination of the cuttings made indicates whether the formation contains sufficient hydrocarbons. A geologist catches cuttings at the shale shaker and analyzes them in a portable laboratory at the well site. He often works closely with a mud logger logger – a technician who monitors and records information brought to the surface by the drilling mud as the hole penetrates formations of interest.

Well logging is another valuable method of analyzing downhole formations. Using a mobile laboratory, well loggers lower sensitive tools to the bottom of the well on wireline and then pull them back up the hole. As they pass back up the hole, the tools measure and record certain properties of the formations and the fluids (oil, gas, and water) that may reside in the formations. Logging tools can also be run as part of the drill string to measure hole conditions and formation properties as the well is being drilled. This is called “measurement while drilling.”

If logging results indicate commercial quantities, a drill stem test may be run. Tools are positioned on the drill pipe to isolate the zone to be flow tested. Downhole formation pressure and fluids enter the tool and activate a recorder. Test may be designed to allow formation fluids to flow to the surface during the test or just to allow a certain volume to enter into the wellbore. In either case, provisions must be made at the surface to separate formation fluids from the mud, and to store and dispose of formation liquids. Natural gas produced during drill stem test is vented or flared. A properly designed and run drill stem test can give excellent indication of the types and volumes of fluid the zone is capable of producing.

In addition to well logging and drill stem testing, formation core samples can be taken from the hole and examined in a laboratory.

Setting Production Casing—After the drilling contractor has drilled the hole to final depth and the operating company has evaluated the formations, the company decides whether to set production casing or plug and abandon the well. If the well is judged to be a dry hole --that is, not capable of producing oil or gas in commercial quantities – the well will be plugged and abandoned.

Several cement plugs will be put in the well to seal it permanently. Cement plugs will be designed and placed to protect the zones of usable water from pollution and to prevent escape of oil, gas, or other fluids to the surface or other zones. Plugging and abandoning a well is considerably less expensive than completing it.

On the other hand, if evaluation reveals that commercial amounts of hydrocarbons exist, the company may decide to set casing and complete the well. The services of a casing crew and cementing company will once more be arranged for; and the production casing will be run and cemented in the well.

The drilling contractor nears the end of his job when the hole has been drilled to total depth and production casing has been set and cemented. In some cases, the rig and crew remain on the location to “complete” the well, or make it ready for production. In other cases, the drilling contractor moves his rig, and the operator brings in a smaller, less expensive completion rig and crew to finish up the job.

Well Completion—Completion equipment and methods employed are quite varied. The perforated completion is by far the most popular method of completing a well. Perforating is the process of piercing the casing wall, cement, and rock to provide openings through which formation fluids may enter the wellbore. Perforating is accomplished by placing guns holding special explosive charges opposite the zone to be produced. The charges are shaped so that an intense, directional explosion is formed. The well must have a good cement job and well-designed and well-executed perforation methods to get effective formation flow.

Explosives used in perforating guns are very stable. Accidents are rare as long as the people involved use proper procedures. Perforating guns may be run in the well on tubing or by wireline. Firing is accomplished by applying electric current, pressure, or mechanical force to a firing head located on the perforating gun.

In some areas, formations are competent enough that production casing is not used. The drilled hole is left uncased. Many wells in Oklahoma are constructed with only surface casing and open hole below.

The final string of pipe usually run in a producing well is the tubing. Tubing is a string of relatively small diameter pipe through which the hydrocarbons are produced. Tubing sizes vary from less than 2 inches in diameter up to 4½ inches for large volume producers. In a flowing well, its smaller diameter produces more efficient flow than casing. Also, since it is not cemented in the hole, tubing may be removed when it becomes plugged or damaged. Tubing, when used with a packer, keeps well fluids and formation pressures away from the casing. Well fluids and high pressures can damage casing, necessitating costly repairs.

The packer consists of a pipe like device through which well fluids can flow. Rubber sealing elements form a fluid tight seal around the inside of the casing. Gripping elements, called slips, hold the packer in place. Because the packer seals off the space between the tubing and the casing, produced fluids are forced into and up the tubing.

Another device often installed in the tubing string near the surface is a “subsurface safety valve.” The valve remains opened, as long a flow is normal. When the valve senses a loss in pressure or significantly increased flow (such as would occur with a flowline break), the valve closes automatically. Subsurface safety valves can prevent uncontrolled well flow in the event of massive surface equipment failure.

Finally, a tubing head is installed at the top of the well to support the tubing. Valves, gauges, and flow control devices are installed on top of the tubing head. Together, they make up what is commonly called a Christmas tree.

When reservoir pressures are not sufficient for the well to flow on its own, operators employ artificial lift methods. The most common by far is rod pumping. A plunger pump is installed deep in the well and connected by rods to a pumping unit on the surface. The pump jack moves the rods up and down to work the downhole pump. Pump jacks are often driven with electric motors or natural gas engines. The gas lift method works by injecting high-pressure gas into the fluid column of a swell to lighten and raise the fluid by expansion of the gas. Instead of pump jacks, there will be a source of high-pressure gas in the field, usually from a gas compressor. The hydraulic pumping method uses a fluid to drive a downhole motor, which in turns drives a pump that pumps the oil to the surface. Surface equipment for hydraulic pumping includes a high-pressure pump and vessels to separate the hydraulic fluid from produced fluid. Yet another type of artificial lift is electric submersible pumping, usually only used on very high-volume wells. An electric motor attached to a pump is installed downhole. Electric current is supplied to the motor through special heavy-duty armored cable. Surface facilities may just be a small transformer/control box.

The well may be stimulated to enhance flow. Stimulation may be performed before or after the completion equipment is installed. Two common types of stimulation are formation acidization and hydraulic fracturing. Stimulation treatments can improve flow to the point where commercial production is achieved in an otherwise uneconomical well.

Formation acidizing is treating the hydrocarbon-bearing rock with large volumes of acid. The most common types of acid used are hydrochloric (HCl) and hydrofluoric (HF). Oilfield acids contain additives to prevent or delay corrosion of the well’s tubulars, inhibit sludging and emulsion reactions with oil in the formation, and make the acid easier to pump. The aim in acidizing is to enlarge the pore spaces and passages by dissolving rock, thus enlarging existing flow channels and opening new ones to the wellbore.

Acid is brought to the well location in tanker trucks and pumped using one or more truck-mounted pumps. Spent acid that is flowed back from the well is often kept separate from field production. The spent acid may be put into temporary tanks until it is trucked off to disposal.

In hydraulic fracturing, fluid is pumped into the formation at high enough pressures and rates to split the rock. Proppants are pumped with the fluid to hold the crack open once pumping stops. Sand and sintered bauxite beads are two common propping agents. Fracturing fluid must not only break down the formation, but also extend and transport the proppant into the fracture. The industry has developed a multitude of complex fluid and proppant systems to achieve the best results in the many varied types of reservoirs.

Many truck-mounted pumps and temporary storage tanks are needed on location to fracture-treat wells. Larger well locations may be needed if hydraulic fracturing is part of a completion procedure.

Field Development—If the wildcat well produces oil or gas in commercial quantities, one or more additional wells are normally drilled to confirm the initial finding and further test and define the extent of the oil or gas reserves. Location of the confirmation wells is dependent upon analysis of discovery well data and any existing seismic surveys. Confirmation progresses by drilling one well after another, each dependent on the results of the previous wells.

With more information in hand, facilities can be designed to handle production from the field. Next, development wells are drilled as needed to efficiently drain the reservoir. The procedures for drilling development wells are about the same as for wildcats, except that there may be a variation in the amount and type of subsurface sampling, testing, and evaluation. More detailed seismic work may be performed to aid in the location of development wells.

A state Oil & Gas Commission usually establishes the field well spacing pattern. Typical well spacing may be one well every 640, 320, 160, 80, or 40 acres. Completely filled spacing patterns would translate to 1, 2, 4, 8, or 16 wells per square mile, respectively. In general, oil well spacing is denser for oil wells than for gas wells, and shallow well spacing is denser than for deeper wells.

Access roads to development wells are usually better planned and constructed than those for wildcat wells because these wells are expected to have longer lives. Typically a lease area will have one main route, with side roads to each well or multi-well pad location. Change from temporary to permanent roads does not take place until a well has been established as being capable of production. The amount of roadway required per square mile of field is 4 miles, based upon a spacing pattern of 40 acres and a separate pad for each well.

Directional drilling is sometimes used to concentrate the surface locations of two or more wells in one area. This technique minimizes the amount of surface area (roads and well pads) needed to develop a field. Multiple well pads may be used when developing a field inside the limits of a city or in environmentally sensitive areas.

Other surface equipment and support facilities are brought in or constructed during field development. For example, a battery of storage tanks or a pipeline may be required to handle produced oil or gas. Separation and treatment facilities are required to separate gas and water from oil. Storage tanks are required to hold brines produced during oil extraction, and a proper disposal capability, most typically reinjection, must be developed. Natural gas must be properly disposed of (usually flared) or treated to remove impurities if it is to used or sold.

Well Servicing and Workover Operations—Sometimes it is necessary to repair downhole mechanical problems. Workover rigs are often used to repair downhole equipment or assist in large stimulation jobs. The most common well servicing operation is related to artificial lift installation, tubing string repairs, and work on other downhole completion equipment that may be malfunctioning. More involved workover operations might include cleanout of sand, scale, or paraffin deposits that accumulate in the well, casing repair, cementing, perforating new or existing zones of production, or even some limited drilling operations.

Workover rigs are scaled-down drilling rigs. They are usually equipped to stand the pipe in the derrick, rotate pipe while it is in the hole, and circulate workover fluids down and back up the well. Workover rigs are usually self-contained on a truck. They are highly mobile and can be rigged up and rigged down quickly. A well servicing jog to replace a rod pump may last only 1 or 2 days. A major workover operation to change or “recomplete” to another productive zone may last more than a month.

PLUGGING/ABANDONMENT/RECLAMATION

Workover rigs are also used to plug and abandon wells once they are depleted. Plugging operations consist of removing the tubing, packer, and other completion equipment; pumping cement across producing zones; and placing cement plugs at various depths to protect freshwater zones. Finally, a cement plug is set at the surface to cap the well, and wellhead equipment is cut off. A permanent abandonment marker is often placed to identify the well’s location.

The surface owner and regulatory agencies often dictate surface reclamation. Reclamation can range from just removing equipment to reclaiming the area to conditions that existed before drilling the well.

Full-scale reclamation can include the following:

- Removal of structures, equipment, and debris used or generated during operations;
- Removal or remediation of contaminated soils;
- Recontouring of disturbed areas to near original grade;
- Spreading and preparation of topsoil;
- Planting of native vegetation, usually grasses, but sometimes also tree saplings;
- Erosion protection measures such as mulching; and
- Monitoring of revegetation and erosion control efforts.

Reclamation may last a few days or a few years, depending on the degree of contamination on the site and the ability of native species to grow.

APPENDIX D: NATIONAL WILDLIFE REFUGE SYSTEM UNITS WITH NON-FEDERAL OIL AND GAS WELLS.

TABLE D. NWRS UNITS WITH NON-FEDERAL OIL AND GAS WELLS

(Other includes wells other than oil and gas: injection, saltwater disposal, enhanced oil recovery, dry, observation, stratigraphic, other, and production type data not available (N/A)).

Region / State / NWRS Unit	Gas	Oil	Oil and Gas	Other	Total
Pacific Region (1)	**0**	**0**	**0**	**0**	**0**
Southwest Region (2)	**358**	**282**	**26**	**308**	**974**
Arizona				**1**	**1**
Buenos Aires National Wildlife Refuge				1	1
New Mexico	**5**	**10**		**2**	**17**
Bitter Lake National Wildlife Refuge	5	10			15
Sevilleta National Wildlife Refuge				2	2
Oklahoma	**62**	**149**		**255**	**466**
Deep Fork National Wildlife Refuge	26	147		227	400
Little River National Wildlife Refuge		1		7	8
Optima National Wildlife Refuge	13			2	15
Salt Plains National Wildlife Refuge	11	1		1	13
Sequoyah National Wildlife Refuge				4	4
Tishomingo National Wildlife Refuge	2			12	14
Washita National Wildlife Refuge	10			2	12
Texas	**291**	**123**	**26**	**50**	**490**
Anahuac National Wildlife Refuge	5	7		3	15
Aransas National Wildlife Refuge	58	8	4	2	72
Attwater Prairie Chicken National Wildlife Refuge	19	1			20
Big Boggy National Wildlife Refuge	1				1
Brazoria National Wildlife Refuge	12	4	3		19
Caddo Lake National Wildlife Refuge	2	2		1	5
Hagerman National Wildlife Refuge	3	71	4	38	116
Laguna Atascosa National Wildlife Refuge	11				11
Lower Rio Grande Valley National Wildlife Refuge	139	23	10	3	175
Mcfaddin National Wildlife Refuge	14	4		2	20
San Bernard National Wildlife Refuge	24	3	2	1	30
Texas Point National Wildlife Refuge			2		2
Trinity River National Wildlife Refuge	3		1		4
Midwest Region (3)	**2**	**7**		**93**	**102**
Indiana		**7**		**89**	**96**
Big Oaks National Wildlife Refuge				5	5

Region / State / NWRS Unit	Gas	Oil	Oil and Gas	Other	Total
Muscatatuck National Wildlife Refuge				1	1
Patoka River National Wildlife Refuge		7		83	90
Michigan	**2**				**2**
Kirtlands Warbler Wildlife Management Area	2				2
Missouri				**4**	**4**
Big Muddy National Fish And Wildlife Refuge				4	4
Southeast Region (4)	**1,709**	**530**	**16**	**1,172**	**3,427**
Alabama				**14**	**14**
Cahaba River National Wildlife Refuge				14	14
Arkansas	**8**	**51**		**6**	**65**
Bald Knob National Wildlife Refuge	3				3
Cache River National Wildlife Refuge	2				2
Felsenthal National Wildlife Refuge	3	48		6	57
Overflow National Wildlife Refuge		1			1
White River National Wildlife Refuge		2			2
Florida				**4**	**4**
Florida Panther National Wildlife Refuge				2	2
National Key Deer Refuge				1	1
Ten Thousand Islands National Wildlife Refuge				1	1
Kentucky				**1**	**1**
Reelfoot National Wildlife Refuge				1	1
Louisiana	**1,693**	**349**	**16**	**772**	**2,830**
Atchafalaya National Wildlife Refuge	9	12	2	23	46
Bayou Cocodrie National Wildlife Refuge				49	49
Bayou Sauvage National Wildlife Refuge				4	4
Bayou Teche National Wildlife Refuge	14	3		18	35
Big Branch Marsh National Wildlife Refuge				4	4
Black Bayou Lake National Wildlife Refuge	78			7	85
Breton National Wildlife Refuge				3	3
Cameron Prairie National Wildlife Refuge				14	14
Cat Island National Wildlife Refuge	2			3	5
Catahoula National Wildlife Refuge	1	20		54	75
D'arbonne National Wildlife Refuge	183			100	283
Delta National Wildlife Refuge	52	214	11	86	363
Grand Cote National Wildlife Refuge				2	2
Lacassine National Wildlife Refuge	32	5	1	42	80
Lake Ophelia National Wildlife Refuge		5		51	56
Mandalay National Wildlife Refuge	13	5		25	43
Red River National Wildlife Refuge	6	24		27	57
Sabine National Wildlife Refuge	22	23	2	51	98

Region / State / NWRS Unit	Gas	Oil	Oil and Gas	Other	Total
St. Catherine Creek National Wildlife Refuge				6	6
Tensas River National Wildlife Refuge	1	36		75	112
Upper Ouachita National Wildlife Refuge	1,280	2		128	1,410
Mississippi	**8**	**130**		**375**	**513**
Grand Bay National Wildlife Refuge				1	1
Mississippi Sandhill Crane National Wildlife Refuge				1	1
Panther Swamp National Wildlife Refuge				2	2
St. Catherine Creek National Wildlife Refuge	8	130		370	508
Yazoo National Wildlife Refuge				1	1
Northeast Region (5)	**7**	**4**	**11**	**28**	**50**
New York				**1**	**1**
Montezuma National Wildlife Refuge				1	1
Pennsylvania	**2**				**2**
Erie National Wildlife Refuge	2				2
West Virginia	**5**	**4**	**11**	**27**	**47**
Canaan Valley National Wildlife Refuge	4			3	7
Ohio River Islands National Wildlife Refuge	1	4	11	24	40
Mountain - Prairie Region (6)	**42**	**37**	**2**	**41**	**122**
Colorado				**3**	**3**
Baca National Wildlife Refuge				2	2
Rocky Mountain Arsenal National Wildlife Refuge				1	1
Kansas	**1**	**25**	**1**		**27**
Quivira National Wildlife Refuge	1	25	1		27
Montana	**40**	**9**		**34**	**83**
Benton Lake National Wildlife Refuge				2	2
Benton Lake Wetland Management District	4			7	11
Bowdoin National Wildlife Refuge	1			1	2
Bowdoin Wetland Management District	21			2	23
Hailstone National Wildlife Refuge				1	1
Halfbreed Lake National Wildlife Refuge	1			4	5
Hewitt Lake National Wildlife Refuge	13			1	14
Lake Mason National Wildlife Refuge				2	2
Medicine Lake National Wildlife Refuge		2		3	5
Northeast Montana Wetland Management District		7		11	18
North Dakota			**1**		**1**
Lake Ilo National Wildlife Refuge			1		1
Utah	**1**	**3**		**3**	**7**
Bear River Migratory Bird Refuge				3	3
Colorado River Wildlife Management Area	1	2			3
Ouray National Wildlife Refuge		1			1

Region / State / NWRS Unit	Gas	Oil	Oil and Gas	Other	Total
Wyoming				**1**	**1**
Mortenson Lake National Wildlife Refuge				1	1
Alaska Region (7)	**75**	**66**	**4**	**54**	**199**
Alaska	**75**	**66**	**4**	**54**	**199**
Alaska Peninsula National Wildlife Refuge				5	5
Becharof National Wildlife Refuge				2	2
Kenai National Wildlife Refuge	75	66	4	46	191
Yukon Delta National Wildlife Refuge				1	1
Pacific Southwest Region (8)	**8**	**45**		**75**	**128**
California	**8**	**45**		**70**	**123**
Bitter Creek National Wildlife Refuge				12	12
Butte Sink Wildlife Management Area				1	1
Colusa National Wildlife Refuge	1			3	4
Delevan National Wildlife Refuge	1			7	8
Grasslands Wildlife Management Area				6	6
Guadalupe-Nipomo Dunes National Wildlife Refuge		2		1	3
Hopper Mountain National Wildlife Refuge		17		2	19
Humboldt Bay National Wildlife Refuge				1	1
Kern National Wildlife Refuge				2	2
Merced National Wildlife Refuge				1	1
North Central Valley Wildlife Management Area	6			22	28
Pixley National Wildlife Refuge				1	1
San Joaquin River National Wildlife Refuge				5	5
San Pablo Bay National Wildlife Refuge				1	1
Seal Beach National Wildlife Refuge		26		4	30
Tijuana Slough National Wildlife Refuge				1	1
Nevada				**5**	**5**
Fallon National Wildlife Refuge				1	1
Stillwater National Wildlife Refuge				4	4
Grand Total	**2,201**	**971**	**59**	**1,771**	**5,002**

APPENDIX E: CLASS I AND CLASS II NATIONAL WILDLIFE REFUGE SYSTEM UNITS IN DESIGNATED NONATTAINMENT AREAS

If the concentration of one or more criteria pollutants in a geographic area is found to exceed the regulated or threshold level for one or more NAAQS, the area may be classified as a nonattainment area

TABLE E-1. REFUGES IN NONATTAINMENT AREAS

NWR Unit	PSD Class	County	NAAQS Nonattainment Area	Pollutant(s)
Class I National Wildlife Refuges				
Edwin B. Forsythe National Wildlife Refuge	I	Atlantic	Philadelphia-Wilmington- Atlantic City, PA-NJ-MD-DE	O_3, $PM_{2.5}$
Breton National Wildlife Refuge	I	St. Bernard Parish	St. Bernard Parish, LA	SO_2
Class II National Wildlife Refuges				
Amagansett National Wildlife Refuge	II	Suffolk	New York, NY-NJ-CT	O_3, $PM_{2.5}$
Anahuac National Wildlife Refuge	II	Chambers	Houston-Galveston-Brazoria, TX	O_3
Antioch Dunes National Wildlife Refuge	II	Contra Costa	San Francisco Bay Area, California	O_3, $PM_{2.5}$, CO
Atchafalaya National Wildlife Refuge	II	St. Martin; Iberville	Baton Rouge, LA	O_3
Big Muddy National Fish and Wildlife Refuge	II	St. Charles; St. Louis County	St. Louis-St. Charles-Farmington, MO-IL	O_3
Bitter Creek National Wildlife Refuge	II	Ke rn	San Joaquin Valley, CA	O_3, $PM_{2.5}$, PM_{10}
Blackwater National Wildlife Refuge	II	Dorchester	Washington, DC-MD-VA	O_3
Blue Ridge National Wildlife Refuge	II	Tulare	San Joaquin Valley, CA	O_3, $PM_{2.5}$, PM_{10}
Brazoria National Wildlife Refuge	II	Brazoria	Houston-Galveston-Brazoria, TX	O_3
Cabeza Prieta National Wildlife Refuge	II	Pi ma	Pima County, Ajo planning area, AZ	PM_{10}
Cape May National Wildlife Refuge	II	Cape May	Philadelphia-Wilmington, PA-NJ-DE	O_3

NWR Unit	PSD Class	County	NAAQS Nonattainment Area	Pollutant(s)
Cibola National Wildlife Refuge	II	Imperial	Imperial County, CA	O_3
Coachella Valley National Wildlife Refuge	II	Riverside	Riverside County (Coachella County), CA	O_3, PM_{10}
Conscience Point National Wildlife Refuge	II	Suffolk	New York, NY-NJ-CT	O_3, $PM_{2.5}$
Desert National Wildlife Refuge	II	Cl ar k	Las Vegas Area, NV	PM_{10}, CO
Detroit River International Wildlife Refuge	II	Wayne	Detroit-Ann Arbor, MI	$PM_{2.5}$, SO_2, CO
Don Edwards San Francisco Bay National Wildlife Refuge	II	Santa Clara	San Francisco Bay Area, CA	O_3, $PM_{2.5}$, CO
Elizabeth Alexandra Morton National Wildlife Refuge	II	Suffolk	New York, NY-NJ-CT	O3, PM2.5
Farallon National Wildlife Refuge	II	Marin	San Francisco Bay Area, CA	O3, PM2.5, CO
Featherstone National Wildlife Refuge	II	Prince William	Washington, DC-MD-VA	O3
Great Swamp National Wildlife Refuge	II	Morris	New York, NY-NJ-CT	O3, PM2.5
Havasu National Wildlife Refuge	II	Mohave	San Bernardino County (part), excluding Searles Valley Planning area and South Coast Air Basin, CA	PM10
Hopper Mountain National Wildlife Refuge	II	Ventura	Ventura County, CA	O3
Imperial National Wildlife Refuge	II	La Paz	Imperial County, CA	O3
John Heinz National Wildlife Refuge at Tinicum	II	Philadelphia; Delaware	Philadelphia- Wilmington, PA-NJ-DE	O3, PM2.5, CO

NWR Unit	PSD Class	County	NAAQS Nonattainment Area	Pollutant(s)
Kern National Wildlife Refuge	II	Kern	San Joaquin Valley, CA	O3, PM2.5, PM10
Lower Klamath National Wildlife Refuge	II	Klamath	Klamath Falls, OR	PM2.5
Marin Islands National Wildlife Refuge	II	Marin	San Francisco Bay Area, CA	PM2.5
Mason Neck National Wildlife Refuge	II	Fairfax County	Washington, DC-MD-VA	O3
McFaddin National Wildlife Refuge	II	Jefferson	Houston-Galveston-Brazoria, TX	O3
McNary National Wildlife Refuge	II	Walla Walla	Walla Walla County, Wallula, WA	PM10
Merced National Wildlife Refuge	II	Merced	San Joaquin Valley, CA	O3, PM2.5, PM10
Middle Mississippi River National Wildlife Refuge	II	Monroe; Jefferson	Jefferson County, MO	O3, SO2
Minnesota Valley National Wildlife Refuge	II	Scott	Minneapolis-St. Paul Area, MN	CO
Nisqually National Wildlife Refuge	II	Pierce	Seattle-Tacoma Area, WA	CO
Nomans Land Island National Wildlife Refuge	II	Dukes	Dukes County, MA	O3
Occoquan Bay National Wildlife Refuge	II	Prince William	Washington, DC-MD-VA	O3
Ohio River Islands National Wildlife Refuge	II	Beaver	Marshall, WV	O3, PM2.5, SO2
Oyster Bay National Wildlife Refuge	II	Suffolk	New York, NY-NJ-CT	O3, PM2.5, CO
Pixley National Wildlife Refuge	II	Tulare	San Joaquin Valley, CA	O3, PM2.5, PM10

NWR Unit	PSD Class	County	NAAQS Nonattainment Area	Pollutant(s)
Prime Hook National Wildlife Refuge	II	Sussex	Seaford, DE	O3
Ridgefield National Wildlife Refuge	II	Clark	Vancouver Area, Clark County (part), WA	CO
Rocky Flats National Wildlife Refuge	II	Jefferson	Denver-Boulder-Greeley-Ft. Collins-Loveland, CO	O3, PM10, CO
Rocky Mountain Arsenal National Wildlife Refuge	II	Adams	Denver-Boulder-Greeley-Ft. Collins-Loveland, CO	O3, PM10, CO
Sacramento River National Wildlife Refuge	II	Butte	Chico, CA	O3, PM2.5
San Bernard National Wildlife Refuge	II	Brazoria	Houston-Galveston-Brazoria, TX	O3
San Diego Bay National Wildlife Refuge	II	San Diego	San Diego County, CA	O3, CO
San Diego National Wildlife Refuge	II	San Diego	San Diego County, CA	O3, CO
San Joaquin National Wildlife Refuge	II	Stanislaus	San Joaquin Valley, CA	O3, PM2.5, PM10
San Luis National Wildlife Refuge	II	Merced	San Joaquin Valley, CA	O3, PM2.5, PM10
San Pablo Bay National Wildlife Refuge	II	Napa, Solano	San Francisco Bay Area, CA	O3, PM2.5, CO
Seal Beach National Wildlife Refuge	II	Orange	Los Angeles, CA	O3, PM2.5, PM10, NO2, CO
Seatuck National Wildlife Refuge	II	Suffolk	New York-N. New Jersey-Long Island, NY-NJ-CT	O3, PM2.5
Seedskadee National Wildlife Refuge	II	Sweetwater	Upper Green River Basin Area, WY	O3
Silvio O. Conte National Wildlife Refuge	II	Middlesex	New York-N. New Jersey-Long Island, NY-NJ-CT	O3, CO

NWR Unit	PSD Class	County	NAAQS Nonattainment Area	Pollutant(s)
Sonny Bono Salton National Wildlife Refuge	II	Imperial	Imperial Co, CA	O3, PM2.5, PM10
Steigerwald Lake National Wildlife Refuge	II	Clark	Vancouver Area, Clark County (part), WA	CO
Stewart B. McKinney National Wildlife Refuge	II	Fairfield	New York, NY-NJ-CT	O3, PM2.5, CO
Stone Lakes National Wildlife Refuge	II	Sacramento	Sacramento, CA	O3, PM2.5, PM10
Supawna Meadows National Wildlife Refuge	II	Salem	Philadelphia- Wilmington, PA-NJ-DE	O3, PM2.5
Sutter National Wildlife Refuge	II	Sutter	Yuba City-Marysville, CA	PM2.5
Target Rock National Wildlife Refuge	II	Suffolk	New York, NY-NJ-CT	O3, PM2.5
Tijuana Slough National Wildlife Refuge	II	San Diego	San Diego County, CA	O3, CO
Trinity River National Wildlife Refuge	II	Liberty	Houston-Galveston-Brazoria, TX	O3
Tualatin River National Wildlife Refuge	II	Washington	Portland Area, Portland Metro Service District Boundary, OR	CO
Two Ponds National Wildlife River	II	Jefferson	Denver-Boulder-Greeley-Ft. Collins-Loveland, CO	O3, PM10, CO
Two Rivers National Wildlife Refuge	II	St. Charles, Jersey	St. Louis-St. Charles-Farmington, MO-IL	O3
Upper Klamath National Wildlife Refuge	II	Klamath	Klamath Falls, OR	PM2.5
Wallkill River National Wildlife Refuge	II	Sussex	New York, NY-NJ-CT	O3, PM2.5
Wapanocca National Wildlife Refuge	II	Crittenden	Memphis, TN-MS-AR	O3

Nonattainment Areas

NWR Unit	PSD Class	County	NAAQS Nonattainment Area	Pollutant(s)
Watercress Darter National Wildlife Refuge	II	Jefferson County	Birmingham, AL	PM2.5
Wertheim National Wildlife Refuge	II	Suffolk	New York, NY-NJ-CT	O3, PM2.5

APPENDIX F: WETLANDS IN NATIONAL WILDLIFE REFUGE SYSTEM UNITS

TABLE F-1. SELECTED WETLAND DESCRIPTIONS

Classification	Type	Description
System	Marine	The marine system consists of the open ocean overlying the continental shelf and its associated high-energy coastline. Marine habitats are exposed to the waves and currents of the open ocean and the water regimes are determined primarily by the ebb and flow of oceanic tides. Salinities exceed 30%, with little or no dilution except outside the mouths of estuaries. Shallow coastal indentations or bays without appreciable freshwater inflow, and coasts with exposed rocky islands that provide the mainland with little or no shelter from wind and waves, are also considered part of the marine system because they generally support typical marine biota.
	Estuarine	The estuarine system consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land. The salinity may be periodically increased above that of the open ocean by evaporation. Along some low-energy coastlines there is appreciable dilution of seawater. The estuarine system includes both estuaries and lagoons. It is more strongly influenced by its association with land than the marine system.
	Riverine	The riverine system includes all wetlands and deepwater habitats contained within a channel, with two exceptions: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean-derived salts in excess of 0.5%. A channel is an open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of standing water. The riverine system is divided into four subsystems: tidal, lower perennial, upper perennial, and intermittent. Each is defined in terms of water permanence, gradient, water velocity, substrate, and the extent of floodplain development.
	Lacustrine	The lacustrine system includes wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30% areal coverage; and (3) total area exceeds 8 ha (20 acres). Similar wetland and deepwater habitats totaling less than 8 ha are also included if an active wave-formed or bedrock shoreline feature makes up all or part of the boundary, or if the water depth in the deepest part of the basin exceeds 2 m (6.6 feet)

Classification	Type	Description
		at low water. Lacustrine waters may be tidal or nontidal, but ocean-derived salinity is always less than 0.5%.
	Palustrine	The palustrine system includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5%. It also includes wetlands lacking such vegetation, but with all of the following four characteristics: (1) area less than 8 ha (20 acres); (2) active wave-formed or bedrock shoreline features lacking; (3) water depth in the deepest part of basin less than 2 m at low water; and (4) salinity due to ocean-derived salts less than 0.5%. The palustrine system was developed to group the vegetated wetlands traditionally called by such names as marsh, swamp, bog, fen, and prairie, which are found throughout the United States. It also includes the small, shallow, permanent, or intermittent water bodies often called ponds.
Subsystem	Intertidal	The substrate is exposed and flooded by tides; includes the associated splash zone.
	Subtidal	The substrate is continuously submerged.
	Tidal	The gradient is low and water velocity fluctuates under tidal influence. The streambed is mainly mud with occasional patches of sand. Oxygen deficits may sometimes occur and the fauna is similar to that in the lower perennial subsystem. The floodplain is typically well developed.
	Lower Perennial	The gradient is low and water velocity is slow. There is no tidal influence, and some water flows throughout the year. The substrate consists mainly of sand and mud. Oxygen deficits may sometimes occur, the fauna is composed mostly of species that reach their maximum abundance in still water, and true planktonic organisms are common. The gradient is lower than that of the upper perennial subsystem, and the floodplain is well developed.
	Upper Perennial	The gradient is high and velocity of the water fast. There is no tidal influence, and some water flows throughout the year. The substrate consists of rock, cobbles, or gravel with occasional patches of sand. The natural dissolved oxygen concentration is normally near saturation. The fauna is characteristic of running water, and there are few or no planktonic forms. The gradient is high compared with that of the lower perennial subsystem, and there is very little floodplain development.
	Intermittent	The channel contains flowing water for only part of the year. When the water is not flowing, it may remain in isolated pools or surface water may be absent.
	Limnetic	All deepwater habitats within the lacustrine system; many small lacustrine systems have no limnetic subsystem.

Classification	Type	Description
	Littoral	All wetland habitats in the lacustrine system. Extends from the shoreward boundary of the system to a depth of 2 m (6.6 feet) below low water or to the maximum extent of nonpersistent emergent plants, if these grow at depths greater than 2 m.
Class	Scrub-Shrub	The scrub-shrub wetland class includes areas dominated by woody vegetation less than 6 m (20 feet) tall. The species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. All water regimes except subtidal are included. Scrub-shrub wetlands may represent a successional stage leading to forested wetland, or they may be relatively stable communities. They are known by many names, such as shrub swamp, shrub carr, bog, and pocosin. For practical reasons we have also included forests composed of young trees less than 6 m tall.
	Aquatic Bed	The aquatic bed class includes wetlands and deepwater habitats dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Water regimes include subtidal, irregularly exposed, regularly flooded, permanently flooded, intermittently exposed, semipermanently flooded, and seasonally flooded.
	Persistent	Persistent emergent wetlands are dominated by species that normally remain standing at least until the beginning of the next growing season. This subclass is found only in the estuarine and palustrine systems. Persistent emergent wetlands dominated by saltmarsh cordgrass (*Spartina alterniflora*), saltmeadow cordgrass (*S. patens*), big cordgrass (*S. cynosuroides*), needlerush (*Juncus roemerianus*), narrowleaved cattail (*Typha angustifolia*), and southern wild rice (*Zizaniopsis miliacea*) are major components of the estuarine systems of the Atlantic and Gulf Coasts of the United States.
	Emergent	The emergent wetland class is characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants. All water regimes are included except subtidal and irregularly exposed.
	Unconsolidated Bottom	The unconsolidated bottom class includes all wetland and deepwater habitats with at least 25% cover of particles smaller than stones, and a vegetative cover less than 30%. Water regimes are restricted to subtidal, permanently flooded, intermittently exposed, and semipermanently flooded. Unconsolidated bottoms are characterized by the lack of large, stable surfaces for plant and animal attachment. They are usually found in areas with lower energy than rock bottoms, and may be very unstable. Exposure to wave and current action, temperature, salinity, and light penetration determines the composition and distribution of organisms.
	Unconsolidated	The unconsolidated shore class includes all wetland habitats having

Classification	Type	Description
	Shore	three characteristics: (1) unconsolidated substrates with less than 75% areal cover of stones, boulders, or bedrock; (2) less than 30% areal cover of vegetation other than pioneering plants; and (3) any of the following water regimes: irregularly exposed, regularly flooded, irregularly flooded, seasonally flooded, temporarily flooded, intermittently flooded, saturated, or artificially flooded. Unconsolidated shores are characterized by substrates lacking vegetation except for pioneering plants that become established during brief periods when growing conditions are favorable. Erosion and deposition by waves and currents produce a number of landforms such as beaches, bars, and flats, all of which are included in this class.
	Rock Bottom	Includes all wetlands and deepwater habitats with substrates having a covered area of stones, boulders, or bedrock 75% or greater and vegetative cover of less than 30%. Water regimes are restricted to subtidal, permanently flooded, intermittently exposed, and semipermanently flooded.
	Rock Shore	Includes wetland environments characterized by bedrock, stones, or boulders which singly or in combination have a covered area of 75% or more and coverage by vegetation of less than 30%. Water regimes are restricted to irregularly exposed, regularly flooded, irregularly flooded, seasonally flooded, temporarily flooded, and intermittently flooded.
	Forested	The forested wetland class is characterized by woody vegetation that is 6 m tall or taller. All water regimes are included except subtidal. Forested wetlands are most common in the eastern United States and in those sections of the West where moisture is relatively abundant, particularly along rivers and in the mountains. They occur only in the palustrine and estuarine systems and normally possess an overstory of trees, an understory of young trees or shrubs, and an herbaceous layer. Forested wetlands in the estuarine system, which include the mangrove forests of Florida, Puerto Rico, and the Virgin Islands, are known by such names as swamps, hammocks, heads, and bottoms. These names often occur in combination with species names or plant associations such as cedar swamp or bottomland hardwoods.

Source: Cowardin et al. 1979.

APPENDIX G: GLOSSARY

Abandon—To stop producing or injecting fluid from a well when it becomes unprofitable, or has failed beyond repair, or to stop further work on a newly drilled well when it does not contain profitable quantities of oil or gas.

Affected environment—A term used in the National Environmental Policy Act to denote surface or subsurface resources (including social and economic elements) within or adjacent to a geographic area that could potentially be affected by a proposed action; the environment of the area to be affected or created by the alternatives under consideration. (40 CFR § 1502.15)

Alternative—A combination of management actions applied in specific amounts and locations to achieve desired management goals and objectives.

Barrel (bbl)—A measure of volume of petroleum product used in the United States. One barrel equals 42 U.S. gallons or 0.15899 cubic meters (6.29 barrels = 1 cubic meter).

Best management practices (BMPs)—BMPs are state-of-the-art mitigation measures applied to oil and natural gas drilling and production to help ensure that energy development and operations are conducted in an environmentally responsible manner. BMPs can be simple, such as choosing a paint color that helps oil and gas equipment blend in with the natural surroundings, while others involve cutting edge monitoring and production technologies.

Borehole (wellbore)— the hole made by a drilling rig.

Bottomhole—The deepest portion of an oil well.

Brine—Formation water produced along with oil and gas and containing relatively large concentrations of dissolved salts, particularly sodium chloride. Brine has higher salt concentrations than ocean water.

Casing—Steel pipe threaded together and cemented into a well as drilling progresses to (1) prevent the wall of the hole from caving in during drilling, and (2) provide a means of extracting oil and/or gas if the well is productive.

Cement plug—A balanced plug of cement slurry placed in the wellbore. Cement plugs are used for a variety of applications including hydraulic isolation, provision of a secure platform, and in window-milling operations for sidetracking a new wellbore.

Code of Federal Regulations (CFR)—A publication that codifies the general and permanent rules and regulations published in the Federal Register by the Executive Branch departments and agencies of the Federal Government, and which carry the force of law.

Completion—The activities and methods used to prepare a well for production. Includes installation of equipment for production from an oil or gas well.

Contaminating substance—Those substances, including but not limited to: saltwater or any other injurious or toxic chemical; waste oil or waste emulsified oil; basic sediment; mud with injurious or toxic substances produced or used in the drilling, development, production, transportation, or onsite storage, refining, and processing of oil and gas.

Cultural resource—Cultural resources include archaeological sites, historic sites, buildings, and districts; cultural landscapes; and ethnographic resources.

Development phase—The phase in which a proven oil or gas field is brought into production by drilling production (development) wells.

Directional drilling—Intentional deviation of a wellbore from the vertical (90 degrees). Although wellbores are normally drilled vertically, it is sometimes necessary or advantageous to drill at an angle from the vertical to avoid surface resources.

Disturbance—Significant alteration of habitat structure or composition or of the behavior of wildlife. May be natural (e.g., fire) or man-made (e.g., seismic testing).

Drill pipe—A steel pipe, in approximately 30-foot (9-meter) lengths, screwed together to form a continuous pipe extending from the drilling rig to the drilling bit at the bottom of the hole. Rotation of the drill pipe and bit causes the bit to bore through the rock.

Drilling fluid ("mud")—Circulating fluid, one function of which is to lift cuttings out of the wellbore and to the surface. While a mixture of clay, water, and other chemical additives is the most common drilling fluid, wells can also be drilled using oil-based muds, air, or water as the drilling fluid.

Endangered species—An animal or plant species in danger of extinction throughout all or a significant portion of its range.

Environmental impact statement (EIS)—A document required by NEPA and prepared to analyze the impacts on the environment of a proposed project or action and released to the public for comment and review. EISs are prepared when there is the potential for major impacts on natural, cultural, or socioeconomic resources.

Exploration phase—The part of operations that covers the search for oil or gas. It involves carrying out detailed geological and geophysical surveys followed up, where appropriate, by exploratory drilling.

Federal Register—Daily publication of the National Archives and Records Administration that updates the Code of Federal Regulations, in which the public may review the regulations and legal notices issued by Federal agencies.

Floodplain—Any land area susceptible to being inundated by floodwaters from any source. Typically low, flat land along a stream or river that may flood but also includes relatively flat areas adjoining inland and coastal waters including floodprone areas of offshore islands.

Flowlines and gathering lines—Lines or pipelines that transport produced fluids (e.g., oil, gas, brine) from the wellhead to storage, treatment or transportation facilities.

Fracturing—A method of stimulating production by opening new flow channels in the rock by pumping fluid at very high pressures into the formation of a production well. Often called a “frac job” or “frac-ing”.

Gas—Any fluid, either combustible or noncombustible, which is produced in a natural state from the earth, and which maintains a gaseous or rarefied state at ordinary temperature and pressures.

Geophysical exploration—Geophysical exploration consists primarily of seismic operations and typically involves selective cutting of vegetation along source and receiver lines as needed, use of shotholes/explosives or seismic vibrators as a source of vibration, and recording the data produced from the soundwaves generated in the ground by the source.

Hydrocarbon—An organic compound containing only the elements hydrogen and carbon. An organic compound can be a solid, liquid, or gas. The term is mainly used in a catchall sense for oil, gas, and condensate (a low-density mixture of hydrocarbon liquids usually produced with natural gas, also referred to as natural gasoline).

Impacts—The likely effects of an action upon specific natural, cultural, or socioeconomic resources. Impacts may be short-term or long-term, beneficial or adverse, and direct or indirect.

Natural gas—A highly compressible and expandable mixture of hydrocarbons with low specific gravity that occurs naturally in a gaseous form.

Mitigation—Activities that can be undertaken to avoid, minimize, restore, or offset impacts of energy development.

Oil—A simple or complex liquid mixture of hydrocarbons that can be refined to yield products such as gasoline, kerosene, and diesel fuel.

Operations Permit—A type of Special Use Permit specifically geared to oil and gas operations that provides stipulations and practices for oil and gas operations on Refuge System lands and waters.

Operator—The person or company actually operating an oil well or lease. It is generally the oil company that engages the drilling, service, and workover contractors.

Petroleum—A thick, flammable, naturally occurring liquid that is a mixture of various hydrocarbons. It is used in a natural or refined state as fuel, or separated by distillation into products such as gasoline, naphtha, benzene, kerosene, or paraffin.

Performance-based standards—Regulatory standards that are results-oriented rather than prescribing specific measures to achieve an outcome. A performance-based standard specifies the outcome required but leaves the concrete measures to achieve that outcome up to the discretion of the regulatory entity.

Plug—An object or device that serves to block a hole or passageway, such as a cement plug in a borehole.

Plug and Abandon—To place cement plugs in a hole to prevent unwanted vertical migration of fluids in an abandoned well into aquifers or other geologic formations. Also referred to as “P & A”.

Plugging—Permanent closing of a well by removing the completion equipment, pumping cement across producing zones, placing cement plugs at various depths to protect freshwater zones, setting a plug at the surface to cap the well, and removing wellhead equipment.

Preferred Alternative—The alternative determined to best achieve the purpose and need of the proposed action, contribute to the Refuge System mission, addresses the significant issues, and is consistent with principles of sound fish and wildlife management.

Programmatic—Following a plan, policy, or program.

Production—Bringing the well fluids to the surface and separating them, and storing, gauging, and otherwise preparing product for the pipeline. Also refers to the amount of oil or gas produced over a given period.

Regulations—Rules or orders prescribed by Federal agencies to regulate conduct, and published in the CFR.

Reservoir—The subsurface, porous, permeable rock body in which oil and gas accumulate. It consists of a porous rock to hold the oil or gas and a caprock that prevents its escape.

Rotary drilling—A method of drilling in which the drill pipe is rotated, thereby rotating the bit.

Seismic survey—Relating to or denoting geological surveys using artificially produced vibrations in the earth, using explosives, air guns or large weights dropped from a vehicle.

Shothole—A drilled hole in which a charge of dynamite placed in the hole and detonated as a way of creating vibrations for seismic surveys. The shothole directs the energy of the explosion downward.

Shut-in well—A well that has been shut off so there is no production occurring because of well problems, lack of a suitable market for selling the oil or gas, or pending connection of the well with a pipeline.

Special Use Permit—General term for all permits issued by the National Wildlife Refuge System of the U.S. Fish and Wildlife Service.

Threatened species—An animal or plant species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Vertical drilling—Drilling of a well vertically (90 degrees) to reach a target zone straight underneath the surface location.

Well—A relatively narrow-diameter hole drilled through the ground and geologic formations to either produce oil and or natural gas or to inject fluids or gases such as saltwater, steam or carbon dioxide.

Well blowout—The uncontrolled release of oil, gas, or other drilling fluids from a well into the atmosphere or other zone after pressure control systems have failed.

Wellbore—The hole made by a drilling bit, including the openhole or uncased portion of the well.

Well completion—The installation of permanent wellhead equipment for the production of oil and gas; the method to establish one or more flow paths for hydrocarbons between the reservoir and the surface.

Well Pad—Well site, usually constructed of local materials, such as gravel, and commonly 4 to 6 acres in size. Pad constructed to support the drilling rig and associated equipment. A well pad can contain one or more wells. After drilling is completed the well pad can be reduced in size depending on the amount of area needed for production equipment such as storage tanks.

Well Stimulation—technique used to increase the permeability of an oil and gas reservoir around the wellbore to increase production. This can include hydraulic fracturing or the use of acids.

Wetlands—Lands that are transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water.

Workover—The performance of remedial or maintenance work on a producing well to try to increase production.

Workover rig—A portable rig used in the workover or maintenance of a well.

APPENDIX H: REFERENCES

Adams, M.B., P.J. Edwards, W.M. Ford, J.B. Johnson, T.M. Schuler, M. Thomas-Van Gundy, F. Wood. 2011. Effects of development of a natural gas well and associated pipeline on the natural and scientific resources of the Fernow Experimental Forest. Gen. Tech. Rep. NRS-76. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 24 p. Available at: http://www.fs.fed.us/nrs/pubs/gtr/gtr_nrs76.pdf. Accessed January 14, 2015.

AWWA (American Water Works Association). 2013. Water and hydraulic fracturing. Am. Water Works Assoc. Denver, CO. Available at: http://www.awwa.org/Portals/0/files/legreg/documents/AWWAFrackingReport.pdf. Accessed January 29, 2015.

Bailey, R.G. 1995. Description of the ecoregions of the United States. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO. Available at: http://www.fs.fed.us/land/ecosysmgmt/colorimagemap/ecoreg1_provinces.html. Accessed October 20, 2014.

Bayne, E.M, L. Habib, and S. Boutin. 2008. Impacts of chronic anthropogenic noise from energy-sector activity on abundance of songbirds in the boreal forest. Conservation Biology 22(5): 1186-1193.

Bradbury, J., M. Obeiter, L. Draucker, W. Wang, and A. Stevens. 2013. "Clearing the Air: Reducing Upstream Greenhouse Gas Emissions from U.S. Natural Gas Systems." Working Paper. Washington, DC: World Resources Institute. Available at: http://www.wri.org/publication/clearing-the-air.

Brittingham, M.C., K.O. Maloney, A.M. Farag, D.D. Harper, and Z.H. Bowen. 2014. Ecological risks of shale oil and gas development to wildlife, aquatic resources and their habitats. Environmental Science and Technology. 48(19): 11034-47.

Bulluck, J, J. Weber, D. Kulas, P. Comer, and P. Crist. 2011. Resource Vulnerability Assessment and Strategies for Management Options for the Eastern Shore of Virginia and Fisherman Island National Wildlife Refuges. NatureServe. Arlington, VA. 123 pp.

BLM. 2006. Final Environmental Impact Statement Jonah Infill Drilling Project, Sublette County, Wyoming. Wyoming State Office, Cheyenne, WY. Available at: http://www.blm.gov/style/medialib/blm/wy/information/NEPA/pfodocs/jonah.Par.1828.File.dat/09chap3.pdf. Accessed October 28, 2014.

Caltrans (California Department of Transportation). 2013. Technical Supplement to the Traffic Noise Analysis Protocol. California Department of Transportation, Division of Environmental Analysis, Environmental Engineering, Sacramento, CA. Available at: http://www.dot.ca.gov/hq/env/noise/pub/TeNS_Sept_2013B.pdf. Accessed January 23, 2015.

Carver, E. and J. Caudill. 2013. Banking on Nature: The Economic Benefits of National Wildlife Refuge Visitation to Local Communities. U.S. Fish and Wildlife Service, Division of Economics, Washington, DC. 365 pp. Available at http://www.fws.gov/refuges/about/RefugeReports/. Accessed October 15, 2014.

CEQ (Council on Environmental Quality). 1981 "Forty Most Asked questions Concerning CEQ's National Environmental Policy Act Regulations." Federal Register 46(55):18026–38. Available at http://energy.gov/nepa/downloads/forty-most-asked-questions-concerning-ceqs-national-environmental-policy-act. Accessed October 6, 20114.

_____1997. Considering Cumulative Effects Under the National Environmental Policy Act. Council on Environmental Quality. January 1997. Available at: https://ceq.doe.gov/nepa/ccenepa/exec.pdf. October 6, 2014.

_____2005. Executive Office of the President. Memorandum. RE: Guidance on the Consideration of Past Actions in Cumulative Effects Analysis. June 24, 2005. FROM: James L. Connaughton, Chairman. TO: Heads of Federal Agencies. Available Available at: http://www.gsa.gov/graphics/pbs/CEQ_Guidance_Consideration_PastActions_CumulativeEffects Analysis.pdf. Accessed January 6, 2015.

_____2007. A Citizen's Guide to the NEPA. Available at: http://ceq.hss.doe.gov/nepa/Citizens_Guide_Dec07.pdf. Accessed October 6, 2014.

Cowardin, L.M., V. Carter, F.C. Golet, E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U. S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. Available at: https://www.fws.gov/wetlands/Documents/Classification-of-Wetlands-and-Deepwater-Habitats-of-the-United-States.pdf. Accessed October 20, 2014.

Crush, J.R. and E.R.Thom. 2011. Review: The effects of soil compaction on root penetration, pasture growth and persistence. Pasture Persistence – Grassland Research and Practice Series 15: 73-78. Available at: http://www.grassland.org.nz/publications/nzgrassland_publication_2237.pdf. Accessed January 8, 2015.

Czech, B., S. Covington, T.M. Crimmins, J.A. Ericson, C. Flather, M. Gale, K. Gerst, M. Higgins, M. Kaib, E. Marino, T. Moran, J. Morton, N. Niemuth, H. Peckett, D. Savignano, L. Saperstein, S. Skorupa, E. Wagener, B. Wilen, and B. Wolfe. 2014. Planning for Climate Change on the National Wildlife Refuge System. US Fish and Wildlife Service, National Wildlife Refuge System, Washington, DC. 132 pp. Available at: http://www.fws.gov/refuges/vision/pdfs/PlanningforClimateChangeontheNWRS.pdf. Accessed October 20, 2014.

Darrah, T.H., A. Vengosh, R.B. Jackson, N.R. Warner and R.J. Poreda. 2014. Noble gases identify the mechanisms of fugitive gas contamination in drinking-water wells overlying the Marcellus and Barnett Shales. Proceedings of the National Academy of Sciences, 2014 DOI: 10.1073/pnas.1322107111. Available at: http://www.pnas.org/content/111/39/14076.full.pdf. Accessed January 28, 2015.

DeJong-Hughes, J., J.F. Moncrief, W.B. Voorhees, and J.B. Swan. 2001.Soil Compaction: Causes, Effects and Control. University of Minnesota Extension. Available at: http://www.extension.umn.edu/agriculture/tillage/soil-compaction/index.html. Accessed January 14, 2015.

Duiker, S.W. 2004. Avoiding and Mitigation Soil Compaction Associated with Natural Gas Development. Available at: http://extension.psu.edu/natural-resources/natural-gas/publications/avoiding-and-mitigating-soil-compaction-associated-with-natural-gas-development. Accessed January 14, 2015.

EIA (U.S. Energy Information Administration). 2013. AEO2013 Early Release Report. Available at: http://www.eia.gov/forecasts/aeo/er/pdf/0383er(2013).pdf. Accessed January 15, 2015.

Engesser M. 2013. An assessment of state oil and gas regulations. Report to the U.S. Fish and Wildlife Service, National Wildlife Refuge System, Div of Natural Resources and Conservation Planning, Wildlife Resources Branch, Washington, DC. August. 26 pp.

FERC (Federal Energy Regulatory Commission). 2004. Research of Wetland Construction and Mitigation Activities for Certificated Section 7(c) Pipeline Projects. FERC,Office of Energy Projects. Washington, D.C. Available at: http://www.ferc.gov/legal/maj-ord-reg/land-docs/2004-wet-lands.pdf. Accessed January 16, 2015.

FHWA (Federal Highway Administration). 2006. FHWA Roadway Construction Noise Model User's Guide. Final Report. January 2006. U.S. Department of Transportation, FHWA-HEP-05-054. Washington, DC. 28 pp. Available at: http://www.fhwa.dot.gov/environment/noise/construction_noise/rcnm/rcnm.pdf. Accessed January 22, 2015.

FEN (Forest Encyclopedia Network). 2008. The Appalachian Plateau Province. Available at: http://www.forestencyclopedia.net/p/p1522. Accessed October 20, 2014.

Fink, J.K. 2003. Oil field chemicals. Gulf Professional Publishing. New York. 495 pp.

Francis, C.D., C.P. Ortega, and A. Cruz. 2009. Noise pollution changes avian communities and species interactions. Current Biology 19: 1-9.

Glick P, J. Clough, A. Polaczyk, B. Couvillion, and B. Nunley. 2013. Potential effects of sea-level rise on coastal wetlands in southeastern Louisiana. Journal of Coastal Research, Special Issue No. 63, pp. 211–233.

Goddard Institute for Space Studies. 2007. Annual Mean Temperature Change for Three Latitude Bands. Datasets and Images. GISS Surface Temperature Analysis, Analysis Graphs and Plots. New York, New York. Available at: http://data.giss.nasa.gov/gistemp/graphs/Fig.B.lrg.gif. Accessed October 21, 2015.

GWPC (Groundwater Protection Council). 2014. State oil and natural gas regulations designed to protect water resources, 2014 Edition. Report to the U.S. Dept Energy, Nat’l Energy Tech. Lab. Prepared by the Groundwater Protection Council, Oklahoma City, OK. 118 pp. Available at: http://www.gwpc.org/sites/default/files/files/Oil%20and%20Gas%20Regulation%20Report%20Hyperlinked%20Version%20Final-rfs.pdf

GWPC and All Consulting. 2009. Modern Shale Gas Development in the US: A Primer. US Department of Energy, Office of Fossil Energy and National Energy Technology Laboratory. Available at: http://energy.gov/sites/prod/files/2013/03/f0/ShaleGasPrimer_Online_4-2009.pdf. Accessed January 15, 2015.

Hawkins, A.D., A.E. Pembroke, and A.N. Popper. 2015. Information gaps in understanding the effects of noise on fishes and invertebrates. Reviews in Fish Biology and Fisheries 25:39-64.

Howard, R.J., C.J. Wells, T.C. Michot, and D.J. Johnson. 2014. Effects of disturbance associated with seismic exploration for oil and gas reserves in coastal marshes. Environmental Management 54:30-50.

IPCC (International Panel on Climate Change). 2007. *Climate Change 2007: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor, and H.L. Miller (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, New York. Available at: http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg1_report_the_physical_science_basis.htm. Accessed October 14, 2014.

_____2013. Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Available at: https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_SPM_FINAL.pdf. Accessed October 21, 2014.

Johnson, D.H. 2001. Habitat Fragmentation Effects on Birds in Grasslands and Wetlands: A Critique of our Knowledge. Great Plains Research 11 (Fall 2001) 21: 1-31.

Keel, J. 2007. An Audit Report on Inspection and Enforcement Activities in the Field Operations Section of the Railroad Commission. Texas State Auditor's Office, Report No. 07-046, August. Austin, TX. 26 pp.

La Plata County. 2002. *La Plata County Impact Report*. La Plata County, Durango, CO. Available at: http://www.co.laplata.co.us/departments_elected_officials/planning/natural_resources_oil_gas/impact_report. Accessed January 14, 2015.

McBroom, M., T. Thomas, and Y. Zhang. 2012. Soil erosion and surface water quality impacts of natural gas development in East Texas, USA. Water 4(4):944-958.

Reinke, D.C, D.K. Ingram. 2009. Working Smart: NIOSH develops technology and products that address exposure to noise at the work site. Water Well Journal 61 (12):16-17.

Mall, A., S. Buccino, and J. Nichols. 2007. Drilling Down: Protecting Western Communities from the Health and Environmental Effects of Oil and Gas Production. October, 2007. Natural Resource Defense Council, New York, New York. Available at: http://www.nrdc.org/land/use/down/down.pdf. Accessed January 7, 2015.

Goddard Institute for Space Studies. 2007. Annual Mean Temperature Change for Three Latitude Bands. Datasets and Images. GISS Surface Temperature Analysis, Analysis Graphs and Plots. New York, New York. Available at: http://data.giss.nasa.gov/gistemp/graphs/Fig.B.lrg.gif. Accessed October 21, 2015.

NRCS (Natural Resources Conservation Service). nd. National soil survey handbook, title 430-VI. Part 622.03 Farmland Classification. Available online: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054226. Accessed December 9, 2014.

_____2007. Hydrologic Soil Groups, Chapter 7, Part 630 Hydrology, National Engineering Handbook. Washington, DC. Available at: http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba

NYDEC (New York State Department of Environmental Conservation). 2011. Revised Draft Supplemental Generic Environmental Impact Statement (SGEIS) on the Oil, Gas and Solution Mining Regulatory Program, Well Permit Issuance for Horizontal Drilling and High Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs issued in September 2011. NYDEC, Division of Mineral Resources, Albany, NY. Available at: http://www.dec.ny.gov/energy/58440.html. Accessed January 27, 2015.

Nicot, J., A. Hebel, S. Ritter, S. Walden, R. Baier, P. Galusky, J. Beach, R. Kyle, L. Symank and C. Breton. 2011. Current and Projected Water Use in the Texas Mining and Oil and Gas Industry. The University of Texas at Austin Bureau of Economic Geology for Texas Water Development Board. Available at: http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/0904830939_MiningWaterUse.pdf. Accessed January 22, 2015.

Palaneasu-Lovejoy M, C. Kranenburg, J.A. Barras, and J.C. Brock. 2013. Land loss due to recent hurricanes in coastal Louisiana, U.S.A. Journal of Coastal Research, Special Issue No. 63, pp. 97-109.

Parida, A.K. and A.B. Das. 2005. Salt tolerance and salinity effects on plants: a review. *Ecotoxicology and Environmental Safety*, Volume 60, Issue 3: pp 324–349.

Pennsylvania State University. 2009. Effects of Soils Compaction. Penn State College of Agricultural Sciences. Agricultural Research and Cooperative Extension. Available at: http://pubs.cas.psu.edu/FreePubs/pdfs/uc188.pdf. Accessed January 7, 2015.

Purpera, D.G. 2014. Regulation of oil and gas wells and management of orphaned wells, Office of Conservation – Dept Natural Resources, Performance Audit. Louisiana Legislative Auditor, Report ID No. 40120061, Baton Rouge, LA. May 28, 2014. 54 pp.

Rozell, D.J. and S.J. Reaven. 2012. Water pollution risk associated with natural gas extraction from the Marcellus Shale. Risk Analysis 32(8):1382-1393.

Sawyer, H., F. Lindzey, D. McWhirter, and K. Andrews. 2002. Potential Effects of Oil and Gas Development on Mule Deer and Pronghorn Populations in Western Wyoming. Transactions of the North American Wildlife and Natural Resources Conference. 67: 350-365.

Sexton N.R., A.M. Dietsch, A.W. Don Carlos, H.M. Miller, L.M. Koontz, and A. N. Solomon. 2012. National wildlife refuge visitor survey results—2010/2011: U.S. Geological Survey Data Series 685. Available at: http://pubs.usgs.gov/ds/685/DS685.pdf. Accessed November 19, 2014.

SHIP (Shale Gas Information Platform). 2013. Information on Drilling, Land Disturbance, Air Emissions, and Noise. Available at: http://www.shale-gas-information-platform.org/categories/operations/the-basics.html. Accessed January 17, 2015.

Stanturf, J.A., S.H. Schoenholtz, C.J. Schweitzer, J.P. Shepard. 2001. Achieving Restoration Success: Myths in Bottomland Hardwood Forests. Restoration Ecology 9 (2): 189-200.

Trombulak, S C. and C.A. Frissell. 2000. Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities. Conservation Biology 14: 18–30.

Tylianakis, J.M., R.K. Didham, J. Bascompte, and D.A. Wardle. 2008. Global Change and Species Interactions in Terrestrial Ecosystems. Ecology Letters 11: 1351–1363. doi: 10.1111/j.1461-

0248.2008.01250.x. Accessed January 20, 2015.

USDA (U.S. Department of Agriculture). 2006. Soil Orders Map of the United States. Available at: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/class/?cid=nrcs142p2_053589. Accessed October 23, 2014. Accessed October 14, 2015.

USDOI (U.S. Department of the Interior). 1980. *516 Departmental Manual 1-7 – NEPA Policies*; 45 FR 27541, amended by 49 FR 21437.

_____1981. *517 Departmental Manual 1 – Pesticides.*

_____1983. *Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation*, 48 FR 44716.

_____1988. *Onshore Oil and Gas Order Number 2, Section III, Drilling Abandonment Requirements*, 53 FR 46810-811.

_____1994. *519 Departmental Manual 1-2 – Protection of the Cultural Environment.*

USEPA (U.S. Environmental Protection Agency). 1999. Regional Haze Regulations; Final Rule. Available at: http://www.epa.gov/ttn/caaa/t1/fr_notices/rhfedreg.pdf. Accessed November 7, 2014.

_____2004. Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reservoirs Study. EPA 816-$-04-003. U.S. Environmental Protection Agency, Office of Water, Office of Ground Water and Drinking Water. Washington, DC. Available at : http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/wells_coalbedmethanestudy.cfm. Accessed October 15, 2014.

_____2009. A national assessment of impaired waters within or near U.S. Fish and Wildlife Service properties – Phase II Final Report. Document #EPA841-R-09-006. Office of Water, US Environmental Protection Agency, Washington, DC. 69 pp.

_____2011. Plan EJ 2014. U.S. Environmental Protection Agency, Office of Environmental Justice. Washington, DC. Available at: http://www.epa.gov/environmentaljustice/resources/policy/plan-ej-2014/plan-ej-2011-09.pdf. Accessed October 16, 2014.

_____2012. Study on the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources: Progress Report. EPA/601/R-12/011. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC. Available at: http://www2.epa.gov/hfstudy/study-potential-impacts-hydraulic-fracturing-drinking-water-resources-progress-report-0. Accessed January 15, 2015.

_____2013a. National Ambient Air Quality Standards (NAAQS). U.S. Environmental Protection Agency, Washington, DC. Available at: http://www.epa.gov/air/criteria.html. Accessed November 7, 2014.

_____2013b. Integrated Science Assessment for Ozone and Related Photochemical Oxidants.EPA 600/R-10/076F. February 2013. U.S. Environmental Protection Agency, National Center for Environmental Assessment-RTP Division, Office of Research and Development, Washington, DC. Available at: http://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=247492. Accessed January 6, 2015.

_____. 2015. Regulatory Impact Analysis of the Proposed Emission Standards for New and Modified Sources in the Oil and Natural Gas Sector. EPA-452/R-15-002, August 2015. US EPA, Office of Air and Radiation, Office of Air Quality Planning and Standards, Research Triangle Park, NC. Available at: http://www3.epa.gov/airquality/oilandgas/pdfs/og_prop_ria_081815.pdf Accessed October 20, 2015.

USGS (U.S. Geological Survey). 2014. Geologic Provinces of the United States: Parks by Geologic Province.USGS Geology in the Parks. U.S. Geological Survey. Available at: http://geomaps.wr.usgs.gov/parks/province/index.html. Accessed October 21, 2014.

USNPS (U.S. National Park Service). 2012. Final Non-Federal Oil and Gas Management Plan / Environmental Impact Statement for the Big South Fork National River and Recreation Area / Obed Wild and Scenic River. Big South Fork National River and Recreation Area, Oneida, TN. Available at: http://parkplanning.nps.gov/document.cfm?documentID=48597. Accessed January 8, 2015.

Vavrek, M.C., H. Hunt, W. Colgan III, and D.L. Vavrek. 2004. Status of oil brine spill site remediation. Paper presented at the 11th Annual International Petroleum Environmental Conference, Albuquerque, NM, Oct. Available at: http://ipec.utulsa.edu/Conf2004/Papers/vavrek_hunt_colgan_vavrek.pdf

Vilà, M., J.L. Espinar, M. Hejda, P.E. Hulme, V. Jarošík, J.L. Maron, J. Pergl, U. Schaffner, Y. Sun, and P. Pyšek. 2011. Ecological Impacts of Invasive Alien Plants: A Meta-Analysis of Their Effects on Species, Communities and Ecosystems. *Ecology Letters*, 14: 702–708.

Wiles, G.J. and H.P. Weeks, Jr. 1986. Movements and Use Patterns of White-Tailed Deer Visiting Natural Licks. Journal of Wildlife Management 50 (3): pp. 487-496.

Williams, S.J. 2013. Sea-level rise implications for coastal regions. Journal of Coastal Research, Special Issue No. 63, pp. 184-196.

Yang, Z., T. Wang, R. Leung, K. Hibbard, T. Janetos, I. Kraucunas, J. Rice, B. Preston, T. Wilbanks. 2014. A modeling study of coastal inundation induced by storm surge, sea-level rise, and subsidence in the Gulf of Mexico. Natural Hazards 71 (3): 1771-1794.