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[EXTERNAL] Comment letter on Draft EIS for Coastal Plain O&G Leasing

1 message

Rick Edwards <watermite@hotmail.com>

Tue, Feb 26, 2019 at 1:50 PM

To: "blm_ak_coastalplain_EIS@blm.gov" <blm_ak_coastalplain_EIS@blm.gov>

Cc: Rick Edwards <watermite@hotmail.com>

Ms. Nicole Hayes - I respectfully submit the attached comment letter on the subject Draft EIS.

I am also sending a hard copy via USPS with a non-electronic signature.

Please reply back to me to let me know that you have received this email and attachment.

Thank you

Richard Edwards

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**Coastal Plain letter 2 26 Final.docx**

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February 26, 2019

USDI Bureau of Land Management
Attn: Nicole Hayes, Project Coordinator
Coastal Plain Oil and Gas Leasing Program EIS
222 West 7th Avenue, Stop #13
Anchorage, Alaska 99513

Submitted in hard copy via USPS and in e-copy via email at: blm_ak_coastalplain_EIS@blm.gov

Subject: Comments on the Draft EIS for the proposed Coastal Plain Oil and Gas Leasing Program

Dear Ms. Hayes:

I respectfully submit the following comments regarding the Draft EIS for the proposed Coastal Plain Oil and Gas Leasing Program (Draft EIS). I am a retired USDA Forest Service Hydrologist with 32 years of experience in wildland resource management.

COMMENT SUMMARY:

BLM's interpretation of PL 115-97 violates its own base legislative mandates. Rushing to explore and develop the Coastal Plain under a fixed timeframe will not provide the American people the best economic result, nor does it provide for adequate consideration of the highest use of this landscape---protection and conservation for fish and wildlife and subsistence purposes. Dismissal of the No Action alternative as non-implementable is invalid. Furthermore, the Agency's interpretation of the 2,000-acre facility occupation limit as a rolling figure results in "Pac-Man" land management that will leave large swaths of the Coastal Plain irreversibly damaged (DEIS Section 3.7 Irreversible and Irretrievable Commitment of Resources, page 3-248). Exclusion of facilities such as gravel mines and pipeline spans highlights the semantics game-play being foisted on the American public. **Significantly, BLM's 2,000-acre interpretation is based on the myth of "rapid reclamation" in the arctic environment---which the Draft EIS actually admits is unproven.**

The Draft EIS dutifully quantifies many aspects of the proposed activity from potential oil reserve estimates through the many specific details in the Hypothetical Development Scenario. However, the document is almost wholly lacking in any useful quantification of the resource impacts of that Hypothetical Development Scenario. The document most often provides only qualitative assessment of resource impacts---with little or no attempt to actually quantify potential impacts in any meaningful way useful to an informed decision ---especially over time. The "appearance of impact quantification" is often provided by inclusion of data tables defining the existing condition--with no actual use of those data in any substantial quantitative analysis of impacts (e.g., Water Resources appendix) or reference to satellite documents to provide assumed weight---and

expediency---to the analysis. Mostly qualitative assessments are followed by stock conclusions that “improved technology” and designated best management practices will minimize potential adverse impacts. For example, at page 3-57 we read: “Future mining pads, airstrips, and roads would be designed to account for thermal criteria (minimum thickness to prevent permafrost degradation) and hydrologic criteria to minimize potential impacts on the surrounding area, as discussed in ROPs 23 and 24.” Yet, we read in Section 3.7 that “Loss or change in vegetation and wetlands where gravel is placed, regardless of whether it is removed at abandonment” is an irreversible and irretrievable commitment of resources.

Lack of impact quantification leaves the Responsible Official poorly informed about the actual range and magnitude of the negative resource impacts of the action alternatives over time. This hastily prepared, contracted draft document falls far short of being adequate to support a valid decision by BLM. The document must undergo significant revision and be re-issued in draft form for an additional period of public comment.

SPECIFIC COMMENTS – DRAFT EIS CHAPTER 1 (Introduction):

1) Defective interpretation of facility acreage relative to Section 20001(c)(3) of PL 115-97 (DEIS Section 1.9.1):

The BLM has conveniently assumed that Congress intended the 2,000-acre limit to be a fluid figure over time---reflecting reclamation efforts on previously disturbed sites. BLM’s interpretation cites this as an “incentive to rapidly reclaim impacted land.” The BLM’s insertion of “at any given time” is a mis-interpretation of Congress’ intent. Most Congress members who even took the time to review Section 20001(c)(3) of PL 115-97 most likely did not in fact consider the occupation acreage limit to be a fluid figure over time and most certainly would have no real concept of what “reclamation” means in the arctic environment. The words “reclamation” and “at any given time” are completely absent from the text of Section 20001(c)(3) of PL 115-97.

Arctic tundra has a very low resistance to disturbance. BLM’s interpretation fails to acknowledge the reality that “rapid reclamation of impacted land” in arctic tundra is, in fact, a grand myth, given the unknown length of time required to recover soil health and re-establish anything close to the thermal regime provided by a native plant community—within time to avoid a cascade of even more adverse soil-hydrologic effects (thermokarst, etc.). Under our changing climate conditions, the probability of these adverse effects is ever-increasing. This myth of arctic tundra “reclamation” is acknowledged within the Draft EIS:

- a) In the Soil Resources section (page 3-47), we find the following statement regarding the future reclamation of roads and pads: “Removal of gravel would affect the underlying soil and permafrost resources by exposing the underlying soils to increased radiation and **leading to continued permafrost degradation** (USACE 2018).”

- b) In the Visuals Resources section (page 3-223), we find the following statement regarding reclamation: "Following the completion of reclamation, the reclaimed acreage would be regained against the 2,000-acre surface disturbance limit at any given time. This could allow for additional development of future fields as initial development is reclaimed; **however, arctic vegetation does not regenerate quickly, extending the timeline for reclaiming disturbed areas, as evidenced by the time it is taking disturbances to recover from seismic testing in 1984 and 1985.**"
- c) Most significantly, in the Water Resources section (page 3-57), we find the following statement of reality: **"Reclamation has not been proven for gravel removal in the arctic environment once operations have ceased."**

BLM's interpretation that unproven arctic tundra reclamation (partial gravel removal followed by re-vegetation efforts, typically with non-native species) gives it license to operate under a moving facility area target is entirely invalid. In Section 3.7 (Irreversible and Irrecoverable Commitments of Resources, page 3-248) we read that one such unrecoverable commitment involves: "Loss or change in vegetation and wetlands where gravel is placed, regardless of whether it is removed at abandonment."

"Rapid reclamation" is a fallacy in this harsh arctic environment. The BLM's interpretation of the 2,000-acre occupation limit is also a fallacy. The Draft EIS must be revised to correct BLM's false assumptions related to the 2,000-acre facility limitation.

2) Defective interpretation of facilities relative to Section 20001(c)(3) of PL 115-97 (DEIS Section 1.9.1):

The BLM has conveniently excluded gravel mines as not being subject to the 2,000-acre occupation limit---equating them to off-site steel mills. This equation defies even the most basic logic. Gravel/road mix is the primary on-site resource that would enable the proposed level of development to occur in the first place. Without site stabilization by sand/gravel materials---assuming one desires to avoid truly massive impacts to the active soil layer and native vegetation---all site access and activity would be limited to ice roads and pads.

There are, of course, no gravel mines in the No Action alternative. Each of the action alternatives would trigger the development of multiple mine sites for both the construction and maintenance of other production and support facilities---**the gravel mines are, in fact, on-site support facilities.** The sites would be used for gravel storage and as secondary staging areas---where surface water conditions allow. Liking them to off-site ore deposits and steel mills defies logic. BLM's interpretation fails to acknowledge this basic fact in the process of semantics play over the 2,000-acre occupation definition. BLM's exclusion also conveniently allows the Agency to minimize attention to the fact that "reclamation" of gravel mine sites in this severe environment is nearly impossible, since most of such sites will irreversibly revert to the equivalent of man-made water

reservoirs, triggering a number of unmitigable negative effects (page 3-57). In fact, the Draft acknowledges that gravel removal represents an on-site resource commitment that cannot be reversed or recovered. In Section 3.7 we find that one of the irreversible and irretrievable commitments of resources includes (page 3-248): “Ground disturbance and permanent change resulting from gravel removal.”

The Draft EIS must be revised to recognize gravel mines as a permanent part of the facility acreage limitation.

SPECIFIC COMMENTS – DRAFT EIS CHAPTER 2 (Alternatives):

1) Failure to Adequately Address a Full Range of Alternatives – No Action Alternative (DEIS Chapter 2):

The Draft EIS is defective in that it fails to consider the “No Action” alternative as implementable. NEPA requires **full** consideration of a reasonable range of alternatives, most importantly including no action. The Draft seems to acknowledge this point in the third paragraph of Chapter I-Introduction, noting that “...any development scenario at this point is highly speculative given that it is unknown whether or where leases will be issued...” (page 1-1). Section 20001 of PL 115-97 does not negate this basic premise of NEPA. In managing federal lands and resources under its jurisdiction, BLM is also directed to follow “multiple use” and “sustained yield” principles pursuant to FLPMA, which require balancing conservation with energy production. The Agency is mandated to manage “public lands and their various resource values so that they are utilized in the combination that will best meet the present and future needs of the American people.” Consistent with these mandates, BLM must manage public lands and resources in order to generate maximum net benefits to the public by considering the full spectrum of environmental, social, and economic costs and benefits of its actions---**over the long-term**. The questionable benefits of drilling in the Coastal Plain are likely far outweighed by the values of conservation and preservation.

NEPA requires consideration of alternatives “that are practical or feasible” and not solely “whether the proponent or applicant likes or is itself capable of carrying out a particular alternative”; in fact, “[a]n alternative that is outside the legal jurisdiction of the lead agency must still be analyzed in the EIS if it is reasonable.”

Because there is no development alternative that can protect the Coastal Plain, the Draft EIS must be revised to address the no-action alternative as a potentially implementable action.

2) Failure to Address a Full Range of Alternatives - Delayed Leasing Alternative(s) (DEIS Chapter 2):

The action alternatives fail to incorporate BLM's mandate to strategically manage the timing of lease offerings. Under the Hypothetical Development Scenario, the BLM intends to make the first lease offering within one year of issuance of the ROD (pages B-10 &11). BLM is also required by law to manage federal fossil fuels to earn "fair market value" for the public, while balancing energy production with resource conservation. The Draft EIS fails to incorporate this significant mandate.

Action Alternatives must include options for: (a) delay of lease sales until the very end of the four-year and seven-year PL 115-97 timeframes, (b) delay of lease sales until the end of the 10-year enactment period of PL 115-97 and (c) delay of lease sales beyond PL 115-97 enactment (e.g., a 15-25-year horizon). Delayed leasing will provide the Agency with more information on oil and natural gas prices, production costs, environmental risks and sensitivities, drilling and emergency response infrastructure, climate change effects, and the benefits of preserving the Coastal Plain. BLM must analyze delayed leasing alternatives in order to account for the option value of irreversible drilling within the Coastal Plain. Delayed leasing alternatives could generate more total revenue for the public from higher bids, lower production costs due to technology advances, and higher total royalties given projected increases in resource price.

Under more rational circumstances, Congress should be interested in delayed leasing alternatives if its goal is to maximize revenue. Analysis of delayed leasing alternatives would likely reveal that the fixed PL 115-97 leasing deadlines are counterproductive in terms of optimizing revenue and ignore the substantial environmental and social benefits of waiting to develop oil and gas in the Coastal Plain. Analyzing alternatives incorporating delayed leasing is necessary in order to determine the optimal time to issue any leases in order to secure the public's right to obtain "fair market value" for its resources and to minimize the environmental risks assessed in the Draft EIS.

A 2018 USGS report found that there were many data gaps and a significant amount of outdated information on Coastal Plain resources and the potential impacts of oil and gas development. Given that no new scientific data were collected in the process of preparing this Draft EIS, this finding by the USGS highlights the need to incorporate delayed leasing options. As an example, the Draft EIS (page B-16) admits to a significant lack of data about groundwater resources in the Program Area---yet the proposal is to plunge ahead hoping that seawater treatment plants will provide sufficient supply. Delayed leasing would provide time to better evaluate on-site resource conditions.

The Draft EIS must be revised to incorporate delayed leasing options as a component of the action alternatives.

3) Failure to Address a Full Range of Alternatives – Minimum Lease Acreage (DEIS Chapter 2):

Section 20001(c)(3) of PL 115-97 states that each lease sale include: "...not fewer than 400,000 acres area-wide.....of those areas that have the highest potential for the discovery of hydrocarbons". The BLM has sought to maximize its flexibility through its creative reading and interpretation of Section 20001(c)(3). In Section 2.3 (Alternatives Considered but Eliminated from

Detailed Analysis; page 3-248), the Draft EIS attempts to “explain away” the need to analyze a least acreage alternative:

“The BLM considered an alternative that would make only 800,000 acres available for lease sales, which is the minimum acreage necessary to comply with the requirement in Section 20001(c)(1) of PL 115-97 to hold not fewer than two lease sales, each of which offers not fewer than 400,000 acres of the areas having the highest potential for discovery of hydrocarbons. The best available information regarding hydrocarbon discovery potential in the Coastal Plain provides a rough estimate of 427,900 acres of high HCP, 658,400 acres of medium HCP, and 477,200 acres of low HCP. Acreages within low and medium HCP areas must be made available, in addition to the high HCP areas, for the two lease sales to meet the 800,000-acre minimum under PL 115-97. In addition, the actual potential development area would be much less with the 2,000-acre limitation on surface disturbance. This alternative would also be similar in concept to Alternatives D1 and D2, which make only 1,037,200 acres available for lease sales. For all these reasons, an alternative that considered only 800,000 acres available for leasing was eliminated from detailed analysis.”

The BLM’s justification for eliminating a least acreage alternative is entirely arbitrary and capricious, as follows:

- a) The BLM purports to follow the text of Section 20001(c)(3) and where there is no text (rapid “reclamation”, etc.), create interpretations that maximize flexibility. Section 20001 is quite clear in its requirement to offer only lands with high hydrocarbon potential---no creative interpretation required. Section 20001(c)(3) can certainly be read to conclude that Congress did not intend for low and medium potential areas to be offered for lease. In a rational world, the disconnect between minimum lease acreage and the reality of on-site conditions would have been reconciled----instead of being ignored in this hastily assembled, industry drafted legislation.
- b) The argument that leasing alternative acreage does not matter since “actual potential development area would be much less with the 2,000-acre limitation on surface disturbance” is invalid. Once again, this argument leads the uninformed reader toward the false assumption that only 2,000 acres will be disturbed. By the Draft EIS’s own admission, Irretrievable and irreversible resource impacts from site disturbance will occur and only increase in scope and extent as lease acreage increases. The complete folly behind this “2,000-acre disturbance limit” has been addressed above in this letter.
- c) Perhaps most significantly, BLM’s argument that Alternatives D1 and D2 (1,037,000 acres) are “close enough” is completely ludicrous. **This defective conclusion essentially equates over two-hundred thousand acres of fragile Coastal Plain to rounding error.** The formative legislative intent behind the creation of this Refuge and BLM’s mission are entirely violated by such an argument.

It is useful to stop here to highlight that the Program Area with high hydrocarbon potential consists of those acres north of the Marsh Creek anticline---essentially the far western end of the

Area and a narrow coastal band leading toward Kaktovik (Map page B-3). **The obvious disconnect between Section 20001(c)(3)'s lease acreage figures and the actual text in the Section is blatantly apparent. Under more rational circumstances, this disconnect might be more properly addressed by an Agency truly intent on following its management principles.**

NEPA requires a full range of alternatives to be considered. Every action alternative offers significantly more acreage than the acreage minimum specified in Section 20001(c)(3) of PL 115-97. BLM has defined an upper boundary of development and adverse impact. In Alternative B, the BLM includes the maximum acreage offering possible with the least regulatory constraint. In other words, Alternative B is the action alternative with the highest potential to adversely impact the largest acreage over both the short and long-term.

In this defective Draft EIS, BLM fails to even analyze the lower boundary of the Responsible Official's action alternative decision space. **What is the action alternative with the lowest potential to adversely impact the smallest acreage over both the short and long-term?**

Once again, NEPA requires consideration of alternatives "that are practical or feasible" and not solely "whether the proponent or applicant likes or is itself capable of carrying out a particular alternative"; in fact, "[a]n alternative that is outside the legal jurisdiction of the lead agency must still be analyzed in the EIS if it is reasonable."

The Draft EIS must be revised to address a full range of alternatives. The lower bound of the Responsible Official's decision-space for action has not been addressed in this defective document. Specifically, this calls for analysis of at least one or both of the following alternatives:

- a) **Alternative E:** An alternative that incorporates a lease offering that equals the minimum acreage identified in Section 20001(c)(3) with the most restrictive management practices (800,000 acres).
- b) **Alternative F:** An alternative that incorporates a lease offering that meets the intent of the related text in Section 20001(c)(3) with the most restrictive management practices. This alternative would only include acres with high hydrocarbon potential (427,900 acres).

At a minimum, BLM must fully analyze these lower bound action alternatives in order to inform the Responsible Official and the public of the consequences of the disconnect between the requirements of Section 20001(c)(3) and BLM's land management principles under FLPMA.

Did Congress intend to minimize damage to the Coastal Plain by only focusing on high potential ground? *I can clearly read that they did so intend.* Was Congress aware that the 800,000-acre lease minimum far exceeded the actual acreage of high potential ground? *I would assume that only a small handful of members knew any related details.* Would a majority in Congress consider 237,000 acres of Coastal Plain to be insignificant from a conservation standpoint? *I would assume that only a small handful of members would be willing to express this opinion.* **These are just a**

few of the many questions that reflect on the haste and bias involved in the creation of both Section 20001(c)(3) and this deficient Draft EIS.

4) Inadequate Reclamation Prescription in Alternative B (DEIS, Chapter 2):

On page 3-207, we discover that for Alternative B: “The long-term, permanent degradation of the program area’s primitive recreation setting could result from not requiring final abandonment to meet minimal standards for WSR designation, not restoring general wilderness characteristics of the area, and allowing exceptions to abandonment conditions.”

Whereas, on page 3-208, we read that for Alternatives C & D: “In the long term, requiring final abandonment to meet minimal standards for WSR designation and intent to restore general wilderness characteristics of the area would allow the program area to return to a primitive recreation setting. The removal of facilities and restoration of disturbed areas would eliminate displacement and access impacts associated with those features.”

Given the already unproven track record of even the most aggressive reclamation efforts to date in this harsh environment and the BLM’s attempt to promote the 2,000-acre occupation limit as a moving target, why would we even consider constructing an alternative incorporating a lesser reclamation standard? **The Draft EIS must be revised to eliminate a low bar reclamation standard as part of any proposed action alternative through revision of ROP #35 (page 2-32).**

5) Needed Revision of Lease Stipulation 9 – Coastal Waters (DEIS, Chapter 2):

Lease Stipulation #9 purports to provide special protective measures for the biologically sensitive coastal waters. However, there is no specific mention of seawater treatment plants. Given critical nature of STP placement and operation in coastal waters, this is a significant omission.

Lease Stipulation #9 must be revised to highlight the specific requirements related to STPs.

6) Needed Revision of Required Operating Procedure 1 (DEIS, Chapter 2):

Although the objective statement refers to “applicable...laws and regulations”, the requirement/standard statement provides the lessee with no specific direction---in contrast to almost all other ROPs.

For example, on page B-17, we find the following description: “Solid, unburnable waste would be disposed of in large trash receptacles or other approved containers and hauled to approved off-site landfills. On-site burial of solid wastes is not anticipated.”

Could this ROP objective be achieved by on-site burial? The last sentence in the above excerpt certainly does not seem to eliminate that as an option. On-site burial of solid, unburnable waste is certainly not a best management practice for the Coastal Plain.

ROP #1 must be revised to provide direct prescriptive guidance to potential lessees.

7) Additional ROP Needed Under Facility Design and Construction to Address STPs (DEIS, Chapter 2):

The existing ROPs do not address any details regarding seawater treatment plants other than a reference to “co-location with other facilities when feasible”. The reality is that, other than gravel mines, water provided by these plants is likely to be the most critical limiting factor in support of the proposed development. Proper plant-type selection, site-selection, design, construction and operation are essential to minimize the adverse impacts of these significant support facilities.

The Draft EIS must be revised to include an additional ROP that addresses issues related to STPs.

SPECIFIC COMMENTS – DRAFT EIS CHAPTER 3 (Affected Environment & Environmental Consequences):

1) Failure to Adequately Address Impacts on Water Resources (DEIS Section 3.2.10 Water Resources):

The Water Resources section and its accompanying Appendix provide the best example of the Draft EIS’s failure to quantify the direct, indirect and cumulative impacts of proposed development—especially over time. The Draft EIS goes into great detail to discuss and quantify oil and gas resource data. It is telling that the Draft falls so short of quantifying potential impacts to water resources---the lifeblood of the Coastal Plain.

The Draft EIS estimates the amount of water needed for the construction of typical facilities (e.g., 1MM gallons for a mile of ice road, 0.5MM gallons for one ice pad, up to 1.9MM gallons to drill one well, etc.). However, nowhere in the document is the total consumptive use of construction activities actually estimated and those results analyzed with respect to potential impacts on hydrologic function and Coastal Plain fish and wildlife habitat.

The Draft EIS also estimates the amount of water needed for oil production once facilities are in place (e.g., 2 MM gallons per day for production of 50,000 barrels of oil---from a single field not at peak production). Once again, nowhere in the document are the total water needs estimated and those results analyzed with respect to potential impacts on hydrologic function and Coastal Plain fish and wildlife habitat.

Given the facility consumptive use figures in the Draft EIS (Hypothetical Development Scenario) the Center for American Progress estimated that: 1) up to and perhaps more than 1.3 billion gallons of water would be needed to drill the proposed oil wells and 2) up to 5.7 billion gallons of water would be needed to support oil production annually during the projected 50-100-year operation in the Coastal Plain. This development scenario is being projected onto a sensitive landscape in which available fresh water is scarce and growing scarcer. In the fisheries section, we find statements such as the following (page 3-48):

“Because unfrozen freshwater in winter is scarce in the program area, any future withdrawal from these areas would have the most adverse effects on fish. These springs and deep lakes are sensitive areas, in part because there are so few of them that they limit the distribution of fish in the program area.”

The document acknowledges that even the most basic snowfall data for the Coastal Plain is limited. We read on page 3-51: “Snowfall measurements date back to 1949 on Barter Island, but the monitoring site was taken out of service in 1989, resulting in a discontinuous record of snow climatology. In 2000, three meteorological stations were established...in remote parts of the Refuge...The limited data available from these stations are the only modern continuous record of snow accumulation in this region of Alaska.” How do we know that the trend in annual precipitation is adequate to satisfy the demands of oil and gas development balanced with conservation---especially in light of accelerated climate change alteration of this environment? We do not---a clear example of the need for delayed leasing at the very minimum.

The Water Quantity discussion in the Water Resources section is totally comprised of the following paragraph (page 3-54):

“Water quantity in the program area has been calculated and documented by the USFWS (Lyons and Trawicki 1994). There are 119 lakes with an annual ice-free volume of 55,382 acre-feet, as summarized in Table H-6 in Appendix H. This volume is reduced to 3,366 acre-feet in April, when there is approximately 7 feet of ice. These values do not represent the total available quantity nor indicate suitable uses of the water, such as for ice road construction.”

The reviewer is left with the question: Then what is the total quantity of water reasonably available for use---by season and by water use activity---in comparison to the demands of the Hypothetical Development Scenario?

The discussion continues on page 3-58, as follows:

“Surface water withdrawals in the future for construction of ice roads, dust abatement, and operations would affect shallow groundwater levels, surface water levels, and drainage patterns during summer season. Lakes would be the principal supply for freshwater during construction. Ice roads and ice pads would be constructed to support construction under all action alternatives for access during the winter season. Although estimates of water use for oil and gas activities on the North Slope have been made in literature, the actual

amount of water used would be project specific and would be based on BMPs, new technology, and the specific needs of the project, such as the width of ice roads, number of camps, number of crew, and ice pad size. Under all action alternatives, no potential long-term impacts on lakes and ponds are anticipated from ice roads, ice pads, or ice bridges, as discussed in BLM 2012, Section 4.5.4.2.”

It is interesting that this paragraph claims both the inability to estimate consumptive water use because it would be “project specific” while also claiming that construction of ice roads, pads and bridges would have no potential long-term impacts on water resources. How is the above conclusion possible? How valid is the scenario presented in the referenced BLM document?

In the Hypothetical Development Scenario, the lack of data and analysis uncertainty regarding available water resources is clearly reflected in this text (page B-16):

“A seawater treatment plant could also be constructed along the coast, if needed, to source saline water for waterflooding, reservoir pressure support, or other subsurface uses. Groundwater aquifers or local lakes and rivers are typically the preferred water sources, due to the cost and maintenance requirements of a seawater desalination plant; however, due to the limited information about groundwater resources in the Coastal Plain, those sources may not be sufficient to meet water needs. Thus, for the purpose of analysis, it is assumed that a seawater treatment plant would be required.”

Perhaps the most telling excerpt from the DEIS that illustrates the inadequacy of the consumptive water use analysis is as follows (page 3-59):

“Freshwater would be withdrawn from lakes in the program area in the future for several primary uses: construction of ice roads and pads, pipeline maintenance, production drilling, and potable water at camps. Water would also be used for dust control on roads. This water would be recharged in the spring when snow and ice melt increase flow volumes in connected water bodies, **assuming that withdrawal rates would not exceed recharge rates**, based on BMPs, permitting, and permitting requirements.”

The discussion of impacts by action alternative (page 3-60) consists of recitation of the lease area and a stock rehash of what Lease Stipulations and ROPs apply to that alternative. Will BMPs really be adequate? This section does not provide the Agency with any quantitative analysis useful to the Responsible Official.

The Draft EIS later acknowledges a resource commitment that cannot be reversed or recovered would be: “Surface water consumption for drilling and other industrial purposes with wastewater disposal via underground injection.” (Section 3.7 Irreversible and Irrecoverable Commitments of Resources, page 3-248). Yet, the Draft EIS fails to adequately address the direct, indirect and cumulative impacts of proposed activities on both water quality and quantity---especially over time. The analysis of consumptive use in the Water Resources section is particularly inadequate in its failure to fully characterize the potential impacts of proposed development activities.

The Draft EIS is wholly deficient in its lack of any Hypothetical Water Use Scenarios to match the detail provided in Appendix B (Hypothetical Development Scenario). The document must be revised to include quantitative analyses of water availability and projected consumptive use in order to provide the Responsible Official with sufficient information relative to critical water resources on the Coastal Plain.

2) Failure to Address the Potential Impacts of Underground Injection Control Wells (DEIS Section 3.2.11 Solid and Hazardous Waste):

In several sections, the Draft EIS states that groundwater injection wells will be utilized to dispose of wastewater discharge from future oil and gas activities (e.g., page 3-59). Such wastewater would include sanitary/domestic waste, produced water, spent fluids and chemicals, as well as wastewater generated from field use of 2 million gallons per day. The document states that “injection of wastewater reduces potential impacts on surface waters or the land by injecting wastewater deep underground into zones isolated from drinking water sources” (page 3-64).

In short, groundwater injection is portrayed as the answer to most water quality issues. However, the Draft EIS lacks any discussion or analysis of the potential risks associated with use of injection wells in this arctic environment. What are the potential impacts of saltwater and wastewater injection in this environment? The practice is portrayed as a neutral best management practice---what are the related risks? What issues arise with this practice over the long-term---after site abandonment?

The Draft EIS must be revised to include discussion and analysis of the potential impacts of groundwater injection wells.

3) Failure to Adequately Address Impacts on SBS Polar Bear Habitat and Population (DEIS Section 3.3.5 Marine Mammals):

The Draft EIS identifies that all action alternatives would affect large areas of the Coastal Plain designated as Critical Habitat for the Southern Beaufort Sea stock of polar bears (only 900 SBS polar bears remaining). The Coastal Plain is identified as the “core activity area” for this Threatened sub-population. The Draft acknowledges that “the potential for injury or mortality of bears could be high when developing new oil and gas projects.” **The Draft fails to estimate how many polar bears would be killed, injured or displaced by exploration and development in the Coastal Plain.** This level of analysis is unacceptable for the Responsible Official to adequately understand the potential impacts on the Threatened SBS stock, especially given that the population has declined by 50% over the last three decades.

On page 3-132, the Draft EIS describes the increasing difficulty for polar bears to deal with ecological change resulting from declining sea ice cover related to climate change. The SBS stock is

identified as being particularly vulnerable (exposed to more days of reduced sea ice, lower reproduction rates, reduced body size, poorer overall condition and more spring fasting, etc.).

On page 3-142, we read: “Any injury or mortality from oil and gas development-related human-bear conflicts would pose a problem because of the declining status of the SBS population. The attraction of polar bears to facilities and the attendant problems from such attraction may increase through the operational life of the proposed program, as more bears use onshore areas during the open-water season due to declining sea ice, leading to increased use of coastal travel routes past oil and gas facilities.”

Continuing on page 3-142, we see the inevitable shift to conclude that all will be minimized with mitigation: “In summary, **although the potential for injury or mortality could be high when developing new oil and gas projects in polar bear habitat**, the risks are well understood. Also, effective mitigation is available and has been implemented in the established North Slope oilfields west of the program area. With mitigation in place, the net effects of program-related activities are likely to be negligible in terms of injury and mortality at the population level. Given the current and predicted continuing decline of the SBS stock of polar bears, emphasis would be placed on avoiding injury or mortality, and current mitigation measures appear to be effective at reducing such risks.”

The Draft EIS basically concludes that avoidance, hazing and den location (using FLIR technology that is only 50% reliable) will be adequate to mitigate the impacts of exploration and development activities on the SBS stock. The Draft acknowledges that interactions will increase as the development footprint increases at the same time as SBS bears are forced to spend an ever-increasing amount of time on land. Indeed, on page 3-249, the Draft EIS acknowledges that the proposed activity will result in irreversible and irretrievable “Loss or abandonment of wildlife habitat.” With more than 77% of the Coastal Plain identified as critical denning habitat and maternal dens concentrated in the area of highest gas/oil potential---Where is the detailed quantitative analysis of this cascade of negative effects over time?

The Draft EIS must be revised to better address the potential impacts of proposed exploration and development on the SBS stock in quantitative terms.

4) Failure to Fully Address the Impacts to Visual Resources (DEIS Section 3.4.8 Visual Resources):

The Draft EIS fails to adequately address the wide-ranging impact of development on visual resources, resulting in long-term degradation of the area’s exceptional wilderness, aesthetic and recreational values. The GIS-based visibility analysis recently provided to you (Stuart Smith, Ph. D., True North GIS, Leasing DEIS comment letter dated 1/11/2019) captures the extensive and significant viewshed impacts associated with the proposed development.

Dr. Smith’s analysis illustrates that the visual impacts of Coastal Plain development would be profound and wide-ranging, as follows:

a) Structures up to 15m in height would potentially be visible to river rafters across 88% of the Coastal Plain. This height class includes a majority of permanent structures such as pipelines, roads, buildings and warehouses.

b) Structures between 30 and 45 m in height (extraction towers and derricks) would be visible to river rafters across 97% of the Coastal Plain. The degradation of aesthetic characteristics, including wilderness and recreational values, would be profound since there would be almost nowhere that towers would not be visible.

c) Industrial-based, visual pollution would extend well outside the Coastal Plain, with nearly 100% of the area visible from high points within the Congressionally-designated Wilderness to the south.

d) Visual impacts from Kaktovik would also be extensive for both residents and visitors (30% of the Plain visible for 15m structures and 45% for structures 30-45m tall).

How long would this visual degradation last? On page B-18, we read: "Field production can last from 10 to 50 years before abandonment (BLM 2012). In the Coastal Plain, assuming the 100,000 barrel-per-day peak production and the 8 percent decline per year, it would take an estimated 35 years after reaching peak production to get to the point of abandoning a potential field." On page 3-6, we read: "The Coastal Plain production could extend much longer than 37 years, perhaps from 50 to 100 years; 70 years is assumed for purposes of making annual GHG projections for this Leasing EIS."

Basically, profound visual resource degradation of the Coastal Plain from on-site structures would last for more than a generation.

More significantly, the visual degradation from a vast network of residual exploration ice road/trail/pad scars---intermingled with the even more obvious scars from gravel mine, gravel road and gravel pad "reclamation" will last for millennia. In short, the aesthetics of the Coastal Plain viewed from on-site and from the designated Wilderness to the south will be irreversibly damaged until the landscape is transformed by the next major global-scale hydro-geologic event.

The Draft EIS must be revised to include more comprehensive analysis of the magnitude of the impacts of the proposed activities on visual resources, such as the analysis cited above.

5) Failure to Identify Impacts to Visual Resources as Irreversible (DEIS Section 3.7 Irreversible and Irretrievable Commitment of Resources):

Based on the discussion above, exploration and development activities as proposed would permanently alter the aesthetics of the Coastal Plain. This fact is reinforced in Section 3.7 by the

admission that irreversible commitments include (page 3-248): **“Loss or change in vegetation and wetlands where gravel is placed, regardless of whether it is removed at abandonment.”**

This admission acknowledges the permanent impact of gravel placement and facility use, even with the myth of “rapid reclamation.”

In one study of long-term ice trail recovery, we find the following statement relative to exploration access*:

“The creation of vehicle trails on the tundra from seismic exploration for oil has accelerated in the past decade (2000-2010), and the cumulative impact represents a geographic footprint that covers a greater extent of Alaska’s North Slope tundra than all other direct human impact combined.”

The health and productivity of the active soil layer is renewable only over a long period of time, representing an irreversible loss. As acknowledged in the DEIS Section 3.7 cited above, the resulting vegetation and wetland loss/change from the Hypothetical Development Scenario will also be long-term. It follows directly then that the resulting degradation of aesthetic resources will also be long-term, and therefore, irreversible.

The Draft EIS must be revised to acknowledge that proposed activities will result in an irreversible loss of visual resource quality in the Coastal Plain.

6) Failure to Adequately Address the Potential for Significant Oil Spills (DEIS Section 3.2.11 Solid and Hazardous Wastes):

The Draft EIS fails to adequately characterize the risk of oil spills by limiting its risk analysis to include only spill records for Alaska’s North Slope. Based on this area-restricted, historical record, the Draft EIS concludes that the risk of a very large spill of more than 100,000 gallons is estimated to be low (page 3-62) to very low (Table 3-15, page 3-64).

However, considering oil spill data from across Alaska, the likelihood of a major spill on the Coastal Plain seems almost inevitable. Statewide from 2002-2016, there were 16 major spills that released at least 10,000 gallons of oil each into the environment. Five of those spills were classified as very large, exceeding 100,000 gallons each (Summary of West Coast Data CY 2016, Pacific States/British Columbia Oil Spill Task Force, May 2017). In April 2017, a BP well near Prudhoe Bay vented gas and oil spray for three days before an ADEC/EPA response team managed to kill the well.

The Draft EIS states that North Slope production activity has resulted in only three documented spills greater than 100,000 gallons (page 3-62). The Draft continues stating that: “Upon detection, spills have been contained and cleaned up, as required by federal, state, and NSB regulations (NRC 2003).” The Draft fails to correlate these events to Table 3-14 Spill Characteristics by Season---

have past major spill events occurred only under weather/site conditions that best promote clean-up and restoration? In addition, the DEIS also fails to mention or discuss the potential for and impacts of an oil spill from a vessel carrying product from Coastal Plain fields.

The Draft EIS must be revised to include a description and quantitative analysis of several Hypothetical Major Oil Spill Scenarios, as follows:

- a) A very large spill on land during the season with the best site/weather conditions for clean-up and removal
- b) A very large oil spill on land during the season with the worst site/weather conditions for clean-up and removal
- c) A very large oil spill, near-shore involving a vessel carrying crude product from Coastal Plain fields during the best marine conditions for clean-up and removal
- d) A very large oil spill, near-shore involving a vessel carrying crude product from Coastal Plain fields during the worst marine conditions for clean-up and removal

7) Failure to Adequately Address the Impacts of Ice Roads and Trails (Throughout DEIS Chapter 3):

Throughout the document, ice road/pad construction and use are most often portrayed as being relatively damage neutral practices. This portrayal is undermined by statements in several places in the Draft EIS, as follows:

- a) In the Soil Resources section (page 3-46), we read: “These future actions, including vehicular travel on snow and ice-covered tundra, change and disturb the insulating surface vegetation layer and increase the active layer thickness, thawing the permafrost, and developing thermokarst structures. Thermokarst changes the surface topography, increasing water accumulation, changing surface water drainage patterns, and increasing the potential for soil erosion and sedimentation (BLM 2018a; Jorgenson et al. 2010).”
- b) Again, under Soil Resources (page 3-48) we read: “Previous seismic survey explorations and an exploratory test well in the program area have disturbed the surface vegetation and affected the thaw of permafrost, changed drainage patterns, and changed vegetation growth for over 25 years after disturbance (USFWS 2014; Jorgenson et al. 2010). Approximately 900 square miles of additional seismic surveys over the program area are required (Appendix B); while improvements have been made to avoid impacts on the ground surface, future seismic surveys may have similar impacts.”
- c) In the Visual Resources section (page 3-219), we read: “Seismic exploration, authorized by Congress, was conducted in the program area during the winters of 1984 and 1985. Exploration during winter causes less damage to tundra vegetation and soils than in summer, but damage does occur. Because of the 1984–1985 seismic exploration, known as 2-D (two-dimensional) seismic, 1,250 miles of trails made by drill, vibrator, and recording vehicles crisscrossed the Coastal Plain tundra. Additional trails were created by D-7

Caterpillar tractors that pulled ski-mounted trailer-trains between work camps. The trails were about 4 miles apart. While 90 percent of all trails recovered well during the first 10 years after exploration, 5 percent of trails had still not recovered by 2009, 25 years after the disturbance. This indicates that about 125 miles of disturbed trail remained in 2009, based on a total length of about 2,500 miles of original trails, both seismic lines and camp-move trails (USFWS 2014). These trails disrupt the visual continuity of the expansive, undeveloped landscape.”

- d) And again, in the Visual Resource section (page 3-223), we read: “The program area is the geographic scope of the analysis area for cumulative impacts. Impacts on visual resources in the program area from past actions occurred from the 1984–1985 seismic exploration. About 125 miles of disturbed trail remained in 2009, based on a total length of about 2,500 miles of original trails (both seismic lines and camp-move trails) (USFWS 2014). The remaining trails create visible lines and faint variations in texture across the undeveloped landscape. **Future seismic exploration would likely have more visible impacts on visual resources, because the trails would be several hundred feet apart, instead of 3 to 4 miles apart during the 1984–1985 testing.**”

In one study of long-term ice trail recovery, we find the following statements relative to exploration access*:

- a) “The creation of vehicle trails on the tundra from seismic exploration for oil has accelerated in the past decade (2000-2010), and the cumulative impact represents a geographic footprint that covers a greater extent of Alaska’s North Slope tundra than all other direct human impact combined.”
- b) “Ice trails with low levels of initial disturbance usually improved well over time, whereas those with medium to high levels of initial disturbance recovered slowly.” (Heavier camp vehicles were found to have much greater impact than relatively lighter seismic survey vehicles.)
- c) “Recovery to pre-disturbance communities was not possible where trail subsidence occurred due to thawing of ground ice.”
- d) “Previous studies of disturbance from winter seismic vehicles in the arctic predicted short-term and mostly aesthetic impacts, but we found that severe impacts to tundra vegetation persisted for two decades after disturbance under some conditions.”

Study findings suggest that exploration access impacts could combine with climate change to greatly alter the permafrost and arctic ecology where exploration activities occur.

According to Appendix B (page B-12), during exploration, over 900 square miles of the Coastal Plain would be subject to seismic testing with equipment access using roads spaced 320-1,320 feet apart. What is the cumulative impact of the resulting network of compacted surfaces?

The Draft EIS must be revised to portray a true picture of the use and impacts of vehicular travel on snow and ice-covered tundra, especially during the seismic exploration phase. In the process, the Draft needs to acknowledge that our understanding of long-term soil compaction and vegetative recovery in the arctic tundra is extremely limited.

8) Failure to Cohesively Address the Impacts of Proposed Seismic Exploration (Throughout DEIS Chapter 3):

Although discussion of seismic exploration is spread throughout the document, the Draft EIS fails to provide a cohesive understanding of the potential direct, indirect and cumulative effects of seismic exploration. It is not possible for the reviewer to get a clear picture of the scope and extent of impacts from seismic exploration given the current structure of the document.

The Draft EIS must be revised to separate the impact analysis of exploration from that of development, production and transport.

9) Failure to Address Potential Impacts to Terrestrial Invertebrates (DEIS Chapter 3):

The Draft EIS includes brief mention of aquatic invertebrates and their great significance to the freshwater food chain (page 3-78). However, the document fails to identify or address any risks or impacts relative to terrestrial invertebrates, primarily insects. There is one brief mention of “insect populations” relative to bird survival (page 3-91). What invertebrate species are present? What species have been identified as having special concern or status? What is the significance of terrestrial insect biomass to the food chain? What are the risks and potential impacts to terrestrial invertebrates from proposed exploration and development activities? Are there concerns relative to invasive invertebrate species given the extent of proposed disturbance?

The Draft EIS must be revised to identify the existing situation relative to terrestrial invertebrates (species present, ecological function, etc.) and to address the potential impacts of the range of alternatives on these species.

10) Failure to Fully Disclose and Address the Potential Impacts of Desalination (DEIS Chapter 3):

The Hypothetical Development Scenario (page B-16) states that a seawater treatment plant (STP) would most likely be constructed for each stand-alone oil development facility. **In fact, the success of the entire development and production effort hinges entirely on these plants and the unquantified magnitude of water made available through desalinization.** On page B-16 we read:

“Groundwater aquifers or local lakes and rivers are typically the preferred water sources, due to the cost and maintenance requirements of a seawater desalination plant; however, **due to the limited information about groundwater resources in the Coastal Plain**, those sources may not be sufficient to meet water needs. Thus, for the purpose of analysis, it is assumed that a seawater treatment plant would be required.”

Although STPs are identified in the document as being highly significant support facilities, the Draft EIS does very little to provide the Responsible Official with a workable understanding of the total number of plants and the range and magnitude of risks and impacts associated with desalination. For the most part, STPs are portrayed as just another relatively neutral support facility.

On page 3-82 (Fish and Aquatic Resources), we do find the following text:

“Discharge of brine to the marine area from a potential STP could further increase salinity, particularly in the winter when freshwater may be frozen. Effects would be particularly pronounced if the discharge was in the brackish lagoon waters that are hypersaline in winter.”

However, most tellingly, within the Water Resources section, there is only one mention of desalination or STPs, as follows (page 3-59):

“Discharges of various pollutant concentrations in the future from an STP would be required to meet standards in the treatment plant’s APDES discharge permit and potential mixing zone requirements.”

The major shortcomings of the Water Resources analysis in this Draft EIS are again highlighted here. There is no discussion of potential desalination impacts----not even a desalination-related bullet item in the list of primary water quality issues resulting from the proposed development (page 3-55). This is significant in light of the fact that STP use may be far greater than anticipated because freshwater is scarce and becoming even more scarce on the Coastal Plain as a result of climate change.

In regards to the potential impacts and unknowns relative to STPs, we find the following in a brief review of the literature:

- a) “Beyond the links to climate problems, marine biologists warn that widespread desalinization could take a heavy toll on ocean biodiversity; as such facilities' intake pipes essentially vacuum up and inadvertently kill millions of plankton, fish eggs, fish larvae and other microbial organisms that constitute the base layer of the marine food chain. And, according to Jeffrey Graham of the Scripps Institute of Oceanography's Center for Marine Biotechnology and Biomedicine, the salty sludge leftover after desalinization for every gallon of freshwater produced, another gallon of doubly concentrated salt water must be disposed of can wreak havoc on marine ecosystems if dumped willy-nilly offshore. For some desalinization operations, says Graham, it is thought that the disappearance of some organisms from discharge areas may be related to the salty outflow.” **

- b) “With the majority of desalination plants extracting water directly through open water intakes in the ocean, there is a direct impact on marine life. Fish and other marine organisms are killed on the intake screens (impingement); organisms small enough to pass through, such as plankton, fish eggs, and larvae, are killed during processing of the salt water (entrainment). The impacts on the marine environment, even for a single desalination plant, may be subject to daily, seasonal, annual, and even decadal variation, and are likely to be species- and site-specific. Another major environmental challenge of desalination is the disposal of the highly concentrated salt brine that contains other chemicals used throughout the process. Because all large coastal seawater desalination plants discharge brine into oceans and estuaries...steps must be taken to ensure its safe disposal; at this stage, we know very little about the long-term impacts of brine disposal on the marine environment. Twice as saline as the ocean, the brine is denser than the waters into which it is discharged and tends to sink and slowly spread along the ocean floor, where there is typically little wave energy to mix it.

These impacts, however, are not well understood. More research is needed, especially to understand the long-term impacts.” ***

The document fails to provide the Responsible Official and the public with even a basic understanding of the risks and magnitude of the potential adverse impacts of desalination on the already increasingly stressed nearshore marine environment of the Coastal Plain.

The Draft EIS must be revised to fully address the range and magnitude of potential impacts of the proposed network of STPs.

11) Failure to Fully Identify the Energy Consumption of the Proposal (DEIS Section 3.7 Irreversible and Irretrievable Commitment of Resources):

The Draft EIS identifies one of the irreversible and irretrievable resource commitments as (page 3-248): “Energy consumption associated with construction and operation phases.”

In the haste to prepare this document, the irretrievable energy consumption associated with exploration and product transport activities has been omitted. **The Draft EIS needs to be revised to identify this resource commitment.**

ADDITIONAL COMMENTS on the DRAFT EIS:

1) Failure to Identify and Address Issues Related to BLM's Ability to Properly Manage Exploration and Development Activity on the Coastal Plain:

The Draft EIS fails to: (1) describe the inspection and control process that BLM will use to monitor and manage exploration and development operators in this remote environment, (2) characterize the performance of the BLM in monitoring and managing past and current development activities in similar remote, arctic environments and (3) describe how BLM's ability to adequately monitor and inspect exploration and development activities would be maintained at an acceptable level given declining agency budgets, personnel shortages and increasing occurrence of government shutdowns. Lease Stipulations, Required Operating Procedures and other applicable regulations and standards will require a significant amount of oversight and control---especially since the proposed operations will involve multiple lessees and sub-contractors.

In addition, the document fails to clearly acknowledge that emergency response relies largely on other agencies (e.g., ADEC, EPA). What are the risks associated with this reliance? What is the past track record of emergency response efforts on the North Slope? Will staffing levels and training of personnel in these sister agencies be sufficient to respond adequately to a major emergency---now and over time?

The Draft EIS must be revised to address concerns related to BLM's ability to properly administer lessee operations and the ability of agencies to respond to an emergency.

2) Failure to Address Impacts on the Short and Long-Term Management of the Arctic National Wildlife Refuge:

The Draft EIS fails to identify and address the impacts of oil and gas exploration and development on the ability of the U. S. Fish and Wildlife Service to manage the Refuge in concert with its intended purposes. ANICLA provided four purposes that guide management of the Refuge: to conserve animals and plants in their natural diversity, ensure a place for hunting and gathering activities, protect water quality and quantity, and fulfill international wildlife treaty obligations.

In short, USFWS is mandated to provide for the long-term protection of this globally significant landscape. How will the ability of the USFWS to successfully manage the Coastal Plain for these purposes be impacted in both the short and long-term by the proposed activities?

The Draft EIS must be revised to adequately address the short and long-term impacts of the proposed activities on USFWS's land management role.is issue.

3) Need to Substantially Revise the Draft EIS and Recirculate for Public Review:

The above comments point out numerous major flaws in the Draft EIS. Other reviewers are highlighting major short-comings with other sections of this hastily prepared document. The current Draft EIS lacks the objectivity and impact quantification required for the Responsible Official to make a well-informed decision. The CFRs require the agency to prepare and circulate a revised draft when a draft statement is so inadequate as to preclude meaningful analysis (40 CFR 1502.9(a)).

The existing document must be substantially revised and a second Draft EIS must be re-issued for another public review period.

The Coastal Plain has long been considered the biological heart of the Arctic National Wildlife Refuge. Other analyses have shown that oil and gas development of the Coastal Plain is not needed for our energy independence and pose grave, long-term risks to the Arctic Refuge.

The Draft EIS fails to enumerate the related risks and potential impacts in a manner adequate to properly inform the public and to support a valid decision by the Responsible Official. The Draft EIS needs to be thoroughly revised and a another Draft EIS submitted for additional public comment. I can then only hope that the bi-partisan vision enacted into law when the Arctic Refuge was first created is reflected in a Final EIS and Record of Decision.

Thank you for entering my comments into the public record and addressing my comments in a revised Draft EIS.

Sincerely,

/s/ Richard Edwards

Richard Edwards
watermite@hotmail.com

Cc:

Senator Patty Murray
Senator Maria Cantwell
Representative Kim Schrier
EarthJustice

* Jorgenson, J., Hoef J., & Jorgenson, M. 2010. Long-Term Recovery Patterns of Arctic Tundra after Winter Seismic Exploration. Ecological Applications, 20 (1), 205-221.

** Scientific American Earth Talk. 2019. The Impacts of Relying on Desalination for Water.

***Cooley, H., Ajami, N. and Heberger, M. 2013. Key Issues in Seawater Desalination in California: Marine Impacts. Pacific Institute (on-line).