Peer Review of "Graham's Beardtongue and White River Beardtongue Biological Status Report of Future Condition"

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Summary of Report

This report identifies two potential conventional (oil and natural gas) and unconventional (oil shale and oil sands) energy development scenarios and examines the viability of two beardtongue species, Graham's and White River, given these scenarios.

Summary of Review

My area of expertise is in the development of unconventional fuels, specifically oil shale and oil sands. My review of this report focuses on the two future energy development scenarios, moderate and high. However, I also have some comments related to the presentation of the material and to punctuation. I added more detailed comments in the text of the report and the accompanying appendix.

General Comments

- I wanted to review several of the references (e.g. USFWS 2017, USFWS 2020b, IEC 2014), but I was unable to find them in an online search. Your references should be available to the public.
- In determining oil shale lands with high economic potential, you mention resource richness (15 GPT) and depth in footnote 1, but you don't mention resource thickness. What is the resource thickness that you considered and why? As noted by Vanden Berg (2008a), it is unlikely that oil shale development will occur for 15-GPT oil shale that is less then 15 feet thick. Either footnote 1 or the text of the report should contain more details about what the shape files included/excluded.
- 15 GPT is floor; aren't you considering resource richness that meets or exceeds 15 GPT?
- You state multiple times that you "did not remove 2014 CA designated conservation areas on private lands from our analysis, because protections on those lands expire in 2029, during our forecast timeframe…" Have you considered including these areas in your "Moderate" forecast given that the likelihood of seeing these areas developed in the final year of your forecast period is very low? If you don't want to do that, can you provide a description of how much of the proposed development on private lands would be prohibited through 2029 due to the 2014 CA?
- Your acknowledgment of the uncertainty in these development projections is very important. Our research institute was involved in two studies that were published in 2013 (ISCE 2013; "Final Report: Uinta Basin Energy and Transportation Study (Phase I)," Project No. S-LC47(14), Uinta Basin Energy Corridor Study, April 2013 (UBETS 2013)). In the first, an economic assessment of oil shale production costs for various scenarios (ICSE. 2013), we determined the capital and operating costs for two large-scale, oil shale development scenarios using data available in the literature and the engineering expertise of our team. Our predicted costs were much higher than those

available from other sources at that time. Many assumptions must be made in these types of calculations, resulting in predictions with high uncertainty. This uncertainty applies not only to the predictions that we made but also to the predictions made by those in the industry as their assumptions and inputs are not as transparent as our publicly-available analysis. In the second study, we worked with industry to develop plausible estimates for development timelines. Among the six oil-shale producers interviewed, the first commercial production was projected to begin in 2015 with the last slated for 2026. By 2020, estimated production was 65,000 barrels of oil per day (UBETS 2013, p. 36). At this point, there is still no commercial production of oil from oil shale in the Uinta Basin. Obviously there have been many unforeseen events since 2013 that have contributed to this lack of development, but there will be another set of unforeseen events in the next 10 years. Given recent history, is the high energy development forecast in this report plausible?

- The high forecast for oil shale development assumes that non-Federal lands will be developed. This assumption leads to a checkerboard pattern of development as depicted in Figures 4 and 5. Access to these non-Federal lands will require that rights-of-way be granted or that land trades be made. These issues add complexity, time and uncertainty to the development of these lands; see Ruple, J.C. 2017. Legal and Policy Considerations Involving Oil Shale-Bearing Lands and the Resources They Contain (Chapter 2), Section 2.2.1.4 Access to Nonfederal Inholdings, pages 25-26. *In* Spinti, J. (Ed) 2017. Utah Oil Shale Science, Technology, and Policy Perspectives. CRC Press. New York. 337 pp. I have the same question as the previous bullet point – is the checkerboard development plausible?
- In Figure 2-5, 7, and 8, it is sometimes difficult to distinguish the boundaries of the forecast development areas and the designated conservation areas to see where they do/don't overlap. A pattern rather than a color for one of the area types would help clarify these regions. The same comment applies to Figure 2-20 in Appendix 1.
- In Figures 2, 4, 6, 8, 10, 12, 14, 16, 18, and 20 of Appendix 1, the yellow color of the "Projected Disturbance Areas under Scenario 2" can be difficult to distinguish from the color used for Federal lands.

Punctuation

- Use of ", because" – in many cases, the comma should be eliminated
- Use of hyphen – a hyphen should be added with numbers in compound adjectives such as "300-foot buffer." I have also included a few edits with hyphens in the report as examples.