Peer Review Report

Hydrologic Evaluation of Alternatives for the Deschutes Basin Habitat Conservation Plan

Date

October 20, 2020

Originating office

Bureau of Reclamation, Columbia-Pacific Northwest Region, Regional Office, Boise, Idaho

Reclamation Roles

Director or delegated manager: Lorri Gray, Regional Director, Columbia-Pacific Northwest Region, Bureau of Reclamation

Peer Review Lead: Jennifer Johnson, Supervisory Civil Engineer (Hydrologic), Columbia-Pacific Northwest Region, Bureau of Reclamation

Peer Review Scope

The modeling assumptions related to the alternative operations for the Habitat Conservation Plan (HCP) and the Environmental Impact Statement (EIS), and the model outputs, are the scientific information that forms the basis for resource effects in the EIS. This is the information that is and has been the subject of peer review. Peer reviewers were asked to provide responses relative to the three questions listed below.

1. Are the assumptions clearly explained in the documentation of the modeling analysis?
2. Does the documentation clearly show the effects of the assumptions on the river-reservoir system?
3. Does the document adequately characterize the uncertainty associated with the analysis?

The scope of this review did not include the selection of RiverWare as the appropriate tool for this analysis, the RiverWare software, or the Deschutes RiverWare model, because these have all been previously reviewed.

Peer Reviewers

Peer reviewers were selected to provide a group of experts representing diversion interests in the Deschutes Basin that had not been involved directly in the model development or analysis. The five selected reviewers are listed below.

Jason Gritzner

Hydrologist, U.S. Forest Service, Bend, Oregon
Expertise: Hydrology

Kyle Gorman

Manager, Oregon Water Resources Department, Bend, Oregon
Expertise: Water rights, Deschutes and Crooked River Operations, Irrigation Deliveries

Jonathan LaMarche, P.E.

Hydrologist, Oregon Water Resources Department, Bend, Oregon
Expertise: Water Rights, Deschutes and Crooked River Operations, Field Hydrology, Irrigation Deliveries

Martin Vaughn

Biologist, Biota Pacific Environmental Sciences, Inc., Bothell, Washington (Consultant for Deschutes Basin Board of Control)
Expertise: Hydrology, Biological effects of Hydrology, Irrigation Operations

Owen McMurtrey

Water Resources Consultant, GSI Water Solutions, Inc., Corvallis, Oregon
Expertise: Water Resources, Hydrology

Summary of Reviewer Comments

Reviewer comments regarding the three questions identified above for the peer review scope (reviewers do not directly correspond to the list above for anonymity with respect to their comments) are summarized below.

Reviewer 1 noted:

> "Yes, all assumptions are clearly explained. Edits were offered to provide additional background on some of the assumptions, but otherwise they are all clear."
>
> "Yes, the graphic presentations are very clear. Comments were offered on possible misplacement of some of the graphs, but the general approach is very understandable and helpful."
>
> "I think the document should provide a bit more explanation on the difference between uncertainty vs. the effects of modeling assumptions. I've provided specific suggestions on this. The results of the modeling could be quite different if different, and equally valid, assumptions were made about things like the use of the uncontracted water on the Crooked River. This should be noted. No need to change the analysis; just elaborate a little on the general impact/importance of assumptions to model outcome."

Reviewer 2 noted:

> "Language regarding bypass of uncontracted flow under Alts 3 and 4 could be clarified. My understanding is that those alts require bypass of uncontracted flow by NUID, and don't actually anticipate protection of uncontracted storage releases. If that's correct, I would not use language saying that flows are protected due to confusion about what that means. Other clarifications/consistency of terminology as noted in the document."

> "Yes. I've noted a few instances where I think the effects may actually be caused by something else. Due to the complexity of the model, I'm not certain about my interpretations either."

> "I would include a stronger blanket statement in the introduction."

Reviewer 3 did not explicitly answer the questions, but provided this input:

> "The overall assumptions and data sets used accurately represents the hydrology of the basin upstream of Lake Billy Chinook. The model parameters, constraints and operating principles represents a probable and an encompassing likelihood of most hydrologic conditions the river would experience over a broad number of years. The representation of the hydrologic conditions in the numerous graphs clearly show effects on the impacts to the rivers and reservoirs of the basin as well as the diversions, district shortages and key stream locations."

> "One aspect of the review that I don't think was explicitly outlined is the uncertainty with the analysis. I think the uncertainty of the model and analysis in built into the output by displaying the 20% to 80% exceedance bands. Because one would expect that if an assumption or hydrologic parameter was wrong or incorrect, the resultant output would show up as an anomaly. I did not find any anomalies in the output and through the work of reviewing previous versions and output over the past few years, I believe the uncertainties were ferreted out and corrected if needed. I don't believe this model or any model is perfect but I believe this model and analysis displays an accurate representation of what is known about the hydrologic conditions in the Upper Deschutes Basin and represents effects of alternate management criteria."

Reviewer 4 noted:

> "The assumptions that went into what is driving the model is clear, and the outputs based on those assumptions are reasonable. Where we are now is much improved."

> "As mentioned above, the outputs in stream flow and reservoir fluctuations seem reasonable based on the assumptions and limitations discussed in the document."

> "Yes, the document does a decent job of characterizing uncertainty with the model. It is impossible to characterize all elements of uncertainty in a modeling effort of this scale, but the general aspects of uncertainty are accounted for."

Reviewer 5 noted:

> "The "assumptions" stated in section 3 are really just the different operational constraints and rules used to simulate each scenario. These assumptions describe different management paradigms that would be followed if the alternative was adopted. Some differences between on-the-ground implementation of these rules and the simulated effects are to be expected, and are noted in the document. However, I'm not sure if I would call these assumptions. More traditional assumptions not stated in the document are as follows: 1) that the past hydrologic conditions (e.g., streamflow) are indicative of near future (~ 30 yr) hydrology as the HCP is implemented. 2) that irrigation practices are relatively unchanged as the HCP is implemented irrespective of other influences such as economic and social pressures, or collaborative efforts. Assumptions related to Crane Prairie seepage losses are documented."

> "The 'assumptions' reflect the different scenarios being proposed and the document does clearly show the effects of the different scenarios compared to the baseline condition. The "traditional" assumptions of a different hydrologic setting from climate change are not shown, but this would also be difficult to include given the hydrologic complexities of the basin and difficulties in developing calibrated hydrologic models in the headwaters of the basin. The assumptions of non-changing irrigation practices are somewhat evaluated in scenario 2a and 2b. However, a systematic improvement in irrigation efficiency over time (for example 1% per year) for each proposal was not evaluated."

> "I did not see uncertainty addressed in the document."

Based on the reviewers' comments, a section on model limitations and uncertainty was added to the technical memorandum. In addition, each reviewer provided further minor edits, all of which were addressed in the technical memorandum. The specific comments and responses are listed in the following table.

Reviewer Number	Page(s) or other reference location	Line Number(s) if applicable	Comment	Agency Response
Reviewer 1	--	49-53	It would help to explain further here that in addition to the ability for management decisions to be made differently in real time, there are actually different assumptions that could be made now. The reader should not be left with the view that there is only one course of action under each alternative, and that we have modeled that course of action as best we can, and the only differences in the future will be things we cannot predict. It's more accurate to say that for some aspects of water management we have chosen the approaches for analysis from a potentially long list of alternatives, any one of which could be modeled now. This is particularly relevant to assumptions about the use of the uncontracted water on the Crooked River. A different set of assumptions about use of the uncontracted, equally as valid as the assumptions that were made here, would produce different results.	Added this text "Some of the operations described in this report were developed based on the best available information and assumptions about how they would be implemented in real time. It is possible that these will be adaptively changed through time within the constraints of NEPA."
Reviewer 1	Table 1	--	This number accounts only for the main canal (Deschutes River water). The Crooked River pumps averaged another 13,796 AF for the period 2012-2017.	Updated Table 1 to include Crooked pump request.
Reviewer 1	12	162	What happens on March 31?	Typo. Corrected.
Reviewer 1	12	166	I know we all agreed to this approach and should not change it now, but for future reference it should be noted in the text of this document that this approach intentionally gives priority for use of uncontracted water to the winter, thereby reducing the amount of uncontracted that will be released in the summer. If summer were a fish and wildlife priority for uncontracted water, the available amount not allocated for winter each year would be divided by 198 (not 365) and released from April 1 to October 15 (not the full year). The model assumption that was provided by the Services clearly indicates that summer use of the water is not a priority. Model results that show low flows in the summer need to be interpreted with this in mind.	Since this was the agreed-upon approach, decided to limit editorial implications of decision and just stated the facts. Added "This approach intentionally reserves water for the winter."

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Reviewer 1	Table 3	--	If winter use of water were not given priority and all water not needed for the winter 50 cfs were only applied to the summer, this release would be 50 cfs. This is important to note somewhere.	Since this was the agreed-upon approach, decided to limit editorial implications of decision and just stated the facts.
Reviewer 1	14	222	It should be noted here NUID is not required to draw on the rental account to meet the DRC agreement. They just have a limit on the amount of live flow they can divert.	Agree. Added additional language.
Reviewer 1	Table 4	--	This should be 43 cfs in No-Action and 50 cfs in the HCP. The increase to 50 cfs is an HCP measure.	50 cfs was included in the No Action model as a result of a miscommunication. It was noted in the report.
Reviewer 1	20	317-330	This all seems like a reasonable assumption for modeling, given the myriad potential uses for the OSF storage during implementation.	Agree - no change made to document.
Reviewer 1	22	381	As noted for previous alternatives, this intentionally favors winter flows at the expense of summer flows in use of uncontracted.	Addressed similarly to above.
Reviewer 1	Figure 25	--	Compare this figure to Figure 34 on Page 101. The plots for HCP 2 C do not appear to be the same. The pulses in flow in June and July under Alt 2C in this figure are puzzling. They are not present in the plot on Page 101.	This pulse happens earlier in the season (May/June) in alt 3c and alt 4b which masks its impact. You can start to see this effect occurring in the range of flows in the 2C plot.
Reviewer 1	Figure 34	--	See comment at Figure 25 on Page 83.	This pulse happens earlier in the season (May/June) in alt 3c and alt 4b which masks its impact. You can start to see this effect occurring in the range of flows in the 2C plot.
Reviewer 1	Figure 325	--	Should this be Figure 34 instead?	Yes; corrected misplaced plot.
Reviewer 1	113	934	Should this summarize Alt 4 rather than Alt 2	Yes; edited.
Reviewer 1	137	1063	This is due to a combination of reduced storage and the summer caps on flows.	This was intended to describe the effects of higher winter outflow, but point taken. Added a sentence to explain, though it might be a little out of place.

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Reviewer 1	137	1069	This is an important point. If uncontracted release under Alts 3 and 4 were kept low (50 cfs) like they are in Alt 2, the requirement to protect the higher of DRC or uncontracted would be negligible. Alts 3 and 4 are not just about protection of the uncontracted, they are about different use of the uncontracted, so it becomes difficult to isolate the effects of change in flow vs. protection of flow.	Noted.
Reviewer 2	1	15	Is it through WY 2009 or WY 2018 (as changed in the parens)?	Yes; corrected typo.
Reviewer 2	1	18	Text edit "excluding Metolius River."	Edit not made - the RiverWare model does include the Metolius as a tributary above Lake Billy Chinook.
Reviewer 2	3	33	Explain what is meant by a control point. For example, is it a management control point (e.g., target flow location), does it represent an infrastructure control point, or is it simply a control point in the model realm?	Added text: (i.e. locations where flow is monitored in the model to ensure minimum flow criteria are maintained).
Reviewer 2	Figure 2	--	If the Whychus "control point" represents the low flow point then it should be below Sokol diversion. If it's the control point for TSID to meet minimum by-pass flows, then it is in the correct location.	Flow is monitored in the model at both locations, but the diversion is regulated based on flow in the model below the TSID diversion. Thus, the control point is shown directly below that location.
Reviewer 2	Figure 3	--	Should there be a control point below NUID pumps?	Added to figure.
Reviewer 2	10	140	Aren't there ramping rate considerations as well?	Not really in the no action model. Ramping is not usually modeled in planning studies because it is something that depends on real time conditions. A form of ramping is included in the fall proposed action alternative operation.
Reviewer 2	12	169	Looked like "UV" was in the denominator of the eqn.	Adjusted equations for better readability.
Reviewer 2	12	173	It looks like the irrigation season storage release can be a negative number.	The model limits this so that it cannot go negative, but for simplicity showing this equation, I chose not to add that detail. Footnote added to explain this.
Reviewer 2	12	173	Looked like 50 cfs was in denominator.	Adjusted equations for better readability.

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Reviewer 2	14	206	Confusing sentence. The demand is met by initially setting the diversion from each source based on the recent historical diversion rates.	Agree - text change accepted.
Reviewer 2	Table 4	--	Suggest rounding these with no decimal and put a note in the table that values have been rounded.	Point taken, though since these are the exact values in the NUID agreement, not going change them in this document. No change made.
Reviewer 2	16	238	These are not really model assumptions. I would describe this as the operational rules and logic used to simulate each scenario.	Changed to Scenario Descriptions.
Reviewer 2	Table 5	--	Is the maximum irrigation season dam scaled between all the diverters based on relative water right rate?	The cap is applied to Wickiup outflows, not the demand. It would impact NUID the most because NUID is junior. Added text to explain this better.
Reviewer 2	Table 5	--	What is the current maximum demand? 1600?	Clarified this since it is not total irrigation demand, but the amount required from Wickiup to satisfy downstream demand, as much as 1,800 cfs.
Reviewer 2	Table 5	--	Need more info: Is this just peak demand reduction, or is it scaled throughout the irrigation season. It'd also be helpful to know the relative magnitude of this change with respect to the current demand (e.g., % of current demand).	Added text in response to earlier comments.
Reviewer 2	19	316	Not clear what is being referenced here. Where is this other "Alternatives" timing defined? Is it the baseline timing? Is it timing with respect to alternatives in table 5? What years are these being implemented?	Agree this is confusing. Clarified text. The point is that TID's implementation timing does not align with the year ranges in 2A, 2B, and 2C, so this was an approximation of how their plan would be implemented to fit within the model scenario.

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Reviewer 2	Table 6	--	Aren't these minimums lower minimums than the current BiOp (baseline simulation)???	Added text to explain the minimums - "The minimum outflows from Crescent are lower than the No Action because it was determined to be more important to shape the outflows at critical times of the year for the species than to maintain a higher flow throughout the year. "
Reviewer 2	21	356	So there is no reduction in demand in contrast to alternative 2?	No. Alternative 3 did not have the reductions in outflows as defined in Alternative 2.
Reviewer 2	21	358	Are the fall and spring operations similar to what is described in alternative 2?	No, they are similar to Alternative 2 as defined in the DEIS. Refinements were mostly focused on the Alternative for the FEIS in the interest of time. So, this was not changed.
Reviewer 2	22	396-400	Similar comment as in earlier scenario.	Adjusted equations for better readability.
Reviewer 2	23	408	How were the reductions in max irrigation demand treated (alternatives 2b, 2c, etc.) treated in this calculation?	Irrigation demand remained the same for all scenarios and shortages were calculated with respect to those demands. It was only the outflows that were reduced. Added text to better explain this.
Reviewer 2	24	439-444	Were the flow and storage objectives met for CP operations?	Yes; see previous sentence.
Reviewer 2	27	454	Good summary. Looking for similar statement for Crane Prairie description.	There was a sentence that stated this, it was just hard to see. Moved it.
Reviewer 2	30	467	No action minimum outflows are much higher than alternatives??	Added similar statement as above.
Reviewer 2	30	468	Good summary.	Noted, thank you.

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Reviewer 2	33	481	Much of the summer flow observed (and simulated) at this site is from storage releases from Crescent Lake. This is apparent in the graphs looking at the magnitude of the Crescent Lake releases versus the summer (July-Sep) flows in Figure 8. Crescent releases make up the majority of that flow.	Fair point. Clarified text.
Reviewer 2	39	504	It is the lowest flow point between Bend and Pelton-Round Butte complex (aka Lake Billy Chinook).	Added clarifying text.
Reviewer 2	48	537	Objectives met in this scenario? No statement if objectives were met in this scenario, in contrast to other sections.	Added clarifying text.
Reviewer 2	48	541	Spring release can be to hold the reservoir below the fill curve, if there is runoff. However, the fall/winter releases are generally when there are releases to make space (if necessary) to capture spring runoff; again according to the rule curve.	Edited to describe fall winter releases to capture spring runoff as necessary.
Reviewer 2	51	553	Similar comment as the description for Prineville. I don't think this captures the general operations correctly.	Edited to describe fall winter releases to capture spring runoff as necessary.
Reviewer 2	54	562	Objectives met?	Added text.
Reviewer 2	57	578	Lower Opal springs is tritium dead, so no irrigation returns at that location. Upper Opal springs does have anthropogenic influences. However, return flows occur over many miles all along the Crooked river from Osborne Canyon area (near Hwy 97 bridge x-ing) downstream to LBC.	Accepted text edits.
Reviewer 2	57	578	Objectives met?	Added text.
Reviewer 2	Figure 17	--	COID has a baseline shortage of about 10 TAF? Given the priority of their water-rights and lack of overall irrigation system efficiency it's difficult to fathom. It'd be helpful to put this shortage into context by adding another y-axis showing % of demand. That way the reader can identify the significance of a 10-15 TAF shortage.	In previous discussions, we identified this as a result of COID shoulder season demand exceeding its live flow water right, and then running out of stored water resulting in a shortage. I did add a table in all the shortage sections to show the shortage relative to total demand - It was difficult to add this

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				directly to the figure, but I think the table captures your intent.
Reviewer 2	68	628	Summary statement on results is missing. Are the target (flow) objectives met? Does the reservoir empty at times?	Added.
Reviewer 2	68	630	Not sure what this means? There are outflows during the irrigation season, but there is no minimum or maximum?	Missing "maximum."
Reviewer 2	71	657	Good summary. Need something similar for Wickiup.	Noted, thank you.
Reviewer 2	Figure 20	--	Seems unusual that the HCP target flows are lower than the baseline.	See previous similar comment responses.
Reviewer 2	74	675	The summer flows are largely influenced by Crescent Lake releases, which account for most of the flow during August and September. Crescent Lake is releasing ~ 100 cfs which is greater than half (and in dry years, almost all) of the flow at the Little Des gage.	Added text similar to earlier similar comment.
Reviewer 2	Figure 21	--	Why are the alternative summer (August and September specifically) flows so much higher than the "no-action" flows when Crescent releases are nearly identical in Alternative 2A, 2b, and 2c? Where is this higher flow coming from?	There was an issue with the model. It has been corrected.
Reviewer 2	79	701	Is the flow target always met?	Added text.
Reviewer 2	79	705	Unclear what this is describing.	Added clarifying text.
Reviewer 2	Figure 27	--	To put the total amount of shortage (the height of each bar) into context, suggest adding y-axis with % of total demand. Otherwise it's unclear the significance graphically.	Added table with %, not easy to show on graph.
Reviewer 2	93	788	Good summary.	Noted, thank you.
Reviewer 2	94	799	Summary? Are these minimum flows achievable?	Added text.
Reviewer 2	107	898	Little Deschutes flows are significantly impacted by Crescent Creek and Lake releases in the summer.	Added clarifying text.
Reviewer 2	119	884	Summary? Are the target flows here always met?	Added clarifying text.

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Reviewer 2	Figure 36	--	Similar suggestions as previous graph: Add % of total as secondary y-axis.	Added table with %, not easy to show on graph.
Reviewer 2	113	929	Summary result statement. This type of statement should be a part of every sub-section results.	Noted, thank you.
Reviewer 2	135	962	See previous comments.	Adjusted language.
Reviewer 2	135	963	Good summary statement on results. Should include some type of summary in other sections.	Noted, thank you.
Reviewer 2	Figure 45	--	Add % of total as secondary y axis.	Added table with %, not easy to show on graph.
Reviewer 3	33	286	Required, or not allowed?	Edited based on previous comment.
Reviewer 3	36	346	So the analyses of Alts 3 and 4 are not separated into an Alt 3A, 3B, and 3C like Alt 2 is. I know there are some differences in the timeframes in which we are getting some of the benchmark flows. Are these model comparisons only for the latest phase of the permit for Alts 3 and 4? We will want to be very explicit about what Alts 3 and 4 are in terms of time period, and what we are looking at in the modeling.	Added description. Only results from 3C are shown to reduce the number of plots and since it is not the preferred.
Reviewer 3	37	369	Alt 4 ABC?	Added description. Only results from 4B are shown to reduce the number of plots and since it is not the preferred.
Reviewer 3	Figure 7	--	What are the spikes in February outflow?	Added a sentence to explain. These are flood control releases in higher flow years.
Reviewer 3	Figure 13	--	May be useful to add a sentence describing outflow pattern through the winter and why the exceedance curve is shaped the way it is - tailing off at the end of each month. That would apply to any anomalous looking fill/discharge graphs.	Added a sentence.
Reviewer 3	Figure 26	--	It would make interpretation a little easier if the y-axis on figures 25 and 26 were the same. Same for previous analyses of these gauges.	The y-axis values were chosen to maximize the data shown. No change made.

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Reviewer 3	Figure 27	--	This comparison of shortages between Alt 2 A, B, and C is a bit confusing since each of those represents a different period of time (2A: 0-7 years; 2B: 8-12 years; 2C: 13-30 years), and the graphs are depicting shortages associated with out years starting in year 1. As an example, Alt 2C, which doesn't begin until year 13 is showing relatively large shortages in years 1-12. It seems that the years of shortage should only pertain to the years when that particular phase of the alternative rather than spread over the whole period of the permit.	Added explanation that each scenario was run through the entire model run period regardless of the length of the implementation phase to understand the potential effects through a wide range of hydrologic effects. The numbers on the graphs indicate the model run year, not the implementation year.
Reviewer 3	93	785	Alt 3C? Is this the same time period as 2C?	No, the time periods are added to the scenario description.
Reviewer 3	129	926	Is this Alt 2C?	Adjusted all scenarios so they referenced the implementation period also (ABC).
Reviewer 3	129	932	We will want to be consistent in what we are calling this Alt 2 or Alt 2.	Adjusted all scenarios so they referenced the implementation period also (ABC).
Reviewer 4	13	204	Note the suggested change to the footnote. My understanding is that the authorized place of use is different, with 5,000 primary acres on the 1968. It's irrelevant to the model, but I wanted to clarify that in theory, there are times when the 1968 priority is diverted.	Change accepted.
Reviewer 4	15	246	Suggested clarifying that it's the oldest water right pertinent to regulation in that portion of the model. Lots of older rights on the Little Deschutes, Crooked, Whychus.	Change accepted.
Reviewer 4	18	312	For Alternative 2, this document describes the schedule for implementation (2A, 2B, 2C). The differences in the schedule for implementation—the implementation years, but also the progressions of the non-irrigation season minimum—should probably be noted here in the same way.	Agree - added text.
Reviewer 4	18	313	Moved max to after season for consistency/clarity.	Change accepted.

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Reviewer 4	18	317	As described above, there are now other differences from alternative 2 that should probably be mentioned.	Change accepted.
Reviewer 4	18	323	I think this will confuse people, so I would suggest not saying anything or saying that there is no summer maximum. If you do need to say something about it, I would suggest the changes in redline.	Agree - deleted statement.
Reviewer 4	18	327	I've noticed that lots of folks have misinterpreted the actual Alt 3 proposal that NUID will bypass flows to mean that flows are protected under an instream water right, which would look very different than what's modeled in RiverWare. I suggest changing the description to narrow the focus to the North Unit bypass to avoid confusion.	Edit made, but added parenthetical (in other words, the water is "protected" from diversion) for those who were used to that terminology.
Reviewer 4	18	330	1) Trying for consistent terminology, but not sure if this actually is a summer minimum and not an irrigation season minimum. 2) I'm assuming RiverWare did not account for big pulse releases that occur early in the irrigation season?	Irrigation season is accurate. This limit only applies to the uncontracted releases, so the pulses would still be allowed if they are releases for flood control or irrigation.
Reviewer 4	19	345	As above.	Same edit made.
Reviewer 4	19	361	Not sure if bypassing uncontracted is actually in alternative 4, but I assumed it was.	Yes, they were.
Reviewer 4	20	396	Figure 5 doesn't appear to show that objective 4 is achieved.	Added "if possible" to #4.
Reviewer 4	23	425	Isn't this true for Wickiup and Crane Prairie, too? We're only looking at 80 percent exceedance.	Yes, but it was also true that the objectives were met in all years at Crane Prairie and Wickiup.
Reviewer 4	24	438	My understanding is that Crescent is the majority of the flow at La Pine once Little Deschutes natural flow drops off in July, sometimes lasting through October or even November.	Edited text to reflect this and other comments.

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Reviewer 4	36	502	The change in flows during July through September that I'm seeing is driven, I believe, by there being more water in Crescent. Because of the high outflows in the NA, Crescent is too frequently empty and no irrigation release is made, even though TID demand is there. Under PA, lower required non-irrigation season outflows allow for increased Crescent releases after Tumalo Creek flows fall off from July through September.	This was an issue with the model that has since been corrected.
Reviewer 4	47	585	I couldn't confirm that that's the reason for the NUID supply increase. Crescent still doesn't fill in a lot of the years that NUID has the greatest shortages, so there wouldn't be any change in a lot of those years. I suspect changes in Crane Prairie storage area a bigger factor, along with what I think might be an anomaly that Troy brought to my attention on the 28th that seems to affect Wickiup releases in a few years, including 2011 and 2015, as examples.	This effect went away with the model edit. Deleted statement. Added table of shortages to more easily compare effects.
Reviewer 4	47	687	For LPID and AID, it looks to me like part of the issue is also the reduction in volume available from Crane Prairie, due to the change in the water level requirements. Since Crane has to stay full through 7/15, shortages occurring before that time cannot be alleviated by Crane Prairie releases.	It is possible that the reduction in water available to LPID and AID is adding to these shortages. Added language.
Reviewer 4	52	734	My understanding is that the difference is almost entirely attributable to the increase in the winter flow minimum in the model from 12 cfs under HCP C to 20 cfs under Alt 3. It looks to me like there should not really be more opportunities for the senior water right holders to call on the Crescent Lake storage right under Alt 3 than under HCP C. Since natural flow shortages generally only occur later into the irrigation season in dry years, Crescent wouldn't typically still be filling. My understanding of LPID, for example, is that their shortages earlier in the irrigation season, when Crescent may still be filling, are driven by lack of access to Crane Prairie storage, because their live flow rights are insufficient to meet modeled demand.	Yes, this is correct; the language was left over from a previous version. Updated language.
Reviewer 4	52	745	As above, LAPO is pretty much all Crescent during late summer/early fall in dry years.	Adjusted text.

Reviewer Number	Page(s) or other reference location	Line Number(s) if applicable	Comment	Agency Response
Reviewer 4	53	747	Decline in LAPO flows from Alt 2 compared to Alt 3 again caused by reduction in Crescent storage irrigation releases.	This was an issue with the model that has since been corrected.
Reviewer 4	55	788	As above, my understanding is that NUID is required to bypass the uncontracted releases, not that they are protected from diversion for irrigation.	Included both ways of saying it since it is still being discussed.
Reviewer 4	62	884	See Alt 3 comments above.	Made edits similar to Alt 3.
Reviewer 4	63	898	See Alt 2 and 3 comments above.	Adjusted text.
Reviewer 4	66	940	As above, change language to something like "must be bypassed by NUID."	Adjusted text.
Reviewer 4	69	986	See Alts 2 and 3 mention of Crane Prairie reductions affecting AID and LPID.	Added.
Reviewer 4	73	1025	As above, it's my understanding that the alternative did not anticipate the issuance of a secondary instream water right, just that NUID would bypass the flow.	Included both ways of saying it since it is still being discussed.
Reviewer 5	13	Footnote 3	There is an assumption that the NUID diversion on the Crooked River would only use 1955 priority date water at these pumps. Although the capacity is limited to 200 cfs which is entirely within the 1955 water right, it is necessary that NUID exercise its 1968 priority date per Oregon Water Law. I only point this out as a matter of water law and not that it would change the outcome of the model results.	Added language to clarify this.
Reviewer 5	appendix	--	The incorporation of the Crooked River hydrographs with the logarithmic Y-axis is very helpful and a marked improvement in the clarity of the information presented.	Noted, thank you.

Reviewer Number	Page(s) or other reference location	Line Number(s) if applicable	Comment	Agency Response
Reviewer 5	General	--	One aspect of the review that I don't think was explicitly outlined is the uncertainty with the analysis. I think the uncertainty of the model and analysis in built into the output by displaying the 20% to 80% exceedance bands. Because one would expect that if an assumption or hydrologic parameter was wrong or incorrect, the resultant output would show up as an anomaly. I did not find any anomalies in the output and through the work of reviewing previous versions and output over the past few years, I believe the uncertainties were ferreted out and corrected if needed. I don't believe this model or any model is perfect but I believe this model and analysis displays an accurate representation of what is known about the hydrologic conditions in the Upper Deschutes Basin and represents effects of alternate management criteria.	Added section on model limitations and uncertainty.