Peer Review Report

Analysis of RiverWare Model, Umatilla River Basin, Oregon

Date

July 13, 2021

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: Sophie Wilderotter, Civil Engineer (Hydrologic), Columbia-Pacific Northwest Region, Bureau of Reclamation

Peer Review Scope

A RiverWare Model was developed and calibrated for the Umatilla River Basin in Oregon. The model was refined and reviewed under the guidance of the Umatilla Field Office and has been developed to serve as a tool in future studies. The modeling assumptions and output are the subject of the peer review described in this report. Peer reviewers were asked to provide responses to the following questions:

1. Are the assumptions acceptable and clearly explained in the documentation of the modeling analysis?
2. Does the output adequately reflect current field operations, and are any deviations in the assumptions and output clearly documented?
3. Does the documentation clearly show the calibration of the model and is the calibration acceptable? Does the document adequately characterize the modeled and historical differences?

The scope of the review did not include the selection of RiverWare as the appropriate tool for this analysis, nor review of the RiverWare software itself, because these actions have been previously reviewed. The scope also did not include the model itself, as it was reviewed internally consistent with the Baseline Hydrologic Models Batch Peer Review plan (June 2021).

Peer Reviewers

Reviewers were selected to include Oregon Department of Water Resources staff hydrologists with experience in the Umatilla Basin and interpreting model results, contractors for the irrigation districts in the Umatilla River Basin, and the Confederated Tribes of the Umatilla Indian Reservation. Given the varying degree of interests and the broad knowledge of the reviewers, it was determined that this group met the requirements for this influential review. The selected reviewers are listed below.

Owen McMurtrey
  Water Resources Consultant, GSI Water Solutions Inc., Corvallis, Oregon
  Expertise: Water Resources, Water Rights

John Carron
  Founder and Principal, Hydros Consulting Inc., Boulder, Colorado
  Expertise: Water Resources, Water Rights, Hydrologic Modeling

Chris Kowitz
  North Central Region Manager, Oregon Water Resources Department, Pendleton, Oregon
  Expertise: Water Rights, Umatilla Operations, Field Hydrology, Irrigation Deliveries

Julian Fulwiler
  Supervising Engineer, Stetson Engineers Inc., San Rafael, California
  Expertise: Water Resources, Hydrology

Summary of Reviewer Comments

Each reviewer provided a summary statement noting any major findings relative to the general questions described in the Peer Review Scope section above. Reviewer comments regarding the identified questions are summarized below. Note that reviewers do not directly correspond to the list above for anonymity with respect to their comments). Comments that were not within the scope of this peer review were not included in this summary.

Reviewer 1 noted:

> Reviewer 1 requests that the calibration plots include a larger focus on smaller time scales than annual.

Reviewer 2 noted:

> "Additional discussion on the types of rules that were adjusted is needed to better understand the calibration process."
>
> "Additional discussion and examples as to what is causing some of the larger differences between modeled and historical."

> Reviewer 2 requests that the calibration figures include larger figures and monthly summarized results.

Reviewer 3 noted:

> "There are a number of modeling assumptions that are not identified, or are not clearly explained. These are identified in specific comments in the attached comment matrix."
>
> "With respect to WEID's water supply, the current output does not reflect current field operations. As described above, the model lacks the required inputs and logic to distinguish between WEID's exchange pumping and conjunctive use pumping from the Columbia River. As a result, the model outputs do not show, nor can the model be used to evaluate, the impacts of historical and future water management changes on WEID's water supply."
>
> "The documentation does not show the calibration of the modeled streamflow at a scale that is useful for evaluating the performance of the model during the irrigation season, so it is unclear whether the differences between the modeled and historical flow are appropriately characterized."

Reviewer 4 noted:

> "The referenced groundwater model summary memo is insufficient to determine if that development and calibration was adequate for development of response functions."
>
> "The description of the water rights (with the exception of duty), target flows, and accounting seem reasonable but without model accounting output and comparison to historical OWRD accounting records (e.g. beginning/end of season storage account values, and live/storage deliveries to the different users) it's impossible to ascertain if he model is simulating this correctly."
>
> "It appears the model is simulating irrigation and non-irrigation seasonal storage, diversions, and streamflow reasonably well. However, monthly (or weekly) comparisons are required to understand both model uncertainty and how well the model simulates current operations."

Based on the reviewers' comments, more details on the model development and additional calibration plots for monthly data were added to the documentation. 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	Page or Other Location Reference	Line Number (if applicable)	Priority	Comment	Response
Reviewer 1	P. 6 lines 6-8	--	2	It would be nice to provide more information on the intended use of the model. Is it a long-term planning model? Will it be used for daily river/reservoir operations? Annual operating plans? More specificity on its intended use(s) would help clarify the review of the model and better direct model refinements that could enhance its future use.	Document updated with the suggested information.
Reviewer 1	P. 10 Sec. 3.2.1	--	2	It appears that a lumped sum approach is used to identify a single daily gain/loss term for each reach. 1) Was travel time a consideration between gages, and if not, why? 2) The lumping of multiple physical processes into a single gain/loss term may only be applicable for future operating paradigms which follow roughly the same pattern of water storage, release, and distribution. Significant changes to water delivery patterns (for example, from new exchange agreements) may change the dynamics of reach gain/loss sufficiently to require recalculation. Recommendation: explore the feasibility of separating out as many specific physical processes as possible; and also quantify the potential impacts of travel times on these calculations, particularly during periods of rapidly changing flows.	1) Travel time between gages is less than the time step of the model, 1 day. Thus, travel times cannot be considered. 2) The model attempts to separate out returns from some canal and on-farm losses from the gains and losses input into reach segments. Historical data limitations do not allow separating out other processes with any confidence.
Reviewer 1	P. 10 Sec. 3.2.2	--	2	The model has individual accounts on McKay reservoir, which are filled annually and then used to supplement direct flow water rights. There is no information regarding the process for accounting for water use from those storage accounts. For example, is water charged against WID's account based on diversions made at the WID headgate, or are charges based on water released from storage? How do potential gains and losses in the intervening reaches impact that accounting?	Document updated to state the accounts track the water usage as water is released from the reservoir.
Reviewer 1	P. 14 Sec. 3.2.3	--	2	It looks like the demands for each headgate are based on historical diversion data (or estimated as needed). This approach is valid for calibrating the model to	Demand patterns will be developed for future scenarios when future scenarios are determined.

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				historical operations but can be limiting for simulations involving future operations. Changes in canal efficiency (lining), crop mix, irrigation practices, etc. may change the patterns of demands in the future. RiverWare has a robust methodology for inputting crop irrigation requirements, irrigation efficiency, acreage, etc. Future enhancement of the model should include a more robust approach to simulating irrigation demands.	
Reviewer 1	P. 15 lines 163-166	--	2	The process of exchanges is not clearly explained. The sentence on line 164 beginning with "The exchanges occur when.." is hard to interpret. Why is canal operational effectiveness subtracted from the live flow? An example or two, and explicitly showing the equation used to determine when exchanges occur, would be helpful.	Reworded the phrase. Added a simplified flow chart to show what the model is doing.
Reviewer 1	P. 15 lines 166-169	--	2	It appears that the "forecast" is really just looking ahead at the known historical data. This should be explicitly stated. The rationale for the buffer flow values should also be given. Were those values derived by trial and error?	Edits were made to the document.
Reviewer 1	P. 15 lines 173-176	--	2	Please explain the exchange credit accounting more clearly. Does this mean that HID only gets credit for 80% of the diverted amount? Also please explain why the model only allows for a 20% loss. That should not be a limitation of RiverWare. Embedding some portion of the loss within the lumped gain/loss term will limit the ability of the model to accurately reflect changes in canal and river operations. As mentioned above, every effort should be made to separate out these various physical processes so that future changes in operating policies can be more accurately modeled.	The 20% loss is a decreed amount determined by the State of Oregon. Once HID actually reaches their 50 kaf diversion plus exchanged entitlement, HID can continue to divert to recoup losses at 20%. In some years, actual losses are up to 30%, where HID can only recover 20% per Oregon law. Feed Canal losses can fluctuate greatly year by year, dependent on Umatilla River sediment concentration, soil moisture conditions, and the amount of canal bed treatment with bentonite.
Reviewer 1	P. 16 Sec. 3.2.5	--	2	Please clarify the behavior of the model if the combination of water rights (direct flow) and stored	Document updated with the requested information.

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				water are insufficient to meet a demand. Is the demand then reduced? How is stored water released and shepherded to the appropriate headgates?	
Reviewer 1	P. 16 lines 210-214	--	2	Regarding the computation of return flows, please see comment above regarding the Water User methods available in RiverWare. I would encourage Reclamation to look into using these methods to simulate canal losses and on-farm efficiency so that the Periodic Fractions do not have to be continually recalculated for different scenarios. This behavior should be modeled within RiverWare.	The model attempts to separate out returns from some canal and on-farm losses from the gains and losses input into reach segments. Historical data limitations do not allow other processes to be separated out with any confidence. This may be added in future versions of the model, but it was outside the scope of this study.
Reviewer 1	P. 18 Sec. 5.0	--	2	This section would benefit from more explanation. How were the rules adjusted? Were maximum diversion rates changed? Timing of diversions? If there is a reason that the water right solver yielded a different solution than observed data, it would be nice to explain in more detail how historical practices have differed from this strict administrative approach. It is difficult (impossible) to evaluate how well the rules reflect historical operations without actually seeing the rules. I hope that Reclamation will make the model and ruleset available for review at a future date.	The Calibration section was reworded to make the section more clear. Diversions used in the model were historical diversions. The scope of this peer review is to review the document. The release of the model was out of the scope of the peer review.
Reviewer 1	P .20 lines 269-270	--	2	The calibration results are hard to see from Figure 10. Given that the significant reservoir operations occur during irrigation season, it would be nice to see a higher resolution plot during those months. In addition, it does appear that releases are higher in spring and lower in late summer in some years ('13, '15, '16) when compared to historical release data. I recommend some simple summary statistics to measure goodness of fit for the reservoir releases during the irrigation season (RMSE, Nash-Sutcliffe Efficiency, etc.).	Log scale images were added to Appendix D for daily flow figures. Statistics such as RMSE are not typically used for time series as they may be misleading.

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Reviewer 1	P. 20 lines 270-271	--	2	There seems to be a focus on annual volumes in the calibration results. While that is important, and the numbers look good, the focus should be on the daily values, since it is a daily timestep model. If the model is to be used for operational modeling and/or water accounting, I suggest increased focus on the daily simulation results.	Daily and monthly comparison plots were added to Appendix D for reservoir outflows and gage streamflows.
Reviewer 1	P. 22 lines 281-285	--	2	Please provide rule logic that determines reservoir releases. These appear to exactly match historical data except in certain instances. Is the model just using historical releases?	The outflows from Cold Springs should match the historical outflows (i.e., ALine canal diversion) since the model is using historical diversions and the only outflow is this diversion. McKay does not match historical outflows one for one and relies on logic. The scope of the current peer review is the documentation and whether it sufficiently describes the assumptions and output.
Reviewer 1	P. 23 lines 294-295	--	2	Recommend that simple goodness of fit metrics also be applied to the modeled gage data (RMSE, Nash-Sutcliffe).	These types of statistics are not typically used for time series and can be misleading.
Reviewer 1	P. 27 lines 336-340	--	2	Please provide a more precise description of the diversions to users that are not part of the exchange program; "the amount of diverted water is similar to historical diversions" needs to be quantified and an explanation provided. Again, some simple statistics would be helpful.	Some information is provided for these diversions when they do not match well. Statistics were not added as these types of statistics are not typically used for time series and can be misleading.
Reviewer 1	P. 32 Fig. 25	--	2	The Furnish Canal plot shows apparently significant variation between modeled and observed during the latter months of every year. This would benefit from an explanation.	The Furnish deliveries later in the season are not associated with the exchange. These are deliveries that are beyond the extent of the exchange program. The model does not capture the variability due to the way water is released from storage for these diversions.

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Reviewer 1	P. 36 lines 452-453	--	2	Assumptions and simplifications are of course a necessary part of modeling. Whether or not the logic implemented in this model is a "suitable test environment" for future conditions cannot be determined without a review of the ruleset.	The scope of the current peer review is the documentation and whether it sufficiently describes the assumptions and output.
Reviewer 2	P. 9 Fig. 2	--	2	Schematic shows a "SID_Fish" water user that appears as a diversion. A discussion of this object needs to be provided in the Report. Is this a diversion or instream flow object? How does the model allocate water to this object?	Document updated with the requested information.
Reviewer 2	P. 9 Fig. 2	--	2	Schematic does not identify Courtney or Pioneer Ditch Companies. How are those diversions handled in the model?	These districts are included in the Westland diversion.
Reviewer 2	P. 9 Fig. 2	--	2	Schematic identifies "Gain/Loss" upstream from the BIRO and PDTO gages but no calculation is shown in Appendix A. Please provide clarification on the data inputs upstream or at those gages.	Added the requested information to Appendix A and Appendix B.
Reviewer 2	P. 10 Sec. 3.2.1	--	1	It appears the general methodology used to calculate Umatilla River reach gains/losses develops a single daily flow value (positive or negative) that represents a combined processes of seepage, surface water runoff, groundwater inflows, and ag return flows (in some reaches these return flows are separated out and in others they are not - an explanation for why included in some and not in others would be helpful). This single combined gain/loss value is developed based on historical flow patterns. If flow patterns change under future model scenarios, the combined gain/loss input data may not correctly capture the changed condition. Suggest evaluating separating out processes that may be affected by future flow differences (e.g., seepage losses).	The model attempts to separate out returns from some canal and on-farm losses from the gains and losses input into reach segments. Historical data limitations do not allow other processes to be separated out with any confidence. This may be included in future efforts as necessary to respond to questions.
Reviewer 2	P. 13 Table 1	126	2	Maximum Storage values in this table do not match values discussed prior in Section 3.2.2. Provide discussion on what the difference is between "Maximum Storage	The maximum storage is based on the physical properties of the system, but the

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				values" in Table 1 and the capacity values previously referenced. The maximum storage value for Cold Springs Reservoir appears to be an error.	system is operated to the active capacity. Active Capacity was added to the table.
Reviewer 2	P. 13 Table 1	126	3	Confirm spillway capacity for Cold Springs Reservoir. Value seems high.	Values updated to match model.
Reviewer 2	P. 14 Table 2	143	2	Suggest clarifying if the Westland Canal diversions include the winter/spring diversions for the county line aquifer recharge project or not.	These diversions are included in the Westland Canal diversions since historical diversions were used in the calibration. If future scenarios need these diversions to be separated out, they can be.
Reviewer 2	P. 14 Table 2	143	2	Suggest clarifying if annual diversions are on Annual or Water Year basis. Additionally, suggest including monthly diversion data since it provides useful information on seasonality of the diversions.	Clarification on water year was added. This table is showing annual volumes to show the relative sizes of the diversions. Demand seasonality can be seen in the calibration plots in section 5.3.
Reviewer 2	P. 14 Table 2	143	2	Feed Canal diversion looks too high (I recall it is closer to 50,000 AF). Please confirm value or update if appropriate.	Table was showing Feed with Exchange water included. Table was adjusted to show exchange volumes separately.
Reviewer 2	Pp. 13 and 14 Sec. 3.2.3	--	1	The model appears to use historical daily diversion data as model input. Additional discussion is needed as to why this approach, instead of an actual agricultural demand input, is adequate for model purposes. For example, historical diversions during a dry year may be low because of insufficient water availability. If, under future model scenarios, additional water supplies were available to a specific user (i.e., imports, storage), then that particular user would likely want to divert more than historical.	Demand patterns will be developed for future scenarios when future scenarios are determined.
Reviewer 2	P. 14 footnote 1	--	3	Footnote states average diversions from 1994 - 2019. Model period from page 7 is 1993-2019. If typo, correct. If not a typo, provide explanation for why 1993 wasn't included.	This footnote was removed when the table was edited.
Reviewer 2	P. 16	190	3	Water Rights are in Appendix C, not B.	This was changed.

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Reviewer 2	P. 16 Sec. 3.2.6	199	2	Please add a table identifying the Periodic Fractions used for each canal.	Table was added.
Reviewer 2	P. 16 Sec. 3.2.6	206, 207	2	It appears the response functions were developed before the Phase II exchange took effect. The Phase II exchange significantly altered diversions in the Feed and Furnish Canals. Does the older MODFLOW model need to be re-evaluated with more recent data given the changes resulting from the Phase II exchange?	Response functions should be valid if the gradients in the aquifer did not change significantly. However, it would be good to update the groundwater model at some point; this is outside the scope of this study.
Reviewer 2	P. 16 Sec. 3.2.6	--	2	Please add a schematic or table identifying where along the Umatilla River the canal seepages and ag return flows are returned.	Figure 2 was updated to include these locations.
Reviewer 2	P. 18	236	2	Additional discussion of the types of rules that were adjusted is needed to better understand the calibration process. Some specific examples would be helpful.	Document reworded.
Reviewer 2	Sec. 5.0	--	2	Generally, the figures depicted in Section 5.0 are too small and in some cases (daily flow figures) use an insufficient scale to adequately review the results. Suggest revising presentation of results. Some possible suggestions include: enlarging figures and moving to an Appendix; including monthly and annual comparisons in tabular form; and using a log-scale for daily flow figures.	Log scale images were added to Appendix D for daily flow figures.
Reviewer 2	Sec. 5.1	--	2	Additional discussion and examples are needed as to what is causing some of the larger differences between modeled and historical reservoir storage data. Specifically, large differences in 2011, 2012, and 2016 in McKay Reservoir and what appear a more consistent overestimation of simulated storage in Cold Springs Reservoir (2011, 2012, 2013, 2016, 2018).	It is unclear what the reviewer is referring to, as the figure appears to replicate historical storage reasonably well.
Reviewer 2	Sec. 5.2	--	2	Figures are included comparing annual flows during the non-irrigation season and the irrigation season. Please include definition for what is considered the irrigation season for the purposes of these comparisons.	Document updated with the requested information.
Reviewer 2	Sec. 5.2	--	2	Flow figures are too small and of insufficient scale to adequately view results, specifically during low flow	Log scale images were added to Appendix D for daily flow figures.

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				periods. See above comment for revising result presentation.	
Reviewer 2	Sec. 5.3	--	2	Suggest adding tabular result comparisons for the diversions on a monthly and annual basis. This will allow a clearer understanding of how the model results compare to the historical diversions.	Annual comparisons were added in a figure.
Reviewer 2	Appendix A Table 6	--	2	The data source for certain gages is from the Hydromet data (e.g. YOKO, PDTO). It may be better to use the OWRD data when available, since our understanding is it goes through higher degrees of post-processing/analysis.	Hydromet pulls in the data from OWRD.
Reviewer 2	Appendix A Table 6	486	2	Include the elevation-seepage table and average monthly evaporation data in the appendix.	Curves added in an appendix.
Reviewer 2	Appendix A Table 6	486	2	Consider including and separating out precipitation from the inflow calculation.	Precipitation was not included directly but is included in the gains and losses. If future scenarios need this to separated out, that could be done.
Reviewer 2	P. 40 Appendix A Table 11	503	1	Instead of using the Feed Canal gage near the head of the canal and subtracting 20% for seepage, suggest using the Feed Canal gage at the terminus of the canal (OWRD 14029550).	Using the difference of the two gages would give a historical time series of seepage. The way seepage is currently included allows for the average seepage value to be changed in future scenarios.
Reviewer 2	P. 40 Appendix A Table 11	503	2	Include the actual elevation-seepage table and average monthly evaporation data in the appendix.	Curves added in an Appendix.
Reviewer 2	P. 40 Appendix A Table 11	503	2	Consider including and separating out precipitation from the inflow calculation.	Precipitation was not included directly but is included in the gains and losses. If future scenarios need this to be separated out, that could be done.
Reviewer 2	P. 42 Appendix B	--	1	Provide discussion and explanation for calculated negative inflows into McKay Reservoir indicated on the figure.	Added discussion to the relevant appendix.

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Reviewer 2	P. 42 Appendix B	--	1	Provide discussion and explanation for calculated negative inflows into Cold Springs Reservoir indicated on the figure.	Added discussion to the relevant appendix.
Reviewer 2	Pp. 41 and42 Appendix B	--	1	Daily calculated gain/losses depicted in the Appendix B figures show flow values in excess of plus/minus 1,000 cfs. These extremes should be examined to develop explanations as to their occurrences (e.g., possible gage error; methodology, etc.) and likely need to be removed from the input dataset. These extremes could have significant effects on daily model results.	Due to how gains and losses are calculated, the day to day variability may include high and low peaks. These could be due the wind and gage error. A 7-day average was added to the plots to show the general trends of the gains and losses. The model handles the variability well, as shown in the calibration plots. For future scenarios, the gains and losses may be further inspected to eliminate some of the variability if needed.
Reviewer 2	Pp. 41 and 42 Appendix B	--	2	Figures depicted in Appendix B are at a scale insufficient for adequate review.	Images in Appendix B were enlarged.
Reviewer 3	Fig. 2	50	1	The schematic shows that the model does not include at least three important objects that are required in order for the model to correctly characterize current conditions, and to be able to evaluate the effect of future management changes: 1) The UMTO gage, which is the basis for WEID's exchange calculation. 2) Flow gains between UMDO and Maxwell. Water available to WEID for exchange is generally equal to unprotected mid-river outflows (minimal) + UMDO to UMTO gains - Maxwell diversion. The Maxwell diversion and UMDO to UMMO (Umatilla below Maxwell) return flows are an important detail for the model to reproduce in order to evaluate the potential impact of, for example, transferring instream the HID water right authorizing the diversion of live flow at Maxwell. Such a change may	1) The UMTO gage was not included since it did not have data until water year 2008, which is only about half of the entire period of record. Even though the gage was not included, the model was calibrated using a pseudo UMTO which is essentially equal to the live flow at UMAO plus the WEID canal diversion. This is likely close to what UMTO live flow would be. If future scenarios are developed to look at this particular location of the River, the model run period could be shortened and the UMTO gage could be included. Calibration plots of the pseudo gages have been added to the document. 2)The data that would be needed to calculate this for the full time period of the

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				reduce the live flow available to WEID, and therefore, the volume of water WEID is able to exchange. 3) Flow gains between Maxwell and UMTO. The flow gains are shown as occurring below WEID's diversion, which would mean they are not available for diversion under WEID's natural flow water rights, nor would they be available for exchange.	model does not exist. 3) The schematic was updated to show where return flows are calculated. Returns are calculated both before and after Maxwell. The gains and losses are other miscellaneous flows that we cannot quantify and are for the entire reach.
Reviewer 3	3.2.2	119	3	Change "Oregon Department of Water Resources" to Oregon Water Resources Department. Additionally, I wanted to confirm that the reference to Jeremy Giffin is correct and it shouldn't be to the Umatilla watermaster.	After conversations with OWRD and UFO, this information was cited as a combination of UFO and OWRD.
Reviewer 3	Table 1	125	3	McKay Reservoir maximum storage is identified as 82,359 AF in the table, but the capacity is identified as ~71,500 AF in the text.	The maximum storage is based on the physical properties of the system, but the system is operated to the active capacity. Active Capacity was added to the table.
Reviewer 3	--	151	2	WEID also holds the right to divert "RETURN FLOW FROM THE IRRIGATION SYSTEMS ALONG THE UMATILLA RIVER USING WATER STORED IN McKAY RESERVOIR," specifically. Consider modifying this sentence to refer to "live flow water supplies and return flows."	Changed in document.
Reviewer 3	Fig. 6	255	2	The scale of the y-axes for Figure 6 makes it appear that the error associated with minimum McKay contents is greater than the error associated with maximum McKay contents; consider using equal scales, whether increasing the y-max on the min contents chart to 80,000 or changing the max contents and min contents charts to 40,000 to 80,000 and 0 to 40,000, respectively.	Axes were changed to be the same.
Reviewer 3	Fig. 8	264	2	Consistent y-scale for Figure 8 (see same comment for Figure 6).	Axes were changed to be the same.
Reviewer 3	Fig. 10, 14, 16, 18, and 20	267	2	The scale of the y-axes for all line charts comparing historical to modeled streamflows are too large to show the calibration of the model and evaluate whether the calibration is acceptable. From a management perspective, the range of flows of interest are all within	Log scale images were added to Appendix D for daily flow figures.

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				approximately 0 to 500 cfs. I would consider using a log scale or simply only showing flows from 0 to 500 cfs and providing a footnote that higher flows are not shown. In order to evaluate the calibration, it is necessary to understand the error during low flow periods. An error of 50 cfs at UMDO or UMAO during the irrigation season reflects a difference in cost of ~$2,000/day for conjunctive use pumping for WEID.	
Reviewer 3	Sec. 5.3	338	2	Footnote 4 on page 14 clarifies that the Maxwell canal "diversion" is mostly comprised of water from the A Line canal. I would suggest changing the title in Figure 22 and description to show only the Maxwell canal diversion, not the combined diversion and A Line spill, or to include additional footnotes in this section to clarify. Whether the water is diverted at Maxwell or spilled from the A Line has a significant impact on the UMDO-UMAO loss/gain calculation.	Footnote added to Figure 22 to clarify.
Reviewer 3	Sec. 5.3	365	1	The RiverWare Model Report characterizes the WEID exchange as "the total pumping rate of the WEID Exchange Pump plant near Hermiston." The pumping rate of the WEID Exchange Pump plant is actually the combination of the exchange volume and WEID's conjunctive use volume--water that WEID pumps at its own expense under its own supplemental water right to replace insufficient water supplies. It is important that the RiverWare model incorporate this distinction between WEID's "exchange" water and water that WEID pumps at its own expense, as various water management actions, including the Phase 1 and Phase 2 exchanges, and additional changes anticipated in the future, reduce the volume of water available for WEID to exchange compared to conditions prior to the Phase 1 exchange. For WEID, the exchange is actually the lesser of the total pumping rate of the WEID Exchange Pump plant and the	Future scenarios can incorporate the distinction if needed.

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				natural flow available for diversion under WEID's water rights. The latter is equal to the flow measured at gage 14032400 (UMTO) below the Hermiston waste water treatment plant, less the amount protected instream. The amount protected instream at the UMTO gage is equal to the amount protected at the UMDO gage, with some modifications to address enlargement and injury that would otherwise be caused by protecting mid-River rights through to the Lower River. Without the Phase 1 exchange logic and the ability to distinguish between conjunctive use pumping and exchange pumping, the model does not accurately characterize current conditions and can't be used as a baseline against which to evaluate the effects of future changes in water management on WEID's live flow and exchange water supply.	
Reviewer 3	Sec. 5.3	372	1	As described above, the model does not currently simulate WEID's exchange, only WEID's diversions. Because the exchange is a function of the water protected instream, and of diversions above WEID's POD, all of the error associated with upstream diversions, gains, and losses on a daily basis will propagate through the daily West Extension exchange calculation if the model is modified to calculate WEID's actual exchange.	Future scenarios can incorporate the distinction if needed.
Reviewer 3	Sec. 5.3	401	1	For the reasons described above, Figures 23 and 24 show only WEID's simulated and historical main canal and Columbia River diversions (pumping), not exchange. From 2013 through 2020, WEID's exchange has ranged from ~48 to 74 percent of the volume measured at the WEPO gage, varying on a daily basis.	Future scenarios can incorporate the distinction if needed.
Reviewer 3	Appendix B	502	2	The figures show losses in the thousands of cfs at times, likely a model artifact that occurs under boundary conditions. It would be useful to confirm that the model is appropriately handling water distribution under such	Due to how gains and losses are calculated, the day to day variability may include high and low peaks. These could be due the wind and gage error. A 7-day average was

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				conditions to ensure that these high calculated losses do not lead to under-allocation of out-of-stream water rights downstream.	added to the plots to show the general trends of the gains and losses. The model handles the variability well, as shown in the calibration plots. For future scenarios, the gains and losses may be further inspected to eliminate some of the variability if needed.
Reviewer 3	Appendix C	520	2	Not sure if it would have much impact on the modeled diversion, since WEID's 1909 priority water right is significant, but WEID holds a water right for "RETURN FLOW FROM THE IRRIGATION SYSTEMS ALONG THE UMATILLA RIVER USING WATER STORED IN McKAY RESERVOIR" that entitles WEID to "the amount of return flows from federal project lands originating from the above source, above the WEID re-diversion point." If the model is modified to allow for evaluation of the flow at the UMTO gage that is and is not exchangeable, the inclusion of this water right may be important. This water right should still be identified in references to WEID's water rights, including in Table 14 as a storage account. The impact on how the model functions will likely be minimal.	The model cannot make the distinction between live or storage water return flows. This water right is not a storage account. As stated in the comment, this would likely have minimal effect on model calibration.
Reviewer 3	Appendix C	520	2	There are capacity constraints on diversions that are exceeded by many of the water rights listed in Appendix C. Existing diversions are also limited by demand functions, which tend to be more important to the current condition model performance. However, potential management changes will modify or make those demand functions irrelevant and make joint capacity constraints more important. For example, the numerous water rights stacked on the Westland canal, including Dillon and Allen rights totaling approximately 500 cfs, may continue to be jointly limited to 250 cfs (the capacity of the Westland canal) if transferred	Details such as these will be addressed as needed for specific scenarios.

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				permanently instream in order to avoid injury or enlargement. The big picture is that modeling water management changes that also entail modifications to existing water rights will require careful review of other model assumptions for consistency with water right authorizations and state water law.	
Reviewer 3	Appendix C	520	2	Similar to above, there may be layered supplemental and primary or layered primary water rights, both within an irrigation district diversion designation, or across private and irrigation district diversions, as it's possible that private rights are supplemental to irrigation district rights. Water management changes may interact with water right changes in a way that the model is not currently set up to address.	Details such as these will be addressed as needed for specific scenarios.
Reviewer 3	Appendix C	520	2	There are a number of water rights shown in the live flow accounts table that differ from the rates authorized by the actual paper water rights (e.g., the paper water right for Maxwell is significantly higher than 26.57 cfs). If the rate used for the account differs from the paper water right, it's important to document why that is.	Model inputs were checked with OWRD data. No changes made.
Reviewer 4	P. 6 Sec. 1	--	--	Introduction should describe the purpose of the model development. Without this context, it's difficult to ascertain if the development and calibration is sufficient to meet the stated purpose (or use) of the model.	The model is intended to be a baseline model that represents current conditions and that may be used for long-term planning. Scenarios will add complexity as needed.
Reviewer 4	P. 7 Sec. 1	27	--	The map and streams appear to be the entire Umatilla Basin and not the Lower Umatilla River Basin. Suggest changing sentence structure or map.	Updated caption and wording in Section 2.0.
Reviewer 4	P. 6 Sec. 2	--	--	Either in the introduction or this section, there should be a description of the model scope and justification for that scope.	The model is intended to be a baseline model that may be used for long-term planning. Statement was added to the introduction.

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Reviewer 4	P. 6 Sec. 2	24	--	Elaborate last sentence. Storage and release of water from reservoirs should also be based on prior appropriation as well as other legal agreements.	Updated wording.
Reviewer 4	P. 7 Sec. 3	32	--	Typo: "Completing" should be "competing."	Spelling error fixed.
Reviewer 4	P. 7 Sec. 3	34	--	Elaborate on why the simulation period of 1993-2019 was chosen and why the operating rules were based on the last 5 years of operations.	The period of record aligns with available data. The operating rules reflect the last 5 years in order to simulate current conditions. Updated the wording in the document.
Reviewer 4	P. 8 Sec. 3.1	39	--	Don't the red circles represent users and demand (as opposed to diversions)? The model simulates the diversions to those demands, but the nodes themselves aren't diversions. They are demands from the individual districts (or aggregated users).	Updated wording.
Reviewer 4	P. 8 Sec. 3.1	46-47	--	Need to add that the relative spatial representation of the objects is depicted in the diagram (Figure 2).	Updated wording.
Reviewer 4	P. 9 Sec. 3.1	Fig. 2	--	Need to label the irrigation districts (water users nodes) in the figure, with the lines referring to the named canal/ditch system. For example, the A-Line supplies water to HID. So, the water user is HID, not the A-Line. The A-Line is the dashed line. Also, there are gages or pump sites with USBR designations described later in the document that should be referenced in this figure.	Figure has been updated.
Reviewer 4	P. 10 Sec. 3.2.1	57-60	--	How were the effects of the irrigation system returns (and also alluvial groundwater pumping) removed from the naturalized system? For example, did the unregulation model also use response functions to back out the effects of anthropogenic GW returns? If so, it should be stated here.	Clarification added.
Reviewer 4	P. 10 Sec. 3.2.1	68	--	What about alluvial groundwater pumping?	Effects from groundwater pumping are currently lumped into the reach gains/losses. Historical data limitations currently do not allow groundwater losses to be separated out with any certainty.

Reviewer	Page or Other Location Reference	Line Number (if applicable)	Priority	Comment	Response
Reviewer 4	P. 10 Sec. 3.2.1	68	--	Umatilla River is incised into CRB flows from approximately Cottonwood Bend to the mouth. Groundwater pumping in shallow CRB aquifers should also be accounted for.	Effects from groundwater pumping are currently lumped into the reach gains/losses. Historical data limitations currently do not allow groundwater losses to be separated out with any certainty.
Reviewer 4	P. 11 Sec. 3.2.2	83-86	--	This is incorrect. HID has a storage right to fill Cold Springs Reservoir with a 50,000AF entitlement. This can be reached either through actual diversions when flows exceed target levels or exchange credits for bypassing water when target levels aren't met. Water is typically diverted during the winter months but can be diverted during the irrigation season until the 50,000AF entitlement is reached. However, they get in line by priority date after March 1st when other irrigators begin competing for the water. If it weren't for the exchange system, HID would be able to divert all of the winter water from the Umatilla when live flows drop below 220 cfs, the carrying capacity of the Feed Canal.	Updated wording.
Reviewer 4	P. 12 Sec. 3.2.2	100-101	--	Describe how carry-over storage is practiced (on-the-ground) and simulated in the model. Describe operational rule curves.	Carryover and rule curve description added.
Reviewer 4	P. 11 Sec. 3.2.2	108-109	--	Depends on the time of year. The BOR releases 10 cfs regardless of what is coming into the reservoir to make sure the distance from the base of the dam to the confluence with the Umatilla does not go dry. We just call this "water the BOR chooses not to store." This happens when the BOR is not releasing fish water to meet target flows in the Umatilla River. If we are releasing water to meet target flows, then yes, the Fish account gets debited.	Altered model to account for this. Updated wording in the document to represent this rule. Results shown in the documentation were unchanged.
Reviewer 4	P. 11 Sec. 3.2.2	119	--	I believe the reference to "Giffin" for the source of reservoir parameters is incorrect. There's a watermaster in the Deschutes, but I doubt he would know about the physical properties of reservoirs in the Umatilla.	After conversations with OWRD and UFO, this information was cited as a combination of UFO and OWRD.

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Reviewer 4	P. 13 Sec. 3.2.2	125	--	82,359AF seems very high for McKay Reservoir. We consider the capacity number 71,534 as the total capacity. Subtract 6,000 for flood space and contracts are 65,534.	The maximum storage is based on the physical properties of the system, but the system is operated to the active capacity. Active Capacity was added to the table.
Reviewer 4	P. 13 Sec. 3.2.2	127	--	How is evaporation calculated? Is it a time series derived from weather data (empirical method)?	Updated wording.
Reviewer 4	P. 13 Sec. 3.2.2	128-129	--	Present seepage rate table and expand on how it was derived? I'm assuming it was from a reservoir mass balance. It'd be helpful to see the regression of seepage rate versus reservoir elevation.	The seepage rate table was derived via a reservoir mass balance. Curves added to the appendix.
Reviewer 4	P. 13 Sec. 3.2.2	130	--	The section needs to describe how the diversions are used in the model (e.g., as the daily demand for the user objects?).	Clarification added.
Reviewer 4	P. 13 Sec. 3.2.2	135	--	Define "live flow", which appears to represent natural flow.	Updated wording.
Reviewer 4	P. 14 Sec. 3.2.3	Table 2	--	Explain why the 1994-2019 POR was used for the average annual diversion, and how the average annual diversion is used in the simulations (e.g., the user demand in the simulations?).	Clarification added.
Reviewer 4	P. 14 Sec. 3.2.3	144	--	Needs clarification. The table implies that one set of average daily demands were calculated from the 1994-2019 POR and used in the calibration, but the text implies the historical time series of diversions was used to represent demands in the calibration (that is an average daily demand hydrograph for each demand was not calculated).	Updated wording.
Reviewer 4	P. 15 Sec. 3.2.3	Table 3	--	Are the target flows for a single location or do they extend through a designated reach?	Updated wording.
Reviewer 4	P. 15 Sec. 3.2.4	Table 4	--	Phase II exchange began (HID, 1995). Partial exchange with SID begins for Phase II (1996). Columbia River Rate should be 150 cfs for Phase I. Phase I exchange started informally in 1988 with WEID exchanging live flow for Columbia River water using its own pumping facility.	Years were updated in the document. The WEID pumping plant has a maximum of 140 cfs.

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Reviewer 4	P. 15 Sec. 3.2.4	165-169	--	Difficult to follow this description. Could this logic be added to Table 5 or put into a separate flow-chart diagram demonstrating how it works (e.g., if/then statements)? I've seen USBR presentations where this was done and it was much clearer (e.g., Flow Condition, Criteria, If/Then statements, etc.).	Added a simplified flow chart.
Reviewer 4	P. 15 Sec. 3.2.4	174-175	--	Unclear what is meant by "exchange credits are accumulated based on a 20% loss". Does that mean the exchange credit is reduced by 20%, or that additional water is diverted to make up for the 20% loss? Also, isn't there a duty limit on the exchanges?	The 20% loss is a decreed amount determined by the State of Oregon. Once HID actually reaches their 50 kaf diversion plus exchanged entitlement, HID can continue to divert to recoup losses at 20%. Some years, actual losses are up to 30%, where HID can only recover 20% per Oregon law. Feed Canal losses can fluctuate greatly year by year, dependent on Umatilla River sediment concentration, soil moisture conditions, and the amount of canal bed treatment with bentonite.
Reviewer 4	P. 15 Sec. 3.2.4	178	--	I'm not familiar with the term Buffer Flow but it seems that human prediction and perfect forecast would be higher than the minimum needed for diversion. For example, we need to determine that 320 cfs is in the river for at least five days for HID to turn on. This equates to 80 cfs for their minimum diversion plus the 250 cfs target. It seems that the buffer flow for HID would be much higher on average because we would never turn them on when there was only 400 cfs in the river if we thought cold weather and a dry weather forecast would not provide 320 cfs for five days.	Clarifying explanation added to the document.
Reviewer 4	P. 16 Sec. 3.2.5	180-191	--	Are the duty limitations associated with the water rights (including the exchanges) included in the model? The duty limits need to be described in this section, and also in the proceeding section.	The model follows all water right limits, including flow and volume. Duty limits on storage accounts and exchanges are included in the model. Duty limits on live flow accounts are adhered to through the

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					use of historical diversions. For future scenarios that involve future demands, duty limits can be added.
Reviewer 4	P. 16 Sec. 3.2.5	185	--	What is a "water user objects"? Suggest defining.	Updated wording.
Reviewer 4	P. 16 Sec. 3.2.5	189	--	Incorrect index referenced for individual water rights. Water rights duties are also not listed in Appendix C.	Fixed in document.
Reviewer 4	P. 16 Sec. 3.2.6	194	--	Won't return flows be overestimated if groundwater pumping is not included? What about return flows from irrigation by deep CRB wells?	Return flows would be slightly higher, but gains and losses would be lower, balancing the amount of water coming back to the Umatilla River. Historical data limitations currently do not allow groundwater losses to be separated out with any certainty.
Reviewer 4	P. 16 Sec. 3.2.6	206	--	Reference should be the Groundwater Model report, not a two-page summary memo.	The references used are the only currently available documentation.
Reviewer 4	P. 17 Sec. 3.2.6	215	--	The use of response functions in evaluating alternative water management scenarios might be inappropriate if the proposal would result in significant changes to groundwater head gradients, as noted in this section. This is a good example of where describing the purpose of the model would help in the review.	The response functions were appropriate for the development of a current conditions model. The reviewer is correct that they should be evaluated and potentially adjusted depending on the scenario.
Reviewer 4	P. 18 Sec. 5	234	--	The section needs a comparison of the modeled versus on-the-ground (OWRD) accounting to ensure that the logic used in the model is a reasonable facsimile of what is done on the ground. Otherwise, the model could appear to be distributing water reasonably close to historical (current) values for the wrong reasons. Many times, this type of discrepancy isn't apparent until the system is stressed or changed through either drought conditions or a new water management paradigm (e.g., ESA flow constraints) being adopted.	If OWRD has this historical information, Reclamation will use it to compare to the accounting in the model.
Reviewer 4	P. 18 Sec. 5	237	--	Explain why the 2010 through 2018 POR was used for the calibration, as opposed to a longer time period.	Updated wording.

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Reviewer 4	P. 19 Sec. 5.1	258	--	A graph of the POR averaged monthly simulated and observed contents and a 1:1 plot of individual EOM contents for McKay Reservoir would further demonstrate reservoir operations are reasonable and unbiased at a sub-seasonal time scale.	Monthly Comparison plots added to Appendix D.
Reviewer 4	P. 20 Sec. 5.1	268	--	A graph of the POR averaged monthly simulated and observed contents and a 1:1 plot of individual EOM contents for Cold Springs Reservoir would demonstrate exchange and reservoir operations are reasonable and unbiased at a sub-seasonal time scale.	Monthly Comparison plots added to Appendix D.
Reviewer 4	P. 21 Sec. 5.1	273	--	McKay Reservoir Outflows: change to a y-axis to log scale or provide a duplicate graph with y-axis set to 250 cfs.	Log scale plot was added to Appendix D.
Reviewer 4	P. 21 Sec. 5.1	276	--	McKay Reservoir Outflows: A graph of average simulated and observed monthly outflows for POR and a 1:1 plot of all individual monthly average flows would demonstrate reservoir operations are reasonable and unbiased at a sub-seasonal time scale.	Daily and monthly comparison plots were added to Appendix D for reservoir outflows and gage streamflows.
Reviewer 4	P. 22 Sec. 5.1	290	--	Cold Springs Reservoir Outflows: A graph of POR averaged simulated and observed monthly outflows and a 1:1 plot of all irrigation season monthly outflows would help demonstrate reservoir operations and the exchange are being simulated reasonably at a sub-seasonal time scale.	Daily and monthly comparison plots were added to Appendix D for reservoir outflows and gage streamflows.
Reviewer 4	Sec. 5.1 Cold Springs Res	--	--	A graph of the simulated vs observed inflows to Cold Springs Reservoir from the Feed Canal and from the pumping plants is required to establish the exchange logic is being simulated correctly.	These graphs are discussed in Section 5.3, Water User Diversions and Exchanges.
Reviewer 4	P. 23 Sec. 5.2, Fig. 14	--	--	Suggest log scale for better comparison of low flow simulation vs observed flows.	Log scale plot was added to Appendix D.
Reviewer 4	P. 23 Sec. 5.2 Fig. 15	--	--	Graph heading: "outflows" should be "streamflow". Additional graphs based on monthly (or daily) values is warranted to demonstrate simulations are reasonable at	Daily and monthly comparison plots were added to Appendix D for reservoir outflows and gage streamflows. Plot titles changed.

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				time scale being simulated and used for real-time operations.	
Reviewer 4	P. 24 Sec. 5.2 Fig. 16 and 17	--	--	Same comments as above: log scale for Figure 16 and added graphs for monthly and/or daily values to demonstrate simulations are reasonable representations of on-the-ground (observed) water management.	Daily and monthly comparison plots were added to Appendix D for reservoir outflows and gage streamflows. Plot titles changed.
Reviewer 4	P. 25 Sec. 5.2 Fig. 18 and 19	--	--	Same comments as above: log scale for Figure 18 and added graphs for monthly and/or daily values to demonstrate simulations are reasonable representations of on-the-ground (observed) water management.	Daily and monthly comparison plots were added to Appendix D for reservoir outflows and gage streamflows. Plot titles changed.
Reviewer 4	P. 26 Sec. 5.2 Fig. 20 and 21	--	--	Same comments as above: log scale for Figure20 and added graphs for monthly and/or daily values to demonstrate simulations are reasonable representations of on-the-ground (observed) water management.	Daily and monthly comparison plots were added to Appendix D for reservoir outflows and gage streamflows. Plot titles changed.
Reviewer 4	P. 27 Sec. 5.3	338	--	The A-Line Canal delivers water from Cold Springs Reservoir, so isn't it implicitly part of the exchange program?	Updated wording.
Reviewer 4	P. 27 Sec. 5.3	340	--	Rotational agreements allow districts to divert more than their water rights at times. Are these agreements incorporated into the model?	These agreements are not explicitly included, but Reclamation feels that the diversions are representative of the system.
Reviewer 4	P. 28 Sec. 5.3	360	--	Rotational agreements allow districts to divert more than their water rights at times. Are these agreements incorporated into the model?	These agreements are not explicitly included, but Reclamation feels that the diversions are representative of the system.
Reviewer 4	P. 29 Sec. 5.3	366-368	--	Identify sites WEPO, CSRO, and SBEO on schematic (Figure 2).	Added WEPO and CSRO to schematic. SBEO is no longer being used in historical comparisons.
Reviewer 4	P. 29 Sec. 5.3	366-369	--	Reference logic to determine how the source of water is determined for each district.	This model only accounts for surface water distribution to the districts and it is distributed based on water rights accounting as described in Section 3.2.5.
Reviewer 4	P. 29 Sec. 5.3	367-369	--	This isn't the best way to do this. SBEO minus CSRO technically should equal SID's pumped water, but the CSRO gage is not very accurate because it takes all of the fluctuation in the canal while the SID pump remains	The CSRO QP dataset was used for the comparisons, including updating the document reference and associated plots.

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				constant. There is a flowmeter on the SID pumped water that provides better data than the method described. The SID flowmeter data is available on the Hydromet by selecting CSRO quantity pumped (QP). For reporting purposes, we don't use SBEO. We use the SID pump flowmeter to account for SID Columbia River water and CSRO to account for Columbia river water delivered to Cold Springs Reservoir. If you subtract SID pumped water from SBEO, you will notice the discrepancy at CSRO easily.	
Reviewer 4	P. 29 Sec. 5.3	374-381	--	The model is underpredicting total deliveries to WEID for every year in the simulation period, not just years 2015-2019 where the HWWTP was dumping water into the canal. What is the reason for the 2011-2014 underprediction? It could be the model is underpredicting irrigation return flows to the lower reach as well, or spill through the null weir. Include 1:1 plot of weekly or monthly simulated vs observed deliveries.	Monthly comparison plots added to Appendix D. The underprediction of historical flows is mostly attributed to the low flows during May to October which are beneath the operational effectiveness of the canal. It's probable that these flows are from seepage into the canal.
Reviewer 4	P. 32 Sec. 5.3	411-414	--	Simulations for SID look pretty reasonable, but any explanation as to why the model doesn't capture the variability in the smaller historical Furnish diversions later in the irrigation season (Figure 25)? Also, include 1:1 plot of weekly or monthly simulated vs observed deliveries.	Monthly comparison plots added to Appendix D. The Furnish deliveries later in the season are not associated with the exchange. These are deliveries that are beyond the extent of the exchange program. The model does not capture the variability due to the way water is released from storage for these diversions.
Reviewer 4	P. 34 Sec. 5.3	441	--	Figure 27 shows a fairly significant and consistent discrepancy between the simulated and observed supply from Exchange (lower graph, Figure 27). The explanation in lines 436 and 437 are plausible for smaller time-scale discrepancies (maybe a good explanation for SID late season simulated differences in Furnish canal), but these look to be weekly or even monthly differences. Include	Monthly comparison plots added to Appendix D. Explanation added to the document.

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				1:1 plot of weekly or monthly simulated vs observed deliveries.	
Reviewer 4	P. 36 Sec. 6	457	--	There should be some quantitative assessment of uncertainty given in this section. A general indication of uncertainty could be based on the simulated versus observed streamflow at various key locations (MCKO, YOKO, MTO, UMAO, etc.) at various time scales (e.g., weekly, monthly, seasonal). Likewise, the uncertainty of total and individual deliveries to district at monthly and seasonal time scales could also be estimated from this comparison. Storage (and storage accounting) uncertainty could similarly be given using this type of comparison.	An uncertainty assessment was outside of the scope of this study. If one is needed for a particular future scenario, it will be completed.
Reviewer 4	P. 36 Sec. 7	468	--	It would be helpful to describe what general types of scenarios are appropriate to evaluate with this tool and which are not.	The model is intended to be a baseline model that can be adapted for different scenarios. Depending on the type of scenario, the model may need minimal or substantive updates.
Reviewer 4	P. 42 Appendix C	522	--	There is .75cfs certificated; .63cfs is what is used.	SolveWaterRights accounts for the values used in the model.
Reviewer 4	P. 42 Appendix C	522	--	.13cfs certificated; .09 hasn't been used in many years, so only .04 is what is used.	SolveWaterRights accounts for the values used in the model.
Reviewer 4	P. 42 Appendix C	522	--	1.94cfs certificated; only .41 are documented in use.	SolveWaterRights accounts for the values used in the model.
Reviewer 4	P. 42 Appendix C	522	--	.37 certificated; only .14 in use.	SolveWaterRights accounts for the values used in the model.
Reviewer 4	P. 42 Appendix C	522	--	.54 certificated; .35 is what is used.	SolveWaterRights accounts for the values used in the model.