Memo

To: Governance Committee, Platte River Recovery Implementation Program (PRRIP)

From: Independent Scientific Advisory Committee (ISAC)
David Galat, Jennifer Hoeting (co-chair), Alan Kasprak (first meeting), David Marmorek (co-chair), Aaron Pearse, Michal Tal

Date: October 29, 2023

Re: ISAC Feedback from ISAC Meeting, October 2023, Kearney Nebraska

Overview

On October 10-23, 2023 in Kearney, Nebraska, the Platte River Recovery Implementation Program (PRRIP or Program) hosted a meeting for the Independent Scientific Advisory Committee (ISAC). Staff of the Executive Director's Office (EDO) and scientists from the University of Nebraska at Lincoln (UNL) gave presentations. Members of the Technical Advisory Committee (TAC) also attended. The stated goal of the meeting was to respond to the ISAC's Feb 2023 document, "ISAC Report on February 2023 PRRIP Science Plan Reporting Session."

The EDO did not provide the ISAC with a specific list of questions for this meeting and did not request a formal report from the ISAC. Thus, this document is unlike a typical ISAC report. This document summarizes comments and suggestions from the collective ISAC and individual members. Most of the document consists of comments and suggestions which we hope are helpful to the EDO and/or may improve an analysis or report.

We also provide a few recommendations below. ISAC recommendations are consensus opinions on important questions raised during the meeting. The main topic in this report where the ISAC provided formal recommendations is related to sediment augmentation. The ISAC recommends against the program changing the current sand dam. The ISAC provides a list of possible alternative actions as well as additional discussion in the section on sediment augmentation below (pages 9-13 with ISAC recommendations on page 11).

In addition, some ISAC members provided feedback in the pdf documents that were included in the pre-meeting materials. A separate document for feedback related to the research on Pallid Sturgeon by UNL was also submitted to the EDO.

Overall

- The ISAC was impressed by the considerable progress by EDO staff on all the projects that were discussed at the meeting.
- We recommend that the EDO continues to maintain a focus on the PRRIP Big Questions. We recommend that the EDO staff state the relevant Extension Big Question(s) near the start of every presentation and relevant program documents. This

recommendation, which echoes a recommendation from the ISAC's report after the February 2023 meeting, was followed by about half of the EDO presenters in October 2023 which was great. With many new EDO, GC, TAC, and ISAC members, it is important to keep everyone focused on the Big Questions.

Wet Meadows

- The wet meadows report which summarizes the work of the EDO on wet meadows is well written and clearly frames the goals and objectives. It does a nice job making links between hydrology and vegetation. The report demonstrates substantial investment in developing tools that can be used and queried as needed to inform management decisions.
- Somewhat beyond the information presented in the report, the ISAC brought up questions about the linkage between whooping cranes and wet meadow sites. What do wet meadows do for cranes? One can envision a hierarchy when considering connections between a species and a specific landcover type. Do individuals use it in equal or unequal proportion to its availability? A related inquiry would be to determine whether individuals are more or less likely to use locations based on the amount of a landcover type in some search area around the used location. To some extent each of these questions has been addressed, and the current analysis will provide more supporting information. Additional insight about a landcover type can be revealed by quantifying behaviors that animals perform in the landcover to uncover potential function(s) of the landcover – e.g., foraging, resting. If certain functions can be ascertained, another step could be to quantify resources used by whooping cranes. For example, if foraging is an identified function of wet meadow sites, variability in intensity of use at different sites might be understood through the lens of the quality and quantity of foraging resources. Do whooping cranes use wet meadow sites or the surrounding landscape more because they are present? What function do wet meadow sites serve for whooping cranes in the Platte River Valley? What resources do whooping cranes use when in wet meadow sites? Are there any resources novel to these sites? Limited use of a specific resource may still be necessary if there is no other place to procure it.
- As PRRIP moves forward, we suggest that the Program may want to consider energy values of different food sources for WC. David Galat would like to see that connection made.
- Hydroperiod of wet meadows: After the meeting, the ISAC had some discussions about hydroperiod of wet meadows. The key points of the discussion are summarized below.
    - Is there any importance not just to the number of days per year that a wet meadow is inundated/saturated, but also to the "connectivity" of that time? For example, is 200 straight days of inundation more valuable for crane habitat than 20 discrete periods of 10 days each, between which times the meadow goes dry? For example, an intermittent hydroperiod might encourage growth of invasive plant species which could degrade the crane habitat quality of the wet meadow. If the duration of a hydroperiod, rather than the total hydroperiod, is something that might be important for habitat, then quantifying this is important.

- Duration of inundation is important, but likely of equal importance to WC use of wet meadows are the other 4 critical aspects of hydroperiod: magnitude, timing, frequency and rate of change. These are collectively referred to as indicators of hydrologic alteration (IHA) and software is readily available to calculate them along with a suite of descriptive statistics. David Galat suggests that the Program could explore the benefits of applying Indicators of Hydrologic Alteration (IHA) to the two sites with monitoring wells, as a way of determining which attributes of hydroperiod appear to be most strongly correlated (spatially and temporally) with healthy wet meadow vegetation. This might aid them in designing future wet meadows and implement management actions to emphasize hydrologic variables associated with selective WC use - if any exist.

Science On-boarding

- When considering a new scientific contribution such as the Ecotope paper, we suggest that the Program use a lens based on structured decision making. In what ways might the new findings affect the Program decisions moving forward? What are links between the possible management actions, uncertainties in data sets and analytical assumptions, and outcomes for the species of concern? Can you build a common understanding of what assumptions are most critical in affecting management decisions, and which ones don't matter?
- Regarding the Ecotope paper:
  - There are five major differences between the PRRIP and Ecotope approaches (e.g., data set, land cover definition, etc). TAC and EDO decided to focus on only one of these differences (landcover classification data set). Will the current approach of one comparison answer your question? Is it worth exploring more of the combinations rather than just one? Working through all the 32 combinations (if feasible) in a decision analysis framework (or at least a sensitivity analysis framework) will help the EDO, TAC and GC to gain insights on which differences are important to management and which are not.
  - Why does the program care so much about the different results in these two papers? What difference does it make to the program's decisions? Maybe there is no need to go through this analysis to compare old vs new papers. How will these analyses impact negotiations for the Second Increment?
  - See David Marmorek's PPT slides below from the Thursday Oct 12 session. On the first slide, only the bolded outcome in the right column is feasibly computed; the other outcomes are what the program uses to assess trends over time but can't be quantitatively connected to management actions on wet meadows. The second slide is a set of questions for the EDO and TAC.
- If there is little uncertainty in a management decision, then the decision analysis framework described below may be unnecessary. However, David Marmorek's experience is that when there are competing data sets and models it can be confusing (to everyone) and doing a thorough sensitivity analysis (not necessarily a decision analysis) adds clarity and improves dialogue.

- EDO may be interested in this yet-to-be peer-reviewed article on reducible science. It will be interesting to see how this article impacts ecological research going forward. https://egouldo.github.io/ManyAnalysts/

Possible Wet Meadow-WC Decision Tree

Alternative Mgmt. Actions	Uncertain States of Nature*	Outcomes
A. Acquire more wet meadows	1. WC use points (20 across AHR; 50 within 3 miles)	**Relative importance of wet meadows to WCs**
B. Acquire more river habitat	2. WC use point data sets (USFWS, PRRIP)	Ultimate Outcomes:
C. Manage water differently	3. Temporal scales (1995-2015; 20?? to 20??)	% WC stopping in the Platte AHR
	4. Landcover types (wet part of riparian grasslands separated; not)	WC use days in the Platte AHR
	5. Diurnal roosting sites in river channel (excluded; included)	

* Ecotope paper (Baasch et al. 2022) listed first; WEST report (Howlin and Nasman 2017) listed second

Wet Meadow Questions to EDO and TAC

1. What are the critical uncertainties in management decisions related to wet meadow acquisition and maintenance?
   - If there are no uncertainties in these management decisions, skip Q2 to Q5.
2. Do alternative assumptions affect outcomes of alternative management decisions on wet meadow acquisition and maintenance?
3. Are all 32 possible combinations of assumptions worth running? Can you get all the data you need to run these combinations?
4. Does PRRIP have a statistical model to predict effects of the different combinations of assumptions on WC habitat preferences?
5. Is it worth doing a quantitative decision analysis, or just a systematic qualitative analysis?

Germination Suppression Flow Releases

- The “2023 Germination Suppression Flow Release Implementation Plan” and related presentation were well done and provide useful information for the program.
- Impact of flow releases on different vegetation types:
    - During the October 2023 meeting it was stated that inundation flows (June – July 1500, cfs) were originally designed to suppress germination from cottonwoods and willows. Meeting document 5 (“2023 Germination Suppression Flow Release Implementation Plan”) states, “Flow releases to inundate the active channel early in the growing season have been designed to test the effectiveness of using Program water to suppress germination of problematic perennial species like cottonwoods (Populus spp.) and willows (Salix spp.), and to attempt to slow encroachment of Phragmites australis into the channel.” Which is correct?
    - The EDO might want to revisit the Active Learning section of the *First Increment Extension Plan* to consider whether changes need to be made to address different vegetation types (e.g., page 45). It is important not to lump the different vegetation types together. The answer to EBQ1 may ultimately be something like this: “with respect to cottonwoods, program water... while with respect to *Phragmites*, program water…”
- What efforts have been made to use the EDO’s 2-D hydrodynamic model-based estimates of stream power/stress to determine whether the model is a good predictor of whether high flows will have a geomorphic effect on the river at a given location? If shear stress/stream power turn out to not line up well (i.e., are poor predictors) with actual changes seen in the field, that’s a hint that vegetation is having an impact on geomorphic resilience, since vegetation isn’t a parameter in the hydraulic model but is present in the field.
- The channel of the Platte is always evolving. Stage relationships are therefore dynamic through time and may not always predict zones of inundation in floodplain areas. To cope with this challenge, is there a way to auto-classify inundation from multispectral imagery? Alan suggests that the EDO consider supervised classification using something like Planet Labs satellite imagery (4-band, RGB/NIR), which are collected daily for the globe at 3 m resolution.

System scale geomorphology and vegetation monitoring

- Excellent work and continued improvements to the modeling.
- ISAC appreciates the plot like Figure 1 in Doc 6 (shown below). Mean maximum unobstructed channel width (MUCW) vs over time. MUCW is shown for multiple measurement approaches (visual classification, object-based classification, and field surveys). These types of plots of key variables measured over time while comparing multiple models or measurement approaches will be useful to the program moving forward to the Second Increment.

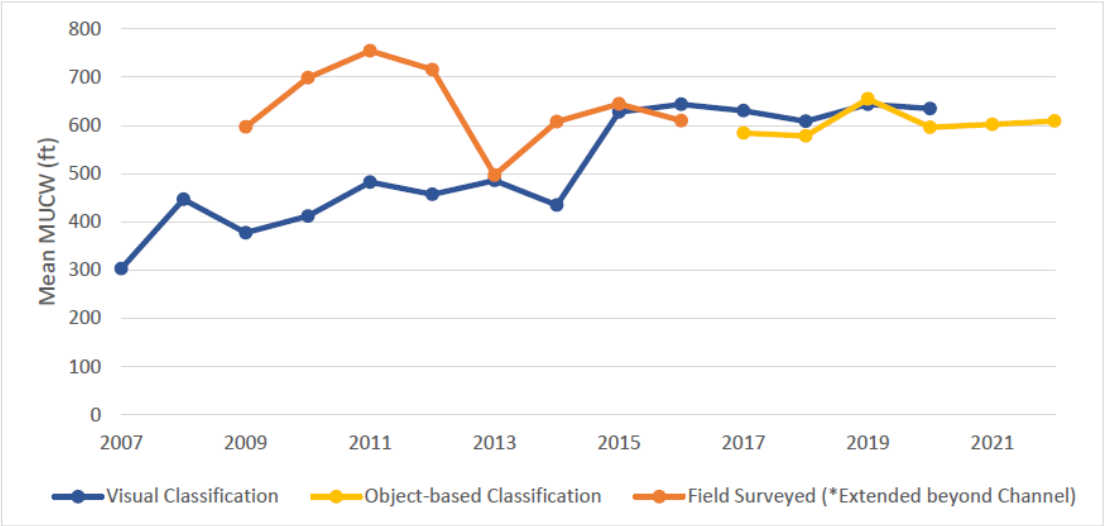


Figure 1. Mean MUCWs by classification method 2007-2022.

- On volume differencing plots: we suggest that you point out the difference in the scales between the J2 to Overton as compared with Overton vs Chapman because of length reach. Even better: could you standardize so the y-axis is aggradation per river mile within the Overton to Chapman, for example? That would make the plots comparable, which could be useful.
- Cutoffs:
    - At the meeting there was considerable discussion about the pros and cons of using firm cut-offs like the 2-foot cut-off for crane vegetation which suggests that cranes can't see over 2 feet. We suggest that doing a sensitivity analysis of how the analysis is affected by the assumed cutoff will improve confidence in the conclusions.
    - Another way to think about these cutoffs might be to consider using a fuzzy-logic based habitat model. These have been explored in rivers for fish replacing a binary scale of habitat (vegetation < 2 feet = 1, vegetation > 2 feet = 0) with a continuum of "optimal-good-marginal-poor". References:
        - Data-driven fuzzy habitat suitability models for brown trout in Spanish Mediterranean rivers - ScienceDirect
        - A fuzzy logic approach to analyse the suitability of nesting habitat for greater sage-grouse in western Wyoming.
    -

UNL Pallid Sturgeon Study

- It was useful to have Mark Pegg, UNL, and Jon Spurgeon, USGS Coop Research Unit, attend the October meeting, provide pre-meeting documentation, and give a presentation.
- It seems like UNL Objective 1 can be feasibly evaluated, but Objectives 2 and 3 may not be feasible due to the many challenges involved, especially the limited capacity to intensively track reproductively ready female pallid sturgeon both during the day and at night, and the difficulty of collecting eggs and embryos. In light of these challenges, we

suggest that UNL and the EDO consider shifting effort away from Objectives 2 and 3 and focusing on Objective 1. Doing so will likely yield a more robust outcome for Objective 1.

- See separate memo on the proposed UNL data analysis. Please share this with the UNL research team including Mark Pegg, Jon Spurgeon, and the project graduate students.
- Some key points from the memo to UNL:
    - Preliminary data analysis: We suggest that the EDO ask the UNL to provide preliminary data analyses beyond the accounting (e.g., number of fish) that they have provided so far. Graduate student or seasoned professional - we suggest any scientist to work with the data, beyond summarizations, at the half-way point in their effort so that they can become more comfortable with what methods might work or not work and to get an initial idea whether they are collecting appropriate data to answer the key questions of interest.
    - Sample sizes: We have some concerns about whether the UNL study will have sufficiently large sample sizes to fit a state-transition model and other similarly complex models that they are proposing. UNL seems to be doing all it can to find every Pallid Sturgeon, so this isn't a criticism about effort. It is a suggestion to be realistic about the models that the data can support. Preliminary analyses will help determine whether such models are feasible to pursue for this project.
    - Detection probability and sophisticated models: We suggest that UNL needs to be explicit about how they will account for detection probability in the modeling. Any model under consideration should be able to deal with fish moving to different states (in this case locations), be able to incorporate predictor variables, and deal with imperfect detection. There may be a conflict between sample sizes and ability to fit these sophisticated models.
    - Glossary of terms: We suggest that UNL define all terms at first use or include a glossary. For example, define how they determined a fish was a 'reproductively ready Pallid Sturgeon.'
- Flow and temperature in the lower Platte River (LPR) are incredibly dynamic – this raises the question: *Even if pallids use LPR, might efforts to provide program water be a population sink?* Also, irrespective of reservoir flow releases the dynamic temp/flow in LPR and travel time of program water to the LMR makes it unlikely Program flows could benefit pallids. Finally, the serious challenges of gathering sufficient data for UNL Objectives 2 and 3 suggest that linkages between flow management and pallid sturgeon should focus primarily on Objective 1. It doesn't seem feasible to establish linkages between flow management and spawning habitat or reproduction (objectives 2 and 3) because it's so hard to acquire data on these pallid sturgeon responses.

Phragmites

- Overall, excellent report and well thought out data collection and modeling plan. The 2023 data collection and proposed data analysis is a major step forward and incorporates learning from the 2021 pilot study as well as ISAC and TAC comments. Focusing on empirical data was a smart approach.

- The *Phragmites* data collection process seems onerous. As part of the analysis of the 2023 data, we suggest that you consider what aspects of the study are providing the most and least useful information for PRRIP to slow growth and spread of *Phragmites*.
- 2023 was the first time that the entire month of June was >1500 cfs. Did the program see a big impact on in-river *Phragmites*? Note that "optimal" conditions for vegetation establishment includes the following: a year of big flows (like 2023), which creates open sandbars, followed by a year of low flows, which provides a disturbance-free environment for vegetation to germinate. In other words, it is important to look at multi-year patterns in vegetation as a function of hydrology. It's something to keep an eye on for this coming spring, especially if snowpack is below average in the headwaters. See
    - The roles of flood magnitude and duration in controlling channel width and complexity on the Green River in Canyonlands, Utah, USA - ScienceDirect
    - A tale of two rivers: Dam-induced hydrologic drought on the lower Dolores River and its impact on tamarisk establishment.
- Model selection:
    - There are many covariates available for this analysis. On page 15 of document 7, a multi-step variable selection approach has been proposed. However, is model selection required after you have removed collinear predictors? What is the purpose of the model selection?
    - Jason Bruggeman and Jennifer Hoeting discussed the proposed model selection approach at the meeting. Jennifer is concerned with the multi-step model selection approach (see page 15-16 of document 7). In step 1 of the proposed approach, all univariate models are fit, and non-significant covariates are eliminated. This univariate approach to selecting variables has been shown to have multiple flaws. It leads to the selection of variables that are noise and to p-values that are smaller than they should be. Thus, the subsequent AIC-like model selection will likely lead to p-values that are smaller than they should be. You might consider other approaches.

Whooping crane roost site selection

- There was good progress on the Whooping Crane Site Selection analyses. The ISAC comments from the February 2023 meeting were well addressed.
- Validating models generated from aerial observations is a good use of telemetry data. There was good discussion at the meeting about model validation results, but we do not recall what final model that validation was based on. Nevertheless, discrepancies noted in this process could be because of issues with model fit or detection. We noted an underprediction of poorer habitat bins, which could be inspected to understand if this lack of fit is related to large-scale changes in river characteristics or other sources. Since there is no set number of categories required to use for this type of validation that we are aware of, it might be useful to try fewer categories along with the 20 used in the presentation.
- We believe the decision to forego using flow-based metrics in the presented analysis is a good decision. It was difficult to understand how unit discharge could be useful in the current analysis, as available and used sites would have similar flow metrics, with the

main difference being channel width (unit discharge = flow/channel width). Also, we had concerns about including both unit discharge and channel width in the same model, where channel width was used to derive unit discharge. We heard some good ideas for abandoning flow in a subsequent analysis in favor of predictors that might be more directly relevant to cranes – for example, wetted width, water depth, velocity.

- The stated approach of developing and comparing a set of models should provide the Program with the necessary insights. One question not posed at the meeting was how you will fit models with seemingly correlated predictor variables. For example, unobstructed and total channel width (Model 6).

Sediment Augmentation

- Excellent report. Past studies, decisions, and arguments for actions taken are very well presented. The ISAC was impressed by the considerable work that has been done to produce multiple relevant new analyses added since February 2023, responding to ISAC recommendations.
- The ISAC appreciated the addition of the changepoint analysis. At the meeting we discussed several possible extensions (if useful) including:
    - Can (and should) you compute confidence intervals around the segments? Which segments have thalweg elevation changes that are significantly different from 0? You may have to just use standard errors instead of confidence intervals to investigate this as it used to be the case that there wasn't a statistical method to get confidence intervals on the y-axis scale for changepoint analyses. Also, if you do this, you probably don't want to add the intervals to the plot as it would be very messy. Alternatively, you could color the bars that don't overlap 0.
    - The ISAC has been asking for a changepoint analysis on flow since long before Sarah joined the EDO. For one gage (or more), can you do changepoint analysis for flow over time? Could you do the same for water temperature? It would be great to have these analyses implemented now that you know how to do a changepoint analysis.
    - Comparing changes in thalweg elevation with changes in mean cross-section elevation will help to determine whether the entire channel is degrading or aggrading or whether the channel is simplifying into a single-thread and migrating.
- LIDAR uncertainty
    - The ISAC would like to see some initial attempts to show uncertainty in the LIDAR measurements. We understand the logic/justification for not thresholding the lidar-derived changes if they're randomly distributed (i.e., not biased). But randomly distributed error isn't the same as no error at all. Communicating some uncertainty bounds on results is a good idea here. Even in the absence of a threshold approach, stakeholders would benefit from understanding potential uncertainties on the numbers presented.
    - Comments from Alan: I'm always a bit skeptical of trusting vendors/contractors to assess LIDAR accuracy, since those are often "best-case" estimates on flat, easily surveyed surfaces. One other way of assessing uncertainty is to use

"coincident points" - because LIDAR collects tons and tons of data points, there will be many within a short distance of each other, on the order of a few inches. Over distances this short, the assumption is that the elevations of the points should be the same. Are they? If you analyze all of the coincident points, what's the average elevation difference between them? That would provide an estimate of vertical uncertainty. More nuanced is the fact that things like slope and vegetation density often influence vertical error - so one could do that analysis of coincident points on locations in bins of slope (low, moderate, steep) and vegetation density (low, moderate, jungle) - and thus have an estimate of error based on landscape characteristics. The errors might be randomly distributed/unbiased, but my bet is that they're not spatially random; errors are highest in the most complex areas of the landscape. See
        - The relationship between particle travel distance and channel morphology: Results from physical models of braided rivers - Kasprak - 2015
        - Error modeling of DEMs from topographic surveys of rivers using fuzzy inference systems - Bangen - 2016 - Water Resources Research - Wiley Online Library.
    - EDO staff may wish to have a Zoom discussion with Alan on LIDAR uncertainty. Michal and Jennifer are also interested participants.

Document continues on next page

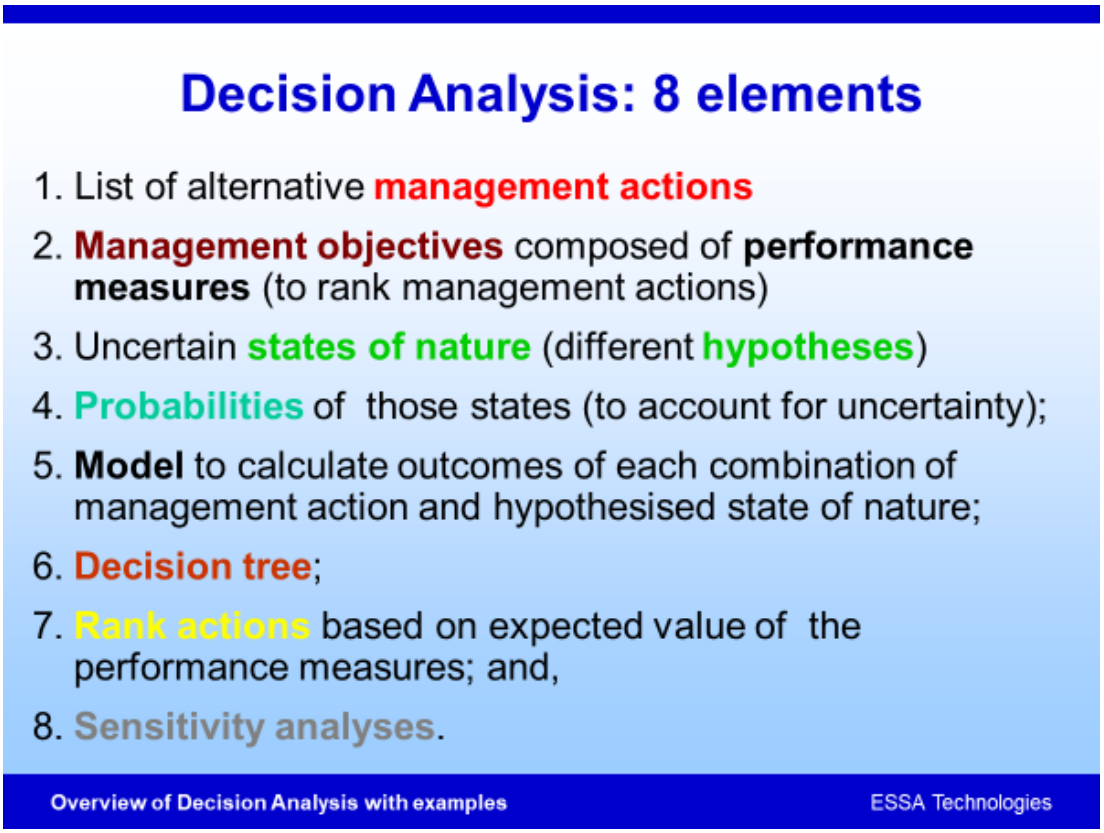
Sand Dam: ISAC Recommendations and Alternative Actions

- After the field trip visit to the sand dam, the ISAC's two fluvial geomorphologists (Michal and Alan) strongly recommend that the program should not change the current sand dam. A lot more information about the feasibility, costs, and risks of such an operation would be needed to justify it.
- One of the concerns they raised is that if the dam were breached, the elevation difference between the North Channel and the "cut-through" channel would be large enough to trigger a migratory knickpoint which would incise the North Channel and adversely impact sediment-water balance in this channel.
- A second concern is that the "channel" the sediment would need to flow through to reach the South Channel is so thickly vegetated as to almost be a marsh/wetland. They don't see sediment making it through there in any reasonable amount of time without considerable spraying, mechanical removal, and probably the construction of a channel.
- Finally, the lateral gradient across the braidplain, which they suggest measuring, could increase the risk of the north channel avulsing.
- A full accounting of sediment budgets for both the North and South channels may be helpful to determine how much sediment the North channel and sediment augmentation are contributing to Overton respectively.

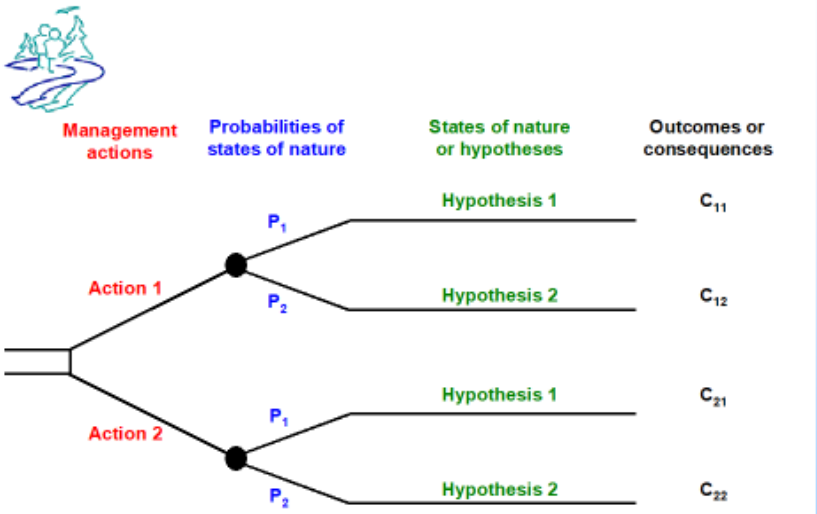
Alternative actions the ISAC suggests that the Program consider:

- Encourage lateral erosion along the south channel by removing vegetation. A wider unvegetated channel may also have the added benefit of serving as crane habitat.
- Augment sediment annually on an as needed basis based on the volume contributed to the channel through lateral migration if this volume is insufficient to make up the sediment deficit.
- Formalize the goals of sediment augmentation. Is the goal of sediment augmentation to plug the J2 hole, or to keep the Platte from eroding downstream of the confluence/at Overton? If the latter, might the best alternative be to augment closer to the reach of concern?
- Creatively explore a wide range of options for sediment augmentation, which could lead to other innovative and practical approaches even though some of the initial ideas may not prove to be cost-effective. For example, would it be possible to change the outlet of the J2 into several outlets spaced across the former braidplain? That way the river might have access to more of its former sediment sources, although it'd probably also be prohibitively expensive.

- Consider performing a mock structured decision-making exercise regarding sediment augmentation (see Marmorek presentation from the meeting). The first question might be: Should it be continued? A second and linked question is how to conduct it (under the idea there may be multiple objectives...minimize cost, maximize the probability that locations downstream will support crane habitat, maximize collateral benefits). The intended outcome of this exercise would not be to find the best alternative, but rather to determine if there is more learning that could be done over the next few years, before a more formal SDM might need to be conducted.
- A decision analysis framework (discussed above for Wet Meadows) seems even more relevant to the sediment augmentation issue. Slides below from Marmorek PPT presented on Thursday, October 12.



Decision Analysis: Basic Elements



MoF Adaptive Management Training Course

Module 3 - 36

Benefits of decision analysis to PRRIP

- Test drive structured decision making / formal decision analysis planned for 2028
- What is the “decision space” of management options?
- Ponder what form of decision analysis would be most helpful in 2028
- Learn what you don’t know but need to know (e.g., data needs, revisions to existing modeling tools)
- Build common understanding of what assumptions are most critical in affecting management decisions

Possible Sediment Augmentation Decision Tree

Alternative Mgmt. Actions	Uncertain States of Nature	Outcomes
A. Maintain recent level of sediment augmentation	1. Year to year variation in flow	Maintenance of channel widths for WCs below Overton
B. Increase level of sediment augmentation	2. Actions ~40 miles upstream that affect sediment budget	Resilience to annual variation in flow
C. Stop sediment augmentation	3. Will hydrocycling at J2 continue?	Longevity / sustainability of management approach
D. Use sand dam as sediment source	4. Response of S. channel	Risk of unexpected impacts on channel and WCs
E. Use Dyer Complex as sediment source	5. Response of N. channel	
F. Add sediment as needed based on apparent need	6. Response of channel downstream of Overton	
G. Other options		

Sed. Aug. Questions to EDO and TAC

1. What tools exist to connect alternative sediment augmentation actions to outcomes of interest, given various alternative hypotheses about key uncertainties?
2. If you can't make **quantitative predictions** of outcomes (*sediment transport is complex!*), can you **rank** expected outcomes for a given action and set of assumptions (i.e., a systematic qualitative analysis)?
3. Can you provide lines of evidence supporting your ranks?