ISAP Evaluation of Draft WRDA IRC Report to Congress
(May 16, 2019)

Introduction

The Independent Science Advisory Panel (ISAP) was tasked to review a draft report to Congress from the U.S. Army Corps of Engineers (USACE, or Corps) on "the impacts of interception-rearing complex construction on the navigation, flood control, and other authorized purposes set forth in the Missouri River Master Manual, and on the population recovery of the pallid sturgeon" as mandated in Section 1226 of the America's Water Infrastructure Act of 2018 (WRDA). The ISAP was provided three compound "charge questions" – actually directions to evaluate – whether the WRDA IRC Report (or hereafter the "Report") accurately and adequately describes the impacts of interception-rearing complexes (IRCs; engineered construction actions in the channel of the Missouri River intended to provide essential habitat) on pallid sturgeon and authorized purposes (activities) and whether the Report has used or considered the best available scientific information in doing so.

The resulting ISAP[1] review finds that the Report contains much relevant information describing the IRC construction program, its purposes, its limited implementation to date, and opportunities for further project actions, but that the Report organization and content in some areas could be revised to make a more compelling case for IRCs. It should be understood that most of the technical comments included in this review are recommendations that might strengthen the Report's "scientific" justification for the IRC actions, clarify issues relating to uncertainties that accompany the IRC actions, and add important detail to the draft Report. The Corps is encouraged to consider the comments in this review, but the ISAP recognizes that there may be reasons based on technical or policy considerations that obviate the need or desire of the Corps to add to or adjust the material presentation in the draft document.

The ISAP observes that Congress has previously directed the Corps to ensure that actions taken to conserve and recover the pallid sturgeon in the Lower Missouri River are based on the best

[1] ISAP panelists contributing to this review include Steve Bartell, Melinda Daniels, Chris Guy, Gary Lamberti, John Loomis, and Dennis Murphy.

available science. Whether the Corps has used the best available scientific information to inform the IRC program is not fully evident in the draft Report. Congress might benefit from further description of how science has been used in the IRC program development and how the program's technical efforts meet the best-available-science criterion. This ISAP review summarizes the steps to IRC implementation whereby scientific (technical) information was used to identify the environmental stressors impacting pallid sturgeon, management planning options for this species, costs and benefits of implementation, and monitoring and assessment options. The ISAP suggests that the Corps develop some form of the timeline of science-based activities and agency determinations that summarize the development of IRC habitat-construction actions presented below for inclusion in the Report.

The Report and supporting material need to be presented as a more compelling argument for continued construction of IRCs. Repeated emphasis of "hypotheses" and "uncertainties," while technically accurate, detracts from a needed more forceful presentation of what is known about pallid population dynamics in the lower Missouri River and the expected contributions of IRCs towards achieving recovery of the species. Uncertainties remain and ought to be rightly recognized, but reducing uncertainties should not be advertised as the driving factor for justifying IRCs.

A useful addition to the Report

The Report to Congress describes well the intent behind the IRC management actions, technical matters relating to IRC installation, potential impacts on authorized purposes, and expectations for responses from pallid sturgeon. The Report is not quite as effective in describing the scientific basis for the management actions, the prioritizing of them from among other alternative actions, and justifying the actions in terms of the ecology of the pallid sturgeon and river hydrodynamics.

The Report acknowledges that much of the scientific support for the IRC actions is developed and documented in detail in the effects analyses that informed the programmatic adaptive management plan and the *Science and Adaptive Management Plan (SAMP).* The SAMP supports the Biological Opinion and guides program decision-making and implementation. However, the

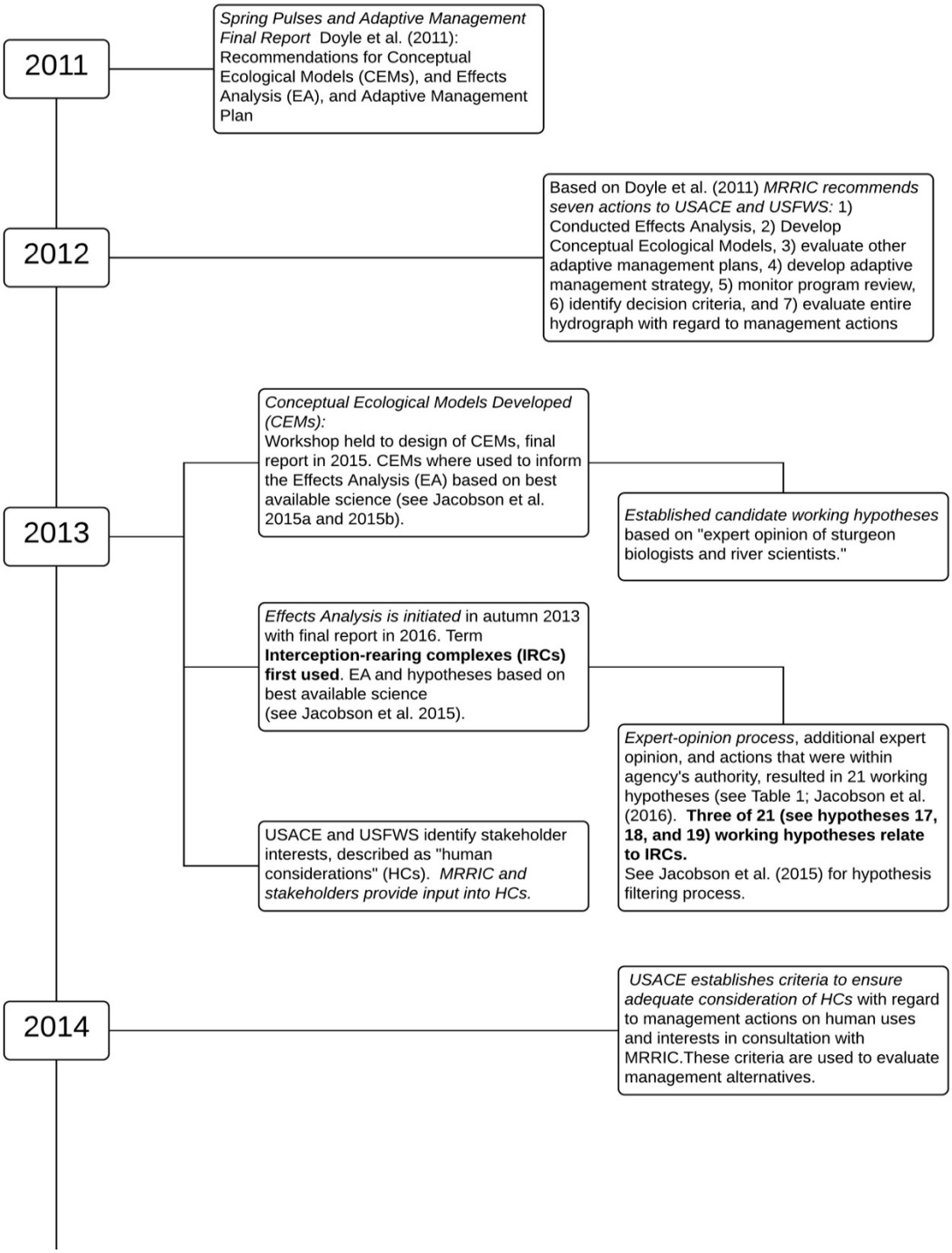
technical information in those documents is not readily accessible to Congress and its staff. Accordingly, the Report could benefit from a concise summary of the "scientific" case for the IRC actions that is detailed in other MRRP program documents. Congress and staff might appreciate a timeline showing the sequence of science-based documents and determinations, from the first MRRP documents that identify IRCs as candidate management actions to the point at which thoroughly vetted IRC management actions are promulgated in the Record of Decision.

A commendable effort is evident in the draft Report in describing likely outcomes and setting reasonable expectations based on a frank assessment of the uncertainties that accompany the IRC actions. Those uncertainties reflect the still limited understanding of the ecology and behavior of the pallid sturgeon and the challenges posed in data collection for the species, including basic monitoring of the fish. However, the discussion of the uncertainties that attend the IRC program as conveyed in the draft could be misunderstood by the Report's intended audience as indicating that IRC actions are not based on the best available science. That would be an inappropriate and incorrect conclusion.

A letter to the USACE from 19 members of Congress (dated 17 December 2015) expressed concern that the Missouri River Recovery Program "could have negative impacts on landowners and stakeholders throughout the Missouri River basin" and directed the USACE to be mindful that management actions that may be taken on the Missouri River main-stem, including IRCs, "should be guided by the best available science, should minimize risks to stakeholders, and should be constrained by the guidelines set out in the current Master Manual."

Recognizing that directive, the Report might recapitulate how "best available science" and efforts to "minimize risks to stakeholders" were used throughout the many steps of the structured management plan development process, from the statement of fundamental objectives and construction of conceptual ecological models and influence diagrams, through the structured effects analysis, and culminating with the prioritization of IRCs among early-identified candidate management actions implemented under the MRRP (see timeline below). Importantly, each step to IRC implementation was based on best science and most steps were reviewed by the ISAP. Figure 1 offers a timeline that might be informative for the USACE to include in the final

Report. The Corps might alternatively choose to use some adaptation of the "we are here" diagram that has been used throughout the planning process to help communicate the big picture concerning IRCs.



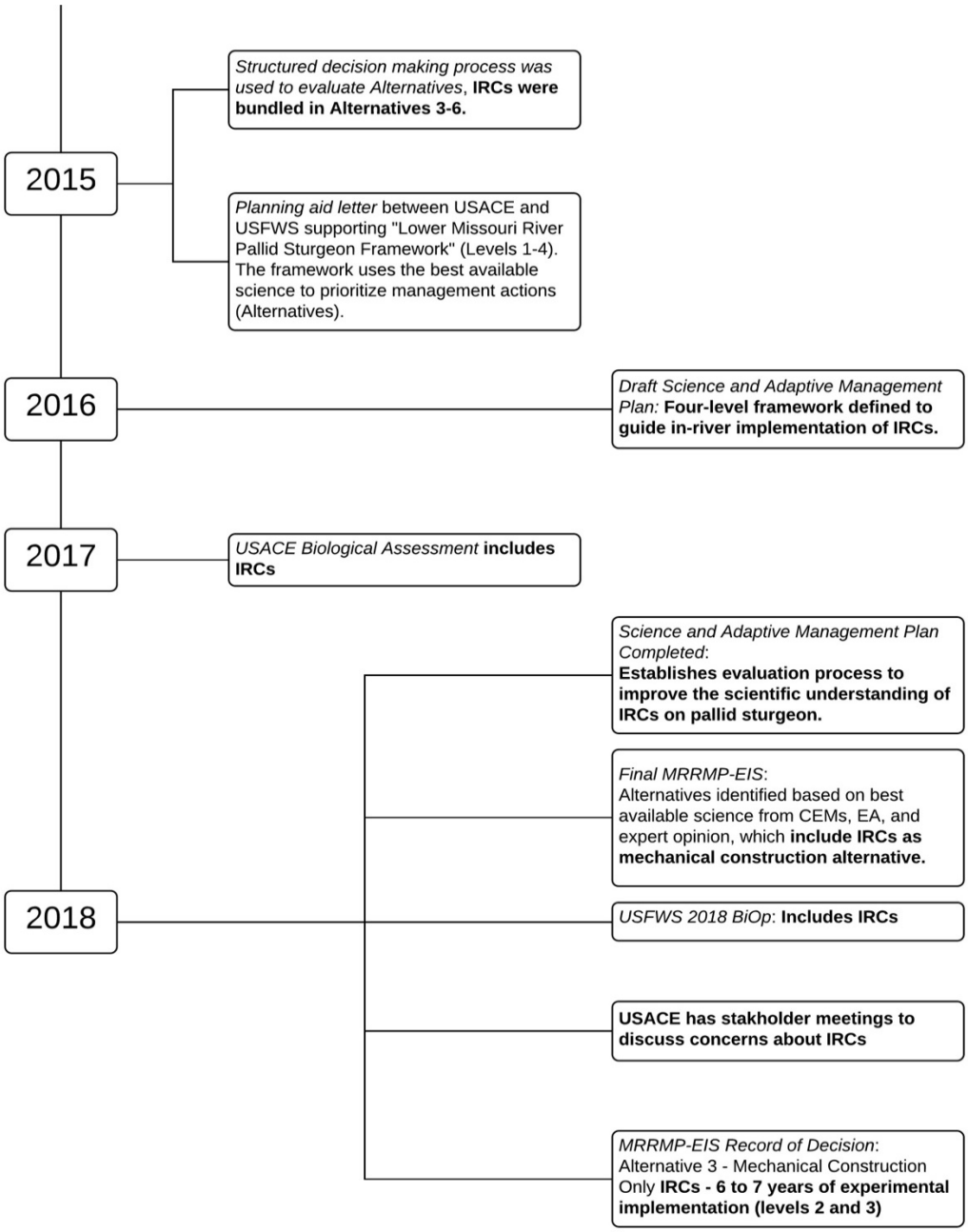


Figure 1. *Example of a timeline that could be used to illustrate the science-based process from initial development of Interception-Rearing Complexes (IRCs) concepts to the Record of Decision. An illustration similar to this could be helpful for congressional staff to understand the decision-support process, which relied on the best available scientific information and expert elicitation, as well as best professional standards and practices in conservation planning.*

Evaluation of the draft WRDA IRC Report and response to questions

As requested by Congress, the Report describes potential impacts of IRCs on eight authorized purposes of the Missouri River and its resources, including flood control, navigation, irrigation, hydropower, water supply, water quality, recreation, and fish and wildlife. Additionally, the Report describes possible impacts of IRCs on commercial sand dredging and bank erosion, two Human Considerations requested for consideration in the Report by MRRIC.

The ISAP evaluation of the Report is organized as outlined in the MRRIC Charge Questions to the ISAP (dated 29 March 2019). Responses to the Charge Questions 1-a. through 1-c. are provided for each of the Authorized Purposes and Human Considerations. One overall response is provided for Charge Question 1-d, which addresses the public engagement process.

1. **Evaluate the report's description of the impacts of IRC construction on "navigation, flood control, and other authorized purposes." Further, evaluate the report's description of impacts of IRCs on commercial sand dredging and bank erosion (which are not authorized purposes).**

    a. **Assess whether the report relied on the best available information and credible analyses (such as hydraulic and economic modeling and monitoring) to describe and assess impacts to authorized purposes as well as commercial sand dredging and bank erosion.**
    b. **Are the interpretations of that information and those analyses scientifically justified and sound?**
    c. **Does the report justify the information and analyses used, or not used if there are alternatives available?**
    d. **Assess the report's description of the engagement processes used for minimizing impacts to the authorized purposes as well as commercial sand dredging and bank erosion and adjusting implementation of IRCs based on information and learning.**

In general, ISAP recommends that each Report section describing the possible impacts of the IRCs on each authorized purpose could be strengthened by including one or more sentences that summarize the key conclusions followed by more detailed content. This reorganization can ensure that the main evaluation approaches and important conclusions are readily identified and then backed up by additional detail in the main document.

Irrigation, Hydropower and Recreation

The USACE's overall statement in the Report with respect to these three authorized uses is:

"Construction of IRCs will not change the regulation guidelines outlined in the Master Manual, and will not affect releases from Gavins Point Dam, the lowermost System dam, to meet the authorized purposes in the lower river. The benefits from the statutory authorization to provide irrigation, hydropower, and recreation are primarily derived from System operations. Because IRC construction will not affect releases, IRC construction will have no impact on these authorized purposes and, therefore, are not further discussed in this report." (Page 10 of the Report)

a. – The conclusion reached by USACE that there will be no impact on any of these three authorized purposes is primarily based on referencing the regulation guidelines in the Master Manual. With respect to these three specific authorized purposes at the location of this discussion in the Report (page 10, lines 41-43) the USACE has not presented a chain of reasoning that, because IRCs require no change in the Master Manual regulation of releases from Gavins Point Dam, the same timing and amount of water releases will: (i) generate the same quantity and value of hydropower as in the pre-IRC conditions; (ii) maintain the same reservoir levels and river flows for recreation; and (iii) produce no measurable changes in water-surface elevations (cited later in the Report, for example page 15).

The Report would make a more compelling argument for no impacts on these three authorized purposes by referencing the Final EIS on the MRRP and its associated Technical Reports. These documents are effectively drawn upon in the discussion for Sand Dredging (Report page 19). Regarding irrigation specifically, the Report could support its conclusion of no impact by citing

the U.S. Army Corps of Engineers Irrigation Environmental Consequences Analysis Technical Report (page 7) which clearly states that there are no currently permitted irrigation intakes on the Missouri River in the State of Missouri. Further, this absence of irrigation water intakes was confirmed with the Missouri Department of Conservation. Taken together, including this information in the Report would document the USACE statement that IRC construction will have no impact on irrigation.

b. – The interpretations in the Report appear scientifically justified and sound. However, the conclusion regarding irrigation, hydropower and recreation in the Report (page 10, lines 41-43) would benefit from citations to key technical documents such as referenced above that could be used to support the USACE's conclusion.

c. – The USACE relied on the Master Manual as the information source for determining no impacts to irrigation, hydropower, and recreation. The Master Manual is the primary document guiding the operation of the USACE's projects. However, supplementing the information in the Master Manual with citations to the appropriate technical reports on each of these three authorized purposes could lend additional strength to the Report.

Navigation

The overall Report statement with respect to potential impacts of IRCs on navigation is: *"…construction of IRCs will not change the regulation guidelines outlined in the Master Manual and will not affect releases from Gavins Point Dam. Therefore, IRCs will not impact USACE's operation of the System or its ability to provide flow support for navigation"* (Report page 11).

a. – The Report documents "Pre-IRC construction" considerations by the USACE to ensure that actual construction of IRCs does not interfere with navigation. This includes: "*The same engineering expertise (and personnel) used to ensure the navigability of the Lower Missouri River is employed in the design of the structure modifications to generate IRC habitat."* (Report page 4). In addition, the proposed locations of the 12 IRCs are generally planned in an area of the Missouri River where the channel width varies from 600-750 feet (Report page 12). The USACE

has also shared its IRC design plans with navigation stakeholders to obtain input and USACE has modified designs to maintain maneuverability at alternative flow regimes.

The Report relies on state-of-the-science hydraulic modeling in evaluating potential navigation impacts. However, while the Report's Appendix B Technical Memorandum is the appropriate location for the bulk of the methodological discussion and data presentation, the main Report should provide specific references to locations in the Appendix B Technical Memorandum drawn to support statements made in Section 2.1.1 on Navigation.

While implied by the hydraulic analysis presented, the Report should include an explicit statement that the required 9-foot depth can and will be maintained in the navigation channel in the vicinity of the IRC sites.

Post-construction monitoring has been conducted by the USACE on the two existing IRCs to date. *"Channel reconnaissance crews have not reported any reduced channel dimensions or adverse channel alignments around existing IRC projects"* (Report page 12). The USACE has agreed to monitor the channel dimensions at least five times per year, and more frequently in low-flow years when channel dimensions are usually reduced (Report page 12). The USACE has also stated that if the monitoring identifies navigation issues due to IRCs "*…steps will be taken to rectify the problem"* (Report page 12). The evidence from past monitoring of the two IRCs, the proposed monitoring effort, and the USACE commitment to address any navigation problems identified should adequately ensure that navigation will be maintained at the levels authorized in the BSNP.

By 1) using the same engineers who built and maintain the river-training (for navigation) and bank stabilization structures to design the proposed IRCs, 2) generally locating the IRCs in areas of wide river-channel widths, and 3) interacting with navigation stakeholders on the specific design elements of the IRCs, the USACE has demonstrated that the best available information and analyses (that also support navigation) were used to assess and minimize the potential impacts of IRCs on navigation.

b. – The Report's interpretations regarding hydraulics impacts of IRCs are justified. Section 3.1.4 in the Technical Memorandum presents the results of AdH modeling that demonstrate that undesirable transverse velocities oblique to downstream velocities are not substantially different between pre- and post-IRC construction. The model results were for simulated flows of 74,000 cfs, a slightly greater than average flow for navigation, for pre- and post-construction bathymetry. The overall patterns and magnitudes of velocity vectors were not demonstrably different for the pre- and post-IRC construction simulations. The Report appears to adequately convey the Technical Memorandum AdH modeling results in its discussion of potential impacts of IRCs on navigation. However, the argument for minimal or no IRC impacts on navigation might be bolstered by some discussion of the effects on navigation of variations in flows near IRCs as compared to near other (non-IRC) river training structures.

c. – Two-dimensional hydraulic models described in the Report are technically adequate for assessing the potential impacts if IRCs on navigation. The majority of river flow velocity components consist of the downstream and lateral flows that are realistically described by these 2-D models. The circumstances where vertical flows might be substantial and influence navigation are rare and do not justify the considerable expense and effort required to model three-dimensional flows.

However, the Report and the associated Appendix B Technical Memorandum could better describe and provide technical references supporting these facts that are generally recognized and accepted among river scientists and engineers. For example, the Technical Memorandum states without supporting citations (page 6, lines 18-21), *"While the horizontal variation of velocities are provided in the 2-d model, the velocity is averaged for the vertical component. However, this vertical component of velocities on large rivers like the Missouri River varies little across the water column and follows a logarithmic profile."* The last sentence accurately describes conditions within the well-defined and managed navigation channel. However, much larger variations in the vertical flows can occur particularly in channel margins or boundary zones and in the lee areas of structures, where substantial upwelling/downwelling zones and shear layers are present. Importantly, these flows are insignificant to navigation because they occur outside the navigation channel. Yet, the lack of constraint and support for statements such

as the one highlighted above might open the Report to criticism. Additionally, the main Report does not discuss findings on channel width encroachment (or lack thereof), which is an important concern to the navigation community.

Flood Control

With regard to flood control, the Report states "*...IRCs will not change the regulation guidelines outlined in the Master Manual and will not affect releases from Gavins Point Dam. There will therefore be no impact to water storage and flow releases or the USACE's operation of the System to meet the authorized purpose of flood control."*

a. – The Report relies on appropriate and credible analytical methods regarding analysis and assessment of the potential for proposed IRCs to impact flooding. Two-dimensional models are sufficient for flood impact evaluation and assessment (see also discussion in Navigation – c. above). While the unmodeled third dimension can contribute to some super-elevation of fluid, the magnitudes of these elevation changes are sufficiently small compared to mean river depth that it has no meaningful impact on flood heights. Therefore, it is justifiable to omit vertical flow in this analysis.

The data presented in the Report that support the findings of no flood impact are based on demonstrated correlation between modeled and measured water surface elevations for *single common navigation discharges* at the two analyzed sites. The assessment and conclusions could be strengthened by evaluating correlations for other relevant discharges. The flood control section of the Appendix B Technical Memorandum begins with a clear and appropriate discussion of the need to evaluate flood impacts at the near bank-full stage discharge. However, model validation is based on measurements of water surface elevation at 0.5 annual chance of exceedance (ACE) or lower discharges. ACE is not defined in the Report, but the Technical Memorandum defines it as 150,000 cfs, which is likely a stage well below bank-full. Given the stakeholder concern for potential flood impacts, the Technical Memorandum should present water-surface elevations modeled over a greater range of higher discharges at each site, particularly including near bank-full discharge.

Stakeholders (Report - Page 16) have also expressed concerns about the effect of IRC's on interior drainage of agricultural fields. The Report indicates that IRC's are designed to not change or affect interior drainage (Page 16). This discussion could be strengthened by emphasizing that the two constructed IRCs and the next six proposed IRC projects shown in Table 1 of the Report are on public lands (e.g., State of Missouri Conservation Areas—CAs or Natural Areas—NAs or USACE land) and correspondingly there should be no agricultural interior drainage issues. Further, the USACE indicates that "… *IRC projects are only located adjacent to publicly owned property and only with permission of the landowner (i.e. state-owned lands)."* (Report, page 17, lines 14-15).

b. – As discussed in the response to a. above, physical modeling is needed for higher flows to provide additional technical support for the conclusions regarding minimal or no flood potential associated with proposed IRCs.

c. – As previously discussed, the USACE's decision to use 2-D modeling is technically well-founded. The USACE sufficiently justifies the use of 2-D modeling for evaluating the potential impacts of IRCs along the large number of miles of the Missouri River. The USACE's rationale for 2-D models (Report page 10) is consistent with conventional professional consensus that little insight would be gained by 3-D modeling of the effect of IRCs on flood control.

Water Supply

The overall Report statement regarding water supply is: *"Construction of IRCs will not require changing the regulation guidelines outlined in the Master Manual and will not affect releases from Gavins Point Dam. Therefore, IRCs will not impact USACE's operation of the System to meet the authorized purpose of Water Supply…"* (Report page 16).

a. – The USACE bases its conclusion on the fact that locations of water intakes are known and these intakes are avoided when the agency identifies potential IRC sites (Report page 16). The USACE's knowledge of the municipal and commercial water intake locations might be better documented by citing the Water Supply Environmental Consequences Analysis Technical Report (2018 – see page 3 of that document). Additionally, the USACE has modified locations of IRCs

to avoid impacts on water supply as a result of eight meetings with stakeholders. The Report might mention these modifications.

Avoiding locating IRCs proximate to water intakes is an important pre-construction consideration. Also, the Report assesses possible changes in water-surface elevations in larger areas around proposed IRC projects (Report page 14). As noted in Section 2.1.2 on flood control, in the pre-construction phase of IRC design "*Water surface elevations are modeled to reflect both pre- and post-project elevations. The pre-project model is calibrated with field verified water surface elevation data and validated with field verified water velocities to ensure model accuracy. If detectable increases are noted, changes are made to the design to avoid impacts"* (Report page 14).

The WRDA Report states that, following construction, water surface elevations are monitored *"multiple times per year"* (page 15, lines 2-3) in order to compare pre-IRC project to post-IRC construction. If changes in surface water elevation are detected, the USACE states that it will remedy the situation (page 15, line 15). To date, no impacts on water elevation have been measured at the IRC located at Searcy's Bend (page 15, line 14; page 16, lines 23-24).

It would benefit the Report to specify the frequency of monitoring water-surface elevations, other than "multiple times per year." An indication of the number of times water surface elevations are currently monitored would be helpful (e.g., monthly from April through October). Nonetheless, the assessment described in the Report, underscored by the USACE's commitment to monitor water-surface levels, demonstrates that the USACE has and continues to use the best information available in concluding no impact of IRCs on water supply intakes.

b. – As noted in response to "a" above, the USACE knows the locations of the water supply intakes and avoids them in siting IRCs. Water elevations are modeled using appropriate 2-D models. IRC designs are modified if simulated post-construction surface elevations are expected to deviate from pre-construction elevations. Post-construction monitoring of water surface elevations will take place and the USACE has committed to make adjustments to IRCs or surrounding structures to maintain the surface water elevations at their pre-construction level.

c. The USACE does not explicitly justify the information used in this section of the Report. However, this section of the Report derives from modeling and data that were previously presented in the Report. Specifically, page 10 of the WRDA Report justifies 2-D modeling and describes monitoring of surface water elevations at existing IRCs (see post-construction monitoring at Searcy's Bend IRC in Section 2.1.2 on Flood Control).

Water Quality

The Report states that IRCs will not affect the USACE's ability to meet the authorized purpose concerning water quality (Report page 16).

a. – Section 2.1.3 includes only a brief discussion on water quality. USACE then refers to the Environmental Assessments for the two constructed IRCs. However, no references are provided to these two Environmental Assessments. Furthermore, the ISAP had difficulty in obtaining them through a web search. For example, the links to Searcy's Bend Environmental Assessment (EA) did not provide the document. Complete references and updated links to these Environmental Assessments should be provided in the final Report. The following comments are based on the Report and the two EA documents provided by the USACE to the ISAP.

Information in the two EAs, combined with statements in the Report (e.g., page 16) that the two IRCs have received Clean Water Act Section 401 water-quality certifications from the Missouri Department of Natural Resource, suggest that the assessment of IRC impacts on water quality was completed using the best available science. However, the Report does not mention if water quality was monitored during and immediately after construction for these two IRC projects. If monitoring occurred, the Report would be correspondingly strengthened by summarizing and referencing the results in the main text.

b. – The Report acknowledges that short-term minor impacts to water quality during the construction of the IRC are generally anticipated. The primary impact is *"localized temporary increases in turbidity"* (WRDA Report page 16, line 26). The Report states that such an increase is not expected to exceed any State of Missouri water quality standards. Drawing on the

experience with the two already-constructed IRC projects "*These projects were in full compliance with section 404 of the Clean Water Act and a Clean Water Act Section 401 water quality certification was also received from the Missouri Department of Natural Resources for each project. It is anticipated that future IRC projects will be similar in nature and result in similar impacts as past IRC projects. Future projects will also comply with Clean Water Act Section 404 and obtain Clean Water Act Section 401 water quality certifications.* (Report page 16).

In addition, as described in the Baltimore Bend EA, the USACE would use rock with minimal "fines" and that would be free of contaminants (Baltimore Bend EA, page 35). Best Management Practices would be followed to minimize water quality impacts from IRC construction (Baltimore Bend EA, page 35).

Based on the information in the WRDA Report and the two EAs, the interpretations appear justified that any impacts to water quality would be short-term and minimal and limited mainly to temporarily increased turbidity. These conclusions are further supported by the Missouri Department of Natural Resources issuing of a Clean Water Act Section 401 water quality certification for each of the past two IRC projects.

c. – The USACE is justified in relying on the EAs of the two existing IRCs and the State of Missouri's DNR Clean Water Act Certification to anticipate water-quality effects of future IRCs, assuming that future IRCs will have similarly negligible impacts as the existing IRCs. The Report would be well-served to provide a brief summary of the results of the water quality data collected during the IRC construction on the Searcy's Bend and Baltimore Bend. This summary of the monitoring data would provide the opportunity to verify USACE's statements regarding the anticipated short-term effects on water quality. Because the USACE is also basing its conclusion regarding short-term water quality impacts of proposed IRCs on an assumed similarity to the two current IRCs, the conclusions in the Report could be strengthened by providing information (perhaps in a footnote) on the similarity of future IRC designs and specification of materials used to construct the IRC, as well as aspects (e.g., soils, sediments) of areas of planned for IRC construction.

Fish and Wildlife

The WRDA Report states that releases from Gavins Point Dam will not be affected by IRC construction. Accordingly, the IRCs will not impact USACE's ability to meet authorized purposes related to Fish and Wildlife that might be affected by alterations in such releases.

The Report caveats that construction of IRCs will convert some terrestrial habitat (e.g., forest, upland grassland) to aquatic habitat (e.g., open water and emergent wetlands). The construction of IRCs would not only benefit pallid sturgeon, but also other native fish that also spawn in these types of aquatic habitats. In this way, the IRCs would "…contribute to the BSNP (Bank Stabilization and Navigation Program) mitigation goals (Report page 17, lines 7-8). The Report further states that the reduction in terrestrial habitat "*…would be negligible compared to the amount of terrestrial habitat available on the Missouri River.*" (Report page 17, lines 1-2).

While this qualitative analysis of the aquatic habitat gained and terrestrial habitat lost appears reasonable, it would benefit from some quantitative detail. This detail could be provided by some simple GIS analysis and summary. For example, it should be possible to map the expected increase in emergent wetland habitat and the scarcity of wetland habitat relative to upland habitat along the Missouri River in the 300-mile stretch under consideration for the additional six IRCs. Furthermore, a few sentences related to the effects on riparian vegetation from the conversion of upland habitat to aquatic habitat, such as emergent wetlands, would improve the completeness of this section and perhaps allow for a discussion of gains and losses of habitat to birds and other wildlife.

Additional Human Considerations – Bank Erosion

a. through **c.** – Section 2.2.1 includes a very brief statement on bank erosion, *"To increase channel margin areas, IRC projects are designed to cause a controlled amount of bank erosion immediately adjacent to the project. To avoid impacts to private property, IRC projects are only located adjacent to publicly owned property and only with permission of the landowner (i.e. state-owned lands)."* (Report, page 17, lines 11-15). As bank erosion is a designed result of IRC

construction, and IRCs are only located adjacent to publicly owned lands, the Report is justified in concluding that there is no bank erosion impact to private landowners.

Additional Human Considerations – Commercial Sand Dredging

While sand and gravel dredging on the Missouri River is not an officially authorized purpose, it is one activity for which USACE provides permits. Due to the possibility that the presence of IRCs might add permit restrictions or additional restricted areas in order to avoid impacts of dredging on the functioning of IRCs, impacts on commercial sand and gravel dredging has emerged as a stakeholder concern.

a. – The Report indicates that some river areas that are desirable for sand and gravel dredging also have characteristics favorable for IRC construction (Page 17, lines 21-22). As the Report indicates (pages 17-19), the USACE relied upon two sources of information in its analysis of potential effects of IRCs on sand dredging: 1) the Final EIS on the Missouri River Recovery Management Plan, which was subject to stakeholder review and public comment, that presented the calculated impacts of the 12 proposed IRCs as 0.3% to 1.5% of the total tonnage in the 42-65 miles of overlap of areas planned for IRCs and areas permitted for sand dredging, and 2) the USACE worked closely with the sand and gravel dredgers as part of the USACE outreach effort (summarized in the next section of the ISAP review) to re-evaluate the location of the IRCs identified in the Final EIS. Accordingly, four of the original IRC sites included in the Final EIS, were replaced with four different IRC *"…sites more amendable to dredging stakeholders"* (Report page 19, lines 11-12).

b. – As result of IRC site substitution, the likely impacts to dredgers will be less than the impacts estimated in the Final EIS (Report page 19, lines 12-14). However, this statement of reduced impact relies on two assumptions: first, that the four remaining IRC treatment sites are equally compatible with sand and gravel dredging; and second, that locations of dredging in the future will be similar to locations used from 2010 through 2017.

Planning discussions between sand-and-gravel stakeholders and the USACE in efforts to replace four of the IRC sites that were identified and analyzed in the EIS makes the USACE's first

assumption reasonable. The USACE has committed to work with stakeholders to identify acceptable future IRC sites. Specifically, the Report states the "…*USACE will continue to take a proactive approach to engage stakeholders to find, to the extent possible, mutually acceptable IRC locations." (page 19, lines 17-18)* and further, if necessary, the *"…USACE could also acquire additional land for IRC construction. The land would need to be sourced from a willing seller, in a location that is both technically and biologically viable, with minimal HC concerns." (Page 19, lines 24-25).*

The second assumption that future dredging will occur in areas of the river similar to where dredging occurred from 2010 through 2017 also appears to be reasonable given the information in the Final EIS. Specifically, the Final EIS notes that dredging operations typically take place in the location 7-10 miles upstream and 3-9 miles downstream of a sand processing plant (Final EIS, page 3-268). The potential locational range of 9 miles downstream of a sand plant to 10 miles upstream of a sand plant provides 19 miles of potential sand and gravel dredging around any given processing plant. This range suggests: (a) that as long as these processing plants remain in their current locations, it is reasonable to assume the 2010-2017 time period is relevant when assessing potential impacts of IRCs on sand and gravel operations; (b) the 19 mile range associated with each processing plant provides some flexibility for USACE and dredgers to find acceptable locations to obtain sand from currently permitted areas, and (c) for USACE to issue future dredging permits for areas that the USACE might also consider for proposed IRCs.

c. – The USACE could strengthen its conclusion in the Report regarding the small impacts to sand dredgers by presenting information from the Final EIS section cited above.

d. Assess the report's description of the engagement processes used for minimizing impacts to the authorized purposes as well as commercial sand dredging and bank erosion and adjusting implementation of IRCs based on information and learning.

Section 1.4 in the Report well describes the interactions of the USACE and USFWS with MRRIC and the public in obtaining feedback regarding the potential impacts of IRCs on human uses of the lower Missouri River. As noted in Section 1.4 of the Report on MRRIC/Public Engagement, the USACE engagement on the IRC approach began as early as in the initial

discussion of Draft EIS Alternatives at MRRIC Plenary meetings and continued through the formal comment periods on the Draft EIS (Figure 1).

With regard to the public engagement process for the two constructed IRCs, page 8 of the Report indicates that the USACE conducted two specific Environmental Assessments of IRCs, which included a 30-day public comment period. In addition, the USACE held a public meeting near each of the two locations proposed for IRC construction.

These two processes for engagement (public comment period and meetings) provided opportunities for stakeholders and individuals potentially affected by the location of these two specific IRCs to express concerns or approval. In addition, these public engagement efforts for the two Environmental Assessments of IRCs provided the interested public opportunity to learn about the possible environmental consequences associated with future IRCs and understand the nature of assessments of future IRCs planned for other locations.

According to the Report (pages 17-18), the USACE held a series of eight IRC Stakeholder Coordination and Outreach engagement activities that were coordinated through MRRIC. These specific engagement activities started in February 2018 and continued through July 2018. As detailed in the Report (page 18), these meetings focused on obtaining feedback on issues concerning IRC site selection and IRC designs from commercial users of the river and how the USACE might address those concerns by changing IRC site selection and redesigning IRCs. As a result of those meetings, the USACE reworked its list of IRC sites and associated control sites to "…identify six sites that would have little to no impact to the dredgers." The Report (page 19) states that the USACE will continue this engagement with stakeholders in locating future IRC sites.

The USACE has done a thorough job with engagement; however, it would be helpful if the Report documented those efforts, perhaps as a brief appendix that lists the specific dates and locations of the eight IRC Stakeholder Coordination and Outreach engagements, as well as the number of individuals participating in each meeting.

In addition, the Report's discussion of stakeholder engagement in the Sand Dredging section 2.2.2 (middle of line 38 on page 17 to line 15 on page 18) could be moved into the Report's Section 1.4 entitled MRRIC/Public Engagement. The detailed discussion of the extensive engagement with the commercial dredgers in section 2.2.2 could be overlooked by Congress and staff who might focus on legally required authorized purposes.

As documented in the Report (page 18, lines 11-12), the USACE reprioritized the agency's original list of IRC sites, as well as the corresponding IRC control sites (lines 19-20). This action by USACE demonstrates the agency's willingness to adjust implementation of the IRCs based on information it obtains from potentially affected stakeholders.

2. Evaluate the report's description of the impacts of IRC construction on pallid sturgeon population recovery.

- **a. Assess whether the report relied on the best available information and credible analyses (such as hydraulic and dispersion modeling and monitoring) to describe and assess impacts on pallid sturgeon.**
- **b. Are the interpretations of that information and those analyses scientifically justified and sound?**
- **c. Does the report address the amount of information available currently and the ability to assess impacts of IRCs on recovery of the pallid sturgeon using that information? If there are insufficient data available to assess impacts, does the report offer sufficient reasons why and plans to obtain the data?**
- **d. Considering that the IRC pilot project is an effort to reduce the uncertainties regarding the interception of age-0 pallid sturgeon, assess the report's explanation of the rationale for IRCs, the experimental design, and timeframe.**

a. – The Report describes the process whereby the best available science was used through a combination of conceptual ecological models (CEMs) and effects analysis (EA) to arrive at the currently recognized need for IRCs in relation to pallid sturgeon management. A schematic (e.g., Figure 1) to accompany the narrative regarding the logical progression from the Doyle et al. (2011) Report to the Record of Decision (ROD) may be helpful to illustrate the process by which

IRCs were included in the ROD. Furthermore, the schematic should clearly illustrate that stakeholders were engaged throughout the process, as was mentioned in the Report.

The 2-D advection and dispersion models used to predict where the IRCs would be most effective at intercepting sturgeon free-embryos (age-0 pallid sturgeon) in the Missouri River were based on the best available science from flow models, pallid sturgeon drift dynamics, and HCs. The reaches selected for IRC construction were based on model outputs as presented in Figure 2 of the Report. The modelling could be updated to include the complete drift dynamics of age-0 pallid sturgeon. Since the CEMs and EA were completed, additional research has indicated that juvenile pallid sturgeon are inhabiting the Mississippi River. The Report recognizes this imperfectly understood phenomenon, but the connection between IRCs in the Missouri River and survival and recruitment in the Mississippi River is not made clear. The Report would be strengthened by emphasizing the link between the two major rivers with regard to pallid sturgeon ecology (best available science) and evaluation of the effectiveness of management actions. These discussions concerning the appropriate spatial domain for pallid sturgeon management have been occurring among scientists who work in the Missouri River and Mississippi River and this might be reflected in the Report.

The Report contains credible technical information for justifying the construction of IRCs. As described in the Report and detailed in the supporting technical memorandum, a combination of monitoring and state-of-the-science, two-dimensional physical models were used to evaluate the expected impact of IRCs on particle (i.e., a surrogate for age-0 sturgeon) transport and interception. Yet, the Report could more convincingly describe the contributions of increased age-0 interception to pallid sturgeon population dynamics, particularly in relation to achieving stated management objectives (e.g., a self-sustaining population, numbers of pallid sturgeon per managed reach). Towards that end, the memorandum might be expanded to include more detailed description of the pallid sturgeon population model, or perhaps this might be better presented in a separate appendix or memorandum. To bolster the case for IRCs, clearly understandable, causal (mechanistic) pathways from increased age-0 interception (i.e., CPUE) by IRCs to increased pallid population size in the Missouri River needs to be presented in the Report with additional supporting detail in an appendix. This Report would also be strengthened

by a paragraph that presents the assumptions associated with IRCs and their hypothesized linkages to pallid sturgeon recovery. The objective of IRCs is not to reduce uncertainty, but to contribute to the development and management of a self-sustaining population of pallid sturgeon in the Lower Missouri River. The Report needs to emphasize this management objective and underscore the hypothesized contributions of IRCs towards achieving this objective.

b. – Given the advection and dispersion modeling, flow modeling at the IRCs sites, the staircase study design, and *a priori* power analysis, the evaluation of IRCs appears scientifically credible at this time. It would be informative to update the power analyses as more data become available; such updating is central to the AM process. In addition, it is important to consider updating the definition of interception habitat, food producing habitat, and foraging habitat for free embryos as new scientific information becomes available. This is mentioned in the Report, but not discussed in detail, especially in terms of how much information and data are needed to adjust a previously defined metric or to evaluate a hypothesis. It is quite possible that IRCs will need to be modified (as part of the AM process), given the continued development of new data that define and refine "best available science" relevant to managing pallid sturgeon populations.

c. – The effectiveness of IRCs on pallid sturgeon population recovery remains to be demonstrated. This circumstance derives from at least three factors: 1) the full-scale implementation of IRCs has not been completed, 2) the power analysis indicated that seven years are needed to detect a significant change in CPUE of sturgeon within IRCs, and 3) if the metric is pallid sturgeon population recovery measured in the Missouri River, it could require decades before recovery can be estimated given that wild sub-adult pallid sturgeon are not sampled in the Missouri River. Recovery would consequently need to be determined from catches of adult pallid sturgeon. The Report describes the application and results of physical modeling in assessing the likely effectiveness of intercepting age-0 sturgeon (i.e., interception potential). The Report also addresses the relevance of modeling the IRCs in meeting foraging needs of young developing sturgeon. Additionally, it would be useful to concisely present the results of the monitoring data for the two built IRCs (and controls) to demonstrate that it is currently possible to capture age-0 sturgeon in the IRCs.

d. – The Report emphasizes the importance of the IRCs in generating data for the pallid sturgeon population model. However, only a brief paragraph is provided that generally describes the model. That emphasis would be assisted with description of how the interception (and rearing) of age-0 pallid sturgeon in IRCs contributes to population dynamics of pallid sturgeon as formulated in the population model. (It would be helpful if there was a reference to the model.) A concise diagram of the model structure and an indication of how data produced by IRCs explicitly enters into the model dynamics could help strengthen the argument for IRCs. Merely indicating that the IRCs will contribute to "future parameterization" of the model does not make a strong case.

The following are additional suggestions for perhaps reorganizing or shifting emphasis in the Report to reinforce the argument for continued IRC construction:

Section 3.2 (page 21, line 3): instead of saying "manage risks", the Report should emphasize the use of AM to achieve management objectives, namely, recovery of the pallid sturgeon in the Missouri River.

Section 3.3: this information might be more forcefully presented in terms of emphasizing and justifying the need for construction of additional IRCs according to the schedule – or sooner, rather than conveying the message that it will take at least 12 IRCs and seven years to arrive at a conclusion.

Section 3.4.1 (lines 7-13): more clarity is needed here… if shovelnose spawn, drift and settle in different parts of the river, might this bias any interpretation of age-0 shovelnose that happen to be captured in IRCs designed with pallid sturgeon biology in mind? Can the key similarities between age-0 shovelnose and pallid sturgeon be underscored to further justify the use of shovelnose CPUE as the focal metric for evaluating the efficacy of IRCs aimed at pallid sturgeon recovery?

Section 3.4.2 (lines 14-18): if any age-0 pallid sturgeon have been captured to date, it would be useful to emphasize this, instead of arguing for IRCs on the promise of future data collection.

Page 27 (lines 7-18): emphasize the ability of the physical models to estimate interception potential, rather than focusing on limitations of the modeling software… and is it possible to present the modeling results without emphasizing uncertainty or mentioning expected reductions in interception potential as sites mature?

3. Does the report adequately describe if and how any impacts to authorized purposes as well as commercial sand dredging or bank erosion, would be revisited if it is determined that IRCs are not having the anticipated impact on pallid sturgeon population recovery recognizing the timing for determining IRC effectiveness has been described in the SAMP?

The Report develops credible arguments that IRCs will not likely have serious impacts on authorized purposes or commercial sand dredging or bank erosion. The Report repeatedly states that if post-IRC construction monitoring (or modeling) indicates that human considerations are being impacted, the particular HC issues will be revisited and addressed accordingly. If in the future the IRCs are determined not to be having the anticipated impact on pallid sturgeon recovery, adjustments to mitigate those HC impacts will of course not be necessary. The Corps might better emphasize that point in the Report, and possibly add that unforeseen or subsequent impacts encountered in the future could be addressed by ongoing BSNP maintenance efforts.

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