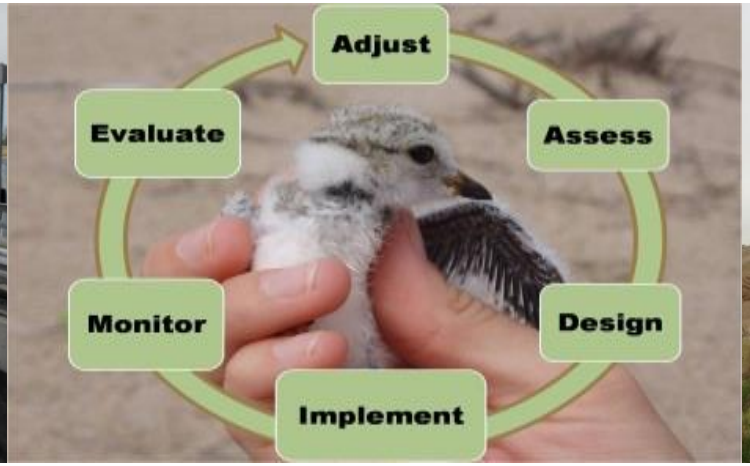
Adaptive Management on the Platte River



09/01/2015

Platte River Recovery Implementation Program
Adaptive Management Plan (AMP)
2014 State of the Platte Report
(updated primarily with 2013-2014 data)

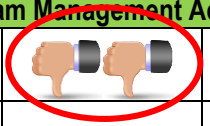
PRRIP Big Question	2014 Assessment	Basis for assessment
Implementation – Program Management Actions and Habitat		
1. Will implementation of SDHF produce suitable tern and plover riverine nesting habitat on an annual or near-annual basis?		Peer-reviewed Program synthesis concludes that SDHF will not produce suitable nesting sandbars.
2. Will implementation of SDHF produce and/or maintain suitable whooping crane riverine roosting habitat on an annual or near-annual basis?		Trending negative; Program synthesis chapters now in development will be discussed with the TAC and ISAC and peer reviewed in 2015; those synthesis chapters and published manuscripts related to the Program's vegetation and lateral erosion research will likely support a "two thumbs down" assessment in the 2015 State of the Platte Report.
3. Is sediment augmentation necessary for the creation and/or maintenance of suitable riverine tern, plover, and whooping crane habitat?		Trending positive; certainty about the sediment deficit; uncertainty about the role of that deficit in habitat creation and maintenance.
4. Are mechanical channel alterations (channel widening and flow consolidation) necessary for the creation and/or maintenance of suitable riverine tern, plover, and whooping crane habitat?		Trending positive; planform management manuscript now in development will be published and will likely support a "two thumbs up" assessment in the 2015 State of the Platte Report.
Effectiveness – Habitat and Target Species Response		
5. Do whooping cranes select suitable riverine roosting habitat in proportions equal to its availability?		A definitive assessment is expected by 2017 once peer review of data analyses (monitoring, telemetry, stopover study data, habitat availability assessments, IGERT research) is complete.
6. Does availability of suitable nesting habitat limit tern and plover use and reproductive success on the central Platte River?		Trending positive; three documents now in development will be peer reviewed and/or published and will likely support a "two thumbs up" assessment in the 2015 State of the Platte Report.
7. Are both suitable in-channel and off-channel nesting habitats required to maintain central Platte River tern and plover populations?		Trending negative; three documents now in development will be peer reviewed and/or published and will likely support a "two thumbs down" assessment in the 2015 State of the Platte Report.
8. Does forage availability limit tern and plover productivity on the central Platte River?		Trending negative; synthesis document related to tern forage (fish) will be peer reviewed that, in combination with the results of the Foraging Habits Study, will likely support a "two thumbs down" assessment in the 2015 State of the Platte Report.
9. Do Program flow management actions in the central Platte River avoid adverse impacts to pallid sturgeon in the lower Platte River?		Peer-reviewed Program stage change study concludes Program flow management actions will avoid adverse impacts.
Larger Scale Issues – Application of Learning		
10. Do Program management actions in the central Platte River contribute to least tern, piping plover, and whooping crane recovery?		By definition, implementation of the Program contributes to recovery of the target species. A definitive answer for this question can only be obtained by a broader analysis of the contribution of the central Platte to range-wide recovery.
11. What uncertainties exist at the end of the First Increment, and how might the Program address those uncertainties?		This question is a "parking lot" for uncertainties that could be addressed through adaptive management in an extended First Increment or new Second Increment.

Table 2. 2014 Big Questions table.

2014 State of the Platte Report Contents

Appendix A
ISAC report to GC – August 2015
ISAC report to GC – November 2014

ISAC Question #1 – Is the "two thumbs up" assessment for Big Question #9 in the 2014 State of the Platte Report logical based on your understanding of Program data and consistent with what you have learned during your involvement with the Program?
1. To address the new information on pallid sturgeon we recommend that the Program repeat its "Alternative Analysis of Program Activities" (Appendix G in HDR et al. 2009) to determine if Program flow management actions also yield minimal predicted effects on water physical and chemical conditions in the Elkhorn to Loup segment of the Lower Platte River.
Program response: The lower Platte River Associated Habitat Reach is defined as being from the mouth of the Elkhorn River down to the mouth of the Platte River where it joins the Missouri River near Plattsmouth, NE. Any Program activity above the mouth of the Elkhorn River would have to be directed by the Governance Committee.
2. The ISAC recommends that the Program formulate an operational rule that would be applied to the operation of the J2 reservoir. Provided that such a rule is put in place by the Program to protect the habitat of pallid sturgeon, then the ISAC supports the conclusion of two thumbs up on Big Question #9.
Program response: The EDO will continue to work with the WAC and others to formalize this operational rule for the proposed J2 reservoir or any other similar Program water projects.
3. The draft 2014 State of the Platte report (pg. 29, lines 881-885) has the following statement: "The U.S. Fish and Wildlife Service maintains the GC needs to address, at the policy level, perceived disagreement between the AMP management objective of "avoid adverse impacts from Program actions on pallid sturgeon populations" and the stated Program goal of "testing the assumption that managing flow in the central Platte River also improves the pallid sturgeon's lower Platte River habitat." The ISAC agrees that the GC needs to address this perceived disagreement.
Program response: The GC will have to provide further direction on this issue.

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Appendix B
DWU comments – June 2015

Comments by the Downstream Water User Technical Advisory Committee members on the 2014 State of the Platte Report
(These comments were developed using a previous draft version of the State of the Platte Report with different line numbers. All responses from the EDO are directed at the State of the Platte Report text in the original line numbers as identified below).

Line 119 and 120 – the term "natural" is somewhat misleading, both areas of river where the islands formed have seen extensive mechanical vegetation control for decades prior to the creation of the PRRIP and some since that time.

EDO response – *Statement now reads: "A total of one plover nest was initiated on a ~~natural~~ sandbar that was disked during fall of 2010 and was overtopped by ~~following~~ the 2011 high-flow event (2012 nesting season). ~~and~~ Similarly,~~-~~two tern nests were initiated on a ~~natural~~ sandbar that was disked during the fall of 2013 and was subsequently overtopped by ~~following~~ the 2013 high-flow event (2014 nesting season). None of these nests were on habitat that ~~did not~~ conformed to the Program's minimum suitability criteria.*

Line 126 – Suggest inserting U.S. Fish and Wildlife in front of proposed. In the Cooperative Agreement era it was agreed those objectives would not be used. However, with increased knowledge of how the river creates habitat it might be time to address what role the central Platte should play in species recovery as noted at line 630.

EDO response – *Reference added at the end of this assessment to indicate species recovery objectives were proposed by the U.S. Fish and Wildlife Service but not agreed to by the Program.*

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Contents

Appendix B
Service comments – June 2015

U.S. Fish and Wildlife Service Comments on the 2014 State of the Platte Report

BQ#1- The Service will work with the TAC to develop recommendations for the Governance Committee regarding tern and plover nesting. The Service supports continuing in-channel mechanical nesting island construction and maintenance and we recognize the importance of off-channel nesting habitat in the central Platte River as well.

EDO response – *The EDO will continue to work with the TAC to develop recommendations for "adjusting" in regard to Big Question #1.*

BQ#2- This big question addresses whether SDHF will produce and/or maintain suitable whooping crane riverine roosting habitat on an annual or near-annual basis. The Service does not agree with one thumb down and we do not support moving this to two thumbs down. We believe "inconclusive" is still appropriate at this time…

EDO response – *The EDO believes that the whooping crane habitat synthesis chapters, now in development, will address many of the issues raised in these comments.*

BQ#9 - The Service will address comments related to this big question at the September 2015 Governance Committee meeting. We have no further comment at this time.

Big Question #1 Assessment

1. Will implementation of SDHF produce suitable tern and plover riverine nesting habitat on an annual or near-annual basis?

How does this Big Question relate to Program priority hypotheses?

Based upon the SedVeg model and associated assumptions in the FSM management strategy, it is hypothesized that under a balanced sediment budget, flows of 5,000 to 8,000 cfs magnitude for three days (SDHF) will build sandbars to an elevation that is suitable for tern and plover nesting. The Program's minimum height suitability criterion is 1.5 ft above the 1,200 cfs stage and represents the minimum height thought necessary for nest initiation.[1]

2014 Assessment for BQ #1:

- Observational studies of natural high flow events since 2007 have provided sufficient data to test the hypothesis that SDHF releases will create suitably-high sandbars.
- Full SDHF magnitude of 8,000 cfs is not sufficient to create sandbars that exceed the PRRIP's minimum height suitability criterion.
- Sandbars created by SDHF releases will be inundated during the nesting season in most years.
- Regardless of peak flow magnitude or duration, AHR sandbars will generally be much smaller than those used by the species in other regional river segments. This due to significant differences in bed material grain size and the mode of sediment transport. These differences are likely intractable.

[1] This is a restatement of the first bullet under broad hypothesis PP-1. See p. 16 of the Adaptive Management Plan.

AMP Management Objectives

1) Improve production of Least Tern and Piping Plover from the central Platte River.

a) Increase number of fledged tern and plover chicks

i) Increase nesting pairs (indicator is nesting pairs)

ii) Increase fledge ratios (indicator is chicks successfully produced per unit adult, nest or pair) and reduce chick mortality from causes such as flooding, predation, weather, inadequate forage.

b) Reduce adult mortality

i) Reduce predation (indicator is nesting pairs)

2) ~~Improve~~ (Contribute to) survival of Whooping Cranes during migration.

a) Increase availability of whooping crane migration habitat along the central Platte River (indicators are the area of suitable roosting habitat, area of suitable foraging habitat, proportion of population, crane use days, etc.).

3) Avoid adverse impacts from Program actions on pallid sturgeon populations.

a) Indicators have not been identified as more research is needed to determine what potential indicators the Program may affect.

4) Within overall objectives 1-3, provide benefits to non-target listed species and non-listed species of concern and reduce the likelihood of future listing.

a) Increase availability of habitats for these species (Land Plan “other species of concern”) along the central Platte River (indicators are species occurrence, Land Plan Tables 1 and 2 characteristics).

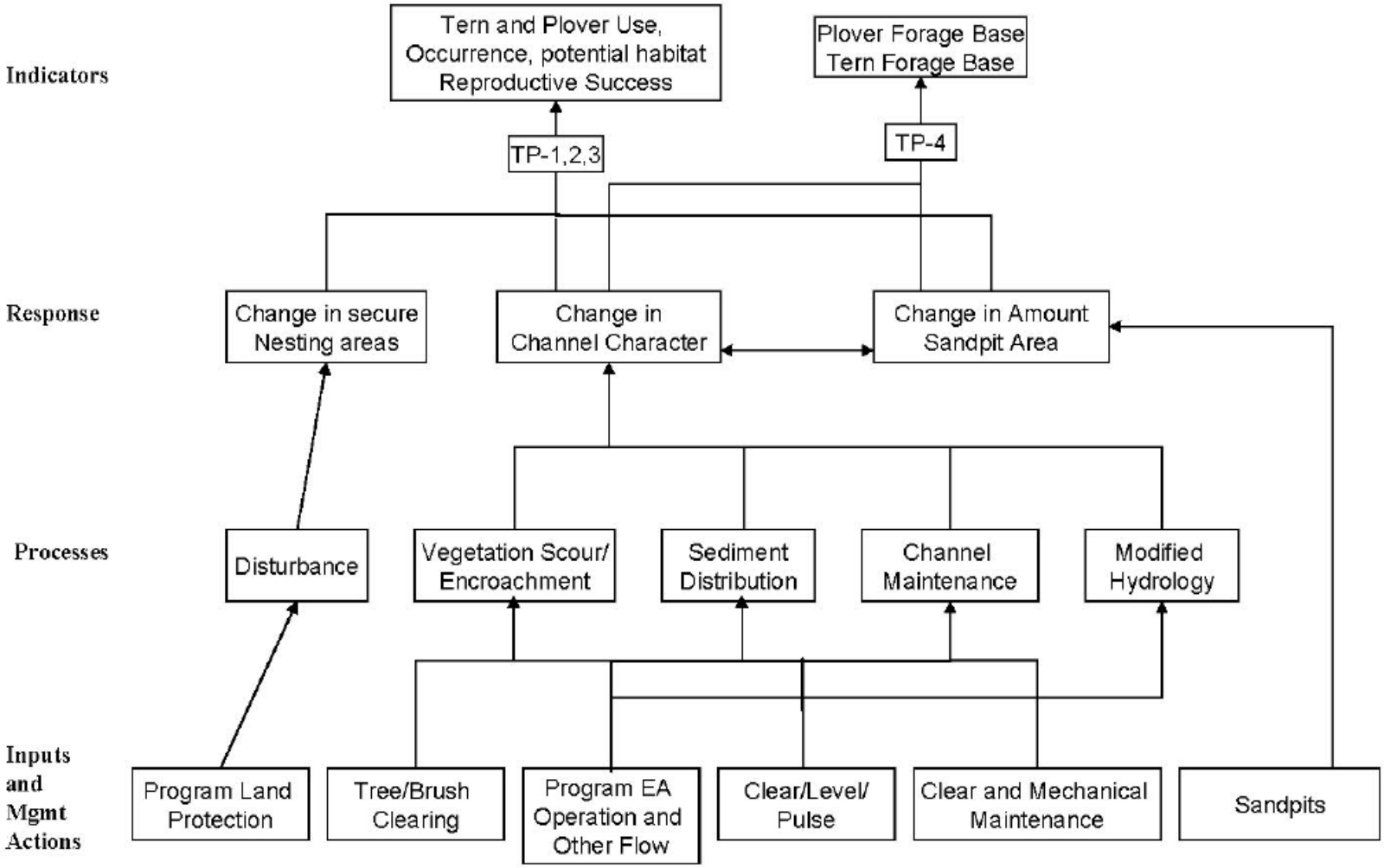


Figure 6. Least tern and piping plover conceptual ecological model (including example locations for current hypotheses).

Least Tern and Piping Plover Broad Hypotheses	Big Question that addresses this Broad Hypothesis:
TP-1: In the central Platte River study area, terns and plovers prefer/do not prefer riverine habitats as described in Land Plan Table 1 and use will/will not increase proportionately to an increase in habitat complexes.	**BQ #6**
TP-2: The maintenance of tern and plover populations in the central Platte requires/does not require that sandpits and river continue to function together to provide nesting and foraging habitat.	**BQ #7**
TP-3: Ephemeral nesting areas in the river are/are not needed for long-term nesting success of tern and plover.	**BQ #7**
TP-4: Existing river flows influenced by drought, floods, hydrocycling, etc., do/do not provide a sufficient forage base (invertebrate/fish recruitment, survival, and correct composition) throughout the central Platte River study reach for populations of terns and plovers during the nesting season.	**BQ #8**

Least Tern and Piping Plover Conceptual Ecological Model Hypotheses

Hypotheses support for Program conceptual ecological models and associated research and monitoring protocols/activities

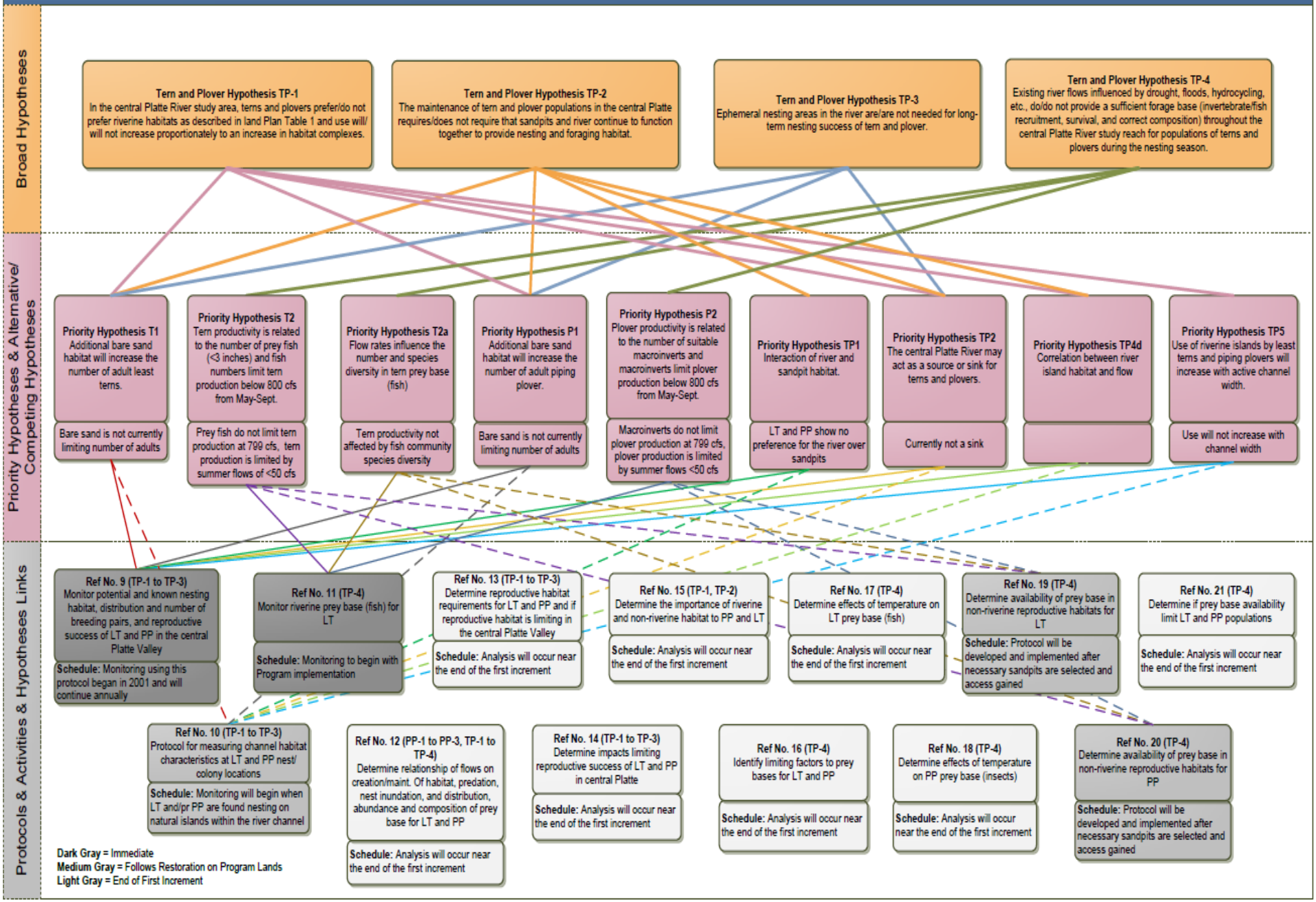


Table 01. Sequencing table for PRRIP priority hypotheses related to interior least terns and piping plovers.

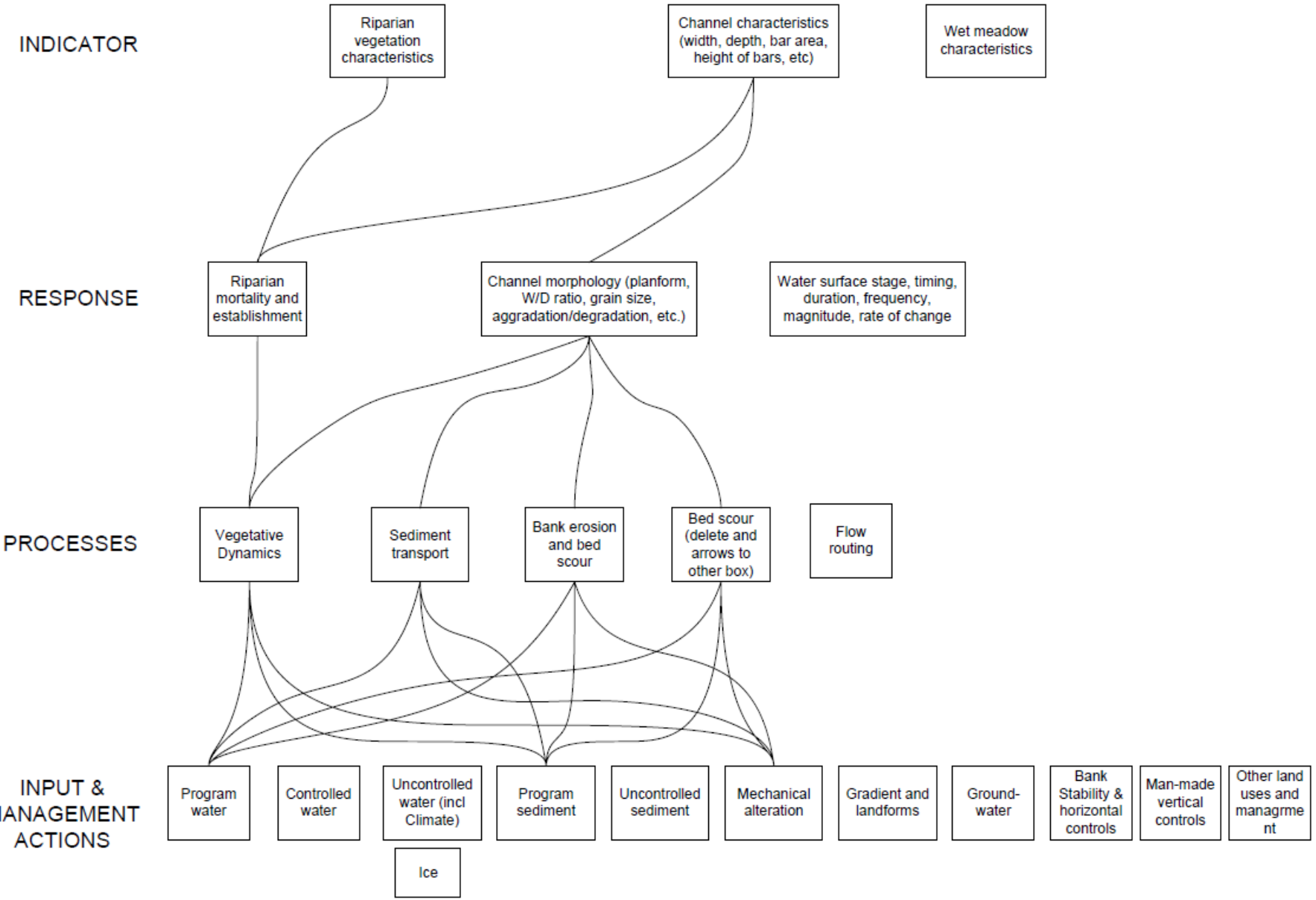
Priority Hypotheses	Detectability	Sensitivity	Feasibility	Priority	Sequence	Critical Path Comments
T1: Additional bare sand habitat will ↑ number of adult least terns.	**High** Get full or nearly full census of birds each year; pilot study of habitat protocol in 2010	**High** Program habitat actions begin in 2010; expect quick bird response	**High** Data collection methodologies already budgeted, well-understood, and repeatable	**High**	**Tier 1** Assess annually through 2015	Need-to-know information; direct link to Management Objective #1 and comparison of FSM and MCM strategies; need agreement on habitat metrics
T2: Tern productivity is related to the number of prey fish (<3") and fish numbers limit tern production below 800 cfs from May-Sept.	Medium Productivity data strong; relating to fish numbers more difficult; learning about foraging effort through USGS study	Medium Availability of fish at all flows may reduce inference ability	Low Requires intensive sampling effort over broad range of time and flows	Medium	Tier 2 Data mining or assess after Tier 1 hypotheses or 2015	NOTE: Ongoing USGS foraging habits study may provide data to assess this hypothesis; **tackle this as initial write-up based on existing data**
T2a: Flow rates influence the number and species diversity in tern prey base.	Medium Proper sampling effort should yield useful data	Medium	Low Requires intensive sampling effort over broad range of time and flows	Medium	Tier 2 Data mining or assess after Tier 1 hypotheses or 2015	Hydraulic models and suitability curves (Peters, Chadwick) for species could be paired to assess this hypothesis
P1: Additional bare sand habitat will ↑ number of adult piping plovers.	**High** Get full or nearly full census of birds each year; pilot study of habitat protocol in 2010	**High** Program habitat actions begin in 2010; expect quick bird response	**High** Data collection methodologies already budgeted, well-understood, and repeatable	**High**	**Tier 1** Assess annually through 2015	Need-to-know information; direct link to Management Objective #1 and comparison of FSM and MCM management strategies; need agreement on habitat metrics
P2: Plover productivity related to the # of suitable macroinverts and macroinverts limit plover production below 800 cfs from May-Sept.	Medium Productivity data strong; relating to invert numbers more difficult	Medium Availability of inverts at all flows may reduce inference ability	Low Requires intensive sampling effort over broad range of time and flows	Medium	Tier 2 Data mining or assess after Tier 1 hypotheses or 2015	NOTE: Ongoing USGS foraging habits study may provide data to assess this hypothesis
TP1: Interaction of river and sandpit habitat.	Medium to **High** Depends on increased use of river islands for nesting and access to sandpits for monitoring	Medium to **High** Depends on bird response and avail. of river and sandpit habitat	**High** Strong methodologies for collecting bird and habitat data	**High**	**Tier 1** Assess annually through 2015	Need-to-know information; key hypothesis for exploring a comparison between FSM and MCM management strategies
TP2: The central Platte River may act as a source or sink for terns and plovers.	Low Small # of birds and mobility make this difficult	Low Current intensity of use makes this difficult to assess	Low Requires range-wide banding and telemetry effort	Low	Tier 3 Only assess after all Tier 1 and 2 hypotheses	
TP4d: Correlation btw river island habitat and flow.	Medium Small gradation of island elevations that fall under flood stage make this difficult to assess	Medium Small gradation of island elevations that fall under flood stage make this difficult to assess	Medium to **High** Habitat and flow measurement methodologies well-established	Medium	Tier 2 Data mining or assess after Tier 1 hypotheses or 2015	Possible data mining or modeling effort related to flow at nest initiation over time might provide data useful for assessing this hypotheses

TP5: Use of riverine islands by least terns and piping plovers will ↑ with active channel width.	**High** ↑ in availability of islands @ different channel widths should make this highly detectable	Medium to **High** Depends on ↑ use of river islands for nesting	**High** Methodologies well established	**High**	**Tier 1** Assess annually through 2015	Need-to-know information; important to compare between FSM and MCM management strategies

Table 02. PRRIP Tier 1 priority hypotheses for interior least terns and piping plovers. Table includes candidate performance measures, criteria, and data collection and analysis methodologies. CM linkage numbers refer to PRRIP least tern and piping plover conceptual model.

Tier 1 Priority Hypothesis	CM Linkages	Candidate Performance Measures	Hypothesis Decision Criteria	Experimental Design & Data Collection	Spatial/Temporal Scale	Data Analysis
AMP Management Objective #1 – Improve production of Least Tern and Piping Plover a) ↑ number of fledged tern and plover chicks [i) ↑ nesting pairs; ii) ↑ fledge ratios and ↓ chick mortality] b) ↓ adult mortality [i) ↓ predation (indicator is nesting pairs)]						
T1: Additional bare sand habitat will ↑ number of tern nesting pairs. **Big Question #6**	TBD	**Species** # of nesting pairs **Habitat** Tie to minimum habitat criteria	- For every ↑ of 1.5 acres in habitat expect ↑ of one nesting pair - ↑ trend over five-year period	- **Bird Response Experiment** - Tern/plover monitoring and habitat selection research	* Lexington-Chapman * Annual census * Expect to detect change on annual basis starting in 2010 after initial PRRIP habitat acquisition & construction * 2010-2015	**Species and Habitat** * Annual ED Office analysis/reporting * Compare inter-annual trends * Utilize habitat measures and bird numbers in Rapid Prototype model * Direct data for evaluation of Management Objective indicator a)i)
P1: Additional bare sand habitat will ↑ number of plover nesting pairs. **Big Question #6**	TBD	**Species** * # of nesting pairs **Habitat** * Tie to minimum habitat criteria	- For every ↑ of 5-6 acres in habitat expect ↑ of one nesting pair - ↑ trend over five-year period	* **Bird Response Experiment** * Tern/plover monitoring and habitat selection research	* Lexington-Chapman * Annual census * Expect to detect change on annual basis starting in 2010 after initial PRRIP habitat acquisition & construction * 2010-2015	**Species and Habitat** * Annual ED Office analysis/reporting * Compare inter-annual trends * Utilize habitat measures and bird numbers in Rapid Prototype model * Direct data for evaluation of Management Objective indicator a)i)
TP1: Interaction of river and sandpit habitat. **Big Question #7**	TBD	**Species** - Fledge ratio - # of nests - Calculate nests/acre **Habitat** - Acres of available river and sandpit habitat - Tie to minimum habitat criteria	- Statistically significant difference in fledge ratio between habitat types	* **Paired Design** * Tern/plover monitoring and habitat selection research	* Lexington-Chapman * Annual census * Expect to detect change on annual basis starting in 2010 after initial PRRIP habitat acquisition & construction * 2010-2015	**Species and Habitat** * Annual ED Office analysis/reporting * Utilize habitat measures and bird numbers in Rapid Prototype model to evaluate differences btw river & OCSW * Direct data for comparison between FSM and MCM * Data for population models
TP5: Use of riverine islands by least terns and piping plovers will ↑ with active channel width. **To be determined**	TBD	**Species** - Location of riverine nests **Habitat** - Channel width at all available habitat	- Statistically significant relationship between utilized habitat and channel width	* **Bird Response Experiment** * Tern/plover monitoring and habitat selection research * Aerial photo. protocol	* Lexington-Chapman * Annual census * Expect to detect change on annual basis starting in 2010 after initial PRRIP habitat acquisition & construction * 2010-2015	**Species and Habitat** * Annual ED Office analysis/reporting * Compare inter-annual trends

Draft Physical Processes CEM for CLEAR/LEVEL/PULSE– 5/31/05



NOTE: The lines illustrate priority hypothesized linkages; however, a complete set of hypothesized interactions is too complex to illustrate here.

Physical Processes Broad Hypotheses Flow-Sediment-Mechanical Approach	Big Question that addresses this Broad Hypothesis:
PP-1: Flows of varying magnitude, duration, frequency and rate of change affect the morphology and habitat quality of the river, including:	
• **Flows of 5,000 to 8,000 cfs magnitude in the habitat reach for a duration of three days at Overton on an annual or near-annual basis will build sand bars to an elevation suitable for least tern and piping plover habitat;**	**BQ #1**
• Flows of 5,000 to 8,000 cfs magnitude in the habitat reach for a duration of three days at Overton on an annual or near-annual basis will increase the average width of the vegetation-free channel;	**BQ#2**
• **Variations in flows of lesser magnitude will positively or negatively affect the sand bar habitat benefits for least terns and piping plovers.**	**BQ #1**

Physical Process Conceptual Ecological Model Hypotheses

Hypotheses support for Program conceptual ecological models and associated research and monitoring protocols/activities

Broad Hypotheses

Physical Process Hypothesis PP-1
Flows of varying magnitude, duration, frequency and rate of change affect the morphology and habitat quality of the river, including:

- Flows of 5,000 to 8,000 cfs magnitude in the habitat reach for a duration of three days oat Overton on an annual or near-annual basis will build sand bars to an elevation suitable for least tern and piping plover habitat;
- Flows of 5,000 to 8,000 cfs magnitude in the habitat reach for a duration of three days at Overton on an annual or near-annual basis will increase the average width of the vegetation-free channel;
- Variations in flows of lesser magnitude will positively or negatively affect the sand bar habitat benefits for least terns and piping plovers.

Physical Process Hypothesis PP-2
Between Lexington and Chapman, eliminating the sediment imbalance of approximately 400,000 tons annually in eroding reaches will:

- Reduce net erosion of the river bed;
- Increase the sustainability of a braided river;
- Contribute to channel widening;
- Shift the river over time into a relatively stable condition, in contrast to present conditions where reaches very longitudinally between degrading, aggrading, and stable conditions; and
- Reduce the potential for degradation in the north channel of Jeffrey Island resulting from headcuts.

Physical Process Hypothesis PP-3
Designed mechanical alterations off the channel at select locations can accelerate changes towards braided channel conditions and desired river habitat using techniques including:

- Mechanically cutting the banks and islands to widen the channel to a width sustainable by Program flows at the site, and distributing the material in the channel;
- At specific locations, narrowing the river corridor and increasing stream power by consolidating over 90 percent of river flow into one channel will accelerate the plan form change form anastomosed to braided, promoting wider channels and more sand bars;
- Clearing vegetation from banks and islands will help to increase the width-to-depth ratio of the river.

Physical Process Hypothesis PP-4
Higher water surface elevations resulting from raised river bed elevations can generate measurable increases in the elevation, extent, frequency, and/or duration of growing-season high water tables in wet meadows within 3,000 feet of the river.

Priority Hypotheses & Alternative/ Competing Hypotheses

Priority Hypothesis Flow 1
Increasing the variation between river stage at peak and average flows, by increasing the stage of the peak flow thorough Program flows, will increase the height of sand bars between Overton and Chapman by 30% to 50% from existing conditions

Priority Hypothesis Flow 3
Increasing 1.5-yr Q with Program flows will increase local boundary shear stress and frequency of inundation at green line. These changes will increase raise green line = more exposed sandbar area and wider main channel

Priority Hypothesis Flow 4
Annual riparian seedling mortality greater than 90% is required to prevent riparian encroachment on exposed bars, thereby increasing (maintaining at least 10 acres/mile) exposed bars between Overton and GI that are usable as LT and PP habitat

Priority Hypothesis Flow 5
Increasing magnitude and duration of a 1.5-year flow will increase riparian plant mortality along the margins of the river. There will be different relations for different species

Priority Hypothesis Sediment 1
Average sediment augmentation near Overton of 185,000 tons/year under existing flow regime and 225,000 tons/yr under GC proposed flow regime achieves a sediment balance to Kearney

Priority Hypothesis Sediment 2
A balanced sediment budget (sediment augmentation of 225,000 tons/year near Overton under proposed GC flows) when implemented with mechanical actions (channel consolidation & widening) in anastomosed reaches will promote braided channel morphology with an average braiding index in the main channel of greater than 3

Priority Hypothesis Sediment 3
Increasing the average braiding index of the main channel by achieving a balanced sediment budget, increases the active unvegetated width of the main channel at an index flow of 2,000 cfs (at Overton)

Priority Hypothesis Sediment 4
Increasing the average braiding index to greater than 3 for the main channel in the sediment deficient reach will increase and maintain exposed bar area greater than 1.5 acres in the reach between Overton and Kearney at an index flow of 1,2000 cfs (at Overton)

Priority Hypothesis Mechanical 2
Increasing the Q1.5 in the main channel by consolidating 85% of the flow, and aided by Program flow and a sediment balance, flows will exceed stream power thresholds that will convert main channel from meander morphology in anastomosed reaches, to braided morphology with an average braiding index > 3

Priority Hypothesis Mechanical 3
Reducing the number of channels in a transect to 3 or less under balanced sediment budget will convert anastomosed reaches of the Platte River between Overton and Chapman to a braided channel morphology. With proposed flow regime, should occur with greater number of channels

Priority Hypothesis Mechanical 4
Increasing the average braiding index to greater than 3 in the main channel by channel manipulation will promote at the mechanically changed sites a total main channel wetted width exceeding 500 to 750 ft at an index flow of 1,700 cfs

Priority Hypothesis Mechanical 5
Increasing the average braiding index to greater than 3 for the main channel by mechanical channel manipulation, will increase and maintain exposed bar area greater than 1.5 acres at mechanical changed sites an index flow of 1,200 cfs

Priority Hypothesis WM2
Wet meadow producing the optimum productivity and diversity of macro-invertebrates potentially consumed by WC exhibit certain characteristic combinations of soils, hydrology, size and location. Mormon Island and adjacent to Rowe have some of best combinations

Priority Hypothesis WM3
Shallow surface water and groundwater in March and April support high productivity and diversity of macro-inverts as potential food sources to WC in wet meadows

Priority Hypothesis WM4
A predominance of organic-rich soils supports the productivity and diversity of macro-inverts as potential WC food sources in bottomland grasslands

Priority Hypothesis WM8a
As the spring depth to groundwater increases, surface soils stay frozen longer. Where groundwater is closer to the surface, soils thaw sooner

Protocols & Activities & Hypotheses Links

Ref No. 1 (PP-1 to PP-3)
Monitoring the channel geomorphology of the central Platte River valley

Schedule: Monitoring will be conducted annually

Ref No. 2 (PP-1 to PP-3)
Monitoring the vegetation of the central Platte River valley

Schedule: Monitoring will be conducted annually

Ref No. 3 (PP-1 to PP-3)
Evaluate sediment erosion, transport, and deposition processes

Schedule: Research will begin once necessary lands are available and specific protocols can be written

Ref No. 4 (PP-1 to PP-3)
Evaluate in-channel vegetation dynamics

Schedule: Research will begin once necessary lands are available and specific protocols can be written

Ref No. 5 (PP-1 to PP-3)
Comprehensive geomorphic assessment from Lexington to Chapman, Nebraska

Schedule: Research will begin once necessary lands are available and specific protocols can be written

Ref No. 6 (PP-1 to PP-3)
Investigation of river restoration activities

Schedule: Research will begin once necessary lands are available and specific protocols can be written

Ref No. 7 (PP-1)
Protocol for Aerial Photography in the central Platte valley

Schedule: Photography began in 2000 and will continue annually as described in the protocol

Ref No. 8 (PP-1)
Protocol for GIS Analysis of Ortho-rectified CIR Photograph – with minimum land cover types as those included in 1998 analysis

Schedule: Analysis will occur near the end of the first increment

Ref No. 12 (PP-4)
Determine relationship of flows on creation/maint. Of habitat, predation, nest inundation, and distribution, abundance of and composition of prey base for LT and PP

Schedule: Analysis will occur near the end of the first increment

Ref No. 22 (PP-1)
Monitor changes in quantity, quality and distribution of WC migrational habitat over time.

Schedule: Analysis will occur near the end of the first increment

Ref No. 23 (PP-1)
Monitor WC migrational habitat use

Schedule: Monitoring annual during Program

Ref No. 28 (PP-4)
Determine relationships between river stage and wet meadow hydrology for WC habitat

Schedule: Analysis will occur when suitable wet meadow sites are protected or restored by Program

Ref No. 29 (PP-4)
Determine relationships between wet meadow hydrology and the physical, biological, and chemical composition of wet meadows for WC habitat

Schedule: Analysis will occur when suitable wet meadow sites are protected or restored by Program

Dark Gray = Immediate
Medium Gray = Follows Restoration on Program Lands
Light Gray = End of First Increment

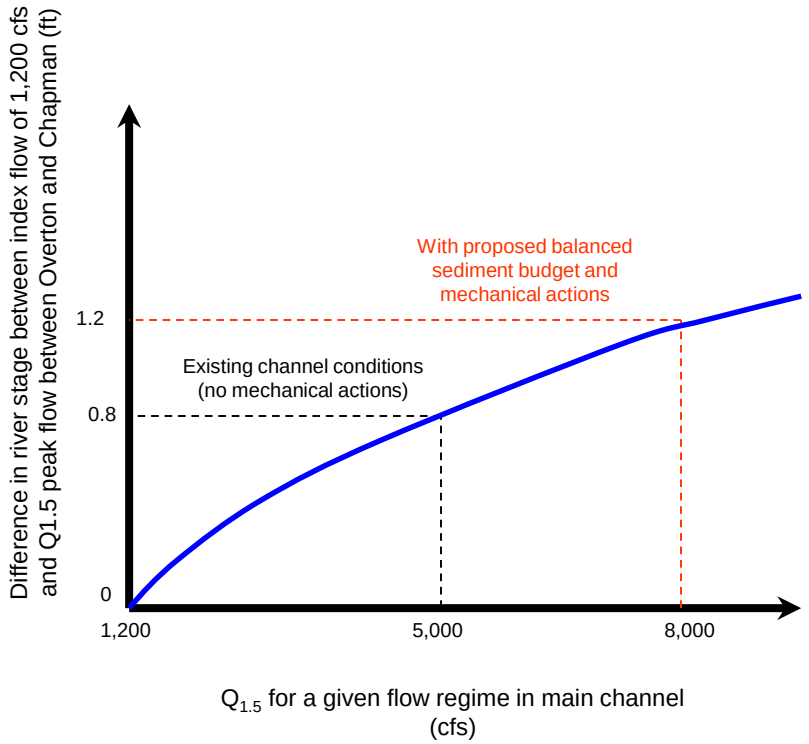
Table 09. Sequencing table for PRRIP priority hypotheses related to flow.

Priority Hypotheses	Detectability	Sensitivity	Feasibility	Priority	Sequence	Critical Path Comments
Flow #1: ↑ the variation between river stage at peak (indexed by Q1.5 flow @ Overton) and average flows (1,200 cfs index flow), by ↑ the stage of the peak (1.5-yr) flow through Program flows, will ↑ the height of sandbars between Overton and Chapman by 30% to 50% from existing conditions.	**High** Sandbar areal coverage can be measured; topographic documentation straight-forward	Medium to **High** Sandbars will respond to flow changes, but evaluation confounded by natural flow events	**High** SDHF will be implemented; data can be collected through system-scale monitoring and project-scale monitoring and/or research	**High**	**Tier 1** Assess annually through 2015	Fundamental FSM hypothesis to be investigated through FSM Proof of Concept experiment
Flow #3: ↑ 1.5-yr Q with Program flows will ↑ local boundary shear stress and frequency of inundation @ existing green line (elevation at which riparian vegetation can establish). These changes will ↑ riparian plan mortality along margins of channel, raising elevation of green line. Raised green line = more exposed sandbar area and wider unvegetated main channel.	**High** Vegetation and green line trends and changes can be easily measured; topographic documentation straight-forward	Medium to **High** Magnitude of SDHF may not provide clear data; natural flow events confound evaluation	**High** SDHF will be implemented; data can be collected through system-scale monitoring and project-scale monitoring and/or research	**High**	**Tier 1** Assess annually through 2015	Fundamental FSM hypothesis to be investigated through FSM Proof of Concept experiment
Flow #4: Annual riparian seedling mortality > 90% is required to prevent riparian encroachment on exposed bars, thereby ↑ (maintaining at least 10 acres/mile) exposed bars between Overton and Grand Island that are useable as LT and PP habitat.	Medium Can monitor seedling mortality	Low Confounding flow and physical process factors	Low Intensive data collection effort to document	Medium	Tier 2 Assess after Tier 1 hypotheses and developing linkages between flow, sediment, and vegetation impacts	Dependent on assessing other flow hypotheses first; can make inferences using multiple years of system-scale monitoring and project-scale research
Flow #5: ↑ magnitude and duration of a 1.5-yr flow will ↑ riparian plan	**High** Research and modeling should yield useful	**High** Research results paired with	**High** Research study design in place;	**High**	**Tier 1** Assess through Directed	Fundamental FSM hypothesis to be investigated through

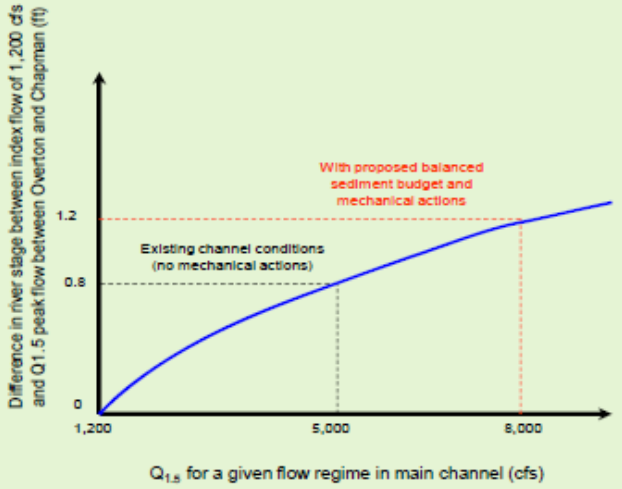
Table 12. PRRIP Tier 1 priority hypotheses for the Flow-Sediment-Mechanical management strategy. Table includes candidate performance measures, criteria, and data collection and analysis methodologies. CEM linkage numbers refer to arrows in PRRIP flow-sediment-mechanical conceptual ecological model.

Tier 1 Priority Hypothesis	CEM Linkages	Candidate Performance Measures	Decision Criteria	Experimental Design & Data Collection	Spatial/Temporal Scale	Data Analysis
AMP Management Objective – No specific management objectives or indicators identified; overall assessment of FSM management strategy; data will be compared against other aspects of experimental design (Bird Response Experiment) to relate to target species objectives						
Flow #1: ↑ the variation between river stage at peak (indexed by Q1.5 flow @ Overton) and average flows (1,200 cfs index flow), by ↑ the stage of the peak (1.5-yr) flow through Program flows, will ↑ the height of sandbars between Overton and Chapman by 30% to 50% from existing conditions. **Big Question #1**	TBD	* **Height of island bars** above 1,200 cfs index flow * **% ↑ in sand bar elevation** for flow > 7,000 cfs * **Sand bar height** vs. maximum water surface elevation	* 30-50% ↑ in sand bar elevation	**FSM Proof of Concept** * System-scale and project-scale monitoring	* Lexington-Chapman * Project-scale at Elm Creek, Cottonwood Ranch, and other potential sites * Expect to detect change on annual basis starting in 2011 after initial PRRIP habitat construction and SDHF (assuming appropriate change in water surface elevation) * Site-specific – 2010 through 2015 * System-level – First Increment	* Relating annual geomorphology monitoring to 1-D and 2-D modeling * Linkage between hydrology/hydraulics and bar height * Stratify based on channel form
Flow #3: ↑ 1.5-yr Q with Program flows will ↑ local boundary shear stress and frequency of inundation @ existing green line (elevation at which riparian vegetation can establish). These changes will ↑ riparian plan mortality along margins of channel, raising elevation of green line. Raised green line = more exposed sandbar area and wider unvegetated main channel. **Big Question #2**	TBD	* Change in **unvegetated channel width** (green line = lowest elevation with vegetation in the active channel) * Change in **unvegetated sand bar area**	* Cannot specify specific quantifiable decision criteria until actions implemented and analyzed to better understand physical process relationships	**FSM Proof of Concept** * System-scale and project-scale monitoring	* Lexington-Chapman * Project-scale at Elm Creek, Cottonwood Ranch, and other potential sites * Expect to detect change on annual basis starting in 2011 after initial PRRIP habitat construction and SDHF (assuming appropriate change in water surface elevation) * Site-specific – 2010 through 2015 * System-level – First Increment	* Relating annual geomorphology monitoring to 1-D and 2-D modeling * Linkage between hydrology/hydraulics and bar height * Stratify based on channel form
Flow #5: ↑ magnitude and duration of a 1.5-yr flow will ↑ riparian plan mortality along the margins of the river. There will be different relations (graphs) for **Big Question #2**	TBD	* Relationship between flow velocity and depth (**shear stress**) and **duration** to species- and	* Cannot specify specific quantifiable decision criteria until actions implemented and analyzed to	**FSM Proof of Concept** * Directed Vegetation Research Project	* Study sites between Lexington-Chapman TBD * Push for sites upstream and downstream * Data collection, flume	* Relate results from research to 1- and 2-D modeling

Flow 1: Increasing river stage variation will increase sand bar height



Increasing the variation between river stage at peak flow (indexed by $Q_{1.5}$ flow at Overton) and average flows (1,200 cfs index flow), by increasing the stage of the peak (1.5-yr) flow through Program flows, will increase the height of sand bars between Overton and Chapman by 30% to 50% from existing conditions, assuming balanced sediment budget.

PRRIP "Big Questions"	Priority Hypotheses	Alternative Hypotheses	X-Y Graphs
<u>Implementation</u> – Program Management Actions and Habitat			
1. Will implementation of SDHF produce suitable tern and plover riverine nesting habitat on an annual or near-annual basis?	**Flow #1:** ↑ the variation between river stage at peak (indexed by Q1.5 flow @ Overton) and average flows (1,200 cfs index flow), by ↑ the stage of the peak (1.5-yr) flow through Program flows, will ↑ the height of sandbars between Overton and Chapman by 30% to 50% from existing conditions.	Flow magnitudes and channel compilations are insufficient to generate bars high enough to provide habitat for ILT and PP. Bars may become quickly vegetated, making them poor habitat for target species. Bars can be created or maintained by mechanical or other means.	Flow 1: Increasing river stage variation will increase sand bar height  Increasing the variation between river stage at peak flow (indexed by $Q_{1.5}$ flow at Overton) and average flows (1,200 cfs index flow), by increasing the stage of the peak (1.5-yr) flow through Program flows, will increase the height of sand bars between Overton and Chapman by 30% to 50% from existing conditions, assuming balanced sediment budget.

PRRIP Management Strategies

Flow-Sediment-Mechanical (FSM)
"Clear/Level/Pulse"

Mechanical Creation & Maintenance (MCM)
"Clear/Level/Plow"

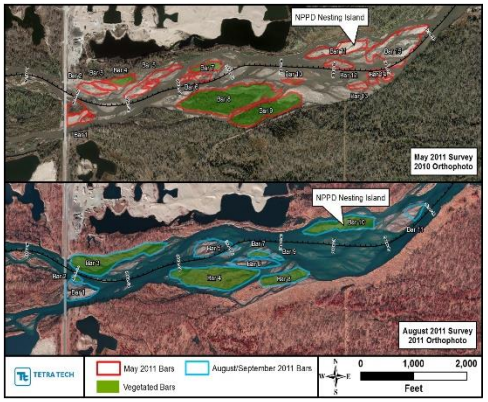
Implementation

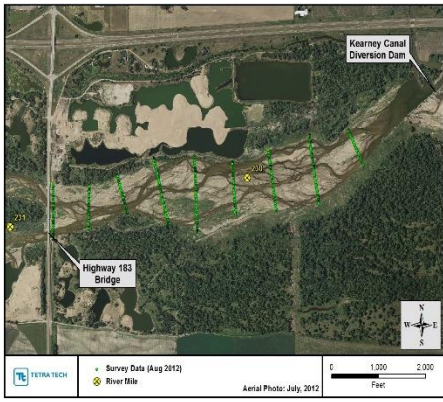
- Tern and plover AMP implementation during the period of 2007-2014 focused on: 1) testing of hypotheses related to ability of FSM management strategy to create and/or maintain suitable tern and plover nesting habitat, and 2) construction and monitoring of on and off-channel MCM nesting habitat as directed in the AMP to evaluate selection and productivity.

- The Program implemented both on- and off-channel mechanical habitat during the First Increment of the Program. Implementation and species response information has been provided to the GC (resource allocation memorandum).

Monitoring Data

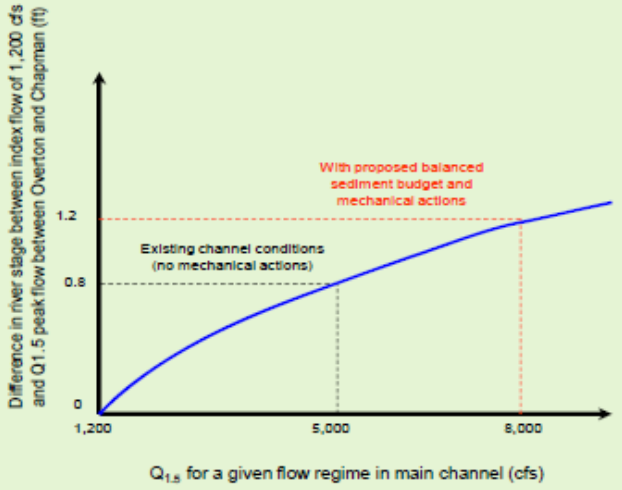
Effort	Frequency	Description
Least Tern and Piping Plover Use and Productivity Monitoring	Annual	Document species use, habitat variables and productivity in the AHR.
Least Tern and Piping Plover Habitat Availability Analysis	Annual	Document occurrence and amount of habitat in AHR meeting minimum species habitat suitability criteria.
Discharge Measurements	Real-time	Real-time Platte River discharge monitoring at six locations in the AHR. Stream gaging conducted in cooperation with the USGS and Nebraska Department of Natural Resources
June Color-Infrared Imagery	Annual	Document in-channel and off-channel habitat conditions during least tern and piping plover nest initiation period.
November Color-Infrared Imagery and Light Detection and Ranging	Annual	Document channel morphology and topography under leaf-off and low discharge conditions.
System-Scale Geomorphology and Vegetation Monitoring	Annual	Monitor sediment transport, channel morphology and in-channel vegetation throughout the AHR. Data include bed and suspended sediment load measurements, repeat channel transect surveys, bed and bank material sampling, and vegetation monitoring.
HEC-GeoRAS Hydraulic Model of AHR	As Necessary	Segment-scale hydraulic model for evaluation of channel hydraulics and development of water surface profiles across a range of discharges.





Synthesis

- Pulled together multiple lines of evidence regarding terns/plover productivity and relationship to flow
- Six “chapters” compiled into a single document
- Extensive review by Technical Advisory Committee and Independent Scientific Advisory Committee
- Utilized internal Program peer review process
- Data utilized to make definitive assessment of Big Question #1

PRRIP "Big Questions"	Priority Hypotheses	Alternative Hypotheses	X-Y Graphs
Implementation – Program Management Actions and Habitat			
NO 1. **Will implementation of SDHF produce suitable tern and plover riverine nesting habitat on an annual or near-annual basis?**	**Rejected** **Flow #1:** ↑ the variation between river stage at peak (indexed by Q1.5 flow @ Overton) and average flows (1,200 cfs index flow), by ↑ the stage of the peak (1.5-yr) flow through Program flows, will ↑ the height of sandbars between Overton and Chapman by 30% to 50% from existing conditions.	**Affirmed (2 out of 3)** Flow magnitudes and channel compilations are insufficient to generate bars high enough to provide habitat for ILT and PP. Bars may become quickly vegetated, making them poor habitat for target species. Bars can be created or maintained by mechanical or other means.	Flow 1: Increasing river stage variation will increase sand bar height  Increasing the variation between river stage at peak flow (indexed by $Q_{1.5}$ flow at Overton) and average flows (1,200 cfs index flow), by increasing the stage of the peak (1.5-yr) flow through Program flows, will increase the height of sand bars between Overton and Chapman by 30% to 50% from existing conditions, assuming balanced sediment budget.

Big Question #1 Assessment

- “Two thumbs down” assessment based on peer-reviewed tern/plover chapters:
  - Assessment supported by ISAC
  - General support from TAC
  - GC accepted final peer reviewed chapters

- GC approved motion of support for “two thumbs down” assessment at June 2015 GC meeting

- Directed EDO to work with ISAC and TAC to recommend next steps

Big Question #1 – Getting to "Adjust"

- The MCM management strategy includes two management actions to create tern and plover nesting habitat. The first is management of off-channel sandpit habitat (Section IV.B.2.a) and the second is creation and maintenance of mechanical in-channel nesting islands (Section IV.B.2.b). These two management actions are the de facto **"adjust" alternatives**.

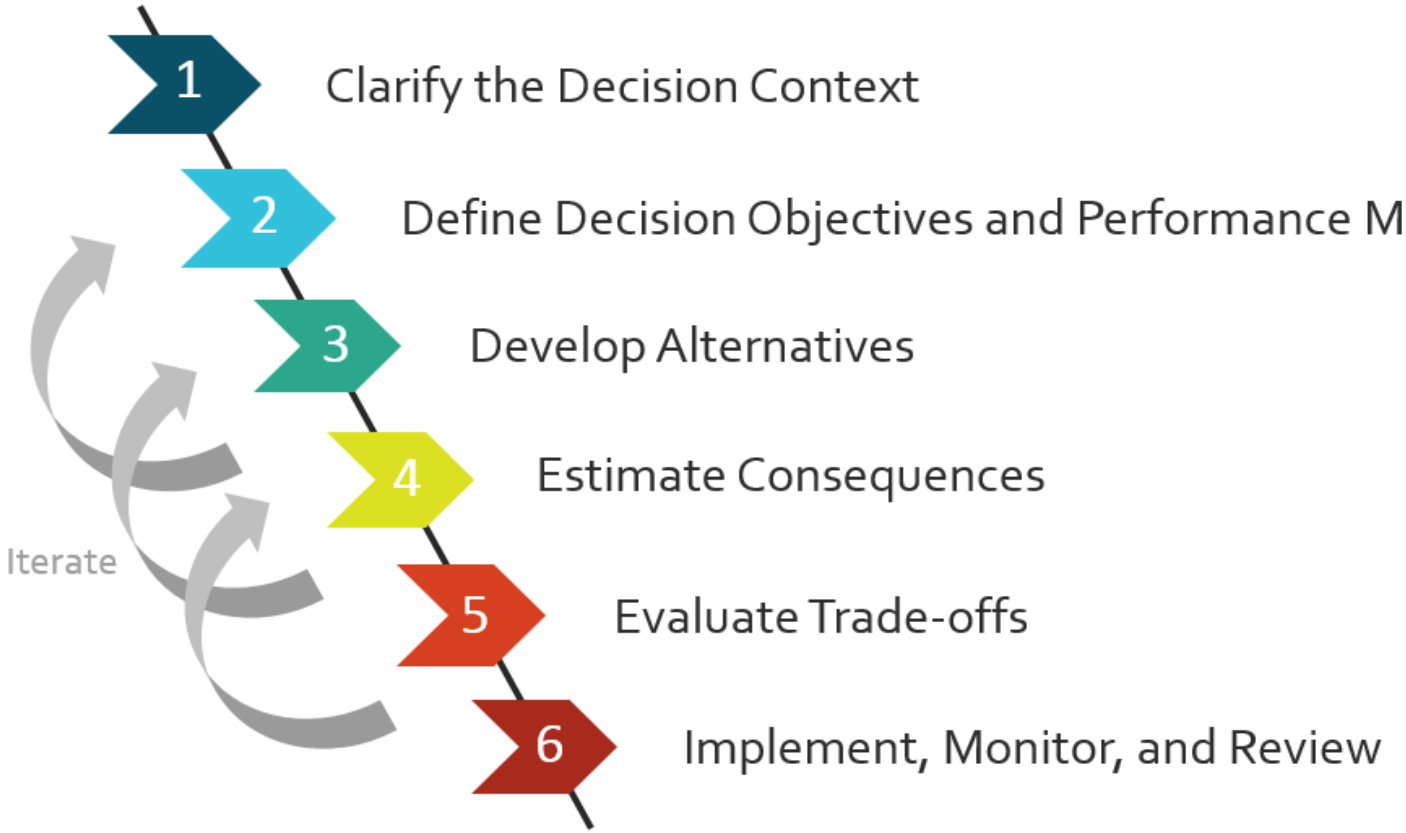
- **Adjust =** how much and what mix of these types of mechanical habitats. This decision has to be made by the GC. Should be based on objectives for the remainder of the First Increment and beyond. Could include:
  - Breeding pairs / fledge ratios
  - Location (spatially and/or on-/vs. off-channel
  - Cost
  - Water Resources
  - Ability to learn – remaining uncertainties (fledge ratios and/or preference)

- **Structured Decision Making** (SDM) provides a rigorous process to address these decisions.

Structured Decision Making (SDM) – What is it?

Definition – Collaborative and facilitated application of multiple objective decision making and group deliberation methods

Goal – Clarify possible actions and their implications across a range of relevant concerns



Structured Decision Making steps (Compass)

Why are we talking about SDM?

- Have been thinking about a rigorous way of getting to “adjust” in AM
- GC guidance to engage the TAC and ISAC in recommending a path forward
- ISAC recommended engaging in a more rigorous process
- EDO sought out guidance and training from Compass Resource Management (Compass) in Vancouver, Canada – working on the Missouri River (familiar with people, species, and issues), other river systems

ISAC guidance on SDM – 2013 and 2014

- "…the best possible use of Program resources within the First Increment is to assess what combinations of actions (flow, sediment, mechanical) are likely to be most *effective* in achieving Program goals and objectives within currently available amounts of land and water, rather than focusing only on tools for determining target flows."

- "This assessment should be accomplished through structured decision analysis…such decision analysis would explore a range of alternative combinations of actions, including changing the frequency, magnitude, timing, and location of interacting flows, sediment, and mechanical actions."

ISAC guidance on SDM – August 2015

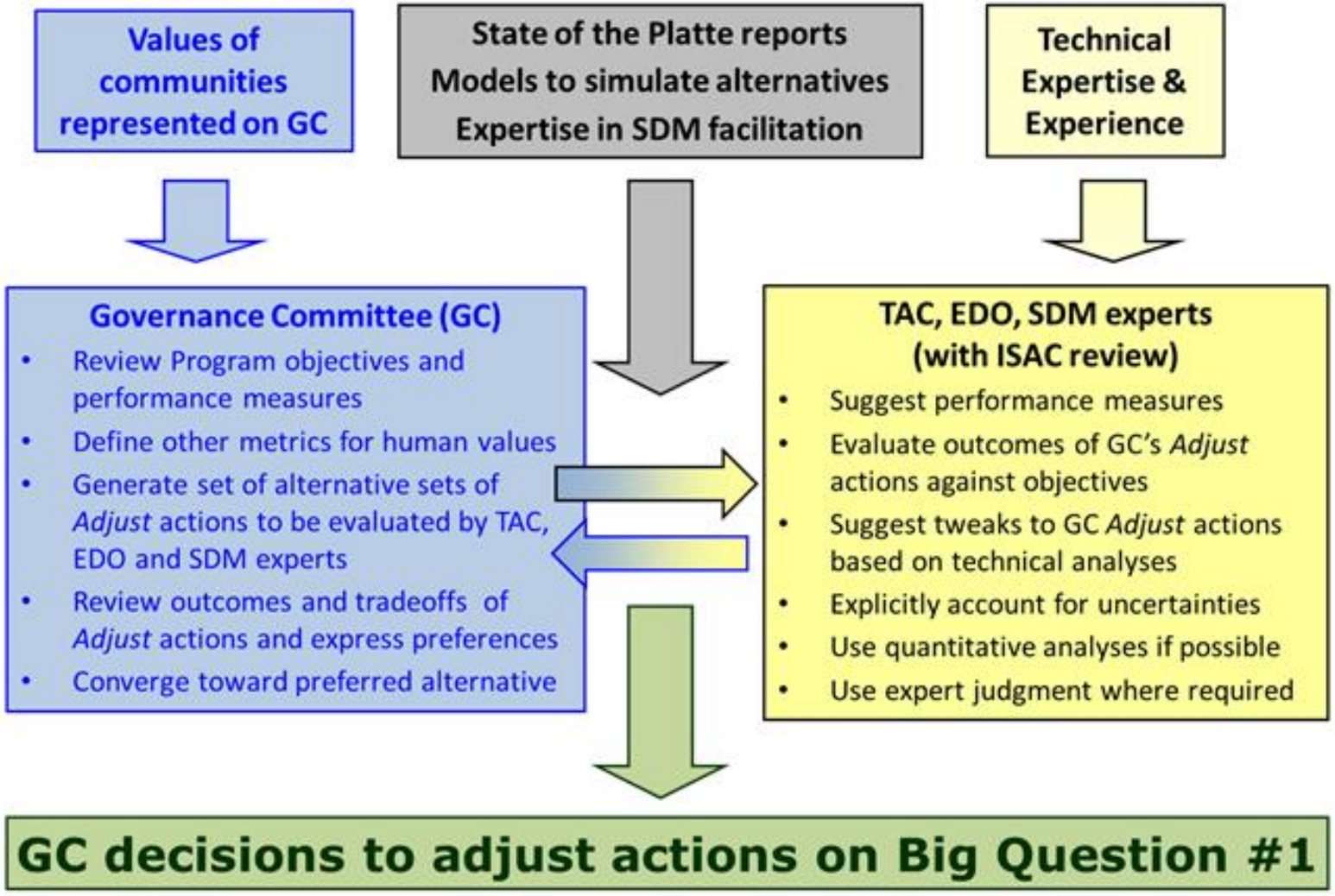
- "We concur with the EDO recommendation to use Structured Decision Making to assist the GC with the adjust step of the AM cycle for Big Question #1."

- "The ISAC endorses the EDO's proposed process, use of outside experts and schedule."

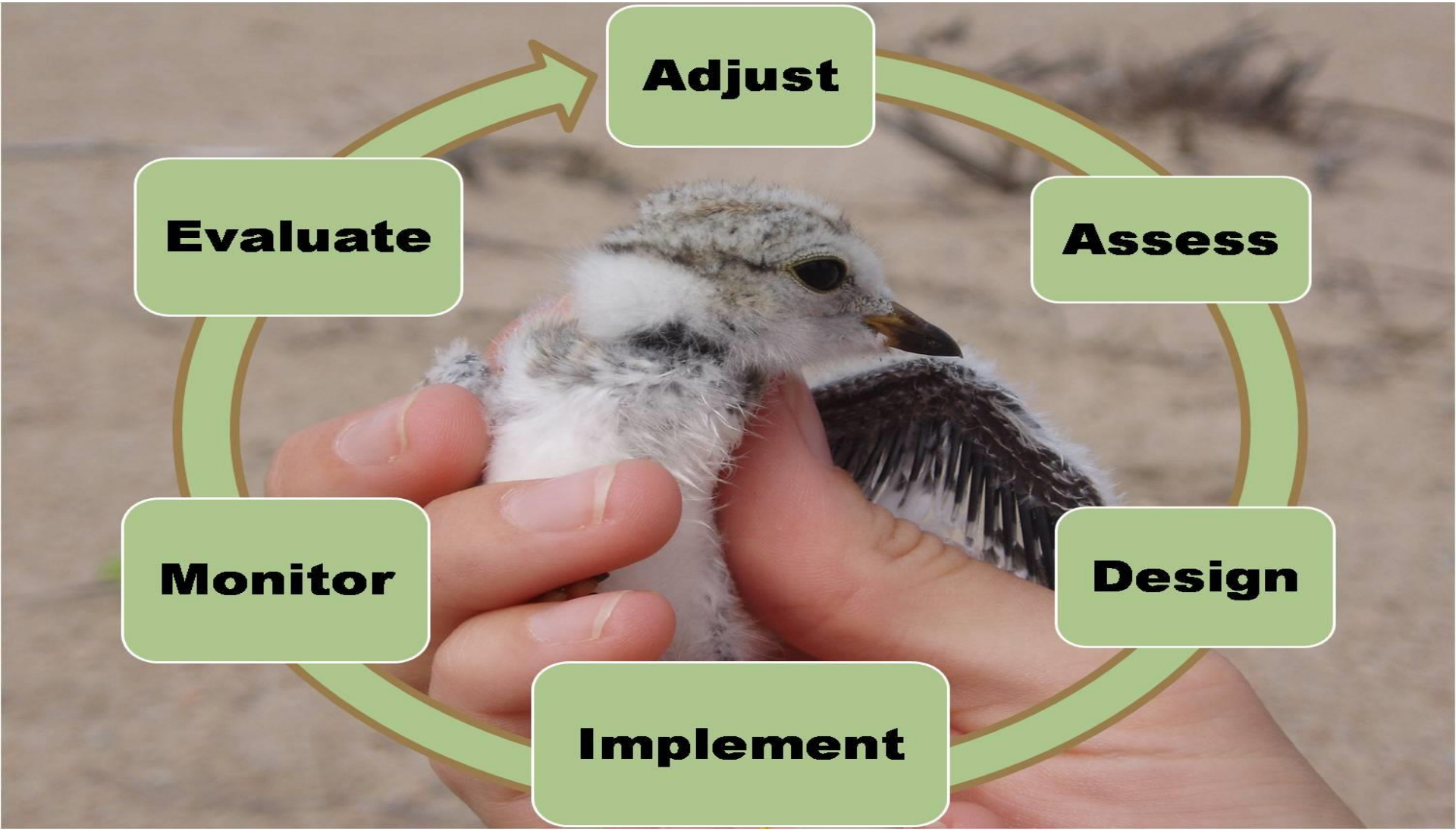
- "It's a good idea to have a test application of this structured process on Big Question #1, to figure out the process of adjustment in the AM cycle, and inform the GC on how this process works, recognizing that decisions on allocation of water and other resources for one big question could affect decisions on other big questions."

- "It's critical that the GC be involved in reviewing existing Program objectives and performance measures, adding other metrics as required related to human values, and that the GC be involved in proposing management alternatives, as well as in evaluating those alternatives (see recommended roles Figure 1)."

ISAC guidance on SDM – August 2015

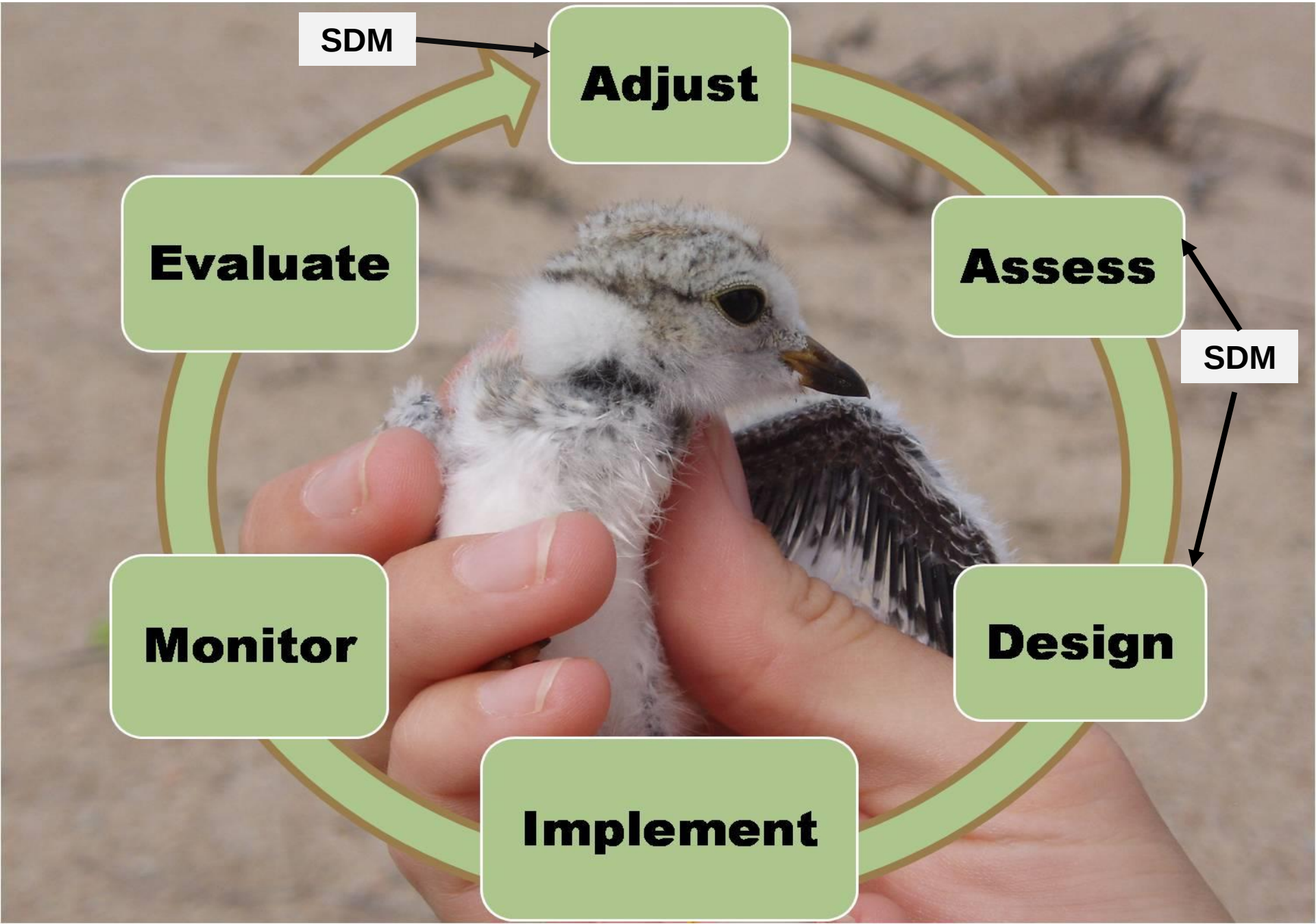


Adaptive Management (AM) – What is it?



Rigorous approach for designing and implementing **management actions** to maximize learning about **critical uncertainties** that affect **decisions**, while simultaneously striving to meet multiple management objectives.

AM and SDM

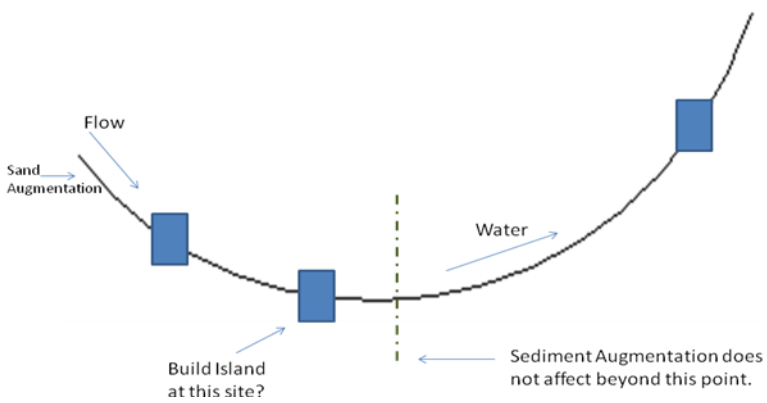


Haven’t we tried SDM before?

PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM
Structured Decision Making Workshop Final Report

Rapid Prototypes for Implementation of Adaptive Management Plan (AMP)
July 21-24, 2008
Headwaters Corporation/Program Conference Center, Kearney, NE

Authors: Drew Tyre, Jamie McFadden, Andrew Furman, Felipe Chavez-Ramirez, Mark Czaplewski, Mike Drain, Jason Farnsworth, Lisa Fotherby, Jim Jenniges, Chad Smith, Kevin Urie, Greg Wingfield



The following questions were raised during the discussion of which problem to focus on:
•Is the Cook property going to be acquired by the Program and used as a test site? Is the Cook property the only test site?
•Should we clear phragmites and other invasives before implementation of the adaptive management plan?
•Given water constraints, how can FSM be tested? And in terms of nesting habitat?
•What is the best statistical and detection design for habitat use, bird monitoring, etc.?
•Over the next 13 years, what is the best testing method between FSM and Mechanical?
•Will birds respond to any action?
•What is the schedule of water release and how do we obligate this limited resource with all its constraints?
•What is the best array of land use configurations at one site? (Single large sandbar or several small sandbars – SLOSS debate in miniature).
In response to the above questions, and after significant discussion, one problem was selected:

“Over 11 years, given water constraints and ‘N’ sites (Program lands), how can we best detect the differences between FSM and Mechanical?” (See Figure 1).

Figure 1: The above figure displays a suggested logistic plan for testing FSM and Mechanical on a given section of river with N sites. Here there are three research sites experiencing various combinations of actions.

SDM process for PRRIP

- EDO leads, expert assistance with independent facilitation, process guidance, and technical guidance (Compass as Special Advisor)
- Engage GC – develop objectives, performance measures, alternatives; workshop to evaluate consequences and trade-offs, evaluate management alternatives, decide on path forward
- Engage TAC – refine conceptual models and Excel model; technical guidance on performance measures and alternatives; in put on consequences and trade-offs
- Conceptual models – build on existing Program management models, Missouri River models (tern and plover)
- Excel model – input for Program data, TAC helps to refine

Tentative SDM work plan

Sept 2015: EDO provides introduction to SDM at GC meeting.

Oct. 13-14, 2015: If ISAC, TAC, and GC support further exploration of SDM, Compass (Lee) goes to AMP Reporting Session in Denver to do an overview of SDM and the Red Truck example.

Nov/Dec 2015: Work with GC to develop objectives, performance measures, alternatives.

January to May 2016: Work with TAC to populate a consequence table.

March 2016: Check-in point with GC.

June 2016: 1-day GC workshop (over afternoon and morning of next day) to evaluate consequence table and evaluate trade-offs.

What do we hope to get out of SDM?

- GC and TAC engaged in more formal process of evaluating decisions (management choices)
- Options for implementing different management actions as “experiments” to learn
- Help complete one full cycle of adaptive management regarding BQ#1
- Better understanding of utility of SDM tool for the Assess and Design steps of AM in an extended First Increment or new Second Increment

Big Question #9 Assessment

9. Do Program flow management actions in the central Platte River avoid adverse impacts to pallid sturgeon in the lower Platte River?

How does this Big Question relate to Program priority hypotheses?

It is hypothesized that Program water management actions, such as diverting excess to target flows for retimed release, will result in a measurable change in stage in the lower Platte River and thus affect pallid sturgeon habitat suitability.[1]

2014 Assessment for BQ #9:

- Stage change study analyses concluded relative change in habitat due to Program water management activities would be very small to undetectable and thus these changes should not provide additional stress to the pallid sturgeon population.
- The greatest potential for negative habitat impacts would occur when lower Platte River discharges are low (4,000 – 6,000 cfs) but central Platte River discharges are high enough that flow could be diverted into storage for retiming. Since 1954, these conditions occurred one time during the spring for two consecutive days and 37 times during the fall with 26 of the instances lasting three consecutive days or less. Impacts can be avoided through development of operational rules that prohibit Program diversions when lower Platte River discharges fall below 4,000 cfs.

[1] This is a re-statement of Priority Hypothesis PS2 in the Adaptive Management Plan, which suggests that Program water management actions in the central Platte River will result in measurable changes in lower Platte River flow.

AMP Management Objectives

1) Improve production of Least Tern and Piping Plover from the central Platte River.

a) Increase number of fledged tern and plover chicks

i) Increase nesting pairs (indicator is nesting pairs)

ii) Increase fledge ratios (indicator is chicks successfully produced per unit adult, nest or pair) and reduce chick mortality from causes such as flooding, predation, weather, inadequate forage.

b) Reduce adult mortality

i) Reduce predation (indicator is nesting pairs)

2) ~~Improve~~ (Contribute to) survival of Whooping Cranes during migration.

a) Increase availability of whooping crane migration habitat along the central Platte River (indicators are the area of suitable roosting habitat, area of suitable foraging habitat, proportion of population, crane use days, etc.).

3) Avoid adverse impacts from Program actions on pallid sturgeon populations.

a) Indicators have not been identified as more research is needed to determine what potential indicators the Program may affect.

4) Within overall objectives 1-3, provide benefits to non-target listed species and non-listed species of concern and reduce the likelihood of future listing.

a) Increase availability of habitats for these species (Land Plan “other species of concern”) along the central Platte River (indicators are species occurrence, Land Plan Tables 1 and 2 characteristics).

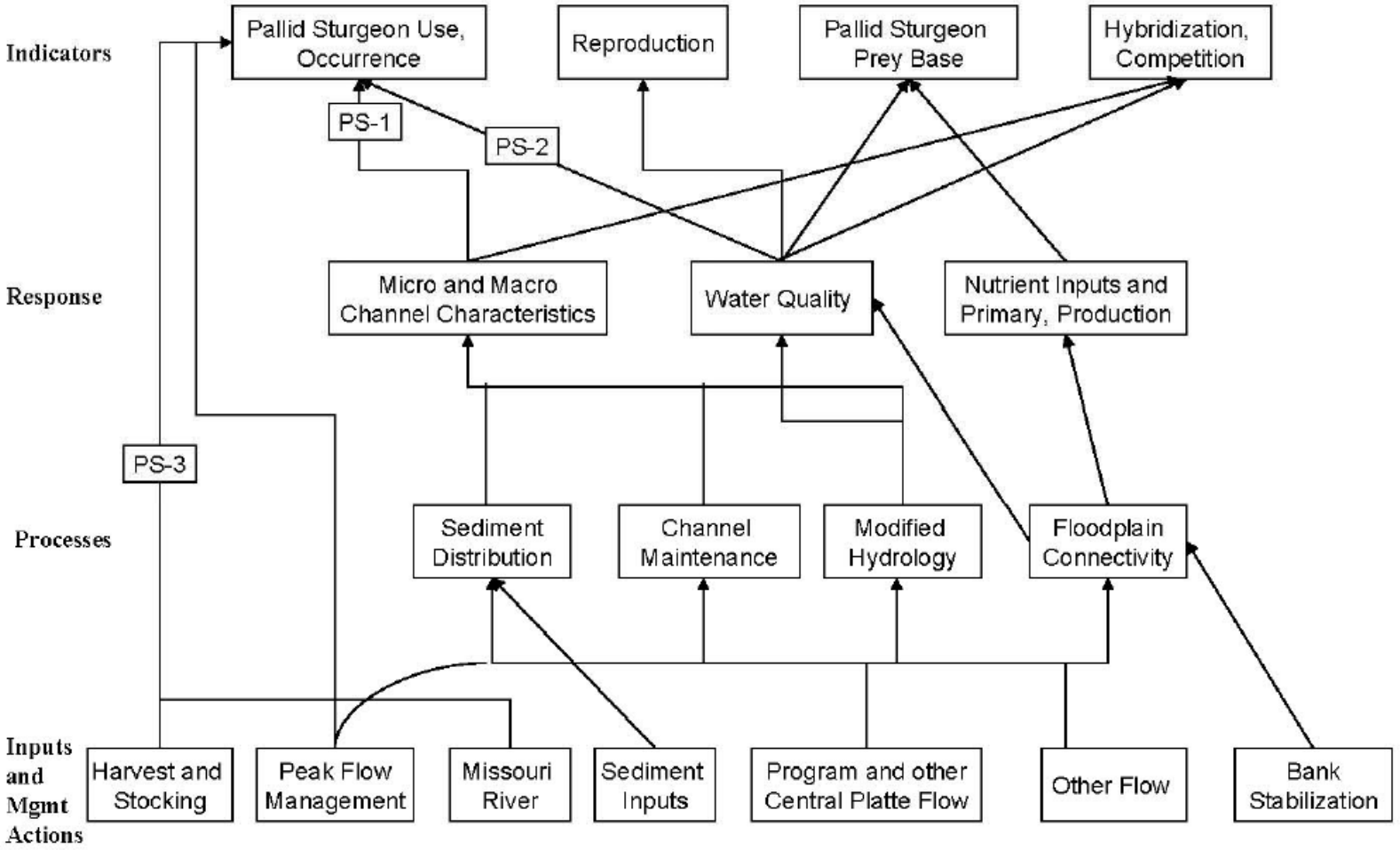


Figure 7. Pallid sturgeon conceptual ecological model (including example locations for current hypotheses).

Pallid Sturgeon Broad Hypotheses	Big Question that addresses this Broad Hypothesis:
PS-1: Current habitat in the lower Platte River is/is not suitable for adult and juvenile pallid sturgeon.	Not being addressed
PS-2: Water related activities above the Loup River do/do not impact pallid sturgeon habitat.	**BQ #9**
PS-3: Non-Program actions (e.g., harvest, stocking, Missouri River conditions) determine the occurrence of pallid sturgeon the lower Platte River	Not being addressed

PS-2	PS-2	Program water management will result in measurable changes on flow in the lower Platte River.	Program water management will result in statistically insignificant changes on flow in the lower Platte River	Influences Program management and Program goals and objectives

Pallid Sturgeon Conceptual Ecological Model Hypothesis

Hypotheses support for Program conceptual ecological models and associated research and monitoring protocols/activities

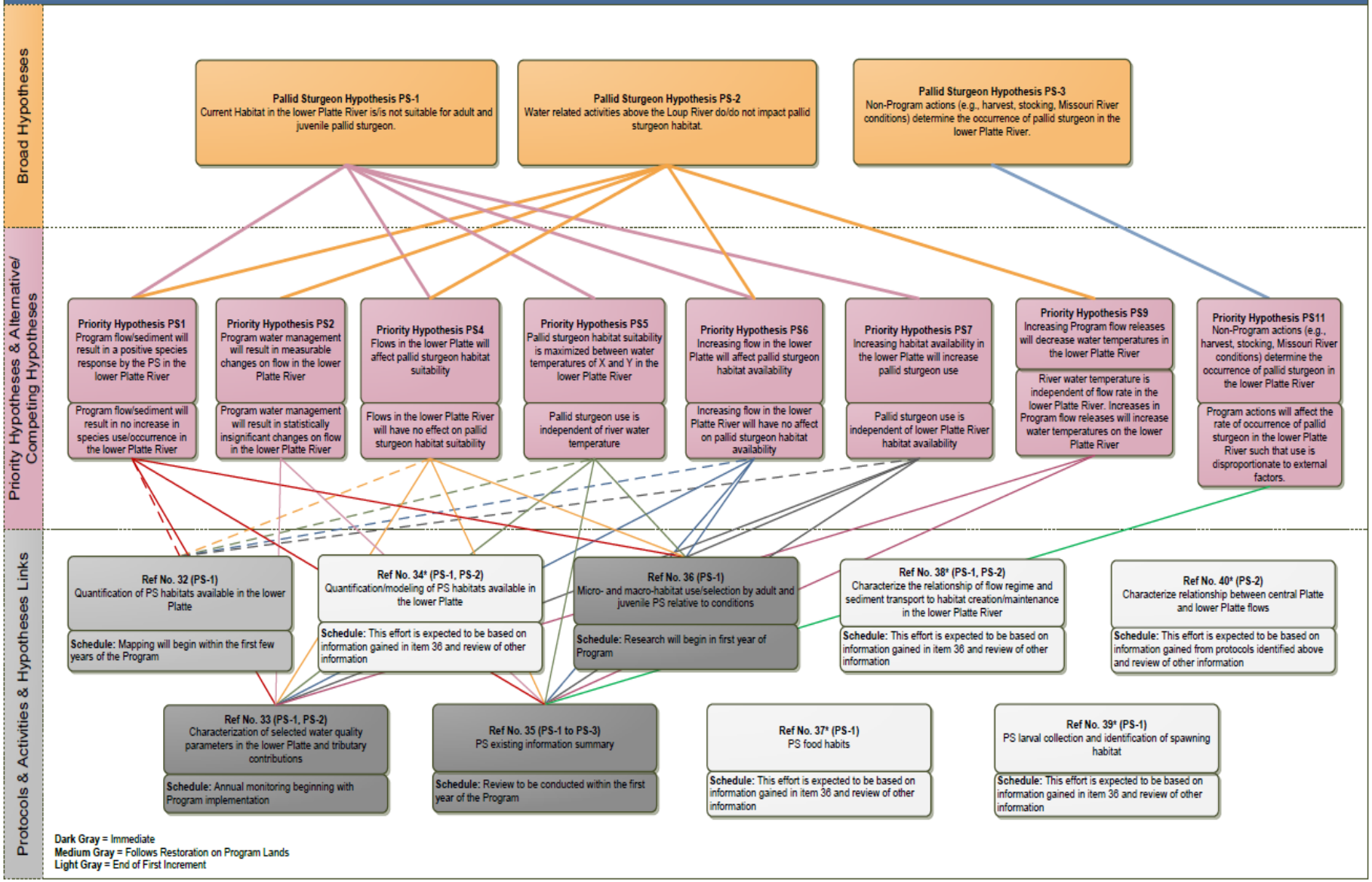


Table 03. DRAFT sequencing table for PRRIP priority hypotheses related to pallid sturgeon.

Priority Hypotheses	Detectability	Sensitivity	Feasibility	Priority	Sequence	Critical Path Comments
PS-1: Program flow/sediment mgmt. will result in a + species response by pallid sturgeon in the lower Platte River.	Low Low population numbers and low translation of Program flow and sediment to lower Platte make detection difficult	Low Low ability to structure analysis to see pop. responses to flow and sed changes	Low Requires spatially and temporally intensive monitoring	Low	Tier 3 Only assess after all Tier 1 and 2 hypotheses	
PS-2: Program water management will result in measurable changes on flow in the lower Platte River.	Medium Tool developed but central Platte flow largely attenuated	**High** Can use tool to evaluate impacts on PRRIP water mgmt.	**High** Study complete and tool developed	**High**	Tier 1 Quantify through Stage Change Study by 2010	Stage change study complete; consider extending spatial scale of study to Loup River confluence and defining additional "worse case scenarios" for analysis
PS-4: Flows in the lower Platte will affect pallid sturgeon habitat suitability.	Medium Proper sampling effort should yield useful data	Medium Experience on Missouri suggests telemetry will work with low #s	**High** Partner with Missouri River agencies to maximize effort and technology	**High**	Tier 1 Assess through habitat selection research; continue through at least 2015	High priority, but low population numbers and large expanse of lower Platte will make this research difficult and expensive
PS-5: Pallid sturgeon habitat suitability is maximized between water temperatures of X and Y in the lower Platte River.	Low Low populations numbers make detection difficult	Medium Could bound habitat use with water temperature	Low Would require spatially and temporally intensive monitoring	Low	Tier 3 Only assess after all Tier 1 and 2 hypotheses	Not feasible unless and until habitat selection research complete; need to include specific measurement of water quality as a variable
PS-6: ↑ flow in the lower Platte will affect pallid sturgeon habitat availability.	Medium Once habitat defined could use stage change study model to evaluate	Medium Tool sensitive to habitat changes over range of flows	Medium Once habitat defined could use stage change tool to evaluate	Medium	Tier 2 Assess after Tier 1 hypotheses	Not feasible unless and until habitat selection research complete
PS-7: ↑ habitat availability in the lower Platte will ↑ pallid sturgeon use.	Medium Small population can be monitored for use	Low Many confounding factors	Low Requires spatially and temporally intensive monitoring	Low	Tier 3 Only assess after all Tier 1 and 2 hypotheses	
PS-9: ↑ Program flow releases will ↓ water temperatures in the lower Platte River.	Low Attenuation and trib inflow make PRRIP water difficult to detect	Low Many confounding factors	Low Requires spatially and temporally intensive monit.	Low	Tier 3 Only assess after all Tier 1 and 2 hypotheses	
PS-11: Non-Program actions (e.g. harvest, stocking, Missouri River conditions) determine the occurrence of pallid sturgeon in the lower Platte River.	Low Too many confounding factors	Low Difficult to assess which factors are controlling	Low Would require substantial effort to develop analysis methodology	Low	Tier 3 Only assess after all Tier 1 and 2 hypotheses	

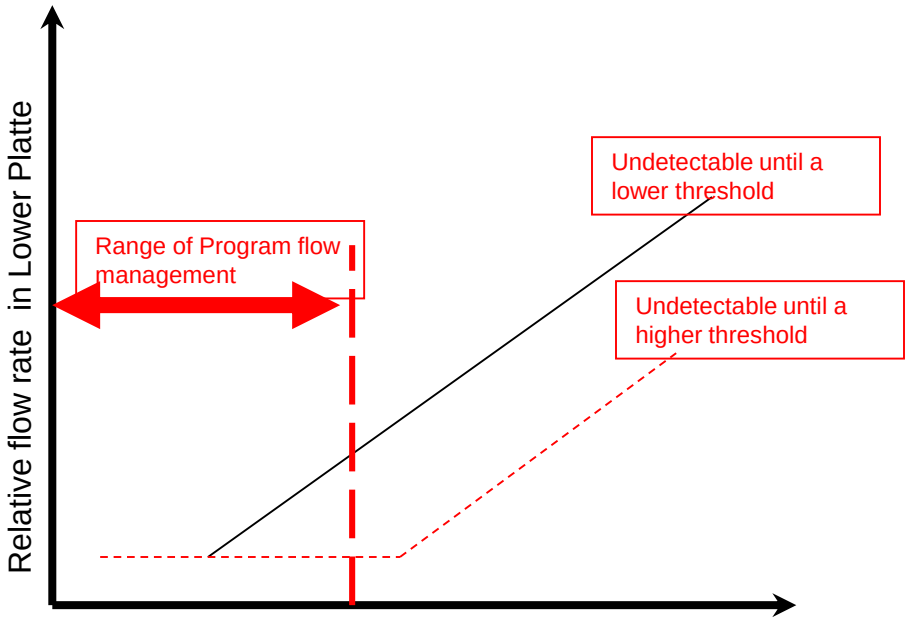
Table 04. PRRIP Tier 1 priority hypotheses for pallid sturgeon. Table includes candidate performance measures, criteria, and data collection and analysis methodologies. CEM linkage numbers refer to arrows in PRRIP pallid sturgeon conceptual ecological model.

Tier 1 Priority Hypothesis	CEM Linkages	Candidate Performance Measures	Decision Criteria	Experimental Design & Data Collection	Spatial/Temporal Scale	Data Analysis
AMP Management Objective #3 – Avoid adverse impacts from Program action on pallid sturgeon populations. a) Indicators have not been identified as more research is needed to determine what potential indicators the Program may affect.						
PS-2: Program water management will result in measurable changes on flow in the lower Platte River.	TBD	* **Water depth and velocity** between 3,700-40,000 cfs * **% of Program water** reaching Louisville * **Changes in habitat classifications** between 3,700-40,000 cfs * **# of days** below 4,000 cfs @ Louisville * **Range of flows** below 4,000 cfs @ Louisville * **Number of consecutive days** below 4,000 cfs @ Louisville	* ↑ **in spring (Feb-Jul) lower Platte River flow rates**	* Not part of experimental design – "Do No Harm" objective with no action specified in lower Platte * Hypotheses evaluated through Lower Platte River Stage Change Study, completed in 2009	* Study reach near Louisville, NE * Need to determine if study reach is characteristic of lower Platte associated habitat (Elkhorn River confluence to Missouri River confluence)	* Contractor (HDR) conducted field surveys, hydrologic analysis, and modeling * Stage change study evaluated potential for Program water management activities to influence lower Platte River flows and habitat classifications
PS-4: Flows in the lower Platte will affect pallid sturgeon habitat suitability.	TBD	* Pallid sturgeon use and occurrence	* ↑**in connectivity and prevalence of habitat**	* Not part of experimental design – "Do No Harm" objective with no action specified in lower Platte * Determine need for, scale, and scope of habitat sel. research in 2010	* Associated habitat	TBD

Big Question #9

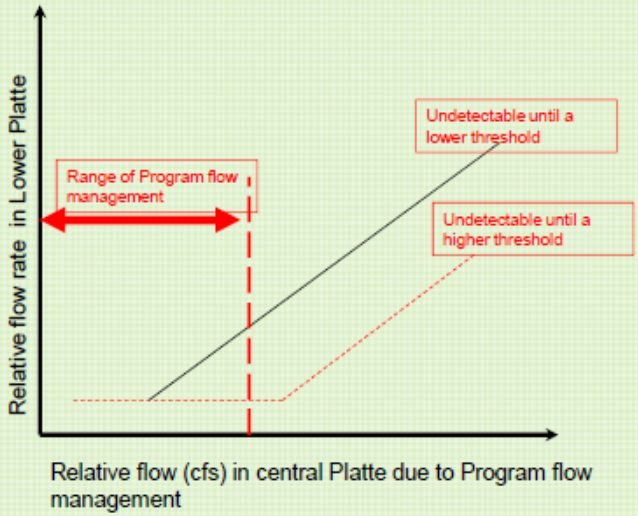
Not being addressed

PS 2: Program water management will result in measurable changes on flow in the lower Platte River.



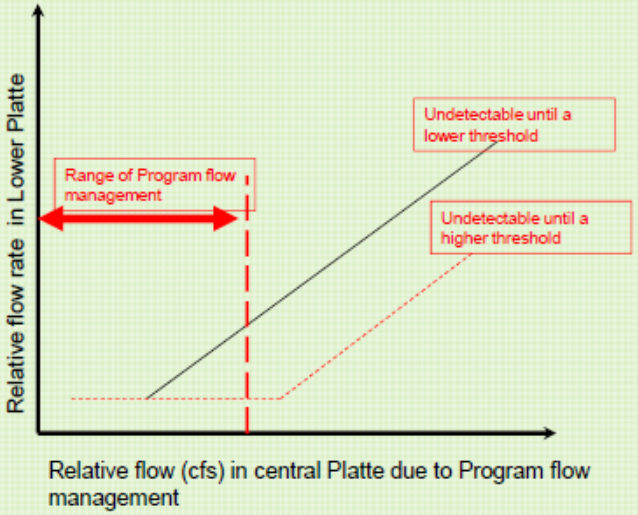
Program flow management results in measurable change in the lower Platte flows. The probability of detecting flow changes in the lower Platte as a result of Program water management activities (e.g., new depletions plans, summer flow augmentation) is improbable.

Program pulse flow management will have the greatest chance of resulting in measurable changes in the lower Platte.

PRRIP "Big Questions"	Priority Hypotheses	Alternative Hypotheses	X-Y Graphs
<u>Effectiveness</u> – Habitat and Target Species Response			
9. Do Program flow management actions in the central Platte River avoid adverse impacts to pallid sturgeon in the lower Platte River?	**<u>PS2</u>**: Program water management will result in measurable changes on flow in the lower Platte River.	Program water management will result in statistically insignificant changes on flow in the lower Platte River.	PS 2: Program water management will result in measurable changes on flow in the lower Platte River.  Program flow management results in measurable change in the lower Platte flows. The probability of detecting flow changes in the lower Platte as a result of Program water management activities (e.g., new depletions plans, summer flow augmentation) is improbable. Program pulse flow management will have the greatest chance of resulting in measurable changes in the lower Platte.

Implementation

- Stage change study – completed in 2011; peer review accepted by GG in June 2012
- Pallid sturgeon literature review – 2009
- Lower Platte River water quality monitoring – 2008-2012

PRRIP "Big Questions"	Priority Hypotheses	Alternative Hypotheses	X-Y Graphs
Effectiveness – Habitat and Target Species Response			
NO 9. **Do Program flow management actions in the central Platte River avoid adverse impacts to pallid sturgeon in the lower Platte River?**	**Rejected** **PS2**: Program water management will result in measurable changes on flow in the lower Platte River.	**Affirmed** Program water management will result in statistically insignificant changes on flow in the lower Platte River.	PS 2: Program water management will result in measurable changes on flow in the lower Platte River.  Program flow management results in measurable change in the lower Platte flows. The probability of detecting flow changes in the lower Platte as a result of Program water management activities (e.g., new depletions plans, summer flow augmentation) is improbable. Program pulse flow management will have the greatest chance of resulting in measurable changes in the lower Platte.

Big Question #9 Assessment

- "Two thumbs up" assessment based on peer-reviewed stage change study:
  - Assessment language generally the same since 2012 State of the Platte Report

- GC discussion of "two thumbs up" assessment at September GC meeting

BQ#9 – Getting to "Adjust"
ISAC Recommendations – August 2015

- "To address the new information on pallid sturgeon we recommend that the Program repeat its "Alternative Analysis of Program Activities" (Appendix G in HDR et al. 2009) to determine if Program flow management actions also yield minimal predicted effects on water physical and chemical conditions in the Elkhorn to Loup segment of the Lower Platte River."

    - ***EDO response**: The lower Platte River Associated Habitat Reach is defined as being from the mouth of the Elkhorn River down to the mouth of the Platte River where it joins the Missouri River near Plattsmouth, NE. Any Program activity above the mouth of the Elkhorn River would have to be directed by the Governance Committee.*

- "The ISAC recommends that the Program formulate an operational rule that would be applied to the operation of the J2 reservoir. Provided that such a rule is put in place by the Program to protect the habitat of pallid sturgeon, then the ISAC supports the conclusion of two thumbs up on Big Question #9."

    - ***EDO response**: The EDO will continue to work with the WAC and others to formalize this operational rule for the proposed J2 reservoir or any other similar Program water projects.*

- "The draft 2014 State of the Platte Report (pg. 29, lines 881-885) has the following statement:
  "The U.S. Fish and Wildlife Service maintains the GC needs to address, at the policy level, perceived disagreement between the AMP management objective of "avoid adverse impacts from Program actions on pallid sturgeon populations" and the stated Program goal of "testing the assumption that managing flow in the central Platte River also improves the pallid sturgeon's lower Platte River habitat."
  "The ISAC agrees that the GC needs to address this perceived disagreement."

    - ***EDO response**: The GC will have to provide further direction on this issue.*