# PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM (PRRIP or Program) Adaptive Management Plan (AMP) Version 2.0

## Introduction

This is Version 2.0 of the Adaptive Management Plan (AMP) for the Program. AMP Version 1.0 (PRRIP 2006a) is fully incorporated by reference.

Adaptive management (AM) is a 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 is routinely characterized as a six-step process, shown in **Figure 1**. AM is not a science endeavor; rather, it is a complex societal collaboration in which decision-makers identify key questions and management strategies and actions characterized by varying degrees of uncertainty and limited resources, including time (Melis et al., 2015). For a program like the PRRIP, this means decision-makers must focus and invest intellectual capacity on understanding the most important question – why (Walters, 2007)?

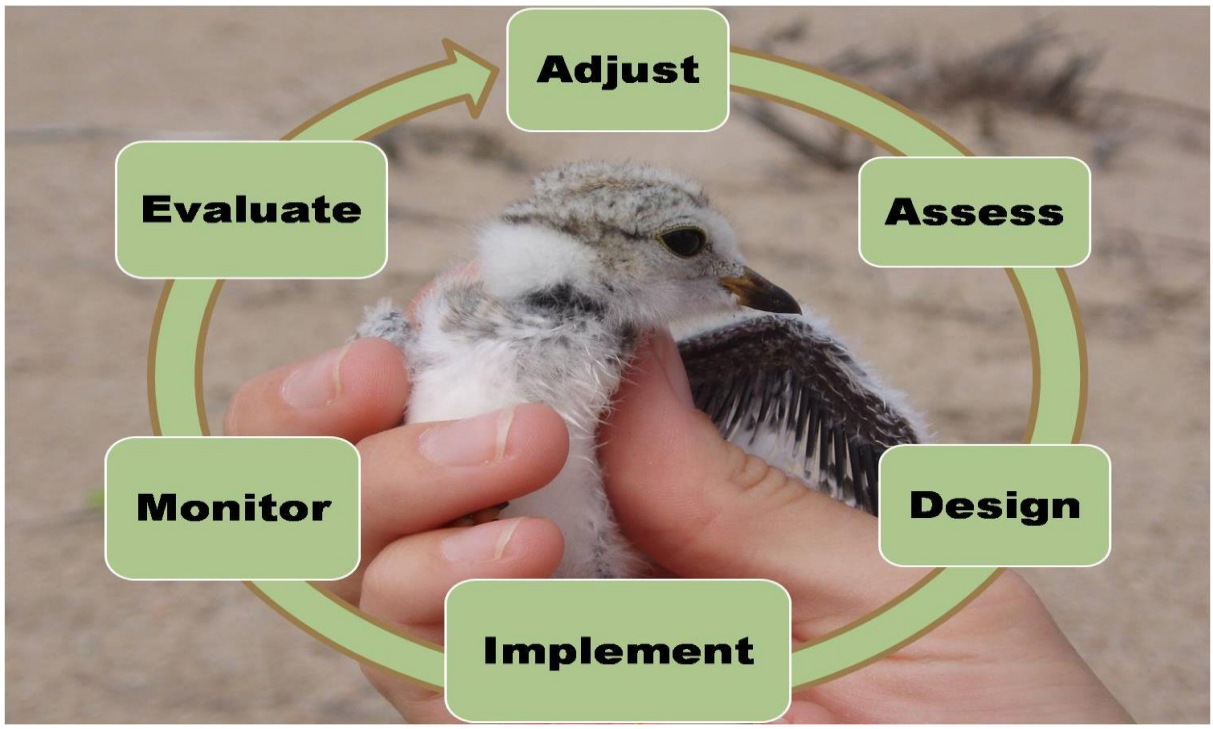



**Figure 1.** The six steps of AM.

In the 2006 AMP (PRRIP 2006a) implemented during the First Increment, Program AM is defined as a systematic process administered by the Governance Committee (GC) for continually improving management by: 1) designing certain Program management activities to test alternative priority hypotheses related to management decisions, and 2) applying information learned from research and monitoring derived from the Integrated Monitoring and Research Plan (IMRP) to improve Program management. This definition is consistent with the general definition provided above and with the foundations of AM as described in a large volume of theoretical and academic literature on AM built since the concept first emerged in the 1970s.

During the First Increment Extension (Extension), these definitional foundations of AM will remain as will the general process of implementing Program AM. AMP Version 2.0 is intended to provide the basis for AM during the Extension focused on decision-making, uncertainty, and learning largely related to the use of Program water. If the First Increment was intended to be the "learning increment" for the Program, so too will the Extension but with less of a focus on testing hypotheses and reducing uncertainties related to two different management strategies and with more of a focus on testing a possible management strategy for the Second Increment.

# AM Cycle Step 1 – Assess

This section describes the building blocks of AMP Version 2.0 and is a roadmap for reducing uncertainty, implementing management actions, and conducting science learning as a useful input to GC decision-making during the Extension.

## 1.1 PRRIP Context

The **purpose** of the Program is *to implement certain aspects of the U.S. Fish and Wildlife Service's (Service) recovery plans for the target species that relate to their associated habitats* by providing for the following:

1) Securing defined benefits for the target species and their associated habitats to assist in their conservation and recovery through a basin wide cooperative approach agreed to by the three states and the Department of the Interior (DOI);
2) Providing Endangered Species Act (ESA) compliance for existing and new water related activities in the Platte River basin;
3) Helping prevent the need to list more basin associated species pursuant to the ESA;
4) Mitigating the adverse impacts of new water related activities on (1) the occurrence of Service target flows and (2) the effectiveness of the Program in reducing shortages to those flows, such mitigation to occur in the manner and to the extent described in the approved depletions plans; and
5) Establishing and maintaining an organizational structure that will ensure appropriate state and federal government and stakeholder involvement in the implementation of the Program (PRRIP 2006b).

To fulfill this purpose, the long-term **goal** of the Program is *to improve and maintain the associated habitats*. This includes: 1) improving and maintaining migrational habitat for whooping cranes and reproductive habitat for least terns and piping plovers; 2) reducing the likelihood of future listings of other species found in this area; and 3) testing the assumption that managing flow in the central Platte River also improves the pallid sturgeon's lower Platte River habitat (PRRIP 2006b).

Program elements consist of increasing streamflows in the central Platte River during relevant time periods through reregulation and water conservation/supply projects; enhancing, restoring, and protecting habitat lands for the target species; and accommodating new water related activities in a manner consistent with long-term Program goals (PRRIP 2006b). These elements are achieved through implementation of the Program's Land Plan, Water Plan, and this Adaptive Management Plan. Program actions occur in the associated habitats ("Associated Habitat Reach" or AHR)[1] and are focused on four target species: interior least tern (*Sterna antillarum athalassos*), piping plover (*Charadrius melodus*), whooping crane (*Grus americana*), and pallid sturgeon (*Scaphirhynchus albus*).

[1] From PRRIP 2006b – The term "associated habitats" means, with respect to the interior least tern, whooping crane, and piping plover, the Platte River valley beginning at the junction of U.S. Highway 283 and Interstate 80 near Lexington, Nebraska, and extending eastward to Chapman, Nebraska, including designated critical habitat for the whooping crane and that portion of any designated critical habitat for piping plover within that Lexington to Chapman reach. With respect to the pallid sturgeon, the term "associated habitat" means the lower Platte River between its confluence with the Elkhorn River and its confluence with the Missouri River.

During the First Increment from 2007-2019, the Program had two primary objectives:

1) Reduce shortages to target flows by an average of 130,000 to 150,000 acre-feet per year at Grand Island, through reregulation and water conservation/supply projects; and

2) Protect, restore where appropriate, and maintain at least 10,000 acres of habitat in the central Platte River area between Lexington and Chapman, Nebraska.

The First Increment land objective was achieved but the GC determined that the First Increment water objective was not achievable by the end of 2019. The purposes of the Extension (2020-2032) are to give the Program more time to achieve the water objective and to conduct scientific investigations through the application of AM to answer questions regarding the effectiveness of and need for Program water in providing target species benefits.

## 1.2 Summary of First Increment Learning

AMP Version 1.0 is organized around a typical set of key components expected in any robust AM plan. A review of First Increment learning relative to those key components is in order to ensure AM during the Extension is focused on scientific and management uncertainties that are most relevant to the GC for decision-making. The key AM components include:

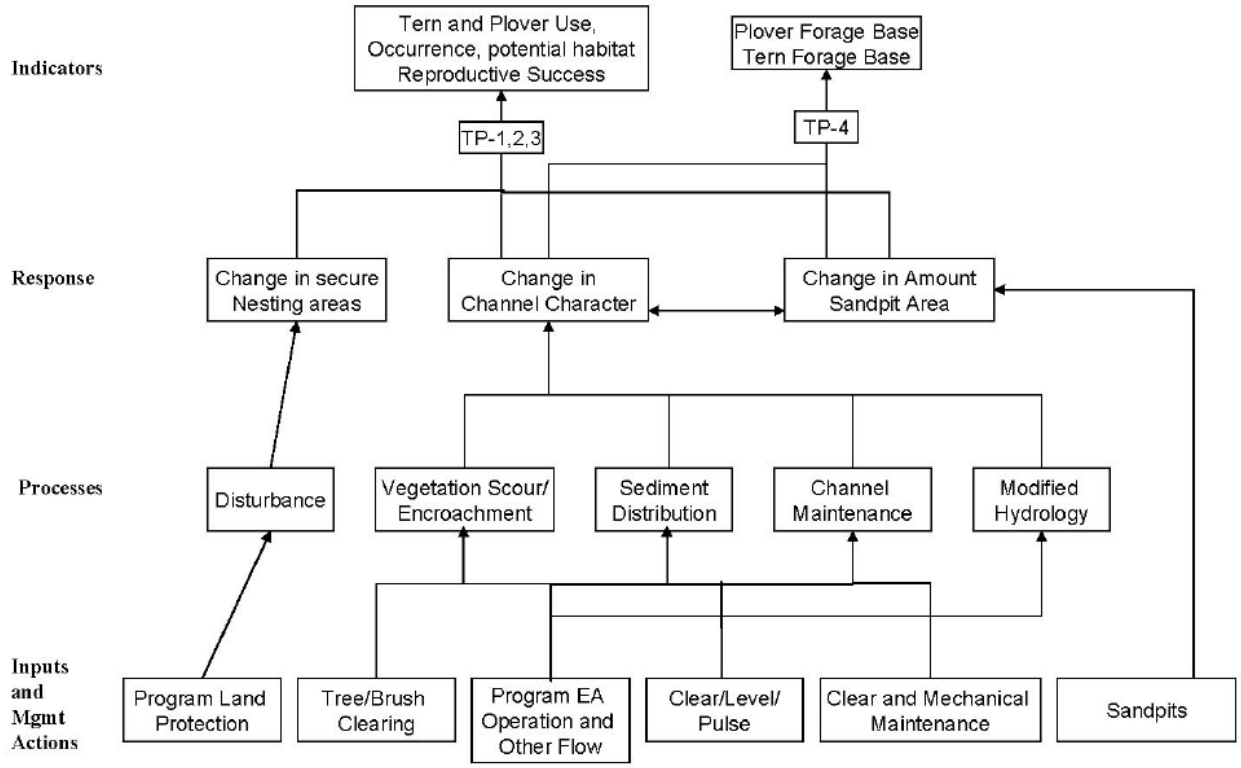
- **Conceptual Ecological Models (CEMs) –** Visualizations of the relationships between the Platte River system, target species, and management actions with emphasis on key uncertainties that can be affected by and reduced through implementation of Program AM.

- **Management Objectives –** Quantitatively describe tangible outcomes the Program is trying to achieve. Performance against these management objectives is used to gauge the ability of the Program's management actions to provide benefits to the target species and achieve the Program Goal and Objectives.

- **Management Strategies –** Logical package of management actions that comprise a range of possible Program implementation on the ground.

## Target Species – Interior Least Tern and Piping Plover

*CEM*




*Management Objective and Indicators*

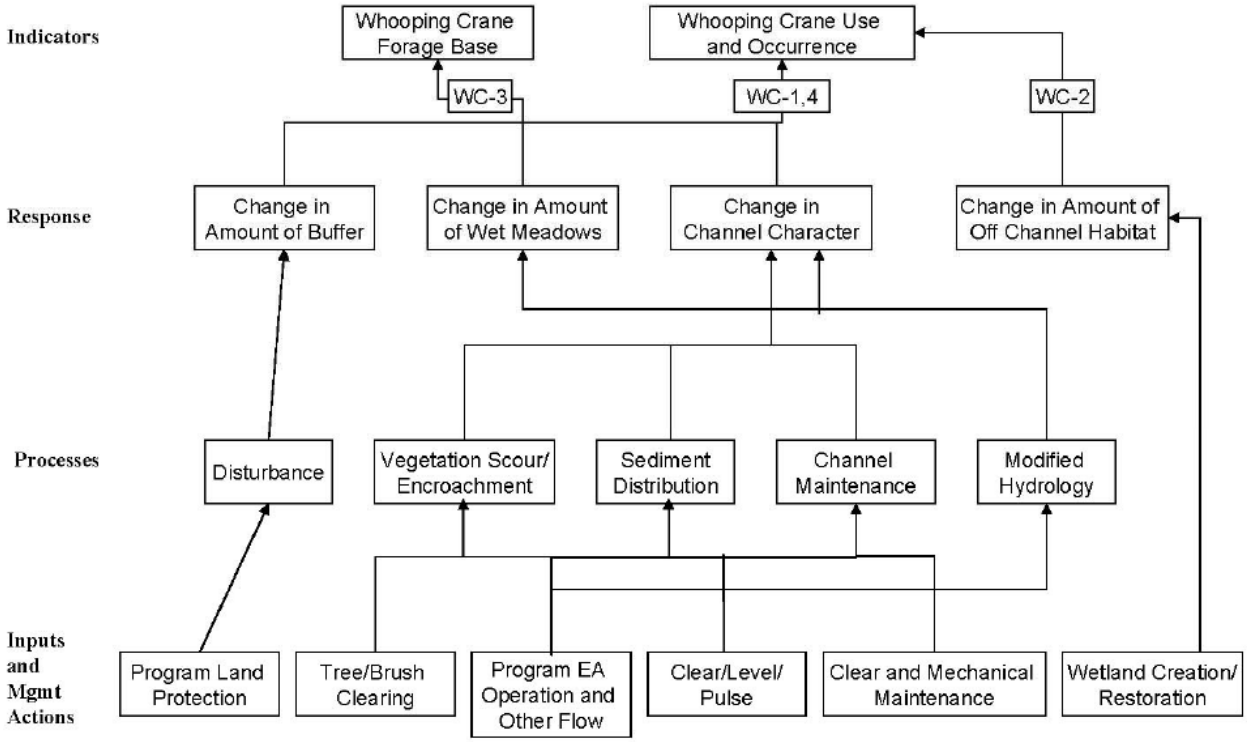
- Improve production of the interior least tern and piping plover from the central Platte River.
  a) Increase number of fledged tern and plover chicks
     i) Increase nesting pairs (indicator is nesting pairs)
     ii) Increase fledge ratios (indicator is chicks successfully produced per unit adult, 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)

❖ **Summary of First Increment Learning – Tern and Plover**

- As currently stated, the Program **met** Management Objective #1 during the First Increment.
- Least tern and piping plover populations in the AHR have increased significantly and proportionately to increases in habitat availability due to Program off-channel habitat creation efforts. Productivity on off-channel habitats has been sufficient to maintain a stable to growing subpopulation.
- Based upon available data, tern and plover productivity is insensitive to river flow. Periods of low flow have not reduced productivity due to a limitation in forage availability.
- The Program agreed to acquire/develop and manage 60 more acres of off-channel tern and plover nesting habitat to meet the Service's requirement of maintainting stable or growing tern and plover populations within the AHR.
- **Remaining uncertainties** – need for and mechanics of summer flow management to distribute tern forage (related to Tern Forage Base indicator in CEM); need for and mechanics of avian predator control related to tern and plover productivity (related to Tern Reproductive Success indicator in CEM).

## Target Species – Whooping Crane

*CEM*




*Management Objective and Indicators*

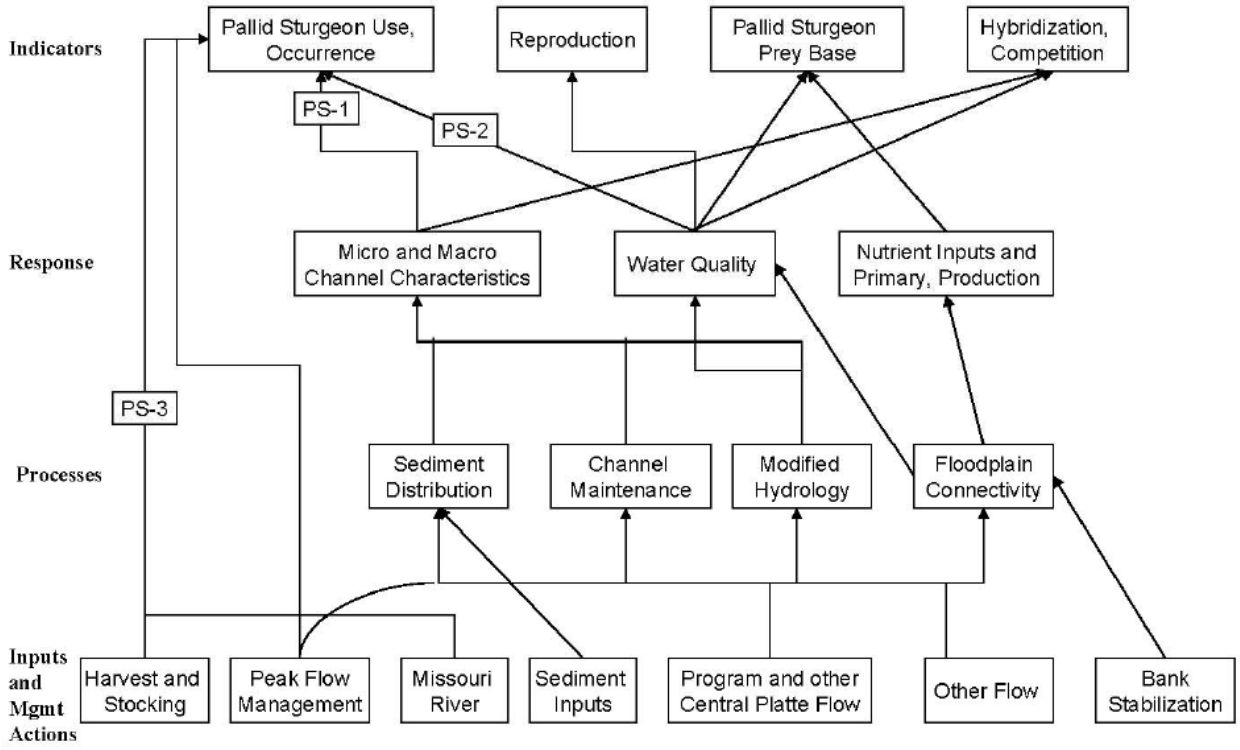
- Contribute to the survival of whooping cranes during migration.
  a) Increase availability of whooping crane migration habitat along the central Platte River (indicators are the area of suitable roosting habitat, area of suitable foraging habitat, proportion of population, crane use days, etc.)

❖ **Summary of First Increment Learning – Whooping Crane**

- As currently stated, the Program **met** Management Objective #2 during the First Increment.
- Whooping crane use of the AHR has increased significantly and proportionally to increases in habitat suitability that are in part due to Program management actions.
- Whooping crane use of the AHR increased significantly while wet meadow use remained stable and low.
- **Remaining uncertainties** – mechanics of flow releases (spring and fall migration flows, summer vegetation germination suppression flows) to ensure Program continues to meet management objective (related to Whooping Crane Use and Occurrence indicator in CEM).

## Target Species – Pallid Sturgeon

*CEM*




*Management Objective and Indicators*

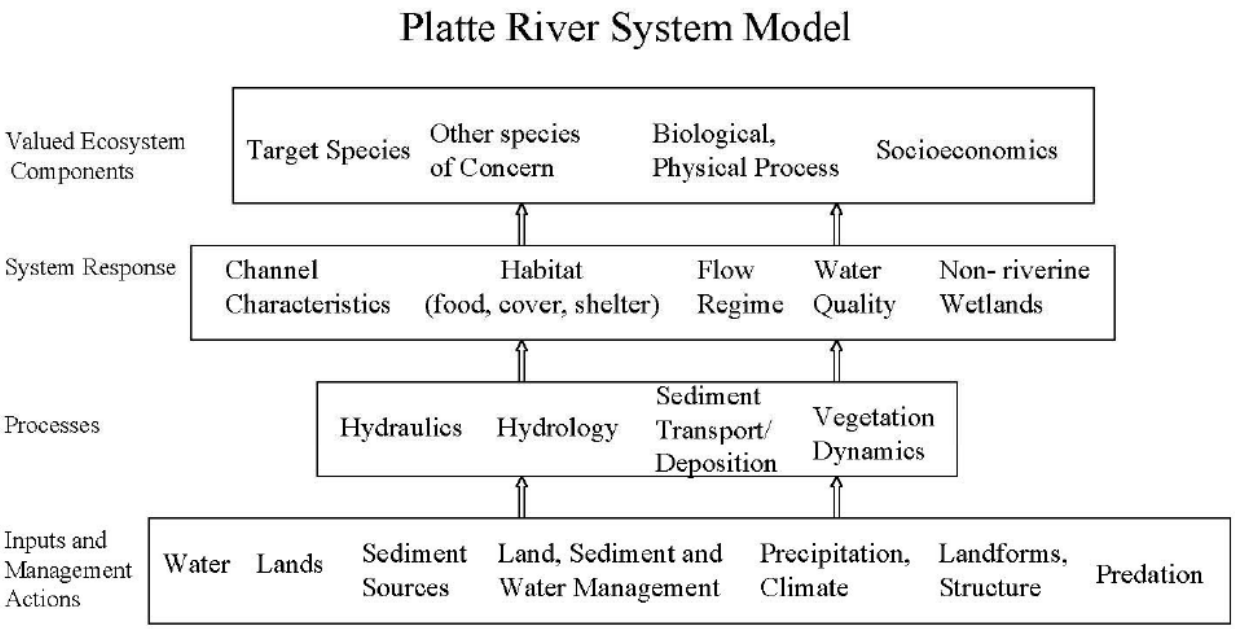
- Avoid adverse impacts from Program actions on pallid sturgeon populations.
  - Indicators have not been identified as more research is needed to determine what potential indicators the Program may affect.

❖ **Summary of First Increment Learning**

- As currently stated, it is **unknown** if the Program met Management Objective #3 during the First Increment.
- Translation of Program flow management actions from the central Platte to the lower Platte is difficult to detect and thus difficult to relate to effects on habitat and species response.
- **Remaining uncertainties** – substantial uncertainty relating to the life history of pallid sturgeon in the lower Platte River (use, productivity, recruitment) limits the the ability of the Program to develop a clear set of testable hypotheses, management actions, monitoring protocols, and a plan for data analysis and synthesis (related to Pallid Sturgeon Use and Occurrence and Reproduction indicators in CEM).

## Other Species

*CEM*




*Management Objective and Indicators*

- 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 (PRRIP, 2006a).

❖ **Summary of First Increment Learning**

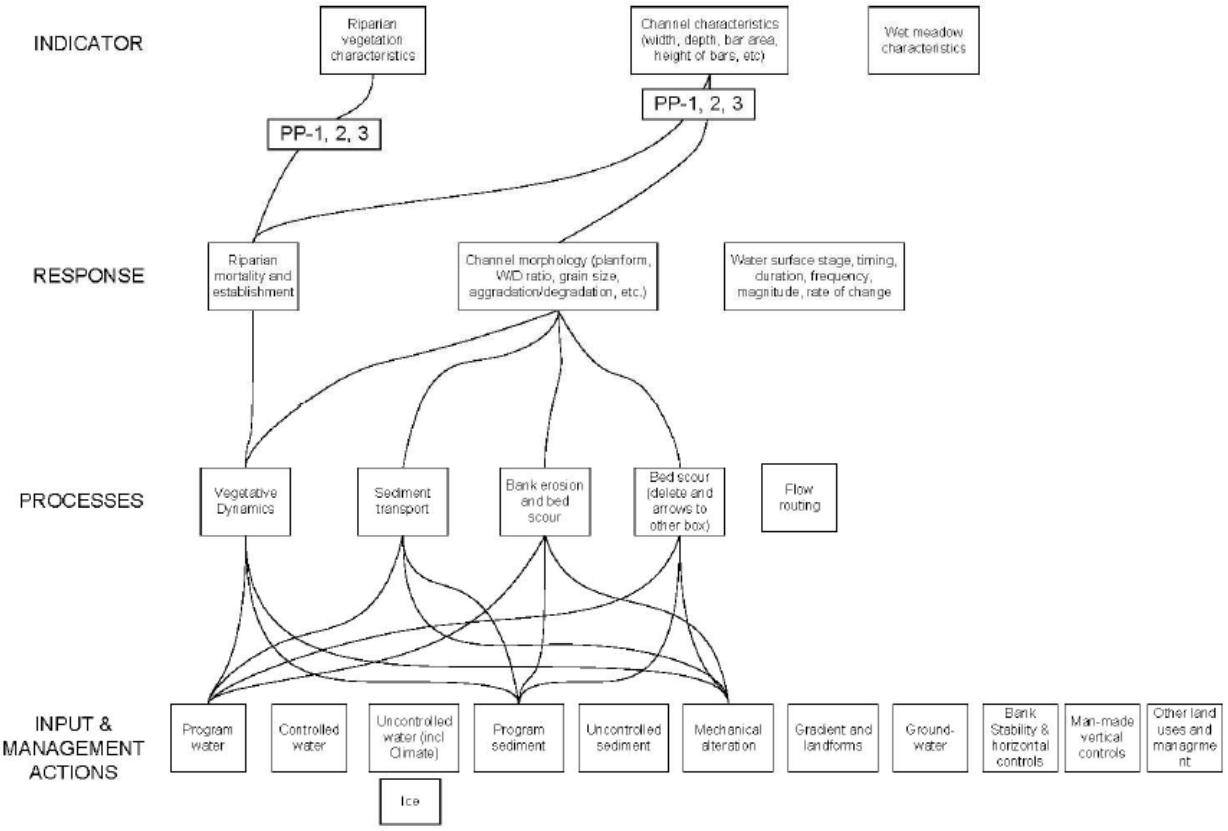
- As currently stated, it is **unknown** if the Program met Management Objective #4 during the First Increment.
- The Program did provide an increase in habitat with Land Plan Tables 1 and 2 characteristics but did not monitor populations of non-target listed species and non-listed species of concern.
- **Remaining uncertainties** – need for and mechanics of flow and habitat management for non-target listed species and non-listed species of concern (related to Other Species of Concern indicator in CEM).

## Management Strategies

During the First Increment, the GC agreed to test two management strategies. One strategy attempts to rehabilitate the Platte River toward a braided channel morphology as the underpinnings of restoring habitat for key management species (now commonly referred to as Flow-Sediment-Mechanical, originally referred to as "Clear/Level/Pulse"). The other strategy attempts to achieve similar management objectives by mechanical creation and maintenance of habitat for target species, which may or may not depend on the Platte River (now commonly referred to as Mechanical Creation and Maintenance or MCM, originally referred to as "Clear/Level/Plow").

### Flow-Sediment-Mechanical (FSM)

*CEM*




The over-arching hypothesis associated with the FSM approach is that a combination of flow management, sediment management, and land management implemented concurrently will generate detectable changes in the channel morphology of the Platte River, and habitats for whooping crane, least tern, piping plover, pallid sturgeon, and other species of concern. This strategy is comprised of the following management actions:

- Increase the acreage of channel area greater than 750 feet wide by 30 percent over the 1998 baseline conditions for the study area and restore channel habitat toward Land Plan Table 1 characteristics through flow consolidation, mechanical removal of vegetation, and mechanical cutting of banks and lowering of islands.

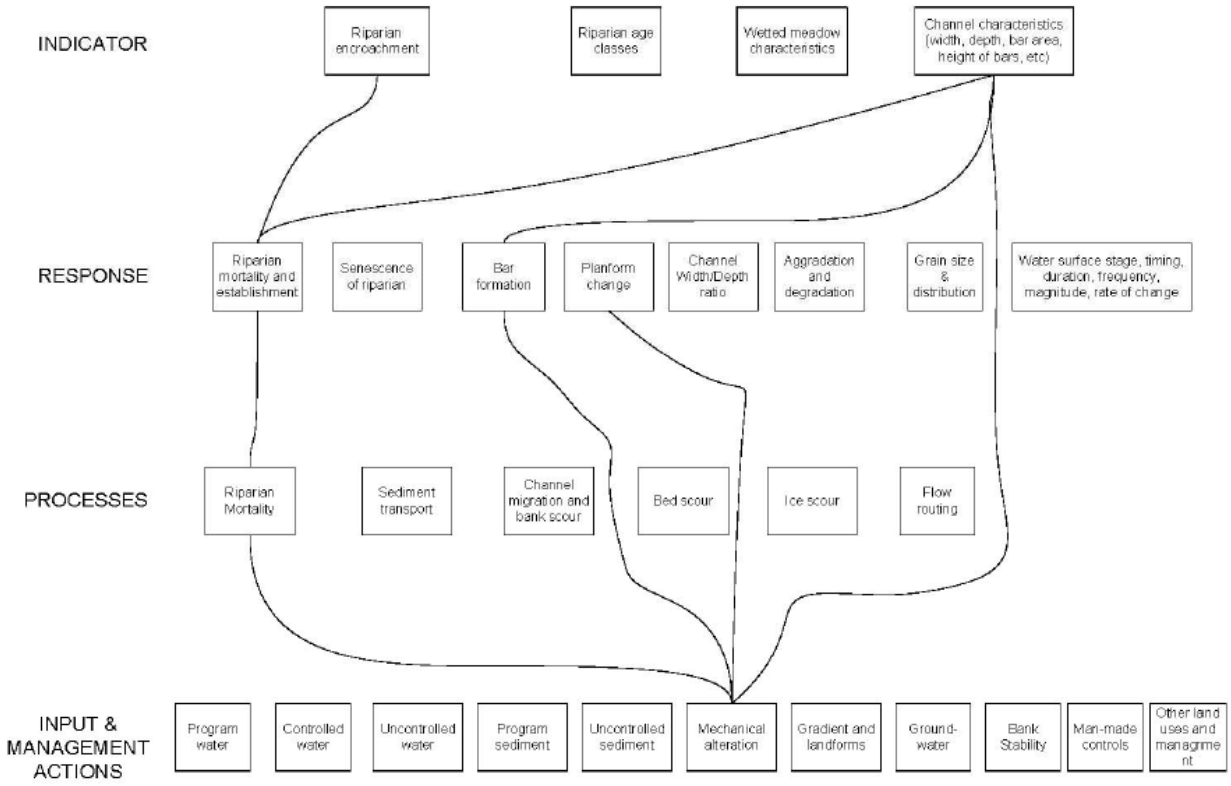
- Sediment augmentation into the river from banks, islands, and out-of-bank areas at a rate that will eliminate the sediment deficit and restore a balanced sediment budget.
- Short-duration near-bankfull flows (now referred to as Short-Duration High Flows or SDHF; defined as 5,000-8,000 cfs at Overton, NE) will be generated in the habitat reach in the springtime or at other times outside of the main irrigation season. The intent is to achieve these flows, if possible, on an annual or near-annual basis.

❖ **Summary of First Increment Learning**

- Attempts to implement the FSM management strategy have **generally produced poor results**.
- SDHF (5,000-8,000 cfs for three (3) days at Overton, NE) are highly unlikely to create or maintain suitable least tern and piping plover nesting habitat or whooping crane roosting habitat.
- Flow consolidation is not feasible due to legal and permitting constraints.
- A sediment deficit exists in the south channel downstream of the J-2 Return. Five to seven years of full-scale sediment augmentation are necessary to assess efficiency and effectiveness in preventing downstream migration of incision and narrowing.
- First Increment learning occurred largely through natural flow events as the Program was unable to implement a true SDHF and was not able to conduct flow consolidation actions.
- **Remaining uncertainties** – effectiveness of summer vegetation germination suppression flow and role of ice scour and winter flows in maintaining channel width (both related to Riparian Vegetation Characteristics and Channel Characteristics indicators in CEM).

## Mechanical Creation and Maintenance (MCM)

*CEM*




The over-arching hypothesis associated with the MCM approach is that a combination of sandpit management, mechanical actions in the channel, and inundated wetlands and upland areas implemented concurrently will generate detectable changes in the channel morphology of the Platte River, and habitats for whooping crane, least tern, piping plover, pallid sturgeon, and other species of concern. This strategy is comprised of the following management actions:

- Increase the amount of nesting habitat available to least terns and piping plovers by acquiring 200 acres of sandpits that will include at least 40 acres of bare sand and an additional 200 acres of abandoned sandpit or habitat created by the Program which is similar in nature to sandpits will be acquired that will include at least 40 acres of bare sand. Vegetation and predator management will be conducted at all sites.
- Increase the acreage of channel area greater than 750 feet wide by 30 percent over the 1998 baseline conditions for the study area and restore channel habitat toward Land Plan Table 1 characteristics through flow consolidation, mechanical removal of vegetation, and mechanical cutting of banks and lowering of islands without the application of Program flow releases.
- Each 0.5 miles of linear wetland (sloughs, backwater) constructed on Program lands will include at least one area that has a shallow water area with a minimum water surface area of 500 feet by 500 feet. Program acquired agricultural fields not previously wetlands should be planted to corn and the Program will explore enhancing the foraging value of these fields by flooding them utilizing existing irrigation

equipment. The Program will utilize the remaining 400 acres of non-complex land to create 300 acres of palustrine wetland.

❖ **Summary of First Increment Learning**

- Implementation of the MCM management strategy has **produced mixed results**.
- Suitable on-channel whooping crane roosting habitat can be mechanically created and maintained but off-channel palustrine wetland roosting habitat is not a viable alternative to on-channel habitat due to a lack of potential restoration sites and costs associated with the creation of new wetland sites.
- Off-channel least tern and piping plover nesting habitat can be created and maintained using a variety of methods but on-channel nesting habitat is difficult to construct and erodes quickly.
- **Remaining uncertainties** – need for and mechanics of wet meadow and palustrine wetland management for whooping crane use (related to Wet Meadow Characterists indicator in CEM).

## 1.3 Adaptive Management in the Extension

*Questions, Decisions, Uncertainties, & Hypotheses*

The decision space for the GC during the Extension will generally follow this hierarchy:

Second Increment Negotiation Question – What amount of water and land is needed (and can be agreed to) for the Program in the Second Increment (2033 and beyond)?

- This question represents the central focus of negotiations for the Program's Second Increment. By implementing AM during the Extension and evaluating whether the associated management actions result in meeting the Program's management objectives, the intention is to provide the GC with useful information it can consider when negotiating this question.

Extension Question – Can you achieve the Program's management objectives using 120,000 acre-feet of Program water annually?

- This question focuses the attention of AM implementation on achieving the management objectives with the water and land assets the Program now has and the potential for those existing assets to allow the Program to continue meeting the management objectives through the Second Increment and beyond.
- This approach to learning will also allow the Program to evaluate the question posed by the GC in the Final Extension Document – does the Program need to acquire an additional 10,000 acre-feet of water annually to meet the management objectives and the Program Goal and Objectives?
- GC decisions during the Extension will include decisions on the application of Program water assets. Annual flow management will be detailed and planned through a Program Annual Operating Plan (AOP) and the GC will make decisions about the annual flow plan through a Structured Decision Making (SDM) process that evaluates consequences and trade-offs related to the forecasted water year, real-time hydrology, weather and climate conditions, water availability and operations, the impact of natural flow events, and the learning potential of various aspects of each flow management action.

Implementation of AM during the Extension will focus on informing GC decision-making by attempting to reduce the following agreed-upon set experimental, management, fundamental science, and policy uncertainties and answer the related set of priority hypotheses and alternative/competing hypotheses:

**Table 3.** Experimental, Management, Science, and Policy uncertainties and associated hypotheses for the Extension, 2020-2032.
**Color key** = red, whooping crane; blue, tern/plover; yellow, pallid sturgeon; orange, uncategorized.

| Uncertainty | Priority Hypotheses & Alternative/Competing Hypotheses | PRRIP Management or AM Test | PRRIP Monitoring Protocol (Existing, Modified, New) | Key Data |
|---|---|---|---|---|
| **Experimental Uncertainties** | | | | |
| Can low-magnitude, long-duration flow releases during the growing season be used to maintain suitable UOCW during normal and dry years when large natural peak flows do not occur? | Maintaining 30-day minimum flows of at least 1,800 cfs during the growing season will not prevent vegetation encroachment into the channel or maintain UOCWs exceeding 650 ft.<br><br>Alternatives:<br>1. Maintaining minimum flows exceeding 1,800 cfs will prevent vegetation encroachment into the channel.<br>2. Maintaining minimum flow of 1,800 cfs is not possible. | **Summer vegetation germination flow test** – Release EA water to maintain minimum flow of 1,800 cfs during the growing season to evaluate total unobstructed channel width response over several years. | **Existing**<br>LiDAR and Aerial Photography<br><br>**Modified**<br>Geomorphology and Vegetation Monitoring Protocol<br><br>**New**<br>Time-lapse Camera Protocol | Bathometric LiDAR<br><br>Aerial imagery<br><br>In-channel vegetation analysis (e-cognition training and validation data, etc.)<br><br>Time-lapse camera imagery (sandbar inundation, vegetation establishment, etc.) |
| **Management Uncertainties** | | | | |
| Will flow management during the spring and fall WC migration seasons, in combination with other management actions, help the Program continue to meet the WC management objective? | The frequency of WC use of the AHR is not influenced by flow magnitude.<br><br>Alternatives:<br>1. Frequency of use increases w/ increasing flow.<br>2. Frequency of use declines when flows are below 1,500 cfs. Above 1,500 cfs, there is no relationship. | **WC migration flow management (spring and fall migration)** – Maintain at least 1,500 cfs during multiple spring and fall migration seasons.<br><br>**NOTE:** this action could likely be considered and addressed as an Experimental Uncertainty if there was agreement within the Program to evaluate the action with flow tests below 1,500 cfs during multiple spring and fall migration seasons. | **Existing**<br>Whooping Crane Monitoring Protocol<br><br>**New**<br>Whooping Crane Tracking Partnership Protocol | WC use location and abundance<br><br>FWS, CWS, and USGS telemetry data |

| Uncertainty | Priority Hypotheses & Alternative/Competing Hypotheses | PRRIP Management or AM Test | PRRIP Monitoring Protocol (Existing, Modified, New) | Key Data |
|---|---|---|---|---|
| Are summer base flows necessary to help the Program continue to meet the tern and plover management objective? | Prolonged periods of river dry up (<300 cfs for >30 days) during the nesting and brood rearing season do not influence tern and/or plover productivity.<br><br>Alternatives:<br>1. Prolonged periods of dry up result in forage fish kills due to temp / DO, dropping forage fish availably below level needed to support adequate reproductive success.<br>2. Periods of low flow concentrate forage fish, reducing foraging effort and increase productivity.<br>3. It is not possible to prevent river dry ups. | **Tern flow management (summer base flow)** – Maintain a base flow of 300 cfs during the nesting season and measure tern productivity and forage fish abundance and diversity annually. | **Existing**<br>Tern and Plover Monitoring Protocol | Tern and plover breeding pair and productivity |
| Does the Program need to control avian predators at Program-managed tern/plover off-channel nesting sites? | Avian Predation does not influence tern and/or plover productivity.<br><br>Alternatives:<br>1. Avian predation significantly reduces tern and/or plover productivity. | **Predator management –** Will be implemented as a routine management action if camera research suggests avian predation is a significant impact on annual tern and plover productivity. | **New**<br>Predator Camera Study Protocol | Nest camera imagery (predator presence, nest success, etc.)<br><br>USDA-APHIS trapping data |
| **Fundamental Science Uncertainties** | | | | |
| What is the role of ice scour and winter flow in maintaining UOCW relative to WC use? | Ice scour does not play a significant role in removing vegetation from the channel and maintaining UOCW for whooping cranes<br><br>Alternatives:<br>Ice scour plays a significant role in removing vegetation from the channel and maintaining UOCW for whooping cranes | **Natural flow ice scour test** – Research uncertainty, conduct winter monitoring of vegetation removal caused by ice scour. | **Existing**<br>LiDAR and Aerial Photography<br><br>**Modified**<br>Geomorphology and Vegetation Monitoring Protocol<br><br>**New**<br>Time-lapse Camera Protocol | Bathometric LiDAR<br><br>Aerial imagery<br><br>In-channel vegetation analysis (e-cognition training and validation data, etc.)<br><br>Time-lapse camera imagery (ice presence, vegetation removal, etc.) |
| Are Program flow management actions detectable in the lower Platte River (LPR)? | Program flow management actions are not detectable in the LPR.<br><br>Alternatives:<br>1. Program flow management actions are detectable in the LPR. | **Expand Stage Change Study –** Research uncertainty, policy implications because much of the fundamental science uncertainties were addressed during the First Increment. | **Modified**<br>Expanded Stage Change Study | |

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| Uncertainty | Priority Hypotheses & Alternative/Competing Hypotheses | PRRIP Management or AM Test | PRRIP Monitoring Protocol (Existing, Modified, New) | Key Data |
|---|---|---|---|---|
| Are Program flow management actions detectable in the lower Platte River (LPR)? | Program flow management actions are not detectable in the LPR.<br><br>Alternatives:<br>1. Program flow management actions are detectable in the LPR. | **Expand Stage Change Study –** Research uncertainty, policy implications because much of the fundamental science uncertainties were addressed during the First Increment. | **Modified**<br>Expanded Stage Change Study | |
| Can the Program influence pallid sturgeon spawning and productivity in the LPR through water management activities? | Program flow management actions do not result in increased spawning and productivity of pallid sturgeon in the LPR.<br><br>Alternatives:<br>1. Program flow management actions result in increased spawning and productivity of pallid sturgeon in the LPR. | **Intensive monitoring and research** (i.e., fish, flow, water temperature, etc.) – Research uncertainty, policy implications related to GC direction on the need to invest Program resources in this level of data collection. | **New**<br>PRRIP (or Other) Monitoring of Radio-tagged Pallid Sturgeon | PRRIP, USGS, UNL, NGPC, and/or other radio telemetry metrics |
| Does the lower Platte River contribute to successful pallid sturgeon reproduction and recruitment? | Current habitat in the LPR is not suitable for pallid sturgeon recruitment.<br><br>Alternatives:<br>1. Current habitat in the LPR is suitable for pallid sturgeon recruitment. | **Extensive research to document successful spawning and recruitment in LPR** – Research uncertainty, policy implications related to GC direction on the need to invest Program resources in this level of data collection. | **New**<br>PRRIP (or Other) Monitoring of Radio-tagged Pallid Sturgeon | PRRIP, USGS, UNL, NGPC, and/or other radio telemetry metrics |
| **Policy Uncertainties** | | | | |
| Does the Program need to continue management of Program-owned palustrine wetlands? | Whooping crane use of the AHR and/or survival are not limited by palustrine wetland foraging and roosting habitat.<br><br>Alternatives:<br>1. The quantity of palustrine wetland habitat limits WC use and/or survival.<br>2. The quality of palustrine wetland habitat limits WC use and/or survival. | **Wetland water management** – Annual augmentation of water in Program wetland sites and vegetation management to encourage whooping crane use. This is largely a policy decision as WC use of the AHR continues to increase while wetland use remains low. | **Existing**<br>Groundwater Monitoring Protocol<br><br>**Existing**<br>Whooping Crane Monitoring Protocol | Groundwater hydrology<br><br>WC use and abundance |

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| Uncertainty | Priority Hypotheses & Alternative/Competing Hypotheses | PRRIP Management or AM Test | PRRIP Monitoring Protocol (Existing, Modified, New) | Key Data |
|---|---|---|---|---|
| Does the Program need to continue management of Program-owned wet meadows? | Whooping crane use of the AHR and/or survival are not limited by wet meadow foraging habitat.<br><br>Alternatives:<br>1. The quantity of wet meadow habitat limits WC use and/or survival.<br>2. The quality of wet meadow habitat limits WC use and/or survival. | **Wet meadow management** – Annual vegetation management to encourage whooping crane use. This is largely a policy decision as WC use of the AHR continues to increase while wet meadow use remains low. | **Existing**<br>Wet Meadow Monitoring Protocol<br><br>**Existing**<br>Whooping Crane Monitoring Protocol | Wet meadow hydrology, precipitation, evapotranspiration, etc. metrics<br><br>WC use and abundance |
| Does the Program need to implement a short-duration high flow (SDHF)? | The magnitude and/or duration of SDHF is insufficient to create and/or maintain suitably wide UOCW for WC roosting.<br><br>Alternatives:<br>1. SDHF will increase UOCW to 650 ft in normal and/or dry years.<br>2. SDHF will maintain UOCWs exceeding 650 ft in normal and/or dry years. | **SDHF release** – This is largely a policy decision as the fundamental science uncertainties were addressed during the First Increment. | **Existing**<br>LiDAR and Aerial Photography<br><br>**Modified**<br>Geomorphology and Vegetation Monitoring Protocol<br><br>**New**<br>Time-lapse Camera Protocol | Bathometric LiDAR<br><br>Aerial imagery<br><br>In-channel vegetation analysis (e-cognition training and validation data, etc.)<br><br>Time-lapse camera imagery (sand bar inundation, vegetation removal, etc.) |
| Considerations for additional species (e.g. Sandhill cranes, Regal fritillary, Henslow's sparrow) | Program management activities do not negatively impact non-target listed species or Program species of concern.<br><br>Alternatives:<br>1. Program management activities negatively impact non-target listed species or Program species of concern. | **Unknown** – The first step is a policy decision related to how or whether to invest Program resources in learning related to non-target species during the Extension. | **New**<br>PRRIP and/or Other Monitoring Protocols | Species use location and/or abundance |

6

*Management Objectives*

The GC directed the management objectives will remain the same during the Extension:

**1)** Improve production of the interior least tern and piping plover from the central Platte River.

**2)** Contribute to the survival of whooping cranes during migration.

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

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

AM efforts in the Extension will focus on ensuring the Program continues to meet Management Objectives #1 and #2 and meets Management Objectives #3 and #4. Further evaluation of Program performance against these management objectives during the Extension can only be accomplished if **specific performance indicators** are identified, particularly in regard to interior least tern, piping plover, and whooping crane. The following performance indicator metrics are suggested as a starting point for Program discussion. Final performance indicators will have to be discussed and evaluated with the Adaptive Management Working Group (AMWG), the Technical Advisory Committee (TAC), and the Independent Scientific Advisory Committee (ISAC) and discussed with and approved by the GC.

**Table 2.** Target species performance indicators to evaluate the Program's progress toward meeting the management objectives during the Extension, 2020-2032.

| Target Species | Indicator | Value, Range, and/or Trend | Method of Data Collection | Rationale |
|---|---|---|---|---|
| Interior least tern and Piping plover | Acres of suitable nesting habitat | 210 | Program documentation | Includes 60 additional acres of PRRIP nesting habitat and 45 acres of NPPD nesting habitat. |
| Interior least tern | Nesting pairs | 100 pair five-year running average | Program tern and plover monitoring protocol | Added 20 pairs for the extra 60 acres of nesting habitat which made this 100 pairs. That is 2.5 times the number the Program started with in 2007. Expect ~10 more pair on 2-3 smaller sites than one large 60-acre site, on which this number is based. |
| Interior least tern | Fledge ratio | 0.70 | Program tern and plover monitoring protocol | Lutey (2002) objective. |
| Piping plover | Nesting pairs | 50 pair 5-year running average | Program tern and plover monitoring protocol | Added 10 pairs for the extra 60 acres of nesting habitat which made this 50 pairs. That is 2.5 times the number the Program started with in 2007. We would expect ~5 more pair on 2-3 smaller sites than one large 60-acre site which is what this number is based on. |
| Piping plover | Fledge ratio | 1.13 | Program tern and plover monitoring protocol | Lutey (2002) objective. |
| Whooping crane | Unobstructed channel widths | ≥ 650-foot wide UOCW on PRRIP properties | Program geomorphology and vegetation monitoring protocol | Based on Program resource selection analyses. |
| Whooping crane | Proportion of population using the central Platte | 6% (spring) and 3.5% (fall) 5-year running average | Program whooping crane monitoring protocol and annual population estimate | Based on five-year running averages, 2007-2018. Below early (2007-2015), above since. |
| Pallid sturgeon | ? | ? | ? | ? |
| Other species | ? | ? | ? | ? |

*Management Strategy*

During the Extension, AM will focus on the implementation and evaluation of one management strategy referred to as the **Target Species Objectives (TSO) Management Strategy**. The over-arching hypothesis associated with the TSO strategy is that a combination of flow tests, target species flow management actions, sediment augmentation in the south channel above Overton, NE, mechanical management of vegetation and channel conditions on Program lands, and continued management of Program off-channel habitat will result in the Program meeting the four management objectives. The TSO management strategy is intended to reduce the **experimental and management uncertainties** identified above and will be modified to address fundamental science and policy uncertainties if so directed by the GC.

The TSO management strategy is comprised of the following management actions during the Extension:

- **Flow test** – The Program will develop a design for implementation of a flow test during the summer to provide learning relative to the ability of these flows to suppress vegetation germination and maintain UOCW and subsequently contribute to the survival of WC during migration.

- **Target species flow management** – The Program will release and manage Program water annually during the spring and fall WC migration seasons to maintain UOCW and contribute to the survival of WC during migration and during the summer as a management action to distribute tern forage (fish).

- **Sediment management –** Annual augmentation of 60,000-80,000 tons of sediment (sand) in the south channel above Overton, NE to reduce or eliminate the annual sediment deficit and channel degradation caused by the clear-water returns from the J2 Return.

- **Mechanical management** – Annual disking and other channel maintenance activities; annual spraying of phragmites and management of other invasive species.

- **Off-channel habitat management** – Annual vegetation and predator management at all Program sandpit and off-channel tern and plover nesting sites.

*Management Actions*

During the Extension, AM implementation and evaluation will focus on the TSO management strategy and its component actions. Flow releases will be implemented as a way to test the hypothesis that water year-type flow tests and target species flow management scenarios, in combination with the other aspects of the TSO management strategy, will allow the Program to continue to meet the management objectives as measured by the target species performance indicators. Annual flow management will focus on a system of natural flow that is protected, retimed, and released in accordance with Program water management priorities. The scenarios are not grounded in existing target flows but rather flow management that is linked to key target species-related categories including spring and fall whooping crane migration, tern foraging, and suppression of vegetation germination to maintain unvegetated channel width. Some general caveats for TSO flow management to be tested during the Extension:

- Target flows will remain the same during the Extension for the purposes of scoring Program water projects and determining excesses.
- Program water will be managed through collaborative development of a Program Annual Operating Plan (AOP).
- Program water will be managed in such a way as to ensure there is enough available to implement these flow management actions.
- Second Increment water needs based on the Program's ability to achieve target species objectives are the ultimate intent of implementing tests of this flow management strategy.

**1) Flow Test**

*Summer vegetation germination suppression flow*

- Amount – 1,800 cfs
- Dates – June 1 through July 15
- Purpose – Suppression of channel vegetation germination to maintain UOCW.

- Flow Volume (AF = acre-feet):
  - Wet Year 95,000 AF
  - Normal Year 114,000 AF (81,000 AF at a 1,500 cfs target species management flow)
  - Dry Year 238,000 AF (144,000 AF at a 1,200 cfs target species management flow)

**2) Target Species Flow Management**

Target species flow management activities during the Extension will focus on providing and maintaining target species habitat. Anticipated flow volumes listed below are based on median natural flow volumes during wet, normal, and dry years from 1958-2018.

*Whooping crane spring and fall migration flow*

- Amount – Reduce flows below 1,500 cfs during multiple spring and fall migration seasons.
- Dates – March 6 through April 20 and October 15 through November 20
- Purpose – Contribute to maintenance of UOCW, encourage whooping crane use of the AHR.
- Flow Volume (using 1,5000 cfs as example flow):
  - Wet Year Spring 0 AF Fall 0 AF
  - Normal Year Spring 2,000 AF Fall 47,000 AF
  - Dry Year Spring 40,000 AF Fall 100,000 AF

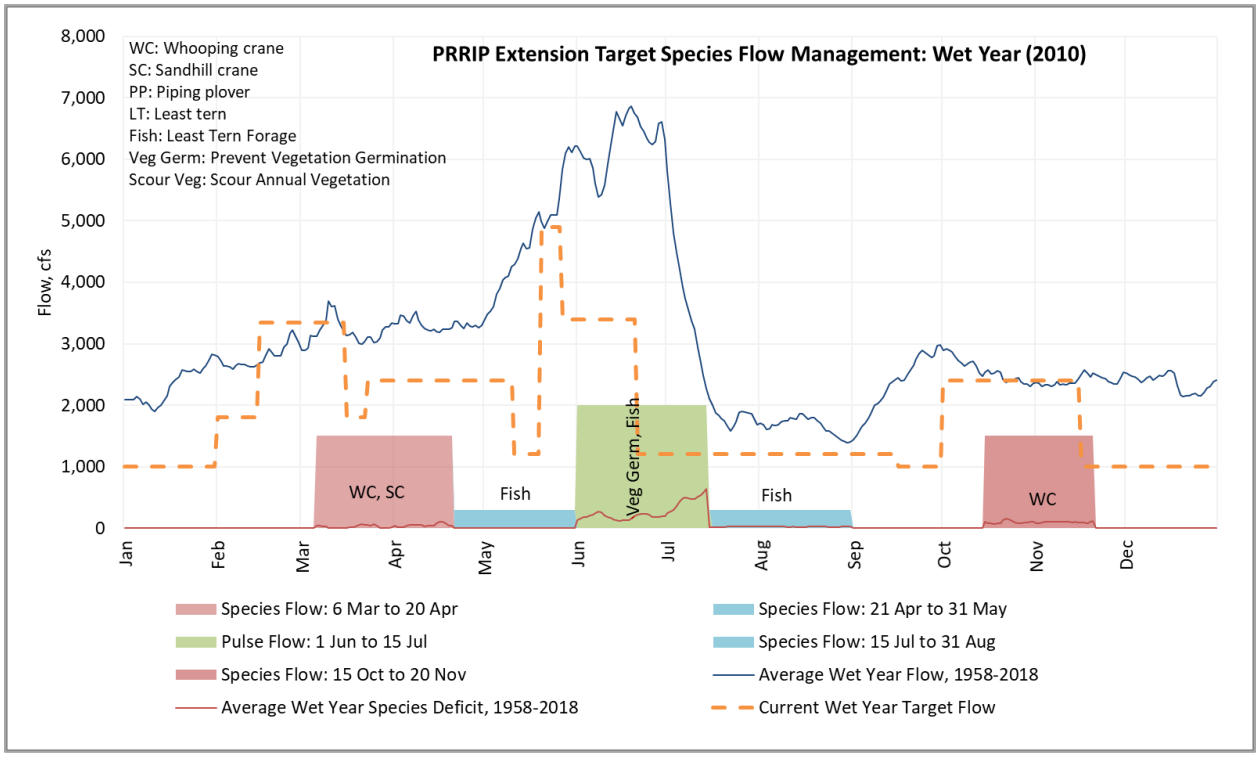
*Summer base flow*

- Amount – 300 cfs
- Dates – May 1 through August 31
- Purpose – distribution of forage for least terns (fish).
- Flow Volume:
  - Wet Year 0 AF
  - Normal Year 3,000 AF
  - Dry Year 59,000 AF

*TSO Management Strategy and Target Flows*

The TSO management strategy hypothesis is that these flow components (flow tests and target species flow management), if implemented based on water year types, in combination with mechanical management, sediment management, and off-channel habitat management will allow the Program to meet the target species management objectives during the Extension utilizing the Program's current land assets and 120,000 acre-feet of water annually. These flows represent target species flow management priorities for the Program and are not considered "new" target flows. Target flows, as currently managed, are essentially administrative in nature and provide guidance on capturing and re-timing natural flows to be managed according to Service (EA) or Program (AMP) priorities. If the over-arching hypothesis for the Extension, as described above, is not rejected then the flow components can be used to help adjust species flow management activities in terms of decision-making for capturing and re-timing natural flow during the Second Increment to ensure the Program continues to meet the management objectives over the long term.

The figures below present a possible approach to flow tests (summer germination suppression flow) and target species flow management (WC spring and fall migration flows, summer base flows for tern forage) during the Extension based on water year type (examples presented for the current water year type categories of Wet, Normal, and Dry). These examples link Program flow management during the Extension to a small number of key flow categories related to the life history and habitat needs of the target species.

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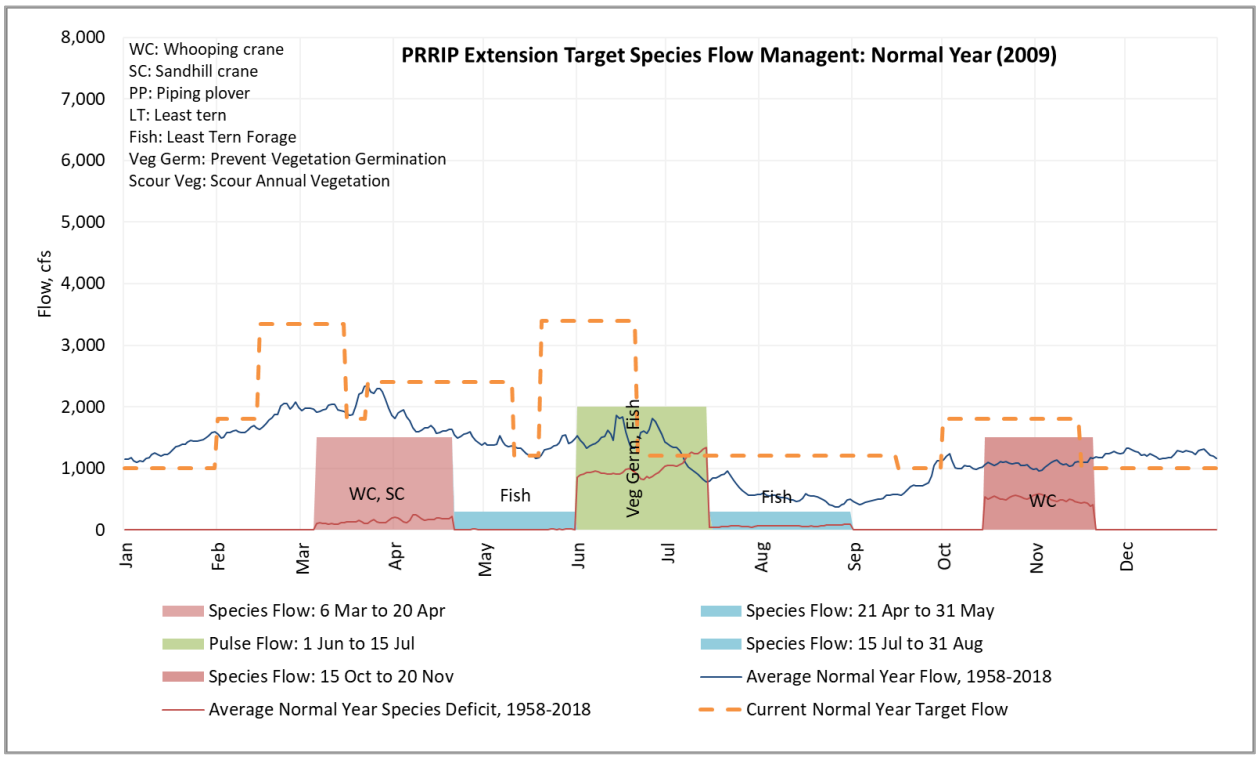


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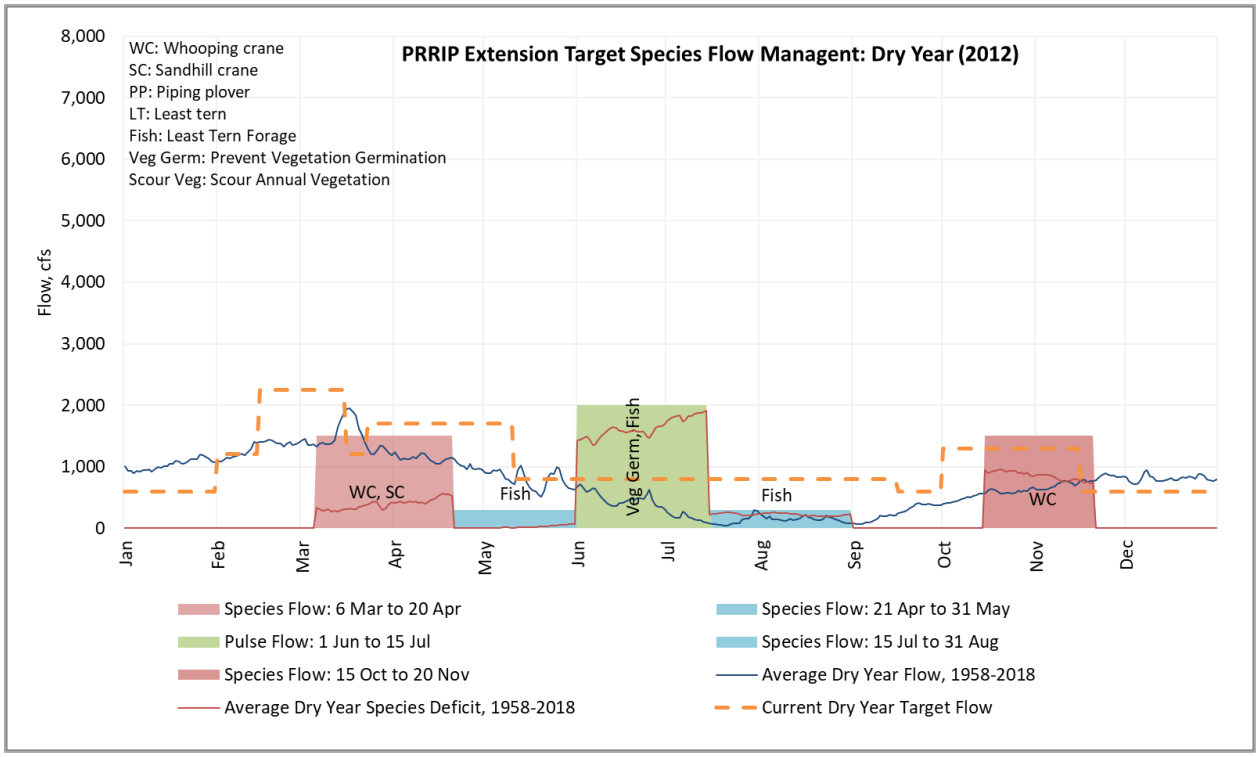


### 3) Sediment Management

- Action – Augmentation of 60,000-80,000 tons of sand annually in the south channel (Jeffrey Island) above Overton, NE.
- Dates – September
- Purpose – To reduce or eliminate the sediment deficit and ongoing channel degradation in the south channel due to clear-water returns from the J2 Return.

### 4) Mechanical Management

- Action – Disking and general management of vegetation in the channel; spraying for phragmites and other channel invasive species.
- Dates – August through October
- Purpose – To maintain unobstructed channel width and prepare the channel for application of Program flow to assist with channel width maintenance. Will need to explore tradeoffs in dry years, evaluating using Program water to maintain width vs. using mechanical management.

### 5) Off-Channel Habitat Management

- Action – Vegetation management and predator control at all sandpit sites and water augmentation and vegetation management on Program wetland sites.
- Dates – April through August
- Purpose – To maintain bare sand nesting habitat for terns and plovers and to improve reproductive success through reduction or elimination of predator impacts on nest success and fledging at all Program sites.

# 2.0 AM Cycle Step 2 – Design

To be added

# 3.0 AM Cycle Step 3 – Implement

## 3.1 Implementation of PRRIP Management Actions

To be added

# 4.0 AM Cycle Step 4 – Monitor

To be added

# 5.0 AM Cycle Step 5 – Evaluate

To be added

# 6.0 AM Cycle Step 6 – Adjust

To be added

# References Cited

Melis et al., 2015. *Surprise and opportunity for learning in Grand Canyon: The Glen Canyon Dam Adaptive Management Program.*

PRRIP 2006a. Adaptive Management Plan Version 1.0.

PRRIP 2006b. Final Program Document.

Walters, 2007. *Is adaptive management helping to solve fisheries problems?*

**Glossary** (placeholder, keep running list)

*Adaptive management* – Adaptive management (AM) is a 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.

*Critical uncertainties* – Critical uncertainties are gaps in knowledge that affect the relative performance of alternative management decisions against stated objectives.

*Effectiveness monitoring* – Monitoring to assess whether project objectives are achieved.
*Goals* – Broad statements of desired outcomes. These are often somewhat intangible, and it is the objectives underlying the goals that are tangible and measurable.

*Implementation monitoring* – Monitoring after project completion to assess whether the project was completed as designed.

*Management actions* – On-the-ground interventions the Program could undertake. Such actions occur within the 'decision space' for the Program and comprise the potential suite of actions to which adaptive management could be applied.

*Management decisions* – These are items the Governance Committee has some degree of decision-making control over. These decisions help bound the AMP, which should focus on reducing critical uncertainties affecting confident management decisions.

*Management strategy* – A logical collection of management actions that would be employed to achieve one or more management objectives.

*Objectives* – The proposed means of achieving goals.

*Priority hypotheses* – Hypotheses that need to be addressed first in a sequence of investigative efforts. The outcomes of tests of priority hypotheses will often inform decisions on which of various additional hypotheses and investigations need to be subsequently undertaken.

*Validation monitoring* – Monitoring of riverine processes and target species to determine if the Platte River and the target species are responding to management actions, critical cause-effect linkages between actions and species' responses, and overall progress towards the Program's objectives.

**Abbreviations** (placeholder, keep running list)

| | |
|---|---|
| AF | Acre Feet |
| AHR | Associated Habitat Reach |
| AM | Adaptive Management |
| AMP | Adaptive Management Plan |
| AMWG | Adaptive Management Working Group |
| AOP | Annual Operating Plan |
| BQ | Big Question |
| CFS | Cubic Feet per Second |
| CWS | Canadian Wildlife Service |
| DO | Dissolved Oxygen |
| DOI | Department of the Interior |
| EA | Environmental Account |
| EDO | Executive Director's Office |
| ESA | Endangered Species Act |
| Extension | First Increment Extension |
| FSM | Flow-Sediment-Mechanical management strategy |
| FWS | U.S. Fish and Wildlife Service |
| GC | Governance Committee |
| IMRP | Integrated Monitoring and Research Plan |
| ISAC | Independent Scientific Advisory Committee |
| LPR | Lower Platte River |
| MCM | Mechanical Creation & Maintenance management strategy |
| NGPC | Nebraska Game and Parks Commission |
| NPPD | Nebraska Public Power District |
| Pallid | Pallid Sturgeon |
| Plover | Piping Plover |
| Program | Platte River Recovery Implementation Program |
| PRRIP | Platte River Recovery Implementation Program |
| Service | U.S. Fish and Wildlife Service |
| SC | Sandhill Crane |
| SDHF | Short-Duration High Flow |
| SDM | Structured Decision Making |
| TAC | Technical Advisory Committee |
| Target Species | Whooping crane, Interior least tern, Piping plover, Pallid sturgeon |
| Tern | Interior Least Tern |
| TSO | Target Species Objectives management strategy |
| UNL | University of Nebraska Lincoln |
| UOCW | Unobstructed Channel Width |
| USDA-APHIS | United States Department of Agriculture Animal and Plant Health Inspection Service |
| USGS | United States Geological Study |
| Veg. Germ. | Vegetation Germination |
| WC | Whooping Crane |

# Appendix A:

To be added if necessary