# ADAPTIVE MANAGEMENT ON THE PLATTE RIVER


**2/14/2011**

**Platte River Recovery Implementation Program**
**Adaptive Management Implementation Plan**
**DRAFT Version 2.0**

PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM

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### *A note on document functionality:*

***This document contains significant additional functionality when viewed in PDF format on a computer with an internet connection. There are numerous hyperlinks to online Program documents and other work products within the text and figures. Left-clicking on the hyperlinks will open the associated documents in your default web browser. If the hyperlinks do not work, hyperlink functionality may be disabled on your computer.***

**Citation:** J. Farnsworth, Smith, C.B., and D. Baasch. 2011. Adaptive Management Implementation Plan – Version 2.0. Prepared by the Executive Director's Office for the Platte River Recovery Implementation Program, Kearney, NE. 96 pp.

# LIST OF ABBREVIATIONS

AM – Adaptive management

AMP – Adaptive Management Plan

CIR – Color-infrared

CNPPID- Central Nebraska Public Power and Irrigation District

DEM – Digital elevation model

EDO – Executive Director's Office

FSM – Flow-Sediment-Mechanical

GC – Governance Committee

ISAC – Independent Science Advisory Committee

LAC – Land Advisory Committee

LiDAR – Light detection and ranging

LT – Interior least tern

MCM – Mechanical creation and maintenance

NGO – Non-governmental organization

NGPC – Nebraska Game and Parks Commission

NPPD – Nebraska Public Power District

OCSW – Off-channel sand and water

PP –piping plover

PRRIP or Program – Platte River Recovery Implementation Program

PRWCT – Platte River Whooping Crane Trust

PS – Pallid sturgeon

SDHF – Short-duration high flow

SOW – State of Wyoming

TAC – Technical Advisory Committee

TNC – The Nature Conservancy

USFWS – United States Fish and Wildlife Service

WAC – Water Advisory Committee

WC – Whooping crane

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# INTRODUCTION | ONE

In 2007, the Platte River Recovery Implementation Program (**Program** or **PRRIP**) began implementation of its Adaptive Management Plan (**AMP**). In this framework, the Program intends to implement management actions and integrated monitoring and research to link science learning to management and policy decision-making (PRRIP, 2006). Management actions will be implemented in the Program's 13-year First Increment (2007-2019) as active adaptive management experiments in an attempt to learn more about the physical processes of the central Platte River and the response of four target species to management actions: interior least tern (*Sterna antillarum*), piping plover (*Charadrius melodus*), whooping crane (*Grus americana*), and pallid sturgeon (*Scaphirhynchus albus*).

The Program initiated activities under a tiered experimental design beginning in 2010 to test hypotheses related to two management strategies: 1) Flow-Sediment-Mechanical (**FSM**) and 2) Mechanical Creation and Maintenance (**MCM**). The *scientific purposes* of these actions are to assess target species' response in the central Platte River and to reduce uncertainty related to the interaction of physical processes and habitat availability and use. In addition to evaluating specific hypotheses, *management objectives* include:

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

Actions under the two management strategies will be undertaken to attempt to achieve the species-focused management objectives. The first strategy, FSM, is river-focused and proposes to use short-duration high flow (**SDHF**) releases on a near-annual basis to create and maintain riverine species habitat. The second strategy, MCM, includes both riverine and off-channel habitat and proposes to mechanically create and maintain species habitat without the need for SDHF releases. The AMP presents the actions to be taken under each strategy and formalizes uncertainties in its ability to produce habitat and species response (strategy performance) in the form of broad-scale and priority hypotheses. The AMP also includes a list of research and monitoring activities designed to be conducted in association with management action implementation in order to test the priority hypotheses and facilitate adjustment of actions based on reduction of performance uncertainty.

This Implementation Plan is intended to guide Program adaptive management (**AM**) actions to benefit endangered species that use the Platte River in Nebraska. AM provides the Program with a systematic approach to addressing uncertainty associated with implementation of management actions and this plan provides the Program with a framework for ensuring Program actions conform to the AM process.


FIGURE 1 - TARGET SPECIES: Least Tern, Piping Plover, Whooping Crane, and Pallid Sturgeon

## The Big Questions

Although it is not the intent of this plan to re-examine the uncertainties that precipitated the development of the AMP, a brief overview provides useful context for the implementation philosophy and actions presented in this document. The list of "Big Questions" in Table 1provides a condensed version of the critical uncertainties that are at the heart of the Program's need for AM implementation and form the basis for testing of the FSM and MCM management strategies. All of the actions presented in this plan are directed toward answering these Big Questions, providing Program decision-makers with the tools to make informed decisions about allocation of Program resources in the future.

TABLE 1 - THE PROGRAM'S BIG QUESTIONS

| Big Questions = What we don't know but want to learn |
|---|
| 1) **Do terns, plovers, and whooping cranes use Program habitat complexes and habitat meeting Program minimum criteria in proportions greater than their availability?** |
| 2) **What is the relationship between concurrently available riverine and sandpit nesting habitat and tern and plover use and productivity?** |
| 3) **What is the relationship between availability of riverine nesting habitat meeting Program minimum criteria and tern and plover use and reproductive success?** |
| 4) **What is the relationship between short-duration high flows (SDHF), sediment balance, tern and plover riverine nesting habitat meeting Program minimum criteria, and channel width?** |
| 5) **What is the relationship between availability of whooping crane roosting habitat meeting Program minimum criteria and whooping crane use?** |
| 6) **What is the relationship between SDHF, sediment balance, and whooping crane habitat meeting Program minimum criteria?** |
| 7) **How do SDHF, restoring sediment balance, and mechanical channel alterations contribute to the maintenance of channel width and creation of a braided river channel?** |
| 8) **Have Program water-related activities avoided adverse impacts to pallid sturgeon in the lower Platte River?** |
| 9) How do central Platte tern, plover, and whooping crane populations relate to overall population recovery objectives? |
| 10) What uncertainties exist at the end of the First Increment, and how might the Program address those uncertainties in the Second Increment? |

## Impetus for Implementation Plan

While the Program's AMP and associated Big Questions lay a strong foundation for AM implementation, the Program's Independent Science Advisory Committee (**ISAC**) recommended development of additional guidance documents to chart a more robust course through implementation. This Implementation Plan is one of those documents and is focused on identifying, organizing, and providing linkages between the AM actions that will be taken during the remainder of the First Increment. **In essence, this document is an exercise in conforming AMP actions to (and organizing them within) the cyclical AM process to produce a roadmap for implementation.** It will be up to Program participants and contractors to be diligent in adhering to the AM process and to understand and address the inherent challenges and limitations of this management approach.

# IMPLEMENTATION PHILOSOPHY | TWO

The implementation philosophy that shapes the organization and content of this plan is the product of experience in implementing AM on the Platte (2008-2010) and communication and coordination with AM practitioners throughout North America. **Program AM implementation philosophy is based on the understanding that science learning can inform policy decision-making but cannot arbitrate policy disagreements.** This dictates an implementation approach that is oriented toward flexibility, adaptability, and production of information that is understandable by Program policy-makers and that proves useful in helping them make informed management decisions. The following sections present practical implications of this philosophy.

## Species-Centricity

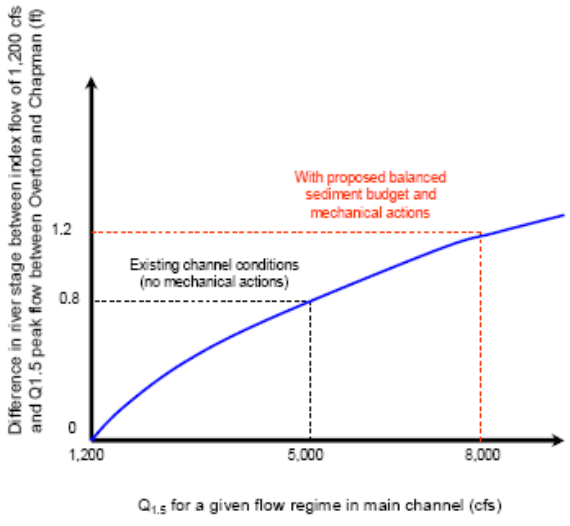
The Program is a species recovery program which is clearly reflected in the Program's management objectives. This dictates that **management experiment design, performance evaluation, and action adjustments will always be tied to outcomes that are consistent with the Program's understanding of target species habitat selection and productivity**. The result is an implementation approach that prioritizes learning about species' habitat use and selection as it is critical for improving the performance of actions taken under both management strategies over the course of the First Increment. This approach is reflected in the organization and presentation of species-related research, monitoring, and assessment separate from management strategy implementation, but with synthesis and evaluation schedules that correspond to anticipated FSM and MCM implementation design and evaluation tasks.

## Performance Orientation (vs. Uncertainty Orientation)

Program AMP implementation will address physical process uncertainty (hypothesis testing) within the context of management experiment performance in producing acceptable outcomes for target species. Many of the Program's FSM priority hypotheses deal with physical process relationships (see Flow 1). These relationships are fundamental to the Program's ability to create and/or maintain species habitat but testing/refining them outside of a performance context does not provide useful information for Program decision-makers.

For example, testing of priority hypothesis Flow 1 is accomplished through implementation of management experiments that produce data that can be used to reduce the uncertainty in the relationship shown in the X-Y graph. A performance orientation dictates that the effort and resources dedicated to testing this hypothesis are based on its importance to acceptable species outcomes, currently defined as creation and/or maintenance of habitat that conforms to minimum species habitat criteria. If increasing bar heights by

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.

30 to 50% is consistent with acceptable species outcomes (habitat predicted to meet minimum criteria), significant resources will likely be dedicated to testing this hypotheses and incorporating the refined relationship into management experiment design and evaluation. If increasing bar heights by 30 – 50% is not expected to produce acceptable species outcomes, the Program will likely not devote significant time or resources to further reducing uncertainty in this physical process relationship.

## Policy Support Focus (vs. Policy Driver)

A review of literature that addresses the relationship between science and policy uncovers strong arguments that science is not capable of dictating policy decisions in situations exhibiting a high degree of uncertainty and/or including intractable values conflicts (Pielke 2007). The Program deals with both scientific uncertainty and values conflicts. In these situations, achieving management goals and objectives appears to be most likely when science is used to develop a range of policy options that are consistent with acceptable outcomes. This is referred to as an "honest broker" approach to integration of science and policy (Pielke 2007). Implementation of adaptive management experiments from a performance orientation is consistent with the honest broker approach and will provide results that are informative for policy decision-making.

## Modular Organization

A review of AM implementation critiques and other literature indicates that all steps of the AM cycle are often not undertaken (or implemented sequentially) and AM fails to produce meaningful changes in management actions (Gregory et al 2006). This has led us to adopt a modular approach to AMP implementation that focuses on development and application of AM action design templates. Implementation of template-driven progressions of activities (following the AM cycle) ensures that actions are not orphaned from the AM process; essentially forcing the Program to conform action to the AM cycle instead of attempting to apply AM principals to unassociated Program actions.

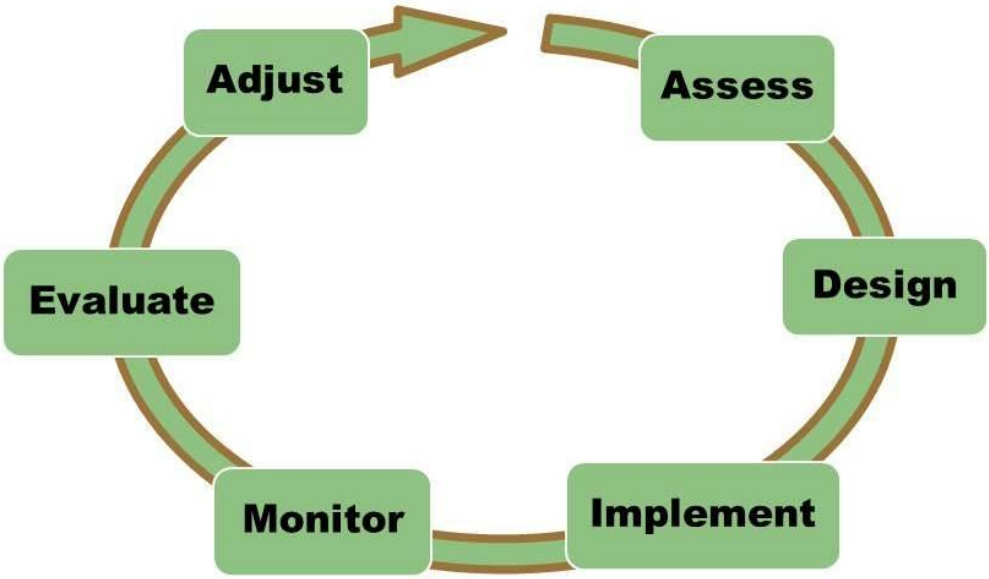
AM is often applied to address management uncertainties in complex natural systems which tend to produce "surprises" that significantly affect outcomes and associated decision-making (Holling 1973). This tempers the Program's expectation that we can predict the objectives and/or performance criteria associated with second or third generation AM experiments. The modular approach also allows us to plan for implementation of these management experiments using action and activity placeholders. The next section expands on the concept of modular plan organization.

# IMPLEMENTATION ACTIVITIES | THREE

Program AMP implementation will be carried out within the context of seven modular activities. These activities are based on the steps of the adaptive management cycle which is presented in Figure 2. This modular approach was selected to allow for flexibility and scalability in implementation while ensuring consistency and uniformity to the steps of the AM cycle. The Program's seven modular activities and the corresponding AM cycle step include:

- ☐ Problem Assessment – Assess
- ☐ Investigation – Assess
- ☐ Implementation Design – Design
- ☐ Management Action Implementation – Implement
- ☐ Monitoring and Data Synthesis – Monitor
- ☐ Performance Evaluation – Evaluate
- ☐ Action Adjustments – Adjust

FIGURE 2 - THE ADAPTIVE MANAGEMENT CYCLE




The following sections provide high-level descriptions of the Program's modular AM activities. Appendix A contains the condensed bullet pointed templates that the Program will use to guide implementation. It should be noted that a review of AM literature and resources did not produce any examples of activity templates or standardized components for the steps of the AM process. As such, the Program developed the draft templates in Appendix A and will refine and improve them as necessary.

## Problem Assessment

Problem assessment is the first step in implementation of the AM process and provides the context for all subsequent actions. As the name implies, this step is the formal identification and characterization of the potential outcomes and uncertainties associated with implementation of management actions designed to address a resource problem or issue. The Program has invested a significant amount of time in problem assessment during AMP development. However, most of that work focused on the uncertainties associated with implementation of the FSM management strategy. This is reflected in the priority hypotheses which largely do not address MCM.

## Investigation

Investigations function as an extension of the problem assessment process and are useful in reducing critical uncertainties that are related to management action performance but are not conducive to being tested as part of a management experiment. Typically, these uncertainties are identifiable as **data that are needed to inform management experiment design**. Fundamental physical process relationships like vegetation scour thresholds are an example of critical Program uncertainties that can be addressed through investigations. Several forms of investigation may be utilized including literature reviews, model development, and directed research projects.

## Implementation Design

Implementation design is the step of the AM cycle where management options and uncertainties identified in the problem assessment step are developed into a full AM experimental design that includes construction, monitoring, analysis, and action adjustment components. **The design step is arguably the most important in the AM cycle as it clarifies management action performance expectations and provides a framework for monitoring, synthesis, and action adjustment under the range of possible outcomes.**

Implementation design may take the form of an active or passive AM experiment. An active AM design will be used in situations with high uncertainty where competing/contrasting management options exist. Testing of the FSM and MCM management strategies is an example of active AM. Passive AM is used in situations where only one action can or should be taken. In passive AM, monitoring and evaluation is used to improve performance but not to choose between competing management actions.

Ideally, experimental design under both scenarios should include controls, replication of treatments in space and time, and other features as necessary to ensure sufficient confidence levels and statistical power. However, this may often not be possible on the central Platte due to small target species sample size, natural variation, limited ability to develop replicates, and other challenges to sound experimental design. In these cases, the design will acknowledge these limitations and contemplate implications for the value of the resulting information and consequences for interpretation of results and decision-making. In essence, active AM actions on the Platte will be undertaken in what is termed a "quasi' experiment" where spatial and temporal controls can be utilized but the typical experimental components of replicates and randomness are difficult to incorporate or unavailable (Williams et al., 2002).

## Management Action Implementation

Implementation of management actions lies at the heart of the process of "learning by doing." During this step of the AM cycle, management treatments are implemented or constructed within the context of the implementation experimental design. Implementation will typically be contracted, often to construction contractors who have not been involved in the design process. The potential need for design modifications during construction necessitate that experiment design team remain engaged through implementation.

## Monitoring and Data Synthesis

Monitoring plan and protocol development is a vital part of implementation design with special emphasis on monitoring to collect "need to know" information that will be used to evaluate management action performance. Monitoring will fall into three categories:

- ☐ **Implementation monitoring –** Monitoring to determine if management actions are being implemented according to design requirements and standards.
- ☐ **Effectiveness monitoring –** Monitoring of physical habitat performance indicators to determine if management actions are achieving, or moving towards, management experiment performance criteria.
- ☐ **Validation monitoring –** Target species use and selection monitoring to determine if target species are responding to management actions and/or Program is making progress towards achieving management objectives.

In order to facilitate timely decision-making, data synthesis should occur annually. Program monitoring and data synthesis will typically be conducted by contractors working with the Executive Director's Office (**EDO**) to synthesize and integrate results of multiple monitoring protocols. The Program will also host annual monitoring reporting sessions that will bring together all Program contractors to present the results of their monitoring efforts. This collaborative sharing of experience and information will be vital in fostering joint understanding of Program objectives, actions and outcomes.

## Performance Evaluation

Performance evaluation provides the path from data to management decision-making. Implementation designs will identify performance criteria and actions to be taken under various outcomes. Analysis, evaluation, and reporting of monitoring data provide the information needed to build performance evaluations that policymakers will use to close the AM loop and adjust actions. The Program will use mock performance evaluations (using synthetic data) during the implementation design process to ensure that actual performance evaluations generate the kind of information that decision-makers want or expect.

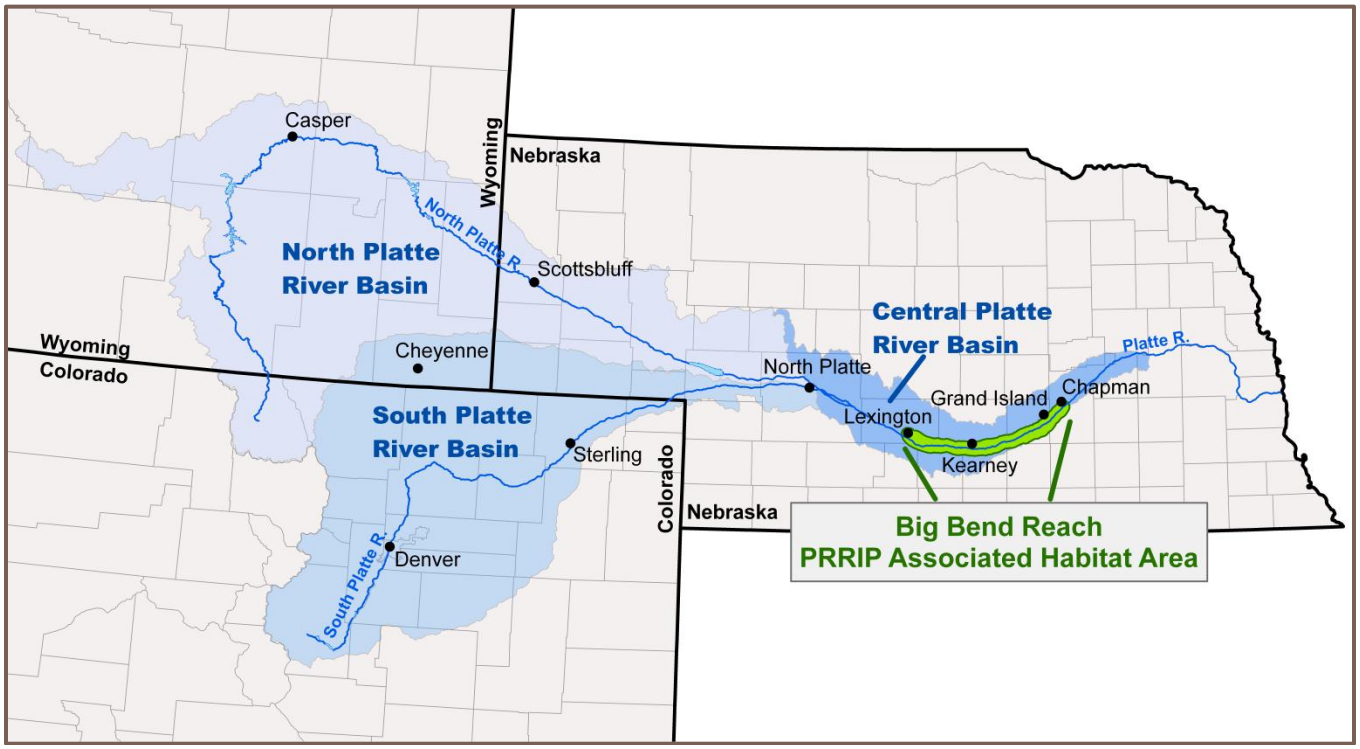
## Action Adjustment

Two types of action adjustments are contemplated in this plan. The first type is management action adjustments that are dictated by management experiment performance. These adjustments are contemplated during the implementation design process and are critical to successful implementation of AM. These adjustments could be as minor as changing the date when annual sediment augmentation operations commence or as significant as repurposing Program flow releases. The second type of action adjustment is suspension or termination of actions due to impact triggers. During management experiment implementation, negative impacts caused by Program actions may occur on or off of Program lands. Implementation design will include impact triggers associated with implementation and effectiveness monitoring. If indicator values surpass impact trigger thresholds, management action implementation activities will be suspended and a viability assessment will occur. That assessment will provide Program decision-makers with mitigation and/or management action modification options. If impacts cannot be avoided or mitigated, a management experiment may be terminated.

# EXTENT AND SCALE OF AM IMPLEMENTATION | FOUR

AM activities will primarily occur in the central Platte River region (Lexington to Chapman, Nebraska) which is referred to as the associated habitats for the Program's three target bird species. The Program will also conduct pallid sturgeon research and monitoring on a reach of the lower Platte River below the Elkhorn River confluence, which is considered to be the associated habitats for that species. Since all of the Program management actions and the vast majority of the research and monitoring will occur in the Central Platte River associated habitats, this section of the implementation plan will focus on the extent and scale of actions in this ninety mile reach in central Nebraska (Figure 3).

FIGURE 3 - THE CENTRAL PLATTE RIVER ASSOCIATED HABITATS




## System-Level Activities and Actions

### System-Level Monitoring and Research Activities

**Almost all of the property in the central Platte River associated habitats is held in private or non-governmental organization (NGO) ownership**. In Nebraska, property ownership rights extend to the bed of the stream. Thus, it is legal to navigate the Platte River by boat but disembarking and wading is a trespass violation. This makes it vital that the Program work closely with landowners to obtain permission to implement system-level conservation monitoring protocols on private property. Currently, the Program has written agreements with approximately 140 landowners that grant access to carry out the Program's system-level monitoring activities. System-level monitoring includes geomorphology and vegetation monitoring and target species use and selection research and monitoring. The purposes and objectives of these efforts are discussed in subsequent sections of this plan. In general, they allow the Program to document system-level physical habitat parameters and species use and selection trends.

### System-Level Management Actions

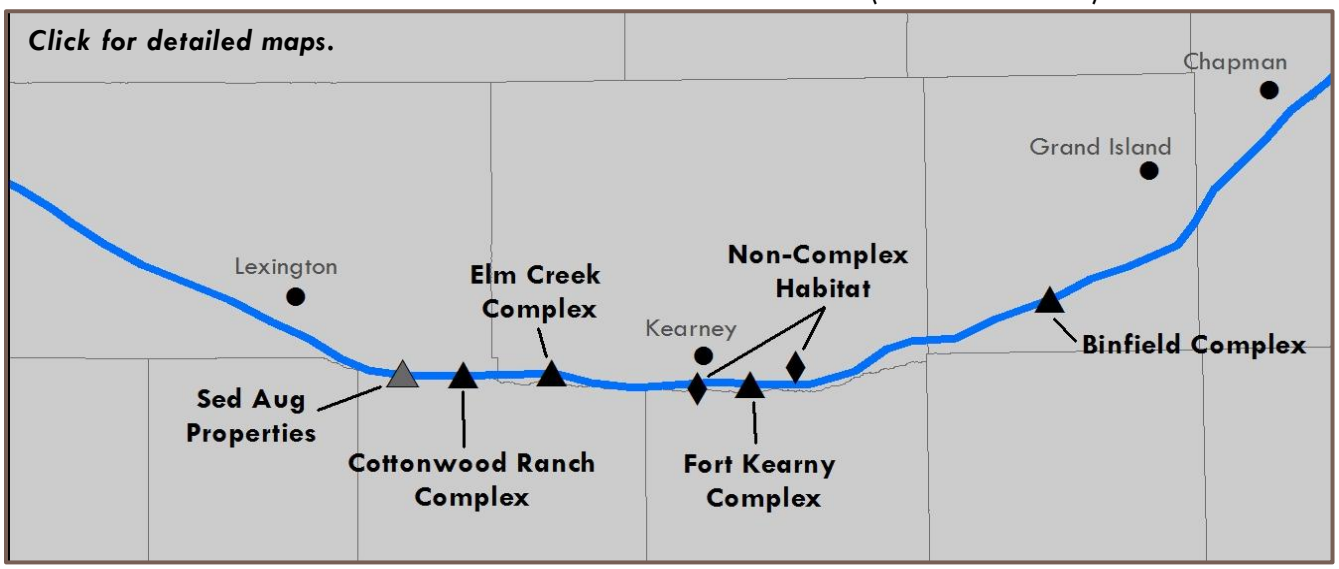
Two Program AM actions will affect the associated habitats at a system-level. They are sediment augmentation and flow releases (SDHF and target flows). Both actions are part of the FSM management strategy and will occur near or upstream of the west end of the associated habitats. Flow and sediment introduced by the Program will be conveyed downstream through the entire reach, affecting the entirety of the channel within the associated habitats. System-level FSM actions will be a complicating factor in evaluating species use and selection of riverine MCM habitat, as riverine MCM habitats cannot be isolated from the effects of FSM actions.

## Habitat Complexes and Non-Complex Habitat

The Program has targeted acquisition of a minimum of 10,000 acres of habitat within the associated habitats by year nine of the First Increment (PRRIP, 2006b). As of January 2011, the Program has secured an interest in approximately 8,000 acres and has executed management agreements to implement management experiments on several hundred additional acres. Progress to date indicates that land acquisition will be substantially complete well ahead of the year nine land milestone. The 10,000 acres that the Program acquires are to be in the form of complex and non-complex habitats with the majority (9,200 acres) to be complex habitat organized into five complexes consisting of channel areas, wet meadow and buffer. The 800 acres of non-complex habitat is to be comprised of 400 acres of off-channel tern and plover nesting habitat and 400 acres of palustrine wetland for whooping crane use.

Habitat complexes comprise the basic functional unit for organization and implementation of non-system-level AM actions and activities. Some non-complex lands will be acquired in areas where the Program is not developing a habitat complex, but generally, non-complex lands will be acquired in the vicinity of habitat complexes for the purpose of evaluating species use and selection of complex versus non-complex habitats. To date, the Program has completed acquisition at two habitat complexes, has partially completed acquisition at two habitat complexes and is seeking to begin acquisition at a fifth. The Program has also acquired a limited amount of complex habitat near the upper end of the associated habitats that will be used for sediment augmentation operations. Approximately 25% of the non-complex habitat has been acquired to date. All of that area is in the form of off-channel tern and plover nesting habitat. Figure 4 presents the location of existing habitat complexes and non-complex habitat. Detailed maps are located in Appendix B.

FIGURE 4 - HABITAT COMPLEXES AND NON-COMPLEX HABITAT (JANUARY 2011)



## Activities and Actions on Non-Program Lands

As mentioned previously, the Program has executed access agreements with landowners along the entire associated habitats for the purpose of carrying out system-level conservation monitoring and research. The Program also has the opportunity to increase the scope and extent of AM management actions by partnering with existing conservation and utility landowners that already own and manage target species habitat. In some cases the Program may be able to conduct species use and selection research on habitat that is currently being managed to provide benefits to the target species. In other cases, the Program may enter into management agreements with the landowner that allow the Program to implement management experiments on non-Program lands. These types of agreements will be considered to be opportunistic in nature and will be pursued as long as the Program maintains adequate resources to fulfill restoration and maintenance obligations on Program lands.

*Construction of off-channel tern and plover nesting habitat at Cottonwood Ranch habitat complex for "paired" riverine versus off-channel habitat selection study.*

# SPECIES-CENTRIC AM ACTIVITIES | FIVE

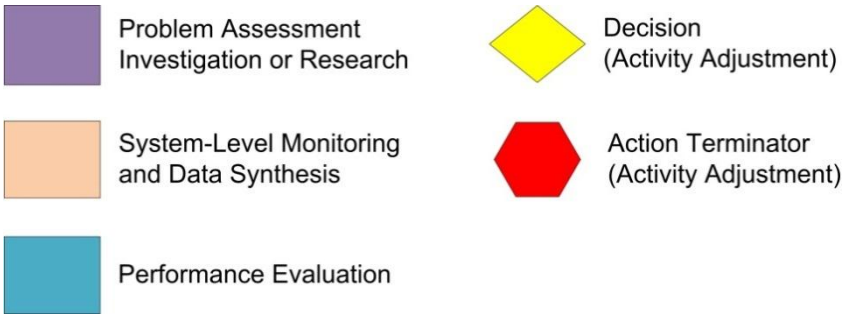
Target species use and selection research and monitoring plays a central role in establishing performance criteria for management experiments and will serve as validation monitoring for those experiments; allowing the Program to determine if target species respond to or select for habitats associated with the FSM and MCM management strategies. **Because Program target species monitoring and research activities are universal in nature, they are presented in this plan by species with implied linkages to every problem assessment, management experiment implementation design, and performance evaluation taken under both management strategies.** The remainder of this section presents action diagrams for the Program's four target species as well as a brief discussion of the Program's approach to non-target listed species and non-listed species of concern.

## Whooping Crane

First Increment whooping crane (**WC**) research and monitoring activities are focused on improving the Program's understanding of WC use and selection as the natural WC flock passes through the associated habitats during the annual spring and fall migration. The Program will monitor and record physical habitat characteristics and behavior at use sites and analyze that data for the purpose of informing management experiment performance criteria and evaluating species response to actions taken under the FSM and MCM management strategies.

In the AMP, wet meadows are addressed within the context of WC use and suitability. **As such, wet meadow research and investigations are presented in this plan as species-centric activities.** If, at some point, the Program wishes to address wet meadow uncertainties outside of a species context, (IE, as a management action to be taken under one of the management strategies) a wet meadows-specific problem assessment would need to be initiated by the Program's Governance Committee (**GC**). Figure 5 presents a legend for all of the action diagrams in this section of the plan. Figure 6 presents a draft action diagram that outlines planned progressions of WC-focused activities and information flow throughout the First Increment. Abbreviated explanatory notes accompany the diagram. More detailed explanatory information for activities in diagram is located in Appendix C.

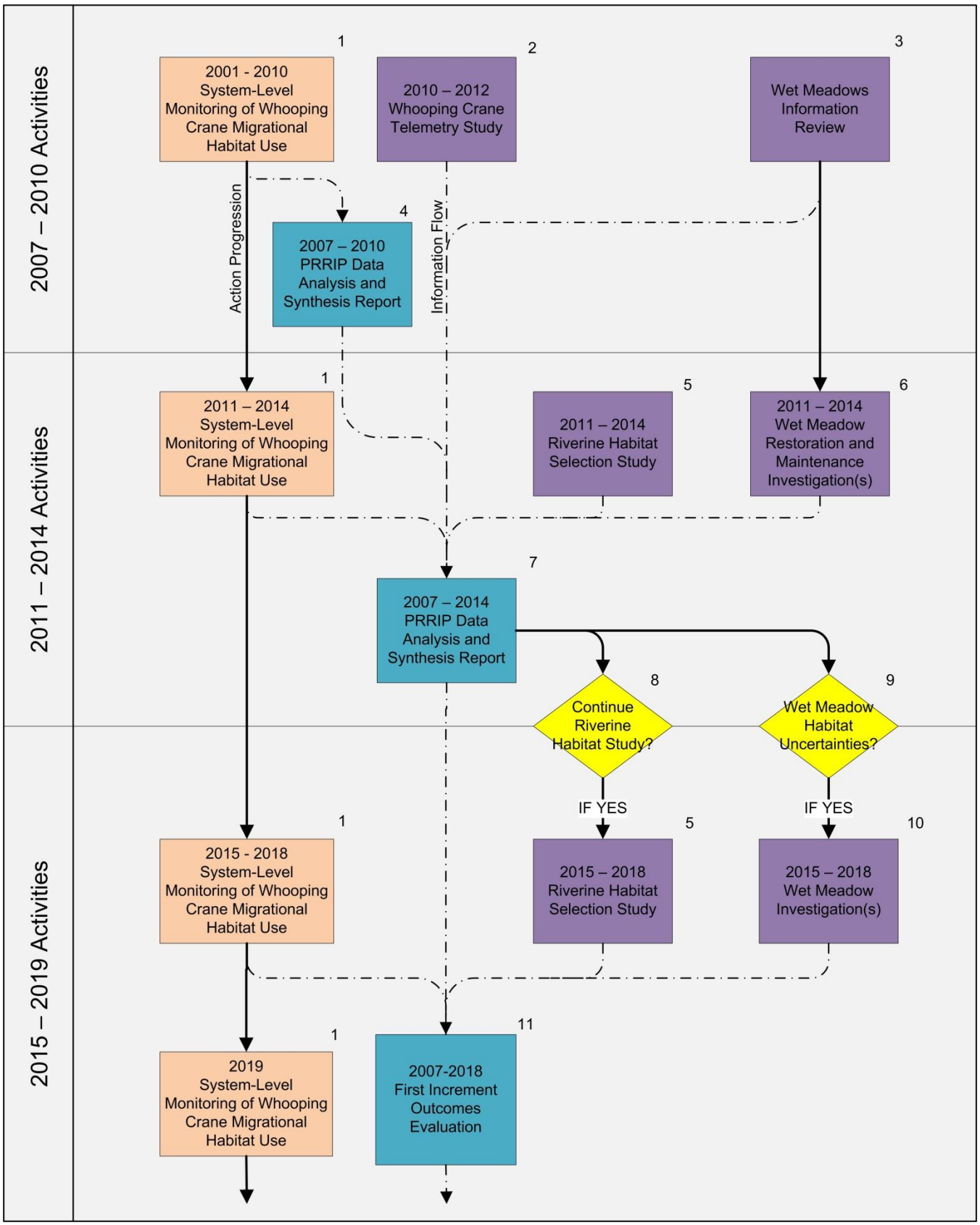
FIGURE 5 - ACTION DIAGRAM LEGEND




***ACTION DIAGRAM INTERACTIVE FEATURES:***

***The action diagrams in this plan contain hyperlinks to additional information located in plan appendices. When viewing using Adobe Reader, you can navigate between diagrams and associated appendices using the Next View and Previous View buttons on the Page Navigation toolbar. You can view the action diagrams and explanatory notes simultaneously in Adobe Reader by changing the Page Display option under the View menu to Two-Up and checking the Show Cover Page During Two-Up option at the bottom of that menu.***

FIGURE 6 - WHOOPING CRANE ACTIVITY DIAGRAM



## WHOOPING CRANE ACTIVITY DIAGRAM EXPLANATORY NOTES

1. Annual system-level whooping crane monitoring to detect WC stopovers in the associated habitat reach, identify the locations of use and crane group movements in the reach, qualitatively document crane group activities at use-sites and document physical and/or biological characteristics of use-sites. Protocol is implemented during the spring and fall migration and is based on daily aerial surveys and opportunistic locates. Data on WC habitat use is compiled and summarized annually.

2. Telemetry study to gain a better understanding of WC stopover areas, habitat use patterns, and factors influencing habitat use at different spatial and temporal scales; define a current migratory route; and identify causes, locations, and conditions of actual or potential mortality.

3. Comprehensive review and summary of information related to wet meadows along the Platte River in central Nebraska; wet meadow hydrology; and the biological, physical and chemical composition of wet meadows as they pertain to use by WC and other species, including PRRIP species of concern. Review will assist PRRIP in identifying the best candidate wet meadow sites to acquire and protect/restore, understand how to best manage and/or restore the sites it does acquire, and implement research activates that are most likely to address critical gaps in knowledge about the characteristics and functionality of wet meadows.

4. Analysis and synthesis of 2007 – 2010 PRRIP target species and physical process data to evaluate progress towards addressing the Program's Big Questions and associated hypotheses. Results will be used to update minimum and target WC habitat criteria.

5. Manipulation of riverine habitat at PRRIP habitat complexes to create a range of active channel and unobstructed view widths. WC response (use) will be used to refine or validate PRRIP minimum and target riverine habitat criteria.

6. Development of wet meadow restoration design criteria (focus on WC use), restoration of candidate wet meadow sites, and management of restored sites for WC use.

7. Analysis and synthesis of 2007 – 2014 PRRIP target species, physical process research and management experiment data to evaluate progress towards addressing the Program's Big Questions and associated hypotheses. Results will be used to evaluate physical process relationships and response to PRRIP actions, update minimum and target WC habitat criteria and evaluate WC response to management actions.

8. Have uncertainties related to minimum and target riverine habitat criteria for WC use been adequately addressed?

9. Do uncertainties remain in relation to restoration and management of wet meadows for WC use?

10. Investigation(s) as necessary to address remaining wet meadow uncertainties.

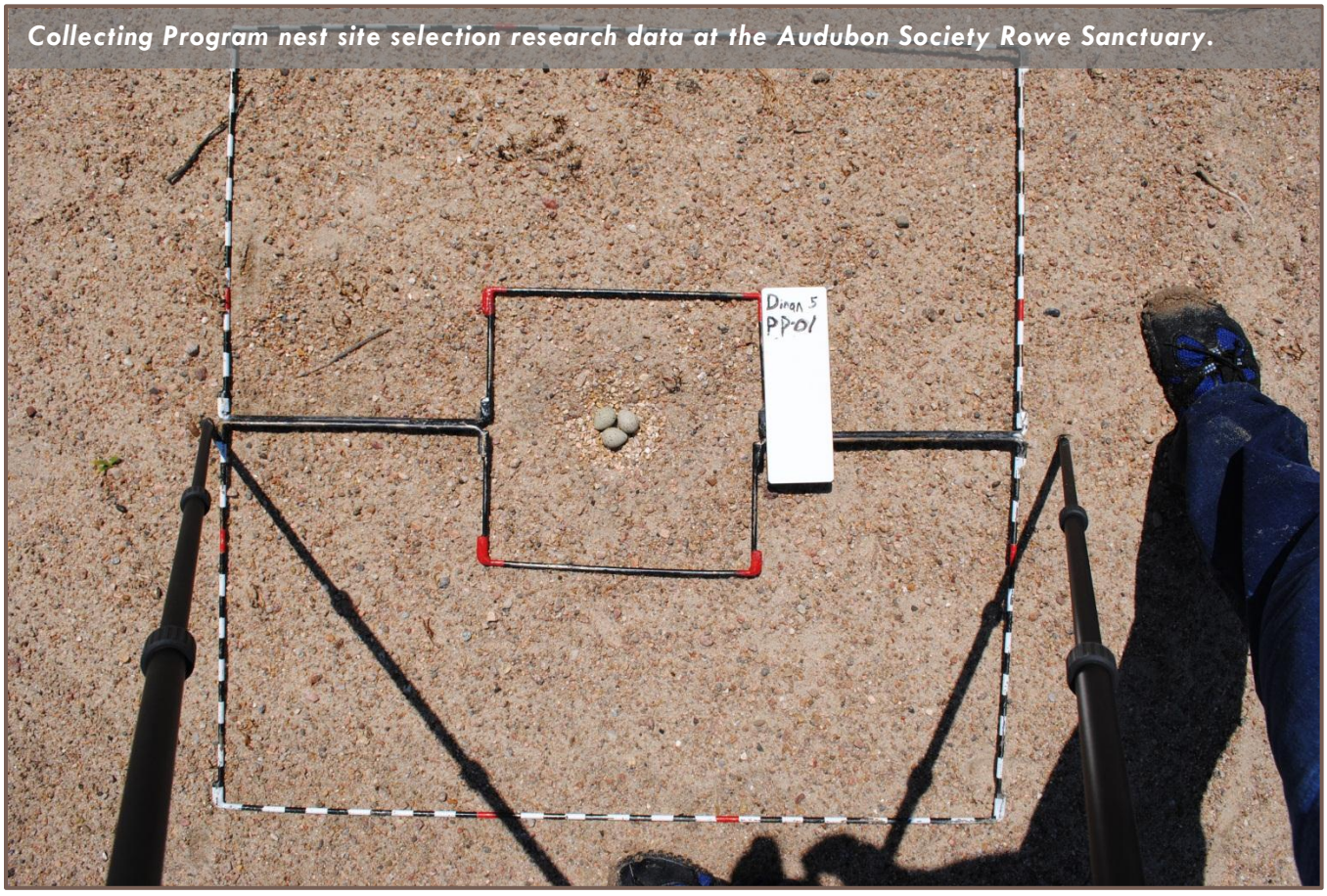
11. Analysis and synthesis of 2007 – 2018 PRRIP target species, physical process, and management experiment outcomes to evaluate progress towards addressing the Program's Big Questions and associated hypotheses. Results will be used to evaluate the performance of the two management strategies and develop a range of management actions that could be taken in the Second Increment.

## Interior Least Tern and Piping Plover

First Increment interior least tern (**LT**) and piping plover (**PP**) monitoring and research activities are focused on improving the Program's understanding of LT and PP use, selection and productivity on in-channel and off-channel nesting habitat. In order to do so, the Program will construct and maintain a continuum of potential nesting habitat with a range of physical characteristics and monitor habitat and productivity metrics at nest locations. That data will be used to establish management experiment performance criteria and to evaluate species response to actions taken under the FSM and MCM management strategies.

LT and PP have unique life histories but are often referred to collectively in Program documents due to their use of the same riverine and off-channel nesting habitats. The LT and PP action diagram has been combined for this reason. However, please note that all research and monitoring data collection and analyses are conducted independently for each species. Figure 7and Figure 8 present a draft action diagram that outlines planned progressions of LT and PP activities and information flow throughout the First Increment. Abbreviated explanatory notes accompany the diagram. More detailed explanatory information for diagram activities can be found in Appendix C.

*Collecting Program nest site selection research data at the Audubon Society Rowe Sanctuary.*



## Pallid Sturgeon

The pallid sturgeon (**PS**) action diagram differs from the other target species diagrams in that it is primarily focused on activities that will allow the Program to evaluate and mitigate for potential adverse impacts of Program actions on PS populations. This is in accordance with the Program's management objective for PS which is essentially a "do no harm" objective (see Section One). Figure 9 and Figure 10 present a draft action diagram that outlines PS-focused activities and information flow throughout the First Increment. Abbreviated explanatory notes accompany the diagram. More detailed explanatory information related to diagram activities is located in Appendix C.

## Other Species of Concern

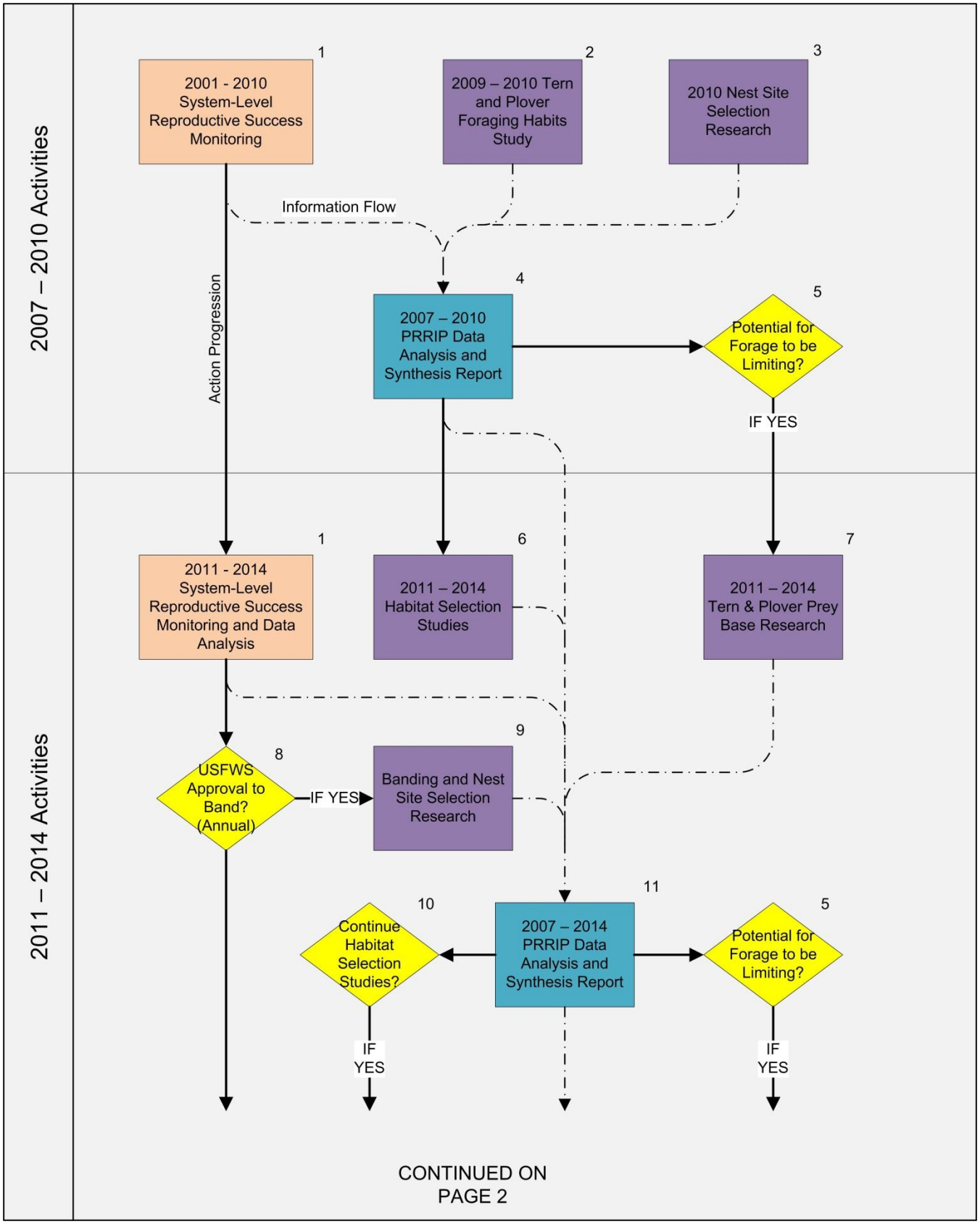
The Program has a commitment to provide benefits to non-target listed species and non-listed species of concern and reduce the likelihood of future listing of these species. This is to be accomplished within the context and to the degree that is compatible with providing benefits to the Program's target species. Essentially, the Program is to avoid (to the degree possible) negatively impacting these species and is to provide benefits to the degree that doing so is consistent with or complementary to benefitting the target species. The list of other species of concern is located in the Program's Land Plan (PRRIP, 2006b) and includes:

- Bald eagle
- Sandhill crane
- River otter
- American burying beetle
- Platte River caddisfly
- Regal fritillary
- Western prairie fringed orchid
- Saltwort
- Mussels – various species

The Program will adhere to the following guidelines for addressing non-listed species of concern and non-target listed species from an AM implementation standpoint:

1. Program lands will be surveyed after acquisition to determine presence or absence of these species (if appropriate habitats exist).
2. Additional research or monitoring will limited to specific instances where it is unknown whether or not Program actions to benefit the target species will cause negative impacts to a population of one of these species.
3. The Program will seek to avoid impacts to known populations. If impacts cannot be avoided, they will be minimized and/or mitigated through consultation with the USFWS and Nebraska Game and Parks Commission (**NGPC**).
4. The USFWS and NGPC will provide a description of habitat requirements for these species. The Program will manage for species of concern habitat characteristics that are consistent with or complementary to Program species habitat.
5. The Program will not conduct validation monitoring to determine if there is a species response to Program actions.
6. If a Program participant wishes to address uncertainties related to a species of concern under the Programs AMP, the GC must approve the initiation of a formal problem assessment.

FIGURE 7 - TERN AND PLOVER ACTIVITY DIAGRAM (PAGE 1 OF 2)



## TERN AND PLOVER ACTIVITY DIAGRAM PAGE ONE EXPLANATORY NOTES

1. Annual system-level LT and PP monitoring to locate LT and PP nests, monitor the reproductive success and reproductive habitat parameters at LT and PP colonies, document long term trends in reproductive and habitat parameters, and evaluate LT and PP response to actions taken under the FSM and MCM management strategies.

2. Investigation to quantify frequency and distance of LT and PP movements away from nesting colonies on off-channel and riverine habitats; quantify time allocation to foraging and foraging success rate; quantify features of foraging habits used; and evaluate linkages between indices of productivity and measures of foraging effort for LT and PP.

3. Research to quantify macro- and micro-scale habitat parameters associated with LT and PP nest initiation and nest and brood survival and evaluate influences the FSM and MCM management strategies have on habitat availability and nest-site selection and reproductive success of LT and PP. A second-tier objective is to assess the impacts of research activities on LT and PP nest and brood survival rates.

4. Analysis and synthesis of 2007 – 2010 PRRIP target species and physical process data to evaluate progress towards addressing the Program's Big Questions and associated hypotheses. Results will be used to update LT and PP minimum and target habitat criteria.

5. Does the analysis and synthesis of 2007 – 2010 LT and PP data indicate that forage availability or suitability may be limiting LT or PP productivity?

6. Creation and maintenance of a continuum of in-channel LT and PP habitat at Program habitat complexes and opportunistic locations to evaluate species use and selection across a range of nesting island sizes and heights. Creation and maintenance of off-channel LT and PP nesting habitat in proximity to in-channel habitat to evaluate use and selection between the habitat types.

7. Monitoring of system-level abundance, distribution, and species diversity of forage fish and/or invertebrates (prey base) on riverine and off-channel habitats. Quantification of availability and suitability of forage for LT and PP nesting and brood-rearing. Evaluate the influence the FSM and MCM management strategies have on forage abundance and suitability.

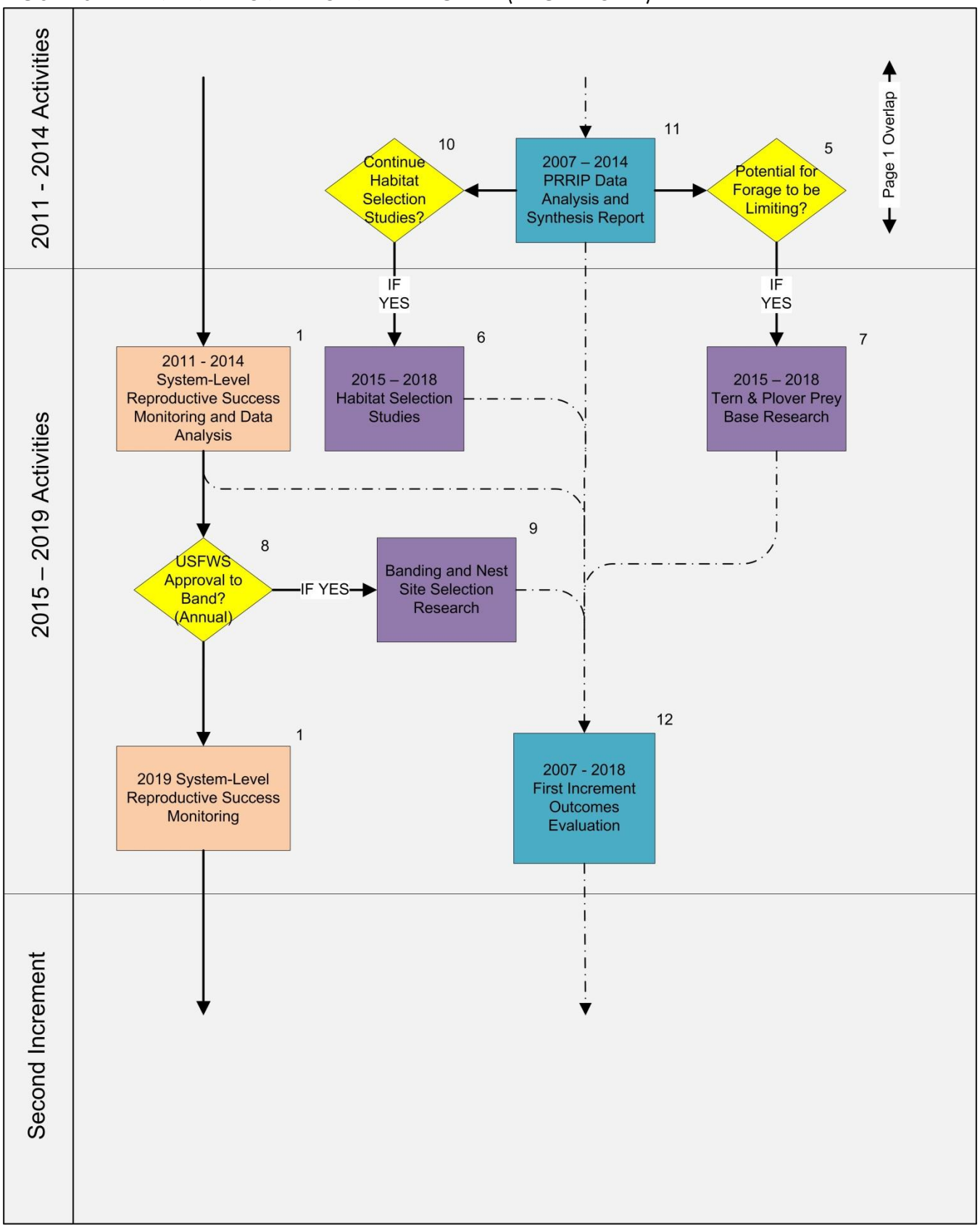
8. Has the United States Fish and Wildlife Service (USFWS) determined that the LT and PP populations nesting in the associated habitats have increased sufficiently to allow the Program to resume banding and nest site selection research? Decision will be made annually based on analysis of system-level LT and PP monitoring data.

9. Banding of LT and PP adults and chicks to allow the Program to evaluate interaction of riverine and off-channel nesting habitat, determine whether or not riverine habitat and/or off-channel habitat is a source or sink for LT and PP populations, and evaluate how central Platte LT and PP populations relate to overall population recovery objectives. Nest site selection research discussed above in #3.

10. Should habitat selection studies be continued in an effort to further reduce uncertainty related to LT and PP use and selection of in-channel and off-channel habitats?

11. Analysis and synthesis of 2007 – 2014 PRRIP target species, physical process and management experiment data to evaluate progress towards addressing the Program's Big Questions and associated hypotheses. Results will be used to evaluate physical process relationships and response to PRRIP actions, update LT and PP minimum and target habitat criteria and evaluate LT and PP response to management actions.

FIGURE 8 - TERN AND PLOVER ACTIVITY DIAGRAM (PAGE 2 OF 2)



TERN AND PLOVER ACTIVITY DIAGRAM PAGE TWO EXPLANATORY NOTES

1. Annual system-level LT and PP monitoring to locate LT and PP nests, monitor the reproductive success and reproductive habitat parameters at LT and PP colonies, document long term trends in reproductive and habitat parameters, and evaluate LT and PP response to actions taken under the FSM and MCM management strategies.

5. Does the analysis and synthesis of 2007 – 2014 LT and PP data indicate that forage availability or suitability may be limiting LT or PP productivity?

6. Creation and maintenance of a continuum of in-channel LT and PP habitat at Program habitat complexes and opportunistic locations to evaluate species use and selection across a range of nesting island sizes and heights. Creation and maintenance of off-channel LT and PP nesting habitat in proximity to in-channel habitat to evaluate use and selection between the habitat types.

7. Monitoring of system-level abundance, distribution, and species diversity of forage fish and/or invertebrates (prey base) on riverine and off-channel habitats. Quantification of availability and suitability of forage for LT and PP nesting and brood-rearing. Evaluate the influence the FSM and MCM management strategies have on forage abundance and suitability.

8. Has the United States Fish and Wildlife Service (USFWS) determined that the LT and PP populations nesting in the associated habitats have increased sufficiently to allow the Program to resume banding and nest site selection research? Decision will be made annually based on analysis of system-level LT and PP monitoring data.

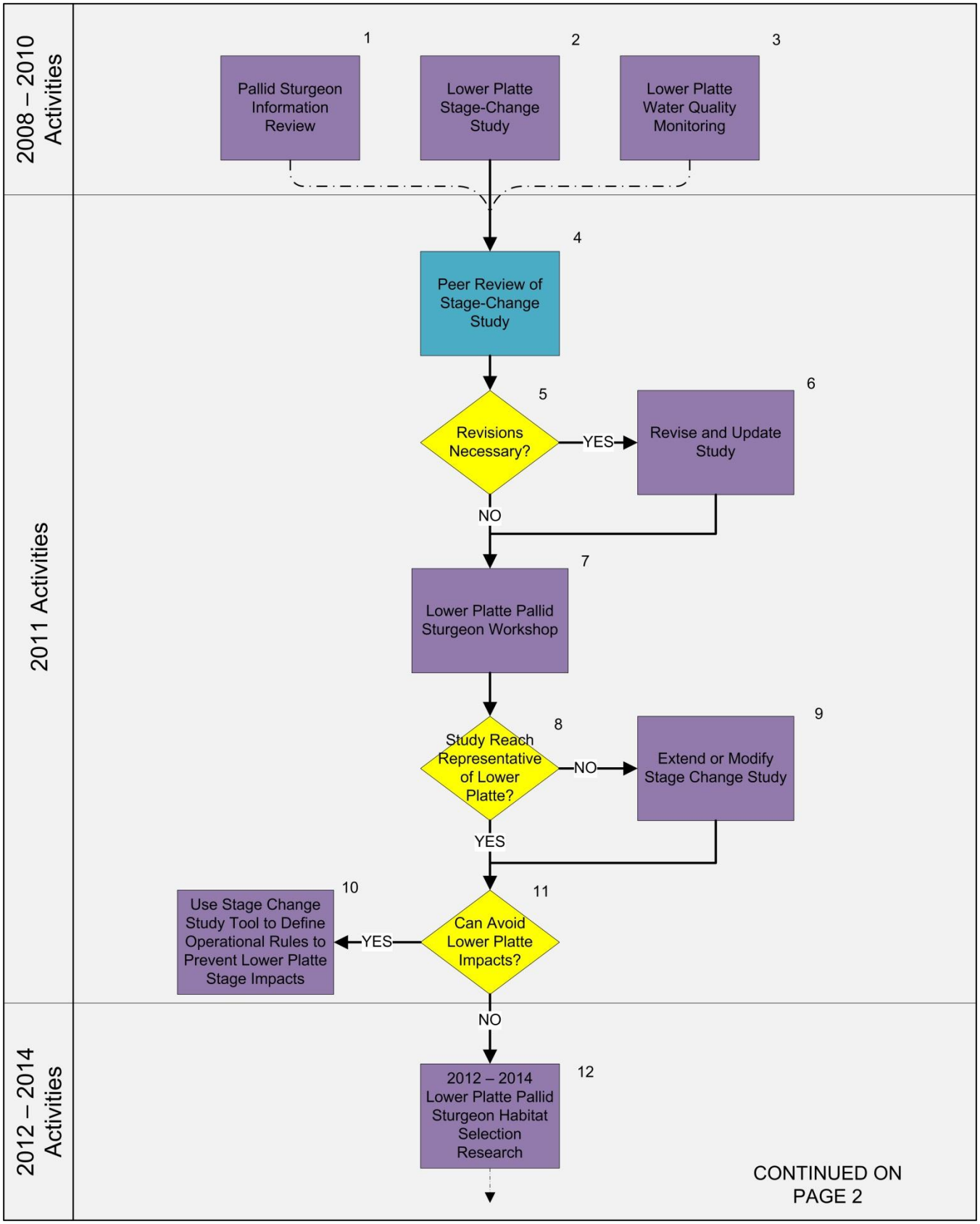
9. Banding of LT and PP adults and chicks to allow the Program to evaluate interaction of riverine and off-channel nesting habitat, determine whether and whether or not riverine habitat and/or off-channel habitat is a source or sink for LT and PP populations, and evaluate how central Platte LT and PP populations relate to overall population recovery objectives. Nest site selection research discussed above in #3.

10. Should habitat selection studies be continued in an effort to further reduce uncertainty related to LT and PP use and selection of in-channel and off-channel habitats?

11. Analysis and synthesis of 2007 – 2014 PRRIP target species, physical process and management experiment data to evaluate progress towards addressing the Program's Big Questions and associated hypotheses. Results will be used to evaluate physical process relationships and response to PRRIP actions, update LT and PP minimum and target habitat criteria and evaluate LT and PP response to management actions.

12. Analysis and synthesis of 2007 – 2018 PRRIP target species, physical process, and management experiment outcomes to evaluate progress towards addressing the Program's "Big Questions" and associated hypotheses. Results will be used to evaluate the performance of the two management strategies and develop a range of management actions that could be taken in the Second Increment.

FIGURE 9 - PALLID STURGEON ACTIVITY DIAGRAM (PAGE 1 OF 2)



## PALLID STURGEON ACTIVITY DIAGRAM PAGE 1 EXPLANATORY NOTES

1. Comprehensive review and summary of information related to the life history, occurrence and habitat selection and use of the PS encompassing information from throughout the species' range and in particular emphasis on information related to PS use of and occurrence in the middle Missouri River and the Lower Platte River below its confluence with the Elkhorn River, Nebraska.

2. Study to develop the information needed to evaluate the effects of Program water management activities, including new activities covered by state and federal depletion plans, on water stage and how those stage changes affect physical parameters in the reach of the lower Platte River from the Elkhorn River confluence to the Missouri River confluence. The intent was to determine if Program water activities can be statistically identified (significant beyond the error of the gauging equipment) from base flow conditions and if Program water activities have a statistically significant impact on stage, velocity, temperature, turbidity, substrate, or channel morphology.

3. Monitoring of the spatial and temporal variation of selected water quality parameters in the lower Platte River as well as the comparative contributions of the various sub-basins.

4. Peer review of stage change study to evaluate scientific soundness, organization, and degree to which conclusions are supported by the data.

5. Did the peer review identify technical gaps or deficiencies that need to be addressed?

6. Revisions and updates to technical analysis to address gaps and/or deficiencies.

7. Workshop with TAC members, ISAC members, and PS experts from the Platte and Missouri Rivers. Workshop discussion to focus on use of the stage-change study model tool to quantify and/or avoid potential Program impacts to the PS.

8. Is the stage-change study reach representative for purposes of further applying the study tool to evaluate and/or mitigate potential impacts?

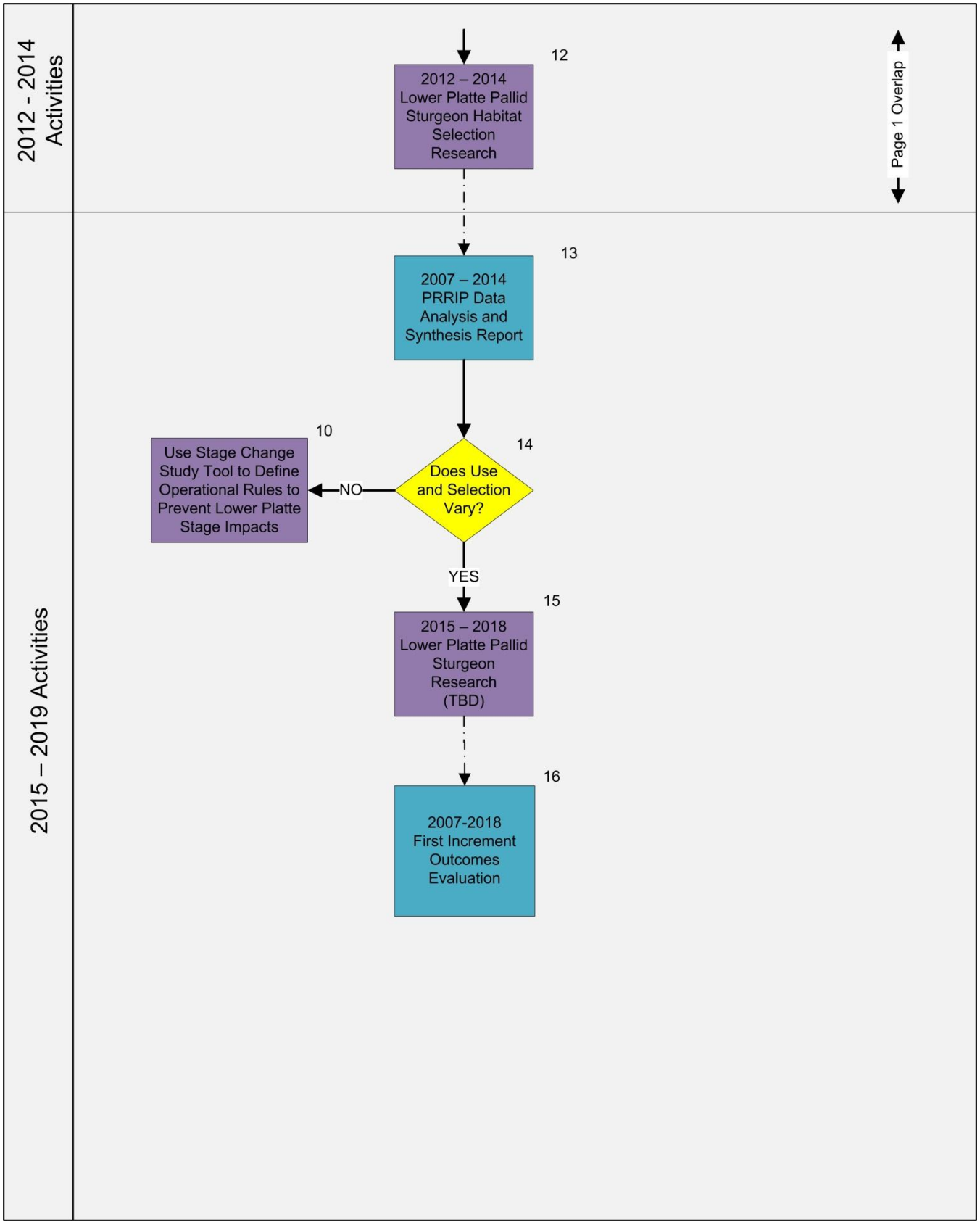
9. Extend or modify stage-change study model tool to make representative.

10. Initiate Program planning process to utilize stage-change study tool to develop water management operational rules that avoid impacts to the PS in the lower Platte.

11. Does the stage-change study tool predict that the Program can manage water (depletions and releases) in such a way as to avoid impacts to PS in the lower Platte?

12. Participate in PS habitat selection research on the lower Platte River to determine what habitats PS use and select for in the lower Platte River and if selection changes with changes in river conditions.

FIGURE 10 - PALLID STURGEON ACTIVITY DIAGRAM (PAGE 2 OF 2)



## PALLID STURGEON ACTIVITY DIAGRAM PAGE 2 EXPLANATORY NOTES

10. Initiate Program planning process to utilize stage-change study tool to develop water management operational rules that avoid impacts to the PS in the lower Platte.

12. Participate in PS habitat selection research on the lower Platte River to determine what habitats PS use and select for in the lower Platte River and if selection changes with changes in river conditions.

13. Analysis and synthesis of 2007 – 2014 PRRIP target species, physical process and management experiment data to evaluate progress towards addressing the Program's Big Questions and associated hypotheses. Results will be used to evaluate physical process relationships and potential for PS impacts due to PRRIP water management actions.

14. Does the 2011 – 2014 habitat selection research and data analysis and synthesis report indicate that PS habitat use and selection would change (and if so, how) given the potential magnitude of Program flow management and depletions impacts?

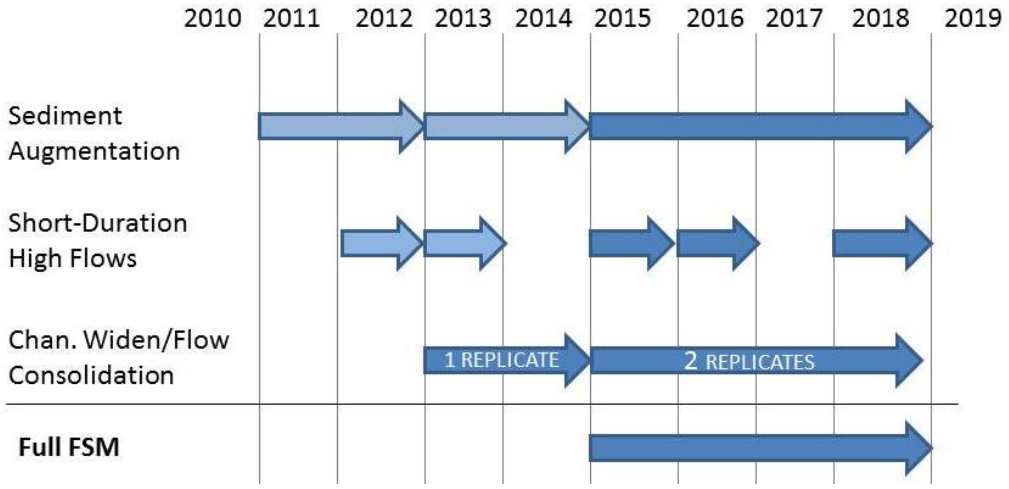
15. Participate in PS research that will assist the Program in better quantifying potential impacts due to Program water management. Possible research focuses include identification of sturgeon food habits, larval collection and identification of spawning habitat, and characterization of the relationship of flow regime and sediment transport to habitat creation/maintenance.

16. Analysis and synthesis of 2007 – 2018 PRRIP target species, physical process, and management experiment outcomes to evaluate progress towards addressing the Program's Big Questions and associated hypotheses. Results will be used to evaluate the performance of the two management strategies and develop a range of management actions that could be taken in the Second Increment.

# FLOW-SEDIMENT-MECHANICAL MANAGEMENT STRATEGY | SIX

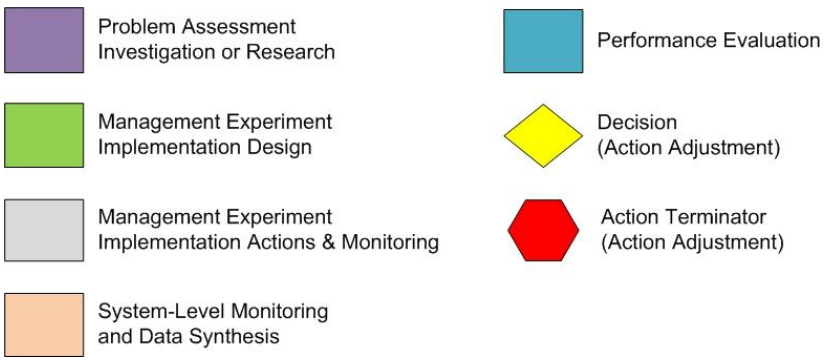
The flow-sediment-mechanical (FSM) management strategy focuses on the use of flow in conjunction with sediment augmentation and mechanical channel manipulation to create and/or maintain target species habitat. Program Big Question #3 (Table 1) summaries the overarching uncertainty and learning objectives related to this strategy. **The Program is approaching FSM AM implementation planning on both strategy and individual action scale. This means that implementation of SDHF, sediment augmentation and mechanical widening/flow consolidation will be conducted as AM experiments that will feed into the larger implementation design for the full FSM management strategy.** This is demonstrated in Figure 11 which shows AM experiment cycles for the individual actions as well as the single AM experiment iteration of the full FSM management strategy. The need to develop full-scale SDHF and sediment augmenation capacities is the limiting factor for implementation of the full FSM strategy and the reason only one cycle of full implementation will be possible during the first increment. The lightened arrows in Figure 11 are a representation of partial implementation capacity.

FIGURE 11 - FSM MANAGEMENT STRATEGY AM IMPLEMENTATION CYCLES




The remainder of this section is comprised of implementation action diagrams that present the critical actions, decisions and linkages associated with FSM implementation throughout the remainder of the First Increment. The actions presented in the diagrams correspond to the AM activities in Section Three and the diagrams are supported by notes that provide additional information and context to the actions. Figure 12 presents a legend for the diagrams.

FIGURE 12 - ACTION DIAGRAM LEGEND



## Sediment Augmentation

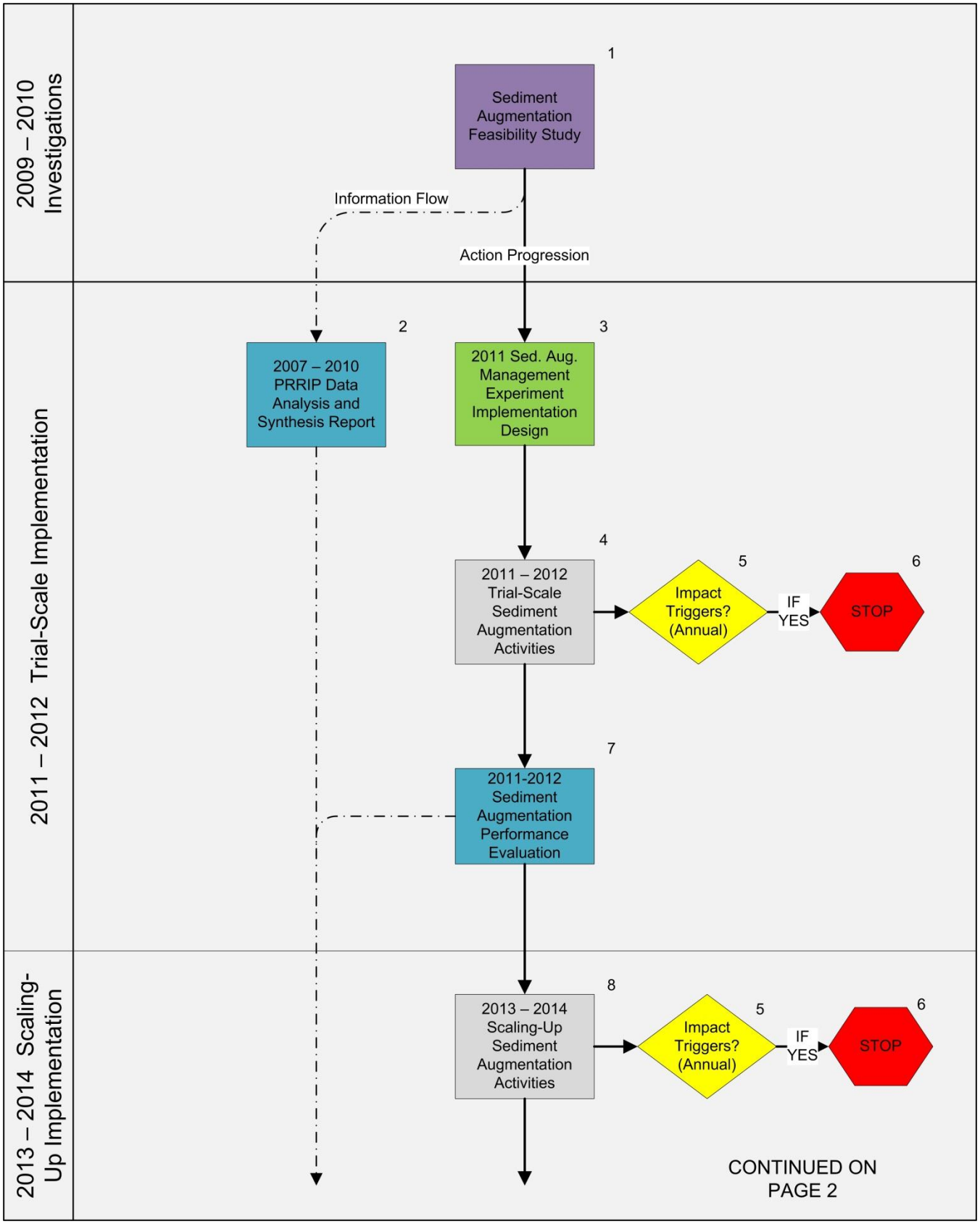
Three cycles of sediment augmentation management experiment implementation are envisioned in this plan. The first cycle would include implementation on a pilot-scale to reduce critical uncertainties associated with augmentation methods, locations and potential for negative impacts to downstream landowners. The second cycle is intended to evaluate augmentation performance and impacts as operations are scaled up to full implementation. The third cycle is expected to encompass the remainder of the First Increment and will focus on augmentation performance and outcomes. A management experiment cycle of two-years has been established as a reasonable period to evaluate the performance of the first two cycles of sediment augmentation implementation (pilot-scale and scaling-up) assuming that effectiveness monitoring is used in conjunction with hydraulic and sediment transport modeling as a basis for decision-making. Figure 13 and Figure 14 present a draft action diagram that outlines planned progressions of activities and information flow throughout the First Increment. Abbreviated explanatory notes accompany the diagram. More detailed explanatory information related to actions and activities is located in Appendix D.

*Sediment augmentation through mechanical channel widening at the Cottonwood Ranch habitat complex.*

***A NOTE ON IMPACT TRIGGERS:***

***Impact triggers are indicators that Program actions may result in physical impacts to neighboring landowners. Examples of possible impacts include channel aggradation resulting in channel avulsions, excessive bank erosion, violation of the National Weather Service flood stage, or other results of Program actions that violate the Program's Good Neighbor Policy. During management experiment implementation design, the Program will identify impact indicators and thresholds (triggers) that would automatically result in suspension of management experiment operations. Assessment of impact triggers will be a component of annual implementation and evaluation monitoring and data analysis.***

FIGURE 13 - SEDIMENT AUGMENTATION ACTION DIAGRAM (PAGE 1 OF 2)



SEDIMENT AUGMENTATION ACTION DIAGRAM PAGE 1 EXPLANATORY NOTES

1. Investigation to refine estimate of sediment shortage and investigate feasibility of sediment augmentation. Project includes 1-dimensional hydraulic and sediment transport modeling to refine sediment deficit estimate and model possible augmentation alternative locations and sediment gradations. Augmentation alternatives will be screened and ranked based on cost, implementability, and other factors. Critical uncertainties will be identified and addressed by designing augmentation implementation as an adaptive management experiment.

2. Analysis and synthesis of 2007 – 2009 PRRIP target species and physical process data to evaluate progress towards addressing the Program's Big Questions and associated hypotheses. Results will be used to update minimum and target species habitat criteria.

3. Development of integrated construction, monitoring and assessment design for the first generation sediment augmentation management experiment. Implementation will be in the form of an active adaptive management experiment designed to reduce uncertainty related to best augmentation methods and/or locations and inform second generation implementation design. Negative impact triggers will be established as part of the monitoring and evaluation portion of the design. Empirical analysis of monitoring data will be conducted annually and compared to impact triggers to determine if negative impacts are occurring.

4. Sediment augmentation management experiment activities include pilot-scale augmentation at approximately 65% of the modeled sediment deficit and annual effectiveness monitoring and data analysis. Augmentation activities would begin in the fall of 2011.

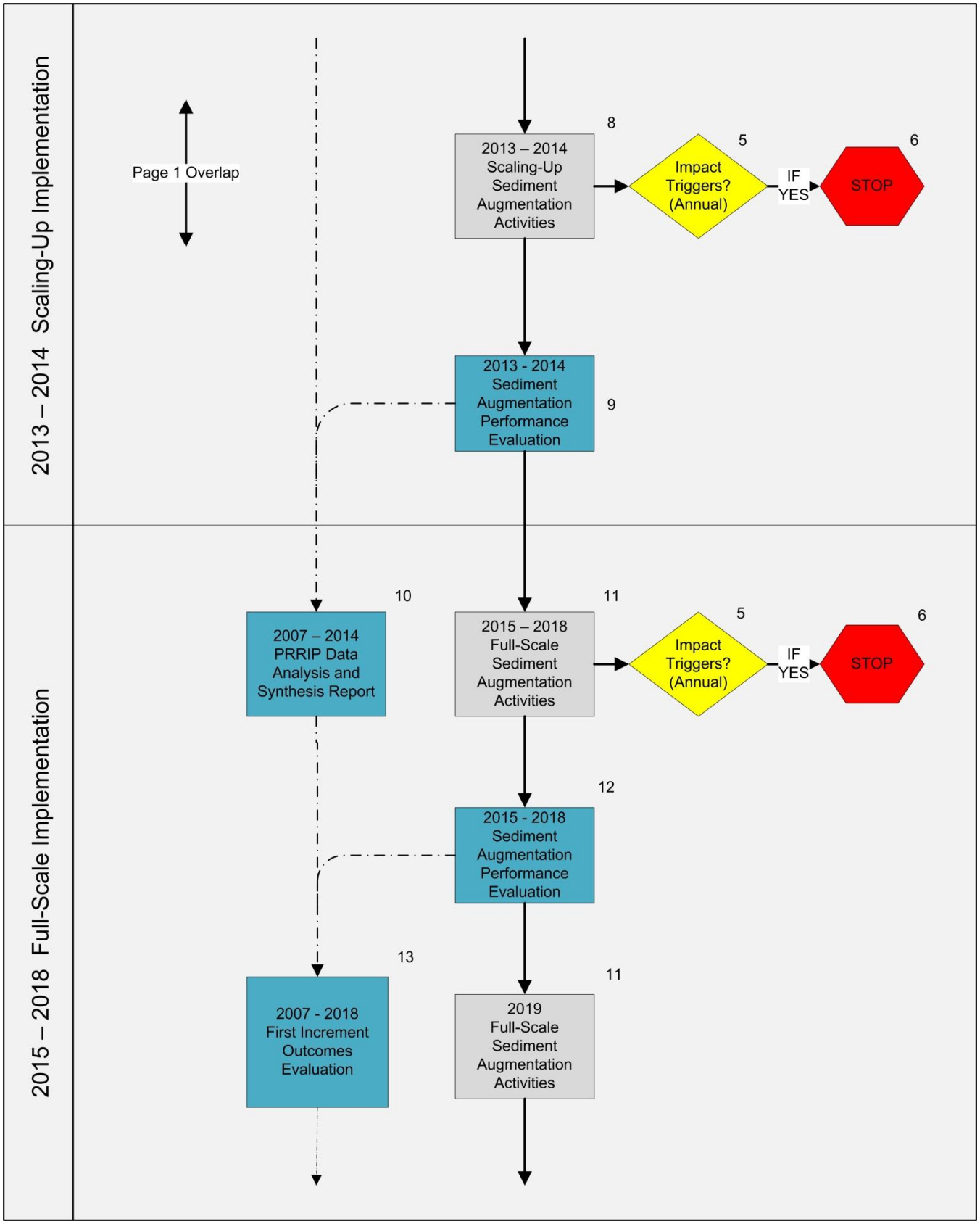
5. Does annual analysis of monitoring data indicate that an impact trigger has been surpassed?

6. Suspend sediment augmentation operations (including planned SDHF releases) and assess viability of continuing management experiment. Operations may resume with design alterations to mitigate negative impacts. If mitigation is not possible, facilities will be decommissioned and the experiment ended.

7. Syntheses and evaluation of sediment augmentation experiment monitoring data for the period of 2011-2012. Evaluate performance of pilot-scale augmentation activities and identify action adjustments for second generation implementation to facilitate scaling up to full augmentation.

8. Sediment augmentation management experiment activities include scaling up of augmentation from approximately 65% of the modeled sediment deficit to 100% of the deficit and annual effectiveness monitoring and data analysis.

FIGURE 14 - SEDIMENT AUGMENTATION ACTION DIAGRAM (PAGE 2 OF 2)



## SEDIMENT AUGMENTATION ACTION DIAGRAM PAGE 2 EXPLANATORY NOTES

5. Does annual analysis of monitoring data indicate that an impact trigger has been surpassed?

6. Suspend sediment augmentation operations (including planned SDHF releases) and assess viability of continuing management experiment. Operations may resume with design alterations to mitigate negative impacts. If mitigation is not possible, facilities will be decommissioned and the experiment ended.

8. Sediment augmentation management experiment activities include scaling up of augmentation from approximately 65% of the modeled sediment deficit to 100% of the deficit and annual effectiveness monitoring and data analysis.

9. Syntheses and evaluation of sediment augmentation experiment monitoring data for the period of 2013-2014. Evaluate performance as augmentation activities are scaled up and identify action adjustments for full-scale implementation of sediment augmentation to offset the entire deficit.

10. Analysis and synthesis of 2007 – 2014 PRRIP target species, physical process and management experiment data to evaluate progress towards addressing the Program's Big Questions and associated hypotheses. Results will be used to evaluate physical process relationships and response to PRRIP actions, update target species minimum and target habitat criteria and evaluate species response to management actions.

11. Sediment augmentation management experiment activities include sediment augmentation to offset 100% of the annual deficit and annual effectiveness monitoring and data analysis.

12. Syntheses and evaluation of sediment augmentation experiment monitoring data for the period of 2015-2018. Evaluate performance and outcomes associated with full-scale sediment augmentation to eliminate the existing sediment deficit.

13. Analysis and synthesis of 2007 – 2018 PRRIP target species, physical process, and management experiment outcomes to evaluate progress towards addressing the Program's Big Questions and associated hypotheses. Results will be used to evaluate the performance of the two management strategies and develop a range of management actions that could be taken in the Second Increment.

## Short-Duration High Flows and Mechanical Actions

Short-duration high flow and mechanical actions share an action diagram because it is hypothesized that SDHF will not create and/or maintain habitat in absence of some mechanical work to "reset" the channel by removing vegetation, lowering islands, and if necessary, consolidating flow. So, for the purposes of FSM implementation, SDHF acts as an event input or component of the implementation design for mechanical actions. There will be an opportunity to modify SDHF implementation timing but the limited number of SDHF releases that can reasonably be conducted during the First Increment reduces flexibility to explore flow combinations. Figure 15 and Figure 16 present a draft action diagram that outlines planned progressions of activities and information flow throughout the First Increment. Abbreviated explanatory notes accompany the diagram. More detailed explanatory information related to diagram actions and activities is located in Appendix D.

## USFWS Target Flows

Section III.C.3 of the Program Document discusses USFWS pulse and species target flows and indicates that those flows are subject to review through the Adaptive Management Plan and may be modified by the USFWS accordingly. However, no actions or activities were prescribed in the AMP to evaluate target flows. One reason is that the commitment to test the FSM management strategy (specifically SDHF releases) is expected to require a significant portion of the Program water that is available during the First Increment. Therefore, there will likely not be water available to conduct target flow management experiments to directly reduce uncertainties associated with these flows.

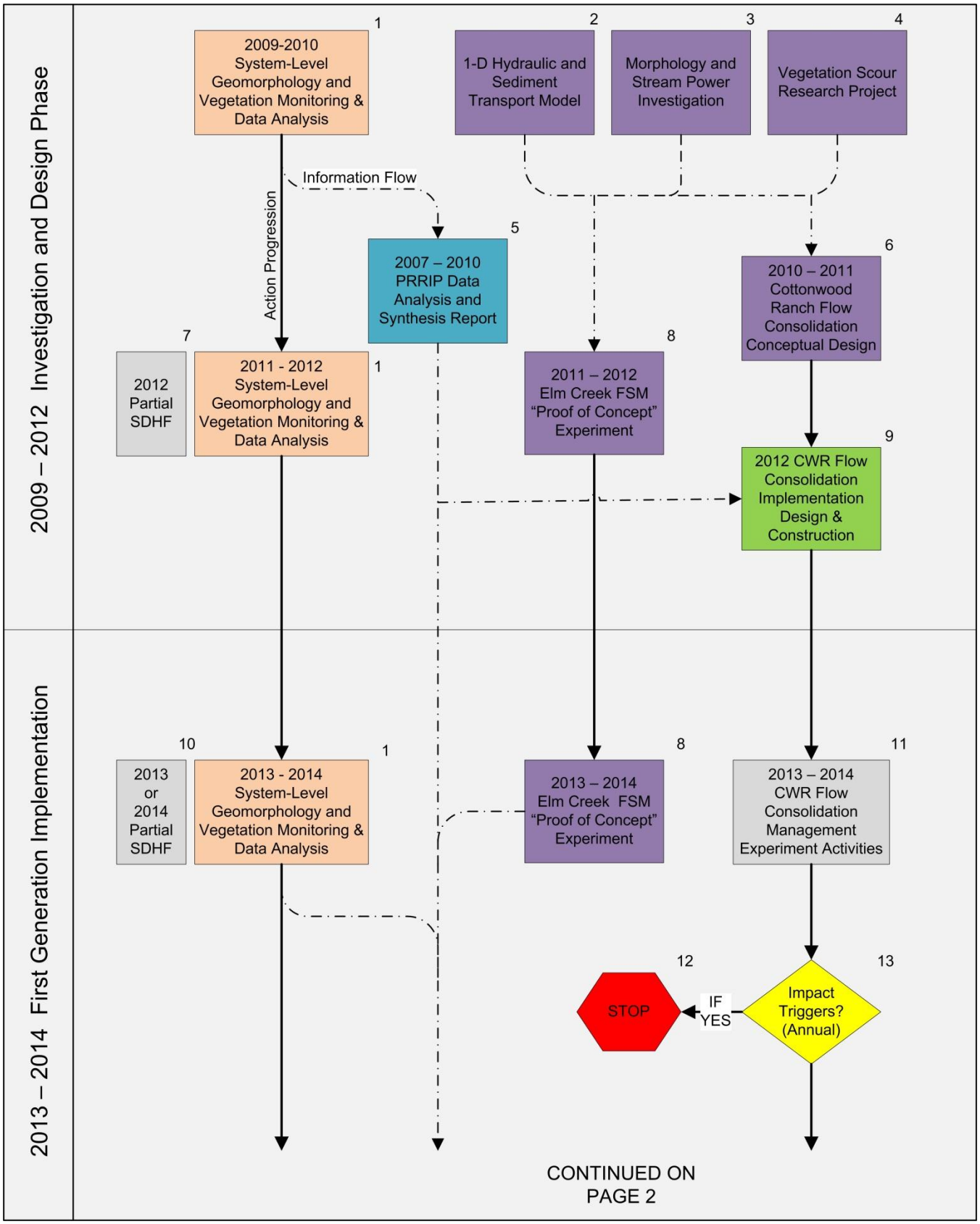
The Program can, however, utilize target species use and selection data in conjunction with hydraulic models to help the USFWS update the flow-based suitability optimizations that form the basis for some of the existing target flows. This approach would be valid for target flows that have direct WC, LT, or PP purposes and objectives. It would not be viable (for example) for optimizing forage fish prey base because the Program currently does not collect the appropriate data. In order to determine which portion of the target flows can be addressed through existing AM actions and activities, the Program will need to work with the USFWS to better understand the quantitative analyses that were used to develop the various targets. If a quantitative basis does not exist for portions of the target flows, the Program and USFWS will need to develop one or acknowledge that that those flows cannot be reviewed and updated as a result of Program AM actions and activities.

*Kearney Canal diversion during June natural high flow event in 2010. Event magnitude approximated a Program SDHF release.*

***A NOTE ON NATURAL HIGH FLOW EVENTS:***

***The following action diagram presents SDHF and mechanical management actions that would be planned and implemented by the Program. However, natural flow events will likely produce flows that would be similar to a SDHF release in magnitude and duration periodically during the First Increment. The Program will take advantage of learning opportunities presented by these events through the inclusion of natural flow monitoring triggers in management experiment implementation and effectiveness monitoring protocols. This ensures that the same data is collected and evaluated for natural flow events as is for Program SDHF releases.***

FIGURE 15 - SDHF AND MECHANICAL ACTION DIAGRAM (PAGE 1 OF 2)



## SDHF AND MECHANICAL ACTION DIAGRAM PAGE 1 EXPLANATORY NOTES

1. System level effectiveness monitoring and data analysis. Monitoring will be systematic observational study through time and is based on pure panel and rotating anchor points located at approximately 2.5 mile intervals along the associated habitat reach. Data collection includes topographic data, bed and bank material sampling, green line elevation, vegetation species occurrence, percent cover by species and average height of woody and herbaceous vegetation. Primary data source for evaluating the Program's ability to create habitat on a system-scale. Contributing data source for evaluating the Program's ability to create and/or maintain habitat using flow.

2. One-dimensional HEC-RAS steady, unsteady and sediment transport model for the reach extending from North Platte downstream to Chapman. Model will be used as a tool for design and operations of in-channel management activities and to inform trend and functional relationship analyses.

3. Investigation to identify relationship between stream power and channel morphology in the central Platte River. Estimated unit stream power threshold for maintenance of braided stream morphology and sand bar formation and erosion relationships will be used (with numerical simulation modeling) to design management experiments and predict outcomes under various management scenarios.

4. Directed research to identify erosion thresholds for representative one and two-year age class perennial riparian vegetation species (phragmites, reed canary grass, cottonwood, and sandbar willow) that colonize sand bars. Results will be coupled with numerical simulation modeling to design management experiments, and predict outcomes under various management scenarios.

5. Analysis and synthesis of 2007 – 2010 PRRIP target species and physical process data to evaluate progress towards addressing the Program's Big Questions and associated hypotheses. Results will be used to update minimum and target species habitat criteria.

6. Investigation to identify and screen flow consolidation alternatives on the Cottonwood Ranch property. Screening will address technical and permitting feasibility of alternatives, rank those alternatives, and provide a discussion of potential impacts to neighboring landowners.

7. Partial SDHF release of approximately 4,000 cfs to support physical process field investigations by increasing river flows above the existing Q1.5 flow. Would occur in March or April of 2012.

8. Project-scale experiment to test the physical processes relationships and expected outcomes that comprise the FSM management strategy. Special emphasis will be placed on evaluating bar formation and erosion and vegetation scour processes. The Elm Creek Complex was chosen for this study because flows are consolidated by the Kearney Canal diversion.

9. Development of integrated construction, monitoring and assessment design for the first generation implementation of the flow consolidation management experiment at the Cottonwood Ranch property. Implementation will be in form of a passive adaptive management experiment designed to test FSM mechanical hypotheses and reduce uncertainty for second generation implementation design. Negative impact triggers will be established as part of the monitoring and evaluation portion of the design effort and analysis of monitoring data will be conducted annually and compared to impact triggers to determine if negative impacts are occurring.

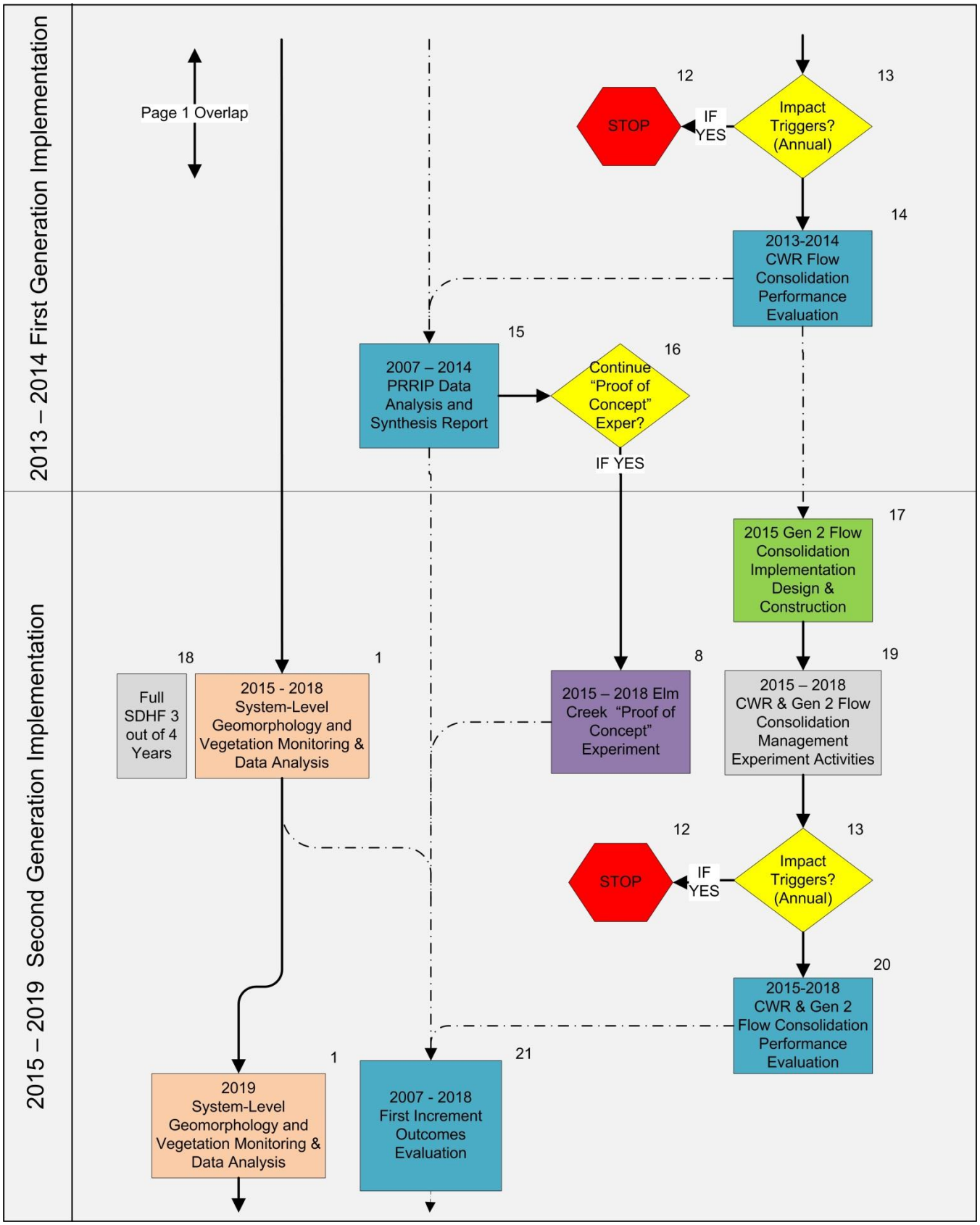
10. Partial SDHF release of approximately 4,000 cfs to support field investigations and physical process monitoring by increasing river flows above the existing Q1.5 flow. Release will occur in 2013 or 2014 depending on water availability. SDHF timing will be determined as part of the planning and coordination process for the release.

11. Flow consolidation management experiment activities include construction and maintenance of consolidation facilities and annual effectiveness monitoring and data analysis. Construction of flow consolidation management action experiment facilities would occur during the winter and early spring of 2012-2013.

12. Suspend flow consolidation operations (including planned SDHF releases). Mitigate and revise operations to avoid future impacts. If mitigation is not possible, facilities will be decommissioned and the management experiment ended.

13. Does annual analysis of monitoring data indicate that an impact trigger has been surpassed?

FIGURE 16 - SDHF AND MECHANICAL ACTION DIAGRAM (PAGE 2 OF 2)



## SDHF AND MECHANICAL ACTION DIAGRAM PAGE 2 EXPLANATORY NOTES

1. System level effectiveness monitoring and data analysis. Monitoring will be systematic observational study through time and is based on pure panel and rotating anchor points located at approximately 2.5 mile intervals along the associated habitat reach. Data collection includes topographic data, bed and bank material sampling, green line elevation, vegetation species occurrence, percent cover by species and average height of woody and herbaceous vegetation. Primary data source for evaluating the Program's ability to create habitat on a system-scale. Contributing data source for evaluating the Program's ability to create and/or maintain habitat using flow.

8. 8. Project-scale experiment to test the physical processes relationships and expected outcomes that comprise the FSM management strategy. Special emphasis will be placed on evaluating bar formation and erosion and vegetation scour processes. The Elm Creek Complex was chosen for this study because flows are consolidated by the Kearney Canal diversion.

12. Suspend flow consolidation operations (including planned SDHF releases). Mitigate and revise operations to avoid future impacts. If mitigation is not possible, facilities will be decommissioned and the management experiment ended.

13. Does annual analysis of monitoring data indicate that an impact trigger has been surpassed?

14. Evaluation of performance and outcomes from 2013 – 2014 CWR flow consolidation management experiment. Evaluation will be used to adjust Cottonwood Ranch sediment augmentation operations (as necessary and able), assess viability of design for second generation flow consolidation experiment and to help optimize second generation design prior to implementation.

15. Analysis and synthesis of 2007 – 2014 PRRIP target species and physical process data to evaluate progress towards addressing the Program's Big Questions and associated hypotheses. Results will be used to evaluate physical process relationships and response to PRRIP actions, update target species minimum and target habitat criteria and evaluate species response to management actions.

16. Does the 2007 – 2014 PRRIP Data Analysis and Synthesis Report indicate that physical process relationship uncertainties remain that can be "tested" through continued implementation of the Elm Creek FSM "proof of concept" study?

17. Development of integrated construction, monitoring and assessment design for the second generation implementation of the flow consolidation management experiment at an as yet undetermined location. Implementation will be in form of a passive adaptive management experiment designed to test FSM mechanical hypotheses. Negative impact triggers will be established as part of the monitoring and evaluation portion of the design effort and analysis of monitoring data will be conducted annually and compared to impact triggers to determine if negative impacts are occurring.

18. Full SDHF release of approximately 8,000 cfs in three out of four years (2016 – 2019) to assess performance of full-scale SDHF as a component of the FSM management strategy. SDHF timing will be determined as part of the planning and coordination process for the release.

19. Flow consolidation management experiment activities include construction and maintenance of consolidation facilities and annual effectiveness monitoring and data analysis. Construction of second generation flow consolidation management action experiment facilities would occur during the winter and early spring of 2015 - 2016.

20. Evaluation of performance and outcomes from 2015 – 2018 CWR and second generation flow consolidation management experiments. Evaluation will be used to assess First Increment flow consolidation management experiment performance and outcomes.

21. Analysis and synthesis of 2007 – 2018 PRRIP target species, physical process, and management experiment outcomes to evaluate progress towards addressing the Program's Big Questions and associated hypotheses. Results will be used to evaluate the performance of the two management strategies and develop a range of management actions that could be taken in the Second Increment.

# MECHANICAL CREATION AND MAINTENANCE STRATEGY | SEVEN

The Mechanical creation and maintenance (MCM) management strategy relies on mechanical manipulation of on and off-channel areas to create and maintain target species habitat without the need for Program-managed flows. Program Big Question #4 (see Table 1) summaries the overarching uncertainty and learning objectives related to this strategy. The MCM strategy is distinct from the FSM strategy in two important ways. First, the MCM strategy has a greater focus on non-riverine habitats including off-channel sand and water (**OCSW**) nesting complexes, palustrine wetlands, and flooded agricultural fields. Second, the MCM strategy does not rely on physical processes (alone or in combination) to create habitat. It can be created and maintained to whatever characteristics for which the target species appear to select. This differs from the FSM strategy which hypothesizes that Program actions can influence or enhance physical processes sufficiently to create and maintain in-channel species habitat.

In January of 2011, the Program held a Technical Advisory Committee (**TAC**) workshop to evaluate uncertainty associated with individual MCM management actions. During that workshop, the TAC determined that given the long track record of MCM action implementation within the associated habitats, there is little uncertainty that the Program can create and maintain habitats that would conform to target criteria. Therefore, the Program will not develop and test action-scale MCM hypotheses. On a strategy scale, the Program will implement MCM actions in a way that will allow the Program to evaluate whether or not target species use and selection differs between riverine and off-channel habitat and/or MCM and FSM habitat. Practically, this means that theProgram will attempt to ahere to a "paired design" implementation model where riverine MCM and FSM habitats and off-channel MCM habitats are available in close enough proximity that target species have the ability to select among the various habitat types. Specific MCM management actions include:

- ☐ **Channel Widening, Leveling and Maintenance** – Mechanical widening of channel and lowering of macroforms to meet active channel and unobstructed view width targets using heavy equipment (same as FSM Strategy). Long-term management of in-channel vegetation through channel disking and application of herbicide to control invasive vegetation.

- ☐ **In-Channel Tern and Plover Nesting Islands –** Construction of non-permanent tern and plover nesting islands using heavy equipment or by dredging sediment into islands. Islands would not be permanently stabilized and would have to be rebuilt periodically. Vegetation control on nesting islands through annual application of pre-emergent herbicide labeled for aquatic use.

- ☐ **Off-Channel Sand and Water Nesting Habitat –** Construction of 200 acres of new off-channel nesting habitat and restoration of 200 acres of existing sandpit area using heavy equipment and/or through dredging or mining operations. Vegetation control on nesting habitat through annual application of pre-emergent herbicide labeled for aquatic use. Predator control through the use of electrified predator fence and/or water barriers.

- ☐ **Palustrine Wetlands –** Construction and/or restoration of 400 acres of palustrine wetlands using heavy equipment. Management of vegetative structure through water level manipulation, prescribed fire, and livestock grazing.

In addition, the AMP description of MCM actions calls for the Program to flood at least 10 to 20 acres of harvested cornfield during one spring and fall migration in order to evaluate the feasibility of flooding crop fields to create foraging (and possibly roosting) opportunities for whooping cranes. The AMP also dictates that each 0.5 miles of linear wetland (sloughs, backwater) constructed on Program lands will include at least one shallow water area with a minimum water surface area of 500 feet by 500 feet in order to create

roosting habitat for whooping cranes. These features would not be necessary within the high banks when channel width already exceeds 750 feet.

## Implementation of MCM Management Actions

Implementation of MCM management actions differs from FSM actions in that there is little uncertainty associated with the Program's ability to create and maintain habitats that conform to minimum and/or target species habitat criteria. Thus, the primary objectives of implementation of the MCM management strategy in the First Increment are documentation of the long term cost of the management actions and determining if there is a difference in use and selection of MCM and FSM habitats by the target species. Additional information on specific MCM habitat creation design criteria and projects is located in Appendix E.

### Channel Widening, Leveling and Maintenance

Channel widening and leveling is a component of both management strategies. The contrast between strategies is the mechanism for long-term maintenance of the modified channel. The FSM strategy contemplates maintaining the modified channel free of vegetation through the use of SDHF releases to scour seedling vegetation. The MCM strategy relies on regular mechanical removal of vegetation to maintain the channel. Mechanical channel maintenance has been ongoing in the associated habitats since the mid-1990s and there is a strong baseline of information related to cost and target species use of mechanically maintained channel. Given that FSM SDHF releases will have system-level effects on the channel and the Program has a good understanding of the long-term performance of mechanical channel maintenance, implementation of this management action will be on an as-needed basis. This means that mechanical channel maintenance will be conducted if and when in-channel vegetation on Program habitat complexes exceeds the Program's hypothesized ability to remove that vegetation using flow. This may include colonization by species that are resistant to flow scour and/or lack of scouring flows over time resulting in establishment of perennial species of sufficient age to withstand scouring.

### In-Channel Tern and Plover Nesting Islands

The Program will defer construction of MCM nesting islands until riverine habitat selection studies are complete. The purpose of the Program's habitat selection studies is to investigate LT and PP use, selection and productivity for the purpose of determining minimum and target habitat criteria. Once the Program determines that the riverine component of the tern and plover habitat selection study has provided adequate data to establish useful minimum and target criteria, the Program will begin constructing MCM riverine nesting islands. This would generally involve modification of habitat selection study islands to conform to target habitat characteristics. A comprehensive evaluation of habitat selection study data is scheduled to occur in 2014. MCM in-channel nesting island construction would likely begin in 2015.

### Off-Channel Sand and Water Nesting Habitat

OCSW nesting habitat will be constructed and maintained as non-complex lands are acquired. As mentioned in Section Four, the Program is employing a "paired design" approach to evaluating use and selection of riverine versus OCSW habitats. This means that OCSW habitat will be developed and maintained in proximity to each Program habitat complex. Depending on land availability and acquisition locations, the Program will also maintain some OCSW habitat that is not associated with a habitat complex. If no non-complex lands are available in proximity to a habitat complex, the Program may also choose to develop OCSW nesting habitat on the buffer portion of that complex as has been done at the Cottonwood Ranch Complex.

### Palustrine Wetlands

Palustrine wetlands for WC use will be constructed and maintained as non-complex lands are acquired. Palustrine wetlands are less likely to be developed in proximity to each habitat complex given the geographic distribution of potential restoration sites and non-complex habitat acreage limitations.

### Other MCM Actions

Flooding of a harvested cornfield and the prescriptive construction of slough and backwater roosting areas will be implemented as lands become available and restoration and management designs are developed. Cropland flooding will likely not be conducted for more than one spring and fall migration if there is no species response and long-term implementation appears to be logistically difficult.

## Evaluation of MCM Management Actions

The Program will conduct implementation monitoring as MCM habitats are constructed and target species use and selection of MCM habitats will be evaluated in the same manner as FSM management actions. Information flow through the First Increment will also conform to the model presented in the species-centric and FSM sections of this plan. Specifically, use and selection data will be used to update minimum habitat criteria as part of the 2007-2014 data analysis and synthesis effort and performance of MCM management actions will be presented in the 2007-2018 First Increment outcomes evaluation.

*Mechanical control of riparian vegetation at the Cottonwood Ranch Complex.*

# AMP SUPPORT ACTIVITIES | EIGHT

The Program has initiated several activities that provide critical data and administrative support for successful implementation of the AMP. They include development of a website and database system and annual collection of color-infrared (**CIR**) photography and Light Detection and Ranging (**LiDAR**) topographic data for the associated habitats. A brief description of these activities follows with additional information located in Appendix F.

## Program Website and Database System

The Program's website and database (**System**) provides a central clearinghouse where Program staff, collaborators, contractors, and committee members, independent of their physical location, exchange information and conduct the daily operations of the Program. As such, the System relies on a collaboration and content management component that is accessible to all users via the Internet. The System's Content Management/Collaboration component utilizes Microsoft Office SharePoint Server and is able to manage a wide variety of information including text documents, spreadsheets, databases, images, contact lists and calendars. Implementation of the research and monitoring protocols discussed in this plan produces a large amount of observational data. These data are stored in a scientific data repository (**SDR**), tightly integrated with the content management component to ensure maximum security and compatibility. SDR users can retrieve and display monitoring data in text format and can download it in several formats that are compatible with spreadsheet and analysis software. The System also includes interactive maps that allow authorized users to access documents and scientific data in a spatial context.

As of January 2011, the collaboration component of the System has been fully deployed and is being used by all Program committees. All existing Program datasets have been integrated into the SDR and basic reporting functionality has been developed. Near-term System improvements include one-click reporting of frequently used monitoring data, improvements to the geospatial component of the System, and modification of the SDR to allow for storage and retrieval of additional datasets as new protocols are implemented. More information on the System is located in Appendix F.

## Color-Infrared Imagery Acquisition

The Program collects annual CIR imagery of the associated habitats annually during the mid-point of the LT and PP nesting season. Imagery is acquired in a digital format at a two-foot per pixel resolution. This imagery provides an annual record of physical habitat characteristics during the nesting season and is used in conjunction with topographic data and hydraulic modeling to estimate annual in- and off-channel nesting habitat availability. The imagery also provides an annual record of Program and other actions that have modified habitat characteristics in the associated habitats, providing a data source for evaluating channel and vegetation community changes/trends over the course of the First Increment. More information on aerial photography acquisition is located in Appendix F.

## Light-Detection and Ranging Acquisition

The Program collected high-accuracy LiDAR data of the channel from Kingsley Dam downstream to Columbus, Nebraska in 2009. In 2010, the Program began collecting annual high-accuracy LiDAR data of the channel area within the associated habitats. The LiDAR data is collected at a six-inch vertical accuracy and the acquisition contractors supply the program with raw data in LAS file format and with processed bare-earth terrain models in digital elevation model (**DEM**) format. More information on Program LiDAR acquisition is located in Appendix F.

# PLAN IMPLEMENTATION | NINE

## Integration of First Increment AM Actions

The actions presented in the previous three sections must be integrated across organizational, spatial, and temporal scales in order for the Program to provide policy-makers with answers to our Big Questions at the end of the First Increment. Important integration concepts include:

- ☐ Species research and monitoring is universal, meaning that it will inform problem assessment, implementation design, and performance evaluation at both management action and strategy scales and will play a vital role in performance and First Increment outcomes evaluations.
- ☐ Multiple management action-scale AM cycles are imbedded within the single First Increment strategy-scale AM cycle for the FSM management strategy. The typical action-scale AM cycle will be approximately two to four years in duration depending on the learning objective. The strategy-scale AM cycle duration will be the First Increment (approximately 10-years).
- ☐ A comprehensive data analysis and synthesis evaluation will be developed in 2015 to assess AMP progress near the midpoint of implementation. The evaluation will address all AM actions related to both strategies focusing on performance in relation to target species learning.
- ☐ The Program is currently developing the framework that will be used for the outcomes evaluation in 2019 (Data Analysis and Synthesis Report). That evaluation will serve as the culmination of First Increment AM actions and will address the Program's Big Questions, providing policymakers with a range of management action adjustments that could be implemented in the Second Increment.

## Implementation Responsibilities

Adaptive management plan implementation responsibilities are generally outlined in the Program Document. Figure 1.b of the AMP showing general task assignments has been reproduced here. The first three years of Program implementation have provided opportunity to evaluate the ability to progress through the AM cycle given these divisions of responsibility. Experience implementing the AMP to date indicates that the EDO needs to to have the capability to call on additional resources and capabilities to effectively perform some of the tasks presented in AMP Figure 1b. A refined division of

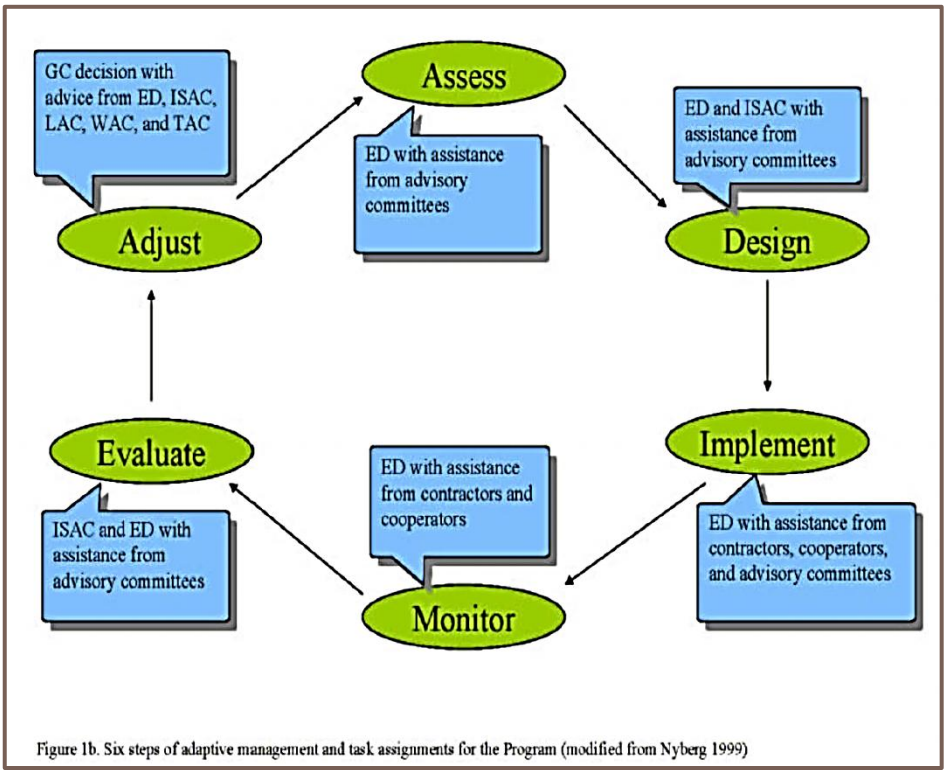



Figure 1b. Six steps of adaptive management and task assignments for the Program (modified from Nyberg 1999)

responsibilities is presented below that focuses the EDO role toward administration, oversight and synthesis. It also highlights the role that EDO special advisors have in filling subject matter technical expert gaps that will occur periodically.

***Refined AMP Implementation Task Assignments***

- ***Assess*** *– EDO in cooperation with advisory committees and special advisors (investigations by contractors with EDO oversight)*
- ***Design*** *– Contractors with oversight by EDO in cooperation with ISAC, special advisors and advisory committees*
- ***Implement*** *– Contractors with oversight by EDO*
- ***Monitor*** *– Contractors with oversight by EDO*
- ***Evaluate*** *– EDO and ISAC with assistance from special advisors and advisory committees*
- ***Adjust*** *– GC with advice from EDO, ISAC, special advisors and advisory committees*

## Water and Land Plan Coordination

The Program is organized around implementation of Land, Water, and Adaptive Management Plans. All three implementation areas have both discrete and overlapping responsibilities and interests. In areas of overlapping interest like land management and flow release planning, coordination occurs at the advisory committee level and is driven by the EDO. The following fundamental coordination items ensure that the appropriate Land and Water Plan actions conform to management experiment designs and implementation.

***Fundamental Land and Water Plan Coordination Actions:***

***Land Plan***

*- AM objectives and needs considered in decision to purchase and dispose of property.*

*- AM objectives, investigations, management experiments and monitoring formalized in restoration and management plans and annual work plans.*

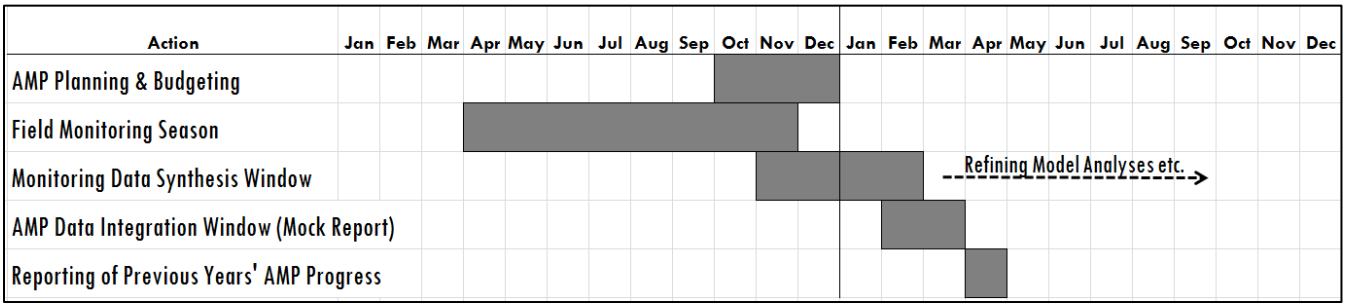
***Water Plan***

*- EDO presents AM water (flow release) needs to USFWS Environmental Account (EA) Manager during annual EA/RCC planning session. Response to request formalized in EA Annual Operating Plan.*

## Implementation Schedule

The general implementation schedules for AMP actions are presented on the action diagrams in Sections 4-6. Actions in the diagrams are presented at an annual time-step level of detail. Within that time-step, there are several time-sensitive actions that must be accomplished in order for implementation to proceed smoothly from year to year including annual synthesis of monitoring data and aggregation of that information for the purpose of informing Program decision-makers about AM findings and performance. Figure 17 presents a generalized implementation schedule for reoccurring tasks. Of special note is the short data synthesis and integration windows dictated by the need to assess annual progress and performance in a timely manner.

FIGURE 17 - GENERAL IMPLEMENTATION SCHEDULE FOR REOCCURING AMP TASKS




## Adaptive Management Plan Investigations & Budget

Table 1 of the Program's AMP provides a list of potential research and monitoring protocols/activities along with draft budget estimates. The table presents a list of 43 potential activities, arranged by focus area. Each activity was reviewed during the development of this plan and many of the proposed protocols/actions were disconnected from the AM process, resulting in the collection and analysis of data outside of the context of implementation of management experiments. For example, only 14% of the budget allocated to geomorphology and vegetation was associated with investigation of the performance of FSM management actions. This disconnect is the result of an attempt to define activities that would address uncertainty and disagreement prior to the introduction of the AM process. The Program's commitment to utilize AM requires a refocusing of effort as is demonstrated by the action diagrams presented in this plan. The total First Increment AM budget in the Program Document is $30,006,275 in 2007 dollars. Cost savings associated with the shift away from large, independent investigations and towards management experiments is not expected to increase First Increment AMP budget needs.

## Independent Science Review of AM Implementation

The Program has established an Independent Scientific Advisory Committee (ISAC) to provide independent scientific advice to the ED and to the GC, as requested, on scientific issues during the First Increment of the Program. The ISAC convenes a minimum of one time each year (and typically more) to review and provide feedback on Program science activities in the form of a report to the GC. This independent review of the Program's science-related activities serves an important role in fostering a robust scientific approach to adaptive management, monitoring and research. More information is located in Appendix G.

# INTEGRATION WITH OTHER PROGRAM DOCUMENTS | TEN

Table 2 presents a matrix of Program documents and contents. The matrix is intended to be used as a quick reference for understanding the scope and focus of AM-related documents as well as a tool for identifying which documents address various components of AM implementation. This table (as well as the contents of the rest of this plan) will be updated on an annual basis.

TABLE 2 - PROGRAM DOCUMENT AND CONTENT MATRIX

| | AMP | Synthesis Report | Annual "State of the Platte" Report | Implement -ation Plan | Data Analysis Plan | Monitoring & Research Protocols | Annual Monitoring & Research Reports |
|---|---|---|---|---|---|---|---|
| Priority Hypotheses | X | | | X | | | X |
| Tier 1 hypotheses | | X | X | X | | | |
| Critical uncertainties = Big Questions | X | X | X | X | X | X | X |
| Objectives hierarchy | | X | | | | | |
| Experimental design | | | | | X | | |
| Contractor guidance for implementation | | | | X | | | |
| Data collection methods | | | | | | X | |
| Data analysis methods | | | | | X | | |
| Decision analysis tree | | X | | | | | |
| Management objectives | X | | | | | | X |
| Management strategies | X | | | | | | X |
| Conceptual models | X | X | | | | | X |
| Synthesis of data | | X | | | | | |
| Annual raw data | | | | | | | |
| Annual data analysis | | | X | | | | |

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# AM ACTIVITY TEMPLATES | APPENDIX A

Appendix A presents bullet point templates for the AM cycle actions that will be carried out by the Program. The templates are part process and part product with the intent being to present the key activity components in broad strokes.

## Problem Assessment

- Problem Scoping
  - Development/review of management objectives
  - Identification of stakeholder resource values and constraints (including disagreements)
  - Determine resource availability and/or values sideboards (constraints)
  - Define appropriate spatial and temporal scale of actions
  - Identify key indicators related to management objective(s)
- Exploration of Management Options
  - Conceptual model development: describe linkages and functional relationships between possible actions and indicators
  - Establish candidate performance criteria (key indicator target values)
  - Identify management options and forecast performance (using modeling) over range of conditions
- Identification and Assessment of Key Uncertainties
  - Record key gaps in system and/or management action performance understanding that are revealed through model development and exploration of management option performance
  - Express key uncertainties as alternative hypotheses of system function
  - Assess sensitivity of management option performance to alternative hypotheses and determine if different hypotheses lead to different management choices
- Assessment Synthesis and Formalization
  - Prioritize and sequence hypotheses
  - Determine which priority hypotheses should be tested through management experiments versus investigations (extensions of assessment).
  - Determine if management experiments should be conducted using passive or active adaptive management experimental design
  - Establish preliminary decision rules for revising hypotheses and management actions

## Investigation

- Investigation Scoping
  - Scope development and review
  - Contractor selection
- Project Management
  - Contractor oversight
  - Updates and progress reporting
- Project Reporting
  - Peer Review
  - Report finalization and acceptance

## Implementation Design

- Management Option Review and Refinement
    - Incorporate investigation results into conceptual modeling (as necessary)
    - Review and update indicators and performance criteria identified during problem assessment
    - Refine management option components/designs based on updated modeling
- Statistical analysis of possible outcomes of management experiment based on refined modeling and performance criteria.
    - Criteria
    - Methods
    - Results
    - Recommended actions and experiment design (locations, replicates, etc)
- Civil Design
    - Land acquisition and/or management agreements
    - Construction drawings and specifications
    - Permits and authorizations
- Monitoring and Analysis Design
    - Conservation Monitoring Plan
        - Implementation
        - Effectiveness
        - Validation
    - Data Analysis Plan
        - Data Management
        - Analysis Procedures
        - Reporting Schedule
    - Performance Evaluation
        - Analysis Decision Tree
            - Performance Criteria
            - Alternative courses of action under range of possible outcomes.

## Management Action Implementation

- Contractor selection
- Construction & operations
- Project Management
    - Contractor oversight
    - Updates and progress reporting
- Project Reporting
    - Construction closeout (as-built drawings)
    - Implementation monitoring and data synthesis

## Monitoring and Data Synthesis

- Monitoring Implementation
    - Responsibilities and Tasks
    - Data QA/QC and warehousing
    - Revision of protocols
- Data Synthesis and Reporting
    - Annual data synthesis and report development
    - Reporting session participation

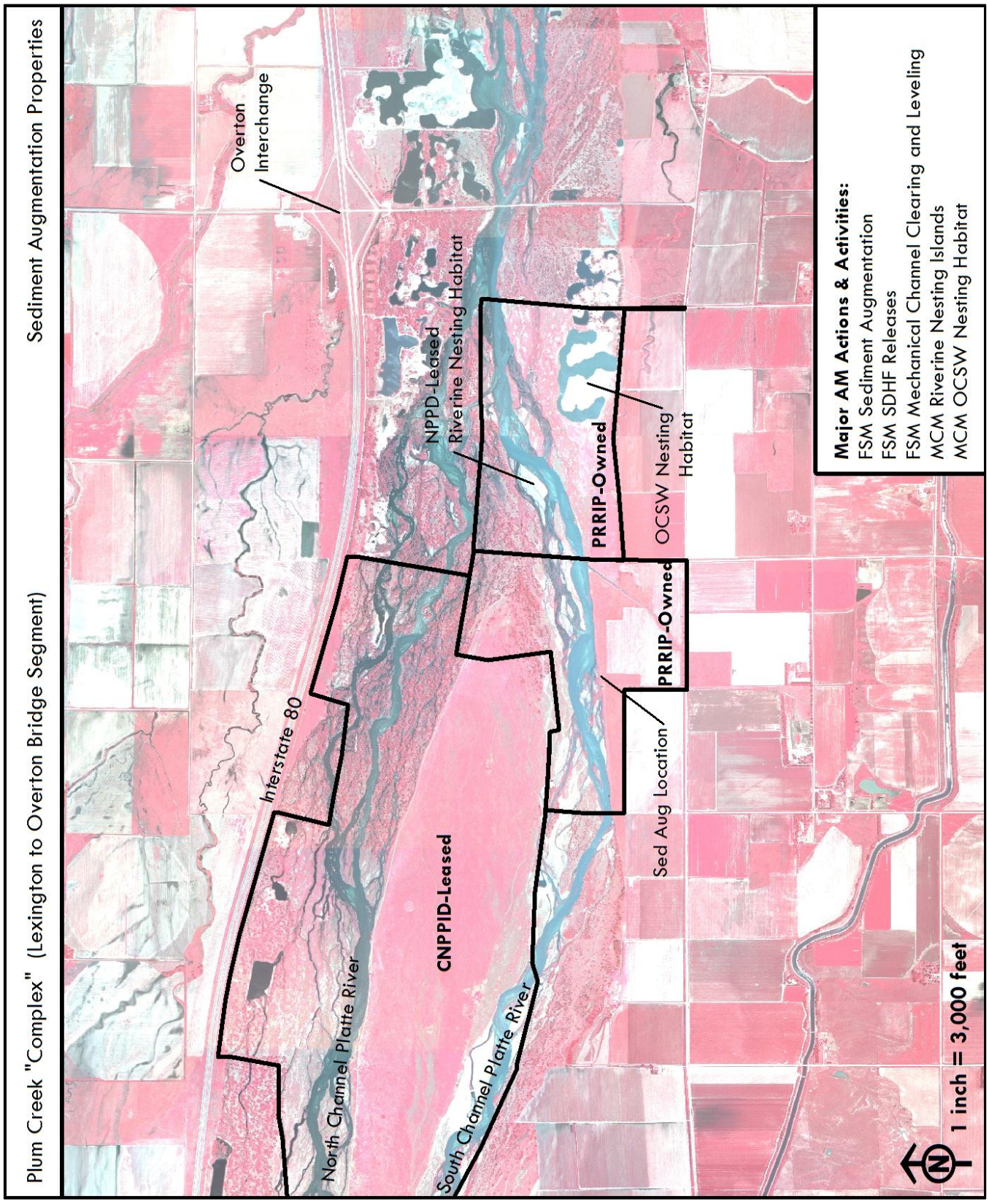
## Performance Evaluation

- Analysis methods and procedures
- Integration of results with decision analysis tools
- Reporting
    - Peer review
    - Program review and acceptance

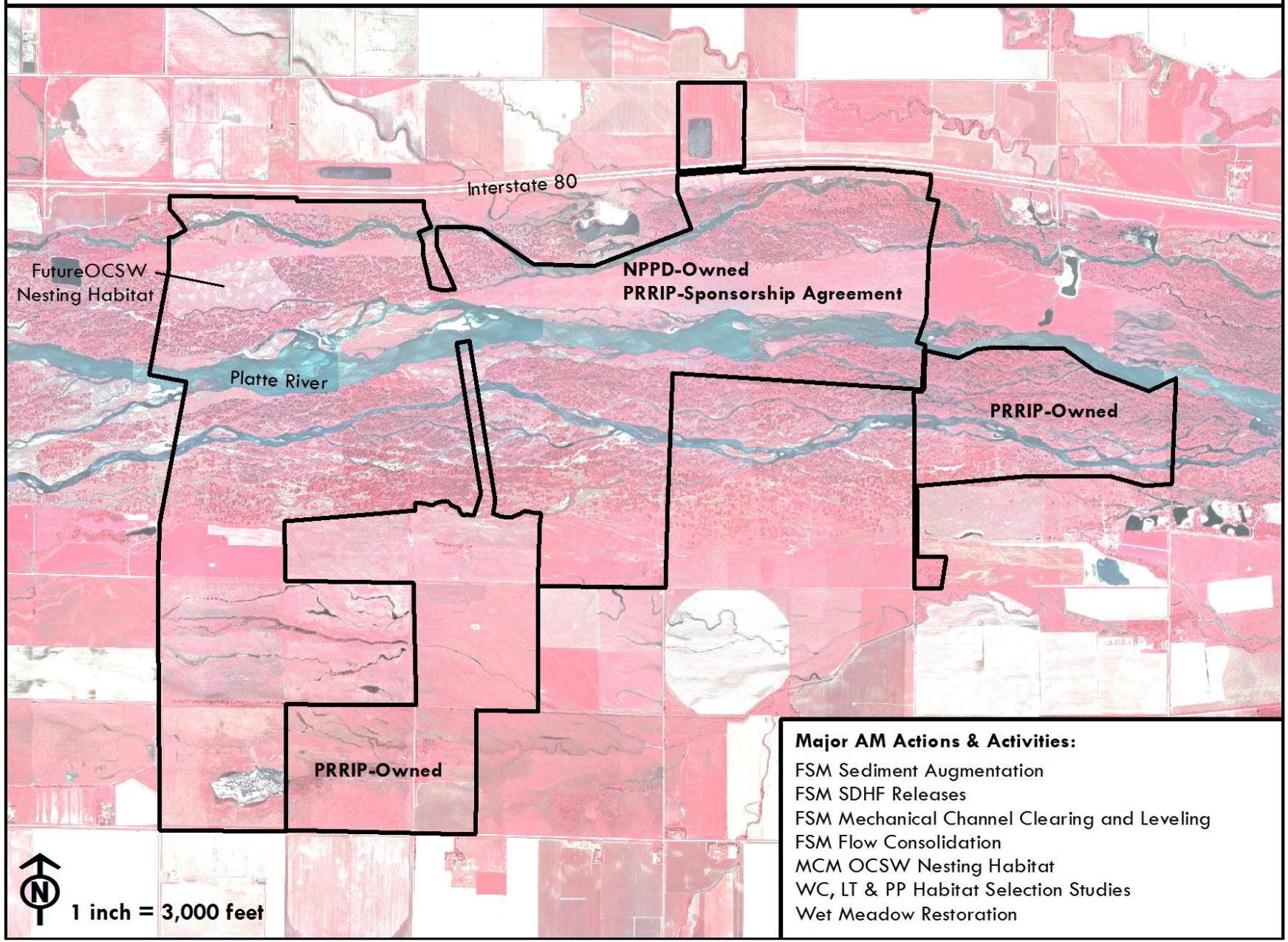
## Action Adjustments

- Presentation of analysis and results to GC
- Assessment of decisions, hypotheses and objectives
- Adjust management actions and associated budget and priorities
- Independent science review

# MAPS | APPENDIX B



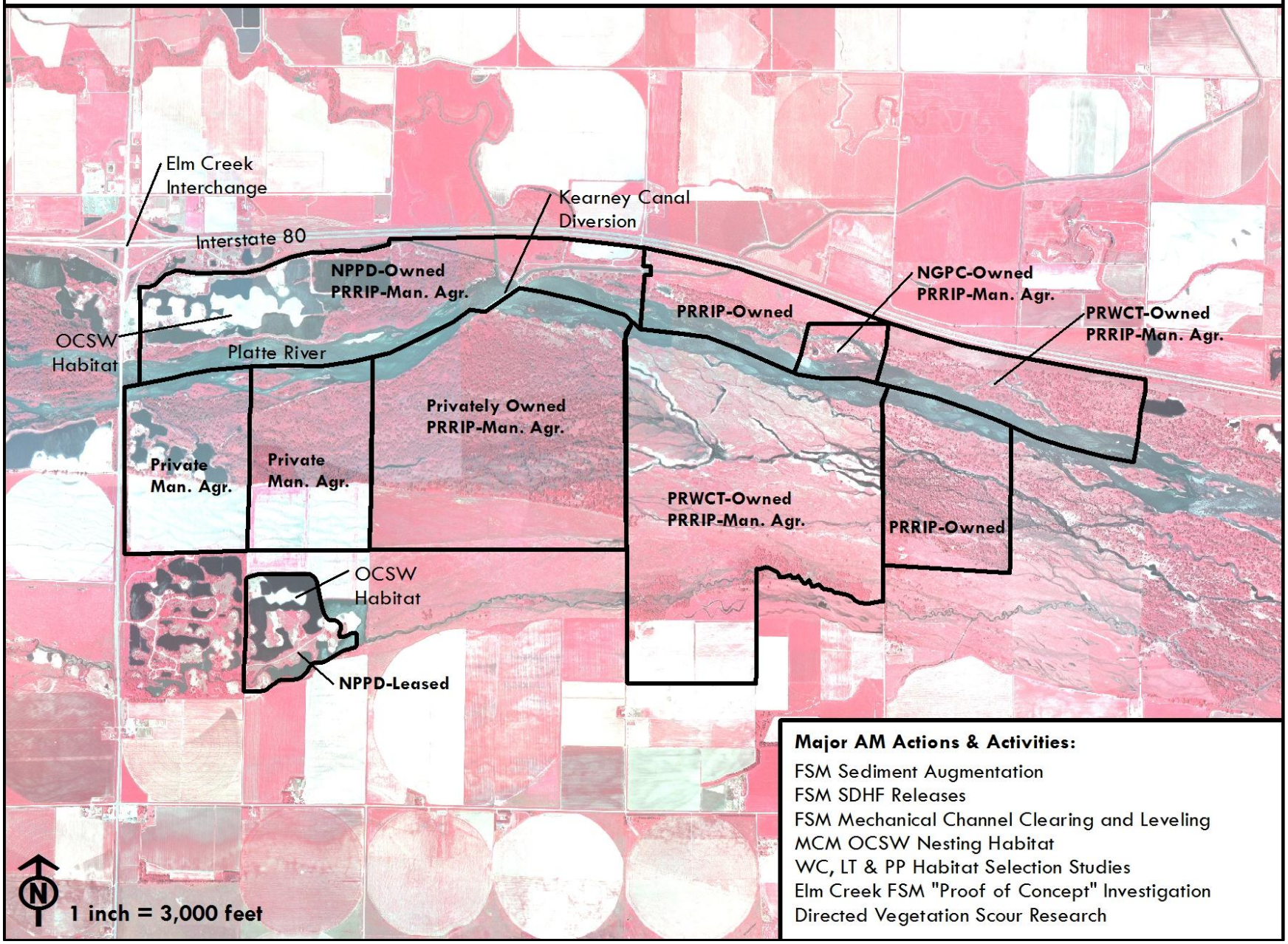
Cottonwood Ranch Complex (Overton to Elm Creek Bridge Segment) — Complex Complete




**Major AM Actions & Activities:**

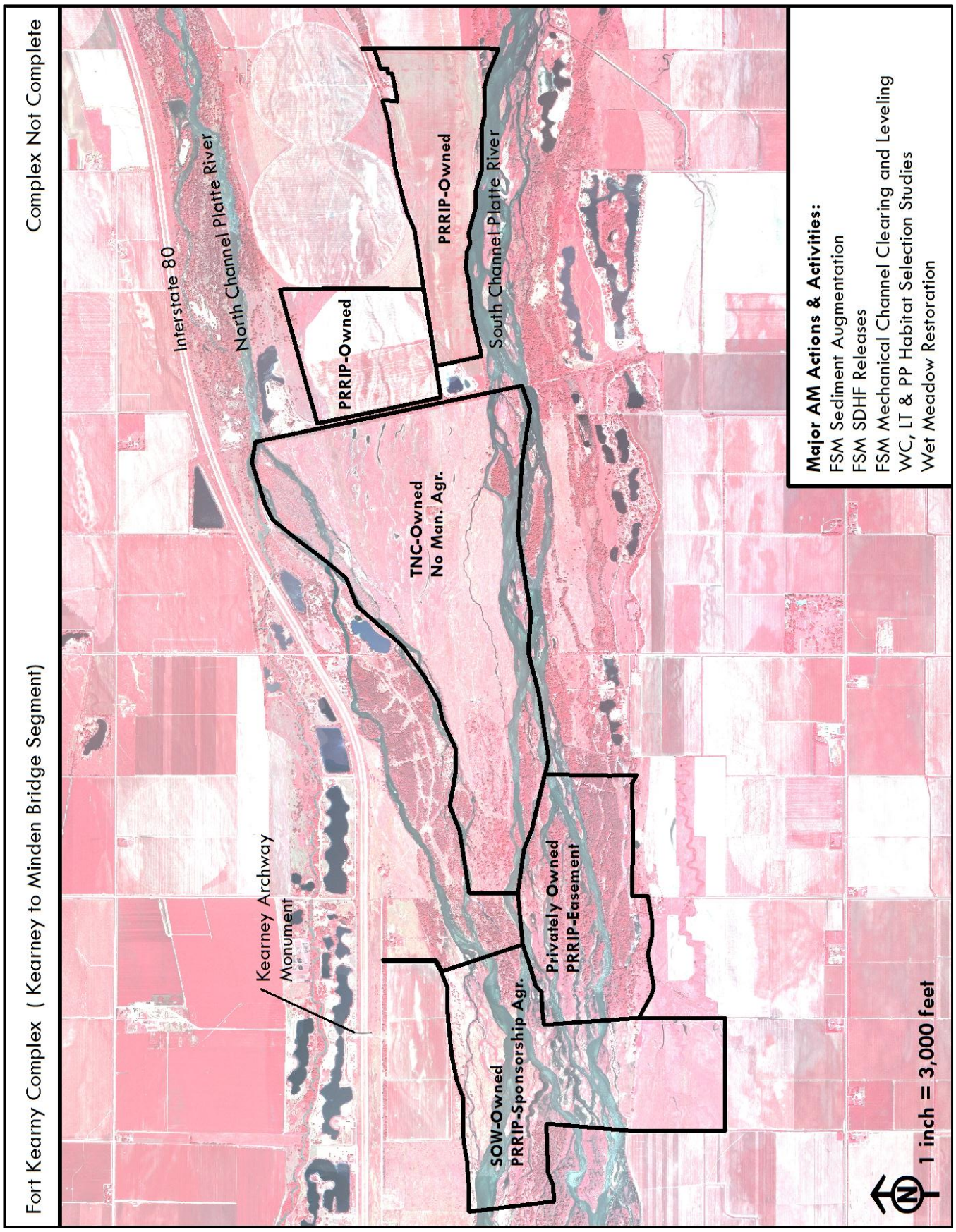
FSM Sediment Augmentation
FSM SDHF Releases
FSM Mechanical Channel Clearing and Leveling
FSM Flow Consolidation
MCM OCSW Nesting Habitat
WC, LT & PP Habitat Selection Studies
Wet Meadow Restoration

Elm Creek Complex ( Elm Creek to Odessa Bridge Segment) — Complex Substantially Complete

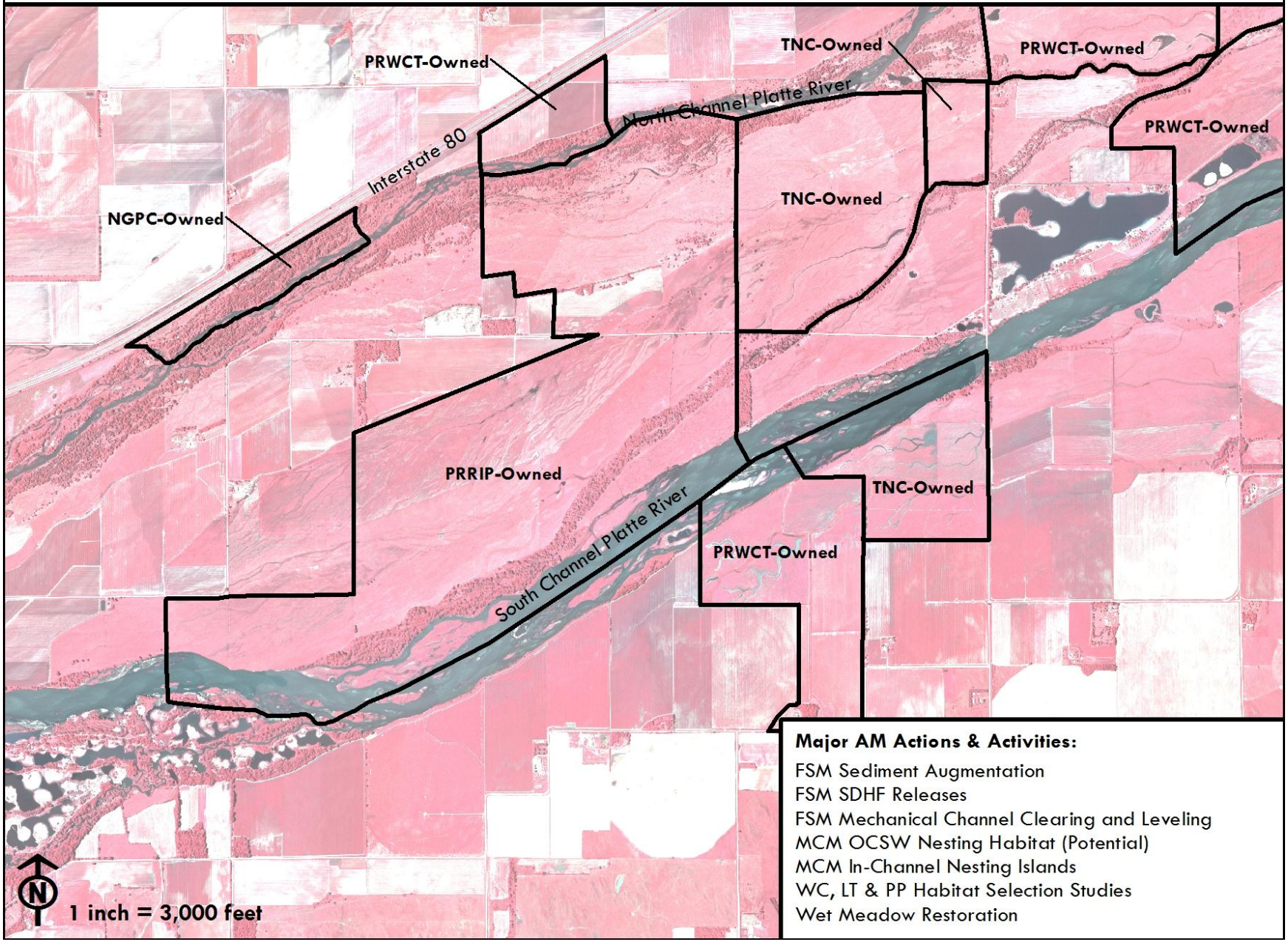



**Major AM Actions & Activities:**

FSM Sediment Augmentation
FSM SDHF Releases
FSM Mechanical Channel Clearing and Leveling
MCM OCSW Nesting Habitat
WC, LT & PP Habitat Selection Studies
Elm Creek FSM "Proof of Concept" Investigation
Directed Vegetation Scour Research


Fort Kearny Complex ( Kearney to Minden Bridge Segment)
Complex Not Complete
Interstate 80
North Channel Platte River
South Channel Platte River
PRRIP-Owned
PRRIP-Owned
TNC-Owned
No Man. Agr.
Kearney Archway
Monument
SOW-Owned
PRRIP-Sponsorship Agr.
Privately Owned
PRRIP-Easement
Major AM Actions & Activities:
FSM Sediment Augmentation
FSM SDHF Releases
FSM Mechanical Channel Clearing and Leveling
WC, LT & PP Habitat Selection Studies
Wet Meadow Restoration
1 inch = 3,000 feet

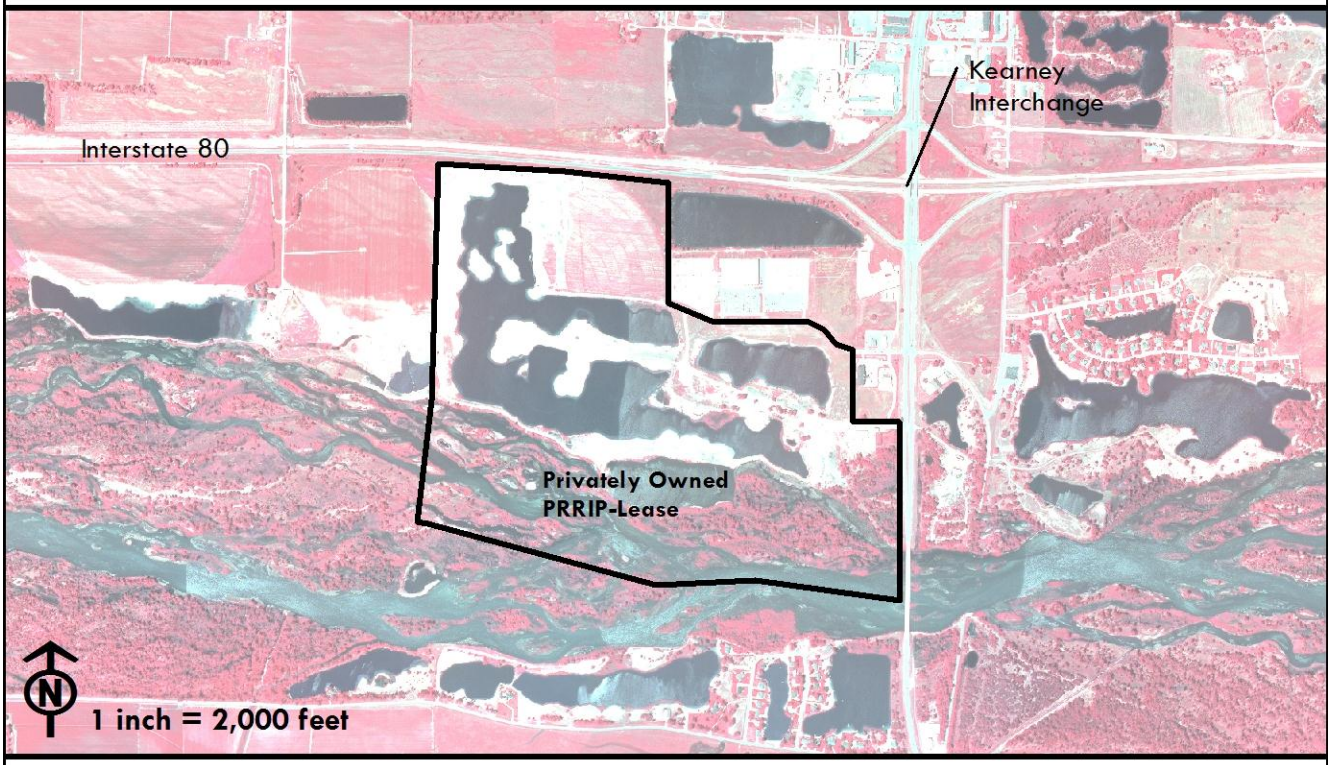
Binfield Complex ( Wood River to Alda Bridge Segment) Complex Not Complete



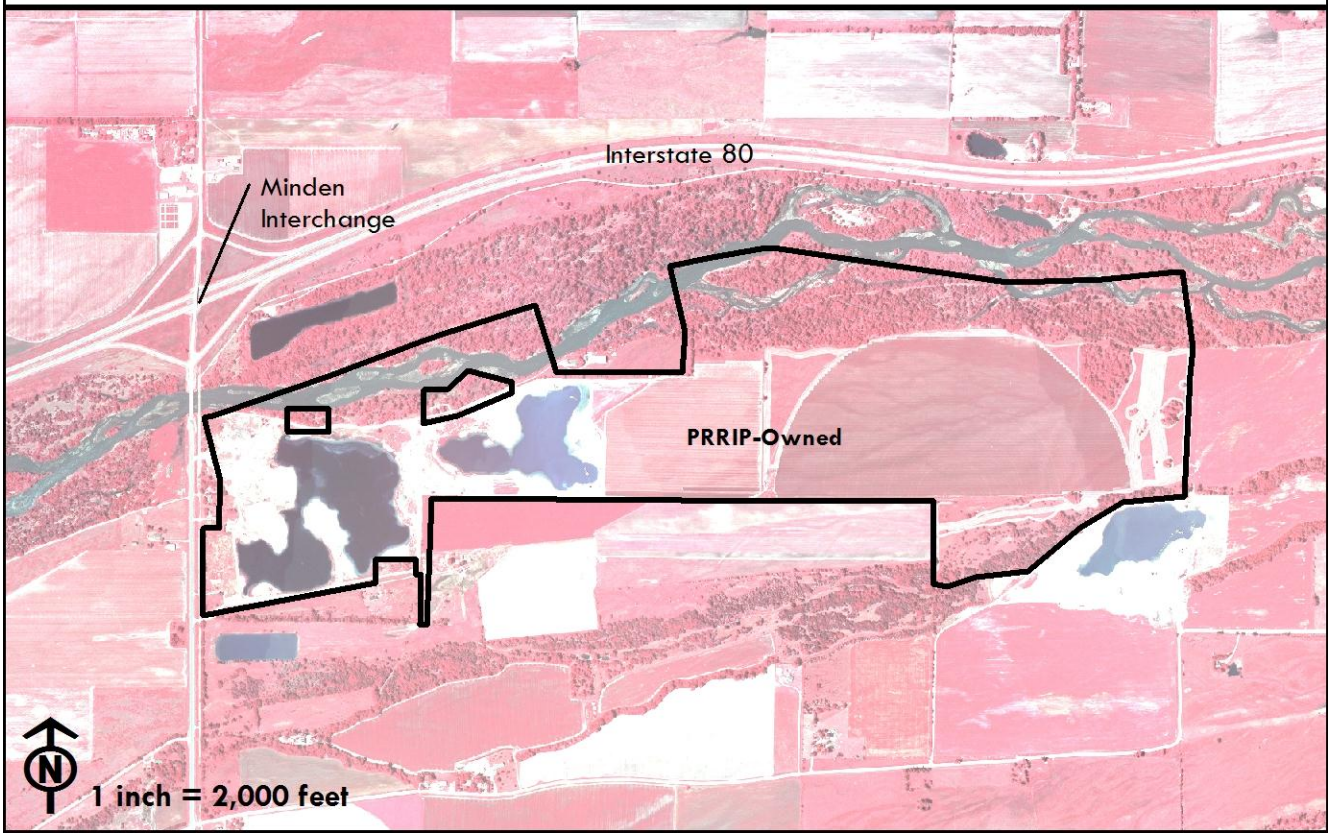

**Major AM Actions & Activities:**

FSM Sediment Augmentation
FSM SDHF Releases
FSM Mechanical Channel Clearing and Leveling
MCM OCSW Nesting Habitat (Potential)
MCM In-Channel Nesting Islands
WC, LT & PP Habitat Selection Studies
Wet Meadow Restoration

Broadfoot Kearney South ( Odessa to Kearney Bridge Segment) Non-Complex OCSW Habitat




Broadfoot Newark ( Minden to Gibbon Bridge Segment) Non-Complex OCSW Habitat



# SPECIES-CENTRIC ACTIVITY INFORMATION | APPENDIX C

## System-Level Monitoring of Whooping Crane Migrational Habitat Use

### Adaptive Management Step

Monitor

### Objective

Annual system-level whooping crane monitoring to detect WC stopovers in the associated habitat reach, identify the locations of use and crane group movements in the reach, qualitatively document crane group activities at use-sites and document physical and/or biological characteristics of use-sites. Protocol is implemented during the spring and fall migration and is based on daily aerial surveys and opportunistic locates. Data on WC habitat use is compiled and summarized annually.

### Associated Broad Hypotheses

S-3: Program management actions will/will not have a detectable effect on target species use of the associated habitats.

WC-1: Whooping cranes that use the central Platte River study area during migration seasons prefer habitat complexes and use will increase proportionately to an increase in habitat complexes. Characteristics of a Program habitat complex are defined in the Land Plan Table 1.

WC-2: Whooping cranes prefer palustrine wetlands to river channel, based on known migratory stopover habitats. Whooping crane use of the central Platte River study area during migration seasons will increase proportionately to an increase in palustine wetlands.

WC-3: Whooping cranes do forage in wet meadows and agriculture fields proportionate to their availability.

WC-4: In the central Platte River study area, whooping cranes prefer conditions created by species target flows and annual pulse flows.

### Associated Tier I Priority Hypotheses

S1b: Program land management actions (i.e., restoration into habitat complexes) will have a detectable effect on target birds species use of the associated habitats

WC 1: Whooping Crane use will increase as function of Program land and water management activities.

### Description of Work / Procurement

See protocol

### Contractor

Spring 2001, Spring 2002, Fall 2004 – Spring 2005, Spring 2006 – Fall 2010 – Assessment Inventory Monitoring Environmental Consulting

Fall 2001 – Cooperative Agreement Executive Director's Office (WEST Inc.)

Fall 2002 & Fall 2003 – Greystone Environmental Consultants

Spring 2004 & Fall 2005 - OtterTail Environmental Inc.

**Protocols**

2005 Monitoring whooping crane migrational habitat use in the central Platte River valley

Changes to the whooping crane monitoring protocol during the Cooperative Agreement

Documentation and implication of changes to the whooping crane monitoring protocol during the CA

**Peer Review**

N/A

**Protocol Implementation**

Spring 2001 Implementation of the Whooping Crane Monitoring Protocol

Fall 2001 Implementation of the Whooping Crane Monitoring Protocol

Spring 2002 Implementation of the Whooping Crane Monitoring Protocol

Fall 2002 Implementation of the Whooping Crane Monitoring Protocol

Fall 2003 Implementation of the Whooping Crane Monitoring Protocol

Spring 2004 Implementation of the Whooping Crane Monitoring Protocol

Fall 2004 Implementation of the Whooping Crane Monitoring Protocol

Spring 2005 Implementation of the Whooping Crane Monitoring Protocol

Fall 2005 Implementation of the Whooping Crane Monitoring Protocol

Spring 2006 Implementation of the Whooping Crane Monitoring Protocol

Draft Fall 2006 Implementation of the Whooping Crane Monitoring Protocol

Spring 2007 Implementation of the Whooping Crane Monitoring Protocol

Fall 2007 Implementation of the Whooping Crane Monitoring Protocol

Spring 2008 Implementation of the Whooping Crane Monitoring Protocol

Fall 2008 Implementation of the Whooping Crane Monitoring Protocol

Spring 2009 Implementation of the Whooping Crane Monitoring Protocol

Fall 2009 Implementation of the Whooping Crane Monitoring Protocol

Spring 2010 Implementation of the Whooping Crane Monitoring Protocol

Draft Fall 2010 Implementation of the Whooping Crane Monitoring Protocol

**Data Analysis and Synthesis**

Evaluation of Models and Data for Assessing Whooping Crane Habitat in the Central Platte River, NE

Whooping Crane Data Analysis Methods Summary

Whooping Crane Migrational Habitat Use in the Central Platte River during the Cooperative Agreement Period, 2001 - 2006

Other whooping crane research, reports, and articles

# Whooping Crane Telemetry Study

### Adaptive Management Step

Problem Assessment Investigation

### Objective

Telemetry study to gain a better understanding of WC stopover areas, habitat use patterns, and factors influencing habitat use at different spatial and temporal scales; define a current migratory route; and identify causes, locations, and conditions of actual or potential mortality.

### Associated Broad Hypotheses

WC-1: Whooping cranes that use the central Platte River study area during migration seasons prefer habitat complexes and use will increase proportionately to an increase in habitat complexes. Characteristics of a Program habitat complex are defined in the Land Plan Table 1.

WC-2: Whooping cranes prefer palustrine wetlands to river channel, based on known migratory stopover habitats. Whooping crane use of the central Platte River study area during migration seasons will increase proportionately to an increase in palustine wetlands.

WC-3: Whooping cranes do forage in wet meadows and agriculture fields proportionate to their availability.

WC-4: In the central Platte River study area, whooping cranes prefer conditions created by species target flows and annual pulse flows.

### Associated Tier I Priority Hypotheses

S1b: Program land management actions (i.e., restoration into habitat complexes) will have a detectable effect on target birds species use of the associated habitats

WC 1: Whooping Crane use will increase as function of Program land and water management activities.

### Description of Work / Procurement

Study proposal whooping crane migratory behavior, stopover habitat use, and survival in the central flyway using GPS and ratio-telemetry

### Contractor

Platte River Whooping Crane Maintenance Trust

### Protocols

See description of work

### Peer Review

N/A

### Protocol Implementation

February 2010 Telemetry Project Update

### Data Analysis and Synthesis

TBD

## Wet Meadows Information Review

### Adaptive Management Step

Problem Assessment Investigation

### Objective

Comprehensive review and summary of information related to wet meadows along the Platte River in central Nebraska; wet meadow hydrology; and the biological, physical and chemical composition of wet meadows as they pertain to use by WC and other species, including PRRIP species of concern. Review will assist PRRIP in identifying the best candidate wet meadow sites to acquire and protect/restore, understand how to best manage and/or restore the sites it does acquire, and implement research activates that are most likely to address critical gaps in knowledge about the characteristics and functionality of wet meadows.

### Associated Broad Hypotheses

WC-3: Whooping cranes do forage in wet meadows and agriculture fields proportionate to their availability.

### Associated Tier I Priority Hypotheses

WM-2: Wet meadows 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 Sanctuary have some of best existing combinations

### Description of Work / Procurement

Wet Meadow Information Review RFP

### Contractor

Platte River Whooping Crane Maintenance Trust

### Protocols

N/A

### Peer Review

TBD

### Work Products

Draft Wet Meadows Information Review Report

## Whooping Crane Riverine Habitat Selection Study

### Objective

Manipulation of riverine habitat at PRRIP habitat complexes to create a range of active channel and unobstructed view widths. WC response (use) will be used to refine or validate PRRIP minimum and target riverine habitat criteria.

### Associated Broad Hypotheses

S-3: Program management actions will/will not have a detectable effect on target species use of the associated habitats.

WC-1: Whooping cranes that use the central Platte River study area during migration seasons prefer habitat complexes and use will increase proportionately to an increase in habitat complexes. Characteristics of a Program habitat complex are defined in the Land Plan Table 1.

### Associated Tier I Priority Hypotheses

S1b: Program land management actions (i.e., restoration into habitat complexes) will have a detectable effect on target birds species use of the associated habitats

WC 1: Whooping Crane use will increase as function of Program land and water management activities.

### Study Design

To be developed in 2011

### Monitoring and Research Protocols

2005 Monitoring whooping crane migrational habitat use in the central Platte River valley

### Riverine Habitat Enhancement Projects

2009 Cottonwood Ranch Habitat Enhancement Project Design Drawings and Specifications

2010 Cottonwood Ranch Habitat Enhancement Project Design Drawings and Specifications

2010 Elm Creek Complex Habitat Enhancement Project Design Drawings and Specifications

## Tern and Plover System-Level Reproductive Success Monitoring

### Adaptive Management Step

Monitor

### Objective

Annual system-level LT and PP monitoring to locate LT and PP nests, monitor the reproductive success and reproductive habitat parameters at LT and PP colonies, document long term trends in reproductive and habitat parameters, and evaluate LT and PP response to actions taken under the FSM and MCM management strategies.

### Associated Broad Hypotheses

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.

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.

TP-3: Ephemeral nesting areas in the river are/are not needed for long-term nesting success of tern and plover.

### Associated Tier I Priority Hypotheses

T1: Additional bare sand habitat will increase the number of adult least terns.

P1: Additional bare sand habitat will increase the number of adult piping plover.

TP1: Interaction of river and sandpit habitat.

TP5: Use of riverine islands by least terns and piping plovers will increase with active channel width.

### Description of Work / Procurement

See protocol for description of monitoring

Annual Tern and Plover Habitat Availability Analysis Memorandum

### Contractor

Executive Director's Office in association with USFWS, NPPD, and CPNRD

### Protocols

Draft - Monitoring Reproductive Success and Reproductive Habitat Parameters of Least Terns and Piping Plovers in the Central Platte River Valley, May 1 2002

Draft - Monitoring Reproductive Success and Reproductive Habitat Parameters of Least Terns and Piping Plovers in the Central Platte River Valley, May 1 2009

Final - Monitoring Reproductive Success and Reproductive Habitat Parameters of Least Terns and Piping Plovers in the Central Platte River Valley, April 24, 2010

**Peer Review**

Summary of 2009 Tern and Plover Monitoring Protocol Peer Review Comments

**Work Products**

Tern and Plover Monitoring Protocol Implementation Report for 2001

Tern and Plover Monitoring Protocol Implementation Report for 2002

Tern and Plover Monitoring Protocol Implementation Report for 2003

Tern and Plover Monitoring Protocol Implementation Report for 2004

Tern and Plover Monitoring Protocol Implementation Report for 2005

Tern and Plover Monitoring Protocol Implementation Report for 2006

Interior Least Tern and Piping Plover Reproductive Monitoring During the Cooperative Agreement (2001-2006), Central Platte River, Nebraska

Tern and Plover Monitoring Protocol Implementation Report for 2007

2008 – 2009 Interior Least Tern and Piping Plover Monitoring and Research Report for the Central Platte River, Nebraska

Draft 2010 Interior Least Tern and Piping Plover Monitoring and Research Report for the Central Platte River, Nebraska

Other tern and plover research, reports and articles

# Tern and Plover Foraging Habits Study

### Adaptive Management Step

Problem Assessment Investigation

### Objective

Investigation to quantify frequency and distance of LT and PP movements away from nesting colonies on off-channel and riverine habitats; quantify time allocation to foraging and foraging success rate; quantify features of foraging habits used; and evaluate linkages between indices of productivity and measures of foraging effort for LT and PP.

### Associated Broad Hypotheses

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.

TP-3: Ephemeral nesting areas in the river are/are not needed for long-term nesting success of tern and plover.

### Associated Tier I Priority Hypotheses

TP1: Interaction of river and sandpit habitat.

### Description of Work / Procurement

Tern and Plover Foraging Habits Study RFP

### Contractor

United States Geologic Survey – Northern Prairie Wildlife Research Center

### Protocols

Tern and Plover Foraging Habits Study Design

### Peer Review

N/A

### Work Products

Tern and Plover Foraging Habits Study 2009 Progress Report

Final Report due March 2011

# Tern and Plover Nest Site Selection Research

### Adaptive Management Step

Monitor

### Objective

Research to quantify macro- and micro-scale habitat parameters associated with LT and PP nest initiation and nest and brood survival and evaluate influences the FSM and MCM management strategies have on habitat availability and nest-site selection and reproductive success of LT and PP. A second-tier objective is to assess the impacts of research activities on LT and PP nest and brood survival rates.

### Associated Broad Hypotheses

None

### Associated Tier I Priority Hypotheses

T1: Additional bare sand habitat will increase the number of adult least terns.

P1: Additional bare sand habitat will increase the number of adult piping plover.

TP1: Interaction of river and sandpit habitat.

TP5: Use of riverine islands by least terns and piping plovers will increase with active channel width.

### Description of Work / Procurement

See protocol

### Contractor

Executive Director's Office

### Protocols

2010 Parameter-based Research on Nest-site Selection and Reproductive Success of Interior Least Terns and Piping Plovers on the Central Platte River, Nebraska

### Peer Review

None

### Work Products

Draft 2010 Interior Least Tern and Piping Plover Monitoring and Research Report for the Central Platte River, Nebraska

# Tern and Plover Habitat Selection Studies

### Objective

Creation and maintenance of a continuum of in-channel LT and PP habitat at Program habitat complexes and opportunistic locations to evaluate species use and selection across a range of nesting island sizes and heights. Creation and maintenance of off-channel LT and PP nesting habitat in proximity to in-channel habitat to evaluate use and selection between the habitat types.

### Associated Broad Hypotheses

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.

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.

TP-3: Ephemeral nesting areas in the river are/are not needed for long-term nesting success of tern and plover.

### Associated Tier I Priority Hypotheses

T1: Additional bare sand habitat will increase the number of adult least terns.

P1: Additional bare sand habitat will increase the number of adult piping plover.

TP1: Interaction of river and sandpit habitat.

TP5: Use of riverine islands by least terns and piping plovers will increase with active channel width.

### Study Design

To be developed in 2011

### Monitoring and Research Protocols

Final - Monitoring Reproductive Success and Reproductive Habitat Parameters of Least Terns and Piping Plovers in the Central Platte River Valley, April 24, 2010

2010 Parameter-based Research on Nest-site Selection and Reproductive Success of Interior Least Terns and Piping Plovers on the Central Platte River, Nebraska

### Riverine Habitat Enhancement Projects

2009 Cottonwood Ranch Habitat Enhancement Project Design Drawings and Specifications

2010 Elm Creek Complex Habitat Enhancement Project Design Drawings and Specifications (Riverine nesting island construction delayed due to USACE permit issues)

### Off-Channel Sand and Water Habitat Creation Projects

2009 Dyer Property Habitat Enhancement Project Design Drawings and Specifications

2010 Cottonwood Ranch Off-Channel Sand and Water Nesting Complex Design Drawings and Specifications

## Pallid Sturgeon Information Review

### Adaptive Management Step

Problem Assessment Investigation

### Objective

Comprehensive review and summary of information related to the life history, occurrence and habitat selection and use of the PS encompassing information from throughout the species' range and particular emphasis on information related to PS use of and occurrence in the middle Missouri River and the Platte River below its confluence with the Elkhorn River, Nebraska.

### Associated Broad Hypotheses

PS-1: Current habitat in the lower Platte River is/is not suitable for adult and juvenile pallid sturgeon.

PS-2: Water related activities above the Loup River do/do not impact pallid sturgeon habitat.

PS-3: Non-Program actions (e.g., harvest, stocking, Missouri River conditions) determine the occurrence of pallid sturgeon the lower Platte River

### Associated Tier I Priority Hypotheses

N/A

### Description of Work / Procurement

Pallid Sturgeon Information Review RFP

### Contractor

Dr. Ed Peters in association with Dr. James Parham

### Protocols

N/A

### Peer Review

N/A

### Work Products

Pallid Sturgeon Literature Review Final Report

## Lower Platte River Stage-Change Study

### Adaptive Management Step

Problem Assessment Investigation

### Objective

Study to develop the information needed to evaluate the effects of Program water management activities, including new activities covered by state and federal depletion plans, on water stage and how those stage changes affect physical parameters in the reach of the lower Platte River from the Elkhorn River confluence to the Missouri River confluence. The intent was to determine if Program water activities can be statistically identified (significant beyond the error of the gauging equipment) from base flow conditions and if Program water activities have a statistically significant impact on stage, velocity, temperature, turbidity, substrate, or channel morphology.

### Associated Broad Hypotheses

PS-2: Water related activities above the Loup River do/do not impact pallid sturgeon habitat.

### Associated Tier I Priority Hypotheses

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

### Description of Work / Procurement

Lower Platte River Stage-Change Study RFP

### Contractor

HDR Inc. in association with Tetra Tech Inc. and The Flatwater Group

### Protocols

See work products

### Peer Review

Scheduled for 2011

### Work Products

Lower Platte River Stage-Change Study Final Report

## Lower Platte Water Quality Monitoring

### Adaptive Management Step

Monitoring

### Objective

Monitoring of the spatial and temporal variation of selected water quality parameters in the lower Platte River as well as the comparative contributions of the various sub-basins.

### Associated Broad Hypotheses

PS-2: Water related activities above the Loup River do/do not impact pallid sturgeon habitat.

### Associated Tier I Priority Hypotheses

TBD?

### Description of Work / Procurement

Water Quality Monitoring RFP

### Contractor

EA Engineering Science and Technology, Inc.

### Protocols

2009 Water Quality Monitoring Protocol

2010 Water Quality Monitoring Protocol

### Peer Review

Water Quality Monitoring Peer Review Comments

### Work Products

Water Quality Monitoring 2009 Data Summary Report

Water Quality Monitoring 2010 Data Summary Report

# FSM MANAGEMENT STRATEGY INFORMATION | APPENDIX D

## Sediment Augmentation Feasibility Study

### Adaptive Management Step

Problem Assessment Investigation

### Objective

Investigation to refine Environmental Impact State (EIS) estimate of sediment shortage, investigate feasibility of sediment augmentation, and screen potential augmentation methods and locations.

### Associated Broad Hypotheses

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 to a relatively stable condition, in contrast to present conditions where reaches vary longitudinally between degrading, aggrading, and stable conditions; and reduce the potential for degradation in the north channel of Jeffrey Island resulting from headcuts.

### Associated Tier I Priority Hypotheses

Sediment #1: Average sediment augmentation near Overton of 185,000 tons/yr under existing flow regime and 225,000 tons/yr under Governance Committee proposed flow regime achieves a sediment balance to Kearney.

### Description of Work / Procurement

Sediment Augmentation Experiment Feasibility Analysis, Design, and Permitting RFP

### Contractor

The Flatwater Group in association with HDR Inc. and Tetra Tech Inc.

### Protocols

N/A

### Peer Review

First Quarter 2011

### Work Products

DRAFT Sediment Augmentation Experiment Alternatives Screening Summary Report

# System-Level Geomorphology and Vegetation Monitoring

### Adaptive Management Step

Monitor

### Objective

Annual system-level monitoring of in-channel geomorphology and vegetation characteristics in the associated habitats to document changes/trends over time. Primary data source for evaluating the Program's ability to create habitat on a system-scale. Contributing data source for evaluating the Program's ability to create and/or maintain habitat using flow.

### Associated Broad Hypotheses

S-1: A combination of flow management, sediment management, and land management (i.e., Clear/Level/Pulse) will/will not generate detectable changes in the channel morphology of the Platte River on Program lands, and/or habitats for whooping crane, least tern, piping plover, pallid sturgeon and other species of concern.

S-2: A combination of non-managed flows, sediment management and land management (i.e., Clear/Level/Mechanical Maintenance) will/will not generate detectable changes in the channel morphology of the Platte River, and/or habitats for whooping crane, least tern, piping plover, pallid sturgeon and other species of concern.

S-4: Program management actions will/will not be of sufficient scale and magnitude to cause detectable system wide changes in channel morphology and/or habitats for the target species.

### Associated Tier I Priority Hypotheses

Sediment #1: Average sediment augmentation near Overton of 185,000 tons/yr under existing flow regime and 225,000 tons/yr under Governance Committee proposed flow regime achieves a sediment balance to Kearney.

Flow #1: Increasing the variation between river stage at peak (indexed by Q1.5 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.

Flow #3: Increasing 1.5-yr Q with Program flows will increase local boundary shear stress and frequency of inundation at existing green line (elevation at which riparian vegetation can establish). These changes will increase riparian plant mortality along margins of channel, raising elevation of green line. Raised green line = more exposed sandbar area and wider unvegetated main channel.

### Description of Work / Procurement

Monitoring the Channel Geomorphology and In-Channel Vegetation of the Central Platte River RFP

### Contractor

Ayres Associates in association with Olsson Associates

### Protocols

2009 Interim Draft Geomorphology and In-Channel Vegetation Monitoring Protocol

2010 Final Geomorphology and In-Channel Vegetation Monitoring Protocol

**Peer Review**

Peer Review Summary Comments – Geomorphology and In-Channel Vegetation Monitoring Protocol

**Work Products**

Geomorphology and Vegetation Monitoring Year 1 (2009) Report

Geomorphology and Vegetation Monitoring Year 2 (2010) Report

## One-Dimensional Hydraulic and Sediment Transport Model

### Adaptive Management Step

Problem Assessment Investigation

### Objective

Develop one-dimensional HEC-RAS steady flow, unsteady flow, and sediment transport model for the reach extending from North Platte, Nebraska downstream to Chapman, Nebraska. Model will be used as a tool for implementation design of FSM management experiments and in-channel MCM actions, to inform hydraulics-related trend and functional relationship analyses, and in support of annual habitat availability analyses.

### Associated Broad Hypotheses

Supporting data/analysis tool for testing multiple broad hypotheses

### Associated Tier I Priority Hypotheses

Supporting data/analysis tool for testing multiple priority hypotheses

### Description of Work / Procurement

1-D Hydraulic and Sediment Transport Modeling RFP

### Contractor

HDR Inc. in association with Tetra Tech Inc. and The Flatwater Group

### Protocols

N/A

### Peer Review

Golder Associates (Review Complete – Need Report)

### Work Products

1-D Hydraulic and Sediment Transport Model Draft Report

## Morphology and Stream Power Investigation(s)

### Adaptive Management Step

Problem Assessment Investigation

### Objective

Identify relationship between stream power and channel morphology in the central Platte River. Estimated unit stream power threshold for maintenance of braided stream morphology and sand bar formation and erosion relationships will be used to inform flow consolidation management experiment implementation design and to predict outcomes of flow consolidation actions and Elm Creek FSM "proof of concept" study.

### Associated Broad Hypotheses

PP-3: Designed mechanical alterations of 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 that 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 from 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

### Associated Tier I Priority Hypotheses

Flow #1: Increasing the variation between river stage at peak (indexed by Q1.5 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.

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.

### Description of Work / Procurement

N/A –No description of work or procurement information because analysis procedures and work conducted by Program Special Advisors in the field of geomorphology and sediment transport.

### Contractor

Chester Watson and Brad Anderson (Anderson Consulting Engineers)

### Protocols

N/A

### Peer Review

TBD

### Work Products

Technical Memorandum due First Quarter 2011

## Vegetation Scour Research Project

### Adaptive Management Step

Problem Assessment Investigation

### Objective

Identify erosion thresholds for representative one and two-year age class perennial riparian vegetation species (phragmites, reed canary grass, cottonwood, and sandbar willow) that colonize sand bars. Results will be coupled with numerical simulation modeling to design flow consolidation management experiments, and predict outcomes under various management scenarios.

### Associated Broad Hypotheses

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; 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.

### Associated Tier I Priority Hypotheses

Flow #3: Increasing 1.5-yr Q with Program flows will increase local boundary shear stress and frequency of inundation at existing green line (elevation at which riparian vegetation can establish). These changes will increase riparian plant mortality along margins of channel, raising elevation of green line. Raised green line = more exposed sandbar area and wider unvegetated main channel.

Flow #5: Increasing magnitude and duration of a 1.5-yr flow will increase riparian plant mortality along the margins of the river. There will be different relations (graphs) for different species.

### Description of Work / Procurement

Directed Vegetation Research RFP

### Contractor

USDA-ARS National Sedimentation Laboratory in association with University of Tennessee

### Protocols

Study Design for Directed Vegetation Research on the Platte River

### Peer Review

TBD

### Work Products

Presentation of Partial Results (Slide Show)

Draft Report due March 1, 2011

# Cottonwood Ranch Flow Consolidation Conceptual Design

### Adaptive Management Step

Problem Assessment Investigation

### Objective

Identify and screen flow consolidation alternatives on the Cottonwood Ranch property. Screening will address technical and permitting feasibility of alternatives, rank those alternatives, and provide a discussion of potential impacts to neighboring landowners.

### Associated Broad Hypotheses

PP-3: Designed mechanical alterations of 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 that 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 from 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

### Associated Tier I Priority Hypotheses

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.

### Procurement

Cottonwood Ranch OCSW Habitat Final Design and Flow Consolidation Conceptual Design RFP

### Contractor

Inter-Fluve Inc. in association with EA Engineering Science and Technology, Inc.

### Protocols

N/A

### Peer Review

TBD

### Work Products

Approach to Flow Consolidation Measures Technical Memorandum

Draft Report due April 4, 2011

# Elm Creek FSM "Proof of Concept" Experiment

### Adaptive Management Step

Problem Assessment Investigation

### Objective

Project-scale experiment to test the physical processes relationships and expected outcomes that comprise the FSM management strategy. Special emphasis will be placed on evaluating bar formation and erosion and vegetation scour processes. The Elm Creek Complex was chosen for this study because flows are consolidated by the Kearney Canal diversion.

### Associated Broad Hypotheses

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; 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.

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 to a relatively stable condition, in contrast to present conditions where reaches vary longitudinally between degrading, aggrading, and stable conditions; and reduce the potential for degradation in the north channel of Jeffrey Island resulting from headcuts.

PP-3: Designed mechanical alterations of 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 that 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 from 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

### Associated Priority Hypotheses

Flow #1: Increasing the variation between river stage at peak (indexed by Q1.5 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.

Flow #3: Increasing 1.5-yr Q with Program flows will increase local boundary shear stress and frequency of inundation at existing green line (elevation at which riparian vegetation can establish). These changes will increase riparian plant mortality along margins of channel, raising elevation of green line. Raised green line = more exposed sandbar area and wider unvegetated main channel.

Flow #5: Increasing magnitude and duration of a 1.5-yr flow will increase riparian plant mortality along the margins of the river. There will be different relations (graphs) for different species.

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.

**Description of Work / Procurement**

Final Draft Elm Creek FSM "Proof of Concept" Experiment RFP (Advertise February 2011)

**Contractor**

Protocol review and revisions - Tetra Tech Inc.

Experiment implementation - TBD

**Protocols**

Draft Project-Scale Geomorphology and Vegetation Monitoring Protocol (Undergoing Revision)

**Peer Review**

TBD

**Work Products**

Protocol Review due March 15, 2011

## Short-Duration High Flow Events and Natural Flow Events

### Flow Release and Natural Flow Dates & Magnitudes

May 2008 Natural Flow Event – 12,000 cfs

April 2009 Flow Routing Test – 3,200 cfs

June 2010 Natural Flow Event – 8,000 cfs

### Flow Release and Natural Flow Event Reports

May 2008 Natural High Flow Event Data Analysis Summary Report

2009 Platte River Flow Routing Test: Results, Information Gleaned, Lessons Learned

Analysis of 2010 natural flow event to occur in 2011

### SDHF-Feasibility and Planning Documents

2009 Water Action Plan Update

Platte River in Central Nebraska Modeling of Pulse-Flow Release

Water Management Study Phase I – Evaluation of Pulse Flows for the PRRIP

Water Management Study Phase II – Evaluation of Pulse Flows for the PRRIP

CNPPID Reregulating Reservoir Elwood and J-2 Alternatives Project Report

# FSM MANAGEMENT STRATEGY INFORMATION | APPENDIX E

## Off-Channel Sand and Water Nesting Habitat

**Minimum Design Criteria**

Target Species Minimum Habitat Parameters

**OCSW Nesting Habitat Projects**

2009 Dyer Property Habitat Enhancement Project Design Drawings and Specifications

2010 Cottonwood Ranch Off-Channel Sand and Water Nesting Complex Design Drawings and Specifications

Note: Information on other MCM actions and projects will be added as those actions are implemented.

# AM SUPPORT ACTIVITY INFORMATION | APPENDIX F

## Program Database System

### Objective

Provide central clearinghouse where Program staff, collaborators, contractors, and committee members, independent of their physical location, exchange information and conduct the daily operations of the Program.

### Description of Work / Procurement

PRRIP Database System RFP

### Contractor

Riverside Technology, Inc.

### Work Products

PRRIP Database System Requirements Document

PRRIP Database System Design Document

## Color-Infrared Imagery

### Objective

Provide an annual record of physical habitat characteristics during the nesting season to be used in conjunction with topographic data and hydraulic modeling to estimate annual in- and off-channel nesting habitat availability. The imagery also provides an annual record of Program and other actions that have modified habitat characteristics in the associated habitats, providing a data source for evaluating channel and vegetation community changes/trends over the course of the First Increment.

### Description of Work / Procurement

PRRIP Aerial Photography RFP

### Contractor

Cornerstone Mapping

### Protocol

Draft 2001 PRRIP Aerial Photography Protocol

Final 2009 PRRIP Aerial Photography Protocol

### Work Products

1998 CIR Imagery (Film – Digitized)
2000 Imagery (Film)
2001 BW Imagery (Digitized Film – Orthorectified)
2002 Imagery (Film)
2003 CIR Imagery (Digitized Film – Orthorectified)
2004 CIR Imagery (Digitized Film – Orthorectified)
2005 Imagery (Film)
2007 CIR Imagery (Digital – Orthorectified)
2008 June CIR Imagery (Digital – Orthorectified)
2009 June CIR Imagery (Digital – Orthorectified)
2010 June CIR Imagery (Digital – Orthorectified)

### Other Imagery

1938 BW Imagery (Digitized Film – Orthorectified)
1951 BW Imagery (Digitized Film – Orthorectified)
1984 CIR Imagery (Digitized Film – Not Orthorectified)
1989 CIR Imagery (Digitized Film – Not Orthorectified)

## Light Detection and Ranging (LiDAR)

### Objective

Provide an annual record of detailed topographic characteristics within the channel. The data provides an annual record of Program and other actions that have modified topography in the associated habitats, providing a data source for evaluating channel changes over the course of the First Increment.

### Description of Work / Procurement

PRRIP 2010 LiDAR RFP

### Contractor

2009 – Data acquisition by Merrick & Company, Project Management by Dewberry

2010 – Data acquisition by Aero-Graphics, Inc., Project Management by Tetra Tech Inc.

### Protocol

See RFP Requirements

### Work Products

March 2009 In-Channel LiDAR Kingsley Dam to Chapman, NE (2009 LiDAR Quality Assurance Report)

October 2010 In-Channel LiDAR of Associated Habitats (2010 LiDAR Data Collection Report)

# INDEPENDENT SCIENCE ADVISORY COMMITTEE | APPENDIX G

### Objective

Provide independent scientific advice to the EC and to the GC, as requested, on scientific issues during the First Increment of the Program.

### Description of Work

ISAC Scope of Work

### ISAC Members

Mr. David Marmorek, ESSA Technologies Ltd. (2009 – Current)

Dr. Philip Dixon, Iowa State University (2009 – Current)

Dr. David Galat, University of Missouri (2009 – Current)

Dr. Robert Jacobson, U.S. Geological Survey, Columbia, Missouri (2009 – Current)

Mr. Kent Loftin, HydroPlan LLC (2009 – Current)

Dr. John Nestler, Fisheries and Environmental Services (2009 – Current)

### ISAC Reports

2009 ISAC Report on the PRRIP

### PRRIP Responses to ISAC Reports

PRRIP Response to Findings in the Final 2009 ISAC Report

*Visit us at www.platteriverprogram.org*