# Platte SDM TAC1 Meeting Pre-read: PM Info-Sheets

## Contents

# 1 PM Info-Sheet: Piping Plovers and Interior Least Terns

| Sub-objective: Reproductive Success | | | |
|---|---|---|---|
| **Candidate Performance Measures** | **Units** | **Description** | **MSIC**[1] |
| **PRRIP Breeding Pairs** | #/year | Primary PM: The number of breeding pairs nesting on PRRIP habitat in the Associated Habitat Reach (AHR) in a year. The PM reports the average for the 50-year simulation period. | 10% |
| **PRRIP Fledge Ratio** | ratio | Alternate PM: The number of fledglings divided by the number of breeding pairs for each year for PRRIP habitat only. The PM reports the ratio of the long-term average breeding pairs and fledglings. | 10% |
| **PRRIP Total Fledglings** | # | Alternate PM: The total number of fledglings produced on PRRIP habitat over the 50-year model simulation period. The PM indicates the PRRIP contribution to the global population over time. | 10% |
| **AHR Breeding Pairs** | #/year | Alternate PM: The number of breeding pairs nesting in the Associated Habitat Reach (AHR) in a year (includes non-PRRIP habitat). The PM reports the average for the 50-year simulation period. | 10% |
| **AHR Fledge Ratio** | ratio | Alternate PM: The number of fledglings divided by the number of breeding pairs for each year within the entire AHR. The PM reports the ratio of the long-term average breeding pairs and fledglings. | 10% |

## Performance Measure Summary

These performance measures reflect the effects of management actions on the population and reproductive success of plovers and terns in the AHR. Other indicators such as annual habitat availability were considered but not included because species-centric metrics more directly address the Program's management objective of increasing species productivity.

[1] Minimum Significant Increment of Change. This is a user-defined value that represents the minimum increment of difference in the performance of two alternatives thought to be significant for decision making. It reflects technical judgments about the precision of modeling as well as value judgments about the magnitude of change that merits decision maker attention when choosing among alternatives. This value is used in the presentation of colour-coded consequence tables to focus attention on significant differences between alternatives.

The most informative PM is average breeding pairs because this PM integrates the population-level effects of the fledge ratio PM. Because the PM reports PRRIP breeding pairs, it provides an indicator of the Program's contribution to the overall plover/tern population in the AHR.

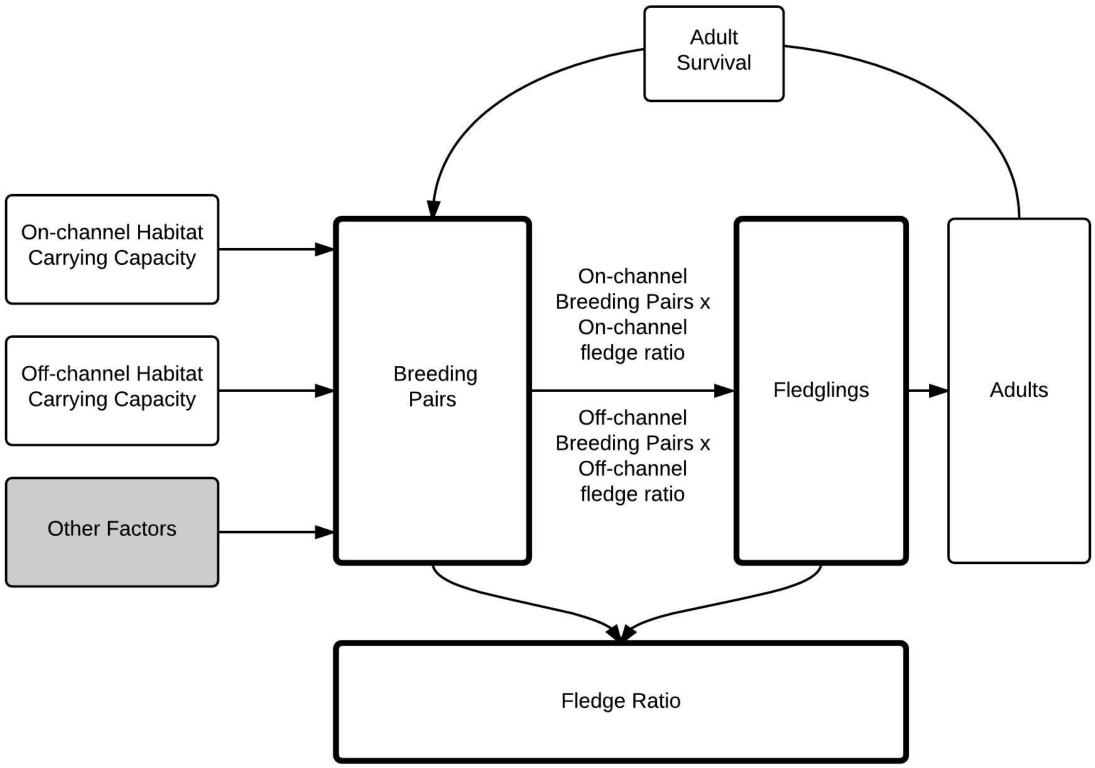
The number of breeding pairs and fledge ratios are often considered together to provide a full picture of reproductive success. The PRRIP fledge ratio provides information on whether Program habitat is a source or sink for birds. The lower the fledge ratio, the fewer fledglings each breeding pair produces. Fledge ratios below the proposed Lutey (2002) objectives (1.13 fledge ratio for plovers and 0.7 for terns) may indicate that Program habitat is a population sink for plovers.

Different management actions – particularly those relying on off-channel habitat – produce population results at different speeds. Because these differences in fledgling production compound on each other, we also report the total number of fledglings produced over the 50-year simulation period. The absolute number of PRRIP fledglings is an indicator of the Program's long-term contribution to the global plover and tern populations.

The reproductive success PMs are estimated using the Plover and Tern Habitat and Population Model. This model is a population-based model of the AHR, and therefore includes the effects of actions on both Program and non-Program habitat. The PMs (# breeding pairs and fledge ratio) are shown for the Program only (PRRIP) as well as for the entire AHR population. Since this SDM process is focused on Program actions, the plover/tern PMs are reflective of the Program contribution to the overall AHR plover/tern numbers.

The AHR is habitat limited for plover and tern nesting. Increasing the amount of on-channel and off-channel habitat increases the number of breeding pairs in the AHR. The influence diagram in Figure 1.1 provides a simple illustration of the relationships between habitat, breeding pairs, fledglings, and fledge ratios.

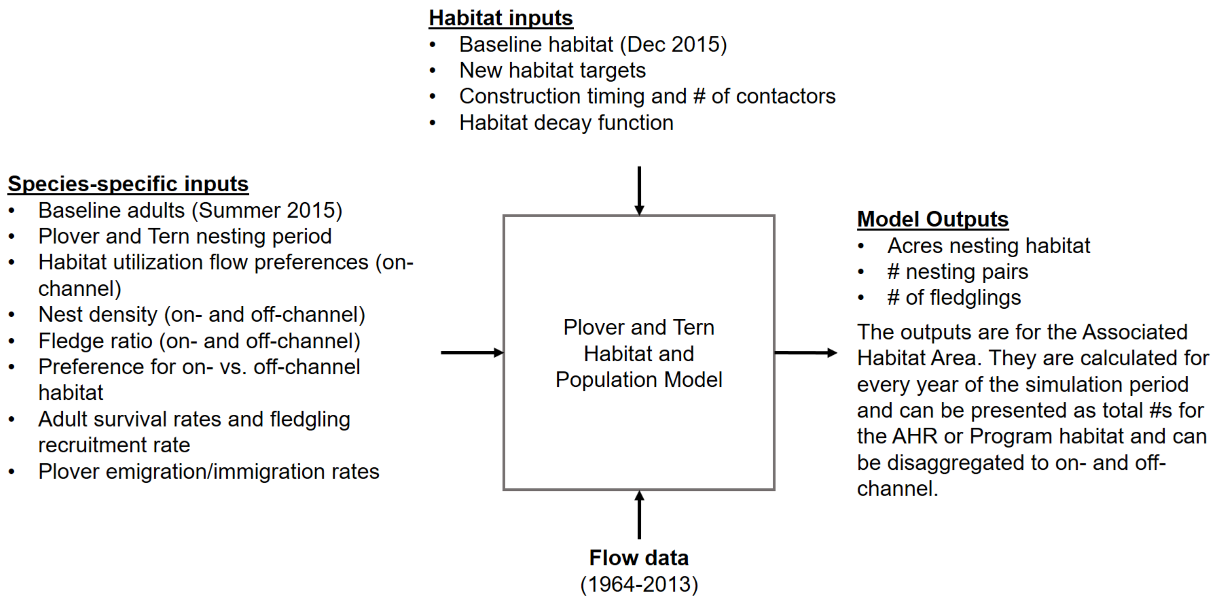
**Figure 1.1: Influence Diagram for terns and plovers**




## Calculations and/or Scoring

The PMs are estimated using the Plover and Tern Habitat and Population Model. The model is driven by the amount of on-channel and off-channel habitat available for plovers and terns in the AHR and predicts reproductive success as a function of hydrologic conditions and other species-specific parameters (Figure 1.2 provides a more complete summary of model inputs and outputs). The model simulates a 50-year period based on flow data from 1964 to 2013. The model includes Program habitat as well as the existing non-Program off-channel habitat for the purpose of modeling AHR breeding population.

## Figure 1.2: Conceptual Diagram – Plover and Tern Habitat and Population Model




The steps to calculate these PMs are:

1. **Nesting Habitat:** Determine the amount of total nesting habitat available in each breeding season during the simulation period as a function of existing habitat, loss of habitat from erosion, hydrologic conditions, and speed at which habitat can be created.

2. **Carrying Capacity:** Determine the carrying capacity for on- and off-channel habitat as a function of maximum plover and tern nest density and habitat utilization. On-channel habitat utilization is modeled using the relationship between flow and nest initiation observed through Program monitoring (explained in more detail in next section). Off-channel utilization is a set value determined by the model user.

3. **Global Population:** Determine the AHR's global population in each simulation year based on numbers from the previous year, # of fledglings, juvenile and adult survival rates, and the % of global population lost during periods when no habitat is available. Note that the model does not yet include plover emigration/immigration in global population calculations.

4. **Breeding Pairs:** Determine the number of plover and tern breeding pairs that nest on the available on- and off-channel habitat in the AHR. This number is bounded at the high-end by the carrying capacity determined in Step 2. A key assumption here is the extent to which plovers and terns prefer on-channel vs. off-channel nesting habitat. The default value in the model is that there is no preference and plovers/terns choose nesting sites in proportion to the area available for each habitat type (off- and on-channel).

5. **Fledglings:** Determine the number of AHR fledglings for each breeding season by multiplying the number of breeding pairs nesting on-channel and off-channel by their respective on-channel and off-channel fledge ratio.

6. **Fledge Ratio:** Calculate the fledge ratio for each breeding season as the # of fledglings divided by the # of breeding pairs across all habitat types (on- and off-channel).

## Key Assumptions and Uncertainties

Key parameters and functions in the Habitat and Population Model that are supported with Program data include:

- **On-channel Habitat Utilization Function**: Program monitoring indicates there is a relationship between flow during the nest initiation period and utilization of on-channel habitat. When discharge has been very low during the majority of the nest initiation period (<600 cfs), available on-channel habitat has not been used. When discharge has exceeded ~1,600 cfs during the majority of the nest initiation period, on-channel habitat has been fully utilized. The model assumes a linear utilization relationship based on average discharge during the nest initiation period for each species. If average discharge is ≤ 600 cfs, 0% of on-channel habitat is utilized. If average discharge ≥ 1,600 cfs, 100% of habitat is utilized.[2]

- **Fledge Ratios:** The fledge ratios for on- and off-channel used in the model are based on Program monitoring from 2001-2015 as well as a literature review of fledge ratios on sandpit and sandbar habitats in other regions. The number of observations in the Program dataset for on-channel fledges is significantly lower (n=26 for plovers and n=15 for terns) than for off-channel fledges (n=464 for plovers and n=960 for terns), contributing to a higher level of uncertainty for the on-channel fledge ratio. A structured expert elicitation interview was conducted to provide an estimate for fledge ratios under alternative island height conditions. This revised estimate is used for alternatives where the island construction height is lower than the Program has typically built habitat islands in the past (up to floodplain elevation).

- **Incubation/Rearing Flows:** Program monitoring has not found a relationship between flows during the incubation and rearing period and fledgling success. While the Habitat and Population Model includes an option to include incubation/rearing flows, these flows do not affect fledging or breeding pair numbers at this time.

- **Preference between on- and off-channel:** It has been hypothesized that plovers and terns may show a "preference" for either on- or off-channel habitat and select that habitat at a proportionally-higher rate. Program monitoring data does not currently indicate a strong preference toward either habitat type. Accordingly, the model assumes the breeding population nests on each habitat type proportionately to its availability if habitat availability

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[2] Daily discharges are capped at 1,600 cfs for the purposes of utilization calculations. This removes the potential for utilization to be skewed upward by very high discharges.

is sufficient to accommodate all breeding pairs and on-channel flows are high enough to support full utilization of on-channel habitat.

- **Habitat Loss Function:** Habitat loss equations are included in the Tern and Plover Habitat Model to determine the extent to which habitat has to be continually rebuilt to meet an alternative's target acreage of on-channel habitat. The model simulates on-channel habitat loss during the winter due to flow and ice action as well as accelerated habitat loss due to overtopping and lateral erosion during high discharge periods. Winter habitat loss is user-defined as a percent of total on-channel habitat at the end of the fall construction period (default is 28%). Accelerated high flow losses are calculated for each day that flow exceeds a user-defined threshold (default is 4,000 cfs). The winter and accelerated high flow habitat loss parameters were developed using observed data from both wet and dry years.

Key assumptions and uncertainties in the modeling that result from data limitations are:

- **% Breeding Pop. Lost Per Yr >1 Yr No Habitat (Habitat Loss Emigration):** During periods when no nesting habitat is available in the AHR for more than one year, the model assumes that 20% of the breeding population is permanently lost to emigration. This assumption is based on limited data and is only used if an alternative assumes that non-Program off-channel habitat is no longer being maintained.

- **Emigration/Immigration:** Each year, a proportion of the AHR breeding population does not return to the AHR to breed (emigration) and individuals that have previously bred on other systems immigrate to and breed in the AHR. Emigration and immigration rates are very difficult to quantify and are highly uncertain. However, they would affect all alternatives equally. Therefore, effects of emigration and immigration are not included in the analysis.

A summary of the plover and tern variables used in the model is included in Appendix 1.1 to this PM Info-Sheet, along with an indication of EDO's assessment of the uncertainty in the assumed value(s).

## Results

Results for tern and plover reproductive success for the Round 2 alternatives are shown in Figure 1.3. It's helpful to have a copy of the alternative descriptions from the Summary document while reviewing this figure.

**Figure 1.3: Results - Plover and Tern PRRIP Reproductive Success**

| Objective | Performance Measure | Units | Dir | STC | A1 | A2 | A3 | A4 | B1 | B2 | B3 | B4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Piping Plovers** | | | | | | | | | | | | |
| Program Repro Success | Average Breeding Pair (BP) | #/year | H | 22 | 18 | 34 | 28 | 29 | 43 | 48 | 49 | 50 |
| | Average Fledge Ratio | #/year | H | 1.30 | 1.40 | 1.27 | 1.37 | 1.34 | 1.40 | 1.40 | 1.38 | 1.37 |
| | Total Fledglings over 50 yr | # | H | 1,420 | 1,271 | 2,144 | 1,903 | 1,929 | 3,006 | 3,346 | 3,379 | 3,400 |
| AHR Repro Success | Average Breeding Pair | #/year | H | 30 | 27 | 42 | 36 | 37 | 51 | 56 | 57 | 58 |
| | Average Fledge Ratio | #/year | H | 1.33 | 1.40 | 1.30 | 1.37 | 1.36 | 1.40 | 1.40 | 1.38 | 1.37 |
| **Interior Least Terns** | | | | | | | | | | | | |
| Program Repro Success | Average Breeding Pair (BP) | #/year | H | 97 | 91 | 141 | 134 | 136 | 215 | 225 | 226 | 226 |
| | Average Fledge Ratio | #/year | H | 1.07 | 1.10 | 1.06 | 1.09 | 1.08 | 1.10 | 1.10 | 1.09 | 1.09 |
| | Total Fledglings over 50 yr | # | H | 5,187 | 4,992 | 7,462 | 7,312 | 7,339 | 11,802 | 12,361 | 12,347 | 12,318 |
| AHR Repro Success | Average Breeding Pair | #/year | H | 140 | 133 | 182 | 176 | 177 | 256 | 263 | 264 | 264 |
| | Average Fledge Ratio | #/year | H | 1.08 | 1.10 | 1.07 | 1.09 | 1.09 | 1.10 | 1.10 | 1.09 | 1.09 |

A few key points are about these results are summarized here:

- Relative to Stay the Course (STC), all alternatives except A1 involve an increase in the amount of available habitat, and therefore show increased levels of productivity.
- A1 involves scaling back on tern and plover habitat by discontinuing on-channel habitat creation and maintenance, and the difference between A1 and STC shows the relative benefit of on-channel habitat.
- The difference in productivity from choosing the Moving Complexes[3] habitat construction approach over the traditional mechanical habitat construction approach is shown in the comparison of Alternatives A3 vs. A2.
- The incremental benefit of augmented flow during the nest initiation period can be seen in the increase in breeding pairs from A3 to A4 and from B3 to B4.
- The "B' alternatives represent options that double the plover population over the course of 30 years (B1) or 20 years (B2-B4).

## Additional Information and/or Context for Interpreting Results

- **Plover Targets.** Lutey (2002) proposes a 10-year running average of 126 piping plovers (63 breeding pair) as a population objective for the Central Platte, which is 45% of the Recovery Plan goal for the entire Platte River. Lutey (2002) also proposes a fledge ratio of 1.13 fledglings/pair to ensure the AHR population is stable to increasing.

- **Tern Targets.** Lutey (2002) proposes a 10-year running average of 300 Least Terns (150 breeding pair) as a population objective for the Central Platte, which is 40% of the Recovery Plan goal for the entire Platte River. Lutey (2002) also proposes a fledge ratio of 0.70 fledglings/pair to ensure the AHR population is stable to increasing.

- **Fledge Ratio implications.** Fledge ratios below the proposed Lutey (2002) objectives may indicate that Program habitat is a population sink for plovers.

## References


Lutey, J.M. 2002. Species Recovery Objectives for Four Target Species in the Central and Lower Platte River (Whooping Crane, Interior Least Tern, Piping Plover, Pallid Sturgeon). United States Fish and Wildlife Service.

McGowan, C.P, Catlin, H., Shaffer, T., Gratto-Trevor, C., and Aron, C., 2014. Establishing endangered species recovery criteria using predictive simulation modeling. *Biological Conservation*, *177*, 220-229.

National Research Council. 2005. Endangered and Threatened Species of the Platte River. Committee on Endangered and Threatened Species in the Platte River Basin, National


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[3] MCA includes both de-vegetating permanent islands and treating naturally-formed sandbars. Naturally-formed sandbars are the only plover and tern habitat considered within the Round 2 alternatives that are not designed for 8,000 cfs flows.

Research Council, National Academy of Sciences. The National Academies Press, Washington, D.C.

## Appendix 1.1 – Plover and Tern Habitat and Population Model Variables

| Model Parameter* | | Plovers | Terns | Unit | Reference | Uncertainty |
|---|---|---|---|---|---|---|
| Nest Initiation Period | | 5/1 - 6/23 | 5/28 - 7/12 | Month/Day | PRRIP monitoring | Low |
| Incubation and Brood Rearing Period | | 6/24 - 8/26 | 7/13 - 8/30 | | | Low |
| Peak Nest Initiation Date | | 5/16 | 6/12 | | | Low |
| Density | On-channel | 0.4 | 1.0 | breeding pair/ acre | PRRIP monitoring | Medium |
| | Off-channel | 0.2 | 1.0 | | | Low |
| Fledge Ratio | On-channel | 0.8 | 0.6 | fledge/ breeding pair | PRRIP monitoring & Literature Review | Medium |
| | Off-channel | 1.4 | 1.1 | | | Low |
| Adult Survival | | 78% | 92% | % annual | McGowan et al. 2014 (Plovers) / NAS 2004 (Terns) | Medium (Plovers) / High (Terns) |
| Recruitment | | 52% | 23% | % fledglings reach breeding | | Medium (Plovers) / High (Terns) |
| % Breeding Pop. Lost Per Yr >1 Yr No Habitat | | 20% | 20% | % of breeding pairs | Assumptions – areas for discussion | High |
| Emigration | | 2% | 2% | % adults & fledglings | | High |
| Immigration | | 2% | 2% | % adult pairs | | High |
| Plovers On-Channel (Preference) | | 50% | 50% | % breeding pairs | | High |
| *The value presented here is used to produce results in the Excel version of the model. Distributions for some of these values are available and results can be produced using Crystal Ball. | | | | | | |

# 2 PM Info-Sheet: Management Cost

| Sub-Objective | Candidate Performance Measures | Units | Description | MSIC[4] |
|---|---|---|---|---|
| Short-term Management Cost | First Increment cost (total over 2017-2019) | 1000$ | The total cost of implementing an alternative for the period of the First Increment (2017-2019). This PM serves as an indicator of the impact on the Program budget. It provides an understanding of the short-term financial opportunity cost of investing in plover/tern habitat during the First Increment rather than other PRRIP projects. | 10% |
| Long-term Management Cost | Net Present Value (50 yrs) | 1000$ | The net present value of habitat creation and maintenance costs assuming the alternative is implemented over a 50-year period. This PM provides a basis for comparing the financial implications of management actions over a range of hydrologic conditions. | 10% |
| Land Acquisition Cost | Total Estimated Cost | 1000$ | The total estimated cost of any required land acquisition. This PM captures the effect on the land purchasing budget. | 10% |
| Long-term Water Use | Proportion of Program water used | % | The opportunity cost of water used for flow-related actions. This PM reports the average annual proportion of Program water used over the 50-year simulation period for three hydrologic year categories – wet, normal and dry water years. | 10% |
| Augmented Volume | Avg. Volume of Program water per year | Ac-ft / yr | The average volume of water augmented per year to reach target discharges for during the nest initiation period and/or the brood rearing period | 10% |

[4] Minimum Significant Increment of Change. This is a user-defined value that represents the minimum increment of difference in the performance of two alternatives thought to be significant for decision making. It reflects technical judgments about the precision of modeling as well as value judgments about the magnitude of change that merits decision maker attention when choosing among alternatives. This value is used in the presentation of color-coded consequence tables to focus attention on significant differences between alternatives.

## Performance Measure Summary

The management cost objective reflects a concern for the wise use of resources. All else being equal, actions that increase tern and plover productivity with lower resource expenditures are preferred. There are two kinds of management costs – financial costs associated with habitat creation or management actions, and water use – the volume of water used for terns and plovers. Money and water used for terns and plovers are not available for use in management actions for other purposes (e.g., whooping cranes, etc.) and thus these objectives also reflect the opportunity cost associated with using resources for terns and plovers.

Two candidate performance measures are proposed for financial management cost – a long-term and a short-term cost measure. The long-term cost measure is the net present value of habitat creation and maintenance costs for the foreseeable future, defined here as 50 years. *Net present value* is a method for bringing cash flows that occur over a number of years into one total cost number (see Calculations section below for more detail). The TAC or GC may want to discuss what time period is most relevant for the purposes of this decision. Generally, the longer the time period, the higher the net-present value cost for on-channel habitat is compared to off-channel habitat (all other things equal). This is because on-channel habitat generally incurs habitat creation costs annually, while off-channel habitat incurs one-time habitat creation costs up-front.

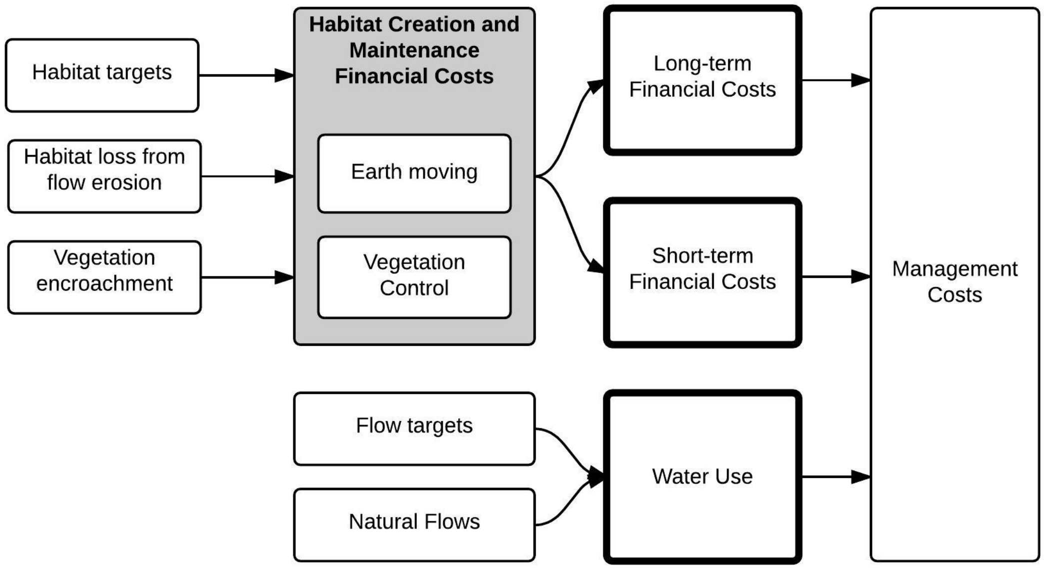
In addition to long-term cost implications, short-term costs may also be an important consideration for the GC as they are currently faced with decisions about how to allocate the Program budget. Some alternatives may require more upfront capital costs than others, requiring more of the First Increment budget.

Because some alternatives require the acquisition of more land, the cost to purchase more land is also included alongside other financial PMs. Though there is considerable uncertainty around the actual cost due to many factors (discussed in detail below), a one-time, up-front cost of $8,000 per acre is assumed to apply equally to all alternatives requiring land purchases.

Water costs are measured in terms of the proportion of available Program water used by an alternative. For the purposes of this decision process, “available Program water” consists of water that could be actively managed/released to increase river flow. Details on how available Program water is calculated are included in the next section. This performance measure was not defined in terms of the monetary cost of water because Program water has already been negotiated for the duration of the First increment. In addition to the proportional use, the average augmented volume across all hydrologic year types is included.

The factors influencing management costs are shown in Figure 2.1. Habitat creation and maintenance costs are composed of payments for earthmoving and vegetation removal. The model simulates habitat loss from erosion, and these erosion rates affect the amount of earthmoving activities that need to occur to reach an annual habitat acreage target. Vegetation control is a static annual operating cost. Water use is a result of the flow targets defined in the alternative and the natural flows (less augmentation is needed to reach a flow target in wetter years compared to drier years).

**Figure 2.1: Influence Diagram Showing Factors Affecting Management Costs (PMs in bold outline)**




## Calculations

*Long-term Financial Costs*

Net present value (NPV) is calculated using the following formula:

$$NPV = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t}$$

where:

T = Total time period
t = year
$C_t$ = habitat creation and maintenance costs during period t, in 2014$
*r* = discount rate

A discount rate of 3% is used, based on current federal government average interest rates on U.S. Treasury securities.[5]

*First Increment Financial Cost*

[5] https://www.treasurydirect.gov/govt/rates/pd/avg/avg.htm

The First Increment financial cost is simply the sum of costs over the 2017-2019 period for implementing an alternative. Since these are near-term costs and an expenditure in 2017 is not appreciably different than an expenditure in 2019, a net present value calculation is not used.

Given that on-channel habitat costs vary with hydrological conditions, on-channel costs for the 2017-2019 period are estimated as an average of 3-year on-channel costs during the model simulation period (which includes hydrology data for 50 years).

*Water Use*

The proportion of Program water used by an alternative is calculated by the following steps:

1. **Calculate average Program water available for wet, normal and dry years:** The volume of available water was estimated for wet, normal, and dry hydrologic year types using the combined scoring yields of the Environmental Account, Pathfinder water, and J-2 reservoir. Available Program water was calculated as the average yield (minus a 10% conveyance loss for non-J-2 water) by hydrologic year type over the scoring period of 1947-1994. The results of this calculation for available Program water are:

   - Wet Year: 113,418 acre-feet
   - Normal Year: 96,009 acre-feet
   - Dry Year: 69,791 acre-feet

2. **Calculate volume of augmented water:** For each simulation year, the augmented flow volume equals the difference between the recorded flow at Grand Island and the target flow as defined in the alternative.

3. **Calculate proportion of Program water used:** For each simulation year, flows are augmented to achieve flow target on each day until all available water is used (as calculated in step 1).

4. **Average % water used over simulation period for wet, normal and dry years**.

## Key Assumptions and Uncertainties

*Financial Costs*

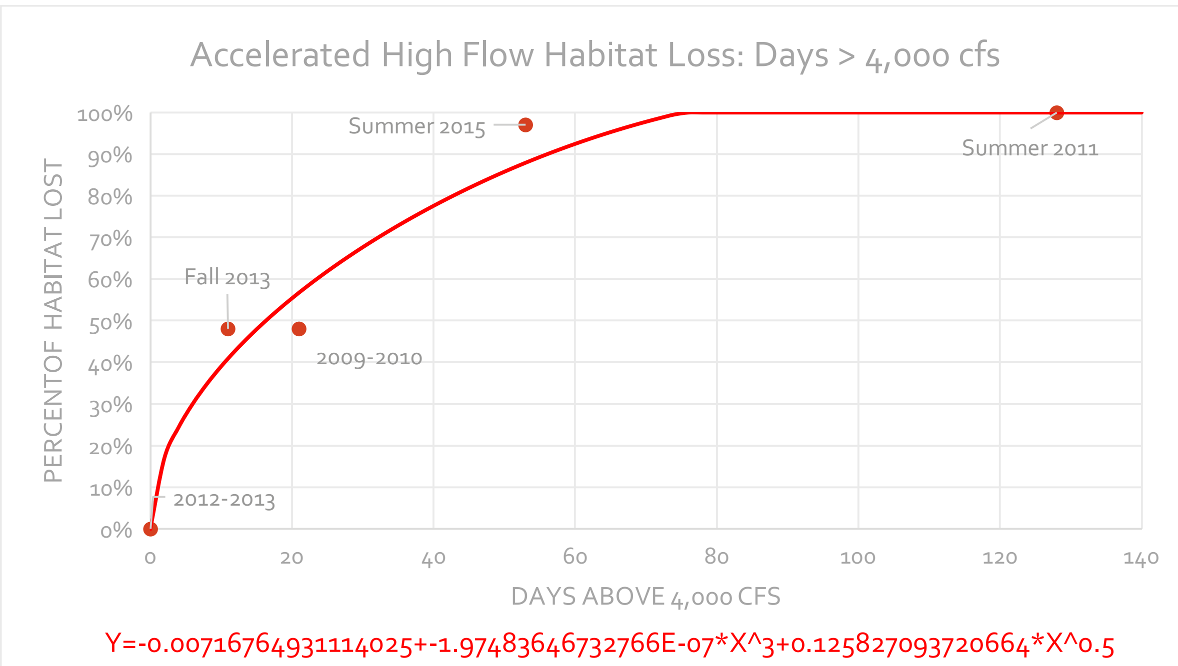
The on-channel and off-channel habitat costs are based on the Program's experience creating and maintaining these habitats during the First Increment. The key assumption underlying the calculation of the financial cost performance measures is that the costs of past habitat creation and maintenance costs can be used to estimate future costs.

The Program began constructing on-channel mechanical sandbar habitat in 2012. Based on this experience (summarized in EDO, 2015), the following parameters are used to calculate on-channel financial habitat costs:

- Average cost of on-channel habitat construction = $3,500/acre when low and high habitat types are roughly equal
- Annual pre-emergent herbicide and follow-up herbicide applications = $300/acre.

The rate of *on-channel habitat loss* is also a key assumption when calculating the total cost of on-channel habit construction. Habitat loss equations are included in the Tern and Plover Habitat Model to determine the extent to which habitat has to be continually rebuilt to meet an alternative's target acreage of on-channel habitat. The model simulates on-channel habitat loss during the winter due to flow and ice action as well as accelerated habitat loss due to overtopping and lateral erosion during high discharge periods. Winter habitat loss is user-defined as a percent of total on-channel habitat at the end of the fall construction period. The parameter value (28%) is based on winter habitat losses observed during the period of 2012-2015. Accelerated high flow losses are calculated for each day that flow exceeds a user-defined threshold (default is 4,000 cfs). The accelerated high flow loss function is presented in Figure 2.2 along with Program observations on habitat loss that were used to develop the function. The habitat loss parameters were developed using observed data from both wet and dry years.

**Figure 2.2: Accelerated High Flow Habitat Loss: Days> 4,000 cfs**




The Program began rehabilitating and constructing off-channel habitat in 2009. Off-channel habitat construction costs have been quite variable, depending on the amount of vegetation on the landscape, the amount of mechanical earth moving required, and whether or not contractors will accept fill material from the site in lieu of payment. To provide conservative cost estimates, construction costs are based on the high-end of costs experienced by the Program (summarized in EDO, 2015), and are as follows:

- Construction costs (One-time upfront costs):
    - New habitat at existing mining operations = $0 / acre[6]

[6] Note: This habitat is acquired through agreements with mine operators. The Program owns the land and receives royalty payments from mine operators that are generally sufficient to pay

- Rehabilitation of existing sandpit habitat = $7,500 / acre
- New mechanically created habitat = $20,000 / acre

- Annual maintenance costs:
    - Pre-emergent herbicide and follow-up herbicide applications = $150 / acre

Habitat loss due to erosion is not expected at off-channel habitat sites under non-flood conditions (EDO, 2015). At high flow magnitudes (i.e. >12,000 cfs), the model includes a damage function to off-channel habitat, and assumes a cost of $750/acre to repair the habitat. In the 50-year simulation period, there are 7 years when these high flows occur.

Land acquisition costs are not included in the management cost performance measures, but are expressed alongside management costs. The Program can and has utilized a variety of approaches to acquire land interests for habitat purposes including management agreements, leases, conservation easements, and fee title acquisition. These approaches vary widely in terms of cost, effort and rights afforded to the Program. Acquiring new land could cost anywhere from $0 to $12,000 per acre depending on the owner's plans for the site and the rights the Program needs. For example, the Program could:

- Buy a sandpit and rehabilitate for a land acquisition cost of $12,000 / acre;
- Lease the site for $200 / acre; or potentially
- Execute a management agreement to rehabilitate and occupy the site during the summer at $0 / acre.

For the "B" set of alternatives, it is conservatively assumed that fee title acquisition is required at a cost of $8,000 per acre, and that this cost is incurred in the first year of the simulation period. If land acquisition costs become a key feature in choosing between alternatives, a detailed scenario analysis may be warranted.

*Water Use*

The main uncertainty in estimating the water use performance measure is the amount of water that the Program would need to augment to natural flows to meet the flow levels targeted in an alternative. If future conditions are drier than the 50-year hydrological record being used, then the model would underestimate how much water would be required.

## Results

Results for tern and plover management cost for the Round 2 alternatives are shown in Figure 2.3. It's helpful to have a copy of the alternative descriptions from the Summary document while reviewing this figure.

- **Short term management cost** is largely driven by the construction costs of building new off-channel habitat. All alternatives with the exception of Stay the Course and A1 involve

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for fencing and other infrastructure improvements to make the site suitable nesting habitat for plovers and terns.

construction of off-channel habitat and incur substantially higher costs in the short term. This will be a direct impact on the Program budget.

- **Long term management cost** is driven less by the one-time construction costs of creating new off-channel habitat, and more by the ongoing costs of building on-channel habitat in the method used by the Program (which typically erodes and requires rebuilding within a few years). A2 therefore shows an increase in long term cost relative all other alternatives, which do not use that method of on-channel habitat construction. On the other hand, alternatives that rely mostly on off-channel habitat (A3, A4) would result in slight cost savings relative to Stay the Course, if they were implemented over the long term. Alternatives B2, B3, and B4 incur higher short-term costs than Stay the Course because they all involve large quantities of off-channel habitat creation, but the long-term costs are similar to the others because they rely heavily on mine operator agreements, which are inexpensive.

- **Low cost alternatives.** A1 has the lowest short-term and long-term management cost because it relies exclusively on maintaining the existing off-channel habitat, and discontinues on-channel habitat creation. B1 also has low short-term and long-term management cost because it is creating off-channel habitat through agreements with mining operations, but it does require land acquisition.

- **Water use**. The only alternatives that use water are A4 and B4. The use of water represents an opportunity cost to the Program as this water would not be available for other purposes.

**Figure 2.3: Results – Management Cost PMs**

| Objective | Performance Measure | Units | Dir | STC | A1 | A2 | A3 | A4 | B1 | B2 | B3 | B4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Management Cost** | | | | | | | | | | | | |
| Short-term Management Cost | 1st Increment Cost (2017-2019) | 1000$ | L | $130 | $41 | $1,220 | $1,081 | $1,081 | $44 | $1,042 | $1,068 | $1,068 |
| Long-term Management Cost | NPV (50 yrs) | 1000$ | L | $2,931 | $464 | $6,225 | $2,343 | $2,343 | $996 | $2,124 | $2,810 | $2,810 |
| Land Acquisition Cost | Est. Total Cost | 1000$ | L | $0 | $0 | $0 | $0 | $0 | $3,200 | $2,920 | $2,920 | $2,920 |
| Water Use - Wet Years | Proportion of Program water used | % | L | 0% | 0% | 0% | 0% | 9% | 0% | 0% | 0% | 9% |
| Water Use - Normal Years | Proportion of Program water used | % | L | 0% | 0% | 0% | 0% | 63% | 0% | 0% | 0% | 63% |
| Water Use - Dry Years | Proportion of Program water used | % | L | 0% | 0% | 0% | 0% | 77% | 0% | 0% | 0% | 77% |
| Augmented Volume | Avg. Volume Program water / yr | ac-ft/year | L | 0 | 0 | 0 | 0 | 39090 | 0 | 0 | 0 | 39090 |

## Additional Information and Context for Interpreting Results

We have not calculated cost-effectiveness directly ($ per unit benefit). Cost-effectiveness is a useful metric when there is only one objective in addition to cost. In problems with multiple objectives, such as this one, it's useful to consider cost-effectiveness when designing alternatives. For example, we created an alternative that achieves the plover target within 30 years (B1) using the most cost-effective methods.

## References

EDO (Executive Director's Office), 2015. PRRIP-EDO Office Memorandum to Technical Advisory Committee. Subject: Tern and Plover Mechanical Habitat Resource Allocation Investigation. January 26, 2015.

# 3 PM Info-Sheet: Whooping Cranes

| Sub-Objective | Performance Measure | Units | Description |
|---|---|---|---|
| Whooping Crane Habitat Use | WC Habitat Suitability Scale | 7-point scale: -3 to +3 | Changes to the availability of suitable whooping crane habitat in the AHR during migratory periods, relative to current conditions, reported using a 7-point scale. This PM is a proxy for habitat use and ultimately migratory survival. The relationship between availability of suitable habitat and habitat use is unknown / unquantified. |

## Performance Measure Overview

This performance measure describes the effect of tern and plover habitat creation and maintenance actions on changes to habitat suitability for whooping crane (WC), and by proxy, the likelihood for use of that habitat (see Figure 3.1). Use of this PM relies on the assumption that habitat suitability leads to increased use. The validity of that assumption depends on the degree to which whooping crane use of the AHR is currently limited by the quantity or quality of habitat.

The creation and maintenance of high on-channel tern and plover nesting islands decreases unobstructed channel width (UOCW) and thus results in decreased habitat suitability for whooping crane. This PM reports *changes to suitability* relative to current conditions, where the Program maintains roughly 45 acres of tern and plover islands in the channel. Therefore, the construction of nesting habitat in Program areas previously managed for cranes potentially results in a negative impact on UOCW while islands are present (visual obstruction) and no impact when islands are absent [PRRIP 2016]. If built islands are reconstructed annually (primarily in the fall), there would be impacts to habitat suitability in most years in any locations where new nesting islands are created. However, the maintenance of currently existing islands does not result in any net change in habitat suitability.

The scale used to describe these changes is defined as follows:

-3 = Reduction in habitat suitability (introduction of visual obstructions) in > 90 acres of the AHR

-2 = Reduction in habitat suitability (introduction of visual obstructions) in < 90 acres and > 45 acres of the AHR

-1 = Reduction in habitat suitability (introduction of visual obstructions) in < 45 acres of the AHR

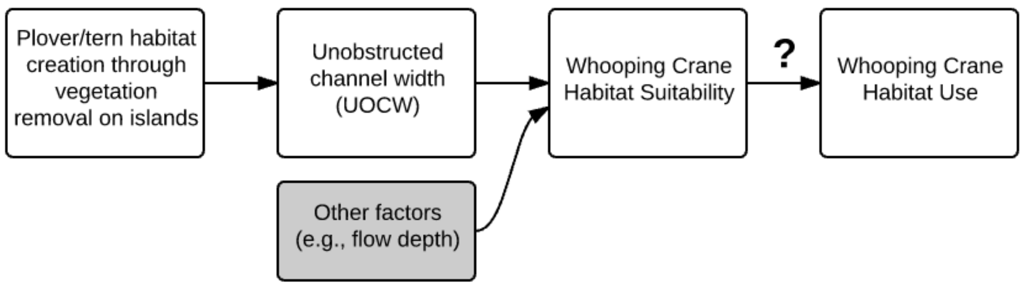
0 = No net change in habitat suitability

1 = Increase in habitat suitability (reduction of visual obstructions) in < 45 acres of the AHR

2 = Increase in habitat suitability (reduction of visual obstructions) in < 90 acres and > 45 acres of the AHR

3 = Increase in habitat suitability (reduction of visual obstructions) in > 90 acres of the AHR

**Figure 3.1. Influence diagram showing the assumed relationship between on-channel management actions and changes to Whooping Crane habitat use.**




## Calculations and/or Scoring

Preliminary scores have been assigned by EDO (Table 3.1). Alternatives that involve expanding tern and plover nesting habitat in the channel using the standard approach (where islands are rebuilt annually in the same reach) receive negative scores in line with the additional acreage of habitat. Alternatives involving an alternative approach to building on-channel habitat (where existing vegetated islands are de-vegetated and left to erode) receive positive scores in line with the amount of acreage involved under that scenario.

## Key Assumptions and Uncertainties

High confidence assumptions (well supported by data/studies) include:

- **The role of Unobstructed Channel Width (UOCW):** The use of this PM assumes that UOCW is a key driver of habitat suitability. This assumption is supported by the recent Program Whooping Crane data synthesis chapter currently in review (PRRIP 2016). Because the alternatives under current consideration do not include flow alterations during the whooping crane migratory period (grey box in Figure 3.1), change to unobstructed channel width is the only mechanism through which changes in habitat suitability are likely to occur.

- **Longevity of changes to suitability:** Any decrease in habitat suitability resulting from building on-channel tern and plover nesting habitat occurs because of the construction of islands that limit visibility for cranes. These islands are assumed to erode within three years in the absence of high flow events, at which point the effect on habitat suitability for crane becomes positive until vegetation re-establishes (vegetation management actions are not assumed to continue once nesting habitat is no longer present because habitat is being managed for terns and plovers). However, for alternatives that involve continuing to de-vegetate islands, the benefit to cranes is assumed to remain constant at the scale of the AHR, though local-scale benefits may reduce over time.

High uncertainty assumptions include:

- **Habitat Limitation**: This PM reports changes to habitat suitability, which is a proxy for habitat use. However, the relationship between habitat suitability and habitat use is uncertain (Figure 3.1) and depends on the extent to which habitat use is limited by the quantity or quality of habitat in the AHR. If this PM becomes an important factor in selecting a preferred alternative, there may be a need to further examine available information and assumptions about this relationship.

## Results

Table 3.1 summarizes the rationale for the preliminary scores assigned by Compass/EDO.

Heavy expansion of on-channel nesting habitat will result in reductions to crane habitat suitability commensurate with the acres of habitat maintained on an annual basis. Alternatives that de-vegetate existing visual obstructions (vegetated islands) and leave them to erode increase the unobstructed width in line with the acreage of islands cleared.

Alternative A2 is expected to result in a loss in suitability in up to 45 acres (5%) of the AHR, relative to current conditions, in most years. Alternatives A3, A4, B3, and B4 are expected to result in a gain in suitability in up to 45 acres (5%) of the AHR.

**Table 3.1: Preliminary scores for whooping crane habitat suitability**

| Alternative | | Score | Rationale |
|---|---|---|---|
| STC | Stay the Course | 0 | No change relative to current conditions |
| A1 | Existing Off Channel | 1 | No on-channel habitat, discontinues the maintenance of visual obstructions (existing on-channel habitat) |
| A2 | Maximum PRRIP on- and off-channel | -1 | Increases the amount of new on-channel nesting habitat over current levels, which involves creating visual obstructions on fewer than 45 new acres. |
| A3 | A2 (off-channel) + MCA | 2 | De-vegetates islands on a regular basis, and allows them to erode, eliminating visual obstructions on fewer than 45 acres. |
| A4 | A3 + initiation flows | 2 | De-vegetates islands on a regular basis, and allows them to erode, eliminating visual obstructions on fewer than 45 acres. |
| B1 | Double Plover Pop in 30 y | 1 | No on-channel habitat, discontinues the maintenance of visual obstructions (existing on-channel habitat) |
| B2 | Double Plover Pop in 20 y | 1 | No on-channel habitat, discontinues the maintenance of visual obstructions (existing on-channel habitat) |
| B3 | B2 + MCA | 2 | De-vegetates islands on a regular basis, and allows them to erode, eliminating visual obstructions on fewer than 45 acres. |
| B4 | B3 + initiation flows | 2 | De-vegetates islands on a regular basis, and allows them to erode, eliminating visual obstructions on fewer than 45 acres. |

## Additional Information and Context for Interpreting Results

- 45 acres of tern and plover habitat is roughly equal to 5% of the AHR.
- Creating plover and tern nesting habitat from de-vegetating permanently vegetated islands would likely be habitat neutral until islands begin to erode – wooded islands (obstruction) would be converted to high nesting islands (obstruction). During the period between island erosion and channel re-vegetation there would be a positive change in UOCW. The duration of this positive benefit at any particular location depends on the rate at which vegetation re-establishes.

## References

PRRIP 2016. Whooping Crane Data Synthesis Chapters.

# 4 PM Info-Sheet: Sediment Supply

| Sub-Objective | Performance Measure | Units | Description |
|---|---|---|---|
| Contribution to Sediment Supply | Sediment Supply Scale | 5-point scale: -2 to +2 | The likely effect of management action on channel sediment supply. The PM is reported using a 5-point scale. It is a proxy for a range of broader ecological benefits that are generally associated with increased sediment supply in a large braided river. The relationship between sediment supply and these broader benefits is unknown / unquantified. |

### Performance Measure Summary

This performance measure describes the effects of habitat construction and maintenance activities on reach-scale sediment abundance in the channel. Sediment deficit and the associated narrowing and incision of the channel are not compatible with maintenance of the wide, shallow river planform thought to be more suitable for target species use. Actions related to on-channel habitat creation may have either positive or negative effects on sediment abundance, which may be either short-term or long-term effects, depending on how they are conducted.

The levels of this scale are defined as follows:

-2 = Potential long-term negative impact to sediment supply

-1 = Potential short-term negative impact to sediment supply

0 = No net influence on sediment supply

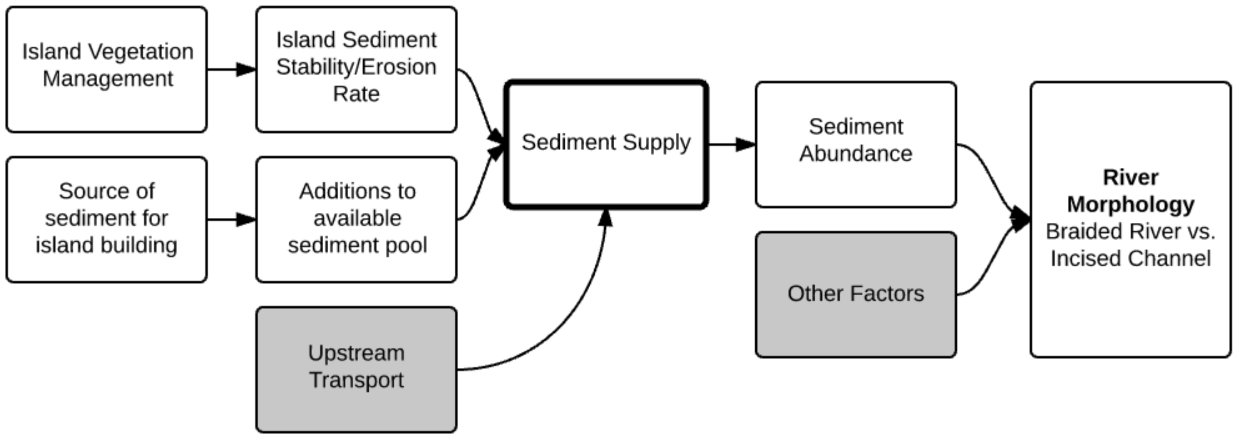
1 = Potential short-term benefit to sediment supply

2 = Potential long-term benefit to sediment supply

In the context of this scale, the phrases “long-term” and “short-term” refer to the length of time over which sediment benefits occur. For example, long-term benefits occur when actions to increase sediment supply are taken every year, whereas short-term benefits occur when actions are taken only once or for a very limited time.

Within the scope of this decision process, there are two primary means of altering the amount of sediment available for transport, and in turn support wide-scale sediment abundance (Figure 4.1). Removing vegetation in the channel (e.g., on wooded islands) may decrease island sediment stability and increase erosion rates. Adding sediment to the active channel (e.g. from the bank) to be used for island building may also positively influence sediment supply. If islands are constructed using sediment from the river bed, there is no new sediment made available for transport. However, if islands are constructed using sediment from the banks or other source, there may be a one-time increase in sediment available for transport. (None of the alternatives considered to date include this latter kind of action).

**Figure 4.1 Influence diagram showing the assumed relationship between on-channel management actions and sediment supply**




## Calculation and/or Scoring

Preliminary scores have been assigned by EDO based on synthesis of Program and other data and literature (see Results, below).

## Key Assumptions and Uncertainties

High confidence assumptions (well-supported by data/studies):

- **Effect of building islands on sediment supply:** An important assumption is that building nesting habitat in the channel does not contribute to local sediment deficit (i.e., Stay the Course scores 0). Implicit in that assumption is that the reach of the Central Platte between the J-2 Return and Overton is in sediment deficit (discussed further below, in *Context*) only at high flows; at low and moderate flows, that section of river becomes transport-limited rather than sediment-limited. Therefore, at low and moderate flows tern and plover nesting islands built in the channel do not contribute to local sediment deficits. At high flows (above ~ 4,000 cfs) when the upstream sections of the channel are sediment-limited, the islands are susceptible to lateral erosion and the sediment in them is available for transport.

- **Temporal value to sediment supply:** Nesting habitat built on ephemeral islands by pushing up bed sediment and allowing it to erode does not add or remove sediment from the channel over the scale of 1-5 years. Accordingly, it has little net effect on sediment supply. Conversion of permanently vegetated islands to nesting habitat does temporarily increase sediment supply as the habitat erodes. Permanent stabilization of constructed habitat (by rip-rap or persistent vegetation) results in long-term decreases in sediment supply.

High uncertainty assumptions:

- None.

## Results

Table 4.1 summarizes the rationale for the preliminary scores assigned by Compass/EDO. Most alternatives are expected to have negligible effect on sediment. Alternatives that increase on-channel nesting habitat (A2) are expected to have short-term sediment benefits (one-time benefits associated with removing existing vegetation). Only the MCA alternatives (A3, A4, B3, B4) are expected to have a long-term (on-going) sediment benefit.

**Table 4.1 Preliminary scores for sediment PM**

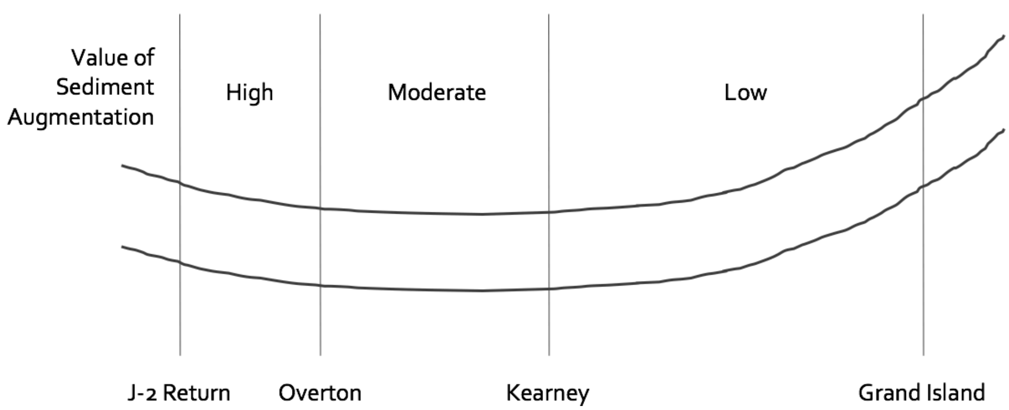
| Alternative | | Score | Rationale |
|---|---|---|---|
| STC | Stay the Course | 0 | On-channel habitat built from bed sediments – no net effect on sediment |
| A1 | Existing Off Channel | 0 | No on-channel habitat. |
| A2 | Maximum PRRIP on- and off-channel | 1 | Increases the amount of on-channel nesting habitat over current levels, which involves removing vegetation from areas where it exists currently. |
| A3 | A2 (off-channel) + MCA | 2 | De-vegetates islands on a regular basis. |
| A4 | A3 + initiation flows | 2 | De-vegetates islands on a regular basis. |
| B1 | Double Plover Pop in 30 y | 0 | No on-channel habitat. |
| B2 | Double Plover Pop in 20 y | 0 | No on-channel habitat. |
| B3 | B2 + MCA | 2 | De-vegetates islands on a regular basis. |
| B4 | B3 + initiation flows | 2 | De-vegetates islands on a regular basis. |

## Additional Information and Context for Interpreting Results

- **Approximate volumes of sediment.** Each acre of in-channel nesting habitat is comprised of approximately 5,000 tons of sediment. If an average of 10 acres of permanently vegetated islands is de-vegetated each year (as is assumed in the Moving Complexes Approach alternatives), the maximum potential for sediment addition is about 50,000 tons per year. Based on long-term average island erosion rates, de-vegetated islands could be expected to contribute between 10,000 and 30,000 tons of sediment per year. Currently contemplated sediment augmentation actions near the J-2 Return are roughly in the vicinity of 60,000 to 80,000 tons per year. Best estimates of total sediment transport through the AHR range from 100,000 to 1,600,000 tons of sediment per year, depending on location and hydrologic conditions (Tetra Tech, 2014).

- **Value of sediment by reach.** Program monitoring and research indicates that there is a long-term sediment deficit in the south channel downstream of the J-2 Return. Sediment transport modeling indicates a sediment deficit downstream of the south channel confluence at Overton to approximately Kearney and a sediment balance downstream of Kearney. However, spatial and temporal variability in sediment flux are much greater than the modeled sediment deficit. Accordingly, the Program ISAC and geomorphology special advisors have concluded that the reach downstream of Overton is generally in dynamic equilibrium. The conversion of wooded islands to nesting habitat therefore provides the most benefit in terms of sediment between the J-2 Return and Overton, less benefit downstream of Overton, and relatively little benefit downstream of Kearney (Figure 4.2).

**Figure 4.2: Relative value of sediment release from vegetated islands in the Central Platte, based on current understanding of sediment balance conditions in the AHR (Tetra Tech 2014).**




- Tern and plover nesting habitat building activities in the AHR are constrained to areas where overall channel widths are suitable for tern and plover, and where permits exist or could be obtained. Based on the miles of river in each sediment benefit zone described above, EDO estimates that about 5% of the potential for on-channel habitat could be built in the reach between the J-2 Return in the South Channel and Overton, about 30% could be built between Overton and Kearney, and the remaining 65% between Kearney and Grand Island. In other words, the majority of habitat building activities are likely to occur in areas where there appears to be no sediment deficit. The location of habitat building activities is not considered in assigning scores, but this context is relevant in interpreting the likely magnitude of actual benefits.

- **On-going sediment augmentation**. Mechanical sediment augmentation actions in the South Channel downstream of the J-2 Return, which serve to prevent further channel incision and to prevent downstream propagation of the sediment deficit, will continue regardless of the outcome of this decision process.

## References

Tetra Tech, 2014. Channel Geomorphology and In-Channel Vegetation: 2013 Final Data Analysis Report. Prepared for the Platte River Recovery Implementation Program.

# 5 PM Info-Sheet: Pallid Sturgeon

| Sub-Objective | Candidate Performance Measures | Units | Description |
|---|---|---|---|
| Pallid Sturgeon Risk | Presence of water diversions during critical times<br><br>(Yes/No) | Yes/No | A yes/no flag that indicates whether the management action includes water diversions during periods of critical low flow in the Platte River. A “No” indicates no negative impacts to pallid sturgeon are expected as a result of an alternative. A “Yes” suggests further analysis may be warranted if the alternative is considered further. |

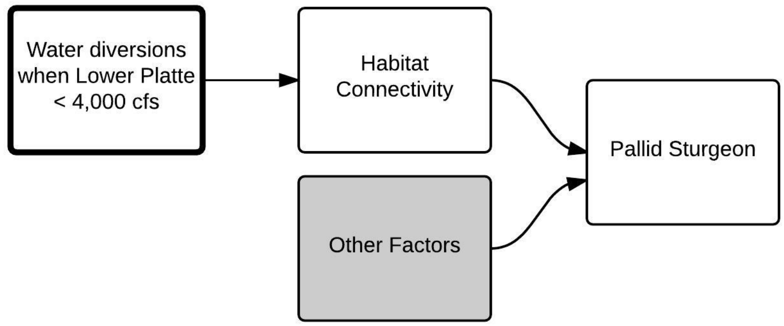
## Performance Measure Summary

Some alternatives under consideration include augmenting flows during the nest initiation period and/or during the incubation/rearing period for plovers and terns (a period spanning from May to late August). The proposed performance measure flags if these flow augmentation actions would result in water diversions at critical periods of low flow in the lower Platte River (from the Elkhorn River confluence to the Missouri River confluence).

This PM is based on analysis in the peer-reviewed Lower Platte River Stage Change Study Draft Protocol Implementation Report (Stage Change Report). This study concluded that the relative change in pallid sturgeon habitat due to Program water management activities would be very small to undetectable and thus these changes should not provide additional stress to the pallid sturgeon population. However, it also found that water diversions during periods of critical low flow in the lower Platte River have the greatest potential for negative impacts to pallid sturgeon habitat in the lower Platte River. The impact of concern is that diversions could further reduce flows in the lower Platte River resulting in a reduction of habitat connectivity for pallid sturgeon. It has been suggested in the literature that there are connectivity concerns when lower Platte River flows are around 4,000 cfs and below (Stage Change Report, 2009) (Figure 5.1).

This use of this PM assumes, in accordance with the Stage Change Report that in the absence of diversions during periods of critical low flow in the lower Platte River (defined as Louisville gage flows < 4,000 cfs), any effects of water management will be very small to undetectable and will not introduce or increase risks to pallid sturgeon. If any alternatives are proposed that involve diversions during periods of critical low flow, then further analysis may be warranted to confirm the nature and significance of effects.

**Figure 5.1: Influence diagram showing the assumed relationship between on-channel management actions and pallid sturgeon (PM shown in bold)**




## Key Assumptions and Uncertainties

In accordance with the direction provided by the GC on December 2, 2015, this PM is based solely on the findings of the peer-reviewed Stage Change Study. This study was identified as the best available information to assess the potential effects of Program water management activities on water stage and how those stage changes might affect pallid sturgeon. The GC also asked EDO/Compass to consider a multi-point scale rather than just a binary yes/no indicator. However, the information in the Stage Change Study did not support the use of a more refined scale. Refinement of this PM, if warranted, would require direction from the TAC and/or GC.

## Results

The Program has previously committed to not diverting water to storage when flows are below 4,000 cfs in the lower Platte. Therefore to date, no alternatives have been considered in the SDM process that would alter that commitment. This PM is thus “No” for all alternatives.

## Context

The peer-reviewed Stage Change Study contains the best available information on how Program water management actions could affect pallid sturgeon habitat in the Lower Platte River. This study concluded that the relative change in pallid sturgeon habitat due to Program water management activities would be very small to undetectable and thus these changes should not provide additional stress to the pallid sturgeon population. The study also found that the greatest potential for negative impacts to pallid sturgeon habitat would occur when lower Platte River discharges are low (4,000 – 6,000 cfs) but central Platte River discharges are high enough that flow could be diverted into storage for retiming. A negative impact to pallid sturgeon could occur if diverting water at this time reduced habitat connectivity in the lower Platte River. The findings from this analysis suggest that if short-term connectivity is a concern for pallid sturgeon in the lower Platte River, operational rules for Program water projects could prohibit diversions when lower Platte River discharges fall below some minimum threshold (State of the Platte Report, 2015).

## References

PRRIP, 2015 (Platte River Recovery Implementation Program Executive Director's Office). PRRIP Adaptive Management Plan: 2014 State of the Platte Report.

Stage Change Report, 2009. Prepared by HDR Engineering, Inc., in conjunction with Mussetter Engineering, Inc., The Flatwater Group, Inc., and Dr. Mark Pegg. Full title: "Lower Platte River Stage Change Study Final Protocol Implementation Report".

# 6 PM Info-Sheet: Implementation

| Sub-Objective | Performance Measure | Units | Description |
|---|---|---|---|
| Implementation Cost and Risks | Implementation Scale | Scale: 0 to -4 | This PM reflects the effort and risks associated with permitting, negotiating with landowners, and coordinating with other agencies for the use of land and/or water. It reflects a range of implementation considerations, including permitting cost ($), neighbor relations and the probability of successful implementation. A score of 0 reflects an alternative requiring minimal effort with little risk of implementation failure, and -4 reflects high effort accompanied by a risk of not achieving full implementation. |

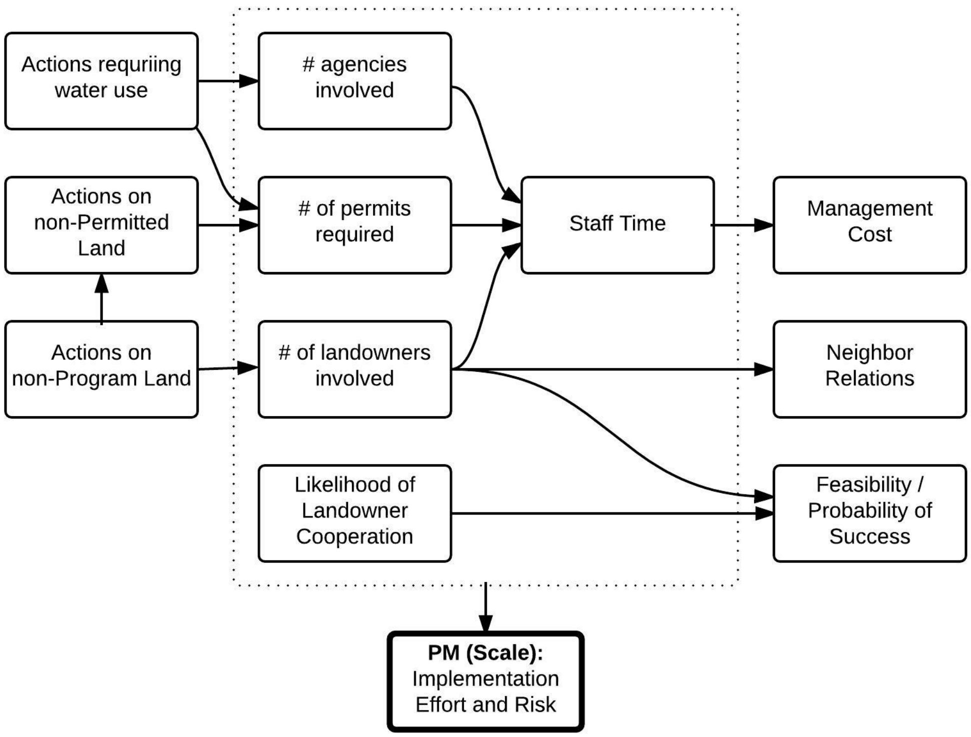
## Performance Measure Overview

This PM is a simple five-point scale that reports the level of management effort required to implement an alternative. It is a proxy for a number of implementation considerations (Figure 6.1) including Program staff effort and associated management costs, the quality of relationships between the Program and its neighbors and the probability of full and successful implementation of a particular management alternative.

Different kinds of alternatives involve different levels of management effort and implementation risks. Alternatives that involve action on non-Program land involve more effort and risk than actions on Program-owned land, and actions involving negotiation and permitting for on-channel land involve more effort and risk than those for off-channel land. Actions involving water use require efforts for the acquisition of permits and coordination with various agencies. Some kinds of negotiations require continuous effort over the long term. Others require short-term effort to secure long-term agreements that then require little on-going effort or risk.

Any alternative that involves actions on non-Program land will require the cooperation of landowners and the acquisition of permits. Some landowners may be willing to enter into a management agreement with the Program to allow management actions on their land; others will not. Negotiations with landowners are a time-consuming activity for Program staff. Staff time, as well as permitting costs, will increase the cost of alternative implementation. Additionally, for alternatives involving on-channel land, there is a risk that negotiations may place stress on the Program’s relationship with neighbors. Ultimately there is no guarantee that landowners will agree to cooperate with the Program. Thus a management alternative that relies heavily on actions taken on non-Program land will have some uncertainty with respect to full and successful implementation.

**Figure 6.1: Influence diagram showing factors contributing to implementation costs and risk (PM shown in bold)**




Influence diagram showing the assumed relationship between on-channel management actions and implementation costs and risks. This PM seeks to incorporate all of these considerations into a single score for each alternative. The scale used to describe implementation effort and risks is defined as follows:

**- 4 =** **Intense Effort/Risk of Failure.** There is a risk (>50% probability) of not achieving the target land or water due to the complexity and/or intensity of permitting and negotiations required.

**-3 =** **High Effort.** Substantial negotiation and permitting for on-channel land or water use is ongoing over the long-term (e.g., for on-channel habitat, a substantial but achievable amount is assumed to be 10 acres or less of habitat per year).

**-2 =** **Moderate Effort.** Negotiation and/or permitting for on-channel land occurs in the short-term (i.e., short term effort for long-term agreements).

**-1 =** **Low Effort**. Negotiation and/or permitting for off-channel land occurs in the short-term.

**0 =** **Minimal Effort.** Minimal implementation effort is required (e.g. no negotiation or permitting for on- or off-channel habitat, and no water use).

## Calculations and/or Scoring

Preliminary scores have been assigned by EDO based on Program experience to date (see *Results*). The following factors are considered in assigning a score (from Figure 6.1):

- whether the alternative involves actions on non-Program land;
- the number and complexity of permits required;
- the number of agencies involved;
- the number of landowners that need to be involved;
- the proportion of landowners that are likely to agree to cooperate with the Program;
- whether the effort required is one-time or on-going.

## Key Assumptions and Uncertainties

The key uncertainty associated with the PM is the likelihood that landowners will agree to cooperate with the Program on the development of new on-channel habitat on non-Program land. For any alternatives that involve the creation of on-channel habitat on non-Program land, the scoring of this PM is based on the following assumptions:

- Maximum habitat per river mile is about 10 acres;
- There are approximately 2-8 landowners per river mile;
- In the absence of financial incentives, approximately 20% of landowners approached will cooperate.

Given the number of landowners that the Program would need to negotiate with, it is difficult to envision a scenario where more than 10 acres could be achieved using this approach. Therefore, any alternative involving the development of more than 10 acres of on-channel habitat on non-Program land will receive a score of -4 (Risk of Failure).

## Results

Preliminary scores assigned by EDO are shown in Table 6.1. The Round 1 alternatives require different levels of effort and risk, but none are considered to pose significant risk to full and successful implementation.

**Table 6.1 Preliminary scores for implementation**

| Alternative | | Score | Rationale |
|---|---|---|---|
| STC | Stay the Course | 0 | All on-channel work is on Program land; no negotiation required. |
| A1 | Existing Off Channel | 0 | Involves only off-channel work on land already owned by the Program; no negotiation required. |
| A2 | Maximum PRRIP on- and off-channel | -2 | Requires negotiating and/or permitting for both on- and off-channel habitat in the near term. |
| A3 | A2 (off-channel) + MCA | -3 | This alternative involves a high level of negotiation effort due to the shifting nature of the habitat building effort, but it is considered feasible. |
| A4 | A3 + initiation flows | -3 | This alternative involves a high level of negotiation effort due to the shifting nature of the habitat building effort, but it is considered feasible. |
| B1 | Double Plover Pop in 30 y | -1 | Requires negotiating and/or permitting for off-channel habitat in the near term. |
| B2 | Double Plover Pop in 20 y | -1 | Requires negotiating and/or permitting for off-channel habitat in the near term. |
| B3 | B2 + MCA | -3 | This alternative involves a high level of negotiation effort due to the shifting nature of the habitat building effort, but it is considered feasible. |
| B4 | B3 + initiation flows | -3 | This alternative involves a high level of negotiation effort due to the shifting nature of the habitat building effort, but it is considered feasible. |

## Additional Information and Context for Interpreting Results

Incremental staff costs are generally a relatively small portion of overall management costs and have not been translated into dollar estimates. However, alternatives that score poorly on this PM also create risks in terms of potentially straining relationships with neighbors, and at the upper levels, increasing risk of incomplete implementation.

## References

N/A

# 7 PM Info-Sheet: Learning

| Sub-Objective | Performance Measure | Units | Description |
|---|---|---|---|
| Learning Potential – Plover and Tern Reproductive Success | Learning Potential Scale | 3-point scale: 0 to 2 | The potential to evaluate differences in plover and tern use and reproductive success from different plover and tern habitat creation and maintenance activities. In particular, the scale considers the ability to learn about incremental performance differences between on-channel and off-channel habitat, and the potential benefits of flow to on-channel plover and tern reproductive success. |

## Performance Measure Summary

This performance measure reports the potential to learn through evaluation of differences in plover and tern use and reproductive success on in-channel versus off-channel habitat as well as how flow influences on-channel use and productivity. The performance measure is a constructed scale that scores alternatives along two dimensions: (1) the extent to which on-channel habitat and off-channel habitat for plovers and terns are being simultaneously implemented, and (2) the number of acres of on-channel habitat (Table 7.1).

The first dimension was chosen because on- and off-channel habitat must be available simultaneously to address uncertainties (i.e., Big Question 6) associated with the comparative use and productivity on- versus off-channel habitat. In particular, this dimension considers the ability to learn about incremental performance differences between on-channel and off-channel habitat.

The second dimension (number of acres of on-channel habitat) was chosen to represent the scale, or speed, at which on-channel learning can occur. The greater the number of on-channel acres, the more likely on-channel use will be of a scale (i.e., adequate sample size) that will facilitate robust comparisons between on-channel and off-channel performance.

This simplified Learning PM therefore provides general information about how much can be learned and how quickly, under different alternatives.

**Table 7.1: Learning Potential Scale**

| **Habitat/Flow Combos** | **Shorter-term learning** (>60 acres on-channel) | **Longer-term learning** (< 60 acres on-channel) |
|---|---|---|
| Only on-channel **or** only off-channel | 0 | 0 |
| On-channel **+** off-channel | 2 | 1 |

## Calculations and/or Scoring

Preliminary scores have been assigned by Compass/EDO using a four-point scale, as described in Table 7.2, below.

## Key Assumptions and Uncertainties

The scale uses a break-point of 60 acres to distinguish between shorter-term and longer-term learning because it is in between the following two levels of on-channel habitat included in the preliminary set of alternatives: (1) the existing quantity of on-channel habitat (42 acres) and (2) the Level 1 quantity of on-channel habitat which includes maintaining existing habitat plus creating and maintaining the maximum amount of new habitat on lands already owned by the Program (82 acres total). As this break-point was chosen merely to distinguish across the preliminary set of alternatives, it is only describing the relative differences in learning times between the alternatives.

Overall, this PM is very simple and intended to show only general differences in learning potential between alternatives. If Learning is an important objective, and one that becomes instrumental in selecting a preferred alternative, a more structured approach to evaluating learning potential will likely need to be developed. A variety of methods are available, including formal value-of-information methods and multi-attribute scoring methods. However, these can be time-consuming to do, and may not be warranted.

**Results**

Table 7.2 summarizes the rationale for the preliminary scores.

**Table 7.2: Preliminary scores for Learning**

| Alternative | | Score | Rationale |
|---|---|---|---|
| STC | Stay the Course | 1 | Combination of off-channel habitat and < 60 ac of on-channel habitat |
| A1 | Existing Off Channel | 0 | Only off-channel habitat |
| A2 | Maximum PRRIP on- and off-channel | 2 | Combination of off-channel habitat and > 60 ac of on-channel habitat |
| A3 | A2 (off-channel) + MCA | 1 | Combination of off-channel habitat and < 60 ac of on-channel habitat |
| A4 | A3 + initiation flows | 1 | Combination of off-channel habitat and < 60 ac of on-channel habitat |
| B1 | Double Plover Pop in 30 y | 0 | Only off-channel habitat |
| B2 | Double Plover Pop in 20 y | 0 | Only off-channel habitat |
| B3 | B2 + MCA | 1 | Combination of off-channel habitat and < 60 ac of on-channel habitat |
| B4 | B3 + initiation flows | 1 | Combination of off-channel habitat and < 60 ac of on-channel habitat |