

**FINAL**

**PLATTE RIVER FROM THE LEXINGTON TO ODESSA  
BRIDGES**

**SEDIMENT AUGMENTATION EXPERIMENT  
ALTERNATIVES SCREENING STUDY  
SUMMARY REPORT**

Prepared for

**PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM**



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# 1 EXECUTIVE SUMMARY

## 2 ES-1 Background

3 In December 2008, the Program's Adaptive Management Working Group developed a sediment  
4 augmentation adaptive management experiment, to be implemented in the 2009 – 2013 timeframe, to test  
5 the following hypothesis: *Average sediment augmentation near Overton, Nebraska, of 185,000 tons/year*  
6 *(t/y) under the existing flow regime and 225,000 t/y under the flow regime proposed by the Governance*  
7 *Committee achieves a sediment balance to Kearney, Nebraska.* This hypothesis, referred to as Priority  
8 Hypothesis Sediment #1 in Program documents, is based on modeling performed by the Bureau of  
9 Reclamation (BOR). The Program initiated the Sediment Augmentation Experiment Alternatives  
10 Screening Study (Study) to investigate the potential of implementing a Sediment Augmentation  
11 Experiment Project (Project) to correct the sediment imbalance in the Platte River reach between the  
12 Lexington and Odessa bridges (Project reach). The 32-mile Project reach extends from above the  
13 Lexington Bridge, at approximately river mile (RM) 255, to the Odessa Bridge, at RM 224.

14 The Program will implement the sediment augmentation management action under the FSM strategy  
15 developed as part of the Program's Adaptive Management Program (AMP). This systematic process of  
16 "learning by doing" involves evaluation of alternative hypotheses by applying an experimental  
17 management program and improving management decisions in ecosystems based on knowledge gained  
18 from those management actions.

19 The assumption from Program documents is that sediment can be mechanically placed into the river at a  
20 rate that will eliminate the sediment deficiency and restore a balanced sediment budget. The Program has  
21 identified a location within the Project reach, just upstream (west) of Nebraska Public Power District's  
22 (NPPD's) Cottonwood Ranch, as the preferred location to evaluate the effectiveness of the Project.

## 23 ES-2 Baseline Modeling

24 Baseline steady-state hydraulic and sediment-transport models using the Corps of Engineers (USACE)  
25 HEC-RAS program were developed and calibrated for the Project reach. The baseline hydraulic model  
26 was developed to evaluate channel capacity and to provide the input for the sediment-transport model.  
27 The modeling determined that the average annual sediment deficit in the vicinity of Cottonwood Ranch is  
28 approximately 150,000 t/y, which is less than the 185,000 t/y estimate in Priority Hypothesis  
29 Sediment #1. In assessing this value, however, it is critical to note that the transport capacities and  
30 resulting sediment deficit are highly dependent on the flow volume and patterns from year to year; thus,  
31 the deficit also varies by over an order of magnitude from year to year.

## 32 ES-3 Identification and Development of Alternatives

33 The identification and development of alternatives started with the pre-screening of the components  
34 which would make up an alternative, listed below. The components were studied to determine a matrix of  
35 options that could be assembled into alternatives.

- 36 • Augmentation delivery locations
- 37 • Sediment sources
- 38 • Sediment production and delivery techniques
- 39 • Delivery timing
- 40 • Augmentation material gradation

1 These components underwent an initial screening to eliminate options that were determined not feasible,  
 2 primarily from the standpoint of cost or implementability. Once the initial screening was completed, the  
 3 options that were retained were assembled into a set of unique sediment augmentation alternatives.  
 4 Where appropriate, alternatives that did not represent a unique solution, or did not offer some advantage  
 5 that warranted consideration were eliminated. In addition, the various permutations of each combination  
 6 were evaluated to determine if a “hybrid” alternative would be feasible. Table ES-1 presents the range of  
 7 feasible alternatives assembled.

8 **Table ES-1 Range of Feasible Alternatives**

Augmentation Delivery Locations	Sediment Sources	Sediment Delivery Technologies	Timing	Augmentation Material Gradation
Cook Tract/ Dyer Property	Cook Tract/Dyer Property	Sand pump	August 1 <sup>1</sup>	D50~0.5 mm <sup>2</sup>
Existing sand and gravel operations at Overton Interchange	Existing sand and gravel operations	Dozers (sand plug)		D50~1.2 mm <sup>2</sup>

9 *Notes:*

10 <sup>1</sup> Review of modeling results suggest that pumping start dates have relatively little effect on the amount that the  
 11 sediment deficit is reduced. The August 1 pumping start date was retained for evaluation purposes because it  
 12 avoids ecologically important timeframes, offers the most flexibility, and some time buffer when compared to a  
 13 September 1 start date.

14 <sup>2</sup> If the augmentation delivery location is on the South Channel, then a fine grain material (similar to the OS&G  
 15 sand piles) is required to avoid excessive aggradation in the vicinity of the discharge location. Conversely, if the  
 16 augmentation delivery location is downstream of the confluence of the North and South channels, such as OS&G,  
 17 then a coarser material is required to provide more sediment transport to the deficit at Cottonwood Ranch.

18  
 19 Table ES-2 presents the alternatives that were assembled for further evaluation.

20 **Table ES-2 Alternatives**

Alternative	Augmentation Delivery Locations	Sediment Source	Delivery Technology	Analysis Type <sup>3</sup>
1	Cook Tract/Dyer Property (two locations)	Imported <sup>1</sup>	Sand pump	Sediment-transport model
2	Cook Tract/Dyer Property (two locations)	On site <sup>2</sup>	Sand pump	Extrapolated results from sediment-transport model <sup>4</sup>
3	Cook Tract/Dyer Property (two locations)	Imported <sup>1</sup>	Dozer (sand plug)	Hydraulic and sediment-transport modeling
4	Cook Tract/Dyer Property (two locations)	On site <sup>2</sup>	Dozer (sand plug)	Hydraulic and sediment-transport modeling
5	Cook Tract/Dyer Property (two locations) and OS&G (one location)	Imported <sup>1</sup>	Sand pump	Extrapolated results from sediment-transport model <sup>5</sup>
6	Cook Tract/Dyer Property (two locations) and OS&G (one location)	On site <sup>2</sup> / Imported <sup>1</sup>	Sand pump	Extrapolated results from sediment-transport model <sup>5</sup>
7	Cook Tract/Dyer Property (two locations) and OS&G (one location)	Imported <sup>1</sup>	Dozer (sand plug)	Extrapolated results from hydraulic and sediment-transport model <sup>6</sup>
8	Cook Tract/Dyer Property (two locations) and OS&G (one location)	On site <sup>2</sup> / Imported <sup>1</sup>	Dozer (sand plug)	Extrapolated results from hydraulic and sediment-transport model <sup>6</sup>

- 1 *Notes:*  
 2 <sup>1</sup> *Imported from existing sand and gravel operation (purchased). Material from off-site sources would be hauled to*  
 3 *the augmentation delivery locations, where it would be temporarily stockpiled prior to being introduced into the*  
 4 *river.*  
 5 <sup>2</sup> *Acquired from Program-controlled property. Material from on-site sources would be from a sand pit dredge*  
 6 *operation established at or near the augmentation delivery location (discussed in Section 5).*  
 7 <sup>3</sup> *Refer to Appendix B for discussion of modeling and analysis.*  
 8 <sup>4</sup> *Results from sediment-transport modeling of pumping at Sites 1 and 2 were used for evaluating this alternative.*  
 9 <sup>5</sup> *Results from sediment-transport modeling of pumping at Sites 1, 2, and 4 were used for evaluating this alternative.*  
 10 <sup>6</sup> *Results from hydraulic and sediment-transport modeling of dozer options at Cook Tract/Dyer Property and*  
 11 *baseline sediment-transport model in the vicinity of OS&G were used for evaluating this alternative.*

12  
 13 Once the alternatives were assembled, the baseline model was modified accordingly and used to evaluate  
 14 the potential response of the river to assess the benefits (i.e., the reduction of the sediment deficit)  
 15 associated with the various components of each alternative. The alternative modeling included a suite of  
 16 the identified potential augmentation components, including likely combinations of delivery technologies,  
 17 augmentation locations, and augmentation material sizes, to assess the combined effects of the various  
 18 components. Although each underlying component associated with the eight identified alternatives was  
 19 modeled, the ultimate assembly of each alternative may not have been explicitly modeled. However,  
 20 results from the model runs were sufficient to evaluate each of the alternatives, either through direct  
 21 modeling or extrapolation of the results from similar model runs. The modeling effort was an iterative  
 22 process, with model results helping to inform the development and modification of alternatives in an  
 23 attempt to identify a range of alternatives that best address the sediment deficit. The modeling concluded  
 24 that it is unlikely any of the identified alternatives would be 100 percent effective in eliminating the  
 25 sediment deficit at the Cottonwood Ranch location.

26 **ES-4 Evaluation Criteria**

27 Alternative evaluation criteria were established to allow for the objective side-by-side comparison of the  
 28 alternatives. The Section 404(b)(1) Guidelines were used as a starting point for identifying the evaluation  
 29 criteria. A total of eight evaluation criteria in four Section 404(b)(1) Guideline categories were identified,  
 30 as listed in Table ES-3:

31 **Table ES-3 Evaluation Criteria**

<b>Evaluation Criteria</b>	<b>Alternative Evaluation Criteria</b>	<b>Section 404(b)(1) Guidelines Practicability Criteria</b>
1	Cost per ton of delivered sediment	Cost
2	Delivery timing	Existing technology
3	Implementability	Logistics
4	Permittability	Logistics
5	Long-term viability	Logistics
6	On-site sediment availability	Logistics
7	Percent effective	Project purpose
8	Provision of other Program benefits	Project purpose

32

1 **ES-5 Alternatives Analysis**

2 Each feasible alternative was evaluated against the eight evaluation criteria, and the feasible alternatives  
3 were compared side by side, as shown in Table ES-4. None of the alternatives fully meet the Project's  
4 need, in that none of the alternatives fully eliminate the sediment deficit. Therefore, the side-by-side  
5 comparison allows the reader to better understand the relative advantages and disadvantages of each  
6 alternative. The Study points to a reasonable set of alternatives that, if implemented, will allow for a  
7 better understanding and improved knowledge of this system. The information and data acquired in the  
8 process can be used to enhance the selection of long-term management decisions related to sediment  
9 augmentation.

Table ES-4 Summary of Alternatives Analysis

<b>Evaluation Criteria</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
<b>Cost</b>								
Cost per ton delivered	\$14.40	\$11.83	\$17.28	\$14.23	\$13.38	\$11.90	\$16.08	\$15.43
<b>Existing technology</b>								
Delivery timing	3.5 months	3.5 months	1-2 months	1-2 months	2.3 months	2.3 months	1 month	1 month
<b>Logistics</b>								
Implementability	Low difficulty	Medium difficulty	Low difficulty	Medium difficulty	Low difficulty	Medium difficulty	Low difficulty	Medium difficulty
Permitting	High difficulty	High difficulty	Medium difficulty	Medium difficulty	High difficulty	High difficulty	Medium difficulty	Medium difficulty
Long-term viability	10+ yrs	10+ yrs	10+ yrs	10+ yrs	10+ yrs	10+ yrs	10+ yrs	10+ yrs
On-site sediment availability	No	Yes	No	Yes	No	Partial	No	Partial
<b>Project purpose</b>								
Percent effective	30 – 60	30 – 60	30 – 40 (max.)	30 – 40 (max.)	60 – 80	60 – 80	>40	>40
Provision of other Program benefits	No	Yes	No	Yes	No	Yes	No	Yes

1 **ES-6 Risk and Uncertainty Analysis**

2 Because this type of large-scale sediment augmentation project is unique and includes numerous  
3 variables, the Project includes major areas of uncertainty, including the following:

- 4 • Unique Project
- 5 • Uncertainties identified or related to modeling
- 6 • Requirement of a location downstream of the confluence of the North and South Channels
- 7 • Availability of augmentation locations downstream of confluence
- 8 • Technologies
- 9 • Effects on downstream landowners
- 10 • Effects on local roads
- 11 • Variation in market conditions
- 12 • Long-term effects
- 13 • Water permits
- 14 • Adaptive management process to address uncertainty

15 **ES-7 Conclusions**

16 Modeling results indicated that the location of the augmentation sites relative to Cottonwood Ranch is a  
17 significant factor in determining effectiveness in meeting the sediment balance goal. Generally,  
18 augmentation sites in closer proximity to Cottonwood Ranch are more effective (i.e., the closer the river  
19 is to sediment balance). Two commercial sand and gravel operations are located downstream of the  
20 confluence, and it is assumed that a commercial arrangement could be negotiated to use either location as  
21 the augmentation site. In addition, Program staff could initiate discussions with other private property  
22 owners located in this reach of the Platte River to investigate potential interest or availability of  
23 augmentation locations.

24 The modeling also indicated that particle size is a significant factor in the effectiveness of meeting  
25 sediment balance. In general, material that is too coarse may settle out before it reaches the Cottonwood  
26 Ranch location (especially if delivered in areas with low hydraulic energy), and finer material flushes  
27 through the system. Determining the optimal balance between coarse and fine material in order to  
28 achieve the maximum effectiveness and the most cost-effective technology to produce the optimal  
29 particle size will require some testing and experimentation.

30 The modeling evaluated several different configurations for the placement of sediment piles using the  
31 dozer options. Some configurations were more effective, but none reached the effectiveness of the sand  
32 pump options.

33 Based on the available modeling, none of the alternatives would likely fully achieve the Project purpose.  
34 In order to eliminate the deficit using the readily available augmentation material at the local sand pit  
35 operations, the volume of material added to the river would have to be slightly more than doubled due to  
36 the amount of the finer gradation material that is flushed downstream. This would essentially double the  
37 total 10-year cost and there could be potential impacts on downstream infrastructure (e.g., Kearney Canal  
38 Diversion) from the material flushed through the system. The Program is instituting a monitoring plan to  
39 evaluate this potential.

40

1 **ES-8 Recommendations**

2 Given the constraints of the split flow conditions around Jeffrey Island, perennial sediment deficiencies,  
3 and augmentation delivery location constraints, none of the identified alternatives would fully achieve  
4 sediment balance at Cottonwood Ranch. In addition, as several major uncertainties remain that should be  
5 evaluated and tested. Alternatives 6 and 8 have the advantage of incorporating a discharge location  
6 downstream of the confluence of the North and South channels while also utilizing some sediment from  
7 Project-owned property. Alternatives 6 and 8 also have a relatively low cost per delivered ton of  
8 sediment and have the potential to provide other Program benefits. However, even though these  
9 alternatives have a high level of effectiveness, they both fall short of fully meeting the Project goal.

10 Therefore, the recommended action is to design and implement a pilot-scale experiment (to address  
11 sediment volume, material size, and augmentation location) based on Alternatives 6 and 8 and to develop  
12 a monitoring plan to determine if the experiment is successful. The model would be updated based on the  
13 results of the pilot study. A two-dimensional model would also be instructive in understanding pilot  
14 study results and further analyzing full-scale sediment augmentation processes. Once the results of the  
15 pilot-scale experiment are evaluated and combined with the results of the modeling, a final design for the  
16 Sediment Augmentation Experiment Project could be completed. The pilot study would be designed to  
17 provide answers to some of the most important areas of uncertainty, including the following:

- 18 • Testing to determine the optimal particle size
- 19 • Technology to produce the optimal particle size
- 20 • Timing and duration of annual augmentation activities
- 21 • Effects of reducing some but not 100 percent of the sediment on providing habitat benefits
- 22 • Cost associated with the commercial acquisition of sediment
- 23 • Timing and difficulty of obtaining required permits for the augmentation
- 24 • Optimal location and windrow/sand plug configuration for augmentation
- 25 • Potential for adverse downstream effects

26 As part of the final design, monitoring plan would need to be refined prior to implementation of both the  
27 pilot-scale and full-scale implementation of the Project. The monitoring plan would be consistent with  
28 the Integrated Monitoring and Research Plan (IMRP) described in the Program's AMP. Specifically, the  
29 IMRP's Program Level Monitoring and Research protocol as well as the Research Protocol for NPPD's  
30 Cottonwood Ranch would provide guidance in developing the monitoring plan.

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1 **1. INTRODUCTION AND BACKGROUND**

2 **1.1 Introduction**

3 The Platte River Recovery Implementation Program (Program or PRRIP), initiated on January 1, 2007, is  
4 the result of a Cooperative Agreement between the U.S. Department of the Interior (USDI); the states of  
5 Nebraska, Colorado, and Wyoming; water users; and conservation groups. The Program is intended to  
6 address issues related to the Endangered Species Act (ESA) and loss of habitat in the Platte River in  
7 central Nebraska. This can be achieved by managing certain land and water resources, following the  
8 principles of adaptive management (discussed below), to provide benefits for the following four “target  
9 species”:

- 10 • The endangered whooping crane (*Grus americana*)
- 11 • The endangered interior least tern (*Sterna antillarum*)
- 12 • The endangered pallid sturgeon (*Scaphirhynchus albus*)
- 13 • The threatened piping plover (*Charadrius melodus*)

14 The Program brings together states, the federal government, water users, and environmental groups  
15 (Program partners) to work collaboratively to improve and maintain the associated habitat for the target  
16 species. The first increment of the Program extends for 13 years, from 2007 to 2019. The long-term goal  
17 of the Program is to improve and maintain associated habitats, which includes:

- 18 1. Improving and maintaining migrational habitat for whooping cranes and reproductive habitat for  
19 least terns and piping plovers
- 20 2. Reducing the likelihood of other species found in the area being listed under the ESA
- 21 3. Testing the assumption that managing water flow in the central Platte River also improves the  
22 pallid sturgeon’s lower Platte River habitat

23 The Program’s Governance Committee reviews, directs, and provides oversight for Program activities.  
24 Several standing advisory committees assist the Governance Committee as well as the Program’s  
25 Executive Director’s office.

26 Central to the Program is its Adaptive Management Plan (AMP). Adaptive management is a systematic  
27 process of “learning by doing”; the best available science is used to test hypotheses, implement  
28 management experiments or actions, learn from the results, and revise actions as required. This process  
29 involves applying an experimental management program to evaluate alternative hypotheses and drawing  
30 on knowledge gained from those management actions to improve management decisions regarding  
31 ecosystems. Adaptive management is used in situations where it is uncertain how actions taken will  
32 affect the outcome, yet decisions regarding management actions must be made despite the unknowns.  
33 Monitoring and directed research are designed to reduce uncertainty and move decisions forward.

34 The AMP is centered on priority hypotheses developed jointly by numerous Program partners. The  
35 hypotheses reflect different interpretations of how river processes work and the best approach to meeting  
36 the Program’s long-term goal. To test these hypotheses, the AMP identifies two management strategies:

- 37 1. Flow-Sediment-Mechanical (FSM) Strategy (Clear/Level/Pulse)
- 38 2. Mechanical Creation and Maintenance Approach (Clear/Level/Plow)

1 The Sediment Augmentation Experiment Project (Project) evaluated in this summary report is designed as  
2 an experiment to test a specific FSM hypothesis developed as part of the Program's AMP.

### 3 **1.2 Sediment Augmentation Experiment Alternatives Screening Study** 4 **Background**

5 In December 2008, the Program's Adaptive Management Working Group developed a sediment  
6 augmentation adaptive management experiment, to be implemented in the 2009 – 2013 timeframe, to test  
7 the following hypothesis: *Average sediment augmentation near Overton, Nebraska, of 185,000 tons/year*  
8 *(t/y) under the existing flow regime and 225,000 t/y under the flow regime proposed by the Governance*  
9 *Committee achieves a sediment balance to Kearney, Nebraska.* This hypothesis, referred to as Priority  
10 Hypothesis Sediment #1 in Program documents, is based on modeling performed by the USDI Bureau of  
11 Reclamation (BOR) (Murphy et al., 2006). The Program initiated the Sediment Augmentation  
12 Experiment Alternatives Screening Study (Study) to investigate the potential of implementing the Project  
13 to correct the sediment imbalance in the Platte River reach between the Lexington and Odessa bridges  
14 (Project reach). The 32-mile Project reach extends from upstream of the Lexington Bridge, at  
15 approximately river mile (RM) 255, to the Odessa Bridge at RM 224. Figure 1-1 shows the general Study  
16 location. (Note that figures are at the end of the section.)

17 The Program will implement the sediment augmentation management action under the FSM strategy.  
18 The assumption from Program documents is that sediment can be mechanically placed into the river at a  
19 rate that will eliminate the sediment deficiency and restore a balanced sediment budget. The Program has  
20 identified a location within the Project reach, just upstream (west) of Nebraska Public Power District's  
21 (NPPD's) Cottonwood Ranch, as the preferred location to evaluate the effectiveness of the Project. The  
22 Program has acquired property along the South Channel (adjacent to Jeffrey Island) downstream of the  
23 Johnson-2 (J-2) Return for sediment augmentation purposes but is also investigating other possible  
24 sediment augmentation actions, including the following:

- 25 • Augmentation downstream of the Overton Bridge with sandpit material
- 26 • Augmentation at Program property upstream of the Overton Bridge with channel and/or overbank  
27 sediment
- 28 • Mechanical augmentation (island leveling and channel widening) in the channel between  
29 Program property upstream of the Overton Bridge and Cottonwood Ranch
- 30 • Potential additional augmentation possibilities downstream of the J-2 Return (PRRIP, 2009)

### 31 **1.3 Purpose and Scope**

32 The purpose of the Study is to verify the sediment deficiency in the Project reach and identify and  
33 evaluate the feasibility of implementing a sediment augmentation experiment that will test the hypothesis  
34 and help achieve the Program's long-term goal. Section IV of the Program's AMP identifies proposed  
35 actions to achieve management objectives on Program lands. Under the FSM strategy, Objective  
36 Number 2 is to:

37 *“Offset the existing sediment imbalance by increasing sediment inputs to the habitat area from*  
38 *one or more of the following sources: a) sand augmentation through mechanical actions – island*  
39 *and bank clearing and leveling, b) sand augmentation from bank and island actions not directly*  
40 *related to bank cutting and island leveling (an example could be excavation associated with*  
41 *wetland development), or c) reducing imbalance through channel plan form changes, tributary*  
42 *delivery improvements, or flow routing changes.”*

1 The Project specifically addresses source b, sand augmentation from bank and island actions not directly  
2 related to bank cutting and island leveling. The Project metric is to achieve sediment balance just  
3 upstream of Cottonwood Ranch.

4 The scope of the Study includes the following:

- 5 • Reviewing existing Program data and information
- 6 • Evaluating the sediment deficiency estimated by BOR by developing a hydraulic and sediment-  
7 transport model
- 8 • Conducting supplemental surveying of the river channel, where needed
- 9 • Identifying potential sediment augmentation delivery locations, sediment sources, and delivery  
10 technologies
- 11 • Conducting material sampling and testing
- 12 • Identifying and screening sediment augmentation experiment alternatives
- 13 • Identifying required permits and conducting early consultation regarding those permits (see  
14 **Appendix A**)

#### 15 **1.4 Previous Studies and Available Information**

16 Previous studies and other available information that were reviewed to provide a basis for evaluating the  
17 Project include the following:

- 18 • Final Environmental Impact Statement (FEIS) completed by BOR and USDI U.S. Fish and  
19 Wildlife Service (USFWS) (2006) – As part of the FEIS, BOR conducted one-dimensional  
20 sediment-transport modeling using the SedVeg model. Results of the modeling suggested a  
21 sediment deficiency in the Platte River system, primarily along the reach from the J-2 Return on  
22 the South Channel to the Odessa Bridge. This reach is within the Project reach.
- 23 • Rainwater Basin Mapping Project data (USACE, 2009) – The primary data used to develop  
24 topographic surfaces of the Study area, shown in Figure 1-1 and described in Section 2, were light  
25 detection and ranging (LiDAR) mapping data collected as part of the Rainwater Basin Mapping  
26 Project.
- 27 • Central Platte River Channel Geomorphology and In-Channel Vegetation Monitoring Program  
28 data, collected by Ayres Associates (2009) on behalf of the Program – Survey (channel cross  
29 sections), bed and bank material, and other morphologic data are included.
- 30 • Nebraska Department of Roads (NDOR) Bridge Survey Data

31 The BOR analysis completed for the FEIS indicated that the addition of the following quantities of  
32 sediment with a D50 particle size of less than 1.00 millimeter (mm) is required downstream of the J-2  
33 Return and upstream of the Overton Bridge to bring the reach into sediment balance: 185,000 t/y of  
34 sediment under the existing flow regime (i.e., a range of stream flows having similar bed forms, flow  
35 resistance, and means of transporting sediment) and 225,000 t/y under the flow regime proposed by the  
36 Governance Committee (Figure 1-2). To verify the sediment imbalance, a baseline sediment-transport  
37 model was developed as part of the Study, as discussed in Section 4. It was implied in the FEIS that the  
38 addition of a volume of sediment equivalent to the imbalance would bring the reach into sediment  
39 balance.

1 However, modeling conducted as part of the Study (see **Appendix B**) indicated that it is not necessarily a  
2 one-to-one correlation; the reason is that introducing new sediment into the reach also has the effect of  
3 increasing the transport rate, particularly if the introduced sediment is finer than the existing bed material.  
4 Thus, more sediment than the indicated imbalance may be necessary to achieve the equilibrium.

## 5 **1.5 Coordination with Other Program Projects**

### 6 **1.5.1 Central Nebraska Public Power and Irrigation District's Reregulating** 7 **Reservoir Project**

8 The Central Nebraska Public Power and Irrigation District (CNPPID) reregulating reservoir project,  
9 currently being evaluated, is part of the Program's flow augmentation project for the central Platte River  
10 (Olsson, 2010). Several reregulating reservoir alternatives were developed to provide temporary storage  
11 for use in creating short-duration high flow (SDHF) events. If constructed, they may generate excess  
12 sediment. However, based on borings and the D50 suggested in the FEIS, it does not appear that the  
13 favored reregulating reservoir alternatives would likely provide enough excess sediment to sustain the  
14 sediment augmentation Project over time. Therefore, they were not considered further.

### 15 **1.5.2 Habitat Complex Projects**

16 The Program has a number of current or planned habitat projects along the Project reach that have been  
17 identified as potential sediment augmentation delivery sites or sources. These include the following:

- 18 • Cottonwood Ranch – The Project should not impact the ongoing habitat complex work at  
19 Cottonwood Ranch.
- 20 • Cook Tract – There are no specific plans for habitat projects on the Cook Tract.
- 21 • Dyer Property – There are no specific plans for habitat projects on the Dyer Property.

## 22 **1.6 Reference Projects**

23 Several sediment augmentation projects and papers were reviewed for the Study. Many of the sediment  
24 augmentation projects for which information is available have been conducted in western states, either in  
25 steep mountain streams or on major rivers with large dams. Goals for the projects reviewed tend to focus  
26 on the development of in-stream habitat, for example fish spawning habitat and increased turbidity and  
27 cover for smaller fish species. Mountain stream projects tend to focus on smaller streams and smaller  
28 volumes of coarse to larger aggregates. Projects on the larger rivers with large dams such as the Colorado  
29 River involve very large quantities of sediment and long sediment transport distances. Many of the  
30 projects are directly downstream of dams that provide a significant, reliable source of water in order to  
31 alter the magnitude of flows and distribute the augmented sediment.

32 Two projects for which good comparative information was available are summarized below.

### 33 **Project – Colorado River Ecosystem Sediment Augmentation**

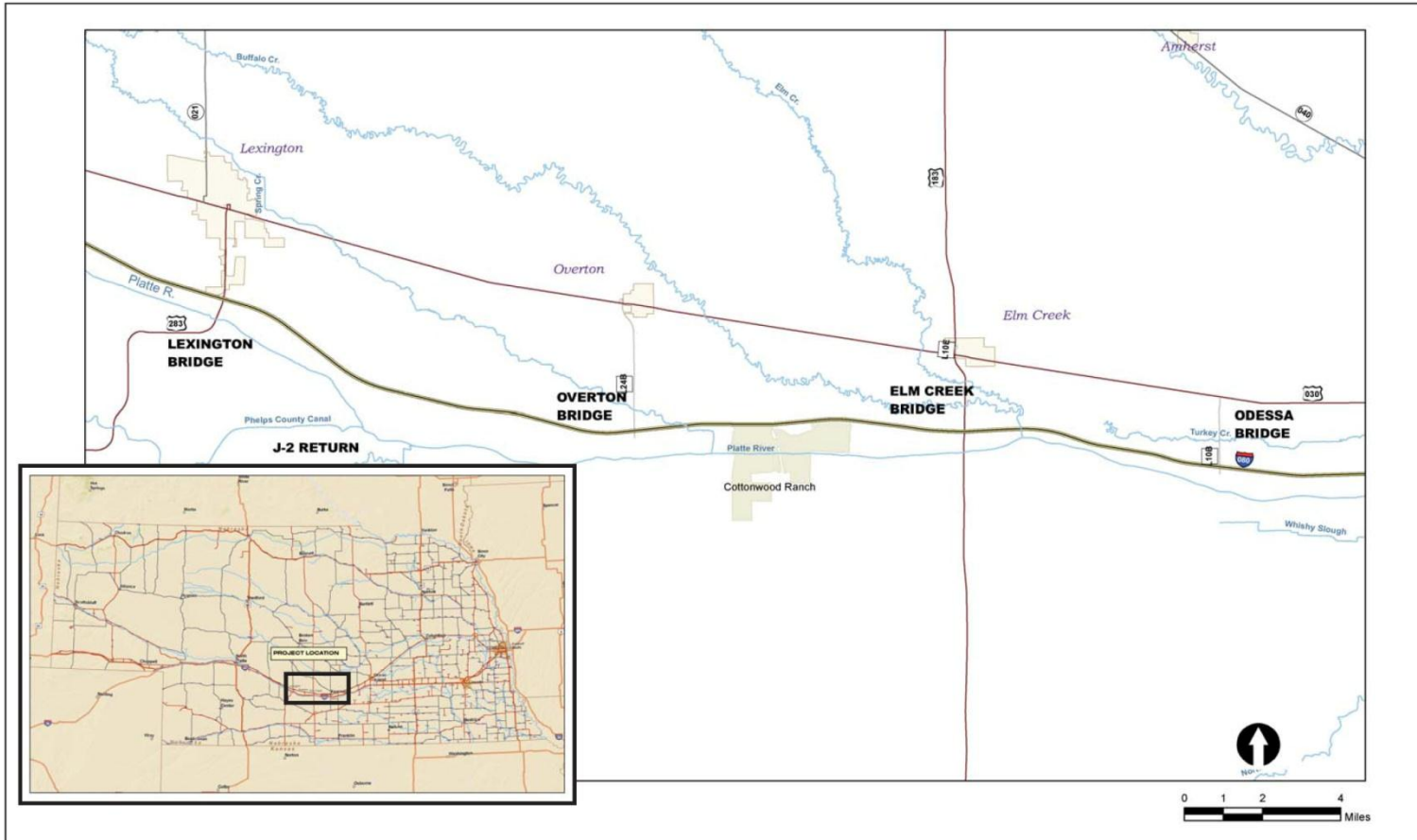
- 34 • Entity – BOR
- 35 • Location – Glen Canyon Dam, Arizona and Utah
- 36 • Description – large western river
- 37 • Project goals – seasonally increase turbidity for native and endangered fish, annually increase  
38 sand supply to the Colorado River during beach building flows
- 39 • Augmentation material – fine sediment (silt and clay-size) and sand
- 40 • Augmentation volume – 4.8 million tons annually

- 1 • Estimated costs – capital costs \$140 to \$430 million, annual operating cost of \$3.6 to \$17 million.

2 **Project – Coarse Sediment Augmentation of the Trinity River, California**

- 3 • Entity – CALFED (2004)
- 4 • Location – Northern California mountains downstream of Lewiston and Trinity dams  
5 (6-kilometer reach)
- 6 • Description – Mountain river
- 7 • Project goals – restore natural fluvial processes; increase and maintain spawning and rearing  
8 habitat for salmon
- 9 • Augmentation material – coarse sediment (gravel to cobbles)
- 10 • Augmentation volume – estimated 100,000-ton initial input followed by annual inputs of  
11 approximately 10,000 tons; recent projects included high flow gravel injection of 2,500 tons and  
12 1,000 tons in key areas.
- 13 • Estimated cost – \$30 per ton

14 For this Study, however, sediment augmentation is unique in terms of the type of river system, Project  
15 goal, type of sediments involved, and magnitude of augmentation proposed. In reviewing the literature  
16 and using its knowledge of augmentation, the Study team looked for information that would help  
17 understand processes, limitations, and costs. The uniqueness of the river system for this Study limited the  
18 amount of useful and comparative information. The Project is located in the central Platte River, a  
19 relatively flat, braided river system with generally low flows relative to the overall channel widths. The  
20 Project goal is to achieve sediment balance in the river that will result in creation of bed and bar habitat  
21 suitable for birds. The estimated annual volume of augmentation material is significantly higher than for  
22 many of the mountain stream projects but significantly lower than for some of the large western river  
23 projects. A primary conclusion in review of other projects points to little guidance regarding the  
24 quantities and grain sizes of material needed to achieve the Project goal.

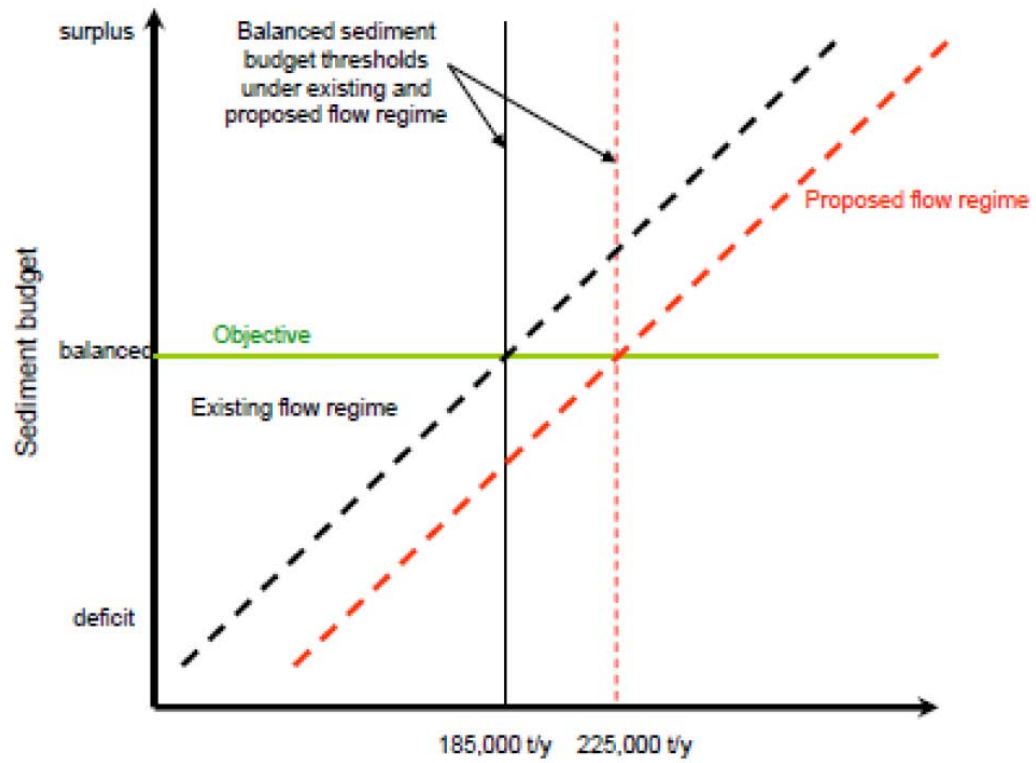


**Study Area**



Sediment Augmentation Feasibility Study  
 Draft Report  
 Platte River Recovery Implementation Program

Date	Nov. 2010
Figure	1-1



1  
2

**Figure 1-2 Estimated Average Annual Sediment Augmentation near Overton (t/y)**

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1 **2. DESCRIPTION OF STUDY AREA**

2 This section discusses the location of the Study area, the Central Platte Habitat Area, the hydrology in the  
3 Platte River near Overton, the central Platte River channel, and the Platte River segment targeted for  
4 sediment augmentation activity.

5 **2.1 Location**

6 As identified above, the Project reach is between the Lexington and Odessa bridges, a distance of  
7 32 miles, and is located within the Central Platte Habitat Area. The FEIS identifies the Central Platte  
8 Habitat Area as the reach of the Platte River from Lexington, Nebraska, to Chapman, Nebraska. Target  
9 species in this habitat area include the whooping crane, interior least tern, and piping plover (BOR and  
10 USFWS, 2006).

11 **2.2 Hydrology**

12 The average annual flows of the Platte River near Overton decreased from 2.65 million acre-feet per year  
13 during the period between 1895 and 1909 to a low of 830,000 acre-feet per year during the period from  
14 1936 to 1969. The mean annual flow of the Platte River near Overton was 1.4 million acre-feet during  
15 the period from 1970 to 1998. The duration and magnitude of low to moderate flows (including the mean  
16 annual peak flow) influence the width of the river. As flow has decreased over time, a corresponding  
17 decrease in the river width has been observed. The FEIS attributed decreased flows to increased water  
18 development and use, including agricultural, domestic, commercial, industrial, and mining uses.  
19 Agricultural uses for irrigation and livestock account for most of the current water use (BOR and  
20 USFWS, 2006).

21 **2.3 Central Platte River Channel**

22 **2.3.1 River Form**

23 In the period from 1900 through 1938, the central Platte River channel maintained a predominantly  
24 braided form, although the width of the river decreased significantly. Braided river forms are  
25 characterized by a series of shallow, interconnected low flow channels within the overall channel. This  
26 form provides desirable riverine habitat (i.e., habitat occurring along a river) for whooping crane, interior  
27 least tern, and piping plover because there are wide areas of water with unobstructed sight distances and  
28 bare sandbars for roosting, nesting, and security from predators (BOR and USFWS, 2006). Figure 2-1  
29 shows an example of a braided river.

30 Over time, reductions in flow volumes, peak flows, and sediment supply have shifted the river's form  
31 from a wide, braided channel to a channel consisting of multiple narrow and deep channels separated by  
32 vegetated islands (anastomosed). These changes have led to a decrease in desirable habitat for the target  
33 species (BOR and USFWS, 2006).

34 **2.3.2 Channel Width**

35 Earlier works suggest that channel widths along the river have decreased in the Project reach since the  
36 1860s. Most of the channel width reduction occurred between 1900 and 1960. Since 1960, channel width  
37 reduction has slowed (BOR and USFWS, 2006).

38 **2.3.3 River Depth**

39 Flow reductions in the central Platte River have resulted in reduced sediment transport. Flow discharged  
40 at the J-2 Return, upstream of Overton, contains very little sediment as it enters the river. The sediment  
41 imbalance created by this low-sediment return flow causes bed and bank erosion in the channel directly

1 below the J-2 Return discharge point and continuing downstream. Findings in the FEIS indicate that over  
2 a 13- to 18-year period from 1989 to 2002, the depth of degradation was about 6 feet near the J-2 Return  
3 and decreased over an approximately 18-mile distance in the downstream direction to less than 1 foot.

4 In degrading river reaches, the rate of bed erosion eventually slows as the slope of the river bed flattens or  
5 as the armoring process builds a protective surface of coarse-grained material on the river bed. The  
6 process of armoring is not desirable in the Platte River because the coarser grain sizes in the river bed do  
7 not support channel geometry as wide as supported by a finer grain size (BOR and USFWS, 2006).

#### 8 **2.3.4 Vegetation**

9 The FEIS cites numerous sources that identify vegetation expansion and loss of open channel area in the  
10 central Platte River since the early 1900s. Estimates in the FEIS indicate that the unvegetated portion of  
11 the channel between Lexington and Grand Island was reduced to roughly 9,500 acres between 1938 and  
12 1998. By restoring the river to a braided system through sediment augmentation and other measures,  
13 greater areas of open channel can be maintained, thereby providing unobstructed views that are preferred  
14 by target species (BOR and USFWS, 2006).

### 15 **2.4 Platte River Segment Targeted for Sediment Augmentation Activity**

16 Although the Project reach is the 32-mile river reach between the Lexington and Odessa bridges, most of  
17 the sediment augmentation activity for the Project would be conducted in a much shorter sub-reach  
18 between the Lexington Bridge and the Elm Creek Bridge. Note that Cottonwood Ranch is located within  
19 this sub-reach, shown in Figure 1-1, above, and discussed in detail in Section 4. Approximately 2 miles  
20 downstream of Lexington, flows in the Platte River historically split around Jeffrey Island. The split  
21 channels, referred to as the North Channel and the South Channel, rejoin near the east end of the Dyer  
22 Property above the Overton Bridge. A sand dam was constructed in the channel upstream of Jeffrey  
23 Island to divert flow to the North Channel. This dam effectively keeps river flows in the North Channel  
24 under all but the highest flow conditions.

25 CNPPID's J-2 Return is located on the South Channel and provides the majority of the flow in the South  
26 Channel under most flow conditions. The main channel (North Channel) capacity is slightly less than  
27 5,000 cubic feet per second (cfs) upstream of the confluence with the South Channel. The capacity of the  
28 Platte River increases to about 6,000 cfs downstream of Jeffrey Island due to the additions from the J-2  
29 Return (see **Appendix B**). Jeffrey Island is privately owned, but most of the island is in a lease-to-own  
30 agreement with CNPPID. Vegetation has significantly encroached on the North Channel along the  
31 channel margins. The South Channel is generally less vegetated, except for downstream portions in the  
32 vicinity of the Program's Cook and Dyer (Cook/Dyer) conservation properties.



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Waimakariri River, New Zealand (Wikimedia Commons, Photograph by Greg O'Beirne)

**Figure 2-1 Example of Braided River Form**

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### 3. ALTERNATIVE DEVELOPMENT AND EVALUATION METHODOLOGY

This section discusses the methodology used in the Study to identify and screen the alternatives for the sediment augmentation experiment.

#### 3.1 Modeling

Baseline steady-state hydraulic and sediment-transport models using the USACE HEC-RAS program were developed and calibrated for the Project reach. The baseline hydraulic model was developed to evaluate channel capacity and to provide the input for the sediment-transport model. The modeling determined that the average annual sediment deficit in the vicinity of Cottonwood Ranch is approximately 150,000 t/y, which is less than the 185,000 t/y estimate in Priority Hypothesis Sediment #1. In addition, the modeling results suggest that the overall sediment deficit between the Lexington and Odessa bridges is approximately 152,000 t/y. Section 4.2.3 discusses further modeling results. In assessing this value, however, it is critical to note that the transport capacities and resulting sediment deficit are highly dependent on the flow volume and patterns from year to year; thus, the deficit also varies by over an order of magnitude from year to year.

Several experiment alternatives were developed and evaluated for their ability to reduce the 150,000 t/y sediment deficit identified by this Study. The alternatives are described in greater detail in Section 10. Once the alternatives were assembled, the baseline model was modified accordingly and used to evaluate the potential response of the river to assess the benefits (i.e., the reduction of the sediment deficit) associated with the various components of each alternative. The alternative modeling included a suite of the identified potential augmentation components, including likely combinations of delivery technologies, augmentation locations, and augmentation material sizes, to assess the combined effects of the various components. The alternative modeling involved an iterative process wherein initial model results were used to develop subsequent alternatives in an attempt to identify a range of alternatives that best address the sediment deficit. The alternative modeling results were initially used to assess the effects of individual components (e.g., the augmentation material gradation) in the context of the other modeled components (e.g., delivery technology and augmentation location) and were ultimately used to evaluate each of the final alternatives as discussed in Section 10. The modeling efforts and baseline results are discussed in greater detail in Section 4. A detailed technical memorandum, entitled “Hydraulic and Sediment-transport Modeling for the Platte River Sediment Augmentation Feasibility Study, Nebraska,” describes the modeling efforts conducted as part of the Study (see **Appendix B**).

The modeling indicated that it is unlikely any of the alternatives would be 100 percent effective in eliminating the sediment deficit at the Cottonwood Ranch. The reason for this conclusion is that more than 150,000 t/y would need to be added based on the available size range of the augmented material with implementation of the augmentation methods for the evaluated alternatives.

#### 3.2 Identification and Screening of Components

The identification and development of alternatives started with the pre-screening of the individual components that make up a complete alternative. The following five major components of a sediment augmentation alternative were evaluated:

1. Sediment augmentation delivery locations – the physical locations on or adjacent to the Platte River where sediment could be discharged into the river such that the deficit at the Cottonwood Ranch location could be addressed. The identification and the screening of the possible sediment augmentation locations are discussed in Section 5.
2. Sediment source – the location or source where appropriate sediment could be acquired for delivery to the river. This includes locations where an available sediment supply could be purchased from an off-site source and those locations where sediment could be mined on

1 Program-controlled property. The identification and screening of sediment sources is discussed  
2 in Section 6.

3 3. Sediment production and delivery technology – the mechanical or hydraulic mechanism for  
4 mining the sediment and actually delivering the sediment to the river. The various delivery  
5 technologies and the screening of technologies are discussed in Section 7.

6 4. Delivery timing – the various delivery timing dates that would be used to begin sediment  
7 augmentation activities. Delivery timing is discussed in Section 8.

8 5. Augmentation material gradation – the various particle gradations that would be used as sediment  
9 augmentation material. The augmentation material gradation is discussed in Section 9.

10 A wide array of options for each of these five components was identified and evaluated to eliminate any  
11 component options that were either not feasible or not reasonable.

### 12 **3.3 Development of Alternatives and Evaluation Criteria**

13 The components that were considered reasonable and feasible were then compiled into a set of complete  
14 sediment augmentation alternatives. Where appropriate, alternatives that did not represent a unique  
15 solution, or did not offer some type of advantage that warranted consideration, were eliminated. In  
16 addition, the various permutations of each combination were evaluated to determine if a “hybrid”  
17 alternative would be feasible. Each alternative was described in detail, and a cost per delivered ton of  
18 sediment was calculated. Representative alternatives were also modeled, as appropriate, to determine the  
19 degree to which the alternative would reduce the sediment deficit. Section 10 describes each of the  
20 unique alternatives.

21 Alternative evaluation criteria were established to enable objective side-by-side comparison of each of the  
22 alternatives. The Corps of Engineers (USACE) Section 404(b)(1) Guidelines were used as a starting  
23 point for identifying of the evaluation criteria. A total of eight evaluation criteria within the four Section  
24 404(b)(1) Guideline categories were identified. Section 11 describes the process by which the evaluation  
25 criteria were developed.

### 26 **3.4 Screening of Alternatives**

27 Each feasible alternative was evaluated against the eight evaluation criteria, and a side-by-side  
28 comparison of each of the feasible alternatives was prepared. Based on the modeling, none of the  
29 evaluated alternatives fully meet the need for the Project, in that none of the alternatives fully eliminate  
30 the sediment deficit. Therefore, the side-by-side comparison allows the reader to better understand the  
31 relative advantages and disadvantages of each alternative. This comparison is presented in Section 12.

### 32 **3.5 Development of Recommendations**

33 Because this type of large-scale sediment augmentation project is unique and includes numerous  
34 variables, the Project includes major areas of uncertainty. Section 13 describes the uncertainties  
35 associated with the Project. Recognizing the areas of uncertainty and the Program’s adaptive  
36 management process, Section 14 identifies the preferred alternative based on the evaluation of the  
37 alternatives and discusses the conclusions and recommendations for the Project.

## 4. BASELINE MODELING AND DESIGN DEVELOPMENT SUMMARY

The baseline steady-state hydraulic and sediment-transport models for the Project reach were developed using USACE's Hydrologic Engineering Centers River Analysis System (HEC-RAS) program. The models were calibrated using measured data to the extent possible. The baseline models were then modified to represent a range of proposed sediment augmentation alternatives. For a detailed technical memorandum describing the modeling efforts conducted as part of the Study, see **Appendix B**.

This section addresses the baseline steady-state hydraulic and sediment-transport model development and results with respect to sediment deficit and surplus volumes, size degradation of eroded and deposited material, and responses to specific hydrologic conditions at key locations.

### 4.1 Baseline Steady-State Hydraulic Model

#### 4.1.1 Inputs

Steady-state hydraulic model inputs include the following, as described below:

- Geometric data
- Hydraulic structures
- Hydraulic roughness
- Ineffective flow areas
- Downstream boundary conditions

Geometric data – The modeled domain includes the approximately 32-mile reach of the main channel between Lexington and Odessa, and the approximately 8-mile reach of the South Channel along Jeffrey Island below the J-2 Return. The model contains 140 cross sections that extend across the active channel and floodplain. Cross sections were located at hydraulic structures, including the upstream and downstream faces of bridges and the Kearney Canal diversion structure. Cross sections were also located at the Program's Anchor Point survey sections<sup>1</sup>, supplemental sections surveyed specifically for the Study, and hydraulic controls (such as constrictions and riffle zones) (Figure 4-1).

The topography for the cross sections was taken from a variety of sources, including the 2009 LiDAR, the Anchor Point surveys, surveys completed for the Study, and fathometer survey information intended to capture the longitudinal main channel thalweg profile.

Hydraulic structures – The model includes four bridge structures: Lexington (U.S. Highway 283), Overton (State Highway 24), Elm Creek (U.S. Highway 183), and Odessa (State Highway 6). As-built bridge plans were obtained from NDOR – Bridges Division and were used to code the bridge piers, abutments, and superstructure into the model using the HEC-RAS bridge data editor. The Kearney Canal diversion structure was also coded into the model based on information from the LiDAR and ground surveys conducted as part of the Study.

Hydraulic roughness – The hydraulic roughness was incorporated into the model using Manning's n-values that vary horizontally across the cross section. Vegetation and land use information from the

---

<sup>1</sup> As part of the Program's Geomorphic Monitoring Program, a systematic sample of points along the river, referred to as "anchor points," has been established. These anchor point cross sections extend laterally across the historic floodplain and incorporate the current main channel as well as all primary split-flow channels. These sections provide for a consistent year-to-year source of topographic and additional data. They were used to supplement other sources of topographic information in the development of the hydraulic and sediment model. (Program, 2009)

1 Program's Vegetation Monitoring Program was used to develop the different roughness zones. The  
2 roughness zones were then assigned a Manning's n-value based on the vegetation description, field  
3 observations, bed material characteristics, past experience with similar rivers, and published values for  
4 similar rivers. Roughness values are provided in **Appendix B**.

5 Ineffective flow areas – Ineffective flow areas were used to ensure that the modeled flow paths are  
6 consistent with the actual flow conveyance. Permanent ineffective flow areas were used to block out  
7 locations that would not convey flow over the range of modeled flows (e.g., up- and downstream from  
8 bridge structures or within the gravel pits), while non-permanent ineffective flow areas were used in  
9 overbank flow paths where the area is ineffective at low flows but would become effective at high flows.  
10 The HEC-RAS levee feature was used only to define contiguous features that would limit conveyance to  
11 the main channel (i.e., the Interstate 80 [I-80] structure).

12 Downstream boundary conditions – The downstream boundary conditions were established assuming  
13 normal depth with a slope of 0.00125, consistent with the average bed slope in the downstream portion of  
14 the model. This slope is also consistent with the slope of the water surface at the time of the LiDAR. The  
15 downstream boundary of the model is located a sufficient distance downstream from the Odessa Bridge to  
16 ensure that error in the assumed starting water surface elevation does not affect the predicted hydraulic  
17 conditions within the Project reach.

#### 18 **4.1.2 Calibration**

19 The model was calibrated, to the extent possible, by comparing the water surface elevations predicted by  
20 the model with available measured water surface elevations obtained from rating curves at the stream  
21 gages, surveyed water surface elevations from a variety of sources, and inferred water surface elevations  
22 from the LiDAR. The results are shown in **Appendix B**.

#### 23 **4.1.3 Results**

24 The baseline hydraulic model was executed over a range of steady-state flows that encompass the  
25 measured flow regime, and included flows up to 30,000 cfs.

26 Results from the steady-state hydraulic model were used to evaluate the channel capacity and to provide  
27 input to the sediment-transport model. Comparison of the predicted water surface elevations with the  
28 top-of-bank elevations indicates the following, although there is significant variability in the data:

- 29 • The North channel capacity is slightly less than 3,500 cfs upstream of the confluence with the  
30 South Channel (i.e., above the flows delivered by the J-2 Return).
- 31 • The channel capacity increases to about 6,000 cfs downstream of Jeffrey Island.

### 32 **4.2 Baseline Sediment-Transport Model**

#### 33 **4.2.1 Inputs**

34 The geometry and other inputs to the steady-state hydraulic model served as the basic framework for the  
35 sediment-transport model. Minor modifications to the geometry were made to address limitations in the  
36 HEC-RAS Sediment Transport Model as well as other sediment-transport model input (i.e., bed material  
37 gradation data, upstream and lateral sediment supplies, and flow hydrographs), as discussed in detail in  
38 **Appendix B**.



1           **4.2.2 Calibration**

2 The baseline sediment-transport model was executed using a 12.5-year period of flow record extending  
 3 from October 1, 1989, to April 1, 2002. This period was selected because it corresponds to the period  
 4 with the largest amount of data with which to calibrate the model and represents a range of hydrologic  
 5 data appropriate for this effort.

6 The model was calibrated, to the extent possible, by comparing the predicted aggradation/degradation  
 7 trends and changes in bed material size to observed data along the Project reach. The baseline model  
 8 includes the existing channel geometry and the existing gradation of the bed material; therefore, only the  
 9 trends in aggradation/degradation and coarsening/fining were considered in calibrating the model. The  
 10 primary data used to calibrate the model were obtained from repeat cross-sectional surveys conducted by  
 11 the BOR between 1985 and 2005 (BOR, 2006).

12           **4.2.3 Results**

13 The primary purpose of the model was to address Priority Hypothesis Sediment #1 that a sediment  
 14 deficiency of 185,000 to 225,000 t/y exists in the Project reach. To evaluate this deficiency, the baseline  
 15 sediment-transport model was executed over the calibration period of flow record between October 1,  
 16 1989, and April 1, 2002, because this period included a reasonable distribution of flows. Results from the  
 17 baseline model simulation were evaluated to assess the magnitude, distribution, and characteristics of  
 18 sediment loading along the Project reach under existing conditions. In general, the results indicate that  
 19 the overall sediment deficit between the Lexington and Odessa bridges is approximately 152,000 t/y over  
 20 the 12.5-year simulation period.

21 To evaluate the distribution of this deficit, the Project reach was divided into five subreaches, identified in  
 22 Table 4-1 and shown in Figure 4-1. The total mass sediment surplus or deficit in each subreach was  
 23 computed using the cumulative mass flux that enters and exits each subreach at various points during the  
 24 simulation. The average annual surplus or deficit was quantified by dividing the cumulative differences  
 25 at the end of the 12.5-year simulation period. Results of the analysis are shown in Table 4-1 and Figure  
 26 4-2. Note that the Program’s preferred location to evaluate the effectiveness of the Project, just upstream  
 27 (west) of NPPD’s Cottonwood Ranch, is within Subreach 3.

28           **Table 4-1 Total Sediment Deficit and Surplus Volumes in Each Reach**

<b>Subreach</b>	<b>Upstream Limit</b>	<b>Downstream Limit</b>	<b>Specific Location</b>	<b>Aggradational/ Degradational</b>	<b>Deficit (-)/ Surplus (+) (t/y)</b>
1	Lexington Bridge	Overton Bridge	North Channel	Slightly to moderately aggradational	+66,400
2	J-2 Return	Overton Bridge	South Channel	Degradational	-96,700
3	Overton Bridge	Elm Creek Bridge	Cottonwood Ranch Reach	Degradational	-108,500
4	Elm Creek Bridge	Kearney Canal diversion structure	Immediately Upstream of Kearney Diversion	Slightly to moderately aggradational	+32,700
5	Kearney Canal diversion structure	Odessa Bridge	Immediately Downstream of Kearney Diversion	Degradational	-46,100
<b>Total Reach</b>					<b>-152,200<sup>1</sup></b>

29 *Note:*

30 <sup>1</sup> For the purpose of the Study, the sediment deficit for the entire Project reach has been rounded to 152,000 t/y.

1 Results also indicate the following:

- 2 • In Subreach 1, the most significant amount of aggradation occurred in water year (WY) 1995 due  
3 to the high-magnitude flood that occurred during the summer of that year.
- 4 • In Subreaches 2 and 3, degradation appears to be most significant during the period between 1996  
5 and 2000 when the runoff volume was relatively large. Upstream of the Kearney Canal diversion  
6 structure, deposition occurred in each year of the simulation except 1995, when extreme flooding  
7 flushed deposited sediments from the reach, and in 2000, when very little change occurred.
- 8 • Subreach 4 is slightly aggradational due to the backwater effects of the Kearney Canal diversion  
9 structure.
- 10 • In Subreach 5, the degradation is probably affected by the gains and losses that occur in this reach  
11 but also mirrors the aggradational trend in Subreach 4, with the largest degradation volumes  
12 occurring during years when sediment trapping in Subreach 4 was the largest. Degradation in  
13 Subreach 5 tends to be greater during years when the unmeasured gains are large compared to the  
14 losses, since no sediment load is associated with the inflow (i.e., WY1996).

15 HEC-RAS does not segregate the erosion/deposition volumes between the overbanks and the main  
16 channel. Because the deficits in the main channel have a significant effect on sandbar development and  
17 morphology, the lateral distribution of the sediment deficits or surplus was estimated by computing the  
18 change in volume in the overbanks and in the main channel using the channel geometry at the start of the  
19 simulation and at various times during the simulation. To compute these volumes, end-area calculations  
20 were performed using the average reach length between the up- and downstream cross sections.

21 The distribution indicates that a significant amount of sediment storage occurs in the overbanks; thus, the  
22 main channel deficits are somewhat greater than the total deficits in subreaches that are degradational, and  
23 the main channel surplus is somewhat less than the total surplus in subreaches that are aggradational.  
24 Results are shown in Table 4-2 and Figure 4-3.

25 **Table 4-2 Main Channel Sediment Deficit and Surplus Volumes in Each Subreach**

Subreach	Upstream Limit	Downstream Limit	Specific Location	Aggradational/ Degradational	Deficit (-)/ Surplus (+) (t/y)
1	Lexington Bridge	Overton Bridge	North Channel	Slightly to moderately aggradational	+47,100
2	J-2 Return	Overton Bridge	South Channel	Degradational	-97,700
3	Overton Bridge	Elm Creek Bridge	Cottonwood Ranch Reach	Degradational	-149,800 <sup>1</sup>
4	Elm Creek Bridge	Kearney Canal diversion structure	Immediately Upstream of Kearney Diversion	Slightly to moderately aggradational	+7,200
5	Kearney Canal diversion structure	Odessa Bridge	Immediately Downstream of Kearney Diversion	Degradational	-50,300

26 <sup>1</sup> For the purpose of the Study, the sediment deficit for Subreach 3 (the reach that includes Cottonwood Ranch) has  
27 been rounded to 150,000 t/y.

### 4.3 Size Gradation of Eroded and Deposited Material

The baseline model results were processed to evaluate the size of the material that makes up the sediment deficit or surplus. Results of this analysis indicate that, in each of the subreaches, most of the eroded or deposited material is in the medium to coarse sand range (0.25 to 1.0 mm). Results indicate the following:

- In Subreach 1, the deposited material includes about 10 percent very fine to fine sand (<0.25 mm), about 67 percent medium to coarse sand, and about 23 percent in the very coarse sand (VCS) to gravel range (>1 mm).
- Of the depositional reaches, the largest percentage of coarse material (29 percent VCS to gravel) is eroded from Subreach 2 due to the availability of the coarse fractions in the surface material and the relatively high transport capacity in most of the South Channel.
- In Subreach 3, eroded material includes nearly equal parts of fine and coarse material (20 percent less than 0.25 mm and 21 percent greater than 1 mm).
- In Subreach 4, VCS and gravel make up a significant portion (about 32 percent) of the material that is deposited upstream of the Kearney Canal diversion structure.
- In Subreach 5, the deficit is well graded, with 24 percent very fine to fine sand, 51 percent medium to coarse sand, and 25 percent VCS and gravel.

### 4.4 Responses to Hydrologic Conditions

The baseline model simulation results were used to evaluate the response of the river to specific hydrologic events at key locations. For this evaluation, the mass fluxes across the subreach boundaries and the associated deficit or surplus within the subreach were plotted with the representative flow hydrographs over the simulation period. Results indicate the following:

- In Subreach 1, most of the aggradation occurs during high flow periods that result in significant overbank storage. Nearly half of the cumulative sediment deposition at the end of the simulation occurred during the 1995 flood.
- Because there is no sediment supply to Subreach 2, the rate of degradation in this reach is directly linked to the J-2 Return flows, with the most significant amounts of degradation occurring during high flow release periods.
- In Subreach 3, degradation appears to be largest during sustained high flow periods, with very little change during low flow periods. Short periods of aggradation or no change occurred during the extreme flood events in 1995, 1997, and 1999 due to the large volume of material delivered from Subreach 1.
- In Subreach 4, the largest amount of aggradation tends to occur during high flow periods when the backwater effects from the Kearney Canal diversion structure are most significant, while very little change occurs during low flow periods.
- In Subreach 5, degradation mirrors the aggradational pattern in Subreach 4.

These results were also used to develop relationships between the predicted deficit or surplus and discharge. As expected, the largest volumes of aggradation or degradation occur at the higher discharges when the sediment transport rates are the largest. Results indicate the following:

- In Subreach 1, the surplus increases in a relatively consistent manner with increasing discharge.
- In Subreach 2, the deficit increases in a relatively consistent manner with increasing discharge.

- 1 • In Subreach 3, the deficit generally increases with increasing discharge at low to moderate flows  
2 (less than about 5,000 cfs), but there is considerable scatter and no consistent trend at higher  
3 flows. This behavior is related to both the variability and uncorrelated sediment contributions  
4 from the North Channel and the South Channel (i.e., Subreaches 1 and 2, respectively), and  
5 hysteresis (i.e., the lagging of an effect behind its cause) during the rising and falling limbs of the  
6 hydrograph as finer sediment is depleted from and added to the active bed layer.
- 7 • In Subreach 4, upstream of the Kearney Canal diversion structure, most of the aggradation occurs  
8 at flows exceeding 2,000 cfs.
- 9 • In Subreach 5, degradation appears to be most significant at flows in excess of 1,000 cfs.

#### 10 **4.5 Summary of Baseline Modeling Results**

11 Conclusions from the baseline steady-state hydraulic and sediment-transport modeling results include the  
12 following:

- 13 • Predicted water surface elevations from the steady-state hydraulic model match the measured data  
14 reasonably well.
- 15 • Model results suggest that the capacity of the main channel (where there are no split-flow paths)  
16 is about 3,500 cfs in the mainstem (i.e., the main course of the river) through Lexington to the  
17 channel split around Jeffrey Island (North and South channels around the island). That same  
18 capacity continues in the North Channel to the confluence with the South Channel at the  
19 downstream end of the island. Downstream of Overton, the channel capacity is about 6,000 cfs.
- 20 • Predicted results from the sediment-transport model compare well with observed  
21 aggradation/degradation and changes in bed material size trends.
- 22 • On an average annual basis, the overall sediment deficit along the reach between the Lexington  
23 and Odessa bridges is approximately 152,000 t/y.
- 24 • Subreach 1 (the reach between the Lexington and Overton bridges, which includes the North  
25 Channel) is moderately aggradational.
- 26 • Subreach 4 (the short reach between the Elm Creek Bridge and the Kearney Canal diversion  
27 structure) is slightly aggradational.
- 28 • Subreaches 2, 3, and 5 (the reaches of the South Channel downstream of the J-2 Return, between  
29 the Overton and Elm Creek bridges, and between the Kearney Canal diversion structure and the  
30 Odessa Bridge) are degradational.
- 31 • Coarsening of the surficial bed material occurs by the end of the simulation along most of the  
32 Project reach.

33 This section provides only a summary of the modeling efforts conducted as part of the Study. The full  
34 technical memorandum, “Hydraulic and Sediment-transport Modeling for the Platte River Sediment  
35 Augmentation Feasibility Study, Nebraska,” found in **Appendix B**, provides a detailed discussion of the  
36 modeling efforts.

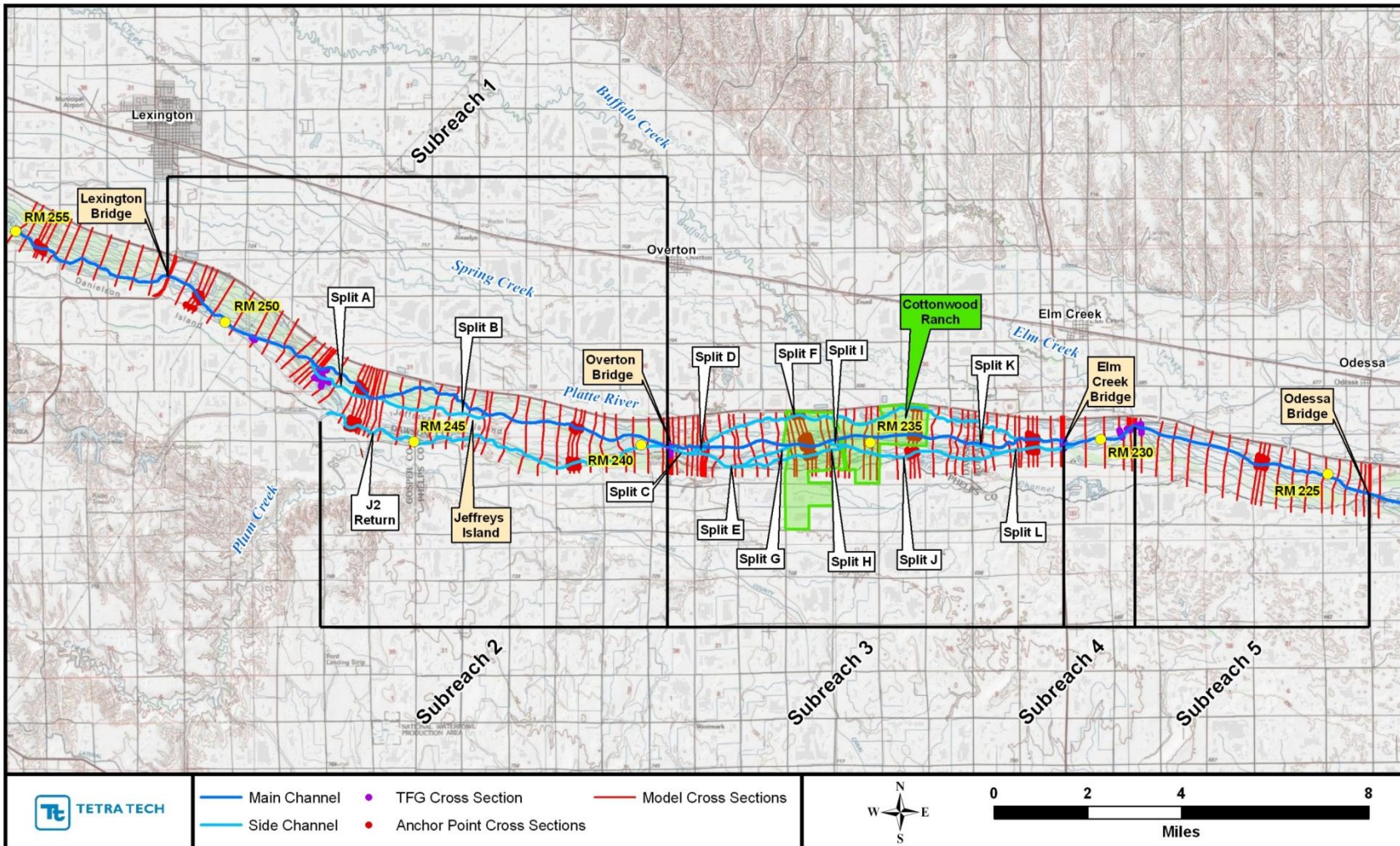
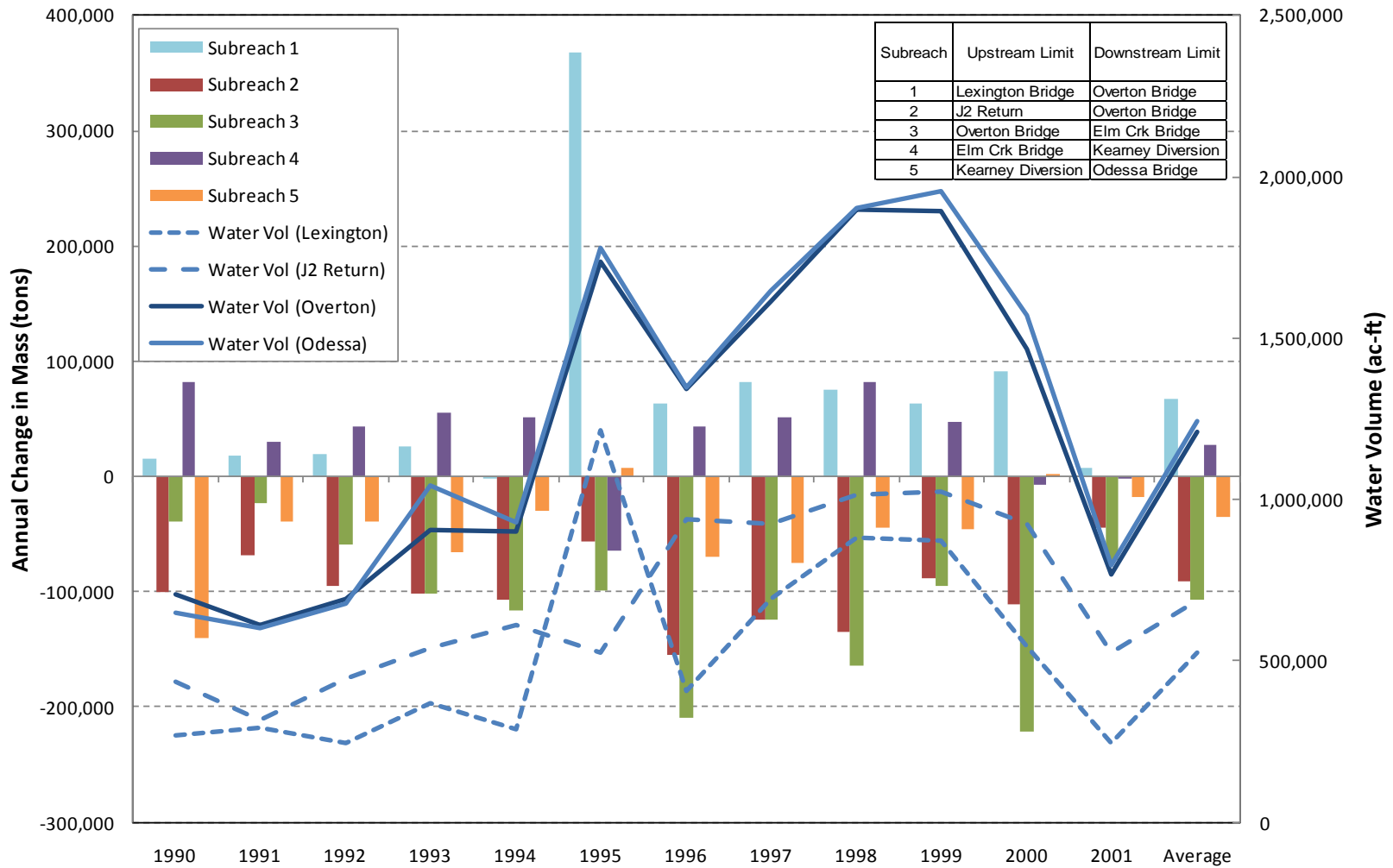


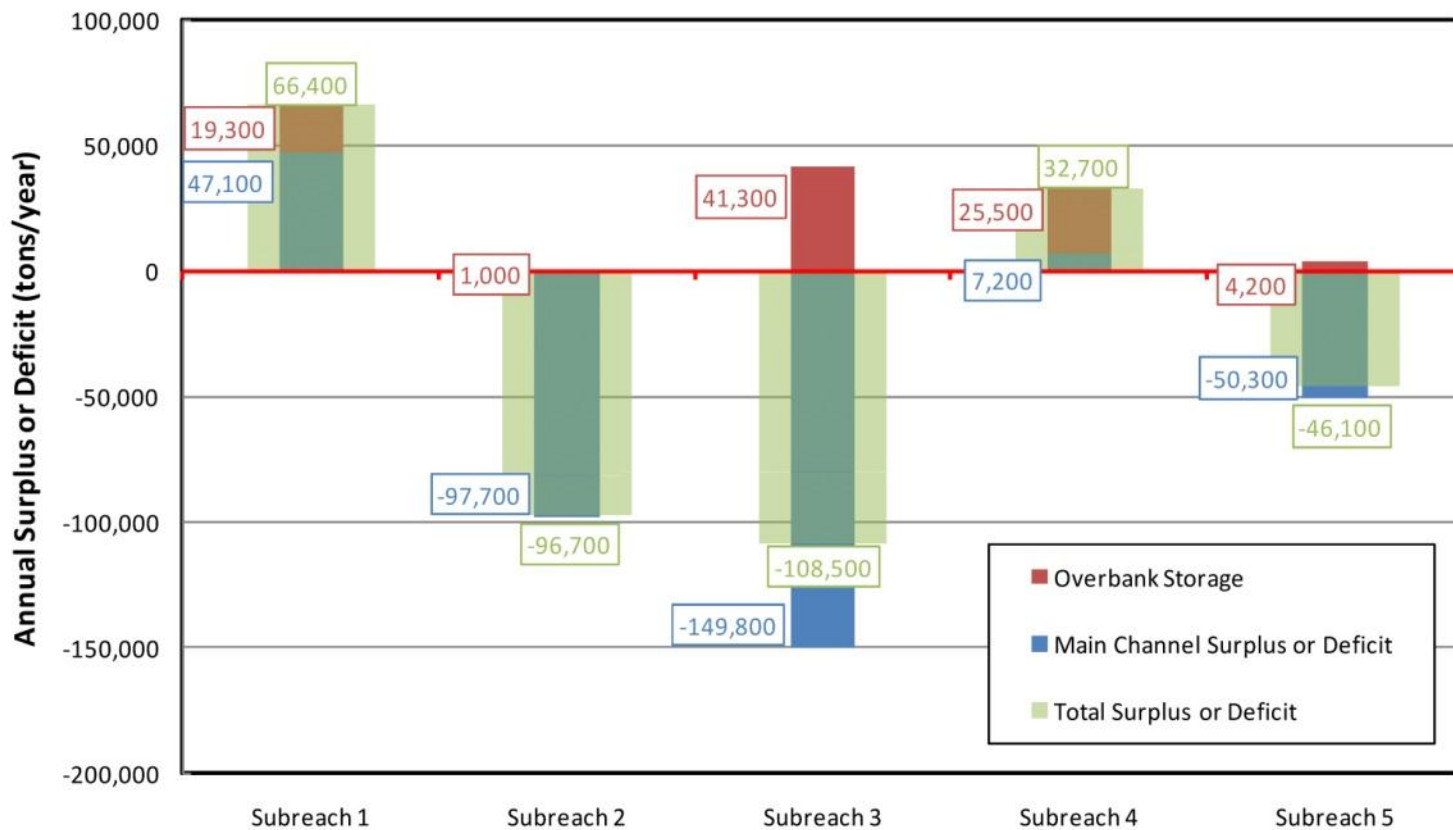
Figure 4-1 Cross Sections Included in the Steady-State Hydraulic Model

1  
2



**Figure 4-2 Annual Sediment Deficit or Surplus in Each Subreach and Annual Water Volume at Representative Locations along Project Reach**

1  
2  
3



**Figure 4-2 Average Annual Total Mass Sediment Deficit or Surplus by Subreach and Estimated Surplus or Deficit in the Main Channel and Overbank**

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2  
3

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1 **5. IDENTIFICATION AND INITIAL SCREENING OF SEDIMENT**  
 2 **AUGMENTATION DELIVERY LOCATIONS**

3 This section identifies potential delivery locations for sediment augmentation within the Project reach and  
 4 includes areas owned or leased by the Program or its collaborators and private land in the vicinity of the  
 5 Project reach.

6 To meet the long-term goal of the Program, the delivery locations must be in areas where the sediment  
 7 can be mobilized in the river prior to reaching the upstream end of Cottonwood Ranch. Other  
 8 requirements include the ability of the location to provide access, staging, and stockpiling. Locations that  
 9 were not deemed feasible were not carried forward for further analysis.

10 **5.1 Conservation Sites**

11 A conservation property is defined as property owned or controlled, through leases or other arrangements,  
 12 by the Program or its collaborators (e.g., NPPD, CNPPID, conservation groups). Figure 5-1 shows the  
 13 location of conservation properties along the Project reach. An initial screening of these conservation  
 14 properties was conducted to eliminate properties that would not be feasible in achieving the Project goal.  
 15 The following initial screening criteria were used to eliminate unsuitable properties:

- 16 • Location downstream of Cottonwood Ranch
- 17 • Significant disruption of the owner’s current use of site
- 18 • Physical constraints, such as size or configuration
- 19 • Location relative to the river (e.g., generally more than 500 feet from the channel)
- 20 • Location along the North Channel – Due to the amount of existing vegetation, limited available  
 21 sites, and potential accumulation of sediment in the channel, augmentation of sediment to the  
 22 North Channel prior to the rejoining of the North and South channels downstream of Jeffrey  
 23 Island was screened out during initial screening of augmentation sites. Modeling also indicated  
 24 that the North Channel is in approximate sediment balance (slightly aggradational), so additional  
 25 sediment augmentation in the North Channel would likely accumulate in the channel.

26 Table 5-1 summarizes the conservation properties in the vicinity of the Project reach, the results of the  
 27 initial screening, and the primary reason(s) that locations were retained for further evaluation as delivery  
 28 locations or eliminated from further consideration. Figure 5-1 shows the conservation properties in the  
 29 affected reach.

30 **Table 5-1 Conservation Properties Initially Screened for Delivery Locations**

Owner	Retained?		Primary Reason(s) Retained or Eliminated
	Yes	No	
<b>PRRIP</b>			
Cook Tract	X		Located upstream of the Overton Bridge on south side of Platte River; suitable size
Dyer Property	X		Located upstream of the Overton Bridge on south side of Platte River; suitable size
Elm Creek/Morse/ Johnson/Robinson		X	Located off-channel
Bartels		X	Located downstream of Cottonwood Ranch; disruption of current use

Owner	Retained?		Primary Reason(s) Retained or Eliminated
	Yes	No	
<b>NPPD</b>			
Lexington Sandpit		X	Located upstream of Jeffrey Island
Lexington Island		X	Located upstream of Jeffrey Island; disruption of existing use
Cottonwood Ranch		X	Located downstream of Cottonwood Ranch; disruption of current use
Kearney Canal diversion structure		X	Located downstream
Johnson Sandpit		X	Located downstream of Cottonwood Ranch and off river
<b>CNPPID</b>			
J-2 Return		X	Small size of site
Jeffery Island and Adjacent River		X	Disruption to island and river
Reregulating Reservoir Project		X	Located off-river
<b>Nebraska Game and Parks Commission (NGPC)</b>			
Dogwood Wildlife Management Area (WMA)		X	Located on North Channel; disruption of current use
Blue Hole WMA		X	Located downstream of Cottonwood Ranch; disruption of current use
Sandy Channel State Recreation Area (SRA)		X	Located downstream of Cottonwood Ranch; disruption of current use
Blue Hole East WMA		X	Located downstream of Cottonwood Ranch; disruption of current use
<b>Platte River Whooping Crane Trust (PRWCT)</b>			
Johns Tract		X	Located downstream of Cottonwood Ranch; disruption of current use
Sullwold		X	Located downstream of Cottonwood Ranch; disruption of current use
<b>The Nature Conservancy (TNC)</b>			
Andersen Tract		X	Located off river

1  
2 Therefore, based on this initial screening, the following conservation properties were retained as potential  
3 sediment augmentation delivery locations:

- 4     • Cook Tract  
5     • Dyer Property

6 There are currently no other conservation properties being considered for inclusion in the Project. The  
7 Program continues to evaluate potential needs for additional conservation properties. If uses for existing  
8 properties change, or the Program acquires control of additional land, those properties may be evaluated  
9 for possible inclusion in future sediment augmentation projects.

### 1           **5.1.1 Cook Tract**

2   The Cook Tract is located 1.5 to 2.5 miles upstream of the Overton Bridge on the south side of the Platte  
3   River (Figure 5-1, at the end of this section). The western edge of the property encompasses the area  
4   around the east end of Jeffrey Island. The tract includes approximately 130 acres within the river channel  
5   and 240 acres of overbank area, for a total area of approximately 370 acres. The overbank areas to the  
6   south are primarily farmed or in pasture. The overbank areas to the north are between the overall north  
7   and south banks of the river and consist of vegetated islands. A small, unnamed drainage flows into the  
8   Platte River at the east end of the property. The southern, rectangular-shaped portion of the Cook Tract is  
9   open and undeveloped, with relatively little vegetation. The northeastern portion of the property is more  
10  densely vegetated.

11  There are currently no other Program projects on the Cook Tract. The Cook Tract has been identified  
12  primarily for evaluation and use in sediment augmentation projects; however, the site may be evaluated  
13  for future potential habitat projects.

### 14           **5.1.2 Dyer Property**

15  The Dyer Property is located 0.5 to 1.5 miles upstream of the Overton Bridge on the south side of the  
16  Platte River (Figure 5-1). It is directly adjacent to the east end of the Cook Tract and has an area of  
17  approximately 360 acres. The Dyer Property includes approximately 150 acres within the river channel  
18  and 210 overbank acres. There are several sandpits on the east end of the property from previous  
19  dredging operations. The overbank areas include farmed areas and pasture as well as the sandpits  
20  mentioned above. Overbank areas in the river consist of vegetated islands.

21  There are no other current Program projects on the Dyer Property. The existing sandpits on the property  
22  offer some habitat. The Dyer Property has also been identified primarily for evaluation and use in  
23  sediment augmentation projects; however, the site may be evaluated for future potential habitat projects in  
24  the channel and/or overbank areas.

## 25           **5.2 Private Properties**

26  The focus for the Project is on properties owned or controlled (e.g., through leases) by the Program or its  
27  collaborators (e.g., NPPD, CNPPID). There were no specific private properties identified as potential  
28  sediment augmentation delivery locations, with the exception of privately owned and operated  
29  commercial sand and gravel operations in the vicinity of the Project reach, which are discussed below as a  
30  separate category of sites. The analysis does not preclude the use of other properties during the  
31  implementation phase of sediment augmentation.

## 32           **5.3 Existing Commercial Sand and Gravel Mining Operations**

33  Commercial sand and gravel mining operations were considered for the potential augmentation delivery  
34  locations. Figure 5-2 shows the locations of active sand and gravel mining operations in the vicinity of  
35  the Project reach, which are clustered near the I-80 interchanges at Lexington, Overton, and Elm Creek  
36  due to the ease of transportation access. All of these operations are pit dredge operations.

37  Because the Program does not control the private sand and gravel operations, the logistics of their  
38  involvement is more complicated. In order for the Program to use a site for augmentation, an agreement  
39  would have to be negotiated with the owner prior to use and would likely involve compensation from the  
40  Program.

1           **5.3.1 Initial Screening of Commercial Sand and Gravel Mining Operations**

2 An initial screening of these existing commercial sand and gravel mining operations was conducted to  
 3 eliminate properties that would not be feasible in achieving the Project goal. The following initial  
 4 screening criteria were used to eliminate unsuitable properties:

- 5           • Locations north of I-80
- 6           • Location downstream of Cottonwood Ranch
- 7           • Significant disruption of the owner’s current use of site
- 8           • Physical constraints, such as size or configuration
- 9           • Location relative to the river (e.g., generally more than 500 feet from the channel)
- 10          • Location along the North Channel

11 Table 5-2 summarizes the existing commercial sand and gravel operations in the vicinity of the Project  
 12 reach and the results of the initial screening.

13           **Table 5-2 Existing Commercial Sand and Gravel Operations near the Project**

Owner	Retained?		Primary Reason(s) Retained or Eliminated
	Yes	No	
<b>Lexington Interchange</b>			
Paulsen, Inc.		X	Located north of I-80
Overton Sand and Gravel Company (OS&G)		X	Less channel area to work within and more potential for negative impacts from modified channel morphology
<b>Overton Interchange</b>			
OS&G	X		Upstream of Cottonwood Ranch
Carl Whitney Sand and Gravel Inc.	X		Upstream of Cottonwood Ranch
<b>Elm Creek Interchange</b>			
Paulsen, Inc.		X	Location downstream of Cottonwood Ranch
T&F Sand and Gravel		X	Location downstream of Cottonwood Ranch

14  
 15 Therefore, based on the initial screening, the following commercial sand and gravel operations were  
 16 retained as potential sediment augmentation delivery locations:

- 17           • Overton Sand and Gravel (Overton Interchange)
- 18           • Carl Whitney Sand and Gravel (Overton Interchange)

19           **5.3.2 Operations at the Overton Interchange**

20 There are two sand and gravel pits operating at the Overton interchange, as shown on Figure 5-2. These  
 21 operations are located approximately 1 to 2 miles upstream of Cottonwood Ranch and are close to the  
 22 Program’s Cook Tract and Dyer Property. Carl Whitney Sand and Gravel is located approximately 0.5  
 23 mile east of OS&G and could also be used as an augmentation site. The cost and evaluation would not  
 24 differ significantly between either location. The two existing sand and gravel pits at the Overton  
 25 interchange are described in the following sections.

1                   **5.3.2.1     Overton Sand and Gravel**

2   The OS&G operation at Overton is south of I-80 and just east of the interchange. The location of the  
3   operation, directly adjacent to the river channel, would allow the site to be used as a delivery location.  
4   The location would allow for direct discharge into the river from ongoing operations if material  
5   gradations and permitting issues allowed. However, direct discharge into the river may have logistical  
6   implications in that it would be difficult to control the quantity and quality of material discharged. Direct  
7   discharge would also be directly tied to the owner’s other operations and not sediment augmentation.  
8   Permitting for potential direct discharge will be addressed during the implementation phases of sediment  
9   augmentation.

10   In 2009, the dike separating the OS&G operation from the river was breached, allowing the river to flow  
11   into the sand pit. Observations by Program staff and review of aerial photographs post-breach indicate  
12   that the sand pit has partially filled with sediment. In its current state, the sand pit is acting as a sediment  
13   sink; however, the volume of sediment entering the pit is unknown. As such, the breached sand pit would  
14   likely trap a significant amount of the augmented material under alternatives involving augmentation  
15   upstream from this location.

16                   **5.3.2.2     Carl Whitney Sand and Gravel**

17   The Carl Whitney Sand and Gravel pit is located approximately 0.5 mile east of OS&G. Similar to the  
18   OS&G operation, the pit is located adjacent to the river channel. This location would allow the site to be  
19   used as a delivery location.

20                   **5.4     North Channel Sediment Augmentation Delivery Locations**

21   As stated above, approximately 2 miles downstream of Lexington, flows in the Platte River historically  
22   split and flow around Jeffrey Island. The North Channel and South Channel rejoin near the east end of  
23   the Dyer Property. A sand dam constructed in the channel upstream of Jeffrey Island diverts flow to the  
24   North Channel.

25   The sediment deficiency analysis by BOR concluded that not all of the sediment deficiency at the Overton  
26   Bridge could be mitigated by augmenting in the South Channel alone, as this channel does not carry all of  
27   the flow. Detailed analysis of the sediment deficiency conducted for the Project indicates that in order to  
28   approach sediment balance at Cottonwood Ranch, some augmentation would have to occur in Subreach 3  
29   downstream of the Overton Bridge.

30   During the initial evaluation of potential delivery sites, the North Channel around Jeffery Island was  
31   screened out from consideration for augmentation based on logistical and flow concerns. These concerns  
32   include the following, as described below:

- 33       • Vegetation
- 34       • Limited opportunities for locating augmentation sites along the North Channel
- 35       • Limited ability to carry additional sediment

36   The North Channel around Jeffrey Island flows through an area with significant stands of vegetation. The  
37   vegetation would likely limit the effectiveness of augmentation in this channel because higher flows  
38   would be in the adjacent vegetated floodplain. This would cause suspended sediment to more readily  
39   settle out rather than being carried downstream.

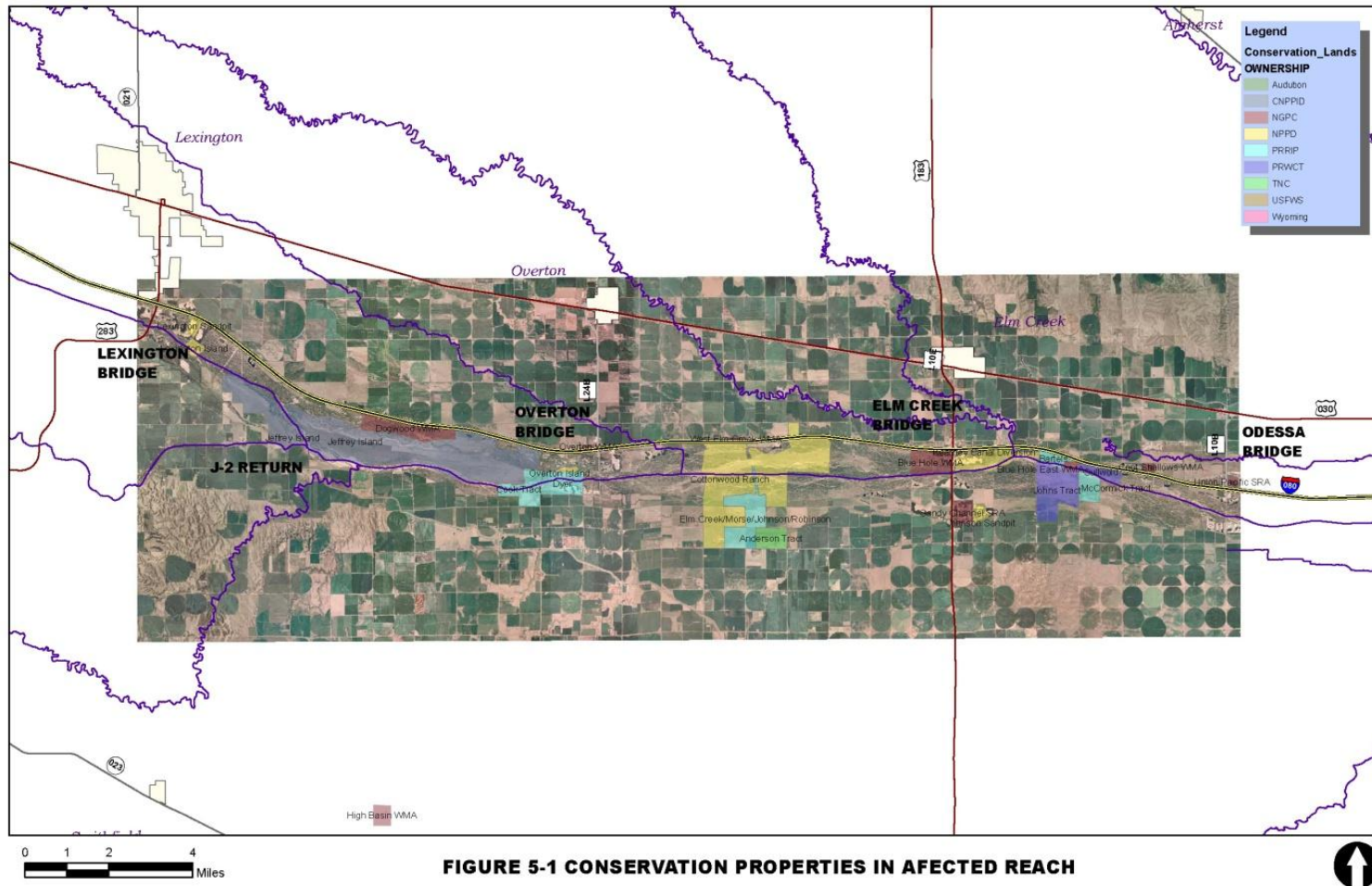
40   NPPD’s Lexington Sandpit and Lexington Island areas are upstream of where the flow splits around  
41   Jeffery Island; however, these areas are primary habitat locations and not suitable for delivery locations.  
42   In addition, these areas are at the upstream end of the Project reach; modeling has indicated that the  
43   farther upstream the augmentation sites are located, the less effective they are at achieving sediment

1 balance at Cottonwood Ranch because sediment settles out prior to reaching that location. CNPPID has  
2 some river access on the north side of Jeffery Island across and slightly upstream of the Cook Tract;  
3 however, this area contains a high density of vegetation as well.  
4 Sediment-transport modeling conducted for the Study indicates that this subreach (Subreach 1) is nearly  
5 in sediment balance, resulting in limited ability to carry additional sediment.  
6 Therefore, based on these logistical and flow concerns and the results of the sediment-transport modeling,  
7 North Channel sites have been eliminated from consideration as delivery locations.

## 8 **5.5 Summary of Viable Sediment Augmentation Delivery Locations**

9 The sites retained for further evaluation as delivery locations are:

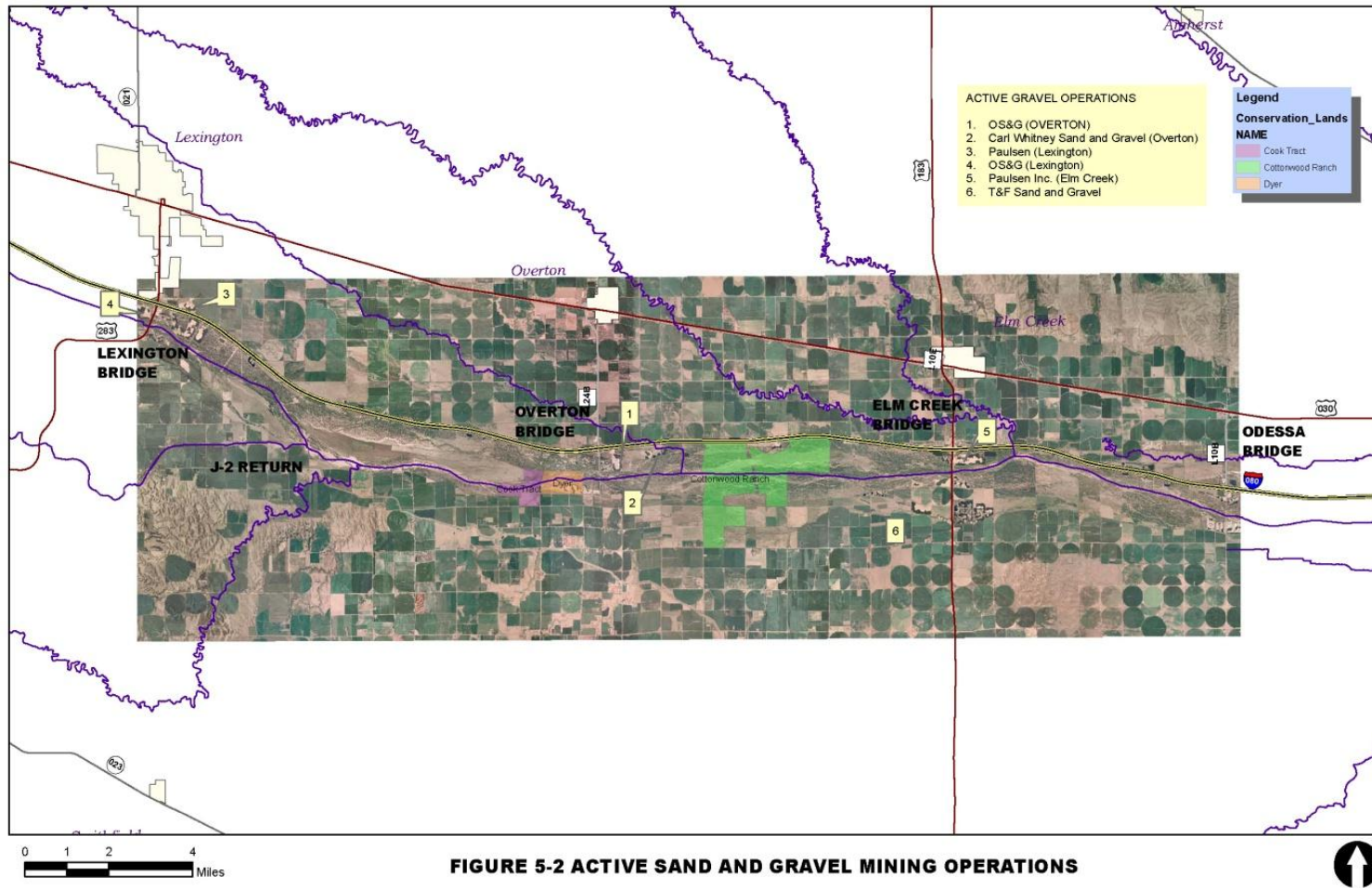
- 10 • Cook Tract
- 11 • Dyer Property
- 12 • OS&G (Overton Interchange)
- 13 • Carl Whitney Sand and Gravel (Overton Interchange)



1

2

**Figure 5-1 Conservation Properties in the Affected Reach**



1

2

Figure 5-2 Active Sand and Gravel Mining Operations



1 **6. IDENTIFICATION AND INITIAL SCREENING OF SEDIMENT SOURCES**

2 This section identifies potential sediment source locations for implementation of the Project. Sites  
 3 identified include areas owned or leased by the Program or its collaborators as well as private land in the  
 4 vicinity of the Project reach. Sites that were not deemed feasible were not carried forward for further  
 5 analysis.

6 Other considerations for the site evaluations included the ability to provide source material and the  
 7 physical space requirements to provide access, staging, and stockpiling activities.

8 **6.1 Conservation Sites**

9 An initial screening of conservation properties in the Project reach (Figure 5-1) was conducted to  
 10 eliminate properties that would not be feasible in achieving the Project goal. The following initial  
 11 screening criteria were used to eliminate unsuitable properties:

- 12 • Lack of viable source material
- 13 • Significant disruption of the owner’s current use of the site
- 14 • Physical constraints, such as size or configuration

15 Table 6-1 summarizes the conservation properties in the vicinity of the Project reach, the results of the  
 16 initial screening, and the primary reason(s) that locations were retained for further evaluation as sediment  
 17 sources or eliminated from further consideration.

18 **Table 6-1 Conservation Properties Screened for Sediment Source Locations**

Owner	Retained?		Primary Reason(s) Retained or Eliminated
	Yes	No	
<b>PRRIP</b>			
Cook Tract	X		Suitable source of augmentation material
Dyer Property	X		Suitable source of augmentation material
Elm Creek/Morse/ Johnson/Robinson		X	Location at the extreme downstream end of the Project reach and existing and planned habitat projects make it less feasible due to potential disturbance of created and maintained habitat; more suitable locations closer to the augmentation delivery sites would create less disturbance to habitat projects
Bartels		X	Disruption of current use
<b>NPPD</b>			
Lexington Sandpit		X	Limited source opportunity; closer sources available
Lexington Island		X	Limited source opportunity; closer sources available; disruption of existing use
Cottonwood Ranch		X	Location at the extreme downstream end of the Project reach and existing and planned habitat projects make it less feasible due to potential disturbance of created and maintained habitat; more suitable locations closer to the augmentation delivery sites would create less disturbance to habitat projects.
Kearney Canal diversion structure		X	Source area under private lease; disruption of current use
Johnson Sandpit		X	Limited source opportunity; closer sources available

Owner	Retained?		Primary Reason(s) Retained or Eliminated
	Yes	No	
<b>CNPPID</b>			
J-2 Return		X	No viable source; site too small
Jeffery Island and Adjacent River		X	Disruption to island and river; minimal ability to process material; limited long-term potential
Reregulating Reservoir Project		X	Project is only in feasibility stage; volume of excess material would not sustain long-term source
<b>NGPC</b>			
Dogwood WMA		X	Disruption of current use
Blue Hole WMA		X	Disruption of current use
Sandy Channel SRA		X	Disruption of current use
Blue Hole East WMA		X	Disruption of current use
<b>PRWCT</b>			
Johns Tract		X	Disruption of current use
Sullwold		X	Disruption of current use
<b>TNC</b>			
Andersen Tract		X	Disruption of current use

1  
2 Therefore, based on this initial screening, the following conservation properties were retained as potential  
3 sediment source locations:

- 4     • Cook Tract  
5     • Dyer Property

6 Currently, no other conservation properties are under consideration for inclusion in the Project. The  
7 Program continues to evaluate potential needs for additional conservation properties. If uses of existing  
8 properties change, or the Program acquires control of additional land, those properties may be evaluated  
9 for possible inclusion in future sediment augmentation projects.

### 10     **6.1.1 Cook Tract**

11 As part of the source material evaluation, two soil borings were collected on the south high bank of the  
12 Cook Tract (Section 5.1.1). Soil boring results (**Appendix C**) indicate that source material is available in  
13 the subsurface to a depth of approximately 36 feet below ground surface (Figure 6-1). Based on gradation  
14 analysis of the soil samples collected, approximately 51 percent of the material is below the 1 mm target  
15 size identified in the BOR model and modeling conducted for the Study (**Appendix B**). Based on the  
16 gradation, it is estimated that 2.5 to 3 million tons of augmentation material (assuming a material density  
17 of 1.4 tons per cubic yard) is available on this site within an approximately 107-acre area identified as a  
18 potential source area in the overbank<sup>2</sup>. Therefore, the overbank material appears to provide a suitable

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<sup>2</sup> To calculate the total amount of material available, it was estimated that the specific gravity of the augmentation material was 104 pounds per cubic foot (lb/cf). The value was not adjusted for moisture content; however, it is within the level of error for a feasibility study.

1 source of augmentation material if excavated or pumped from a sand mining operation. Figure 6-1 shows  
2 overbank source areas on the Cook Tract.

3 Potential source material is available from features within the high bank river channel on the property.  
4 Areas that would typically not be undated from most flows were examined as an additional, albeit likely  
5 limited, additional source of augmentation material. Evaluation of source material potential within the  
6 river channel was generally limited to material above elevations corresponding to river flows of 1,500 to  
7 2,000 cfs flows in the South Channel. These flows represent a practical maximum elevation for the  
8 introduction of sediment into the river and elevations that might serve a future habitat purpose. These  
9 elevations are approximately 2,314.5 feet at the west end and 2,311 feet at the east end of the Cook Tract.  
10 Figure 6-1 shows the approximate boundaries of the high banks and potential source material within the  
11 channel between the high banks. Based on evaluation of cross section and topographic data, it is  
12 estimated that there are 100,000 to 400,000 gross tons of material available for augmentation. The  
13 material in the river channel is expected to be similar to the material present in the overbank areas, as it is  
14 all depositional material. Based on the gradation evaluation of the overbank material, only about half of  
15 the material is of sufficient size to provide a transportable sediment source.

16 Experiments leveling higher macroforms at Cottonwood Ranch using dozers indicated that the  
17 effectiveness of mobilizing the sediment pushed into the channels from adjacent higher elevations was  
18 dependent on how the material was placed. Some methods were more effective than others. Because of  
19 Because of the limited volume of material within the channel and the observations from the experiments  
20 at Cottonwood Ranch, the higher macroforms within the channel were not further evaluated as a potential  
21 long-term source of augmentation material. If the higher macroforms were leveled in the future, there  
22 would likely be some short-term benefit, such as a potential reduction of the amount of augmentation  
23 material needed from other sources during those years when macroform leveling occurs.

24 However, the Cook Track was retained for consideration as a sediment source location for the overbank  
25 areas.

### 26 **6.1.2 Dyer Property**

27 As part of the sediment source evaluation, three soil borings were collected on the Dyer Property,  
28 (Section 5.1.2). Soil boring results (**Appendix C**) indicate that source material is available to a depth of  
29 approximately 30 feet below ground surface (Figure 6-2). Based on gradation analysis of the soil samples  
30 collected, approximately 56 percent of the material is below the 1 mm target size identified in the BOR  
31 model and modeling conducted for this Study (**Appendix B**). It is estimated that 1.5 to 2 million tons  
32 (assuming a material density of 1.4 tons per cubic yard) of augmentation material is available on this site  
33 within an approximately 55-acre area identified as a potential source area<sup>3</sup>. Therefore, the overbank  
34 material appears to provide a suitable source of augmentation material if excavated or pumped from a  
35 sand mining operation. Figure 6-2 shows overbank source areas on the Dyer Property.

36 The Dyer Property is more heavily vegetated outside the central portion of the property where the active  
37 channel flows. Similar to the Cook property, the higher elevation areas offer a potential limited surface  
38 source of augmentation material. As discussed with the Cook Tract, source material is generally limited  
39 to elevations above those that would correspond to desired elevations for potential future habitat projects.  
40 Those elevations range from approximately 2,309 ft on the west end of the property to 2,305 ft on the east  
41 end of the property. The volume of source material available within the channel on the Dyer Property is  
42 estimated to be similar or less than that available on the Cook Track. Figure 6-2 shows the boundaries  
43 (high banks) of potential surface source material within the channel on the Dyer Property. Similar to the

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<sup>3</sup> To calculate the total amount of material available, it was estimated that the specific gravity of the augmentation material was 104 lb/cf. The value was not adjusted for moisture content; however, it is within the level of error for a feasibility study.

1 Cook Tract, the higher macroforms within the channel on the Dyer Property were not further evaluated as  
2 a potential long-term source of augmentation material.

3 The Dyer Property was retained for consideration as a sediment source location for the overbank  
4 materials.

## 5 **6.2 Existing Commercial Sand and Gravel Mining Operations**

6 Existing commercial sand and gravel mining operations were considered for sediment sources for the  
7 Project. Figure 5-2 shows the location of the active sand and gravel mining operations in the vicinity of  
8 the Project reach, which are clustered near the I-80 interchanges at Lexington, Overton, and Elm Creek  
9 due to the ease of transportation access. All of these operations, listed below, are pit dredge operations:

- 10 • Lexington Interchange – Paulsen, Inc.
- 11 • Lexington Interchange – OS&G
- 12 • Overton Interchange – OS&G
- 13 • Overton Interchange – Carl Whitney Sand and Gravel
- 14 • Elm Creek Interchange – Paulsen, Inc.
- 15 • Elm Creek Interchange – T&F Sand and Gravel

16 Because the Program does not control the private sand and gravel operations, the logistics of their  
17 involvement is more complicated. Any of the sand and gravel operations would likely be able to provide  
18 sediment source material; however, the material would likely need to be purchased. Hauling costs would  
19 also need to be factored into the costs, with the potential for price variability from one producer to the  
20 next. Since there are six active sand pit operations in the vicinity of the Project, additional sources on  
21 private properties were not considered.

22 Samples were collected from the sand piles at the six active sand and gravel mining operations listed  
23 above and submitted to a laboratory for gradation analyses. Results indicate that, on average, the material  
24 appeared to be consistent with the gradations recommended by the BOR (that is,  $D_{50} < 1$  mm) to make it a  
25 suitable sediment source with minimal, if any, further processing. However, as discussed below in  
26 Section 9, the gradation of the augmented material may need to be somewhat coarser than that  
27 recommended by the BOR. Results from the sediment-transport model indicate that, if the augmented  
28 material is obtained from the sand and gravel mining operations and is not processed, a significant  
29 amount of the augmented material would be entrained and flushed through the Project reach, thereby  
30 providing minimal benefits to the sediment deficit. As such, it may be necessary to increase the volume  
31 of augmented material if this material were used without any processing. There were slight variations  
32 between the different operations, likely due to differing products being produced at the time the sand piles  
33 were created. This is expected because the sand piles are byproducts of the primary products (e.g.,  
34 concrete gravel, road gravel, armor coat) with varying gradations.

35 The sampling results are summarized in Table 6-2. The table shows the estimate of the percentage of  
36 available material from the sand pile samples collected at the various operations. Note that the BOR  
37 modeling in support of the FEIS indicated that the sediment deficiency was mostly in the size range less  
38 than 1 mm in diameter.

1

**Table 6-2 Sand and Gravel Operations – Material Samples**

Location	Operation	> 1 mm (%)	<1 mm (%)	< 1 mm and > 0.25 mm (%)	<0.25 mm (%)
Lexington	Paulsen, Inc.	20	80	66	14
Lexington	OS&G	14	86	71	25
Overton	OS&G	18	82	66	16
Overton	Carl Whitney Sand and Gravel	16	84	69	15
Elm Creek	Paulsen, Inc.	23	77	63	14
Elm Creek	T&F Sand and Gravel	19	81	65	16
<b>Average</b>	<b>Average of all six operations</b>	<b>18</b>	<b>82</b>	<b>67</b>	<b>17</b>

2 *Note: Refer to Appendix C for detailed gradation information.*

3

4 The sediment-transport model was used to further evaluate the sediment deficit in the Cottonwood Ranch  
5 reach. Results indicate that the sediment deficit is mostly in the medium to coarse sand fraction (~60  
6 percent 0.25 mm – 1 mm), while 20 percent is smaller than medium sand (<0.25 mm) and 20 percent falls  
7 into the VCS to gravel (>1 mm) range. Based on these refined percentages, there appears to be a  
8 deficiency in material in the sand piles in the VCS gravel fraction greater than 1 mm in size as well as the  
9 0.25 mm and smaller fraction.

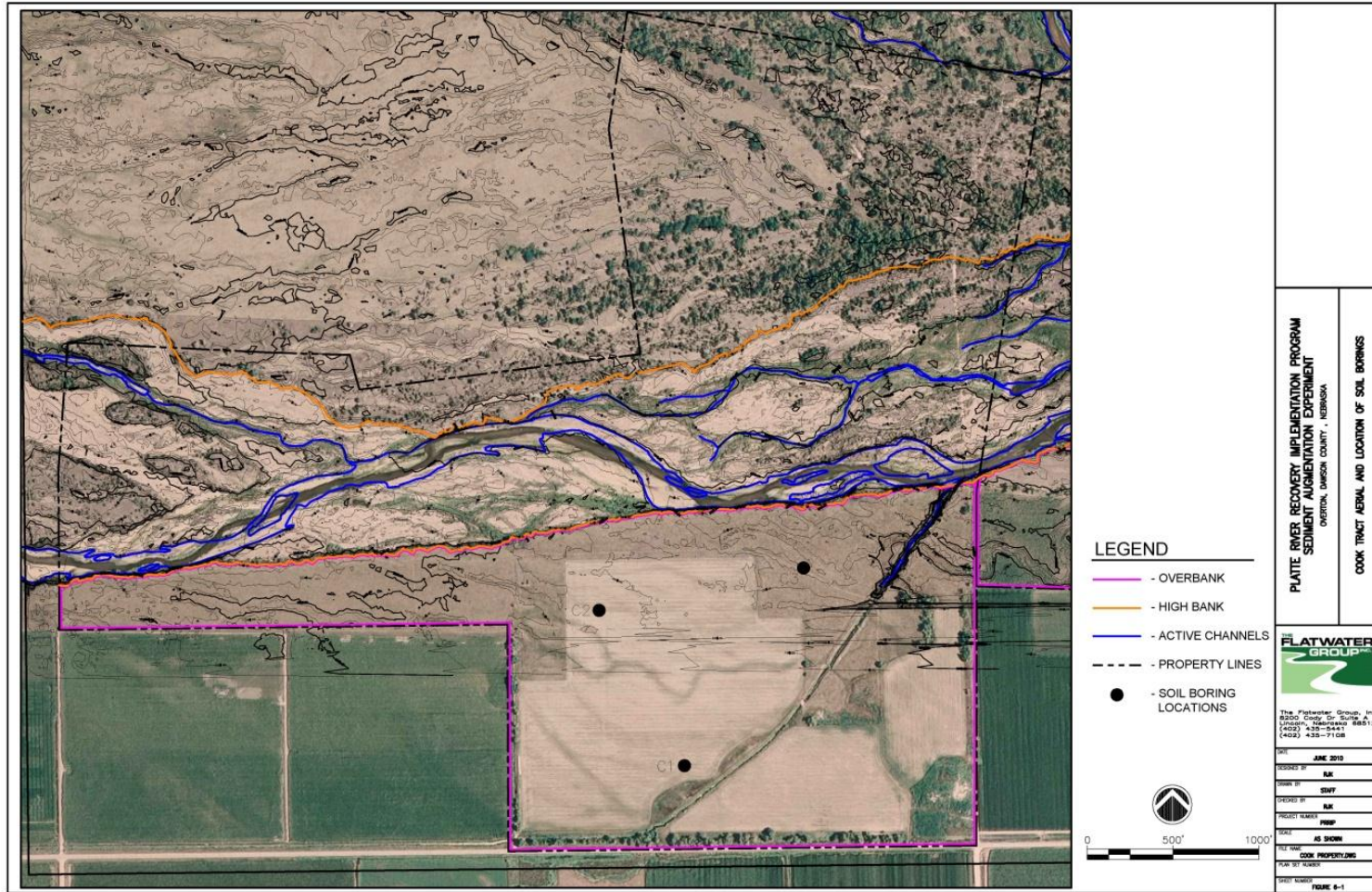
10 A large fraction of the fine sand material produced at the local sand pits and available in the stock piles at  
11 these operations is less than the 1 mm size identified in the FEIS. Compared to the model results, on  
12 average, the fraction of material at the sand pits is slightly lacking in sizes greater than 1 mm (18 percent  
13 as opposed to 20 percent) and less than 0.25 mm (17 percent as opposed to 20 percent). The lack of the  
14 coarser fraction appears to be more influential as modeling indicates a good portion of the sand material  
15 from the pits tends to flush through the system requiring additional material added to the stream to  
16 achieve balance. This is described further in the modeling results section. The Paulsen pits at Lexington  
17 and Elm Creek and the T&F pit at Elm Creek have the highest percentage of material greater than 1 mm.  
18 If coarser material is necessary to meet the Project goal, processing of this material would be required.

19 The existing sand and gravel operations are retained for further evaluation.

### 20 **6.3 Summary of Viable Sediment Sources**

21 The following sites were retained for further evaluation as sediment sources:

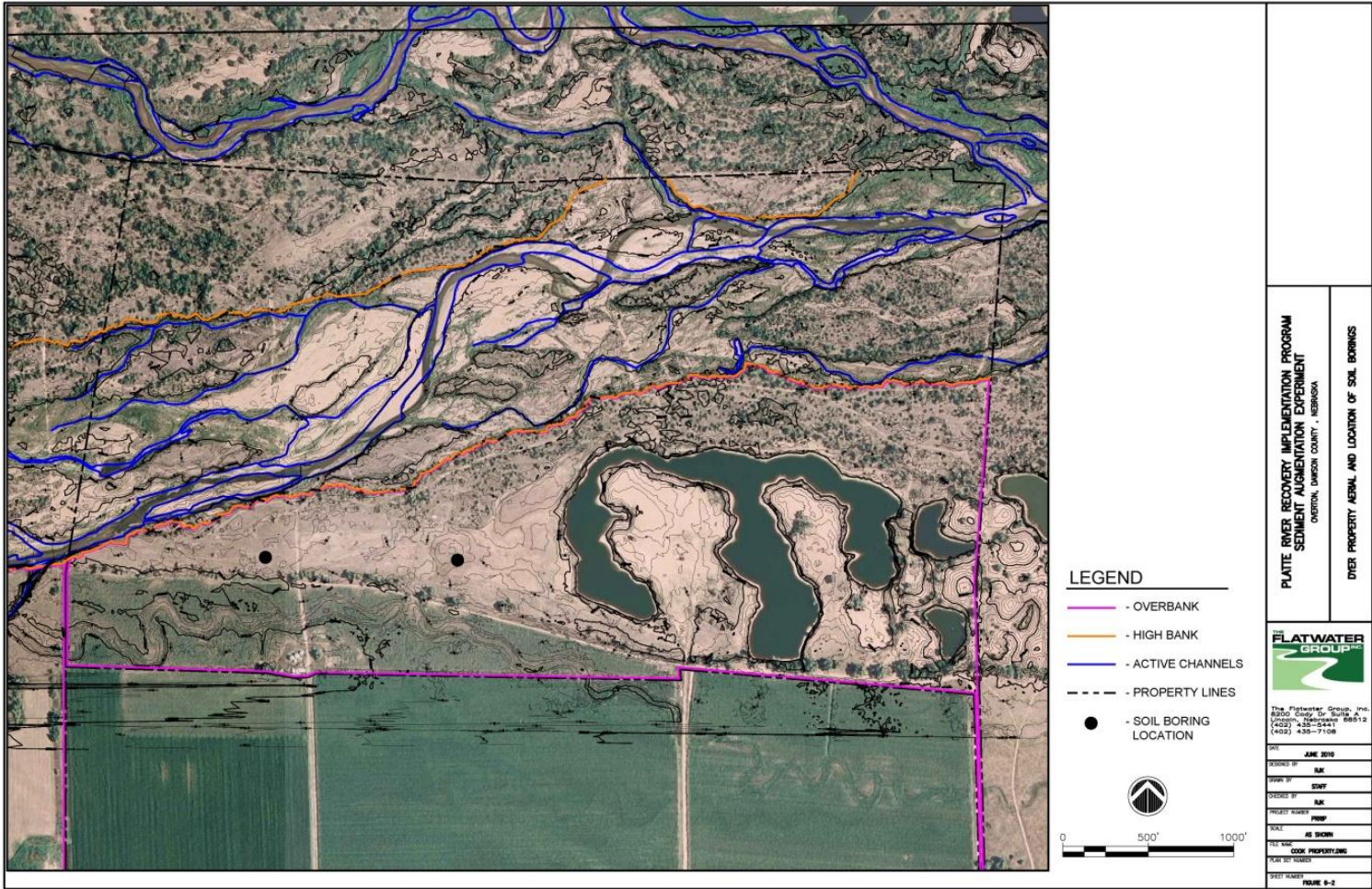
- 22 • Cook Tract
- 23 • Dyer Property
- 24 • Existing sand and gravel operations at Lexington, Overton, and Elm Creek interchanges



1

2

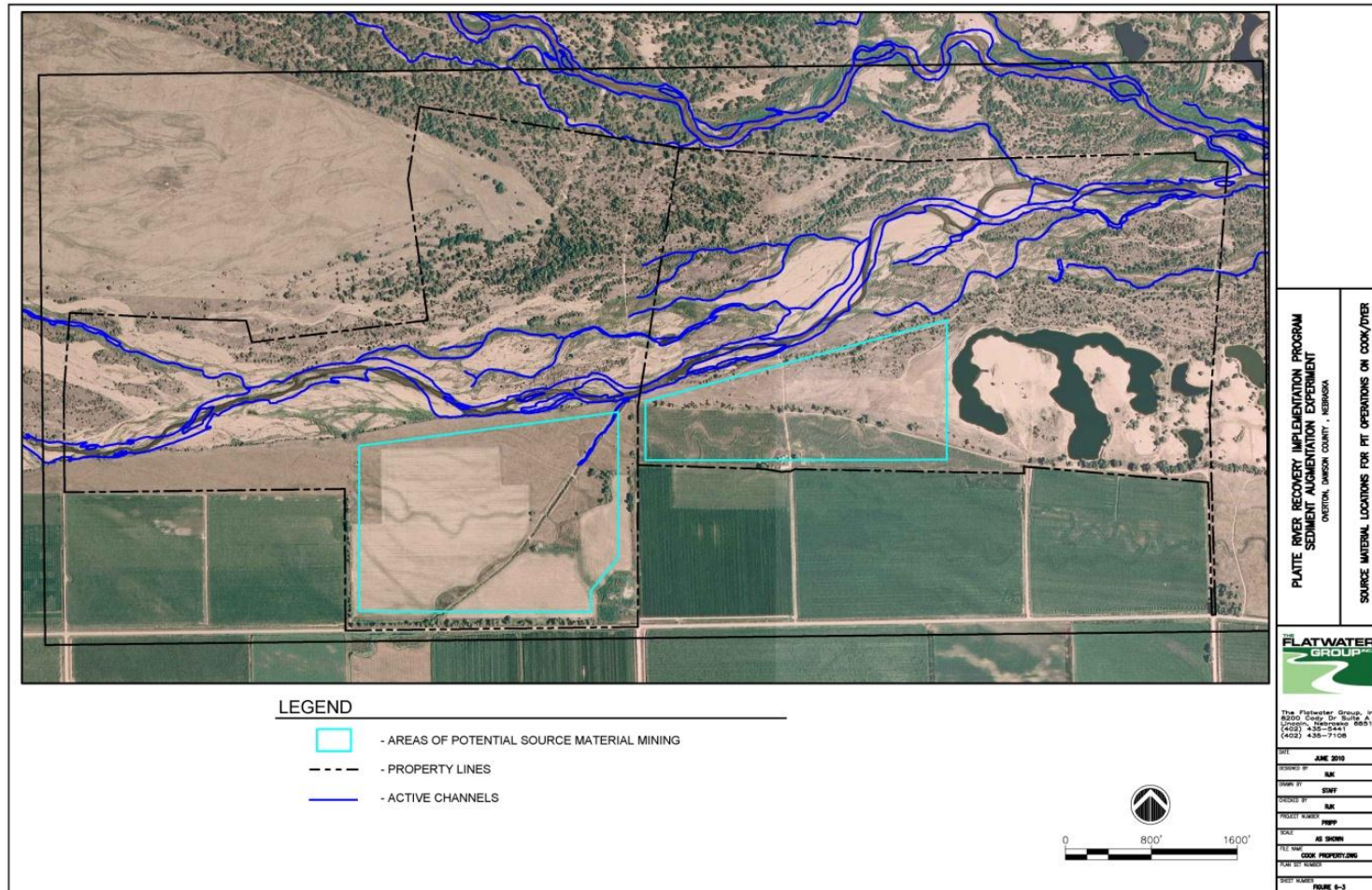
Figure 6-1 Cook Tract and Location of Soil Borings



1

2

Figure 6-2 Dyer Property and Location of Soil Borings



1

2

**Figure 6-3 Source Material Locations for Pit Operations on Cook/Dyer**



1 **7. IDENTIFICATION AND INITIAL SCREENING OF TECHNOLOGIES**

2 This section identifies various sediment production technologies, as well as methods of delivering  
 3 sediment to the river, that were considered for the development of alternatives. These technologies are  
 4 the most feasible and likely to be used during implementation of the Project. The Project is results based  
 5 (i.e., sediment balance at the upstream end of Cottonwood Ranch) and, ultimately, there will be numerous  
 6 means and methods of achieving those results within the parameters of the final design. The actual  
 7 technologies used to implement the design will partly depend on how the Project is implemented  
 8 (e.g., competitive bidding, sole source), the entity selected to implement the Project, and how specific the  
 9 methods of implementation are dictated by the Program. An initial screening of the available  
 10 technologies was conducted so that only the technologies that are most likely to be used were considered  
 11 in the cost evaluation.

12 **7.1 Sediment Production Technologies**

13 The initial screening of sediment production technologies eliminated technologies that would not be  
 14 feasible in achieving the Project goal. The following initial screening criteria were used to eliminate  
 15 unsuitable technologies:

- 16 • Limited ability to screen out unsuitable material
- 17 • Not viable long-term
- 18 • Contributor to future sediment deficits
- 19 • Limited amount of sediment available
- 20 • Not cost-effective
- 21 • Ineffective due to shallow groundwater

22 Table 7-1 summarizes the sediment production technologies evaluated, the results of the initial screening,  
 23 and the primary reason(s) that technologies were retained for further evaluation as sediment production  
 24 technologies or eliminated from further consideration.

25 **Table 7-1 Sediment Production Technologies**

Sediment Production Technologies	Retained?		Primary Reason(s) Retained or Eliminated
	Yes	No	
Portable River Dredges		X	Limited ability to screen out material that is not optimal; not a viable long-term solution; possible contributor to future sediment deficits; limited amounts of sediment available; other technologies are more cost effective
On-site Pit Dredges	X		Common technology to mine material; efficient and economical; ability to process material at production site
Excavators (hoes, shovels, clam shells, etc.)		X	Due to shallow groundwater, other technologies are more effective
Dozers and Loaders	X		Cost effective for shallow excavations
Off-site Sources	X		Numerous commercial sand and gravel mining operations in vicinity of Project reach

26

1 Therefore, based on this initial screening, the following technologies for sediment production were  
2 retained:

- 3 • On-site pit dredges
- 4 • Dozers and loaders
- 5 • Off-site sources

### 6 **7.1.1 On-site Pit Dredges**

7 Off-river pit dredges are the most common method of mining aggregate in the Platte Valley (Figure 7-1).  
8 Shallow groundwater and an abundance of material make pit dredges an efficient and economical  
9 technology to produce augmentation material. The ability to process material using screens at the  
10 production site makes this technology beneficial in producing optimal sized material. The dredged  
11 material can be processed to obtain the optimal gradation, identified in the modeling efforts, needed to  
12 achieve sediment balance in the reach. There is sufficient space on Program-controlled property to  
13 establish a new pit dredging operation, if desirable.

14 Two of the active dredging operations are located directly adjacent to the river and are upstream of  
15 Cottonwood Ranch. These operators have the ability to discharge directly into the river with minimal  
16 adjustment to their operations. Direct discharge to the river from a pit dredging operation would only be  
17 possible if the gradation of the material discharged fits within the parameters identified during sediment-  
18 transport modeling and if permit requirements can be met.

19 Pit dredging operations result in permanent land disturbance. One or more lakes remain on the property  
20 after production ceases. There is also a significant amount of the larger material that would not be used  
21 and would need to be stockpiled or removed from the site. These larger fractions may have a beneficial  
22 market value, although there are six current private production sites in the immediate vicinity. If pit  
23 dredging operations are implemented on Program properties, these would be considerations in  
24 determining the final habitat development of the properties.

25 Therefore, on-site pit dredges were retained as a potential sediment production technology.

### 26 **7.1.2 Dozers and Loaders**

27 Dozers and loaders are effective at moving material on or near the surface for short distances. Dozers  
28 could be used to mine material from sandbars within the river and from adjacent overbank areas. Dozers  
29 are retained for inclusion as a sediment production technology for source areas within the river (e.g.,  
30 existing sandbars) and directly adjacent to the river. While not specifically for sediment augmentation,  
31 similar processes have been used to move material into the river for habitat creation at Cottonwood  
32 Ranch. Therefore, dozers and loaders were retained as a potential sediment production technology.

### 33 **7.1.3 Off-site Source**

34 There are numerous privately owned sand and gravel mining operations in the vicinity (within 10 miles)  
35 of the Project reach that utilize pit dredges for sediment production (discussed in Section 7.1.1). These  
36 sand and gravel mining operations are equally distributed at the upstream, middle, and downstream end of  
37 the Project reach and are described in Section 5.3. Hauling augmentation material from these operations  
38 to the delivery site or sites is a viable option and is retained for consideration in the development of  
39 alternatives.

40 Therefore, off-site sources were retained as a potential sediment production technology.

1 **7.2 Sediment Delivery Technologies**

2 An initial screening of sediment delivery technologies was conducted to eliminate technologies that  
 3 would not be feasible in achieving the Project goal. The following initial screening criteria were used to  
 4 eliminate unsuitable technologies:

- 5 • Limited effectiveness
- 6 • Higher mobilization costs
- 7 • Not viable long term
- 8 • Contributor to future sediment deficits
- 9 • Limited amount of sediment available
- 10 • Not cost-effective
- 11 • Ineffective due to shallow groundwater

12 Table 7-2 summarizes the sediment delivery technologies evaluated, the results of the initial screening,  
 13 and the primary reason(s) that technologies were retained for further evaluation as sediment delivery  
 14 technologies or eliminated from further consideration.

15 **Table 7-2 Sediment Delivery Technologies**

Sediment Delivery Technologies	Retained?		Primary Reason(s) Retained or Eliminated
	Yes	No	
Dozers and Loaders	X		Traditional method; effective at moving material; cost-effective
Portable Conveyor Systems	X		Common technology
Fixed Conveyor Systems		X	Less available; higher mobilization costs; because of the changing nature of the river channel and the potential for flooding, fixed conveyor systems are not feasible for extending the reach into the river bed
Clamshell or Backhoe		X	Limited effectiveness due to limited reach and lower mobility
Sand Pump/Slurry Pipeline	X		Minimal construction footprint; effective at placing material in river
Portable River Dredges		X	Limited effectiveness; possible contributor to future sediment deficits; other technologies are more cost effective
Pit Dredging Operations Adjacent to River	X		Ability to discharge directly into river

16  
 17 Therefore, based on this initial screening, the following technologies for sediment delivery were retained  
 18 for consideration in the development of alternatives:

- 19 • Dozers and loaders
- 20 • Conveyor systems
- 21 • Sand pump/slurry pipeline
- 22 • Pit dredging operations

1           **7.2.1 Dozers and Loaders**

2 Dozers and loaders are the traditional method of placing and shaping sand and gravel in rivers. Direct  
 3 access to the river is required for their use. They are effective at moving material on or near the surface.  
 4 Dozers are effective at delivering material to the river at locations where direct access to the river is  
 5 available and the material is available locally (e.g., sand bars) or where material can be delivered  
 6 relatively close (within 500 to 600 feet) to its final disposition. Dozers can traverse rugged and wet  
 7 terrain.

8 Dozers would be used to push the material to the desired locations in the channel from stockpiles along  
 9 the south bank. Access points to the river will need to be constructed to allow dozer access from the high  
 10 bank down into the river channel. The easiest locations for placement of the material are those areas  
 11 where the active channel is closer to the south high bank of the river where stockpiles will be located.  
 12 This will minimize push distance and placement time and therefore minimize cost.

13 Dozers can be used to place material in numerous configurations, depending on the terrain and needs of a  
 14 project. Configurations evaluated for this Project include those listed in Table 7-3, which were evaluated  
 15 using the hydraulic and sediment-transport models (see **Appendix B**):

16           **Table 7-3 Dozer Placement Techniques and Results of Modeling**

<b>Dozer Placement Technique</b>	<b>Results of Modeling</b>
Placement of material in windrows along the bank toes	Some scouring of the pile toes would likely result in the sloughing of a relatively limited amount of material into the active channel that would be available for transport, but most of the material in the windrows would remain in-place, with relatively little effect on downstream deficits.
Placement of material in windrows located to increase inundation	The reduced shear stress caused by the windrow configuration would probably not be sufficient to entrain and transport the augmented material.
Placement of material in one concentrated (short-length) sediment plug in overall channel	A relatively large percentage of the augmented material is eroded from the plug; however, a significant portion of this material is deposited upstream from the confluence with the North Channel due to backwater conditions in the area, especially at high flows.
Placement of material in a distributed (long-length) sediment plug in low flow channel	Most of the material that is eroded from the plug is transported through the reach downstream from the plug and delivered to the Overton Bridge; however, during a wet year, a significant portion of the material that is eroded from the sediment plug is deposited in the reach upstream from the confluence.

17  
 18 Therefore, for the purposes of further evaluation of alternatives, placement of material in a distributed  
 19 (long-length) sediment plug located in the low flow channel bed is retained as a delivery option for  
 20 consideration in the development of alternatives. Ultimately, there will be numerous means and methods  
 21 of achieving the desired results within the parameters of the final design. The actual technologies used to  
 22 implement the design will partly depend on how the Project is implemented (e.g., competitive bidding,  
 23 sole source), the entity selected to implement the Project, and how specific the methods of  
 24 implementation are dictated by the Program. These uncertainties are further discussed in Section 13.

## 7.2.2 Conveyor Systems

Conveyor systems are a common technology for moving and stockpiling large volumes of material. There are a variety of conveyor systems available, from fixed to portable to truck or crane mounted.

Access to the high bank at most augmentation locations is relatively easy, making the use of portable-type conveyors, such as traditional belt-type conveyors and truck-mounted conveyors, feasible for the Project (Figures 7-2 and 7-3). The specific type used would mostly depend on availability. Portable conveyor systems can be designed and constructed to virtually any length; however, the practical distance that material can be delivered from the end run is 200 feet or less. If material is required beyond the reach of the conveyor system, a secondary technology, such as a dozer, would be required to place material at the desired location. Conveyors would likely be used to augment other delivery options and could be used for stockpile management, truck loading, or material processing.

Therefore, for the purposes of further evaluation of alternatives, the use of conveyor systems as a stand-alone delivery technology is eliminated for consideration in the development of alternatives. This option may, however, be feasible when combined with dozers to assist in placement of the material into the river channel from the high bank. Benefits may be realized by getting the material down to the bed of the river more efficiently and reducing dozer travel time and distance.

## 7.2.3 Sand Pump/Slurry Pipeline

Sand pumps/slurry pipelines (Figures 7-4 and 7-5), hereafter referred to as sand pumps, are practical where there is a good water source. Water from the river is fed through a pump or pumps and combined with augmentation material (sand) fed through a hopper. The hopper can be fitted with a grizzly (screens) and vibrating plate to process the material as necessary and keep out large material that may clog pipelines. The combined sand/water combination is then pumped through a slurry pipeline back into the river at the ultimate point of placement. The length of the discharge pipeline can be easily changed to allow for augmentation at multiple locations. The material delivery rate can also be easily adjusted and timed as necessary to provide a sufficient volume of augmentation material while minimizing aggradation of material at the point of discharge.

The use of sand pumps to deliver sediment would allow sediment to be introduced in slurry form at point locations with minimal disturbance from equipment in the channel. Discharge locations can be adjusted with modifications to the distribution pipeline. The pumping systems are relatively portable and can be moved to various locations if needed.

In order to deliver the required volume of sediment identified in the model in a sufficient timeframe to optimize sediment delivery with the timing of flows in the South Channel, a minimum of two augmentation locations were evaluated. Modeling results indicate that using two or more locations would also allow a greater distribution of material and minimize the potential for negative localized impacts on the flow regime.

Sand pump delivery sites could be set up in any number of locations where there is access to the river. For evaluation purposes, several specific sand pump augmentation sites were identified at various locations within the Project reach, as described below. These locations represent a sound evaluation of the effectiveness for sand pumping and the model results can be reasonably extrapolated to other locations.

- Sand Pump Site 1 (Figure 7-6) – Sand Pump Site 1 is on the west end of the Cook Tract. This location is the farthest upstream and would maximize channel length on Program property downstream of the augmentation site.
- Sand Pump Site 2 (Figure 7-6) – Sand Pump Site 2 is on the west end of the Dyer Property. This location is easily accessible and provides more than 4,000 feet of stream length on Program property downstream of the augmentation site.

- 1 • Sand Pump Site 3 (Figure 7-7) – Sand Pump Site 3 is on the east end of the Dyer Property in the  
2 vicinity of the existing sandpits.
- 3 • Sand Pump Site 4 (Figure 7-8) – Sand Pump Site 4 is downstream of the confluence of the North  
4 and South channels on private property at OS&G. For costing and evaluation purposes, OS&G  
5 was used as the potential private location. Carl Whitney Sand and Gravel is located  
6 approximately 0.5 mile east of OS&G and could also be used as an augmentation location. The  
7 cost and evaluation would not differ significantly between either location. In order to use any  
8 private property, agreements will need to be negotiated with the private operations.
- 9 • Sand Pump Site 5– Sand Pump Site 5 is a non-specific location in close proximity to the active  
10 dredging operation. This site can be moved as the operation moves to maintain short haul  
11 distances.

12 Therefore, for the purposes of further evaluation of alternatives, sand pumps are retained as a delivery  
13 option for consideration in the development of alternatives.

#### 14 **7.2.4 Pit Dredging Operations Adjacent to River**

15 Pit dredging operations directly adjacent to the river have the ability to discharge material directly into the  
16 river (Figure 7-9). Two of the active dredging operations are located directly adjacent to the river and are  
17 upstream of Cottonwood Ranch. These operations have the ability to discharge sediment to the river with  
18 minimal adjustment to their operations. A new pit dredge operation on Program-controlled property  
19 directly adjacent to the river would also have the ability to discharge sediment directly to the river. A  
20 permanent sand pit or pits would be created as a result of this operation. These sand pits could have a  
21 future habitat benefit.

22 Direct discharge to the river from a pit dredging operation would be viable only if the proper gradation  
23 and volume of the material discharged fits within the parameters identified during sediment-transport  
24 modeling or parameters identified by the Program. Larger material could build up in the channel rather  
25 quickly if not screened out prior to discharge. Any material screened out would need to be removed from  
26 the site, stockpiled, or used in other habitat development projects. The material could also be replaced in  
27 the pit upon completion of the Project. There also may be issues with permitting a direct discharge  
28 operation.

29 For evaluation purposes, two pit dredging operation locations were selected, as described below. These  
30 locations represent a sound evaluation of the effectiveness of dredging and the model results can be  
31 reasonably extrapolated to other locations

- 32 • Dyer Property, just west of the existing abandoned sandpits – Approximately 4 to 5 acres of land  
33 would need to be made available on the Dyer Property at the initial startup to establish the  
34 operation. In addition, 3 to 4 acres of land would be required yearly to provide 150,000 tons of  
35 source material on the Dyer Property.
- 36 • Cook Tract – Approximately 4 to 5 acres per year would be required as materials are removed  
37 and the operation is expanded.

38 For evaluation purposes, it is assumed that the initial sandpit operation would be established on the Dyer  
39 Property just west of the existing sandpits. The sand pit option is discussed in Section 10, Compilation of  
40 Alternatives. The actual layout would partly depend on the contractor's preference.

41 Because the source material is being generated on Program property and material would not have to be  
42 purchased from outside sources, augmentation of material produced on Program property is considered  
43 only for delivery locations on Program properties (Cook/Dyer). The incentive for a private sand and  
44 gravel operation to allow augmentation locations on their property without having the opportunity to

- 1 provide the material is low. Also, there would be additional hauling costs to produce the material on
- 2 Program property and haul it off site to another location.
- 3 There are two existing operations directly adjacent to the river and the potential to establish a new pit
- 4 dredge operation on Program property; therefore, this technology was retained for consideration in the
- 5 development of alternatives.



1  
2

**Figure 7-1 Pit Dredge**



3  
4  
5

StraightLine of Sandborn, Conveyors and Aggregate Equipment, 12226 Knox Avenue, Sandborn, MN 56083

**Figure 7-2 Belt-type Conveyor**





1

2

**Figure 7-3 Truck-mounted Conveyor**



3

4

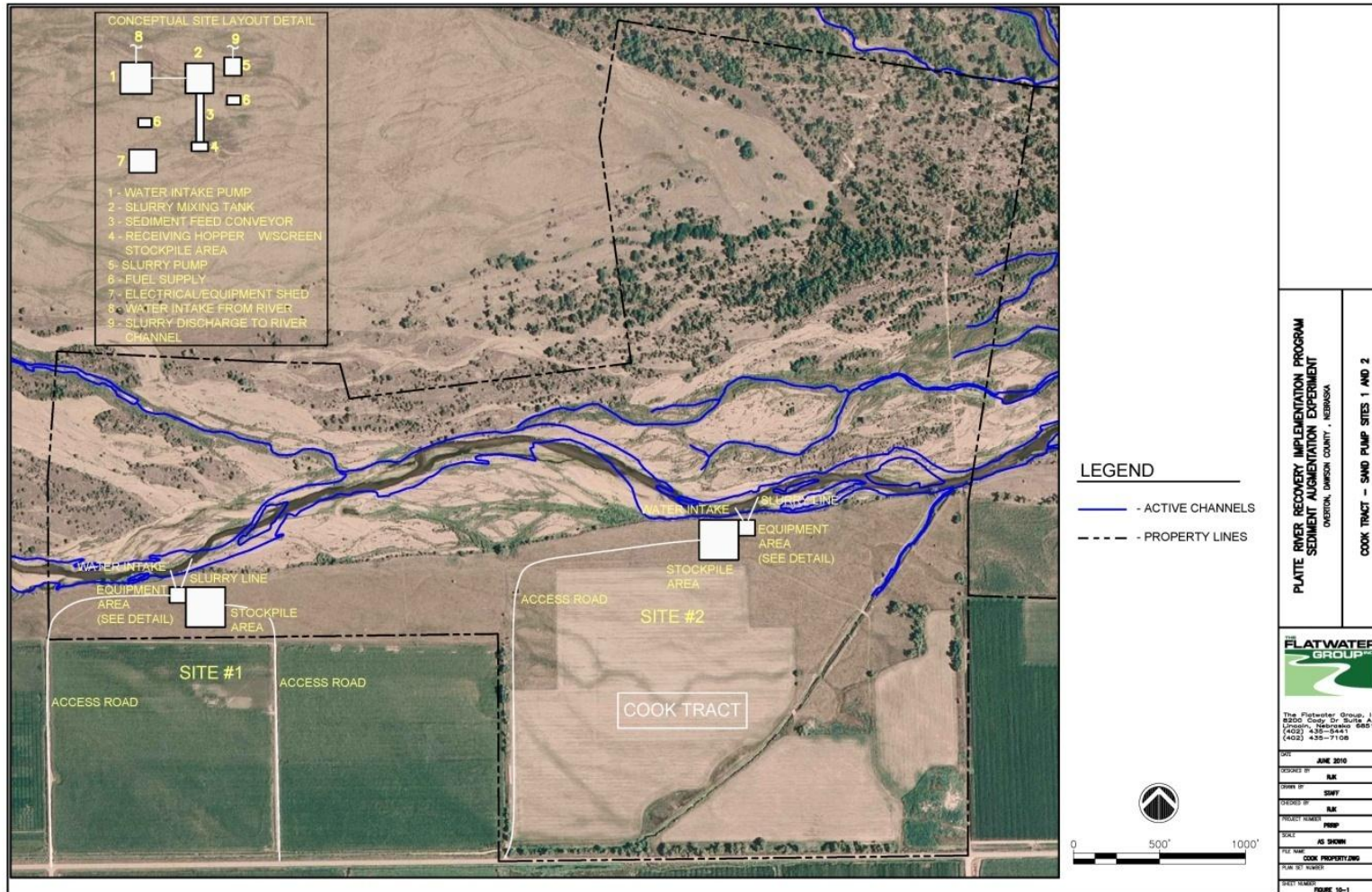
**Figure 7-4 Sand Pipeline/Sand Pump**



1

2

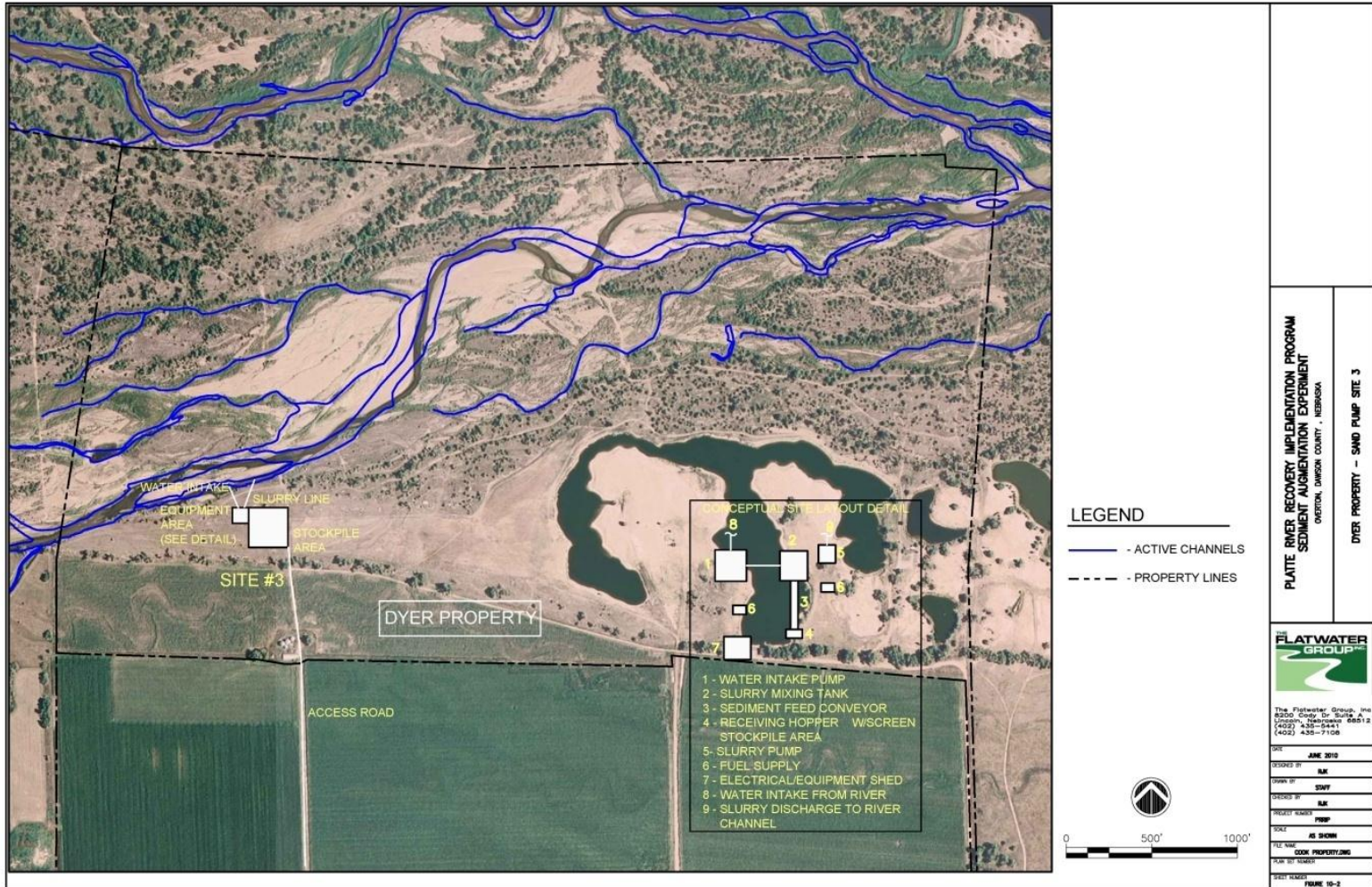
**Figure 7-5 Slurry Pipeline Delivering Sand**



1

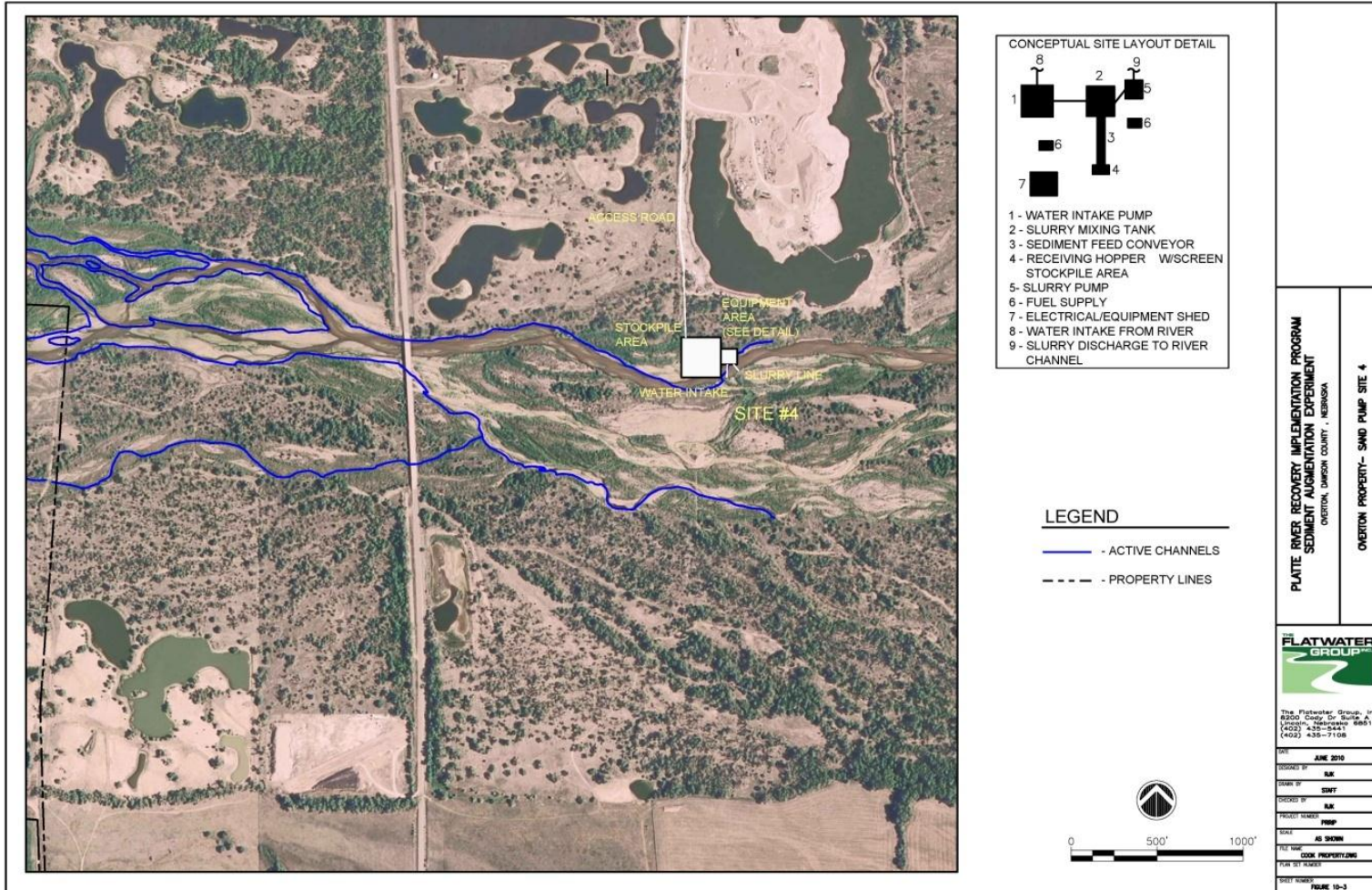
2

Figure 7-6 Cook Tract – Sand Pump Sites 1 and 2



1  
2

Figure 7-7 Dyer Property – Sand Pump Site 3



1

2

Figure 7-8 OS&G – Sand Pump Site 4



1  
2  
3

**Figure 7-9 Discharging Sediment Directly to River**

1 **8. IDENTIFICATION AND INITIAL SCREENING OF DELIVERY TIMING**

2 This section identifies various delivery timing dates that were considered for the development of  
3 alternatives. These dates are the most feasible and likely to be used during implementation of the Project.  
4 The actual delivery timeframes used to implement the design will partly depend on how the Project is  
5 implemented (e.g., competitive bidding, sole source); the entity selected to implement the Project; and  
6 how specific the methods of implementation are dictated by the Program. An initial screening was  
7 conducted using the delivery timeframes likely to be used for augmentation activities.

8 To evaluate delivery timing, the calibrated sediment-transport model was used, with sand pumps as the  
9 delivery technology implemented. Assumptions used for model development include the following:

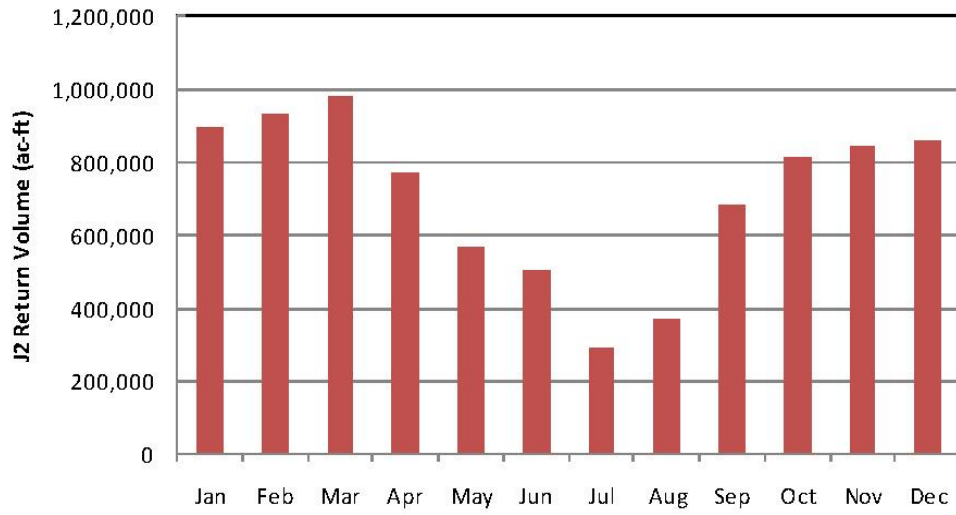
- 10 • 500 gallon per minute (gpm) pumps
- 11 • 25 percent solids
- 12 • Pumping completed 5 days/week

13 To augment 150,000 t/y using these parameters, two pumps would be required for about three months; or  
14 three pumps would be required for two months. Preliminary estimates indicate similar durations would  
15 be required for placement of the augmented material if dozers were used as the delivery technology.

16 In the South Channel, flows from the J-2 Return tend to be relatively low during the first month of the  
17 pumping in August, increasing to relatively high flows during the last month of pumping in October  
18 (Figure 8-1). River flows at the Overton gage are also relatively low during August and increase to  
19 moderate levels in October (Figure 8-2). To evaluate the effects of the hydrologic conditions during and  
20 after the augmentation period, the sediment load series used to represent the pumping operations was  
21 adjusted to start on:

- 22 • February 15
- 23 • August 1
- 24 • September 1

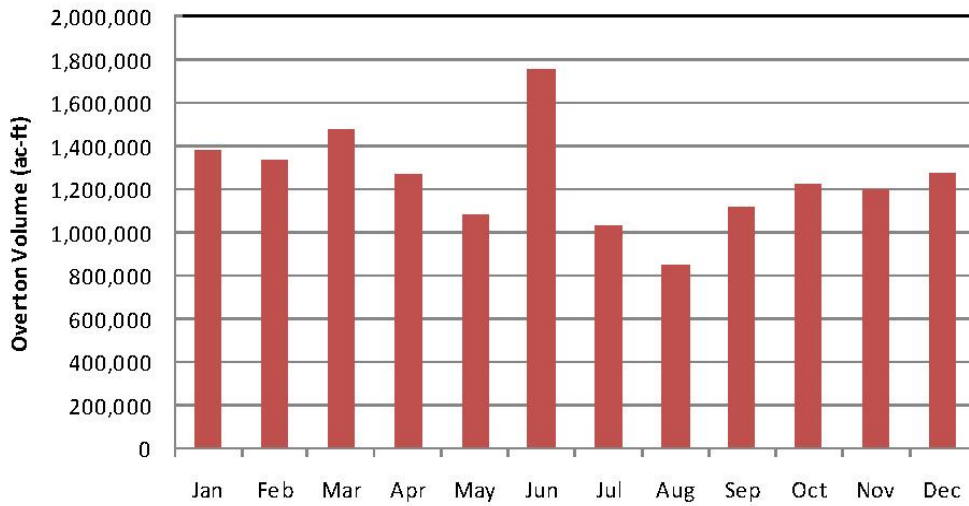
25 Review of modeling results suggest that pumping start dates have relatively little effect on the amount  
26 that the sediment deficit is reduced. The August 1 pumping start date was retained for evaluation  
27 purposes as it offers the most flexibility and some time buffer when compared to a September 1 start date.



1

2

**Figure 8-1 Flows from J-2 Return, August through October**



3

4

**Figure 8-2 Flows at Overton Gage, August through October**



## 9. IDENTIFICATION AND INITIAL SCREENING OF AUGMENTATION MATERIAL GRADATION

As discussed in Section 4.3, the baseline model results were processed to evaluate the gradation of the augmentation material that makes up the surplus or deficit in the Project reach. Results from this analysis indicate that, in each of the subreaches, most of the eroded or deposited material is in the medium to coarse sand range (0.25 to 1.0 mm). However, the gradation of the augmented material that would be required to restore a sediment balance to the Project reach would likely be somewhat coarser, since the gradation of the material in transport is typically somewhat finer than the resident bed material.

To evaluate the effects of the augmentation material gradation on aggradation/degradation, the sediment-transport model simulations for the pumping alternatives were executed with two different gradations of the augmented material, including the following:

- Unprocessed material from OS&G, D50~0.5mm
- Coarser material that is similar to the existing bed material, D50~1.2mm

The gradation of the unprocessed material from OS&G was selected since this material is readily available, while the coarser material that is similar to the existing bed material was selected since this gradation would likely be consistent with the gradation that would be necessary to minimize the augmentation volume (i.e., maintain an augmentation volume of 150,000 t/y). The Project is a results based (i.e., sediment balance at the upstream end of Cottonwood Ranch) and ultimately, there will be numerous means and methods of achieving those results within the parameters of the final design. The actual gradation used will partly depend on how the Project is implemented (e.g., competitive bidding, sole source); the entity selected to implement the Project; and how specific the methods of implementation are dictated by the Program.

As discussed in Section 3, it should be noted that the alternative modeling included a suite of the identified potential augmentation components, including likely combinations of delivery technologies, augmentation locations, and the material sizes identified above, to assess the combined effects of the various components. The alternative modeling results were initially used to assess the effects of the augmentation material gradation in the context of the selected delivery technology (pumping) and augmentation location as discussed in the following subsections, and were ultimately used to evaluate each of the final alternatives as discussed in Section 10.

### 9.1 Augmentation with Unprocessed Material from OS&G, D50~0.5mm

Under this sediment-transport model simulation, the augmented material would be obtained from OS&G. Two samples were collected from OS&G sand storage piles. The gradation of the augmented material is somewhat finer than the existing channel bed material, with a median grain size (D50) of about 0.5 mm (fine gradation).

Results from these simulations indicate that a significant portion of the relatively fine-grained augmented material would be transported through the Project reach, regardless of pumping location, and only moderately reduced the sediment deficit in any of the degradational reaches.

### 9.2 Augmentation with Coarser Material that is Similar to Existing Bed Material, D50~1.2mm

Under this sediment-transport model simulation, the gradation of the augmented material was coarsened to more closely resemble the existing bed material. This gradation was developed by averaging the representative gradation of the bed material at the three anchor points in Subreach 3 (the Overton Bridge

1 to the Elm Creek Bridge). The resulting average gradation has a median diameter of about 1.2 mm and  
2 includes about 35-percent gravel.

### 3 **9.3 Summary**

4 Results from these simulations indicate that if coarse material is augmented to the South Channel of  
5 Jeffrey Island (Cook Tract/Dyer Property), a significant amount of this material would deposit in the  
6 vicinity of the pumps and would not be transported to downstream degradational reaches due to the  
7 relatively low hydraulic energies near the pumping locations, thereby reducing the effectiveness of the  
8 augmentation. However, if at least one of the pumping operations is relocated to a location in the vicinity  
9 of Overton Sand and Gravel (downstream from Jeffrey Island), where the hydraulic energies are  
10 somewhat higher, use of the coarser material appears to result in a more significant reduction to the  
11 deficit. The temporal patterns of aggradation and degradation are similar to those observed using finer  
12 material, but the magnitude of the reduction in degradation is somewhat less.

13  
14 Therefore, it appears that use of the coarser gradation material could improve the effectiveness of the  
15 augmentation, so long as the material is augmented at a location where the hydraulic energy is sufficient  
16 to transport the material to the downstream degradational reaches.

17  
18 In other words, if the augmentation delivery location is on the South Channel, then a fine grain material  
19 (similar to the OS&G sand piles) is required to avoid excessive aggradation in the vicinity of the  
20 discharge location. Conversely, if the augmentation delivery location is downstream of the confluence of  
21 the North and South channels, such as OS&G, then a coarser material is required to provide more  
22 sediment transport to the deficit at Cottonwood Ranch.

23  
24 The optimal augmentation material gradation for sediment augmentation is not known. There may not be  
25 an optimal gradation of material that economically meets the goal of eliminating 100 percent of the  
26 sediment deficit without causing adverse impacts on local flow conditions (i.e., flooding) or downstream  
27 landowners. Section 13 discusses some of the risk and uncertainty associated with quantity and gradation  
28 of augmentation material required.

1 **10. COMPILATION OF ALTERNATIVES**

2 The previous sections provided identification and initial screening of various components which will form  
 3 the basis for alternative development, including the following:

- 4 • Sediment augmentation delivery locations
- 5 • Sediment sources
- 6 • Sediment production and delivery technologies
- 7 • Delivery timing
- 8 • Augmentation material gradation

9 A wide array of options for each of these five components was identified and evaluated to eliminate any  
 10 component options that were either not feasible or not reasonable. The components that were considered  
 11 reasonable and feasible were then assembled to develop a set of complete sediment augmentation  
 12 alternatives. Options that were retained after the initial screenings are listed in Table 10-1.

13 **Table 10-1 Options Retained after Initial Screenings**

<b>Augmentation Delivery Locations</b>	<b>Sediment Sources</b>	<b>Sediment Delivery Technologies</b>	<b>Timing</b>	<b>Augmentation Material Gradation</b>
Cook Tract/ Dyer Property  Existing sand and gravel operations at Overton Interchange	Cook Tract/Dyer Property  Existing sand and gravel operations	Sand pump  Dozers (sand plug)	August 1 <sup>1</sup>	D50~0.5 mm <sup>2</sup>  D50~1.2 mm <sup>2</sup>

14 *Notes:*  
 15 <sup>1</sup> *Review of modeling results suggest that pumping start dates have relatively little effect on the amount that the*  
 16 *sediment deficit is reduced. The August 1 pumping start date was retained for evaluation purposes because it*  
 17 *avoids ecologically important timeframes, offers the most flexibility, and some time buffer when compared to a*  
 18 *September 1 start date.*  
 19 <sup>2</sup> *If the augmentation delivery location is on the South Channel, then a fine grain material (similar to the OS&G*  
 20 *sand piles) is required to avoid excessive aggradation in the vicinity of the discharge location. Conversely, if the*  
 21 *augmentation delivery location is downstream of the confluence of the North and South channels, such as OS&G,*  
 22 *then a coarser material is required to provide more sediment transport to the deficit at Cottonwood Ranch.*

23 Once the initial screenings were completed, the options that were retained were assembled into a set of  
 24 unique sediment augmentation alternatives. Where appropriate, alternatives that did not represent a  
 25 unique solution, or did not offer some advantage that warranted consideration were eliminated. In  
 26 addition, the various permutations of each combination were evaluated to determine if a “hybrid”  
 27 alternative would be feasible.

28 There are various combinations of options above that, when assembled, result in a large number of  
 29 potential alternatives for further evaluation. To reduce this number to a manageable list of comparable,  
 30 feasible alternatives, the following assumptions were made:

- 31 1. To the extent practical, a sufficient volume of sediment will be placed in the river to test whether  
 32 sediment balance at Cottonwood Ranch can be achieved. Initial alternative evaluation was  
 33 conducted using the 150,000 t/y average annual sediment deficit in the Cottonwood Ranch reach  
 34 (modeling Subreach 3) predicted by the baseline sediment-transport model.

2. Sediment augmentation may occur at one or more locations. For evaluation purposes, specific locations were selected for each alternative based on local hydraulic conditions and logistical considerations.
3. For purposes of developing a relative comparison of costs for one technology versus another, a single delivery technology was evaluated for each alternative. This does not preclude the use of a combination of delivery technologies during final design and implementation, if determined to be more efficient.
4. Initial cost estimates assume that sediment would be delivered in the minimum time possible based on the production rates of the equipment assumed for each alternative. This would minimize cost by minimizing labor and equipment expense. Exceptions to this are when the duration of the augmentation period is mandated by the selected delivery technology (i.e., two pumps versus three pumps).
5. As part of the Program's adaptive management approach, alternatives were developed that allow for adjustments over the course of the Project based on ongoing monitoring of the Project. Adjustments may need to be made to the rate of sediment introduction based on river response in habitat creation as well as any adverse impacts such as bank destabilization or increased flooding of downstream landowners.

Based on the assumptions above, the alternatives listed in Table 10-2 were assembled for further evaluation.

**Table 10-2 Alternatives**

Alternative	Augmentation Delivery Locations	Sediment Source	Delivery Technology	Analysis Type <sup>3</sup>
1	Cook Tract/Dyer Property (two locations)	Imported <sup>1</sup>	Sand pump	Sediment-transport model
2	Cook Tract/Dyer Property (two locations)	On site <sup>2</sup>	Sand pump	Extrapolated results from sediment-transport model <sup>4</sup>
3	Cook Tract/Dyer Property (two locations)	Imported <sup>1</sup>	Dozer (sand plug)	Hydraulic and sediment-transport modeling
4	Cook Tract/Dyer Property (two locations)	On site <sup>2</sup>	Dozer (sand plug)	Hydraulic and sediment-transport modeling
5	Cook Tract/Dyer Property (two locations) and OS&G (one location)	Imported <sup>1</sup>	Sand pump	Extrapolated results from sediment-transport model <sup>5</sup>
6	Cook Tract/Dyer Property (two locations) and OS&G (one location)	On site <sup>2</sup> / Imported <sup>1</sup>	Sand pump	Extrapolated results from sediment-transport model <sup>5</sup>
7	Cook Tract/Dyer Property (two locations) and OS&G (one location)	Imported <sup>1</sup>	Dozer (sand plug)	Extrapolated results from hydraulic and sediment-transport model <sup>6</sup>
8	Cook Tract/Dyer Property (two locations) and OS&G (one location)	On site <sup>2</sup> / Imported <sup>1</sup>	Dozer (sand plug)	Extrapolated results from hydraulic and sediment-transport model <sup>6</sup>

Notes:

<sup>1</sup> Imported from existing sand and gravel operation (purchased). Material from off-site sources would be hauled to the augmentation delivery locations, where it would be temporarily stockpiled prior to being introduced into the river.

<sup>2</sup> Acquired from Program-controlled property. Material from on-site sources would be from a sand pit dredge operation established at or near the augmentation delivery location (discussed in Section 5).

<sup>3</sup> Refer to Appendix B for discussion of modeling and analysis.

1 <sup>4</sup> Results from sediment-transport modeling of pumping at Sites 1 and 2 were used for evaluating this alternative.  
2 <sup>5</sup> Results from sediment-transport modeling of pumping at Sites 1, 2, and 4 were used for evaluating this alternative.  
3 <sup>6</sup> Results from hydraulic and sediment-transport modeling of dozer options at Cook Tract/Dyer Property and  
4 baseline sediment-transport model in the vicinity of OS&G were used for evaluating this alternative.

5 As discussed above, the modeling of the alternatives was carried out to evaluate the effects of individual  
6 components (e.g., augmentation material gradation) of the various alternatives in the context of the other  
7 components (e.g., delivery technology and location). While all of the underlying components associated  
8 with the alternatives listed above were modeled, the ultimate assembly of each alternative may not have  
9 been directly modeled. However, results from the available model runs are sufficient to evaluate each of  
10 the alternatives, either through direct modeling or extrapolation of the results from similar model runs.

### 11 **10.1 Alternative 1**

12 Under Alternative 1, sediment would be imported from one or more of the local sand and gravel  
13 producers onto the Cook Tract and Dyer Property. This alternative would use two sand pump locations  
14 (Sand Pump Sites 1 and 2) to pump sediment into the river. Sediment stockpiles would be established in  
15 close proximity to the sand pump operations. Figure 7-6 shows the sand pump locations and a conceptual  
16 site layout of the augmentation operations.

### 17 **10.2 Alternative 2**

18 Under Alternative 2, sediment would be produced on site using a sand pit dredge operation established by  
19 a contractor on the Cook Tract and Dyer Property. A sand pit or pits would be created as a result of this  
20 operation, which could provide a future habitat benefit. Two sand pump locations (Sand Pump Sites 2  
21 and 5) would be used to pump sediment into the river. Site 5 would be located in close proximity to the  
22 on-site sand pit operation to minimize hauling costs. The location would move as the dredging operation  
23 moves. Figure 7-6 shows the sand pump locations and a conceptual site layout of the augmentation  
24 operations.

### 25 **10.3 Alternative 3**

26 Under Alternative 3, sediment would be imported from one or more of the local sand and gravel  
27 producers to the Cook Tract and Dyer Property. Dozers would be used to push the material to the desired  
28 location and configuration in the channel from stockpiles along the south bank.<sup>4</sup> Access points to the  
29 river would need to be constructed to allow dozer access from the high bank down into the river channel.

### 30 **10.4 Alternative 4**

31 Under Alternative 4, sediment would be produced on site using sand pit dredge operations established on  
32 the Cook Tract and Dyer Property. A sand pit or pits would be created as a result of this operation, which  
33 could provide a future habitat benefit. Dozers would be used to push the material to the desired locations  
34 in the channel from stockpiles along the south bank. Access points to the river would need to be  
35 constructed to allow dozer access from the high bank down into the river channel.

### 36 **10.5 Alternative 5**

37 Under Alternative 5, sediment would be imported onto the Cook Tract and Dyer Property from one or  
38 more of the local sand and gravel producers. This alternative would use two sand pump locations on

---

<sup>4</sup> Using the sediment-transport model, the preferred configuration was developed after several iterations with varying sediment placement configurations (see Appendix B). The preferred configuration is a long-length sand plug.

1 Program properties (Sand Pump Sites 2 and 3) as well as the augmentation location at OS&G (Sand Pump  
2 Site 4). Augmentation material for the sand pump location at OS&G would be obtained from their  
3 operations. Material for the sand pumps sites on Cook/Dyer would be obtained from OS&G or other  
4 local producers. It should be noted that although OS&G was selected for purposes of this evaluation,  
5 other locations are available that would likely produce the same results. Figures 7-6, 7-7, and 7-8 show  
6 the locations and conceptual site layouts of the augmentation operations.

## 7 **10.6 Alternative 6**

8 Under Alternative 6, sediment would be produced on site using sand pit dredge operations established on  
9 the Cook Tract and Dyer Property. A sand pit or pits would be created as a result of this operation, which  
10 could provide a future habitat benefit. This alternative would use two sand pump locations on Program  
11 properties (Sand Pump Sites 2 and 3), supplied by material from the on-site sand pit operation established  
12 on Cook/Dyer. In addition, a sand pump location would be established on the OS&G property (Sand  
13 Pump Site 4), supplied by sediment obtained from the existing OS&G sand pit operation. It should be  
14 noted that while OS&G was selected for the purposes of this evaluation, other locations may be available  
15 to establish a sand pump delivery location that would likely produce the same results. Figures 7-6, 7-7,  
16 and 7-8 show the locations and conceptual site layouts of the augmentation operations.

## 17 **10.7 Alternative 7**

18 Under Alternative 7, sediment would be imported from one or more of the local sand and gravel  
19 producers on to the Cook Tract and Dyer Property. Dozers would be used to push the material to the  
20 desired locations in the channel from stockpiles along the south bank. Access points to the river would  
21 need to be constructed to allow dozer access from the high bank down into the river channel. In addition,  
22 dozers would be used to push material into the river at OS&G. Material stockpiles and access points  
23 would be created on the north bank on the OS&G property. Material at this location would be supplied  
24 from the existing OS&G sand pit operation. It should be noted that while OS&G was selected for the  
25 purposes of this evaluation, other locations may be available to establish a delivery location that would  
26 likely produce the same results.

## 27 **10.8 Alternative 8**

28 Under Alternative 8, sediment would be produced on site using sand pit dredge operations established on  
29 the Cook Tract and Dyer Property. A sand pit or pits would be created as a result of this operation, which  
30 could provide a future habitat benefit. Dozers would be used to push the material to the desired locations  
31 in the channel from stockpiles along the south bank. Access points to the river would need to be  
32 constructed to allow dozer access from the high bank down into the river channel. Similar to  
33 Alternative 7, dozers would be used to push material into the river at OS&G. Material stockpiles and  
34 access points would be created on the north bank on the OS&G property. Material at this location would  
35 be supplied from the existing OS&G sand pit operation. It should be noted that while OS&G was  
36 selected for the purposes of this evaluation, other locations may be available to establish a delivery  
37 location that would likely produce the same results.

## 11. ALTERNATIVES ANALYSIS EVALUATION CRITERIA

A set of evaluation criteria was developed to enable a side-by-side comparison of each of the assembled alternatives. The evaluation criteria were developed to allow for the identification of the most cost-effective and efficient Project possible that meets the Project metric of achieving sediment balance at Cottonwood Ranch. This evaluation resulted in development of a list of potential alternatives that could also be considered to address sediment deficiencies at other locations in the river.

One important consideration in assembling the alternatives and establishing evaluation criteria is that this Project will be implemented as an experiment in sediment augmentation developed as part of the Program's AMP. Because there is a level of uncertainty regarding how the river system would react as a result of implementing the augmentation alternatives, this evaluation criteria approach may not necessarily lend itself to a single preferred alternative. Rather, a group of feasible alternatives was developed that, based on the predictive functions within the model, would likely achieve the Project goal. The evaluation and ranking of the alternatives, described below, is a useful exercise to provide the Program with a relative starting point in determining how best to achieve the Project goal and to develop an estimated cost to complete the Project using the various alternatives.

Another consideration when determining how to develop and evaluate the various alternatives is to do so in the context of the USACE Section 404(b)(1) Guidelines (Guidelines), given the importance of permitting the alternatives. The 404(b)(1) considerations are discussed in the following section.

### 11.1 Relationship of Section 404(b)(1) Guidelines to Evaluation Criteria

The Program proposes to implement the sediment augmentation experiment to rectify the sediment imbalance in the Platte River system within the Project reach. The Project would unavoidably involve the discharge of dredged and/or fill material into the Platte River, which is a water of the U.S.<sup>5</sup>, and would therefore require authorization from USACE under Section 404 of the Clean Water Act (Section 404) (USACE, 1985).

In its review of projects that require a Section 404 fill permit, USACE applies the Guidelines, developed jointly by the U.S. Environmental Protection Agency (EPA) and the USACE, to determine whether the proposed activities are permissible under Section 404.<sup>6</sup> One of the primary determinations that USACE must reach under the Guidelines is whether there is a *practicable alternative* to the proposed discharge that would have less adverse impact on the aquatic ecosystem, so long as the alternative would not have other significant adverse environmental impacts. The practicable alternative under this test is frequently referred to as the least environmentally damaging practicable alternative or LEDPA (40 Code of Federal Regulations [CFR] 230.10(a)).<sup>7</sup>

The Guidelines define the term *practicable* to mean available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall Project purposes (40 CFR 230.10(a)(2)). Consistent with the requirements of the Guidelines, USACE evaluates the practicability of alternatives based on the four general criteria: 1) cost, 2) existing technology, 3) logistics, and 4) project purpose. Because implementing the sediment augmentation experiment will require a Section 404 fill permit, and obtaining the permit will require that the Program identify the LEDPA, the specific criteria

---

<sup>5</sup> Waters of the U.S. include lakes, rivers, streams, oxbows, ponds, and wetlands such as prairie potholes, wet meadows, marshes, swamps, and bogs (33 CFR 328.3).

<sup>6</sup> The Guidelines, along with the public interest review and other federal laws, are the substantive criteria that USACE uses when reviewing an application to determine whether a Project is permissible.

<sup>7</sup> The river is already considered to be in a degraded state. Therefore, any alternative, except for No Action, is intended to improve the aquatic function of the river.

1 used to evaluate alternatives have been structured to be consistent with the four general criteria used in  
2 the Guidelines.

### 3 **11.2 Evaluation Criteria**

4 To facilitate the Section 404 fill permit process, the specific criteria used to evaluate the alternatives have  
5 been separated into the following four Section 404(b)(1) categories:

- 6 1. Cost
- 7 2. Existing technology
- 8 3. Logistics
- 9 4. Project purpose

10 These evaluation criteria and the specific alternative evaluation criteria are discussed in detail in the  
11 following sections. The evaluation criteria are shown in Table 11-1.

#### 12 **11.2.1 Cost**

13 Under cost, one specific evaluation criterion was established. The cost criterion is the “cost per ton of  
14 sediment delivered.” The criterion is the average cost per ton to acquire and place sediment in the river at  
15 the locations identified. The use of a unit cost rather than total cost to evaluate the alternatives allows for  
16 easy adjustments to the cost criteria if sediment volumes need to be adjusted.

17 Project costs include construction costs, material costs, and labor costs. Costs under the Project would be  
18 incurred annually, and each year a contractor would be hired to place a specific amount of sediment in the  
19 channel at specified locations either under an annual or long-term contract. Generally, both capital and  
20 operational costs are considered over a given time period. However, the Program would be contracting  
21 out the services required under the Project and would not be acquiring infrastructure or permanent  
22 facilities requiring operation or maintenance. Therefore, the Project costs are the estimated annual  
23 construction costs, engineering fees, and contingencies, as follows:

- 24 • Annual construction costs were estimated using recent earthwork projects in the region, estimates  
25 provided by aggregate producers and contractors in the area, and cost indices including RS Means  
26 Cost Data references (RSMeans, 2010). All costs were indexed to 2010 costs. Contractor  
27 mobilization costs – which include contracting, bonding, establishing the job site, and moving  
28 equipment to and from the site – generally range from 2 to 5 percent of the construction cost. For  
29 the Project, mobilization was estimated at 2.5 percent of construction cost, before contingencies.
- 30 • Engineering fees include construction permitting, engineering design, and construction  
31 management fees. Design fees, including permitting for the Project, are estimated at 10 percent.  
32 Construction management fees can vary depending on the level of oversight required. For the  
33 Project, construction management fees are estimated at 5 percent.
- 34 • Contingencies are used to account for uncertainties in the design relative to the status of the  
35 design (e.g., conceptual as opposed to final), unforeseen and unpredictable conditions, and  
36 variability in the marketplace. Design contingencies at the feasibility/conceptual phase generally  
37 range from 20 to 30 percent and can be as high as 50 to 100 percent or more depending on the  
38 complexity of the project. Construction contingencies to account for potential additional work  
39 that may be identified during construction are generally in the range of 5 to 10 percent of the  
40 construction cost. For this Study, a 25 percent contingency was used for the alternatives  
41 evaluated.

42 An escalation factor of 5 percent was used to project costs over a fixed time period of 10 years. To arrive  
43 at the cost per ton of sediment delivered, the first-year cost was calculated using the volume of material  
44 identified in the alternatives. This volume is an estimated average annual input. The first-year cost was



1 the projected over the 10-year period using the escalation factor. The volume of material delivered in the  
2 first year was multiplied by 10 years to get a total volume of material delivered. The 10-year cost was  
3 divided by the total volume of sediment delivered to the river over the time period to obtain the cost per  
4 ton of sediment delivered.

### 5 **11.2.2 Existing Technology**

6 Most of the technology constraints were discussed and evaluated in Section 7, Identification and  
7 Screening of Technologies. For the evaluation of assembled alternatives, one criterion, delivery timing,  
8 was established under the technology category. This criterion evaluates how long it would take to deliver  
9 the required volume of sediment at the alternative site or sites. Factors include the following:

- 10 • Ability of existing technology to provide usable sediment from on-site sources (i.e., local  
11 sediment)
- 12 • Ability of existing technology to extract sediment at sufficient rate
- 13 • Consideration of the physical constraints

14 In addition, technologies that provide a faster timeframe for delivery afford the most flexibility in  
15 coinciding sediment deliveries with flow variations. The delivery time is the actual working time (i.e.,  
16 equipment operation time) it would take to deliver 150,000 tons of sediment to the river. Due to seasonal  
17 restrictions (such as, duck hunting seasons starting in mid-October, fall whooping crane migration in  
18 October and November, and other migratory bird migrations), alternatives that can be implemented in a  
19 shorter timeframe have the greatest ability to be implemented and the most flexibility during  
20 implementation.

### 21 **11.2.3 Logistics**

22 The logistics criterion evaluates the logistics of constructing and operating an alternative, the difficulty in  
23 obtaining the required authorizations, the time required until startup of the operation, and the time needed  
24 to deliver the required volume of sediment at the alternative site or sites. Four specific evaluation criteria  
25 were established under the logistics category: 1) implementability, 2) permissibility, 3) long-term  
26 viability, and 4) on-site sediment availability. Logistics was evaluated qualitatively based on these  
27 criteria, and ranked as high, medium, or low.

#### 28 **11.2.3.1 Implementability**

29 Implementability considers the challenges and difficulty in physically implementing an alternative.  
30 Factors considered as part of the evaluation of implementability criteria include the following:

- 31 • Ease of siting
- 32 • Physical space requirements for sediment delivery
- 33 • Ramp-up time
- 34 • Ease of constructing or setting up equipment
- 35 • Startup complexity
- 36 • Magnitude of operation and maintenance required

#### 37 **11.2.3.2 Permissibility**

38 The permissibility evaluation criterion considers the complexity and potential timeframe associated with  
39 obtaining any required state and federal authorizations for the Project. The basic assumption is that some  
40 form of permit would be required for any of the alternatives. Alternatives that are similar to activities

1 currently authorized by USACE were assumed to be generally less complex and easier to permit than  
2 alternatives that involve activities less familiar to the regulatory agencies, or alternatives that might  
3 involve more complex state permitting.

#### 4 **11.2.3.3 Long-Term Viability**

5 The long-term viability criterion evaluates how long a particular alternative can be effectively used for  
6 sediment augmentation. Availability of source material and long-term access to the delivery location are  
7 the factors considered under this criterion. One of the primary considerations is the extent to which the  
8 alternative would be viable through the first increment of the Program. A secondary consideration is the  
9 extent to which the alternative would be viable for a longer duration.

#### 10 **11.2.3.4 On-site Sediment Availability**

11 The on-site sediment availability criterion evaluates the availability of usable sediment on site (locally) at  
12 the delivery location. Sites were evaluated based on how many years of sediment supply were available.  
13 Alternatives with higher availability of local sediment will be able to be used for a longer period without  
14 supplementing from other sources. Use of material that can be obtained on site on Program-controlled  
15 property offers the advantage of eliminating the dependency on resources not controlled by the Program.

#### 16 **11.2.4 Project Purpose**

17 To identify evaluation criteria under the Project purpose, consideration was given to both the specific  
18 purpose of the sediment augmentation experiment as well as purpose of the overall Platte River Recovery  
19 Implementation Program. Therefore, two evaluation criteria were established under Project purpose:  
20 1) percent effectiveness in meeting the Project goal, and 2) provision of other Program benefits.

#### 21 **11.2.4.1 Percent Effective**

22 The percent effective criterion evaluates the extent to which the alternative meets the established  
23 objective of the sediment augmentation experiment. Modeling and analytical analysis suggests that none  
24 of the assembled alternatives would likely fully address the sediment deficit. Therefore, the percentage  
25 by which an alternative addresses the sediment deficiency becomes an important consideration.

#### 26 **11.2.4.2 Provision of Other Program Benefits**

27 The criterion evaluates each alternative in the context of the overall Program. The extent to which a  
28 sediment augmentation alternative may provide secondary Program benefits is considered under this  
29 criterion. Examples of secondary benefits include actions or results that occur in conjunction with or  
30 while implementing the Project, creating habitat (either directly or indirectly) that meets objectives  
31 outlined in the Program's AMP, and providing a revenue source to the Program.

### 32 **11.3 Summary of Criteria**

33 Table 11-1 lists the specific criteria used to evaluate each of the assembled sediment augmentation  
34 alternatives. The Table also shows the relationship of the specific criteria to the Section 404(b)(1)  
35 Guidelines.

**Table 11-1 Evaluation Criteria**

<b>Evaluation Criteria</b>	<b>Alternative Evaluation Criteria</b>	<b>Section 404(b)(1) Guidelines Practicability Criteria</b>
1	Cost per ton of delivered sediment	Cost
2	Delivery timing	Existing technology
3	Implementability	Logistics
4	Permittability	Logistics
5	Long-term viability	Logistics
6	On-site sediment availability	Logistics
7	Percent effective	Project purpose
8	Provision of other Program benefits	Project purpose

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1 **12. ANALYSIS AND SCORING OF ALTERNATIVES**

2 Each of the alternatives shown in Table 10-2 was evaluated using each of eight criteria listed in Table  
3 11-1, as detailed in the following sections.

4 **12.1 Cost**

5 Alternatives were evaluated based on the cost per ton of sediment delivered to the River. An estimate of  
6 the cost per ton of sediment was prepared for each of the alternatives. Section 11 discusses the approach  
7 and assumptions used for the cost studies. Additional costing assumptions specific to each alternative are  
8 noted on the itemized cost tables in **Appendix D**.

9 Table 12-1 shows the first-year construction costs for each alternative as well as a projected 10-year cost  
10 using an escalation factor of 5 percent per year.

11 **Table 12-1 Alternatives Cost Summary**

Alternative	First-Year Cost	10-Year Cost	Cost per Ton
1	\$1,717,500	\$21,602,300	\$14.40
2	\$1,410,700	\$17,743,500	\$11.83
3	\$2,061,000	\$25,922,100	\$17.28
4	\$1,697,500	\$21,350,600	\$14.23
5	\$1,595,200	\$20,064,500	\$13.38
6	\$1,419,300	\$17,851,800	\$11.90
7	\$1,917,400	\$24,116,500	\$16.08
8	\$1,839,700	\$23,139,900	\$15.43

12

13 **12.2 Existing Technology**

14 Alternatives were evaluated in terms of ability of the technology to provide usable sediment from on-site  
15 sources, to extract sediment at a sufficient rate, to operate within the physical constraints that may be  
16 present, and to deliver sediment at a rate sufficient to meet the overall Project purpose. Technologies that  
17 provide a faster timeframe for delivery provide the most flexibility in coinciding sediment deliveries with  
18 flow variations. Two technologies included as part of the alternatives were sand pumps and dozers.

19 **12.2.1 Sand Pumps**

20 Evaluating the timing of the delivery of sediment using sand pumps is highly dependent on the equipment  
21 used. Pump technology and pump production rates can vary significantly. To determine the timing of  
22 sediment delivery, it was assumed that the average production from the sediment slurry delivery pump(s)  
23 is 1,500 gpm with a minimum 25 percent solids content. This equates to a sediment production rate of  
24 approximately 150 tons/hour per pump system. Assuming an 8-hour work day and an efficiency rate of  
25 50 minutes/hour (0.83), the daily sediment delivery rate is approximately 1,000 tons/day (5,000  
26 tons/week). Using 5-day work weeks, the delivery time is approximately 6.9 months for one unit. For  
27 two sand pump units, the delivery time is just under 3.5 months, and for three units about 2.3 months.

1           **12.2.2 Dozers**

2 Estimating delivery timing is dependent on equipment selected as well as the number of pieces of  
3 equipment assigned to the task. Evaluation of delivery timing for these alternatives assumed the use of  
4 large 460-horsepower dozers (Caterpillar D9 or equivalent). The preferred configuration of material  
5 placement is a long-length sand plug. Including the efficiency and work week assumptions above,  
6 delivery time is 1.9 months using one dozer and just under 1 month using two dozers.

7           **12.2.3 Summary**

8 Results of the existing technology analysis are shown in Table 12-2.

9                           **Table 12-2 Results of Existing Technology Analysis**

<b>Alternative</b>	<b>Delivery Timing</b>	<b>Technology</b>
1	3.5 months	Sand pumps – two locations
2	3.5 months	Sand pumps – two locations
3	1-2 months	Dozers – one to two
4	1-2 months	Dozers – one to two
5	2.3 months	Sand pumps – two locations
6	2.3 months	Sand pumps – three locations
7	1 month	Dozers – two
8	1 month	Dozers – two

10           **12.3 Logistics**

11 Alternatives were evaluated in terms of the ease of construction and operation, the difficulty in obtaining  
12 required authorizations, the time required until startup of the operation, and the time needed to deliver the  
13 required volume of sediment at the alternative site or sites. Four specific evaluation criteria were  
14 established under the logistics category: 1) implementability, 2) permissibility, 3) long-term viability, and  
15 4) on-site sediment availability.

16           **12.3.1 Implementability**

17 Implementability considers the challenges and difficulty in physically implementing an alternative.  
18 Alternatives were developed using either imported material or on-site material:

- 19       • Imported material – Imported material would be purchased from existing sand and gravel  
20 operations. Imported material would be hauled to the augmentation delivery locations, where it  
21 would be temporarily stockpiled prior to being introduced into the river. Importing sediment  
22 using trucks to haul the material to the sites does not pose any unusual implementation problems.  
23 Haul distances to the Cook Tract and Dyer Property from the closest sources at the Overton  
24 interchange are approximately 3 to 5 miles. Therefore, under these alternatives, implementability  
25 is considered to be low in terms of difficulty.
- 26       • On-site material – Material that is produced on site from a sandpit dredge operation established at  
27 or near the augmentation delivery location would be more difficult to implement. Setting up a  
28 sand pit pumping operation has significant equipment mobilization and space requirements.  
29 These alternatives rely on an outside contractor setting up a long-term operation on Program  
30 property. These alternatives would be the most labor intensive and would require electrical  
31 power. A short lead time would be required to establish the dredging operation and to produce

1 and process the material. Therefore, under these alternatives, implementability is considered to  
2 be medium in terms of difficulty.

### 3 **12.3.2 Permittability**

4 Permittability considers the complexity and potential timeframe associated with obtaining any required  
5 state and federal authorizations for the Project. The basic assumption is that some form of permit would  
6 be required for any of the alternatives, whether using sand pumps or dozers:

- 7 • Sand Pump Alternatives – These alternatives are generally less familiar to the regulatory agencies  
8 and may involve more complex state permitting. Sand pump alternatives were assumed to be  
9 generally more complex and harder to permit than alternatives that involve activities that are  
10 similar to those currently authorized by USACE. Depending on how water is acquired, sand  
11 pump alternatives could also involve state water rights issues, which could complicate the  
12 approval process. Therefore, under these alternatives, permittability is considered to be high in  
13 terms of difficulty.
- 14 • Dozer Alternatives – These alternatives are generally similar to activities currently authorized by  
15 USACE. These alternatives were assumed to be generally less complex and easier to permit than  
16 alternatives that involve activities less familiar to the regulatory agencies, or alternatives that  
17 might involve more complex state permitting. Therefore, under these alternatives, permittability  
18 is considered to be medium in terms of difficulty.

### 19 **12.3.3 Long-Term Viability**

20 Long-term viability considers how long a particular alternative can be effectively used for sediment  
21 augmentation, through use of imported material or on-site material:

- 22 • Imported material – Several alternatives use augmentation material that is imported from local  
23 sand and gravel operations. With six operations within 10 miles of the Project site, long-term  
24 viability of the source is not an issue.
- 25 • On-site material – Based on the results of gradation analysis from samples collected on the Cook  
26 Tract and Dyer Property, there is an adequate supply of material and a large enough area to  
27 provide an augmentation source over a Project life of 10 years (the approximate time remaining  
28 in the first increment of the Program).

### 29 **12.3.4 On-site Sediment Availability**

30 On-site sediment availability considered the availability of usable sediment on site (locally) at the  
31 delivery location. Alternatives with higher availability of local sediment can be used for a longer period  
32 without supplementing from other sources. Use of local material offers the advantage of eliminating the  
33 dependency on resources not controlled by the Program.

### 34 **12.3.5 Summary**

35 Results of the logistics analysis are shown in Table 12-3.

36

**Table 12-3 Results of Logistics Analysis**

Alternative	Implementability	Permittability	Long-Term Viability	On-site Sediment Availability
1	Low Difficulty	High Difficulty	10+ years	No
2	Medium Difficulty	High Difficulty	10+ years	Yes
3	Low Difficulty	Medium Difficulty	10+ years	No
4	Medium Difficulty	Medium Difficulty	10+ years	Yes
5	Low Difficulty	High Difficulty	10+ years	No
6	Medium Difficulty	High Difficulty	10+ years	Partial
7	Low Difficulty	Medium Difficulty	10+ years	No
8	Medium Difficulty	Medium Difficulty	10+ years	Partial

**12.4 Project Purpose**

Two evaluation criteria were established under the Project purpose: 1) percent effectiveness in meeting the Project goal, and 2) provision of other Program benefits.

**12.4.1 Percent Effective**

Alternatives were evaluated in terms of the extent to which the alternative meets the established objective of the sediment augmentation experiment. Modeling results indicated that up to 300,000 t/y of sediment would need to be introduced to the river to achieve sediment balance at Cottonwood Ranch. Therefore, alternatives that introduce 150,000 t/y would likely not achieve sediment balance. In addition, modeling indicated that the South Channel does not provide adequate flow to fully mobilize the introduced sediment. Therefore, alternatives located entirely on the South Channel are less efficient than alternatives that have at least one discharge location downstream of the confluence of the North and South channels.

Modeling and analytical analysis suggests that none of the assembled alternatives would likely fully address the sediment deficit. Therefore, the percentage by which an alternative addresses the sediment deficiency becomes an important consideration.

The percent effective values were obtained by computing the total average annual deficit at the end of the alternative simulation in the vicinity of Cottonwood Ranch (Overton Bridge to Elm Creek Bridge). The percent effective value was then obtained by computing the difference between the deficit under alternative conditions and the deficit under baseline conditions, divided by the baseline deficit. For alternatives that were not explicitly modeled, the deficit volumes were estimated using results from the available model runs. For example, under Alternative 2, the model results from Alternative 1 were used to estimate the sediment deficit, since both of these alternatives involve pumping operations at Site 1, and since the results are likely to be similar if pumping operations are implemented at Site 2 (Alternative 1) or Site 5 (Alternative 2).

**12.4.2 Provision of Other Program Benefits**

Alternatives were evaluated on the extent to which an alternative would provide secondary Program benefits. Long-term benefits to the Program that may result from this Project include habitat creation and additional revenue sources. These benefits would be realized primarily from establishing an on-site sand pit operation at the Cook Tract and Dyer Property. With this, permanent sand pits would be created as the augmentation material and other intermixed material is removed. At the completion of the 10-year Project period, approximately 30 to 45 acres of sandpits would have been created. These alternatives



1 could help meet the FSM Management Action #3, Mechanical Management Action #1: Sandpit  
 2 Management. The full benefit of the sandpits created under these alternatives may not be realized until  
 3 pumping operations cease and there is an opportunity to complete habitat components.

4 Another benefit that the Program would realize under these alternatives is that the operation could  
 5 generate revenue for the Program. The independent contractor hired to set up the pumping operation  
 6 could compensate the Program for the opportunity to pump on contractor property. The Program has  
 7 realized benefits from similar arrangements at other Program properties.

8 **12.4.3 Summary**

9 Results of the Project purpose analysis are shown in Table 12-4.

10 **Table 12-4 Results of Project Purpose Analysis**

Alternative	Percent Effective <sup>1</sup>	Provision of Other Program Benefits
1	30 - 60 <sup>1</sup>	No
2	30 - 60 <sup>1</sup>	Yes
3	30 (maximum) – 40 (maximum) <sup>3</sup>	No
4	30 (maximum) – 40 (maximum) <sup>3</sup>	Yes
5	60 – 80 <sup>4</sup>	No
6	60 – 80 <sup>4</sup>	Yes
7	>40 <sup>5</sup>	No
8	>40 <sup>5</sup>	Yes

11 *Notes:*

12 <sup>1</sup> *Estimated based on interpreted results from modeling efforts.*

13 <sup>2</sup> *Lower end of range is for coarse (D50 ≈ 1.2 mm) sediment and higher end of range is for fine (D50 ≈ 0.5 mm)*  
 14 *sediment*

15 <sup>3</sup> *Percent of material eroded from sediment plug based on 1-year dry-year and wet-year simulations. Other*  
 16 *alternatives evaluated on full 12.- year simulation period. The actual percent reduction in sediment deficiency in*  
 17 *Subreach 3 will be less than the percent of material eroded. Only the coarse material (D50 ≈ 1.2 mm) was modeled*  
 18 *for these alternatives. See modeling discussion in Appendix B for further discussion.*

19 <sup>4</sup> *Lower end of range is for fine (D50 ≈ 0.5 mm) sediment, and higher end of range is for coarse (D50 ≈ 1.2 mm)*  
 20 *sediment*

21 <sup>5</sup> *Dozer options for augmentation of material at OS&G or other properties downstream of the confluence of the*  
 22 *North and South channels were not evaluated. Based on the results of modeling simulations for other alternatives,*  
 23 *the percent effectiveness when augmenting coarse material downstream of the confluence would be expected to be*  
 24 *greater than alternatives where augmentation is limited to location upstream of the confluence.*

25 **12.5 Summary of Alternative Analysis**

26 Table 12-5 presents a summary of the alternatives analysis conducted for this Study.

1

Table 12-5 Summary of Alternatives Analysis

Evaluation Criteria	1	2	3	4	5	6	7	8
<b>Cost</b>								
Cost per ton delivered	\$14.40	\$11.83	\$17.28	\$14.23	\$13.38	\$11.90	\$16.08	\$15.43
<b>Existing technology</b>								
Delivery timing	3.5 months	3.5 months	1-2 months	1-2 months	2.3 months	2.3 months	1 month	1 month
<b>Logistics</b>								
Implementability	Low difficulty	Medium difficulty	Low difficulty	Medium difficulty	Low difficulty	Medium difficulty	Low difficulty	Medium difficulty
Permitting	High difficulty	High difficulty	Medium difficulty	Medium difficulty	High difficulty	High difficulty	Medium difficulty	Medium difficulty
Long-term viability	10+ yrs	10+ yrs	10+ yrs	10+ yrs	10+ yrs	10+ yrs	10+ yrs	10+ yrs
On-site sediment availability	No	Yes	No	Yes	No	Partial	No	Partial
<b>Project purpose</b>								
Percent effective	30 – 60	30 – 60	30 – 40 (max.)	30 – 40 (max.)	60 – 80	60 – 80	>40	>40
Provision of other Program benefits	No	Yes	No	Yes	No	Yes	No	Yes

2

*Note:*

3

<sup>1</sup> See Section 12.4.3 for a summary of effectiveness.

1 **13. RISK AND UNCERTAINTY ANALYSIS**

2 This section identifies specific uncertainties in implementing the Project and some of the risks associated  
3 with those uncertainties.

4 **13.1 Unique Project**

5 As stated in Section 1, the Project is unique in terms of the type of river system, Project goal, type of  
6 sediments involved, and the magnitude of augmentation proposed. Many of the sediment augmentation  
7 projects for which information is available have been conducted in western states, either in steep  
8 mountain streams or on large rivers with large dams. Goals for those projects tend to focus on the  
9 development of in-stream habitat, for example fish spawning habitat and increased turbidity and cover for  
10 smaller fish species. Mountain stream projects, such as the Trinity River projects in northern California,  
11 tend to focus on small to medium streams and rivers and smaller volumes of coarse to larger aggregates.  
12 Projects on the larger rivers with large dams such as the Colorado River involve very large quantities of  
13 sediment and long sediment transport distances. Many of the projects are directly downstream of dams  
14 that provide a significant, reliable source of water in order to alter the magnitude of flows and distribute  
15 the augmented sediment. However, this Project in the central Platte River is in a relatively flat, braided  
16 river system with generally low flows relative to the overall channel widths. The Project goal is to  
17 achieve sediment balance in the river that will result in creation of bed and bar habitat suitable for birds.  
18 The estimated annual volume of augmentation material is significantly higher than many of the mountain  
19 stream projects but significantly lower than some of the large western river projects. There is little  
20 guidance regarding the quantities and grain sizes of material needed to achieve the Project goal.

21 **13.2 Uncertainties Identified or Related to the Modeling**

22 The use of hydraulic and sediment-transport models to predict river responses to specific conditions is a  
23 commonly accepted and widely used practice to help identify feasible actions that may meet the goals of a  
24 project. Ultimately, the hope is that model results translate well to what occurs in the field. Both the  
25 hydraulic and sediment-transport model simulations for this Project were generally similar to the  
26 observed conditions in the river, indicating a high level of calibration; therefore, they are good predictors  
27 of what may be expected in the field. However, several uncertainties were identified during the modeling  
28 process. Once again, the modeling of the alternatives was carried out to evaluate the effects of individual  
29 components (e.g., material gradation) of the various alternatives in the context of the other components  
30 (e.g., delivery technology and location). Although each of the underlying components associated with the  
31 selected alternatives was modeled, the ultimate assembly of each alternative may not have been directly  
32 modeled. However, results from the available model runs are sufficient to evaluate each of the  
33 alternatives, either through direct modeling or extrapolation of the results from model runs with similar  
34 Project components.

35 **13.2.1 Sediment Deficit and Particle Size**

36 Initial assumptions on sediment particle size were obtained from the BOR modeling conducted as part of  
37 the FEIS. This modeling identified a sediment deficiency within the Project reach estimated at 185,000 to  
38 225,000 t/y (on average), and identified the deficient sediment gradation as a D50 less than 1.00 mm. The  
39 general assumption from the BOR modeling was that finer material would be more effective in reducing  
40 the sediment deficit. Modeling conducted as part of this Study confirmed that there was a sediment  
41 deficit, estimated at 152,000 t/y on average for the entire Project reach and 150,000 t/y on average in the  
42 subreach that includes Cottonwood Ranch (Subreach 3). A large majority of the eroded material was  
43 smaller than 1 mm in diameter. This reinforced the initial assumptions that a sediment source with a  
44 median size of less than 1 mm would be desirable for implementation of the experiment.  
45

1 Because of the numerous sand and gravel pit mining operations in the Platte Valley, there is an ample  
2 supply of fine sand material in “waste” piles at most of the local pits. The material in the sand piles is  
3 generally a byproduct of the production of other marketable aggregate gradations such as road gravel and  
4 concrete aggregate. Initial assumptions were that since this material was readily available and could be  
5 obtained by the Program for a relatively low cost, it would be a good source of augmentation material.  
6 Sampling of the sand piles at six of the operations in the vicinity of the Project identified a D50 of  
7 approximately 0.50 mm, which is well within the finer D50 range identified by the BOR modeling.  
8 Modeling simulations were conducted using the 150,000 t/y sediment deficit in the Cottonwood Ranch  
9 subreach as the volume of augmented material. Results of the sediment-transport modeling indicated that  
10 the addition of 150,000 t/y of this finer sediment still resulted in a 40,000 to 60,000 t/y deficit in the reach  
11 that includes Cottonwood Ranch (Overton Bridge to Elm Creek Bridge; Subreach 3 in the model) under  
12 the most favorable alternatives (sand pumping alternatives). The reason that the deficit is not fully  
13 addressed is that a significant amount of the finer material flushes through the system without providing  
14 any benefit at Cottonwood Ranch. Various iterations of the sand pump and dozer options all resulted in  
15 continued sediment deficits using the finer sand material. Further modeling simulations indicated that it  
16 was not until 300,000 t/y of the fine material was augmented into the river that the river approached a  
17 balanced sediment condition at the upstream end of Cottonwood Ranch. Adding this volume of sediment  
18 to the river is likely not feasible from a cost standpoint and could have negative consequences on  
19 downstream landowners.

20  
21 To minimize the problem of the finer sediment flushing through the system, a gradation with larger  
22 material was evaluated. Bed material data from samples collected within the Project reach indicated that  
23 the existing bed material has a gradation with a D50 of approximately 1.2 mm in diameter and a larger  
24 fraction of gravel than the finer material discussed above. Results using the coarser material under the  
25 most favorable alternatives (those with at least one augmentation location downstream of the confluence  
26 of the North and South channels) indicate that there is significant additional reduction in the sediment  
27 deficit in the Cottonwood Ranch subreach (23,000 t/y as opposed to 73,000 t/y), although sediment  
28 balance is still not achieved. However, increased deposition of augmented material occurs with the  
29 coarser material in the vicinity of the insertion points that are located in areas with low hydraulic energy.  
30 Under alternatives using only augmentation locations on Cook/Dyer upstream of the confluence,  
31 augmenting with the coarser material would be less effective than using the finer material due to the low  
32 hydraulic energy at the insertion points. This deposition could lead to increased flooding or other  
33 potentially adverse flow conditions.

34  
35 The optimal augmentation material gradation for sediment augmentation is not known. There may not be  
36 an optimal gradation of material that economically meets the goal of eliminating 100 percent of the  
37 sediment deficit without causing adverse impacts on local flow conditions (i.e., flooding) or downstream  
38 landowners. In order to alleviate some of the risk and uncertainty associated with quantity of  
39 augmentation material needed and what gradations are required, a sediment-transport monitoring program  
40 that includes measurements of sediment flux will need to be developed. A sediment budget can then be  
41 developed to aid in determining how much and what size of material needs to be added to the river over  
42 the long term to sustain habitat for the target species. A pilot study could be developed and incorporated  
43 into the Project to determine actual river response to the addition of sediment to the system. In addition,  
44 development of a two-dimensional model would be an addition to the existing modeling suite.

### 45 **13.2.2 Potential Additional Modeling Simulations**

46 Although the range of alternatives and scenarios modeled under this Project provides a thorough  
47 evaluation of potential augmentation options, additional modeling efforts may be beneficial to further  
48 refine the preferred augmentation alternatives during final design and implementation. Additional  
49 modeling scenarios that may be helpful include:

- 1 • Determination of the volume of material similar in size and gradation to the existing bed material  
2 that would be required to achieve sediment balance at Cottonwood Ranch
- 3 • Determination of the effects that material would have on localized bed elevations in the vicinity  
4 of the insertion locations
- 5 • Determination of the impact of using multiple augmentation locations downstream of the North  
6 and South Channel confluence

### 7 **13.3 Requirement of a Location Downstream of the Confluence of the North and** 8 **South Channels**

9 Based on the results of the modeling simulations and assuming availability of a coarser sediment supply,  
10 augmentation at a location downstream of the confluence of the North and South channels is preferred to  
11 augmentation in the South Channel. The reason is that the downstream location more efficiently  
12 addresses the sediment deficiency at the upstream end of Cottonwood Ranch. The model simulations  
13 provided a reasonable estimate of the effects of augmentation in the South Channel. On the Cook/Dyer  
14 properties, the fine sand pit material is more effective at reducing the deficit and bed degradation at  
15 Cottonwood Ranch than the coarse gradation found in the existing bed material; the fine gradation is more  
16 readily entrained and transported to the downstream degradational reaches than the coarse gradation.  
17 However, a significant portion of the finer material is transported through the degradational reaches,  
18 thereby limiting the benefits that can be achieved with this material. To achieve sediment balance, the  
19 amount of the fine material introduced at these locations needs to be twice the actual modeled deficit.

### 20 **13.4 Availability of Augmentation Locations Downstream of Confluence**

21 This availability of augmentation locations downstream of the confluence has a direct correlation with the  
22 above-mentioned uncertainty related to the augmentation effectiveness at Cook/Dyer. Modeling  
23 simulations indicate that the most effective augmentation occurs at locations downstream of the  
24 confluence using relatively coarse sand material. The Program does not control any property between the  
25 confluence of the North and South channels and Cottonwood Ranch. This results in reliance on the use of  
26 private property as an augmentation location. There are two active sand pit operations on the north bank  
27 of the river downstream of the Overton Bridge. The Program has been in contact with the owner of  
28 OS&G. The assumption in the alternative development and evaluation was that downstream  
29 augmentation would be conducted at OS&G. However, the other sand pit, Carl Whitney Sand and  
30 Gravel, could also be used. There are also properties on the south side of the river that may be suitable as  
31 augmentation sites. As stated above, the more augmentation that occurs downstream of the confluence,  
32 the more effective the sediment augmentation is due to increased stream power below the confluence.  
33 The number and location of sand pump sites could be tested in the pilot program.

34 There is also some uncertainty as to the specific arrangement that would need to be made between the  
35 Program and private landowners, what properties might be available, and whether any or all of the  
36 landowners would be willing to work with the Program.

### 37 **13.5 Technologies**

38 There are several uncertainties that have been identified with potential production and delivery  
39 technologies. If an optimal gradation of the material can be determined, that material will require  
40 processing in order to meet the optimal gradation. It may not be practical or cost effective to produce a  
41 specific gradation solely for the purpose of augmenting sediment as part of the Project. In the Platte  
42 Valley and elsewhere, specific aggregate gradations are generally produced using a series of screens to  
43 separate out various sizes of aggregate as it is pumped from the pit. The screens progress from a larger to  
44 a smaller diameter as the larger fractions are separated out. The more screens required and the smaller the

1 screen size, the more likely the screens are to plug and the more difficult it is to produce the desired  
2 product. The existing technology commonly used to produce aggregates may not be able to effectively  
3 differentiate between the small grain sizes needed for this Project. There is effectively little difference  
4 between 0.5 mm and 1.0 mm with this technology. Rotary aggregate wash machines and aggregate  
5 classifiers (a combination of gravity and air) are used to provide fine aggregate gradations; however, they  
6 are not readily available locally (there is only one known operation in the state) and are expensive pieces  
7 of equipment to acquire. Also, if a specific aggregate gradation is processed to meet the Project goal, the  
8 byproducts left may not be marketable without additional processing. That would make it less attractive  
9 for a contractor or would result in higher unit costs.

10  
11 Sand pumps and slurry pipelines are commonly used to move materials. Though major problems with the  
12 use of this technology are not anticipated, there are no analogous projects for comparison on the river.

13  
14 The use of dozers in the Platte River is not uncommon; however, there are limitations as to where dozers  
15 can effectively operate. Dozing macroforms into the channel from on top is much easier than trying to  
16 distribute material across active channels as the river continues to flow. The configuration of  
17 windrows/sand plugs in the river would affect the productivity and effectiveness of dozers if one of those  
18 options is implemented.

### 19 **13.6 Effects on Downstream Landowners**

20 The effect of the Project on downstream property owners is not known. Some of the augmented sediment  
21 will pass through the system and continue downstream, where it will potentially settle out at some point.  
22 Landowners in the vicinity of the augmentation could also be affected by flooding that could result from  
23 deposition in the vicinity of the insertion points.

### 24 **13.7 Effects on Local Roads**

25 The assumption is that if imported materials are used, they can be safely transported on the local road  
26 network. Truck hauling is not expected to significantly detract from any of the options because there are  
27 numerous sand and gravel operations in the vicinity of the Project, resulting in significant continuous  
28 truck traffic unrelated to this Project. However, the exact route distance and conditions of the local roads  
29 is unknown and could influence the effectiveness of alternatives requiring substantial trucking.

### 30 **13.8 Variation in Market Conditions**

31 The cost of implementing any augmentation alternative will depend on market conditions at the time. In  
32 order to implement the Project, the assumption is that the Program will hire a contractor rather than  
33 acquire the equipment and operators necessary to complete the work. The work will be competitively bid,  
34 with the lowest qualified bidder selected to complete the work. The bids will be affected by workloads of  
35 the firms bidding and how many potentially competing jobs there are at the time. For example, if large  
36 road projects are occurring at the same time, the availability of augmentation material, trucks, and/or  
37 contractors to do the work may be limited and bids may be higher. For off-site source material, the  
38 assumption is that there will be a readily available supply of material to purchase or acquire and a  
39 sufficient number of trucks to deliver the material.

40  
41 Under alternatives in which the source material is produced from pits on Program property, aggregate  
42 produced that is not suitable for the Project could be sold on the open market, likely through the  
43 contractor selected to set up and operate the sand pit. The Program would be directly competing with  
44 other producers, and the amount of compensation to the Program for material taken from their property  
45 would depend on the demand for the material. If it is necessary to produce a specific aggregate gradation

1 to meet the Project goal, the byproducts left may be less marketable if they need to undergo additional  
2 processing or blending to meet specifications.

### 3 **13.9 Long-Term Effects**

4 Alternatives were evaluated over a 10-year period that coincides with the end of the Program’s first  
5 increment. Long-term effects beyond 10 years were not evaluated. If the Project is successful, there is a  
6 potential that sediment augmentation will occur for a very long time. The effects of long-term sediment  
7 augmentation may need to be evaluated.

### 8 **13.10 Water Permits**

9 Several alternatives could require the diversion of natural flow from the river. For example, water may be  
10 diverted and used to remix and entrain sediment and then discharged back to the river. In those instances,  
11 coordination with the Nebraska Department of Natural Resources (DNR) will be required. Nebraska  
12 statutes require a permit for all diversions of surface water for irrigation, hydropower, industrial use,  
13 municipal use, domestic use, storage, and other uses. The requirements are explained under Nebraska  
14 Title 457 – Department of Natural Resources Rules for Surface Water. Because the Study area includes  
15 locations that are within a moratorium or stay area, a petition of variance may be required; the petition of  
16 variance would describe the operation and address items such as consumptive use offsets. It would be  
17 necessary to demonstrate that the Project would be a beneficial use of the water in the public interest.  
18 DNR could then issue a permit allowing the natural diversion of water for the Project.

### 19 **13.11 Adaptive Management Process to Address Uncertainty**

20 The Project is designed as an experiment to test a specific hypothesis (Flow-Sediment-Mechanical  
21 Strategy [Clear/Level/Pulse or FSM]) developed as part of the Program’s AMP. This systematic process  
22 of “learning by doing” involves evaluation of alternative hypotheses by applying an experimental  
23 management program and improving management decisions in ecosystems based on knowledge gained  
24 from those management actions.

25  
26 The process of Adaptive Management is used in situations where it is uncertain how actions taken will  
27 affect the outcome but decisions regarding management actions must be taken despite the unknowns.  
28 Monitoring and directed research are designed to reduce uncertainty and move decisions forward. It is a  
29 process of using the best available science to test hypotheses, implement management experiments or  
30 actions, learn from the results, and revise actions as required. It should be pointed out that there are no  
31 “true” alternatives that will completely resolve Priority Hypothesis Sediment #1. However, the results of  
32 this Study point to a reasonable set of alternatives that, if implemented even at some level, will lead to a  
33 better understanding and improved knowledge of this system. Information and data acquired in the  
34 process can be used to enhance the selection of long-term management decisions related to sediment  
35 augmentation.

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## 14. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

### 14.1 Summary

In December 2008, the Program's Adaptive Management Working Group developed a sediment augmentation adaptive management experiment, to be implemented in the 2009 – 2013 timeframe, to test the following hypothesis: *Average sediment augmentation near Overton, Nebraska, of 185,000 tons/year (t/y) under the existing flow regime and 225,000 t/y under the flow regime proposed by the Governance Committee achieves a sediment balance to Kearney, Nebraska.* This hypothesis, referred to as Priority Hypothesis Sediment #1 in Program documents, is based on modeling performed by BOR. The Program initiated the Study to investigate the potential of implementing the Project to correct the sediment imbalance in the Project reach. The 32-mile Project reach extends from above the Lexington Bridge, at approximately RM 255, to the Odessa Bridge, at RM 224 (Figure 1-1).

The Program will implement the sediment augmentation management action under the FSM strategy developed as part of the Program's AMP. This systematic process of "learning by doing" involves evaluation of alternative hypotheses by applying an experimental management program and improving management decisions in ecosystems based on knowledge gained from those management actions.

The assumption from Program documents is that sediment can be mechanically placed into the river at a rate that will eliminate the sediment deficiency and restore a balanced sediment budget. The Program has identified a location within the Project reach, just upstream of NPPD's Cottonwood Ranch, as the preferred location to evaluate the effectiveness of the Project.

Baseline steady-state hydraulic and sediment-transport models using the USACE HEC-RAS program were developed and calibrated for the Project reach. Results from the baseline sediment-transport model indicated that, on an average annual basis, the overall sediment deficit along this reach is approximately 152,000 t/y. The modeling of the alternatives was carried out to evaluate the effects of individual components (such as material gradation) of the various alternatives in the context of the other components (such as delivery technology and location). Although each underlying component associated with the eight identified alternatives was modeled, the ultimate assembly of each alternative may not have been explicitly modeled. However, results from the available model runs were sufficient to evaluate each of the alternatives, either through direct modeling or extrapolation of the results from similar model runs. The modeling effort was an iterative process, with model results helping to inform the development and modification of alternatives in an attempt to identify a range of alternatives that best address the sediment deficit. The modeling concluded that it is unlikely any of the identified alternatives would be 100 percent effective in eliminating the sediment deficit at the Cottonwood Ranch location.

The identification and development of alternatives started with the pre-screening of the components which would make up an alternative, listed below. The components were studied to determine a matrix of options that could be assembled into alternatives.

- Augmentation delivery locations
- Sediment sources
- Sediment production and delivery techniques
- Delivery timing
- Augmentation material gradation

These components underwent an initial screening to eliminate options that were determined not feasible, primarily from the standpoint of cost or implementability. Once the initial screening was completed, the options that were retained were assembled into a set of unique sediment augmentation alternatives.

1 Where appropriate, alternatives that did not represent a unique solution, or did not offer some advantage  
 2 that warranted consideration were eliminated. In addition, the various permutations of each combination  
 3 were evaluated to determine if a “hybrid” alternative would be feasible. Table 14-1 presents the range of  
 4 feasible alternatives assembled.

5 **Table 14-1 Range of Feasible Alternatives**

Augmentation Delivery Locations	Sediment Sources	Sediment Delivery Technologies	Timing	Augmentation Material Gradation
Cook Tract/ Dyer Property	Cook Tract/Dyer Property	Sand pump	August 1 <sup>1</sup>	D50~0.5 mm <sup>2</sup>
Existing sand and gravel operations at Overton Interchange	Existing sand and gravel operations	Dozers (sand plug)		D50~1.2 mm <sup>2</sup>

6 *Notes:*

7 <sup>1</sup> Review of modeling results suggest that pumping start dates have relatively little effect on the amount that the  
 8 sediment deficit is reduced. The August 1 pumping start date was retained for evaluation purposes because it  
 9 avoids ecologically important timeframes, offers the most flexibility, and some time buffer when compared to a  
 10 September 1 start date.

11 <sup>2</sup> If the augmentation delivery location is on the South Channel, then a fine grain material (similar to the OS&G  
 12 sand piles) is required to avoid excessive aggradation in the vicinity of the discharge location. Conversely, if the  
 13 augmentation delivery location is downstream of the confluence of the North and South channels, such as OS&G,  
 14 then a coarser material is required to provide more sediment transport to the deficit at Cottonwood Ranch.

15  
 16 Table 14-2 presents the alternatives that were assembled for further evaluation.

17 **Table 14-2 Alternatives**

Alternative	Augmentation Delivery Locations	Sediment Source	Delivery Technology	Analysis Type <sup>3</sup>
1	Cook Tract/Dyer Property (two locations)	Imported <sup>1</sup>	Sand pump	Sediment-transport model
2	Cook Tract/Dyer Property (two locations)	On site <sup>2</sup>	Sand pump	Extrapolated results from sediment-transport model <sup>4</sup>
3	Cook Tract/Dyer Property (two locations)	Imported <sup>1</sup>	Dozer (sand plug)	Hydraulic and sediment-transport modeling
4	Cook Tract/Dyer Property (two locations)	On site <sup>2</sup>	Dozer (sand plug)	Hydraulic and sediment-transport modeling
5	Cook Tract/Dyer Property (two locations) and OS&G (one location)	Imported <sup>1</sup>	Sand pump	Extrapolated results from sediment-transport model <sup>5</sup>
6	Cook Tract/Dyer Property (two locations) and OS&G (one location)	On site <sup>2</sup> / Imported <sup>1</sup>	Sand pump	Extrapolated results from sediment-transport model <sup>5</sup>
7	Cook Tract/Dyer Property (two locations) and OS&G (one location)	Imported <sup>1</sup>	Dozer (sand plug)	Extrapolated results from hydraulic and sediment-transport model <sup>6</sup>
8	Cook Tract/Dyer Property (two locations) and OS&G (one location)	On site <sup>2</sup> / Imported <sup>1</sup>	Dozer (sand plug)	Extrapolated results from hydraulic and sediment-transport model <sup>6</sup>

18 *Notes:*

19 <sup>1</sup> Imported from existing sand and gravel operation (purchased). Material from off-site sources would be hauled to

1 *the augmentation delivery locations, where it would be temporarily stockpiled prior to being introduced into the*  
 2 *river.*  
 3 <sup>2</sup> *Acquired from Program-controlled property. Material from on-site sources would be from a sand pit dredge*  
 4 *operation established at or near the augmentation delivery location (discussed in Section 5).*  
 5 <sup>3</sup> *Refer to Appendix B for discussion of modeling and analysis.*  
 6 <sup>4</sup> *Results from sediment-transport modeling of pumping at Sites 1 and 2 were used for evaluating this alternative.*  
 7 <sup>5</sup> *Results from sediment-transport modeling of pumping at Sites 1, 2, and 4 were used for evaluating this alternative.*  
 8 <sup>6</sup> *Results from hydraulic and sediment-transport modeling of dozer options at Cook Tract/Dyer Property and*  
 9 *baseline sediment-transport model in the vicinity of OS&G were used for evaluating this alternative.*

10  
 11 Alternative evaluation criteria were established to allow for the objective side-by-side comparison of the  
 12 alternatives. The Section 404(b)(1) Guidelines were used as a starting point for identifying the evaluation  
 13 criteria. A total of eight evaluation criteria in four Section 404(b)(1) Guideline categories were identified,  
 14 as listed in Table 14-3:

15 **Table 14-3 Evaluation Criteria**

<b>Evaluation Criteria</b>	<b>Alternative Evaluation Criteria</b>	<b>Section 404(b)(1) Guidelines Practicability Criteria</b>
1	Cost per ton of delivered sediment	Cost
2	Delivery timing	Existing technology
3	Implementability	Logistics
4	Permittability	Logistics
5	Long-term viability	Logistics
6	On-site sediment availability	Logistics
7	Percent effective	Project purpose
8	Provision of other Program benefits	Project purpose

16  
 17 Each feasible alternative was evaluated against the eight evaluation criteria, and the feasible alternatives  
 18 were compared side by side, as shown in Table 14-4. None of the alternatives fully meet the Project's  
 19 need, in that none of the alternatives fully eliminate the sediment deficit. Therefore, the side-by-side  
 20 comparison allows the reader to better understand the relative advantages and disadvantages of each  
 21 alternative. The Study points to a reasonable set of alternatives that, if implemented, will allow for a  
 22 better understanding and improved knowledge of this system. The information and data acquired in the  
 23 process can be used to enhance the selection of long-term management decisions related to sediment  
 24 augmentation.

1

Table 14-4 Summary of Alternatives Analysis

2

<b>Evaluation Criteria</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
<b>Cost</b>								
Cost per ton delivered	\$14.40	\$11.83	\$17.28	\$14.23	\$13.38	\$11.90	\$16.08	\$15.43
<b>Existing technology</b>								
Delivery timing	3.5 months	3.5 months	1-2 months	1-2 months	2.3 months	2.3 months	1 month	1 month
<b>Logistics</b>								
Implementability	Low difficulty	Medium difficulty	Low difficulty	Medium difficulty	Low difficulty	Medium difficulty	Low difficulty	Medium difficulty
Permitting	High difficulty	High difficulty	Medium difficulty	Medium difficulty	High difficulty	High difficulty	Medium difficulty	Medium difficulty
Long-term viability	10+ yrs	10+ yrs	10+ yrs	10+ yrs	10+ yrs	10+ yrs	10+ yrs	10+ yrs
On-site sediment availability	No	Yes	No	Yes	No	Partial	No	Partial
<b>Project purpose</b>								
Percent effective	30 – 60	30 – 60	30 – 40 (max.)	30 – 40 (max.)	60 – 80	60 – 80	>40	>40
Provision of other Program benefits	No	Yes	No	Yes	No	Yes	No	Yes

3

*Note:*

4

<sup>1</sup> See Section 12.4.3 for a summary of effectiveness.

1 **14.2 Conclusions**

2 Modeling results indicated that the location of the augmentation sites relative to Cottonwood Ranch is a  
3 significant factor in determining effectiveness in meeting the sediment balance goal. Generally,  
4 augmentation sites in closer proximity to Cottonwood Ranch are more effective (i.e., the closer the river  
5 is to sediment balance). Two commercial sand and gravel operations are located downstream of the  
6 confluence, and it is assumed that a commercial arrangement could be negotiated to use either location as  
7 the augmentation site. In addition, Program staff could initiate discussions with other private property  
8 owners located in this reach of the Platte River to investigate potential interest or availability of  
9 augmentation locations.

10 The modeling also indicated that particle size is a significant factor in the effectiveness of meeting  
11 sediment balance. In general, material that is too coarse may settle out before it reaches the Cottonwood  
12 Ranch location (especially if delivered in areas with low hydraulic energy), and finer material flushes  
13 through the system. Determining the optimal balance between coarse and fine material in order to  
14 achieve the maximum effectiveness and the most cost-effective technology to produce the optimal  
15 particle size will require some testing and experimentation.

16 The modeling evaluated several different configurations for the placement of sediment piles using the  
17 dozer options. Some configurations were more effective, but none reached the effectiveness of the sand  
18 pump options.

19 Based on the available modeling, none of the alternatives would likely fully achieve the Project purpose.  
20 In order to eliminate the deficit using the readily available augmentation material at the local sand pit  
21 operations, the volume of material added to the river would have to be slightly more than doubled due to  
22 the amount of the finer gradation material that is flushed downstream. This would essentially double the  
23 total 10-year cost and there could be potential impacts on downstream infrastructure (e.g., Kearney Canal  
24 Diversion) from the material flushed through the system. The Program is instituting a monitoring plan to  
25 evaluate this potential.

26 **14.3 Recommendations**

27 Given the constraints of the split flow conditions around Jeffrey Island, perennial sediment deficiencies,  
28 and augmentation delivery location constraints, none of the identified alternatives would fully achieve  
29 sediment balance at Cottonwood Ranch. In addition, as discussed in Chapter 13, several major  
30 uncertainties remain that should be evaluated and tested. Alternatives 6 and 8 have the advantage of  
31 incorporating a discharge location downstream of the confluence of the North and South channels while  
32 also utilizing some sediment from Project-owned property. Alternatives 6 and 8 also have a relatively  
33 low cost per delivered ton of sediment and have the potential to provide other Program benefits.  
34 However, even though these alternatives have a high level of effectiveness, they both fall short of fully  
35 meeting the Project goal.

36 Therefore, the recommended action is to design and implement a pilot-scale experiment (to address  
37 sediment volume, material size, and augmentation location) based on Alternatives 6 and 8 and to develop  
38 a monitoring plan to determine if the experiment is successful. The model would be updated based on the  
39 results of the pilot study. A two-dimensional model would also be instructive in understanding pilot  
40 study results and further analyzing full-scale sediment augmentation processes. Once the results of the  
41 pilot-scale experiment are evaluated and combined with the results of the modeling, a final design for the  
42 Sediment Augmentation Experiment Project could be completed. The pilot study would be designed to  
43 provide answers to some of the most important areas of uncertainty, including the following:

- 44 • Testing to determine the optimal particle size
- 45 • Technology to produce the optimal particle size

- 1 • Timing and duration of annual augmentation activities
- 2 • Effects of reducing some but not 100 percent of the sediment on providing habitat benefits
- 3 • Cost associated with the commercial acquisition of sediment
- 4 • Timing and difficulty of obtaining required permits for the augmentation
- 5 • Optimal location and windrow/sand plug configuration for augmentation
- 6 • Potential for adverse downstream effects

7 As part of the final design, monitoring plan would need to be refined prior to implementation of both the  
8 pilot-scale and full-scale implementation of the Project. The monitoring plan would be consistent with  
9 the Integrated Monitoring and Research Plan (IMRP) described in the Program's AMP. Specifically, the  
10 IMRP's Program Level Monitoring and Research protocol as well as the Research Protocol for NPPD's  
11 Cottonwood Ranch would provide guidance in developing the monitoring plan.  
12

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5



# **APPENDIX A**

## **SEDIMENT AUGMENTATION PERMITTING**

# Appendix A

## Sediment Augmentation – Section 404 Strategy

### 1.1 Permit Background

In April 2006, a Final Environmental Impact Statement (FEIS) was completed by U.S. Department of the Interior (USDI) to address a proposed basinwide, cooperative Platte River Recovery Implementation Program (Program) that would meet obligations under the Endangered Species Act. The Corps of Engineers (USACE) was a cooperating agency in the preparation of the FEIS.

Various concepts were analyzed in the FEIS that would integrate measures to improve the quality of the central Platte River habitat for the four threatened and endangered target species—whooping crane, interior least tern, piping plover, and pallid sturgeon—using the Central and Lower Platte River in Nebraska. Each concept included a sediment augmentation experiment (Project) to rectify the sediment imbalance in the Platte River system. The Project would unavoidably involve the discharge of dredged and/or fill material into the Platte River, which is a water of the U.S.<sup>1</sup>, and would therefore require authorization from USACE under Section 404 of the Clean Water Act (Section 404).

The USACE Section 404 regulatory process involves two types of permits: general permits for actions that are similar in nature and will likely have a minor effect on wetlands, and individual permits for discharges not covered by a general permit, typically an action that may have more than minimal impact. A nationwide permit is a form of general permit that authorizes a category of activities throughout the nation and is valid if the conditions applicable to the permit are met. The USACE has stated that, because the Program's mission is to assist in the recovery of targeted threatened and endangered species, activities consistent with the FEIS (such as sediment augmentation) would potentially qualify for coverage under Nationwide Permit 27 – Stream and Wetland Restoration Activities (NWP 27) (see attached USACE, June 23, 2006 letter).

Therefore, the first step in the proposed permitting approach will be to determine if the Project qualifies for authorization under NWP 27. If, for whatever reason, the Project is not authorized under NWP 27, authorization under either a regional general permit or an individual permit will be required.

### 1.2 Lead Agency Determination

The USACE Omaha District, Nebraska Regulatory Office is responsible for evaluating permit applications on the Platte River in Nebraska on behalf of USACE.

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<sup>1</sup> *Waters of the U.S. include lakes, rivers, streams, oxbows, ponds, and wetlands such as prairie potholes, wet meadows, marshes, swamps, and bogs (33 CFR 328.3).*

Because the Program has a history of Bureau of Reclamation (BOR) involvement, USACE has sought clarification concerning any ongoing responsibility that BOR has for the Program in a letter dated June 11, 2010. Responding in letters dated July 9, 2010, and October 19, 2010 (see attached letters), BOR provided clarification of its responsibilities as a federal agency involved in the Program, which indicated:

- USDI provides non-reimbursable funding to the Program, similar to a grant.
- BOR's role is to participate on the Governance Committee and other advisory committees. BOR's role on the committee is the same as that of other participants and does not signify that it is responsible for, or leads, the Program.
- There is no lead federal agency for the Program.

Should the Program seek a Section 404 permit, USACE would be the responsible lead federal agency of the specific permit action. Issues such as compliance with the Endangered Species Act and the National Historic Preservation Act may need to be discussed in the pre-construction notice, as discussed below.

### **1.3 Section 404 Permitting Process**

The following actions are required for Section 404 permitting under NWP 27, in advance of any discharge of fill material:

- Wetland Delineation and Functional Assessment
- Pre-Application Consultation Meetings
- Pre-Construction Notice (PCN) Preparation

#### **1.3.1 Wetland Delineation and Functional Assessment**

Section 404 permitting requires completion of wetland delineations of the source location(s) of sediment, the location of sediment introduction into the system, and the potential area of effect of the Project. A functional assessment using the methodology developed for the 2010 in-channel habitat will be used to assess wetland functions of affected wetland areas and anticipated creation of habitat.

#### **1.3.2 Pre-Application Consultation Meetings**

Pre-application consultation meetings have been conducted in coordination with USACE and the Section 404 permit commenting agencies. The purpose of the pre-application meetings was to discuss the Project; its potential impacts on aquatic resources; the minimization of effects, the functional change of affected resources in relation to created aquatic resources and habitat; and post-Project monitoring. The following summarizes the two meetings held with USACE, Nebraska Regulatory staff. Information from these meetings helped to form the strategy for preparing the required PCN.

##### **1.3.2.1 December 22, 2009**

A pre-application consultation meeting was held on December 22, 2009 with USACE and Program Staff resulting in the following summary points:

- Flow consolidation/sediment augmentation work will require conditions that are different from or additive to those of the NWP 27. The Program will need to demonstrate that the Project will have minimal effect on aquatic resources.
- USACE is concerned about bank stabilization to downstream land owners. If there is an actual or perceived problem, the new action may be identified as the potential cause. Secondary effects need to be considered as part of the evaluation.

- Minimal effect discussion is needed for work other than in-channel habitat. USACE has a history with in-channel work at Cottonwood Ranch. The first set of actions, such as sediment augmentation and flow consolidation, may require additional evaluation to show minimal impact. The Program will need to show that bank erosion is not an issue and to demonstrate that this can be facilitated with existing and proposed monitoring. The Program will also need to document the origin of fill material.

#### 1.3.2.2 **March 31, 2010**

A pre-application consultation meeting was held on March 31, 2010 with USACE, Section 404 Commenting Agencies, and Program Staff resulting in the following summary points:

- The meeting included a site visit to view potential augmentation sites and source material areas.
- Sediment transport may result in downstream impacts and will need to be evaluated and monitored.
- Program will need to demonstrate in its permit applications that impact on one habitat type is required in order to improve the function of a different habitat type. USACE recognized that a wetland providing a certain functional value in the form of riverine habitat might be changed to provide habitat for threatened and endangered species. Some of the required information is being collected through monitoring of the interior least terns and piping plovers to demonstrate how the areas are being used. The FEIS describes the alternatives that were considered and states why the preferred alternative provides the best opportunity for species recovery.
- U.S. Fish and Wildlife Service (USFWS) indicated that, as long as the Project is consistent with the range of actions covered by the FEIS and the associated biological opinion, the Project should be covered under the Section 7 consultation that occurred during preparation of the FEIS.

#### 1.3.3 **Section 404 Permit Pre-Construction Notice**

NWP 27 requires that a PCN be submitted to USACE. The PCN must include supplemental information that was identified during pre-application consultation meetings, including the following:

- **Demonstration of Minimal Effects** – It must be demonstrated that important aquatic and/or terrestrial habitats will not be affected at the sediment source and sediment delivery locations. In addition, Project-related secondary effects must also be considered. Secondary effects of the Project are those that are further removed in time or distance from the direct impacts. USACE is concerned about actual or perceived effects, such as bank stabilization on downstream properties. A review of this and other secondary effects (such as deposition and increased flood hazard) will be necessary to demonstrate that secondary effects of the Project are minimal.
- **Demonstration of a Net Increase in Functions** – Changes in functions resulting from Project impacts on aquatic resources will also need to be identified. Aquatic resources affected by the Project provide functions to the ecosystem, including species habitat. Similarly, the intent of the Project, and the Program as a whole, is to provide a means to recover targeted threatened and endangered species. A functional assessment that focused on habitat for targeted threatened and endangered species was established for the 2010 in-channel habitat projects. However, specific locations of habitat creation for this Project are not known. Therefore, it will be necessary to estimate the effects (change in function) that returning the Platte River system in this location to a state of sediment balance would have on habitat for targeted species.
- **Post-Project Monitoring** – The Program's monitoring protocol will provide a means for the physical assessment of pre-existing and post-Project conditions. The Program has developed detailed monitoring protocols at the Project site and other locations. These protocols will be

necessary to demonstrate to USACE that methods are in place not only to monitor success but also to identify potential secondary impacts. Finally, the Program should demonstrate its process in working with adjacent landowners should a real or perceived impact occur. These elements will likely be included as conditions of a permit.

#### **1.4 Section 404(b)(1) Permit Guidelines**

In its review of projects that require a Section 404 fill permit, USACE applies the Section 404(b)(1) Guidelines, developed jointly by the U.S. Environmental Protection Agency (EPA) and the USACE, to determine whether the proposed activities are permissible.<sup>2</sup> One of the primary determinations that USACE must reach under the Guidelines is whether there is a *practicable alternative* to the proposed discharge that would have less adverse impact on the aquatic ecosystem, so long as the alternative would not have other significant adverse environmental impacts. The permissible alternative under this test is frequently referred to as the least environmentally damaging practicable alternative or LEDPA (40 Code of Federal Regulations [CFR] 230.10(a)).<sup>3</sup>

The Guidelines define the term *practicable* to mean available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall Project purposes (40 CFR 230.10(a)(2)). Consistent with the requirements of the Guidelines, USACE evaluates the practicability of alternatives based on the four general criteria: 1) cost, 2) existing technology, 3) logistics, and 4) project purpose. Because implementing the sediment augmentation experiment will unavoidably result in the discharge of sediment into the Platte River, a Section 404 permit will be required. In order to provide USACE with an alternatives evaluation that will fulfill its permitting requirements the Program used the specific 404(b)(1) criteria used to evaluate experiment alternatives in the Study. USACE will be responsible for the 404(b)(1) Guideline evaluation, which will include consideration of alternatives, during the permitting process.

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<sup>2</sup> *The Guidelines, along with the public interest review and other federal laws, are the substantive criteria that USACE uses when reviewing an application to determine whether a Project is permissible.*

<sup>3</sup> *The river is already considered to be in a degraded state. Therefore, any alternative, except for No Action, is intended to improve the aquatic function of the river.*



DEPARTMENT OF THE ARMY  
CORPS OF ENGINEERS, OMAHA DISTRICT  
106 SOUTH 15<sup>TH</sup> STREET  
OMAHA NE 68102-1618

JUN 23 2006

District Commander

Mr. Curtis Brown, Manager  
Platte River EIS Office, PL-100  
PO Box 25007  
Denver, Colorado 80225

Dear Mr. Brown:

The Omaha District Corps of Engineers' Regulatory Branch has reviewed your agency's Final Environmental Impact Statement (FEIS) for the Platte River Recovery Implementation Program. As you are aware, the Omaha District previously provided comments November 12, 2003 on the preliminary Draft Environmental Impact Statement (DEIS) as well as amended comments to the DEIS in correspondence dated September 14, 2005. Our review of this FEIS was conducted in light of those issues identified, and our concerns have been adequately addressed.

Therefore, this correspondence focuses on the transition of the Corps as a cooperating agency to considerations for future regulatory compliance relative to our permitting authority under the provisions of Section 404 of the Clean Water Act. It is intended to set the stage for future review of site-specific actions associated with flow management/water delivery infrastructure changes and habitat restoration activities within the Central Platte River corridor. We recognize that the programmatic nature of the EIS and a final determination of potential permit requirements can only be accomplished as project proponents proceed toward more detailed feasibility and design phases.

As the Governance Committee proceeds in its project planning, we would wish to maintain dialog in order to determine potential permit requirements, permit application formulation, and identification of additional site-specific information requirements. This coordination, through pre-application consultation, will provide more streamlined permit reviews for those activities under our authority and timely identification of activities not subject to Section 404 permitting. I have enclosed more detailed information regarding future regulatory compliance needs that will assist the Governance Committee in future coordination with this office.

## Section 404 of the Clean Water Act: Future Regulatory Compliance Needs

### **1. NEPA (National Environmental Policy Act) Compliance relative to Reasonable Alternatives associated with the Governance Committee Alternative:**

The EIS (Environmental Impact Statement) states that the Governance Committee Alternative is the preferred alternative. This option involves the anticipated raising of Pathfinder Dam. The FEIS states that this proposed action does not appear to require authorization under Section 404. The Omaha District recognizes that the reconnaissance level of information in the EIS is adequate for your purposes and the intent of the EIS. We also appreciate the additional information contained in the Platte River EIS Screening Report in Volume 2 to address our concerns relative to the alternative screening of elements.

If a permit is not needed for the Pathfinder Dam raise then the level of documentation to date is satisfactory. However, if additional design (feasibility level) of the anticipated work reveals that the Pathfinder Modification Project requires authorization in accordance with Section 404 of the Clean Water Act, a more in-depth analysis will be needed to satisfy our permit review process. The FEIS further indicates that additional water supply from this action may be applied to uses other than those of the Recovery plan. In this event, the Corps will need to evaluate the purpose and need for the additional water supply by a more thorough alternatives analysis. Again, this assumes a nexus to Section 404 permitting.

### **2. Future Permit Requirements:**

For habitat restoration within the Central Platte River corridor, the Omaha District believes that the majority of actions to be undertaken to achieve the implementation of your preferred alternative will meet the requirements for authorization under some form of general permit, either Nationwide Permit 27 or through the establishment of a Regional General Permit.

For flow management activities, some actions may require Standard (Individual) permit reviews (e.g., Nebraska Off-stream Reservoir in the Central Platte and Pathfinder Modification) and would require substantially more information. We believe the level of information contained in the FEIS adequately supports the purpose and need for these types of actions and would be relied upon to satisfy any forthcoming Corps standard permit reviews. We intend to tier to the FEIS as much as practical in accordance with 40 CFR 1508.28 for these potential permit actions. We also recognize that either or both of these actions may be modified or designed such that no regulated discharges will occur in waters of the U.S. that are subject to Section 404 of the Clean Water Act. Additionally, it is perceived that hydrologic modification due to re-regulation efforts from existing facilities will not require authorization. However, if regulated discharges of dredge or fill material are needed (this can include the sluicing of sediment from reservoirs) to allow for these hydrologic modifications, then some of permitting will be required.

For site specific actions authorized by the Corps, monitoring and the associated success/failure determinations relative to the goals of the Recovery Program remain the responsibility of the Governance Committee or their appointed representative. The Corps may need to incorporate special conditions in permits on a project specific basis that parallel or overlap these responsibilities. Coordination will be required in such circumstances to ensure each agency addresses their respective procedural/substantive needs.

### **3. Future Information/Data Needs Associated with Section 404 Permitting:**

The level of detail and analysis relative to wetland impacts, monitoring, water quality and hydrological models is considered to be acceptable at the current level (reconnaissance) for your efforts. Please be aware that additional data collection and analysis will be required at the site-specific level for mechanical habitat modifications as well as associated flow alteration activities subject to section 404 permit reviews. A preliminary list of information needed for permit applications includes:

- Site identification and delineation of all waters of the U.S. in project area
- Type of action proposed: mechanical habitat restoration/alteration vs. flow management
- Identification of goals established in the EIS that a site-specific project is to address (e.g., resting habitat, feeding habitat, sediment source, etc.) and actions proposed to achieve those goals (e.g., vegetation conversion or elimination, hydrological modifications, etc.)
- Identification of wetlands/waters acreage to be impacted directly and indirectly by proposed action(s). Classification should follow the Cowardin et. al.(1979) system; complementary land use descriptive information should be used in conjunction with these data
- Documentation that ESA (Endangered Special Act) has been addressed
- Documentation that NHPA (National Historic Preservation Act) has been addressed
- For proposed channel change activities, geomorphological data (including plan, profile, and dimensions) and hydraulic analyses (HEC-RAS) may be needed for channel stability determinations.



MB MB  
CP

Thank you for the opportunity to comment on the FEIS. We consider our commitments as a cooperating agency to the EIS process completed. Ms. Martha Chieply, Chief, Regulatory Branch, or Mr. Michael Gilbert, Project Manager, can be contacted for continued assistance and coordination.

Sincerely,

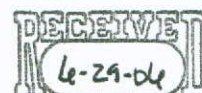
Signed

---

Joel R. Cross  
Lieutenant Colonel, Corps of Engineers  
District Commander

Copies Furnished:

CENWO-OD-R (Gilbert)  
CENWO-OD-RWY (Bilodeau/Peters)  
CENWO-OD-RCO (Carey)  
CENWO-OD-RNE (Rabbe)





IN REPLY REFER TO:

WY-4007  
ADM-13.00

# United States Department of the Interior

BUREAU OF RECLAMATION  
Great Plains Region  
Wyoming Area Office  
P.O. Box 1630  
Mills, Wyoming 82644-1630

JUL 09 2010

received  
7-12-10



Mr. John Moeschen  
U.S. Army Corps of Engineers  
Nebraska Regulatory Office  
Wehrspann Field Office  
8901 S. 154th Street  
Omaha, NE 68138-3621

Subject: Platte River Recovery Implementation Program Environmental & Regulatory Compliance

Dear Mr. Moeschen:

This is in response to Dr. Jerry Kenny's letter of June 11, 2010, in which he requested that the Bureau of Reclamation provide clarification to the United States Army Corps of Engineers (USACE) on "lead federal agency" responsibilities for Platte River Recovery Implementation Program (Program) activities as they relate to Clean Water Act permitting requirements and compliance with the National Environmental Policy Act and the Endangered Species Act.

The Program is a collaborative effort of its participants to implement actions to help recover listed species. The Program is formally governed and administered by a 10 member Governance Committee (GC) comprised of one representative each from Reclamation, U.S. Fish and Wildlife Service (Service), the states of Colorado, Nebraska, and Wyoming, Colorado Water Users, Downstream Water Users, Upper North Platte Water Users, and two representatives from environmental groups. The GC is responsible for Program implementation.

Reclamation's role in the Program is to participate on the GC and the various advisory committees as one of two representatives for the Secretary of the Interior and the other representative being the Service. The Department of the Interior funding is provided to the Program through Reclamation and is considered to be non-reimbursable funding similar to a grant. Reclamation's role and participation in the GC is the same as the other participants. Reclamation's participation in the Program does not imply or signify that it is responsible for, or leads, the Program.

It has been the intent of the Program since its establishment that all business between the Program and other entities would be conducted through the GC or its' designated representative (i.e. Executive Director). Attachment 2 (Milestones Document) (enclosed) to the Final Program Document clearly demonstrates that the Governance Committee is responsible for regulatory and

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environmental compliance as it relates to the implementation of Program land and water activities.

Section 4.4 of the Milestones document states:

*“The Governance Committee is responsible for acquiring the necessary permits for individual water related activities and for insuring compliance with all relevant local, state and federal laws and regulations.”*

Section 5.2 of the Milestones document states:

*“The Governance Committee will insure the acquisition of necessary permits for individual land protection and habitat restoration activities and for insuring compliance with all relevant local, state and federal laws and regulations.”*

The GC employs an Executive Director and staff whose role and responsibility is to carry out the day to day operations and other functions of the Program under direction of the GC. Accordingly, the GC working through the Executive Director and his staff is responsible for seeking and acquiring all necessary permits and regulatory compliance documents for the Program. Reclamation’s position is that the GC, through its Executive Director, is the designated party for site-specific applications for Clean Water Act regulatory permits and authorizations for Program projects and activities. Therefore, there is no “lead federal agency” for the Program.

If you have any questions regarding this matter, please contact me at 307-261-5671.

Sincerely,

JOHN H. LAWSON

John H. Lawson  
Area Manager

Enclosure

cc: Dr. Jerry Kenny  
Executive Director  
Platte River Recovery Implementation Program  
4111 4<sup>th</sup> Avenue, Suite 6  
Kearney, NE 68847

Regional Director, Billings, MT  
Attention: GP-1000 (Michael J. Ryan)

Deputy Regional Director, Billings, MT  
Attention: GP-1100 (Gary Campbell)

Resource Services, Billings, MT  
Attention: GP-4000 (Dan Fritz) (ea w/encl)

**PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM**

**ATTACHMENT 2**

**MILESTONES DOCUMENT**

PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM  
Attachment 2

Milestones Document

December 7, 2005

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## **I. PURPOSE OF MILESTONES**

During the First Increment of the Program, progress toward the Program objectives for Endangered Species Act (ESA) compliance purposes will be measured through the achievement of the Milestones. The Program will continue to serve as the ESA compliance for water related activities upstream of the confluence of the Loup River, Nebraska, so long as the Milestones are being met. The Governance Committee may change the Program's First Increment Milestones, provided such changes are consistent with accomplishing the First Increment Objectives.

## **II. MILESTONES**

The Milestones are as follows:

- 1. The Pathfinder Modification Project will be operational and physically and legally capable of providing water to the Program by no later than the end of Year 4 of the First Increment.**
- 2. Colorado will complete construction of the Tamarack I and commence full operations by the end of Year 4 of the First Increment.**
- 3. CNPPID and NPPD will implement an Environmental Account for Storage Reservoirs on the Platte System in Nebraska as provided in FERC licenses 1417 and 1835.**
- 4. The Reconnaissance-Level Water Action Plan, as may be amended by the Governance Committee, will be implemented and capable of providing at least an average of 50,000 acre-feet per year of shortage reduction to target flows, or for other Program purposes, by no later than the end of the First Increment.**
- 5. The Land Plan, as may be amended by the Governance Committee, will be implemented to protect and, where appropriate, restore 10,000 acres of habitat by no later than the end of the First Increment.**
- 6. The Integrated Monitoring and Research Plan, as may be amended by the Governance Committee, will be implemented beginning Year 1 of the Program.**
- 7. The Wyoming Depletions Plan, as may be amended with the approval of the Governance Committee, will be operated during the First Increment of the Program.**
- 8. The Colorado Depletions Plan, as may be amended with the approval of the Governance Committee, will be operated during the First Increment of the Program.**
- 9. The Nebraska Depletions Plan, as may be amended with the approval of the**



Governance Committee, will be operated during the First Increment of the Program.

10. The Federal Depletions Plan, as may be amended with the approval of the Governance Committee, will be operated during the First Increment of the Program.

### III. EXPLANATORY MATERIAL AND SCHEDULES

Following are explanatory materials and estimated time frames for anticipated interim steps that will be taken toward meeting each Milestone. The explanatory information and related interim steps and schedules are to be considered as background information and are not to be considered as individual Milestones for purposes of ESA compliance. The scheduling, whether in relation to the Milestones themselves or the explanatory material, is referenced to the term of the First Increment, which is thirteen years.

The explanatory material illustrates progress that all parties expect to see and may form the basis to begin discussions within the Governance Committee concerning whether the Program should adjust or alter its current methods and administrative processes in order to achieve the Milestone using a revised approach.

#### **1. The Pathfinder Modification Project will be operational and physically and legally capable of providing water to the Program by no later than the end of Year 4 of the First Increment.**

##### Explanatory Information

A description of the Wyoming's Pathfinder Modification Project is found in the Program Water Plan (Attachment 5, Section 4). Funding the construction of this project is Wyoming's responsibility. Because Pathfinder Dam and Reservoir are federal facilities, however, the United States Bureau of Reclamation (USBR) is responsible for meeting federal construction specifications and oversight.

1.1. The appropriate party (Wyoming, USBR or Nebraska) is expected to apply for the necessary approvals and permits during Year 1 of the Program. It is expected that such approvals and permits will be obtained in Year 2. The approvals will include appropriate compliance pursuant to the National Environmental Policy Act (NEPA). It is expected that the following approvals and permits will be necessary:

1.1.1. The USBR, with assistance from Wyoming, will seek an amendment to the federal authorization for the Pathfinder Reservoir to allow the water that is stored in the Pathfinder Modification Project to be used for environmental and municipal purposes in a manner consistent with Wyoming law.

1.1.2. The USBR will seek a partial change of use for its water right for Pathfinder Reservoir from the Wyoming Board of Control to allow the water stored in the Pathfinder Modification Project to be used for environmental and municipal

purposes.

1.1.3. Wyoming will seek approval from the Wyoming Legislature for the export of water for downstream environmental uses specific to the goals and duration of the Program.

1.1.4. Subject to the appropriate approvals and conveyance losses, Wyoming, in accordance with its law, will assure delivery of the storage water from the Pathfinder Modification Project designated for downstream environmental purposes to the Wyoming/Nebraska state line. A permit will be secured by Wyoming pursuant to Nebraska water law to conduct the designated environmental water to specified locations between the state line and Chapman, Nebraska. Beyond the state line, Nebraska will assure delivery of the water in accordance with the terms of any such permit granted and applicable Nebraska law.

1.2. Project construction will be initiated and completed by no later than the end of Year 3 of the Program. Final operational criteria will be developed by no later than the end of Year 3 of the Program. The Pathfinder Modification Project will be operational and capable of providing water to the Program by no later than the end of Year 4.

1.3. Environmental releases from the Pathfinder Modification Project will be provided in coordination with the FWS Environmental Account Manager in accordance with the stipulation entitled, "Amendment of the 1953 Order to Provide for the Modification of Pathfinder Reservoir."

1.4. Wyoming will develop an annual operations plan for the environmental account in the Pathfinder Modification Project and coordinate those plans with the FWS Environmental Account Manager.

**2. Colorado will complete construction of Tamarack I and commence full operations by the end of Year 4 of the First Increment.**

**Explanatory Information**

A description of Colorado's Tamarack I is found in the Program Water Plan (Attachment 5, Section 3). Funding the construction of this project is Colorado's responsibility. It is anticipated that the following tasks will be accomplished leading up to full operation of Tamarack Phase I for Program purposes:

2.1. Colorado will secure any necessary Colorado or federal authorizations and appropriate compliance under the National Environmental Policy Act (NEPA) prior to the end of Year 2 of the Program.

2.2. Colorado will construct and begin operation of 50% of the Tamarack I by the end of Year 2 of the Program.

2.3. Colorado will account for Tamarack I water passing to the Colorado-Nebraska state line. Nebraska initially will rely on accounting to track this water within Nebraska to the associated habitats. The effectiveness of this strategy to accomplish Program objectives will be assessed. In the event that permitting is deemed necessary to protect this water, Colorado will cooperate with Nebraska to enable acquisition of the needed permits.

2.4. Colorado will commence full Tamarack I operations by the end of Year 4, after consultation with the FWS's Environmental Account Manager to help Colorado maximize the benefit of its operations for Program purposes.

2.5. Colorado will develop an annual operations plan and coordinate that plan with the FWS's Environmental Account Manager.

**3. CNPPID and NPPD will implement an Environmental Account for Storage Reservoirs on the Platte System in Nebraska as provided in FERC licenses 1417 and 1835.**

Explanatory Information

“An Environmental Account for Storage Reservoirs on the Platte River System in Nebraska” (EA Document) is found in the Program Water Plan (Attachment 5, Section 5).

3.1. CNPPID will make contributions to the Environmental Account as set forth in its license, and will make releases from the Environmental Account as requested by the Environmental Account Manager in accordance with CNPPID's FERC-approved Administrative Plan.

3.2. Other water contributions may be provided to the Environmental Account as set forth in “An Environmental Account for Storage Reservoirs on the Platte River System in Nebraska” and as permitted and tracked by the Nebraska Department of Natural Resources (NDNR).

**4. The Reconnaissance-Level Water Action Plan, as may be amended by the Governance Committee, will be implemented and capable of providing at least an average of 50,000 acre-feet per year of shortage reduction to target flows, or for other Program purposes, by no later than the end of the First Increment.**

Explanatory Information

The terms “reduction in shortage”, “target flows”, and how water projects are evaluated to determine their contribution to reduction in shortage is described in the Platte River Recovery Implementation Program, Section III.E.

The combined three state water projects (Pathfinder Modification, Tamarack I, and the Nebraska Environmental Account) were evaluated and determined to provide an average reduction in shortage of 80,000 acre-feet per year. The combined effect of the original three projects and the Reconnaissance-Level Water Action Plan is intended to achieve the Program objective of “providing water capable of improving the occurrence of Platte River

flows in the central Platte River associated habitats relative to the present occurrence of species and annual pulse target flows.... by an average of 130,000 to 150,000 acre-feet per year as measured at Grand Island....” (Platte River Recovery Implementation Program, Section III.A.3.b.(1)). Therefore, the Reconnaissance-Level Water Action Plan is intended to provide an average of at least 50,000 acre-feet per year reduction in shortage in addition to the three state water projects.

As Reconnaissance-Level Water Action Plan projects move forward from the reconnaissance level, to feasibility, to project implementation, the reduction in shortage credited to an individual project will remain as evaluated and agreed upon by the Governance Committee prior to project implementation, so long as the project is implemented in general and reasonable conformance with the project description. That amount of reduction in shortage for the Reconnaissance-Level Water Action Plan project will be credited towards the completion of Milestone 4, and is not dependent upon annual or day-to-day management decisions made by the Environmental Account Manager or future variations in hydrologic conditions during the First Increment.

The Program’s Reconnaissance-Level Water Action Plan is found in the Program Water Plan (Attachment 5, Section 6). The following steps are necessary to implement the Water Plan and are needed to successfully complete Milestone 4.

4.1. The Governance Committee is responsible for allocating funds necessary to implement the Reconnaissance-Level Water Action Plan in accordance with the Program budget, as approved by the signatories and may be revised by the Governance Committee.

4.2. The Governance Committee is responsible for acquiring the necessary permits for individual water related activities and for insuring compliance with all relevant local, state and federal laws and regulations.

4.3. The Governance Committee will determine which projects in the Reconnaissance-Level Water Action Plan are retained through the reconnaissance, feasibility, and implementation level. Water related activities implemented in accordance with the Water Plan will be credited to the Program’s long-term objective as set forth in the Platte River Recovery Implementation Program, Section III.A.3.a.(1) and the objective for the First Increment of the Program. As appropriate, the Governance Committee will develop and use protocols to determine what quantities of water are to be credited to the individual projects.

4.4. Recognizing that the initial Reconnaissance-Level Water Action Plan (Attachment 5, Section 6), is based on reconnaissance level project evaluations, the Governance Committee will complete feasibility studies on proposed projects and develop a Water Action Plan, if necessary, by the end of Year 3 of the First Increment.

4.5. This Water Action Plan, as may be amended by the Governance Committee, will be capable of providing at least an average of 25,000 acre-feet per year of shortage reduction to target flows, or for other Program purposes, by the end of Year 8 of the First Increment.

4.6. The Governance Committee will ensure that projects implemented under this Water Action Plan are operated in accordance with approved operating plans and that they are having the intended effects on Program purposes.

4.7. The Governance Committee will ensure that water produced by projects implemented under this Water Action Plan is included in approved tracking and accounting procedures and that these projects are coordinated with other Program activities including other water projects and with the management of the Environmental Account.

**5. The Land Plan, as may be amended by the Governance Committee, will be implemented to protect and, where appropriate, restore 10,000 acres of habitat by no later than the end of the First Increment.**

Explanatory Information

The Program's Land Plan is found in Attachment 4. The following steps are necessary to implement the Land Plan and are needed to successfully complete Milestone 5.

5.1. The Governance Committee is responsible for allocating the Land Plan funds in accordance with the Program budget, as approved by the signatories and may be revised by the Governance Committee.

5.2. The Governance Committee will insure the acquisition of necessary permits for individual land protection and habitat restoration activities and for insuring compliance with all relevant local, state and federal laws and regulations.

5.3. Land protected in accordance with the Land Plan and land acquired by or on behalf of existing water related activities completing ESA Section 7 consultation prior to the Program will be credited to the Program's long-term objective as set forth in Platte River Recovery Implementation Program, Section III.A.3.a.(2), and the objective for the First Increment of the Program.

5.4. NPPD is responsible for implementing the Cottonwood Ranch Development Plan as approved by FERC, in accordance with Article 407 of the license for Project 1835 and the settlement agreement. The Governance Committee will fund the habitat maintenance plan for the NPPD Cottonwood Ranch Property in accordance with the FERC License and the settlement agreement. The Governance Committee will reimburse NPPD for the Cottonwood Ranch development costs in accordance with the FERC License and the settlement agreement. The Program and this Milestone will be credited for 2,650 acres for the NPPD Cottonwood Ranch Property.

5.5. Management, restoration, and maintenance of Program lands will be accomplished according to the principles of adaptive management, including the identification of a habitat baseline for each parcel and the implementation of monitoring and research activities as described in the Program's Adaptive Management Plan found in Attachment 3.

5.6. A management and restoration plan specific to each parcel of land protected will be prepared within one year of acquisition and implemented as provided in the plan.

5.7. The Land Plan and management and restoration plan will be implemented with the advice of the Land Advisory Committee.

5.8. The Governance Committee will establish a land holding entity in accordance with the Program's Land Plan by the end of Year 1 of the Program.

5.9. Recognizing that restoration plans may require a number of years to complete, the Governance Committee will use its best efforts to protect 10,000 acres of habitat, including the 2,650 acres of habitat with the NPPD Cottonwood Ranch Property, by the end of Year 9 of the First Increment.

**6. The Integrated Monitoring and Research Plan, as may be amended by the Governance Committee, will be implemented beginning Year 1 of the Program.**

**Explanatory Information**

6.1. The Program's Integrated Monitoring and Research Plan (Attachment 3, Section 5) will be implemented to conduct biological response monitoring and research of all water and land actions as needed for adaptive management.

6.2. The Program is responsible for allocating the Integrated Monitoring and Research Plan (Attachment 3, Section 5) funds in accordance with the Program budget, as approved by the signatories and may be revised by the Governance Committee.

6.3. All aspects of the Program's Integrated Monitoring and Research Plan will be subject to independent peer review, as approved by the Governance Committee.

6.4. The results of the Program's Integrated Monitoring and Research Plan will be evaluated annually, to determine if the Program is operating as originally envisioned and to determine if management changes are warranted in accordance with the Adaptive Management Plan (Attachment 3).

6.5. Monitoring and research will be conducted to determine the impact of the Program's habitat development and maintenance activities and enable modifications to minimize impacts to the environment and adjoining landowners.

**7. The Wyoming Depletions Plan, as may be amended with the approval of the Governance Committee, will be operated during the First Increment of the Program.**

Explanatory Information

7.1. Operate Wyoming's Depletions Plan according to Section 7 of the Water Plan (Attachment 5)

**8. The Colorado Depletions Plan, as may be amended with the approval of the Governance Committee, will be operated during the First Increment of the Program.**

Explanatory Information

8.1. Operate Colorado's Depletions Plan according to Section 9 of the Water Plan (Attachment 5).

**9. The Nebraska Depletions Plan, as may be amended with the approval of the Governance Committee, will be operated during the First Increment of the Program.**

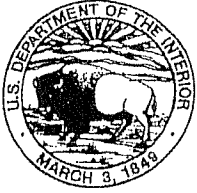
Explanatory Information

9.1. Operate Nebraska's Depletions Plan according to Section 8 of the Water Plan (Attachment 5).

**10. The Federal Depletions Plan, as may be amended with the approval of the Governance Committee, will be operated during the First Increment of the Program.**

Explanatory Information

10.1. Operate the Federal Depletions Plan according to Section 10 of the Water Plan (Attachment 5).



IN REPLY REFER TO:

WY-4007  
ADM-13.00

# United States Department of the Interior

BUREAU OF RECLAMATION  
Great Plains Region  
Wyoming Area Office  
P.O. Box 1630  
Mills, Wyoming 82644-1630



OCT 19 2010

Mr. John Moeschen  
U.S. Army Corps of Engineer  
Nebraska Regulatory Office  
8901 S. 154<sup>th</sup> Street  
Omaha, NE 68138-3621

Subject: Platte River Recovery Implementation Program (Program) Environmental and  
Regulatory Compliance

Dear Mr. Moeschen:

This is in follow-up to the telephone discussion which took place on Friday, September 24, 2010, which included Bureau of Reclamation, Corps of Engineers (Corps) and U.S. Fish and Wildlife Service (Service) staff and Dr. Jerry Kenny, Executive Director of Platte River Recovery Implementation Program. This response provides additional explanation and clarification to my July 9, 2010, letter.

The questions posed by you on behalf of the Corps were: (1) what is Reclamation's continuing role, if any, as a Federal agency during implementation of the Program and; (2) what Federal agency is responsible for providing project-specific information/data needs associated with Section 404 permitting.

Reclamation was a joint lead agency, along with the U.S. Fish and Wildlife Service, under the National Environmental Policy Act (NEPA) for preparation of the April 2006 Final Environmental Impact Statement (FEIS) for the Program. The September 27, 2006 Platte River Recovery Implementation Program Record of Decision (ROD) signed by then Secretary of the Interior Kempthorne approved the following federal actions: (1) approval of and signature on the Platte River Recovery Implementation Program Cooperative Agreement; (2) funding and implementation of the Program by Reclamation and the Service in coordination with States of Wyoming, Colorado and Nebraska and other participating organizations, and that the Preferred Alternative and the Program approved and adopted implemented in the ROD will be implemented in accordance with the Program Document and the BO and; (3) appointment of the Platte River Recovery Implementation Program Governance Committee to act as the a recovery implementation team pursuant to section 4(f)(2) of the ESA.

The ROD (page 16) states that "*Both Reclamation and the Service are participants in the formulation and implementation of the specific Program actions and will monitor the compliance with federal laws and regulations as needed along with other responsible federal agencies such as EPA and the Corps of Engineers (Corps).*" The ROD (page 18) further states that, "*The FEIS defines and commits to a process for proceeding with analysis of site-specific channel restoration activities pursuant to executive orders 11988 and 11990 and sections 401 and 404 of the Clean Water Act as*



*well as other water quality permitting*". This is in reference to pages 7-2 and 7-4 in the FEIS where the Environmental Commitments related to compliance with the Clean Water Act are stated. The process for obtaining site-specific Section 404 permits is defined in this section of the FEIS.

Reclamation's understanding is that implementation of site-specific projects is the responsibility of the Governance Committee consistent with the delegation from the Secretary of the Interior made in the ROD and described in the Final Program Document.

The Program was authorized by Congress in Section 515 of the Consolidated Natural Resources Act of 2008 (P.L. 110-229). Under Public Law 110-229, the Secretary of the Interior, in cooperation with the Governance Committee, was authorized to participate in the Program and carry out any projects and activities that are designated for implementation during the Program's First Increment. Public Law 110-229 also authorized \$157.14 million to be appropriated to carry out projects and activities for Program, with adjustments for inflation, and the federal funds that are to be appropriated are to be considered non-reimbursable federal expenditures. The Program's annual appropriation approved by Congress is not an action subject to the procedural requirements of NEPA.

The site-specific projects and activities of the Program are developed and implemented by the Governance Committee through its Executive Director. The agencies/entities proposing the site-specific actions undertake the appropriate environmental compliance including Section 401 and 404 of the Clean Water Act. This is consistent with the with the June 23, 2006, letter from the Corps regarding its comments on the FEIS. The Corps stated in that letter that "*As the Governance Committee proceeds in its project planning, we would wish to maintain dialogue in order to determine potential permit requirements, permit application formulation, and identification of additional site-specific information requirements.*" That letter also states that "*For site specific actions authorized by the Corps, monitoring and the associated success/failure determinations relative to the goals of the Recovery Program remain the responsibility of the Governance Committee or their appointed representative.*" The Program has acted consistently with that advice provided by the Corps.

We reiterate that Reclamation's role in the Program, as stated in the third paragraph of my July 9, 2010 letter to you, is to participate in the Governance Committee. The Governance Committee, through its Executive Director is responsible for providing the information/data needed by the Corps for permitting. We support an increased effort by the Executive Director to engage in pre-application consultation and coordination with the Corps. This would yield a better understanding of both the scope and nature of proposed projects under the Program and the environmental compliance, including Clean Water Act, needs for those projects.

If you have any questions, please contact me at 307-261-5671.

Sincerely,

**JOHN H. LAWSON**

John H Lawson  
Area Manager

cc: Regional Director, Billings, MT  
Attention: GP-1000 (Mike Ryan)

Deputy Regional Director, Billings, MT  
Attention: GP-1100 (Gary Campbell)

Resource Services, Billings, MT  
Attention: GP-4000 (Mike Fritz)

Dr. Jerry Kenny  
Executive Director  
Platte River Recovery Implementation Program  
4111 4<sup>th</sup> Avenue, Suite 6  
Kearney, NE 68845

Mr. Mike Thabault  
Assistant Regional Director  
U.S. Fish & Wildlife Service  
134 Union Blvd.  
Lakewood, CO 80228

Mr. Mike George  
Project Leader  
U. S. Fish & Wildlife Service  
203 West Second Street  
Federal Building, Second Floor  
Grand Island, NE 68801

**APPENDIX C**

**SOIL BORINGS**

**AND**

**GRADATION ANALYSIS**

<b>Contract Exploration Drilling Inc.</b>	<b>SOIL BORING LOG</b>		
Field Location of Boring:	Project No.:	_____	Date: <u>4/12/2010</u> Boring No.: <u>C-1</u>
	Client:	<u>Flatwater Group</u>	
	Location:	<u>Cook Habitat, Overton, NE</u>	Sheet <u>1</u>
	Logged By:	<u>R. Kuehn</u>	Driller: <u>R. Kuehn</u> of <u>1</u>
	Drilling Method and Equipment:	<u>4 1/4" ID H.S.A.</u>	

Drilling Start Date \_\_\_\_\_ Finish \_\_\_\_\_ Water Level and Date 5.5'

Depth Below Surface	Sample Screening			Soil Description	Soil Type	Well Construction
	Interval	Percent Recovery	Spoon blow Count			Casing Type, Depth of Casing, Well Screen Interval, Screen Pack Type, Seal Interval, Seal Type, Surface Construction, Well Details
			6 - 6 - 6 - 6" (N)	Cornfield <u>1.5' Developed zone roots.</u> Recent Alluvium, lean clay, trace of fine sand, dark brown, moist. 3.5' ----- Fine, medium & some coarse sand, light reddish brown, wet.	Sandy Silty Clay  3.5' Sand	
5	3' - 5' SS-1					5
10						10
15	13' - 15' SS-2					15
20						20
25	23' - 25' SS-3					25
30						30
35	33' - 35' SS-4			<u>34.5'</u> Weathered clay stone, light pink 35' Bottom of Hole	<u>34.5'</u> Sandy Silty Clay	35
40						40
45						45
50						50

<b>Contract Exploration Drilling Inc.</b>	<b>SOIL BORING LOG</b>		
Field Location of Boring:	Project No.:	_____	Date: <u>4/12/2010</u> Boring No.: <u>C-2</u>
	Client:	<u>Flatwater Group</u>	
	Location:	<u>Cook Habitat, Overton, NE</u>	Sheet <u>1</u>
	Logged By:	<u>R. Kuehn</u>	Driller: <u>R. Kuehn</u> of <u>1</u>
	Drilling Method and Equipment:	<u>4 1/4" ID H.S.A.</u>	

Drilling Start Date \_\_\_\_\_ Finish \_\_\_\_\_ Water Level and Date 6.5'

Depth Below Surface	Sample Screening			Soil Description	Soil Type	Well Construction Casing Type, Depth of Casing, Well Screen Interval, Screen Pack Type, Seal Interval, Seal Type, Surface Construction, Well Details
	Interval	Percent Recovery	Spoon blow Count 6" - 6" - 6" - 6" (N)			
5	3' - 5' SS-1			Cornfield <u>1' Developed zone roots.</u> Recent Alluvium, lean clay with trace of fine sand, dark brown, moist. 3.5' ----- Clean fine, medium & coarse sand with some fine to medium gravel, light reddish brown, wet.	Sandy Silty Clay  3.5' Sand	
15	13' - 15' SS-2					
30	23' - 25' SS-3					
40	33' - 35' SS-4			33.5' Clay stone, light reddish brown, moist. 35' Bottom of Hole	33.5' Sandy Silty Clay	

<b>Contract Exploration Drilling Inc.</b>	<b>SOIL BORING LOG</b>		
Field Location of Boring:	Project No.:	_____	Date: <u>4/12/2010</u> Boring No.: <u>C-3</u>
	Client:	<u>Flatwater Group</u>	
	Location:	<u>Cook Habitat, Overton, NE</u>	Sheet <u>1</u>
	Logged By:	<u>R. Kuehn</u>	Driller: <u>R. Kuehn</u> of <u>1</u>
	Drilling Method and Equipment:	<u>4 1/4" ID H.S.A.</u>	

Drilling Start Date \_\_\_\_\_ Finish \_\_\_\_\_ Water Level and Date 5.5'

Depth Below Surface	Sample Screening			Soil Description	Soil Type	Well Construction Casing Type, Depth of Casing, Well Screen Interval, Screen Pack Type, Seal Interval, Seal Type, Surface Construction, Well Details
	Interval	Percent Recovery	Spoon blow Count 6 - 6 - 6 - 6" (N)			
5	3' - 5' SS-1			Cornfield <u>1' Developed zone roots.</u> Recent Alluvium, lean clay with trace of fine sand, dark brown, moist. 3.5' ----- Clean fine, medium & coarse sand with some fine to medium gravel, light reddish brown, wet.	3.5' Sandy Silty Clay  Sand	
15	13' - 15' SS-2					
30	23' - 25' SS-3					
40	33' - 35' SS-4			33.5' Clay stone, light reddish brown, moist. 35' Bottom of Hole	33.5' Sandy Silty Clay	

<b>Contract Exploration Drilling Inc.</b>	<b>SOIL BORING LOG</b>		
Field Location of Boring:	Project No.:	Date:	4/12/2010 Boring No.: C-4
	Client:	Flatwater Group	
	Location:	Cook Habitat, Overton, NE	Sheet 1
	Logged By:	R. Kuehn	Driller: R. Kuehn of 1
	Drilling Method and Equipment:	4 1/4" ID H.S.A.	

Drilling Start Date \_\_\_\_\_ Finish \_\_\_\_\_ Water Level and Date 4.5'

Depth Below Surface	Sample Screening			Soil Description	Soil Type	Well Construction Casing Type, Depth of Casing, Well Screen Interval, Screen Pack Type, Seal Interval, Seal Type, Surface Construction, Well Details
	Interval	Percent Recovery	Spoon blow Count 6" (N)			
5	3' - 5' SS-1			Cornfield 5' Developed zone roots. Recent Alluvium, fine, medium & coarse sand with fine to medium gravel, light reddish brown, wet.	Sand	
15	13' - 15' SS-2					
30	23' - 25' SS-3					
40	33' - 35' SS-4			36' Clay stone, weathered, light pink, moist. 36' Bottom of Hole	36' Sandy Silty Clay	

<b>Contract Exploration Drilling Inc.</b>		<b>SOIL BORING LOG</b>					
Field Location of Boring:	Project No.:	_____	Date:	4/13/2010	Boring No.:	C-5	
	Client:	Flatwater Group					
	Location:	Cook Habitat, Overton, NE				Sheet	1
	Logged By:	R. Kuehn	Driller:	R. Kuehn	of	1	
	Drilling Method and Equipment:	4 1/4" ID H.S.A.					

Drilling Start Date \_\_\_\_\_ Finish \_\_\_\_\_ Water Level and Date 5.5'

Depth Below Surface	Sample Screening			Soil Description	Soil Type	Well Construction Casing Type, Depth of Casing, Well Screen Interval, Screen Pack Type, Seal Interval, Seal Type, Surface Construction, Well Details
	Interval	Percent Recovery	Spoon blow Count 6" (N)			
5	3' - 5' SS-1			Cornfield 1' Developed zone roots. Recent Alluvium, lean clay, trace of fine sand, dark brown, moist. 2' ----- Clean fine, medium & some coarse sand, with some fine to medium gravel, light reddish brown, wet.	Sandy Silty Clay 2' Sand	
15	13' - 15' SS-2					
20	18' - 20' SS-3					
36	33' - 35' SS-4			36' Weathered clay stone, light pink 36' Bottom of Hole	36' Sandy Silty Clay	



SEDIMENT AUGMENTATION EXPERIMENT ALTERNATIVES SCREENING SUMMARY REPORT

Grain Size Analysis

Site	Location	Date	Sample ID	Depth (ft)	D <sub>50</sub>	% < 1mm	% < #200	% < 1mm	% < 0.25 mm	% < #200	Available Material < 1mm	% of hole	% < 1mm (net)	Factored
Cook		4/12/2010	C1-1	3-5	0.332	76.3	21.2	0.0						
Cook		4/12/2010	C1-2	13-15	0.380	75.8	2.3	2.3			0.048387	55.1	2.66371	
Cook		4/12/2010	C1-3	23-25	0.938	52.9	0.4	0.4			0.322581	73.5	23.72043	
Cook		4/12/2010	C1-3 DUP	23-25	0.940	52.5	1.7	1.7			0.322581	51.7	16.66398	
Cook		4/12/2010	C1-4	33-35	0.073 < #200	95.4	56.0	0.0			0.306452	39.4	12.0793	
Cook		4/12/2010	C1-4	33-35	0.073	95.4	56.0	0.0			0.306452	39.4	12.0793	55.12742
Cook		4/12/2010	C2-1	3-5	0.477	75.4	3.0	3.0			0.05	72.4	3.620833	
Cook		4/12/2010	C2-2	13-15	1.120	47.1	3.8	3.8			0.333333	43.3	14.42778	
Cook		4/12/2010	C2-2 DUP	13-15	1.120	47.1	3.8	3.8			0.333333	46.8	15.61111	
Cook		4/12/2010	C2-3	23-25	0.989	50.8	4.0	4.0			0.333333	52.2	14.77583	
Cook		4/12/2010	C2-4	33-35	0.730	58.8	6.6	6.6			0.283333	48.43556		
Cook		4/12/2010	C3-1	3-5	0.541	66.7	3.3	3.3			0.05	65.0	3.252083	
Cook		4/12/2010	C3-1 DUP	3-5	0.509	70.4	3.7	3.7			0.333333	54.3	18.08889	
Cook		4/12/2010	C3-2	13-15	0.792	56.7	2.4	2.4			0.333333	38.5	12.84444	
Cook		4/12/2010	C3-3	23-25	1.400	40.8	2.3	2.3			0.333333	52.5	14.86556	
Cook		4/12/2010	C3-4	33-35	0.905	54.2	1.7	1.7			0.283333	49.05097		
Average					0.7	61.4	7.7	2.6			without outliers			
Dyer		4/13/2010	C4-1	3-5	0.602	71.3	1.3	1.3			0.126761	70	8.873239	
Dyer		4/13/2010	C4-1 DUP	3-5	0.617	71.3	1.2	1.2			0.28169	60.2	16.94836	
Dyer		4/13/2010	C4-2	13-15	0.796	61.7	1.5	1.5			0.28169	41.4	11.66197	
Dyer		4/13/2010	C4-3	23-25	1.120	45.8	2.5	2.5			0.309859	66.5	20.60047	
Dyer		4/13/2010	C4-3 DUP	23-25	1.240	41.7	2.2	2.2			0.309859	66.5	20.60047	
Dyer		4/13/2010	C4-4	33-35	0.634	69.6	3.1	3.1			0.088235	54.1	4.769118	
Dyer		4/13/2010	C5-1	3-5	0.752	56.3	2.2	2.2			0.294118	52.5	15.42892	
Dyer		4/13/2010	C5-2	13-15	0.687	58.8	2.9	2.9			0.294118	62.1	18.2598	
Dyer		4/13/2010	C5-2 DUP	13-15	0.939	51.7	2.6	2.6			0.323529	49.7	16.06324	
Dyer		4/13/2010	C5-3	23-25	0.703	64.6	2.5	2.5			1	54.52108		
Dyer		4/13/2010	C5-4	33-35	0.873	53.8	4.1	4.1			1			
Average					0.815	58.8	2.4	2.4			1			

Samples from Sandpit Piles at Active S&G Operations

Site	Location	Date	Sample ID	Depth (ft)	D <sub>50</sub>	% < 1mm	% < 0.25 mm	% < #200
OS & G East	Overton	5/5/2010	W-1A	--	0.499	79.6	17.0	1.3
OS & G West	Overton	5/5/2010	W-1B	--	0.498	83.8	15.0	0.9
OS & G West	Overton	5/5/2010	W-2	--	0.449	85.0	16.0	1.0
Whitney	Overton	5/5/2010	W-2 DUP	--	0.473	83.8	15.0	0.9
Paulsen	Lexington	5/5/2010	W-3	--	0.510	80.4	14.0	1.7
OS & G	Lexington	5/5/2010	W-4	--	0.347	96.3	25.0	1.3
Paulsen	Elm Creek	5/5/2010	W-5	--	0.513	77.1	15.0	0.9
T & F	Elm Creek	5/5/2010	W-6	--	0.461	83.3	17.0	1.4
T & F	Elm Creek	5/5/2010	W-6 DUP	--	0.507	78.3	14.0	1.0
Average					0.473	83.1	16.4	1.2

# **APPENDIX D**

## **COST TABLES**

## Appendix D Cost Tables

**Table B-1  
Preliminary Estimate of Probable Construction Costs  
Alternative 1  
Augmentation of Imported Material at Two Locations on Cook/Dyer using Sand Pumps**

### Sand Pump Site 1 (Cook)

Item	Description	Quantity	Unit	Unit Cost	Total
1	Mobilization	1	LS	\$15,176.25	\$15,176.25
2	Temporary Facilities	4	month	\$500.00	\$2,000.00
3	Site Preparation	1	LS	\$800.00	\$800.00
4	Construct Water Intake Sump	1	LS	\$500.00	\$500.00
5	Water Supply Pump	75	day	\$355.29	\$26,646.60
6	Intake Piping (100 feet)	75	day	\$31.15	\$2,336.25
7	Feed Conveyor	75	day	\$85.00	\$6,375.00
8	Screening Plant	75	day	\$553.94	\$41,545.20
9	Receiving Mixing Sump,	75	day	\$100.00	\$7,500.00
10	Slurry Pump	75	day	\$355.29	\$26,646.60
11	Discharge Piping (500 feet)	75	day	\$155.75	\$11,681.25
12	Generator Set (250 kW)	75	day	\$714.85	\$53,613.60
13	Equipment Operators (1)	75	day	\$120.00	\$9,000.00
14	FE Loader	75	day	\$558.74	\$41,905.65
15	Augmentation Material	75,000	ton	\$3.00	\$225,000.00
16	Haul Material to Site (9.3 mrt)	75,000	ton	\$1.72	\$129,000.00
17	Stockpile Management	75,000	ton	\$0.30	\$22,500.00
18	<b>Direct Cost Subtotal</b>				<b>\$622,226.40</b>
19	Design and Engineering Support			10.00%	\$62,222.64
20	Construction Management			5.00%	\$31,111.32
21	Contingency			25.00%	\$155,556.60
22	<b>Indirect Cost Subtotal</b>				<b>\$248,890.56</b>
23	Total Estimated Construction Costs				<b>\$871,116.97</b>
24	Cost per Cubic Yard Delivered				<b>\$11.61</b>

**Assumptions:**

Equipment costs are contractor owning and operating costs.

Costs per pump system

1/2 of material delivered by system at Site 1 (west end of Cook)

3.5-month delivery time

**Table B-1**  
**Preliminary Estimate of Probable Construction Costs**  
**Alternative 1**  
**Augmentation of Imported Material at Two Locations on Cook/Dyer using Sand Pumps (continued)**  
**Sand Pump Site 2 (Dyer)**

Item	Description	Quantity	Unit	Unit Cost	Total
1	Mobilization	1	LS	\$14,745.00	\$14,745.00
2	Temporary Facilities	4	month	\$500.00	\$2,000.00
3	Site Preparation	1	LS	\$800.00	\$800.00
4	Construct Water Intake Sump	1	LS	\$500.00	\$500.00
5	Water Supply Pump	75	day	\$355.29	\$26,646.60
6	Intake Piping (100 feet)	75	day	\$31.15	\$2,336.25
7	Feed Conveyor	75	day	\$85.00	\$6,375.00
8	Screening Plant	75	day	\$553.94	\$41,545.20
9	Receiving Mixing Sump,	75	day	\$100.00	\$7,500.00
10	Slurry Pump	75	day	\$355.29	\$26,646.60
11	Discharge Piping (500 feet)	75	day	\$155.75	\$11,681.25
12	Generator Set (250 kW)	75	day	\$714.85	\$53,613.60
13	Equipment Operators (1)	75	day	\$120.00	\$9,000.00
14	FE Loader	75	day	\$558.74	\$41,905.65
15	Augmentation Material	75,000	ton	\$3.00	\$225,000.00
16	Haul Material to Site (7.6 mrt)	75,000	ton	\$1.49	\$111,750.00
17	Stockpile Management	75,000	ton	\$0.30	\$22,500.00
18	<b>Direct Cost Subtotal</b>				<b>\$604,545.15</b>
19	Design and Engineering Support			10.00%	\$60,454.52
20	Construction Management			5.00%	\$30,227.26
21	Contingency			25.00%	\$151,136.29
22	<b>Indirect Cost Subtotal</b>				<b>\$241,818.06</b>
23	Total Estimated Construction Costs				<b>\$846,363.22</b>
24	Cost per Cubic Yard Delivered				<b>\$11.28</b>

Assumptions:

Equipment costs are contractor owning and operating costs.  
Costs per pump system  
1/2 of material delivered by system at Site 2 (middle of Dyer)  
3.5-month delivery time

**1-year Cost**

**Total Alternative 1 Cost** **\$1,717,480.18**  
**Average Cost per Cubic Yard Delivered** **\$11.45**

**10-year Cost**

**Total 10-year Cost (5% annual escalation)** **\$21,602,293.96**  
**Average Cost per Cubic Yard Delivered** **\$14.40**

**Table B-2**  
**Preliminary Estimate of Probable Construction Costs**  
**Alternative 2**  
**Augmentation of On-site Material at Two Locations on Cook/Dyer Using Sand Pumps**

**On-site Dredging Operation (Cook/Dyer)**

<b>Item</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Cost</b>	<b>Total</b>
1	Mobilization	1	LS	\$10,000.00	\$10,000.00
2	Temporary Facilities	4	month	\$500.00	\$2,000.00
3	Stripping Overburden (2 feet)	5	acre	\$4,000.00	\$20,000.00
4	Production Costs	150,000	ton	\$1.79	\$268,500.00
5	FE Loader	75	day	\$558.74	\$41,905.50
6	Stockpile Management	150,000	ton	\$0.30	\$45,000.00
7	<b>Direct Cost Subtotal</b>				<b>\$387,405.50</b>
8	Design and Engineering Support			10.00%	\$38,740.55
9	Construction Management			5.00%	\$19,370.28
10	Contingency			25.00%	\$96,851.38
11	<b>Indirect Cost Subtotal</b>				<b>\$154,962.20</b>
12	Total Estimated Construction Costs				<b>\$542,367.70</b>
13	Cost per Cubic Yard Delivered				<b>\$3.62</b>

Assumptions:

Equipment costs are contractor owning and operating costs.

Augmentation material cost limited to production cost as part of agreement with operator

**Table B-2**  
**Preliminary Estimate of Probable Construction Costs**  
**Alternative 2**  
**Augmentation of On-site Material at Two Locations on Cook/Dyer Using Sand Pumps (continued)**

**Sand Pump Site 2 (Dyer)**

<b>Item</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Cost</b>	<b>Total</b>
1	Mobilization	1	LS	\$7,901.25	\$7,901.25
2	Temporary Facilities	4	month	\$500.00	\$2,000.00
3	Site Preparation	1	LS	\$800.00	\$800.00
4	Construct Water Intake Sump	1	LS	\$500.00	\$500.00
5	Water Supply Pump	75	day	\$355.29	\$26,646.60
6	Intake Piping (100 feet)	75	day	\$31.15	\$2,336.25
7	Feed Conveyor	75	day	\$85.00	\$6,375.00
8	Screening Plant	75	day	\$553.94	\$41,545.20
9	Receiving Mixing Sump,	75	day	\$100.00	\$7,500.00
10	Slurry Pump	75	day	\$355.29	\$26,646.60
11	Discharge Piping (500 feet)	75	day	\$155.75	\$11,681.25
12	Generator Set (250 kW)	75	day	\$714.85	\$53,613.60
13	Equipment Operators (1)	75	day	\$120.00	\$9,000.00
14	FE Loader	75	day	\$558.74	\$41,905.65
15	Augmentation Material	75,000	ton	\$0.00	\$0.00
16	Haul Material to Site (1.5 mrt)	75,000	ton	\$0.84	\$63,000.00
17	Stockpile Management	75,000	ton	\$0.30	\$22,500.00
18	<b>Direct Cost Subtotal</b>				<b>\$323,951.40</b>
19	Design and Engineering Support			10.00%	\$32,395.14
20	Construction Management			5.00%	\$16,197.57
21	Contingency			25.00%	\$80,987.85
22	<b>Indirect Cost Subtotal</b>				<b>\$129,580.56</b>
23	Total Estimated Construction Costs				<b>\$453,531.97</b>
24	Cost per Cubic Yard Delivered				<b>\$6.05</b>

Assumptions:

Equipment costs are contractor owning and operating costs.

Costs per pump system

1/2 of material delivered by system at Site 2 (EAST end of Cook)

3.5-month delivery time

**Table B-2**  
**Preliminary Estimate of Probable Construction Costs**  
**Alternative 2**  
**Augmentation of On-site Material at Two Locations on Cook/Dyer Using Sand Pumps (continued)**

**Sand Pump Site 5 (near location of on-site sandpit at Cook/Dyer)**

<b>Item</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Cost</b>	<b>Total</b>
1	Mobilization	1	LS	\$7,226.25	\$7,226.25
2	Temporary Facilities	4	month	\$500.00	\$2,000.00
3	Site Preparation	1	LS	\$800.00	\$800.00
4	Construct Water Intake Sump	1	LS	\$500.00	\$500.00
5	Water Supply Pump	75	day	\$355.29	\$26,646.60
6	Intake Piping (100 feet)	75	day	\$31.15	\$2,336.25
7	Feed Conveyor	75	day	\$85.00	\$6,375.00
8	Screening Plant	75	day	\$553.94	\$41,545.20
9	Receiving Mixing Sump,	75	day	\$100.00	\$7,500.00
10	Slurry Pump	75	day	\$355.29	\$26,646.60
11	Discharge Piping (500 feet)	75	day	\$155.75	\$11,681.25
12	Generator Set (250 kW)	75	day	\$714.85	\$53,613.60
13	Equipment Operators (1)	75	day	\$120.00	\$9,000.00
14	FE Loader	75	day	\$558.74	\$41,905.65
15	Augmentation Material	75,000	ton	\$0.00	\$0.00
16	Haul Material to Site (1,000 ft rt)	75,000	ton	\$0.48	\$36,000.00
17	Stockpile Management	75,000	ton	\$0.30	\$22,500.00
18	<b>Direct Cost Subtotal</b>				<b>\$296,276.40</b>
19	Design and Engineering Support			10.00%	\$29,627.64
20	Construction Management			5.00%	\$14,813.82
21	Contingency			25.00%	\$74,069.10
22	<b>Indirect Cost Subtotal</b>				<b>\$118,510.56</b>
23	<b>Total Estimated Construction Costs</b>				<b>\$414,786.97</b>
24	<b>Cost per Cubic Yard Delivered</b>				<b>\$5.53</b>

Assumptions:

Equipment costs are contractor owning and operating costs.

Costs per pump system

1/2 of material delivered by system at Site 5 (located near dredging operation)

3.5-month delivery time

**1-year Cost**

**Total Alternative 2 Cost** **\$1,410,686.63**

**Average Cost per Cubic Yard Delivered** **\$9.40**

**10-year Costs**

**Total 10-year Cost (5% annual escalation)** **\$17,743,475.37**

**Average Cost per Cubic Yard Delivered** **\$11.83**

**Table B-3**  
**Preliminary Estimate of Probable Construction Costs**  
**Alternative 3**  
**Augmentation of Imported Material on Cook/Dyer using Dozers**

Item	Description	Quantity	Unit	Unit Cost	Total
1	Mobilization	1	LS	\$35,904.64	\$35,904.64
2	Temporary Facilities	2	month	\$500.00	\$1,000.00
3	Site Preparation	1	LS	\$12,500.00	\$12,500.00
4	Tree Removal	1	LS	\$5,000.00	\$5,000.00
5	Excavate/Doze Material	150,000	ton	\$4.04	\$605,357.14
6	Augmentation Material	150,000	ton	\$3.00	\$450,000.00
7	Haul Material to Site (8.9 mrt)	150,000	ton	\$1.93	\$289,500.00
8	Stockpile Management	150,000	ton	\$0.30	\$45,000.00
9	Equipment Operators (1)	41	day	\$120.00	\$4,920.00
10	FE Loader	41	day	\$558.74	\$22,908.42
11	<b>Direct Cost Subtotal</b>				<b>\$1,472,090.20</b>
12	Design and Engineering Support			10.00%	\$147,209.02
13	Construction Management			5.00%	\$73,604.51
14	Contingency			25.00%	\$368,022.55
15	<b>Indirect Cost Subtotal</b>				<b>\$588,836.08</b>
16	Total Estimated Construction Costs				<b>\$2,060,926.29</b>
17	Cost per Cubic Yard Delivered				<b>\$13.74</b>

Assumptions:

Equipment costs are contractor owning and operating costs.  
 Stockpiles every 500 feet on bank  
 Average Push Distance = 460 ft  
 1.9 month delivery time

**1-year Cost**

**Total Alternative 3 Cost** **\$2,060,926.29**  
**Average Cost per Cubic Yard Delivered** **\$13.74**

**10-year Cost**

**Total 10-year Cost (5% annual escalation)** **\$25,922,124.73**  
**Average Cost per Cubic Yard Delivered** **\$17.28**



**Table B-4**  
**Preliminary Estimate of Probable Construction Costs**  
**Alternative 4**  
**Augmentation of On-site Material on Cook/Dyer Using Dozers**

**On-site Dredging Operation (Cook/Dyer)**

<b>Item</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Cost</b>	<b>Total</b>
1	Mobilization	1	LS	\$10,000.00	\$10,000.00
2	Temporary Facilities	2	month	\$500.00	\$750.00
3	Stripping Overburden (2 feet)	5	acre	\$4,000.00	\$20,000.00
4	Production Costs	150,000	ton	\$1.79	\$268,500.00
5	Equipment Operators (1)	32	day	\$120.00	\$3,840.00
6	FE Loader	41	day	\$558.74	\$22,908.34
7	Stockpile Management	150,000	ton	\$0.30	\$45,000.00
8	<b>Direct Cost Subtotal</b>				<b>\$370,998.34</b>
9	Design and Engineering Support			10.00%	\$37,099.83
10	Construction Management			5.00%	\$18,549.92
11	Contingency			25.00%	\$92,749.59
12	<b>Indirect Cost Subtotal</b>				<b>\$148,399.34</b>
13	Total Estimated Construction Costs				<b>\$519,397.68</b>
14	Cost per Cubic Yard Delivered				<b>\$3.46</b>

Assumptions:

Equipment costs are contractor owning and operating costs.

Augmentation material cost limited to production cost as part of agreement with operator.

**Table B-4**  
**Preliminary Estimate of Probable Construction Costs**  
**Alternative 4**  
**Augmentation of On-site Material on Cook/Dyer Using Dozers (continued)**

**Delivery Option (Cook/Dyer)**

Item	Description	Quantity	Unit	Unit Cost	Total
1	Mobilization	1	LS	\$19,871.43	\$19,871.43
2	Temporary Facilities	2	month	\$500.00	\$1,000.00
3	Site Preparation	1	LS	\$12,500.00	\$12,500.00
4	Tree Removal	1	LS	\$5,000.00	\$5,000.00
5	Excavate/Doze Material	150,000	CY	\$4.04	\$605,357.14
6	Augmentation Material	150,000	ton	\$0.00	\$0.00
7	Haul Material to Site (1.5 mrt)	150,000	ton	\$0.84	\$126,000.00
8	Stockpile Management	150,000	ton	\$0.30	\$45,000.00
9	Equipment Operators (1)	32	day	\$120.00	\$3,840.00
10	FE Loader	41	day	\$558.74	\$22,908.42
11	<b>Direct Cost Subtotal</b>				<b>\$841,476.99</b>
12	Design and Engineering Support			10.00%	\$84,147.70
13	Construction Management			5.00%	\$42,073.85
14	Contingency			25.00%	\$210,369.25
15	<b>Indirect Cost Subtotal</b>				<b>\$336,590.80</b>
16	Total Estimated Construction Costs				<b>\$1,178,067.79</b>
17	Cost per Cubic Yard Delivered				<b>\$7.85</b>

Assumptions:

Equipment costs are contractor owning and operating costs.

Stockpiles every 500 feet on bank

Average Push Distance = 460 ft

1.9 month delivery time

**1-year Cost**

**Total Alternative 4 Cost**

**\$1,697,465.47**

**Average Cost per Cubic Yard Delivered**

**\$11.32**

**10-year Cost**

**Total 10-year Cost (5% annual escalation)**

**\$21,350,550.89**

**Average Cost per Cubic Yard Delivered**

**\$14.23**

**Table B-5**  
**Preliminary Estimate of Probable Construction Costs**  
**Alternative 5**  
**Augmentation of Imported Material at Two Locations on Cook/Dyer and One Location**  
**on Private Property (OS&G) Using Sand Pumps**

**Sand Pump Site 2 (Dyer)**

<b>Item</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Cost</b>	<b>Total</b>
1	Mobilization	1	LS	\$9,838.75	\$9,838.75
2	Temporary Facilities	3	month	\$500.00	\$1,250.00
3	Site Preparation	1	LS	\$800.00	\$800.00
4	Construct Water Intake Sump	1	LS	\$500.00	\$500.00
5	Water Supply Pump	50	day	\$355.29	\$17,764.40
6	Intake Piping (100 feet)	50	day	\$31.15	\$1,557.50
7	Feed Conveyor	50	day	\$85.00	\$4,250.00
8	Screening Plant	50	day	\$553.94	\$27,696.80
9	Receiving-Mixing Sump,	50	day	\$100.00	\$5,000.00
10	Slurry Pump	50	day	\$355.29	\$17,764.40
11	Discharge Piping (500 feet)	50	day	\$155.75	\$7,787.50
12	Generator Set (250 kW)	50	day	\$714.85	\$35,742.40
13	Equipment Operators (1)	50	day	\$120.00	\$6,000.00
14	FE Loader	50	day	\$558.74	\$27,937.10
15	Augmentation Material	50,000	ton	\$3.00	\$150,000.00
16	Haul Material to Site (7.6 mrt)	50,000	ton	\$1.49	\$74,500.00
17	Stockpile Management	50,000	ton	\$0.30	\$15,000.00
18	<b>Direct Cost Subtotal</b>				<b>\$403,388.85</b>
19	Design and Engineering Support			10.00%	\$40,338.89
20	Construction Management			5.00%	\$20,169.44
21	Contingency			25.00%	\$100,847.21
22	<b>Indirect Cost Subtotal</b>				<b>\$161,355.54</b>
23	Total Estimated Construction Costs				<b>\$564,744.39</b>
24	Cost per Cubic Yard Delivered				<b>\$11.29</b>

Assumptions:

- Equipment costs are contractor owning and operating costs.
- Costs per pump system
- 1/3 of material delivered by system at Site 2 (middle of Dyer)
- 2.3-month delivery time

**Table B-5**  
**Preliminary Estimate of Probable Construction Costs**  
**Alternative 5**  
**Augmentation of Imported Material at Two Locations on Cook/Dyer and One Location**  
**on Private Property (OS&G) Using Sand Pumps (continued)**

**Sand Pump Site 3 (Dyer)**

<b>Item</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Cost</b>	<b>Total</b>
1	Mobilization	1	LS	\$9,563.75	\$9,563.75
2	Temporary Facilities	3	month	\$500.00	\$1,250.00
3	Site Preparation	1	LS	\$800.00	\$800.00
4	Construct Water Intake Sump	1	LS	\$500.00	\$500.00
5	Water Supply Pump	50	day	\$355.29	\$17,764.40
6	Intake Piping (100 feet)	50	day	\$31.15	\$1,557.50
7	Feed Conveyor	50	day	\$85.00	\$4,250.00
8	Screening Plant	50	day	\$553.94	\$27,696.80
9	Receiving-Mixing Sump	50	day	\$100.00	\$5,000.00
10	Slurry Pump	50	day	\$355.29	\$17,764.40
11	Discharge Piping (500 feet)	50	day	\$155.75	\$7,787.50
12	Generator Set (250 kW)	50	day	\$714.85	\$35,742.40
13	Equipment Operators (1)	50	day	\$120.00	\$6,000.00
14	FE Loader	50	day	\$558.74	\$27,937.10
15	Augmentation Material	50,000	ton	\$3.00	\$150,000.00
16	Haul Material to Site (5.9 mrt)	50,000	ton	\$1.27	\$63,500.00
17	Stockpile Management	50,000	ton	\$0.30	\$15,000.00
18	<b>Direct Cost Subtotal</b>				<b>\$392,113.85</b>
19	Design and Engineering Support			10.00%	\$39,211.39
20	Construction Management			5.00%	\$19,605.69
21	Contingency			25.00%	\$98,028.46
22	<b>Indirect Cost Subtotal</b>				<b>\$156,845.54</b>
23	Total Estimated Construction Costs				<b>\$548,959.39</b>
24	Cost per Cubic Yard Delivered				<b>\$10.98</b>

Assumptions:

Equipment costs are contractor owning and operating costs.

Costs per pump system

1/3 of material delivered by system at Site 3 (east end of Dyer)

2.3-month delivery time

**Table B-5**  
**Preliminary Estimate of Probable Construction Costs**  
**Alternative 5**  
**Augmentation of Imported Material at Two Locations on Cook/Dyer and One Location**  
**on Private Property (OS&G) Using Sand Pumps (continued)**

**Sand Pump Site 4 (OS&G)**

Item	Description	Quantity	Unit	Unit Cost	Total
1	Mobilization	1	LS	\$8,388.75	\$8,388.75
2	Temporary Facilities	3	month	\$500.00	\$1,250.00
3	Site Preparation	1	LS	\$800.00	\$800.00
4	Construct Water Intake Sump	1	LS	\$500.00	\$500.00
5	Water Supply Pump	50	day	\$355.29	\$17,764.40
6	Intake Piping (100 feet)	50	day	\$31.15	\$1,557.50
7	Feed Conveyor	50	day	\$85.00	\$4,250.00
8	Screening Plant	50	day	\$553.94	\$27,696.80
9	Receiving Mixing Sump,	50	day	\$100.00	\$5,000.00
10	Slurry Pump	50	day	\$355.29	\$17,764.40
11	Discharge Piping (500 feet)	50	day	\$155.75	\$7,787.50
12	Generator Set (250 kW)	50	day	\$714.85	\$35,742.40
13	Equipment Operators (1)	50	day	\$120.00	\$6,000.00
14	FE Loader	50	day	\$558.74	\$27,937.10
15	Augmentation Material	50,000	ton	\$3.00	\$150,000.00
16	Haul Material to Site (1000 ft rt)	50,000	ton	\$0.48	\$24,000.00
17	Stockpile Management	50,000	ton	\$0.15	\$7,500.00
18	<b>Direct Cost Subtotal</b>				<b>\$343,938.85</b>
19	Design and Engineering Support			10.00%	\$34,393.89
20	Construction Management			5.00%	\$17,196.94
21	Contingency			25.00%	\$85,984.71
22	<b>Indirect Cost Subtotal</b>				<b>\$137,575.54</b>
23	Total Estimated Construction Costs				<b>\$481,514.39</b>
24	Cost per Cubic Yard Delivered				<b>\$9.63</b>

Assumptions:

Equipment costs are contractor owning and operating costs.

Costs per pump system

1/3 of material delivered by system at Site 4 (assumed OS&G)

2.3-month delivery time

**1-year Cost**

**Total Alternative 5 Cost** **\$1,595,218.18**

**Average Cost per Cubic Yard Delivered** **\$10.63**

**10-year Cost**

**Total 10-year Cost (5% annual escalation)** **\$20,064,494.75**

**Average Cost per Cubic Yard Delivered** **\$13.38**

**Table B-6**  
**Preliminary Estimate of Probable Construction Costs**  
**Alternative 6**  
**Augmentation of On-site Material at Two Locations on Cook/Dyer**  
**and Imported Material at One Location on Private Property (OS&G) using Sand Pumps**

**On-site Dredging Operation**

<b>Item</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Cost</b>	<b>Total</b>
1	Mobilization	1	LS	\$10,000.00	\$10,000.00
2	Temporary Facilities	3	month	\$500.00	\$1,500.00
3	Stripping Overburden (2 feet)	5	acre	\$4,000.00	\$20,000.00
4	Production Costs	100,000	ton	\$1.79	\$179,000.00
5	FE Loader	50	day	\$558.74	\$27,937.10
6	Stockpile Management	100,000	ton	\$0.30	\$30,000.00
7	<b>Direct Cost Subtotal</b>				<b>\$268,437.10</b>
8	Design and Engineering Support			10.00%	\$26,843.71
9	Construction Management			5.00%	\$13,421.86
10	Contingency			25.00%	\$67,109.28
11	<b>Indirect Cost Subtotal</b>				<b>\$107,374.84</b>
12	Total Estimated Construction Costs				<b>\$375,811.94</b>
13	Cost per Cubic Yard Delivered				<b>\$3.76</b>

Assumptions:

Equipment costs are contractor owning and operating costs.

Augmentation material cost limited to production cost as part of agreement with operator.

**Table B-6**  
**Preliminary Estimate of Probable Construction Costs**  
**Alternative 6**  
**Augmentation of On-site Material at Two Locations on Cook/Dyer**  
**and Imported Material at One Location on Private Property (OS&G) using Sand Pumps (continued)**

**Sand Pump Site 3 (Cook/Dyer)**

<b>Item</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Cost</b>	<b>Total</b>
1	Mobilization	1	LS	\$4,964.22	\$4,964.22
2	Temporary Facilities	3	month	\$500.00	\$1,250.00
3	Site Preparation	1	LS	\$800.00	\$800.00
4	Construct Water Intake Sump	1	LS	\$500.00	\$500.00
5	Water Supply Pump	50	day	\$355.29	\$17,764.50
6	Intake Piping (100 feet)	50	day	\$31.51	\$1,575.50
7	Feed Conveyor	50	day	\$85.00	\$4,250.00
8	Screening Plant	50	day	\$553.94	\$27,697.00
9	Receiving-Mixing Sump	50	day	\$100.00	\$5,000.00
10	Slurry Pump	50	day	\$355.29	\$17,764.50
11	Discharge Piping (500 feet)	50	day	\$155.75	\$7,787.50
12	Generator Set (250 kW)	50	day	\$714.85	\$35,742.50
13	Equipment Operators (1)	50	day	\$120.00	\$6,000.00
14	FE Loader	50	day	\$558.74	\$27,937.10
15	Augmentation Material	50,000	ton	\$0.00	\$0.00
16	Haul Material to Site (1500 ft rt)	50,000	ton	\$0.59	\$29,500.00
17	Stockpile Management	50,000	ton	\$0.30	\$15,000.00
18	<b>Direct Cost Subtotal</b>				<b>\$203,532.82</b>
19	Design and Engineering Support			10.00%	\$20,353.28
20	Construction Management			5.00%	\$10,176.64
21	Contingency			25.00%	\$50,883.20
22	<b>Indirect Cost Subtotal</b>				<b>\$81,413.13</b>
23	Total Estimated Construction Costs				<b>\$284,945.94</b>
24	Cost per Cubic Yard Delivered				<b>\$5.70</b>

Assumptions:

Equipment costs are contractor owning and operating costs.

Costs per pump system

1/3 of material delivered by system at Site 3 (east end of Dyer)

Material cost is equal to production cost on Program property.

2.3-month delivery time

**Table B-6**  
**Preliminary Estimate of Probable Construction Costs**  
**Alternative 6**  
**Augmentation of On-site Material at Two Locations on Cook/Dyer**  
**and Imported Material at One Location on Private Property (OS&G) using Sand Pumps (continued)**

**Sand Pump Site 5 (near location of on-site sandpit at Cook/Dyer)**

Item	Description	Quantity	Unit	Unit Cost	Total
1	Mobilization	1	LS	\$4,826.25	\$4,826.25
2	Temporary Facilities	3	month	\$500.00	\$1,250.00
3	Site Preparation	1	LS	\$800.00	\$800.00
4	Construct Water Intake Sump	1	LS	\$500.00	\$500.00
5	Water Supply Pump	50	day	\$355.29	\$17,764.40
6	Intake Piping (100 feet)	50	day	\$31.15	\$1,557.50
7	Feed Conveyor	50	day	\$85.00	\$4,250.00
8	Screening Plant	50	day	\$553.94	\$27,696.80
9	Receiving Mixing Sump,	50	day	\$100.00	\$5,000.00
10	Slurry Pump	50	day	\$355.29	\$17,764.40
11	Discharge Piping (500 feet)	50	day	\$155.75	\$7,787.50
12	Generator Set (250 kW)	50	day	\$714.85	\$35,742.40
13	Equipment Operators (1)	50	day	\$120.00	\$6,000.00
14	FE Loader	50	day	\$558.74	\$27,937.10
15	Augmentation Material	50,000	ton	\$0.00	\$0.00
16	Haul Material to Site (1000 ft rt)	50,000	ton	\$0.48	\$24,000.00
17	Stockpile Management	50,000	ton	\$0.30	\$15,000.00
18	<b>Direct Cost Subtotal</b>				<b>\$197,876.35</b>
19	Design and Engineering Support			10.00%	\$19,787.64
20	Construction Management			5.00%	\$9,893.82
21	Contingency			25.00%	\$49,469.09
22	<b>Indirect Cost Subtotal</b>				<b>\$79,150.54</b>
23	Total Estimated Construction Costs				<b>\$277,026.89</b>
24	Cost per Cubic Yard Delivered				<b>\$5.54</b>

Assumptions:

Equipment costs are contractor owning and operating costs.

Costs per pump system

1/3 of material delivered by system at Site 5 (location varies - generally located near dredging operation)

Material cost is equal to production cost on Program property.

2.3-month delivery time



**Table B-6**  
**Preliminary Estimate of Probable Construction Costs**  
**Alternative 6**  
**Augmentation of On-site Material at Two Locations on Cook/Dyer**  
**and Imported Material at One Location on Private Property (OS&G) using Sand Pumps (continued)**

**Sand Pump Site 4 (OS&G)**

Item	Description	Quantity	Unit	Unit Cost	Total
1	Mobilization	1	LS	\$8,388.75	\$8,388.75
2	Temporary Facilities	3	month	\$500.00	\$1,250.00
3	Site Preparation	1	LS	\$800.00	\$800.00
4	Construct Water Intake Sump	1	LS	\$500.00	\$500.00
5	Water Supply Pump	50	day	\$355.29	\$17,764.40
6	Intake Piping (100 feet)	50	day	\$31.15	\$1,557.50
7	Feed Conveyor	50	day	\$85.00	\$4,250.00
8	Screening Plant	50	day	\$553.94	\$27,696.80
9	Receiving Mixing Sump,	50	day	\$100.00	\$5,000.00
10	Slurry Pump	50	day	\$355.29	\$17,764.40
11	Discharge Piping (500 feet)	50	day	\$155.75	\$7,787.50
12	Generator Set (250 kW)	50	day	\$714.85	\$35,742.40
13	Equipment Operators (1)	50	day	\$120.00	\$6,000.00
14	FE Loader	50	day	\$558.74	\$27,937.10
15	Augmentation Material	50,000	ton	\$3.00	\$150,000.00
16	Haul Material to Site (1000 ft rt)	50,000	ton	\$0.48	\$24,000.00
17	Stockpile Management	50,000	ton	\$0.15	\$7,500.00
18	<b>Direct Cost Subtotal</b>				<b>\$343,938.85</b>
19	Design and Engineering Support			10.00%	\$34,393.89
20	Construction Management			5.00%	\$17,196.94
21	Contingency			25.00%	\$85,984.71
22	<b>Indirect Cost Subtotal</b>				<b>\$137,575.54</b>
23	Total Estimated Construction Costs				<b>\$481,514.39</b>
24	Cost per Cubic Yard Delivered				<b>\$9.63</b>

Assumptions:

Equipment costs are contractor owning and operating costs.

Costs per pump system

1/3 of material delivered by system at Site 4 (assumed OS&G)

Material purchased from property owner (assume OS&G)

2.3-month delivery time

**1-year Cost**

**Total Alternative 6 Cost**

**\$1,419,299.17**

**Average Cost per Cubic Yard Delivered**

**\$9.46**

**10-year Cost**

**Total 10-year Cost (5% annual escalation)**

**\$17,851,803.01**

**Average Cost per Cubic Yard Delivered**

**\$11.90**

**Table B-7**  
**Preliminary Estimate of Probable Construction Costs**  
**Alternative 7**  
**Augmentation of Imported Material on Cook/Dyer using Dozers**

**Augmentation on Cook/Dyer**

<b>Item</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Cost</b>	<b>Total</b>
1	Mobilization	1	LS	\$23,868.81	\$23,868.81
2	Temporary Facilities	1	month	\$500.00	\$500.00
3	Site Preparation	1	LS	\$12,500.00	\$12,500.00
4	Tree Removal	1	LS	\$5,000.00	\$5,000.00
5	Excavate/Doze Material	100,000	ton	\$4.04	\$403,571.43
6	Augmentation Material	100,000	ton	\$3.00	\$300,000.00
7	Haul Material to Site (8.9 mrt)	100,000	ton	\$1.93	\$193,000.00
8	Stockpile Management	100,000	ton	\$0.30	\$30,000.00
9	Equipment Operators (1)	15	day	\$120.00	\$1,800.00
10	FE Loader	15	day	\$558.74	\$8,381.13
11	<b>Direct Cost Subtotal</b>				<b>\$978,621.37</b>
12	Design and Engineering Support			10.00%	\$97,862.14
13	Construction Management			5.00%	\$48,931.07
14	Contingency			25.00%	\$244,655.34
15	<b>Indirect Cost Subtotal</b>				<b>\$391,448.55</b>
16	Total Estimated Construction Costs				<b>\$1,370,069.92</b>
17	Cost per Cubic Yard Delivered				<b>\$13.70</b>

Assumptions:

Equipment costs are contractor owning and operating costs.

2/3 of material delivered at Cook/Dyer

Stockpiles every 500 feet on bank

Assumed average push distance = 460 ft

1-month delivery time

**Table B-7**  
**Preliminary Estimate of Probable Construction Costs**  
**Alternative 7**  
**Augmentation of Imported Material on Cook/Dyer using Dozers (continued)**

**Augmentation at OS&G**

<b>Item</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Cost</b>	<b>Total</b>
1	Mobilization	1	LS	\$9,534.85	\$9,534.85
2	Temporary Facilities	1	month	\$500.00	\$500.00
3	Site Preparation	1	LS	\$12,500.00	\$12,500.00
4	Tree Removal	1	LS	\$5,000.00	\$5,000.00
5	Excavate/Doze Material	50,000	ton	\$3.39	\$169,642.86
6	Augmentation Material	50,000	ton	\$3.00	\$150,000.00
7	Haul Material to Site (1,000 ft rt)	50,000	ton	\$0.48	\$24,000.00
8	Stockpile Management	50,000	ton	\$0.30	\$15,000.00
9	Equipment Operators (1)	7	day	\$120.00	\$840.00
10	FE Loader	7	day	\$558.74	\$3,911.19
11	<b>Direct Cost Subtotal</b>				<b>\$390,928.90</b>
12	Design and Engineering Support			10.00%	\$39,092.89
13	Construction Management			5.00%	\$19,546.45
14	Contingency			25.00%	\$97,732.23
15	<b>Indirect Cost Subtotal</b>				<b>\$156,371.56</b>
16	Total Estimated Construction Costs				<b>\$547,300.46</b>
17	Cost per Cubic Yard Delivered				<b>\$10.95</b>

Assumptions:

Equipment costs are contractor owning and operating costs.

1/3 of material delivered at OS&G

Imported source is OS&G

Stockpiles every 500 feet on bank

Assumed Push Distance = 375 ft

1-month delivery time

**1-year Cost**

**Total Alternative 7 Cost**

**\$1,917,370.38**

**Average Cost per Cubic Yard Delivered**

**\$12.78**

**10-year Cost**

**Total 10-year Cost (5% annual escalation)**

**\$24,116,492.96**

**Average Cost per Cubic Yard Delivered**

**\$16.08**

**Table B-8**  
**Preliminary Estimate of Probable Construction Costs**  
**Alternative 8**  
**Augmentation of On-site Material on Cook/Dyer**  
**and Imported Material on Private Property (OS&G) Using Dozers**

**On-site Dredging Operation (Cook/Dyer)**

<b>Item</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Cost</b>	<b>Total</b>
1	Mobilization	1	LS	\$10,000.00	\$10,000.00
2	Temporary Facilities	2	month	\$500.00	\$750.00
3	Stripping Overburden (2 feet)	5	acre	\$4,000.00	\$20,000.00
4	Production Costs	100,000	ton	\$1.79	\$179,000.00
5	FE Loader	22	day	\$558.74	\$12,292.32
6	Stockpile Management	100,000	ton	\$0.30	\$30,000.00
7	<b>Direct Cost Subtotal</b>				<b>\$252,042.32</b>
8	Design and Engineering Support			10.00%	\$25,204.23
9	Construction Management			5.00%	\$12,602.12
10	Contingency			25.00%	\$63,010.58
11	<b>Indirect Cost Subtotal</b>				<b>\$100,816.93</b>
12	Total Estimated Construction Costs				<b>\$352,859.25</b>
13	Cost per Cubic Yard Delivered				<b>\$3.53</b>

Assumptions:

Equipment costs are contractor owning and operating costs.

Augmentation material cost limited to production cost as part of agreement with operator

**Table B-8**  
**Preliminary Estimate of Probable Construction Costs**  
**Alternative 8**  
**Augmentation of On-site Material on Cook/Dyer**  
**and Imported Material on Private Property (OS&G) Using Dozers (continued)**

**Augmentation on Cook/Dyer**

<b>Item</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Cost</b>	<b>Total</b>
1	Mobilization	1	LS	\$16,368.81	\$16,368.81
2	Temporary Facilities	1	month	\$500.00	\$500.00
3	Site Preparation	1	LS	\$12,500.00	\$12,500.00
4	Tree Removal	1	LS	\$5,000.00	\$5,000.00
5	Excavate/Doze Material	100,000	ton	\$4.04	\$403,571.43
6	Augmentation Material	100,000	ton	\$0.00	\$0.00
7	Haul Material to Site (8.9 mrt)	100,000	ton	\$1.93	\$193,000.00
8	Stockpile Management	100,000	ton	\$0.30	\$30,000.00
9	Equipment Operators (1)	15	day	\$120.00	\$1,800.00
10	FE Loader	15	day	\$558.74	\$8,381.13
11	<b>Direct Cost Subtotal</b>				<b>\$671,121.37</b>
12	Design and Engineering Support			10.00%	\$67,112.14
13	Construction Management			5.00%	\$33,556.07
14	Contingency			25.00%	\$167,780.34
15	<b>Indirect Cost Subtotal</b>				<b>\$268,448.55</b>
16	Total Estimated Construction Costs				<b>\$939,569.92</b>
17	Cost per Cubic Yard Delivered				<b>\$9.40</b>

Assumptions:

Equipment costs are contractor owning and operating costs.

2/3 of material delivered at Cook/Dyer

Stockpiles every 500 feet on bank

Assumed average push distance = 460 ft

1-month delivery time

**Table B-8**  
**Preliminary Estimate of Probable Construction Costs**  
**Alternative 8**  
**Augmentation of On-site Material on Cook/Dyer**  
**and Imported Material on Private Property (OS&G) Using Dozers (continued)**

**Augmentation at OS&G**

<b>Item</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Cost</b>	<b>Total</b>
1	Mobilization	1	LS	\$9,534.85	\$9,534.85
2	Temporary Facilities	1	month	\$500.00	\$500.00
3	Site Preparation	1	LS	\$12,500.00	\$12,500.00
4	Tree Removal	1	LS	\$5,000.00	\$5,000.00
5	Excavate/Doze Material	50,000	ton	\$3.39	\$169,642.86
6	Augmentation Material	50,000	ton	\$3.00	\$150,000.00
7	Haul Material to Site (1,000 mrt)	50,000	ton	\$0.48	\$24,000.00
8	Stockpile Management	50,000	ton	\$0.30	\$15,000.00
9	Equipment Operators (1)	7	day	\$120.00	\$840.00
10	FE Loader	7	day	\$558.74	\$3,911.19
11	<b>Direct Cost Subtotal</b>				<b>\$390,928.90</b>
12	Design and Engineering Support			10.00%	\$39,092.89
13	Construction Management			5.00%	\$19,546.45
14	Contingency			25.00%	\$97,732.23
15	<b>Indirect Cost Subtotal</b>				<b>\$156,371.56</b>
16	Total Estimated Construction Costs				<b>\$547,300.46</b>
17	Cost per Cubic Yard Delivered				<b>\$10.95</b>

Assumptions:

Equipment costs are contractor owning and operating costs.

1/3 of material delivered at OS&G

Imported source is OS&G

Stockpiles every 500 feet on bank

Assumed Push Distance = 375 ft

1-month delivery time

**1-year Cost**

**Total Alternative 7 Cost**

**\$1,839,729.64**

**Average Cost per Cubic Yard Delivered**

**\$12.26**

**10-year Cost**

**Total 10-year Cost (5% annual escalation)**

**\$23,139,935.42**

**Average Cost per Cubic Yard Delivered**

**\$15.43**

**APPENDIX E**

**RESPONSE TO COMMENTS ON**

**DRAFT**

**PLATTE RIVER FROM THE**  
**LEXINGTON TO ODESSA BRIDGES**  
**SEDIMENT AUGMENTATION**  
**EXPERIMENT ALTERNATIVES**  
**SCREENING STUDY**  
**SUMMARY REPORT**

1 **COMMENT AND RESPONSE INTRODUCTION**  
2

3 This appendix addresses comments received on the Draft Sediment Augmentation Experiment  
4 Alternatives Screening Study. The section includes comments from the U.S. Fish and Wildlife Service  
5 and meeting minutes from the 13 January 2011 workshop held in Kearney where the report was presented  
6 to the PRRIP TAC. The responses to the comments reflect discussion and clarifications made during the  
7 13 January workshop. Modifications to the final report as a result of a comment response are noted.  
8

9 **USFWS Technical Advisory Committee comments on “Draft-Sediment Augmentation**  
10 **Experiment Alternatives Screening Study”**

11 **January 7, 2011**

12 **General comments:**

13 **Comment 1:** When reviewing the sediment transport, TAC and Program staff should think in  
14 terms of habitat creation and maintenance, not just maintaining sediment balance. Physical  
15 Process Hypothesis #2 in the Adaptive Management Plan states that between Lexington and  
16 Chapman, eliminating the sediment imbalance in eroding reaches will:

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

24 Sediment-related priority hypothesis links the maintenance of a sediment balance to an increase  
25 in the braiding index (Sediment Hypothesis #2). A braiding index of greater than 3 is then linked  
26 to an increase in active channel width per a 2,000 cfs reference flow (Sediment Hypothesis #3),  
27 and an increase in sandbar area per a 1,200 cfs reference flow (Sediment Hypothesis #4).

28 Arresting channel degradation is one benefit from maintaining a sediment balance via sediment  
29 augmentation. The fining of the Platte River bedload was an additional benefit of sediment  
30 augmentation that would allow for easier mobilization of sediment within vegetated islands.  
31 Bedloads of a certain grain size distribution may be needed to build sandbars that are suitable for  
32 least tern and piping plover nesting.

33 Summary - We recognize that the researchers for the Sediment Augmentation Experiment  
34 Alternatives Screening Study (Augmentation Study) were not tasked to incorporate all of these  
35 benefits when developing a prescription for sediment augmentation. However, the TAC and  
36 Program staff should recognize that a final prescription for sediment augmentation must address  
37 all of the above benefits.



1 **Response: Comment noted. No changes to document required.**

2 **Comment 2.** The potential for on and off-site impacts are important considerations when  
3 developing sediment augmentation alternatives. The Service encourages the Program to avoid  
4 adverse impacts to federally listed species, state listed species, species of conservation concern,  
5 vegetation communities of ecological importance, jurisdictional wetlands, non-jurisdictional  
6 wetlands, and impacts to downstream landowners. The potential for on and off-site impacts is an  
7 important component of the U.S. Army Corps of Engineers (COE) permitting process and should  
8 be considered under the Permitting criterion in the Augmentation Study.

9  
10 The COE document on Stream Impact Assessment/functional assessment could be used  
11 to balance out the positive benefits (habitat creation, maintenance, etc.) of this project vs. the  
12 potential negative impacts (i.e. would this contribute to coarsening, are their impacts to  
13 downstream landowners' property, impact to wetlands, etc.). Investigating potential impacts and  
14 developing monitoring to assess positive/negative effects will be important considerations in  
15 permitting. Ultimately, a project will only be permitted if it is determined to be the least  
16 environmentally damaging practicable alternative. Another thing to point COE toward is other  
17 systems across the United States where this type of activity is being used routinely to offset  
18 anthropogenic effects of water management. The Sacramento district routinely permits  
19 "spawning gravel injection" projects under nationwide permit (NWP) #27 (Rabbe was a project  
20 manager on a number of these). These were done at many sites every year to benefit listed  
21 species and mitigate the effect of altered flow regimes and sediment or "spawning gravel"  
22 imbalances caused by man-made structures. NWP #27 must have the specific goal of improving  
23 the aquatic habitat. It cannot have more than minimal impact individually or cumulatively, and  
24 may require additional terms and special conditions in addition to the general conditions of  
25 NWP#27. It also must have a net increase in aquatic functions and services. The COE can  
26 require an individual permit if it feels there is more than minimal impact or potential public  
27 interest review concerns. The biggest concern they will likely have is the potential to impact  
28 downstream landowners. Using historic examples where man-made or natural high flow events  
29 (under an imbalanced sediment load) caused damage to landowners from erosion, down cutting,  
30 etc. can help strengthen our case as well.

31  
32 Summary - Augmentation Study should incorporate the potential for on and off-site impacts  
33 when ranking sediment augmentation alternatives using the Permitting criterion. Permittability  
34 should be based on practicability and environmental impacts. Investigating the additional  
35 impacts listed above for each alternative could help in accurately predicting permittability.

36  
37 **Response: Concur with comment. Offsite and downstream impacts will be an important**  
38 **consideration during the permitting phase of the project.**

39  
40 **Comment 3.** It may be difficult to correctly develop a prescription for sediment augmentation  
41 when evaluating historic hydrographs. Sediment transport should be estimated for different  
42 modeled release points (i.e., J-2 Re-Regulating Reservoir, Elm Creek Reservoir, CNPPID  
43 Bypass, etc.). Augmentation Study evaluated flow release patterns associated with the 2009 flow  
44 routing test in Appendix B. However, magnitudes for Short Duration High Flows (SDHF) are in

1 the 6,000 to 8,000 cfs range, and these flows are dependent on the aforementioned flow  
2 augmentation strategies. The concern regarding this uncertainty is with the prioritization of  
3 sediment source location and not the quantities of sediment needed to offset deficits. For  
4 example, both the Elm Creek Reservoir and CNPPID Re-Regulation Reservoir may be used to  
5 augment SDHF or shortages to target flows. Both provide flows without corresponding sediment  
6 load. Furthermore, the outlet for the Elm Creek Reservoir is near the Elm Creek bridge  
7 downstream of Cottonwood Ranch. A feasible sediment augmentation alternative in the  
8 Augmentation Study may not remain as feasible when water projects come online.

9 Summary - This consideration does not warrant changes to the Augmentation Study. Rather,  
10 TAC and Program staff should consider future operations when developing preferred sediment  
11 augmentation alternatives.

12 **Response: Comment noted. No changes to document required.**

13 **Comment 4.** The recommendation based on modeling of using sediments with a D50 courser  
14 than 1mm is of concern to the Service. Historic data from the COE (1931), Smith (1971),  
15 Kirscher (1981), USBR 1989 as published by Holburn (2006), and Kinzel (1999) points toward  
16 significant coarsening of sediment grain sizes throughout the entire reach. This report indicates  
17 material too coarse may settle out before Cottonwood Ranch and finer material would flush  
18 through the system. Sediment gradation alternatives are prioritized based on the ability to  
19 achieve sediment balance at or within Cottonwood Ranch. The Service has previously indicated  
20 and currently maintains the position that sediment augmentation is a tool to correct the sediment  
21 size and load needed to offset an imbalance that is currently impacting target species and their  
22 habitat. Though the scope of this feasibility report and ensuing project focuses on metrics to  
23 achieve sediment balance (i.e. sediment load) at Cottonwood Ranch, it is well known throughout  
24 other systems and was explicitly stated in the EIS (EIS, page 4-36) that the ability to build  
25 sandbars increases with: 1) increasing annual peak discharge, 2) cumulative sand transport, and  
26 3) with the fineness of the bed-material. It may be helpful to have a separate goal (or implement  
27 additional projects/research) to reverse the coarsening trend that Ayres has pointed toward in two  
28 years of geomorphology monitoring (referencing 1989 BOR data) and that recognized from  
29 historic data. The augmentation of sediments that are coarser than that described in the EIS or  
30 BO may not realize benefits comparable to that envisioned under the FSM strategy.

31 Summary - This consideration may not warrant changes to the Augmentation Study. TAC and  
32 Program staff should attempt to maximize learning by conducting other passive adaptive  
33 management experiments designed to examine the above considerations. These could be  
34 incorporated within the constructs of this study (by selecting alternatives that would accomplish  
35 multiple purposes) or by initiating independent studies directed at these additional  
36 considerations.

37 **Response: The feasibility report recommended a pilot study. One component of the pilot**  
38 **study will be the implementation of a monitoring plan. The comment is noted. No changes**  
39 **to document required.**

1 **Comment 5.** The AMP identified that sediment can be offset by various sources: a) sand  
2 augmentation through mechanical actions – island and bank clearing and leveling, b) sand  
3 augmentation from bank and island actions not directly related to bank cutting and island  
4 leveling (an example could be excavation associated with wetland development), or c) reducing  
5 imbalance through channel plan form changes, tributary delivery improvements, or flow routing  
6 changes.” Augmentation Study only focuses on source b), but the Augmentation Study RFP  
7 requested an evaluation of all three sediment augmentation sources.

8 Additionally, the feasibility results suggest difficulty in permitting and ability to deliver  
9 the targeted amount within the next few years. Alternatives 6 and 8 are both able to deliver  
10 >40% effectiveness with alternative 6 potentially providing 60-80%. Based off this, it appears  
11 that both alternatives scoring the highest have the potential to offset more than 40% and  
12 collectively, they have a combined estimate of 100%.

13 Summary - Augmentation Study researchers should consider sources a) and c) as alternatives in  
14 the Augmentation Study in addition to evaluating the effectiveness of combining alternatives as  
15 identified within the study.

16 **Response: All three sources were evaluated. Only those sources that were the most**  
17 **promising based on potential sediment availability on specific lands that the Program has**  
18 **access to were carried through to alternative development.**

19 **The combination of the efficiencies of two alternatives is not necessarily a linear**  
20 **comparison. The combined alternatives would need to be modeled to determine the**  
21 **combined efficiency. Modeling conducted during development of this report covered a**  
22 **range of scenarios that allowed development of a group of viable alternatives. No changes**  
23 **to the document required.**

24 **Comment 6.** There may be spatial and temporal aspects of sediment transport that Augmentation  
25 Study may not capture. The Augmentation Study concludes that using a D50 of 0.5 mm (i.e. high  
26 percentage of fine sediments) would likely result in a majority of the sediment to stay suspended  
27 and be transported through the target reach. This may be true when evaluating sediment  
28 transport using yearly time intervals. However, seasonal differences in sediment transport may  
29 show differences in how sediments with D50 of 0.5 mm move through the system. It is possible  
30 that a portion of the fine sediments would not be transported as a result of low summer flows, but  
31 would eventually migrate through the system as flows increased in the fall. This seasonal  
32 deposition of fine sediments may result in a beneficial but temporary means of creating and/or  
33 maintaining habitats.

34 One limitations of the 1-D modeling is the inability to model sandbars. The conclusion that a  
35 majority of the sediment would be transported through the target reach using a D50 of 0.5 mm  
36 (i.e. high percentage of fine sediments) would only apply if sediments remained available in the  
37 water column. In other braided river systems visited by the Service, high flows create bedforms

1 that become sandbars as flows recede in the summer. These emergent sandbars could represent a  
2 source of fine sediment that would not be available for immediate transport.

3 Summary – The Service does not know to what extent the above considerations represent  
4 limitations in the scope of work and limitations in modeling. If limitations in the scope of work  
5 and modeling are realized, then the Service looks forward to working with the group to address  
6 these limitations when developing and ranking sediment augmentation alternatives. The Service  
7 recognizes that consideration of these limitations (if warranted) may be supplemental to the  
8 Augmentation Study.

9 **Response: The modeling considers the seasonal variability in flows and the effects of this**  
10 **variability on sediment transport rates by including mean daily flows in the hydrologic**  
11 **input for the 12.5-year simulation; thus, the results should reflect storage of fine sediment**  
12 **during low-flow periods and removal of the stored material during high-flow periods.**  
13 **While the model does not explicitly model the sandbar building process, the storage and**  
14 **removal of fine sediment should be adequately accounted for on an overall mass balance**  
15 **basis. The effects of emergent sandbars during low flows should be considered in detail in**  
16 **subsequent monitoring and modeling efforts. If it is determined that this is a significant**  
17 **issue with respect to the overall mass balance, methods should be developed to incorporate**  
18 **a routine into the model that would approximate the effect of the process. No changes to**  
19 **the document required.**

20 **Comment 6.** This report concludes that using a D50 of 0.5 mm (i.e. high percentage of fine  
21 sediments) would likely result in a majority of the sediment to stay suspended and be transported  
22 through the target reach. Given the high transport rate of fine materials, the Service seeks to  
23 learn if these fines may be instrumental in downstream bar formation/channel geomorphology  
24 and pallid sturgeon habitat creation/maintenance in the lower Central Platte or Lower  
25 Platte/Missouri River. It was recognized within the 2009 geomorphology monitoring report that  
26 there was little to no suspended sediments below 5,000 cfs and thus, no need to sample for  
27 suspended sediments below those flows. Augmenting sediment of finer gradations would  
28 contribute to increasing suspended sediments below 5,000 cfs. This would likely restore  
29 conditions closer to those reported historically by early settlers (i.e. “exceedingly muddy”, James  
30 Evans, 1850). The benefits of sediment augmentation were intended to extend beyond the  
31 project reach of Cottonwood Ranch. Sediment coarsening has occurred throughout the entire  
32 program area and contributing finer sediments that may wash throughout the system (not settle at  
33 Cottonwood Ranch) could be beneficial to the target species and other ecologically important  
34 species. For example, the Pallid Sturgeon Information Review identified the potential  
35 importance of turbidity in pallid sturgeon ecology in the lower Platte River. Furthermore, use of  
36 coarse sediment gradations may contribute to more permanent bar formations that are  
37 detrimental to ephemeral bars needed for braiding conditions.

1 **Response: The comment is noted. No changes to document required.**

2 **Specific Comments for Augmentation Report**

3

4 Page 4 line 22- This only reviews other projects for applicability to quantities and grain sizes. It  
5 may be helpful to broaden the scope of how we relate other examples to our circumstances and  
6 use them to assist in proceeding with COE permitting (i.e. how did other COE districts make a  
7 case that their project should be permitted under a NWP#27).

8 **Response: Given the stated goal of reducing sediment, the project review was appropriate.**  
9 **No changes to document required.**

10 Page 23- Many of the proposed alternatives are below or at the end of subreach 2 or far from  
11 subreach 5 where sediment imbalances occur. What does the modeling show will happen (to  
12 sediment load and size) at the rest of the reaches outside of reach 3 where Cottonwood Ranch is?

13 **Response: While the specific goal for this project was achieving sediment balance at**  
14 **Cottonwood Ranch, the five model subreaches were delineated to evaluate anticipated**  
15 **aggradation or degradation on a subreach basis. The results of this evaluation are**  
16 **presented in Section 4 of Appendix B “Hydraulic and Sediment-transport Modeling for the**  
17 **Platte River Sediment Augmentation Feasibility Study, Nebraska.” No changes to the**  
18 **document required.**

19 Page 27 section 5.3- Private operations weren’t looked into with much detail. This feasibility  
20 analysis should have looked at all our options in depth. Discounting private sand and gravel  
21 operations simply because they “would likely involve compensation” is not a thorough  
22 evaluation of these options. There are many questions for these that should have been  
23 investigated such as “what level of compensation would be involved?”.

24 **Response: Private operations were looked at (Overton Sand and Gravel, Carl Whitney**  
25 **Sand and Gravel) both as source and potential augmentation locations. There were no**  
26 **specific private properties other than the sand and gravel operations although it was**  
27 **recognized that there could be potential source or augmentation location possibilities in the**  
28 **future. No changes to document required.**

29 Page 34- See general comment 5. Reregulating reservoir should be tabled for future  
30 consideration and not removed from consideration. We understand feasibility cannot be  
31 performed yet, but we should list it as a site for future consideration. The south channel below J-  
32 2 is the most degraded stretch of river within the Central Platte and it would be beneficial from a  
33 habitat standpoint to attempt to improve habitat as far up stream as possible (i.e. J-2 reregulating  
34 reservoir?).

35 **Response: Comment noted. Any of the sites or projects such as the J-2 Reregulating**  
36 **Reservoir could be and will likely have to be re-evaluated in the future regarding impacts**  
37 **to sediment balance. No changes to document required.**

38 Page 35- See general comment 5. In channel sediment augmentation (leveling high macroforms)  
39 serves multiple purposes such as: 1) sediment source and 2) increasing unobstructed widths, bare

1 sand area and 3) increasing characteristics more toward suitable target species habitat. The  
2 amount may be small but the benefits serve multiple purposes. Was macroform leveling  
3 investigated throughout the Jeffery Island property? Why was this thrown out for Cook  
4 property? Cook macroform leveling might not provide much volume but it is easily permittable  
5 and the benefits go beyond putting sediment in the river. Same goes for Dyer in-channel  
6 macroforms. Short term augmentation options are still options and shouldn't be thrown out. The  
7 analysis shows that no one option is capable of providing 100% of the project need. Therefore,  
8 we will have to use a combination of projects and considering in channel macroforms should  
9 figure into the equation.

10 **Response: Jeffrey Island is currently privately owned and under lease to NPPD. Leveling**  
11 **Jeffrey Island could cause drastic changes in that stretch of river and the impacts to**  
12 **landowners would need to be thoroughly thought out and mitigated. Leveling of**  
13 **macroforms was evaluated as part of this project; however, there is not a long-term**  
14 **sediment source available so it was screened out. The goal of the project was specifically to**  
15 **provide enough sediment source material annually to add to the river so that sediment**  
16 **balance was achieved at a specific location just upstream of Cottonwood Ranch. The**  
17 **report states at the end of the paragraph that if macroforms were leveled onsite, a**  
18 **reduction in augmentation of sediment at other areas may be realized. No changes to**  
19 **document required.**

20 Page 35- Are the volume estimates for Cook and Dyer (2.5-3 million and 1.5-2 million) the  
21 amount left after coarse sediment is removed? If approximately 50% is unusable, it makes a big  
22 difference. If so, present the numbers for in-channel sediment estimates to coincide. In other  
23 words, does the 100,000-400,000 in channel estimate relative to the out of channel estimates or  
24 do we need to shave off 50% of that estimate to compare the two equally?

25 **Response: The volumes of available sediment stated on Cook and Dyer in the report are**  
26 **gross volumes. The last sentence states that the amount available for transport would be**  
27 **approximately half of that. To compare the two equally, you would need to use half of the**  
28 **gross volume. The discussion under the Dyer and Cook sections refer to “augmentation**  
29 **material” which is material in the useable size range. No changes to document required.**

30 Page 36- See general comment 1 and 4. The geomorphology and vegetation report completed by  
31 Ayers suggests the “wash” load sediments are defined as those less than 0.0625 MM. This is  
32 significantly smaller than 1mm. The majority of our sediment used (<1mm) for augmentation  
33 will not be anywhere near the 0.0625mm threshold. There is a disconnect between wash load as  
34 defined within the geomorphology monitoring reports and the results of the modeling reported  
35 here (0.0625 mm vs. 0.25-1.0 mm). Furthermore, fines that wash through the Cottonwood  
36 Ranch reach have the potential to benefit by being deposited elsewhere within the Central Platte.  
37 To achieve sediment balance at Cottonwood Ranch, it may simply take longer and/or require  
38 more sediment if a higher percentage of sediment is transported through this reach.

39 **Response: “Wash load” as defined in this comment and the finer material evaluated as**  
40 **part of the project (0.5 mm) are two different things. The gradations selected for**  
41 **evaluations were based on the most practical available material. The average gradation of**  
42 **the “waste” or unused material at the sandpits has a D50 of approximately 0.5 mm. That**

1 material is readily available and is in the size range (i.e., D50 smaller than the 1.0 mm)  
2 suggested in the EIS. The “coarser” 1.2 mm gradation was based on a D50 of the bed  
3 samples collected as part of the Ayers study. In other words, that is the size of material  
4 currently moving in the bed. Regarding the last part of the comment, the report states that  
5 modeling indicated approximately 300,000 tons of the finer (D50 = 0.5 mm) material, or  
6 double the modeled deficit, would need to be added to achieve balance. No changes to  
7 document required.

8 Page 42, section 7.1.1- This section points out that pit dredges are efficient and economical to  
9 produce optimum sized material using screens at production site. Page 77 indicates that the  
10 existing technology (i.e. screen for optimum particle size) makes any additional processing for  
11 specific gradation impractical.

12 **Response: The statement is in reference to additional processing of the 0.5 mm material**  
13 **that has already been screened and is in the stockpiles. Further screening would likely be**  
14 **impractical and inefficient due to the material’s already small size. It may be possible to**  
15 **use a series of screens on newly mined material that could produce some variation in the**  
16 **D50; however, the typical mechanical screening processes may not differentiate the**  
17 **gradational sizes at this smaller end of the useable aggregate sizes. No changes to**  
18 **document required.**

19 Page 46, 7.2.4- See general comment 1 and 4. “Direct discharge is only possible if the proper  
20 gradation fits within the parameters identified during sediment transport modeling”... Need to  
21 add “OR parameters identified by the program”. The program participants and the TAC have  
22 input on the decisions that ultimately determine on the ground actions.

23 **Response: Text will be clarified.**

24 Page 55- How do modeling results suggest that pumping start date has little effect on the amount  
25 that the sediment deficit is reduced? The analysis showed that historically the deficits and  
26 excesses were eroded and deposited based on different high flow events or high annual flows.  
27 Knowing there is a big difference in the river flows of August 1 to February 15, this suggestion  
28 raises questions.

29 **Response: There is some variation but not enough that modifying the start date had a**  
30 **significant impact of achieving sediment balance at Cottonwood Ranch. There may other**  
31 **reasons you would put material in at different times of the year, but that evaluation was**  
32 **not part of this project. No changes to document required.**

33 Page 57- section 9.2- See comment 1 and 4 regarding concerns for this alternative.

34 **Response: See responses to comments 1 and 4.**

35 Page 58- Use of coarse material would make both Cook and Dyer infeasible due to the low  
36 hydraulic energy. These sites are prime candidates for augmentation of finer material.

37 **Response: That is the conclusion that is drawn in the report. Finer material placed at**  
38 **Cook/Dyer would require approximately 300,000 tons be augmented to nearly eliminate the**

1 **152,000 ton deficit. Coarser material is more effective downstream of the confluence**  
2 **because there is more stream power and less of the material will flush through the system.**  
3 **No changes to document required.**

4 Page 59- Existing Sand and gravel operations at Overton should not be limited to a gradation of  
5 D50-1.2. A D50 of 0.5 is modeled to require larger volumes and/or take longer to eliminate the  
6 sediment deficit. The TAC and Program staff should not eliminate this option based on General  
7 Comment 1.

8 **Response: The limitation was specifically related to the goal of achieving sediment balance**  
9 **at the upstream end of Cottonwood Ranch. See response to comment above. No changes to**  
10 **document required.**

11 Page 64- It appears the evaluation criteria focused on a practicability evaluation? How did  
12 “Least **environmentally damaging** practicable alternative” get narrowed to only practicability?  
13 There needed to be an environmental impact criterion in this screening. This alternatives  
14 analysis should address the biggest concern that the COE will likely have (environmental  
15 damage and impacts to downstream landowners). There needs to be a lot of discussions with the  
16 COE before we are able to move forward with these. A pre-application meeting should happen  
17 now presenting a lot of these screening results. Early feedback from COE may have led us to  
18 dismiss a number of alternatives or show increased feasibility of others.

19 **Response: The comment is correct that the feasibility screening criteria was focused on**  
20 **eliminating alternatives that were not practicable using criteria that would be consistent**  
21 **with the 404(b)(1) Guidelines. The feasibility report did not attempt to conduct a complete**  
22 **404(b)(1) analysis which will be required during the permitting phase. Instead, the**  
23 **feasibility study was structured so that it would help support the permitting process and**  
24 **feed into the Corps of Engineer’s 404(b)(1) analysis. As suggested in the comment, the**  
25 **Program has initiated pre-application consultation with the Corps of Engineers. Appendix**  
26 **A, Section 1.4 will be updated to reflect the comment and to clarify that there are other**  
27 **element so of the 404 (b)(1) Guidelines that will need to be evaluated during the permitting**  
28 **process.**

29 Page 66- “Provision of Other Program Benefits” mentions creating habitat (either directly or  
30 indirectly). The report never once mentions creating habitat in the river with the sediment (as  
31 this was also not within the stated project purpose). It only uses abandoned sand mining  
32 operations which would provide pits for potential habitats at some point in the future. Sediment  
33 augmentation is part of the FSM strategy, not the MCM. This was intended to be a key  
34 component in building habitat naturally out in the river. River habitat isn’t mentioned while  
35 OCSW habitat (which is part of the MCM strategy) is listed as a potential benefit. The  
36 “Provision of Other Program Benefits” should include benefits for the target species within the  
37 river as described in general comments 1 and 6.

38 **Response: Comment noted. As noted in the comment, this was not within the stated**  
39 **project goal. It is hoped that as a consequence of achieving sediment balance that habitat**  
40 **creation will be improved or sustained. No changes to document required.**



1 Page 67- Least environmental damage... not considered again relative to the 404(b)1 guidelines.

2 **Response: Comment is correct, Appendix A, Section 1.4 has been revised to clarify that the**  
3 **Corps of Engineers will be conducting a 404 (b)(1) Guideline analysis as part of the permit**  
4 **evaluation process. In addition, footnote #7, on page 63 will be updated to clarify that the**  
5 **404(b)(1) evaluation will be completed during the permit evaluation process.**

6 Page 71- Have any recent discussions with the COE occurred (like during feasibility screening)?  
7 There is no feedback on the feasibility of any different alternatives here. Permitting was used as  
8 screening criteria, yet it does not appear the COE has had recent input related to feasibility and  
9 permissibility of any of these alternatives (preferred techniques, methods, etc.). We need another  
10 pre-application meeting to discuss alternatives not involving those that have been previously  
11 permitted at Cottonwood Ranch. Has the COE indicated which of these alternatives might be  
12 considered under a NWP #27? Using dozers to do this type of work has been routinely  
13 authorized under a nationwide permit in other districts. Alternatives that could be authorized  
14 using a nationwide permit should be considered low difficulty. The Service would appreciate  
15 being included in the any pre-application meetings with the COE.

16 **Response: We agree with the comment. Additional pre-application consultation meetings**  
17 **will be required with the Corps of Engineers and the U.S. Fish and Wildlife Service will be**  
18 **invited to participate in future pre-application consultation meetings.**

19 Page 72, line 10- Service interpretation of modeling indicates that flow in the South Channel is  
20 capable of mobilizing sediment, but a finer gradation of sediment is necessary to be able to fully  
21 mobilize the sediment.

22 **Response: This is recognized and discussed in detail in the report and modeling appendix.**  
23 **No changes to document required.**

24 Page 73- Sandpits don't help meet the FSM management strategy. See other program benefits  
25 above. There are a multitude of target species benefits from sediment augmentation, as  
26 described in general comments 1 and 6, that go beyond offsetting a volume deficit at  
27 Cottonwood Ranch. These benefits represent aspects of the criterion "Provision of Other  
28 Program Benefits".

29 **Response: Regardless of the strategy, the sandpits would be a direct benefit from mining**  
30 **sediment onsite for the purpose of achieving the goal of the project, which is sediment**  
31 **balance at Cottonwood Ranch. No changes to document required.**

32 Page 75, line 9 and 17- See general comment 1 and 4. The goal to "eliminate sediment deficit at  
33 Cottonwood Ranch" does not reflect the overall purpose of sediment augmentation. Line 17  
34 states a project goal different than that outlined throughout the rest of this product. If the  
35 intended result is to build habitat, there is disconnect between that and achieving sediment  
36 balance at Cottonwood Ranch.

37 **Response: Line nine refers to the fact that most of the projects available for comparison**  
38 **had the stated goals of creating instream habitat (e.g., spawning habitat) and that the**  
39 **Sediment Augmentation is different in that the stated goal is to achieve sediment balance.**

1 **It is hoped that by achieving sediment balance, instream habitat may be improved or**  
2 **maintained in a more favorable condition. No changes to document required.**

3 Page 77- This is not consistent with previous assertion that it is easy and economical to screen  
4 sediment for our desired size. What are the costs associated with screening for coarse vs. fine  
5 sediment?

6 **Response: The 0.5 mm gradation is readily available as a by-product of production of**  
7 **other aggregates so in that sense, it is economical and easily acquired. There is a difference**  
8 **between using material that is “left over” from another process and specifically designing a**  
9 **system to differentiate very small variations in aggregate size at the small end of the scale.**  
10 **The practicality of specifically producing products that differentiate between 0.5 mm, 1.0**  
11 **mm, and 1.2 mm, for example may not be easy or economical. No changes to document**  
12 **required.**

13 Page 85-86- There are no recommendations as to the scale of the pilot study here. In the AMP  
14 implementation plan and mock report, the first two years are projected at 25%. It’s not clear  
15 what that is in relation to. Is it referring to a 25% reduction in sediment deficit or 25% of a  
16 defined volume needed for offset? According to the modeling, the volume needed will change  
17 drastically based on gradation of sediment used.

18 Good suggestion of refining monitoring plan. This will be the key to successfully being able to  
19 implement augmentation on a full scale.

20 **Response: The scope of the pilot project is being developed and will include monitoring**  
21 **plan refinement.**

## 22 **Specific Comments for Appendix A-**

23 1.3.2.2- Range of alternatives considered in the FEIS/FBO did not include coarse gradation  
24 augmentation.

25 **Response: Coarse is a relative term. In this report, the coarse material was the existing**  
26 **bed load material with an average D50 of 1.2 mm which only slightly larger than the 1.0**  
27 **mm recommended in the FEIS. The fine material was the 0.5 mm material at the sand pits.**  
28 **No changes to document required.**

29 1.3.3- We need to get across to COE that without sediment augmentation, any future high flows  
30 will create a need for downstream landowners to perform bank stabilizations as degrading areas  
31 will continue further down cutting and erosion. Do I understand that a PCN has only been done  
32 for in-channel work at Cottonwood Ranch?

33 1.4- See discussion above about “least environmentally damaging practicable alternative”.

34 **Response: See response to comment pertaining to page 64 above.**

## 35 **Specific Comments for Appendix B, C, D -**

- 1 Page 17- Points out that significant coarsening is likely to continue. This justifies previous
- 2 concerns with sediment augmentation gradation.
- 3 **Response: Comment Noted. No changes to document required.**
- 4 Page 81- See general comment 3 regarding SDHF magnitudes.
- 5 **Response: See response to comment 3.**



**PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM**  
**Technical Advisory Committee (TAC)**  
**Sediment Augmentation Feasibility Analysis Report Workshop Minutes**  
 ED Office – Kearney, NE  
 January 13, 2010

**Attendees**

Chad Smith – ED Office  
 Dave Baasch – ED Office  
 Jason Farnsworth – ED Office  
 Steve Smith – ED Office (Teleconference)  
 Mike Besson – Wyoming (Chair)  
 Brock Merrill – Bureau of Reclamation  
 Suzanne Sellers – Colorado Water Conservation Board  
 Kevin Urie – Colorado Water Users (teleconference)  
 Bob Mussetter – Tetra Tech  
 Tom Riley – Flatwater Group  
 Rick Krushenisky – Flatwater Group  
 Pat Engelbert – HDR  
 John Morton – HDR  
 Jim Jenniges – Nebraska Public Power District  
 Mark Peyton – Central Nebraska Public Power & Irrigation District  
 Mike Drain – Central Nebraska Public Power & Irrigation District  
 Jeff Runge – U.S. Fish and Wildlife Service  
 Matt Rabbe – U.S. Fish and Wildlife Service  
 Mike Fritz – Nebraska Game and Parks Commission  
 Pat Golte – Nebraska Department of Natural Resources  
 Mark Czaplewski – Central Platte Natural Resource District  
 Rich Walters – The Nature Conservancy

**Welcome and Administrative**

Besson welcomed everyone to the meeting and the group proceeded with a roll call.

**Sediment Augmentation Feasibility Analysis Report**

Engelbert led the discussion, introduced the core group of people that worked on the project, and walked through background information for the Sediment Augmentation Feasibility Analysis Report. Mussetter discussed the base-line modeling behind the analyses. Engelbert discussed sediment augmentation locations, sources, production and delivery technologies, delivery timing, and material gradation. Riley discussed evaluation criteria (cost, existing technology, logistics, and project purpose), alternative analyses, and risk and uncertainty analyses.

**Recommendations:**

- Pilot-scale study based on alternatives 6 & 8
- Develop monitoring plan
- Update model based on findings
- Develop final design

Besson asked how we get a handle on annual variability in sediment deficit. Mussetter stated we could introduce sediment at a rate the river can transport or stockpile sediment in the channel so it's available when the flows are there to transport it. Mussetter stated a key uncertainty is how best to augment sediment so the river can transport it. Farnsworth said we may have to tier it so we add a consistent amount annually and add more when needed. Fritz asked if the amount of sediment added needed to be determined on a real-time basis. Mussetter said it will be tough to add enough sediment during periods of high flow if sediment is not stock piled in the channel. Drain stated NPPD stock pile sediment below the diversion dam that is removed during periods of high flow. Besson asked how much sediment would be needed if the actual material size needed was <1.2mm. Mussetter stated they analyzed a scenario using 0.5mm sediment and it appeared to be over 300,000 tons of material and still didn't fill the hole. Drain asked if the amount of sediment we will augment will offset the deficits during years the river is not at a low deficit level. Mussetter stated the amount we plan to add would be more than enough to offset the deficit, but during other years it may require 250,000 tons of sediment. Farnsworth stated NPPD put sediment in the channel during drought years and Jenniges stated he thought it was about 120,000-130,000 tons of sediment during 2005-2009 and it seemed the material was stored on the bed of the channel and was moved downstream when flows were high. Krushenisky stated stockpiling didn't appear to meet sediment balance at Cottonwood Ranch, but the river may have been in balance further downstream.

Jenniges asked what we need to do to offset the deficit and if the only reason we couldn't was because we didn't want to put in 300,000 tons of material. Mussetter stated we may run into downstream effects with that much material. Peyton asked if we could move the equilibrium point upstream if we added material even if we don't meet sediment balance at Cottonwood Ranch. Mussetter said he thought it would take time to move equilibrium, but in the mean time the holes would be filling in. Besson asked how many other types of service water uses were in this reach of the river. Farnsworth stated Kearney Canal was the last water right other than ground-water wells downstream. Riley stated there would be a certain amount of sediment that would be deposited on the banks and vegetated islands during periods of high flow as Jenniges described. Runge asked if we could cooperate with NGO's and others so we don't get deposition of material out of the channel (i.e., could we mechanically widen channels). Mussetter said widening channels would definitely increase the capacity of the channel. Runge asked if sediment size impacts our ability to build sandbar macroforms. Mussetter stated we could build bars with an overload of any sized material and would build slower moving sandbars with courser material. Rabbe asked what would happen to coarsening if we put finer material in the system. Mussetter stated we could make the channel bed less course by adding finer material. Runge asked how adding 'clear' water from reservoirs (SDHF) would affect the system. Mussetter stated SDHFs will not impact sediment transport to a large extent where the durations were so short. Jenniges asked that if we balance the sediment deficit aren't we just stopping degradation rather than filling the holes. Riley stated we would need more than 185,000 tons of sediment to offset the deficit and cause agradation in the channel. Smith stated that if we want to increase the braiding index we need to add more sediment so we can agrade the channels and increase the braiding index.

**BREAK**

This document is a draft based on one person's notes of the meeting. The official meeting minutes may be different if corrections are made by the Technical Advisory Committee.



Morton discussed permitting issues with sediment augmentation and stated implementing a pilot study under an individual permit would make it easier for the Program to obtain a regional general permit for full implementation of sediment augmentation in the future. Besson asked what track we should pursue to allow us to conduct a pilot study and the timeframe for getting required permit. Morton stated we should attempt to obtain an individual permit for the pilot study and a regional permit when full implementation takes place and it would be a 6-12 month process for obtaining the permits. Rabbe asked Jenniges what type of permit NPPD had for their Cottonwood Ranch Permit and Jenniges stated they were operating under a regional permit that expired 13 December, 2010. Rabbe asked if they thought the Corp would react more favorably to dozing islands than other potential options for implementing sediment. Morton said the Corp is more familiar with that approach so they may react more favorably to that approach. Rabbe asked if they are pursuing multiple options to augment sediment and Morton stated they Sed-Aug team need to meet with ED Office staff to discuss potential options and would decide how to proceed from there. Jenniges asked how much sediment they would try to permit (150,000 or 300,000 tons). Morton said they would try to permit enough sediment for the pilot study, but didn't have a specific number in mind yet. Farnsworth stated we could get 50,000 at Cottonwood Ranch through channel widening and could add more at Dyer. Smith stated that if the TAC is comfortable with implementing a pilot study then the Sed-Aug team could finalize the feasibility report and draft the pilot study design and pursue permitting. Drain stated we should give the GC background information (cost, feasibility, etc) on implementing a pilot study and for full implementation of sediment augmentation. Jenniges asked if doing a pilot study was to monitor downstream affects or for permitting. Morton stated the pilot study would be easier to permit but that the pilot study would help learn a lot about sediment augmentation. Jenniges stated it would be 2013 before we could implement a pilot study and 2016 before full implementation. Besson asked how and how much we would implement sediment during the pilot study. Farnsworth stated he thinks we need about 100,000 tons sediment implemented with pumps. Smith stated time is an issue for the Program because we still need to build re-regulation reservoirs to be able to implement a SDHF. Jenniges asked if NPPD should look at permitting the 50,000 tons at Cottonwood Ranch or if the Program would permit that activity. Farnsworth stated the Program would try to permit all the work if possible, but may need NPPD to permit the Cottonwood Ranch work if the Corp won't permit the work for the Program. Besson stated we need more detail from ED Office staff and Sediment Augmentation group. Farnsworth stated we would have impact triggers so that when a threshold is met we would stop and assess the problem. Runge stated flow bypass at North Platte could contribute sediment to the central Platte. Rabbe asked if the sediment by North Platte could be mobilized or if vegetation would trap the sediment. Walters stated the vegetation below North Platte was sprayed. Farnsworth said the North Channel was in balance so wouldn't transport more sediment.

Besson asked if we had a timeline for presenting this information to the GC. Smith stated we may have the Sed-Aug team put together a presentation for the GC meeting in March and discuss the pilot study idea with the GC. Jenniges stated the TAC could review the pilot study plan and then present the information to the ISAC to get their feedback prior to going to the GC.

### Closing Business

**Final comments on Sediment Augmentation Feasibility Analysis Report are due 1 February, 2011.**

**ED Office staff will meet with the Sediment Augmentation team to discuss Final Report and a design for a Pilot Study.**