Seepage Project Handbook

Working Draft
Subject to Revision

SAN JOAQUIN RIVER
RESTORATION PROGRAM

Draft
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List of Abbreviations and Acronyms

Act	San Joaquin River Restoration Settlement Act
BNLL	Blunt Nosed Leopard Lizard
C-B	soil-cement-bentonite (C-B
CDFG	alifornia Department of Fish and Game
CEC	Categorical Exclusion Checklist
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CNDDB	California Natural Diversity Database
CVRWQCB	Central Valley Regional Water Quality Control Board
dBA	A-weighted decibeL
dS/m	deci-Siemens per meter
DWR	California Department of Water Resources
EA	Environmental Assessment
EC	electrical conductivity
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FONSI	Finding of No Significant Impact
ft	feet
IS	Initial Study
ITA	Indian Trust Assets
LTAA	Likely to adversely affecT
MOA	Memorandum of Agreement
NEPA	National Environmental Policy Act
NLTAA	Not likely to adversely affect
NPDES	National Pollution Discharge Elimination System
NRDC	National Resources Defense Council
O&M	operations and maintenance
QAPP	Quality Assurance Project Plan
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
ROD	Record of Decision
RPA	Reasonable and Prudent Alternative
S-B	soil-bentonite
SCTFG	Seepage and Conveyance Technical Feedback Group

SHPO	California State Historic Preservation Officer
SJRRP	San Joaquin River Restoration Program
SJVAPCD	San Joaquin Valley Air Pollution Control District
SMAQMD	Sacramento Metropolitan Air Quality Management District
SMP	Seepage Management Plan
SPH	Seepage Project Handbook
TEP	temporary entry permit
USACOE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
USDA	U.S. Department of Agriculture
USFWS	United State Fish and Wildlife Service
USGS	U.S. Geological Survey
VdB	vibration decibels

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1.0 Introduction

Document Versions

2011.05.10.....Initial outline and draft components for discussion at the Seepage and Conveyance Technical Feedback Meeting.

2011.08.01.....Draft Prioritization and Site Evaluation section for discussion at August Seepage and Conveyance Technical Feedback Meeting.

2011.09.02.....Draft Plan Formulation and Design Data Collection sections for discussion at September Seepage and Conveyance Technical Feedback Meeting.

2011.10.31.....Completed Environmental Compliance Section

2011.11.07.....Edits incorporating input from Seepage and Conveyance Technical Feedback Meetings

2011.12.08.....Draft of Construction Section added; edits made to other sections

1.1 Purpose

The Seepage Project Handbook (SPH) establishes the process the Bureau of Reclamation will use to coordinate with landowners on evaluation, design and construction of projects to reduce or avoid adverse material impacts from groundwater seepage as part of the San Joaquin River Restoration Program (SJRRP).

1.2 Background

The release of Interim and Restoration flows under the SJRRP will raise water surface elevations, which contribute to shallow groundwater table rise on lands adjacent to the river and bypasses. Consistent with the Seepage Management Plan (SMP), Reclamation will coordinate with local operators to limit releases from Friant Dam, Mendota Dam, and Sack Dam to non-damaging flow rates and identify projects. The SJRRP developed this SPH to coordinate with landowners on a process for building seepage projects that increase channel capacity.

The SMP includes thresholds for groundwater levels and salinity, and describes the operations Reclamation will take to limit Interim and Restoration flows to the current channel capacity to avoid material adverse impacts. The SMP also identifies fields or parcels potentially at risk to impacts due to Interim or Restoration flows, and prioritizes those locations into tiers of parcel groups for evaluation.

The objectives of seepage management actions and completed seepage projects include:

1) Reduce or avoid material adverse impacts from groundwater seepage, salinity, or levee instability from Interim or Restoration flows along the San Joaquin River from Friant Dam to the confluence with the Merced River without harming conditions for fish.

2) Increase channel capacity along the San Joaquin River in Reaches 1, 2A, 3, 4A, and 5 to allow up to maximum anticipated default flow schedule releases under Restoration Flows.

The Stipulation of Settlement (Settlement) in *Natural Resources Defense Council (NRDC), et al., v. Kirk Rodgers, et al.*, establishes two primary goals, one to restore and maintain fish populations in "good condition" in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, and the other to reduce or avoid adverse water supply impacts to the Friant Division long-term contractors that may result from the Interim and/or Restoration Flows provided for in the Settlement.

The San Joaquin River Restoration Settlement Act (Act), part of Public Law 111-11, authorizes Reclamation to implement the Settlement. The Act, passed in 2009, also requires the Department of the Interior to "reduce Interim Flows to the extent necessary to address any material adverse impacts to third parties from groundwater seepage" caused by Interim or Restoration Flows identified by SJRRP monitoring.

1.3 Seepage Projects Process

Objectives of the SPH include:

1) Delineate expectations of Reclamation, landowners, Settling Parties, third parties and other stakeholders for implementing seepage projects

2) Establish a process for implementing seepage projects, including estimated timelines and lists of potential activities

3) Identify deliverables for stakeholder input

4) Anticipate obstacles before they arise on a site-specific project

Site-specific seepage projects may refer to the SPH for guidance on process, timelines, and deliverables.

Reclamation will prioritize sites for seepage project planning and construction by the severity of the flow constraint. An initial priority tier developed in the Seepage Management Plan identifies the areas with the worst potential effects (in other words, those parcel groups that most restrict flows). Reclamation or designee will work through these parcel groups first, conducting site evaluations, plan formulation, and if deemed necessary, installing projects. Then the team will update the Seepage Management Plan

with the next round of priority locations, and the next group of potential seepage projects will begin the process set out in this document. Site-specific projects will be pursued concurrently with developing the SPH, and the SPH will be updated on an annual basis to reflect additional knowledge gained from the site-specific seepage projects.

Projects may include a variety of real estate or physical actions, including license agreements, easements, acquisition, habitat, interceptor drains, relief drains, drainage ditches, seepage berms, slurry walls, shallow groundwater pumping, buildup of low lying lands, or channel conveyance improvements. Depending on the site, a variety of constraints may exist, such as:

1) Presence of threatened and endangered species.
2) Presence of historical and cultural resources.
3) Compliance with water quality regulations regarding drainage water.
4) Maintenance of existing flood protection facilities and/or channel capacities.
5) Limited or no access to private property.
6) Conflicts between fish habitat and existing waterfowl habitat

1.4 Document Outline

This SPH walks through the steps to implementing seepage management projects. Specific sections include:

- **Section 1 - Introduction**: Describes the overall purpose and objectives.
- **Section 2 - Site Evaluation**: Introduces the conceptual model to describe the scientific method, and process for evaluating sites and developing initial alternatives.
- **Section 3 - Plan Formulation**: Describes selection criteria, and weighting of criteria used to evaluate alternatives and chose a preferred alternative.
- **Section 4 - Design Data Collection**: Explains procedures to gather design level data.
- **Section 5 - Design**: Discusses final design protocols for the preferred alternative.
- **Section 6 - Environmental Compliance**: Identifies the steps needed to comply with the National Environmental Policy Act, the California Environmental Quality Act if required, and other applicable environmental laws.

- **Section 7 - Construction**: Explains construction timelines and constraints.
- **Section 8 - Financial Assistance**: Describes process for funding seepage projects. Includes a template landowner agreement.

Appendices include:

- **Appendix A**: Reclamation's Final Design Process, April 2008
- **Appendix B**: Chapter 3 Section 8 of Reclamation's Technical Services Center Data Collection for Feasibility Designs Standards
- **Appendix C**: Slurry Wall Template Design Sketch and Cost Estimate

1.5 Seepage Projects Process, Timelines and Milestones

Table 1 shows the estimated timelines for different steps in the seepage project process. The rest of this handbook goes into detail about these steps. Items in bold are deliverables or other check-in points with landowners.

Table 1
Seepage Project Process and Due Dates

Event	Timeline
Initial Site Visit. Kicks off the seepage project process.	Following hotline call follow-up site visit or identification in SMP
Site Evaluation – Records Review	Immediately following site visit
Site Evaluation – Methods Report	~1 month after site visit
Site Evaluation – Fieldwork & Analysis	Following landowner approval of Methods Report
Site Evaluation Report	~6 months after site visit
Appraisal Level Designs for Initial Alternatives	Following Site Evaluation Report
Plan Formulation Meeting	~8 months after site visit
Feasibility Design	Following plan formulation and choosing of preferred alternative
Quantities and Cost Estimates	With feasibility design
Project Report	~10 months after site visit
Environmental Compliance	~10 months after site visit
Financial Assistance Agreement	~10 months after site visit
Final Design	Following Project Report
Bid	Following final design
Pre-Construction Meeting	Following bid, with contractor
Pre-construction surveys	Immediately prior to construction
Construction	Following notice to proceed

2.0 Site Evaluation

2.1 Introduction

The site evaluation identifies and screens potential project alternatives prior to extensive design and environmental compliance work. Evaluations identify the major sources of groundwater and potential salinity and identify advantages and limitations of specific projects based on site-specific conditions. Evaluations result in a Site Evaluation Report that will list potential project alternatives.

An investigation into all potential causes of groundwater rise and/or increased salinity provides backup and justification for the chosen seepage project. A Site Evaluation Report allows both Reclamation and landowners to understand why specific projects may or may not work. Figure 1 below shows a graphical depiction of influences on groundwater levels and root-zone salinity.

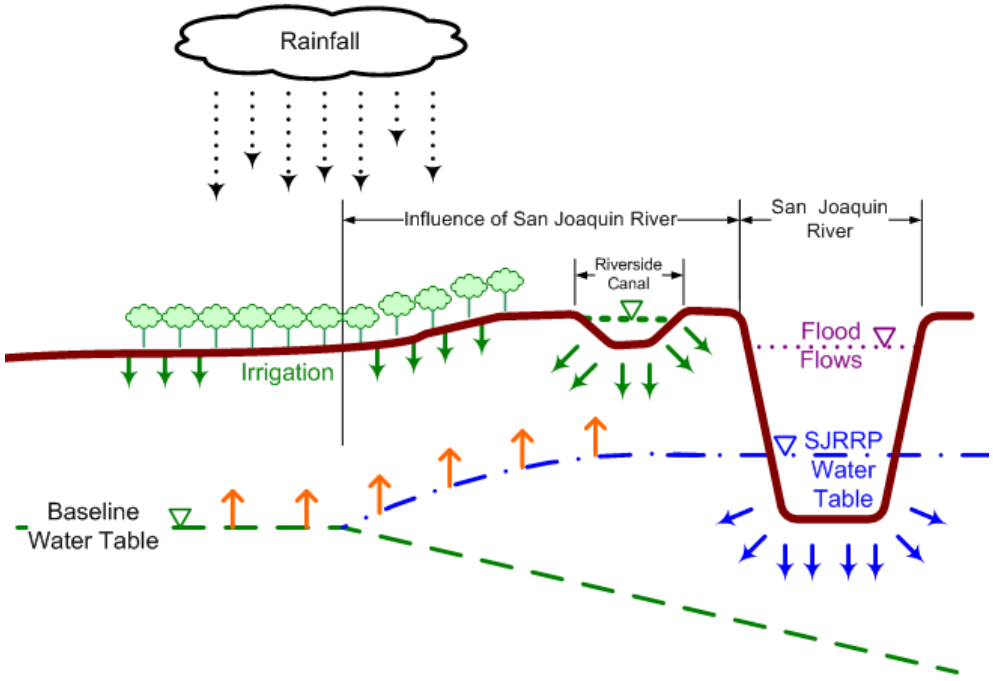

Figure 1
Site Evaluation Conceptual Model

Salinity sources may include:

- Irrigation Water
- Fertilizer and Soil Amendments

- Weathering of Natural Soil Minerals
- Shallow Groundwater Rise into the Root Zone

Groundwater recharge sources may include:

- Rainfall
- Irrigation
- Canal Seepage
- Flood Flow Seepage
- SJRRP Seepage

Additional factors for agricultural conditions would include: meteorological conditions influencing the temperature of the ambient air and soils; and pumping, bare-soil evaporation, and transpiration from water table affecting groundwater levels.

The evaluation of a particular site will include:

1) **Records Review**: Records review may include collection of existing groundwater, flow, soil texture and precipitation records, as well as any available information from Reclamation or the landowner regarding areas such as salinity sampling, irrigation practices, or canal seepage. A full list of information that may be required is attached in Reclamation's Feasibility Designs – Drains – Chapter 3.
2) **Field Work**: Field work gathers missing data pieces that may be key for a particular site. Examples include hydraulic conductivity testing, soil salinity sampling, and water quality testing. For sites without prior access, activities may include installation of groundwater monitoring wells.
3) **Analysis**: Analysis gathers together existing data and field work to evaluate the key influences on a particular site and the sources of groundwater or salinity issues. Analysis may include hydraulic calculations, flow net diagrams, qualitative descriptions from cross-sections and profiles, and modeling.
4) **Reporting**: Reporting documents the steps above, publishes the data and conclusions to allow for landowner input, and establishes initial alternatives for future analysis during design.

2.2 Records Review

Reclamation will gather existing data on the particular site including publicly available data, data Reclamation may have collected if the landowner allowed access, and data the landowner may be able to share. Chapter 3 Section 8 of Reclamation's Technical Services Center Data Collection for Feasibility Designs Standards describes all data collected for drainage design.

The following sections describe the purpose of obtaining records.

2.2.1 Precipitation

Precipitation records allow analysis of the effects, if any, of precipitation on groundwater levels, irrigation scheduling, and soil salinity changes. Reclamation will collect precipitation records in inches of rainfall per day from nearby meteorological stations via internet searches or from local landowner or water district records. Precipitation events plotted against groundwater levels may or may not show rises in groundwater that correspond in timing and amount to precipitation events. Groundwater rise may be greater than the precipitation measured due to the available pore space (porosity) of the soil column. Groundwater rise that corresponds only to precipitation events indicates other factors do not greatly influence groundwater levels.

2.2.2 Aerial Photos

Aerial photos may identify sand stingers from old sloughs for drainage evaluation. Imagery such as LandSAT or others may allow comparison of crop health to known historical conditions. Reclamation will request true-color aerial photos in digital or hard copy formats from existing public domain imagery such as LandSAT, historic or current aerial flights, ESRI aerial services, or other available aerial imagery from landowners. Reclamation will obtain aerial photos and look for lighter colored curved lines indicating old river channels. Reclamation will also compare crop health using infrared or true-color imagery over time, and look for the historical flooding range. Properties with numerous historical river channels may demonstrate greater connectivity to the river channel and indicate a need to perform calculations of loss and flow net analysis or modeling. Also, surface or buried sand sloughs may be ideal locations for drainage projects due to relatively high hydraulic conductivity. Correlation of crop health to historical conditions allows for estimation of primary factors controlling yields. For example, good crop health during flood flow years may indicate river flows are not a primary influencing factor.

2.2.3 Cultural Resources

Cultural resources review allows analysis of the effects, if any, of potential projects on cultural resources or National Historic Preservation Act compliance. Initial estimates of the likelihood for discovery of cultural resources help inform future data collection. Reclamation will review their existing cultural resources information for the seepage project site. Maps showing a high probability for buried resources and confirmed sites with historical resources will be overlain on the site. Seepage project sites located on areas of high probability for cultural resources may be less likely to develop a physical project due to expense associated with archeological surveys. Additional cultural surveys in areas of high probability may add significant costs to the project.

2.2.4 Endangered Species Act Effects

Locations with high likelihood of endangered species may help inform future planning. Reclamation will review the California Natural Diversity Database (CNDDB), as well as information from United State Fish and Wildlife Service (USFWS) species accounts, and California Department of Fish and Game (CDFG) species accounts available online. CNDDB database maps and other sources will be scanned to look for any critical habitat or potential species on the property. Identified species of concern may help dictate timelines and planning efforts.

2.2.5 Irrigation Records

Irrigation records allow analysis of the effects, if any, of irrigation on groundwater levels. Reclamation will obtain irrigation measurements in inches or acre-feet per day per acre from landowners or water districts in hand-written or digital format. Water district records may not show the level of detail desired. Reclamation will plot irrigation volumes with groundwater levels and river flows and note the range of daily fluctuations, if any, in groundwater levels. Reclamation will make correlations between irrigation events and river stages and/or groundwater level changes and note any delay, or lag, between irrigation events and water-table responses. This can occur where fine-grained materials exist in the shallow subsurface. Groundwater level increases that correspond to irrigation events, whether immediate or lagged, indicate that irrigation affects groundwater levels.

2.2.6 Fertilizer and Soil Amendment Applications

Fertilization and soil amendment records allow analysis of the effects, if any, of fertilizer or soil amendments on salinity and sodicity levels. Some fertilizers may contain charged ions or salts that increase salinity. Applied gypsum can increase soil salinity (ECe) by two to three deci-Siemens per meter (dS/m). Reclamation will obtain fertilization and soil amendment measurements in tons or pounds per acre per application or some similar unit from landowners, in hand-written or digital format, including the type of fertilizers or soil amendments used and the date of application. Obtain records of timing and amount of fertilizer or soil amendment application. Research salinity of fertilizer and compare to other salt sources. Fertilizer or soil amendments in absence of other salt sources may be a major influence on salinity levels. Soil amendments may not substantially influence salinity levels except within a few weeks of an application.

2.2.7 Yield Data

Yield data allows observation of possible correlation and potential impacts of high groundwater, and/or salinity, and/or river flows. Reclamation will request yield data in tons per acre or some similar unit from landowners, in hand-written or digital format. Reclamation will plot yield data per year. Evaluation of trends and correlation of crop yields to groundwater, salinity and other potential factors allows for a simple, preliminary, qualitative estimate of the primary factors affecting crop production.

2.2.8 Infrastructure

Reclamation will identify nearby canals, surface and subsurface drains, groundwater pumping, etc. to understand effects, if any, on groundwater levels. Also, this information may help with conceptual designs as part of initial alternatives development. Reclamation will request maps in digital or paper format showing locations of surface and subsurface drains, groundwater pumping wells, nearby canals, sloughs, head and drainage ditches from the landowner. Combined with discharge or loss measurements, nearby infrastructure can be included or ruled out as an influencing factor on groundwater levels. Combined with water quality information, nearby infrastructure locations can identify potential effects of drains, canals, etc. on salinity levels. Finally, infrastructure may indicate additional data collection needs. For example, if a certain site uses drip irrigation, examining and sampling a soil profile may be useful.

2.2.9 Historical Flooding

Reclamation or consultant will search for available records such as those available from the California Department of Water Resources (DWR), local agencies, and the United States Army Corps of Engineers (USACOE), as well as aerial photos, gaging station records or anecdotal evidence describing historical flooding on the property. This indicates potential levee concerns as well as the extent of seepage and flooding risk on the property. It also informs operation and maintenance costs of the project in the long term as well as potential effects from the project after floods to downstream neighbors or species.

2.2.10 Property Easements / Contracts / Programs

Reclamation, partner agency or consultant will work with the landowner to identify prior encumbrances on the property or programs specifying specific uses of the property. These could include United States Department of Agriculture (USDA) drainage programs, fertilization programs, interceptor drains, habitat improvements, or conservation easements. In addition, the team will record other programs such as regional land use plans, resource management initiatives, flood management plans, groundwater management plans, water quality programs, or species habitat areas. These programs could preclude certain types of projects, or could place added cost on the project construction.

2.3 Field Work

Approximately a month after the initial site visit to initiate site evaluation, following the Records Review, a methods report will detail future field work plans and requests for landowner approval. Field work may include hydraulic conductivity testing, soil salinity sampling, water quality sampling, groundwater monitoring, and other methods. The following sections describe these different field work efforts, their purpose, and analysis techniques. Additional methodology details are included in Appendix B.

2.3.1 Groundwater Monitoring

Groundwater monitoring identifies groundwater depths and gives a general indication of groundwater flow patterns and drainage over time. Reclamation, DWR, U.S. Geological Survey (USGS), or contractor drill crews will drill monitoring wells as approved by landowners along existing farm roads or other locations out of the way of farm operations. Wells may be drilled after access is granted, environmental compliance and permitting is complete, and a monitoring well agreement is signed with the landowner. Drill crews will use dry hollow-stem-auger collection methods for temporary disturbance in an area approximately 100 by 50 feet. The permanent structure of PVC piping, steel casing, protective posts and a concrete pad covers an area of 3 feet in diameter and protrudes 2-3 feet from ground surface. Reclamation will oversee installation of instrumentation in the wells to provide a continuous (often hourly) record of water levels in each well, making it possible to measure responses to precipitation, irrigation, and flow events.

Reclamation will calculate depth to groundwater by subtracting the difference between the top of casing elevation and the ground surface elevation from the depth below top of casing. These measurements plotted over time will allow Reclamation and the landowner to see various groundwater level responses to various influences such as river stage, canal seepage, crop

irrigation, rainfall, leaching practices, etc. Groundwater depths below ground surface compared with thresholds may or may not indicate drainage issues. Reclamation will convert these depths below ground surface to elevations to establish groundwater horizontal and vertical hydraulic gradients by subtracting the depth from the top of the casing from the elevation of the top of the casing.

2.3.2 Surface Water Monitoring

Surface water monitoring allows elevations to be collected to see the effects, if any, of river stage on groundwater levels. River elevation monitoring also helps determine the extent of the river's influence and compare elevations for drainage assessment. Reclamation will install staff gages on metal posts in the river channel adjacent to groundwater monitoring well transects. In some cases Reclamation may drive larger tubes into the riverbed and install pressure transducers to take hourly measurements of stage.

Correlations may be made by plotting water surface elevations with groundwater levels, either to track responses in groundwater, or in cross-section to calculate groundwater slope. These allow one to determine the effect of river stage on groundwater levels and if seepage is forcing groundwater levels to rise underneath adjacent fields.

2.3.3 Soil Texture

Soil texture data helps interpret soil salinity and groundwater movement in soils and substrata, and identify soil types for conceptual designs as part of initial alternatives development. Reclamation or Reclamation's contractor will drill hand-auger holes. Soil borings can be evaluated to a depth of about 10 feet or until hardpan layers or saturated unstable soils below the water table are encountered and make deeper hand auguring impractical. If the landowner agrees, backhoe pits can allow observation of broader soil texture trends. Reclamation will log soils in hand-auger borings or pit holes according to USDA standards to identify soil texture, texture changes, mottling, gleying, estimated in-situ moisture content, capillary fringe thickness, and water table level. Reclamation drillers that install the observation wells will collect soil texture information using the unified soil classification system (USCS).

Soil texture may determine limitations of a certain project alternative due to high clay content or high sand content. Soil texture also helps identify field locations or influences (river flows, drains) that may be more hydraulically connected to groundwater levels than others due to sand stringers or soil types. Soil texture also helps to properly interpret electrical conductivity (EM38) data and as supplemental information for drain spacing calculations.

2.3.4 Soil Salinity Sampling

Salinity sampling determines the existence of any historic or current root-zone salinity issues, and provides a baseline for pre-SJRRP soil salinity levels. Reclamation or Reclamation's contractor will drill hand auger holes approximately 5 feet deep or until free water is standing in the hole in several locations representative of field conditions. Reclamation will spread a tarp on the ground adjacent to the borehole to examine and log soils, and collect soil samples in plastic bags. Following logging, Reclamation will backfill the borehole with excavated material and tamp into place.

Salinity sampling allows for evaluation of salinity trends and sources. For example an increase in surface soil salinity may indicate upflux of water and salts from a shallow groundwater table. This situation may improve with installation of artificial drainage.

2.3.5 Electrical Conductivity (EM 38) Measurements

EM 38 measurements allow a wide area to be quickly surveyed for shallow salinity levels, evaluating spatial and depth soil salinity variation trends in soils and fields. Reclamation will take EM 38 measurements during springtime, when moisture contents are still relatively high, in a dozen or more locations throughout a given field. The EM 38 is a hand held portable instrument that is placed on the ground in 2 positions. The instrument provides both horizontal and vertical real-time bulk soils electrical conductivity measurements. These measurements are recorded and adjusted to a soil temperature of 25-degrees Celsius. This allows measurement of bulk soil electrical conductivity and salt distribution patterns to depth of 5 feet. EM 38 can identify shallow salinity trends, helping identify salt sources.

2.3.6 Water Quality Testing

Reclamation will evaluate shallow groundwater, irrigation supply, subsurface drain system and San Joaquin River water quality for SJRRP seepage investigations. Tests conducted on water quality samples show potential problems prior to implementation of physical solutions to drainage problems. Reclamation will use this data to evaluate alternatives for disposal of water discharged from interceptor drains or shallow wells that may provide subsurface drainage. During site evaluation, Reclamation will collect water quality samples from groundwater wells, surface water supplies and surface or subsurface drain effluent, if any, using 3/8-inch vinyl tubing connected to a surface deployed peristaltic pump or grab samples to a churn splitter. Reclamation will send water quality samples to a certified analytical lab for analysis in accordance with a project Quality Assurance Project Plan (QAPP).

Reclamation will measure the specific conductivity (EC), pH, temperature and turbidity at the sample locations at times of sample collection. Lab testing may include Bicarbonate, Calcium, Carbonate, Chloride, Magnesium, Nitrate as NO_3, Potassium, Sodium, Sulfate, Boron, Selenium, pesticides, and other constituents, and will show irrigation or river discharge suitability.

2.3.7 Hydraulic Conductivity Testing

Shallow groundwater flow from irrigation, canal losses, and river seepage loss, is subject to the hydraulic conductivity (or permeability) of the soil material it is flowing through. Subsurface materials are not uniform and can have a wide range of permeability due to factors that include depositional environment, grain size, degree of compaction, soil structure and soil structure stability to name a few. Hydraulic conductivity constrains the rate at which water can move through soil, a key parameter in determining seepage rates from various sources such as canals or rivers to groundwater. Knowledge of the local subsurface properties also informs initial alternatives development choices as well as drainage design.

During site evaluation, Reclamation or Reclamation's contractor will mobilize a small drilling rig to drill several small boreholes (4 to 6 inch diameter and generally to a depth of 20 ft). Reclamation will describe and record the soil profile, the depth to the water table and the depth of various soil layers at all locations of exploration holes. Reclamation will conduct hydraulic conductivity tests at any number of sites in order to obtain a representation of the subsurface

hydraulic conductivity of the area. Reclamation will conduct tests to evaluate both the permeable high flow zones and the slowly permeable relative barrier zones. Reclamation will use the two most common field test methods: the shallow well bail-out test (also called the auger hole test) and the piezometer test, both conducted in saturated soil (below the water table). Reclamation will perform the tests and calculations as described in Reclamation's Drainage Manual.

Hydraulic conductivity tests will be used to identify and describe the properties of the subsoil associated with the movement of groundwater. Measured hydraulic conductivity values provide site-specific data that can be used for various types of computations of groundwater flow, interceptor and relief drain flow, and potential quantity of discharge or discharge rate for initial alternatives development. The site evaluation process will include an exploration plan intended to identify the subsurface hydraulic properties of the local area. The exploration plan may become a grid pattern of exploration holes or a cross section type of exploration plan. The exploration plan and location of investigation holes and tests will generally work around existing crop areas and use field edges and field access roads. Reclamation may ask to install some temporary monitoring wells or in some cases staked open soil borings to track localized changes in the depth to the water table. Reclamation will describe subsurface soil profiles and record the depth to the water table.

2.4 Data Interpretation and Analysis

The following sections describe data analysis activities of Reclamation. Appendix B includes additional information.

2.4.1 Cross-Sections

Cross-sections of groundwater and surface water elevations show the lateral groundwater gradients. Gradients can indicate the extent of the San Joaquin River influence, the direction of drainage in relation to river stage and time of the year, and the potential degree of connectivity of fields with the river channel.

2.4.2 Profiles

Longitudinal profiles of groundwater, surface water, and terrain elevations show the relationship of the river to surrounding fields and well elevations. Profiles show the maximum potential for groundwater rise from river sources and areas at risk for a range of flow rates.

2.4.3 Depth to Water / Elevation Maps

Reclamation or the USGS will develop maps of groundwater-level elevation and depth below ground surface using monitoring data to determine groundwater gradients and variability over the site, and to identify areas potentially most vulnerable to seepage effects.

2.4.4 Flow Nets

Reclamation or SJRRP partners may use flow nets to delineate groundwater contours and associated flow lines, and thus provide information on the local hydraulic gradients and flow directions.

2.4.5 Modeling

The USGS or Reclamation may use modeling to interpret groundwater responses to individual sources of recharge, enabling determination of the key influences on a site. Tools currently being developed by the SJRRP will enable development of parcel- or multi-parcel-scale hydrologic models nested within a regional-scale model, thus enabling consideration of hydrologic responses to off-site activities such as irrigation of adjacent fields, wetting-up of habitat areas, and other activities.

The USGS or Reclamation may use parcel-scale models to evaluate the potential effectiveness of various physical seepage control alternatives prior to making large expenditures.

2.5 Reporting

The Site Evaluation Report provides for landowner input on any missing information, gathers site-specific soil and water data together for future landowner use, and sets initial alternatives for future seepage project plan formulation. It will be shared with the landowner in draft form approximately 6 months after the initial site visit for project kick-off, and will include a write-up of methods used, results obtained, discussion and conclusions from the site evaluation and data collection, as well as sections devoted to initial screening and initial alternatives as described below. The following lists the anticipated sections of the Site Evaluation Report.

I. Introduction: description of the site and relevant features
II. Methods: proposed approach for evaluation
III. Results: data collection and numerical analysis
IV. Discussion: applicability and limitations of the evaluation
V. Conclusions and Recommendations: process for moving forward including initial screening, initial alternatives for a project and/or revised threshold pending completion of a project
VI. Field Visit Documentation Appendix: attendees, data collected, and discussion items for each trip to the site
VII. Data Appendix – measurements including:
    1. Groundwater Levels
    2. Surface Water
    3. Water Quality
    4. Soil Hydraulic Conductivity
    5. Soil Chemistry
VIII. Numerical Analysis Appendix: computations and results

2.6 Initial Screening

Potential seepage projects may include real estate actions, such as easements or acquisition, or physical projects, including relief drains, interceptor drains, slurry walls, drainage ditches, shallow well pumping, or conveyance improvements.

Reclamation and its SJRRP partners will perform initial screening of projects with the data gathered during site evaluation. Site evaluation informs the design, feasibility, and suitability to site conditions criteria for project selection. Additional considerations at this step include landowner acceptability and environmental compliance.

The following bullets describe initial screening that may be done as part of the Site Evaluation Report to identify and remove unreasonable options and develop initial alternatives.

- Effective existing surface or subsurface drains may lean towards relief or interceptor drains as a project
- Lack of availability of a suitable outlet for subsurface drain discharge may rule out subsurface drains as a project
- Very fine soils may decrease effectiveness or increase costs of drainage projects
- Sand stringers may require further analysis or specialized solutions for drainage projects
- High EC drain water may not be allowed to enter San Joaquin River; may require drainage discharge to irrigation district for blending
- Heavy Metals or other trace elements may impact fish populations; may require drainage discharge to irrigation district for blending
- High probability of cultural resources may limit project options requiring extensive excavation if cost is a priority
- Excavation in Blunt Nosed Leopard Lizard (BNLL) habitat if there is state involvement may be adverse effects to species; may not choose that project
- Lands historically flooded may not be considered for subsurface drains
- Projects that improve lands beyond the productivity historically experienced would require cost share with the landowner

2.7 Initial Alternatives Development

The Site Evaluation Report results in a list of initial alternatives potentially feasible for the site. Initial Alternatives will include all projects that make it through initial screening. Initial Alternatives will also include potential placement, size, or extent, and design data collection. Plan formulation, the next step, will evaluate the initial alternatives in detail, perform additional design work, and select a preferred project through weighting of various selection criteria.

The list below provides a starting point for initial options. Landowners may identify additional options upon initiation of a site evaluation.

- Interceptor Drains
- Relief Drains
- Drainage Ditches
- Shallow Groundwater Pumping with existing or new wells
- Slurry or Cutoff Walls
- Buildup of Low Lying Areas
- Channel Conveyance Improvements
- License Agreements / Easements
- Acquisition
- Changes to Cropping Patterns: Working with the USDA or other programs to incentivize salt or shallow groundwater tolerant crops
- Partnerships: Partner with Non-government organizations for conservation easements, acquisition for wetland mitigation, etc.

National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) compliance requires establishment of a baseline for comparison of potential environmental impacts. The baseline is described as a No Action Alternative that would evaluate conditions with Interim and Restoration flows in the San Joaquin River without the seepage project in place.

2.8 Process and Timelines

The site evaluation process begins with a site visit. Following the site visit, Reclamation or designee will review existing records and put together a Methods Report detailing future field investigations. The landowner may expect Reclamation or designee to contact them to review the Methods Report approximately 1 month following the site visit. At this time, the landowner may raise any concerns they may have about field site investigation and adjustments can be made as necessary to the Methods Report. Landowners or other interested parties they approve will have two weeks to review the report.

If not already agreed, the landowner must sign a temporary entry permit (TEP) to allow Reclamation to access their land to conduct the site investigation, and may need to sign a monitoring well agreement or other agreement for specific fieldwork. The draft TEP and any necessary agreements will be sent to the landowner with the Methods Report for approval. The landowner may suggest changes to the TEP or monitoring well agreement in the same two week period they have to review the Methods Report. Reclamation or designee will make revisions to documents within two weeks or less of receipt of comments, or if the landowner raises major

concerns, both parties will work to resolve them as quickly as possible. Parties understand that delay in review will delay the project.

Following landowner approval of the Methods Report or a preliminary draft that provides a maximum extent of impact, Reclamation initiates the permitting process with a second site visit focused on permitting activities. Based on the results of this second site visit, an Endangered Species Act affects analysis and cultural resources analysis are prepared and submitted to the appropriate agencies for review and approval. These analyses are required for National Environmental Policy Act compliance, and are typically completed with a Categorical Exclusion. The permitting timelines can take between 1.5 to 3 months assuming no issues arise.

After satisfactory environmental compliance and any necessary permitting, Reclamation or designee will begin fieldwork. Fieldwork, depending on the extent and type, can take 1-3 months. Reclamation or designee will then conduct data analysis and write the Site Evaluation Report. As data comes in for the Site Evaluation Report, Reclamation or designee will begin the screening process and come up with a list of initial alternatives for inclusion in the Site Evaluation Report. The landowner can expect a draft Site Evaluation Report with all collected data 6 months following the initial site visit assuming no issues arise..

3.0 Plan Formulation

3.1 Introduction

The purpose of plan formulation is to select a preferred alternative from a list of initial alternatives. Plan formulation needs a defensible approach to identify project components of importance and rank projects based on these components. During the plan formulation process Reclamation and the landowner will use weighted selection criteria to score each alternative, obtain a final project type, and move on to design data collection and design.

Quantitative criteria allow for fair and transparent decision making. Any team member may suggest adjustments to these criteria, as well as to any aspect of the SPH, on an annual basis. Reclamation will evaluate suggested revisions and gather input from the Seepage and Conveyance Technical Feedback Group, as the group initially developed the criteria.

3.2 Appraisal Level Designs

Reclamation's contractor or other team members will develop appraisal level designs for each initial alternative identified in the Site Evaluation Report to inform plan formulation. Appraisal level designs follow Reclamation's final design step Concept. Appraisal level designs should include review of existing geologic, hydrologic, and groundwater data, lab testing reports, general plan/ arrangement of concept alternatives, thirty-percent-design cost estimates, etc.

For additional detail on appraisal level design, see Reclamation's Final Design Process Stage: Concept, pages 6 – 9, as included in Attachment A. Section 5 also includes additional information about design.

3.3 Criteria

Reclamation developed the criteria shown below with input from the Seepage and Conveyance Technical Feedback Group (SCTFG). Landowners may request revisions to criteria or additional criteria through comments on the SPH, but adjustments to the plan formulation criteria will apply to all upcoming projects throughout the SJRRP area. This maintains consistency and defensibility. The following list (Table 2) describes the criteria used, and includes various wordings developed by attendees at the August 4, 2011 SCTFG.

Table 2
Plan Formulation Criteria and Original Stakeholder Text from SCTFG

Criteria Topic	Stakeholder Text
Ability to increase flows to 4,500 cfs	Ability to increase flows; meeting 4,500 cfs goal
Effectiveness of project in protecting lands	Projects to avoid damages; Certainty of performance;
Landowner acceptability, including upstream and downstream landowners	Landowner acceptability; landowner acceptability - with neighboring lands protected; consideration of surrounding land use; project works with both upstream and downstream landowners; impacts to adjacent landowners; coordination with other seepage projects
Regional solutions ranked higher	Entire regions of reach protected; larger projects, especially near river; how the project fits into the larger regional 'mitigation' program i.e. no impacts to others
Temperature	Not increase water temp when fish in the river;
Water Quality (especially Selenium)	water quality will not be degraded; not increase selenium runoff (green sturgeon);
Site Suitability (near the seepage source)	Site Suitability; suitability to site conditions as per *all* criteria from SCTFG; soil structure - extremely important; projects oriented at the source - near the river; cropping patterns
Long term viability & low O&M costs	Cost, long-term viability; Sustainability of improvements over the long term; long term O&M costs; long term O&M;
Opportunities for habitat improvements	Opportunities for habitat improvements;
No barriers to fish passage (stranding)	Does not create a barrier to fish passage; does not create stranding of adult fish without addressing passage; does not preclude the ability for fish to be in the river while projects are installed - fish do not wait for 4500 cfs
Project ownership	Ownership of project;
Does not increase subsidence	design such that if there is a potential for subsidence, the issue is not exacerbated;
Alignment with other programs (district water quality plans, regional plans)	Fits with other programs i.e. EQUIP or CMS programs
Creates rearing habitat for fish	Creates rearing habitat for fish;
Cost	Cost of project; cost;
Regulatory permitting (time)	Regulatory permitting (time); temporary solutions can be used until such time as funds are available for higher dollar options
Environmental Compliance	Environmental Compliance;

3.4 Rankings

Reclamation and the landowner will discuss the appraisal level designs and score alternatives at a meeting. Reclamation's final design process calls this a concept briefing meeting, or a plan formulation meeting. Parties will reach an agreement on the preferred alternative before continuation of designs.

Reclamation developed quantitative statements for each selection criteria described above. These are shown in Table 4 below. The specific values for each alternative and criteria will come from site evaluation and appraisal-level designs. This allows comparison with data collected on the site during the site evaluation and information from the appraisal-level designs, and helps create an objective selection process.

Reclamation and the landowner will chose the preferred alternative as the alternative that scores the best on the plan formulation criteria. Reclamation, or designee, will weight each criterion according to the High, Medium or Low weight in Table 3. Reclamation, or designee, will convert each criterion to a score out of 100 before weighting so that each 'high' criterion has the same weight as another 'high' criterion. This preferred alternative will then continue to additional design data collection, design, environmental compliance, permitting and agreements.

3.5 Documentation

The Project Report will include the results of plan formulation, appraisal level designs, and work for the preferred alternative as discussed in Section 7.

3.6 Process and Timelines

Reclamation expects plan formulation to take up to 2 months to develop appraisal level designs, determine criteria numbers for each alternative, schedule and hold a meeting with the landowner assuming no issues arise. In total, it is expected that the plan formulation meeting will occur approximately 8 months after the initial site visit.

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Table 3
Plan Formulation Criteria and Assessment Methodology

Criteria Topic	Criteria	Unit	Analytical Tool	Weight
Ability to increase flows to 4,500 cfs	4,500 cfs WSE does not cause surface ponding in fields	Y/N	hydraulic model, CVHM	screening
Environmental Compliance	Major environmental concern – significant impact to a resource area and unavoidable with mitigation measures	Y/N	Environmental compliance	screening
Effectiveness of project in protecting lands	-1 point for each 0.5 groundwater level above threshold at 4,500 cfs	feet	hydraulic model, CVHM	High
Landowner acceptability, including upstream and downstream landowners	+1 point for each landowner	point	landowner meeting	High
Regional solutions ranked higher	+1 for each additional seepage parcel group solved	point	appraisal level design	High
Temperature	-1 point for each degree increase in river temperature	degree	Water Quality monitoring	High
Water Quality (especially Selenium)	-1 point for each 0.5 increase in Selenium	ppb	Water Quality monitoring	High
Site Suitability (near the seepage source)	Project targets seepage source	Y/N	appraisal level design; site evaluation - CVHM	High
Long term viability & low O&M costs	+1 point for each unit less than most expensive O&M alternative. Expected effectiveness over time (scale 0-5, 0 being most effective), estimated O&M for 20 years. (Effectiveness x $50,000 + O&M)/#acres protected	$10 per acre	appraisal level design & cost estimate	High
Opportunities for habitat improvements	+1 point for each mile of non-hard structural fix adjacent to river (within 500 feet of levee)	mile	appraisal level design	High
	+1 point for each 50 acres of fallow or open land near river	acre	appraisal level design	High
	+1 point for each additional 50 acres of riparian habitat	acre	appraisal level design	High
No barriers to fish passage (stranding)	-1 point for each 0.5 foot lowered river WSE post project compared with pre project conditions	WSE	hydraulic model	High
Project ownership	Landowner owns project	Y/N	project agreement	Medium
Does not increase subsidence	-1 point for each 0.5 foot lowered ground surface	feet	CVHM / subsidence model	Medium
Alignment with other programs (district water quality plans, regional plans), habitat corridor,	+1 point if project aligns with a regional plan	Y/N	Site Evaluation Records Review	Medium

Criteria Topic	Criteria	Unit	Analytical Tool	Weight
and migration pathways				
Creates rearing habitat for fish	+1 point for each additional 5 acres of rearing habitat	acre	hydraulic model	Medium
Cost	+1 point for each $10 less per acre than the lowest cost project alternative	dollars per acre	appraisal level cost estimate	Medium
Time to construction	+1 point for each month sooner the project is in the ground than the slowest alternative	months	Project schedule	Low

1

4.0 Design Data Collection

4.1 Introduction

Design data collection expands upon the earlier site evaluation efforts to gather site-specifics for the preferred alternative. The project report includes this information.

4.2 Field Work

Additional site investigations will likely include additional surveying and geotechnical investigation. Please see the Site Evaluation section for more information on fieldwork activities and disturbance. Also, please see Reclamation's guidance on design data collection for drains attached to this Handbook as Appendix B.

4.3 Process and Timelines

Design data collection can be lengthy process, and as such it is important to define initial design data needs early in the process. In Reclamation's design process, definition happens during the SCHED phase and data collection itself happens during design concept phase. Reclamation anticipates that much of the data collection will occur under site evaluation, and so design data collection will take a relatively short amount of time. If investigations involve ground disturbance, permits will be required. This process could take two to four months, including permitting and field work time, assuming no issues arise.

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5.0 Design

5.1 Introduction

Design determines the conceptual layout of the seepage project, quantities of materials and excavation / fill needed, and costs. Reclamation or designee will develop appraisal level designs for all initial alternatives to quantify criteria for the plan formulation stage. Reclamation or designee will also develop a feasibility level design for the preferred alternative. Feasibility design for the preferred alternative will include conceptual layouts, quantities and costs. After feasibility level design, Reclamation will likely contract or provide financial assistance for another entity to conduct Final Design, with Reclamation in a review capacity. Please see Reclamation's guidance on the Final Design Process attached as Appendix A.

5.2 Feasibility Design

The design steps involve developing the scope of design, including functional and operational requirements. Preliminary items include establishing a funding source, scheduling, staffing, and definition of design data requirements as described in Section 4, Design Data Collection.

Feasibility design, approximately equivalent to industry's 5 to 30% design, involves any additional field exploration, materials testing and hydraulic studies necessary. It also involves developing the design drawings, cost estimates and a schedule, and completing value engineering. Reclamation or designee would complete feasibility level designs for the preferred alternative.

5.3 Project Report

Reclamation or designee will document the feasibility designs, data, analysis, and environmental compliance in a Project Report. The report will include, in this approximate outline:

I. Introduction
II. Methods
III. Results
IV. Discussion
V. Conclusion and Recommendation
VI. Field Visit Documentation Appendix
VII. Data Appendix
VIII. Analysis Appendix
IX. Environmental Compliance (EA/IS or EIS/EIR)
X. Appraisal Designs
XI. Feasibility Design for Preferred Alternative
XII. Permit Applications

5.4 Final Design

Final design will occur after the completed Project Report. A non-federal entity will likely complete final design.

Final design, approximately equivalent to industry's 30 to 60% design, involves preliminary drawings, and permits initiated. Draft specifications, which is actually a design phase approximately equivalent to industry's 90% design, involves specifications sent for review, quantities and bid schedules completed, and all lab testing and TMs finalized. Following the 90% design a review phase occurs, at which point Reclamation conducts a Design Estimates and Constructability review of the project.

Reclamation calls 100% design FINAL SPEC, at which point final design drawings and specifications are completed and sent for bids.

5.5 Template Designs

This section contains template designs for several seepage control projects.

5.5.1 Slurry Wall

Reclamation designed a template slurry wall for comparison purposes. This section details the assumptions made, includes a sketch of a potential slurry wall, and includes estimated costs for different depth and slurry mixtures.

The river water surface elevation used was based on the elevation at 800 cfs. The historic/target ground water table depth in the farm lands adjacent to the river was assumed to be 6 feet below the ground surface.

Based on what appeared to be the predominant geology along the river, seepage analysis was performed using silty-sand and clayey soil foundations with assumed permeability values. Figure 2 shows the results of just one of the seepage analyses performed. Cost estimates were determined for 60-feet deep and 40-feet deep cutoff walls included in Appendix C. It is noted that the geology was not studied in detail, and a deeper wall may be required in the event that the soils, either locally or globally, are more permeable than estimated. It is not likely that a shallower wall would lower the groundwater sufficiently.

Preliminary level cost estimates were provided for soil-bentonite (S-B) and soil-cement-bentonite (C-B) slurry cutoff walls. A typical slurry cutoff wall thickness of 3 feet was used. The S-B wall is more economical and would likely perform comparably to the C-B wall. Reclamation calculated costs for a 40-foot deep S-B wall of approximately $5 million per mile. A 60-foot deep S-B wall calculated a cost of $9 million per mile, while the C-B wall at 60-feet deep was $13 million per mile. Approximately 40% of these costs are contingencies.

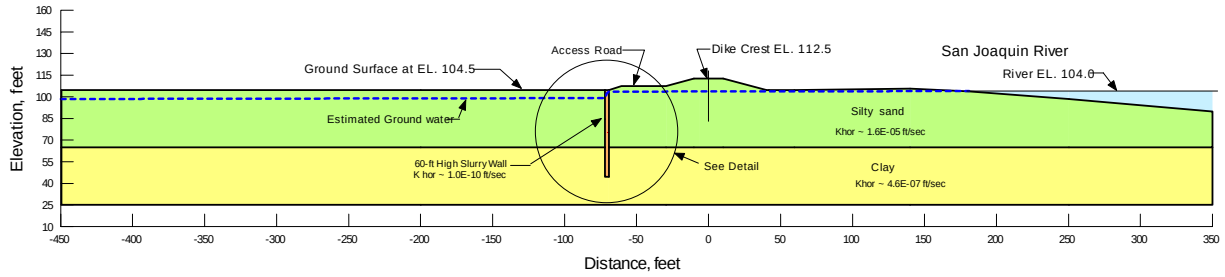

Figure 2
Slurry Wall Template Design

5.5.2 Seepage Berm

Estimated costs indicate around $2.3 million per mile of seepage berm installed. Approximately 40% of this cost is contingencies. This includes clearing and grubbing, borrow excavation, inspection trench excavation, compacted embankment, and bank protection. Reclamation calculated a clearing and grubbing cost assuming very few large trees or other major vegetation, primarily stripping below organic material in foundation for one foot. Borrow excavation assumes borrow sources are within 3 miles of the levee centerline.

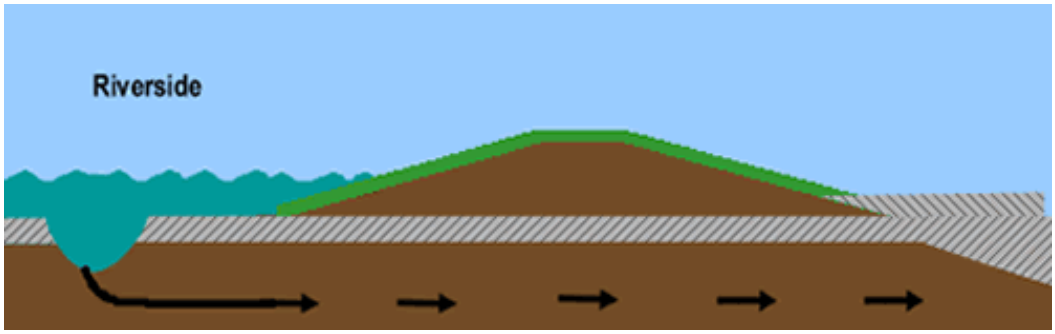

Figure 3
Seepage Berm Template Design

5.5.3 Drainage Ditch

To be developed.

5.5.4 Interceptor Line

The templates for drains could estimate costs per mile of constructing drains 8, 10 or 12 feet deep. These costs may be misleading in terms of costs of water table control since under some conditions a 12 foot deep drain may be more economical than tightly spaced 8 foot deep drains.

5.5.5 Shallow Groundwater Pump

To be developed.

5.5.6 Buildup of Low Lying Areas

To be developed.

5.5.7 Channel Conveyance Improvements

Channel conveyance improvements include dredging of material out of the river channel, removal of structures, adjustments to channel bathymetry such as creation of low flow or side channels, levee work, and other adjustments to the channel.

Generally sediments coarser than fine sand could be used to buildup road surfaces, while fine sand or finer sediments could improve and build up low lying agricultural lands near the river or bypass. The dredging could create a low water channel in the bypass / rivers.

5.5.8 Habitat Improvements

To be developed.

5.6 Process and Timelines

Project partners can expect completed feasibility level design approximately 10 months after the initial site visit assuming no issues arise. If issues arise such as environmental compliance or permitting challenges, design discrepancies, project partner disagreements, or weather or other delays in site evaluation or design data collection fieldwork, the completed final design may exceed the estimated timeframe. Reclamation, irrigation districts, landowners, or other recipients of financial assistance may perform the actual design.

Completed final design may take 3 months assuming no issues arise and environmental compliance only requires a categorical exclusion assuming no issues arise. This translates to 13 months after the initial site visit. Also if issues arise such as permitting challenges, design discrepancies, project partner disagreements, disagreements about financial assistance, weather or other delays in final design fieldwork, the completed final design may exceed the estimated timeframe.

6.0 Environmental Compliance

6.1 Introduction

Environmental compliance includes documentation and permitting to meet federal, state, and local requirements. After completing environmental documentation, the responsible party will apply for required permits with appropriate state or federal agencies that may have jurisdiction over parts of the project. Reclamation or irrigation districts under a financial assistance agreement will likely conduct environmental compliance.

Federal agencies must comply with NEPA for projects in which there is a Federal undertaking. As the lead Federal agency, Reclamation will review and approve NEPA documents to ensure all essential information is obtained, and the analysis is adequate to meet NEPA standards. Projects involving state agencies require compliance with CEQA. A project is a "Federal undertaking" and requires NEPA compliance if any of the following are true:

- Has Federal discretion (i.e., permits, approvals, etc.),
- Is on Federal property, or
- Is funded wholly or in part through a Federal source.

6.2 National Environmental Policy Act

To initiate the appropriate environmental compliance process(es), Reclamation and the project partner will develop a project description for review by the SJRRP Environmental Compliance and Permitting Workgroup. A project description explains the proposed action and the methods used to get to an expected outcome. A project description also explains what the project consists of in order for agencies to determine what environmental compliance activities will be required. Project descriptions include:

- Alternatives considered
- Objective of proposed action
- Project limits (depths, quantities, length, staging areas, etc.)
- Construction methods and best management practices (types of equipment needed, dust abatement, etc.)

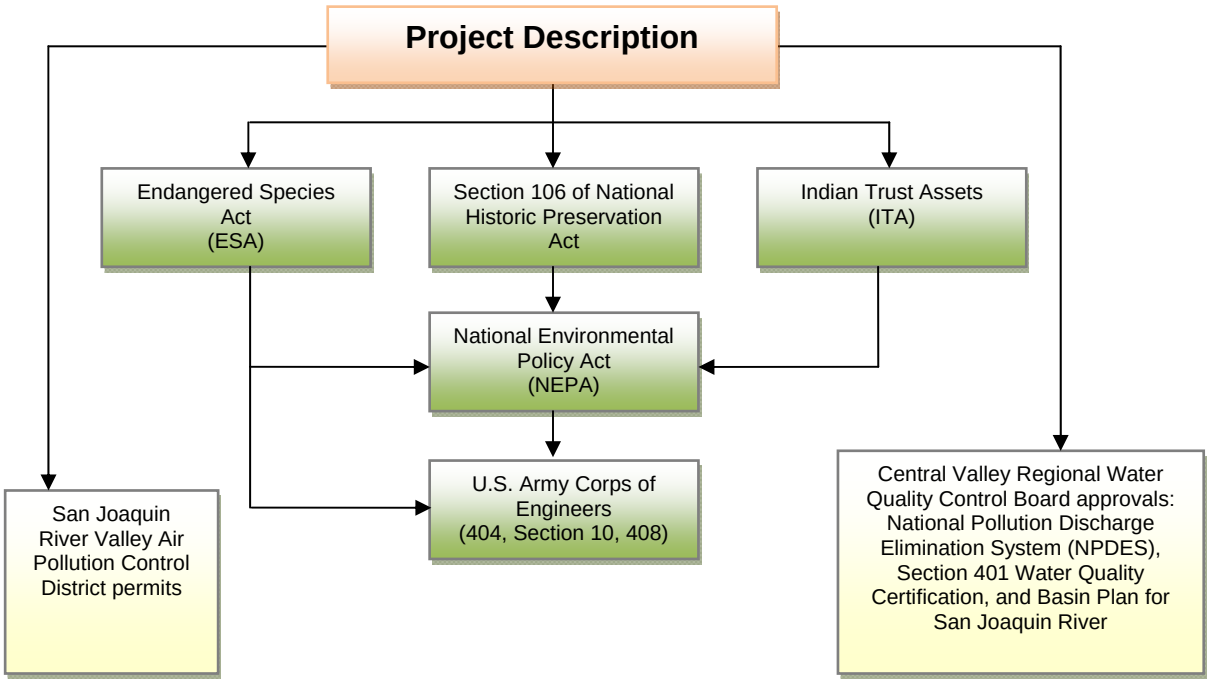

Figure 4
Federal Environmental Compliance Process

NEPA documents impacts to environmental resources. The NEPA document, if an EA or EIS, could include the following environmental resources and analysis.

- **Aesthetics**: Visual resources analysis includes a qualitative assessment of views from communities or buildings occupied from people, and any changes that may occur to them.

- **Agricultural Resources**: Analysis identifies project area agricultural revenue, acres of farmland including prime farmland, unique farmland, and farmland of statewide importance, and irrigated acres of farmland. Any effects to agricultural resources such as reduced water supply, bridge closures, Williamson Act impacts, or a positive effect from additional lands to convert to agriculture would be included in the analysis.

- **Air Quality**: Air quality analysis would likely include estimating construction criteria pollutant and precursor pollutant emissions using the San Joaquin Valley Air Pollution Control District's (SJVAPCD) Guide for Assessing and Mitigating Air Quality Impacts and guidance provided by SJVAPCD staff. Construction emission estimates would likely include calculations from the Sacramento Metropolitan Air Quality Management District's (SMAQMD) Road Construction Emissions Calculator based on default fleet characteristics, the most conservative emissions factors. These calculated values would then be compared to SJVAPCD thresholds and Federal conformity determinations.

- **Biological Resources**: The ESA effects analysis would include searches of USFWS's species database, CDFG's species accounts, reports, the CNDDB, and literature from other sources. Then a comparison would document any overlap of the project area where construction would occur and the habitat of special status species. An assumed presence approach would then dictate biological protection measures or Best Management Practices as per the SJRRP Conservation Strategy. An alternate approach would be to conduct biological surveys to determine presence in the field, and suggest biological protection measures based on field survey data.

- **Cultural Resources**: Records reviews of prehistoric and historical archaeological sites, architectural properties of importance such as buildings, bridges, and infrastructure, and resources important to Native Americans will include existing and eligible inclusions on the National Register of Historic Places. For any projects involving ground disturbance, cultural resources surveys will evaluate any potential effects to archeological resources, and the State Historic Preservation Office may concur. Identified archeological resources will include mitigation through consultations with the State Historic Preservation Office, Native American tribes, and interested parties.

- **Environmental Justice**: Environmental justice evaluations include searches for local economically disadvantaged communities, and potential effects on their visual resources, noise levels, air quality, and jobs.

- **Earth Science**: Earth science analysis includes potential impacts to geology, soils or paleontological resources. Analysis would include an assessment of ground-disturbing activities and changes as a result.

- **Groundwater**: The Kings, Delta-Mendota, Madera, Chowchilla, or Merced groundwater subbasins of the San Joaquin Valley Groundwater Basin may contain the project. Groundwater analysis will likely include research from the California Water Plan Updates as well as U.S. Geological Survey modeling, and the San Joaquin Valley Drainage Monitoring Program on groundwater overdraft. Environmental documentation would also show calculations of any predicted changes in groundwater levels.

- **Land Use**: Analysis will identify any potential changes to land use (such as conversion to agriculture, conversion to natural areas, etc.) from the project.

- **Noise**: Noise analysis includes calculations of construction equipment noise emission levels and traffic in A-weighted decibel (dBA) equivalent noise levels. Analysis would also include calculations from groundborne vibration and noise in units of vibration decibels (VdB). Then environmental documentation would show comparisons between calculated noise levels and local noise standards at nearby sensitive receptors with the lowest allowed levels.

- **Public Health**: Public health analysis includes potential for emergency services disruption due to traffic, and potential for hazardous waste spills.

- **Recreation**: Analysis includes identification of nearby recreation areas, any generated demand for recreation, construction or expansion of recreation amenities, or restrictions for access to recreation.

- **Socioeconomics**: Analysis documents existing population, income, and job levels in the area. Environmental compliance would include qualitative assessments of how population, income and job levels could change with the project.

- **Transportation**: Analysis includes descriptions of existing roads, uses, and extent of use. Analysis of the proposed action includes calculations of additional traffic, changes to road cross-sections, stability, or alignments, road closings, and any removal of existing utilities.

- **Utilities**: Analysis will identify nearby utilities and any utilities disturbed or removed as part of the Proposed Action. Utility providers would be contacted before project construction to determine the location of any underground utilities.

- **Water Supply**: Analysis would include calculations on changes in water supplies for fish and wildlife as well as agricultural uses, both in terms of quantities, timing, and locations.

- **Water Quality**: Analysis will include summaries of existing water quality testing in the area, and comparison to municipal and agricultural standards. Alternatives with a discharge may require water quality sampling in the river, groundwater and sampling or predicted discharge water quality.

- **Other**: Other resource areas may include climate change, power and energy resources or population and housing.

Project effects will be evaluated based on the criteria of context and intensity. Context means the affected environment in which a proposed project occurs. Intensity refers to the severity of the effect, which is examined in terms of the type, quality, and sensitivity of the resource involved, location and extent of the effect, duration of the effect (short- or long-term), and other consideration of context. Both adverse and beneficial effects are considered. When there is no measurable effect, no impact is found to occur. The intensity of adverse effects will be described in terms of the degree or magnitude of the potential adverse effect and will be summarized as negligible, moderate, or substantial.

The significance criteria used in the project environmental compliance document will be based on the environmental checklist presented in Appendix G of the State CEQA Guidelines; factual or scientific information and data; and regulatory standards of Federal, State, regional, and local agencies. These thresholds will also include the factors

taken into account under NEPA to determine the significance of the action in terms of the context and the intensity of its effects. The Project environmental compliance document will use these or similar criteria as appropriate.

NEPA requires all federal agencies to fully and publicly disclose any reasonably foreseeable adverse impacts that could result from the federal undertaking.

Reclamation may prepare and distribute the following documents for NEPA:

- Categorical Exclusion Checklist (CEC)
- Environmental Assessment (EA) and Finding of No Significant Impact (FONSI)
- Environmental Impact Statement (EIS) and Record of Decision (ROD)

An EA and EIS both require public comment periods. Following a Public Draft document and a Final Draft, Reclamation would issue a Finding of No Significant Impact FONSI for an EA, or a ROD for an EIS to document the final alternative.

The following sections provide more details about some key portions of NEPA compliance.

6.3 Endangered Species Act

The Endangered Species Act requires analysis for potential impacts to species. Projects with Federal-only action only require analysis of federally listed species per ESA, while projects with a state action require analysis of state listed species per the California Endangered Species Act, which includes more species. Field reviews/surveys are needed to identify both:

- Presence/absence of species and
- Presence/absence of potential habitat.

Following biological surveys, Reclamation prepares an effects analysis and makes one of the following determinations.

- **No Effect**: The proposed project has no effect on the species. The means the project will not harm, harass, injure, pursue, capture or kill the species.
- **May effect, not likely to adversely affect (NLTAA)**: The proposed project is within the habitat of the species or near a sighting, but with or without conservation measures the project is not likely to adversely affect the species.
- **Likely to adversely affect (LTAA)**: The project may have take and harm, harass, injure, pursue, capture or kill the species.

If the project determines a NLTAA or LTAA, consultation must be undertaken with U.S. Fish and Wildlife Service and/or National Marine Fisheries Service per Section 7 of the Endangered Species Act, as Reclamation's involvement triggers a federal nexus. If no Federal agency is involved, the project team must go through a habitat conservation plan process which is generally more complex. The U.S. Fish and Wildlife service has an informal consultation process for a NLTAA determination, and a formal consultation process for a LTAA determination. The formal consultation process results in a Biological Opinion, which may include either a jeopardy opinion (the project will have take) or a no jeopardy opinion.

USFWS consultation may result in requirements that help the project go forward without creating affects to species. In informal consultation, these are called conservation measures. In a Biological Opinion they are called either Reasonable and Prudent Alternatives (RPA) or Terms and Conditions. Terms and Conditions are the most stringent in terms of putting requirements on the project.

6.4 Section 106 – National Historic Preservation Act

Section 106, or the National Historic Preservation Act, requires analysis to determine potential effects to historic properties, paleontological or prehistoric resources. If any ground excavation is proposed, field surveys are needed to identify:

- Surface cultural and archaeological resources,
- Subsurface cultural and archaeological resources, and
- Eligibility status of resources.

Reclamation gathers the findings from surveys in a report and sends a letter to the California State Historic Preservation Officer (SHPO) with a request for concurrence for a finding. Findings may include:

- **No Historic Properties Affected**: No eligible resources in the area that will be effected
- **No Effect**: No change to an eligible resource
- **No Adverse Effect**: A change to the resource, but not damaging
- **Adverse Effect**: Will alter, damage, destroy, or change the resource and its eligibility

SHPO has 30 days to respond with their concurrence with Reclamation's findings. If the proposed action has an Adverse Effect, then the project needs additional coordination through a Memorandum of Agreement (MOA).

6.5 Indian Trust Assets

Indian Trust Assets analysis is necessary to approve any Department of Interior undertaking. Indian Trust Assets (ITA) is the protection of property interests held by the U.S. for the benefit of Indian Tribes or Individuals. ITA analysis generally involves a simple request to identify the nearest ITA asset. There are no known ITA assets in the program area.

6.6 Permitting

6.6.1 San Joaquin Valley Air Pollution Control District

The SJVAPCD may require permits for ozone and particulate matter emissions.

6.6.2 U.S. Army Corps of Engineers Permits

USACOE permits are required for work within Waters of the U.S., navigable waterways, and for modifications to federal flood control projects. USACOE permits come in two forms – Section 404 permits, authorized under the Clean Water Act, regulate disposal of dredge and fill material. Section 10 of the Rivers and Harbors Act gives the USACOE authority over navigable waterways, and requires permits for actions that could disrupt boating traffic.

6.6.3 Central Valley Regional Water Quality Control Board

The Central Valley Regional Water Quality Control Board (CVRWQCB) requires permits for construction activities in relation to water quality protections (stormwater and activities within state waters), basin plan authorities and enforcement.

Alternatives or projects with a discharge will require a NPDES permit. Reclamation, landowner or designee must file a report on waste discharge with the CVRWQCB that includes a description of the project, the quantity of discharge water, the quality of discharge water, and completed CEQA environmental compliance. The CVRWQCB would specify limits on discharge and a monitoring program to ensure compliance. Discharges to go to agricultural supply canals may have fewer restrictions, providing the canals do not drain to the San Joaquin River or a tributary of the San Joaquin River. Options, including agricultural water supply for salt tolerant crops, should be described in the report on waste discharge if they are possible especially in cases with discharge water high in salinity, selenium, boron or molybdenum.

CVRWQCB approvals of the permit application / report on waste discharge must be approved by the board. Approvals may take 120 days or more.

6.7 Process and Timelines

If project expected to have no or minor impacts to cultural resources, ESA, etc. and no discharge:

- **Field surveys for Section 106 and ESA**: 1 day to 2 weeks (includes time to schedule staff and coordinate with property owners, depends on size of site, etc.)
- **Compilation of Field Results**: Approximately 2 weeks
- **NEPA (assuming CEC)**: Approximately 3 days
- **Section 106 SHPO Concurrence**: 30 days

The total compliance time for a minor project with no adverse or significant impacts to resources, such as installation of a monitoring well, is approximately 2 months.

If greater impacts to resources are suspected from a project based on field reviews, then the project participants would need to assess timelines on a case-by-case basis. EIS documents generally take at least a year to complete. Reclamation or a designee would develop a schedule for these projects that outlines the process and expected timelines.

If Reclamation / the landowner expect a discharge, the Regional Water Quality Control Board or another non-federal agency may be the CEQA lead. Reclamation and the CEQA lead can prepare a joint NEPA/CEQA document, and then submit this to the CVRWQCB for approval for a NPDES permit among other permit applications. CVRWQCB approvals of the permit application / report on waste discharge must be approved by the board. Approvals may take 120 days or more.

7.0 Construction

7.1 Introduction

This section discusses construction planning activities necessary to begin construction of the project. Reclamation or the partnering agency, in coordination with the landowner, will develop a construction plan to be included as part of the specifications in the RFQ for the construction contract.

In developing the construction plan, Reclamation or the partnering agency will adopt an approach that would cause minimal disturbance to grower operations, property, or crops. Reclamation or the partnering agency would also ensure that construction is undertaken such that effects to the environment (e.g., any endangered species, whether plant or animal) are minimized. The construction plan will include the timeline of construction. Reclamation or the partnering agency and the landowner will develop the construction plan together, with an initial meeting to bring up ideas and landowner review of the draft plan.

The following sections describe timelines and constraints/limitations associated with each potential physical project.

7.2 Potential Constraints

7.2.1 Slurry Wall

This section outlines the preliminary timeline and potential limitations associated with the construction of a slurry wall as discussed in Section 5. The location and length of the slurry wall would be determined based on local site conditions. Construction of slurry walls would involve a process that includes: (1) mobilization of trenching and mixing equipment; (2) excavation of trenches; (3) mixing and placing slurry in trenches; and (4) demobilization of equipment. The following factors will be considered during the scheduling of construction activities:

1) **Schedule**: Construction would be scheduled to occur during winter months (i.e., December to March) if possible to minimize disturbance to local farming activities. The schedule may vary depending on the crop types and irrigation facilities and practices of the site.

2) **Mobilization**: Mobilization of construction equipment would be made through existing farm roads wherever possible; however, if existing roadways cannot be used, care would be taken to minimize property damages. Proper dust mitigation measures would be used during construction.

3) **Construction Footprint**: The construction plan will optimize the digging/trenching and staging footprints to reduce disturbance to the land owners and minimize permanent loss

of agricultural land. Use of fallow fields or bare areas will likely be required for staging areas.

4) **Endangered Species**: The effects of construction activities on endangered species/plants will be factored into the planning, permitting, and scheduling of construction efforts. Reclamation and partnering agencies will follow the Program Biological Assessment and existing conservation strategy to protect endangered species present on the site.

7.2.2 Seepage Berm

This section outlines the preliminary timeline and potential limitations associated with the construction of a seepage berm. Designs would likely place seepage berms along the levee toe. Construction of seepage berms would involve a process that includes: (1) mobilization of equipment; (2) excavation of foundation; (3) excavation of borrow areas; (4) placing and compaction of soil; and (5) bank protection. The following factors will be considered during the scheduling of construction activities:

1) **Schedule**: Construction would be scheduled to occur during winter months (i.e., December to March) if possible to minimize disturbance to local farming activities. The schedule may vary depending on the crop types and irrigation facilities and practices of the site.

2) **Mobilization**: Mobilization of construction equipment would be made through existing farm roads wherever possible; however, if existing roadways cannot be used, care would be taken to minimize property damages. Proper dust mitigation measures would be used during construction.

3) **Construction Footprint**: The construction plan will optimize the staging footprints to reduce disturbance to the landowners. Use of fallow fields or bare areas will likely be required for staging areas.

4) **Endangered Species**: The effects of construction activities on endangered species/plants will be factored into the planning, permitting, and scheduling of construction efforts. Reclamation and partnering agencies will follow the Programmatic Biological Assessment and existing conservation strategy to protect endangered species present on the site.

7.2.3 Drainage Ditch

Construction of drainage ditches would require deepening of existing drainage ditches/trenches or the excavation of new ditches/trenches. This activity would involve: (1) mobilization of digging/trenching equipment; (2) digging/trenching and stabilization of drainage slopes (if required); (3) demobilization of construction equipment. The following factors will be considered during the scheduling of construction activities:

1) **Schedule**: Construction would be scheduled to occur during winter months (i.e., December to March) if possible to minimize disturbance to local farming activities. The

schedule may vary depending on the crop types and irrigation facilities and practices of the site.

2) **Construction**: For new ditches, the construction plan will optimize the digging/trenching and staging footprints to reduce disturbance to the land owners and minimize permanent loss of agricultural land. Proper dust mitigation measures will be used during construction.
3) **Endangered Species**: The effects of construction activities on endangered species/plants will be factored into the planning, permitting, and scheduling of construction efforts. Reclamation and partnering agencies will follow the Programmatic Biological Assessment and existing conservation strategy to protect endangered species present on the site.

7.2.4 Interceptor Line

Construction of an interceptor line would involve similar activities as involved for a slurry wall. However, interceptor line construction would occur more quickly and be less intrusive because the interceptor line would typically be installed shallower than a slurry wall, and no mixing of a slurry mixture would be required. This construction activity would involve: (1) mobilization of digging/trenching equipment; (2) digging and trenching; (3) laying interceptor pipelines and installing sump pumps (if necessary) which could include electrical work; (4) demobilization of construction equipment. The following factors will be considered during the scheduling of construction activities:

1) **Schedule**: Construction would be scheduled to occur during winter months (i.e., approximately December through March) if possible to minimize disturbance to local farming activities. The schedule may vary depending on the crop types and irrigation facilities and practices of the site.

2) **Mobilization**: Mobilization of construction equipment would be made through existing farm roads wherever possible; however, if existing roadways cannot be used, care would be taken to minimize property damages. Proper dust mitigation measures would be used during construction.

3) **Construction**: The construction plan will optimize the digging/trenching and staging footprints to reduce disturbance to the landowners. The design and construction plan would describe use or modification of any existing drainage infrastructure in the design and construction.

4) **Endangered Species**: The effects of construction activities on endangered species/plants will be factored into the planning, permitting, and scheduling of construction efforts. Reclamation and partnering agencies will follow the Programmatic Biological Assessment and existing conservation strategy to protect endangered species present on the site.

7.2.5 Shallow Groundwater Pump

Shallow groundwater pump installation would include: (1) mobilization of drill rig equipment; (2) digging/installation of shallow wells and groundwater pump; (3) some electrical work may be necessary depending on the location of the pump; and (4) demobilization of equipment. The following factors will be considered during the scheduling of construction activities:

1) **Schedule**: Construction would be scheduled to occur during winter months (i.e., December to March) if possible to minimize disturbance to local farming activities. The schedule may vary depending on the crop types and irrigation facilities and practices of the site.

2) **Mobilization**: Mobilization of construction equipment would be made through existing farm roads wherever possible; however, if existing roadways cannot be used, care would be taken to minimize property damages. Proper dust mitigation measures would be used during construction.

3) **Construction Footprint**: The construction plan will optimize the digging/trenching and staging footprints to reduce disturbance to the landowners and minimize permanent loss of agricultural land. Reclamation would try to install the pumps adjacent to farmlands wherever possible to reduce property damage.

4) **Endangered Species**: The effects of construction activities on endangered species/plants will be factored into the planning, permitting, and scheduling of construction efforts. Reclamation and partnering agencies will follow the Programmatic Biological Assessment and existing conservation strategy to protect endangered species present on the site.

7.2.6 Buildup of Low Lying Areas

The buildup of low lying areas would require clearing and cultivation of land prior to raising the ground surface. The land surface would be built up using finer textured sediments to reduce seepage effects in these areas. This activity could involve significant earthwork including dredging or excavating soil from the bypass or river channels and filling nearby low lying areas with the dredged or excavated material. Buildup of low lying areas may occur in conjunction with channel conveyance and improvements, providing an area to place dredged material. Reclamation and the partnering agencies will consider the constraints discussed above for other seepage control projects; however, the nature of this activity would make it difficult to ensure no disturbance to farm land during a growing season. The net effect of this type of project would be to improve the agricultural productivity of lands that are currently adversely affected by seepage.

7.2.7 Channel Conveyance Improvements

Channel conveyance improvements include: (1) mobilization of dredging and removal equipment; (2) dredging of material out of the river channel, removal of structures, construction of levee and side channels; (3) demobilization of equipment. The following factors will be considered during the scheduling of construction activities:

1) **Schedule**: Reclamation would try to schedule construction during the winter months (i.e. December to March) if possible; however, the nature of this activity might require a longer construction period. Reclamation would try to ensure minimal disturbance to farming activities during the growing season.

2) **Mobilization**: Mobilization of construction equipment would be made through existing farm roads wherever possible; however, if existing roadways cannot be used, care would be taken to minimize property damages. Proper dust mitigation measures would be used during construction.

3) **Construction Footprint**: the construction plan will optimize the digging/trenching and staging footprints to reduce disturbance to the landowners and minimize permanent loss of agricultural land.

4) **Endangered Species**: The effects of construction activities on endangered species/plants will be factored into the planning, permitting, and scheduling of construction efforts. Reclamation and partnering agencies will follow the Programmatic Biological Assessment and existing conservation strategy to protect endangered species present on the site.

7.2.8 Habitat Improvements

Habitat improvements include: (1) mobilization of excavation and grading equipment; (2) cut, fill and grading of land; and potentially (3) revegetation. The following factors will be considered during the scheduling of construction activities:

1) **Schedule**: Reclamation would try to schedule construction during the winter months (i.e. December to March) if possible; however, the nature of this activity might require a longer construction period. Reclamation would try to ensure minimal disturbance to farming activities during the growing season.

2) **Mobilization**: Mobilization of construction equipment would be made through existing farm roads wherever possible; however, if existing roadways cannot be used, care would be taken to minimize property damages. Proper dust mitigation measures would be used during construction.

3) **Construction Footprint**: The construction plan will optimize the staging footprints to reduce disturbance to the landowners.

4) **Endangered Species**: The effects of construction activities on endangered species/plants will be factored into the planning, permitting, and scheduling of construction efforts. Reclamation and partnering agencies will follow the Programmatic Biological Assessment and existing conservation strategy to protect endangered species present on the site.

7.3 Process and Timelines

Reclamation or the partner agency or consultant will develop the construction plan with the final design process and specifications. The landowner will receive at least one opportunity to review the plan and the team will schedule a meeting to discuss details with the landowner if any concerns arise.

8.0 Financial Assistance

To be developed.

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9.0 References

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