Attachment A - Arroyo Canal Fish Screen and Sack Dam Fish Passage Project Operation & Maintenance Plan

General Operations

1. The facility is designed to be operated year-round but will require maintenance to perform according to criteria. There are three categories of maintenance for this project: scheduled maintenance, unscheduled maintenance, and emergency maintenance.

2. Scheduled maintenance is predictable maintenance to ensure equipment and facilities continue to operate as intended and is conducted throughout the year. Routine maintenance for long-term operation, facility modifications, or other activities that will require the project to be out of service will be conducted during the summer maintenance period of May 15 – October 31. Efforts will be made to reduce the frequency of outages during the fish passage season of November 1–May 14. Scheduled maintenance for project components is further described below in this Operation and Maintenance Plan.

3. Unscheduled maintenance is a non-emergency maintenance need that was not predicted as part of a regular maintenance schedule. Unscheduled maintenance that may affect fish passage will be coordinated with the Reclamation biologist, who will coordinate with National Marine Fisheries Service (NMFS) for approval of unscheduled maintenance prior to commencing the activity. Project maintenance that has no effect on special status fish may occur at any time of the year.

4. Emergency situations will be immediately addressed in coordination with the Reclamation biologist. The Reclamation biologist will assess the emergency, consider alternatives to reduce the potential impacts to fish, and will document the recommended corrective action for reporting out to NMFS. If the Reclamation biologist is unavailable, the Project staff may proceed with corrective action but must document the action and inform the Reclamation biologist within 24 hours. The Reclamation biologist is responsible for coordinating with NMFS within 48 hours regarding the corrective action taken to remedy emergency situations.

5. The Reclamation biologist will ensure operation, maintenance and monitoring activities are implemented in accordance with the terms and conditions of the biological opinion for the project, unless the activity is an emergency situation as described above. All operation, maintenance and monitoring activities will be coordinated with NMFS to the extent feasible.

General Maintenance

1. Gauges would be inspected quarterly, or as needed, to ensure that outages are minimized, and measurements are accurate.

2. The Supervisory Control and Data Acquisition (SCADA) system and controls are held in the maintenance building and would be regularly tested and inspected consistent with manufacturer recommendations and specifications. A secondary communications system will be established via cellular or satellite to ensure connectivity if the traditional radio system goes offline.

3. Should an outage be required for a modification of the facility or a maintenance activity, every effort would be made to ensure passage opportunities are still available for native species at the time of the outage. Outage windows are preferred to occur outside of the migration windows and will be coordinated with NMFS to ensure outages and modifications are consistent with the terms and conditions of the biological opinion.

Facilities

1. Fish Ladder

1.1 Description

The vertical slot fish ladder is a concrete structure ten feet wide and 175 feet total length with a full build out of ten baffles each at 7.5 feet tall (Figure 1). The downstream fish ladder entrance is 4.5 feet wide with a slot to install a bulkhead and allow or preclude fish entrance. The bulkhead is in place when the ladder is non-operational and fully removed when operational. The fish ladder is located on the left bank (west side of the re-routed river channel), adjacent to the downstream end of the fish screen. The fish ladder entrance is located within the river bypass immediately adjacent to overshot gate number one (Gate 1) which provides supplemental attraction flow to the ladder. The entrance to the fish ladder is positioned within the low flow channel of the river bypass. The low flow channel invert is 1.5 feet deeper than the river bypass floor to ensure adequate downstream depth at all flow conditions. The upstream fish ladder exit is ten feet wide and has a bulkhead/slide gate which is either fully open to facilitate ladder operation or fully closed when the ladder is non-operational. Ladder flow is between 30 and 50 cfs and is dictated by the upstream water surface elevation (WSE). The fish ladder will include ten 7.5 foot tall vertical baffle weirs, each spaced 12 feet apart. The six upstream weirs only have the wider baffle wall section installed. The narrower left baffle sections will be added as needed to create a vertical weir and maintain proper fish ladder hydraulic conditions. Each baffle is intended to accommodate half a foot of head loss rather than the traditional one foot of head per baffle. The edges of the baffle walls and corners are rounded for lamprey passage, as per NMFS criteria. Additionally, the wider baffle section of each weir contains a 12-inch by 12-inch lamprey orifice at the bottom

right corner of each baffle to facilitate lamprey passage. Orifices in the fish ladder would be inspected during daily visual inspections to ensure clogging by debris has not occurred that would impact lamprey passage.

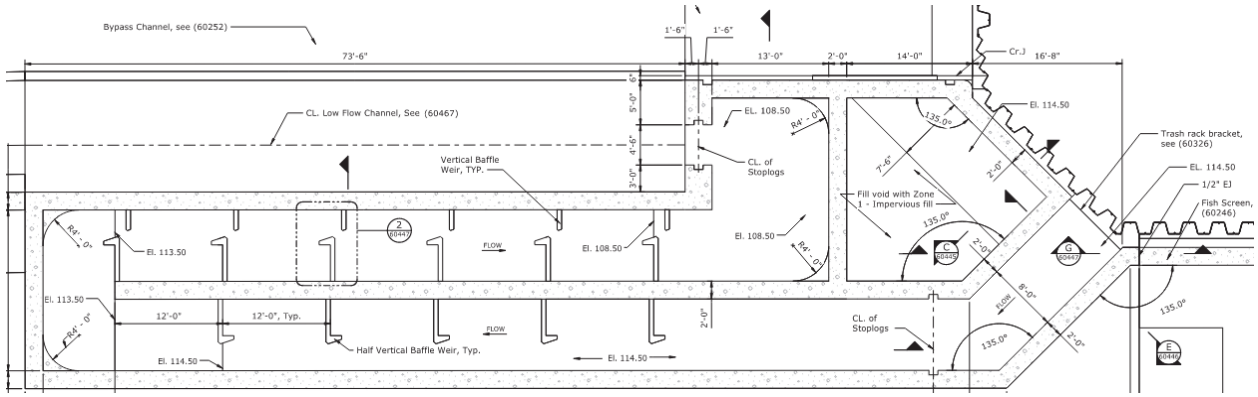

Figure 1. Fish Ladder Plan View

1.2 Operations

The fish ladder would be the first feature to receive flow under all flow conditions and would remain in the fully open position when operational. Initial flow is intended to be between 30-50 cfs, depending on the upstream water surface elevation. The fish ladder will remain operational during adult salmonid migratory season (November 1 – May 14). This would also apply to when the river bypass is fully open, allowing for the fish ladder to be open or closed to allow for maintenance as long as fish passage criteria is met in the river bypass.

Downstream releases of 0-250 cfs will be released as attraction flows through the fish ladder and two overshot gates, Gate 1 and Gate 8, located on the left and right sides of the river bypass, respectively. Gate 1, located adjacent to the fish ladder entrance, is the primary gate for downstream releases to assist fish in locating the fish ladder entrance. However, Gate 8 may also be used to pass floating aquatic vegetation as needed. These overshot gates prevent upstream fish passage and provide attraction to the fish ladder by creating a splashing sound at the entrance of the ladder. This flow scenario (Figure 2) is modeled as Scenario A in the Hydraulics Report.

To wet up the fish ladder for operation, the downstream bulkhead would be pulled first, allowing water to fully fill the downstream entrance of the fish ladder before pulling the upstream bulkhead. The upstream bulkhead would be pulled following an equalization of flow downstream, allowing for the fish ladder to function while meeting criteria from first opening.

Draw down would occur in the reverse of wet up, with the upstream bulkhead installed before the downstream bulkhead to prevent upstream passage in the feature with no attraction flow. The downstream bulkhead would be installed following draining of the ladder to equalize downstream flow before installation of the downstream bulkhead.

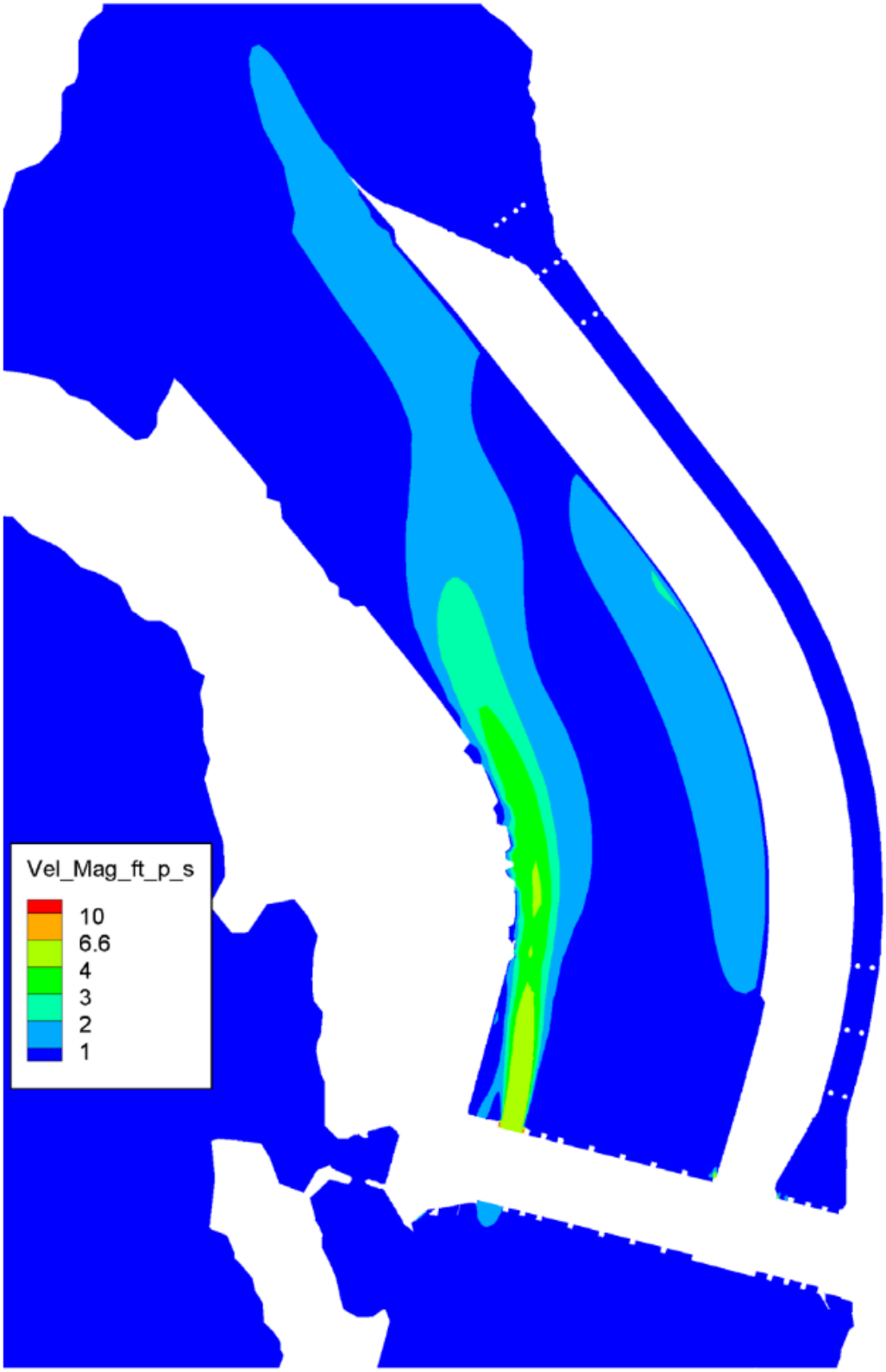

Figure 2. Hydraulic Modeling Scenario A

1.3 Maintenance

Although the fish ladder is intended to be frequently operated, it will require maintenance to ensure that it meets criteria and operates as designed. Scheduled maintenance for the fish ladder would include regular cleaning and dewatering which will occur during the summer maintenance period (May 15 through October 31). Construction, maintenance, research, or other heavy activity during the fish passage season that may impact fish passage, fish survival, or operating according to criteria will not be permitted without prior coordination with the Reclamation biologist, as per NMFS criteria. The Reclamation biologist will ensure these activities are coordinated and approved by NFMS prior to implementation, unless the activity is an emergency situation.

Maintenance would include inspecting all staff gauges and repairing or cleaning as necessary, clearing debris from lamprey orifices, clearing debris from gaps in baffles, confirming that joints and gaps in the ladder that are sealed with joint compound are intact, and confirming that rounded and smooth surfaces are still in good condition. The ladder was designed so that none of the baffles are located under the driving deck to allow for visual inspections, easy access for maintenance crews, and the ability to clean out all orifices and openings without having to enter or drop down into the ladder.

Daily Maintenance – Inspect orifices, located in the bottom right corner of each wide baffle wall, and vertical weir slots to ensure no debris is obstructing the openings. Sticks present in and against the openings act as a strainer and quickly collect debris and could impinge and kill fish. If blockages are detected during the fish passage season, attempts to remove the blockage will be made prior to dewatering the ladder. Additionally, the facility will be inspected for the presence of contaminants (e.g., oil).

Weekly Maintenance – Weekly fishway inspections will ensure fishway entrance hydraulic drop is maintained between 1.0 and 1.5 feet as determined by staff gauges inside the entrance pool and in the tailwater just outside of the fishway and channel velocity is 1.5-4.0 feet/s, as per NMFS criteria. Channel velocity may be measured by dropping a piece of floating woody debris with time recorded for travel over a fixed distance.

Annual Maintenance – In the summer maintenance period (May 15 through October 31), when adult migration is complete, the fish ladder will be closed, dewatered, cleaned, and inspected. The upstream bulkhead would be installed first to allow the water in the ladder to recede and encourage fish to exit into the main river. Prior to installing the downstream bulkhead, a visual inspection of the ladder would be performed and a long-handled net will be used to encourage any remaining fish to exit the ladder. A portable pump would be used to dewater the ladder in a manner consistent with the fish rescue plan approved by NMFS for dewatering during construction. Any fish remaining in the ladder will be rescued and immediately relocated to the main river channel. All debris and sediment would be removed. Joints and gaps in the ladder would be inspected and

sealed with joint compound to ensure that they are intact and maintain a rounded/smooth surface.

2. Fish Ramp

2.1 Description

The fish ramp is located on the right bank (east side of the river) between the river bypass channel and the levee. The channel is approximately 500 feet long with 2:1 riprap lined slopes and a four-foot wide cobble floor. There are seven sets of chevrons (26-foot tall concrete pillars) in the channel to optimize hydraulic conditions for fish passage conditions. Each set of chevrons consists of four concrete pillars in a row perpendicular to the channel. The two center pillars are 4.5 feet apart and the two outer pillars are 1.5 feet apart from the center pillars. Each pillar is 26 feet tall and three feet in diameter. The headworks (Figure 3) has four slide gates, each 4.5-foot wide with stoplogs upstream and downstream to allow for the isolation of each individual gate. The fish ramp has a flared entrance and exit to the headworks, creating equal flow distribution on the entrance and exit. At the gates, the fish ramp floor elevation, at the gates, is designed at elevation 109 feet, with a top of structure elevation 15 feet higher.

2.2 Operations

The fish ramp's optimal operational range for fish passage is between 250 cfs and 500 cfs in the ramp. The fish ramp hydraulic models show that the ramp is most effective at meeting fish passage criteria with flows between 250 cfs and 500 cfs and can operate independently (Figure 4). The chevrons in the fish ramp channel allow for additional water surface elevation (depth) and uniform velocities from the headworks to the tailwater. Tailwater effects at higher flows from the river bypass often slow velocities and allow for backwater on the downstream end of the ramp. The ramp can operate at river flows from 250 cfs through 4,500 cfs but would remain at flows between 250 and 500 cfs. Although the ramp operates at various flow rates, it maintains between 250 cfs and 500 cfs at all times. When possible, Gates 9 and 10 would be opened fully (out of the water) allowing for through gate passage as often as possible. When needed to allow for supplemental flow, the third gate would be opened to a minimum of 18 inches to prevent impingement of fish.

Gates 9 and 10 would be utilized initially for wet up, allowing flow to equalize in the channel to the appropriate depths and allowing for through gate passage as quickly as possible upon channel activation, prior to the opening of Gates 11 and 12 to provide supplemental flow. As the gates are being opened, a visual observation of the downstream channel will be made to ensure that all chevrons are free of debris and in good condition.

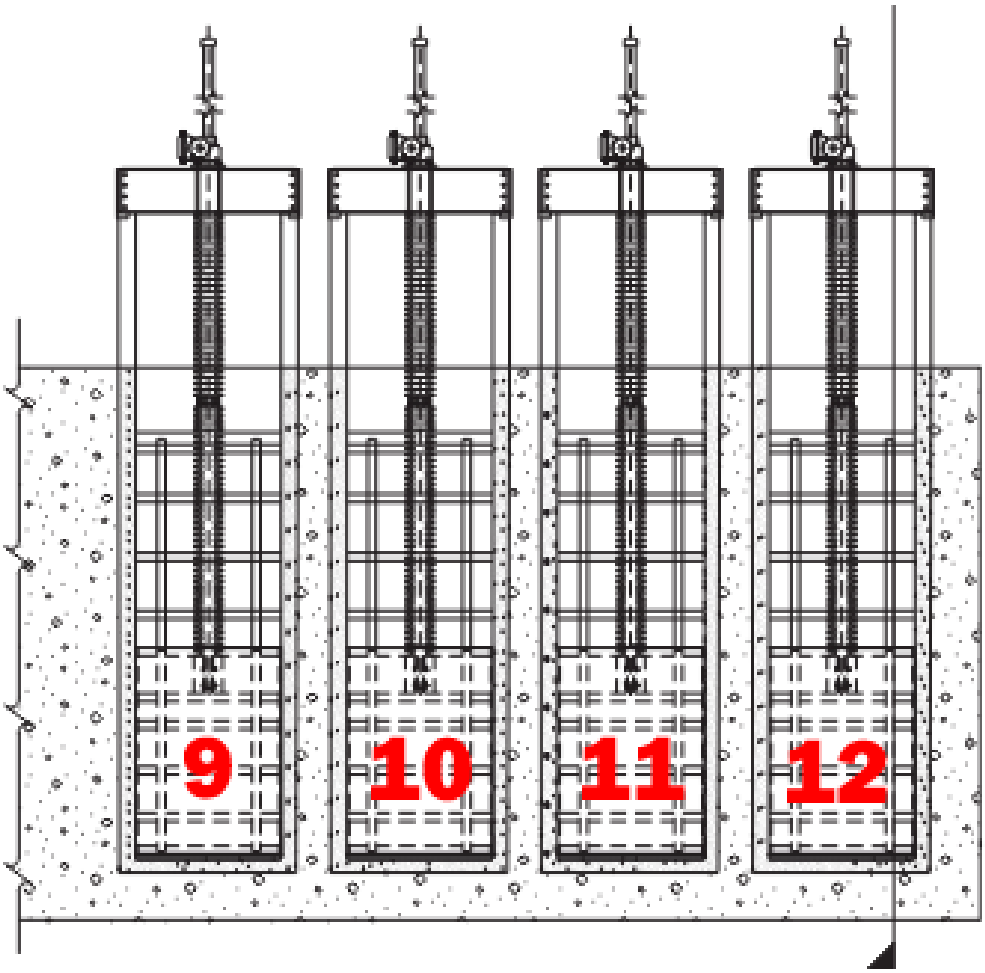

Figure 3. Fish Ramp Headworks Downstream Section View

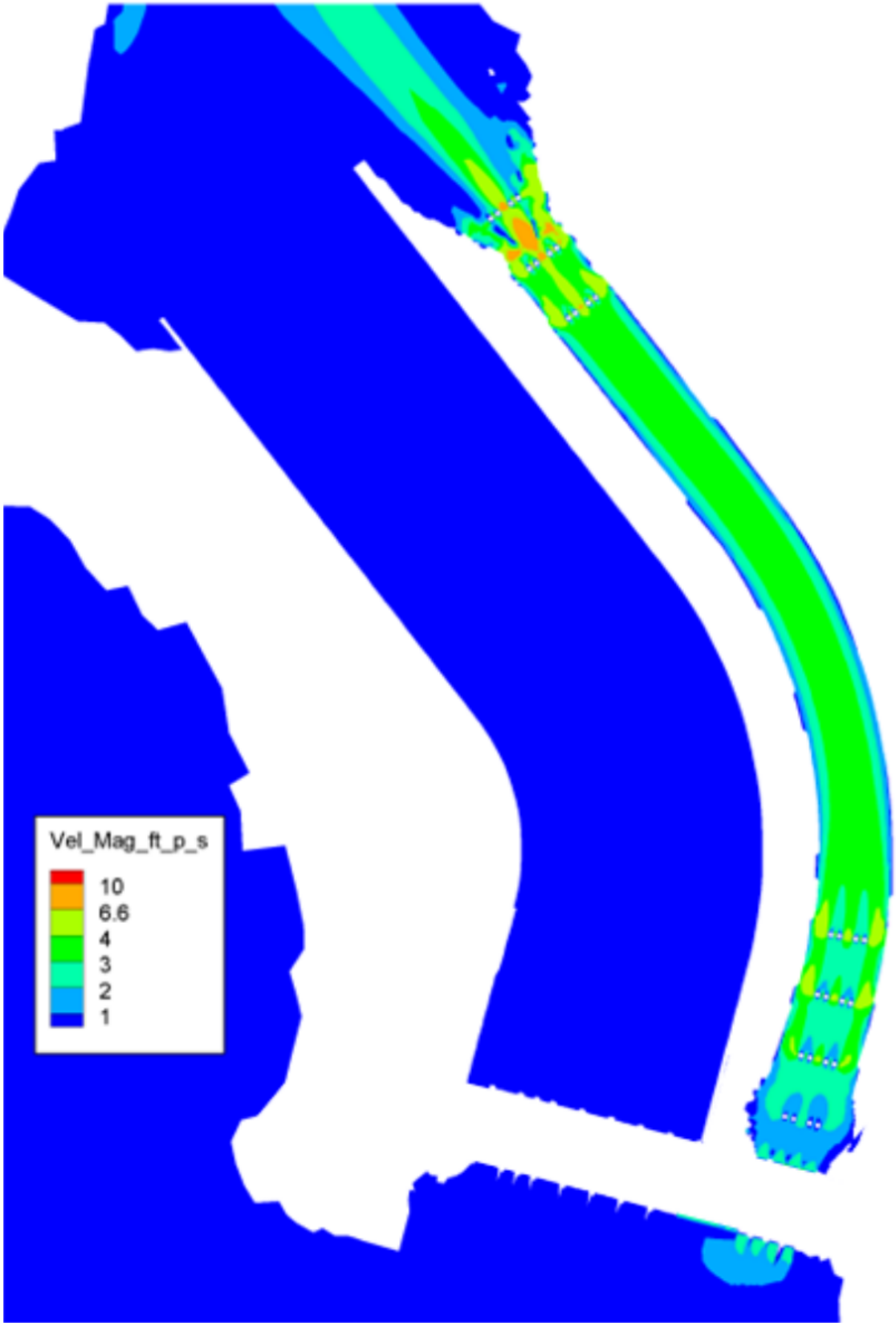

Figure 4. Hydraulic Modeling Scenario E

2.3 Maintenance

Daily/Weekly Maintenance – The downstream channel and headworks would be inspected when in operation daily to ensure there are not impingements or debris blocking the downstream pillars and gates from operating as expected.

Annual Maintenance – gate inspection and maintenance would occur in the summer months when downstream flow releases are low and can be released through the river bypass overshot gates. During gate isolation the slide gate is shut, then the upstream bulkhead is installed, followed by the downstream bulkhead. A visual inspection would be performed during gate closure and bulkhead placement to ensure fish are not being impinged or trapped in the isolation area. The downstream ramp would be inspected and cleared of any vegetation growth and debris impinging on the sidewalls of the channel.

3. River Bypass

3.1 Description

The river bypass is 93.5 feet wide and 15 feet deep over a length of 395 feet. The river bypass channel contains the fish ladder entrance and a low flow channel to provide the necessary depth and access to the fish ladder entrance for upstream passage of salmon in the lowest flow conditions. The river bypass is primarily designed to provide for conveyance of large flows and provides fish passage through the ladder and through the gates in high flow conditions. The bypass can move flow up to 4,000 cfs through eight gate bays (Figure 5). Gates 1 and 8 are 10-foot-wide overshot gates intended to provide supplemental flow for the fish ladder and be capable of passing debris downstream. Gates 2 and 3 are 4.5-foot-wide dual leaf slide gates to allow for fine-tuned flow changes and earlier through gate operation in the river bypass as flows ramp up. Gates 4 through 7 are 10-foot-wide dual leaf slide gates that will open from the bottom with a minimum 18-inch opening to move high flows through the system. The river bypass will be constructed to allow for an additional five feet of upstream water surface elevation to account for regional subsidence. The gates are dual leaf to reduce the overall structure height when all gates are in the open position.

The approach and exit of the river bypass headworks structure are confined by the river bypass on river right (east) and the fish ladder on river left (west). The fish ladder entrance is immediately adjacent to Gate 1, an overshot gate, on the downstream end, to allow for the gate to provide supplemental attraction flow. Each gate bay in the river bypass allows for independent isolation with upstream and downstream stoplog slots. Each gate bay is separated by a two-foot-thick wall to allow for the support of the overhead drive deck. The gates are located on the upstream end of the drive deck allowing for access with cranes and/or by foot.

The apron downstream of the river bypass gates collects the fish ladder flow and river bypass flow into a single concrete channel (low flow channel). During low flow

conditions flows will be in the low flow channel on the river left (west). The low flow channel is 18 inches deep and is lined with engineered streambed material (ESM). The ESM provides a more fish-friendly bottom surface for the approach to the fish ladder entrance. The remainder of the river bypass is concrete lined with vertical walls to provide the capacity needed to pass 4,000 cfs without incurring significant erosion or scour given the shear stress applied by the high flows. The transition from the river bypass to the natural river channel will be made with a rounded rock-filled outlet section that is 15 feet long and four feet deep. The bank of the Poso Canal and downstream berms are lined with rip rap to prevent scouring and erosion during high flows.

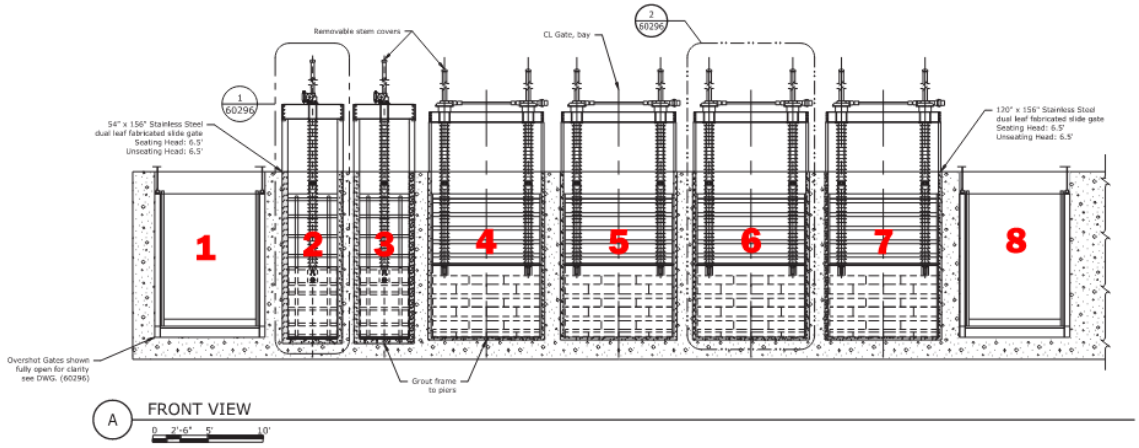

Figure 5. River Bypass Headworks Plan View

3.2 Operations

The hydraulic modeling results (Scenario J) show that the river bypass is effective at moving all flows (up to 4,500 cfs) and retaining an additional five feet of water surface elevation if subsidence continues (Figure 6). The river bypass provides supplemental flows during low flow conditions to promote attraction to the fish ladder and can move medium flows through smaller slide gates and the overshot gates. As the structure is transitioned into high flows, additional slide gates will be opened in conjunction with the fish ramp to move flood water downstream. The river bypass meets the required depth and velocity for salmon passage to the entrance of the fish ladder and often meets criteria for salmon to move upstream through the river bypass gates in high flow conditions, providing multiple fish passage route opportunities.

The river bypass is intended to promote passage via the fish ladder and provide supplemental flow for the ladder in low flow conditions. As flows increase, the overshot gates would be used until the point where the fish ramp is activated, and the river bypass provides supplemental flow. As flows increase, the slide gates will be operated from river left to river right, maintaining the minimum openings to meet NMFS criteria as ramping up in flows continues. The overshot gates would be used during wet up and for consistently passing supplemental flows. The overshot gates will be used to manage flow variations, and the slide gates will be set within the criteria and remain consistent with the desired flows. Gates would be opened from river left (west) to river right (east) for slide gates. Overshot gates can be used interchangeably, but Gate 1 would be used when the fish ladder is the primary passage route. For additional details, see gate operations under Flow Descriptions in Operation Details.

Draw down will entail the reverse of wet-up operations when flows are decreasing. Gates will be closed from river right (east) to river left (west). Visual observations would be made during gate closures to prevent potential impacts to fish waiting downstream of the gates. Each gate would be closed one at a time during the transition period to prevent potential stranding downstream.

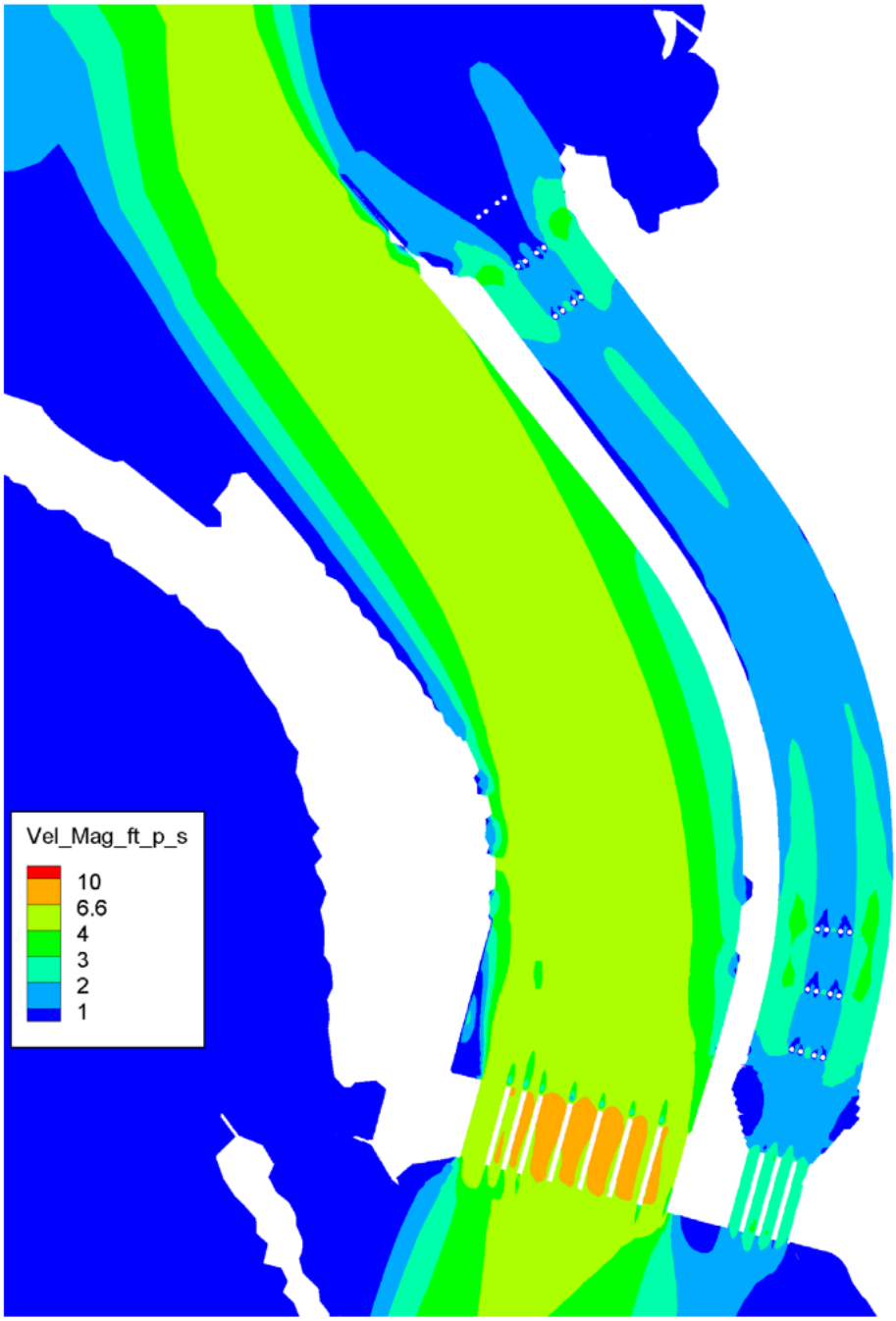

Figure 6. Hydraulic Modeling Scenario J

3.3 Maintenance

Daily/Weekly Maintenance – Each gate would be visually inspected when coming in and out of operation to ensure that gates are in good operational condition. Each gate bay has an upstream and downstream stop log slot to allow for independent isolation and maintenance while the structure is still operational. A visual inspection of the low flow channel and confluence with the natural river channel would be done when a change in operation is made to ensure the rock and material installed at those locations is performing as expected. Floating aquatic vegetation would be moved downstream through the overshot gate(s) as frequently as necessary to prevent mats/buildup from forming.

Aquatic Vegetation – When aquatic vegetation is present, the operations of the bypass facility would include the opening of the overshot gates to encourage the passage of the vegetation downstream. Debris booms would be placed in locations consistent with the above operations to best pass vegetation and should additional intervention be needed; mats would be broken into pieces capable of moving through open gates and downstream.

Roads, fences, door locks and gates – At least twice a year, the entire facility would be inspected for repairs, and all repairs performed within 30 days. During regular operations, crews would visually inspect the roads, fences, and gates for proper function and issues. If there are major issues identified that prevent functionality of the item (i.e. gate doesn't open, fence has a hole in it, or road is unsafe to drive on) these would be repaired as soon as possible. Minor repairs would be noted and fixed during the next scheduled repair.

Levees - At least twice a year, the entire facility would be inspected for needed repairs and all repairs performed within 30 days of identification. Levee repairs would be performed with engineering oversight. During regular operations, crews would visually inspect the levees. If there are major issues identified that prevent functionality or threaten the functionality of the levee, they would be repaired as soon as possible. Minor repairs would be noted and fixed during the next scheduled repair period.

4. Fish Screen

4.1 Description

The fish screen foundation measures 400 feet in length and has a cutoff wall measuring five feet deep to prevent undercutting and differential settlement issues. The total screen length is 376 feet and ten inches with the additional 14 feet being used for transition pieces, structures for screen maintenance, and access including monorails and platforms. The screen measures a total height of 15 feet with seven feet being screen and eight feet being blank panels (Figure 7). The screen area would always be submerged, maximizing

the screen's ability to meet fish flow criteria and deliveries to the Arroyo Canal under all current and subsided conditions. The fish screen is separated into two sections with two blanking panels in the center of the screen area. Above the fish screen is the walking deck for maintenance staff and employees inspecting the fish screen. This deck is made of steel supports with a metal grating and guard rails on both sides. Overhead is a monorail sitting 30 feet above the foundation for removing and replacing screen and/or blank panels as necessary. Power will run along the entire screen length for the cleaning mechanism. The cleaning mechanism is two brush cleaners that move up and down each panel, working from the center of the screen toward each end.

Panels – The fish screen panels are made of two-inch-thick stainless steel. The panels slide into slots that hold them in place. The fish screen slots sit in front (upstream) of the blanking panel slots to allow for the insertion of blanking panels, if a screen panel becomes damaged and needs replacement. Two I beams support the blanking panels, baffles, and screen panels. Each panel spans five feet wide between the supports with a total of 66 panels and two spares for replacement in case some become damaged. The total height of the screen structure stands at 30 feet tall from the river bottom, with each screen panel standing at seven feet from river bottom, and a blanking panel above each screening panel that is also seven feet. Each panel screens flow with porosity panels behind the screens, setting the opening area to equalize the sweeping and approach velocities across the screen. The current water surface elevation of 116 feet above sea level will leave the fish screen submerged by 0.5 feet and the future water surface elevation, with subsidence, will have the screen submerged by 5.5 feet.

Brush Cleaner – The fish screen brush cleaner consists of two drive motors mounted on dedicated platforms on both the upstream and downstream ends of the fish screen. Each motor drives a cleaning brush and trolley mounted to a cable. The drive motors will include tensioning systems with return sheaves located on the opposite end, at the center of the fish screen structure. There are position sensors at the upstream and downstream ends of each fish screen brush cleaner. The cleaner travel speed will be adjustable from 0.1 foot per second to 1.0 foot per second. The fish screen brush cleaner moves in both the upstream and downstream directions along a travel beam in front of the fish screens. The cleaner is designed to operate against a water velocity of five feet per second. The brush cleaner has a control panel for setting the automated cleaning cycle and can also be operated manually.

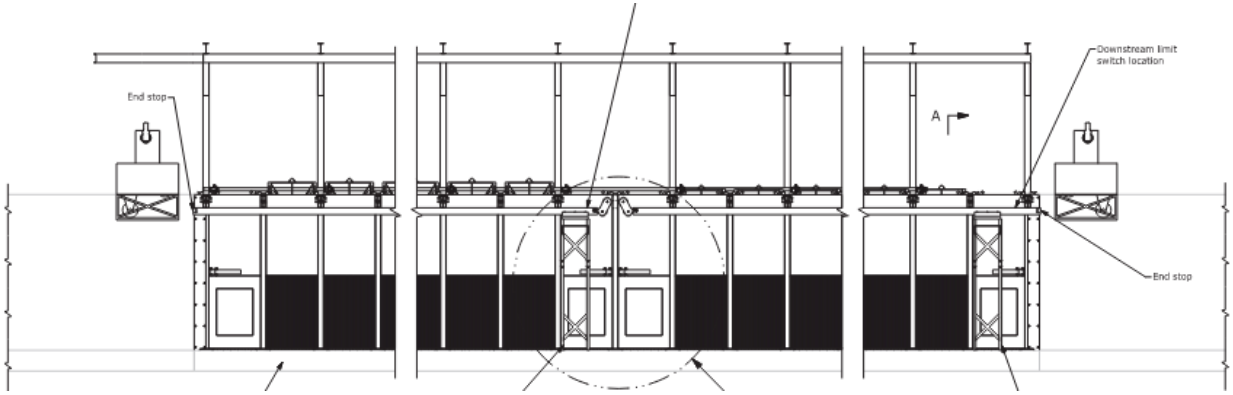

Figure 7. Fish Screen Section View

There are level sensors on the upstream and downstream face of the fish screen to determine the differential pressure across the fish screen to trigger an automatic cleaning cycle. The brush cleaner cycle can be adjusted manually to ensure screen performance. At the maximum brush speed of 1.0 foot per second, the brushes will take approximately three minutes to complete a pass from upstream to downstream and another three minutes for the return pass (8.5.5.1, Appendix E). Each brush cleaner (two total) cleans about 183 feet of screened length in six minutes. The brushes will be strip brushes with polypropylene bristles and will span the height of the screen (7 feet). There will be two brushes required per trolley/brush cleaner assembly, for a total of four brush heads. An additional four brush heads will be located in the O&M building for replacement. The additional brush heads will be kept out of sun light and indoors until used to preserve their lifespan and effectiveness at brushing the screen when installed.

Air Burst System – The air burst cleaning system is a controlled release of compressed air to aid in clearing sediment from the travel path of the fish screen brush cleaners. The air burst cleaning system consists of a 10-horsepower air compressor, a 120-gallon receiver tank, stainless steel piping, and solenoid valves to provide adequate air volume to clear sediment from in front of the fish screen panels for the fish screen brush cleaner travel path. The system is divided into 35 zones, each zone including two fish screens (or relief panel) and each zone controlled by a single solenoid valve. The air compressor and receiver tank are sized to provide three times the estimated cleaning volume (area in front of the screen) times the pressure of the maximum river water surface elevation. The air compressor will provide a minimum full-load air inlet capacity of 35 cfs at a discharge pressure of 125 pounds per square inch (gage) at an elevation of 125 feet above sea level.

4.2 Operations

Hydraulic modeling results for the screen are provided in the hydraulics report depicting the screen conditions at 116 feet above sea level and future screen condition with subsidence at various flow scenarios to demonstrate how the screen will perform when different gate operations at the headworks are occurring. The left bank screen length of 376 feet and ten inches exceeds a 60-second contact time and therefore falls under the criteria of approach velocity less than 0.33 feet per second and sweeping velocity greater than the approach velocity (8.5.1 and 8.5.3 Appendix E). The 2-D hydraulic modeling demonstrates that the differing operational conditions impact the screen performance and sometimes can cause the approach velocity to exceed the sweeping velocity and fall outside of the criteria. The screen calibration and continued learning on site over time will allow for the operations to improve the screen's effectiveness in meeting the criteria. The sweeping velocities are lowest when Restoration Flows are at their lowest. Restoration Flows will be low during the summer months and drought years. Typically, special status fish species are not at this location during the summer and therefore the potential for impacts during this time would be discountable.

The operation of the air burst cleaning system can be either manual or automatic. Manual operation is implemented by selecting the air burst to operate at the human-machine interface. Automatic mode will be by timer. For either mode, the system will start by cleaning the two most upstream fish screens first (zone 1), then continue cleaning the next two fish screens (zone 2) until all of the fish screens have been cleaned. The cleaning system will be operated by the controller located within the O&M building. After installation and testing, each solenoid valve adjustable timer will be set to 15 seconds and the cleaning interval timer set for 12 hours for automatic operation. The interval timer setting can be adjusted once operators gain field experience and determine the debris loads in the river. Operators will also be able to adjust the number of zones to clean at once, although the system may only accommodate cleaning one to two zones at a time.

Based on the hydraulic modeling and the screen design, flow constraints are not expected under any flow conditions following the calibration of the fish screen. The screen hydraulic modeling demonstrates that the screen performance is ideal when Restoration Flows exceed the delivery to the Arroyo Canal. This is a typical operation for the SJRRP from the fall through the spring when not in a critical dry year type. The anticipated summer operations will likely have the screen outside of criteria; however, this is during a period of the year when the species of concern are not present. The screen length allows for the full delivery or a smaller delivery to the Arroyo Canal from day one of operation and through the future anticipated subsidence condition. Screen openings are controlled by a set of baffles behind the screen to allow for equalization of the approach and sweeping velocities across the screen. It is anticipated that initial screen calibration will occur in lower flow conditions or typical Restoration Flows, and a future calibration will occur in high flow conditions to allow for baffle position settings in both typical and high flow conditions. The screen area would always be wet and submerged in the water column.

4.3 Maintenance

If a panel needs to be replaced or removed, the operator or maintenance personnel would install a backup screen panel behind one of the current blanking panel slots. They would then remove the blanking panel, effectively adding a section of screen. Using the monorail, the operator or maintenance staff would then move the blanking panel into the section of screen to be replaced and place it into the blanking panel tracks. Following the installation of the blanking panel, the operator would move the baffles on the screen into the closed position before pulling the screen panel out. The screen panels would only be removed after the blanking panels are installed in front of them and after a screen panel has been inserted to where one of the existing blank panels sits.

Weekly Maintenance – A lifting beam that is interchangeable with all panel types for removal, replacement, and installation (i.e., fish screen, blocking, relief, control baffles) would be on site. There would be periodic inspections to pull panels to inspect for any damage or material failure in accordance with NMFS criteria. Two spare panels of each

type would be provided by the contractor, and routine inspection would be required for the structure. Baffles would only be moved into a closed position for the installation of a blanking panel and removal of that screen section for repair or replacement. The blanking panel would be inserted in front of the screen section to be removed prior to removal of the screen panel. If the screen panel needs to be replaced it would be done in the reverse order. Screen panels would be continuously cleaned by a brush moving up and down as well as left to right across the screen to maintain the open area and keep it free of debris. To ensure screen cleaning mechanisms are performing correctly, weekly inspections will record head differential across the screen by subtracting stream gauge measurements in front of and behind the screen to ensure the differential does not exceed 0.3 feet, as per NMFS criteria (8.5.5.1, Appendix E). Maintenance activities would include routine inspections, lubricating, and adjustments of the fish screen brush cleaning system (i.e., gearmotors, bearings, brush head, wire rope sheaves, wire rope, and the overall assembly), which would all be completed in accordance with the instructions of the individual component manufacturers. O&M/service manuals will be provided for all equipment purchased from vendors or secondary contractors. Spare parts including motors, bearings, strip brushes, gear motor lubricating oil, and limit position switches will be maintained on site.

Sediment Management – Maintenance of the fish screen includes the removal and potential excavation of sediment depositions behind the fish screen. The maintenance of the area behind the fish screen is the responsibility of Henry Miller Reclamation District (HMRD) to ensure that the delivery water is able to freely move through the screen into the Arroyo Canal.

5. Debris Boom

5.1 Description

The debris boom will be anchored with concrete and offset from the screen face to allow for fluctuations in water surface without modifications to the screen face. The debris boom will be purchased by the contractor and will be like other floating debris barriers that have been successful at retaining aquatic vegetation. Anchors will be concrete blocks on the floor of the channel to allow for boom movement up and down with water surface changes under different flow delivery conditions. Anchors on the bank will be installed with similar concrete blocks to allow for a flood condition or change in water surface.

5.2 Operation

The purpose of the debris boom is to keep floating debris from hitting or collecting on the fish screen and the gates on the headworks structure. The debris boom will guide floating debris to one or both overshot gates to pass all debris through the headworks instead of allowing vegetation and other debris to continue to collect upstream of the structure.

5.3 Maintenance

Debris boom would be visually inspected during each inspection of the facility. If there are signs of wear or damage, the debris would be pulled and repaired as soon as possible. At least once a year, the debris boom would be removed, inspected, repaired, and then replaced if needed.

Operation Details

Flow Descriptions

Table 1 demonstrates gate operation order by flow rate.

Table 1. Gate Operations by Flow Rate

Flow (cfs)	Fish Ladder and River Bypass Gates	Fish Ramp Gates (when opera onal)
0-250	1, 8	0
250-450	1, 8	9, 10
450-900	1, 2, 3, 8	9, 10, 11
900-1200	1, 2, 3, 4, 5, 8	9, 10, 11
1200-2200	1-8	9, 10, 11, 12
2200-4500	1-8	9, 10, 11, 12

0-250 cfs: Releases will be made via the fish ladder and Gate 1 (overshot gate) adjacent to the fish ladder. River left debris boom deployed from the upstream end of the fish screen to the left (west) support wall of Gate 1. River right (east) debris boom will be deployed to the right support wall of Gate 8.

250-450 cfs: Primary releases will be made via the fish ramp slide gates. The fish ladder will remain open when fish are present and will be closed when outside of the migratory windows. The overshot gate adjacent to the fish ladder (Gate 1) will be utilized for moderate daily flow changes to avoid changing slide gate(s) position in the fish ramp. River left debris boom would be deployed from the upstream end of the fish screen to the left support wall of Gate 9. River right debris boom will be deployed to the right support wall of gate 12.

450-900 cfs: Primary releases will be made via the fish ramp slide gates. The fish ladder will remain open when fish are present and will be closed when outside of the migratory windows. The river bypass will be used to increase flows from above 300 cfs using Gate 1 (overshot gate), Gates 2, 3 (4.5-foot-wide slide gates), and Gate 8 (overshot gate) to provide supplemental flow. Minor changes in flow would be made through use of the overshot gates to prevent regular changes to the fish ramp, allowing for continuous passage opportunities. River left debris boom would be deployed from the upstream end

of the fish screen to the left support wall of Gate 1. River right debris boom will be deployed to the right support wall of Gate 8.

900-1200 cfs: Primary releases will be made via the river bypass slide Gates 1, 2, 3, 4, 5, and 8. The fish ladder will remain open during primary releases of the river bypass. The fish ramp will be used to pass a minimum of 300 cfs using Gates 9, 10, and 11, all of which are 4.5-foot slide gates and are intended to provide the primary route of passage for all native species. Minor changes in flow would be made through use of the overshot gates and river bypass to prevent regular changes to the fish ramp gates. River left debris boom deployed from the upstream end of the fish screen to the left support wall of Gate 1. River right debris boom will be deployed to the right support wall of Gate 8.

1200-2200 cfs: Primary releases will be made via the river bypass slide Gates 1 through 8. The fish ladder will remain open during primary releases of the river bypass. The fish ramp will be used to pass a minimum of 300 cfs using Gates 9, 10, and 11, all of which are 4.5-foot slide gates and are intended to be opened for a flow through condition as often as possible and provide the primary route of passage for all native species. Minor changes in flow would be made through use of the overshot gates and river bypass to prevent regular changes to the fish ramp gates. River left debris boom would be deployed from the upstream end of the fish screen to the left support wall of Gate 1. River right debris boom would be deployed to the right support wall of Gate 8.

2200-4500 cfs: Primary releases would be made via the river bypass slide Gates 1 through 8. The fish ladder will remain open during primary releases of the river bypass. The fish ramp will be used to pass at a minimum 300 cfs using Gates 9, 10, 11, and 12 all of which are 4.5-foot slide gates and are intended to be opened for a flow through condition as often as possible and provide the primary route of passage for all native species. Minor changes in flow would be made through use of the overshot gates and river bypass to prevent regular changes to the fish ramp gates. River left debris boom would be deployed from the upstream end of the fish screen to the left support wall of Gate 1. River right debris boom will be deployed to the right support wall of Gate 8.

6.2 Operating Criteria

The slide gates on the fish ramp and river bypass will be opened a minimum of 18 inches when in operation, exceeding criteria for Headworks Control Gates, as per NMFS criteria. Operations staff will be present and observe the last 18 inches of gate closure to ensure fish are not being impinged when the fish ramp gates are closed, and flows are transitioning to between 0-250 cfs. The fish ladder will be operational when flows are below 250 cfs during periods of fish migration. The fish ladder will be operational in high flows to provide an additional passage opportunity while the river bypass is operating. Staff would be present to observe the fish ladder in operation and ensure lamprey orifices are clear of debris and functioning as intended at a minimum once a day. Visual observation of the fish screen would occur any time a staff is present on site to ensure the screen cleaning mechanism and air burst system are operating as designed and field calibrated. Fish screen baffles will be set following commissioning of the fish

screen and would remain in place unless recalibration of the baffle locations is conducted to ensure uniform velocities across the face of the fish screen.

HMRD Deliveries

HMRD deliveries are expected to remain mostly unchanged with the construction and operation of the project. The fish screen is designed to be capable of delivering the full delivery of water to the mouth of the Arroyo Canal consistent with existing water rights. The headworks structure of the Arroyo Canal currently operates in a flow control condition, setting the flow and moving the gates to accommodate that flow into the canal. The proposed new facility will operate in level control, maintaining the water surface elevation while passing all Restoration Flows downstream of the new facility. This is intended to avoid impacts to HMRD operations and maintain the existing deliveries.

Emergency Operations

Electricity – In the event of a power failure or outage, the facility will be powered with a generator located outside of the O&M building. Facility light, controls, gates, and brush cleaner system are all installed on backup power to allow for continuity of operations for the facility. The backup power is expected to last for 48 hours, at which point it will need additional fuel and oversight to continue operation. Gates will be capable of moving one at a time while on backup power and capable of being manually lifted and lowered as needed if the backup power is insufficient to move the gates.

Gate Operation – Gates will remain in the position they are currently in when a power outage is incurred until a manual change is made at the O&M building interface or with a manual shift at the gate. Gates can be moved one at a time on the backup power, or multiple can be operated with manual gate shifts on site (wheel crank).

Fish Screen Cleaning – The fish screen brushes, and airburst system will be installed on backup power and continue operation to prevent a power outage from impacting the fish screen. In addition to the fish screen cleaning mechanisms, should the screen become impacted with sediment or debris, there are two shear pin panels installed on the structure that will fail, allowing water to flow behind the screen without causing a failure of the structure and allow for expedited repairs. Level alarms will be installed to prevent the shear pin failure from occurring and maintain the screen operation as intended.