Rancho Murieta
Community Services District

Granlees Dam Accessibility Restriction Predesign Alternatives Study and Type Selection Report

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HDR

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Granlees Dam Accessibility Restriction

Predesign Alternatives Study and Type Selection Report

Rancho Murieta Community Services District

December 2005

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Executive Summary

The Rancho Murieta Community Services District (District) has requested a Predesign Alternatives Study and Type Selection report to address accessibility reduction design services associated with Granlees Dam crossing the Cosumnes River, the fish ladder to the south of the dam, the forebay serving the Granlees Raw Water Pump Station, and two canal crossings downstream of the forebay. This preliminary report will serve to define the project components, explore alternatives for effective accessibility reduction and improvement, and provide recommended solutions.

Meetings and site visits have been conducted in order to determine the District's needs and recommend alternative measures to achieve the accessibility restriction objectives.

The project background and a discussion of Cosumnes River historical flows are presented in Section 1. The design criteria considered for accessibility restriction measures are summarized in Section 2. A summary of existing conditions for the project components is presented in Section 3. The alternatives analysis and recommendations, which includes a conceptual level cost estimate for the preferred alternatives, are summarized in Section 4. Additional consideration, including construction prioritization, historic use, environmental considerations, real estate issues, and an estimated project schedule are presented in Section 5.

Based on the analyses described herein, various accessibility restriction measures are recommended surrounding Granlees Dam and its appurtenant structures. These recommendations are discussed in detail in Section 4 and summarized below. A general plan and typical details are shown on Plates 1 and 2.

Table ES-1 – Recommended Accessibility Restriction Measures

AREA	ELEMENT	RECOMMENDED PLAN
General	Mobilization	
	Demolition	
	Earthwork	
Fencing and General Access: Dam, Forebay & Fish Ladder	North Shore	Install 6' tall chain link and heavy duty fencing with 3-strand barbed wire topper.
	North & South Shores	Install Chain Link "Fan" Fence Posts at both ends of dam crest.
	North & South Shores	Install double-swing vehicular access gates (heavy duty at South shore).
	South Shore	Install 6' tall heavy duty fencing with 3-strand barbed wire topper.
Canal Modifications	Excavation & Backfill	Excavate for Pipe Placement and backfill.
	Piping	Place reinforced concrete pipe.
	Manholes	Place precast manholes along pipe segment.
	Aqueduct	Install metal pipe across ravine.
	Aqueduct Crossing	Install timber deck and guardrails atop metal pipe.

AREA	ELEMENT	RECOMMENDED PLAN
Forebay	Guardrail	Install 42" tall metal pipe guardrail.
	Guardrail Gate	Install 42" tall metal pipe guardrail gate with spring-mounted hinge.
	Grating / Cover	Install new grating over existing steel beams.
	Access Hatch	Install hatch in forebay cover for ladder access to forebay interior.
	Access Ladder	Install one ladder inside forebay and one from forebay wall down to dam crest and north shore fish ladder.
	Safety Rack	Install safety rack upstream of two 3'x3' intake openings
	Sluice Gate	Install two 3'x3' sluice gates to act as bulkhead on forebay intakes for forebay maintenance.
Fish Ladder on South Shore	Guardrail	Install 42" tall metal pipe guardrail.
Safety	Signage	Install "Danger/No Trespassing" Signs.
	Dam Openings	Install metal plates or existing openings in dam face.

Estimated costs based on conceptual level analysis for the recommended alternatives, broken into project element, are presented below:

Table ES-2 – Conceptual Level Cost Estimate

Project Element	Conceptual Level Cost
Mobilization, Demolition & Earthwork	$37,900
Fencing and General Access: Dam, Forebay & Fish Ladder	$26,200
Canal Modifications	$115,600
Forebay	$52,700
Fish Ladder on South Shore	$6,900
Safety	$1,700
Contingencies (20%)	**$48,200**
Estimated Project Total	**$289,200**

1. Introduction

1.1 Project Background and Description

The Rancho Murieta Community Services District (District) has requested a Predesign Alternatives Study and Type Selection report to address accessibility reduction design services associated with Granlees Dam crossing the Cosumnes River, the fish ladder to the south of the dam, the forebay serving the Granlees Raw Water Pump Station, and two canal crossings downstream of the forebay. This preliminary report will serve to define the project components, explore alternatives for effective accessibility reduction and improvement, and provide recommended solutions. The analysis and report discuss the aforementioned project elements; this project does not encompass the Granlees Raw Water Pump Station adjacent to Granlees Dam.

Granlees Dam was completed in 1921, and is owned by the Cosumnes Irrigation Association. Granlees Dam is registered nationally, with an identification number of CA00599. The gravity dam has a 75 acre reservoir capacity, with a reservoir area and a drainage area of 30 acres and 535 acres, respectively. The crest elevation is recorded at 160.0 and the dam height at 17 feet. The crest length is 364 feet and its width is 3 feet. The dam is comprised of two segments, separated by a mid-river island.

Granlees Dam, crossing the Cosumnes River just upstream of River Mile 34, is flanked on the south by a fish ladder, and on the north by the Granlees Raw Water Pump Station and Forebay. In addition, an outlet canal parallels the river downstream of the forebay and is crossed in three locations by pedestrian bridges. The approximate locations of the structures along the Cosumnes River are shown on Plate 1. The overall project intent is to restrict access to these structures in an effort to increase safety levels for the public as well as District employees, and improve or redesign the structures as necessary to meet District needs as well as current design and safety standards.

1.2 Historic Cosumnes River Flows

Design for the accessibility restriction measures will consider historic Cosumnes River flows as required by the District. High flows through the area may wash away safety measures that would otherwise remain intact. For example, the fencing located near the river bank may become clogged with debris, causing the forces on the upstream side of the fence to exceed those anticipated for the fence and its foundation. In addition, clogged fencing will increase local flooding as flows are impeded from passing. Permanent railings and other safety measures should consider the additional forces caused by high river flows.

Historic data for the Cosumnes River at DWR's Michigan Bar Recording Station, upstream of Granlees Dam, is available online at the California Department of Water Resources Division of Flood Management site. Flows in cubic feet per second and feet of water are listed for specific recorded dates and times. DWR records the Peak Stage of Record at 18.5 feet on January 2,

1997, with the monitoring stage at 7.0 feet and the flood stage at 12.0 feet. Design of the accessibility restriction measures should consider high water flows and elevations determined by the District. Recommendations for design flood events can be provided for design purposes by HDR at the District's request.

2. Design Criteria

For this report, conceptual designs and estimates have been prepared to evaluate potential accessibility reduction options. Concepts have been prepared considering design criteria and standards for safety and serviceability established by the Occupational Safety and Heath Administration (OSHA), the U.S. Bureau of Reclamation (USBR), and California Division Safety of Dams (DSOD), which are listed below.

2.1 OSHA and CalOSHA Standards

Concepts for the accessibility restriction measures included in this report conform to the design criteria established by OSHA and CalOSHA. In some instances, California state standards are more stringent than the national OSHA regulations; conceptual designs in this report consider both state and national criteria, and list the more stringent, if applicable. CalOSHA design criteria contained in the following California Code of Regulations (CCR) references should be followed for design of construction plans and specifications:

Table 1 – California Code of Regulations Applicable Design Criteria

Title No.	Subchapter	Group	Article	Section No.	Document Title
8	7	1	2	3209	Standard Guardrails
8	7	1	2	3212	Floor Openings, Floor Holes and Roofs
8	7	1	4	3270	Access General
8	7	1	4	3277	Fixed Ladders

2.1.1 Guardrails

CalOSHA specifies that guardrail shall consist of a top rail, mid rail, and posts, and shall have a vertical height of 42 to 45 inches from the top of the top rail to the floor or platform below. The guardrail system shall be designed for 20 pounds per linear foot applied either horizontally or vertically to the top rail. Toe board height shall not be less than 3-½ inches above the floor, with no more than ¼ inch bottom clearance.

A common type of guardrail is that which is currently on site along the inboard edge of the forebay, metal pipe guardrail. For this type of guardrail, CalOSHA requires 1-½ inch diameter pipe or larger for the rails and posts, with the posts spaced at no more than 8 feet.

2.1.2 Access / Egress Ladders

Cal OSHA lists ladder requirements in detail; for brevity, we have listed only the most pertinent requirements herein, while all requirements should be followed during design. CalOSHA requires a minimum metal rung diameter of ¾ inch (1 inch diameter if embedded in concrete), length of 16 inches, and spaced at no more than 12 inches. The rungs shall be designed so that the climber's foot may not slip off the end of the rung. 30 inches of clear space on the climbing side of a vertical ladder must be maintained; 7 inches of clear space to the nearest permanent object must be maintained on the back side of the ladder. A clear width of 15 inches shall be provided in both directions from the centerline of the ladder. Cages and landings must be provided for ladders of more than 20 feet, and cages must extend at least 42 inches over the top of the landing, unless other acceptable protection is provided.

Counterweighted hatch covers are required to open a minimum of 60 degrees from the horizontal. Thirty inches of space must be provided form the centerline of the rungs to the edge of the hatch opening on the climbing side.

2.2 USBR Design Criteria

The following information is taken from *Design of Small Canal Structures*, United States Department of the Interior, Bureau of Reclamation, 1987.

USBR presents safety and health standards for Reclamation employees in *Reclamation Safety and Health Standards (RSHS)*, published May 2002. Sections applicable to this project are as follows:

Table 2 – RSHS Sections

Section	Description
Section 9	Signs, Signals and Barricades
Section 13	Walking and Working Surfaces
Section 16	Fall Protection and Rope Supported Work
Section 25	Concrete, Masonry, Construction, and Formwork

USBR presents the design and selection of waterway safety devices, based on their classification and use. Classification of hazards is largely dependent on the number of people exposed through operation, recreation, or living nearby. USBR Hazard Exposure Classifications are as follows:

Table 3 – Hazard Exposure Classifications

Classification	Description
Class A	Those canals adjacent to schools and recreational areas, such as playgrounds, subject to frequent visits by children

Classification	Description
Class B	Those canals nearby or adjacent to urban areas or highways and subject to frequent visits by the public
Class C	Those canals nearby or adjacent to farms or highways which could be subject to visits by children seeking recreation, such as swimming
Class D	Those canals far removed from any dwelling subject to infrequent visits by operating personnel and an occasional sportsman
Class E	Those canals that would be a hazard to domestic animals
Class F	Those canals that would be an extreme hazard to big game animals

Types of safety devices include (1), those that limit or deter access, and (2), those that provide a means of escape in the event a person enters a canal. Fencing, guardrails, warning signs, and pipe safety barriers are devices that fall under the first category. Ladders, safety nets, safety cables, and safety racks are devices that fall under the second category. Only safety devices applicable to this project will be discussed in this report.

2.2.1 Fencing

USBR typically uses one of six types of safety fencing. The type used is dependent on the hazard exposure classification. Safety fence classifications are as follows:

Table 4 - Safety Fence Classifications

			FENCING FABRIC				POSTS		
HAZARD EXPOSURE CLASS	TYPE OF SAFETY FENCE	TOTAL HEIGHT	CHAIN LINK HEIGHT	WIRE MESH HEIGHT	WOVEN WIRE HEIGHT	NUMBER BARBED WIRE STRANDS	SPACING	MATERIAL	TOP RAIL
A	School	7'-0"	6'-0"	-	-	3	10'-0"	Steel	Yes
B	Urban	5'-0"	4'-0"	-	-	3	10'-0"	Steel	Yes
C	Rural	5'-0"	-	4'-0"	-	2	12'-0"	Steel	-
C	Rural	5'-0"	-	4'-0"	-	2	16'-0"	Wood	-
D	None[1]	-	-	-	-	-	-	-	-
E	Stock	4'-0"	-	-	-	4	16'-0"	Wood	-
E	Stock	4'-0"	-	-	2'-8"	3	16'-0"	Wood	-
E	Stock	4'-0"	-	-	-	4	12'-0"	Steel	-
E	Stock	4'-0"	-	-	2'-8"	3	12'-0"	Steel	-
F	Deer	8'-0"	-	7'-0"	-	3	16'-0"	Wood	-

1 – No fence necessary, unless required by right-of-way agreement

Due to the imminent further development south of the river, and the history of children playing and swimming in the forebay, the Hazard Exposure Class suggested for design is Class A, the most conservative safety measure.

2.2.2 Guardrails

The guardrails discussed here are those that are used to prevent pedestrians from falling into canals at structures. The rails and posts comprising the guardrail are usually constructed of 1½-inch diameter metal pipe, with the posts set in concrete or attached by wall mounting. For a Class A exposure, three horizontal pipe rails are recommended, with the top rail at a 42-inch height. USBR allows for removable pipe rails when necessary for maintenance access.

Generally, USBR requires handrails where the top of the walkway or operating platform is more than 3-½ feet above the downstream floor of the structure. In addition, handrails are required on the downstream side of a walkway when the walkway is 3-½ to 5 feet above the downstream floor; handrails are required on both sides of the walkway when the distance exceeds 5 feet. As there are no as-built drawings of the canal to verify the invert elevation, for the purposes of this report, guardrails are suggested for both sides of the canal crossing walkways. For similar reasons, guardrails are suggested around the perimeter of the forebay, at the ends of the dam, and along the south shore fish ladder.

2.2.3 Warning Signs

USBR recommends "well-worded warning signs advertising of specific dangers" be installed near structures in conspicuous places. "No Trespassing" signs are seen to serve a useful purpose, however signs pointing to a specific danger are more highly favored. USBR specifications for signs can be found in Section 9 of *Reclamation Safety and Health Standards*.

2.2.4 Safety Racks

Safety racks are recommended as barriers across inlets to prevent people from being drawn into structures, and to provide a means for a person to climb out of the water. Safety racks and guardrails in combination can be used in lieu of fencing and safety nets or cables at inlet transitions[1]. Generally, materials for safety racks consist of standard steel galvanized pipe, bolted and/or welded together to form a grill. The vertical pipes are typically 1-½ inches in diameter with 9 inches of clear spacing between pipes. The welded frame may be 2-inch pipe or larger depending on the span of the safety rack. Horizontal pipes may be used for additional rigidity and to provide steps for aiding in escape from the water, but do add to difficulty in cleaning debris from the rack. Racks should be installed on a 3 to 1 slope, or flatter, so that a person may escape more easily from the canal or water feature.

2.2.5 Safety Ladders

Ladders are a common escape device in concrete-lined canals. Safety ladders are required to be installed at 500-foot intervals in bench flumes where walls are 36 inches and higher. As the majority of the ladders are located along an open canal, they may be combined with warning signs stating that the ladders are for emergency egress only. Where the ladders would be

[1] USBR refers specifically to inlet transitions to siphons 30-inch diameter and larger, however we will interpret the concept to apply equally to the forebay intakes.

located in the fence-protected canal, the District may elect to forego the ladders, or install gates in the fencing to allow access to the ladders and canal for District personnel.

A ladder is recommended for installation in the forebay, however its purpose will be maintenance access rather than a means of emergency egress.

2.3 Division of Safety of Dams

The California Department of Water Resources, Division of Safety of Dams (DSOD) provides reference to publications that should be adhered to during design, as applicable. Granlees Dam is under the jurisdiction of DSOD. Consideration during design should be given to the California Code of Regulations, Title 23. Waters, Division 2. Department of Water Resources, Chapter 1. Dams and Reservoirs. In addition, the California Water Code, Division 3. Dams and Reservoirs should be consulted.

3. Existing Conditions

3.1 North Shore General Area

Along the north shore of the Cosumnes River near Granlees Dam and Pump Station Forebay, several "No Trespassing" signs are placed along trails and at a vehicular entrance, which is also blocked by a locked chain gate, see photo below. The area is physically accessible to foot traffic, as there is no fencing limiting entry from any direction. The only fencing in the area surrounds the Granlees Raw Water Pump Station, located just uphill from the dam and forebay. This slatted, chain link fencing is 6 feet tall, and is topped by strung barbed wire.

3.2 South Shore General Area

Along the south shore of the river near the fish ladder, no fencing or signage is present in the area. The area is accessible by foot and vehicular traffic, and will be in close proximity to the expanding development just to the south.

3.3 Granlees Dam

Granlees Dam crosses the Cosumnes river in two segments, one on either side of a mid-river island. The dam is essentially a broad-crested (flat-topped) weir, approximately two feet wide, allowing for passage across the river along its crest during lower flows. A low concrete curb running perpendicular to the dam on the north side of the river is the foundation for a metal tube railing. A break in this railing is located in line with the dam; a chain blocks access to the dam and upstream portion of the forebay. See photo below.

Metal ladder rungs are embedded in the wall of the forebay, leading down to the dam crest and the upstream end of a fish ladder adjacent to the forebay.

On the south side of the river, the top of the dam is accessible from the upstream portion of the fish ladder. There is no access restriction to the dam or fish ladder in this area.

The District has noted that two openings in the dam face exist adjacent to the fish ladder. The openings are approximately 4'x4' and 2-1/2'x3' in size. Timber pallets currently block those openings, but when removed, pose safety concerns, as it is possible for people or objects in the river to be pulled through the opening by the current. These openings also redirect flow away from the fish ladder, rendering it ineffective.

3.4 Fish Ladder

On the south side of the river, a fish ladder is in place to provide a means of transport for fish migrating upstream. The fish ladder is accessible from the shore, and no railing or fencing is present. At the downstream end of the fish ladder, the outboard wall of the chute is somewhat level with the surrounding shoreline ground level, and provides a 1-foot-wide surface by which the public can access the dam by walking up the top of the wall separating the fish ladder from the shore. The rushing water in the fish ladder varies in height, and the overall distance from the top of the wall to the invert of the fish ladder likely exceeds four feet.

3.5 Forebay

On the north side of the river, a forebay is located immediately adjacent to the dam. The forebay accepts flows through an upstream intake, and exports flows through an intake pipe for the nearby pumping station, through a downstream sluice gate for the river outlet, and through a 36-inch diameter pipe in the downstream wall of the forebay for outlet into the downstream canal. For an overall view of the forebay, see the photo below.

Metal tube railing is located along a portion the top perimeter of the forebay's walls. The top of the forebay tank is covered by transverse and longitudinal beams, as well as a chain link mesh. Transverse steel I-beams 10 inches in depth and with a flange width of 4 inches span the top of the forebay at 3 feet on center and comprise the lowest level of the cover. Longitudinal 2x12 timber is placed at 4 feet on center on top of the steel beams. Topping the timber layer is chain link mesh, bolted to the timber and to the top of the forebay's concrete walls. There is no

access to the forebay interior from the top without disassembling the cover and removing portions of the mesh and timber, see photo below.

Two upstream intakes in the forebay are approximately 3 feet wide (per as-builts), and are likely 3 feet in height. Although the intakes have been protected by steel grate bulkheads in the past, they are currently covered by what appears to be aluminum grating in an aluminum tube frame, bolted directly to the upstream face of the forebay. Three of the four vertical metal channels used for the previous bulkhead system are still in place outside of the aluminum frames, see photo below.

A small fish ladder is immediately adjacent to the forebay on the river-side, just downstream of the dam. No as-builts were available, but the general outline of the ladder is shown on Plate 1, along with the adjacent dam, forebay, and canal. A view of the fish ladder is shown in the photo below, looking downstream. The fish ladder is accessible by walking along the upstream

wall of the forebay and climbing down the wall's metal ladder rungs leading to the top of the dam.

3.6 Canal

Water flows out of the forebay, down a canal that essentially parallels the Cosumnes River on the north shore. The canal is approximately 5 to 8 feet wide, with vertical concrete walls along some of its length, and sloped banks in other areas. Although no as-builts are available, the distance from the top of the canal walls to its invert likely exceeds four feet in most areas. No fencing or railing is present along the length of the canal.

3.7 Upstream Concrete Slab Canal Crossing

The upstream concrete slab canal crossing is located approximately 250 feet downstream of the forebay. The slab is approximately 9 feet long across the canal, 11 feet wide, and 6 inches thick. The concrete is heavily spalled at the upstream and downstream ends, exposing what appear to be railroad steel rail longitudinal supports at each edge, and transverse twisted square reinforcing bent around the rails at approximately 18 inches on center, see photo below. There is no visible means of positive connection between the slab and the canal walls on which its ends rest. No railings are present, although the distance from the top of slab to the canal invert likely exceeds 4 feet.

In this area, the outboard one-foot-wide top of canal wall is exposed and accessible. It is possible to walk along the top of the wall up toward the forebay on the river-side of the canal. Access along the inboard top of canal wall is obstructed by vegetation.

3.8 Downstream Wood Panel Canal Crossing and Underlying Aqueduct

The downstream wood panel canal crossing and underlying aqueduct are located approximately 180 feet downstream of the concrete slab canal crossing. The aqueduct is in place to carry the canal water across a ravine and stream leading into the Cosumnes River from the north. The structure is approximately 8 feet from edge to edge across the aqueduct width, and 30 feet in length from one end of the aqueduct to the other. Above and on each side of the semicircular aqueduct, there is a 20-inch-deep beam. 4x4 timbers at approximately 3 feet on center sit transversely on top of the beams and span the aqueduct width. Mixed timber panels approximately 4 inches thick top the 4x4s and do not completely cover the aqueduct below, see photo below. There is no visible means of positive attachment for the wood panels. No railings are present. The photo below shows the larger downstream crossing, looking upstream.

About 12 feet downstream of the larger wood panel crossing and aqueduct is a smaller wood panel canal crossing. The crossing is approximately 7 feet in length across the canal and 4.5 feet wide. The crossing is comprised of mixed-size timbers, and does not appear to be positively attached to the canal walls, see photo below.

3.9 Previous Investigations

In the years 1983 through 1993, observations were made at Granlees Dam and Pump Station associated with the Occupational Safety & Health Hazard Identification Survey for the SDRMA Workers' Compensation Program (*SDRMA Workers' Compensation Program, Occupational Safety & Health Hazard Identification Survey, Revisit 12/15 & 17/04, pages 50-52*). The following table summarizes the year noted, key observations relevant to the project features in this report, actions suggested by the Identification Survey, and the mitigating actions recommended as part of this project.

Table 5 – Occupational Safety & Health Hazard Identification Survey Items and Recommendations

YEAR	OBSERVATIONS	SURVEY SUGGESTIONS	RECOMMENDATIONS
1984	Granlees Dam: Employees working on top of dam to complete repairs. No fall protection.	Install fall protection system meeting OSHA requirements. Consider tether cable across full width of dam for attachment to harness.	Tether cable not needed and may encourage dam crossing. See Section 4.2.3 of report.
1985	Diversion Dam Area: No fall protection along outside edges of walls and pathways where employees work.	Install 42" high railings with mid-rail and 4" toe board along all outside edges of walls and walkways.	Concur with survey suggestions. See Section 4.4 of report.
1986	Diversion Dam Area: Chain in front of access to diversion area from pumping plant not acceptable fall protection.	Replace chain with spring-loaded 42" high, locked gate.	Concur with survey suggestions. See Section 4.4 of report.
1987	Diversion Dam Area: Steel ladder rungs embedded in wall leading to stream bed lack grab rail extensions and standard railings 6 feet to each side of top of ladder.	Install 42" high railings with mid-rail along edge of narrow cement walkway. Leave opening in railing at top of ladder equal to width of ladder, using vertical rail posts as grab rail extensions for ladder. Install spring-loaded gate over opening in railing.	Concur with survey suggestions. See Section 4.4 of report

4. Alternatives Analysis and Recommendations for Accessibility Restriction

Several options are available for accessibility restriction and reduction for the area as a whole, and for each of the project elements. This section presents an analysis of alternatives and recommendations for each element, considering effectiveness of access restriction, durability of materials, sustainability through high flows, access as needed for District employees, and cost differentials.

4.1 General Area

In general, virtually unrestricted access is currently allowed to Granlees Dam and the surrounding structures. Signs are present to deter trespassers, but do not physically restrict access. Fencing around the entire area, in conjunction with signage, are effective means to reduce access and increase safety.

4.1.1 Fencing

As currently used at the nearby Granlees Raw Water Pump Station, 6 foot high chain link fencing is effective at restricting access. Galvanized chain link and post materials are fairly durable and minimize long-term rust and corrosion. A barbed wire strand topper is also an effective means of keeping trespassers from climbing over fences for access. Six-foot fencing with a barbed wire strand topper is recommended by USBR design criteria; standard details are included on Plate 2. Unit costs for chain link fencing can be found in Appendix A.

In order to address the issue of debris build-up and backed-up water potentially increasing flooding due to high flows, it is possible to specify break-away fencing near the shore designed to specific force requirements. The base of the fence posts would essentially be pinned, with a portion of the connection designed to shear at a specific force, allowing the fence to rotate about its base, lying flat on the ground while high flows and debris rush over. This would prevent the fence from being swept away entirely, forcing the District to replace the fencing. After the flows recede, the fence may be repaired if necessary, cleaned, and the break-away connections replaced.

Another type of fencing similar to this is a chain link fence hinged at the top, at the rail just below the barbed wire strings. Designed to a certain force, the panels would break free at the bottom connection, rotating up and theoretically allowing the debris to pass underneath. This type of fencing would be comprised of a pinned connection in much the same way as that described above, with the exception that the posts and top rail would remain vertical, exposed to high flows and debris. Debris accumulation around the posts, top rail, and barbed wire may in effect create a dam, increasing the forces on the fencing beyond that allowable for chain link fencing. Although the fence would be designed to remain vertical, the District would still need to clean out the debris and restore the bottom connections once flows recede.

For areas closest to structures, and perpendicular to the flow, another option is to install heavy-duty fencing, designed to withstand the forces expected due to high flows and debris build-up. Such fencing would likely be constructed of vertical metal tubes or bars, spaced such that passage between them is impossible, with barbed wire strands along the top to deter access. It is likely that several widely-spaced horizontal rails of the same material as the vertical tubes or bars will be required for strength. A sloped, “cattle catcher” fencing component may be added to the upstream side of the fence, to aid in debris collection, however, this component will create a “pocket” between the vertical portion of the fence and the sloped face, providing space for debris accumulation and potentially increasing maintenance for the District.

Other types of fencing include horizontal cable fencing, wire mesh fencing, and fencing with horizontal metal bars. Cost estimates for horizontal cable and wire mesh fencing are provided in Appendix A. While barbed wire strands at the top would help to deter access, fence panels with closely-spaced horizontal rail components may serve to act as a ladder for those wishing to cross the fence line, and are not recommended. In addition, wire or cable fencing with spacings

often greater than 6 inches will not provide the taut, interlocking panel strength offered by chain link fencing.

Personal and vehicular lockable gates may be provided as necessary for District employees. Standard details are included on Plate 2. Unit costs for chain link fencing gates can be found in Appendix A. On the south side of the river, as the gate will be perpendicular to flow, it is possible to construct the gate similar to the heavy-duty fencing described above.

Little variance exists in the possible locations for the fencing. For the north shore, one option is to limit the fencing to the immediate area surrounding the forebay and dam abutment. Another option is to enlarge the enclosed area to cut off all access from upstream (between the upstream end of the pump station fence and the shore) and from downstream (extend the downstream end of the pump station fence to the existing gate location, replace the metal tube gate with a double swing chain link gate, and extend the fence from there down to the canal). The latter will allow for adequate work area and parking inside the fencing, will provide a more comprehensive access restriction measure, and will not increase costs by a prohibitive amount. The proposed layout for fencing is shown on Plate 1.

The possibilities for the south shore are similar to those of the north shore. However, on the south shore, the terrain becomes very steep, with large boulders embedded in the ground surface on the hillside. It is possible to run fencing completely around the fish ladder, from the shore up the hillside on one end of the ladder and down the hillside to the shore on the other side, however this alternative is not recommended due to the extent of clearing and grubbing, avoiding boulders, and the sheer length of the fencing required to enclose the entire area. Rather, shorter lengths of fencing near the upstream and downstream extents of the fish ladder, running from the shore to the base of the hillside, seems a more reasonable option. The steep terrain outside of the proposed fence line is likely to be as much of a deterrent to accessibility as fencing completely surrounding the area.

In general, heavy duty fencing and gates are recommended nearest the major structures, and within high river stage areas perpendicular to the flow. In other locations, chain link fencing as recommended by USBR will be adequate. In both cases, fencing should be 6 feet in height, with an additional foot of 3-strand barbed wire on top. Although the heavy duty fencing recommended is not noted in USBR design criteria, we feel that the aforementioned features meet and exceed the chain link fencing specifications. The proposed layout for fencing is shown on Plate 1.

4.1.2 Signage

Additional signage may be added to those already in place, calling attention to specific dangers, per USBR recommendations. Signs are recommended on the north shore where the hiking trail intersects the proposed fencing line, as well as at the vehicular entrance gate. For the south shore, signs are recommended at both the upstream and downstream proposed fence layouts.

4.2 Granlees Dam

4.2.1 Fencing / Railing

As discussed in section 4.1.1, while it is possible to limit fencing to the immediate area surrounding the dam abutment and forebay on the north shore, it is recommended to enlarge the enclosed area to cut off all access from upstream and downstream. Although this will increase the cost for fencing, we believe it is outweighed by the added benefits of restricting access to the public and providing adequate working and parking space for District employees within the fence line. On the south shore, shorter lengths of fencing near the upstream and downstream extents of the fish ladder, running from the shore to the base of the hillside, should protect the dam and fish ladder from access. The types of fencing recommended are consistent with those described in Section 4.1. See Appendix A for the cost estimate and comparisons of fencing layouts.

Regardless of the chosen fencing layout, CalOSHA requires railing along the top of the walls of the forebay. This railing should be extended, as it is currently, upstream along the low wall separating the shore from the river. Due to rusting and coating delamination, it is recommended that the existing railing be removed and new, galvanized railing be installed in the area. Materials for the railing are discussed for the forebay in section 4.4; the same recommendations are made for the aforementioned low wall railing as for the forebay railings.

In addition to the general area fencing, it is recommended to install posts at either end of the dam crest, with a "fan" chain link or barbed wire panel mounted on it. This will serve as an additional measure of deterrence for pedestrians who may somehow get past the fencing and wish to cross the dam during low flows.

4.2.2 Signage

We recommend replacing the sign near the dam abutment on the north shore with a specific danger sign, as recommended by USBR. An example of a sign with text highlighting the specific dangers might read: "Danger, High Velocity Flows With Strong Undercurrents, Do Not Enter." On the south shore, specific signage near the dam is discussed along with signage for the fish ladder, in section 4.3.

4.2.3 Access Ladder to the Dam Crest

District employees use the existing metal rungs leading from the top of the forebay down to the dam crest on the north side of the river for maintenance. These rungs should be removed and replaced with a ladder meeting CalOSHA requirements. At the entrance to the ladder at the top of forebay elevation, a spring-loaded gate made of the railing materials should be installed, per the Occupational Safety & Health Hazard Identification Survey recommendations. See Plate 2 for a conceptual ladder detail. Metal ladder rungs are also embedded in the side of the dam wall on the south side of the river. The District has expressed that there is no need for maintenance access to the top of the dam; these rungs should therefore be removed to prevent easy access for the public down to the dam crest.

4.2.4 Blocking Openings in the Dam Face

The existing timber pallets should be removed and replaced with a permanent system that cannot be removed easily by the public. The District has noted that there is no need for these openings, although their originally intended purpose is unknown. Therefore, a blockage system as simple as a steel plate with neoprene seals, bolted at the edges into the dam, would serve to allay safety concerns and keep most, if not all, of the flows from passing through the openings. The openings may also be filled with concrete, and doweled into the existing dam surrounding the holes. However, as the danger of inadvertently releasing construction materials is much higher with concrete than with steel; permitting issues will likely be less significant with the steel plate option. Construction of either option may require the use of a cofferdam on the upstream side of the dam, depending on the openings' depth below the water surface. Less permanent solutions for blocking the openings such as sluice gates or bulkheads exist, but would be more easily subject to public tampering. In addition, bulkheads and sluice gates would be more expensive than a steel plate, and would prove to be an unnecessary expense, given the District's desire to see the openings permanently blocked.

4.2.5 Sloping the Dam Crest

Prior discussions with the District have included the possibility of sloping the crest of the dam to make the surface impassable to pedestrian traffic during low flows, when there is no water flowing over the dam. If this option is pursued, hydraulics analyses will be necessary to determine the effect of a modified crest shape, and approval will be required by DSOD, at a minimum. In addition, permits for construction in the Cosumnes River will undoubtedly be required and will add regulatory agency review time into the overall schedule between design and construction. Preparation of these documents and review times could easily add 2 to 3 years to the permitting process.

Consideration must also be given to constructibility and scheduling. This type of work must be conducted during low flows, and even then the contractor would be operating "in the wet," as there would still be water present upstream and downstream of the dam. In addition, concrete operations in the wet are inherently more costly due to increased risk to the contractor's personnel and equipment.

It is also possible to install a temporary sloped crest, to be bolted on to the top of the dam during low flows to prohibit pedestrian traffic. Various crest shapes might be used to prevent passage across the dam, as the intent of the addition is to prevent traffic, and not to interfere with water flow; the crest would have to be removed prior to rising water levels. This method would also require some degree of construction in the wet, as well as permitting. Hydraulic models would likely have to be created in any event, to account for the possibility of rapid increase in river stage prior to the District's ability to remove the temporary crest.

Due to the risk and permitting time impact to the construction schedule, this alternative, whether permanent or temporary, for restricting access across the dam is not recommended.

4.2.6 Tether Cable Across the Dam

Among the recommendations made at Granlees Dam and Pump Station associated with the Occupational Safety & Health Hazard Identification Survey for the SDRMA Workers' Compensation Program (*SDRMA Workers' Compensation Program, Occupational Safety & Health Hazard Identification Survey, Revisit 12/15 & 17/04, pages 50-52*) was a suggestion to install a tether cable across the dam. The idea was that employees could attach themselves to the cable during maintenance or repair procedures. The District has determined that its employees do not need access to the top of the dam, and although there was once a safety cable for the forebay, it was never used. In addition, a tether cable may likely attract the attention of members of the public who may try to cross the dam. This would counter the District's intent to increase safety in the area and may encourage access by the public to the dam and its appurtenant structures. Also, a tether cable across the dam could restrain floating debris during flood flows and acerbate flooding. Therefore, this alternative is not recommended.

4.3 Fish Ladder

4.3.1 Fencing

On the south shore, shorter lengths of fencing near the upstream and downstream extents of the fish ladder, running from the shore to the base of the hillside, should protect the dam and fish ladder from access. We recommend a 12-foot-wide double swing gate be provided in the fencing to allow vehicular access for District personnel. Parking for District employees would still be available outside, and likely inside, the fencing limits, depending on the river's water surface elevation. As discussed in Section 4.1.1, heavy duty fencing near the structure and perpendicular to river flows is also recommended. See Appendix A for the cost estimate of the fencing layout.

4.3.2 Guardrails

Guardrails are recommended along the inboard wall of the fish ladder. The rails will serve to prevent accidental falls into the ladder by District personnel as well as to keep foot traffic away from the top of this narrow wall. If the District, the Department of Fish and Game, or other agency requests access into the fish ladder, a spring-loaded guardrail gate and access ladder may be incorporated into the design.

For the guardrails, wood and metal are two material possibilities, but the fact that wood will deteriorate and decay in a wet environment makes it an unwise choice. A much more durable and common choice is metal pipe railing. A galvanized finish will add corrosion resistance and is recommended for this damp environment. Rail posts may be mounted on top of the walls if the wall width and concrete condition will allow attachment without concrete breakage. Posts may also be mounted to the sides of the walls to avoid these concerns. Costs for guardrails in this area are included in Appendix A.

4.3.3 Signage

We recommend placing specific danger signs on the proposed upstream and downstream fencing, as recommended by USBR. An example of a sign with text highlighting the specific dangers might read: "Danger, High Velocity Flows, Do Not Enter."

4.4 Forebay

4.4.1 Guardrails

Wood and metal are two material possibilities, but the fact that wood will deteriorate and decay in a wet environment makes it an unwise choice. A much more durable and common choice is metal pipe railing. A galvanized finish will add corrosion resistance and is recommended for this damp environment. Rail posts may be mounted on top of the walls if the wall width and concrete condition will allow attachment without concrete breakage. Posts may also be mounted to the sides of the walls to avoid these concerns. Costs for guardrails in this area are included in Appendix A.

4.4.2 Forebay Cover and Access

The existing forebay cover is effective at restricting access, but is not a permanent solution, given the timber and chain link materials. In addition, access by District personnel into the forebay is difficult, as the chain link mesh and timber have to be disassembled in part in order to climb down into the forebay. However, the District has noted that lack of a designated access hatch is not a problem; access to the forebay is infrequent enough to do without, and disassembly of the forebay cover for access is acceptable. However, a lockable access hatch is a relatively small cost as compared to a new forebay cover system, and it would provide a means for quick access should an emergency arise. It is therefore still recommended to include an access hatch with any new forebay cover system. The underlying transverse steel beams appear to be in good condition, and if left in place, will form the support structure for the new forebay cover material.

Several material choices and grating types are possible and applicable in this damp environment. Grating types considered include expanded metal, rectangular bar, and riveted "truss" bar. Various materials are available for each grating type, including stainless steel, aluminum, galvanized steel, plain steel, and fiberglass. Stainless steel is corrosion-resistant and durable, but is often more costly than other materials. It is often used in treatment plant applications, and may be useful in this case, at the District's discretion. Aluminum is light-weight, which would ease installation and maintenance, and is fairly corrosion-resistant, but is less durable due to its light weight. Galvanized steel is corrosion-resistant and durable, but heavier than aluminum or fiberglass. Plain steel may be less expensive, but will not provide the long-term corrosion resistance of the other materials, and is not recommended. Fiberglass is lightweight and corrosion-resistant. Grating material and type will likely be determined by District preference and cost differentials. A conceptual level cost estimate is provided in Appendix A.

It is also possible to keep the cover system in place as is, and install additional timber planks between the existing planks. This would be a low-cost solution, however timber is generally not recommended as a permanent solution in a wet environment. Also, the chain link laid over the top of the timber forms an uneven walking surface and may constitute a tripping hazard by OSHA standards. Therefore, it is recommended that the timber planks and chain link be removed and replaced with one of the aforementioned grating systems.

4.4.3 Intake Safety Racks

The existing vertical metal tube grating affixed to the upstream side of the forebay wall, over the intakes, is an effective means of keeping large debris and recreational river users from entering the forebay through the intakes. USBR does recommend that safety racks be installed at a 3 to 1 slope for ease of escape from the water. We recommend that safety racks be installed at this angle or flatter over both intake openings. The rack material should be 1-½ inch diameter galvanized steel pipe with 9 inches of clear space between vertical pipes. Horizontal pipes of the same size, or galvanized metal bars should be spaced at approximately 2 feet on the racks to provide "steps" for emergency egress from the water.

4.4.4 Intake Bulkheads / Slide Gates

There are currently no operational bulkheads providing a positive closure structure for the intakes. A system such as this would provide the District with a way to restrict water flow into the forebay, and drain or pump water out for maintenance access. Two, hand-operated slide gates are recommended for positive closure of these intakes.

4.5 Canal

4.5.1 Canal Replacement

One option that would eliminate the need for fencing, fall protection, or egress along the canal is to enclose it. This can be accomplished in several ways: new concrete slabs installed over the existing canal, removal of the canal and installation of a pipe, removal of the canal and installation of a cast-in-place or precast concrete box section, or removal of the canal and installation of a U-shaped concrete drainage canal with removable concrete lid panels.

While it is possible to place concrete slabs over the existing canal, the canal is of varying width, and the walls are of varying condition and degree from the vertical. In some locations, the walls of the canal do not appear to be lined with concrete, just soil. These existing conditions would require analysis of the structure to determine its load capacity for concrete slabs, and might require retrofit or replacement.

A replacement pipeline would be more expensive than simple concrete slabs, but would provide all the benefits of a closed canal: safety for community residents and District personnel, protection of the water from environmental elements, and elimination of the need for fencing, fall protection and egress. However, the curved surface of the pipe would still need to be crossed with a bridge or covered with fill at the upstream canal crossing location near the

beach, at a minimum. As the water in the existing canal is used for irrigation and other non-potable applications, pipe materials such as black steel, coated metal or high density polyethylene (HDPE) would be unnecessary in this case. Prestressed concrete pipe is an acceptable choice, but this is not a pressure pipe, nor will the external loads exceed the pedestrian level. The most economical and appropriate pipe section for this application is a reinforced concrete pipe. Cost estimates for several pipe types are found in Appendix A.

A simple reinforced concrete box section, a prestressed concrete box, or a new U-shaped canal with removable concrete lid panels has all the advantages of the pipeline listed above, with the added benefit of a flat-top walking and crossing surface. Removable concrete panels may not be needed, as the District has expressed that access into the canal is not necessary. It is possible to maintain the canal and flush out debris by controlling flows through the forebay, however at least two locked manhole points are nevertheless advisable. Prestressed boxes are available, but with non-pressure flow and the light pedestrian traffic loading in the area, would be an overly conservative design for this application.

Due to the advantages of reinforced concrete in this application and the benefits listed above for a closed canal, it is recommended that the District proceed with replacing the canal with a reinforced concrete pipe. Cost estimates for selected alternatives above can be found in Appendix A.

If the canal replacement option is not chosen, it is recommended to install ladders and fencing along the entire stretch of the canal as recommended in the following two sections.

4.5.2 Egress / Maintenance Access Ladders

One way to facilitate egress from a canal that is recommended by USBR is to provide ladders at regular intervals along the canal's length. While the intent of the ladders would be to help a person escape from the canal should they fall in, the ladders may be interpreted by the public as access ladders for recreation in the canal. For this reason, ladders are only recommended for District maintenance use, and should be completely enclosed by fencing along the canal, accessible by gates in the fencing. This would ensure that the ladders would be used for District access only.

4.5.3 Fencing

To prevent access into the canal and provide fall protection for District employees and the public, a fence should be installed along both sides of the canal, for the entire length of the canal that falls within District right-of-way. As the hazard exposure is the same at the canal as it is for the other project structures, USBR criteria calls for six-foot chain link fencing with a barbed wire strand topper on both sides of the canal. For this fencing, a narrow strip on both sides of the canal would require clearing and grubbing prior to fencing installation. It is recommended that the fence post connections be set in concrete post bases outside the canal walls or slopes. The sloped canal walls (whether concrete lined or soil sloped) do not provide

an adequate foundation for the fence line; the existing canal walls similarly may not provide an adequate base.

4.6 Upstream Concrete Slab Canal Crossing

4.6.1 Crossing Type

It is recommended that the existing slab crossing be removed in its entirety due to its substandard condition. Two options for crossing replacement include timber or a new concrete slab. A concrete slab is preferable with regard to durability and longevity, however a timber crossing may have a more aesthetic appeal. Prefabricated concrete slabs as well as cast-in-place slabs are viable options. Cost differentials between concrete and timber may be found in Appendix A. Cost savings, durability and longevity factors suggest a replacement concrete slab crossing.

If the canal is replaced in its entirety as recommended, a new crossing will not be needed, as pedestrians may cross over the top surface of the canal structure for its entire length.

4.6.2 Guardrails / Fencing

Fall protection is recommended over the crossings regardless of crossing type. The suggested material for the rails and posts would normally vary depending on the crossing type. However, in this case, the canal width is under 10 feet, and the 6-foot chain link fencing recommended for the sides of the canal is also recommended for installation along the edges of the crossing.

Again, if the canal is replaced as recommended, fencing will not be needed, as the canal will be enclosed, posing no fall protection or egress concerns.

4.7 Downstream Wood Panel Canal Crossing and Underlying Aqueduct

4.7.1 Crossing Type

Similar to the upstream crossing, it is recommended that the downstream crossing and aqueduct be completely removed and replaced. For the crossing deck, the two materials considered in this report are concrete and timber. Like the upstream crossing, a concrete slab is preferable with regard to durability and longevity, however a timber crossing may have a more aesthetic appeal. The additional advantage of a timber deck is that it can be constructed of removable panels, so that the underlying aqueduct may be accessed for maintenance. While concrete may be cheaper than timber construction (see Appendix A for cost estimate), the need for maintenance access likely outweighs the cost benefit of concrete.

Approximately 12 feet downstream of this crossing is another wood panel crossing about 4 feet in width. If the canal is not replaced, we recommend that this crossing be replaced with a concrete slab crossing, similar to the upstream canal crossing.

If the canal is replaced in its entirety as recommended, a new crossing will be needed atop the pipe. It is recommended that a metal pipe be extended over the ravine as a replacement for the aqueduct, as described below.

The canal replacement pipe may be extended past the ravine at the District's discretion, considering right of way and property lines, overall cost implications, and frequency of pedestrian traffic. Our recommendation is to eventually extend the reinforced concrete pipe down the canal to the extent of the District's right of way, whether this occurs in one construction phase, or several, for budgetary or environmental reasons.

4.7.2 Aqueduct Type

Our recommendation, as mentioned above, is to transition the reinforced concrete pipe into a metal pipe in order to cross the ravine at the downstream canal crossing locations. A metal pipe over the crossing is recommended over extending the concrete pipe due to the advantageous structural properties of metal pipe. An adequate substructure for support of the section will have to be designed, likely using steel beams similar to those existing in the longitudinal direction.

However, if the canal itself is not replaced and extended over the ravine, replacement of the aqueduct may be achieved with a metal or fiberglass reinforced plastic pipe (FRP). FRP would be the lightest material, and would ease installation and maintenance if provided in a half-pipe shape similar to the existing aqueduct. A metal pipe would be heavier, likely more durable, and more expensive. See Appendix A for cost estimates of both options. Transitioning from an open channel into a closed pipe would require some degree of hydraulic analysis and a more complicated transition design. If the canal remains open, for maintenance, installation and cost reasons, we recommend a FRP half-pipe.

4.7.3 Guardrails / Fencing

Fall protection is recommended over the crossings regardless of crossing type, if the canal remains open. The suggested material for the rails and posts would normally vary depending on the crossing type. However, in this case , the canal width is under 10 feet, and the 6-foot chain link fencing recommended for the sides of the canal is also recommended for installation along the edges of the crossing, should this option be chosen.

If the canal is replaced with a reinforced concrete pipe and extended over the ravine with a metal pipe as recommended, side-mounted metal tube railing affixed to the crossing substructure is recommended over the crossing.

4.8 Preferred Alternatives Summary and Cost Estimate

Preferred alternatives for each project element were selected based on review of the Alternatives Analysis and Recommendations presented in Section 4. The preferred alternatives

are presented in the following table, and conceptual level cost estimates have been prepared for these alternatives.

Table 6 – Preferred Alternatives and Costs

AREA	ELEMENT	RECOMMENDED PLAN	COST ESTIMATE
General	Mobilization		$11,200
	Demolition		$8,300
	Earthwork		$11,700
Fencing and General Access: Dam, Forebay & Fish Ladder	North Shore	Install 6' tall chain link and heavy duty fencing with 3-strand barbed wire topper.	$15,600
	North & South Shores	Install Chain Link "Fan" Fence Posts at both ends of dam crest.	$500
	North & South Shores	Install double-swing vehicular access gates (heavy duty at South shore).	$4,100
	South Shore	Install 6' tall heavy duty fencing with 3-strand barbed wire topper.	$6,000
Canal Modifications	Excavation & Backfill	Excavate for Pipe Placement and backfill.	$27,400
	Piping	Place reinforced concrete pipe.	$58,000
	Manholes	Place precast manholes along pipe segment.	$3,100
	Aqueduct	Install steel pipe across ravine.	$19,200
	Aqueduct Crossing	Install timber deck and guardrails atop metal pipe.	$4,900
Forebay	Guardrail	Install 42" tall metal pipe guardrail.	$8,400
	Guardrail Gate	Install 42" tall metal pipe guardrail gate with spring-mounted hinge.	$500
	Grating / Cover	Install new grating over existing steel beams.	$23,400
	Access Hatch	Install hatch in forebay cover for ladder access to forebay interior.	$500
	Access Ladder	Install one ladder inside forebay and one from forebay wall down to dam crest and north shore fish ladder.	$1,400
	Safety Rack	Install safety rack upstream of two 3'x3' intake openings	$4,000
	Sluice Gate	Install two 3'x3' sluice gates to act as bulkhead on forebay intakes for forebay maintenance.	$14,500
Fish Ladder on South Shore	Guardrail	Install 42" tall metal pipe guardrail.	$6,900
Safety	Signage	Install "Danger/No Trespassing" Signs.	$1,100
	Dam Openings	Install metal plates or existing openings in dam face.	$600

Conceptual level cost estimates have been developed by unit costs for all alternatives, and by recommended alternatives, organized by project element. These estimates can be found in Appendix A. The cost estimate was developed from prevailing costs of construction, material acquisition, and evaluation of the major construction items deemed necessary to complete the work. The cost estimate is based on the conceptual design presented in this report and is anticipated to change as the project progresses through to final design. Quantities and applicable construction items were developed from the conceptual design.

The cost estimate does not include permitting, surveying, design or real estate costs, as these are unknown at this time. A 20% contingency has been included to account for uncertainties and fluctuations in item costs, changes in construction during the refinement of the design, and unforeseen items that may arise during design. The contingency is anticipated to decrease as the project proceeds through to final design.

5. Additional Considerations

5.1 Construction Prioritization

From an engineering standpoint, our recommendation regarding construction prioritization is based on the deviation of existing conditions from current design standards. As a design firm, we are unable to make recommendations based on the risk to public safety or associated liability concerns.

Should the District decide to proceed with the design of the canal crossings, we suggest that this construction proceed as soon as possible, given the extent of deviation from current design standards. The upstream canal crossing slab has spalled extensively, exposing a reinforcing system not compliant with current design practice. In addition, the lack of guardrails deviates from CalOSHA and USBR requirements. Likewise, the downstream crossing lacks a complete deck surface and guardrails. The underlying aqueduct leaks considerably, according to the District, and should be replaced at the same time as the deck, as the aqueduct no longer performs at an acceptable level.

Next, we suggest that the chain link fencing be installed on both the north and south shores in order to restrict access to the areas to District personnel and contractors. After access is secured, the existing railings can be removed and the forebay cover replaced, along with all related ladders, guardrails and safety measures. With fencing surrounding the area, the chance for the public to access the open forebay during construction is greatly reduced. It is likely that the contractor will want to install guardrails on the north shore structures and the south shore fish ladder at the same time.

5.2 Considerations Regarding Historic and Future Use

Consideration should be given to the ramifications of restricting public access to the established hiking trail on the north shore. If the fencing recommendations for access restriction outlined in this report are implemented, the trail that runs between Granlees Raw Water Pumping Station and its forebay will be blocked from public use. The District should pursue this issue to gather community input and determine whether any regulating agency will have enforceable comments or requirements resulting from the access restriction design.

5.3 Environmental Considerations

For this project, the District should consider potential environmental constraints under the National Environmental Policy Act (NEPA), the California Environmental Quality Act (CEQA), and the Clean Water Act, as well as regulatory agency involvement by the U.S. Army Corps of Engineers (USACE) and the California Department of Fish and Game (DFG). Environmental considerations for this project may not be limited to these environmental laws or regulatory agencies. See Appendix B for a flowchart of typical environmental law compliance requirements.

In order to know the extent of the permits required by USACE, DFG, or other agencies, the District or its representative should develop a permitting plan based on the design, and present it to the reviewing agencies for their concurrence. The agencies will inform the District which permitting processes need to be considered. HDR would be pleased to suggest an environmental consulting firm for initial project review and permitting assistance, either through subcontract to HDR or direct contract with the District.

5.3.1 USACE Regulatory Issues

USACE regulates navigable waters within the ordinary high water mark, although they will accept the 2 year flood as the ordinary high water mark, or clear evidence along the shore that water has risen to a certain elevation. Construction work within this area will trigger Section 404 of the Clean Water Act, and will require a permit. USACE may also regulate the Cosumnes River under Section 10 of the Rivers and Harbors Act.

If Federal action is needed for a project (as would be the case if USACE becomes involved), this triggers NEPA. Permitting requirements under NEPA may be avoided if USACE determines action is not required, or if the project work falls under one or more pre-existing Nationwide Permits. If the project falls under Nationwide Permits, an Individual Permit is not required, and NEPA will be addressed under the Nationwide Permit. The permitting process can take approximately 180 days (if there are Environmental Species Act issues, less if there are not), plus 30 days of review time. If USACE action is not required, there will be little impact to the design and construction schedule. If USACE determines action is required and the project work does not fall under Nationwide Permits, the NEPA process can take 1 to 3 years (an Environmental Impact Study takes approximately 2 to 3 years, an Environmental Assessment may be completed in half that time).

It should be noted that USACE staff has been reduced of late due to the war in Iraq and deployments for hurricane Katrina recovery project permitting; the District should expect a backlog of work at USACE and extended review and response times as a result. It should also be noted that USACE is under no obligation to complete the permitting process within any specified timeframe. Due to the aforementioned likely delays and the uncertainty of the permits required, we recommend the District begin the permitting process for this project as soon as possible in order to meet targeted construction timelines.

5.3.2 DFG Regulatory Issues

DFG regulates the entire streambed of rivers (typically this is designated as levee crown to levee crown). The project work will most likely require a 1602 Permit, which consists of a submitting a complete Notification of Lake or Streambed Alteration Form (FG2023) and Project Questionnaire Form (FG2024) (Notification Package), which will also identify the lead agency responsible carrying out or approving the activity and ensuring compliance under CEQA. DFG will verify that the Notification Package application is complete within 30 calendar days for a regular agreement (an agreement for a term less than 5 years). Upon receiving a complete Notification Package, DFG will determine whether your activity needs a Lake or Streambed Alternation Agreement (LSAA). If an agreement is required, DFG will conduct an onsite inspection and return a draft LSAA outlining measures for protecting fish and wildlife resources within 60 calendar days after receiving a complete Notification Package. DFG should be notified within 30 calendar days that the measures in the draft LSAA are acceptable by signing and returning the LSAA. Upon written notification that any measures are not acceptable, DFG will meet within approximately 14 calendar days to resolve the disagreement. Note: if DFG does not receive a written response within 90 calendar days of receiving the draft LSAA, it may withdraw the agreement.

After DFG receives the signed draft LSAA and appropriate notification fee, and after the lead agency has fully complied with CEQA, it finalizes the draft LSAA by signing it. (In many instances, DFG will receive a signed draft LSAA from an applicant before the lead agency has fully complied with CEQA. In those instances, DFG must wait for the lead agency to fully comply with CEQA before it may sign the draft LSAA, thereby making it final.) Then, the project may begin provided any other necessary local, State, and federal authorizations have been obtained.

If the proposed activity is determined to be a Project pursuant to CEQA (an activity which may cause either a direct physical change in the environment or a reasonably foreseeable indirect change in the environment), it will require at least some environmental review, unless an exemption applies. If the project is categorically exempt, there is a 30-day statute of limitations before construction may begin. Alternatively, the District may file an Initial Study with DFG if a project description is recommended. This process will likely take approximately 3 months, as there is a 30-day public review associated with it, and no response to comments is required. If there is any question that the project will result in a significant impact, an Environmental Impact Report (EIR) will be needed. The shortest time period associated with the CEQA EIR process is approximately 6 months, including a 30-day agency review and response to comments.

5.3.3 Clean Water Act

This project will likely fall under the requirements of Section 401 of the Clean Water Act. Under this act, discharges into waters of the U.S. require certification from the Regional Water Quality Control Board (in this case, the Central Valley Regional Water Quality Control Board)

regarding Clean Water Act requirements. In addition, the project will require a Section 402 Non-Point Discharge Elimination System Permit if the affected area exceeds one acre. This requirement is satisfied by contractor preparation of a Storm Water Pollution Prevention Plan.

5.4 Real Estate Issues

We have received grant deeds from the District laying out District property in the area. Unfortunately, without survey information for the project area and structures, it is not possible to determine whether all recommended project components fall within District property.

After a survey has been conducted in the area, it will be possible to locate the property lines in the area, and work toward locating all proposed project elements (most notably fencing) within District right-of-way. Should the proposed work fall outside District property, and relocating the project elements within the property lines will impair the intent of the access restriction, real estate negotiations should be pursued with adjacent landowners for rights of entry, easements, and/or land acquisition.

5.5 Estimated Schedule

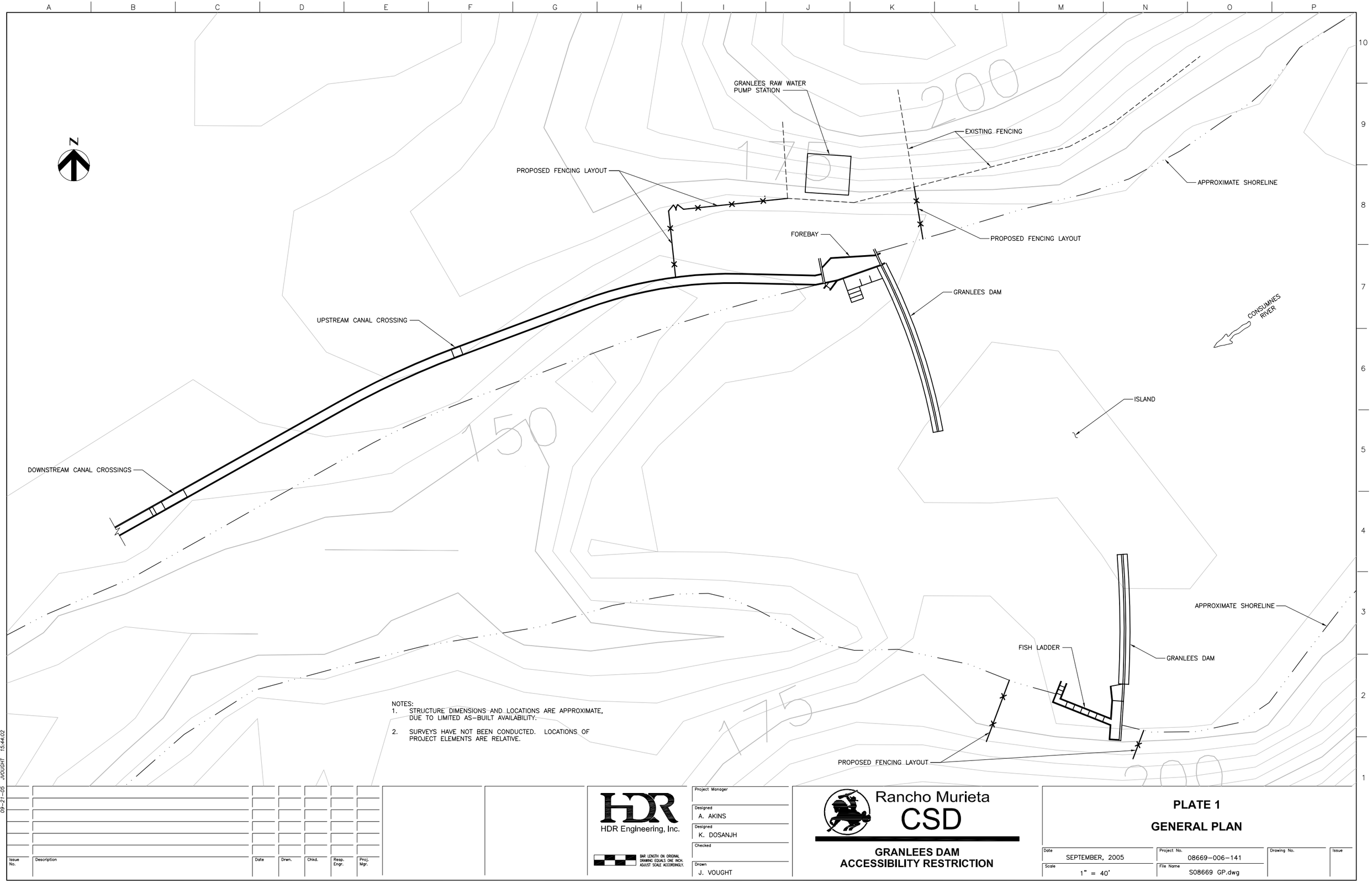
Should the District elect to request design services for this project based on this alternatives analysis, the following timeline is anticipated.

We anticipate that the District Board review of the Alternatives Analysis will take up to one month, as reviews and decisions will likely span until the next monthly Board meeting. Securing design services for Plans, Specifications and Estimates (PS&E) will likely take 2 weeks to 1 month, again due to necessary approval at the monthly Board meeting.

If the District requests initial environmental assistance with permitting processes, it is anticipated to take 1 to 2 months to secure contracts and provide services. The permitting process itself may take 3 months to 2 years, depending on agency-required permitting processes and the results of the initial environmental assistance process.

Surveying of the area, including contract initiation and completion of services should require approximately one month.

Preparation of 30% PS&E will likely take 3 months, and 90% PS&E 2 months. A 2 week duration is expected for District review of each submittal. Completion of final PS&E may be expected in 2 to 3 weeks.



NOTES:
1. STRUCTURE DIMENSIONS AND LOCATIONS ARE APPROXIMATE, DUE TO LIMITED AS-BUILT AVAILABILITY.
2. SURVEYS HAVE NOT BEEN CONDUCTED. LOCATIONS OF PROJECT ELEMENTS ARE RELATIVE.

Issue No.	Description	Date	Drwn.	Chkd.	Resp. Engr.	Proj. Mgr.

HDR Engineering, Inc.

BAR LENGTH ON ORIGINAL DRAWING EQUALS ONE INCH. ADJUST SCALE ACCORDINGLY.

Project Manager	
Designed	A. AKINS
Designed	K. DOSANJH
Checked	
Drawn	J. VOUGHT

Rancho Murieta CSD

GRANLEES DAM
ACCESSIBILITY RESTRICTION

PLATE 1

GENERAL PLAN

Date: SEPTEMBER, 2005	Project No.: 08669-006-141	Drawing No.	Issue
Scale: 1" = 40'	File Name: S08669 GP.dwg		

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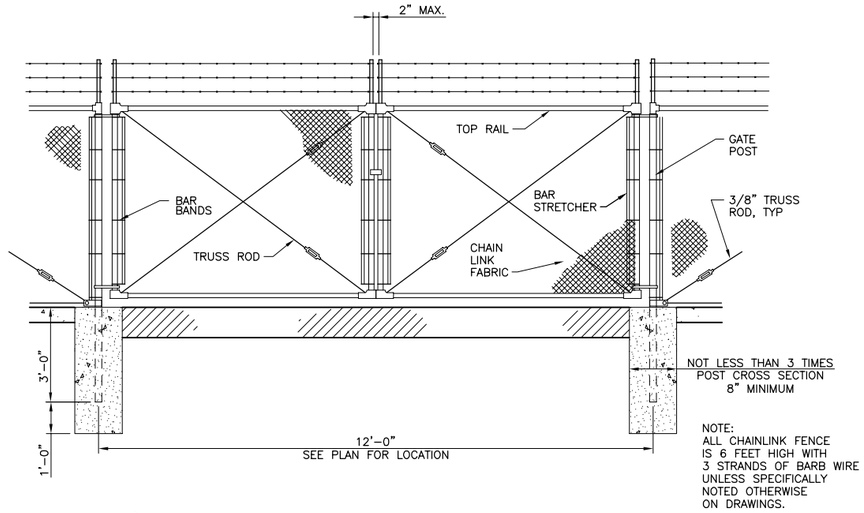
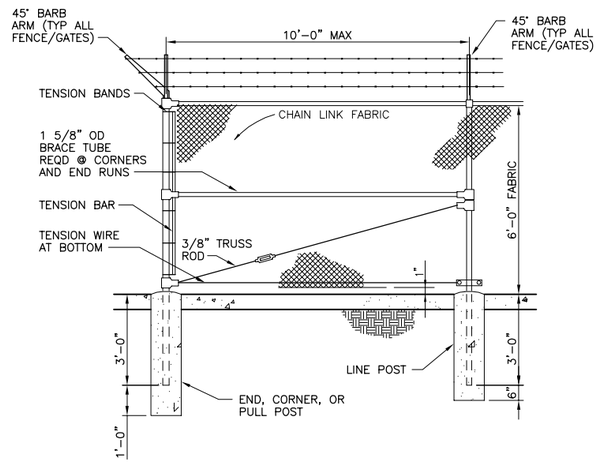
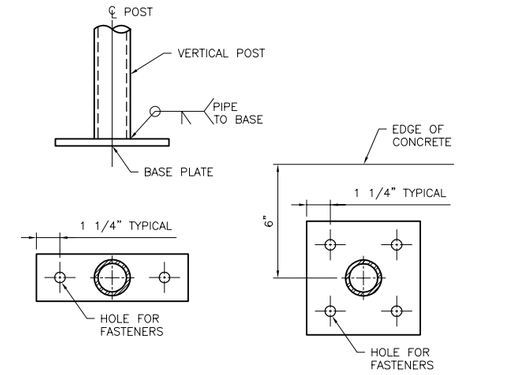


6' FOOT CHAIN LINK GATE DETAIL
NTS



6' CHAIN LINK FENCE DETAIL
NTS



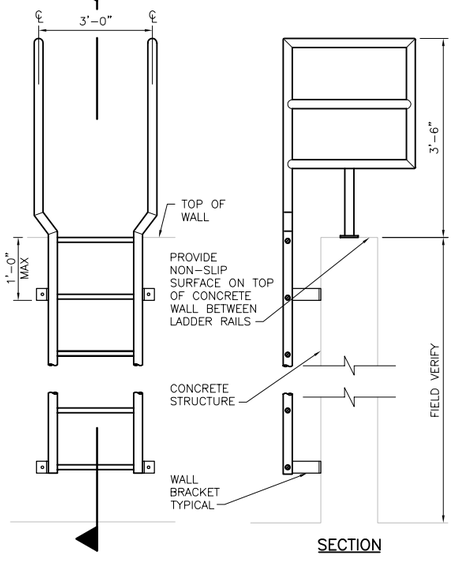
BASE PLATE ALTERNATIVE A

BASE PLATE ALTERNATIVE B

NOTE:

1. TOEBOARD NOT SHOWN.

STEEL GUARDRAIL POST DETAIL
NTS



TYPICAL LADDER DETAIL
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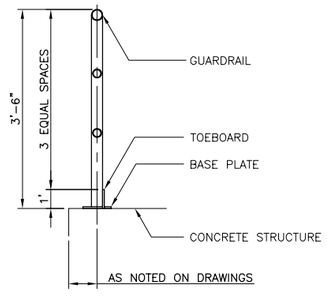
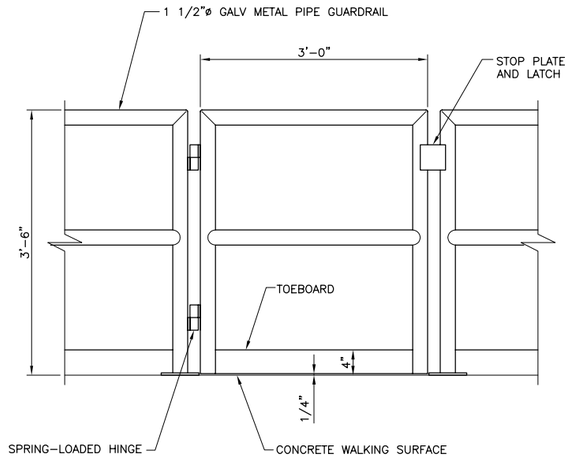


GUARDRAIL
NTS



GUARDRAIL GATE
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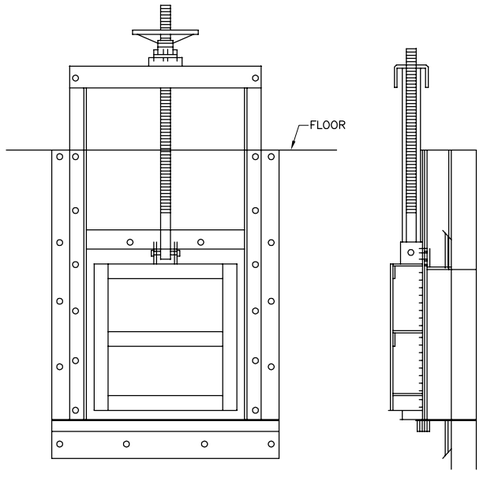

SLUICE GATE DETAIL
NTS

Issue No.	Description	Date	Drwn.	Chkd.	Resp. Engr.	Proj. Mgr.

HDR Engineering, Inc.

BAR LENGTH ON ORIGINAL DRAWING EQUALS ONE INCH. ADJUST SCALE ACCORDINGLY.

Project Manager	A. AKINS
Designed	A. AKINS
Designed	K. DOSANJH
Checked	
Drawn	J. VOUGHT

Rancho Murieta CSD

GRANLEES DAM ACCESSIBILITY RESTRICTION

PLATE 2

TYPICAL DETAILS

Date: SEPTEMBER, 2005	Project No.: 08669-006-141	Drawing No.	Issue
Scale: AS NOTED	File Name: S08669 GP.dwg		

Granlees Dam Accessibility Restriction

Conceptual Level Cost Estimate of Recommended Features by Project Element[1]

	QUANTITY	UNITS	UNIT PRICE	TOTAL COST
MOBILIZATION				
Mobilization and Demobilization (5%)				$11,156
Insurance and Bonds (3%)				$6,694
SUBTOTAL				**$17,850**
DEMOLITION				
Remove Existing Concrete Crossing	99	SF	$2.88	$285
Remove Existing Wood Crossing	240	SF	$2.88	$691
Remove Existing Aqueduct	30	LF	$25.00	$750
Remove Forebay Guardrails	75	LF	$11.90	$893
Remove Forebay Cover Timber and Chain Link	1	LS	$500.00	$500
Remove Canal Concrete	300	LF	$17.30	$5,190
SUBTOTAL				**$8,309**
EARTHWORK				
Clearing and Grubbing, North Shore	0.50	Acre	$6,190.00	$3,095
Clearing and Grubbing, Canal	0.50	Acre	$6,190.00	$3,095
Clearing and Grubbing, South Shore	0.50	Acre	$6,190.00	$3,095
Grading, North Shore	1,800	SF	$1.36	$2,448
SUBTOTAL				**$11,733**
FENCING AND GENERAL ACCESS: DAM, FOREBAY & FISH LADDER				
6' Tall Chain Link Fence, With Barbed Wire (North Shore Upslope Only)	315	LF	$17.75	$5,591
6' Tall Heavy Duty Fence, With Barbed Wire (North Shore Near Structures and Flow)	100	LF	$100.00	$10,000
6' Tall Heavy Duty Fence, With Barbed Wire (South Shore Near Structures and Flow)	60	LF	$100.00	$6,000
6' Tall Chain Link Double Swing Gate With Barbed Wire 12' Wide Opening (North)	1	EA	$1,100.00	$1,100
6' Tall Heavy Duty Double Swing Gate With Barbed Wire 12' Wide Opening (South)	1	EA	$3,000.00	$3,000
6' Tall Chain Link "Fan" Fence Post (Both Ends of Dam Crest)	2	EA	$250.00	$500
SUBTOTAL				**$26,191**
FOREBAY				
42" Tall Metal Tube Railing, Steel 3 Rail 1-1/2" Diameter (Around Forebay)	222	LF	$38.00	$8,436
42" Metal Tube Railing, Spring-Mounted Gate (2 @ Forebay)	2	EA	$250.00	$500
Grating	1,550	SF	$15.10	$23,405
Access Hatch	1	EA	$500.00	$500
Access Ladder	2	EA	$720.00	$1,440
Safety Rack (1 1/2" Diameter Pipe @ 9" OC, 3:1 Slope)	1	EA	$4,000.00	$4,000
Sluice Gate for U/S Intakes (Stainless Steel)	2	EA	$7,235.00	$14,470
SUBTOTAL				**$52,751**
FISH LADDER				
42" Metal Tube Railing (South Shore Fish Ladder)	180	LF	$38.00	$6,840
SUBTOTAL				**$6,840**
CANAL MODIFICATIONS				
Excavate for Pipe Placement (2:1 Side Slopes)	430	LF	$49.30	$21,199
Place Reinforced Concrete Pipe, 48" diameter[2]	430	LF	$135.00	$58,050
Backfill Trench and Pipe (Assume 12" cover)	430	LF	$14.50	$6,235
Precast Manhole, Frame and Cover, 4' I.D., 6' deep	2	EA	$1,525.00	$3,050
Aqueduct - Steel Pipe, 48" diameter[2]	40	LF	$480.00	$19,200
Timber Deck 40' x 8'	320	SF	$15.00	$4,800
42" Tall Metal Tube Railing, Steel 3 Rail 1-1/2" Diameter	80	LF	$38.00	$3,040
SUBTOTAL				**$115,574**
SAFETY				
Signage (No Trespassing, Danger, Etc)	10	EA	$112.50	$1,125
Metal Plates with Gaskets for Dam Openings	2	EA	$300.00	$600
SUBTOTAL				**$1,725**
PROJECT SUBTOTAL				**$240,973**
DESIGN & CONSTRUCTION CONTINGENCIES (20%)				$48,195
CONCEPTUAL LEVEL ESTIMATE OF CONSTRUCTION COST				**$289,167**

1 - Costs include labor and materials only. Additional costs for project completion may be expected, including those for: design, environmental permitting and mitigation, public outreach, and real estate.
2 - Conservative estimate of pipe size given 0.6 cfs flow data from the District.

Granlees Dam Accessibility Restriction

Conceptual Level Unit Cost Estimate for Alternatives by Component Type[1]

	QUANTITY	UNITS	UNIT PRICE	TOTAL COST
MOBILIZATION				
Mobilization and Demobilization (5%)				$11,156
Insurance and Bonds (3%)				$6,694
DEMOLITION				
Remove Existing Concrete Crossing	99	SF	$2.88	$285
Remove Existing Wood Crossing	240	SF	$2.88	$691
Remove Existing Aqueduct	30	LF	$25.00	$750
Remove Forebay Guardrails	75	LF	$11.90	$893
Remove Forebay Cover Timber and Chain Link	1	LS	$500.00	$500
Remove Canal	250	LF	$17.30	$4,325
EARTHWORK				
Clearing and Grubbing, North Shore	0.50	Acre	$6,190.00	$3,095
Clearing and Grubbing, Canal	0.50	Acre	$6,190.00	$3,095
Clearing and Grubbing, South Shore	0.50	Acre	$6,190.00	$3,095
Grading, North Shore	1,800	SF	$1.36	$2,448
FENCING				
6' Tall Chain Link Fence, With Barbed Wire (North Shore Entire General Area)	315	LF	$17.75	$5,591
6' Tall Cable Railing Fence (North Shore Entire General Area)	315	LF	$22.86	$7,201
6' Tall Wire Mesh Fence, With Barbed Wire (North Shore Entire General Area)	315	LF	$9.14	$2,880
6' Tall Chain Link Fence, With Barbed Wire (North Shore Upslope Only)	215	LF	$17.75	$3,816
6' Tall Cable Railing Fence (North Shore Upslope Only)	215	LF	$22.86	$4,915
6' Tall Wire Mesh Fence, With Barbed Wire (North Shore Upslope Only)	215	LF	$9.14	$1,966
6' Tall Heavy Duty Fence, With Barbed Wire (North Shore Near Structures & Flow)	100	LF	$100.00	$10,000
6' Tall Chain Link Fence, With Barbed Wire (Around Forebay Only)	75	LF	$17.75	$1,331
6' Tall Chain Link Fence, With Barbed Wire (South Shore General Area, Near Structures & Flow)	60	LF	$17.75	$1,065
6' Tall Cable Railing Fence (South Shore General Area, Near Structures & Flow)	60	LF	$22.86	$1,372
6' Tall Wire Mesh Fence, With Barbed Wire (South Shore General Area, Near Structures & Flow)	60	LF	$9.14	$549
6' Tall Heavy Duty Fence, With Barbed Wire (South Shore General Area, Near Structures & Flow)	60	LF	$100.00	$6,000
6' Tall Chain Link Fence, With Barbed Wire (Around Fish Ladder Only)	52	LF	$17.75	$923
6' Tall Chain Link Double Swing Gate With Barbed Wire 12' Wide Opening	1	EA	$1,100.00	$1,100
6' Tall Heavy Duty Double Swing Gate With Barbed Wire 12' Wide Opening (South Shore Only)	1	EA	$3,000.00	$3,000
6' Tall Chain Link 4' Gate Opening With Barbed Wire	1	EA	$258.00	$258
6' Tall Chain Link Fence, With Barbed Wire (Both Sides of Canal, Forebay to U/S Crossing)	389	LF	$17.75	$6,905
6' Tall Chain Link Fence, With Barbed Wire (Both Sides of Canal, U/S Crossing to D/S Crossing)	378	LF	$17.75	$6,710
6' Tall Chain Link "Fan" Fence Post, (Both Ends of Dam Crest)	2	EA	$250.00	$500
RAILING				
42" Tall Metal Tube Railing, Steel 3 Rail 1-1/2" Diameter (Around Forebay)	222	LF	$38.00	$8,436
42" Metal Tube Railing, Spring-Mounted Gate (2 @ Forebay)	2	EA	$250.00	$500
42" Metal Tube Railing (U/S Canal Crossing)	18	LF	$38.00	$684
42" Metal Tube Railing (D/S Canal Crossing)	108	LF	$38.00	$4,104
42" Metal Tube Railing (D/S Canal Crossing 2)	16	LF	$38.00	$608
42" Metal Tube Railing (South Shore Fish Ladder)	180	LF	$38.00	$6,840
42" Tall Wood Railing (U/S Canal Crossing)	18	LF	$38.00	$684
42" Tall Wood Railing (D/S Canal Crossing)	108	LF	$38.00	$4,104
42" Tall Wood Railing (D/S Canal Crossing 2)	16	LF	$38.00	$608
FOREBAY COVER				
Replace Exisitng Chain Link	16	CSF	$170.00	$2,720
Replace Existing Timber Beams	0.40	MBF	$3,500.00	$1,400
Replace Existing Timber Beams With Steel Beams	400	LF	$18.95	$7,580
1 1/2" x 1/8" Aluminum Bar Grating	1,550	SF	$10.75	$16,663
1 1/2" x 1/8" Steel Bar Grating	1,550	SF	$15.10	$23,405
1 1/2" x 1/8" Galvanized Steel Bar Grating	1,550	SF	$18.88	$29,264
3/4" x 1/8" Stainless Steel Bar Grating	1,550	SF	$32.00	$49,600
Expanded Steel Grating	1,550	SF	$11.45	$17,748
FOREBAY ACCESS AND MAINTENANCE				
Access Ladder	2	EA	$720.00	$1,440
Sluice Gate for U/S Intakes (Cast Iron)	2	EA	$10,597.00	$21,194
Sluice Gate for U/S Intakes (Stainless Steel)	2	EA	$7,235.00	$14,470
Safety Rack (1 1/2" Diameter Pipe @ 9" OC, 3:1 Slope)	1	EA	$4,000.00	$4,000
U/S CANAL CROSSING				
Timber Deck 9' x 11'	99	SF	$15.00	$1,485
Concrete Deck 9' x 11'	99	SF	$10.00	$990
Deck Reinforcement 9' x 11'	67	LB	$1.13	$76

Granlees Dam Accessibility Restriction

Conceptual Level Unit Cost Estimate for Alternatives by Component Type[1]

	QUANTITY	UNITS	UNIT PRICE	TOTAL COST
D/S CANAL CROSSING - LARGE				
Timber Deck 40' x 8'	320	SF	$15.00	$4,800
Concrete Deck 40' x 8'	320	SF	$10.00	$3,200
Deck Reinforcement 40' x 8'	216	LB	$1.13	$244
Aqueduct - Coated Metal Pipe, 8' diameter	1	EA	$21,000.00	$21,000
Aqueduct - Fiberglass (FRP) Half Pipe, 8' diameter	1	EA	$10,000.00	$10,000
D/S CANAL CROSSING - SMALL				
Timber Deck 5' x 8'	40	SF	$15.00	$600
Concrete Deck 5' x 8'	40	SF	$10.00	$400
Deck Reinforcement 5' x 8'	27	LB	$1.13	$31
CANAL MODIFICATIONS				
4" Concrete Slab Over Existing Canal	250	LF	$14.90	$3,725
6" Concrete Slab Over Existing Canal	250	LF	$18.30	$4,575
Remove Canal	250	LF	$17.30	$4,325
Excavate for Channel Removal and Pipe / Culvert Placement (2:1 Side Slopes)	250	LF	$49.30	$12,325
Place Black Steel Pipe, 48" diameter[2]	290	LF	$355.00	$102,950
Place Reinforced Concrete Pipe, 48" diameter[2]	290	LF	$135.00	$39,150
Place Prestressed Concrete Pipe, 72" diameter (smallest size available)	290	LF	$300.00	$87,000
Place Steel Pipe, 48" diameter	40	LF	$480.00	$19,200
Place Precast Concrete Box Culvert	290	LF	$235.00	$68,150
Backfill Trench and Pipe (Assume 12" cover)	250	LF	$14.50	$3,625
Backfill Trench and Culvert (Assume 12" cover)	250	LF	$9.50	$2,375
Precast Manhole, Frame and Cover, 4' I.D., 6' deep	2	EA	$1,525.00	$3,050
SAFETY				
Signage (No Trespassing, Danger, Etc)	10	EA	$112.50	$1,125
Metal Plates with Gaskets for Dam Openings	2	EA	$300.00	$600

1 - Costs include labor and materials only. Additional costs for project completion may be expected, including those for: design, environmental permitting and mitigation, public outreach, and real estate.
2 - Conservative estimate of pipe size given 0.6 cfs flow data from the District.

Regional Planning & Programming	Preliminary Project Design and Draft Environmental Document					Final Environmental Document & Project Approval			
NEPA[1] (EIS assumed)	File Notice of Intent	Formal Scoping	Prepare Draft EIS	Publish NOA	Circulate Draft (45 Days)	Select Preferred Alternative	Prepare Final EIS	Publish NOA	30-Day Public Review Period	Issue Record of Decision
CEQA (EIR assumed) (Note: Filing Notice of Exemption for SE or CE starts a 35-day statue of limitation)	File NOP – Responses from Responsible Agencies within 30 days	"Scoping" Meetings, if held, must be within 30 days of request for meeting	Prepare Draft EIR	Notice of Completion and NOA	Public Review Period (30 or 45-60 Days)	Prepare Final EIR	Response to public agency comments at least 10 days before certifying EIR	Issue Findings (& Statement of Overriding Considerations)	Issue NOD within 5 working days (Starts 30 Day Statute of Limitations)	
Section 10 of the Federal Endangered Species Act of 1973 (Non-Federal Lead)	Incidental Take Permit Processing Phases: 1) HCP development, 2) Formal permit application processing, 3) Post-issuance	HCP must include: Approved NEPA (EA or EIS) document (may be concurrent process), Impacts of take, MMRP (including funding), Project alternatives, and Other measures deemed necessary by USFWS				Field Office approves HCP	Regional Office receives "complete application package", begins formal incidental take permit process	30-Day Public Review Period		
Section 7 of the Federal Endangered Species Act of 1973 (Federal Lead)	Request List from USFWS/NMFS	Draft Biological Assessment (BA)				Final BA	Formal Consultation with USFWS/NMFS (90 days)	USFWS/NMFS writes Opinion (45 days)		
California Endangered Species Act (Section 2081 of the California Fish and Game Code)	Request list from CDFG						Formal Consultation with CDFG (no time limit)			
Sections 1601-1603 of the California Fish and Game Code	Coordination with CDFG					Streambed Alternation Agreement application (CDFG has 30 days to propose mitigation). Agency has 14 days to respond				
Section 106 – National Historic Preservation Act of 1966 (Adverse Effect and MOA assumed)	Identify Historic Properties in consultation with SHPO (30-90 days)	SHPO comment on eligibility (30 days)	Dispute – go to Keeper of NR (no time limit)	SHPO comment on Finding of Adverse Effect (30 days)	Consultation with ACHP & SHPO (no time limit)	Submit MOA – SHPO/ACHP have 30 days to review. Absent MOA, 60 days to "comment". If ACHP, SHPO & Agency "fail to agree" on MOA, ACHP has 30 days to comment on undertaking				
Section 401 of the Clean Water Act	Discharges into waters of the US require certification from RWQCB regarding Clean Water Act Requirements									
Section 404 of the Clean Water Act	Wetlands Delineation	Coordination with USFWS, ACOE, EPA, NMFS	Development of Mitigation Plan	"Finding of No Practicable Alternative" to impact on wetlands						
NEPA/404 Integration Process (applies to signatory agencies only)	Participation of signatory agencies in permit development & processing	Concurrence on Purpose and Need (45 days)	Concurrence on Criteria for Selection of Alternatives (45 days)	Concurrence on Alternatives to be studied in EIS (45 days)	Delineation of Waters of the United States (ACOE) (45 days)	Impacts to Waters of US & Associate Species (45 days)	Mitigation Plan (45 days)	Determination of LEDPA (45 days)		

[1] Laws in boldface have specified review periods in statute or regulation

Acronyms

ACHP: Advisory Council on Historic Preservation
ACOE: U.S. Army Corps of Engineers
BA: Biological Assessment
CDFG: California Department of Fish and Game
CE: Categorical Exemption
CEQA: California Environmental Quality Act
EIR: Environmental Impact Report
EIS: Environmental Impact Statement
EPA: Environmental Protection Agency
HCP: Habitat Conservation Plan
LEDPA: Least Environmentally Damaging Practicable Alternative
MMRP: Mitigation Monitoring and Reporting Plan
MOA: Memorandum of Agreement
NEPA: National Environmental Policy Act
NMFS: National Marine Fisheries Service
NOA: Notice of Availability
NOD: Notice of Determination
NOP: Notice of Preparation
NR: National Register
RWQCB: Regional Water Quality Control Board
SE: Statutory Exemption
SHPO: State Historic Preservation Office
USFWS: U.S. Fish & Wildlife Service