San Clemente Dam
Fish Passage Assessment

Prepared for
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General

This evaluation has the focus on the National Oceanic and Atmospheric Administration Fisheries (NOAA) prescription for adult and juvenile fish passage that includes passage of adults over the San Clemente dam and safely across the silt covered portions of the reservoir. Provisions in the design will allow for upstream homing preference from a bifurcation pool into the two main basins entering the main reservoir pool. In addition, an established downstream fish bypass will be provided for juvenile and kelt out-migration through the same configuration to agreed-to limits of flow based on information based on the basin hydrograph.

Without current detailed engineering data, certain assumptions need to be made in order to configure a conceptual layout to attain an opinion of probable cost. One design element is the complexity of flow separation along with sediment transport issues during certain stages of the hydrograph. In the general concepts developed we will be applying a high contingency factor to the opinion of probable cost to cover such assumptions which are unknown at this time.

In addition to the design assumptions noted below, the overall construction feasibility of mainly the upstream collection/screening portions have to be assumed as practical at this stage of conceptual development. Access, easements, power supply, permitting, geotechnical conditions, bedload control, operation/maintenance and construction in remote locations are all assumed to be attainable. However all these elements would need to be addressed in more detail to attain a level of comfort relative to overall feasibility.

In general, the adult fish will pass over the San Clemente Dam from the lower river through a vertical slot fishway to a pool at the dam crest. From this bifurcation pool the adult fish are expected to sense their choice of direction to the basin of preference. The migration path will lead in two directions through separate passage pipelines, daylighted at 100 ft intervals, that route in different directions and terminate in the upper reaches of the two main basins of the reservoir.

Juvenile out-migrant fish will pass down the same pipelines from the upper portions of the same two basins to the bifurcation pool and subsequently down the vertical slot fishway to the river below. There were two options considered at each point of upstream diversion for collecting the juveniles, Option 1 being an on-channel screened diversion, and the other, Option 2, is an off-channel screened diversion. The off-channel option may have a slight preference over the on-channel facility relative to bedload control.

Basic Design Assumptions

Fisheries Background Information

Based on the Draft EIR (Entrix 2006), the Carmel River supports numerous native fish populations. Of these populations, steelhead (*Oncorhynchus mykiss*) are considered the most important management species. The Carmel River steelhead population is part of the South-Central California Coast (SCCC) Evolutionarily Significant Unit (ESU) and is designated as threatened. The designated Critical Habitat area for steelhead in the Carmel River includes all accessible reaches including those accessible through truck-and-trap activities above Los Padres Dam. The steelhead run in the Carmel River is the largest in the SCCC which includes approximately 27 anadromous streams.

Migration timings and duration depend on several factors including water year type, storm intensity and size of fish run (see Figure 1). There are, however, typical times for adult, smolt and kelt migration. Adults usually enter the river from early-January through mid-April. The end of the adult migration typically extends through mid-May but can last through early June. Juvenile out-migration occurs throughout the entire year, but peak migration occurs during the high-flow events during the March through May smolt out-migration period. Adult steelhead do not necessarily die after spawning like other salmon. Spawned-out adults (kelts) migrate back to the ocean from February through mid-April. Flows in the river are lowest from mid-September through mid-November, outside of the normal migration times for all of the life history stages in the Carmel River, based on data from USGS gauging station 11143200 Carmel River at Robles Del Rio. When flows are less than 47 cfs in the river, the downstream diversion pipe flows will increase over the 10% percentage, to potentially 40% of the main channel flow, as required to maintain downstream fish passage conditions and maintain a selected bypass flow through the reservoir to an established, appropriate amount. This will allow for instream flow needs to be managed during these limited duration low flow periods during salmonid migration.

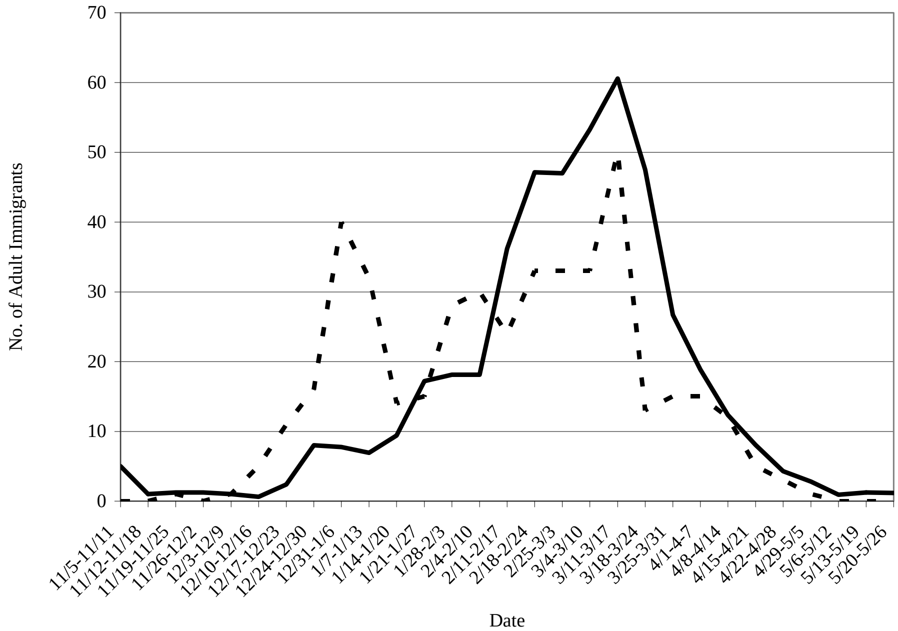


Figure 1. Timing of immigrating adult steelhead in Waddell Creek, Santa Cruz County (1933-1942; dashed line) and the Carmel River, Monterey County (1992-2005; solid line). Source: Waddell Creek information: Shapovalov and Taft (1954) and Carmel River information: Dave Dettman, Monterey Peninsula Water Management District, unpublished data obtained from NMFS.

Sedimentation Issues

Information reported in the Draft EIR indicates that the dam is nearly full of sediment, with the San Clemente Creek delta about 1,000 feet upstream of the dam and the Carmel River delta within 150 to 200 feet of the dam (summer 2005). Only 125 acre-feet of storage capacity remains from the original 1,425 acre-feet in 1921 when the dam was built. The impact of future reservoir sedimentation on the proposed fish passage facility is an issue of concern.

In general, the ultimate topset slope of the sediment deposits behind a dam can range from 30% to 70% of the gradient of the original channel before the dam was constructed (Leopold, Luna B., 1978, El Asunto del Arroyo, in Geomorphology, C. Embleton, ed., Oxford University Press, London, p.25-40). The U.S. Army Corps of Engineers recommends using 50% of the original stream bed profile as a design guideline rule of thumb (Engineer Manual EM 1110-2-4000, Sedimentation Investigations of Rivers and Reservoirs, 15 December 1989, p. 5-3); however, numerical sediment transport modeling would be required to more confidently predict the ultimate topset slope.

Looking at Figure 6 of the Mussetter Engineering, Inc. Report in Appendix I of the Draft EIR (reproduced and edited below in Figure 2), the original channel bed slope is noted as

0.0131 ft/ft. Using the low end of the ultimate sediment topset slope range, 30% of the original slope is 0.0039 ft/ft. Figure 2 shows a line extending at that slope upstream from the dam crest at elevation 525 ft. This extended line nearly intersects the existing thalweg in the Carmel River about 7,000 feet upstream of the dam. It may be that the ultimate topset slope will stabilize at 30% of the original slope; however, more detailed analysis will be required to confirm this.

From a design standpoint, the location of the upstream termination of the bypass conduit for each basin will need to be evaluated in more detail to assure it will not be buried by the ultimate sediment pool as just described. Option 2, using the side flow concept for the bypass structure, may be less susceptible for sediment plugging with the screens out of the main flow path. Additionally, Option 2 may allow unusually high flows to bypass without overtopping the walkway.

Freeboard should be provided from the top of the proposed bifurcation pool structure to the ultimate sediment pool elevation at the dam face. Some surcharge of sediment elevation above the dam crest can be expected in the long term. Another requirement is to set the elevation of the top of the grated manholes in the conduits that are used for the lighted resting pools above the expected sediment pool or to include provisions to raise the manhole tops in the future if needed.

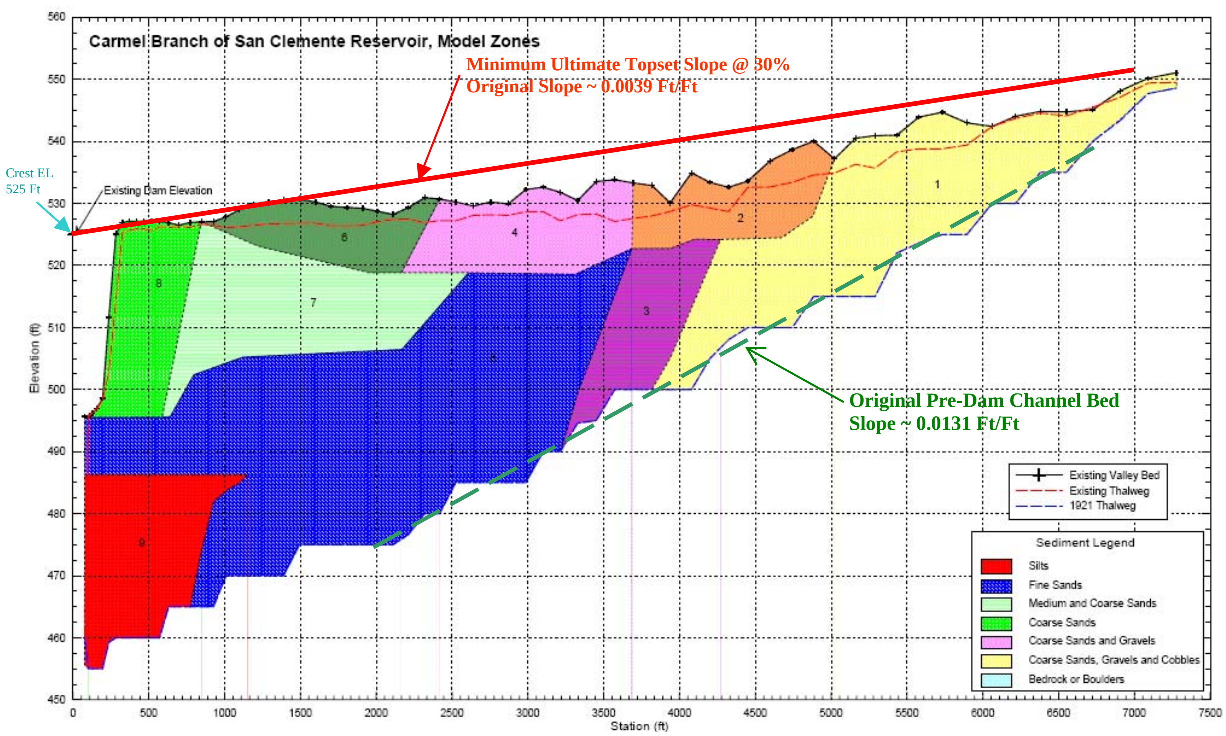


Figure 2. Adapted from Draft EIR, Appendix I, Figure 6. Simplified Stratigraphic profile of the Carmel River Branch of the reservoir (from MEI, 2003).

Basin Discharge Range for Passage Operation: 600 cfs to 15 cfs

This is based on 5% exceedence, high flow, and 95% for low flow, California Department of Fish and Game (CDFG) criteria. However, low flow based on USGS gage information at Robles del Rio is 0, and is not appropriate. A low flow of 15 cfs is selected based on biological reality of actual conditions of estuary breaching and temperature when upstream migration is likely to occur. General consensus was reached based on previous work, and discussion with CDFG that 600 cfs was the target flow that would be used in developing the alternatives for upstream passage above the dam.

Adult Vertical Slot Fishway Operational Flow: 15 cfs to 60 cfs

The design will follow current NOAA criteria for maximum of one ft height, water surface to water surface through the slots at maximum flow. This gives a ladder length of approximately 680 ft which can be operated without adjustment. An auxiliary water supply (AWS) can be provided for enhanced ladder attraction. The 60 cfs is assumed to be 10% of the maximum passage flow for attraction at the ladder entrance, which is based on the maximum fish passage flow regime in the river system determined by the information available.

Reservoir Passage

Bifurcation of the passage route from the ladder upstream to an assumed free water surface in the two major bays above the reservoir by a structural channel or pipeline is designed to meet NOAA bypass criteria for juvenile/kelt downstream and adult upstream. (In a meeting with NOAA and CDFG it was determined that juvenile upstream passage will not be considered in this exercise). A point was selected for the preferred screening at upper reaches of the two main bays that are arbitrary and are for estimating purposes only.

Entrance and release hydraulics at each basin collection/screening point will be active up to 600 cfs in total reservoir outflow operation with controls to minimize sediment bypass and open the water way above the establish collection flow. For the fishway it appears that the new ladder will be best placed on the left dam abutment (looking downstream) with provisions for two bypass conduits leading to each bay. Water flow to the ladder will be controlled by a weir in the top bifurcation pool at the ladder exit/entrance in the reservoir. Provision is required for homing of the returning adults to the preferred watershed.

Based on very limited data, it will be assumed that a free water (not silted in) channel in the upper reaches can be used as the terminus for the bypass conduit in each basin. An assumption of the proportional flows for each basin is required for determining screening area. Sediment control provisions using radial bypass gates will be used in order to provide an opinion of probable cost.

The conduit flow range for both bypass pipelines will be assumed from 15 to 60 cfs, using the reservoir water surface and an assumed elevation difference in the upper screened diversion areas. The approximate 600 cfs stage of 526.6 ft (above the crest height of 525.0 ft) is used along with assumed grade at the upstream locations to size the conceptual bypass pipeline. Lighted resting pools every 100 ft are also assumed necessary for upstream migrating adult fish.

It is assumed that a convergence pool at the ladder exit point to the two upstream bypass conduits can be designed to allow olfactory selection by the upstream migrants to the basin flow of choice.

Actual design of this or any similar system will require more detailed site information. This assessment is purely conceptual in nature, has significant design challenges and will be used with a high contingency in the estimating process for decision-making purposes only.

The estimated distance to the near draw to an acceptable point to confluence to the larger basin (right side, looking downstream) is 6800 ft with 80% of the operational flow (480 cfs). The estimated distance is 2600 ft for the shorter arm at 20% of the operational flow (120 cfs). For bypass pipe flow calculations (for both upstream and downstream migration), a range (from 100% to 75%) of 10% of the maximum basin flow was used in pipe sizing considering total flow to the ladder, acceptable velocity and a free flowing water surface in the pipeline. See example calculations in Appendix A.

It is assumed that fish friendly solar powered screens and controls can be placed at these locations with screening and weir structures to limit flows to the conduits to the range of the ladder operation (approximately 15 cfs to 60 cfs total). Radial and bypass gate operators are assumed to have a generator/battery pack power source. Corrugated metal pipe (CMP) material, (4 ft diameter for the larger basin, and 3 ft diameter for the shorter basin,) will be assumed for this exercise. Velocities through the bypass range will be calculated within acceptable fish passage swimming abilities for upstream migrating adults.

The graphs shown in Appendix B indicate a selected range of flows, velocities and depth of flow through the two fish passage conduits during a range of basin flow, that compare favorably with the appropriate fish passage timing through the basin hydrograph relative to NOAA downstream fish passage design guidelines. During low flow periods (7-8 cfs recorded) during salmonid migration, the diversion to the downstream passage and flows through the reservoir would be controlled to the appropriate proportions. At these low stream flows, water may be passed through the fish passage facility to maintain an appropriate depth in the pipe.

During these short duration low flow periods during salmonid migration, instream habitat and flow needs will be met by managing the entrance flows. As stated above, fish passage flows will be maintained to the 95% exceedence (low flows). When flows are below the 95% exceedence level, the fish passage structure is designed to be shut down. With 7 cfs (flows less than 95% exceedence – 12 cfs in main channel) in the river, flow through the reservoir can be maintained past the screened fish passage entrance. However, instream needs may be balanced with fish passage needs based on annual fish migration timings. Instream flows can be reduced to maintain fish passage below the 95% exceedence stream flows if desired. Flows in the bypass reach of the river (from the pipe exit to entrance of the ladder) will increase as natural flows increase during December.

The pool level elevation at the 775 cfs flow is known to be approximately 526.7 ft and the lower crest elevation of the dam is 526.0 ft. For 600 cfs, a reservoir elevation will be assumed at 526.6 ft for any relative conceptual design purposes.

Alternative Bypass Routing through the Reservoir

Two potential routes were considered from the ladder confluence point on the dam to the preferred upper reaches of the pool. One is to follow the shorelines right and left to the assumed point of diversions for each branch. The second is to cross the reservoir directly from this same point with two bypass pipes that would split at the point of the peninsula dividing the two main branches.

Each possible route has its own challenges; both were compared in general approach in relation to cost and complexity. The crossing of the reservoir to go directly to the peninsula would have to be supported by piling through the silted area. The route along the shorelines is significantly longer and would require more complex design solutions at the crossings of the secondary tributaries along the route and along the crest of the dam.

<u>For this exercise, we have assumed that the shorter route directly across the reservoir, with the support piling, would be the most preferred with respect to cost and overall comparative feasibility.</u>

Two options for the configuration of the terminal collection, screening and bypass facilities were considered utilizing the benefit of previous studies for screen submergence water depth. One is assumed in-channel and the second on a side channel with both relying on water control by radial gates. Approach velocity was calculated at 0.3 fps and, based on previous studies, the submerged screen depth will be controlled at 12 ft minimum. We assume that back watering at the locations selected is not a concern as indicated on previously developed information.

Opinion of Probable Cost

The following is a summary of probable conceptual level cost of construction, based on the design assumptions stated above.

Based on the assessment of the proposed passage improvements for the main fishway and reservoir passage, it appears that there will be no change in the buttressing improvement configuration and cost.

See Appendix C for a more detailed breakdown of costs.

Capital Construction (in 2007 Dollars)	Option 1 (On-Channel Screening)	Option 2 (Off-Channel Screening)
Vertical Slot Fishway*	$4,984,800	$4,984,800
Bifurcation Pool	397,020	397,020
Reservoir Bypass - 48" Diameter	3,013,400	3,013,400
Reservoir Bypass - 36" Diameter	1,023,620	1,023,620
Screening / Diversion, Main Basin	4,988,490	5,711,940
Screening / Diversion, Secondary Basin	2,218,515	2,475,980
Total	$16,625,845	$17,606,760

*Original cost estimate of agreed configuration escalated to 2007 dollars.

Annual O&M Costs (in 2007 Dollars)	$133,783	$138,499

References

ENTRIX, Inc. 2006. DRAFT Environmental Impact Statement Report for the San Clemente Dam Seismic Retrofit Project. Prepared for California Department of Water Resources and U.S. Army Corps of Engineers.

MEI (Mussetter Engineering, Inc.) 2003. San Clemente Reservoir and Carmel River Sediment-Transport Modeling to Evaluate Potential Impacts of Dam Retrofit Options. Prepared for American Water Works Service Company, Voorhees, New Jersey.

Appendix A

Example Calculations

Example Calc. Sheet

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.024	
Channel Slope	0.00200	ft/ft
Normal Depth	3.50	ft
Diameter	4.00	ft

Results

Discharge	36.56	ft^3/s
Flow Area	11.66	ft^2
Wetted Perimeter	9.68	ft
Top Width	2.65	ft
Critical Depth	1.80	ft
Percent Full	87.5	%
Critical Slope	0.01271	ft/ft
Velocity	3.14	ft/s
Velocity Head	0.15	ft
Specific Energy	3.65	ft
Froude Number	0.26	
Maximum Discharge	37.43	ft^3/s
Discharge Full	34.79	ft^3/s
Slope Full	0.00221	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	87.50	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

GVF Output Data

Normal Depth	3.50	ft
Critical Depth	1.80	ft
Channel Slope	0.00200	ft/ft
Critical Slope	0.01271	ft/ft

Example Calc Sheet

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.024	
Channel Slope	0.00460	ft/ft
Normal Depth	1.50	ft
Diameter	3.00	ft

Results

Discharge	12.25	ft³/s
Flow Area	3.53	ft²
Wetted Perimeter	4.71	ft
Top Width	3.00	ft
Critical Depth	1.11	ft
Percent Full	50.0	%
Critical Slope	0.01344	ft/ft
Velocity	3.47	ft/s
Velocity Head	0.19	ft
Specific Energy	1.69	ft
Froude Number	0.56	
Maximum Discharge	26.36	ft³/s
Discharge Full	24.50	ft³/s
Slope Full	0.00115	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	50.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 1

GVF Output Data

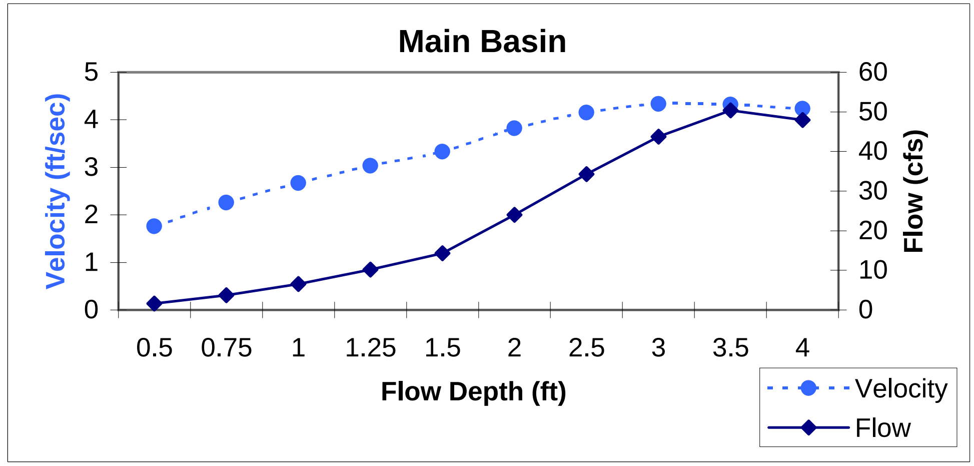
Normal Depth	1.50	ft
Critical Depth	1.11	ft
Channel Slope	0.00460	ft/ft
Critical Slope	0.01344	ft/ft

Appendix B

Fish Conduit Hydraulics

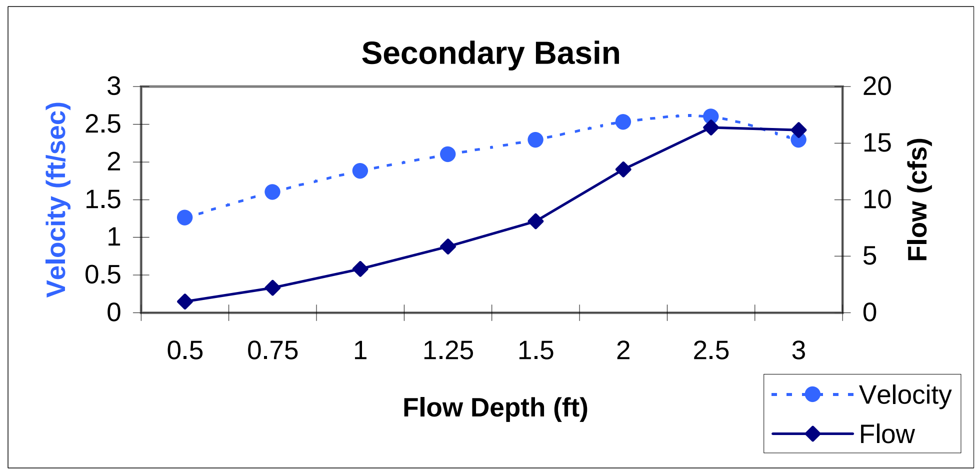
SamClemente Dam Date: 5/30/07
Reservoir Fish Bypass Flow Calculations
(Based on 4/2007 Report, Slope of 0.0038 ft/ft)

Main Basin (4' Diameter CMP)		
Flow Depth (ft)	**Flow** (cfs)	**V** (ft/s)
0.5	1.6	1.76
0.75	3.68	2.26
1	6.57	2.67
1.25	10.16	3.03
1.5	14.35	3.33
2	23.98	3.82
2.5	34.27	4.15
3	43.73	4.33
3.5	**50.39**	4.32
4	47.96	4.23



(Based on 4/2007 Report, Slope of 0.002 ft/ft)

Secondary Basin (3' Diameter CMP)		
Flow Depth (ft)	**Flow** (cfs)	**V** (ft/s)
0.5	0.98	1.26
0.75	2.21	1.6
1	3.87	1.88
1.25	5.86	2.1
1.5	8.08	2.29
2	12.66	2.53
2.5	**16.39**	2.6
3	16.16	2.29



Target: 60 cfs Total, Actual (above): 52.97cfs

Options: Bypass selected ladder flow at bifurcation pool

Appendix C

Opinion of Probable Cost Details

San Clemente Dam
Fish Ladder Renovation, Option 1
Opinion of Probable Construction Costs

Item	Quantity	Unit	Unit Cost	Amount	Total
Bifurcation Structure					305,400
dewatering	1	LS	20,000	20,000	
excavation	300	CY	15	4,500	
backfill	200	CY	15	3,000	
dam connection	1	LS	50,000	50,000	
concrete, slab	86	CY	750	64,500	
concrete, wall	22	CY	1,050	23,100	
Collector Screen	168	SF	350	58,800	
Metals, grating	1,020	LBS	25	25,500	
Metals, embeds	2,000	LBS	8	16,000	
Metals, beams	5,000	LBS	4	20,000	
Piping, wall spools	1	LS	20,000	20,000	
Outlet Structure (Option 1)					
Main Basin Bypass and Screen					3,837,300
dewatering	1	LS	50,000	50,000	
excavation	1,500	CY	15	22,500	
backfill	1,000	CY	15	15,000	
concrete, slab / footing	313	CY	750	234,750	
concrete, wall	251	CY	1,050	263,550	
Screen	1,750	SF	350	612,500	
Metals, grating	280	SF	25	7,000	
Metals, embeds	7,500	LBS	8	60,000	
Metals, beams	15,000	LBS	4	60,000	
overhead gantry	80	LF	400	32,000	
Shuttoff gate	1	EA	20,000	20,000	
Weir gates	1	LS	2,400,000	2,400,000	
Backup generator	1	LS	60,000	60,000	
Secondary Basin Bypass and Screen					1,706,550
dewatering	1	LS	20,000	20,000	
excavation	600	CY	15	9,000	
backfill	400	CY	15	6,000	
concrete, slab / footing	111	CY	750	83,250	
concrete, wall	106	CY	1,050	111,300	
Screen	450	SF	350	157,500	
Metals, grating	140	SF	25	3,500	
Metals, embeds	2,500	LBS	8	20,000	
Metals, beams	5,000	LBS	4	20,000	
overhead gantry	40	LF	400	16,000	
Shuttoff gate	1	EA	20,000	20,000	
Weir gate	1	EA	1,200,000	1,200,000	
Backup generator	1	LS	40,000	40,000	

Fish Ladder Renovation, Option 1
Opinion of Probable Construction Costs

Item	Quantity	Unit	Unit Cost	Amount	Total
Main bypass pipeline (48")					2,318,000
site clearing	6,800	LF	10	68,000	
trenching	6,800	LF	24	163,200	
bedding	6,800	LF	15	102,000	
48" cmp	6,800	LF	116	788,800	
resting pool	68	EA	17,000	1,156,000	
piling	5	EA	8,000	40,000	
Secondary bypass pipeline (36")					787,400
site clearing	2,600	LF	10	26,000	
trenching	2,600	LF	20	52,000	
bedding	2,600	LF	12	31,200	
48" cmp	2,600	LF	82	213,200	
Resting pool	25	EA	17,000	425,000	
Piling	5	EA	8,000	40,000	
Total Construction Costs					$8,954,650
Contingency (30%)					2,238,663
Total with Contingency					$11,193,313

San Clemente Dam
Fish Ladder Renovation, Option 2
Opinion of Probable Construction Costs

Item	Quantity	Unit	Unit Cost	Amount	Total
Bifurcation Structure					305,400
dewatering	1	LS	20,000	20,000	
excavation	300	CY	15	4,500	
backfill	200	CY	15	3,000	
dam connection	1	LS	50,000	50,000	
concrete, slab	86	CY	750	64,500	
concrete, wall	22	CY	1,050	23,100	
Collector Screen	168	SF	350	58,800	
Metals, grating	1,020	LBS	25	25,500	
Metals, embeds	2,000	LBS	8	16,000	
Metals, beams	5,000	LBS	4	20,000	
Piping, wall spools	1	LS	20,000	20,000	
Outlet Structure (Option 2)					
Main Basin Bypass and Screen					4,393,800
Gates / Sill					
dewatering	1	LS	50,000	50,000	
excavation	900	CY	15	13,500	
backfill	600	CY	15	9,000	
concrete, slab / footing	178	CY	750	133,500	
concrete, wall	112	CY	1,050	117,600	
Metals, embeds	1,500	LBS	8	12,000	
Weir gates	1	LS	2,400,000	2,400,000	
Bypass and Screen					
dewatering	1	LS	25,000	25,000	
excavation	2,250	CY	15	33,750	
backfill	1,500	CY	15	22,500	
concrete, slab / footing	407	CY	750	305,250	
concrete, wall	339	CY	1,050	355,950	
Screen	2,080	SF	350	728,000	
Metals, grating	950	SF	25	23,750	
Metals, embeds	5,000	LBS	8	40,000	
Metals, beams	15,000	LBS	4	60,000	
overhead gantry	160	LF	400	64,000	

San Clemente Dam
Fish Ladder Renovation, Option 2
Opinion of Probable Construction Costs

Item	Quantity	Unit	Unit Cost	Amount	Total
Secondary Basin Bypass and Screen					1,904,600
Gates / Sill					
dewatering	1	LS	20,000	20,000	
excavation	450	CY	15	6,750	
backfill	300	CY	15	4,500	
concrete, slab / footing	67	CY	750	50,250	
concrete, wall	75	CY	1,050	78,750	
Metals, embeds	1,000	LBS	8	8,000	
Weir gate	1	EA	1,200,000	1,200,000	
Bypass and Screen					
dewatering	1	LS	10,000	10,000	
excavation	900	CY	15	13,500	
backfill	600	CY	15	9,000	
concrete, slab / footing	107	CY	750	80,250	
concrete, wall	202	CY	1,050	212,100	
Screen	442	SF	350	154,700	
Metals, grating	672	SF	25	16,800	
Metals, embeds	1,200	LBS	8	9,600	
Metals, beams	3,600	LBS	4	14,400	
overhead gantry	40	LF	400	16,000	
Main bypass pipeline (48")					2,318,000
site clearing	6,800	LF	10	68,000	
trenching	6,800	LF	24	163,200	
bedding	6,800	LF	15	102,000	
48" cmp	6,800	LF	116	788,800	
resting pool	68	EA	17,000	1,156,000	
piling	5	EA	8,000	40,000	
Secondary bypass pipeline (36")					787,400
site clearing	2,600	LF	10	26,000	
trenching	2,600	LF	20	52,000	
bedding	2,600	LF	12	31,200	
48" cmp	2,600	LF	82	213,200	
Resting pool	25	EA	17,000	425,000	
Piling	5	EA	8,000	40,000	
Total Construction Costs					$9,709,200
Contingency (30%)					2,427,300
Total with Contingency					$12,136,500

San Clemente Fish Passage Assessment
Preliminary Opinion of Probable Annual O&M Costs
Option 1

Item	Quantity	Unit Cost	Amount	Total
Labor				$67,000
Maintenance person direct labor cost (average 0.0 hrs/day for 0-month operating period)	0.5 FTE	41,000	20,500	
Maintenance person benefits @1.15 labor cost	0.5 FTE	47,200	23,600	
Seasonal technician direct laor cost (average 0.0 hrs/day for 0-month operating period)	0.5 FTE	21,300	10,650	
Seasonal technician benefits @1.15 labor cost	0.5 FTE	24,500	12,250	
General Maintenance / Repair and Replacement				$55,967
Estimated at 0.5% of capital cost	0.50%	11,193,313	55,967	
Fuel costs (Backup generators)				
See note 1 below for daily fuel costs	1	10,816	10,816	$10,816
Total Annual O&M Costs				$133,783

Note 1. Daily power unit cost estimate

Item	Work Duration	Quantity	Unit Cost	Amount
Generator 1	2 hr/wk - 10 gal/hr - 52 wk/yr	1040 GAL	5.00	5,200
Generator 2	2 hr/wk - 6 gal/hr - 52 wk/yr	624 GAL	5.00	3,120
			Daily power use subtotal:	8,320
			Contingency (30%):	2496
			Daily power use total with contingency:	10,816

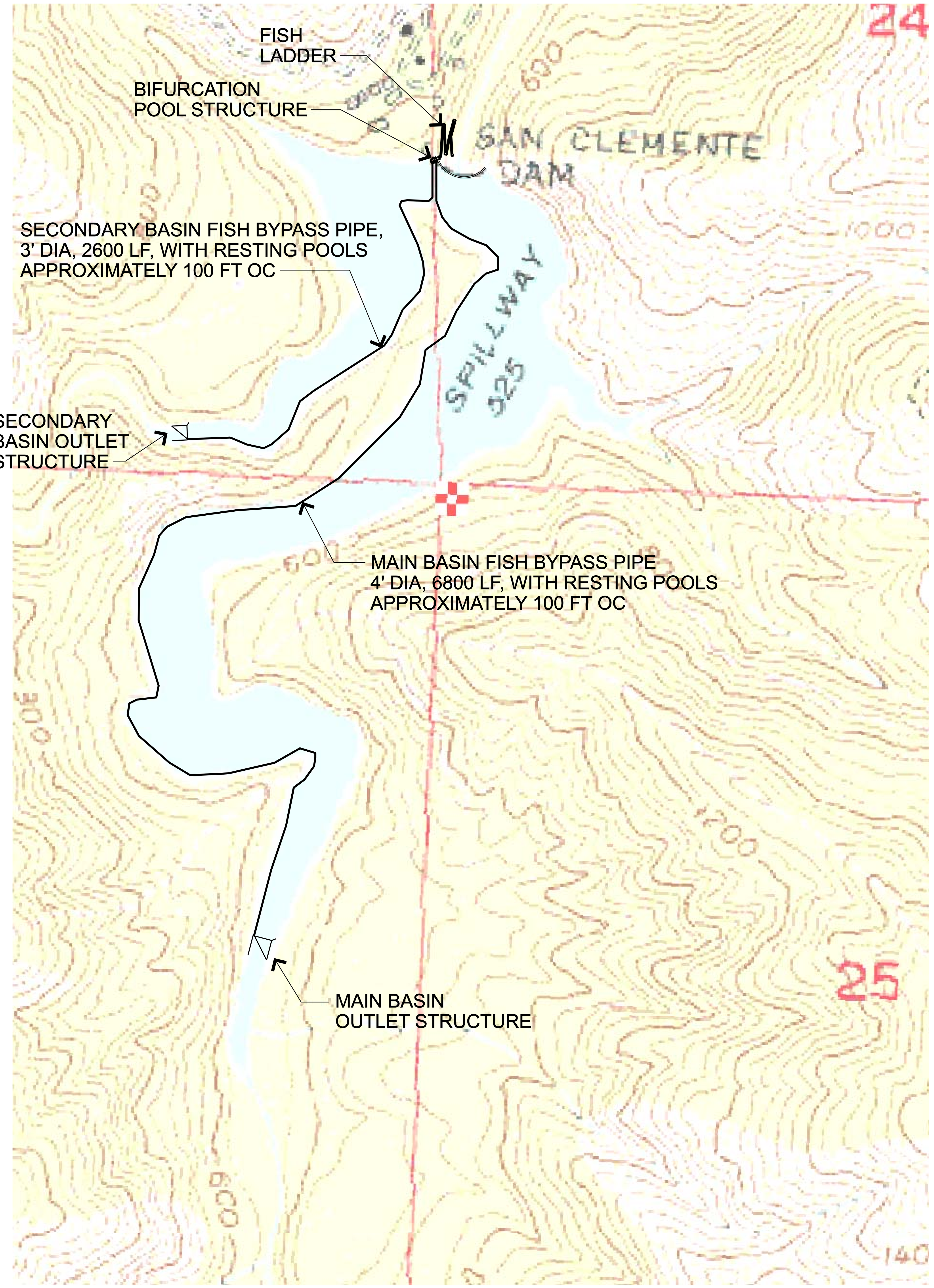
San Clemente Fish Passage Assessment
Preliminary Opinion of Probable Annual O&M Costs
Option 2

Item	**Quantity**		**Unit Cost**	**Amount**	**Total**
Labor					$67,000
Maintenance person direct labor cost	0.5	FTE	41,000	20,500	
(average 0.0 hrs/day for 0-month operating period)					
Maintenance person benefits @1.15 labor cost	0.5	FTE	47,200	23,600	
Seasonal technician direct laor cost	0.5	FTE	21,300	10,650	
(average 0.0 hrs/day for 0-month operating period)					
Seasonal technician benefits @1.15 labor cost	0.5	FTE	24,500	12,250	
General Maintenance / Repair and Replacement					$60,683
Estimated at 0.5% of capital cost	0.50%		12,136,500	60,683	
Fuel costs (Backup generators)					
See note 1 below for daily fuel costs	1		10,816	10,816	$10,816
Total Annual O&M Costs					$138,499

Note 1. Daily power unit cost estimate

Item	Work Duration	Quantity		Unit Cost	Amount
Generator 1	2 hr/wk - 10 gal/hr - 52 wk/yr	1040	GAL	5.00	5,200
Generator 2	2 hr/wk - 6 gal/hr - 52 wk/yr	624	GAL	5.00	3,120
				Daily power use subtotal:	8,320
				Contingency (30%):	2496
				Daily power use total with contingency:	10,816

Sheets



SITE PLAN

0 200 400 800 1200 FT

SCALE: 1"=400'

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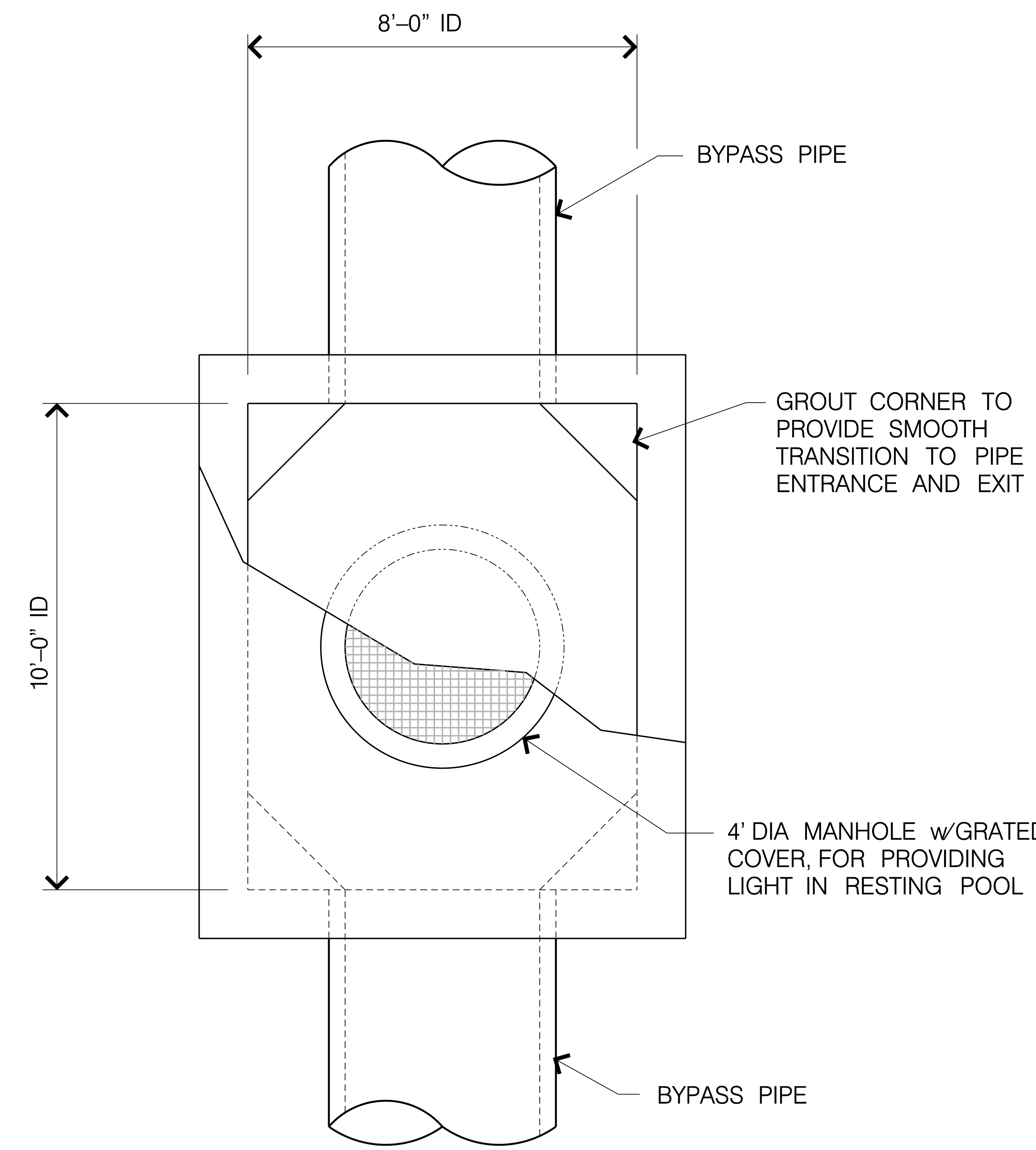

RESTING POOL PLAN

0 1 2 4 6 FT

SCALE: $\frac{1}{2}$"=1'-0"

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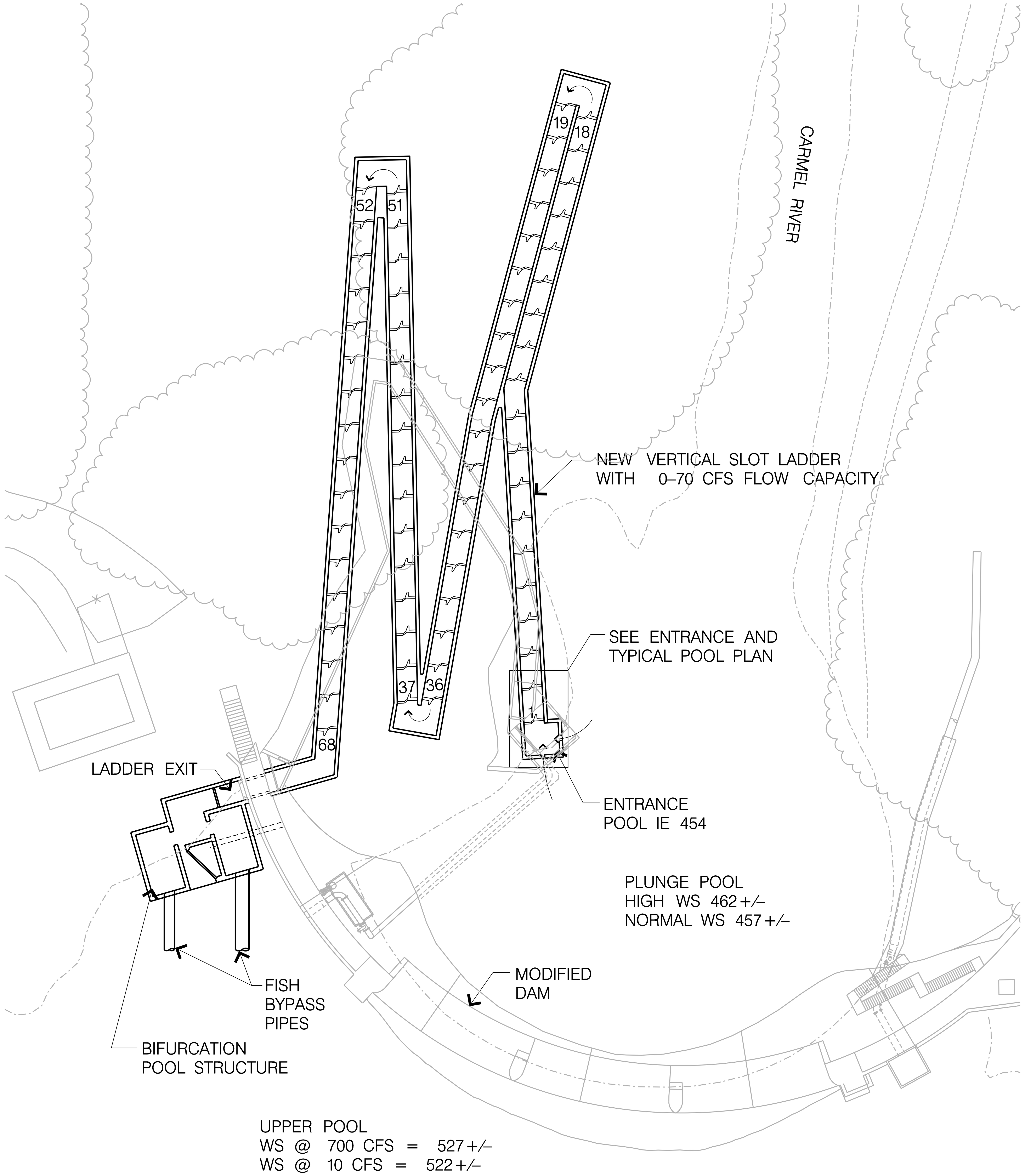
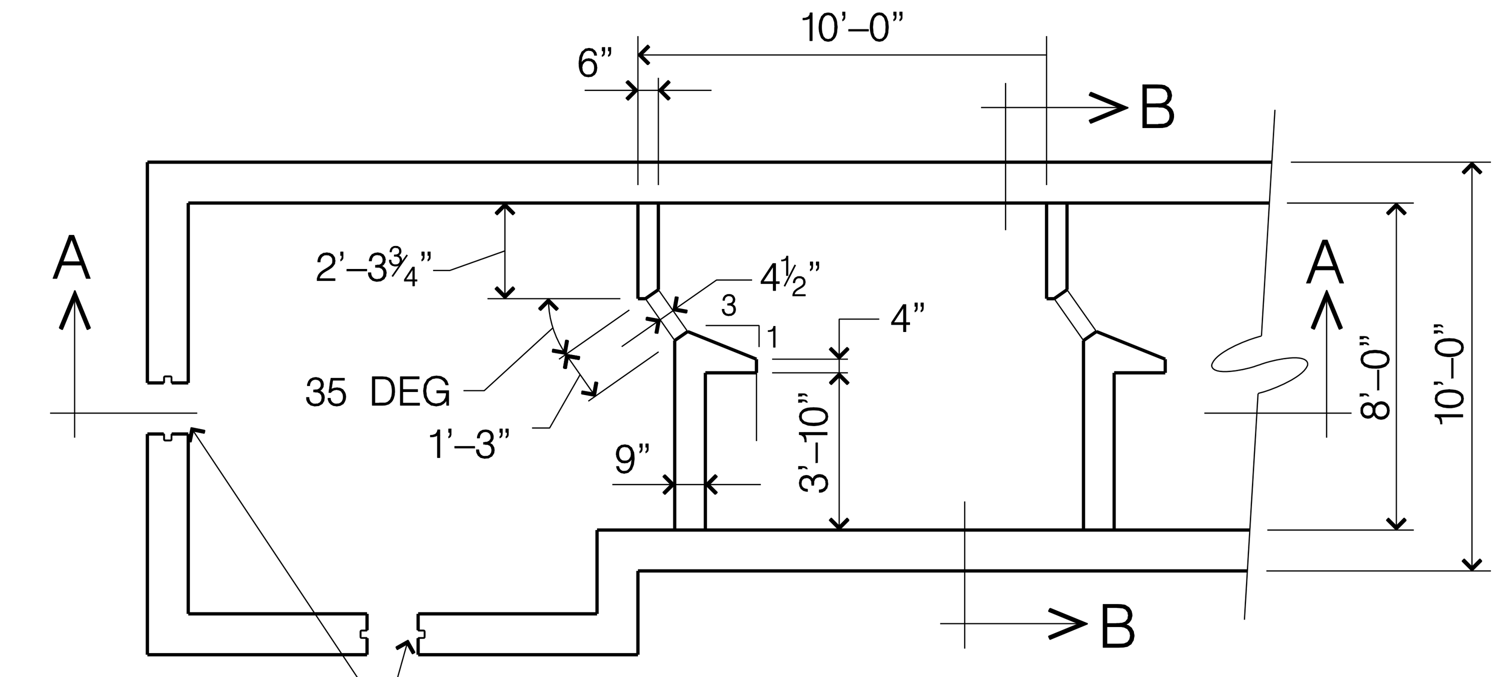
scdfpa_sheet_1.dgn

SAN CLEMENTE DAM FISH PASSAGE ASSESSMENT	SITE PLAN AND RESTING POOL PLAN
DATE	4/5/2007
SCALE	AS NOTED
SHEET	1 OF 5



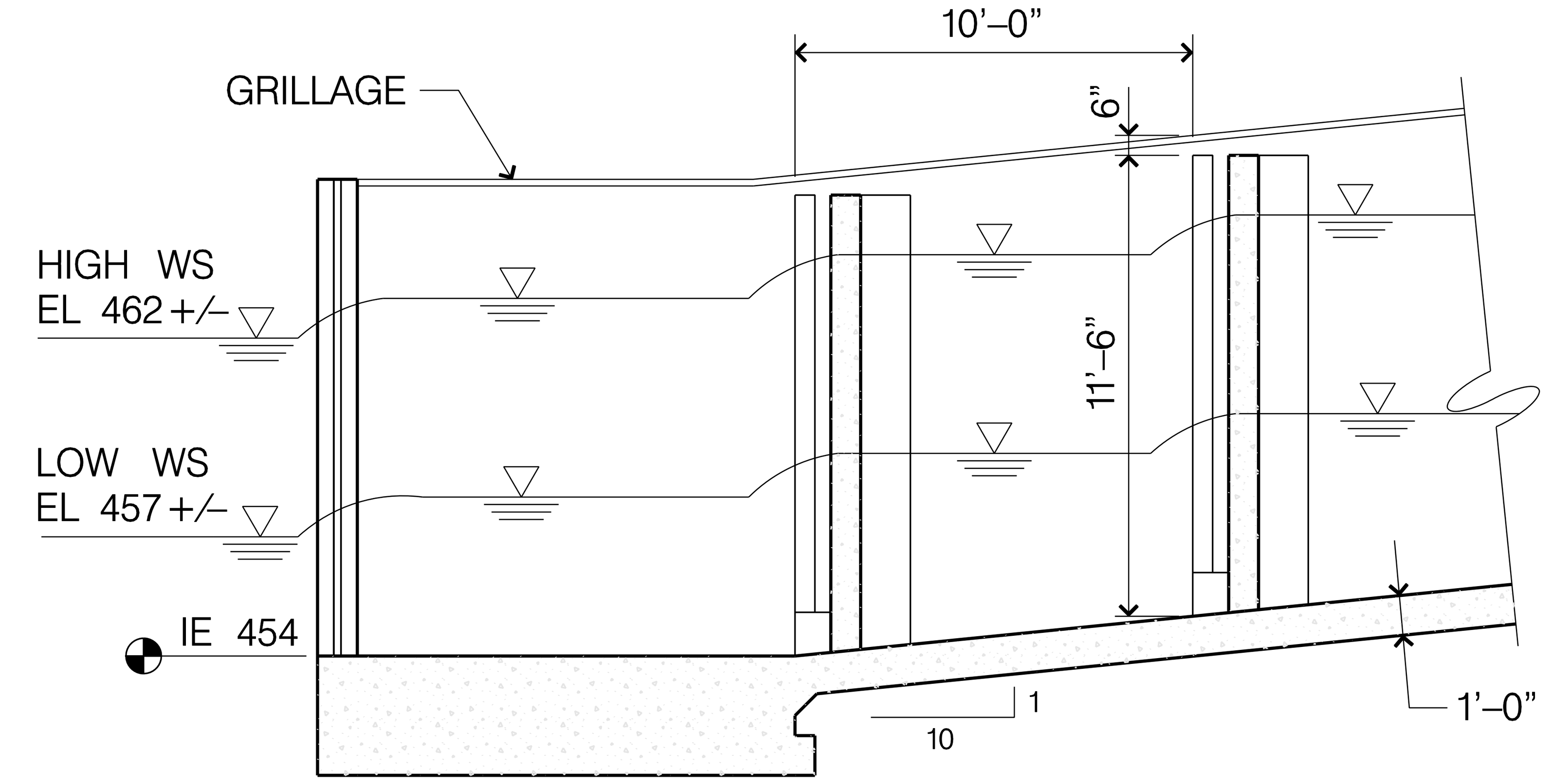
FISH LADDER PLAN

0 1 2 4 6 FT
SCALE: 1/2"=1'-0"



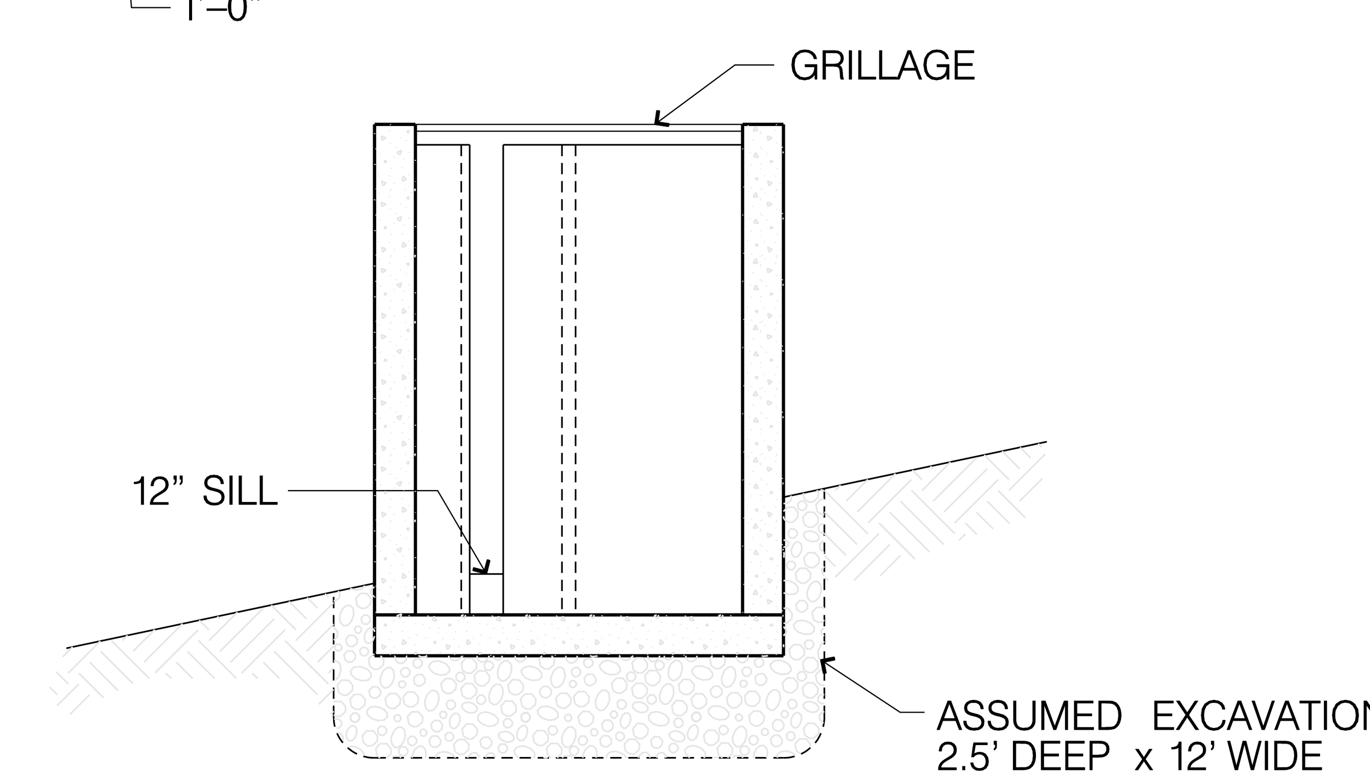
ENTRANCE AND TYPICAL POOL PLAN

0 4 8 12 FT
SCALE: 1/4"=1'-0"



SECTION AA

0 4 8 12 FT
SCALE: 1/4"=1'-0"



SECTION BB

0 4 8 12 FT
SCALE: 1/4"=1'-0"

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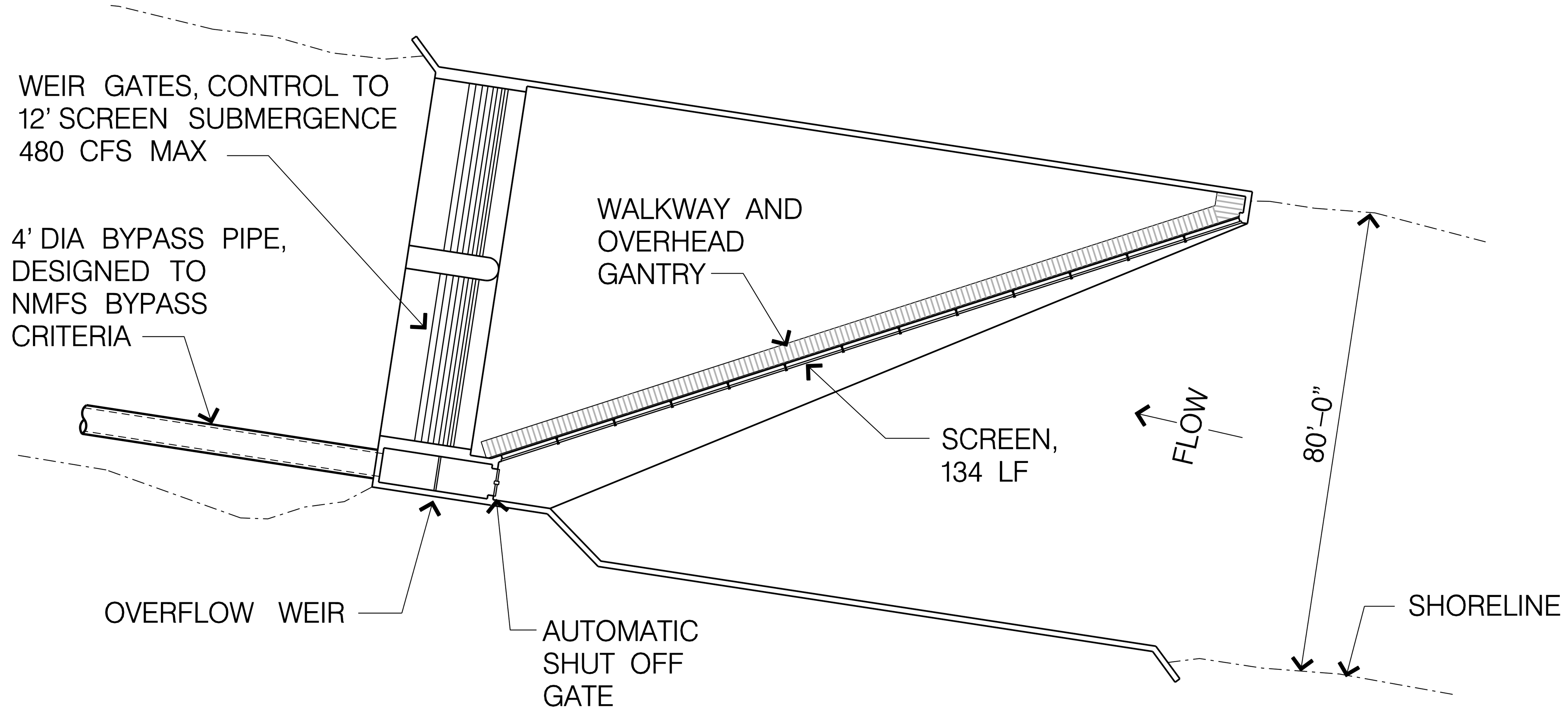
SAN CLEMENTE DAM

FISH PASSAGE ASSESSMENT

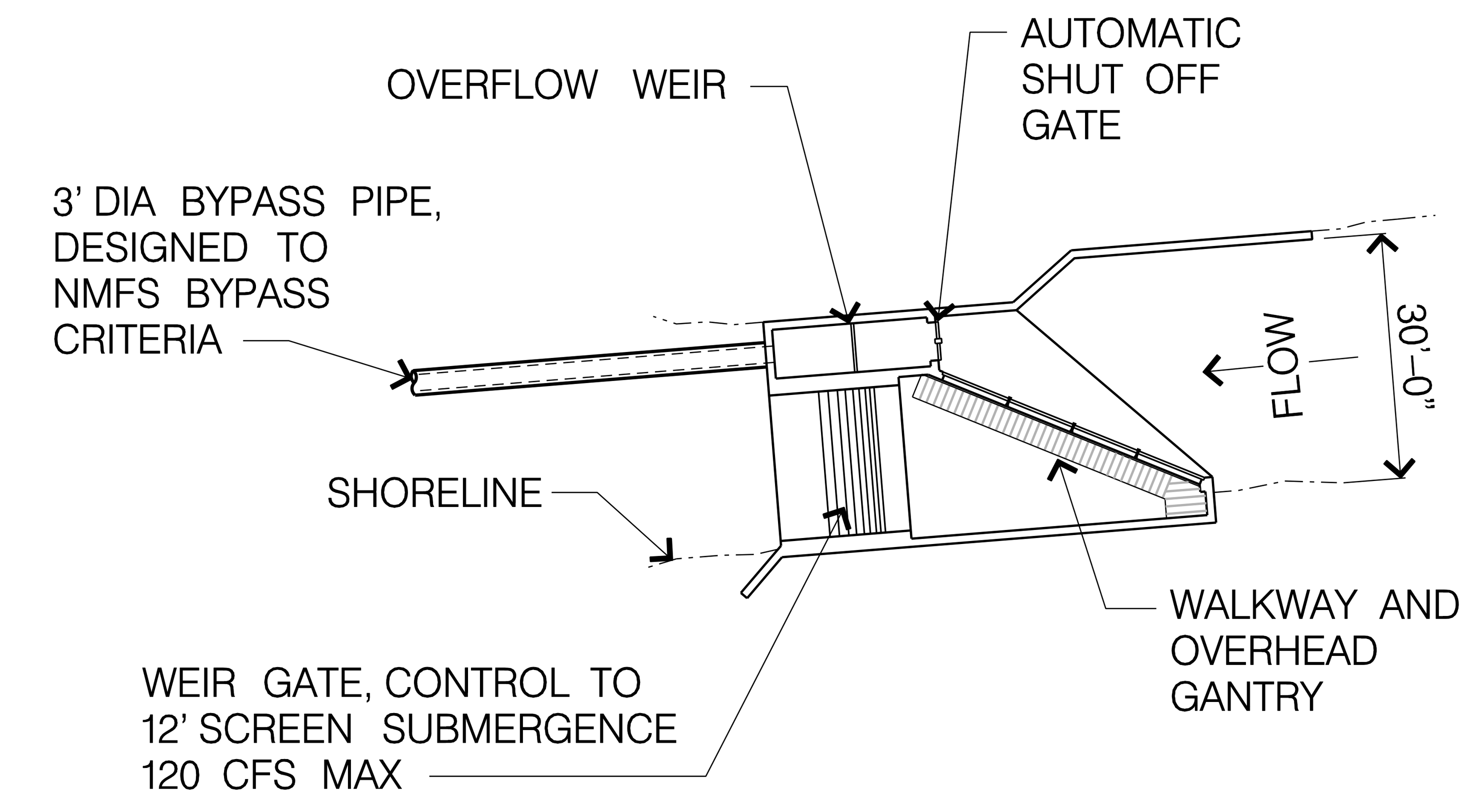
FISH LADDER STRUCTURE PLANS AND SECTIONS

DATE	4/5/2007	SHEET	2 OF 5
SCALE	AS NOTED		



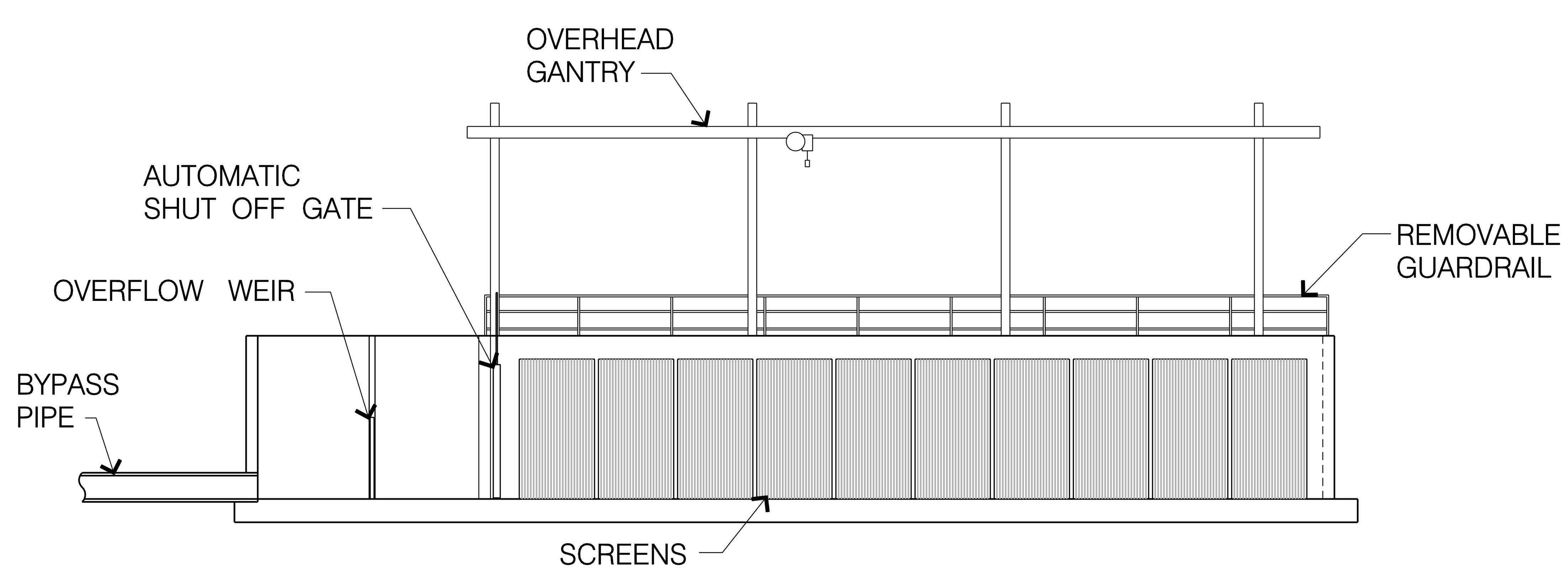
MAIN BASIN BYPASS AND SCREEN

0 10 20 40 60 FT
SCALE: 1"=20'



SECONDARY BASIN BYPASS AND SCREEN

0 10 20 40 60 FT
SCALE: 1"=20'



BYPASS AND SCREEN ELEVATION

0 5 10 20 30 FT
SCALE: 1"=10'

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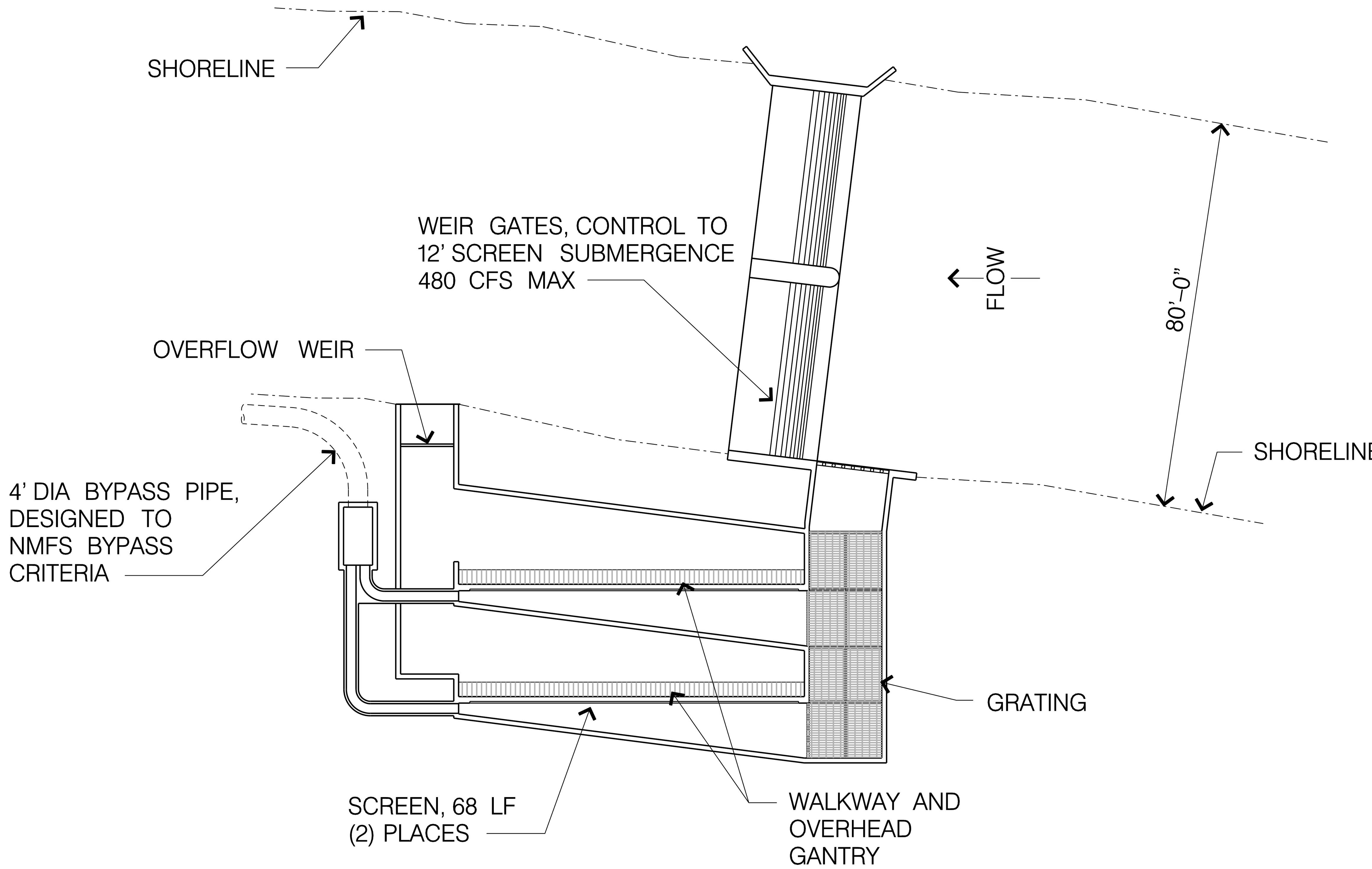
SAN CLEMENTE DAM
FISH PASSAGE ASSESSMENT

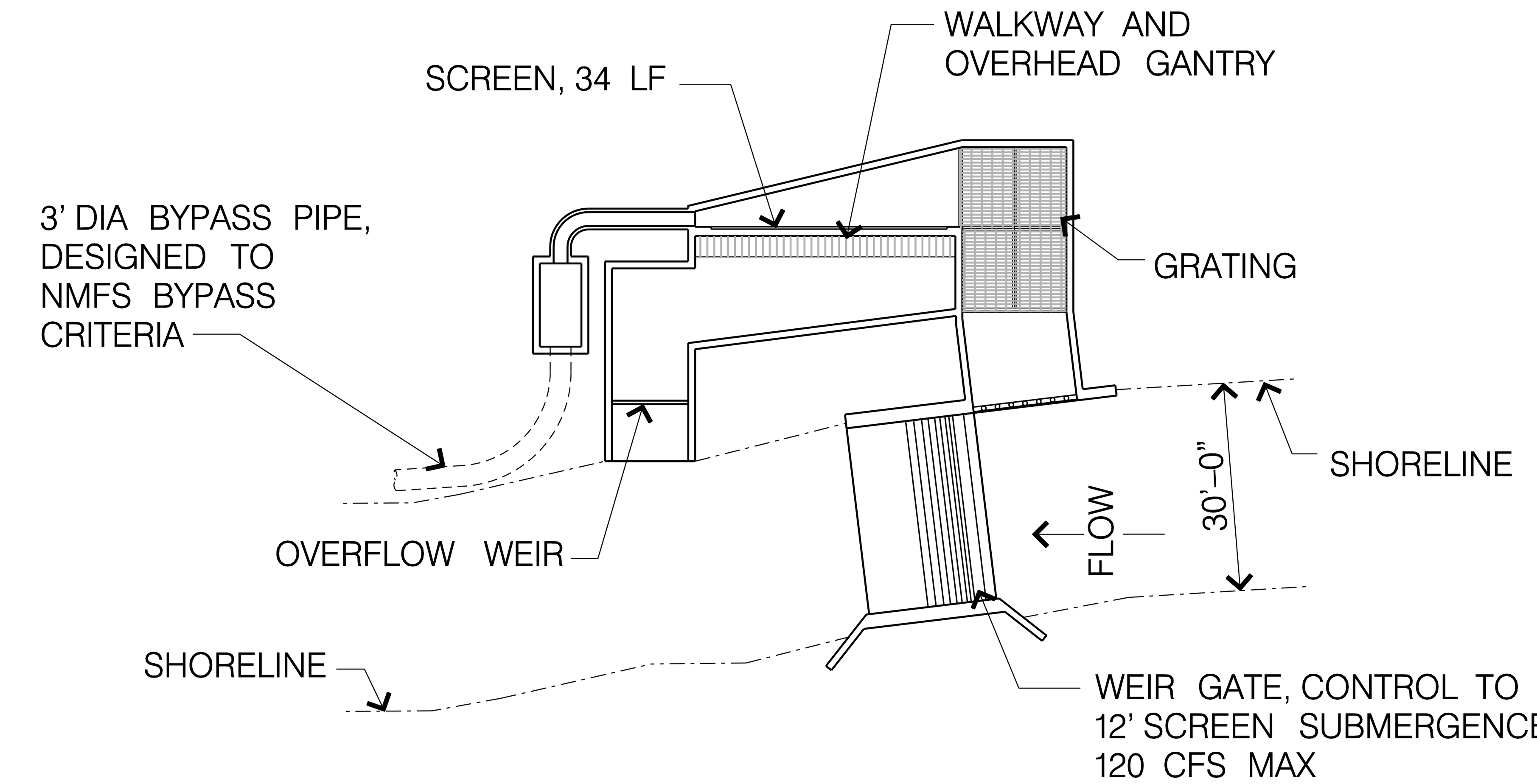
OUTLET STRUCTURE – OPTION 1
PLANS AND ELEVATION

DATE 4/5/2007
SCALE AS NOTED
SHEET 3 OF 5



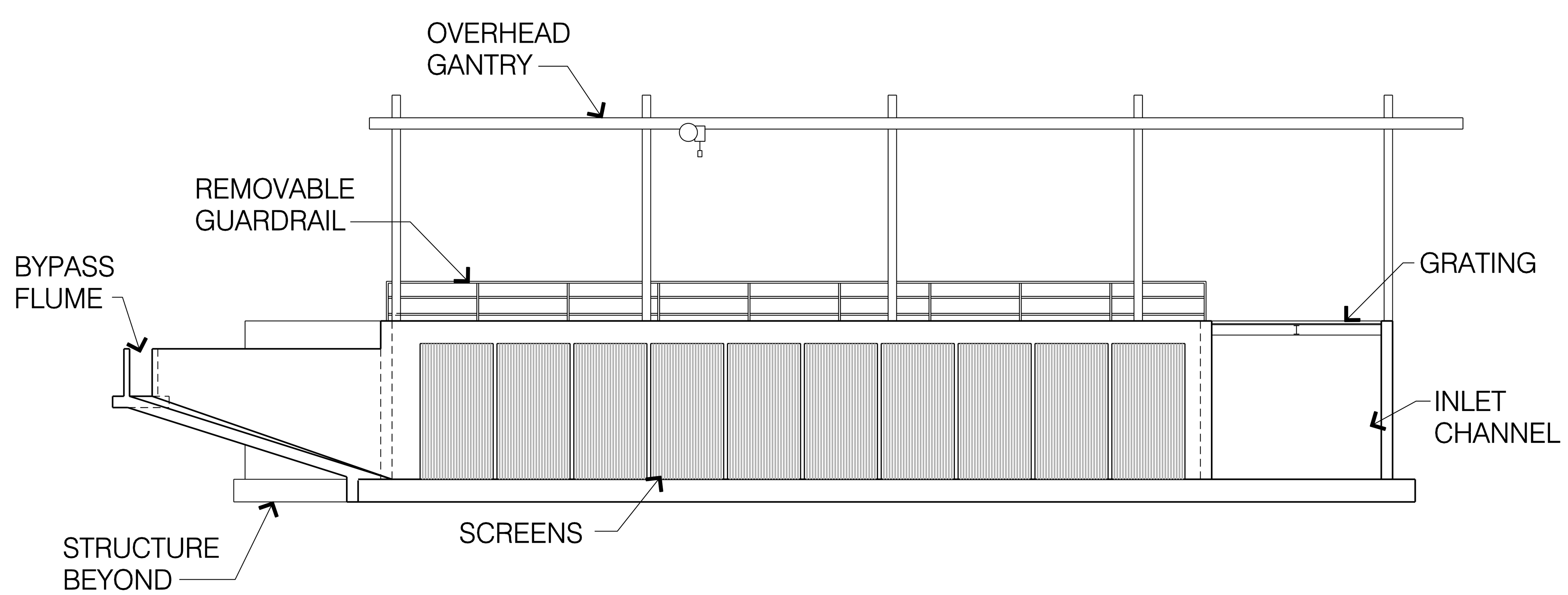
MAIN BASIN BYPASS AND SCREEN

0 10 20 40 60 FT
SCALE: 1"=20'



SECONDARY BASIN BYPASS AND SCREEN

0 10 20 40 60 FT
SCALE: 1"=20'



BYPASS AND SCREEN ELEVATION

0 5 10 20 30 FT
SCALE: 1"=10'

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SAN CLEMENTE DAM FISH PASSAGE ASSESSMENT	OUTLET STRUCTURE – OPTION 2 PLANS AND ELEVATION			
		DATE	4/5/2007	SHEET 4 OF 5
		SCALE	AS NOTED	

0 4 8 12 FT

SCALE: 1/4"=1'-0"

N

SAN CLEMENTE DAM

FISH PASSAGE ASSESSMENT

BIFURCATION POOL STRUCTURE
PLAN

DATE	4/5/2007	SHEET	
SCALE	AS NOTED	5 OF 5	

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